OPTO-ELECTRONIC INTERCONNECT SOLUTIONS
For Ruggedized Ethernet, Video, High-Speed Data, and Signal Aggregation Applications

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 a revolutionary new Opto-Electronic product series of fiber-optic transmitter and receiver modules, copper-to-fiber media converters, and copper-to-fiber signal aggregators well-suited to military, aerospace and other applications. These harsh-environment interconnect technologies improve the performance of Ethernet, Video and High-Speed Digital applications by leveraging the strengths of both electrical and optical media. Glenair Opto-Electronic Interconnect Solutions enhance network performance and reliability in harsh environment applications such as avionic displays, In-Flight Entertainment (IFE) systems, 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 and where resistance to vibration, shock, temperature extremes and other harsh conditions are required. Most importantly, the products take away much of the complexity of incorporating fiber optics into high-speed Ethernet, video and data transmission applications, by moving transmitter and receiver functions directly onto printed circuit boards, into easy-to-install connector contacts or even within interconnect hardware and cabling. Glenair offers both standard catalog...
solutions, as well as the integration of electronics or Opto-Electronics into rugged custom packages and cable assemblies per customer and application requirements.

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.

THE CHALLENGE: AEROSPACE-GRADE OPTO-ELECTRONIC INTERFACES

Since each fiber in an optical transmission link requires separate electrical-to-optical media conversion at each end, the cost and complexity of integrating fiber-optics in short-run networks such as are found on airplanes has often been considered prohibitive. In addition, there are few media converter choices for mil/aero applications resistant to the temperature extremes, environmental hazards and high levels of vibration and shock typical of military and aerospace environments. Most potential users also lack in-house fiber-optic expertise to develop and build their own media converter solutions or deal with fiber termination, test and maintenance of complex fiber-optic systems.

Commercially available transmitters and receivers, used to convert electrical bits to photons, are typically not suited for higher-performance applications due to their size and weight. Additionally, they are geared for use in general-duty telecommunications installations not requiring aerospace levels of mechanical, electrical and environmental performance, particularly resistance to temperature extremes. 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

Glenair printed-circuit-board mounted high-speed Opto-Electronic transceivers are of great interest to electronic systems designers using the state-of-the-art high-speed processor families from companies like Xilinx and Altera for phased-array-radar beam-forming, advanced signal processing, electronic warfare and video switching applications. Commercial avionics designers also appreciate the AS9100C heritage of Glenair.

THE SOLUTION: GLENAIR OPTO-ELECTRONIC PRODUCTS

Glenair Opto-Electronic Products are the perfect solution to enable equipment to interface with optical fiber. For Mil-Aero applications, Glenair has developed Ruggedized PCB-mounted transceivers to withstand harsh environments, and due to their small package size, they can be placed close to processors with high-speed I/O ports. And since many of our transceiver solutions are PCB-based, the electrical-to-optical conversion process is accomplished as soon as possible to maximize signal integrity.

Glenair’s Opto-Electronic fabrication facility is AS9100 Rev C certified

Fiber-optic media and photonics provide superior performance in high-bandwidth, long-distance applications compared to purely electrical interconnect systems. This is particularly the case in 10G Ethernet applications where the complexity of PHY layer signal processing in electronics increases to enable 10G transmission on copper twisted pair due the need to “step down” and “step up” both ends of the link and also various layers of processing that must occur to the signal to ensure integrity.

WHAT ARE OPTO-ELECTRONICS?

Opto-electronics are small form-factor optical and electrical technologies designed to convert high-speed data between the electrical and optical domains to support fiber optic transmission links. Opto-electronics consist of fiber-to-copper transceivers, switches, signal aggregators, and other devices located directly on printed circuit boards, as I/O devices on panels and boxes, or integrated into interconnect cabling.
transceivers for use in In Flight Entertainment systems, video security systems, file-servers, flight displays, Ethernet and AFDX media converters and switches, and all other avionic applications requiring a rugged aerospace-grade Opto-Electronic conversion.

Glenair transceivers are available in a wide range of capabilities to convert high-speed data from electrical bits to optical fiber and back again at rates up to 10 Gbps. The products offer the same functionality and mating interfaces as legacy commercial-grade transceivers, but they are ruggedized and qualified for military/aerospace environments and are built in an AS9100C environment with full traceability. Unlike commercial transceivers, all Glenair parts are thermally shocked 10 times from -40°C to +85°C, burned-in, and tested operationally over their full temperature range.

Glenair transceivers have passed the following qualification tests, under operating conditions, without dropping any bits:

• Shock pulses up to 650 G,
• Random vibration levels up to 54 Grms
• 10-day humidity test
• Temperatures from -40°C up to and exceeding 85°C.
• Altitude up to 70,000 ft
• Rapid decompression and overpressure
• ESD

Commercial-grade components are not suitable for, and cannot pass the qualification testing required for military/aerospace applications.

Glenair Opto-Electronic clean room and ESD control area

The expanding list of applications for Glenair Opto-Electronic solutions includes phased-array radar, electronic warfare systems, video transport and switching, Ethernet switching, box-to-box and board-to-board 10 Gbps high-speed communications between processors, and network storage devices.

