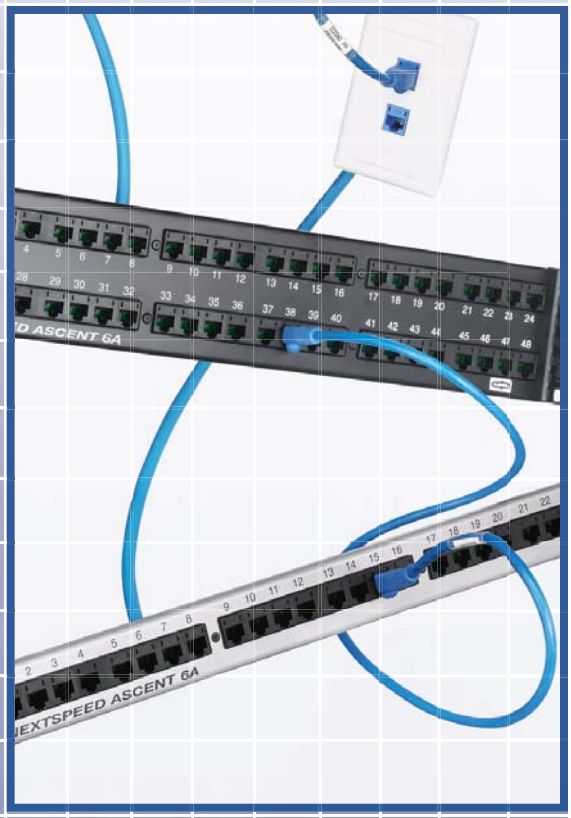
Hubbell Sets the Performance Bar
Augmented Category 6 Jacks and Patch Panels

publication

technology



HUBBELL®

Hubbell Premise Wiring

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Introduction

Hubbell Premise Wiring's new Augmented Category 6 (C6A) RJ45 modular connector is the highest performing connector on the market, exceeding all current C6A specifications. This innovative connector technology is the backbone of Hubbell's **NEXTSPEED®** Ascent™ C6A jack and patch panel.

Whether it's unmatched alien crosstalk (ANEXT) performance, enhanced common mode design or industry leading performance for return loss (RL), near-end crosstalk (NEXT) and other critical parameters, Hubbell's Ascent C6A jack and patch panel provide the data transmission performance required for the high bandwidth digital world. At the same time, Hubbell maintains a familiar footprint for installation, and manufactures all components in an environmentally-conscious "green" manner right here in the USA.

The Category 6A Market

Current C6A products available on the market provide marginal performance and often come with application or configuration restrictions, such as minimum distances, loose bundling and smaller bundle sizes. Many vendors use elusive system descriptions such as "C6A compatible" or "supporting 10Gig performance". Most have only achieved C6A channel compliance that is not assured through actual design and qualification of individual components. This can negate backward compatibility and interoperability, requiring extensive qualification testing of installed systems using proprietary performance limits with pages of fine print. Hubbell's C6A Ascent solution provides one of the industry's first true component compliant systems—no fine print, no restrictions.

The Hubbell Solution

The common perception that "a jack is a jack" is simply not true. Not all C6A jacks are created equal. Hubbell's Ascent C6A jacks and patch panels are superior in every aspect of performance and reliability, exceeding all standards requirements by considerable margins. The Hubbell C6A solution delivers significant headroom over other minimally compliant jacks and eliminates the need for restricted configurations and installation limits.

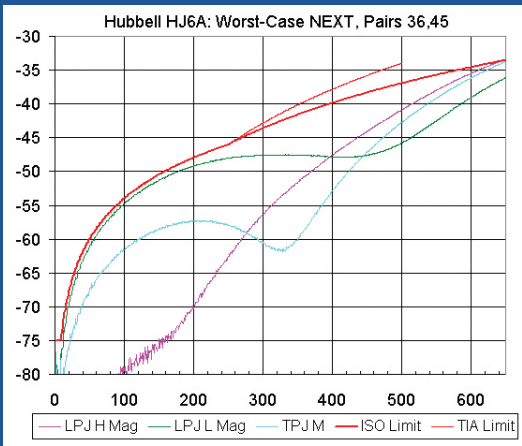
This paper describes the Hubbell Ascent C6A jack and patch panel technology, with emphasis on key parameters that users need for designing a C6A cabling infrastructure.

