VTRX+, CERN-ECUO

Customizing FireFly for CERN

October 3, 2018

Agenda

- Introduction and background
- FireFly design and customization
- RF performance
- Thermal performance
- Other considerations
- Summary and conclusions

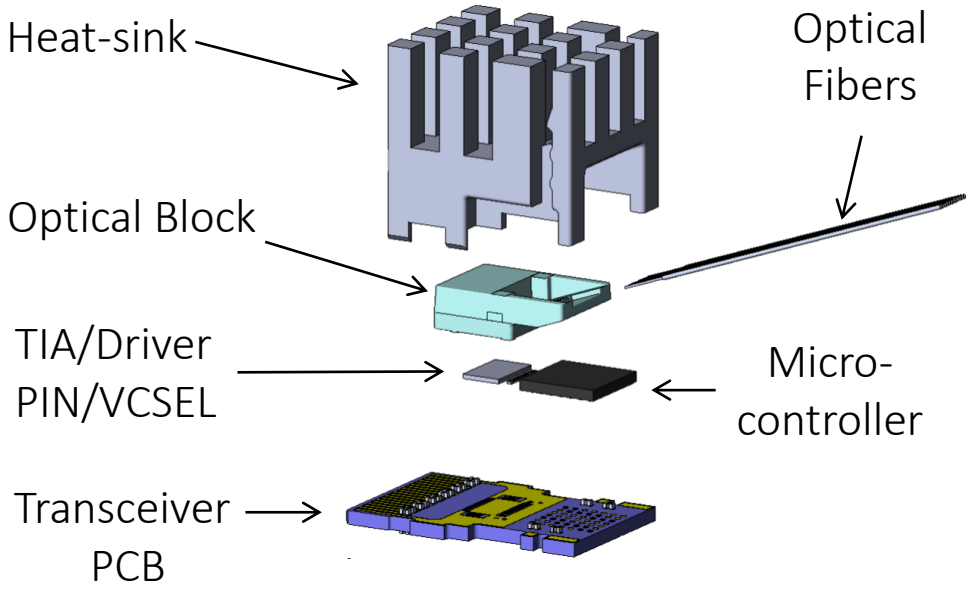
Introduction and Background

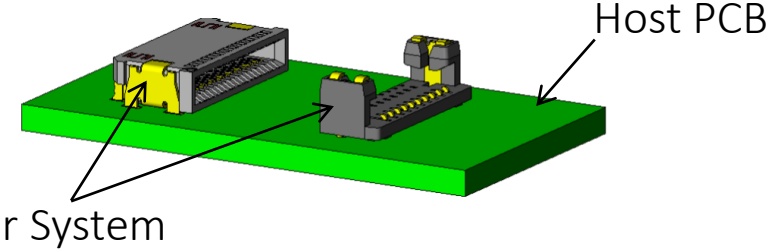
- As Part of the VTRX+ project headed by Francois Vasey, CERN is sourcing solutions for two low profile miniature optical transceivers for use in a radiation environment.
- The transceivers will use a CERN designed TIA and Driver.

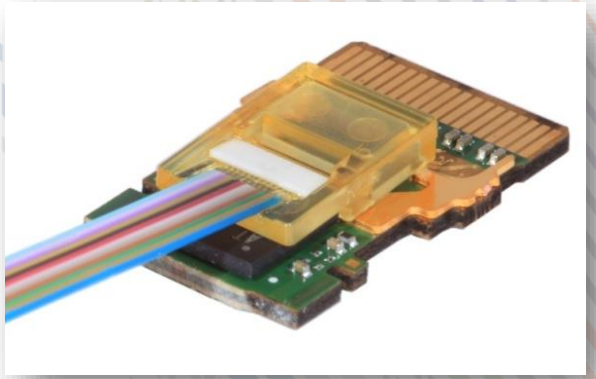
Samtec's approach:

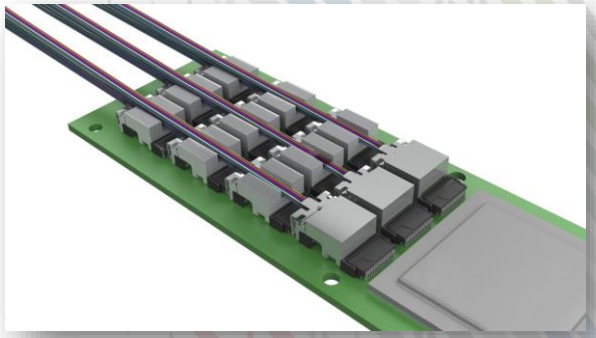
- Retrofit the existing FireFly design to meet CERN's needs.
  - Minimize risks and development time.
  - Build on proven and mass produced technologies.
  - Reuse existing infrastructure (supply chain, assembly and test lines).
- New low profile design with a 10x20x2.5mm envelope.
  - Fully custom design

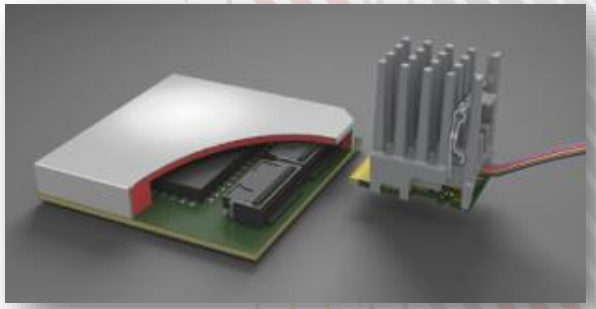
FireFly Design





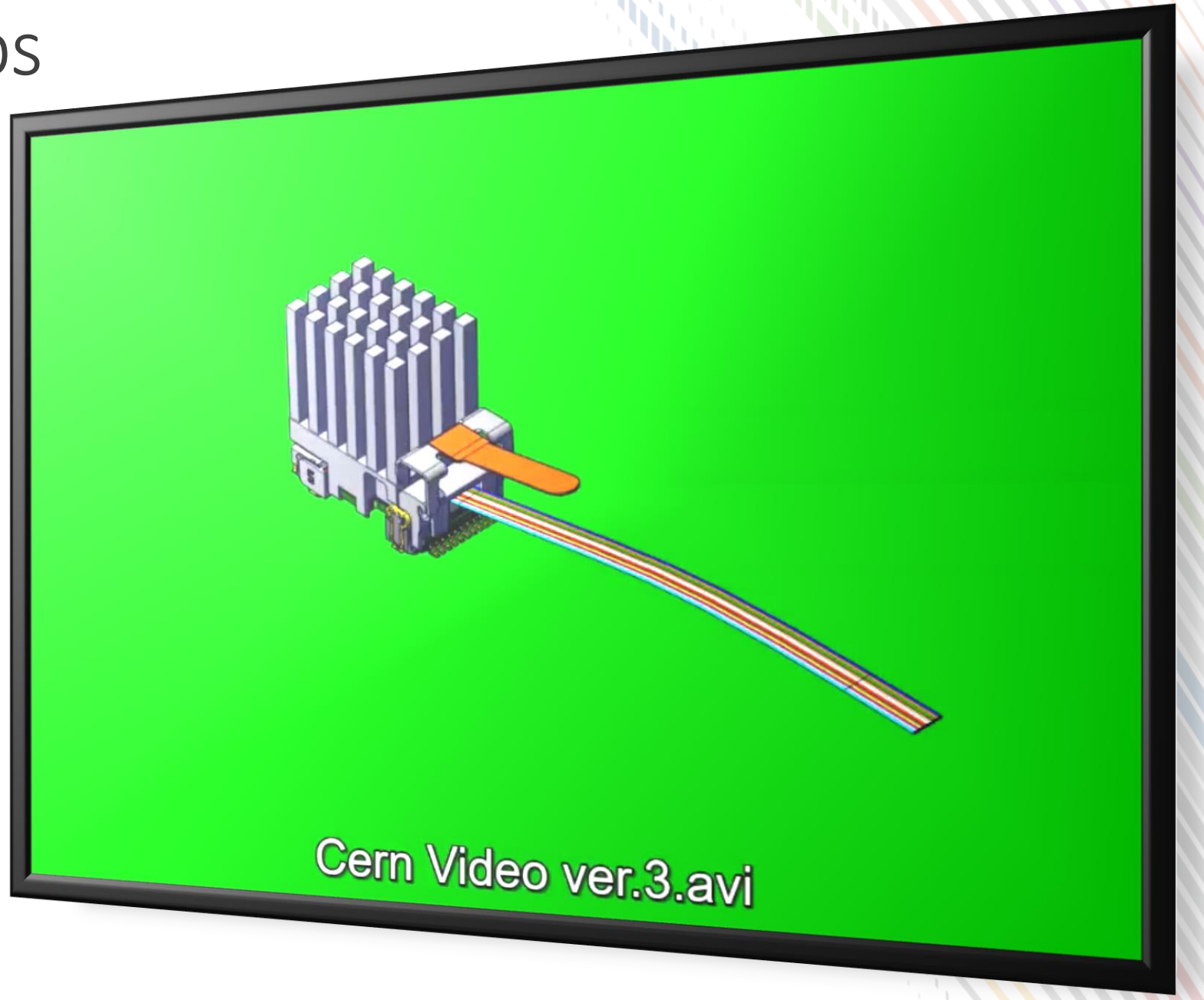






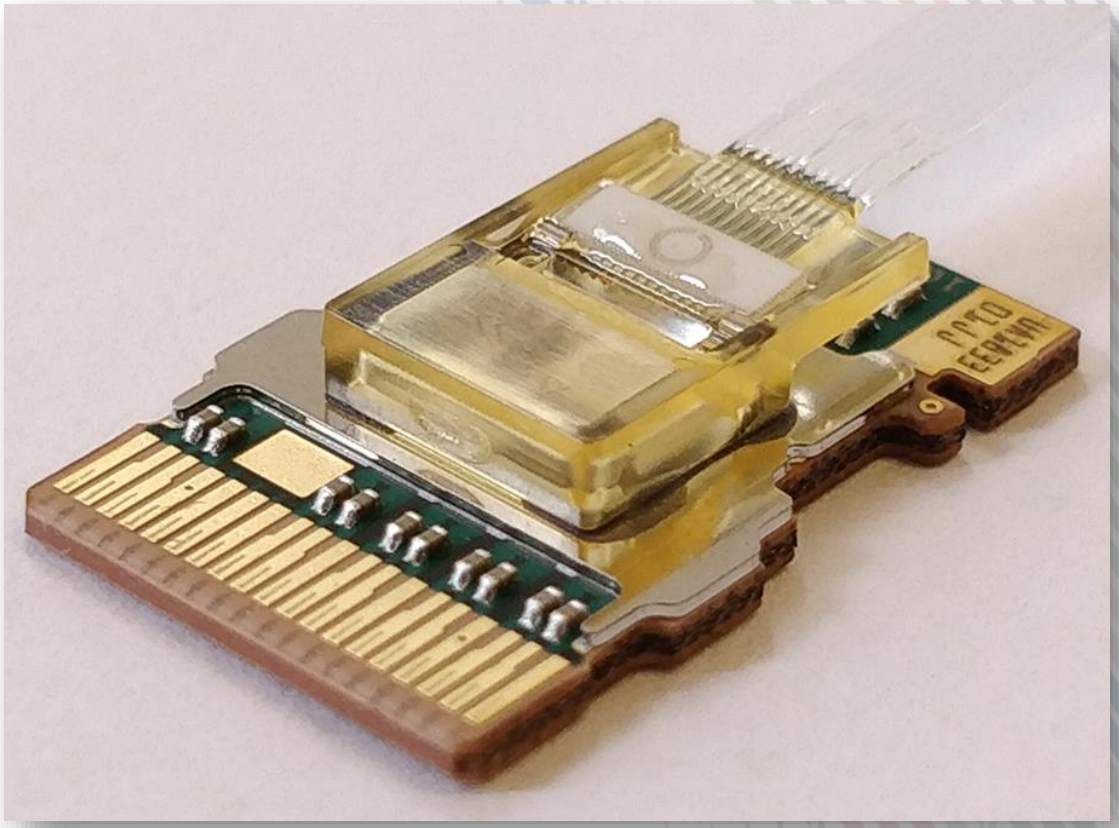
Customization Steps

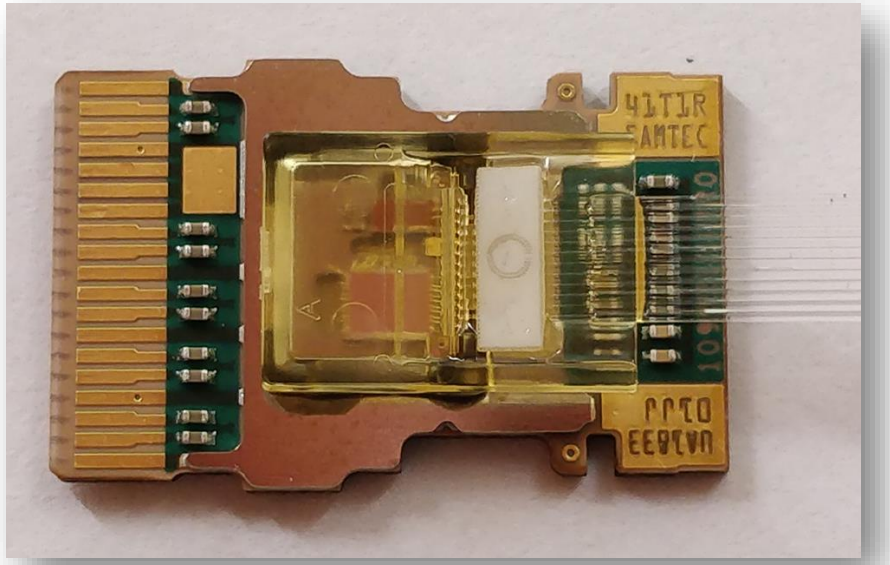
- Start with a x4 FireFly
- Discard Heatsink
- Discard Microcontroller
- Use the CERN TIA and DRV
- Use Rad Hard Fibers
- Custom PCB
  - Optimized SI
