802.3 25 Gb/s Study Group
Considerations for 25 Gb/s Cable Assembly, Test Fixture and Channel Specifications

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Purpose

- Considerations for 25 Gb/s cable assembly, test fixture and channel specifications consistent with adopted objectives
  - –Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 3m
  - –Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 5m
- Make progress on cable assembly, test fixture and channel specifications pending other PMD/PHY decisions
- PMD/PHY considerations

Cable assembly naming

- CA-L = up to at least 5 meter cable assembly
- CA-S = up to at least 3 meter cable assembly
- Cable assembly with QSFP28 plug = QSFP-CA
- Cable assembly with SFP28 plug = SFP-CA
- Cable assembly with breakout = QSFP-x4SFP-CA

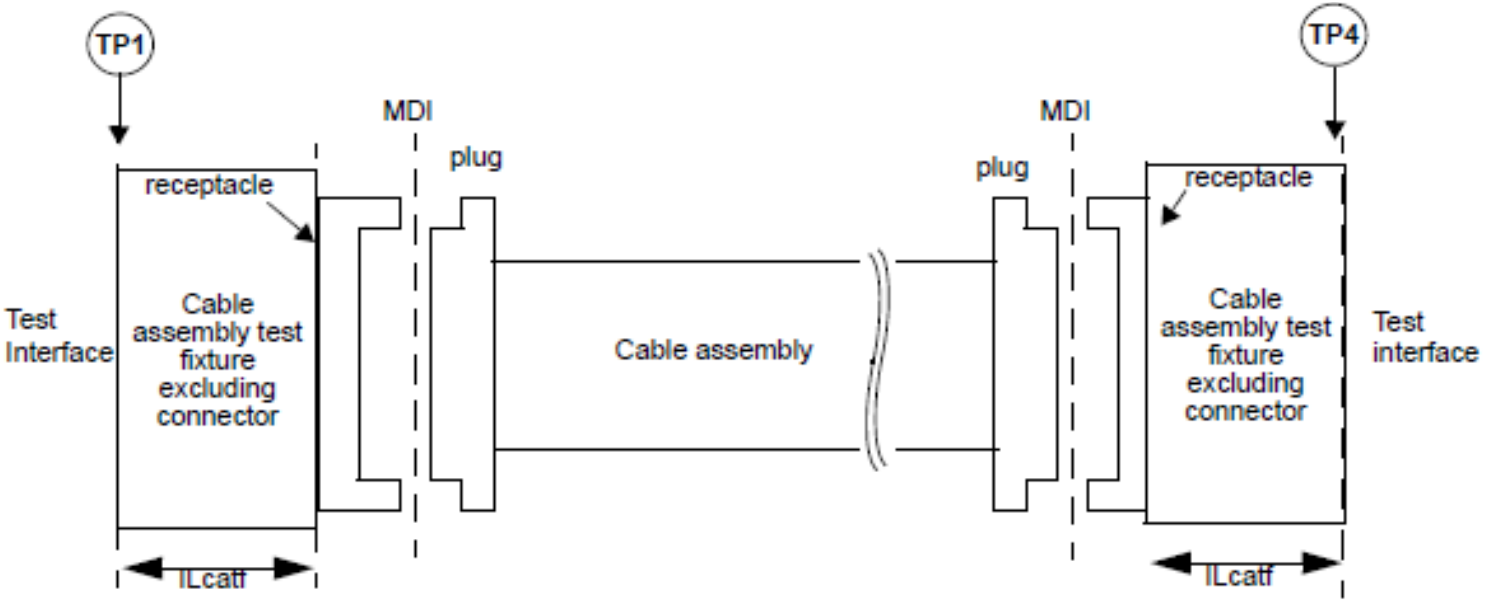
	QSFP-CA (QSFP28)	SFP-CA (SFP28)	QSFP-x4SFP-CA - breakout
CA-L	**5m**	**5m**	**5m**
CA-S	**3m**	**3m**	**3m**

- Note that the cable assembly naming used here is explicit in plug types to avoid ambiguity in short hand notation in developing the standard but may not translate directly into optimal notation to be used in the standard.

25 Gb/s Ethernet – Cable assembly – QSFP-CA-L

Use 802.3bj clause 92

92.10 Cable assembly characteristics
92.10.1 Characteristic impedance and reference impedance
92.10.2 Cable assembly insertion loss
92.10.3 Cable assembly differential return loss
92.10.4 Differential to common-mode return loss
92.10.5 Differential to common-mode conversion loss
92.10.6 Common-mode to common-mode return loss
92.10.7 Cable assembly Channel Operating Margin



25 Gb/s Ethernet – Cable assembly – QSFP-CA-S

Use 802.3bj clause 92 with revisions to 92.10.2 and 92.10.5 to account for length dependent impairments

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92.10.1 Characteristic impedance and reference impedance
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  –Limit specified as Conversion _loss(f)-IL(f)
92.10.6 Common-mode to common-mode return loss
92.10.7 Cable assembly Channel Operating Margin

25 Gb/s Ethernet – Cable assembly – SFP-CA-L

Use 802.3bj clause 92 and implement COM with appropriate crosstalk paths

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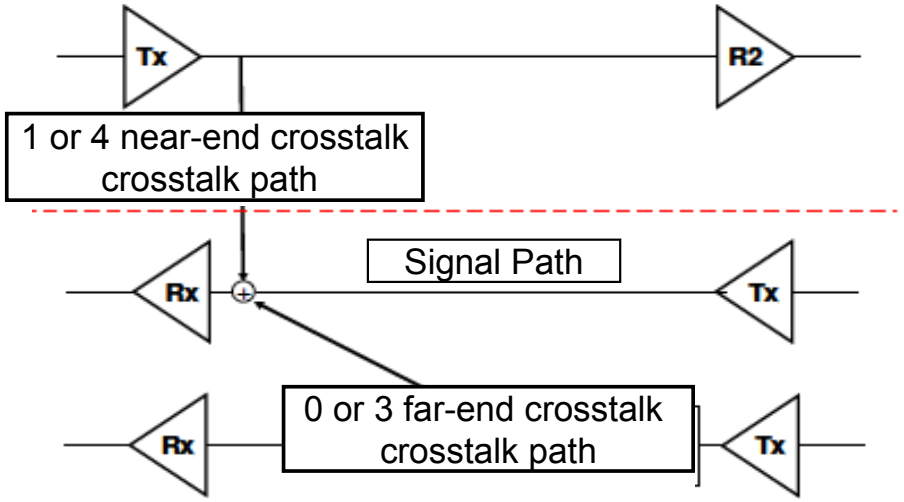
- 92.10.7 Cable assembly Channel Operating Margin



