

MISSION-CRITICAL  
INTERCONNECT  
SOLUTIONS



*Glennair*  
SIGNATURE SERIES



# Space-Grade Interconnect Solutions

Proven, Rugged, Flight-Heritage Technologies



# Space-Grade Design Disciplines: *Reliability*

Deep fluency in the real-world mechanical challenges of designing for space

- Launch shock and vibration
- Temperature extremes
- Dynamic and installation flex
- Blind separation



# Space-Grade Design Disciplines: *Performance*

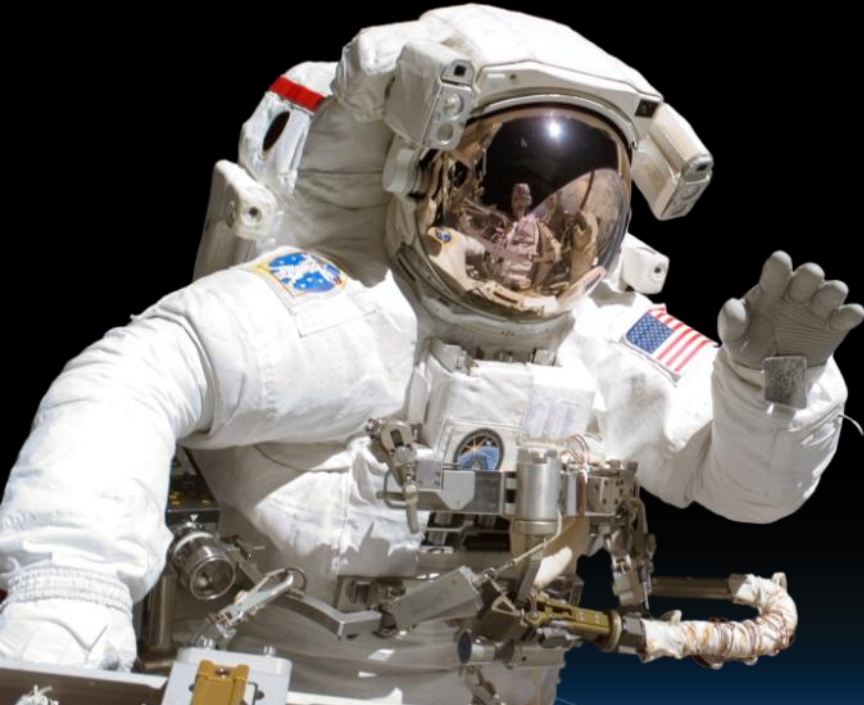
## Deep fluency in optimizing package design for advanced performance

- Reduce payload weights
- Reduce interconnect package size/ increase contact density
- Reduce wear and tear mating-cycles on deliverable connectors
- Assure reliable satellite deployment/interconnect separation



# Space-Grade Design Disciplines: *Survival*

Deep fluency in the extremes of space that degrade performance



- Eliminate condensable material outgassing
- Assure barrier/interconnect sealing and hermeticity
- Manage EMI/RFI and high-dose-rate space radiation
- Survive temperature extremes
- Prevent atomic oxygen corrosion

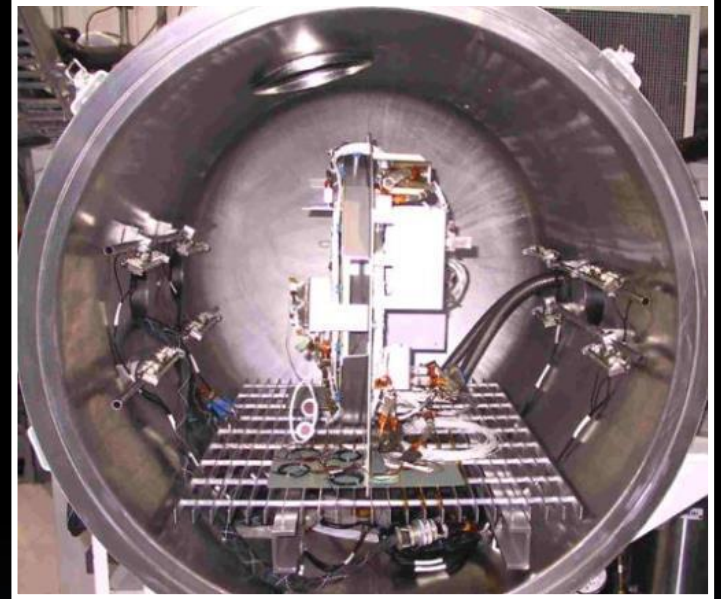
# Glenair Worldwide Space-Grade Manufacturing and Assembly Capabilities



- Three space-grade manufacturing and assembly factories with clean rooms: Glendale, CA; Mansfield UK; Glenair Space Systems (Salem, Germany)
- Certified independent test laboratories (ISO/IEC 17025:2005, IECQ 01 and IECQ 03-6)
- Nadcap and ESA special processes and PCB assembly
- In-House space-grade Class G Plating
- Flight legacy on hundreds of programs
- NASA, ESA and JAXA outgassing and screening processing

# So What is Materials Outgassing Exactly?

- Inorganic materials tend to exhale volatile materials when exposed to high temps and very low pressure
- Different materials exhale differently
- Materials can be subjected to outgassing processing on Earth (bakeout and/or vacuum) to prevent potential damage from outgassing in Space



# Materials Selection and Outgassing

- EEE-INST-002 defines suitable metallic and non-metallic materials for use in space
- ASTM E 595 testing is used to ensure low measures for
  - TML
  - CVCM
  - WVR
- NASA / ESA screening levels allow engineers to select preventative factory outgas processing, if warranted by mission and application

**Table A: Sample Identification**

Sample #	Material	Assembly and Baking at Glenair		Thermal Vacuum 10 <sup>-6</sup> torr outgassing at Wilson Scientific	
		Temperature (°C)	Time (Hours)	Temperature (°C)	Time (Hours)
1	EPIALL 1908 Epoxy	150	3	175	48
2	FLUROSILICONE BLEND40 DUROMETER, Momentive 23590-BLU	150	0.5	175	48
3	DC1204	38	8	175	48

**Table 1: Outgas Results for the samples.**

Sample	TML (%)	CVCM (%)	WVR (%)
Sample #1	0.16	<0.01	0.15
Sample #2	0.04	<0.01	0.05
Sample #3	4.16	<0.01	3.53



