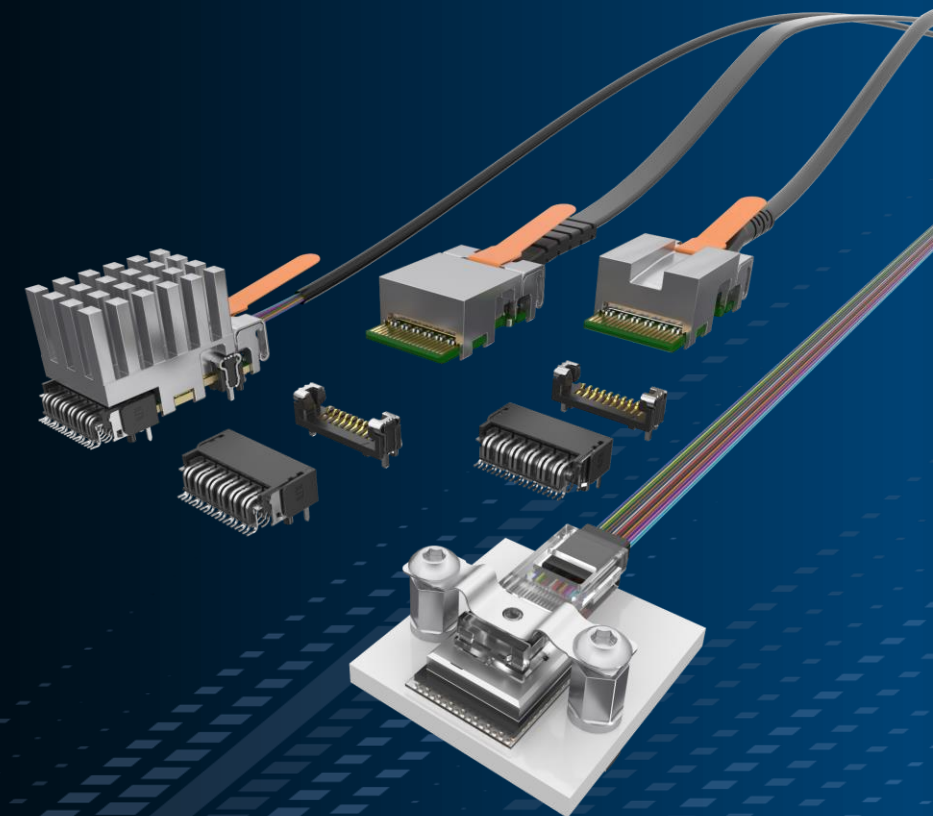




SAMTEC FIREFLY MIDBOARD OPTICS

September 2022



- **Introduction to Flyover**
 - Overcoming PCB insertion loss
- **Introduction to Midboard Optics**
 - Benefits of midboard optical modules
- **Samtec Optical Product Offering**
 - FireFly
 - CSP

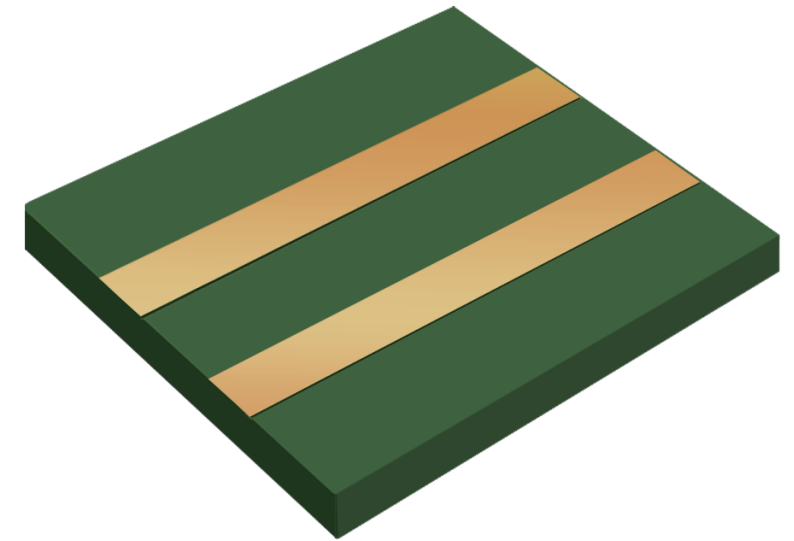
PRINTED CIRCUIT BOARDS

Base Material

- Typically woven fiberglass / epoxy
- Different PCB materials have different:
 - Glass Material
 - Glass fabric thickness
 - Weave pitch
 - Number of strands
- Leads to different electrical properties of different materials

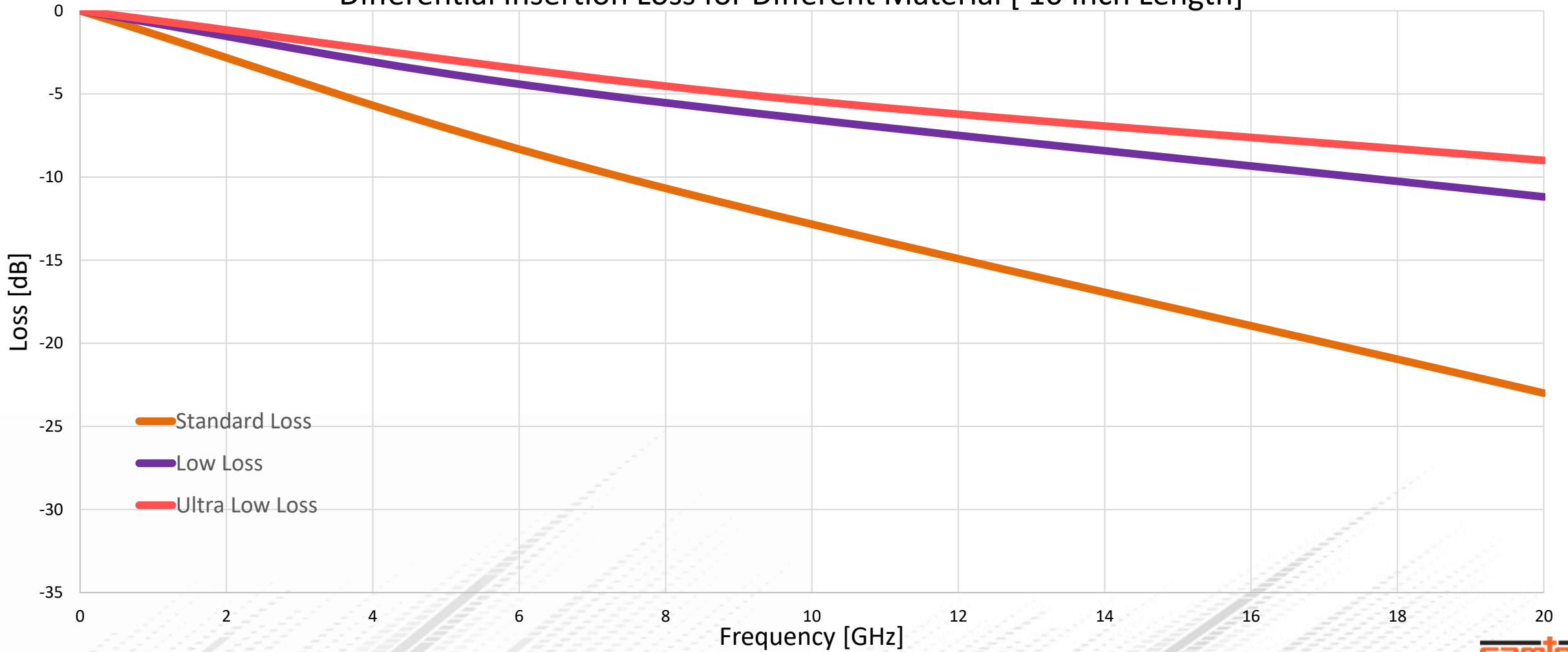
Copper Traces

- Skin depth decreases with increasing frequency
- Copper/Base material interface has to be rough to stick



