

# QwikConnect

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## SMALL SATELLITES <sup>~AND</sup> <sup>THE~</sup> GLOBAL INTERNET REVOLUTION





THE QUEST TO  
CONNECT THE  
WORLD—WITH  
BROADBAND  
INTERNET BY  
SATELLITE

# SMALL SATELLITES AND THE GLOBAL INTERNET REVOLUTION

A number of global leaders in space launch and satellite technology have applied to the Federal Communications Commission for the launch of broadband Internet satellites to be deployed in a non-geostationary (NGSO) earth orbit. These satellite systems would use the Ku and Ka frequency bands to blanket the globe in broadband Internet connectivity. "Every point on the Earth's surface will see, at all times, [an internet] satellite," one company stated in its application. The ambition to build a space-based broadband Internet network is shared by many organizations including Boeing, Samsung, ViaSat, and Telesat, and are currently planning Low Earth Orbit (700 miles or so above the earth) Internet satellite constellations. OneWeb, a consortium backed by Virgin's Richard Branson and Airbus, has already been granted approval by the FCC for an ambitious 720 satellite system.

OneWeb has been working on plans for its broadband satellite Internet since the year 2000. Like Boeing, OneWeb is looking to launch a massive constellation of low Earth orbit satellites that, due to their proximity, will provide extremely fast, low-lag-time, low-latency global Internet service. Down on the ground, an expanded network

of satellite control antennas and user terminals will provide Internet access speeds in the range of 50 megabits/second. Developers cite the opportunity to bring Internet services to rural and other hard-to-reach areas, particularly in developing countries that lack established communications infrastructure. The goal of bringing first-world connectivity to isolated schools, medical clinics, and scientific research institutions is front-and-center in most applications and proposals. Even so, developers acknowledge pure-play commercial activities including web commerce, gaming, streaming video entertainment, social networking, and advertising will also leverage the expanded range of geographic coverage and high-speed bandwidth.

Satellite designs for these new systems are significantly smaller than most current high-throughput satellites with capacity and bandwidth suitable for Internet services. Current satellites such as ViaSat's ViaSat-1 provide Internet access for rural customers as an alternative to dial-up, ADSL or cable. With a launch payload weight of over 14,000 lbs, ViaSat-1 type satellites absolutely dwarf next-generation designs that, although small in size, are deployed in constellation formations to achieve overlapping coverage.

Weighing in at just 400 pounds, OneWeb and other small form-factor satellites will enable global Internet services with significantly lower size, weight, and cost. New satellite constellations, in tandem with such technology as electronically-steerable phased-array antennas (ESA), will also extend coverage and bandwidth to mobile ground vehicles and aircraft.

Potential electromagnetic interference with existing ground satellite antennas and larger geostationary orbit satellites will be addressed by OneWeb with a sophisticated technology called "Progressive

◀ A ground segment antenna for Ka band gateway uplink and downlink



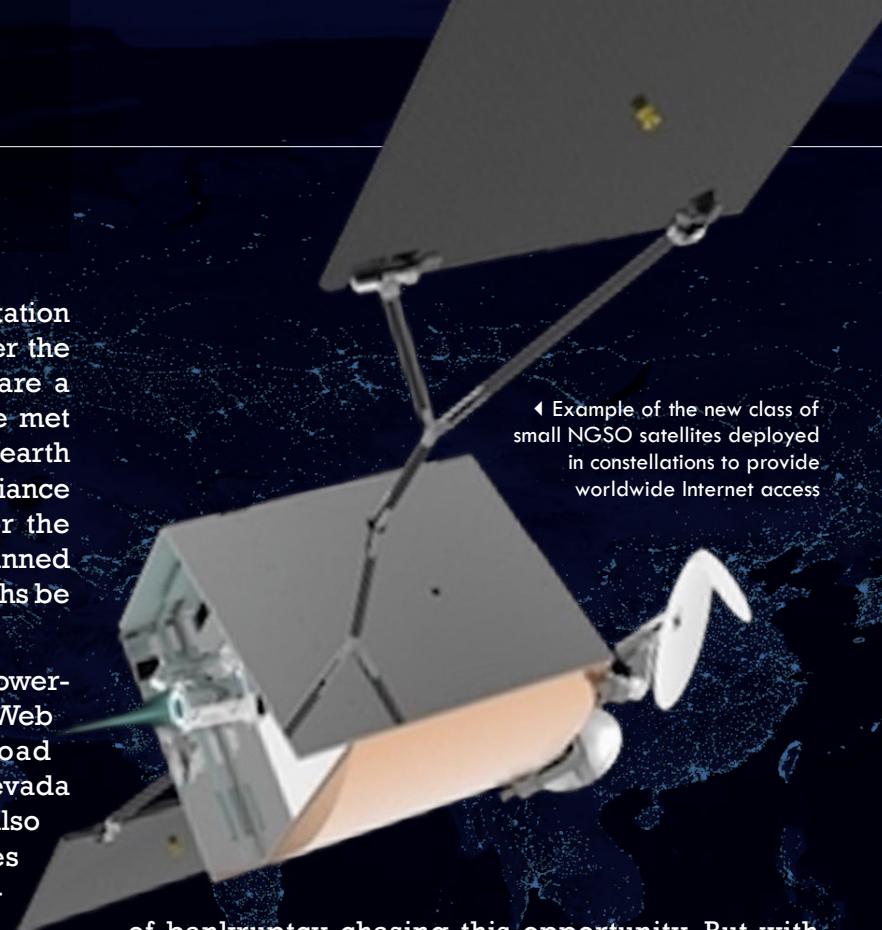
Pitch,” which will dynamically alter the orientation and power levels of satellites as they pass over the equator. Such Ku band interference issues are a significant challenge, one that will have to be met by every organization looking to deploy lower earth orbit satellite constellations. In addition, compliance with orbital debris mitigation guidelines for the removal of out-of-service satellites must be planned for and strictly enforced, lest available orbit paths be polluted with hazardous waste.

As mentioned, the design and manufacture of lower-cost small satellites is not limited to just OneWeb and ViaSat. Other space launch and payload equipment manufacturers such as Sierra Nevada Corp. and Surrey Satellite Technology Ltd. are also laser-focused on miniaturization technologies that will enable the next generation of satellite-based communications. Additional potential competitors in the small-satellite Internet space include Samsung, which has proposed its own 4600-satellite constellation orbiting at 900 miles above the earth. The Samsung System is ambitiously designed to deliver 200 gigabytes per month of Internet data to 5 billion internet users worldwide. Facebook and Google have launched parallel initiatives, all vying to control the space that is so crucial to the growth of their respective business models.

That Internet access is critical for both private enterprise and public services goes without saying. But the idea of a globe-spanning satellite network, one that can radically expand digital datarates and bandwidth, has been an elusive solution to the problem. Any number of commercial entities have paid the ultimate price



◀ ▶ Satcom-enabled Internet broadband terminals for fixed ground locations, vehicles, and aerospace applications (flight deck and passenger cabin) will provide fast LTE, 3G, and WiFi access to LRUs as well as cell phones, laptops, and tablets.



◀ Example of the new class of small NGSO satellites deployed in constellations to provide worldwide Internet access

of bankruptcy chasing this opportunity. But with the advent of 5G technologies just a few years away, and so many other breakthroughs fueling investor enthusiasm, the time for massive expansion of satellite Internet may finally be upon us. Time will tell the story. And of course, given the many space-grade interconnect solutions available from Glenair—particularly solutions that contribute to miniaturization, weight reduction, and more bits-per-second in digital satellite payloads—we’ll be working as hard as anyone to help these lofty dreams come true.

## OVERVIEW OF CORE GLOBAL INTERNET SATELLITE NETWORK TECHNOLOGY

1. Small mass-production satellites deployed in low Earth orbit: Leveraging modular and commercially available payload technology including electrical propulsion, thermal control, electrical power, avionics, guidance, navigation, interconnect, and so on.
2. Ground segment antennas: New and existing gateway parabolic antennas for forward and reverse Ka band data uplink and downlink.
3. Low-cost end-user terminals: Affordable, compact, multi-user access terminals (Ku band) for local area LTE, 3G, and WiFi Internet access.
4. Mobile planar antennas: Providing ground vehicles and commercial, business, and military aircraft with low lag time/ low latency broadband Internet.



**On the cover:** An artist created this image of all of the satellites and debris currently orbiting earth. The objects are shown at an exaggerated size to make them visible at the scale shown. Image credit European Space Agency, via nasa.gov



PROVEN FLIGHT HERITAGE

# SPACE-GRADE SOLUTIONS

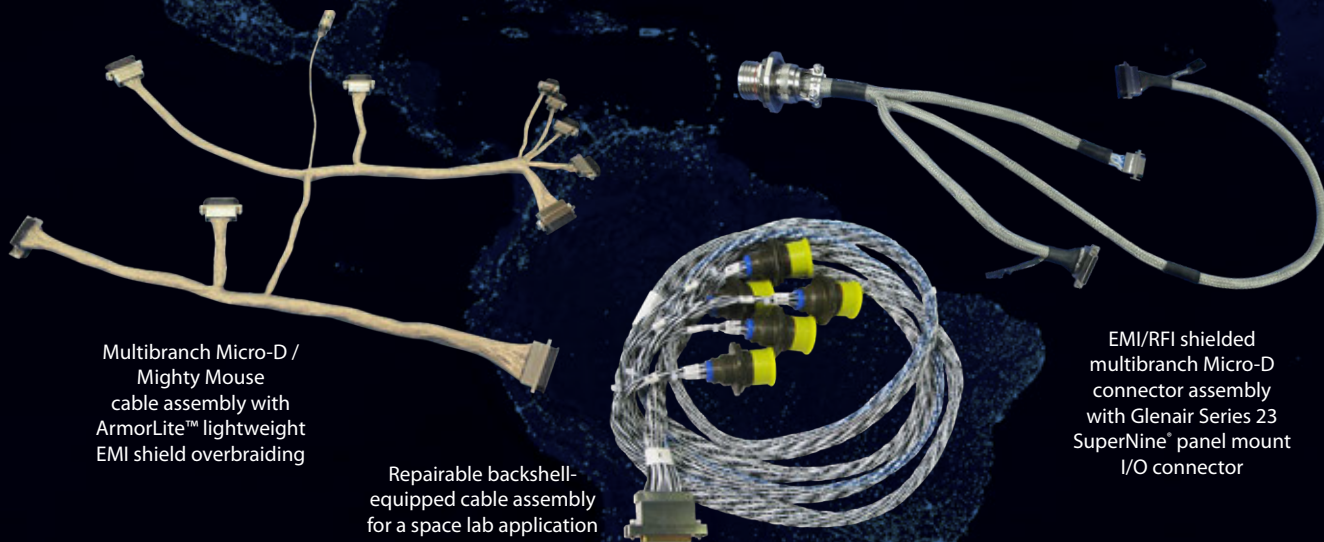
NASA · ESA · JAXA · Commercial



Complex space-grade cable assemblies (shown: Glenair-made "Golden Umbilical")

Glenair has been in the business of providing space-grade interconnect technologies since the 1960s. This special issue of *QwikConnect* highlights a number of solutions specifically geared to small satellite launch and payload applications. As the headline states, these interconnect solutions have proven flight heritage, and have been qualified for use on both government and commercial systems.

