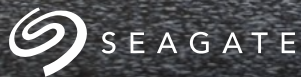


A blurred photograph of a crowd of people walking across a street with white zebra crossings. The motion blur suggests a busy, fast-paced environment. The people are wearing various casual clothing like jeans, t-shirts, and sneakers. A person on a bicycle is visible on the right side of the frame.

802.3cb PMD and Channel Update



Anthony Calbone 2/25/2016

Introduction

- The presentation is meant to give an update on the PMD and channel discussions in 802.3cb to date
- The test point locations, which are described in the following slides, were adopted in the January interim meeting.

- Slides 16 - 18 contain new content that includes the loss budget for 2.5 Gb/s
- Notes from previous meetings:
 - It was noted that the test point nomenclature needs work. I am keeping it the same until we decide on new nomenclature.
 - Working on specifications of the oscilloscopes that will be used to measure compliance



Test Point Definitions

Backplane Reference Model Test Points

- Use 802.3bj as a reference to define ball-to-ball loss
- There is a closed and/or proprietary environment in which the only loss budget is ball-to-ball
- Test points used here are TP0, TP0a, TP5, and TP5a

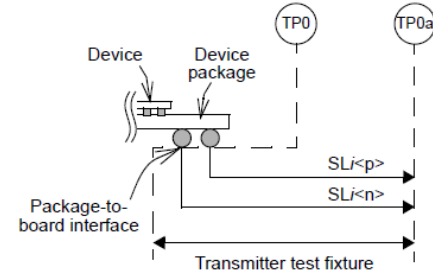
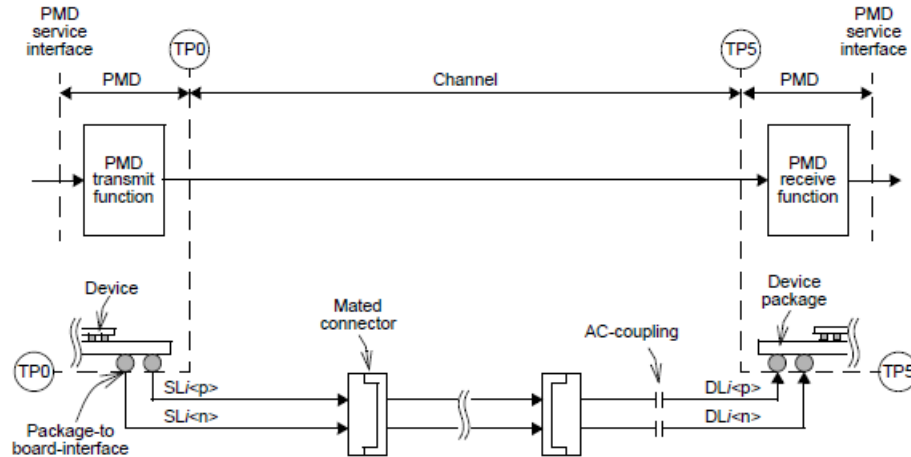


Figure 93-5—Transmitter test fixture and test points

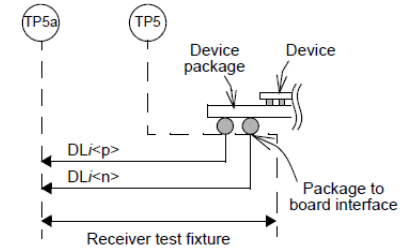
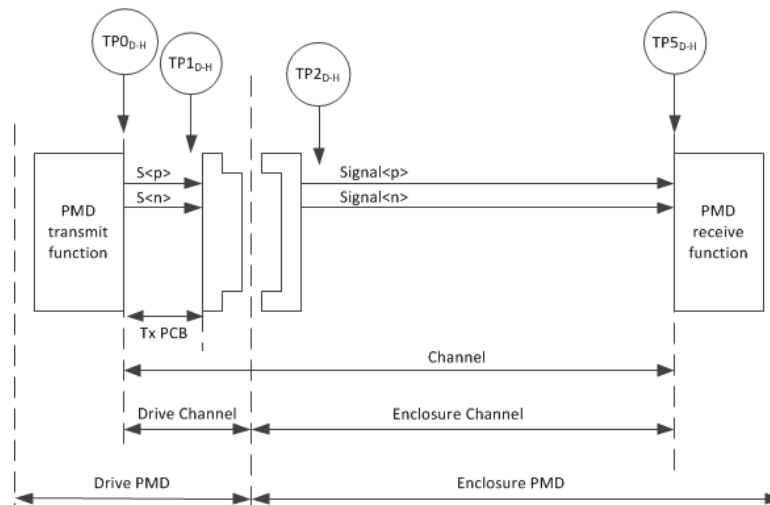


