PANDUIT®
infrastructure for a connected world

Copper Patch Cords

Impact on Network Performance and Reliability

The Impact of Copper Patch Cords on Network Performance and Reliability

As network infrastructures continue to have a higher impact on an organization's productivity and competitive position, it becomes increasingly important to select a reliable end-to-end structured cabling system that will allow for future network growth. To maximize usable network bandwidth, it is critical that patch cords properly support the performance, quality, and dependability of the entire structured cabling system. The performance of the link between the switch and computer is most impacted by noise generated in the area of the channel closest to the active equipment. This is where the patch cords are located and where quality should never be compromised by using off-brand patch cords. It is vital that patch cords have the following design features:

- Mated performance with connecting hardware to maximize cancellation of near-end-crosstalk
- Robust construction to ensure long-term reliability of the network under day-to-day moves, adds and change conditions
- Certified component performance to ensure maximum network availability.

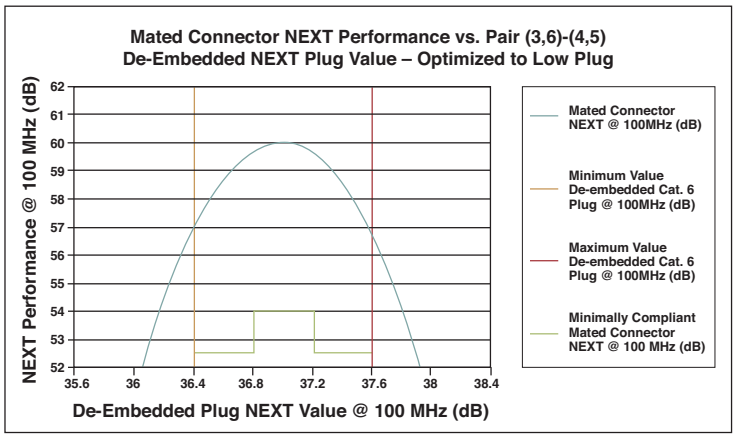
Investing in high quality patch cords ensures the channel components work together as an end-to-end solution to maximize performance and reliability. Various testing scenarios, as outlined in this document, provide quantifiable results to support the importance of high quality patch cords.

Importance of Mated Connecting Performance

One of the key factors to achieve high-end channel bandwidth is the optimum mated performance of the patch cord plug and the jack connector. Fundamentally, connectors and plugs are designed to have equal but opposite component pair coupling effects. A properly tuned jack compensates for the noise generated by the patch cord plug. Thus, mated performance is achieved when the crosstalk within the patch cord plug is cancelled by the compensation in the connector.

The TIA/EIA 568-B.2 Category 6 standard addresses the issue of mated performance by establishing a "de-embedding" procedure to test the electrical performance of modular plugs. De-embedding is a process that uses a reference jack connector with known values to obtain the NEXT loss values for plugs. The mated performance of a typical Category 6 connector has a bell shape performance curve across the de-embedded patch cord plug range. If a jack connector is designed correctly, the optimal mated performance is at the center of the Category 6 de-embedded test plug range.

Conversely, the connector must also meet the mated connecting hardware pair-to-pair NEXT loss specification across the allowable Category 6 de-embedded test plug NEXT loss range. In the case of pair combination 3,6-4,5, the optimum performance is with a centered deembedded plug of 37.0 dB at 100 MHz (shown in Graph 1) but the connector must also pass the mated connecting hardware pair-to-pair NEXT loss specification with test plugs ranging from 36.4 dB to 37.6 dB. When a plug is outside of this range, mated performance declines and is no longer compatible to the connecting hardware.

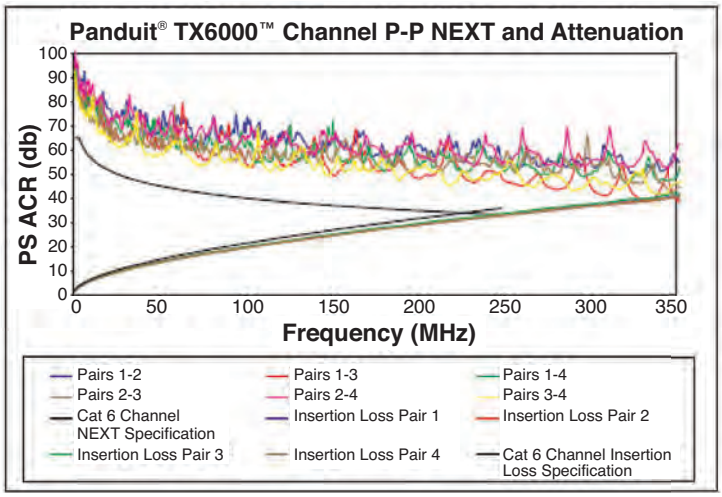


Graph 1.

