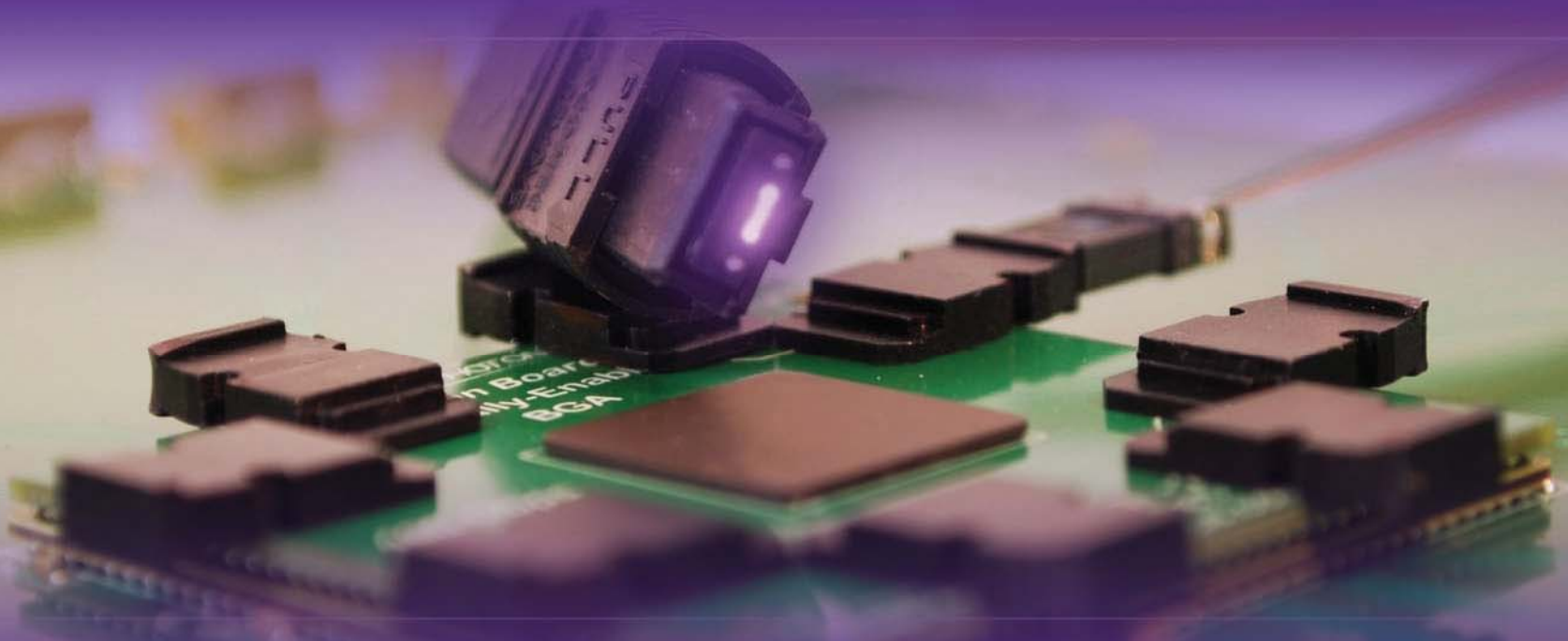


# Reflex Photonics Inc.

The *Light on Board*® Company



Semiconductor IC packaging using modular optical components

**REFLEXPHOTONICS™**

Author: Dave Rolston, Rob Coenen

# The Problem

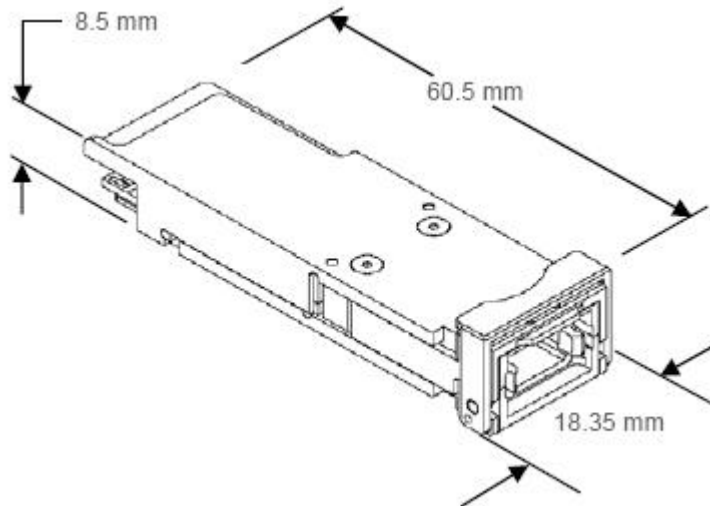
- ASICs are becoming more and more powerful, capable of processing multiple gigabytes of data per second which is leading to the problem of:

