Storage Bridge Bay (SBB) Specification

Version 2.1

April 20, 2011

Revision History

Revision	Date	Sections	Originator:	Comments
2.0	1/28/2008			
2.1	4/20/2011	6.2: Table 69		Added Binary and ASCII field descriptions to specify byte order for multiple byte VPD fields.
		6.2: Table 70		SBB Signal Usage Type/Length field value corrected to 0011h.
		6.2: Table 70		Changed “SBB Signal Usage Area” name to “SBB Signal Usage Area and LED Condition Records Area”. Changed “Signal Usage Area Checksum” name to “Signal Usage and LED Condition Records Checksum”.
		6.2: Table 70		Added note to clarify SGPIO Usage Type/Length field.
		6.2: Figure 52		Corrected max address in figure to 8191.
		6.2		Corrected references from states F and G to states D and E.
		5.2.5:Table 30 & 5.4.6: Table 57		Updated references to ENCLOSURE_INTR_L signal to use consistent spelling.
		6.2.3 & 6.2.4		Updated text to clarify drive spin up.
		5.2.4: Table 29		Corrected LS signal Valid Power-On States.
		6.3.4: Figure 56		Clarification in power-up flow chart.
		2.5.8.4.4 Added		Added section to define location for differential signal skew matching.
		Appendix A: Figure 60		Corrected Figure 60.
		2.5.8.1, 2.5.8.2, 5.2.5.3		Added text to define MATED_L signal pin can optionally use a short pin.
		Appendix A		Typographical correction.
		1.2.7, 5.3.1.1, 5.3.1.2, Appendix D		Added 6Gb/s SAS profile
		5.2.2.1: Figure 43		Added 12G SAS and 8.0G PCIe signaling.
		6.2: Table 70		SBB specification rev increased to 02.01.00

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].

Numeric field values are listed as decimal numbers unless specifically identified as binary or hexadecimal numbers. Binary numbers are identified with the suffix "b" and hexadecimal numbers with the suffix "h".

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1 Overview

The following document is a Storage Bridge Bay (SBB) specification. It is designed as a reference and guideline for storage solution providers who would like to have a standard controller and 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 vendors. A storage controller based on this SBB specification shall be able to fit, connect, and operate within a storage enclosure controller slot based on this same specification.

The SBB specification defines:

- Physical dimensions of the controller canister and slot or bay constraints (e.g. length, width, height, latch);
- 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 48 drives. The intent is for SBB compliant controllers to plug into an 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 only 16 drives.

1.1 Terminology Conventions

Figure 1 and Figure 2 givesome terminology conventions used in the text throughout this document.

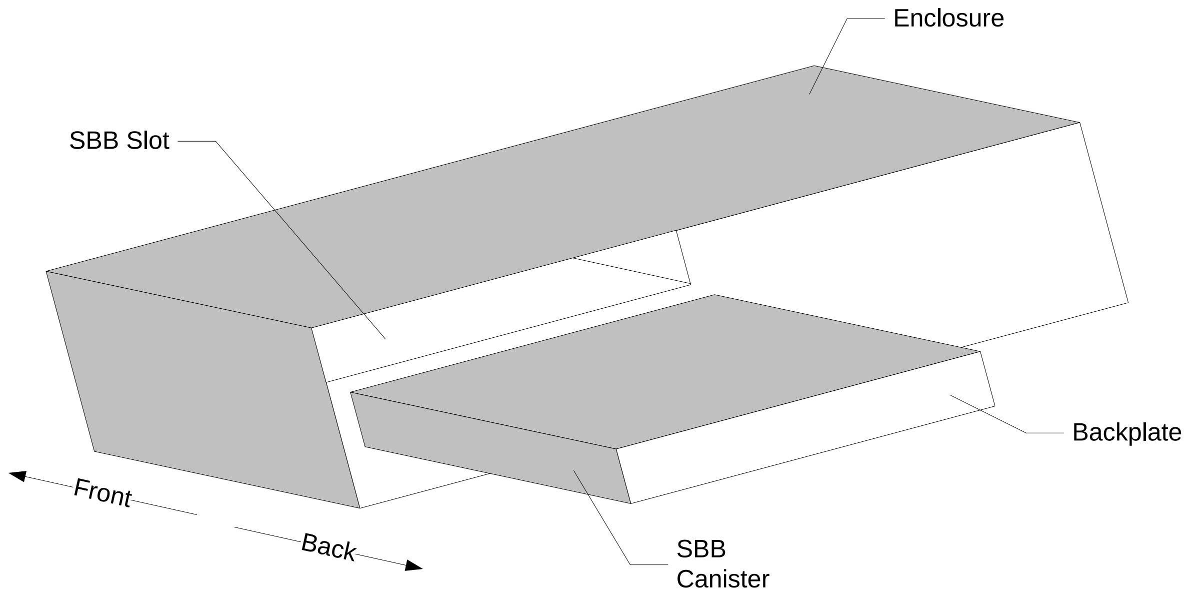


Figure 1: Terminology Conventions (Back View)

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 a storage enclosure that accepts an SBB canister. If an SBB enclosure has two SBB slots, the slots are referred to as SBB Slot A and SBB Slot B.

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 card. When an enclosure has two SBB slots, the SBB canister inserted into Slot A is designated SBB Canister A and the SBB canister inserted into Slot B is designated SBB Canister B.

1.2.3 SBB Canister Envelope

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

1.2.4 Bridge/Controller card

Bridge/controller card is the term used to represent the electronics packages 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 a single SBB canister and the midplane in a storage enclosure. The SBBMI connector pair consists of plugs and receptacles designed for high-speed signaling, low-speed signaling and power distribution. When an enclosure has two SBB slots, the SBBMI in Slot A is designated SBBMI A and the SBBMI in Slot B is designated SBBMI B.

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 Drive Signal Profiles

The SBB specification is applicable to several signal types (e.g. 2Gb/s FC, 4Gb/s FC, 3Gb/s SAS, and 6Gb/s SAS). The specification recognizes differing signal types with *signal profiles.* A signal profile defines the requirements of the 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 2.5.10) 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 and 6Gb/s SAS Signal Profile*. The 3Gb/s and 6Gb/s SAS Signal Profile uses 3Gb/s and 6Gb/s SAS signals for communication with drives. Certain sections of the specification are noted as *Signal Profile Defined*. Requirements in these sections apply to the 3Gb/s and 6Gb/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.

[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 and slot.

2.1 Tolerances and Datum

2.1.1 Dimensions and Tolerances

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 X.XX = ± 0.25
Angular = ± 0° 30’

2.1.2 System Datum Plane Definition

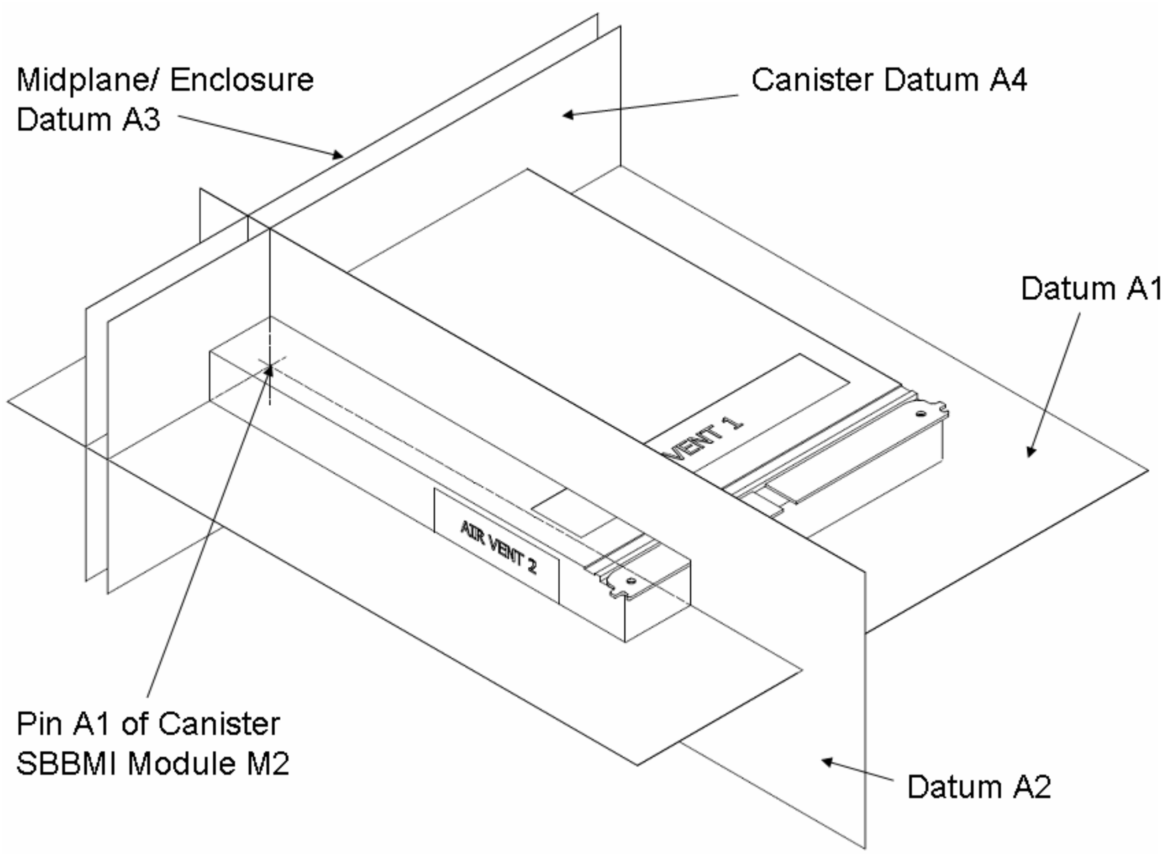


Figure 3: Datum plane definition

Table 2: System Datum Plane definitions

Datum Name	Definition
A1	Horizontal plane, coincident with the primary component surface of the canister PCB
A2	Vertical plane, perpendicular to both the canister PCB and midplane, coincident with the centre of pin A1 of SBBMI module M2
A3	Vertical plane, coincident with the primary component surface of the midplane. This is the main reference datum for the enclosure SBBMI connector system.
A4	Vertical plane, parallel to the primary component surface of the midplane in which the canister plugs and coincident with the centre of pin A1 of SBBMI module M2. This is the main reference datum for the SBB canister.

Note: Pin 1 of module M2 is chosen as it is the first module that is not ‘Optional’ on the canister.

2.1.3 SBB Canister Envelope

One goal of this version of the SBB specification is to allow bridge/controller card vendors to develop a single canister/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 to develop an enclosure which is physically compatible with all SBB compliant canisters. To satisfy these goals, the SBB specification defines physical requirements for the SBB canister and the enclosure slot.

The SBB Canister Definition gives the physical dimensions to which a designer of bridge/controller cards can build. If the designer adheres to the SBB Canister Definition, their design should be physically compatible with enclosures designed to be SBB compliant.

The Enclosure Slot Definition gives the physical dimensions to which a designer of storage enclosures can build. If the designer adheres to the Enclosure Slot Definition, their design should be physically compatible with canisters designed to be SBB compliant.

2.1.4 SBB Canister Definition

The SBB canister consists of a housing to which the bridge/controller card is mounted (see Figure 4). At one extreme is the SBBMI that plugs into the system’s midplane connectors. At the opposite end is the backplate where there are connectors that allow the attachment of cables from peripherals outside of the system. Attached to the upper side of the backplate are levers that are used for injection, extraction, and module retention. Adjacent to the levers is an Electromagnetic Interference (EMI) gasket. See Section 2.4 for gasket details. The material adjacent to the backplate provides the surfaces for EMI containment. The plane of contact of the canister mounted EMI gasket is coincident with that of the enclosure slot mounted gasket thus providing a full peripheral EMI seal for the canister/enclosure interface.

SBB canisters may use different construction methods but MUST [3] comply with the SBB canister envelope defined to provide physical interchangeability between SBB compliant enclosures. Figure 5 shows the SBB canister envelope dimensions.

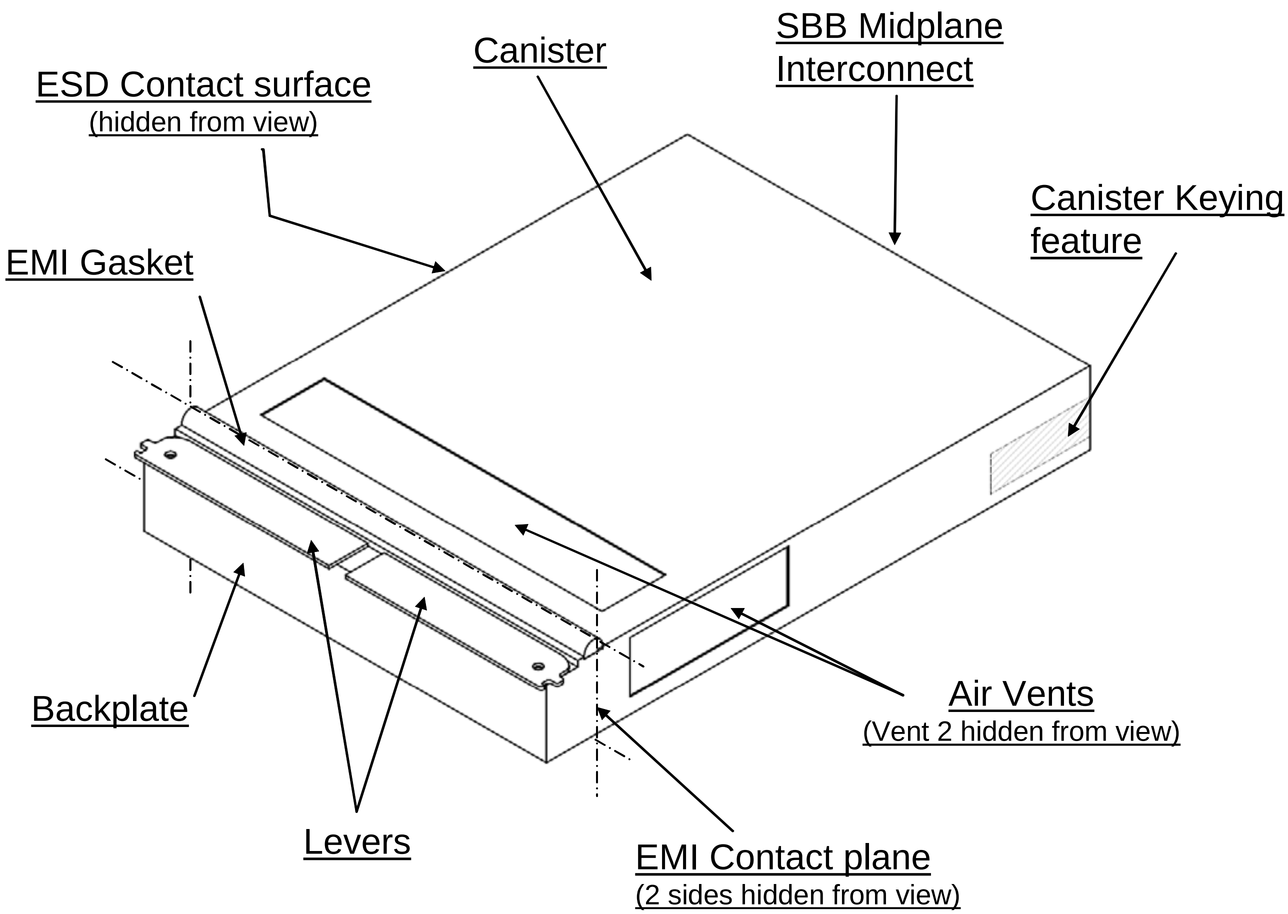


Figure 4: Example SBB Canister Envelope

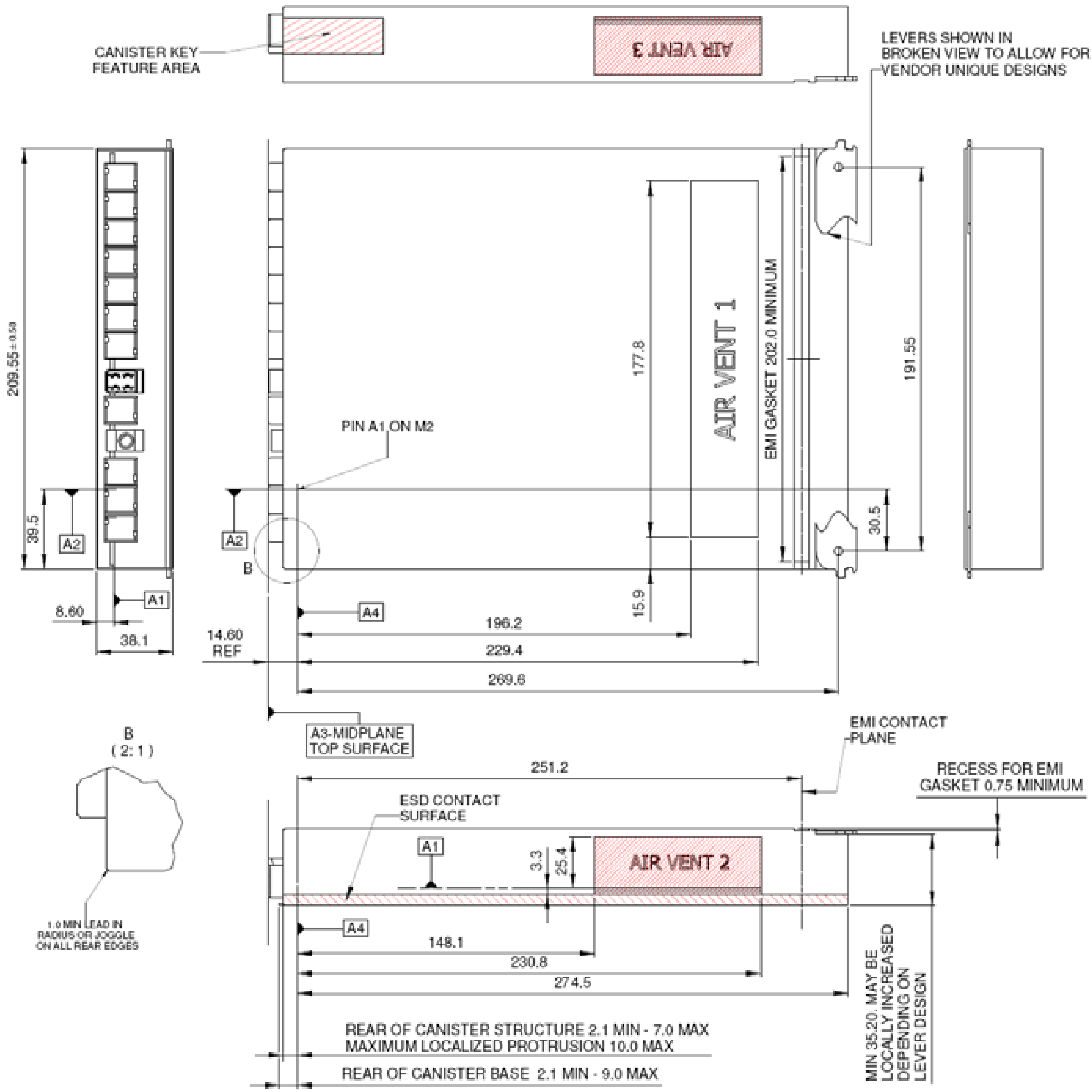
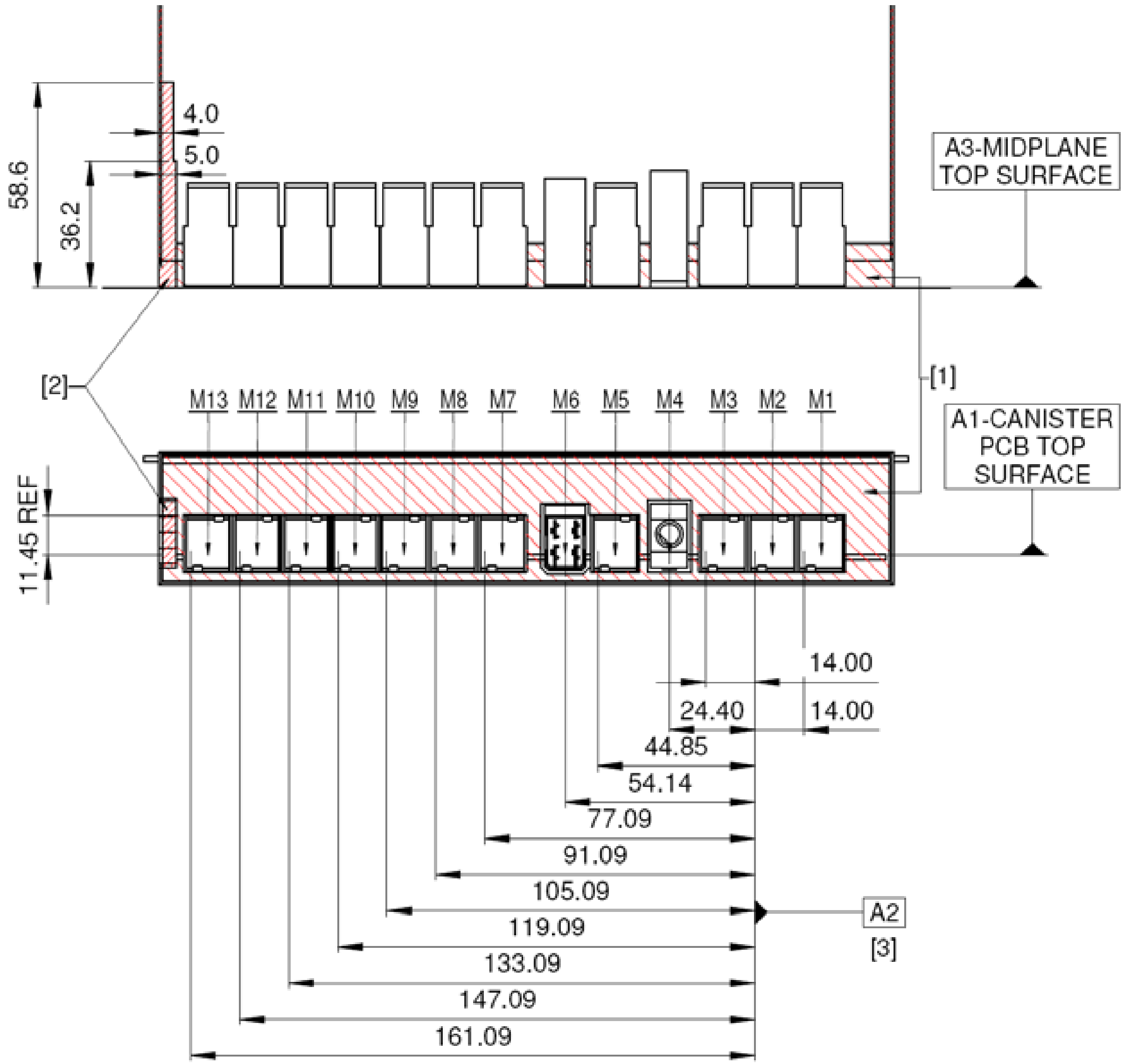


Figure 5: SBB Canister Envelope Dimensions.

Figure 6 gives the locations of the air inlet (see Section 2.2) and the modules of the SBBMI (see Section 2.5.7).



[1] VENT AREA KEEPOUT RESERVED FOR AIRFLOW IMPEDANCE REQUIREMENTS.

[2] CANISTER KEYING KEEPOUT

[3] TOLERANCES FOR BASELINE DIMENSIONS DEFINING MODULE LOCATION REFERENCED FROM DATUM A2 ARE +/- 0.13

Figure 6: Air Inlet and SBBMI Module Locations

2.1.4.1 Canister Materials

The canister materials are not defined by this specification with the exception of the surfaces that contact the enclosure and EMI and ESD contact surfaces (e.g. guide rails, ejector, EMI gasket). These surfaces

MUST [4] be corrosion free and galvanically compatible to zinc finishes, including any EMI gasket material chosen. The conductivity of the contact surfaces MUST [5] not exceed 1 mΩ when measured using the test equipment and methodology defined in Section 2.1.4.1.1 All canister parts shall be free of burrs and sharp edges.

It is strongly recommended that the materials selected for construction of the canister comply with applicable hazardous materials restrictions as defined by the countries in which the product is marketed.

There are a number of materials from which canisters may be formed from that will meet this specification's requirements. One common material used in the industry today is precoated steel. Precoated steel can provide EMI containment, grounding, and structural support for the electronics PCB within the canister. Systems are typically produced from precoated zinc steels or are post plated with nickel plate. The canister can be formed out of sheet steel that is either preplated with electro galvanic zinc or hot dipped zinc. If zinc coating is chosen, it should be 20 to 25 g/m2 on each side and should be finished with an anti-fingerprint treatment (AFP) for corrosion resistance. Due to the industry's switch away from hex-chrome based AFP treatments, the corrosion resistance and the surface conductivity of some of these sheet metals may not have sufficient performance to effectively meet this specification's requirements. Therefore, a minimum corrosion and electrical conductance are defined. The tests for corrosion and electrical conductivity are detailed below. The same test panel may be used for both tests provided that the conductivity test is performed before the corrosion test. If the sample fails the conductivity test, there is no point in running the corrosion test.

2.1.4.1.1 <u>Conductivity Measurement Procedure</u>

The surface conductivity of the base sheet metal MUST [6] be measured using a four point Loresta- EP CP-T360 (or equivalent) meter equipped with type BSP probes. The maximum allowable impedance of the surface MUST [7] not exceed 1 mΩ.

The Loresta BSP probes are gold plated for low resistance and spring loaded to give approximately 210 grams of force when fully depressed. The tips are rounded with a 0.37 mm radius. A mechanical fixture can be designed to hold the two probes at a constant separation with full deflection of the probe tips to achieve maximum force. A separation between probes of 2.5 cm minimum was found to be satisfactory for the purpose of evaluating the AFP coating.

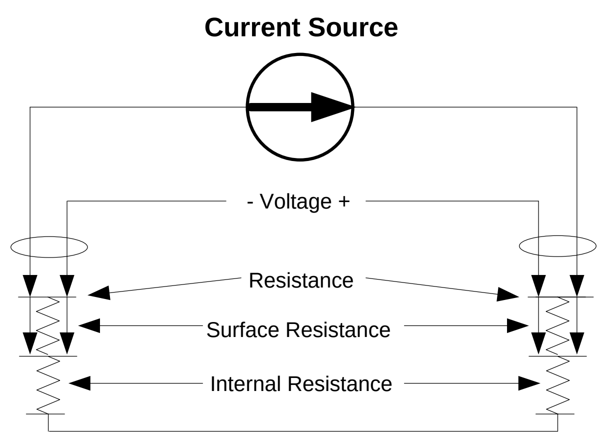


Figure 7: Simple Circuit Representation of AFP Steel Using Four-point Resistance Method

The following procedure is used to measure AFP material conductivity:

1. Draw a 5 x 5 cm grid on the metal surfaces, front and back.

2. Gently wipe the surfaces using a soft dry towel or cloth to remove surface contaminants. DO NOT USE ABRASIVES, CHEMICAL CLEANERS, or SOLVENTS.

3. Place the probe tips in the approximate center of each grid cell with the probe tips separated by a minimum of 2.5 cm and fully depressed.

4. Allow the meter to stabilize.

5. Record the resistance in each cell.

Measurements MAY be repeated up to three times if there are inconsistencies or unexplained variations observed. The sample passes when all of the cells have attained a reading of no more than 1 mΩ.

2.1.4.1.2 Corrosion Measurement Procedure

The following defines an acceptable test for zinc precoated steel; other surface coatings MUST [8] be tested to an equivalent corrosion level.

If zinc precoated sheet steel is used for the canister to enclosure contact surfaces, it MUST [9] be able to withstand a minimum of 72 hours of salt spray testing per specification ASTM B117. After a rinse of the sample, “white rust” MUST [10] not cover more than 5% of the total area. White rust is the corrosion of the zinc coating and will precede the onset of “red rust” (corrosion of base steel). The ASTM specification details the specific control parameters for chamber operation and sample orientation so that the corrosion rate is controlled. When testing precoated steel samples, the edges are sealed (either with a plastic tape or some other type of barrier coating such as epoxy or silicone) so that there is no exposed base material which would rust prematurely.

2.1.5 Enclosure Slot Definition

The enclosure slot for the SBB canister is defined by the mechanical interfaces that are required for the SBB canister to function in a system. Dimensions and details not defined here are left to be defined by the enclosure designer.

The enclosure slot MUST [11] provide the following key features:

- Accommodations to ensure smooth canister insertion and prevent damage to a canister mounted EMI gasket (e.g., lead-ins, edge smoothing, etc.). These accommodations MAY be formed out of plastic but MUST [12] provide for a conductive connection between the enclosure and the SBB canister to complete the EMI and ESD management solution

- Enclosure/canister mounted EMI gasket solution which meets the requirements described in section 2.1.6

- A slot which functions with the lever mechanism described in section 2.3

- The enclosure feature corresponding to the canister key defined in section 2.5

- The SBBMI connector system as described in section 2.5.6

- Openings in the enclosure to provide airflow as required in sections 2.2 and 4

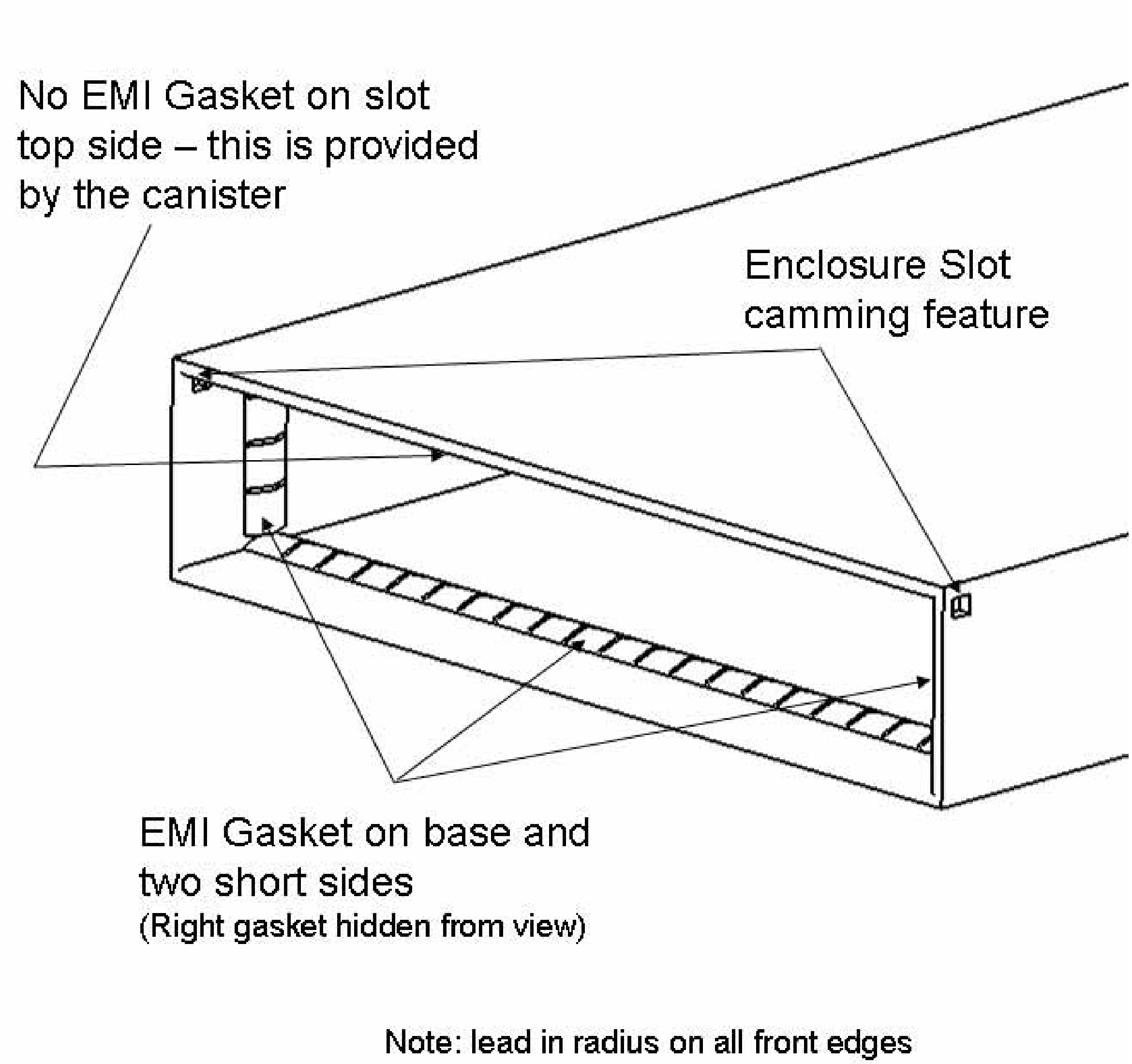


Figure 8: Example SBB Enclosure Slot

2.1.6 EMI and ESD requirements

The implementation of the connection between signal ground and enclosure/chassis ground is the responsibility of the system integrator. The connection SHOULD be made at a point that minimizes EMI.

For the purposes of discharging the ESD from the canister to the chassis as soon as the canister is inserted, an ESD contact surface MUST [13] be provided at the base of the vertical side of the canister on the opposing side to the Keying feature (Detailed in Figure 5). The slot MUST [14] provide an ESD contact that is not deeper than the plane of the slot EMI gasket and which mates with the canisters ESD contact surface.

EMI/ESD gasketing at the bottom, left and right sides of the enclosure slot to complete the four sided EMI seal. The EMI gasket solution MUST [15] be designed to provide SBB canister to enclosure slot contact at the EMI contact plane defined in Figure 5 and Figure 11. The enclosure slot MAY be comprise of enclosure structure or an adjacent module.

2.2 Air Inlet and Exhaust Vent Locations

An SBB compliant enclosure MUST [16] provide airflow to the SBB canister in a manner that air will enter the SBB canister envelope boundary through the area bounded by the *air vent keepout* shown in Figure 6. The SBB specification provides three air vent exit locations, *air vent 1, air vent 2* and *air vent 3*. The position and dimensions of the air vents relative to the SBB canister envelope are shown in Figure 5. An SBB compliant enclosure MUST [17] provide airflow to the SBB canister in a manner that air will exit the SBB canister envelope boundary at, at least one of the three exit air vent locations. SBB compliant enclosures MUST [18] provide at least one exit air vent location. SBB canisters are not required to operate with every exit air vent location. SBB canister designers may design their system to support only one exit air vent location if desired. Further requirements related to cooling and airflow are given in Section 4.

2.3 Lever Mechanism Requirements

The SBB canister lever mechanism comprises of a horizontal lever arrangement mounted at the top of the SBB canister to control the insertion and extraction of the canister. The lever definition is restricted to the critical operating dimensions to allow individual canister vendors scope for unique design in this area. The levers may, for instance, be interchangeable components or customizable to a particular customers requirements.

The length or number of levers is also at the vendor's discretion and should be suitable for the insertion force associated with the canister implementation and associated number of SBBMI modules supported (see Section 2.3.1 and Section 2.5.6).

All supporting chassis structures MUST [19] be capable of supporting the maximum loading criteria imposed. SBB enclosure slots MUST [20] be capable of accepting SBB canisters with dual levers.

The lever rotates through approximately 60 degrees from the open position to the closed position. In the open position the lever is aligned such that the cam surfaces do not extend beyond the profile of the SBB canister and the SBB canister may be inserted into the enclosure. In the closed position the lever is aligned such that the cam surfaces extend into the structure adjacent to the SBB canister, retaining the fully inserted SBB canister in the enclosure. It is RECOMMENDED that a stop feature is provided for the lever mechanism to prevent over rotation.

Figure 9, Figure 10, and Figure 11 include a recommended reference design for a camming lever that would provide the optimum canister insertion and extraction when used with the specified enclosure interface dimensions.

2.3.1 Force Criteria

The lever mechanism is required to overcome the multiple pin insertion force of the SBBMI connector system, plus the force required to compress both the canister and enclosure EMI gasket. The force requirement will vary according to the EMI implementation from each enclosure provider but is estimated to be around 270N for a full implementation containing SBBMI modules M1 to M13.

2.3.2 Mechanism Definition

Insertion of the SBB canister into the enclosure is controlled by the lever mechanism. The canister with the levers in the open position is inserted into the enclosure. The lever primary cam makes first contact with the enclosure structure and starts the rotation of the lever around its pivot point. This engages the secondary cam into the enclosure feature. Manual pressure on the levers provides the mechanical advantage for the cam to act on the enclosure feature and move the canister fully into the enclosure.

During insertion of the canister into the enclosure, the lever mechanism SHOULD start the camming action prior to the initial engagement of the mating connectors. It is RECOMMENDED that the lever mechanism provides a camming pivot travel distance in the range of 11 mm on insertion and extraction from the enclosure.

The enclosure vendors MUST [21] maintain a nominal dimensional location for the injection and ejection surfaces, and allow the lever camming feature adequate rotational clearance (see Figure 11).

Extraction of the SBB canister from the enclosure is controlled by the action of both the primary and the secondary cam. Pulling the levers away from the backplate of the canister allows them to rotate to bring the secondary cam into contact with the enclosure structure and starts to extract the canister from the enclosure. Further rotation of the levers brings the primary cam into contact with its operating face and allows the cam to act on the enclosure structure and extract the canister from the enclosure.

Lever operation, together with any retention latches should remain within the projected volume (height and width) of the SBB backplate so that lever operation does not foul on the enclosure or interfere with adjacent modules.

Figure 9: SBB Lever Mechanism in the Open and Closed Positions

2.3.3 Lever Dimensions

Figure 10 shows an example lever with the critical dimensions defined.

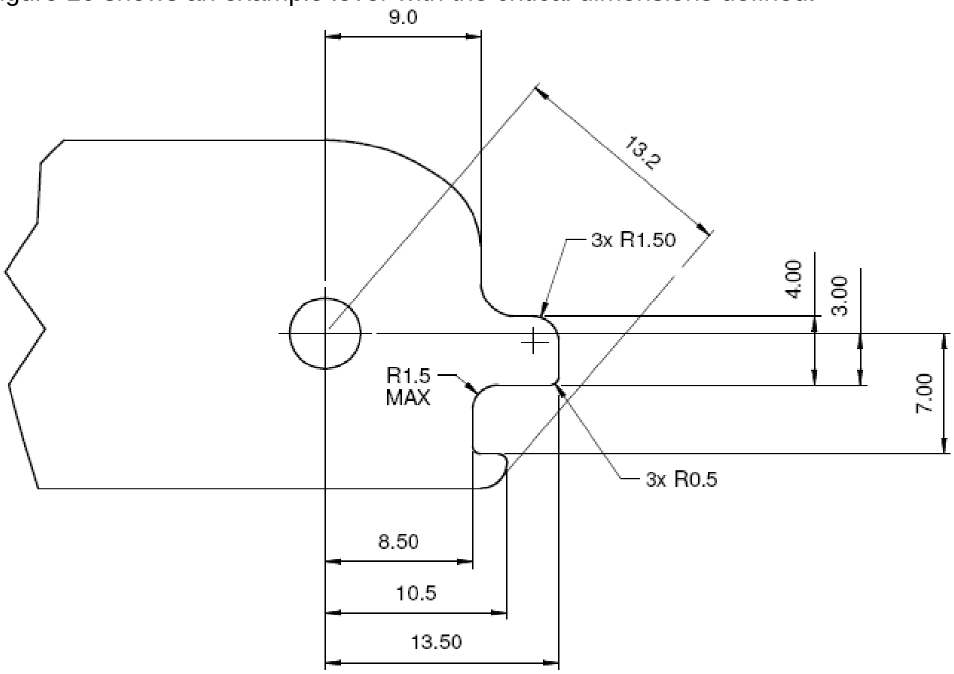


Figure 10: SBB Lever Mechanism Dimensions

2.3.4 Enclosure Slot Camming feature

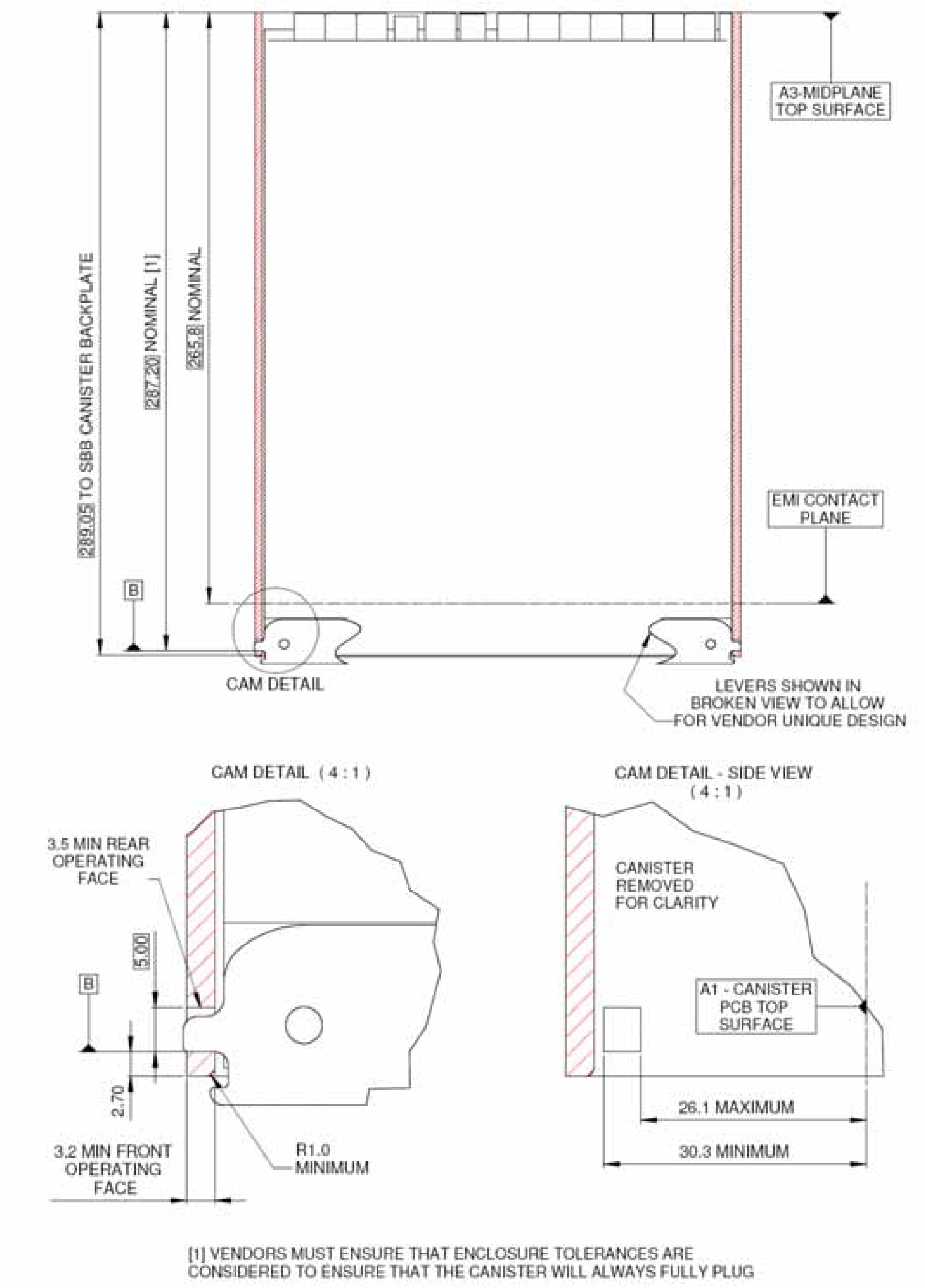


Figure 11: SBB Enclosure Slot Camming Feature Dimensions.

The distance from the midplane top surface to the exterior surface of an SBB canister envelope backplate on which a host (external) connector is located MUST [22] adhere to the dimension given in Figure 11

2.4 Canister EMI Gasket

The SBB canister MUST [23] provide an EMI Gasket as defined in Figure 4 and Figure 5. The choice of gasket is left to the canister designers; however:

- The gasket MUST [24] be recessed as defined in Figure 5. The canister recess MUST [25] be 0.75mm MINIMUM.
- The gasket material MUST [26] have a finish that is galvanically compatible with zinc.
- Gasket MUST [27] support a worst case tolerance gap of up to 2.0mm while maintaining gasket compression within the manufacturer's recommended limits (e.g. 10% min, 30% nominal, 70% max).
- The gasket MUST [28] meet minimum specification of Table 3.

Table 3: Minimum gasket specification

Shielding Effectiveness (MIL-G-83528B, 20Mhz to 10GHz)	> 97dB (Average)
Abrasion Resistance (ASTM D3886)	> 200 Cycles
Surface Resistivity (ASTM F390)	< 0.05 ohm/sq. and CpK >= 2.0
Contact Resistance	< 0.1 ohm-inch at 1kg load/inch
Adhesion Strength	>80N/100mm

For the purpose of allowing configurations supporting canister to canister contact without intervening sheet metal it is RECOMMENDED that the gasket be of the 'fabric over foam' type

2.5 Keying Options

Four enclosure keys and canister keying slots are defined. The keying features allow enclosure slots to restrict support for canisters that support different revision levels of the SBB specification. The enclosure keys are to be used singly (i.e. Key 0 or Key 1 or Key 2 or Key 3) and are used by an enclosure to limit what types of canisters may be inserted. A canister can support a single or multiple adjacent keying slots. The keying slots define the revision level of the SBB specification to which a canister adheres. Keying slots are provided only on one side of the canister to provide anti-inversion protection. One key MUST [29] be provided in an enclosure slot and at least one keying slot MUST [30] be present in a canister.

The canister keying slot is designed to mate with an enclosure key which allows or prevents insertion of a canister based on the key position. This feature MAY be created from an insert, created from a screw, be formed from the enclosure material, or be formed by some other method. Whatever method is used to form the key MUST [31] conform to the dimensions in Figure 13 and Figure 14 to ensure that damage does not occur to incorrectly plugged canisters. The enclosure key MUST [32] not exceed the keying keepout defined in Figure 6, Figure 13, and Figure 15 under all plugging conditions.

2.5.1 Key 0

Enclosure slots that are keyed with Key 0 MUST [33] support SBB 2.x level canisters and SBB 1.x level board assemblies which have only 12V power requirements mounted in SBB 2.x canister envelopes. Enclosures should use this key to provide products which support the requirements of both SBB 1.x and SBB 2.x.

