

400Gb/s 2km & 10km duplex SMF NRZ PMD Nominal Specifications

400 Gb/s Ethernet Task Force
802.3 Plenary Session
San Antonio, TX
4 - 6 November 2014
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Background

- Nominal specifications based on:

http://www.ieee802.org/3/bs/public/adhoc/smf/14_10_14/cole_01a_1014_smf.pdf

- The NRZ channel insertion loss is reduced by ½ dB from above because of lower MPI penalty

| | 2km NRZ | 2km PAM-4 | 10km NRZ | 10km PAM-4 |
|----------------------|---------|-----------|----------|------------|
| Channel Loss | 4.0 | 4.0 | 6.0 | 6.0 |
| MPI Penalty | 0.5 | 1.0 | 0.5 | 1.0 |
| Total Insertion Loss | 4.5 | 5.0 | 6.5 | 7.0 |

(See Appendix 2 & 3 for updated summary tables)

- 10km spec. is w/ BCH FEC, but KP4 FEC is viable option
- These specifications are not a final proposal because of insufficient measurements

Transmit Characteristics (duplex SMF)

| Description | 2km NRZ | 10km NRZ | Unit |
|---|---------|----------|-------|
| Signaling Rate, each lane | 53.2 | 55.9 | GBd |
| Operating BER | 2.0E-04 | 1.0E-03 | |
| Total average launch power (max) | 11.7 | 12.2 | dBm |
| OMA, each lane (max) | 2.5 | 3.0 | dBm |
| OMA, each lane (min) | -2.8 | -2.3 | dBm |
| Launch Power in OMA – TDP, each lane (min) | -3.8 | -3.3 | dBm |
| Transmitter and dispersion penalty, (TDP) each lane (max) | 1.8 | 2.3 | dB |
| Extinction ratio (ER) (min) | 4.5 | 4.5 | dB |
| RIN OMA (max) | -130.0 | -130.0 | dB/Hz |
| Transmitter 3dB frequency (min) | 21 | 21 | GHz |
| Optical return loss tolerance (max) | 20.0 | 20.0 | dB |

Receive Characteristics (duplex SMF)

| Description | 2km NRZ | 10km NRZ | Unit |
|--|---------|----------|------|
| Signaling Rate, each lane | 53.2 | 55.9 | GBd |
| Operating BER | 2.0E-04 | 1.0E-03 | |
| Receiver reflectance (max) | -26.0 | -26.0 | dB |
| Receiver Sensitivity (OMA), each lane (max) | -8.3 | -9.8 | dBm |
| Receiver 3 dB electrical upper cutoff frequency, each lane (max) | 42 | 42 | GHz |
| Stressed receiver sensitivity (OMA), each lane (max) | TBD | TBD | dBm |
| Conditions of stressed receiver sensitivity test | TBD | TBD | |
| | | | |
| | | | |
| | | | |

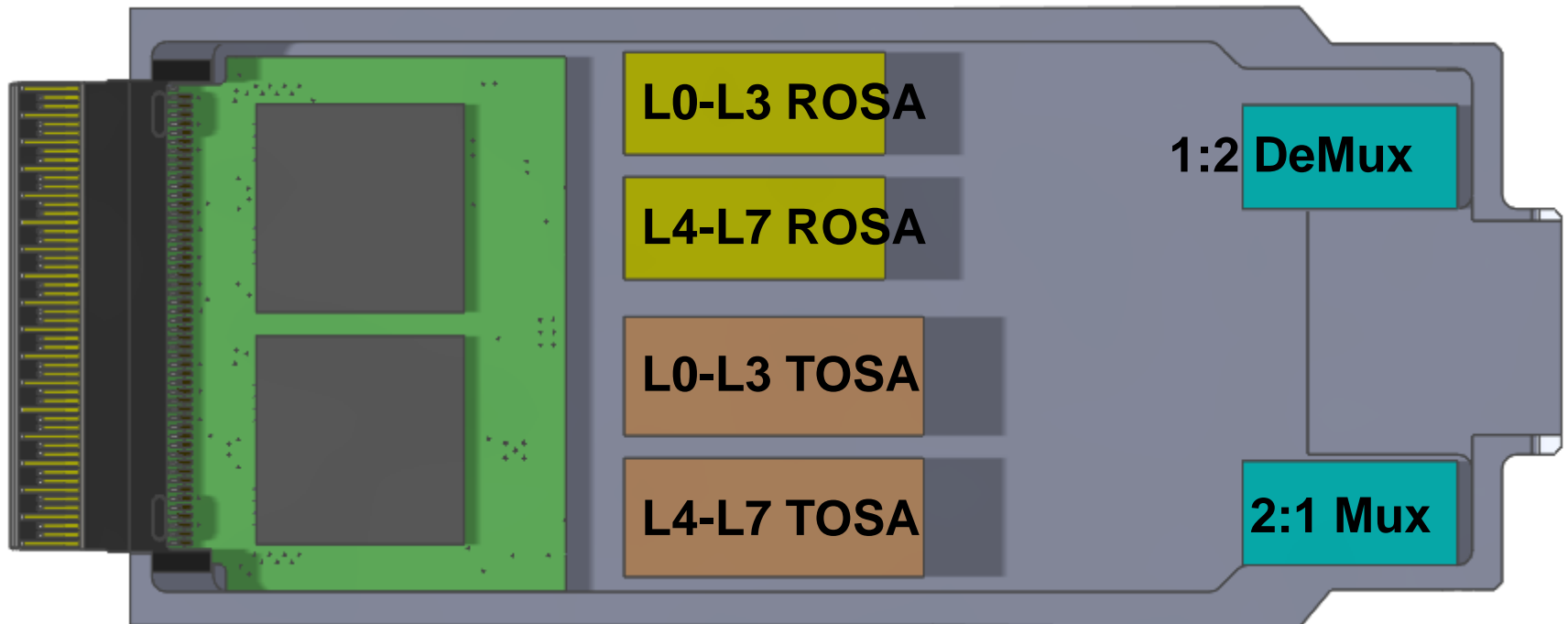
Illustrative Link Power Budgets (duplex SMF)