PCB LOSS

Differential Insertion Loss for Different Material [10 Inch Length]



PCB performance is affected by:

- Base Material Type
- Base Material Weave profile
- Copper roughness

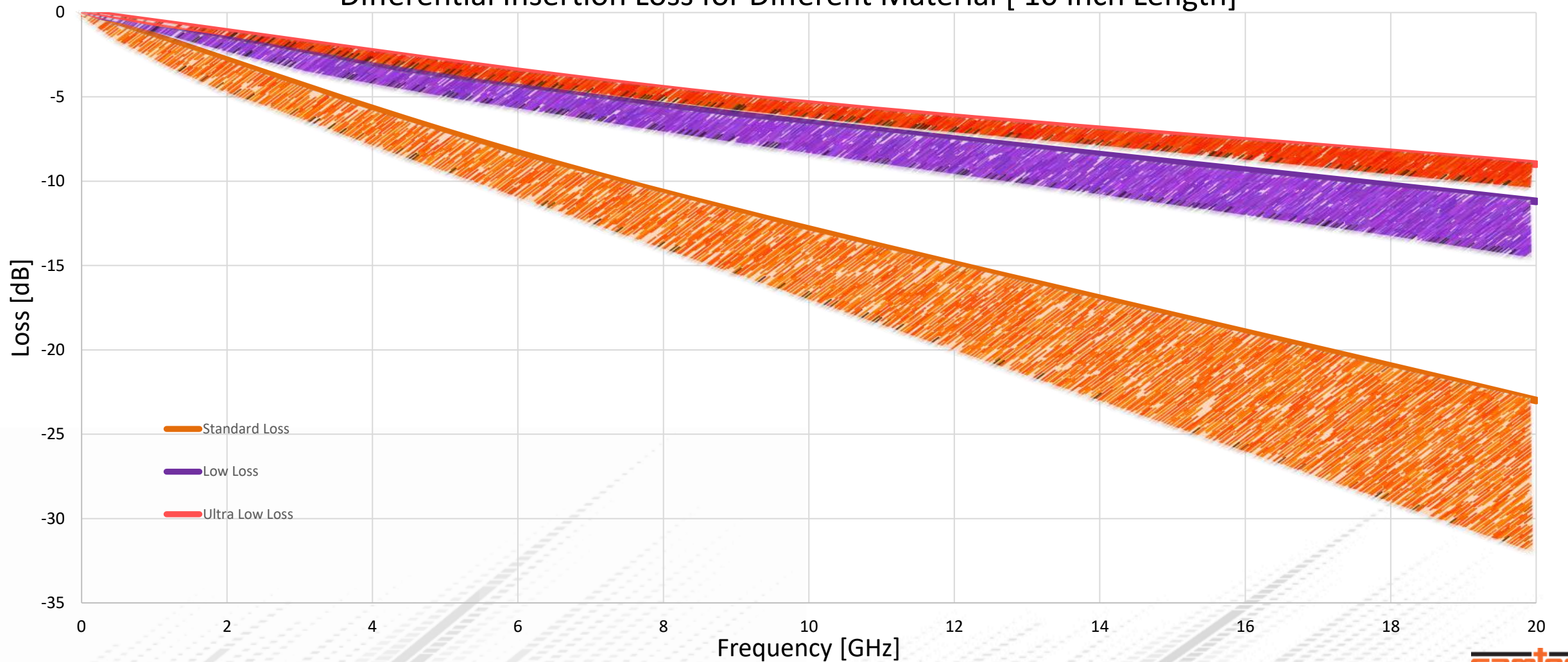
These all are affected by temperature:

- Dielectric constant
- Coefficient of Thermal Expansion

PCB LOSS OVER TEMPERATURE



Differential Insertion Loss for Different Material [10 Inch Length]



