

# RUGGEDIZED HIGH-DENSITY OPTICAL INTERCONNECTS > FOR HARSH ENVIRONMENTS





## Capabilities

### Molex Fiber Optics Capabilities

- **Diverse product mix**
  - Standard - ST, FC, SC, LC, MPO connectors Loop backs, attenuators
  - Ruggedized - LC, 38999, 28876, Circular MT, Array, Optical D-sub, Industrial LC, SC and MPO, mechanical splices
  - Optical flex circuits
  - Optical shuffles
  - Back plane (blind mate) solutions
- **Support**
  - In-house customer and technical support, product management, program management, engineering and manufacturing
- **Customized solutions**
  - Cables
  - Interconnect
  - Hardware
  - Testing
- **Vertically integrated**
  - Connector, cable assembly and specialty fiber engineering

### Design and development

- **Connectors**
  - Industry standards, custom solutions
- **Bulkhead adapters**
  - Industry standards, custom, EMI containment, sealed
- **Cable assemblies**
  - Standard and custom. Telecom, Datacom, Industrial and Mil/Aerospace
- **Fibers and capillary tubing**
  - Specialty and Custom products - large core fibers, rad-hard deep UV fibers, precision glass capillaries

### Manufacturing

- **Prototyping**
- **Molding**
- **Machining**
- **Automated fiber laying/routing**
- **Fiber manufacturing**
- **Connectors**
- **Adapters**
- **Cable assemblies**
- **Testing**
- **Global locations**

## Ruggedized High-Density Optical Interconnects for Harsh Environments



## Applications

### Telecommunications

- Base stations
- Vault I/Os
- Wireless antennas
- Video transmission

### Military/aerospace

- Avionics
- Communications
- Satellites
- Data terminals
- Remote antennas
- Signal processors
- Data switches
- Sensors
- Space systems
- Vacuum systems

### Industrial

- Oil exploration
- Factory automation/networking
- Sensors
- Process equipment
- Security cameras
- Mining

### Commercial Vehicles

- Over road
- Agriculture
- Heavy equipment

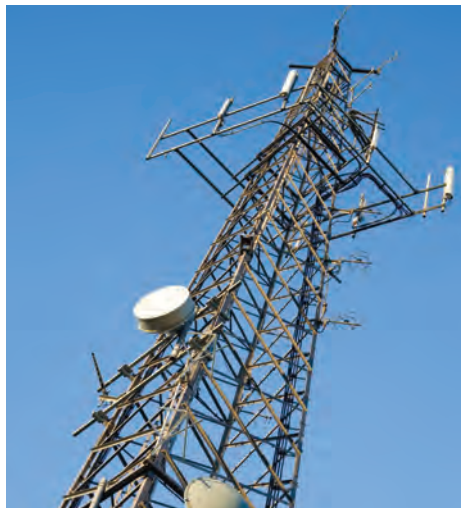
### Medical

- Operating rooms
- Diagnostic equipment

# molex®

## Applications

## Fiber Optics Product Capabilities



### Diverse Product Mix

- **Cable assemblies based on these connector types:**
  - Expanded Beam
  - MXL38999 (high density)
  - MIL-DTL-38999
  - Circular MT
  - Industrial LC
  - Industrial MT
  - QMD
  - LC2+
  - 28876
  - Hermaphroditic
  - TFOCA
  - Hermetic Sealed Circular MT
  - Others on request
- **Support**
  - In-house customer technical support, product management, program management, engineering and manufacturing
- **Customized solutions**
  - Molex is open to discussing and providing unique cabling products. Bring us your needs and we will work with you to develop a well designed solution.



