Amphenol Active Optics Products

Mil-grade next-generation fiber optic on-board transceivers

Connecting the world at the speed of light

Amphenol Active Optics Products

AOP Focus Areas

MILITARY & AEROSPACE

- Ground Vehicle
- Maritime
- Radar
- Avionics
- Missiles
- Sattelites
- IFE
- Electronic Warfare

and more.

INDUSTRIAL

- Telescopes
- AI Supercomputers
- Particle Accelerators
- Hardware Emulation
- AOI Systems
- Server Networking
- Industrial Instrumentation

and more.

COMMERCIAL

- AI Desktop PC
- Perconal Computer
- Datacom Networking
- Datacentre
- Storage
- 5G

and more.

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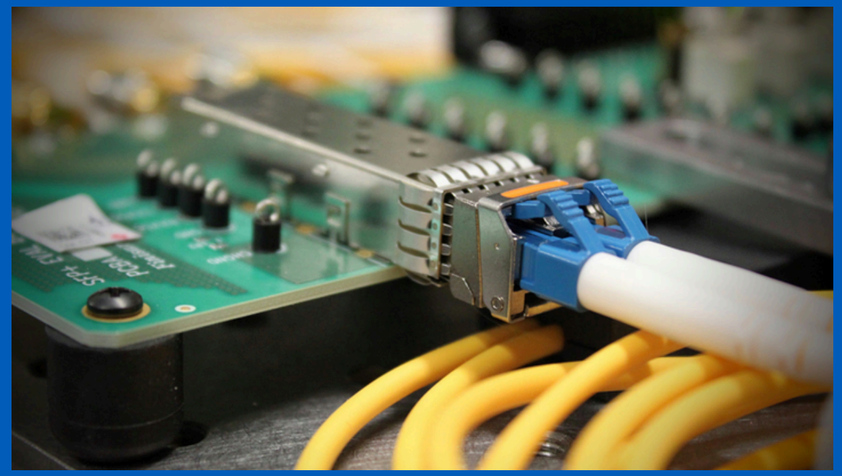
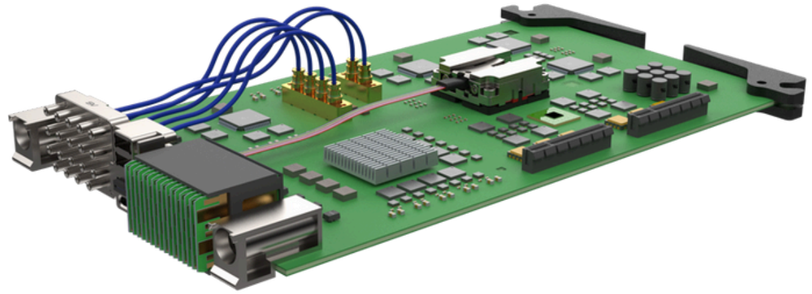
Problem

In current SFP+ designs, how to minimize trace losses to save link budget, increase bandwidth, reduce board space and overall weight, while also maintaining low cooling requirements and power consumption, all while ensuring EMI/RFI protection?



Solution



AOP ON-BOARD TRANSCEIVERS SAVES → ~12 dB

Higher data rates and advanced modulation to enhance bandwidth with a compact design integrating multiple functions, saving space and weight. Our transceivers consume less power, reducing cooling needs, and operate with light signals, practically eliminating any susceptibility to electromagnetic interference (EMI) and radio frequency interference (RFI). Overall, we enable more efficient, reliable, and compact designs for modern high-speed data communication systems.

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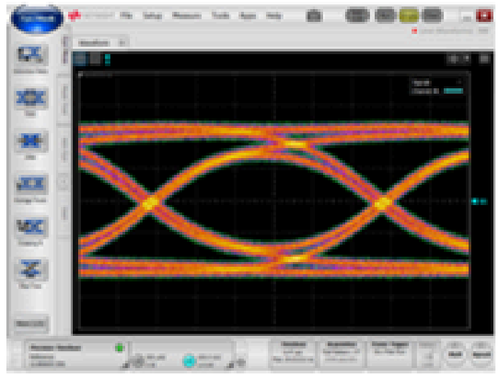
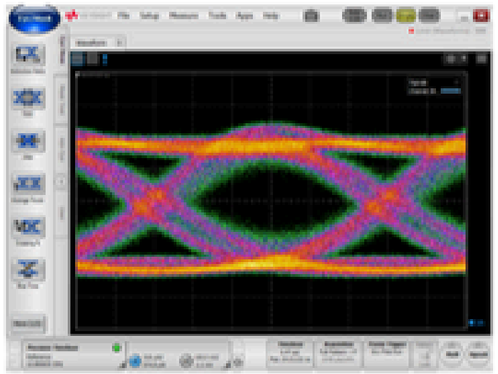
Eye Diagram

