ITT

Electronic Components

Cannon & VEAM Fiber Optics Products and Design Guide

Engineered for life

High Performance Fiber Optics Connectors

ITT Electronic Components is a division of the multi-national ITT Corporation a $7.5 billion dollar global enterprise. Our extensive portfolio offers the most reliable and cost effective range of interconnect solutions. These innovations have enabled ITT to provide products and technologies to such markets as:

- Aerospace
- Computers Systems
- Defense Electronics
- Geophysical
- Industrial Automation
- Medical Electronics
- Network Systems
- Telecom Switching
- Underwater Systems
- Wireless

Offering the broadest selections of standard and custom fiber optic interconnect solutions, ITT is the one stop source for design, development, manufacturing, and testing of sophisticated connectors.

The Standard of Six Sigma

When you specify a Cannon fiber optic connector, you can rely on a product designed, developed, and manufactured to the highest quality and reliability standards in the industry. This tradition of excellence is based on ITT's corporate culture of operating its entire business under the principles of Six Sigma. At ITT, Six Sigma is not just a quality philosophy but a complete corporate culture that drives the entire business. Our Value Based Management and Value Based Product Development systems are two cornerstones of ITT that allows for the development of both leadership and product development principles, ensuring that the correct industry leading products are developed to the accepted market driven lead times. These principles have allowed ITT to become the market leader in all of our business portfolios.

Six Sigma Engineering

ITT, utilizing its six sigma tools and multiple lean initiatives, offers the most experienced engineering design team. ITT operates a world class test lab offering state of the art capabilities in electronic, fiber optic, and mechanical test expertise . Our certified test engineers and technicians can develop a specific test plan based on our customer's specific needs. Additionally, our team is experienced in providing test services and programs for US DOD Defense electronics and Space related programs.

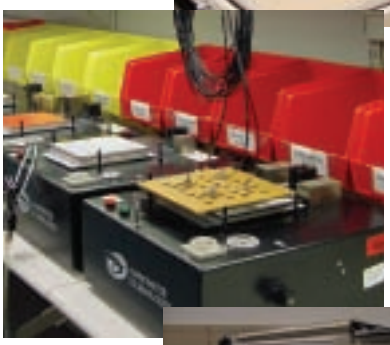
Six Sigma Manufacturing

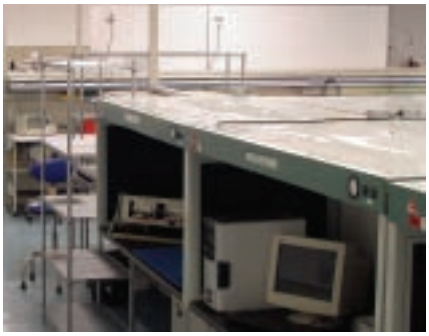
ITT operates manufacturing facilities in the United States, France, Germany, Italy, Mexico, China, and the UK, all of which have particular product area strengths allowing ITT to offer a truly global footprint to our customers. Our facilities are world class and accommodate full vertical integration with the latest manufacturing technologies including: automated and robotic machining centers, Super Market manufacturing cells, Kanban pull systems, and automated electrical, mechanical, and optical test and inspection equipment.

The Custom Difference

ITT's world class engineering teams will work directly with our customers to design and develop cost effective solutions for their applications . In many cases we may modify one of our standard designs to ensure a highly reliable solution where timing is critical. Yet, in those cases where a complete custom interconnect solution is required, ITT will work with our customer's Engineers to design an interconnect solution which will be cost effective yet highly reliable.

In addition to custom connectors, ITT offers sophisticated custom cable assembly capabilities for a wide range of applications. Our in house expertise translates to our ability to integrate different technologies within a custom cable harness.





Design Guide

Product Catalog

Section 1: Introduction to Fiber Optics and Optical Interconnection Technology

1. From Theory to Practical Application: A Quick History Of Fiber Optics

An important principle in physics became the theoretical foundation for optical fiber communications: light in a glass medium can carry more information over longer distances than electrical signals can carry in a copper or coaxial medium.

The first challenge undertaken by scientists was to develop a glass so pure that one percent of the light would be retained at the end of one kilometer (km), the existing unrepeatered transmission distance for copper-based telephone systems. In terms of attenuation, this one-percent of light retention translated to 20 decibels per kilometer (dB/km) of glass material.

Glass researchers all over the world worked on the challenge in the 1960s, but the breakthrough came in 1970, when Corning scientists Drs. Robert Maurer, Donald Keck, and Peter Schultz created a fiber with a measured attenuation of less than 20 dB per km. It was the purest glass ever made. The three scientists' work is recognized as the discovery that led the way to the commercialization of optical fiber technology. Since then, the technology has advanced tremendously in terms of performance, quality, consistency, and applications.

Working closely with customers has made it possible for scientists to understand what modifications are required, to improve the product accordingly through design and manufacturing, and to develop industry-wide standards for fiber.

The commitment to optical fiber technology has spanned more than 30 years and continues today with the endeavor to determine how fiber is currently used and how it can meet the challenges of future applications. As a result of research and development efforts to improve fiber, a high level of glass purity has been achieved. Today, fiber's optical performance is approaching the theoretical limits of silica-based glass materials. This purity, combined with improved system electronics, enables fiber to transmit digitized light signals well beyond 100 km (more than 60 miles) without amplification. When compared with early attenuation levels of 20 dB per km, today's achievable levels of less than 0.35 dB per km at 1310 nanometers (nm) and 0.25 dB per km at 1550 nm, testify to the incredible drive for improvement.

2. How Optical Fiber Works

The operation of an optical fiber is based on the principle of total internal reflection. Light reflects (bounces back) or refracts (alters its direction while penetrating a different medium), depending on the angle at which it strikes a surface.

One way of thinking about this concept is to envision a person looking at a lake. By looking down at a steep angle, the person will see fish, rocks, vegetation, or whatever is below the surface of the water (in a somewhat distorted location due to refraction), assuming that the water is relatively clear and calm. However, by casting a glance farther out, thus making the angle of sight less steep, the individual is likely to see a reflection of trees or other objects on an opposite shore. Because air and water have different indices of refraction, the angle at which a person looks into or across the water influences the image seen.

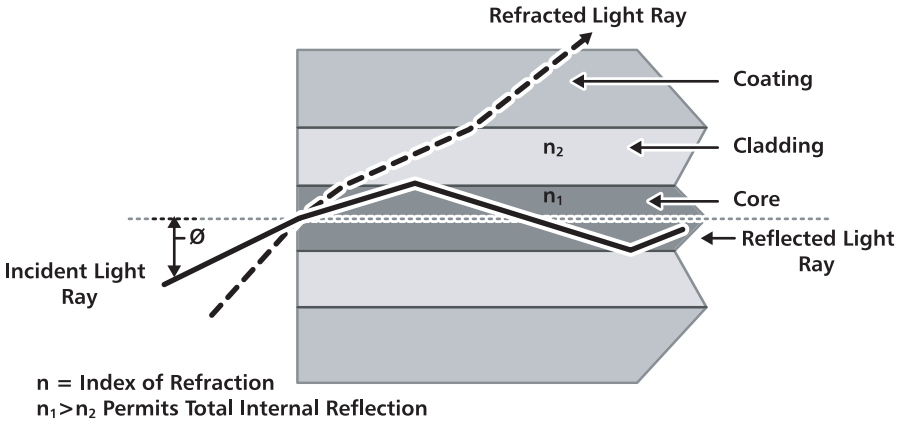
This principle is at the heart of how optical fiber works. Lightwaves are guided through the core of the optical fiber in much the same way that radio frequency (RF) signals are guided through coaxial cable. The lightwaves are guided to the other end of the fiber by being reflected within the core. Controlling the angle at which the light waves are transmitted makes it possible to control how efficiently they reach their destination. The composition of the cladding glass relative to the core glass determines the fiber's ability to reflect light. The difference in the index of refraction of the core and the cladding causes most of the transmitted light to bounce off the cladding glass and stay within the core. In this way, the fiber core acts as a waveguide for the transmitted light.

The Design of Fiber

Core, Cladding, and Coating

An optical fiber consists of two different types of highly pure, solid glass, composed to form the core and cladding. A protective acrylate coating (see Figure 1) then surrounds the cladding. In most cases, the protective coating is a dual layer composition.

Figure 1. Core, Cladding, and Coating



A protective coating is applied to the glass fiber as the final step in the manufacturing process. This coating protects the glass from dust and scratches that can affect fiber strength. This protective coating can be comprised of two layers: a soft inner layer that cushions the fiber and allows the coating to be stripped from the glass mechanically and a harder outer layer that protects the fiber during handling, particularly the cabling, installation, and termination processes.

Singlemode and Multimode Fibers

There are two general categories of optical fiber: singlemode and multimode (see Figure 2).

Figure 2. Singlemode and Multimode Fibers

Multimode fiber was the first type of fiber to be commercialized. It has a much larger core than singlemode fiber, allowing hundreds of modes of light to propagate through the fiber simultaneously. Additionally, the larger core diameter of multimode fiber facilitates the use of lower-cost optical transmitters (such as light emitting diodes [LEDs] or vertical cavity surface emitting lasers [VCSELs]) and connectors.

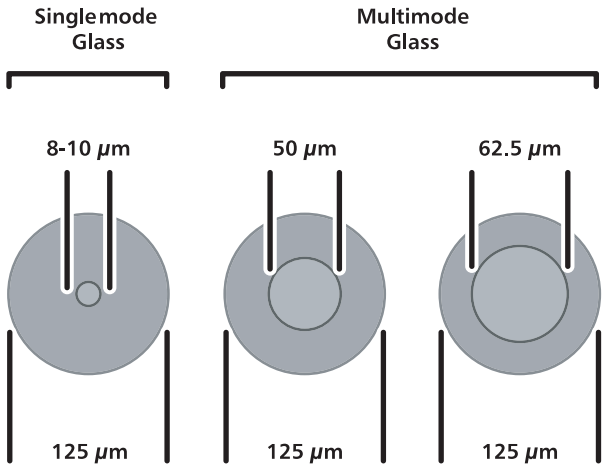
Singlemode fiber, on the other hand, has a much smaller core that allows only one mode of light at a time to propagate through the core. While it might appear that multimode fibers have higher capacity, in fact the opposite is true. Singlemode fibers are designed to maintain spatial and spectral integrity of each optical signal over longer distances, allowing more information to be transmitted.

Its tremendous information-carrying capacity and low intrinsic loss have made singlemode fiber the ideal transmission medium for a multitude of applications. Singlemode fiber is typically used for longer-distance and higher-bandwidth applications (see Figure 3). Multimode fiber is used primarily in systems with short transmission distances (under 2 km), such as premises communications, private data networks, and parallel optic applications.

Optical Fiber Sizes

The international standard for outer cladding diameter of most singlemode optical fibers is 125 microns (µm) for the glass and 245 µm for the coating. This standard is important because it ensures compatibility among connectors, splices, and tools used throughout the industry.
Standard singlemode fibers are manufactured with a small core size, approximately 8 to 10 µm in diameter. Multimode fibers have core sizes of 50 to 62.5 µm in diameter.

Figure 3. Optical Fiber Sizes



Basic Optical Cable Design

There are two basic cable designs:

Loose-tube cable, used in the majority of outside-plant installations in North America, and tight-buffered cable, primarily used inside buildings.

The modular design of loose-tube cables typically holds up to 12 fibers per buffer tube with a maximum per cable fiber count of more than 200 fibers. Loose-tube cables can be all-dielectric or optionally armored. The modular buffer-tube design permits easy drop-off of groups of fibers at intermediate points, without interfering with other protected buffer tubes being routed to other locations. The loose-tube design also helps in the identification and administration of fibers in the system.

Single-fiber tight-buffered cables are used as pigtails, patch cords and jumpers to terminate loose-tube cables directly into opto-electronic transmitters, receivers and other active and passive components.

Multi-fiber tight-buffered cables also are available and are used primarily for alternative routing and handling flexibility and ease within buildings.

Loose-Tube Cable

In a loose-tube cable design, color-coded plastic buffer tubes house and protect optical fibers. A gel filling compound impedes water penetration. Excess fiber length (relative to buffer tube length) insulates fibers from stresses of installation and environmental loading. Buffer tubes are stranded around a dielectric or steel central member, which serves as an anti-buckling element. The cable core, typically uses aramid yarn, as the primary tensile strength member.

The outer polyethylene jacket is extruded over the core. If armoring is required, a corrugated steel tape is formed around a single jacketed cable with an additional jacket extruded over the armor.
Loose-tube cables typically are used for outside-plant installation in aerial, duct and direct-buried applications.

Tight-Buffered Cable

With tight-buffered cable designs, the buffering material is in direct contact with the fiber. This design is suited for "jumper cables" which connect outside plant cables to terminal equipment, and also for linking various devices in a premises network.

Multi-fiber, tight-buffered cables often are used for intra-building, risers, general building and plenum applications.

The tight-buffered design provides a rugged cable structure to protect individual fibers during handling, routing and connectorization. Yarn strength members keep the tensile load away from the fiber.

As with loose-tube cables, optical specifications for tight-buffered cables also should include the maximum performance of all fibers over the operating temperature range and life of the cable. Averages should not be acceptable.

3. Fiber Geometry: A Key Factor in Coupling and System Performance

As greater volumes of fiber in higher fiber-count cables are installed, system engineers are becoming increasingly conscious of the impact of splicing and connectors on their systems. Splice yields, connector counts and system losses have a profound impact on the quality of system performance and the cost of installation.

Glass geometry, the physical dimensions of an optical fiber, has been shown to be a primary contributor to splice loss and splice yield in the field as well as overall interconnect performance. Early on, one company recognized the benefit provided by tightly controlled fiber geometry and has steadily invested in continuous improvement in this area. The manufacturing process helps engineers reduce systems costs and support the industry's low maximum splice-loss requirement, typically at around 0.05 dB and reducing losses in connectors, typically less than .3 dB for the latest interconnect systems.

Fiber that exhibits tightly controlled geometry tolerances will not only be easier and faster to couple but will also reduce the need for testing by ensuring predictable, high-quality coupling performance. This is particularly true when fibers are spliced by passive, mechanical, or fusion techniques for both single fibers and fiber ribbons. In addition, tight geometry tolerances lead to the additional benefit of flexibility in equipment choice.

The benefits of tighter geometry tolerances can be significant. In today's fiber-intensive architectures, it is estimated that splicing, interconnect installation and testing can account for more than 30 percent of the total labor costs of system installation.

Fiber Geometry Parameters

The three fiber geometry parameters that have the greatest impact on splicing or interconnect performance include the following:

- cladding diameter—the outside diameter of the glass
- core/clad concentricity (or core-to-cladding offset)—how well the core is centered in the cladding glass region
- fiber curl—the amount of curvature over a fixed length of fiber

These parameters are determined and controlled during the fiber-manufacturing process. As fiber is cut and spliced according to system needs, it is important to be able to count on consistent geometry along the entire length of the fiber and between fibers and not to rely solely on measurements made.

Cladding Diameter

The cladding diameter tolerance controls the outer diameter of the fiber, with tighter tolerances ensuring that fibers are almost exactly the same size. During splicing, inconsistent cladding diameters can cause cores to misalign where the fibers join, leading to higher splice losses.

The drawing process controls cladding diameter tolerance. Some manufacturers are able to control the tolerance of the cladding to a level of 125.0±1.0 µm. Once the cladding diameter tolerance is tightened to this level, core/clad concentricity becomes the single largest geometry contributor to splice loss.

Core/Clad Concentricity

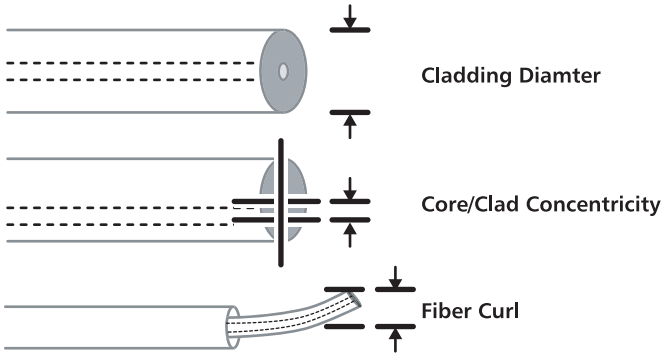
Tighter core/clad concentricity tolerances help ensure that the fiber core is centered in relation to the cladding. This reduces the chance of ending up with cores that do not match up precisely when two fibers are spliced together. A core that is precisely centered in the fiber yields lower-loss splices more often.

Core/clad concentricity is determined during the first stages of the manufacturing process, when the fiber design and resulting characteristics are created. During these laydown and consolidation processes, the dopant chemicals that make up the fiber must be deposited with precise control and symmetry to maintain consistent core/clad concentricity performance throughout the entire length of fiber.

Fiber Curl

Fiber curl is the inherent curvature along a specific length of optical fiber that is exhibited to some degree by all fibers. It is a result of thermal stresses that occur during the manufacturing process. Therefore, these factors must be rigorously monitored and controlled during fiber manufacture. Tighter fiber-curl tolerances reduce the possibility that fiber cores will be misaligned during splicing, thereby impacting splice loss.

Figure 8. Cladding Diameter, Core/Clad Concentricity, and Fiber Curl



4. How to Choose Optical Fiber

Singlemode Fiber Performance Characteristics

The key optical performance parameters for singlemode fibers are attenuation, dispersion, and mode-field diameter.

Optical fiber performance parameters can vary significantly among fibers from different manufacturers in ways that can affect your system's performance. It is important to understand how to specify the fiber that best meets system requirements.

Attenuation

Attenuation is the reduction of signal strength or light power over the length of the light-carrying medium. Fiber attenuation is measured in decibels per kilometer (dB/km).

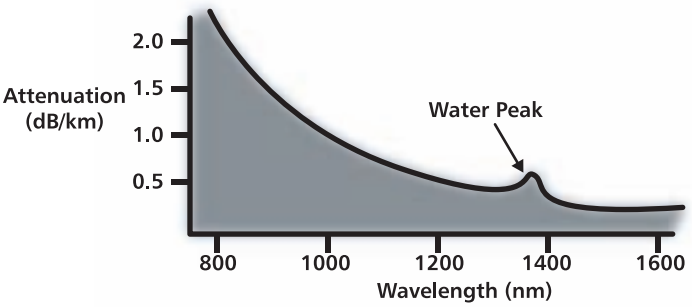
Optical fiber offers superior performance over other transmission media because it combines high bandwidth with low attenuation. This allows signals to be transmitted over longer distances while using fewer regenerators or amplifiers, thus reducing cost and improving signal reliability.

Attenuation of an optical signal varies as a function of wavelength (see Figure 9). Attenuation is very low, as compared to other transmission media (i.e., copper, coaxial cable, etc.), with a typical value of 0.35 dB/km at 1300 nm. Attenuation at 1550 nm is even lower with a typical value of 0.25 dB/km. This gives an optical signal, transmitted through fiber, the ability to travel more than 100 km without regeneration or amplification.

Attenuation is caused by several different factors, but scattering and absorption primarily cause it.

The scattering of light from molecular level irregularities in the glass structure leads to the general shape of the attenuation curve (see Figure 9). Further attenuation is caused by light absorbed by residual materials, such as metals or water ions, within the fiber core and inner cladding. It is these water ions that cause the “water peak” region on the attenuation curve, typically around 1383 nm. The removal of water ions is of particular interest to fiber manufacturers as this “water peak” region has a broadening effect and contributes to attenuation loss for nearby wavelengths. Light leakage due to bending, splices, connectors, or other outside forces are other factors resulting in attenuation.

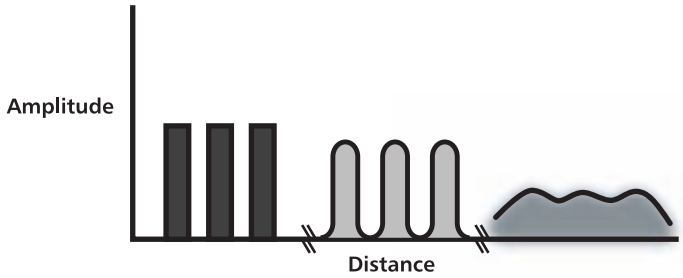
Figure 9. Typical Attenuation vs. Wavelength



Dispersion

Dispersion is the time distortion of an optical signal that results from the many discrete wavelength components traveling at different rates and typically result in pulse broadening (see Figure 10). In digital transmission, dispersion limits the maximum data rate, the maximum distance, or the information-carrying capacity of a singlemode fiber link. In analog transmission, dispersion can cause a waveform to become significantly distorted and can result in unacceptable levels of composite second-order distortion (CSO).

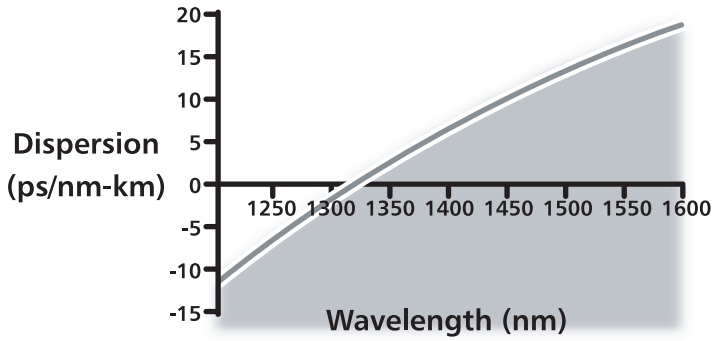
Figure 10. Impact of Dispersion



Dispersion vs. Wavelength

Fiber dispersion varies with wavelength and is controlled by fiber design (see Figure 11). The wavelength at which dispersion equals zero is called the zero-dispersion wavelength. This is the wavelength at which fiber has its maximum information-carrying capacity. For standard singlemode fibers, this is in the region of 1310 nm. The units for dispersion are also shown in Figure 11.

Figure 11. Typical Dispersion vs. Wavelength Curve



Chromatic dispersion consists of two kinds of dispersion. Material dispersion refers to the pulse spreading caused by the specific composition of the glass. Waveguide dispersion results from the light traveling in both the core and the inner cladding glasses at the same time but at slightly different speeds. The two types can be balanced to produce a wavelength of zero dispersion anywhere within the 1310 nm to 1650 nm operating window.

Transmission in the 1550 nm Window

Optical fibers also can be manufactured to have the zero dispersion wavelength in the 1550-nm region, which is also the point where silica-based fibers have inherently minimal attenuation. These fibers are referred to as dispersion-shifted fibers and are used in long-distance applications with high bit rates. For applications utilizing multiple wavelengths, it is undesirable to have the zero dispersion point within the operating wavelength range and fibers known as nonzero dispersion-shifted fiber (NZDSF) are most applicable. NZDSF fibers with large effective areas are used to obtain greater capacity transmission over longer distance than would be possible with standard singlemode fibers. These fibers are able to take advantage of the optical amplifier technology available in the 1530 to 1600+ nm operating window while mitigating nonlinear effects that can be troublesome at higher power levels.

For applications such as the interconnection of headends, delivery of programming to remote node sites, high-speed communication networks, and regional and metropolitan rings (used primarily for competitive access applications), NZDSF fiber can improve system reliability, increase capacity, and lower system costs.

Mode-Field Diameter

Mode-field diameter (MFD) describes the size of the light-carrying portion of the fiber. This region includes the fiber core as well as a small portion of the surrounding cladding glass. MFD is an important parameter for determining a fiber's resistance to bend-induced loss and can affect splice loss as well. MFD, rather than core diameter, is the functional parameter that determines optical performance when a fiber is coupled to a light source, connectorized, spliced, or bent. It is a function of wavelength, core diameter, and the refractive-index difference between the core and the cladding. These last two are fiber design and manufacturing parameters.

Cutoff Wavelength

Cutoff wavelength is the wavelength above which a singlemode fiber supports and propagates only one mode of light. An optical fiber that is singlemoded at a particular wavelength may have two or more modes at wavelengths lower than the cutoff wavelength.

The effective cutoff wavelength of a fiber is dependent on the length of fiber and its deployment and the longer the fiber, the lower the effective cutoff wavelength. Or the smaller the bend radius of a loop of the fiber is, the lower the effective cutoff wavelength will be. If a fiber is bent in a loop, the cutoff is lowered.

Environmental Performance

While cable design and construction play a key role in environmental performance, optimum system performance requires the user to specify fiber that will operate without undue loss from microbending.

Microbends are small-scale perturbations along the fiber axis, the amplitude of which are on the order of microns. These distortions can cause light to leak out of a fiber. Microbending may be induced at very cold temperatures because the glass has a different coefficient of thermal expansion from the coating and cabling materials. At low temperatures, the coating and cable become more rigid and may contract more than the glass. Consequently, enough load may be exerted on the glass to cause microbends. Coating and cabling materials are selected by manufacturers to minimize loss due to microbending.

Specification Examples of Uncabled Fiber

To ensure that a cabled fiber provides the best performance for a specific application, it is important to work with an optical fiber–cable supplier to specify the fiber parameters just reviewed as well as the geometric characteristics that provide the consistency necessary for acceptable splicing and connectorizing.

