Classification of Laser/LED Arrays Under IEC 60825-1

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ABSTRACT
The classification of an array of laser or LED sources under the 2001 IEC 60825-1 standard can be a complicated process. It is necessary to determine the most restrictive case for various combinations of source geometry within the array. This paper presents an approach to solving that problem for typical array patterns.

The first step is to determine the combinations of source geometry with the greatest density of sources - one of those is likely to be the most restrictive case. The next step is to calculate the angular subtense for each of these combinations from the source and array dimensions. This value and the data supplied on the source emission can then be used to calculate the allowable power/energy per source for each combination. The geometry of sources within the array with the minimum value of that parameter will be the most restrictive case.

<u>IEC 60825-1:2001 Requirements</u>

Includes both LED and laser arrays

Consider all geometric combinations within array, and select patterns of highest source density

Determine allowable power per source for selected patterns

Use most restrictive result to determine class or allowable power

<u>Information Needed</u>

Array geometry and center-to-center spacing of sources

Data on individual sources

Power level, wavelength, and any pulse parameters

Source dimension and beam divergence (1/e values)

<u>Analysis Approach</u>

1. Select the patterns likely to be the most restrictive

Those with highest density of sources

Complexities:

Varying source power, size, or wavelength

Non-Uniform array geometry

Wavelengths in photochemical hazard region (< 550 nm)

2. Calculate angular subtense of apparent source (α) for each selected pattern:

Add source spacing to 1/e source diameter to obtain X and Y dimensions of pattern (See Note below)

Calculate angular subtense values α_X and α_Y at 100 mm distance from those dimensions, and then $\alpha_{Ave} = (\alpha_X + \alpha_Y)/2$, with minimum values of α_X, α_Y = 1.5 mrad

3. Find Accessible Emission Limit (AEL) for desired class for each selected pattern

AEL = 0.7 C4 C6/(T2)$^{1/4}$ mW (most cases for Class 1, 1M)

Use α_{Ave} to find classification time T_2 from IEC formula

Use α_{Ave} to find correction factor $C_6 = \alpha_{Ave}/1.5$

Calculate C_4 from wavelength and IEC formula

Divide by number of sources in the pattern to obtain AEL_{source}

4. Calculate allowable measured power for each pattern

Find measurement distance r from α_{Ave} and IEC formula, or use r = 100 mm for Class 1M or 2M

Use (1/e) beam divergence and r to determine actual beam diameter at measurement distance

Calculate fraction η collected in measurement aperture of 7 mm (for most cases)

Determine allowable power per source $P_S = AEL_{source}/\eta$

Result

The pattern with the minimum value of P_s is the most restrictive. (For many arrays with spacing > 5-10 source dimension, a single source is the most restrictive pattern.)

The total power allowed for an array of n sources is then P_s x n for the class being evaluated

Note:
This is one proposal to determine the angular subtense values of laser/LED arrays that is being discussed in the IEC TC-76 committee. Recommended approach(es) should be confirmed in a document to be published.

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