# Storage Bridge Bay (SBB) Specification

Version 1.0

September 21, 2006

# Revision History

| Revision | Date | Sections | Originator: | Comments |
|---|---|---|---|---|
| 1.0 | 9/21/2006 | | | |

# Typographical Conventions

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in RFC2119 [http://www.ietf.org/rfc/rfc2119.txt].

TABLE OF CONTENTS

# 1 Overview

The following document is a Storage Bridge Bay (SBB) specification. It is designed to act as the reference and guideline for storage solution providers who would like to have controller slot compatibility between their storage solutions. The objective is to define mechanical, electrical and low-level enclosure management requirements for an enclosure controller slot that will support a variety of storage controllers from a variety of independent hardware vendors ("IHVs") and independent software vendors ("ISVs"). Any storage controller design based on this SBB specification shall be able to fit, connect, and operate within any storage enclosure controller slot design based on the same specification.

The SBB specification defines:

- physical dimensions of the controller board volume constraints (e.g. length, width, height;
- physical dimensions and electrical characteristics of the connector that attaches a controller to an enclosure midplane;
- power and cooling to be provided to controllers that will reside in the controller bay;
- minimum enclosure management function to be provided by the controllers;
- other items required to further the standardization of the controller slot.

The SBB specification does not define:

- host interfaces used to connect the controllers to outside computers or networks;
- exact functions and board design of controllers provided by different vendors;
- physical characteristics of the entire storage chassis;
- enclosure drive carriers;
- other items not required to further the standardization of the controller slot.

The SBB specification is not intended to provide a guideline for interoperability between SBB compliant controllers from different vendors. It is expected that each storage controller vendor solution will maintain unique differentiators within their controller electronics and firmware/software architectures.

It is also important to indicate that the SBB specification does not provide or define any controller level data storage mapping protocol for interfacing with the disk storage units. Each SBB compliant solution can have different high-level data storage mapping protocol that is not necessarily compatible with SBB solutions from different vendors.

This version of the SBB specification is focused on storage enclosure controller slots that connect to anywhere from 1 to 28 drives. The intent is for SBB compliant controllers to plug into a SBB compliant storage enclosure slot and operate with the number of drives that it's capable of connecting to, provided that the controller firmware supports the functions required by the enclosure (e.g. drive protocol, management functions, etc.). For example, a 16-drive SBB canister should be able to plug into both a 12 and a 24 drive capable SBB enclosure. In the 12-drive SBB compliant enclosure, the controller will only see and connect to 12 drives, where as in the 24-drive SBB compliant enclosure the controller will connect to 16 drives.

## 1.1 Terminology Conventions

Figure 1 gives some terminology conventions used in the text throughout this document.

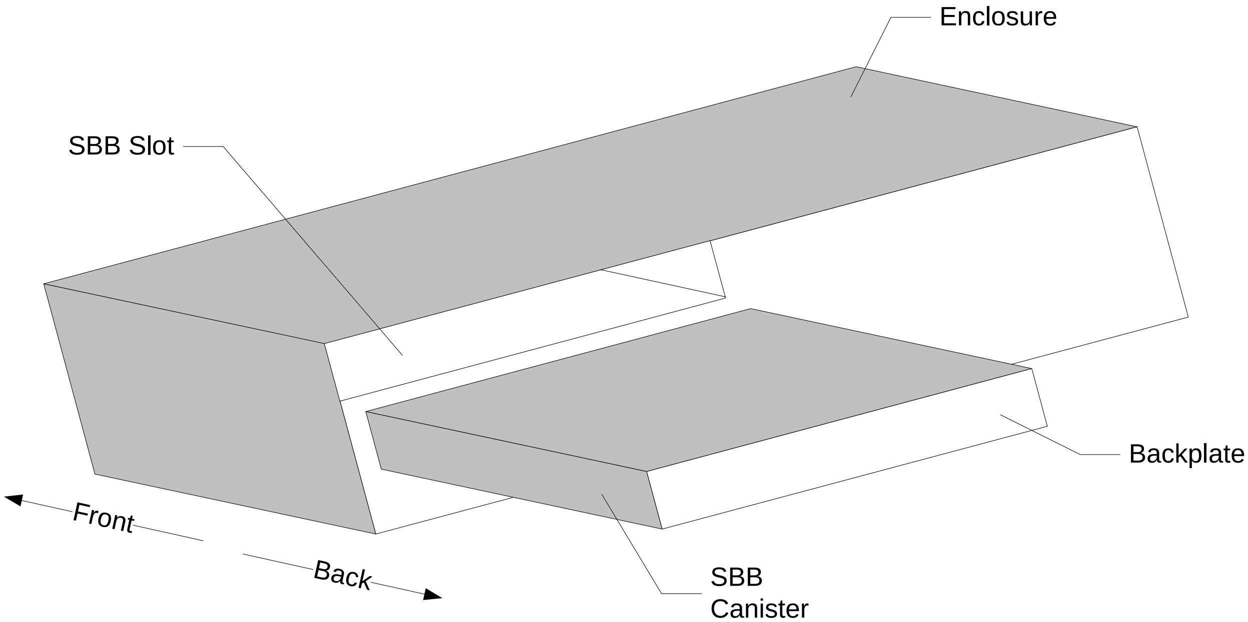


**Figure 1: Terminology Conventions (Back View)**

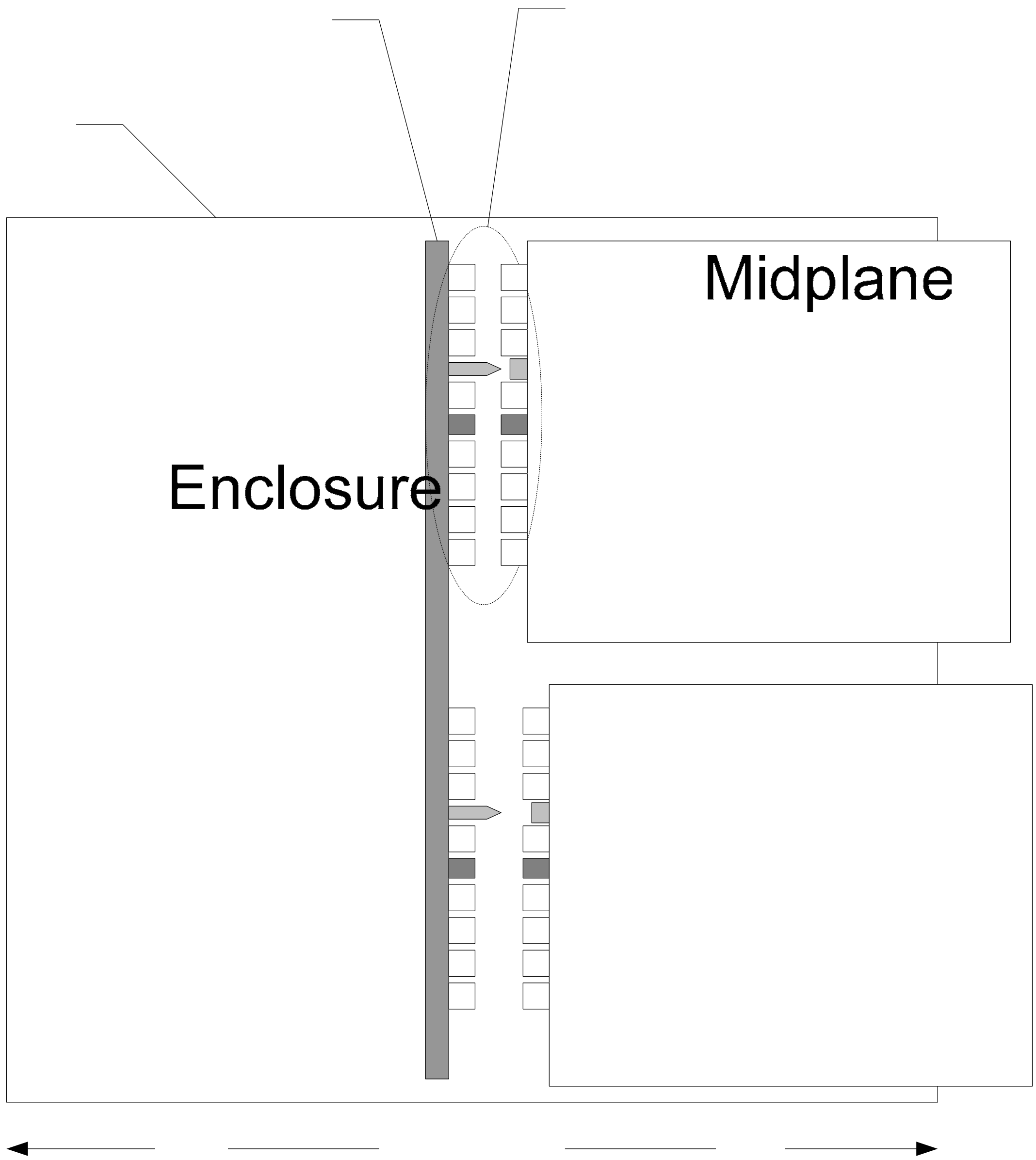


**Figure 2: Terminology Conventions (Top View)**

## 1.2 Definitions

This section defines the terminology used throughout the specification.

### 1.2.1 SBB Slot

SBB slot is the term used for the opening in an enclosure that accepts an SBB canister. If an SBB enclosure has two SBB slots, the slots are referred to as SBB Slot 1 and SBB Slot 2.

### 1.2.2 SBB Canister

SBB canister is the term used for any functional entity that can be inserted into an SBB slot. The canister is a replaceable unit that includes the SBB canister envelope and the bridge/controller.

### 1.2.3 SBB Canister Envelope

SBB canister envelope is the term used for the physical entity that encases a bridge/controller card.

### 1.2.4 Bridge/Controller card

Bridge/controller card is the term used to represent the electronics package that reside inside the SBB canister envelope. The electronics package includes printed circuit boards (PCB), electrical components, heat sinks, etc. The SBB specification defines the physical constraints to which bridge/controller cards must be designed.

### 1.2.5 SBB Midplane Interconnect (SBBMI)

SBB Midplane Interconnect is the data transport hardware element that provides the interface between the SBB canister and the midplane in a storage enclosure. The SBBMI connector pair consisting of plugs and receptacles designed for high-speed signaling, low-speed signaling and power distribution.

### 1.2.6 Backplate

Backplate is the term used for the only side of the SBB canister that is visible when the SBB canister is fully inserted into the SBB slot. The SBB canister's user accessible data interface ports, management interface ports, status LEDs, address switches, etc. MUST [1] only be exposed through the backplate.

### 1.2.7 High-Speed Signal Profiles

The SBB specification is applicable to several high-speed signal types (e.g. 2Gb/s FC, 3Gb/s SAS). The specification recognizes differing signal types with *signal profiles.* A signal profile defines the requirements of the high-speed differential signals used by an SBB canister. Each SBB canister MUST [2] support one and only one signal profile. An SBB canister is not required to operate within an enclosure that does not support its signal profile.[1] A keying mechanism provided by the SBBMI guide module (see Section 2.3.4) prevents an SBB canister from being inserted into an enclosure that does not support its signal profile.

The nominal signal profile for the SBB specification is called the *3Gb/s SAS Signal Profile*. The 3Gb/s SAS Signal Profile uses 3Gb/s SAS signals for communication with drives and uses 3Gb/s SAS or 2.5Gb/s PCI Express signals for inter-canister communication. Certain sections of the specification are noted as *Signal Profile Defined*. Requirements in these sections apply to the 3Gb/s SAS Signal Profile. These sections can be superseded by requirements for a separate signal profile. The superseding requirements are defined in appendixes attached to the SBB specification.

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[1] If a canister supports multiple signal types, the combination of signals supported will be represented by a unique signal profile.

# 2 Physical Requirements

This section describes the physical characteristics of the SBB canister. Unless otherwise specified, Table 1 gives the tolerances of dimensions described in the mechanical drawings shown in this specification. Unless otherwise specified, all dimensions are in millimeters (mm).

**Table 1: Mechanical Drawing Tolerances**

| Tolerances |
|---|
| X.X = ± 0.5<br>X.XX = ± 0.25 |
| Angular = ± 0° 30’ |

## 2.1 SBB Board Volume Constraints

One goal of this version of the SBB specification is to allow intelligent storage bridge/controller card vendors to develop a single electronics/firmware package that is physically compatible with all SBB compliant enclosures. Another goal of this version of the SBB specification is to allow enclosure vendors enough latitude to adjust their canister designs to fit the specific requirements of their products. To satisfy both these goals, the SBB specification defines physical requirements *board volume constraints*. The board volume constraints give the physical dimensions to which a designer of intelligent storage bridge/controller cards can build. If the designer adheres to the board volume constraints, his/her design should be compatible with canister envelopes designed to be SBB compliant. By switching the canister envelope wrapped around the bridge/controller cards, it should be physically possible to move the bridge/controller cards between different SBB enclosures[2].

Figure 3 gives an example of a sheet metal canister that will accept a bridge/controller designed to the SBB board volume constraints. The sheet metal described in Figure 3 should be used as a reference only. Individual SBB canister envelopes designs will have details tailored to their own specific enclosures.

[2] Note, cards moved from one SBB compliant enclosure to another are not guaranteed to operate. The cards may not support the appropriate signals and/or functions required by the enclosure. For example, a bridge/controller card that supports SAS drives cannot be expected to function in an enclosure that only supports Fibre Channel drives.

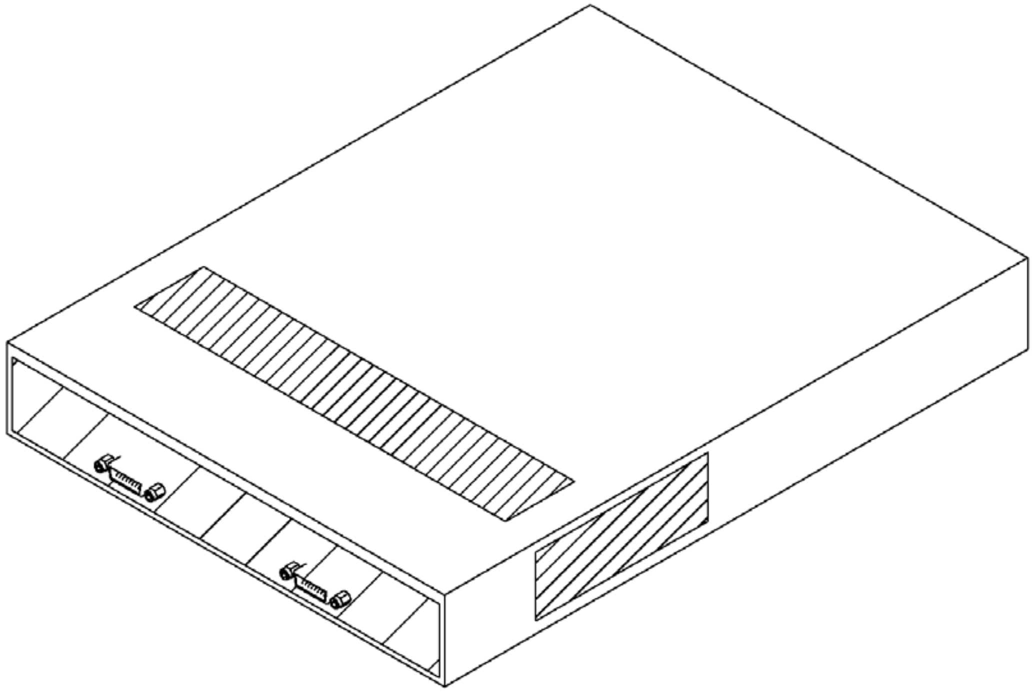

**Figure 3: Example SBB Canister Envelope**

Figure 4, Figure 5 and Figure 6 give the SBB board volume constraints. The components of any SBB bridge/controller MUST [3] be bounded by the dimensions given in Figure 4, Figure 5 and Figure 6[3].

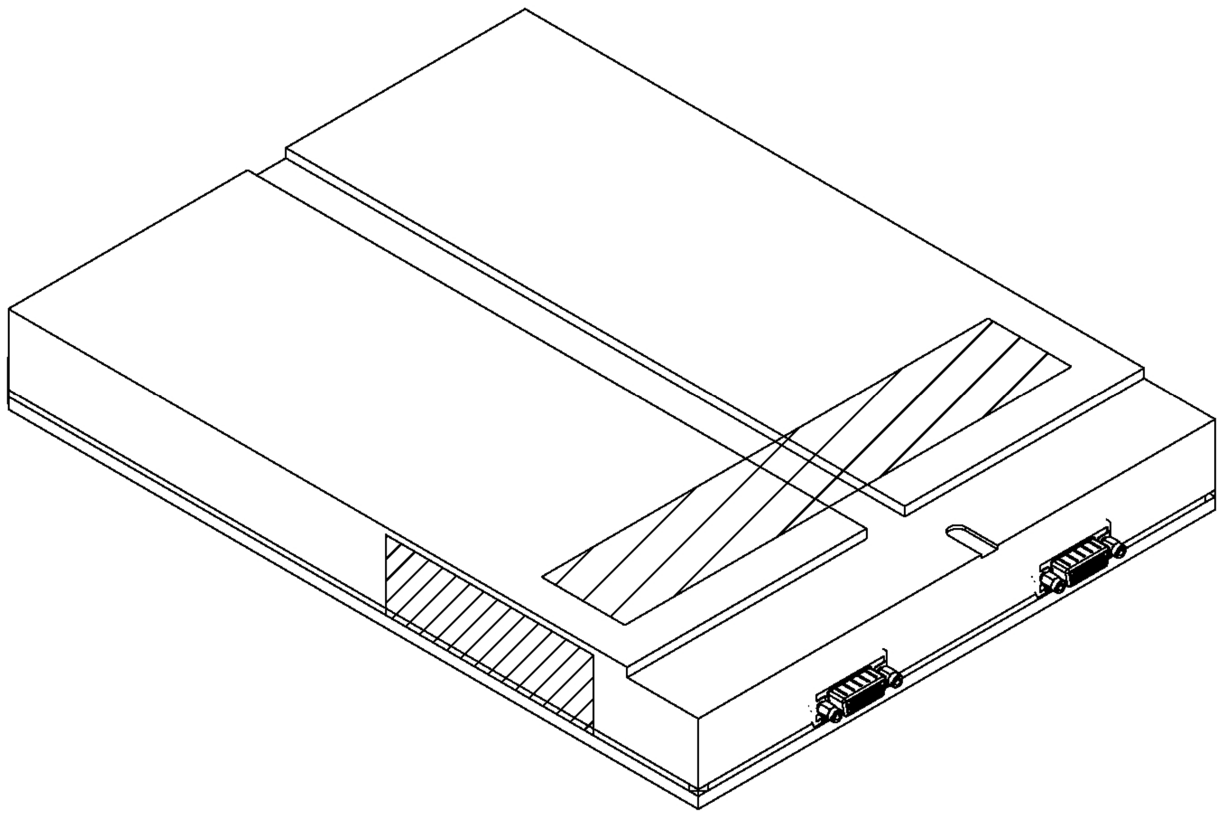

**Figure 4: Board Volume Constraints Angled View**

[3] The host connections on the backplate shown in the drawings are examples only. No type, number or location of host connections on the backplate is implied other than that their locations are bounded by the connector keep-in.

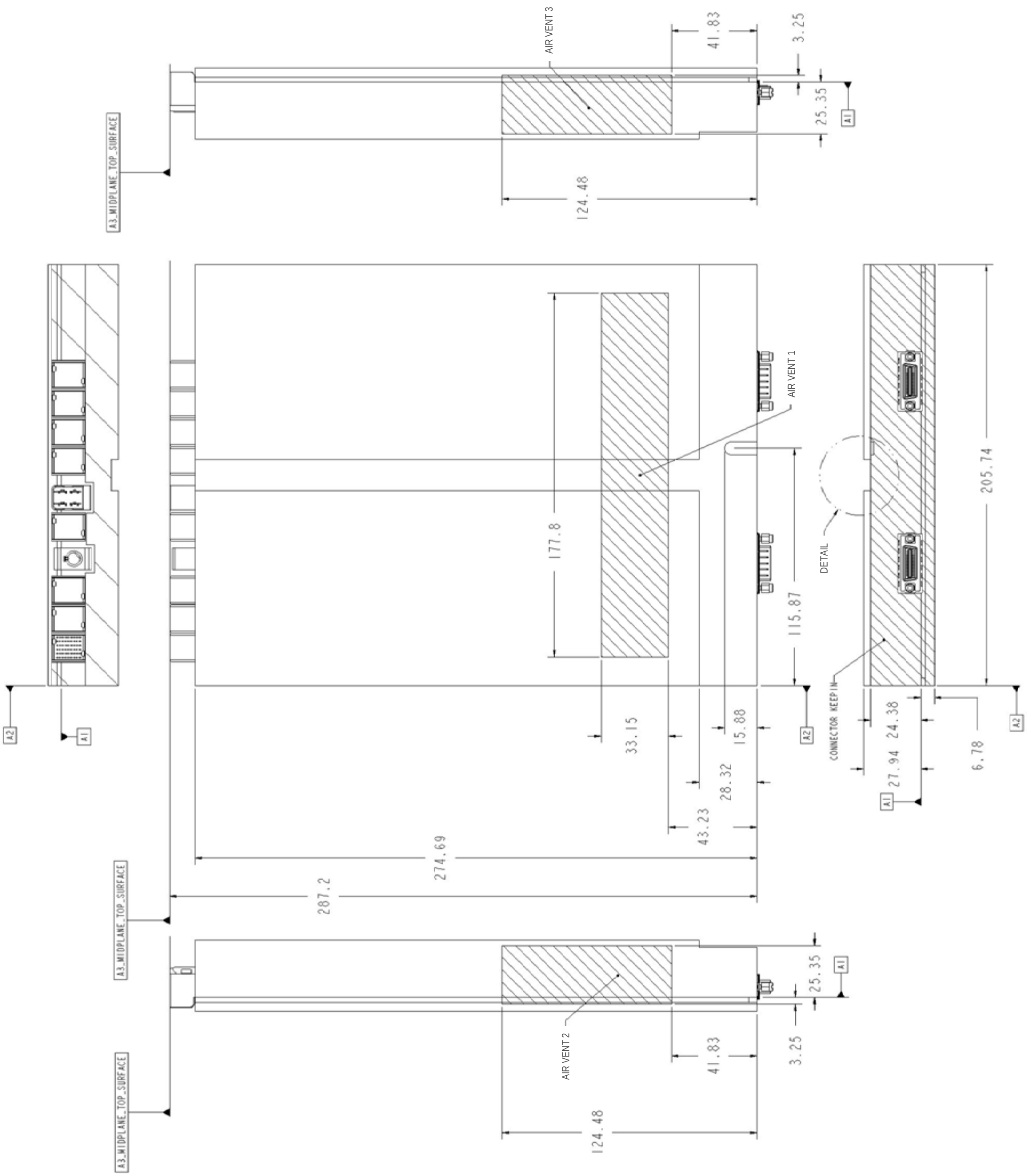


**Figure 5: Board Volume Constraints**[4]

[4] Dimensions indicate the maximum component height on the top or bottom of any SBB Bridge/Controller PCB.

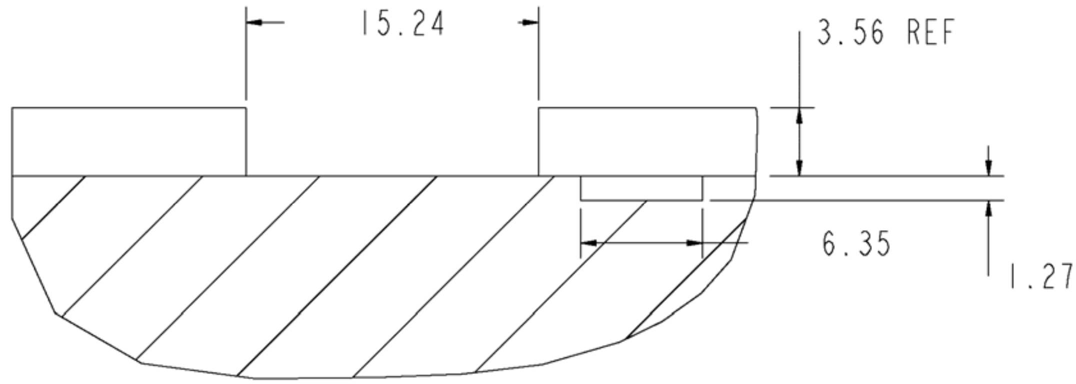


**Figure 6: Board Volume Constraint Detail**

Figure 7gives the locations of the air inlet (see Section 2.2) and the modules of the SBBMI (see Section 2.3.1).

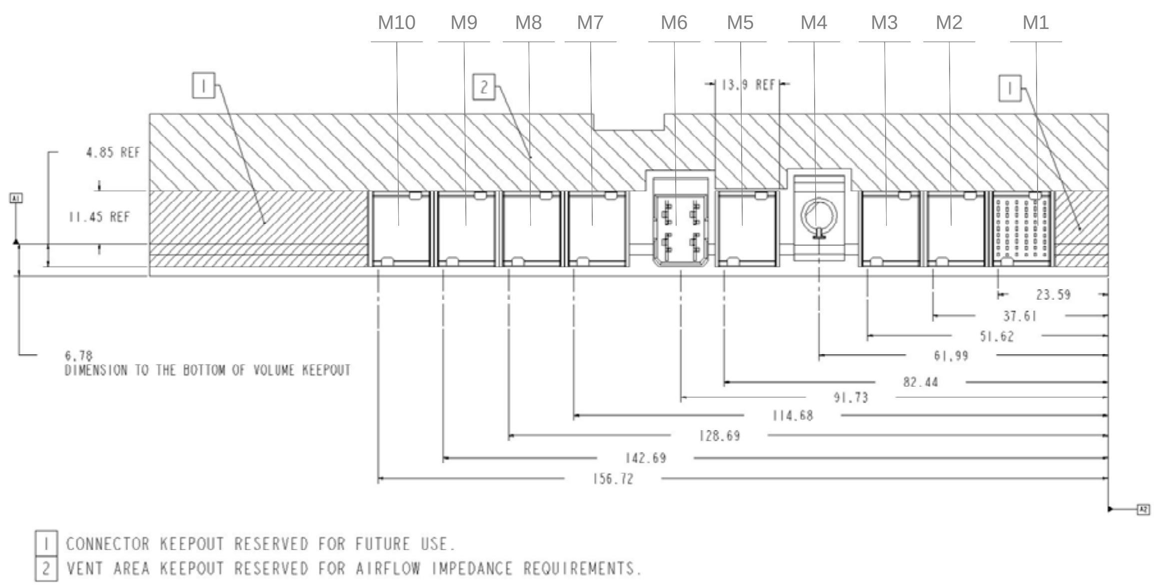


**Figure 7: Air Inlet and SBBMI Module Locations**

The distance from reference A3 to the exterior surface of an SBB canister envelope backplate on which a host (external) connector is located MUST [4] adhere to the dimension given in Figure 8.

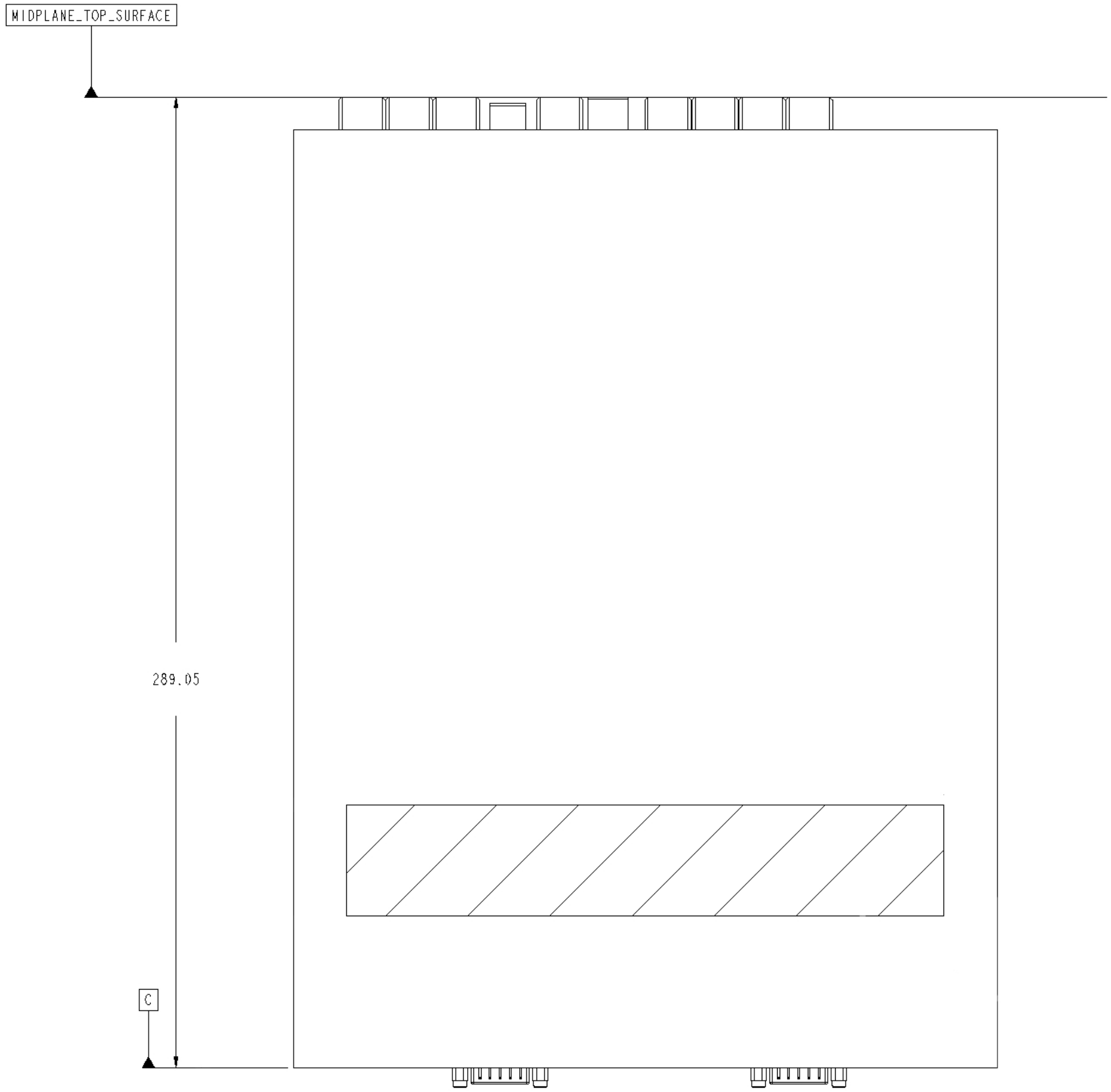


**Figure 8: Backplate Distance to Reference A3**

## 2.2 Air Inlet and Air Vent Options

An SBB compliant enclosure MUST [5] provide airflow to the SBB canister in a manner that air will enter the SBB board volume constraint boundary through the area bounded by the *air vent keepout* shown in Figure 7. The SBB specification provides three air vent options, *air vent 1, air vent 2* and *air vent 3*. The position and dimensions of the air vents relative to the board volume constraints are shown in Figure 5. An SBB compliant enclosure MUST [6] provide airflow to the SBB canister in a manner that air will exit the SBB board volume constraints boundary at one of the air vent locations. SBB compliant enclosures MUST [7] provide at least one air vent location. SBB bridge/controller cards are not required to operate with every air vent location. Bridge/controller card designers may design their system to support only one location if desired.  Further requirements related to cooling and airflow are given in Section 4.