Importance of Mated Connecting Performance (continued)

A jack connector that performs well when mated to a patch cord plug with high or low de-embedded NEXT may not provide the same performance when mated with a patch cord plug that is centered in the de-embedded range. In some cases, that connector may even fail the Category 6 connecting hardware requirements when using a patch cord plug at the other end of the de-embedded range. In other words, when a connector is not optimized with a centered plug, it minimizes backward compatibility and interoperability with other channel components. This can limit network performance. Conversely, the Panduit® Mini-Com® TX6™ PLUS Jack Module and DP6™ Patch Panels are designed with complementary technology to meet the connecting hardware pair-to-pair NEXT specification with the de-embedded NEXT loss ranges. However, if one of these connectors is mated with an off-brand patch cord that is not tightly centered to the de-embedded range, the channel performance could be significantly degraded.

To deliver superior reliability, the Panduit® TX6™ PLUS Category 6 Patch Cords are manufactured with plugs that are tightly centered in the Category 6 de-embedded plug NEXT loss ranges for maximum performance when mated with the Panduit® Mini-Com® TX6™ PLUS Jack Module or DP6™ Patch Panels. The Panduit® TX6000™ Copper Cabling System delivers usable bandwidth beyond 300 MHz (shown in Graph 2), over 50% higher than specified by the TIA/EIA Category 6 standard!



Graph 2.

Affects of Mechanical Testing

Besides having properly mated patch cords and connectors to ensure maximum performance during initial installation, patch cords also have to be designed to easily handle frequent moves, adds, and changes. Due to the handling that patch cords receive, TIA/EIA 568-B.2 requires mechanical stress testing of patch cords to ensure they continue to operate under real-world conditions.

Per the TIA/EIA 568-B.2 requirements, patch cords are mechanically tested for performance after bending in various configurations:

Patch cord put into a 6-inch diameter cable loop, up to 10 loops total.

Patch cord compressed into a 2.5-inch coil to form an ellipse cable loop, up to 10 loops total.

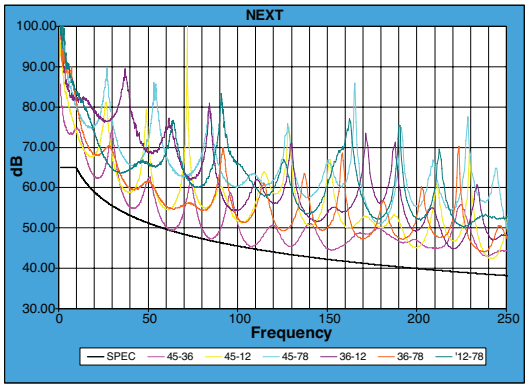
Patch cord rotated on one end on the coil ellipse by 180° to form a figure eight cable loop, up to 10 loops total.

Affects of Mechanical Testing (continued)

Testing of off-brand patch cords by Panduit Laboratories has shown consistent deterioration of electrical performance to levels below the TIA/EIA 568-B.2 specifications resulting in non-compliant patch cords and **degraded channel performance**.

TIA/EIA 568-B.2 Mechanical Stress Test of Off-Brand Patch Cords

NEXT BEFORE Mechanical Testing



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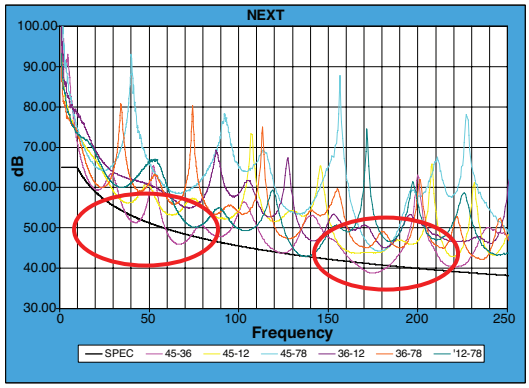
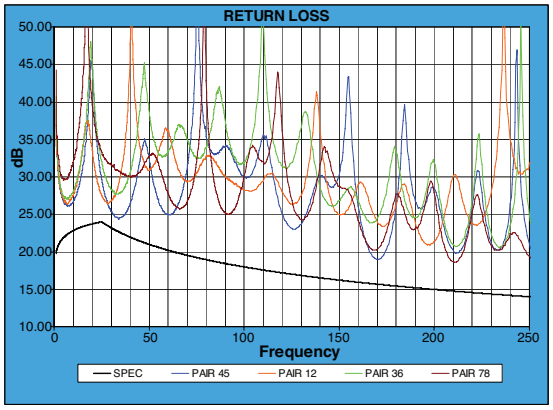