SBB canisters with only Keying Slot 0 MUST [34] be compatible with 1.x levels of the SBB specification and MUST [35] be compatible with the power requirements of Section 3.2. SBB 2.x compatible SBB canisters MUST [36] have both Keying Slot 0 and 1.

2.5.2 Key 1

Enclosure slots that are keyed with Key 1 MUST [37] support SBB 2.x level canisters. Enclosures should use this key to provide products which support the requirements of SBB 2.x or higher.

SBB canisters (including board) that use Keying Slot 1 MUST [38] be compatible with the 2.x level of the SBB specification. SBB 2.x compatible canisters MUST [39] support both Keying Slot 0 and 1.

2.5.3 Key 2

Key 2 is reserved for future use.

2.5.4 Key 3

Key 3 is reserved for future use.

2.5.5 Supported Keying Options

Figure 12 shows the enclosure key and canister keying slot options supported by the specification.

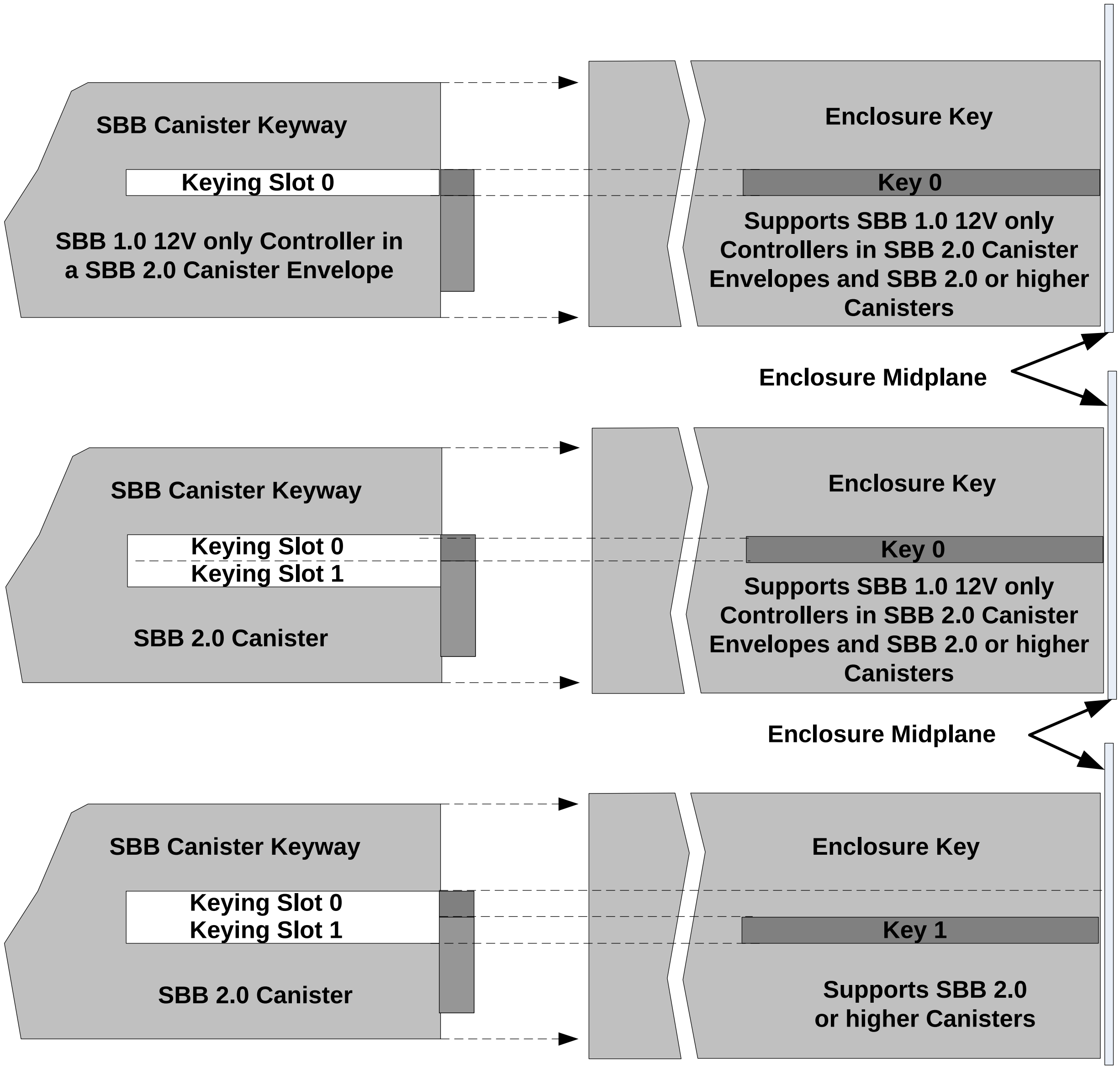


Figure 12: Supported Keying Options

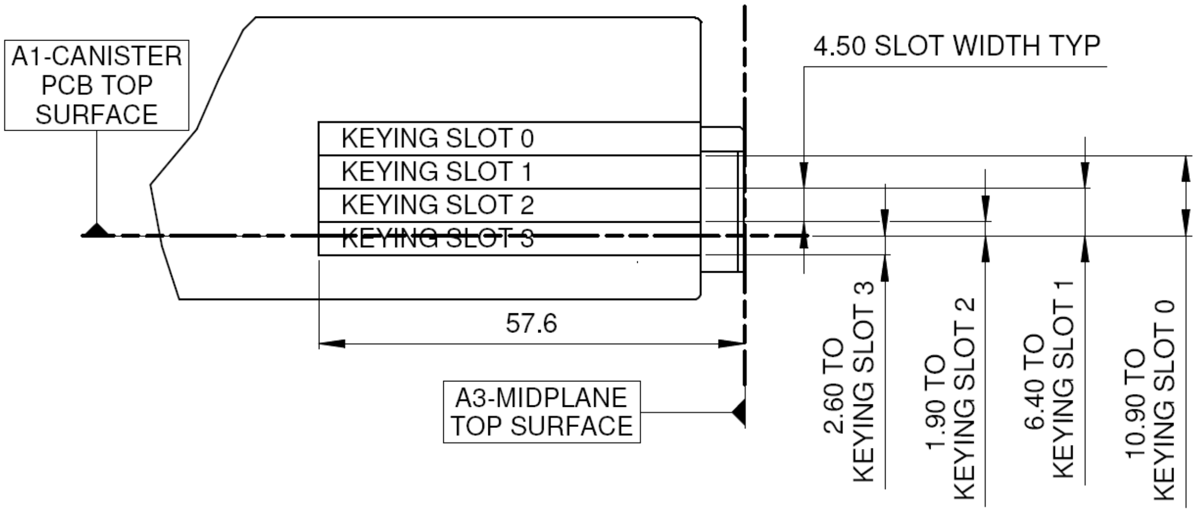


Figure 13: SBB Canister Keying Feature Dimensions

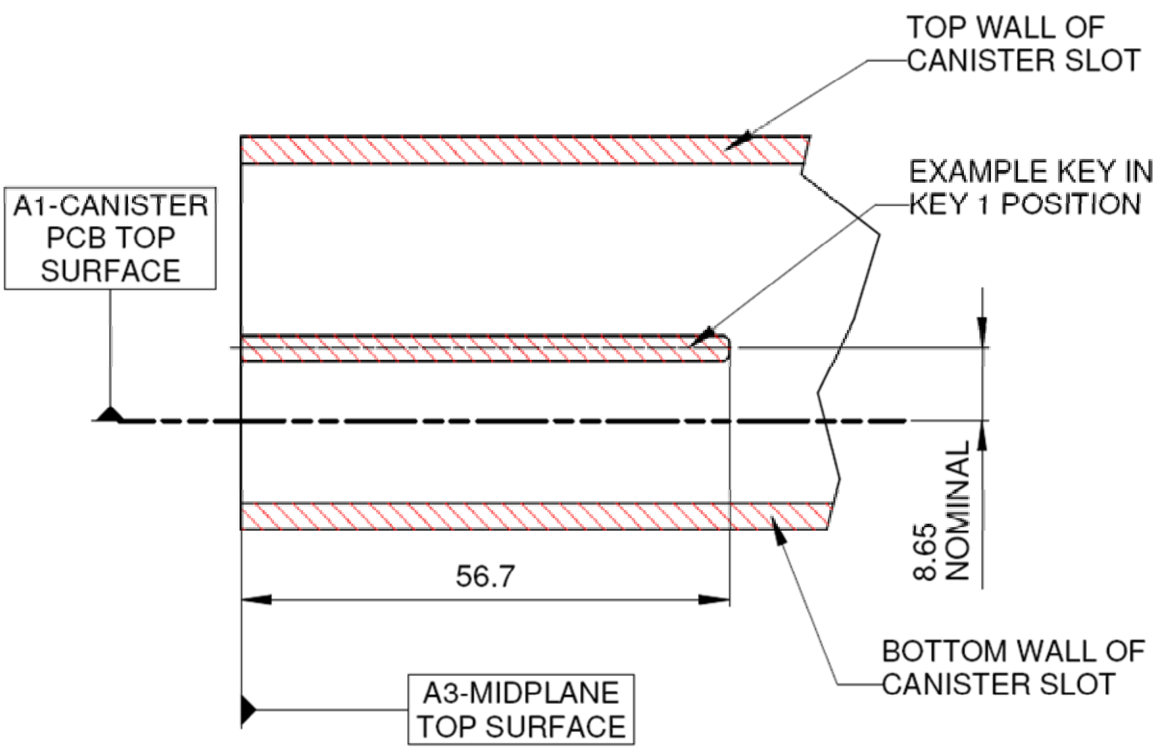


Figure 14: SBB Enclosure Key Example

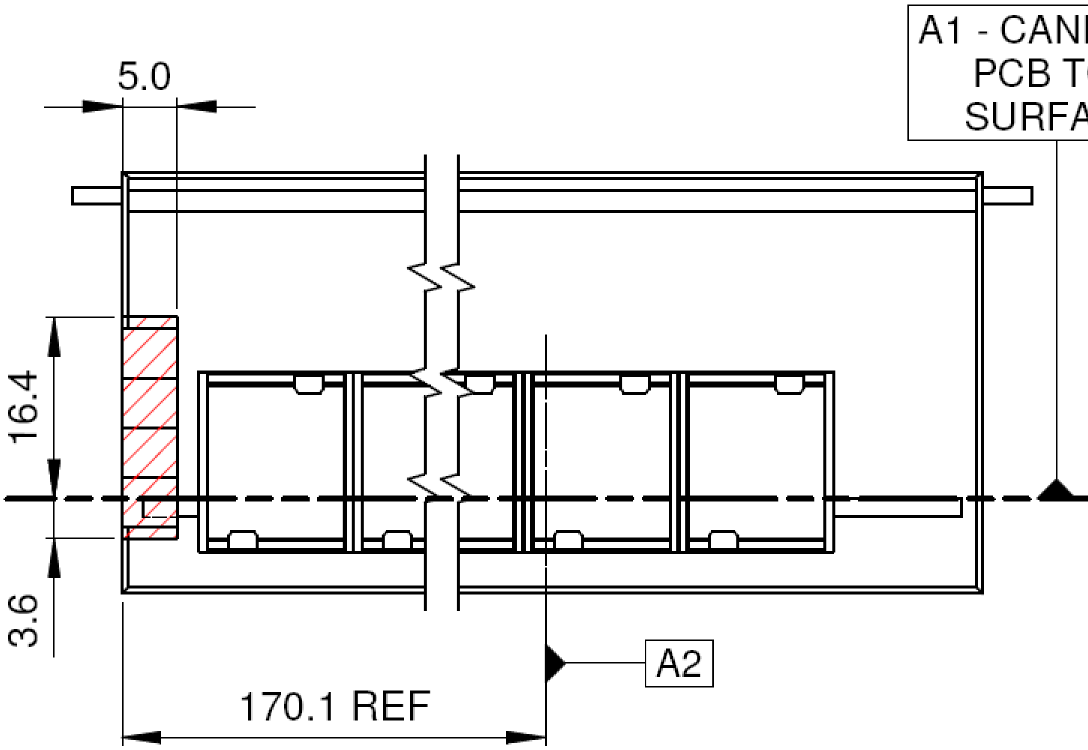


Figure 15: Canister Keying Keepout

2.5.6 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.

2.5.7 SBBMI Module Locations

Figure 6 shows the locations of the SBBMI modules in relation to the SBB canister dimensions. If used, M1, M2, M3, M5, M7, M8, M9, M10, M11, M12 and M13 MUST [40] be signal modules as defined in Section 2.5.8. Section 5.4 states which signal modules are required and which modules are optional. M4 MUST [41] be a guide module as defined in Section 2.5.10. M6 MUST [42] be a power module as defined in Section 2.5.9. The locations of the SBBMI modules MUST [43] adhere to the dimensions given in Figure 6. Signal module location dimensions are referenced at pin A1 of the module. Guide module and power module location dimensions are referenced at the center of the module.

2.5.8 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 receptacle.

2.5.8.1 SBBMI Canister Signal Header

The SBBMI canister signal header is detailed in Figure 16 and Figure 17. 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 [44] adhere to the dimensions of Figure 16 and Figure 17. All dimensions of the signal header external to the SBB canister, regardless of where the PCB is mounted within the SBB canister dimensions, MUST [45] exactly match the dimensions outside the SBB canister dimensions shown in Figure 16 and Figure 17.

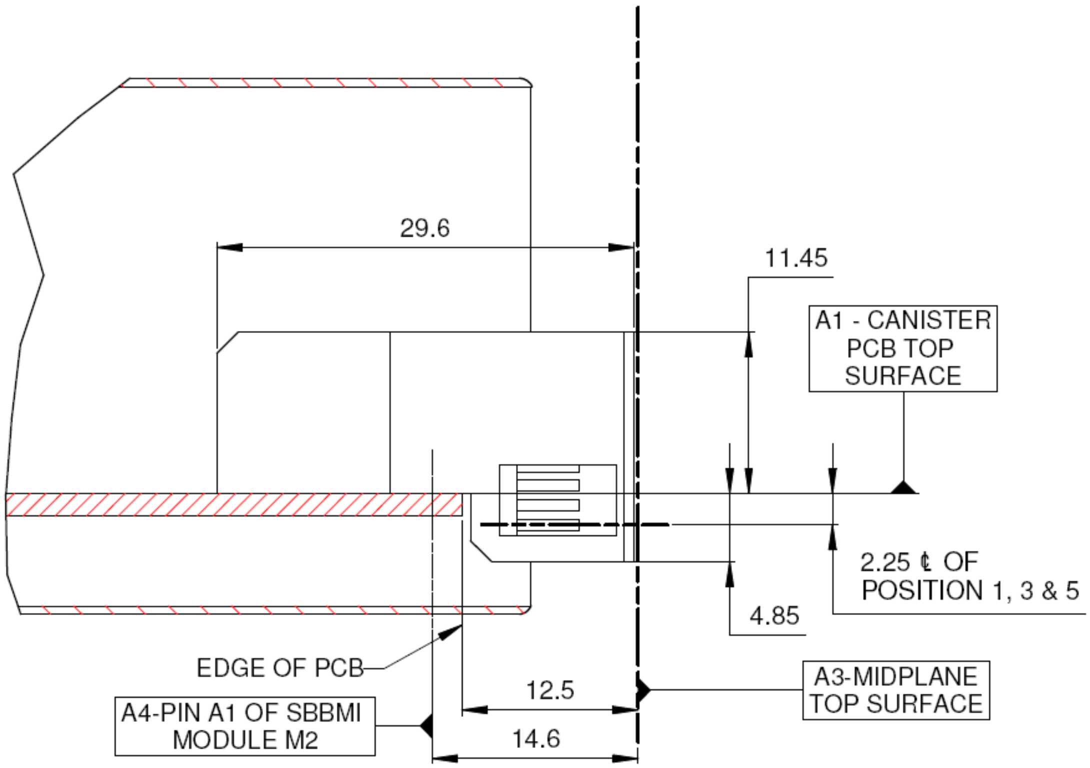


Figure 16: SBBMI Canister Signal Header Dimensions[2]

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

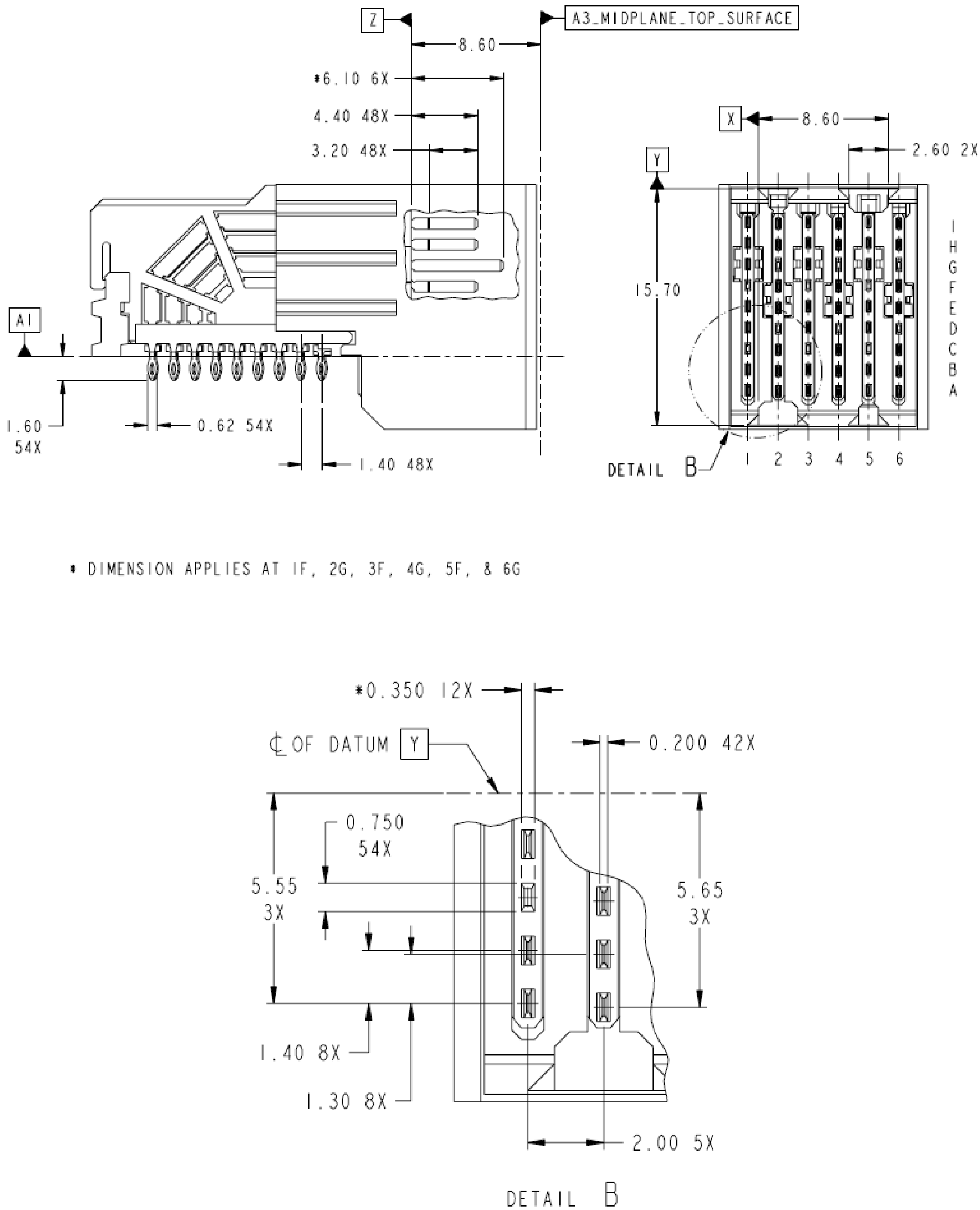


Figure 17: SBBMI Canister Signal Header Pin Dimensions[2]

Figure 18 gives a RECOMMENDED layout for a PCB, mounted at reference plane A1 and using the right-angle header described in Figure 16 and Figure 17. 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. Designers MAY use connectors which incorporate an optional short pin in location A6. The important point being that the position of the external pins MUST [46] remain fixed to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described Figure 6.

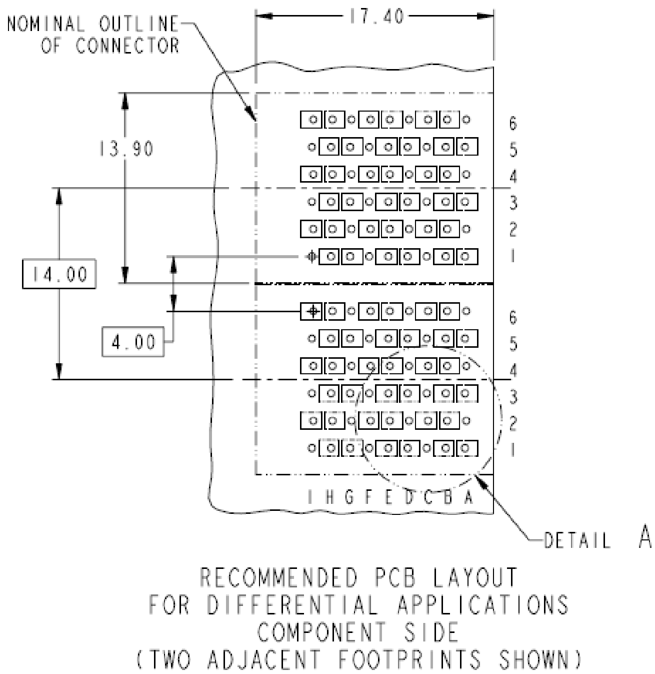


Figure 18: Recommended SBBMI Canister Signal Header PCB Layout[2]

2.5.8.2 SBBMI Signal Receptacle

The SBBMI signal receptacle is detailed in Figure 19. 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 [47] adhere to the dimensions of Figure 19. If the SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI signal receptacle that interfaces to an SBBMI canister signal header MUST [48] exactly mimic the dimensions of the interfacing portion of an SBBMI signal receptacle on an imaginary midplane mounted at reference plane A3 as described in Figure 19. The nominal wipe length at contacts 1F, 2G, 3F, 4G, 5F, and 6G MUST [49] be 4.0mm. The nominal wipe length at contact A6 MUST [50] be 1.8mm if an optional short pin is used in the SBBMI Canister Signal Header. The minimum nominal wipe length at all other contacts MUST [51] be 2.3mm.

Figure 20 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 20 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 [52] remain fixed to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described in Figure 6.

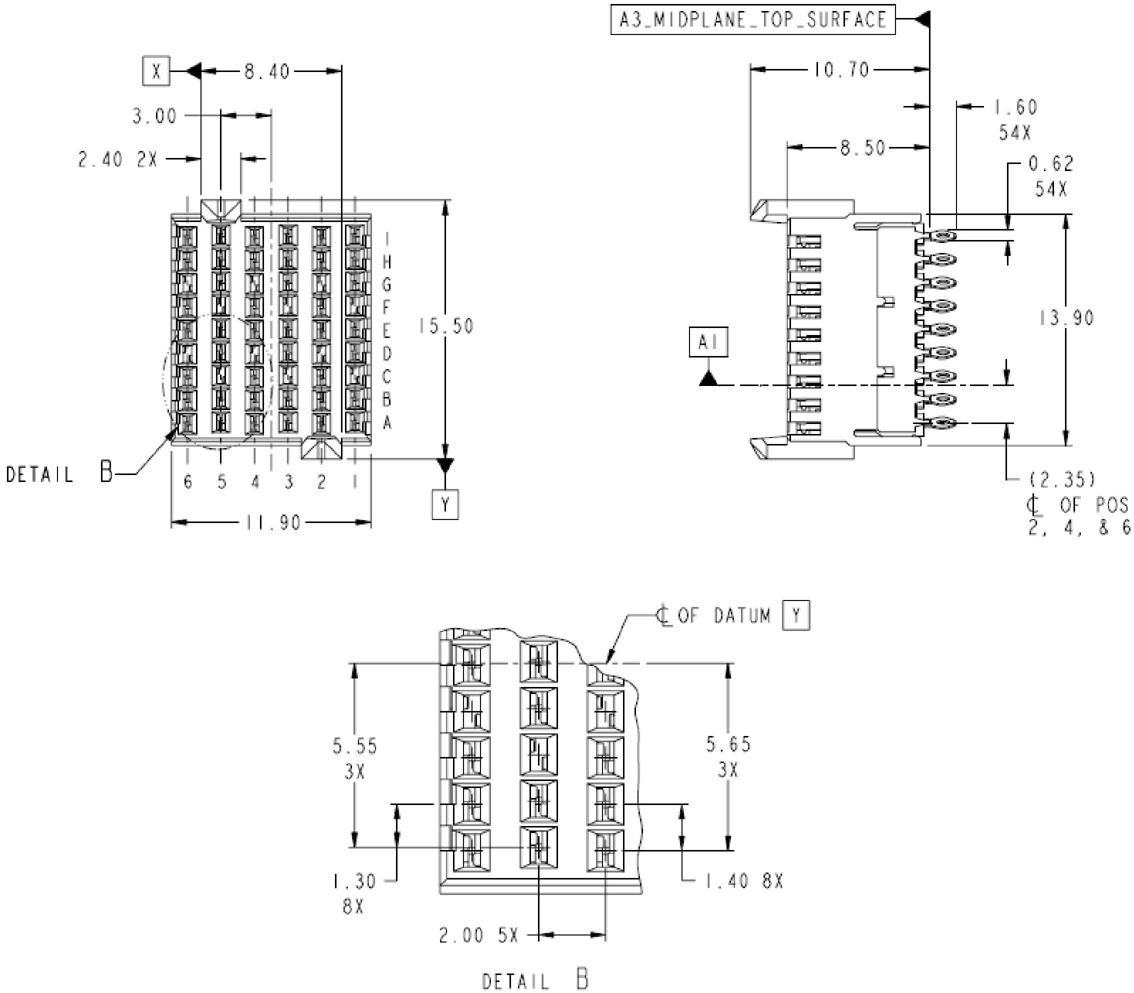


Figure 19: SBBMI Signal Receptacle Dimensions[2]

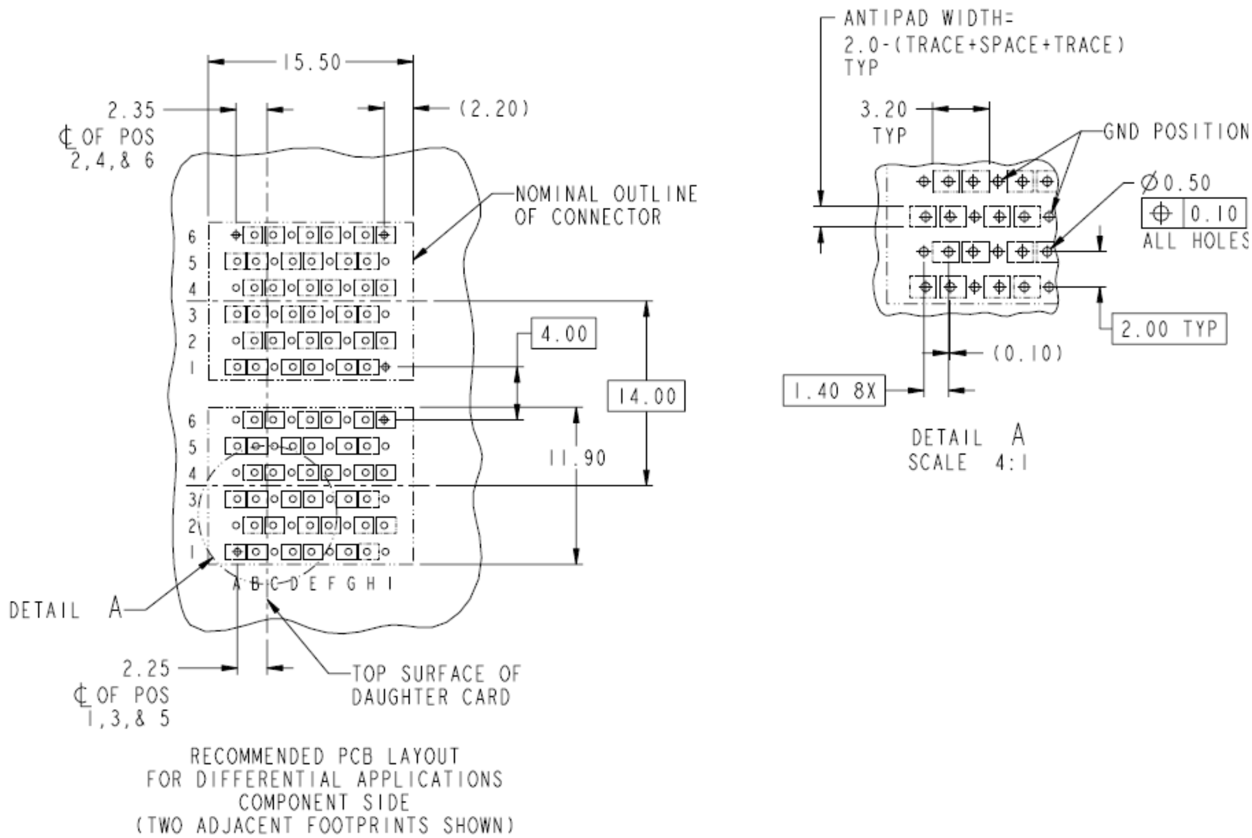


Figure 20: Recommended SBB Signal Receptacle Midplane PCB Layout[2]

2.5.8.3 SBBMI Signal Module Physical Requirements

A single SBBMI signal module MUST [53] adhere to the requirements given in Table 4.

Table 4: 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

2.5.8.4 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.

2.5.8.4.1 Differential Impedance

The differential impedance of the signal module MUST [54] conform to the performance shown in Table 5.

Table 5: 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

2.5.8.4.2 Differential Insertion Loss

The differential insertion loss of the signal module MUST [55] conform to the performance shown in Table 6.

Table 6: Signal Module Differential Insertion Loss

< 1dB loss through 3.125GHz (6.25Gbps)

2.5.8.4.3 Differential-Mode Multi-Pair-Active Crosstalk

The differential-mode multi-pair-active crosstalk of the connector MUST [56] conform to the performance shown in Table 7.

Table 7: 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 21) 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.

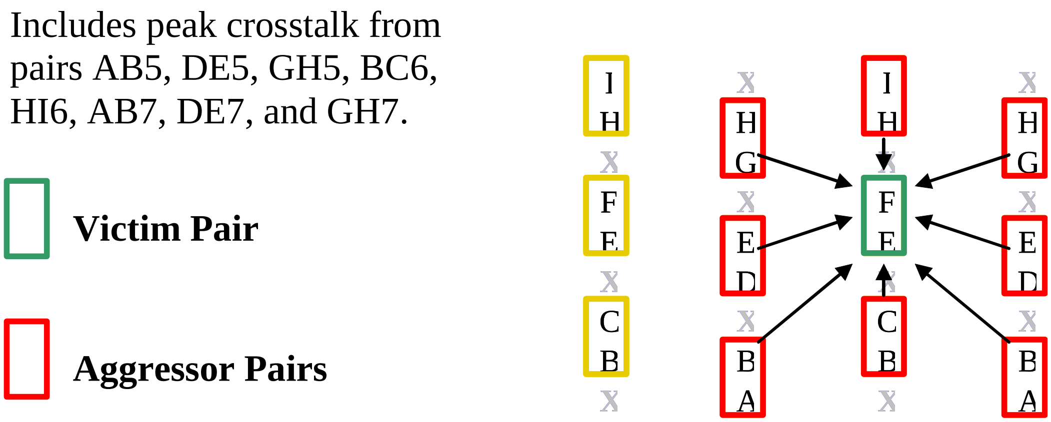


Figure 21: Worst-Case Multi-Pair Active Crosstalk for Pair EF

2.5.8.4.4 *Introduced SBBMI Connector Differential Signal Skew*

Any differential pair skew introduced by either the SBBMI Signal Header or the SBBMI Signal Receptacle connector MUST [57] be accounted for in the differential pair routing of the PCB that the connector with the skew is mounted on. As a typical SBBMI Signal Header is a right angle connector, for most typical applications it is the responsibility of the SBB Canister vendor to compensate for the connector signal skew.

2.5.9 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.

2.5.9.1 SBBMI Canister Power Header

The SBBMI canister power header is detailed in Figure 22. 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 plane of A1, the SBBMI canister power header MUST [57] adhere to the dimension of Figure 22. All dimensions of the canister power header external to the SBB canister envelope dimensions, regardless of where the PCB is mounted within the constraints, MUST [58] exactly match the dimensions outside the SBB canister envelope dimensions of the SBBMI canister power header shown in Figure 22.

Figure 23 gives a RECOMMENDED layout for a PCB mounted at reference plane A1and using the right-angle power header described in Figure 22. Designers MAY use a different connector or PCB layouts that are more appropriate for their individual applications. The important point being that the position of the external pins relative MUST [59] remain fixed to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described Figure 6.

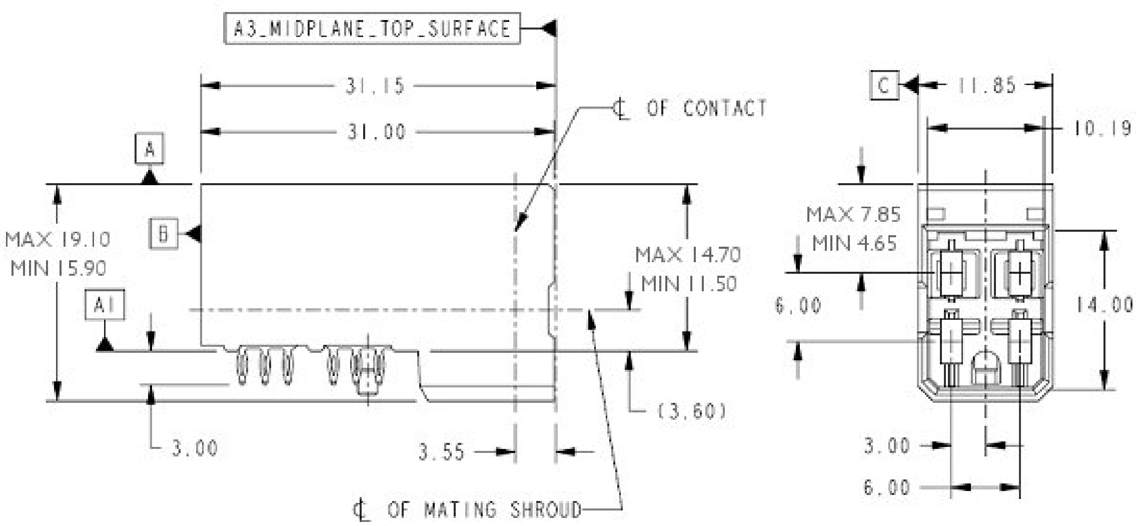


Figure 22: SBBMI Canister Power Header Dimensions[2]

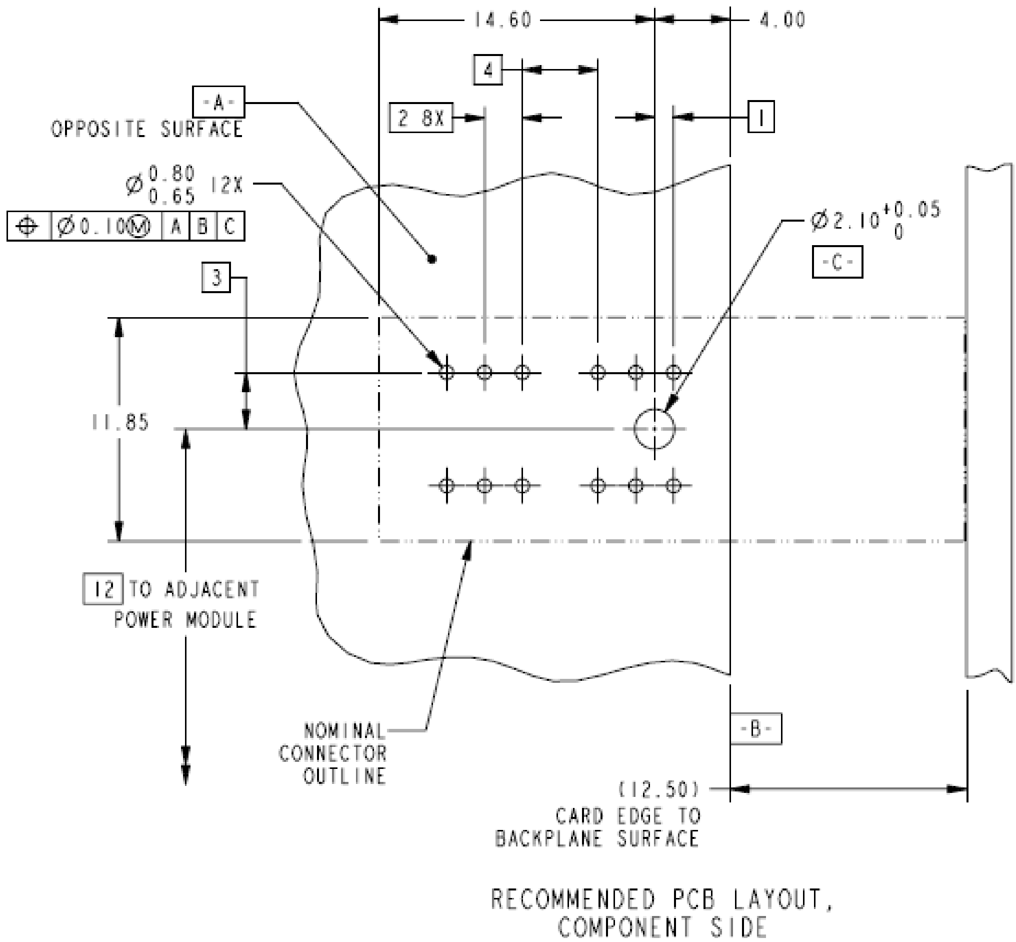


Figure 23: Recommended SBBMI Canister Power Header PCB Layout[2,3]

2.5.9.2 SBBMI Power Receptacle

The SBBMI power receptacle is defined in Figure 24. 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 [60] adhere to the dimensions of Figure 24. If the SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI power receptacle that interfaces to an SBBMI canister power header MUST [61] exactly mimic the interfacing portion of an SBBMI power receptacle on an imaginary midplane mounted at reference plane A3 as described in Figure 24.

Figure 25 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 [62] remain fixed to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described in Figure 6.

[3] 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

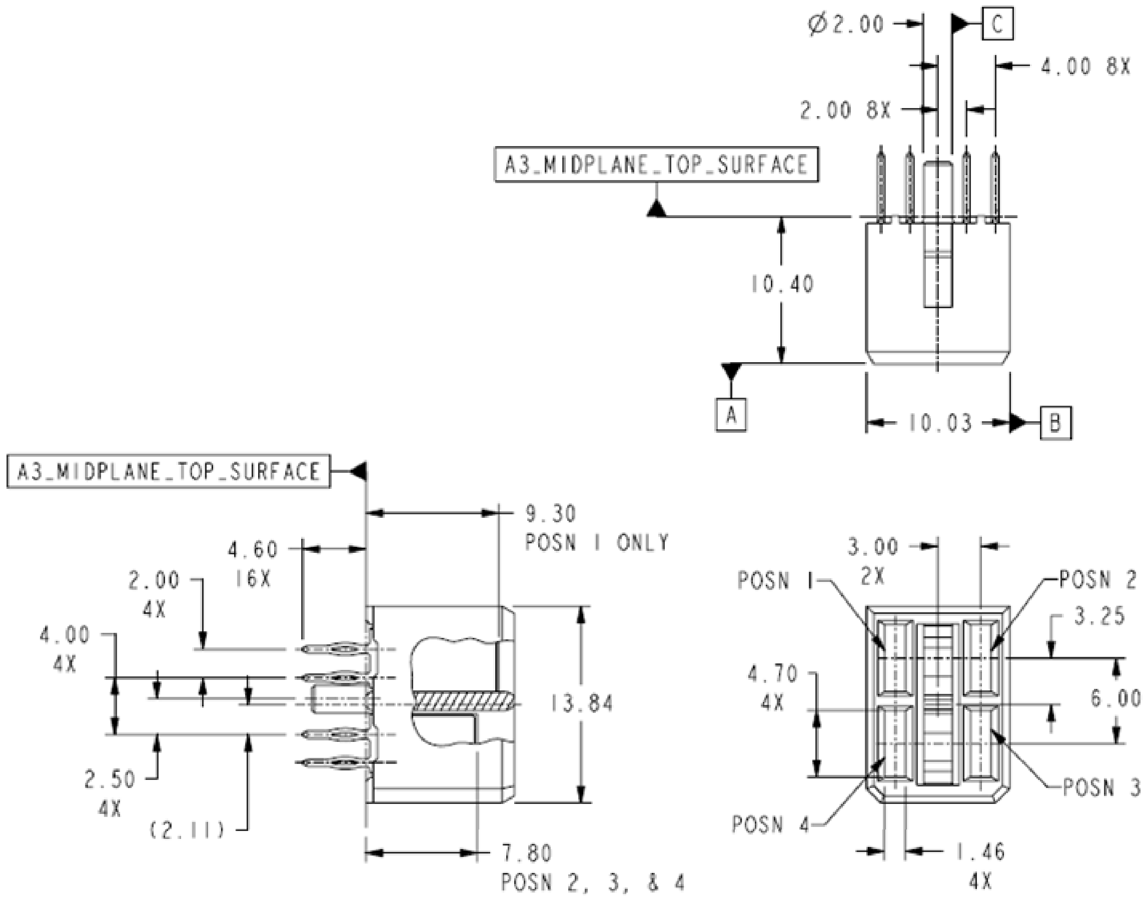


Figure 24: SBBMI Power Receptacle Dimensions[2]

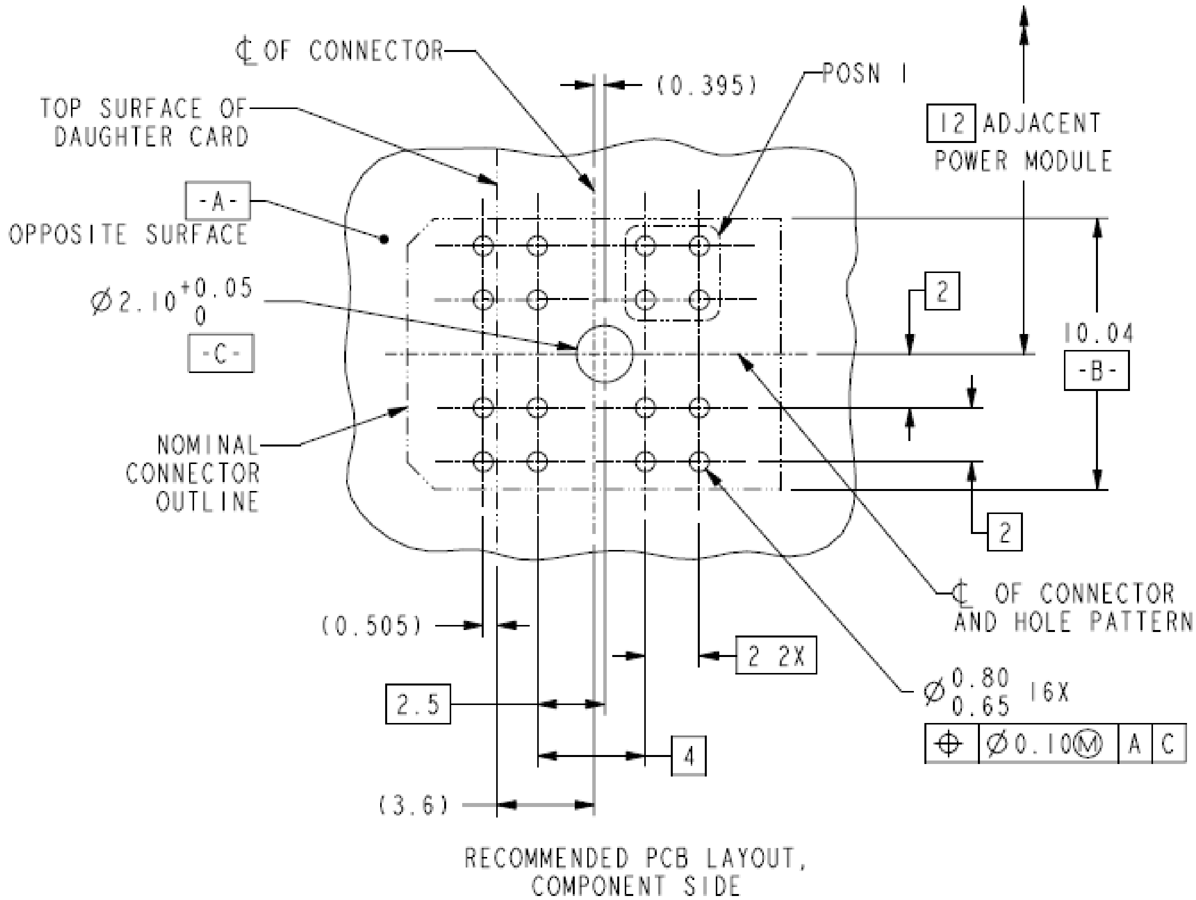


Figure 25: Recommended SBBMI Power Receptacle Midplane PCB Layout[2,3]

2.5.9.3 SBBMI Power Module Physical Requirements

The SBBMI power module MUST [63] adhere to the requirements given in Table 8.

Table 8: 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

2.5.10 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 2.5.10.1 and 2.5.10.2 define the guide module requirements for the 3Gb/s and 6Gb/s SAS Signal Profile.

2.5.10.1 SBBMI Canister Guide Pin Receptacle

The SBBMI canister guide pin receptacle is described in Figure 26. 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 [64] adhere to the dimensions of Figure 26. All dimensions of the guide pin receptacle external to the SBB canister envelope dimensions, regardless of where the PCB is mounted, MUST [65] exactly match the dimensions outside the SBB canister envelope dimensions of the receptacle shown in Figure 26. The ESD contact on the guide pin receptacle is OPTIONAL.

Figure 27 gives a RECOMMENDED layout for a PCB mounted at reference plane A1 using the right-angle header described in Figure 26. 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 guide pin MUST [66] remain fixed to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described in Figure 6.

