

QwikConnect

G L E N A I R ■ A P R I L 2 0 0 9 ■ V O L U M E 1 3 ■ N U M B E R 2

**Connector
Technology For
the Vanguard
of Innovation**



Inside

Connector
Reference &
Design Guide

Out of This World Connector Performance

Multi-contact electrical connectors used in aerospace and other mission-critical applications are key subassemblies within the interconnect wiring system. Correctly, considerable focus is applied to selection of connection devices that can withstand the severe environmental stresses, electromagnetic threats, and durability requirements of extreme, high-reliability applications.

While commercial connectors such as the M24308 d-subminiature can be broadly applied in consumer electronic hardware, it takes a special class of connector to perform in genuinely extreme environments such as missile systems, down-hole drilling equipment, satellites, field-deployable robots and other rough-duty applications. Although many connector types and styles find ready use in prototype and experimental systems, designers generally turn to connector packages with proven track-records and performance benchmarks for actual production and field deployment of mission-critical platforms.

That's where Glenair comes in. The key attribute of the many connector series we manufacture is their measurably higher reliability compared to commercial connectors. System reliability depends on the failure rate of its components. Connectors can fail due to electrically dependent mechanisms, wear mechanisms or corrosion mechanisms. Total system life, power on-hours (POH) and system on/off cycles (times a product powers on and off) are important system reliability factors. High reliability connectors are chosen when

the application rigors—and failure risks—justify employing superior materials and precision fabrication.

This issue of *QwikConnect* serves as a designer's guide for the many high-reliability connector products we manufacture in our four main plants in Glendale, California, Chicago, Illinois, Mansfield, England and Bologna, Italy. The products selected for this designer's guide are all either mil-spec approved or have proven performance based on extensive deployment in mission-critical systems. The Series 80 "Mighty Mouse" Connector Series, for example, is well known for its high-reliability in soldier systems and other rigorous military applications. This non-mil-spec product is so widely used it has become a de-facto standard for systems that require higher performance benchmarks than common commercial connectors.



Glenair fiber optic and electrical interconnect solutions perform key roles in mission-critical space applications, such as launch vehicles, satellites, probes and the International Space Station. The rigors of space place unique demands on interconnect systems, including temperature extremes and exposure to space radiation.

Connector Reference and Design Guide

While there is great variety in the makeup and design of the connectors surveyed in this guide, they share a common set of design elements and components. To function as a separable interconnect device, a connector usually has the following features:

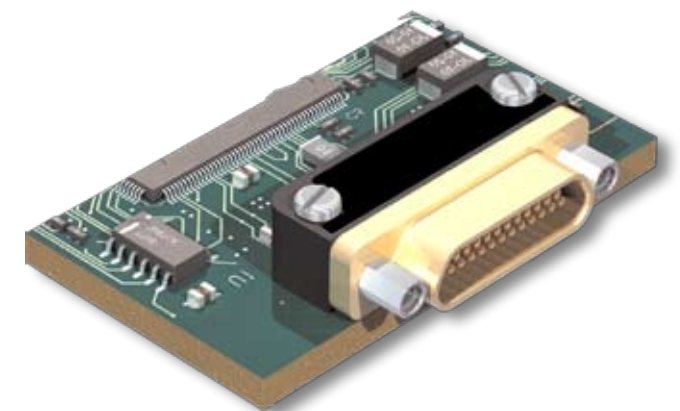
- **Contact Interface:** a mechanical means to join the conductive contacts together under normal force
- **Contact Spring Members:** a means to generate the normal force required to maintain the electrical path between conductive contact elements
- **Contact Finish:** a means to protect contacts from corrosion, and for optimizing lubricity and durability of the contact interface
- **Contact Housing:** a means to hold the contacts and spring members in place maintaining their exact position and alignment. The contact housing also shields the contacts from the operating environment.

Connectors are selected with consideration to electrical, mechanical, environmental and EMC requirements. Electrical requirements include current rating, DWV, and contact resistance. Mechanical specifications, such as thermal shock, vibration resistance and mating durability indicate how well a connector will perform under critical stress factors. Environmental requirements include moisture absorption and resistance to temperature extremes, corrosion and caustic chemicals. EMI/RFI connectors must be effectively shielded against interference lest critical electronic equipment suffer serious performance degradation. All four categories of performance, as well as key dimensions and package descriptions, are presented in the design and reference guide for each product series.

Levels of Interconnection and Connector Packaging Overview

While the same connector shell design may be used for signal, power, high-frequency or fiber optic applications, it is the specific role of the connector in the wire interconnection system that dictates the "packaging" or architecture of the interconnect device. Glenair connector products are generally deployed into one of three roles:

- **Board-to-Board:** interconnection of electronic sub-assemblies within an electronic housing, such as between two printed circuit boards.
- **Subassembly-to-I/O-Panel:** interconnection of an internal subassembly, such as a backplane or PCB, to the outside world via an input-output connection.
- **System-to-System:** interconnection of electronic black boxes via connectorized cables and panel mounted receptacles.



A common role for a Micro-D PCB connector in the wire interconnection system is as a data and power I/O device terminated directly to a PCB.

In terms of basic architecture and packaging, connector families are distinguished by their coupling mechanisms, physical shape, contact types, environmental classes and termination methodologies.



Subassembly-to-I/O-Panel level connectors and cables destined for extraterrestrial duty on Mars. The connectors shown are Glenair Series 80 "Mighty Mouse" which are specified for their reduced size and weight compared to standard Mil-Spec connector series.

Plug and receptacle connector pairs are available in various mounting configurations to accommodate different levels of interconnection and different application requirements. The most common configurations serve in-line (wire-to-wire) applications, or various bulkhead, chassis and enclosure mountings.

Circular connectors are compact, rugged and able to seal the connector from environmental hazards. Circular connectors may incorporate bayonet couplings, threaded couplings, ball detent couplings (push/pull), and/or breech lock couplings to lock the mated pairs together.

Rectangular connectors maximize the number of contacts possible in a restricted space. However, standard rectangulars are not as easily sealed against fluid damage and other environmental hazards. A notable exception is the Series 79 Micro-Crimp rectangular connector series which offers advanced levels of EMI and environmental protection. Spring style rack and panel couplings, guide pins as well as machined jackscrew fasteners are common coupling and mating elements in high reliability rectangular connectors.

Both circulars and rectangulars can accommodate multiple contact types including power or high-voltage contacts, signal contacts, coaxial and triaxial contacts, or fiber-optic termini. High reliability contacts are usually made from gold plated, copper alloy material. Large diameter power contacts and solder type contacts may be either gold or silver plated copper alloy.

Dielectric materials used in higher current/voltage power applications are designed to withstand the higher temperatures experienced by power connectors.

Installation of crimp and solder type contact connectors requires unobstructed working room behind the connector rear-end. Rear release crimp contacts require additional working room to install the extraction tool to remove the contact. Another important design feature of crimp type contact connectors is the wire sealing grommet. The grommet is permanently fixed to the connector insert, and provides moisture sealing around each individual wire.

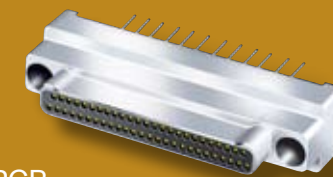
Crimp style contacts are preferred for aerospace and other high reliability applications (except those requiring a hermetic seal) due to their relative ease of assembly and maintenance. Crimp contacts can be removed from the connector for servicing or to replace a bad contact. Solder type contacts, permanently fixed in the connector, are usually selected when cost is the primary consideration and repairability secondary. Solder type contacts are also used in hermetics and in applications with unique termination requirements, such as high-voltage power connectors.

The following three pages provide a quick overview of the key features and performance attributes of each connector series covered in this design and reference guide. Each family is then presented in greater detail in a separate spread that outlines the most relevant performance attributes and ratings.

Overview of Connector Families

Series 89 Nanominiature

Series 89 Nanominiature are ultra high reliability I/O connectors for use in applications where size and weight are of the utmost importance. These ultraminiature board-to-wire connectors feature vibration and shock resistant #30 TwistPin contacts on 0.025" center spacing and 1 Amp current rating with #30 and #32 AWG wire compatibility. The Glenair Series 89 offers options beyond what is covered in MIL-DTL-32139, including PCB versions, back-to-back jumpers and pigtails with uninsulated wire. Glenair is also qualified to MIL-DTL-32139, which covers pre-wired single and double row metal shell connectors, and ensures interchangeability and interchangeability with other qualified connector families.



Micro-D Subminiature

The Glenair high-reliability MIL-DTL-83513 Micro-D offers a wealth of performance benefits—such as 0.050" contact spacing and a TwistPin and solid-tube socket contact system—which far outweigh any potential cost savings realized by specifying a lesser caliber connector. Micro-D is a MIL-DTL-83513 qualified microminiature connector ideally suited to applications where interconnect failure is simply not an option. If downtime is a critical concern, other connectors cannot match the long-term durability and performance advantages of the MIL-DTL-83513 Micro-D.



Series 79 Micro-Crimp

The Series 79 Micro-Crimp is a high-performance power and signal connector ideally suited to blind-mate rack-and-panel and/or module-to-chassis applications. The Series 79 Micro-Crimp features improved EMI shielding and environmental sealing compared to standard M24308 D-Subminiature connectors. The crimp, rear-release size #23 contacts are placed on .075" (1.9 mm) centers. The connector series also supports size #12 and #16 power and coaxial crimp contacts, plus pneumatic "pitot contacts" in 29 hybrid insert arrangements. The connector is equipped with guide pins for controlled mating, making it an ideal choice for backplane applications in both military and commercial aerospace.



CB Series "PogoPin" Connectors

The VG95351 and -96934 qualified "PogoPin" connector is an advanced, highly-miniaturized version of the MIL-DTL-55116 waterproof connector used on military radios. The CB Series features bayonet-lock coupling, self-wiping spring loaded contacts, IP68 ingress resistance and a 5000 mating cycle durability rating. The Glenair CB connector is designed to address audio equipment and field radio interconnect requirements in military and other demanding applications where size and weight reduction is a critical requirement. The ultra-miniature reverse bayonet connector and its spring-loaded, wiping contacts ensure reliable electrical and environmental performance with each mating, and is just half the size and weight of the lower contact count MIL-DTL-55116 product.



Series 80 “Mighty Mouse” Connectors

The Series 80 “Mighty Mouse” Connector is currently available with 33 high density insert arrangements from 1 to 130 contacts on 0.076” spacing, in bayonet, triple-start threaded and push-pull coupling styles. “Mighty Mouse” is designed for high-reliability aerospace/defense interconnect applications requiring robust environmental performance in an ultra-miniature package. The connector series is broadly applied in ground soldier ensembles—including Land Warrior—and offers virtually equal performance to MIL-DTL-38999 interconnects with up to 71% weight and 52% size savings. The Series 80 “Mighty Mouse” supports a flexible range of contact types, including #23 and #20 signal contacts, #16 and #12 power contacts, size #16 and #12 coaxial contacts, as well as #12 pneumatic contacts.



Hermetic Connectors

Glenair MIL-DTL-38999 qualified Series I, II, III and IV hermetic connectors are designed for high pressure/low leakage applications, with a helium leak rate of less than 1×10^{-7} cc/sec at one ATM. Insert arrangements are available in 2 to 128 contacts in solder, wall mount, box mount and jam nut styles. Hermetic connectors are designed for use in pressurized or severe environmental applications, such as geophysical, medical and military aerospace. And since Glenair makes all of its hermetic connectors in-house, we can offer unsurpassed turnaround and availability.



MIL-DTL-38999 Type Environmental Connectors

Environmental class plugs and receptacles are offered in high-density insert arrangements (up to 128 contacts) with crimp removable contacts, PC tails, and solder cups—in Series I, II and III configurations. Glenair manufactures a wide range of environmental class MIL-DTL-38999 type connectors including lanyard-release products, composites, specialty metal cable plugs and receptacles, and Coax contact equipped products. Both MIL-qualified and one-off “specials” are available to meet the requirements of every application.



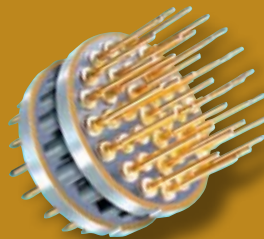
Series ITS Reverse Bayonet MIL-DTL-5015 Type

The Glenair ITS connector series is based on the MIL-DTL-5015 standard, but in lieu of threads features an improved reverse bayonet coupling that provides positive mating and excellent shock and vibration resistance. These rugged connectors are available in hundreds of power and signal insert arrangements, and offer exceptional environmental protection.



EMI/EMP Filtered Connectors

Glenair’s EMI/EMP filter connectors are available with 400pF to 240,000pF Pi or C filter elements that meet or exceed military standards, and are intermateable with non-filtered plugs and connector adapters. Transient voltage suppression diodes are also available to safeguard against lightning strike. Glenair’s family of circular military standard type EMI/EMP filter connectors is designed to meet stringent aerospace performance requirements. Each connector series is offered with standard low-pass Pi or C filter arrays, or with customized filters to meet specific frequency and capacitance requirements.



