

The widest range of
mission-critical interconnect
technologies in the world



**High-Speed Datalink Connectors and
Cables for Ethernet-Grade Protocols**

Preface: Essential Science and Specifications for High-Speed Datalink Protocols

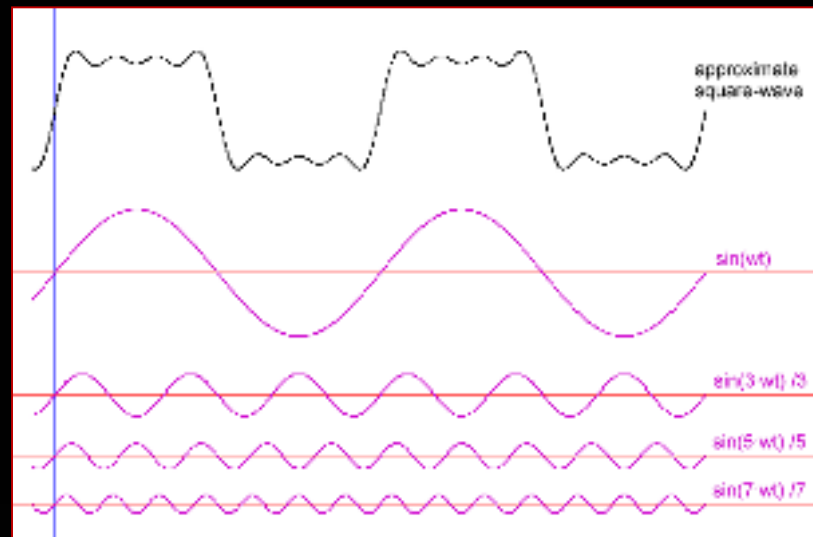
Key information and vocabulary for electrical wire interconnect
system engineers designing for high-speed applications



Preface:

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



Preface:

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

Ethernet

- 10-BaseT
- 100-BaseT
- 1000-BaseT
- 10G-BaseT

Mil/Aero Data Bus

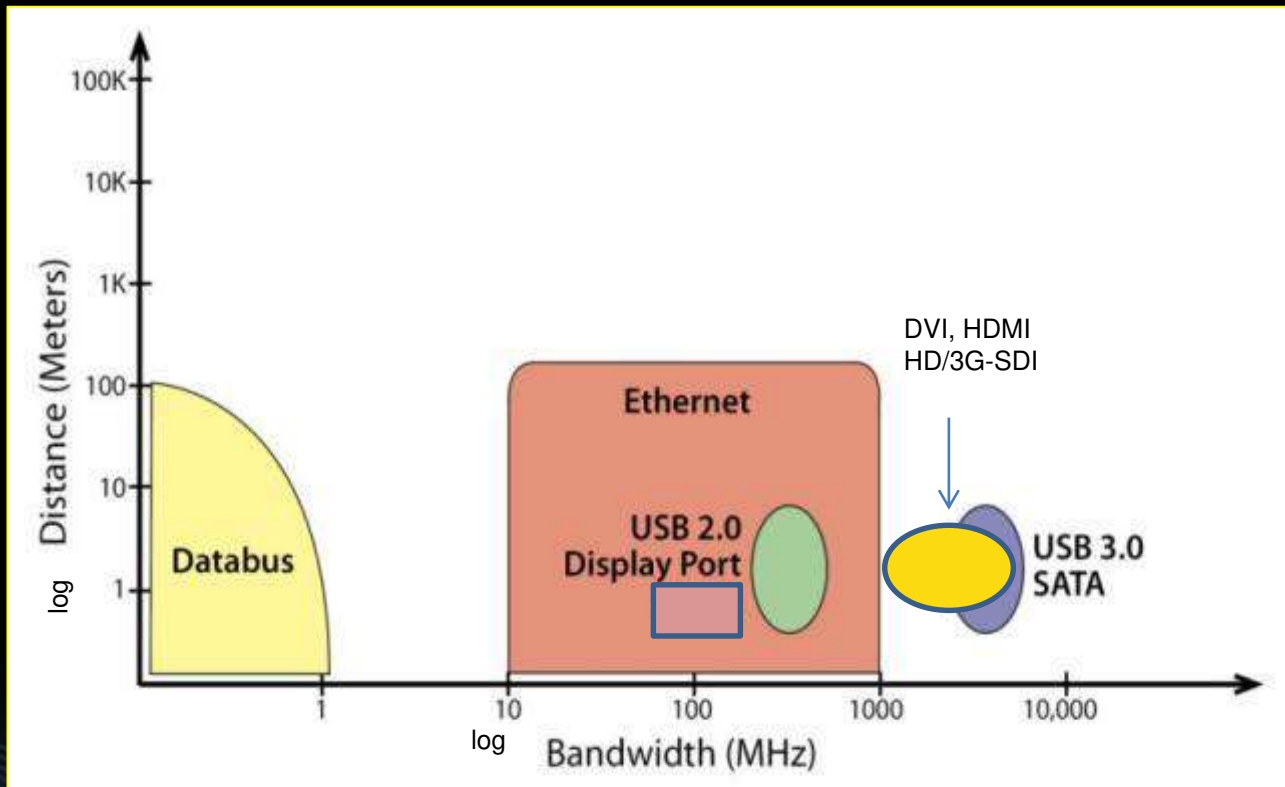
- MIL-STD-1553
- CANBUS
- MIL-STD-1760
- ARINC-429
- IEEE-1394 (Firewire)
- ARINC-664

