



NextGen Fiber Optics Transceivers

www.amphenol-aop.com

Nov 2023

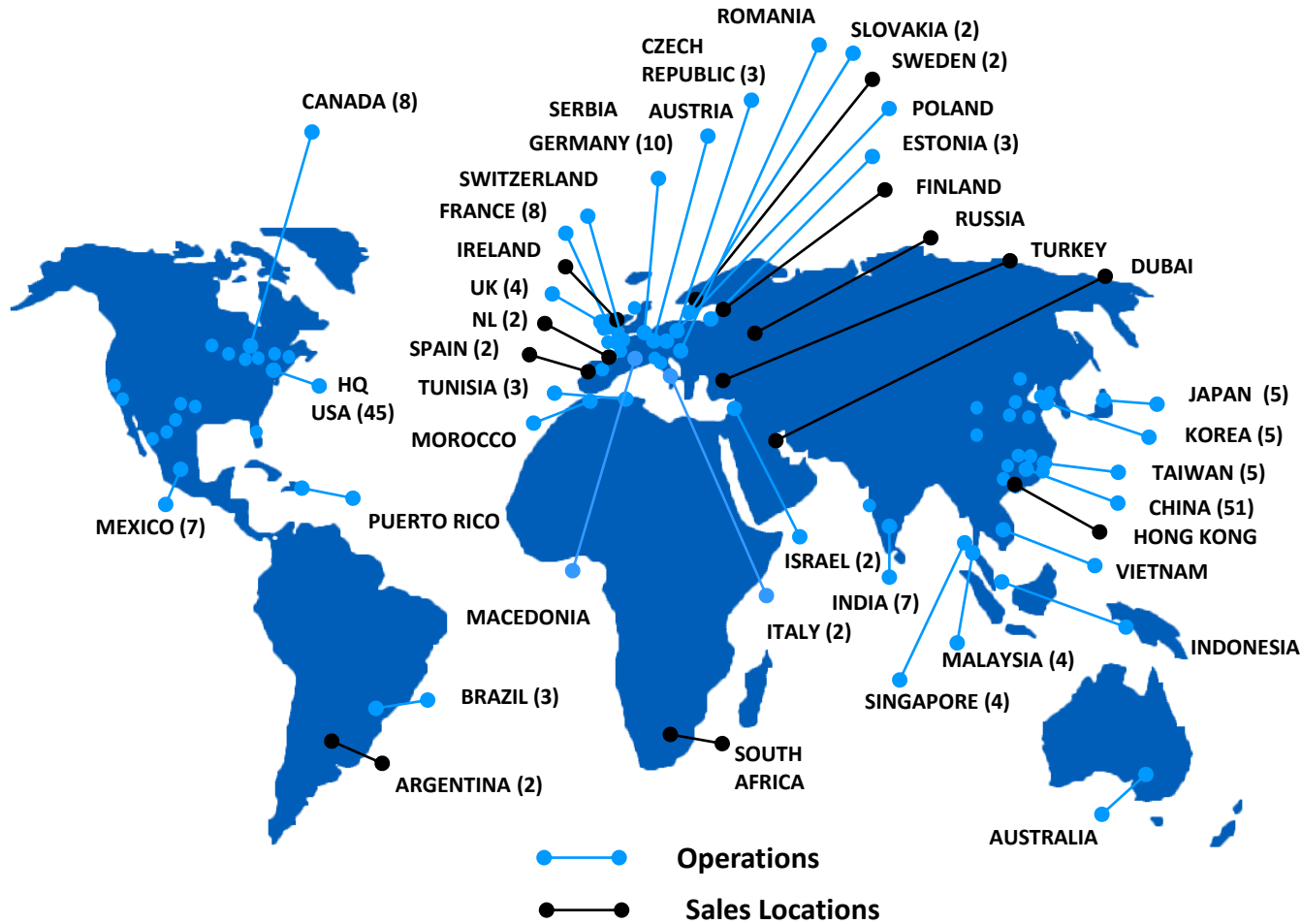
Amphenol is a global manufacturer of interconnect products



- ✓ 85 years history
- ✓ Net sales >B\$ 12.6
- ✓ 91 000+ employees worldwide
- ✓ 160+ facilities
- ✓ More than 100 operating units worldwide in North America, Asia, Europe, Japan, India, and Australia
- ✓ 3 Divisions

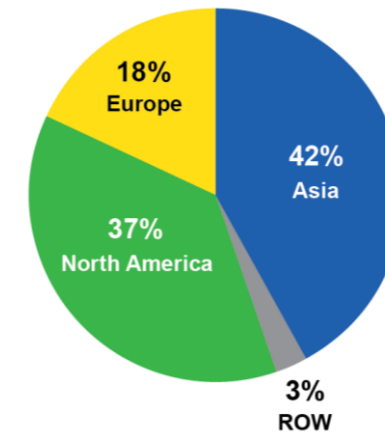
GLOBAL reach → LOCAL support

Amphenol Corporation (APH)



~91,000 Employees

% Sales by Region



**2022 Sales
\$12.6 Billion**

% Sales by Market



Amphenol Harsh Environment Solutions (“AHES”) Division:



Military & Commercial Airborne



Naval



Ground Vehicles & Radar



Industrial



Space



Test & Measurement



Wireless communication

AHES provides all interconnect needs, from small, lightweight attachments to large, complex assemblies



AHES Product Portfolio



Circular Connectors



**Rectangular & Board
Level Connectors**



RF Interconnects



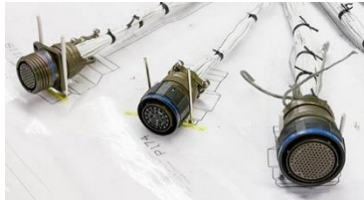
**Junction Modules Relay
Sockets
Terminal Blocks**



Contacts & Termini



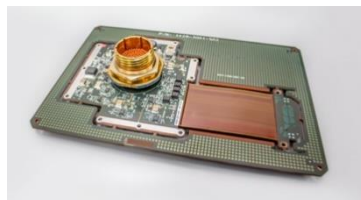
**Backshells & System
Attachments**



**Cabling & Cable
Harnesses**



**High Speed & Fiber
Optics**



**Backplanes | PCBs Flex
| Rigid Flex &
Assemblies**



**Fiber Optics Onboard
Transceivers &
Evaluation Kits**



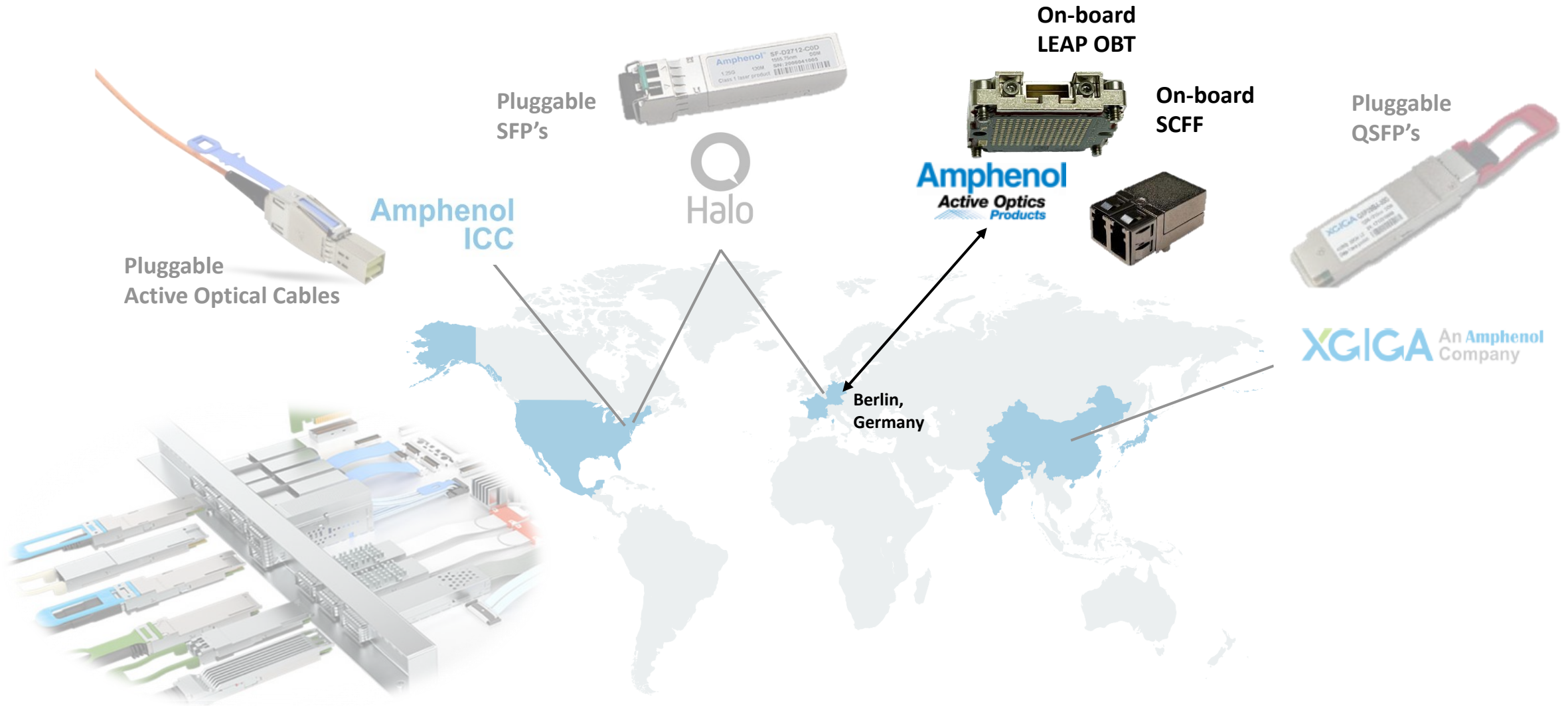
**Media Converters &
Ethernet Switches**