## 2.3 SBBMI Modular Connector Requirements

The SBB Midplane Interconnect (SBBMI) uses a modular scheme to provide several functions. The SBBMI provides high-speed differential signals for communication between the SBB canisters and drives. It also includes high-speed differential signals for communication between SBB canisters. Additionally, the SBBMI provides low-speed signals for canister control, internal system management and drive control. The SBBMI has a guide pin to assist in alignment of the SBB canister and the midplane. Finally, the SBBMI provides a power connecter to distribute power to the SBB canister through the system midplane.

### 2.3.1 SBBMI Module Locations

Figure 7 shows the locations of the SBBMI modules in relation to the SBB canister board volume constraints. If used, M1, M2, M3, M5, M7, M8, M9, and M10 MUST [8] be signal modules as defined in Section 2.3.2. Section 5.4 states which signal modules are required and which modules are optional. M4 MUST [9] be a guide module as defined in Section 2.3.4. M6 MUST [10] be a power module as defined in Section 2.3.3. The locations of the SBBMI modules MUST [11] adhere to the dimension given in Figure 7. Signal module location dimensions are referenced at pin 1 of the module. Guide module and power module location dimensions are referenced at the center of the module.

### 2.3.2 SBBMI Signal Modules

All high-speed and low speed signals included in the SBBMI are provided by the connector described in this section. The SBBMI uses a number of these connectors to provide all the required and optional signals used by an SBB compliant canister and midplane. An SBBMI signal module is comprised of a SBBMI canister signal header and an SBBMI midplane receptacle.

#### 2.3.2.1 SBBMI Canister Signal Header

The SBBMI canister signal header is detailed in Figure 9 and Figure 10. These figures describe a right-angle header attached to a PCB residing on the reference plane A1. If an SBB canister uses a PCB located at the reference plane of A1, the SBBMI canister signal header MUST [12] adhere to the dimensions of Figure 9 and Figure 10. All dimensions of the signal header external to the board volume constraints, regardless of where the PCB is mounted within the board volume constraints, MUST [13] exactly match the dimensions outside the board volume constraints shown in Figure 9 and Figure 10.

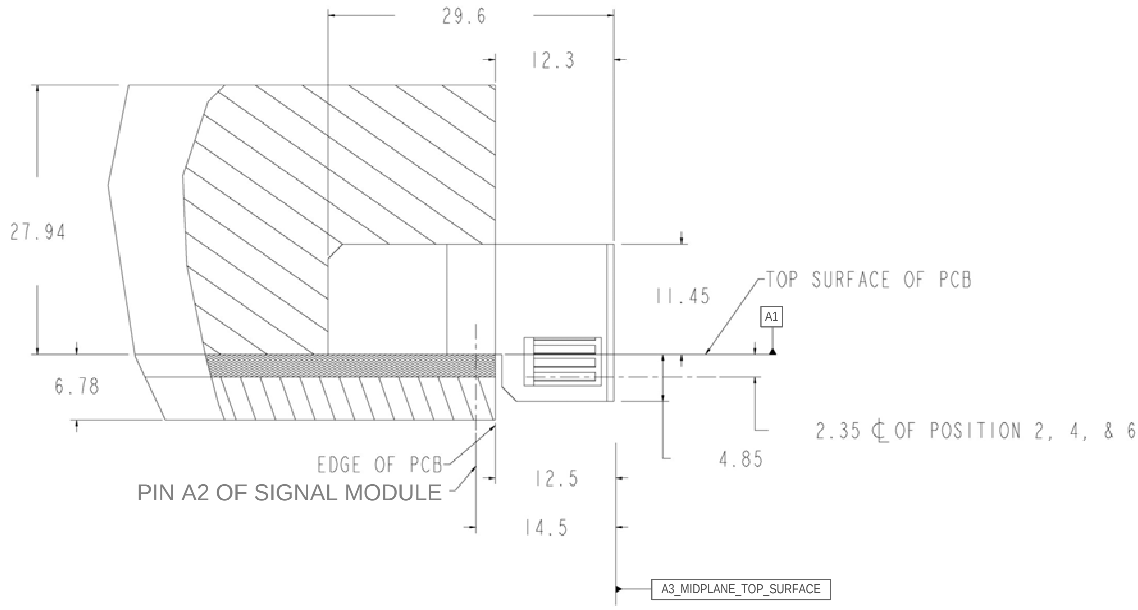


**Figure 9: SBBMI Canister Signal Header Dimensions**[5]

[5] Tolerances of dimensions required to ensure the ability to mate connectors may be obtained from FCI Americas Technology.

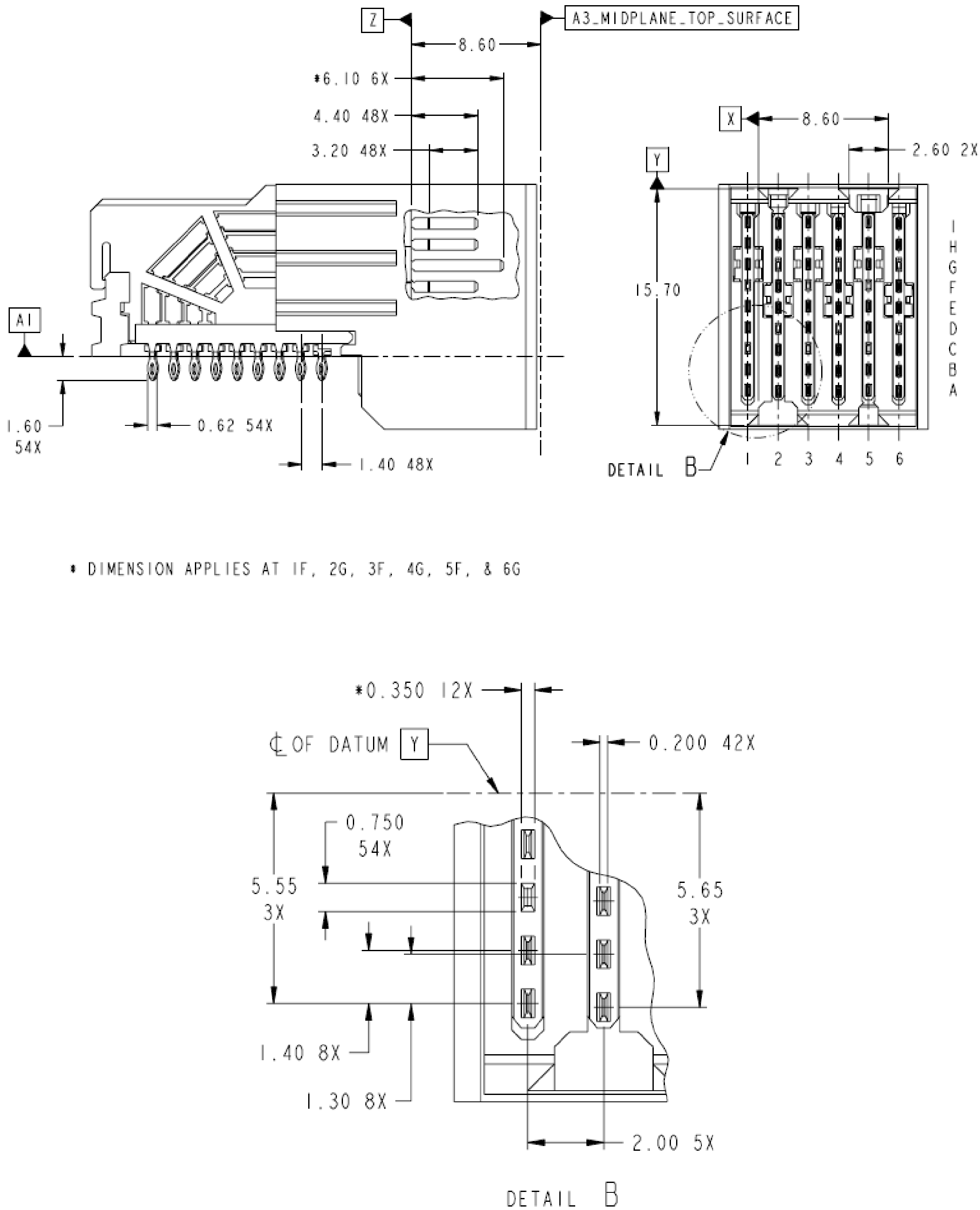


**Figure 10: SBBMI Canister Signal Header Pin Dimensions**[5]

Figure 11 gives a RECOMMENDED layout for a PCB mounted at reference plane A1and using the right-angle header described in Figure 9 and Figure 10. The position of the grounds will vary depending on the application of the module. Designers MAY use different connectors or PCB layouts that are more appropriate for their individual applications. The important point being that the position of the external pins

MUST [14] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

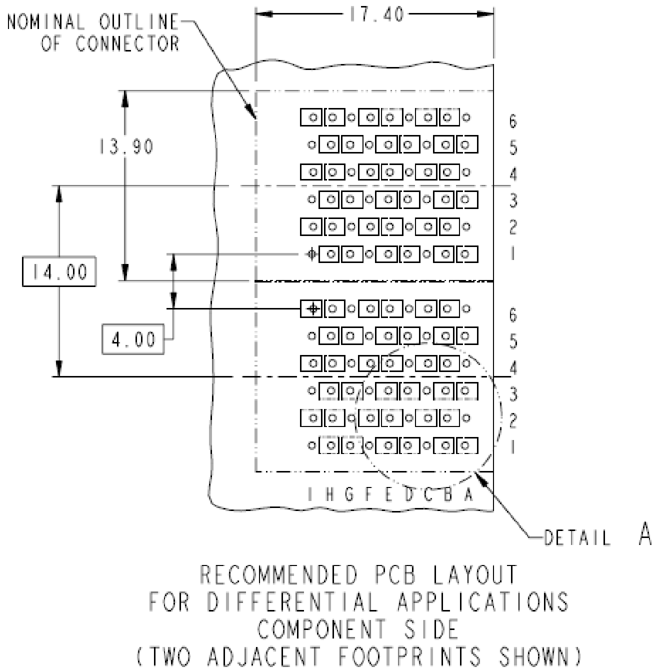


**Figure 11: Recommended PCB Layout**[5]

## 2.3.2.2 SBBMI Midplane Signal Receptacle

The SBBMI midplane signal receptacle is detailed in Figure 12. This figure describes a vertical receptacle attached to a midplane located at reference plane A3. If an SBB enclosure has a midplane located at reference plane A3, the midplane signal receptacle MUST [15] adhere to the dimensions of Figure 12. If the SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI midplane signal receptacle that interfaces to an SBBMI canister signal header MUST [16] exactly mimic the dimensions of the interfacing portion of an SBBMI midplane signal receptacle on an imaginary midplane mounted at reference plane A3 as described in Figure 12. The nominal wipe length at contacts 1F, 2G, 3F, 4G, 5F, and 6G MUST [17] be 4.0mm. The minimum nominal wipe length at all other contacts MUST [18] be 2.3mm.

Figure 13 gives a RECOMMENDED midplane layout for a vertical receptacle attached to a midplane located at reference plane A3. The positions of the grounds in Figure 13 will vary depending on the application of the module. Designers MAY use different connectors or PCB layouts that are more appropriate for their individual applications. However, the position of the pin receptacles that interface with the pins of the SBBMI canister signal header MUST [19] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

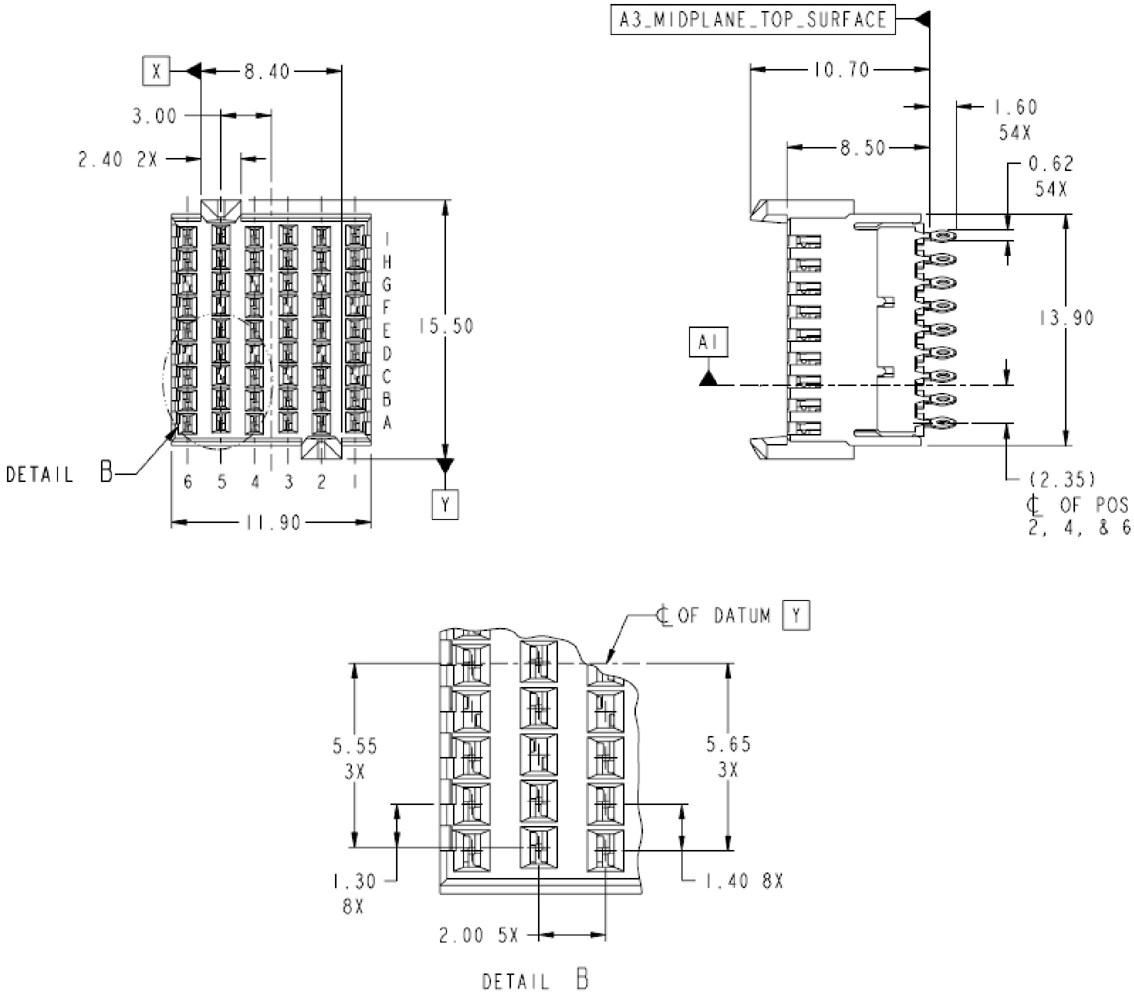


**Figure 12: SBBMI Midplane Signal Receptacle Dimensions[5]**

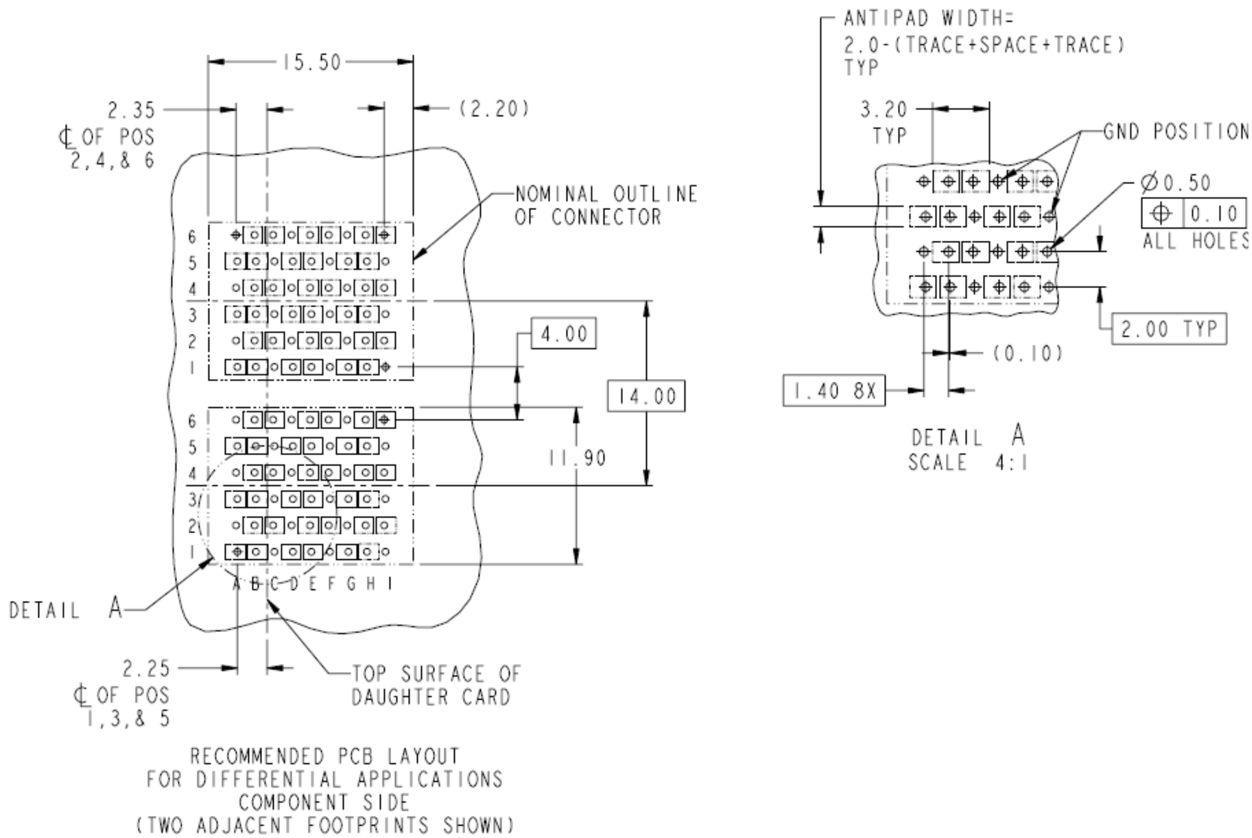


**Figure 13: Recommended Midplane Layout**[5]

### 2.3.2.3 SBBMI Signal Module Physical Requirements

A single SBBMI signal module MUST [20] adhere to the requirements given in Table 2.

**Table 2: Signal Module Physical Requirements**

| Symbol | Parameter | Minimum | Maximum | Units | Conditions/Comments |
|---|---|---|---|---|---|
| N | Durability | 200 | | Mating cycles | Without physical damage or exceeding low level contact resistance when mated |
| $F_i$ | Insertion force | | 24.3 | N | |
| $F_w$ | Withdrawal force | | 8.1 | N | |
| $H_m$ | Horizontal misalignment correction | ±1.7 | | mm | Misalignment correction in direction parallel to reference plane A1 in Figure 5 |
| $V_m$ | Vertical misalignment correction | ±1.0 | | mm | Misalignment correction in direction perpendicular to reference plane A1 in Figure 5 |
| $T_m$ | Midplane thickness | 1.575 | | mm | A compliant pin requires a minimum board thickness but no maximum |
| $T_c$ | Canister PCB thickness | 1.575 | | mm | A compliant pin requires a minimum board thickness but no maximum |
| $A_{max}$ | Maximum amps per pin | | 0.5 | A | At 30 degree C rise from ambient temperature assuming natural convection |

### 2.3.2.4 SBBMI Signal Module Electrical Performance

This section of the document discusses the minimum required electrical performance to which the signal modules must adhere. The requirements are stated in terms of a signal module pair which consists of a canister signal header mated with a midplane signal receptacle.

#### *2.3.2.4.1 Differential Impedance*

The differential impedance of the signal module MUST [21] conform to the performance shown in Table 3.

**Table 3: Signal Module Differential Impedance at Various Risetimes**

| |
|---|
| 100 ± 8 ohms @ 35ps (20-80%) / 50ps (10-90%) risetime |
| 100 ± 6 ohms @ 55ps (20-80%) / 80ps (10-90%) risetime |
| 100 ± 5 ohms @ 70ps (20-80%) / 100ps (10-90%) risetime |

### 2.3.2.4.2 Differential Insertion Loss

The differential insertion loss of the signal module MUST [22] conform to the performance shown in Table 4.

**Table 4: Signal Module Differential Insertion Loss**

| |
|---|
| < 1dB loss through 3.125GHz (6.25Gbps) |

### 2.3.2.4.3 Differential-Mode Multi-Pair-Active Crosstalk

The differential-mode multi-pair-active crosstalk of the connector MUST [23] conform to the performance shown in Table 5.

**Table 5: Signal Module Differential-Mode Multi-Pair-Active Crosstalk**

| |
|---|
| < 3.25% NEXT, <5.75% FEXT @35ps (20-80%) / 50ps (10-90%) risetime |
| < 2.50% NEXT, <3.00% FEXT @55ps (20-80%) / 80ps (10-90%) risetime |
| < 2.00% NEXT, <2.25% FEXT @70ps (20-80%) / 100ps (10-90%) risetime |

Multi-pair-active crosstalk is the maximum crosstalk that can be measured at one pair of the connector when a signal is injected in all adjacent pairs of the connector. (See Figure 14) The multi-pair-active crosstalk is calculated as the sum of the absolute values of the single-pair crosstalk peaks from each adjacent pair. This is sometimes referred to as “asynchronous” crosstalk, since the crosstalk waveforms from individual pairs are not simply added synchronously. “Synchronous” crosstalk would result in lower numbers, since the individual single-active peaks would not line up. This means that the multi-pair-active crosstalk results reported must be interpreted as the absolute worst-case value.

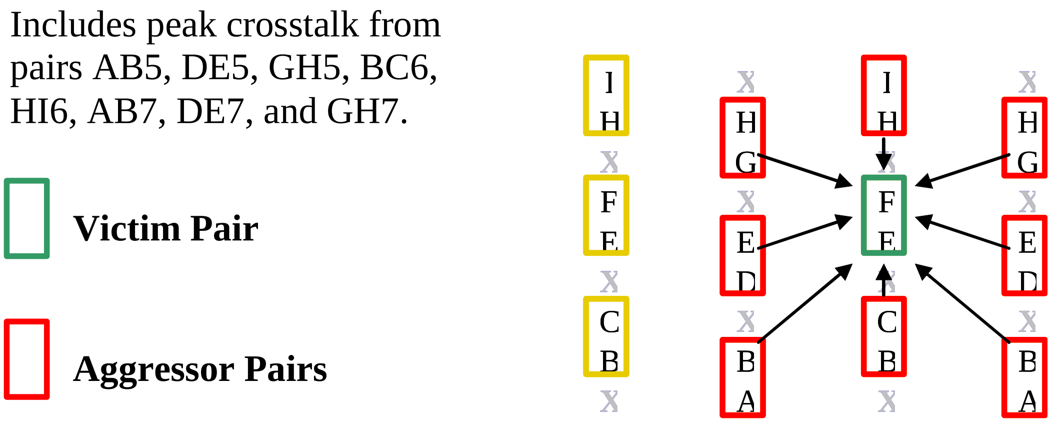


**Figure 14: Worst-Case Multi-Pair Active Crosstalk for Pair EF**

### 2.3.3 SBBMI Power Modules

The SBBMI power module is comprised of a power header that resides on the SBB canister and a power receptacle that resides on the enclosure midplane.

#### 2.3.3.1 SBBMI Canister Power Header

The SBBMI canister power header is detailed in Figure 15. This figure describes a right-angle connector attached to a PCB residing on reference plane A1. If an SBB canister uses a PCB located at the reference planes of A1, the SBBMI canister power header MUST [24] adhere to the dimension of Figure 15. All dimension of the canister power header external to the board volume constraints, regardless of where the PCB is mounted within the constraints, MUST [25] exactly match the dimensions outside the board volume constraints of the SBBMI canister power header shown in Figure 15.

Figure 16 gives a RECOMMENDED layout for a PCB mounted at reference plane A1and using the right-angle power header described in Figure 15. Designers MAY use a different connectors or PCB layouts that are more appropriate for their individual applications. The important point being that the position of the external pins relative MUST [26] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

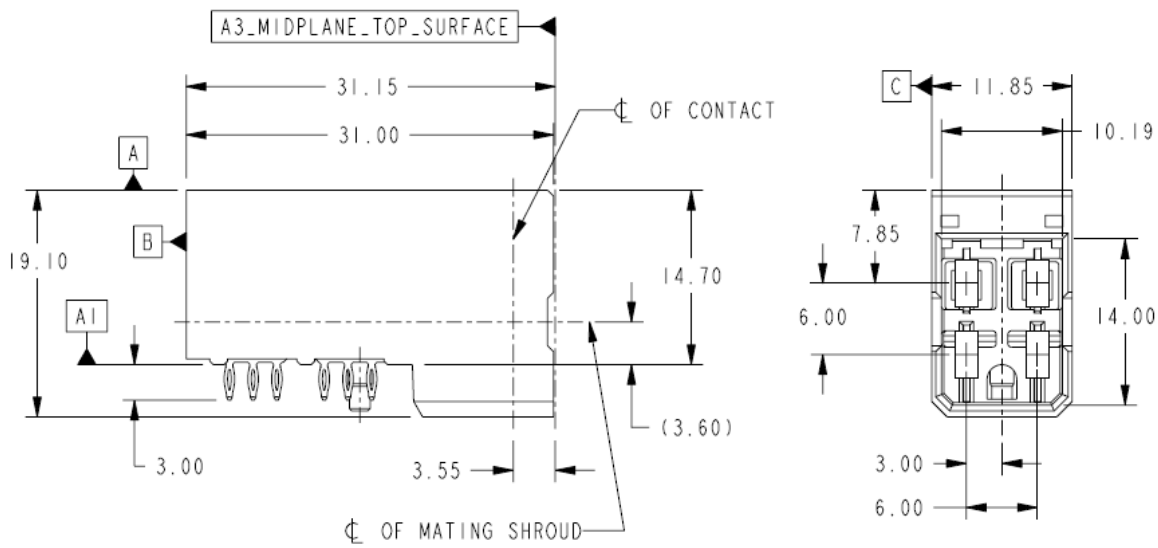


**Figure 15: SBBMI Canister Power Header Dimensions**[5]

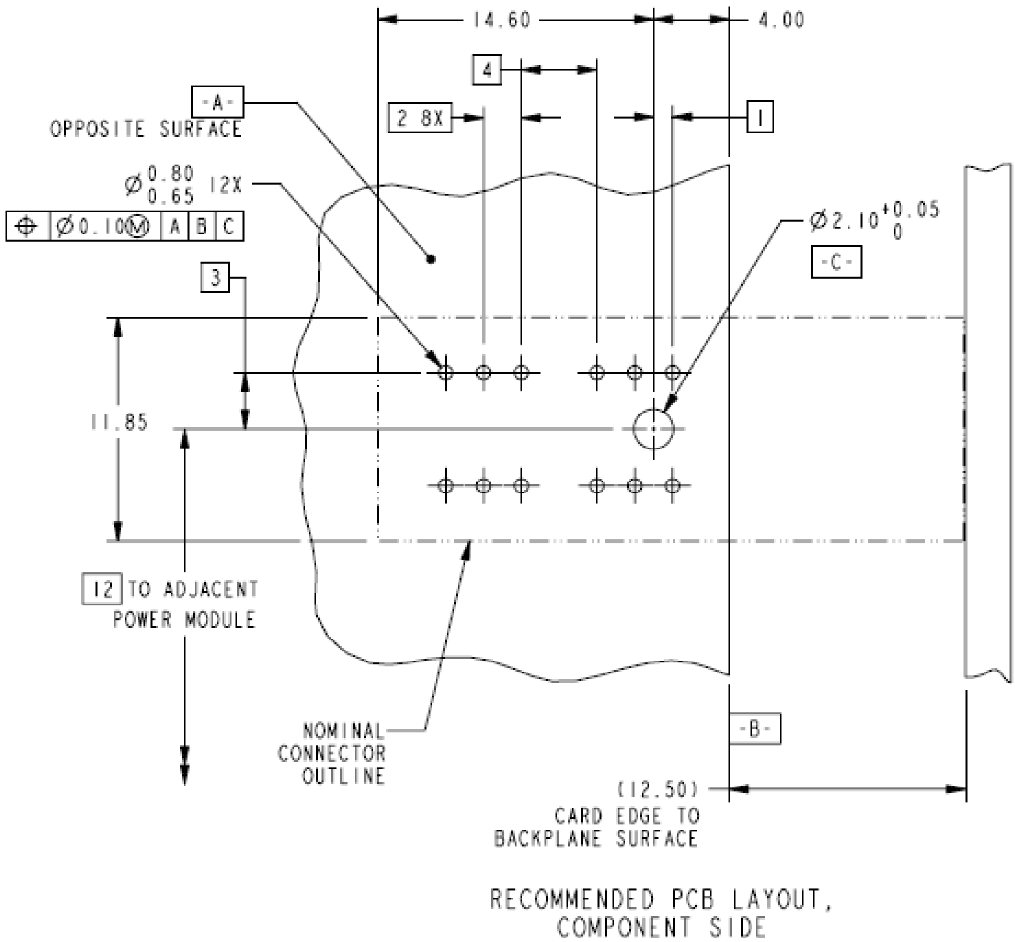


**Figure 16: Recommended PCB Layout**[5,6]

### 2.3.3.2 SBBMI Midplane Power Receptacle

The SBBMI midplane power receptacle is defined in Figure 17. This figure describes a vertical receptacle attached to a midplane located at reference plane A3. If an SBB enclosure has a midplane located at reference plane A3, the midplane power receptacle MUST [27] adhere to the dimensions of Figure 17. If the SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI midplane power receptacle that interfaces to an SBBMI canister power header MUST [28] exactly mimic the interfacing portion of an SBBMI midplane power receptacle on an imaginary midplane mounted at reference plane A3 as described in Figure 17.

