

Signal Interference

When a particular installation is prone to EMI/RFI/ESI interference from either internal or external sources, some form of cable shielding will be required. The types of interference—or noise—cables are exposed to can determine the type of cable shielding required. There are basically four types of noise which will affect the wiring or cabling of an instrument or control circuit: static, magnetic, common mode, and crosstalk noise.

Static Noise

This refers to signal distortion due to the electrical field radiated by a voltage source, which has coupled into the signal-bearing circuit. Simple shielding of the full circuit is a typical means of mitigating this electrostatic type of interference. Foil shields, which offer 100% shielding efficiency, have proven most effective against this type of interference. It is critical that the shield be continued to, and completely encompass, the transmitting and receiving ends of the circuit if high levels of noise reduction are required. Effective grounding of the shield is also required; “floating” or non-grounded shields only partially reduce the effects of noise.

Magnetic Noise

Magnetic fields, radiated by power wiring found in large AC motors, transformers and knife switches, can set up current flows in opposition to the instrument circuit field. The result is the superimposing of a noise current on the signal current. The simplest and best means of mitigating the effects of such magnetic interference is by simple twisting of the cable elements.

Common Mode Noise

Common mode interference is the result of currents flowing between different potential grounds located at various points within a system. Receivers with very high common mode rejection ratios minimize this type of interference.

Crosstalk

This refers to the superimposing of either pulsed DC or standard AC signals carried on one wire pair to another wire pair in close proximity. Although pair twist tends to reduce crosstalk levels, the most effective means of mitigation is individual cable pair shielding coupled to pair twist.

Noise Levels

Once it has been determined that noise currents are going to pose a system problem, it becomes necessary to determine if the noise is of a low, medium or high level. The table below gives general guidelines as to the areas which are subject to these generalized noise levels:

Noise Level Chart

Noise Level Sources	Noise Sources	Typical Locations
High	Electrolytic processes Large motors, generators, transformers Induction heating Relay controls Power Lines	Heavy processing plants such as steel mills and foundries
Medium	Medium-size motors, generators, transformers Relay controls	Average manufacturing plants
Low	Small motors, generators, transformers	Storage areas, labs, offices and light assembly operations

Shielding

Shielding Performance

The shielding of electronic interconnect cables can play a critical role in overall system performance. System configuration, type of signals transmitted and proximity to noise generating sources all must be considered. These factors plus the type of interference, whether electromagnetic, electrostatic discharge (ESD) or radio frequency, will determine the necessity and type of shielding required. Alpha's Xtra-Guard cables are available in two shielded constructions providing protection for the majority of installation needs.

Shield Coverage: Braided Shield

The effectiveness of a braided shield depends upon the percent coverage afforded by the shield. Leakage in a braided shield is due to air spaces which exist between the weave. The following equation can be used to determine the percent coverage of a braided shield.

$$\tan a = \frac{2\pi (D + 2d)P}{C}$$

where

- C = Number of carriers
- D = Diameter under shield, inches
- d = Diameter of one strand, inches
- P = Picks per inch
- a = Shield angle, degrees
- K = Percent coverage, where

$$K = (2F - F^2) \times 100$$

and

$$F = \frac{NdP}{\sin a}$$

N = Number of strands per carrier

Shield Resistance

The D.C. resistance for braided shields can be calculated using the following equation:

$$R = \frac{dR}{\cos a (NC)}$$

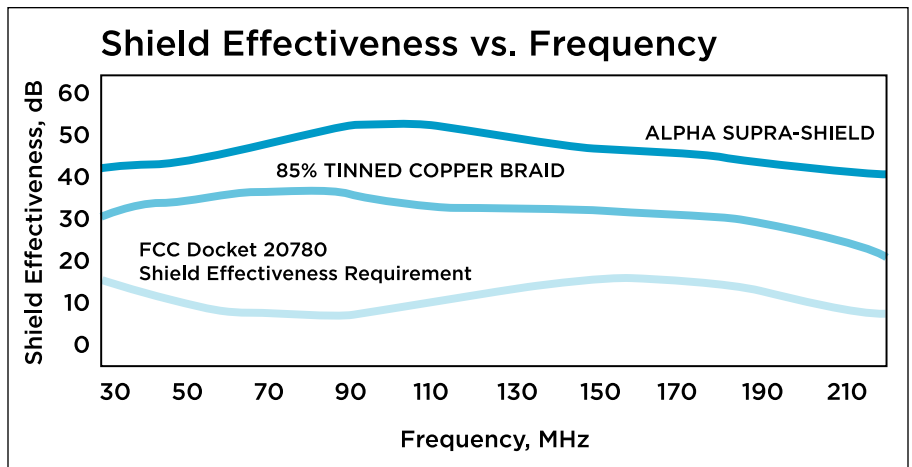
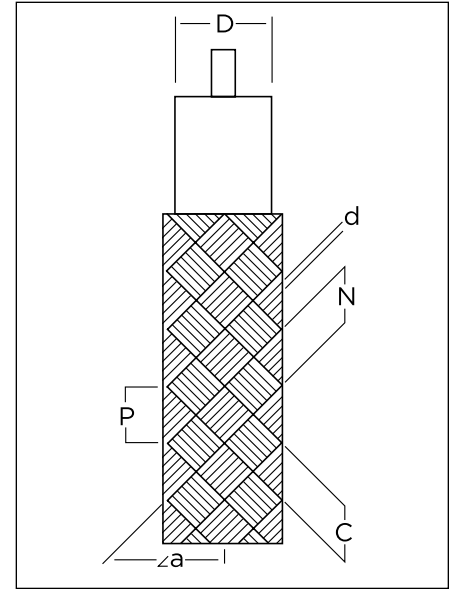
where

R = D.C. resistance, ohms/unit length

dR = D.C. resistance of 1 strand end, ohms/unit length

N = Number of strand ends in one carrier

C = Number of carriers a

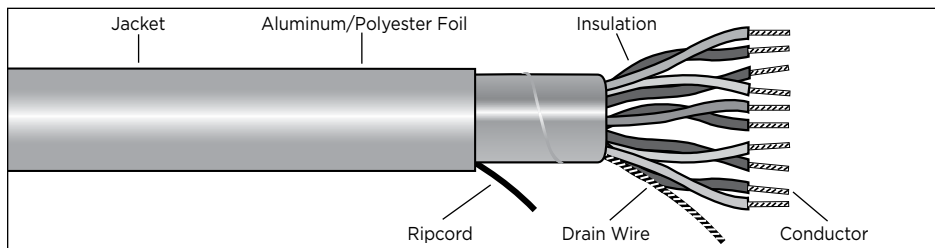


Xtra-Guard Shielding Options

Alpha Aluminum/Polyester Foil Shielding

- Lightweight shielding
- Low cost
- Ease of termination with use of stranded tinned copper drain wire
- Low-frequency interference
- 100% coverage over the core of cable conductors

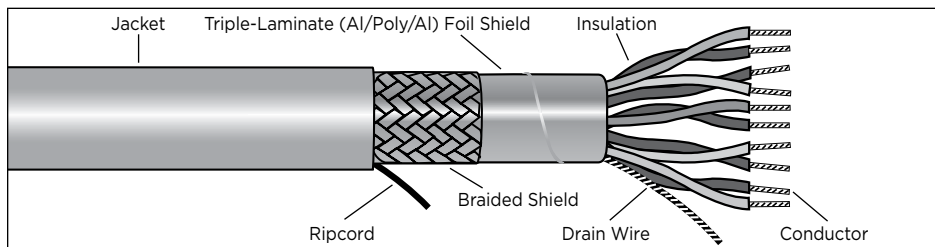
Alpha aluminum/polyester foil shielding consists of an aluminum polyester tape, foil side facing inward, with a 25% overlap and in contact with a stranded, tinned copper drain wire equal in size to insulated cable conductors.



Alpha Supra-Shield® (Foil/Braid) Shielding

- Ease of termination with use of stranded tinned copper drain wire
- High-frequency interference
- High physical strength

Alpha Supra-Shield® (foil/braid) shielding system consists of a unique triple-laminate tape. An aluminum/polyester/aluminum tape is bonded in one layer with a 25% overlap and in contact with a stranded tinned copper drain wire equal in size to the insulated cable conductors. A 70% coverage tinned copper braid shield is applied overall.



Xtra-Guard Flexible Cable Braid Shielding

- EMI/RFI resistance in power, control and data applications
- Continuous shield continuity in flexing applications
- High physical strength

Xtra-Guard flexible cables have specific shielding requirements resulting from the stresses of motion and flexing. Where foil shields will tear and lose continuity, Xtra-Guard flexible cables use a flexible, 85% coverage, tinned copper braid with a double jacket isolating the shield from the cable's inner core.