MIL-DTL-38999 Type Fiber Optic Connectors

Glenair’s unique alignment techniques maximize optical performance and provide reliable, repeatable interconnection of optical fibers. Ferrule design—critical to performance—has traditionally relied upon a machined stainless steel terminus incorporating a precision micro drilled hole. Glenair’s unique precision ceramic ferrules, with concentricity and diametric tolerances controlled within one micron (.00004 of an inch), meet the needs of high bandwidth and low allowable insertion loss applications. In fact, Glenair’s ferrules are approximately 10 times more accurate than alternative designs, and have reduced insertion loss values from 1.5dB to less than .5dB (typical loss for Glenair termini is .3 dB).



GFOCA Hermaphroditic Fiber Optic Connectors

Most commonly used by the army for long-run battlefield communications, the GFOCA Connection System is also well suited to dockside naval communications, down-hole drilling and other harsh environment applications. The hermaphroditic system uses low insertion loss butt-joint termini and a ruggedized coupling mechanism for reliable, repeatable mating. The genderless mating system is rated to 2000 cycles, depending on fiber media selection.



Glenair High Density (GHD) Fiber Optic Connectors

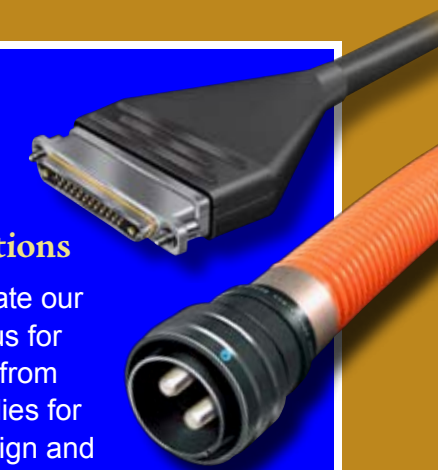
The Glenair High Density Fiber Optic Connector System is designed for applications that require reduced size and weight as well as outstanding optical and environmental performance. The System accommodates a broad range of single- and multi-mode fiber media, and offers insertion loss values less than .5dB (typical loss for Glenair termini is .3 dB). Dense cavity spacing is achieved with an innovative #18 genderless Front Release terminus design that provides nearly double the density of standard M28876 and D38999 fiber optic connector series.



Fact! Glenair Build-to-Order and Off-the-Shelf Cable and Conduit Systems

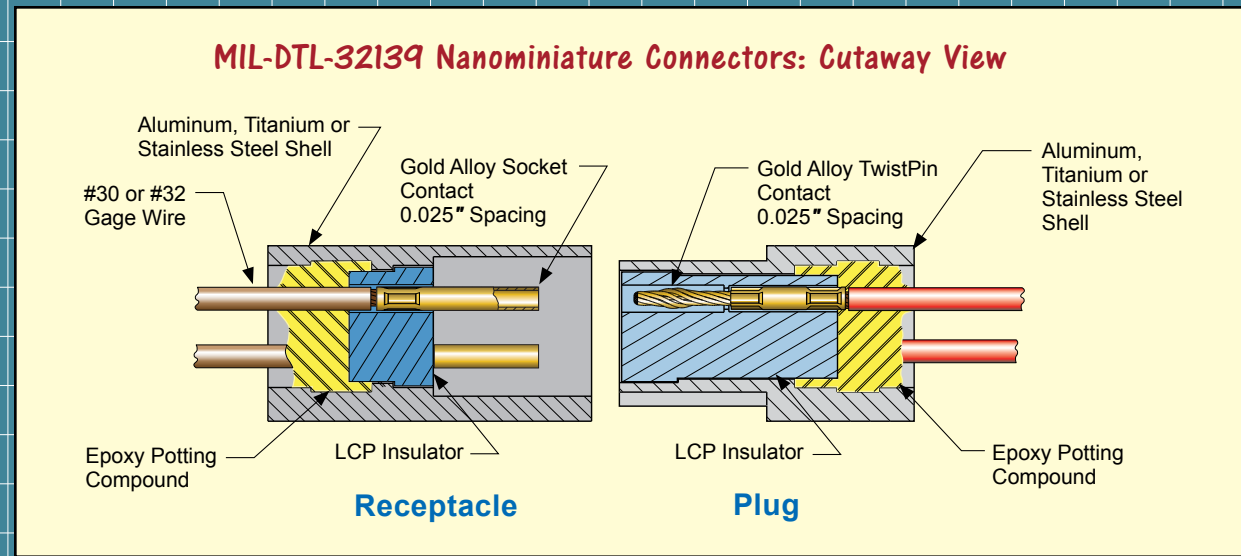
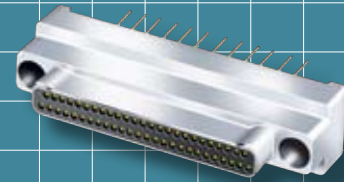
Designed to survive in demanding air, sea, land and space applications

Glenair is unique in the interconnect components industry because we also operate our own Mil-qualified wire cable harness and conduit assembly facility. We are famous for our ability to handle even the most complex projects and production schedules—from simple point-to-point conduit systems to our signature overmolded cable assemblies for harsh application environments. All of the connector families surveyed in this design and reference guide are available as discrete components or in wired and tested assemblies built to survive the most extreme environmental, mechanical, electrical and optical requirements.



Series 89 Nano MIL-DTL-32139

0.025" Contact Spacing
Gold Alloy TwistPin Contacts
From 9 to 51 Contacts
For #30 and #32 AWG wire



- Pigtail Assembly Wire Types**
- A**
Ultra lightweight XLETFE Insulation, Silver-Coated Ultrahigh-Strength Copper (Not available for #32 gage)
 - B**
Extruded PTFE Insulation, NEMA HP3-ETX (MIL-W-16878/6)
 - C**
Cross-Linked Modified ETFE Insulation, MIL-W-22759/33 (Not available for #32 AWG)
 - D3**
Single Strand Copper Wire, Uninsulated, with Gold Plating

Dielectric Withstanding Voltage

(Sea level). 250 volts AC, rms 60 Hz. Connectors shall show no evidence of breakdown or flashover when subjected to the DWV test of EIA-364 Procedure 20

(70,000 feet). 100 volts AC, rms 60 Hz. Connectors shall show no evidence of breakdown or flashover when subjected to the DWV test of EIA-364 Procedure 20.

Service Rating

Nano TwistPin contacts handle 1 AMP current rating and 70 Volts AC RMS operating voltage using #30 or #32 AWG wire.

Shell Materials and Finishes

Code	Specifications
A1	Aluminum Alloy, Cadmium Plated per SAE-AMS-QQ-P-416 Type II Class 1.
A2*	Aluminum Alloy, Electroless Nickel Plated Per SAE-AMS-C-26074, Class 3 or 4, Grade B
T*	Titanium Alloy per MIL-T-81556, Unplated
S*	300 Series Stainless Steel per ASTM A582

* RoHS Compliant

Space Grade Mod Codes

NASA Screening Level	Special Screening Only	8 Hour Oven Bake 400° F.	Special Screening Plus Outgassing Processing Thermal Vacuum Outgassing 24 hrs. 125° C.
Level 1 Highest Reliability	Mod 429B	Mod 429J	Mod 429C
Level 2 High Reliability	Mod 429	Mod 429K	Mod 429A
Level 3 Standard Reliability	(Use standard part number)	Mod 186	Mod 186M

Insulation Resistance

5,000 megohms minimum between any pair of contacts and any contact and the shell when tested in accordance with EIA-364 Procedure 21. Test voltage 100 volts DC.

Electrical Performance Specifications

Contact Spacing	.025" (0.64) Contact Centers
Wire Accommodation	#30-#32 AWG
Current Rating	1 AMP Maximum
Voltage Rating (DWV)	250 VAC RMS Sea Level, 100 VAC RMS 70,000 Feet
Insulation Resistance	5000 Megohms Minimum
Contact Resistance	71 Millivolt Drop Maximum, 1 AMP Current, #30 AWG Wire

Physical Performance Specifications

Operating Temperature	-55° C. to +125° C.
Vibration	20 g's, In Accordance With EIA-364-28, Condition IV
Shock	100 g's, In Accordance With EIA-364-27, Condition G
Durability	200 Mating Cycles
Corrosion Resistance	48 Hours Salt Spray In Accordance With EIA-364-26, Condition B
Humidity	96 Hours, In Accordance With EIA-364-31 Condition A
Mating and Unmating Force	7 Ounces Per Contact Maximum
Contact Engaging and Separation Forces	5 Ounces Maximum, 0.4 Ounces Minimum
Thermal Vacuum Outgassing	Total Mass Loss (TML) 1.0% Max., Volatile Condensable Material (VCM) 0.1% Max.
Polarization	Single (890-XXX) or Double Row (891-XXX) Rectangular Shells; Lobed Mating Interface

Termination Styles

Pre-terminated pigtails plus thru-hole, straddle mount and surface mount PCB versions

Durability Rating

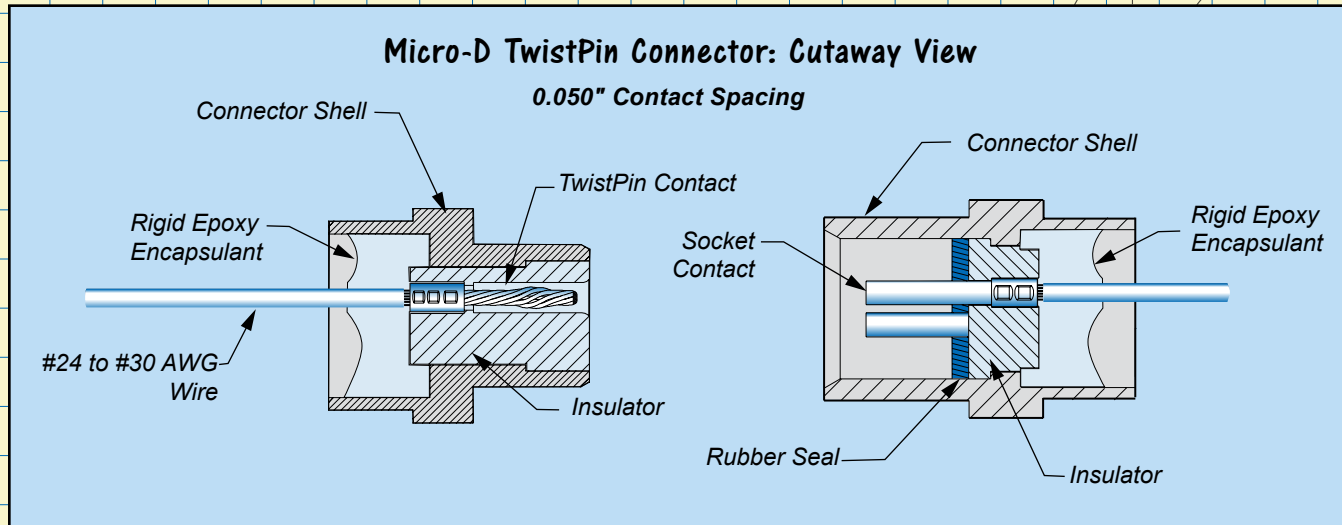
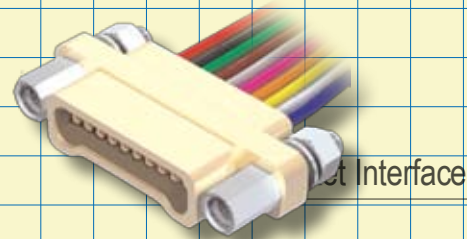
200 mating and unmating cycles in accordance with test procedure EIA-364-09. Engaging and separation force and mating forces shall not exceed the requirements of 3.2.1 and 3.2.2. Connectors shall withstand shock vibration and DWV tests following durability.