Figure 93-10—Receiver test fixture and test points

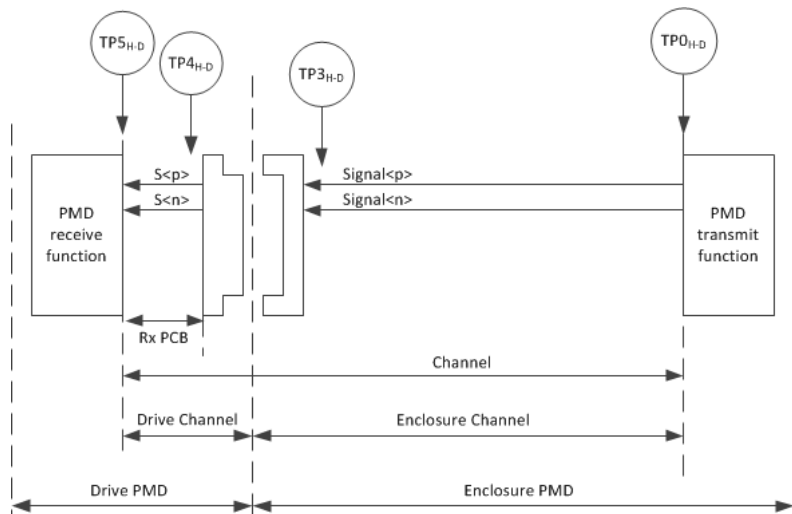
Storage Reference Model Test Points – Drive to Host

- For the storage application, it's important to budget the drive loss since it's an external component.
- The rest of the “box” is vender specific and can be any combination of cable and backplane
- This model is asymmetric, which is the reason there are two separate figures (the second one is on the next page)



Test Points	Descriptions
TP0 _{D-H} to TP5 _{D-H}	The channel including the drive transmitter differential controlled impedance printed circuit board insertion loss and the enclosure insertion loss.
TP0 _{D-H} to TP1 _{D-H}	The drive transmitter traces
TP0 _{D-H} to TP2 _{D-H}	The mated connector pair has been included in the drive transmitter specifications. The recommended maximum insertion loss is ...
TP1 _{D-H} to TP5 _{D-H}	Enclosure channel with mated connector pair included. The recommended maximum insertion loss is ...

Storage Reference Model Test Points – Host to Drive



Test Points	Descriptions
TP0 _{H-D} to TP5 _{H-D}	The channel including the drive receiver differential controlled impedance printed circuit board insertion loss and the enclosure insertion loss.
TP4 _{H-D} to TP5 _{H-D}	The drive receiver traces
TP3 _{H-D} to TP5 _{H-D}	The mated connector pair has been included in the drive receiver specifications. The recommended maximum insertion loss is ...
TP0 _{H-D} to TP4 _{H-D}	Enclosure channel with mated connector pair included. The recommended maximum insertion loss is ...

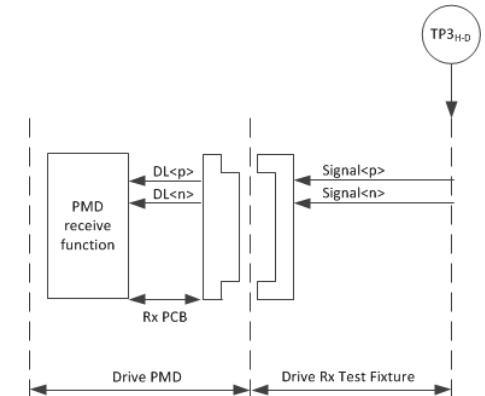
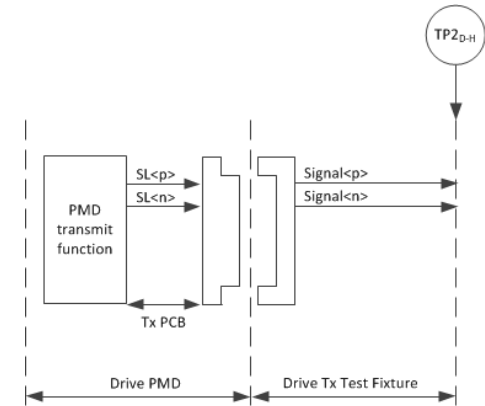
Storage Model – Compliance Measurement Locations

