



# Opto-Packs for On-Detector Pixel Opto-Links

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# Outline

- Opto-pack design
- Production experience
- Summary



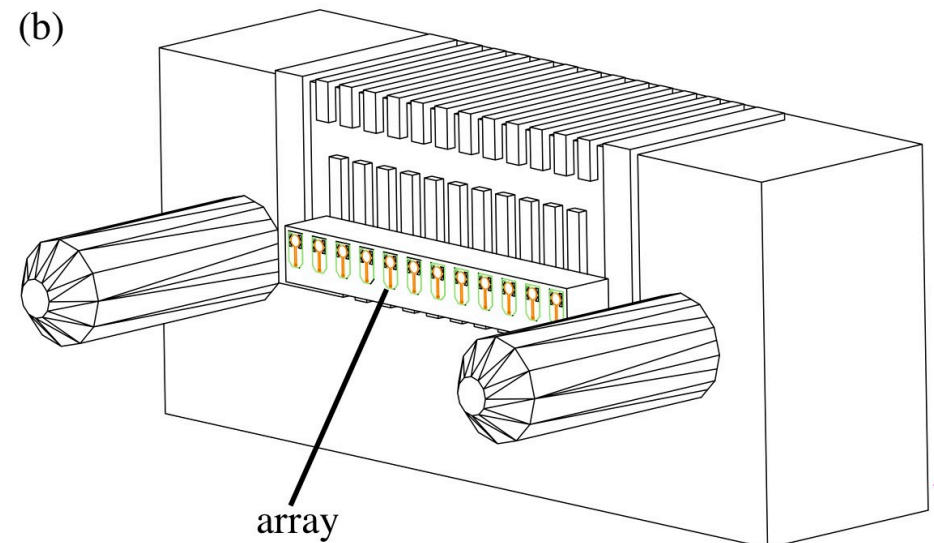
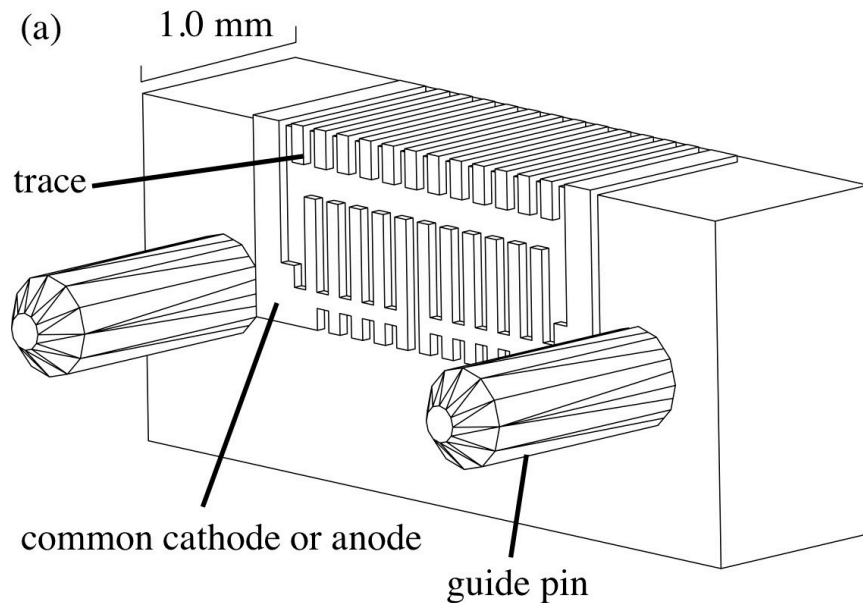
# History of Pixel Opto-Packs

- 1<sup>st</sup> generation opto-boards used opto-packs produced by Taiwan
  - ◆ clever design but difficult to connect
  - ◆ 0.1% of optical links built by Ohio State failed
  - ◆ used Truelight VCSEL/PIN arrays
  - ⇒ new opto-pack design used in 2<sup>nd</sup> generation opto-boards
    - 2% of optical links failed
    - used Finisar VCSEL and ULM PIN arrays
    - no indication that problem is due to opto-packs
    - ⇒ propose to continue to use 2<sup>nd</sup> generation opto-pack
    - some of data shown are from 2013/14 production



