

Noise Coupling Part II

Pair balance an important parameter — for both screened and unscreened cabling — to reduce susceptibility to external noise.



This is the second of a two-part article on the subject of noise coupling into balanced pair cabling. In last month's column I explained the different sources of noise including induced

common mode noise from nearby power lines, transformers, electric motors as well as radio frequency interference (RFI) from intentional and unintentional radiators.

To counteract these noise sources required a cabling system with very good pair balance characteristics. Pair balance was defined as the ratio in decibels (dB) between the "wanted" differential-mode signal and the "unwanted" common-mode noise signal. The higher the pair balance in dB, the better the noise immunity.

Pair balance depends on the symmetry of the pairs with respect to the other pairs and the surrounding screen, if present. It is more difficult to achieve for screened cabling systems because the proximity of the pairs to the screen can create additional capacitive and inductive unbalance.

A screened cabling system relies primarily on the circulating currents in the screen to counteract the induced common mode noise. For the screen to work effectively at high frequencies it must be grounded at both ends through a low impedance ground, generally less than 1 Ohm.

A screen that is grounded at one end only looks like at open circuit at a quarter wavelength (~ 0.5 metres at 100 MHz) and at every odd multiple of a quarter wavelength. If the ground impedance is infinite (open circuit), the effectiveness of the screen to mitigate common mode noise is reduced to zero. The TIA 568 B.2 cabling

standard requires that shield continuity be maintained from one end to the other end of the cabling system. It is left up to the equipment manufacturer to determine how the shield is terminated to the local ground at the equipment connector interface, either directly or through a termination network.

There is a requirement in the TIA 568 B.2 cabling standard that voltage difference between the shield and the ground wire of the work area equipment outlet shall not exceed 1 V rms. The cause of any higher voltage should be removed before using the cable. Higher voltages can affect the integrity of the signal and in severe cases can cause damage to the equipment.

This creates a dilemma for the end user. What to do if there is an excessive voltage difference between the local and remote grounds? There is no easy way to solve this problem. The solution would require a means for equalizing the ground potential for different parts of the building.

This is hard to do after the fact, or for older buildings that do not have an adequate grounding infrastructure.

A power quality grounding expert may recommend some solutions for segregating certain equipment or for conditioning the power supply. More often than not, a solution may involve removing grounds to eliminate ground loops.

A ground loop is created when the cable shield, which is bonded to the chassis of the networked devices, are connected together. The work area equipment could be located at the opposite end of the building from the equipment in the telecommunications room (TR) or the equipment room (ER).

Separate power panels would likely serve the two, but there would be a continuous ground path between them.

Whenever a large motor is started or a copy machine is turned on or the infamous pencil sharpener is plugged in, transient or steady state ground potential differences could appear between these two systems.

This would cause a noise current to flow along the cable screen, which in turn would be converted to differential-mode noise across the line drivers at either end of the data cable depending on the pair balance of the cabling system.

In researching the information for this column, I came across an interesting article by Mark Waller, of Waller & Associates, Ground Loops — Truth or Consequences, published in Smart Power Quarterly in April 2000.

Here is what he wrote: "In modern LAN installations there are no ground loop issues for one reason. As shown in figure 5, there is no ground path in the data cable. This is because we are going to use either fiber optic cable or Category 5 cable. The benefit of fiber is clear. Electricity can't flow through glass, therefore no ground loop. Category five cable, on the other hand, is metallic. However, there is no ground!"

Shielding proponents may conclude that this is an oversimplification of reality, and I will not argue with you. I will come back to what I said in the first part of this two-part article. I would like to conclude by saying that both UTP and ScTP cabling can be designed to work effectively to reduce external noise coupling. In my opinion, pair balance is an important parameter for both screened and unscreened cabling to reduce the susceptibility to external noise. **CNS**

Paul Kish is Director, Systems and Standards at Belden. The information presented is the author's view and is not official TIA correspondence