SOLUTION



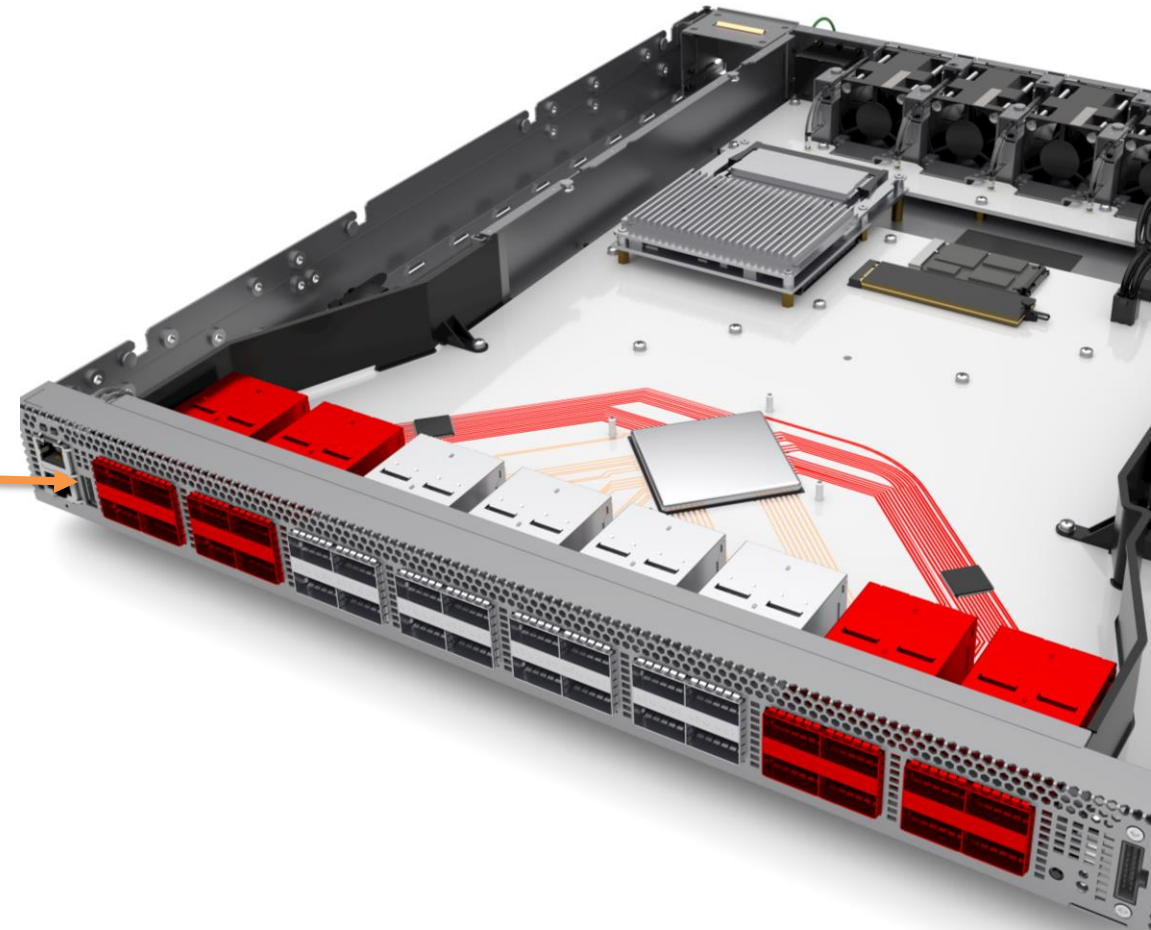
High Performance Material

Shorter Channels

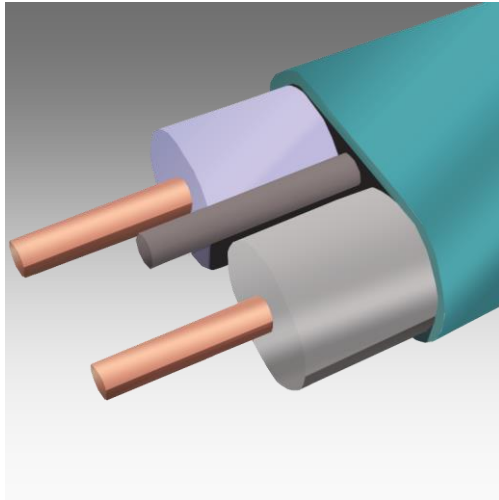
Adding retimers

- Increases complexity and development time
- Increases power dissipation

Or you could ignore the board altogether...

