Status of Opto-Board Production/Postmortem

K.K. Gan, R. Ishmukhametov, H. Kagan, R.D. Kass,
J. Moss, J. Moore, S. Smith, B. Tannenwald, Y. Yang
The Ohio State University

P. Buchholz, M. Ziolkowski
Universität Siegen

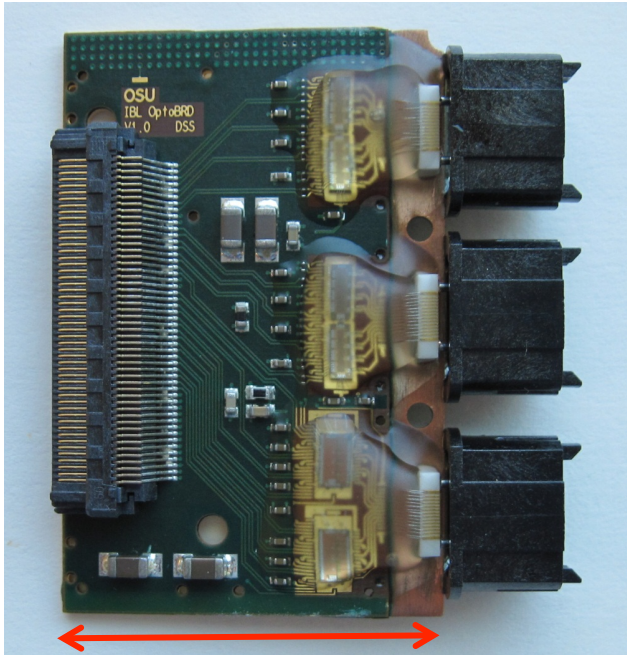
June 12, 2013

Outline

- Status of opto-board production
- Results of opto-board postmortem
- Summary

Introduction

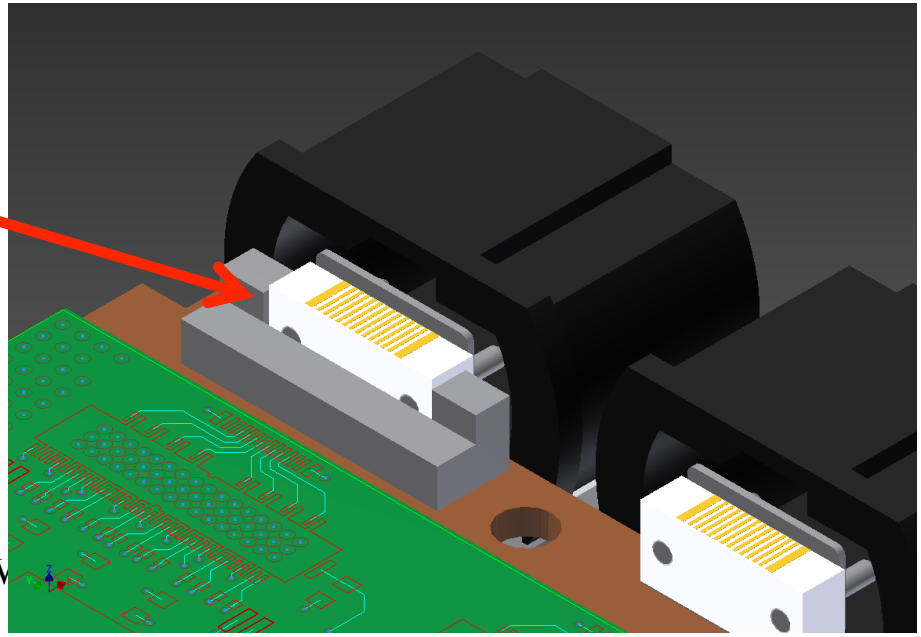
- 3 opto-board flavors
  - nSQP D opto-board (disk, L1, L2): 7 TTC + 14 data links
  - nSQP B opto-board (B-layer): 7 TTC + 14 data links
  - IBL opto-board: 8 TTC + 16 data links



Opto-Pack Enforcement

- Several opto-packs detached at various stages of production
  - ⇨ detailed investigations + discussion with epoxy vendor
  - ⇨ no obvious causes of failure found
  - ⇨ two improvements:
    - scoring of PCB surface to improve adhesion
    - add aluminum brace to greatly increase epoxy contact area
      - ⇨ cannot remove opto-pack without destroying opto-pack

Sandblasted surfaces
to improve adhesion



Wire Bonding

- Bond pads on ASICs are not designed for double bonds
  - previous opto-boards used double bonds
  - double bonding was difficult with K&S 1470 but doable
- Use K&S 8060 for new opto-boards
  - double bonding is very challenging and needs significant more programming development
  - ⇨ use single bonds