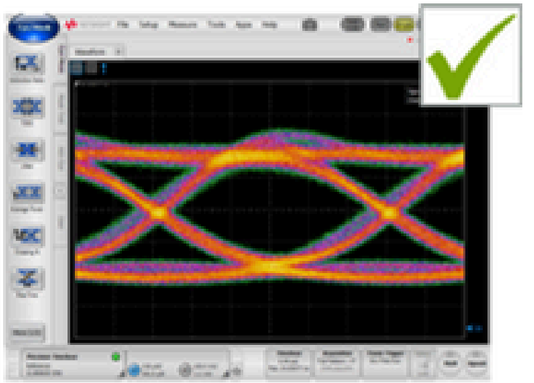
EQUALIZER



TX input eye

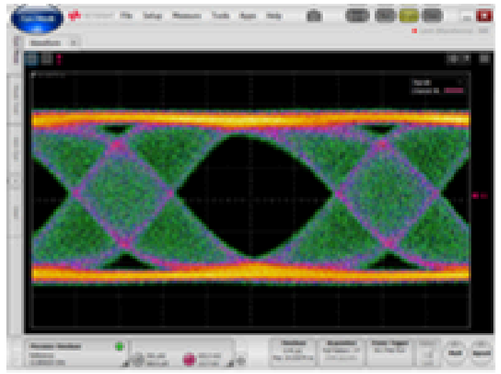


TX output eye
MidEQ=0, HiEQ=0

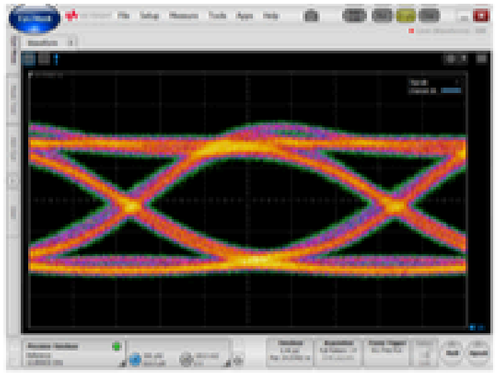


TX output eye
MidEQ=15, HiEQ=4

CDR

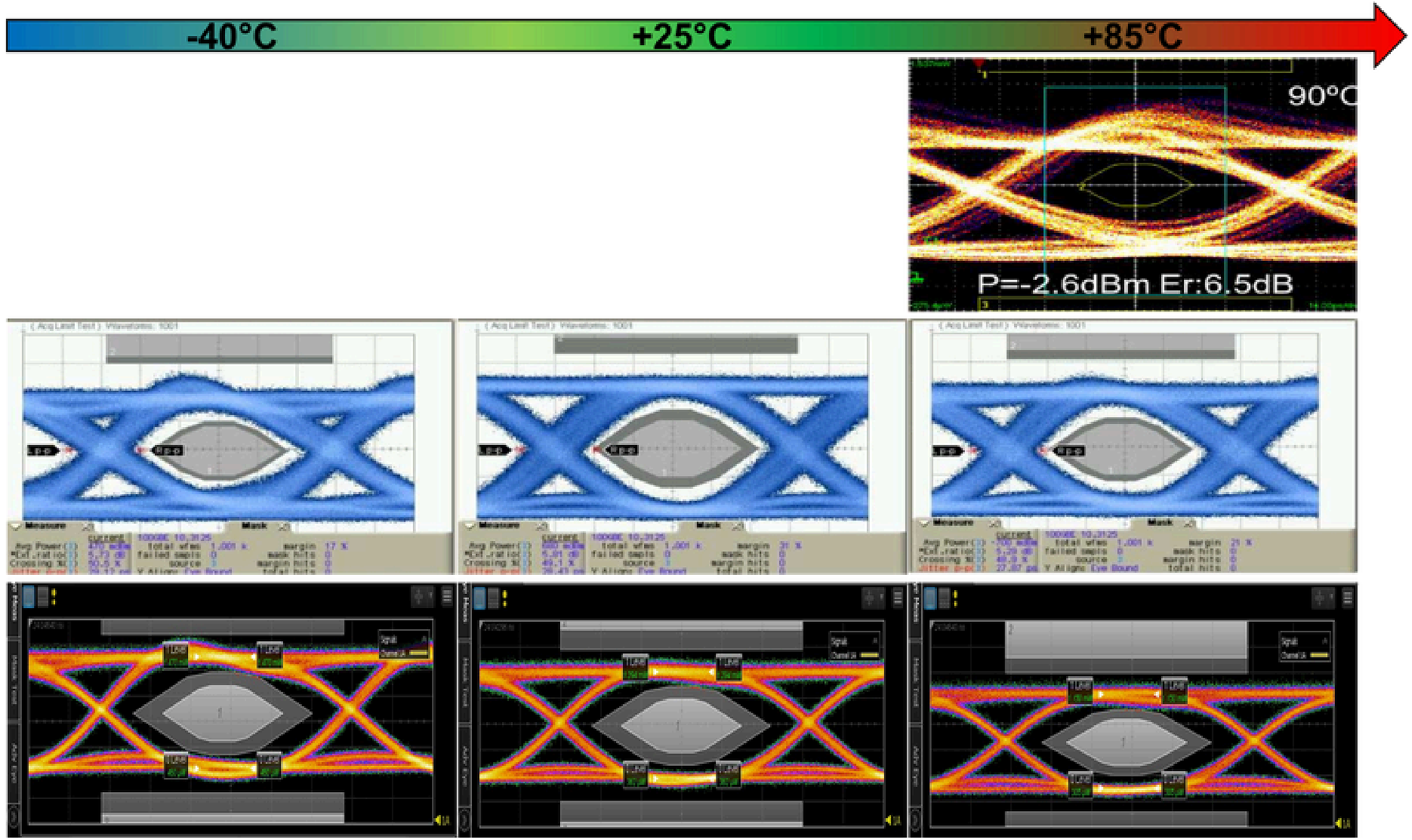


Bad TX input signal



TX output eye
CDR ON

Eye Diagram



COMPETITOR 1

COMPETITOR 2

Amphenol Active Optics Products

Amphenol Active Optics Products

Portfolio Snapshot

MIL-AERO GRADE
-40°C TO +85°C
STD-883 SHOCK & VIBE

SCFF

UP TO 28 GBPS

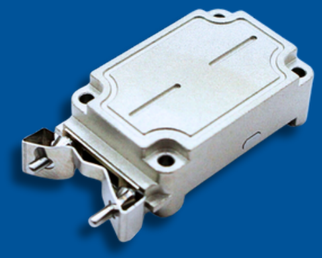
Small Cubic Form Factor

- 1 TX + RX
- Multimode – 850nm
- 10 & 25 Gbps /channel
- Half size of SFP+
- LC connection
- Solderable

QEPT

UP TO 200 GBPS

Quad Embedded Pluggable Transceiver

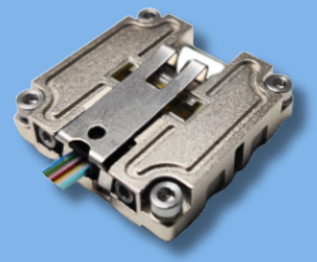


- 4 TX + RX
- Multimode – 850nm
- 28 & 56 Gbps /channel
- Hot pluggable
- Fiber removable
- Easy path to PAM4

LEAP® OBT

UP TO 300 GBPS

On-board Transceiver



- 12 TX + RX
- Multimode – 850nm
- 16 & 25 Gbps /channel
- World's Fastest & Smallest
- Fiber Removable
- LGA Mountable

Amphenol Active Optics Products

PERFORMANCE	1-channel multi-mode (1TX +1RX) 28 Gbps per channel BER < 10^{-12} Operating Temp: -40°C TO 85°C Power Consumption: <1.1 W Radiation Resistant: 100 krad*
FEATURES	Integrated CDR TX Equalizer RX Amplifier. & De-empahsys Digital Monitoring
MECHANICAL INFO	Die-casted housing Standard LC duplex Solderable Connector STD-883 Shock & Vibe
DIFFERENTIAL	Chip onboard technology Radiation resistant