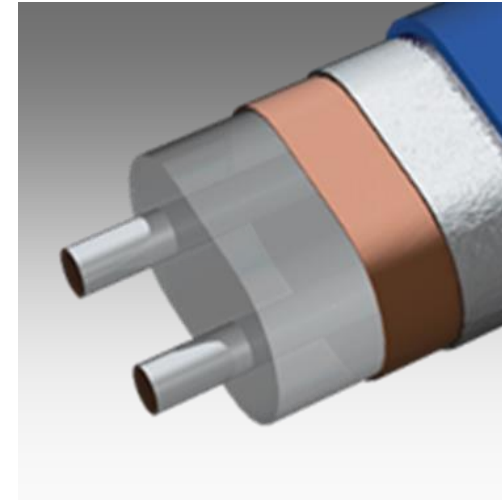


TWINAX CABLE



Two individual cables

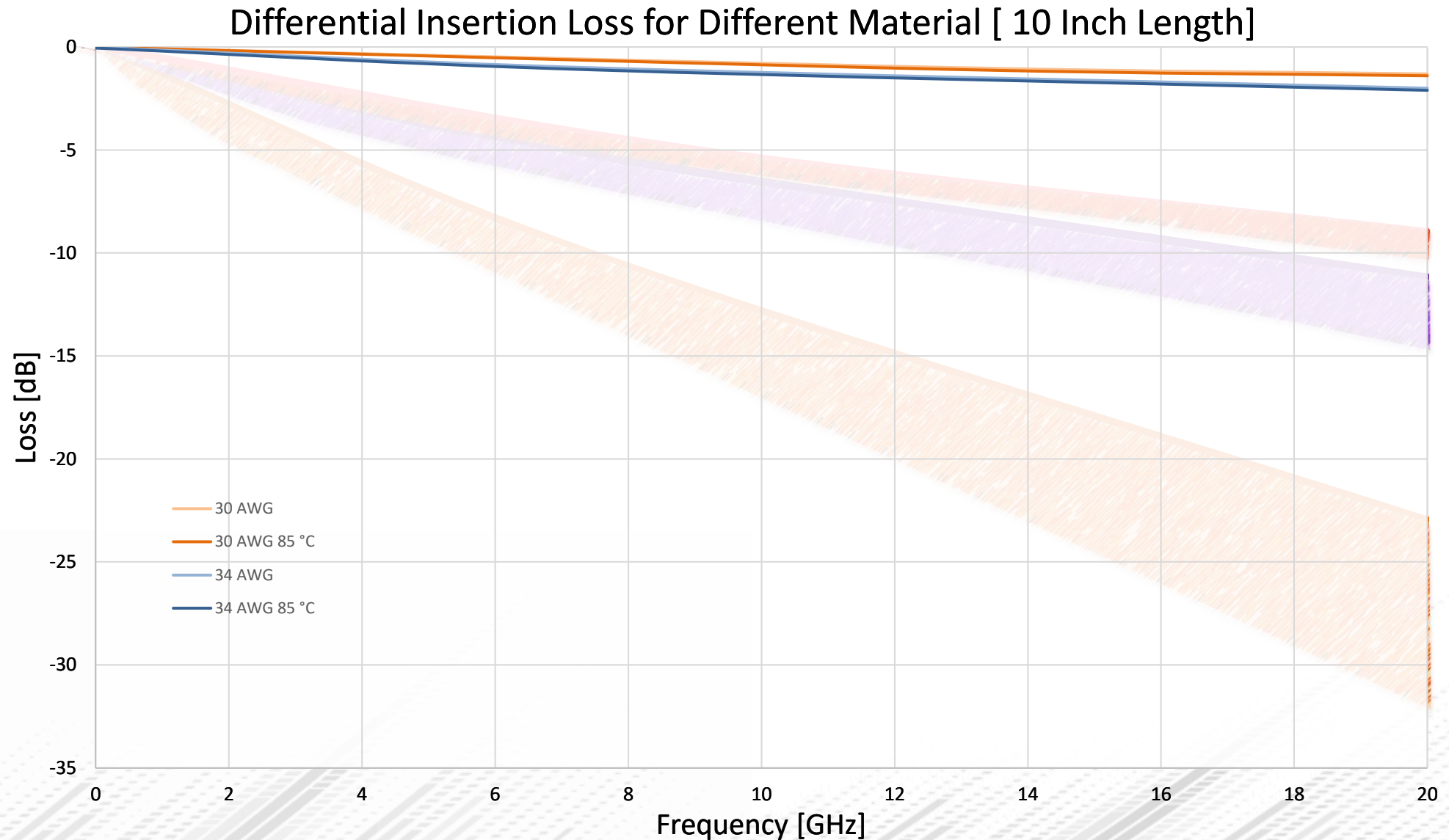
- Conductor
- Dielectric
- Drain wire



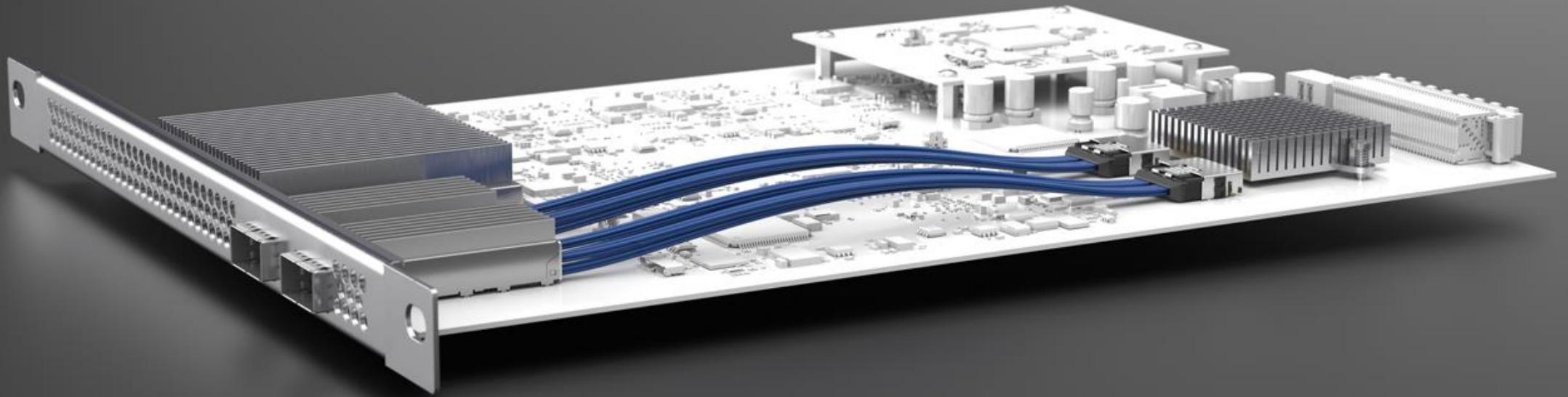
Single cable construction

- Solid center conductor
- Co-extruded dielectric
- Copper Shield
- Secondary Metalized Barrier

TWINAX LOSS OVER TEMPERATURE



FLYOVER CABLING



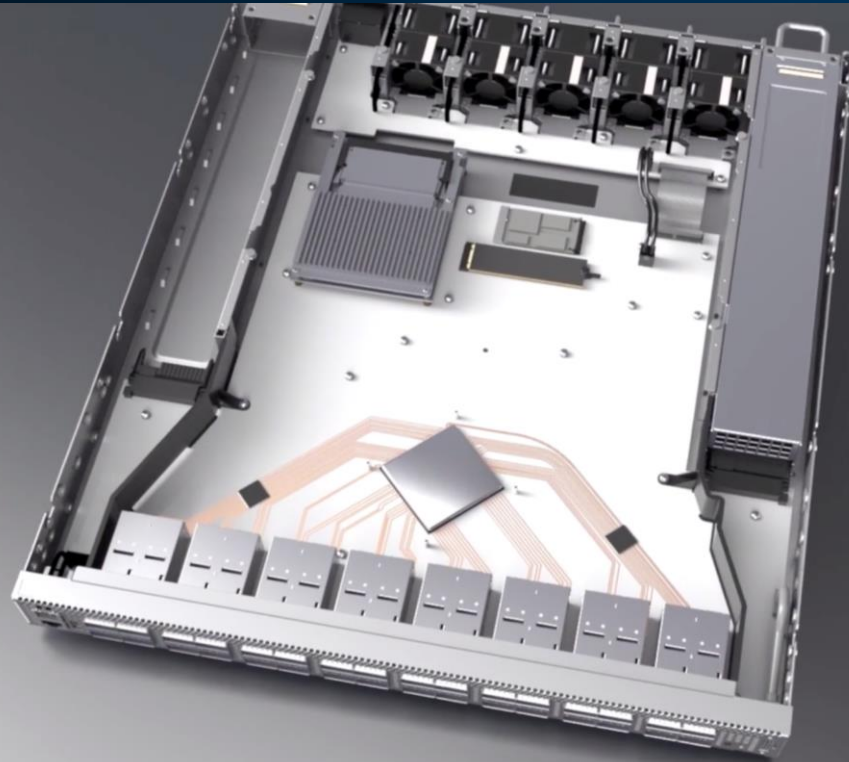
Flyover takes the signal off board and into high performance cables