Splicers and Connectors

As optical fiber moves closer to the customer, where cable lengths are shorter and cables have higher fiber counts, the need for joining fibers becomes greater. Splicing and connectorizing play a critical role both in the cost of installation and in system performance.

The object of splicing and connectorizing is to precisely match the core of one optical fiber with that of another in order to produce a smooth junction through which light signals can continue without alteration or interruption.

There are two ways that fibers are joined:
- splices, which form permanent connections between fibers in the system
- connectors, which provide remateable connections, typically at termination points

Fusion Splicing

Fusion splicing provides a fast, reliable, low-loss, fiber-to-fiber connection by creating a homogenous joint between the two fiber ends. The fibers are melted or fused together by heating the fiber ends, typically using an electric arc. Fusion splices provide a high-quality joint with the lowest loss (in the range of 0.01 dB to 0.10 dB for singlemode fibers) and are practically nonreflective.

Mechanical Splicing

Mechanical splicing is an alternative method of making a permanent connection between fibers. In the past, the disadvantages of mechanical splicing have been slightly higher losses, less-reliable performance, and a cost associated with each splice. However, advances in the technology have significantly improved performance. System operators typically use mechanical splicing for emergency restoration because it is fast, inexpensive, and easy. (Mechanical splice losses typically range from 0.05–0.2 dB for singlemode fiber.)

Section 2: Fiber Optic Interconnect Product Offerings

Connectors

Connectors are used in applications where flexibility is required in routing an optical signal from lasers to receivers, wherever reconfiguration is necessary, and in terminating cables. These remateable connections simplify system reconfigurations to meet changing customer requirements. There are two broad categories of connectors. The first, is a broad collection of connectors intended for commercial applications. Typically these are single channel (simplex) or dual channel (duplex) solutions. With the on-going development of smaller interconnect solutions many of the historical “standards” are nearly gone from use. The latest commercial optical interconnects are based upon Telcordia’s GR-326 requirements for “Small Form Factor” optical interconnects. The most popular optical interconnect today is the LC developed by Lucent and the MU developed by NTT. Both of these interconnects utilize a 1.25mm ceramic ferrule and sleeve physical contact interface. The smaller form factor ceramic is proving to deliver significantly lower insertion losses and in a more consistent performance across varied environments.

The second category of optical interconnects is a centered around a collection of more specialized solutions intended for severe environments typically found in outdoor applications, military/aerospace or heavy industrial locations. The foundation for military optical interconnect is the Mil-T-29504 specification. Various configurations of products have resulted from that specification for various interconnect solutions. Typically, the optical termini defined by that specification are used in mixed mode (electrical/optical) interconnects.

ITT Fiber Optic interconnect solutions;

2.1 Ground Tactical: FOMC / ITAC (MIL-PRF-83526)

The Cannon FOMC and ITAC connector system is offered in two different connector styles with both being considered a field tactical connector and was primarily designed to meet the needs of the military and commercial customers who require a harsh environmental multi-fiber field connector. Both the FOMC and ITAC connectors combines features which provide the user with a connector that will withstand rough handling and weather extremes with features such as elastomeric cable and interface sealing, scoop proof interface to prevent optical contact damage, removable front insert for easy optical contact cleaning, anodized shell finish and a attached dust cap. Both connector series utilize an industry standard physical contact ceramic ferrule assembly, and have an internal fiber chamber for extra fiber storage which eliminates tensile loads form being applied to the terminated fiber and allows for contact re-termination. Another feature is the hermaphroditic design which enables multiple FOMC or ITAC plug or receptacle assemblies to be daisy-chained together in the field. For additional information for FOMC please see page 24 and for ITAC page 28.

2.2 FOHC

The Cannon FOHC contact is offered in 2 different alignment styles, a metallic body with ceramic zirconia ferrule tip and a patented metallic body with jewel tip. Both contact series conforms to the MIL-T-29504 fiber optic termini specification and fits into any size 16 cavity with no modification to the connector. The FOHC contact is designed for use with the standard size 16 insertion/extraction tool, and both the pin and socket end faces have easy access for cleaning. The FOHC precision ceramic tip offers superior coupling performance and a simplified termination process. Ceramic zirconia tips more accurately center the fiber within the contact body. During the mating engagement there is a rugged alignment sleeve which precisely aligns the mating contacts together for optimum performance. The jewel ferrule alignment system provides precise alignment regardless of fiber size, accommodates fiber tolerances, eliminates the requirement for a minimum end gap, and allows for spring loading of contacts. For additional information please see page 32.

2.3 PHD

ITT provides flexibility in the optical system design with the Cannon PHD line of high density optical interconnects. The PHD connector system's open architecture delivers high performance, density and serviceability in a flexible and scalable product configuration. The PHD optical interconnect provides solutions for the Telecommunication, Automotive, Commercial Aircraft, Data Communications, Industrial, Medical and Military Electronic industries.

The Cannon PHD interconnect is based around the industry standard 1.25 mm ceramic ferrule technology which allows rapid system integration and a common terminus platform for singlemode and multimode optical fiber solutions. The contact systems is offered in both a size 22 and size 16 contact assembly configuration which provides a cable termination range form 250 micron up to a 2 millimeter outer jacket along with different I.D. ferrule sizes to accommodate a large range of fiber types. Both the size 22 and size 16 contact assemblies utilize the same ceramic zirconia ferrule which meets the GR-326 endface geometry compliance. The PHD system assures the industry's highest and most stable performance for any multi-channel interconnect, resulting in the lowest insertion loss value, less channel to channel variance and a higher return loss of any fiber optic interconnect in the industry. For additional information please see page 38.

2.4 NGCON

The NGCON connector system is the new standard for military fiber optic interconnect applications. ITT's design will be qualified to the yet to be released NGCON Specification and will provide a high-performance fiber optic interconnect solution for air, sea and space applications. This new connector system was designed with innovations including genderless contacts and high density packaging combined with proven technology and features from connector standards 28876 and 38999. For additional information please see page 61.

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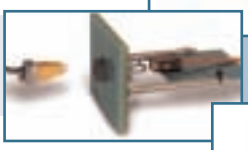


	AIRBORNE		GROUND		NAVAL	
	Exposed	Non-Exposed	Exposed	Non-Exposed	Exposed	Non-Exposed
PHD 38999	P [1]	R	P [1]	R	P [1]	R
PHD Panel Mount		R		R		R
PHD Backplane		R		R		R
PHD Super LC		R		R		R
D-Sub Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini		R		R		R
Trident Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini		R		R		R
Rack & Panel Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini		R		R		R
D38999 Hybrid Connector (Electrical & F.O.) w/ FOHC or 29504 Termini	P [2]	R	P [2]	R	P [2]	R
Rack & Panel Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & 29504 termini		R		R		R
M38999 Physical Contact	P [2]	R	P [2]	R	P [2]	R
M38999 Expanded Beam	P [2]	R	P [2]	R	P [2]	R
FOMC			R	R	P	P
NGCON	P [3]	P [3]	P [3]	P [3]	R [3]	R [3]
ITAC			R [3]	R [3]		

R = Recommended Application

P = Possible Application

= Not recommended for this application

1 = Required for this application: Environmental sealed backshell, Mated condition or environmental sealed dust cap. Consult factory for recommended plating requirements

2 = Required for this application: Environmental sealed backshell. Consult factory for recommended plating requirements

3 = Product Release Scheduled for 2007 Q2

Performance / Compliance Matrix

Connector Product Offering	Shell Size / Type	Contact Size	Contact Ferrule O.D.	Channel Count	Plating (Connector)	Strain Relief System	Fiber Type (MM / SM)	Max. Fiber Buffer / Coating Dia.	Max. Diameter, (Simplex / Sub-Cable)	Cable Construction Type	Operating Temperature Range	Mating Durability	Vibrations	Shock
	ITT SPECIFICATIONS													
	Product Configuration						**Fiber / Cable Compatibility**				**Environmental**			
PHD 38999	11 thru 25 Circular	22	1.25 mm	Standard Min. 4 Max 72	Nickel OD Cad	Sealed Backshell - Used with Breakout / Distribution cable types	Single Mode - 9/125 Multi Mode - 50/125, 62.5/125, 100/140 For Large Core / Plastic Fiber consult factory for compatibility requirements	900um	SM 1.1mm MM -1.2mm	Buffered Fiber, Cable-Simplex & Multi Channel Distribution Breakout	-65C to +165C		PHD variation of MIL-DTL-38999	PHD variation of MIL-DTL-38999
		16		Standard Min. 2 Max 36				900um	2 mm					
PHD Panel Mount	Rectangular	22		Standard Min. 8 Max 64	Nickel	Backshell - Used with Breakout / Distribution cable types		900um	SM 1.1mm MM -1.2mm		-65C to +125C	500	EIA/TIA-455-11 test condition VI-D	EIA/TIA-455-14, test condition A
PHD Backplane		22		8	Robust Design - Nickel	None		900um	SM 1.1mm MM -1.2mm	Buffered Fiber or Simplex Cable	-55C to +85C		Test Pending	Test Pending
PHD Super LC Simplex / Duplex	Rectangular LC Simplex / Duplex	16		1-Simplex 2-Duplex	NA	Boot		900um	2 mm	Buffered Fiber, Simplex & Zip Cord Duplex Cable	-65C to +125C	500	Test Pending	Test Pending
D-Sub Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini	Rectangular	22		Consult Factory	Cadmium Tin Zinc	Specials Only Consult Factory		900um	NA	Buffered Fiber or Simplex Cable	-55C to +125C	500	MIL-DTL-24308	MIL-DTL-24308
Trident Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini	Circular	22			NA			900um	NA		-55C to +105C	500	Consult Factory	Consult Factory
Rack & Panel Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & PHD termini	Rectangular	22			Nickel OD Cad	Specials Only		900um	SM 1.1mm MM -1.2mm		-65C to +125C	500	MIL-C-81659	MIL-C-81659
		16						900um	2 mm			500		
D38999 Hybrid Connector (Electrical & F.O.) w/ FOHC or 29504 Termini	11 thru 25 Circular	16	2.50 mm	37	Nickel OD Cad	Sealed Backshell - Used with Breakout / Distribution cable types		900um	2 mm			500	MIL-DTL-38999	MIL-DTL-38999
Rack & Panel Specials Hybrid Connector (Electrical & F.O.) w/custom F.O. inserts & 29504 termini	Rectangular	16		Consult Factory	Nickel OD Cad	None		900um	2 mm	Buffered Fiber, Cable-Simplex & Multi Channel Distribution / Breakout	-65C to +200C Cable / Contact dependent	500	MIL-C-81659	MIL-C-81659
M38999 Physical Contact	Circular			Consult Factory	Nickel OD Cad	Sealed Backshell - Used with Breakout / Distribution cable types		900um	2 mm			500	MIL-DTL-38999	MIL-DTL-38999
M38999 Expanded Beam	Circular			Consult Factory	Nickel OD Cad	Sealed Backshell - Used with Breakout / Distribution cable types		900um	2 mm			500	MIL-DTL-38999	MIL-DTL-38999
FOMC	Circular	16		Standard Min. 2 Max 12	Hard Black Anodize	Sealed Backshell - Used with Breakout / Distribution cable types		900um	2 mm		-65C to +150C	200	Consult Factory	Consult Factory
NGCON	Circular	16		Standard Min. 2 Max 36	Nickel OD Cad			900um	2 mm		-65C to +165C	500	MIL-PRF-Pending	MIL-PRF-Pending
TFOCA II	Circular	16		Standard Min. 2 Max 4	Hard Black Anodize			900um	2 mm		-65C to +165C	500	MIL-PRF-83526	MIL-PRF-83526

Compliance Notes

1 = Required Configuration: Environmental sealed backshell, mated condition or environmental sealed dust cap.

2 = Consult factory for recommended plating requirements

3 = Cable Dependent. Consult factory for Mil-spec, Ground Tactical & Avionic Cable offering

4 = Compliant with mating assist feature (Coupling Nut / Jackscrew)

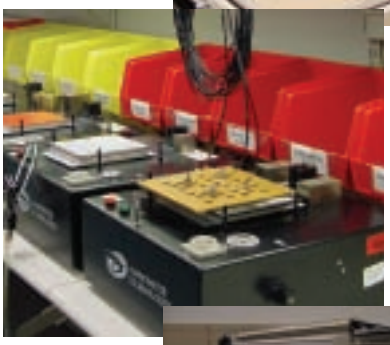
Compliance Key

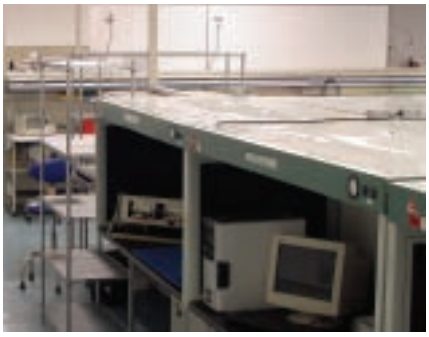
TBD = Consult Factory for specific configuration requirements

C = Compliant

= Not recommended for this requirement

Optical Performance				TYPICAL MILITARY/AEROSPACE REQUIREMENTS													
Insertion Loss (dB Max.)	Insertion Loss (dB Typical)	Return Loss (dB Min.)	Return Loss (dB Typical)	Insertion Force < 50 lbs	Mating Durability (>100 cycles)	Bend Life (repeated flexing)	Vibration Rigid body motion / >200Hz primary modes	Temperature -55 to +85 degrees C	Shock Drop, Handling, Etc.	Maintenance Removal and Installation	Humidity 5% non-condensing / 100% condensing	Cable Retraction System (Exposed)	Cable Retraction System (Non-Exposed)	Corrosion Resistance	Exposed Completely exposed to outside environment	Non-Exposed Cabin / Cabinet / etc (Environmentally Controlled
				C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
				C [4]	C	C [3]	C	C	C	C	C		C	C [2]		C
				C	C	C [3]	C	C	C	C	C			C [2]		C
M tuned 0.3 MM-0.5	SM tuned 0.2 MM-0.3	SM-50 MM-20	SM-56 MM-25	C	C	C [3]	C	C	C	C	C			C		C
				C	C	C [3]	C	C	C	C	C		C	C [2]		C
				C [4]	C	C [3]	C	C	C	C	C		C	C		C
				C	C	C [3]	C	C	C	C	C			C [2]		C
M-1.0 M-0.75	SM-0.6 MM-0.75	SM-50 MM-20	SM-55 MM-25	C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
				C [4]	C	C [3]	C	C	C	C	C			C [2]		C
Consult Factory				C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
Consult Factory				C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
MM-1.5	MM-1.0	MM-20	MM-25	C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
MM-0.5	MM-0.3	MM-20	MM-25	C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C
MM-0.5	MM-0.3	MM-20	MM-25	C [4]	C	C [3]	C	C	C	C	C	C [1]	C	C [2]	C [1]	C





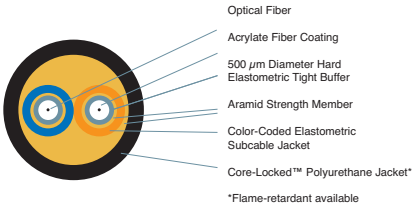
Build To Order Fiber Optic Harness Solutions

ITT has a world class Fiber Optic facility with proven reputation of delivering high quality, high performance fiber optic cable assemblies, for the Telecommunication, Automotive, Commercial Aircraft, Data Communications, Industrial, Medical and Military Electronic industries. ITT's fiber optic production facility is staffed with both project and manufacturing engineers along with highly skilled technicians/operators which work to strict military and commercial standards. Our in-house capabilities allow us to design, manufacture and test all in our production facility, and build standard to highly custom multi-channel cable assemblies complete in house. Our proven expertise allows us the ability to terminate all type of fiber in both single-mode and multimode along with terminating ferrule assemblies ranging from 1.25mm to 2.50mm and plastic fiber too, and meet the requirements of today's severe mechanical/environmental conditions. The key to developing a successful fiber optic system is understanding the performance and environmental requirements, implementing good design practices and utilizing appropriate components. For additional information please see pages 17-18 of Design Guide.

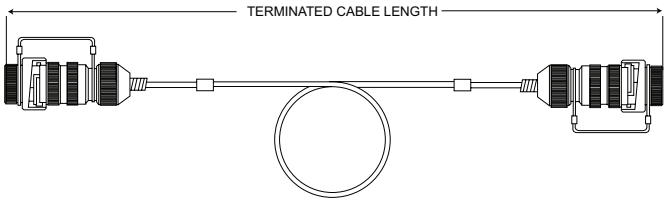
Typical Harness Configurations

Consult Factory for Connector / Cable Options and Pricing

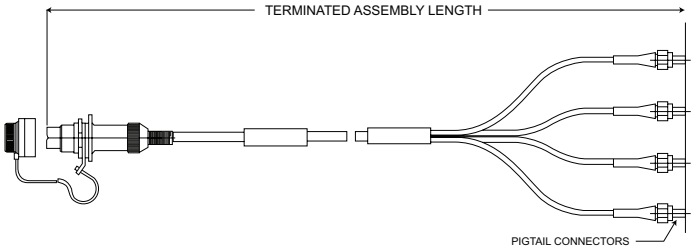
Harness Options with Breakout Cable



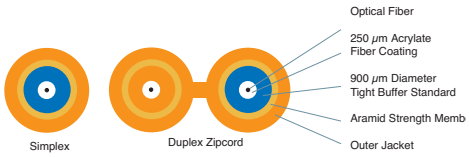
Harness Configuration: Connector to Connector



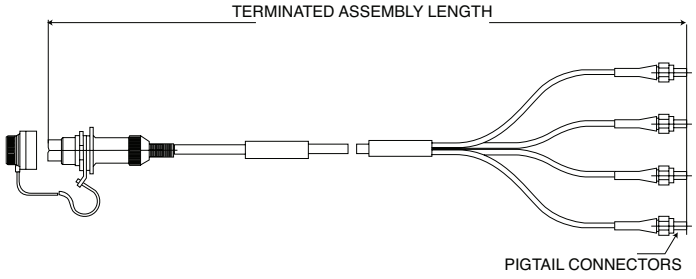
Harness Configuration: Connector to Sub-Cable Fan Out



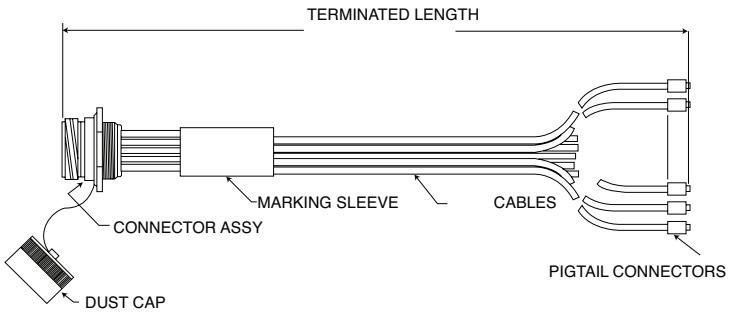
Harness Options with Simplex Cable



Harness Configuration: Connector to Fan Out



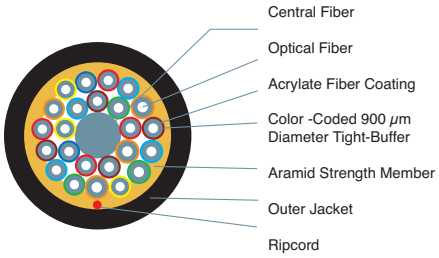
Harness Configuration: Connector to Simplex Fan Out



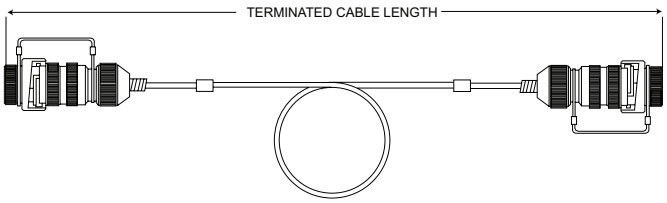
Typical Harness Configurations

Consult Factory for Connector / Cable Options and Pricing

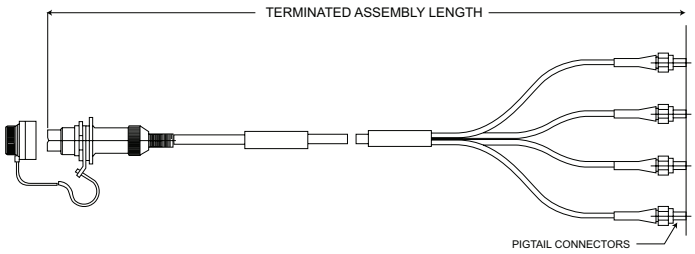
Harness Options with Distribution Cable



Harness Configuration: Connector to Connector

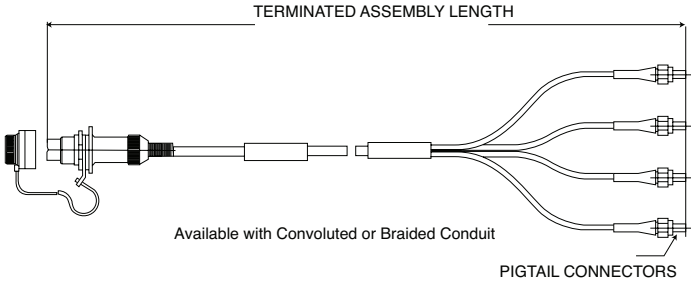


Harness Configuration: Connector to Discrete Fiber Fan Out

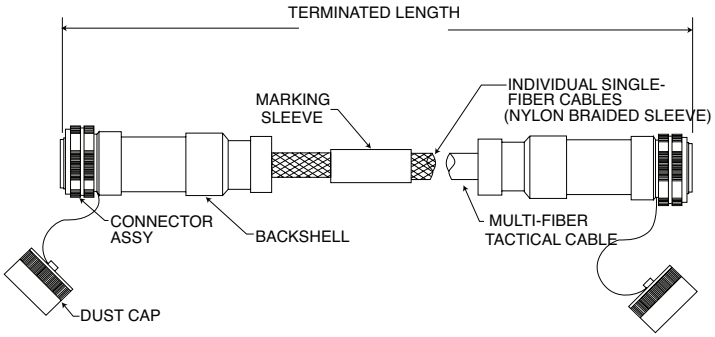


Harness Options with Simplex Buffered Fiber

Harness Configuration: Connector to Discrete Fiber Fan Out



Harness Configuration: Connector to Connector



FIBER OPTIC HARNESS ASSEMBLY WORKSHEET

Customer: _____ **Project/Program:** _____ **Description:** _____

APPLICATION

Type: ❑ Air ❑ Land ❑ Sea ❑ Space ❑ Special: _____

Industry / Market: ❑ Military ❑ Industrial ❑ Commercial ❑ Transportation
❑ Space ❑ Medical ❑ Other: _____

Environment: ❑ Exposed (Outside Environment – Sealed Connector / Backshell)
❑ Non-Exposed (Inside the Box)

Temperature: Operating:_____ Storage:_____ Thermal Cycle / Shock_____

Shock / Vibe: _____

Additional Environmental Conditions: _____

FIBER / CABLE

Fiber: ❑ Single Mode ❑ Multi-mode (50/125, 62.5/125) ❑ Multi Mode (100/140)
❑ Large Core: _____ ❑ Special: _____

Cable: ❑ Customer Specified: Manufacturer: _____ P/N: _____
❑ Supplier Standard: ❑ Mil Tact. ❑ Shipboard ❑ Ground Tactical
❑ Riser ❑ Plenum ❑ Zero Hal.