Component Materials and Finishes

Insulator	Liquid Crystal Polymer (LCP), per MIL-M-24519 GLCP-30F, 30% Glass-Filled
Pin Contact	Spring Temper Gold Alloy, Unplated, Per ASTM B477 and ASTM B541.
Socket Contact	Gold Alloy, Unplated, Per ASTM B477 or ASTM B541.
Hardware	300 Series Stainless Steel
PCB Trays	Liquid Crystal Polymer (LCP), per MIL-M-24519 GLP-30F, 30% Glass-Filled
Encapsulant	Epoxy

Micro-D MIL-DTL-83513

0.050" Contact Spacing
Copper Alloy TwistPin Contacts
From 9 to 100 Contacts
For #24 to #30 AWG wire



Wire Test Data

Pigtail Wire, Insulated Hookup	Wire Type E: 7 Strand Silver-Coated Copper Wire, Extruded PTFE Insulation, 600 Volts RMS, 200°C., In Accordance with NEMA HP3 (Replaces MIL-W-16878/4) Wire Type K: 19 Strand Silver-Coated Copper Wire, Extruded PTFE Insulation, 600 Volts RMS, 200°C., In Accordance with SAE AS 22759/11 Wire Type J: 19 Strand High-Strength Silver-Coated Copper Alloy Wire, Crosslinked Modified ETFE Insulation, 600 Volts RMS, 200°C., In Accordance with SAE AS 22759/33
Pigtail Wire, Uninsulated	Wire Finish Code 3: Solid Copper Wire In Accordance With A-A-59551, Gold-Plated, Solder Dipped in 63/37 tin-lead Wire Finish Code 4: Solid Copper Wire In Accordance With A-A-59551, Gold-Plated

Performance Ratings

Operating Temperature	-55° to +150° C.	
Salt Spray (Corrosion)	48 hours	EIA-364-26, test Condition B
Mechanical Shock	50 g.	EIA-364-27, Test Condition E
Vibration (Sine)	20 g.	EIA-364-28, Test Condition IV
Magnetic Permeability	2 Mu max	EIA-364-54
DWV	600 VAC (sea level)	EIA 364-20
	150 VAC (70,000ft)	
Durability	500 Cycles	

PCB Termination Styles

- CBS** - Condensed Vertical Mount
- CBR** - Condensed 90°
- BR** - Standard 90°
- BS** - Standard Vertical Mount
- SMR** - Surface Mount 90°

Materials and Specifications

Metal Shell Material	Aluminum alloy 6061 IAW SAE AMS-QQ-A-250/11
Pin Contact (TwistPin)	Copper alloy, Gold Plated In Accordance With ASTM B 488 Type II Class 1.27 (50 Microinches Minimum) Code C, Over Nickel Underplate In Accordance With SAE AMS-QQ-N-290, Class 2, (50-150 Microinches).
Socket Contact	Phosphorous Bronze ASTM 139 Gold Plated In Accordance With ASTM B 488 Type II Class 1.27 (50 Microinches Minimum) Code C, Over Nickel Underplate In Accordance With SAE-AMS-QQ-N-290, Class 2, (50-150 Microinches).
Contact Current Rating	3 Amps continuous from -55° to +150° C.
Contact Resistance	8 milliohms maximum
Low Level Contact Resistance	32 milliohms maximum
Plastic Shell, Insulator, Terminal Block	Rigid epoxy encapsulant; tested as specified in test method EIA-364-21 5000 megohms min. at 25° C

Standard Materials

Connector Shell, Metal	Aluminum Alloy 6061 In Accordance With SAE AMS-QQ-A-250/11 Stainless Steel, 300 Series
Connector Shell, Plastic	Liquid Crystal Polymer, 30% Glass-Filled, In Accordance With MIL-M-24519
Insulator	Liquid Crystal Polymer, 30% Glass-Filled, In Accordance With MIL-M-24519
Interfacial Seal	Fluorosilicone Rubber In Accordance With A-A-59588
Terminal Block, PCB	Liquid Crystal Polymer, 30% Glass-Filled, In Accordance With MIL-M-24519
Encapsulant (Potting)	Epoxy Resin, Hysol EE4215/HD3561
Hardware	Stainless Steel, Passivated In Accordance With SAE AMS 2700

Physical Performance Specifications

Outgassing	1.0% Total Mass Loss max., 0.1% Collected Volatile Condensable Materials	ASTM E595
Mating and Unmating Force	10 ounces per contact maximum	EIA-364-13
Contact Engaging and Separation Forces	6 ounces maximum, 0.5 ounces minimum	
Crimp Tensile Strength, #26 AWG	5 pounds min. M22759/11, 10 pounds min. M22759/33	EIA-364-08
Humidity, Metal Shell with Interfacial Seal	100 megohms IR following ten 24 hour cycles	EIA-364-31, Method IV.
Fluid Immersion	20 hours synthetic lubricating oil, 1 hour coolanol	MIL-DTL-83513F, para. 4.5.18
Shielding Effectiveness, Metal Shell with Ground Spring	65 dB minimum	EIA-364-66

Standard Finishes

- 1 - Cadmium with yellow chromate conversion coating over electroless nickel per SAE-AMS-QQ-P-416, Type II, Class
- 2* - Electroless nickel IAW ASTM B733-90 SC2 Type 1 Class 5
- 3* - Stainless steel shell, passivated IAW SAE AMS 2700
- 4* - Black anodize over aluminum MIL-A-8625 Type II Class 2
- 5* - Gold over aluminum IAW with ASTM B48
- 6 - Chem film IAW MIL-C-5541 Class 3
- 29* - Alumiplated
- 31 - Zinc Nickel
- 33* - 1000 Hour Grey™

* RoHS Compliant

Micro-D Part Number Series Designators

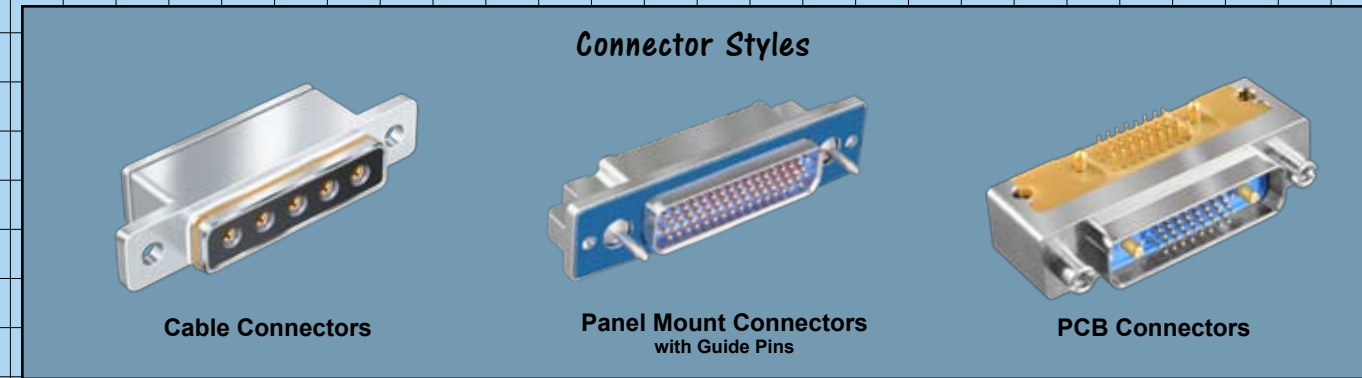
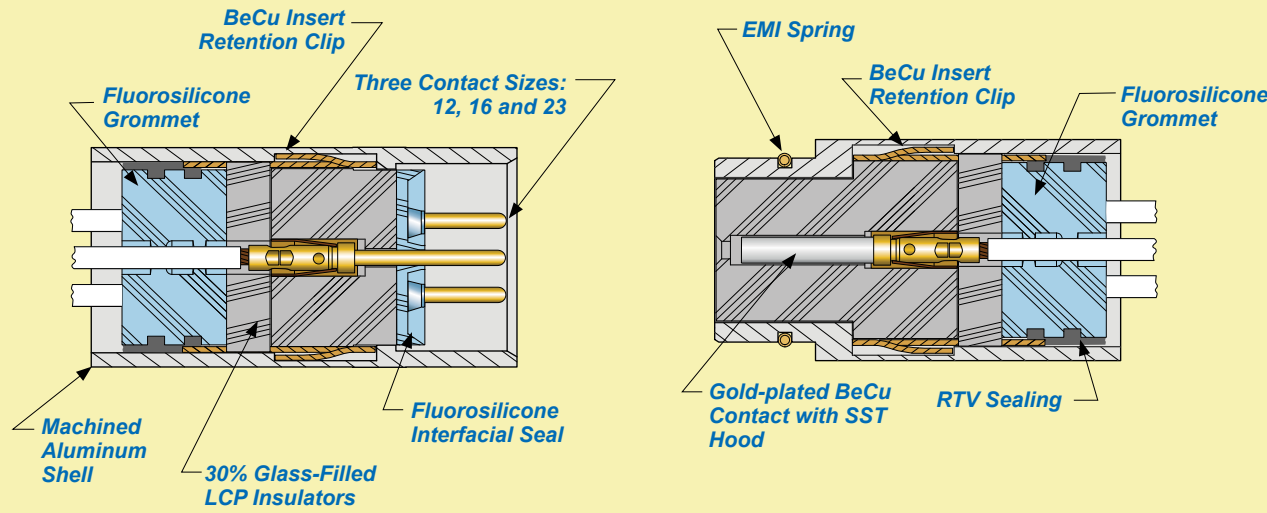
Series	Description
MWDM	Standard metal shell solder cup, pigtail and PCB connectors
GMDE	O-ring sealed, metal shell panel mount receptacles
GMR75	Special .075" pitch connector series
GMSM	Single-row metal shell solder cup, pigtail and PCB connectors
GMPPM	Metal shell combination power and signal contact connectors
240	Filter class connectors, all styles
177-***H	Glass sealed hermetic connectors
MWDL	LCP thermoplastic shell solder cup, pigtail and PCB connectors
500 and 507	EMI and environmental backshells to fit Micro-D connectors
780	"Marshall Bean" protective rubber covers
MWEB	Micro EdgeBoard connectors
MWS	TwistPin contact equipped MicroStrip connector
MWKQ	Quick disconnect micro circular connectors

Series 79 Micro-Crimp

0.075" Contact Spacing
Copper Alloy Crimp Contacts
From 2 to 66 Signal, Power
Coax or Pitot Contacts



Series 79 Micro-Crimp Connectors: Cutaway View



Connector Materials and Specifications

Size #23 contacts	Highly conductive copper alloy, plated gold over nickel
Size #16 and #12 contacts	Copper alloy
Coaxial Contacts	50 and 75 Ohm standard and 50 Ohm matched impedance IAW SAE AS 39029
Insulators	Liquid crystal polymer, 30% glass-reinforced
Shell	Aluminum alloy. See ordering info for finish options
Interfacial seal and grommet	Fluorosilicone
Contact and insert retention clips	Highly conductive copper alloy, heat-treated, unplated
Jackposts and guide pins	Stainless steel, passivated
EMI Shroud for right angle PCB	Aluminum alloy
Trays for right angle PCB	Thermoplastic
Spring, EMI (plug)	Stainless steel or copper alloy, gold plated

Shell Size	Contact Arrangement	Contact Quantity			Shell Dim.	
		#23	#16	#12	X	Y
A	A-5	5	—	—	.785	.308
B	B-2P2	—	2	—	.935	
	B-9	9	—	—		
C	C-13	13	—	—	1.085	
	D-15	15	—	—		
D	D-3P3	—	3	—	1.185	
	D-7P2	5	2	—		
E	E-11P2	9	2	—	1.335	
	E-19	19	—	—		
F	F-15P2	13	2	—	1.485	
	F-23	23	—	—		
G	F-5P5	—	5	—		
	G-33	33	—	—	1.435	.395
H	H-10P4	6	—	4	2.175	.410
	H-29P7	22	7	—		
	H-36P2	34	—	2		
	H-54P2	52	2	—		
J	H-5P5	—	—	5	1.845	.308
	H-66	66	—	—		
	J-17P4	13	4	—		
	J-25P2	23	2	—		
K	J-33	33	—	—	2.240	
	J-7P7	—	7	—		
	K-27P4	23	4	—		
	K-35P2	33	2	—		
L	K-43	43	—	—	2.420	.410
	K-9P9	—	9	—		
	L-6P6	—	—	6	2.420	

Standard Finishes

Plating Code	Shell Plating
M*	Electroless Nickel
MT*	Nickel-PTFE 1000 Hour Grey™
ZN	Zinc-Nickel with Olive-Drab Chromate
ZNU	Zinc-Nickel with Black Chromate
N	Cadmium with Olive-Drab Chromate
J	Cadmium with Yellow Chromate
C*	Black Anodize
Z2*	Gold
E	Chem Film

* RoHS Compliant

Series 79 Part Number Series Designators

Series	Description
790-024P 790-025S	Standard cable connector
790-026P 790-027S	Panel mount cable connector
790-028P 790-029S	Panel mount PCB connector
790-036P 790-037S	Right angle PCB panel mount connector
790-043P 790-044S	Board mount connector
790-041P 790-044S	Right angle board mount connector

Contact Current Rating

Contact Size	Max Amps	Insulation Resistance	DWV
12	23	5000	1800
16	13	megohms	1800
23	5	Min.	500

Advanced EMI Shielding Technology



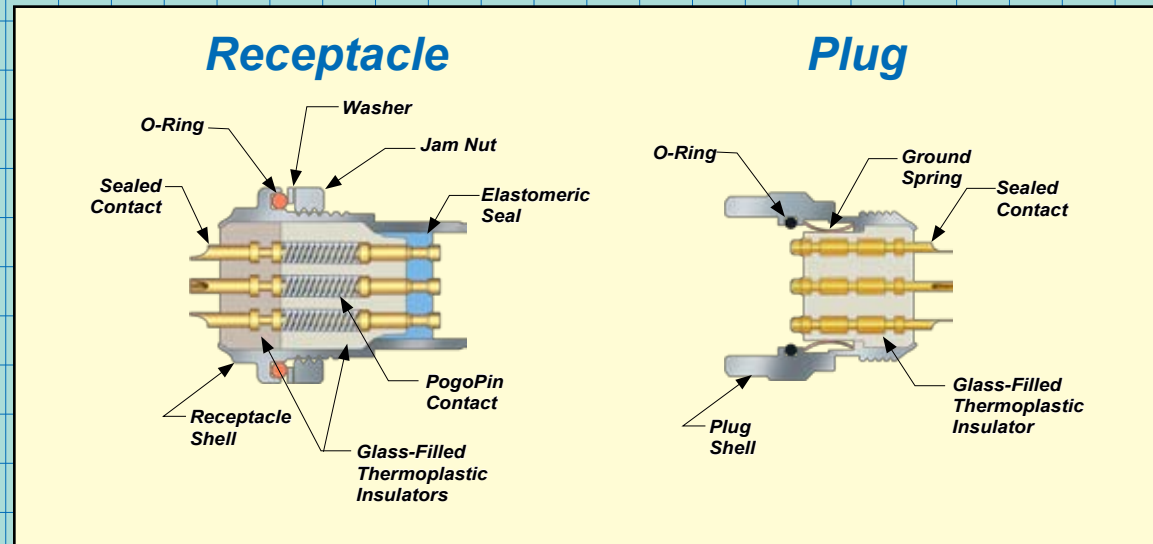
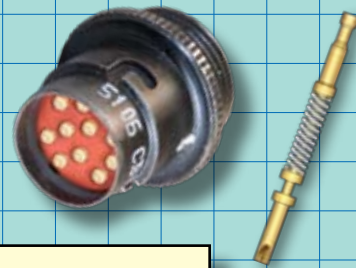
An integrated EMI ground spring provides a substantial increase in protection against electromagnetic interference by assuring consistent shell-to-shell resistance.

