

# QwikConnect

GLENAIR ■ JANUARY 2016 ■ VOLUME 20 ■ NUMBER 1



Embedded Subsystem  
Electronics and  
Opto-Electronics  
@ Glencair

# Harsh Environment Printed Circuit Board (PCB) and Embedded Opto-Electronic Subsystems @ Glenair

At the heart of every electronic subsystem is a purpose-designed printed circuit board with its core processors, analog and digital sensors, power supplies, electrical filters, multiplexed communications links and other electronic and mechanical components such as opto-electronic conversion technologies. From initial requirements analysis, schematic capture, PCB layout and other aspects of architecture design, to mechanical modeling, FW/FPGA development, PCB assembly and housing fabrication, the business of supplying high-reliability electronics for harsh and extreme environments is an exacting marriage of sound development practices and rock-solid engineering.

For electronic and opto-electronic systems designed for aerospace, battlefield gear, avionics, defense, energy, industrial and other harsh application environments, we bring professional levels of expertise and focus to all aspects of design and packaging. Stringent environmental, electromagnetic, and mechanical stress specifications are adhered to, including:

- MIL-STD-810G vibration and shock
- MIL-STD-461 electromagnetic shielding
- MIL-STD-1275 land vehicle power/EMI management
- MIL-STD 704 aircraft power/EMI management
- DO 160 commercial aerospace environmental, mechanical, and electromagnetic protection

Acceptance test stations and software, leveraging LabView, Visual Basic and other tools, have been developed in-house by Glenair to support comprehensive board qualification and testing.

## MARKET FOCUS

Our specific expertise applies to highly miniaturized systems suited for applications such as ground soldier systems, where attention to size and weight is paramount. The Glenair Electronic Systems Team is fully equipped for all aspects of schematic capture, PCB layout, FPGA development and firmware design for ultraminiature applications.

Many high-speed data transmission protocols rely on impedance controlled transmission lines, EMI shielding and exacting management of trace paths and board densities. Glenair is able to support these high-speed electrical and optical requirements for the broad range of common protocols, including 10G Ethernet and USB 3.0. Other core application capabilities include electrical-to-optical Ethernet media conversion, multiplexed signal aggregation, RF over fiber data transmission, soldier communications and computing subsystems, device power management, Ethernet and/or USB switching, routing and more.

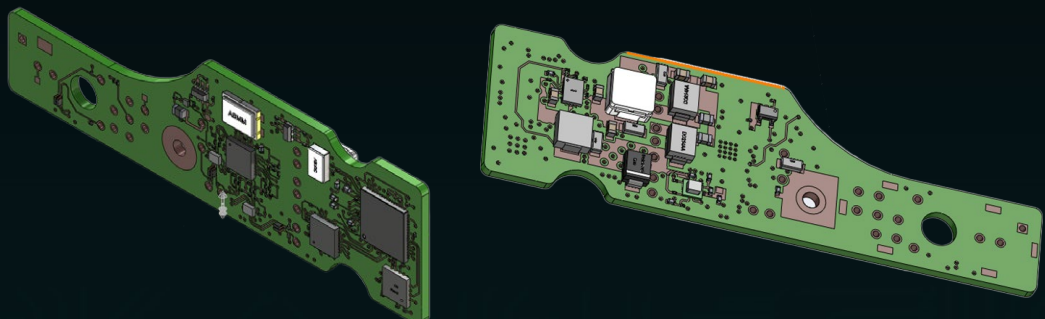
Glenair's ability to support the entire range of Mil-Aero system engineering deliverables—from requirements capture and derivation to system architecting and management—makes us an ideal partner for OEMs looking to outsource these activities to a trusted supplier.

## It's all about the people

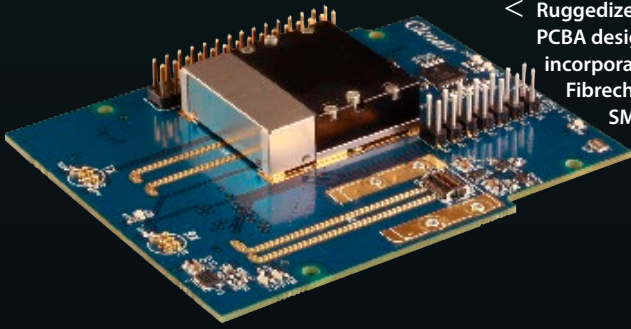
Our growing team of technical professionals who manage PCBA design and fabrication at Glenair include electrical and mechanical engineers, FPGA / firmware programmers, PCBA layout engineers, wet process technicians, photo technicians, certified assemblers and more. Our system debug and acceptance test professionals play key roles in every PCBA project.



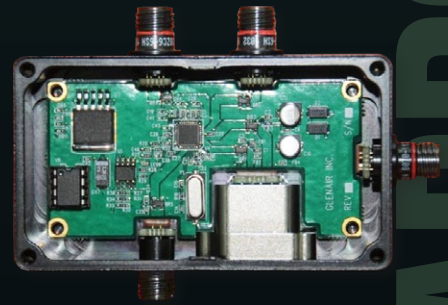
> Solidworks models: powerful tools used for PCBA mechanical modeling and enclosure design



Solidworks model of an assembled PCB for a tactical USB data/power hub and protocol converter application



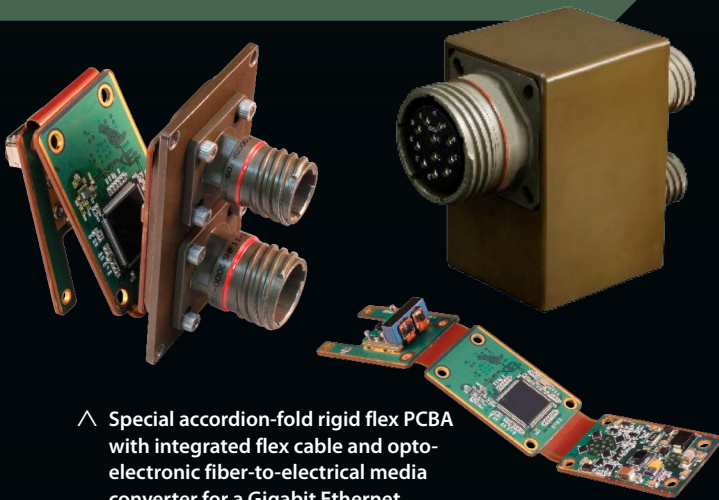
< Ruggedized FMC connectivity PCBA designed for modular incorporation into Ethernet, Fibrechannel, and/or DVI, SMPTE video system applications



