

OPTICAL SOLUTIONS FOR RUGGED ENVIRONMENTS

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.

Optical fibers accommodate 10G Ethernet and other fast communications protocols—with the capacity to handle next-generation 40G and 100G when needed—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 Connectivity 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



TE Components ... TE Technology ... TE Know-how ...

Get your product to market faster with a smarter, better solution.

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. With the addition of DEUTSCH to the TE family, our product offering is more complete than ever.

Solving the problem of rugged readability.

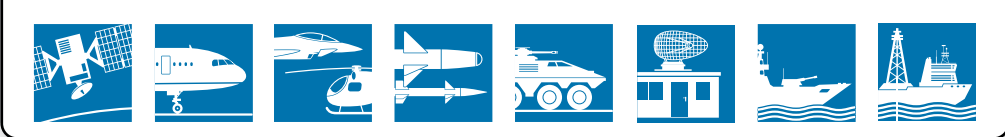
Ruggedness has always been a challenge to fiber optic systems. The thin glass strand transmitting the optical signal is well protected within the cable, but the exposed fiber ends transmitting the signal through a mating interface are susceptible to contamination and mechanical damage. For protection and alignment reasons, the fiber is usually terminated via an epoxy bond to a precision ceramic ferrule followed by an end face polish. Generally, there are two main methods of transmitting an optical signal between two fibers: physical contact (PC) and expanded beam (EB).

Designed to be compatible with single-mode and multimode fibers, the connectors include such features as:

- Rear-removable optical contacts
- Removable alignment sleeve that helps support simple, effective cleaning and maintenance
- Dowel pin alignment
- Environmental sealing
- Standard and tight-tolerance keying
- Anti-vibration coupling mechanism
- PC and EB interface styles

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Here you can get connected to the inner circle of TE AD&M's best thinkers. Working together early in your design review process, we can help you reach a better connectivity solution.



TYPICAL DEFENSE APPLICATIONS

Ship-to-Shore and Airborne Networks

Ship-to-shore, vehicle-to-station
Sonar, radar, and electronic systems
Surveillance, information and security systems
Simulation and training systems
Antennas
Surveillance, security and control

Shipboard and Unmanned Platforms

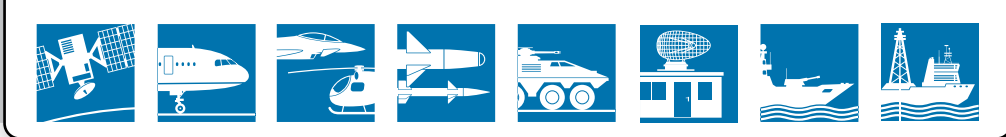
Communication networks
Surveillance, security and control
Mine sweeper vehicles
Underwater warfare systems
Sonar systems

Rugged Cabling for Shelters, Vehicles, Fixed Bases and Facilities

Radar and electronic systems
Tactical and strategic communication
Simulation and training systems
Antennas
Surveillance, security and control

Rapid Set Up Network of Mobile Shelters

Radar and electronic systems
Tactical and strategic communication
Simulation and training systems

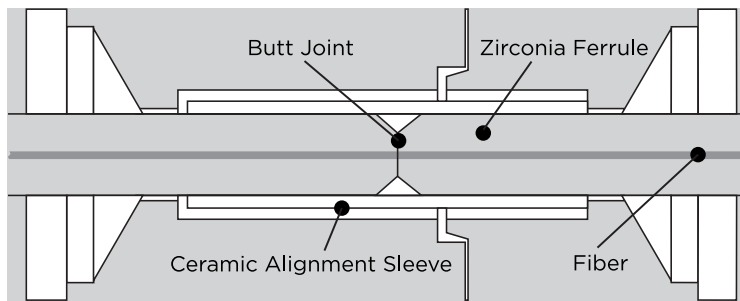


1. PHYSICAL CONTACT (PC)

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 the lowest insertion loss and less reflection in a compact format.

Due to the rugged design, PC connectors are suitable to a wide range of indoor and outdoor applications and are therefore typically subjected to a more challenging environment.