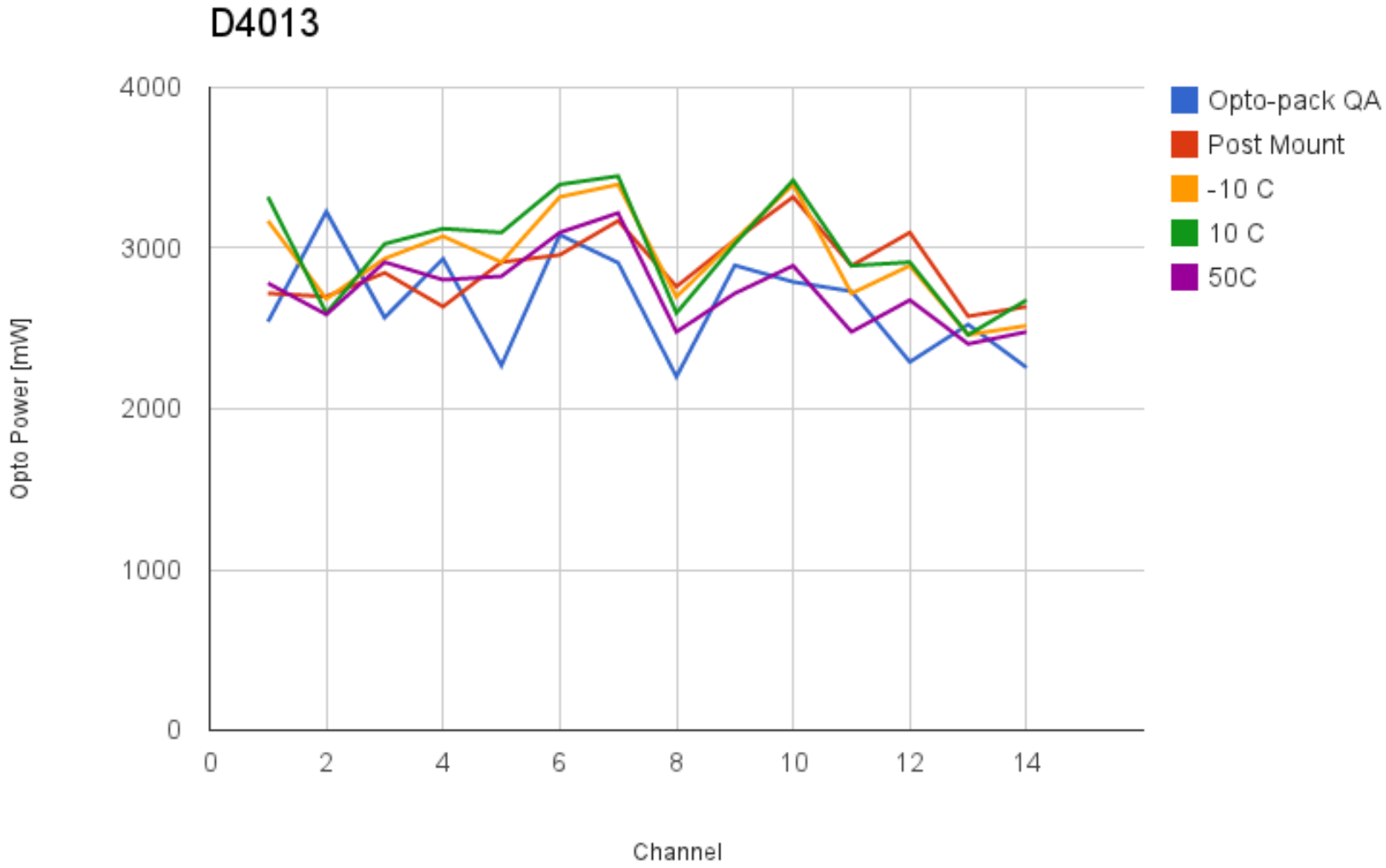
Second PCB Vendor

- Exception (UK) is the second PCB vendor
  - 25 PCB delivered
  - 2 PCB delaminated
  - 1 PCB delaminated during solder paste reflow
  - ⇨ use PCBs from Cirexx (US) which delivered high-quality PCB

Production Status

- 22 D opto-boards have passed QA
  - 7 boards with optical epoxy on PIN arrays and no opto-pack re-enforcement
  - 9 boards without opto-pack re-enforcement
  - 6 boards with final configuration
- 2 opto-boards failed QA due to bad duty cycle
  - duty cycle will be checked before QA in order to stack a second layer of ASIC
    - ⇨ board will be classified as 2nd class
- B opto-boards with mounted passive components will be delivered next Wednesday
- IBL opto-boards will be fabricated after B boards

Opto-Board Optical Power



- Excellent optical power!!!

Reception Test System

- Reception test system is now operational at SR1
  - use to retest delivered IBL, D and B boards
  - also use in the old opto-board postmortem
  - 16 D boards passed reception test

What to Expect on Old Opto-boards

- 54 failed modules are attributed to opto-link problems based on a calculation
  - including three totally failed opto-boards

Verification of Extraction Procedure

- Extraction procedure tested on service panel A12
  - visual inspection revealed that all opto-boards were well secured
  - ⇨ no sign of loose connection in causing an opto-link to fail
- 36 opto-boards on A12:
  - all boards extracted and tested
  - 1 out of ~252 channels non functional (DORIC) as expected
    - ⇨ extraction procedure does not induce additional damage
    - ⇨ will only test problematic boards for other service panels

Failure Classification

- 7 opto-boards have a broken DORIC reset line on chip 2
  - reset line is routed from chip 1 to 2 but it carries little current
  - unclear why failure occurs on chip 2 only
  - 3-4 modules are connected to chip 2
  - some modules can still be operated if DORIC can lock in
    - ⇨ ~10 modules are operational at one time
- 16 VCSELs and 6 PINs are non operational
  - include 1 dead VCSEL
  - one module connected to both disconnected VCSEL/PIN
  - 15 VCSELs are connected to modules
  - caused by cold solder joints
    - ⇨ 20 modules non operational
- 54 module failures were predicted to be caused by opto failures
- probably no wire bond failures since there were no random failures

Summary

- opto-pack re-enforced to increase adhesion
- will use single wire bonds
- PCB from second vendor not acceptable
- opto-board production has started with 7% produced
- opto-board postmortem reveals:
  - no dead opto-boards
  - probably no random (wire bond) failures
  - failure on chip 2 reset line not understood
    - ⇨ cause ~10 modules non operational at a given time
  - 20 modules connected to disconnected/dead VCSEL or PIN