Figure 18 gives the RECOMMENDED midplane layout for a vertical receptacle attached to a midplane located at reference plane A3. Designers MAY use different connectors or PCB layouts that are more appropriate for their individual applications. However, the position of the pin receptacles that interface with the pins of the SBBMI canister power header MUST [29] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

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[6] The finished hole diameter range listed in this figure is for a SnPb plated through hole (PTH) finish. This diameter varies with the PTH finish. Contact FCI Americas Technology for more information

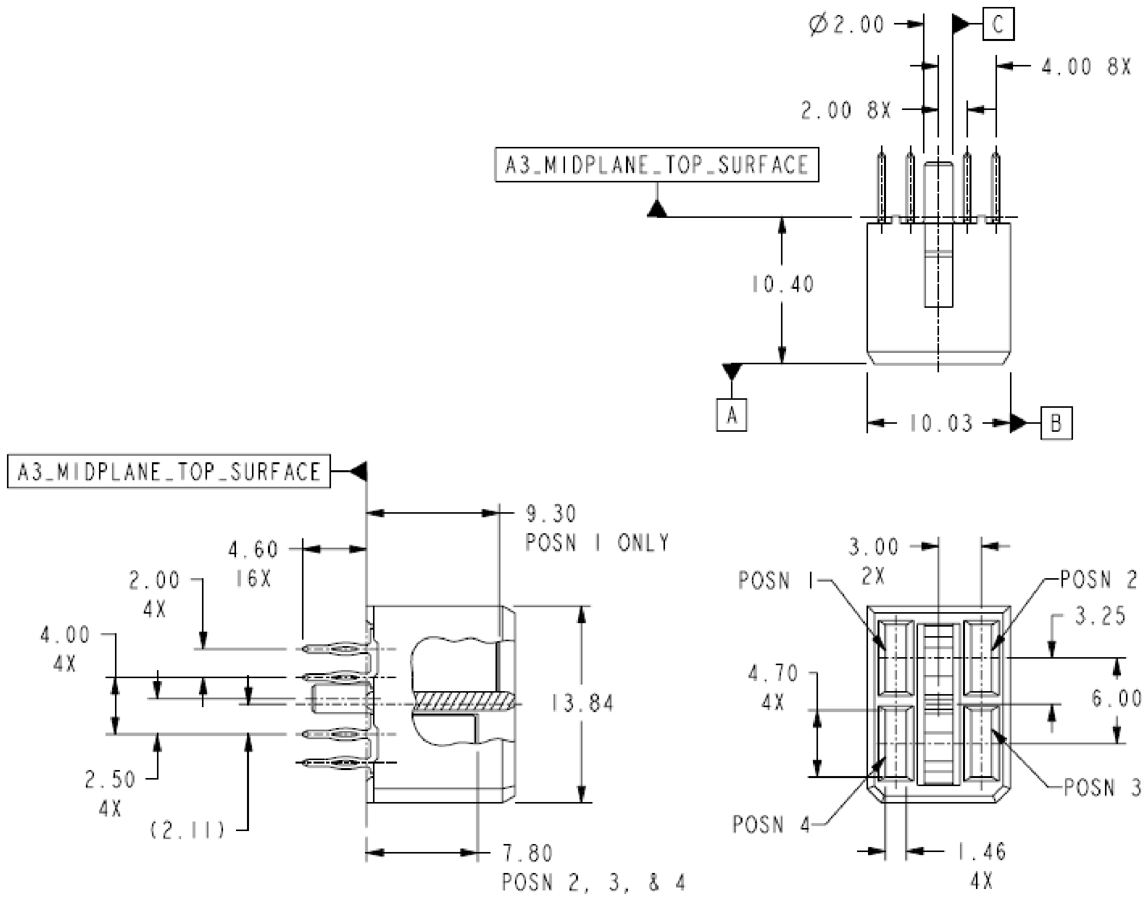


**Figure 17: SBBMI Midplane Power Receptacle Dimensions**[5]

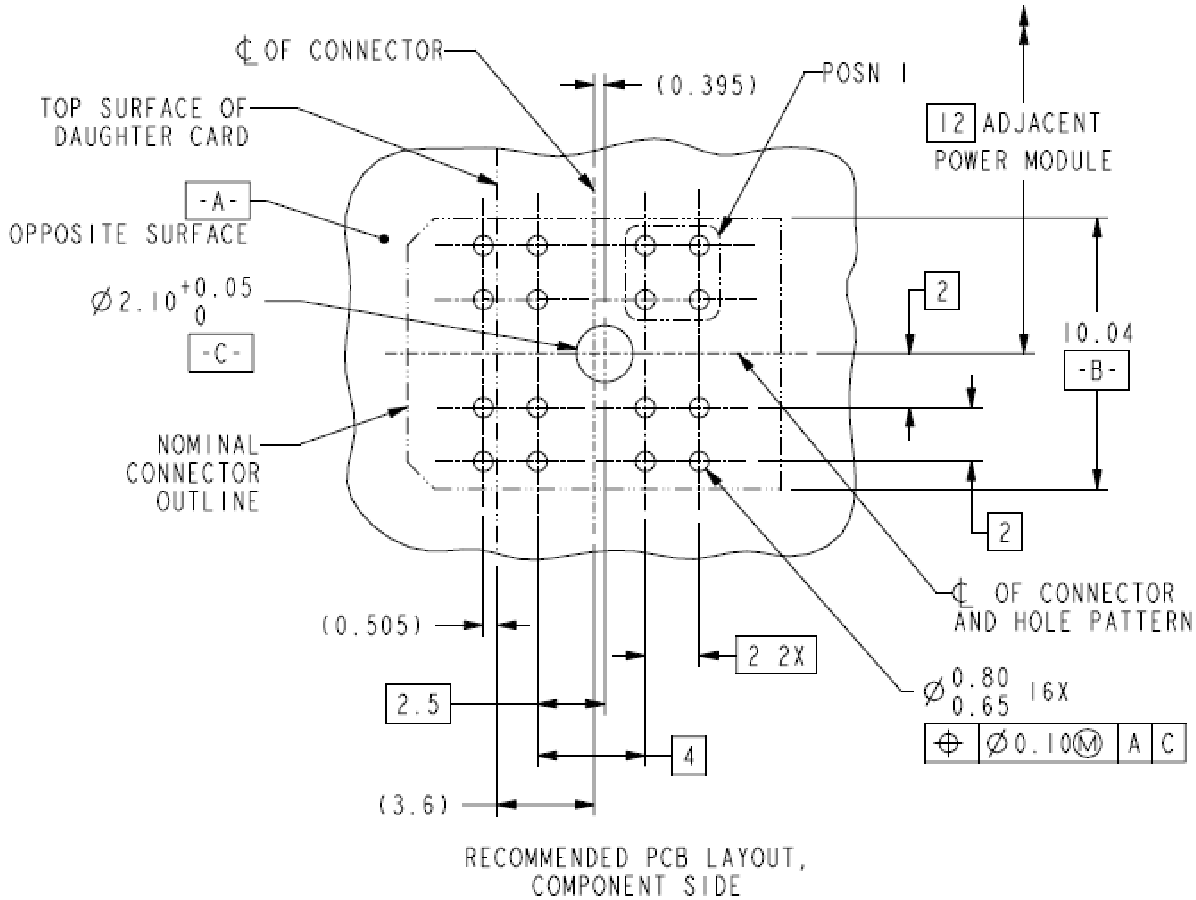


**Figure 18: Recommended Midplane Layout[5,6]**

### 2.3.3.3 SBBMI Power Module Physical Requirements

The SBBMI power module MUST [30] adhere to the requirements given in Table 6

**Table 6: Power Module Physical Requirements**

| Symbol | Parameter | Minimum | Maximum | Units | Conditions/Comments |
|---|---|---|---|---|---|
| N | Durability | 200 | | Mating cycles | Without physical damage or exceeding low level contact resistance when mated |
| $F_i$ | Insertion force | | 31.2 | N | |
| $F_w$ | Withdrawal force | | 9 | N | |
| $H_m$ | Horizontal misalignment correction | ±0.8 | | mm | Misalignment correction in direction parallel to reference point A1 in plane A1 in Figure 5 |
| $V_m$ | Vertical misalignment correction | ±0.8 | | mm | Misalignment correction in direction perpendicular to reference point A1 in plane A1 in Figure 5 |
| $T_m$ | Midplane thickness | 2.375 | | mm | A compliant pin requires a minimum board thickness but no maximum |
| $T_c$ | Canister PCB thickness | 1.575 | | mm | A compliant pin requires a minimum board thickness but no maximum |

### 2.3.4 SBBMI Guide Module *(Signal Profile Defined)*

The SBBMI guide module is comprised of a guide pin receptacle that resides on an SBB canister and a guide pin that resides on an enclosure midplane. The guide module has a keying mechanism that prevents canisters from interfacing with enclosures that have a different signal profile (see Section1.2.7). Sections 2.3.4.1 and 2.3.4.2 define the guide module requirements for the 3Gb/s SAS Signal Profile.

#### 2.3.4.1 SBBMI Canister Guide Pin Receptacle

The SBBMI canister guide pin receptacle is described in Figure 19. The figure describes a right-angle receptacle attached to a PCB located at reference plane A1. If an SBB canister mounts a PCB located at reference plane A1, the guide pin receptacle MUST [31] adhere to the dimensions of Figure 19. All dimensions of the guide pin receptacle external to the board volume constraints, regardless of where the PCB is mounted, MUST [32] exactly match the dimensions outside the board volume constraints of the receptacle shown in Figure 19. The ESD contact on the guide pin receptacle is OPTIONAL.

Figure 20 gives a RECOMMENDED layout for a PCB mounted at reference plane A1 using the right-angle header described in Figure 19. Designers MAY use different receptacles or PCB layouts that are more appropriate for their individual applications. However, the position of the receptacle that mates with the SBBMI midplane guide pin MUST [33] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

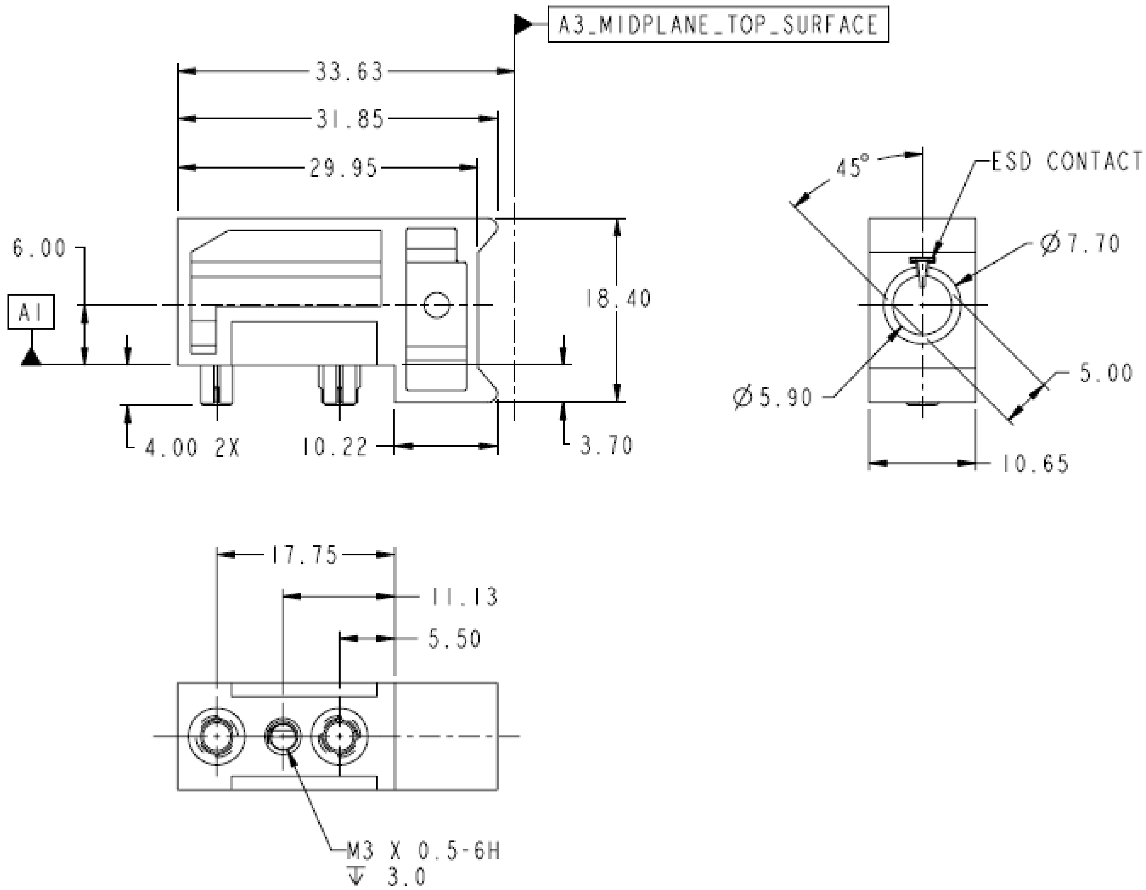


**Figure 19: SBBMI Canister Guide Pin Receptacle Dimensions[5]**

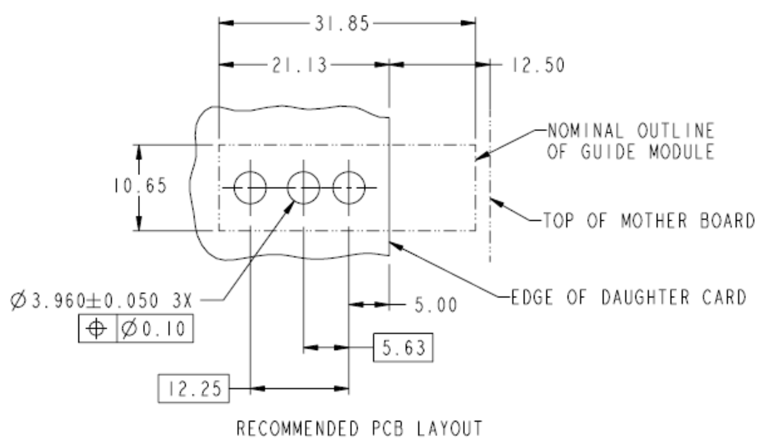


**Figure 20: Recommended PCB Layout[5]**

### 2.3.4.2 SBBMI Midplane Guide Pin

The SBBMI midplane guide pin is detailed in Figure 21. This figure describes a vertical guide pin attached to a midplane located at reference plane A3. If an SBB enclosure has a midplane located at reference plane A3, the guide pin MUST [34] adhere to the dimensions of Figure 21. If an SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI midplane guide pin that interface to an SBBMI canister guide pin receptacle MUST [35] exactly mimic the dimension of the interfacing portion of an SBBMI midplane guide pin on an imaginary midplane mounted at reference plane A3 as described in Figure 21.

Figure 22 gives a RECOMMENDED midplane layout for a vertical guide pin attached to a midplane located at reference plane A3. Designers MAY use different connectors or PCB layouts that are more appropriate for their individual applications. However, the position of the guide pin that interfaces with the SBBMI canister guide pin receptacle MUST [36] remain fixed relative to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

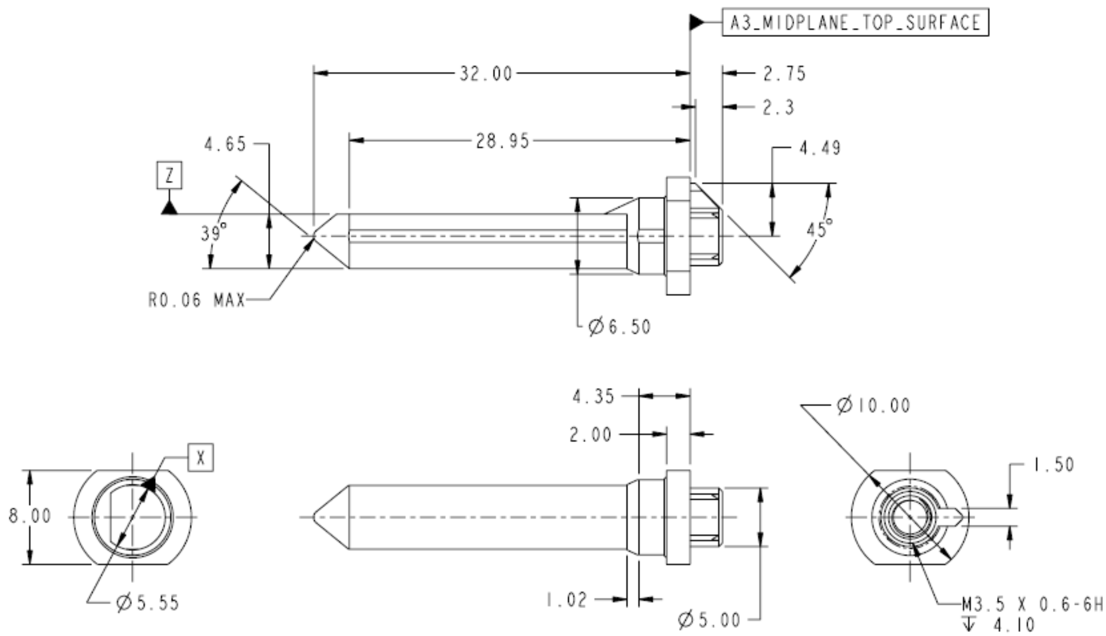


**Figure 21: SBBMI Midplane Guide Pin Dimensions**[5]

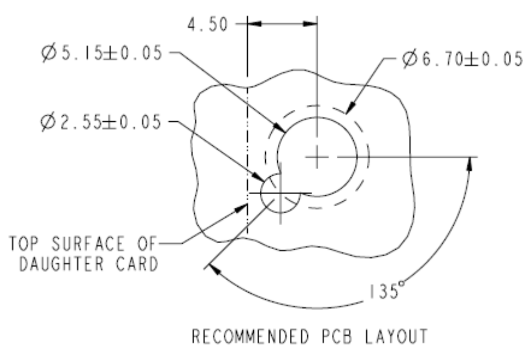


**Figure 22: Recommended Component Side Midplane Layout**[5]

# 3 Power Requirements

The SBB specification provides two power options, 12V DC and 5V DC. An enclosure that provides power to SBB slots must provide 12V power only or a combination of 12V and 5V power.

## 3.1 SBBMI Midplane Power Receptacle Power Requirements

This section defines the power requirements for the SBBMI midplane power receptacle located on an enclosure midplane that provides power to an SBB slot. See Section 2.3.3 for the physical details of the SBBMI midplane power receptacle. An enclosure may provide 12V power only or a combination of 5V and 12V power.

### 3.1.1 12V DC Power

The SBBMI midplane power receptacle MUST [37] provide 12V power. POSN 1 MUST [38] be grounded and POSN 2 MUST [39] provide +12V. Furthermore, the 12V power MUST [40] satisfy the parameters in Table 7. The SBBMI midplane power receptacle MUST [41] be able to supply the current listed in the Minimum Sustainable Current column. If the SBBMI midplane power receptacle is capable of providing more than the minimum sustainable current, the maximum sustainable current that the power receptacle can provide MUST [42] be indicated in the VPD (see Section 6.2) and be less than or equal to the value in the Maximum Sustainable Current column.

**Table 7: 12V DC Power**

| Power Pin | Voltage | Voltage Tolerance | Minimum Sustainable Current | Maximum Sustainable Current |
|---|---|---|---|---|
| POSN 1 | GND | | | |
| POSN 2 | +12V DC | ±5% (max) | 5A | 8.33A |

### 3.1.2 5V DC Power

If 5V power is not provided by the SBBMI midplane power receptacle, POSN 3 MUST [43] not be connected. If 5V power is provided by the power receptacle, POSN 4 MUST [44] be grounded and POSN 3 MUST [45] provide +5V. If 5V power is provided, it MUST [46] satisfy the parameters in Table 8. The SBBMI midplane power receptacle MUST [47] be able to supply the current listed in the Minimum Sustainable Current column. If the SBBMI midplane power receptacle is capable of providing more than the minimum sustainable current, the maximum sustainable current that the power receptacle can provide MUST [48] be indicated in the VPD (see Section 6.2) and be less than or equal to the value in the Maximum Sustainable Current column.

**Table 8: 5V DC Power**

| Power Pin | Voltage | Voltage Tolerance | Minimum Sustainable Current | Maximum Sustainable Current |
|---|---|---|---|---|
| POSN 3 | +5V DC | ±5% (max) | 8A | 15A |
| POSN 4 | GND | | | |

## 3.2 SBBMI Canister Power Header Power Requirements

This section defines the power requirements for an SBB canister that draws power through the SBBMI canister power header. See Section 2.3.3 for the physical details of the SBBMI canister power header. An SBB canister may use only 12V power or a combination of 12V and 5V power. The SBB canister MUST [49] not draw more than 100W from any combination of the 5V and/or 12V power provided by the SBBMI midplane power receptacle.

### 3.2.1 12V DC Power

The SBB canister MUST [50] not draw more 12V current than the current indicated in the Minimum Sustainable Current column of Table 7. Before drawing more current, the SBB canister MUST [51] determine if the Max 12V Current field is present in the VPD (See Section 6.2). If the field is not present, the SBB canister MUST [52] not draw any more current than the value indicated in the Minimum Sustainable Current column of Table 7. If the field is present, the SBB canister MUST [53] not draw any more current than value indicated in the Max 12V Current field in the VPD. If the enclosure does not provide the 12V current the SBB canister requires, the SBB canister is NOT REQUIRED to operate.

### 3.2.2 5V DC Power

If an SBB canister requires 5V power and does not detect 5V power on the SBBMI midplane power receptacle, the enclosure in which the SBB canister is inserted does not provide 5V power and the canister will not operate in this enclosure. If 5V power is provided by the midplane power receptacle, the SBB canister MUST [54] not draw more current than the current indicated in the Minimum Sustainable Current column of Table 8. Before drawing more current, the SBB canister MUST [55] determine if the Max 5V Current field is present in the VPD (See Section 6.2). If the field is not present, the SBB canister MUST [56] not draw any more current than the value indicated in the Minimum Sustainable Current column of Table 8. If the field is present, the SBB canister MUST [57] not draw any more current than value indicated in the Max 5V Current field in the VPD. If the enclosure does not provide the 5V current the SBB canister requires, the SBB canister is NOT REQUIRED to operate.

## 3.3 Over Voltage

The SBB canister MUST [58] be able to tolerate a maximum over voltage of 14.4V on the 12V rail and 6.2V and the 5V rail.

## 3.4 Overshoot at Turn-On

The output voltage overshoot during the turn-on of any power rail MUST [59] be less than 10% above the nominal voltage and not be above the regulation band (nominal voltage plus tolerance) for more than 20ms. There MUST [60] be a smooth and continuous ramp of each power rail from 10% to 95% of its final set point within the regulation band).

There is no implied voltage sequencing requirement.

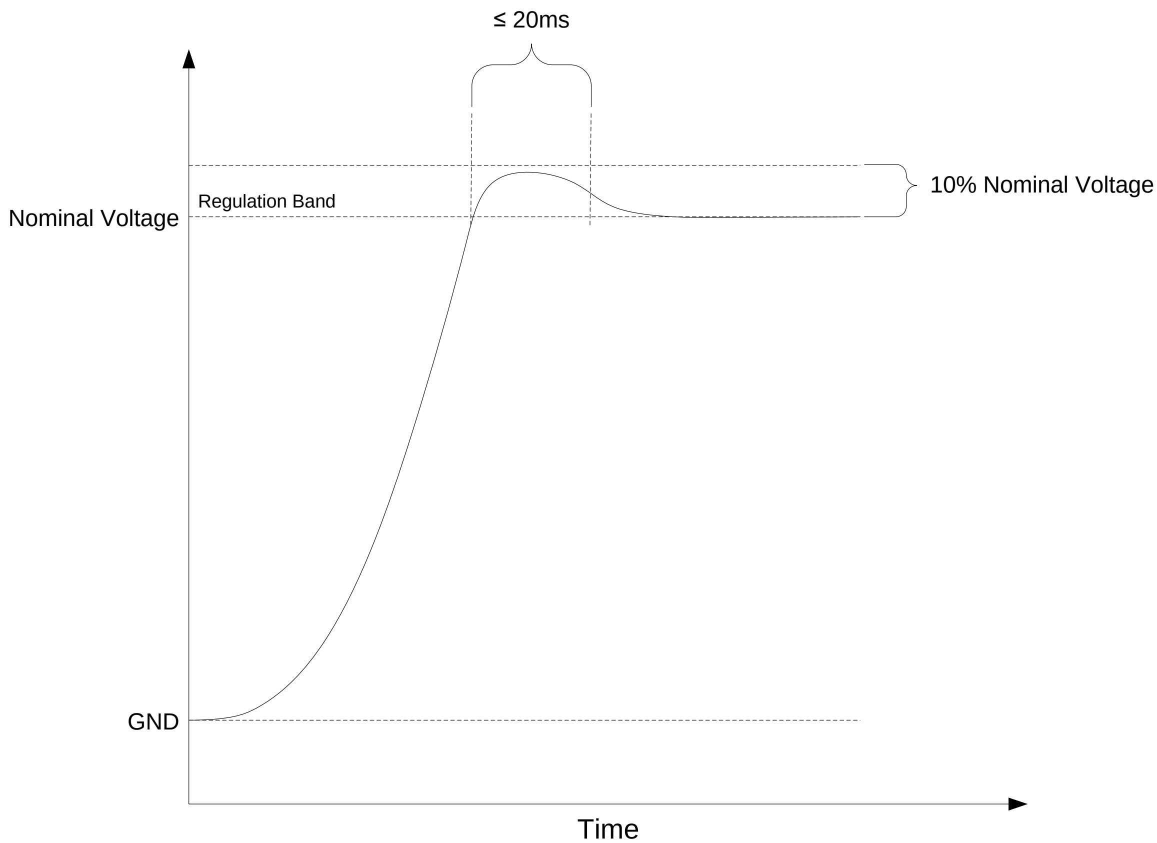


**Figure 23: Overshoot at Turn-On**

## 3.5 Maximum Dynamic Load

The maximum dynamic load step presented by an SBB canister on a power rail MUST [61] adhere to the values of Table 9. The SBB canister load slew rate MUST [62] not exceed 0.2A/uS. Frequency of the dynamic load MUST [63] be 50Hz to 10kHz with a duty cycle of 10% to 90%.

**Table 9: Maximum Dynamic Load Step**

| Output Level | Maximum Load Step |
|---|---|
| 12V | 6.0833A |
| 5V | 4.5A |

## 3.6 SBB Canister Input Capacitance

SBB canisters MUST [64] not exceed the maximum input capacitance indicated in Table 10. Input capacitance is defined as the capacitance presented to the system by the canister during a hot insertion.

**Table 10: Primary Power SBB Canister Input Capacitance**

| Power Pin | Voltage | Maximum Input Capacitance |
|---|---|---|
| POSN 1 | GND | |
| POSN 2 | +12V DC | 5000 pF |
| POSN 3 | +5V DC | 5000 pF |
| POSN 4 | GND | |

## 3.7 SBB Midplane Interconnect Power Signals

The SBB Midplane Interconnect (SBBMI) provides three OPTIONAL signals related to power: AC_GOOD_L, STANDBY_PWR, and POWER_OFF_L.

### 3.7.1 AC_GOOD_L

The AC_GOOD_L signal is OPTIONAL. This signal is an input to the canister. If implemented, AC_GOOD_L indicates that AC power is present on the power supplies. This signal MUST [65] have open drain drivers on the power supplies. Multiple power supplies MUST [66] have their signals connected together as one signal. The power supplies MUST [67] drive this signal low if AC power is present. Power MUST [68] be provided to the canister for at least 5ms after this signal goes high.

### 3.7.2 STANDBY_PWR

STANDBY_PWR is OPTIONAL. This signal is a power input to the canister. If implemented, the STANDBY_PWR signal supplies standby power to the SBB canister. If implemented, the SBBMI on the midplane MUST [69] provide 0.5A of power at +5V on STANDBY_PWR as long as AC_GOOD_L is asserted. Power MUST [70] be provided to the STANDBY_PWR signal for at least 5ms after this AC_GOOD_L goes high. SBB canisters MUST [71] have a maximum input capacitance of 5000 pF on STANDBY_PWR.

### 3.7.3 POWER_OFF_L

POWER_OFF_L is OPTIONAL. This signal is an output from the canister. If implemented, when an SBB canister asserts this signal, all power supplies MUST [72] power down.

# 4 Cooling Requirements

## 4.1 Design Criteria

The SBB canister MUST [73] operate in the environment defined below:

- Target Operating Temperature Range (dry bulb) 10°C - 45°C (Local Inlet)
- Operating Relative Humidity Range 5% - 85% NON-CONDENSING
- Altitude -50 ft - 10K ft

## 4.2 Airflow

Airflow MUST [74] be provided by the overall system design. An SBB canister MUST [75] be designed to operate in an enclosure that provides air inlet and air venting as described in Section 2.2. An SBB canister MAY be designed to support multiple air vent locations or MAY be designed to support only one. An enclosure MUST [76] provide a low pressure zone in at least one of the air vent locations. Figure 24 illustrates the airflow through an SBB canister that exits out air vent 1.