RUGGEDIZED PCB-MOUNT TRANSCEIVERS

For Mil-Aero applications Glenair has developed Ruggedized PCB-mounted transceivers that can better withstand harsh environments, and due to their small package size, be placed close to processors with high-speed I/O ports. And since the transceiver is mounted directly on the printed circuit board, the electrical-to-optical conversion process is accomplished as soon as possible, maximizing signal integrity.

Ruggedized transceivers: conventional fiber-optic transceivers, such as the small form-factor commercial transceiver shown on the left, are ill-suited for use in military and aerospace applications. They lack environmental resistance to vibration, shock, and temperature extremes. Glenair PCB-mount transceivers are ideally suited for high-performance, high-speed applications as they are optimized for rugged performance and may be incorporated at lower levels in the system hierarchy, including directly on printed circuit boards, as well as in I/O ports in electronic equipment housings, or into standalone media converters.
**HOW ETHERNET WORKS IN COPPER VS. FIBER OPTIC SYSTEMS**

10G SERIAL DATA VS. 10G ETHERNET

Ethernet is the *Lingua Franca* of computer and peripheral interconnects. How Ethernet works in serial, copper media systems versus 10G Ethernet fiber optic systems makes a clear and concise argument for why Opto-Electronic topologies have become by far the preferred solution.

10/100/1000BASE-T interfaces are ubiquitous on all types of equipment. In electrical-only systems, Ethernet Physical-Layer (or PHY) and serializer/de-serializer (SERDES) electronics transform a high-speed serial BASEband digital signal into a series of parallel signals. Each parallel signal uses highly-bandwidth-efficient modulation/demodulation of an RF carrier signal at each end of the cable. This allows for dramatic reduction of cable bandwidth requirements, but adds the cost of sophisticated Ethernet signal processing electronics at each end. For example, since transmission is bi-directional (on 4 twisted pairs of wires for GB Ethernet and 10GB Ethernet) it requires echo-cancellation and other processing. This is why a shielded twisted pair can support 10GBASE-T Ethernet, but could never support 10 Gigabit serial transmission.

Ethernet signal processing breaks up a high-speed data stream up to 10 Gbps into 4 lower-data-rate streams, reducing the required bandwidth by 10X. This allows straight-pin connectors and twisted pair wiring to be used. Significantly, all of the Ethernet signal processing can be avoided by incorporating fiber-optics into the system. Using 10G fiber-optic transceivers between chips, for example, eliminates the need to convert high-data-rate signals to 10G Ethernet and back again. Fiber optics easily supports 10G serial data rates over long distances, simplifying system design and maximizing signal integrity.

In fact all high-speed signal formats benefit from incorporation of fiber optics, including 10/100/1000 BASE-T and 10 GBE Ethernet; DVI and HDMI Video; High Speed Digital Data (1-10 Gbps or higher).

As fiber-optic technology has advanced, particularly in the ability to utilize field-programmable gate arrays (FPGA) as high-performance optical interconnections at the logic (board) level in high-speed 10G+ systems, the value of photonic technology has become much more tangible. As a result, the point or level at which optical technology offers a demonstrable advantage compared to purely electrical systems has moved lower—out of stand-alone transceivers and interconnect cabling to board and logic layer solutions and integration components.
OPTO-ELECTRONIC APPLICATION EXAMPLES

From RF signal amplifiers to copper-to-fiber-optic media converters, switches and FPGA transceivers, Glenair Opto-Electronic technologies reduce the size and weight of interconnect cabling and enable longer runs for high-bandwidth, high-speed data.

REDUCED FORM FACTOR COPPER TO FIBER MEDIA CONVERSION

The broad utilization of fiber optics in airframe applications, such as for in-flight entertainment and other complex electrical/optical interconnect systems, currently demands transmitter and receiver solutions that are reduced in size and weight. Designed for use in protocol-specific application environments such as IEEE 802.3-2005 GB Ethernet, these small form-factor copper-to-fiber media converters reduce weight and complexity while still meeting shock, vibration, and fiber-link distance requirements of traditional F/O transmitter/receiver equipment. In addition to 100/1000BASE-T and DVI compliant converters, many IFE applications are able to utilize Opto-Electronic contacts in transmitter and receiver roles directly incorporated into ARINC 801 and other standard airframe connector packages. These ultra-lightweight transmitter/receivers are designed for the rigors of in-cabin use and multiple electrical to fiber optic junctions. The technology supports GB Ethernet, AFDX, Fibre Channel, DVI, HDMI and more.

Hundreds of feet of copper wire media are typically used in a commercial aircraft. Legacy airframe databus protocols such as MIL-STD-1553 put very little stress on copper media in terms of datarates and bandwidth. But new requirements including GB Ethernet and high-definition IFE have led to new databus requirements that can only be met by incorporating fiber optic media and Opto-Electronic technology.

HIGH-DEFINITION VIDEO SURVEILLANCE

The growing requirement for high resolution, high color fidelity, and high-speed frame rates has become a major development direction in video surveillance. Efforts to ensure video output resolution is adequate for use in preventative surveillance such as is conducted in municipal policing and facility security have led to the development of camera and recording technologies with extremely high bandwidth and high-speed requirements. Copper media is increasingly considered to be unsuitable for use in this field. Opto-Electronic technologies that can both affect digital-to-optical conversion as well as high-speed and high-bandwidth data transport are as a result in high demand.
ULTRA HIGH-BANDWIDTH ELECTRONICS

The proliferation of radar technology, combined with higher-resolution data requirements, has led to the incorporation of fiber optic and Opto-Electronic media conversion—particularly small-footprint PCB mount transceivers. Next-generation military radar offers longer standoff range and the ability to simultaneously detect, identify and track multiple air and surface targets. These compact and lightweight radar modules increasingly rely on interference-free small form-factor Opto-Electronic componentry.