*to be qualified by similarity
** 10 Gbps version available

SCFF 28G NRZ

Small Cubic Form Factor

Key Features

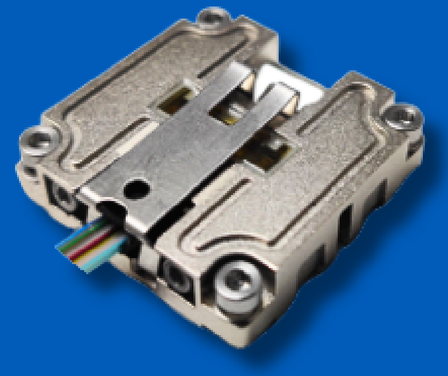
- Single-channel duplex transceiver
- Any data-rate from 1.25 up to 28 Gbps per channel**
- -40°C to 85°C operating case temperature
- Standard duplex LC-connector
- 12-pin solderable proprietary connector

Amphenol Active Optics Products

PERFORMANCE	12-channel multi-mode (12TX +12RX)* 25 Gbps per channel BER < 10^{-12} Operating Temp: 0°C TO 70°C Power Consumption: 6.0 W
FEATURES	Integrated CDR TX Equalizer RX Amplifier. & De-empahsys Digital Monitoring Internal PRBS9, PPG & ED
MECHANICAL INFO	Various heat sink versions Plugabble MT-24 Ferrule Amphenol LGA/BGA Socket Mounted
DIFFERENTIAL	World's Fastest & Smallest Power Consumption

LEAP OBT 300G NRZ

On-board Transceiver



Key Feautures

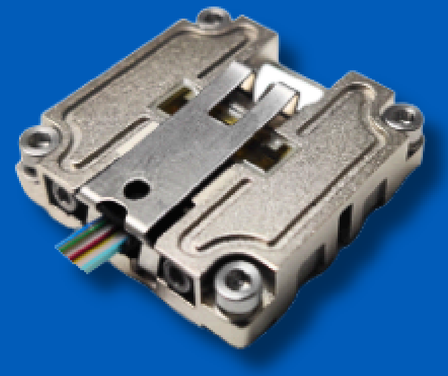
- 12-channel duplex transceiver
- Any data-rate from 1 up to 25 Gbps per channel (300 Gbps aggregate data rate)
- 0°C to 70°C operating case temperature
- Standard MT-24 ferrule compatible
- LGA mounted

Amphenol Active Optics Products

PERFORMANCE	12-channel multi-mode (12TX +12RX)* 16 Gbps per channel BER < 10^{-12} Operating Temp: -40°C TO 85°C Power Consumption: 3.5 W
FEATURES	TX Equalizer RX Amplifier. & De-empahsys Digital Monitoring Internal PRBS9, PPG & ED
MECHANICAL INFO	Various heat sink versions Plugabble MT-24 Ferrule Amphenol LGA/BGA Socket Mounted STD-883 Shock & Vibe
DIFFERENTIAL	World's Fastest & Smallest Power Consumption Mil-graded

LEAP RUGGED 192G NRZ

On-board Transceiver



Key Feautures

- 12-channel duplex transceiver
- Any data-rate from 1 up to 16 Gbps per channel (192 Gbps aggregate data rate)
- -40°C to 85°C operating case temperature
- Standard MT-24 ferrule compatible
- LGA mounted

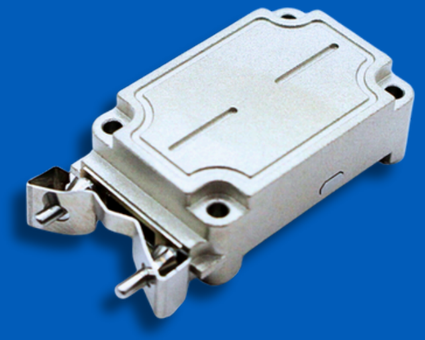
Amphenol Active Optics Products

PERFORMANCE	4-channel multi-mode (4TX +4RX)* 28 Gbps per channel BER < 10^{-12} Operating Temp: -40 °C TO 85 °C Power Consumption: 1.6 W
FEATURES	Integrated CDR TX Equalizer RX Amplifier. & De-empahsys Digital Monitoring
MECHANICAL INFO	Flat top or heat sink versions Standard MT-Ferrule Mezzanine Connector STD-883 Shock & Vibe
DIFFERENTIAL	Hot-Pluggable Same footprint for PAM4 version Radiation resistant

* 8-TX and 8-RX versions in development
** next page

QEPT 100G NRZ

Quad Embedded Pluggable Transceiver



Key Features

- 4-channel duplex transceiver*
- Any data-rate from 1.25 up to 28Gbps per channel
- -40°C to 85°C operating case temperature
- Pluggable MT-12F ferrule
- Hot-pluggable mezzanine mounted

