FIBER OPTIC PRODUCTS FOR RUGGED APPLICATIONS

Rugged End-to-End Solutions for More Bandwidth, More Distance, More Performance
FIBER OPTIC PRODUCTS
Rugged End-to-End Solutions for Challenging Applications

Trusted Solutions
TE Connectivity’s (TE) ruggedized fiber optics brings the benefits of optical technology to the challenging environments of defense and aerospace applications.

Higher Speeds over Longer Transmission Distances. Ethernet and other fast communications protocols—with the capacity to handle next-generation 40G and 100G when you are ready—without the severe distance limitations of copper cable.

EMI Immunity. Because it is a dielectric, an optical fiber neither radiates nor receives electrical noise. The bulky shielding of copper cables is unnecessary.

Small Size, Light Weight. Optical cables offer significant size and weight savings to help meet SWaP goals.

As the need for higher bandwidth, speed and capacity continues to expand, TE’s ruggedized products are helping empower applications such as:
• Commercial, General and Military Avionics
• C4ISR Electronic Systems
• Air, Ground, and Marine Defense Systems
• Missile Defense
• Offshore and Subsea Systems
• Commercial Marine
• Space

End-to-End Connectivity Solutions
We offer comprehensive end-to-end solutions to help you deploy optical systems from ASIC to ASIC.
• Connectors
• Cable
• Optical Flex Circuitry
• Bypass Switches
• Active Devices

Built to Survive
As a trusted leader in optical technology, TE offers connector solutions that are also easy to maintain in the field. Our products are designed to operate reliably in harsh and challenging environments, and the company’s technical specialists have an in-depth understanding of application requirements.

Ease of Use
• Rear-removable optical contacts
• Removable alignment sleeve that helps support simple, effective cleaning and maintenance

Get your product to market faster with a smarter, better solution.
Precision Connections
• Dowel pin alignment
• Standard and tight-tolerance keying

Ruggedness
• Environmental sealing
• Anti-vibration coupling mechanisms
• Pressure-balanced subsea connectors

Wide Range
• PC and EB interface styles
• Versions for land, sea, and air

Physical Contact (PC) Connectors
A PC connection uses ferrules that are mated within a precision sleeve to assure radial alignment to minimize optical misalignment losses. The termini and mating sleeves can be incorporated into standard circular and rectangular connectors to provide multichannel operation. PC connections offer:
• Lowest insertion loss
• Lower reflection
• Compact format

While most PC connectors use a ceramic ferrule for a single fiber, the MT ferrule is a multifiber variation typically holding 12 or 24 fibers.
Expanded Beam (EB) Connectors

EB connectors expand and re-focus light at the fiber end faces and allow an air gap in the optical pathway. The EB concept uses optical lenses (typically a 3-mm ball lens for dedicated inserts or 1.25 lens for EB16 termini) to expand and collimate the beam emitted from the launch fiber. The expanded beam remains collimated across the mechanical interface until the receiving lens focuses the beam onto the receiving fiber.

Channel counts for EB-specific connectors are 1, 2, 4 and 8. Since these connectors are used in rugged environments they are usually terminated on robust fiber cables as well as in the tactical applications with rugged optical cable, metal tubed or avionics/flight-grade cable.

The absence of physical fiber contact makes EB connectors very useful in demanding environments. They offer

- Sealed optical interface
- High vibration and shock resistance
- High mating-cycle durability
- Tolerance to dirt and debris
- Easy cleaning

### COMPARISON OF PC AND EB CONNECTOR TECHNOLOGIES

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>PC</th>
<th>EB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>★★★★</td>
<td>★★</td>
</tr>
<tr>
<td>Return Loss (SM)</td>
<td>★★★★</td>
<td>★★</td>
</tr>
<tr>
<td>Return Loss (SM) – Unmated</td>
<td>★</td>
<td>★★</td>
</tr>
<tr>
<td>Lateral Connector Misalignment</td>
<td>★★★★</td>
<td>★★</td>
</tr>
<tr>
<td>Connector Angular Tilt</td>
<td>★★★★</td>
<td>★★</td>
</tr>
<tr>
<td>Mating Durability</td>
<td>★★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Water Exposure</td>
<td>★★★</td>
<td>★★</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>PC</th>
<th>EB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust Exposure</td>
<td>★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Vibration Susceptibility</td>
<td>★★★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Repair</td>
<td>★★★</td>
<td>★</td>
</tr>
<tr>
<td>Cleanability</td>
<td>★★★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Wear</td>
<td>★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Wavelength Range</td>
<td>★★★★★</td>
<td>★</td>
</tr>
</tbody>
</table>
# Fiber Optic Products