## TURNKEY, SPACE-GRADE EMI/RFI WIRE HARNESS AND CABLE ASSEMBLIES



Multibranch Micro-D / Mighty Mouse cable assembly with ArmorLite™ lightweight EMI shield overbraiding

Repairable backshell-equipped cable assembly for a space lab application

EMI/RFI shielded multibranch Micro-D connector assembly with Glenair Series 23 SuperNine® panel mount I/O connector

## HOLD-DOWN RELEASE MECHANISMS, PIN PULLERS AND PIN PUSHERS



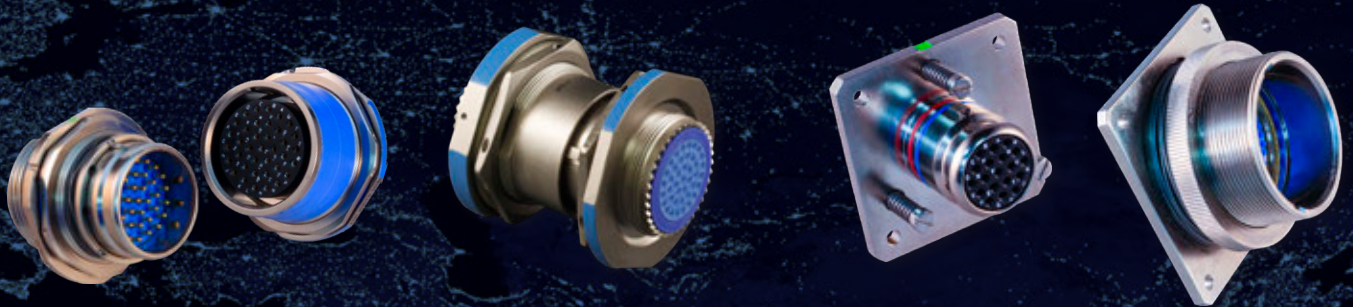
Light Duty  
Up to 75 lb release payload

Medium Duty  
Up to 1,000 lb release payload

Heavy Duty  
Up to 20,000 lb release payload

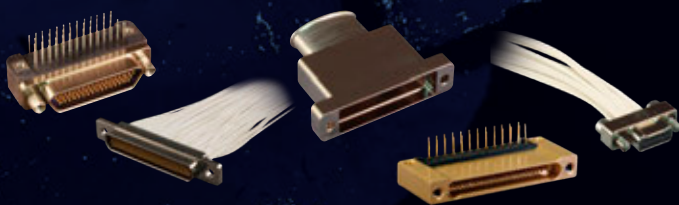


## ASSISTED-RELEASE QUICK-DISCONNECT BLIND-MATE CONNECTORS

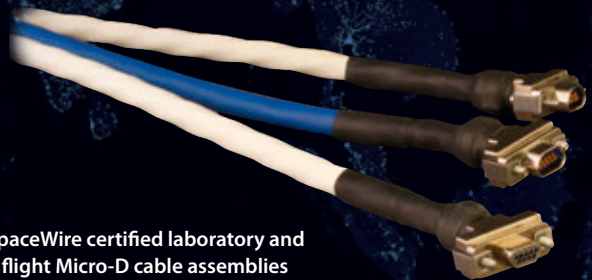


Glenair Series 253 connectors are designed to meet applicable environmental, electrical and mechanical performance characteristics of D38999 Series III. The technology is well suited for use in commercial blind-mate instrumentation panels, satellite deployment, scientific research and development payloads, as well as interstage, UAV, and munitions release applications.

## SPACE-GRADE M24308 HIPER-D, MICRO-D, AND NANOMINIATURE CONNECTORS AND CABLES



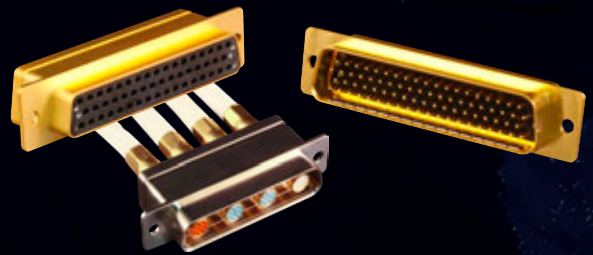
ESA and NASA screened connectors and backshells available as discrete components or wired pigtail assemblies



SpaceWire certified laboratory and flight Micro-D cable assemblies

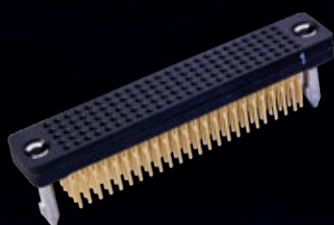


Latching MicroStrips™: cable-to-cable and cable-to-board reduced size- and weight Micro-D TwistPin connectors

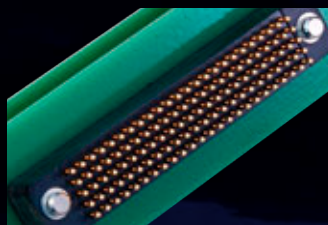


Qualified MIL-DTL-24308 Class K Space-Grade Hermetic, plus HiPer-D high-performance space-grade and high-speed environmentals

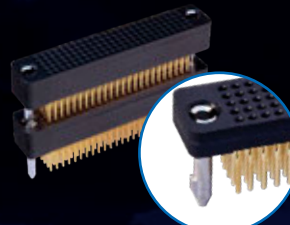
## NEW HD STACKER™ FOR MISSION-CRITICAL BOARD-TO-BOARD APPLICATIONS



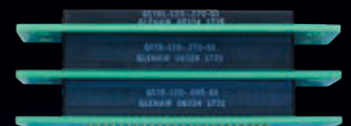
Solder-free press-fit (compliant pin) board mounting



.0625" pitch contact spacing: highest available density




Polarized shells and keyed guide pin hardware prevent mis-mating



Controlled signal integrity for differential applications (test reports available)





# SPACE-GRADE Complex Cable Assemblies

We like to begin our presentation of Glenair's proven-performance space-grade products with the golden umbilical life support cable used by Commander Ed White in the first American space walk in 1965. This was a complex cable assembly with an exacting set of performance requirements. Even though this application is now over 50 years old, it still reflects Glenair's design and fabrication expertise and that we have been a go-to supplier for the space industry for almost 5 decades. Today we continue to fabricate high-performance cables for space, from rugged Viton<sup>®</sup> overmolded designs to ultra-lightweight SpaceWire jumpers for the high-speed space data transmission protocol. Other notable space cable applications include:



- Dozens of robotic spacecraft, including orbiters, landers, and rovers, have been launched to Mars since the 1960s. Glenair cables have ridden along on several, helping to fulfill navigation, data and communication requirements.

▪ Complex interconnect cable assemblies made by Glenair have also traveled to and from orbit dozens of times on the Space Shuttle, as well as numerous space-launch vehicles. Glenair-made interconnect harnesses also served on all twelve manned Gemini capsules.



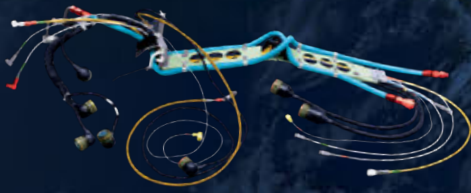
Commander Ed White on the first American spacewalk, 1965 with Glenair-manufactured "Golden Umbilical" cable

## PROVEN PERFORMANCE IN SPACE

- The "Golden Umbilical" life-support cable
- JPL Mars probes (orbiters, landers, and the Curiosity rover)
- AIRS satellite
- Gravity Probe mission
- Space Shuttle
- Titan II launch vehicles
- SpaceWire (MIL-DTL-83513)



## COMPLEX MULTIBRANCH AND OVERMOLDED CABLE ASSEMBLIES



F/A-18 radar pantograph assembly



Overmolded cable assembly



AWACS radar assembly



Hybrid fabric braid and overmolded environmental cable assembly



Desert tan fabric overbraided tactical interconnect assembly



Soldier radio power and USB data overmolded cable assembly

## TURNKEY FACTORY-TERMINATED CONDUIT ASSEMBLIES



Complex multibranch fighter jet electrical wire conduit assembly

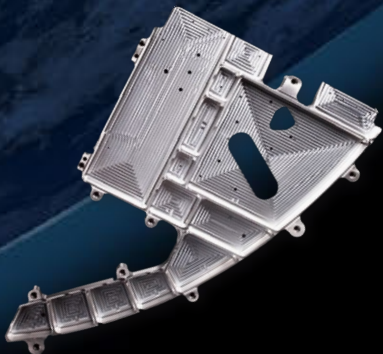


Lightweight, halogen-free rail industry wire conduit assembly



Crush-resistant commercial aerospace metal-core conduit assembly

## INTEGRATED SYSTEMS



Precision-machined, injection molded or stamped-and-formed boxes and structural members

+



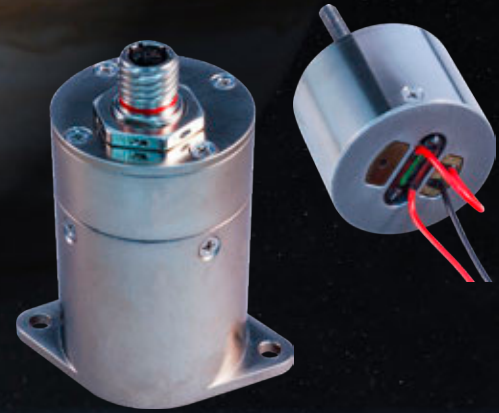
Multibranch interconnect cable harnesses and assemblies—terminated, tested, and ready for use

=



Turnkey integrated system components: Vertically integrated manufacturing, from backplanes to avionic control panels





## SERIES 06

# Pyrotechnic-Free Space Mechanisms

High-reliability, non-explosive (split-spool) separation nuts and electromechanical release mechanisms for dependable stowage and release of deployable space systems

**G**lenair space mechanisms are optimized for foolproof release reliability with built-in mechanical and electrical redundancy. The planned release of the deployable satellite/payload is activated by a pre-determined value of electrical current to a fuse-wire system which causes the wire to break under tension and allows a pre-loaded mechanical bolt to actuate. Glenair's line of low-shock, redundant and non-redundant space mechanisms includes both HDRM devices as well as a family of pin pushers and pin pullers. Customer-defined housing and mounting configurations are available. Consult factory for specific device TR level and qualification test reports.



Glenair pyrotechnic-free release mechanisms offer quick release time, low shock, relatively low power input, and virtually no temperature sensitivity. Series includes separation nuts, HDRMs, pin pushers, and pin pullers—direct wired or connectorized—with higher preload carrying capacity compared to competitor solutions.

