Why Upgrade to Fiber Optics?

In a variety of applications, fiber-optics are steadily replacing copper wire as an alternative means of signal transmission.

1. **Reduced Weight**
   
   Compared to copper, optical fiber is relatively small in size and light in weight—a major advantage in interconnect systems servicing airborne avionics. As a practical matter, optical fiber is simply easier to install—especially in retrofit programs—because the smaller cable diameters can fit comfortably within the footprint or layout of existing electrical conduits and harnesses.

2. **Reduced Size**
   
   Fiber media is also significantly smaller than copper. This reduction in size makes it possible to run multiple backup cables for each electronic system or device. The ability to provide complete redundancy for all critical cabling is a major motivating factor driving the use of fiber optics in mission-critical systems.

3. **EMI Immunity**
   
   Optical fiber is particularly useful in high-reliability applications due to its electromagnetic immunity. Since fiber optic media uses light to transmit signals, it is not subject to electromagnetic interference, radio frequency interference or voltage surges, and so provides greater transmission reliability.

4. **Spark/Arc Immunity**
   
   The total electrical isolation of fiber also makes it a safer, spark-free media for use in hazardous environments, such as aircraft fuel cells.

5. **Enhanced Security**
   
   This characteristic also provides for enhanced transmission security, as light pulses, unlike electrical signals, are almost impossible to intercept or monitor.

6. **Huge Bandwidth**
   
   Fiber can transmit a mind-boggling quantity of data with extremely good transmission quality. Two strands of optical fiber, both no thicker than a human hair, can transmit the equivalent of 24,000 telephone calls simultaneously. By way of comparison, two strands of copper wire can transmit but a single phone conversation—in a much heavier and larger cable. The smaller and lighter fiber strand has over 150 times the data carrying capacity of the bulkier copper cable! Additionally, data is typically transmitted digitally (the natural form for computerized equipment) which reduces translation errors and bottlenecks. Simply put, fiber can transmit signals over the longest distance at the lowest cost.
Glenair's High-reliability fiber optic connectors, such as our D38999 style products, are built to ensure precise optical alignment of optical fibers. Connector polarization keys, keyways and optical cavities are manufactured to tighter tolerances than required by general commercial specifications to reduce radial misalignment and insertion loss.
Total Internal Reflection

The principle of **total internal reflection** is made possible by the difference in materials used in the core and the cladding of the fiber cable, which creates a reflective surface at the point in which they interface. Light pulses entering the fiber core reflect off the core/cladding interface and thus remain within the core as they move down the line.
The optic core is the light-carrying element at the center of the optical fiber. It is commonly made from a combination of highly purified silica and germania. Surrounding the core is the optic cladding made of pure silica. The combination of these materials makes the principle of total internal reflection possible.
The Starting Point of Every Fiber Application: Is it Single Mode or Multimode?

Optical Performance and Bandwidth Requirements Drive Choice

- **Multimode** fiber allows numerous “modes” or light rays to be carried simultaneously through the waveguide—ideal for short-distance applications.

- **Single-mode** fiber allows for a higher data transmission capacity because it retains the fidelity of each light pulse over longer distances, and does not exhibit the dispersion common in multimode systems.

- **Single-mode** fiber also enjoys lower optical attenuation than multimode fiber, so more information can be transmitted per unit of time. But the smaller core diameter requires much tighter tolerances for connectors, splices and termini to achieve satisfactory performance.
Multimode is Easy, Single Mode is Hard

- The ample size of multimode fiber means multimode applications can use lower tolerance tactical, or even commercial type, connectors and still achieve satisfactory performance.
- But low .db loss single mode applications absolutely require tight tolerance connection systems.
Termini Design Elements

Critical Design Elements in Termini Selection

- Mating Cycles
- Gender or Genderless
- Ferrule Material and Design
- Alignment Sleeve Material and Design
- Environmental Sealing
- Insertion Loss Ratings
- Angle Polish (APC)
- Tuning Capabilities
- End-Face Geometry
- Polishing Procedures
Critical Design Elements in Connector Selection

- Contact Size and Density
- Military Specification
- Environmental Sealing
- Dimensional Tolerances
- Front or Rear Release
- Shell Material
- Coupling Mechanism
- Backshell/Dustcover Availability
Specifying Fiber Optic Connection Systems