Advanced Electrical Design

To achieve C6A component compliant design, Hubbell engineers started with an optimal electrical design and enhanced this design with advanced electrical and mechanical modeling techniques. The resulting design challenged all aspects of mechanical and manufacturing technologies to deliver patented connectors with the shortest possible electrical distance between the plug and the jack. This, combined with a balanced contact structure, achieved much more effective noise reduction without any excess unbalance. The result is superior component NEXT performance in a worst-case scenario, testing that exceeds the highest proposed industry standards by 3dB at 500MHz and passes extended limits out to 650MHz. This level of performance is unmatched in the industry.

In addition to this superior performance is that it has been achieved with 100% standards-compliant, backward compatible and interoperable components.

Figure 1
HJ6A Worst Case NEXT. Pair Combination 3,6-4,5



Hubbell's Ascent C6A jack does not require a specialized proprietary plug to meet C6A performance levels. Hubbell did not violate Telecommunications Industry Association (TIA) and International Standards Organization (ISO) standards or sacrifice backward compatibility—the connector is compliant with C5e and C6 component requirements throughout the frequency range. The Hubbell jack is designed to exceed the performance requirements at 500MHz, without sacrificing lower frequency performance.[1]

Stringent Test Limits

Hubbell's C6A connectivity testing is performed against the most stringent electrical performance requirements, without relying on any relaxations permitted in by the standard. For example, the NEXT results shown in Figure 1 for pair combination 3/6 and 4/5 are tested against ISO proposed test limits with a limit of 37dB at 500MHz. This exceeds the TIA standard of 34dB by 3dB at that frequency. Furthermore, Hubbell does not rely on the 1.5dB relaxation allowed with test plugs—the resulting TIA effective limit at 500MHz being 32.5dB. This means that Hubbell's Ascent C6A connector with a worst-case NEXT of 40dB at 500MHz performs more than 7.5dB beyond other connecting hardware that is minimally compliant to the standard. That's nearly THREE TIMES the minimum performance, providing significant headroom to the installed system.

Component performance with significant headroom contributes to installed permanent link and channel margin. Where a minimally compliant connector often fails in the worst-case short channel configuration[2], as assumed by the standards (i.e. 10m of horizontal cable and two 1m patch cords), the Hubbell Ascent system delivers 7dB of headroom. This means that the Hubbell system can pass NEXT and RL performance specifications in significantly shorter links typically used in high-end data centers that support 10GBASE-T in links ranging from 1m to 100m. Hubbell's 2m permanent link provides 5dB of NEXT headroom and 1.3dB of RL headroom.

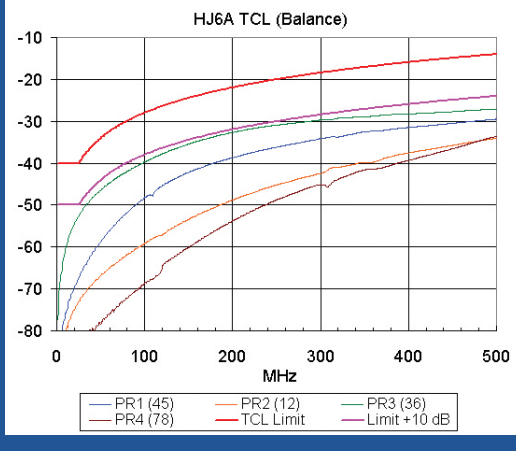
The enhanced performance of Hubbell's Ascent C6A connector is achieved with simple connector geometry and a straightforward termination process. Hubbell continues the tradition of offering the fastest terminating jacks in the industry. Jacks and panels can be terminated using either a standard 110-termination tool or Hubbell's patented One-Punch™ tool for additional labor savings.