**Complex Systems &
Assemblies**



Amphenol's optical high-speed I/O global footprint



~ 20 years from MergeOptics to Amphenol

2003

MergeOptics
creation



2010

Acquisition by
FCI Group



2016

Acquisition by
Amphenol CS

Amphenol
COMMUNICATIONS SOLUTIONS

2020

Transfer to
Amphenol MAO



2022

Integration
Amphenol AHES

BERLIN

We design and manufacture fibre optic transceivers in Berlin

■ Creation 2003 (Merge Optics)

- Located in Berlin, Germany
- Legal entity “FCI Deutschland GmbH”

■ Fiber optics transceivers

- Optical Engines for Active Optical Cables up to 28Gbps
- On Board Transceiver up to 28Gpbs

■ Market served

- High-Performance Computing
- Industrial instrumentation
- Military & Aerospace

■ Activities: ISO9001 &ISO14001

- Product Development
- Process Development
- NPI and Manufacturing

■ Highly Experienced Team

- 20 years of proven track record in designing and manufacturing optoelectronic products
- Core competencies in RF, optical packaging, optical engine integration, assembly process;
- Test & automation, design for manufacturability;



State of the art optical transceivers manufacturing

■ Manufacturing Processes

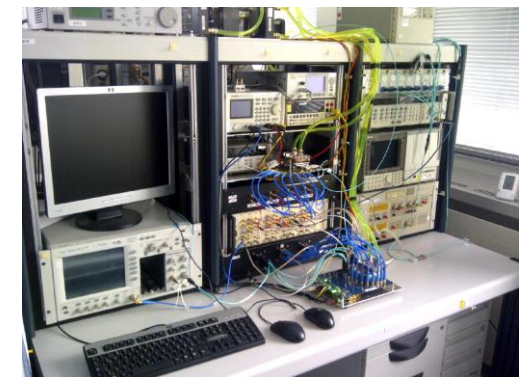
- Die/wire bonding:
 - High accuracy die bonding (1um accuracy)
 - High speed die bonding (7um accuracy)
 - SOB, BOS, BSOB wire bonding capability
- High precision lens placement/Active alignment:
 - Fully automated, in-house engineered alignment station
 - Suitable for parallel optics (24 channels simultaneously)
- Burn-in design/testing:
 - Adaptable platform, live monitoring of critical parameters
 - Fully automated pre and post BI measurement stations
- 25Gbps testing:
 - Fully automated RF test stations for 10Gbps and 28Gbps
 - Integrated temperature controllers for fast temperature ramps (-40°C to 85°C)



Product Development Capabilities

■ Product design

- Electronic design:
 - Transceivers and Active Optical Cables
 - Signal integrity: Data rates up to 28Gb/s NRZ and 56Gbd PAM4
 - PCB design, integration of components (Cadence OrCAD)
 - Connector designs for optimized signal integrity
 - Simulation (ADS, Pspice)
 - Evaluation of optical and integrated circuit for high-speed data transfer
 - Host Compliance board / Qualification board designs including GUI
- Mechanical design:
 - Die-cast design (Solidworks) (Example)
 - Tolerance analysis
 - Simulation (temperature, mechanical stress analysis)
- Optical coupling unit design:
 - Lens design for parallel optical beams
 - Mechanical design of plastic molded parts
- Firmware development:
 - “Mini OS” allowing transceiver to run optimally
 - Monitoring/driving all the electronics on the board
 - Experience with many MCU and development platforms
 - Standard compliant or customized FW
- Design verification testing:
 - Performance analysis over temperature and voltage
 - From station concept to full assembly
 - Automated test software development



AAOP: Manufacturing Area 3x BIGGER than before

Wire-bonding



High-speed die bonding



Higher burn-in capacity



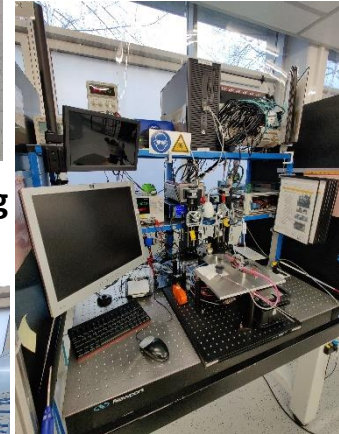
High accuracy die-bonding



New product lines



In-house active optical alignment



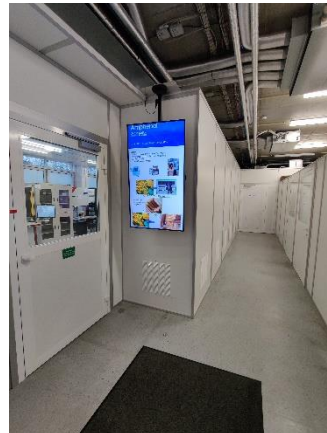
Air shower



Garment room



Entrance area



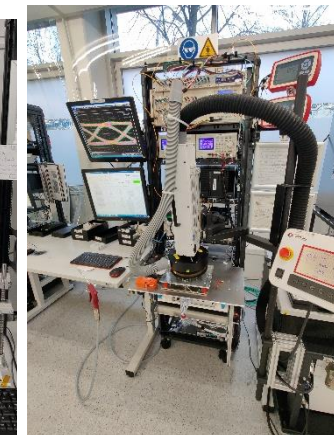
Expansion: 3x production area in 2021



Automated DC testing



Automated RF testing



Differentiators

■ Portfolio

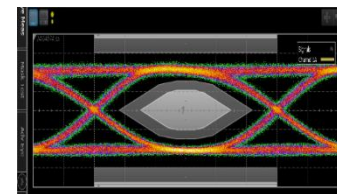
- Latest generation designs:
 - High performance
 - Safer supply chain (risk of EOL minimized)
- Extended range of data rates / channels supported:
 - Single, 4-channel, and 12-channel
 - From 1.25Gbps to 16Gbps, 28Gbps, or even 56Gbps*
 - Footprint can be re-used over several generations (QEPT platform)

■ Pluggability:

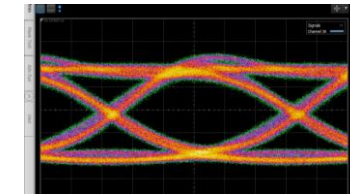
- Optical pluggability:
 - Easier/more flexible routing
 - Cost-effective replacement in case of fiber damage
- New: Hot-pluggability (QEPT platform)
 - No need to shut down system to insert/remove transceivers
 - Plug&Play solution

■ Thermal designs:

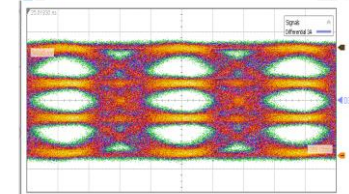
- Effective heat dissipation:
 - Heat dissipated towards the top for use of cooling plate
 - No constraints in customer board design (no dissipation inside the board)
- Effective mechanical designs:
 - Die-casted housings
 - Support customized heat-sink designs