Return Loss BEFORE Mechanical Testing



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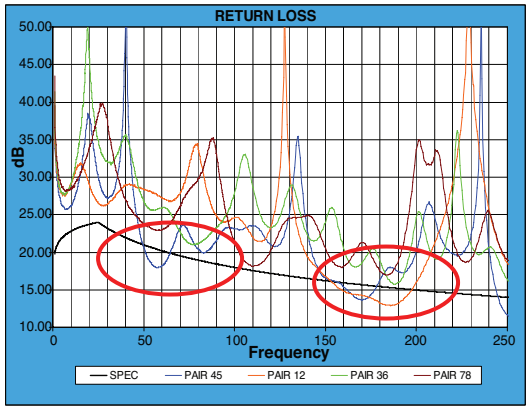
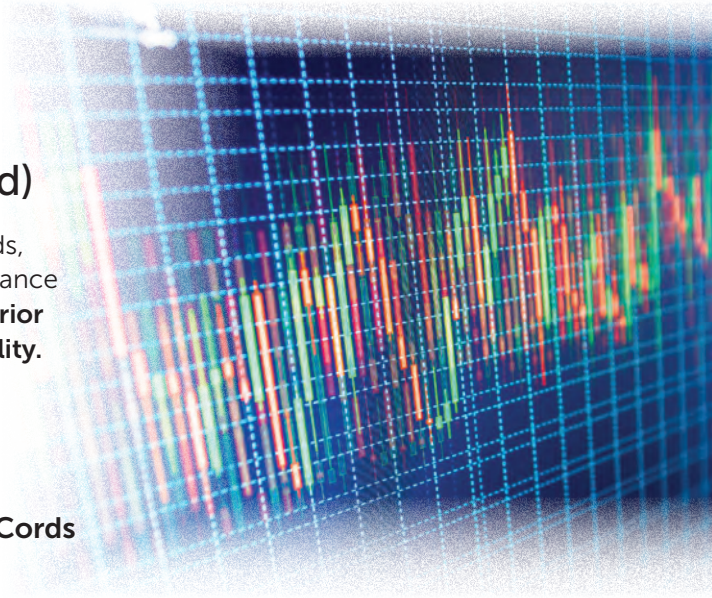


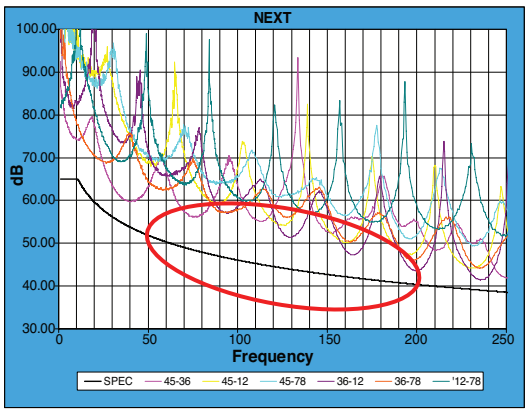


Affects of Mechanical Testing (continued)

TIA/EIA 568-B.2 mechanical stress test of high quality patch cords, such as the Panduit® TX6™ Patch Cords shows electrical performance that exceeds the TIA/EIA 568-B.2 specifications resulting in **superior long-term channel performance and increased network reliability.**

TIA/EIA 568-B.2 Mechanical Stress Test of Panduit Patch Cords

NEXT BEFORE
Mechanical Testing



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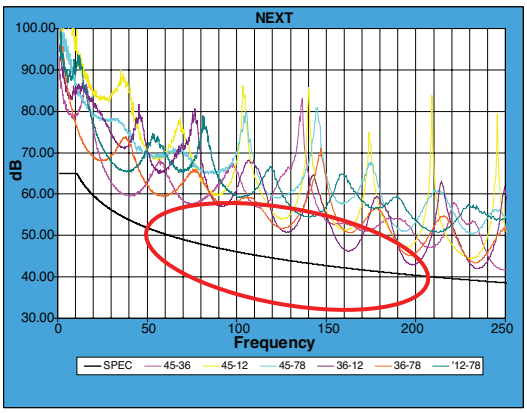

