



100 Gbps Copper Cable Measurement and S-Parameter File

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Supporters

Agenda

- Review of prior presentations and data
- Presentation of measured 2m, 26 AWG OSFP cable assembly data
- S-Parameter file review
- Conclusions

Measured Cable Assembly Analysis, & Simulations: Work Done To Date

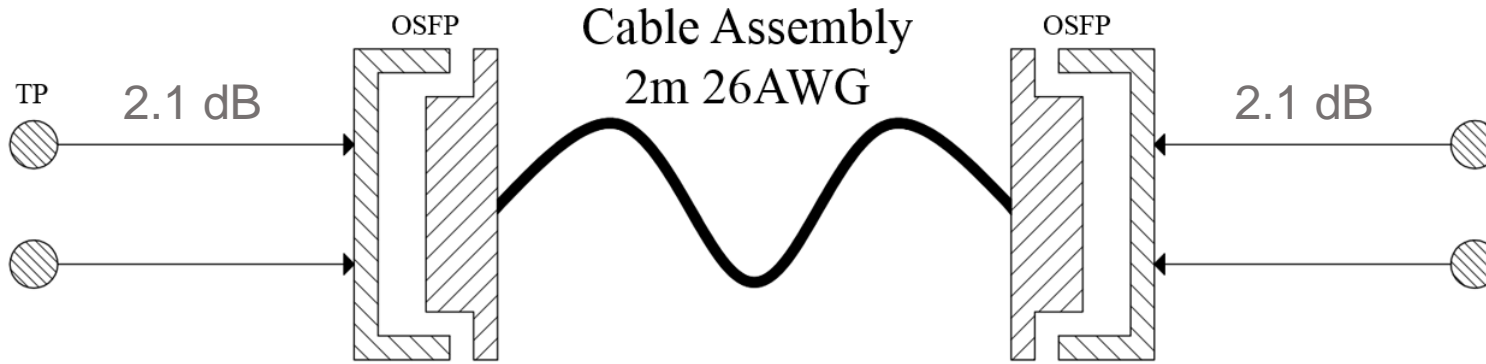
TE has presented cable assembly simulation and measured data previously as our development results have progressed

- tracy_100GEL_01a_0318, recommends 30dB loss budget
- tracy_3ck_02a_1118, suggests there is going to be an issue with the 28dB 2m goal
- February 27, 2019 P802.3ck ad hoc, provided simulation and measured results for a number of cables and configurations, projecting a 19.4 to 20.4 dB loss range of loss for 2m cable assemblies
- tracy_3ck_01a_0319, March 2019, presented some of the Feb 27, 2019 data and contributed two new cable assembly channel S-Parameter simulations for a 1.5m 28AWG cable assembly and a 2m 28AWG cable assembly for working group analysis