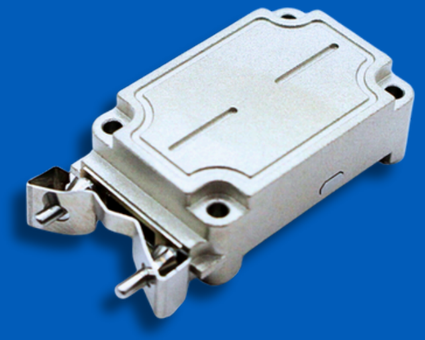
Amphenol Active Optics Products

PERFORMANCE	4-channel multi-mode (4TX +4RX)* 56 Gbps PAM4 per channel BER < $2.4 \cdot 10^{-4}$ Operating Temp: 0 °C TO 70 °C Power Consumption: 3.0 W
FEATURES	Integrated CDR TX Equalizer RX Amplifier. & De-empahsys Digital Monitoring Internal PRBS13Q, PPG & ED
MECHANICAL INFO	Flat top or heat sink versions Standard MT-Ferrule Mezzanine Connector
DIFFERENTIAL	Hot-Pluggable Same footprint as NRZ version

8-TX and 8-RX versions in development

QEPT 200G PAM4

Quad Embedded Pluggable Transceiver



Key Features

- 4-channel duplex transceiver*
- Any data-rate from 1.25 up to 25Gbps NRZ
- or 56Gbps PAM4 per channel
- 0°C to 70°C operating case temperature
- Pluggable MT-12F ferrule
- Hot-pluggable mezzanine mounted

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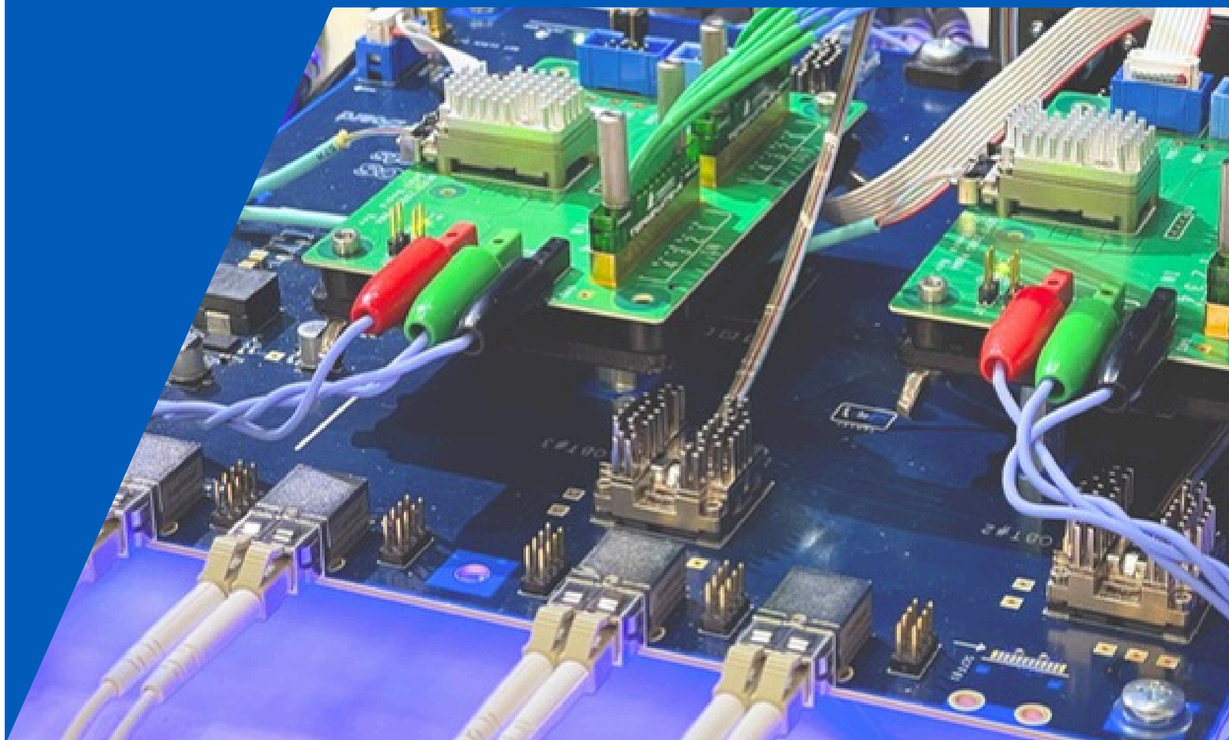
	SCFF	DUAL SCFF	QEPT 100 NRZ	QEPT 200 PAM4	QEPT TX/RX	LEAP RUGGED	LEAP OBT 300G
TX / RX	TX+RX	TX+RX	TX+RX	TX+RX	TX or RX	TX+RX	TX+RX
Number of Channels	1 + 1	2 + 2	4 + 4	4 + 4	8	12 + 12	12 + 12
Aggregated Data Rate (Gbps)	10 or 25	20 or 50	100	200	100	192	300
Size LxWxH (mm)	26x14x10	36x30x12	29x18x9	29x18x9	29x18x9	24x24x8	24x24x8
Multimode	✓	✓	✓	✓	✓	✓	✓
Wavelength (nm)	850	850	850	850	850	850	850
Modulation	NRZ	NRZ	NRZ	PAM4	NRZ	NRZ	NRZ
Operating Temperature Minimum, Maximum (°C)	-40, +85	-40, +85	-40, +85	0, +70	-40, +85	-40, +85	0, +70
Vibe MIL-883	✓	✓	✓	✓	✓	✓	✓ *
Shock MIL-883	✓	✓	✓	✓	✓	✓	✓ *
Power Dissipation (W)	10G: 0.45 25G: 0.65	20G: 0.90 50G: 1.30	1.5	3.0	1.5	3.5	5.8
Mounting	Soldering	Daughter card	Mezzanine connector	Mezzanine connector	Mezzanine connector	BGA socket	BGA socket
Heat Dissipation	Die-cast housing	Die-cast housing	Heatsink, coldplate	Heatsink, coldplate	Heatsink, coldplate	Heatsink, coldplate	Heatsink, coldplate
Fiber Connection	LC	LC	MT-12 ferrule	MT-12 ferrule	MT-12 ferrule	MT-24 ferrule	MT-24 ferrule
Hot-Pluggable	✗	✗	✓	✓	✓	✗	✗
Fiber cable can be replaced	✓	✓	✓	✓	✓	✓	✓
Bit Error Rate (BER)	$< 10^{-12}$	$< 10^{-12}$	$< 10^{-12}$	$<2.4*10^{-4}$	$< 10^{-12}$	$< 10^{-12}$	$< 10^{-12}$
Two-wire serial interface (i^2c)	✓	✓	✓	✓	✓	✓	✓
CDR (Clock Data Recovery)	✓	✓	✓	✓	✓	✗	✓
Input Equalization, Output Amplitude & Pre-Emphasis	✓	✓	✓	✓	✓	✓	✓
Digital Monitoring (Voltage, Temperature, RSSI)	✓	✓	✓	✓	✓	✓	✓
Evaluation Kit Available	✓	✓	✓	✓	coming soon	✓	✓
Parts Available	✓	✓	✓	coming soon	coming soon	✓	✓
Packaging (pcs)	10	10	10	10	10	1 or 10	1 or 10