  - Optimized DFM
- Optimized thermal
- Reuse connectors
- Reuse optical block
- Added optional thermal bridge



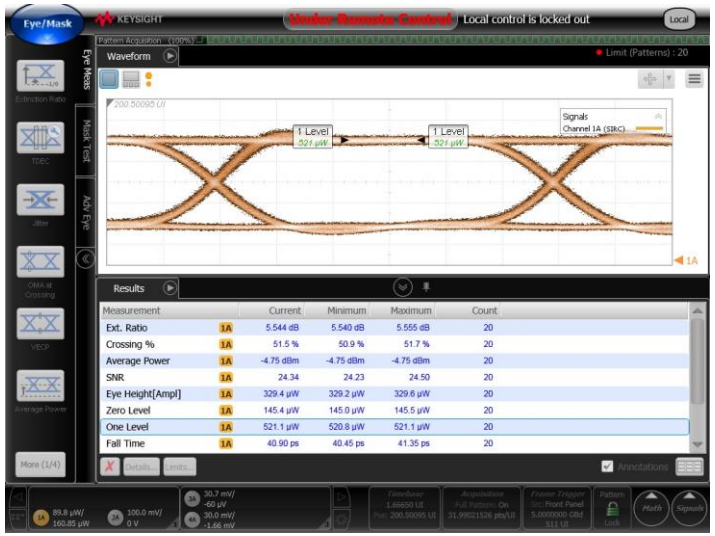
Result

- Rad Hard FireFly
- Based on mature technologies and proven components with over 1 Billion operating hours in the field.
- Manufactured on existing high volume production lines.

