802.3cb PMD and Channel Update

Anthony Calbone 2/18/2016

SEAGATE

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 13 - 15 contain new content

- Notes from previous meeting:

  - It was noted that the test point nomenclature needs work. I am keeping it the same until we decide on new nomenclature.

  - We need specifications of the oscilloscopes that will be used to measure compliance

Test Point Definitions

SEAGATE

Backplane Reference Model Test Points

- Use 802.3bj as a reference to define ball-to-ball loss

- The is a closed and/or proprietary environment in which the only loss budget is ball-to-ball
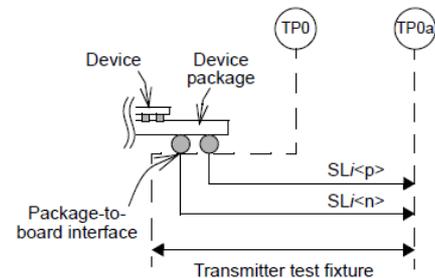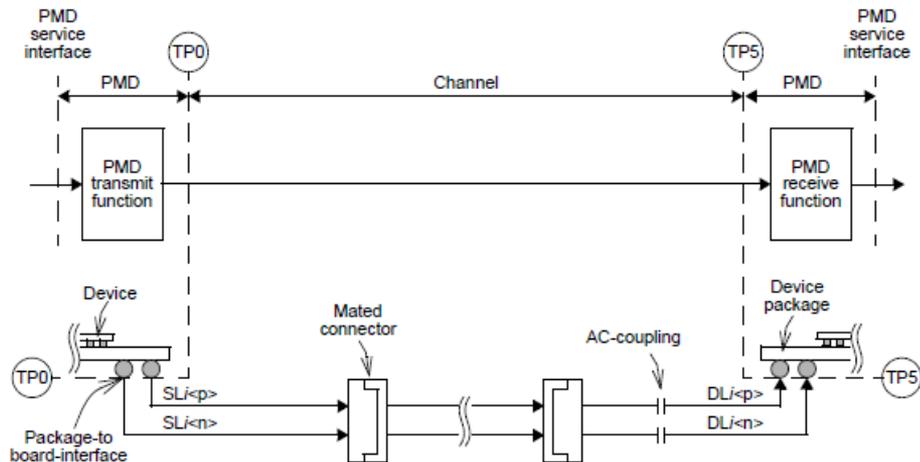
- Test points used here are TP0, TP0a, TP5, and TP5a

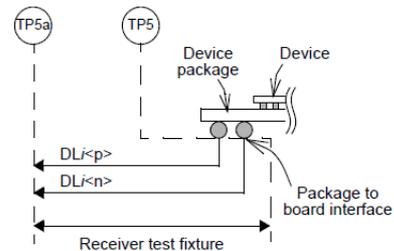Figure 93–5—Transmitter test fixture and test points

