QwikConnect®

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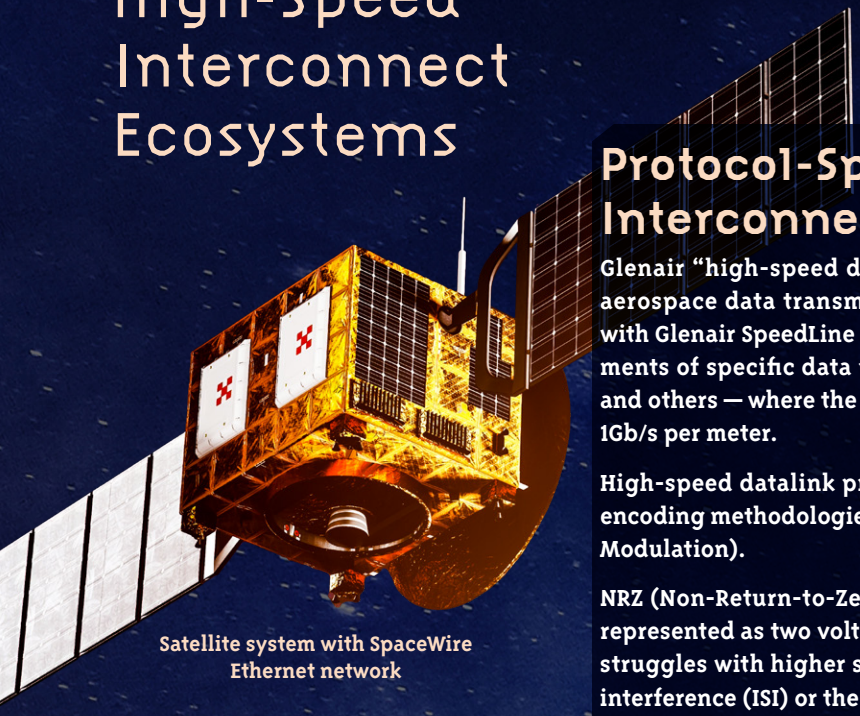
SpeedLine™
High-Speed Interconnect Ecosystems

Glenair®

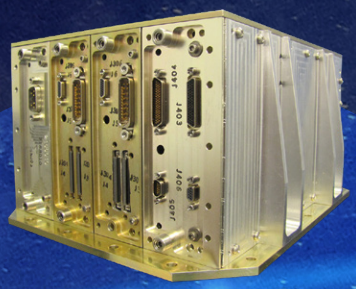
SpeedLine™
High-Speed Protocol Cables

SpeedLine™

High-Speed Interconnect Ecosystems



Satellite system with SpaceWire Ethernet network



Satellite control computer with SATA datalinks

Flight computer with PCIe board-to-board interface

Subsea camera with LVDS and Ethernet datalinks

Protocol-Specific, High-Speed Interconnect Ecosystems

Glenair "high-speed datalink" products are designed for rugged military-aerospace data transmission applications and optimized for compatibility with Glenair SpeedLine cables. Assemblies are engineered to meet the requirements of specific data protocols — such as Ethernet, USB, DisplayPort, HDMI, and others — where the product of the data rate times the cable length exceeds 1Gb/s per meter.

High-speed datalink protocols fall broadly into two categories according to encoding methodologies: NRZ (Non-Return-to-Zero) and PAM (Pulse Amplitude Modulation).

NRZ (Non-Return-to-Zero) is a simple binary signaling method where data is represented as two voltage levels (high = 1, low = 0). It's easy to implement but struggles with higher speeds due to signal integrity issues like inter-symbol interference (ISI) or the distortion that may occur in a signal when overlapping symbols blur together, causing errors in data transmission.

PAM (Pulse Amplitude Modulation) uses multiple amplitude levels to encode more bits per signal change. For example, PAM-4 (commonly used in modern high-speed data transmission) uses four levels, allowing it to transmit twice the data rate in the same bandwidth compared to NRZ.

The distinction between these two signaling formats is important because it forces the design of cables and connectors into different directions. NRZ data streams are typically more robust against noise and jitter, whereas PAM format does not require as high a frequency bandwidth for the same data rate. Examples of protocols using these two formats are:

NRZ:

- USB (cellular phones, PDA computers, digital storage devices)
- PCIe (board-to-board data comms)
- SATA (flight computers, hard drives, and SSDs)
- CAN Bus (automobile networks and industrial machines)
- RS-485 and RS-422 (legacy serial communications)
- LVDS (high-resolution screens and cameras)

PAM:

- Ethernet (ubiquitous land, sea, air, and space; 10Gbps and faster)
- PCIe 6.0+ (board-to-board graphic cards and SSDs)
- USB4 v2.0 and Thunderbolt 4 (latest-generation USB interconnections)

Glenair high-speed datalink products are conceived as integrated ecosystems designed to work seamlessly together to meet the specific bandwidth and compatibility requirements of the above protocols. Assembled from fully qualified cable, contact, and connector components, our high-speed solutions are optimized to meet the distance, bandwidth, and signal integrity requirements of even the most rugged military / aerospace environments.

El Ochito Octaxial Interconnect Ecosystems

Legacy 10/100 Base-T Ethernet protocols on aircraft use a quadraxial cable and contact system made up of two 100 Ohm differential pairs laid crosswise in a shielded cable. Cables are terminated to a four-pin shielded contact with ground continuity provided through the connector interface. The four-pin quadrax contact is designed for ready insertion into a size #8 connector cavity. The popular cable/contact technology is supported by any number of standard connector insert configurations for use in aerospace-grade mulitpin connectors such as MIL-DTL-38999.

Building on this successful architecture, Glenair developed a higher-density 8-contact module for higher data rate protocols called El Ochito ("The Little Eight"). Doubling the density of contacts compared to quadrax enables users to seamlessly upgrade from 10/100 Base-T to Gigabit-Ethernet — all within a single contact cavity, saving significant size and weight. The corresponding Glenair SpeedLine cable is engineered for high crosstalk suppression, as demanded by the PAM modulation format of the faster Ethernet protocols.

A careful study of the signal integrity of El Ochito contacts for Ethernet showed that the same architecture could be utilized with dielectric modifications for higher bandwidth NRZ protocols such as Super-Speed USB and HDMI. This led to the expansion of the series to a 90-Ohm USB variant —El Ochito Blue, with 2 SuperSpeed Pairs, one power pair and a legacy data pair — as well as a tightly controlled 4-pair 100 Ohm version for DisplayPort protocols (El Ochito Red).

For each of the above El Ochito ecosystem variants, a carefully-constructed SpeedLine cable was developed by Glenair utilizing materials suitable to the wide range of temperatures encountered in military and aerospace environments. While low-speed applications may reliably use single-ended hook-up wire per Mil-Star GS22759, high-speed differential data pairs must use high-performance cables with low-dielectric constant fluoropolymers and multiple layers of shielding.

Incorporation of El Ochito into the full range of Glenair signature connector shells is another key aspect of this ecosystem solution. In fact, El Ochito has been engineered for easy incorporation into Glenair mission-critical connector platforms such as SuperNine, Series 806 Mil-Aero, SuperFly DataLink, and Series 792 rectangular. Aerospace industry standard EN 4165, ARINC 600, and D38999 Series I through IV are also supported.

El Ochito®

El Ochito high-speed interconnect ecosystem for 10 Gb Ethernet, SuperSpeed USB 3.0, HDMI, SATA, and DisplayPort

The packaging versatility of El Ochito enables designers to take advantage of superior interconnect environmental, mechanical, and electrical performance — regardless of selected data protocol. Long gone are the days of compromising system performance envelopes due to the forced use of commercial-grade interconnect platforms.

The complete El Ochito ecosystem supports 90% of the industry standard I/O protocols, is available in almost any connector geometry, and has optimized cable designs for each situation. The product is supplied in discrete component parts, as well as pre-terminated single- and double-ended SpeedLine jumpers, plus turnkey cable, I/O, and board assemblies.

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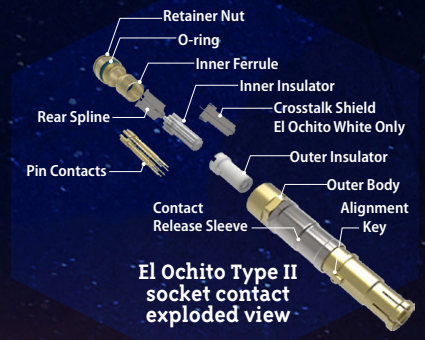
EL OCHITO ECOSYSTEM



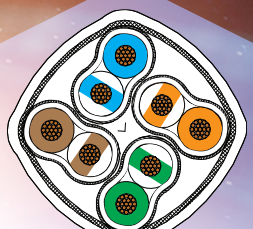
El Ochito Type II socket contact exploded view

El Ochito White
1000BASE-T / 10GBASE-T
40GBASE-T

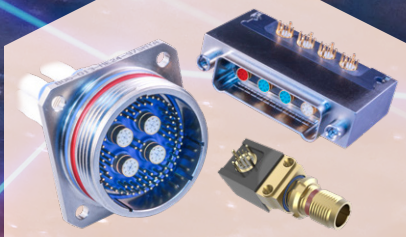
El Ochito Blue
SuperSpeed USB 3.0

El Ochito Red
HDMI, SATA,
DisplayPort

Contact Dielectric Variants



SpeedLine
963-066-24 100 Ohm #24AWG
4-pair shielded cable



El Ochito connector packaging

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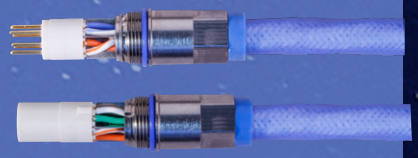
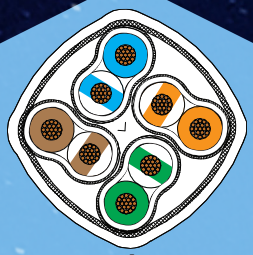
High-Speed Protocol Cables
SPEEDMASTER ECOSYSTEM

SpeedMaster™ 10G contact modules



SpeedMaster™ crimp termination



SpeedLine
963-066-24 100 Ohm #24AWG
4-pair shielded cable

SpeedMaster™ interconnect packaging

SpeedMaster™ 10G Ethernet Ecosystem

SpeedMaster is an 8-way shielded contact system for 10GbE applications. SpeedMaster offers support for up to 24 AWG wire, uses the same standard M39029 size #22D contacts as those terminating single-ended hookup wire, and can be repaired in the field since shield termination is threaded and not crimped. The SpeedMaster 10G contact system offers industry-leading NEXT, return loss, and insertion loss performance due to its highly-engineered isolation and separation architecture. SpeedMaster meets the broad range of aerospace industry requirements for vibration, temperature cycling, durability, and safe, reliable performance — all with considerable weight savings compared to Quadrax 10G Ethernet solutions.

Easily removable and repairable, the shielded high-performance contact system — packaged in signature Glenair aerospace-grade connectors — reduces network downtime and improves network function and performance. SpeedMaster is not a drop-in contact module solution like Quadrax or El Ochito. SpeedMaster is a turnkey connector / contact assembly with its own high-density insert arrangements for SuperNine (up to 7 channels), Series 7925 advanced-performance rectangular, and Series 804 push-pull Mighty Mouse. Each SpeedMaster shielded contact module is a complete 10G datalink consisting of 4 pairs of industry-standard size #22D contacts. Each module is individually shielded and retained in place with a threaded ferrule. Connector insert cavities are genderless, allowing both a pin or socket interface for plugs and receptacles. Environmental and hermetic-class connectors are available.

Similar to El Ochito, the SpeedMaster ecosystem is a complete interconnect and cable offering. The larger size #22D contact is primarily optimized for high-speed Ethernet protocols. In this regard, SpeedMaster uses the same SpeedLine cable as El Ochito White for 10 Gb Ethernet protocol applications. Turnkey SpeedLine / SpeedMaster assemblies are factory-terminated and tested for optimal signal integrity.

10K PSI RATED

SeaKing 700 Subsea overmolded assembly with 10 Gb Ethernet SpeedMaster inserts

VersaLink™ 28 Gbps Twinax Ecosystem

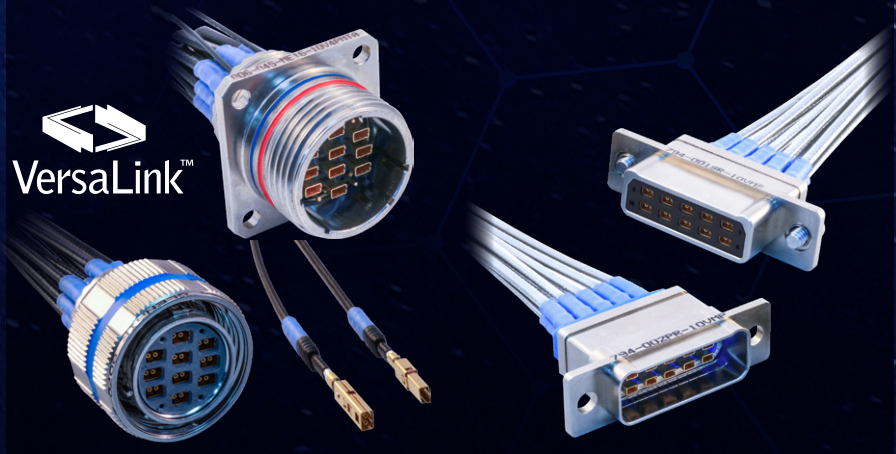
VersaLink is a revolutionary "zero-crosstalk" high-speed shielded twinax contact system capable of the highest-speed digital data transmission of any Glenair shielded contact, and is optimized for ultra high-bandwidth 40GbE, USB 3.1 gen 2, USB 3.2, USB4, SATA, PCIe, DisplayPort, and HDMI protocols. This is one of the first Glenair products developed from the ground up using ANSYS simulation software, which which allowed simulation of signal integrity performance with limitless iterations before prototyping.

The VersaLink contact module evolved from concentric mil-spec twinax contacts with circular outer shields to a rectangular form-factor, resulting in greatly improved signal integrity, contact density, and mechanical alignment within the connector. Installed in a multi-cavity connector, each shielded VersaLink twinax contact module outputs virtually zero crosstalk to adjacent modules.

In VersaLink, the pin and socket are molded and shielded as a pair, wire crimped as a pair, and installed as a pair. This enables the transition from cable-to-contact-to-connector to be exquisitely matched to the impedance of the line.

The starting point for this signature connector ecosystem is the 26AWG 100-Ohm differential pair SpeedLine cable, available in both a twisted-pair configuration and an innovative flat-pair design. The twisted-pair version is optimized for flexibility, while the flat-pair delivers best-of-class signal integrity.

VersaLink is packaged in a variety of Glenair signature connectors. The crimp-removable contact pair is housed in a rectangular connector cavity, available in numerous insert arrangements for both circular (Series 806 Mil-Aero micro miniature) and rectangular (high-performance Series 794 and industry-standard Micro-D) connectors. Rectangular form-factor connectors deliver space-efficient, high-density contact layouts, while the circular Series 806 variant is ideal for applications that require frequent mating and demating.