| Parameter | 2km NRZ | 10km NRZ | Unit |
|---|---------|----------|------|
| Power Budget (for maximum TDP) | 6.3 | 8.8 | dB |
| Operating Distance | 2.0 | 10.0 | km |
| Channel Insertion Loss | 4.5 | 6.5 | dB |
| Maximum Discrete Reflectance | -26.0 | -26.0 | dB |
| Allocation for Penalties (for maximum TDP) | 1.8 | 2.3 | dB |
| Allocation for Modulation Penalties | 0.0 | 0.0 | dB |

WDM Lane Assignments

| Lane | Center Frequency THz | Center Wavelength nm | Wavelength Range nm |
|------|----------------------|----------------------|---------------------|
| L0 | 231.4 | 1295.56 | 1294.53 to 1296.59 |
| L1 | 230.6 | 1300.05 | 1299.02 to 1301.09 |
| L2 | 229.8 | 1304.58 | 1303.54 to 1305.63 |
| L3 | 229.0 | 1309.14 | 1308.09 to 1310.19 |
| L4 | 235.4 | 1273.55 | 1272.55 to 1274.54 |
| L5 | 234.6 | 1277.89 | 1276.89 to 1278.89 |
| L6 | 233.8 | 1282.26 | 1281.25 to 1283.28 |
| L7 | 233.0 | 1286.66 | 1285.65 to 1287.69 |

Appendix1: Example Gen1 400G CFP2 Layout



Appendix 2: 2km Duplex SMF PMDs Specs

| Specifications | NRZ 4x25G LR4 No FEC MOD / DML | 8x50G NRZ KP4 FEC MOD | 8x50G PAM4 KP4 FEC MOD / DML | 4x100G BCH FEC PAM4 MOD | 4x100G DMT BCH FEC 25G DML |
|---|--------------------------------------|-----------------------------|------------------------------------|-------------------------------|----------------------------------|
| Symbol (or Sample) Rate Gbaud (or GS) | 25.8 | 53.2 | 26.6 | 55.9 | 55.9 |
| Operating BER | 1.0E-12 | 2.0E-04 | 2.0E-04 | 1.0E-03 | 1.0E-03 |
| ER Full Scale (min) dB | 4.0 | 4.5 | 4.5 | 7.0 | 4.5 |
| TX OMA (min) @TDP (max) dBm | -0.1 | -2.0 | -0.5 | 1.0 | 2.5 |
| Modulation Penalty (MP) dB | 0.0 | 0.0 | 5.0 | 5.0 | 9.0 |
| TDP (max) dB | 2.2 | 1.8 | 1.0 | 2.0 | 2.5 |
| TX OMA - MP -TDP each lane (min) dBm | -2.3 | -3.8 | -6.5 | -6.0 | -9.0 |
| Channel Insertion Loss & MPI penalty dB | 6.3 | 4.5 | 5.0 | 5.0 | 5.0 |
| RX Sens. OMA pre-FEC each lane (max) dBm | -8.6 | -8.3 | -11.5 | -11.0 | -14.0 |

Appendix 3: 10km Duplex SMF PMDs Specs

| Specifications | NRZ 4x25G LR4 No FEC MOD / DML | 8x50G NRZ BCH FEC MOD | 8x50G PAM4 BCH FEC MOD / DML | 4x100G BCH FEC PAM4 MOD | 4x100G DMT BCH FEC 25G DML |
|---|--------------------------------------|-----------------------------|------------------------------------|-------------------------------|----------------------------------|
| Symbol (or Sample) Rate Gbaud (or GS) | 25.8 | 55.9 | 28.0 | 55.9 | 55.9 |
| Operating BER | 1.0E-12 | 1.0E-03 | 1.0E-03 | 1.0E-03 | 1.0E-03 |
| ER Full Scale (min) dB | 4.0 | 4.5 | 4.5 | 7.0 | 4.5 |
| TX OMA (min) @TDP (max) dBm | -0.1 | -1.0 | 0.0 | 1.0 | 2.5 |
| Modulation Penalty (MP) dB | 0.0 | 0.0 | 5.0 | 5.0 | 9.0 |
| TDP (max) dB | 2.2 | 2.3 | 1.5 | 2.5 | 3.0 |
| TX OMA - MP -TDP each lane (min) dBm | -2.3 | -3.3 | -6.5 | -6.5 | -9.5 |
| Channel Insertion Loss & MPI penalty dB | 6.3 | 6.5 | 7.0 | 7.0 | 7.0 |
| RX Sens. OMA pre-FEC each lane (max) dBm | -8.6 | -9.8 | -13.5 | -13.5 | -16.5 |

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Thank you