# Optional Space-Grade Connector Screening

Per NASA screening levels and IAW MSFC-SPEC-548 for vacuum outgassing of electrical connectors for space payloads

ESA and NASA Screening Levels and Modification Codes				
Screening Level	Special Screening Only		Special Screening Plus Outgassing Processing	
	Interfacial Seal is Installed	Interfacial Seal is Omitted	48 Hour Oven Bake 175° C	Thermal Vacuum Outgassing 24 hrs. 125° C
ESA Level 1 Highest Reliability	Mod Code 897E	Mod Code 897F	Mod Code 897J	Mod Code 897C
ESA Level 2 High Reliability	Mod Code 897B	Mod Code 897D	Mod Code 897K	Mod Code 897A
ESA Level 3 Standard Reliability	Mod Code 897	Mod Code 897L	Mod Code 897P	Mod Code 897M
NASA Level 1 Highest Reliability	Mod Code 429B	Mod Code 429F	Mod Code 429J	Mod Code 429C
NASA Level 2 High Reliability	Mod Code 429	Mod Code 429D	Mod Code 429K	Mod Code 429A
NASA Level 3 Standard Reliability	(Use standard part number)	Mod Code 432	Mod Code 186	Mod Code 186M

# Special Qualification of Metallic Materials for Control of Stress Corrosion Cracking

## Per MIL-STD-3029 Rev A

- Dynamic and static stress tests in NaCl (salt fog) over proscribed timeframes to control for potential premature material failure (cracking)



# Space-Grade Complex Cable Assemblies

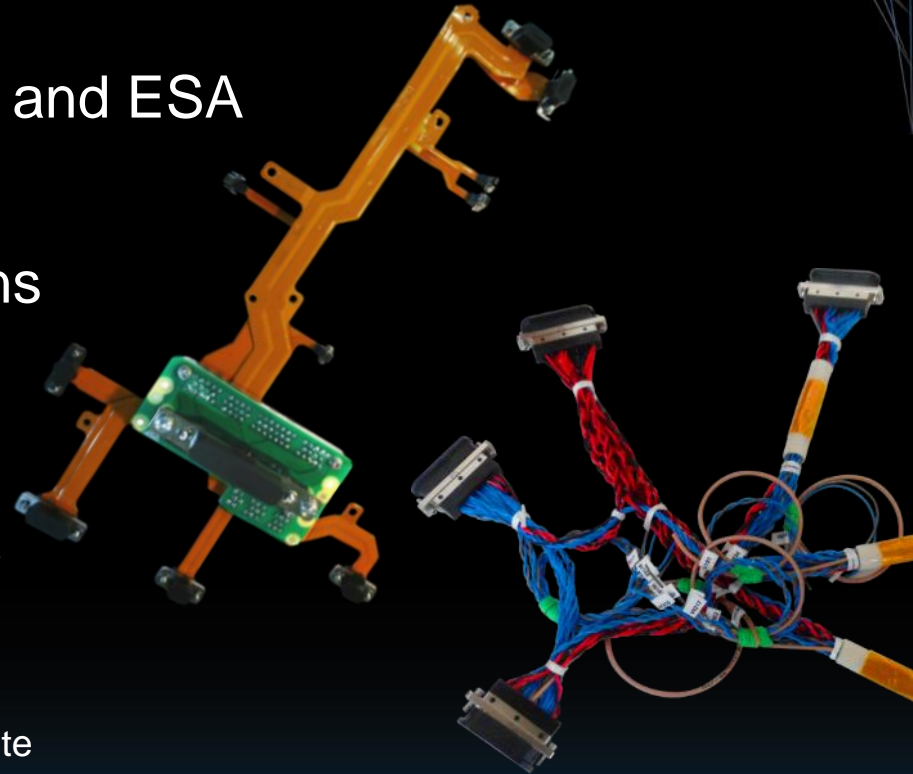
Heritage dating from Commander Ed White's first spacewalk

- Molded (Viton) assemblies
  - Turnkey conduit assemblies
  - Shielded harnesses
  - Integrated Flex assemblies
- 
- JPL Mars Probes
  - AIRS Satellite
  - Gravity Probe Satellite
  - Space Shuttle
  - Titan Launch Vehicle



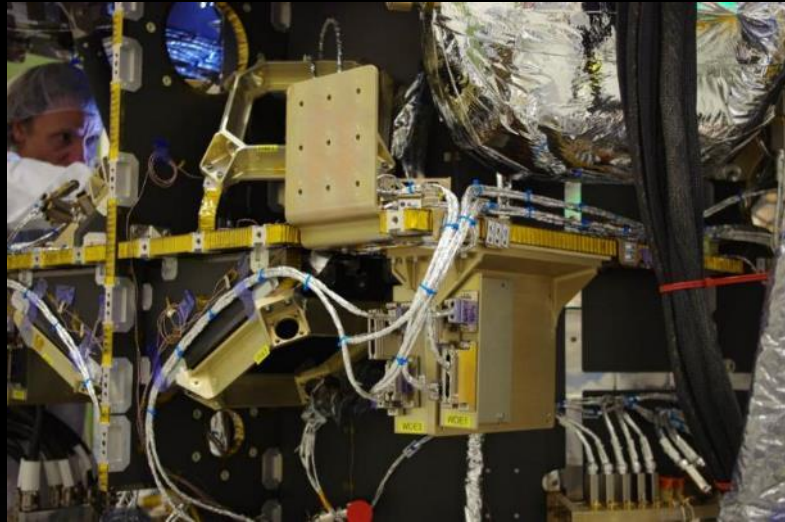
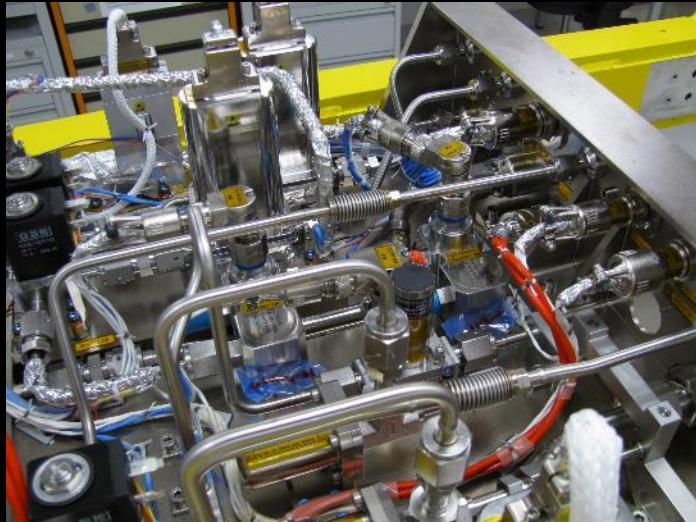
# Space-Grade Micro and Nano Wire and Flex Assemblies