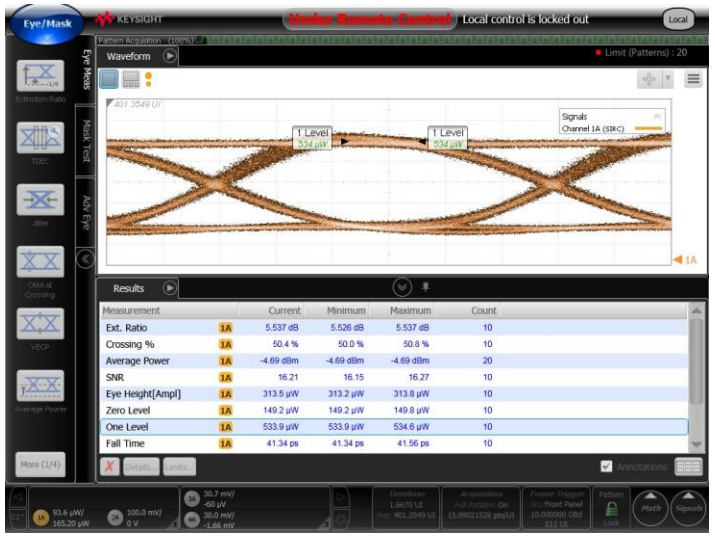




Transmitter High Speed Performance



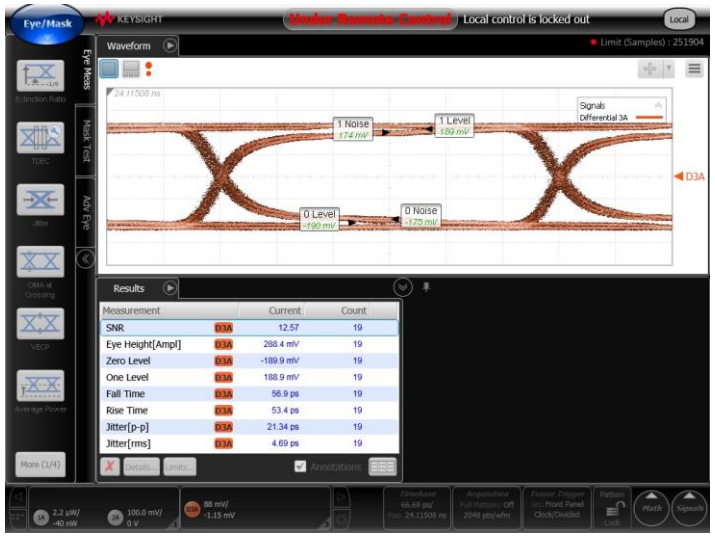
5G



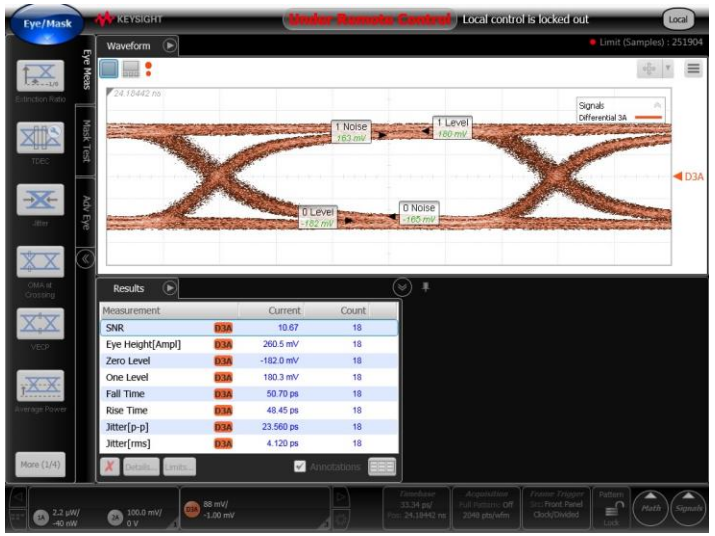
10G

Parameters	Unit	Typical Values
Mask Margin	[%]	60
AOP	[dBm]	1
OMA	[dBm]	1
ER	[dB]	4.8
RJ	[ps]	1
DJ	[ps]	8
TJ	[ps]	20