Peripherals/Display/Video

- USB 2.0/3.0 and SATA
- DVI/HDMI/Displayport
- SMPTE HD/3G-SDI
- ARINC 818 Video
- Serial Rapid I/O (sRIO)
- FiberChannel
- PCI Express (PCIe)
- Aurora (Xilinx serial I/O)
- SGMII / XGMII
 - Serialized 1 & 10GB Ethernet

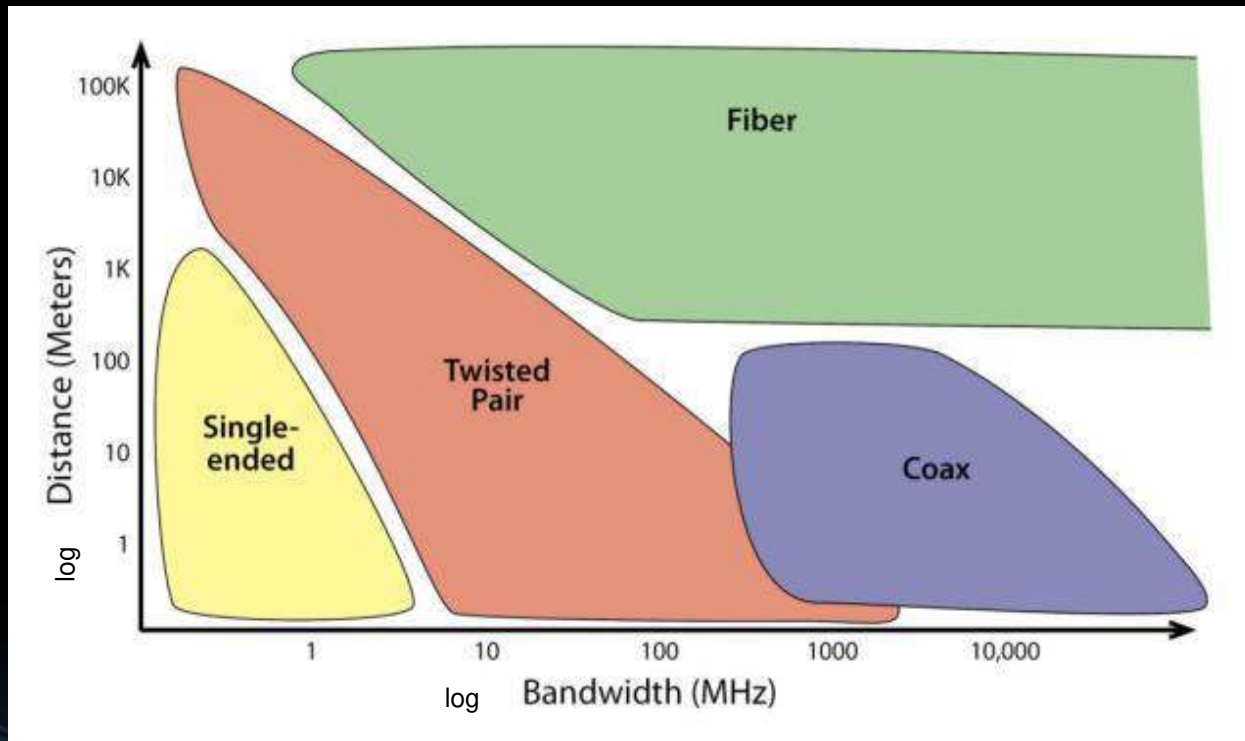
Preface:

Data Protocols: Bandwidth and Distance



Preface:

Copper vs. Fiber: Bandwidth and Distance



Preface:



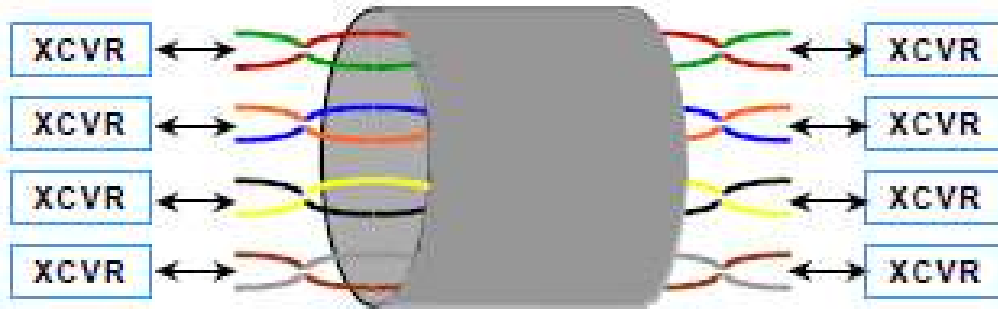
Why is Ethernet so Prevalent?

- 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

Preface:

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



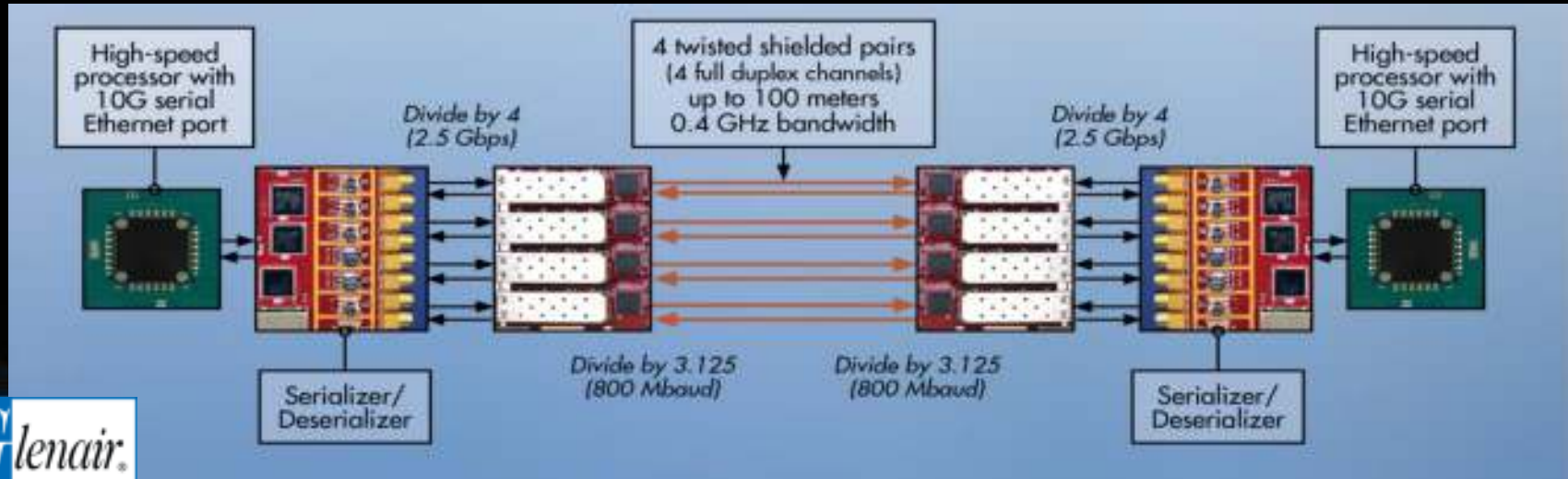
250 Mbits/sec on each
pair in each direction

2 bits/symbol -> 125
Msymbols/sec

Preface:

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

RF, Microwave, and DataLink Contact Selection Guide

**Size #8 AS39029 Coaxial**

For RG-180 cable. Crimp termination. Snap-in, rear release. Compatible with D38999, SuperNine, and Mighty Mouse connectors with size 8 cavities. dc – 700 MHz.

**Size #12 AS39029 Coaxial**

For RG-174, RG-179, RG-180 and RG-316 cable. Crimp termination. Snap-in, rear release. Compatible with D38999, SuperNine, Series 79 MicroCrimp and Mighty Mouse connectors with size 12 cavities. dc – 3 GHz.

**Size #16 AS39029 Coaxial**

For RG-174, RG-178, RG-179 and RG-316 cable. Crimp termination. Snap-in, rear release. Compatible with D38999, SuperNine, Series 79 and Mighty Mouse connectors with size 16 cavities. dc – 500 MHz.