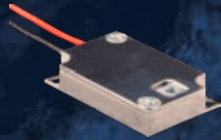
- **Pyrotechnic-free alternative (low-shock fuse-wire) for single-event release of deployable space systems—electrical initiation up to 5 amps**
- **User-serviceable and refurbishable units**
- **Redundant or non-redundant actuation circuit**
- **Not susceptible to transient and noise (EMI/EMP/ESD/RFI) inputs**
- **Extended temperature ranges: -150°C to +150°C**



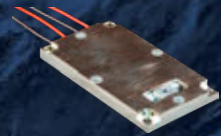
## HDRM CATALOG PRODUCT SELECTION GUIDE



Note: Preloading assembly, release actuator, and load-carrying structure may also be custom-packaged per customer requirements



**061-002**  
Light-Duty HDRM  
Non-redundant circuit,  
5 or 20 lb release preload



**061-003**  
Light-Duty HDRM  
Redundant circuit,  
30 lb release preload



**061-014**  
Light-Duty HDRM  
Non-redundant circuit,  
75 lb release preload,  
Side load bearing "SideWinder"



**061-007**  
Medium-Duty HDRM  
Redundant circuit,  
300 lb release



**061-006**  
Medium-Duty HDRM  
Redundant circuit,  
1000 lb release preload



**061-005**  
Medium-Duty HDRM  
Redundant circuit,  
2500 lb release preload



**062-002**  
Heavy-Duty HDRM  
Redundant circuit,  
5000 lb release preload



**063-001**  
Heavy-Duty HDRM  
Redundant circuit,  
8750 lb release preload



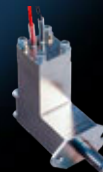
**064-001**  
Heavy-Duty HDRM  
Non-redundant circuit,  
20,000 lb release preload



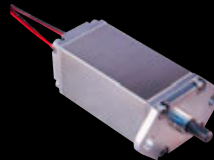
**061-010**  
Light-Duty Pin Pusher  
Non-redundant circuit  
6 lb push force



**061-009**  
Light-Duty Pin Puller  
Non-redundant circuit  
18 lb pull force



**061-011**  
Light-Duty Pin Puller  
Non-redundant circuit  
18 lb pull force



**061-013**  
Medium-Duty Pin Puller  
Redundant circuit  
50 lb pull force

## DEPLOYMENT APPLICATIONS



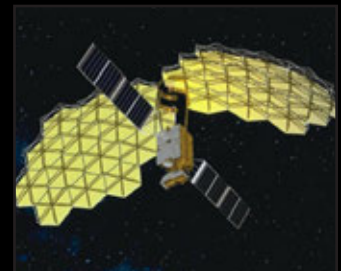
Solar Arrays



Booms and Masts



Antennas

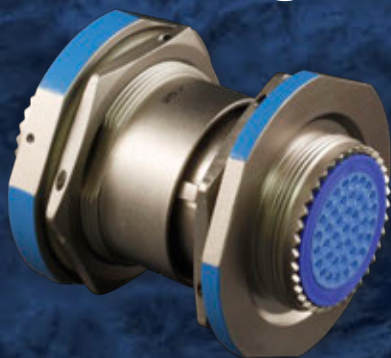


Reflectors



# Blind-Mate Connectors

## Rack and Panel Sealed, Assisted Kick-off and Feed-Through Blind-Mate to D38999



**Application:** Glenair Series 253 connectors are designed to meet applicable environmental, electrical and mechanical performance characteristics of D38999 Series III. The technology is well suited for use in commercial blind-mate instrumentation panels, satellite deployment, scientific research and development payloads, as well as interstage, UAV, and munitions release applications.

- Blind-mate, float mount interconnects for non-ITAR commercial as well as military/defense applications
- Optional assisted release (spring force) solutions to overcome pin/socket engagement force
- Panel-mount versions feature self-aligning float-mount technology for repeatable mating and de-mating
- Available in most symmetrical MIL-STD-1560 insert arrangements with contacts sizes from #23 to #12
- Selected materials offer low outgassing properties and high resistance to both corrosion and stress corrosion cracking
- Optional outgassing bake-out process available
- Designed to withstand the rigors of launch and flight—including shock, vibration, thermal vacuum, acceleration, and temperature extremes
- Standard accessory threads and teeth per MIL-DTL-38999 accommodate a wide range of backshell accessories

Current Rating	
Size Contact	Amps
23	5
22D	5
20	7.5
16	13
12	23

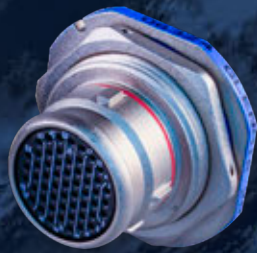
Altitude (Feet)	Unmated Test Voltages, AC RMS, 60 Hz			
	Service Rating M	Service Rating N	Service Rating I	Service Rating II
Sea Level	1300	1000	1800	2300
50,000	550	400	600	800
70,000	350	260	400	500
100,000	200	260	200	200



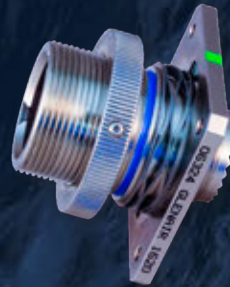
# Space-grade blind-mate

## Float-mount and assisted-release connectors

### CRITICAL MECHANICAL FEATURES OF BLIND-MATE CONNECTORS WITH ASSISTED SEPARATION FORCE (ASF) AND MISALIGNMENT ACCOMMODATION



**Roll-off nose:** allows for the smooth disconnection of a blind mate connector. Without this feature, connectors can catch or hang during mate and demate.



**Misalignment accommodation:** Radial, axial, and angular misalignment in blind-mate applications is resolved in the receptacle design with mechanical float mounting and integral wave form springs.



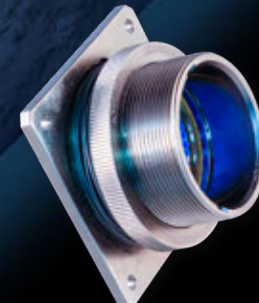
**Sealing:** Integrated misalignment accommodation makes environmental sealing difficult in blind mate circulars. Glenair SuperNine® blind-mate and assisted release connectors are available with auxiliary exterior seals.



**EMI shielding:** Glenair blind-mate circulars are available with auxiliary ground springs on receptacles, and ground fingers on plugs (shown), to optimize 360° shell-to-shell continuity.



**Assisted separation:** Spring-loaded kick-off posts are designed to overcome contact separation force (normal force) with adjustable flange-mounted springs. Separation force may be calibrated IAW application requirements and insert arrangement.



**Assisted separation:** Adjustment ring on receptacle shells provides reliable and repeatable calibration of assisted separation force. The adjustment ring interfaces directly with the spring-loaded kick-off posts on the plug. A set screw fitting locks the ring in place after adjustments have been made.

### PRODUCT SELECTION GUIDE

#### Available non-ITAR rack-and-panel blind-mate and zero separation force solutions

Basic Part No.	Description	Mates With
<a href="#">253-014</a>	Float-mount plug with roll-on roll-off nose, environmental crimp contact	<a href="#">253-015</a>
<a href="#">253-015</a>	Float-mount receptacle with optional auxiliary seal and misalignment accommodation, environmental crimp contact	<a href="#">253-014</a>
<a href="#">253-016</a>	Float-mount plug with roll-on roll-off nose and spring-assisted release, environmental crimp contact	<a href="#">253-017</a>
<a href="#">253-017</a>	Float-mount receptacle with spring-assisted release and misalignment accommodation, environmental crimp contact	<a href="#">253-016</a>
<a href="#">253-018</a>	Bulkhead feed-thru with optional threaded plug or jam nut receptacle side IAW MIL-DTL-38999 Series III	<a href="#">253-019</a>
<a href="#">253-019</a>	Blind mate float mount jam nut receptacle with misalignment accommodation	<a href="#">253-018</a>
<a href="#">253-033</a>	Blind mate float mount jam nut receptacle and MIL-DTL-38999, series III feed-through with misalignment accommodation	<a href="#">253-018 and 38999</a>

#### Also available: consult factory for specifications and how-to-order information

Basic Part No.	Description	Mates With
<a href="#">253-022</a>	Hermetic, blind mate receptacle	<a href="#">253-015</a>
<a href="#">253-027-07</a>	Blind mate PC tail receptacle with threaded standoff	<a href="#">253-015</a>



JAXA Kibo Laboratory module  
from the International  
Space Station

Certified SpaceWire cables for both  
laboratory/test applications and  
flight applications

# SERIES MWDM Micro-D Connectors

- High density Micro TwistPin contacts set on .050" centers
- 9 to 130 contact arrangements
- Pigtail, PCB, solder cup, and flex terminations
- Single row, multi-row, low profile and high density insert arrangements
- QPL and commercial versions
- Same-day availability on all part numbers
- Qualified for use in ESA, NASA, JAXA applications



Standard

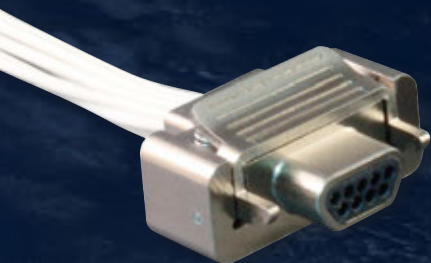


Hermetic



EMI Filter

TwistPin equipped MIL-DTL-83513 Micro-D connectors offer outstanding mating performance, durability and minimal contact resistance



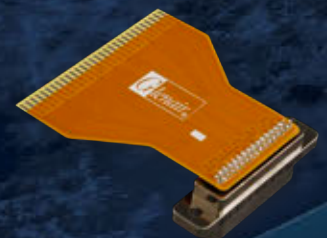
MasterLatch™



Surface Mount



Rear Panel Mount



Flex Circuit



# MIL-DTL-83513 AND COMMERCIAL Micro-D Connectors

Mission-critical mating performance



## Metal Shell Micro-D for Harnessing Applications

GRPM Solder Cup	GRPM Insulated Wire	GRPM Uninsulated Wire	MWDM Solder Cup	MWDM Insulated Wire	MWDM Back-To-Backs
Shielded Cable Assembly	MWDM Uninsulated Wire	GMDR Insulated Wire	GMDE Environmental	GSWM SpaceWire	GMLM MasterLatch

## Micro-Ds for Printed Circuit Board

GRPM-CBS	GRPM-CBR	MWDM-BS	MWDM-BR
MWDM-CBR	MWDM-CBS	90° Surface Mount	GMR7580
GMR7590	GMR7580C	GMR7590C	Right Angle Filter



