Accelerated Lifetime Test Of Opto-Boards

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Accelerated Lifetime Test

- Industry standard: opto-boards should survive for 1,000 hours at 85°C/85% relative humidity
  - operate each VCSEL channel with 10 mA (pk-pk)
  - perform weekly measurements
Accelerated Lifetime Test-Phase I

- Started the test with two IBL boards in Feb. 2014
  - All VCSEL channels survived
  - Both PIN arrays became leaky before 1,000 hours
    - PIN biased at 10 V
    - ULM photonics: recommend operating at 5 V even though spec. sheet lists bias as up to 10 V

Spike in dark currents
Accelerated Lifetime Test-Phase II

- June/July 2014: started four D opto-boards in 85°C/85% RH
  - 2 boards fabricated in 6/2013 (early production)
  - 2 boards fabricated in 12/2013 (late production)
  - PIN arrays biased at 10 V in ~4 days of burn-in/thermal cycle
    - No leaky PIN arrays for 5 V bias for over 2,000 hours!!
Accelerated Lifetime Test-Phase II

- One VCSEL on board 4014 failed between 1,740 and 2,266 hours

Wirebond broken during cleaning

One VCSEL failure

black spot in aperture (not dirt)
Accelerated Lifetime Test-Phase II

- One VCSEL on board 4022 died between 1,740 and 2,266 hours

Board dropped

One VCSEL failure

black spot near aperture (not dirt)
Accelerated Lifetime Test-Phase II

- VCSEL optical power OK up to 2,086 hours in 85°C/85% RH
Accelerated Lifetime Test-Phase III

- November 2014: started four D opto-boards in 50°C/50% RH
  - Boards fabricated throughout production (4041, 4209, 4151, 4311)
  - Run VCSELs at 40 MHz (50% duty cycle), 10 mA pk-pk
  - Have accumulated 1,246 hours running time
Accelerated Lifetime Test-Phase III

- VCSEL optical power stable during 1,246 hours in 50°C/50% RH
Accelerated Lifetime Test-Phase III

- VCSEL optical power stable during 1,246 hours in 50°C/50% RH
Summary

- Production opto-boards passed accelerated lifetime test at 85°C/85% RH
  - VCSEL and PIN arrays survived for at least 1,740 hours
  - Significantly longer than industrial minimum of 1,000 hours
- Have accumulated 1,246 hours of test at 50°C/50% RH
  - Will continue this study for at least two years