**How to get such large amounts of data  
into and out of the ASIC?**

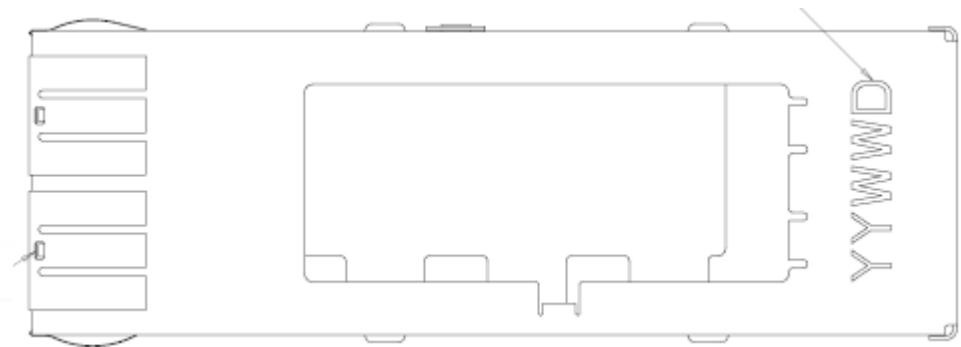
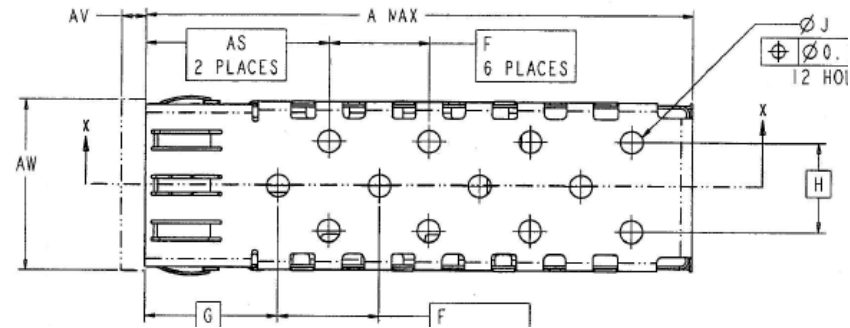
- High bandwidth electrical data transfer is limited by package constraints, PCB materials and physical distances between ICs, circuit boards and chassis'.
- There is a need to augment copper lines with optical fibers to increase the rate and distance at which data flows to ICs.
- This needs to be done seamlessly and at low cost.

# Current optical solutions

## Existing commercial optical module form factors: SFP, SFP+, QSFP, Snap-12



- Existing optical module packages are large and designed to address longer reaches.
- For strictly short reach applications (<300m), size and cost can be greatly reduced



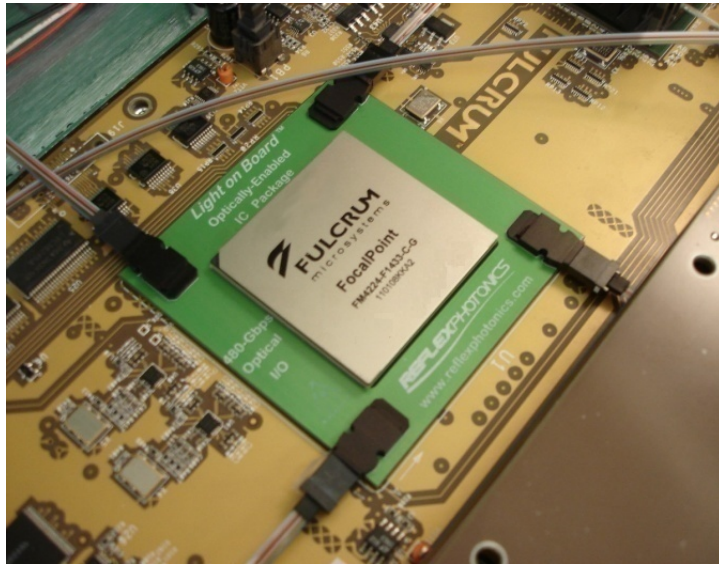
**The Reflex Solution:**  
***Light on Board***® and **Optically Enabled**  
**BGA packaging**

