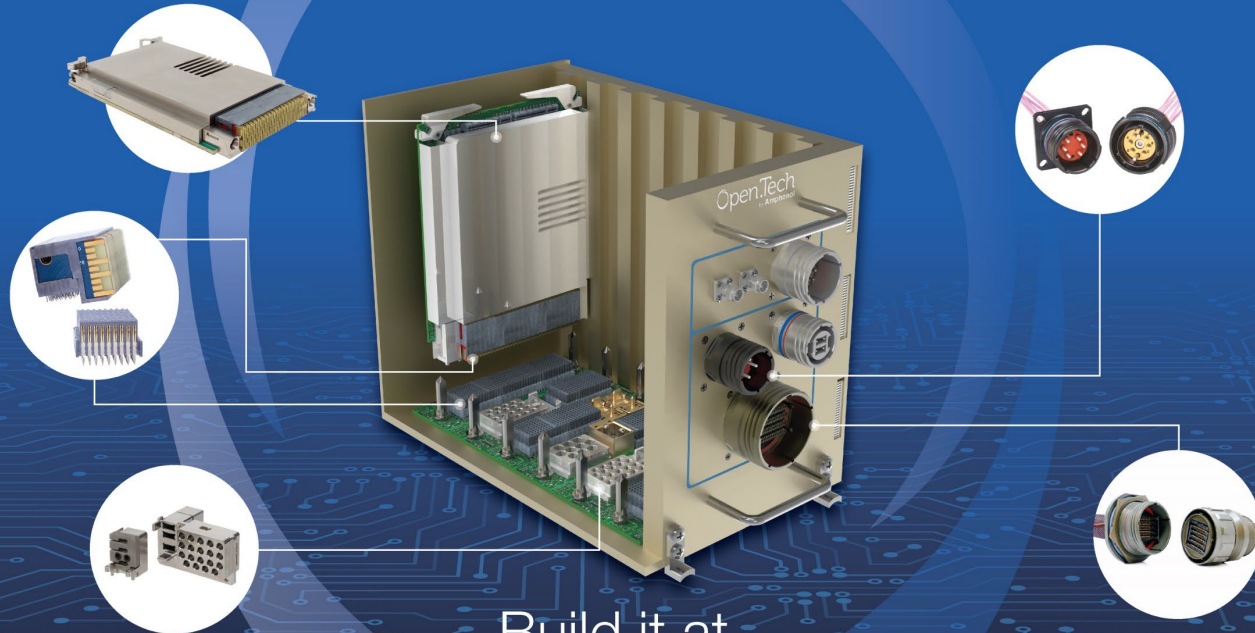


2025 EMBEDDED TECH TRENDS

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Everything **Modular**  
Everything **Scalable**  
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**Faster, Stronger, More:  
Removable MT Fiber Connections**

# Agenda

- What the industry wants: Faster, Smaller, Resilient, More
- The Rise of MT Ferrules
  - History
  - Products: connectors, transceivers, cables, switches
- The Future....and YOU
  - Single mode
  - Expanded beam
  - CWDMs/DWDM
  - Data centers vs the military

# Condensed History Fiber Connectors

- Fiber Optic Connectors: devices used to join optical fibers where the ability to connect and disconnect is required.
- The development of the connectors and fiber optic cable continues to be driven by the demands of telecommunications and data networks.

## 1. 1970s-1980s: Early Developments

1. **Biconic Connector:** Developed by AT&T, it was one of the first connectors used in long-haul telecommunications.
2. **ST Connector:** Introduced in the 1980s, it became widely used for multimode fiber optic networking.
3. **MT Ferrule:** (Mechanical Transfer Ferrule) Developed by NTT in Japan

## 2. 1990s: Advancements and New Designs

1. **SC Connector:** Developed by NTT in Japan, it featured a push-pull design for easier connections.
2. **FC Connector:** Known for its threaded design, providing a secure connection.
3. **LC Connector:** Developed by Lucent Technologies, it reduced space requirements on patch panels.
4. **MPO Connector:** Allows for packaging density equal to size of the standard Telcom fibers.
5. **MIL-T-29504/ MIL-PRF-29504** – First Military specification of harsh environment applications