✓ * : qualified per similarity

Product Matrix Comparison



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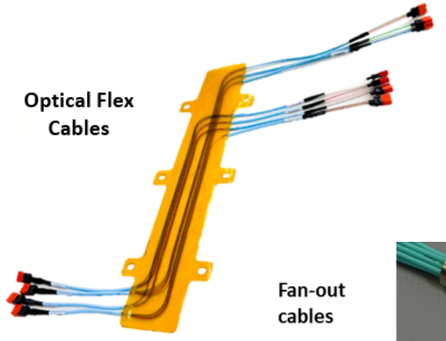
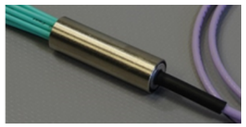
END TO END SOLUTIONS

OpenTech by Amphenol

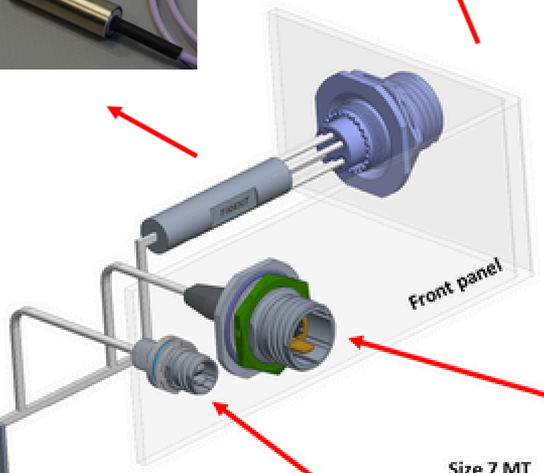


Optical Flex Cables

MT38999 to M29504/04 Short Fanout assembly



Fan-out cables



Backplane

Front panel

LEAP OBT (12TX+12RX)