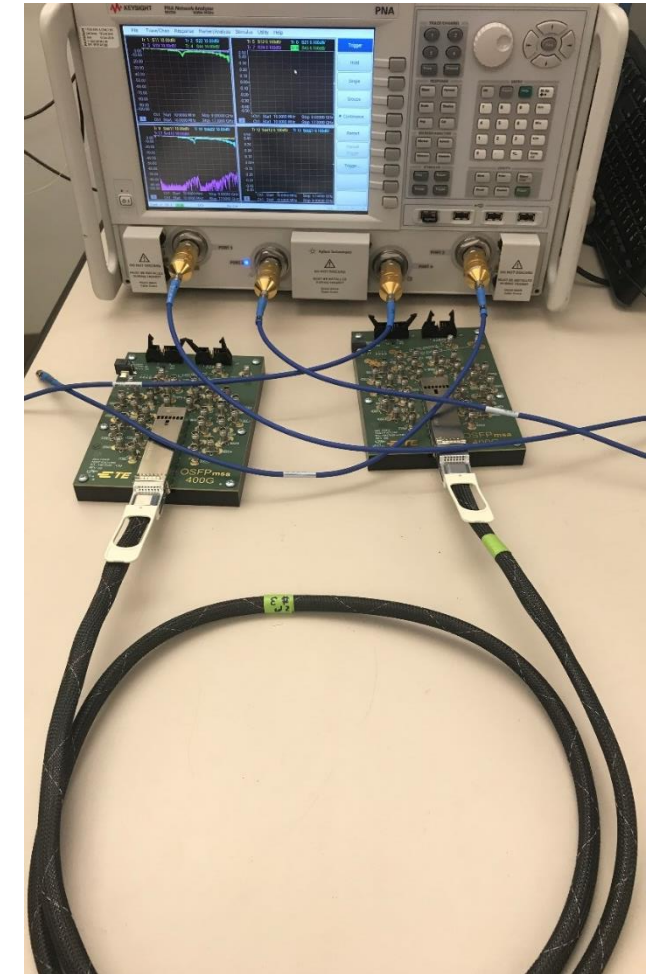
New Work Being Shared

- 2m, 26 AWG OSFP cable assemblies have been built
- Tested with prototype OSFP MCBs and connectors
- MCB trace loss is slightly below draft specification and is approx. 2.1 dB instead of the draft spec. 2.3 dB
 - Slide 7 shows per channel loss limit adjusted by 0.4 dB to 19.6 dB (vs. proposed 20dB) due to MCB loss being low (2 x 0.2 dB)
 - All S-Parameter data is raw measurement and is not adjusted
- S-Parameter files have been contributed as `tracy_3ck_02_0719`

2m, 26AWG OSFP Cable: TP1-TP4 Test Data



- Data taken from TP1 to TP4
- 10 MHz to 50 GHz
- All Thru files and all XT collected



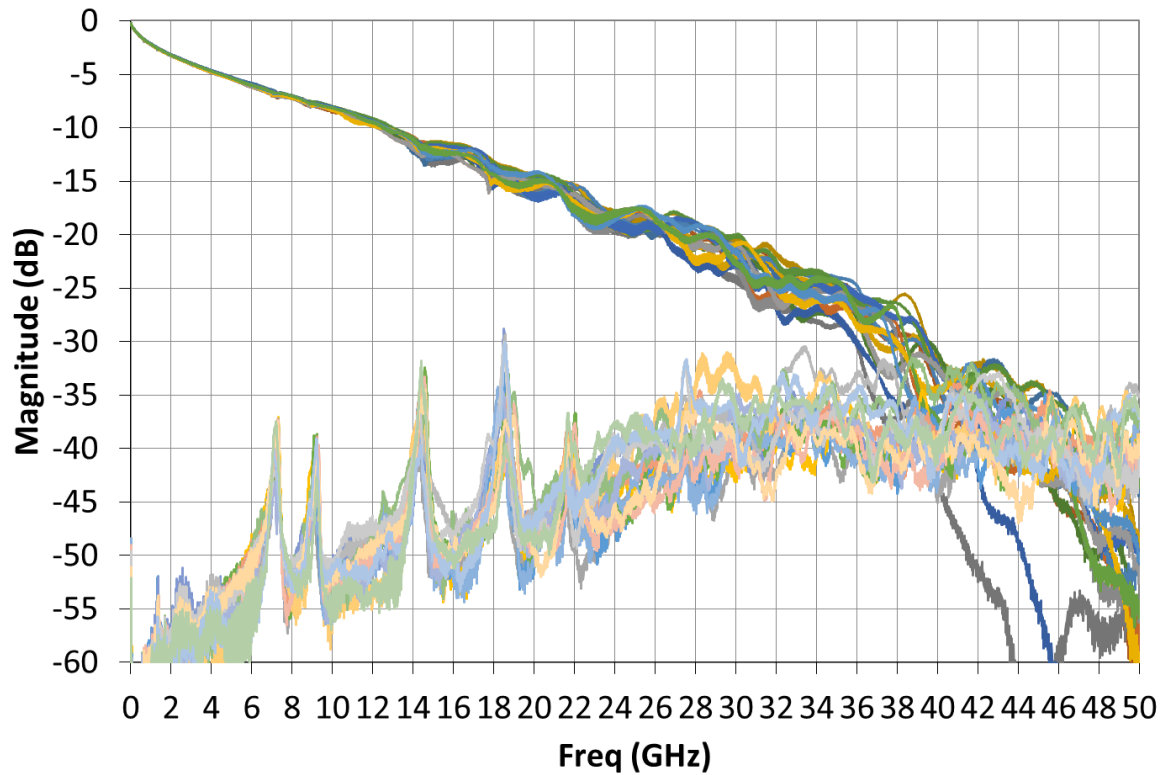
OSFP Pin Map

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------|----|------|------|----|------|------|----|------|------|----|------|------|----|----|----|----|----|----|------|------|----|------|------|----|------|------|----|------|------|----|
| Pin # | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 |
| | G | Tx1+ | Tx1- | G | Tx3+ | Tx3- | G | Tx5+ | Tx5- | G | Tx7+ | Tx7- | G | SB | SB | SB | SB | G | Rx8- | Rx8+ | G | Rx6- | Rx6+ | G | Rx4- | Rx4+ | G | Rx2- | Rx2+ | G |
| | G | Tx2+ | Tx2- | G | Tx4+ | Tx4- | G | Tx6+ | Tx6- | G | Tx8+ | Tx8- | G | SB | SB | SB | SB | G | Rx7- | Rxy+ | G | Rx5- | Rx5+ | G | Rx3- | Rx3+ | G | Rx1- | Rx1+ | G |
| Pin # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