## OVERVIEW OF TE FIBER OPTIC CONNECTORS

<table>
<thead>
<tr>
<th>Family</th>
<th>Shell Materials</th>
<th>Termini Styles</th>
<th>Shell Sizes</th>
<th>No. of Fibers</th>
<th>Insertion Loss, Typ. (dB)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-DTL-38999 QPL and 38999-Style Connectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MC801</td>
<td>Aluminum, Composite</td>
<td>ARINC 801</td>
<td>—</td>
<td>—</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>MC5</td>
<td>Composite</td>
<td>DEUTSCH 1.25 mm</td>
<td>11-25</td>
<td>1, 2, 4, 6, 8, 10, 18, 30</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>MC4</td>
<td>Aluminum</td>
<td>2.5 mm</td>
<td>9</td>
<td>2</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>MC3</td>
<td>Aluminum</td>
<td>DEUTSCH 2.5 mm</td>
<td>19, 23, 25</td>
<td>5, 8, 12</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Expanded Beam 38999 III Style</td>
<td>Aluminum</td>
<td>Inserts</td>
<td>11, 15</td>
<td>1, 2, 4, 8</td>
<td>0.7</td>
<td>Insert Lens assembly</td>
</tr>
<tr>
<td>Expanded Beam</td>
<td>Aluminum, Composite</td>
<td>Size 16 EB</td>
<td>11-25</td>
<td>Up to 36</td>
<td>&lt;1.0</td>
<td>MIL-PRF-29504 style, but with a lens</td>
</tr>
<tr>
<td>D38999 Series III QPL</td>
<td>Aluminum, Composite</td>
<td>M29504</td>
<td>11-25</td>
<td>Up to 36</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Special Purpose, 38999 Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSC</td>
<td>ARCAP CRES</td>
<td>DEUTSCH 2.5 mm EB16</td>
<td>—</td>
<td>1</td>
<td>0.5</td>
<td>Single channel 38999 style, PC, APC, tunable, and EB versions</td>
</tr>
<tr>
<td>MC6</td>
<td>Composite</td>
<td>MT</td>
<td>11</td>
<td>12, 24</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Rectangular Connectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN4165</td>
<td>Aluminum, Composite</td>
<td>ARINC 801</td>
<td>2 801 + 5 size 16 and 2 size 22 contacts 6</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Composite</td>
<td>DEUTSCH 1.25 mm MT</td>
<td>12, 24</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>369 Series</td>
<td>MT</td>
<td>—</td>
<td>12, 24</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ARINC</td>
<td>Aluminum, Composite</td>
<td>ARINC 801 Mini EB</td>
<td>12, 36 (ARINC 801)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GPR</td>
<td>Aluminum, Composite</td>
<td>ARINC 801 Mini EB</td>
<td>1 – 12 (ARINC 801) 4, 8 (EB)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Field Deployable Expanded Beam Connectors</td>
<td>Aluminum</td>
<td>EB</td>
<td>2 and 4 SM and MM</td>
<td>0.7</td>
<td>Hermaphroditic coupling</td>
<td></td>
</tr>
<tr>
<td>PRO BEAM Series</td>
<td>Aluminum</td>
<td>EB</td>
<td>1, 2, 4 or 8 SM and MM</td>
<td>0.7</td>
<td>Three sizes: Sr., Jr. and Mini</td>
<td></td>
</tr>
<tr>
<td>Board-Level Connectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VITA 66</td>
<td>Stainless Steel</td>
<td>MT</td>
<td>ARINC 801</td>
<td>12, 24</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ARINC 801 EB</td>
<td>4</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LightCrimp PLUS</td>
<td>LC, SC, ST, Splice</td>
<td>No epoxy, no polish</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