# The Reflex Solution: *Light on Board*<sup>®</sup> and OE-BGA

REFLEXPHOTONICS™

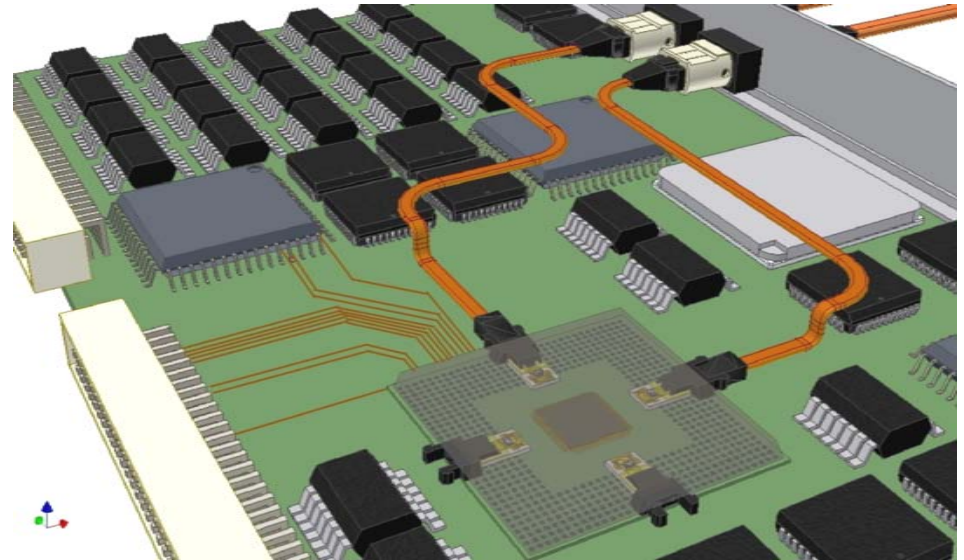
A two-step approach employing parallel fiber optics:

## Light on Board



Now - Tiny optical engines (LightABLE™) mounted on a daughtercard with existing IO constrained ICs

## Optically Enabled BGA

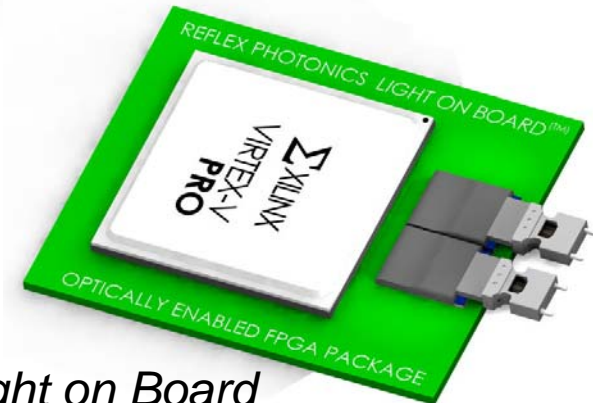


Next - Optical engines built into IC packages with integrated laser driver and LA circuitry

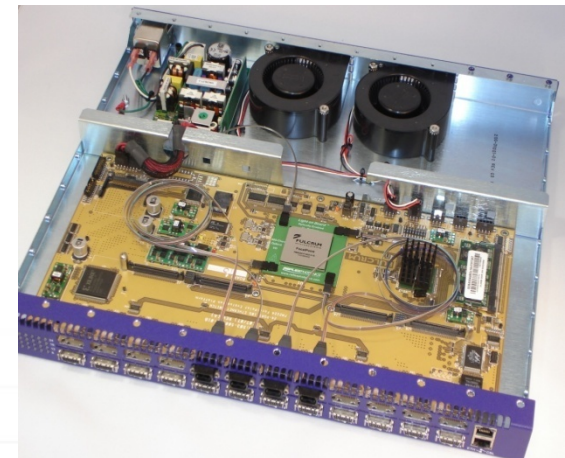
# Now - *Light on Board*®

REFLEXPHOTONICS™

- The Light on Board package is comprised of optical sub-assemblies (LightABLE™) mounted upon a high-speed printed circuit board along with the ASIC. Ribbon fibers attach to the optical engines for connectivity between chassis', blades, and ICs
- Tiny LightABLE optical engines have been proven to be commercially producible and reliable.