WellMaster™ 260



Sav-Con®



Latching MicroStrip



Low Profile

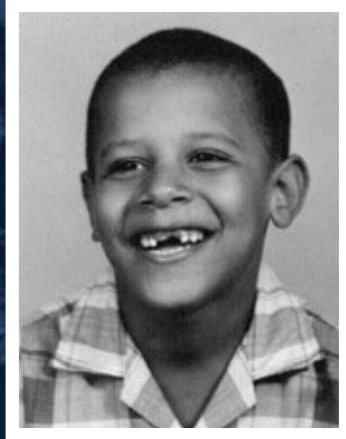


## NOT THEIR REAL NAMES

*Our souvenir photo album from space camp got messed up at the printer. Now even we can't figure nice if the names were just shuffled around a bit. But instead it looks like someone just winged it with*



Chelsea Clinton



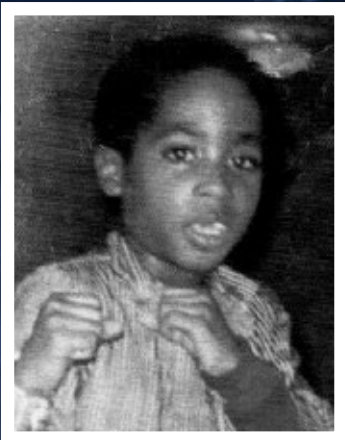
Denzel Washington



Drew Barrymore



Macaulay Culkin



Biggie Smalls



Ralphie Wiggum



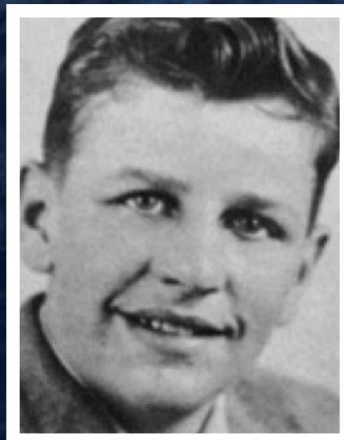
Anne Frank



John Coltrane



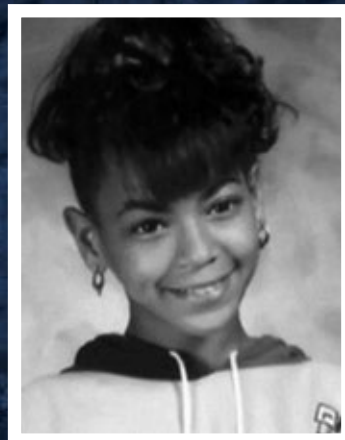
Sandy Koufax



Billy Graham



Henry Kissinger



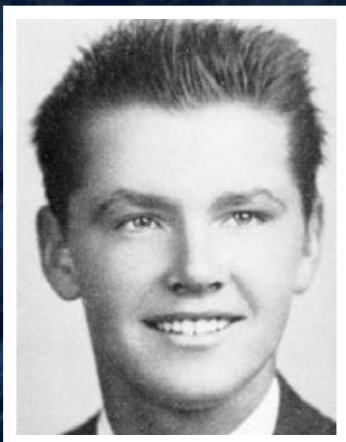
Janet Jackson



out who all these famous campers were. It would have been some truly bad guesses. Although that one guy really does look like E.T.



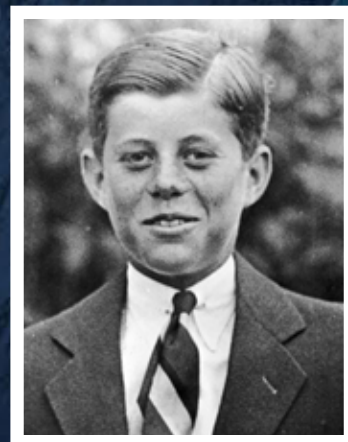
Bill Clinton



Dennis Quaid



Lt. Sulu



Charles, Prince of Wales



E.T.



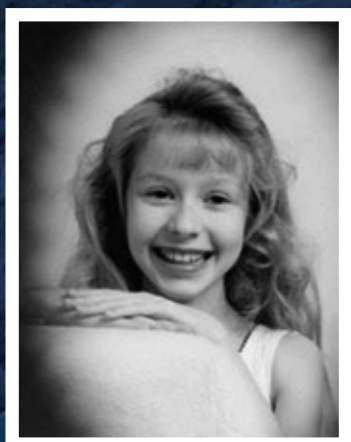
Stephen Hawking



Amelia Earhart



Reese Witherspoon



Julia Roberts



David Duchovny



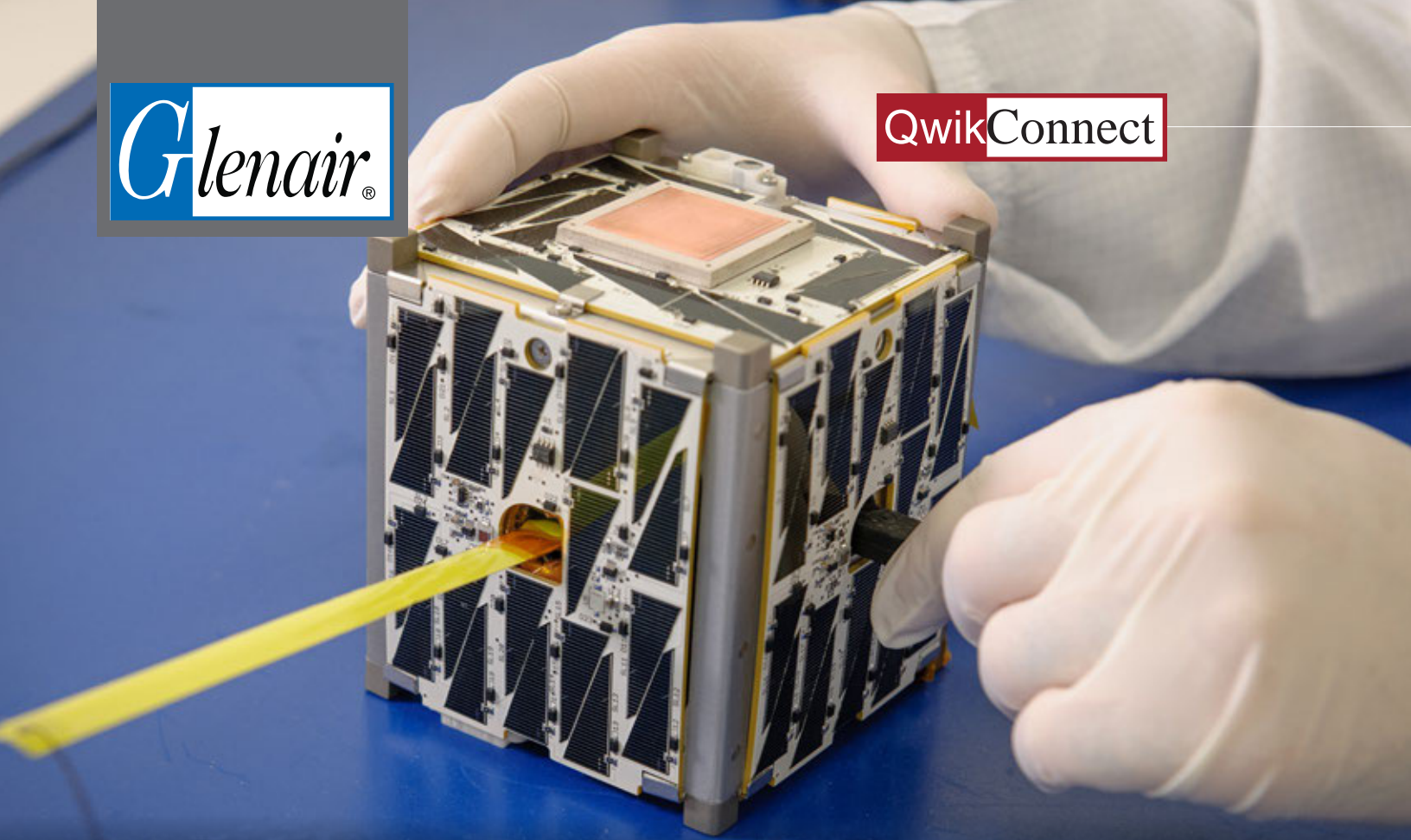
Charlie Sheen



Paul Ryan

Answers published February 15th [www.glenair.com/qwikconnect](http://www.glenair.com/qwikconnect)



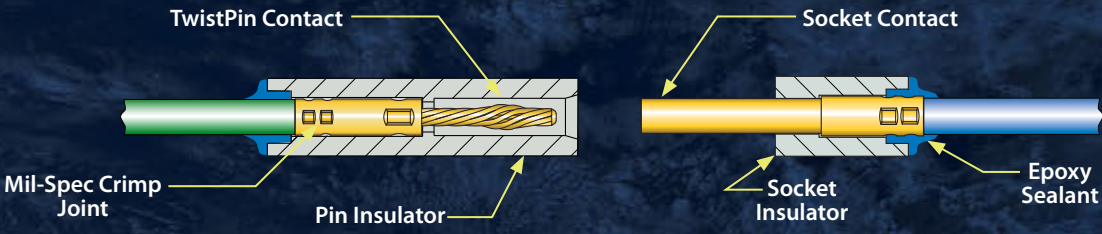


# SERIES 171 Latching MicroStrips™

**TwistPin performance and durability in an economical, space-saving single row package**

Series 171 MicroStrips™ are made for high-reliability wire-to-board and wire-to-wire applications. These high-density strip connectors are typically used in ruggedized 3 Amp signal applications, where higher-performance contacts, precision machined shells and space-grade dielectrics offer significant advantages compared to commercial-grade headers and jumpers. Glenair's rugged, high force TwistPin contact accepts up to #24 gage wire, the current rating is 3 Amps, the voltage rating is 600 Vac, and the temperature rating is -55C to +150C. The Series 171 Latching MicroStrip connector meets all applicable requirements of MIL-DTL-83513. Choose solder cup, pre-wired, or printed circuit board versions. A stainless steel latch provides secure coupling.

- High-reliability TwistPin contact system
- #24-30 AWG wire size
- .050" pitch contact spacing
- Solder cup, pre-wired or PCB header terminations
- 3 Amps, +150C, 600 Vac





SERIES 171

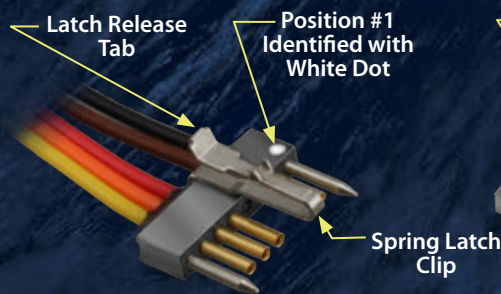
# Latching MicroStrips™

## Superior TwistPin contact performance



### ABOUT SPRING LATCHES, GUIDE PINS AND MOUNTING HOLES

Optional stainless steel latch clips provide secure mating when subjected to shock and vibration. A single center latch is suitable for most applications (Fig. 1 and Fig. 2). Dual end latches are also available (Fig. 3). The spring latch is always installed on the socket strip (Fig. 1). The latch receiver is installed on the pin strip (Fig. 2). To unmate the connectors, simply press the release tab while pulling the connectors apart. MicroStrips™ are available with stainless steel guide pins. A single guide pin provides circuit polarization. A guide pin on each end (Fig. 2) helps to align connectors when mating and prevents damage to contacts. For most applications the preferred configuration is a single center latch with no guide pins. Mounting holes are now available (Fig.3). Attach strips to circuit boards with size 0-80 screws (customer-supplied).

