VTAC HSD

THE NEW STANDARD IN HIGH SPEED DATA TESTING

Virginia Panel Corporation recently developed a new industry-leading solution – VTAC High Speed Data (HSD), a successful design for high speed data transfers greater than 12.5 Gbps per differential pair. While other high speed solutions exist, VTAC HSD's revolutionary design helps to mitigate crosstalk and insertion loss when tested in a real life application. The following case study examines the challenges faced when designing a broadband cable for the automotive industry.

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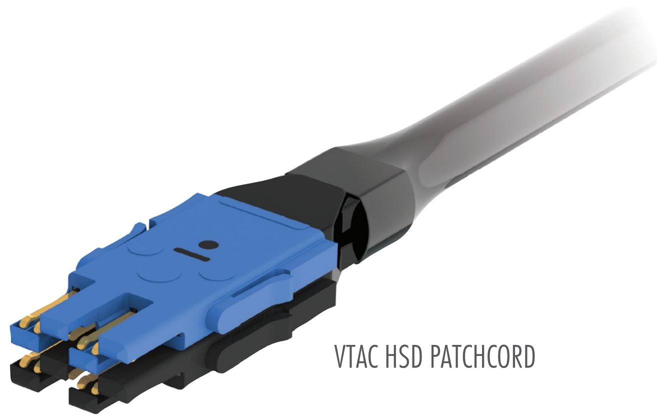

VTAC HSD PATCHCORD

As clock frequencies continue to increase, corresponding data transfer rates of 1 Gbps or more are considered high speed. The application of high speed data is broad and is found in a variety of military and commercial applications, ranging from military drone surveillance aircraft to high definition televisions. High speed data is even being incorporated in the automotive industry through a variety of standards.

Emerging technologies in infotainment, telematics, audio/visual, and monitoring equipment industries all contribute to the cost of testing. Testing capabilities will increasingly rely on the use of high speed data independent of the protocol used. Serial buses such as Controller Area Network (CAN), Local Interconnect Network (LIN), and FlexRay have a long history in automotive design, but there are advantages and limitations to each. While CAN supports a multi-master system with message prioritization, CAN usage is limited by its maximum transfer speed of 1 Mbps, which is only viable if the maximum cable length is not exceeded. LIN has experienced great application to door modules, sunroofs, and seat and climate control, but only has a maximum transfer speed of 20 kbps. FlexRay supports high data transfer rates—up to 10 Mbps—and allows for both synchronous and asynchronous data transfer in a fault-tolerant environment; however, its lower operating voltage levels and asymmetrical edges lead to problems in extending network length.

The increased complexity of interoperability and the demand for more interactive systems to report real-time data requires data transmission at ever-increasing speeds. For instance, vehicles equipped with RF, GPS, audio signaling, serial busses, rear headrest screens, front dashboard screens, and backup cameras may require test speeds of 3 GHz (6 Gbps). The abundance of electrical devices creates challenges like electromagnetic interference (EMI). To combat interference, VTAC HSD was designed to protect signal integrity and reduce interference from other signal transmissions.

PROTECTING SIGNAL INTEGRITY

Signal integrity is an important component to any test setup, especially when it comes to testing with broadband data. Properties of the signal transmission such as crosstalk, attenuation (insertion loss), return loss, impedance matching, and signal path are critical to successful testing. Additionally, connectors, printed circuit boards (PCB), and cables can have a significant effect on a signal's transmission speed and signal integrity. Each new connection creates an opportunity for signal degradation. Any failure to transmit or receive signal during a test creates potential for erroneous data that would otherwise indicate a system failure or other problem not caused by the device under test (DUT).

Wire manufacturers strive to design high speed cables that limit the effects of EMI, prevent crosstalk between the different signals within the cable, maintain impedance matching, and minimize energy loss from the signal. Nevertheless, each application is different and the challenge of matching impedance and controlling interference can only be ensured with proper utility.

That is where Mass InterConnect systems come in. Mass InterConnect systems encourage uniformity in design, connection, and operation. They also provide additional EMI protections where applicable.

