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White Paper

Cabling System Selection

A product and system approach

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Goals

Elevated permanent link and channel performance that is significantly higher and more visible to the end-user and installer with field testing and active system performance.

Individual product with transmission performance meeting and exceeding the proposed TIA Category 6 component specifications.

Tools to Use

Category 5e (present) and Category 6 (2002) component compliance become key qualification points in writing project specification that will comply with the entirety of the TIA 568B standards.

Improved balance, combined with balance sensitive noise elimination techniques (example Dual Reactance Cross-talk Cancellation, patent pending), allows greater end-to-end signal strength and minimizes noise contribution for significant improvement in signal to noise ratio (Shannon's law).

A connector approach designed to meet the interoperability and backwards compatibility requirements elevates performance to 100 MHz or 250 MHz.

Component specification — "The minimum benchmark"

Ratification of the Category 5e component specifications made component compliance a part of every job specification to follow. The same can be expected following ratification of the TIA Category 6 component specifications. New installations using "Channel Solutions" that do not meet component compliance will be at a disadvantage by not meeting all elements of the TIA 568B standard.

One of the TIA's reasons for component compliance is to ensure backwards compatibility with lower performance level components. This is to ensure that installed Category 6 cabling systems will operate with Category 5e patch cords or other cabling items at least to the performance of the lowest level component. This was considered necessary to encourage installation of the higher performance cabling, which has a greater application life expectancy.

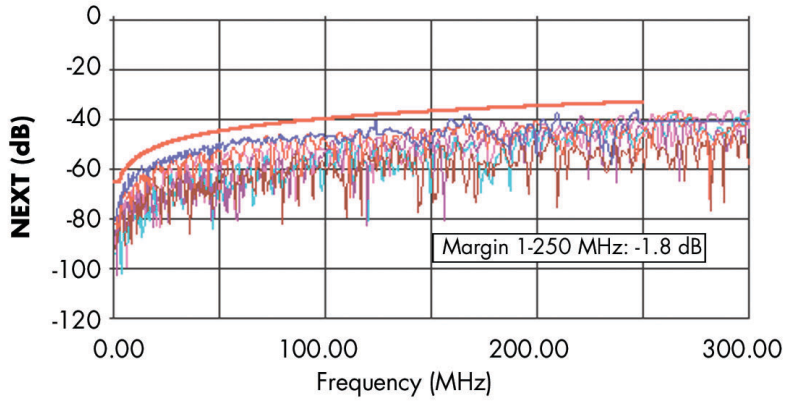
Another TIA goal for component compliance is to ensure interoperability so that customers can know in advance if connectivity assembled from different manufacturers will pass a Category 6 field test when installed. However, this is only to ensure a field pass. Without prior Beta testing, there is no guarantee of headroom when using components from different manufacturers together in a channel. See Figure 1.

Designing Your Channel

Standards typically characterize the minimum levels of acceptable performance. To optimize installed performance, you want to assemble interrelated connectivity components that individually meet the next critical performance threshold of Category 6 component compliance. More importantly, they should be designed to **attain optimum performance when installed together** as a link or channel in the field. This field measurable performance is what is viewable to the customer, the installer and ultimately the equipment that will operate on the cabling system.

Figure 1

90m Channel Link NEXT Test w/C6 Out of Specified Plug Range, Patch Cords



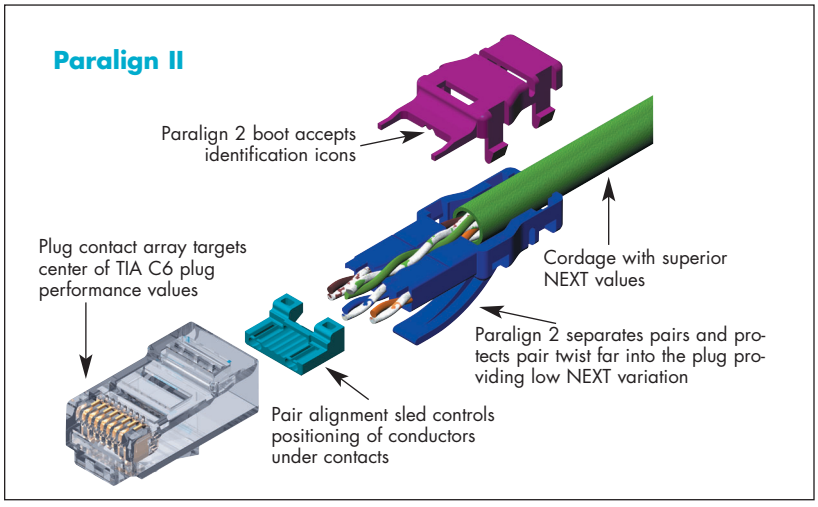
System solutions whose elements meet component requirements will almost always outperform systems assembled from products from different manufacturers. A defining premise in Ortronics development of the Clarity 6 product offering was the emphasis placed on the installed performance of the system.