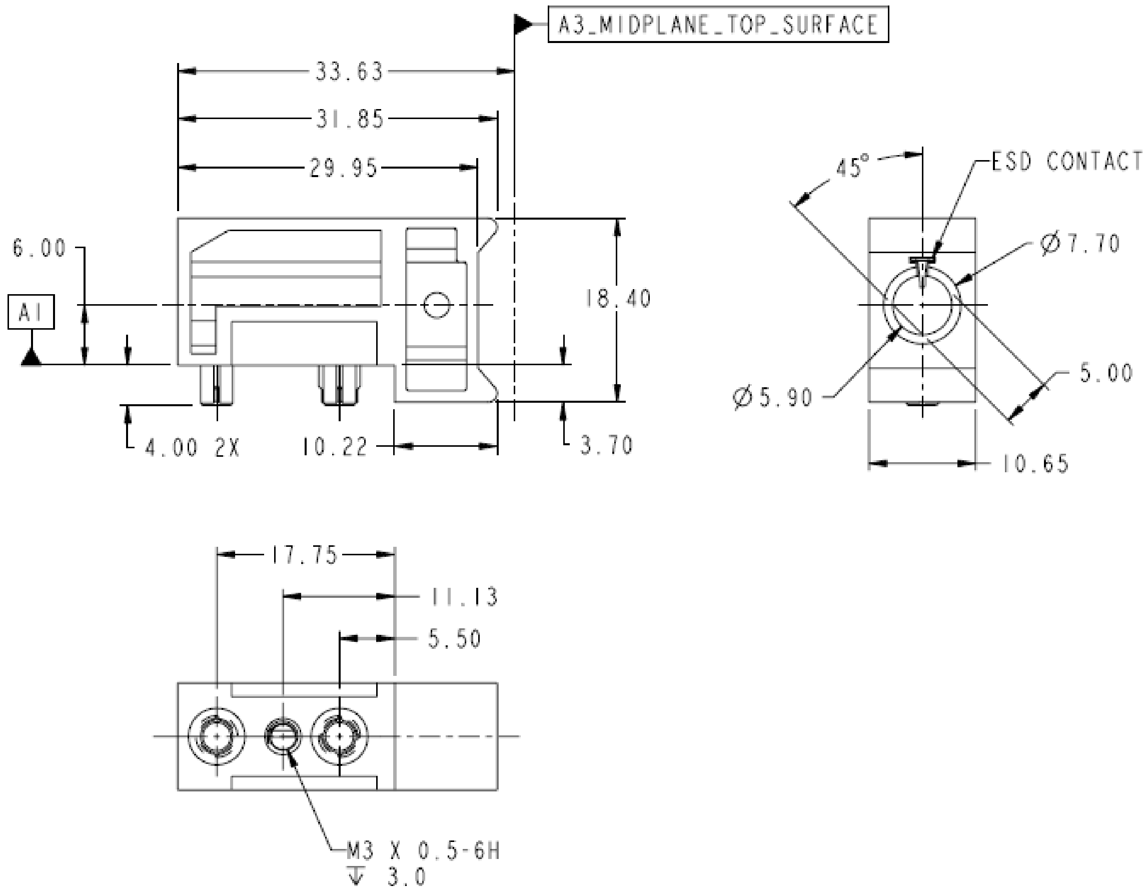


Figure 26: SBBMI Canister Guide Pin Receptacle Dimensions[2] (SAS key position shown)

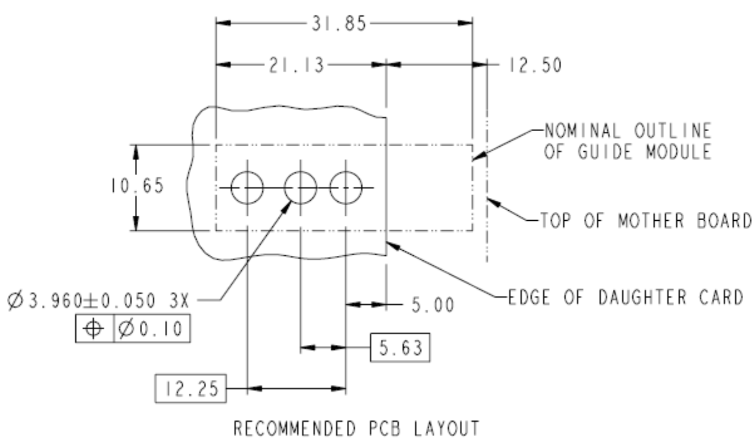


Figure 27: Recommended SBBMI Canister Guide Pin Receptacle PCB Layout[2]

2.5.10.2 SBBMI Guide Pin

The SBBMI guide pin is detailed in Figure 28. 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 [67] adhere to the dimensions of Figure 28. If an SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI guide pin that interface to an SBBMI canister guide pin receptacle MUST [68] exactly mimic the dimension of the interfacing portion of an SBBMI guide pin on an imaginary midplane mounted at reference plane A3 as described in Figure 28.

Figure 29 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 [69] remain fixed relative to the SBB canister envelope dimensions described in Figure 5 and SBBMI module locations described in Figure 6.

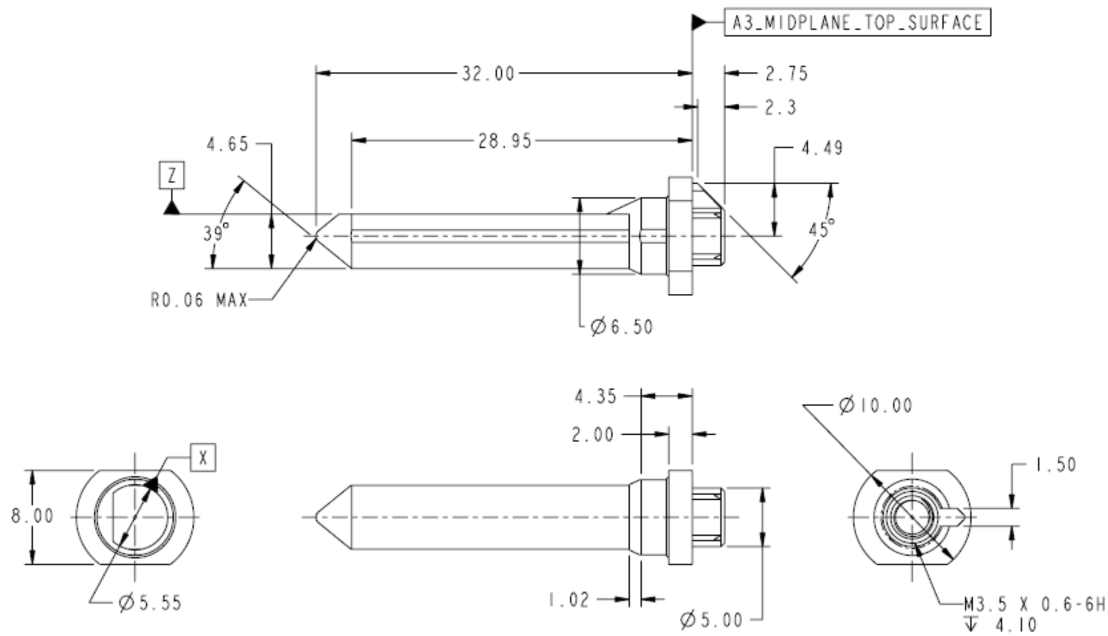


Figure 28: SBBMI Guide Pin Dimensions[2]

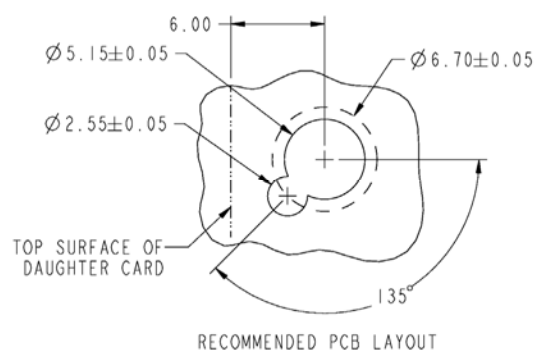


Figure 29: Recommended Component Side Midplane Layout[2] (SAS key position shown)

3 Power Requirements

The SBB specification provides a power receptacle with 4 power pins to supply 12V DC to the SBB slots. The 12V is distributed over 2 pairs of pins to distribute the load.

3.1 SBBMI Power Receptacle Power Requirements

This section defines the power requirements for the SBBMI power receptacle located on an enclosure midplane that provides power to a single SBB slot. See Section 2.5.9 for the physical details of the SBBMI power receptacle.

3.1.1 Slot 12V DC Power

The SBBMI power receptacle MUST [70] provide +12V power to POSN 2 and POSN 3. POSN 1 and POSN 4 MUST [71] be grounded. Furthermore, the 12V power MUST [72] satisfy the parameters in Table 9. The SBBMI power receptacle MUST [73] be able to supply the current listed in the Slot minimum supplied current column. If the SBBMI power receptacle is capable of providing more than the minimum supplied current, the maximum supplied current that the power receptacle can provide MUST [74] be indicated in the VPD (see Section 6.2) and be less than or equal to the value in the Maximum supplied Current column of Table 9.

Table 9: Slot 12V DC Power

Power Pin	Voltage	Voltage Tolerance	Slot Minimum Supplied Current	Slot Maximum Supplied Current
POSN 1 + 4	GND			
POSN 2+3	+12V DC	±5% (max)	5A	16.66A

3.1.2 12V Turn On

The +12V DC rails MUST [75] rise monotonically from 10% to 95% of the nominal output setpoint. This rise time MUST [76] be between 5ms and 50ms. Once the output has reached 95% of its nominal it MUST [77] remain within the regulation band.

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 2.5.9 for the physical details of the SBBMI canister power header. The SBB canister MUST [78] not draw more than 200W from any combination of the two 12V power pins provided by the SBBMI power receptacle.

3.2.1 Canister 12V DC Power

Before a canister exceeds the Slot Minimum Supplied Current rating in Table 9, the SBB canister MUST [79] read the Max 12V Current field in the VPD. The SBB canister MUST [80] not draw any more current than the value indicated in the Max 12V Current field in the VPD.

3.3 Over Voltage

The SBB canister MUST [81] be able to tolerate, without physical damage, a maximum over voltage of 14.4V on the 12V bus. The canister is not required to operate outside of the range defined in Table 9.

3.4 Maximum Canister Dynamic Load

The maximum dynamic load step presented by an SBB canister on a power rail MUST [82] not exceed 60% of the canister's maximum current draw. The SBB canister load slew rate MUST [83] not exceed 0.2A/μS.

3.5 SBB Canister Input Capacitance

SBB canisters MUST [84] 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. This value was chosen to minimize damage to the connector during hot insertions. The maximum 12V canister capacitance is defined to help enclosure developers to define the power supply requirements.

Table 10: SBB Canister Input Capacitance

Power Pin	Voltage	Maximum Input Capacitance	Maximum 12V Canister Capacitance
POSN 1+4	GND		
POSN 2+3	+12V DC	5000 pF	4500 uF

3.6 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.

3.6.1 AC_GOOD_L

The AC_GOOD_L signal is OPTIONAL. This signal is an input to the canister. If the SBB canister uses this signal it MUST [85] examine the AC_Good_L_Usage field in the SBB VPD to determine if the enclosure implements this signal. Table 11 gives the allowable values for the AC_Good_L_Usage field and Table 30 defines the signal information.

Table 11: Usage Options for AC_GOOD_L

AC_Good_L_Usage Field Value	Description
0	Not Supported: The enclosure does not drive the AC_GOOD_L signal. An SBB canister MUST [2] ignore any signal on this pin.
1	Reserved
2	AC_GOOD_L Implemented: AC_GOOD_L indicates that AC power is present on the power supplies. This signal MUST [86] have open drain

	drivers on the power supplies. Multiple power supplies MUST [87] have their signals connected together as one signal. The power supplies MUST [88] drive this signal low if AC power is present. Power MUST [89] be provided to the canister for at least 5ms after this signal goes high.

3.6.2 STANDBY_PWR

STANDBY_PWR is OPTIONAL for both the canister and the enclosure. If STANDBY_PWR is provided by the enclosure, the SBB canister is NOT REQUIRED to utilize STANDBY_PWR. If a canister supports STANDBY_PWR, it MUST [90] operate if STANDBY_PWR is not supported by the enclosure. It is permissible for an SBB canister to provide functions when STANDBY_PWR is present that it does not when STANDBY_PWR is not present. SBB canisters MUST [91] have a maximum input capacitance of 5000 pF on STANDBY_PWR.

STANDBY_PWR is a power input to the canister. To determine if STANDBY_PWR is provided by the enclosure to the SBB canister, the SBB canister MUST [92] examine the STANDBY_PWR signal. If power is present on this signal, the enclosure provides STANDBY_PWR and the requirements of the next paragraph MUST [93] be satisfied by the enclosure and/or the canister.

The STANDBY_PWR signal supplies standby power to the SBB canister. If implemented, the SBBMI on the midplane MUST [94] provide 1A (5W) of power at +5V$\pm$8% on STANDBY_PWR. An SBB canister MUST [95] NOT draw more than 1A from STANDBY_PWR. All VPDs and power controlling devices (See Section 5.2.5.15) MUST [96] be accessible while power is present on STANDBY_PWR.

3.6.3 POWER_OFF_L

POWER_OFF_L is OPTIONAL. This signal is an output from the canister. The SBB canister MUST [97] examine the Power_Off_L_Usage field in the SBB VPD to determine if the enclosure implements this signal. Table 12 gives the allowable values for the Power_Off_L_Usage field and Table 30 defines the signal information.

Table 12: Usage Options for Power_Off_L

Power_Off_L_Usage Field Value	Connect Type[1]	Description
0	N/A	Not Supported: The enclosure does not support the POWER_OFF_L signal. An SBB canister MUST [98] NOT drive this signal.
1	N/A	Reserved
2	Com_O	POWER_OFF_L Standby Control: An SBB canister MAY assert this signal to turn the power supplies on and off. If the enclosure supports multiple SBB canisters, the enclosure MUST [99] tie the POWER_OFF_L signals from all SBB canisters together. If an SBB canister does not support STANDBY_PWR, the canister MUST [100] not assert this signal. When this signal is asserted by an SBB canister, the enclosure power supplies MUST [101] power down. The enclosure MUST [102] not provide 12V power on the SBBMI power receptacle and the enclosure MUST [103] provide power to the STANDBY_PWR signal. After asserting the

		POWER_OFF_L signal, the SBB canister MUST [104] continue to assert this signal while operating under STANDBY_PWR for as long as the canister requires the power supplies to be powered down. The SBB canister MUST [105] de-assert this signal to instruct the power supplies to power up and resume providing power to the SBBMI power receptacle. When POWER_OFF_L is de-asserted, enclosure power supplies MUST [106] provide power to the SBBMI power receptacle.
3	Com_O	POWER_OFF_L Latch: An SBB canister MAY assert this signal to latch the power supplies in an off state. If the enclosure supports multiple SBB canisters, the enclosure MUST [107] tie the POWER_OFF_L signals from all SBB canisters together. When an SBB canister asserts POWER_OFF_L, the enclosure power supplies MUST [108] turn off and power MUST [109] NOT be present on the SBBMI power receptacle. Outside action MUST [110] occur before the enclosure power supplies will resume providing power to the SBBMI power receptacle (e.g., cycling an external power switch on the enclosure).
4	Ind_O	POWER_OFF_L Agreed Standby Control: An SBB canister MAY assert this signal to turn the power supplies on and off. If the enclosure supports multiple SBB canisters, all SBB canisters present in the system MUST [111] assert the POWER_OFF_L signal to instruct the power supplies to power down. If an SBB canister does not support STANDBY_PWR, the canister MUST [112] not assert this signal. When this signal is asserted by all SBB canisters present in the system, the enclosure power supplies MUST [113] power down. The enclosure MUST [114] NOT provide 12V power on the SBBMI power receptacle and the enclosure MUST [115] provide power to the STANDBY_PWR signal. After asserting the POWER_OFF_L signal, the SBB canisters MUST [116] continue to assert this signal while operating under STANDBY_PWR for as long as the canister requires the power supplies to be powered down. The SBB canister/s MUST [117] de-assert this signal to instruct the power supplies to power up and resume providing power to the SBBMI power receptacle. When POWER_OFF_L is de-asserted, enclosure power supplies MUST [118] provide power to the SBBMI power receptacle.

Note[1]: See Section 5.1 for definitions of Connect Types.

3.6.4 Power Supply Management

The following items are defined in the enclosure VPD to describe the enclosure power interface to the canister.

3.6.4.1 Number of Power Supply Slots

The enclosure VPD MUST [119] provide a field identifying the number of power supply slots within the enclosure. This field is used to inform the canister of the total number of power supplies the enclosure can support. The SBB specification defines requirements for 1 or 2 power supplies. Values greater than 2 are for information only. Enclosures that provide more than 2 power supplies have additional vendor specific requirements which are beyond the scope of this specification.

3.6.4.2 Power Supply VPD TWI Address

The enclosure VPD MUST [120] provide a field for power supply 1 and power supply 2 that identifies the TWI address and bus of the power supply VPD EEPROM. See section 6.2 for field location. The Power_Supply_VPD_Address field is 2 bytes per power supply. The first byte indicates if the power supply has a VPD EEPROM and the TWI bus it is connected to as well as identifies the EEPROM family compatibility. The second byte is the TWI address starting with bit "7" as the most significant bit and with bit '0" set to "0". If the power supply does not have a power supply VPD the address value MUST [121] be set to 00h. See section 6.2 for field location in the VPD.

The first byte of the Power_Supply_VPD_Address field is divided into two groups of bits. The first group is bits "1" and "0". These bits indicate VPD present and TWI bus. Table 13 defines the valid values for this two bit field.

The second group of the first byte is bits 7 – 2 that define the type of EEPROM family compatibility. Table 14 defines the numeric value for these bits.

Table 13: Power Supply VPD Bus Location

PS VPD location bits 1 - 0 values	Description
0	The power supply does not support a VPD EEPROM
1	This power supply VPD EEPROM is on TWI Bus 1
2	This power supply VPD EEPROM is on TWI Bus 2
3	Both TWI bus 1 and Bus 2

Table 14: Power Supply VPD EEPROM Type

PS_VPD EEPROM Type Value (bits 7-2)	Description
0	EEPROM (compatible with the Atmel® AT24C01A/02/04/08 family)
1	EEPROM (compatible with the Microchip® 24xx16/32/64SC family)
2	EEPROM (compatible with the ST Microelectronics M24C32/64 & M24128 family)
3	EEPROM (compatible with the ST Microelectronics M24128,M24256, M245212 family)

3.6.4.3 Power Supply Control TWI Address

The enclosure VPD MUST [122] provide a field for power supply 1 and power supply 2 that identifies the TWI address of the power supply control or power supply VPD. See section 6.2 for field location. If the power supply does not support control by TWI this value MUST [123] be set to 00h.

3.6.4.4 Power Supply Control Protocol

The enclosure VPD MUST [124] provide a field for power supply 1 and power supply 2 control protocol. These fields identify the type of interface available from the power supplies. Table 15 identifies the valid values for this field and a description of each. See section 6.2 for field location in the VPD.

Table 15: Power Supply Control

Power_Control_Protocol Field Value	Description
0	Not Supported: The power supply does not support a TWI interface
1	Vendor Specific
2	PMBus
3	PSMI

3.6.4.5 Power Supply Control Bus

The enclosure VPD MUST [125] provide a field for power supply 1 and power supply 2 control TWI bus. These fields identify the TWI bus or buses that are interfaced to the power supply. Table 16 identifies the valid values for this field and a description of each. See section 6.2 for field location in the VPD

Table 16: Power Supply Control Bus

Power_Control_Bus Field Value	Description
0	Not Supported: The power supply does not support a TWI interface
1	TWI Bus 1 only
2	TWI Bus 2 only
3	Both TWI bus 1 and Bus 2

4 Cooling Requirements

4.1 Design Criteria

The RECOMMENDED SBB canister operating environment is defined in Table 17.

Table 17: Environmental Requirements

SBB canister (Local) inlet air operating temperature range (dry bulb)	5°C to 45°C
SBB canister exit air operating temperature	55°C
SBB canister non operating ambient range	-40°C to 60°C
Local midplane power header linear velocity min	1.5 m/s
Relative Humidity	5% - 85% non condensing
Altitude	-15m to 3048m

4.2 Airflow Guidelines

The overall system MUST [126] provide airflow through the canister(s) to cool the SBB canister electronics and midplane connectors. The airflow required by any SBB canister will be dependent on its power dissipation and design point temperature rise. This specification divides SBB Canisters into four classifications based on their maximum required power. The classifications are defined in Table 18.

Table 18: SBB Canister Power Profiles

Power Profile	Maximum Required Power
P60	≤ 60W
P100	60W – 100W
P150	100W – 150W
P200	150W – 200W

Canister air temperature rise vs. airflow at the maximum power boundary of each of the four standard power profiles is shown in Figure 30. Canister air temperature rise vs. air flow for other power levels will need to be interpolated.

It must be noted that the temperature rise vs. airflow curves shown in Figure 30 are calculated for sea level conditions. Additional design margin to accommodate altitude is the responsibility of the canister designer.

Once the required airflow has been determined the SBB canister impedance curves shown in Figure 32 can be referenced to establish the pressure drop across the canister to drive the required airflow. The formula for calculating these curves is in Appendix G.1.

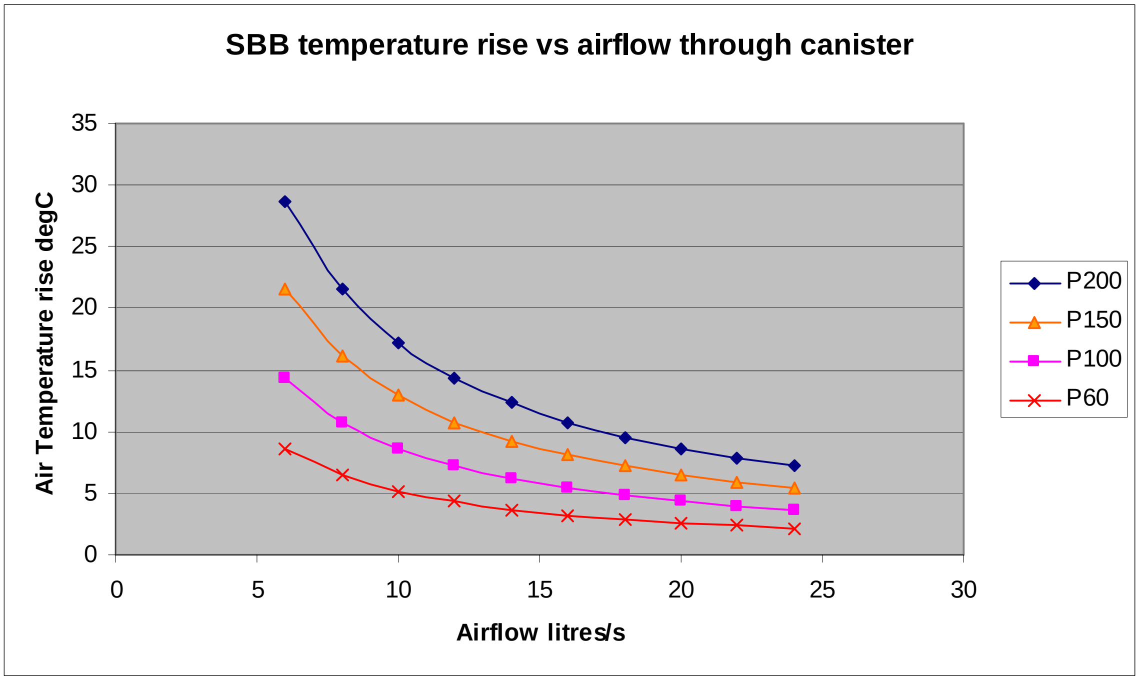


Figure 30: SBB Airflow vs. Temperature rise

The pressure drop verses airflow characteristic of a canister is dependent upon the density of the electronics packaged in the canister and the exit air vent(s) used. An SBB canister MUST [127] be designed to operate in an enclosure that provides inlet air and exit air venting as described in Section 2.2. An SBB canister MAY be designed to support multiple air vent configurations or MAY be designed to support only one. The canister airflow direction MUST [128] be from the inlet vent to any exit vent(s).

Figure 31 illustrates the airflow through an SBB canister that exits from air vent 1.

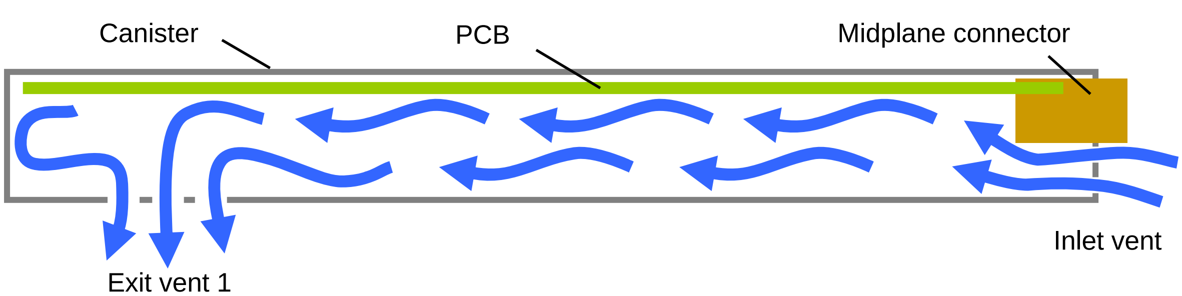


Figure 31: Example SBB Air Vent 1 Airflow Depiction

The canister impedance ranges defined in the enclosure VPD are illustrated in the impedance curves shown in Figure 32: SBB Canister Airflow Impedance Graph. This specification defines the canister impedance range for all power profiles.

The airflow impedance of a canister is a function of both the density of the electronics packaged within the canister and the exit air venting configuration. The impedance curves defined in Figure 32 covers the full range of electronics packaging densities (from low component count, low power dissipation through high component count, high power dissipation) and the range of exit vent configurations. The four impedance curves are based on CFD modeling and/or empirical data.

The power and vent configurations for each of the impedance curves shown in Figure 3 are as follows:

Curve A: The lowest impedance curve is typical for a low power dissipating canister venting through any vent configuration defined in Section 2.2.

Curve B: This impedance curve depicts that of a canister having a higher component density and power dissipation than the canister of curve A, but vented through either vent 1 or the two side vents (vents 2 and 3).

Curve C: This impedance curve depicts a high power canister with the same venting configuration (either venting through vent 1 or the two side vents (vents 2 and 3)) as curve B above.

Curve D: This impedance curve represents that of a medium density canister, vented with a single side vent (vent 2 or 3).

A summary of the above is given in Table 19**.**

Table 19: Summary of Canister Impedance Curves

Impedance Curve	Module Component Density	Approximate Module Power	Vent Configuration
A	Low	≤60 W	Any
B	Medium	60 W - 150 W	1 or 2 & 3
C	High	150 W - 200 W	1 or 2 & 3
D	Medium	≤100 W	2 or 3

The expected airflow impedances are shown in Figure 32 and the formula for calculating them is in Section G.1**.** This specification defines expected canister impedance ranges for the exit air vent options and power profiles P60, P100, P150 and P200.

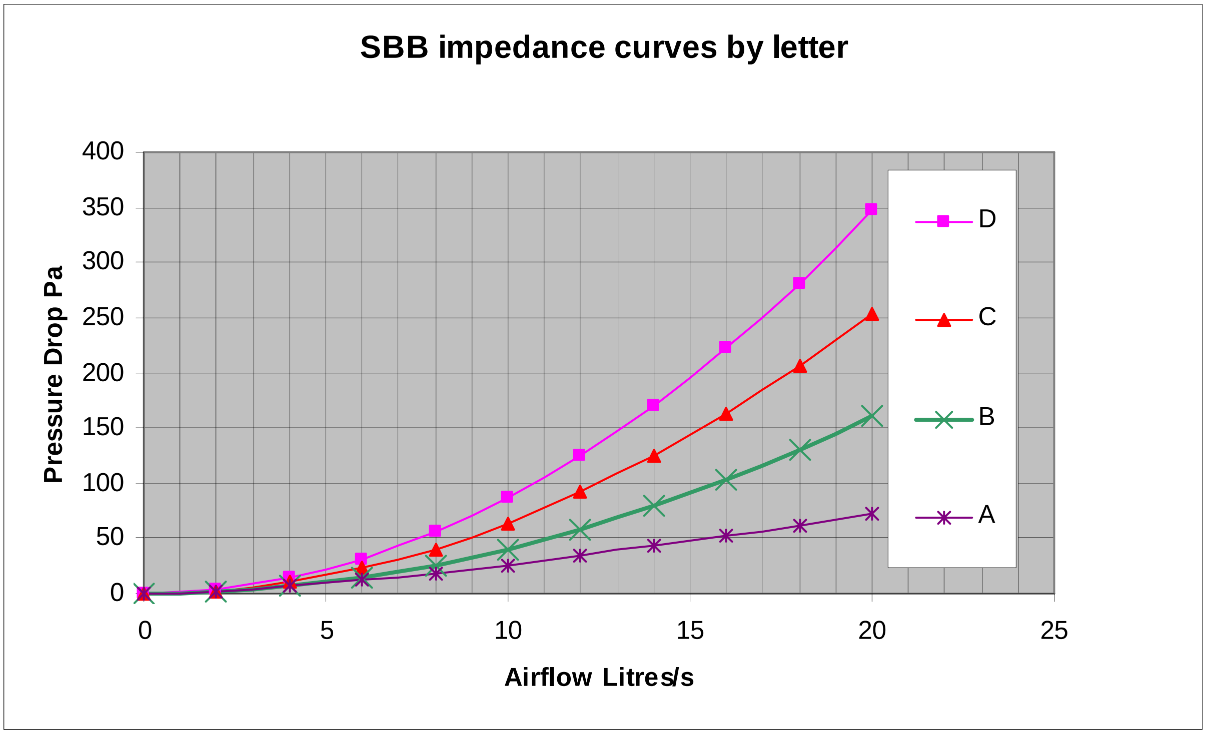


Figure 32: SBB Canister Airflow Impedance Graph

Note: The importance of airflow balancing needs to be considered. A low airflow impedance in the SBB slot will short circuit airflow reducing the power supply airflow to a level that could result in the supply overheating. Further, an empty canister slot has the potential to allow for airflow recirculation, reducing airflow over drives. It is RECOMMENDED therefore to fill empty canister slots with 'blank canisters' having airflow impedances similar to an actual canister.

The SBB canister may support up to 4 standard vent configurations. Vent configurations are identified by number as shown in Table 20.

Table 20: Vent configurations

	Vents used, 1=used, 0=not used		
Configuration	Vent 1	Vent 2	Vent 3
1	1	0	0
2	0	1	0
3	0	0	1
4	0	1	1

Note: Designs targeted at a single side vent applications are RECOMMENDED to use vent 2 as the exit vent to ensure the widest range of compatibility between canister and enclosures.

All SBB canisters, when initially powered, will discover from the enclosure VPD the following:

- The vent configurations supported
- The impedance curve A-D that applies to each supported vent configuration
- The maximum airflow that can be supplied for each vent configuration at sea level

With this data the SBB canister can determine whether the enclosure environment will support its power and cooling needs before enabling its full power up sequence and begin normal operation.

The VPD data set covering cooling compatibility may look as follows:

Table 21: Example VPD data proposal for cooling compatibility

Not supported = 0	Impedance & Max airflow supported liters/s			
Configuration	A	B	C	D
1	20	18	15	12
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0

Enclosure designs MUST [129] fall into four main categories of power/cooling; those supporting P60, P100, or P150 and P200 canisters. Enclosures that support P150 or P200 canisters MUST [130] use either Vent1 or both Vent 2 and 3. This will keep the canister impedance level low enough to allow the enclosure fan pressure to drive the required airflow. Enclosures supporting P60 or P100 canisters are expected to be sufficiently cooled using any of the 4 standard vent configurations.

4.3 Data Collection Methodology

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 canister 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 Figure 32 for the vent combinations being supported by the canister.

5 SBB Midplane Interconnect Requirements

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

a) communicate with up to 48 drives;
b) include SBB canisters in single or redundant configurations;
c) provide communication links between an SBB canister and its optionally redundant partner.

The SBBMI provides the following types of signals:

- high-speed drive communication signals;
- high-speed inter-Canister communication signals;
- low-speed drive status signals;
- low-speed inter-canister communication signals;
- low-speed canister support signals.

The connection topologies of these signals are described in Section 5.1. The functions of each of the signals in the SBBMI are defined in Section 5.2. The electrical characteristics of the signals are described in Section 0.

5.1 Connection Topologies

Figure 33 shows the components of an example enclosure. The names of these components will be used in this section to describe the signal connection topologies supported by the SBB specification.

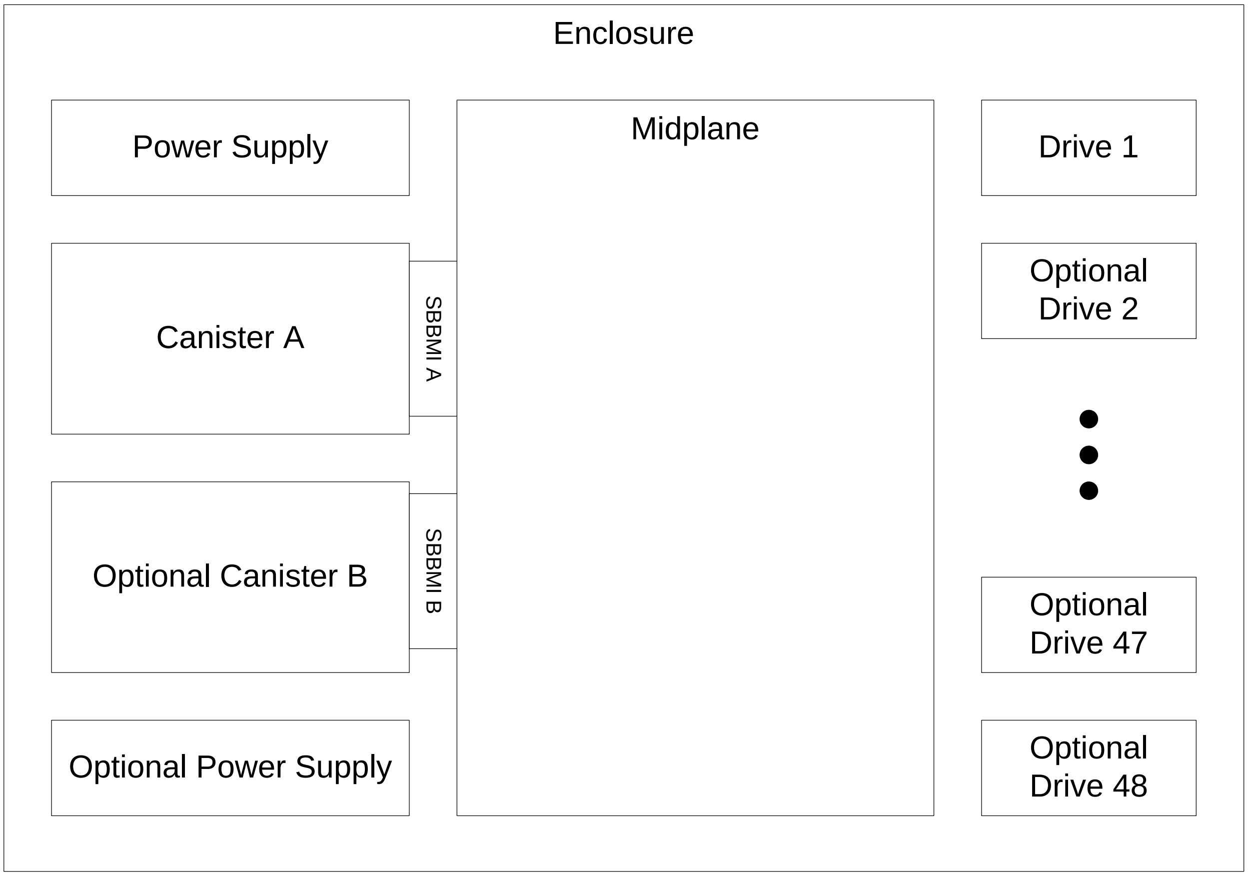


Figure 33: Conceptual Enclosure Components

The signals defined by the SBB specification have several connection types. The definition of the connection type describes how the signal is connected to the various components in an SBB compliant enclosure. Table 22 lists the connection types. The following subsections define the connection types in detail.

Table 22: Connection Type

Connect Type	Description
Ind_I	Independent Input
Ind_O	Independent Output
C_Con	Cross Connect
Com_O	Combined Output
Sync_I	Synchronized Input
D_Con	Direct Connect

5.1.1 Independent Input (Ind_I)

Independent input (Ind_I) signals are inputs into SBB canisters. When a signal is designated as Ind_I in a dual canister environment, the voltage levels or input stream of the signal on SBBMI A is independent of the signal with the same name on SBBMI B. Furthermore, no sequencing or timing of the signals relative to one another is implied. Figure 34 illustrates Ind_I signals coming from a drive.

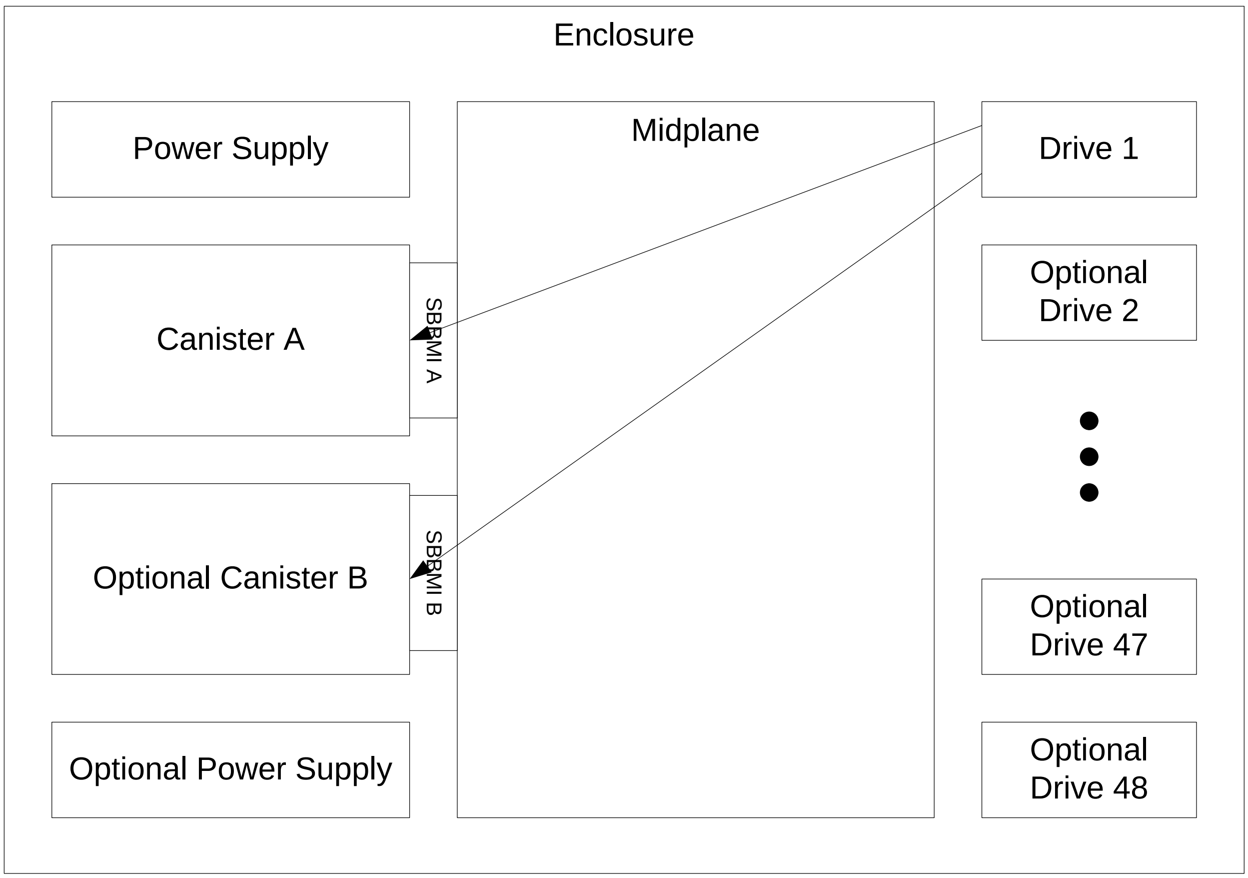


Figure 34: Example of Independent Input (Ind_I) Signals

5.1.2 Independent Output (Ind_O)

Independent Output (Ind_O) signals are outputs from SBB canisters. When a signal is designated as an Ind_O in a dual canister environment, the voltage levels or output stream of the signal on SBBMI A is independent of the signal with the same name on SBBMI B. Furthermore, no sequencing or timing of the signals relative to one another is implied. Figure 35 illustrates Ind_O signals going to a drive.

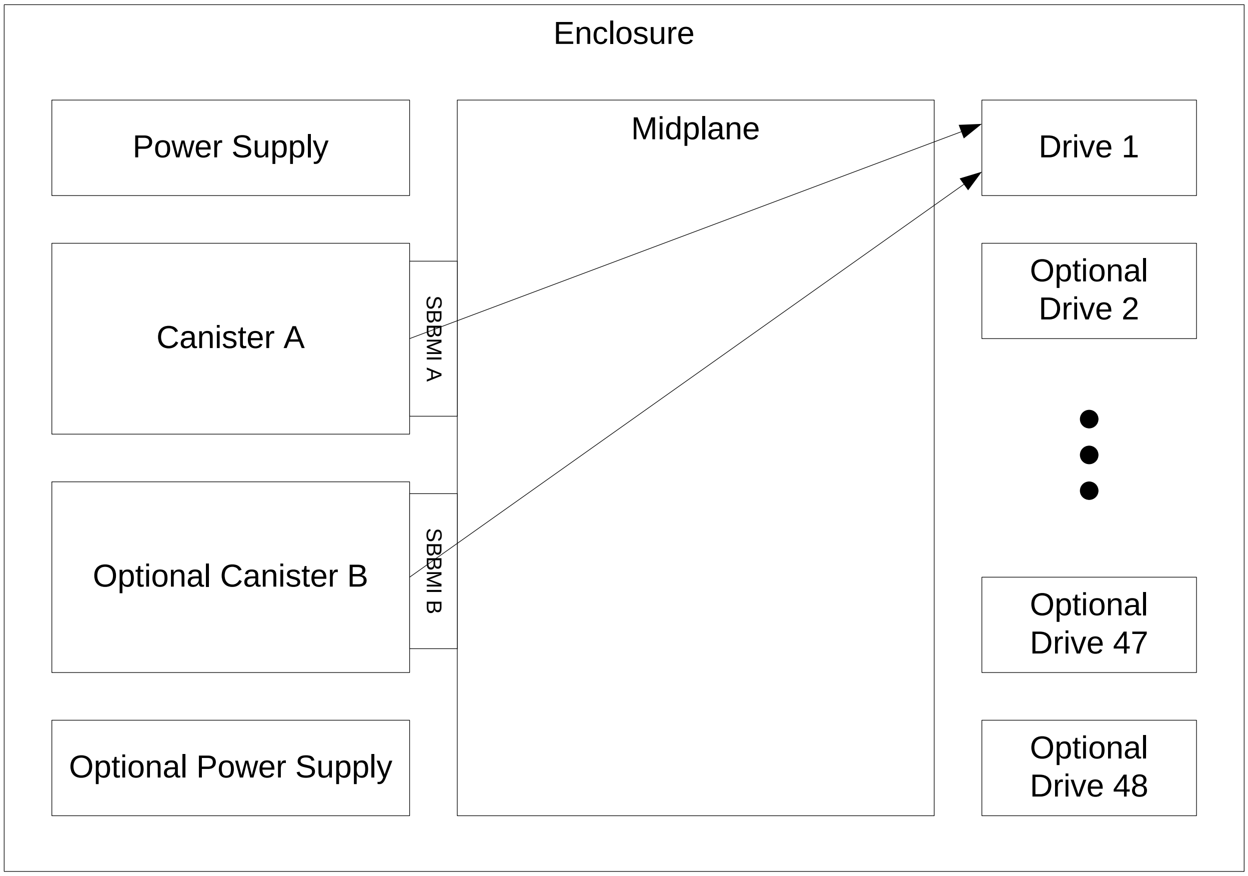


Figure 35: Example of Independent Output (Ind_O) Signals

5.1.3 Cross Connect (C_Con)

Cross Connect (C_Con) signals are inter-canister communication signals. C_Con signals are only used in environments with dual SBB canisters. Figure 36 illustrates how C_Con signals are routed between canisters. Figure 37 shows how a high-speed differential C_Con signal is connected between SBBMI A and SBBMI B. Figure 38 shows how a low-speed C_Con signal is connected between SBBMI A and SBBMI B.