In addition to aerospace applications of high-bandwidth radar technology, numerous ground-to-air radar systems have been developed to support ground soldiers with more robust air traffic control capabilities.

COCKPIT AVIONICS AND DISPLAYS

Glenair Opto-Electronic technologies are designed specifically for military/aerospace environments where commercial transceivers can’t go. They are fully self-contained and require no soldering to the host board. FPGAs with 10 Gbps I/O are being widely deployed in mil/aero equipment (processor boards employing Xilinx, Altera, etc.) for 100-ohm differential CML 10 Gbps data, because there is simply no good solution for transporting these signals on copper, flex or micro-coax for more than a few inches. The best available solution is to quickly convert the signals to photons. Glenair Harsh-Environment Fiber Optic Transceivers are perfectly applied in these applications to increase signal integrity, reduce system complexity and optimize size and weight requirements.
Unlock the huge bandwidth of optical fiber and dramatically reduce the size and weight of interconnect systems

Glenair leverages its extensive portfolio of military and aerospace interconnect products to bring you ruggedized Opto-Electronic solutions, converting signals between the electrical domain and the fiber domain. These Opto-Electronic products are designed for harsh military/aerospace system and subsystem environments and will operate reliably over very wide temperature ranges and high shock and vibration conditions; they have been optimized to minimize size, weight and power and offer electrical-to-fiber conversion for Ethernet, video, signal aggregation and high-speed digital signals.

Glenair also offers integration of electronics or Opto-Electronics into rugged connector packages and cable assemblies per specific customer requirements. We offer rapid response in-house electrical/PCB design, and mechanical connector/backshell engineering from our vertically integrated factory. Our product portfolio is constantly evolving—please contact Glenair for the latest developments, or custom solutions.

ADVANTAGES OF GLENAIR OPTO-ELECTRONICS

- Reduced size, weight, and power consumption
- Leverages the virtues of fiber optics: EMI immunity, network security, increased transmission distance
- Advanced management & control features
- High shock and vibration to support mil/aero applications
- Wide operating temperature range: -40°C to +85°C and beyond
- Designed IAW military and aviation requirements: MIL-STD-883, MIL-STD-461, DO-160 and others
Series 050 Overview
Harsh-Environment, Small Form-Factor Opto-Electronic Interconnect Solutions

Proven-Performance Opto-Electronic Interconnect Solutions
- Military, industry-standard and custom connector integration
- Custom aggregation media converters
- Integration of active components into cable assemblies
- Link testing and qualification

Laboratory link test and qualification data for harsh-environment Opto-Electronic solutions are available—just contact the factory.
Opto-Electronic Contacts

Size 8 Opto-electronic contacts transmit and receive differential CML or LVPECL electrical signals over Multimode fiber optic cable. Transmitters consist of a laser driver or LED driver with a temperature compensation circuit to maintain optical power over the entire operating temperature range, and a 850nm VCSEL laser or a 1300nm LED. Receivers consist of a PIN Photo Detector, a Transimpedance Amplifier with automatic gain control circuit, and a Limiting Amplifier. Differential output data signals are LVPECL or CML compatible. The transmitter has a Tx Disable pin to turn off transmitter output.

- Transmit (Tx) and Receive (Rx) Opto-Electronic contacts for use in ARINC 600 and other size #8 cavity equipped connectors
- Current offerings include 1.25mm ARINC 801 and 2.5mm ELIO® solutions
- 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 500 meters, multimode
- Single, 3.3 V power supply
- Wave-solderable termination with RoHS-compliant solders
- Evaluation Test Boards Available

4.25 Gbps / +25°C
Size 8 Opto-Electronic Transmitter and Receiver Contacts for Ethernet, Video and High-Speed Data

PRODUCT SELECTION GUIDE

TRANSMITTER AND RECEIVER CONTACTS, 850nm LASER, ARINC 801 1.25mm TERMINUS

Size 8 Opto-electronic contacts transmit and receive differential CML electrical signals over Multimode fiber optic cable. Transmitters consist of a laser driver with a temperature compensation circuit to maintain optical power over the entire operating temperature range, and a 850nm VCSEL laser. Receivers consist of an 850nm PIN Photo Detector, a Transimpedance Amplifier with automatic gain control circuit, and a Limiting Amplifier. Differential output data signals are CML compatible. The transmitter has a Tx Disable pin to turn off transmitter output and a Tx Fault pin to signal a fault condition. Receiver includes a CMOS compatible Loss of Signal Indicator to prevent invalid data.