10Gbps NRZ Eye



25Gbps NRZ Eye

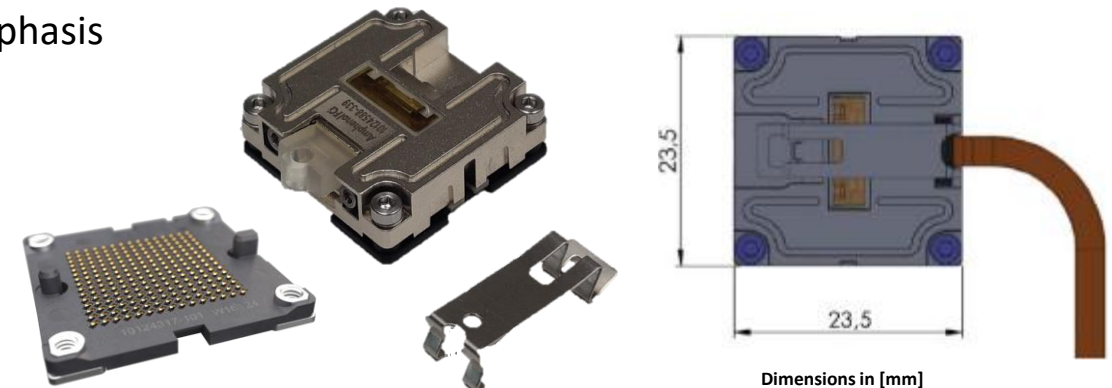
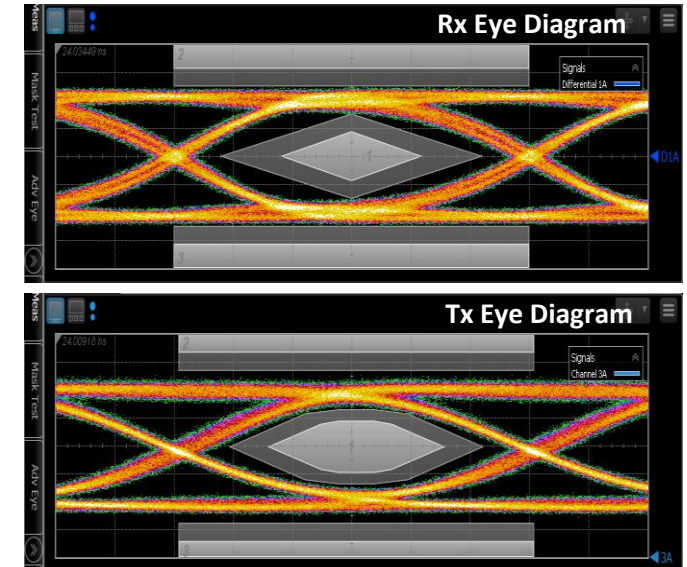


56 Gbd PAM4 Eye

Leap[®] OBT | 12TX+12RX | 300Gbps - COTS1

Overview:

- **12x25Gbps full duplex -> 300Gbps duplex aggregate**
- Up to 100m reach with MM fiber
- 0°C to 70°C operating case temperature
- Bit error rate < 10^{-12} (no FEC needed)
- **Data rate from 300Mbps up to 28Gbps**
- Power consumption:
 - 25Gbps @12TRx: 5.8W (typical)
- Accessible through two-wire serial interface
- Digital monitoring (temperature, voltage, RSSI)
- Programmable input equalization, output amplitude, pre-emphasis
- Programmable CDR (for 25GbE operation)
- Standard MT-ferrule interface (24 fibre MT ferrule)
- Customized heat sink designs
- Fully qualified according to Telcordia standard
- Running volume production in Rev. D



Leap[®] OBT - comes with no strings attached!

LEAP OBT integration on
socket (4 screws)

Step 1

Optical cavity
or „I/O“

Customer
PCB

LEAP OBT
socket

LEAP OBT
Module

(as received by
customer)

Fiber cable into
optical cavity

Step 2

MT ferulle fixation with
metallic clip

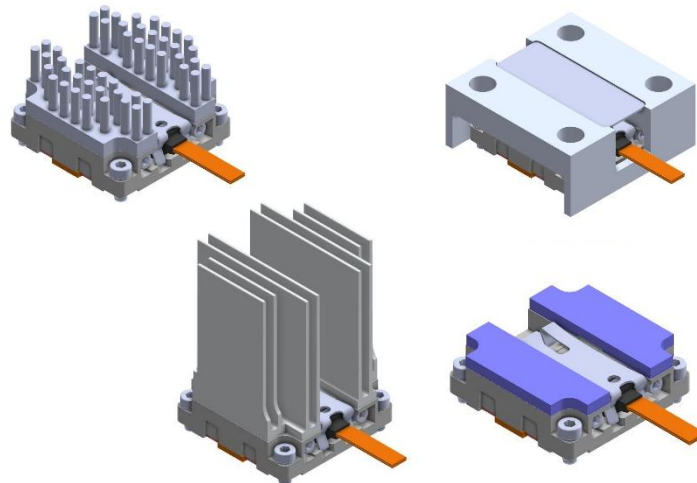
Step 3

Cable to be defined by customer
Can be provided by AFSI/AAO or other
sister entities

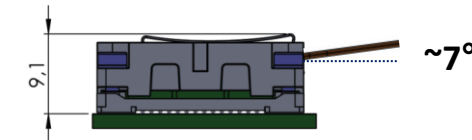
Leap® OBT p/n, heat sink options & sockets

PART NUMBER SELECTOR

10124588	-	x		y		z
		Standard	3	Laser Class 1M	3	
		Conformal coating	4	Laser Class 3B	1	
No heat sink for customer or water cooled thermal solutions						0
Short height air cooled heat sink – 23.5x23.5x14.6mm (Lxlxh)						1
Medium height air cooled heat sink – 23.5x23.5x17.6mm (Lxlxh)						2
Pillar based tall height air cooled heat sink – 23.5x23.5x23.4mm (Lxlxh)						4
Pillar based tall height air cooled heat sink 2 – 23.5x23.5x31.7mm (Lxlxh)						6
Fin based tall height air cooled heat sink – 23.5x23.5x31.7mm (Lxlxh)						7
"Wings" form air cooled heat sink – 33.2x55.4x12.6mm (Lxlxh)						8
"Block" form air cooled heat sink – 33.2x38.0x15.6mm (Lxlxh)						9
"Flat adapter" for customized or water cooled – 28.4x28.4x12.0mm (Lxlxh)						B
"Cubic" form air cooled heat sink – 37.4x49.4x24.4mm (Lxlxh)						C
Flat adapter – 23.5x23.5x8.2mm (Lxlxh)						D

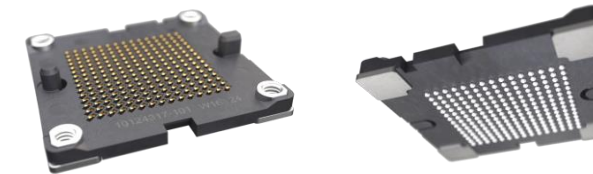


MT cavity angle to PCB plane



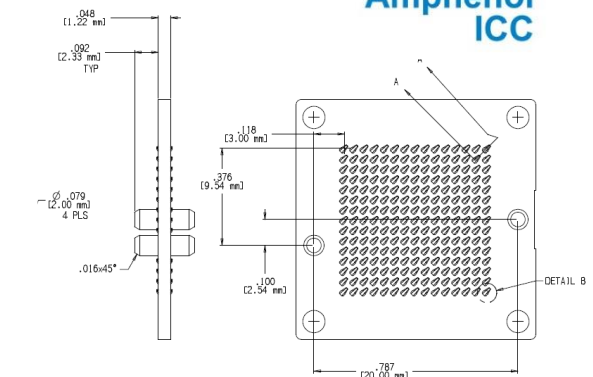
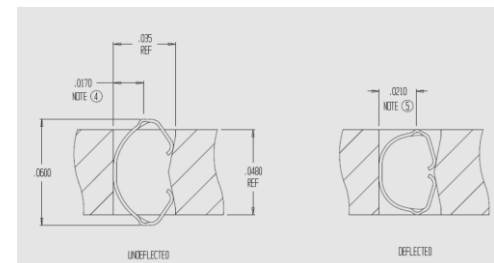
Top - LGA Springs

Bottom - BGA Solder



Amphenol LGA-BGA socket
10140369 (lead free or leaded)