## 3. 2000s: Higher-Density and Multifiber Connectors for Harsh Environments

1. Wide adoption of MPO/MTPs in Datacom
2. Adoption of MT ferrules in Harsh Environments Connector form factors



# MTs in Connectors

- **VITA 89 - MT38999**
  - 20+ years of market leadership
  - High density with all benefits of 38999 connector shell
  - Strain relief to the cable strength member (no backshell needed for strain relief)
  - Performance metrics (BER) more accurately depict a real-life signal compared to CIT
- **VITA 66.X** – Rectangular blind mates facilitating board to board connections
- **VITA 87** – MIL-DTL-D38999 –High density – Gang retention – no native support for aramid strain relief.
- **MTC-HD**
  - Decreased weight compared to VITA 87
  - Individual ferrule retention
- **NanoDMT**
  - Superior reliability, exceptional signal
  - Integrity, and compact size, making them ideal for modern electronic systems requiring
  - Robust interconnection solutions.
  - Support for round cable and aramid strain relief.



# Advantages of Removable Fibers

- Maintenance
  - Quickly isolate potential failures in systems
- Cost
  - Component reuse reduces complexity and allows for larger quantity pricing
- Reliability
- Flexibility and Scalability
  - Keeping with the modular theme of VITA, new interfaces allows for easy upgrades
- Improved Testing and Validation
  - Modular troubleshooting during qualification testing



# Myths about Fixed (non-removable) Fibers

## Myths about non-removable interfaces:

- Higher mechanical robustness
  - NOT TRUE – a removable interface can achieve the same mechanical shock/vibe criteria
- Reduced intervention
  - While this is a benefit for some people, fiber end faces need to be cleaned and inspected
- Lower quantity of part numbers
  - In the end, designing a removable fiber interface makes the whole system MODULAR and SCALABLE



# Brief History of Pluggable On-Board Transceivers (OBT)

**2009** - Amphenol Active Optical Products releases the Small Cubic Form Factor (SCFF) OBT with the ubiquitous “LC” connectors optical interface.

**2015** - Amphenol Active Optical Products releases the “MT” Ferrule Optical Interface, 12TX -12 RX, Leap OBT.

**2024** – Amphenol Active Optical Products releases 4TX-4RX, Quad Embedded Pluggable Transceiver (QEPT), hot pluggable with 12F MT ferrule interface. MT Optical interface and a mezzanine electrical connector IO facilitates system maintenance and future upgrades.