### Discrete Connectors for Equipment Hook-Up and Restoration

<table>
<thead>
<tr>
<th>Type</th>
<th>Styles</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight Construction</td>
<td>LC, SC For tight-buffered cable epoxy applied</td>
<td>0.3</td>
</tr>
<tr>
<td>LightCrimp PLUS</td>
<td>LC, SC, ST, Splice No epoxy, no polish</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Fiber Optic Products

PHYSICAL CONTACT TERMINI

ARINC 801 Termini
- Industry-standard 1.25 mm ceramic ferrule
- MIL-DTL-38999 and ARINC connectors

MIL-PRF-29504/4 Pin and /5 Socket Termini
- Size 16 ceramic termini designed for use in 38999 circular connectors
- Spring-loaded socket helps maintain consistent contact between mated ferrules

DEUTSCH MC5 1.25-mm Termini
- 1.25-mm ceramic ferrule for high contact densities
- Designed specifically for use in the MC5 connector

DEUTSCH MC3 2.5-mm Termini
- 2.5-mm ceramic ferrules
- For use in a variety of DEUTSCH connectors

EXPANDED BEAM TERMINI

EB Lens Insert Assemblies
- Inserts for military and ARINC connectors
- Fully sealed interface designs

HDLT Termini Assemblies
- Ultra-high density
- 12, 24, or 36 fibers in a size 8 cavity
- Lens protection for each fiber
- Available as factory-terminated cables assemblies

PRO BEAM EB16 Termini
Compact Size 16
- Fit standard size 16 cavity
- Drop-in replacement for M29504/4 and /5 physical contact termini
**Fiber Optic Products**

**MULTICANAL CONNECTORS**

**DEUTSCH MC810 Connectors**
- **Rugged**
  - Resists shock and vibration, moisture, and corrosion
  - 100% scoop proof
  - Self-locking threaded coupling for anti-vibration integrity
- **Lightweight**
  - High-strength aluminum shells
  - 38999 Series III style
  - ARINC 801 termini

**DEUTSCH D38999 Series III QPL Connectors**
- **Rugged**
  - Resists shock and vibration, moisture, and corrosion
  - 100% scoop proof
  - Self-locking threaded coupling for anti-vibration integrity
- **Lightweight**
  - High-strength aluminum shells
  - MIL-PRF-29504 style termini

**DEUTSCH MC4 Connectors**
- **High Density**
  - Compact 1.25 mm precision zirconia ceramic ferrules
  - Extensive range including 1, 2, 4, 6, 8, 10, and 30 positions
- **Robust**
  - Sustained performance over a wide range of environmental conditions
  - Simple termination process and tooling

**DEUTSCH MC5 Connectors**
- **High Density**
  - Compact 1.25 mm precision zirconia ceramic ferrules
  - Extensive range including 1, 2, 4, 6, 8, 10, and 30 positions
- **Robust**
  - Sustained performance over a wide range of environmental conditions
  - Simple termination process and tooling

**DEUTSCH MC6 Connectors**
- **High Density**
  - MT ferrules for 12 and 24 channels
- **Convenient**
  - Rear release contact using size 8 extraction tools
  - Retrofit triple rear seal available
  - MIL-DTL-38999 Series III anti-vibration coupling with tri-start thread

**DEUTSCH MC801 Connectors**
- **Rugged**
  - Resists shock and vibration, moisture, and corrosion
  - 100% scoop proof
  - Self-locking threaded coupling for anti-vibration integrity

**DEUTSCH RSC Connectors**
- **Rugged**
  - Single-channel connectors
  - Manufactured from Arcap alloy for corrosion resistance
  - Anti-vibration coupling mechanism
- **Versatile**
  - RSC:
  - RSC EB: Accepts EB16 and M29504/4 and /5 termini
  - RSC-v: APC or tunable interface

**HDLT Connectors**
- **High-Density Lensed Termini**
  - Uses standard Quadrax contact geometry and shell inserts
  - 12, 24, or 36 fibers in a 8 cavity
  - Lens protection for each fiber
  - Up to 8 termini or 288 fibers per connector
  - TE ribbonized discrete cable for full degrees of freedom
  - Flexibility for easier routing
Fiber Optic Products

