Foldable Twin Axial Ribbon Cables Free Space, Maintain High Performance

Doug Gundel, 3M Electronic Solutions Division, 3Mconnectors.com

Designers of enterprise computing systems face a difficult challenge every day. How can I pack more performance and increasing I/O in the same volume as the previous product generation? Cables and cable assemblies, which perform much of the internal I/O, can make this challenge more difficult by requiring a large-volume pathway for routing.

Let’s face it: cables are necessary for routing I/O in high-performance enterprise systems, but they can also be a nuisance to the designer. Cables do not improve system performance (although they can certainly make it perform worse). Yet, if you’re working with limited space (as most system designers are), they consume precious real estate, contributing to congestion in the box. Cable congestion can restrict critical air flow around the electronic components. In addition to their bulk, most high-speed cables require a generous bend radius, demanding even more volume. However, relative to other options, such as flexible circuits and printed circuit boards, cabling remains a cost-effective alternative and provides better signal integrity. In short, cables are here to stay.

In response to the problem of cable congestion, cable suppliers are striving to produce thinner, more routable high-speed twin axial cables. Increased data rates have taken away the option of mitigating cable congestion with smaller wire gauges, so cable manufacturers must address the materials that go around wire pairs.

A major barrier to decreasing cable assembly bulk and increasing routability has been the method and materials used for shielding the wire pairs. Shielding, of course, is necessary to maintain signal integrity and allow for high-speed data transfer rates. In typical twin axial cables, the central conductor is commonly surrounded by a primary insulation, such as foamed or solid polyolefin. The insulation is then wrapped spirally in a shielding material, and further overwrapped with a film that provides support and retention of the shield wrap. In a bundle of eight such pairs, the final cable is typically 4 mm to 8 mm thick (depending on the material used to contain the bundle and the gauge).

While wrapped-shield cables offer some limited ability to bend around corners, designers must be careful not to bend the cables too much because the shielding and overwrap materials can distort the precise cable geometry needed to maintain impedance control and can in turn produce degraded signal performance. Moreover, the wrapped shield, with repeated breaks in the shield along the cable length, can produce an unwanted resonance effect, evident at certain frequencies.

However, a different approach to high-speed twin axial cable achieves thinness and

very low bend radius while maintaining high performance by using a single-thickness, longitudinal shield structure whose signal response is highly tolerant of decreased bend radii.

Usually the design rule is: Do not bend the cable in any one place. But this cable can be easily bent and folded with very little force. Yet, bending and folding, even in multiple places, does not significantly impact its performance. Tests show that each fold (180° fold at 1 mm bend radius) impacts impedance at the fold location by approximately 0.5 ohms (70ps 20/80 percent rise time), well within the tightest impedance specification. (The impedance at each fold is not cumulative.)

At only 0.88 mm thick for a single ribbon of 30 AWG cable (two ribbons stacked or side-by-side are needed for an 8-pair cable), the 3M SL 8800 Series cable is remarkably slimmer than its wrapped-shield predecessors, yet it can outperform them. It is resonance-free up to 20 GHz, according to tests conducted by 3M, whereas conventional wrapped twin axial cables can exhibit an enormous loss of signal at a particular frequency range (Figure 1) much lower than 10 GHz. This cable is suitable to be used in current and emerging high-speed serial transmission standards, such as SAS 2.1, PCI Express, Ethernet, Infiniband, SFP+, QSFP, etc.