Products designed to optimize installed performance can still pass all component requirements while attaining maximum headroom when installed together as a system. This is by tuning all components to the common center values of the TIA test plugs. Tuning to the standards defined center targets provides a superbly balanced system. All jacks, patch panel ports and patch cord terminations share the same precise target. The result is viewable in the lab or in the field with improved cabling system performance.

It is equally important that this balance shows its benefits across all types of installation configurations, links and channels, short or long lengths. This balance must start with a uniform target. All connectors must be designed to these targets. There is no benefit to having jack and panel ports with different values, since both have to connect with the same patch cord design. In fact, the patch cord terminated plug value should be the foundation value that all other connectivity is built to.

The Perfect Patch Cord

The perfect cord termination would fall right in the middle of the range of de-embedded test plugs that the TIA has identified to qualify connectors (jacks panels etc) and plugs. To qualify connectors (jacks and panels) to the TIA Category 6 component spec, parts are tested with a high and low range of test plugs (de-embedded plugs). This high and low range of plugs determines the window of inter-operability and backwards compatibility. In addition, the design and manufacturing process needs to hold very tight tolerances, keeping each cord on this target. This also applies to field tester cords. The result is finely controlled and repeatable termination for greatly improved cord consistency and better installed performance with jacks and panels built to be optimized to this target plug value.



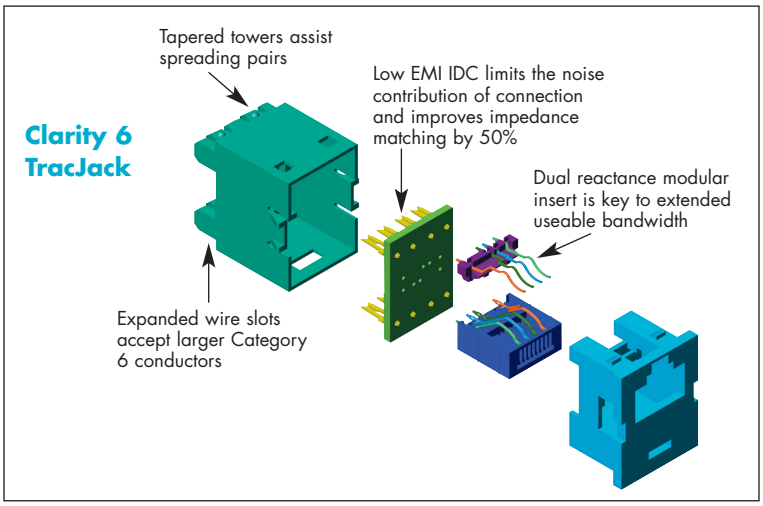
To construct these higher performing cords, manufacturers work to control pairs after they exit the cable jacket, maintaining designed pair twist. The Ortronics design keeps each pair in quadrant separated spacing as they approach the plug contact. This quadrant spacing matches the internal star construction of most Category 6

cable. Prior to being placed under the contacts, conductors are oriented to a plug-wiring format using a balanced separation sled. This sled compartmentalizes and segregates each pair minimizing the cross-talk affect of adjacent pairs. Lastly, the cords are terminated with a plug designed with a proprietary balanced contact array centered to the TIA Category 6 performance values.

This cord technology gives a consistently centered target for the design of the connectors. Every degree of imbalance between the cord and connector provides opportunity for noise to be introduced into the circuit. This becomes increasingly more important as you test at the higher frequencies of Category 6 (up to 250 MHz).