25 Gb/s Ethernet – Cable assembly – SFP-CA-S

Use 802.3bj clause 92 with revisions to 92.10.2 and 92.10.5 to account for length dependent impairments and implement COM with crosstalk paths

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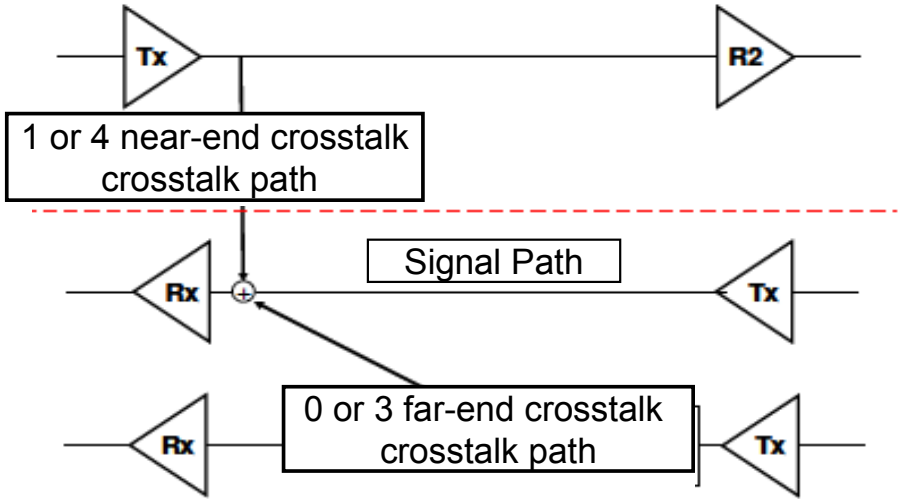

25 Gb/s Ethernet – Cable assembly – QSFP-x4SFP-CA-L

Use 802.3bj clause 92 and implement COM with appropriate crosstalk paths for plug type

92.10 Cable assembly characteristics
92.10.1 Characteristic impedance and reference impedance
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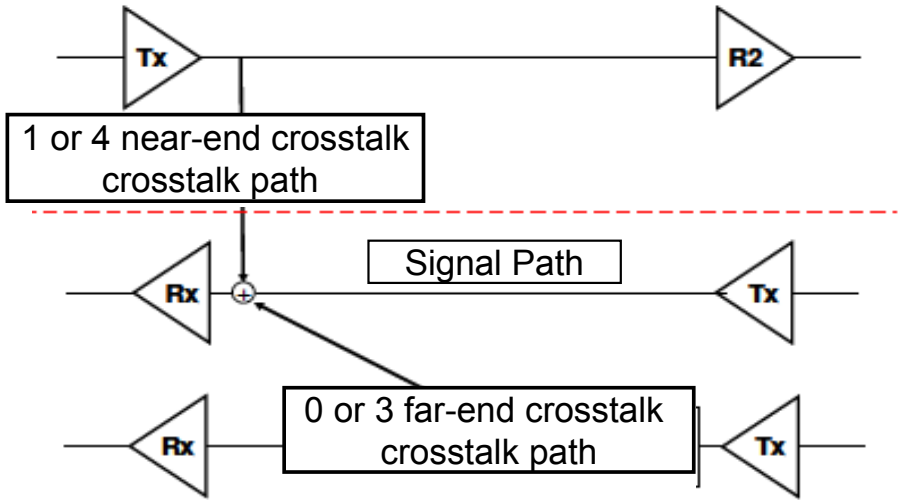
92.10.7 Cable assembly Channel Operating Margin



25 Gb/s Ethernet – Cable assembly – QSFP-x4SFP-CA-S

Use 802.3bj clause 92 with revisions to 92.10.2 and 92.10.5 to account for length dependent impairments and implement COM with appropriate crosstalk paths for plug type