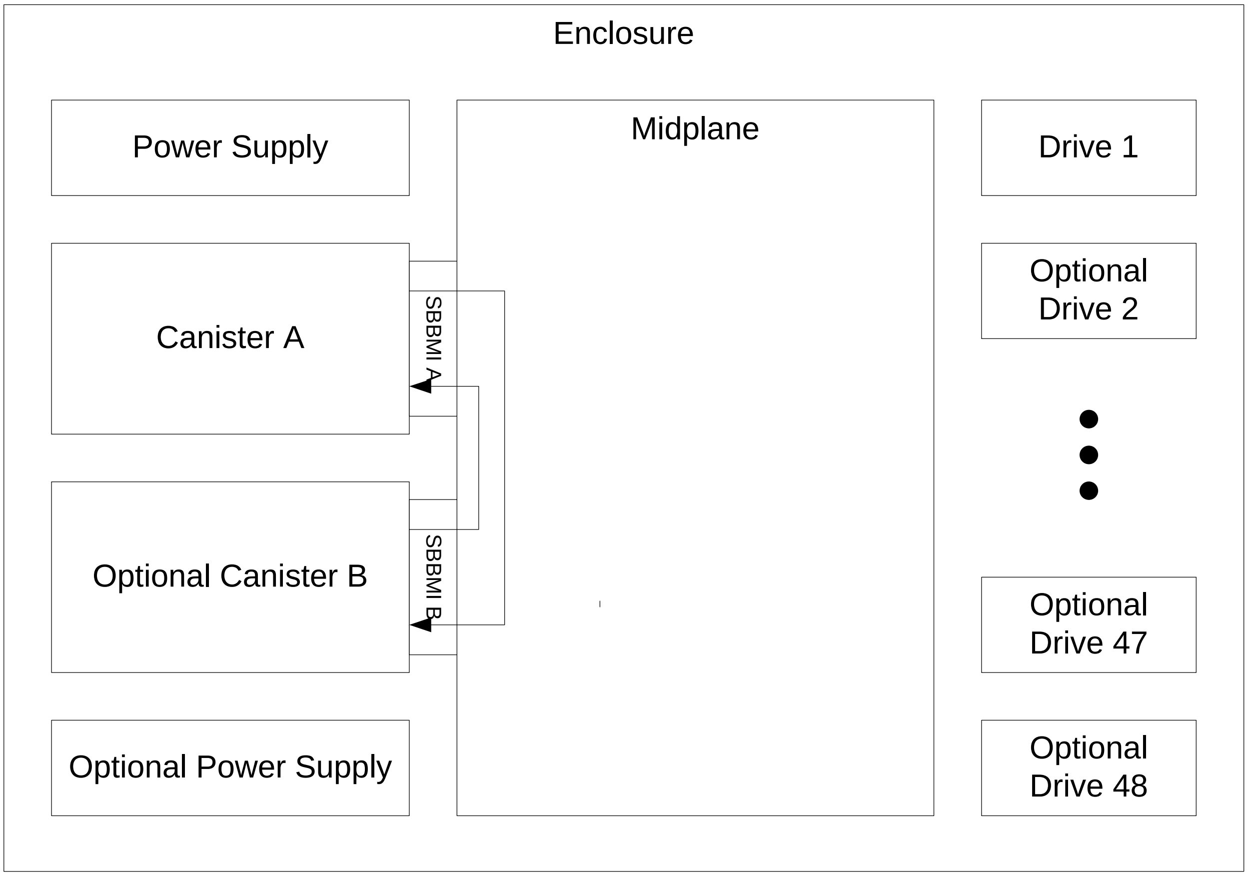


Figure 36: Example of Cross Connect (C_Con) Signals

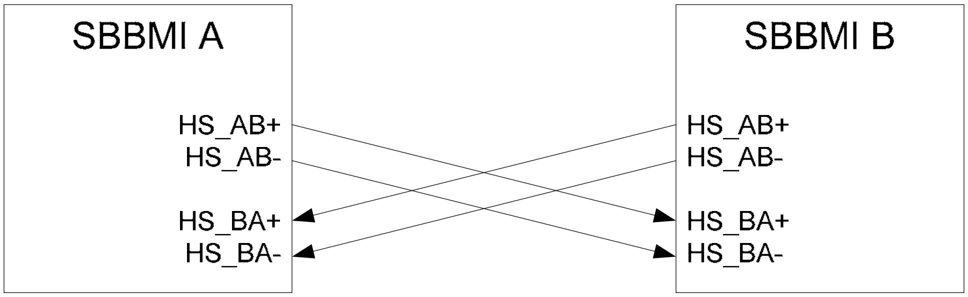


Figure 37: High-Speed Cross Connect

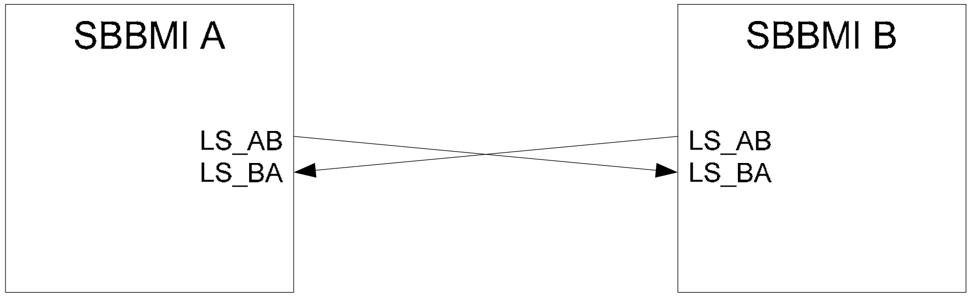


Figure 38: Low-Speed Cross Connect

5.1.4 Combined Output (Com_O)

Combined Output (Com_O) signals are outputs from SBB canisters. When a signal is designated as Com_O in a dual canister environment, the output stream of the signal on SBBMI A is logically combined with the output signal with the same name on SBBMI B. The combination of the signals occurs outside the canisters within the enclosure. Figure 39 illustrates Com_O signals. In this example, the signals from SBBMI A and SBBMI B are logically combined on the midplane. It should be noted that the logical combination may be accomplished through the use of logic circuits or, in the case of active low signals with pull-up resistors, tying the signals together in the midplane.

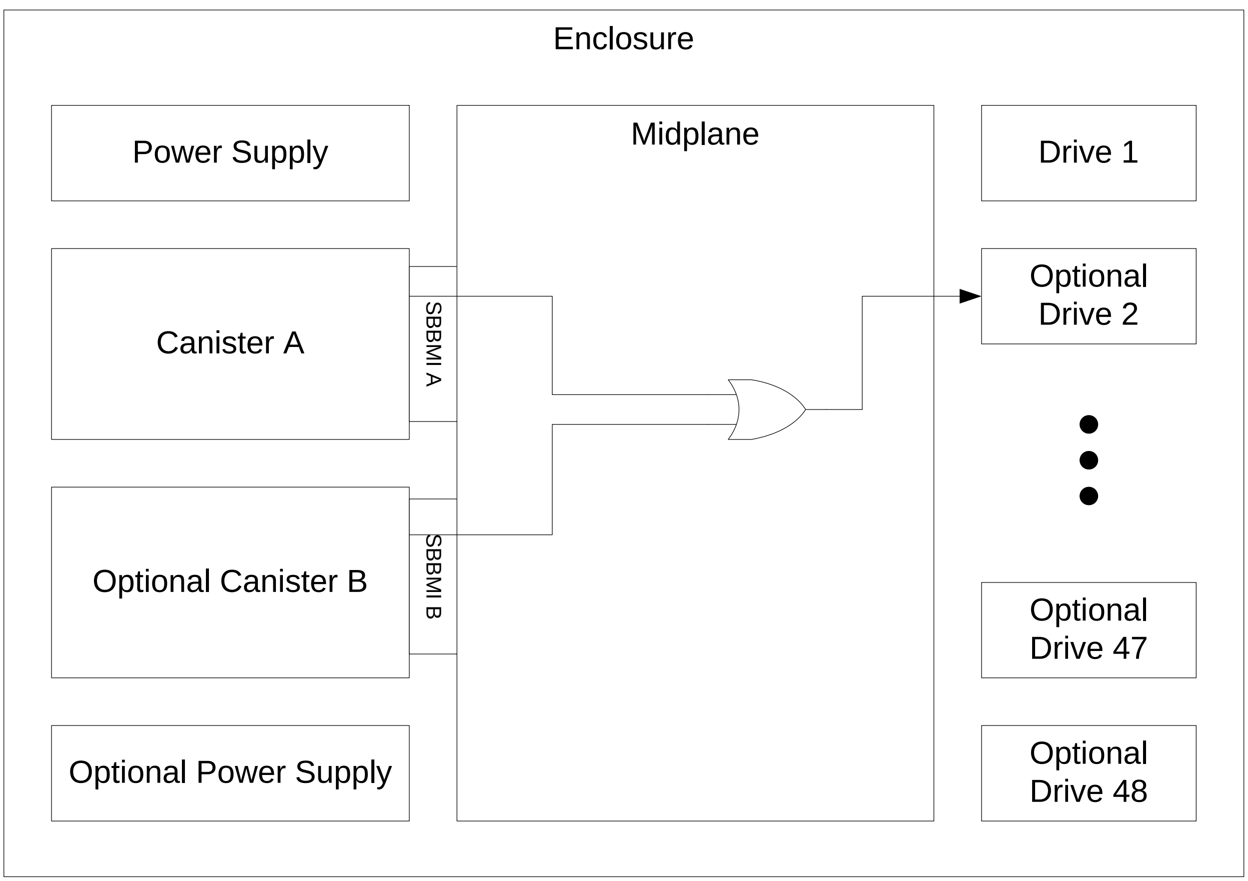


Figure 39: Example of Combined Output (Com_O) Signals

5.1.5 Synchronized Input (Sync_I)

Synchronized Input (Sync_I) signals are inputs into SBB canisters. When a signal is designated as Sync_I in a dual canister environment, the input stream of the signal on SBBMI A is exactly the same as the input stream of the signal with the same name on SBBMI B. Figure 40 illustrates Sync_I signals originating from a single power supply.

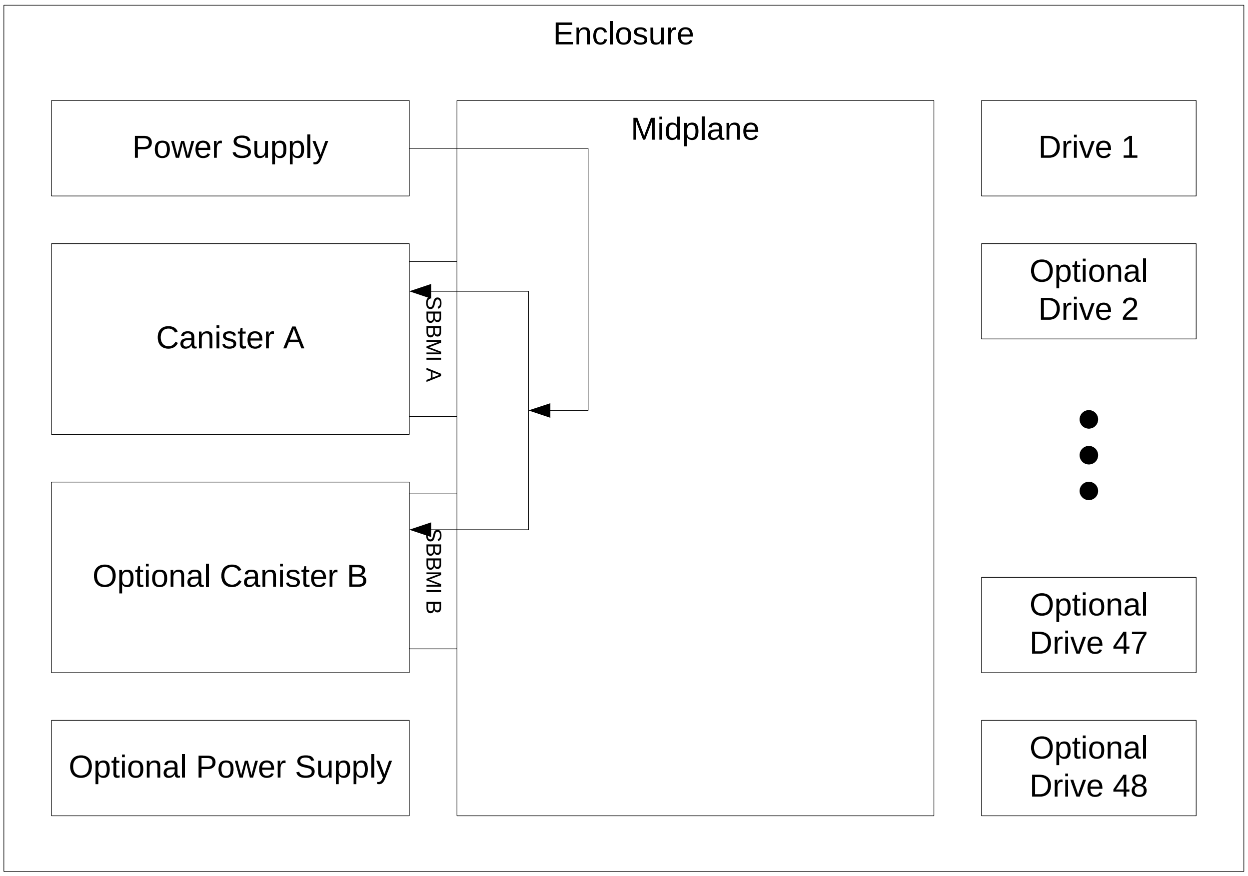


Figure 40: Example of Synchronized Input (Sync_I) Signals

5.1.6 Direct Connect (D_Con)

Direct Connect (D_Con) signals are directly connected input/output signals between canisters. D_Con signals are only used in dual canister environments. When a signal is designated as D_Con on SBBMI A, it is connected directly to the signal of the same name on SBBMI B. Figure 41 illustrates D_Con signals.

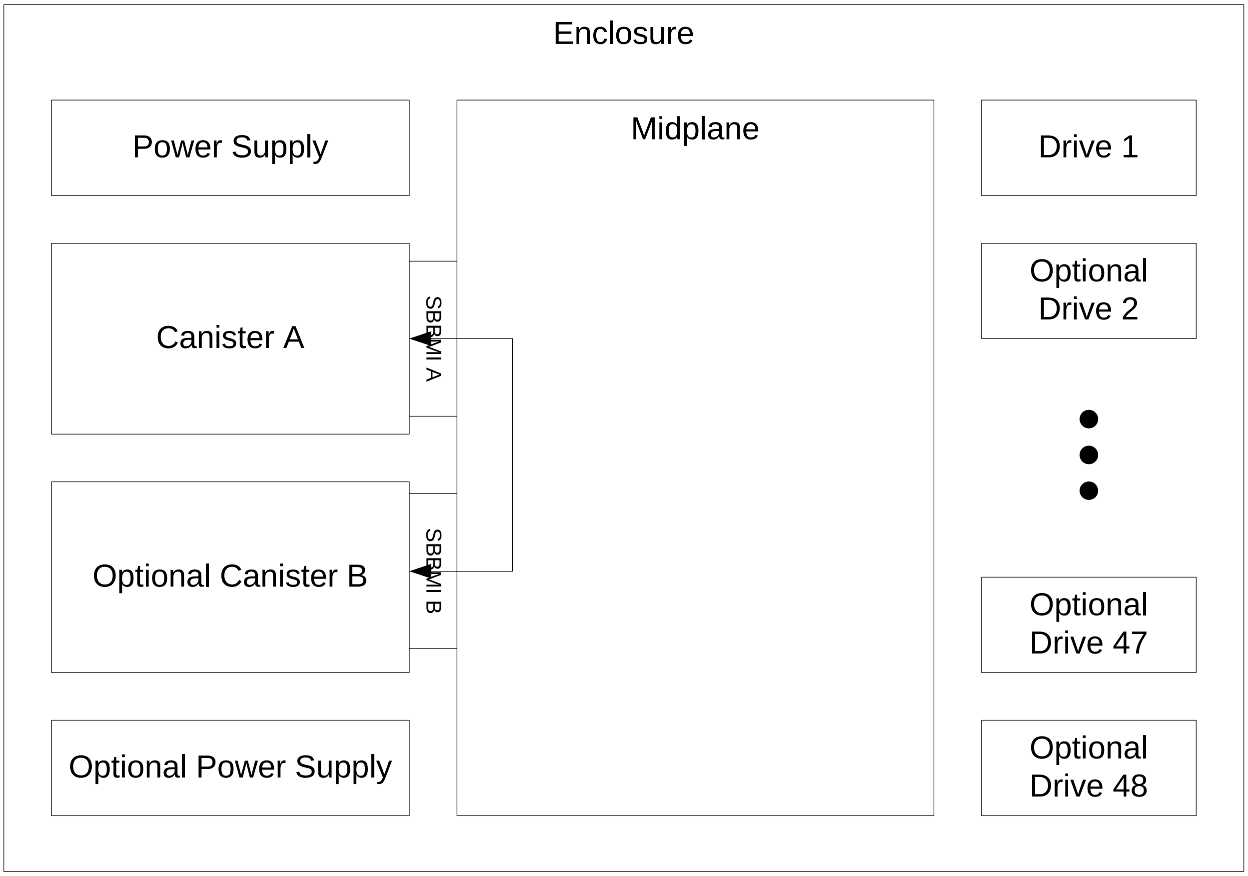


Figure 41: Example of Direct Connect (D_Con) Signals

5.2 Signal Definitions

5.2.1 High-Speed Drive Communication Signals

Table 23 describes the high-speed drive communication signals that connect the SBB canister to drives (via the midplane). The SBBMI provides up to 48 differential signaling pairs. Neither a SBB canister nor a SBB midplane is REQUIRED to provide all of the connections described in Table 23. If however, Table 23 defines a signal as REQUIRED, the canister or midplane MUST [131] provide a physical pin for the signal.

Table 23: SBBMI High-Speed Drive Communication Signals

Signal Name	Module	Valid Power-on States	Description	Connect Type	Input / Output[3]	Required / Optional	
						Canister	Midplane
DRIVE_[1:48]_RX+ DRIVE_[1:48]_RX-	Various	D, E[4]	High speed differential pair received FROM drive [1:48]	Ind_I	I_{dif}	Required [1]	Required [2]
DRIVE_[1:48]_TX+ DRIVE_[1:48]_TX-	Various	D, E[5]	High speed differential pair transmitted TO drive [1:48]	Ind_0	O_{dif}	Required [1]	Required [2]

Note [1]: The canister is only required to provide the signals for the number of drives it supports
Note [2]: The midplane is only required to provide the signals for the number of drives it supports
Note [3]: See Table 52 for I/O signal characteristics
Note [4]: The SBB canister MUST [132] ignore these signals when not in these states as described in Section 6.3.4.
Note [5]: The SBB canister MUST [133] not drive these signals when not in these states as described in Section 6.3.4.

5.2.1.1 Qualified Drive Interfaces

The Qualified_Drive_Interfaces field of the midplane VPDs is a 2 byte field that identifies interfaces for canister to drive communication that have been validated for the enclosure. Figure 42 defines bit locations corresponding to the interfaces supported by the enclosure. The enclosure MUST [134] set the bits that correspond to the interfaces for which it complies with the signaling requirements described in the appendixes. The enclosures vendor MUST [135] only set bits for the types of drives supported within the enclosure. An enclosure MAY support other interfaces but SBB specifications do not provide or have no plans to provide signaling requirements for interfaces that are not represented in Figure 42.

Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	4G FC	2G FC	12G SAS[1]	6G SAS	3G SAS
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Note[1]: The requirements for this interface will be included in a future release of the SBB specification.

Figure 42: Qualified Drive Interfaces

5.2.2 High-Speed Inter-Canister Communication Signals

Table 24 describes the high-speed inter-canister communication signals. The SBBMI provides for up to seventeen 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 [136] adhere to the definition of the signal in Table 24.

Table 24: SBBMI High-Speed Inter-Canister Communication Signals

Signal Name	Module	Valid Power-on States	Description	Connect Topology	Input / Output[2]	Required / Optional	
						Canister	Midplane
HS[1:8]_AB+ HS[1:8]_AB-	M1	E[3]	The HS[1:8] signals MUST [137] be used as high-speed inter-canister communication differential pairs.	C_Con	O_{dif}	Optional	Required[1]
HS[1:8]_BA+ HS[1:8]_BA-	M1	D, E[4]	The HS[1:8] signals MUST [138] be used as high-speed inter-canister communication differential pairs.	C_Con	I_{dif}	Optional	Required[1]
HS[9:17]_AB+ HS[9:17]_AB-	M5	E[3]	The usage requirements of these signals are defined in Table 25	See Table 25	O_{dif}	Optional	Optional
HS[9:17]_BA+ HS[9:17]_BA-	M5	D, E[4]	The usage requirements of these signals are defined in Table 25	See Table 25	I_{dif}	Optional	Optional

Note [1]: Signals are only required if enclosure supports dual canisters
Note [2]: See Section 0 for I/O signal characteristics
Note [3]: The SBB canister MUST [139] not drive these signals when not in these states as described in Section 6.3.4.
Note [4]: The SBB canister MUST [140] ignore these signals when not in these states as described in Section 6.3.4.

Table 25 lists the optional usages for the HS[9:17]_AB+, HS[9:17]_AB-, HS[9:17]_BA+, and HS[9:17]_BA- signals. An SBB enclosure MUST [141] implement these signals in a way that satisfies the requirements for one of the usage options defined in the table. The HS[9:17]_Usage field of the midplane VPDs MUST [142] contain the value of the usage option supported by the enclosure.

Table 25: Usage Options for HS[9:17] Signals

HS[9:17]_Usage Value	Description
0	Signals Not Present: These signals are not provided by the SBB midplane. An SBB canister MUST [143] ignore these signals.
1	Vendor specific: The usages of these signals are unique to the enclosure. The SBB canister MUST [144] determine whether or not it is compatible with the usage of these signals through a method other than examination of the HS[9:17]_Usage field in the midplane VPDs. If the SBB canister determines it does not understand the usages or is incompatible with the usages of these signals, the SBB canister MUST [145] not drive these signals.
2	Inter-Canister Communication: The HS[9:17] signals MUST [146] be used as high-speed inter-canister communication differential pairs. These signals MUST [147] be connected as C_Con signals.
3	Fibre Channel Low Speed Drive Signals: The signal module on which the HS[9:17] signals reside is repurposed for additional FC sideband signals that are defined in Appendix E.

5.2.2.1 Qualified Inter-canister Communication Interfaces

The Qualified_Inter-canister_Communication_Interfaces field in the midplane VPDs identifies which fabrics the enclosure designer has verified satisfy the signaling requirements identified in the appendixes. The Qualified_Inter-canister_Communication_Interfaces field is a 2 byte field. Figure 43 defines bit locations corresponding to the interfaces supported by the enclosure. The enclosure MUST [148] set the bits that correspond to the interfaces for which it complies with the signaling requirements described in the appendixes. An enclosure MAY support other interfaces but SBB specifications do not provide or have no plans to provide signaling requirements for interfaces that are not represented in Figure 43.

Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	1G Ethernet[1]	8.0G PCIe[1]	5.0G PCIe[1]	2.5G PCIe	Reserved	4G FC	2G FC	12G SAS[1]	6G SAS	3G SAS
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Note[1]: The requirements for this interface will be included in a future release of the SBB specification.

Figure 43: Qualified Inter-canister Communication Interfaces

5.2.3 Low-Speed Drive Status Signals

Table 26 describes the low-speed drive status signals provided by the SBBMI.

Table 26: SBBMI Low-Speed Drive Status Signals

Signal Name	Module	Valid Power-on States	Description	Connect Topology	Input / Output[2]	Pull-up (C/O[3])	Required/Optional	
							Canister	Midplane
DRIVE_[1:48]_FAULT_L	Various	D, E[4]	Output. The usage requirements of this signal are defined in Table 27.	Com_O	O_{OD2}	O	Optional	Optional
DRIVE_[1:48]_GPO_L	Various	D, E[4]	General purpose output. The usage requirements of this signal are defined in Table 28.	Com_O	O_{OD2}	O	Optional[6]	Optional
DRIVE_[1:48]_INPL_L	Various	All[5]	Active low input signal that indicates a drive is inserted into the physical slot mapped to this drive port.	Sync_I	$I_{pull-up}$	C	Optional	Required[1]

Note [1]: Signals are only required for drives supported by the enclosure
Note [2]: See Table 52 for I/O signal characteristics
Note [3]: Denotes location of pull-up (C – inside canister, O – outside canister)
Note [4]: The SBB canister MUST [149] not drive these signals when not in these states as described in Section 6.3.4.
Note [5]: These signals are valid in any of the states described in Section 6.3.4.
Note [6]: SBB canisters that do not implement the Drive_?_GPO_L signals may be incompatible with some enclosures. See Table 28.

Table 27 lists the optional usages for the Drive_[1:48]_Fault_L signals. The Drive_Fault_L_Usage field of the midplane VPDs MUST [150] contain the value of the usage option supported by the enclosure.

Table 27: Usage Options for Drive_[1:48]_Fault_L

Drive_Fault_L_Usage Value	Description
0	Not Supported: The enclosure MUST [151] not provide connections for the Drive_[1:48]_Fault_L signals.
1	Reserved
2	Drive Fault Indicator: The enclosure MUST [152] implement the Drive_[1:48]_Fault_L signals as SBB canister driven active low drive fault indicators. An SBB canister MAY assert a given Drive_[1:48]_Fault_L signal to operate the associated drive's drive fault indicator.

Table 28 lists the optional usages for the Drive_[1:48]_GPO_L signals. The Drive_GPO_L_Usage field of the midplane VPDs MUST [153] contain the value of the usage option supported by the enclosure for all the Drive_[1:48]_GPO_L signals. An SBB canister MUST [154] initially leave the all the Drive[1:48]_GPO_L signals in a high-impedance state until it reads the Drive_GPO_L_Usage field from the midplane VPDs. If the SBB canister does not support the usage described in the midplane VPDs Drive_GPO_L_Usage field, the SBB canister MUST [155] leave all the Drive_[1:48]_GPO_L signals in a high-impedance state.

Table 28: Usage Options for Drives_[1:48]_GPO_L

Drive_GPO_L_Usage Value	Description
0	Not Supported: The enclosure MUST [156] not provide connections for the Drive_[1:48]_GPO_L signals.
1	Vendor Specific: The usage of these signals is unique to the enclosure. The SBB canister MUST [157] determine whether or not it is compatible with the usage of these signals through a method other than examination of the Drive_GPO_L_Usage field in the midplane VPDs. If the SBB canister determines it does not understand the usage or is incompatible with the usage of these signals, the SBB canister MUST [158] not drive these signals and MUST [159] leave these signals in a high-impedance state.
2	Drive Activity Indicator: The enclosure MUST [160] implement the Drive_[1:48]_GPO_L signal as SBB canister driven drive activity indicators. If the SBB canister supports canister Driven Drive Activity Indicator usage, the SBB canister MUST [161] assert a drive's corresponding Drive_[1:48]_GPO_L signal when it is accessing the drive. If the SBB canister determines it does not understand or is incompatible with the Drive Activity Indicator usage of these signals, the SBB canister MUST [162] leave these signals in a high-impedance state.
3	Drive Ready for Removal Indicator: The enclosure MUST [163] implement the Drive_[1:48]_GPO_L signals as SBB canister driven, active low drive ready for removal indicators. If the SBB canister supports the Drive Ready for Removal Indicator, the SBB canister MUST [164] assert this signal to notify the enclosure that the corresponding drive is ready for removal from the enclosure. This signal MAY be used to drive an LED indicating that it is permissible for the drive to be removed from the system. If the SBB canister determines it does not understand or is incompatible with the Drive Ready for Removal Indicator usage of these signals, the SBB canister MUST [165] leave these signals in a high-impedance state.
4	Identify Drive Indicator: The enclosure MUST [166] implement the Drive_[1:48]_GPO_L signals as SBB canister driven, active low identify drive indicators. This signal MAY be used to drive an LED that the enclosure uses to physically identify a particular drive to the user. If the SBB canister supports the Identify Drive Indicator, the SBB canister MUST [167] assert this signal to identify the corresponding drive to the enclosure. If the SBB canister determines it does not understand or is incompatible with the Identify Drive Indicator usage of these signals, the SBB canister MUST [168] leave these signals in a high-impedance state.

5	Drive Power Control: The enclosure MUST [169] implement the Drive_[1:48]_GPO_L signals as active low drive power control signals. When a drive's corresponding Drive_[1:48]_GPO_L signal is asserted, the enclosure MUST [170] turn the drive on. When a drive's corresponding Drive_[1:48]_GPO_L is de-asserted, the enclosure MUST [171] turn the drive off. If an SBB canister supports drive power control, the SBB canister MUST [172] assert a drive's Drive_1:48]_GPO_L signal to turn a drive on and de-assert the signal to turn the drive off. If the SBB canister determines it does not understand or is incompatible with the Power Control usage of these signals, the SBB canister MUST [173] not drive these signals and MUST [174] leave these signals in a high-impedance state. Note: Canisters that do not implement this usage will be unable to turn on the drives of enclosures that implement this usage.

5.2.4 Low-Speed Inter-Canister Communication Signals

Table 29 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 [175] implement these signals.

Table 29: SBBMI Low-Speed Inter-Canister Communication Signals

Signal Name	Module	Valid Power-on States	Description	Connect Topology	Input / Output[1]	Required / Optional	
						Canister	Midplane
LS[1:7]_AB	M3	D, E[3]	General purpose inter-canister output	C_Con	O_{PPL}	Optional	Required[2]
LS[1:7]_BA	M3	D, E[4]	General purpose inter-canister input.	C_Con	I_{TTL}	Optional	Required[2]
LS8_AB	M1	D, E[3]	General purpose inter-canister output	C_Con	O_{PPL}	Optional	Required[2]
LS8_BA	M1	D, E[4]	General purpose inter-canister input.	C_Con	I_{TTL}	Optional	Required[2]

Note [1]: See Table 52 for I/O signal characteristics
Note [2]: Signals are only required if enclosure supports dual canisters
Note [3]: The SBB canister MUST [176] not drive these signals when not in these states as described in Section 6.3.4.
Note [4]: The SBB canister MUST [177] ignore these signals when not in these states as described in Section 6.3.4.

5.2.5 Low-Speed Canister Support Signals

Table 30 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 [178] adhere to the definitions of Table 30 and the requirements of following subsections.

Table 30: SBBMI Low-Speed Canister Support Signals

Signal Name	Module	Valid Power-on States	VPD Field	Connect Topology	Input / Output[1]	Pull-up (C/O[3])	Required / Optional	
							Canister	Midplane
AC_GOOD_L	M1	All[7]	AC_GOOD_L_Usage	Sync_I	$I_{pull-up}$	C	Optional	Optional
STANDBY_PWR	M1	All[7]	N/A	Sync_I	See Section	NA	Optional	Optional

Signal Name	Module	Valid Power-on States	VPD Field	Connect Topology	Input / Output[1]	Pull-up (C/O[3])	Required / Optional	
							Canister	Midplane
					3.6.2			
MATED_L	M3	All[7]	N/A	Ind_I	$I_{pull-up}$	C	Required	Required
ENCLOSURE_INTR_L	M3	All[7]	Enclosure_Intr_L_Usage	Sync_I	$I_{pull-up}$	C	Optional	Optional
SGPIO_SLI	M3	D, E[6]	SGPIO_SLI_Usage	See Section 5.2.5.5	O_{SGPIO}	NA	Optional	Optional
SGPIO_SCK	M3	D, E[6]	SGPIO_SCK_Usage	See Section 5.2.5.5	O_{SGPIO}	NA	Optional	Optional
SGPIO_SDO	M3	D, E[6]	SGPIO_SDO_Usage	See Section 5.2.5.5	O_{SGPIO}	NA	Optional	Optional
SGPIO_SDI	M3	D, E[6]	SGPIO_SDI_Usage	See Section 5.2.5.5	I_{SGPIO}	NA	Optional	Optional
SCL0	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required[4]	Required
SDA0	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required[4]	Required
SCL1	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required	Required
SDA1	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required	Required
SCL2	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required	Required
SDA2	M3	All[7,8]	N/A	See Section 6.1	I/O_{TW}	O	Required	Required
POWER_OFF_L	M3	D, E[6]	Power_Off_L_Usage	See Section 3.6.3	O_{OD1}	O	Optional	Optional
PS1_LED_L	M3	D, E[6]	PS[1:2]_LED_L_Usage	Com_O	O_{OD2}	O	Optional	Optional
PS2_LED_L	M3	D, E[6]	PS[1:2]_LED_L_Usage	Com_O	O_{OD2}	O	Optional	Optional
PS1_PRES_L	M3	All[7]	N/A	Sync_I	$I_{pull-up}$	C	Optional	Required
PS1_ALERT_L	M3	All[7]	N/A	Sync_I	$I_{pull-up}$	C	Optional	Required
PS2_PRES_L	M3	All[7]	N/A	Sync_I	$I_{pull-up}$	C	Optional	Required[2]
PS2_ALERT_L	M3	All[7]	N/A	Sync_I	$I_{pull-up}$	C	Optional	Required[2]
SLOT ID	M3	All[7]	N/A	Ind_I	$I_{pull-up}$	C	Optional	Required
CARD_IO_TEST_L	M3	D, E[5,6]	N/A	D_Con	$I_{pull-up}$ / O_{OD1}	C	Optional	Required
TWI_BUS1_RST_L	M3	B, D, E[6]	TWI_BUS[1:2]_RST_L	Com_O	O_{OD1}	O	Optional	Optional
TWI_BUS2_RST_L	M3	B, D, E[6]	TWI_BUS[1:2]_RST_L	Com_O	O_{OD1}	O	Optional	Optional

Note [1]: See Table 52 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)
Note [4]: This signal is only required if enclosure supports dual canisters
Note [5]: The SBB canister MUST [179] ignore this signal when not in these states as described in Section 6.3.4.
Note [6]: The SBB canister MUST [180] not drive this signal when not in these states as described in Section 6.3.4.
Note [7]: This signal is valid in any of the states described in Section 6.3.4.
Note [8]: The SBB canister MAY drive this signal in any of the states described in Section 6.3.4.

5.2.5.1 AC_GOOD_L

See Section 3.6.1 for requirements.

5.2.5.2 STANDBY_PWR

See Section 3.6.2 for requirements.

5.2.5.3 MATED_L

This signal MUST [181] be grounded on the midplane. The canister MAY use this signal to detect when it is inserted into the enclosure. The MATED_L signal is among the last to mate pins, however it is possible for the SBB canister to detect the MATED_L signal and not have the canister fully inserted. Full contact of all connector modules is ensured by the lever(s) being fully closed. See Section 2.3 for details on the lever mechanism. Designers MAY optionally use a SBBMI Canister Signal Header with a short pin in location A6 to determine insertion of the canister.

5.2.5.4 ENCLOSURE_INTR_L

Table 31 lists the optional usages for the ENCLOSURE_INTR_L signal. An SBB enclosure MUST [182] implement this signal in a way that satisfies the requirements for one of the usage options defined in the table. The Enclosure_Intr_L_Usage field of the midplane VPDs MUST [183] contain the value of the usage option supported by the enclosure.

Table 31: Usage Options for ENCLOSURE_INTR_L

Enclosure_Intr_L_Usage Field Value	Description
0	Not Supported: The enclosure does not drive the ENCLOSURE_INTR_L signal. An SBB canister MUST [184] ignore any signal on this pin.
1	Vendor Specific: The usage of this signal is unique to the enclosure. The SBB canister MUST [185] determine whether or not it is compatible with the usage of this signal through a method other than examination of the Enclosure_Intr_L_Usage field in the midplane VPDs. If the SBB canister determines it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [186] ignore this signal.
2	Temperature Interrupt: The enclosure MUST [187] assert this signal if it detects a thermal event. The canister SHOULD take whatever action it requires to correct the thermal problem. The SBB canister is NOT REQUIRED to take any action when the enclosure asserts this signal.
3	General TWI Interrupt: The enclosure MAY assert this signal to alert the SBB canister of any enclosure management event. TWI devices with interrupt signals MAY have their interrupt signals attached to this signal. If the SBB canister determines it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [188] ignore this signal.

5.2.5.5 SGPIO Interface

SGPIO_SLI, SGPIO_SCK, SGPIO_SDO and SGPIO_SDI are OPTIONAL signals. If implemented, these signals form a four wire serial bus which MUST [189] be compliant with the requirements in SFF-8485 Specification for Serial GPIO (SGPIO) Bus, Revision 7, 1 February 2006.

Serial General Purpose Input Output (SGPIO) is a method to serialize general purpose IO signals. SGPIO defines the communication between an initiator and a target. In the context of SBB, the initiator resides within the SBB canister and communicates with a target which is housed in the enclosure (e.g., on the enclosure midplane). Since the target could comprise of multiple chips it would be possible for both the canister and the enclosure to include a SGPIO target. This specification limits itself to the interface definition of SGPIO targets housed within the enclosure so that their use can be interpreted by the SBB canister.

Typically the target converts the output signals into multiple LED signals, and provides the initiator with inputs such as device detection etc. When used in SBB, the functions provided by SGPIO are split between drive related functions, similar to those provided by the optional SBBMI Low-Speed Drive Status Signals (Section 5.2.3), and enclosure based functions similar to those provided by the Low-Speed Canister Support Signals (Section 5.2.5).

Where SGPIO is used for drive related functions, it is RECOMMENDED that these signals are used to supplement the optional SBBMI Low-Speed Drive Status Signals to provide additional features or functions. This SGPIO use provides a method of having more drive related functions than supported by the dedicated Low-Speed Drive Status Signals.

Where SGPIO is used for enclosure based functions, it is RECOMMENDED that where these functions duplicate those provided by the Low-Speed Canister Support Signals, that the Low-Speed Canister Support Signals are also driven. For example, if SGPIO is used to determine the presence of multiple power supplies (PS?_PRES_L), it is RECOMMENDED that PS1_PRES_L and PS2_PRES_L are also supported. This allows the canister to monitor the SGPIO bitstream for all of its power supply presence data in an enclosure with more than two power supplies, but also allows it to use the dedicated signals in enclosures with two or less power supplies.

Four signals (SGPIO_SCK, SGPIO_SLI, SGPIO_SDO and SGPIO_SDI) comprise the SGPIO bus. These signals are directly equivalent to the SFF-8485 defined SClock, SLoad, SDataOut and SDataIn signals respectively.

SGPIO_SLI indicates the end of a bit stream and the start of the next. SGPIO_SLI contains 4 bits of data. The generic name of these bits is SLoad L[0:3], where [0:3] refers to the index of the individual bit. For example, SLoad L2 refers to the third bit (index 2) in the SGPIO_SLI bit stream.

SGPIO_SDO and SGPIO_SDI carry the serial bit streams. SGPIO_SDO and SGPIO_SDI contain multiple sets of 3 bits nominally associated with the number of drives supported. For Example, in a system that contains 12 drives, there would be 36 bits (3 x 12) in each of the SGPIO_SDO and SGPIO_SDI bit streams. The generic names of these bit streams are SDataOut OD[0:47].[0:2] and SDataIn ID[0:47].[0:2], where [0:47] refers to an individual set of three bits and [0:2] indexes the individual bits in the set. For example, SDataIn ID14.1 refers to the second bit in the fifteenth 3-bit set. All signals are sequenced by the SGPIO_SCK clock signal.

If the enclosure supports redundant SBB canisters, the SGPIO output bitstreams (SLoad L[0:3] and SDataOut OD[0:47].[0:2]) MUST [190] be generated independently by both SBB canisters and MUST [191] be interpreted by the enclosure as a single combined signal which is the logical ‘OR’ of the individual canister bitstreams. For example, if the canister connected to SBBMI A sets SDataOut OD9.2 = 0 and the canister connected to SBBMI B sets SDataOut 9.2 = 1, the enclosure must interpret the value of SDataout OD9.2 to be ‘1’ and take the appropriate action. The SBB canisters are NOT REQUIRED to synchronize their SGPIO output bitstreams.

If the enclosure supports redundant SBB canisters, the SGPIO input bitstreams (SDataIn ID[0:47].[0:2]) MUST [192] be generated by the enclosure and MUST [193] provide the same bitstream data to both canisters.

The following sections define the optional uses for the SGPIO signals.

5.2.5.5.1 SGPIO_SLI

Table 32 lists the optional usages for the SGPIO_SLI signal. The SGPIO_SLI_Usage field of the midplane VPDs MUST [194] contain the value of the usage option supported by the enclosure. An SBB enclosure MUST [195] implement the SGPIO_SLI signal in a way that satisfies the requirements of one of the usage options defined in Table 32.

Table 32: Usage Options for the SGPIO_SLI Signal

SGPIO_SLI_Usage Field Value	Description
0	Not Supported: The enclosure does not drive or accept input on the associated signal. The SBB canister MUST [196] leave this signal in a high impedance state and ignore any input signal that may be present on this pin. The enclosure MUST [197] ignore any signal that an SBB canister may drive on this pin.
1	Vendor Specific: The usage of this signal is unique to the enclosure and not defined within this specification. The SBB canister MUST [198] determine whether or not it is capable of utilizing this signal in a manner that satisfies the requirements of the enclosure through a method other than examination of the SGPIO_SLI_Usage field in the midplane VPDs. The signal characteristics (e.g., voltage levels) of this usage MUST [199] still conform to the signal type defined for this signal in the Input/Output column of Table 30. If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [200] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.
2	SGPIO_SLI: This signal is an output from the SBB canister. This signal is the SGPIO_SLI signal of the SGPIO signal set. If the enclosure supports this usage it MUST [201] support all four SGPIO signals (SGPIO_SCK, SGPIO_SLI, SGPIO_SDO and SGPIO_SDI) . If the canister determines that is does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [202] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.

If the SGPIO_SLI_Usage field of the midplane VPDs has a value of ‘2’, the enclosure supports the SGPIO_SLI signal and the values of the four SLoad L[0:3]_Usage fields in the midplane VPDs are valid. The four usage fields for SLoad (SLoad_L0_Usage, SLoad_L1_Usage, SLoad_L2_Usage and SLoad_L3_Usage) describe the function of the corresponding bit in the 4-bit SLoad bit steam. For example, the SLoad_L2_Usage field defines the use of the SLoad L2 bit. Table 33 lists the valid optional usages for individual bits in the SLoad bit stream. In cases where the indicated usage duplicates the indicated usage of one of the other discrete signals in the SBBMI, the SBB canister MUST [203] drive the same logical value on the discrete signal as it indicates in the SLoad bit stream.

Table 33: Usage Options for bit stream values SLoad L[0:3]

SLoad L[0:3] Usage Field Value	Description
0	Not Supported: The enclosure MUST [204] ignore any value of the corresponding SLoad L[0:3] bit. The SBB canister MUST [205] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
1	Vendor Specific: The usage of this SLoad L[0:3] bit is unique to the enclosure and not defined within this specification. The SBB canister MUST [206] determine whether or not it is capable of utilizing this bit in a manner that satisfies the requirements of the enclosure through a method other than examination of the corresponding SLoad_L[0:3]_Usage field in the midplane VPDs. If the canister determines that it does not understand the usage or is incompatible with the usage of this bit, the SBB canister MUST [207] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
2	Power LED: The bit allows an SBB canister to drive an indicator when an enclosure is powered on. The enclosure MUST [208] provide an indicator located on the enclosure that is activated when an SBB canister indicates a ‘1’ (One) at the relevant position in the bit stream. If an SBB canister does not support this usage, the SBB canister MUST [209] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
3	Online LED: The bit allows an SBB canister to drive an indicator when an enclosure is online. The enclosure MUST [210] provide an indicator located on the enclosure that is activated when an SBB canister asserts indicates a ‘1’ (One) at the relevant position in the bit stream. If an SBB canister does not support this usage, the SBB canister MUST [211] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
4	Fault LED: The bit allows an SBB canister to drive an indicator when a fault condition exists in the enclosure. The enclosure MUST [212] provide an indicator located on the enclosure that is activated when the SBB canister indicates a ‘1’ (One) at the relevant position in the bit stream. If an SBB canister does not support this usage, the SBB canister MUST

	[213] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
5	Identify LED: The bit allows an SBB canister to drive an indicator to identify an enclosure to a system administrator. The enclosure MUST [214] provide an indicator located on the enclosure that is activated when an SBB canister indicates a ‘1’ at the relevant position in the bit stream. If an SBB canister does not support this usage, the SBB canister MUST [215] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
6	Alarm Driver Output: The bit allows an SBB canister to drive an alarm within the enclosure. The enclosure MUST [216] provide an alarm located on the enclosure that is activated when the SBB canister indicates a ‘1’ (One) at the relevant position in the bit stream. The alarm MAY be audible. The SBB canister MAY assert this bit to indicate an alarm condition in the enclosure. The exact alarm condition indicated when the SBB canister asserts this bit is SBB canister implementation specific and is not defined in this specification If an SBB canister does not support this usage, the SBB canister MUST [217] indicate a ‘0’ (Zero) at the relevant position in the bit stream.

5.2.5.5.2 SGPIO_SDO

Table 34 lists the optional usages for the SGPIO_SDO signal. The SGPIO_SDO_Usage field of the midplane VPDs MUST [218] contain the value of the usage option supported by the enclosure. An SBB enclosure MUST [219] implement these signals in a way that satisfies the requirements for one of the usage options defined in the table.

Table 34: Usage Options for the SGPIO_SDO Signal

SGPIO_SDO_Usage Field Value	Description
0	Not Supported: The enclosure does not drive or accept input on the associated signal. The SBB canister MUST [220] leave this signal in a high impedance state and ignore any input signal that may be present on this pin. The enclosure MUST [221] ignore any signal that an SBB canister may drive on this pin.
1	Vendor Specific: The usage of this signal is unique to the enclosure and not defined within this specification. The SBB canister MUST [222] determine whether or not it is capable of utilizing this signal in a manner that satisfies the requirements of the enclosure through a method other than examination of the SGPIO_SDO_Usage field in the midplane VPDs.

	The signal characteristics (e.g., voltage levels) of this usage MUST [223] still conform to the signal type defined for this signal in the Input/Output column of Table 30. If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [224] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.
2	SGPIO_SDO: This signal is an output from the SBB canister. This signal is one of the four SGPIO signals. If the enclosure supports this usage it MUST [225] support all four SGPIO signals (SGPIO_SCK, SGPIO_SLI, SGPIO_SDO and SGPIO_SDI). If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [226] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.

If the SGPIO_SDO_Usage field of the midplane VPDs has a value of '2', the enclosure supports the SGPIO_SDO signal and the values of the SDataOut_OD[0:47].[0:2]_Usage fields in the midplane VPDs are valid. The SDataOut_OD[0:47].[0:2]_Usage fields have two indexes. The first index, [0:47], references up to 48 3-bit sets in the SDataOut output stream. The second index, [0:2], references the bit location in a specific 3-bit set. For example, the SdataOut_OD14.1_Usage field defines the use of the SDataOut OD14.1 bit (i.e., the second bit in the fifteenth 3-bit set).

The number of 3-bit sets supported by the enclosure is determined by the number of entries reserved for the SDataOut_OD[0:47].[0:2]_Usage fields in the midplane VPDs. For example, if the enclosure supports 12 3-bit sets, the VPDs will have space for 36 SDataOut OD usage fields (i.e., SDataOut_OD[0:11].[0:2]). Table 35 lists the optional usages that may be assigned to the individual bits of the SDataOut bit stream. In cases where the indicated usage duplicates the indicated usage of one of the other discrete signals in the SBBMI, the SBB canister MUST [227] drive the same logical value on the discrete signal as it indicates in the SDataOut bit stream.