- 30 years experience plus IPC and ESA Certification
- Radar, EO sensors, missiles, satellite and space applications
  - Herschel Space Observatory
  - James Webb Space Telescope
  - GAIA optical astronomy satellite
  - Skynet 5 Military Satellite
  - ALMA Space Telescope
  - JPL Mars Probe and Mars Curiosity Rover
  - AIRS Satellite
  - Kinetic Kill Vehicle (KKV)
  - Cassini
  - CrIS and Northrop Space NPOESS Satellite



# Flight-Grade Harness Assemblies: GSS (Salem)

Glenair ESA-certified facility in Europe for wire harness fabrication



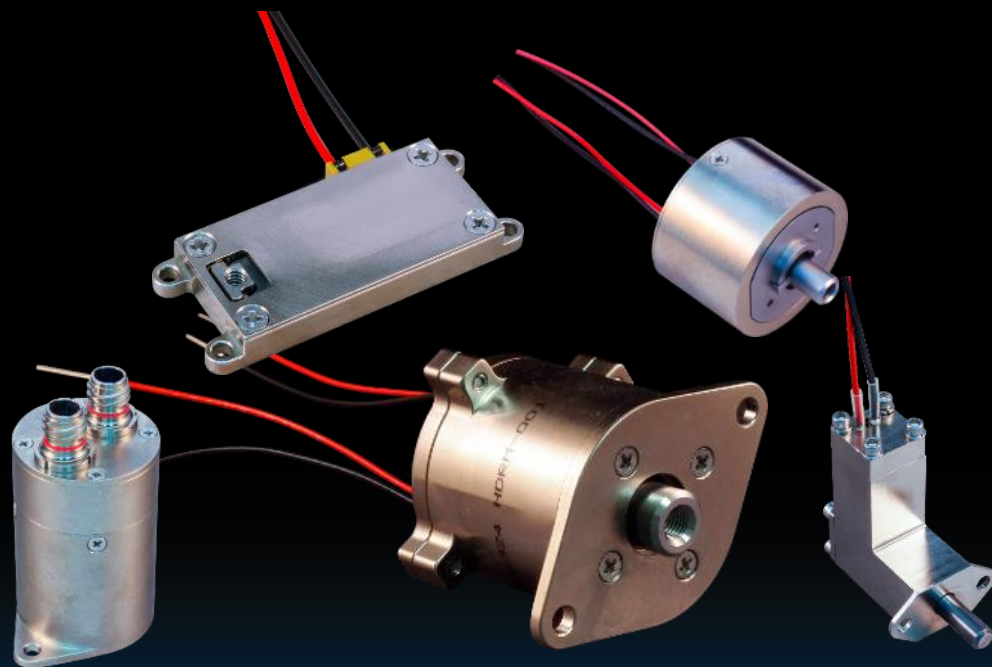
Reference applications: ACLS and Lisa Pathfinder



# Hold Down and Release Mechanisms

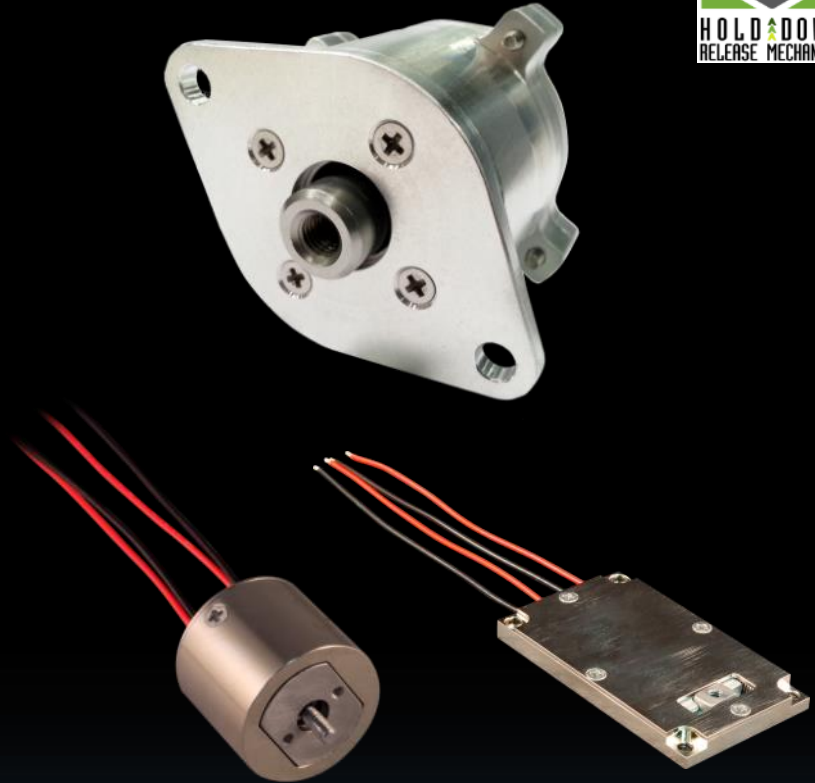
## North American and European-Made Flight heritage HDRMs, Pin Pullers, and Pin Pushers

- Yes, Glenair has flight heritage (multiple times)
- Pyrotechnic-free and low shock
- User-serviceable and refurbishable
- Extended temperature range -150°C to +150°C
- EMI/EMP/RFI/ESD insensitive
- Scalable: Light, medium, and heavy-duty solutions



# Scalable Design

- Fuse-wire based technology
- Electrical initiation as low as 1.5 Amps with no maximum current limit
- Scalable designs: from Nano-Satellite versions to rated 20,000 pound units