SCFF

1 Duplex Channel  
2 LC connectors



LEAP® OBT

12 Duplex channels in  
1 removable MT  
25G

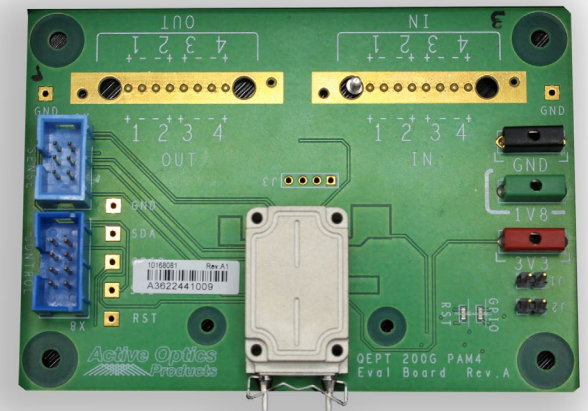
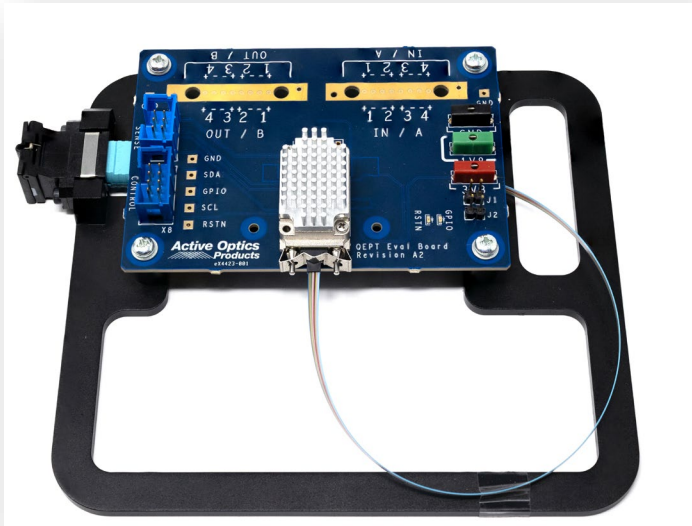
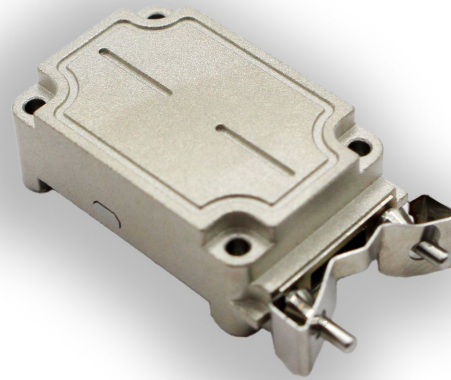
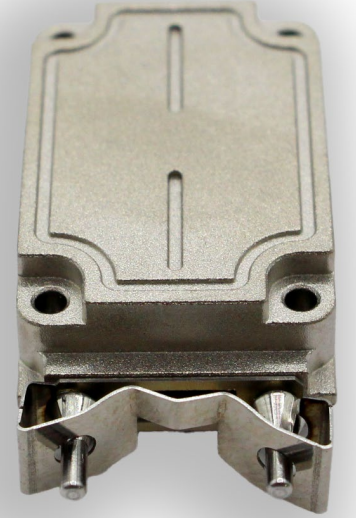


QEPT

4 Duplex channels in  
1 removable MT  
50G

# New for 2025 QEPT 4-TRX 200G PAM4 - HOT PLUGGABLE

- Backwards compatible with 100G NRZ
- Footprint compatible with QEPT-100G





# Ruggedized Fiber Solutions for Embedded Applications

**Simplex 1.8mm**, aramid reinforced Fluoropolymer Jacketed Cable (-65°C to 125°C)

**Simplex 0.8mm**, aramid reinforced Fluoropolymer Jacketed Cable (-65°C to 150°C)

**Standard Temp Range** (-40°C to 85°C) 4, 12 and 16 fiber Ribbons

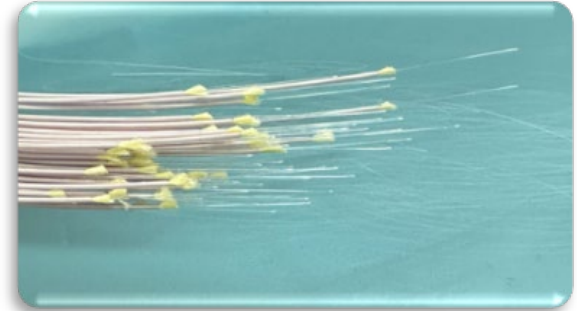
**Extended Temp Range** (-55°C to 125°C) 4, 12 and 16 Fiber Ribbons