Basic Specifications

Operating Temperature	-65° C. to +150° C.
Durability	≥ 2000 mate/unmate cycles
Water Ingress Protection	IP67
Altitude Immersion	≥ 75000 feet
Vibration	> 40G, random, 50-2000 Hz
Mechanical Shock	> 300 G's, 3 μSec, half sine
Shielding Effectiveness	55 dB min. attenuation from 100 MHz to 10 GHz
Shell-to-Shell Resistance	2.5 mV max

Series CB "Pogo Pin"

VG95351 and VG96934 Qualified
Self-Wiping Spring Loaded Contacts
#20 to #24 AWG Wire Accomodation
Bayonet Lock Coupling



Shell-To-Shell Resistance
(Connectors with Ground Springs)
2.5 millivolt drop maximum

Mechanical Shock
No discontinuity of greater than 10 microseconds, no cracking, breaking or loosening of parts, plug shall not become disengaged from receptacle. Connectors shall meet electrical and air leakage requirements after shock test.
EIA-364-27 Method H
IEC-60512-6-3 Severity A
3 shocks X 3 axes X 2 directions = 18 shocks 294 m/s² (30 g's), 11 ms, half-sine, 2.07 m/s velocity change

Current Rating
2.5 amp at 70° C per EIA-364-70
Method 1 IEC-60512-5 Test 9b

Shielding Effectiveness
70 dB attenuation up to 10MHz 50 dB attenuation at 100 MHz per VG 95214-13 Method KS 13 B

Termination Styles
Solder cup contacts accept up to #20 AWG stranded wire (1mm max. diameter). PC tail contacts are available in two lengths: 3.5 mm and 8.0 mm Factory terminated pigtail cord-sets are also available.

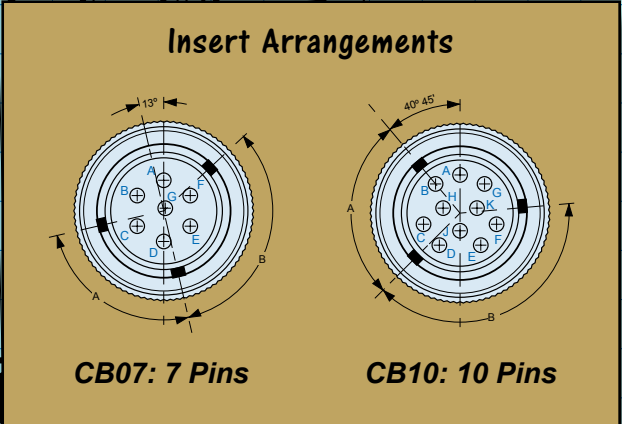
Connector Materials

Contacts	Copper alloy, plated hard gold over nickel
Insulators	Glass-filled nylon
O-ring, internal	Silicone rubber
Interfacial seal (receptacle)	Silicone rubber
Washer (jam nut)	300 series stainless steel, with black chromate over nickel
Spring, EMI (plug)	Copper alloy, gold plated

Dielectric Withstanding Voltage
Sea Level 500 volts AC rms 50 or 60 Hz. 1 minute dwell.

Environmental Protection Ratings

Water ingress protection	IP68 per IEC-60529
Water immersion	2 meters, 48 hours
Air pressure	0.4 bar
Operating temperature	-55° C to +85° C



Electrical Specifications

Insulation resistance	5000 megohms minimum
Durability	5000 cycles of mating, minimum
Contact resistance	5 milliohms maximum
Corrosion resistance (salt spray)	48 hours
Maximum wire size	1mm maximum diameter. Not recommended for 19/32 strand #20 wire.

Connector Materials and Finishes

Plug shell	Aluminum alloy, plated zinc-cobalt with black chromate
Receptacle shell	300 series stainless steel, with black chromate over nickel finish
Jam Nut	300 series stainless steel, with black chromate over nickel finish
Bayonet pin	Stainless steel

Receptacle Connector, Panel Mount

Style 1: Jam nut receptacle for rear panel mounting

Style 2: Jam nut receptacle with M14X1 accessory threads for rear panel mounting

Style 3: Two hole flange mount receptacle for front panel mounting

Style 4: "Thread-in" receptacle with PG9 threads for installation directly into a tapped hole

Receptacle Connector, In-Line

Style 1: Receptacle with knurl for use with Glenair 809-060 heat shrinkable boots

Style 2: Receptacle with M14 x 1 accessory threads for use with adapters

Style 3: Shrouded receptacle for in-line cable mounting

Style 4: Shrouded receptacle for in-line cable mounting with M14 x 1 accessory threads for use with adapters.

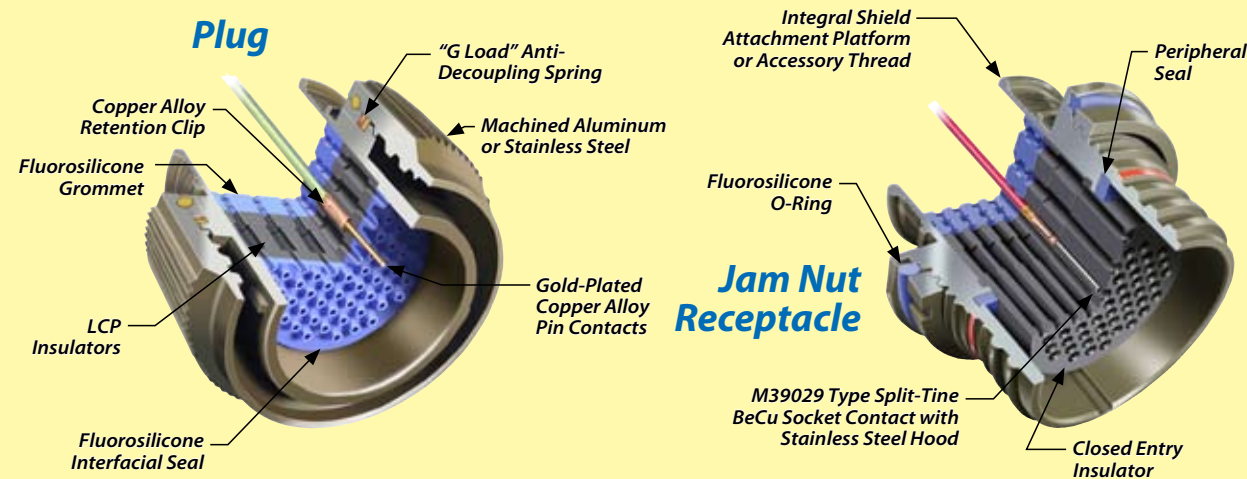
3.5

Series 80 "Mighty Mouse"

0.076" Contact Spacing
#12, #16 and #23 Crimp Contacts
#12 to #28 AWG Wire Accomodation
From 1 to 130 Contacts



Series 80 "Mighty Mouse" Connectors: Cutaway View



Materials and Finishes	
Shells, Coupling Nuts, Jam Nuts	Aluminum alloy per ASTM B211, or stainless steel per AMS-QQ-S-763
Standard Contacts	Highly conductive copper alloy, 50 μInch gold plated per ASTM B488 Type 3, Code C, Class 1,27 over nickel underplate per QQ-N-290 Class 2. Socket contact hood: stainless steel, passivated. Hermetic Pin Contacts: Nickel-Iron Alloy per ASTM-F-30, 50 μInch Gold Plated per ASTM B488 Type 3, Code C, Class 1,27.
Coaxial Contacts	50 and 75 Ohm standard and 50 Ohm matched impedance IAW SAE AS 39029
Insulators	Liquid crystal polymer (LCP) per MIL-M-24519 GLP-30F, 30% glass-filled
Contact Retention Clip	Highly conductive copper alloy
Shells, Coupling Nuts, Jam Nut Plating Finish	Code C*: Black anodize per MIL-A-8625, Type II Class 2 Code M*: Electroless nickel per AMS-C-26074 Code MT*: Ni-PTFE 1,000 Hr. Grey™ Nickel Fluorocarbon Polymer per MIL-DTL-38999 (500 Hr. Salt Spray) Code NF: Olive Drab Cadmium per AMS-QQ-P-416 over Electroless Nickel Code ZN: Olive Drab Zinc-Nickel per ASTM B841-91 over Electroless Nickel Code ZNU: Black Zinc-Nickel per ASTM B841-91 over Electroless Nickel (500 Hour Salt Spray) Code Z1*: Passivate per AMS-QQ-P-35
Grommet, Seal	Blended elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988

*RoHS Compliant

Electrical Specifications

Insulation Resistance	5000 megohms minimum
Operating Temperature	-55° C. to +150° C.
Immersion	1 meter water immersion for 1 hour (Series 803 splashproof only)
Shielding	-55° C. to +150° C.
Shock	300 g.
Vibration	37 g.
Magnetic Permeability	2.0 μ maximum

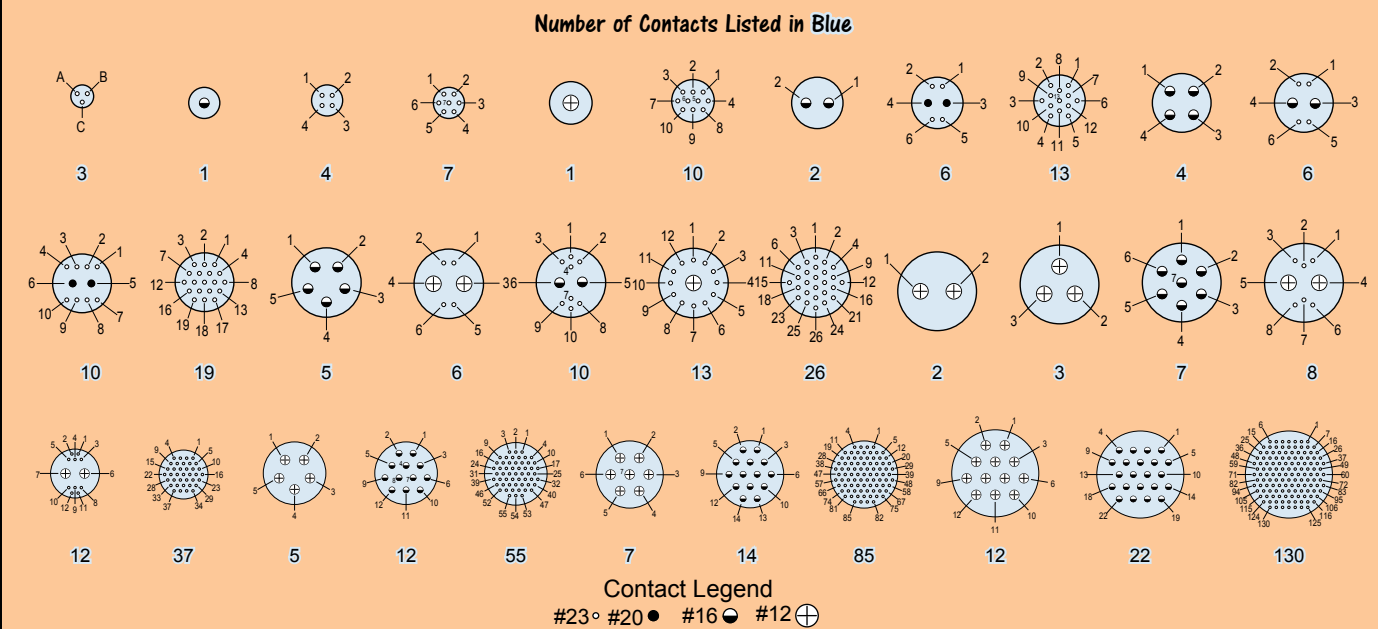
Pre-Terminated Cable Assemblies: High-Speed Options

Glenair's ASAP "Mighty Mouse" cordsets are available for 100BASE-T, Gigabit Ethernet, IEEE 1394, USB 2.0 and other high-speed applications.