MXL38999 (high density)



MT Xtreme

### Design and Development

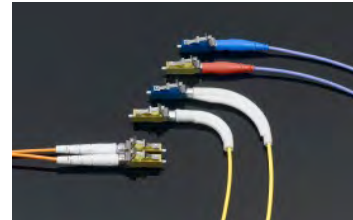
- **Cable Assemblies**
  - Standard and custom: For Telecom, Datacom, Industrial and Aerospace/Defense

### Manufacturing

- **Prototyping**
- **Testing**
- **Global locations**



Industrial LC



LC2+



Hermetic Sealed Circular MT



TFOCA



## Achieve installation and maintenance simplicity for rugged embedded VPX MIL/AERO backplane applications with the VITA 66.1 Ruggedized Optical MT Backplane Interconnect System

The VITA 66.1 Ruggedized Optical MT Backplane Interconnect System is designed to meet the ANSI ratified VITA 66.1 specification for VPX architecture. VPX (previously known as VITA 46 — an ANSI standard), provides component- and system-design recommendations to ensure compliance in military defense and other applications.

VITA 66 defines the optical requirements for VPX architecture. Molex's VITA 66.1 Ruggedized Optical MT Backplane Interconnect System, available with two industry standard MT termini styles, is designed for blind-mate backplane applications that require optically robust interfaces with simple accessibility (no need for hand tools) to streamline MT assembly installation or regular maintenance. The anodized aluminum-based housings provide a rugged solution for use in the designated VPX card space as determined by the standard, or can be used as a stand-alone solution outside of the VPX architecture.

## VITA 66.1 Ruggedized Optical MT Backplane Interconnect System

**106601** Daughtercard Connector, Backplane Receptacle



VITA 66.1 Ruggedized Optical MT Backplane Interconnect System

### Features and Benefits

Fully compliant with the ANSI-ratified VITA 66.1 specification	Ensures complete design and function compatibility with specification
Patented MT ferrule-carrier design enables field servicing without hand tools	Provides access for installation and maintenance with no service tools required. Reduces installation and maintenance time plus associated costs
Robust housing with heavy-duty anodized aluminum construction and VITA 66.1 compliant footprint	Ideal for rugged military and non-automotive commercial applications. Withstands extreme temperature ranges
Supports up to two (2) floating MT ferrules (termini)	Aids in proper mating in blind-mate applications
MT termini available in 8, 12 or 24 fibers in standard multimode and singlemode or VersaBeam™ (expanded beam MT)	Provides design flexibility with multimode and singlemode compatibility
Planned intermatibility with competitors' products	Anticipated second source option

### Specifications

#### Reference Information

Packaging: Bag

Mates With:

Daughtercard Connector Mates With:  
Backplane Receptacle  
(106601-1050)

Backplane Receptacle Mates With:  
Daughtercard Connector  
(106601-1150)

Use With:

MT (Series 106283) and VersaBeam™  
(Series 106268) Cable Assemblies

Designed In: Millimeters

RoHS: Yes

Halogen Free: Yes

#### Mechanical

Insertion Force to PCB:  
10Nm per MT (20Nm total)

Mating Force:  
10Nm per MT (20 Nm total)

Unmating Force:  
< 10Nm per MT (<20 Nm total)

Durability (min.): 500 mating cycles

#### Physical

Housing: Aluminum

Contact: Precision plastic

Plating: Clear Anodized

PCB Thickness (max.): 4.75mm

Operating Temperature:

MT Ferrule: -55 to +105°C

VersaBeam Ferrule: -10 to +60°C



## High-density Circular MT Optical Cable Assemblies are designed for critical, high-reliability applications

Molex’s rugged, high-density circular MT cable assemblies are designed to meet requirements mandated by telecommunication, military, medical and many other industries. Utilizing the low-profile Circular MT connector, these cable assemblies are designed to meet or exceed the mechanical specifications of traditional datacommunication and telecommunication inter-chassis connections.

The Circular MT assemblies use a single MT ferrule housed in a nickel-plated, metal-connector shell. Fiber counts range from 12 to 72 fibers. The metal housing and stainless steel push-pull locking ring provide a more robust design than the current industry standard MPO connector polymer housings and latches. The MT ferrule is recessed in both the circular connector and receptacle housings, providing an additional improvement over traditional MT connectors. Recessing the ferrule ensures it is scoop-proof, preventing damage to the precise MT alignment pins and ferrule endface during handling and mating of the connector.

The circular MT receptacle housing features a deep, polarized mating cavity which will reduce alignment pin hole damage that may occur during the mating process with traditional MT connector systems.