Virginia Panel Corporation (VPC) recently developed the VTAC HSD insert, capable of data transfer rates greater than **12.5 Gbps** per differential pair with minimal signal loss. The insert was designed to be used within a Mass InterConnect solution, as well as with small secondary connectors, to meet both current and future demands of test engineers.

CASE STUDY APPLICATION

The VTAC HSD insert was tested for insertion loss, return loss, and crosstalk. Engineers prepared a study by using two one-meter-long cables terminated with small form factor pluggables (SFP+) at either end. One of the cables was bisected and terminated to VTAC HSD inserts in its center while the other was left intact (Figure 1).

Signal degradation is inherent in all switching circuits. In theory, a square waveform would have instantaneous transitions between highs and lows of the signal. However, in practice it takes time for a signal to transition between the high and low states. The time it takes for the signal to change states is referred to as the rise or fall time of the waveform. As the rise and fall times increase, they begin to degrade the signal's integrity. Transmission line effects generally refer to signal losses that originate from impedance mismatches and the resulting

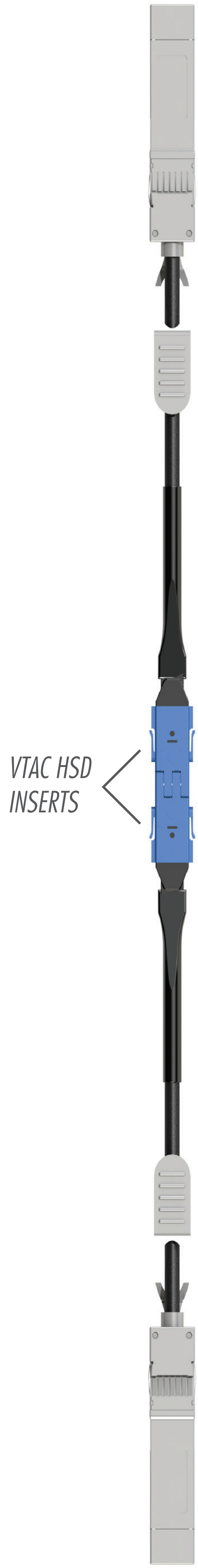

FIGURE 1. ONE -METER-LONG CABLE WITH SFP PLUGGABLES ON BOTH ENDS AND TERMINATED TO VTAC HSD IN ITS CENTER.

signal reflections. Impedance is the cumulative reactance and resistance a circuit presents to a current when a voltage is applied. As a signal propagates along a transmission line, any variations in the impedance create signal reflections. These reflections reduce the generated or emitted energy of the signal resulting in signal loss and distortion.

When the VTAC HSD connector is added to the cable, it creates a new connection point. The additional connection point increases the potential for impedance mismatches, which can result in signal reflections. If the connector changes the impedance, the signal risks being reflected back unto itself. In Figure 2, we see that after 100,000 cycles there is no significant deviation from the SFP+ signal until approximately 6.25 GHz. In fact, we see less than -1 dB of loss between the standalone SFP+ cable and the SFP+ cable bisected with VTAC HSD inserts. We found that the VTAC HSD was capable of transfer rates greater than 12.5 Gbps per differential pair. Notwithstanding, the signal may function at a higher frequency, but not without additional degradation.

We also tested the performance of the VTAC HSD inserts for crosstalk. Crosstalk is an imposed signal on the transmission line from another adjacent transmission line. This induced signal causes interferences to the intended signal, thus reducing the integrity of the intended signal. Similarly, each connection in the signal path creates an opportunity for crosstalk beyond the specified limitations of the cable. Similar to the insertion loss test, engineers completed a base test with the SFP+ cable to acquire a control data set. A 100,000 cycle test was then run with VTAC HSD inserts where no significant crosstalk between components was found. VTAC HSD was tested in an array of different configurations, but in each configuration the loss was found to be less than -40 dBs. In Figure 3, the data shows that the higher the decibel rating of the SFP+ terminated with VTAC, the higher the signal interference that is present.