# HD Stacker Board-to-Board Connectors

The high-density, rugged board-to-board stacking connector

- Parallel board stacking connector
  - Board-to-board
  - Board-to-cable/flex
- PCIe 3.0 capable
- Solder free “eye of the needle” compliant tail for press fit installation
- Replaceable BeCu contacts
- High-density .0625" pitch Chevron Contact System



**HDSTACKER™**

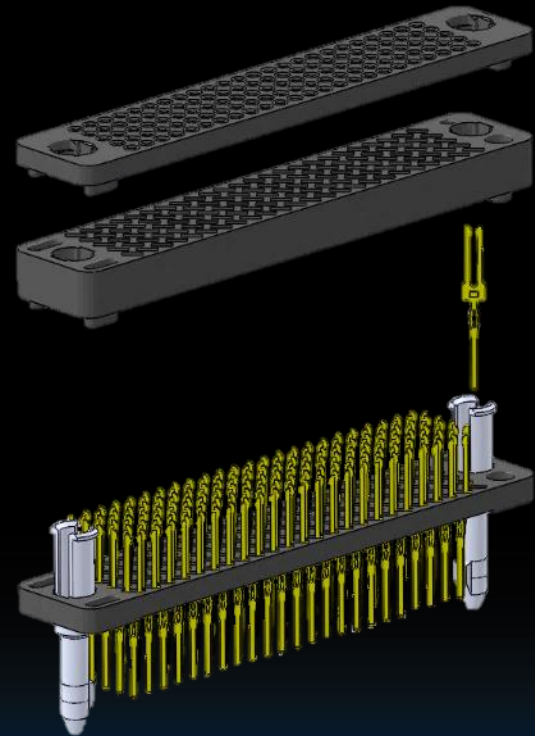


# HD Stacker Key Features



The high-density, rugged board-to-board stacking connector

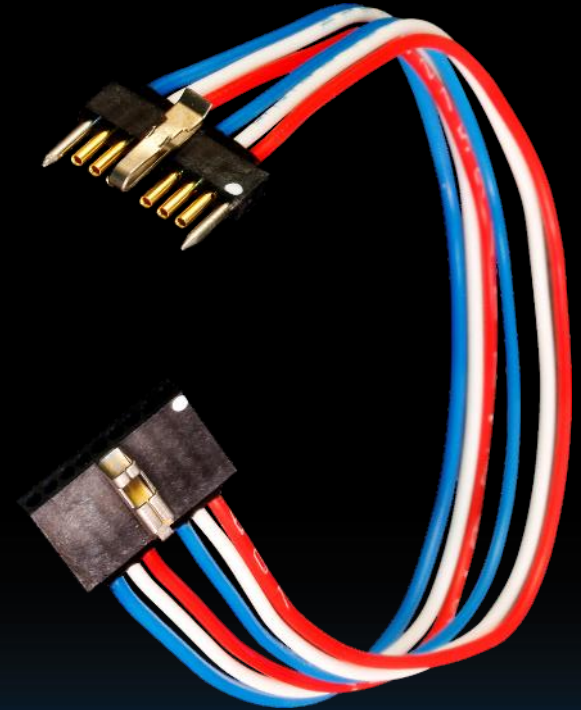
- Performance up to 10.5 Gbps
- Polarized insulator and hardware options
- High-temp PPS insulator meets NASA outgassing requirements
- Available wired / flex jumpers
- Available between-board spacers up to 1 inch



# Latching MicroStrips™

## TwistPin contact performance, optimal size and weight

- 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



# Latching MicroStrips™

## Packaging

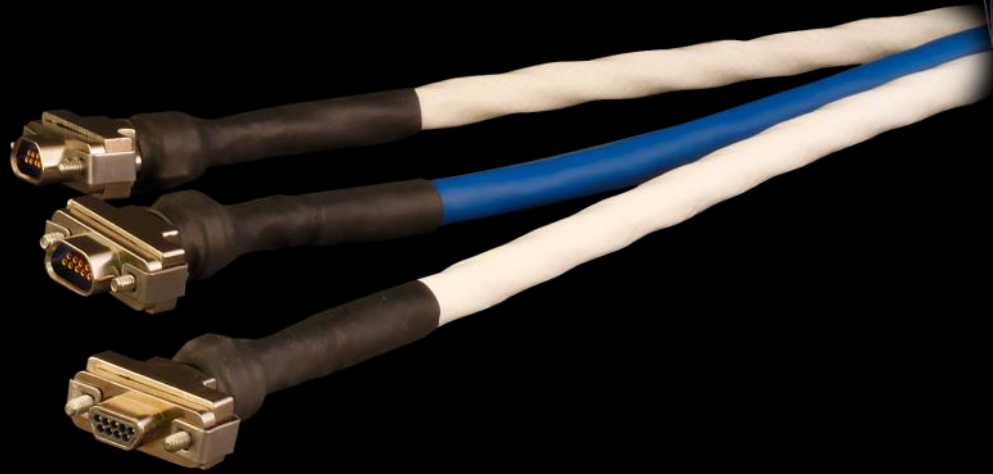
- Socket and pin strips with guide pins for wire-to-wire applications
- Right-angle PCB headers with end latches
- Right-angle PCB headers with staggered PC tails and center latch
- Back-to-back jumpers



# GSWM SpaceWire

## SpaceWire cable assemblies

- The SpaceWire protocol has been used on over 100 flight programs.
- Glenair offers lab and flight cables IAW ESA/ ECSS-E-ST-50 standard
- Uses qualified MIL-DTL-83513 Micro-D connectors
- 100-Ohm impedance shielded twisted pair cable
- Suitable for Ethernet protocol, radar sensor applications, high-resolution camera equipment, and telemetry



# SuperNine MT: Rugged High-Density Fiber Optics

Ruggedized, high-density MT ferrule fiber optics in Glenair Signature SuperNine space-grade MIL-DTL-38999 connectors

- Singlemode and multimode fiber
- Low insertion loss
- Environmental sealing: IP67 mated, IP68 available at interface
- Physical contact and expanded beam



# Series 79 MT: Rugged High-Density Fiber Optics

Single-ferrule high-density MT datalinks in Glenair Signature Series 79 rectangular packaging optimize SWaP in mission-critical mil-aero applications

