



Delphi™ Fiber Optic Cable Assemblies



We Energize Innovation.™



Delphi™ branded fiber optic products are now under the Winchester Interconnect brand.

M28876 Product Profile



Delphi™ branded Shipboard / MIL- PRF-28876 fiber optic connectors feature low optical insertion loss, repeatability, exceptional strain relief, and reliability in harsh environments. Commercial-Off-The-Shelf (COTS) equivalents are available that maintain key performance factors of the MIL-Spec versions. Complete tool kits and support infrastructure are commercially available.

The Delphi Shipboard / MIL- PRF-28876 Connectors are used extensively by the United States and allied naval forces in shipboard applications, and have been on the United States government's Qualified Products List (QPL) since 1983.

Benefits/Features

- Low optical insertion loss
- Available in 2, 4, 6, 8, 18 and 31 channel configurations
- In-line and wall mount receptacles
- Singlemode and multimode capabilities
- Hybrid (electro-optic) versions available

Typical/Application

- Navy shipboard
- Military and commercial
- Hybrid configurations for electro-optical signal transmission

Performance Characteristics

- Optical insertion loss:
 - 9/125 SM fiber: 0.25 dB avg.
 - 62.5/125 MM fiber: 0.6 dB avg.
- Operating temperature: -28°C to +65°C
- Vibration: per TIA/EIA-455-11, Condition II & VII
- Shock: MIL-S-901, GR.A, CL.1, high impact
- Mating durability: 500 cycles

The performance characteristics above are for reference only and may not account for all the variables that would be present in an actual application. For detailed product performance information, contact an expert on www.winconn.com.

M28876 Product Profile

Connector Performance Criteria

Description	Specifications
Optical Insertion Loss*	9/125 SM Fiber -0.25 dB avg., 62.5/125 MM Fiber -0.6 dB avg. <i>Note - Values measured at 1300 nm per TIA/EIA-455-34</i>
Optical Backreflection (SM)*	Better than -40 dB with PC polish, better than -50 dB with enhanced PC polish
Mating Durability	500 cycles per TIA/EIA-455-21
Vibration	Per MIL-STD-1344, Method 2005, Condition II & VI
Mechanical Shock	Per MIL-S-901, Grade A
Thermal Cycling	-62°C to +70°C per MIL-STD-1344, Method 1003
Corrosion Resistance	500 hour salt spray per MIL-STD-1344, Method 1001
Ozone Exposure	150 PPM/2 hours per MIL-STD-1344, Method 1007
Humidity	240 hours per MIL-STD-1344, Method 1002
Fluid Immersion	Per MIL-STD-1344, Method 1016
Crush Resistance	225 pounds per MIL-STD-1344, Method 2008.1
Maintenance Aging	Per MIL-STD-1344, Method 2002
Terminus Retention Force	22 pounds minimum per MIL-STD-1344, Method 2007
Insert Retention Axial	100 PSI minimum per MIL-STD-1344, Method 2010
Cable Pull Out Force	162 pounds minimum per MIL-STD-1344, Method 2009
Cable Seal Flexing	100 cycles per MIL-STD-1344, Method 2017
Impact	Per MIL-STD-1344, Method 2015
Flammability	Per MIL-STD-1344, Method 1012
Operating Temperature Range	-54°C to +65°C
Storage Temperature Range	-62°C to +71°C

**Optical performance data figures are derived from actual field measurements taken from thousands of mated pairs of termini across Delphi multichannel connectors.*

Standard Materials and Finishes:

Description	Material	Finish
Insert	Per MIL-C-28876	Per MIL-C-28876
Boot, Strain Relief	Fluorosilicone	None
Connector and Backshell Housings	Per MIL-C-28876	Per MIL-C-28876

M29504/14 and /15 Product Profile



Delphi branded Shipboard Termini / MIL-PRF-29504/14 & /15 are free floating, self-aligning termini which are the foundation of Delphi's field proven fiber optic connectors. The self-aligning MIL-PRF-29504 qualified termini are available in both MIL-Spec and COTS (Commercial-Off-The-Shelf) versions.

The Delphi fiber optic termini utilize a constant mating force from specially designed Belleville springs to help prevent termini separation resulting from shock, vibration or thermal cycling.