Glenair SpeedLine high-speed cable assemblies for VersaLink™ include factory-terminated pigtails and double-ended jumpers as well as turnkey Series 806 Mil-Aero and Series 794 Micro-Crimp high-density solutions

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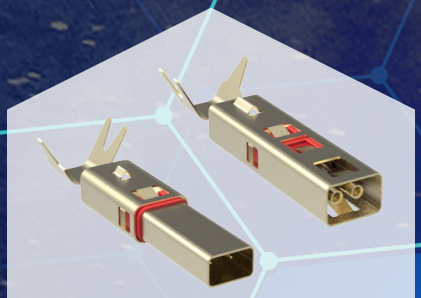
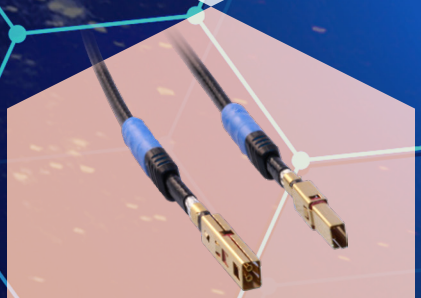
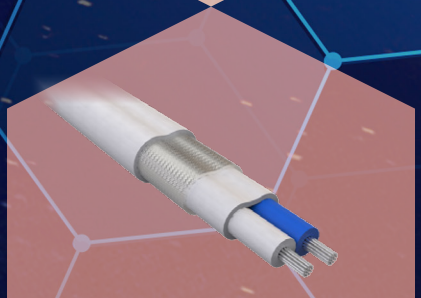
VERSALINK ECOSYSTEM



VersaLink™ shielded twinax contact module



VersaLink™ crimp contact wire termination



SpeedLine 100 Ohm differential pair cable

High-speed, rugged mil-aero rectangular VersaLink Micro-D

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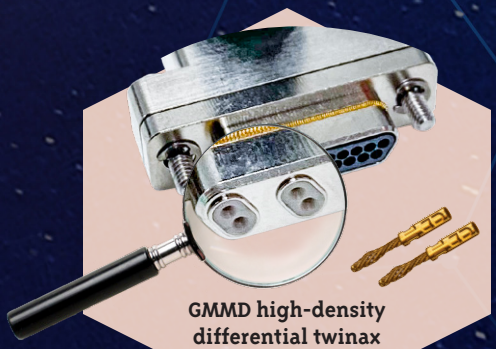
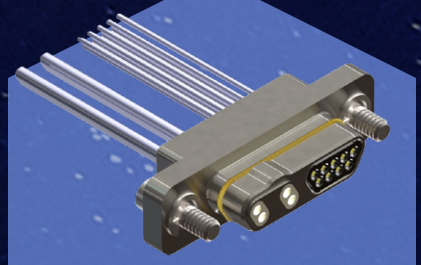
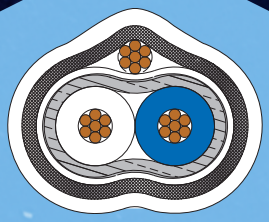
High-Speed Protocol Cables
GMMD ECOSYSTEM



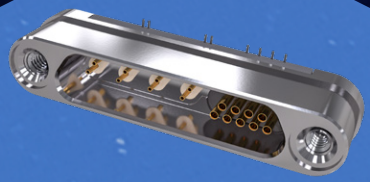
GMMD high-density differential twinax contact modules



GMMD SpeedLine wire lead terminations



SpeedLine differential twinax cable with drain wire 963-065-30



GMMD Micro-D packaging with up to 16 twinax modules

Glenair Modular Micro-D (GMMD) Ecosystem

Glenair Modular Micro-D (GMMD) is a high-speed micro miniature ecosystem that delivers up to 18 Gbps data rate performance per Twinax pair. Like VersaLink, it is a unique Signature solution with an insert configuration purpose-designed to incorporate the low-crosstalk paired Nano TwistPin contact modules that are the heart of this Micro connector. But this connector also has the ability to support hybrid layouts that include both the unique GMMD high-speed Twinax as well as 50 and 75 Ohm coax, mixed signal and power. This capability makes the GMMD extremely versatile and valuable for applications that require high density, miniaturization, and high signal integrity from I/O to board.

The ultra high-density Nano TwistPin differential twinax contact module is the heart of the GMMD ecosystem. The nanominiature contact results in possibly the highest-density fully shielded contact solution in the Mil-Aero industry. As an example, a single size 67 connector shell can accommodate either 16 differential pairs (100 Ohm) or 16 coaxial lines (50 Ohm). The series also contains a complement of hybrid arrangements for single-ended low-speed lines in combination impedance-controlled twinax or coax channels. Feed-through shielded contact technology maintains the GMMD's outstanding signal integrity, crosstalk, and return loss performance.

Available SMT receptacles provide easy PCB design and mounting, as well as optimum high-speed and RF performance. A canted ground spring on the plug side ensures a low-resistance ground path from cable shield to box. Other than this enhancement, the GMMD is in every other respect a Micro-D, utilizing familiar TwistPin contact technology, standard shell sizes, panel footprints, hardware, and backshells. Note that cable plugs must be terminated by Glenair, as both the nano TwistPin module and coax contacts perform best when terminated and tested end-to-end at the factory. To that end, a #30 AWG SpeedLine twisted pair cable has been optimized for use with GMMD twinax contact modules.

This interconnect ecosystem is ideally suited for satellite and other high-speed protocol space applications with rigorous ground test and mating cycle requirements for deliverable connectors. The GMMD is also supplied in a Sav-Con format for both twinax and coax arrangements.

DisplayPort
SERIAL ATA
HDMI™ HIGH DEFINITION MULTIMEDIA INTERFACE
dvi digital visual interface
SUPERSPEED CERTIFIED USB

SpeedLine™ cables in the GMMD ecosystem are optimized for high-datarate Ethernet, USB, SATA, PCIe, DisplayPort, and HDMI protocols

GMMD is available as turnkey, factory-terminated and tested point-to-point and multibranch cable assembies

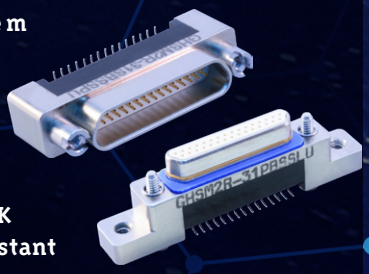
Glenair High-Speed Micro-D (GHSM) Ecosystem

The High-Speed Micro-D is arguably the smallest and lightest aerospace-grade high-speed interconnect. GHSM achieves its high-speed signal integrity and high data rate performance through innovative modifications of the standard Micro connector insert, principally in the use of an insulator with an ultra-low-dielectric constant. But in addition, with the use of Nano TwistPin contacts, exactingly spaced and isolated to eliminate crosstalk and maintain impedance levels through the connector mating interface.

The series utilizes an advanced SpeedLine twisted pair, shielded/jacketed cable with integrated drain wire for the differential data pairs in each Micro-D insert arrangement, and supports high-speed protocols from 10 Gb Ethernet to 4K DisplayPort at 144 Hz refresh rate.

Like other next-generation rectangulars from Glenair, the High-Speed Micro-D incorporates an auxiliary EMI ground spring on the plug, further enhancing the signal integrity of this ultra-small form-factor connector. In addition, PC tails are length-matched to simplify skew matching for the PCB designer, a significant challenge with standard Micro-D connectors with uncontrolled tail lengths.

The High-Speed Micro-D ecosystem is optimized for multi-gigabit digital datalink protocols including USB 3.0, 10 Gb Ethernet, Camera Link, and PCIe 3.0. The series features precision-machined shell packaging, impedance optimized contact spacing and low-k PEEK insulators, and Glenair shock- and vibe-resistant Nano TwistPin contacts.



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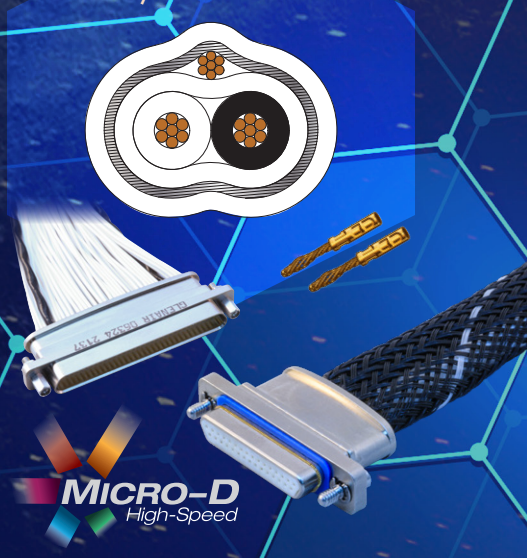
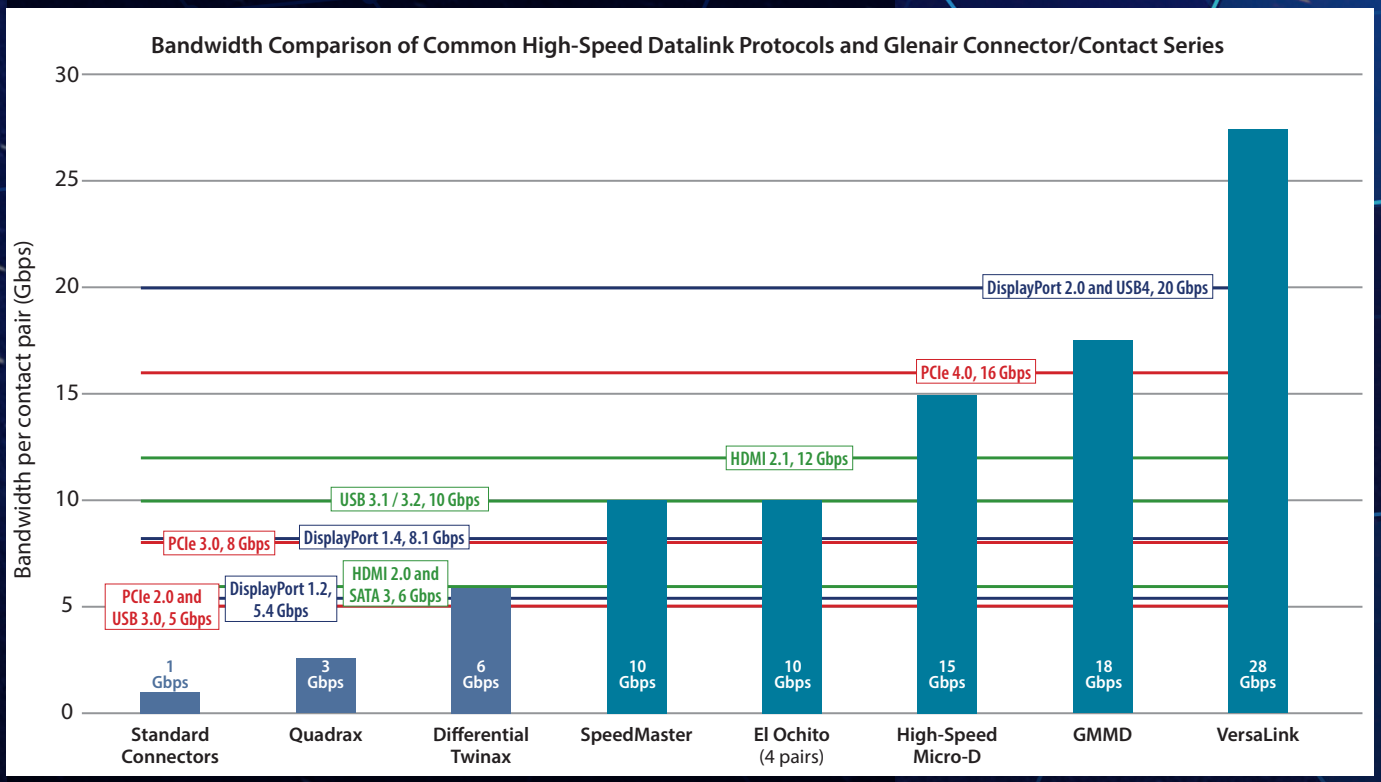
High-Speed Protocol Cables
GHSM ECOSYSTEM

The smallest and lightest aerospace-grade high-speed Micro-D solution: SpeedLine cable, TwistPin contacts, and factory-terminated assemblies



MICRO-D
High-Speed



In summary, the Glenair high-speed ecosystems, SpeedMaster, El Ochito, High-Speed Micro-D, GMMD, and VersaLink are all designed for specific datalink protocols and are engineered in terms of signal integrity to meet their exact bandwidth requirements. SpeedMaster is optimized for 10Gbps Ethernet. El Ochito has been optimized for both USB 3.1 /3.2 and 10 Gbps Ethernet; High-Speed Micro-D delivers 15 Gbps bandwidth IAW USB, HDMI, and 10 Gb Ethernet; GMMD meets the 18 Gbps bandwidth of HDMI 2.1 and the 16 Gbps requirement for PCIe 4.0; and VersaLink delivers 28 Gbps performance IAW DisplayPort 2.0 and USB4.

The Physics of High-Speed Signal Integrity

Common S-Parameters used in measuring source-to-load power losses in interconnect data links

VersaLink Micro-D Insertion Loss

Insertion loss refers to the loss of signal power resulting from traveling through a cable or other component in a transmission line. High insertion loss can lead to signal degradation, reduced signal strength, and potentially cause errors in high-speed data transmission. The X axis in the graph charts frequency in GHz, the Y axis represents the magnitude of insertion loss in dBs. The graph below shows the insertion loss added by the VersaLink contacts is extremely low for the full frequency range required by all of the protocols shown in the chart on page 7.