Enhanced Common Mode Performance

Previous generations of connectivity in the industry were unable to reduce noise levels inside a connector without compromising balance, which increased noise outside the connector. This noise did not affect applications preceding 10GBASE-T, which operated at lower frequencies and higher voltage levels. However, with the required higher frequencies to support 10GBASE-T, noise radiating from the connector adds to ANEXT that occurs between adjacent cables and connectors. Suppression of ANEXT remains a challenge being addressed by industry standards organizations.

Hubbell's jack and panel designs maintain superior balance, achieving 10dB of headroom above the standard, utilizing advanced electromagnetic design to optimize impedance and common mode performance. Through this innovative technology, Hubbell's engineers are able to deliver connectivity that minimizes excess ANEXT in the installed link and channel. Furthermore, this performance is achievable with any component compliant, balanced C6A cable.

Figure 2
HJ6A Worst Case TCL (Balance)

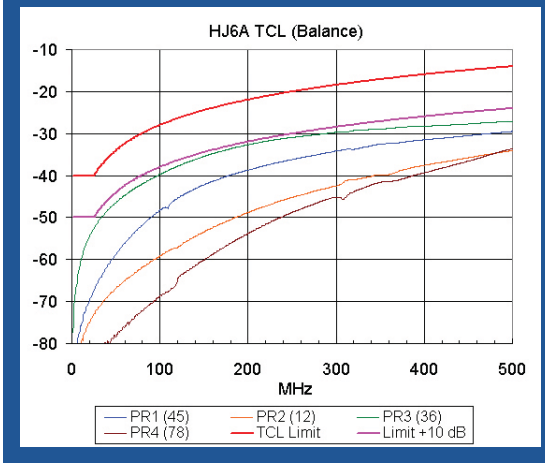


1 Refer to Appendix A for NEXT results of other commercially available "C6A" connecting hardware.
2 ANSI/TIA-568-C.2 Annex J provides the worst-case channels and link assumptions used to derive connector limits. Additional information presented on page 6 of this paper.

Enhanced ANEXT Performance

The combination of advanced common mode design and ANEXT isolation yields a jack and patch panel that is compliant in all available mounting configurations. There are no restrictions on the use of the Ascent C6A jack in Hubbell's full line of keystone mounting plates and panels. The jack maintains C6A ANEXT performance in all available Hubbell plates and in Hubbell's high-density, 1-rack unit, 48-port UDX jack panel configurations.

Figure 3
HJ6A Worst Case TCTL Balance



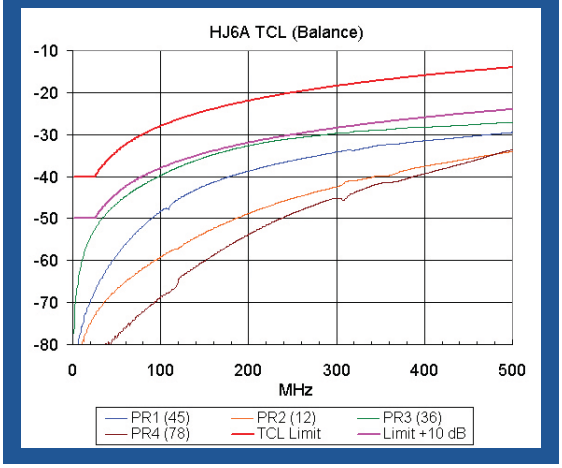
Revolutionary Mechanical Design

To compliment the enhanced electrical performance, Hubbell's Ascent C6A jack and patch panel are designed to exceed every mechanical requirement listed in ISO 60603-7, TIA 568C.2 and TIA 570B. This was accomplished through the careful selection of advanced materials, extensive computer simulation and real world testing.