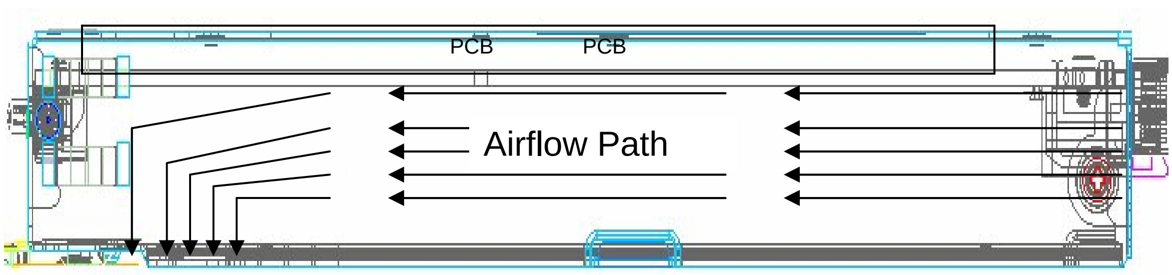


**Figure 24: Example SBB Air Vent 1 Airflow Depiction**

The maximum allowable airflow impedances through an SBB canister are shown in Figure 25 and Figure 26. The SBB specification defines two impedance profiles. The P60 impedance profile is RECOMMENDED for canisters that use less than 60W. However, canisters that use less than 60W MAY use the P100 impedance profile if it is required by their design. When measuring impedance for a canister that uses air vent 1, the impedance curves in Figure 25 MUST [77] be used. When measuring impedance for an SBB canister that uses air vent 2 or air vent 3, the impedance curves in Figure 26 MUST [78] be used. If a canister provides multiple air vent options, impedance at each used air vent location MUST [79] be measured in isolation and the appropriate impedance curve in either Figure 25 or Figure 26 applies. The impedance of SBB canisters that utilize the P60 impedance profile MUST [80] lie below the curve labeled P60 in Figure 25 or Figure 26. The impedance of all SBB canisters MUST [81] lie below the curved labeled P100 in Figure 25 or Figure 26.

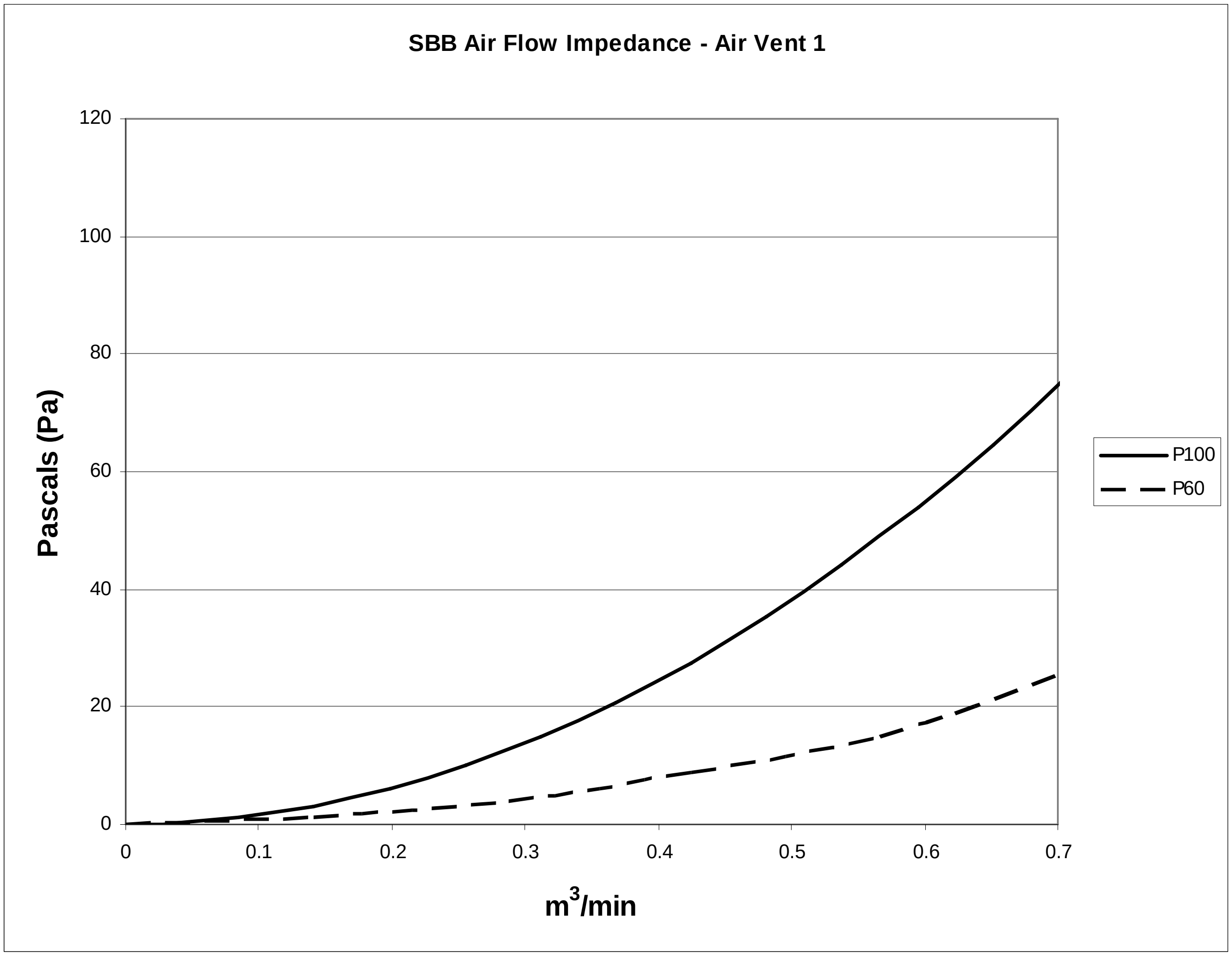


**Figure 25: SBB Canister Air Vent 1 Exhaust Airflow Impedance Graph**

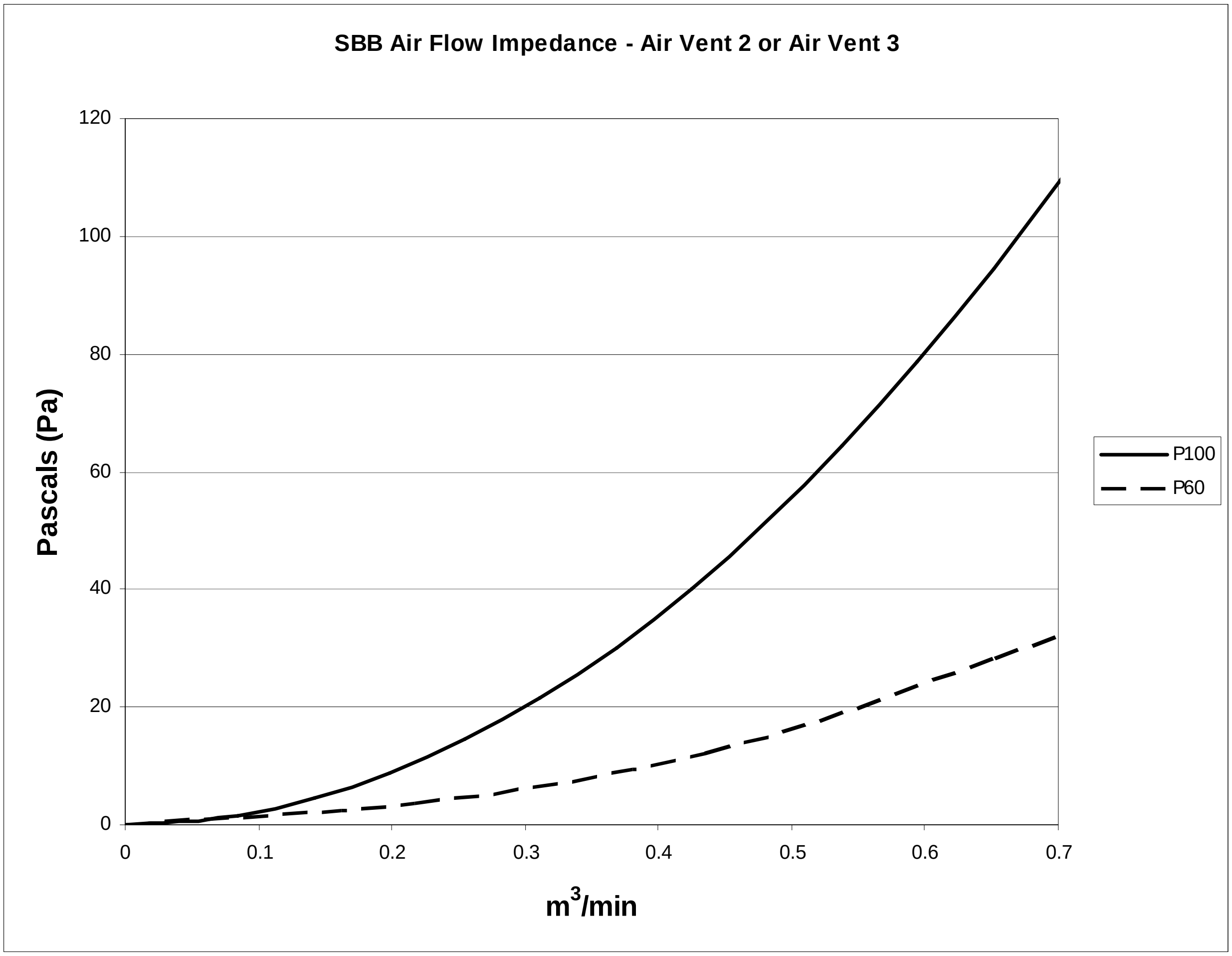


**Figure 26: SBB Canister Air Vent 2 or Air Vent 3 Exhaust Airflow Impedance Graph**

## 4.3 Data Collection Methodology

The overall SBB canister system impedance curve should be obtained by qualified individuals that utilize proper lab practices. The SBB canister, with the controller board mounted inside, should be ducted to a flow bench such that the airflow is representative of airflow when the SBB is placed in the system. The canister should be tightly ducted so that airflow is allowed only through the canister. Measurements of both airflow and static pressure utilizing the flow bench should be taken to obtain curves like those in either Figure 25 or Figure 26.

# 5 SBB Midplane Interconnect Requirements

The SBB Midplane Interconnect (SBBMI) provides the signaling interface between an SBB canister with an enclosure midplane. The SBBMI was developed with several design assumptions. The assumptions ensure that a compliant enclosure can:

a) communicate with up to 28 drives;
b) include SBB canisters in single or redundant configurations;
c) provide communication links between an SBB canister and its optionally redundant partner.

## 5.1 Signal Definitions

### 5.1.1 Overview

Table 11 gives an overview of the types and number of pins provided by the SBBMI. Figure 27 conceptually describes the high-speed communication signal connections in and enclosure with redundant SBB canisters.

**Table 11: SBBMI Signal Overview**

| Signal Description | Total Pins |
|---|---|
| Section 5.1.2 High-Speed Drive Communication | 112 |
| Section 5.1.3 High-Speed Inter-Canister Communication Signals | 32 |
| Section 5.1.4 Low-Speed Drive Status Signals | 84 |
| Section 5.1.5 Signal Profile Defined Signals | 56 |
| Section 5.1.6 Low-Speed Inter-Canister Communication Signals | 16 |
| Section 5.1.7 Low-Speed Canister Support Signals | 25 |
| Section 5.1.8 System Defined Inputs and Outputs | 11 |
| Section 5.1.9 Grounds | 91 |
| Reserved | 5 |

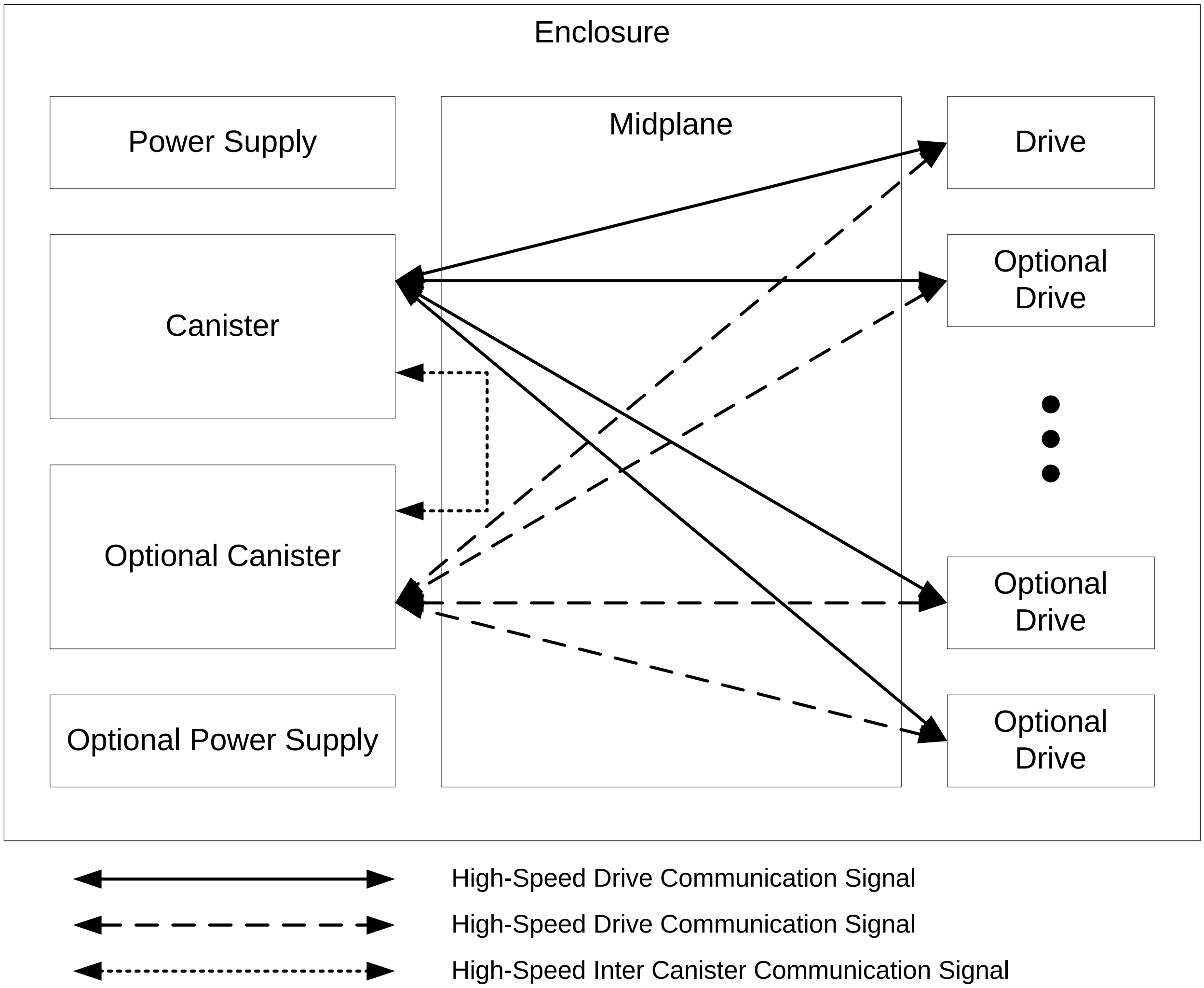


**Figure 27: High-Speed Communication Signals**

### 5.1.2 High-Speed Drive Communication Signals

Table 12 describes the high-speed drive communication signals that connect the SBB canister to drives (via the midplane). The SBBMI provides up to 28 differential signaling pairs. Neither a SBB canister nor a SBB midplane is REQUIRED to provide all of the connections described in Table 12. If however, Table 12 defines a signal as REQUIRED, the canister or midplane MUST [82] provide a physical pin for the signal.

**Table 12: SBBMI High-Speed Drive Communication Signals**

| Signal Name | Module | Description | Input / Output[3] | Required / Optional | |
|---|---|---|---|---|---|
| | | | | Canister | Midplane |
| DRIVE_1_RX+<br>DRIVE_1_RX- | Various | High speed differential pair received FROM drive 1 | $I_{dif}$ | Required | Required |
| DRIVE_1_TX+<br>DRIVE_1_TX- | Various | High speed differential pair transmitted TO drive 1 | $O_{dif}$ | Required | Required |
| DRIVE_[2:28]_RX+<br>DRIVE_[2:28]_RX- | Various | High speed differential pair received FROM drive [2:28] | $I_{dif}$ | Optional[1] | Optional[2] |
| DRIVE_[2:28]_TX+<br>DRIVE_[2:28]_TX- | Various | High speed differential pair transmitted TO drive [2:28] | $O_{dif}$ | Optional[1] | Optional[2] |

Note [1]: Signals are only optional if the drive is not supported by the canister
Note [2]: Signals are only optional if the drive is not supported by the enclosure
Note [3]: See Table 21 for I/O signal characteristics

### 5.1.3 High-Speed Inter-Canister Communication Signals

Table 13 describes the high-speed inter-canister communication signals. The SBBMI provides for up to sixteen high-speed signal pairs for inter-canister communication between two SBB canisters in the same SBB enclosure. All of these connections are OPTIONAL for the canister. The SBB canister MAY utilize a subset of these connections. If an SBB canister utilizes a signal, it MUST [83] adhere to the definition of the signal in Table 13. SBB midplanes MUST [84] provide the full set of connections described in Table 13.

**Table 13: SBBMI High-Speed Inter-Canister Communication Signals**

| Signal Name | Module | Description | Input / Output[2] | Required / Optional | |
|---|---|---|---|---|---|
| | | | | Canister | Midplane |
| HS[1:8]_AB+<br>HS[1:8]_AB- | M1 | High speed inter-canister differential pair transmitted TO another canister | $O_{dif}$ | Optional | Required[1] |
| HS[1:8]_BA+<br>HS[1:8]_BA- | M1 | High speed inter-canister differential pair transmitted FROM another canister | $I_{dif}$ | Optional | Required[1] |

Note [1]: Signals are only required if enclosure supports dual canisters
Note [2]: See Section 5.2 for I/O signal characteristics

### 5.1.4 Low-Speed Drive Status Signals

Table 14 describes the low-speed drive status signals provided by the SBBMI. Table 14 states whether or not an SBB canister's SBBMI or an SBB midplane's SBBMI MUST [85] include a given drive status signal.

**Table 14: SBBMI Low-Speed Drive Status Signals**

| Signal Name | Module | Description | Input / Output[3] | Pull-up (C/O[4]) | Required/Optional | |
|---|---|---|---|---|---|---|
| | | | | | Canister | Midplane |
| DRIVE_1_FAULT_L | M2 | Active low output to drive the fault LED on | $O_{OD2}$ | O | Required | Required |
| DRIVE_1_GPO_L | M2 | General purpose output. MAY be used as an activity LED driver. | $O_{OD2}$ | O | Optional | Optional |

| | | | | | | |
|---|---|---|---|---|---|---|
| DRIVE_1_INPL_L | M2 | Active low input signal that indicates a drive is inserted into the physical slot mapped to this drive port. | $I_{pull\text{-}up}$ | C | Required | Required |
| DRIVE_[2:28]_FAULT_L | M2 | Active low output to drive the fault LED on. | $O_{OD2}$ | O | Optional[1] | Optional[2] |
| DRIVE_[2:28]_GPO_L | M2 | General purpose output. MAY be used as an Activity LED driver. | $O_{OD2}$ | O | Optional | Optional |
| DRIVE_[2:28]_INPL_L | M2 | Active low input signal that indicates a drive is inserted into the physical slot mapped to this drive port. | $I_{pull\text{-}up}$ | C | Optional[1] | Optional[2] |

Note [1]: Signals are only optional if the drive is not supported by the canister
Note [2]: Signals are only optional if the drive is not supported by the enclosure
Note [3]: See Table 21 for I/O signal characteristics
Note [4]: Denotes location of pull-up (C – inside canister, O – outside canister)

### 5.1.5 Signal Profile Defined Signals *(Signal Profile Defined)*

The SBBMI provides a number of signals that are defined by the signal profile. For the SBB specification's nominal signal profile (i.e. 3Gb/s SAS Signal Profile) all profile defined signals MUST [86] be reserved.

### 5.1.6 Low-Speed Inter-Canister Communication Signals

Table 15 describes the signals provided by the SBBMI for low-speed inter-canister communication. The implementation of these signals by SBB canisters is OPTIONAL. An SBB enclosure's midplane MUST [87]implement these signals.

**Table 15: SBBMI Low-Speed Inter-Canister Communication Signals**

| Signal Name | Module | Description | Input / Output[1] | Required / Optional | |
|---|---|---|---|---|---|
| | | | | (Canister) | (Midplane) |
| LS[1:8]_AB | M3 | General purpose inter-canister output | $O_{PPL}$ | Optional | Required[2] |
| LS[1:8]_BA | M3 | General purpose inter-canister input. | $I_{TTL}$ | Optional | Required[2] |

Note [1]: See Table 21 for I/O signal characteristics
Note [2]: Signals are only required if enclosure supports dual canisters

### 5.1.7 Low-Speed Canister Support Signals

Table 16 describes low-speed signals the SBBMI provides for canister support. The table states whether or not an individual signal is REQUIRED. If the SBB canister includes these signals, they MUST [88] adhere to the definitions of Table 16.

**Table 16: SBBMI Low-Speed Canister Support Signals**

| Signal Name | Module | Description | Input / Output[1] | Pull-up (C/O[3]) | Required / Optional | |
|---|---|---|---|---|---|---|
| | | | | | Canister | Midplane |
| AC_GOOD_L | M1 | Power supply AC good signal. See Section 3.7.1 for additional requirements. | $I_{pull\text{-}up}$ | C | Optional | Optional |
| STANDBY_PWR | M1 | This signal supplies standby power to the SBB canister as long as AC power is present. See Section 3.7.2 for requirements. | $I_{5V}$ | NA | Optional | Optional |
| MATED_L | M3 | Signal MUST [89] be grounded on the midplane. Use to detect a fully | $I_{pull\text{-}up}$ | C | Required | Required |

| Signal Name | Module | Description | Input / Output[1] | Pull-up (C/O[3]) | Required / Optional | |
|---|---|---|---|---|---|---|
| | | | | | Canister | Midplane |
| | | mated SBBMI connector | | | | |
| TEMP_INTR_L | M3 | This signal MUST [90] be asserted from the midplane indicating a temperature event. | $I_{pull\text{-}up}$ | C | Optional | Optional |
| SGPIO_SLOAD | M3 | Super GPIO LOAD signal. | $O_{SGPIO}$ | NA | Optional | Optional |
| SGPIO_SCK | M3 | Super GPIO SCK signal. | $O_{SGPIO}$ | NA | Optional | Optional |
| SGPIO_SDO | M3 | Super GPIO SDO signal. | $O_{SGPIO}$ | NA | Optional | Optional |
| SGPIO_SDI | M3 | Super GPIO SDI signal. | $I_{SGPIO}$ | NA | Optional | Optional |
| SCL0 | M3 | Shared CLK signal of two wire bus 0. MUST [91] be pulled to 5V on midplane. Active pull-ups MAY be used. | $I/O_{TW}$ | O | Required | Required |
| SDA0 | M3 | Shared SDA signal of two wire bus 0. MUST [92] be pulled to 5V on midplane. Active pull-ups MAY be used. | $I/O_{TW}$ | O | Required | Required |
| SCL1 | M3 | Shared CLK signal of two wire bus 1. MUST [93] be pulled to 5V on midplane. Active pull-ups MAY be used. | **$I/O_{TW}$** | O | Required | Required |
| SDA1 | M3 | Shared SDA signal of two wire bus 1. MUST [94] be pulled to 5V on midplane. Active pull-ups MAY be used. | $I/O_{TW}$ | O | Required | Required |
| SCL2 | M3 | Shared CLK signal of two wire bus 2. MUST [95] be pulled to 5V on midplane. Active pull-ups MAY be used. | $I/O_{TW}$ | O | Required | Required |
| SDA2 | M3 | Shared SDA signal of two wire bus 2. MUST [96] be pulled to 5V on midplane. Active pull-ups MAY be used. | $I/O_{TW}$ | O | Required | Required |
| POWER_OFF_L | M3 | This signal turns off the power supplies. See Section 3.7.3 for requirements. | $O_{OD1}$ | O | Optional | Optional |
| PS1_SAALED_L | M3 | Power Supply 1 Alert output. Active low signal to drive the fault LED | $O_{OD2}$ | O | Optional | Optional |
| PS2_SAALED_L | M3 | Power Supply 2 Alert output. Active low signal to drive the fault LED | $O_{OD2}$ | O | Optional | Optional |
| PS1_PRES_L | M3 | Active low input signal. Indicates Power Supply 1 is inserted. | $I_{pull\text{-}up}$ | C | Optional | Required |
| PS1_ALERT_L | M3 | Active low input signal. Any power fault in the power supply should assert this signal. | $I_{pull\text{-}up}$ | C | Optional | Required |
| PS2_PRES_L | M3 | Active low input signal. Indicates Power Supply 2 is inserted | $I_{pull\text{-}up}$ | C | Optional | Required[2] |
| PS2_ALERT_L | M3 | Active low input signal. Any power fault in the power supply should assert this signal. | $I_{pull\text{-}up}$ | C | Optional | Required[2] |
| SLOT ID | M3 | Input designating which SBB slot a canister is inserted in. Slot 1 MUST [97] be grounded on the midplane. Slot 2 MUST [98] float on the midplane. | $I_{pull\text{-}up}$ | C | Optional | Required |
| CARD_IO_TEST_L | M3 | Bidirectional signal used to initiate any self test mechanisms between SBB canisters. This signal MUST [99] be bidirectional between the two canisters. | $I_{pull\text{-}up}$ / $O_{OD1}$ | C | Optional | Required |
| TWI_BUS1_RST_L | M3 | Used to reset TWI bus 1 | $O_{OD1}$ | O | Optional | Optional |

| Signal Name | Module | Description | Input / Output[1] | Pull-up (C/O[3]) | Required / Optional | |
|---|---|---|---|---|---|---|
| | | | | | Canister | Midplane |
| TWI_BUS2_RST_L | M3 | Used to reset TWI bus 2. | $O_{OD1}$ | O | Optional | Optional |

Note [1]: See Table 21 for I/O signal characteristics
Note [2]: Only required if enclosure supports multiple power supplies
Note [3]: Denotes location of pull-up (C – inside canister, O – outside canister)

### 5.1.8 System Defined Inputs and Outputs

System defined inputs and outputs are intended to give the system designer flexibility. They can be used as either as inputs or outputs. When a system powers up, these pins SHOULD be left as high impedance inputs until the canister can read the VPD to decide if it is compatible with the enclosure and is capable of utilizing the system defined inputs and outputs. If the canister recognizes the enclosure, it can configure the pins as input or outputs as appropriate. If the canister does not recognize the enclosure, then the canister should leave signals as high impedance inputs and ignore the signals. The signals can be used for canister-to-canister or canister-to-enclosure communications.

**Table 17: SBBMI System Defined Inputs and Outputs**

| Signal Name | Module | Description | Input / Output[1] | Pull-up (C/O[1]) | Required / Optional | |
|---|---|---|---|---|---|---|
| | | | | | (Canister) | (Midplane) |
| SYS_DEF_LP[1:7] | M3 | System defined input or output | $I_{Pull-up}/O_{OD1}$ | C | Optional | Optional |
| SYS_DEF_HP[1:4] | M3 | System defined input or output | $I_{TTL}/O_{OD3}$ | 0 | Optional | Optional |

Note [1]: Denotes location of pull-up (C – inside canister, O – outside canister)

### 5.1.9 Grounds

Table 18 describes the grounds provided by the SBBMI. If the SBB canister implements an optional signal module, all the grounds on that module MUST [100] be connected to ground.

**Table 18: SBBMI Grounds**

| Ground Type | Module | Required/ Optional | Number |
|---|---|---|---|
| Regular-Pin Ground | M1 | Optional | 12 |
| Long-Pin Ground | M1 | Optional | 6 |
| Regular-Pin Ground | M2 | Required | 6 |
| Long-Pin Ground | M2 | Required | 6 |
| Long-Pin Ground | M3 | Required | 6 |
| Long-Pin Ground | M5 | Optional | 6 |
| Regular-Pin Ground | M7 | Required | 6 |
| Long-Pin Ground | M7 | Required | 6 |
| Regular-Pin Ground | M8 | Optional | 6 |
| Long-Pin Ground | M8 | Optional | 6 |
| Regular-Pin Ground | M9 | Optional | 6 |
| Long-Pin Ground | M9 | Optional | 6 |
| Regular-Pin Ground | M10 | Optional | 7 |
| Long-Pin Ground | M10 | Optional | 6 |

## 5.2 Electrical Characteristics

### 5.2.1 High-Speed Signals *(Signal Profile Defined)*

The SBB specification provides two types of high-speed differential signals, drive signals and inter-canister communication signals. Section 5.2.1.2 defines the requirements for differential signals used for communication between an SBB canister and drives. Section 5.2.1.3 defines the requirements for differential signals used for inter-canister communication.

All high-speed differential signals MUST [101] have a differential impedance of 100 ohms with +/- 15% tolerance.

#### 5.2.1.1 Eye Masks

Section 5.2.1.2 and Section 5.2.1.3 use *eye masks* to specify requirements. The eye masks shown are a graphical representation of the voltage and time limits at a given compliance point. The eye mask boundaries define the eye contour of the BER 10-12 jitter population at any compliance point. For more information refer to *ANSI INTCITS TR-35-2004, Information Technology - Fibre Channel - Methodologies for Jitter and Signal Quality Specification (FC-MJSQ)*. The eye mask applies to jitter after the application of a single pole high-pass frequency weighting function that progressively attenuates jitter at 20 dB/decade below a frequency of bit rate/1667. Verification of compliance points with the limits represented by the transmitter eye mask should be done with the reverse channel traffic present in order that the effects of crosstalk are taken into account. For 3Gb/s SAS, the compliance jitter tolerance pattern (CJTPAT) as defined in *ANSI INCITS 376-2003 Information Technology – Serial Attached SCSI (SAS)* MUST [102] be used for measurements at SBB compliance points. For PCIe, the compliance pattern defined in *PCI Express™ Base Specification Revision 1.1* MUST [103] be used for measurements at SBB compliance points.

