

# P802.3cd Clause 138 hazard level recommendations

P802.3cd Interim meeting, May 2017

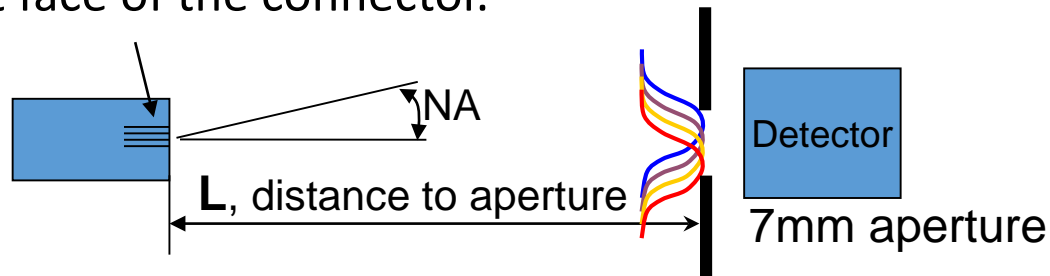
Richard Johnson and Jonathan King, Finisar

# Laser safety assessment

- 50GBASE-SR, 100GBASE-SR2, 200GBASE-SR4
  - Max average power per lane is +4 dBm
  - MDI: Optical connectors assumed to be the same as either 100GBASE-SR4 and 10GBASE-SR
- Applicable standards:
  - IEC 60825-1 Edition 3.0 (May 2014)
    - Hazard level 1: Upper limit for average laser power based on power measured through a 7mm diameter aperture placed 100 mm from the front face of the connector (100 mm test distance).
  - IEC 60825-1 Edition 2.0 (March 2007) - will be superseded by edition 3.0 in Europe
    - Single laser on, Hazard level 1M: Upper limit for average laser power based on power measured through a 7 mm diameter aperture, 100 mm test distance.
    - Multiple lasers on, Hazard level 1: Upper limit for average laser power based on power measured through a 7 mm diameter aperture, 100 mm test distance.
  - IEC 60825-2 Edition 3.2 December 2010
    - Hazard level 1M: Upper limit for average laser power based on power measured through a 7 mm diameter aperture, 100 mm test distance.

# Example of 100GBASE-SR4 laser safety analysis

- 100GBASE-SR4 classified as Hazard level 1M
- Contribution from Richard Johnson (Finisar) to P802.3bm MMF ad hoc, August 21<sup>st</sup> 2014
  - [http://www.ieee802.org/3/bm/public/mmfdhdc/meetings/aug21\\_14/100GBASE-SR4lasersafetyassessment.pdf](http://www.ieee802.org/3/bm/public/mmfdhdc/meetings/aug21_14/100GBASE-SR4lasersafetyassessment.pdf)
- Testing of 100GBASE-SR4 (with MPO receptacle) showed a 9 dB ratio between the power measured at the MPO connector vs the power collected through a 7mm diameter aperture placed 100 mm from the front face of the connector.



# 100GBASE-SR4 laser safety analysis recap

- The safety limits for VCSEL light depend upon the precise wavelength; it is most restrictive at the shortest wavelength; for 100GBASE-SR4 this is 840 nm.
- There are also different limits depending on how many lasers are on at any given time. The details of this calculation are given in IEC 60825-13 in clause 7.5.4.3.
- Max average power per fibre of 100GBASE-SR4 is +2.4 dBm
- At 100 mm test distance, the power captured by the 7 mm aperture is some 9 dB lower, for a predicted power per laser of  $2.4 - 9 = -6.6$  dBm = 0.22 mW. With two lasers turned ON, the captured power doubles to 0.44 mW, etc.

7 mm aperture, 100 mm test distance			
Number of lasers ON	Total expected power transmitted through 7 mm diameter aperture, mW	Max test limit at 840nm, mW	Ratio to limit
1	0.22	0.75	29%
2	0.44	1.00	44%
3	0.66	1.61	41%
4	0.88	2.21	40%

# 50GBASE-SR, 100GBASE-SR2 & 200GBASE-SR4 laser safety

- Following 100GBASE-SR4 methodology
- Max average power per fibre of 100GBASE-SR4 is +4 dBm
- At 100 mm test distance, the power captured by the 7 mm aperture is some 9 dB lower, for a predicted power per laser of  $4 - 9 = -5$  dBm = 0.316 mW. With two lasers turned ON, the captured power doubles to 0.632 mW, etc.

7 mm aperture, 100 mm test distance*			
Number of lasers ON	Total expected power transmitted through 7 mm diameter aperture, mW	Max test limit at 840nm, mW	Ratio to limit
1	0.316	0.75	42.1%
2	0.632	1.00	63.2%
3	0.948	1.61	58.9%
4	1.264	2.21	57.2%

\*Test conditions correspond to:

Hazard level 1M for IEC 60825-2, Edition 3.0 (September 2010)

Hazard level 1 for single laser, or 1M for multiple lasers, for IEC 60825-1, Edition 2.0 (March 2007)

Hazard level 1 for IEC 60825-1, Edition 3.0 (May 2014)

# Recommendation

- Based on the max average power per lane of +4 dBm and MPO geometries for multi-lane implementations, 50GBASE-SR, 100GBASE-SR2 and 200GBASE-SR4 PMDs can be consistent with a Hazard level 1M classification for IEC 60825-2, Edition 3.2 (December 2010).