It's important to distinguish between power and voltage, because the rules for addition for power and voltage are different. Power is a real number. AC voltage is a real number times a phase:

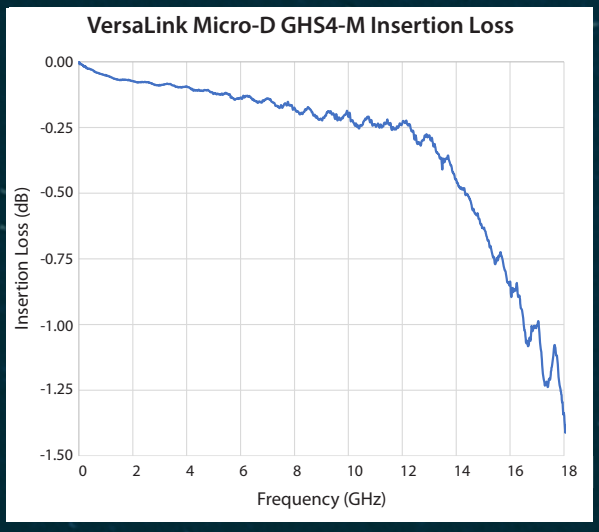
1 Watt plus 1 Watt is always 2 Watts

But AC voltage at a given frequency:

1 Volt plus 1 Volt is anything between 0 and 2

depending on how the phases line up. Most link budgets are estimated using power, because it's simple. But in complex links with multiple connectors, the effects of phases must be considered, resulting in insertion loss being expressed in logarithmic form:

$$IL = 10*\text{Log}_{10}(power\_in/power\_out)$$



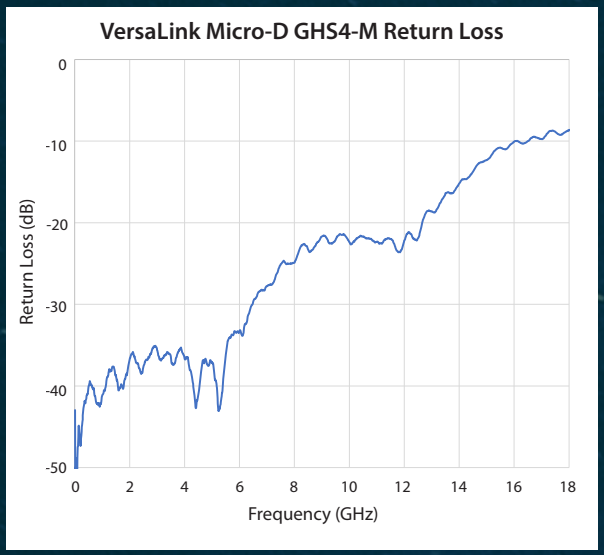
This chart shows the insertion loss of a mated VersaLink Micro-D connector pair. The insertion loss is about 0.5 dB at 14 GHz. This performance is ideal for a 28 Gbps NRZ signal.

VersaLink Micro-D return Loss

Return loss is a measure of the amount of signal power that is reflected back toward the source due to impedance mismatches in the transmission line. It quantifies how well the cable or component matches the characteristic impedance of the system. High return loss indicates good impedance matching and minimal reflections—crucial for maintaining signal integrity in high-speed data transmission. X axis represents frequency in GHz, Y axis represents the magnitude of return loss in dB. Higher dB values indicate better performance (less reflection). Results of this test indicate high return loss values across the target protocol frequency range. A simple way to think about this is muffled sound versus sound echo. A strong echo is a different distortion than sound that is just at a low volume.

$$IL = 10*\text{Log}_{10}(power\_incident/power\_reflected)$$

The cause of return losses is a change in impedance along the link, often at the connectors, but potentially originating in the cable due to a kink, sharp bend, or construction defect. Intermittent defects in a cable (for instance due to restrictions from taping or braiding) can create strong return-loss reflections at certain frequencies, as if a mirror had been inserted into the system.

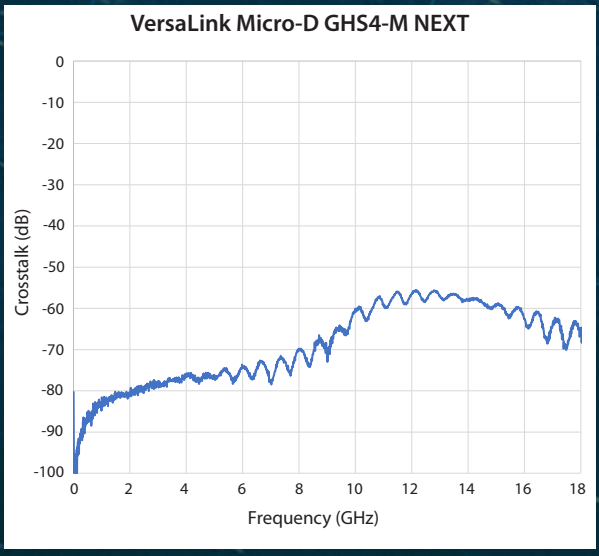


This chart shows the return loss of the same mated VersaLink Micro-D connector pair. The return loss is about -15 dB, which is ideal for a 28 Gbps NRZ signal.

VersaLink Micro-D Near-End Crosstalk (NEXT)

For the high-speed cable assembly under test, NEXT refers to the unwanted coupling of a signal from the aggressor line into the victim line at the same end of the cable assembly where the signal was transmitted (the Near End). It's a measure of how much signal noise from the line carrying the high-speed data (the aggressor) interferes with the monitored non-transmission (victim) line close to the source. This interference can degrade signal integrity, leading to reduced performance and potential transmission errors in high-frequency applications.

NEXT is a critical parameter in assessing cable performance, particularly in environments where multiple high-speed signals are transmitted simultaneously. The X-axis in NEXT analysis represents frequency, measured in GHz, while the Y-axis represents the magnitude of crosstalk, measured in decibels (dB). Lower dB values indicate more significant interference, which can negatively impact signal fidelity. Conversely, higher NEXT values demonstrate superior cable design and shielding, which effectively minimize signal leakage and maintain data integrity.



VersaLink Micro-D crosstalk test results: the X-axis represents frequency, measured in GHz. The Y-axis represents the magnitude of crosstalk, measured in dB. Lower dB values indicate more significant interference. These results demonstrate Near-End Crosstalk dB values well above the magnitude of significant interference at target protocol frequencies.

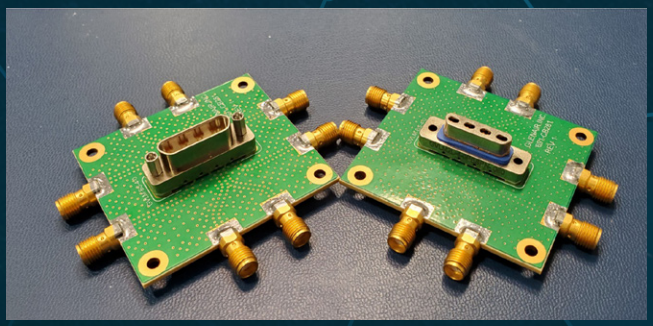
Impedance Matching

Electrical impedance, or simply "impedance," describes a measure of opposition to alternating current (AC). Electrical impedance extends the concept of resistance to AC circuits, describing not only the relative amplitudes of the voltage and current, but also the relative phases. When the circuit is driven with direct current (DC), there is no distinction between impedance and resistance; the latter can be thought of as impedance with zero phase angle.

How Impedance is Measured: A Time Domain Reflectometer (TDR) transmits a short rise time pulse along the conductor. If the conductor is of a uniform impedance and is properly terminated, the entire transmitted pulse will be absorbed in the far-end termination, and no signal will be reflected toward the source. Any impedance discontinuities will cause some of the incident signal to be sent back toward the source.

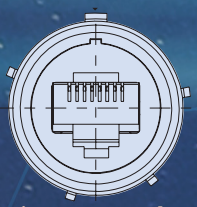
Increases in the impedance create a reflection that reinforces the original pulse, while decreases in the impedance create a reflection that opposes the original pulse. The resulting reflected pulse is displayed or plotted as a function of time, and because the speed of signal propagation is almost constant for a given transmission medium, it can be read as a function of cable length.

Impedance matching is the practice of designing the input impedance of an electrical load or the output impedance of its corresponding signal source in order to get maximum power transfer from source to load.

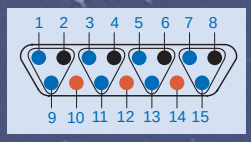


This photograph shows a typical test board used to quantify insertion loss and return loss of a PCB-mounted connector pair. The threaded SMA connectors on the edge of the board are used for signal input and output (two SMA connectors are necessary per differential pair). This board configuration can also energize two differential pairs simultaneously and characterize crosstalk.

PHYSICAL LAYER RUGGEDIZATION



Housing of a commercial connector in a sealed / grounded shell



Modification of an open pin field type connector with ground pin separators between the differential pairs

Housing a shielded contact module within a fully-ruggedized interconnect assembly

High-Speed Protocols In Action

Data networks are divided into layers, with each performing a function in the transmission of data. The connectors, cables, and the general electrical description of the signal (number of wires, frequency spectrum, type of modulation technique, encoding etc.) are part of the lowest layer, called the physical layer (PHY). The description of the physical layer should contain everything needed to create a link with wires and connectors. There are three harsh-environment approaches to the physical layer: enclosing the commercial connector in a ruggedized housing, modifying open pin field connectors to incorporate ground pins between the differential pairs, and finally housing fully-shielded contact modules in mil-aero grade connector shells.

Ethernet

The computer network standard as produced by the IEEE 802.3 working group since 1983. It has evolved from speed of a few Mb/s to 400Gb/s. The transmission medium ranges from coax, to twisted pairs, to optical fiber. Readers are likely familiar with the 1000Base-T designation. The nomenclature for newer designations is shown in the table below. The encoding method scrambles the data to balance its average voltage value, and X and R identify the size of the encoding blocks. The number of lanes indicates how many data pairs (for electrical) per link.

So for instance 10Base-T1 is a 10Mb/s DataStream, where the voltage is modulated directly with 1's and 0's over a single twisted pair (this is used in automotive and industrial applications). This nomenclature has not been implemented consistently, and short-hand descriptions are frequent.

Ethernet Nomenclature	XXXXG	BASE	–T	X	4
Usable Speed	in Mb/s or Gb/s if followed by a G (10, 100, 1000)				
Signaling Spectrum	(BASE, BROAD, PASS)				
Medium Designation	-T, -S, -L, -E, -Z, -B, -P, -C, -K...				
Encoding Method	(X, R)				
Number of Lanes	(1, 2, 4, 10)				

Popular Ethernet Protocol Standards

Name	Standard	Connector	Description
100BASE-TX	802.3u-1995 (24, 25)	8P8C (FDDI TP-PMD standard, ANSI INCITS 263-1995)	Category 5 cable using two twisted pairs. Still very popular.
1000BASE-T	802.3ab-1999 (40)	8P8C (IEC 60603-7)	PAM-5 coded signaling, at least Category 5 cable, with Category 5e copper cabling with four twisted pairs. Each pair is used in both directions simultaneously. Extremely wide adoption.
1000BASE-KX	802.3ap-2007 (70)		1 m over backplane
10GBASE-T	802.3an-2006 (55)	8P8C (IEC 60603-7-4 (unscreened) or IEC 60603-7-5 (screened))	Uses Cat 6A twisted-pair wiring, four lanes at 800 MBd each, PAM-16 with "DSQ128" line code
10GBASE-KX4	802.3ap-2007 (48&71)		1 m over 4 lanes of backplane
10GBASE-KR	802.3ap-2007 (49&72)		1 m over a single lane of backplane

Ethernet Nomenclature Descriptions

XXXXG: Usable speed is the amount of data per second the link can transmit

BASE: Signaling spectrum refers to the frequency range used by the signaling. Baseband means there is no modulation other than the bits turning on or off. Broadband means that multiple frequency channels are individually modulated. Passband means that the signal modulation is confined to a narrow frequency band (the pass band).

X, R: Encoding block size

The medium designations are:

T: Twisted pair wire

S: Short wavelength multi-mode optical fiber (850nm)

L: Long wavelength single mode optical fiber (1300nm)

E (or Z): Long wavelength single mode optical fiber (1550nm)

B: Bi-directional optical fiber, using different wavelengths

P: Passive optical network

C: Copper/Twinax

K: Backplane

It is important to note that the physical layer will often contain a description of the connector to be used (for example, 8P8C in the table is the official name of what's usually called an RJ45). At a minimum it will define the necessary electrical performance.

Some readers may wonder why there is an Ethernet protocol for backplanes. This has emerged from embedded systems (or computers), where the computation capacity can be increased modularly by populating more slots in a backplane. The communication protocol of choice is still Ethernet, but the physical link is so different that it warrants its own family of specifications.

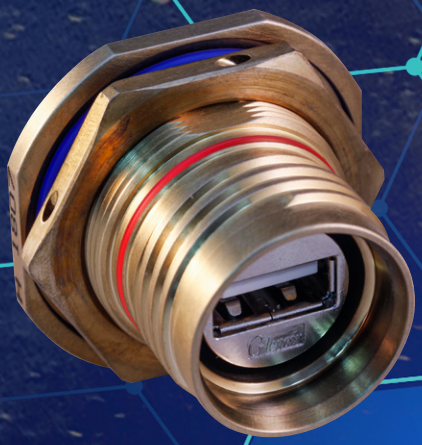
USB

After Ethernet, this is the most widely deployed mode of data transmission. But unlike Ethernet, it is not a network protocol and is meant to be used as a point-to-point connection between a host and a device (or several devices). As mentioned earlier, the product lifespan is shorter for devices using this protocol, and the protocol revisions are frequent. It also tends to be closer to a user and have more frequent mating cycles compared to Ethernet connections. Ruggedizing USB links is more challenging than traditional Ethernet because the signal spectrum reaches to much higher frequencies, and because the link configuration budgets do not explicitly allow for disconnect points.

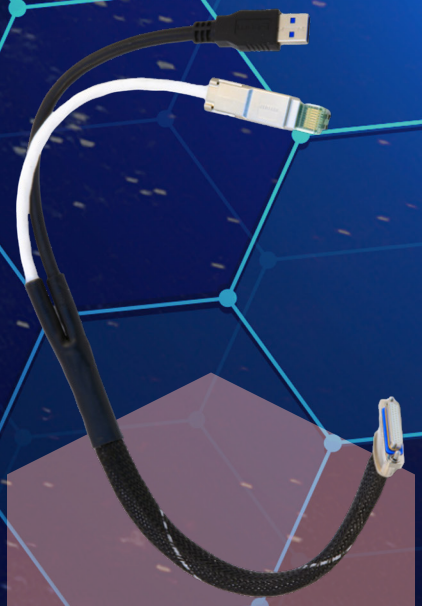
Evolutions of the USB standard have revolved around higher data rates and more power delivery options (battery charging and device power). The most significant recent hardware development is the USB-C connector because it merges the serial port standard with display capability; HDMI and DisplayPort can both be carried through a USB-C cable.

USB 2.0

This protocol is now almost 30 years old, roughly the same age as our Mighty Mouse connector family. It's interesting to note that to this day, a double digit percentage of our Mighty Mouse connectors we ship end up carrying USB 2.0 because that's what most soldier systems use to connect the various devices. The maximum data transmission capability is 480Mb/s, and the power delivery can go up to 100W when supporting battery charges (in more recent editions). The signal and power are delivered over 4 wires.