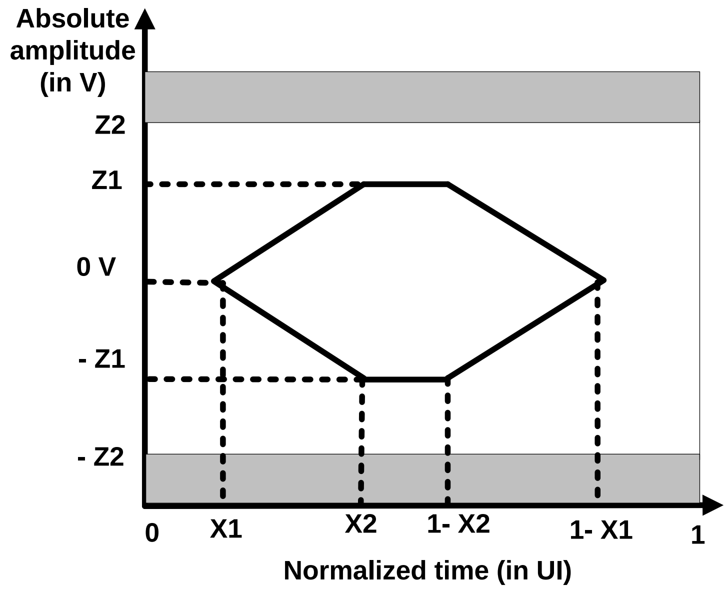


**Figure 28: Eye Mask at Compliance Point**

### 5.2.1.2 High-Speed Drive Signals

This section defines the high-speed drive signal eye mask requirements for the 3Gb/s SAS Signal Profile. If 3Gb/s SAS (as defined in *ANSI INCITS 376-2003 Information Technology – Serial Attached SCSI (SAS)*) is used for any of the high-speed differential drive signals (DRIVE_[1:28]_RX+, DRIVE_[1:28]_RX-, DRIVE_[1:28]_TX+, DRIVE_[1:28]_TX-), then requirements of this section MUST [104] be satisfied. The eye mask requirements are specified at the compliance points ITx and IRx. Figure 29 illustrates the positions of the compliance points ITx and IRx. Appendix 1 describes the method used to perform measurements at ITx and IRx using a zero length test load.

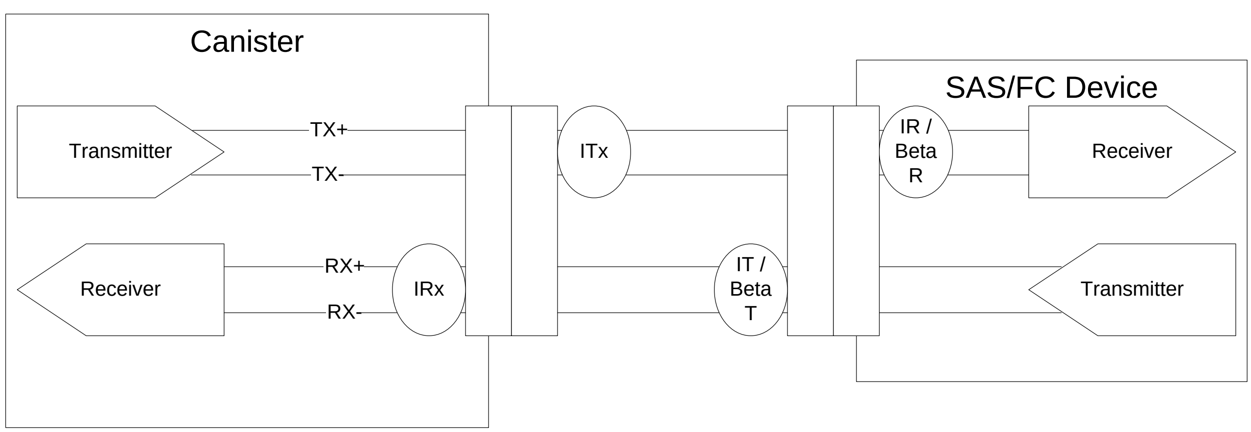


**Figure 29: High-Speed Drive Signal Compliance Points**

The eye mask measured with a test load at ITx MUST [105] equal or exceed the opening defined in Table 19. The SBB canister MUST [106] be capable of operating with an eye mask opening as small as the opening defined in Table 19 when measured with a test load at IRx.

**Table 19: Eye Mask Characteristics for ITx and IRx**

| Eye Mask Characteristic | 3Gb/s SAS | | Unit |
|---|---|---|---|
| | ITx | IRx | |
| Z1 | 237.5 | 150 | mV |
| Z2 | 800 | 800 | mV |
| X1 | 0.260 | 0.250 | UI |
| X2 | 0.475 | 0.475 | UI |

### 5.2.1.3 High-Speed Inter-Canister Signals

This section defines the high-speed inter-canister signal eye mask requirements for the 3Gb/s SAS Signal Profile. The 3Gb/s SAS Signal Profile allows 3Gb/s SAS (as defined in *ANSI INCITS 376-2003 Information Technology – Serial Attached SCSI (SAS)*) or 2.5Gb/s PCIe (as defined in *PCI Express™ Base Specification Revision 1.1*) to be used for any of the high-speed differential inter-canister communication signals (HS[1:8]_AB+, HS[1:8]_AB-, HS[1:8]_BA+, HS[1:8]_BA-).

High-speed inter-canister signal eye mask requirements are specified at the compliance points ITy and IRy. Figure 30 illustrates the positions of the compliance points ITy and IRy. Appendix 1 describes the method used to perform measurements at ITy and IRy using a zero length test load.

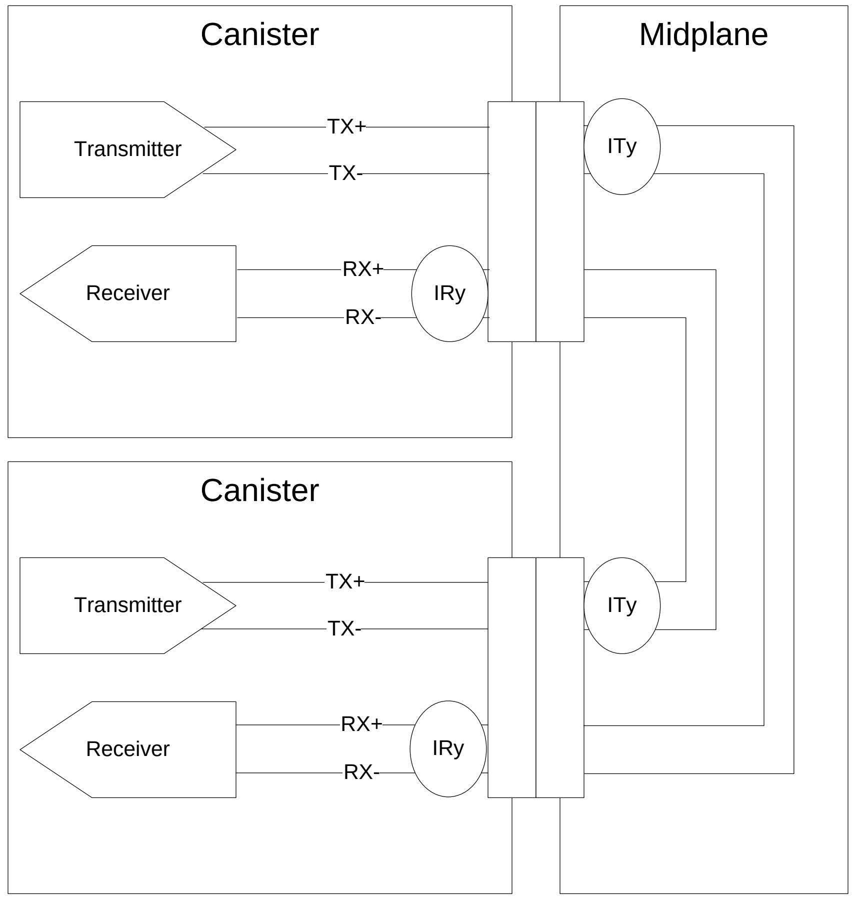


**Figure 30: High-Speed Inter-Canister Signal Compliance Points**

If an SBB canister uses 3Gb/s SAS or 2.5Gb/s PCIe Gen1 for inter-canister communication, then the eye mask measured with a test load at ITy MUST [107] equal or exceed the opening defined in Table 20. The SBB canister MUST [108] be capable of operating with an eye mask opening as small as the opening defined in Table 20 when measured with a test load at IRy.

**Table 20: Eye Mask Characteristics for ITy and IRy**

| Eye Mask Characteristic | 3Gb/s SAS | | 2.5Gb/s PCIe | | Unit |
|---|---|---|---|---|---|
| | ITy | IRy | ITy | IRy | |
| Z1 | 250 | 150 | 212.75 | 200 | mV |
| Z2 | 800 | 800 | 600 | 600 | mV |
| X1 | 0.225 | 0.250 | 0.2125 | 0.225 | UI |
| X2 | 0.45 | 0.475 | 0.4375 | 0.5 | UI |

### 5.2.2 Low Speed Signals

Table 21 gives the characteristics and tolerances to which all low speed signals MUST [109] adhere.

**Table 21 - I/O Characteristics**

**Absolute Maximum Ratings**

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{I/O}$ | DC Voltage on an I/O | | -0.5 | 5.5 | V |

**Electrical Characteristics**

**$I_{TTL}$** TLL Level Input

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{IH}$ | Input High Voltage | | 2 | 5.5 | V |
| $V_{IL}$ | Input Low Voltage | | -0.5 | 0.8 | V |
| $I_{IL}$ | Input Leakage Current | $0<V_{IN}<5.5$ | | +/- 10 | uA |

**$I_{pull-up}$** TLL Level Input w/ pull-up

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{IH}$ | Input High Voltage | | 2 | 5.5 | V |
| $V_{IL}$ | Input Low Voltage | | -0.5 | 0.8 | V |
| $I_{IL}$ | Input Leakage Current | $0<V_{IN}<5.5$ | | +/- 1 | mA |

**$I_{pull-down}$** TLL Level Input w/ pull-down

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{IH}$ | Input High Voltage | | 2 | 5.5 | V |
| $V_{IL}$ | Input Low Voltage | | -0.5 | 0.8 | V |
| $I_{IL}$ | Input Leakage Current | $0<V_{IN}<5.5$ | | +/- 1 | mA |

**$O_{OD1}$** Open Drain Output - Low Current

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 4 mA | | 0.4 | V |
| $I_{OZ}$ | Max 3-State Current | $V_O$ = 5.5V | | +/- 10 | uA |

**$O_{OD2}$** Open Drain Output - High Current (15mA)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 15 mA | | 0.4 | V |
| $I_{OZ}$ | Max 3-State Current | $V_O$ = 5.5V | | +/- 10 | uA |

**$O_{OD3}$** Open Drain Output - High Current (24mA)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 24 mA | | 0.4 | V |
| $I_{OZ}$ | Max 3-State Current | $V_O$ = 5.5V | | +/- 10 | uA |

**$O_{PPL}$** TTL Push Pull Output - Low Current

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{OH}$ | Output High Voltage | $I_{OH}$ = 4 mA | 2.4 | | V |
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 4 mA | | 0.4 | V |

**$I_{dif}$** Differential Pair Input Signal

| |
|---|
| See Section 5.2.1 for signal requirements |

**$O_{dif}$** Differential Pair Output Signal

| |
|---|
| See Section 5.2.1 for signal requirements |

**$I_{5V}$** 5V Input

| |
|---|
| This input provides 5V at 0.5A |

**$I_{SGPIO}$** SGPIO Input

| |
|---|
| Signal defined in SFF-8485 Specification for Serial GPIO (SGPIO) Bus, Revision 0.3,25 January 2007 |

**$O_{SGPIO}$** SGPIO Output

| |
|---|
| Signal defined in SFF-8485 Specification for Serial GPIO (SGPIO) Bus, Revision 0.3,25 January 2007 |

**$I/O_{TWI}$** Two Wire Interface I/O

| |
|---|
| See Section 6.1 for requirements |

## 5.3 Inter-Canister Communication Signal Routing

The SBBMI provides signals for interconnecting two SBB canisters. These signals are used to provide intercommunication links for high availability. These connections are OPTIONAL on the SBB canister and are MUST [110] be implemented on a midplane if the midplane supports multiple SBB canisters.

If a solution requires communication between two SBB canisters, the SBBMI MUST [111] provide the interconnections described in this section. For the purposes of illustration, the solution MUST [112] have two SBBMI's designated SBBMI A and SBBMI B. SBBMI A and B MUST [113] interconnect the high and low-speed signals as described in Figure 31.

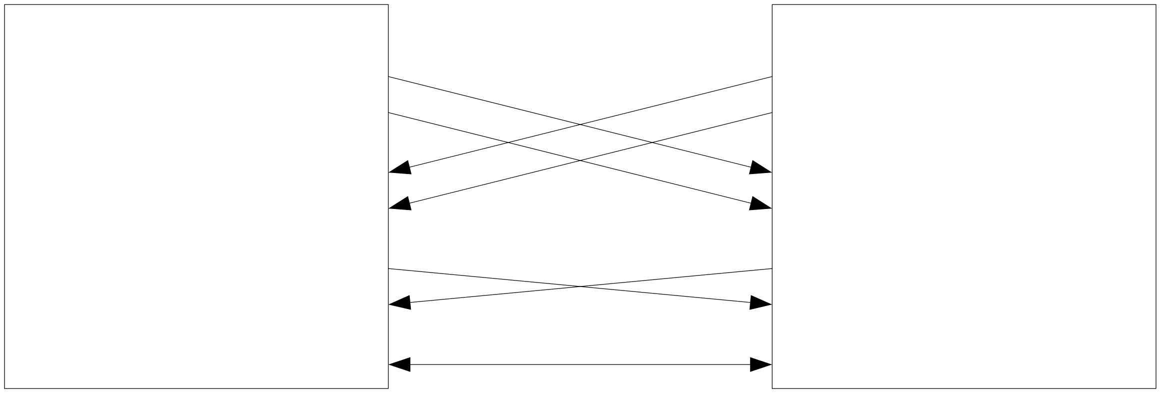

**Figure 31: SBBMI Interconnections**

## 5.4 Modular Connector

The SBBMI uses a modular connector scheme. The number of modules used by a solution SBBMI varies depending on the type and number of drives supported by the solution.

### 5.4.1 Module Designation

The modules used by the SBBMI are designated according to Figure 32. The following subsections describe the modules in more detail. Table 22 gives the type of each module and whether or not the module is required or optional on the midplane and the canister. Some modules are OPTIONAL depending on the signals required by the solution. If Table 22 states that a module is required for the SBB canister, the SBBMI on the canister MUST [114] include the module. If Table 22 states that a module is required for the enclosure midplane, the SBBMI on the midplane MUST [115] include the module.

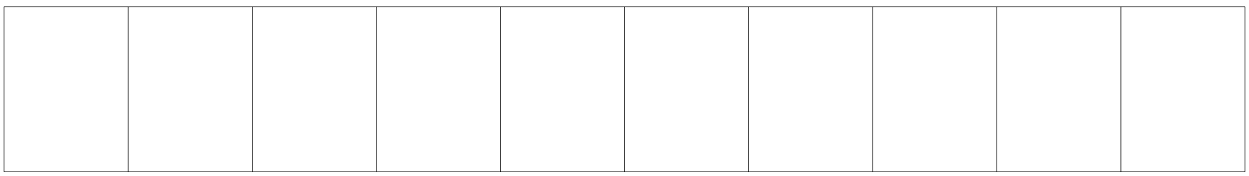


**Figure 32: Modular Connector Designations**

**Table 22: Module Descriptions**

| Module Designation | Module Type | Description | Required Optional | |
|---|---|---|---|---|
| | | | Canister | Midplane |
| M1 | Signal | High-speed inter-canister and enclosure support signals | Optional | Required |
| M2 | Signal | Support for drives 1 – 6 | Required | Required |
| M3 | Signal | Low-speed inter-canister and enclosure support signals | Required | Required |
| M4 | Guide | Mechanical guide pin and receptacle | Required | Required |
| M5 | Signal | Fibre channel drive support | Optional | Optional |
| M6 | Power | Power header and receptacle | Required | Required |
| M7 | Signal | Support for drives 7 – 12 | Optional | Optional |
| M8 | Signal | Support for drives 13 – 18 | Optional | Optional |
| M9 | Signal | Support for drives 19 – 24 | Optional | Optional |
| M10 | Signal | Support for drives 25 – 28 | Optional | Optional |

### 5.4.2 Drive Ports *(Signal Profile Defined)*

Modules M2, M5, M7, M8, M9, and M10 contain high-speed and low-speed signals to support drives. The signals required to support a single drive are called a *drive port.* A drive port includes:

- Drive_?_RX+
- Drive_?_RX-
- Drive_?_TX+
- Drive_?_TX-
- Drive_?_FAULT_L
- Drive_?_GPO_L
- Drive_?_INPL_L

Where “?” refers to the index of the drive. Drives are indexed from 1 through 28 inclusive.

Collectively a drive port for a drive with index “?” is designated Drive_Port_?. SBB canisters MUST [116] use drive ports starting from Drive_Port_1 and increasing contiguously to the drive port that represents the total number of drives supported by the canister. For example, if an SBB canister supports 6 drives, the SBB canister must use only Drive_Port_1, Drive_ Port _2, Drive_ Port _3, Drive_ Port _4, Drive_ Port _5, and Drive_ Port _6. SBBMI’s on an enclosure MUST [117] use drive ports starting from Drive_ Port _1 and increasing contiguously to the drive port that represents the total number of drives supported by the enclosure. For example, if an enclosure only supports four drives, the SBBMI’s on the enclosure midplane must use only Drive_ Port _1, Drive_ Port _2, Drive_ Port _3, and Drive_ Port _4.

### 5.4.3 Signal Type Legend

Table 23 is the signal type legend for the tables in the following subsections. Detailed information on the individual signals is given in Section 5.1. The physical location of each modular connector is given in Section 2.3.

**Table 23: Modular Connector Pin-Out Legend**

| Symbol | Type |
|---|---|
| HS | High-Speed Signal |
| LS | Low-Speed Signal |
| FC | Optional FC Low-Speed Signal |
| RG | Regular-Pin Ground |
| LG | Long-Pin Ground |

### 5.4.4 Module M1

M1 is composed entirely of signals used for communication between redundant SBB canisters. Table 24 gives the positions individual signals MUST [118] occupy in M1.

**Table 24: Module M1 Pin-Outs**

| Row | Column 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | GND$_{RG}$ | HS2_AB+ $_{HS}$ | GND$_{RG}$ | HS4_AB+ $_{HS}$ | GND$_{RG}$ | HS6_AB+ $_{HS}$ |
| B | HS1_AB+ $_{HS}$ | HS2_AB- $_{HS}$ | HS3_AB+ $_{HS}$ | HS4_AB- $_{HS}$ | HS5_AB+ $_{HS}$ | HS6_AB- $_{HS}$ |
| C | HS1_AB- $_{HS}$ | GND$_{RG}$ | HS3_AB- $_{HS}$ | GND$_{RG}$ | HS5_AB- $_{HS}$ | GND$_{RG}$ |
| D | GND$_{RG}$ | HS2_BA+ $_{HS}$ | GND$_{RG}$ | HS4_BA+ $_{HS}$ | GND$_{RG}$ | HS6_BA+ $_{HS}$ |
| E | HS1_BA+ $_{HS}$ | HS2_BA- $_{HS}$ | HS3_BA+ $_{HS}$ | HS4_BA- $_{HS}$ | HS5_BA+ $_{HS}$ | HS6_BA- $_{HS}$ |
| F | HS1_BA- $_{HS}$ | GND$_{LG}$ | HS3_BA- $_{HS}$ | GND$_{LG}$ | HS5_BA- $_{HS}$ | GND$_{LG}$ |
| G | GND$_{LG}$ | HS7_BA+ $_{HS}$ | GND$_{LG}$ | HS8_AB+ $_{HS}$ | GND$_{LG}$ | LS8_AB$_{LS}$ |
| H | HS7_AB+ $_{HS}$ | HS7_BA- $_{HS}$ | AC_GOOD_L$_{LS}$ | HS8_AB- $_{HS}$ | HS8_BA+ $_{HS}$ | LS8_BA$_{LS}$ |
| I | HS7_AB- $_{HS}$ | GND$_{RG}$ | STANDBY_PWR$_{LS}$ | GND$_{RG}$ | HS8_BA- $_{HS}$ | GND$_{RG}$ |

### 5.4.5 Module M2

M2 contains signals used to support one to six drives. Table 25 gives the positions of individual signals MUST [119] occupy in M2.

**Table 25: Module M2 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_1_FAULT_L$_{LS}$ | DRIVE_2_FAULT_L$_{LS}$ | DRIVE_3_FAULT_L$_{LS}$ | DRIVE_4_FAULT_L$_{LS}$ | DRIVE_5_FAULT_L$_{LS}$ | DRIVE_6_FAULT_L$_{LS}$ |
| B | DRIVE_1_GPO_L$_{LS}$ | DRIVE_2_GPO_L$_{LS}$ | DRIVE_3_GPO_L$_{LS}$ | DRIVE_4_GPO_L$_{LS}$ | DRIVE_5_GPO_L$_{LS}$ | DRIVE_6_GPO_L$_{LS}$ |
| C | DRIVE_1_INPL_L$_{LS}$ | DRIVE_2_INPL_L$_{LS}$ | DRIVE_3_INPL_L$_{LS}$ | DRIVE_4_INPL_L$_{LS}$ | DRIVE_5_INPL_L$_{LS}$ | DRIVE_6_INPL_L$_{LS}$ |
| D | GND$_{RG}$ | DRIVE_2_RX+ $_{HS}$ | GND$_{RG}$ | DRIVE_4_RX+ $_{HS}$ | GND$_{RG}$ | DRIVE_6_RX+ $_{HS}$ |
| E | DRIVE_1_RX+ $_{HS}$ | DRIVE_2_RX- $_{HS}$ | DRIVE_3_RX+ $_{HS}$ | DRIVE_4_RX- $_{HS}$ | DRIVE_5_RX+ $_{HS}$ | DRIVE_6_RX- $_{HS}$ |
| F | DRIVE_1_RX- $_{HS}$ | GND$_{LG}$ | DRIVE_3_RX- $_{HS}$ | GND$_{LG}$ | DRIVE_5_RX- $_{HS}$ | GND$_{LG}$ |
| G | GND$_{LG}$ | DRIVE_2_TX+ $_{HS}$ | GND$_{LG}$ | DRIVE_4_TX+ $_{HS}$ | GND$_{LG}$ | DRIVE_6_TX+ $_{HS}$ |
| H | DRIVE_1_TX+ $_{HS}$ | DRIVE_2_TX- $_{HS}$ | DRIVE_3_TX+ $_{HS}$ | DRIVE_4_TX- $_{HS}$ | DRIVE_5_TX+ $_{HS}$ | DRIVE_6_TX- $_{HS}$ |
| I | DRIVE_1_TX- $_{HS}$ | GND$_{RG}$ | DRIVE_3_TX- $_{HS}$ | GND$_{RG}$ | DRIVE_5_TX- $_{HS}$ | GND$_{RG}$ |

### 5.4.6 Module M3

M3 contains signals used for communication between SBB canisters and general signals used for SBB canister support. Table 26 gives the positions individual signals MUST [120] occupy in M3.

**Table 26: Module M3 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| **A** | MATED_L$_{LS}$ | SYS_DEF_LP_2$_{LS}$ | SYS_DEF_LP_6$_{LS}$ | SCL0 $_{LS}$ | LS6_AB $_{LS}$ | PS1_PRES_L $_{LS}$ |
| **B** | SYS_DEF_HP_1$_{LS}$ | SYS_DEF_LP_3$_{LS}$ | SYS_DEF_LP_7$_{LS}$ | SDA0 $_{LS}$ | LS6_BA $_{LS}$ | PS1_ALERT_L $_{LS}$ |
| **C** | SYS_DEF_HP_2$_{LS}$ | SYS_DEF_LP_4$_{LS}$ | SGPIO_SLOAD $_{LS}$ | SCL1 $_{LS}$ | LS7_AB $_{LS}$ | PS2_PRES_L $_{LS}$ |
| **D** | SYS_DEF_HP_3$_{LS}$ | SYS_DEF_LP_5$_{LS}$ | SGPIO_SCK $_{LS}$ | SDA1 $_{LS}$ | LS7_BA $_{LS}$ | PS2_ALERT_L $_{LS}$ |
| **E** | SYS_DEF_LP_1$_{LS}$ | I2C_BUS1_RST_L $_{LS}$ | SGPIO_SDO $_{LS}$ | SCL2 $_{LS}$ | PS1_SAALED_L $_{LS}$ | SDA2 $_{LS}$ |
| **F** | TEMP_INTR_L$_{LS}$ | GND$_{LG}$ | SGPIO_SDI $_{LS}$ | GND$_{LG}$ | PS2_SAALED_L $_{LS}$ | GND$_{LG}$ |
| **G** | GND$_{LG}$ | LS2_AB $_{LS}$ | GND$_{LG}$ | LS4_AB $_{LS}$ | GND$_{LG}$ | SLOT ID $_{LS}$ |
| **H** | LS1_AB $_{LS}$ | LS2_BA $_{LS}$ | LS3_AB $_{LS}$ | LS4_BA $_{LS}$ | LS5_AB $_{LS}$ | SYS_DEF_HP_4$_{LS}$ |
| **I** | LS1_BA $_{LS}$ | I2C_BUS2_RST_L $_{LS}$ | LS3_BA $_{LS}$ | POWER_OFF_L $_{LS}$ | LS5_BA $_{LS}$ | CARD_IO_TEST_L $_{LS}$ |

### 5.4.7 Module M4

M4 is the guide module for the SBBMI. The requirements for the guide module are defined in Section 2.3.4 .

### 5.4.8 Module M5 *(Signal Profile Defined)*

All of the signals in M5 are defined by the signal profile. For the 3Gb/s SAS Signal Profile, all signals in M5 are reserved for future use.

**Table 27: Module M5 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| B | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| C | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| D | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| E | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| F | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| G | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| H | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |
| I | Reserved | Reserved | Reserved | Reserved | Reserved | Reserved |

### 5.4.9 Module M6

M6 contains the power connections for the SBB canister. The requirements for the power module are defined in Section 2.3.3 and Section 3.

### 5.4.10 Module M7

M7 includes signals required to support drives seven through twelve. Table 28 gives the positions of individual signal in M7.

**Table 28: Module M7 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_7_FAULT_L$_{LS}$ | DRIVE_8_FAULT_L$_{LS}$ | DRIVE_9_FAULT_L$_{LS}$ | DRIVE_10_FAULT_L$_{LS}$ | DRIVE_11_FAULT_L$_{LS}$ | DRIVE_12_FAULT_L$_{LS}$ |
| B | DRIVE_7_GPO_L$_{LS}$ | DRIVE_8_GPO_L$_{LS}$ | DRIVE_9_GPO_L$_{LS}$ | DRIVE_10_GPO_L$_{LS}$ | DRIVE_11_GPO_L$_{LS}$ | DRIVE_12_GPO_L$_{LS}$ |
| C | DRIVE_7_INPL_L$_{LS}$ | DRIVE_8_INPL_L$_{LS}$ | DRIVE_9_INPL_L$_{LS}$ | DRIVE_10_INPL_L$_{LS}$ | DRIVE_11_INPL_L$_{LS}$ | DRIVE_12_INPL_L$_{LS}$ |
| D | GND$_{RG}$ | DRIVE_8_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_10_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_12_RX+$_{HS}$ |
| E | DRIVE_7_RX+$_{HS}$ | DRIVE_8_RX-$_{HS}$ | DRIVE_9_RX+$_{HS}$ | DRIVE_10_RX-$_{HS}$ | DRIVE_11_RX+$_{HS}$ | DRIVE_12_RX-$_{HS}$ |
| F | DRIVE_7_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_9_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_11_RX-$_{HS}$ | GND$_{LG}$ |
| G | GND$_{LG}$ | DRIVE_8_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_10_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_12_TX+$_{HS}$ |
| H | DRIVE_7_TX+$_{HS}$ | DRIVE_8_TX-$_{HS}$ | DRIVE_9_TX+$_{HS}$ | DRIVE_10_TX-$_{HS}$ | DRIVE_11_TX+$_{HS}$ | DRIVE_12_TX-$_{HS}$ |
| I | DRIVE_7_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_9_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_11_TX-$_{HS}$ | GND$_{RG}$ |

### 5.4.11 Module M8

M8 contains signals needed to support disks thirteen through eighteen. Table 29 gives the positions of individual signals in M8.

**Table 29: Module M8 Pin-Outs**

Column

| Row | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_13_FAULT_L$_{LS}$ | DRIVE_14_FAULT_L$_{LS}$ | DRIVE_15_FAULT_L$_{LS}$ | DRIVE_16_FAULT_L$_{LS}$ | DRIVE_17_FAULT_L$_{LS}$ | DRIVE_18_FAULT_L$_{LS}$ |
| B | DRIVE_13_GPO_L$_{LS}$ | DRIVE_14_GPO_L$_{LS}$ | DRIVE_15_GPO_L$_{LS}$ | DRIVE_16_GPO_L$_{LS}$ | DRIVE_17_GPO_L$_{LS}$ | DRIVE_18_GPO_L$_{LS}$ |
| C | DRIVE_13_INPL_L$_{LS}$ | DRIVE_14_INPL_L$_{LS}$ | DRIVE_15_INPL_L$_{LS}$ | DRIVE_16_INPL_L$_{LS}$ | DRIVE_17_INPL_L$_{LS}$ | DRIVE_18_INPL_L$_{LS}$ |
| D | GND$_{RG}$ | DRIVE_14_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_16_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_18_RX+$_{HS}$ |
| E | DRIVE_13_RX+$_{HS}$ | DRIVE_14_RX-$_{HS}$ | DRIVE_15_RX+$_{HS}$ | DRIVE_16_RX-$_{HS}$ | DRIVE_17_RX+$_{HS}$ | DRIVE_18_RX-$_{HS}$ |
| F | DRIVE_13_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_15_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_17_RX-$_{HS}$ | GND$_{LG}$ |
| G | GND$_{LG}$ | DRIVE_14_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_16_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_18_TX+$_{HS}$ |
| H | DRIVE_13_TX+$_{HS}$ | DRIVE_14_TX-$_{HS}$ | DRIVE_15_TX+$_{HS}$ | DRIVE_16_TX-$_{HS}$ | DRIVE_17_TX+$_{HS}$ | DRIVE_18_TX-$_{HS}$ |
| I | DRIVE_13_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_15_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_17_TX-$_{HS}$ | GND$_{RG}$ |

### 5.4.12 Module M9

M9 contains signals needed to support disks nineteen through twenty four. Table 30 gives the positions of individual signals in M9.