**Size #8 50 Ohm Matched-Impedance**

For RG-316 and M17/220-0001 cable. Compatible with D38999, SuperNine and Mighty Mouse connectors. Crimp termination. Snap-in, rear-release. 50 ohm impedance. dc – 6 GHz.

**Size #12 50 Ohm Matched-Impedance**

For RG-178, RG-316, and RG-405 flex cable. Compatible with D38999, SuperNine, Series 79 and Mighty Mouse connectors. Crimp termination. Snap-in, rear-release. 50 ohm impedance. dc – 3 GHz.

**Size #8 75 Ohm Matched-Impedance**

For RG-179, RS170, SMPTE 292M, SMPTE 424M and other cables. Compatible with D38999, SuperNine and Mighty Mouse connectors. Crimp termination. Snap-in, rear-release. dc – 4 GHz.

**Size #12 75 Ohm Matched-Impedance**

For high performance RS170, SMPTE 292M and other video cables. Compatible with D38999, SuperNine, Series 79 and Mighty Mouse connectors. Crimp termination. Snap-in, rear-release. dc – 3 GHz.

**Size #8 Spring-Loaded BMB 18 GHz**

Conform to the MIL-STD-348 BMB interface standard. For RG-402-FLEX and RG-405-FLEX cables. Compatible with D38999, SuperNine and Mighty Mouse connectors. Solder termination. dc – 18 GHz.

**Size #12 SMPM Style Spring-Loaded 40 GHz**

For RG-405-FLEX cable, compatible with D38999, SuperNine, Series 79 and Series 80 Mighty Mouse connectors. Solder termination. dc – 40 GHz.



Size #8 AS39029 Concentric Twinax
For 77 ohm shielded twisted pair cable. Meet the requirements of M39029/T13 and /T14. Compatible with D38999, SuperNine and Mighty Mouse connectors. Use with M17/176-00002 databus cable, 10 MHz maximum operating frequency.

**Size #8 100 Ohm Concentric Twinax**

For 24 AWG 100 ohm shielded twisted pair data cable. Compatible with D38999, SuperNine and Series 80 Mighty Mouse connectors. Accepts TE/Raychem 0021A0024 and Gore GSC-03-81416-00 cables.

**Size #12 Concentric Twinax**

For 77 ohm shielded twisted pair data cable. Used for MIL-STD-1553 databus applications. Meet the requirements of JN1104, DSCC 02003 and DSCC 02004. For D38999. Snap-in, rear release, crimp termination.

**Size #8 100 Ohm Differential Twinax**

For 68, 75, 77 and 100 ohm shielded twisted pair cable including M17/176-00002 databus cable. For Mighty Mouse connectors and Glenair 233-217 D38999-type Series II connectors with keyed #8 cavities. dc – 3 GHz

**Size #12 100 Ohm Differential Ultra-Twinax**

For multi-gigabit data rate applications such as CML, LVDS. Use high-speed #30 AWG twisted pair cable. For Mighty Mouse connectors with size #12 cavities. dc – 10 GHz; frequency range. Solder termination.

**Size #8 100 Ohm and 150 Ohm Quadrax**

100 ohm Ethernet / 150 ohm Fibre Channel. Compatible with Mighty Mouse and Glenair 233-217 D38999-type Series III connectors with keyed #8 inserts. Accept aerospace grade quad cable.

**Size #8 EI Ochito™**

1000BASE-T and 10GBASE-T capability. #8 snap-in contact with eight inner contacts. Data pair isolation technology reduces crosstalk between pairs. Accepts flight-grade Cat6a cable with #26AWG conductors.