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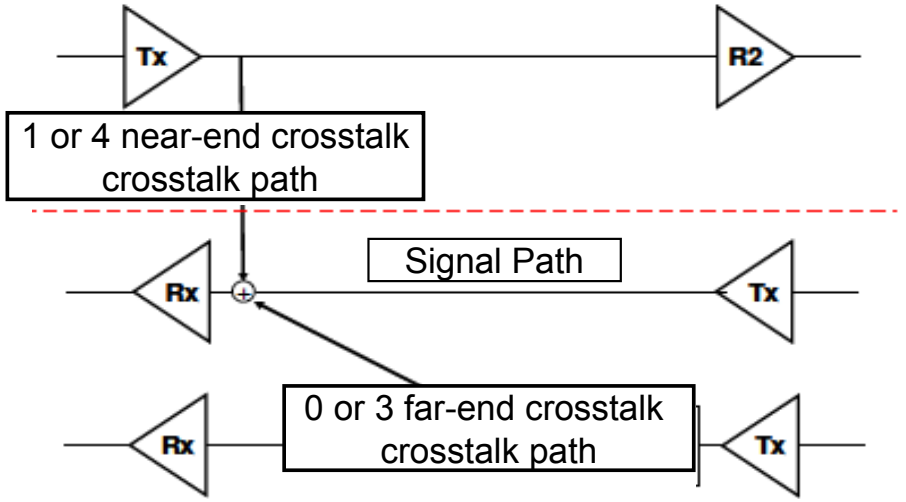
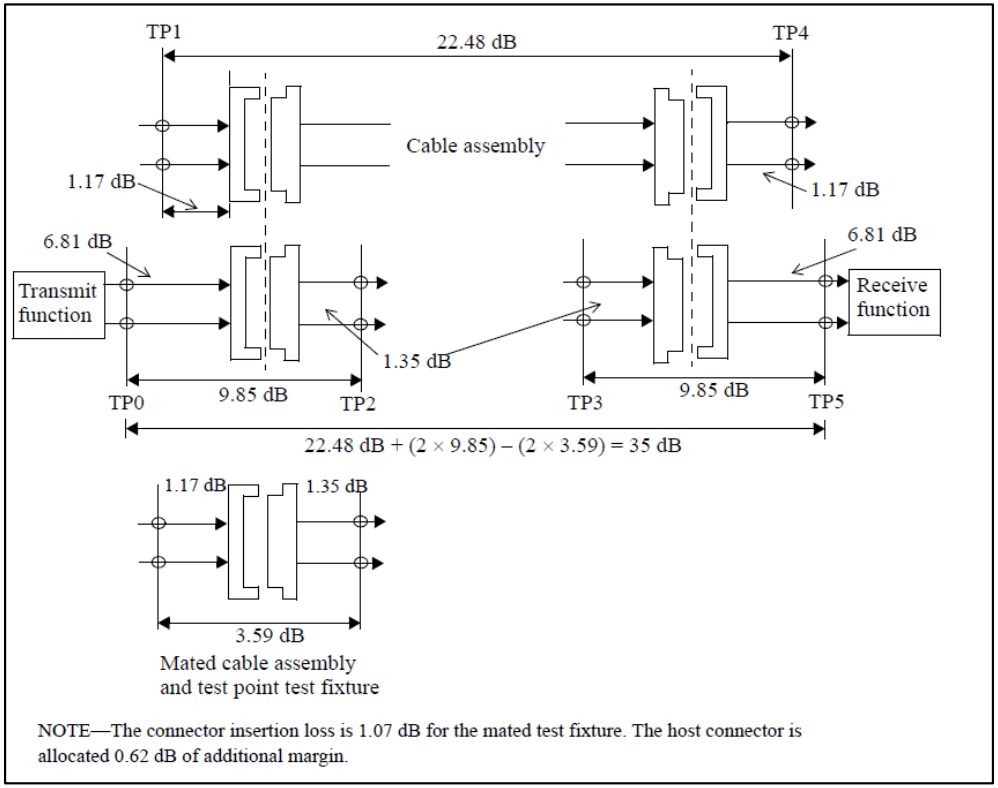


25 Gb/s Channel loss budget 35 dB

- Supports up to at least 5m cable assembly (CA-L) – 802.3bj Host Loss = 6.81 dB
- Supports up to at least 3m cable assembly (CA-S) – 802.3bj Host Loss + 3.6 dB = 10.41 dB
- RS-FEC

	CA-L (35 dB)	CA-S (35 dB)
	dB (@12.8906 GHz)	dB (@12.8906 GHz)
Host connector allocation	1.69	1.69
Host PCB	6.81	10.41
(TP2/TP3) HCB PCB	1.35	1.35
Total Host IL	9.85	13.45
CATF PCB	1.17	1.17
(TP2/TP3) HCB PCB	1.35	1.35
Host connector allocation	1.07	1.07
Total MTF	3.59	3.59
Bulk cable assumed	18	10.8
CATF PCB IL	1.17	1.17
Host connector allocation	1.07	1.07
Cable Assembly	22.48	15.28



- CA-S - 3m cable assembly (bulk cable assumptions need to align with 30 dB budget to enable common 3m cable assembly specifications)

25 Gb/s Channel loss budget 30 dB

- Supports up to at least 3m cable assembly (CA-S) Host Loss = 6.81 dB (TBD) same as 802.3bj
- no RS-FEC

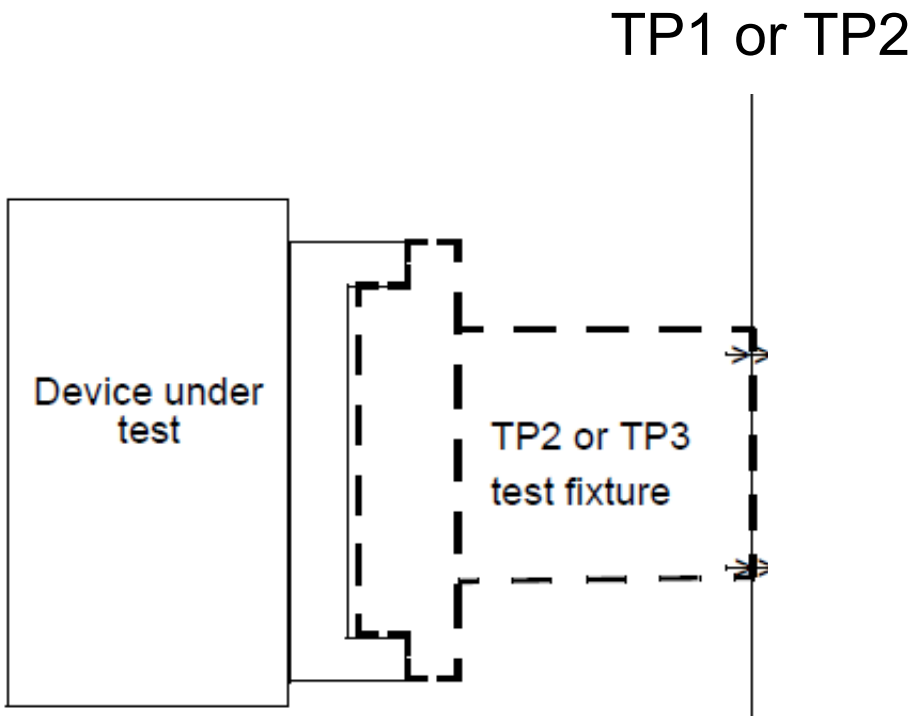
	CA-S (30 dB)
	dB (@12.8906 GHz)
Host connector allocation	1.69
Host PCB	6.81
(TP2/TP3) HCB PCB	1.35
Total Host IL	9.85
CATF PCB	1.17
(TP2/TP3) HCB PCB	1.35
Host connector allocation	1.07
Total MTF	3.59
Bulk cable assumed	13
CATF PCB IL	1.17
Host connector allocation	1.07
Cable Assembly	17.48
Channel	30