Series 80 "Mighty Mouse" Product Families



Mating Face View of Pin Insert, Socket Cavity Numbers are Reversed



Vibration and Shock

37 G's Random Vibration
300 G's Shock

Test Voltage and Current Rating

Contact Size	Amperes	DWV
23	5	500 VAC
16	13	1800 VAC
12	23	1800 VAC

"Mighty Mouse" Size Comparison



Leakage Attenuation, dB Minimum

Frequency	Connector Series					
	800	801	802	803	804	805
100 MHz	75	75	75	60	80	90
1GHz	55	55	55	40	60	80
10GHz	40	40	40	---	40	60

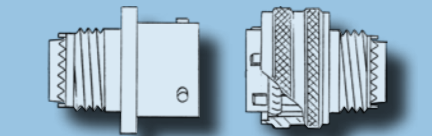
MIL-DTL-38999

Hermetic

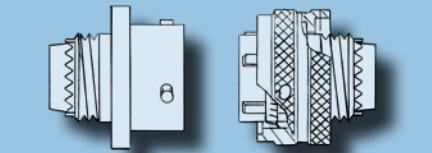
Helium Leak rate $<1 \times 10^{-7}$ cc/sec
 From 2 to 128 Contacts
 #8 through #22D Contacts Available
 Jam Nut, Solder, Wall and Box Mount



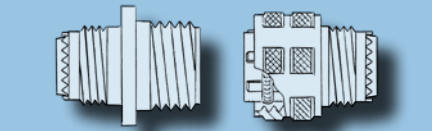
D38999 Series Styles:



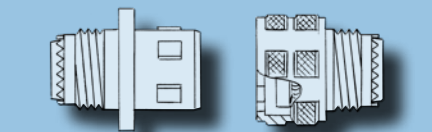
Series I
 Scoop-Proof, 3 Point Bayonet Coupling
 Four Alternate Key Positions:
 A, B, C, D



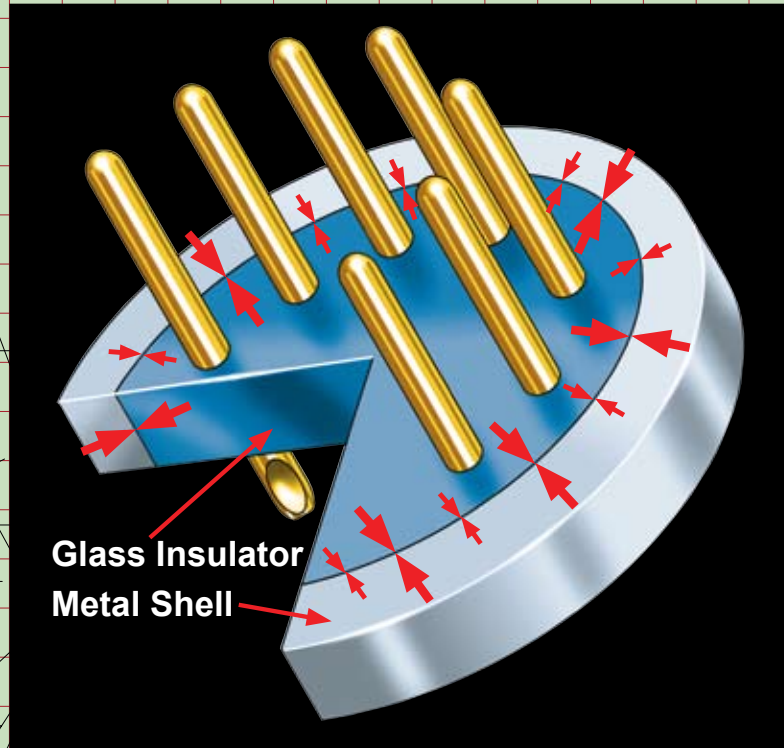
Series II
 Low Profile, 3 Point Bayonet Coupling
 Four Alternate Key Positions:
 A, B, C, D



Series III
 Scoop-Proof, Triple Start, Self-Locking
 Five Alternate Key Positions:
 A, B, C, D, E



Series IV
 Scoop-Proof, Breech Lock
 Nine Alternate Key Positions:
 A, B, C, D, K, L, M, R, U



Glass Insulator
 Metal Shell

MS and Commercial Part Number Cross Reference

MS Part Number	Glenair Commercial Part Number	Description
MS27469	231-100-H0	Series I Wall Mount
MS27470	231-100-H7	Series I Jam Nut
MS27471	231-100-H5	Series I Solder Mount
MS27475	232-100-H0	Series II Wall Mount
MS27476	232-100-H2	Series II Box Mount
MS27477	232-100-H7	Series II Jam Nut
MS27478	232-100-H5	Series II Solder Mount
D38999/21	233-100-H2	Series III Box Mount
D38999/23	233-100-H7	Series III Jam Nut
D38999/25	233-100-H5	Series III Solder Mount
D38999/27	233-100-H8	Series III Weld Mount
D38999/41	234-100-H2	Series IV Box Mount
D38999/43	234-100-H7	Series IV Jam Nut
D38999/45	234-100-H5	Series IV Solder Mount
D38999/48	234-100-H8	Series IV Weld Mount

Performance Rating

Shock and Vibration	300 G's Shock; 37 G's Random Vibration
Thermal Shock	-40° C to + 90° C
Operating Temperature	D (FT) -65° C to +150° C; E and Y (Z1), and N (ZL) -65° C to +200° C
Mating Cycles	500 Mating Cycles
Corrosion Resistance	1000 Hours on Stainless Steel Shells
Shielding Effectiveness	Effective over a range of 100MHz to 10GHz with a minimum 50dB effectiveness at 10GHz, IAW test method EIA-364-10
Shell-to-Shell Resistance Series I & II (with spring fingers)	E (Z1) 2.5 Millivolt drop maximum N (ZL) 1 Millivolt drop maximum D (FT) N/A
Shell-to-Shell Resistance Series I & II	ALL - 200 Millivolt
Shell-to-Shell Resistance Series III & IV	N (ZL) 1 Millivolt H & Y (Z1S, Z1) 10 Millivolt

Compatible Sav-Con® Connector Savers

Part Number	Description
942-003	Series I Type Sav-Con® Plug/Receptacle Connector Saver
GC443	Series I Type Sav-Con® Plug/Plug In-Line Connector Saver
942-004	Series II Type Sav-Con® Plug/Receptacle Connector Saver
942-005	Series III Type Sav-Con® Plug/Receptacle Connector Saver
947-221	Series III Type Sav-Con® Plug/Plug In-Line Connector Saver
947-139	Series III Type Sav-Con® Pin/Pin or Socket/Socket In-Line Saver

Contact Current Rating

Contact Size	Max Amps	Millivolt Drop
22D	3	85
20	5	60
16	10	85
12	17	82
10	24	72

Supported Wire Sizes

Contact Size	Wire Gauge
22D	#22 - #28
20	#20 - #24
16	#16 - #20
12	#12 - #14
10	#10 - #12

Terminations

Terminations: Pin, Socket Solder Cups; Pin, Socket Eyelets; Vertical Mount PCB Feedthrough

Service Rating

Test voltage, Volts AC (rms). Wired, assembled, unmated connectors:

Service Rating	Sea Level	70,000 ft..
M	1300 VRMS	350 VRMS
N	1000 VRMS	260 VRMS
I	1800 VRMS	400 VRMS
II	2300 VRMS	500 VRMS

Hermetic Connector Shell Materials and Finishes

Plating Code	Material	Finish	Specification
Glenair Commercial Equivalent Plating Codes			
Z1*	Stainless Steel	Passivate	AMS-QQ-P-35
FT*	Carbon Steel	Fused Tin Plate	ASTM A 108
ZL*	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290, Class 2
MIL-DTL-38999 Plating Codes			
D*	Carbon Steel	Fused Tin Plate	ASTM-B545 or ASTM-B339
E*	Stainless Steel	Passivate	AMS-QQ-P-35
N*	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290, Class 2

* RoHS Compliant

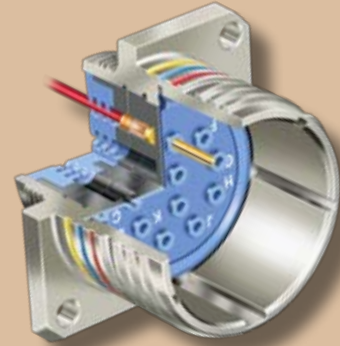
MIL-DTL-38999

Environmental

Stainless, Aluminum or Composite
From 2 to 128 Contacts
#8 through #22D Contacts
Jam Nut, Solder, Wall and Box Mount



MIL-DTL-38999 Series III



Available Mounting Styles

Mounting Style	Part Number
Wall Mount	233-105-00, D0 & T0
Jam Nut	233-105-07
In-Line Receptacle	233-105-05
Plug Connector	233-105-G6
Box Mount with PC Tails	257-455

GROUNDING

WR
CTI
OD
T

Contacts, Layouts and Terminations

Contacts: Copper alloy / Gold plate, available in sizes 8 (Quadrax), 10, 12, 16, 20 and 22D.
Layouts: Available with 2 to 128 contacts. Insert arrangements IAW MIL-STD-1560
Terminations: Pin, Socket Solder Cups; Pin, Socket Eyelets; Vertical Mount PCB Feedthrough

Performance Ratings

Shock and Vibration	300 G's Shock; 37 G's Random Vibration
Thermal Shock	-65° C to +175° C per EIA-364-32 test
Operating Temperature	-55° C to +150° C
Mating Cycles	500 Mating Cycles
Corrosion Resistance	1000 Hours on Stainless Steel Shells
Shielding Effectiveness	Effective over a range of 100MHz to 10GHz with a minimum 50dB effectiveness at 10GHz, IAW test method EIA-364-10
Shell-to-Shell Resistance	2 Millivolt drop maximum, per EIA-364-83

Supported Wire Sizes

Contact Size	Wire Gauge
22D	#22 - #28
20	#20 - #24
16	#16 - #20
12	#12 - #14
10	#10 - #12

Environmental Connector Materials and Specifications

Component	Material
Shells, Coupling Nuts, Jam Nuts	Aluminum alloy 6061 per ASTM B211; Engineering grade thermoplastic; CRES passivated stainless steel
Rigid Insulators	Glass-filled liquid crystal polymer (LCP) in accordance with MIL-M-24519, Type GLP-30F
Contact Retention Clip	Highly conductive copper alloy, heat-treated, unplated
Grommet, Peripheral Seal, Interfacial Seal, O-ring	Blended fluorosilicone/silicone elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988
Pin Contact	Copper alloy per ASTM B197, 50 micro inches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 micro inches
Socket Contact	Copper alloy per ASTM B197, 50 micro inches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 microinches.
Socket Contact Hood	Stainless steel, passivated per AMS-QQ-P-35
Adhesives	Silicone and Epoxy
Potting Compound: PCB and Solder Cup Versions	High-strength epoxy, Hysol EE4215

Crimp Quadrax Pin and Socket Contacts

Contact Size	Type	Glenair Part Number	Military P/N	Cable Type Dash No.	Wire Size	Sample Contact
#8	Quadrax	854-001	N/A	-01 - Tensolite NF26Q100	26AWG	
				-02 - Tensolite NF24Q100	24AWG	
		-03 - Draka Fileca F 4704-6		26AWG		
		-04 - Draka Fileca F 4704-4		24AWG		

Materials and Finishes

Plating Code	Material	Finish	Specification
M*	Aluminum	Electroless Nickel	AMS-C-26074
NF	Aluminum	Cadmium Plate Olive Drab over Electroless Nickel	AMS-QQ-P-416, over AMS-C-26074 (1000 Hour Salt Spray)
ZN	Aluminum	Olive Drab Zinc-Nickel	Zinc alloy per ASTM B841-91, Class 1 Type E Grade 3 over Electroless nickel per ASTM B733-90 SC2, Type 1 Class 5
MT*	Aluminum	Ni-PTFE 1,000 Hour Grey™ (Nickel Fluorocarbon Polymer)	MIL-DTL-38999L (500 Hour Salt Spray)
XM*	Composite	Electroless Nickel	AMS-C-26074
XMT*	Composite	Ni-PTFE 1,000 Hour Grey™ (Nickel Fluorocarbon Polymer)	MIL-DTL-38999L (2000 Hour Salt Spray)
XW	Composite	Cadmium Olive Drab over Electroless Nickel	AMS-QQ-P-416, over AMS-C-26074 (1000 Hour Salt Spray)
Z1*	Stainless Steel	Passivate	AMS-QQ-P-35
ZL*	Stainless Steel	Electrodeposited Nickel	SAE-AMS-QQ-N-290, Class 2

*RoHS Compliant

Contact Current Rating

Contact Size	Test Current (Amps)	Max Millivolt Drop
22D	5	73
20	7.5	55
16	13	49
12	23	42
10	33	33

Service Rating

Test voltage, Volts AC (rms). Wired, assembled, unmated connectors:

Service Rating	Sea Level	70,000 ft..
M	1300 VRMS	350 VRMS
N	1000 VRMS	260 VRMS
I	1800 VRMS	400 VRMS
II	2300 VRMS	500 VRMS

1.81 MAX
(46.0 MAX)

TYPE 4 (METAL)

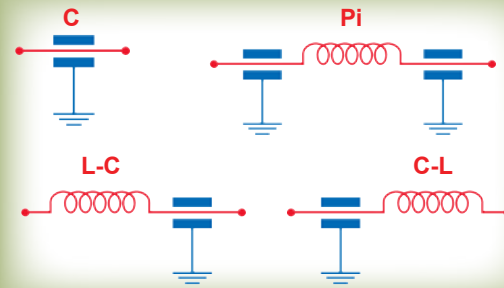
EMI/EMP Filter Connectors

PC Tail, Solder Cup or Crimp-Contacts
 Transient Voltage Suppression Diodes
 400 to 240,000 pF Capacitance
 C, L-C, C-L and Pi Filter Styles



Filter Types

- C** Single capacitor with low self inductance
- LC, CL** Single capacitor combined with an inductive element
- Pi** Dual capacitors with a single inductive element positioned between.