Cost saving

Easier layout

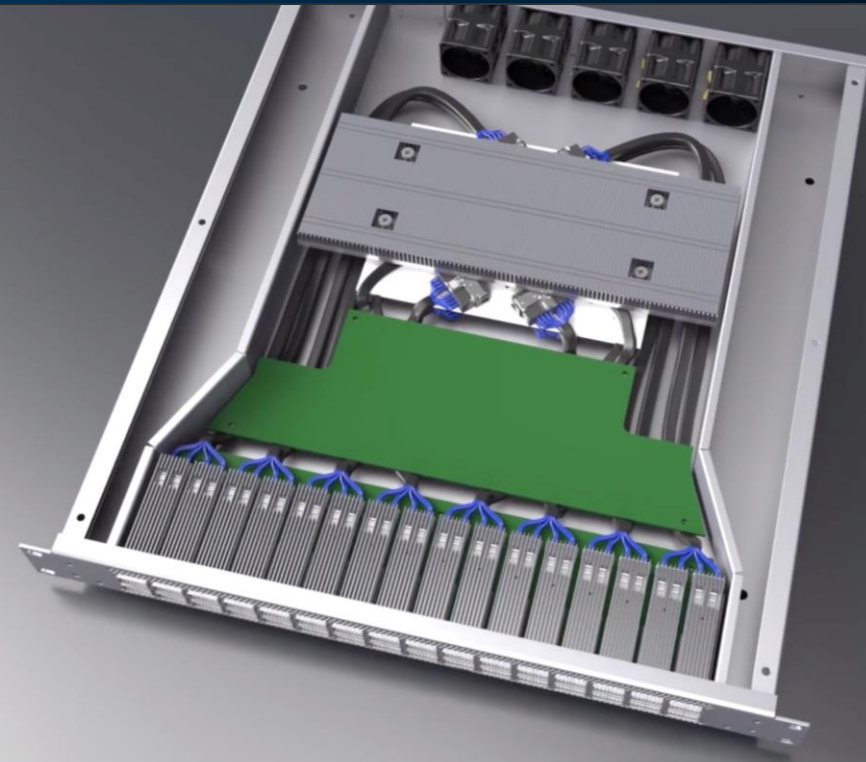
Thermal efficiency

FLYOVER CABLING



Conventional Design

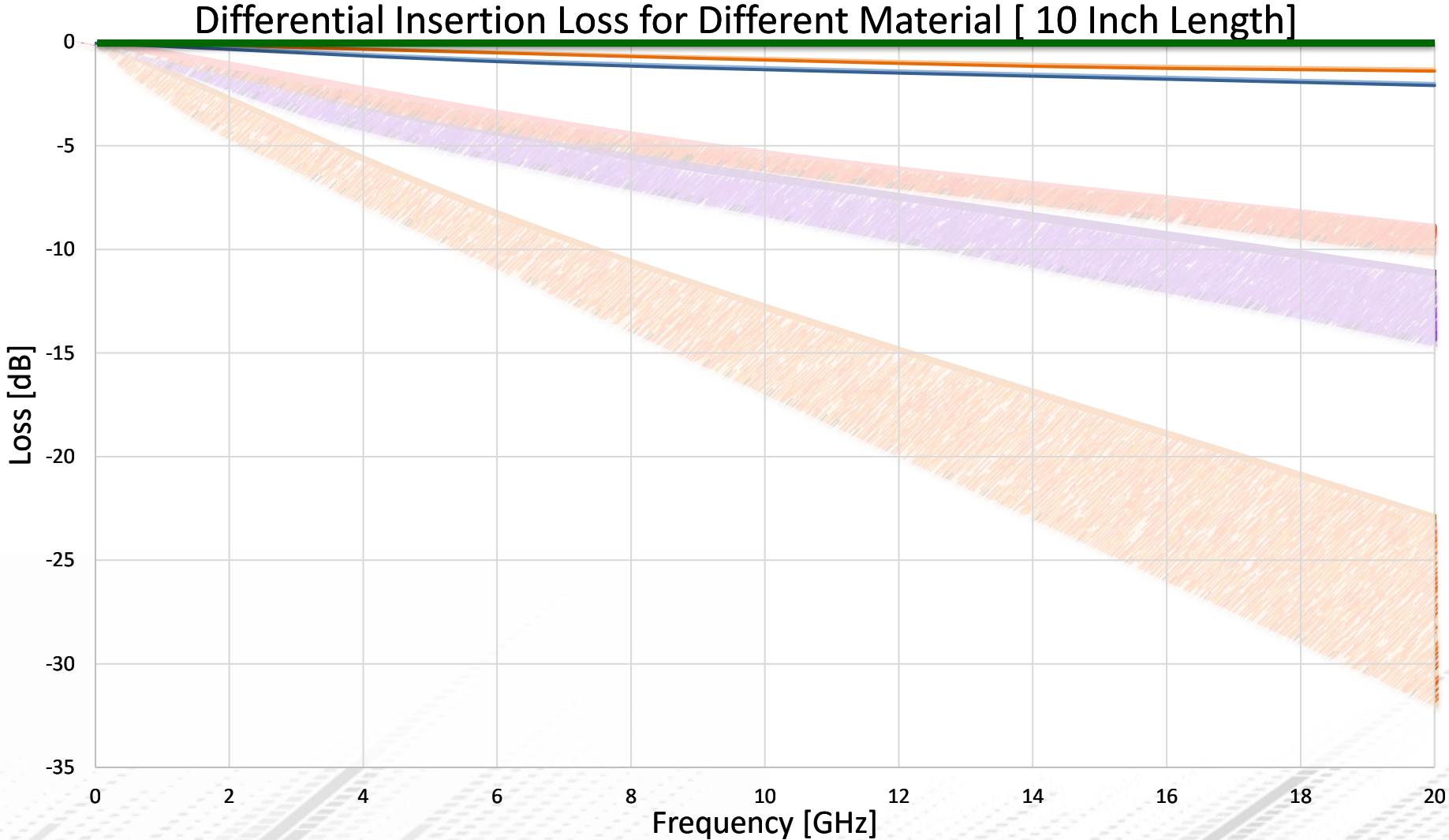
- Single PCB
- SI forces ASIC close to ports
- Thermal challenges for optical ports



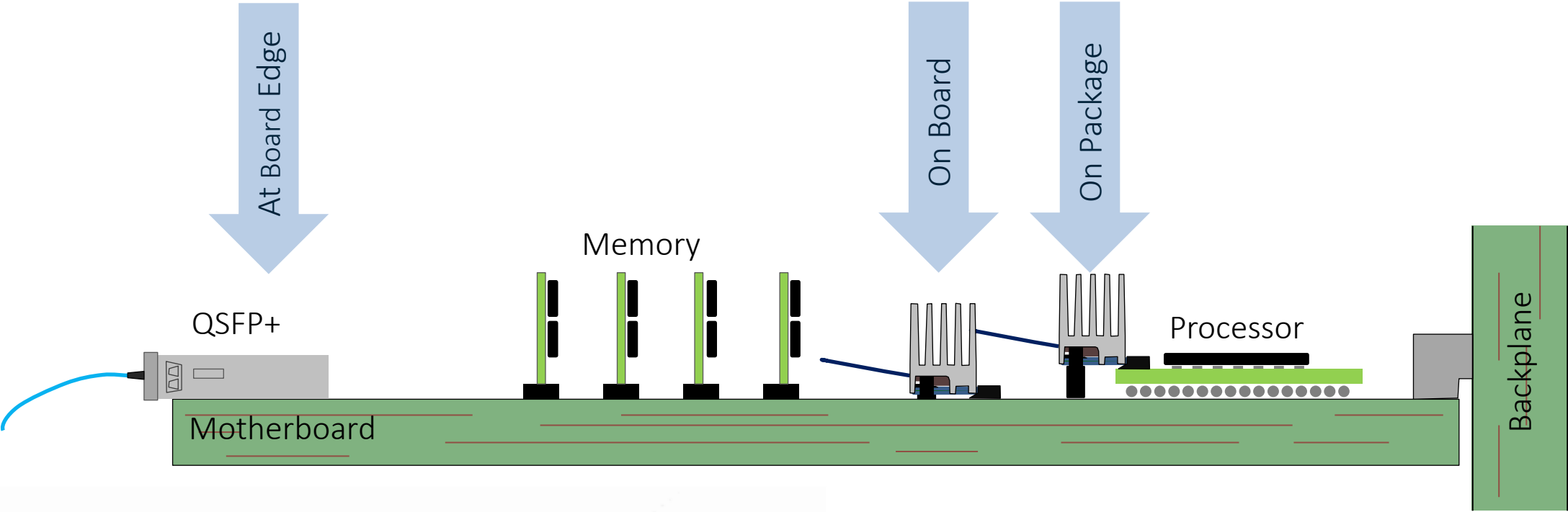
Modular Design

- Separate PCBs
- ASIC close to fans
- Thermal isolation

OPTICAL FIBER INSERTION LOSS



WHAT IS MIDBOARD OPTICS?



Easier Layout, Higher Density, Better Signal Integrity, Lower Power

FIREFLY OPTICAL FLYOVER SYSTEM



*Data connection is taken "off board,"
simplifying board layout and enhancing
signal integrity from IC to faceplate*