- Small form-factor, high-density fiber optic solution for rugged mil-aero applications
- Optimized for use with parallel optic transceivers in ribbon or round cable applications
- Designed for optimal low insertion loss performance in high vibration and shock environments



# Ruggedized PCB-Mount Tx, Rx, Xcvr Modules

Radiation-tolerant solutions for Ethernet, high-speed video, and data storage



EMI shielded and radiation-tolerant transceivers



Dual transceivers, quad transmitters, quad receivers



Bi-directional transceivers



Parallel optical transceivers

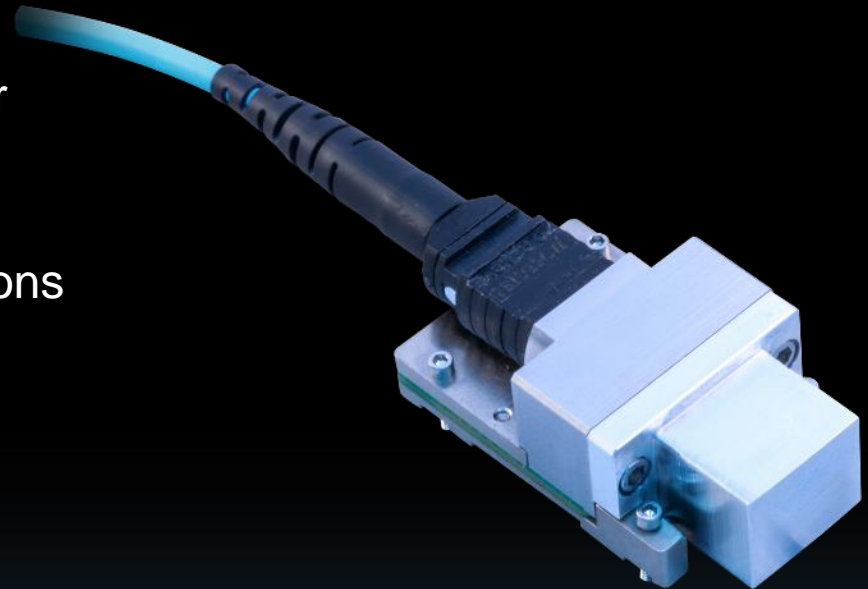


Small form-factor, high-vibration, high-temperature tolerant

# Parallel Optic Transceivers

## Ultra high data-rate (25 Gb/s per channel) technologies for use in free space optics (FSO)

- 4 x 14 to 4 x 25 Gbps per fiber
- Compatible with MTP optical connector
- SiGe and GaAs optoelectronic ICs
- Hermetic opto-electronic hybrid
- Conduction-cooling for space applications
- 46 Grms, 650G shock
- -40°C to +85°C case temp
- Heavy ion radiation-tested





# RF-Over-Fiber for SATCOM

High-frequency up to 40 GHz for conversion of RF satellite feeds to low-noise optical data streams

- 2MHz – 3.5 GHz antenna signal distribution
- New high-frequency 20 and 40 GHz units in development
- High-vibration PCB mount solution
- -40°C to +85°C operating case temperature
- High Spurious Free Dynamic Range (SFDR) link
- APC fiber optic contact standard
- Integrated high-speed PIN photo diode and low-noise RF amplifiers



# Ruggedized Photonic Contacts and Connectors

For I/O-to-box conversion of electrical-to-optical Ethernet, video, and other high-speed protocol data streams

- Fast and Gigabit Ethernet, DVI, HDMI video capable transmitter and receiver-equipped contacts
- ARINC 664, 801, 803, 804 and 818 standard compliant
- Link distances up to 550 meters, multimode
- Single, 3.3 V power supply
- Wave-solderable termination with RoHS-compliant solders
- For use in ARINC 600 and other size #8 cavity-equipped connectors
- Current offerings include 1.25mm ARINC 801 and 2.5mm ELIO® solutions



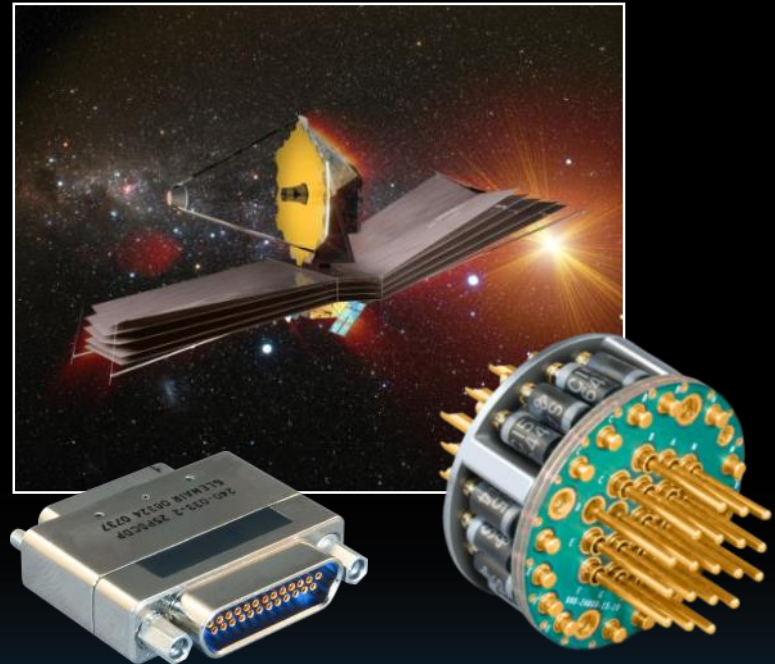
# EMI/RFI Filter Connectors

## Compliant to EEE-INST-002, Table 2G



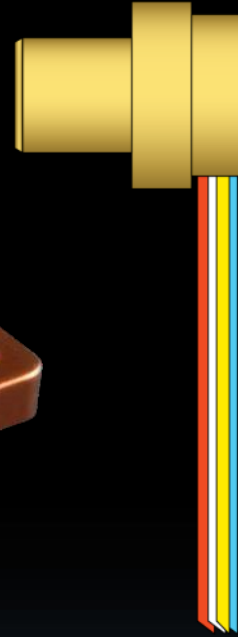
- MIL-DTL-38999 type, Series 80 Mighty Mouse, and other circulars
- Series 28 HiPer-D and Series 79 Micro-Crimp filtered rectangulars

Ball Aerospace	Nasa / JPL
Boeing	Northrop Grumman
General Dynamics	Orbital Science
Honeywell	Sierra Nevada Corp
Lockheed Martin	Tesat
MIT Lincoln Labs	



# Space- and Lab-Qualified Micro-D Connectors and Cables

Hundreds of configurations. New Pigtail Micro-D GMDR with right-angle wire exit – saves space!