- CA-S - 3m cable assembly (bulk cable assumptions need to align with 35 dB budget to enable common 3m cable assembly specifications)

25 Gb/s Ethernet – Test Fixtures

- Use 802.3bj clause 92

92.11 Test Fixtures
92.11.1 TP2 or TP3 test fixtures (Host Compliance Boards)
92.11.1.1 Test fixture return loss (Mated)
92.11.1.2 Test fixture insertion loss (PCB reference insertion loss)



25 Gb/s Ethernet – Test Fixtures

- Use 802.3bj clause 92

92.11.2 Cable assembly test fixture (Module Compliance Board)
>>>PCB reference insertion loss
92.11.3 Mated test fixtures
92.11.3.1 Mated test fixtures insertion loss
92.11.3.2 Mated test fixtures return loss
92.11.3.3 Mated test fixtures common-mode conversion loss
92.11.3.4 Mated test fixtures common-mode return loss
92.11.3.5 Mated test fixtures common-mode to differential-mode return loss
92.11.3.6 Mated test fixtures integrated crosstalk noise

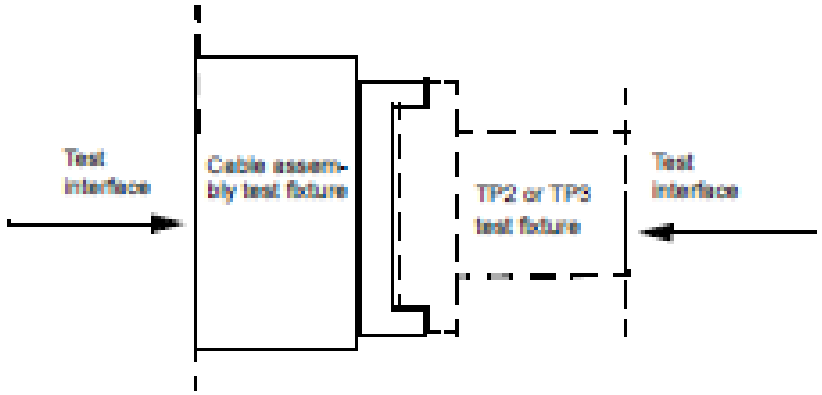
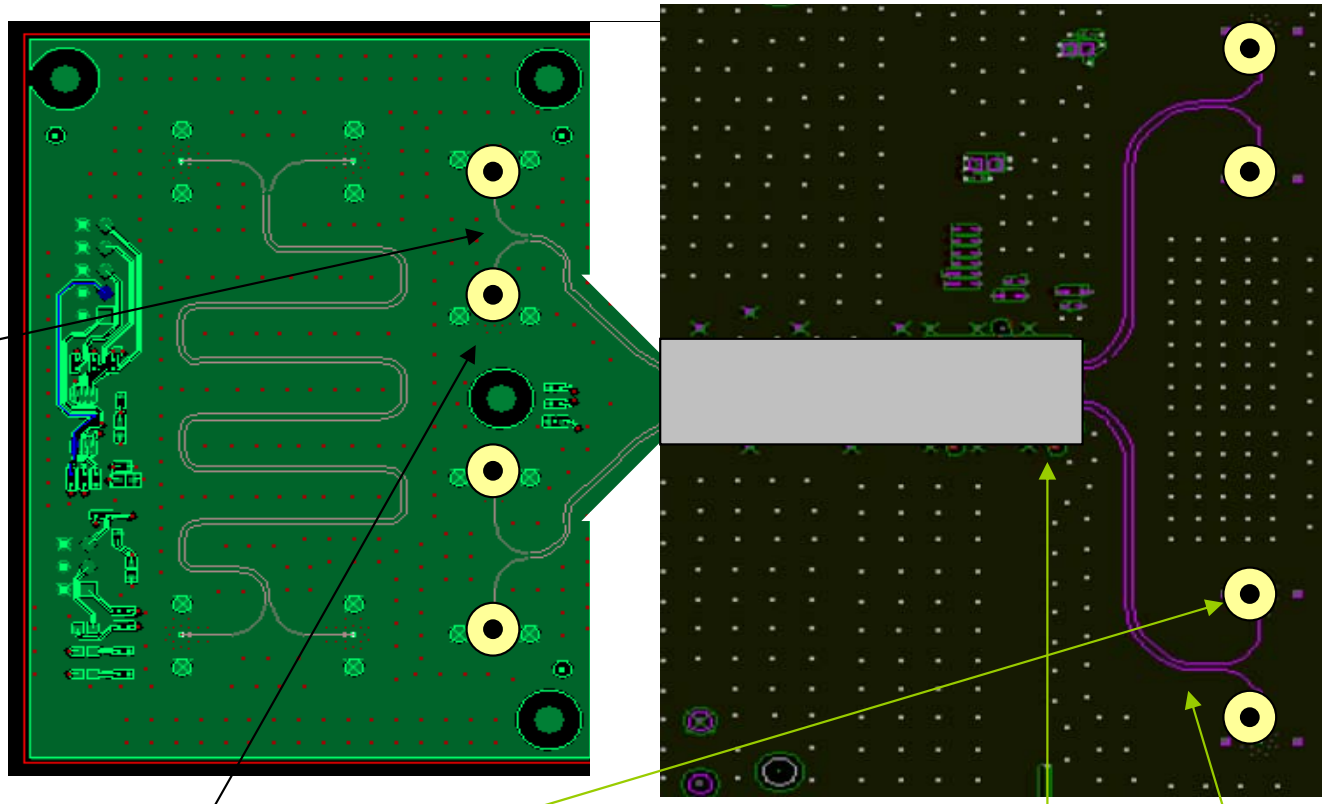