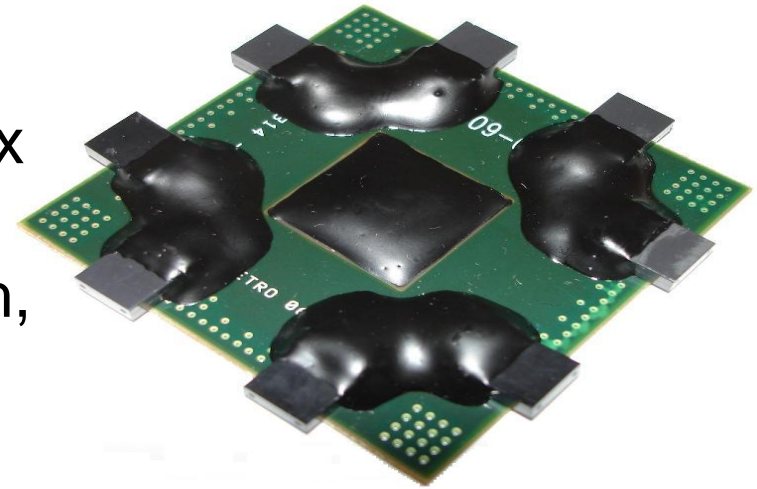


*Light on Board*  
with Xilinx Virtex-V



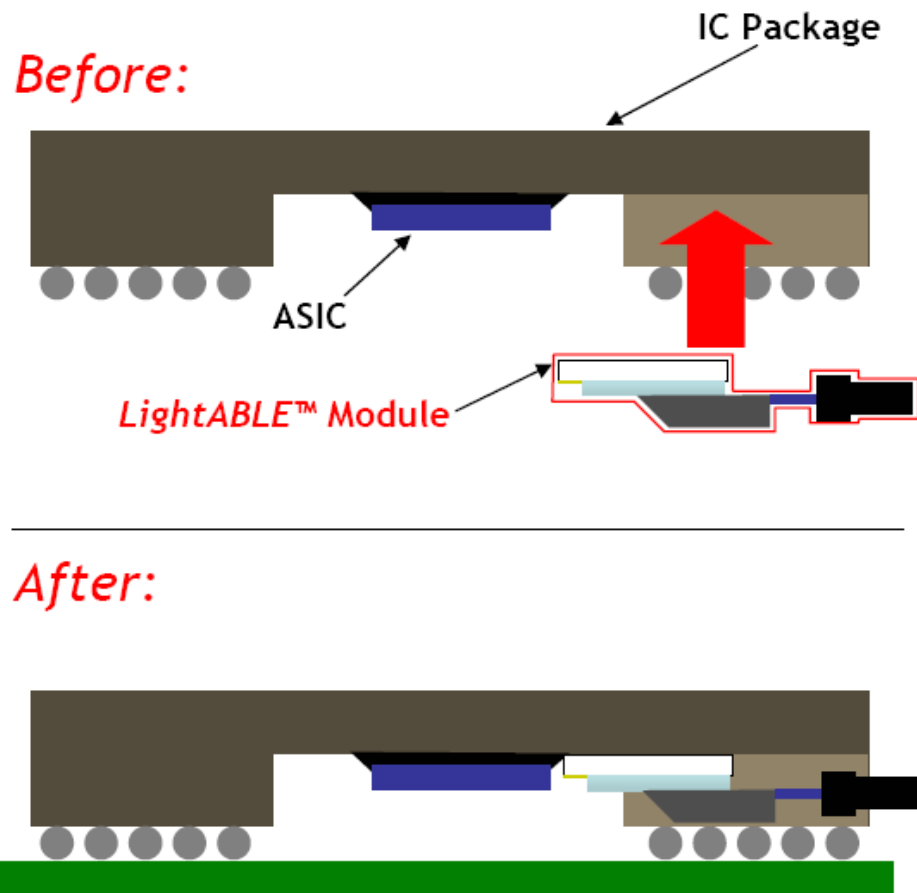
*Light on Board* with Fulcrum  
switch demo

- Based on an MT-style optical connector
- Very short connections between ASIC and optics improves signal quality and lowers cost
- 8 optical modules, each with 12x arrays of optical channels, operating at 10.3125 Gbps each, allows for 1 Tbps aggregate
- This is in addition to the electrical connections
- **Commercially available now**



