



Laser Safety Standards Update and Impact on 850 nm Serial PMD

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1

IEC 60825 Part 1 - Basic Std

- Defines
 - Laser Classes, Exposure Levels & Times, Tests
- IEC Technical Committee 76 Revision Progress
 - Committee Draft for Vote (CDV) approved 9/99
 - Only one negative vote
 - comments not impacting new classifications
 - Final Draft International Standard (FDIS) due 4/00
 - CDV comment incorporation in progress
 - Expected to take effect around 9/00
- Modifies Classification Requirements

2

IEC 60825 Part 1 Changes

- New Classes
 - Class 1 = safe even if viewed with instruments
 - Class 1M = safe if not using instruments (new)
- Uses New Maximum Permissible Exposures
 - biologically safe limits defined by International Committee on Non-Ionizing Radiation Protection (ICNRP)
- Increases Accessible Emission Limits (AELs)
 - Derived from new MPEs
 - Set at 100 second exposure duration

3

Class 1 AEL Example

At 840 nm on 50 μm MMF (NA = 0.20)

$$P_{1,\text{AEL}} = 3.9 \times 10^{-4} (10^{0.002(840 - 700)}) = 0.743 \text{ mW}$$

For Class 1, $r = 14 \text{ mm}$, at which distance the beam diameter d_{63} is

$$d_{63} = \frac{2r\text{NA}}{1.7} = \frac{2(14)(0.20)}{1.7} = 3.294 \text{ mm}$$

The fraction of the total emitted power (P_a) that passes through a 7 mm measurement aperture at 14 mm is

$$P_a = P_0 \left[1 - e^{-\left(\frac{7}{3.294}\right)^2} \right] = 0.989$$

The maximum emitted power for Class 1 is $0.743 / 0.989 \text{ mW}$

$$= 0.751 \text{ mW} = -1.24 \text{ dBm}$$

a 2.46 dB increase over today's limit

4

Class 1M AEL Example

At 840 nm on 50 μm MMF (NA = 0.20)

$$P_{1,\text{AEL}} = 3.9 \times 10^{-4} (10^{0.002(840 - 700)}) = 0.743 \text{ mW}$$

For Class 1, $r = 100 \text{ mm}$, at which distance the beam diameter d_{63} is

$$d_{63} = \frac{2rNA}{1.7} = \frac{2(100)(0.20)}{1.7} = 23.53 \text{ mm}$$

The fraction of the total emitted power (P_a) that passes through a 7 mm measurement aperture at 100 mm is

$$P_a = P_0 \left[1 - e^{-\left(\frac{7}{23.53}\right)^2} \right] = 0.085$$

The maximum emitted power for Class 1M is $0.743 / 0.085 \text{ mW}$
 $= 8.77 \text{ mW} = 9.43 \text{ dBm}$

a **13.1 dB increase** over today's Class 1 limit

5

IEC 60825 Part 2 - Optical Fiber Communications Systems Std.

- Defines
 - Limitations on classes of energy accessible at different locations (controlled, restricted, unrestricted)
- IEC Technical Committee 76 Revision Progress
 - Final Draft International Standard (FDIS) approved 12/99
 - Expected publication 3/00
 - Further updates when Part 1 approved (classification realignment)
- Modifies and Relaxes shutdown times for determination of Hazard Level

6

FDA / CDRH Std. 21 CFR 1040

Performance Stds for Light Emitting Products

- Appears to be evolving to adopt IEC standards
 - Chairman of IEC TC76 is also the prime laser safety official at FDA
 - **Harmonize with expected IEC standard** except for LEDs which will not be regulated at this time
 - Public review process may take at least a year
 - Manufactures must comply for sales to US market
 - **FDA will probably grant variances** for products that are safe under IEC rules until then

7

ANSI Z136 - "Safe Use" Standards

- Applies to User not Manufacturers
 - Pertinent to safe use of lasers / occupational safety
- Expected to evolve to commonality with IEC standards
 - Currently voting on older version (no change to classification scheme) with new IEC changes in appendix.
 - As soon as IEC is approved, ANSI will revise to harmonize – will occur within a year of IEC approval.

8

Impact on 850 nm Serial PMD

- Keep present 8 dB power budget
- Use additional transmit power to reduce receiver sensitivity specification

Parameter	Present Proposal	Will Become	Units
Tx avg launch power (max)	-3.7	-1.3	dBm
Tx avg launch power (min)	-8.0	-5.5	dBm
Rx sensitivity	-16.0	-13.5	dBm
Power Budget	8.0	8.0	dB