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)
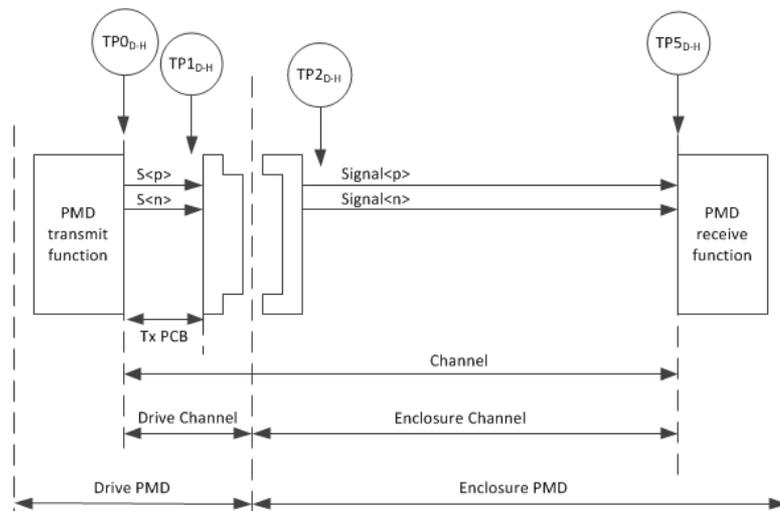
Test Points	Descriptions
TP0$_{D-H}$ to TP5$_{D-H}$	The channel including the drive transmitter differential controlled impedance printed circuit board insertion loss and the enclosure insertion loss.
TP0$_{D-H}$ to TP1$_{D-H}$	The drive transmitter traces
TP0$_{D-H}$ to TP2$_{D-H}$	The mated connector 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
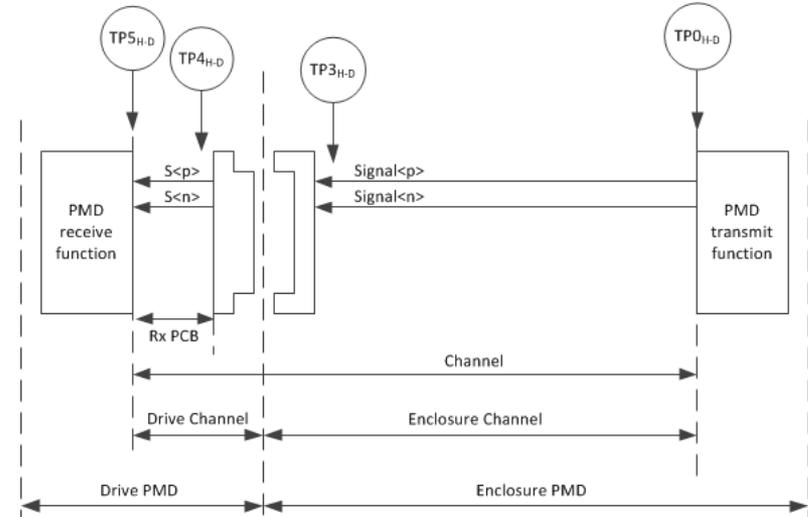
| Test Points	Descriptions
TP0$_{H-D}$ to TP5$_{H-D}$	The channel including the drive receiver differential controlled impedance printed circuit board insertion loss and the enclosure insertion loss.
TP4$_{H-D}$ to TP5$_{H-D}$	The drive receiver traces
TP3$_{H-D}$ to TP5$_{H-D}$	The mated connector pair has been included in the drive reciever 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
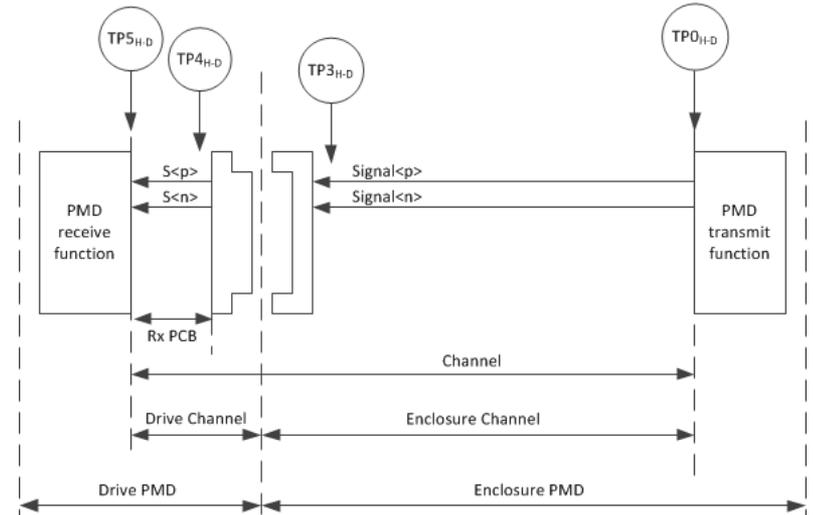
Storage Model – Drive Measurement Locations