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 for a rugged environment.

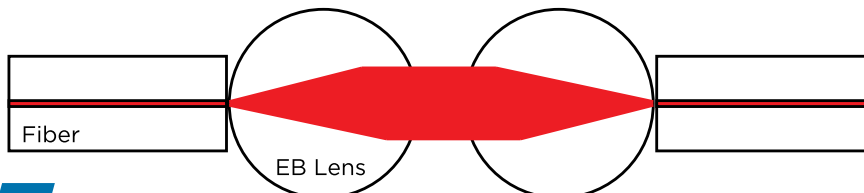


2. EXPANDED BEAM (EB)

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) 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. The mini connector insert is also used with a MIL-DTL-38999 Series III, size 11 circular shell as well as a size 15 shell for an 8 position Sr. insert. Within an ARINC 600 connector the mini EB insert can provide up to 128 expanded beam channels or in the GPR 8 fibers in each cavity. 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 simplicity of the PC design provides a lower single-mode insertion loss (0.2 dB typ.) than what is achieved by the single-mode expanded beam concept (0.7 dB typ.). A major advantage of the expanded beam concept, however, is that there is no mechanical contact between the optical elements of the two mated connectors and there is no need for use of fragile alignment sleeves or microscope-level cleaning. This makes the EB connectors especially suitable for use in rugged environments, which are subjected to vibrations, such as avionics, industrial and military applications, and mating without cleaning.



MULTICHANNEL TERMINI TYPES

- **ARINC 801** uses an industry-standard 1.25 mm ceramic ferrule for use in MIL-DTL-38999 and ARINC connectors.



- **MIL-PRF-29504/4 and /5 termini** are size 16 termini designed for use in 38999 circular connectors. The ferrule is 1.59 mm in diameter.

M29504/4 covers the pin terminus. M29504/5 covers the socket terminus, which is spring-loaded to maintain consistent contact between mated ferrules.

MIL-PRF-29504 Termini

- **DEUTSCH MC5 1.25 mm** termini are designed specifically for use in the MC5 connector.

- **DEUTSCH MC3 2.5 mm** termini use an industry-standard 2.5-mm ceramic ferrules for use in a variety of DEUTSCH connectors.

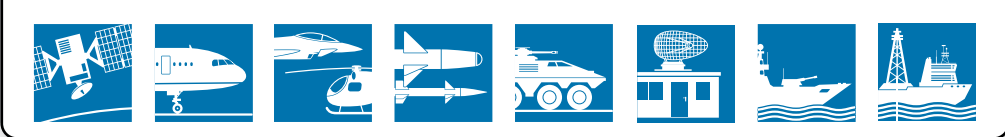
- **EB lens insert assemblies** provide excellent EMI/RFI performance and fully sealed interface designs.



- **EB termini** are a combination of inserts (containing the lens) and EB termini (for terminating the fiber).



- **MT ferrules** provide very-high-density multifiber connectivity. The polymer ferrules typically hold 12 or 24 fibers.



COMPARISON OF PC AND EB CONNECTOR TECHNOLOGIES

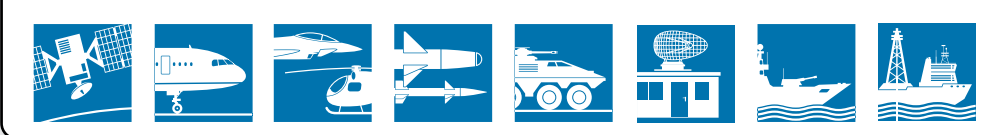
Performance Criteria	PC	EB
Insertion Loss	★★★★	★★
Return Loss (SM)	★★★★	★★
Return Loss (SM) – Unmated	★	★★
Lateral Connector Misalignment	★	★★★★
Connector Angular Tilt	★★★★	★
Mating Durability	★★	★★★★
Water Exposure	★★★	★★

Performance Criteria	PC	EB
Dust Exposure	★	★★★
Vibration Susceptibility	★★	★★★
Repair	★★	★★
Cleanability	★★	★★★★
Wear	★	★★★★
Wavelength Range	★★★★	★★