LGA-LGA interposer options



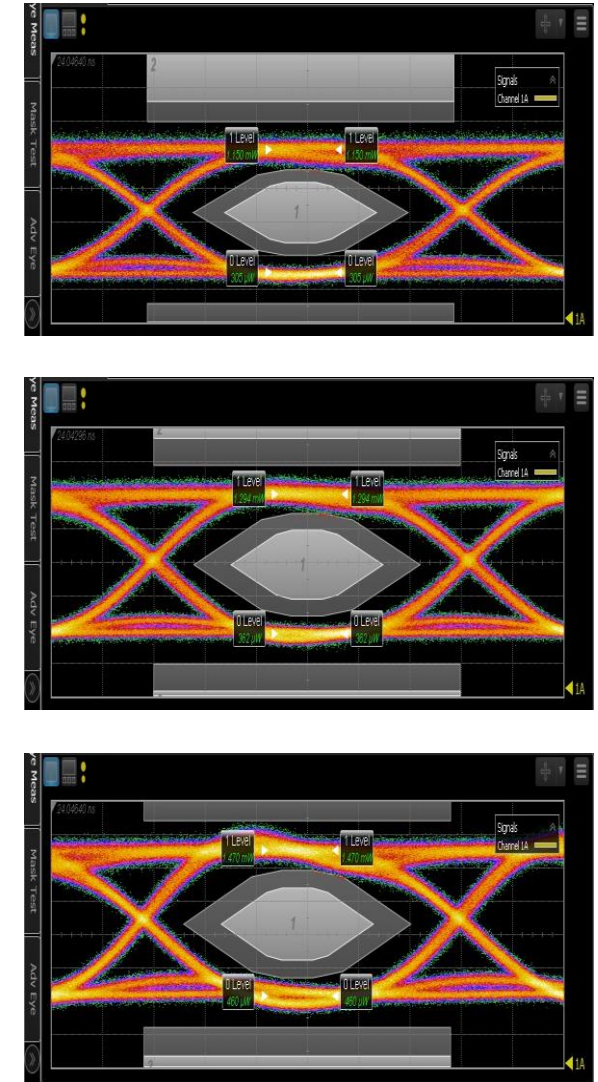
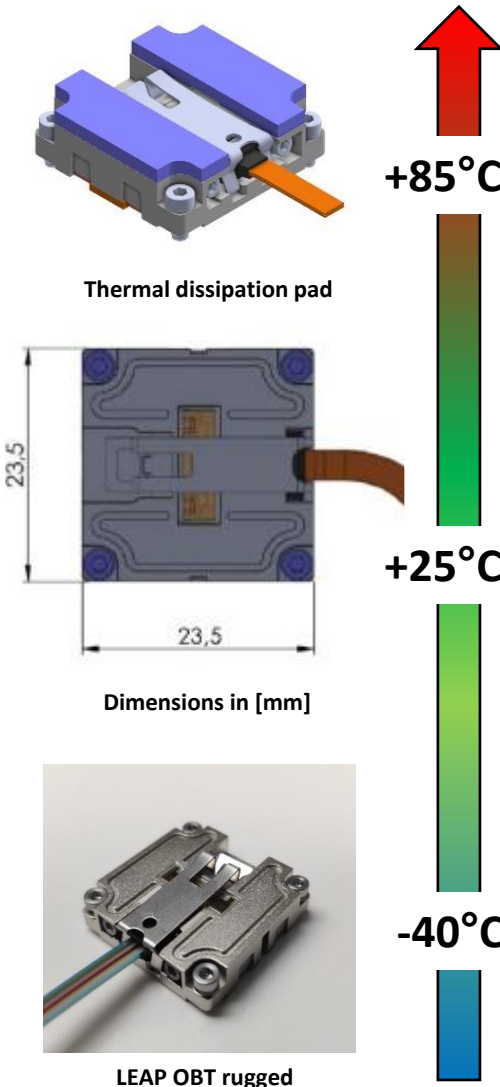
Leap[®] OBT | 12TX+12RX | rugged optical transceiver

Product specification

- Up to 12x16Gbps [-40°C to +85°C] (TX+RX)
- Up to 100m reach over MMF; Laser Class 1M or 3B
- 40°C to 85°C operating temperature
- MIL-STD-883: Shock Method 2002.4 (500g; 1ms), Vibe Method 2007.3 (20g sine; 20Hz-2000Hz)
- Bit error rate < 10⁻¹² (no FEC needed)
- Power consumption:
 - 10Gbps @12TRx: <3.5W

Functionalities

- Accessible through two-wire serial interface (I2C)
- Digital monitoring (temperature, voltage, RSSI)
- Programmable CDR (for 25GbE operation)
- Programmable input equalization, output amplitude, pre-emphasis
- Customized cooling design
- Standard MT-ferrule interface (24 fibre MT ferrule)



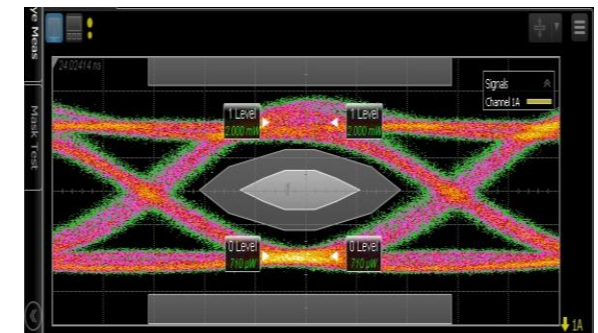
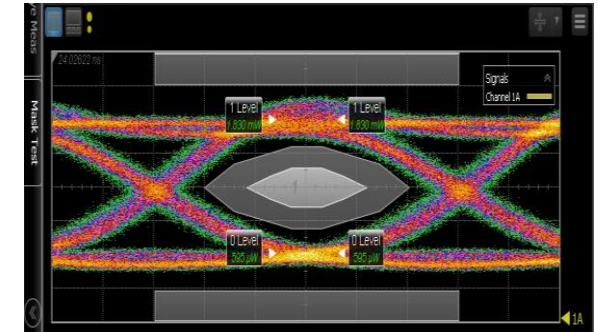
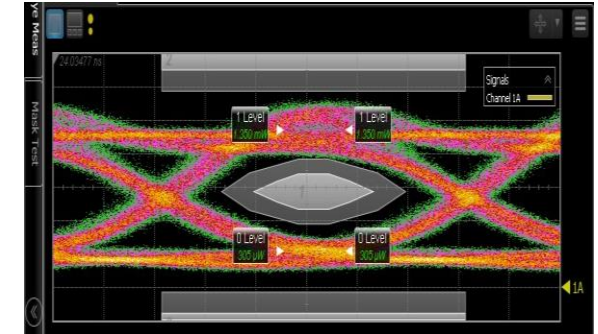
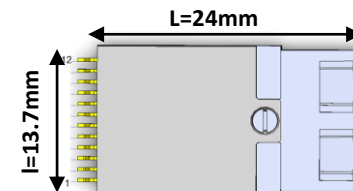
SCFF | 1TX+1RX | 25Gbps rugged optical transceiver

Product specification

- Up to 1x25Gbps full duplex (from 1Gbps to 28Gbps)
- Up to 100m reach over MMF; Laser Class 1M or 3B
- 40°C to 85°C operating temperature
- MIL-STD-883: Shock Method 2002.4 (500g; 1ms), Vibe Method 2007.3 (20g sine)
- Bit error rate < 10⁻¹² (no FEC needed)
- Power consumption:
 - 10Gbps @1TRx: <0.45W
 - 25Gbps @1TRx: <0.80W

Functionalities

- Accessible through two-wire serial interface (I2C)
- Digital monitoring (temperature, voltage, RSSI)
- Programmable CDR (for 25GbE operation)
- Programmable input equalization, output amplitude, pre-emphasis
- Die-cast housing for optimal thermal dissipation



NEW

4TRx 200Gbps PAM4



COMING SOON: QEPT 200G PAM4

Scope:

- 4-channel PAM4 56Gbps TRX
- Commercial temperature (0°C to 70°C)
- Platform re-usable for 28Gbps extended temperature TRX

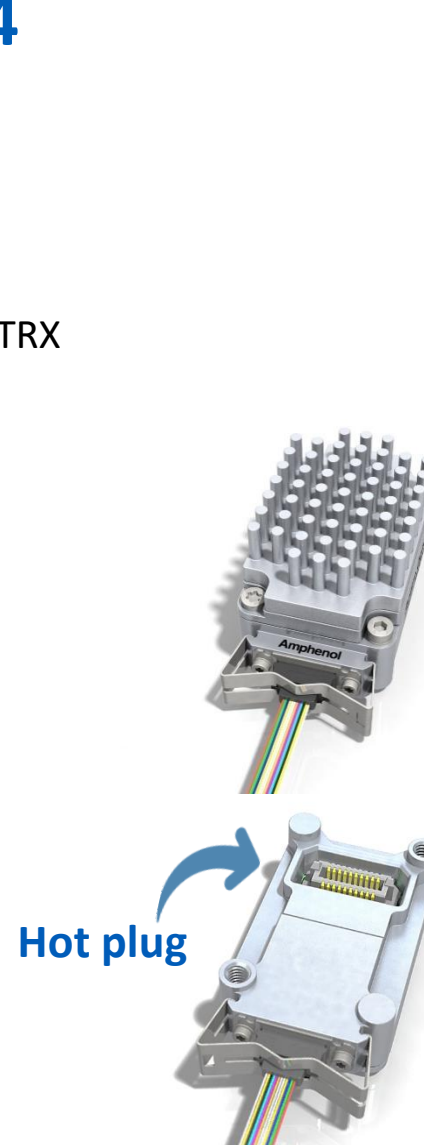
Performance (targets):

- BER < 10⁻¹² at @ 26.5625GBaud/s < 2.4E-4
- Power consumption below 3W
- Backward compatibility for 28Gbps NRZ

Mechanical features (targets):

- 26 x 18 x 8 mm - effective PCB area used of 180 mm²
- Thermal dissipation towards flat top
- Optically and electrically **hot pluggable**

Release → 2023 Dec



ECOC 2023 AAOP DEMONSTRATOR

ALSO AVAILABLE IN 100G NRZ

Scope:

- 4-channel NRZ 28Gbps TRX | 8-channel NRZ 28 Gbps Tx or Rx
- **Extended temperature (-40°C to 85°C)**
- Platform re-usable for 56Gbps PAM4