Designing an RJ45 connector with the combined electrical performance, and mechanical reliability has always been a challenge in this industry given the complex connector geometry. The trade off between electrical and mechanical performance has typically revolved around the contact length—a shorter contact improves the electrical performance, but is more difficult to design mechanically and requires high performance materials. As a result, many connectors in the industry do not yield a desired contact normal force of 100g and offer only minimal electrical performance.

Adequate normal force in connector contact mating is vital to long-term reliability to support repeated insertions. A normal force too low does not provide consistent and reliable electrical connections, especially in high frequency operation. An excessive normal force leads to premature wear and damage well before the prescribed number of insertion cycles. Hubbell's Ascent C6A jack and patch panel represent a revolution in contact design, yielding the optimal desired normal forces (100g), while providing the shortest electrical lengths of any solid contact design. The result is long-term reliability that extends well beyond the life of Hubbell's 25-year mission critical warranty.

Figure 4
HJ6A Worst Case Component PSANEXT



The reduction in contact length, while optimizing normal force on the contacts, was achieved through the use of a non-stationary support. The RF circuit is mounted to a precision spring that compensates for contact movement caused by variations in plug design. This creates an electrical path that is shorter and more consistent than those found in other connectors. The non-stationary primary compensation path is a patented industry first, which translates to best-of-class electrical performance.

Figure 5
HJ6A

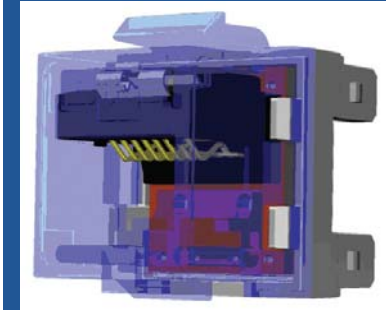
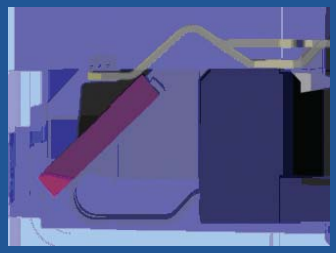


Figure 6
HJ6A Cross Section
Showing short contacts and non-stationary compensation



PoE+ and Beyond

Hubbell's innovative jack and panel designs exceed all existing and anticipated PoE application power levels. With the high current carrying traces and contacts, Hubbell's connectivity is able to support low-voltage power without any impact on transmission performance or reliability. Both the Ascent C6A jacks and patch panel are designed and tested for 850mA of continuous current per conductor (1.7A per pair). This is twice the guideline of 850 mA per pair called out in TIA TSB-184, "Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling", and three times the 600mA per pair required by IEEE 802.3at (PoE+).

Environmentally Conscious Approach

In addition to superior electrical performance, Hubbell made a concentrated effort to make the Ascent C6A jack more environmentally friendly. The contacts were designed with a compliant pin to completely eliminate the soldering operation. The form factor of the jack was reduced to minimize the amount of raw material needed. All retail packaging for the jack has been reduced by at least 30% and is manufactured out of recycled materials. The components will also be offered in fully recyclable, re-sealable convenience bulk packs that drastically reduce job-site waste. Manufacturing the Ascent jack and patch panels in the USA has also minimized transportation and maintains a smaller carbon footprint.