Construction: ❑ Distribution ❑ Breakout ❑ Simplex ❑ Buffered Fiber

CONFIGURATION

Total Channel Count: _____ ❑ Mixed Mode: Fiber: _____ _____ _____

Electrical: _____ _____ _____

Harness Length (Termini End A to Termini End B): _____

Labels: ❑ Standard (ITT PN) ❑ End Markers:_____ ❑ Special:_____

End A Termini: ❑ Pin ❑ FOHC ❑ PHD Size 22 ❑ PHD Size 16 ❑ 29504
❑ Socket ❑ NGCON ❑ ITAC ❑ FOMC ❑ Other:_____

Connector Family:_____ , (PHD, NGCON, Std 38999, ITAC, FOMC, PHD Backplane, Other) ❑ Dust Cap

Connector Config: ❑ 38999 ❑ 38999 (Precision) ❑ Panel Mount ❑ Rack & Panel ❑ D-Sub

Connector Type: _____ (Plug, Jam-nut, Wall Mt., In-line, Special) Arrangement:_____

Backshell: ❑ None ❑ Configuration: ❑ Straight ❑ 90 ❑ Other_____

End B Termini: ❑ Pin ❑ FOHC ❑ PHD Size 22 ❑ PHD Size 16 ❑ 29504
❑ NONE ❑ Socket ❑ NGCON ❑ ITAC ❑ FOMC ❑ Other:_____

Connector Family:_____ , (PHD, NGCON, Std 38999, ITAC, FOMC, Back Plan, Other)) ❑ Dust Cap

Connector Config: ❑ 38999 ❑ 38999 (Precision) ❑ Panel Mount ❑ Rack & Panel ❑ D-Sub

Connector Type: _____ (Plug, Jam-nut, Wall Mt., In-line, Special)

Arrangement:_____

Backshell: ❑ None ❑ Configuration: ❑ Straight ❑ 90 ❑ Other_____

MISCELLANEOUS INFO

❑ No Customer Spec. / Build to ITT Part Number Customer Supplied Material: _____

❑ Customer Spec: _____ _____

Price Target: _____ (1 – 9), _____(10 - 49), _____(50 – 250), _____ (Over 250)

GENERAL REQUIREMENTS

Testing/Inspection: ❑ Standard (Includes IL-one direction, End Face Geometry, Visual Inspection)

Requirements: IL_____ RL_____ ❑ Other: _____ (Return Loss, Bi-Directional IL, Mechanical)

ITT

Harness Assembly Configuration Matrix

	AIRBORNE		
	Exposed	Non-Exposed	Exp
Connectors (Product Type)	PHD38999, D38999, M38999	PHD38999, D38999, M38999 PHD backplane, SuperLC, D-sub Specials, Trident, Rack & Panel Specials/ ARINC NGCON	PHD38999, D38999, M38999, FOMC, TFOCA II, NGCON
Contacts (Product Type / Size)	PHD (22 & 16), FOHC, 29504	PHD (22 & 16), FOHC, 29504	PHD (22 & 16) FOHC, 29504, FOMC NGCON TFOCA II
Fiber (Single Mode, 50/125, 62.5/125, 100/140)	All - Single Mode-9/125, Multi Mo		
Cable Type (Ground Tactical, Avionics, Zero Halogen, Commercial-Riser & Plenum)	Avionics	Avionics Zero Halogen	Ground Ta
Harness Configurations (Fan-out, Distribution, Breakout, Simplex or Buffered Fiber w/conduit)	Distribution	Fan-out, Distribution, Breakout, Simplex Buffered Fiber (with or without conduit)	Distribution Breakout
Cable Groupings	Standard offering		
Cable Min. Bend Radius	Cable Dependent (Channel Count, Cable Type),		
Special handling Cleaning requirements (How, frequency, etc)	Clean Connector & F.		

GROUND		NAVAL	
osed	Non-Exposed	Exposed	Non-Exposed
	PHD38999, D38999, M38999 PHD Panel Mount PHD backplane, SuperLC, D-sub Specials, Trident, Rack & Panel Specials/ ARINC NGCON, FOMC, TFOCA II	PHD38999, D38999, M38999, FOMC, TFOCA II, NGCON	PHD38999, D38999, M38999 PHD Panel Mount PHD backplane, SuperLC, D-sub Specials, Trident, Rack & Panel Specials/ ARINC NGCON, FOMC, TFOCA II
,	PHD (22 & 16), FOHC, 29504, FOMC NGCON TFOCA II	PHD (22 & 16), FOHC, 29504, FOMC NGCON TFOCA II	PHD (22 & 16), FOHC, 29504, FOMC NGCON TFOCA II
de-50/125, 62.5/125, 100/140. For Large Core/Plastic Fiber consult factory			
actical	Ground Tactical Avionics, Zero Halogen, Commercial-Riser Commercial-Plenum	Ground Tactical	Ground Tactical Avionics, Zero Halogen, Commercial-Riser Commercial-Plenum
	Fan-out, Distribution, Breakout, Simplex Buffered Fiber (with or without conduit)	Distribution Breakout	Fan-out, Distribution, Breakout, Simplex Buffered Fiber (with or without conduit)
g - 2-72 channel. For larger channel count consult factory			
General rule is 10X the outer jacket diameter for multi channel & 5X for simplex cables.			
O. Termini end-face prior to each connector mating			

Hermaphroditic design means plugs will mate with an identical plug as well as receptacles. The removable insert assures correcting mating and alignment. In the Cannon FOMC, ruggedness is combined with good optical performance, rapid coupling and attractive pricing. Another feature for the FOMC design is the fiber flexure chamber which prevents tensile loads from being applied to the terminated fiber. The chamber provides space for surplus fiber in a service loop of sufficient length to permit one retermination of one or more fibers in the plug and cable receptacle without reterminating the strength member at the same time. This versatility is an ITT exclusive.

The FOMC 2, 4, and 8 channel connector are available as a cable plug, and several receptacle shell configurations. The 8 channel can also be used with less contacts i.e. 6,4, or 2 channels. Sealing plugs are supplied with the 8 channel connector when using less than the full complement of contacts. This catalog provides complete ordering information on available shell types, contact layouts, fiber and cable dimensional and mechanical parameters.

ITT's FOMC series fiber optic connectors are designed to meet the needs of military and commercial customers who require a rugged environmental multi-fiber field connector. The FOMC combines features which provide the user with a connector that will withstand rough handling and weather extremes with features of elastomeric cable and interface sealing, scoop proof interface to prevent optical contact damage, removable front insert for easy optical contact cleaning, anodized shell finish, and a tough, strong dust cap with attaching stainless steel strap.

Standard Data

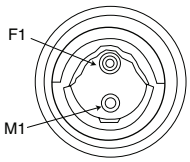
Fungus inert per requirement 4 of MIL-STD-454 Fluid resistant (elastomeric materials) per
- MIL-H-5606-Hydraulic fluid, petroleum base
- MIL-L7808-Lubricating oil, synthetic base
- MIL-G-3056-Gasoline
- MIL-A-8243-Ethelyne gylcol

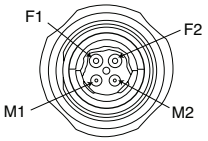
Description	Materials
Shell Hardware	Aluminum Alloy
Cable Clamp	Aluminum Alloy
Insert, Front Removable	Thermoplastic
Interfacial Seal	Elastomer
Cable Seal	Elastomer
O Rings	Elastomer
Alignment Guide	Thermoplastic
Strain Relief Spring	Stell wire with black chrome finish
Mandrel/Yoke	Thermoplastic
Receptacle Yoke	Thermoplastic
Dust Cap	Elastomer
Marking	Laser with clear chromate over exposed base metal

Contact Arrangements

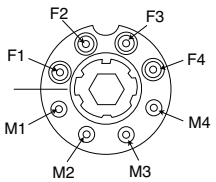
Face View of Insert

2 and 4 Channel





8 Channel



How to Order

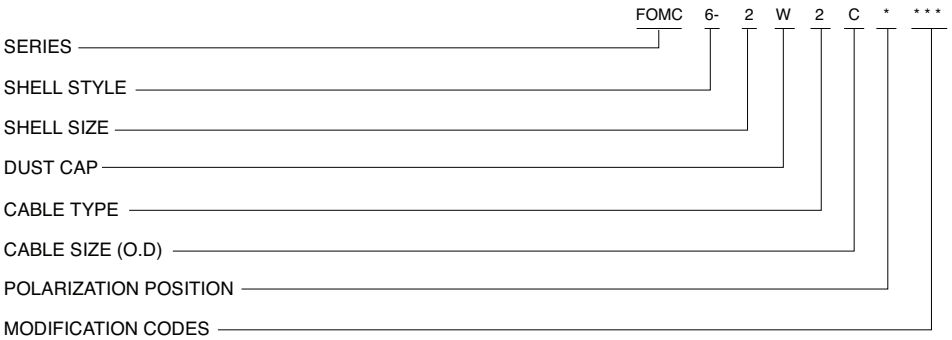
SERIES
Fiber Optic Multi-Channel

SHELL STYLE
2 - Square Flange Receptcale (2/4) channel only)
6 - Cable Plug
7 - Jam Nut Receptacle

SHELL SIZE (Channels)
(Maximum number of contact positions)
2
4
8

DUST CAP
W - Connector supplied with dust cap
X - Without dust cap

CABLE TYPE
1 - Pigtail buffered fiber (receptacle only)
2 - Multi fiber strengthened cable
3 - Singel fiber strengthned cables (8 channel only)



CABLE SIZE (O.D)
A - .190 ±.015 (4.83 ±.38)
D - .236 ±.019 (6.0 ±.5)
F - .276 ±.015 (7.0 ±.4)
G - .374 ±.015 (9.50 ±.38)*
H - .500 ±.015 (12.70 ±.38)*
P - Pigtail buffered fiber

*NOTE: Cable size G and H are for 8 channel FOMC Connector only

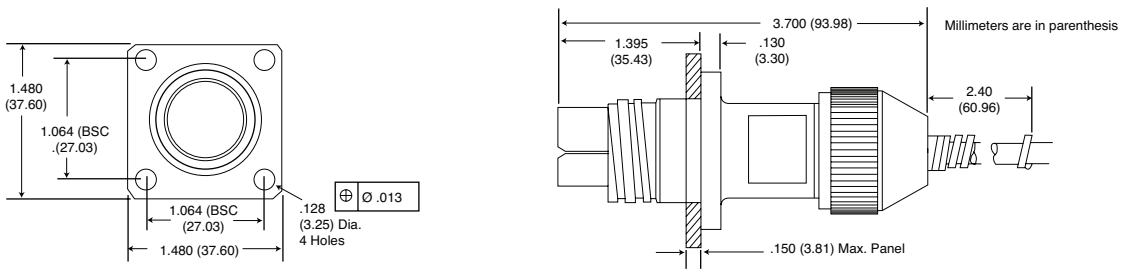
POLARIZATION
(8 channel plug only. Omit for 2/4 channel)
0 - Not polarized
1 thru 6 - key position

MODIFICATION CODES
Consult factory

2 and 4 Channel

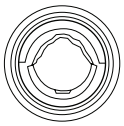
Square Flange Receptacle

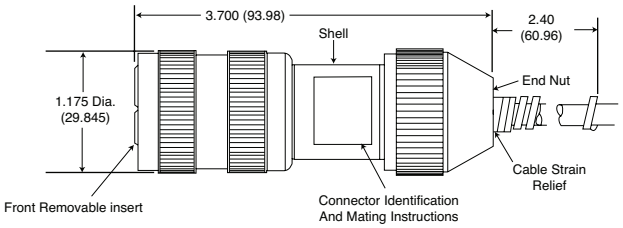
FOMC 2



Plug

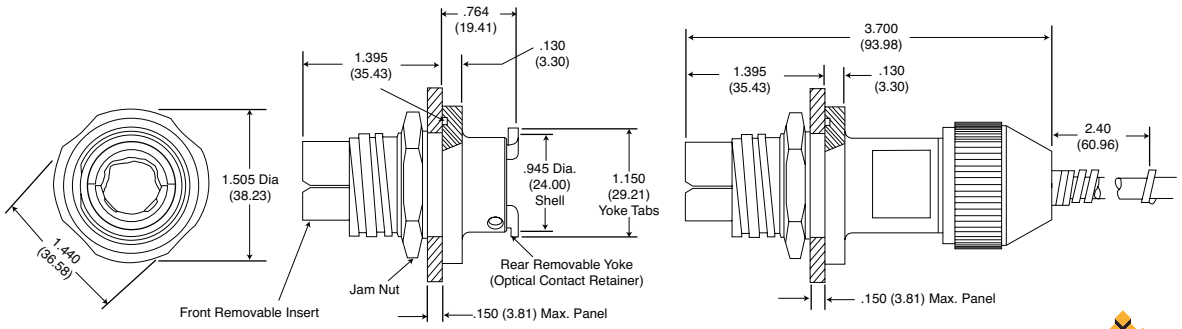
FOMC 6





Jam Nut Receptacle

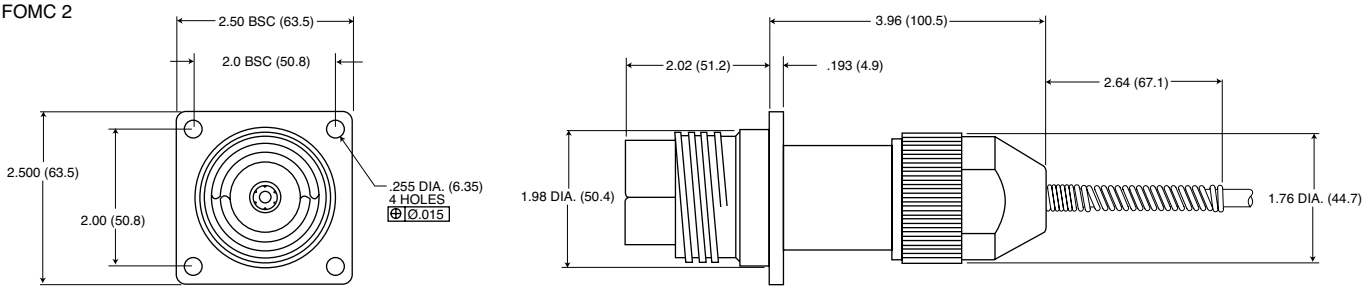
FOMC 7



8 Channel

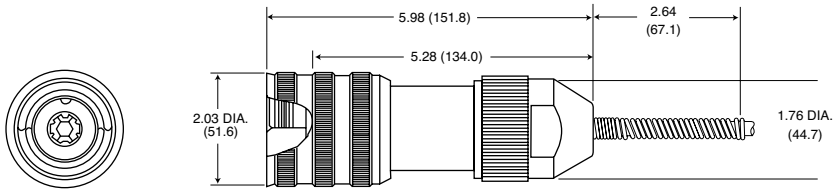
Square Flange Receptacle

FOMC 2



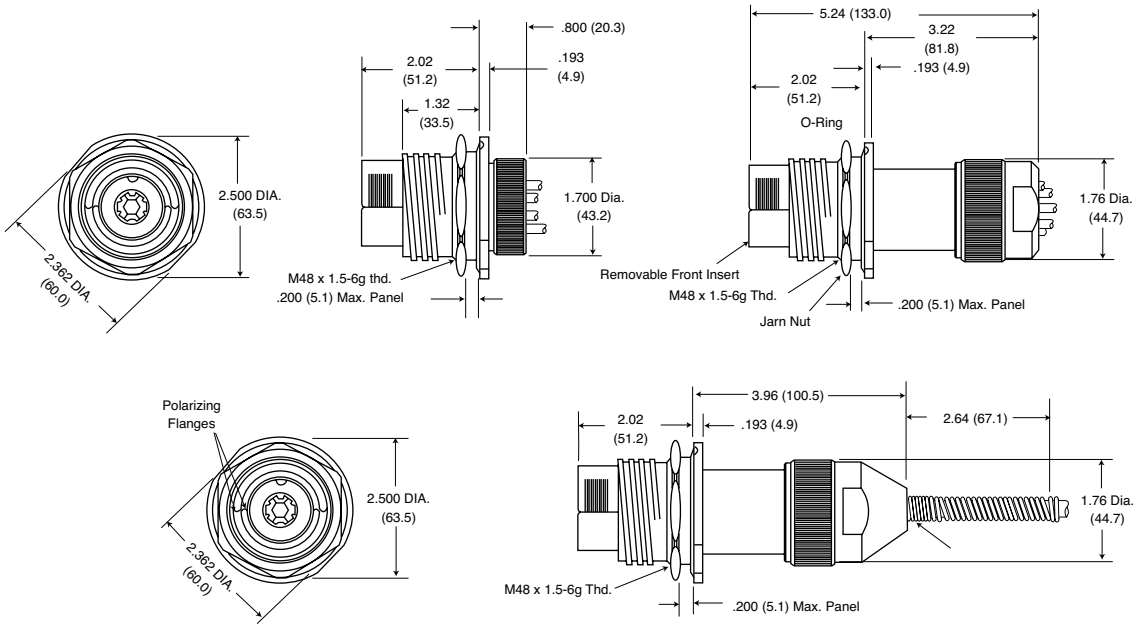
Plug

FOMC 6



Jam Nut Receptacle

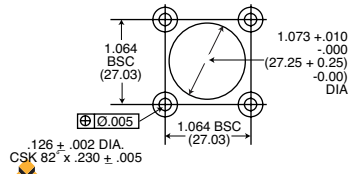
FOMC 7



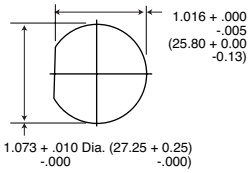
Recommended Panel Cutouts

2 and 4 Channel

FOMC 2

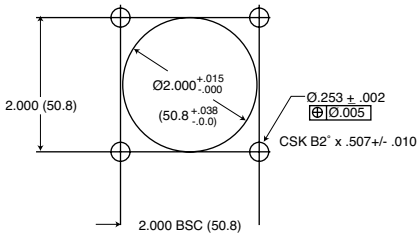


FOMC 7

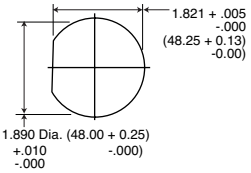


8 Channel

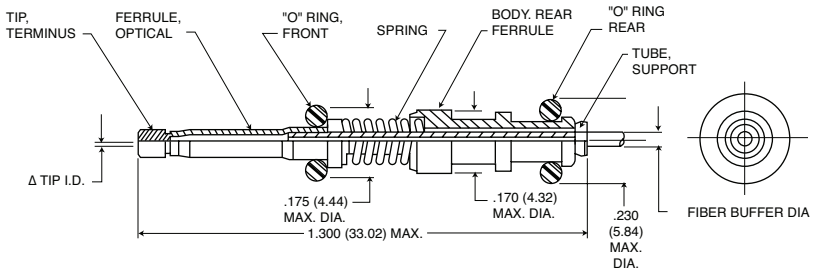
FOMC 2



FOMC 7



Contact Assembly



How to Order - Contacts

FOMC - T - 10 - 1270

ITT SERIES

TERMINUS ASSEMBLY

BUFFER DIAMETER

TIP

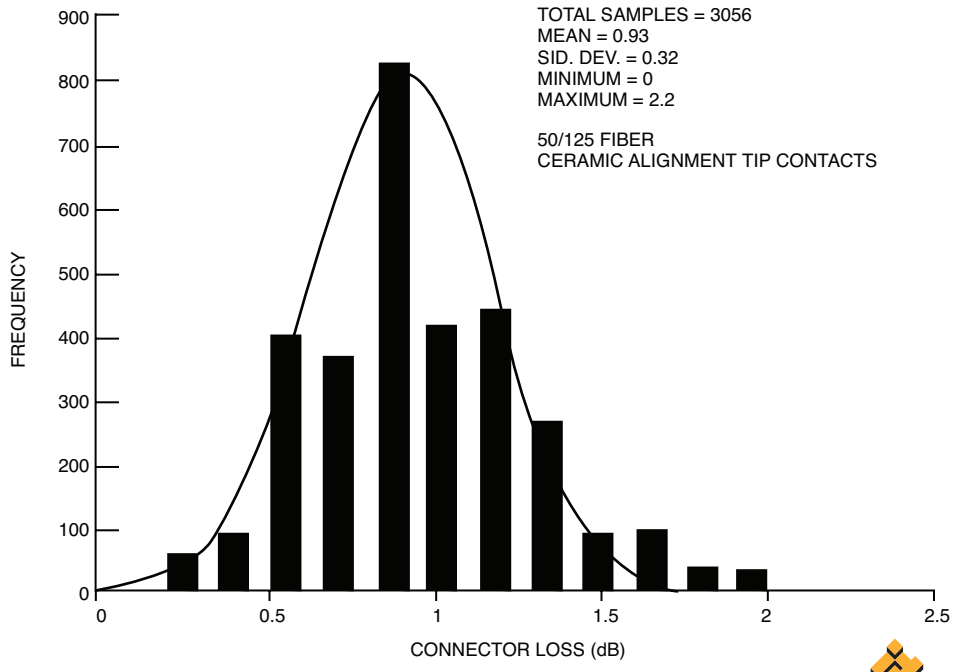
SERIES
FOMC - Fiber Optic Multi-Channel

TERMINUS ASSEMBLY

BUFFER DIAMETER (in millimeters)
05 - 0.5 mm Buffer
10 - 1.0 mm Buffer
11 - 1.1 mm Buffer

TIP (I.D. in tenths of microns)
1270 - 127.0 μm min.
1300 - 130.0 μm min.
1440 - 144.0 μm min.

Coupling Performance



Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

The next generation connector system for military tactical deployments.

MIL-PRF-83526 Compliant Fiber Optic Connector System

ITAC, ITT's Ground Tactical connector system was designed primarily for harsh environmental conditions and utilizes industry standard physical contact ceramic ferrule and keyed termini. Although designed for minimal maintenance in the field, the removable end insert, with four separate keying options, allows direct access to the alignment sleeves and termini for easy cleaning and inspection. Hermaphroditic design enables multiple ITAC plug assemblies to be daisy-chained together.

Product Features

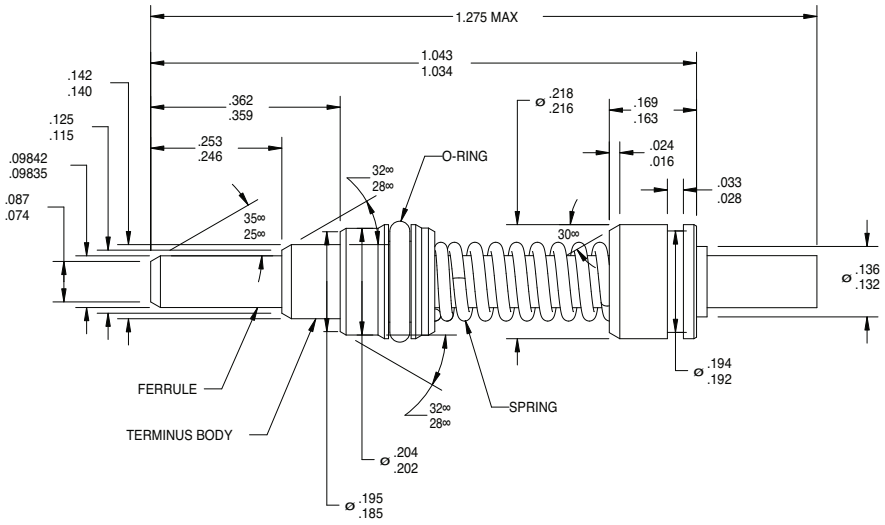
- Conforms to MIL-PRF-83526/16 and /17 Specifications
- Hermaphroditic Connection System
- Genderless Termini
- Hermaphroditic Plug & Jam-Nut Receptacle Configurations
- High Density Arrangements
- Operating Temperature Range: -65C to +160C.
- Environmental Sealing Terminus
- 2.5 mm Diameter Ceramic Ferrule

	Multimode	Singlemode
Ferrule (O.D.)	2.5 mm	2.5 mm
Fiber Type	62.5/125	SMF 28
Insertion Loss (dB typ.)	0.40	0.60
Maximum Loss (dB max.)	0.75	1.00
Return Loss (dB typ.)	25	55
Return Loss (dB min.)	20	50
Channel Servicing	Single	
Channel Repair	Single	
Cyclic Durability	500	

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

ITAC 4 Channel Fiber Optic Connector System

Genderless Terminus design with Low Loss Optical Performance.



Contact Part Numbers		
M29504/16		
Genderless Terminus for use with M83526 /16 /17 Connectors		
Fiber Size	**Ferrule I.D.**	**Dash Number**
Singlemode 9/125	125 +1/-0	- 1250
Singlemode 9/125	125.5 +1/-0	- 1255
Singlemode 9/125	126 +1/-0	- 126S
Multimode 50/125, 62.5/125	126 +1/-0	- 126M
Multimode 50/125, 62.5/125	127 +1/-0	- 1270
Multimode 100/140	142 +1/-0	- 1420

Descriptive Part Number

ITAC / T – 1250 – M001

- **ITT Series**
- **Terminus Assy**
- **Ferrule I.D. Dash Number**
- **Modification Code**

Modification Code

Consult Factory for Modification Codes
(Omit for none)

- **Crimp Sleeve may be ordered separately. Part Number 252-1318-000**

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Terminus assembly:
   Ferrule: Zirconia Ceramic / N.A.
   Body: Stainless steel / Passivate
   Sleeve: Stainless steel / Passivate
   Crimp Sleeve: Brass Alloy/N.A
   Seal: Fluorosilicone
   Spring: High Tensile Stainless Steel/Passivate
3. **Tooling:**
   Insertion / Removal tool: 274-0059-000
4. **Instructions:** Consult factory for contact termination instructions and tooling.
5. **Connector:** Genderless Terminus used in with M83526 /16 /17 Plug and Receptacle configurations. See Page 61 for connector options.

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

ITAC 4 Channel Fiber Optic Connector System

Hermaphroditic design allows plugs to mate with an identical plug as well as receptacle.