The M29504 termini "float" within the connector and self-align to provide precise mating every time due to the unique shape of the ferrule and alignment sleeve hood.

Benefits/Features

- Qualified to MIL-PRF-29504/14 & /15
- Free-floating, self-aligning design
- Available in singlemode and multimode

Typical Applications

- Military/aerospace
- Shipboard/pierside
- Harsh environment
- Broadcast
- Hybrid electronics
- Circular and rectangular connectors

Performance Characteristics

- Optical insertion loss:
 - 9/125 SM fiber: 0.25 dB avg.
 - 62.5/125 MM fiber: 0.60 dB avg.
 - Return loss: (9/125) SM: 48 dB avg.
- Operating temperature: -28°C to +65°C
- Mating durability: 2,000 cycles
- Terminus retention force: 22 lbs. minimum

The performance characteristics above are for reference only and may not account for all the variables that would be present in an actual application. For detailed product performance information, contact an expert on www.winconn.com

M29504/14 and /15 Product Profile

Ceramic Alignment and Optical Performance

The termini comply to both MIL-T-29504 and MIL-C-28876 specifications. The specifications and known test limits below represent actual performance testing conducted by Delphi Connection Systems' engineering.

This data is derived from several different connector types and is only a guideline.

Consult the factory to discuss your specific application.

Performance Criteria:

Operating Temperature Range	-65°C to +150°C (dependent on epoxy and cable)
Thermal Cycling	-54°C to +65°C
Thermal Shock	-55°C to +85°C
Temperature Life	+110°C for 240 hours
Vibration	68 G random
Physical Shock	500 G
Mating Durability	2,000 cycles
Salt Spray	500 hours
Pressure Sealing (Wiper Seal)	2,000 psi
Terminus Mating Force	5 lbs. [22.2 N] nominal
Terminus Retention Force	22 lbs. [97.9 N]
Cable Retention Force	25 lbs. [111.2 N] (dependent on cable construction)
Weight	0.7 grams max.

Optical Performance:

Insertion Loss (IL) and Backreflection (BR) readings are heavily dependent on launch conditions and test setup. The figures below are actuals for overfilled source fibers at 1300 nm when standard setup and testing procedures are followed per TIA/EIA-455-171. Please consult the factory for information on additional fiber sizes.

Optical Performance Average Insertion Loss (IL):

Fiber Size	Average Insertion Loss
9/125	-0.25 dB
62.5/125	-0.60 dB

Backreflection (BR) – Singlemode:

Better than -4.0 dB – PC polish

Better than -5.0 dB – enhanced PC polish

Standard Materials and Finishes:

Description	Material	Finish
Terminus Body	Stainless Steel	Passivated
Alignment Sleeve	Zirconia	None
Alignment Sleeve Hood	Beryllium Copper	Nickel Plated
Ferrule (bushing)	Zirconia	None
Retaining Clip	Beryllium Copper	None
Belleville Springs	Beryllium Copper	None
O-Ring Seal	Fluorosilicone	None

Hermaphroditic Product Profile



Delphi™ branded Hermaphroditic Connectors have been developed to meet the stringent demands of outdoor applications and to provide superior optical performance. Hermaphroditic Connectors allow concatenations (linked together in series) of cable assemblies to extend equipment separation without concern for connector male / female interface compatibility. Additionally "blind mating" and "scoop-proof" features help ensure easy to mate interconnects.

Benefits/Features

- Available in 4, 6 and 12 channel configurations
- Singlemode and multimode capabilities
- 4 channel complies to SMPTE (Society of Motion Picture and Television Engineers) Standard 358M-2001
- Plug-to-plug in-line cable linking system
- Utilizes Delphi's field proven termini
- Full environmental sealing

Typical Applications

- Broadcast
- Military pierside and tactical field usage
- Petroleum field exploration
- Field deployed equipment

Performance Characteristics

- Optical insertion loss:
 - 9/125 SM fiber: 0.25 dB avg.
 - 62.5/125 MM fiber: 0.6 dB avg.
- Operating temperature: -54°C to +85°C
- Cable retention: 400 lbs. minimum (depending on cable construction)
- Mating durability: 1000 cycles
- Terminus retention force: 22 lbs. minimum

The performance characteristics above are for reference only and may not account for all the variables that would be present in an actual application. For detailed product performance information, contact an expert on www.winconn.com.