Figure 7
Worst Case Short Permanent Link & Channel

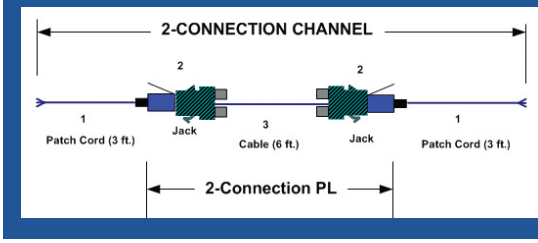
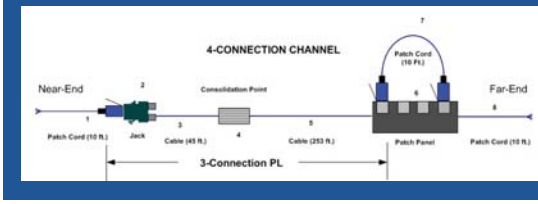


Figure 8
Worst Case Long Permanent Link & Channel



Putting it all Together

Hubbell's industry leading Ascent C6A system is engineered to provide the best possible permanent link and channel performance in every possible configuration and length. The system is tested beyond the worst-case assumptions of the standards, providing significant margin in both worst-case longest and shortest lengths.

Worst-Case Configurations

To provide assurance of performance in real world installations, Hubbell fully qualified the Ascent system in channel and link configurations ranging from 1m to 100m. These lengths are significantly worse than those used by TIA to develop the standard limits. For example, the shortest permanent link length assumed in the standard is 10m, as defined in TIA 568-C.2 Annex J. In contrast, Hubbell successfully tested the Ascent C6A jack in a 2m link and a 1m patch cord.

The channel and link performance of the **NEXSTPEED®** Ascent C6A system is summarized below.

Channel & Permanent Link NEXT and RL

Superior component NEXT performance yields channels and links with significant headroom throughout the frequency range. Channel and Link RL in Figure 11 also significantly exceed the standard requirements. Improved RL minimizes reflected power into the transmitter, thereby reducing power usage in the electronics.