Space Grade Ratings

Test	Methods
Visual	EEE-INST-002 per Table 4A
Mechanical	EEE-INST-002 per Table 4
Voltage Conditioning	MIL-STD-202 Method 108
DWV	MIL-STD-1344 Method 303
Insulation Resistance (room temp.)	MIL-STD-202 Method 302
Capacitance and Dissipation Factor	MIL-STD-202 Method 305
Attenuation	GSFC S-311-P-626, ¶ 4.8.9
Outgassing	ASTM-E595
Mating Force	MIL-STD-1344, Method 2013, 2014

Mod Codes

Highest Reliability	Level 1 -429B-2G
High Reliability	Level 2 -429-2G
Standard Reliability	Level 3 -429L-2G

Mod-Codes are added to the end of part numbers.

Contact Current Rating

Contact Size	Max Amps
22D	3
20	5
16	10
12	17
10	24
08	46
4	80
0	150

Available Shell Styles

- P - Plug
- Q - Crimp Removable Plug
- W - Wall Mount
- J - Jam Nut
- S - Crimp Removable Jam Nut
- D - Dual Flange* Wall Mount
- E - Dual Flange* Jam Nut
- R - Crimp Removable Wall Mount
- A - Connector Adapter

* Dual Flange Available Only with PC Tail Terminations

The Industry's Most Comprehensive and Compliant Filter Service

Connector Series:

38999	83513
26482	32139
83723	Series 80
28840	Series 79
24308	Series ITS

Line Types:

CAN BUS	TTL
ARINC 629	Analog Sensors
RS 232	Thermocouple Wires
RS 422	USB
RS 485	Ethernet

Requirement Compliance:

MIL-STD-449D	RF Spectrum
MIL-STD-461E	EMI Susceptibility
MIL-STD-1310G	Shipboard EMC
MIL-STD-1512	Electroexplosive Subsystems
MIL-STD-1541A	EMC for Space Systems
MIL-STD-1795A	Aerospace Lightning Protection
MIL-STD-1857	Grounding, Bonding and Shielding
MIL-STD-1542B	EMC and Grounding for Space Systems
EN 61000-4-2...4-3, 4-4, 4-5, 4-6, 4-8	Electromagnetic, RF and Power
RTCA/DO-160 Section 22	Pin and Cable Level and Waveform

Electrical Performance

Current Rating	up to 220 Amps
Capacitance	40pF to ???µF
Insulation Resistance	5GΩ
Dielectric Withstanding Voltage	100 to 2500 VDC
Dissipation Factor	2.5% Max
Diode Clamping Voltage Range	3.3V to 260V
Diode Peak/Pulse Power	up to 30KW

Contacts, Layouts and Terminations

Contacts: Highly Conductive Copper Alloy, Gold Plated per ASTM B488 Type 3, Code C, Class 1,27 over Nickel Underplate per QQ-N-290 Class 2. Socket Contact Hood: Corrosion Resistant Steel, Passivated.

Insulator: Liquid Crystal Polymer (LCP) per MIL-M-24519 GLP-30F, 30% Glass-Filled

Interfacial Seal, O-Ring and Peripheral Seal: Fluorosilicone Elastomer per A-A-59588, Color Blue

Potting Compound: Thermally Conductive Epoxy

Layouts: Available with 2 to 128 contacts. Insert arrangements IAW MIL-STD-1560

Performance Ratings

Shock and Vibration	IAW MIL-DTL-38999 Rev. L
Thermal Shock	-65° C to +175° C per EIA-364-32; 1000 cycles
Operating Temperature	-55° C to +125° C
Mating Cycles	500 Mating Cycles
Corrosion Resistance	1000 Hours on Stainless Steel Shells
Shielding Effectiveness	Effective over a range of 100MHz to 10GHz with a minimum 50dB effectiveness at 10GHz, IAW test method EIA-364-10
Immersion Rating	MIL-STD-810 Method 512; 1 Meter for 1 Hr. (selected series)
Shell-to-Shell Resistance	2.5 Millivolt drop maximum, per EIA-364-83

Space Rating

Component	Material	Space Flight
Pin Contact	Highly conductive copper alloy per ASTM B197, 50 microinches gold plated per ASTM B488 Type 3 Code C Class 1 over nickel plate per QQ-N-290 Class 2, 50-100 microinches	Approved
Socket Contact	Highly conductive copper alloy per ASTM B197, 50 microinches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 microinches.	Approved
Socket Contact Hood	Stainless steel, passivated per AMS-QQ-P-35	Approved

Capacitor Array Code

CLASS	PI - CIRCUIT (pF)	C - CIRCUIT (pF)
X	160,000 - 240,000	80,000 - 120,000
Y	80,000 - 120,000	40,000 - 60,000
Z	60,000 - 90,000	30,000 - 45,000
A	38,000 - 56,000	19,000 - 28,000
B	32,000 - 45,000	16,000 - 22,500
C	18,000 - 33,000	9,000 - 16,500
D	8,000 - 12,000	4,000 - 6,000
E	3,300 - 5,000	1,650 - 2,500
F	800 - 1,300	400 - 650
G	400 - 600	200 - 300

Materials and Finishes

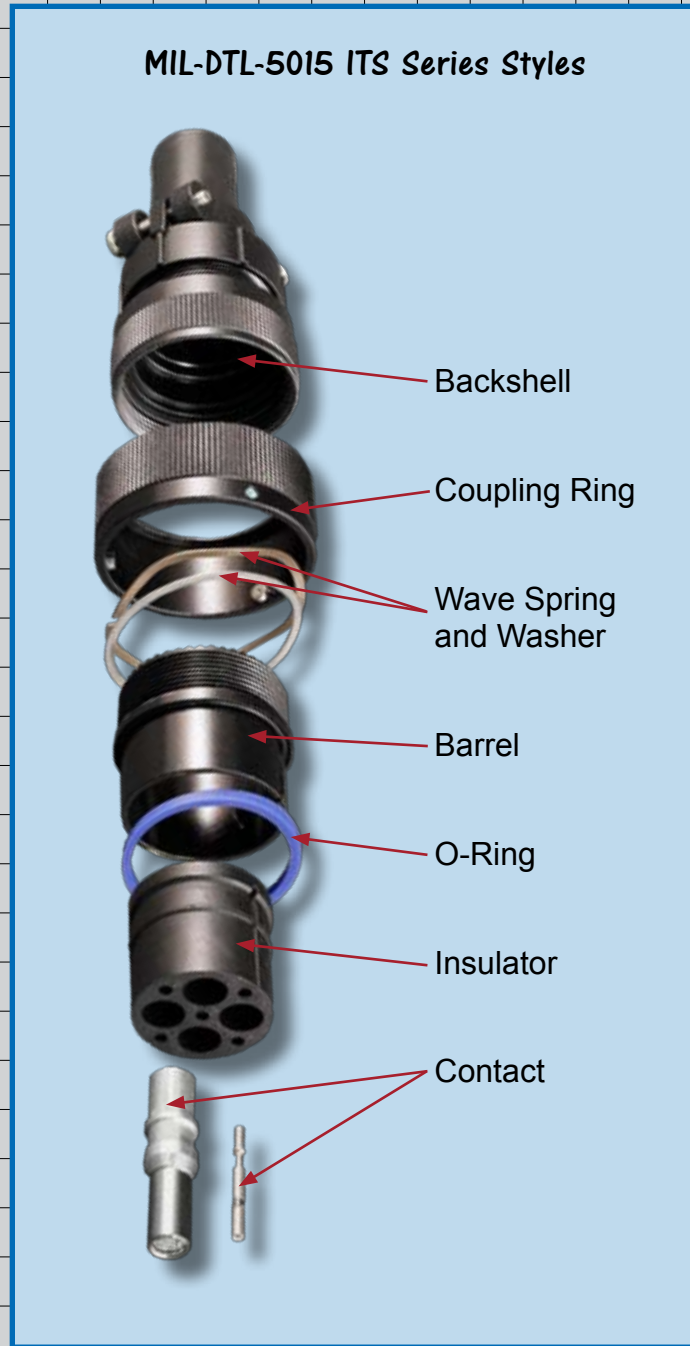
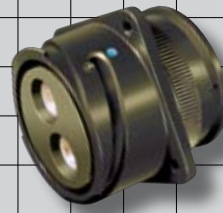
SYM	CLASS	MATERIAL	FINISH DESCRIPTION
M*	Environmental	Aluminum	Electroless Nickel
MT*	Environmental	Aluminum	Nickel Fluorocarbon Polymer (Ni-PTFE)
NF	Environmental	Aluminum	Cad. O.D. Over Electroless Nickel
P*	Environmental	Stainless	Electro-Deposited Nickel
XM*	Environmental	Composite	Electroless Nickel
XMT*	Environmental	Composite	Nickel Fluorocarbon Polymer (Ni-PTFE)
XW	Environmental	Composite	Cad. O.D. Over Electroless Nickel
ZN	Environmental	Aluminum	Zinc-Nickel Over Electroless Nickel
H2*	Hermetic	Stainless	Electroless Nickel

*RoHS Compliant

MIL-DTL-5015

Series ITS Reverse Bayonet

From 1 to 150 Contacts
 #20 to #4/0 Contacts
 For 26 to 4/0 AWG Wire
 Solder, Crimp or PCB



Finish Options

Plating Code	Material	Finish
*	Aluminum	Cadmium Olive Drab
F2**	Aluminum	Bright Nickel
F6**	Aluminum	Black Electrodeposited Paint
F7**	Aluminum	Black Zn-Co
F8	Aluminum	Olive Drab Zn-Co

* Standard unless otherwise specified
 ** RoHS Compliant

Connector/Backshell Class

A - Non-Environmental
G, GR, SP - Environmental (Includes Wire Sealing Grommet)
F, R, RS - Environmental (Includes Wire Sealing Grommet and Compression Ring)

Shell Material Options

Standard Shell Material:
 Aluminum Alloy

FK - Stainless Steel Passivate
MB - Marine Bronze
RG - Rubber Coated

Series Variants

Series ITH - Rigid Inserts
Series ITZ - Trapezoidal Threaded Coupling
Series IT - MIL-DTL-5015 Type Threaded Coupling
VG95234 - German Military Standard
Series IFO - Fiber Optic

Service Rating

(Minimum insulating resistance: $\geq 5 \times 10^3 \text{ M}\Omega$)

Class	Operating Voltage VDC	Operating Voltage VAC RMS	Test Voltage VAC RMS
Inst.	250 V	200 V	1000 V
A	700 V	500 V	2000 V
D	1250 V	900 V	2800 V
E	1750 V	1250 V	3500 V
B	2450 V	1750 V	4500 V
C	4200 V	3000 V	7000 V

Standard Configurations

Shell Style	Description	Shell Style	Description
ITS 00	Front panel mount square flange receptacle with accessory threads	ITS 02	Front panel mount square flange receptacle; No accessory threads
ITS 01	In line cylindrical receptacle with accessory threads	ITS 03	Rear panel mount square flange receptacle; No accessory threads
ITS 030	Rear panel mount square flange receptacle with accessory threads	ITS 07	Rear panel mount jam nut receptacle; No accessory threads
ITS 06	Straight cylindrical plug connector with accessory threads	ITS 08	90° cylindrical plug connector with accessory threads

Contact Specifications

Copper alloy with silver plating (Std) or gold plating (available on request).