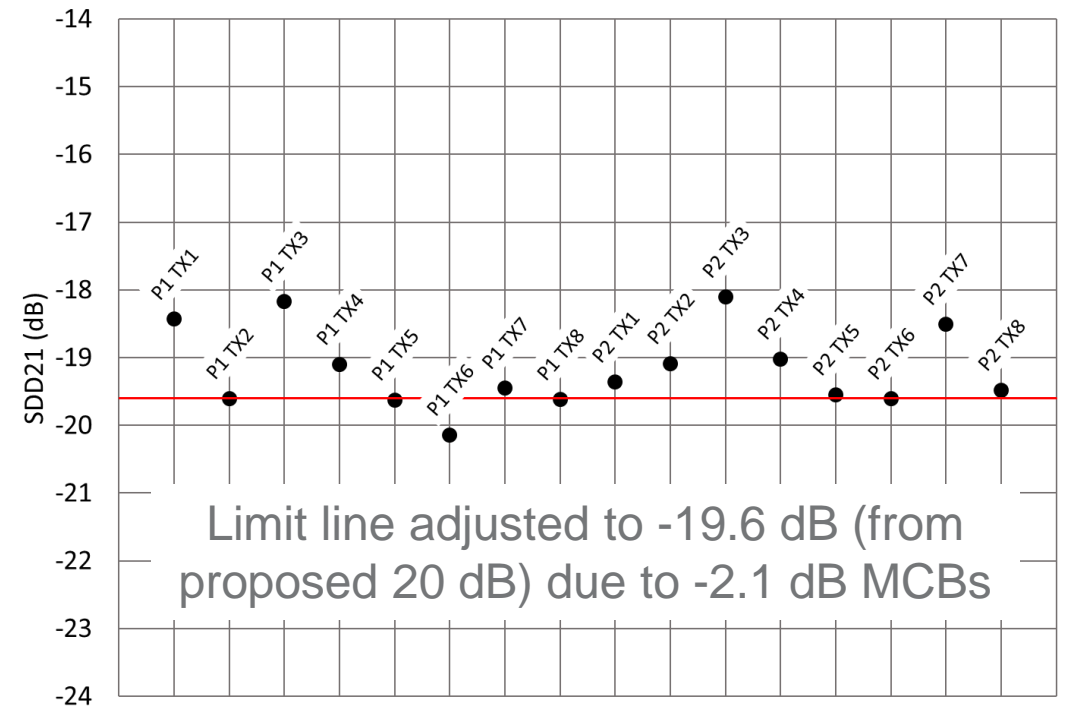
2m, 26AWG OSFP Cable: TP1-TP4 Test Data

- Test data taken using 2.1dB MCBs (Chart on bottom right compensated for this by adjusting limit line by 0.4 dB)
- PSXT includes all aggressors (7 FEXT & 8 NEXT)
- Resonances in crosstalk are from receptacle connector (improvements in development)

SDD21/PSXT of 2m 26AWG OSFP, Tp1-Tp4



Insertion Loss at 26.56 GHz



IL, COM, ERL

Longer host

Used COM 2.70 script
Config file shown later

- Cd = 120 fF
- Ls = 120 pH
- Cb = 30 fF
- 16 fixed taps with 2 banks of 4 up to 80 UI

PCB Length = 102.7 mm*

* Improvements expected with less PCB trace

Case 1

- z_p (Tx) = 12mm
- z_p (Rx) = 12mm

Case 2

- z_p (Tx) = 31mm
- z_p (Rx) = 29mm

| | IL at 26.56 GHz | COM Case 1 | COM Case 2 | ERL 11 | ERL 22 |
|--------|-----------------|------------|------------|--------|--------|
| P1_Tx1 | -18.432 | 4.408 | 3.363 | 10.084 | 9.824 |
| P1_Tx2 | -19.602 | 3.688 | 2.569 | 9.040 | 9.846 |
| P1_Tx3 | -18.171 | 4.731 | 3.768 | 10.586 | 11.172 |
| P1_Tx4 | -19.097 | 4.524 | 3.453 | 8.610 | 9.889 |
| P1_Tx5 | -19.622 | 3.795 | 2.890 | 10.955 | 10.701 |
| P1_Tx6 | -20.143 | 4.237 | 3.086 | 9.556 | 10.383 |
| P1_Tx7 | -19.452 | 3.904 | 2.938 | 10.437 | 8.804 |
| P1_Tx8 | -19.619 | 3.890 | 2.902 | 9.314 | 10.089 |
| P2_Tx1 | -19.359 | 4.867 | 3.728 | 10.867 | 10.949 |
| P2_Tx2 | -19.086 | 4.510 | 3.440 | 10.153 | 10.478 |
| P2_Tx3 | -18.107 | 4.852 | 3.863 | 10.533 | 11.116 |
| P2_Tx4 | -19.017 | 4.408 | 3.440 | 9.562 | 10.100 |
| P2_Tx5 | -19.548 | 3.688 | 2.865 | 10.612 | 9.458 |
| P2_Tx6 | -19.607 | 3.999 | 3.086 | 10.604 | 11.060 |
| P2_Tx7 | -18.508 | 3.768 | 2.938 | 10.449 | 9.696 |
| P2_Tx8 | -19.479 | 3.836 | 2.950 | 9.854 | 10.117 |