ITT Series
ITAC - ITT Ground Tactical Connector Series

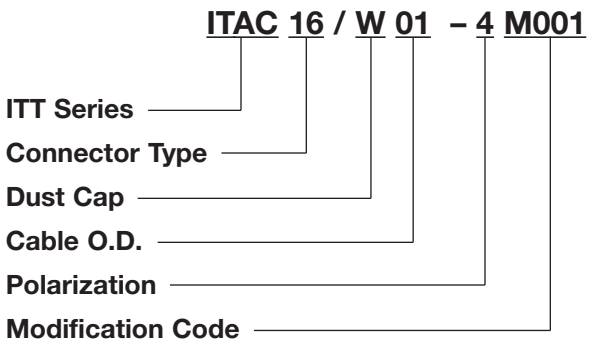
Connector Type
16 - Hermaphroditic Plug Connector
17 - Jam Nut Mount Receptacle Connector

Dust Cap
W - Connector Supplied with Dust Cap
X - Without Dust Cap

Cable O.D. Inches (mm)
01 - .190 - .239 (4.83 - 6.07)
02 - .240 - .279 (6.10 - 7.09)
03 - .280 - .315 (7.11 - 8.00)
04 - .316 - .346 (8.03 - 8.79)
05 - .347 - .379 (8.81 - 9.63)
06 - .380 - .423 (9.64 – 10.74)
07 - .424 - .465 (10.77 – 11.81)

Polarization
0 - Universal
1 - Key Configuration 1
2 - Key Configuration 2
3 - Key Configuration 3

Descriptive Part Number

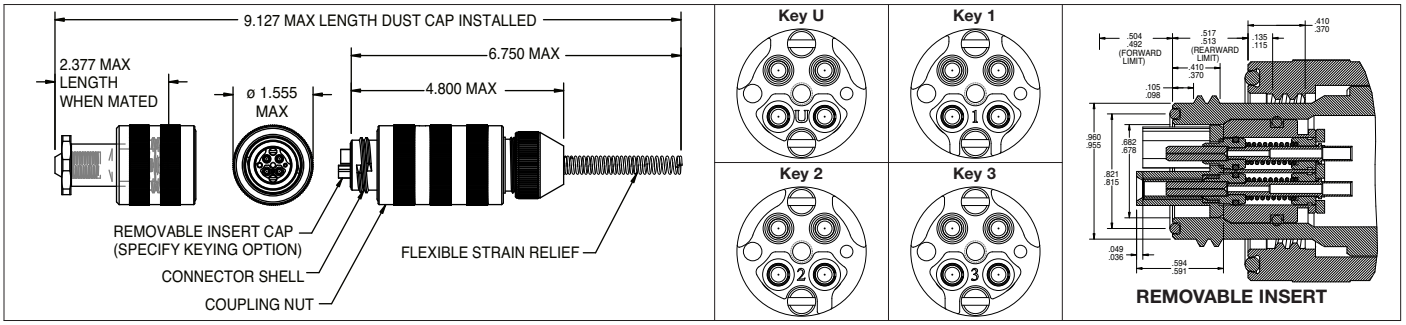


Modification Code
Consult Factory for Modification Codes
(Omit for none)

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

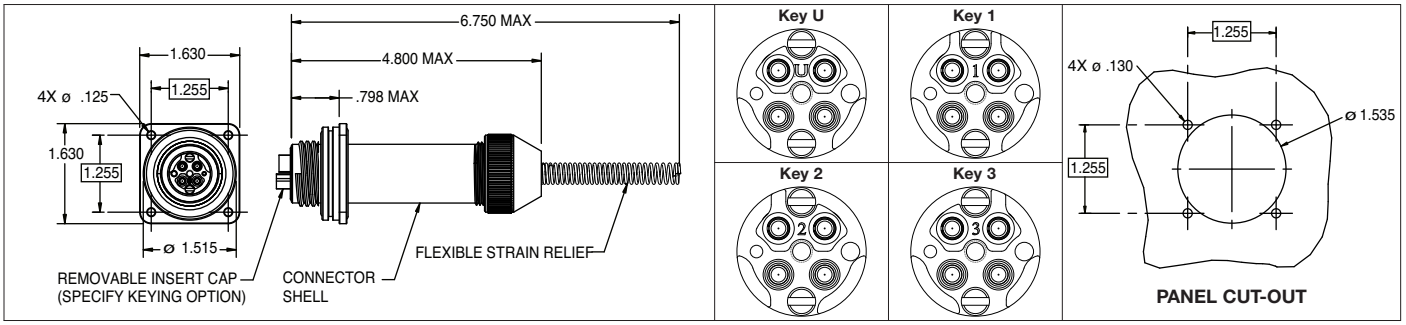
ITAC 4 Channel Fiber Optic Connector System

ITT is a major supplier of fiber optic cable assemblies for multi channel tactical ground based and avionics applications



M83526/16 Hermaphroditic Plug Connector — PRODUCT NOTES

1. **Material / Finish:**
   Insert: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Screws, Washers, Alignment pins: Stainless Steel/NA
2. **Tooling:**
   Insertion / Removal tool: 274-0059-000
3. **Instructions:** Consult factory for assembly, installation and maintenance instructions.
4. **Termini:** Genderless design allows termini to be used in Plug and Receptacle configurations.
   See Page 61 for Product Details.



M83526/17 Jam Nut Mount Receptacle Connector — PRODUCT NOTES

1. **Material / Finish:**
   Insert: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Screws, Washers, Alignment pins: Stainless Steel/NA
2. **Tooling:**
   Insertion / Removal tool: 274-0059-000
3. **Instructions:** Consult factory for assembly, installation and maintenance instructions.
4. **Termini:** Genderless design allows termini to be used in Plug and Receptacle configurations.
   See Page 61 for Product Details.

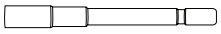
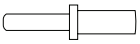
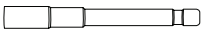
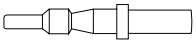
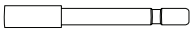
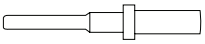
ITT fiber optic contacts are a standard in the industry. We offer the most complete line of fiber optic contacts, engineered to fit today's MIL-Spec circular, rack and panel, edgecard/LRM, and D Subminiature connectors.

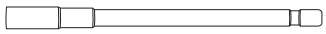
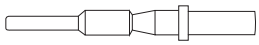
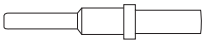
- Conforms to MIL-T-29504 fiber optic termini.
- Fits any size 16 cavity with no modification to connector.
- Designed for use with standard size 16 contact insertion/extraction tool.
- Both pin and socket contact end faces are easily cleaned.

Fiber Optic Contact Performance Data

Durability	< 0.5 dB change after 500 matings
Temperature Shock	< 0.5 dB change during and after test
Operating Temperature	- 65˚C to + 200˚C (Cable/contact dependent)
Vibration, random (16 hrs/MIL-C-38999)	< 0.5 dB change during and after test
Optical Loss Performance	1.0 dB loss for 62.5 / 125 fiber

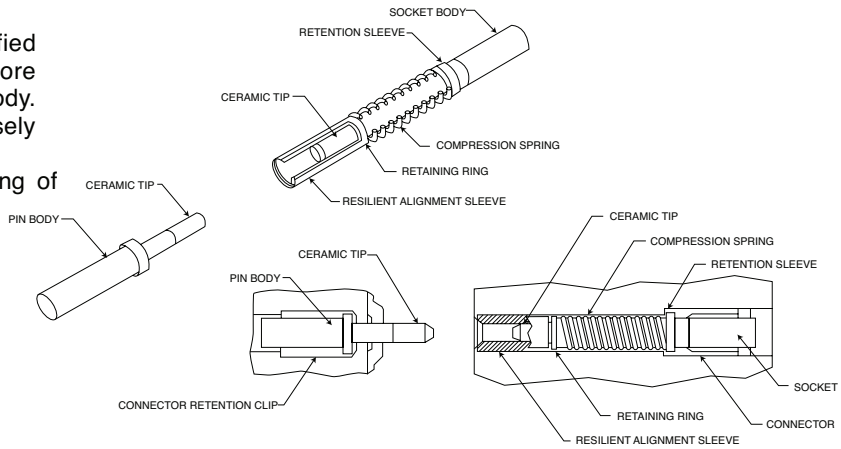
Standard MIL-Spec Connector

Standard Connector	Cannon Designator	Number of Size #16 Cavities Available Dependent Upon Shell Size	Fiber Optic Contact Socket (Body)	Fiber Optic Contact Pin (Body)
MIL-C-38999 Series I 	KJL	1-29	 MIL-T-29504/5	 MIL-T-29504/4
MIL-C-38999 Series III MIL-C-38999 SeriesIV	KJA	1-29		
MIL-C-26482 Series I 	KPSE	1-31		
MIL-C-26482 Series II	PV7	1-31		
MIL-C-83723 Series I	PVA	1-31		
MIL-C-83723 Series III	HTMF	1-52	 MIL-T-29504/11	 MIL-T-29504/10
MIL-C-83733 	DPK	Up to 64		

MIL-C-28840	KFS	Up to 8	 MIL-T-29504/9	 MIL-T-29504/8
 ARINC 600	BKAD	Up to 6		
			 MIL-T-29504/7	 MIL-T-29504/6
MIL-C-83527	BKW	Up to 30		

Ceramic Tip Optical Contacts

ITT' s new precision optical contacts offer superior coupling performance and a simplified termination process. Ceramic zirconia tips more accurately center the fiber within the contact body. A rugged thermoplastic alignment sleeve precisely aligns the mating contacts. Solid state epoxy retained within the contact eliminates any handling of epoxy.



How to Order Fiber Optic Hybrid Contacts

FOHC - P A 1422 J P

SERIES
GENDER
TERMINUS/CONNECTOR SERIES
HOLE SIZE (1422 means 142.2 microns)
ALIGNMENT SYSTEM
PREFORM

SERIES- Fiber Optic Hybrid Contacts

GENDER
P - Pin
S - Socket

TERMINUS/CONNECTOR SERIES
A - MIL-C-29504/4 & /5: For use in MIL-C-38999 Series I, III & IV Connectors.
B - MIL-T-29504/10 & /11: For use in MIL-C-83723 Series I, III; MIL-C-83733; and MIL-C-26482 Series II Connectors.
C - MIL-C-29504/6 & 7; For use in MIL-C-83527; MIL-C-81659; ARINC 600; and ARINC 404 Connectors.
D - (No Terminus Spec): For use in MIL-C-26482 Series I & MIL-C-26500 Connectors.
E - (No Terminus Spec): For use in MIL-C-83723 Series II & MIL-C-5015G Connectors.
F - MIL-C-29504/8 & /9: For use in MIL-C-28840 Connectors.
G - (No Terminus Spec): For use in MIL-C-83723 Series III/82, /83, /86 & /87 Connectors.
H - (No Terminus spec): For use in D*M Mark I, G06, E2P (DIN) Fiber Optic/Coaxial Housing.

HOLE SIZE (MICRONS)* - JEWEL
1219 1321 1422 1650 2200 2400 2600 2800
1245 1346 1447 1700 2250 2450 2650
1270 1372 1550 1750 2300 2500 2700
1295 1397 1600 1800 2350 2550 2750

HOLE SIZE (MICRONS)* - CERAMIC TIP

1250	1400	1700
1270	1420	1720
1290	1440	1740

ALIGNMENT SYSTEM
J - Jewel, Synthetic Ruby
P - Precision Ceramic Tip

PREFORM
P - Preform Epoxy Supplied (available for terminus/connector series A, B and G only)
N - No Preform Epoxy Supplied

*For Size not listed, consult factory.

How to Order Fiber Optic Receptacles (Mates with MIL-T-29504/4 Contacts)

FOHC- * - *

SERIES
SHELL STYLE
SEALING

SERIES - Fiber Optic Hybrid Contacts

SHELL STYLE
3 - Receptacle, Device, PCB Mount
4 - Receptacle, Device, Flange Mount
7 - Receptacle, Adapter, In-Line Cable Panel Mount

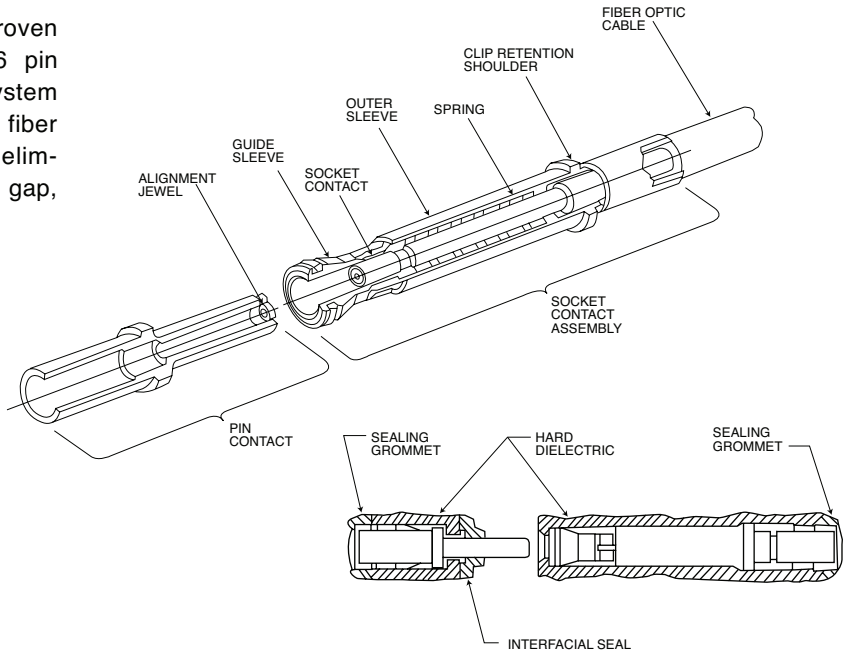
SEALING
N - Non-Sealed
S - Sealed

Adapter for in-line cable mechanical splice.

Receptacle for mounting T0-18/T0-46/T0-52 devices.

Jewel Ferrule Alignment System

ITT's patented* optical contacts allow the use of all standard fibers via the field-proven jewel ferrule alignment system in a size 16 pin or socket contact. The jewel ferrule system provides precise alignment regardless of fiber size, accommodates fiber tolerances, eliminates the requirement for a minimum end gap, and alloys for spring loading of contacts.



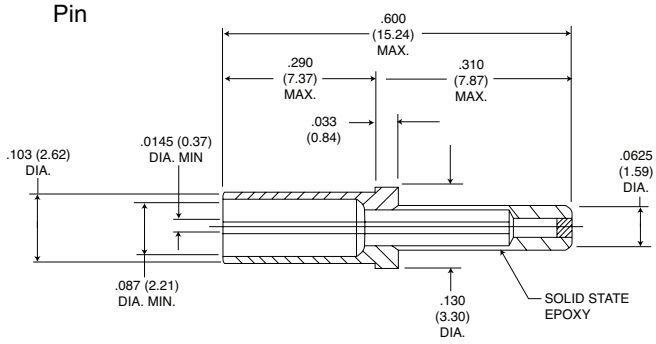
*U.S. Patent No 4,351,586, No. 3,947,182, and No. 4,747,658

Solid State Epoxy

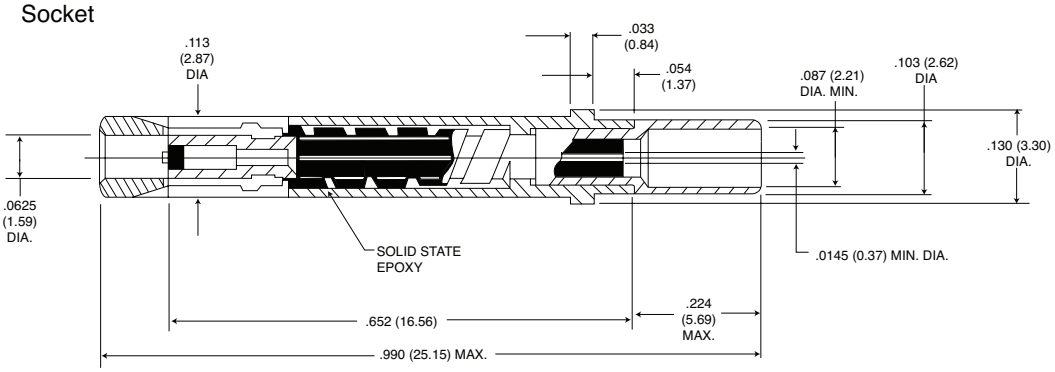
Since the advent of fiber optics, fibers have been terminated in optical contacts using messy two-part liquid epoxy. This process is cumbersome and not conducive to high volume production.

Optical contacts are now available with solid state epoxy. The fiber is inserted into the contact and the epoxy is reflowed in a cure fixture. No mixing of liquids is required; the volume and flow viscosity is controlled, resulting in a perfect bond and the elimination of clean-up.

Pin



Socket



Note: Dimensions are for 38999 contacts.

MIL-DTL-29504 /4 and /5 Termini

Size 16 termini for use in standard MIL-DTL-38999 connectors provide flexibility of combining electrical and optical circuits in the same connector.

ITT has been in the forefront of optical interconnect technology development for over 30 years. One of the original products were MIL-DTL-29504 termini, patented in 1976, utilizing jewels with metallic ferrule/alignment sleeve technology for fiber alignment. These termini are still in use. Improvements to the original approach include use of precision ceramic ferrules and ceramic alignment sleeves to yield lower optical loss performance. ITT now offers MIL-DTL-29504 QPL'd termini incorporating the latest ceramic alignment technology with stainless steel bodies.

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

Product Features

- Low Cost Termini Solution
- Stainless Steel Hardware
- Removable Hood
- Precision Ceramic Ferrule and Alignment Sleeve
- Used in MIL-DTL-38999 Connectors with Size 16 cavities
- Operating Temperature Range: -65C to +200C.

	Multimode	Singlemode
Ferrule Type	1.59 mm	1.59 mm
Fiber Type	Multimode 62.5/125	Singlemode SMF 28
Insertion Loss (dB typ.)	0.40	0.60
Maximum Loss (dB max.)	0.75	1.00
Return Loss (dB typ.)	25	55
Return Loss (dB min.)	20	50
Channel Servicing	Single	
Channel Repair	Single	
Channel Density (Chan./sq-in.)	30	
Cyclic Durability	500	

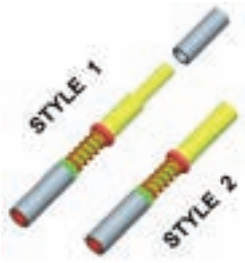
Size 16 termini for use in standard MIL-DTL-38999 connectors provide flexibility of combining electrical and optical circuits in the same connector.

Style 1 – Captive Strength Member Outside Barrel (Body) with Heat Shrink Tubing

Style 2 – Cable Jacket Bonded inside Barrel (Body)

PIN TERMINUS

MIL-DTL-29504/4



SOCKET TERMINUS

MIL-DTL-29504/5

		Part Numbers					
		MIL-PRF-29504/4 Pin Terminus			MIL-PRF-29504/4 Socket Terminus		
Fiber	Ferrule I.D.	Style 1	Style 2	Reference Only M29504/4-XXXX	Style 1	Style 2	Reference Only M29504/5-XXXX
Singlemode 9/125	125.5 +1/-0	031-9740-000	031-9740-000	M29504/4-4208*	031-9741-000	031-9743-000	M29504/5-4237*
Singlemode 9/125	126 +1/-0			M29504/4-4209*			M29504/5-4238*
Multimode 50/125, 62.5/125	126 +1/-0	031-9740-004	031-9740-004	M29504/4-4210*	031-9741-004	031-9743-004	M29504/5-4239*
Multimode 50/125, 62.5/125	127 +1/-0			M29504/4-4040			M29504/5-4046
Multimode 100/140	142 +1/-0	031-9740-007	031-9740-007	M29504/4-4043	031-9741-007	031-9743-007	M29504/5-4049
Multimode 100/140	144 +1/-0			M29504/4-4044			M29504/5-4050
Multimode 62.5/125/155	156 +3/-0			M29504/4-4211*			M29504/5-4240*
Multimode 62.5/125/155	157 +3/-0	031-9740-006	031-9740-006	M29504/4-4212*	031-9741-006	031-9743-006	M29504/5-4241*
Multimode 100/140/172	173 +3/-0	031-9740-011	031-9740-011	M29504/4-4087	031-9741-011	031-9743-011	M29504/5-4088
Multimode 100/140/172	175 +3/-0			M29504/4-4213*			M29504/5-4242*

PRODUCT NOTES

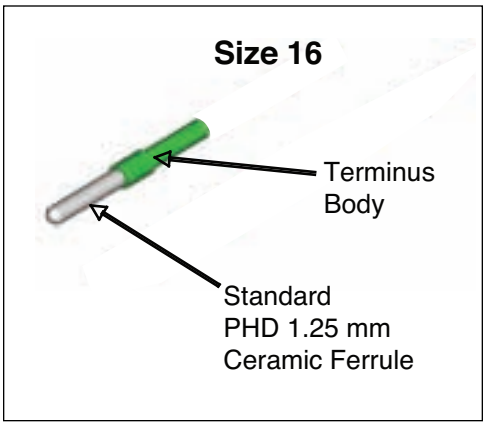
1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Ferrule: Zirconia Ceramic / N.A.
   Terminus assembly Stainless steel / Passivate
3. **Tooling:**
   Size 16 Plastic Insertion/Extraction CIET-16-03
   Size 16 Metal Insertion – 995-0001-732
   Size 16 Metal Extraction – 995-0001-731
4. **Instructions:** Consult factory for assembly instructions and termination tool list

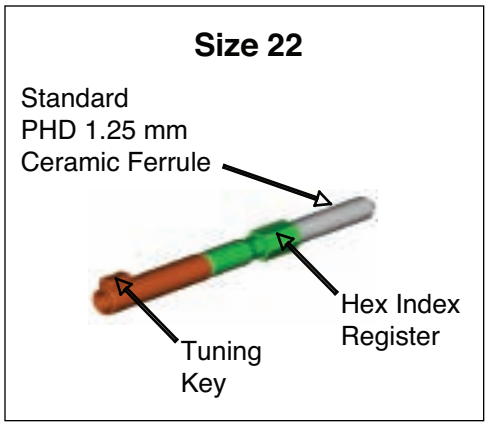
PHD Fiber Optic Terminus (Size 16 & 22)

The PHD Terminus System provides the industry's highest and most stable performance for multi-channel interconnects. The PHD design delivers reduced insertion loss, less channel-to-channel variance and easy integration into High Density Interconnect Hardware.

The optical terminus system builds off LC/MU Small Form Factor (SFF) technology:

- 1.25 Zirconia discrete channel ceramic ferrule based
- Thermal cured epoxy fiber retention
- 250 micron, 650 micron, 900 micron fiber up-sizing compatible
- Singlemode/Multimode compatible
- Telecordia GR-326 end face geometry compliant
- APC compatible





PHD's Size 22 Tuned Optical Terminus provides a significant reduction in average and maximum random mated insertion loss.

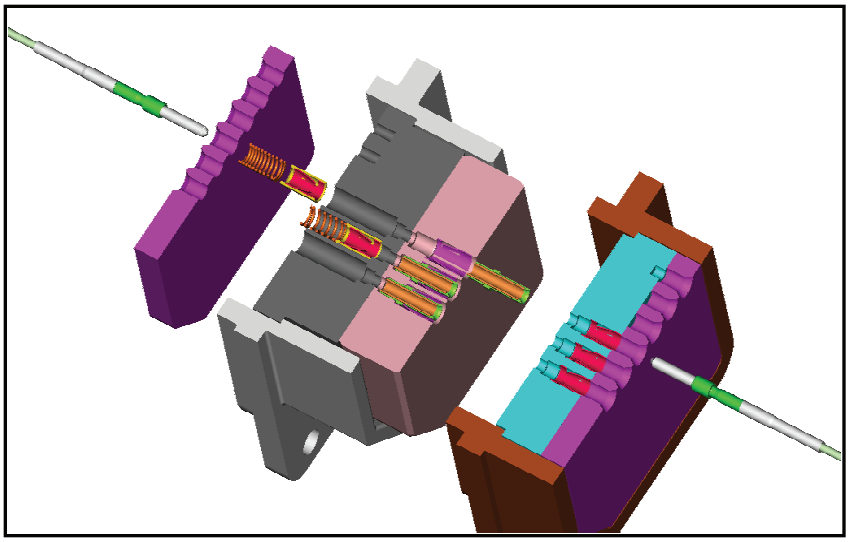
	Multimode 62.5/125	Singlemode SMF 28
Ferrule (O.D.)	1.25 mm	1.25 mm
Insertion Loss (dB typ.)	0.30	0.20
Maximum Loss (dB max.)	0.50	0.30
Return Loss (dB typ.)	25	56
Return Loss (dB min.)	20	50
Channel Servicing	Single	
Channel Repair	Single	
Cyclic Durability	1000	

The PHD Terminus systems compatible with the following connector configurations:

PHD38999
ARINC Special
PHD Panel Mount
D-Sub
Rack & Panel
PHD Backplane
Plastic Bodied Circular

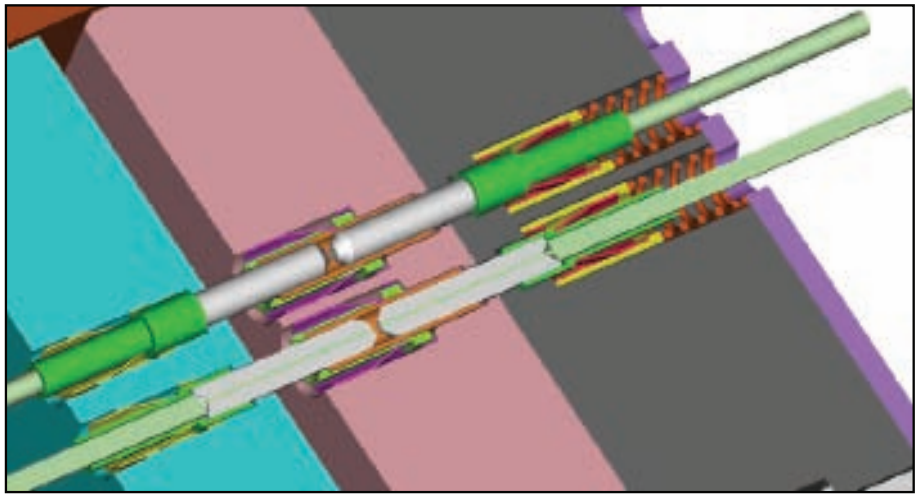
See respective catalog page for product specifications/options.