Glenair signature SuperSeal USB 2.0 connector with outstanding metal-to-metal grounding and IP68 environmental sealing



Ruggedized high-speed cable assembly: GHSM I/O on one end and non-environmental USB 2.0 and RJ45 on the other

USB NAMING CHANGES AND COMPATIBLE GLENAIR CONNECTORS

New Name	Old Name	Original Name	SuperSpeed Name	Max Speed	USB Type	Compatible Glenair Interconnects
USB 3.2 Gen 2x2	N/A	USB 3.2	SuperSpeed USB 20Gbps	20Gbps	C	VersaLink
USB 3.2 Gen 2	USB 3.1 Gen 2	USB 3.1	SuperSpeed USB 10Gbps	10Gbps	C	VersaLink
USB 3.2 Gen 1	USB 3.1 Gen 1	USB 3.0	SuperSpeed USB	5Gbps	A	El Ochito Blue VersaLink SuperSeal 233-350 SuperSeal 233-352 SuperSeal 233-354 Series 806 Mil-Aero High Speed Micro-D SuperFly Datalink

USB 3.0, with its recognizable blue insert, in a ruggedized SuperSeal connecor

Harsh-environment SuperNine HDMI recceptacle connector with spring-action protective cover

Series 806 Mil-Aero Micro Miniature with rugged El Ochito DisplayPort insert

USB 3.0

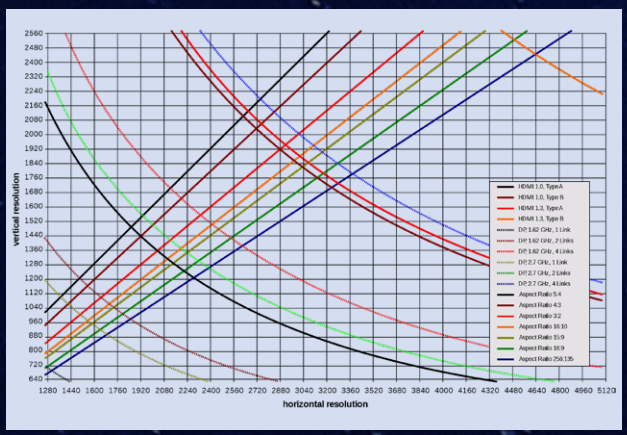
Just 10 years after its predecessor, this protocol was a major revision in terms of speed and largely backward compatible. But with the addition of 2 SuperSpeed pairs, the link can support close to 10 times the data rate of USB 2.0. The hardware implementation looks exactly like USB 2.0 (except for USB-C cables which we will discuss in more detail below), but the electrical requirements are different. SuperSpeed USB connectors are distinguished by the blue color of their inserts. Rugged implementations of this protocol require much closer attention to signal integrity compared to USB 2.0, impedance matching through the interconnect is very important.

Ensuring backwards compatibility has led to a strange nomenclature, where newer revisions of the specifications re-named the older protocols. The table on the previous page identifies the relationships between the specification, protocol, brand, and data transmission rate

Cables for USB 3.X protocols require two high-speed pairs, a power pair and the legacy data pair to support USB 2.0.

HDMI

HDMI (High-Definition Multimedia Interface) is a compact audio/video interface for transmitting uncompressed video data. It is a digital alternative to consumer analog standards, such as radio frequency (RF) coaxial cable, composite video, or VGA. HDMI digital signals are backward-compatible with DVI (same electrical definition, called Transmission-Minimized Differential Signaling, or TMDS). In both cases, the data stream is a combination of image data, audio data, and control information (for instance mute commands and color compatibility information). All this data is transferred over 4 high-speed differential pairs (requiring 12 pins in the connector because each pair has a ground pin). There are 7 additional pins in the connectors for separate communication channels. These are dedicated to handling specific consumer electronics situations (Audio Return, Digital Rights Protection, an Ethernet link to reduce cable clutter, and an interface for remote controls). The protocol does not specify a maximum length but a link loss.



DisplayPort resolutions: The straight lines indicate screen resolutions for given aspect ratios, the curved lines show the theoretical limit of various interconnects.

DisplayPort

DisplayPort is a digital display interface standard. The specification defines a digital interconnect and data transmission for audio and video. The interface is primarily used to connect a video source to a display device such as a computer monitor (as opposed to HDMI which was originally meant for consumer entertainment systems). DisplayPort is considered more versatile than HDMI, and is able to support higher image resolutions with the same number of lanes. It also allows more flexibility with computers supporting multiple displays, which may have different resolutions.

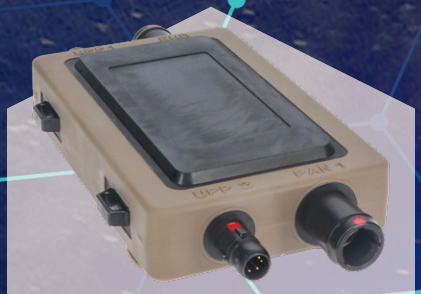
Unlike HDMI and DVI, DisplayPort runs at fixed data transmission rates and 'stuffs' the channels if the full rate is not used. The standard transmission rates for each digital pair in DisplayPort are 1.62Gb/s (Reduced Bandwidth Rate or RBR), 2.7 Gb/s (High Bandwidth Rate or HBR), 5.4 Gb/s (HBR2), 8.1 Gb/s (HBR3). Future versions will add 10, 13.5 and 20 Gb/s lanes.

USB-C

The promise of USB-C is that it can potentially carry all the popular peripheral protocols in a single package (Ethernet, USB, DisplayPort, and HDMI) as well as provide a battery charging capability. USB-C is not a single-protocol connector, rather a platform that can support multiple data and power formats.

The hardware implementation consists essentially on a double USB 3.X connector, with additional discrete pins used for the connections required by HDMI and DisplayPort. The connector pin-out looks identical when flipped 180 degrees. When packaged with an orientation key, all lines can be used for signal or power transmission. The result is either a USB connector that can be plugged in "upside-down", or a display connector that is used in only one orientation.

The USB-C connector accommodates 6 differential pairs, 3 on either side (4 are shielded high-speed lanes, 2 support legacy USB 2.0 data). Interspersed among those pairs are 8 discrete pins for power and auxiliary functions. The four corner pins are signal ground pins for the SuperSpeed pair shields. The interleaving separates the high-speed data streams and improves the crosstalk performance. USB-C connectors are also compatible with Thunderbolt 3, another data transmission protocol for displays and storage devices.



USB-C Mighty Mouse Series 807
Nett Warrior qualified

PCIe

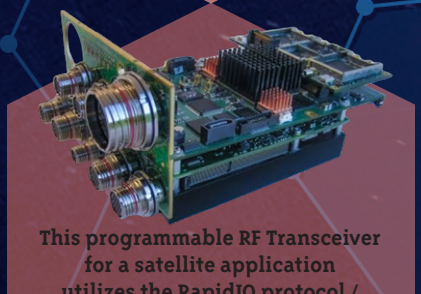
PCIe (Peripheral Component Interconnect express) is an inside-the-box, board-level protocol. In this context, the term "interconnect" does not refer to a mechanical connector, but rather to the link between logical units. The PCIe protocol is the data bus your computer uses to exchange data between the main board and its daughter cards, such as a memory or a graphics card. The connector itself is usually a set of gold pads on the edge of the daughter card that plug directly into a socket on the mother board. There is a separate area of the connector for power supply and bus management, followed by clock and signal pairs. The size of the bus is measured in number of lanes, each lane consisting of two differential pairs (transmit and receive). The bus may not run all the pairs available mechanically, so it's possible to have an X16 bus running only at X4. The data rate in PCI protocols is expressed in transfers per second instead of bits per second. For the hardware engineer, transfer-per-second is the same as bits-per-second. This is different for software engineers, because all bits are not data, i.e. there is coding overhead. A 2.5 Gb/s link only really transmits 2.0 Gb/s because of the overhead required.

"Zero-Crosstalk" VersaLink series
for DVI or DisplayPort

PCIe-ready HD Stacker
board-to-board series

RapidIO

RapidIO is another inside-the-box data protocol. It is also used inside systems to transport data among memory and computing chips, be it on a large circuit board, from one board to another or through a backplane. The specification does not call out a connector or cable, instead it relies on electrical compliance to other specifications such as 10GBASE-KR (or 40GBase-KR). Those in turn essentially analyze the eye-diagram and set acceptable signal levels for the transmission. The implementation is often described by the number of lanes, each running maximally at 6.25Gb/s, 10.3Gb/s or 25.3Gb/s (for generation 2, 3, and 4 respectively). RapidIO deserves special attention because it is the protocol of choice for space applications and has been utilized in many military platforms as well.



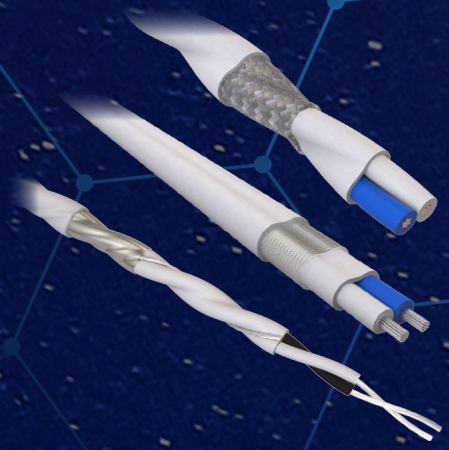
This programmable RF Transceiver
for a satellite application
utilizes the RapidIO protocol /
OpenVPX form-factor for
PCB connectivity

SpeedLine™

High-Speed Protocol Cables

Glenair supplies a wide range of high-speed shielded twisted pair cabling for use with El Ochito®, VersaLink™, SpeedMaster™, and other of our shielded high-speed connector and contact technologies. High flexibility and high-density reduced-weight cable designs are a specialty. Glenair offers turnkey Cat 8 Ethernet, SuperSpeed USB 3.0, HDMI, SATA, and other solutions for today's most mission-critical application platforms.

Glenair SpeedLine cables are optimized for signal integrity, weight savings, flexibility, and durability. In addition, these aerospace and space-grade cables have been optimized for ease of termination and across-the-board compatibility with our broad range of high-speed contact modules and connectors.



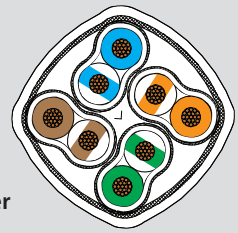
- **Cat 8 Ethernet, SuperSpeed USB 3.0, HDMI, SATA, and other solutions for mission-critical applications**
- **Individual foil shielding around each data pair for reduced crosstalk and attenuation**
- **Up to 200°C high-temperature-rated cable**
- **Skydrol resistant, RoHS compliant versions**
- **Ethernet versions meet ANSI/TIA 568-C.2 Category 6A requirement up to 262 feet/80 meters**
- **SuperSpeed USB pairs with industry-leading low attenuation**
- **LSZH jacketing options including Duralectric and polyurethane**

DisplayPort SERIAL ATA HDMI™ HIGH DEFINITION MULTIMEDIA INTERFACE SUPERSPEED CERTIFIED USB

SpeedLine™ high-speed protocol cables: shielded differential data-pair cables for high-datarate Ethernet, USB, SATA, PCIe, DisplayPort, and HDMI protocols

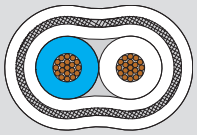
SpeedLine cables are selected for protocol compliance in accordance with industry standards for Ethernet, USB, and SATA/eSATA and other popular high-speed specifications. Without exception, the cables have been designed and fabricated to optimize flexibililty, weight reduction, ruggedness, and insulator quality. Each cable is offered with specific guidance as to shielding properties, impedance performance, attenuation, temperature rating, bend radius, weight, and maximum practical transmission distance. Signal integrity and S-parameter test results are available for Glenair cable, contact, and connector combinations.

963-066 -24, -26, and -28



- 100 Ohm twisted pair shielded cable
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and #40 AWG silver-plated copper braid

963-073 -24, -26, 28, and -30

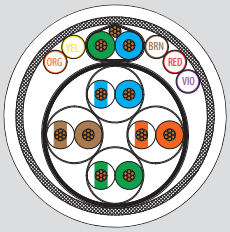


- 100 Ohm twisted pair shielded cable
- -65 to +200 °C
- FEP jacket, FEP insulation
- Silver-plated alloy conductors

963-077-26

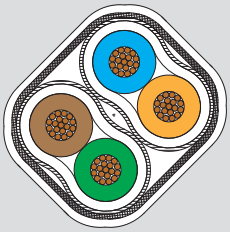
- 90 Ohm twisted pair shielded cable
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and silver-plated copper braid

963-127



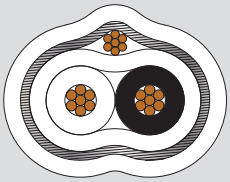
- 100 Ohm twisted pair shielded cable
- PFA jacket, PFA insulation
- Dual shields: aluminized polyimide tape and silver-plated copper braid

963-072-24



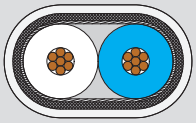
- 100 Ohm twisted pair shielded cable
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and silver-plated copper braid

963-057-28



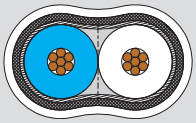
- 100 Ohm twisted pair shielded cable for use with GHSM connectors
- Performance up to 10 GHz
- -65 to +200 °C
- FEP jacket, FEP insulation
- Shield: aluminized polyimide tape

963-069-26



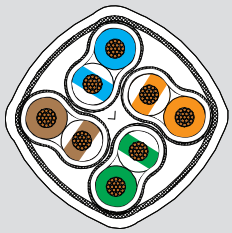
- 100 Ohm #26 AWG flat pair shielded cable for use with VersaLink™ connectors
- Performance up to 18 GHz
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and #44 AWG silver-plated copper braid

963-068-26



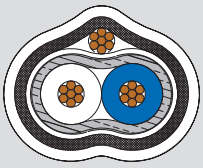
- 100 Ohm #26 AWG twisted pair shielded cable for use with VersaLink™ connectors
- Performance up to 10 GHz
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and silver-plated copper braid

963-080 -24 and -26



- 100 Ohm twisted pair shielded cable
- Performance up to 8 GHz
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: aluminized polyimide tape and silver-plated copper braid

963-065-30



- 100 Ohm #30 AWG twisted pair shielded cable for use with GMMD connectors
- Performance up to 10 GHz
- -65 to +200 °C
- FEP jacket, FEP insulation
- Dual shields: polyimide and silver-plated copper braid

SpeedLine™
High-Speed Protocol Cables

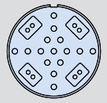
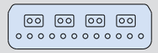
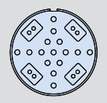
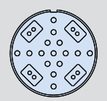
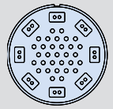
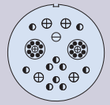



