High-Speed Datalink Connectors and Cables for Ethernet-Grade Protocols
Preface: Essential Science and Specifications for High-Speed Datalink Protocols

Key information and vocabulary for electrical wire interconnect system engineers designing for high-speed applications
Bandwidth vs. Data Rate (Bits vs. Hertz)

- **Data Rate**: The number of BITS transmitted per unit time. This includes data compression via specialized integrated circuits.
- **Bandwidth**: Frequency of the carrier wave.
USB 3.1 (Gen 2) vs. 10G-BaseT Ethernet

Interconnect selection depends on protocol specifications

**USB 3.1**
- Data Rate: 10 Gb/s
- Simplex communication for transmit / receive
- Up to 7.5 GHz bandwidth, 90 ohm
- 5 m typical max length, point-to-point link
- Powered

**10G Ethernet**
- Data rate: 10 Gb/s
- Full duplex over 4 pairs.
- Up to 500 MHz of bandwidth, 100 ohm
- 100 m typical max length, 6 mated pairs
- Unpowered
Preface:
Common Ethernet and other High-Speed Signal Protocols

<table>
<thead>
<tr>
<th>Ethernet</th>
<th>Mil/Aero Data Bus</th>
<th>Peripherals/Display/Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-BaseT</td>
<td>MIL-STD-1553</td>
<td>USB 2.0/3.0 and SATA</td>
</tr>
<tr>
<td>100-BaseT</td>
<td>CANBUS</td>
<td>DVI/HDMI/Displayport</td>
</tr>
<tr>
<td>1000-BaseT</td>
<td>MIL-STD-1760</td>
<td>SMPTE HD/3G-SDI</td>
</tr>
<tr>
<td>10G-BaseT</td>
<td>ARINC-429</td>
<td>ARINC 818 Video</td>
</tr>
<tr>
<td></td>
<td>IEEE-1394 (Firewire)</td>
<td>Serial Rapid I/O (sRIO)</td>
</tr>
<tr>
<td></td>
<td>ARINC-664</td>
<td>FiberChannel</td>
</tr>
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<td></td>
<td>PCI Express (PCIe)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aurora (Xilinx serial I/O)</td>
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<td></td>
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<td>SGMII / XGMII</td>
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<td></td>
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<td>Serialized 1 &amp; 10GB Ethernet</td>
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</tbody>
</table>
Copper vs. Fiber: Bandwidth and Distance
Why is Ethernet so Prevalent?

- Ethernet permits lots of data to be efficiently moved (low-bandwidth) over copper cabling.
- Standard Ethernet can reach up to 100 m over copper through multiple mated interconnects.
- The Ethernet protocol is ubiquitous, backward-compatible and subject to ongoing improvement.
How Does Ethernet Work?

- Example of 1000BASE-T, or Gigabit Ethernet
- 1 Gbps data stream is broken into four 250 Mbps streams
- Four transceivers on each end of four twisted pairs
What about 10GB Ethernet?

- Four pairs, 16-level signaling, requires 500 MHz per pair
- Higher-grade twisted pair and shielded pair contacts
- Near- and far-end cross-talk management and echo-cancellation
Preface:

Why is USB prevalent?

- Very high data rates (10Gbps) using cheap hardware (electronics, connectors and cables)
- Cost-effective for use in commercial products for a wide variety of applications
- Massive ecosystem (installed base) of products and solutions
- Power, power, power (up to 100 W with USB3.1)
Preface:

What about other high-speed data protocols?

- SATA, DVI, HDMI, SMPTE 3G-SDI, etc.
- Ideally suited for transmission via shielded (high-frequency) contacts and cables
- Each protocol poses its own unique signal integrity challenges
Overview of Electrical Connector Designs
Optimized for RF/High-Speed/Ethernet

D-Sub miniature
Series 28
HiPer-D high-speed

Sub miniature
Series 233
SuperNine

Ultra Miniature
Series 79
Micro-Crimp

Ultra miniature
Series 80
Mighty Mouse

Micro miniature
MWDM
Micro-D
High-Density 4-Pair Contact

The 10G Ethernet Size 8 contact with patented data pair isolation technology now for both for AWG#26 and AWG#24

- Market leader for Mil-Aero high-speed Ethernet
- 4 differential contact pairs, 90/100Ohm Impedance
- Patented cross-talk isolation technology
- Snap-in, rear release
- Integrated removal tool
- Repairable contact
- Compatible with most current data protocols

The information presented here is Glenair proprietary and confidential.
Construction