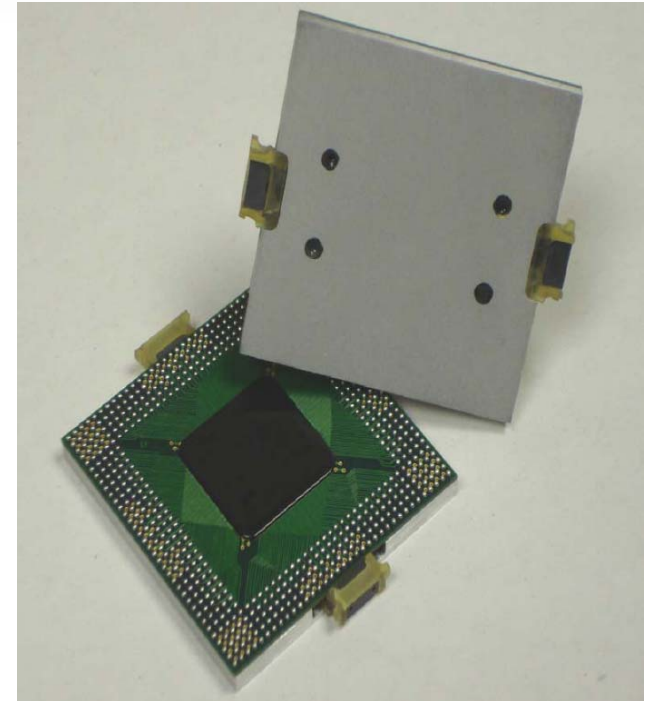
96-port Light on Board

- Using the existing manufacturing capabilities of IC packaging houses, the LightABLE™ module can be treated as a pick-and-place component within the overall build of an IC package.
- This strategy impacts only the IC packaging assembly, but to a low degree.



# Optically Enabled BGA Demonstrator

- This was the first prototype of a fully integrated optically enabled OE-BGA IC package.
- It included 24-ports (two 12-channel optical connectors)
- 600 solder ball array on a 1.27mm pitch and follows the JEDEC standard for a cavity-down, 45-mm x 45-mm package.



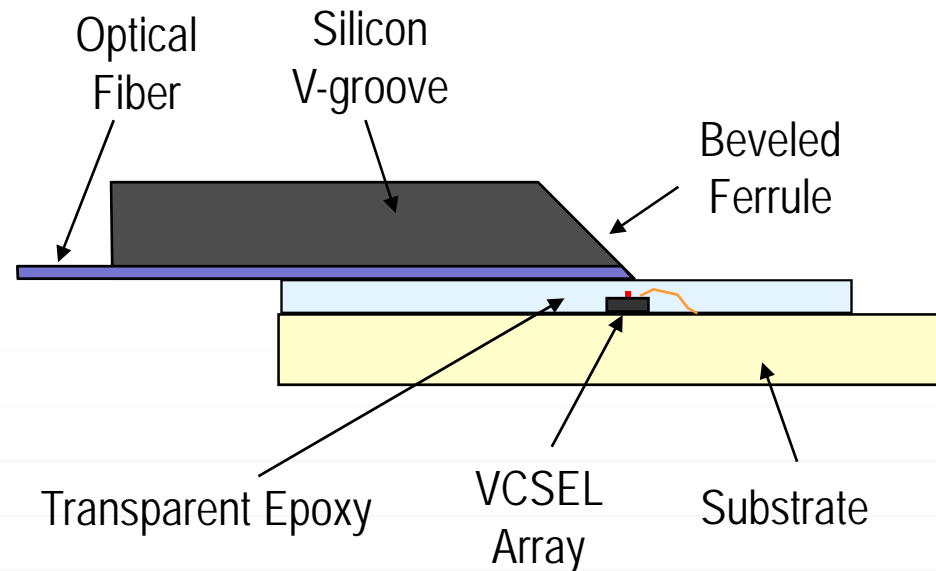
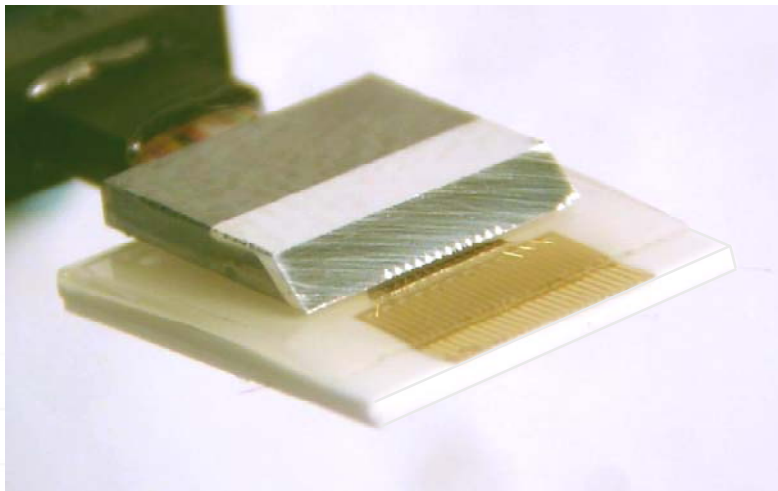
OE-BGA  
demonstrator