Molex’s circular MT cable assemblies offer a more robust MT ferrule-based interface versus ribbon-based optical interfaces, which have traditionally been rectangular. This new design ensures improved alignment benefits, increased pull strength and the use of new round, ribbon-cable constructions. Circular MT connectors will be sold only as terminated cable assemblies.

Circular MT Cable Assemblies complement Molex’s existing line of MT products. For more information on Molex’s extensive optical product offering, please visit: [www.molex.com/fiber](http://www.molex.com/fiber).

## Circular MT Optical Cable Assemblies

1062751-by-3 Circular MT



Lensed MT



1-by-3 Circular MT Connector and Adapter

## Features and Benefits

MT ferrules are recessed in the connector and receptacle housings ensuring scoop-proof mating which prevents damage to alignment pins and ferrule endface	Standard MT ferrules which provide an industry standard interface with high density and reliable performance
Aluminum connector and receptacle housings provide a robust interconnect with exceptional pull strength	19.05mm (.750”) diameter receptacle features a small footprint and similar size to industry standard MPO connector
Electro Magnetic Interference (EMI) gasket	Designed for round, multi-fiber jackets providing improved fiber management

## Specifications

### Reference Information

Packaging: Custom per assembly

### Optical

Ferrule Type: MT Ferrule

Fiber Density: 12 to 72 fibers

Fiber Type:

Single mode: 9/125µm

Multimode: 50/125µm or

62.5/125µm

Insertion Loss:

Single mode:

8 Fiber: 0.12 dB typical <0.5dB max.

12 Fiber: 0.15 dB typical <0.75dB max.

24 Fiber: 0.20 dB typical <0.75dB max.

Multimode:

12 Fiber: 0.15 dB typical <0.5dB max.

24 Fiber: 0.22 dB typical <0.75dB max.

36 Fiber: 0.30 dB typical <1.0dB max.

72 Fiber: 0.35 dB typical <1.25dB max.

### Mechanical

Operating Temperature Range:

-5 to +75°C

Durability: 200 matings

### Physical

Housing: Nickel-plated aluminum



## Delivering extreme sealing performance in the industry's smallest footprint, Molex's Hermetic-Sealed Multi-Fiber Circular MT Optical Assemblies provide system reliability in harsh environments

Extreme environments including severe weather conditions, high altitudes and atmospheric pressure can cause critical surveillance and sensor equipment to fail. Hermetic sealing for fiber optic connections has historically been limited to large, single-channel applications and until now unavailable in a high-density, reduced-footprint, multi-channel option. Molex's Hermetic-Sealed Multi-Fiber Circular MT Optical Assemblies, designed for critical user applications where long-term system reliability in harsh environments is paramount, ensure industry-leading gas-tight-sealing for superior performance.

### Features and Benefits

Multi-fiber MT interface with 12 to 24 flat-ribbon fiber counts	Provides the industry's densest fiber count in a compact hermetic interface for maximum data transfer. Ideal for tight panel configurations
Sealing rates to $1 \times 10^{-6}$ helium (He) cc/sec at one atmosphere differential pressure	Ideal for exposure to gases, liquids, dust and other extreme environmental factors
Stainless steel connector housings	Provides durability and corrosion resistance
Singlemode and multimode fibers options	Offers a choice between long- and short-distance transmissions with associated costs

## Hermetic-Sealed Multi-Fiber Circular MT Optical Assemblies

**106503** Hermetic Circular MT Plugs and Receptacle Cable Assemblies



Hermetic-Sealed Multi-Fiber Circular MT Optical Assemblies  
A) Receptacle Assembly  
B) Plug Assembly

### Specifications

#### Reference Information

Packaging: Box  
Mates With: Hermetic Circular MT Plug or Receptacle  
RoHS: Yes, Compliant by Exemption

#### Optical

Ferrule Type: MT  
Fiber Density: 12 to 24 fibers  
Fiber Type: Singlemode: 9/125 $\mu$ m  
Multimode: 50/125 $\mu$ m or 62.5/125 $\mu$ m

#### Insertion Loss:

Singlemode:  
12-fiber: 0.15 dB typical <0.75dB max.  
24-fiber: 0.20 dB typical <0.75dB max.  
Multimode:  
12-fiber: 0.15 dB typical <0.5dB max.  
24-fiber: 0.22 dB typical <0.75dB max.

