

10x10G VCSEL Array Feasibility Issues

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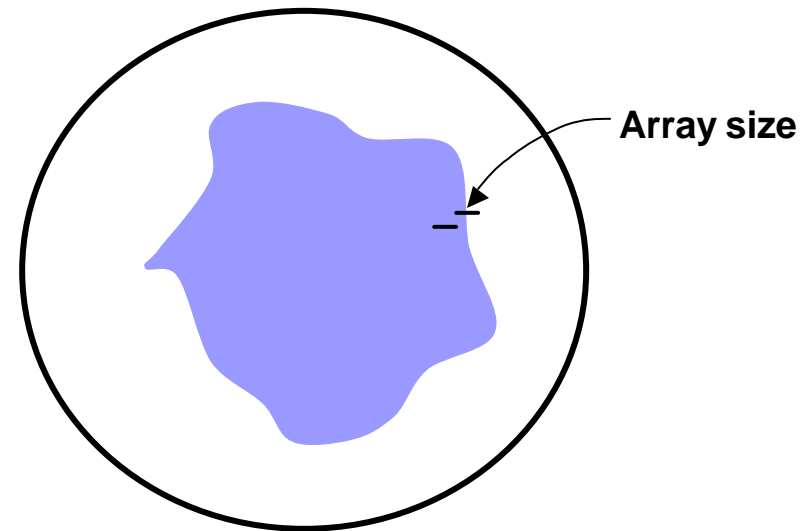
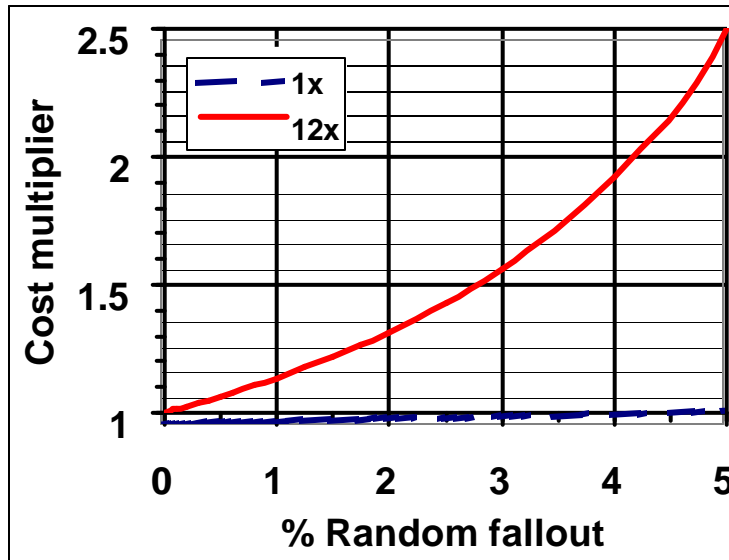
General Comments

- **General principles described apply equally to 850nm VCSEL arrays, 1310nm VCSEL arrays, 1550nm DFB arrays, etc.**
- **Yield/reliability penalty for going from 1x to 12x is:**
 - **Heavy for random failures (unless they're small)**
 - **Slight for non-random failures**
- **10x and 12x used interchangeably until # channels is defined**

Economic Feasibility - VCSEL Yields

10x10G VCSEL yield suggested as main cost feasibility issue

- VCSEL array is only a small portion of a 10x10G overall cost (same applies to 1x10G and 12x2.7G)
- Random microscale fallout:
 - 12x a small number is still a small number - not significant factor
- Areal-dependent performance fallout:
 - Affects 1x and 12x similarly (slight penalty for 12x)



Array yield will not be a significant cost factor

Technical Feasibility - 10x10GVCSEL Reliability

Wearout Time (Depends on uniformity)

- Perfect uniformity ® 12x same as 1x
- Exp. reports: 12x wearout time ~1/2 as for 1x

Random Failures

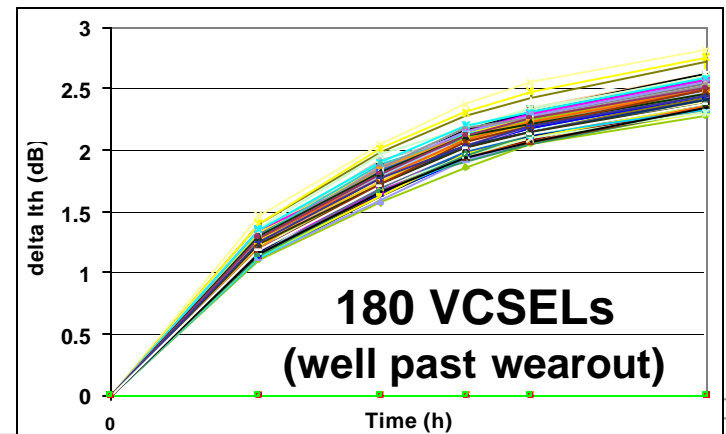
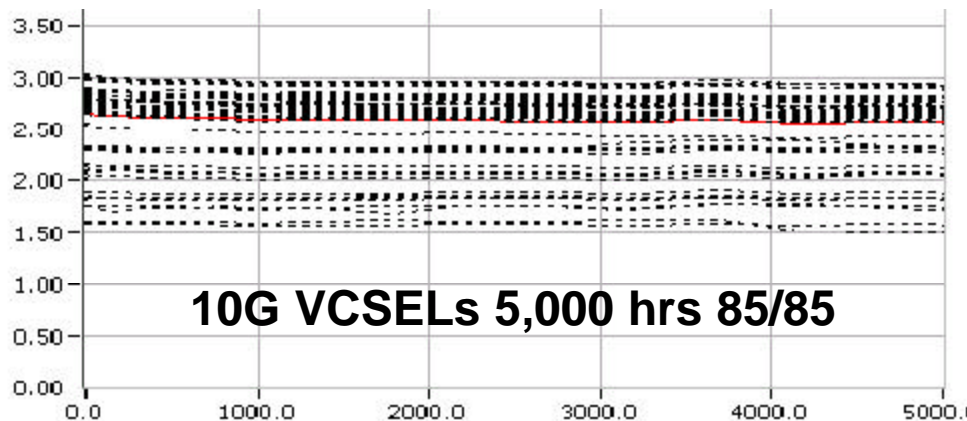
- 12x array failure rate nearly 12 times the 1x failure rate
- Virtually all “random” failures are eliminated through burn-in

ESD-Related Failures

- Above-threshold ESD events damage 1x and 12x about equally

Non-Hermetic Packaging

- 12x3G VCSELs robust to harsh environments



10x10G VCSEL Feasibility - Data, Conclusions

Burn-in Fallout

- 12x3G only slightly higher than 1x3G
- 1x10G only slightly higher than 1x3G
- \ 10x10G fallout expected to be only slightly higher than 12x3G

Field Data

- For 1x10G and 12x3G products (10^4 - 10^6 each), Picolight has not experienced any failures due to VCSEL manufacture/technology

Expectation

- 10G VCSEL technology will mature to the level that 3G is today

Conclusions

- The 10x10G VCSEL arrays will be there for 100Gig Ethernet
- The 10x10G VCSEL arrays will be cost effective
- The 10x10G VCSEL arrays will be reliable