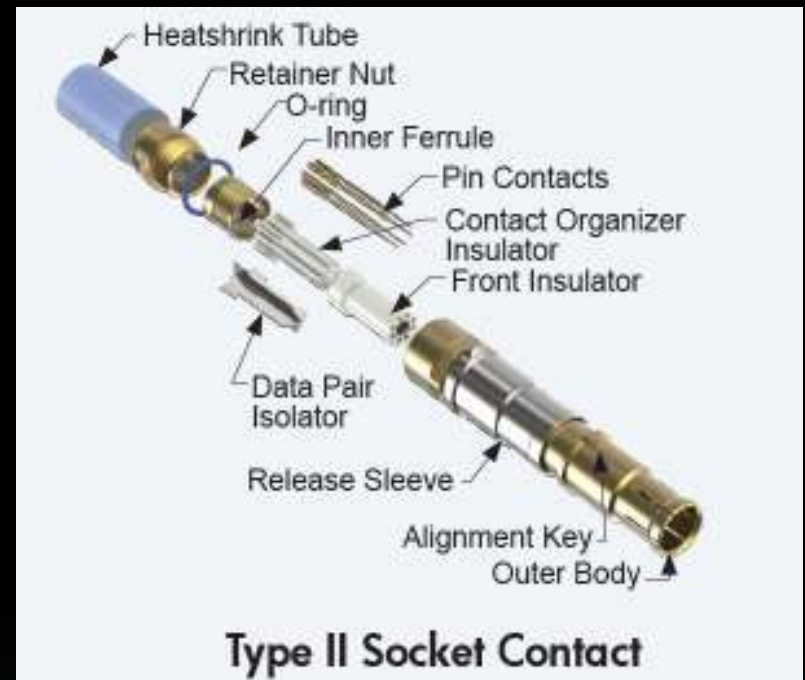
El Ochito[®] High-Density 4-Pair Contact

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



El Ochito® Construction



El Ochito® 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



El Ochito[®] 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



El Ochito® Data Protocol Support

Ochito "White"



1000BASE-T, 10GBASE-T

1GbE/10GbE

- Straight upgrade for Quadrx solutions to higher-speed Ethernet applications
- Compliant with ARINC 664

Ochito "Blue"



SuperSpeed USB

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

Ochito "Red"



HDMI, Displayport, SATA

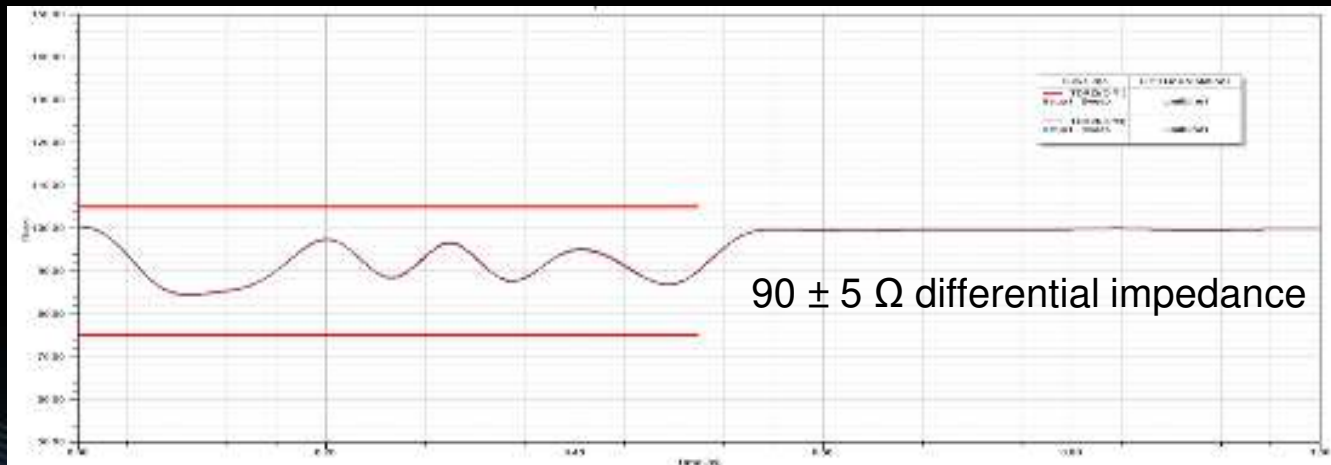
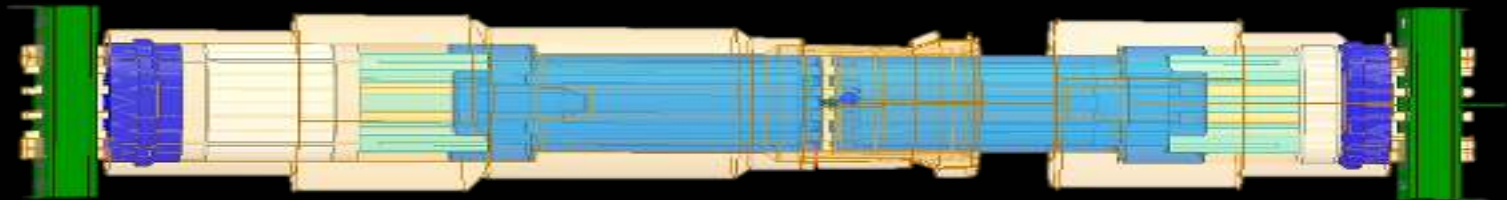
HDMI/DisplayPort/SATA