# ***Light*ABLE™ Core Technology**

# LightABLE™ Core Technology Optical Sub Assembly (OSA)

REFLEXPHOTONICS™

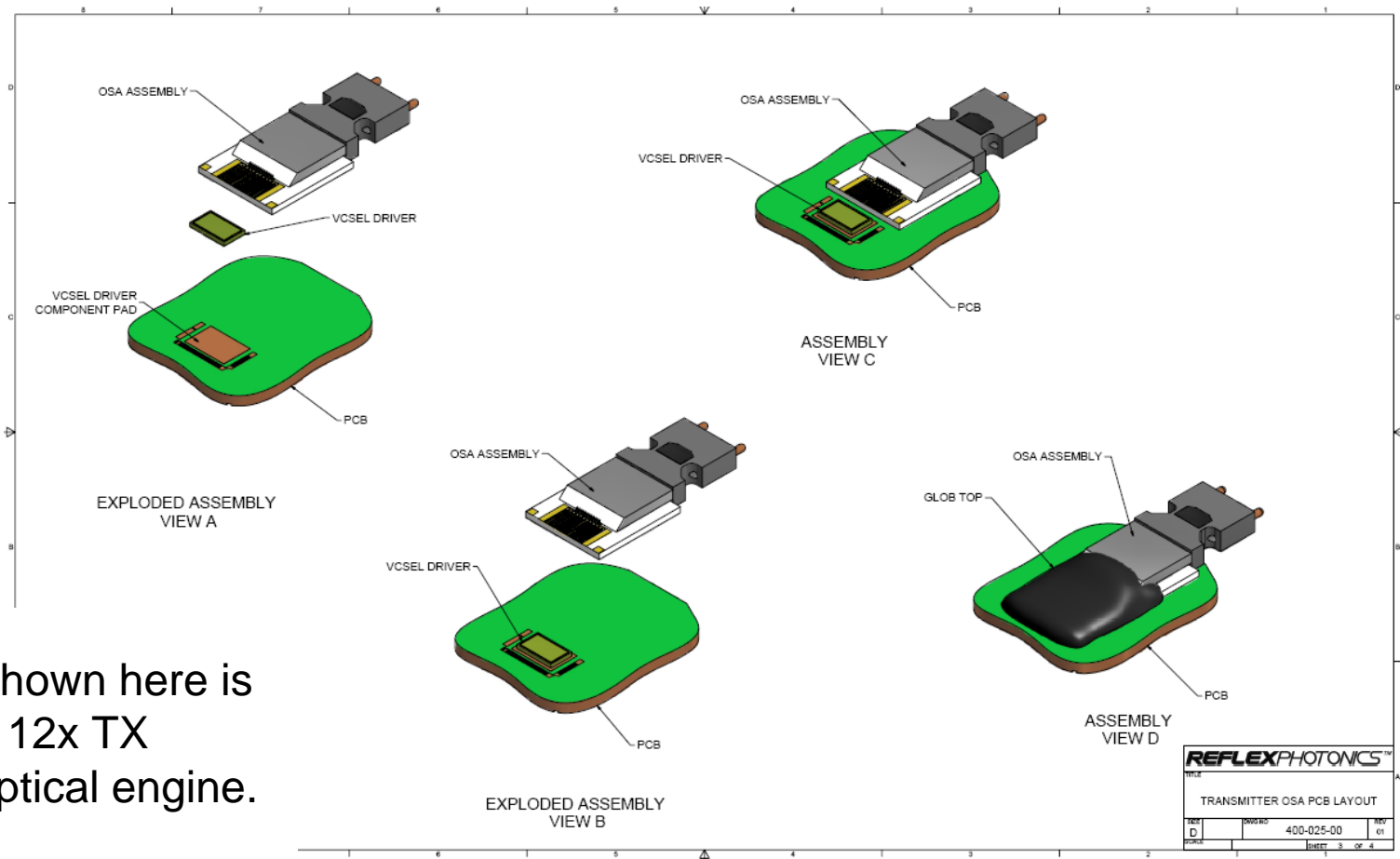
- Modular
- Planar Assembly → Low Profile
- No Microlenses → Single Alignment Step
  - Very low cost, pre-aligned, and small sub-module
  - Essential for parallel optic modules