MULTICHAEL CONNECTORS

M83526/20, /21 and PRO BEAM Connectors

**Expanded Beam Interface**
- Performs consistently and reliably
- 3000-mating-cycle durability
- Vibration tolerant

**Flexible**
- 1, 2, 4 or 8 fibers in a single connector interface
- Available in Sr., Jr. and Mini sizes

DEUTSCH DMC-M Connectors

**Flexible**
- Multi-insert configurations
- MC5, MT, and ARINC 801 interfaces
- Hybrid electrical/ARINC 801 inserts

**Lightweight**
- Composite housing

DEUTSCH EN4165 Connectors

**Flexible**
- Interchangeable modular inserts
- MC5, MT, and ARINC 801 interfaces
- ARINC 801/electrical hybrid

**Easy to Use**
- Easy-to-use insertion/extraction tool
- Easy access to optical contacts for cleaning and maintenance

DEUTSCH 369 Connectors

**Compact**
- 24-fiber MT ferrule
- Single mode or multimode ribbon or discrete fibers
- Integrated plug-side coupling bushing

**Versatile**
- In-line or flange mount

DEUTSCH 9316 Series Connectors

**Rugged**
- Withstands high mechanical stress
- Explosion-proof for use in hazardous areas and polluted environments

**Versatile**
- Two shell sizes for 3 or 12 contacts
- Optical and hybrid versions available
- Custom backshell designs available

GPR Connectors

**Versatile**
- Shell accepts inserts for signal, power, coax, data bus, and fiber optic contacts
- GPRB version for fiber optics
- F12 insert for up to 12 ARINC 801 termini
- M2 insert holds two 4-channel mini-EB inserts

DEUTSCH Showet Series

**Splash-Zone Connectors**
- Hybrid Design
- Copper and fiber in a single shell
- Supports signal and control needs
- 4 multimode optical and 4 copper contacts

ARINC Connectors

**Flexible**
- Inserts for ARINC 404 and 600 connectors
- Up to 4 Mini EB termini per insert or 128 per connector
- Up to 36 standard 1.25 mm MC5 termini per insert

**Convenient**
- Easily removable front insert allows cleaning or replacing damaged alignment sleeves

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- Optical and hybrid versions available
- Custom backshell designs available
**Fiber Optic Products**

**DRY-MATE CONNECTORS**

**DEUTSCH MOD Series**
Splash-Zone Connectors
- **Safe**
  - Quick connect/disconnect in hazardous areas
  - Explosion-proof
  - Up to 8 fibers
  - Rated to 580 psi

**SEACON MSS Series**
Connectors
- **Flexible Hybrid Design**
  - 6 shell sizes, with a variety of inserts
  - Up to 48 optical and 44 size 8 electrical contacts
  - Rated to 20,000 psi

**SEACON OPTI-CON Connectors**
Versatile
- 5 shell sizes in stainless steel or titanium
- Up to 20 optical or electrical contacts in any combination
- Rated up to 5200 m and 7500 psi

**SEACON GRE Connectors**
- Glass reinforce epoxy
- Rated to 20,000 psi
- Bulkhead version for penetrator applications

**WET-MATE CONNECTORS**

**DEUTSCH DO3000 Series**
Connectors
- **Optimized for Subsea Distribution Systems**
  - Up to 12 fibers
  - ROV, bulkhead, stab plate, and diver versions
  - Operational seawater depths to 4500 meters
  - Rated at 6600 psi

**DEUTSCH O-1DH Series**
Connectors
- **High-Pressure, High-Temperature Downhole Applications**
  - Fit into in-well tight casings
  - Optical connectivity from in-well measurement systems
  - Rated to 15,000 psi
  - 350°F working temperature

**DEUTSCH OFS Series**
Connectors
- **Rugged Reliability**
  - Connects permanently installed downhole sensors/instrumentation and a data acquisition system
  - Provides pressure barrier between wellbore and the subsea environment
  - Rated at up to 22,500 psi