- There was much discussion at the January interim meeting regarding measurements of a storage system
- There are two use cases to consider with the enclosure
 - **Enclosure design:** There needs to be a reasonable way for an enclosure designer to determine compliance, or have some indication of compliance in an informative annex. This would need to be done pre-fabrication of the system.
 - **Assembled enclosure:** Some test points that would be available in simulation or in a design-for-test scenario will not be available in a production system. There needs to be a way to determine compliance at measureable test points.
- The drive compliance measurement locations are done after the mated connector and are more straight forward since there will be an open eye at this test point

Storage Model – Drive Measurement Locations

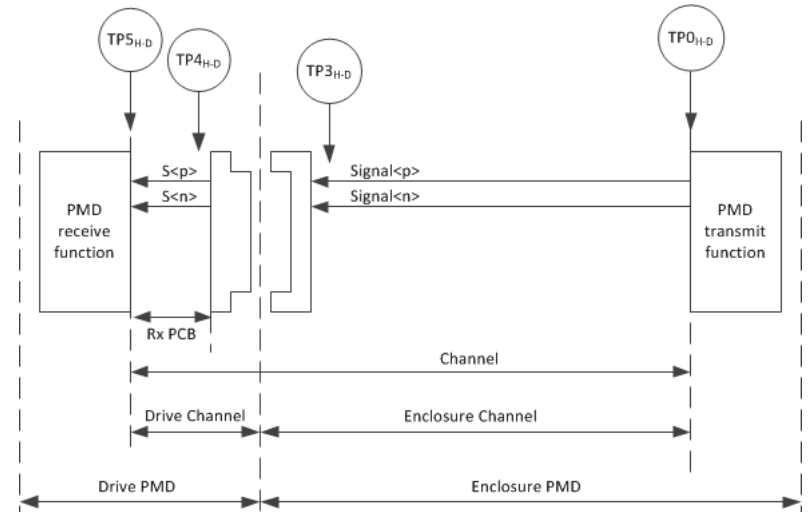
- The wording below is for brainstorming and does not imply adoption by the working group
- TP2_{D-H}
 - Drive transmitter compliance is measured through a test fixture to provide a measurable test point
- TP3_{H-D}
 - Drive receiver compliance is measured through a test fixture to provide a measurable test point (not all, but measurements such as return loss)
- Need wording similar to 802.3bj referencing the test fixture specification
 - Example wording is shown in the table below

Test Points	Descriptions
TP2 _{D-H}	Transmitter measurements of the drive are made at TP2 _{D-H} using the test fixture specified in ...
TP3 _{H-D}	Receiver measurements of the drive are made at TP3 _{H-D} using the test fixture specified in ...



Storage Model – Drive Measurement Locations Cont'd

- $TP4_{H-D}$
 - Drive receiver tolerance testing is calibrated here. The calibration routine may “extend” the test point to $TP5_{H-D}$.
 - The idea is that the test is calibrated at $TP4_{H-D}$ to ensure the drive can operate with the delivered signal at the external interface.
- Need wording similar to 802.3bj referencing the test fixture specification
 - Example wording is shown in the table below

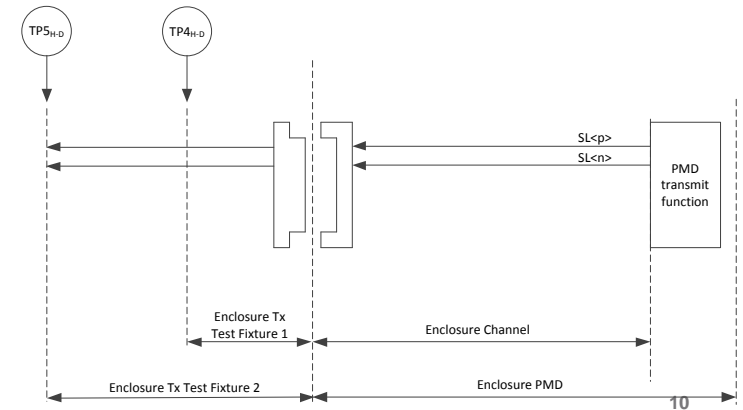
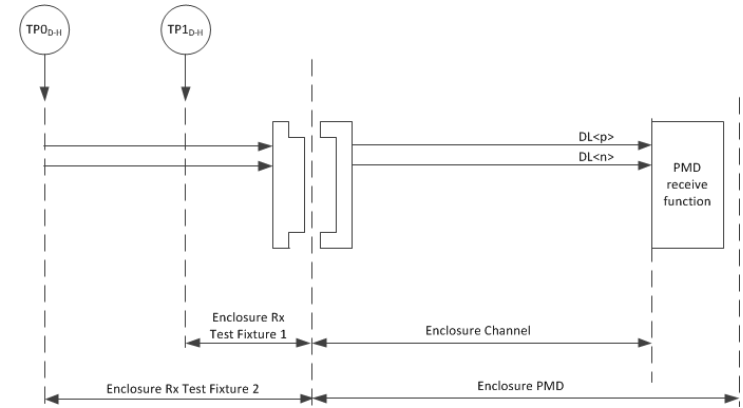