Table 35: Usage Options for bit stream values SDataOut OD[0:47].[0:2]

SDataOut_OD[0:47].[0:2]_Usage Field Value	Description
0	Not Supported: The enclosure MUST [228] ignore any value of the corresponding SDataOut OD[0:47].[0:2] bit. If an SBB canister does not support this usage, the SBB canister MUST [229] indicate a '0' (Zero) at the relevant position in the bit stream.
1	Vendor Specific: The usage of this SDataOut OD[0:47].[0:2] bit is unique to the enclosure and not defined within this specification. The SBB canister MUST [230] determine whether or not it is capable of utilizing this bit in a manner that satisfies the requirements of the enclosure through a method other than

	examination of the SDataOut_OD[0:47]_[0:2]_Usage field in the midplane VPDs. If the canister determines that it does not understand the usage or is incompatible with the usage of this bit, the SBB canister MUST [231] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
2	Drive Activity Indicator: The enclosure MUST [232] implement the relevant SDataOut OD[0:47].[0:2] bit stream location as an SBB canister driven drive activity indicator. The [0:47] index of the SDataOut_OD[0:47].[0:2] usage field indicates which drive port is associated with the relevant bit. If the SBB canister supports canister driven drive activity indicator usage, the SBB canister MUST [233] indicate a ‘1’ in the corresponding SDataOut OD[0:47].[0:2] bit stream location when it is accessing the associated drive port. If the SBB canister determines it does not understand or is incompatible with the drive activity indicator usage of this bit, the SBB canister MUST [234] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
3	Drive Fault Indicator: The enclosure MUST [235] implement the relevant SDataOut OD[0:47].[0:2] bit stream location as an SBB canister driven drive fault indicator. The [0:47] index of the SDataOut_OD[0:47].[0:2] usage field indicates which drive port is associated with the relevant bit. If the SBB canister supports canister driven drive fault indicator usage, the SBB canister MUST [236] indicate a ‘1’ in a drive port’s corresponding SDataOut OD[0:47].[0:2] bit stream location when it has determined that the drive has a fault. If the SBB canister determines it does not understand or is incompatible with the fault indicator usage of this bit, the SBB canister MUST [237] indicate a ‘0’ (Zero) at the relevant position in the bit stream.
4	Drive Ready for Removal Indicator: The enclosure MUST [238] implement the relevant SDataOut OD[0:47].[0:2] bit stream location as an SBB canister driven drive ready for removal indicator. The [0:47] index of the SDataOut_OD[0:47].[0:2] usage field indicates which drive port is associated with the relevant bit. If the SBB canister supports the drive ready for removal indicator, the SBB canister MUST [239] indicate a ‘1’ in a drive port’s SDataOut OD[0:47].[0:2] bit stream location when it has determined that the corresponding drive is ready for removal from the enclosure. This signal MAY be used to drive an LED indicating that it is permissible for the drive to be removed from the system. If the SBB canister determines it does not understand or is incompatible with the Drive Ready for Removal Indicator usage of this bit, the SBB canister MUST [240] indicate a ‘0’ (Zero) at the relevant position in the bit stream..

5	Identify Drive Indicator: The enclosure MUST [241] implement the relevant SDataOut OD[0:47].[0:2] bit stream location as an SBB canister driven identify drive indicator. The [0:47] index of the SDataOut_OD[0:47].[0:2] usage field indicates which drive port is associated with the relevant bit. This bit MAY be used to drive an LED that the enclosure uses to physically identify a particular drive to the user. If the SBB canister supports the identify drive indicator, the SBB canister MUST [242] indicate a '1' in a drive port's SDataOut OD[0:47].[0:2] bit stream location to identify the corresponding drive to the enclosure. If the SBB canister determines it does not understand or is incompatible with the identify drive indicator usage of these signals, the SBB canister MUST [243] indicate a '0' (Zero) at the relevant position in the bit stream.
6	Power Supply Alert LED : The enclosure MUST [244] implement the relevant SDataOut OD[0:47].[0:2] bit stream location as a Power Supply Alert LED indicator. If the SBB canister supports the Power Supply Alert LED, the SBB canister MAY assert a power supply's corresponding SDataOut OD[0:47].[0:2] bit stream location to indicate an alert/fault condition associated with that power supply. This usage allows an enclosure to support the use of greater than two power supplies. If the SBB canister determines it does not understand or is incompatible with the Power Supply Alert LED usage of these bits, the SBB canister MUST [245] indicate a '0' (Zero) at the relevant position in the bit stream.

5.2.5.5.3 SGPIO_SDI

Table 36 lists the optional usages for the SGPIO_SDI. The SGPIO_SDI_Usage field of the midplane VPDs MUST [246] contain the value of the usage option supported by the enclosure. An SBB enclosure MUST [247] implement these signals in a way that satisfies the requirements for one of the usage options defined in the table.

Table 36: Usage Options for the SGPIO_SDI Signal

SGPIO_SDI_Usage Field Value	Description
0	Not Supported: The enclosure does not drive or accept input on the associated signal. The SBB canister MUST [248] leave this signal as a high impedance input and ignore any input signal that may be present on this pin. The enclosure MUST [249] ignore any signal that an SBB canister MAY drive on this pin.
1	Vendor Specific: The usage of this signal is unique to the enclosure and not defined within this specification. The SBB canister MUST [250] determine whether or not it is capable of utilizing this signal in a manner

	that satisfies the requirements of the enclosure through a method other than examination of the SGPIO_SDI_Usage field in the midplane VPDs. The signal characteristics (e.g., voltage levels) of this usage MUST [251] still conform to the signal type defined for this signal in the Input/Output column of Table 30. If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [252] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.
2	SGPIO_SDI: This signal is an input to the SBB canister. This signal is one of the four SGPIO signals. If the enclosure supports this usage it MUST [253] support all four SGPIO signals (SGPIO_SCK, SGPIO_SLI, SGPIO_SDO and SGPIO_SDI.) If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [254] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.

If the SGPIO_SDI_Usage field of the midplane VPDs has a value of ‘2’, the enclosure supports the SGPIO_SDI signal and the values of the SDataIn_ID[0:47].[0:2]_Usage fields are valid. The SDataIn_ID[0:47].[0:2]_Usage fields have two indexes. The first index, [0:47], references up to 48 3-bit sets in the SDataIn input stream. The second index, [0:2], references the bit location in a specific 3-bit set. For example, the SdataIn_ID14.1_Usage field defines the use of the SDataIn ID14.1 bit (i.e., the second bit in the fifteenth 3-bit set).

The number of 3-bit sets supported by the enclosure is determined by the number of entries reserved for the SDataIn_ID[0:47].[0:2]_Usage fields in the midplane VPDs. For example, if the enclosure supports 12 3-bit sets, the VPDs will have space for 36 SDataIn ID usage fields (i.e., SDataOut_OD[0:11].[0:2]). Table 37 lists the optional usages that may be assigned to the individual bits of the SDataIn bit stream. In cases where the indicated usage duplicates the indicated usage of one of the other discrete signals in the SBBMI, the SBB enclosure MUST [255] drive the same logical value on the discrete signal as it indicates in the SDataIn bit stream.

Table 37: Usage Options for bit stream values SDataIn ID[0:47].[0:2]

SDatain_ID[0:47].[0:2]_Usage Field Value	Description
0	Not Supported: The enclosure MUST [256] indicate a ‘0’ (Zero at the relevant position in the bit stream. An SBB canister MUST [257] ignore any value of the corresponding SDataIn ID[0:47].[0:2] bit.
1	Vendor Specific: The usage of this SDataIn ID[0:47].[0:2] bit is unique to the enclosure and not defined within this specification. The SBB canister MUST [258] determine whether or not it is capable of utilizing this bit in a manner that satisfies the requirements of the enclosure through a method other than examination of the SDataIn_ID[0:47]_[0:2]_Usage field in the midplane VPDs.

	If the canister determines that it does not understand the usage or is incompatible with the usage of this bit, the SBB canister MUST [259] ignore the value at the relevant position in the bit stream.
2	Drive Presence; The enclosure MUST [260] assert the relevant SDataIn ID[0:47].[0:2] bit stream location as an SBB enclosure driven drive presence signal. The [0:47] index of the SDataIn_ID[0:47].[0:2] usage field indicates which drive port is associated with the relevant bit. If the SBB enclosure supports drive presence usage, it MUST [261] assert a drive port's corresponding SDataIn ID[0:47].[0:2] bit stream location when a drive is inserted into the physical slot mapped to this drive port. If the SBB canister determines it does not understand or is incompatible with the drive presence usage of this bit, the SBB canister MUST [262] ignore the value at the relevant position in the bit stream.
3	SBB Canister Presence; The enclosure MUST [263] assert the relevant SDataIn ID[0:47].[0:2] bit stream location as an SBB enclosure driven SBB Canister presence signal. If the SBB enclosure supports SBB Canister Presence usage, it MUST [264] assert an SBB Canister's corresponding SDataIn ID[0:47].[0:2] bit stream location when an SBB Canister is inserted into the physical slot mapped to this SBB Canister. If the SBB canister determines it does not understand or is incompatible with the SBB Canister Presence usage of these bits, the SBB canister MUST [265] ignore the value at the relevant position in the bit stream.
4	Power Supply Presence; The enclosure MUST [266] assert the relevant SDataIn ID[0:47].[0:2] bit stream location as an SBB enclosure driven Power Supply presence signal. If the SBB enclosure supports Power Supply Presence usage, it MUST [267] assert a Power Supply's corresponding SDataIn ID[0:47].[0:2] bit stream location when a Power Supply is inserted into the physical slot mapped to this Power Supply. This usage allows an enclosure to support the use of greater than two power supplies. If the SBB canister determines it does not understand or is incompatible with the Power Supply Presence usage of this bit, the SBB canister MUST [268] ignore the value at the relevant position in the bit stream.
5	Audible Alarm Mute; The enclosure MUST [269] assert the relevant SDataIn ID[0:47].[0:2] bit stream location as an SBB enclosure driven Audible Alarm Mute signal. If the SBB enclosure supports Audible Alarm Mute usage, it MUST [270] assert an Audible Alarm Mute's corresponding SDataIn ID[0:47].[0:2] bit stream location when a switch located on the enclosure is activated by the system administrator. When an SBB canister detects that this signal is asserted, the canister MUST [271] de-assert the Alarm Driver Output signal if it is driving the

	Alarm Driver Output Signal (see Table 43). Also, when an SBB canister detects that this signal is asserted, the canister MUST [272] set the Alarm Driver Output bit in the SLoad bit stream to ‘0’, if it is using the Alarm Driver Output usage for one of the bits in the SLoad bit stream (see Table 33). If the SBB canister determines it does not understand or is incompatible with the Audible Alarm Mute usage of this bit, the SBB canister MUST [273] ignore the value at the relevant position in the bit stream.

5.2.5.5.4 SGPIO_SCK

Table 38 lists the optional usages for the SGPIO_SCK signal. An SBB enclosure MUST [274] implement this signal in a way that satisfies the requirements for one of the usage options defined in the table. The SGPIO_SCK_Usage field of the midplane VPDs MUST [275] contain the value of the usage option supported by the enclosure.

Table 38: Usage Options for the SGPIO_SCK Signal

SGPIO_SCK_Usage Field Value	Description
0	Not Supported: The enclosure does not drive or accept input on the SGPIO_SCK signal. The SBB canister MUST [276] leave this signal in a high impedance state and ignore any input that signal that may be present on this pin. The enclosure MUST [277] ignore any signal that an SBB canister may drive on this pin.
1	Vendor Specific: The usage of this signal is unique to the enclosure and not defined within this specification. The SBB canister MUST [278] determine whether or not it is capable of utilizing this signal in a manner that satisfies the requirements of the enclosure through a method other than examination of the SGPIO_SCK_Usage field in the midplane VPDs. The signal characteristics (e.g., voltage levels) of this usage MUST [279] still conform to the signal type defined for this signal in the Input/Output column of Table 30. If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [280] leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.
2	SGPIO_SCK: This signal is an output from the SBB canister. This signal is one of the four SGPIO signals. If the enclosure supports this usage it MUST [281] support all four SGPIO signals (SGPIO_SCK, SGPIO_SLI, SGPIO_SDO and SGPIO_SDI.) If the canister determines that it does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [282]

	leave this pin in a high impedance state and ignore any signal the enclosure may drive on the pin.

5.2.5.5.5 SGPIO Usage Example

The following example indicates the encoded SGPIO bit stream for an enclosure with the features below:

- 12 drives (each with an Activity LED driven from the canister)
- 1 identify enclosure LED
- 3 power Supplies (each with an Alert LED and monitored for presence)
- 1 enclosure mounted audible alarm with an associated audible alarm mute switch
- 2 vendor specific functions in the enclosure driven from the SBB canister (SLoad)
- 2 vendor specific functions in the enclosure driven from the SBB canister (SDataOut)
- 2 vendor specific functions per drive signaled to the canister by the enclosure

Table 39: SGPIO Usage example

		Usage Field Value	Description
SLoad	L0	5	Identify LED output
	L1	6	Alarm Driver output
	L2	1	Vendor Specific
	L3	1	Vendor Specific
SDataOut	OD0.0	2	Drive Port 1 Activity LED output
	OD0.1	1	Vendor Specific
	OD0.2	6	Power Supply 1 Alert LED output
	OD1.0	2	Drive Port 2 Activity LED output
	OD1.1	1	Vendor Specific
	OD1.2	6	Power Supply 2 Alert LED output
	OD2.0	2	Drive Port 3 Activity LED output
	OD2.1	0	Not Supported
	OD2.2	6	Power Supply 3 Alert LED output
	OD3.0	2	Drive Port 4 Activity LED output
	OD3.1	0	Not Supported
	OD3.2	0	Not Supported
	OD4.0	2	Drive Port 5 Activity LED output
	OD4.1	0	Not Supported
	OD4.2	0	Not Supported

Sequence repeats until :			
	OD11.0	2	Drive Port 12 Activity LED output
	OD11.1	0	Not Supported
	OD11.2	0	Not Supported
SDataIn	ID0.0	1	Vendor Specific
	ID0.1	1	Vendor Specific
	ID0.2	4	Power Supply 1 Presence input
	ID1.0	1	Vendor Specific
	ID1.1	1	Vendor Specific
	ID1.2	4	Power Supply 2 Presence input
	ID2.0	1	Vendor Specific
	ID2.1	1	Vendor Specific
	ID2.2	4	Power Supply 3 Presence input
	ID3.0	1	Vendor Specific
	ID3.1	1	Vendor Specific
	ID3.2	5	Audible Alarm Mute input
	ID4.0	1	Vendor Specific
	ID4.1	1	Vendor Specific
	ID4.2	0	Not Supported
	ID5.0	1	Vendor Specific
	ID5.1	1	Vendor Specific
	ID5.2	0	Not Supported
Sequence repeats until :			
	ID11.0	1	Vendor Specific
	ID11.1	1	Vendor Specific
	ID11.2	0	Not Supported

5.2.5.6 SCL0/SDA0

These signals form a two wire serial bus. SCL0 is the shared clock signal and SDA0 is the shared data signal. See Section 6 for further requirements.

5.2.5.7 SCL1/SDA1

These signals form a two wire serial bus. SCL1 is the shared clock signal and SDA1 is the shared data signal. See Section 6 for further requirements.

5.2.5.8 SCL2/SDA2

These signals form a two wire serial bus. SCL2 is the shared clock signal and SDA2 is the shared data signal See Section 6 for further requirements.

5.2.5.9 POWER_OFF_L

This signal turns off the enclosure power supplies. See Section 3.6.3 for requirements.

5.2.5.10 Power Supply LED

Table 40 lists the optional usages for the PS[1:2]_LED_L signals. An SBB enclosure MUST [283] implement these signals in a way that satisfies the requirements for one of the usage options defined in the table. The PS[1:2]_LED_L_Usage field of the midplane VPDs MUST [284] contain the value of the usage option supported by the enclosure.

Table 40: Usage Options for PS[1:2]_LED_L

PS[1:2]_LED_L_Usage Field Value	Description
0	Not Supported: The enclosure does not provide connections to the PS[1:2]_LED_L signals. An SBB canister MUST [285] ignore any signal on these pins. The SBB canister MUST [286] leave the PS[1:2]_LED_L signals in a high-impedance state.
1	Reserved
2	PS_ALERT_LEDs: The enclosure provides these signals as Power Supply Alert LEDs that can be controlled by the SBB canister. An SBB canister MAY assert a power supply's corresponding PS[1:2]_LED_L signal to indicate an alert/fault condition associated with that power supply.

5.2.5.11 Power Supply Present

The PS1_PRES_L and PS2_PRES_L signals are driven active when the first and second power supplies are present. The purpose of these signals is to inform the canister(s) of the number of supplies present. These signals MUST [287] be asserted outside the SBB canister when the matching power supply is present. These signals are active low.

5.2.5.12 Power Supply Alert

PS1_ALERT_L and PS2_ALERT_L are signals that notify the SBB canister of a change in the status of Power Supply 1 or 2. These signals are driven by the enclosure and are active low input signals. The enclosure MAY assert these signals when there is a change in the status of the associated power supply. This includes any faults that may have occurred within a power supply.

5.2.5.13 SLOT_ID

This signal is an input to the SBB canister that designates which SBB slot a canister is inserted in. Slot A MUST [288] be grounded on the midplane. Slot B MUST [289] float on the midplane.

5.2.5.14 CARD_IO_TEST_L

This signal is a bidirectional signal used to initiate any self test mechanisms between SBB canisters.

The function of the specific card test that is initiated is vendor specific. However, if implemented, initiation of the test is limited to the following two cases:

1. Before exiting State B of the Power-On algorithm described in Section 6.3, the SBB canister MAY sample the CARD_IO_TEST_L line. If CARD_IO_TEST is sampled low before exiting State B, the canister MAY enter a diagnostic or self test state instead of booting up as normal. The exiting of this state is also vendor specific. This usage of the CARD_IO_TEST signal is intended to be implemented in canister test fixtures.

2. If the canisters are running in Shared mode (i.e., State E of the Power-On algorithm described in Section 6.3), the CARD_IO_TEST_L line MAY be asserted for purposes of initiating a vendor specific inter-canister diagnostic. A canister MAY assert this signal to initiate canister-canister diagnostics. A canister MUST [290] not assert this signal when it is not running in Shared mode as defined by the Power-On algorithm described in Section 6.3.

5.2.5.15 Two Wire Interface (TWI) Bus Reset

Table 41 lists the optional usages for the TWI_BUS1_RST_L and TWI_BUS2_RST_L signals. The TWI_BUS[1:2]_RST_L_Usage field of the midplane VPDs MUST [291] contain the value of the usage option supported by the enclosure.

Table 41: Usage Options for TWI_BUS1_RST_L and TWI_BUS2_RST_L

TWI_BUS[1:2]_RST_L_Usage Value	Description
0	Not Supported: The enclosure MUST [292] not provide connections for the TWI_BUS1_RST_L and TWI_BUS2_RST_L signals.
1	Reserved
2	TWI BUS Resets: The enclosure MUST [293] implement the TWI_BUS1_RST_L and TWI_BUS2_RST_L signals as SBB canister driven TWI bus resets. When an SBB canister asserts TWI_BUS1_RST_L, the TWI bus formed by SCL1 and SDA1 MUST [294] be reset. When an SBB canister asserts TWI_BUS2_RST_L, the TWI bus formed by SCL2 and SDA2 MUST [295] be reset.

5.2.6 Enclosure Defined Inputs and Outputs

Enclosure defined inputs and outputs are intended to give the enclosure designer flexibility. The ENC_DEF_LP[1:7] and ENC_DEF_HP[1:4] can be used as either as inputs or outputs. Table 42 lists the enclosure defined inputs and outputs and gives their characteristics.

Table 42: SBBMI System Defined Inputs and Outputs

Signal Name	Module	Valid Power-on States	Description	Connect Type	Input / Output[1]	Pull-up (C/O[1])	Required / Optional	
							Canister	Midplane
ENC_DEF_LP[1:7]	M3	D, E[2]	Enclosure defined input or output	See Table 43	$I_{Pull-up}/O_{OD1}$	C	Optional	Optional
ENC_DEF_HP[1:4]	M3	D, E[2]	Enclosure defined input or output	See Table 43	I_{TTL}/O_{OD3}	O	Optional	Optional

Note [1]: Denotes location of pull-up (C – inside canister, O – outside canister)
Note [2]: The SBB canister MUST [296] not drive these signals and MUST [297] ignore these signals when not in these states as described in Section 6.3.4.

Each ENC_DEF_LP signal and each ENC_DEF_HP signal has an associated midplane VPD entry that states how the enclosure expects the SBB canister to utilize the signal. The midplane VPD entries are labeled ENC_DEF_LP_[?]_Usage for the ENC_DEF_LP[1:7] signals, where "?" is the index of the associated signal. The VPD entries are labeled ENC_DEF_HP[?]_Usage for the ENC_DEF_HP[1:4] signals, where "?" is the index of the associated signal.

Table 43 lists the valid values for the ENC_DEF_LP[1:7]_Usage and ENC_DEF_HP[1:4]_Usage fields. An SBB enclosure MUST [298] implement these signals in a way that satisfies the requirements for one of the usage options defined in the table. The ENC_DEF_LP[1:7]_Usage and ENC_DEF_HP[1:4]_Usage fields of the midplane VPDs MUST [299] contain the value of the usage option supported by the enclosure.

The ENC_DEF_HP[1:4] signals MAY be particularly useful as outputs to drive LEDs on an enclosure front panel.

Table 43: Usage Options for ENC_DEF_LP[1:7] and ENC_DEF_HP[1:4]

ENC_DEF_LP[1:7]_Usage Field Value	Connect Type	Description
0	N/A	Not Supported: The enclosure does not drive or accept input on the associated signal. The SBB canister MUST [300] leave this signal as a high impedance input and ignore any input signal that may be present on this pin. The enclosure MUST [301] ignore any signal that an SBB canister MAY drive on this pin.
1	Vendor Specific	Vendor Specific: The usage of this signal is unique to the enclosure and not defined within this specification. The SBB canister MUST [302] determine whether or not it is capable of utilizing this signal in a manner that satisfies the requirements of the enclosure through a method other than examination of the ENC_DEF_LP[1:7] or ENC_DEF_HP[1:4] usage fields in the midplane VPDs. If the canister determines that is does not understand the usage or is incompatible with the usage of this signal, the SBB canister MUST [303] leave this pin as a high impedance input and ignore any signal the enclosure may drive on the pin.
2	Com_O	Enclosure LED with VPD Defined Behavior: This usage provides a method for the enclosure to define exactly what behavior it wishes an SBB canister to drive on this particular signal. It differs from the other usages described in this table in that it allows relationships among other signals with this usage to be described. For example, two signals may be combined to represent multiple enclosure conditions An SBB canister MUST [304] drive this signal in a manner that satisfies the requirements described in Section 5.2.6.1. If an SBB canister does not support this usage, the SBB canister MUST [305] leave this pin as a high impedance input.
3	Com_O	Power LED: This signal is an output from the SBB canister. This signal allows an SBB canister to drive an indicator when an enclosure is powered on. The enclosure MUST [306] provide an indicator located on the enclosure that is activated when the SBB canister

		asserts this signal. If an SBB canister does not support this usage, the SBB canister MUST [307] leave this pin as a high impedance input.
4	Com_O	Online LED: This signal is an output from the SBB canister. This signal allows an SBB canister to drive an indicator when an enclosure is online. The enclosure MUST [308] provide an indicator located on the enclosure that is activated when the SBB canister asserts this signal. If an SBB canister does not support this usage, the SBB canister MUST [309] leave this pin as a high impedance input.
5	Com_O	Fault LED: This signal is an output from the SBB canister. This signal allows an SBB canister to drive an indicator when a fault condition exists in the enclosure. The enclosure MUST [310] provide an indicator located on the enclosure that is activated when the SBB canister asserts this signal. If an SBB canister does not support this usage, the SBB canister MUST [311] leave this pin as a high impedance input.
6	Com_O	Identify LED: This signal is an output from the SBB canister. This signal allows an SBB canister to drive an indicator to identify an enclosure to a system administrator. The enclosure MUST [312] provide an indicator located on the enclosure that is activated when the SBB canister asserts this signal. If an SBB canister does not support this usage, the SBB canister MUST [313] leave this pin as a high impedance input.
7	Com_O	Alarm Driver Output: This signal is an output from the SBB canister and is used to drive an alarm within the enclosure. The alarm MAY be audible. The SBB canister MAY assert this signal to indicate an alarm condition in the enclosure. The exact alarm condition indicated when the SBB canister asserts this signal is SBB canister implementation specific and is not defined in this specification. If an SBB canister does not support this usage, the SBB canister MUST [314] leave this pin as a high impedance input.
8	Sync_I	Audible Alarm Mute: This signal is an input to the SBB canister and is used to cancel an alarm condition. When an SBB canister detects that this signal is asserted, the canister MUST [315] de-assert the Alarm Driver Output signal if it is driving the Alarm Driver Output Signal. The Audible Alarm Mute signal is usually asserted by the enclosure when a switch located on the enclosure is activated by the system administrator. The SBB canister MUST [316] interpret this signal as an edge triggered signal and the enclosure is not required to assert this signal for any minimum time. If an SBB canister does not support this usage, the SBB canister

		MUST [317] leave this pin as a high impedance input.
9	Sync_I	Enclosure Location Input: This signal is an input into the SBB canister. Typically, an enclosure will assert this signal when a system administrator activates a switch located on the enclosure to physically identify the enclosure. The SBB canister MUST [318] interpret this signal as an edge triggered input and the enclosure is not required to assert this signal for any minimum time. If an SBB canister does not support this usage, the SBB canister MUST [319] leave this pin as a high impedance input.

5.2.6.1 Enclosure LED with VPD Defined Behavior

When the usage field for an enclosure defined pin is defined as Enclosure LED with VPD Defined Behavior. The behavior of that signal is described by Enclosure LED State Records in the midplane VPDs. The Enclosure LED State Records allow complex LED behaviors to be described while keeping the number of bytes used for the description in the midplane VPDs low. Each Enclosure LED State Record is variable in length and describes behaviors the SBB canister MUST [320] drive on the ENC_DEF_HP[1:4] or ENC_DEF_LP[1:7] signals. Table 44 shows the format of an Enclosure LED State Record.

Table 44: Enclosure LED State Record Format

Byte	Descriptions
1	Enclosure State
2	Size in Bytes (N)
3	ENC_DEF_HP Signals Referenced
4	ENC_DEF_LP Signals Referenced
5 - N	Signal Behavior Definitions

Byte 1 of the Enclosure LED State Record contains the enclosure conditions (Table 45) associated with the record. Byte 1 is also called the Enclosure State field. The Enclosure Conditions field can represent the presence or absence of any combination of eight conditions. The conditions are defined in Table 45.

Table 45: Enclosure Conditions

Enclosure Conditions	Descriptions
Powered	This condition indicates the enclosure is powered on. The absence of this condition indicates that the enclosure is powered off.
Online	This condition indicates that the enclosure is online. The absence of this condition indicates the enclosure is offline.
Fault	This condition indicates that the enclosure is experiencing a fault condition. This condition usually requires the activation of a fault LED or alarm on the enclosure. The absence of this condition indicates that the enclosure is not experiencing any faults.
Identify	This condition indicates that the SBB canister is trying to assist a user in physically identifying the enclosure. For example, the SBB canister MAY blink a specific LED on the enclosure.
Reserved 1	This condition type is reserved for future use.
Reserved 2	This condition type is reserved for future use.
Reserved 3	This condition type is reserved for future use.
Reserved 4	This condition type is reserved for future use.

Each bit of the Enclosure State field corresponds to the presence or absence of the condition described in Table 45. Figure 44 shows the bit assignments for the conditions described in Table 45. When the bit is 'set', the associated condition is present. When the bit is 'cleared', the associated condition is not present.

	Reserved 4	Reserved 3	Reserved 2	Reserved 1	Identify	Fault	Online	Powered
Enclosure State Field	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Figure 44: Enclosure State Field Bit Assignments

Byte 2 defines the size (in bytes) of the Enclosure LED State Record including the Enclosure State field. The additional byte for the size is intended to allow canister software to navigate records in the VPD without scanning them completely.

The remaining fields in the Enclosure LED State Record describe the behavior the SBB canister MUST [321] drive on the ENC_DEF_HP[1:4] or ENC_DEF_LP[1:4] signals when the conditions described the Enclosure State field are present.

Byte 3 and Byte 4 are bit fields that state which ENC_DEP_HP[1:4] and ENC_DEF_LP[1:7] signals are referenced by the Enclosure LED State Record. Figure 45 and Figure 46 show the formats of the ENC_DEF_HP Signals Referenced field and the ENC_DEF_LP Signals Referenced field. The presence of a 'set' bit in a bit field indicates that the respective ENC_DEP_HP[1:4] and or ENC_DEF_LP[1:7] signal is referenced by the Enclosure LED State Record and is expected to be driven by the canister at some point in the signal definition. The presence of a 'cleared' bit indicates the signal is not referenced and should not be driven at anytime by the signal definition. The reserved bits MUST [322] be 'cleared'.

	Reserved	Reserved	Reserved	Reserved	ENC_DEF_HP[4]	ENC_DEF_HP[3]	ENC_DEF_HP[2]	ENC_DEF_HP[1]
ENC_DEF_HP Pins Referenced	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Figure 45: ENC_DEF_HP Pins Referenced Assignments

	Reserved	ENC_DEF_LP[7]	ENC_DEF_LP[6]	ENC_DEF_LP[5]	ENC_DEF_LP[4]	ENC_DEF_LP[3]	ENC_DEF_LP[2]	ENC_DEF_LP[1]
ENC_DEF_LP Pins Referenced	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Figure 46: ENC_DEF_LP Pins Referenced Assignments

The number of bits asserted in the bit fields defines the number of Signal Behavior Definitions that follow (see Table 46). For example, suppose Byte 3 of the Enclosure State Record has Bit 0 and Bit 3 set. Further suppose that Byte 4 has Bit 1 and Bit 5 set. The Enclosure LED State Record would include 4 Signal Behavior Definitions for the signals ENC_DEF_HP[1], ENC_DEF_HP[4], ENC_DEF_LP[2], and ENC_DEF_LP[6]. The sequence of the Signal Behavior Definitions is determined by a signal's location in the ENC_DEF_HP Signals Referenced field and ENC_DEF_LP Signals Referenced field. In the previous example, the order of Signal Behavior Definitions would be in the order of the definitions associated ENC_DEF_HP[1], ENC_DEF_HP[4], ENC_DEF_LP[2] and END_DEF_LP[6].

Each Signal Behavior Definition defines the state of a single ENC_DEF_HP[1:4] or ENC_DEF_LP[1:7] signal over a time range in units of 50ms. All Signal Behavior Definitions in an Enclosure LED State Record MUST [323] be synchronized with a common start time.

Table 46 shows the format of Signal Behavior Definitions. A Signal Behavior Definition consists of at least one Signal Behavior byte followed by a Signal Behavior Definition Termination byte. Figure 47 defines the format of the Signal Definition Behavior Bytes. The most significant bit (Bit 7) defines the signal level. If the bit is 'set', the canister MUST [324] drive the signal high. If the bit is 'cleared', the canister MUST [325] drive the signal low. Bits 0 thru 6 define the duration in units of 50ms that the canister should drive the signal level defined in Bit 7. The maximum number of 50ms units defined by Bits 0 through Bit 6 MUST [326] not exceed 126 (6.3 seconds).

The Signal Behavior Definition Termination Byte ends the Signal Behavior Definition. The Signal Behavior Definition Termination Byte MUST [327] have a value of 0x00 or 0xFF. If the byte is 0x00, the Signal Behavior Definition defines a periodic behavior for the signal whose period is the sum of all the 50ms units described by the Signal Behavior Bytes. If the byte is 0xFF, the Signal Behavior Definition defines a behavior that does not repeat once it has completed and the value asserted by the canister on the associated signal at the end of the pattern is the value indicated in Bit 7 of the last Signal Behavior Byte.

Table 46: Signal Behavior Definition

Byte	Descriptions
1	Signal Behavior Byte 1
2	Signal Behavior Byte 2 (optional)
…	…
j	Signal Behavior Byte j (optional)
j+1	Signal Behavior Definition Termination Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Signal Level	50ms Units (msb)	50ms Units	50ms Units	50ms Units	50ms Units	50ms Units	50ms Units (lsb)

Figure 47: Signal Definition Behavior Byte

5.2.6.1.1 ENC_DEF_HP Used as Enclosure LEDs - Example

This section gives an example of how the Enclosure LED State Records defined in the previous section can be used to describe the behaviors an enclosure requires an SBB canister to drive on the ENC_DEF_HP[1:4] signals. For this example, the enclosure maps sets of enclosure conditions to two ENC_DEF_HP signals. Suppose the enclosure provides two enclosure LEDs (LED1 and LED2) that can be driven by the SBB canister. The enclosure assigns ENC_DEF_HP[1] and ENC_DE_HP[2] to drive LED1 and LED2 respectively. Further suppose that the enclosure has three conditions that are to be represented by these LEDs (ONLINE, FAULT, and IDENTIFY). Table 48 describes the behavior the enclosure requires of the LEDs and thus the behavior of ENC_DEF_HP[1] and ENC_DEF_HP[2] driven by the SBB canister.

Table 47: Example of ENC_DEF_HP usage

Condition	LED1 Behavior	LED2 Behavior
Online, No Fault, No Identify	On	Off
Online, No Fault, Identify	Blink at 1 second intervals	Off
Offline, Fault, No Identify	Off	Blink at 500 millisecond intervals
Offline, Fault, Identify	Blink at 1 second Intervals	Blink at 500 millisecond intervals

Based on the information in Table 47, there will be four Enclosure LED Condition Records. The first condition record will describe the behaviors of ENC_DEF_HP[1] and ENC_DEF_HP[2] when the enclosure condition is Online, No Fault, No Identify. Table 48 shows the contents of this Enclosure LED Condition Record.

Table 48: Enclosure LED Condition Record 1 (Online, No Fault, No Identify)

Byte	Contents 7654-3210	Description
1	0000-0010	Enclosure State (Online, No Fault, No Identify)

2	0000-1000	Size in Bytes (8 bytes)
3	0000-0011	ENC_DEF_HP Signals Referenced (ENC_DEF_HP[1:2] are referenced)
4	0000-0000	ENC_DEF_LP Signals Referenced (ENC_DEF_LP[1:7] are not referenced)
5	1001-0100	ENC_DEF_HP[1] Signal Behavior Byte 1 (ENC_DEF_HP[1] is driven high for 1 second)
6	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)
7	0001-0100	ENC_DEF_HP[2] Signal Behavior Byte 1 (ENC_DEF_HP[2] is driven low for 1 second)
8	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)

Enclosure LED Condition Record 2 describes the behaviors of ENC_DEF_HP[1] and ENC_DEF_HP[2] when the enclosure condition is Online, No Fault, Identify. Table 49 shows the contents of the record.

Table 49: Enclosure LED Condition Record 2 (Online, No Fault, Identify)

Byte	Contents 7654-3210	Description
1	0000-1010	Enclosure State (Online, No Fault, Identify)
2	0000-1001	Size in Bytes (9 bytes)
3	0000-0011	ENC_DEF_HP Signals Referenced (ENC_DEF_HP[1:2] are referenced)
4	0000-0000	ENC_DEF_LP Signals Referenced (ENC_DEF_LP[1:7] are not referenced)
5	1001-0100	ENC_DEF_HP[1] Signal Behavior Byte 1 (ENC_DEF_HP[1] is driven high for 1 second)
6	0001-0100	ENC_DEF_HP[1] Signal Behavior Byte 2 (ENC_DEF_HP[1] is driven low for 1 second)
7	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)
8	0010-1000	ENC_DEF_HP[2] Signal Behavior Byte 1 (ENC_DEF_HP[2] is driven low for 2 second)
9	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)

Enclosure LED Condition Record 3 describes the behaviors of ENC_DEF_HP[1] and ENC_DEF_HP[2] when the enclosure condition is Offline, Fault, No Identify. Table 50 shows the contents of the record.

Table 50: Enclosure LED Condition Record 3 (Offline, Fault, No Identify)

Byte	Contents 7654-3210	Description
1	0000-0100	Enclosure State (Offline, Fault, No Identify)
2	0000-1001	Size in Bytes (9 bytes)
3	0000-0011	ENC_DEF_HP Signals Referenced (ENC_DEF_HP[1:2] are referenced)
4	0000-0000	ENC_DEF_LP Signals Referenced (ENC_DEF_LP[1:7] are not referenced)
5	0001-0100	ENC_DEF_HP[1] Signal Behavior Byte 1 (ENC_DEF_HP[1] is driven low for 1 second)
6	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)
7	1000-1010	ENC_DEF_HP[2] Signal Behavior Byte 1 (ENC_DEF_HP[2] is driven high for 500ms)
8	0000-1010	ENC_DEF_HP[2] Signal Behavior Byte 2 (ENC_DEF_HP[2] is driven low for 500ms)
9	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)

Enclosure LED Condition Record 4 describes the behaviors of ENC_DEF_HP[1] and ENC_DEF_HP[2] when the enclosure condition is Offline, Fault, Identify. Table 51 shows the contents of the record.

Table 51: Enclosure LED Condition Record 4 (Offline, Fault, Identify)

Byte	Contents 7654-3210	Description
1	0000-1100	Enclosure State (Offline, Fault, Identify)
2	0000-1100	Size in Bytes (12 bytes)
3	0000-0011	ENC_DEF_HP Signals Referenced (ENC_DEF_HP[1:2] are referenced)
4	0000-0000	ENC_DEF_LP Signals Referenced (ENC_DEF_LP[1:7] are not referenced)
5	1001-0100	ENC_DEF_HP[1] Signal Behavior Byte 1 (ENC_DEF_HP[1] is driven high for 1 second)
6	0001-0100	ENC_DEF_HP[1] Signal Behavior Byte 2 (ENC_DEF_HP[1] is driven low for 1 second)
7	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)
8	1000-1010	ENC_DEF_HP[2] Signal Behavior Byte 1 (ENC_DEF_HP[2] is driven high for 500ms)
9	0000-1010	ENC_DEF_HP[2] Signal Behavior Byte 2 (ENC_DEF_HP[2] is driven low for 500ms)
10	1000-1010	ENC_DEF_HP[2] Signal Behavior Byte 3 (ENC_DEF_HP[2] is driven high for 500ms)
11	0000-1010	ENC_DEF_HP[2] Signal Behavior Byte 4 (ENC_DEF_HP[2] is driven low for 500ms)
12	0000-0000	Signal Behavior Definition Termination Byte (Repeat the sequence)

5.3 Electrical Characteristics

5.3.1 High-Speed Signals

The SBB specification provides two types of high-speed differential signals, drive signals and inter-canister communication signals. Section 5.3.1.1 defines the requirements for differential signals used for communication between an SBB canister and drives. Section 5.3.1.2 defines the requirements for differential signals used for inter-canister communication.

All high-speed differential signals MUST [328] have a differential impedance of 100 ohms with +/- 15% tolerance.

5.3.1.1 High-Speed Drive Signals

The current high-speed drive signal profiles are SAS (3Gb/s and 6Gb/s) and Fibre Channel (2Gb/s and 4Gb/s). These drive signal interface requirements are defined in Appendix D and H (SAS) and Appendix E (FC). The High-speed drive signal requirements are specified by eye mask at the compliance points ITx and IRx. Figure 48 illustrates the positions of the compliance points ITx and IRx. Appendix A describes the method used to perform measurements at ITx and IRx using a zero length test load.

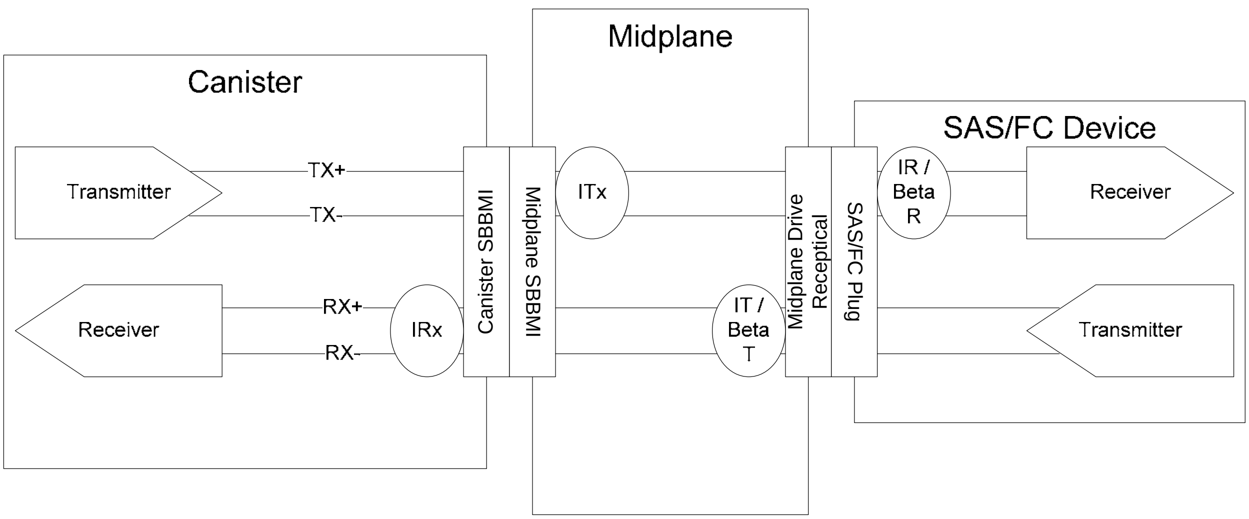


Figure 48: High-Speed Drive Signal Compliance Points

5.3.1.2 High-Speed Inter-Canister Signals

The current high-speed inter-canister signal profiles are SAS (3Gb/s and 6Gb/s), Fibre Channel (2Gb/s and 4Gb/s) and PCI Express (2.5Gb/s). These inter-canister signal interface requirements are defined in Appendix D, Appendix E, Appendix F, and H. The high-speed inter-canister signal eye mask requirements are 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 49 illustrates the positions of the compliance points ITy and IRy. Appendix A describes the method used to perform measurements at ITy and IRy using a zero length test load.

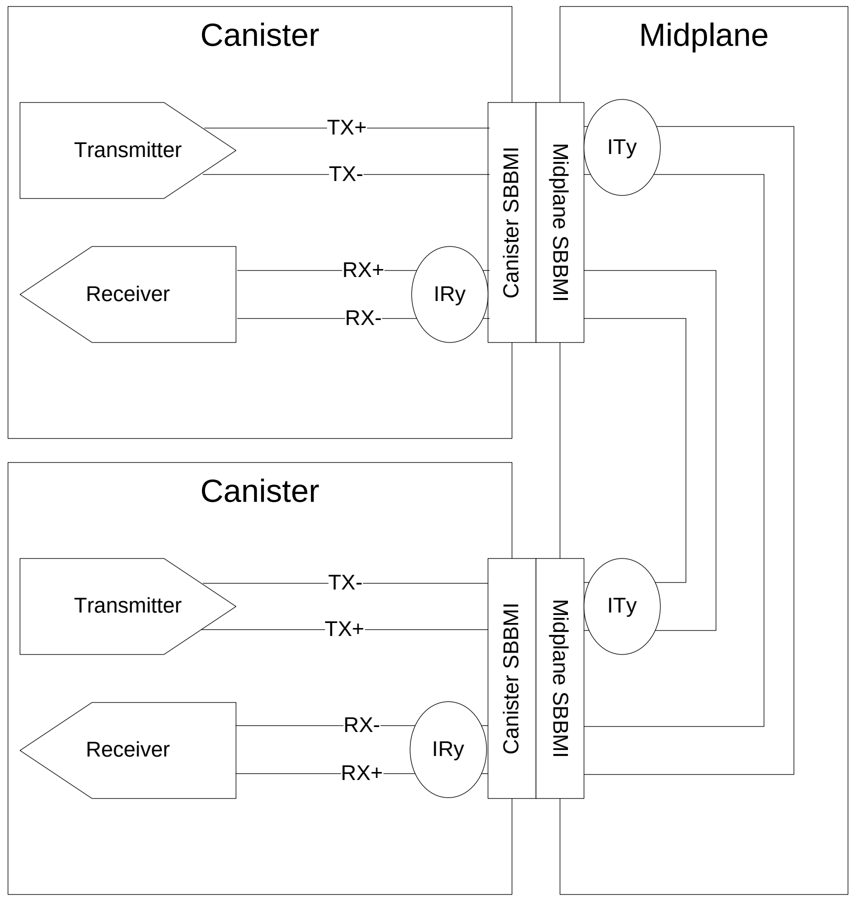


Figure 49: High-Speed Inter-Canister Signal Compliance Points

5.3.2 Low Speed Signals

Table 52 gives the characteristics and tolerances to which all low speed signals MUST [329] adhere.

Table 52 - 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		2.4	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_{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 Appendix D, Appendix E, and Appendix F for signal requirements

O_{dif} Differential Pair Output Signal

See Appendix D, Appendix E, and Appendix F for signal requirements

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

.

5.4 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 50. The following subsections describe the modules in more detail. Table 53 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 53 states that a module is required for the SBB canister, the SBBMI on the canister MUST [330] include the module. If Table 53 states that a module is required for the enclosure midplane, the SBBMI on the midplane MUST [331] include the module.

M13	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1

Figure 50: Modular Connector Designations

Table 53: Module Descriptions

Module Designation	Module Type	Description	Required Optional	
			Canister	Midplane
M1	Signal	High-speed inter-canister and enclosure support signals	Optional	Optional
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	High-speed inter-canister signals	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 – 30	Optional	Optional
M11	Signal	Support for drives 31 – 36	Optional	Optional
M12	Signal	Support for drives 37 – 42	Optional	Optional
M13	Signal	Support for drives 43 – 48	Optional	Optional

5.4.2 Drive Ports

Modules M2, M7, M8, M9, M10, M11, M12 and M13 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 48 inclusive.

Collectively a drive port for a drive with index “?” is designated Drive_Port_?. SBB canisters MUST [332] 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 [333] use drive ports starting from Drive_ Port _1 and increase 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 54 is the signal type legend for the tables in the following subsections. Detailed information on the individual signals is given in Section 5.2. The physical location of each modular connector is given in Figure 6.

Table 54: 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 comprised of signals used for communication between redundant SBB canisters as well as signals used for power supply monitoring and standby power. Table 55 gives the positions individual signals MUST [334] occupy in M1.

Table 55: Module M1 Pin-Outs

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

5.4.5 Module M2

M2 contains signals used to support one to six drives. Table 56 gives the positions individual signals MUST [335] occupy in M2.

Table 56: Module M2 Pin-Outs

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

5.4.6 Module M3

M3 contains signals used for communication between SBB canisters and general signals used for SBB canister support. Table 57 gives the positions individual signals MUST [336] occupy in M3.