#### Mechanical

Durability: 200 mating cycles

#### Physical

Housing: Stainless Steel  
Contact: MT ferrule  
Operating Temperature: -40 to +70°C



**Designed with rugged and compact housings, Molex's optical industrial cable assemblies incorporate the high-performance of a fiber optic connection with the versatility of a rugged industrial connector and are ideal for harsh industrial environments**

Molex industrial cable assemblies provide an environmentally sealed optical connection for harsh environments. Plus, the assemblies guarantee an easy, one-step connection system with the combined push-pull insertion and bayonet-style mechanical latch.

The industrial panel-mount, plastic adapters serve as a sealed feed-through for the fiber connection. The industrial metal body adapters offer a more robust means of interconnection on outdoor nodes and enclosures over their plastic counterparts meeting Spec GR3120. The new industrial integrated flange-mount adapters are designed for tight, side-by-side applications. A single shutter, available in plastic or metal, is secured inside the adapter to cover both LC duplex ports and provide dust and laser protection for the internal fiber connection.

Molex's optical metal- and plastic-body industrial assemblies are compatible with many fiber types and cable constructions; assemblies are ideal for both indoor and outdoor applications. These assemblies are particularly well-suited for long distances or remote connections using either single mode or multimode fiber. The optical industrial assemblies are available in simplex SC, duplex LC (metal-body is currently only available in LC duplex) and multi-fiber MPO versions. Each assembly offers a sealed fiber optic connection to fit many applications, from bi-directional single fiber up to 12-fiber ribbon connections. Assemblies are available in pigtailed (single-ended), jumpers (dual-ended) and breakout assemblies, to any Molex standard fiber optic connector. The optical industrial assemblies can be manufactured in lengths from 1.0 meter to well over 1.0 kilometers.

The industrial duplex LC assembly has been ratified as a 'Standard Interface' in the ODVA\* (Open DeviceNet Vendors Association) as a next-generation industrial interconnect.

## Features and Benefits

Provides moisture and dust protection for use in harsh industrial environments; housing is NEMA 6P and IP67 rated

Sealed panel feed-through design for easy installation into enclosures

100% optically tested to ensure quality performance assemblies

Available in single mode and multimode styles to work with any common fiber type

Metal body LC connectors have been tested to GR-486, salt and fog exposure for extreme environments

Push-pull insertion with bayonet-style mechanical latch provides easy installation and removal

Broad temperature range (-40 to +85°C) is ideal for indoor or outdoor applications

## Optical Industrial Cable Assemblies and Adapters: LC Duplex, SC, MPO

106059 Industrial Connectors: LC Duplex, SC Simplex, MPO Multi-Fiber

106059 Industrial Adapters Panel Mount: LC Duplex, SC Simplex, MPO Multi-Fiber

106501 Integrated Industrial Adapters Flange Mount: LC Duplex



Metal Body, LC Duplex (for single-mode or multi-mode fiber)



Metal Body LC Industrial connector and adapter (shown with plastic Industrial LC version)

## Applications

### Reference Information

Packaging: Cable Assemblies:

Individual bag or spool

Adapters: Individual bag

Mates With: Standard LC, SC, or MPO assemblies (respectively)

Designed In: Inches

### Optical

Insertion Loss:

Single mode <0.35dB max. (0.13dB typical)

Multimode <0.50dB max. (0.10dB typical)

Return Loss: Single mode 45 to 55dB

Wavelength:

Single mode 1310 or 1550nm

Multimode 850 or 1300nm

### Physical

Housing: Polymer or metal

Ferrule: Zirconia Ceramic

Cable Type: Indoor or outdoor

Fiber Type: Single mode or multimode

Fiber Count: Duplex or simplex

Operating Temperature: -40 to +85° C

\*DeviceNet is a trademark of Open DeviceNet Vendor Association (ODVA)





**Molex offers the industry's only metal-housing LC2+ connectors, the ideal high-performance, discrete-fiber solution for use in severe operating environments in industrial, telecom, military and medical applications**