# Design of 2<sup>nd</sup> Generation Opto-Pack

- Use BeO as substrate for heat management
- Use wire bonds to connect to opto-board
- Final system needs 600 VCSEL and 300 PIN opto-packs



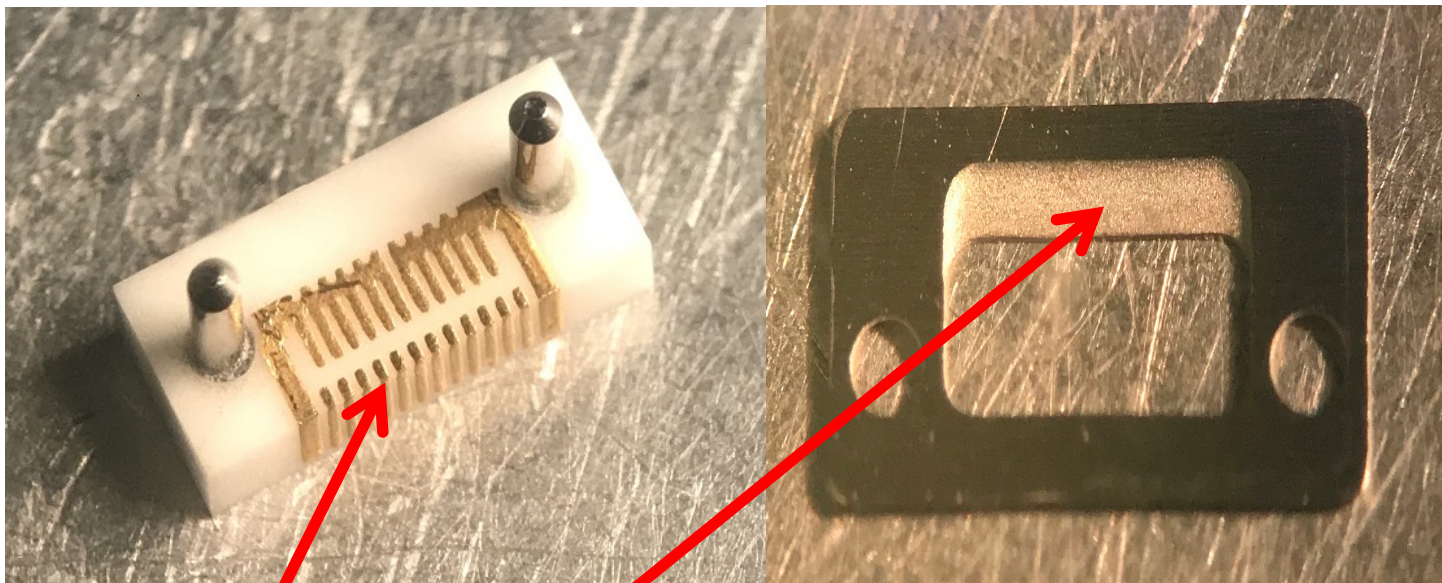


# Production Procedure

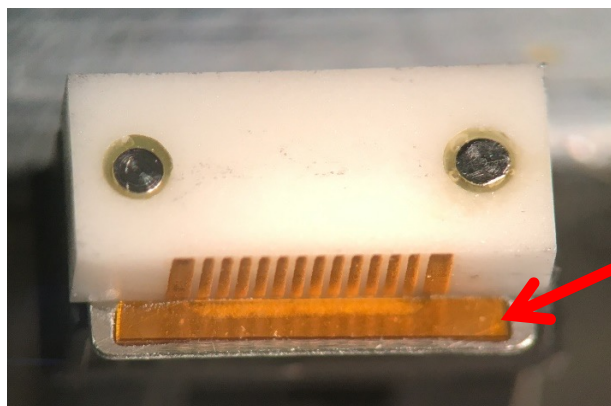
- Glue guide pins to BeO with precise location defined by MT ferrule
- Cure the epoxy
- Insertion force test to ensure two guide pins are parallel
- Deposit conducting epoxy on BeO
- Place VCSEL or PIN array on BeO
- Align the array
- Cure the epoxy
- Wire bond the array
- Attach shield to prevent wire bonds being crashed by MT ferrule
- Add Kapton tape to seal off opening to prevent dust from entering
  - ⇒ all steps (exclude epoxy curing) is ~2 hours



