Engineering Techbits

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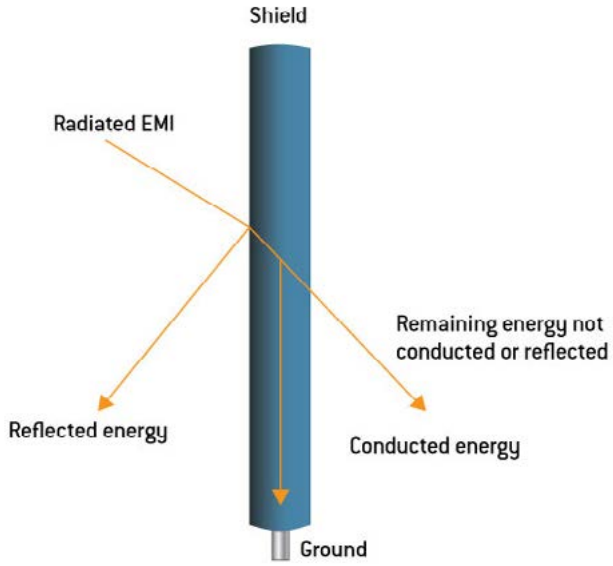
CABLE SELECTION: SHIELDNG

In this engineering TechBit, we will discuss important considerations when selecting the type of shielding required for your application. We will focus on different aspects of common shielding options used in custom and off-the-shelf cable solutions.

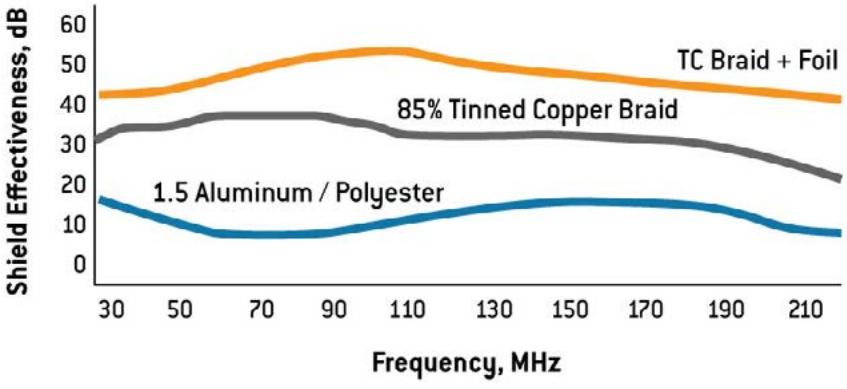


Shielded cables are electrical cables that contain insulating conductors encased in a standard conductive layer. The shield can be made from strands of braided copper (or a similar metal), spiral copper or aluminum "tape" or "foil", and/or some other conducting polymer.

Shielded cables are used to protect the data being transferred through the cable from degradation by Electromagnetic Interference (EMI) exposure. This type of exposure is commonly found in applications where computer technology, electrical equipment, or electronic equipment is in heavy use. EMI is generated by an external source that affects an electrical circuit through an electrostatic coupling, conduction, or electromagnetic induction. EMI disturbance can reduce the performance of a circuit or even cease its functioning altogether. Wherever a data path exists, these effects can vary from increased error rates to a complete loss of data. Both natural and artificial sources can generate the variable electrical currents and voltages that cause EMI. The shielding in shielded cables reduces the volume and intensity of the electrical noise, lowering its effect on signals and transmission while also reducing electromagnetic radiation.

One of the principal indicators used for measuring the effectiveness of EMI shielding is called attenuation. Attenuation refers to differences between the intensity of electromagnetic signals prior to a shield and the intensity after having a shield installed, in relation to a constant frequency. Attenuation uses decibels (dB) as a reference point that correspond to ratios between field strength—with and without the presence of a protective medium (a shield).

SHIELD EFFECTIVENESS vs. FREQUENCY



Two of the most common types of shielded cables found in the market today are braided shielded cables and foil shielded cables. Foil shielding incorporates a thin sheet of either copper or aluminum. This "foil" is usually bonded to a polyester carrier to enhance the strength of the cable. Also known as "tape" shielding, this type of shielded cable provides 100% protection for the conductor wire they are wrapped around. No EMI from the environment can penetrate. However, because the foil within the cable is extremely delicate, these cables are very difficult to work with, particularly when using a connector. More often than not, a drain wire will be used rather than trying to ground the foil shield entirely. Foil shielding should be used for applications and environments where the cable can be expected to go undisturbed by workers, machines, or other factors.

The second method used to shield cables is braiding. Braided shielded cables employ a mesh of woven copper wires. Braided shields provide less coverage than foil shields, but are much more durable. The braid creates a low-resistance path to grounding and has a higher level of manufacturability when terminating the shield to the connector. In general, braided shielding will provide between 70% to 95% protection from EMI, depending on how tightly the braid is woven. Braided shields are more effective than foil shields because they are less prone to internal damage. This type of shielding also increases the mechanical strength of the cable itself, and as a result, the cable assembly. When developing or designing a cable assembly, sometimes an increase in the tensile strength is required and this can be achieved by designing in a braided shield. This is by no means the only way to increase the mechanical strength of a cable, but is a useful byproduct of the design. This type of shielding should be considered when designing a cable for an application in which the cable will be continuously handled or required to be exposed to pressure or impact. Braided shield cables are heavier, more rigid and ultimately more expensive than tape shields, as they are more durable and offer better performance.

Additionally, in some instances you may find cables that contain both types of shields, this is not uncommon when running multiple data signals or power signals that require isolation from each other. Depending on the work environment and application, one type of cable may be preferable to the others. In all cases, shielded cables must be properly grounded to ensure the safety of workers and equipment. This grounding of the shielded cable is achieved by the inclusion of a drain wire. The function of the drain wire is to create a low resistance connection to the metallic shield resulting in a very effective grounding. The wire remains in contact with the metallic side of the shielding/tape all through the body of the cable. This places the drain wire in an ideal position to connect a shielded cable to its ground terminal. What this means for the cable is that it is effectively protected against electrical surges that inevitably occur within a system. Any excess electricity finds a pathway through the drain wire, to the ground, without causing harm to the system that is connected to the wire.

Wherever your cable assembly design takes you, shielding is an important consideration for any system. Whether you choose to add a shield or just a twisted pair to mitigate the noise of a cable make sure to consult a cable expert regarding your cable selection.

Look for the next TechBit in this series, which will cover **choosing the right cable jacket for your application.**

Read our previous TechBit in this series: **Cable Selection: Conductor and Insulation Material** here

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