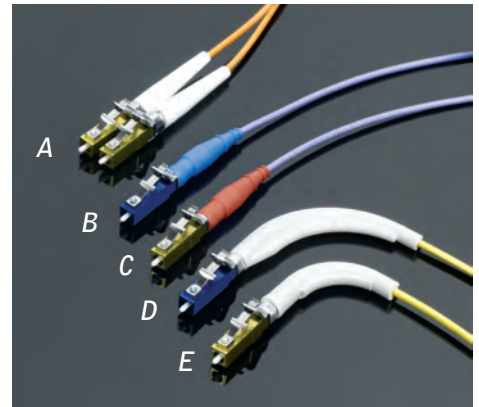
LC2+ connectors are available in three versions (standard, high-temperature and sealed), to provide customers with design flexibility. LC2+ metal connectors feature an enhanced latch for improved latch retention which is important in high-shock and vibration environments. Various strain-relief boots are available to address cable-routing issues. LC2+ connectors are designed to support the Enhanced Performance (EP) aerospace-grade optical cabling, available from cable manufacturing vendors.

The standard LC2+ connector is a metal body and latch version of the popular industry-standard LC connector system and is fully compatible with all LC form factor connectors, adapters, active devices and tooling. High-temperature LC2+ connectors will support long-run operating temperatures up to +150°C to withstand harsh operating environments that the legacy plastic-body LC interconnects could not handle. The LC2+ sealed connectors are available with an internal O-ring that seals to the internal part of an adapter or active device, along with a special strain-relief boot that seals the rear of the connector and around the optical cabling to protect against moisture propagation.

LC2+ connectors are the next-generation solution to the highly popular LC connector interface. The LC2+ interface is found on many active devices (LED and laser-based) in common equipment applications related to telecom (i.e. antennas), premise wiring, industrial, military, aerospace and medical industries. In addition, LC2+ connectors meet all FOCIS 10 specifications.

**LC2+ Metallic Optical Connectors**

106397



LC2+ Connectors:  
 A = Duplex,  
 B = Sealed,  
 C = High temperature,  
 D = Standard, singlemode with 90° boot,  
 E = Standard multimode with tight bend radius 90° boot

**Features and Benefits**

High-temperature metal body withstands long-run operating temperatures up to +150°C and withstands extended severe shock and vibration exposure without risk of breaking

Enhanced latch gives improved latch retention in severe shock and vibration situations

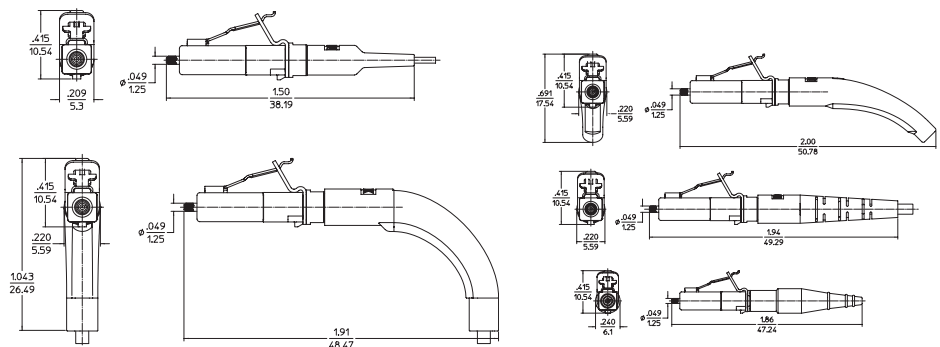
Sealing O-ring and strain-relief boots protect from moisture propagation through the connector to expensive devices

Multiple strain-relief boot styles available support many cable sizes and applications including 900µm buffered fiber, 1.20mm (.047"), 1.60mm (.063"), 1.80mm (.070") and 2.00mm (.079") jacketed cable and 45° and 90° strain-relief routing configurations

Simplex, duplex, singlemode and multimode versions with industry standard colors provides a variety of options to suit many applications