**Table 30: Module M9 Pin-Outs**

Column

| Row | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_19_FAULT_L$_{LS}$ | DRIVE_20_FAULT_L$_{LS}$ | DRIVE_21_FAULT_L$_{LS}$ | DRIVE_22_FAULT_L$_{LS}$ | DRIVE_23_FAULT_L$_{LS}$ | DRIVE_24_FAULT_L$_{LS}$ |
| B | DRIVE_19_GPO_L$_{LS}$ | DRIVE_20_GPO_L$_{LS}$ | DRIVE_21_GPO_L$_{LS}$ | DRIVE_22_GPO_L$_{LS}$ | DRIVE_23_GPO_L$_{LS}$ | DRIVE_24_GPO_L$_{LS}$ |
| C | DRIVE_19_INPL_L$_{LS}$ | DRIVE_20_INPL_L$_{LS}$ | DRIVE_21_INPL_L$_{LS}$ | DRIVE_22_INPL_L$_{LS}$ | DRIVE_23_INPL_L$_{LS}$ | DRIVE_24_INPL_L$_{LS}$ |
| D | GND$_{RG}$ | DRIVE_20_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_22_RX+$_{HS}$ | GND$_{RG}$ | DRIVE_24_RX+$_{HS}$ |
| E | DRIVE_19_RX+$_{HS}$ | DRIVE_20_RX-$_{HS}$ | DRIVE_21_RX+$_{HS}$ | DRIVE_22_RX-$_{HS}$ | DRIVE_23_RX+$_{HS}$ | DRIVE_24_RX-$_{HS}$ |
| F | DRIVE_19_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_21_RX-$_{HS}$ | GND$_{LG}$ | DRIVE_23_RX-$_{HS}$ | GND$_{LG}$ |
| G | GND$_{LG}$ | DRIVE_20_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_22_TX+$_{HS}$ | GND$_{LG}$ | DRIVE_24_TX+$_{HS}$ |
| H | DRIVE_19_TX+$_{HS}$ | DRIVE_20_TX-$_{HS}$ | DRIVE_21_TX+$_{HS}$ | DRIVE_22_TX-$_{HS}$ | DRIVE_23_TX+$_{HS}$ | DRIVE_24_TX-$_{HS}$ |
| I | DRIVE_19_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_21_TX-$_{HS}$ | GND$_{RG}$ | DRIVE_23_TX-$_{HS}$ | GND$_{RG}$ |

### 5.4.13 Module M10 *(Signal Profile Defined)*

M10 contains signals needed to support disks twenty five through twenty eight. Table 31 gives positions of individual signals in M10.

**Table 31: Module M10 Pin-Outs**

| Row | Column 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_25_FAULT_L$_{LS}$ | DRIVE_26_FAULT_L$_{LS}$ | DRIVE_27_FAULT_L$_{LS}$ | DRIVE_28_FAULT_L$_{LS}$ | Reserved | Reserved |
| B | DRIVE_25_GPO_L$_{LS}$ | DRIVE_26_GPO_L$_{LS}$ | DRIVE_27_GPO_L$_{LS}$ | DRIVE_28_GPO_L$_{LS}$ | Reserved | Reserved |
| C | DRIVE_25_INPL_L$_{LS}$ | DRIVE_26_INPL_L$_{LS}$ | DRIVE_27_INPL_L$_{LS}$ | DRIVE_28_INPL_L$_{LS}$ | Reserved | Reserved |
| D | GND$_{RG}$ | DRIVE_26_RX+ $_{HS}$ | GND$_{RG}$ | DRIVE_28_RX+ $_{HS}$ | Reserved | Reserved |
| E | DRIVE_25_RX+ $_{HS}$ | DRIVE_26_RX- $_{HS}$ | DRIVE_27_RX+ $_{HS}$ | DRIVE_28_RX- $_{HS}$ | Reserved | Reserved |
| F | DRIVE_25_RX- $_{HS}$ | GND$_{LG}$ | DRIVE_27_RX- $_{HS}$ | GND$_{LG}$ | Reserved | GND$_{LG}$ |
| G | GND$_{LG}$ | DRIVE_26_TX+ $_{HS}$ | GND$_{LG}$ | DRIVE_28_TX+ $_{HS}$ | GND$_{LG}$ | Reserved |
| H | DRIVE_25_TX+ $_{HS}$ | DRIVE_26_TX- $_{HS}$ | DRIVE_27_TX+ $_{HS}$ | DRIVE_28_TX- $_{HS}$ | Reserved | Reserved |
| I | DRIVE_25_TX- $_{HS}$ | GND$_{RG}$ | DRIVE_27_TX- $_{HS}$ | GND$_{RG}$ | Reserved | Reserved |

# 6 Enclosure Management Requirements

This section enumerates the SBB requirements for enclosure management. The requirements specify the features provided to the SBB canisters for enclosure management. These features are limited to the interface between the SBB canisters and the rest of the enclosure. This includes temperature sensors, EEPROMs for vital product data (VPD), enclosure management processors, etc. The SBB specification does not provide enclosure management requirements that the SBB canisters need to provide on the host connection interfaces. The host connection interface enclosure management features are implementation dependent.

## 6.1 Two Wire Interface (TWI) Management Buses

The SBB specification provides three TWI buses for enclosure management. Figure 33 illustrates these buses. The SBBMI MUST [121] provide the three TWI buses. The TWI buses MUST [122] adhere to requirements in *The I2C Bus Specification, Version 2.1, January 2000.* A midplane in an SBB compliant enclosure MUST [123] connect the TWI connections on both SBBMIs. Bus 0 is a private bus that is used exclusively by the SBB canister implementations. An SBB compliant midplane and enclosure MUST NOT [124] place any devices on Bus 0. Bus 1 and Bus 2 MAY be used to connect SBB canisters to management devices on the midplane or in the enclosure. Only two management devices (VPD EEPROMs) are REQUIRED[125] to reside on the SBB midplane or be addressable through the SBB midplane. The requirements for the VPD EEPROMs are described in Section 6.2. 80pF of the total capacitance of Bus 0 MUST [126] be reserved for the midplane or enclosure. The remainder of the total capacitance MUST [127] be left to the SBB canisters. 80pF of the total capacitance of Bus 1 MUST [128] be reserved for each SBB canister used in the solution. 240pF of the total capacitance of Bus 1 MUST [129] be reserved for the midplane or enclosure. 80pf of the total capacitance of Bus 2 MUST [130] be reserved for each SBB canister used in the solution. 240pF of the total capacitance of Bus 2 MUST [131] be reserved for the midplane or enclosure.

Table 32 and Table 33 show the address ranges on the TWI buses that are assigned to the different components of an SBB compliant solution. An device with a given address MUST [132] reside in or on the components for which its address is assigned in Table 32 and Table 33.

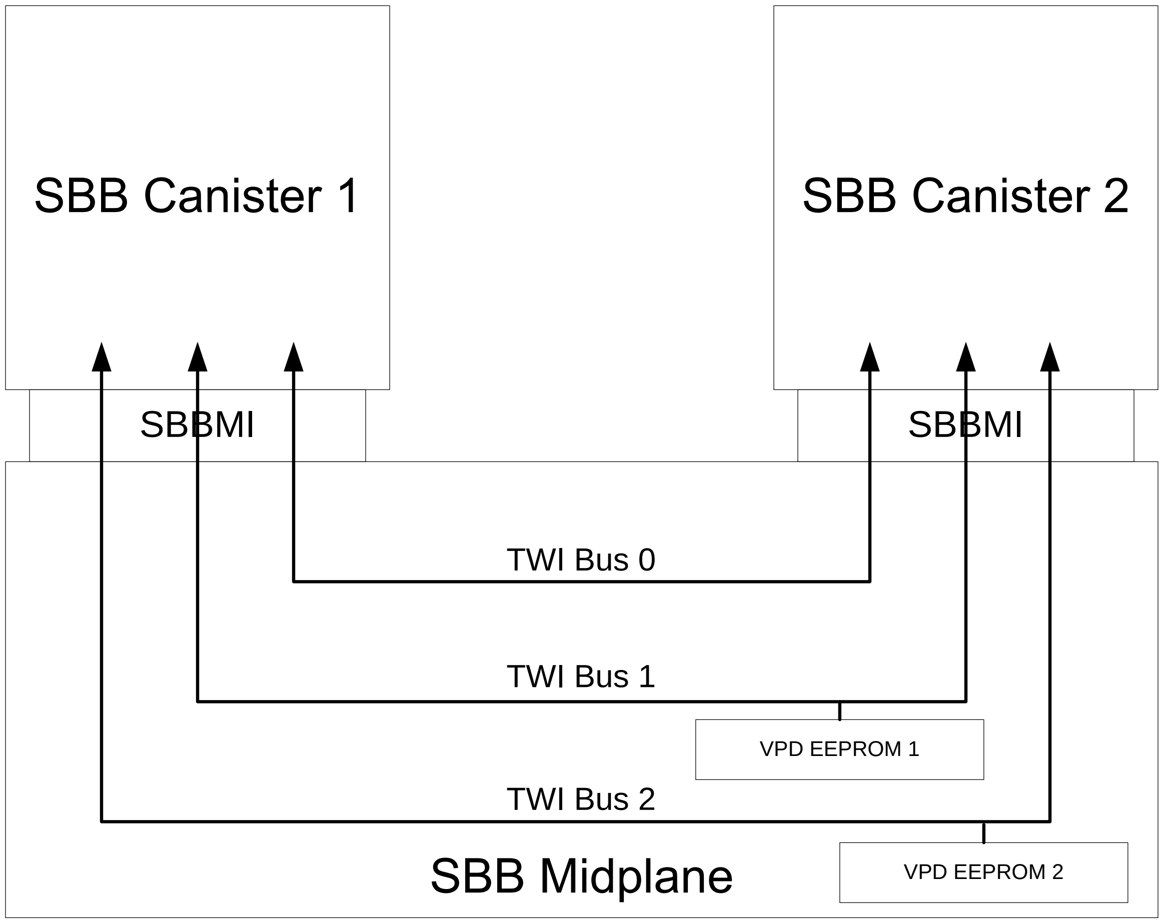


**Figure 33: SBB TWI Buses**

**Table 32: Legend for TWI Address Range Assignments**

| Component | Description |
| --- | --- |
| C | Devices in this address range MUST [133] reside in either Canister 1 or Canister 2. |
| C1 | Devices in this address range MUST [134] reside in Canister 1. |
| C2 | Devices in this address range MUST [135] reside in Canister 2. |
| E | Devices in this address range MUST [136] reside in the Enclosure. Enclosure components include all components except SBB canisters or the midplane. Devices in this address range MUST NOT [137] reside in the SBB canisters or on the midplane. |
| M | Devices in this address range MUST [138] reside on the midplane. |
| R | This address range is reserved. Devices MUST NOT [139] have addresses within this range. |

**Table 33: TWI Address Range Assignments**

| Address Range | Address | Bus | Component | Notes |
|---|---|---|---|---|
| 0000_000x:1111_111x | 00h:FEh | 0 | C | All devices on Bus 0 MUST [140] reside inside the SBB canisters |
| 0000_000x:0001_000x | 00h:10h | 1 or 2 | C | |
| 0001_001x: | 12h | 1 or 2 | M | |
| 0001_010 | 14h | 1 or 2 | E | |
| 0001_011x:0010_000x | 16h:20h | 1 or 2 | C | |
| 0010_001x:0010_011x | 22h:26h | 1 or 2 | M | |
| 0010_100x:0010_101x | 28h:2Ah | 1 or 2 | C | |
| 0010_110x:0010_111x | 2Ch:2Eh | 1 or 2 | E | |
| 0011_000x:0011_011x | 30h:36h | 1 | M | |
| | | 2 | E | |
| 0011_100x:0011_101x | 38h:3Ah | 1 or 2 | C | |
| 0010_110x:0010_111x | 3Ch:3Eh | 1 | E | |
| | | 2 | M | |
| 0100_000x:0100_010x | 40h:44h | 1 or 2 | M | |
| 0100_011x:0100_101x | 46h:4Ah | 1 or 2 | C | |
| 0100_110x:0100_111x | 4Ch:4Eh | 1 or 2 | E | |
| 0101_000x:0101_011x | 50h:56h | 1 or 2 | M | |
| 0101_100x | 58h | 1 or 2 | C1 | |
| 0101_101x | 5Ah | 1 or 2 | C2 | |
| 0101_110x:0101_111x | 5Ch:5Eh | 1 or 2 | E | |
| 0110_000x:0110_111x | 60h:6Eh | 1 or 2 | R | |

| Address Range | Address | Bus | Component | Notes |
|---|---|---|---|---|
| 0111_000x:0111_011x | 70h:76h | 1 or 2 | M | |
| 0111_100x:0111_101x | 78h:7Ah | 1 or 2 | C | |
| 0111_110x:0111_111x | 7Ch:7Eh | 1 or 2 | E | |
| 1000_000x | 80h | 1 or 2 | C1 | |
| 1000_001x | 82h | 1 or 2 | C2 | |
| 1000_010x:1000_011x | 84h:86h | 1 or 2 | M | |
| 1000_100x:1000_101x | 88h:8Ah | 1 or 2 | C | |
| 1000_110x:1000_111x | 8Ch:8Eh | 1 or 2 | E | |
| 1001_000x | 90h | 1 or 2 | C1 | |
| 1001_001x | 92h | 1 or 2 | C2 | |
| 1001_010x:1001_011x | 94h:96h | 1 or 2 | M | |
| 1001_100x:1001_101x | 98h:9Ah | 1 or 2 | C | |
| 1001_110x:1001_111x | 9Ch:9Eh | 1 or 2 | E | |
| 1010_000x | A0h | 1 | C1 | EEPROM device |
| | | 2 | E | |
| 1010_001x | A2h | 1 | C2 | EEPROM device |
| | | 2 | E | |
| 1010_010x:1010_011x | A4h:A6h | 1 or 2 | M | The SBB VPD devices MUST [141] reside at this address on the SBB midplane |
| 1010_100x:1010_101x | A8h:AAh | 1 | E | EEPROM device |
| | | 2 | C | |
| 1010_110x:1010_111x | ACh:AEh | 1 or 2 | E | EEPROM device |
| 1011_000x:1011_001x | B0h:B2 | 2 | E | |

## 6.2 Vital Product Data

The enclosure containing an SBB slot MUST [142] provide two nonvolatile memory locations for the storage of vital product data VPD. The two nonvolatile memory locations are referred to as VPD1 and VPD2. VPD1 and VPD2 MUST [143] be at least 512 bytes in size and addressable as EEPROMs. VPD1 MUST [144] be readable on TWI Bus 1 and have an address of A4 (0100_010x, where x = R/W* bit). VPD2 MUST [145] be readable on TWI Bus 2 and have an address of A4 (0100_010x, where x = R/W* bit). VPD1 and VPD2 MUST [146] be compatible with the Atmel® AT24C01A/02/04 families. VPD1 and VPD2 MUST [147] have the data fields described in Table 35. VPD1 and VPD2 are redundant and MUST [148] have the same values in all of their fields. If one of the VPDs becomes corrupted, it is up to the SBB canister implementation to determine which VPD memory is valid. The VPDs MUST [149] adhere to the *IPMI Platform Management FRU Information Storage Definition, v1.0, Document Revision 1.1, September 27, 1999*. The data section in the VPDs MAY be organized as described in Table 34.

**Table 34: Vital Product Data Organization**

| Size | Name | Required/ Optional | Description |
|---|---|---|---|
| 8 | Common Header | Required | Offsets to other areas |
| Variable | Board Info Area | Required | This area MUST [150] be included in the VPDs. It contains information describing the SBB Midplane. |
| 0 minimum | Internal Use Area | Optional | This area is OPTIONAL and is used to contain vendor specific information. |
| Variable | Chassis Info Area | Required | This area MUST [151] be included in the VPDs. It contains SBB specific information. |
| 0 minimum | Product Info Area | Optional | This area is OPTIONAL. It MAY contain vendor specific product information. |

**Table 35: Vital Product Data Fields**

| Area | Field Descriptor | Field Length (bytes) | Format | Content | Comment |
|---|---|---|---|---|---|
| Common Header Area | Common Header Format Version | 1* | Binary | 01h | Format version number = 1 for IPMI Platform management FRU Information Storage Definition v1.0 |
| | Internal User Area Starting Offset | 1* | Binary | 0Ah | Offset is in multiples of 8 bytes. Actual offset is 10x8 = 80. |
| | Chassis Info Area Starting Offset | 1* | Binary | ? | |
| | Board Info Area Starting Offset | 1* | Binary | ? | |

| Area | Field Descriptor | Field Length (bytes) | Format | Content | Comment |
|---|---|---|---|---|---|
| | Product Info Area Starting Offset | 1* | Binary | 00h or ? | |
| | Multi-Record Area Starting Offset | 1* | Binary | 00h or ? | |
| | Reserved | 1* | Binary | 00h | |
| | Common Header Checksum | 1* | Binary | ? | Zero Checksum |
| Board Info Area | Board Info Area Format Version | 1* | Binary | 01h | Format version number =1 for IPMI Platform Management FRU Information Storage Definition v1.0 |
| | Board Info Area Length | 1* | Binary | ? | |
| | Language Code | 1* | Binary | ? | |
| | Manufacturing Date/Time | 3* | Binary | ? | |
| | Board Manufacturer Type/Length | 1* | Binary | ? | |
| | Board Manufacturer | A* | Binary | ? | |
| | Board Product Name Type/Length | 1* | Binary | ? | |
| | Board Product Name | B* | ASCII | ? | |
| | Board Serial Number Type/Length | 1* | Binary | ? | |
| | Board Serial Number | C* | ASCII | | |
| | Board Part Number Type/Length | 1* | Binary | ? | |
| | Board Part Number | D* | ASCII | ? | |
| | FRU File ID Type/Length | 1* | Binary | 00h or ? | |
| | FRU File ID | E | Binary | | |
| | Type/Length | 1* | Binary | C1h | End of fields indicator |
| | Reserved | F | Binary | ? | |
| | Board Info Area Checksum | 1* | Binary | ? | Zero Checksum |
| Internal Use Area | | | | | Minimum 0 bytes |

| Area | Field Descriptor | Field Length (bytes) | Format | Content | Comment |
| --- | --- | --- | --- | --- | --- |
| | Chassis Info Area Format Version | 1* | Binary | 01h | Format version number =1 for IPMI Platform Management FRU Information Storage Definition v1.0 |
| | Chassis Info Area Length | 1* | Binary | ? | |
| | Chassis Type | 1* | Binary | ? | |
| | Chassis Part Number Type/Length | 1* | Binary | ? | |
| | Chassis Part Number | G | Binary | ? | |
| | Chassis Serial Number Type/Length | 1* | Binary | ? | |
| Chassis Info Area* | Chassis Serial Number | H | Binary | ? | |
| SBB Info Area* | SBB Signature Type/length | 1* | Binary | 04h | |
| | SBB Signature | 4* | Binary | 104A5100h | |
| | SBB Specification Revision type/length | 1* | Binary | C8h | Language code specific |
| | SBB Specification Revision | 8* | ASCII | xx.xx.xx | This current version of the specification is 01.00.00 |
| | SBB Slot 1 Drive Port Mapping Table type/length | 1* | Binary | ? | See Section 6.2.1 |
| | SBB Slot 1 Drive Port Mapping Table | ?* | Binary | | See Section 6.2.1 |
| | SBB Slot 2 Drive Port Mapping Table type/length | 1* | Binary | ? | See Section 6.2.1 |
| | SBB Slot 2 Drive Port Mapping Table | ? | Binary | | See Section 6.2.1 |
| | Vendor Unique Data Area Type/length | 1 | Binary | 00h or ? | |
| | Vendor Unique Data | F | ? | ? | |
| | Power Levels Type/length[1] | 1 | Binary | 04h | If present, power supplies MUST [152] be capable of providing the current defined in the next two fields |
| | Max 12V Current (A) /100[1] | 2 | Binary | 00h – 0341h | Not to exceed 8.33A |
| | Max 5V Current (A) /100[1] | 2 | Binary | 00h – 05DCh | Not to exceed 15A |

| Area | Field Descriptor | Field Length (bytes) | Format | Content | Comment |
|---|---|---|---|---|---|
| | C1h (type/length byte encoded to indicate no more fields) | 1* | Binary | C1h | |
| | Reserved | G | Binary | 00h | |
| | Chassis Area Checksum | 1* | Binary | ? | Zero Checksum |
| Product Info Area | | | | | Minimum 0 Bytes |

Note [1]: See Section 3.1.2

**Table 36: Legend for Vital Product Data Fields**

| Special Marker | Note |
|---|---|
| * in Field Length | This field MUST [153] be set in the SBB VPDs. Other fields required by the IPMI specification not indicted by this marker MUST [154] be set in the SBB VPDs. Fields not indicated by this marker and not required by the IPMI specification are OPTIONAL. |
| ? in Content | This field MUST [155] be calculated as described by the *IPMI Platform Management FRU Information Storage Definition* and set by the SBB implementation. |
| Capital Letter (e.g. A, B, C, etc.) | The number of bytes used by this field is SBB implementation dependent. |

Note [1]: See Section 3.1.2

### 6.2.1 Drive Port Mapping

The Drive Port Mapping Tables are required in the SBB Info Area of the SBB VPD memories. The Drive Port Mapping Tables are used to map the *drive ports* (see Section 5.4.2) on the SBBMI modules to the physical locations where hard drives reside in an SBB compliant enclosure. The capability to map any drive port to any physical drive location is required to allow midplane designers the ability to optimally route drive signals on the midplane.

There are two Drive Port Mapping Tables. The Slot 1 Drive Port Mapping Table MUST [156] be used by the SBB canister inserted into SBB Slot 1. The Slot 2 Drive Port Mapping Table MUST [157] be used by the SBB canister inserted into SBB Slot 2. If the enclosure does not have two SBB slots, the SBB canister inserted into the enclosure MUST [158] use the Slot 1 Drive Port Mapping Table and the Slot 2 Drive Port Mapping Table Type/Length field MUST [159] be set to 00h.

The Drive Port Mapping Tables MUST [160] have an entry for each drive port on the SBBMI that is supported by the SBB enclosure. The Slot 1 Drive Port Mapping Table Type Length field MUST [161] be set to a value equal to number of drives supported in the enclosure. The field descriptor in the Drive Port Mapping Table MUST [162] correspond to the similarly named SBBMI drive port. The Drive Port Mapping

Table has a variable length. The length MUST [163] be equal to the maximum number of physical drives supported by the enclosure. The Drive Port Mapping Table MUST [164] have a 1 byte entry for each of the drive ports supported by the SBB enclosure. The entries in the Drive Port Mapping Table MUST [165] be indexed starting at Drive Port 1 and continue contiguously through the maximum number of drive ports supported by the SBB enclosure. The value in each entry MUST [166] correspond to the physical drive location in the enclosure to which the drive port is connected. Physical drive locations MUST [167] be indexed starting at 0 and continue contiguously through the maximum number of physical drive locations supported minus 1. Valid entries in the Drive Port Mapping Table MUST [168] be between 0h and 1Bh inclusive.

For example, Table 37 shows drive port mapping table entries for an enclosure that supports 28 drives. The enclosure supports both SBB slots. The drive ports from Slot 1 are mapped to the physical drive locations in the enclosure in increasing order. The drive ports from Slot 2 are mapped to the physical drive location in the enclosure in decreasing order.

As another example, Table 38 shows drive port mapping table entries for an enclosure that supports 12 drives. The enclosure only supports one SBB slot so the Slot 2 Drive Port Mapping Table Type/Length field has an entry of 00h. The SBB Slot 1 Drive Port Mapping Table Type/Length field has a value of 0Ch allowing 12 entries. The entries in the SBB Slot 1 Drive Port Mapping Table are not mapped to the physical drive locations in increasing or decreasing order. Out-of-order mapping may indicate that the midplane signals were mapped to provide the optimal routing of the signals on the midplane.

**Table 37: Example Port Mapping Tables for 28 Drives**

| Field Descriptor | Field Length (bytes) | Format | Content |
|---|---|---|---|
| SBB Slot 1 Drive Port Mapping Table Type/Length | 1* | Binary | 1Ch |
| Drive Port 1 Mapping | 1* | Binary | 0h |
| Drive Port 2 Mapping | 1* | Binary | 1h |
| Drive Port 3 Mapping | 1* | Binary | 2h |
| Drive Port 4 Mapping | 1* | Binary | 3h |
| Drive Port 5 Mapping | 1* | Binary | 4h |
| Drive Port 6 Mapping | 1* | Binary | 5h |
| Drive Port 7 Mapping | 1* | Binary | 6h |
| Drive Port 8 Mapping | 1* | Binary | 7h |
| Drive Port 9 Mapping | 1* | Binary | 8h |
| Drive Port 10 Mapping | 1* | Binary | 9h |
| Drive Port 11 Mapping | 1* | Binary | Ah |
| Drive Port 12 Mapping | 1* | Binary | Bh |
| Drive Port 13 Mapping | 1* | Binary | Ch |
| Drive Port 14 Mapping | 1* | Binary | Dh |
| Drive Port 15 Mapping | 1* | Binary | Eh |
| Drive Port 16 Mapping | 1* | Binary | Fh |
| Drive Port 17 Mapping | 1* | Binary | 10h |
| Drive Port 18 Mapping | 1* | Binary | 11h |
| Drive Port 19 Mapping | 1* | Binary | 12h |
| Drive Port 20 Mapping | 1* | Binary | 13h |
| Drive Port 21 Mapping | 1* | Binary | 14h |
| Drive Port 22 Mapping | 1* | Binary | 15h |
| Drive Port 23 Mapping | 1* | Binary | 16h |
| Drive Port 24 Mapping | 1* | Binary | 17h |

| Field Descriptor | Field Length (bytes) | Format | Content |
|---|---|---|---|
| Drive Port 25 Mapping | 1* | Binary | 18h |
| Drive Port 26 Mapping | 1* | Binary | 19h |
| Drive Port 27 Mapping | 1* | Binary | 1Ah |
| Drive Port 28 Mapping | 1* | Binary | 1Bh |
| SBB Slot 2 Drive Port Mapping Table Type/Length | 1* | Binary | 1Ch |
| Drive Port 1 Mapping | 1* | Binary | 1Bh |
| Drive Port 2 Mapping | 1* | Binary | 1Ah |
| Drive Port 3 Mapping | 1* | Binary | 19h |
| Drive Port 4 Mapping | 1* | Binary | 18h |
| Drive Port 5 Mapping | 1* | Binary | 17h |
| Drive Port 6 Mapping | 1* | Binary | 16h |
| Drive Port 7 Mapping | 1* | Binary | 15h |
| Drive Port 8 Mapping | 1* | Binary | 14h |
| Drive Port 9 Mapping | 1* | Binary | 13h |
| Drive Port 10 Mapping | 1* | Binary | 12h |
| Drive Port 11 Mapping | 1* | Binary | 11h |
| Drive Port 12 Mapping | 1* | Binary | 10h |
| Drive Port 13 Mapping | 1* | Binary | Fh |
| Drive Port 14 Mapping | 1* | Binary | Eh |
| Drive Port 15 Mapping | 1* | Binary | Dh |
| Drive Port 16 Mapping | 1* | Binary | Ch |
| Drive Port 17 Mapping | 1* | Binary | Bh |
| Drive Port 18 Mapping | 1* | Binary | Ah |
| Drive Port 19 Mapping | 1* | Binary | 9h |
| Drive Port 20 Mapping | 1* | Binary | 8h |
| Drive Port 21 Mapping | 1* | Binary | 7h |
| Drive Port 22 Mapping | 1* | Binary | 6h |
| Drive Port 23 Mapping | 1* | Binary | 5h |
| Drive Port 24 Mapping | 1* | Binary | 4h |
| Drive Port 25 Mapping | 1* | Binary | 3h |
| Drive Port 26 Mapping | 1* | Binary | 2h |
| Drive Port 27 Mapping | 1* | Binary | 1h |
| Drive Port 28 Mapping | 1* | Binary | 0h |

**Table 38: Example Port Mapping Tables for 12 Drives and 1 Slot**

| Field Descriptor | Field Length (bytes) | Format | Content |
|---|---|---|---|
| SBB Slot 1 Drive Port Mapping Table Type/Length | 1* | Binary | 0Ch |
| Drive Port 1 Mapping | 1* | Binary | 1h |
| Drive Port 2 Mapping | 1* | Binary | 3h |
| Drive Port 3 Mapping | 1* | Binary | 5h |
| Drive Port 4 Mapping | 1* | Binary | 7h |
| Drive Port 5 Mapping | 1* | Binary | 9h |
| Drive Port 6 Mapping | 1* | Binary | Bh |
| Drive Port 7 Mapping | 1* | Binary | 0h |
| Drive Port 8 Mapping | 1* | Binary | 2h |

| Field Descriptor | Field Length (bytes) | Format | Content |
|---|---|---|---|
| Drive Port 9 Mapping | 1* | Binary | 4h |
| Drive Port 10 Mapping | 1* | Binary | 6h |
| Drive Port 11 Mapping | 1* | Binary | 8h |
| Drive Port 12 Mapping | 1* | Binary | Ah |
| SBB Slot 2 Drive Port Mapping Table Type/Length | 1* | Binary | 00h |

# Appendix 1 Signaling Compliance Points

To define high-speed differential signal behavior at the SBBMI requires the definition of *compliance points*. Compliance points give the physical location at which signal requirements are applicable. Signal characteristics are measured at the compliance points at physical positions on a test load called *probe points*. The test load for the SBB specification and the location of the probe points within the test load are defined in Appendix 2. Measurement at the probe points in a test load approximate measurement at the compliance point at the SBBMI for the high-speed signals.

Table A - 1 describes the complaints points used by the SBB specification.