Receiver High Speed Performance



2.5G

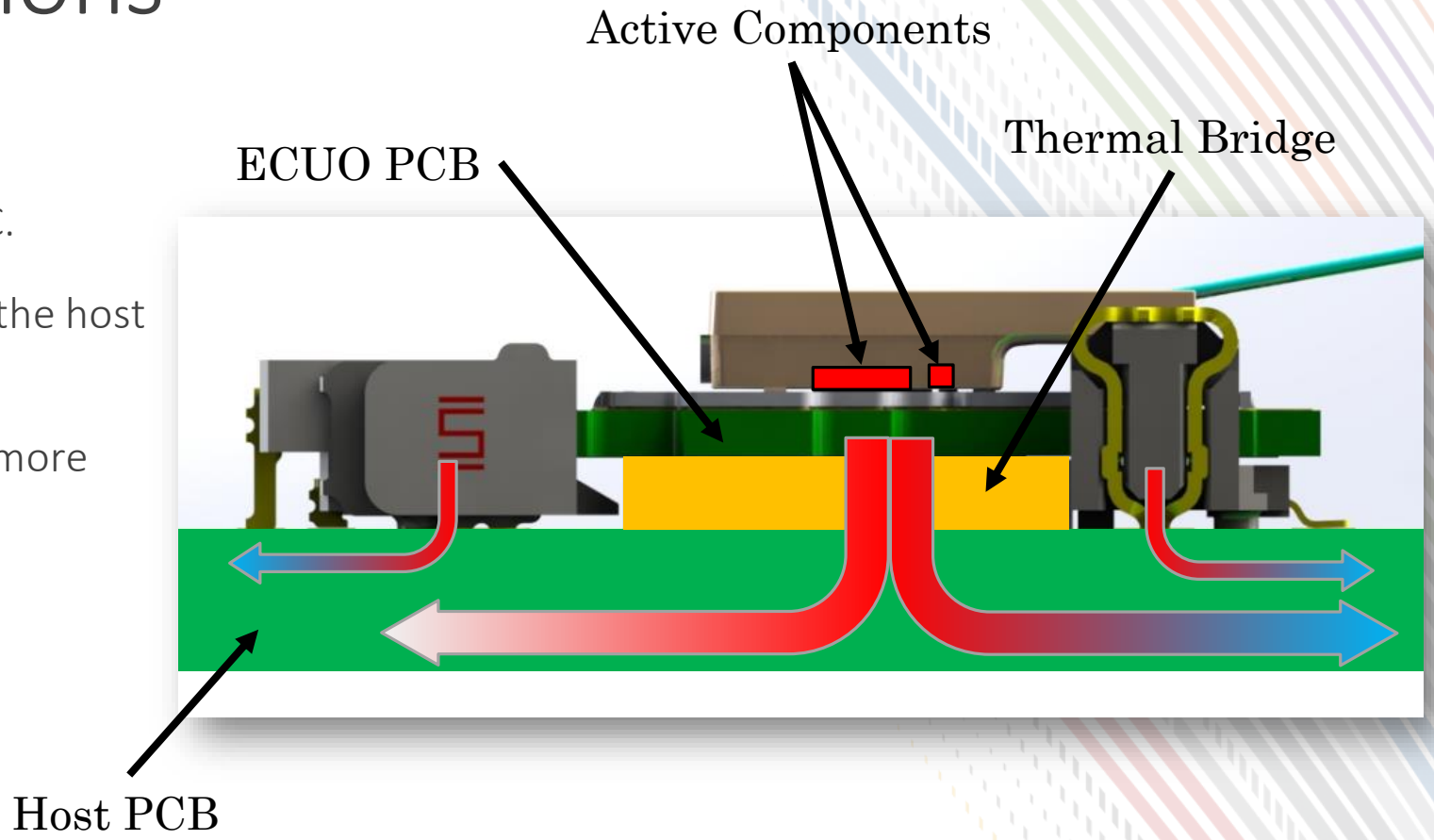


5G

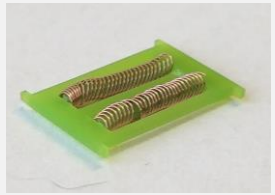
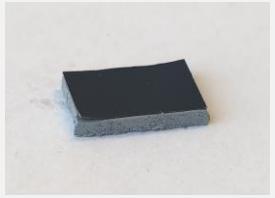
Parameter	Unit	Typical Values
Sensitivity (1E-12)	[dBm-OMA]	-15
Mask Margin	[%]	60
Eye Height	[mV]	250
RJ	[ps]	< 1
DJ	[ps]	10
TJ	[ps]	40

Thermal considerations

- Operating temperature range: -40 to 60°C.
- No Heatsink, conduction cooling through the host PCB.
- Developed an optional thermal bridge to more efficiently evacuate the transceiver heat.