FIREFLY™

14 G b p s	x4 x12	25 G b p s	x4 x12
16 G b p s	x12	28 G b p s	x4

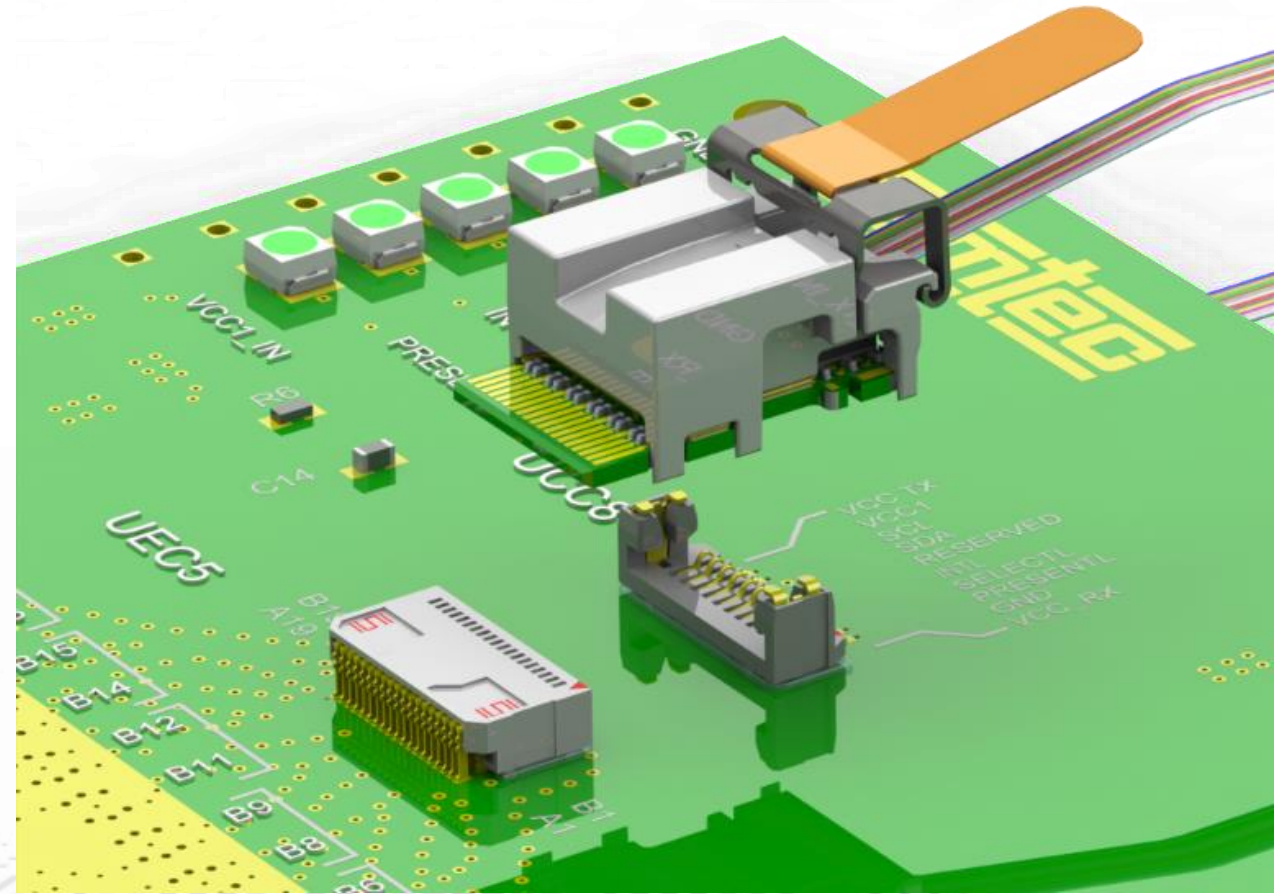
FEATURES

- Up to 28 Gbps per channel via optical cable for greater reach
- Industry leading miniature footprint allows for higher density close to the data source
- Simple to use system with easy insertion/removal and trace routing, no through-holes, and a surface mount connector system
- Supports data center, HPC and FPGA Protocols, including 10/40/100 GbE Ethernet, InfiniBand™, Fibre Channel, and Aurora

RUGGED TWO-PIECE CONNECTOR SET



- **Future-Proof Design**
 - Connector system accommodates both FireFly™ Optical & Copper systems
- **High Speed Data (UEC5 Series)**
 - 0.5 mm pitch
 - 12 differential pairs (GSSG)
 - Designed for 56 Gbps Performance
 - Easy Breakout Region layout
- **Power & Communication (UCC8 Series)**
 - 0.8 mm pitch
 - Latching locking mechanism
 - Rugged weld tabs
- **Easy to Assemble & Easy to Service**

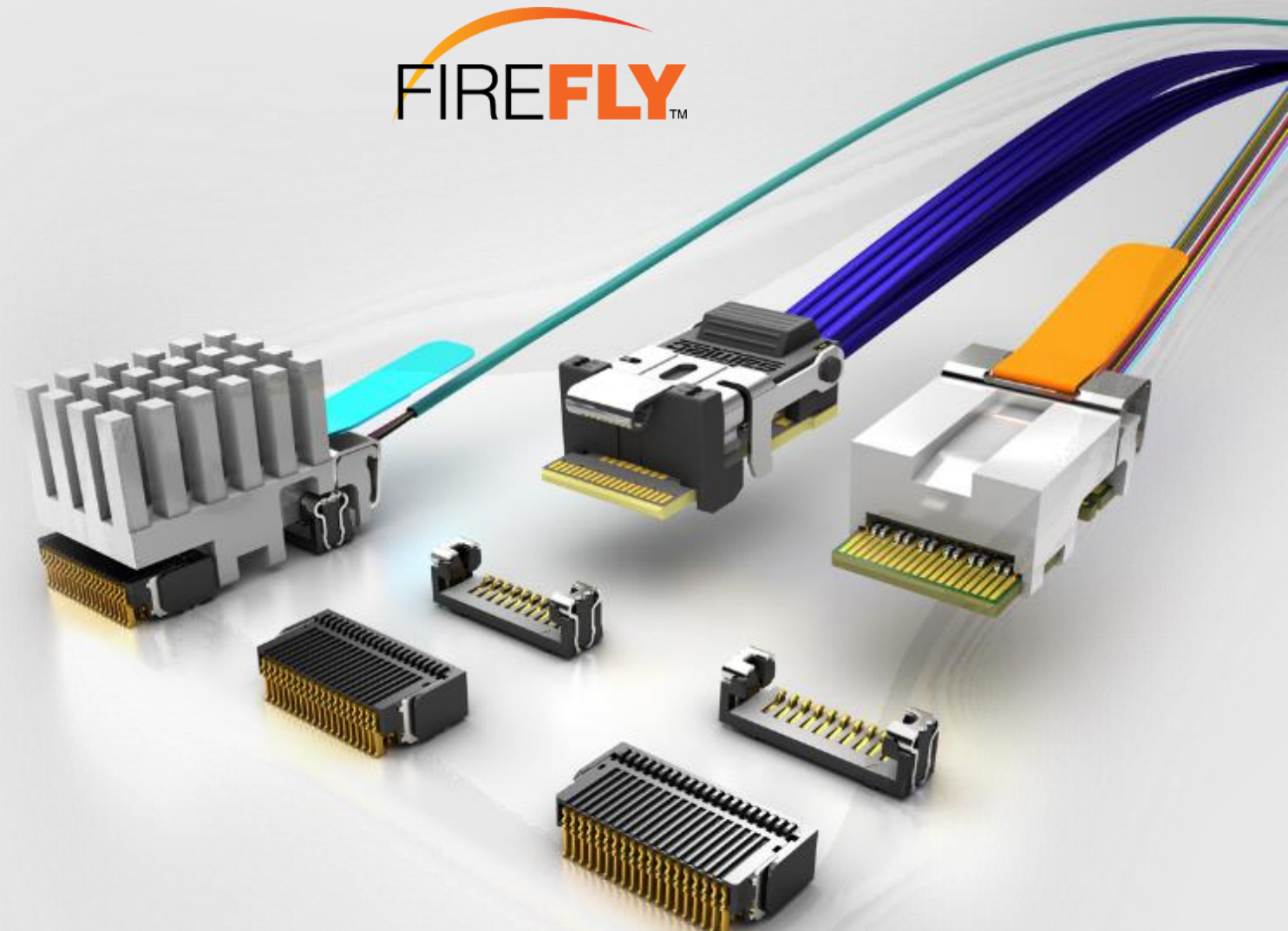


FIREFLY PLATFORM

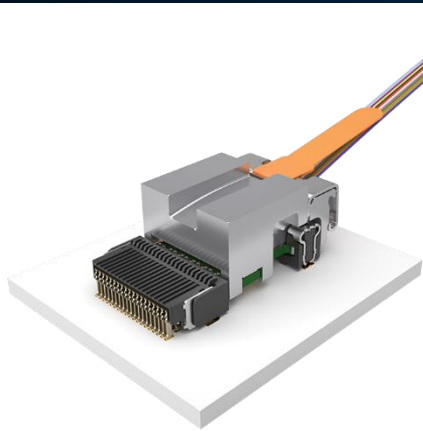


- Samtec is the only company to offer a future-proof system design that supports both copper and mid-board optics in the same footprint
- In addition to design flexibility, this also allows for easy test of PCBA before the optics are added
- Excellent for lab environment-to-deployable, rugged applications