Tuning the Connector

Connector design must also show sensitivity to higher frequencies by utilizing noise elimination techniques that have a balance influence on the system. Otherwise, NEXT improvement will be at the expense of increase in return loss and FEXT. On the modular side of the connector, Ortronics developed Dual Reactance Technology. In each port the modular insert uses contact separation and positioning with the mating plug to provide a balanced compensation for crosstalk (NEXT) introduced by the plug. This is an improvement from previous noise compensation methods that degraded the balance of the connection causing issues with return loss and FEXT, especially at higher frequencies. The identical connector attribute exists in our individual jacks and panel ports.



High performance printed circuit boards must be designed to maintain the attained plug/jack performance within a traditional panel or individual jack footprint.

Impedance matched low noise IDCs (Insulation Displacement Contacts) in jacks and panels are then used to provide proper impedance balance and noise control profiles.

This centered system approach means the cable termination interface is the same regardless of whether it is a jack or panel. When used with the above-mentioned cord technology, the result is visible with laboratory and field-testing, and becomes increasingly apparent when the lengths of the tested links or channels are shortened.

The Short Link Phenomena

Over the past few years, the TIA has recognized a circumstance that the original standards (Category 3, 4 and 5) did not anticipate. In many installations, short links or channels tested with measurably worst values than longer links and channels. What became known as the "short link phenomena" is caused by the closer proximity of the signal imbalance and additive noise from these connections to each other. This is part of the reason for the development of the Category 5e spec, adding Return Loss as one measurement of balance. This also identified that the 90 meter link or 100 meter channel did not represent the worst case in all situations.

New high performance connectors that are tuned to a narrower range of targets minimize these effects in a short link. The new Category 5e and proposed Category 6 component specs identify a narrowing range of performance targets. For example, the Category 5e de-embedded range for pairs 1 and 3 is 34.4dB to 37.6dB, while the Category 6 de-embedded range for pairs 1 and 3 is 36.4dB to 37.6dB. Category 6 is a more narrow range within the Category 5e range. Improving balance in tandem with noise control minimizes the proximity effect of the connectors caused by the shorter length of horizontal cable.

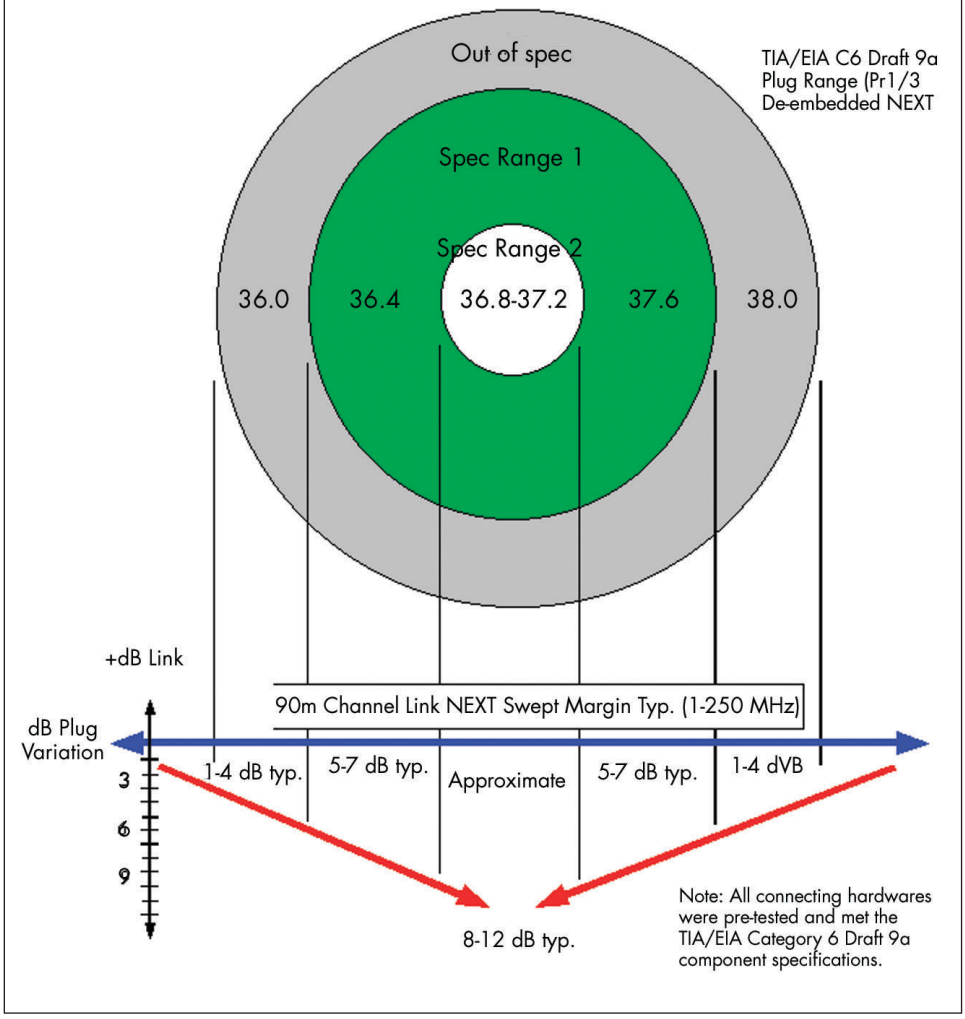
What this identifies for any evaluation process is the importance of testing short links and channels as well as maximum length links and channels in order to anticipate the potential range of field experiences.