Hermaphroditic Product Profile

4 Channel Harsh Environment Hermaphroditic Fiber Optic Connectors

Description:

Fiber optic cable connectors for harsh environment applications.
Compliant to SMPTE Standard 358M-2001.

Benefits/Features:

- Genderless connection..... Plug connectors can link together in series without regard to connector gender
- Channel count..... 4 fiber optic channels
- Fiber type Singlemode and multimode capabilities
- Cable compatibility Tactical field type, distribution, and breakout
- Ruggedness..... Designed to withstand crush, impact, cable pull-out, cable twist, bending moment, water and mud immersion, and many other harsh environments
- Reliability Proven performance in harsh environment applications



Connector Performance Criteria

Description	Specifications
Optical Insertion Loss*	9/125 SM Fiber -0.25 dB avg., 62.5/125 MM Fiber -0.6 dB avg. <i>Note - Values measured at 1300 nm per TIA/EIA-455-34</i>
Optical Backreflection (SM)*	Better than -40 dB with PC polish, better than -50 dB with enhanced PC polish
Mating Durability	1000 cycles minimum per TIA/EIA-455-21
Vibration	Per MIL-STD-1344, Method 2005, Condition II & VI-A
Mechanical Shock	Per TIA/EIA-455-2, Method C
Thermal Shock	-54°C to +85°C* per TIA/EIA-455-3, test condition A
Operating Temperature Range	-54°C to +85°C*
Storage Temperature	-65°C to +85°C*
Corrosion Resistance	500 hours salt spray per TIA/EIA-455-16
Ozone Exposure	ASTM-D-1149, 100-150 PPM for 2 hours
Temperature Humidity	Per TIA/EIA-455-5, type 2
Crush Resistance	225 pounds per TIA/EIA-455-26
Maintenance Aging	10 contact insertions/removals per MIL-STD-1344, Method 2002
Terminus (Contact) Retention Force	22 pounds minimum per MIL-STD-1344, Method 2007
Cable Retention	400 pounds minimum per TIA/EIA-455-6 (depending on cable construction)
Cable Seal Flexing	100 cycles per MIL-STD-1344, Method 2017
Cable Twist	1000 cycles per TIA/EIA-455-36
External Bending Moment	45 ft - lb at mounting panel
Impact	Per TIA/EIA-455-2
Water Pressure Sealing	Up to 25 PSI for 48 hours
Fluid Immersion	24 hours per fluid, per TIA/EIA-455-12

*Temperature ranges listed above are limited by the fiber optic cable performance window.

Hermaphroditic Product Profile

6/12 Channel Harsh Environment Hermaphroditic Fiber Optic Connectors

Description:

Fiber optic cable connectors for harsh environment applications.

Benefits/Features:

Genderless connection..... Cable connectors can link together in series without regard to connector gender

Maintainability Removable socket endface

Channel count..... 6 or 12 fiber optic channels

Fiber type Singlemode and multimode capabilities

Cable compatibility Tactical field type, distribution and breakout

Ruggedness..... Designed to withstand crush, impact, cable pull-out, cable twist, bending moment, water and mud immersion, and many other harsh environments