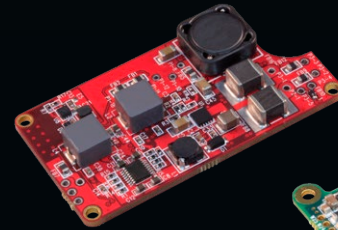
^ Small form-factor soldier-worn data hub and power distribution module with Series 80 Mighty Mouse interconnects

> Examples of Ruggedized Embedded Electronic and Opto-Electronic Subsystem PCBAs Designed and Fabricated by the Glenair Electronic Systems Team

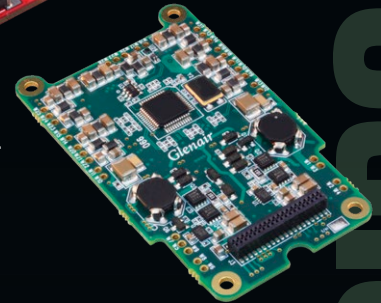
> Complex PCBA and interconnect assembly with programmable electronics for a high-speed data aggregation application



^ Special accordion-fold rigid flex PCBA with integrated flex cable and opto-electronic fiber-to-electrical media converter for a Gigabit Ethernet application



^ Small form-factor PCBAs for a USB hub and protocol conversion application



Glenair assembly techs ensure final subsystem assemblies are optimized for rugged performance and resistance to vibration, shock, and other mechanical stress factors. Technicians perform rapid prototyping and module assembly/test of PCBA integrated circuits, resistors, capacitors, transceivers, and other components.



# But the printed circuit board electronics are only part of the story

Unique in the mil-aero industry, Glenair can supply the entire electronic interconnect system, including:

1. Embedded electronic and opto-electronic PCBA's
2. Ruggedized enclosures and housings
3. Fiber optic and electrical connectors
4. Flex circuit jumpers and harsh environment cables

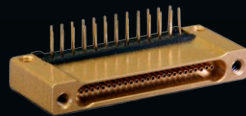
All optimized for harsh environments and manufactured under one roof and one worldwide quality system.

## Rectangular PCB I/O Connectors

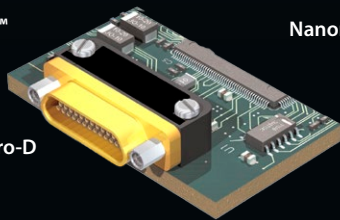
> SEE PAGE 12



AlphaLink™



Nanominiature



Micro-D

## Circular PCB I/O Connectors

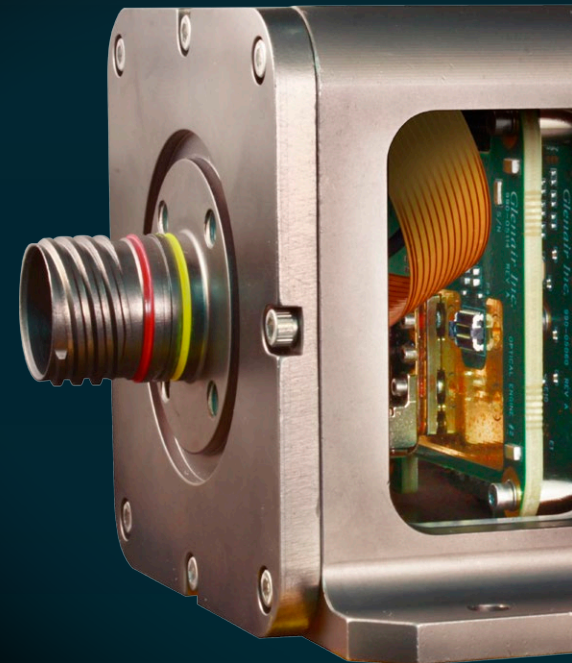
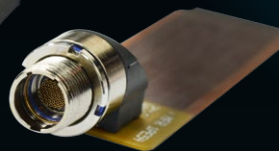
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Series 88 SuperFly™

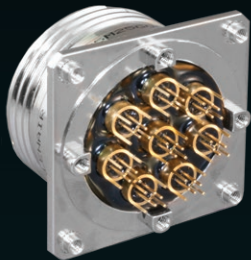


Series 80 Mighty Mouse



## Aerospace PCB I/O Connectors

> SEE PAGE 13



Series 23 SuperNine® PCB I/O Connectors

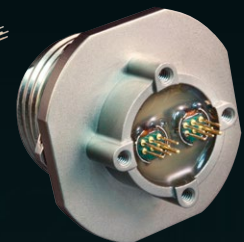


## Opto-Electronic Transceivers, Contacts, and Connectors

> SEE PAGE 14

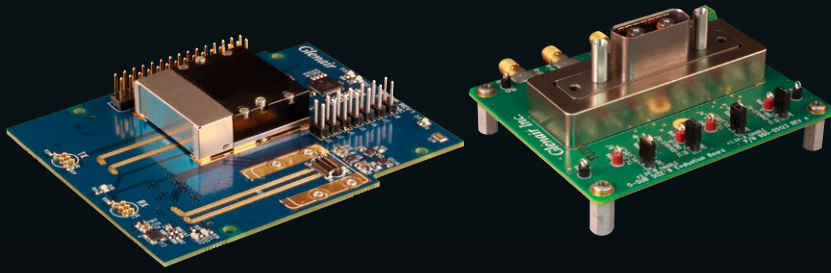


Opto-Electronic PCB-Mount Transceivers and Size #8 Opto-Electronic Contacts



## Complex Electronic and Opto-Electronic Printed Circuit Boards

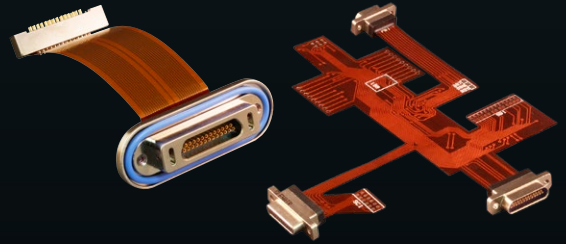
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Opto-Electronic FMC transceiver mezzanine card and evaluation board for Opto-Electronic HiPer-D connector