Both Optical & Copper Modules
Fit in the Same Rugged 2-Piece
Connector System



FIREFLY PRODUCT FAMILY



Commercial Temp

ECUO Series

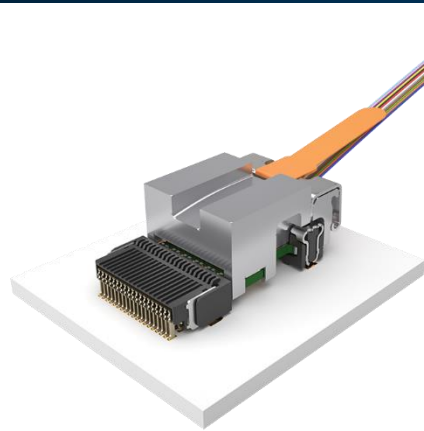
x4 & x12

Up to 28 Gbps

Multiple standard
& custom heat sinks

Temperature range
0 °C to 70 °C

Multiple end options



Extended Temp

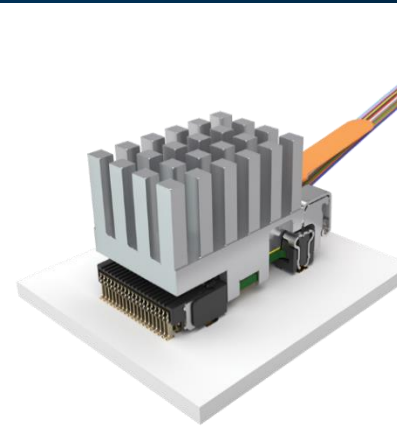
ETUO Series

x4 & x12

Up to 28 Gbps
per channel

Temperature range
-40 °C to 85 °C

Multiple end options



Extreme Environments

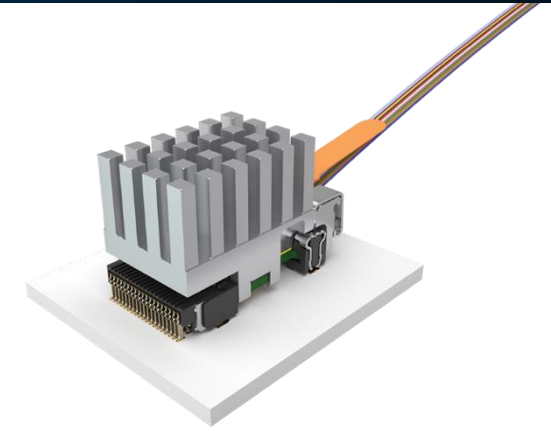
ETMO Series

x4 & x12

Sealed for submersible and
extreme environments

Temperature range
-40 °C to 85 °C

Multiple end options



PCIe® over Fiber

PCUO Series

X4 and x8 PCIe®
micro-optical engines

Meets PCIe®
4.0 specifications

Transmits PCIe®
signals up to 100 m

CUSTOMIZATION OPTIONS



Mechanical: Fiber types, end options, heatsinks, packaging

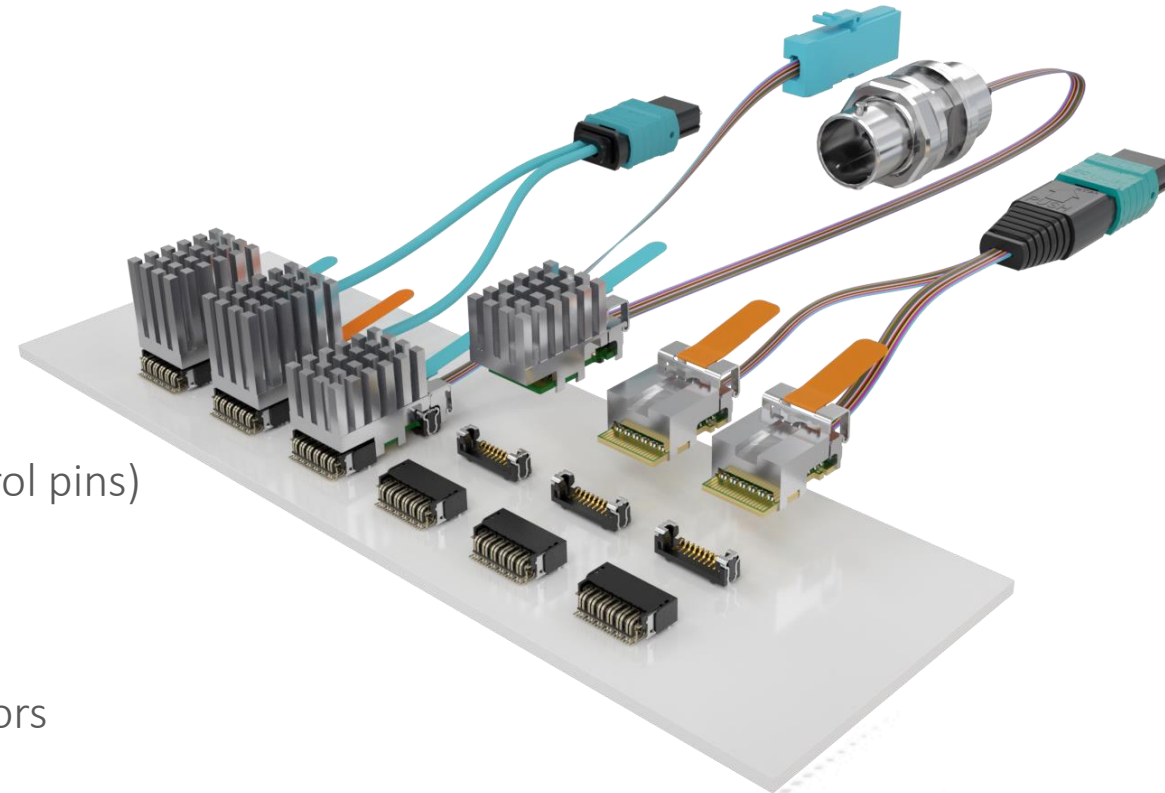
- Multiple fiber types, optical connectors, and heatsink options
- Custom labels and packaging

Firmware: Custom firmware and EEPROM

- I2C address, identifiers, module settings
- Adding functionality or modifying module behavior (eg. control pins)