- 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 measureable test point

- $TP3_{H-D}$
  - Drive 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
$TP2_{D-H}$	Transmitter measurements of the drive are made at $TP2_{D-H}$ using the test fixture specified in …
$TP3_{H-D}$	Reciever measurements of the drive are made at $TP3_{H-D}$ using the test fixture specified in …
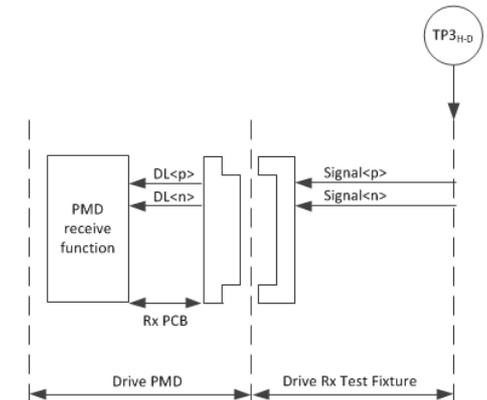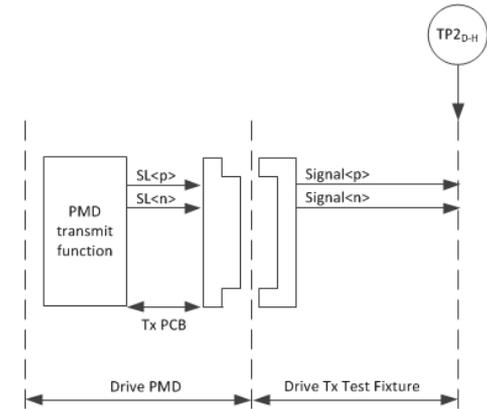
Storage Model – Drive Measurement Locations Cont'd

- 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
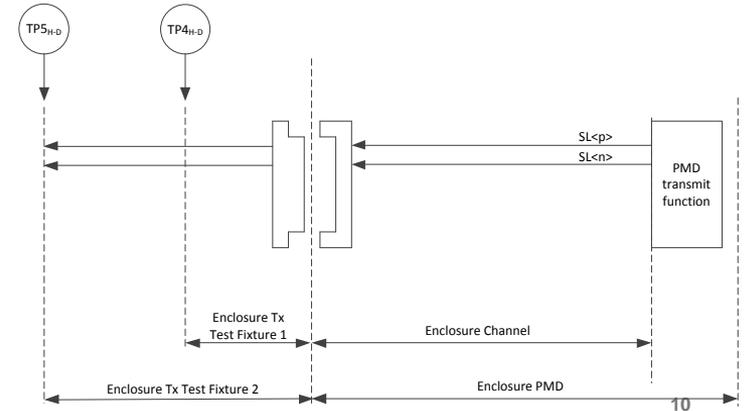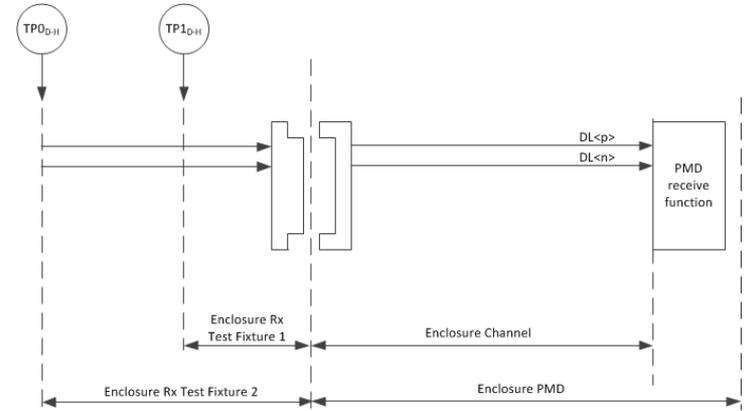 - Example wording is shown in the table below

Test Points	Descriptions
TP4$_{H-D}$	Drive Rx tolerance test is calibrated at TP4$_{H-D}$ using the test fixture specified in...

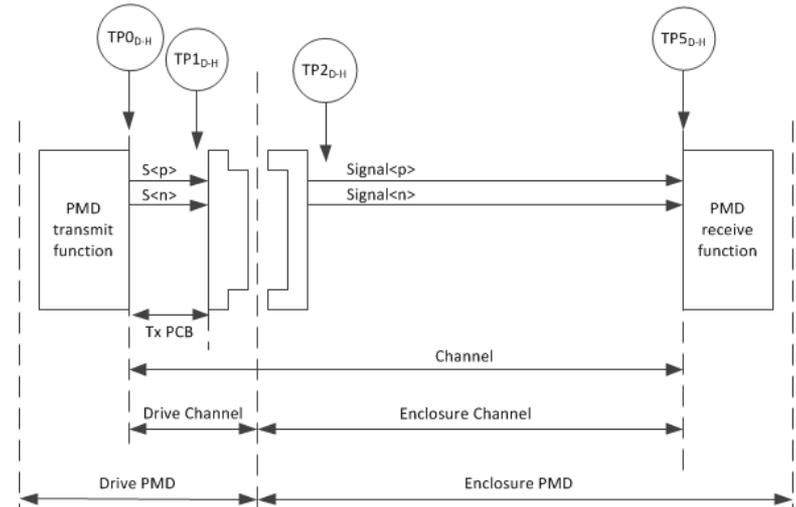# Storage Model – Enclosure Measurement Locations