## Flex and Rigid Flex Circuits

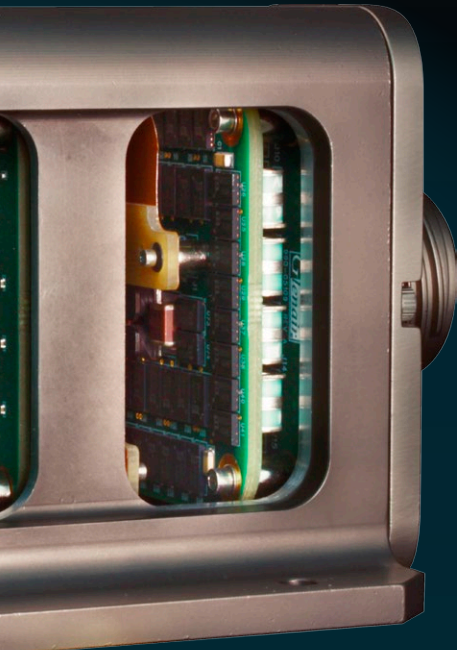
> SEE PAGE 6/7



Board-to-I/O Jumpers and Multibranch Assemblies

## Environmental Boxes and Electronic Enclosures

> SEE PAGE 8/9



Small Form-Factor Metal and Composite Housings and Enclosures



## Environmental Interconnect Assemblies

> SEE PAGE 16/17



Turnkey harsh environment interconnect cable assemblies



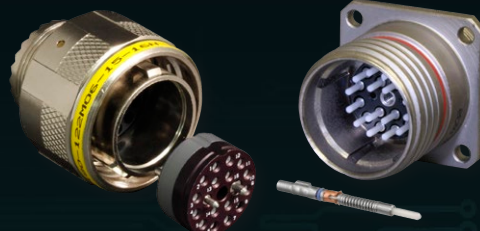
Copper-to-Fiber Aggregation Media Converter (cutaway view)

## Fiber Optic Connectors and Cables

> SEE PAGE 15



Inside-the-box fiber optic cable



High-density fiber optic connectors

## PRINTED CIRCUIT BOARD AND FLEX CIRCUIT INTERCONNECT ASSEMBLIES

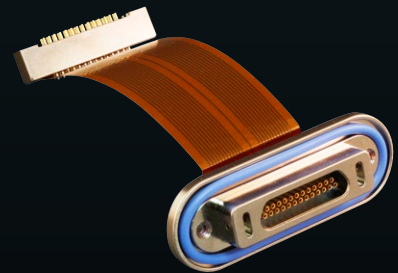
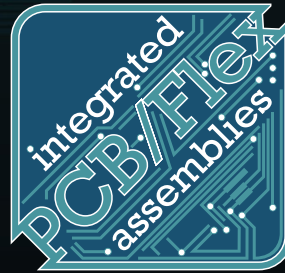
Electrical wire interconnect designers are increasingly turning to small form-factor flex circuitry to replace board-to-I/O wiring. Glenair offers turnkey PCB/Flex interconnect design and assembly. PCB/flex circuits offer unsurpassed size and weight reduction compared to cable bundles, especially in tight spaces with multi-branch routing. Flex circuitry offers outstanding mechanical performance, being able to withstand extreme vibration environments and capable of extended duty even through thousands of flexing cycles. Replacing complicated wire bundle assemblies with high-density flex assures faster, error-free assembly.

From concept drawings and fabrication data packages, to PCB/flex fabrication and assembly, we offer a complete solution. Termination to Glenair-manufactured printed circuit board connectors ensures high quality and technical performance to even the most challenging delivery requirements.

The ability to deliver connectorized flex and rigid flex assemblies is an important enabling technology contributing to our overall embedded subsystem electronics offering. We offer IPC Class III manufacturing for multiple panel sizes and panel thicknesses up to .5 inch. A broad variety of materials are available including Polyimide, FR-4, Rogers 4003, and Isola. Available surface finishes include ENIG, HASL, Ni/Au and more. Our PCB/Flex Interconnect team offers:

- Circuit design and generation of PCB/Flex fabrication data packages
- Full component-level documentation
- Top-level assembly drawings and BOM management
- 200+ certified PCB and cable assemblers
- IPC-6012 Class I, II, III, types 1-4; ISO 9001, AS9100
- ESD management
- NADCAP certification for special processes
- Tests such as DWV/IR, continuity, and others.
- Overmolding with multiple materials, including Hysol for PCB terminations

> Point-to-Point Connectorized Flex and Rigid Flex Jumpers



^ Harsh-environmental Micro-D to AlphaLink jumper



< Low-profile Micro-D jumper



^ 804 Mighty Mouse to Samtec surface mount jumper



> Micro-D to ZIF jumper

∇ Series 23 SuperNine® to AlphaLink jumper



### It's all about the people

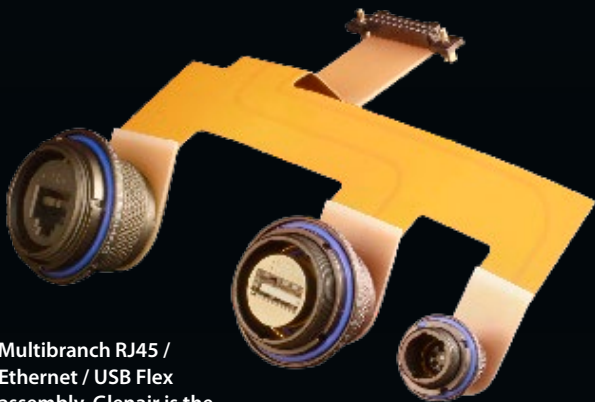
At Glenair, our PCB/Flex interconnect team is housed together under one roof. The group offers unparalleled expertise in connectorized PCB design, termination and test for point-to-point and multibranch interconnect applications. From electrical design to computer aided manufacturing and assembly, the team has a well-deserved reputation for on-time delivery of even the most complex, high-reliability PCB/Flex assemblies.