**Table A - 1: Differential Signal Compliance Test Points**

| Compliance points | Description |
|---|---|
| ITx | The transmitting signal from an SBB canister to a drive measured at the probe point in a test load attached to the SBBMI (See Figure A - 1 and Figure A - 2) |
| IRx | The transmitting signal to an SBB canister measured at the probe point in a test load attached to the SBBMI (See Figure A - 1 and Figure A - 3) |
| ITy | The transmitting signal from an SBB canister to another canister measured at the probe point in a test load attached to the SBBMI (See Figure A - 4 and Figure A - 5 . |
| IRy | The transmitting signal to an SBB canister from another canister measured at the probe point in a test load att ached to the SBBMI (Figure A - 4 and Figure A - 6) |
| IT | The transmitting signal to an SBB canister from a SAS drive measured at probe points in a test load attached to the SAS connector of the drive in place of the midplane. The SBB specification places no requirements at this point. See the relevant SAS specifications for system requirements. |
| IR | The transmitting signal from an SBB canister to a SAS drive measured at the probe points in a test load attached to the SAS connector in a midplane in place of a drive. The SBB specification places no requirements at this point. See the relevant SAS specification for system requirements. |
| Beta T | Beta transmit compliance point as per FC standard. Note the SBB places not requirements at this test point. |
| Beta R | Beta receive compliance point as per Fiber channel standard. Note the SBB places not requirements at this test point. |

Figure A - 1 shows the location of the ITx and IRx compliance points for the SBB canister. The figure illustrates a "fully assembled system" with a midplane and a SAS or FC device (e.g. hard drive). Measurements at compliance points are not made in fully assembled systems. Instead, compliance points are measured using *test loads*. Test loads for ITx and IRx are described in Appendix 2. See the relevant SAS specification for the techniques for measuring the SAS compliance points IT and IR or the relevant FC specification for the techniques for measure the FC compliance points. The SBB specification does not place requirements on IT, IR, Beta T or Beta R. All requirements at the ITx and IRx compliance test points assume a maximum return loss at the transmitter or receiver device (i.e. silicon and package) of -12db at 1.5GHz.

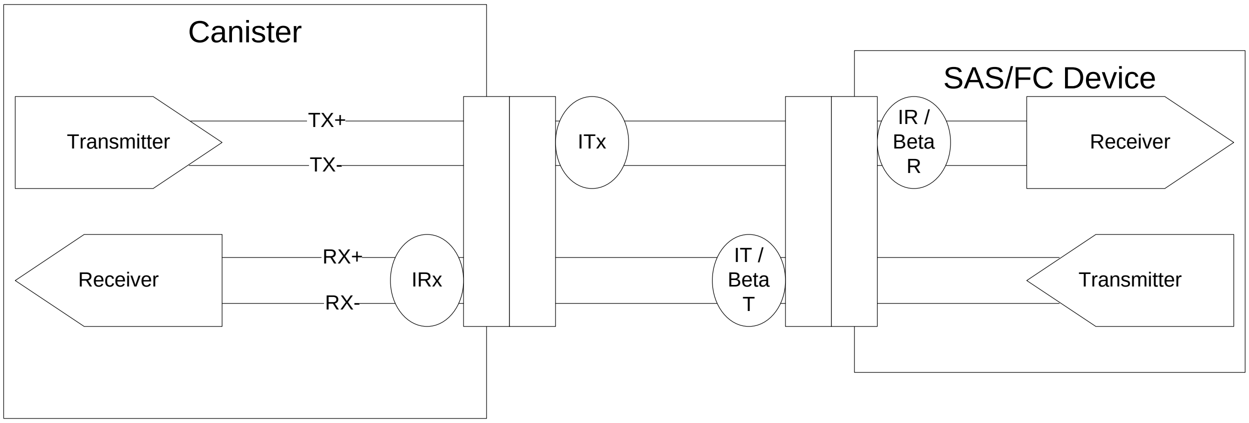


**Figure A - 1: ITx and IRx Compliance Points**

Figure A - 2 shows how measurements are made for compliance point ITx. The test load is attached to an SBB canister directly at the SBBMI, replacing a system midplane. The measurement for ITx is taken at the probe points on the test load. The measurement taken at the probe points approximates the signal supplied to the system at ITx by an SBB canister.

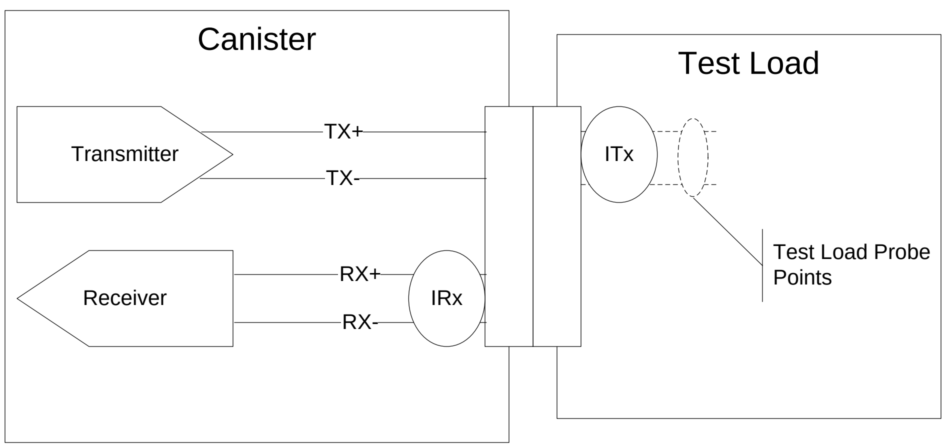


**Figure A - 2: ITx Measurement**

Figure A - 3 illustrates how measurements are made at compliance point IRx. The test load is attached directly at the SBBMI replacing the canister. The measurement is then taken at the probe points on the test load. The measurement taken at the test load approximates the signal supplied by the system to an SBB canister at compliance point IRx.

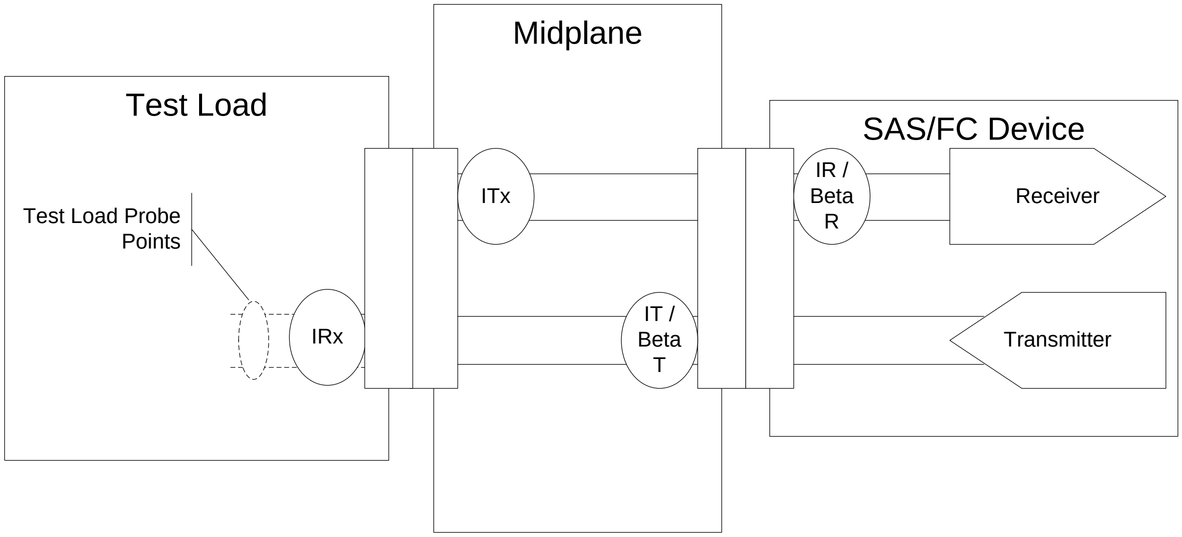


**Figure A - 3: IRx Measurement**

Figure A - 4 shows the location of the ITy and IRy compliance points for the SBB canister. The figure illustrates a “fully assembled system” with a midplane. Measurements at ITy and IRy are measured using test loads (See Appendix 2). All requirements at the ITy and IRy compliance test points assume a maximum return loss at the transmitter or receiver of -12db at 1.5GHz.

Canister SBBMI

Midplane SBBMI

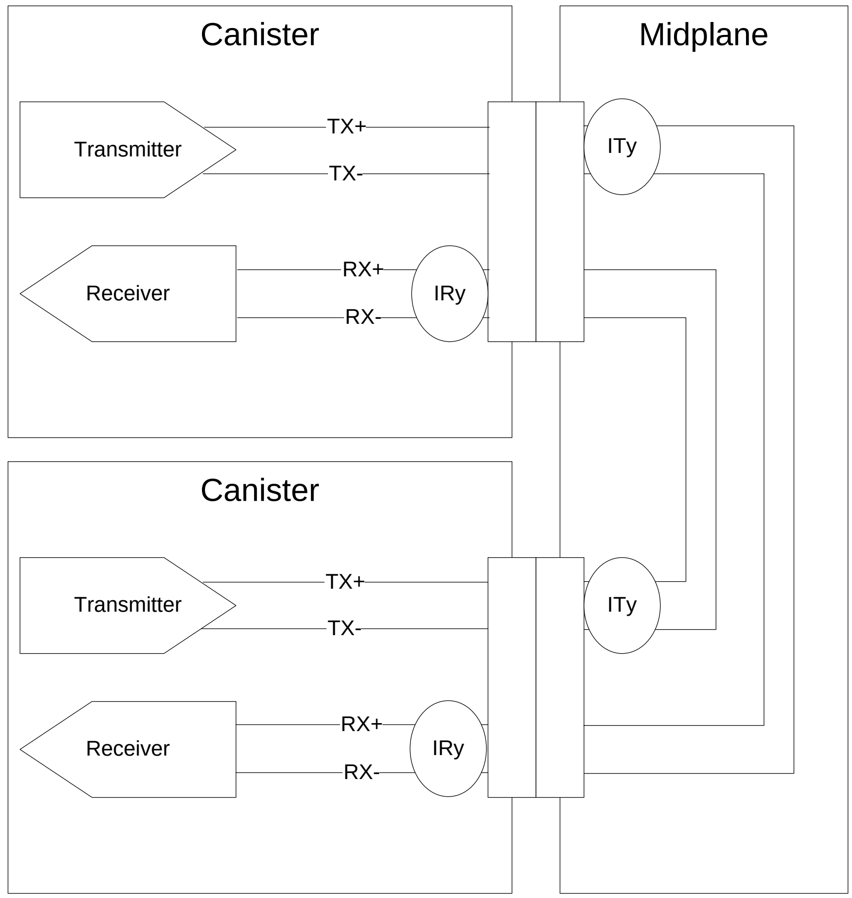


**Figure A - 4: ITy and IRy Compliance Points**

Figure A - 5 shows how measurements are made for compliance point ITy. The test load is attached to an SBB canister directly at the SBBMI, replacing a system midplane. The measurement for ITy is taken at the probe points on the test load. The measurement taken at the probe points approximates the signal supplied by the SBB canister to the system at ITy.

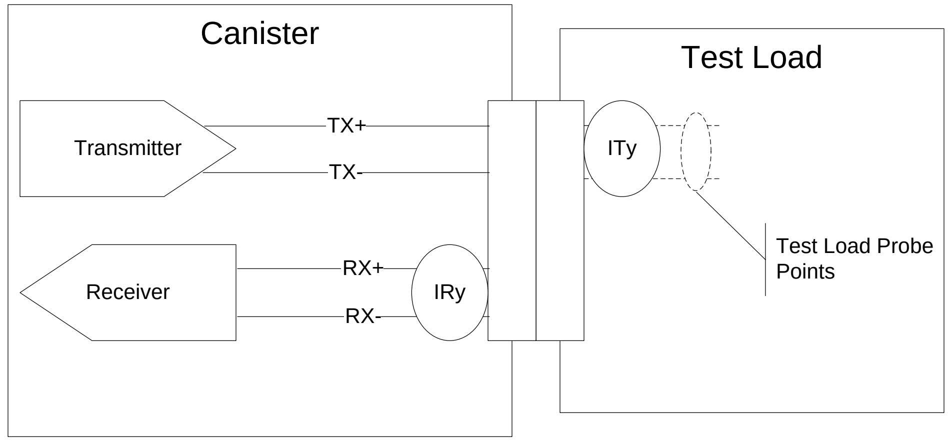


**Figure A - 5: ITy Measurement**

Figure A - 6 shows how measurements are made at compliance point IRy. The test load is attached directly to the SBBMI in place of the redundant SBB canister. The measurement of IRy is then taken at the probe points on the test load. The measurement at the test load represents the signal supplied to an SBB canister at IRy.

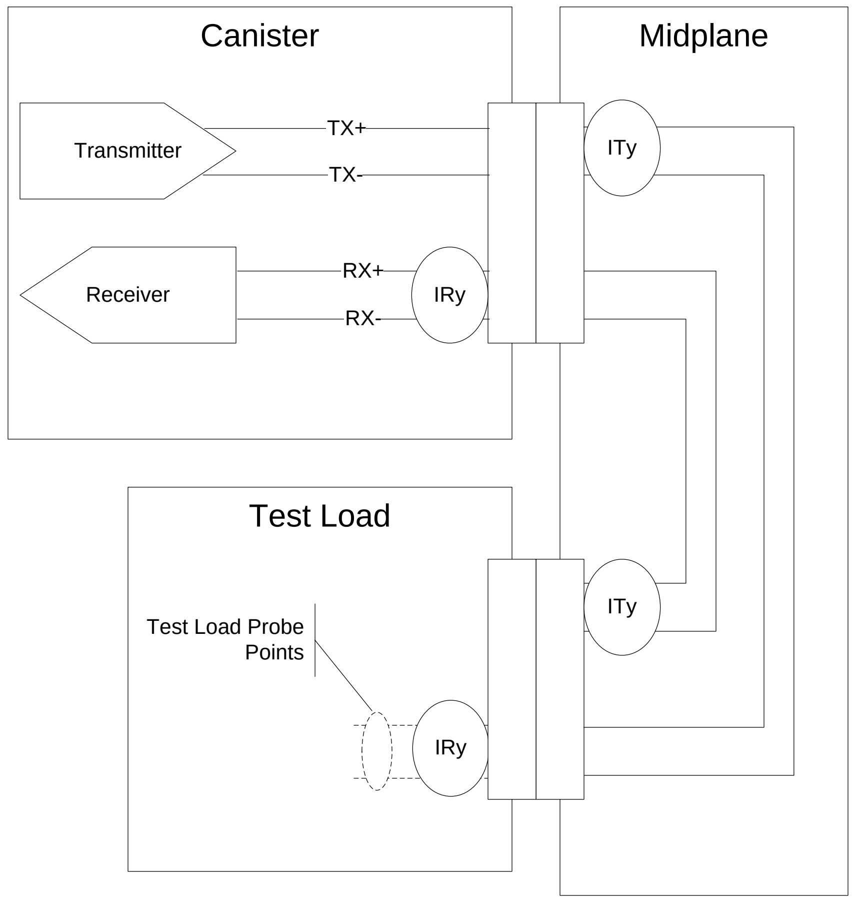


**Figure A - 6: IRy Measurement**

# Appendix 2 SBB Test Load

A test load with a connector compatible with the SBBMI should be used for differential measurement at the compliance test points. The signal characteristics for the compliance points are measured at the physical positions called probe points in the test load. Figure A - 7 shows the test load for the compliance points. The test load card should represent very low insertion and return loss. The values of the capacitors in the test load are defined by the requirements of the signal type. See the relevant specification for the signal type being tested (e.g. FC, SAS, PCIe).

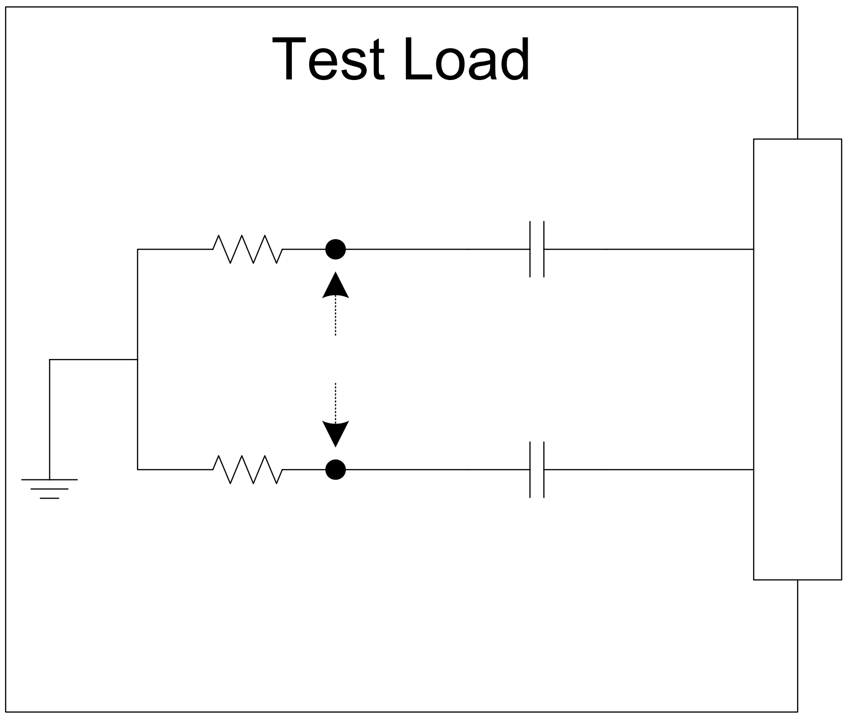


**Figure A - 7: SBB Test Load**

Probe Point

# Appendix 3 SBB Signaling Requirements Reference

This section provides background on the development of the high-speed signal requirements of the SBB specification. The section describes the topologies used for the development of the requirements. Nothing in this section should be interpreted as a requirement on an SBB canister or an enclosure with SBB compliant slots or be interpreted as a design guide. This section describes topologies of example SBB canister PCBs and midplane PCBs. These topologies were used in simulation to determine the SBB solution space. Nothing in the SBB specification should be interpreted as prohibiting designs outside of these boundaries described by these technologies provided that such designs satisfy the signaling requirements described in Section 5.2. Also, designs that fall within the boundaries described in this appendix are not guaranteed to satisfy the requirements Section 5.2.

## Appendix 3.1 Channel Topologies

Figure A - 8 gives a legend for the topology diagrams used in the remainder of this appendix.

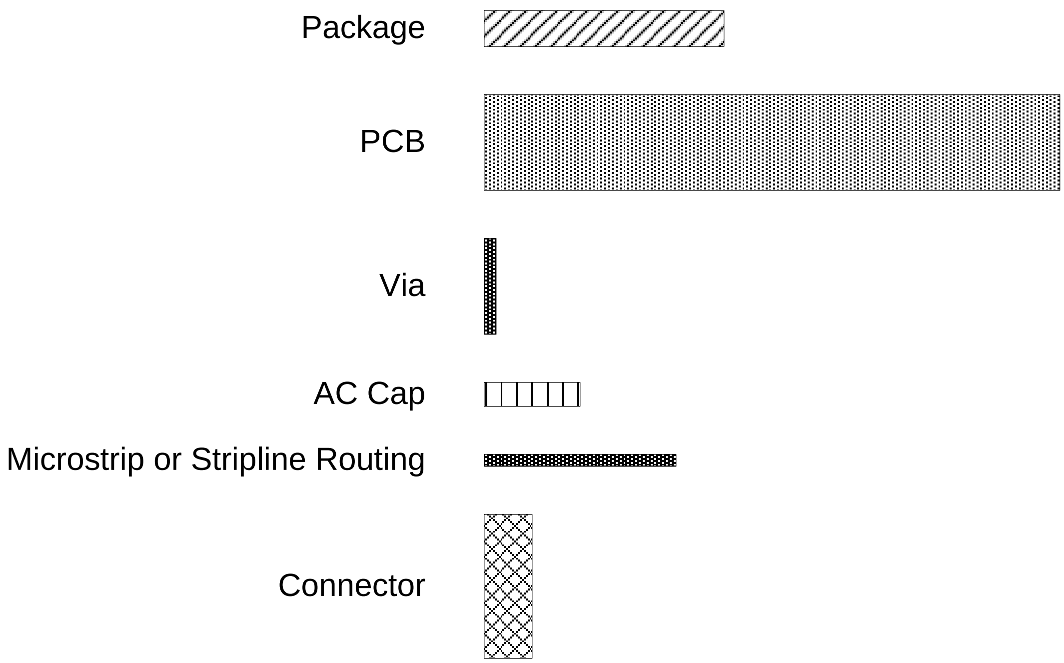


**Figure A - 8: Topology Legend**

Figure A - 9, Figure A - 10, and Figure A - 11 show the channel topologies for the canister, midplane, and hard drive used to develop the high-speed drive signal requirements and the high-speed inter-canister signal requirements. The parameters of the topologies differ according to the type of channel (i.e. drive or inter-canister) and the type signal (i.e. 3Gb/s SAS, 2Gb/s FC, 2.5Gb/s PCIe).

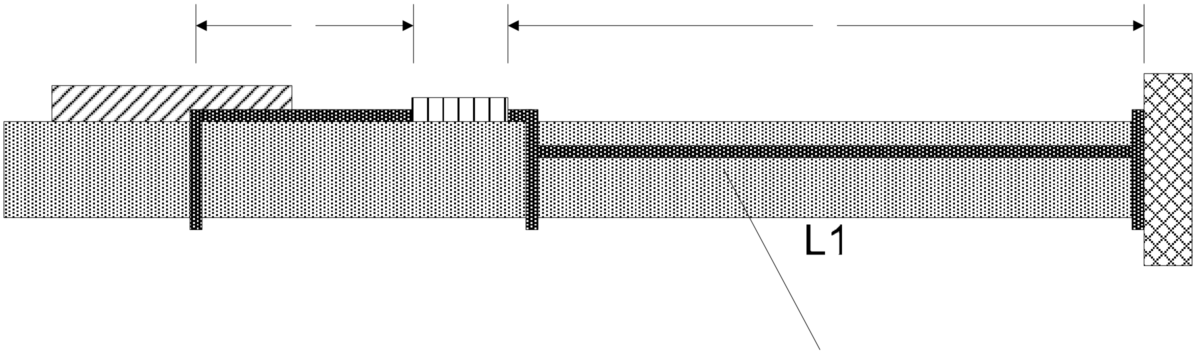


**Figure A - 9: Canister Channel Topology**

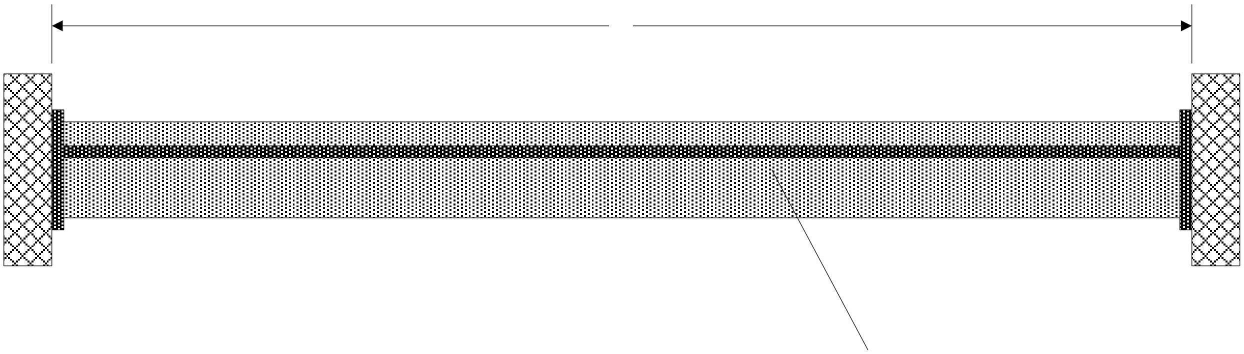

**Figure A - 10: Midplane Channel Topology**

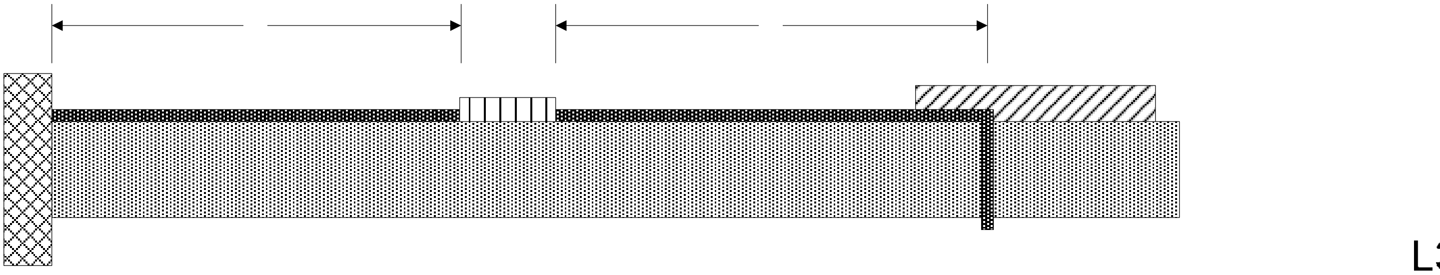


**Figure A - 11: Hard Drive Channel Topology**

## Appendix 3.2 Complete Canister to Drive Channel

Figure A - 12 shows the complete canister to drive channel topology used to develop the eye mask requirements at compliance points ITx and IRx. The requirements at ITx and IRx are only defined for 3Gb/s SAS and 2Gb/s FC. Table A - 2 gives the parameters for 3Gb/s SAS and 2Gb/s FC. The eye mask requirements were set to allow channels with the parameters given in the tables. Again, SBB canisters and enclosures with SBB slots may exceed the boundaries of these parameters and still be compliant with the eye mask requirements. Also, SBB canisters and enclosures with SBB slots that fall within these boundaries are not guaranteed to satisfy the eye mask requirements.

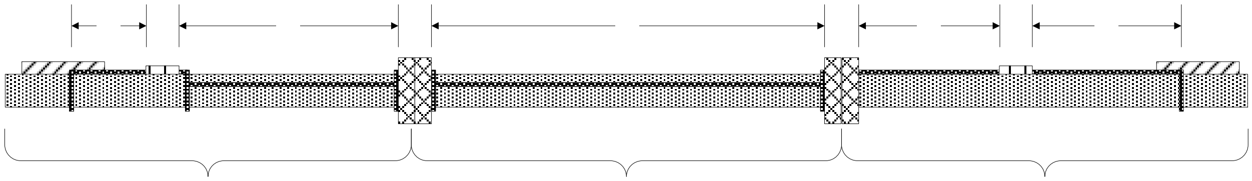


**Figure A - 12: Canister to Drive Channel Topology**

**Table A - 2: 3Gb/s SAS and 2Gb/s FC Canister to Drive Channel Parameters**

| Parameter | Typical | Minimum | Maximum |
|---|---|---|---|
| Canister PCB Thickness (mils) | 100 | N/A | N/A |
| Canister Layer Count | 12 | N/A | N/A |
| L1 (mm) | 25 | 13 | 38 |
| L2 (mm) | 96 | 38 | 152 |
| Canister Vias | 3 | N/A | NA |
| Midplane PCB Thickness (mils) | 130 | N/A | NA |
| Midplane Layer Count | 16 | N/A | NA |
| L3(mm) | 228 | 51 | 406 |
| Midplane Vias | 2 | N/A | NA |
| HDD PCB Thickness (mils) | 62 | N/A | NA |
| HDD Layer Count | 4 | N/A | NA |
| L4(mm) | 16 | 13 | 19 |
| L5(mm) | 6.5 | 5 | 8 |
| HDD Vias | 1 | N/A | NA |

## Appendix 3.3 Complete Canister to Canister Topology

Figure A - 13 shows the complete canister to canister channel topology used to develop the eye mask requirements at the compliance points ITy and IRy. The requirements at ITy and IRy are only defined for 3Gb/s SAS, 2Gb/s FC and 2.5Gb/s PCIe. Table A - 3 gives the parameters for 3Gb/s SAS, 2Gb/s FC and 2.5Gb/s PCIe. The eye mask requirements were set to allow channels with the parameters given in the tables. As with the canister to drive channel, SBB canisters and enclosures with SBB slots may exceed the boundaries of these parameters and still be compliant with the SBB specification's eye mask requirements. Also, SBB canisters and enclosures with SBB slots that fall within these boundaries are not guaranteed to satisfy the eye mask requirements.

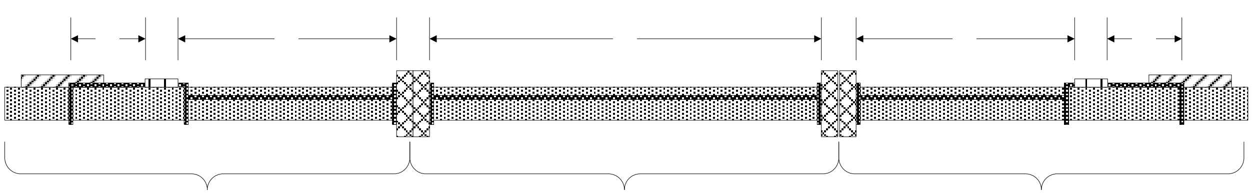

**Figure A - 13: Complete Canister to Canister Topology**

**Table A - 3: 3Gb/s SAS, 2Gb/s FC and 2.5Gb/s PCIe Canister to Canister Channel Parameters**

| Parameter | Typical | Minimum | Maximum |
|---|---|---|---|
| Canister 1 PCB Thickness (mils) | 100 | N/A | N/A |
| Canister 1 Layer Count | 12 | N/A | N/A |
| L1 (mm) | 25 | 13 | 38 |
| L2 (mm) | 96 | 38 | 152 |
| Canister 1 Vias | 3 | N/A | NA |
| Midplane PCB Thickness (mils) | 130 | N/A | NA |
| Midplane Layer Count | 16 | N/A | NA |
| L3(mm) | 228 | 51 | 406 |
| Midplane Vias | 2 | N/A | NA |
| Canister 2 PCB Thickness (mils) | 100 | N/A | N/A |
| Canister 2 Layer Count | 12 | N/A | N/A |
| L4(mm) | 25 | 13 | 38 |
| L5(mm) | 96 | 38 | 152 |
| Canister 2 Vias | 3 | N/A | NA |

# Appendix 4 2Gb/s Fibre Channel Signal Profile

The SBB Specification provides signal profiles to define the requirements specifically related to signal types. The nominal signal profile for the SBB Specification is the 3Gb/s SAS Signal Profile. The requirements for the 3Gb/s SAS Signal Profile are defined within the specification proper. This appendix defines the requirements for 2Gb/s Fibre Channel Signal Profile when they differ from the requirements of the nominal signal profile.