Figure 92–18—Mated test fixtures

zSFP+ mated test fixture HFSS model

HCB HFSS model from board files

MCB HFSS model from board files



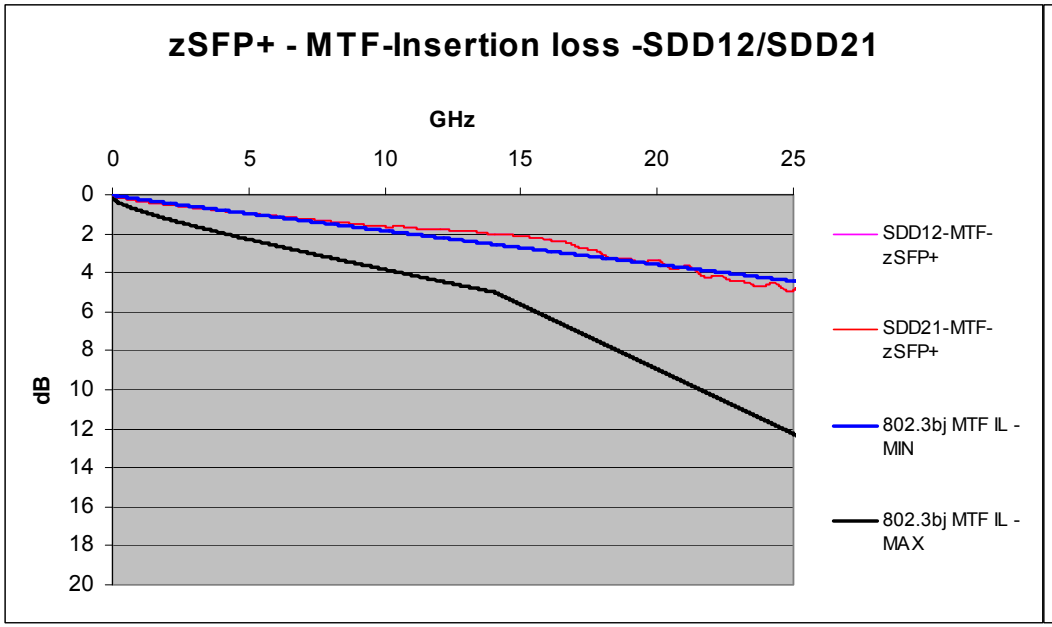
differential pairs ~3”