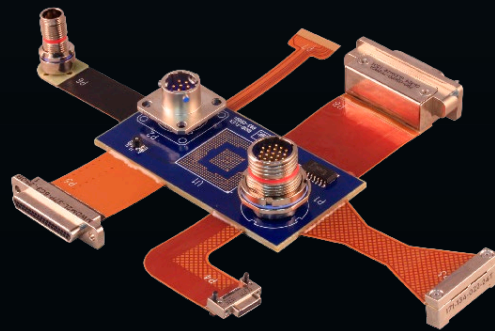


Our flex fabrication cell delivers IPC 6012 and 6013 Class III manufacturing and is managed under the same ISO 9001 and AS9100 certified quality system as the rest of the Glenair operation

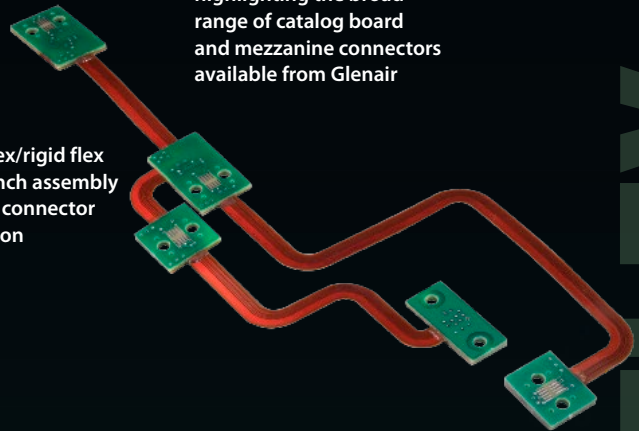
### > Multibranch Flex and Rigid Flex Connectorized Assemblies



^ Multibranch RJ45 / Ethernet / USB Flex assembly. Glenair is the only manufacturer of catalog PCB-tail field RJ and USB connectors

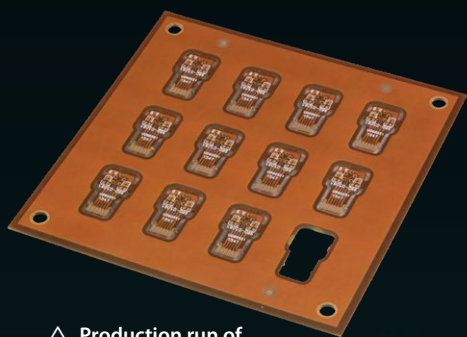


^ Multibranch factory demo rigid flex assembly highlighting the broad range of catalog board and mezzanine connectors available from Glenair



> Hybrid flex/rigid flex multibranch assembly ready for connector termination

### > Special-Purpose Flex and Rigid Designs



^ Production run of individual PCBs in panelized form



^ Space-grade Series 28 HiPer-D to Series 80 Mighty Mouse I/O jumper



^ High-shock matched-impedance Mighty Mouse assembly with flex circuit

PCB / FLEX ASSEMBLIES

## BOXES AND ENCLOSURES

Glenair is the recognized leader in composite thermoplastic research and development for the interconnect accessory industry. And this material expertise extends to our line of lightweight and corrosion resistant composite boxes and enclosures. A broad range of design factors are typically considered in enclosure design, including:

- Material
- Form-factor
- Grounding
- DFMA
- Thermal dissipation
- EMI
- User ergonomics
- Resistance to shock and vibration.

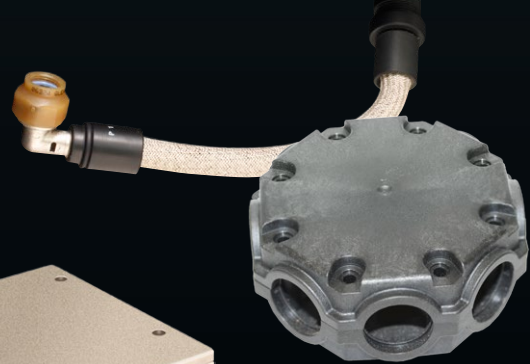
Glenair's lightweight/high-strength CostSaver Composite EMI/RFI Junction Boxes are ideally suited for use in harsh environments where resistance to electromagnetic interference, corrosive fluids, high temperatures, and shock and vibration are critical requirements.

Glenair composite boxes are designed to meet the shock and vibration requirements of MIL-STD-810, MIL-STD-901D and MIL-STD-167SHIPS. Box materials also meet stringent EMI/RFI/HIRF and indirect lightning strike performance specifications. Increasingly, Glenair is employing our box design and fabrication expertise in integrated solutions that house small form-factor embedded electronic and opto-electronic systems.

The ability to fabricate a broad range of lightweight and small metal enclosures for applications that require thermal management, unique form-factors, or must meet other requirements best suited by a metal box is an additional Glenair strength. Fast prototype designs as well as industry-best deliveries on production quantities—without the time and expense of tooling an injection molded box—are yet another reason Glenair's experience in metal box design is a vital capability.

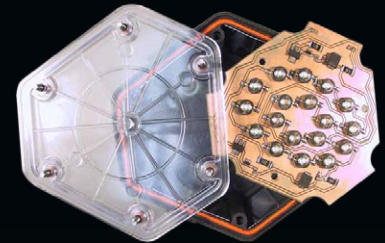
> CostSaver composite thermoplastic COTS electronic boxes and enclosures

> 8-port composite thermoplastic COTS enclosure



^ Split-shell octagonal composite thermoplastic COTS enclosure

> Mini form-factor D-subminiature COTS enclosure



^ Special LED lighting board and composite thermoplastic COTS enclosure



< High vibration / shock shipboard composite thermoplastic COTS enclosures



## It's all about the people

When it comes to boxes, Glenair customers are able to take full advantage of our team's ability to function as a virtual extension of their own engineering and design groups. In many cases, our in-house electronic systems team can take existing customer PCBA designs and engineer compact, ruggedized housings and interconnect interfaces that accommodate all requirements—from size and weight reduction to user ergonomics. Throughout the process our composite tooling engineers employ Solidworks models of the PCBA and the housing enclosure for real-time analysis of form, fit, and function before any metal is cut.