VITA66.4

Daughter card

VITA66.1 (or VITA66.3/.4)

Size 7 MT

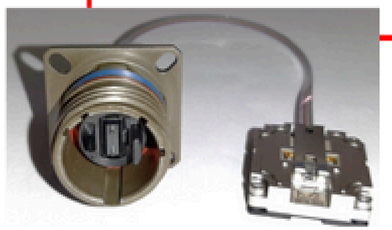
MT + Shell 38 999 size 7

NGCON M64266

LC Field

Double LuxBeam

THDM to MTP 24 Channels crossover



38 999 shell

MPO field

MPO + Shell 38 999 size 13

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

Amphenol Active Optics Products

Overview

Amphenol Active Optics Products

Amphenol AOP

- Founded in 2003 (MergeOptics GmbH)
- Located in Berlin
- ISO 9001 & 14001 certified

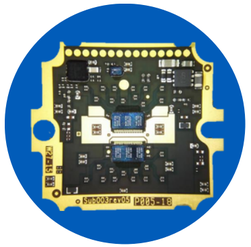
- Capabilities
  - Product Development
  - Process Development
  - Machine Development
  - NPI and Manufacturing

- 22 years of proven track record in designing and manufacturing optoelectronic products.
- Core competencies in RF, optical packaging, optical engine integration, assembly process
- Product, process development and manufacturing hosted at the same location.

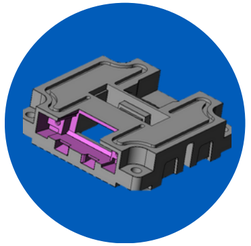
Amphenol Active Optics Products

AOP Capabilities

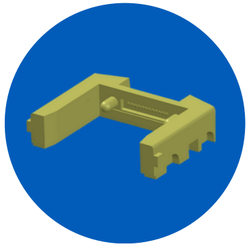
PRODUCT DEVELOPMENT



ELECTRONIC DESIGN
Transceiver & Active Optical Cables
PCB design and component integration
Connector design for optimal SI



MECHANICAL DESIGN
Die-casted and machined parts designs
Tolerance analysis
Simulations (thermal, mechanical stress)



OPTICAL DESIGN
Lens design for parallel optical beams
Mechanical designs of plastic molded parts

FIRMWARE & TEST
Firmware design programming
Standard compliant or customized FW
E/O performance testing capability
Characterization over temperatures and voltages

PROCESS / MANUFACTURING

DIE / WIRE BONDING
High volume / high accuracy die-bonding
High-capacity gold wire bonding equipment
Development of tooling & processes

BURN-IN
VCSEL burn-in process development
High-capacity burn-in equipment
Pre- and post burn-in VCSEL characterization

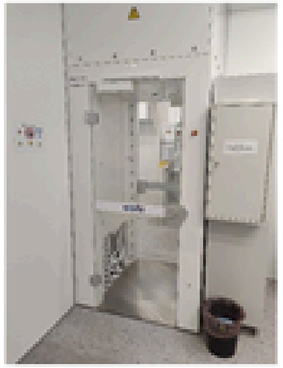
ACTIVE OPTICAL ALIGNMENT
Customized alignment station development
Automated optimal coupling process
Alignment algorithms programming

HIGH-SPEED E/O TEST
Fully automated E/O tester design
Measurements from -40°C to 85°C
Internal software development