Reliability Proven field performance in harsh environment applications



Connector Performance Criteria

Description	Specifications
Optical Insertion Loss*	9/125 SM Fiber -0.4 dB avg., 62.5/125 MM Fiber -0.7 dB avg. <i>Note - Values measured at 1300 nm per TIA/EIA-455-34</i>
Optical Backreflection (SM)*	Better than -40 dB with PC polish, better than -50 dB with enhanced PC polish
Mating Durability	1000 cycles minimum per TIA/EIA-455-21
Temperature Cycling	-40°C to +65°C* per TIA/EIA-455-3
Operating Temperature Range	-54°C to +85°C*
Storage Temperature	-65°C to +85°C*
Corrosion Resistance	500 hours salt spray per TIA/EIA-455-16
Ozone Exposure	ASTM-D-1149, 100-150 PPM for 2 hours
Temperature Humidity	Per TIA/EIA-455-5, type 2
Crush Resistance	225 pounds per TIA/EIA-455-26
Maintenance Aging	10 contact insertions/removals per MIL-STD-1344, Method 2002
Terminus (Contact) Retention Force	22 pounds minimum per MIL-STD-1344, Method 2007
Cable Retention	400 pounds minimum per TIA/EIA-455-6 (depending on cable construction)
Cable Seal Flexing	100 cycles per MIL-STD-1344, Method 2017
Cable Twist	1000 cycles per TIA/EIA-455-36
External Bending Moment	50 ft-lb at mounting panel
Impact	Per TIA/EIA-455-2
Water Pressure Sealing	Up to 25 PSI for 48 hours
Fluid Immersion	24 hours per fluid, per TIA/EIA-455-12
Water Pressure Sealing	Up to 25 PSI for 48 hours
Fluid Immersion	24 hours per fluid, per TIA/EIA-455-12

*Temperature ranges listed above are limited by the fiber optic cable performance window.

DFOCA Product Profile



Delphi™ Fiber Optic Cable Assembly (DFOCA) Connectors are next-generation hermaphroditic fiber optic connectors engineered for harsh environments and military tactical applications. DFOCA Connectors are high performance, high quality connectors built in accordance to military specifications MILPRF-83526 and MIL-PRF-29504/16. These second generation connectors with genderless termini replace an original biconical termini design. This cable assembly is first-to-market with advanced design features that help simplify assembly and repair in the field, where time is critical. DFOCA Connectors feature an innovative internal subassembly that provides several advantages, including, reduced assembly complexity, fewer subcomponents, and quicker access to termini.

An innovative one-piece terminus insertion/removal tool is designed for ease of use and to help prevent fiber breakage. These features help make assembly and field repair easier, quicker and safer while still providing superior optical performance and reliability. DFOCA Connectors have a rugged design that withstands crush, impact, cable pull-out, water and mud immersion, and other harsh environments.

Benefits/Features

- Designed and built to MIL-PRF-83526
- Genderless connection
- Singlemode and multimode
- Removable endface
- Reduced assembly complexity
- Innovative one-piece insertion/removal tool

Typical Applications

- Tactical field communications
- Radar systems
- Missile defense systems
- Mobile launchers

Performance Characteristics

- Optical insertion loss:
 - 9/125 SM fiber: 0.25 dB avg.
 - 62.5/125 MM fiber: 0.6 dB avg.
- Operating temperature: -46°C to +71°C
- Mating durability: 2000 cycles
- Crush resistance: 450 lbs.

The performance characteristics above are for reference only and may not account for all the variables that would be present in an actual application. For detailed product performance information, contact an expert on www.winconn.com.

DFOCA Product Profile

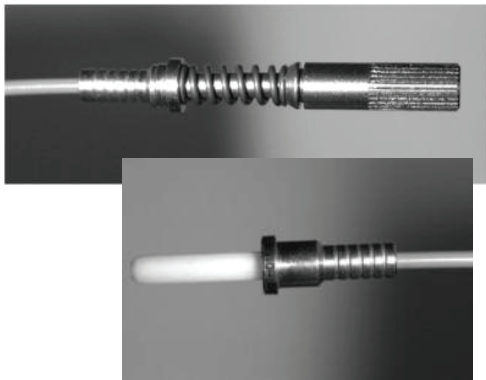


Connector Performance Criteria*

Description	Specifications
Optical Insertion Loss	9/125 SM Fiber – 0.4 dB avg., 62.5/125 MM Fiber – 0.3 dB avg.
Optical Back Reflection	Singlemode > -50 dB with UPC polish
Fiber Type	Singlemode and multimode
Ferrule	2.5 mm ceramic
Operating Temperature Range	-46°C to +71°C
Storage Temperature	-52°C to +85°C
Humidity Immersion	Per MIL-STD-1344, Method 2010, 5 cycles
Corrosion Resistance	500 hours salt spray per TIA/EIA-455-16
Mud	5 minute immersion, 10 cycles
Water Pressure	1 meter for 24 hours
Freezing Water Immersion	7 hour immersion
Mating Durability	2000 cycles minimum per TIA/EIA-455-21
Flammability	MIL-STD-1344, Method 1012
Vibration	Per MIL-STD-1344, Method 2005.1
Mechanical Shock	Per TIA/EIA-455-14, Condition A
Impact	Per TIA/EIA-455-2
EMI Shielding	> 60 dB
Crush Resistance	450 pounds per TIA/EIA-455-26
Cable Retention	400 pounds minimum per TIA/EIA-455-6
Cable Twist	1000 cycles per TIA/EIA-455-36
Cable Seal Flexing	100 cycles per MIL-STD-1344, Method 2017, Procedure 1