# GMSM Low-Profile Single-Row

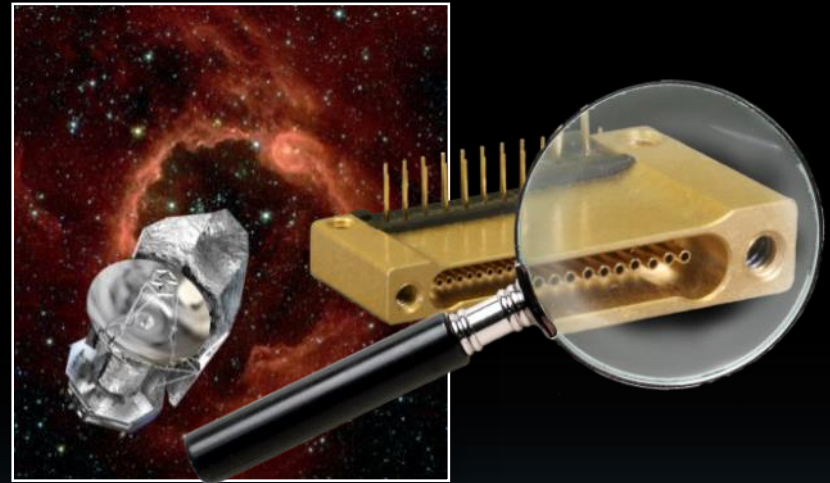
- Low profile Micro-D in a single row format
- Ideal for when signal pairs need to be kept separate
- Flying lead, solder bucket and PCB mount options available
- Contact arrangements: 4 to 35 ways
- Backshells available



# DSCC Space Qualified Series 89 Class S Nano Connectors: Environmental, Filter, and Flex

**MIL-DTL-39129 QPL (ESCC3401-086) board-mount, panel mount and free-cable connectors**

- Herschel Space Observatory
- James Webb Space Telescope
- LSST Space Telescope
- ESA/ESTEC qualification in progress

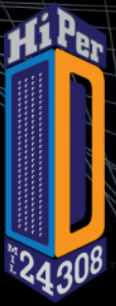


# Nano Back-To-Back Assemblies

- Contact spacing 0.025 inches (0.635 mm) housed within a metal body
- Available space-grade materials:
  - Plated aluminium (Electroless Nickel)
  - Stainless Steel
  - Titanium
- Single or Dual row layouts
- Contact arrangement 9 to 51 way and 65, 69, 85
- Qualified MIL-DTL-32139 and commercial versions



# Series 28 HiPer-D High Performance M24308 Intermateable D-Sub



## Qualified MIL-DTL-24308 Class K Space-Grade Hermetic

Series 28 HiPer-D  
environmental, hermetic, filter,  
Sav-Con and cordsets

- Ball Aerospace
- LMCO Denver
- Orbital Sciences

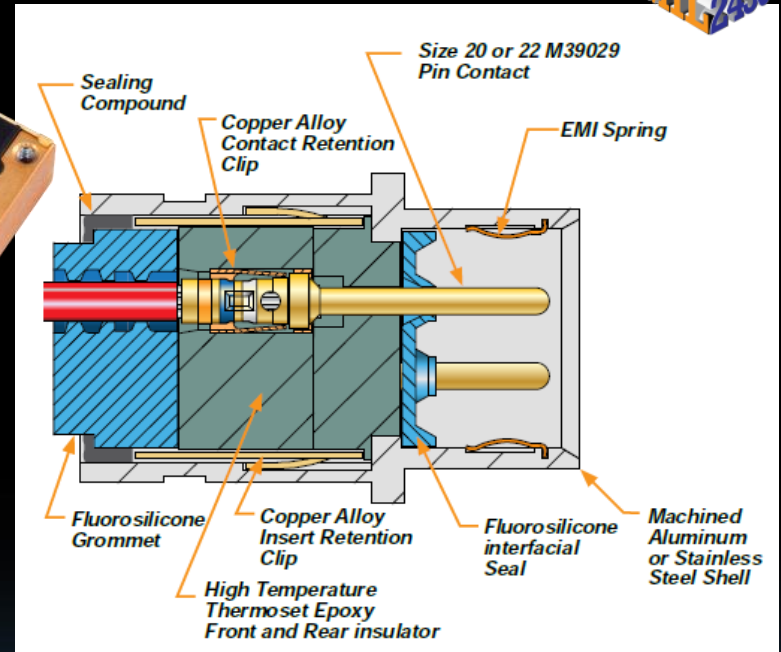
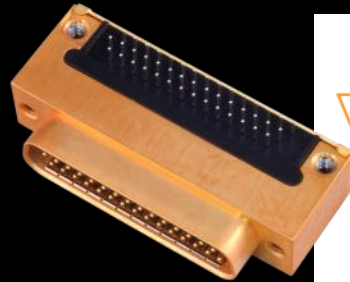




# HiPer-D High-Performance M24308

## Materials and construction

- Precision-machined aluminum shell
- Thermoset epoxy insulators
- Sealing at front and rear
- Electroless Nickel plated EMI spring fingers





# Ultraminiature Series 80 Mighty Mouse Connectors

Package size, ultra light weight and contact density  
are ideally for Space Grade programs

Series 80 Mighty Mouse  
environmental, hermetic, filter,  
Sav-Con and cordsets

- Mars Exploration Rovers
- Mars Science Laboratory



# Series 806 Mil-Aero



## Next-generation high-density connector for demanding aerospace and defense applications

- Signal/sensor interconnect for both pressurized and non-pressurized airframe applications or suitable applications
- Meets 38999HD performance benchmarks (altitude immersion, vibration and shock, mating durability, temperature and voltage)
- Class G Space-Grade with flight heritage (HDRM application)