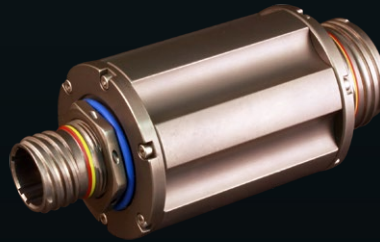


> Small form-factor tactical soldier system boxes, hubs and housings



< Small form-factor factory demo highlighting box, connector, and PCB capabilities

> Unique metal enclosures optimized for thermal dissipation and EMI/RFI shielding



< In-line microminiature signal aggregator in a thermal dissipation enclosure



> Turnkey soldier radio data/audio hub and power management unit with 100% Glenair content

> Opto-electronic signal aggregator for a high-speed Ethernet and video application



> Nanominature PCBA subsystem for a dismantled soldier application



^ Milled rectangular enclosure with thermal dissipation



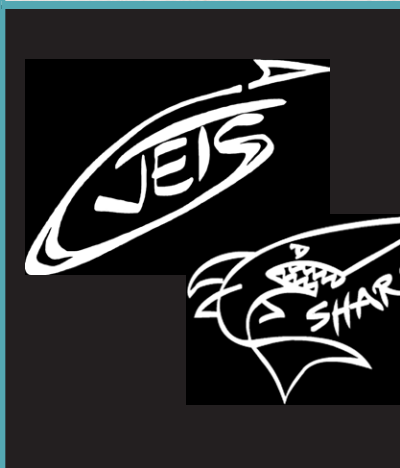
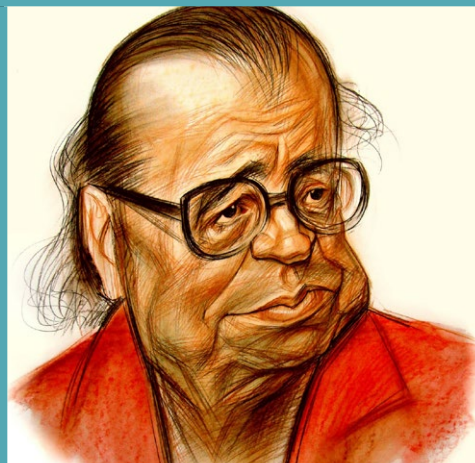
Composite

Glenair's high-capacity, state-of-the-art composite thermoplastic injection molding cell in Glendale, California

# HOLLYWOOD SQUARES?

Fill in the blanks to solve this "Best Picture" movie title puzzle.

1. \_ \_ d \_ \_
2. \_ a \_ \_ \_
3. \_ \_ \_ \_ \_ n \_ \_ \_ r \_ \_
4. \_ \_ \_ \_ s \_ u \_ \_
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Solution posted February 15th  
[www.glenair.com/qwikconnect](http://www.glenair.com/qwikconnect)



## RUGGEDIZED INTERCONNECTS



The ability to supply the widest possible range of rugged connector types and to manage their delivery and quality as part of an embedded electronic sub-system build is a unique Glenair strength. Made in-house and stocked for high-availability, these interconnect solutions may be incorporated at board-to-board, system-to-board and I/O layers throughout the assembly. Glenair is first and foremost a connector company, with over one million square feet of engineering and manufacturing facilities in Glendale, California, Mansfield U.K. and Bologna Italy primarily dedicated to interconnect design and manufacture. Throughout our business history in the aerospace, defense, oil & gas, nuclear, and rail industries, we have prioritized in-house interconnect development as our primary pathway to continued growth. Over the past 60 years, Glenair has qualified to hundreds of military and commercial industry standards for circular, rectangular, miniature, subminiature and nanominiature connectors and backshell accessories for use in mission-critical fiber optic and electrical interconnect systems. In addition we have pioneered a wide range of unique and special-purpose connector series to meet interconnect requirements not addressed by existing standards. Above all, Glenair connectors are built to survive harsh application environments and withstand rugged use and handling.

Today, we offer MIL-qualified as well Glenair-designed interconnect solutions for virtually every ruggedized application requirement. The Series 80 Mighty Mouse circular and Series 79 Micro-Crimp rectangular are just two such examples. Glenair interconnect technologies are deployed on the most demanding platforms, from the Joint Strike Fighter to the Mars Curiosity Rover. In addition we offer interconnect solutions for every class and duty of application, from high-pressure sealed subsea connectors to hermetics, EMI/EMP filters, weight-reducing composites, high-power, and of course high-speed designs.



### It's all about the people

Ruggedized interconnects for electronic subsystems come to life out on the factory floor. Assembly and test of miniaturized connectors requires microscopic attention to

detail to ensure environmental sealing, mechanical mating, and electrical performance is managed and controlled. This is no easy task, but our talented team of assembly techs do it day in and day out, with truly amazing levels of productivity and quality.

