TP1 and TP4 testing with compliance boards

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Supporters

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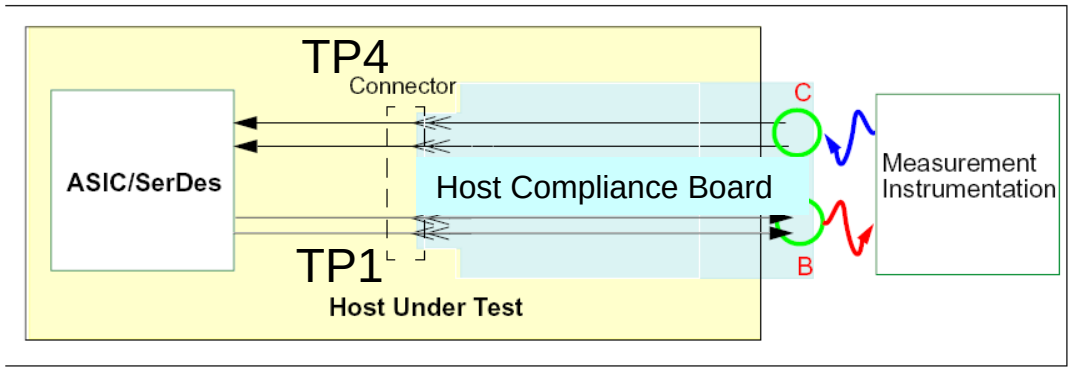
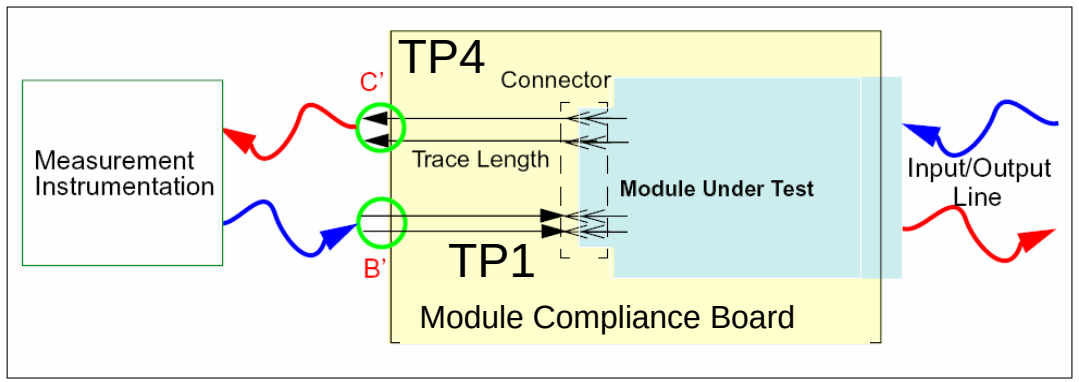
- Petar Pepeljugoski IBM
- Ali Ghiasi Broadcom.

Method typically used for 1GBE

- Host test



- Module test



The exact positions of TP1 and TP4 were not well specified in Clause 38

Comments on previous slide method

- The assumption is that TP1 is equivalent to B on the host testing and B' on the module testing and TP4 is equivalent to C on the host C' on the module. Assumes that the connectors and compliance boards are perfect and lossless
  - OK assumption at 1 GBd, very poor at 10 GBd
- De-embedding the compliance boards is extremely difficult for the key parameters for optical systems
  - jitter including total jitter
  - Eye mask including noise effects
- De-embedding using standard microwave techniques can be used for S-parameter measurements but for simplicity and consistency it is better not to do this for these parameters for the optical system

Purpose of test points

- For compliance testing
  - Must be accessible
  - S-parameters e.g. reflection, transmission specs of a cable
    - Microwave de-embedding is feasible; measurement can be done at a distance to specification point
  - Including sensitivity, eye diagrams and similar with nonlinear electrical-optical converters (PMDs, optical modules)
    - Microwave style de-embedding is not feasible
- For interoperability
  - Must be related to connectors
- For precise results
  - As frequencies increase and higher performance product is specified, have to be more particular about test point definition

Method used in SFF8431(SFP+) and Fibre Channel

- For Outputs: Measure and specify the signals with the compliance board in place.
- For inputs: Calibrate the signals with both compliance boards in place, making the signal more similar to the test for the output signal.
- Compliance boards have fully specified 4 port differential S parameters including crosstalk.

Note for simplicity in the following diagrams the counter-flow signals that create crosstalk are not shown. However in practice they are included.

References.