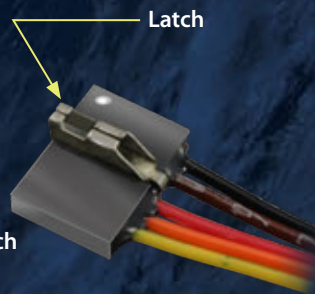


**Figure 1**

*Socket Strip with Center Latch*

**Part Number 171-003-8S-6K7-18-PBCL**

Spring latch installed in the center cavity of the socket MicroStrip. Ordering Code CL for Center Latch. This strip has 5 circuits plus one cavity for the latch and two for the guide pins, for a total of 8 cavities. Note the white paint dot on the insulator. This dot indicates position #1. The wire color code system is "10 Color Repeating". Wire #1 is black, followed by brown, red, orange, yellow, green, blue, violet, grey and white.

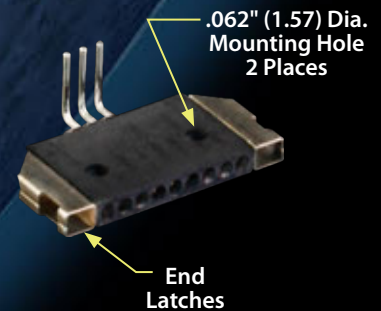


**Figure 2**

*Pin Strip with Center Latch and Guide Pins at Both ends.*

**Part Number 171-003-8P-6K7-18-PBCL**

Spring latch installed in the center cavity and guide pins installed in end cavities. This strip has five electrical circuits plus two positions for guide pins and one position for the latch for a total of eight cavities. The stainless steel guide pins are installed into the end cavities of the socket strip. The end cavities of the pin strip are opened up to accept the mating guide pins.



**Figure 3**

*Right Angle PCB Header*

**with End Latches and Mounting Holes. Part Number 171-004-11P-.250-BLMH.**

Latch clips installed into the end cavities of the MicroStrip. Ordering Code BL for Both end Latches. Note the mounting holes. These holes allow the strip to be attached to a circuit board. Each mounting hole requires three cavities. The board mount leads are formed into a single row on .050" centers.

### ABOUT BOARD MOUNT STRIPS

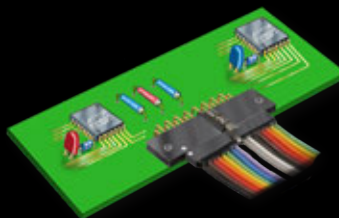
Space customers typically use MicroStrips™ for high reliability board-to-wire I/O applications. The pin strip is usually configured with right angle thru-hole PC tails. The strip is bonded to the PC board with epoxy, or attached to the board with screws installed in optional mounting holes. Surface mount and vertical mount versions are also available.

**Figure 4**

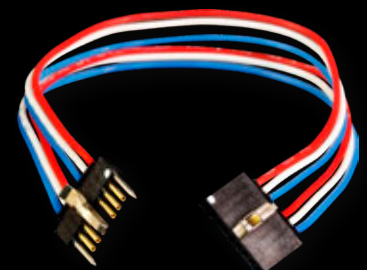
*Right Angle Pin Strip with Staggered PC Tails, Mounting Holes and Center Latch*

**P/N 171-005-23P-.125-CLMH**

Note that the board mounted strip has 23 cavities called out in the part number, but the mating socket strip (Fig. 1) has 17. Also note that three cavities are taken up by the mounting holes, and the position #1 white dot moves to the first electrical position.



### SINGLE ROW BACK-TO-BACK MICROSTRIPS



.050" pitch single row surface mount microstrips available with 1 to 30 contacts. Optional guide pins for circuit polarization. Gold-plated TwistPin contacts. molded LCP housing. Suitable for high-reliability applications where long-term resistance to fretting corrosion is a necessity. 3 A., 600 Vac, -55°C to +150°C.



JAXA Kounotori H2  
Transfer Vehicle and the  
Canadarm on the ISS

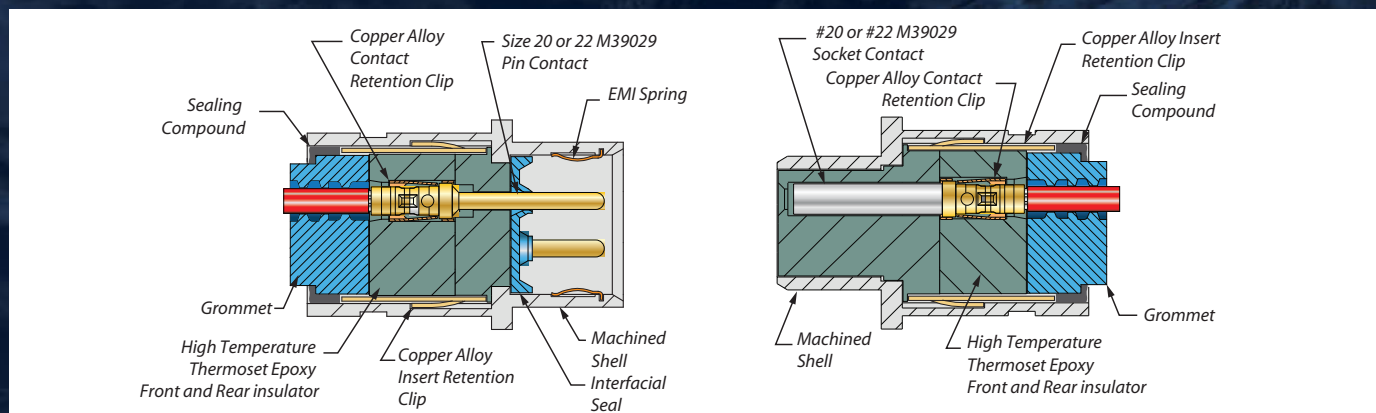
# ADVANCED-PERFORMANCE HiPer-D Connectors

## Space-grade M24308 intermateable

The HiPer-D connector is a M24308-type D-Subminiature connector with superior design features. Unlike standard M24308 connectors with stamped steel shells, the HiPer-D connector features a one-piece machined shell, 200°C continuous operating temperature rating and enhanced, mated shell EMI/RFI protection via an integrated ground spring. Aerospace grade fluorosilicone grommets and face seals (JAXA / NASA outgassing available) provide environmental protection. The HiPer-D is intermateable, intermountable and interchangeable with standard M24308 D-Sub connectors.

- Advanced temperature, vibration and EMC/ electrical performance
- 11 standard and 20 combo insert arrangements
- High temperature epoxy insulators
- Watertight sealing
- Rugged machined one-piece shell

### STANDARD AND HIGH DENSITY HiPer-D® - CUTAWAY

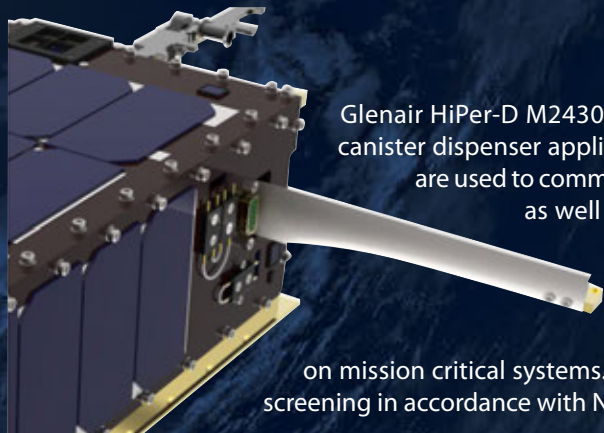




# SERIES 28

## HiPer-D Space Grade Connectors

### Product features and specifications



Glenair HiPer-D M24308 D-sub connectors are ideally suited for CubeSat or NanoSat canister dispenser applications where rack and panel or connectorized wire assemblies are used to communicate with HDRMs, pin pullers, pin pushers, door status sensors, as well as system communications and testing prior to deployment of satellite equipment. Standardized usage of M24308 connectors on hardware interfaces simplifies interconnection and communication. Glenair HiPer-D space grade M24308 D-sub connectors eliminate potential interconnect electrical problems on mission critical systems. Connectors are supplied with NASA/ESA/JAXA outgassing and screening in accordance with NASA EEE-INST-0002.

HiPer-D High-Performance D-Sub vs. MIL-STD-24308		
Specification / Feature	M24308	HiPer-D
Temperature	-55°C to +125°C	-65°C to +200°C
Insulator	Thermoplastic	Thermoset Epoxy
Shell	Steel (Brass)	Aluminum (SST)
Voltage	1000 VAC	1000 VAC
Grounding	Dimples in shell (not in Mil-Spec)	Nickel-plated Copper Alloy EMI spring
Environmental	No	Yes
Vibration, sine	20 g	60 g
Vibration, random	N/A	43 g
Shock	50 g	300 g
Bolt-on backshells	No	Yes

### HiPer-D M24308 COMBO-Ds for power, signal, and RF applications

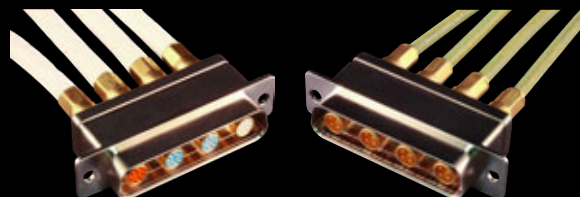
- Size #8 power and 50 ohm or 75 ohm RF contacts
- Mixed layouts with #8's and #20's
- 200°C continuous operating temperature
- 20 tooled layouts
- Crimp and PC tail terminations