Signal Type
-01 = 1.25 Gbps
-03 = 3.20 Gbps
-02 = 2.50 Gbps
-04 = 4.25 Gbps

TRANSMITTER AND RECEIVER CONTACTS, 850nm LASER, ELIO® 2.5mm TERMINUS

Size 8 Opto-electronic contacts transmit and receive differential CML electrical signals over Multimode fiber optic cable. Transmitters consist of a laser driver with a temperature compensation circuit to maintain optical power over the entire operating temperature range, and a 850nm VCSEL laser. Receivers consist of an 850nm PIN Photo Detector, a Transimpedance Amplifier with automatic gain control circuit, and a Limiting Amplifier. Differential output data signals are CML compatible. The transmitter has a Tx Disable pin to turn off transmitter output and a Tx Fault pin to signal a fault condition. Receiver includes a CMOS compatible Loss of Signal Indicator to prevent invalid data.

Signal Type
-01 = 1.25 Gbps
-03 = 3.20 Gbps
-02 = 2.50 Gbps
-04 = 4.25 Gbps

TRANSMITTER AND RECEIVER CONTACTS, 1300 nm LED, ARINC 801 1.25mm TERMINUS

Size 8 Opto-electronic contacts transmit and receive differential LVPECL electrical signals over Multimode fiber optic cable. Transmitters consist of an LED driver with a temperature compensation circuit to maintain optical power over the entire operating temperature range, and a 1300nm LED. Receivers consist of a PIN Photo Detector, a Transimpedance Amplifier with automatic gain control circuit, and a Limiting Amplifier. Differential output data signals are LVPECL. The transmitter has a Tx Disable pin to turn off transmitter output.

Signal Type
-01 = 100 Mbps

OPTO-ELECTRONIC CONTACT EVALUATION BOARD

The evaluation board is designed as an interface to allow evaluation of the size 8 transmitters or receivers. Devices are powered through the 3.3V and GND connections. For the transmitter fault pin can be monitored and the transmitter disable can be controlled via an external voltage supply. For the receiver, loss of signal (LOS) state can be monitored. Test configuration options:
- Transmitter only
- Receiver only, and
- Both transmitter and receiver either in a single link or two separate links.

050-301 (patent pending)

050-307 (patent pending)

050-308 (patent pending)

050-301

visit glenair.com for detailed product datasheets
PCB-Mount Opto-Electronics

Connectorized, high-density, board-mount transceivers built for rugged vibration and shock applications up to 10Gbps

Glenair PCB mount transceivers are ruggedized harsh-environment equivalents to SFP transceivers but with mechanical design suited to the harsh temperature and vibration environments found in Military and Aerospace applications. PCB mount optical transceivers support optional Digital Monitoring Interface (DMI) features in accordance with SFF 8472. The Transceiver is comprised of a transmitter section and a receiver section that reside on a common package and interface with a host board through a high speed electrical connector.

- Smallest footprint available
- Passed jet fighter and space launch shock and vibration testing
- No soldering required
- CML 100 Ohm differential input and output
- -40°C to +85°C operating temperature range—extended temperature ranges available

| GC fiber optic connector retained with mounting screws to withstand high vibration and shock | PCB-mount Opto-Electronics feature Samtec high-speed surface-mount connectors | Dual-transceiver, Quad-Transmitter and Quad-Receiver form factor with ARINC 801 contacts | Evaluation boards for all PCB mount transceiver configurations are available |
## General Purpose Applications:

High Speed Digital balanced signals (i.e. 4B/5B, 8B/10B, 62B/64B etc)  
Fast Ethernet, Gigabit Ethernet, 10G Ethernet Fiber Channel (1X, 2X, 4X, 8X), ARINC 818, AFDX, SFPDP, Serial Rapid I/O (sRIO)

## Video Applications

DVI, ARINC 818, SMPTE (SDI, HD-SDI, 3G-SDI)

### Evaluation Boards

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>050-315</td>
<td>PCB Mount OE Transceiver 5G, MMF</td>
</tr>
<tr>
<td>050-316</td>
<td>PCB Mount OE Dual-Transmitter 5G, MMF</td>
</tr>
<tr>
<td>050-317</td>
<td>PCB Mount OE Dual-Receiver 5G, MMF</td>
</tr>
<tr>
<td>050-318</td>
<td>PCB Mount OE Transceiver, 4G, SMF</td>
</tr>
<tr>
<td>050-319</td>
<td>PCB Mount OE Dual Transmitter, 1310nm FP, 4G, SMF</td>
</tr>
<tr>
<td>050-320</td>
<td>PCB Mount OE Dual Receiver, 1310nm, 4G, SMF</td>
</tr>
<tr>
<td>050-321</td>
<td>PCB Mount OE Transceiver, 1300nm LED, 200M, MMF</td>
</tr>
<tr>
<td>050-322</td>
<td>PCB mount 10Gbps XVR, 1310nm FP, 2km, SMF</td>
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<tr>
<td>050-324</td>
<td>PCB Mount OE Transceiver, 1310nm DFB, 4G, SMF</td>
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<td>050-325</td>
<td>PCB Mount OE Dual Transmitter, 1310nm DFB, 4G, SMF</td>
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<td>050-326</td>
<td>PCB Mount OE Dual Receiver, 1310nm DFB, 4G, SMF</td>
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<td>050-327</td>
<td>PCB mount 10Gbps SR Serial XVR, 850nm, MMF</td>
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<td>050-328</td>
<td>PCB mount 10Gbps XVR, 1310nm DFB, 10km</td>
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<td>050-331</td>
<td>PCB Mount OE Dual-Transmitter SMPTE 3G-SDI</td>
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<td>050-332</td>
<td>PCB Mount OE Dual-Receiver SMPTE 3G-SDI</td>
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<td>PCB Mount OE Dual-Transceiver 5G MMF, ARINC 801</td>
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<td>050-336</td>
<td>PCB Mount OE Quad-Transmitter 5G MMF, ARINC 801</td>
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<td>050-337</td>
<td>PCB Mount OE Quad-Receiver 5G MMF, ARINC 801</td>
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<td>050-339</td>
<td>PCB Mount OE Dual Transceiver, 10G MMF, ARINC 801</td>
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<td>050-340</td>
<td>SINGLE FIBER Bidirectional Transceiver, 2.5G, SMF</td>
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<td>050-341</td>
<td>SINGLE FIBER Bidirectional Transceiver, 10G, SMF</td>
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<tr>
<td>050-342</td>
<td>CWDM Transceiver, 2.5G, SMF</td>
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<tr>
<td>050-343</td>
<td>CWDM Transceiver, 10G, SMF</td>
</tr>
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### Accessories