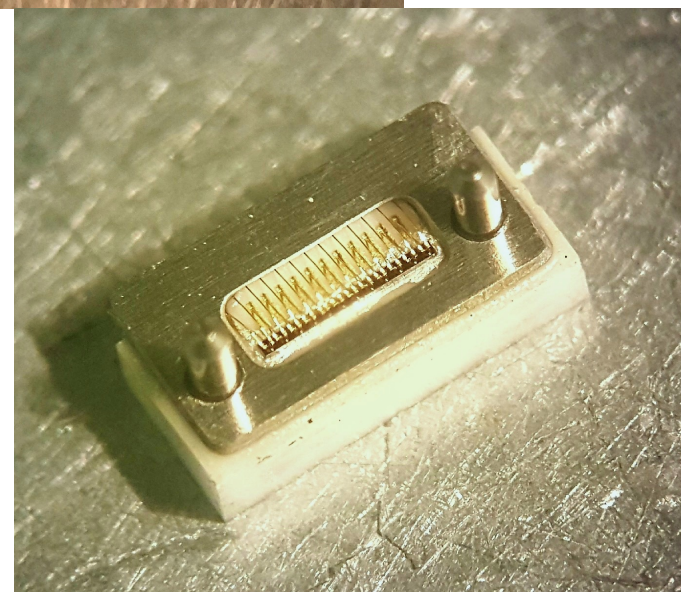
# Opto-Pack



Indentation to prevent shorting of traces



Opening covered with Kapton tape



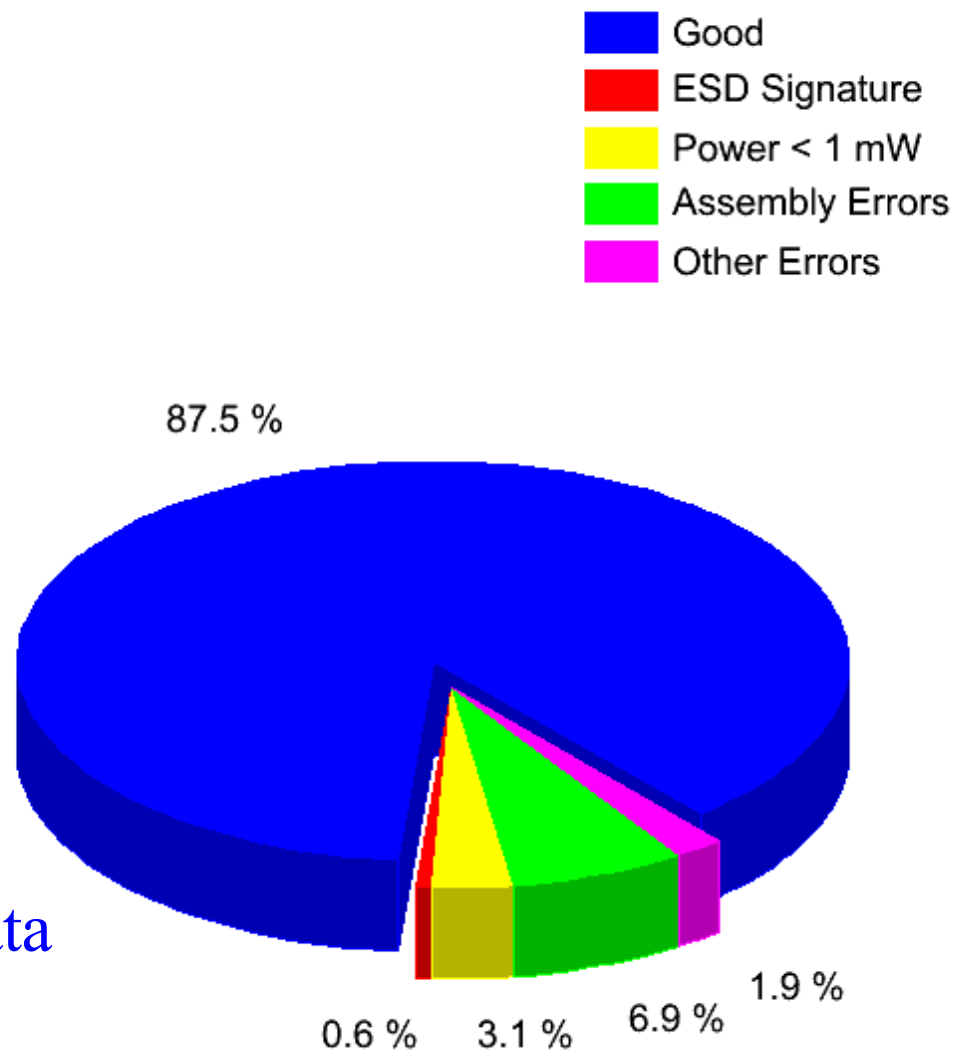