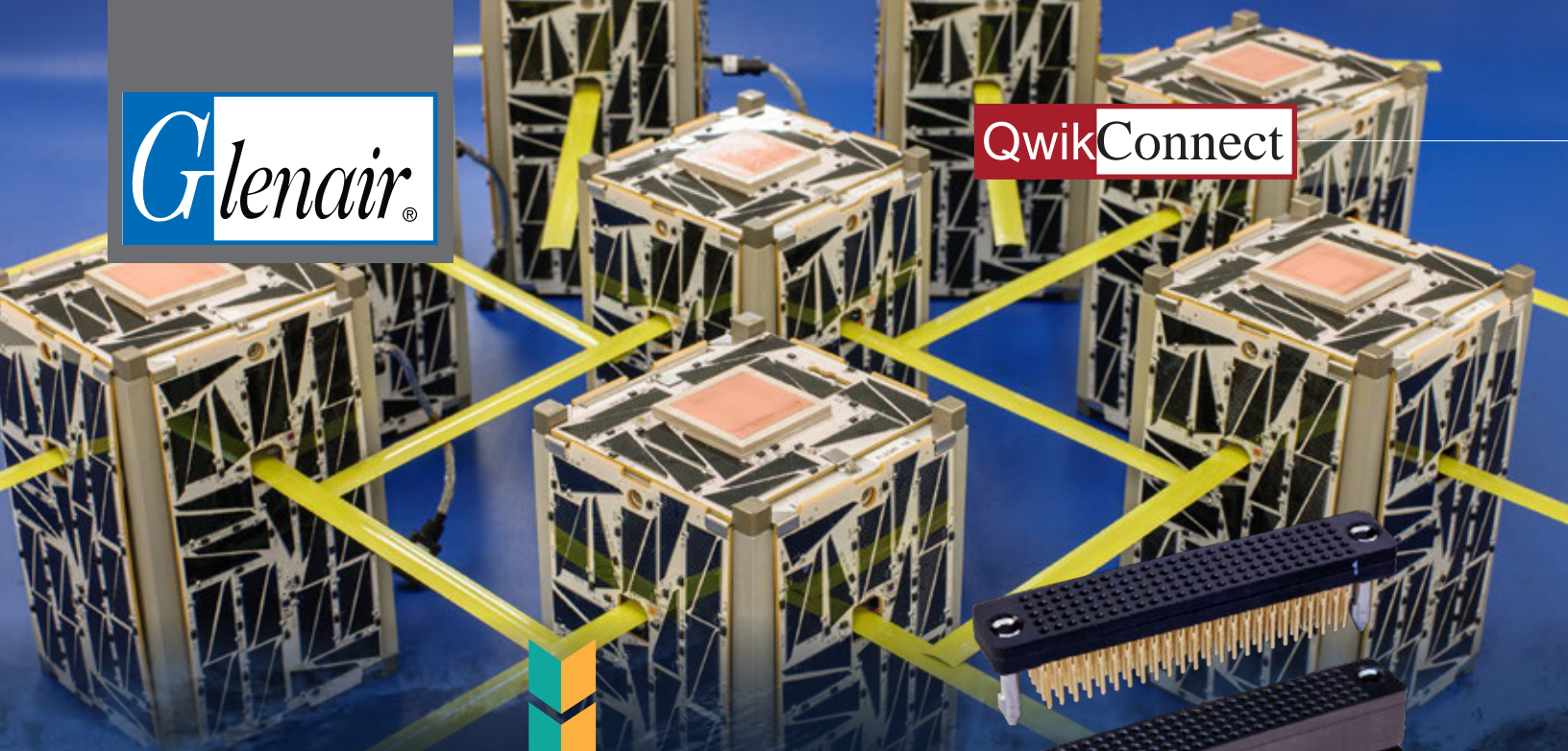
### HIGH-SPEED HiPer-D HIGH-PERFORMANCE M24308

#### Crimp contact non-environmental connectors with #8 contacts for high-speed data transmission

- One-piece rugged machined aluminum shell
- Two to five size 8 Coax, Twinax, Quadrax or Ochito contacts
- Common ground plane (no insulators)
- Available in straight and right angle PCB versions







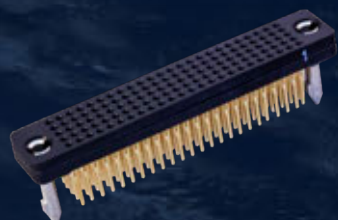
# HD STACKER™

## High-density, solder-free, PCIe-ready board-to-board stackable connectors

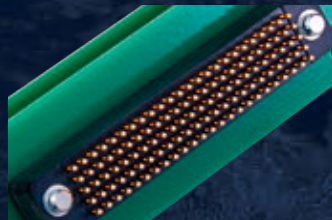
Mission-critical board-to-board connector applications demand fail-safe signal integrity as well as rugged and reliable harsh-environment performance. The HD Stacker™ brings Glenair innovation to stacking board-to-board connectors with several significant design improvements: Ultra high-density .0625" Chevron Contact System provides 55% more contacts per connector size, or a 31% size reduction for the same number of contacts as compared to current industry solutions. Polarized connector bodies and available polarized guide pins prevent accidental mismatching. The solder-free press-fit compliant pin contacts are removable, repairable, and available in custom lengths. HD Stacker™ connectors may also be ordered with pre-wired cable or flex jumper terminations. High-speed signal integrity test reports are available upon request. Choose HD Stacker™ for the ultimate in high-density, rugged board-to-board stackable connector performance.

- High-density .0625" pitch Chevron Contact System
- PCIe Rev 3 capable
- Signal integrity to 10.5Gb/sec.
- Polarized insulator and hardware options
- Solder free "eye of the needle" compliant tail for press fit installation
- High-temp PPS insulator meets NASA outgassing requirements
- Available wired / flex jumpers
- Available between-board spacers up to 1 inch

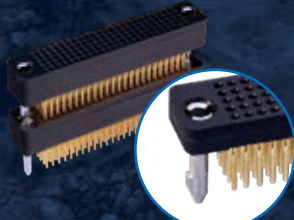
### HD STACKER™ FOR MISSION-CRITICAL BOARD-TO-BOARD APPLICATIONS



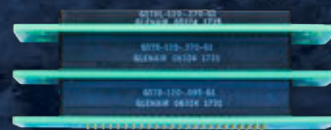
Solder-free press-fit (compliant pin) board mounting



.0625" pitch contact spacing: highest available density



Polarized shells and keyed guide pin hardware prevent mis-mating



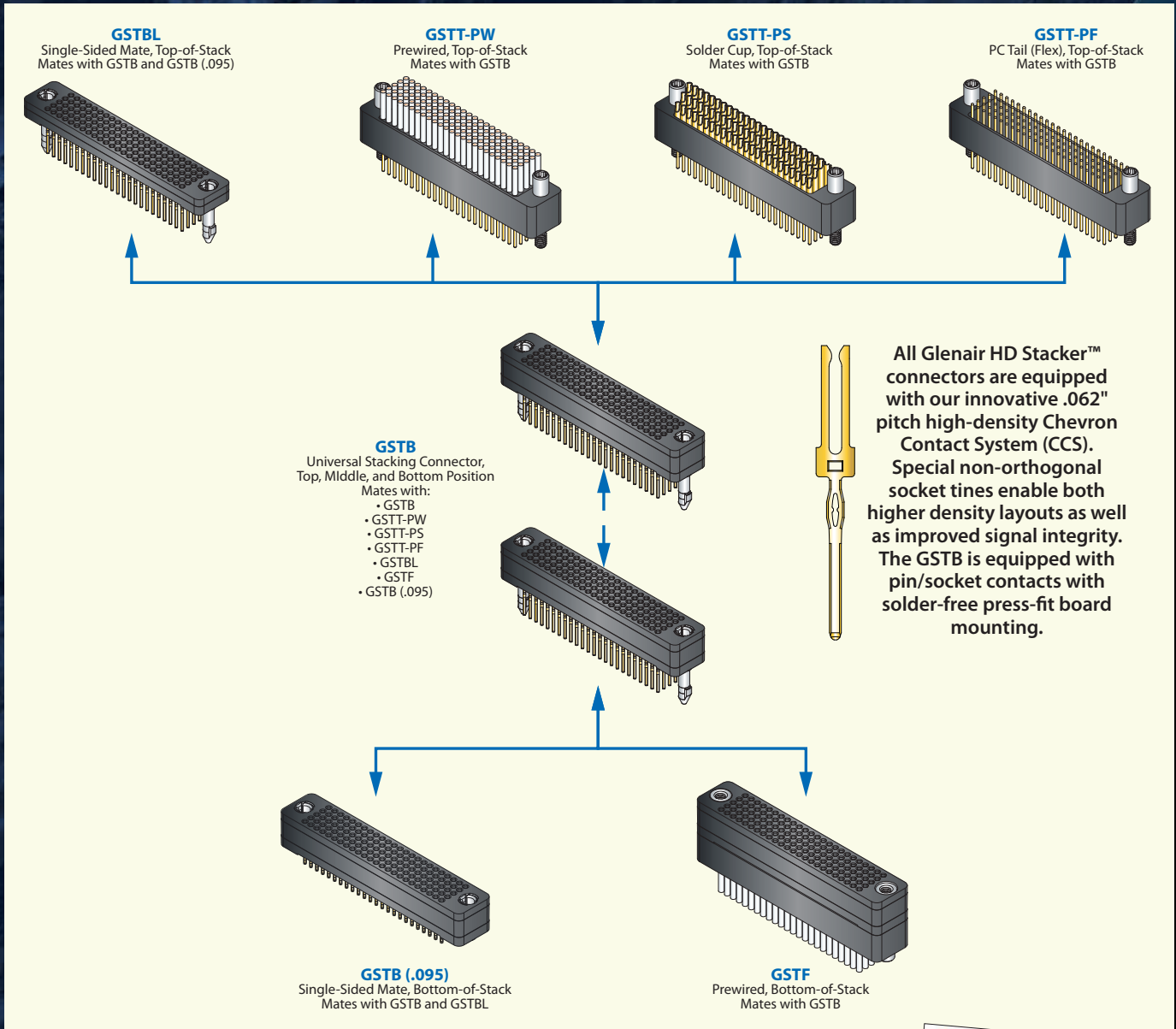
Controlled signal integrity for differential applications (PCIe Rev 3 capable)



# .0625" PITCH COMPLIANT PIN High-Density Stacker™

## Rugged board-to-board stackable connectors

### HD STACKER™ POSITION AND MATING COMPATIBILITY GUIDE



### QUALIFICATION TESTING / HIGH-SPEED PERFORMANCE

Stacker connectors were qualified in accordance with MIL-DTL-55302G testing for:

- Contact engagement/separation
- Contact retention
- DWV
- Electrical resistance
- Mechanical vibration and shock
- Insulation resistance
- Thermal shock
- Contact resistance
- Humidity

High-frequency electrical performance tests were performed for: Insertion loss, return loss, crosstalk, and time domain performance metrics including impedance and eye pattern. Complete test reports are available at [www.glenair.com/technical\\_information\\_test\\_reports](http://www.glenair.com/technical_information_test_reports)





NASA / ESA SCREENING

# Outgassing Properties and Requirements

## Specification information

### Space-grade interconnect manufacturing and test capability

#### Outgassing and Inspection Modification Codes

Glenair space mechanisms and related interconnect solutions are ideally designed for deployment of CubeSat and NanoSat equipment. All HDRMs, and connectors feature materials, finishes, and performance specifications that perform to NASA EEE-INST-002

#### Outgassing

Space flight equipment requires low-outgassing components in order to prevent degradation to optics and other sensitive instruments. Various Glenair connectors contain nonmetallic materials such as rubber, plastic, adhesives and potting compounds which can give off gasses when subjected to a vacuum or high heat. Unless the connector is specially processed, the TML and CVCM can exceed allowable limits. The space industry has adopted a standardized test procedure, ASTM E595, to evaluate outgassing properties. The MIL-DTL-38999 specification Class G also details specific TVM and CVCM values. In Glenair's 186T process, for example, connectors and connector materials are heated to 175° C at a vacuum of 5 X 10<sup>-6</sup> Torr for 48 hours. Items under test are then weighed to calculate the Total Mass Loss (TML), which may not exceed 1.0% of the total initial mass. A collector plate is used to determine the Collected Volatile Condensable Material (CVCM), which may not exceed 0.1% of the total original specimen mass. Glenair is able to offer outgas processing which assures all materials comply with their respective standards.