Introduction to the Hardcopy Documentation

- Catalog is Organized by Connector Systems (Connector/Termini)
  - D38999 Connection System
  - GHD High Density Connection System
  - M28876 Style Connection System
  - NGCON Connection System
  - GFOCA Connection System
  - Expanded Beam Connection System
  - Custom Front-Release Connection System
  - (Accessories)
  - (Test, Inspection and Cleaning Kits)
D38999 Fiber Optic Connection System

- Glenair 38999 style connector
  - Modified version of the 38999 electrical connector in order to insure tighter tolerance and better alignment
  - Available materials range from composite thermoplastic to stainless steal
  - Shell sizes range from 11 to 25, and the corresponding cavity counts from 2 to 37 channels

- Glenair Mil-Qualified 29504/4 and /5 Termini
  - Available in our sameday inventory under both the mil-spec number and commercial equivalent
  - Utilizes precision ceramic ferrules and alignment sleeve integrated with stainless components
  - Typical insertion loss is < 0.5 db
  - Full range of single and multimode versions
Glenair Fiber Optic Termini: Mil-PRF 29504/4&5

Socket Terminus

Pin Terminus

See Note 4

Bottoming Surface

Shrink Tube

Max Dia Cable

080 (2.0)
28876 Style Fiber Optic Connection System

- **28876 Style Connector**
  - Shipboard application connector
  - Glenair offers the commercial equivalent and are now pursuing qualification of this product
  - Shell sizes 11 thru 23, maximum fiber count of 31
  - Aluminum housing and inserts
  - Complete environmental sealing

- **Glenair 29504/14 and /15 Termini**
  - Prototyping stage
  - Precision Ceramic Ferrule and alignment sleeve, coupled with stainless steal components
  - Will be qualified with connector
“NGCON” Fiber Optic Connection System

- Next Generation Connector
  - Glenair is currently participating in a Navy working group to develop a next generation “pure optical” connection system
  - Utilizes the proven technology of both the 28876 and 38999 connector/termini package, the NGCON connection system
  - Mil-PRF document expected Q4 2007
  - 2-36 channels in shell sizes 11, 13, 15, and 25
“NGCON” Terminus Design

Image courtesy Delphi Connection Systems and NGCon Working Group
GHD 18 AWG Fiber Optic Connection System

- 18 AWG Front Release High Density Connection System
  - Nearly double the density of M28876 and D38999
  - Genderless terminus design
  - Precision Mating with guide pins
  - Removable alignment sleeve module
  - APC polish and tunable termini designs
  - Complete environmental sealing
  - Equal optical performance to D38999
  - M85045/16 cable support
Glenair High Density Connector
- Nearly doubles the amount of fiber termini in both the 28876 and 38999 shell sizes.
- Initial prototype production and testing began in early March, 2005.
- Will meet the full range of environmental and optical requirements set forth by its many predecessors.

Terminus Cavity Spacing of .125 inch is achievable by using Glenair’s Front Release Design with M85045/16 Cable

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>Shell Size</th>
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<tbody>
<tr>
<td></td>
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<td>28876 Cavity Count</td>
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<tr>
<td>Glenair High Density Cavity Count</td>
<td>4</td>
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</tbody>
</table>

Glenair High Density Connection System: 8 Insert Arrangements, 4 to 70 contacts
GHD Mating Sequence: 1=Shells, 2=Keys, 3=Guide Pins, and 4=Termini
How to Order GHD Hex Terminus 181-041

Diagram showing dimensions and parts of the GHD Hex Terminus 181-041.
How to Order GHD Keyed APC Polish Terminus 181-047
Detailed View of GHD Removable Alignment Sleeve
How to Order GHD 180-122 (06) Plugs

180-122 XW 06-15-16 NC

- Product Series
- Basic Number
- Material and Finish Symbol (Table I, Page C-6)
- 06 - Plug with Alignment Sleeve Retainer
- C = Conductive O-Ring Included (Omit for Standard O-Ring)
- Alternate Key Position per MIL-DTL-38999 A, B, C, D or E. N = Normal
- Insert Arrangement (See Page C-6)
- Shell Size (Table II)
How to Order GHD 180-122 (H7) Receptacles
GFOCA Fiber Optic Connection System