Signature Connector Series	Series 806 Mil-Aero / Mighty Mouse				SuperNine® D38999 Type		Series 79™ Micro-Crimp			Micro-D			SuperFly® Datalink
Protocol	816 El Ochito	806 El Ochito	806 VersaLink	824 SpeedMaster	233 El Ochito	233 SpeedMaster	792 El Ochito	794 VersaLink	7925 SpeedMaster™	GHSM Micro-D	GHS4-M VersaLink	GMMD	882 SuperFly DataLink
Ethernet up to 10GBase-T Cat 6A	10-1 - El Ochito White	10-1 - El Ochito White	11-4V	824-010	9G5 - El Ochito White	11-1	A-1W1 - El Ochito White	F-4V or P-4V		15E	4-0 (Shell Size 25)	4T (Shell Size 15)	882-001/002 White
SpeedLine Cables	**963-066-26 963-066-24**	**963-066-26 963-066-24**	**963-068-26 twisted 963-069-26 flat**	**963-066-26 963-066-24**	**963-066-26 963-066-24**	**963-066-26 963-066-24**	**963-066-26 963-066-24**	**963-068-26 twisted 963-069-26 flat**	**963-066-26 963-066-24**	**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-066-26 963-066-24**
Ethernet up to 40GBase-T Cat 8	10-1 - El Ochito White	10-1 - El Ochito White	11-4V	N/A	9G5 - El Ochito White	N/A	A-1W1 - El Ochito White	F-4V or P-4V		15E	4-0 (Shell Size 25)	4T (Shell Size 15)	882-001/002 White
SpeedLine Cables	**963-066-26 963-066-24**	**963-066-26 963-066-24**	**963-068-26 twisted 963-069-26 flat**		**963-066-26 963-066-24**		**963-066-26 963-066-24**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-066-26 963-066-24**
SpaceWire	10-1 - El Ochito Red	10-1 - El Ochito Red	11-4V	824-010	9G5 - El Ochito Red	11-1	A-1W1 - El Ochito Red	F-4V or P-4V		9	4-0 (Shell Size 25)	4T (Shell Size 15)	882-001/002 Red
SpeedLine Cables	**963-080-26 963-080-24**	**963-080-26 963-080-24**	**963-068-26 twisted 963-069-26 flat**	**963-080-26 963-080-24**	**963-080-26 963-080-24**	**963-080-26 963-080-24**	**963-080-26 963-080-24**	**963-068-26 twisted 963-069-26 flat**	**963-080-26 963-080-24**	**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-080-26 963-080-24**
USB 3.2 Gen 1x1 * USB 3.2 Gen 2x1 Type A, B, uB	10-1-El Ochito Blue	10-1-El Ochito Blue	11-2V9*	N/A	9G5-El Ochito Blue	N/A	A-1W1- El Ochito Blue	D-2V4*		15U*	2-9* (Shell Size 25)	2T9* (Shell Size 21)	882-009/010 Blue
SpeedLine Cables	**963-077-26**	**963-077-26**	**963-068-26 twisted 963-069-26 flat**		**963-077-26**		**963-077-26**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-077-26**
USB 3.2 Gen 2x1 USB 3.2 Gen 2x1 USB 3.2 Gen 2x2 USB4 Gen 2x2 USB4 Gen 3x2 Type C	N/A	N/A	14-4V15	N/A	N/A	N/A	N/A	G-4V12		N/A	4-15 (Shell Size 51-2)	N/A	N/A
SpeedLine Cables			**963-068-26 twisted 963-069-26 flat**					**963-068-26 twisted 963-069-26 flat**			**963-068-26 twisted 963-069-26 flat**		

GLENAIR SIGNATURE CONNECTORS, CONTACTS, AND CABLE ECOSYSTEMS FOR POPULAR HIGH-SPEED PROTOCOLS

SpeedLine™
High-Speed Protocol Cables




Signature Connector Series	Series 806 Mil-Aero / Mighty Mouse				SuperNine® D38999 Type		Series 79™ Micro-Crimp			Micro-D			SuperFly® Datalink
Protocol	816 El Ochito	806 El Ochito	806 VersaLink	824 SpeedMaster	233 El Ochito	233 SpeedMaster	792 El Ochito	794 VersaLink	7925 SpeedMaster	GHSM Micro-D	GHS4-M VersaLink	GMMD	882 SuperFly DataLink
HDMI up to 2.0 * up to HDMI 2.1	 14-20A - El Ochito Red	 14-20A - El Ochito Red	 14-4V15*	N/A	 13-14 - El Ochito Red	N/A	 B-23W1 - El Ochito Red	 G-4V12*	N/A	21*	 4-15* (Shell Size 51-2)	 4T9 (Shell Size 31)	 882-019/020 Red
SpeedLine Cables	**963-127-3**	**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-127-3**		**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-127-3**
DisplayPort up to 1.4 * up to DisplayPort 2.0	 14-20A - El Ochito Red	 14-20A - El Ochito Red	 14-4V15*	N/A	 13-14 - El Ochito Red	N/A	 B-23W1 - El Ochito Red	 G-4V12*	N/A	21	 4-15* (Shell Size 51-2)	 4T9 (Shell Size 31)	 882-019/020 Red
SpeedLine Cables	**963-127-3**	**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-127-3**		**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-066-26 963-066-24**
DVI Single	 14-20A - El Ochito Red	 14-20A - El Ochito Red	 14-4V15	N/A	 13-14 - El Ochito Red	N/A	 B-23W1 - El Ochito Red	 G-4V12	N/A	21	 3-9 (Shell Size 37)	 4T9 (Shell Size 31)	 882-019/020 Red
SpeedLine Cables	**963-127-3**	**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-127-3**		**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-066-26 963-066-24**
DVI Dual	 16-22 - El Ochito Red (2)	 16-22 - El Ochito Red (2)	 18-8V31	N/A	 19-17 - El Ochito Red (2)	N/A	 C-24W2 - El Ochito Red (2)	 H-6V16	N/A	25	8-9 (Shell Size 67)	 8T15 (Shell Size 51-2)	N/A
SpeedLine Cables	**963-127-3**	**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-127-3**		**963-127-3**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	
eSATA SATA 3.0	 10-1 - El Ochito Red	 10-1 - El Ochito Red	 9-2V	N/A	 9G5 - El Ochito Red	N/A	 A-1W1 - El Ochito Red	 B-2V	N/A	9	2-0 (Shell Size 15)	 2T (Shell Size 9)	 882-023/024 Red
SpeedLine Cables	**963-072-24**	**963-072-24**	**963-068-26 twisted 963-069-26 flat**		**963-072-24**		**963-072-24**	**963-068-26 twisted 963-069-26 flat**		**963-057-28**	**963-068-26 twisted 963-069-26 flat**	**963-065-30**	**963-072-24**

Fast Lyrics Make for Fast Songs
Which Whip Are They Riding On?

GLENAIR
QwikConnect

NOBODY GONNA
TAKE MY CAR, I'M
GONNA RACE IT
TO THE GROUND
NOBODY GONNA
BEAT MY CAR, IT'S
GONNA BREAK THE
SPEED OF SOUND

ALWAYS GOT THE
COPS COMING
AFTER ME
CUSTOM BUILT BIKE
DOING 103

I BOUGHT YOU A BRAND
NEW MUSTANG,
A NINETEEN SIXTY FIVE
NOW YOU COME AROUND
SIGNIFYING A WOMAN,
YOU DON'T WANNA
LET ME RIDE

WELL SHE GOT HER
DADDY'S CAR,
AND SHE CRUISED
THROUGH THE
HAMBURGER STAND NOW
SEEMS SHE FORGOT ALL
ABOUT THE LIBRARY,
LIKE SHE TOLD HER
OLD MAN NOW

WHEN I TAKE HER TO THE
TRACK SHE REALLY SHINES
SHE ALWAYS TURNS IN
THE FASTEST TIMES

KEEP ME MOVING, OVER FIFTY
KEEP ME GROOVIN,'
JUST A HIPPIE GYPSY

GET YOUR MOTOR RUNNIN,'
HEAD OUT ON THE HIGHWAY
LOOKIN' FOR ADVENTURE,
AND WHATEVER COMES OUR WAY

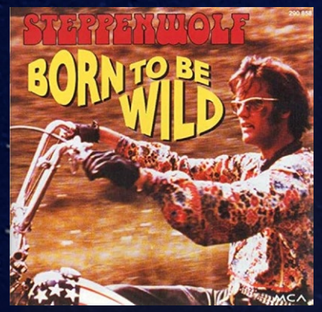
I TOLD THAT GIRL I CAN
START RIGHT AWAY,
WHEN SHE SAID,
"LISTEN, BABE, I GOT
SOMETHIN' TO SAY
I GOT NO CAR AND IT'S
BREAKING MY HEART,
BUT I'VE FOUND A DRIVER
AND THAT'S A START"

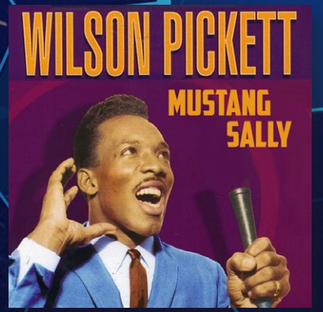
THE HIGHWAY PATROL GOT HIS
EYES ON ME,
I KNOW WHAT HE'S THINKIN'
AND IT AIN'T GOOD
I'M MOVIN' SO FAST HE CAN
BARELY SEE ME,
GONNA LOSE THAT MAN,
I KNOW I SHOULD

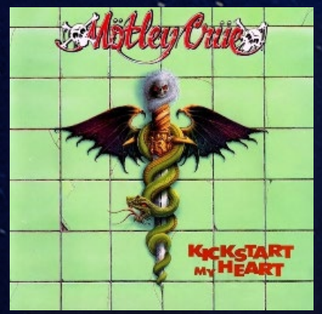
WE'LL GET SOME
PURPLE FRINGE
TAIL LIGHTS AND
THIRTY INCH FINS
A PALOMINO
DASHBOARD
AND DUAL
MUFFLER TWINS

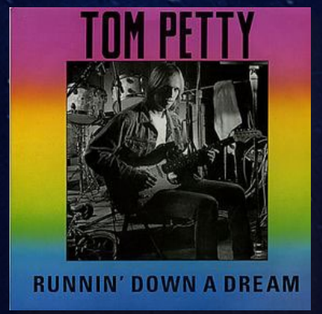
IT WAS A BEAUTIFUL DAY,
THE SUN BEAT DOWN, I
HAD THE RADIO ON,
I WAS DRIVIN'
TREES WENT BY,
ME AND DEL WERE SINGIN',
"LITTLE RUNAWAY,
I WAS FLYIN'

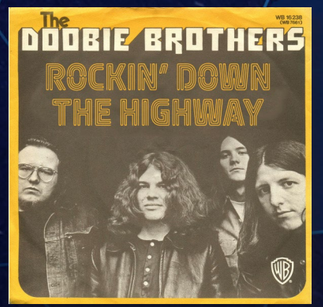
ONE FOOT ON THE BRAKE
AND ONE ON THE GAS, HEY
WELL, THERE'S TOO MUCH
TRAFFIC, I CAN'T PASS, NO











Answers: www.glenair.com/qwikconnect

OPTIMIZED FOR USE WITH

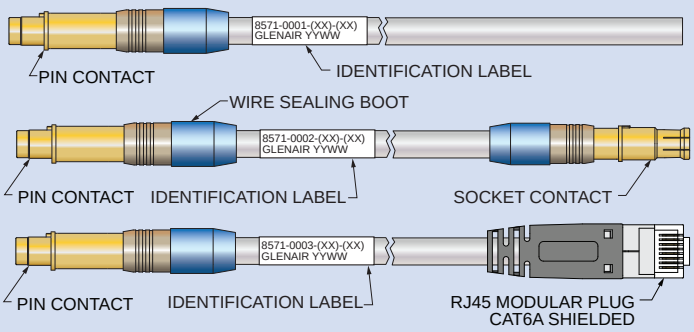
SpeedLine™
High-Speed Protocol Cables

El Ochito®

High-speed **octaxial contacts** for Ethernet, SuperSpeed USB, and multi-gigabit datalinks

High speed, harsh environment El Ochito® octaxial contacts save size and weight in avionics, weapons systems, satellites, radars, and communications equipment.

TURNKEY FACTORY JUMPERS AND PIGTAIL ASSEMBLIES



Glenair signature high-speed Octaxial El Ochito contact series may be specified as factory-wired jumpers and pigtails, including El Ochito-to-commercial RJ45 and USB connectors.

- **CAT8 40GBASE-T Ethernet, SuperSpeed USB, and multi-gigabit shielded pairs**
- **Universal drop-in for keyed size #8 connector cavities**
- **Data-pair isolation for optimal signal integrity**
- **Crimp or threaded shield termination contact types**
- **Snap-in, rear release**
- **Environmentally sealed**
- **Aerospace-grade cable assemblies**
- **50% cable / contact reduction compared to Quadrax**

HIGH-SPEED OCTAXIAL

El Ochito® Contacts

Protocols, exploded views of Type I and Type II contacts

El Ochito® White

1000BASE-T, 10GBase-T, 40GBASE-T
El Ochito® White octaxial contacts provide 40GbE (when used with Cat 8 cable) in a single size #8 contact cavity (compared to two Quadrax) for 100BASE-T solutions.

El Ochito® Blue

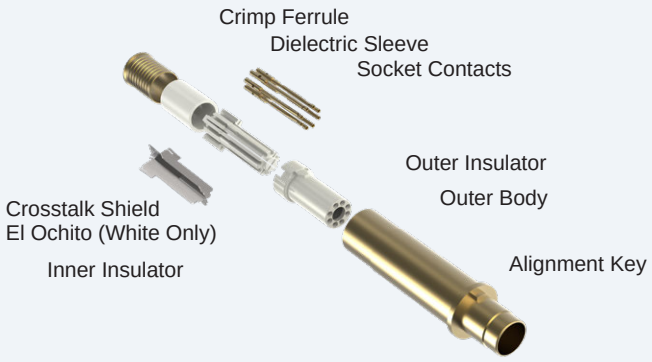
SuperSpeed USB
Low-dielectric material. 90 ohms. **El Ochito® Blue octaxial contacts provide an aerospace-grade solution for SuperSpeed USB 3.0**

El Ochito® Red

HDMI, DisplayPort 1.4, SATA
Low-dielectric material. Up to 10 Gbps per pair. 100 ohms. **El Ochito® Red octaxial contacts provide an aerospace-grade solution for multi-gigabit data rates.**

El Ochito® White Type I Contacts, Non-Serviceable

26 AWG, Crimp Wire Shield Termination

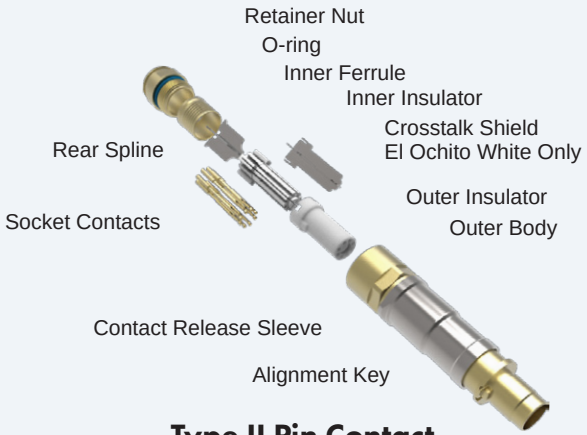


Type I Pin Contact

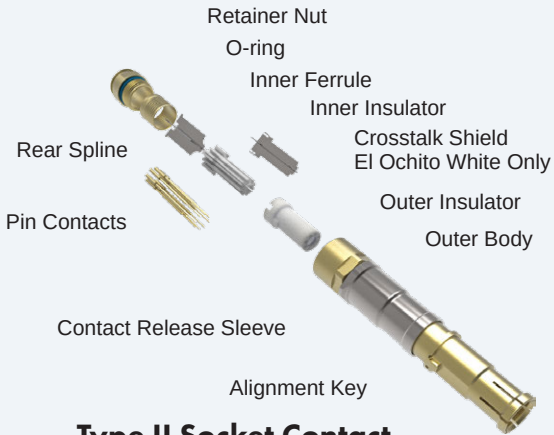
Type I Socket Contact

El Ochito® Type II Contacts, Serviceable

24-26 AWG, Threaded Wire Shield Termination, Integral Contact Release Sleeve



Type II Pin Contact



Type II Socket Contact

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

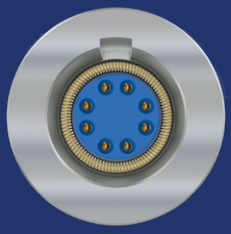
SUPERFLY DATALINK

The Nano Miniature 10G Ethernet, USB 3.0, and DisplayPort connector with El Ochito® octaxial contact technology

High speed, harsh environment SuperFly® Datalink connectors–with shielded El Ochito® octaxial contacts for 10Gb Ethernet, SuperSpeed USB, and high datarate video display protocols–deliver outstanding signal integrity and save significant size and weight compared to Quadrax.