- 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

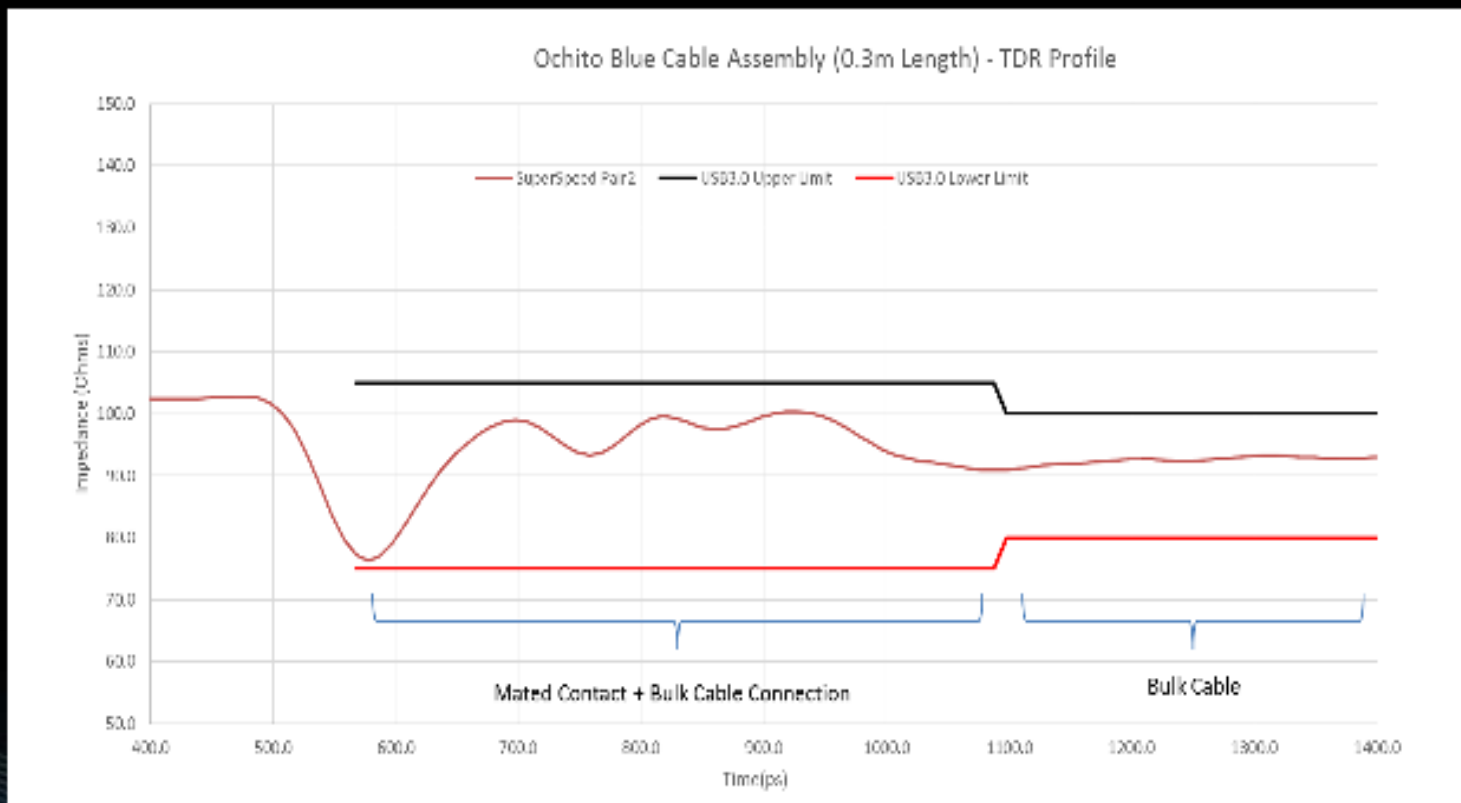


El Ochito[®] Signal Integrity

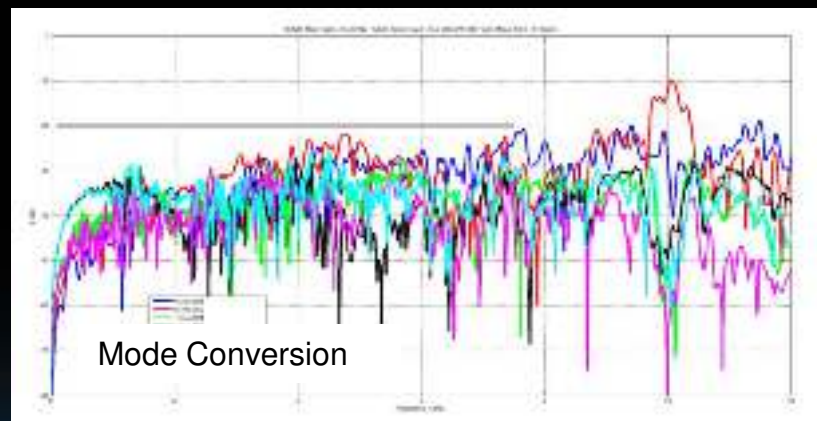