# VCSEL Opto-pack Production Experience

Total	321
Good	281
ESD	2
Power	10
Assembly	22
Other	6

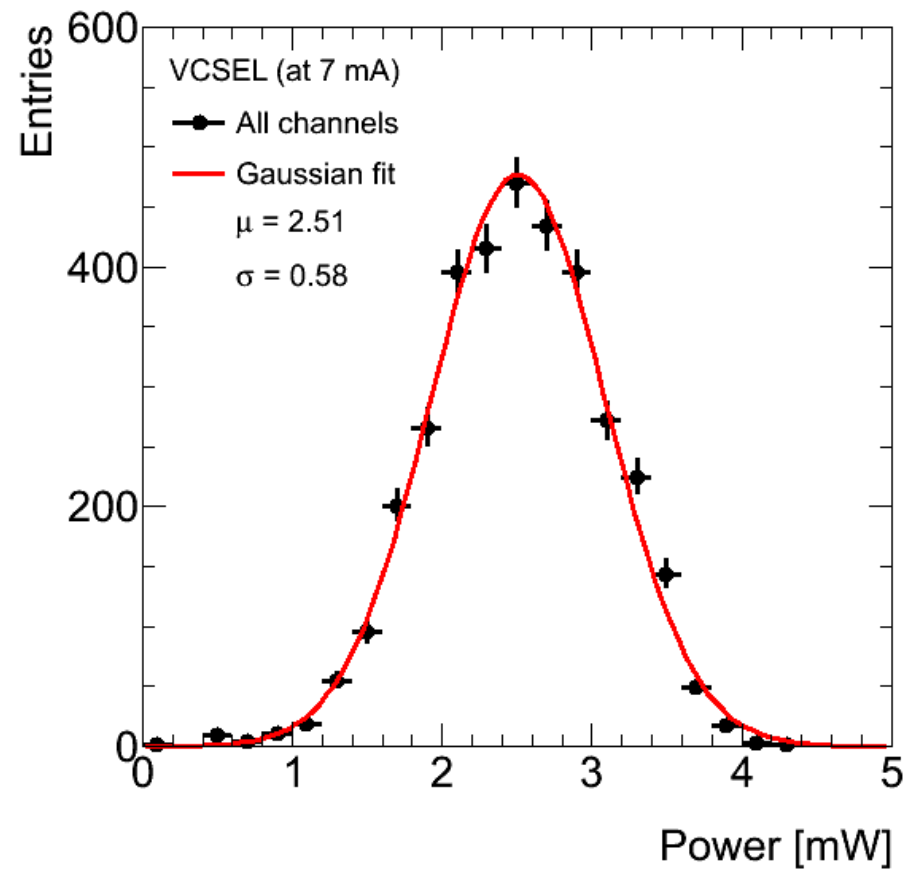
- Finisar arrays
- 2013/14 pre-production data
- 800 produced