- GFOCA Connector
  - Most commonly used by the army for long run battle field communication, the GFOCA is a hermaphroditic connector design
  - Aluminum housing and inserts.
  - Complete environmental sealing
  - 2 and 4 channel singlemode and multimode design

- GFOCA Termini
  - Genderless termini which relies on the ceramic alignment sleeve housed in the connector to provide alignment
  - Precision Ceramic Ferrule, 2.5 mm in diameter
GFOCA: Meets Requirements of MIL-PRF-29504/16 and MIL-DTL-83526/16 and /17

- Optical insertion loss: 9/125 SM fiber: 0.25 dB avg.
  - 62.5/125 MM fiber: 0.6 dB avg.
- Operating temperature: -46°C to +71°C
- Mating durability: 2000 cycles
- Crush resistance: 450 lbs.
- Designed for use in
  - Radar Systems
  - Missile Defense Systems
  - Tactical field communications
  - Mobile launchers
How to Order GFOCA 181-050 Termini
How to Order GFOCA 180-117 Receptacle Connector
Expanded Beam Fiber Optic Connection System

- Glenair Lens Connector
  - Second source to the Stratos traditional qualified hermaphroditic product
  - Uses a ball lens to expand transmission beam:
    - 800 times expansion for multimode
    - 2000 times expansion for single mode
  - Beam expansion virtually eliminates any concerns involving contamination
  - Stratos Lens package can be designed into a number of new connector packages:
    - D38999 1 to 4 channels
    - Lanyard release connectors
    - ARINC style connection package
Butt Joint Versus Lens

Optical Performance Versus Environmental Durability

Glenair uses Stratos Lens Connector Technology for its D38999 style lens connector products. Lens technology is ideally suited for environmental field applications.
1-4 Channel Expanded Beam
38999 Series III
Stratos 8 Channel (2X4) Expanded Beam Lens in Mil-C-5015 Type Connector
Glenair now offers Mil-PRF-29504/6 & /7 type termini that “snap” into existing size 16 cavities of ARINC 600 and 404 connectors.
Glenair D-Subminiature and Micro-D Fiber Optics with Front-Release COTS F/O Termini

Glenair Front-Release COTS Termini Features
Integrated O-Ring Sealing and Contact Retention Clip
Fiber Optic Cable

- Engineering expertise in cable design and fabrication
- Aggressive delivery on specialty products
- Standard simplex cable in stock

- Glenair Fiber Optic Cable
  - Extruded in house with no set minimum buy length
  - Multimode and Single-mode product offering
  - Simplex to hybrid special construction
Glenair Fiber Optic Backshells

- **Product Information**
  - Over 50 years of design experience
  - Designed to meet the specific/unique requirements of fiber optic connections
    - Min. Bend radius
    - Pull strength
    - Compressive forces
- **Product Examples**
  - FiberCon grommet feature
  - Retractable conduit fittings
  - Special Clamshell designs
  - Convoluted tubing adapters
Exploded View: Glenair F/O Backshells
Role of Alignment Grommet
Use the Application Checklist to Insure you Have Captured All Technical Requirements for the Application.
Use the Basic Cable Design Worksheet to Insure You Have Captured All Technical Requirements for the Cable Assembly
Use Online “QwikCreate” to Build Part Number Including Glenair ASAP Fiber Optic Cable Assemblies

Glenair ASAP Fiber Optic Assemblies

OUTSIDE THE BOX

- Harsh Environment Overmolded
- Plastic and Metal Core Conduit
- Banding Backshell Assembly

INSIDE THE BOX

- Pigtail with FiberCon Backshell
- Receptacle Pigtail Assembly
- Pigtail Assembly with Conduit

http://www.glenair.com
Why Glenair?

*With so many Mil-Spec connector manufacturers to choose from, what does Glenair bring to the table?*

- Second source to compete with problem suppliers
- Ability to respond to small quantity RFQs for new applications
- Engineering support for package modifications
- No minimum orders for catalog products
- Same-day availability on selected part numbers
- Mil-Spec qualifications on selected series
- Approved and trusted supplier for interconnect hardware
- Complete capability: from MS to custom; from discrete connectors to wired assemblies
A World of Interconnect Solutions