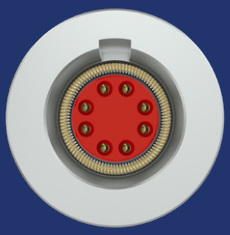
SuperFly Datalink White

Up to 40G Ethernet



SuperFly Datalink Blue

SuperSpeed USB



SuperFly Datalink Red

HDMI, DisplayPort 1.4, and SATA

El Ochito®

- **Ultra-small size**
- **Shielded Octaxial contacts**
- **Up to 5 Gbps**
- **10Gb Ethernet and SuperSpeed USB**
- **New Red insert for high-speed video, consult factory for layouts**
- **Environmentally protected**
- **Factory-terminated cables or discrete contacts and cables for customer assembly**

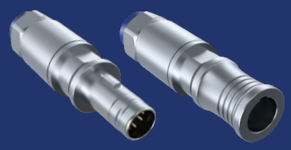
SERIES 882

SuperFly® Datalink

The high-speed nano miniature connector for harsh environments

CONNECTOR CONFIGURATIONS

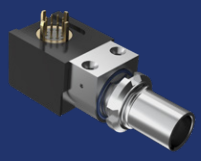
Quick -disconnect "push-pull" versions are ideal for tactical gear. Threaded-coupling versions are intended for aircraft and space-grade applications where secure mating is a requirement.



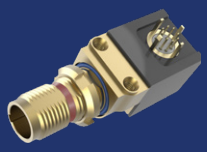
Quick Disconnect

Threaded Coupling

Straight PC Tails



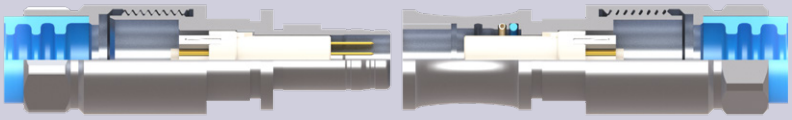
Right Angle PC Tails



Conformal-coating-compliant panel mount connectors

SpeedLine™
High-Speed Protocol Cables

PUSH-PULL QUICK-DISCONNECT

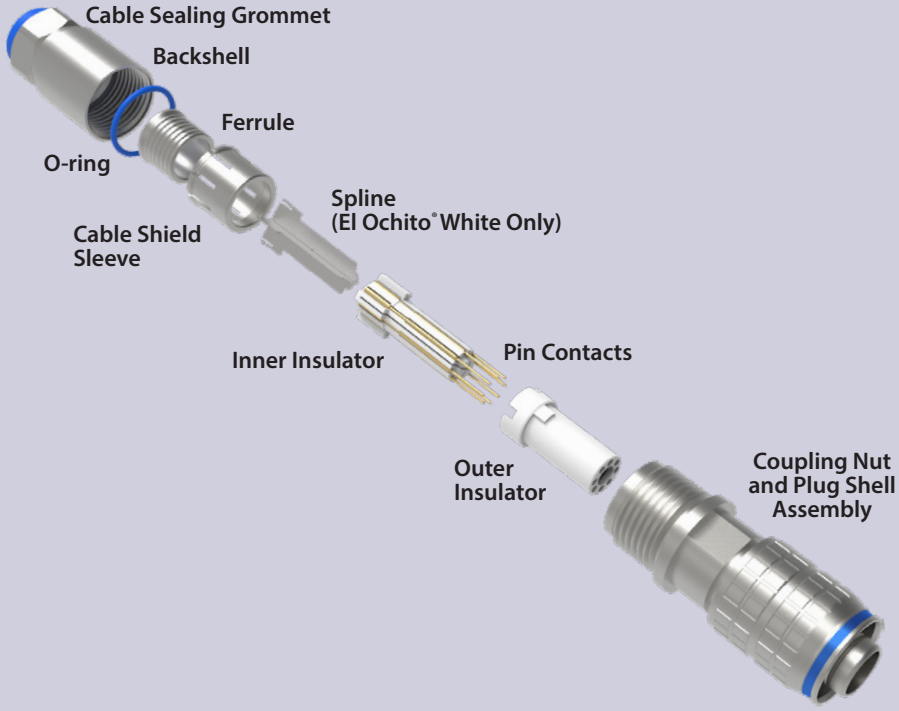


882-001
Plug Connector

882-002
Receptacle Connector

Push-pull SuperFly Datalink receptacle connectors feature a canted coil spring for secure mating and excellent EMI protection. A fluorosilicone O-ring provides watertight sealing when mated. Cable connectors feature gold-plated crimp contacts, precision insulators, integral backshell, sealing grommet, and machined shells. Cable connectors are available as unassembled kits or ready-to-use factory-terminated cordsets.

THREADED-COUPLING CABLE CONNECTOR



SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: SUPERFLY DATALINK	
Part No.	**Protocol**
963-066-26 963-066-24	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8 DisplayPort up to 1.4 • DVI Single
963-080-26 963-080-24	SpaceWire
963-077-26	USB 3.2 Gen 1x1 Type A, B, uB
963-127-3	HDMI up to 2.0
963-072-24	eSATA / SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

SERIES 792™
SEVEN NINETY-TWO

The next-generation **micro miniature rectangular** connector with El Ochito contacts for high-speed aerospace applications

The robotics workstation inside the ISS cupola

The Series 792 connector brings high-speed data-rate performance to the Glenair Series 79 rectangular family. Size 8 cavities accept standard Quadrax or El Ochito® shielded octaxial contacts making it a perfect choice for radars, weapons systems, mission computers and displays, communications gear, and more.

El Ochito®

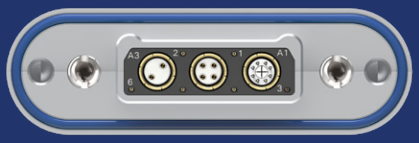
- High-speed Ethernet, USB 3.0, HDMI, and DisplayPort
- Industry-leading SpeedLine high-speed data link cable assemblies
- PCB-mount and cable
- Scoop-proof interface
- 12 arrangements, 6 shell sizes, from 1 to 9 way
- Precision-machined dual-lobe polarized shells
- Integrated EMI shielding and grounding
- Blind mate environmental

HIGH-SPEED
Series 792

The next-generation micro miniature rectangular for high-speed aerospace applications

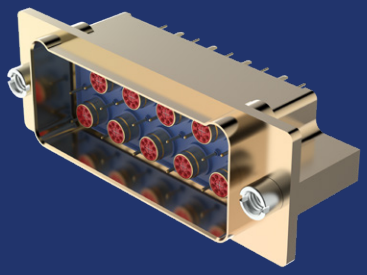
DESCRIPTION	REQUIREMENT	PROCEDURE / NOTES
Operating temperature	-65° to +175°C	EIA-364-32 Test Condition IV
Current rating	1.5 Amps (datalink contacts) 5 Amps (Size #23 contacts)	Datalink contacts tested: El Ochito® White
DWV (sea level)	750 VAC (Size #23 contacts) 1000 VAC (datalink contacts)	EIA-364-20
Insulation resistance	5000 MΩ minimum	EIA-364-21
Contact resistance, 25°C	55 millivolt maximum	EIA-364-06, 1.0 A test current, #24 AWG wire

DESCRIPTION	REQUIREMENT	PROCEDURE / NOTES
Shell-to-shell resistance	2.5 millivolt maximum	EIA-364-83
Shielding effectiveness	Frequency / Attenuation dB 100 / 75 1000 / 50 3000 / 44 6000 / 38 10000 / 35	EIA-364-66
Ingress protection	IP67 rating	IEC-60529



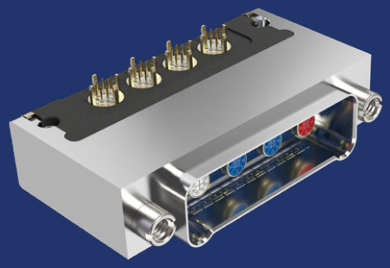
Twinax, Quadrax and El Ochito®

Connectors are available in three configurations: twinax for a single high-speed wire pair, quadrax for two data pairs, and El Ochito® for four.



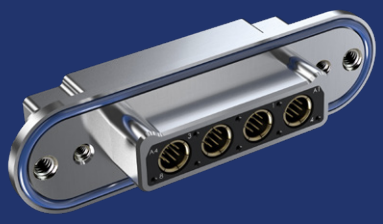
Up to 9 data ports

The Series 792 Size F with nine ports is the largest connector in the series and is the only two row version. Sizes A – E, with one to five ports, are single row.



PCB Connectors

Series 792 PCB connectors have straight or right angle PC tails. Contacts are non-removable and are epoxy sealed.

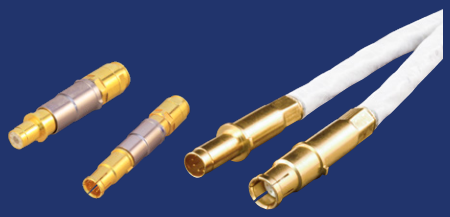


Panel Mount

Panel mount connectors have O-ring and threaded mounting holes for easy installation and are available with guide pins and float mounts.

Cable Connectors

High-speed shielded contacts snap into Series 792 cable connectors and are easily removed with a standard plastic tool.



El Ochito® Contacts and Jumpers

El Ochito® octaxial contacts and jumpers supplied for Ethernet, SuperSpeed USB, HDMI, DisplayPort, SATA and other multi-gigabit protocols.

SpeedLine™
High-Speed Protocol Cables

SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: SERIES 792 WITH EL OCHITO	
Part No.	**Protocol**
963-066-26 963-066-24	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8
963-080-26 963-080-24	SpaceWire
963-077-26	USB 3.2 Gen 1x1 Type A, B, uB
963-127-3	HDMI up to 2.0 • DisplayPort up to 1.4 • DVI Single and Dual
963-072-24	eSATA / SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

SERIES 806 MIL-AERO

Advanced performance, reduced size and weight connector series IAW MIL-DTL-38999

Series 806 meets key performance benchmarks for harsh vibration, shock, and environmental settings—as well as high-altitude, unpressurized aircraft zones with aggressive voltage ratings and altitude immersion standards.

Series 806 with four 10GbE El Ochito channels

CONNECTOR CONSTRUCTION

- Shell and coupling nut: aluminum or stainless steel
- Contacts: copper alloy, gold plating
- Wire grommet: fluorosilicone
- Dielectric inserts: high grade rigid dielectric
- Peripheral seal: fluorosilicone
- Ground spring: copper alloy, nickel plating
- Contact retention clips: copper alloy
- Ratchet springs, Retainer rings, clinch nuts: stainless steel, passivated

El Ochito®

- **Next-generation micro miniature aerospace-grade circular connector**
- **Upgraded environmental, electrical and mechanical performance IAW MIL-DTL-38999 Series III**
- **Integrated anti-decoupling technology**
- **High-Speed El Ochito® and hybrid #22HD contact arrangements**

HIGH-SPEED

Series 806 Mil-Aero Micro Miniature Circular Connectors

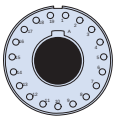
With El Ochito® octaxial contacts

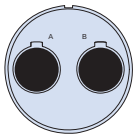
Series 806 with El Ochito® contact arrangements

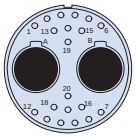
Contact Key

El Ochito® Size #8 Octaxial

Size #22HD





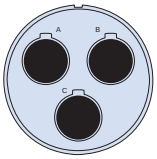


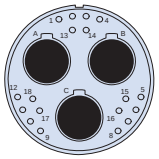
Insert Arrangement	10-1	14-20A		16-2	16-22	
No. of Contacts	1x #8	1x #8	19x #22HD	2x #8	2x #8	20x #22HD

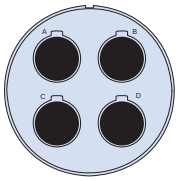
Contact Key

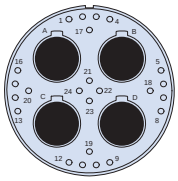
El Ochito® Size #8 Octaxial

Size #22HD







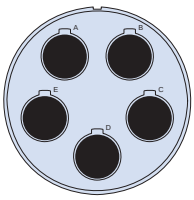


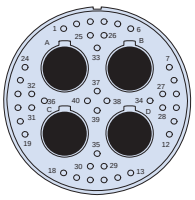
Insert Arrangement	18-3	18-21		20-4	20-28	
No. of Contacts	3x #8	3x #8	18x #22HD	4x #8	4x #8	24x #22HD

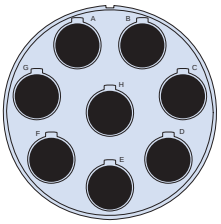
Contact Key

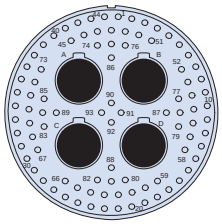
El Ochito® Size #8 Octaxial

Size #22HD



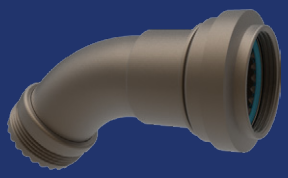






Insert Arrangement	22-5	22-44		24-8	24-97	
No. of Contacts	5x #8	4x #8	40x #22HD	8x #8	4x #8	93x #22HD

SPECIAL BACKSHELLS



Provide robust axial alignment and protection of high-speed contact-to-cable termination

SpeedLine™ High-Speed Protocol Cables

FEATURES

- Modified triple-start stub ACME mating thread for optimal vibration resistance
- El Ochito® Octaxial and hybrid high-density #22HD arrangements for combined high-speed protocol and standard hookup wire applications
- Aerospace-grade materials and construction IAW MIL-DTL-38999 Series III
- Meets all D38999 performance requirements including 70,000 ft. altitude immersion
- Optimal Size, Weight, and Power performance

SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: SERIES 806 WITH EL OCHITO	
Part No.	**Protocol**
963-066-26 963-066-24	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8
963-080-26 963-080-24	SpaceWire
963-077-26	USB 3.2 Gen 1x1 Type A, B, uB
963-127-3	HDMI up to 2.0 • DisplayPort up to 1.4 • DVI single and dual
963-072-24	eSATA / SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

SuperNine®

"Better than QPL" MIL-DTL-38999 high-speed solution

SuperNine® high-speed connectors with special inserts to accommodate El Ochito® octaxial contacts

- **Tooled and ready-to-ship high-speed and hybrid insert arrangement connectors for size #8 El Ochito shielded contacts. Arrangements for #8, #12, and #16 Coax, Twinax, and Quadrax also available.**
- **Supported applications: 10/100/1G/10G BASE-T Ethernet, HDMI, DisplayPort, SATA, USB 3.0 , 1553 databus and general RF or differential data transmission**

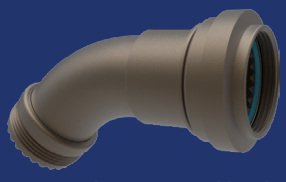
El Ochito®

Crimp contact and PC tail configurations

EL OCHITO CONTACT REFERENCE GUIDE

Contact Type	White, Type I	White, Type II	Blue, Type I	Blue, Type II	Red, Type I	Red, Type II
Pin	858-003	858-005	858-028	858-069	858-030	858-063
Socket	858-004	858-006	858-029	858-070	858-031	858-064

RECOMMENDED BACKSHELLS



Glenair supplies a special backshell series for use with El Ochito shielded size #8 contacts which provide robust axial alignment and protection of the cable-to-contact termination

"BETTER THAN QPL"

High-Speed SuperNine® MIL-DTL-38999

With El Ochito® octaxial contacts and industry-standard coax, differential twinax, and quadrax contacts

Square-flange receptacle with hybrid signal / El Ochito arrangement

Plug with 500 mating-cycle ratcheted coupling technology

Square-Flange Receptacle with metric clinch nut mounting

Jam-Nut Receptacle with PC tail termination and threaded standoffs

Size #8 Shielded Contact Quick Reference Guide					
Contact Type	**Glenair P/N**		**AWG**	**Cable Type**	**Application Notes**
 Coax	Pin: 852-007 Socket: 852-006	Coax 50 ohm (M39029/59 & /60)	22 - 28	M17/95-RG180	Analog radio frequency or microwave applications
	Pin: 852-056-01 & -02 Socket: 852-057-01 & 02	75 ohm	26	**-01**: V73263, V75268, V76261, **-02**: M17/94-RG179	
 Differential Twinax	Pin: 853-014-05 Socket: 853-013-05		24	M17/176-00002	1553 Databus/ Differential Signal
 El Ochito® Octaxial	Pin: 858-003, Type I • Socket: 858-004, Type I	El Ochito® White	26 - 28	963-033-26	1G/40G BaseT Ethernet
	Pin: 858-005, Type II • Socket: 858-006, Type II	El Ochito® White	24 - 26	963-033-24	
	Pin: 858-028, Type I • Socket: 858-029, Type I	El Ochito® Blue	26 - 28	963-110	USB 3.0
	Pin: 858-030-01, Type I • Socket: 858-031, Type I	El Ochito® Red	26 - 28	Varies	SATA, HDMI, Display Port
 Quadrax	Pin: 854-001 Socket: 854-002		22 - 26	Varies	10/BASE-T Ethernet
 Triax/ Concentric Twinax	Pin: 853-003 Socket: 853-004		22 - 28	M17/176-00002	1553 Databus

SpeedLine™
High-Speed Protocol Cables

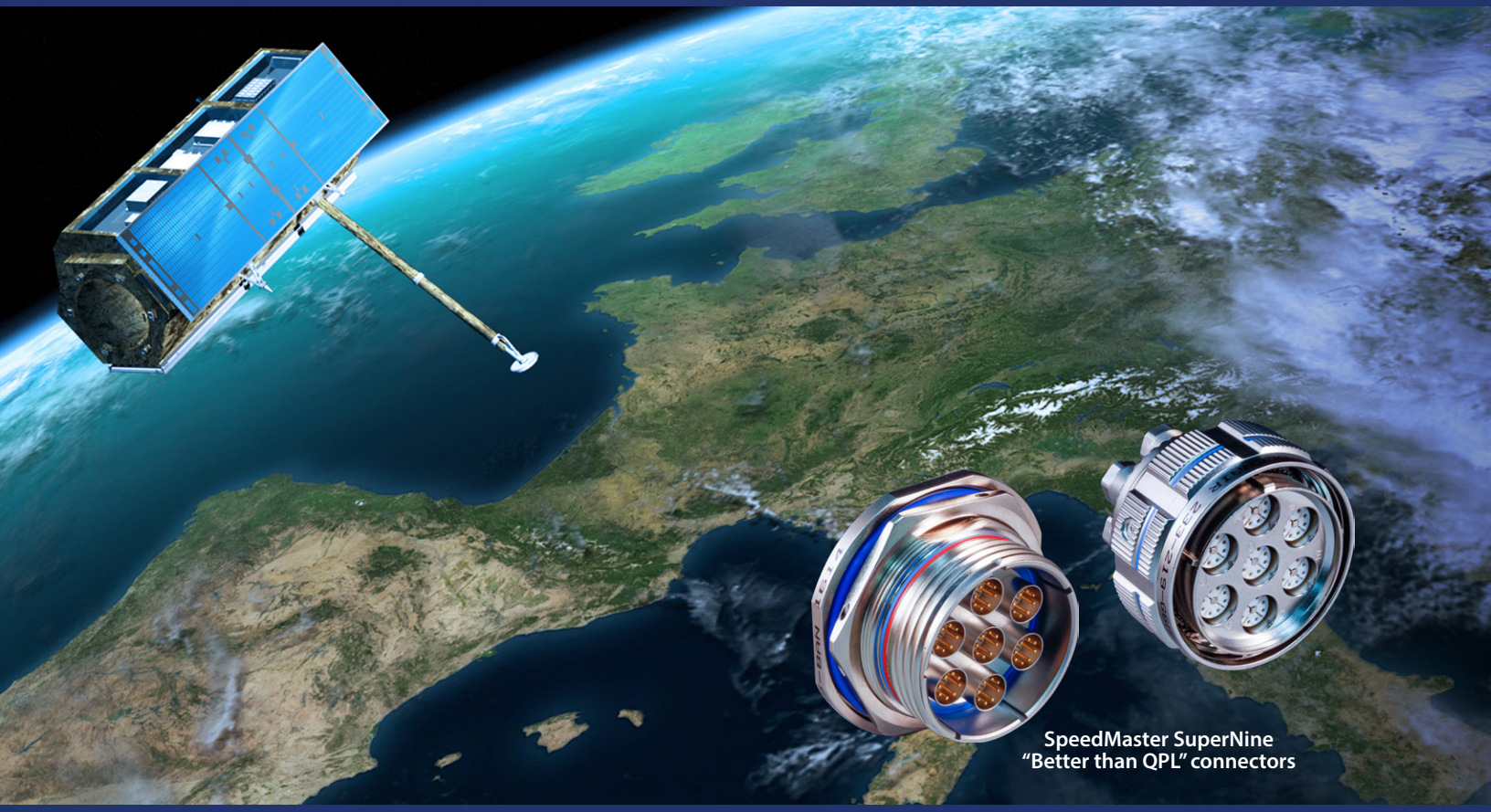
SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: SUPERNINE WITH EL OCHITO	
Part No.	**Protocol**
963-066-26 963-066-24	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8
963-080-26 963-080-24	SpaceWire
963-127-3	HDMI up to 2.0 • DisplayPort up to 1.4 • DVI single and dual
963-072-24	eSATA / SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

SPEEDMASTER™

High-speed **10G Ethernet** connection system for Glenair SuperNine, Mighty Mouse, and Series 79 connectors

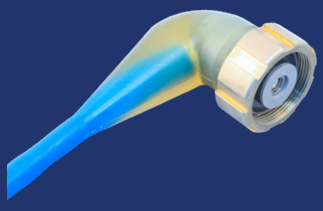


SpeedMaster SuperNine
"Better than QPL" connectors

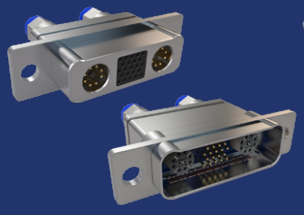
SpeedMaster™ is a dedicated size #22D crimp-contact module and insert package for SuperNine®, Mighty Mouse, and Series 79 connectors. Optimized for high-speed Cat 6A Ethernet, the SpeedMaster™ 10G system offers industry-leading NEXT, return loss, and insertion loss performance

- **Utilizes aerospace industry standard #22D contacts, tools, and widely available Ethernet flight cable**
- **Significant weight reduction compared to Quadrax solutions (reduces cable requirement by half)**

SpeedMaster Mighty Mouse Locking Push/Pull Connectors



Pressure-rated overmolded subsea cable assembly



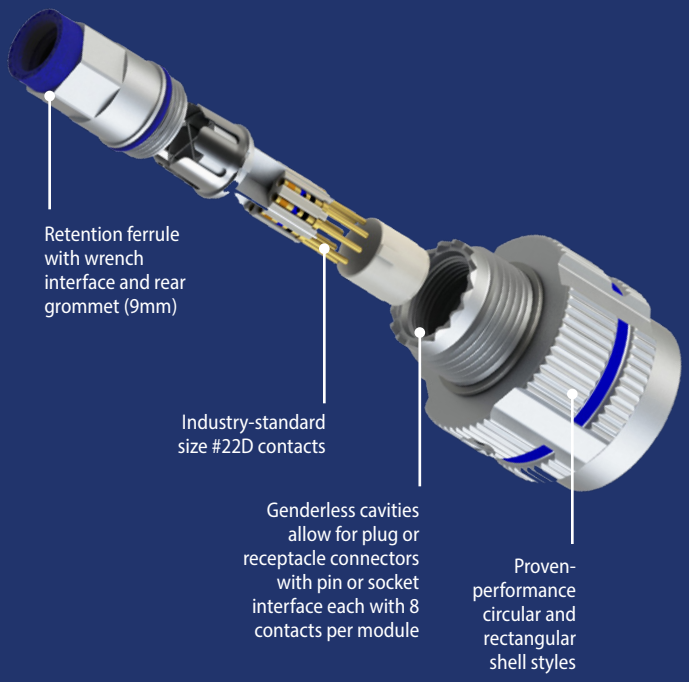
Series 7925 advanced-performance rectangular

SuperNine SpeedMaster with hybrid contact arrrangement

SpeedMaster™ High-Speed 10G Connection System

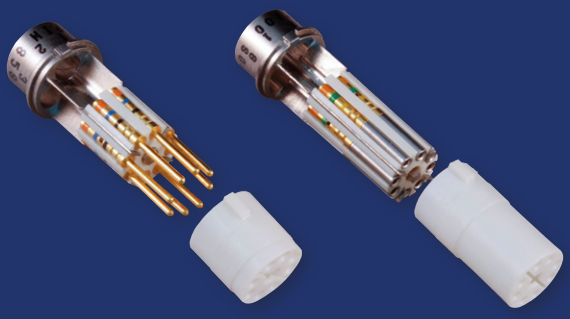
For Glenair SuperNine, Mighty Mouse, and Series 79 connectors

SPEEDMASTER 10G NEXT-GENERATION HIGH-SPEED CONNECTION SYSTEM



The SpeedMaster Difference

Each SpeedMaster module consists of 4 pairs of pins or sockets incorporating industry-standard size 22D contacts. Each module is individually shielded within the shell and retained in place with a threaded ferrule. Module cavities are genderless, allowing pin or socket interface for plugs or receptacles. SpeedMaster contacts are available as a drop-in high-speed 10G Ethernet solution in 3 connector packages: Small form-factor Mighty Mouse Series 824 locking push/pull, Series 7925 advanced-performance rectangular, and "Better than QPL" SuperNine D38999 Series III type connectors. SpeedMaster modules are easily removable and repairable to reduce network downtime.



SpeedMaster 10G modular inserts are available for Series 23 SuperNine – 38999, Series 80 Mighty Mouse – Locking Push / Pull and Series 7925 high-performance scoop-proof rectangular connectors.

The SpeedMaster 10G is optimized for high-speed Ethernet performance and incorporates standard M39029 #22D contacts isolated for superior NEXT, return loss and insertion loss performance.

SpeedMaster Glass-Sealed Hermetic: **Fully qualified to MIL-DTL-38999 Series III environmental and mechanical specifications. 10^{-7} Helium leak rate. Outstanding high-speed performance. Bulkhead feed-thru shown.**

SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: SPEEDMASTER						
Cable P/N	Cable Cat.	Cable Const.	Wire Gage	Cable Dia.	Cable Size	Assembly Instruction
963-066-24	Cat 6A	S/FTP	24	.260 (6.60)	3	AI85082
963-066-26	Cat 6A	S/FTP	26	.238 (6.05)	6	
963-075-24	Cat 6A	SF/UTP	24	.265 (6.73)	3	

SpeedLine™ High-Speed Protocol Cables

Manufactured and tested in-house for optimal high-speed performance

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

VersaLink™

High-speed twinax **"zero crosstalk"** contact, cable, and connector technology

VersaLink Micro-D turnkey prewired assemblies

Innovative differential twinax crimp contacts with highest available bandwidth—up to 28Gbps each—in rugged mil-aero circular and rectangular connector packaging. Hybrid insert arrangements support both standard signal as well as high-speed differential data.

VersaLink pin and socket crimp contacts sold separately. Save assembly time and labor with pre-wired, 100% tested VersaLink single-ended pigtails and cable assemblies, supplied with cable grommet follower if applicable.

- **Shielded differential data-pair solution for Ethernet, USB, SATA, PCIe, DisplayPort, and HDMI protocols**
- **Higher speed and density than standard mil-spec style twinax designs—up to 28 Gbps**
- **Aggressively shielded pairs result in virtually zero crosstalk**
- **Hybrid contact layouts with standard signal pins**
- **Optimized for use with Glenair SpeedLine™ 100 Ohm flat pair shielded cable**

HIGH-SPEED

VersaLink™ Interconnect System

Contact, cable, and connector packaging guide

VersaLink Contact Technology

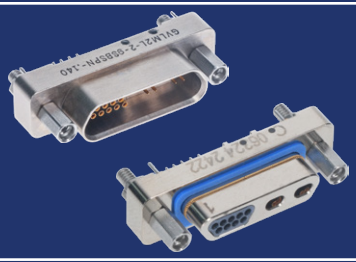
VersaLink Twinax contact technology supports high-speed serial data protocols including USB 3.1 Gen2, USB-C, SATA, PCIe, DisplayPort, and HDMI. Crimp-contact twinax modules are sold separately for ready packaging in Glenair signature circular and rectangular connectors.