Test Points	Descriptions
$TP4_{H-D}$	Drive Rx tolerance test is calibrated at $TP4_{H-D}$ using the test fixture specified in...

Storage Model – Enclosure Measurement Locations

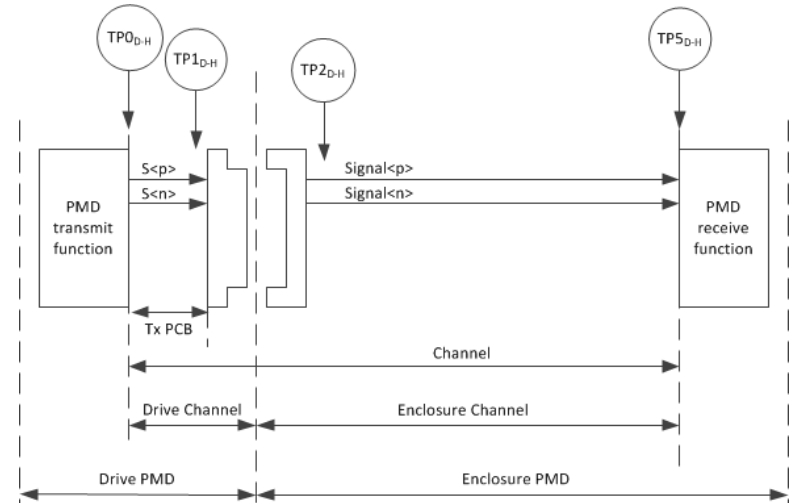
- The wording below is for brainstorming and does not imply adoption by the working group
- Test Fixture 1 would provide a low insertion method of measuring the enclosure
- Test Fixture 2 would provide a worst case drive loss to extend the measurement point to $TP0_{D-H}$ and $TP5_{H-D}$
- $TP4_{H-D}$ and/or $TP5_{H-D}$
 - Enclosure transmitter compliance is measured through a test fixture to provide a measureable test point.
- $TP1_{D-H}$
 - Enclosure receiver compliance is measured through a test fixture to provide a measureable test point (not all, but measurements such as return loss)
- Need wording similar to 802.3bj referencing the test fixture specification
 - Example wording is shown in the table below

Test Points	Descriptions
$TP4_{H-D}$ and/or $TP5_{H-D}$	Transmitter measurements of enclosure are made here using the test fixture specified in...
$TP1_{D-H}$	Receiver measurements of enclosure are made at $TP1_{D-H}$ using the test fixture specified in...



Storage Model – Enclosure Measurement Locations Cont'd

- $TP0_{D-H}$ and/or $TP1_{D-H}$
 - Enclosure receiver tolerance testing is calibrated here.
 - The idea is that the test is calibrated such that compliance testing ensures the enclosure can operate with the delivered signal at the external interface.
- Need wording similar to 802.3bj referencing the test fixture specification
 - Example wording is shown in the table below



Test Points	Descriptions
$TP0_{D-H}$ and/or $TP1_{D-H}$	Enclosure Rx tolerance test is calibrated here using the test fixture specified in...