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Details</th>
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<tbody>
<tr>
<td>FA02454</td>
<td>Fiber Optic jumper cable, GC</td>
<td>Singlemode or multimode connects transceiver to mil/aero connector</td>
</tr>
<tr>
<td>FA03286</td>
<td>Fiber Optic jumper cable, ARINC 801</td>
<td>Singlemode or multimode connects transceiver to mil/aero connector</td>
</tr>
<tr>
<td>059-0007</td>
<td>PCB Threaded Insert</td>
<td>Simplifies installation of PCB transceivers</td>
</tr>
</tbody>
</table>

Visit [glenair.com](http://glenair.com) for detailed product datasheets
Opto-Electronic Connectors

Environmentally sealed, triple-start connectors housing turnkey copper-to-fiber transceiver technology

Glenair is able to offer our Opto-Electronic solutions customers turnkey multichannel receptacle connectors housing integrated transceiver technology for fast/gigabit Ethernet, DVI and HDMI video, as well as various high-speed data transfer protocols. The two available connector designs incorporate Glenair small form-factor Opto-Electronic contacts (050-301) or an ELIO® equipped configuration that intermates with the standard ELIO® 2.5mm fiber optic terminus (050-307). Receptacles are populated with factory-tested size #8 contacts, and are ready for immediate use as fiber-optic-to-electrical circuit board I/O connectors. Special size #8 cavity adapters are also available to enable construction of compatible plug connectors on the cable side.

- Catalog solutions include:
  - 2.5mm ELIO® solution for multimode Ethernet, video, and high speed data applications
  - 1.25mm ARINC 801 multimode fiber optic termini solution for Ethernet, video, and high speed data

- Made-to-order configurations with a wide range of connector packages including Glenair Series 80 Mighty Mouse

Special size #8 cavity adapters facilitate construction of standard fiber optic plug connectors that intermate with the size #8 Opto-Electronic transceiver contacts

Opto-electronic receptacle connectors are populated with size #8 contacts, and ready for immediate assembly in I/O to circuit board applications

ELIO® is a registered trademark of SOURIAU
## Opto-Electronic Connectors for Ethernet, Video, and High-Speed Data Applications

**PRODUCT SELECTION GUIDE**

Visit glenair.com for detailed product datasheets

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
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</table>
| **050-304** | **050-304** MIL-DTL-38999 Series III Type Receptacle Connectors with Size 8 Opto-Electronic Contacts  
The 050-304 series of Active Opto-electronic sealed panel mount connectors offers customers the power to convert from electrical to fiber optic signals within a D38999 connector to support high speed fiber optic transmission in harsh environments. The 050-304 incorporates size 8 active contacts in one of three standard configurations to enable optical Transmitters, optical Receivers or Optical Transceivers, or custom configurations. |
| **059-0001** | **059-0001** Size 8 cavity adapter kit for 1.25mm ARINC 801 terminus  
Size 8 cavity adapter will convert D38999 size 8 cavities (Twinax, Coax, Quadrax or power) into ARINC 801 fiber optic cavities. Kit includes the adapter and an ARINC 801 terminus. |
| **059-0002** | **059-0002** Size 8 cavity adapter for ELIO® 2.5mm terminus  
Size 8 cavity adapter will convert D38999 size 8 cavities (Twinax, Coax, Quadrax or power) into ELIO® fiber optic cavities per EN4531. |
| **050-313** | **050-313** Opto-Electronic Transceiver, MIL-DTL-38999 Type 2.5mm ELIO® Compatible, 100Mbps – 4.25Gbps  
Glenair 050-313 is a D38999 Type 11-02 receptacle connector incorporating an Opto-Electronic transceiver operating from 100Mbps to convert electrical signals to multimode fiber. The Glenair optical transceiver is ideal for harsh-environment, extreme shock, vibration and temperature avionics and military applications where copper cable link distance, bandwidth, weight or bulk make the use of twisted pair, Twinax or Quadrax copper conductors unacceptable. |
| **050-303** | **050-303** Opto-Electronic Receiver with Mighty Mouse connectors, 100Mbps – 2.5 Gbps  
Glenair 050-303 optical transceiver, connectorized with Series 805 Mighty Mouse connectors, employs state-of-the-art opto-electro-mechanical technology to provide effective harsh environment fiber-optic interconnect solutions for high-speed digital data. |

(Reg. U.S. Pat. Off.)