* Verification testing in progress

M29504/4 and /5 Product Profile



Delphi™ Flight Termini / MIL-PRF-29504/4 & /5 Style contain self-aligning termini which are the foundation of field proven fiber optic connectors. The self-aligning termini are available in a COTS (Commercial-Off-The-Shelf) version.

The fiber optic termini utilize constant pressure from a specially designed coil spring to help prevent termini separation resulting from shock, vibration or thermal cycling. The M29504 termini “float” within the connector and self-align to provide precise mating every time due to the unique shape of the ferrule and alignment sleeve hood.

Benefits/Features

- Designed to MIL-PRF-29504/4 & /5
- Available in Style 1 shrink sleeve or Style 3 crimp sleeve
- 1.58 mm ferrule
- Singlemode and multimode
- Improved terminus retention features

Typical Applications

- Military avionics
- Commercial avionics
- D38999 connectors

Performance Characteristics

- Optical insertion loss:
 - 9/125 SM fiber: 0.25 dB avg.
 - 62.5/125 MM fiber: 0.60 dB avg.
- Return loss (9/125 SM): 48 dB avg.
- Operating temperature: -55°C to +165°C
- Cable retention (Style 3): 50 lbs.

The performance characteristics above are for reference only and may not account for all the variables that would be present in an actual application. For detailed product performance information, contact an expert on www.winconn.com.

M29504/4 and /5 Product Profile

Optical Performance

Insertion Loss (IL) and Backreflection (BR) readings are heavily dependent on launch conditions and test setup. The figures below are actuals for overfilled source fibers at 1300 nm when standard setup and testing procedures are followed per TIA/EIA-455-171. Please consult the factory for information on additional fiber sizes.

Performance Criteria:

Operating Temperature	-67°F to +329°F (-55°C to +165°C)
Storage Temperature	-40°F to +185°F (-40°C to +85°C)
Terminus Engagement Force	30 oz. (8.3 N) Max. /5 only
Cable Pull Out Force	22 lbs. (98 N) Min.
Mating Durability	500 mating cycles, per TIA/EIA-455-6
Maintenance Aging	10 insertion/removal
Weight	1.0 gram maximum
Salt Spray	TIA/EIA-455-16, Test Condition C
Mechanical Shock	MIL-S-901, Grade A, Type B, Class I
Vibration, Sine and Random	Sine vibration, 60 G @ ambient temperature, per MIL-DTL-38999
Thermal Shock	-55°C to +165°C, per TIA/EIA-455-71, Schedule C-0 (5 cycles)
Temperature Life	165°C for 1,000 hours, per TIA/EIA-455-4

Optical Performance Average Insertion Loss (IL):

Fiber Size	Average Insertion Loss
9/125	-0.25 dB
62.5/125	-0.60 dB

Backreflection (BR) – Singlemode:

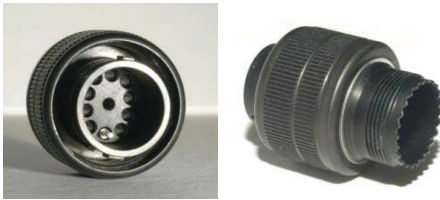
Better than -40 dB – PC polish

Better than -50 dB – enhanced PC polish

Standard Materials and Finishes:

Description	Material	Finish
Terminus Body	Stainless Steel	Passivated
Alignment Sleeve	Zirconia	None
Alignment Sleeve Hood	Stainless Steel	Passivated
Ferrule (bushing)	Zirconia	None
Spring	Stainless Steel	Passivated

M64266 NGCon Product Profile



New Standard for High Density Fiber Optic Interconnect Applications

NGCon connectors combine proven technology from M28876 and D38999 designs.