### > Pogo-pin board-level connectors

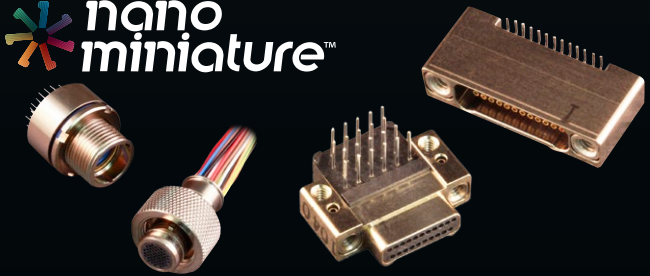
**Alphalink**



The spring-loaded contact, solderless board-level connector

### > Nano circular and rectangular board-to-I/O connectors

**nano miniature**



Threaded and QDC circular PCB nano

Rectangular thru-hole and surface mount nano

### > Nano tactical connectors

**SuperFly**



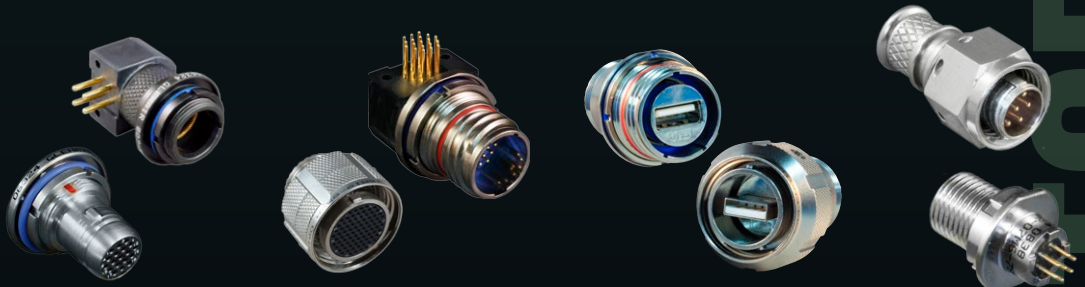
PCB-mount and free cable designs

### > JTRS Radio Audio and Power Connectors



HiPer 55116 Audio and M26482 Power

> Series 80 Mighty Mouse ultraminiature crimp-contact circular



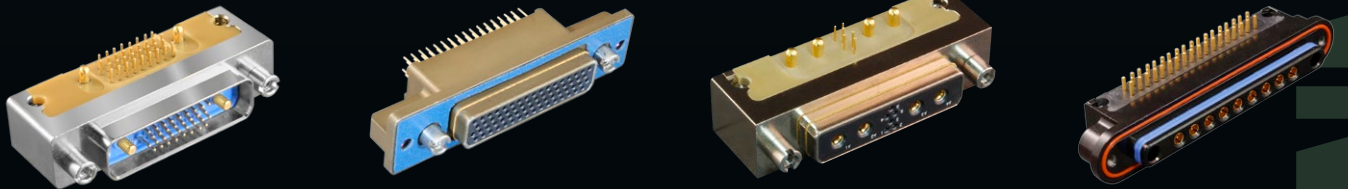
Series 804 breakaway quick-disconnect

Series 805 triple-start stub ACME thread

Series 801 threaded Micro-USB SuperSeal

Series 800 UNC thread

> Series 79 Micro-Crimp ultraminiature crimp-contact rectangular



Right-angle board mount with PC tail shroud

Straight board mount with EMI ground spring

Hybrid right-angle power and signal PCB mount

Shielded RF microwave PC mount with O-ring seal

> SuperNine MIL-DTL-38999 environmental, hermetic, and filter connectors



High-performance environmental series

RJ45 field series with PC tail board terminations

Broad range of PC tail standoffs including stepped contacts and low-profile designs

> High-speed data rate and bandwidth interconnects for Ethernet-type applications



El Ocho Ethernet solution: 8 contacts in a size #8 contact cavity

Quadrax Ethernet solution 4 contacts per size #8 contact cavity

PCB-mount EMI filtered D38999 Series III with shielded RF contacts

# FIBER OPTIC AND OPTO-ELECTRONIC TECHNOLOGY

## It's all about the people

Production control and manufacturing engineering are key to the business delivering complex cables, assemblies, and embedded electronic subsystems. This is particularly true for Fiber Optic and Opto-Electronic devices. From managing Bills Of Materials and component stores to completion of customer documentation and testing requirements, these guys do it all!



Huge bandwidth requirements, combined with the need for reduced weight, smaller size and faster speeds in ruggedized high-performance applications, have led Glenair to develop board-level opto-electronic technologies such as fiber optic transmitter and receiver modules. Glenair Opto-Electronic Interconnect Solutions enhance network performance and reliability in harsh environment applications such as avionic displays, In-Flight Entertainment (IFE) systems, seismic and oil field equipment, high-definition video systems, phased-array radars, and a wide range of other applications where copper media is challenged to support multi-gigabit data rate transport. The technology is suited for use in military, aerospace and other systems where size and weight reduction are valued, and where resistance to vibration, shock, temperature extremes and other harsh conditions are required. Most importantly, the technologies simplify the incorporation of fiber optics into high-speed Ethernet, video and data transmission applications by reducing complexity, employee training, and assembly time.

Glenair also offers the high-performance industry's broadest range of optical fiber cable, connector, and termination solutions that can be brought to bear to complete a fully-qualified, end-to-end fiber optic interconnection system, including tools, training, and engineering support. No other manufacturer of Opto-Electronic solutions has equal breadth in its fiber optic interconnect offerings.

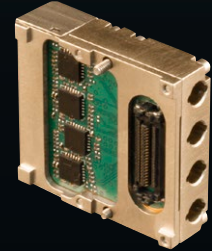
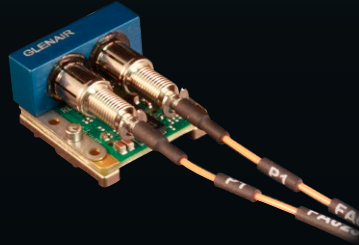
All Glenair Opto-Electronic technologies meet these key requirements:

- -40°C to +85°C operation
- MIL-STD 810 shock and vibration
- MIL-STD-1344 immersion resistance
- Ruggedized packaging

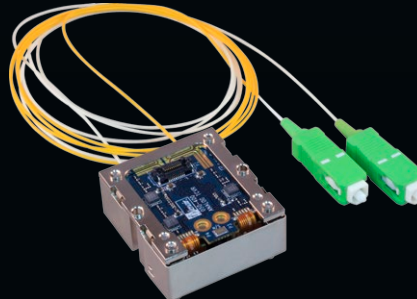
## Harsh-Environment Small Form-Factor Opto-Electronic Interconnects



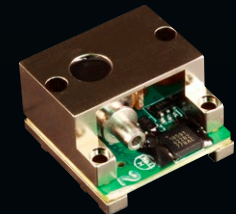
Opto-electronic transmitter and receiver contacts for Ethernet, video, and high-speed data



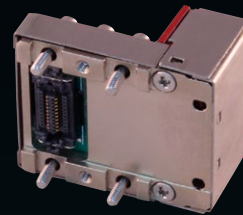
High vibration and shock board-mount transmitters and receivers with Samtec surface-mount connectors



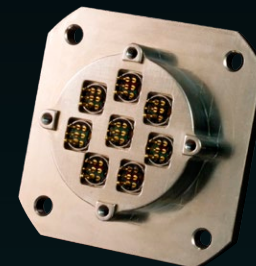
RF-over-fiber board-mount transceiver



High vibration and shock Bi-directional transceiver



EMI shielded PCB transceiver showing Samtec surface-mount connector and Glenair GC F/O interconnects



