

# Reel Time

## Keeping Up the Balancing Act

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### Q: WHAT DOES IT MEAN FOR CABLE TO BE BALANCED?

A: UTP cable has become the dominant media in data communications, but UTP systems depend on electrical balance between signals transmitted over each pair. Simply put, twisted-pair cable is a “balanced” media because the system is designed to cancel electrical interference based on the pair’s physical symmetry – or “balance” between each other. The conductors of one pair should be manufactured identical to each other and twisted at the same rate over the length of the cable. When this occurs, the data current and voltage of each conductor is equal magnitude, but in opposite polarity. Unwanted coupled noise will be of equal levels, same polarity, on each conductor which allows for its cancellation by the receiving equipment.

Cable balance is an important parameter for high-speed computer network reliability as the better the balance between

the conductors of a pair, the greater the reduction in noise within the pairs, as well as external EMI and RFI.

Without balanced pairs, interferences including crosstalk and noise, will basically degrade the cable signal and ultimately the system performance. Examples of noise sources include power lines and electrical equipment, alien crosstalk from other cables, cell phones, radio and radar stations and even fluorescent light fixtures. As a UTP channel is being applied in more and more environments and as data network speeds increase, balance is becoming a critical parameter to the operation of the cabling system.

### BALANCED STANDARDS

Cable balance is a main concern in recent standards’ activities because of its effect on data transmission and tight tolerances, especially with the escalation of bandwidth and speed requirements. The Telecommunications Industry Association (TIA) has made recommendations concerning the balance of cable and connectivity in the Category 6 standard, TIA/EIA-568-C.2. In addition, the TIA TR-42.7 Balance Task Group is studying cable balance measurement methods and recommended specifications.

TIA recommends a test procedure to measure transfer conversion loss (TCL) which provides a metric of a cable’s ability to reject noise from external sources. This test is used with a network analyzer that injects a differential mode signal on the pairs, and then measures the common mode noise signal between the pair and ground. The TCL is the ratio between these two signals, expressed in decibels (dB). The higher the dB, the better the balance.

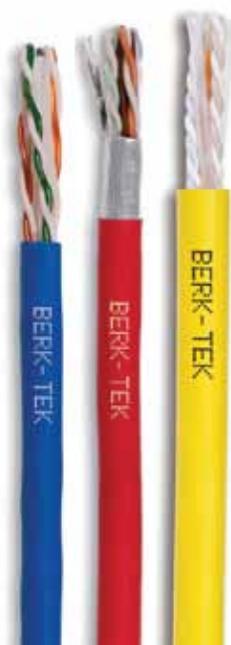
### BETTER CABLES, BETTER BALANCE

Balance is determined by the precision of the manufacturing process. First, the conductor must be centered within perfectly round insulation. Then it must be paired with an insulated conductor that is its mirror image. Twist also impacts balance. A rule of thumb is that the larger the number of twists per foot that are applied to a pair, the better that pair’s balance will be. This is due to the ability of tightly twisted pairs to maintain better geometric stability than a longer, loosely twisted pairs. For example, the typical pair lay of a Category 5e cable ( 1.5” to 4.0”) will deform easier vs. the lay of Category 6a (.250” to 0.500”).

In a study at the Nexans Data Center Competence Center (DCCC), New Holland, PA, seven different Category 5e cables and seven Category 6 cables from different manufacturers were tested for balance and Electrical Fast Transient (EFT). EFT is a good representation of real noise on power lines, office equipment or fluorescent lighting switching. The test procedure measured the TCL while EFT pulses were applied to provide a good indication of overall noise immunity of cabling systems. Each cable was 90 meters and terminated to connectors of the appropriate Category and each link was connected to ports of a Gigabit Ethernet switch using the appropriate patch cords. Category 6 UTP cables exhibited 17-10 dB better balance performance than Category 5e UTP cables, indicating that Category 6 minimizes the number of errors due to noise on Ethernet data traffic.

### CREATING PERFECT BALANCE

Careful design and precise manufacturing techniques of the cable control the



**For UTP, a tight and consistent twist ratio contributes to cable balance and performance. Berk-Tek's LANmark™-10G2 Augmented Category 6 cable has a tighter twist over LANmark™-2000 Enhanced Category 6 and LANmark™-6 standard Category 6, making it better suited for higher bandwidth applications and higher speed networks.**

parameters that determine balance. The connectivity and associated hardware can also contribute to the balance of the pair. In addition, proper installation and termination of the cable is critical to maintaining balance. So, although the cable must meet certain manufacturing parameters, make sure that the entire sum of parts – patch cords, jacks, patch panels, active equipment and installation procedures – are in sync to create a perfectly tuned and balanced channel. ■



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