# Series 806 Mil-Aero vs. D38999 Size Comparison



## D38999 Size 9

3 #20 Contacts  
6 #22 Contacts  
9 #23 Contacts  
.858" Diameter



## Sr. 806 Size 11

10 #20 Contacts  
19 #22 Contacts  
.890" Diameter



# Series 791 High-Density Rectangular Crimp contact (.076 contact spacing), dual-lobe shell

- Recessed scoop-proof pins
- Integral ground spring
- Panel O-ring seals
- Integral band platform
- Available keying
- Series 79 flight heritage:  
Orion Spacecraft • Ball Aerospace •  
Honeywell Space • LMCO Denver •  
NuStar / NASA JPL



# Series 792 <sup>EI</sup>Ochito<sup>®</sup>

SERIES

792

SEVEN  
NINETY-TWO

The next-generation mil-aero rectangular for high-speed datalink applications

- Next-generation rear-release blind-mate rectangular
- Insert arrangements for 1 – 9 EI Ochito<sup>®</sup> contacts, combo inserts accommodate #23 signal and/or power contacts
- Polarization key and ground spring options available
- Dual-lobe, scoop-proof interface





# Connector Savers

Available for every currently specified circular and rectangular connector series

- Boeing Satellite Systems
- Delta 4 Launch Vehicle
- NASA Space Shuttle
- Voyager , Galileo, Magellan, Cassini, Pathfinder, Curiosity, Orion



# Polymer- and Metal-Core Conduit Systems

For rocket launch / tower applications and other rugged wire protection requirements

- Hermetically sealed and flexible
- Lightweight and crush-resistant
- High-temperature and flame-resistant
- Turnkey, factory-terminated assemblies with launch and flight heritage





# Ultra-Lightweight AmberStrand® Composite Plastic EMI Braid

Microfilament metal-clad composite  
EMI/RFI cable braid and ground straps

- EADS Astrium
- Honeywell Space
- Cassini Program
- Orbital Sciences Space Probes
- Space Crest Program
- Lockheed-Martin Missiles and Space Systems
- JPL Mars Pathfinder
- CrIS Satellite



# AmberStrand<sup>®</sup> Composite EMI/RFI Braid

Nickel-plated microfilament composite shielding offers lightest weight solution to electromagnetic compatibility

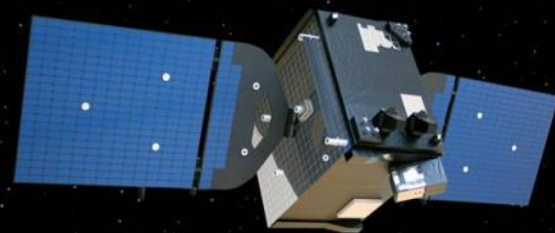
- Electrically conductive plated composite
- Superior high-frequency shielding in high temperature applications
- Comparable shielding performance to 36 AWG plated tubular copper braid
- Lightweight, corrosion-free
- Weight savings up to 88% per foot compared to standard nickel-copper braid



# ARMORLITE Microfilament Braided Shielding

Innovative expandable, high-strength conductive stainless-steel braid

- Orbital Sciences - BMD / MDA GMD Programs
- Ball Aerospace - OMPS, Aquila, JPSS



# ARMORLITE

## Microfilament EMI/RFI Shielding

**70+% lighter than standard metal EMI/RFI braid**

- Expandable, flexible, high-strength, lightweight, conductive, microfilament material
- Provides abrasion resistance and EMI shielding at a fraction of the weight of standard metallic braid
- Maintains metallic core conductivity in event of plating damage during assembly or maintenance

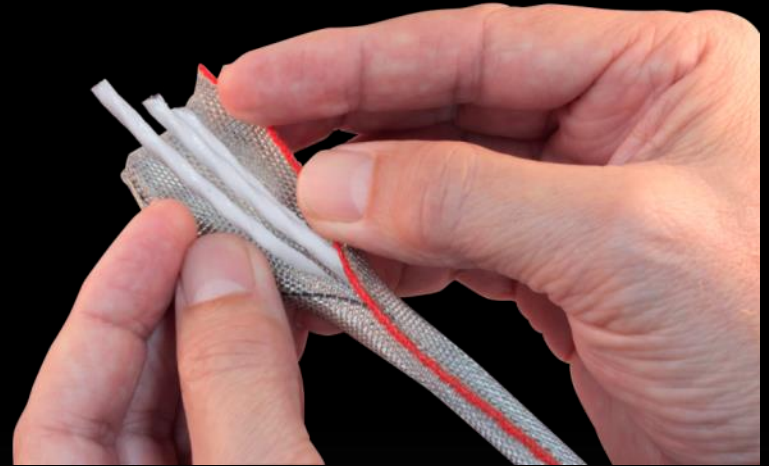


# MasterWrap™ with ArmorLite Technology



## Ultra-flexible, side-entry EMI/RFI shielding

- **Saves weight:** 70% material weight reduction compared QQ-B-575 / A-A-59569 nickel copper
- **Simplifies Installation:** Replaces harder-to-install tubular EMI/RFI sleeving
- **Saves Time:** Fast and easy side-entry installation and removal
- **Improves EMI/RFI shielding:** Reduces windowing and coverage gaps
- **Improves Performance:** Delivers superior flexibility, durability and reparability



# SuperNine Class G Space

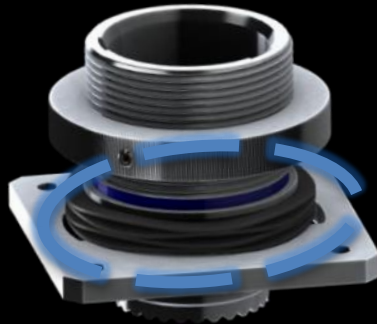
- MIL-DTL-38999 QPL Connector Styles
  - D38999/20 (wall-mount receptacle)
  - D38999/24 (jam nut receptacle)
  - D38999/26 (plug)
- QPL Plating classes
  - F (electroless nickel, 48 hr. salt spray)
  - G (space-grade electroless nickel, 48 hr. salt spray, RoHS compliant)
  - W (cad/O.D. over electroless nickel, 500 hr. salt spray, non-RoHS compliant)
  - T (Nickel-PTFE, 500 hr. salt spray, RoHS compliant)