Data is not adjusted for low MCB loss. IL is "as measured" and COM / ERL is calculated based on measured data

IL, COM, ERL

Shorter host

Used COM 2.70 script
Config file shown later

- Cd = 120 fF
- Ls = 120 pH
- Cb = 30 fF
- 16 fixed taps with 2 banks of 4 up to 80 UI

PCB Length = **92.7 mm**

Case 1

- z_p (Tx) = 12mm
- z_p (Rx) = 12mm

Case 2

- z_p (Tx) = 31mm
- z_p (Rx) = 29mm

| | IL at 26.56 GHz | COM Case 1 | COM Case 2 | ERL 11 | ERL 22 |
|--------|-----------------|------------|------------|--------|--------|
| P1_Tx1 | -18.432 | 4.657 | 3.596 | 10.084 | 9.824 |
| P1_Tx2 | -19.602 | 3.782 | 2.902 | 9.040 | 9.846 |
| P1_Tx3 | -18.171 | 4.928 | 4.041 | 10.586 | 11.172 |
| P1_Tx4 | -19.097 | 4.702 | 3.755 | 8.610 | 9.889 |
| P1_Tx5 | -19.622 | 3.972 | 3.248 | 10.955 | 10.701 |
| P1_Tx6 | -20.143 | 4.365 | 3.375 | 9.556 | 10.383 |
| P1_Tx7 | -19.452 | 3.986 | 3.299 | 10.437 | 8.804 |
| P1_Tx8 | -19.619 | 4.096 | 3.160 | 9.314 | 10.089 |
| P2_Tx1 | -19.359 | 5.130 | 4.082 | 10.867 | 10.949 |
| P2_Tx2 | -19.086 | 4.792 | 3.702 | 10.153 | 10.478 |
| P2_Tx3 | -18.107 | 5.067 | 4.027 | 10.533 | 11.116 |
| P2_Tx4 | -19.017 | 4.642 | 3.755 | 9.562 | 10.100 |
| P2_Tx5 | -19.548 | 3.958 | 3.110 | 10.612 | 9.458 |
| P2_Tx6 | -19.607 | 4.110 | 3.236 | 10.604 | 11.060 |
| P2_Tx7 | -18.508 | 3.849 | 3.198 | 10.449 | 9.696 |
| P2_Tx8 | -19.479 | 3.945 | 3.160 | 9.854 | 10.117 |

Comments on *tracy_3ck_02_0719* S-Parameter File

S4P files

Data is TP1 to TP4

10MHz to 50 GHz

All thru files and all cross talk included

Included “Read Me” file provides port identification guidance

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------|----|------|------|----|------|------|----|------|------|----|------|------|----|----|----|----|----|----|------|------|----|------|------|----|------|------|----|------|------|----|
| Pin # | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 |
| | G | Tx1+ | Tx1- | G | Tx3+ | Tx3- | G | Tx5+ | Tx5- | G | Tx7+ | Tx7- | G | SB | SB | SB | SB | G | Rx8- | Rx8+ | G | Rx6- | Rx6+ | G | Rx4- | Rx4+ | G | Rx2- | Rx2+ | G |
| | G | Tx2+ | Tx2- | G | Tx4+ | Tx4- | G | Tx6+ | Tx6- | G | Tx8+ | Tx8- | G | SB | SB | SB | SB | G | Rx7- | Rxy+ | G | Rx5- | Rx5+ | G | Rx3- | Rx3+ | G | Rx1- | Rx1+ | G |
| Pin # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

Summary

2m, 26 AWG, TP1 to TP4 OSFP cable assembly measured results have been presented and contributed

Based on multiple cables built, we believe this demonstrates performance that is consistent with the inclusion of manufacturing variations

Supports 20dB loss proposal for TP1 to TP4 cable assembly

Requires 29dB for end to end link, TP0 to TP5, to enable the 20dB cable assembly channel

Further performance improvements will be required, but we have time

S-Parameter files included for working group analysis

Recommendation: use this contributed file to get COM configuration narrowed down