Type 1 Socket Contact

Type II Socket Contact

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**Circular Connector Packages**

**Sr. 88 SuperFly**
- Ultra-small
- Lightweight
- IP67
- Push-Pull or thread coupling
- Right-angle PCB option

**Sr. 801 Mighty Mouse**
- Double-Start mating thread
- 10 Insert configurations
- High-performance miniature connector
- Compatible with D38999 contacts

**Sr. 805 Mighty Mouse**
- Triple-start mating thread
- Compatible with D38999 contacts

**Sr. 23 SuperNine**
- MIL-DTL-38999 Series III
- High-vibration/temperature performance
- Compatible with M85049 accessories

The information presented here is Glenair proprietary and confidential.
Rectangular Connector Packages

**Sr. 791 MicroCrimp**
- Next Generation rear-release rectangular connector
- Up to 4 El Ochito contacts
- Scoop proof interface
- Straight and right-angle PC tails
- Environmentally and EMI sealed
- Guide-pins for blind mate

**Sr. 792 MicroCrimp**
- Mini Rack-and-Panel
- Rear-release rectangular connector
- Scoop proof interface
- Environmentally and EMI sealed
- Guide-pins for blind mate

**Sr. 28 HiPer-D**
- Standard M24308 interface dimensions
- Rugged 6061 aluminum shell
- Grounded metal insert
- 2-5 El Ochito contacts
- Straight PC tail
- EMI protected

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Data Protocol Support

**1GbE/10GbE**
- Straight upgrade for Quadrax solutions to higher-speed Ethernet applications
- Compliant with ARINC 664

**USB 3.1 Gen 1**
- Low-dielectric material for 90 Ohm impedance on SuperSpeed USB pairs
- 24AWG wire for power pairs
- Fully compliant with USB 3.1 gen. 1 specification

**HDMI/DisplayPort/SATA**
- 100 ±15 Ohm Board-to-cable and cable-to-cable (50ps 10/90 rise time).
- Suitable for high-resolution displays and peripheral drives
- May require additional discrete contacts

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Signal Integrity Calculations

Full HFSS model simulations for optimal material and contact design

90 ± 5 Ω differential impedance

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Protocol Compliance Testing

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Cable Assembly Performance

- Insertion Loss
- Near-End Cross-Talk
- Far-End Cross-Talk
- Mode Conversion

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## Environmental Testing

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Test Standard</th>
<th>Condition</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability</td>
<td>250 mate-de-mate cycles</td>
<td>No damage/exposed base metal</td>
<td>PASS</td>
</tr>
<tr>
<td>Performance at temperature</td>
<td>TIA 568-C.2</td>
<td>Cat 5E STP</td>
<td>PASS</td>
</tr>
<tr>
<td>Thermal shock testing</td>
<td>EIA-364-32C</td>
<td>test condition VII (25 Cycles, -55°C/+175°C)</td>
<td>PASS</td>
</tr>
<tr>
<td>Vibration</td>
<td>SAE AS39029/120</td>
<td>50.5G RMS</td>
<td>PASS</td>
</tr>
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Assembly Process

Standard tooling, detailed instructions, factory support

- Straight-forward termination process
- No critical insertions
- Faster and easier termination than twin-Quadrax

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Ochito Cable Assemblies

857X
- 8571: Ochito White
- 8572: Ochito Blue
- 8573: Ochito Red

-000X
- -0001: Single Ended Ochito
- -0002: Back to Back Ochito
- -0003: Ochito to COTS

Cables
White: 963-033 & 963-003
Blue: 963-110 & 963-118
Red: 963-033
Flight Heritage

Acceptance on major OEM platforms

- General Dynamics
- Raytheon
- Embraer
- Gulfstream
- Bombardier
- Kontron
- Honeywell
- Harris
- Curtiss-Wright
Octobyté™: The Ethernet MVB-WTB Datalink Solution for Rail / Industrial Environments

Ruggedized 4/8 pole interconnect system

- High-speed Ethernet for ultra-harsh industrial environments
- Hybrid Ethernet, signal and power
- Anti-vibration coupling
- MWB-WTB and Coax with limited loss over long distances and/or multiple interconnection breaks
Size #12 Ultra-Twinax Contacts

For Mighty Mouse, Micro-Crimp, and Super-Twin connectors

- Size 12 Differential Twinax contacts
  - 10GHz electrical bandwidth
  - Compatible with all high-speed protocols
  - Modular deployment
  - Field-tested performance
Size #8 Keyed Twinax Contacts