The PHD Clip Style Retention System provides application proven termini integration within High Density Interconnect Solutions.



PHD Terminus retention is via Cannon's patented "Little Ceasar" contact retention clip technology. This allows unparalleled flexibility in installing, servicing, cleaning and repairing single optical channels without disturbing parallel channels.

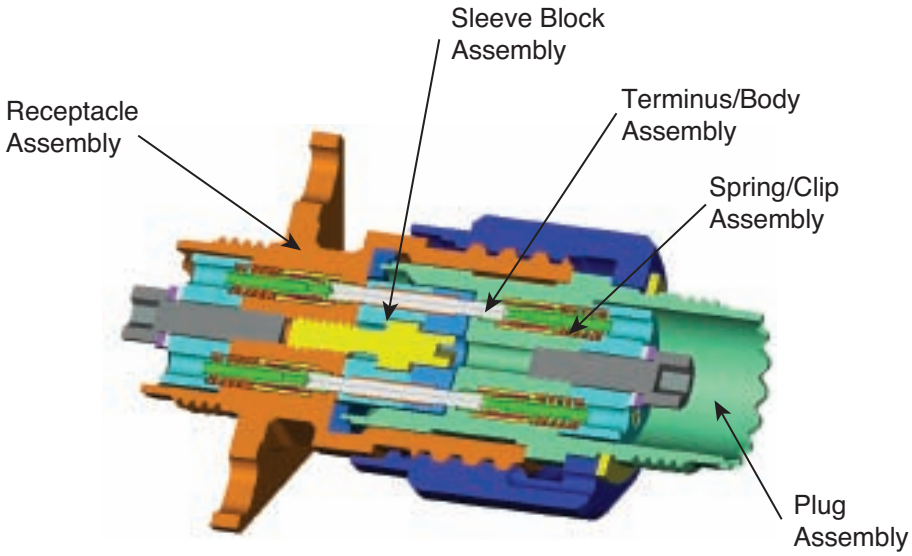
The use of modified industry standard components ensures a mature supply chain, proven manufacturing technologies and an embedded testing infrastructure.



PHD Termini Packaging (38999 Example)

The ease of packaging PHD SFF termini into various footprints has allowed ITT to grow the technology into an entire product structure within 2 years.

- Rear release clip retention system
- All ceramic LC optical channel coupled with dual spring packaging provides robust operation in severe environments
- Sealed connector design assure long-term reliability in wet/moist environments
- Standard 38999 backshell thread enables a broad range of shell termination options



Engagement Sequences

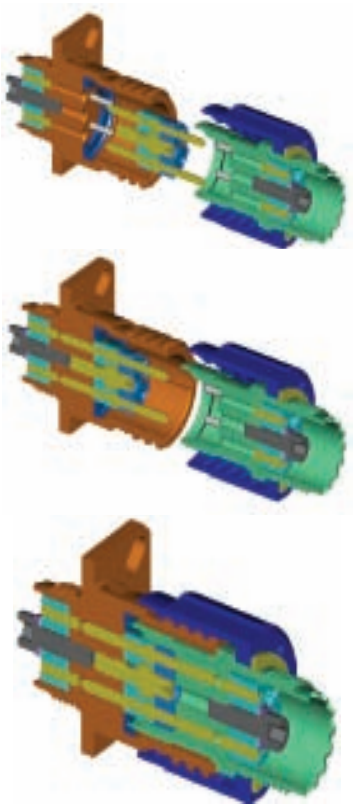
Since PHD optical connectors were designed “day-one” as all optical interconnects, specific features have been in corporated to ensure protection of optical termini during mating. In general a minimum of three alignment features are incorporated:

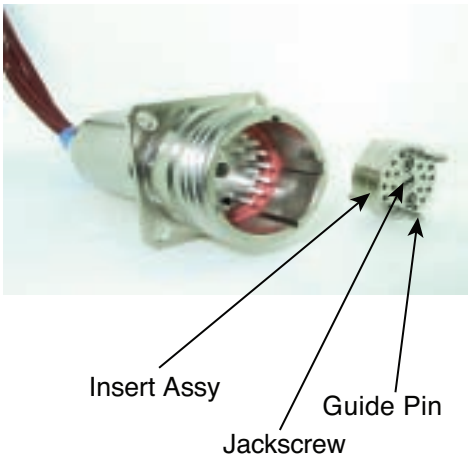
1st Stage: (Course) During connector mating standard keyways and inner/outer shell features provide and assure proper rotational alignment and gross axial alignment.

2nd Stage: (Intermediate) Fine axial and rotational alignment is ensured by the sleeve block assembly and precision guide pins.

3rd Stage: (Final) Ceramic Terminus Engagement Into The Ceramic Split Guide Sleeves (note: floating terminus and sleeve design is utilized within each terminus cavity).

Rules of Engagement





Removable sleeve inserts allow direct end-face access for terminus cleaning / inspection.

- ITT designs all of its PHD optical interconnects with removable sleeve assemblies. This ensures:
  - Direct endface access for individual terminus cleaning
  - Direct endface access for individual terminus inspection
  - Mass endface exposure for mass cleaning
- Jackscrew push-out of sleeve block precludes terminus damage due to handling
- Sleeve assembly mountable in either plug or receptacle in some connector configurations
- Extended sleeve keying is provided to prevent endface contact during installation

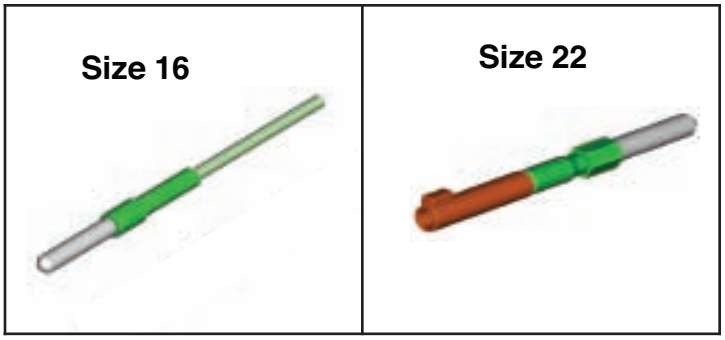
PHD Advantage

Robust Design with proven performance and reliability in harsh environments

- Common termini solution deployable across all fiber sizes and types (SM & MM).
- High Density (up to 50 channels per sq.-inch. Comparable to MT ferrule products)
- Packaging Flexibility: Package solutions across many military/ standard connector envelopes (Circular and rectangular)
- Removable sleeve inserts allow direct end-face access for terminus cleaning / inspection.
- Serviceable and maintainable at the discrete pathway level
- Discrete keyed contact system for low loss performance

Attribute / Performance Comparison

	Multimode			Singlemode		
	PHD	**29504**	**MT**	**PHD**	**29504**	**MT**
Ferrule Type	1.25 mm	1.59 mm	MT Ferrule	1.25 mm	1.5 mm	MT Ferrule
Fiber Type	62.5/125	62.5/125	62.5/125	SMF 28	SMF 28	SMF 28
Insertion Loss (db typ.)	0.30	0.40	0.30	0.20 (tuned)	0.60	0.40
Maximum Loss (db max.)	0.50	0.75	0.75	0.30 (tuned)	1.00	0.75
Return Loss (db typ.)	25	25	20	56	55	55
Return Loss (db min.)	20	20	15	50	50	50
Channel Servicing	Single	Single	8 >	Single	Single	8 >
Channel Repair	Single	Single	8 >	Single	Single	8 >
Channel Density (chan./sq-in)	50	30	48	50	30	48
Cyclic Durability	1000	500	75	1000	500	25



PHD / T 22 – 1250 – M001

- ITT Series
- Terminus Assy
- Terminus Size
- Ferrule I.D. Dash Number
- Modification Code

Fiber Size	Ferrule I.D.	Dash Number
Singlemode 9/125	125 +1/-0	- 1250
Singlemode 9/125	125.5 +1/-0	- 1255
Singlemode 9/125 & Multimode 50/125, 62.5/125	126 +1/-0	- 1260
Multimode 50/125, 62.5/125	127 +1/-0	- 1270
Multimode 100/140	142 +1/-0	- 1420

Terminus Size
16 or 22

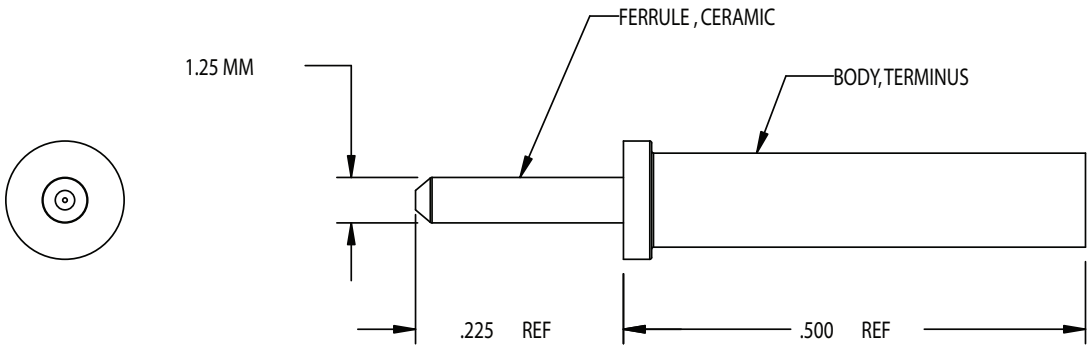
Modification Code
Consult Factory for Modification Codes
(Omit for none)

Terminus Part Numbers
Cross Reference

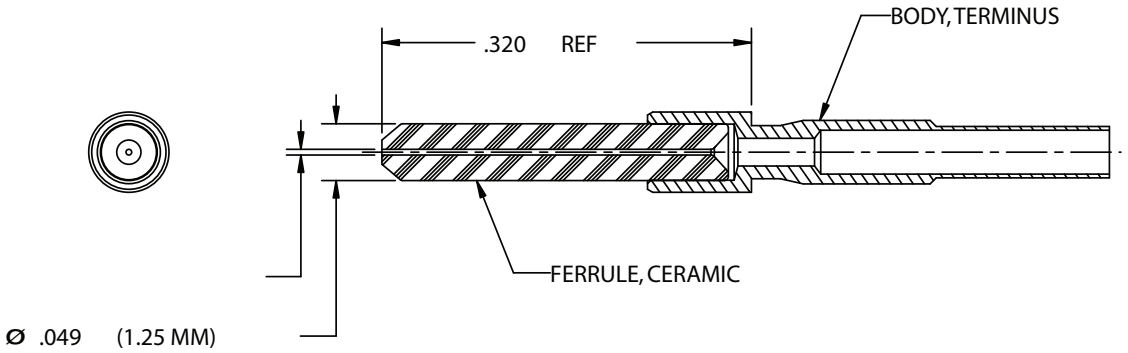
Fiber Type	Ferrule I.D.	Size 22 Max. Buffer/Jacket O.D. 1.1 mm		Size 16 Max. Buffer/Jacket O.D. 2.0 mm	
		ITT Internal Part Number	Descriptive Part Number	ITT Internal Part Number	Descriptive Part Number
Singlemode SMF28	125 +1/-0	031-9727-007	PHD-T22-1250	031-9728-000	PHD-T16-1250
	125.5 +1/-0	NOT ASSIGNED	PHD-T22-1255	NOT ASSIGNED	PHD-T16-1255
	126 +1/-0	NOT ASSIGNED	PHD-T22-1260	031-9728-001	PHD-T16-1260
Multimode 50/125 & 62.5/125	127 +1/-0	031-9727-008	PHD-T22-1270	031-9728-002	PHD-T16-1270
Multimode 100/140	142 +1/-0	031-9727-003	PHD-T22-1420	031-9728-003	PHD-T16-1420

PHD Fiber Optic Terminus (Size 16 & 22)

Size 16

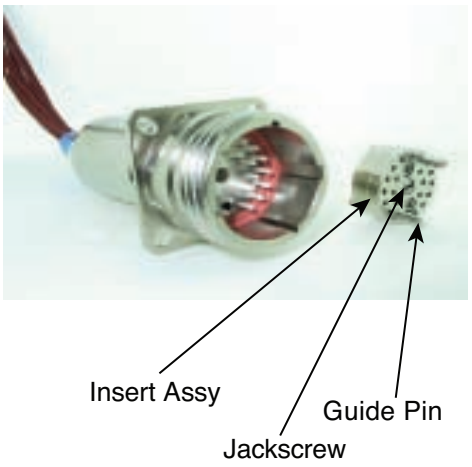


Size 22



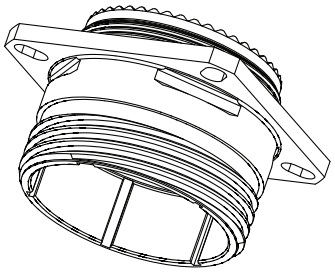
PRODUCT NOTES	
1. **Packaging:** Identification includes manufacturer's name and part number 2. **Material / Finish:** Ferrule: Zirconia Ceramic / N.A. Terminus assembly: Brass Alloy / Gold plating	3. **Insertion / Removal tools:** Size 22 – Metal Insertion/Extraction 274-0053-0000 Size 16 Plastic Insertion/Extraction CIET-16-03 Size 16 Metal Insertion – 995-0001-732 Size 16 Metal Extraction – 995-0001-731 4. Consult factory for assembly and termination tools or factory build cable assemblies. 5. **Applications:** Military/Aero space Fiber Optic Interconnect environments.

Meets MIL-DTL-38999 envelope dimensions including Standard Polarization, Backshell Threads and Panel Cut-Out / Mounting Holes.

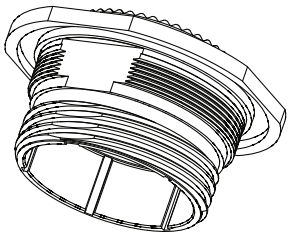


Product Features

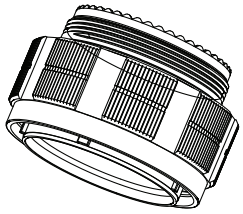
- PHD Optical Contact System (Including Tuned Contacts)
- All Metallic 38999 Compatible Outside Dimensions
- Internal Metallic Web for EMI Suppression and Terminus Stability
- Standard 38999 Keys
- All Metallic Backshell w/Sealing Grommet
- Size 22 and Size 16 Termini Back body to accommodate large variety of fiber buffering/Jackets
- Removable alignment insert assembly mountable in either plug or receptacle.



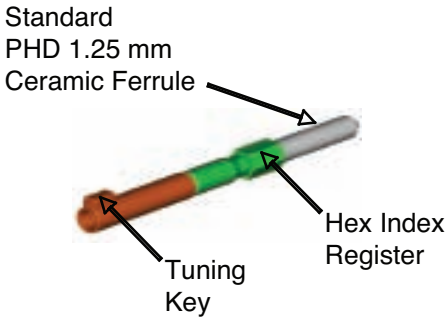
Wall Mount Receptacle



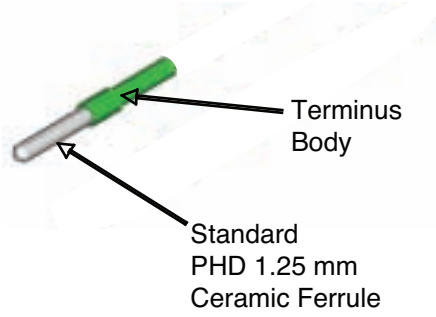
Jam Nut Receptacle



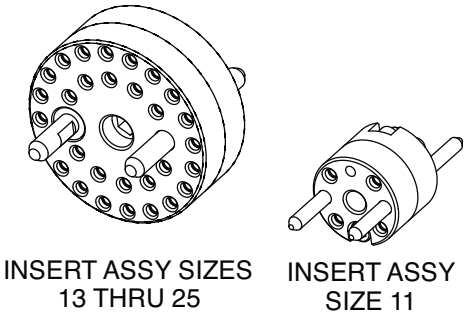
Plug



Size 22 Termini



Size 16 Termini

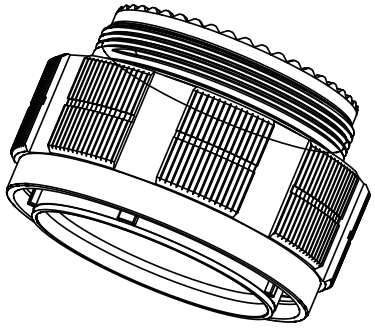


Front Alignment Insert Assembly

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Insert: Aluminum Alloy / Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy/Electroless Nickel or Cadmium plating. See Connector Assembly Matrix for Part Numbers
   Internal Springs, Cups, Clips, Screws, Washers, Alignment pins: Stainless Steel / NA
3. **Insertion / Removal tool:**
   Size 22 – Metal Insertion/Extraction 274-0053-0000
   Size 16 Plastic Insertion/Extraction CIET-16-03
   Size 16 Metal Insertion – 995-0001-732
   Size 16 Metal Extraction – 995-0001-731
4. Alignment Insert Assembly may be added to the Plug Assembly or the Receptacle Assembly but not both. See Connector Assembly Matrix for Part Numbers.
5. **Applications:** Military/Aero space Fiber Optic Interconnect environments.

PHD Plug Connector



NOTES: UNLESS OTHERWISE SPECIFIED.

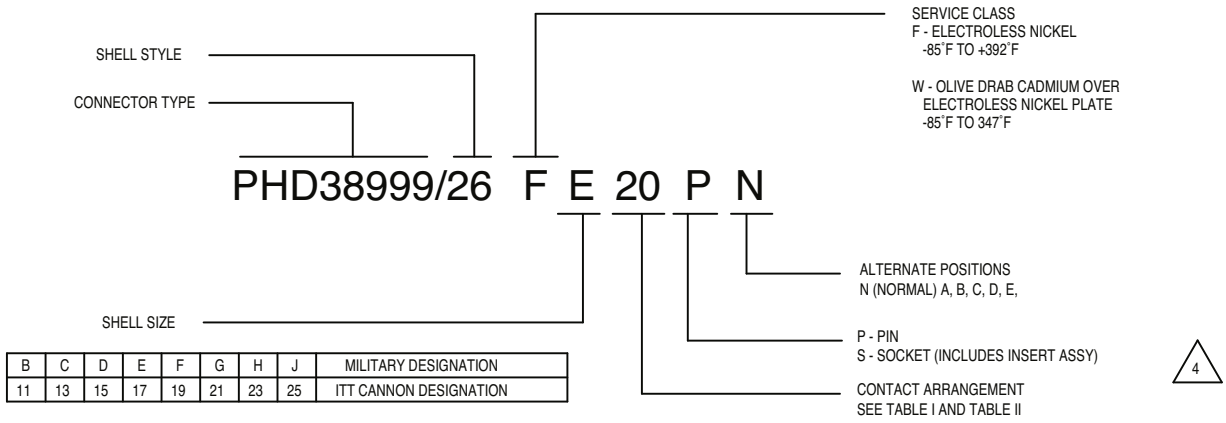
1. FOR CAVITY LAYOUT / MARKING, SEE APPLICABLE "CSA" CANNON STANDARD ARRANGEMENT.

2. MATERIAL TYPE:
   BARREL: ALUMINUM ALLOY
   COUPLING NUT: ALUMINUM ALLOY
   REAR PLATE: ALUMINUM ALLOY
   COUPLING NUT RETAINING RING: STAINLESS STEEL
   SCREW, WASHERS, DOWEL PINS: STAINLESS STEEL
   INTERNAL SPRINGS: STAINLESS STEEL
   INTERNAL CUPS / CLIPS: COPPER

3. FINISH: ELECTROLESS NICKEL PLATING OR CADMIUM PLATING
   SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.

△4 INSERT ASSEMBLY SHOWN IS OPTIONAL AND MAY BE ADDED TO, THE PLUG ASSEMBLY OR THE RECEPTACLE ASSEMBLY BUT NOT BOTH. SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.
INSERT ASSEMBLY MATERIALS: ALUMINUM ALLOY
FINISH: ELECTROLESS NICKEL PLATING
STAINLESS STEEL HARDWARE
INTERNAL SLEEVES CERAMIC

PART NUMBER
SHOWN: SHELL SIZE 17/20 POSITION CONTACT ARRANGEMENT

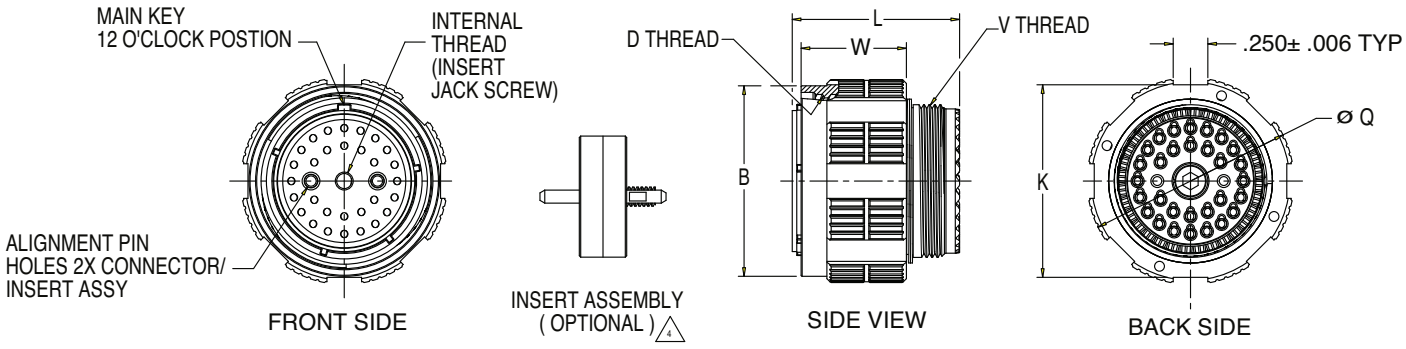


B	C	D	E	F	G	H	J	MILITARY DESIGNATION
11	13	15	17	19	21	23	25	ITT CANNON DESIGNATION

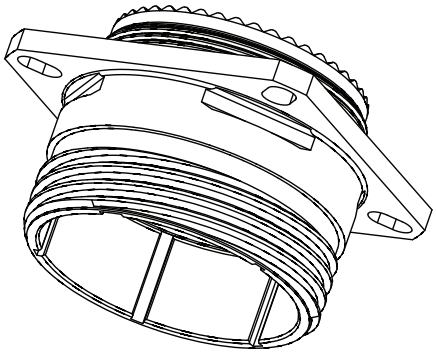
PHD Plug Connector

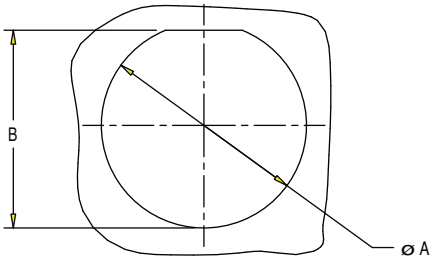
CONNECTOR ASSEMBLY - SIZE #22 CONTACT MATRIX / 900um CABLE TYPE												
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	B +.008 -.000	D THREAD CLASS 2B (PLATED)	K MAX	L MAX	Q DIA. MAX	METRIC V THREAD (PLATED)	W +.008 -.004	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/26FB4XX	CSA-PHD 11-4	NICKEL	11	4	.831	.7500-0.1P-0.3L-TS	.862	1.234	.969	M15X1-6g0.100R	.760	195-2000-003
PHD38999/26FC8XX	CSA-PHD13-8		13	8	1.000	.8750-0.1P-0.3L-TS	1.027		1.141	M18X1-6g0.100R		195-2000-005
PHD38999/26FD12XX	CSA-PHD15-12		15	12	1.130	1.0000-0.1P-0.3L-TS	1.153		1.266	M22X1-6g0.100R		195-2000-007
PHD38999/26FE20XX	CSA-PHD17-20		17	20	1.268	1.1875-0.1P-0.3L-TS	1.291		1.391	M25X1-6g0.100R		195-2000-009
PHD38999/26FF30XX	CSA-PHD19-30		19	30	1.374	1.2500-0.1P-0.3L-TS	1.398		1.500	M28X1-6g0.100R		195-2000-011
PHD38999/26FG40XX	CSA-PHD21-40		21	40	1.500	1.3750-0.1P-0.3L-TS	1.524		1.625	M31X1-6g0.100R		195-2000-013
PHD38999/26FH48XX	CSA-PHD23-48		23	48	1.618	1.5000-0.1P-0.3L-TS	1.642		1.750	M34X1-6g0.100R		195-2000-015
PHD38999/26FJ72XX	CSA-PHD25-72		25	72	1.744	1.6250-0.1P-0.3L-TS	1.768		1.875	M37X1-6g0.100R		195-2000-017

CONNECTOR ASSEMBLY - SIZE #16 CONTACT MATRIX / 2MM CABLE TYPE												
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	B +.008 -.000	D THREAD CLASS 2B (PLATED)	K MAX	L MAX	Q DIA. MAX	METRIC V THREAD (PLATED)	W +.008 -.004	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/26FB2XX	CSA-PHD11-2	NICKEL	11	2	.831	.7500-0.1P-0.3L-TS	.862	1.234	.969	M15X1-6g0.100R	.760	195-2000-002
PHD38999/26FC4XX	CSA-PHD13-4		13	4	1.000	.8750-0.1P-0.3L-TS	1.027		1.141	M18X1-6g0.100R		195-2000-004
PHD38999/26FD6XX	CSA-PHD15-6		15	6	1.130	1.0000-0.1P-0.3L-TS	1.153		1.266	M22X1-6g0.100R		195-2000-006
PHD38999/26FE8XX	CSA-PHD17-8		17	8	1.268	1.1875-0.1P-0.3L-TS	1.291		1.391	M25X1-6g0.100R		195-2000-008
PHD38999/26FF12XX	CSA-PHD19-12		19	12	1.374	1.2500-0.1P-0.3L-TS	1.398		1.500	M28X1-6g0.100R		195-2000-010
PHD38999/26FG16XX	CSA-PHD21-16		21	16	1.500	1.3750-0.1P-0.3L-TS	1.524		1.625	M31X1-6g0.100R		195-2000-012
PHD38999/26FH24XX	CSA-PHD23-24		23	24	1.618	1.5000-0.1P-0.3L-TS	1.642		1.750	M34X1-6g0.100R		195-2000-014
PHD38999/26FJ36XX	CSA-PHD25-36		25	36	1.744	1.6250-0.1P-0.3L-TS	1.768		1.875	M37X1-6g0.100R		195-2000-016



PHD Wall Mount Receptacle





SCALE 2:1

CONNECTOR PANEL CUTOUT		
SHELL SIZE	A +.010/-.000	B +.000/-.010
11	.825	.770
13	1.010	.995
15	1.135	1.085
17	1.260	1.210
19	1.385	1.335
21	1.510	1.460
23	1.635	1.585
25	1.760	1.710

NOTES: UNLESS OTHERWISE SPECIFIED.