Figure 9
4 Connection, 100m Channel, Worst Case PSNEXT

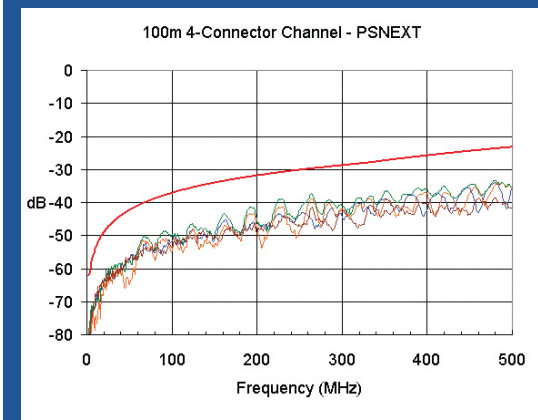


Figure 10
2 Connection, 2m Link, Worst Case PSNEXT

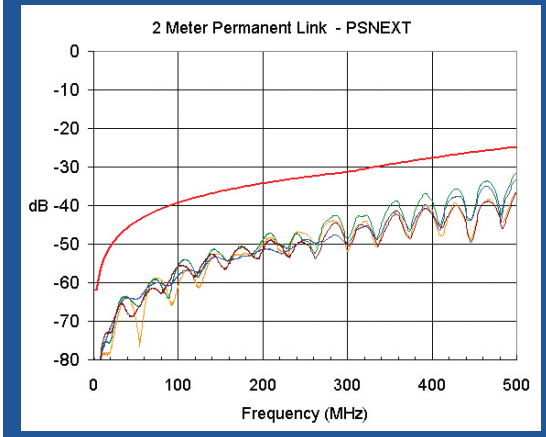


Figure 11
4 Connection, 100m Channel, Worst Case Return Loss

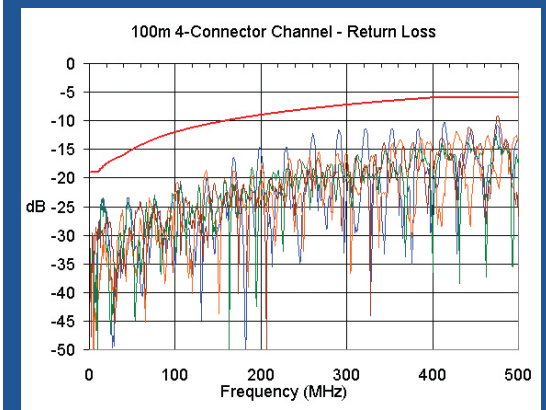
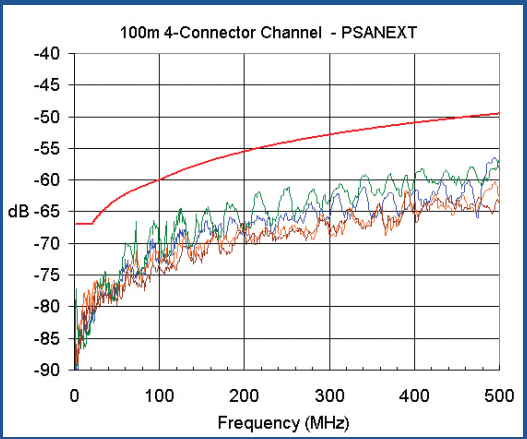


Figure 12
4 Connection, 100m Channel, Worst Case PSANEXT



Channel & Permanent Link ANEXT

NEXTSPEED® Ascent C6A PSANEXT is shown in the following figures. Worst-case PSANEXT provides signal-to-noise headroom for 10GBASE-T operation up to 100m. Figures 12 and 13 show PSANEXT of the longest channel configuration and corresponding permanent link, demonstrating significant margins obtained with Hubbell Ascent C6A jack. These margins are produced by the component performance of Hubbell's jack, exceeding all standards requirements.

Although the worst-case signal-to-noise ratio is typically obtained at 100m, worst-case PSANEXT occurs in shorter configurations and can often fail the requirements. While active equipment can compensate for some of this unexpected signal degradation, the added noise can result in higher power consumption and latency, increasing the probability for transmission errors that reduce the dynamic range of transmitters and receivers. Figure 14 demonstrates the PSANEXT for Hubbell's Ascent C6A system measured at a length of 2m. This result is an industry first—other systems exhibit marginal PSANEXT performance when lengths approach 10m and often fail at lengths shorter than 10m. See Figure 14 - 2m Permanent Link, Worst Case PSANEXT.

Although the TIA and ISO standards do not cover link and channel lengths less than 10m, shorter lengths are very common in data centers, server farms and other high-density network installations. Hubbell considers short length performance as critical to these applications.

Summary

Hubbell has achieved industry leading performance with a true component compliant system that exceeds all TIA and ISO standards, while maintaining familiar jack/panel footprints, easy termination and configurations that are recognized by the industry. This level of flexibility eliminates restrictions placed on designers, installers and end users, while providing assurance that the system will support the latest 10GBASE-T applications and provide backward compatibility and interoperability.

Designed for longevity, the Ascent C6A system performs with statistically proven margins and is backed by Hubbell's extended Mission Critical 25-Year Warranty.

Figure 13
3 Connection, 90m Permanent Link, Worst Case PSANEXT

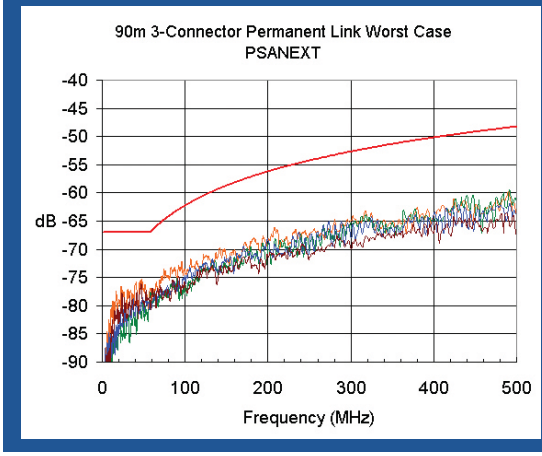
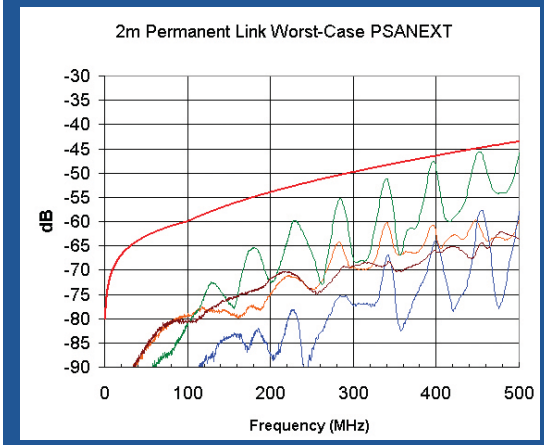