Table 57: Module M3 Pin-Outs

Row \ Column	1	2	3	4	5	6
I	CARD_IO_TEST_L $_{LS}$	LS5_BA $_{LS}$	POWER_OFF_L $_{LS}$	LS3_BA $_{LS}$	TWI_BUS2_RST_L $_{LS}$	LS1_BA $_{LS}$
H	ENC_DEF_HP_4 $_{LS}$	LS5_AB $_{LS}$	LS4_BA $_{LS}$	LS3_AB $_{LS}$	LS2_BA $_{LS}$	LS1_AB $_{LS}$
G	SLOT ID $_{LS}$	GND$_{LG}$	LS4_AB $_{LS}$	GND$_{LG}$	LS2_AB $_{LS}$	GND$_{LG}$
F	GND$_{LG}$	PS2_SAALED_L $_{LS}$	GND$_{LG}$	SGPIO_SDI $_{LS}$	GND$_{LG}$	ENCLOSURE_INTR_L $_{LS}$
E	SDA2 $_{LS}$	PS1_SAALED_L $_{LS}$	SCL2 $_{LS}$	SGPIO_SDO $_{LS}$	TWI_BUS1_RST_L $_{LS}$	ENC_DEF_LP_1 $_{LS}$
D	PS2_ALERT_L $_{LS}$	LS7_BA $_{LS}$	SDA1 $_{LS}$	SGPIO_SCK $_{LS}$	ENC_DEF_LP_5 $_{LS}$	ENC_DEF_HP_3 $_{LS}$
C	PS2_PRES_L $_{LS}$	LS7_AB $_{LS}$	SCL1 $_{LS}$	SGPIO_SLOAD $_{LS}$	ENC_DEF_LP_4 $_{LS}$	ENC_DEF_HP_2 $_{LS}$
B	PS1_ALERT_L $_{LS}$	LS6_BA $_{LS}$	SDA0 $_{LS}$	ENC_DEF_LP_7 $_{LS}$	ENC_DEF_LP_3 $_{LS}$	ENC_DEF_HP_1 $_{LS}$
A	PS1_PRES_L $_{LS}$	LS6_AB $_{LS}$	SCL0 $_{LS}$	ENC_DEF_LP_6 $_{LS}$	ENC_DEF_LP_2 $_{LS}$	MATED_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 2.5.10.

5.4.8 Module M5

The M5 module usage is defined in the HS[9:17]_Usage field of the midplane VPD. If the HS[9:17]_Usage field indicates the “Inter-Canister Communication” usage, Table 58 gives the positions individual signals MUST [337] occupy in M5. If the HS[9:17]_Usage field indicates the “Fibre Channel Low-Speed Signals” usage, the definitions and positions of the individual signals in M5 are defined in Appendix E. If the HS[9:17]_Usage field indicates the “Vendor Specific” usage, the definition and position of signals within M5 are beyond the scope of this specification.

Table 58: Module M5 Pin-Outs for high speed inter-canister communication

Row \ Column	1	2	3	4	5	6
I	GND$_{RG}$	HS16_BA- $_{HS}$	GND$_{RG}$	HS17_AB- $_{HS}$	GND$_{RG}$	HS15_AB- $_{HS}$
H	HS17_BA- $_{HS}$	HS16_BA+ $_{HS}$	HS16_AB- $_{HS}$	HS17_AB+ $_{HS}$	HS15_BA- $_{HS}$	HS15_AB+ $_{HS}$
G	HS17_BA+ $_{HS}$	GND$_{LG}$	HS16_AB+ $_{HS}$	GND$_{LG}$	HS15_BA+ $_{HS}$	GND$_{LG}$
F	GND$_{LG}$	HS13_BA- $_{HS}$	GND$_{LG}$	HS11_BA- $_{HS}$	GND$_{LG}$	HS9_BA- $_{HS}$
E	HS14_BA- $_{HS}$	HS13_BA+ $_{HS}$	HS12_BA- $_{HS}$	HS11_BA+ $_{HS}$	HS10_BA- $_{HS}$	HS9_BA+ $_{HS}$
D	HS14_BA+ $_{HS}$	GND$_{RG}$	HS12_BA+ $_{HS}$	GND$_{RG}$	HS10_BA+ $_{HS}$	GND$_{RG}$
C	GND$_{RG}$	HS13_AB- $_{HS}$	GND$_{RG}$	HS11_AB- $_{HS}$	GND$_{RG}$	HS9_AB- $_{HS}$
B	HS14_AB- $_{HS}$	HS13_AB+ $_{HS}$	HS12_AB- $_{HS}$	HS11_AB+ $_{HS}$	HS10_AB- $_{HS}$	HS9_AB+ $_{HS}$
A	HS14_AB+ $_{HS}$	GND$_{RG}$	HS12_AB+ $_{HS}$	GND$_{RG}$	HS10_AB+ $_{HS}$	GND$_{RG}$

5.4.9 Module M6

M6 contains the power connections for the SBB canister. The requirements for the power module are defined in Section 2.5.9 and Section 3.

5.4.10 Module M7

M7 includes signals required to support drives seven through twelve. Table 59 gives the positions of individual signals in M7.

Table 59: Module M7 Pin-Outs

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

5.4.11 Module M8

M8 contains signals needed to support disks thirteen through eighteen. Table 60 gives the positions of individual signals in M8.

Table 60: Module M8 Pin-Outs

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

5.4.12 Module M9

M9 contains signals needed to support disks nineteen through twenty four. Table 61 gives the positions of individual signals in M9.

Table 61: Module M9 Pin-Outs

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

5.4.13 Module M10

M10 module contains signals needed to support disks twenty five through thirty. Table 62 gives positions of individual signals in M10. The FC signal profile described in Appendix E defines an alternate pin-out for M10.

Table 62: Module M10 Pin-Outs

Row	Column 1	2	3	4	5	6
I	GND$_{RG}$	DRIVE_29_TX- $_{HS}$	GND$_{RG}$	DRIVE_27_TX- $_{HS}$	GND$_{RG}$	DRIVE_25_TX- $_{HS}$
H	DRIVE_30_TX- $_{HS}$	DRIVE_29_TX+ $_{HS}$	DRIVE_28_TX- $_{HS}$	DRIVE_27_TX+ $_{HS}$	DRIVE_26_TX- $_{HS}$	DRIVE_25_TX+ $_{HS}$
G	DRIVE_30_TX+ $_{HS}$	GND$_{LG}$	DRIVE_28_TX+ $_{HS}$	GND$_{LG}$	DRIVE_26_TX+ $_{HS}$	GND$_{LG}$
F	GND$_{LG}$	DRIVE_29_RX- $_{HS}$	GND$_{LG}$	DRIVE_27_RX- $_{HS}$	GND$_{LG}$	DRIVE_25_RX- $_{HS}$
E	DRIVE_30_RX- $_{HS}$	DRIVE_29_RX+ $_{HS}$	DRIVE_28_RX- $_{HS}$	DRIVE_27_RX+ $_{HS}$	DRIVE_26_RX- $_{HS}$	DRIVE_25_RX+ $_{HS}$
D	DRIVE_30_RX+ $_{HS}$	GND$_{RG}$	DRIVE_28_RX+ $_{HS}$	GND$_{RG}$	DRIVE_26_RX+ $_{HS}$	GND$_{RG}$
C	DRIVE_30_INPL_L$_{LS}$	DRIVE_29_INPL_L$_{LS}$	DRIVE_28_INPL_L$_{LS}$	DRIVE_27_INPL_L$_{LS}$	DRIVE_26_INPL_L$_{LS}$	DRIVE_25_INPL_L$_{LS}$
B	DRIVE_30_GPO_L$_{LS}$	DRIVE_29_GPO_L$_{LS}$	DRIVE_28_GPO_L$_{LS}$	DRIVE_27_GPO_L$_{LS}$	DRIVE_26_GPO_L$_{LS}$	DRIVE_25_GPO_L$_{LS}$
A	DRIVE_30_FAULT_L$_{LS}$	DRIVE_29_FAULT_L$_{LS}$	DRIVE_28_FAULT_L$_{LS}$	DRIVE_27_FAULT_L$_{LS}$	DRIVE_26_FAULT_L$_{LS}$	DRIVE_25_FAULT_L$_{LS}$

5.4.14 Module M11

M11 contains signals needed to support disks thirty one through thirty six. Table 63 gives positions of individual signals in M11. The FC signal profile described in Appendix E defines an alternate pin-out for M11.

Table 63: Module M11 Pin-Outs

Row \ Column	1	2	3	4	5	6
I	GND_{RG}	DRIVE_35_TX- $_{HS}$	GND_{RG}	DRIVE_33_TX- $_{HS}$	GND_{RG}	DRIVE_31_TX- $_{HS}$
H	DRIVE_36_TX- $_{HS}$	DRIVE_35_TX+ $_{HS}$	DRIVE_34_TX- $_{HS}$	DRIVE_33_TX+ $_{HS}$	DRIVE_32_TX- $_{HS}$	DRIVE_31_TX+ $_{HS}$
G	DRIVE_36_TX+ $_{HS}$	GND_{LG}	DRIVE_34_TX+ $_{HS}$	GND_{LG}	DRIVE_32_TX+ $_{HS}$	GND_{LG}
F	GND_{LG}	DRIVE_35_RX- $_{HS}$	GND_{LG}	DRIVE_33_RX- $_{HS}$	GND_{LG}	DRIVE_31_RX- $_{HS}$
E	DRIVE_36_RX- $_{HS}$	DRIVE_35_RX+ $_{HS}$	DRIVE_34_RX- $_{HS}$	DRIVE_33_RX+ $_{HS}$	DRIVE_32_RX- $_{HS}$	DRIVE_31_RX+ $_{HS}$
D	DRIVE_36_RX+ $_{HS}$	GND_{RG}	DRIVE_34_RX+ $_{HS}$	GND_{RG}	DRIVE_32_RX+ $_{HS}$	GND_{RG}
C	DRIVE_36_INPL_L$_{LS}$	DRIVE_35_INPL_L$_{LS}$	DRIVE_34_INPL_L$_{LS}$	DRIVE_33_INPL_L$_{LS}$	DRIVE_32_INPL_L$_{LS}$	DRIVE_31_INPL_L$_{LS}$
B	DRIVE_36_GPO_L$_{LS}$	DRIVE_35_GPO_L$_{LS}$	DRIVE_34_GPO_L$_{LS}$	DRIVE_33_GPO_L$_{LS}$	DRIVE_32_GPO_L$_{LS}$	DRIVE_31_GPO_L$_{LS}$
A	DRIVE_36_FAULT_L$_{LS}$	DRIVE_35_FAULT_L$_{LS}$	DRIVE_34_FAULT_L$_{LS}$	DRIVE_33_FAULT_L$_{LS}$	DRIVE_32_FAULT_L$_{LS}$	DRIVE_31_FAULT_L$_{LS}$

5.4.15 Module M12

M12 contains signals needed to support disks thirty seven through forty two. Table 64 gives positions of individual signals in M12. The FC signal profile described in Appendix E defines an alternate pin-out for M12.

Table 64: Module M12 Pin-Outs

Row \ Column	1	2	3	4	5	6
I	GND_{RG}	DRIVE_41_TX- $_{HS}$	GND_{RG}	DRIVE_39_TX- $_{HS}$	GND_{RG}	DRIVE_37_TX- $_{HS}$
H	DRIVE_42_TX- $_{HS}$	DRIVE_41_TX+ $_{HS}$	DRIVE_40_TX- $_{HS}$	DRIVE_39_TX+ $_{HS}$	DRIVE_38_TX- $_{HS}$	DRIVE_37_TX+ $_{HS}$
G	DRIVE_42_TX+ $_{HS}$	GND_{LG}	DRIVE_40_TX+ $_{HS}$	GND_{LG}	DRIVE_38_TX+ $_{HS}$	GND_{LG}
F	GND_{LG}	DRIVE_41_RX- $_{HS}$	GND_{LG}	DRIVE_39_RX- $_{HS}$	GND_{LG}	DRIVE_37_RX- $_{HS}$
E	DRIVE_42_RX- $_{HS}$	DRIVE_41_RX+ $_{HS}$	DRIVE_40_RX- $_{HS}$	DRIVE_39_RX+ $_{HS}$	DRIVE_38_RX- $_{HS}$	DRIVE_37_RX+ $_{HS}$
D	DRIVE_42_RX+ $_{HS}$	GND_{RG}	DRIVE_40_RX+ $_{HS}$	GND_{RG}	DRIVE_38_RX+ $_{HS}$	GND_{RG}
C	DRIVE_42_INPL_L$_{LS}$	DRIVE_41_INPL_L$_{LS}$	DRIVE_40_INPL_L$_{LS}$	DRIVE_39_INPL_L$_{LS}$	DRIVE_38_INPL_L$_{LS}$	DRIVE_37_INPL_L$_{LS}$
B	DRIVE_42_GPO_L$_{LS}$	DRIVE_41_GPO_L$_{LS}$	DRIVE_40_GPO_L$_{LS}$	DRIVE_39_GPO_L$_{LS}$	DRIVE_38_GPO_L$_{LS}$	DRIVE_37_GPO_L$_{LS}$
A	DRIVE_42_FAULT_L$_{LS}$	DRIVE_41_FAULT_L$_{LS}$	DRIVE_40_FAULT_L$_{LS}$	DRIVE_39_FAULT_L$_{LS}$	DRIVE_38_FAULT_L$_{LS}$	DRIVE_37_FAULT_L$_{LS}$

5.4.16 Module M13

M13 contains signals needed to support disks forty three through forty eight. Table 65 gives positions of individual signals in M13. The FC signal profile described in Appendix E defines an alternate pin-out for M13.

Table 65: Module M13 Pin-Outs

Column

Row	1	2	3	4	5	6
I	GND_{RG}	DRIVE_47_TX- $_{HS}$	GND_{RG}	DRIVE_45_TX- $_{HS}$	GND_{RG}	DRIVE_43_TX- $_{HS}$
H	DRIVE_48_TX- $_{HS}$	DRIVE_47_TX+ $_{HS}$	DRIVE_46_TX- $_{HS}$	DRIVE_45_TX+ $_{HS}$	DRIVE_44_TX- $_{HS}$	DRIVE_43_TX+ $_{HS}$
G	DRIVE_48_TX+ $_{HS}$	GND_{LG}	DRIVE_46_TX+ $_{HS}$	GND_{LG}	DRIVE_44_TX+ $_{HS}$	GND_{LG}
F	GND_{LG}	DRIVE_47_RX- $_{HS}$	GND_{LG}	DRIVE_45_RX- $_{HS}$	GND_{LG}	DRIVE_43_RX- $_{HS}$
E	DRIVE_48_RX- $_{HS}$	DRIVE_47_RX+ $_{HS}$	DRIVE_46_RX- $_{HS}$	DRIVE_45_RX+ $_{HS}$	DRIVE_44_RX- $_{HS}$	DRIVE_43_RX+ $_{HS}$
D	DRIVE_48_RX+ $_{HS}$	GND_{RG}	DRIVE_46_RX+ $_{HS}$	GND_{RG}	DRIVE_44_RX+ $_{HS}$	GND_{RG}
C	DRIVE_48_INPL_L$_{LS}$	DRIVE_47_INPL_L$_{LS}$	DRIVE_46_INPL_L$_{LS}$	DRIVE_45_INPL_L$_{LS}$	DRIVE_44_INPL_L$_{LS}$	DRIVE_43_INPL_L$_{LS}$
B	DRIVE_48_GPO_L$_{LS}$	DRIVE_47_GPO_L$_{LS}$	DRIVE_46_GPO_L$_{LS}$	DRIVE_45_GPO_L$_{LS}$	DRIVE_44_GPO_L$_{LS}$	DRIVE_43_GPO_L$_{LS}$
A	DRIVE_48_FAULT_L$_{LS}$	DRIVE_47_FAULT_L$_{LS}$	DRIVE_46_FAULT_L$_{LS}$	DRIVE_45_FAULT_L$_{LS}$	DRIVE_44_FAULT_L$_{LS}$	DRIVE_43_FAULT_L$_{LS}$

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 for up to three TWI buses for enclosure management. Figure 51 illustrates these buses. The TWI buses MUST [338] adhere to requirements in *The I2C Bus Specification, Version 2.1, January 2000.* A midplane in an SBB enclosure that only has one SBB slot MUST [339] provide Bus 1 and Bus 2. A midplane in an SBB enclosure that has redundant SBB slots MUST [340] provide all three TWI buses. A midplane in an SBB enclosure with redundant SBB slots MUST [341] connect the TWI connections on both SBBMIs. Bus 0 is a private bus that MAY be used exclusively by the SBB canister implementations. An SBB compliant midplane and enclosure MUST [342] NOT 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. In enclosures with redundant SBB slots, canisters inserted into these slots MAY both be bus masters on Bus 1 and Bus 2. All TWI devices on the TWI buses MUST [343] be compatible with the bus arbitration requirements defined in *The I2C Bus Specification, Version 2.1, January 2000.* Only two management devices (VPD EEPROMs) are REQUIRED [344] 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 [345] be reserved for the midplane or enclosure. The remainder of the total capacitance MUST [346] be left to the SBB canisters. 80pF of the total capacitance of Bus 1 MUST [347] be reserved for each SBB canister used in the solution. 240pF of the total capacitance of Bus 1 MUST [348] be reserved for the midplane or enclosure. 80pf of the total capacitance of Bus 2 MUST [349] be reserved for each SBB canister used in the solution. 240pF of the total capacitance of Bus 2 MUST [350] be reserved for the midplane or enclosure. An SBB canister MUST [351] not disrupt any ongoing TWI bus transactions that may be occurring when the canister is hot-plugged into an SBB slot.

Table 66 and Table 67 show the address ranges on the TWI buses that are assigned to the different components of an SBB compliant solution. A device with a given address MUST [352] reside in or on the components for which its address is assigned in Table 66 and Table 67.

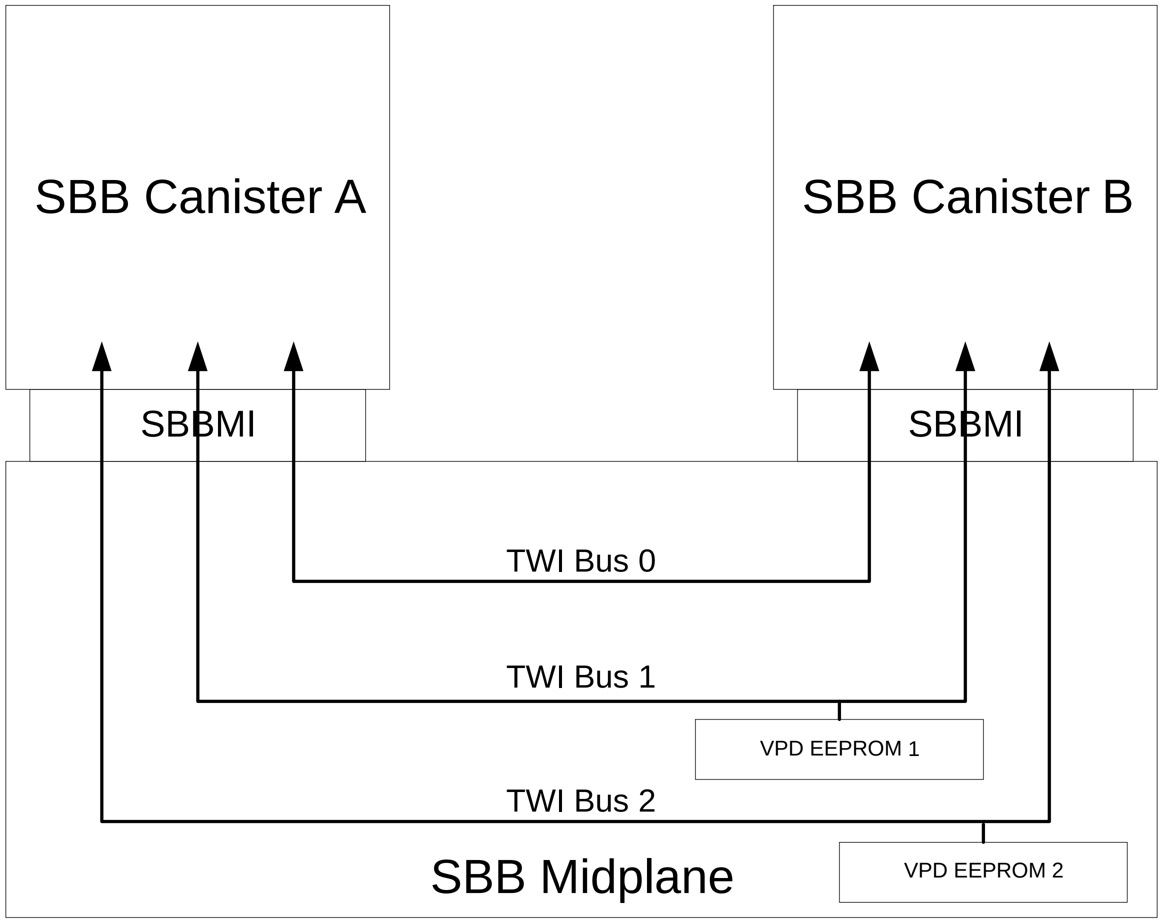


Figure 51: SBB TWI Buses

Table 66: Legend for TWI Address Range Assignments

Component	Description
C	Devices in this address range MUST [353] reside in either Canister A or Canister B.
CA	Devices in this address range MUST [354] reside in Canister A.
CB	Devices in this address range MUST [355] reside in Canister CB.
E	Devices in this address range MUST [356] reside in the Enclosure. Enclosure components include all components except SBB canisters or the midplane. Devices in this address range MUST NOT [357] reside in the SBB canisters or on the midplane.
M	Devices in this address range MUST [358] reside on the midplane.
R	This address range is reserved. Devices MUST NOT [359] have addresses within this range.

Table 67: TWI Address Range Assignments

Address Range	Bus	Component	Notes
00h:FFh	0	C	All devices on Bus 0 MUST [360] reside inside the SBB canisters
00h:11h	1 or 2	C	
12h:13h	1 or 2	M	
14h:15h	1 or 2	E	
16h:21h	1 or 2	C	
22h:27h	1 or 2	M	
28h:2Bh	1 or 2	C	
2Ch:2Fh	1 or 2	E	
30h:37h	1	M	
	2	E	
38h:3Bh	1 or 2	C	
3Ch:3Fh	1	E	
	2	M	
40h:45h	1 or 2	M	
46h:4Bh	1 or 2	C	
4Ch:4Fh	1 or 2	E	
50h:57h	1 or 2	M	
58h:59h	1 or 2	CA	
5Ah:5Bh	1 or 2	CB	
5Ch:5Fh	1 or 2	E	
60h:6Fh	1 or 2	R	Reserved
70h:77h	1 or 2	M	
78h:7Bh	1 or 2	C	
7Ch:7Fh	1 or 2	E	

Address Range	Bus	Component	Notes
80h:81h	1 or 2	CA	
82h:83h	1 or 2	CB	
84h:87h	1 or 2	M	
88h:8Bh	1 or 2	C	
8Ch:8Fh	1 or 2	E	
90h:91h	1 or 2	CA	
92h:93h	1 or 2	CB	
94h:97h	1 or 2	M	
98h:9Bh	1 or 2	C	
9Ch:9Fh	1 or 2	E	
A0h:A1h	1	CA	EEPROM device
	2	E	
A2h:A3h	1	CB	EEPROM device
	2	E	
A4h:A7h	1 or 2	M	SBB 1.0 VPD devices MUST [361] reside at this address on the SBB midplane
A8h:ABh	1	E	EEPROM device
	2	C	
ACh:ADh	1 or 2	M	SBB 2.0 VPD device MUST [362] reside at this address on the SBB midplane
AEh:AFh	1 or 2	E	EEPROM device
B0h:B3h	1	C	
	2	E	
B4h:C1h	1 or 2	E or M	
C2h:C3h	1 and 2	R	Reserved. SMBus 2.0 device default address
C4h:FFh	1 or 2	E or M	

6.2 Midplane Vital Product Data

The enclosure containing an SBB slot MUST [363] 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 are referred to as midplane VPDs but are NOT REQUIRED to physically reside on the enclosure midplane. However, they MUST [364] reside outside of the SBB canisters. VPD1 and VPD2 MUST [365] be 8192 bytes in size and addressable as EEPROMs. VPD1 MUST [366] be write/read accessible on TWI Bus 1 and have a write address of ACh and a read address of ADh (1010_110x, where x = R/W* bit). VPD2 MUST [367] be write/read accessible on TWI Bus 2 and have a write address of ACh and a read address of ADh (1010_110x, where x = R/W* bit). VPD1 and VPD2 MUST [368] be compatible with the Microchip® 24AA64/24LC64 families.

The VPDs are divided into three parts as shown in Figure 52. The first *m* bytes contain data defined in the *IPMI Platform Management FRU Information Storage Definition*, *v1.0, Document Revision 1.1, September 27, 1999* specification. The next *n* bytes contain data defined in the SBB specification. The remaining bytes are scratch areas that are writable by the SBB canisters. The information written to the scratch areas of the VPDs and the management of this information is controlled by the individual SBB canister implementations and is not defined in this specification. However, SBB canisters MUST [369] NOT write to the scratch area of a VPD until they have completed the Hot-Plug Sequence Algorithm and entered into State D or State E as described in Section 6.3.

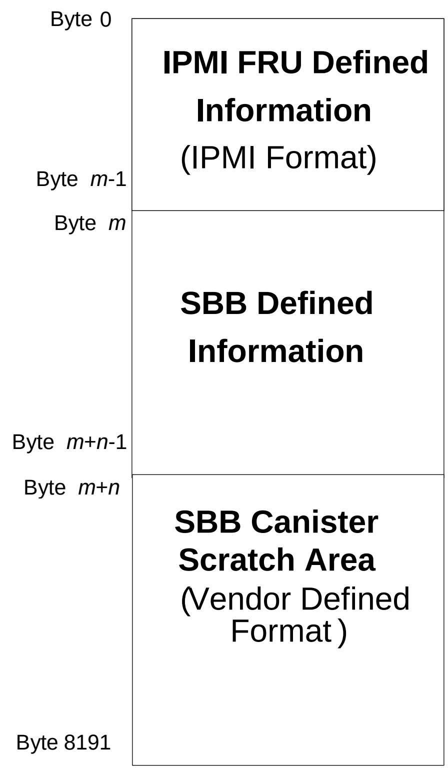


Figure 52: Midplane VPDs

The IPMI FRU Defined Information and SBB Defined Information of VPD1 and VPD2 MUST [370] have the mandatory data fields described in Table 70. The IPMI FRU Defined Information and SBB Defined Information of VPD1 and VPD2 are redundant and MUST [371] 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 IPMI FRU Defined Information of the VPDs MUST [372] adhere to *the IPMI Platform Management FRU Information Storage Definition*, *v1.0, Document Revision 1.1, September 27, 1999*[4]. The IPMI Defined Information and SBB Defined Information of the VPDs MAY be organized as described in Table 68. The SBB Defined Information of the VPDs MUST [373] start directly after the last byte of the IPMI FRU Defined Information. The SBB Canister Scratch Area of the VPDs MUST [374] start directly after the last byte of the SBB Defined Information.

Table 68: Vital Product Data Organization

Size	Name	Required/ Optional	Description
8	Common Header	Required	Offsets to other areas
Variable (0 Minimum)	Internal Use Area	Optional	This area MAY contain vendor specific information describing the SBB midplane.
Variable (0 Minimum)	Chassis Info Area	Optional	This area MAY contain chassis information.
Variable	Board Info Area	Required	This area MUST [375] be included in the VPDs. It contains information describing the SBB Midplane.
Variable (0 Minimum)	Product Info Area	Optional	This area is OPTIONAL. It MAY contain vendor specific product information.
Variable (0 Minimum)	MultiRecord Area	Optional	
Variable	SBB Defined Information Area	Required	This area MUST [376] be included in the VPDs. It contains SBB system configuration and compatibility information.
Variable (0 Minimum)	SBB Canister Scratch Area	Optional	This area MAY contain vendor specific SBB canister information.

Table 69: Legend for Vital Product Data Fields

Special Marker	Note
* in Field Length	This field MUST [377] be set in the SBB VPDs. Other fields required by the IPMI specification but not indicated by this marker MUST [378] 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 [379] be calculated as described by the *IPMI Platform Management FRU Information Storage Definition* and set by the SBB implementation or otherwise specified in the SBB specification.
Capital Letter (e.g. A, B, C, etc.)	The number of bytes used by this field is SBB implementation dependent.

[4] The IPMI Defined Information in the SBB VPD may only deviate from the *IPMI Platform Management FRU Information Storage Definition*, *v1.0, Document Revision 1.1* specification in two ways: 1) the SBB VPD must be compatible with the Microchip® 24AA64/24LC64 families; 2) The Common Header Area byte seven must contain a pointer to the SBB Defined Information Area.

Special Marker	Note
# in Field Length	This field is a two byte Type/Length field. The bit definitions are show below. See the *IPMI Platform Management FRU Information Storage Definition, Version 1.0, Revision 1.1* specification section 13 for type code descriptions. Bits Description 15:14 Type code. 13:12 Reserved. Set to 00b. 11:0 Number of data bytes. 000h indicates that the field is empty. When the type code is 11b a length of 001h indicates 'end of fields'. I.e. Type/Length# = C001h indicates 'end of fields'.
^ in Field Length	This field is a two byte Starting Offset field. The bit definitions are shown below. Bits Description 15:13 Reserved. Set to 000b. 12:0 EEPROM data address bits 12:0. Offset = field value.
Binary Format	The contents of the field are binary. If the field is more than one byte in length, the data MUST be stored little-endian (i.e., the LSB in the lowest address used by the field and the MSB in the highest address).
ASCII Format	The contents of the field are an ASCII string. If the field is more than one byte in length, the lowest memory location stores the left-most character, with progressing characters placed in each successive memory location. Example: if the specification revision number is "uv.wx.yz", then byte n+0 contains 'u', n+1 contains 'v', progressing to n+7 containing 'z'.

Table 70: 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 Use Area Starting Offset	1*	Binary	00h or ?	Offset represents EEPROM data address bits 10:3. Offset = field value*8.
	Chassis Info Area Starting Offset	1*	Binary	00h or ?	EEPROM data address bits 10:3. Offset = field value*8.
	Board Info Area Starting Offset	1*	Binary	?	EEPROM data address bits 10:3. Offset = field value*8.
	Product Info Area Starting Offset	1*	Binary	00h or ?	EEPROM data address bits 10:3. Offset = field value*8.
	Multi-Record Area Starting Offset	1*	Binary	00h or ?	EEPROM data address bits 10:3. Offset = field value*8.
	SBB Defined Info Area Starting Offset	1*	Binary	?	EEPROM data address bits 10:3. Offset = field value*8.
	Common Header Checksum	1*	Binary	?	Zero checksum

Area	Field Descriptor	Field Length (bytes)	Format	Content	Comment
Internal Use Area					Minimum 0 bytes
Chassis Info Area	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	A	Binary	?	
	Chassis Serial Number Type/Length	1*	Binary	?	
	Chassis Serial Number	B	Binary	?	
	Custom Chassis Info fields	C	Binary		Optional
	Terminator Field	1*	Binary	C1h	End of fields indicator
	Pad	D	Binary	00h	Any unused space to end of Chassis Info Area
	Chassis Info Area 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	E*	Binary	?	
	Board Product Name Type/Length	1*	Binary	?	
	Board Product Name	F*	?	?	Data type is language code specific
	Board Serial Number Type/Length	1*	Binary	?	
	Board Serial Number	G*	ASCII	?	

Area	Field Descriptor	Field Length (bytes)	Format	Content	Comment
	Board Part Number Type/Length	1*	Binary	?	
	Board Part Number	H*	?	?	Data type is language code specific
	FRU File ID Type/Length	1*	Binary	00h or ?	
	FRU File ID	I	Binary		
	Terminator Field	1*	Binary	C1h	End of fields indicator
	Pad	J	Binary	00h	Any unused space to end of Board Info Area
	Board Info Area Checksum	1*	Binary	?	Zero checksum
Product Info Area					Minimum 0 bytes
MultiRecord Area					Minimum 0 bytes
SBB Info Area / SBB Header Area	SBB Canister Identification Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB General Enclosure Characteristics Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB Venting Options Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB Power Characteristics Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB Slot A/Slot B Drive Port Mapping Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB Signal Usage Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	SBB SGPIO Usage Starting Offset	2*^	Binary	?	EEPROM data address bits 12:0. Offset = field value.
	Reserved	2*	Binary	0000h	Reserved
	Reserved	2*	Binary	0000h	Reserved
	Reserved	2*	Binary	0000h	Reserved
	Reserved	2*	Binary	0000h	Reserved

Area		Field Descriptor	Field Length (bytes)	Format	Content	Comment
		SBB Vendor Defined Data Starting Offset	2*^	Binary	0000h or ?	EEPROM data address bits 12:0. Offset = field value.
		SBB Canister Scratch Area Starting Offset	2*^	Binary	0000h or ?	EEPROM data address bits 12:0. Offset = field value.
		SBB Signature Type/Length	2*#	Binary	0004h	
		SBB Signature	4*	Binary	104A5100h	
		SBB Specification Revision type/length	2*#	Binary	C008h	
		SBB Specification Revision	8*	ASCII	xx.xx.xx	This current version of the specification is 02.01.00
		SBB Header Area Checksum	1*	Binary	?	Zero checksum
	ICID Area	Incumbent Canister ID (ICID)	24*	ASCII/ Binary	?	See Section 6.3
	ICID Area	Incumbent Canister ID Checksum	1*	Binary	?	Zero checksum
	SBB Gen Encl Area	SBB General Enclosure Characteristics type/length	2*#	Binary	0005h	
	SBB Gen Encl Area	Qualified Drive Interfaces	2*	Binary	0h - 0FFFh	See Section 5.2.1.1
	SBB Gen Encl Area	Qualified Inter-canister Communication Interfaces	2*	Binary	0h - 0FFFh	See Section 5.2.2.1
	SBB Gen Encl Area	Number of SBB Canister Slots	1*	Binary	1h - FFh	See Section 6.2.1
	SBB Gen Encl Area	SBB General Enclosure Area Checksum	1*	Binary	?	Zero checksum
	SBB Venting Options Area	SBB Venting Options Type/Length	2*#	Binary	0010h	
	SBB Venting Options Area	Vent Configuration 1, Impedance A (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 1, Impedance B (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 1, Impedance C (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 1, Impedance D (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 2, Impedance A (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 2, Impedance B (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 2, Impedance C (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 2, Impedance D (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 3, Impedance A (litres/s)	1*	Binary	0h - FFh	See Section 4.2
	SBB Venting Options Area	Vent Configuration 3, Impedance B (litres/s)	1*	Binary	0h - FFh	See Section 4.2

Area		Field Descriptor	Field Length (bytes)	Format	Content	Comment
		Vent Configuration 3, Impedance C (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		Vent Configuration 3, Impedance D (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		Vent Configuration 4, Impedance A (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		Vent Configuration 4, Impedance B (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		Vent Configuration 4, Impedance C (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		Vent Configuration 4, Impedance D (litres/s)	1*	Binary	0h - FFh	See Section 4.2
		SBB Venting Options Area Checksum	1*	Binary	?	Zero checksum
	SBB Power Characteristics Area	SBB Power Characteristics Type/Length	2*#	Binary	000Dh	
		SBB Slot A Max 12V Current (mA)/100	1*	Binary	32h – A7h	See Section 3
		SBB Slot B Max 12V Current (mA)/100	1*	Binary	32h – A7h	See Section 3
		Number of Power Supply Slots	1*	Binary	1h - FFh	See Section 3.6.4.1
		Max Simultaneous Drive spin up	1*	Binary	1h - 30h	See Section 6.2.3
		Reduced Power Max Simultaneous Drive spin up	1*	Binary	1h - 30h	See Section 6.2.4
		Power Supply VPD Address for power supply 1	2*	Binary	?	See Section 3.6.4.2
		Power Supply VPD Address for power supply 2	2*	Binary	?	See Section 3.6.4.2
		Power Supply 1 Control TWI Address	1*	Binary	00h - B2h	See Section 3.6.4
		Power Supply 1 Control TWI Bus (bits 7-4)	1*	Binary	0h - 3h	0: None 1: TWI Bus 1 2: TWI Bus 2 3: Both TWI Buss
		Power Supply 1 Control Protocol (bits 3-0)			0h - 3h	0: None 1: Vendor Specific 2: Pmbus 3: PSMI
		Power Supply 2 Control TWI Address	1*	Binary	00h - B2h	See Section 3.6.4
		Power Supply 2 Control TWI Bus (bits 7-4)	1*	Binary	0h - 3h	0: None 1: TWI Bus 1 2: TWI Bus 2 3: Both TWI Buss
		Power Supply 2 Control Protocol (bits 3-0)			0h - 4h	0: None 1: Vendor Specific 2: Pmbus 3: PSMI
		SBB Power Characteristics Area Checksum	1*	Binary	?	Zero checksum

Area		Field Descriptor	Field Length (bytes)	Format	Content	Comment
	SBB Drive Port Mapping Area	SBB Slot A Drive Port Mapping Table type/length	2*#	Binary	?	See Section 6.2.2
		SBB Slot A Drive Port Mapping Table	?*	Binary		See Section 6.2.2
		SBB Slot B Drive Port Mapping Table type/length	2*#	Binary	?	See Section 6.2.2
		SBB Slot B Drive Port Mapping Table	?	Binary		See Section 6.2.2
		SBB Drive Port Mapping Area Checksum	1*	Binary	?	Zero checksum
	SBB Signal Usage Area and LED Condition Records Area	SBB Signal Usage Type/Length	2*#	Binary	0011h	
		HS[9:17]_Usage (bits 7-4)	1*	Binary	0h - 3h	See Table 25
		Drive_GPO_L_Usage (bits 3-0)			0h - 5h	See Table 28
		Drive_Fault_L_Usage	1*	Binary	0h, 2h	See Table 27
		Drive_[1:40]_FLTDET_L_Usage (bits 7-4)	1*	Binary	0h, 2h	This field MUST [380] be set to 0h for enclosures that do not implement the signal profile described in Appendix E. For enclosures that implement the signal profile described in Appendix E, see Table 80.
		Drive_[1:40]_BYP_L_Usage (bits 3-0)			0h, 2h	This field MUST [381] be set to 0h for enclosures that do not implement the signal profile described in Appendix E. For enclosures that implement the signal profile described in Appendix E, see Table 81.
		AC_Good_L_Usage (bits 7-4)	1*	Binary	0h, 2h	See Table 11
		Power_Off_L_Usage (bits 3-0)			0h, 3h	See Table 12
		Enclosure_Intr_L_Usage (bits 7-4)	1*	Binary	0h – 3h	See Table 31
		PS[1:2]_LED_L_Usage (bits 3-0)			0h – 2h	See Table 40
		TWI_BUS[1:2]_RST_L_Usage	1*	Binary	0h – 2h	See Table 41
		ENC_DEF_LP[1]_Usage	1*	Binary	0h – 9h	See Table 43
		ENC_DEF_LP[2]_Usage	1*	Binary	0h – 9h	See Table 43
		ENC_DEF_LP[3]_Usage	1*	Binary	0h – 9h	See Table 43

Area		Field Descriptor		Field Length (bytes)	Format	Content	Comment
		ENC_DEF_LP[4]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_LP[5]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_LP[6]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_LP[7]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_HP[1]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_HP[2]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_HP[3]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_HP[4]_Usage		1*	Binary	0h – 9h	See Table 43
		ENC_DEF_HP Enclosure LED Condition Records Type/Length		2*#	Binary	?	The value of this field is the total number of bytes in all ENC_DEF_HP Enclosure LED Condition Records as defined by section 5.2.6.1
		ENC_DEF_HP Enclosure LED Condition Records		?	Binary	?	This field contains all the Enclosure LED Event Records. Defined by section 5.2.6.1
		Signal Usage and LED Condition Records Checksum		1*	Binary	?	Zero checksum
	SBB SGPIO Usage Area	SBB SGPIO Usage Type/length		2*#	Binary	0000h or ?	Length of 0000h may indicate not used.
		SGPIO_SLI_Usage (bits 7-4)		1*	Binary	0h – 2h	See Table 32
		SGPIO_SDO_Usage (bits 3-0)			Binary	0h – 2h	See Table 34
		SGPIO_SDI_Usage (bits 7-4)		1*	Binary	0h – 2h	See Table 36
		SGPIO_SCK_Usage (bits 3-0)			Binary	0h – 2h	See Table 38
		SLoad	L0	1*	Binary	0h – 6h	See Table 33
			L1	1*	Binary	0h – 6h	See Table 33
			L2	1*	Binary	0h – 6h	See Table 33
			L3	1*	Binary	0h – 6h	See Table 33
		Drive 1 Usage SDataOut	OD0.0	1*	Binary	0h – 6h	See Table 35
			OD0.1	1*	Binary	0h – 6h	See Table 35
			OD0.2	1*	Binary	0h – 6h	See Table 35

Area		Field Descriptor		Field Length (bytes)	Format	Content	Comment
		SDataIn	ID0.0	1*	Binary	0h – 5h	See Table 37
			ID0.1	1*	Binary	0h – 5h	See Table 37
			ID0.2	1*	Binary	0h – 5h	See Table 37
		Drive 2 Usage SDataOut	OD1.0	1*	Binary	0h – 6h	See Table 35
			OD1.1	1*	Binary	0h – 6h	See Table 35
			OD1.2	1*	Binary	0h – 6h	See Table 35
		SDataIn	ID1.0	1*	Binary	0h – 5h	See Table 37
			ID1.1	1*	Binary	0h – 5h	See Table 37
			ID1.2	1*	Binary	0h - 5h	See Table 37
		Repeating sequence					
		Drive n Usage SDataOut	OD(n-1).0	1*	Binary	0h – 6h	See Table 35
			OD(n-1).1	1*	Binary	0h – 6h	See Table 35
			OD(n-1).2	1*	Binary	0h - 6h	See Table 35
		SDataIn	ID(n-1).0	1*	Binary	0h - 5h	See Table 37
			ID(n-1).1	1*	Binary	0h – 5h	See Table 37
			ID(n-1).2	1*	Binary	0h – 5h	See Table 37
		SBB SGPIO Usage Area Checksum		1*	Binary	?	Zero checksum
	SBB Vendor Data Area	SBB Vendor Defined Data Area Type/length		2*^	Binary	0000h or ?	
		SBB Vendor Defined Data		K	?	?	
		SBB Vendor Defined Data Area Checksum		1*	Binary	?	Zero checksum
SBB Canister Scratch Area							Minimum 0 Bytes

6.2.1 Number of SBB Canister Slots

The Number_of_SBB_Canister_Slots field is a single byte field that identifies the number of SBB canister slots within the enclosure. This field MUST [382] contain the number of SBB canister slots in the enclosure. The SBB specification only includes requirements for a maximum of two canister slots (Slot A and Slot B). Enclosures that support more than two canisters may have additional vendor specific requirements. Vendor specific requirements for systems supporting more than two canister slots are beyond the scope of this specification.

6.2.2 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 A Drive Port Mapping Table MUST [383] be used by the SBB canister inserted into SBB Slot A. The Slot B Drive Port Mapping Table MUST [384] be used by the SBB canister inserted into SBB Slot B. If the enclosure does not have two SBB slots, the SBB canister inserted into the enclosure MUST [385] use the Slot A Drive Port Mapping Table and the Slot B Drive Port Mapping Table Type/Length field MUST [386] be set to 0000h.

The Drive Port Mapping Tables MUST [387] have an entry for each drive port on the SBBMI that is supported by the SBB enclosure. The Slot A Drive Port Mapping Table Type Length field MUST [388] be set to a value equal to the number of drives supported in the enclosure. The field descriptor in the Drive Port Mapping Table MUST [389] correspond to the similarly named SBBMI drive port. The Drive Port Mapping Table has a variable length. The length MUST [390] be equal to the maximum number of physical drives supported by the enclosure. The Drive Port Mapping Table MUST [391] 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 [392] 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 [393] correspond to the physical drive location in the enclosure to which the drive port is connected. Physical drive locations MUST [394] 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 [395] be between 0h and 2Fh inclusive.

For example, Table 71 shows drive port mapping table entries for an enclosure that supports 28 drives. The enclosure supports both SBB slots. The drive ports from Slot A are mapped to the physical drive locations in the enclosure in increasing order. The drive ports from Slot B are mapped to the physical drive location in the enclosure in decreasing order.

As another example, Table 72 shows drive port mapping table entries for an enclosure that supports 12 drives. The enclosure only supports one SBB slot so the Slot B Drive Port Mapping Table Type/Length field has an entry of 0000h. The SBB Slot A Drive Port Mapping Table Type/Length field has a value of 000Ch allowing 12 entries. The entries in the SBB Slot A 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 optimal routing of signals on the midplane.

Table 71: Example Port Mapping Tables for 28 Drives

Field Descriptor	Field Length (bytes)	Format	Content
SBB Slot A Drive Port Mapping Table Type/Length	2*	Binary	001Ch
Drive Port 1 Mapping	1*	Binary	0h
Drive Port 2 Mapping	1*	Binary	1h
Drive Port 3 Mapping	1*	Binary	2h

Field Descriptor	Field Length (bytes)	Format	Content
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
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 B Drive Port Mapping Table Type/Length	2*	Binary	001Ch
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

Field Descriptor	Field Length (bytes)	Format	Content
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 72: Example Port Mapping Tables for 12 Drives and 1 Slot

Field Descriptor	Field Length (bytes)	Format	Content
SBB Slot A Drive Port Mapping Table Type/Length	2*	Binary	000Ch
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
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 B Drive Port Mapping Table Type/Length	2*	Binary	0000h

6.2.3 Max Simultaneous Drive Spin Up

This field is used by SBB canisters to determine how many drives to spin up simultaneously during initial power up or after a low power state that had the drives spun down. The enclosure MUST [396] define in this field the maximum number of drives allowed to simultaneously be sent a command to spin up, when all enclosure power supplies are installed and active. The SBB canister MUST [397] insure that the number of drives sent a spin up command simultaneously does not exceed this number. The SBB canister SHOULD ensure a sufficient delay between sets of simultaneous spinup commands to not overload the power supplies in the enclosure or the system. A future revision of this specification will include a field to define the value, in seconds, for this delay.