- 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
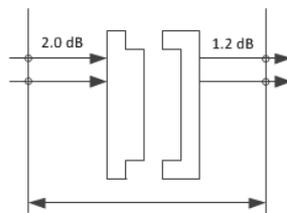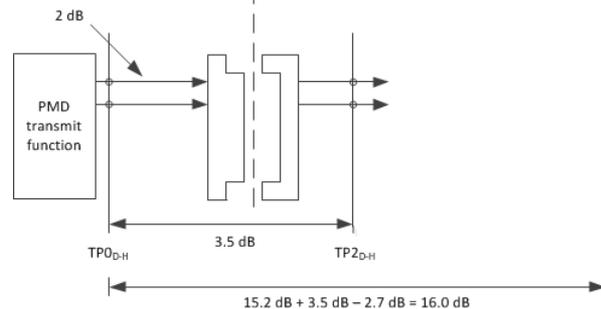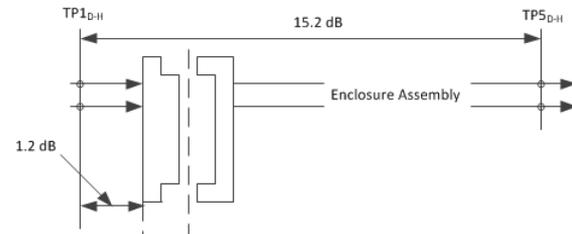
Insertion Loss Budgets

SEAGATE

Backplane Reference Model – 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
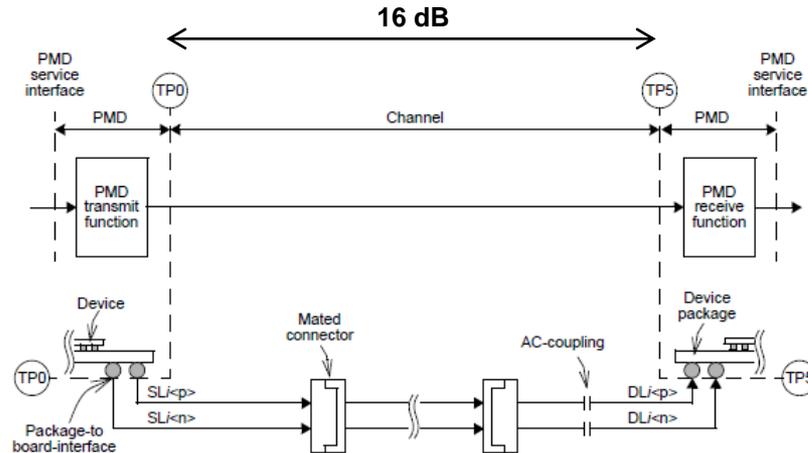
Storage Reference Model Loss

- 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.

$TP1_{D-H}$ 15.2 dB $TP5_{D-H}$

Enclosure Assembly

1.2 dB

2 dB

PMD transmit function

$TP0_{D-H}$ 3.5 dB $TP2_{D-H}$

15.2 dB + 3.5 dB − 2.7 dB = 16.0 dB

2.0 dB   1.2 dB

3.5 dB

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.

1.2 dB   1.2 dB

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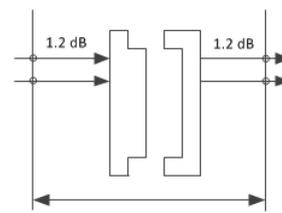
Mated connector assembly
and test point test fixture
using enclosure test fixture 1

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

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