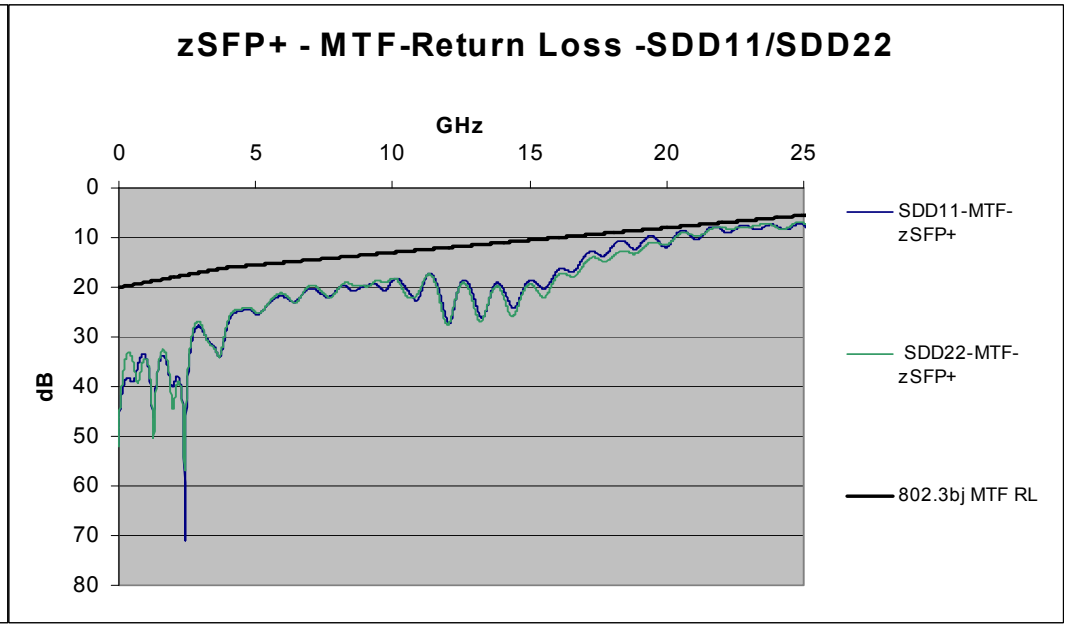
2.92 mm SMA
HFSS model

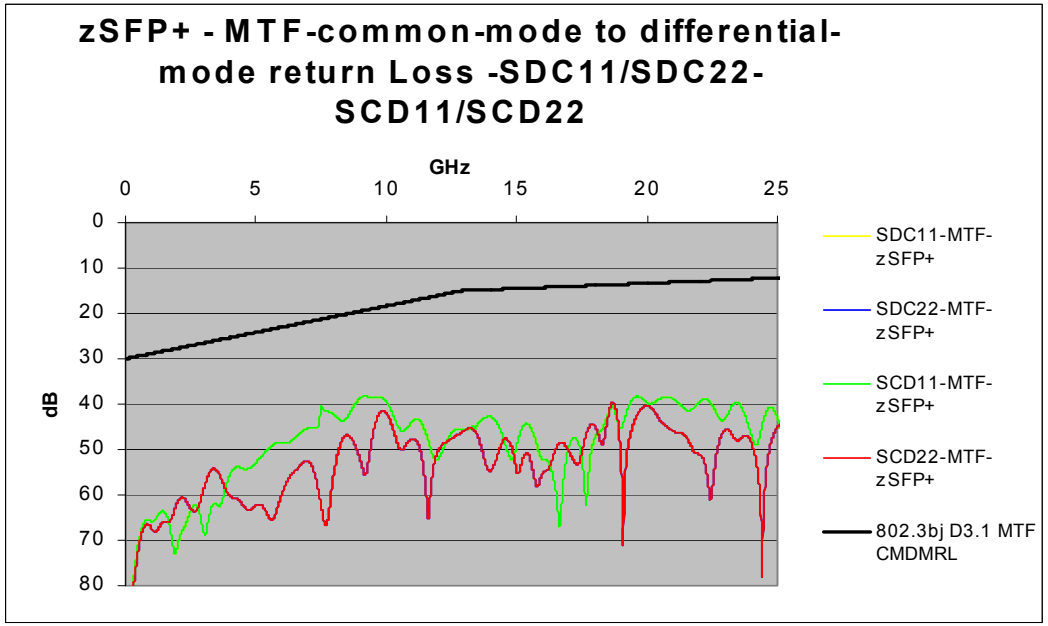
zSFP+ HFSS
Connector model

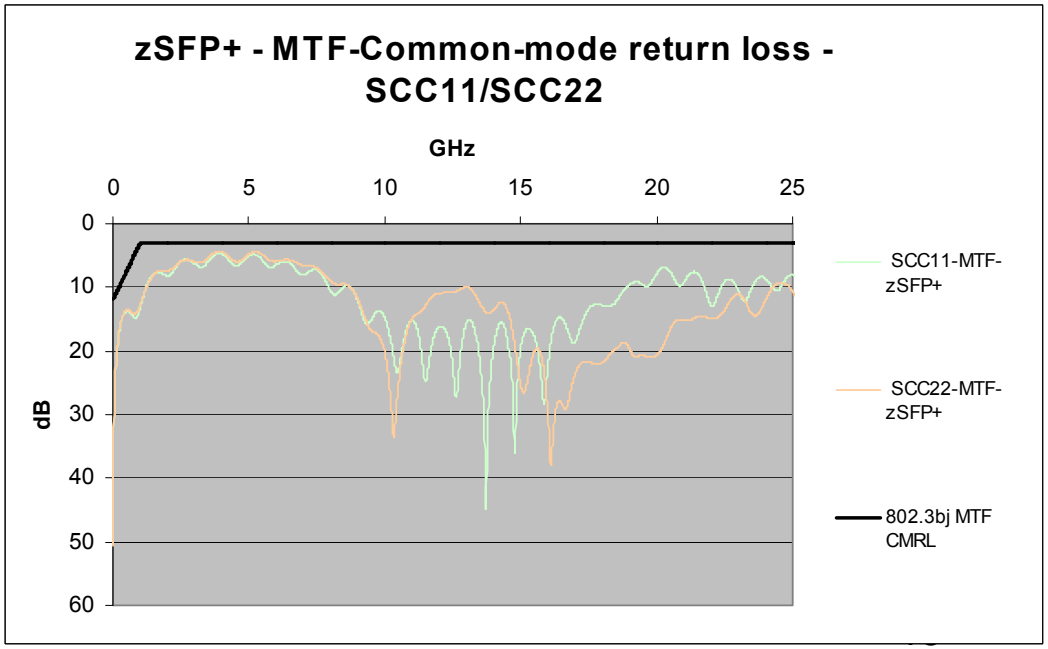
differential pairs ~2”