# VCSEL Optical Power

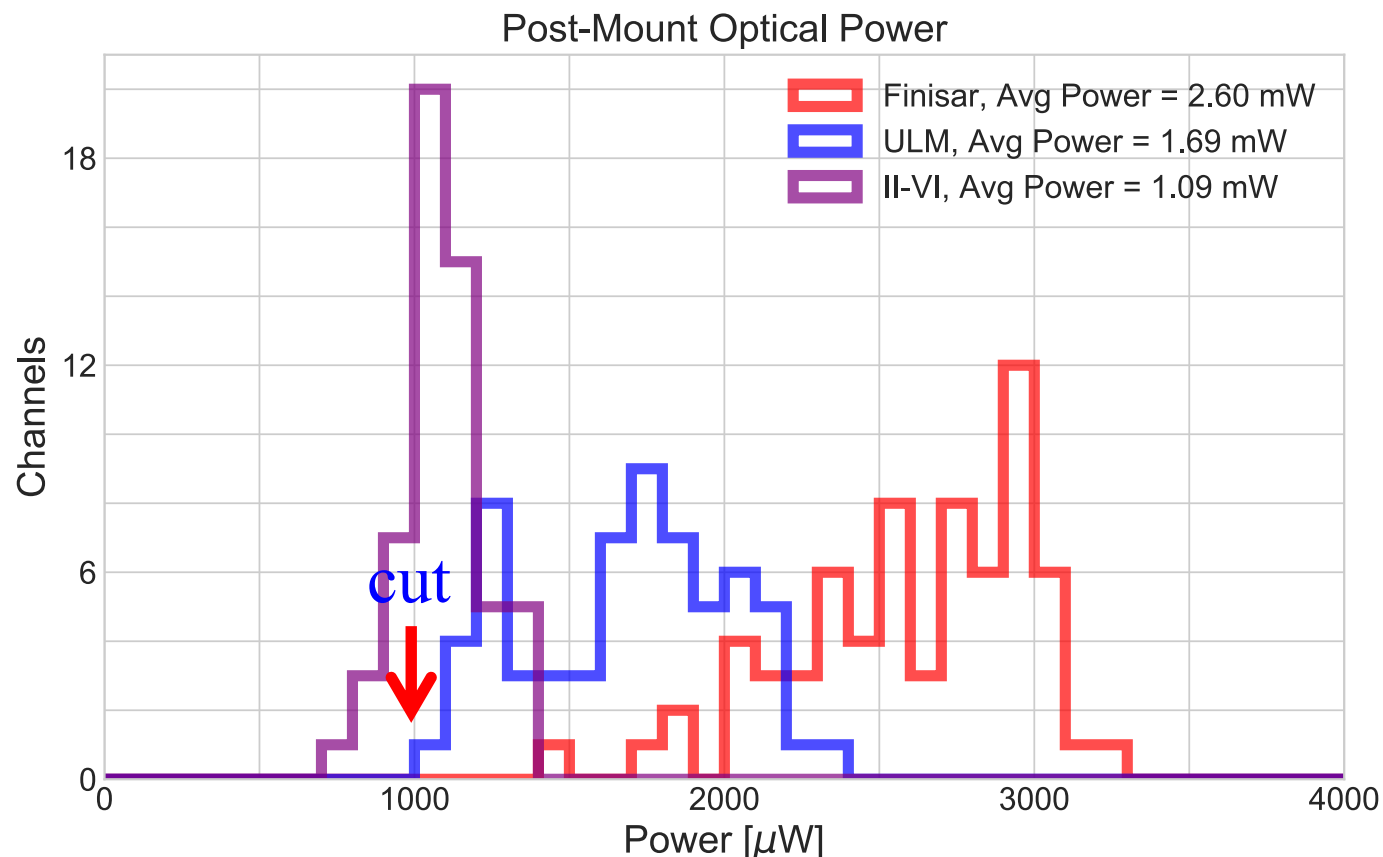
- average optical power  $\sim 2.5$  mW
- require 1 mW @ 7 mA in QA (max current 11 mA)







# Optical Power

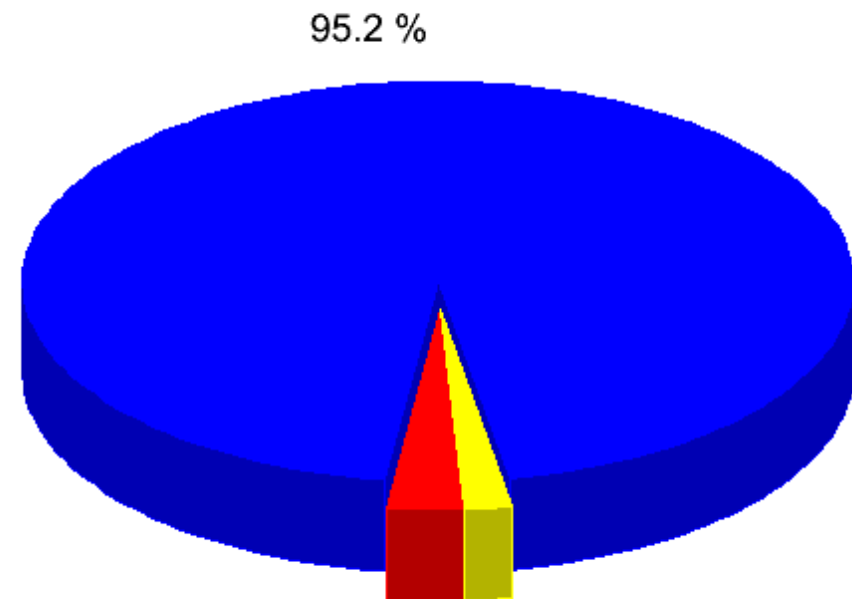
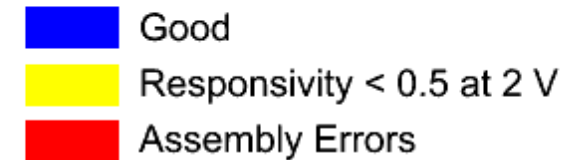