Storage Model – Enclosure Measurement Locations Cont'd

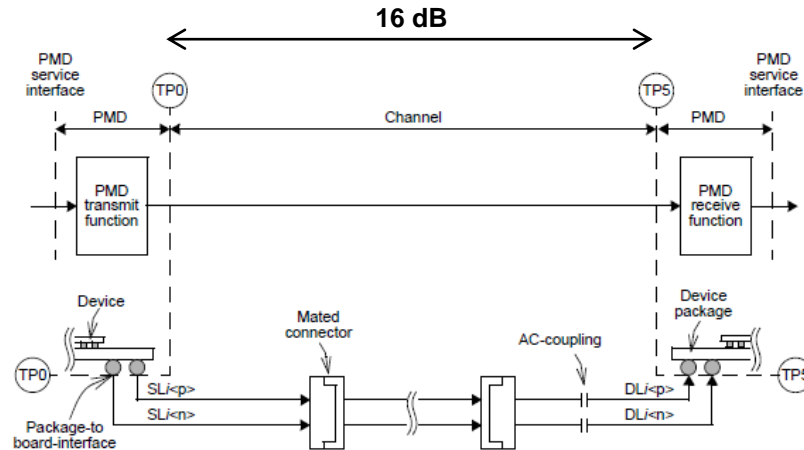
- Concerns relate to having both measureable test points on an assembled enclosure, in addition to having the ability to predict compliance in the design phase and a design-for-test enclosure build
- Design phase:
 - Potentially use COM with TP1_{D-H} and TP5_{D-H} during the enclosure design phase and a targeted design-for-test build
 - These test points can be made available in these situations
- Assembled phase:
 - Discussions included the possibility of using COM on the “delivered signal” measured at TP4_{H-D} or TP5_{H-D} to determine compliance of an assembled enclosure transmitter. This would require the ability to use COM on a signal that has been measured with a scope.
 - Potentially using COM in combination with other measurements such as Rj with a clock-like pattern could be used



5 Gb/s Insertion Loss Budgets

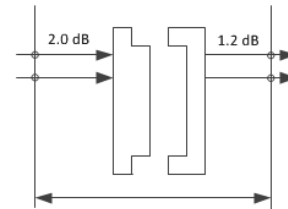
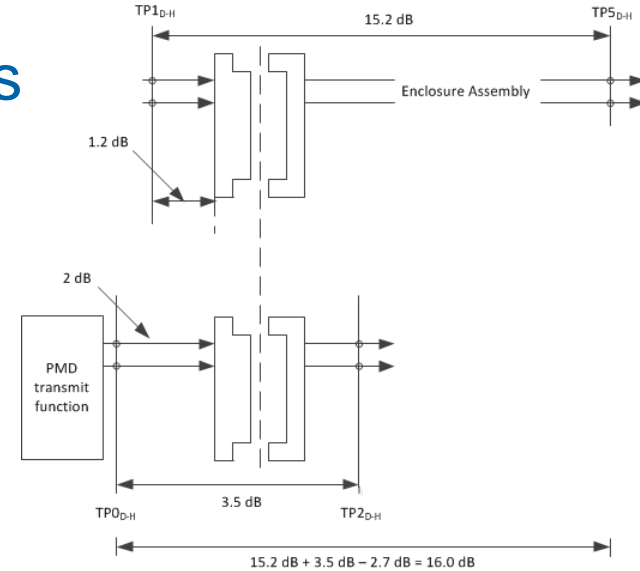
Backplane Reference Model for 5 Gb/s – Ball-to-Ball Loss

- All loss numbers are in reference to 2.578 GHz
- 16 dB of ball-to-ball loss from TP0 to TP5
- Mapping from 6G SAS
 - Removed 0.61 dB from the die-to-die SAS spec for this ball-to-ball to account for package loss spec as a starting point.
 - This number may need to be refined based on package loss requirements and COM results.
- Need insertion loss numbers between TP0 and TP0a, as well as TP5 and TP5a



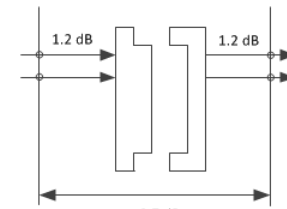
Storage Reference Model Loss for 5 Gb/s

- TP0 to TP5 has same 16 dB ball-to-ball loss as the backplane reference model
 - Enclosure: 14 dB
 - Drive: 2 dB
- Only showing one direction
- Mapping from 6G SAS
 - Assume 0.75 dB for the zero-length test load fixture
- Test fixture assumptions to arrive at 1.2 dB
 - 2.5 in of trace using Rogers material
 - 1 m of SMA cable
 - If enclosure test fixture 2 is needed, this 1.2 dB value would need to be increased to 2 dB to represent the worst case drive loss.



Mated connector assembly and test point test fixture using enclosure test fixture 2

NOTE – The connector insertion loss is 0.3 dB for the mated test fixture.