25 Gb/s Ethernet – HFSS zSFP+ Mated Test Fixtures

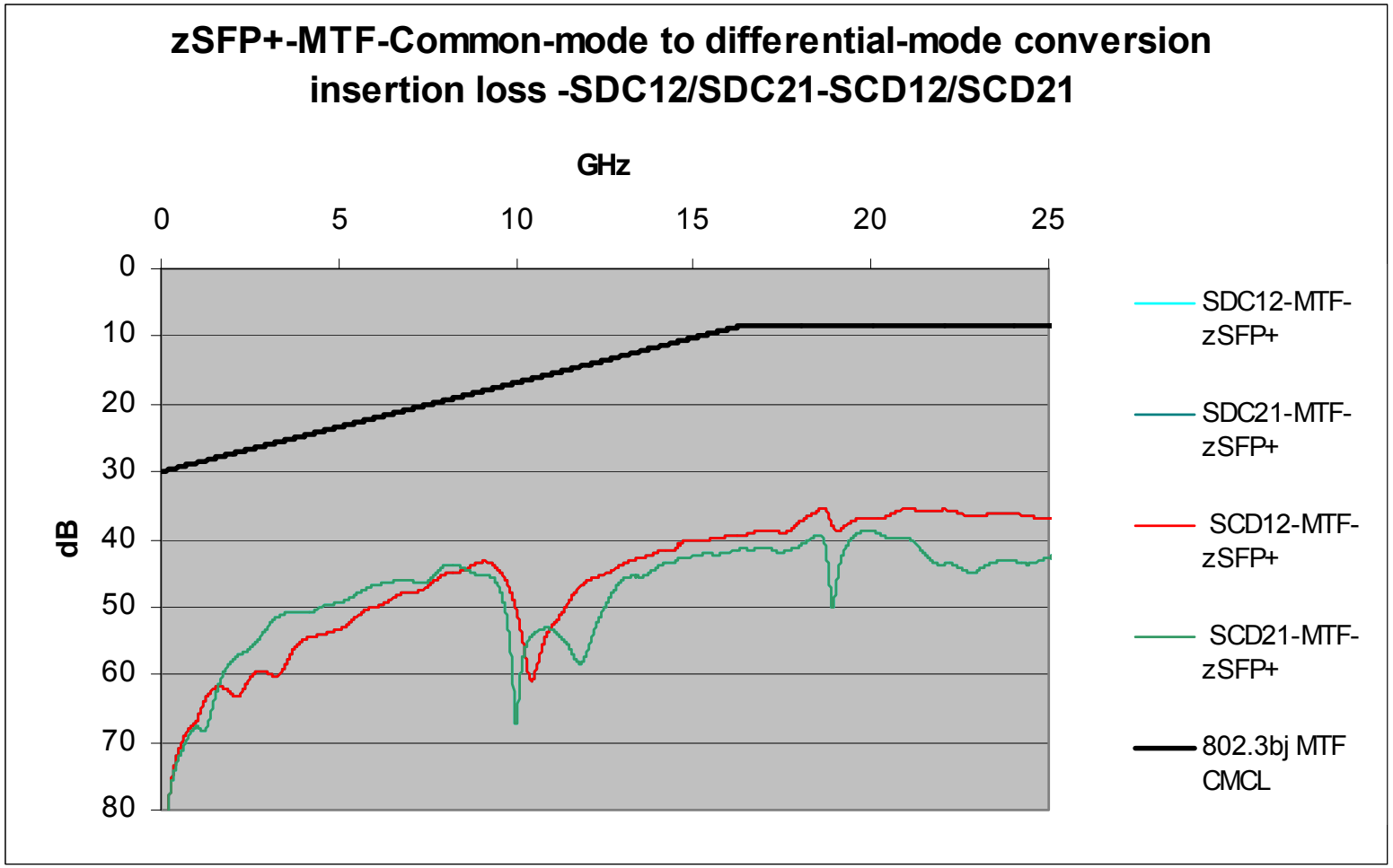








25 Gb/s Ethernet – HFSS zSFP+ Mated Test Fixtures



PHY, PMD's and Options – 802.3bj

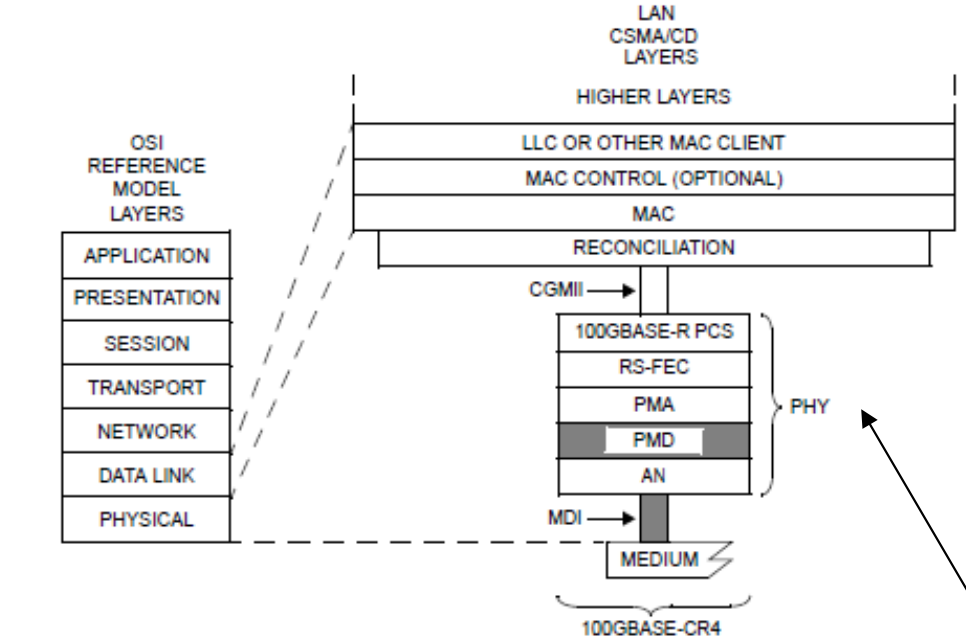


Figure 92–1—100GBASE-CR4 PMD relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 CSMA/CD LAN model

Table 92–1—Physical Layer clauses associated with the 100GBASE-CR4 PMD

Associated clause	100GBASE-CR4
81—RS	Required
81—CGMII[a]	Optional
82—PCS for 100GBASE-R	Required
91—RS-FEC	Required
83—PMA for 100GBASE-R[b]	Required
83A—CAUI	Optional
73—Auto-Negotiation	Required
78—Energy Efficient Ethernet	Optional

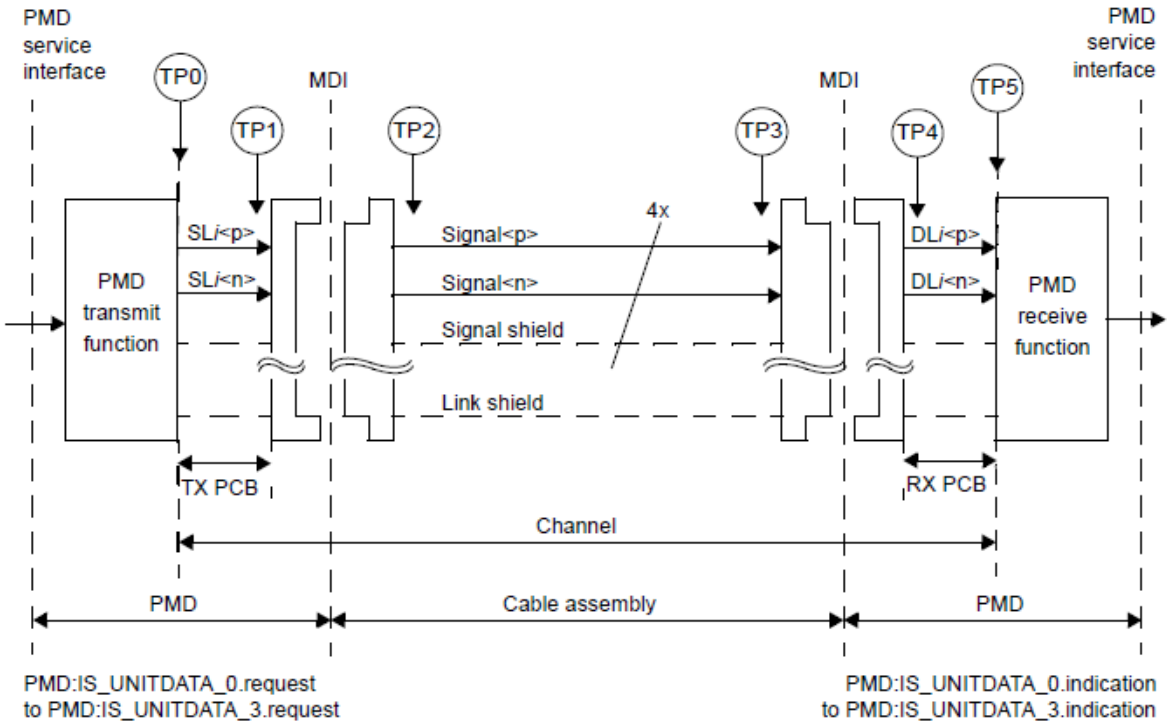
[a]The CGMII is an optional interface. However, if the CGMII is not implemented, a conforming implementation must behave functionally as though the RS and CGMII were present.
[b]There are limitations on the number of PMA lanes that may be used between sublayers, see 83.3.