Benefits/Features

- Designed to meet the requirements of MIL-PRF-64266
- Removable Alignment Sleeve Retainer (ASR) for easy cleaning of terminations on both sides of the connector
- Tighter mechanical tolerances than D38999, allowing interoperability
- High density arrangements available
- Removable genderless design
- Rear insertion/ rear release
- 1.25 mm ferrules
- Singlemode and multimode capability
- Captive alignment sleeves
- Environmental sealing on the termini
- Allows for multiple backshell designs, many styles and configurations available off the shelf.

Typical Applications

- Maritime
- Aerospace
- Industrial

M64266 NGCon Product Profile

Optical Performance

Insertion Loss (IL) and Backreflection (BR) readings are heavily dependent on launch conditions and test setup. The figures below are actuals for overfilled source fibers at 1300 nm when standard setup and testing procedures are followed per TIA/EIA-455-171. Please consult the factory for information on additional fiber sizes.

Performance Criteria:

Terminus Retention Force	22 lbs. (98 N)
Cable Pull Out Force	162 lbs. (720.3 N) Min.
Mating Durability	500 mating cycles, per TIA/EIA-455-6
Thermal Shock	TIA/EIA-455-71, Schedule C (5 cycles)
Temp./Humidity Cycling	TIA/EIA-455-5, Method B
Temperature Cycling	TIA/EIA-455-3
Life Aging	TIA/EIA-455-4
Freezing Water Immersion	TIA/EIA-455-98, Method A, Procedure 1
Sand and Dust	TIA/EIA-455-35
Electromagnetic Effects	IEEE-299, from 100-18,000 MHz
Fluid Immersion	TIA/EIA-455-12
Salt Spray	TIA/EIA-455-16, Condition I
Flammability	EIA-364-81
Fungus Resistance	TIA/EIA-455-56
Ozone Exposure	TIA-455-189
Vibration	Shipboard, TIA/EIA-455-11, Test Condition II, IV & VII
Shock	Shipboard, MIL-S-901, Grade A, Class I. Aerospace, EIA-364-27, Condition D (300 G, 3 ms)
Water Pressure	32 ft. (9.8 m) for 48 hours
Shell to Shell Conductivity	EIA-364, Method 83
Altitude Immersion	EIA-364, Method 3

Optical Performance Average Insertion Loss (IL):

Fiber Size	Average Insertion Loss
9/125	-0.25 dB
62.5/125	-0.60 dB

Backreflection (BR) – Singlemode:

Better than -40 dB – PC polish
Better than -50 dB – enhanced PC polish

Standard Materials and Finishes:

Description	Material	Finish
Connector and Backshell Housings	Per MIL-PRF-NGCon	Per MIL-PRF-NGCon
Boot, Strain Relief	Fluorosilicone	None
Terminus Cavity Insert	Per MIL-PRF-NGCon	Per MIL-PRF-NGCon
Alignment Sleeve Retainer (ASR)	Per MIL-PRF-64266	Per MIL-PRF-64266
Terminus Body	Stainless Steel	Passivated
Alignment Sleeve	Zirconia	None
Ferrule (bushing)	Zirconia	None
Retaining Clip	Stainless Steel	Passivated
Spring	Beryllium Copper	None
O-Ring Seal	Fluorosilicone	None



RF & Microwave
Fiber Optics
Custom Cable
Multi-pin
Hermetic Solutions
Cable Assemblies

Interconnect Solutions That Fuel Customer Success

At Winchester Interconnect, we believe that design creativity and streamlined execution can solve any connectivity challenge.

We are passionate about helping to deliver the power and data your designs need when failure is not an option. We focus on designing and delivering precision-engineered interconnect solutions for your exact needs, whatever your design challenge.

Winchester Product Brands

Stronger and more unified, Winchester Interconnect now offers solutions under four powerful product brands. Be assured that all of the solutions you rely on today are available from Winchester Interconnect.

For more information on Delphi™ branded connectors and assemblies, talk to your current sales expert or visit winconn.com/brands.