![image](glenair.com)
**ETHERNET**

**Copper-to-Fiber Media Converters**

**Reduced form factors for harsh-environment applications**

Glenair offers turnkey harsh-environment media converters for in-line and select panel mount applications. The devices facilitate conversion of 10/100/1000BASE-SX/LX fiber optic gigabit Ethernet data streams to electrical signals servicing switches, routers, and other peripherals. Designed for use in ruggedized applications such as geophysical, naval, commercial and military aerospace, these reduced form factor electrical-to-optical transceivers deliver proven performance with significant size and weight savings compared to conventional form factor technologies. Available for a wide range of fiber optic formats, including 1.25mm, 1.57mm, 2.0mm, and 2.5mm ferrules, in both singlemode and multimode, Glenair’s complete range of media converters meets virtually every fiber-optic-to-copper application requirement.

- Reduced form factor devices for in-line conversion of electrical and optical signals
- Active cable versions that reduce the risk of damage to fiber optic interfaces
- Weight-saving technology that incorporates power and signal conversion functions
- Auto-negotiation 10/100/1000BASE-T to 100BASE-FX, 1000BASE-SX and 1000BASE-LX
- Advanced monitor & control functions via serial interface to facilitate network management and BIT
**Table I: Signal Protocol**

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>-SX</td>
<td>1000BASE-SX</td>
<td>Multimode Fiber</td>
</tr>
<tr>
<td>-LX10</td>
<td>1000BASE-LX10</td>
<td>Singlemode Fiber</td>
</tr>
</tbody>
</table>

**EXAMPLE FUNCTIONAL BLOCK DIAGRAM FOR GLENAIR 050-105 ETHERNET MEDIA CONVERTER**

- **Part No.** 050-101  
  **Description:** 1000BASE-T to 1000BASE-SX/LX Media Converter
- **Part No.** 050-103  
  **Description:** 10/100/1000BASE-T to 1000BASE-SX/LX Media Converter with Mighty Mouse Connectors
- **Part No.** 050-104  
  **Description:** 10/100/1000BASE-T to 1000BASE-SX/LX Active Cable with Mighty Mouse Connectors
- **Part No.** 050-110  
  **Description:** 10/100/1000BASE-T to 1000BASE-SX/LX, GFOCA, 38999 Quadrix (signal and BIT), 38999 (Power)
- **Part No.** 050-105  
  **Description:** 10/100/1000BASE-T to 1000BASE-SX/LX Media Converter
- **Part No.** 050-112  
  **Description:** 10/100/1000BASE-T to SX, LX10, or FX Fiber Optic Ethernet, GFOCA Fiber Optic interface
- **Part No.** 050-113  
  **Description:** 10/100/1000BASE-T to SX, LX10, or FX Fiber Optic Ethernet, MIL-DTL-1560 interface
- **Part No.** 050-114  
  **Description:** 10/100/1000BASE-T to 1000BASE CWDM Media Converter
- **Part No.** 050-115  
  **Description:** LRU Media Converter, Single or Dual Channel, 10/100/1000BASE-T to SX/LX Lightning Strike Protection DO160 level 3

Visit glenair.com for detailed product datasheets.
VIDEO

Copper-to-Fiber Media Converters

Reduced form factor media converters for harsh-environment video applications

Glenair Copper to Fiber Optic Video Media Converters enable extended link distances, improved EMI and security in harsh environments and provide solutions for both MMF and SMF applications. These media converters support ruggedized military systems applications and are tailored to support a variety of Video protocols including DVI, HDMI, SMPTE (SDI, HD-SDI and 3G-SDI), ARINC 818 and more.

Many options for mil-spec and military-grade electrical and fiber optic connectors are available. Contact Glenair for custom configurations, application-specific designs and engineering services.
MIL-DTL-38999 SERIES III TYPE DVI VIDEO MEDIA CONVERTER

How To Order

<table>
<thead>
<tr>
<th>Product Series</th>
<th>Transmitter = TX</th>
<th>Receiver = RX</th>
<th>Dash Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>050-201</td>
<td>TX</td>
<td>SEND</td>
<td>01</td>
</tr>
</tbody>
</table>

DVI Media Converter (See Table)
Plating Code

ENVIRONMENTAL PERFORMANCE

- -40°C to +85°C operating temperature range
- Meets MIL-STD-810 Mechanical Shock and Vibration
- Meets MIL-STD-1344 immersion resistance

VIDEO MEDIA CONVERTER FUNCTIONAL BLOCK DIAGRAM

<table>
<thead>
<tr>
<th>TRANSMITTER</th>
<th>TMDS - Red</th>
<th>TMDS - Green</th>
<th>TMDS - Blue</th>
<th>TMDS - Data/Clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lasers x 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laser Drivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVER</th>
<th>PIN/TIA x 4</th>
<th>TMDS - Red</th>
<th>TMDS - Green</th>
<th>TMDS - Blue</th>
<th>TMDS - Data/Clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limiting Amplifiers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graphics Card Source

TMDS - Red
TMDS - Green
TMDS - Blue
TMDS - Data/Clock
18-36V

R,G,B, Clock
Power

Fiber optic Cable
up to 500m MMF
up to 10km SMF

050-201-TX

050-201-RX

Power

Monitor

Rev. 8.28.14
SIGNAL AGGREGATION

Copper-to-Fiber Media Converters

Low data-rate signal multiplexing copper-to-fiber media conversion

Glenair signal aggregation media converters integrate a set of compact Opto-Electronic modules to digitize and/or aggregate multiple common signal types, and combine them onto high-data-rate serial optical fiber channels. Silicon field-programmable gate array (FPGA) technology provides a flexible way to accommodate many signal I/O types.