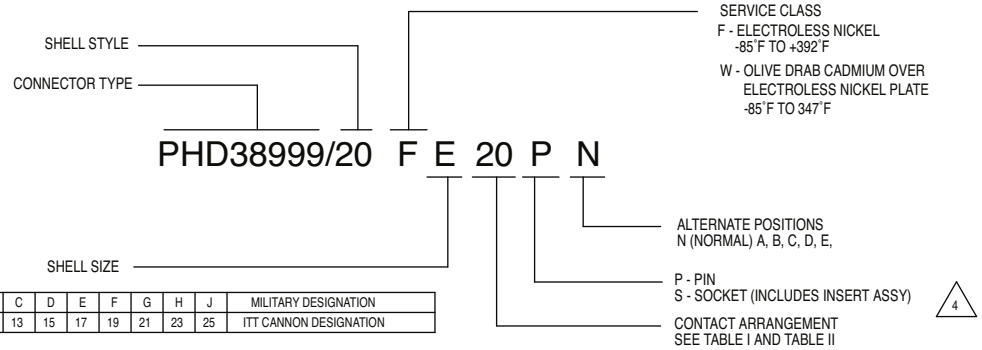
1. FOR CAVITY LAYOUT / MARKING, SEE APPLICABLE "CSA" CANNON STANDARD ARRANGEMENT.

2. MATERIAL TYPE:
   BARREL: ALUMINUM ALLOY
   COUPLING NUT: ALUMINUM ALLOY
   REAR PLATE: ALUMINUM ALLOY
   COUPLING NUT RETAINING RING: STAINLESS STEEL
   SCREW, WASHERS, DOWEL PINS: STAINLESS STEEL
   INTERNAL SPRINGS: STAINLESS STEEL
   INTERNAL CUPS / CLIPS: COPPER

3. FINISH: ELECTROLESS NICKEL PLATING OR CADMIUM PLATING
   SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.

4 INSERT ASSEMBLY SHOWN IS OPTIONAL AND MAY BE ADDED TO, THE PLUG ASSEMBLY OR THE RECEPTACLE ASSEMBLY BUT NOT BOTH. SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.
   INSERT ASSEMBLY MATERIALS: ALUMINUM ALLOY
   FINISH: ELECTROLESS NICKEL PLATING
   STAINLESS STEEL HARDWARE
   INTERNAL SLEEVES CERAMIC

PART NUMBER
SHOWN: SHELL SIZE 17/20 POSITION CONTACT ARRANGEMENT

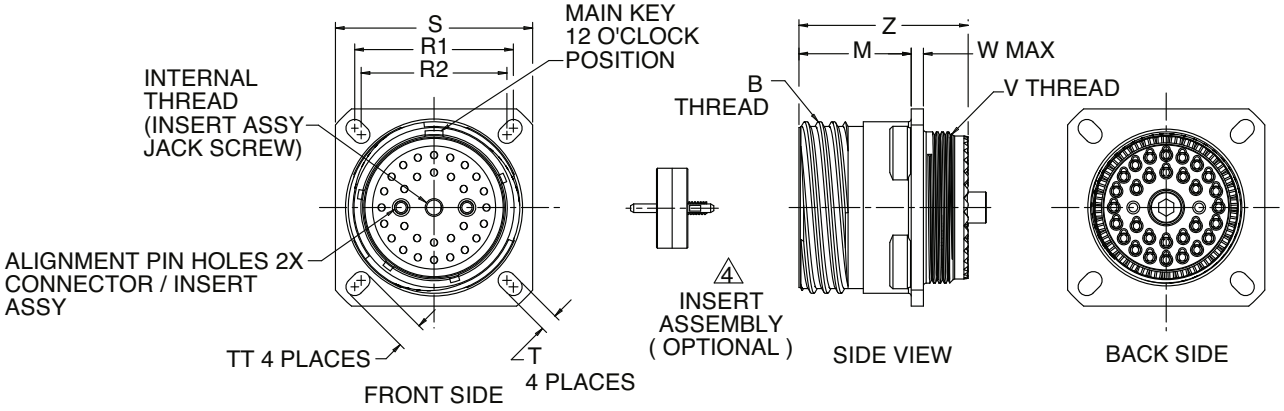


B	C	D	E	F	G	H	J	MILITARY DESIGNATION
11	13	15	17	19	21	23	25	ITT CANNON DESIGNATION

PHD Wall Mount Receptacle

CONNECTOR ASSEMBLY - SIZE #22 CONTACT MATRIX / 900um CABLE TYPE															
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	B THREAD CLASS 2 A (PLATED)	M +.000 -.005	R1	R2	S +/-.012	T +.004 -.002	TT +.004 -.002	METRIC V THREAD (PLATED)	W MAX	Z +.005 -.010	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/20FB4XX	CSA-PHD11-4	NICKEL	11	4	.7500-0.1P-0.3L-TS	.820	.812	.719	1.031	.128	.194	M15X1-6g0.100R	.098	1.235	195-2000-003
PHD38999/20FC8XX	CSA-PHD13-8		13	8	.8750-0.1P-0.3L-TS		.906	.812	1.125			M18X1-6g0.100R			195-2000-005
PHD38999/20FD12XX	CSA-PHD15-12		15	12	1.0000-0.1P-0.3L-TS		.969	.906	1.219		.173	M22X1-6g0.100R			195-2000-007
PHD38999/20FE20XX	CSA-PHD17-20		17	20	1.1875-0.1P-0.3L-TS		1.062	.969	1.312			M25X1-6g0.100R			195-2000-009
PHD38999/20FF30XX	CSA-PHD19-30		19	30	1.2500-0.1P-0.3L-TS		1.156	1.062	1.438		.194	M28X1-6g0.100R			195-2000-011
PHD38999/20FG40XX	CSA-PHD21-40		21	40	1.3750-0.1P-0.3L-TS	.790	1.250	1.156	1.562			M31X1-6g0.100R	.126		195-2000-013
PHD38999/20FH48XX	CSA-PHD23-48		23	48	1.5000-0.1P-0.3L-TS		1.375	1.250	1.688	.154	.242	M34X1-6g0.100R			195-2000-015
PHD38999/20FJ72XX	CSA-PHD25-72		25	72	1.6250-0.1P-0.3L-TS		1.500	1.375	1.812	.154		M37X1-6g0.100R			195-2000-017

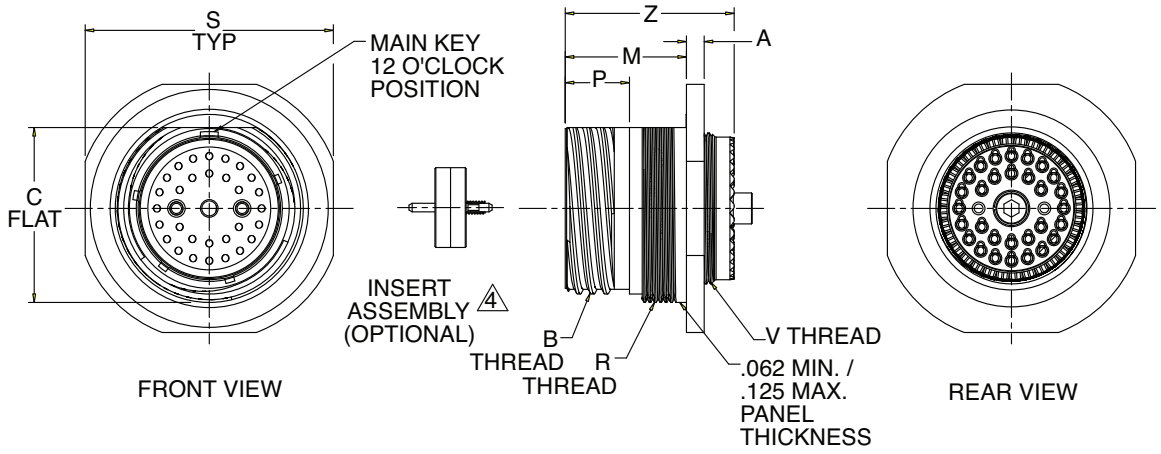
CONNECTOR ASSEMBLY - SIZE #16 CONTACT MATRIX / 2MM CABLE TYPE															
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	B THREAD CLASS 2 A (PLATED)	M +.000 -.005	R1	R2	S +/-.012	T +.004 -.002	TT +.004 -.002	METRIC V THREAD (PLATED)	W MAX	Z +.005 -.010	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/20FB2XX	CSA-PHD11-2	NICKEL	11	2	.7500-0.1P-0.3L-TS	.820	.812	.719	1.031	.128	.194	M15X1-6g0.100R	.098	1.235	195-2000-002
PHD38999/20FC4XX	CSA-PHD13-4		13	4	.8750-0.1P-0.3L-TS		.906	.812	1.125			M18X1-6g0.100R			195-2000-004
PHD38999/20FD6XX	CSA-PHD15-6		15	6	1.0000-0.1P-0.3L-TS		.969	.906	1.219		.173	M22X1-6g0.100R			195-2000-006
PHD38999/20FE8XX	CSA-PHD17-8		17	8	1.1875-0.1P-0.3L-TS		1.062	.969	1.312			M25X1-6g0.100R			195-2000-008
PHD38999/20FF12XX	CSA-PHD19-12		19	12	1.2500-0.1P-0.3L-TS		1.156	1.062	1.438		.194	M28X1-6g0.100R			195-2000-010
PHD38999/20FG16XX	CSA-PHD21-16		21	16	1.3750-0.1P-0.3L-TS	.790	1.250	1.156	1.562			M31X1-6g0.100R	.126		195-2000-012
PHD38999/20FH24XX	CSA-PHD23-24		23	24	1.5000-0.1P-0.3L-TS		1.375	1.250	1.688	.154	.242	M34X1-6g0.100R			195-2000-014
PHD38999/20FJ36XX	CSA-PHD25-36		25	36	1.6250-0.1P-0.3L-TS		1.500	1.375	1.812	.154		M37X1-6g0.100R			195-2000-016



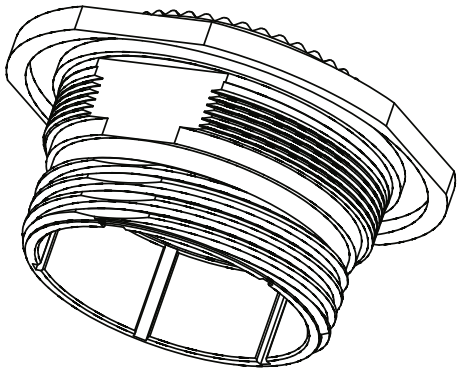
PHD Jam-Nut Receptacle

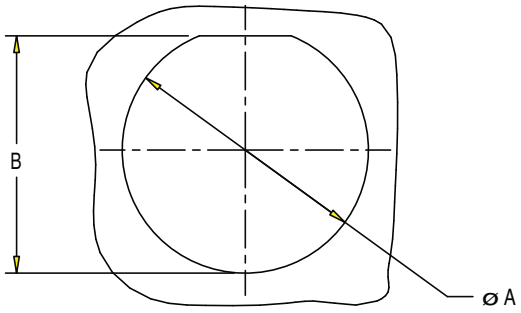
PHD38999 JAM RECEPTACLE - SIZE 22 CONTACT MATRIX / 900um CABLE TYPE														
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	A +.010 -.005	B THREAD CLASS 2 A (PLATED)	C +.004 -.010	Z +.005 -.004	M +.005 -.004	P +.016 -.004	S	METRIC R THREAD (PLATED)	METRIC V THREAD (PLATED)	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/24FB4XX	CSA-PHD11-4	NICKEL	11	4	.104	.7500-0.1P-0.3L-TS	.751	1.243	.871	.555	1.250	M20X1-6g0.100R	M15X1-6g0.100R	195-2000-003
PHD38999/24FC8XX	CSA-PHD13-8		13	8	.104	.8750-0.1P-0.3L-TS	.938		.878	.563	1.375	M25X1-6g0.100R	M18X1-6g0.100R	195-2000-005
PHD38999/24FD12XX	CSA-PHD15-12		15	12	.104	1.0000-0.1P-0.3L-TS	1.062				1.500	M28X1-6g0.100R	M22X1-6g0.100R	195-2000-007
PHD38999/24FE20XX	CSA-PHD17-20		17	20	.104	1.1875-0.1P-0.3L-TS	1.187				1.625	M32X1-6g0.100R	M25X1-6g0.100R	195-2000-009
PHD38999/24FF30XX	CSA-PHD19-30		19	30	.135	1.2500-0.1P-0.3L-TS	1.312				1.812	M35X1-6g0.100R	M28X1-6g0.100R	195-2000-011
PHD38999/24FG40XX	CSA-PHD21-40		21	40	.135	1.3750-0.1P-0.3L-TS	1.437				1.938	M38X1-6g0.100R	M31X1-6g0.100R	195-2000-013
PHD38999/24FH48XX	CSA-PHD23-48		23	48	.135	1.5000-0.1P-0.3L-TS	1.562				2.062	M41X1-6g0.100R	M34X1-6g0.100R	195-2000-015
PHD38999/24FJ72XX	CSA-PHD25-72		25	72	.135	1.6250-0.1P-0.3L-TS	1.687				2.188	M44X1-6g0.100R	M37X1-6g0.100R	195-2000-017

PHD38999 JAM RECEPTACLE - SIZE #16 CONTACT MATRIX / 2MM CABLE TYPE														
SAMPLE PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	A +.010 -.005	B THREAD CLASS 2 A (PLATED)	C +.004 -.010	Z +.005 -.004	M +.005 -.004	P +.016 -.004	S	METRIC R THREAD (PLATED)	METRIC V THREAD (PLATED)	INSERT ASSEMBLY (OPTIONAL) 4
PHD38999/24FB2XX	CSA-PHD11-2	NICKEL	11	2	.104	.7500-0.1P-0.3L-TS	.751	1.243	.871	.555	1.250	M20X1-6g0.100R	M15X1-6g0.100R	195-2000-002
PHD38999/24FC4XX	CSA-PHD13-4		13	4	.104	.8750-0.1P-0.3L-TS	.938		.878	.563	1.375	M25X1-6g0.100R	M18X1-6g0.100R	195-2000-004
PHD38999/24FD6XX	CSA-PHD15-6		15	6	.104	1.0000-0.1P-0.3L-TS	1.062				1.500	M28X1-6g0.100R	M22X1-6g0.100R	195-2000-006
PHD38999/24FE8XX	CSA-PHD17-8		17	8	.104	1.1875-0.1P-0.3L-TS	1.187				1.625	M32X1-6g0.100R	M25X1-6g0.100R	195-2000-008
PHD38999/24FF12XX	CSA-PHD19-12		19	12	.135	1.2500-0.1P-0.3L-TS	1.312				1.812	M35X1-6g0.100R	M28X1-6g0.100R	195-2000-010
PHD38999/24FG16XX	CSA-PHD21-16		21	16	.135	1.3750-0.1P-0.3L-TS	1.437				1.938	M38X1-6g0.100R	M31X1-6g0.100R	195-2000-012
PHD38999/24FH24XX	CSA-PHD23-24		23	24	.135	1.5000-0.1P-0.3L-TS	1.562				2.062	M41X1-6g0.100R	M34X1-6g0.100R	195-2000-014
PHD38999/24FJ36XX	CSA-PHD25-36		25	36	.135	1.6250-0.1P-0.3L-TS	1.687				2.188	M44X1-6g0.100R	M37X1-6g0.100R	195-2000-016



PHD Jam-Nut Receptacle





SCALE 2:1

NOTES: UNLESS OTHERWISE SPECIFIED.

1. FOR CAVITY LAYOUT / MARKING, SEE APPLICABLE "CSA" CANNON STANDARD ARRANGEMENT.

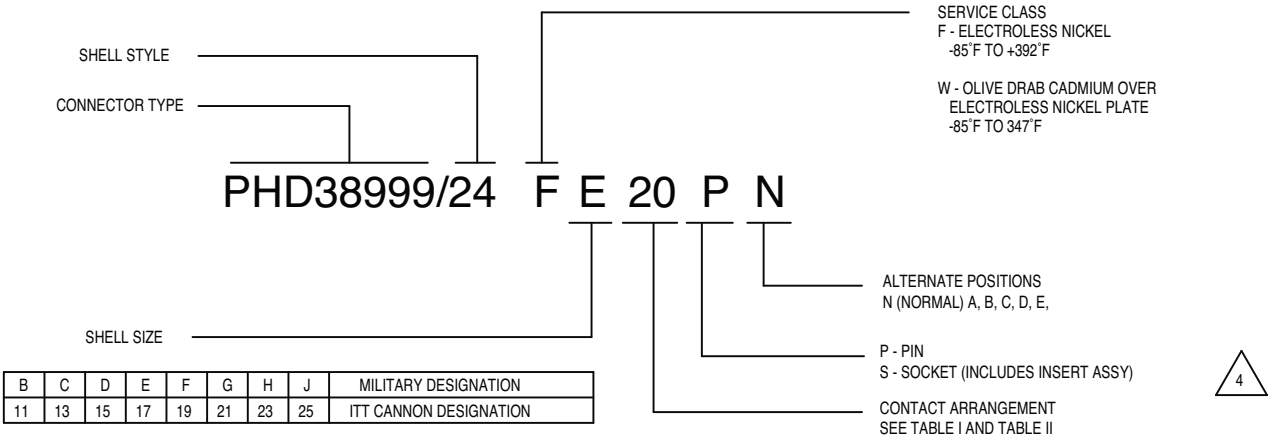
2. MATERIAL TYPE:
   SHELL: ALUMINUM ALLOY
   FRONT PERIPHERIAL SEAL: FLUOROSILICONE
   REAR PLATE: ALUMINUM ALLOY
   SCREWS, WASHERS, DOWEL PINS: STAINLESS STEEL
   INTERNAL SPRINGS: STAINLESS STEEL
   INTERNAL CUPS / CLIPS: COPPER

3. FINISH: ELECTROLESS NICKEL PLATING OR CADMIUM PLATING
   SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.

4 INSERT ASSEMBLY IS OPTIONAL AND MAY BE ADDED TO THE PLUG ASSEMBLY OR THE RECEPTACLE ASSEMBLY BUT NOT BOTH. SEE CONNECTOR ASSEMBLY MATRIX TABLE FOR PART NUMBERS.
INSERT ASSEMBLY MATERIALS:
   ALUMINUM ALLOY
   STAINLESS STEEL HARDWARE
   INTERNAL SLEEVES CERAMIC

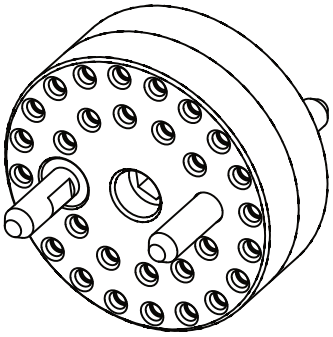
CONNECTOR PANEL CUTOUT		
SHELL SIZE	A +.010/-.000	B +.000/-.010
11	.825	.770
13	1.010	.995
15	1.135	1.085
17	1.260	1.210
19	1.385	1.335
21	1.510	1.460
23	1.635	1.585
25	1.760	1.710

PART NUMBER
SHOWN: SHELL SIZE 17/20 POSITION CONTACT ARRANGEMENT

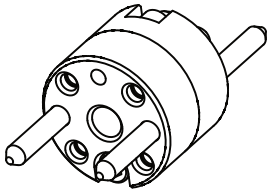


B	C	D	E	F	G	H	J	MILITARY DESIGNATION
11	13	15	17	19	21	23	25	ITT CANNON DESIGNATION

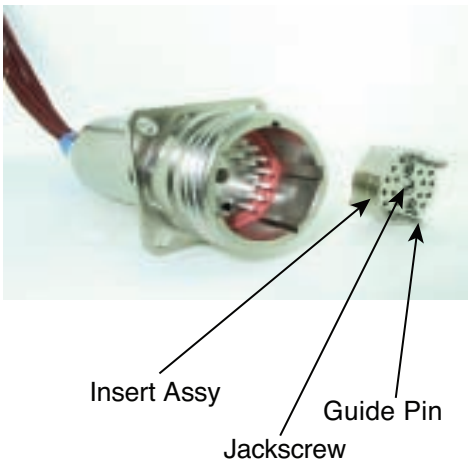
PHD Front Insert Assembly



INSERT ASSY SIZES
13 THRU 25



INSERT ASSY
SIZE 11

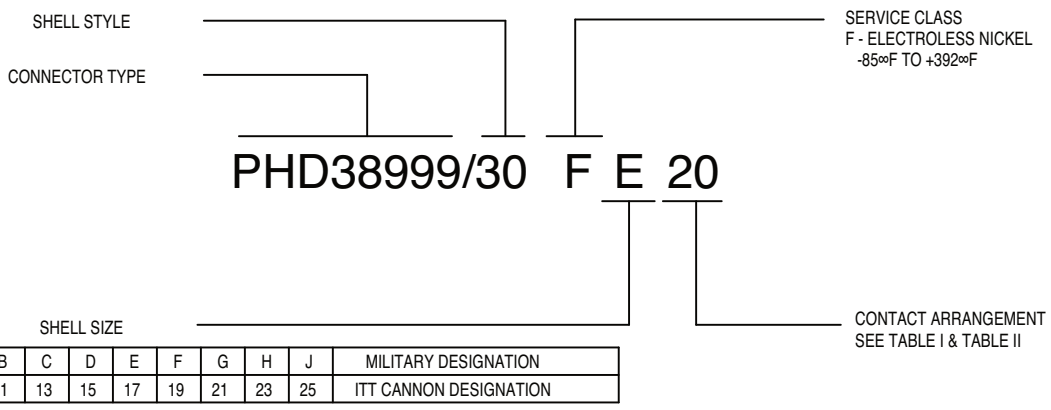


NOTES: UNLESS OTHERWISE SPECIFIED.