# ***LightABLE Optical Engine***

# The LightABLE Optical Engine

- Combined with electronics, the OSA becomes an optical engine.



- Shown here is a 12x TX optical engine.

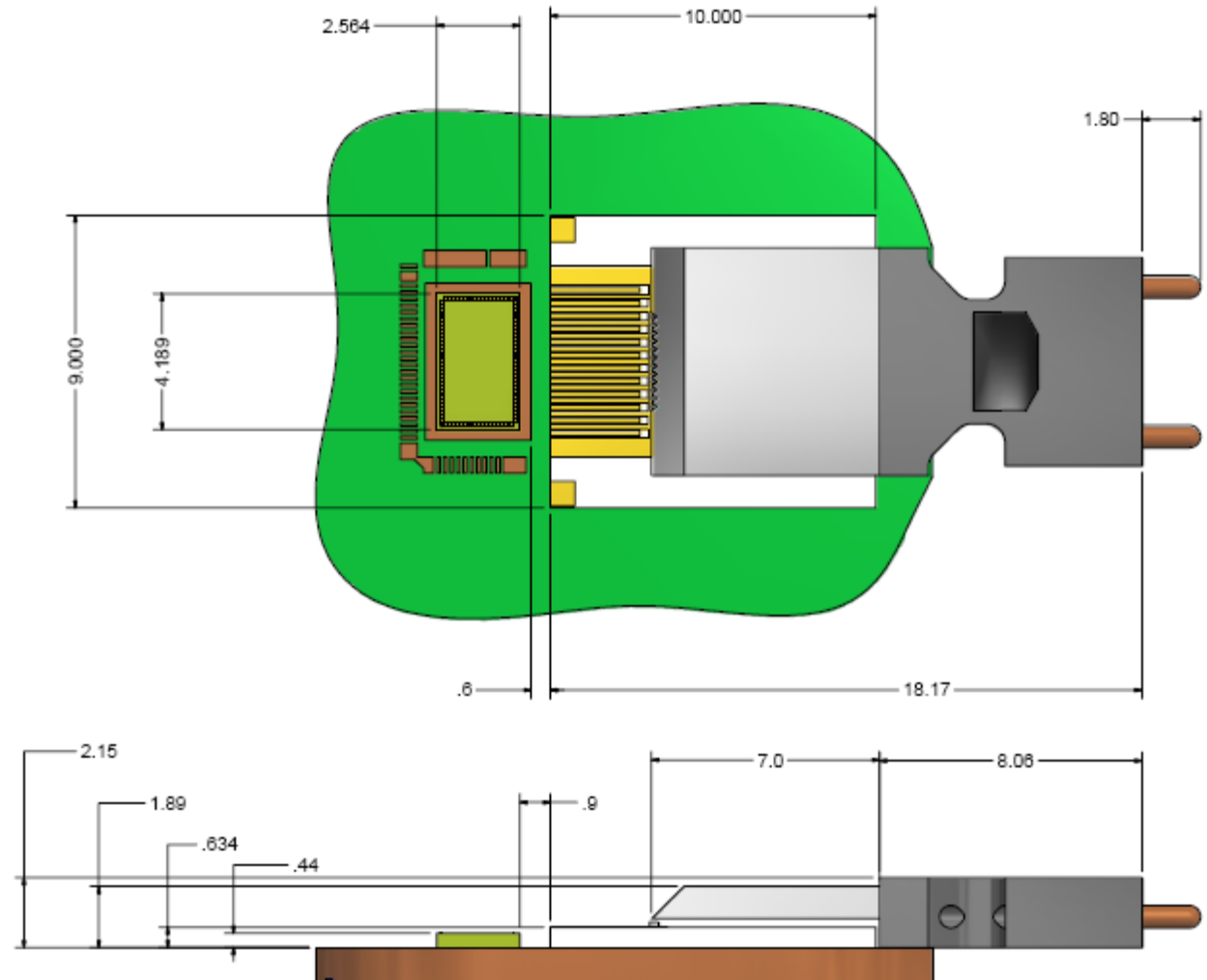
|                            |            |      |     |
|----------------------------|------------|------|-----|
| REFLEXPHOTONICS™           |            |      |     |
| TRANSMITTER OSA PCB LAYOUT |            |      |     |
| REV                        | DATE       | BY   | APP |
| D                          | 400-025-00 | 01   |     |
| PAGE 3                     |            | OF 4 |     |