The method for determining if all enclosure power supplies are installed and active is not defined in this specification. If a canister is unable to determine if all enclosure power supplies are installed and active the canister MUST [398] insure that the number of drives simultaneously sent the command to spin up does not exceed the number specified in the Reduced Power Max Simultaneous Drive Spin Up field. See Section 6.2.4 for a description of the Reduced Power Max Simultaneous Drive Spin Up field.

6.2.4 Reduced Power Max Simultaneous Drive Spin Up

This field is used by SBB canisters to determine how many drives to spin up simultaneously when the enclosure does not have all power supplies installed or active. The enclosure MUST [399] define in this field the maximum number of drives allowed to simultaneously be sent a command to spin up, when one or more enclosure power supplies are not installed or are not active. The SBB canister MUST [400] ensure that the number of drives sent a spin up command simultaneously does not exceed this number when one or more enclosure power supplies are not installed or are not active. The SBB canister SHOULD ensure a sufficient delay between sets of simultaneous spin up commands to not overload the power supplies in the enclosure or the system. A future revision of this specification will include a field to define the value, in seconds, for this delay.

The method for determining if all enclosure power supplies are installed and active is not defined in this specification. If a canister is unable to determine if all enclosure power supplies are installed and active the canister MUST [401] insure that the number of drives sent a spin up command simultaneously does not exceed the number specified in the Reduced Power Max Simultaneous Drive Spin Up field. If an enclosure can simultaneously spin up the same number of drives regardless of the number of power supplies installed and active then the Reduced Power Max Simultaneous Drive Spin Up field MUST [402] be set to the same value as the Max Simultaneous Drive Spin Up field.

6.2.5 Reading and Writing of VPDs

Throughout this specification, references are made to SBB canisters “reading” from VPD fields and “writing” to VPD fields. Because there are redundant VPDs and there are zero checksums covering different sections of the VPDs, SBB canisters writing to fields of VPDs must account for these features. When an SBB canister writes to a VPD field, the field and its associated zero checksum MUST [403] be updated in both VPDs. Furthermore, a canister SHOULD attempt to update the fields and zero checksums in both VPDs within 1 second of each other. It should be noted that due to the possibility of contention on the TWI buses, this time period cannot be guaranteed. The writes SHOULD be verified to insure the updates were completed correctly. It is up to the SBB canister implementation to determine how to handle updates that were not completed successfully. Furthermore, when performing read operations, SBB canisters SHOULD take advantage of the fact that there are multiple VPDs and zero checksums to detect errors in VPD fields or malfunctioning VPD EEPROMs.

6.3 Canister Power-On Requirements

The SBB 2.0 specification has defined the physical characteristics of the SBB canister (see Section 2). The benefits of adding a common canister design also bring some challenges. The common physical canister design means that mismatching canisters and enclosures is possible. The algorithm described in this section is designed to determine canister and enclosure compatibility and to avoid physical or logical damage when a mismatch occurs. This section defines the power-on requirements for all SBB canisters. These requirements are in the form of an algorithm that MUST [404] be followed by all SBB canisters. The goal is to ensure that:

a) valid data stored on disks is not corrupted when a canister is introduced into an enclosure that is incompatible with the canister that originally wrote the data;

b) incompatible canisters that are installed into the same enclosure do not cause physical electrical damage to either canister;

c) incompatible canisters that are installed into the same enclosure do not cause an unexpected loss of data availability to a host that was previously operating normally.

The intent is not to describe how SBB canisters will ensure complete interoperability, rather only the provisions to prevent loss of data and data availability. The specification limits the requirements to avoiding the physical and logical hazards mentioned above.

A typical SBB system implementation includes an enclosure, one or two canisters, and disk drives. When the system is powered on or a canister is hot plugged, the canister MUST [405] verify compatibility with the enclosure and the other canister to insure data integrity and data access continuity. If a canister is plugged into an enclosure that is incompatible with the last canister to operate in the enclosure, the new canister MUST [406] not corrupt data or interfere with normal operation.

6.3.1 Power-On Algorithm Overview

The power-on algorithm described in this section is designed to facilitate the following objectives:

- Power-on and resume normal operation without host/human intervention
- Transparent recovery from mis-plugging incompatible canisters
- Pair with redundant canister without host/human intervention
- Prevent interruption of service from incompatible canister (cold or hot-plugging)
- Prevent data corruption from incompatible canister (cold or hot plugging)

These objectives are accomplished by restricting what signals can be driven on the midplane until enclosure, incumbent canister and slot canister compatibility are established. Compatibility is established primarily through reading data from the midplane VPDs. See Table 70 for a list of the VPD data fields.

Compatibility is first established with the enclosure to verify sufficient power and cooling capacity and that the enclosure and canister support the same drive interface and inter-canister communication along with other system characteristics. Determining compatibility is accomplished through reading the data in the VPDs. Each SBB canister design uses its own criteria for determining compatibility with an enclosure.

An SBB canister then verifies its compatibility with the type of SBB canister that last successfully operated on data in the enclosure, known as the Incumbent Canister Type. A field in the VPDs identifies the Incumbent Canister Type.

Finally, each SBB canister determines its compatibility with the canister inserted in the alternate SBB slot (if present). If both canisters are compatible with the Incumbent Canister Type, a vendor specific method is used to pair the canisters to operate in shared mode for fail-over protection.

6.3.2 Midplane Signal Limitations During Power-On

During power-on, an SBB canister MUST [407] limit its interaction with the enclosure and alternate canister connections until proper enclosure and alternate canister identification is determined. Each SBBMI signal has limitations on when it can be driven by a canister if it is a canister output or when a canister may trust its level when it is a canister input. The limitations are described in Table 23, Table 24, Table 26, Table 29, Table 30, and Table 42. These tables indicate when it is allowable to drive an SBBMI canister output or trust an SBBMI canister input in relation to the states of the power-on sequence algorithm described in Figure 54.

6.3.3 Incumbent Canister ID (ICID)

The ICID field of the VPDs identifies the canister type that is authorized to operate in the enclosure. The ICID field MAY be initialized during enclosure manufacture or updated during the power-on algorithm as the result of user interaction. The value in the ICID field MUST [408] be comprised of the two subfields shown in Figure 53.

Byte 0 … Byte 7	Byte 8 … Byte 23
T10 Vendor ID (ASCII)	**Vendor Specific Binary Value (Binary)**

Figure 53: ICID Format

The first 8 bytes of the SBB canister ICID MUST [409] contain the T10 Vendor ID[5] in ASCII format. The next 16 bytes MUST [410] contain a vendor specific binary value.

6.3.4 Power-On Algorithm

Figure 54 shows the state diagram of the power-on algorithm. Table 73 describes the states in the diagram. Figure 55, Figure 56 and Figure 57 provide a flowchart describing the power-on algorithm.

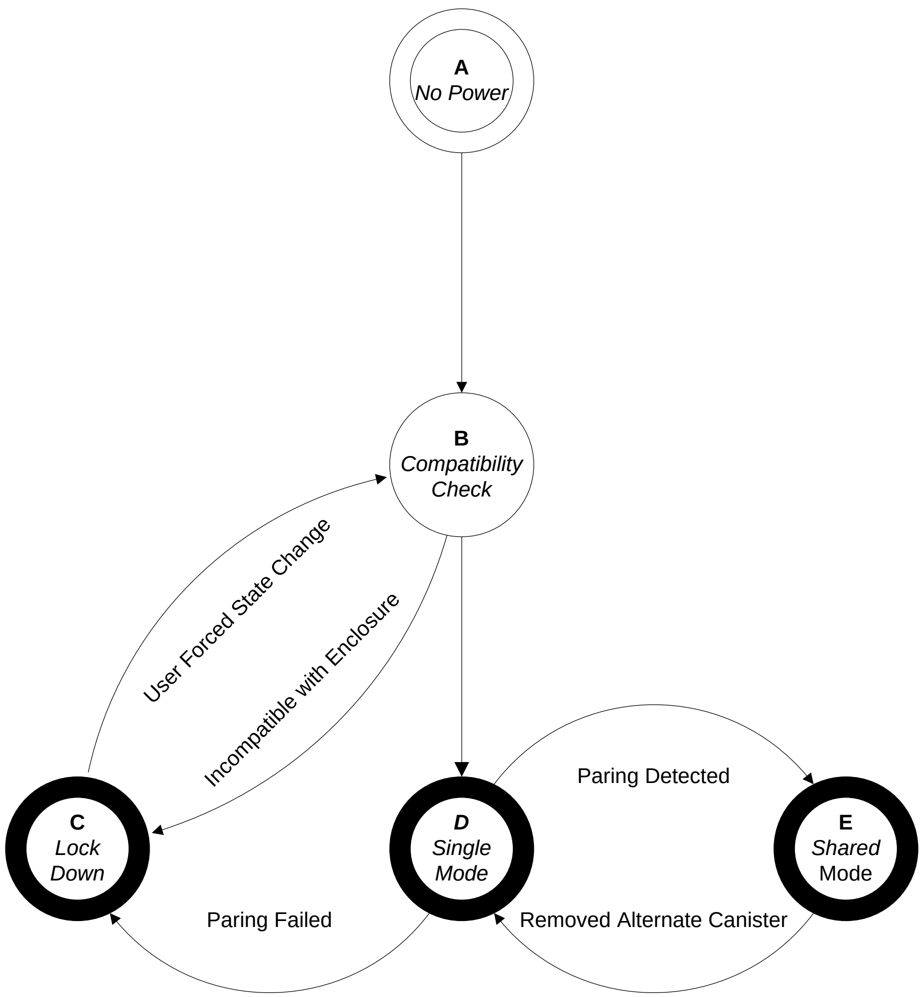


Figure 54: Power-On State Diagram

[5] Information about T10 Vendor IDs and information on obtaining a T10 Vendor ID can be found at the T10 website (www.t10.org).

Table 73: Power-On Algorithm States

State	Name	Description
A	No Power	The canister is not powered. Power is not present on any of the pins of the SBBMI power receptacle (see Section 3.1.1). Standby Power may be present (see Section 3.6.2).
B	Compatibility Check	The canister is checking compatibility with the enclosure. It is also determining if it is compatible with ICID recorded in the VPDs. This is a transient state.
C	Lock Down	The canister has determined that it is incompatible with the ICID or has failed pairing with the alternate canister. The canister MUST [411] not drive low or high speed midplane signals or high speed inter-canister signals. In effect, this canister must not interfere with the alternate canister, which may have determined itself authorized to run in State D *Single Mode*. A canister in the Locked down state is allowed to communicate on its external (host) connections.
D	Single Mode	The canister has determined it is compatible with the ICID but has not established compatibility with the alternate canister. The alternate canister is either not present or in State C *Lock Down*. In this state, the canister may drive the low speed inter-canister as necessary to implement a vendor specific paring detection algorithm but care must be taken by the single operating canister to not allow interruption of service in the event that the alternate canister is not compatible. This behavior must be maintained until alternate canister compatibility is determined. The high speed inter-canister signals MUST [412] not be driven. In this mode there should be a vendor specific method to detect an alternate canister has entered shared mode and transition to shared mode itself.
E	Shared Mode	The canister has determined that it is compatible with the ICID and the alternate canister. All low speed and high speed midplane and inter-canister signals may be driven and read as needed.

The flowcharts in Figure 55, Figure 56 and Figure 57 use the following convention. The canister performing the algorithm is designated SBB Canister *X* and is inserted in SBB Slot *X*. The alternate canister with respect to SBB Canister *X* is designated SBB Canister *Y* and is inserted in SBB Slot *Y*. For example, if the canister performing the algorithm is SBB Canister A, then in this instance *X* = A and *Y* = B.

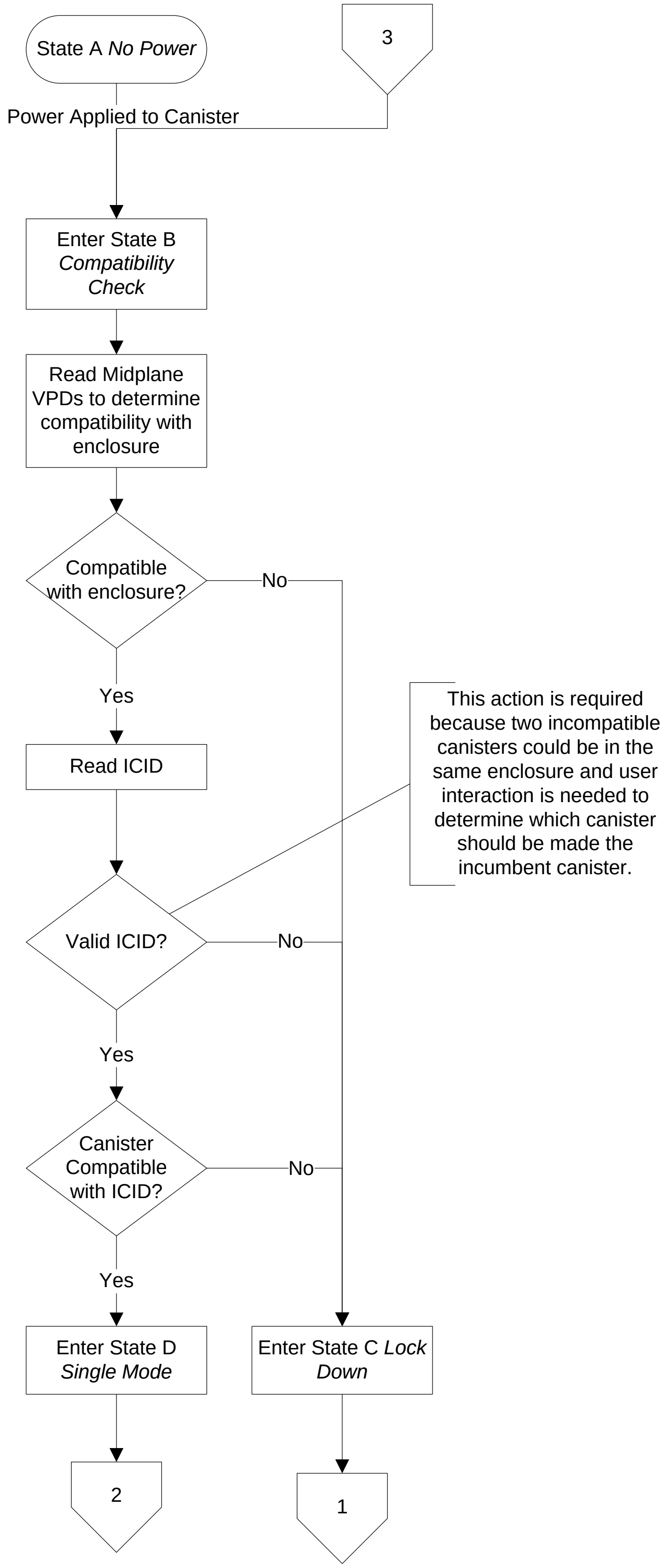


Figure 55: Power-On Algorithm Flowchart

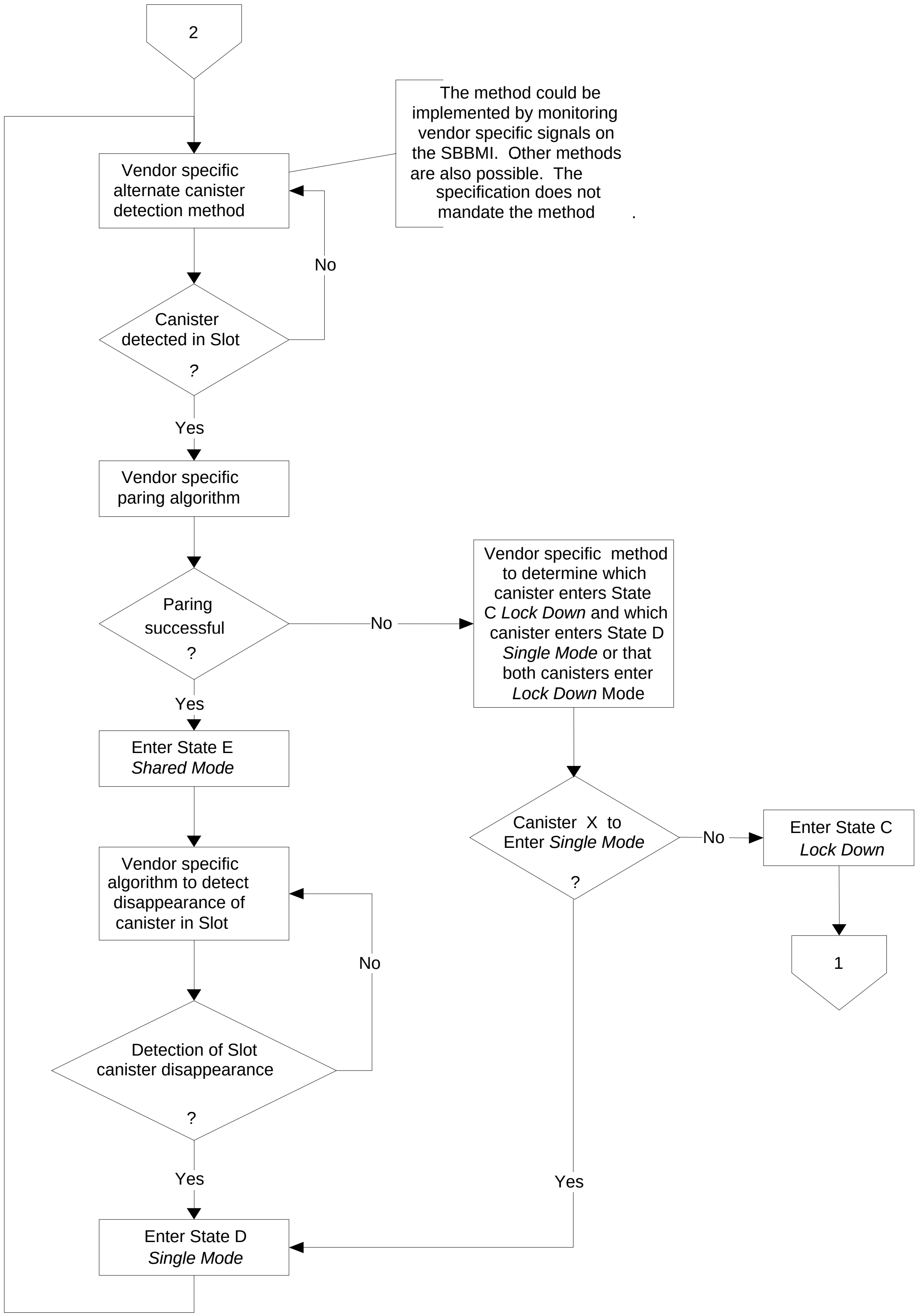


Figure 56: Power-On Algorithm Flowchart (cont.)

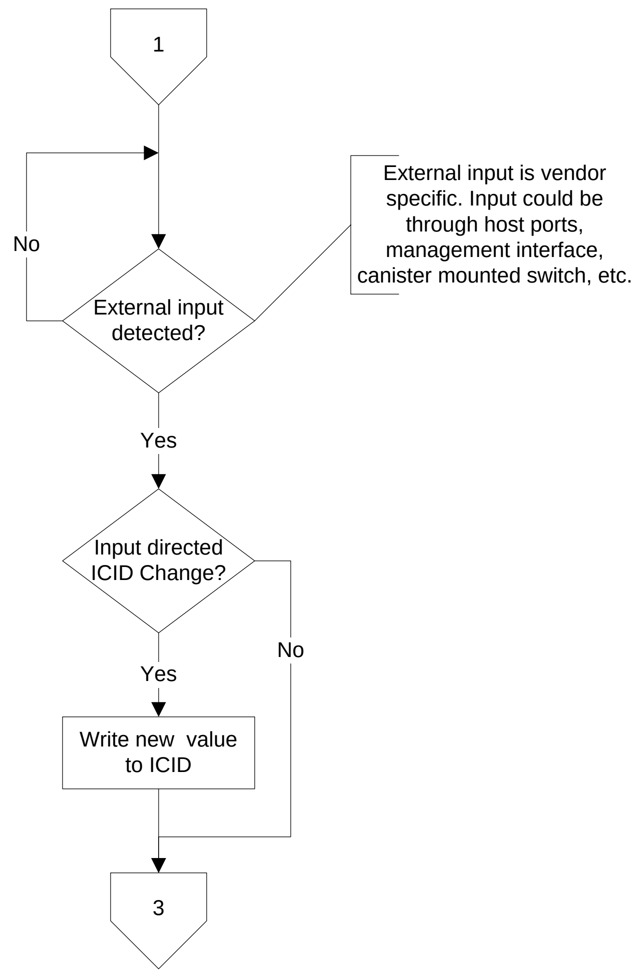


Figure 57: Power-On Algorithm Flowchart (cont.)

Appendix A 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 B. Measurement at the probe points in a test load approximate measurement at the compliance point at the SBBMI for the high-speed signals.

Table 74 describes the compliance points used by the SBB specification.

Table 74: 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 58 and Figure 59).
IRx	The transmitting signal to an SBB canister measured at the probe point in a test load attached to the SBBMI (See Figure 58 and Figure 60).
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 61 and Figure 62).
IRy	The transmitting signal to an SBB canister from another canister measured at the probe point in a test load attached to the SBBMI (Figure 61 and Figure 63).
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 Fibre Channel standard. The SBB places no requirements at this test point.
Beta R	Beta receive compliance point as per Fibre Channel standard. The SBB places no requirements at this test point.

Figure 58 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 B. 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 measuring 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.

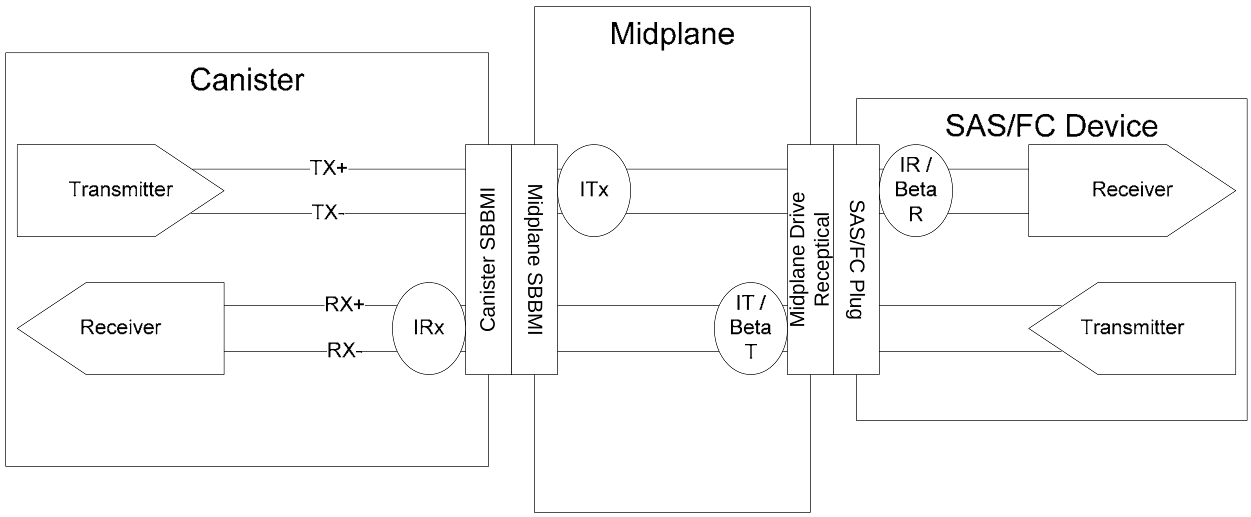


Figure 58: ITx and IRx Compliance Points

Figure 59 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.

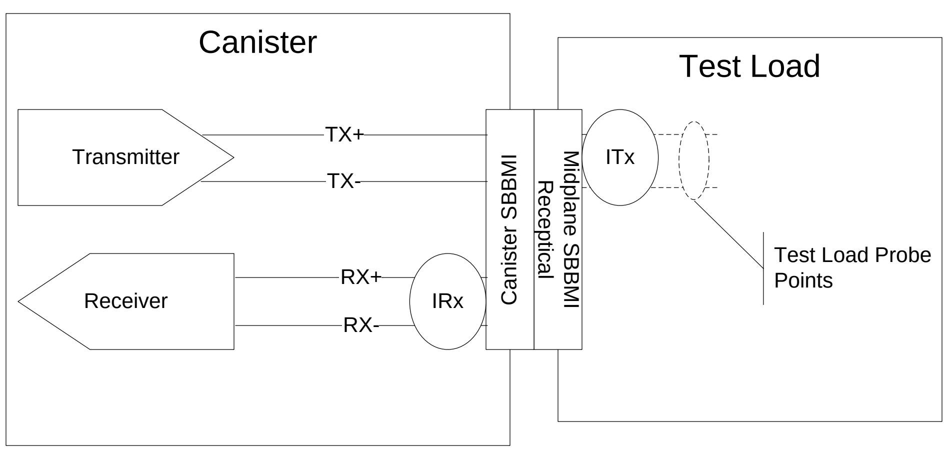


Figure 59: ITx Measurement

Figure 60 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.

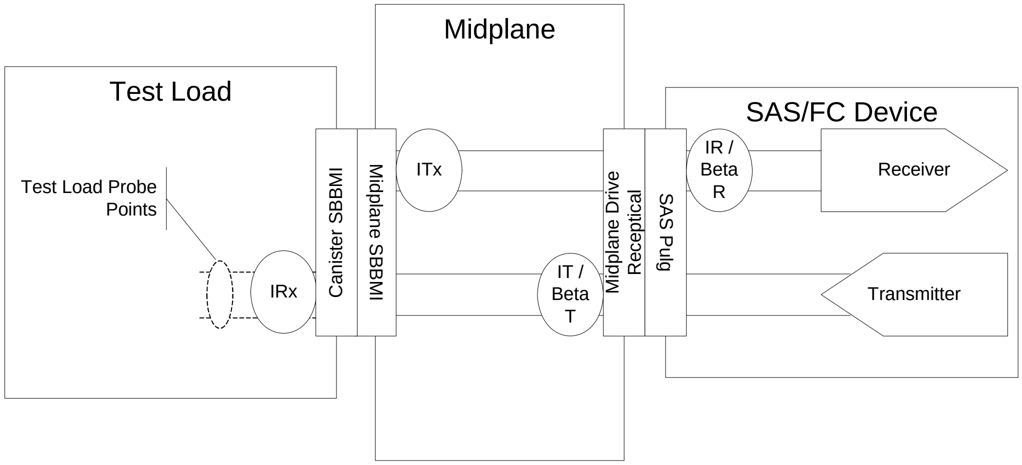


Figure 60: IRx Measurement

Figure 61 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 B). 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.

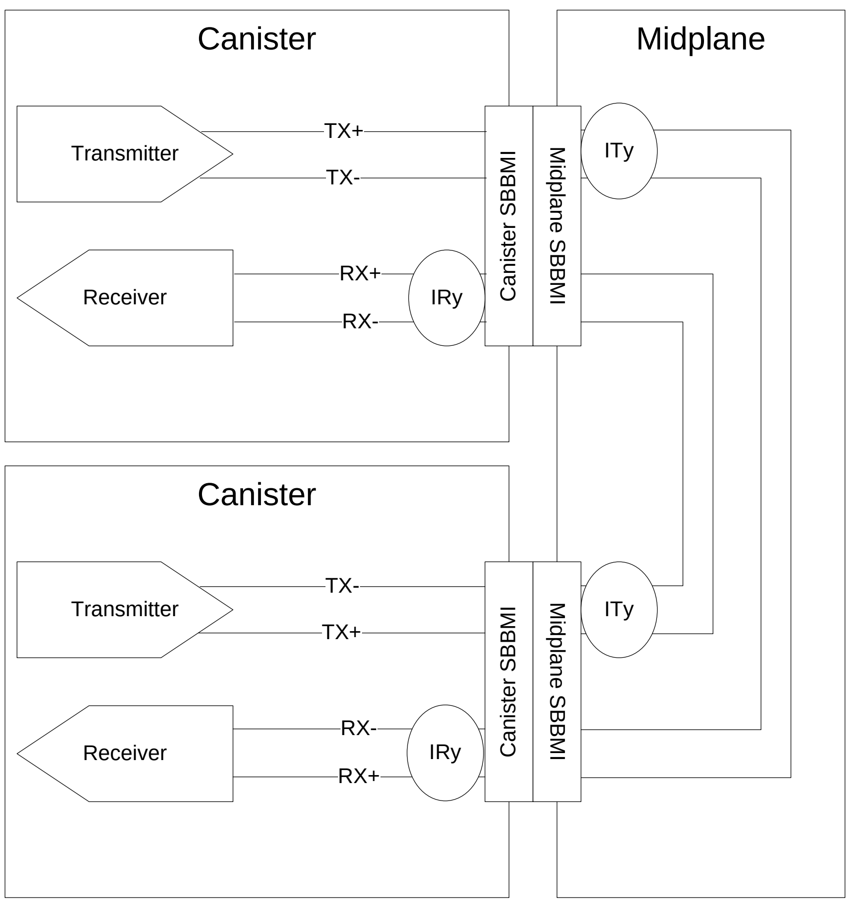


Figure 61: ITy and IRy Compliance Points

Figure 62 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.

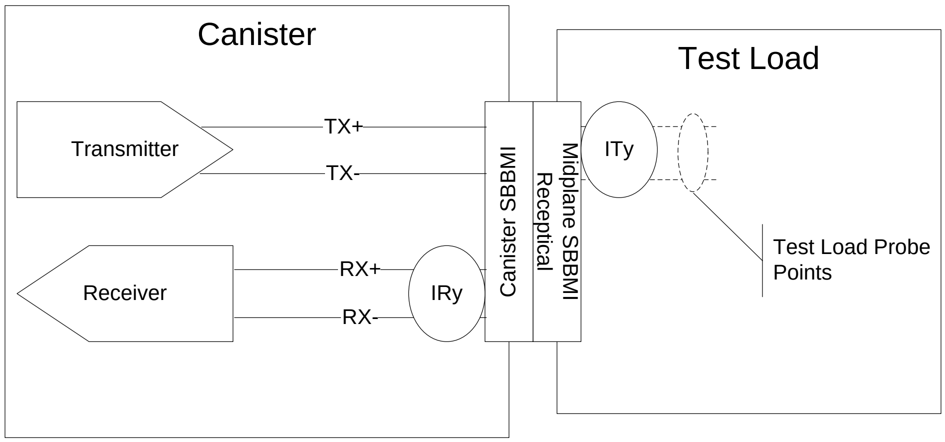


Figure 62: ITy Measurement

Figure 63 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.

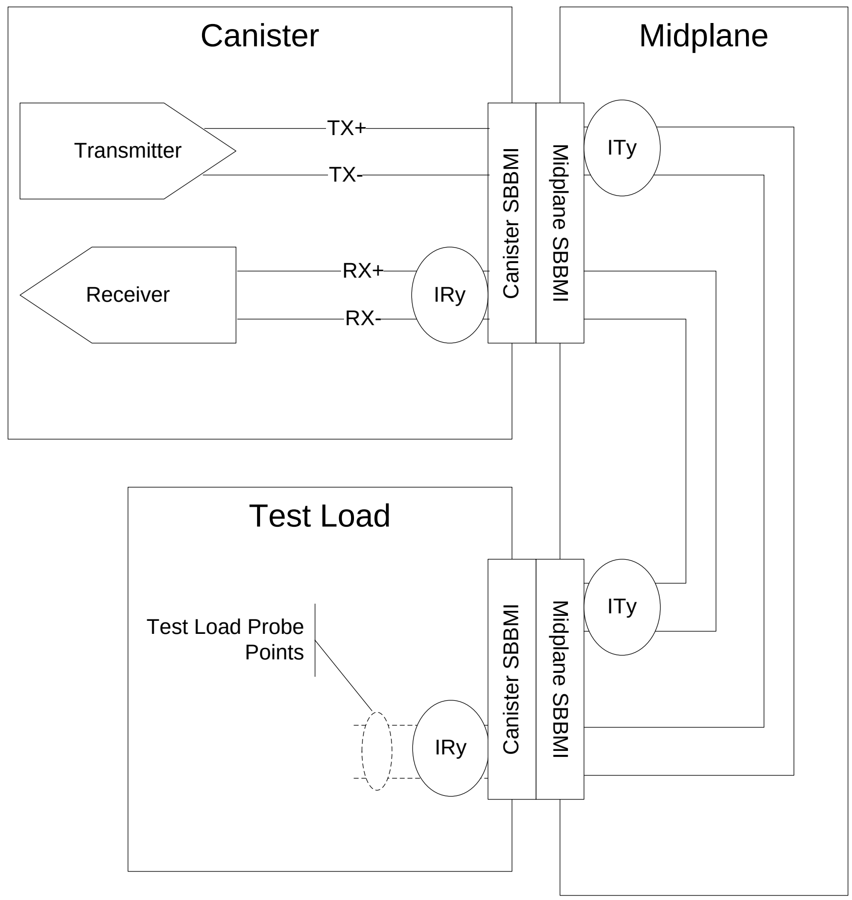


Figure 63: IRy Measurement

Appendix B SBB Canister 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 64 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).

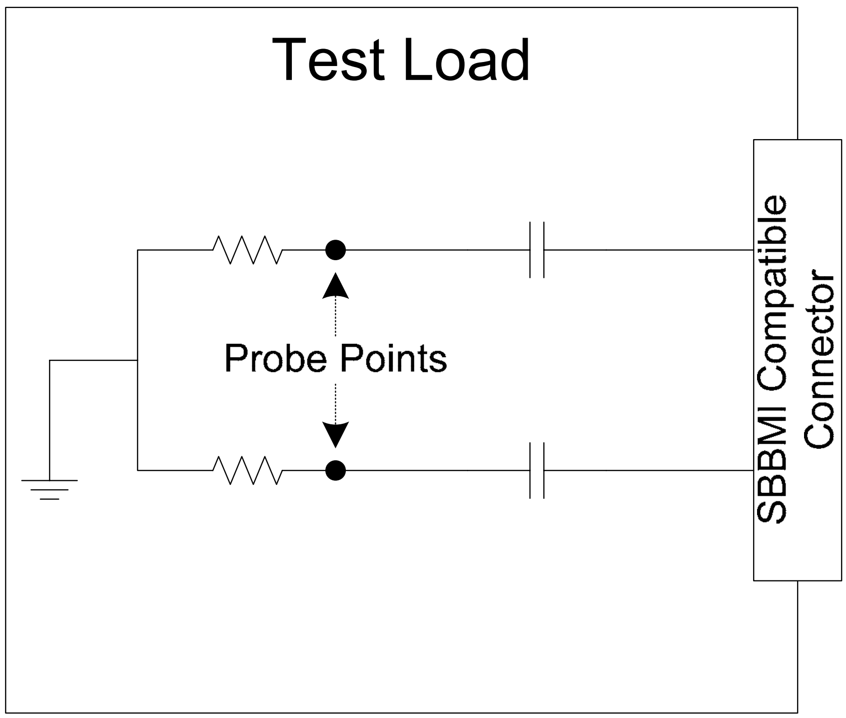


Figure 64: SBB Canister Test Load

Appendix C 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 the boundaries described by these technologies provided that such designs satisfy the signaling requirements described in one of the signal profiles (e.g., Appendix D, Appendix E, and Appendix F). Also, designs that fall within the boundaries described in this appendix are not guaranteed to satisfy the requirements of any of the signal profiles.

C.1 Channel Topologies

Figure 65 gives a legend for the topology diagrams used in the remainder of this appendix.

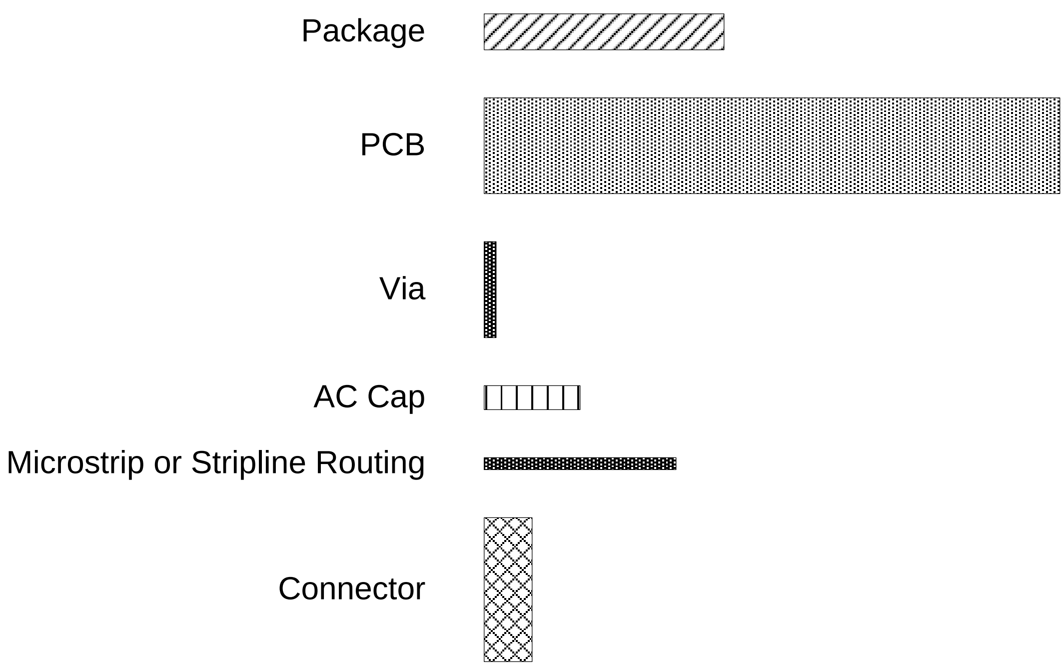


Figure 65: Topology Legend

Figure 66, Figure 67, and Figure 68 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).

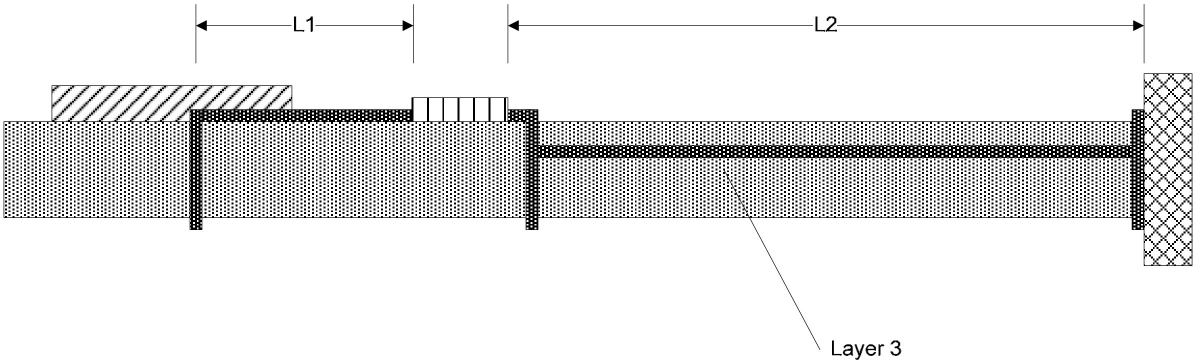


Figure 66: Canister Channel Topology

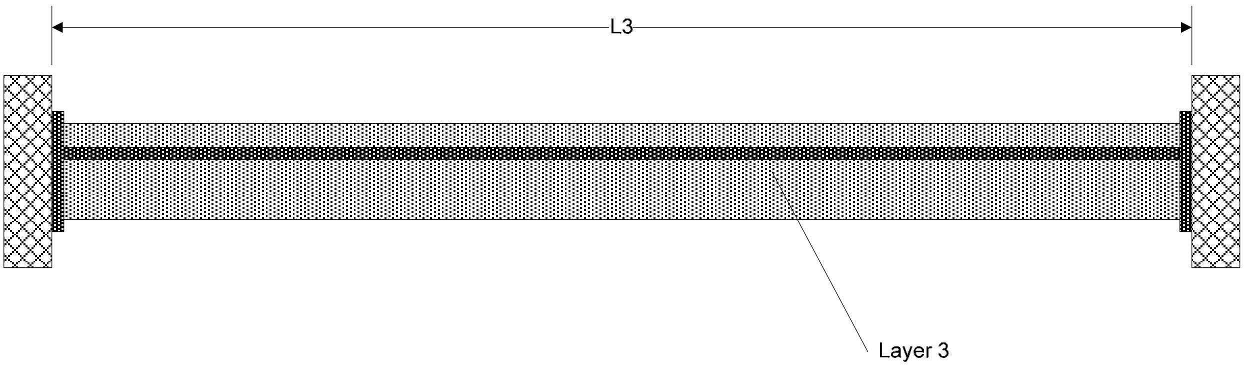


Figure 67: Midplane Channel Topology

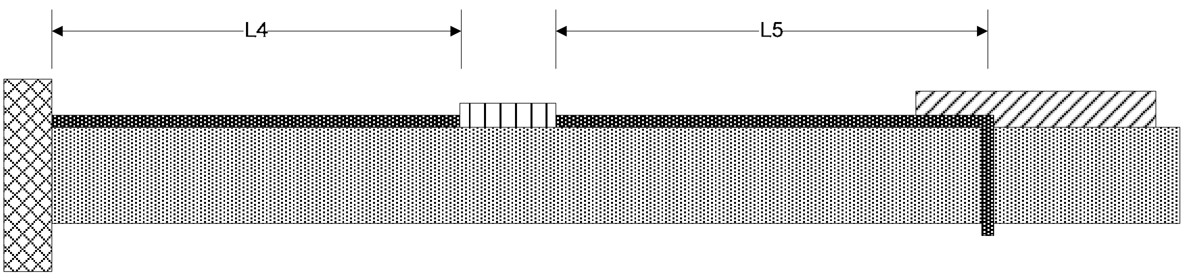


Figure 68: Hard Drive Channel Topology

C.1.1 Complete Canister to Drive Channel

Figure 69 shows the complete canister to drive channel topology used to develop the eye mask requirements at compliance points ITx and IRx. Table 75 gives the parameters for the canister to drive channel. 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.

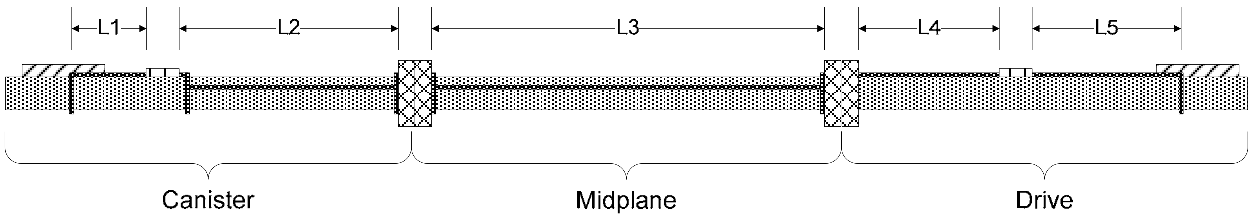


Figure 69: Canister to Drive Channel Topology

Table 75: Canister to Drive Channel Parameters

Parameter	Typical	Minimum	Maximum
Canister PCB Thickness (mm)	2.54	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 (mm)	3.30	N/A	NA
Midplane Layer Count	16	N/A	NA
L3(mm)	228	51	406
Midplane Vias	2	N/A	NA
HDD PCB Thickness (mm)	1.57	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

C.1.2 Complete Canister to Canister Topology

Figure 70 shows the complete canister to canister channel topology used to develop the eye mask requirements at the compliance points ITy and IRy. Table 76 gives the parameters for the canister to canister channel. 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.

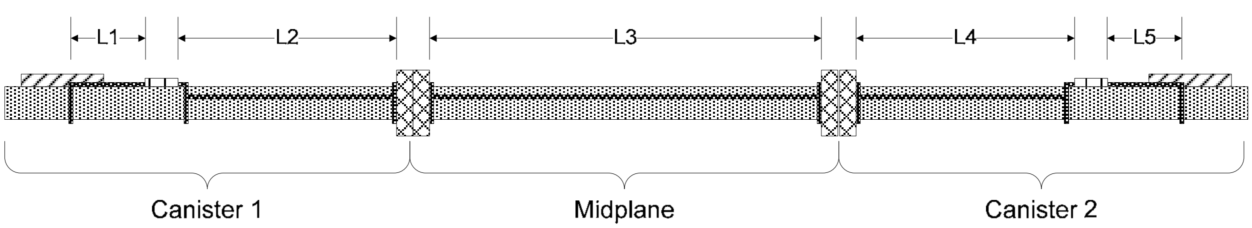


Figure 70: Complete Canister to Canister Topology

Table 76: 3Gb/s SAS, 6Gb/s SAS, 2Gb/s FC and 2.5Gb/s PCIe Canister to Canister Channel Parameters

Parameter	Typical	Minimum	Maximum
Canister 1 PCB Thickness (mm)	2.54	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 (mm)	3.30	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 (mm)	2.54	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 D 3Gb/s and 6Gb/s SAS 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 and 6Gb/s SAS Signal Profile. The requirements for the 3Gb/s and 6Gb/s SAS Signal Profile are defined within this appendix. Any SAS signaling parameters not specifically defined in this SBB 3Gb/s and 6Gb/s SAS signaling profile appendix must meet 3Gb/s or 6Gb/s SAS signaling requirements as defined in the *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)* specification.

D.1 Eye Masks

D.1.1 and D.1.2 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 frequency-weighting jitter transfer function. The frequency-weighting jitter transfer function is defined in *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)*. The eye masks for 6Gb/s SAS IRx and IRy compliance points also require the application of receiver equalization simulation. Receiver equalization requirements are defined in section D.1.1 Verification of compliance points with the limits represented by the transmitter eye mask should be done with traffic present on adjacent channels so that the effects of crosstalk are taken into account. The SAS compliance jitter tolerance pattern (CJTPAT) as defined in *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)* MUST [413] be used for measurements at SBB compliance points.