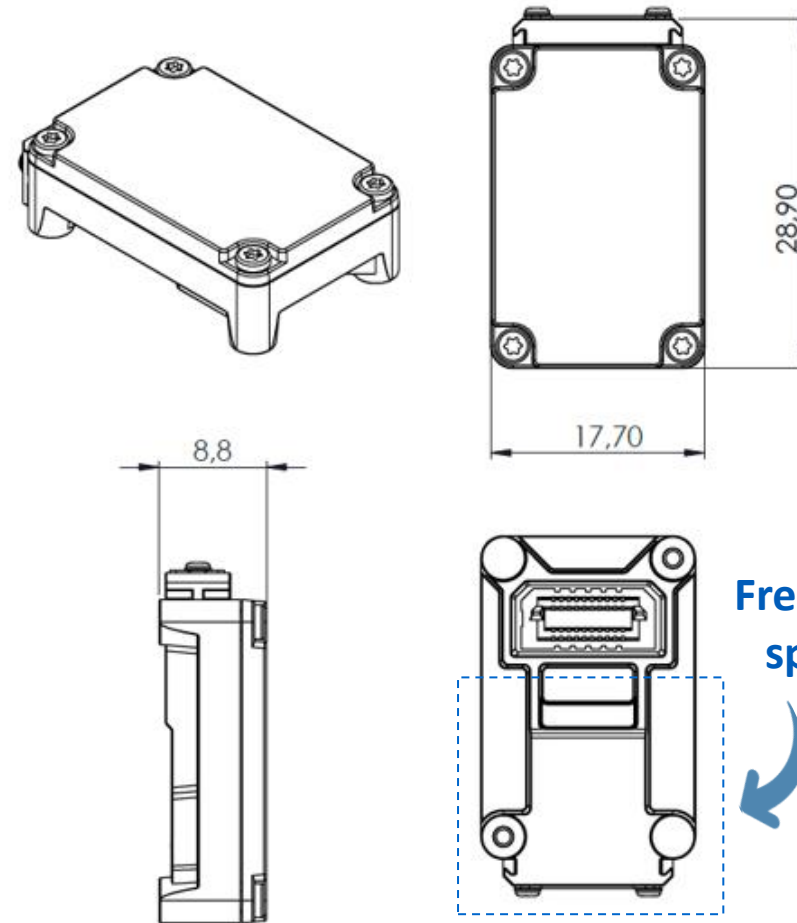
Performance (targets):

- BER < 10⁻¹² at @ 25.78 Gbps below 10-12
- Power consumption below 2W
- Upward compatibility for 56Gbps PAM4

Mechanical features (targets):

- 26 x 18 x 8 mm - effective PCB area used of 180 mm²
- Thermal dissipation towards flat top
- Optically and electrically **hot pluggable**

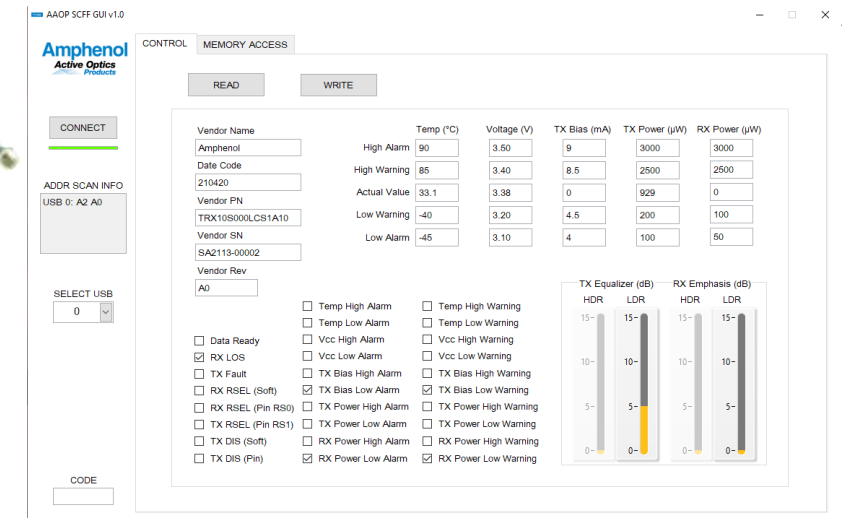
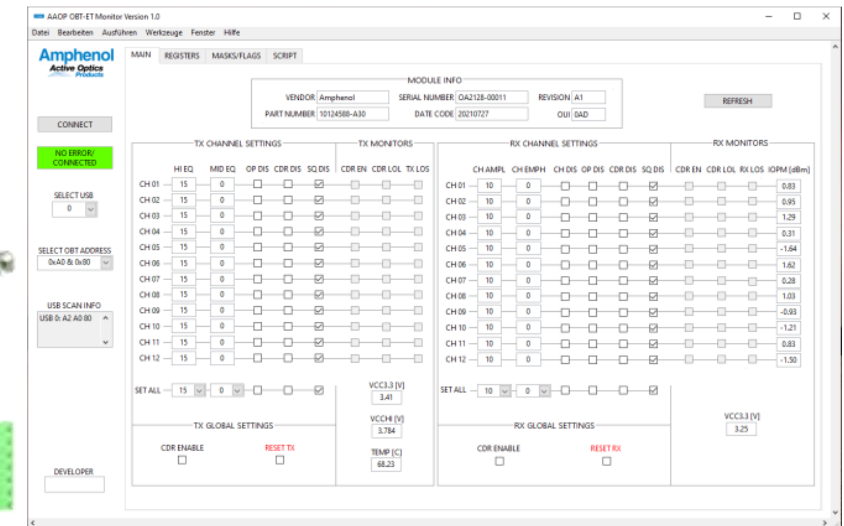
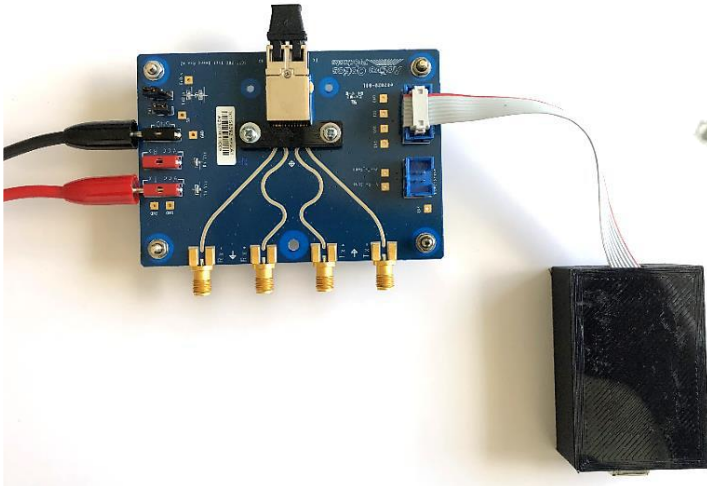
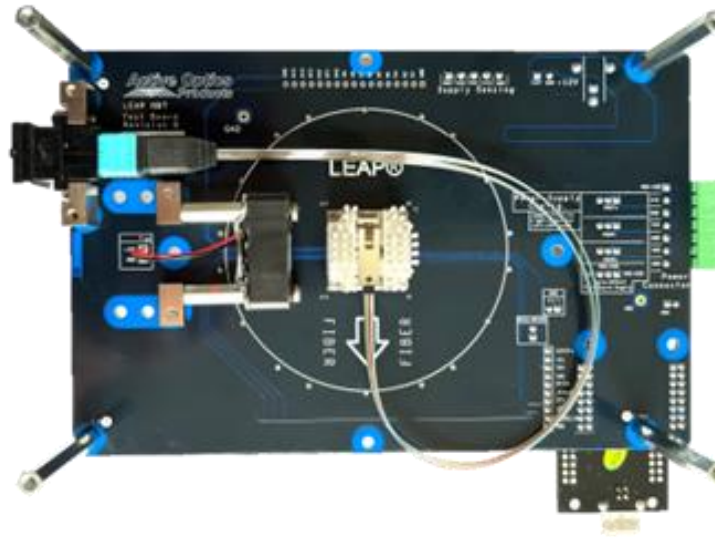
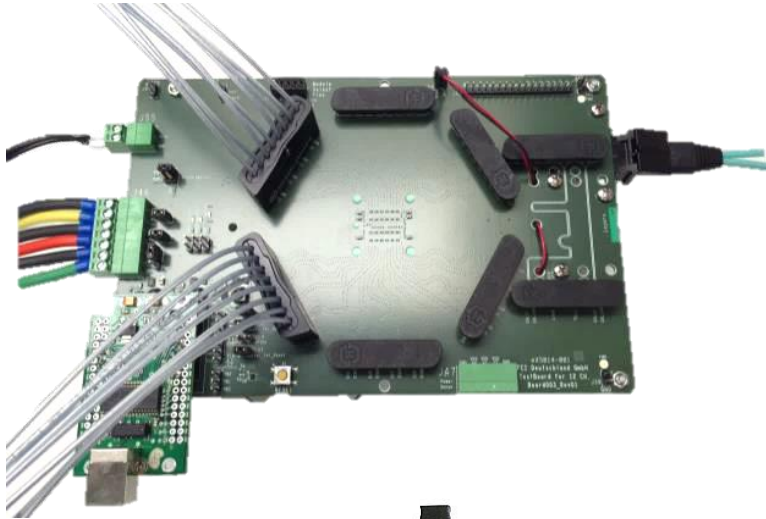
→ **Samples Available!**