Figure 14
2m Permanent Link Worst Case PSANEXT

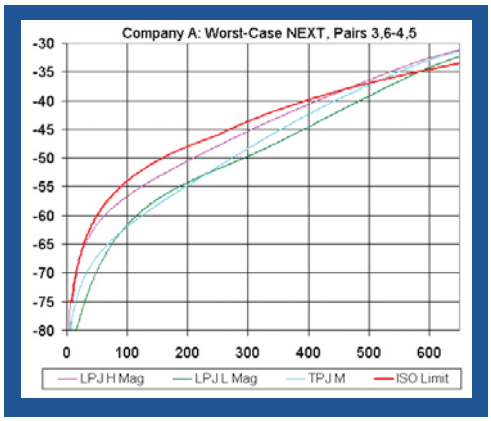


Appendix A: Industry Comparison

For reference, we provide the equivalent testing on a representative sample of industry hardware claiming C6A performance.

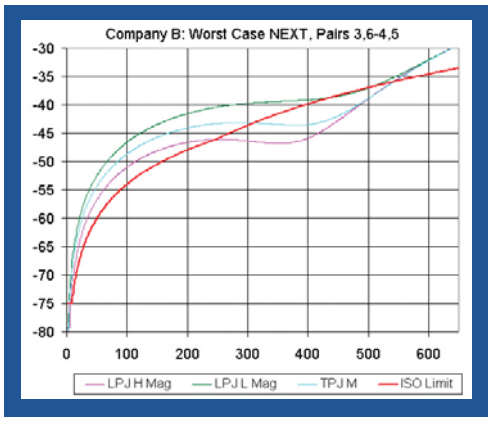
Company A:

This connector meets the TIA limit of 34 dB at 500 MHz in the worst-case scenario. It does not meet ISO limits.



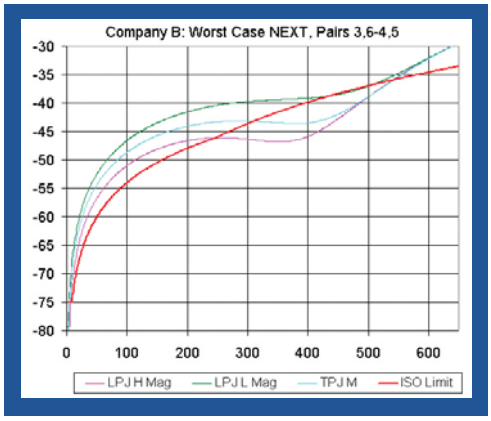
Company B:

This connector is marketed as “C6A” on the nose, yet it provides marginal performance at 500MHz at the cost of yielding C5e performance at 100 MHz. This connector claims to yield C6A performance levels with proprietary plugs.



Company C:

This connector does not meet C6A levels of TIA or ISO standards. It most likely makes its claims based on the marginal performance to the relaxed TIA limit for pair combination 3/6-4/5 (32.5 dB at 500MHz). This connector will have poor performance in short links.



Company D:

This is another example of a connector with marginal TIA levels of performance at 500 MHz. This connector is a better design than company B and company C with ~34 dB at 500 MHz and only a small sacrifice in performance in the 150 to 275 MHz range.