**Specifications**

- Reference Information
- Packaging: Bag
- Ferrule: Zirconia Ceramic
- Plug Body: Metal
- Outer Body Materials: Metal
- Standard Strain Relief Boots:
  - Straight, 45°, 90°
- Operating Temperature: 150° C
- Sealed - straight, flourosilicone
- Standard Fiber Jacket Sizes:
  - 900µ, 1.60mm, 2.00mm, 3.00mm



**Optical Performance**

Parameter	SM UPC	APC SM	MM
Insertion Loss (db typ.)	0.25	0.35	0.20
Return Loss (db typ.)	50	65	30



# MXL38999 Circular Optical Connectors

## MXL38999 All Optical Circulars

Our all-optical version of the popular MIL-DTL-38999 Series III connector system uses the Molex LumaCore™ optical terminus technology to deliver dense optical connections with stable optical performance into harsh environments. It is available in all standard shell materials and platings.

MXL38999 introduces the first full range of all optical MIL-DTL-38999 connectors designed specifically for singlemode APC applications. This high level of design integrity enables the connector system to deliver superior optical performance across all optical fiber applications including UPC polish singlemode and multimode fibers.

MXL38999 connectors include precision-machined and plated metallic inserts. Without plastic distortions found in other 38999 connector designs, the MXL38999 connector can deliver stable optical performance across broad temperature ranges. The durability of the connector is further enhanced with a removable alignment sleeve holder. This enables mass cleaning and inspection of the installed LumaCore terminus on both the plug and receptacle.



## Features and Benefits

Unique 1/8-turn retention feature allows LumaCore terminus to be installed and removed from the rear of a connector solution with a simple push and turn

Metallic inserts enhance EMI performance of the connector when installed into enclosures

Receptacles available in both jam nut and flange-mount configuration with geometry per MIL-DTL-38999

Plug connectors include an anti-vibration ratchet mechanism in the triple start acme thread coupling ring

Available in aluminum and stainless steel construction

Color banding and product marking are available to customer specifications

Removable alignment sleeve assembly for ease of maintenance and cleaning

Suitable for multimode and singlemode applications - PC, UPC and APC end face geometry capable

Precision stainless steel guide pins ensure accurate optical cavity alignment, during and after mating

MIL-DTL-38999 Series III plug to receptacle sealing and accessory threads are standard

Available with full interfacial seal surrounding each terminus for added moisture protection

## Specifications

### PERFORMANCE CHARACTERISTICS

See LumaCore Optical Terminus

### REFERENCE INFORMATION

Body Materials: Aluminum Alloy (Olive Drab Cadmium or Nickel Plated) Stainless Steel (Passivated)

Shell Certifications: QPL per DSCC MIL-DTL-38999 Series III

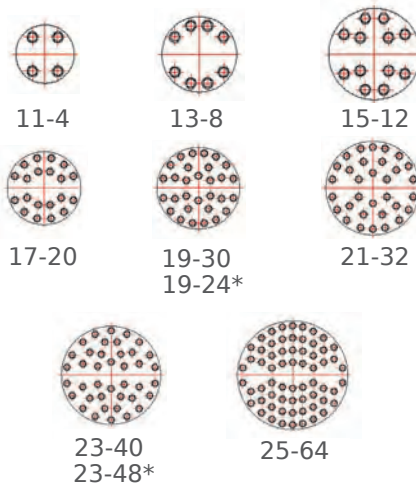
Insert Material: Plated Aluminum Alloy

Guide Pins: Precision-Ground Stainless Steel

Alignment Sleeves: Zirconia Ceramic

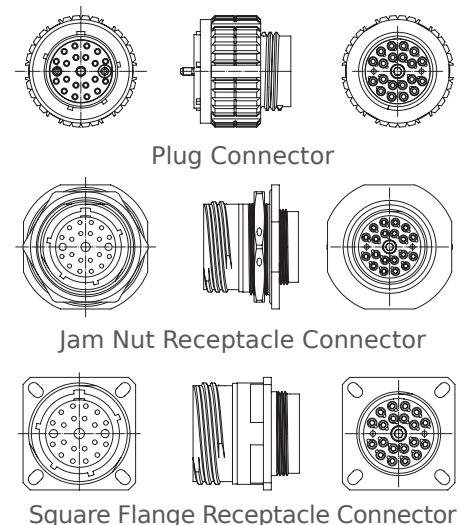
Sealing Gasket: Fluorosilicone Elastomer