Decimals
X,X: +/-0,3
X,XX +/-0,1
X,XXX +/-0,051

Angles
5°

All dimensions in mm



Rugged Active Optical Cable

Product specification

- Transmit high speed 5Gbps / 10Gbps differential pair protocols over fiber (Board ethernet, USB3 SuperSpeed)
- Up to 200m reach over MMF
- -40°C to 85°C operating temperature, Dust
- MIL-STD-883: Shock Method 2002.4 (500g; 1ms), Vibe Method 2007.3 (20g)
- Bit error rate < 10⁻¹² (no FEC needed)
- Hi Rel. Amphenol SOCAPEX TVUCom connector
- Turret (optional)

Applications:

- C5ISR tactical deployment
- Airborne HEFO needs

Adaptations possible:

- Board level ethernet
- SD/HD/3G/6G SDI video transmission
- D-Sub & Micro-D with Positronic products



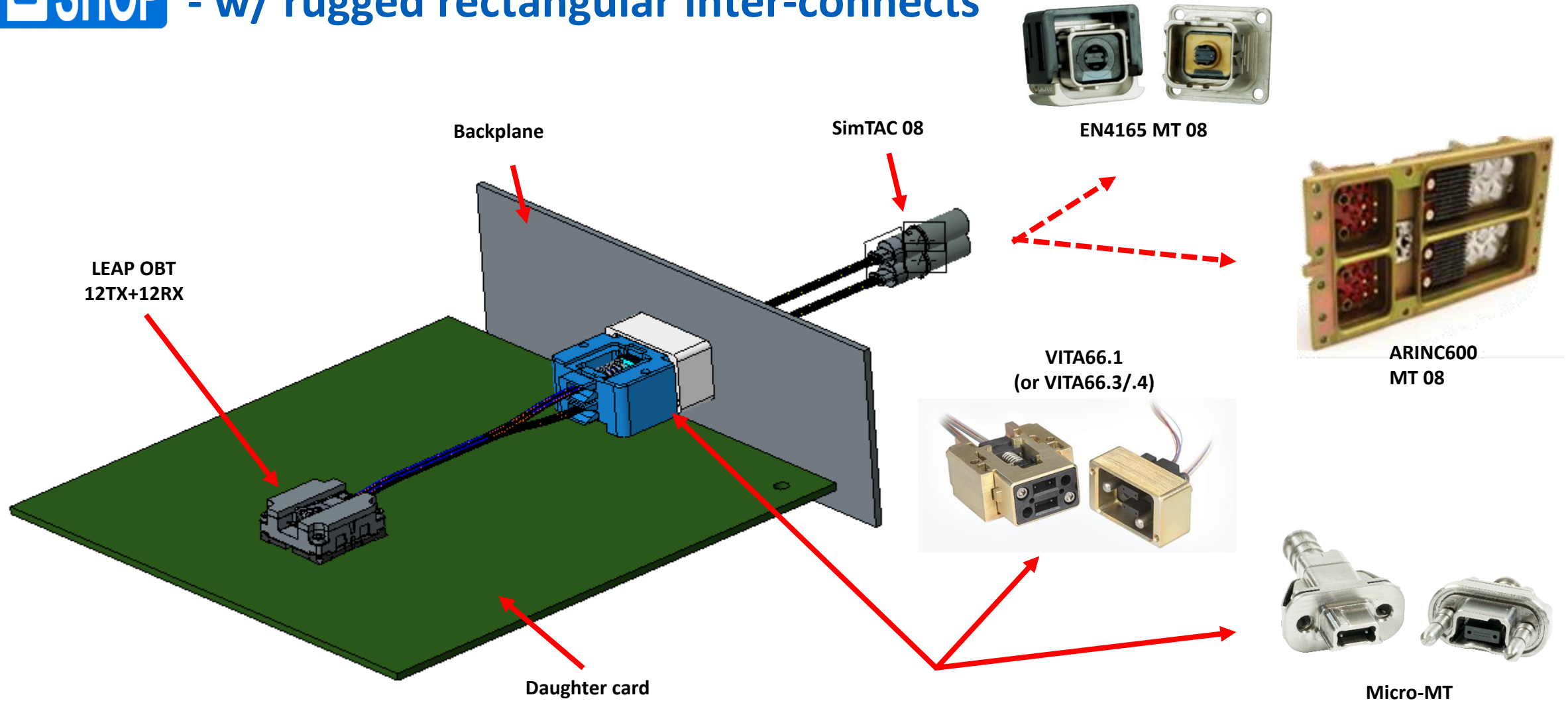
Amphenol
MILITARY & AEROSPACE



**ONE STOP
SHOP**

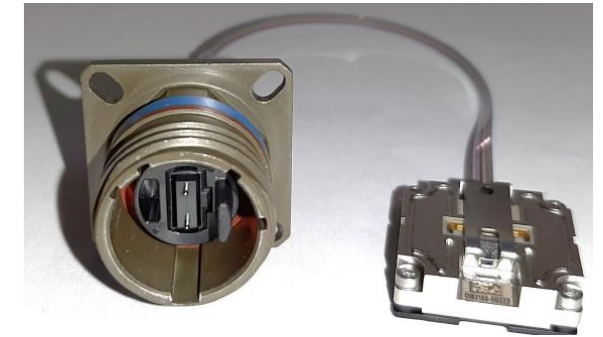
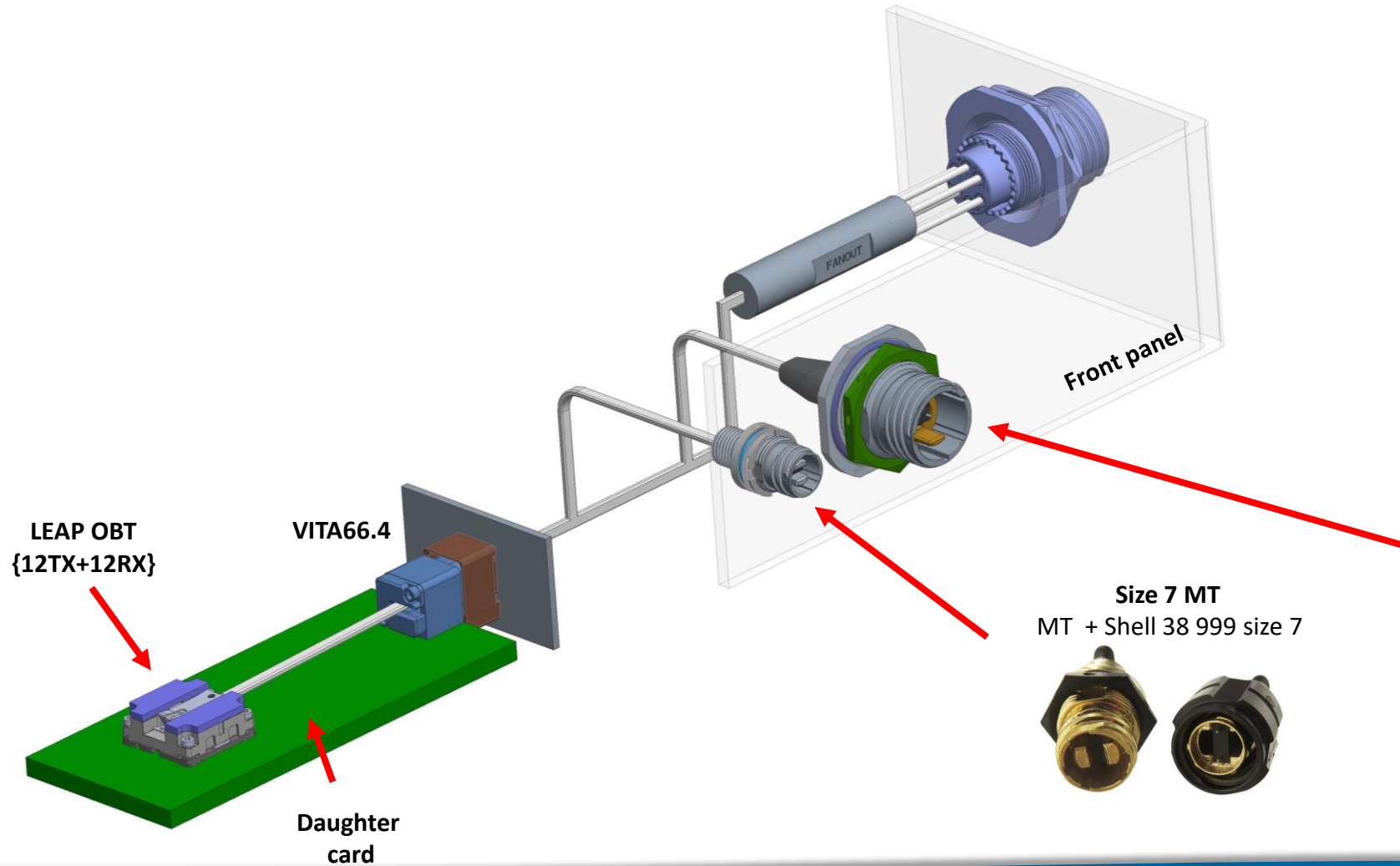