Differential Twinax contacts for #24 and #26 AWG twisted-pair wire

- Snap-in, rear-release
- For Series 80 Mighty Mouse and MIL-DTL-38999 type connectors
- 68 ohm, 75 ohm, 77 ohm and 100 ohm impedance
- Operating frequency 0 – 20 MHz
Quadrax Contacts

High-speed, industry-standard, flight ready

- Crimp size #24 contact for 22, 24, and 26 AWG cable
- Field-repairable
- Rugged, durable mating performance
- Accepts broad range of flight-ready 100 Ohm Ethernet Quadrax cable
- Drop-in solution to keyed size #8 cavity inserts
Connector Packaging for Quadrax Contacts

SuperNine
(MIL-DTL-38999 Series III)

Series 80
Mighty Mouse

Series 28 MIL-DTL-24308
type HiPer-D

Series 79
Micro-Crimp
The modular high-speed contact system for Cat 6A 10G Ethernet applications

- Uses industry standard #22D contacts for #24 AWG high-speed Ethernet cable
- Available today for SuperNine – the better than QPL MIL-DTL-38999
- Shell sizes 9, 17, 19, 21, 23 and 25 with one to seven contact modules
**SPEEDMASTER**

Exploded View

- Threaded shield ferrule with wrench interface (9mm), shield ferrule without threads also available
- Genderless contact module for plug with pin/socket or receptacle with pin/socket interface with 8 contacts per module
- Industry standard size #22 contacts
- Proven performance 38999 type shell

Glenair
The modular high-speed contact system for Cat 6A 10G Ethernet

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Excellent high-speed / Ethernet performance</td>
<td>Cat6A with large NEXT, return loss, and insertion loss margins</td>
</tr>
<tr>
<td>Fast and reliable assembly, termination, rework and repair</td>
<td>• Standard 22D crimp contacts and tools&lt;br&gt;• Wide range of supported 24 AWG high-speed cable&lt;br&gt;• Straightforward shield termination process</td>
</tr>
<tr>
<td>Aerospace-grade environmental and mechanical performance</td>
<td>• Temperature shock cycling&lt;br&gt;• Random vibration&lt;br&gt;• Mating durability</td>
</tr>
<tr>
<td>Diverse connector packaging</td>
<td>Modular design to fit inside D38999 style and ARINC 801 shells</td>
</tr>
<tr>
<td>Weight reduction</td>
<td>High-density, small form-factor, aluminum and composite materials</td>
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SuperSeal High-Speed Mighty Mouse and D38999 Field RJ45 and USB

- IP67 sealing in unmated condition
- Crimp and poke termination
- Superior grounding
SuperSeal D38999 Type Field RJ45 Connectors

- Connector/Adapter with RJ45 Jack/Jack or Plug/Jack Couplers
- Connector with RJ45 Jack or Plug to Rear Crimp Contact Termination
- Connector with RJ45 Jack to PC Tail Termination
- Connector with RJ45 Jack to Rear Solder Cup Termination
- Connector with Pin or Socket Contacts to RJ45 Jack or Plug Interface
- Connector with Pin or Socket Quadrax to RJ45 Jack or Plug
- Feed-Thru Receptacle with RJ45 Jack-to-Jack Coupler
SuperSeal D38999 Type Field USB Connectors

- Connector with USB Type A or B Plug-to-Receptacle or Receptacle-to-Receptacle Coupler
- Connector with USB Type A or B Receptacle to Crimp Contacts
- Receptacle with USB Type A or B Receptacles to PC Tail Termination
- Receptacle with USB Type A or B Receptacles to Solder Cup Termination
- Connector with Pin or Socket Contacts to USB Type A or B Receptacles
SuperSeal Series 80 Mighty Mouse Field USB Connectors

Plug with Micro-B USB Plug and Rear Crimp Contacts

Receptacle with Micro-AB USB Receptacle and Rear Crimp Contacts

Plugs with Front and Rear Micro-B USB Plugs

Receptacle with Front and Rear Micro-AB USB Receptacles

Sav-Con® with Micro-B USB Plug and Micro-AB USB Receptacle
Glenair Culture

One-of-a-Kind Service From a One-of-a-Kind Supplier

- Outstanding product availability: literally thousands of items in stock
- Liberal policies on NRE costs, samples, and RMA’s
- The industry’s best engineering and technical support team
- No dollar or quantity minimums on standard products
- Comprehensive product documentation and information access
- Ample, professionally-managed manufacturing capacity
- The size and scale to tackle every interconnect challenge
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