1. FOR CAVITY LAYOUT SEE APPLICABLE "CSA"
   CANNON STANDARD ARRANGEMENT.

2. MATERIAL: TYPE / FINISH
   INSERT: ALUMINUM ALLOY / ELECTROLESS NICKLE PLATE
   HARDWARE: STAINLESS STEEL / PASSIVATED
   INTERNAL SLEEVES: CERAMIC

PART NUMBER
SHOWN: SHELL SIZE 17/20 POSITION CONTACT ARRANGEMENT

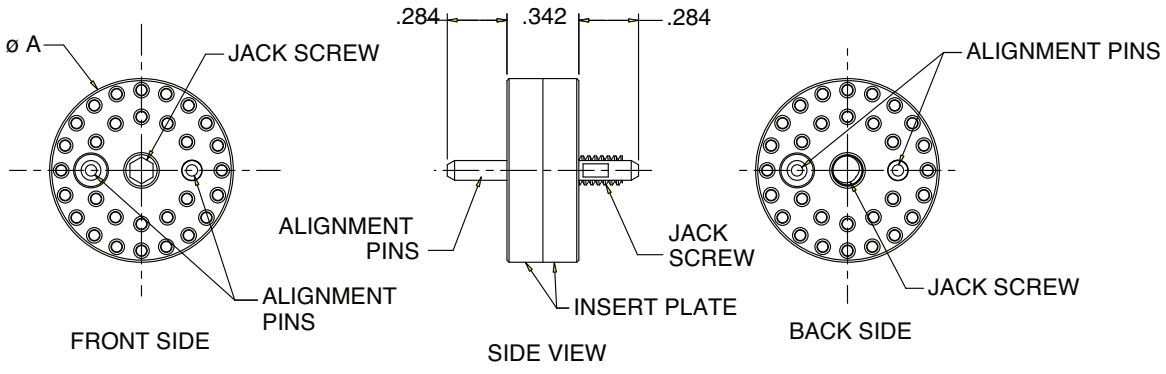


B	C	D	E	F	G	H	J	MILITARY DESIGNATION
11	13	15	17	19	21	23	25	ITT CANNON DESIGNATION

PHD Front Insert Assembly

INSERT ASSEMBLY - SIZE #22 CONTACT MATRIX					
PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	A (DIA)
PHD38999/30FB4	CSA-PHD11-4	NICKEL	11	4	.421
PHD38999/30FC8	CSA-PHD13-8		13	8	.535
PHD38999/30FD12	CSA-PHD15-12		15	12	.660
PHD38999/30FE20	CSA-PHD17-20		17	20	.785
PHD38999/30FF30	CSA-PHD19-30		19	30	.874
PHD38999/30FG40	CSA-PHD21-40		21	40	1.000
PHD38999/30FH48	CSA-PHD23-48		23	48	1.124
PHD38999/30FJ72	CSA-PHD25-72		25	72	1.248

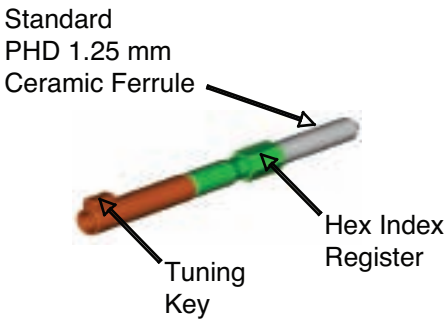
INSERT ASSEMBLY - SIZE #16 CONTACT MATRIX					
PART NUMBER	CSA NUMBER CAVITY LAYOUT	FINISH	SHELL SIZE	STANDARD NO. OF CAVITIES	A (DIA)
PHD38999/30FB2	CSA-PHD11-2	NICKEL	11	2	.421
PHD38999/30FC4	CSA-PHD13-4		13	4	.535
PHD38999/30FD6	CSA-PHD15-6		15	6	.660
PHD38999/30FE8	CSA-PHD17-8		17	8	.785
PHD38999/30FF12	CSA-PHD19-12		19	12	.874
PHD38999/30FG16	CSA-PHD21-16		21	16	1.000
PHD38999/30FH24	CSA-PHD23-24		23	24	1.124
PHD38999/30FJ36	CSA-PHD25-36		25	36	1.248



PHD Panel Mount Series

The PHD Panel Mount Connector incorporates a low profile design with a discrete keyed contact system for repeatable low loss optical performance.

Size 22 Termini

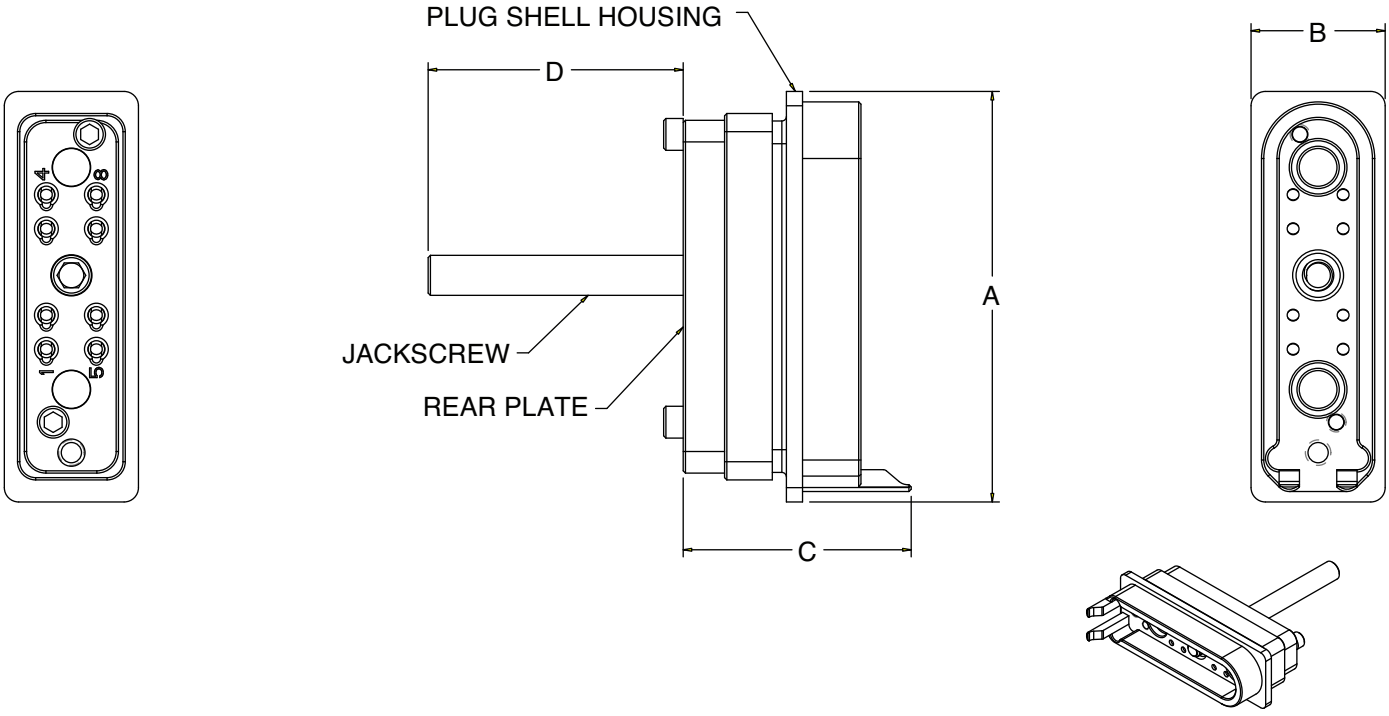


Product Features

- Three Piece Connector features Bulkhead Feed thru Design in standard 8, 16, 18 and 32 Channel Configurations.
- PHD Optical Contact System (Tuned size 22 Termini)
- All Metallic Bodies for Radiated Emission Suppression
- Internal Metallic Web for EMI Suppression and Terminus Stability
- Integrated Metallic Shutter System for Reduced Eye Hazard
- All Metallic Backshell (45 & 90 Degree)
- Removable alignment insert assembly mountable in either plug or receptacle.

	Multimode 62.5/125	Singlemode SMF 28
Ferrule (O.D.)	1.25 mm	1.25 mm
Insertion Loss (dB typ.)	0.30	0.20
Maximum Loss (dB max.)	0.50	0.30
Return Loss (dB typ.)	25	56
Return Loss (dB min.)	20	50
Channel Servicing	Single	
Channel Repair	Single	
Cyclic Durability	1000	

Plug Connector Assembly

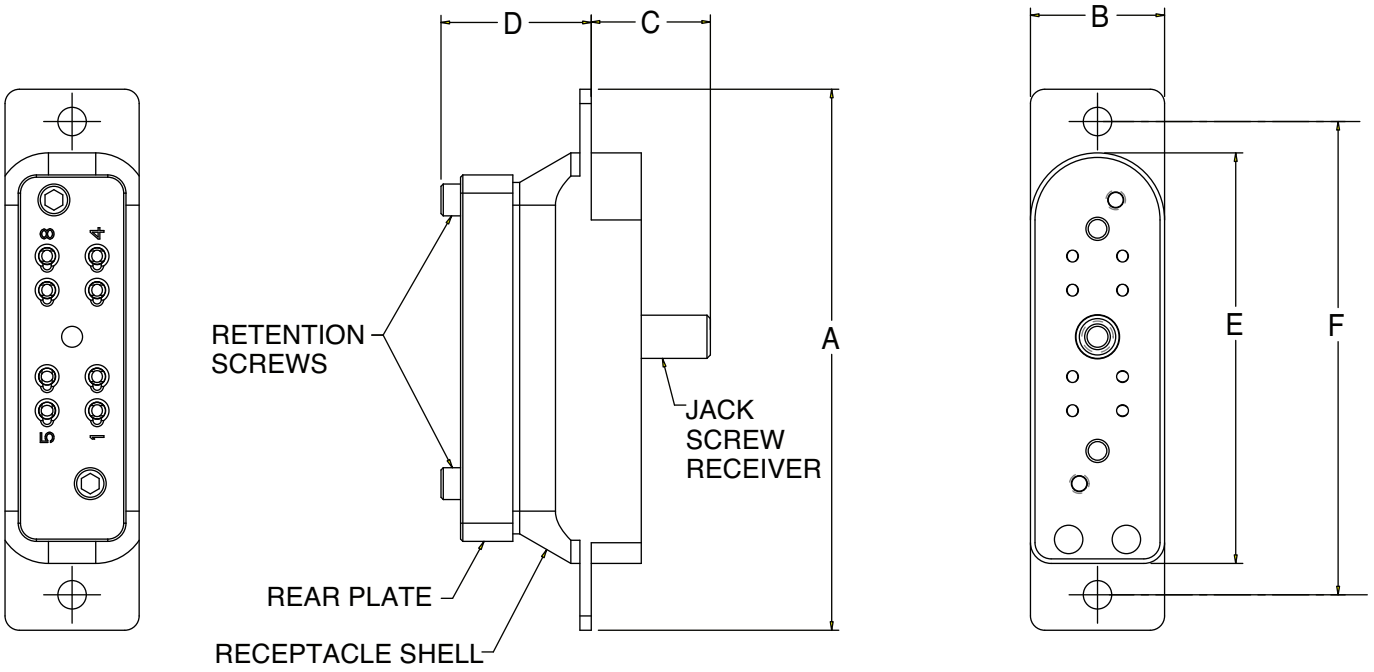


Shell Size	PHD Patch Panel Standard Part Number	A	B	C	D
8	PHD140259-9	1.810	.590	1.000	1.122
16	PHD140259-7	2.110	.590	1.000	1.122
32	PHD140259-6	3.006	.590	1.000	1.122

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Plug Housing / Backplate: Aluminum Alloy / Electroless Nickel plating.
   Jackscrew: Heat treated Stainless Steel Alloy / Passivated
   Screws & Washers : Stainless Steel / NA
3. **Tooling:** Insertion / Removal tool:
   Size 22, Part Number 274-0053-0000
4. Plug Connector to be used with a Panel Mount Receptacle and Adapter Assembly (Pages 46-47). Termini – PHD Size 22 (Pages 30-31).
5. **Applications:** Military/Aero space & Commercial Fiber Optic Interconnect environments.

Bulkhead Receptacle Connector Assembly

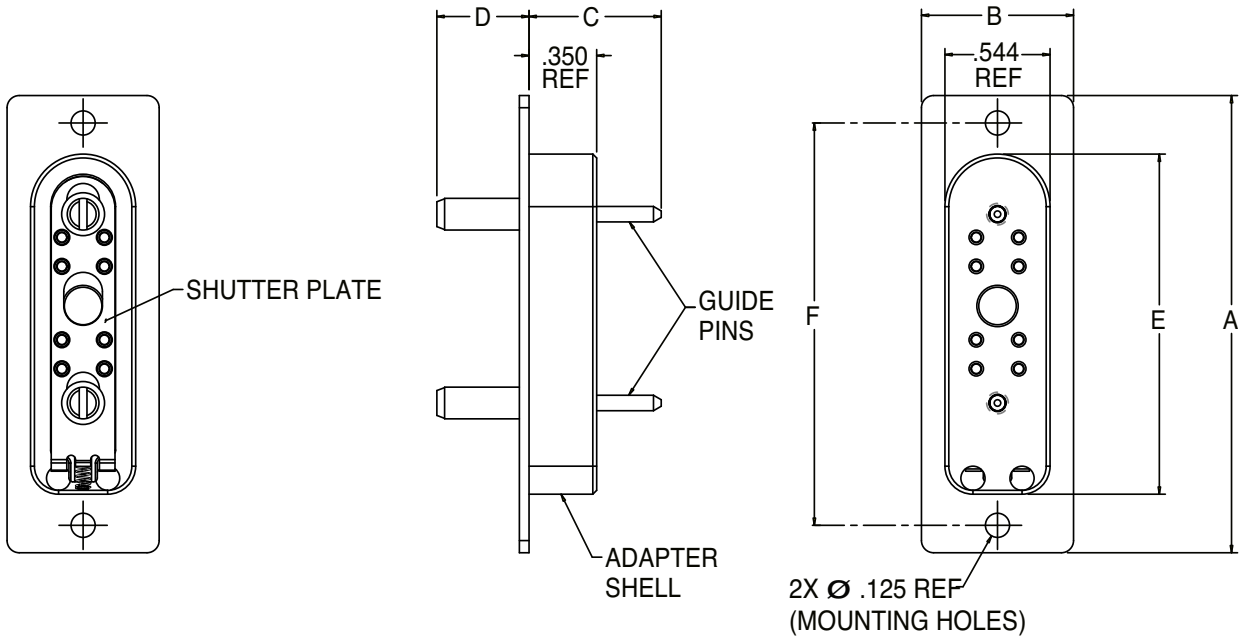


Shell Size	PHD Patch Panel Standard Part Number	A	B	C	D
8	PHD140260-10	2.366	.590	.509	.661
16	PHD140260-8	2.666	.590	.524	.661
32	PHD140260-7	3.566	.590	.574	.611

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Receptacle Housing / Backplate: Aluminum Alloy / Electroless Nickel plating.
3. **Tooling:** Insertion / Removal tool:
   Size 22, Part Number 274-0053-0000
4. Plug Connector to be used with a Panel Mount Receptacle and Adapter Assembly (Pages 45-47). Termini – PHD Size 22 (Pages 30-31).
5. **Applications:** Military/Aero space & Commercial Fiber Optic Interconnect environments.

Alignment Adapter Insert Assembly



Shell Size	PHD Patch Panel Standard Part Number	A	B	C	D
8	PHD140261-2	2.366	.787	.448	.684
16	PHD140261-3	2.666	.787	.448	.684
32	PHD140261	3.566	.787	.448	.684

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Adapter Housing Insert: Aluminum Alloy / Electroless Nickel plating.
   Sutter/Plate, Spring & Guide Pins: Stainless Steel Alloy / Passivated.
   Alignment Sleeve: Ceramic
   Retention Clip: Stainless Steel Alloy / Passivated.
3. **Tooling:** Insertion / Removal tool:
   Size 22, Part Number 274-0053-0000
4. Adapter Insert to be used with a Panel Mount Receptacle and Patch Panel Plug (Pages 45-46). Termini – PHD Size 22 (Pages 30-31).
5. **Applications:** Military/Aero space & Commercial Fiber Optic Interconnect environments.

PHD Fiber Optic Terminus Adapter for Combo D-Sub Connectors

Hybrid Connector (Electrical/Fiber Optic)

Size 8 terminus adapter allows any PHD optical terminus to be coupled into Combo D connector.

Multi-functional Interconnect Series

Combining: 30 Amp power contacts (straight/right-angle)
RF contacts (straight/right angle)
Size 22 LF signal contacts (straight/right angle)
Size 22 Fiber Optic Termini (Singlemode & Multimode)

	Multimode 62.5/125	Singlemode SMF 28
Ferrule (O.D.)	1.25 mm	1.25 mm
Insertion Loss (dB typ.)	0.30	0.25
Maximum Loss (dB max.)	0.50	0.35
Return Loss (dB typ.)	25	56
Return Loss (dB min.)	20	50
Channel Servicing	Single	
Channel Repair	Single	
Cyclic Durability	1000	

Fiber Optic Terminus Part Numbers		
Genderless Terminus for use with PHD Adapters & Combo-D Connectors		
Fiber Type	Ferrule I.D.	Part Number
Singlemode SMF28	125	031-9727-007
Multimode 50/125 & 62.5/125	127	031-9727-008
Multimode 100/140	142	031-9727-003

PHD Adapter Part Numbers	
Pin	Socket
140285-0000	140286-0000

PRODUCT NOTES

1. **Packaging:** Identification includes manufacturer's name and part number
2. **Material / Finish:**
   Ferrule: Zirconia Ceramic / N.A.
   Terminus assembly: Brass Alloy / Gold plating
   Adapter assembly: Stainless steel / Passivate-hardware
3. **Insertion / Removal tool:** (Termini): 274-0053-0000
   Extraction Tool (Adapter): CET-C6B-2
4. Consult factory for assembly and termination tools or factory build cable assemblies.
5. **Applications:** Military/Aero space Fiber Optic Interconnect environments.

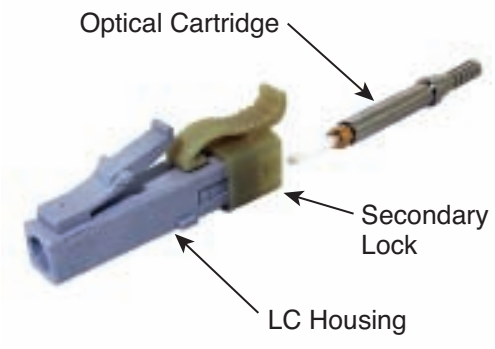
LC Compliant Fiber Optic Connector System to meet Telecordia GR-326-CORE

Harsh environmental small form-factor connector system providing higher thermal environment and superior mechanical environment stability/durability than a standard LC connector while maintaining the same high-end optical performance characteristics that supports both singlemode and multimode fiber configurations.

Product Features

- Higher thermal environment stability/durability
  High temperature plastic used for housing and secondary lock.
  Secondary Lock prevents thermal relaxation of cantilever latch in high temperature environments.
- Superior mechanical environment stability/durability\
  Secondary Lock prevents mechanical release in high shock/vibration environment.
- Reparability / Maintenance
  Optical Cartridge a standalone optical element separable from connector plastic body for quick and easy field repair.
- Crimp termination of cable jacketing to rear body section
- Designed for use with either tight or loose buffered fiber cable solutions
- Singlemode (tuned or un-tuned) and multimode fiber capable
- Meets Lucent 640-252-053 & Telecordia GR-326 requirements insuring Mechanical / optical interface Intermatability / Compatibility.

	Multimode 62.5/125	Singlemode SMF 28
Ferrule (O.D.)	1.25 mm	1.25 mm
Insertion Loss (dB typ.)	0.30	0.25
Maximum Loss (dB max.)	0.50	0.40
Return Loss (dB typ.)	25	55
Return Loss (dB min.)	20	50
Cyclic Durability	1000	



Connector Configuration	Fiber Type	Part Number	Housing Color
SIMPLEX	Multimode	140277-0000	Beige
	Singlemode	140290-0000	Blue
	APC	140292-0000	Green
DUPLEX	Multimode	140289-0000	Beige
	Singlemode	140291-0000	Blue
	APC	140293-0000	Green

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Ferrule: Zirconia Ceramic / N.A.
   Terminus assembly: Stainless steel / Passivate- hardware
   Housing: High Temperature thermal plastic
3. **Tooling:** Tuning Wrench PN - 980-2007-001
   Tuning Kit PN – 980-2007-002
4. **Instructions:** Consult factory for assembly instructions and termination tool list.
5. **Applications:** Military/Aero space Fiber Optic Interconnect environments.

PHD Fiber Optic Backplane Connectors

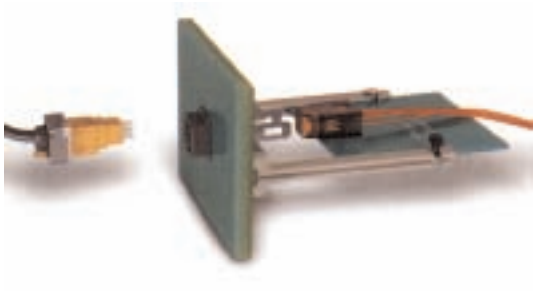
8 channel High Performance, Load Releasing Optical Backplane Connector

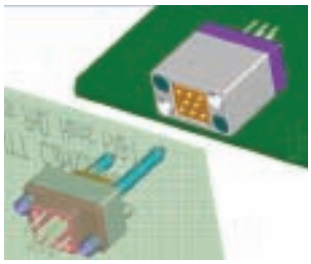
ITT has developed a FutureBus-compatible PHD backplane product to provide all of these listed features while also delivering the density of ribbon fiber connectors. ITT's unique PHD product design meets ribbon interconnect density while offering significantly lower insertion loss, higher return loss, single channel serviceability and all of the maintainability features found in simplex interconnects.

Product Features

- PHD Optical Contact System (Including Tuned Contacts)
- Patented Dual Latch/Float Housing To Provide Interoperability With A Broad Range Of 2mm Copper Backplane Connectors.
- Blind Mate Guidance Features +/- 2.5mm X/Y-Axis float and +/- 2mm Z-axis float (4mm wipe)
- Removable Right Angle Or Straight Cable Plug On Backplane Module.
- Dual latch coupling systems with zero residual force from the daughter cards to backplane.
- Clip style retention system provides application proven termini integration within a connector body and serviceability at the discrete pathway level.

	Multimode 62.5/125	Singlemode SMF 28
Insertion Loss (dB typ.)	0.30	0.25 tuned
Maximum Loss (dB max.)	0.50	0.40 tuned
Return Loss (dB typ.)	25	55
Return Loss (dB min.)	20	50
Cyclic Durability	1000	





Product Type	Connector Type	Part Number
Standard Plastic Design	Backplane	140263-0000
	Daughter Card	140263-0001
	Plug Assembly	140263-0002
All Metallic Robust Design	Backplane	140263-0005
	Daughter Card	140263-0006

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Ferrule: Zirconia Ceramic / N.A.
   Terminus assembly: Stainless steel / Passivate-hardware
   Housing: thermal plastic/Stainless steel
3. **Tooling:**
   Contact Insertion/Removal Tool: 274-0053-0000
4. **Instructions:** Consult factory for assembly instructions and termination tool list.
5. **Application:** Military/Aero space Fiber Optic Interconnect environments.

ITT's NGCON Fiber Optic Connector System

The next generation connector system for Naval and other Military/Aero-Space applications

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

MIL-PRF-NGCON Compliant Fiber Optic Connector System

ITT's Next Generation Connector (NGCON) combines proven technology and features from connector standards 28876 and 38999. This new connector system was designed with innovations including genderless contacts and high density packaging. ITT led the high performance connector development effort and is an active member of the NGCON design committee.

Product Features

- Conforms to NGCON Military Standard
- Rear Release Termini
- Genderless Termini
- Wall-Mount & Jam-Nut Receptacle Configurations
- High Density Arrangements
- Operating Temperature Range: -55C to +200C.
- Environmental Sealing Terminus
- 125 mm Diameter Ceramic Ferrule
- Removable front insert
  Easy access to termini for cleaning / inspections.

	Multimode	Singlemode
Ferrule (O.D.)	1.25 mm	1.25 mm
Fiber Type	62.5/125	SMF 28
Insertion Loss (dB typ.)	0.40	0.30
Maximum Loss (dB max.)	0.75	0.75
Return Loss (dB typ.)	35	50
Return Loss (dB min.)	30	50
Channel Servicing	Single	
Channel Repair	Single	
Cyclic Durability	500	

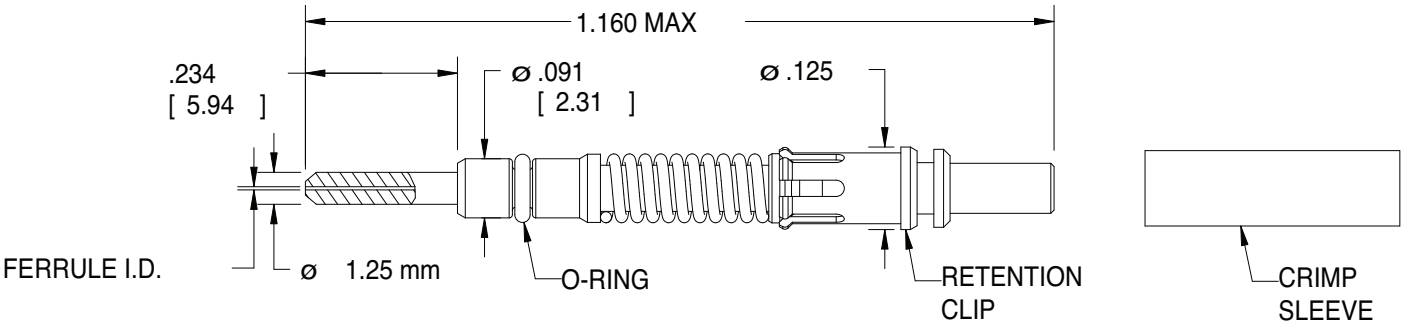
Applications include: Naval Shipboard / Dockside Communications and other Military Fiber Optic Interconnect Applications.