- shield with thickness of 254  $\mu\text{m}$  was designed for Finisar array with thickness of 200  $\mu\text{m}$
- ULM/II-VI array thickness is 150  $\mu\text{m}$ 
  - ⇒ near new shield with thickness of 200  $\mu\text{m}$



# PIN Opto-pack Production Experience

Total	161
Good	153
Responsivity	3
Assembly	5

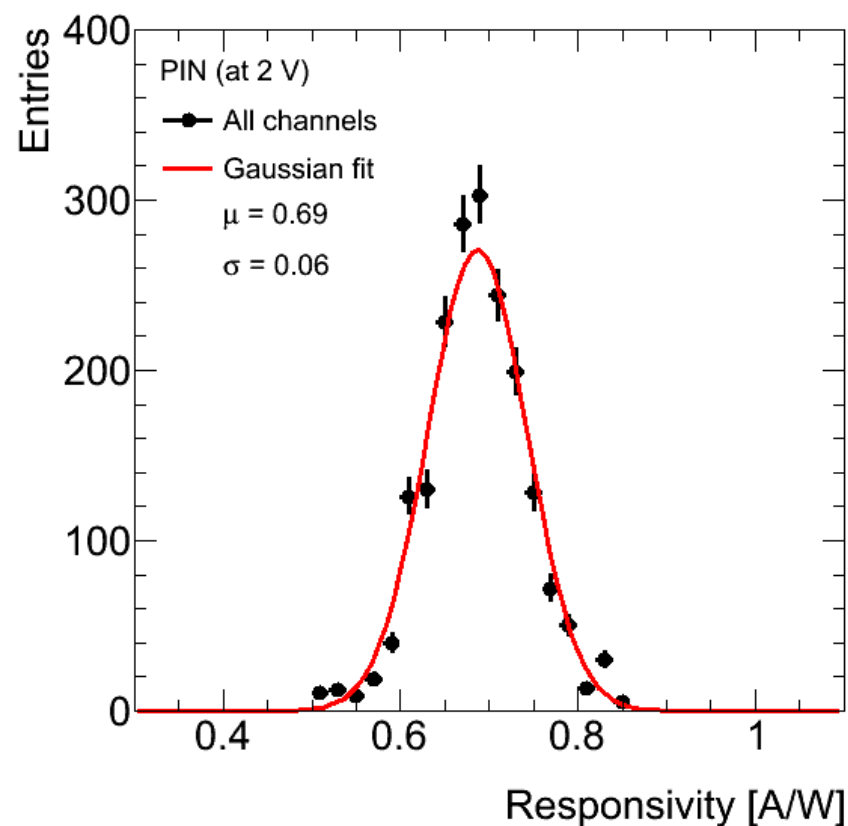


- ULM arrays
- 2013/14 pre-production data
- produced 400 for opto-boards + 400 for RX