IEEE Std 802.3bj-2014

Amendment 2—This amendment includes changes to IEEE Std 802.3-2012 and adds Clause 91 through Clause 94 as well as associated annexes. This amendment adds 100 Gb/s Physical Layer (PHY) specifications and management parameters for operation on electrical backplanes and twinaxial copper cables. This amendment also specifies optional Energy Efficient Ethernet (EEE) for 40 Gb/s and 100 Gb/s operation over electrical backplanes and copper cables.

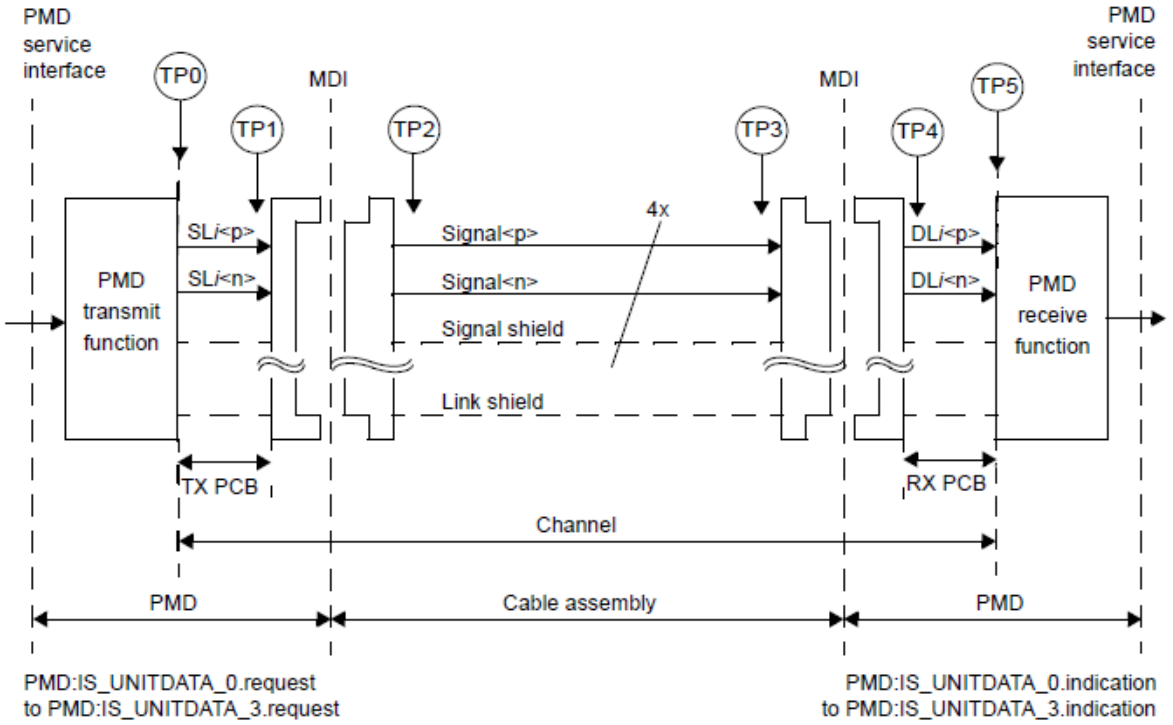
PHY, PMD's and Options – 25 Gb/s

- PMD - Channel loss budget 35 dB (TP0-TP5) [25GBASE-CRF1]
  - –Supports up to at least 5m cable assembly (CA-L) – 802.3bj Host Loss = 6.81 dB
  - –Supports up to at least 3m cable assembly (CA-S) – 802.3bj Host Loss + 3.6 dB = 10.41dB
  - –RS-FEC
  - –Support no RS-FEC mode of operation
  - –Common electrical's (Tx/Rx, etc) for CA-L and CA-S – reuse 802.3bj



PHY, PMD's and Options – 25 Gb/s

- PMD - Channel loss budget 30 dB (TP0-TP5) [25GBASE-CR1]
  - –Supports up to at least 3m cable assembly (CA-S) - 802.3bj Host Loss = 6.81 dB (TBD)
  - –no RS-FEC
  - –Electrical's (Tx/Rx, etc) possibly different than 35 dB Channel PMD



Summary

- Presented 25 Gb/s cable assembly test fixture and channel specifications consistent with adopted objectives
  - –Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 3m
  - –Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 5m
- PMD/PHY considerations - One PHY, two PMDs
  - Two PMD's with common cable assembly specifications (3m and 5m) and for 25GBASE-CRF1 an option for asymmetrical hosts
    - 25GBASE-CRF1 (Mandatory FEC with possible optional FEC mode of operation) -35 dB channel
      - –5m cable assembly = reuse 802.3bj
      - –3m cable assembly = reuse 802.3bj except for IL and possibly conversion loss IL
      - –Tx/Rx reuse 802.3bj
    - 25GBASE-CR1 (no FEC) 30 dB channel.
      - –3m cable assembly = same as 25GBASE-CRF1
      - –Tx/Rx possibly not same as 802.3bj

Summary

- For asymmetrical host:
  - –25GBASE-CRF1 (Mandatory FEC with possible optional FEC mode of operation) -35 dB channel
  - –35 dB channel allocation different than 802.3bj
  - –Cable assembly length (TBD) = 802.3bj except for IL and possibly conversion loss IL for cable assembly length
  - –Tx/Rx reuse 802.3bj