- Dramatically reduce size, weight, wire count, and shielding of copper cables
- Leverage the high bandwidth of optical fiber by multiplexing many lower-data-rate signals onto a few fibers
- One high-speed Opto-Electronic interface can serve practically all signal types
- Ideal solution to enable optical rotary joints
- -40°C to +85°C operating temperature range
- Meets MIL-STD-810 Mechanical Shock and Vibration
- Meets MIL-STD-1344 immersion resistance
- Advanced monitor & control functions via serial interface to facilitate network management and BIT

<table>
<thead>
<tr>
<th>Signal Aggregation Media Converter Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>050-501</td>
</tr>
<tr>
<td>050-502</td>
</tr>
<tr>
<td>050-503</td>
</tr>
<tr>
<td>050-504</td>
</tr>
<tr>
<td>050-505</td>
</tr>
</tbody>
</table>
Copper-to-Fiber Media Converters
Multiplexing Signal Aggregator

PRODUCT SELECTION GUIDE

SIGNAL AGGREGATOR FUNCTIONAL DIAGRAMS

- One compact LRU digitizes or aggregates multiple electrical signals on copper using an FPGA
- FPGA digitizes and serializes the signals onto a high-speed data stream
- Opto-electronic converters get the serialized signals on and off the optical fiber

FPGA MAIN BOARD AND DAUGHTER CARD ARCHITECTURE CAN HANDLE MANY SIGNAL TYPES

SERIAL
- RS422/RS485
- RS232
- USB
- MIL-STD-1553
- CAN Bus
- ARINC 429
- SMBus
- I2C
- SPI
- Ethernet 10/100/1000

VIDEO
- DVI
- HDMI
- SMPTE SDI
- SMPTE HD-SDI
- SMPTE 3G-SDI
- ARINC 818
- VGA

ANALOG
- RF/IF Sampling
- Analog Sensor Data

Contact the factory for other signal formats and custom configurations.
SMALL FORM-FACTOR

Ethernet Switches and Breakout Cables

Glenair unmanaged Ethernet switches are layer 2 switches with Auto negotiation and Auto MDI / MDIX circuitry that enables port expansion with IEEE-802.3U 10/100/1000Base-T Ethernet ports. Developed for use in harsh environment applications, the electronics are incorporated into a panel-mountable housing that is sealed against liquid and solid contaminants and designed for shock and vibration resistance. Standard connector interfaces include high-performance size- and weight-saving Glenair Series 805 Mighty Mouse jam nut receptacles and M28876 type fiber-optic connectors.

- Unmanaged—plug and play operation—no configuration required
- Jumbo frame support in all speeds (10/100/1000 Mbps)
- Operating temperature range: -40°C to +85°C
- Standard ultraminiature Mighty Mouse electrical and M28876 type fiber optic connector interfaces
- Experienced Opto-Electronic engineering services available for special connector and form-factor configurations
- Breakout cables with industry-standard connector interfaces available
Small Form-Factor Ethernet Switches and Breakout Cables

PRODUCT SELECTION GUIDE

visit glenair.com for detailed product datasheets

052-101 7-PORT UNMANAGED ETHERNET SWITCH

- 7 copper (10/100/1000 Mbps) Ethernet ports per IEEE 802.3:2005
- Non-Blocking switch fabric allows 1000 Mbps data rate on all 7 ports simultaneously
- Cable link distances up to 100 Meters (EIA/TIA Cat-5E)
- Full duplex flow control per IEEE Std 802.3X and half duplex back pressure, symmetric and asymmetric
- Shock, vibration and immersion resistant per MIL-STD-810F
- Auto sensing of half or full duplex operation
- Mighty Mouse Series 805 shell is water-tight to MIL-STD-810 when mated
- 3 form factors available

050-118 5-PORT UNMANAGED ETHERNET SWITCH

- 1 PORT : 10/100/1000 BASE-T consistent with IEEE 802.3
- 4 PORTS: 1000BASE-LX (IEEE 802.3)
- Non-blocking switch fabric allows 1000 Mbps on all ports
- Material/Plating: Aluminum with Cadmium Olive Drab over electroless Nickel (500 hours salt spray plating)
- 6 Status LEDs to Denote: (Power, Ethernet activity with one LED for each of the 5 ports)
- 4 M28876 type fiber-optic connectors
- Mighty Mouse ultraminiature electrical connector interface
- IP67 in mated condition