## Appendix 4.1 SBBMI Guide Module

The requirements of this section replace the requirements of Section 2.3.4.

The SBBMI guide module is comprised of a guide pin receptacle that resides on an SBB canister and a guide pin that resides on an enclosure midplane. The guide module has a keying mechanism that prevents canisters from interfacing with enclosures that have a different signal profile (see Section 1.2.7). Sections Appendix 4.1.1 and Appendix 4.1.2 define the guide module requirements for the 2Gb/s FC Signal Profile.

### Appendix 4.1.1 SBBMI Canister Guide Pin Receptacle

The SBBMI canister guide pin receptacle is described in Figure A - 14. The figure describes a right-angle receptacle attached to a PCB located at reference plane A1. If an SBB canister mounts a PCB located at reference plane A1, the guide pin receptacle MUST [169] adhere to the dimensions of Figure A - 14. All dimensions of the guide pin receptacle external to the board volume constraints, regardless of where the PCB is mounted, MUST [170] exactly match the dimensions outside the board volume constraints of the receptacle shown in Figure A - 14. The ESD contact on the guide pin receptacle is OPTIONAL.

Figure A - 15 gives a RECOMMENDED layout for a PCB mounted at reference plane A1 using the right-angle header described in Figure A - 14. Designers MAY use different receptacles or PCB layouts that are more appropriate for their individual applications. However, the position of the receptacle that mates with the SBBMI midplane guide pin MUST [171] remain fixed to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

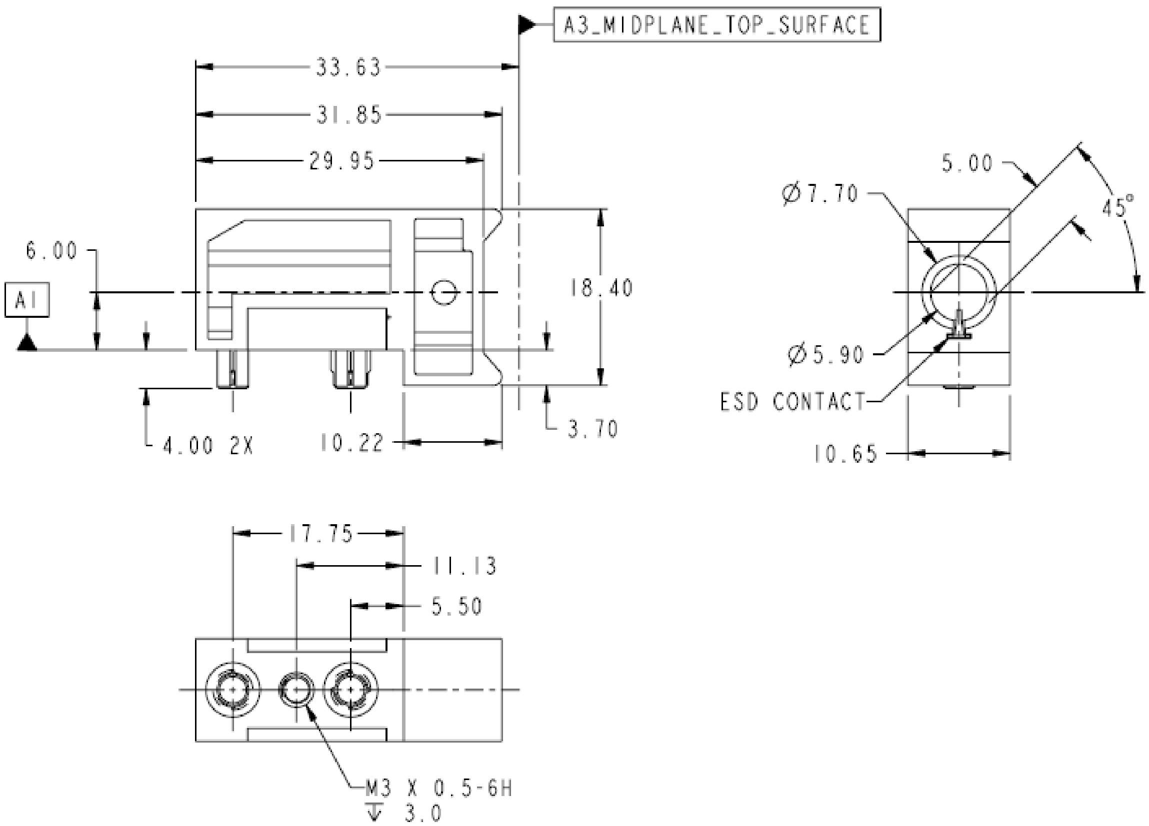


**Figure A - 14: SBBMI Canister Guide Pin Receptacle Dimensions[1]**

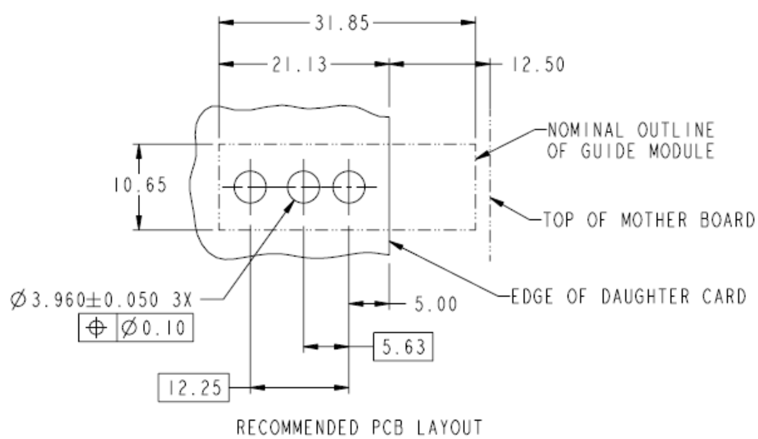


**Figure A - 15: Recommended PCB Layout[1,2]**

[1] Tolerances of dimensions required to ensure the ability to mate connectors may be obtained from FCI Americas Technology.

[2] The finished hole diameter range listed in this figure is for a SnPb plated through hole (PTH) finish. This diameter varies with the PTH finish. Contact FCI Americas Technology for more information

## Appendix 4.1.2 SBBMI Midplane Guide Pin

The SBBMI midplane guide pin is detailed in Figure A - 16. This figure describes a vertical guide pin attached to a midplane located at reference plane A3. If an SBB enclosure has a midplane located at reference plane A3, the guide pin MUST [172] adhere to the dimensions of Figure A - 16. If an SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI midplane guide pin that interface to an SBBMI canister guide pin receptacle MUST [173] exactly mimic the dimension of the interfacing portion of an SBBMI midplane guide pin on an imaginary midplane mounted at reference plane A3 as described in Figure A - 16.

Figure A - 17 gives a RECOMMENDED midplane layout for a vertical guide pin attached to a midplane located at reference plane A3. Designers MAY use different connectors or PCB layouts that are more appropriate for their individual applications. However, the position of the guide pin that interfaces with the SBBMI canister guide pin receptacle MUST [174] remain fixed relative to the board volume constraints described in Figure 5 and SBBMI module locations described Figure 7.

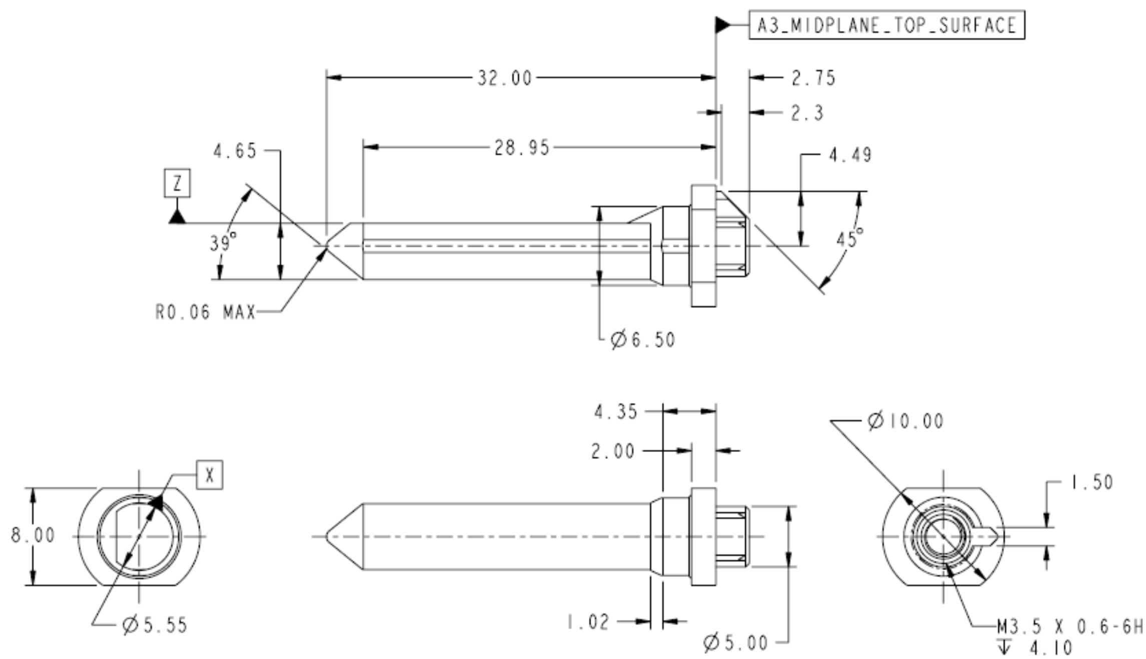


**Figure A - 16: SBBMI Midplane Guide Pin Dimensions**[1]

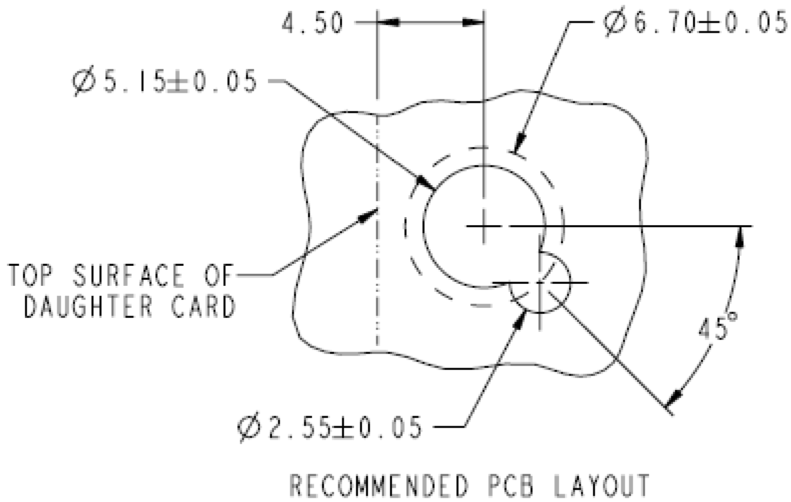


**Figure A - 17: Recommended Component Side Midplane Layout[1]**

## Appendix 4.2 Signal Profile Defined Signals

This section replaces requirements in Section 5.1.5.

The 2Gb/s Fibre Channel Signal Profile uses the SBBMI's profile defined signals for low-speed FC drive status signals. Table A - 4 describes the 2Gb/s FC Signal Profile's drive status signals. If the SBB canister uses these signals, the signals MUST [175] adhere to the definitions given in Table A - 4. Table A - 4 also states whether or not a given signal is required or optional.

**Table A - 4: Profile Defined Signals**

| Signal Name | Module | Description | Input / Output[3] | Required / Optional | |
|---|---|---|---|---|---|
| | | | | (Canister) | (Midplane) |
| DRIVE_1_FLTDET_L | M5 | Active Low FC drive fault sensed. Pull-down for normal operation. | $I_{pull-down}$ | Required | Required |
| DRIVE_1_BYP_L | M5 | Active Low FC loop bypass signal. A pull-down is required for normal operation. | $I_{pull-down}$ | Required | Required |
| DRIVE_[2:24]_FLTDET_L | M5 | Active Low FC drive fault sensed. Pull-down for normal operation. | $I_{pull-down}$ | Optional[1] | Optional[2] |
| DRIVE_[2:24]_BYP_L | M5 | Active Low FC loop bypass signal. A pull-down is required for normal operation. | $I_{pull-down}$ | Optional[1] | Optional[2] |
| DRIVE_[25:28]_FLTDET_L | M10 | Active Low FC drive fault sensed. Pull-down for normal operation. | $I_{pull-down}$ | Optional[1] | Optional[2] |
| DRIVE_[25:28]_BYP_L | M10 | Active Low FC loop bypass signal. A pull-down is required for normal operation. | $I_{pull-down}$ | Optional[1] | Optional[2] |

Note [1]: Signals are only optional if the drive is not supported by the canister
Note [2]: Signals are only optional if the drive is not supported by the enclosure

## Appendix 4.3 High-Speed Signals

This section replaces requirements in Section 5.1.5.

The SBB specification provides two types of high-speed differential signals, drive signals and inter-canister communication signals. Section Appendix 4.3.2 defines the requirements for differential signals used for communication between an SBB canister and drives. Section Appendix 4.3.3 defines the requirements for differential signals used for inter-canister communication.

All high-speed differential signals MUST [176] have a differential impedance of 100 ohms with +/- 15% tolerance.

## Appendix 4.3.1 Eye Masks

Section Appendix 4.3.2 and Section Appendix 4.3.3 use *eye masks* to specify requirements. The eye masks shown are a graphical representation of the voltage and time limits at a given compliance point. The eye mask boundaries define the eye contour of the BER 10-12 jitter population at any compliance point. For more information refer to *ANSI INTCITS TR-35-2004, Information Technology - Fibre Channel - Methodologies for Jitter and Signal Quality Specification (FC-MJSQ)*. The eye mask applies to jitter after the application of a single pole high-pass frequency weighting function that progressively attenuates jitter at 20 dB/decade below a frequency of bit rate/1667. Verification of compliance points with the limits represented by the transmitter eye mask should be done with the reverse channel traffic present in order that the effects of crosstalk are taken into account. For 2Gb/s FC signals, the compliance jitter tolerance pattern (CJTPAT) as defined in as defined in *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)* MUST [177] be used for measurements at SBB compliance points. For PCIe, the compliance pattern defined in *PCI Express™ Base Specification Revision 1.1* MUST [178] be used for measurements at SBB compliance points.

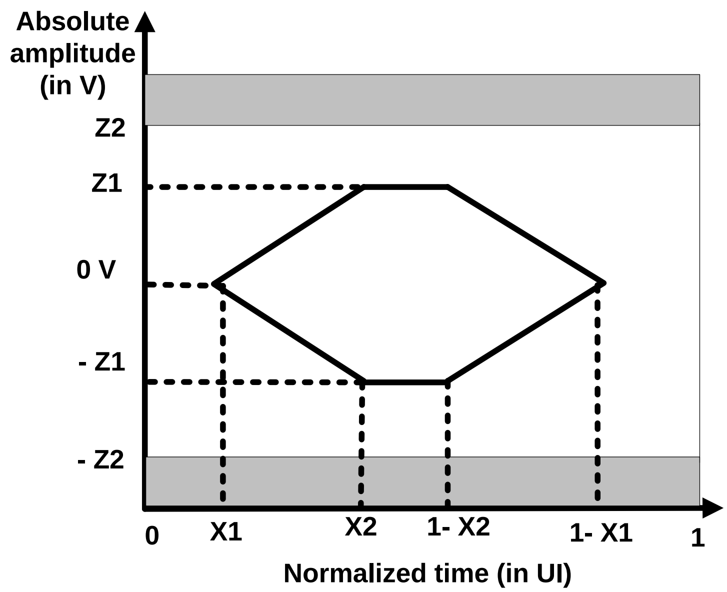


**Figure A - 18: Eye Mask at Compliance Point**

## Appendix 4.3.2 High-Speed Drive Signals

This section defines the high-speed drive signal eye mask requirements for the 2Gb/s FC Signal Profile. If 2Gb/s FC (as defined in *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*) is used for any of the high-speed differential drive signals (DRIVE_[1:28]_RX+, DRIVE_[1:28]_RX-, DRIVE_[1:28]_TX+, DRIVE_[1:28]_TX-), then requirements of this section MUST [179] be satisfied. The eye mask requirements are specified at the compliance points ITx and IRx. Figure A - 19 illustrates the positions of the compliance points ITx and IRx. Appendix 1 describes the method used to perform measurements at ITx and IRx using a zero length test load.

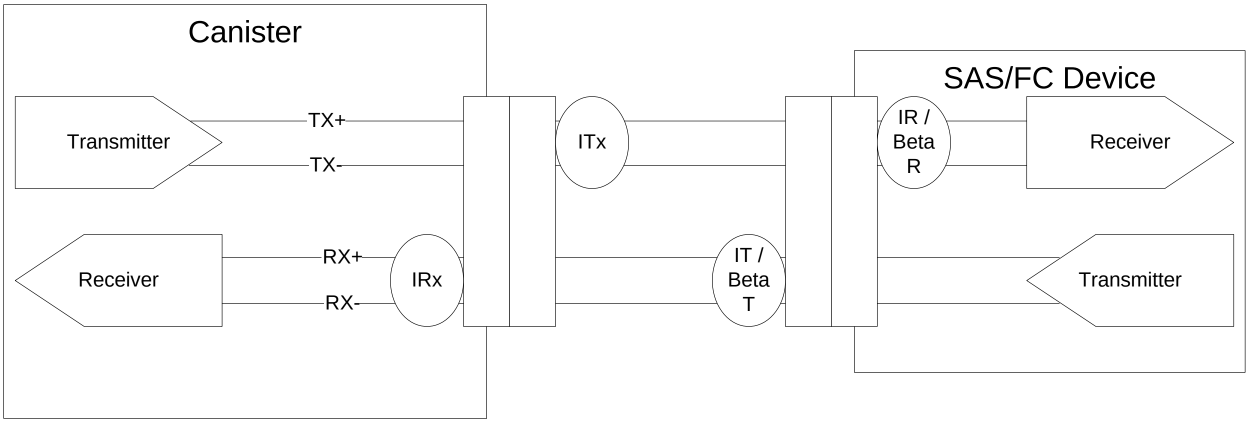


**Figure A - 19: High-Speed Drive Signal Compliance Points**

The eye mask measured with a test load at ITx MUST [180] equal or exceed the opening defined in Table A - 5. The SBB canister MUST [181] be capable of operating with an eye mask opening as small as the opening defined in Table A - 5 when measured with a test load at IRx.

Canister SBBMI

Midplane SBBMI

**Table A - 5: Eye Mask Characteristics for ITx and IRx**

| Eye Mask Characteristic | 2Gb/s FC | | Unit |
|---|---|---|---|
| | ITx | IRx | |
| Z1 | 300 | 200 | mV |
| Z2 | 1000 | 1000 | mV |
| X1 | 0.165 | 0.26 | UI |
| X2 | 0.355 | 0.5 | UI |

## Appendix 4.3.3 High-Speed Inter-Canister Signals

This section defines the high-speed inter-canister signal eye mask requirements for the 2Gb/s FC Signal Profile. The 2Gb/s FC Signal Profile allows 2Gb/s SAS (as defined in *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*) or 2.5Gb/s PCIe (as defined in *PCI Express™ Base Specification Revision 1.1*) to be used for any of the high-speed differential inter-canister communication signals (HS[1:8]_AB+, HS[1:8]_AB-, HS[1:8]_BA+, HS[1:8]_BA-).

High-speed inter-canister signal eye mask requirements are specified at the compliance points ITy and IRy. Figure A - 20 illustrates the positions of the compliance points ITy and IRy. Appendix 1 describes the method used to perform measurements at ITy and IRy using a zero length test load.

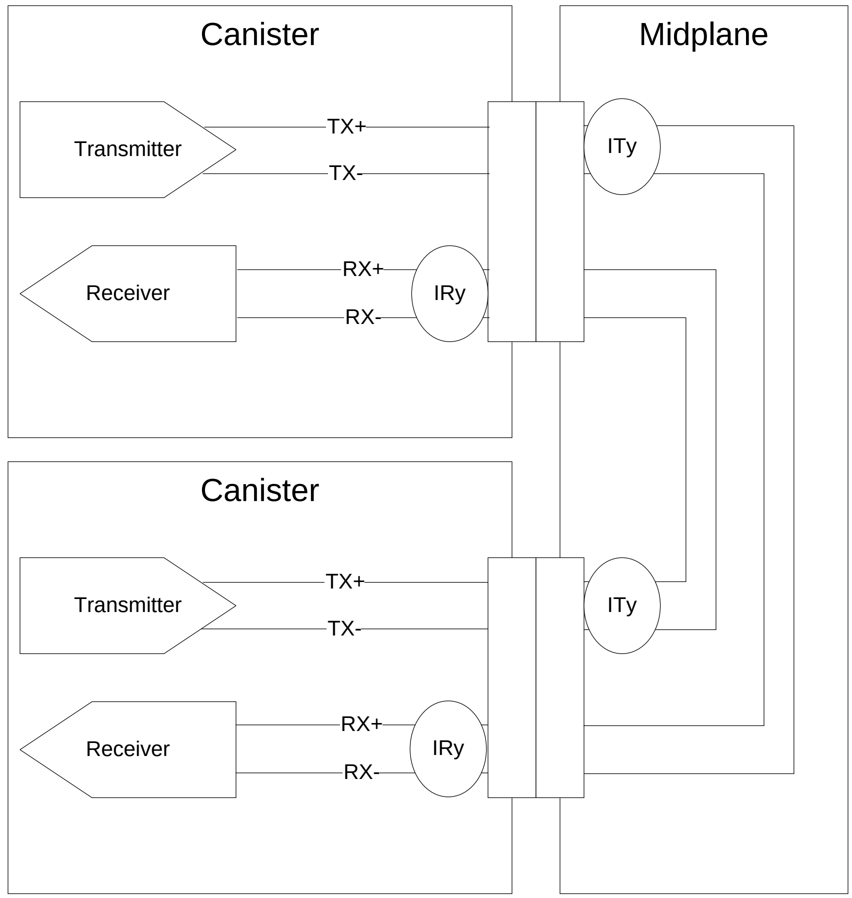


**Figure A - 20: High-Speed Inter-Canister Signal Compliance Points**

If an SBB canister uses 2Gb/s FC or 2.5Gb/s PCIe Gen1 for inter-canister communication, then the eye mask measured with a test load at ITy MUST [182] equal or exceed the opening defined in Table A - 6. The SBB canister MUST [183] be capable of operating with an eye mask opening as small as the opening defined in Table A - 6 when measured with a test load at IRy.

**Table A - 6: Eye Mask Characteristics for ITy and IRy**

| Eye Mask Characteristic | 2Gb/s FC | | 2.5Gb/s PCIe | | Unit |
|---|---|---|---|---|---|
| | ITy | IRy | ITy | IRy | |
| Z1 | 312.5 | 212.5 | 212.75 | 200 | mV |
| Z2 | 1000 | 1000 | 600 | 600 | mV |
| X1 | 0.19 | 0.24 | 0.2125 | 0.225 | UI |
| X2 | 0.38 | 0.5 | 0.4375 | 0.5 | UI |

# Appendix 4.4 Drive Ports (Signal Profile Defined)

This section replaces requirements in Section 5.4.2

Modules M2, M5, M7, M8, M9, and M10 contain high-speed and low-speed signals to support drives. The signals required to support a single drive are called a *drive port.* A drive port includes:

- Drive_?_RX+
- Drive_?_RX-
- Drive_?_TX+
- Drive_?_TX-
- Drive_?_FAULT_L
- Drive_?_GPO_L
- Drive_?_INPL_L
- Drive_?_FLTDET_L
- Drive_?_BYP_L

Where "?" refers to the index of the drive. Drives are indexed from 1 through 28 inclusive.

Collectively a drive port for a drive with index "?" is designated Drive_Port_?. SBB canisters MUST [184] use drive ports starting from Drive_Port_1 and increasing contiguously to the drive port that represents the total number of drives supported by the canister. For example, if an SBB canister supports 6 drives, the SBB canister must use only Drive_Port_1, Drive_ Port _2, Drive_ Port _3, Drive_ Port _4, Drive_ Port _5, and Drive_ Port _6. SBBMI's on an enclosure MUST [185] use drive ports starting from Drive_ Port _1 and increasing contiguously to the drive port that represents the total number of drives supported by the enclosure. For example, if an enclosure only supports four drives, the SBBMI's on the enclosure midplane must use only Drive_ Port _1, Drive_ Port _2, Drive_ Port _3, and Drive_ Port _4.

# Appendix 4.5 Module M5

This section replaces Section 5.4.8.

M5 contains low-speed signals required to support Fibre Channel drives. Table A - 7 gives the positions of individual signals in M5.

**Table A - 7: Module M5 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | DRIVE_1_FLTDET_$L_{LS}$ | DRIVE_9_FLTDET_$L_{LS}$ | DRIVE_17_FLTDET_$L_{LS}$ | DRIVE_1_BYP_$L_{LS}$ | DRIVE_9_BYP_$L_{LS}$ | DRIVE_17_BYP_$L_{LS}$ |
| B | DRIVE_2_FLTDET_$L_{LS}$ | DRIVE_10_FLTDET_$L_{LS}$ | DRIVE_18_FLTDET_$L_{LS}$ | DRIVE_2_BYP_$L_{LS}$ | DRIVE_10_BYP_$L_{LS}$ | DRIVE_18_BYP_$L_{LS}$ |
| C | DRIVE_3_FLTDET_$L_{LS}$ | DRIVE_11_FLTDET_$L_{LS}$ | DRIVE_19_FLTDET_$L_{LS}$ | DRIVE_3_BYP_$L_{LS}$ | DRIVE_11_BYP_$L_{LS}$ | DRIVE_19_BYP_$L_{LS}$ |
| D | DRIVE_4_FLTDET_$L_{LS}$ | DRIVE_12_FLTDET_$L_{LS}$ | DRIVE_20_FLTDET_$L_{LS}$ | DRIVE_4_BYP_$L_{LS}$ | DRIVE_12_BYP_$L_{LS}$ | DRIVE_20_BYP_$L_{LS}$ |
| E | DRIVE_5_FLTDET_$L_{LS}$ | DRIVE_13_FLTDET_$L_{LS}$ | DRIVE_21_FLTDET_$L_{LS}$ | DRIVE_5_BYP_$L_{LS}$ | DRIVE_13_BYP_$L_{LS}$ | DRIVE_21_BYP_$L_{LS}$ |
| F | DRIVE_6_FLTDET_$L_{LS}$ | $GND_{LG}$ | DRIVE_22_FLTDET_$L_{LS}$ | $GND_{LG}$ | DRIVE_14_BYP_$L_{LS}$ | $GND_{LG}$ |
| G | $GND_{LG}$ | DRIVE_14_FLTDET_$L_{LS}$ | $GND_{LG}$ | DRIVE_6_BYP_$L_{LS}$ | $GND_{LG}$ | DRIVE_22_BYP_$L_{LS}$ |
| H | DRIVE_7_FLTDET_$L_{LS}$ | DRIVE_15_FLTDET_$L_{LS}$ | DRIVE_23_FLTDET_$L_{LS}$ | DRIVE_7_BYP_$L_{LS}$ | DRIVE_15_BYP_$L_{LS}$ | DRIVE_23_BYP_$L_{LS}$ |
| I | DRIVE_8_FLTDET_$L_{LS}$ | DRIVE_16_FLTDET_$L_{LS}$ | DRIVE_24_FLTDET_$L_{LS}$ | DRIVE_8_BYP_$L_{LS}$ | DRIVE_16_BYP_$L_{LS}$ | DRIVE_24_BYP_$L_{LS}$ |

## Appendix 4.6 Module M10

This section replaces Section 5.4.13.

M10 contains signals needed to support disks twenty five through twenty eight. Table A - 8 gives positions of individual signals in M10.

**Table A - 8: Module M10 Pin-Outs**

| Row \ Column | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| A | $DRIVE\_25\_FAULT\_L_{LS}$ | $DRIVE\_26\_FAULT\_L_{LS}$ | $DRIVE\_27\_FAULT\_L_{LS}$ | $DRIVE\_28\_FAULT\_L_{LS}$ | $DRIVE\_25\_FLTDET\_L_{LS}$ | $DRIVE\_25\_BYP\_L_{LS}$ |
| B | $DRIVE\_25\_GPO\_L_{LS}$ | $DRIVE\_26\_GPO\_L_{LS}$ | $DRIVE\_27\_GPO\_L_{LS}$ | $DRIVE\_28\_GPO\_L_{LS}$ | $DRIVE\_26\_FLTDET\_L_{LS}$ | $DRIVE\_26\_BYP\_L_{LS}$ |
| C | $DRIVE\_25\_INPL\_L_{LS}$ | $DRIVE\_26\_INPL\_L_{LS}$ | $DRIVE\_27\_INPL\_L_{LS}$ | $DRIVE\_28\_INPL\_L_{LS}$ | $DRIVE\_27\_FLTDET\_L_{LS}$ | $DRIVE\_27\_BYP\_L_{LS}$ |
| D | $GND_{RG}$ | $DRIVE\_26\_RX+_{HS}$ | $GND_{RG}$ | $DRIVE\_28\_RX+_{HS}$ | $GND_{RG}$ | $DRIVE\_28\_BYP\_L_{LS}$ |
| E | $DRIVE\_25\_RX+_{HS}$ | $DRIVE\_26\_RX-_{HS}$ | $DRIVE\_27\_RX+_{HS}$ | $DRIVE\_28\_RX-_{HS}$ | $GND_{RG}$ | Reserved |
| F | $DRIVE\_25\_RX-_{HS}$ | $GND_{LG}$ | $DRIVE\_27\_RX-_{HS}$ | $GND_{LG}$ | $DRIVE\_28\_FLTDET\_L_{LS}$ | $GND_{LG}$ |
| G | $GND_{LG}$ | $DRIVE\_26\_TX+_{HS}$ | $GND_{LG}$ | $DRIVE\_28\_TX+_{HS}$ | $GND_{LG}$ | Reserved |
| H | $DRIVE\_25\_TX+_{HS}$ | $DRIVE\_26\_TX-_{HS}$ | $DRIVE\_27\_TX+_{HS}$ | $DRIVE\_28\_TX-_{HS}$ | $GND_{RG}$ | Reserved |
| I | $DRIVE\_25\_TX-_{HS}$ | $GND_{RG}$ | $DRIVE\_27\_TX-_{HS}$ | $GND_{RG}$ | Reserved | Reserved |