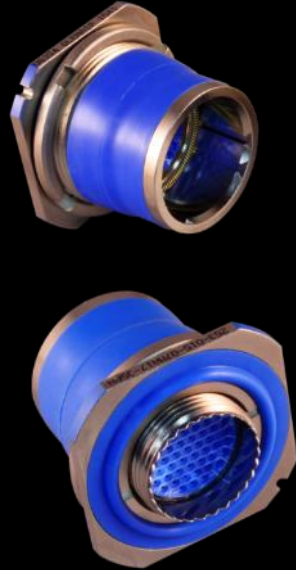
# SuperNine Circular Blind Mate, Rack-and-Panel and Assisted Separation Series



Roll-off nose



Misalignment accommodation



Environmental sealing



EMI shielding



Kick-off capability  
(assisted separation force)

# SAE-AS81703 Series 3 Type

## IAW NASA, ESA and JAXA standards

- Designed for rugged vibration and shock, including space-grade applications such as space telescope deployment and rack-and-panel research equipment
- Signal and power insert arrangements
- High-speed shielded Coax, Twinax and Quadrax





# Hermetic Receptacles and Bulkhead Feed-thru Connectors



## High-pressure/low-leakage space applications

MIL-DTL-38999 Series I, II, III and IV QPL and Series 80 Mighty Mouse hermetic circulars

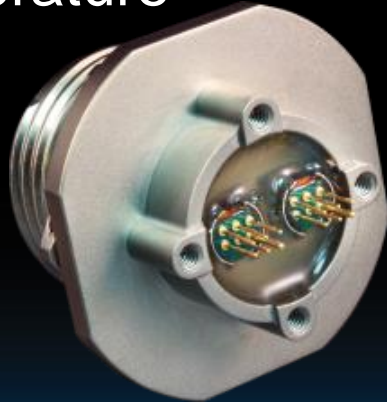
Series 79 Micro-Crimp and Series 28 HiPer-D hermetic rectangulars

- X-38 Jettison Escape Pod (International Space Station)
- Qualified SSQ21635 Class Y Bulkhead Feedthrus (ISS)
- Pegasus
- Boeing Satellite Systems
- MetOp satellite



# Lightweight CODE RED Hermetics

- Hermetic Seal =  $1 \times 10^{-7}$
- Light weight, corrosion resistant materials
- Low-resistance copper alloy contacts
- Extreme temperature tolerance
- Meets NASA outgassing
- Turnkey, drop-in replacement for glass-seal hermetics
- Can be used in various product families and shell geometries



**CODE RED**

# Circular Backshells and Accessories

Qualified to **SSQ 21635, 21636 and 22698**

EMI shield termination, cable strain relief, connector protective covers and more  
Lightweight composite versions

- International Space Station
- Northrop Grumman Space Technologies
- Loral Space Systems
- Boeing Satellite Systems
- Ariane Launch Vehicle
- SEA Launch
- Space Shuttle
- Titan Vehicle



# Space-Grade Rectangular Backshells

## Qualified to SSQ 22681

EMI shielding and strain relief backshells for D-Sub micro and nano connectors (ESCC3401)  
Lightweight composite versions

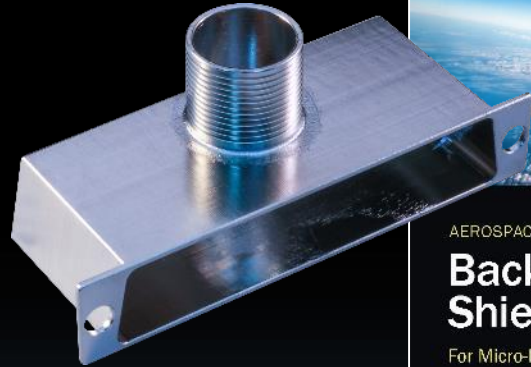
- Gravity Probe
- International Space Station
- MetOps
- Space Infrared Telescope
- Northrop Grumman Space Technologies
- Boeing Satellite Systems
- Herschel Space Observatory
- GAIA satellite
- Skynet 5 Military Satellite
- James Webb Telescope



# ESCC M24308 D-Sub Backshells

## Qualified for ESA and NASA applications

- New removable-entry and cable clamp backshells
- Full range of space-grade Micro-D backshells
- For wire harness grounding applications
- Lightweight composite and thin-wall versions



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INTERCONNECT  
SOLUTIONS

**Glencair.**

AEROSPACE-GRADE / FLIGHT HERITAGE

### Backshells and Shielding Accessories

For Micro-D and D-Subminiature Rectangular Connectors

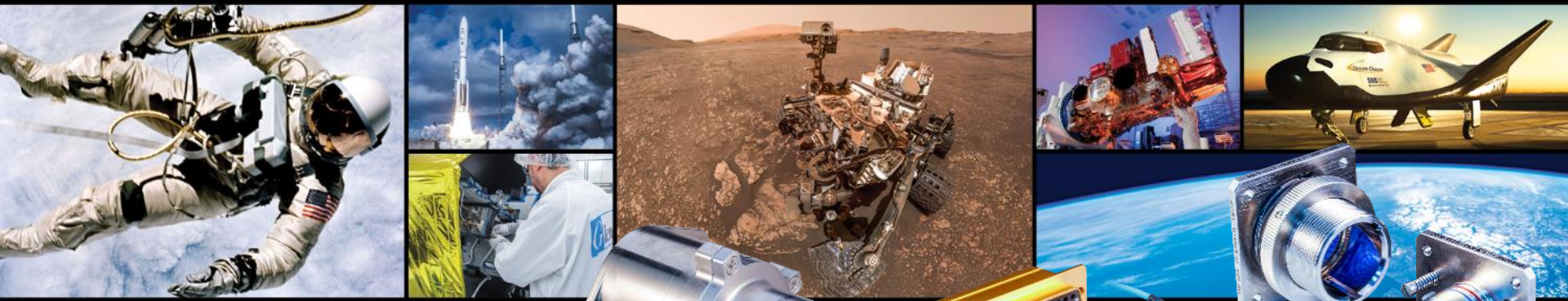
JULY 2019

# Glenair is the High-Reliability, High-Quality Standard

- Depth of qualifications and approvals from 60 years in the business
- Deep fluency in materials, design, test and fabrication
- Proven interconnect solutions that solve major performance problems
- “On the print” of thousands of bench-mark programs



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SIGNATURE SERIES



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