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Shielding Considerations For High-Speed Microminiature Connector Systems

Bigger TVs and smaller phones are dominating the market. But before you design your next moneymaker, make sure your components have the right protection.

As applications such as flat-panel displays and mobile phones enter the giga-level transfer-speed range, connector makers are being challenged to provide compact designs that offer sufficient shielding to manage impedance control and noise emissions. Various methods are being employed for connectors across the board to address the dual challenges of reducing size while still controlling electromagnetic interference (EMI) and radio-frequency interference (RFI).



1. An integral metal shield and grounding tabs provide ESD protection and pc-board retention on high circuit-size board-to-board connectors. (courtesy of Molex)

The cable is shielded on the outside, and that shield is also connected to the ground. The contact area on the cable for the signal and ground terminals is separated to further ensure signal integrity. The result is superior signal-line impedance conformity and reduced cross-talk and noise emissions.

These LVDS connectors are typically available in one-piece designs, offering low-profile features. But some connector makers offer two-piece versions with a jacket that holds the FPC and positions it for mating for superior mating accuracy

and assurance versus one-piece designs. It also enables secure mating for up to 80 circuits.

This two-piece version offers a positive lock that provides additional mating retention, as well as guide posts that help in blind-mating applications. These connectors include grounding terminals to accommodate multi-strip cable for LVDS applications. Most one-piece and two-piece versions come in 0.50-mm (0.020-in.) pitch.

These two-piece connectors are also ideal for accepting other types of custom high-speed FFC or FPC cable suitable for LVDS applications. Two recent types of high-speed FPC cable designs use standard cable materials but route the signal patterns within the cable for good EMI control and matched signal impedance.

Some makers are also developing fully shielded microminiature FFC/FPC connectors, where the outer metal shield along with integral grounding tabs provides full frame grounding and additional EMI/noise protection. Some non-LVDS FPC connectors include dust covers that protect against metal shavings that can come in contact with terminals and cause potential short-circuiting during board assembly.

LVDS DRIVING NEW REQUIREMENTS • The flat-panel display (FPD) TV market, with its ever-increasing move toward higher resolutions, has been a growing area requiring new high-speed shielded connectors. Many of the shielded connectors in flat-panel displays are designed for low-voltage differential signaling (LVDS) applications. With its low power and high-speed capabilities, LVDS is perfect for the various interconnect needs of both plasma-display panel (PDP) and LCD-type flat-panel TVs.

Flat flexible cable/flexible printed-circuit (FFC/FPC) connectors have been one of the key new interconnect areas adopting shielding, or in some cases special grounding techniques, to meet LVDS requirements. FFC/FPC connectors have typically been lower-speed signal connectors used to carry signals over short distances economically within various electronic units.

To accommodate LVDS, one method employed for FFC/FPC connectors is to add grounding terminals. These grounding terminals are often added to the outside connector wall, where they wrap over the housing to mate with the cable on the opposite side from the signal contact terminals. Connectors are offered in both vertical and right-angle styles, with common circuit sizes including 15, 30, 40, 50, and 80 positions.

MICROSTRIP FFC CABLE FOR IMPEDANCE CONTROL

• These specially designed FFC connectors with ground terminals use industry-standard shielded microstrip FFC cable to achieve the required LVDS performance. This microstrip cable has an insulation dielectric layer sandwiched between a ground plane on one side and signal line on the other. The cable adjusts the impedance value through the width of the signal-line pattern and thickness of space between signal line and ground.

SHIELDED BOARD-TO-BOARDS • Stacking-type board-to-board connectors have become popular in FPD applications as a way to save space and route high-circuit signaling. Shielding has also come into play here as a way to manage EMI and RFI and reduce noise emissions.

A typical pitch size, 0.635 mm (.025 in.), has been in wide use for non-shielded versions and presents an easy transition to shielded types. In the 0.635-mm range, stack heights of 20.00 mm are common. Some connector makers have introduced 18.00-mm mated height versions for further space sav-

ings. The most common circuit size is 110 positions.

A new shielded 0.635-mm board-to-board version from Molex (Fig. 1) includes an integral grounding tab on each side that provides secure pc-board retention and an improved method of grounding noise emissions. Some makers have also introduced 0.50-mm pitch versions with profile heights as low as 6.00 mm (0.236 in.). Some of these versions have expanded the available circuit size range up to 240 positions.