Amphenol Active Optics Products

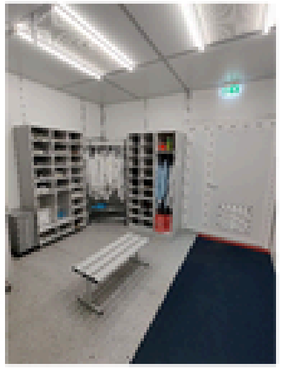
Amphenol AOP - Process Flow

Air shower

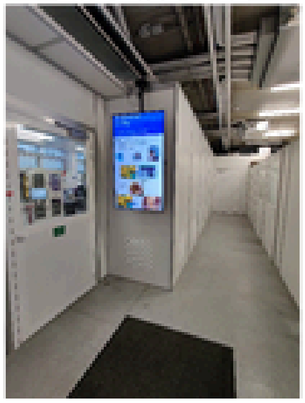


START

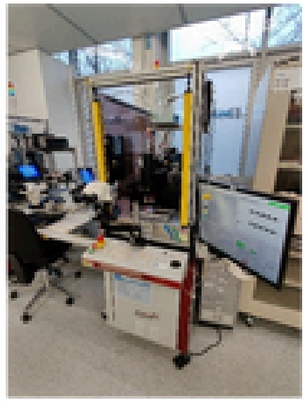
Garment room



Entrance area



Wire-bonding



High-speed die bonding

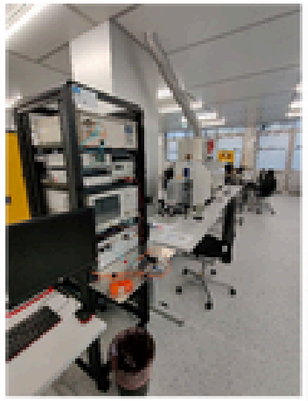
Higher burn-in capacity

Expansion: 3x production area in 2021

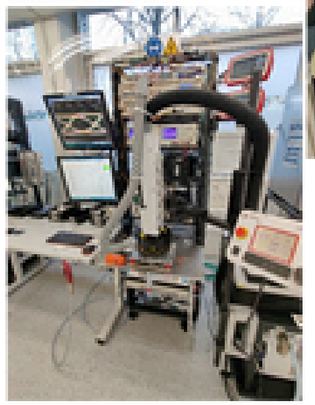
High accuracy die-bonding

Automated DC testing

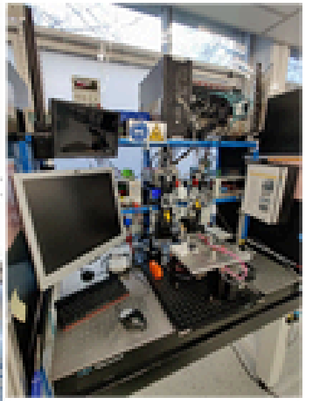
New product lines



Automated RF testing



In-house active optical alignment



BERLIN, DE

Amphenol Active Optics Products

AOP 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: optical cables can be removed

- 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 transceiver
- 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:

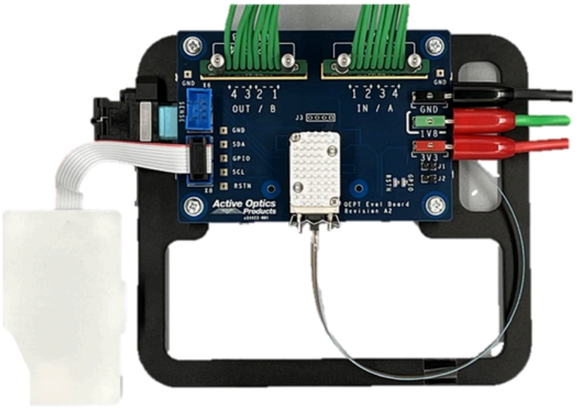
- Die-casted housings
- Support customized heat-sink designs

Amphenol Active Optics Products

Evaluation Kits

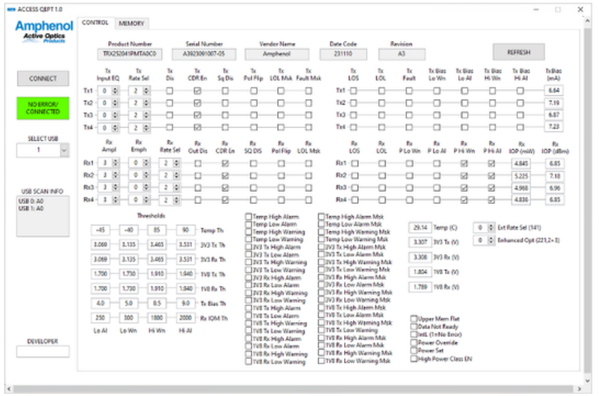
EVALUATION BOARDS

Designed to streamline and increase your go-to market time.



KEY FEAUTURES

- Evaluation board including high-speed electrical I/O
- Functional transceiver
- USB to i²c adapter
- Graphical User Interface software to access customer registers
- Fiber Optics cable assemblies and RF cables available in option



AVAILABLE VERSIONS

- LEAP® OBT 300G
- Ruggedised LEAP OBT
- Ruggedised SCFF
- QEPT 100G NRZ
- QEPT 200G PAM4*

* Coming soon

Amphenol Active Optics Products

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