External Dimensions: per MIL-DTL-38999 Contact Molex for external and mounting dimensions



Standard Cavity Layouts (Shell Size Cavities)

\*Optional cavity layouts



Square Flange Receptacle Connector

\* Additional shell size options

### LumaCore™ Technology Shining Through

The COTS (Commercial Off the Shelf) LumaCore terminus from Molex provides a high-performance discrete fiber optic interconnect solution that can be packaged into a number of connector formats. LumaCore products deliver high density solutions with the ease of service and maintainability available in familiar LC or MU solutions. Customers can design systems from backplanes to front panels with a common optical terminus.

LumaCore products use industry-standard 1.25mm Zirconia ceramic ferrules making a full range of support equipment instantly available. The terminus can be specified for use with either small or large core optical fibers. LumaCore products are terminated to optical fiber meeting the latest industry standards such as Telcordia GR-326-CORE.



### Features and Benefits

Unique 1/8-turn retention feature allows the terminus to be installed and removed from a connector solution with a simple push and turn

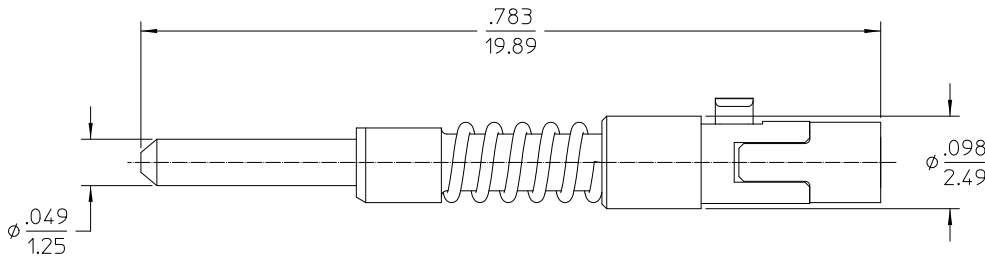
1.25mm precision Zirconia ceramic ferrule is available with a broad range of ferrule hole sizes from 80 to 650 microns

All retention features are integrated on-board the terminus assuring simplicity and reliability in final connector products

Suitable for singlemode and multimode applications  
- PC, UPC and APC end face geometry capable and plastic optical fiber (POF)

Available in a large array of connector configurations including circular MIL-DTL-38999, D-subminiature, backplane mount and custom applications

### Specifications



#### REFERENCE INFORMATION

Ferrule: Zirconia Ceramic  
Body Materials: Copper Alloy  
Plating: Gold/Nickel  
Spring: Stainless Steel

#### OPTICAL PERFORMANCE

Parameter	SM UPC	APC SM	MM
Insertion Loss (db typ.)	0.25	0.35	0.20
Return Loss (db typ.)	50	60	25



## Design Flexibility Sets Molex Apart

Molex can design new connector configurations or modify nearly any existing connector to become a high performance optical solution. Call us to find out about our latest developments or visit our website at [www.molex.com/fiber](http://www.molex.com/fiber). Molex continues to innovate to customer demand on a daily basis.

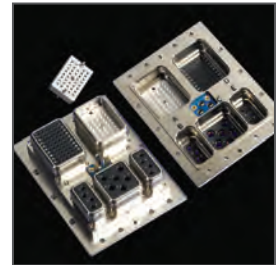
Examples of our newest products include:

### OPTICAL ARINC

Molex has designed and manufactured inserts with various termini densities from 32 to 72 fibers for ARINC connectors. Features such as precision alignment pins and removable sleeve assemblies to simplify inspection and cleaning are enabling ARINC connectors to finally deliver high density and stable optical performance in harsh environments. The ARINC inserts are designed to mount in the ARINC frame cavity of your choice and are provided with the insert mounting hardware.

## LumaCore™ Multi-Fiber Specialty Connectors

Optical ARINC



Get more insight at: [molex.com/fiber](http://molex.com/fiber)