Mated connector assembly and test point test fixture using enclosure test fixture 1

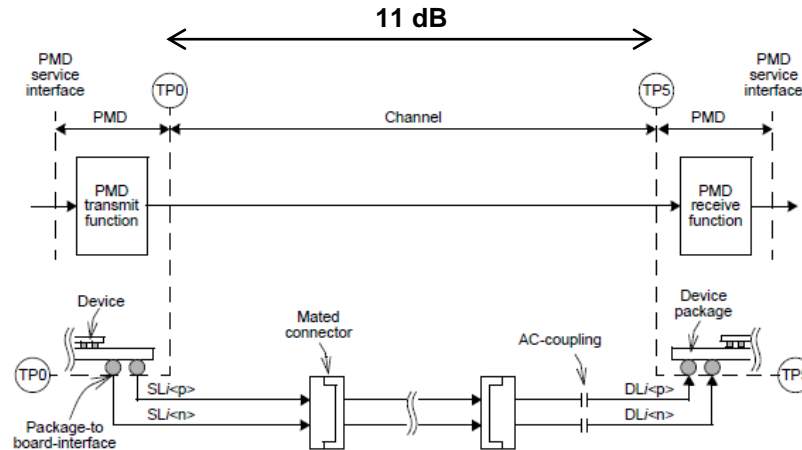
NOTE – The connector insertion loss is 0.3 dB for the mated test fixture.



2.5Gb/s Insertion Loss Budgets

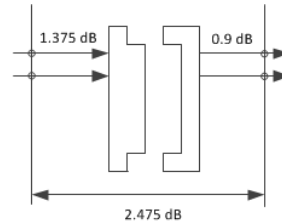
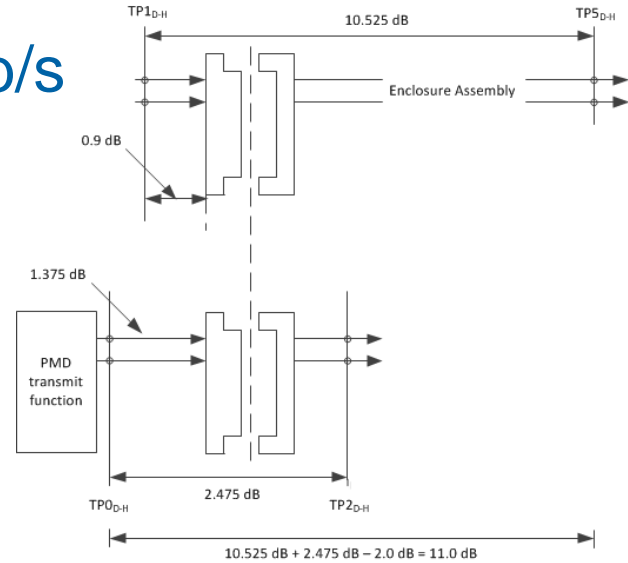
Backplane Reference Model for 2.5 Gb/s – Ball-to-Ball Loss

- All loss numbers are in reference to 1.5625 GHz
- 11 dB of ball-to-ball loss from TP0 to TP5
- Mapping from 6G SAS
 - Removed 0.38 dB from the die-to-die SAS spec for this ball-to-ball to account for package loss spec as a starting point.
 - This number may need to be refined based on package loss requirements and COM results.
- Need insertion loss numbers between TP0 and TP0a, as well as TP5 and TP5a



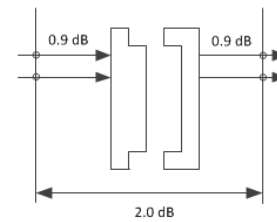
Storage Reference Model Loss for 2.5 Gb/s

- TP0 to TP5 has same 11 dB ball-to-ball loss as the backplane reference model
 - Enclosure: 9.625 dB
 - Drive: 1.375 dB
- Only showing one direction



Mated connector assembly and test point test fixture using enclosure test fixture 2

NOTE – The connector insertion loss is 0.2 dB for the mated test fixture.



Mated connector assembly and test point test fixture using enclosure test fixture 1

NOTE – The connector insertion loss is 0.2 dB for the mated test fixture.

Potential Next Steps

- Ensure we're on the correct path at a high level, particularly with the storage model compliance measurement points
- Define measurements at each test point
- Define limits of these measurements
- Determine package loss requirements
- Determine insertion loss requirements for TP0a and TP5a