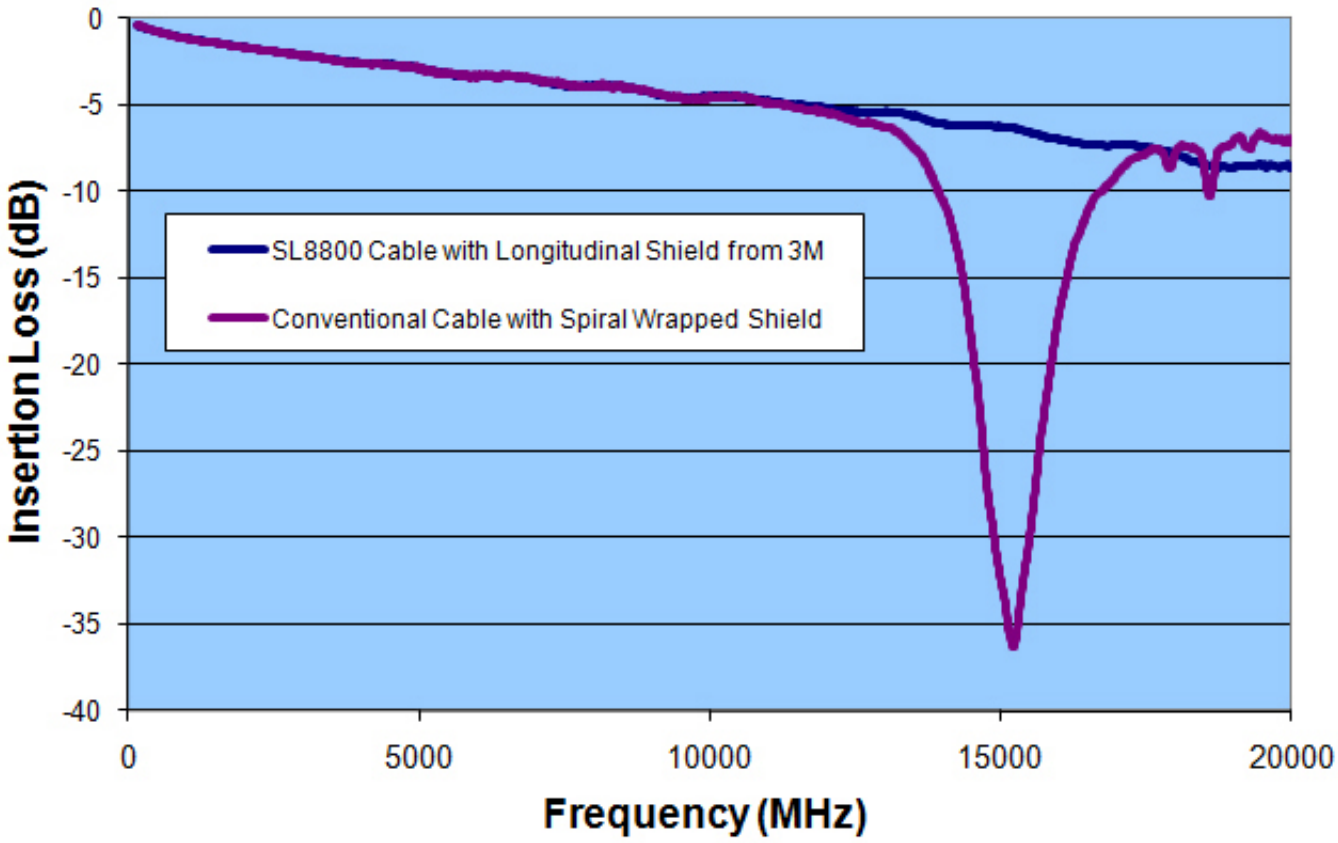

Figure 1. 3M Twin Axial Cable SL8800 Series exhibits low loss and no "suckout."

Moreover, it can be customized to meet specific application requirements, including various wire gauges (AWGs), cabling constructions and jacketing options for internal and external uses. The cable is also low skew, and the ribbon construction allows users to further control skew that sometimes occurs when managing discrete

individual twin axial pairs, which is especially important at speeds above 10 Gbps.

A tight bend radius and low profile opens up entirely new options for routing cable. Cable can now be run along cabinet walls and bend flush into corners. It can snake between processors, heat sinks and fans, freeing up valuable space in the mechanical design of the unit for components or air flow. The cable can be placed out of the way of air flow and therefore can potentially reduce the cost, complexity and power consumption of cooling the system.

Additionally, the cable's high-end signal performance and lack of resonance to 20 GHz provide the designer with the confidence and ability to use the same cable for current and many future higher bandwidth protocols. Plus, its construction makes it easy to prepare for assembly and termination. The cable's longitudinal shielding means no wrapped or braided material to strip, and the wire pairs lie flat and in the correct position for terminating, saving time and cost during assembly.