OVERVIEW OF TE FIBER OPTIC CONNECTORS

Family	Shell Materials	Termini Styles	Shell Sizes	No. of Fibers	Insertion Loss, Typ. (dB)	Notes
MIL-DTL-38999 QPL and 38999-Style Connectors						
MC5	Composite	DEUTSCH 1.25 mm	11-25	1, 2, 4, 6, 8, 10, 18, 30	0.3	
MC3	Aluminum	DEUTSCH 2.5 mm	19, 23, 25	5, 8, 12	0.5	
Expanded Beam 38999 III Style	Aluminum	Inserts	11, 15	1, 2, 4, 8	0.7	Insert Lens assembly
Expanded Beam	Aluminum, Composite	Size 16 EB	11-25	Up to 36	<1.0	MIL-PRF-29504 style, but with a lens
D38999 Series III QPL	Aluminum, Composite	M29504	11-25	Up to 36	0.75	
Special Purpose, 38999 Type						
RSC	ARCAP CRES	DEUTSCH 1.5 mm	—	1	0.5	Single channel 38999 style, PC, APC, and tunable versions
MC6	Composite	MT	11	12, 24	0.5	
Rectangular Connectors						
EN4165	Aluminum Composite	ARINC 801		2 801 + 5 size 16 and 2 size 22 contacts	0.3	
		DEUTSCH 1.25 mm		6	0.3	
		MT		12, 24	0.5	
ARINC	Aluminum	ARINC 801 Mini EB		12, 36 (ARINC 801) 4,16, 24 (EB) in size 2 shell inserts	0.3 0.7	
GPR	Aluminum	ARINC 801 Mini EB		1 – 12 (ARINC 801) 4, 8 (EB)	0.3 0.7	
Field Deployable Expanded Beam Connectors						
M83526/20 and /21	Aluminum	EB		2 and 4 SM and MM	0.7	Hermaphroditic coupling
PRO BEAM Series	Aluminum	EB		1, 2, 4 or 8 SM and MM	0.7	Three sizes: Sr., Jr. and Mini
Board-Level Connectors						
VITA 66	Stainless Steel	MT		12, 24	0.5	
		ARINC 801		4	0.3	
		EB		4	0.7	
Discrete Connectors for Equipment Hook-Up and Restoration						
Type	Styles					
Tight Construction	LC, SC	For tight-buffered cable epoxy applied			0.3	
LightCrimp PLUS	LC, SC, ST, Splice	No epoxy, no polish			0.5	





MULTICHANNEL CONNECTORS



**D38999 Series III QPL
MIL-PRF-29504 style termini**

- Rugged design for resistance to shock and vibration, moisture, and corrosion
- 100% scoop proof
- High-strength aluminum shells
- Advanced fluorosilicone seals to help maximize tear resistance and sealing memory
- Self-locking threaded coupling for anti-vibration integrity



DMC-M Connectors

- Single- and multi-insert configurations
- 6 standard MC5, 12-position MT ferrule, 4 ARINC 801, or two ARINC 801 termini with five size 22 and two size 22 electrical contacts
- Lightweight composite housing
- Color coded
- Screw coupling



MC3 MKII Connectors

- High-performance, maintainable optical connectivity in the harshest of environments
- Insert-to-insert keying assists precision alignment
- Individually rear insertable/removable optical contacts enable easy assembly
- Backshells and adapters available for most single and multifiber cable types



EN4165 Connectors

- Modular inserts for MC5, MC6 ribbon, and ARINC 801 optical termini and ARINC 801/electrical hybrid
- Interchangeable modular inserts
- Easy-to-use insertion/extraction tool
- Easy access to optical contacts for cleaning and maintenance
- Complements DMC-M multichannel connectors



MC5 Connectors

- High-density connectors for sustained performance over a wide range of environmental conditions.
- Compact 1.25 mm precision zirconia ceramic ferrules
- Extensive range including 1, 2, 4, 6, 8, 10, and 30 positions
- Simple termination process and tooling