MIL-DTL-38999 Series III type (ARINC 801 and ELIO systems also available) harsh-environment opto-electronic connectors for Ethernet, video, and high-speed data

# Harsh-Environment Fiber Optic Interconnect Systems



MIL-DTL-38999 Type Fiber Optic



GHD High Density Fiber Optic



Series 80 Mighty Mouse Fiber Optic



MIL-PRF-28876 Fiber Optic



GFOCA M83526 Compliant Fiber Optic



Eye-Beam® GLT Expanded Beam Fiber Optic



NGCON MIL-PRF-64266 Fiber Optics



Glenair Front Release (GFR) Fiber Optics



Eye-Beam® GMA Expanded-Beam IAW M83526



ARINC 801 Fiber Optics

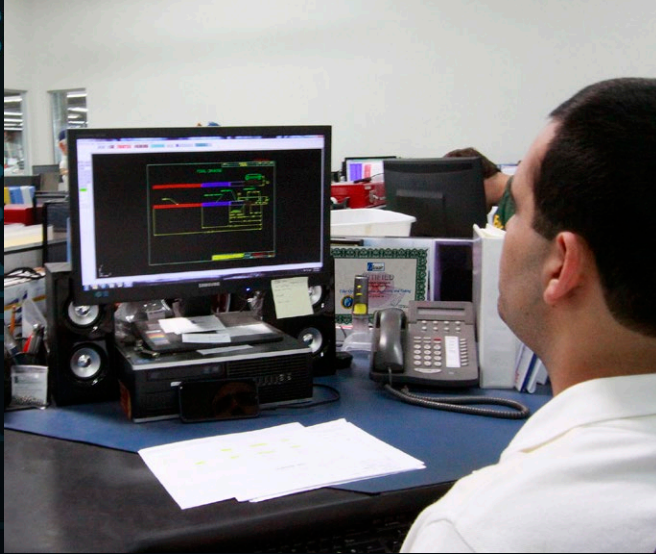


MT Ferrule Fiber Optics



Fiber optic systems for harsh application environments require specific expertise in inspection, test, cleaning, termination, and assembly. Glenair offers complete test kits as well as Certified Fiber Optic Expert training.

## TURNKEY INTERCONNECT CABLE FABRICATION AT GLENAIR



△ Glenair engineers utilize computer-aided design for multibranch cable assemblies, wire layouts and schematics



△ Small form-factor connector and cable assembly is intense, precision hand labor. Our operators have long tenure and broad experience building mission-critical point-to-point and multibranch cables.

Environmental cables are an absolutely key component in electrical and fiber optic based systems. All “black box” technologies—from the smallest soldier-carried system, to aircraft avionics bays—utilize purpose-designed cabling to interconnect modular electronic components. All three Glenair factories—Glendale, Mansfield and Bologna—offer turnkey interconnect cable design and assembly for both fiber optic and electrical applications. Glenair-designed interconnect cables are optimized for rugged performance as well as user handling. Our Complex Cable design and fabrication team utilizes many unique in-house Glenair technologies, including ultra-lightweight and flexible ArmorLite™ EMI/RFI shielding, and UV and heat-resistant Duraelectric™ jacketing.



Overmolded breakout assembly featuring 100% Glenair content; a true turnkey solution



Turnkey overmolded GPS cable assembly with integrated switch



Multibranch cable assembly with Glenair Mighty Mouse, HiPer-D M24308 and customer-supplied power connector



Environmental cable with Glenair Series 804 Mighty Mouse, Series 79 Micro-Crimp, and RF Coax terminations





^ Overmolded cable technology provides the ultimate in environmental protection for interconnect systems deployed in harsh application environments.



^ Glenair electrical and fiber optic assembly facilities are geared for every requirement, from one piece to one thousand.



Non-environmental aircraft cable with integrated circuit breakout box and Mighty Mouse 804 push-pull connectors



< Glenair specializes in small form-factor cables and electronics for soldier applications



Heads-up display (HUD) cable with custom Series 804 Mighty Mouse and low-profile cable routing



Series 88 SuperFly™ overmolded cable assembly with ultra-flexible GhostWire cable

COMPLEX CABLES

To review, Glenair alone can supply the entire electronic interconnect subsystem, including

1. Embedded electronic and opto-electronic PCBA's
2. Ruggedized enclosures and housings
3. Fiber optic and electrical connectors
4. Flex circuit jumpers and harsh environment cables

All optimized for harsh environments and manufactured under one roof and one worldwide quality system.

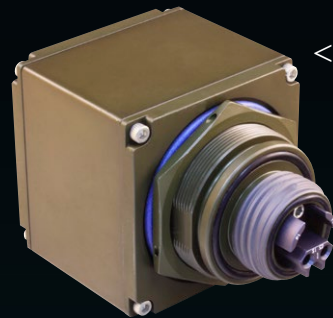


This spread illustrates just a small sampling of the many turnkey electronic and opto-electronic subsystems fabricated and supplied by Glenair. Note the many examples of lightweight corrosion-resistant composite thermoplastic enclosures and the broad range of interconnect technologies from Nanominiature tactical to large form-factor military/aerospace designs. These solutions are built around ruggedized printed circuit boards with diverse fixed or programmable capabilities such as electrical-to-optical Ethernet media conversion, multiplex signal aggregation, RF over fiber data transmission, soldier communications and computing subsystems, device power management, Ethernet and/or USB switching, routing and more. Further, and key to Glenair's unique strength in systems

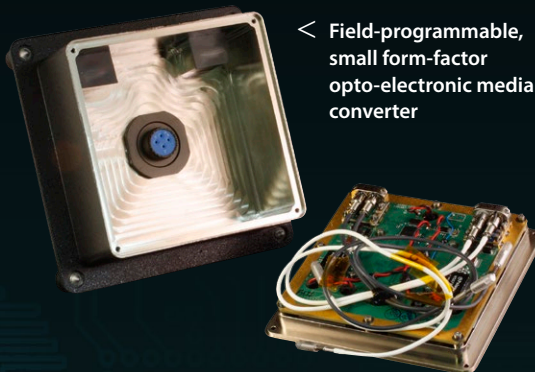
of this type, these electronic and opto-electronic subsystems are packaged within Glenair manufactured enclosures, and interconnected with Glenair fiber optic and/or electrical connectors and cables. We believe Glenair's capability to design and produce turnkey solutions of this type is unmatched in our industry. No other interconnect manufacturer is able to offer such vertically integrated solutions—from board design and qualification to assembly, packaging and interconnection—all with in-house technologies and processes controlled under a single quality system.