- SFF-8431 (ftp://ftp.seagate.com/sff/)
- Fibre Channel Physical interface-4 (FC-PI-4) http://www.t11.org/t11/docreg.nsf/alldrflat?OpenView&startkey=FC-PI-4&expandview

Test point definitions 1/2

- TP1, TP2, TP3, TP4 in Clause 38 (Gigabit Ethernet) is well known
  - TP1, electrical: host output, module input
  - TP2, module optical output
    - Actually, 2 m after the MDI
  - TP3: module optical input
  - TP4, electrical: module output, host input
  - TP0, TP5 have been used informally for a some time (at IC within host)
- Clause 39, CX4, also has TP1, TP2, TP3, TP4 (all electrical)
  - TP1: upstream of transmit MDI
  - TP2: just downstream of transmit MDI
  - TP3: just upstream of receive MDI
  - TP4: downstream of receive MDI

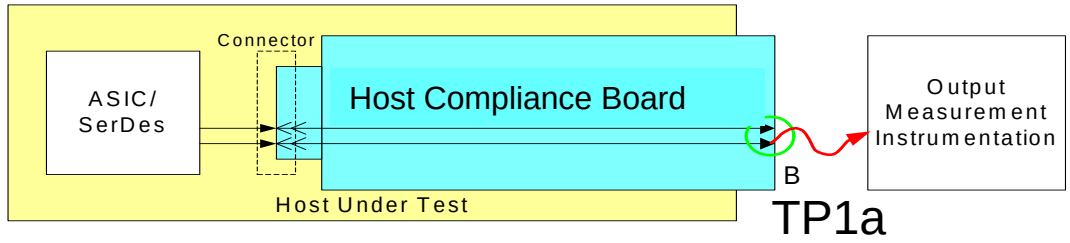
"It is expected that in many implementations TP1 and TP4 will be common between 1000BASE-SX (Clause 38), 1000BASE-LX (Clause 38), and 1000BASE-CX"

Test point definitions 2/2

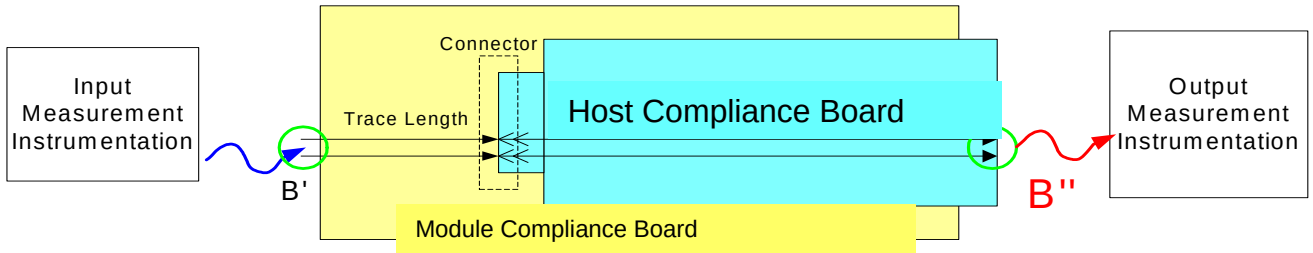
- Fibre Channel up to 4GFC has alpha gamma delta (α_T δ_T γ_T γ_R δ_R α_R)
  - For an optical link,
  - α_T: Output of IC in host
  - δ_T: host output, module input, just downstream of module transmit electrical connector
  - γ_T: module optical output, 2 m after the MDI
  - γ_R: module optical input
  - δ_R: module output, host input, just downstream of module receive electrical connector
- For 8GFC, "just downstream" is taken to mean the input or output of a compliance board with a defined electrical loss
- SFP+ is the same as 8GFC but with different names
- XFP is an earlier, less thorough, version of SFP+

Example for Host output/module input

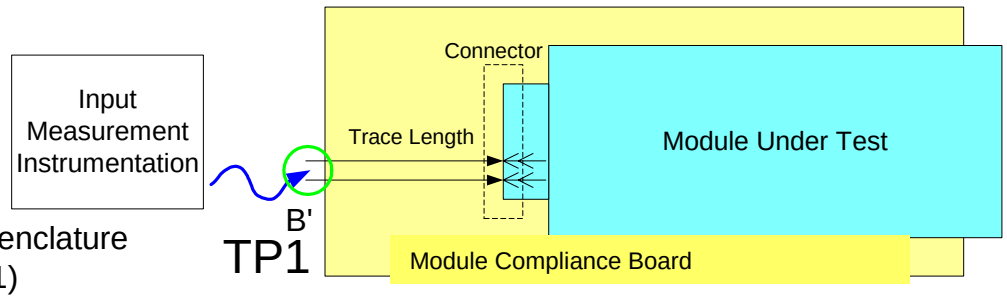
- Host output test:



- Module input test calibration:



- Module test:

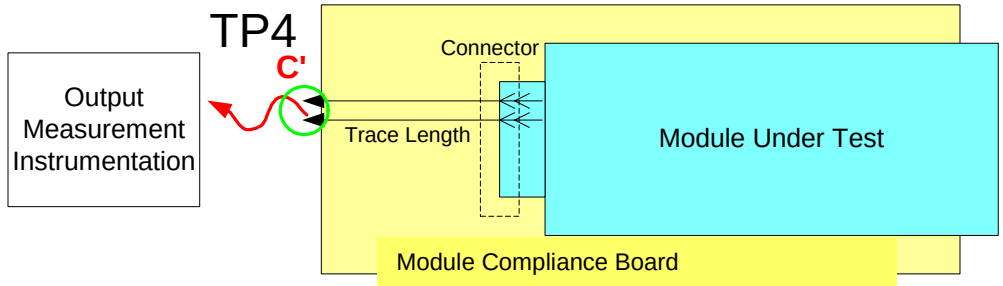


TP1 and TP1a are 802.3ba nomenclature
B, B' and B" are SFP+ (SFF8431)

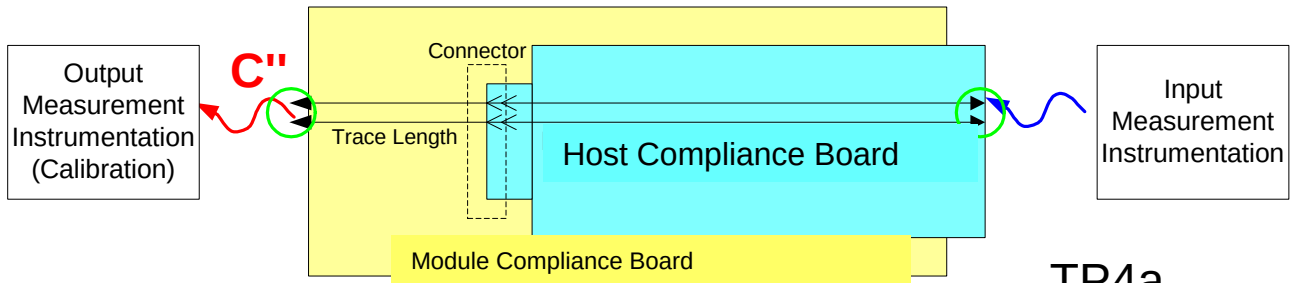
- Advantage: By specifying the input signal calibration at B'' the connector and compliance test board degradations are calibrated out
  - Note that change from calibration to test requires no disconnection of SMA connections

Example for module output/host input

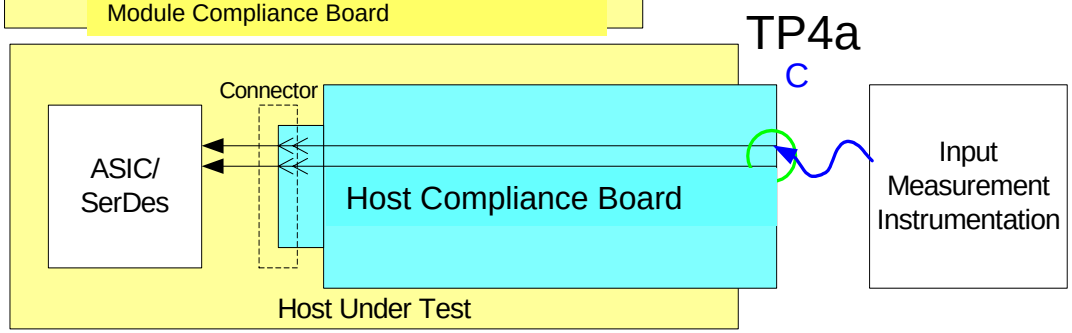
- Module output test:



- Host input test calibration:



- Host test:



TP4 and TP4a are 802.3ba nomenclature
C, C' and C" are SFP+ (SFF8431)

- Advantage: By specifying the input signal calibration at C" the Connector and compliance test board degradations are calibrated out
  - Note that change from calibration to test requires no disconnection of SMA connections

Test points for different sublayers 1/2

- Untimed optical module
  - Use methodology established in SFP+ and 8GFC
- 10GBASE-CR4, 10GBASE-CR10
  - Compatible with above
    - In practice, implementers can choose whether to use specified compliance boards or their own, because CR specs can be de-embedded from one end of a compliance board to the other
- Optical module with CDRs
  - Annex 153A XLAUI / CAUI (*n*AUI for short) is XFP's XFI electrical interface with some second thoughts
  - But it doesn't yet show the connector
  - Use same test points and electrical compliance board specs as for unretimed optical module
  - TP1 and TP4 spec numbers will differ

Test points for different sublayers 2/2

- Other *n*AUI
  - For a pair of ICs to be soldered on a board without a connector, e.g. PCS chip and FEC connected by *n*AUI
  - Assess the ICs on demo boards, sum of trace lengths/losses to equal or exceed target trace length/loss
  - May be able to give some credit (in extra length or loss) for the absence of a connector
- 40GBASE-KR4
  - Have to decide if we want interoperability
  - If so, use compliance board methodology but different connectors may imply different electrical specs (e.g. for reflection and crosstalk)
  - TP0, TP5 at ASIC to be informative
  - TP1-4 related to connector, normative
- Recommend that we revisit the test point Ad Hoc to discuss this further