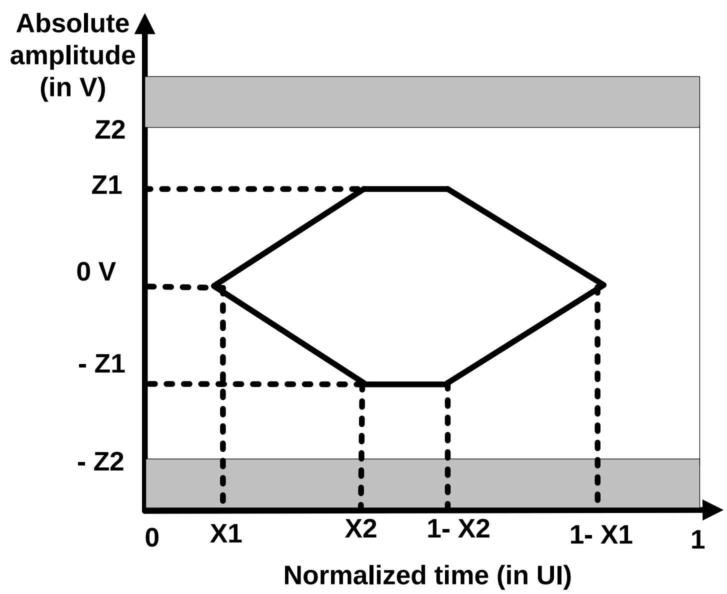


Figure 71: Eye Mask at Compliance Point

D.1.1 Receiver Equalization

6Gb/s SAS receivers apply equalization to improve recovered signal quality. The 6Gb/s SAS IRx and IRy eye masks defined in this appendix apply after the application of a three-tap decision feedback equalization (DFE) simulation with one unit interval per tap and infinite resolution. The DFE simulation should optimize the tap coefficients to maximize the eye opening. For more information on receiver equalization see *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)* specification section 5.7.5.7.3 *Reference receiver device characteristics*.

D.1.2 High-Speed Drive Signals

This section defines the high-speed drive signal eye mask requirements for the 3Gb/s and 6Gb/s SAS Signal Profile. These requirements MUST [414] be satisfied for all 3Gb/s and 6Gb/s SAS (as defined in *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)*) signals that drive any of the high-speed differential drive interfaces (DRIVE_[1:48]_RX+, DRIVE_[1:48]_RX-, DRIVE_[1:48]_TX+, DRIVE_[1:48]_TX-). The eye mask requirements are specified at the compliance points ITx and IRx. Figure 72 illustrates the positions of the compliance points ITx and IRx. Appendix A describes the method used to perform measurements at ITx and IRx using a zero length test load. D.1.1 describes receiver equalization to be applied to the 6Gb/s SAS waveforms measured at ITx and IRx compliance points.

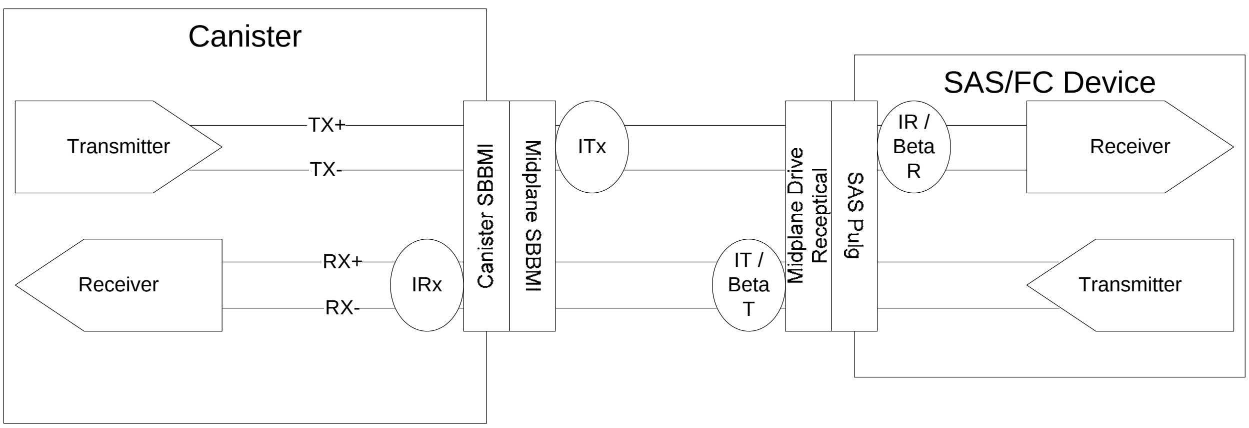


Figure 72: High-Speed Drive Signal Compliance Points

The signal eye opening measured with a test load at ITx MUST [415] equal or exceed the eye mask opening defined in Table 77. The SBB canister MUST [416] be capable of operating with a signal eye opening as small as the opening defined in Table 77 when measured with a test load at IRx.

Table 77: Eye Mask Characteristics for ITx and IRx

Eye Mask Characteristic	3Gb/s SAS		6Gb/s SAS		Unit
	ITx	IRx	ITx	IRx	
Z1	237.5	150	181	92.5	mV
Z2	800	800	600	600	mV
X1	0.260	0.250	0.17	0.195	UI
X2	0.475	0.475	0.50	0.50	UI

D.1.3 High-Speed Inter-Canister Signals

This section defines the high-speed inter-canister signal eye mask requirements for the 3Gb/s and 6Gb/s SAS Signal Profile. The 3Gb/s and 6Gb/s SAS Signal Profile allows 3Gb/s and 6Gb/s SAS (as defined in *ANSI INCITS 457-2010 Information Technology – Serial Attached SCSI-2 (SAS-2)*) to be used for any of the high-speed differential inter-canister communication signals (HS[1:17]_AB+, HS[1:17]_AB-, HS[1:17]_BA+, HS[1:17]_BA-).

High-speed inter-canister signal eye mask requirements are specified at the compliance points ITy and IRy. Figure 73 illustrates the positions of the compliance points ITy and IRy. Appendix A describes the method used to perform measurements at ITy and IRy using a zero length test load. D.1.1 describes receiver equalization to be applied to 6Gb/s SAS waveforms measured at the IRy compliance point.

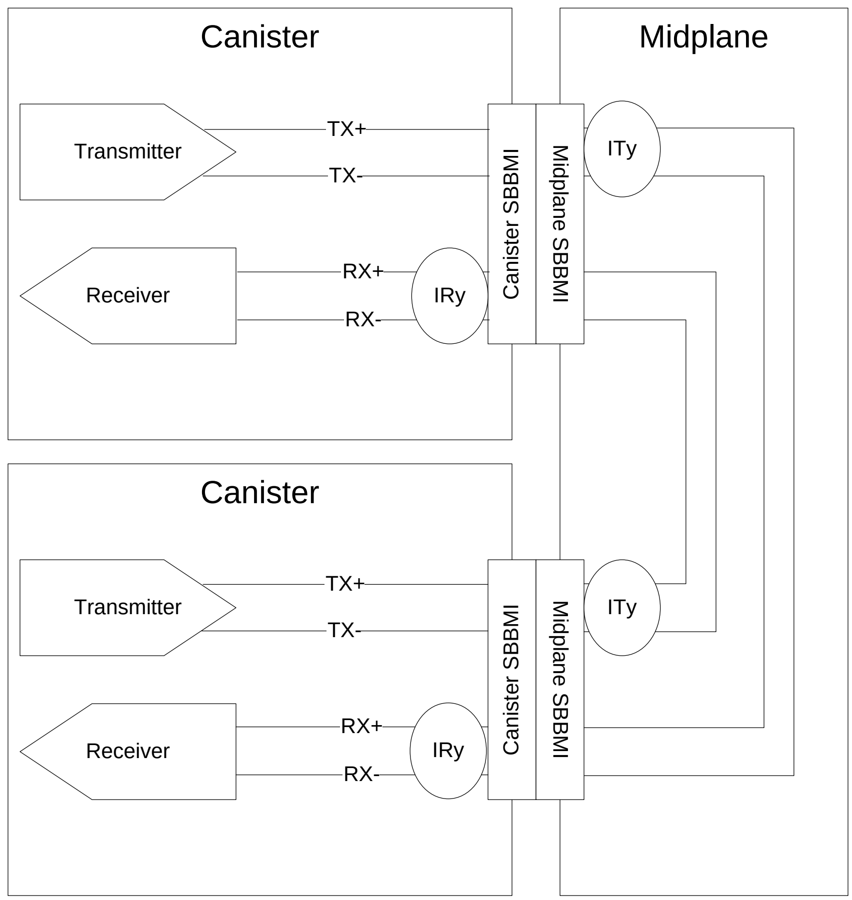


Figure 73: High-Speed Inter-Canister Signal Compliance Points

If an SBB canister uses 3Gb/s or 6Gb/s SAS for inter-canister communication, then the signal eye opening measured with a test load at ITy MUST [417] equal or exceed the opening defined in Table 78. The SBB canister MUST [418] be capable of operating with a signal eye opening as small as the opening defined in Table 78 when measured with a test load at IRy.

Table 78: Eye Mask Characteristics for ITy and IRy

Eye Mask Characteristic	3Gb/s SAS		6Gb/s SAS		Unit
	ITy	IRy	ITy	IRy	
Z1	250	150	181	92.5	mV
Z2	800	800	600	600	mV
X1	0.225	0.250	0.17	0.215	UI
X2	0.45	0.475	0.50	0.50	UI

Appendix E 2Gb/s and 4Gb/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 and 6Gb/s SAS Signal Profile. The requirements for the 3Gb/s and 6Gb/s SAS Signal Profile are defined within Appendix D. This appendix defines the requirements for 2Gb/s and 4Gb/s Fibre Channel Signal Profile when they differ from the requirements of the nominal signal profile.

E.1 SBBMI Guide Module

For the 2Gb/s and 4Gb/s Fibre Channel Signal Profile, the requirements of this section replace the requirements of Section 2.5.10.

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 E.1.1 and E.1.2 define the guide module requirements for the 2Gb/s and 4Gb/s FC Signal Profile.

E.1.1 SBBMI Canister Guide Pin Receptacle

The SBBMI canister guide pin receptacle is described in Figure 74. 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 [419] adhere to the dimensions of Figure 74. All dimensions of the guide pin receptacle external to the SBB canister envelope dimensions, regardless of where the PCB is mounted, MUST [420] exactly match the dimensions outside the SBB canister envelope dimensions of the receptacle shown in Figure 74. The ESD contact on the guide pin receptacle is OPTIONAL.

Figure 75 gives a RECOMMENDED layout for a PCB mounted at reference plane A1 using the right-angle receptacle described in Figure 74. 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 guide pin MUST [421] remain fixed to the canister constraints described in Figure 5 and SBBMI module locations described in Figure 6.

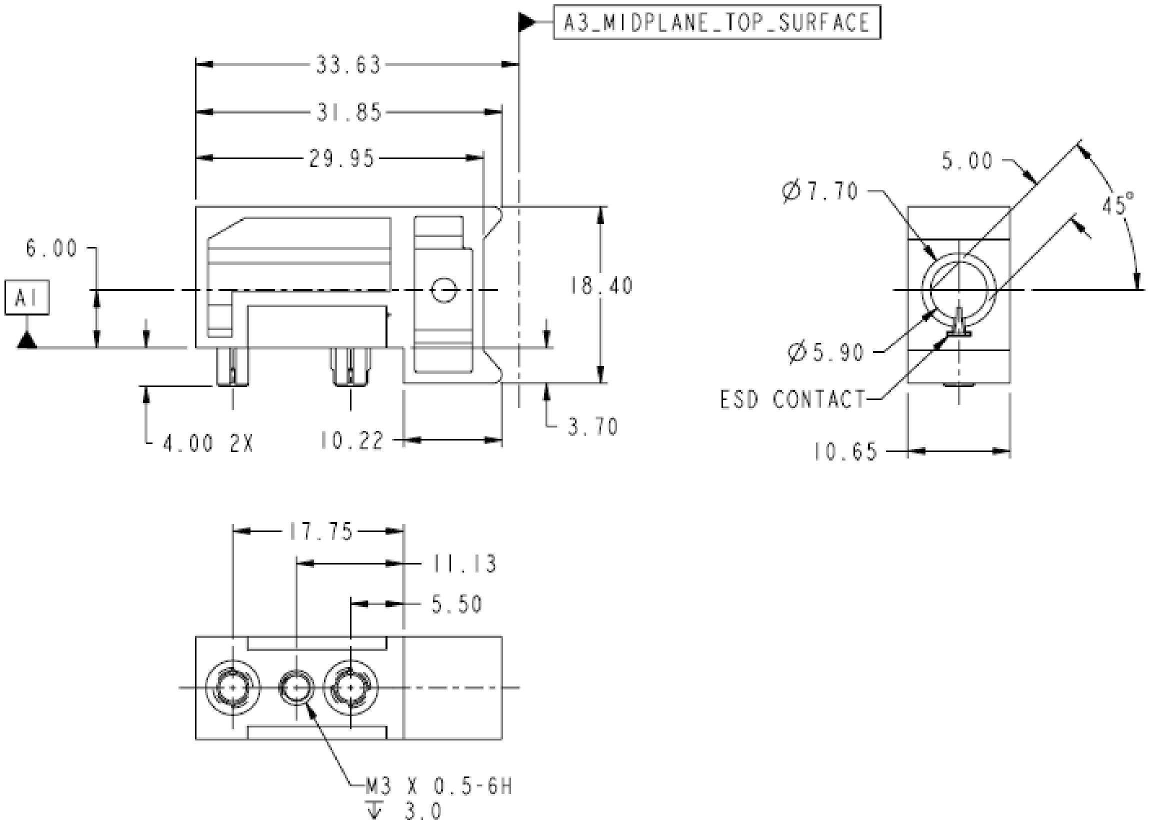


Figure 74: SBBMI Canister Guide Pin Receptacle Dimensions (FC key position shown)[1]

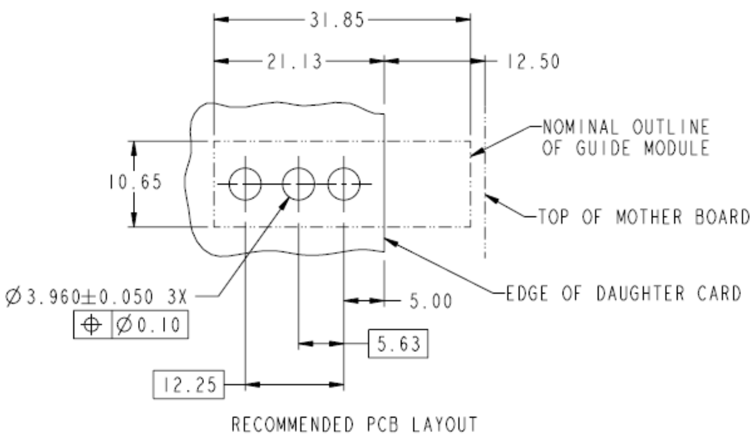


Figure 75: Recommended Guide Pin Receptacle PCB Layout[1,2]

[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

E.1.2 SBBMI Guide Pin

The SBBMI guide pin is detailed in Figure 76. 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 [422] adhere to the dimensions of Figure 76. If an SBB enclosure uses a midplane that is not mounted at reference plane A3, the portion of the SBBMI guide pin that interfaces to an SBBMI canister guide pin receptacle MUST [423] exactly mimic the dimension of the interfacing portion of an SBBMI guide pin on an imaginary midplane mounted at reference plane A3 as described in Figure 76.

Figure 77 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 [424] remain fixed relative to the canister constraints described in Figure 5 and SBBMI module locations described in Figure 6.

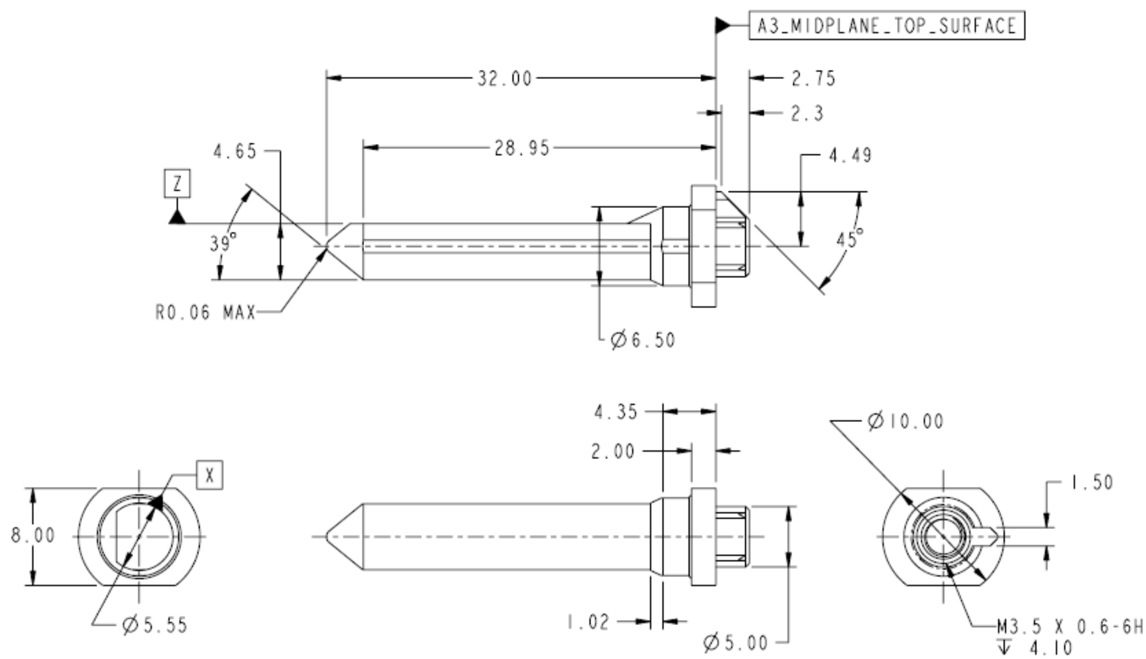


Figure 76: SBBMI Guide Pin Dimensions[1]

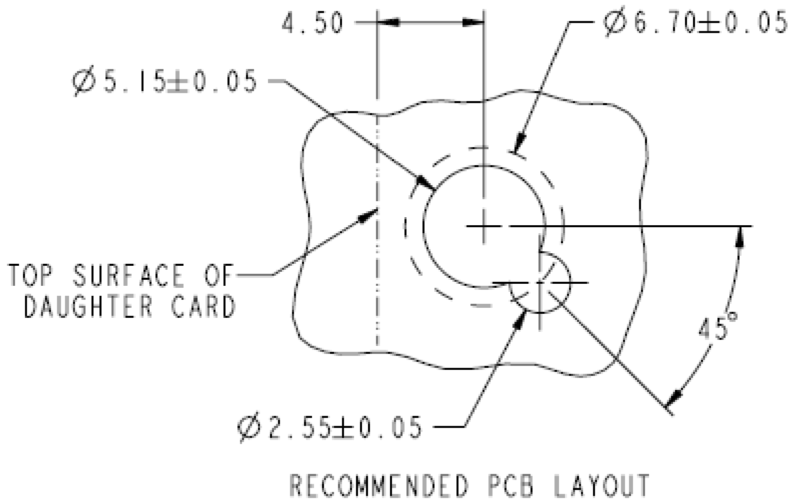


Figure 77: Recommended Guide Pin Midplane PCB Layout (Midplane Component Side)[1]

E.2 Signal Profile Defined Signals

This section describes the low speed signals available only to the FC Signal Profile.

The 2Gb/s and 4Gb/s Fibre Channel Signal Profile uses the SBBMI's profile defined signals for low-speed FC drive status signals. Table 79 describes the 2Gb/s and 4Gb/s FC Signal Profile's drive status signals. If the SBB canister uses these signals, the signals MUST [425] adhere to the definitions given in Table 79. Table 79 also states whether or not a given signal is required or optional.

Table 79: Profile Defined Signals

Signal Name	Module	Valid Power-on States	Description	Connect Topology	Input / Output[1]	Pull-up/ down (C/O[2])	Required/Optional	
							Canister	Midplane
DRIVE_[1:40]_FLTDET_L	Various	All[3]	Active low signal. Pulled low by the drive to indicate fault detected.	Sync_I	$I_{pull-up}$	C	Optional	Optional
DRIVE_[1:40]_BYP_L	Various	All[3]	Active low signal. If this signal is low, the drive associated with this signal is bypassed. Pulled high by the drive to request to establish high speed communication with the canisters.	Sync_I	$I_{pull-down}$	C	Optional	Optional

Note [1]: See Table 52 for I/O signal characteristics
Note [2]: Denotes location of pull-up/down (C – inside canister, O – outside canister)
Note [3]: These signals are valid in any of the states described in Section 6.3.4.

Table 80 lists the optional usages for the Drive_[1:40]_FLTDET_L signals. The Drive_[1:40]_FLTDET_L_Usage fields of the midplane VPDs MUST [426] contain the value of the usage option supported by the enclosure.

Table 80: Usage Options for Drive_[1:40]_FLTDET_L

Drive_FLTDET_L_Usage Value	Description
0	Not Supported: The enclosure MUST [427] not provide connections for the Drive_[1:40]_FLTDET_L signals.
1	Reserved
2	FLTDET: The enclosure MUST [428] implement the Drive_[1:40]_FLTDET_L signals as drive driven active low drive fault alerts.

Table 81 lists the optional usages for the Drive_[1:40]_BYP_L signals. The Drive_[1:40]_BYP_L_Usage fields of the midplane VPDs MUST [429] contain the value of the usage option supported by the enclosure.

Table 81: Usage Options for Drive_[1:40]_BYP_L

Drive_BYP_L_Usage Value	Description
0	Not Supported: The enclosure MUST [430] not provide connections for the Drive_[1:40]_BYP_L signals.
1	Reserved
2	BYP: The enclosure MUST [431] implement the Drive_[1:40]_BYP_L signals as drive driven active low drive bypass signals.

E.3 High-Speed Signals

The SBB specification provides two types of high-speed differential signals, drive signals and inter-canister communication signals. Section E.3.2 defines the requirements for differential signals used for communication between an SBB canister and drives. Section E.3.3 defines the requirements for differential signals used for inter-canister communication.

All high-speed differential signals MUST [432] have a differential impedance of 100 ohms with +/- 15% tolerance.

E.3.1 Eye Masks

Section E.3.2 and Section E.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 and 4Gb/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 [433] be used for measurements at SBB compliance points.

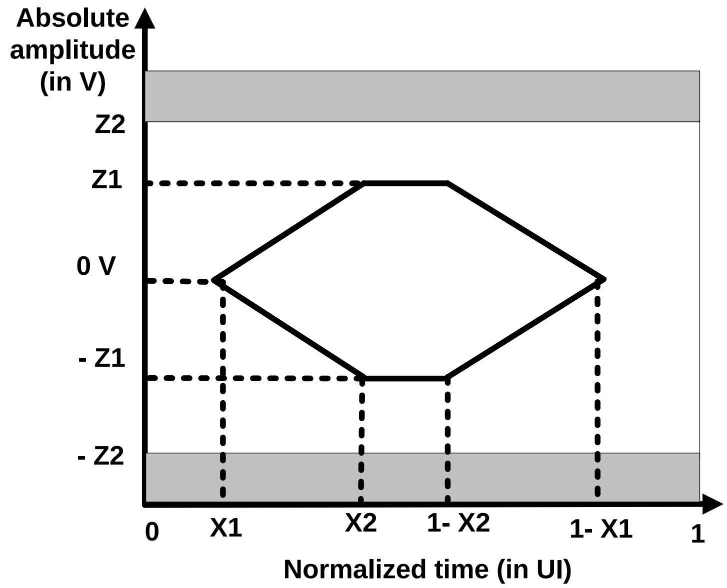


Figure 78: Eye Mask at Compliance Point

E.3.2 High-Speed Drive Signals

This section defines the high-speed drive signal eye mask requirements for the 2Gb/s and 4Gb/s FC Signal Profile. If 2Gb/s or 4Gb/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 [434] be satisfied. The eye mask requirements are specified at the compliance points ITx and IRx. Figure 79 illustrates the positions of the compliance points ITx and IRx. Appendix A describes the method used to perform measurements at ITx and IRx using a zero length test load.

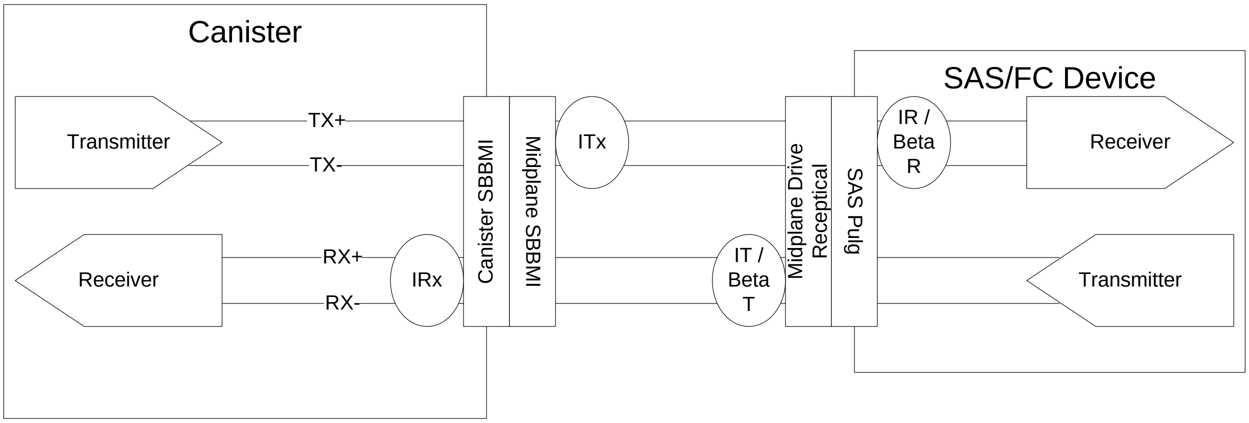


Figure 79:High-Speed Drive Signal Compliance Points

The signal eye opening measured with a test load at ITx MUST [435] equal or exceed the opening defined in Table 82. The SBB canister MUST [436] be capable of operating with a signal eye opening as small as the opening defined in Table 82 when measured with a test load at IRx.

Table 82: Eye Mask Characteristics for ITx and IRx

Eye Mask Characteristic	2Gb/s FC		4Gb/s FC[2,3]		Unit
	ITx	IRx	ITx[1]	IRx	
Z1	300	200	310	276	mV
Z2	1000	1000	800	800	mV
X1	0.165	0.26	0.26	0.26	UI
X2	0.355	0.5	0.5	0.5	UI

Notes:

1. SBB ITx for 4Gb/s FC signaling is equivalent to the BetaT interoperability point defined in sub clause 9.3.2, Table 21, of *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*. **This eye mask must be met not only under simple resistive load (referred to as zero-length load), but also under an interconnect load which matches or exceeds the transmitter compliance transfer function (TCTF) discussed in clause 9.11**. Based upon SBB simulation results, meeting this TCTF requirement is consistent with achieving higher eye amplitudes at the ITx and IRx points when measured with only a resistive load:

- 310mV under a TCTF load is approximately equivalent to an eye height greater than 450mV using resistive loading at the ITx point.
- 310mV under a TCTF load is approximately equivalent to an eye height greater than 375mV using resistive loading at the IRx point.

The above statement is informative rather than normative, and shall not be construed as waiving any of the requirements for 4GFC signaling detailed in section 9 of *INCITS 404 Information*

Technology – Fibre Channel – Physical Interfaces (FC-PI-2).

2. 4Gb/s FC channels must satisfy return loss requirements defined in sub clauses 9.3.4 and 9.4.3 of *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*.

3. 4Gb/s FC channels must satisfy two BER tests defined in sub clauses 9.3.3 and 9.4.2 of *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*. One test is performed at the ITx point and involves calibrating a TX device into a resistive load, adjusting signal amplitude and output jitter to a specified level. A second BER test at the IRx point requires similar calibration into a TCTF load. The BER is required to be better than 10^{-12}.

E.3.3 High-Speed Inter-Canister Signals

This section defines the high-speed inter-canister signal eye mask requirements for the 2Gb/s and 4Gb/s FC Signal Profile. The 2Gb/s and 4Gb/s FC Signal Profile allows 2Gb/s FC (as defined in *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*) 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 80 illustrates the positions of the compliance points ITy and IRy. Appendix A describes the method used to perform measurements at ITy and IRy using a zero length test load.

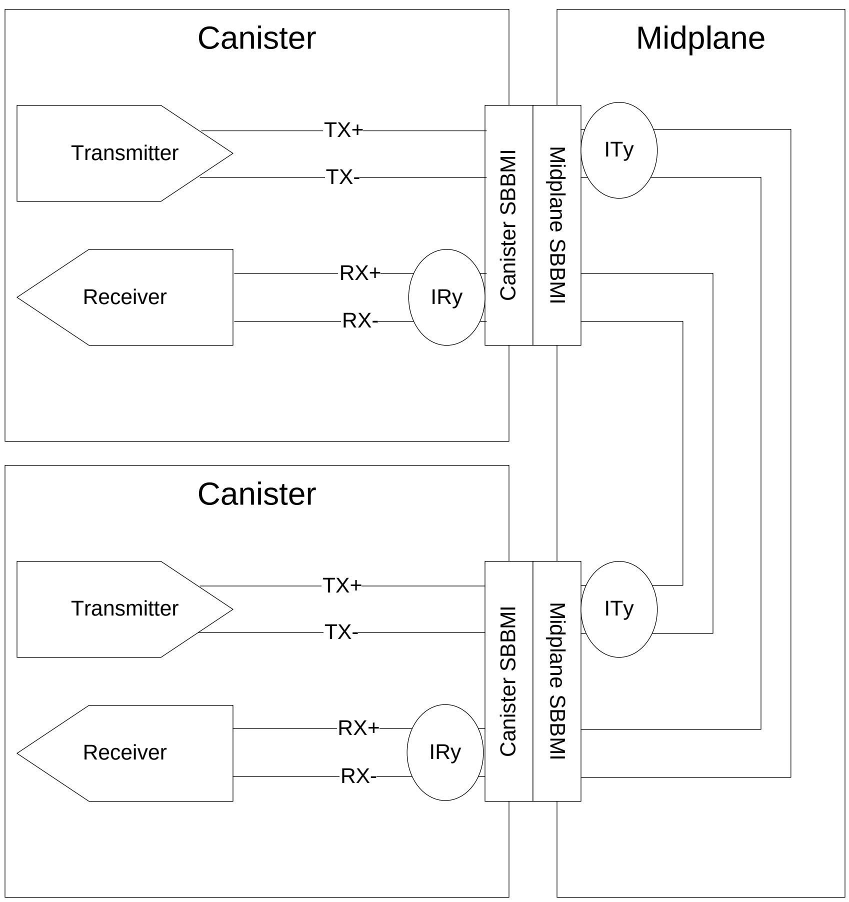


Figure 80: High-Speed Inter-Canister Signal Compliance Points

If an SBB canister uses 2Gb/s or 4Gb/s FC for inter-canister communication, then the signal eye opening measured with a test load at ITy MUST [437] equal or exceed the opening defined in Table 83. The SBB canister MUST [438] be capable of operating with a signal eye opening as small as the opening defined in Table 83 when measured with a test load at IRy.

Table 83: Eye Mask Characteristics for ITy and IRy

Eye Mask Characteristic	2Gb/s FC		4Gb/s FC[2,3]		Unit
	ITy	IRy	ITx[1]	IRx	
Z1	312.5	212.5	310	276	mV
Z2	1000	1000	800	800	mV
X1	0.19	0.24	0.26	0.26	UI
X2	0.38	0.5	0.5	0.5	UI

Notes:

1. SBB ITx for 4Gb/s FC signaling is equivalent to the BetaT interoperability point defined in sub clause 9.3.2, Table 21, of *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*. **This eye mask must be met not only under simple resistive load (referred to as zero-length load), but also under an interconnect load which matches or exceeds the transmitter compliance transfer function (TCTF) discussed in clause 9.11**. Based upon SBB simulation results, meeting this TCTF requirement is consistent with achieving higher eye amplitudes at the ITx and IRx points when measured with only a resistive load:

- 310mV under a TCTF load is approximately equivalent to an eye height greater than 450mV using resistive loading at the ITx point.
- 310mV under a TCTF load is approximately equivalent to an eye height greater than 375mV using resistive loading at the IRx point.

The above statement is informative rather than normative, and shall not be construed as waiving any of the requirements for 4GFC signaling detailed in section 9 of *INCITS 404 Information Technology – Fibre Channel – Physical Interfaces (FC-PI-2)*.

E.4 Drive Ports (Signal Profile Defined)

This section replaces requirements in Section 5.4.2

Modules M2, M5, M7, M8, M9, M10, M11, M12 and M13 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 40 inclusive.

Collectively a drive port for a drive with index “?” is designated Drive_Port_?. SBB canisters MUST [439] 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 [440] 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.

E.5 Module M5

This section replaces Section 5.4.8.

M5 contains low-speed signals required to support Fibre Channel drives. Table 84 gives the positions of individual signals in M5.

Table 84: 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$_{LS}$

E.6 Module M10

This section replaces Section 5.4.13.

M10 contains signals needed to support disks twenty five through twenty eight. Table 85 gives positions of individual signals in M10.

Table 85: 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

E.7 Module M11

This section replaces Section 5.4.14.

M11 contains signals needed to support disks twenty nine through thirty two. Table 86 gives positions of individual signals in M11.

Table 86: Module M11 Pin-Outs

Row	Column 6	5	4	3	2	1
A	DRIVE_29_FAULT_L_{LS}	DRIVE_30_FAULT_L_{LS}	DRIVE_31_FAULT_L_{LS}	DRIVE_32_FAULT_L_{LS}	DRIVE_29_FLTDET_L_{LS}	DRIVE_29_BYP_L_{LS}
B	DRIVE_29_GPO_L_{LS}	DRIVE_30_GPO_L_{LS}	DRIVE_31_GPO_L_{LS}	DRIVE_32_GPO_L_{LS}	DRIVE_30_FLTDET_L_{LS}	DRIVE_30_BYP_L_{LS}
C	DRIVE_29_INPL_L_{LS}	DRIVE_30_INPL_L_{LS}	DRIVE_31_INPL_L_{LS}	DRIVE_32_INPL_L_{LS}	DRIVE_31_FLTDET_L_{LS}	DRIVE_31_BYP_L_{LS}
D	GND_{RG}	DRIVE_30_RX+ $_{HS}$	GND_{RG}	DRIVE_32_RX+ $_{HS}$	GND_{RG}	DRIVE_32_BYP_L_{LS}
E	DRIVE_29_RX+ $_{HS}$	DRIVE_30_RX- $_{HS}$	DRIVE_31_RX+ $_{HS}$	DRIVE_32_RX- $_{HS}$	GND_{RG}	Reserved
F	DRIVE_29_RX- $_{HS}$	GND_{LG}	DRIVE_31_RX- $_{HS}$	GND_{LG}	DRIVE_32_FLTDET_L_{LS}	GND_{LG}
G	GND_{LG}	DRIVE_30_TX+ $_{HS}$	GND_{LG}	DRIVE_32_TX+ $_{HS}$	GND_{LG}	Reserved
H	DRIVE_29_TX+ $_{HS}$	DRIVE_30_TX- $_{HS}$	DRIVE_31_TX+ $_{HS}$	DRIVE_32_TX- $_{HS}$	GND_{RG}	Reserved
I	DRIVE_29_TX- $_{HS}$	GND_{RG}	DRIVE_31_TX- $_{HS}$	GND_{RG}	Reserved	Reserved

E.8 Module M12

This section replaces Section 5.4.15.

M12 contains signals needed to support disks thirty three through thirty six. Table 87 gives positions of individual signals in M12.

Table 87: Module M12 Pin-Outs

Row \ Column	6	5	4	3	2	1
A	DRIVE_33_FAULT_L$_{LS}$	DRIVE_34_FAULT_L$_{LS}$	DRIVE_35_FAULT_L$_{LS}$	DRIVE_36_FAULT_L$_{LS}$	DRIVE_33_FLTDET_L$_{LS}$	DRIVE_33_BYP_L$_{LS}$
B	DRIVE_33_GPO_L$_{LS}$	DRIVE_34_GPO_L$_{LS}$	DRIVE_35_GPO_L$_{LS}$	DRIVE_36_GPO_L$_{LS}$	DRIVE_34_FLTDET_L$_{LS}$	DRIVE_34_BYP_L$_{LS}$
C	DRIVE_33_INPL_L$_{LS}$	DRIVE_34_INPL_L$_{LS}$	DRIVE_35_INPL_L$_{LS}$	DRIVE_36_INPL_L$_{LS}$	DRIVE_35_FLTDET_L$_{LS}$	DRIVE_35_BYP_L$_{LS}$
D	GND$_{RG}$	DRIVE_34_RX+$_{HS}$	GND$_{RG}$	DRIVE_36_RX+$_{HS}$	GND$_{RG}$	DRIVE_36_BYP_L$_{LS}$
E	DRIVE_33_RX+$_{HS}$	DRIVE_34_RX-$_{HS}$	DRIVE_35_RX+$_{HS}$	DRIVE_36_RX-$_{HS}$	GND$_{RG}$	Reserved
F	DRIVE_33_RX-$_{HS}$	GND$_{LG}$	DRIVE_35_RX-$_{HS}$	GND$_{LG}$	DRIVE_36_FLTDET_L$_{LS}$	GND$_{LG}$
G	GND$_{LG}$	DRIVE_34_TX+$_{HS}$	GND$_{LG}$	DRIVE_36_TX+$_{HS}$	GND$_{LG}$	Reserved
H	DRIVE_33_TX+$_{HS}$	DRIVE_34_TX-$_{HS}$	DRIVE_35_TX+$_{HS}$	DRIVE_36_TX-$_{HS}$	GND$_{RG}$	Reserved
I	DRIVE_33_TX-$_{HS}$	GND$_{RG}$	DRIVE_35_TX-$_{HS}$	GND$_{RG}$	Reserved	Reserved

E.9 Module M13

This section replaces Section 5.4.16.

M13 contains signals needed to support disks thirty seven through forty. Table 88 gives positions of individual signals in M13.

Table 88: Module M13 Pin-Outs

Row \ Column	6	5	4	3	2	1
A	DRIVE_37_FAULT_L$_{LS}$	DRIVE_38_FAULT_L$_{LS}$	DRIVE_39_FAULT_L$_{LS}$	DRIVE_40_FAULT_L$_{LS}$	DRIVE_37_FLTDET_L$_{LS}$	DRIVE_37_BYP_L$_{LS}$
B	DRIVE_37_GPO_L$_{LS}$	DRIVE_38_GPO_L$_{LS}$	DRIVE_39_GPO_L$_{LS}$	DRIVE_40_GPO_L$_{LS}$	DRIVE_38_FLTDET_L$_{LS}$	DRIVE_38_BYP_L$_{LS}$
C	DRIVE_37_INPL_L$_{LS}$	DRIVE_38_INPL_L$_{LS}$	DRIVE_39_INPL_L$_{LS}$	DRIVE_40_INPL_L$_{LS}$	DRIVE_39_FLTDET_L$_{LS}$	DRIVE_39_BYP_L$_{LS}$
D	GND$_{RG}$	DRIVE_38_RX+$_{HS}$	GND$_{RG}$	DRIVE_40_RX+$_{HS}$	GND$_{RG}$	DRIVE_40_BYP_L$_{LS}$
E	DRIVE_37_RX+$_{HS}$	DRIVE_38_RX-$_{HS}$	DRIVE_39_RX+$_{HS}$	DRIVE_40_RX-$_{HS}$	GND$_{RG}$	Reserved
F	DRIVE_37_RX-$_{HS}$	GND$_{LG}$	DRIVE_39_RX-$_{HS}$	GND$_{LG}$	DRIVE_40_FLTDET_L$_{LS}$	GND$_{LG}$
G	GND$_{LG}$	DRIVE_38_TX+$_{HS}$	GND$_{LG}$	DRIVE_40_TX+$_{HS}$	GND$_{LG}$	Reserved
H	DRIVE_37_TX+$_{HS}$	DRIVE_38_TX-$_{HS}$	DRIVE_39_TX+$_{HS}$	DRIVE_40_TX-$_{HS}$	GND$_{RG}$	Reserved
I	DRIVE_37_TX-$_{HS}$	GND$_{RG}$	DRIVE_39_TX-$_{HS}$	GND$_{RG}$	Reserved	Reserved

Appendix F PCI Express Inter-canister Profile

F.1 Eye Masks

F.1.1 uses *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. The compliance pattern defined in *PCI Express™ Base Specification Revision 1.1* MUST [441] be used for measurements at SBB compliance points.

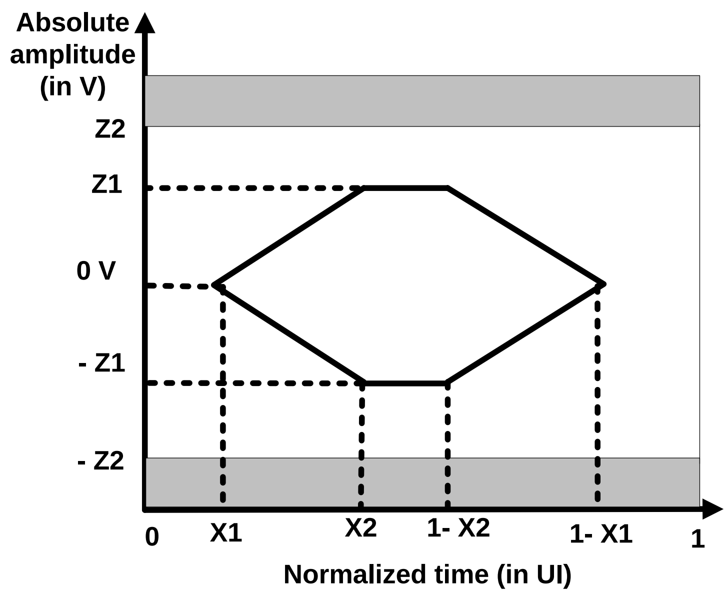


Figure 81: Eye Mask at Compliance Point

F.1.1 High-Speed Inter-Canister Signals

This section defines the high-speed inter-canister signal eye mask requirements for the 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[1:17]_AB+, HS[1:17]_AB-, HS[1:17]_BA+, HS[1:17]_BA-).

High-speed inter-canister signal eye mask requirements are specified at the compliance points ITy and IRy. Figure 82 illustrates the positions of the compliance points ITy and IRy. Appendix A describes the method used to perform measurements at ITy and IRy using a zero length test load.

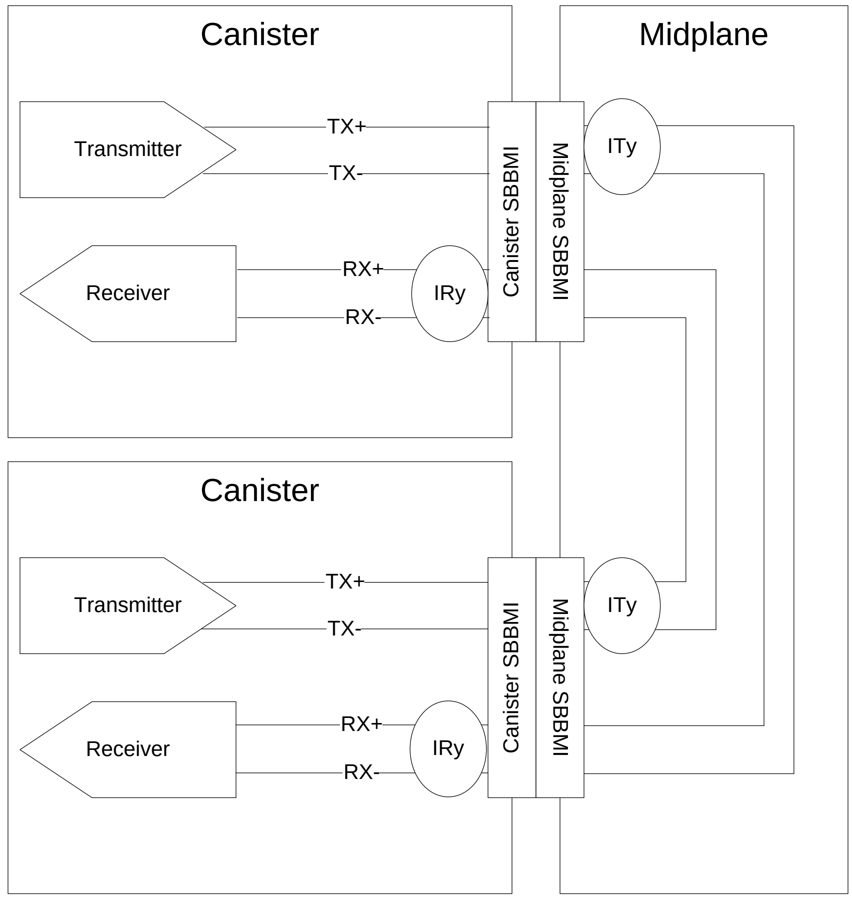


Figure 82: High-Speed Inter-Canister Signal Compliance Points

If an SBB canister uses 2.5Gb/s PCIe Gen1 for inter-canister communication, then the signal eye opening measured with a test load at ITy MUST [442] equal or exceed the opening defined in Table 89. The SBB canister MUST [443] be capable of operating with a signal eye opening as small as the opening defined in Table 89 when measured with a test load at IRy.

Table 89: Eye Mask Characteristics for ITy and IRy

Eye Mask Characteristic	2.5Gb/s PCIe		Unit
	ITy	IRy	
Z1	212.75	200	mV
Z2	600	600	mV
X1	0.2125	0.225	UI
X2	0.4375	0.5	UI

Appendix G Cooling formulas

G.1 Impedance Curves Support Data

The SBB canister impedance curves A to D relating the airflow to pressure drop across the canister shown in the graphs of Figure 32 can be reproduced using the following formula.

$$dP=ZQ^N$$

dP	Pressure Drop in Pa
Z	Impedance
Q	Airflow in Litres/s
N	Index

Impedance Curve	N	Z
A	1.50	0.81
B	2.00	0.40
C	2.00	0.64
D	2.00	0.87

Airflow	Impedance Curve Pressure Drop Pa			
L/s	A	B	C	D
0	0	0	0	0
2	2	2	3	3
4	6	6	10	14
6	12	14	23	31
8	18	26	41	56
10	26	40	64	87
12	34	58	91	125
14	42	79	124	170
16	52	103	163	222
18	62	130	206	281
20	72	161	254	347

G.2 Airflow VS. Temperature Curves Supporting Data

The SBB canister curves relating the airflow to air temperature rise across the canister shown in the graphs in Figure 30 can be reproduced with more precision using the following relationship if required.

$$dT = P/(1.16Q)$$

dT	air temperature rise across canister in degC
P	canister power dissipation in W
Q	Airflow in Litres/s

	Power vs Airflow vs Air Temperature rise			
Profile	P60	P100	P150	P200
Power	60	100	150	200
Airflow L/s	Temperature Rise			
6	9	14	22	29
8	6	11	16	22
10	5	9	13	17
12	4	7	11	14
14	4	6	9	12
16	3	5	8	11
18	3	5	7	10
20	3	4	6	9