#### Note on Connector Material and Finish Options

Some types of metals are prohibited for space flight. "Pure Tin, Cadmium, Zinc shall not be used as a final finish on EEE part (NASA EEE-INST-002 Instructions for EEE Parts Selection, Screening, Qualification, and Derating). NASA recommends electroless nickel or gold finish on connector shells and gold finish for contacts.

#### Specifying Appropriate NASA Screening

**1** Choose a NASA EEE-INST-002 Table 2A screening level. This table contains three screening levels: **Level 1** for missions requiring the highest reliability and lowest level of risk, **Level 2** for low to moderate risk missions, and **Level 3** missions where enhanced screening and inspection is not invoked.

**2** Choose outgassing process and/or NASA inspection requirements. 9 options are available for NASA outgassing, see Table I for details. Cross reference Table II for inspections completed by screening level as required by NASA standards.

**3** Select the modification code from the table and add it to the part number. Example: 253-01600ME21-35PNMSA-429.

**Table I: Outgassing per NASA Screening Levels and D38999, Class G**

Screening Level	No Outgas Processing	48 Hour Oven Bake 175° C 100%	Thermal Vacuum* Outgassing 24 Hour 125° C 100%	Thermal Vacuum* Outgassing 48 Hour 175° C 100%	Mod Code
No Screening			●	●	186M (ASTM E595) 186T (Class G)
3			●		429L
2	●		●		429 429A 429K
		●			429B 429C 429J
1	●		●		
		●			

\*Thermal vacuum of 10<sup>-6</sup> Torr.

**Table II: NASA EEE-INST-02, Table 2A Screening Levels**

Inspection	Level 1	Level 2	Level 3
Visual	100%	100%	100%
Mechanical	2	2	
Dielectric Withstanding Voltage	2	2	
Insulation Resistance	2	2	
Contact Engagement & Separation Force	2		
Hermeticity (Sealed Receptacles Only)	100%	100%	100%
Coupling Force	2		

Note: required inspection quantity shown. Zero acceptance of failures allowed for all quantities inspected. Inspection is not performed/required for MIL-DTL-38999, Class G



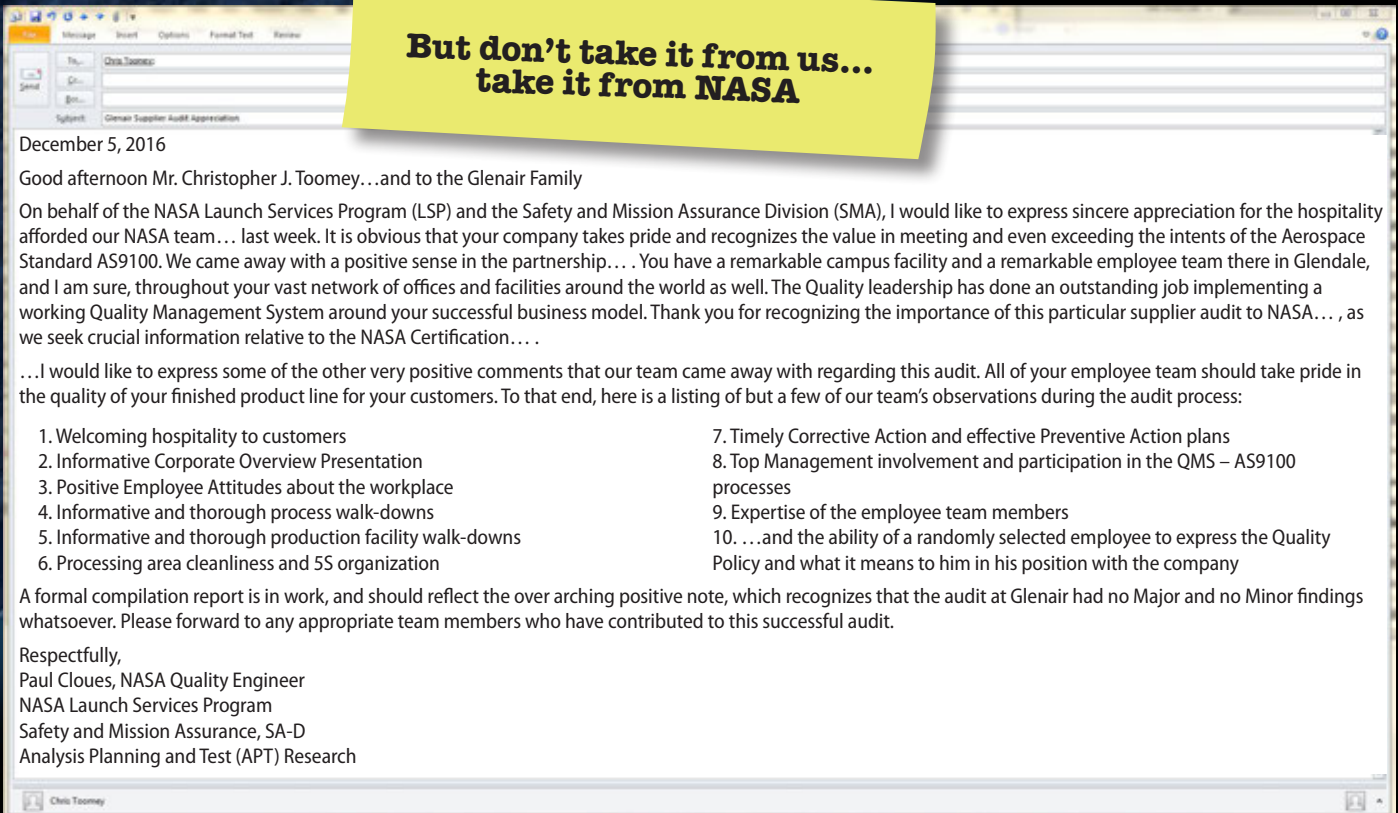


**NASA  
ESA, JAXA  
SCREENED**



Glenair's family of space mechanisms are manufactured in certified cleanrooms. Full qualification test reports are available for every device type. NASA/ESA outgas processing and screening completed on-site. All operations are managed under a single certified quality system with unprecedented levels of performance.

**But don't take it from us...  
take it from NASA**



December 5, 2016

Good afternoon Mr. Christopher J. Toomey...and to the Glenair Family

On behalf of the NASA Launch Services Program (LSP) and the Safety and Mission Assurance Division (SMA), I would like to express sincere appreciation for the hospitality afforded our NASA team... last week. It is obvious that your company takes pride and recognizes the value in meeting and even exceeding the intents of the Aerospace Standard AS9100. We came away with a positive sense in the partnership... You have a remarkable campus facility and a remarkable employee team there in Glendale, and I am sure, throughout your vast network of offices and facilities around the world as well. The Quality leadership has done an outstanding job implementing a working Quality Management System around your successful business model. Thank you for recognizing the importance of this particular supplier audit to NASA... as we seek crucial information relative to the NASA Certification...

...I would like to express some of the other very positive comments that our team came away with regarding this audit. All of your employee team should take pride in the quality of your finished product line for your customers. To that end, here is a listing of but a few of our team's observations during the audit process:

- 1. Welcoming hospitality to customers
- 2. Informative Corporate Overview Presentation
- 3. Positive Employee Attitudes about the workplace
- 4. Informative and thorough process walk-downs
- 5. Informative and thorough production facility walk-downs
- 6. Processing area cleanliness and 5S organization
- 7. Timely Corrective Action and effective Preventive Action plans
- 8. Top Management involvement and participation in the QMS – AS9100 processes
- 9. Expertise of the employee team members
- 10. ...and the ability of a randomly selected employee to express the Quality Policy and what it means to him in his position with the company

A formal compilation report is in work, and should reflect the over arching positive note, which recognizes that the audit at Glenair had no Major and no Minor findings whatsoever. Please forward to any appropriate team members who have contributed to this successful audit.

Respectfully,  
Paul Cloues, NASA Quality Engineer  
NASA Launch Services Program  
Safety and Mission Assurance, SA-D  
Analysis Planning and Test (APT) Research



# Reference Applications

## Brief history of Glenair space-grade design-ins



**Atmospheric Infrared Sounder (AIRS)**

Glenair-built cables provide signal and power interconnection on a broad range of space applications including The **Atmospheric Infrared Sounder (AIRS)** instrument aboard the Aqua Earth-observing satellite, JPL Mars Probes, the Space Shuttle, and the AIRS satellite. Several notable space applications would include:

The **Gravity Probe**, designed to measure two key predictions of Einstein's general theory of relativity by monitoring the orientations of ultra-sensitive gyroscopes relative to a distant guide star. Glenair-built cables are on board.



**Gravity Probe**

**Titan II** space-launch vehicles, with Glenair-made interconnect harnesses, propelled all twelve manned Gemini capsules.

**Hermetic connectors** are ideal for high-pressure/low-leakage applications in air, sea and space environments. Made of stainless steel (CRES) with glass insulators fused to the connector shell, and suitable contacts meeting a leak rate of  $1 \times 10^{-6}$  cubic centimeters of Helium per second, these mounted receptacle connectors and bulkhead feed thru's prevent gases from travelling through apertures or penetrations created for the routing of interconnect cabling. Glenair hermetics have protected a range of space programs including:

The **X-38** program implemented to design and build a spacecraft capable of flying itself and the Space Station crew back to Earth in an orbital emergency.



**The X-38**

**Pegasus** rockets, the winged space booster vehicles used in an expendable launch system developed by private industry.

**MetOp-A**, Europe's polar-orbiting satellite dedicated to operational meteorology.

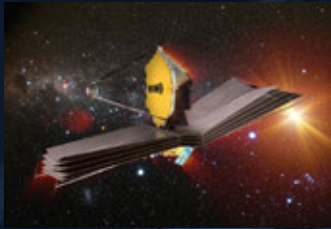


**MetOp-A**

A well designed interconnect system will include a complement of grounding and shielding technologies to insure EMC. **EMI filter connectors** are an effective method to achieve electro-magnetic compatibility. Glenair is extremely well versed in supplying filter connector products optimized for use in space-grade applications, providing products compliant to EEE-INST-002, Table 2G, the recognized standard for space grade filters. Glenair MIL-DTL-38999, Series 80 Mighty Mouse, Series 28 HiPer-D, and Series 79 Micro-Crimp filter connectors are currently qualified and used by Ball Aerospace, Boeing Space, NASA/JPL, Orbital Sciences, Sierra Nevada Corp., and others. Notable Glenair Filtered connector space applications include:

**Skynet**, for the United Kingdom Ministry of Defence, to provide strategic communication services to the three branches of the British Armed Forces and to NATO forces engaged on coalition tasks.