AHES fiber optics end-to-end solutions - w/ rugged rectangular inter-connects





AHES fiber optics end-to-end solutions - w/ rugged circular inter-connects



Size 7 MT
MT + Shell 38 999 size 7

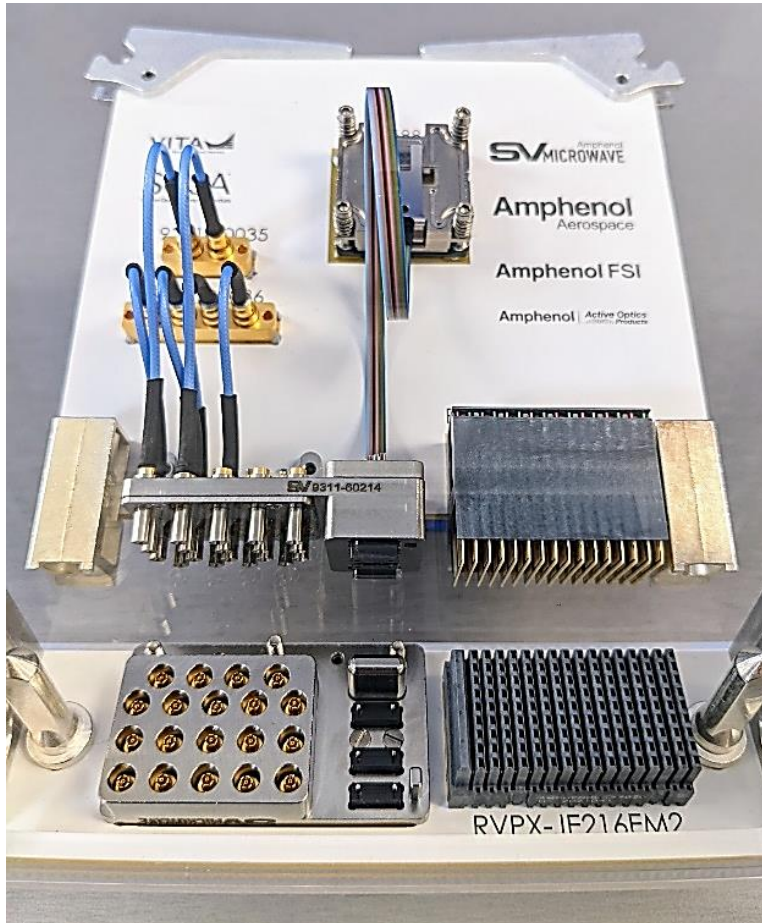


MPO field
MPO + Shell 38 999 size 13





AHES integrates both RF & optics into VITA

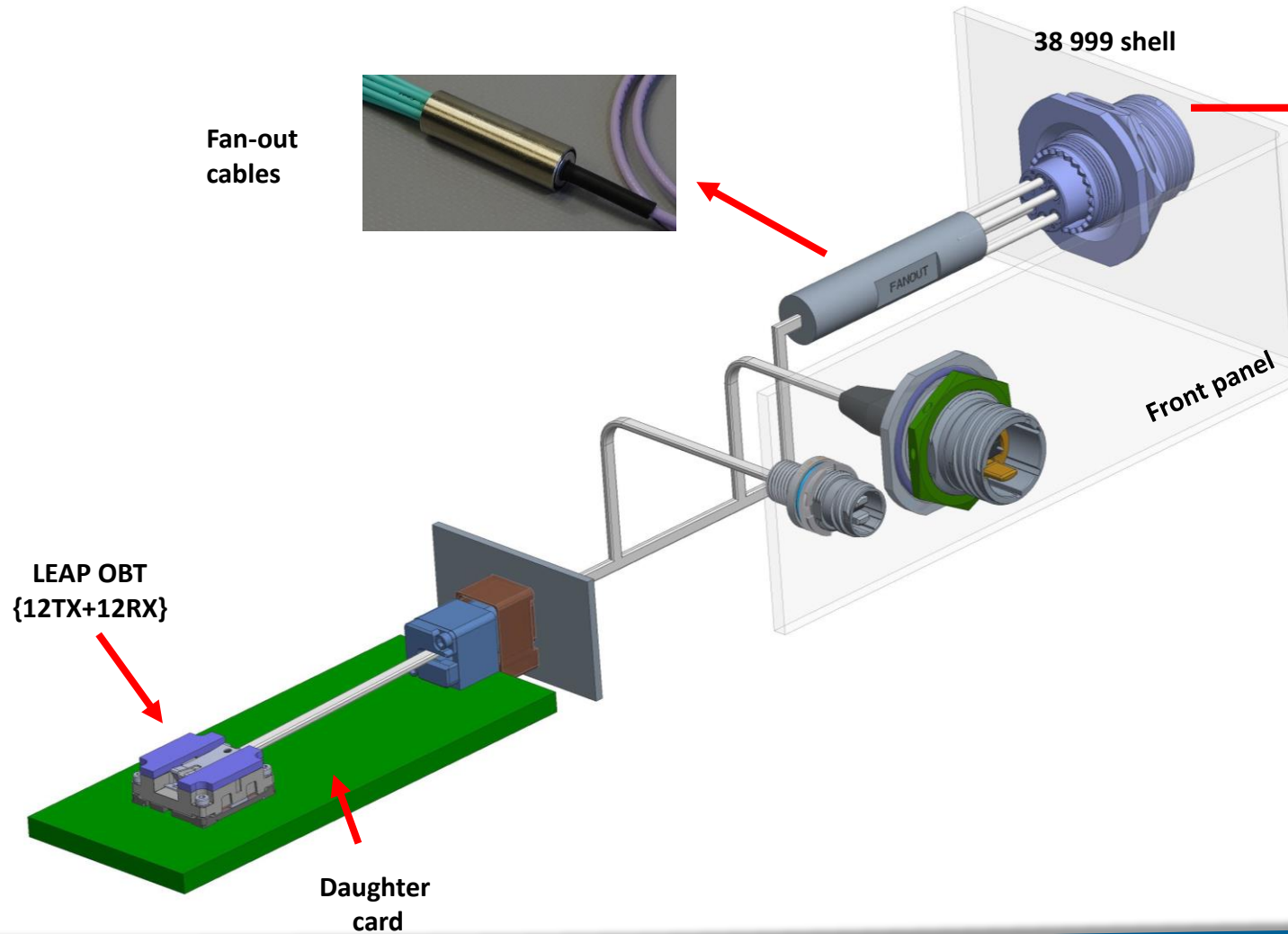


- VITA 67 contain RF and Fiber hybrid for first time
 - Amphenol collaborative demo kit
- Support for 3 (2 x 24) fiber channels and 19 RF
 - Current draft in VITA 66.5 limits MT locations
- A product of:
 - SV microwave
 - Amphenol Aerospace
 - Amphenol FSI
 - Amphenol Active Optics products



AHES fiber optics end-to-end solutions - w/ rugged circular inter-connects

Fan-out cables



TV + 29504/4 & /5
38 999 Shell
Ceramic Optical termini
29504 (butt joint)



38 999 LUX-BEAM
38999 + Optical termini
Luxbeam #16 EN4869
Expanded beam termini



ARINC 801
38 999 shell
ARINC 801 insert
& ceramic optical termini 1,25mm
Butt joint