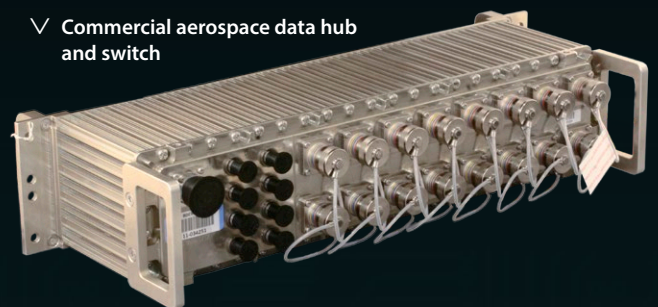
^ High-speed Ethernet data switch



< GFOCA opto-electronic Ethernet media converter



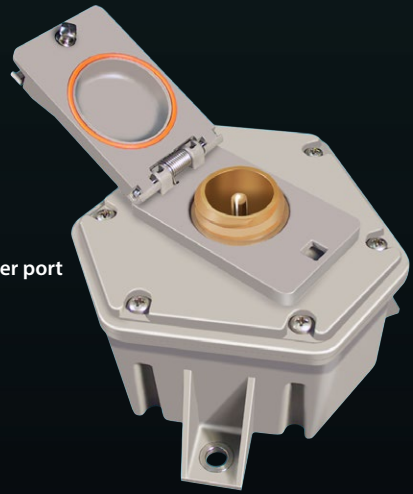
< Field-programmable, small form-factor opto-electronic media converter



∇ Commercial aerospace data hub and switch

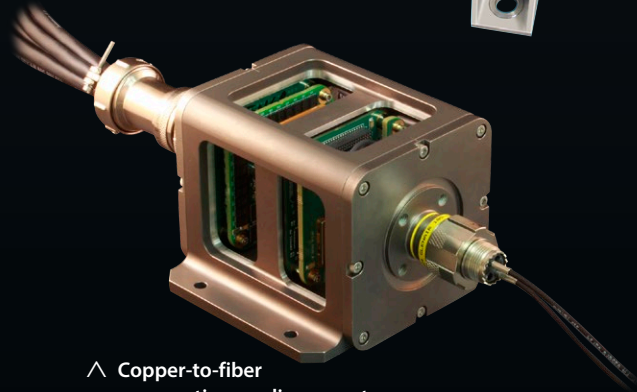


< Quadrax-to-optical fiber Ethernet media converter



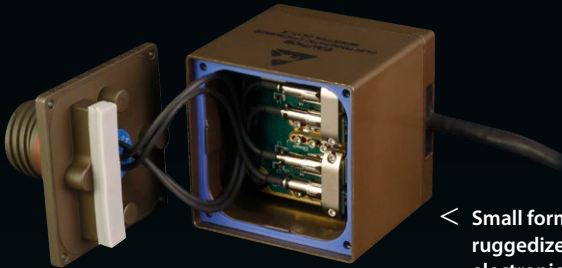
> Electronic sound/power port

∨ EMP and lightning strike hardened ARINC 801 to Quadrax Ethernet media converter



∧ Copper-to-fiber aggregation media converter (cutaway view)

> Ruggedized harsh-environment data distribution unit



< Small form-factor ruggedized opto-electronic media converter



< Ruggedized field RJ45 data management switch

EMBEDDED SUBSYSTEMS

## The Pulse of the Industry

I read a great deal of interconnect industry analysis that, more often than not, misses the boat on the business trends, pressures and values that truly affect our business. But several times recently I have been surprised by what I believe are some rather insightful observations—so much so that I would like to share a few of them with the Glenair family:

(1) Aerospace, defense and other high-reliability industries are generally poised for growth, particularly in high-touch technology areas where robust technical support and high levels of service are key customer requirements.

(2) The defense industry will likely see niche defense spending increases for US and NATO affiliates re-tooling for enhanced special-forces deployment in terrorist hotspots such as Iraq and Syria. Regional military growth in United Arab Emirates (UAE), Saudi Arabia, India, South Korea, Singapore and Japan will fuel additional growth as these countries continue to equip their fighting forces with modern defense platforms and technologies in such area as cyber security, C4ISR communications, precision strike, remote sensors and unmanned aerial systems.

(3) Commercial aircraft manufacturers will continue to set new records for aircraft production with no apparent end in sight. Several trends are contributing to the unprecedented backlog in commercial aircraft orders including accelerated replacement of older aircraft with more fuel-efficient designs, the continued growth of the affordable leasing sector and a burgeoning worldwide passenger travel demand, especially in the Middle East and the Asia-Pacific region.

(4) Global sourcing woes such as rising wages in Asia, higher shipping costs and pressure to meet aggressive delivery schedules and time-to-market standards, has led many OEM's to retreat from off-shore outsourcing and once again seek out domestic partners (such as Glenair!) for their most challenging, mission-critical projects.

As a first-world based manufacturer, our approach has always been to focus on the customer service deliverables of greatest value to our customers—from responsive engineering and technical support services to rapid prototyping and short lead-time production. The ability to truly understand the customer's complete range of requirements (to genuinely "speak their language") has indeed led many OEM's to change their view of low-cost manufacturing zones and instead turn to reliable, local partners such as Glenair. Lately, such work has evolved to include complete electronic subsystem design and manufacture, particularly in highly-technical opto-electronic applications but also in more mainstream Ethernet and USB electronics.

As highlighted in this issue, Glenair now fields a special in-house team of engineers and operations experts with deep fluency in printed circuit board design, layout, assembly and test. This advanced PCB capability, combined with our world-class interconnect and packaging expertise, enables Glenair to design, prototype and deliver increasingly complex electronic and opto-electronic sub-systems and interconnect assemblies. The combination of these burgeoning in-house capabilities with the positive trends we see in our industry will make for exciting and fun days ahead.

*Chris Toomey*

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