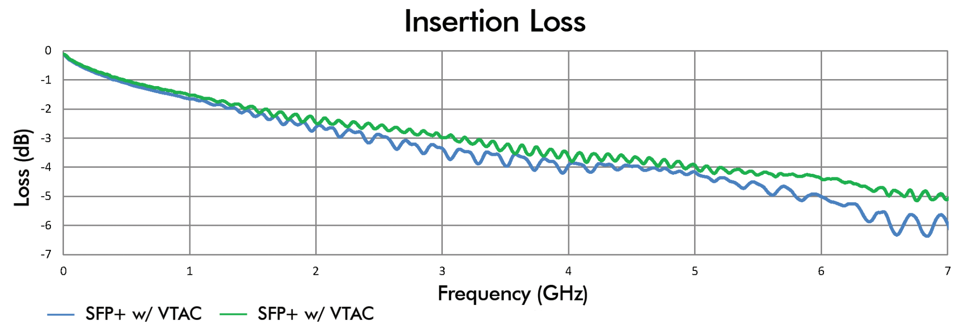

FIGURE 2. THIS PLOT SHOWS THE INSERTION LOSS OF A ONE-METER-LONG SFP+ CABLE TO THE SAME CABLE TERMINATED VTAC HSD INSERTS IN THE MIDDLE. THE RESULTS WERE CONSISTENT UP TO 100,000 CYCLES.

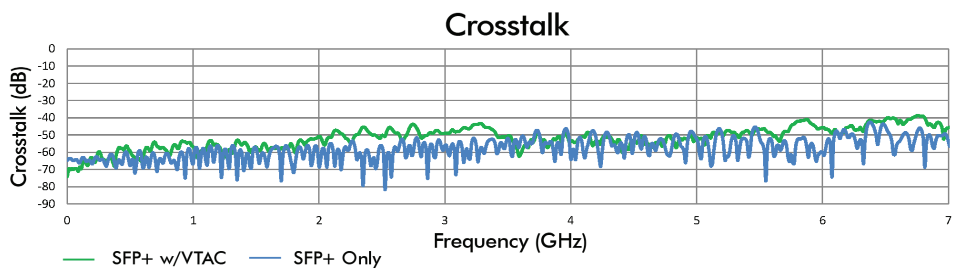

FIGURE 3. THIS PLOT SHOWS THE CROSSTALK BETWEEN DATA PAIRS WITHIN A ONE-METER-LONG SFP+ CABLE TO THE SAME CABLE TERMINATED WITH VTAC HSD INSERTS IN THE MIDDLE. THE RESULTS WERE CONSISTENT UP TO 100,000 CYCLES.

CURRENT SOLUTION LIMITATIONS

Solutions already exist for many kinds of high speed applications, but many of them are limited. Test engineers may build their own cable assemblies, but run into trouble with impedance matching. For instance, FPD-Link III LVDS may face issues when used with twinax cable since it is only rated for 25 ohms. The VTAC HSD insert was designed to minimize transmission line and coupling effects to reduce signal degradation. The result is a 100 ohm connection athat accommodates two differential pairs per insert. While the VTAC HSD inserts create an additional connection in the signal path, it does not add significant signal route loss.

Where other solutions might offer 1,000 to 2,000 mating cycles, VTAC HSD is rated for 100,000 mating cycles, which translates to fewer replacements in the life of the project. Furthermore, it is compatible with several standard HSD protocols such as: HDMI, USB 3.0, RosenbergerHSD, VHDCI, DVI, Gigabit Ethernet, QSFP, and InfiniBand. In terms of compatibility, the test engineer can expect his or her signal integrity to be safeguarded while leveraging some of the highest data transfer rates available.

CONCLUSION

Modern vehicles may contain up to 50 microprocessors that govern everything from instrument display panels and climate controls to airbag response. Since failure can be potentially catastrophic, an automotive test engineer shoulders an enormous responsibility. Real-time communication between the DUT and the test application via reliable high speed data transfer is critical in order to keep up with testing demands and reduce cost. Product innovations such as VTAC HSD can aid in ensuring the most reliable high speed data transfer within any test application. It is not enough to simply make faster technology; VPC is taking steps to ensure that signal integrity is safeguarded and that reliability is a priority to improve industrial application. ■

Virginia Panel Corporation is a world-leader in Mass InterConnect Solutions and has developed an industry-leading solution – VTAC HSD. For more information about the solution or the methodology used in this case study, please visit us online at

VPC.com/VTAC

For additional questions not answered here or online, please give us a call:

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