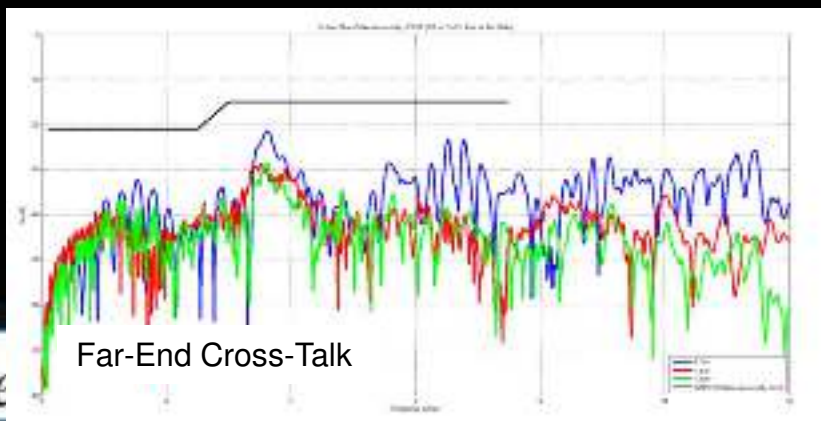
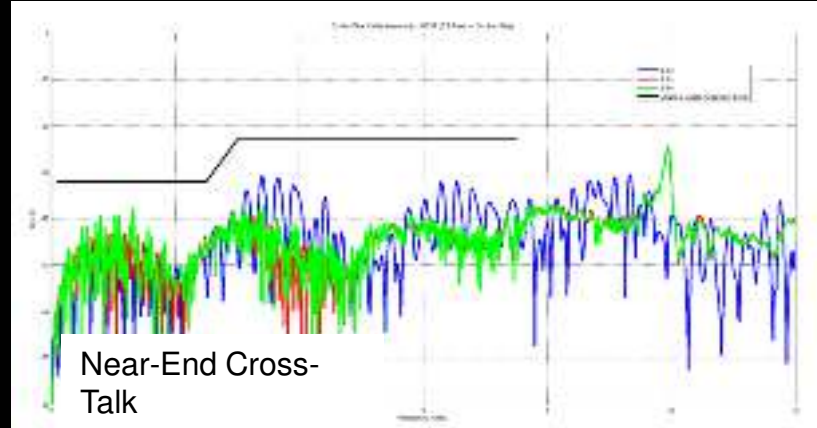
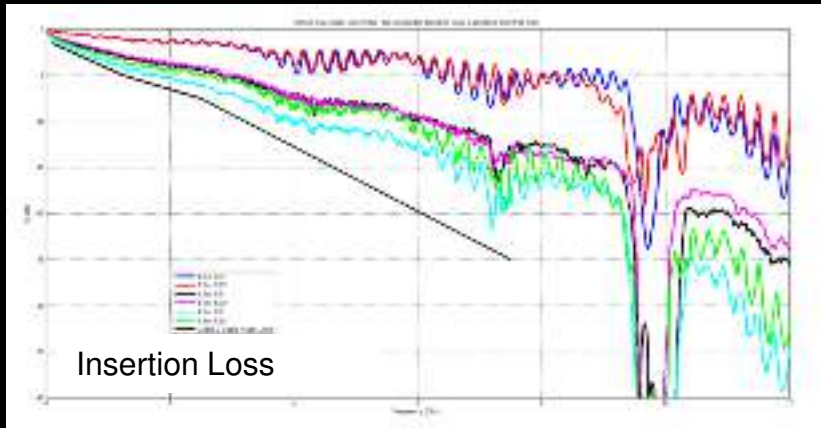
Full HFSS model simulations for optimal material and contact design
Calculations