# LightABLE Optical Engine

## Small size and low power

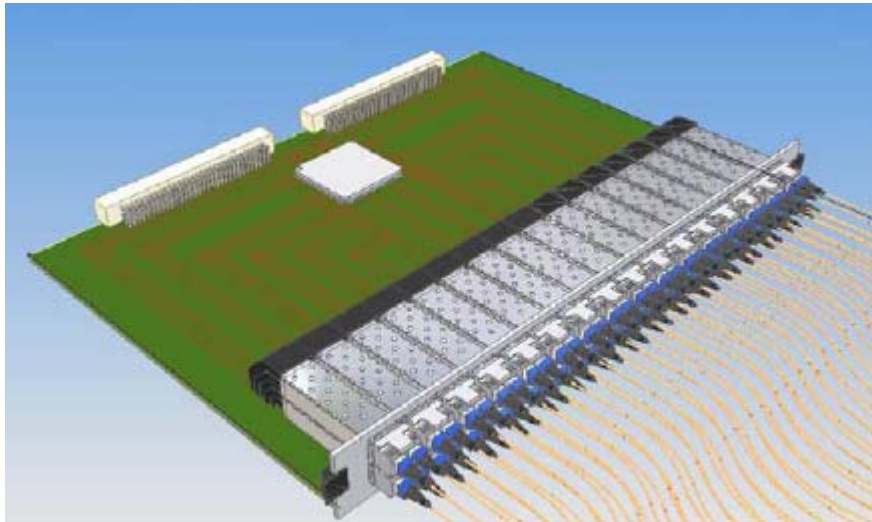
REFLEXPHOTONICS™

- 12 XFP or SFP+ modules replaced with 2 Reflex optical engines
- $< 4 \text{ cm}^2$  as compared to  $>80 \text{ cm}^2$  for SFP+ (not including space for SFI traces )
- $< \frac{1}{2}$  the power of SFP+
- Lower EMI (no long high speed traces or electronics at the bulkhead)

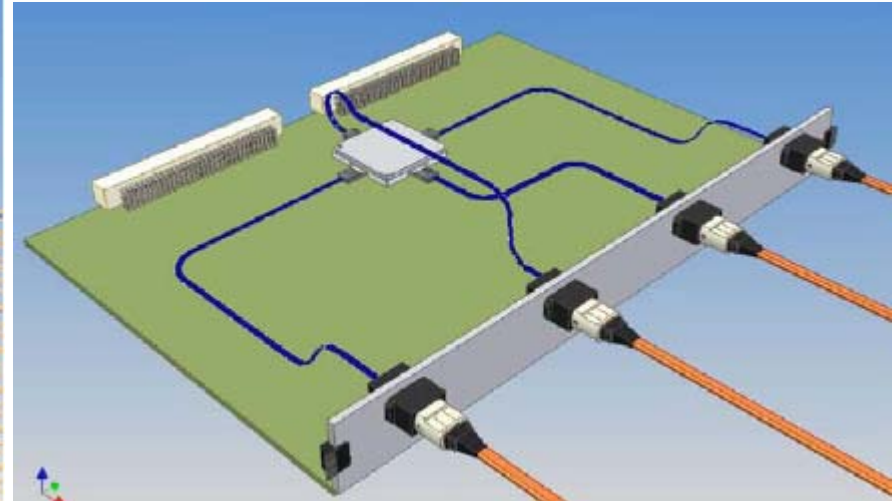


# Sample Application

Traditional optics



OE-BGA



## ■ Reduces

- Optics cost
- EMI
- Time and complexity of PCB design
- Cost of PCB

## ■ Increases

- Data rate
- Port density

- Reflex *Light on Board* and OE-BGA eliminate the need for long traces to expensive modules saving space, power and cost.
- The optics are brought to the IC.
- EMI emissions reduced by moving electronics away from the faceplate.
- Maximum density
- Proven technology

***Thank You***