Shielding is finding its way into more ultra-micro applications for mobile devices as well. Some makers have developed versions as small as 0.40-mm (0.016-in.) pitch and 2.00-mm (0.079-in.) height with full outer shielding. As mobile phones add more functionality and internal antennas, shielding on many micro components within mobile phones will grow in importance.

MICROMINIATURE COAXIAL • Fully shielded microminiature wire-to-board connectors using coaxial cable have found use in mobile applications such as swivel-style mobile phones, primarily to route signaling through tight hinges that connect the LCD to the main body. The ultra-thin micro coaxial cable is mechanically better than FPC in withstanding the bending and twisting needed to fit through the tight hinge openings.

These systems are offered in both right-angle and vertical versions. Some systems use insulation displacement technology (IDT) for wire termination. IDT provides a more consistent termination method and better wire protection than hand soldering. Some connector makers have designed in special grounding methods between the wire and connector shield that offer full frame grounding.

This method offers various electrical benefits versus hand-soldering, including: consistent grounding between wires and connector; better prevention of signal skew; up to 30% diameter space savings; and up to 60% less transmission (dB) loss at frequencies up to 3 MHz.

Many of these micro coaxial systems have been designed in 0.40-mm (0.016-in.) pitch, with 40 circuits as the norm. To meet the further downsizing needs of mobile phones, systems on 0.30-mm (0.012-in.) pitch are now in development with mating heights as low as 1.50 mm (0.059 in.).

These fully shielded connectors often include multiple grounding tabs to help carry high-speed signals from coaxial cable through connectors to the pc board with minimal EMI. Connector makers offer various solutions such as short grounding paths within the signal lines of the connector or multiple spring-style grounding tabs on the front or sides of the connector.

SHIELDS AS MECHANICAL SUPPORTS • Metal shields are used on most types of miniature memory cards, but the primary considerations are mechanical. The newest and smallest flash memory cards suit the microSD card standard and come in push-push and hinge types of designs.

The metal shells protect some of the mechanisms such as cams and brakes that help control card ejection. Some shells are designed with features that are an integral part of the brake mechanism, while others such as hinge types often include slots for operators to open and close the connector.



2. SMT Micro-USB connectors allow On-The-Go functionality, such as transferring images and data, between different mobile devices. (courtesy of Molex)

Shielding can play a part in miniature memory cards when phone makers have specific requirements to manage EMI or noise. These issues often affect more advanced 3G phones with multiple antennas or advanced functions. Integral grounding tabs that are part of the metal frame can improve shielding.

MINIATURE I/Os OFFER FULL SHIELDING • Shielding is perhaps most important and common in the I/O area, connecting electronic equip-

ment to outside-the-box units. New developments in miniaturization and high-speed cabling for I/Os help manage EMI while handling increasingly higher transmission rates.

HDMI connectors have become the standard to provide an uncompressed digital link between FPD TVs and consumer electronics equipment such as DVD players and set-top boxes. HDMI connectors include features such as a signal pattern with coupled ground that provide low impedance mismatch. Other mechanical features such as shell detent fingers and panel-mounting flanges provide additional grounding features.

One method for controlling impedance inside the box with HDMI connectors is to use a custom FPC that has active equalizer chips mounted on it. These chips help suppress ESD and allow two HDMI connectors to be mounted to the cable, saving space and cost.

DisplayPort is one of the newest high-speed shielded interconnects for notebooks and PC LCDs. It includes differential-pair signaling with a dedicated reference terminal to minimize impedance discontinuities. The system is fully shielded from cable termination through a mating interface with three levels of mating and redundant points of contact to maintain a low-impedance ground path and ESD protection.

Micro-USB connectors are set to bring On-The-Go features into today's smaller, thinner phones (Fig. 2). These surface-mount (SMT) connectors save about 50% of space compared to Mini-USB versions while allowing On-The-Go functionality such as transferring images and data between different mobile devices.

Various pc-board receptacle versions such as B and AB styles are typically fully shielded for ESD protection and often include features such as detent locking windows and grounding fingers for secure mating. Shells are made of durable stainless steel, which helps enable up to 10,000 mating cycles.

Shielding is finding its way into connector designs more and more across the board. So far, connector makers are meeting the challenge to deliver compact designs that offer mechanical stability and good high-speed electrical performance and shielding. As bandwidth requirements increase, even greater demands will be placed on developing effective shielding for connectors and cabling. ☛

TOM TYRRELL has worked closely with Molex's Asia product development teams throughout his 20-year tenure to globally commercialize innovative fine-pitch microminiature connectors.