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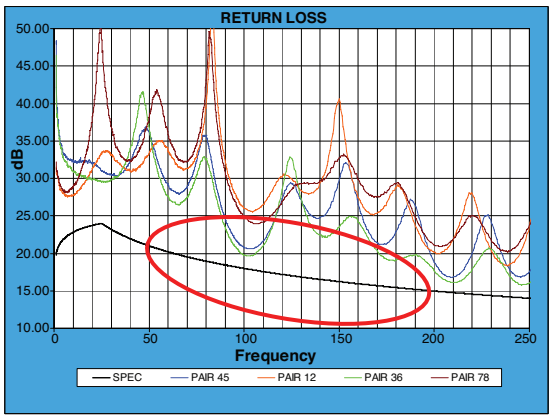
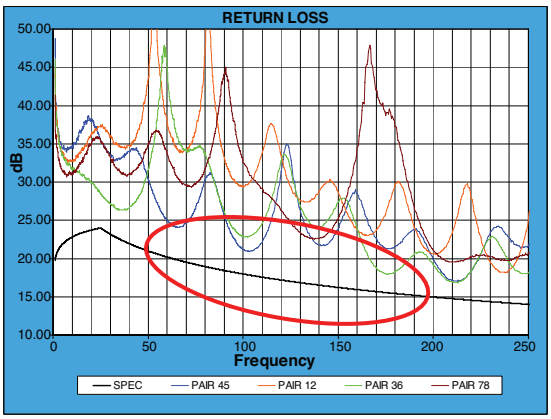
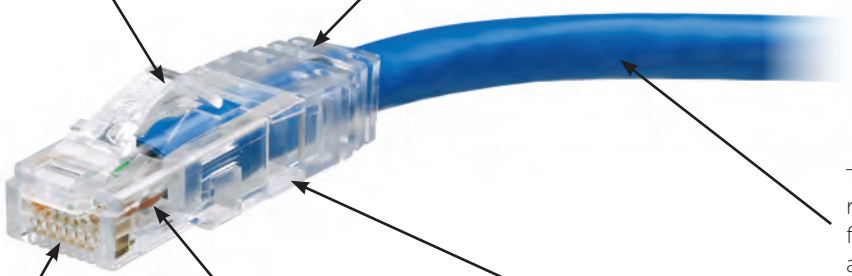


Return Loss AFTER
Mechanical Testing



Affects of Mechanical Testing (continued)

To ensure Panduit patch cords withstand the stress of actual installations, Panduit has incorporated the following innovative features in its design for maximum channel performance, reliability and usability:



100 % Component Testing

Beyond mated performance and mechanical testing, an additional measure to ensure patch cord performance is to test each patch cord to the TIA/EIA-568-B.2 component requirement. Panduit implements a strict ISO 9001 quality procedure that 100% tests every Panduit patch cord to the electrical transmission requirements per TIA/EIA-568-B.2. Every patch cord assembly produced is tested for Wire Map, NEXT, and Return Loss using a Fluke* Digital Cable Analyzer. Each patch cord is then shipped with a quality control label, which is referenced to actual test data verifying high performance.

*Fluke is a registered trademark of Fluke Corporation,

Conclusion

Patch cords are an integral component impacting the performance of the entire structured cabling system. Investment should be made in patch cords that utilize advanced features to deliver maximum reliability and usability of the network.

Off-brand patch cords jeopardize network performance due to:

- High degree of plug variability which leads to degradation of channel performance
- Inferior design features which do not perform over time due to the mechanical stresses of real-world conditions
- Untested, low quality patch cords which may not meet electrical requirements

In addition, patch cords must be properly mated and tuned to connecting hardware (jacks, panels, and horizontal cable) to keep the network running at peak performance. This directly minimizes the impact of costly network downtime.

The proven performance of high quality Panduit copper patch cords, tested to exceed TIA/EIA 568-B.2 specifications as a key component of the complete end-to-end solution, helps ensure maximum network bandwidth. Specifying and installing these patch cords can support the critical network demands for today and tomorrow.

Additional References:
1. The Weakest Link in High-Performance Cabling Systems, Fluke Networks, 5/2005 2062074 A-US-N rev B
2. Testing Proves Most Cords Fail TIA Requirements (Buyers are not getting what they paid for), Quabbin Wire & Cable Co., Inc., 4/03 ©2006

PANDUIT®

Since 1955, Panduit's culture of curiosity and passion for problem solving have enabled more meaningful connections between companies' business goals and their marketplace success. Panduit creates leading-edge physical, electrical, and network infrastructure solutions for enterprise-wide environments, from the data center to the telecom room, from the desktop to the plant floor. Headquartered in Tinley Park, IL, USA and operating in 112 global locations, Panduit's proven reputation for quality and technology leadership, coupled with a robust partner ecosystem, help support, sustain, and empower business growth in a connected world.

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