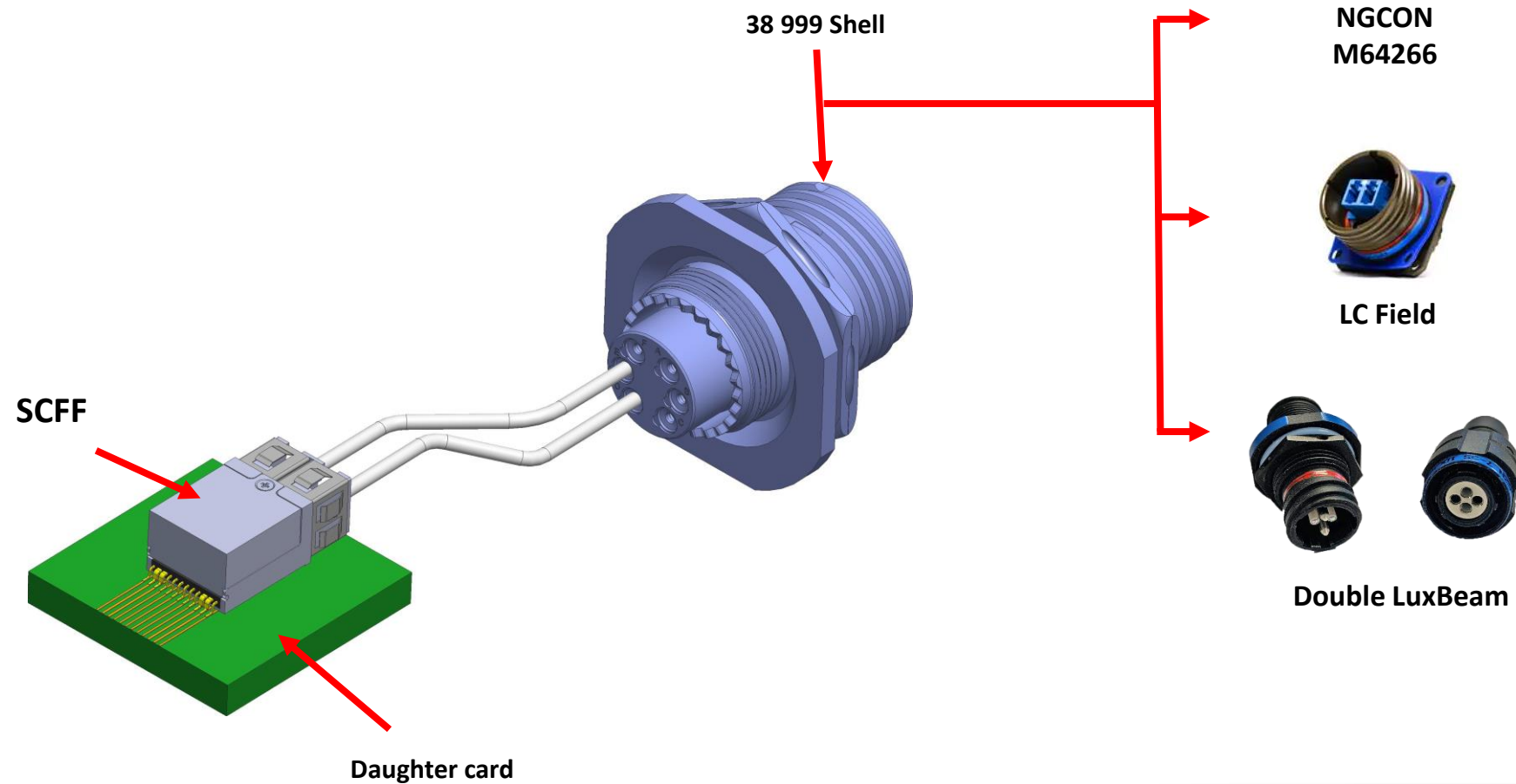


TVOP
38 999 shell
Ceramic optical termini 2,5mm
Butt joint





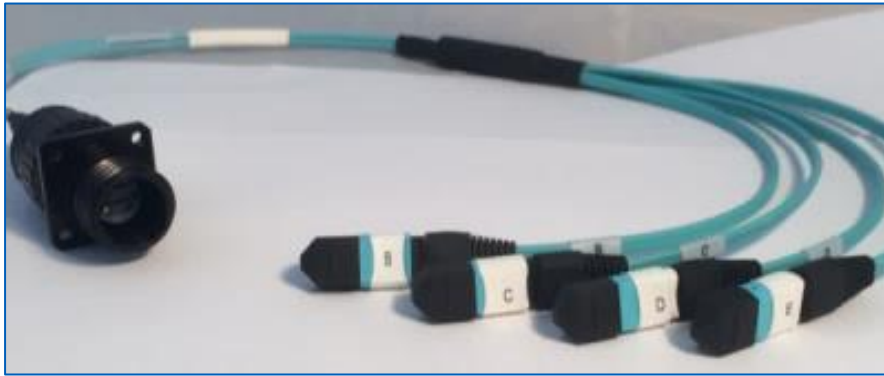
AHES fiber optics end-to-end solutions - SCFF based examples



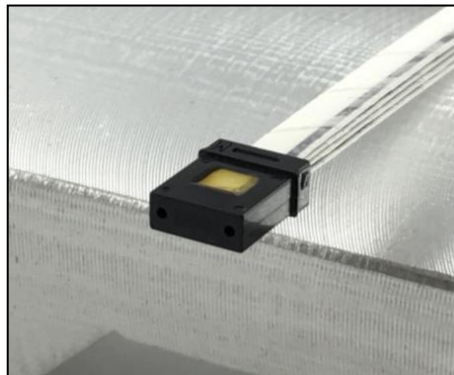
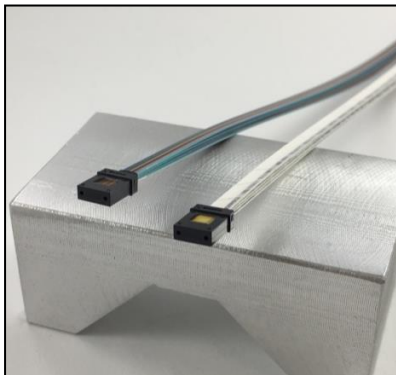


AHES fiber optics end-to-end solutions - w/ harsh environment FO cabling solutions

**THDM to MTP
24 Channels crossover**



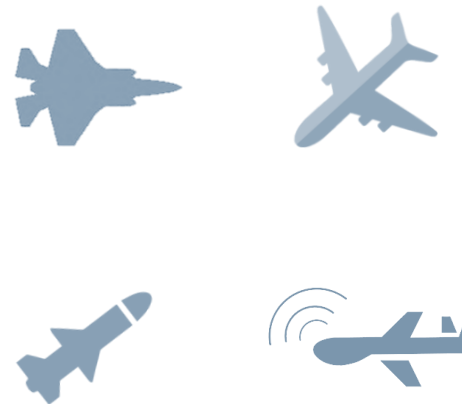
**MT38999 to M29504/04
Short Fanout assembly**



**MT Ferrule 48Channels
Termination capabilities**

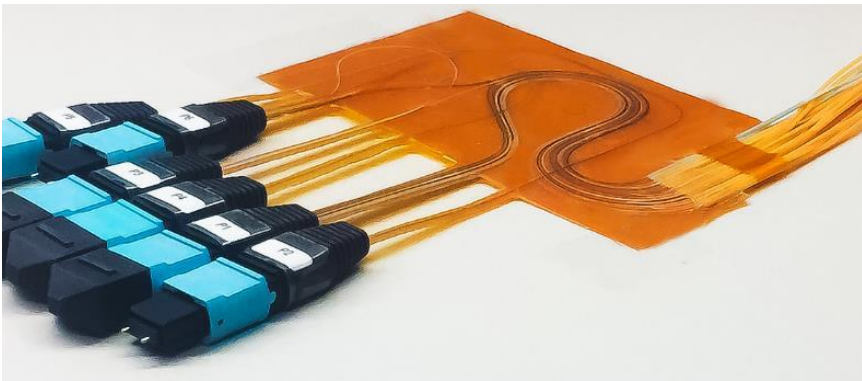
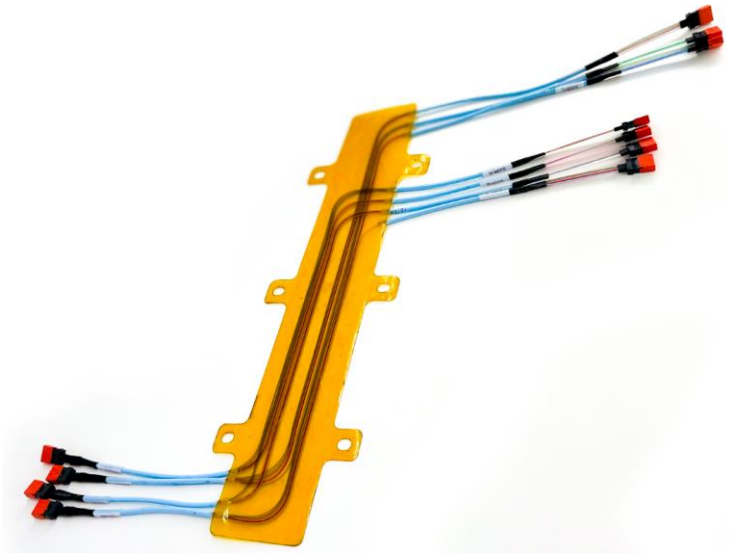


**MT38999 to FC connector
Loop back (2 channels) + right angle backshell**





AHES fiber optics end-to-end solutions - Optical Flex Planes -



- Product specification
 - Ideal for high density applications
 - Can be designed for routing around Board Level components
 - Improves Airflow for cooling vs Traditional cable approach
 - Temp Range -55 to +95C
 - Flame resistant substrate

Contact

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Visit: www.amphenol-aop.com

Leading edge **high-speed
opto-electronic modules**,
global communication needs
made simple



SCFF Rugged (1TRx)

The rugged SCFF ("Small Cubical Form Factor") is a harsh environment 1-channel duplex optical transceiver operating at data-rates up to 25Gbps on multi-mode fiber.

[View Product](#)



LEAP OBT Rugged (12TRx)

The LEAP® On-Board Transceiver is a rugged 12-channel duplex optical transceiver capable of running data-rates of up to 16Gbps per channel (192Gbps cumulative) on multi-mode fiber.

[View Product](#)



LEAP OBT (12TRx)

The LEAP® On-Board Transceiver is a commercial 12-channel duplex optical transceiver capable of running data-rates of up to 25Gbps per channel (300Gbps cumulative) on multi-mode fiber.

[View Product](#)



FiberQuad (1Tx or 1Rx)

The FiberQuad® is a rugged optical contact fitting in a size 8 cavity (e.g. D38999) operating at data-rates up to 10Gbps on multi-mode and single-mode fiber.

[View Product](#)