Contact Size	Rated Current at 20°C	Rated Current at 80°C	Max Contact Resistance	Wire Size
20	7.5 A	7.5 A	12.0 mΩ	20-26 AWG
18	10 A	7.5 A	12.0 mΩ	18-26 AWG
16	22 A	13 A	6.0 mΩ	16-22 AWG
12	41 A	23 A	3.0 mΩ	12-14 AWG
8	73 A	46 A	1.0 mΩ	8-10 AWG
4	135 A	80 A	0.5 mΩ	4-6 AWG
0	245 A	150 A	0.3 mΩ	0-2 AWG
4/0	350 A	225 A	0.2 mΩ	4/0 AWG

CONTACT LEGEND

Standard Power and Signal Contacts: ● 20 ⊕ 18 ○ 16 ⊕ 12 ● 8

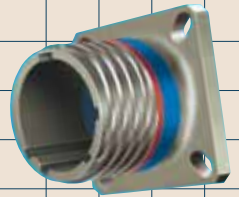
#8 Coaxial Contacts: ○ 4 ⊕ 0 ⊕ 4/0

Materials

Metal parts: Aluminium alloy with Cadmium free surface coatings with an olive drab plating.
Insulating parts: High insulation synthetic rubber resistant to oils and high range of temperatures (-55°C to +125°C) in accordance with MIL-R-3065. All connectors are also available in fire resistant and halogen free materials.

MIL-DTL-38999 Type 180-091 Fiber Optic Connectors

From 2 to 37 Termini
#16 Rear Release Termini
Typical Insertion Loss < .5dB
Plug and In-Line, Jam Nut and
Square Flange Receptacles



**MIL-DTL-38999
Series III Type Connectors**

*Scoop-Proof, Triple Start, Self-Locking
Five Alternate Key Positions:
A, B, C, D, E (N = Normal)*

Termini Materials and Finishes

Ferrule, Alignment Sleeve*	Zirconia Ceramic
Terminus Assembly	Stainless Steel/Passivate
Shrink Tube	Kynar

*Consult factory for Stainless Steel / Passivate option

**D38999 Type
Fiber Optic Part Number Reference**

Glenair Part Number*	Product Description
181-001	#16 Socket Terminus
181-002	#16 Pin Terminus
181-048	#16 Dummy Terminus
180-091 (05)	In-Line Receptacle Connector
180-091 (06)	Plug Connector
180-091 (08)	Jam Nut Mount Receptacle Connector
180-091 (H7)	Square Flange Wall Mount Receptacle with Standard Holes
180-091 (S7)	Square Flange Wall Mount Receptacle with Slotted Holes
180-091 (T7)	Square Flange Wall Mount Receptacle with Tapped Holes

* See fiber optic catalog for complete part number information

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M29504/4 and /5 Type Fiber Optic Termini Part Numbers

Socket Termini		Pin Termini		Fiber Size Core/Cladding**	A Dia.** [microns]
Commercial	MIL-Spec	Commercial	MIL-Spec		
181-001-125	M29504/5-4237*	181-002-125	M29504/4-4208*	9/125 (Singlemode)	125.5
181-001-126S	M29504/5-4238*	181-002-126S	M29504/4-4209*	9/125 (Singlemode)	126.0
181-001-126	M29504/5-4239*	181-002-126	M29504/4-4210*	50/125, 62.5/125	126.0
181-001-127	M29504/5-4046	181-002-127	M29504/4-4040	50/125, 62.5/125	127.0
181-001-142	M29504/5-4049	181-002-142	M29504/4-4043	100/140	142.0
181-001-144	N/A	181-002-144	N/A	100/140	144.0
181-001-145	M29504/5-4050	181-002-145	M29504/4-4044	100/140	145.0
181-001-156	M29504/5-4240*	181-002-156	M29504/4-4211*	62.5/125/155 (Polyimide)	156.0
181-001-157	M29504/5-4241*	181-002-157	M29504/4-4212*	62.5/125/155 (Polyimide)	157.0
181-001-173S	M29504/5-4296*	181-002-173S	M29504/4-4293*	100/140/172 (Polyimide)	173.0
181-001-173	M29504/5-4088	181-002-173	M29504/4-4087	100/140/172 (Polyimide)	173.0
181-001-175	M29504/5-4242*	181-002-175	M29504/4-4213*	100/140/172 (Polyimide)	175.0
181-001-231	N/A	181-002-231	N/A	200/230	231.0
181-001-236	M29504/5-4243*	181-002-236	M29504/4-4214*	200/233	236.0
181-001-286	M29504/5-4244*	181-002-286	M29504/4-4215*	200/280	286.0
181-001-448	M29504/5-4245*	181-002-448	M29504/4-4216*	400/440	448.0
181-001-533	N/A	181-002-533	N/A	486/500	533.0

* Consult factory for qualification status.

** Consult factory for additional sizes.

Connector Material and Finish Options

TABLE II: MATERIAL AND FINISH

SYM	MATERIAL	FINISH DESCRIPTION
M*	Aluminum	Electroless Nickel
MT		Nickel - PTFE
NF		Cadmium, Olive Drab
ZNU		Zinc-Nickel, Black
XM*	Composite	Electroless Nickel
XMT		Nickel - PTFE
XO		No Plating
XW		Cadmium, Olive Drab
XZN	Zinc-Nickel, Black	
ZL*	Stainless Steel	Electro-Deposited Nickel
Z1*		Passivate

*RoHS Compliant

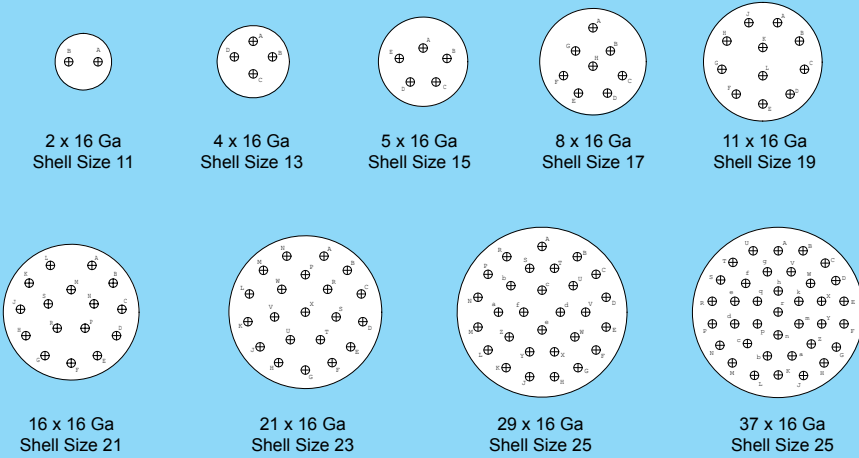
NOTES: Jam Nut for composite Jam Nut Mount Receptacle is Aluminum and plated same as connector shell.

"XO" Finish composite Jam Nut Receptacle is supplied with Unplated Composite Jam Nut and accommodates .093 maximum panel thickness.

MIL-PRF-29504/4 and /5 Fiber Optic Termini Performance Data

Test Type	Performance Requirement
Operating Temperature	-55°C to +165°C (dependant on epoxy and cable)
Temperature Cycling	-65°C to +175°C
Thermal Shock	-55°C to +150°C, 5 cycles
Temperature Life	+150°C for 1,000 hours
Random Vibration	20-2,000 Hz, 42.2 g's
Shock (Half-sine Pulse)	300 g Peak Load
Mechanical Shock	MIL-S-901, Grade A, Type B, Class 1
Mating Durability	500 cycles (cleaning after 100 matings)
Salt Spray	48 hours (Terminus only)
Cable Retention Force	22.0 lbs (dependant on cable construction)

Insert Arrangements

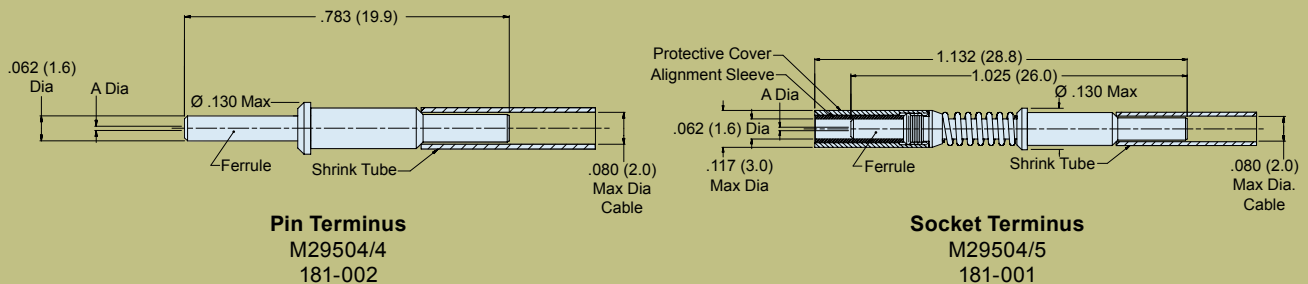


Per MIL-STD-1560. Mating face of pin insert shown.

Additional Connector Component Materials

Insulators	High grade rigid dielectric
Contact Retention Clip	Copper alloy
Interfacial Seal	Fluorosilicone
Grommet and Peripheral Seal	Fluorosilicone/silicone blend
Adhesives	Silicone and epoxy

Fiber Optic Termini Dimensional Data



GFOCA Hermaphroditic Fiber Optic Connectors

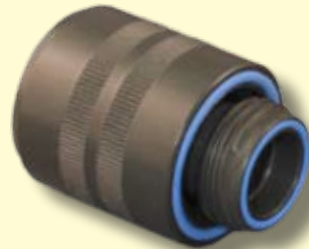
Rugged Field Deployable System
Genderless Butt Joint Termini
Environmentally Sealed



GFOCA Components:



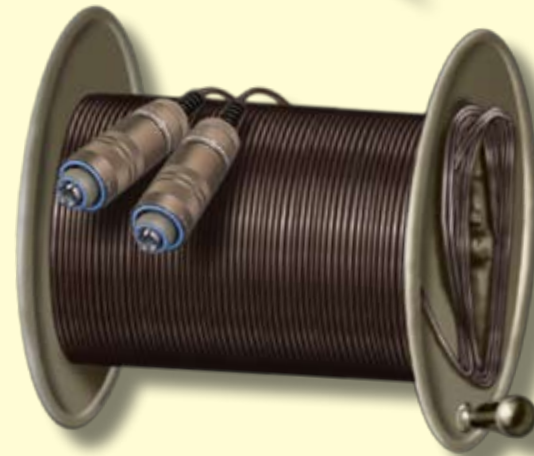
Hermaphroditic Cable Connector



Dust Cap



Terminus



Factory Terminated Fiber Optic Cable Spool

Insertion Loss

Single Mode

Typical: 0.40dB; Maximum: 0.75dB

Multi Mode

Typical: 0.30dB; Maximum: 0.75dB

Fiber Optic Pin Termini Part Numbers

Assembly Dash Number	Fiber Size Core/Cladding*	A Dia.* [microns]
181-050-1255	9/125 (Singlemode)	125.5
181-050-1260	9/125, 50/125, 62.5/125	126.0
181-050-1420	100/140	142.0

* Consult factory for additional sizes.

Termini Materials and Finishes

Component	Material / Finish
Ferrule	Zirconia Ceramic
Terminus Assembly	Stainless Steel / Passivate
Spring	Stainless Steel / Passivate
Seal, O-ring	EPDM
Crimp Sleeve	Brass Alloy / Nickel
Shrink Tube	Polyolefin

Cable Pull Resistance

400 pounds minimum
per EIA/TIA-455-6, 1 hour;
applies to plug and strain relief receptacles

GFOCA Connector Materials and Finishes

Plating Code	Material	Finish
G2*	Aluminum	Anodize, Hardcoat, Grey (Plug)
ZN	Aluminum	Zinc-Nickel, Olive Drab (Recp) (1000 Hour Salt Spray)

* RoHS Compliant.

Component	Material / Finish
Insert Cap	Aluminum Alloy / Anodize
Strain Relief Sub Assy	Aluminum Alloy / Anodize, Stainless Steel / Passivate
Bend Restrictor	Nylon
Dust Cover Lanyard	Stainless Steel / Coated
Seals	Fluorosilicone, Viton, Nitrile, Urethane
Other	Stainless Steel / Passivate

GFOCA Part Number Reference

Glenair Part Number	Product Description
181-050	Pin Terminus
181-059	Dummy Terminus
180-116*	Plug Connector, Hermaphroditic, 4 Channel
180-117*	Jam Nut Receptacle, 4 Channel
180-125*	Square Flange Receptacle, 4 Channel
180-127*	Jam Nut Receptacle, 4 Ch, Internal Mount

* Dust Covers supplied with Connectors when indicated in Part Number Development.