MIL-PRF-NGCON

NGCON Fiber Optic Connector System

Genderless Terminus design with Low Loss Optical Performance.

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status



Descriptive Part Number

NGCON / T 18 M 1 - 1260 – M0001

- **ITT Series**
- **Terminus Assy**
- **Terminus Style**
- **Terminus Type**
- **Crimp Sleeve - Jacket O.D.**
- **Ferrule I.D. Dash Number**
- **Modification Code**

M29504/18
Genderless Terminus
for use with MIL-PRF-NGCON style NGCON Connectors

Fiber Size	Ferrule I.D.	Dash No.	ITT Part Number
Singlemode 9/125	125 +1/-0	-1250	031-9747-001
Singlemode 9/125	125.5 +1/-0	-1255	031-9747-003
Singlemode 9/125	126 +1/-0	-1260	031-9747-004
Multimode 50/125, 62.5/125	126 +1/-0	-1260	031-9747-005
Multimode 50/125, 62.5/125	127 +1/-0	-1270	031-9747-002
Multimode 100/140	142 +1/-0	-1420	031-9747-006
Multimode 100/140	145 +1/-0	-1450	031-9747-007
Multimode 50/125, 62.5/125/155	156 +3/-0	-1560	031-9747-008
Multimode 50/125, 62.5/125/155	157 +3/-0	-1570	031-9747-009
Multimode 100/140/172	173 +3/-0	-1730	031-9747-010
Multimode 100/140/172	175 +3/-0	-1750	031-9747-011

- Crimp Sleeve may be ordered separately.
  Part Number 252-0378-000

Terminus Type
S – Singlemode
M – Multimode

Terminus Style
18 – Genderless Terminus
19 – Dummy Terminus
20 – Keyed Terminus

Crimp Sleeve - Jacket O.D
1 – 1.6mm - 2.0mm
2 – 1.8mm - 2.4mm
3 – 2.4mm - 3.0mm

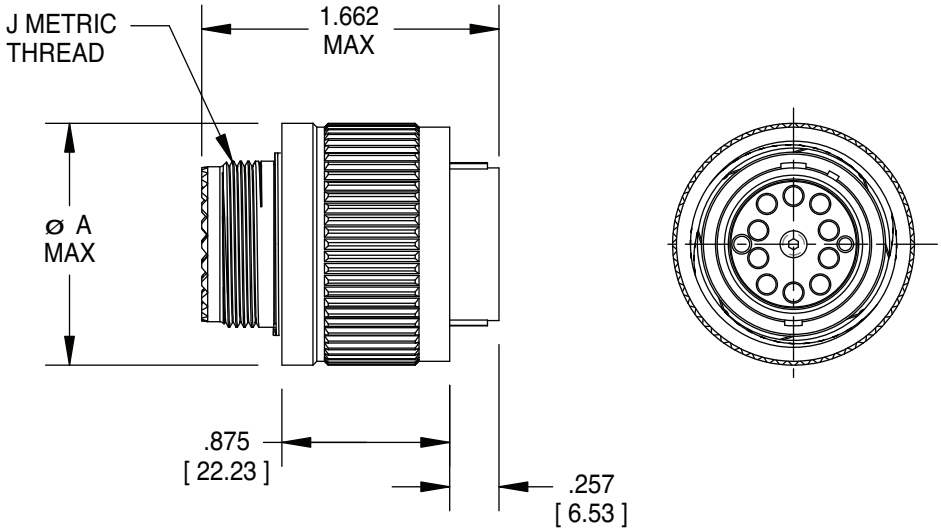
Modification Code -
Consult Factory for Modification Codes (Omit for none)

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number
2. **Material / Finish:**
   Ferrule Connector assembly : Zirconia Ceramic/N.A.
   Terminus assembly: Stainless Steel / Passivate
   Retaining Clip: Beryllium Copper/NA
   Crimp Sleeve: Brass Alloy/N.A
   O-Ring: Fluorosilicone
   Spring: High Tensile Stainless Steel/Passivate
3. **Tooling:**
   Insertion: Tool Part Number: 274-0058-000
   Removal Tool Part Number: 274-0058-001
4. **Instructions:** Consult factory for contact termination instructions and tooling.
5. **Connector:** Genderless Terminus used in NGCON Plug and Receptacle configurations. See Page 56-58 for connector options.

Plug Connector (MIL-PRF-NGCON/2)

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status



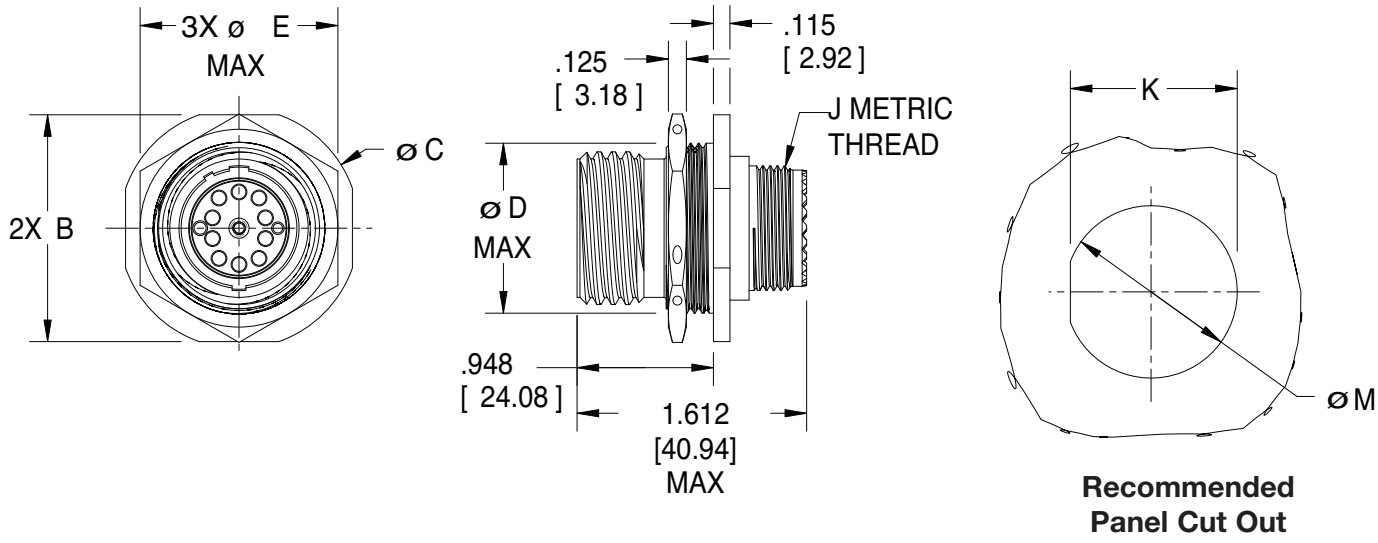
Shell Size	Channels	A	J - Accessory Thread
11	2	1.028 (26.1)	M15 X 1
13	6	1.141 (30.0)	M18 X 1
15	10	1.263 (32.1)	M22 X 1
23	36	1.705 (43.3)	M34 X 1

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number.
2. **Material / Finish:**
   Insert: Aluminum Alloy / Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Screws, Washers, Alignment pins: Stainless Steel / NA
3. **Tooling:**
   Termini Insertion Tool Part Number: 274-0058-000
   Termini Removal tool Part Number: 274-0058-001
4. **Insert:** Front Alignment Insert Assembly may be added to the Plug Assembly or the Receptacle Assembly but not both. See Connector Assembly Matrix for Part Numbers.
5. **Termini:** Genderless design allows termini to be used in Plug and Receptacle configurations. See Page 54 for Product Details.

Jam-Nut Mount Receptacle Connector (MIL-PRF-NGCON/3)

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status



Recommended Panel Cut Out

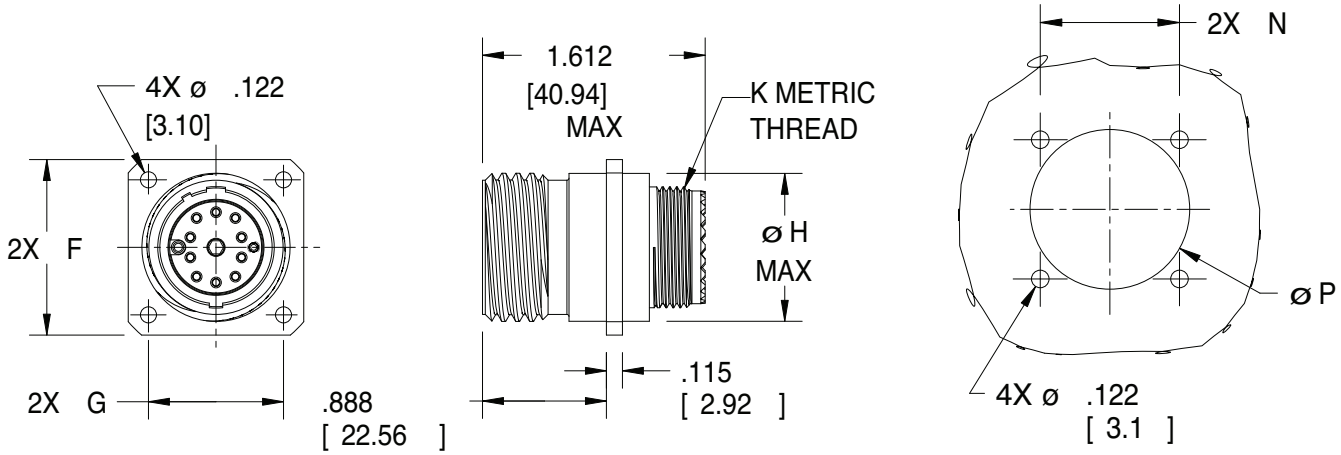
Shell Size	Channels	B	C	D	E	K	M	Max Panel Thickness	J-Accessory Thread
11	2	1.264 (32.1)	1.358 (34.5)	.875 (22.2)	1.075 (27.3)	.848 (21.5)	.885 (22.5)	.188 (4.78)	M15 X 1
13	6	1.389 (35.3)	1.498 (38.1)	1.000 (25.4)	1.205 (30.6)	.973 (24.7)	1.010 (25.7)	.188 (4.78)	M18 X 1
15	10	1.577 (40.1)	1.671 (42.4)	1.188 (30.2)	1.392 (35.4)	1.160 (29.5)	1.198 (30.4)	.188 (4.78)	M22 X 1
23	36	2.004 (50.9)	2.098 (53.3)	1.625 (41.3)	1.812 (46.0)	1.593 (40.5)	1.630 (41.4)	.188 (4.78)	M34 X 1

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number.
2. **Material / Finish:**
   Insert: Aluminum Alloy / Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Screws, Washers, Alignment pins: Stainless Steel / NA
3. **Tooling:**
   Termini Insertion Tool Part Number: 274-0058-000
   Termini Removal tool Part Number: 274-0058-001
4. **Insert:** Front Alignment Insert Assembly may be added to the Plug Assembly or the Receptacle Assembly but not both. See Connector Assembly Matrix for Part Numbers.
5. **Termini:** Genderless design allows termini to be used in Plug and Receptacle configurations. See Page 54 for Product Details.

Wall Mount Receptacle Connector (MIL-PRF-NGCON/1)

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status



Recommended Mounting

Shell Size	Channels	F	G	H	N	P	Max Panel Thickness	J-Accessory Thread
11	2	1.023 (26.0)	.750 (19.1)	.750 (19.1)	.750 (19.1)	.800 (20.3)	.188 (4.78)	M15 X 1
13	6	1.138 (28.9)	.843 (21.4)	.875 (22.2)	.843 (21.4)	.925 (23.5)	.188 (4.78)	M18 X 1
15	10	1. 258 (31.9)	.968 (24.6)	1.062 (27.0)	.968 (24.6)	1.110 (28.2)	.188 (4.78)	M22 X 1
23	36	1.718 (43.6)	1.281 (32.5)	1.500 (38.1)	1.281 (32.5)	1.550 (39.4)	.188 (4.78)	M34 X 1

PRODUCT NOTES

1. **Packaging:** Packaging identification includes manufacturer's name and part number.
2. **Material / Finish:**
   Insert: Aluminum Alloy / Electroless Nickel
   Hardware Stainless Steel / Passivated
   Internal Alignment Sleeves: Ceramic
   Shell / Shell Hardware: Aluminum Alloy / Olive Drab Cadmium over Electroless Nickel
   Screws, Washers, Alignment pins: Stainless Steel / NA
3. **Tooling:**
   Termini Insertion Tool Part Number: 274-0058-000
   Termini Removal tool Part Number: 274-0058-001
4. **Insert:** Front Alignment Insert Assembly may be added to the Plug Assembly or the Receptacle Assembly but not both. See Connector Assembly Matrix for Part Numbers.
5. **Termini:** Genderless design allows termini to be used in Plug and Receptacle configurations. See Page 54 for Product Details.

Consult Factory for C.O.T.S/MIL Spec Product Availability and Qualification Status

ITT Series
NGCN - NGCON Fiber Optic Connector System

Connector Type
1 - Receptacle, Wall Mount
2 - Plug
3 - Receptacle, Jam Nut Mount

Arrangement (Shell Size / Channels)
B - Shell Size 11 / 2 Channels
C - Shell Size 13 / 6 Channels
D - Shell Size 15 / 10 Channels
H - Shell Size 23 / 36 Channels

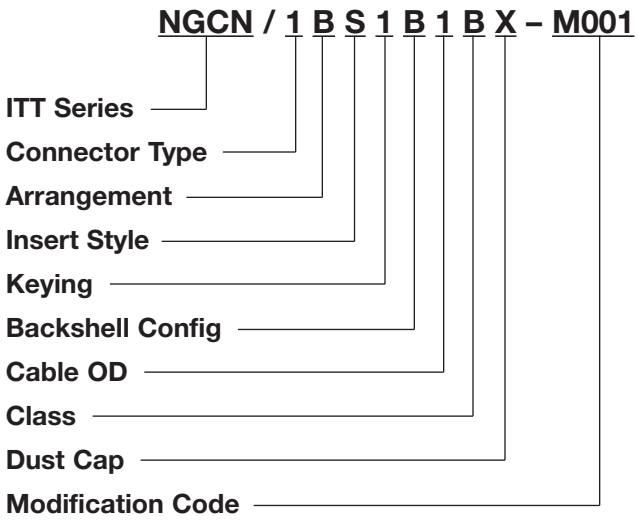
Insert Style
P - Pin
S - Socket (With Front Alignment Insert)

Keying Position
Key Configuration
1 through 9, A, B, C

Backshell Configuration
B - Straight
C - Environmental 45°
D - 90°
E - Straight, Light Duty
F - EMI Retention Nut
X - No Backshell

Backshell Cable OD
1 - .315 [8.00]
2 - .425 [10.80]
3 - .563 [14.30]
4 - .817 [20.75]
F - .071/.094 [1.80/2.39]
0 - No Backshell

Descriptive Part Number



Class
F - Electroless nickel finish
W - Olive drab over electroless nickel finish
A - Anodize, Black finish
S - Stainless Steel, Passivated

Dust Cap
W - Connector Supplied with Dust Cap
X - Without Dust Cap

Modification Code
Consult Factory for Modification Codes
(Omit for none)

VEAM Duplex Connectors

The VEAM duplex connector with 10SL-2 size arrangement, with its small dimensions, performs the connection where there are critical environmental conditions.

The typical bayonet coupling allows an easy mating and a good mechanical resistance; the IP67 protection degree allows the use anywhere; the cable clamp and the Kevlar retention device guarantee a perfect integration with the cable; and the standard Ø2,5mm ceramic ferrules offer high optical performance.

- 2 channels weatherproof connector
- Small dimensions
- Bayonet coupling
- Zirconia ferrule 2.5mm diam epoxy – polish type
- Standard duplex jacketed cable applicable
- 0.5dB max insertion loss.
- Single and Multimode fiber applicable

Markets: Military
Industrial

VEAM VOC, 4 Channel Optical Connectors

The VEAM 4 channel optical connector VOC is available in both threaded and bayonet coupling; in addition to excellent characteristics of mechanical and environmental resistance, it offers small size and high optical performances. It uses alignment sleeve and the standard ceramic ferrules of FC/PC connectors.

The receptacle connector is suitable for use with single fiber cables and offer the crimping of Kevlar reinforcement; the plug connector accepts multi-fiber jacketed cables.

- Easy to use and reliable 4 channels connector
- Threaded or bayonet coupling system
- Standard 2.5mm ferrules FC/PC type
- Water-tightness IP67
- Epoxy – crimp – polish termination method
- 0.5dB max insertion loss
- Single and Multimode fiber applicable

Markets: Industrial
Railway
Military

Please contact our Italy or Watertown CT Customer Service Centers for more information on the VEAM Custom Optical Solutions

VEAM 6 Channel Connectors

The VEAM 6 Channel connector was developed for data transmission on trains (Internet, satellite HDTV and entertainment). It allows the optical connection of six channels between coaches, with high signal performances and reliable mechanical and environmental characteristics.

Protected by the robust design of the CIR bayonet connectors, six optical contacts are located in a metallic insert; the ceramic ferrules, the alignment split sleeves and the sprung female contacts always guarantee low signal loss.

- 6 channels waterproof connector
- Stainless steel mating shells with rubber covered coupling nut
- Coaxial backshell on plug for easy harnessing procedures
- Zirconia ferrule 2.5mm diam epoxy – polish type
- Female front insert removable for easy ferrules cleaning
- 0.8dB max insertion loss
- Multimode fiber applicable

Market: Railway

Please contact our Italy or Watertown CT Customer Service Centers for more information on the VEAM Custom Optical Solutions

Heavy Duty Connectors

The FRBOF series of circular multi-channel optical connectors have quarter turn bayonet coupling and utilize the shells and accessories of the extremely reliable VEAM CIR series. They are available in varied configurations for both cable and panel mount applications. This is a very rugged, heavy duty connector family for use in hostile environments (external use, railways applications, etc.). In addition to being rugged, waterproof and dust proof, the optical interface is easily cleaned in the field without disassembly.

Available in 2, 4, 9 and 12 channels configurations

Markets: Railway

22 Channel Optical Connector

Incorporating the MVPOC–miniature type contacts with 1,5mm diameter ferrule, these connectors offer an increased number of optical channels with small external dimensions.

The coupling is bayonet type, and varied configurations for cable and panel mount are available.

Resistance to environmental conditions allows the use of these connectors in applications where water tightness, retention and protection of the cable and resistance to mechanical damages are required.

Market: Industrial

Hybrid Connector with VFOT Contacts

The connector with standard rubber insert 18-11 size arrangement is a typical example of the VFOT contacts application.

This connector is available with 3 electric contacts size 12 and 2 optical contacts for Multimode fiber.

This connector was selected to transmit signals along the motorways; the 3 electrical contacts supply the power to the electronic devices, which collect and transmit information over the two optical channels in the same connector.

The jacketed cable on the plug is clamped and screened with the shells and then protected by a plastic overmolding.

Market: Industrial

Please contact our Italy or Watertown CT Customer Service Centers for more information on the VEAM Custom Optical Solutions

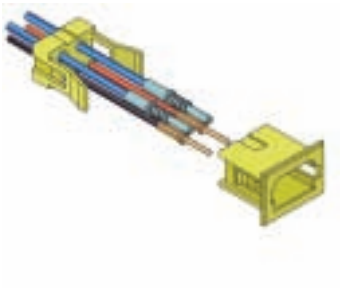
DIN 41626-3 Optical Contacts

These contacts can be used on DIN 41612 and D-sub standard connectors. They are available in male and female passive configurations.

Versions with transmitting and receiving diodes are also available.

- Standard 2.5mm ferrule.
- Multimode fibers. Contacts termination epoxy-crimp-polish type.
- Simplicity of assembly; insertion into the connectors snap-in type.
- Visual identification of component type (emitter or receiver).
- Setting of the optical characteristics

Market: Railway



Miniaturized Hybrid Connector

The MHC4—is a custom design connector developed according to the specific requirements of the customer: mixed contacts (for electrical and optical signals), very small dimensions, easy to assembly without tools, with a dedicated fixing layout to satisfy the need of floating push pull mating characteristics and to comply to the customer hardware.

Market: Military

16 Channel PCB Connector

VEAM has developed a system of active optical connection, based on the dimensional standard of DIN41612 style E, but able to accommodate up to 16 electro-optic components. The VRC41612E-16—system allows the adoption of industrial methods of soldering to PCB, thus avoiding the long and expensive operations of pin to pad soldering, required when traditional components are used. The 90° dip-solder terminal on the back connector are soldered onto the card; this connector is provided with plug-in sockets for the active components. The front connector fix the device and allows the coupling with the plug connector.

Installation, substitution and maintenance is extremely simple and fast and can be effected in the field without the aid of special tools.

Please contact our Italy or Watertown CT Customer Service Centers for more information on the VEAM Custom Optical Solutions

THIS NOTE MUST BE READ IN CONJUNCTION WITH THE PRODUCT DATA SHEET/CATALOG. FAILURE TO OBSERVE THE ADVICE IN THIS INFORMATION SHEET AND THE OPERATING CONDITIONS SPECIFIED IN THE PRODUCT DATA SHEET/ CATALOG COULD RESULT IN HAZARDOUS SITUATIONS.

1. MATERIAL CONTENT AND PHYSICAL FORM

Electrical connectors do not usually contain hazardous materials. They contain conducting and non-conducting materials and can be divided into two groups.

a) Printed circuit types and low cost audio types which employ all plastic insulators and casings.

b) Rugged, Fire Barrier and High Reliability types with metal casings and either natural rubber, synthetic rubber, plastic or glass insulating materials. Contact materials vary with type of connector and also application and are usually manufactured from either: Copper, copper alloys, nickel, alumel, chromel or steel. In special applications, other alloys may be specified.

2. FIRE CHARACTERISTICS AND ELECTRIC SHOCK HAZARD

There is no fire hazard when the connector is correctly wired and used within the specified parameters. Incorrect wiring or assembly of the connector or careless use of metal tools or conductive fluids, or transit damage to any of the component parts may cause electric shock or burns. Live circuits must not be broken by separating mated connectors as this may cause arcing, ionization and burning. Heat dissipation is greater at maximum resistance in a circuit. Hot spots may occur when resistance is raised locally by damage, e.g. cracked or deformed contacts, broken strands of wire. Local overheating may also result from the use of the incorrect application tools or from poor quality soldering or slack screw terminals. Overheating may occur if the ratings in the product Data Sheet/Catalog are exceeded and can cause breakdown of insulation and hence electric shock. If heating is allowed to continue it intensifies by further increasing the local resistance through loss of temper of spring contacts, formation of oxide film on contacts and wires and leakage currents through carbonization of insulation and tracking paths. Fire can then result in the presence of combustible materials and this may release noxious fumes. Overheating may not be visually apparent. Burns may result from touching overheated components.

3. HANDLING

Care must be taken to avoid damage to any component parts of electrical connectors during installation and use. Although there are normally no sharp edges, care must be taken when handling certain components to avoid injury to fingers. Electrical connectors may be damaged in transit to the customers, and damage may result in creation of hazards. Products should therefore be examined prior to installation/use and rejected if found to be damaged.

4. DISPOSAL

Incineration of certain materials may release noxious or even toxic fumes.

5. APPLICATION

Connectors with exposed contacts should not be selected for use on the current supply side of an electrical circuit, because an electric shock could result from touching exposed contacts on an unmated connector. Voltages in excess of 30 V ac or 42.5 V dc are potentially hazardous and care should be taken to ensure that such voltages cannot be transmitted in any way to exposed metal parts of the connector body. The connector and wiring should be checked, before making live, to have no damage to metal parts or insulators, no solder blobs, loose strands, conducting lubricants, swarf, or any other undesired conducting particles. Circuit resistance and continuity check should be made to make certain that there are no high resistance joints or spurious conducting paths. Always use the correct application tools as specified in the Data Sheet/Catalog. Do not permit untrained personnel to wire, assemble or tamper with connectors. For operation voltage please see appropriate national regulations.

IMPORTANT GENERAL INFORMATION

(i) Air and creepage paths/Operating voltage. The admissible operating voltages depend on the individual applications and the valid national and other applicable safety regulations.

For this reason the air and creepage path data are only reference values. Observe reduction of air and creepage paths due to PC board and/or harnessing.

(ii) Temperature

All information given are temperature limits. The operation temperature depends on the individual application.

(iii) Other important information

Cannon continuously endeavors to improve their products. Therefore, Cannon products may deviate from the description, technical data and shape as shown in this catalog and data sheets.

Product Warranty

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