VCSEL Operating Temperature Projections

Description	Picture
Metal based thermal bridge	
Silicone free putty	
Silicone based putty	

Temperature	-40°C	+30°C	+70°C
Expected Dissipated power [W]*	0.305	0.305	0.305

	Thermal resistance [W/mK]	Temperature Increase at -40°C [°C]	Temperature Increase at +30°C [°C]	Temperature Increase at +70°C [°C]
No riser, No bridge	46.7	14.2	14.2	14.2
Standard part, No bridge	34.1	10.4	10.4	10.4
Metal based bridge	29.1	8.9	8.9	8.9
Silicone free putty	14.5	4.4	4.4	4.4
Silicone based putty	10.3	3.1	3.1	3.1

Maximize Temperature Rise

Minimize Cost

Minimize Temperature Rise

* Based on Samtec Settings for V1 units

Other Considerations

- Completed material compliance review against environmental factors per DO-30869/EP document.
  - IS-41, RoHs, EU regulations.
  - Mostly compliant, several exemption approvals requested.
- Completed manufacturing compliance review per DO-30869/EP document.
- Partial Telcordia qualification by similarity.
  - Same VCSEL, transceiver and optical design.
  - New TIA, Driver and PIN.
  - Full re-qualification possible and quoted.

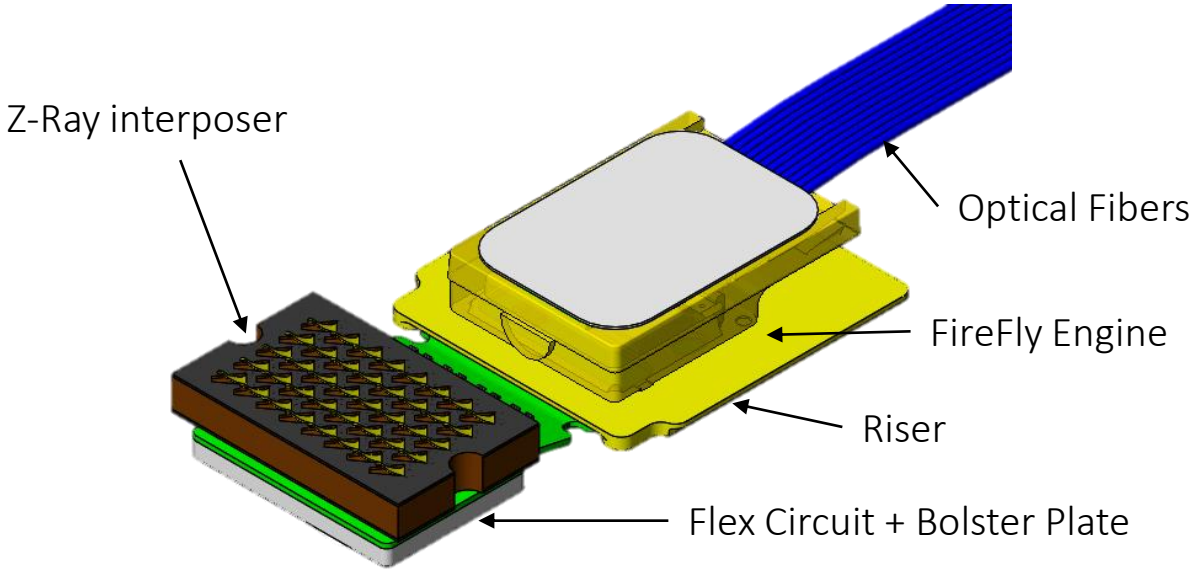
Summary and Conclusions

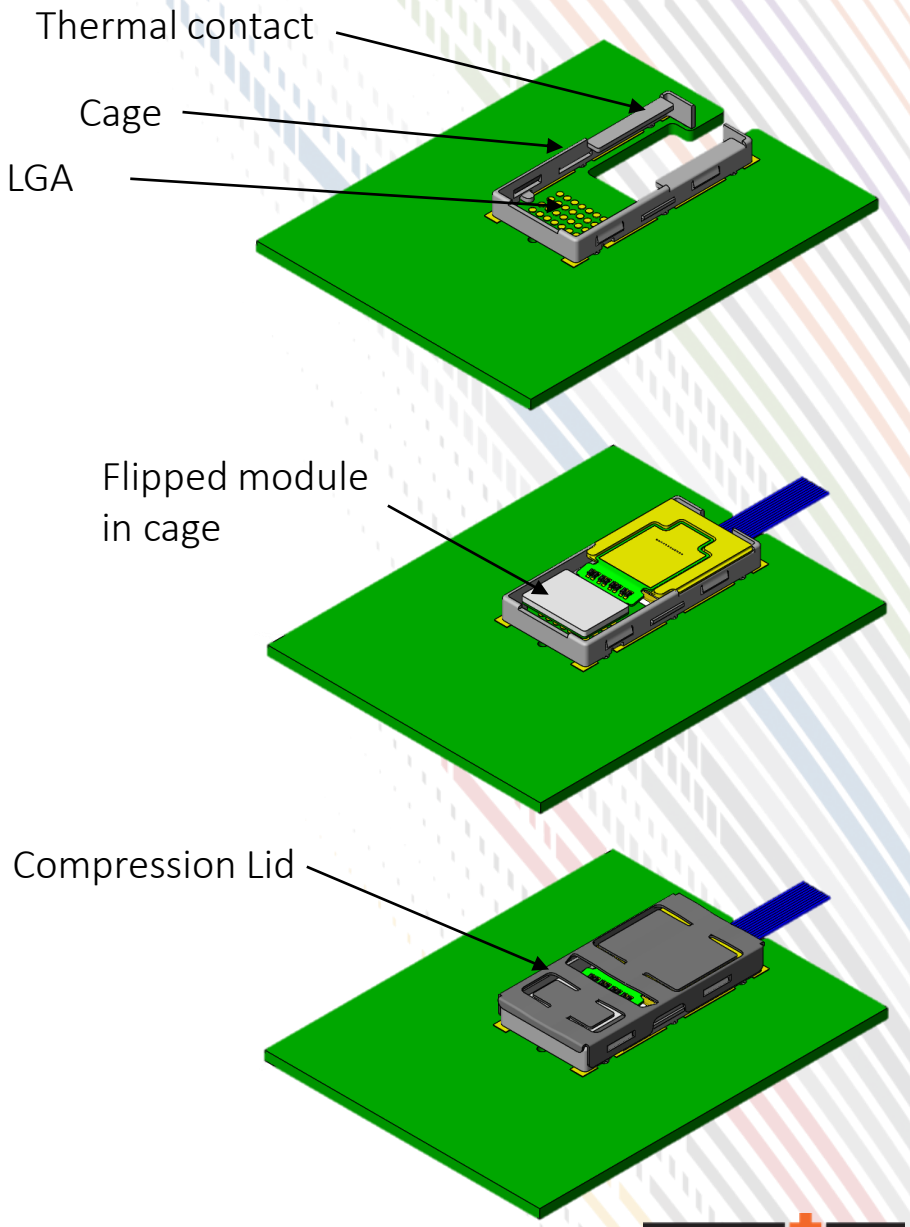
- Samtec's Roadmap is heavily customer driven
- Product customization capabilities
  - Across all Samtec Product Lines: Connector, Cabling and Optical.
  - From "designed in" options (length, heat-sink, connector, data-rate, etc.)
  - To heavy retrofit (CERN-ECUO)
  - As well as brand new products and form factors (LPUO)
- Each Project needs to be evaluated on a case by case basis
  - Customization effort versus volume.
- Advanced engineering capabilities
- HVM manufacturing ready

Backup Slides

LPUO Concept

- A low profile optical engine is attached via flex circuit to a compression connector.
- The assembly is mounted with the optical engine upside down into a cage attached to the host board.
- A compression lid provides the compression forces for the connector contacts and the optical engine thermal contacts.





Customization (short movie)

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