Series 806 VersaLink Connectors

Glenair Signature Series 806 Mil-Aero connectors with VersaLink contacts feature advanced electrical, mechanical, and environmental performance plus reduced size and weight compared to D38999. Rapid-advance ratcheted coupling optimizes fast and reliable mating and demating.

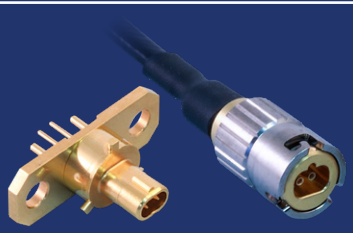
Series 794 VersaLink Connectors

The 794 rectangular series is designed for avionics and other high-datarate aerospace applications that require optimal contact and connector density. Dual-lobe scoop-proof shells prevent mating damage and optional polarizing keys prevent mis-mating issues. Rugged environmental design with robust EMC performance, ideal for blind-mate applications.



Micro-D VersaLink Connectors

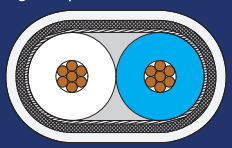
Ultra miniature Micro-D connectors with High-Speed VersaLink contacts offer the industry's highest speed and density compared to conventional mil-spec style twinax solutions. Hybrid arrangements with VersaLink contact modules and standard Micro-D contacts available for signal and power applications. Series is intermountable with standard Micro-D panel cutout dimensions.



VersaLink Bridge Board Level Connectors

The Glenair VersaLink Bridge is a high-density, micro-form factor twinax connector / jumper assembly used to bridge the gap between point A and point B on the board with better signal integrity than native board traces. VersaLink Bridge is equally capable at reducing insertion loss and signal latencies for data traffic between an ASIC and the I/O.

SpeedLine™
High-Speed Protocol Cables



SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: VERSALINK	
Part No.	**Protocol**
963-068-26 twisted 963-069-26 flat	Ethernet up to 10GBase-T1, 100GBase-T SpaceWire USB 3.2 Gen 1x1, Gen 2x1 • USB 3.2 Gen 2x1, Gen 2x2 USB4 Gen 2x2, 3x2 USB Type C HDMI up to 2.1 DisplayPort up to 2.0 • DVI Single, DVI Dual eSATA, SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

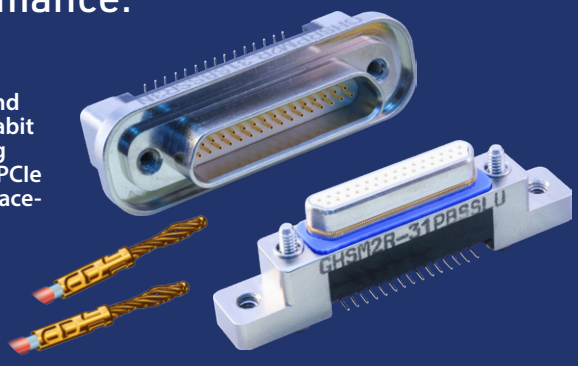
MICRO-D
High-Speed

The smallest and lightest aerospace-grade, **high-speed Micro-D** connector Solution

Prewired cordset with overbraiding for abrasion protection

The High-Speed Micro-D uses an impedance optimized open pin field for high-density signal routing flexibility. 1 Amp pre-wired cable and PCB solutions deliver up to 15 Gbps performance per differential pair. Auxiliary EMC ground springs on plugs ensure data integrity and low attenuation performance.

High-Speed Micro-D connectors and cables are optimized for multi-gigabit digital datalink protocols including USB 3.0, 10GbE, Camera Link, and PCIe 3.0. The high-performance, aerospace-grade connector series features machined-shell packaging, low-attenuation contact spacing, low-κ PEEK dielectric insulators, and Glenair shock- and vibe-resistant Nano TwistPin contacts.



- **Pre-wired factory pigtails, cordsets, and PCB connectors**
- **Unique contact isolation and spacing for optimal high-speed performance up to 15 Gbps**
- **Supports maximum #28 AWG wire**
- **Low-κ dielectric insulator combined with optimized contact size and spacing**
- **Precision-machined shells with gold or nickel plating**
- **1 Amp TwistPin contacts for optimal performance in harsh vibration, shock, and high-temperature environments**

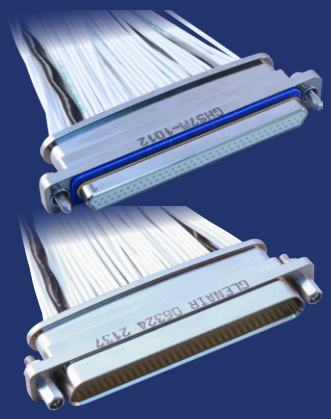
SERIES GHSM

High-Speed Micro-D

The miniature high-speed connector with mil-spec pedigree connector and contact packaging

SHELL SIZES AND CONTACT ARRANGEMENTS OPTIMIZED FOR HIGH-SPEED PROTOCOLS			
21 Display Port 1.2	21 HDMI 2.0	25 DVI-D Dual	21 DVI-D Single
15 SATA Gen 1, 2, and 3	15 USB 3.0 SuperSpeed	15 Ethernet Cat 6A 10GBase-T	31 Camera Link

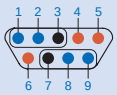
PREWIRED PIGTAIL AND BACK-TO-BACK CABLES



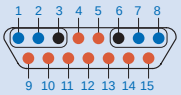
Turnkey, prewired plug and receptacle cable connectors are available as single-ended pigtails or back-to-back cable assemblies with pin or socket contacts per customer requirements. Shielded twisted pair (STP) wiring for differential data pairs is supplied in either 100 or 90 Ohms with a selection of jacketing and color. Discrete hookup wires may be specified in #28 or #30 gauge. Variable lengths of the assembly may be specified in 1 inch increments.

High-Speed Micro-D contact arrangements
face view pin connector

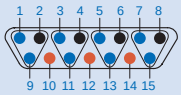
- high-speed signal pair
- signal-pair drain wire
- low-speed signal or power contacts



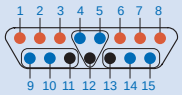
9 pin
(2 high-speed signal pairs)



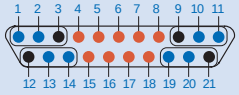
15 pin
(2 high-speed signal pairs)



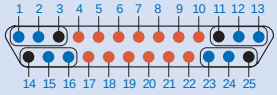
15E pin
up to 10GBASE-T Ethernet
(4 high-speed signal pairs)



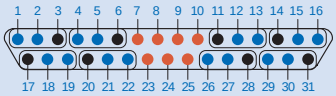
15U pin
USB 3.0
(3 high-speed signal pairs)



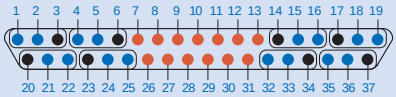
21 pin
(4 high-speed signal pairs)



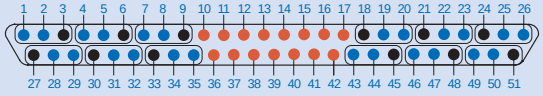
25 pin
(4 high-speed signal pairs)



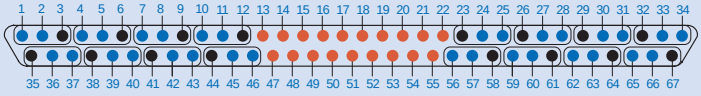
31 pin
(8 high-speed signal pairs)



37 pin
(8 high-speed signal pairs)



51 pin (special 2 row)
(12 high-speed signal pairs)



67 pin
(16 high-speed signal pairs)

SpeedLine™
High-Speed Protocol Cables

SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE	
Part No.	Protocol
963-057-28	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8 • SpaceWire USB 3.2 Gen 1x1, Gen 2x1 • USB 3.2 Gen 2x1, Gen 2x2 • HDMI up to 2.0 DisplayPort up to 1.4 • DVI Single, DVI Dual • eSATA, SATA 3.0

OPTIMIZED FOR USE WITH

SpeedLine™
High-Speed Protocol Cables

GMMD

The modular Micro-D differential twinax / RF coax high-speed solution

GMMD: an innovative modular Micro-D connector for RF coax and high-speed differential datalink applications. The unique micro miniature design of the GMMD also accommodates standard analog signal and power contacts, making it the most versatile Micro-D rectangular in the industry. GMMD leverages Glenair Signature Micro and Nano TwistPin contact inserts, as well as ultra small form-factor differential twinax modules delivering 18 Gb/second per pair and RF to 20 GHz. GMMD is supplied as factory-terminated pigtails, point-to-point jumpers, and SMT receptacles for easy PCB mounting.

Glenair Signature Twinax contact modules (left) are fully shielded for outstanding crosstalk isolation and signal integrity. Standard Micro-D TwistPin contact modules deliver reliable performance IAW MIL-PRF-83513.

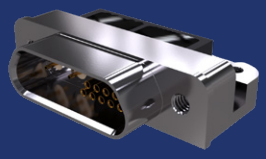
- **Low crosstalk, high bandwidth twinax modules for 18Gb/s per pair and RF beyond 30 GHz**
- **Cable and 90° PCB configurations for matched 100 Ohm differential impedance performance from I/O to board**
- **SMT receptacles for easy PCB mounting**
- **Combo layouts include twinax, 50 and 75Ω coax, mixed signal and power**
- **TwistPin contacts for low resistance and high shock and vibe performance**
- **Standard Micro-D shell sizes and hardware**

GMMD

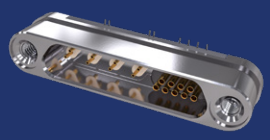
Modular High-Speed Micro-D Connectors

Product Showcase · Twinax, Coax, and Combo contact arrangements

GMMD DISCRETE CONNECTORS AND PIGTAIL / JUMPER ASSEMBLIES



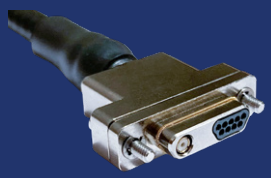
Horizontal PCB-mount twinax and combo twinax receptacles



Vertical PCB-mount twinax and combo twinax plug and receptacles

Twinax and combo twinax jumpers and pigtails

Horizontal PCB-mount coax and combo coax receptacles



Coax and combo coax jumpers and pigtails

GMMD TWINAX AND COMBO TWINAX CONTACT ARRANGEMENTS (additional arrangements are available, consult factory)

Contact Arrangement	**2T**	**4T**	**2T9**	**2T15**	**4T9**
Shell Size	9	15	21	25	31
No. / type of contacts	2 Twinax	4 Twinax	2 Twinax, 9 #24	2 Twinax, 15 #24	4 Twinax, 9#24
Example applications	SpFi	10GbE, 2xSATA, SpW, 2xSpFi	USB 3.1, SATA + power		HDMI, DP, DVI, 10GbE + power

Contact Arrangement	**5T9**	**8T**	**4T15**	**8T15**	**4T31**	**12T**
Shell Size	31	31	37	51-2	51-2	51-2
No. / type of contacts	5 Twinax, 9 #24	8 Twinax	4 Twinax, 15 #24	8 Twinax, 15 #24	4 Twinax, 31 #24	12 Twinax
Example applications	DP incl. Aux channels	2x10GbE		DP, HDMI+, USB 3.1, dual DVI		

Contact Arrangement	**12T15**	**6T37**	**8T31**	**16T**
Shell Size	67	67	67	67
No. / type of contacts	12 Twinax, 15 #24	6 Twinax, 37 #24	8 Twinax, 31 #24	16 Twinax
Example applications				4x10GbE

GMMD COAX AND COMBO COAX CONTACT ARRANGEMENTS (additional arrangements are available, consult factory)

Contact Arrangement	**2C**	**4C**	**6C**
Shell Size	9	21	25
No. / type of contacts	2 X 50Ω Coax	4X 50Ω Coax	6X 50Ω Coax

Contact Arrangement	**8C**	**16C**
Shell Size	37	67
No. / type of contacts	8 X 50Ω Coax	16X 50Ω Coax

Contact Arrangement	**2C9**	**1V9**	**2V9**	**4V**
Shell Size	21	21	31	21
No. / type of contacts	2X 50Ω Coax, 9 X #24	1 X 75Ω Coax, 9 X #24	2 X 75Ω Coax, 9 X #24	4 X 75Ω Coax

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SPEEDLINE™ COMPATIBLE HIGH-SPEED CABLE: GMMD	
Part No.	**Protocol**
963-065-30	Ethernet up to 10GBase-T Cat 6A, up to 40GBase-T Cat 8 • SpaceWire USB 3.2 Gen 1x1, Gen 2x1 • USB 3.2 Gen 2x1, Gen 2x2 • HDMI up to 2.0 DisplayPort up to 1.4 • DVI Single, DVI Dual • eSATA, SATA 3.0

Outlook

Glenair to the Rescue

We hosted some of our European sales-team members here at the factory this past month, and quite a few of their stories from the field centered around the important role we've been playing helping our customers solve their most challenging interconnect problems.

They talked about our ability to reverse engineer and quickly deliver components that have been obsoleted by other suppliers. How our no minimum order policy is helping harness shops with immediate requirements for short lengths of high-performance cable. How difficult plating compatibility issues are being solved with Tin-Zinc, our new cadmium-free replacement finish. How our many innovative and signature connectors are solving size, weight, and power issues in everything from satellites to downhole drilling equipment.

A major recurring theme in these anecdotes is how well the factory is performing when it comes to anticipating customer requirements even before orders are placed. I know this to be the case in all our facilities. Our factory teams have gotten extremely good at inventing, producing, and stocking — on our dime, I might add — the exact interconnect solutions our high-reliability customers need. Again, often before they even ask for it.

I remember an old TV commercial for Alka-Seltzer. It showed somebody in distress from overeating, getting immediate help from the product. The ad featured a little jingle at the end with the tag-line, Alka-Seltzer to the rescue!

On a more serious level, that is exactly what we are doing at Glenair. We are coming to the rescue of our customers — time and time again — with the exact solutions they need. And we are doing it with outstanding product quality and velocity. From someone who started his interconnect-industry career carrying a bag, I can tell you personally how happy this aspect of the factory's performance is making every customer we have.

We spend a great deal of time at sales meetings reminding our team that much of the success we enjoy at Glenair is born out of our habit of listening to the folks who buy and use our products. Pretty simple concept, but man is it important. There is no better way to truly understand problems and opportunities, than by switching your mouth and your mind from broadcast to receive.

"Coming to the rescue" might sound a bit dramatic or even a bit corny. But a company that can do that is pure gold to its customers. And by the way, it is exactly this reputation we have worked so hard to earn at Glenair — the reputation of being the best in the industry when it comes to pulling out all the stops to help our customers solve a tough problem. Way to go team!

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