** See fiber optic catalog for complete part number information

Mating Durability

2000 Cycles
per EIA/TIA-455-21 test requirements

Cable Diameter Accommodation

.190" Minimum to .379" Maximum

Operating Temperature

-46° C to +71° C

Storage Temperature

-55° C to +85° C

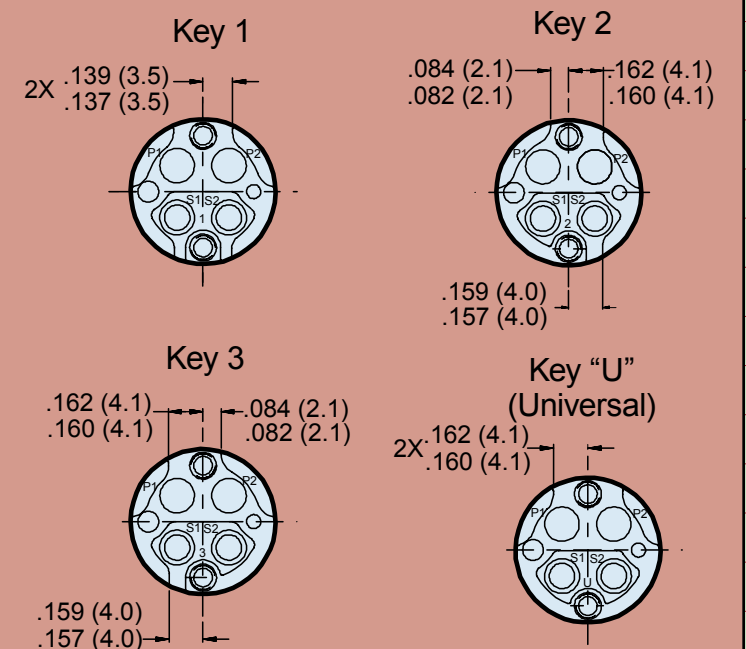
Cable Spool Options

GFOCA connectors are offered in pre-terminated field-deployable metal spools with M85045 style cable.

Customer defined lengths are available up to 2000 meters, with no minimum order quantity.

Available Key Positions

1, 2, 3 (U = Universal)



Glenair High Density 180-122 Fiber Optic Connectors

4 to 70 Genderless Termini
Twice the Density of Std. D38999
Removable Alignment Sleeve Retainer
#18 Front-Release Termini



Glenair GHD Architecture

D38999 Series III Style Coupling

Five Alternate Key Positions:
A, B, C, D, E (N = Normal)

GHD Fiber Optic Part Number Reference

Glenair Part Number	Product Description
181-047	#18 Pin Terminus, Keyed for APC Polish
181-056	#18 Pin Terminus (non-keyed)
181-058	#18 Dummy Terminus
180-122 (05)	In-Line Receptacle Connector
180-122 (06)	Plug Connector with Alignment Sleeve Retainer
180-122 (08)	Jam Nut Mount Receptacle Connector
180-122 (H7)	Square Flange Receptacle with Round Holes
180-122 (S7)	Square Flange Receptacle with Slotted Holes

* See fiber optic catalog for complete part number information

Pin Density Cross-Reference

Glenair High Density Versus D38999 and M28876

Connector Style / Size	11	13	15	17	19	21	23	25
D38999 Cavity Count	2	4	5	8	11	16	21	29/37
M28876 Cavity Count	2	4	6/8	N/A	N/A	N/A	18/31	N/A
GHD Cavity Count	4	6	16	20	30	40	52	70

Additional Connector Component Materials

Insulators	High grade rigid dielectric
Seals	Fluorosilicone
Adhesives	Silicone and Epoxy
ASR Housing*	Aluminum alloy / Anodized
ASR Guide Pins*	Stainless Steel / Passivate
Alignment Sleeves*	Zirconia Ceramic

* ASR (alignment sleeve retainer) and alignment sleeves supplied with plug connectors

Fiber Optic Pin Termini Specifications

Assembly Dash Number		Fiber Size Core/Cladding*	A Dia.* [microns]
Keyed	Non-Keyed		
181-047-1255	181-056-1255	9/125 (Singlemode)	125.5
181-047-1260	181-056-1260	9/125, 50/125, 62.5/125	126.0
181-047-1270	181-056-1270	50/125, 62.5/125	127.0
181-047-1420	181-056-1420	100/140	142.0
181-047-1450	181-056-1450	100/140	145.0
181-047-1560	181-056-1560	62.5/125/155 (Polyimide)	156.0
181-047-1570	181-056-1570	62.5/125/155 (Polyimide)	157.0
181-047-1730	181-056-1730	100/140/172 (Polyimide)	173.0
181-047-1750	181-056-1750	100/140/172 (Polyimide)	175.0
181-047-2360	181-056-2360	200/233	236.0
181-047-2860	181-056-2860	200/280	286.0

Connector Material and Finish Options

TABLE II: MATERIAL AND FINISH

SYM	MATERIAL	FINISH DESCRIPTION
M*	Aluminum	Electroless Nickel
MT		Nickel - PTFE
NF		Cadmium, Olive Drab
ZNU		Zinc-Nickel, Black
XM*	Composite	Electroless Nickel
XMT		Nickel - PTFE
XO		No Plating
XW		Cadmium, Olive Drab
XZN		Zinc-Nickel, Black
ZL*	Stainless Steel	Electro-Deposited Nickel
Z1*		Passivate

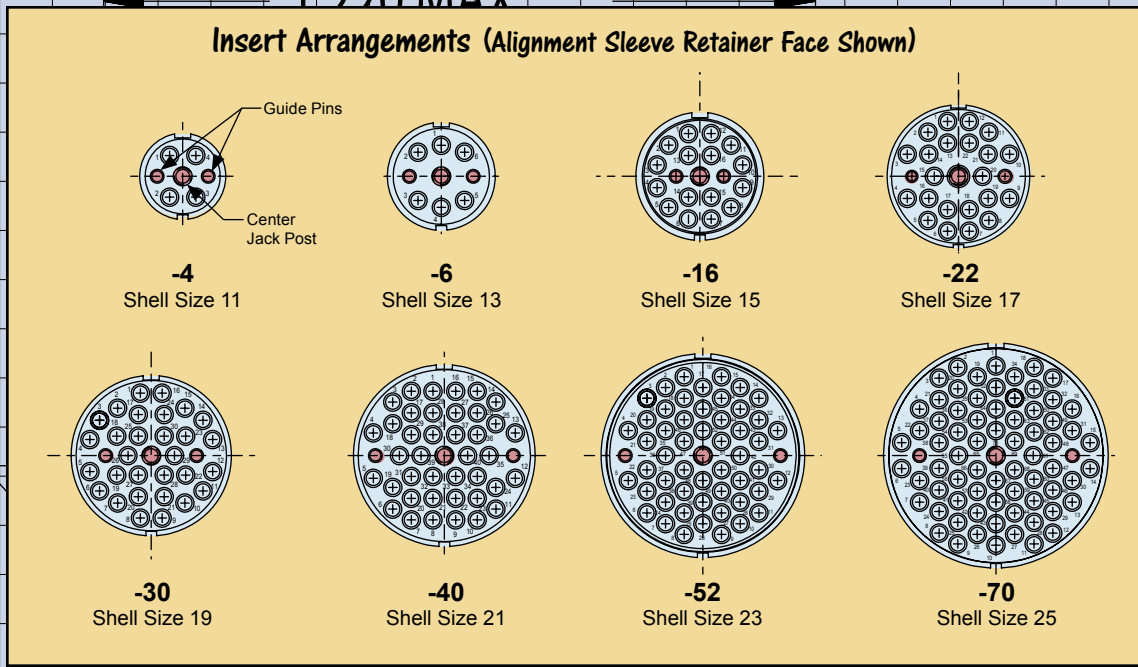
*RoHS Compliant

NOTES: Jam Nut for composite Jam Nut Mount Receptacle is Aluminum and plated same as connector shell.

"XO" Finish composite Jam Nut Receptacle is supplied with Unplated Composite Jam Nut and accommodates .093 maximum panel thickness.

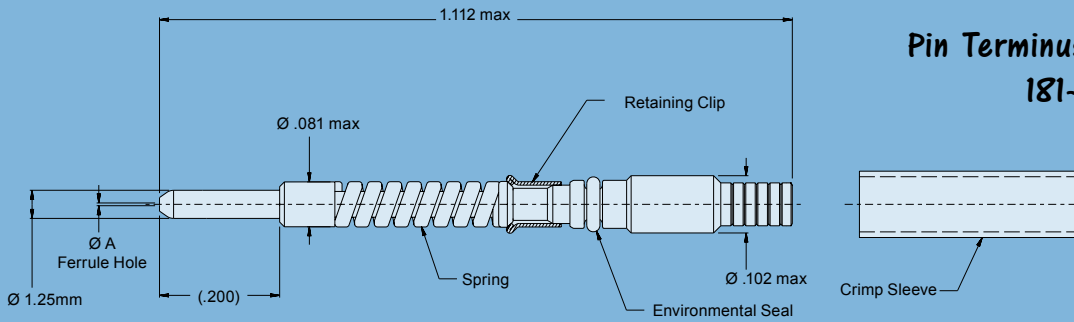
1.220 MAX

Insert Arrangements (Alignment Sleeve Retainer Face Shown)

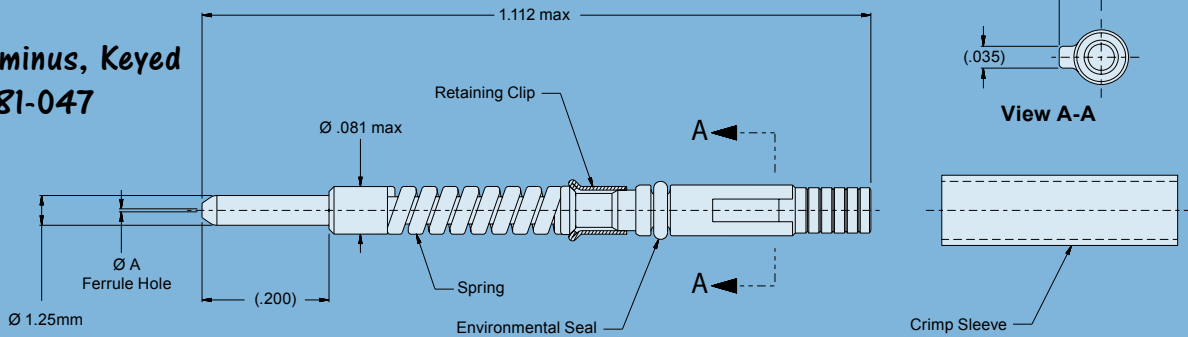


MAX

**Pin Terminus, Non-Keyed
181-056**



**Pin Terminus, Keyed
181-047**



Termini Materials and Finishes:

Ferrule	Zirconia Ceramic	Spring	Stainless Steel / Passivate
Terminus Assembly	Stainless Steel / Passivate	O-Ring	Fluorosilicone
Retention Clip	Copper Alloy	Crimp Sleeve	Brass Alloy / Nickel

Vasa Matter with Wall Street?

I make the trip from Glendale to Boston to Europe frequently, to visit my roots in “Beantown” and then on to our Glenair operations in Europe. On most of these visits I try to take time to look around and sample the local culture. One of my favorite outings is the *Vasamuset*, the spectacular maritime museum in Stockholm that houses a fully restored 17th century sailing ship, the *Vasa*.

Vasa was built for King Gustavus Adolphus of Sweden in 1628 and was one of the largest and most heavily armed warships ever launched in the Baltic. *Vasa* cost 40,000 Riksdaler to construct, a huge sum of money for its day. But a steeper price was ultimately paid: On her maiden voyage, the *Vasa* was so top-heavy with guns, sails, crew and equipment—and so insufficiently ballasted—that she foundered and sank less than a mile from shore. For all of you land-lubbers, ballast (heavily weighted material located below the water-line), is necessary to prevent a ship from tipping over in stormy seas and high winds. In the case of the *Vasa*, the ship was so inadequately ballasted against stormy weather that she met her bitter end in a mild sea within hailing distance of the dock.

While the story of the *Vasa* is interesting in its own right, I have a larger point to make concerning the financial crisis that currently has so many businesses, institutions and countries over a barrel. Global economics are extremely complex. And I don’t pretend to understand even a fraction of what is happening in the financial markets, the housing industry, the banks and elsewhere. It is, however, safe to say that the organizations and businesses that are now in the worst shape were, like the *Vasa*, woefully ill-prepared to weather bad stretches in their operational terrain.

When businesses—or governments for that matter—borrow more than they can afford to repay, gamble excessively on risky or wasteful ventures, or incentivize irresponsible or unethical behavior, then outright failure cannot be far away. In the business world, capital is the equivalent of ballast. And too many enterprises, like the *Vasa*, fail miserably to maintain the appropriate ratio of capital (ballast) to that big mountain of debt riding precariously above the waterline.

I’d like to promise you that Glenair is unsinkable. But such promises are foolish and impossible to keep. What I can tell you is that the good ship Glenair is equipped with a deep keel and plenty of ballast, and that, unlike the *Vasa*, we have successfully sailed through many a stormy sea and emerged right side up.

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