BREAKOUT CABLES FOR 7-PORT ETHERNET SWITCH

How To Order

<table>
<thead>
<tr>
<th>Active Product Code</th>
<th>Material/Finish (see Table I)</th>
<th>Length (in Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3089</td>
<td>8071</td>
<td>M A 48</td>
</tr>
<tr>
<td>3667</td>
<td>L-Com Cable</td>
<td>PIC Cable</td>
</tr>
</tbody>
</table>

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Fiber Optic interconnect solutions

Glenair Fiber Optic interconnect technologies deliver high data rate and bandwidth, reduced size and weight, EMI immunity, enhanced security, and spark/arc immunity. Our broad offering of fiber optic systems includes qualified MIL-PRF-28876 connectors and termini for shipboard applications, MIL-DTL-38999 Series III type fiber optic connectors and termini for aerospace applications, as well as our revolutionary Eye-Beam™ and Hi-Beam™ Expanded Beam technologies.

FIVE REASONS WHY FIBER OPTICS ARE IDEALLY SUITED FOR HIGH-DATARATE APPLICATIONS

- Reduced Size and Weight
- EMI Immunity
- Huge Bandwidth Over Long-Distances
- Spark/Arc Immunity
- Enhanced Security

TERMINATED AND TESTED FIBER OPTIC CABLE ASSEMBLIES

- Point-to-point and multibranch
- Simplex fiber optic cable—graded index, stepped index, and singlemode
- Lightweight and flexible polymer-core and metal-core fiber optic media routing and physical protection systems
### HIGH-PERFORMANCE

**Fiber optic interconnect solutions**

![Glenair Logo](https://www.glenair.com)

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#### Fiber Optic Interconnect Systems

<table>
<thead>
<tr>
<th>MIL-DTL-38999 Type Fiber Optic</th>
<th>GHD High Density Fiber Optic</th>
<th>Series 80 Mighty Mouse Fiber Optic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-PRF-28876 Fiber Optic</td>
<td>GFOCA M83526 Compliant Fiber Optic</td>
<td>Eye-Beam™ Expanded Beam Fiber Optic</td>
</tr>
<tr>
<td>NGCON MIL-PRF-64266 Fiber Optics</td>
<td>Glenair Front Release (GFR) Fiber Optics</td>
<td>Hi-Beam™ Expanded-Beam IAW M83526</td>
</tr>
</tbody>
</table>

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### FIBER OPTIC KITS AND TOOLS

Our fiber optic termination kits, inspection tools, and cleaning supplies allow both lab and field technicians to complete reliable assembly of fiber optic systems. Our termination kits, for example, are equipped with all of the necessary tools—pin and socket polishing tools, jacket strippers, shears, scribes—literally every device required for ongoing termination and test of fiber optic systems. The same holds true for our test probe, inspection and cleaning tools. Have a special toolkit requirement? Glenair can supply the right assortment of tools for every application as well as professional caliber training and process documentation.

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**Fiber optic test probes and adapters**

Traditional optical test harnesses are expensive and easily contaminated in normal use. Glenair’s test probe, in conjunction with our precise-mating test adapter, offers a complete solution to optical test and measurement.
Velocity

I was catching up on my reading this past weekend and came across an essay on the topic of velocity. If you can stomach a little math and physics, I think the following ideas are worthy of study and understanding (don't worry, there won't be a test!). The subject of velocity has some delightful applications to business, but it's important to get a few definitions out of the way. First of all, velocity describes both the speed and direction of motion. For example “70 MPH to the north” would describe the velocity I travel on my way home for the weekend.

Next, let’s discuss the difference between potential energy and kinetic energy. Potential energy describes the energy that a body at rest could bring to bear if and when it moves. You might picture, for example, a big truck parked at the top of a hill: lots of potential energy but currently no action. By contrast, kinetic energy is based on current action—in other words the energy of what the object is doing right now.

The contrast between potential and kinetic energy is stark. It took a lot of work to get that truck up to the top of the hill. But now it's just sitting there; its velocity is zero. Being up high gives it a lot of potential energy, but no kinetic energy. In business we might describe that big truck sitting at the top of a hill as a company of scale. One that has enormous potential based on its size and position but one not necessarily geared for immediate speed or focused action.

I am reminded of one of my first and favorite jobs in life at The Oyster Harbors Club on Cape Cod (shining shoes and parking cars). I remember one of the resident pros trying to talk a duffer out of wasting his money on a new driver with an enormous head by explaining that it is the velocity and the accuracy of the swing and not the scale or size of the club head that makes all the difference.

Now, are there individuals or organizations that, having worked for years to get to the top of the hill are now comfortably at rest? Would it be fair to describe such outfits as having lost their punch, their velocity, their speed-of-response to the markets they serve? In many cases the answer is, “yes.” The decline of once mighty outfits like Sears, JC Penney and GM has become almost the rule rather than the exception. It almost goes without saying that earlier in their life-cycles these enterprises bristled with the kinetic energy and velocity typical of more entrepreneurial organizations.

If I had just one chance to add just one thing to a business or organization I was part of, I would add velocity. It has an exponential effect unmatched by mere linear dynamics such as scale. I know everyone on our team has heard our exhortation to be “the first with the most.” Because that simple bromide is really how we make it happen, folks. By executing with velocity and plenty of kinetic energy we position ourselves to enjoy the business results we seek to achieve.

Chris Toomey