El Ochito[®] Protocol Compliance Testing



El Ochito[®] Cable Assembly Performance



El Ochito[®] Environmental Testing

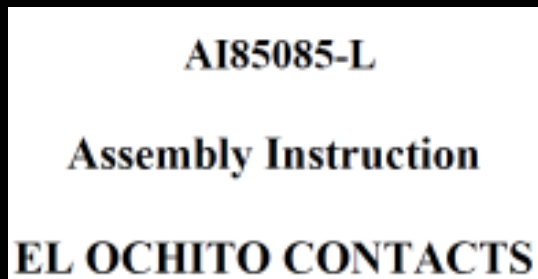
Test Description	Test Standard	Condition	Result
Durability	250 mate-de-mate cycles	No damage/exposed base metal	PASS
Performance at temperature	TIA 568-C.2	Cat 5E STP	PASS
Thermal shock testing	EIA-364-32C	test condition VII (25 Cycles, -55°C/+175°C)	PASS
Vibration	SAE AS39029/120	50.5G RMS	PASS



El Ochito[®] Assembly Process

Standard tooling, detailed instructions, factory support

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



- M12520-2-01 AFM8 Crimper & positioner or equivalent.



- Hot Tweezers



- Nice Files, Cutter, Exacto Knife, Tweezer, Caliper.



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

El Ochito® Flight Heritage

Acceptance on major OEM platforms

- General Dynamics
- Raytheon
- Embraer
- Gulfstream
- Bombardier
- Kontron
- Honeywell
- Harris
- Curtiss-Wright



Octobyte™: 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
- MVB-WTB and Coax with limited loss over long distances and/or multiple interconnection breaks

Octobyte



Size #12 Ultra-Twinax Contacts

HighSpeed
datalink group

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

HighSpeed
datalink group

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

HighSpeed
datalink group



SuperNine
(MIL-DTL-38999 Series III)



Series 80
Mighty Mouse



Series 28 MIL-DTL-24308
type HiPer-D



Series 79
Micro-Crimp

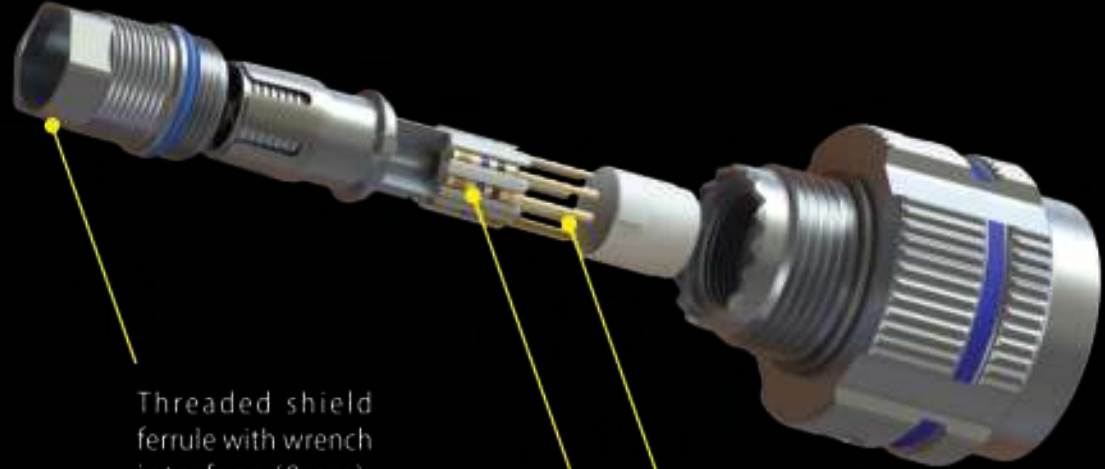
The modular high-speed contact system for Cat 6A 10G Ethernet applications

- 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

HighSpeed
datalink group



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



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

Excellent high-speed / Ethernet performance	Cat6A with large NEXT, return loss, and insertion loss margins
Fast and reliable assembly, termination, rework and repair	<ul style="list-style-type: none">• Standard 22D crimp contacts and tools• Wide range of supported 24 AWG high-speed cable• Straightforward shield termination process
Aerospace-grade environmental and mechanical performance	<ul style="list-style-type: none">• Temperature shock cycling• Random vibration• Mating durability
Diverse connector packaging	Modular design to fit inside D38999 style and ARINC 801 shells
Weight reduction	High-density, small form-factor, aluminum and composite materials

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/Plug or Plug/Plug 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



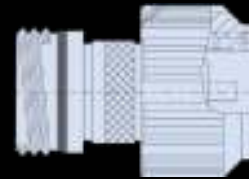
Receptacle with Micro-AB USB Receptacle
and Rear Crimp Contacts



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



The widest range of
mission-critical interconnect
technologies in the world



**High-Speed Datalink Connectors and
Cables for Ethernet-Grade Protocols**