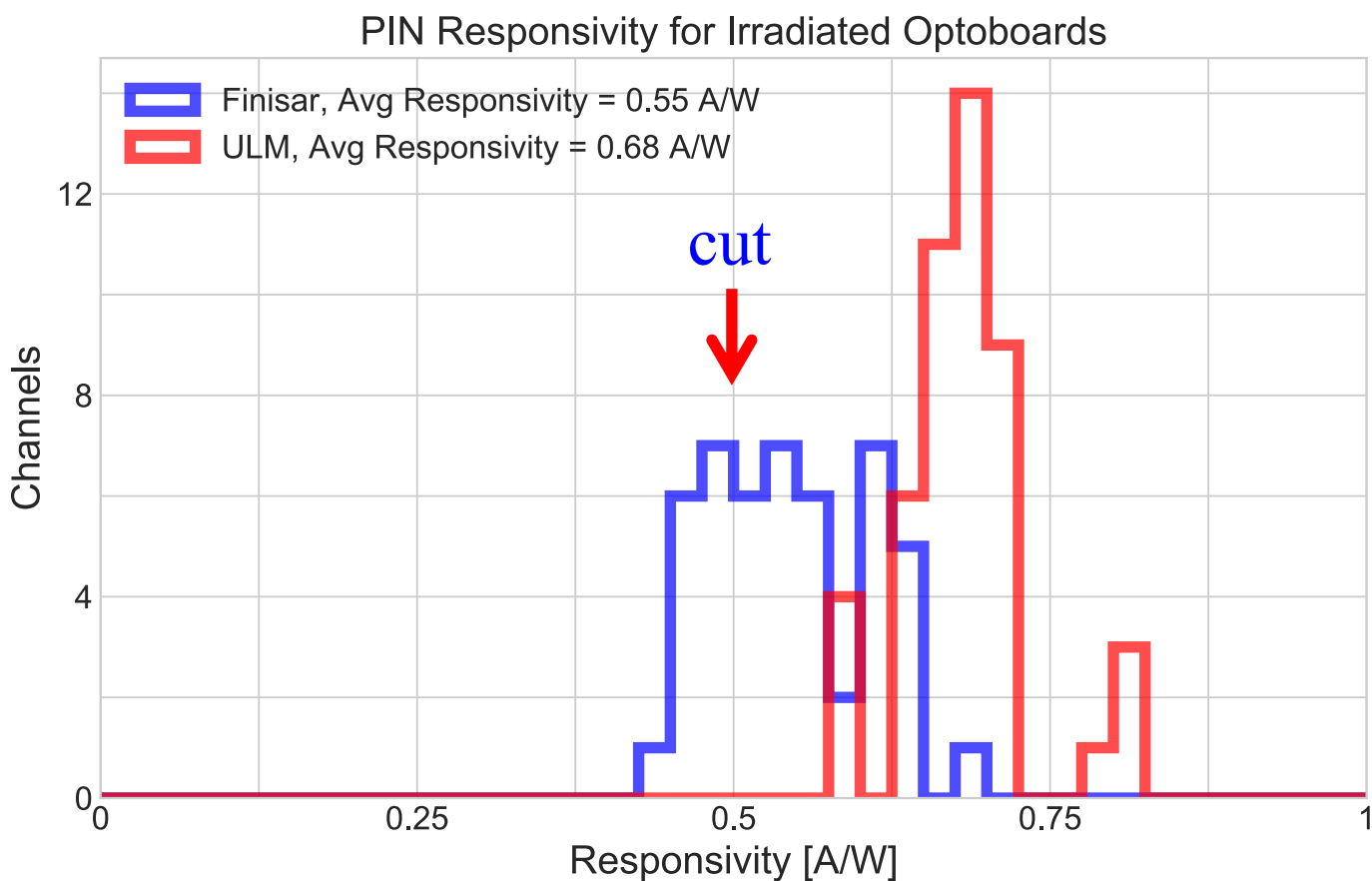
# PIN Responsivity

- average PIN responsivity  $\sim 0.69$  A/W
- require 0.5 A/W @ 2 V in QA





# PIN Responsivity



- ULM PIN has higher responsivity



# VCSEL/PIN Array Cost

	VCSEL	PIN
Finisar	\$188	\$57
ULM	€28	€16
II-VI	€70	

- quotation based on 1000 VCSEL/500 PIN array
- Finisar announced end-of-life for VCSEL/PIN
  - ◆ order by May 31
- ULM: 2-3 months lead time due to shortage of VCSEL wafers
- ULM VCSEL optical power is acceptable
  - ◆ might be as good as Finisar with thinner shield
- ULM PIN responsivity is better than Finisar
- one ULM channel started to degrade at 140 hour and die at 250 hour but other 55 channels are alive for 1400 hours
- use ULM for both VCSEL and PIN arrays?



# Summary of Proposal

- use opto-pack design used in 2<sup>nd</sup> generation opto-boards
- use ULM VCSEL/PIN arrays?
- follow the 2013/14 assembly/QA procedure