GPR Connectors

- Shell can accommodate a wide variety of inserts for signal, power, coax, data bus and fiber optic contacts
- GPRB - Fiber Optics
- F12 insert for up to 12 ARINC 801 termini
- M2 insert holds two 4-channel Mini-Expanded Beam inserts



MC6 Connectors

- MT ferrules for 12 channels
- 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
- Interchangeable with MIL-DTL-38999 Series III



ARINC Connectors

- Inserts for ARINC 404 and 600 connectors support EB and MC5 termini
- Up to 4 Mini EB termini per insert or 128 per connector
- Up to 36 standard 1.25 mm MC5 termini per insert
- Easily removable front insert allows cleaning of the optical faces and replacement of damaged alignment sleeves



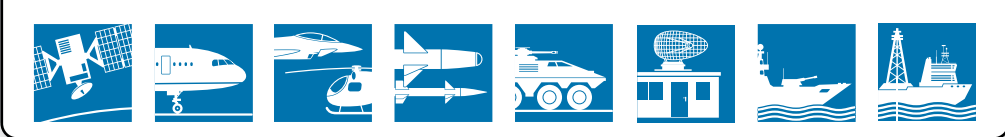
RSC Connectors

- Ruggedized single-channel connectors
- Manufactured from Arcap alloy for corrosion resistance
- Anti-vibration coupling mechanism
- Common ferrule carriers for the plug and receptacle
- Easily accessible fiber faces for cleaning purposes
- RSC-V offers APC or tunable interface

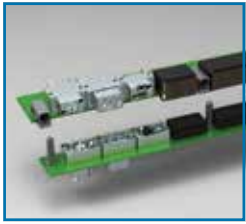


PRO BEAM and M83526/20 and /21 Connectors

- 1, 2, 4 or 8 fibers in a single connector interface
- Available in Sr., Jr. and Mini connectors
- Performs consistently and reliably
- High-cycle resistance of more than 3000 mating cycles

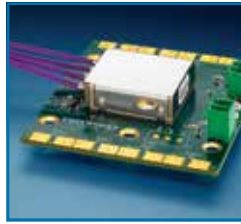


BOARD-LEVEL CONNECTORS



VITA 66 Optical Modules

- MT, EB and ARINC 801 termini
- Compatible with VITA 46 VPX systems
- MT: extreme density with up to 48 fibers/module
- ARINC 801: excellent single-mode performance
- Expanded beam: noncontacting interface for frequent mating cycles



Rugged Electro-Optic Packaging

- Sealed board-to-board interface
- Mezzanine-style mating to the pc board
- High reliability in applications subject to vibration, shock and other mechanical disturbances.
- Built-in digital diagnostics
- Matches or exceeds VITA specs for shock and vibratio

DISCRETE CONNECTORS



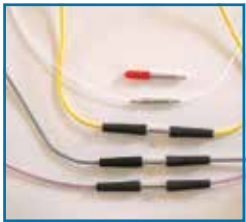
LightCrimp Plus Connectors

- Fast, easy field termination: no epoxy, no polish
- Simple strip, cleave and crimp process
- Factory-polished ferrule for consistent, high-quality finish
- SC, ST and LC styles
- Tight-jacketed epoxy connectors also available



U.S. Navy Commercial Item Description Approved

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



Mechanical Optical Splice

- Manufactured to single-mode tolerances
- Capable of jacketed and buffered fiber
- High-reliability optical terminations

FIBER OPTIC CABLES AND CABLE ASSEMBLIES



Rochester ARMOR-LIGHT Tactical Field-Deployable Fiber Optic Cable

- 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



Cable Assemblies and Harnesses

- Ruggedized cable assemblies custom tailored for field use in harsh environments
- Complete assemblies, tested and ready to go
- Widest range of configurations, fiber types and hybrid electrical/fiber harnesses

ACCESSORIES



Tactical Optical Cable Repair Kit

- 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
- Options include special backpack harnesses, separate reel stand or combination reel/reel stand

FOR MORE INFORMATION

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Consult TE for the latest dimensions and design specifications.



EVERY CONNECTION COUNTS