**JWST**

The **James Webb Space Telescope (JWST)** is a large, infrared-optimized space telescope. JWST is designed to find the first galaxies that formed in the early Universe, connecting the Big Bang to our own Milky Way Galaxy.

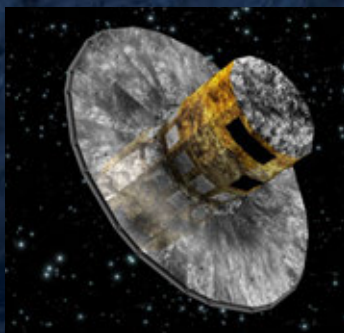
**Micro-D connectors**, including environmental solutions, hermetics, filters, and flex assemblies are commonly used in space applications due to their high-performance and small size. The

precision-machined shell of the Micro-D, with its robust mating retention forces, makes for an ideal connector for missile, rocket and space-vehicle applications that are subject to high-levels of vibration and shock. The Micro-D is easily customized with package and mounting modification to fit virtually any integration challenge. A short list of Glenair Micro-D space applications would include the James Webb Space Telescope, SkyNet 5 military satellite, ALMA space telescope, JPL Mars Probe, Mars Curiosity Rover, AIRS satellite, and others. Several notable space applications that use Glenair Micro-D connectors include:

The **Herschel Space Observatory**, from the European Space Agency, will determine facts about Galaxy formation, Star formation, and the Chemical composition of atmospheres and surfaces of planets, comets and moons.

The European Space Agency also developed and built the **Gaia** satellite. Launched in 2013, its mission is to construct the largest and most precise map to date of the Milky Way.

An earth-orbiting satellite system combining surveillance and intercept functions on a single spacecraft that would be able to detect, identify, discriminate, and track ballistic missile targets. An interceptor would destroy a missile by direct impact at high speed.



**Gaia satellite**

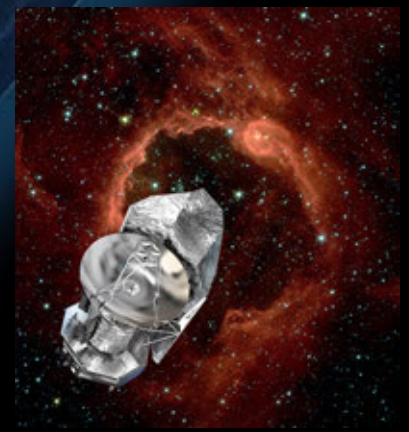
**Cassini-Huygens** was a joint NASA/ESA/ASI robotic spacecraft mission studying the planet Saturn and its moons.

**CrIS** is an advanced atmospheric sounding instrument being built for the National Polar-orbiting Operational Environmental Satellite System. Nanominiature connectors are high-reliability ultraminiature interconnects for critical applications where size and weight restrictions will not allow the use of larger connectors. Contact spacing of 0.025 (25 thousandths) of an inch combined with a rugged twist pin contact system allow these nano connectors to be used in extremely small applications, such as satellite payloads, while still delivering reliable electrical and mechanical performance.

**Glenair M32139 Class S Nanominiature** connectors are DSCC approved for space programs. Glenair Nanominiature connectors, cable assemblies and flex circuit assemblies are currently in use on the several space-based telescopes,



**Skynet**



**Herschel Space Observatory**



**Cassini-Huygens**





**CrIS NPOESS Satellite**

including the **Large Synoptic Survey Telescope (LSST)**, **James Webb Space Telescope**, and others

The **Series 79** connector is a Glenair original design. It features crimp, rear-release size #23 contacts on 0.075" spacing, as well as size #12 and #16 power and coaxial crimp contacts available in 29 insert arrangements for data and power transmission. The Series 79 Micro-Crimp is ideally suited for blind-mate rack and panel and/or module-to-chassis applications; and is currently qualified for use by Orion, Ball Aerospace, Honeywell Space, and LMCO Denver.

Glenair **Series 80 Mighty Mouse** connector and cable assemblies were developed as a smaller and lighter alternative to MIL-DTL-38999, offering virtually equal performance with up to 71% (weight) and 52% (size) savings for similar contact layouts. Mighty Mouse is well established in hundreds of safety-critical military, medical, industrial and geo-physical and space applications. Some space applications for this reduced form factor connector include:

NASA's **Mars Exploration Rover (MER)** Mission, an ongoing robotic mission to explore the Martian surface and geology.

The Mars Science Laboratory **Curiosity** recently landed on the Martian surface. This rover is over five times as heavy and carries over ten times the weight in scientific instruments as previous rovers. It will analyze soil samples to determine Mars' ability to support microbial life.



**LSST Telescope**

**Aquarius** is a satellite mission to measure global Sea Surface Salinity. It provides the global view of salinity variability needed for climate studies.

Glenair **Sav-Con® Connector Savers** protect deliverable connectors subject to repeated mating and unmating cycles, especially from repetitive qualification test cycles. Sav-Con® Connector Savers prevent costly repair or replacement of cable plugs and receptacle connectors by absorbing connect and disconnect abuse and by reducing mating cycles during testing to the absolute minimum.



**Aquarius Satellite**

A virtual "Who's Who" of space programs use Glenair Sav-Cons including Boeing Satellite Systems, the Delta IV launch vehicle, Voyager, Galileo, Magellan, Cassini, and others—both during fabrication testing and in operation.

One of the most dramatic applications of our Sav-Con connectors is on the **Space Shuttle Orbiter** where they provided protection for the umbilical connectors from liftoff to touchdown on every mission.

For many space applications, the cable shield is the most important element in controlling EMI and radiation damage. Unfortunately, metal shielding—especially when applied in multiple layers—can be extremely heavy. **AmberStrand** composite thermoplastic braid, and **ArmorLite** microfilament stainless steel braid provide robust EMI shielding at a fraction of the weight of conventional shielding. Glenair lightweight braid technologies are currently qualified for use by EADS Astrium, Honeywell Space, Orbital Sciences, and Ball Aerospace. These unique products notably served on:



**A NASA LEO (Low Earth Orbit) Satellite**



The **Cassini-Huygens** Program, an international science mission to the Saturnian system.

**Mars Pathfinder**, which delivered an instrumented lander and a free-ranging robotic rover to the surface of the red planet.

The Glenair **Qwik-Clamp backshell** is used on the **International Space Station**. This gold plated part is extremely resistant to space corrosion and radiation and is designed with all smooth surfaces to eliminate potential damage to space suits.



*Space-grade Qwik-Clamp backshell designed for the International Space Station*



*Ariane 5*

Other circular backshell and connector accessory space applications include:

The European Space Agency's **Ariane 5**, which launches satellites and other craft into geostationary transfer orbit (GTO), medium and low Earth orbits, Sun-synchronous orbits (SSO) and Earth-escape trajectories

**SEA Launch** is a spacecraft launch service using a mobile sea platform for equatorial launches of commercial payloads.

As with circular backshells and accessories, Glenair has the rectangular interconnect world well covered. We supply everything from miniaturized backshells for Micro-D connectors to larger rack-and-panel connector accessories. Glenair rectangular accessories are used on dozens of space programs including the International Space Station, MetOps, Herschel Space Observatory, James Webb telescope, and others.

### **Recent / Notable Space-Grade Application Wins for Glenair**

Glenair is the exclusive interconnect connector and cable supplier to the Sierra Nevada Dream Chaser reusable crewed suborbital and orbital space plane. The Dream Chaser electrical wire interconnect system incorporates Glenair Micro-D subminiature connectors, EMI filter connectors, flex circuitry, lightweight microfilament braid, metal and composite backshells, and other technologies.



*Gold-plated space-grade Series 28 HiPer-D connectors*

### **The Glenair Series 28 HiPer-D High-Performance MIL-24308 Intermateable**

Glenair's qualified MIL-DTL-24308 Class K space-grade hermetic, and our recently-introduced Series 28 HiPer-D connector series have become the go-to standard for mission-critical space applications and are now qualified for use by Ball Aerospace, LMCO Denver, Orbital Sciences, and others.



## How We Get There

There is an African proverb that gets quoted quite often here at Glenair:

*If you want to go quickly, go alone. If you want to go far, go together.*

Back when I “carried a Glenair bag” as a sales rep in Florida, we were pretty much like all the other “accessory” suppliers serving the mil-aero marketplace (Sunbank, Electro Adapter, ESC, Diverse Terminations, Pulse and others). We had just a limited range of interconnect technologies to sell (backshells, conduit, dust caps and so on) all with long lead-times on both quotes and deliveries. Truth be told, even with long lead-times, we were frequently delinquent on our promised ship dates. Like I said, we were, unfortunately, pretty much like all the other suppliers.

Nowadays we pride ourselves on being “the first with the most” in our market space, which we define as in-stock products, short turnarounds on customer orders, sales and support professionals that actually answer their phones, abundant engineering muscle, free samples, no minimums and so on. Shipping product on time is always a challenge—especially with our growth and the volume of custom, high-touch work we do. But now our speed—our velocity—is up there with the best suppliers in the industry. And by the way, a huge percentage of our shipments come straight out of our same-day inventory. You can’t get any faster than that.

Turning to product range, we now make and sell a broader set of interconnect technologies than ever before. What a journey it’s been from that simple backshell house to the full-spectrum connector supplier we are today. I can’t say that I’m surprised (given the dedication of our team) but I could never have predicted we would ever produce such a diverse range of solutions—from flex assemblies to photonics, from STAR-PAN™ soldier hubs to lightweight EMI/RFI braid.

Let’s get back to that African proverb we are so fond of. From my perspective, it looks like we have followed both approaches at Glenair. We have made fast action and velocity an absolute watchword of our business. And we have taken our operation farther than ever before with innovative product and market development. One look at our filter connector production line or opto-electronic clean room, to cite just two examples, is all you need to see to conclude there are no barriers at Glenair limiting how far ultimately we can go.

So it’s a push? Going fast and going far? Perhaps as far as the raw mechanics of the business are concerned, but not when it comes to our human capital—the colleagues and friends we spend our days with in Glendale, Bologna, Mansfield, Paso, Anaheim, Wallingford, Chicago, San Diego, Frankfurt, Solna, Toulouse, Seoul and elsewhere around the globe. When it comes to people, when it comes to keeping the “win-win” alive and happy at Glenair, nothing could be more important than “going together.”

We have become a mighty enterprise over the last few decades. The hiring report our Engineering V.P. Greg Brown puts together each year lists dozens of new engineers having joined our team in 2017. Fabulous! But these talented folks won’t stay with us for long if we don’t work hard to take them on the trip together; to ensure that every one of us, in every role, is treated with respect and honest dealing. Happy new year gang. Let’s see how far we can go in 2018.

*Chris Toomey*

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