Tuned Connectivity

Tuned connectivity is key to providing a cabling path that seeks to be transparent to the signal. The technology developed for Ortronics has been built around this foundation. All elements of Clarity are **tuned to the center of the TIA target connector values**.

Figure 2

Category 6 Plug for
Patch Cords (NEXT pair 1/3) vs Channel Link Margins



Providing these advancements within the footprints of standard products (jacks and panels) that support sound installer preferred practices further ensures that the installed cabling system will perform to expectations.

The result is high performance installation made easier without asking the installer to change from good practices they prefer and use today. See Figure 2.

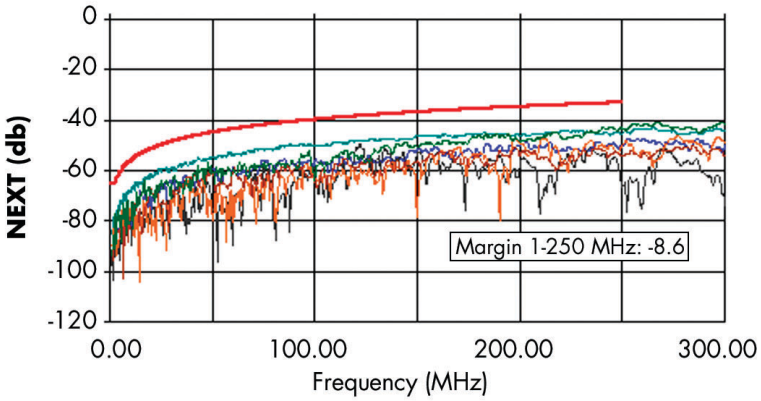
Conclusion

Your cabling system should pass all component requirements while attaining maximum headroom when installed together as a system. The tuning of connector elements to the common center values of the TIA guidelines provides a superbly balanced system. Jacks, patch panel ports and patch cord terminations must share the same precise target.

The improved performance of such a system will be viewable in the lab or in the field. This performance will be visible in 2, 3 and 4 connector channels, in permanent link tests and in both short (10 meter) and long (90 meter) configurations. See figure 3.

Figure 3

90m Channel Link NEXT Test w/C6 Specified Plug Range 2, Patch Cords



Notes

Some changes to expect:

New IDCs (Insulation Displacement Contacts) reduce the overall contact mass, minimizing the ability to act as a noise antenna. In addition, this contact design is better matched to the cable impedance by 50%, reducing signal reflection.

Larger Category 6 conductor diameters require expanded wiring slots to more easily receive these larger conductors.

Tapering plastic 110 towers aids in the separation of conductors within a pair while maintaining pair twist as close as possible to the terminal.

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