**Round 12F and 24F** aramid reinforced Fluoropolymer Jacketed Cable (-65°C to 125°C)

**Printed Optical Flex Circuits** for high density, complex routings and internal fiber distribution. (-55°C to 90°C)

**Encapsulated Optical Cables** for ultimate high vibration and maximum fluid contamination protection. (-45°C to 85°C)

LITEflight® Fiber Optic Cables



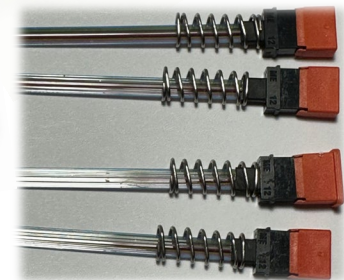
OFS FlightLinx™



Amphenol-FSI Optical Flex Circuits



Amphenol-FSI Encapsulated Optical Cables



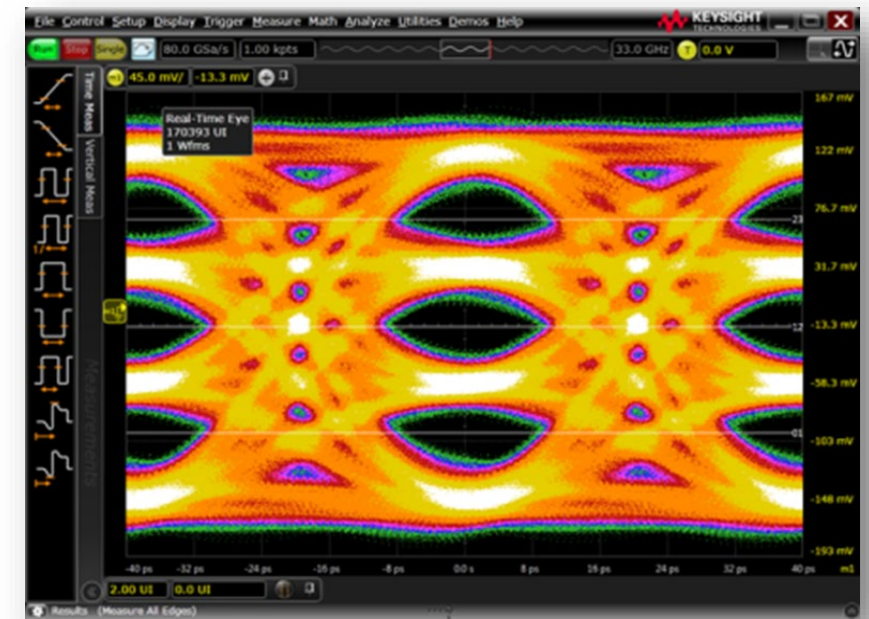
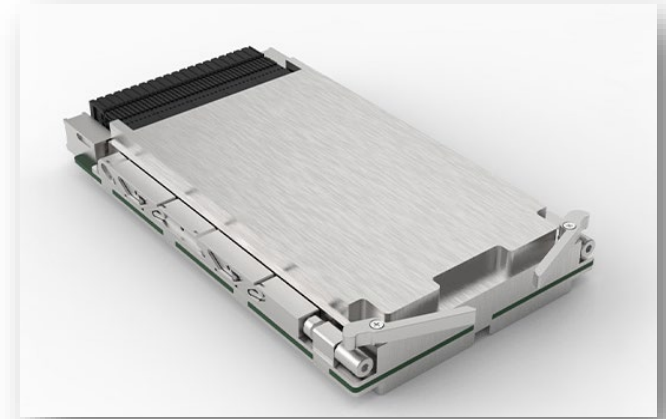
Amphenol-FSI Fiber Ribbon Cables

# 50G PAM4 Speeds

## 3U VPX SOSA Aligned Ethernet Switch

- 64 channels at 50G, backwards compatible to 1G, 10G, 25G NRZ modulation and 50G PAM4 modulation
- Adoption of Vita 91 connectors, which are the only double density pin count VPX connector standardized within Sosa and Vita
- Designed for rugged aerospace and military environments
  - Dual quad core ARM processors
- Macsec security and TSN

MILSTD 461 for EMI/EMC



# The Future...and YOU

- Our Thoughts:
  - Trends
    - Single Mode: Data Center are quickly shifting to SMF...what is the impact on MMF investments
    - Expanded Beam: do you really want it?
    - CWDM/DWDM: Is it practical for harsh environments?
  - Long term Availability
    - Data centers vs the Military do not have aligned priorities
- YOUR Thoughts