Link Budget: Custom, high-loss link budgets

- Enables complex fiber trunks with multiple high loss connectors



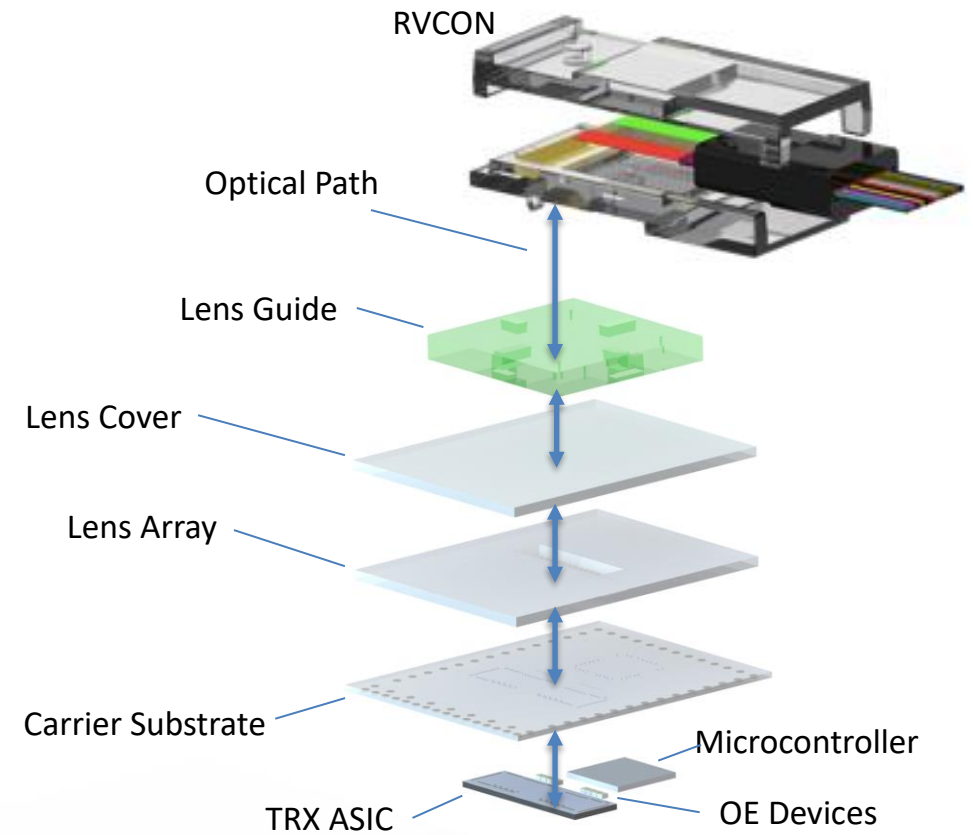
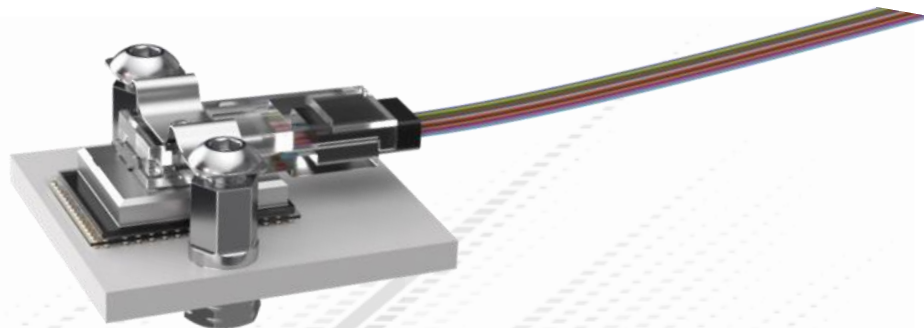
SAMTEC ACQUIRES ULTRACOMM



- **Samtec acquired UltraComm from Psemi/Murata in December 2021**
- **UltraComm is a team of ~45 associates (eng and ops) located in Vista, CA (near San Diego)**
 - Ultra-rugged optical modules for harsh environments
- **The acquisition provides Samtec with a radiation hardened, solder reflowable transceiver**

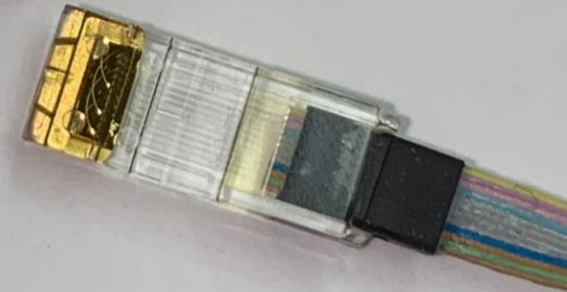
CHIP SCALE PACKAGE (CSP)

- **Solder reflowable module**
 - Excellent shock and vibration performance
 - Through the board cooling
- **Optically pluggable with a custom ferrule**
 - RVCON is a proprietary optical connector
 - A strap and screws are used to clamp the RVCON in place



CSP VARIANTS

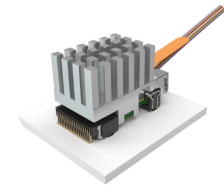
- **Two Variants are Under Development**
 - X80SC: up to 10 Gbps per channel (4 channels)
 - X200SC: 10 to 25 Gbps per channel (4 channels)
 - Option for rad-hard version with no microcontroller
- **Features and Benefits**
 - Solder reflowable
 - Optically pluggable with RVCON connector
 - Compact size: 8 x 10 mm footprint
 - Light: 0.4 grams for CSP, and low-weight fibers
 - Low-power: 100 to 200 mW per channel
 - Wide operating temperature: -40 C to 95 C



OPTICS PRODUCT ROADMAP



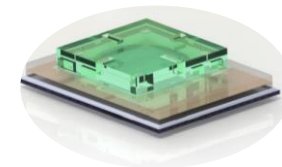
Series	Lanes	Gbps	Features
CSP	4 + 4	10	Radiation hardened
CSP	4 + 4	10	Industrial temperature range
ETUO	4 + 4 / 12	10.3	
ETUO	4 + 4	25	
ECUO	4 + 4 / 12	14.1	Aligns with FDR InfiniBand and 14G FPGA speeds
ECUO	12	16.1	Maximizes FGPA interconnection
PCUO	x4 / x8 / x16	PCIe® Gen 3 and Gen 4	x4 / x8 / x16, Transparent and Non-Transparent PCIe FireFly™
PCOA	x4 / x8 / x16	PCIe® Gen 3 and Gen 4	x4 / x8 / x16, Transparent PCIe Extension Card
ECUO	4+4 / 12	25	Exceeds specs IEEE 802.3ab for 100G SR4
ECUO	4+4	28	112 Gbps aligns with faster FPGAs



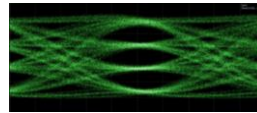
**ECUO 25G x12
Production Release**



**ETMO
Samples**



**25G CSP
Samples**



**56G PAM-4
Samples**

Today

2023

The logo features the word "samtec" in a bold, orange, sans-serif font. The letters are contained within a white rectangular frame consisting of two horizontal bars. The letter 't' is taller than the others and extends above the top bar. The letters 'a', 'm', 'e', and 'c' are shorter and sit between the two bars.

samtec

SUDDEN SERVICE®