**SEACON HYDRA-LIGHT Connectors**
- 6 to 48 optical channels
- 100 mating cycle durability
- Qualified to 7000 m and up to 10,000 psi
- Hybrid version with power rated to 1000 VAC
Fiber Optic Products

WET-MATE CONNECTORS

SEACON G3 Connectors

**Compact Low Profile**
- Suitable for stab, diver and ROV operations
- 6 optical channels
- Rated to 15,000 psi

SEACON Microstar Connectors

**Slimline Design**
- 4 optical channels in <1.8” diameter

**High-Integrity**
- Qualified for 7000 m and up to 10,000 psi
- 25-mating-cycle durability

BOARD-LEVEL PRODUCTS

VITA 66 Optical Modules

**Industry Standard**
- Compatible with VITA 46 VPX systems

**Versatile**
- MT: extreme density with up to 48 fibers/module
- ARINC 801: excellent single-mode performance
- Expanded beam: noncontacting interface for frequent mating cycles

Optical Flex Circuits

**Versatile**
- Symmetrical and asymmetrical designs
- Very low insertion loss over a broad temperature range
- Range of packaging options for environmental conditions

Electro-Optic Packaging

**Rugged**
- Sealed board-to-board interface
- High reliability
- Meets or exceeds VITA specs for shock and vibration
- Mezzanine-style mating to the pc board

DISCRETE CONNECTORS

LightCrimp Plus Connectors

**Fast, Easy Field Termination**
- No epoxy, no polish
- Simple strip, cleave and crimp process

**High Performance**
- Factory-polished ferrule for consistent, high-quality finish

**Standard Interfaces**
- SC, ST and LC styles
- Tight-jacketed epoxy connectors also available

Sealed LC Connectors

**Robust**
- ODVA style
- IP 67 sealing
- Aluminum or composite shells
Fiber Optic Products

DISCRETE CONNECTORS

U.S. Navy Commercial Item
Description Approved

**NAVSEA Approved**
- Approved for shipboard use
- LightCrimp Plus ST multimode connectors
- Tight construction single-mode and multimode SC and LC connectors

**Mechanical Optical Splice**

**High Performance**
- NAVSEA approved for shipboard use
- Manufactured to single-mode tolerances
- Capable of jacketed and buffered fiber
- High-reliability optical terminations

CABLES AND CABLE ASSEMBLIES

Rochester Armored Fiber Optic Cable

**Rugged Tactical, Field Deployable**
- 2 and 4 fiber constructions with color-coded fibers
- Stainless-steel, gel-filled rodent-resistant tube
- Steel-wire strength members
- Hybrid copper/fiber options available

Phoenix Optix Cable Assemblies and Harnesses

**Convenient**
- Complete assemblies, tested and ready to go
- Optical performance exceeds industry standards
- Widest range of configurations, truck and patch cables, and fiber types

Phoenix Optix Cassettes and Adapter Panels

**Full Range**
- LC, SC, and MPO interfaces
- Standard and high-density versions
- Support for single-mode and multimode applications

ACCESSORIES

Tactical Optical Cable Repair Kit

**Convenient**
- Fusion splice for repairing up to four fibers at once
- Cable repair protection sleeves
- Solutions for rodent-resistant cables and standard tactical cable

Reels

**Heavy-Duty, Lightweight**
- Cable reel to organize and protect connectors
- Up to 500 meters

**Flexible**
- Options include special backpack harnesses, separate reel stand or combo reel/reel stand
For More Information

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Austria  +43 1 905 601 228  
Baltic Regions  +46 8 5072 5000  
Benelux  +31 73 6246 999  
Czech Republic  +420 800 701 462  
France  +33 1 34 20 86 86  
Germany  +49 6251 133 1999  
Hungary  +36 809 874 04  
Italy  +39 011 401 2632  
Nordic  +46 8 5072 5000  
Poland  +48 800 702 309  
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Spain/Portugal  +34 93 2910366  
Switzerland  +41 52 633 66 26  
United Kingdom  +44 800 267 666

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RUGGED END-TO-END SOLUTIONS FOR MORE BANDWIDTH, MORE DISTANCE, MORE PERFORMANCE

te.com/fiberoptics