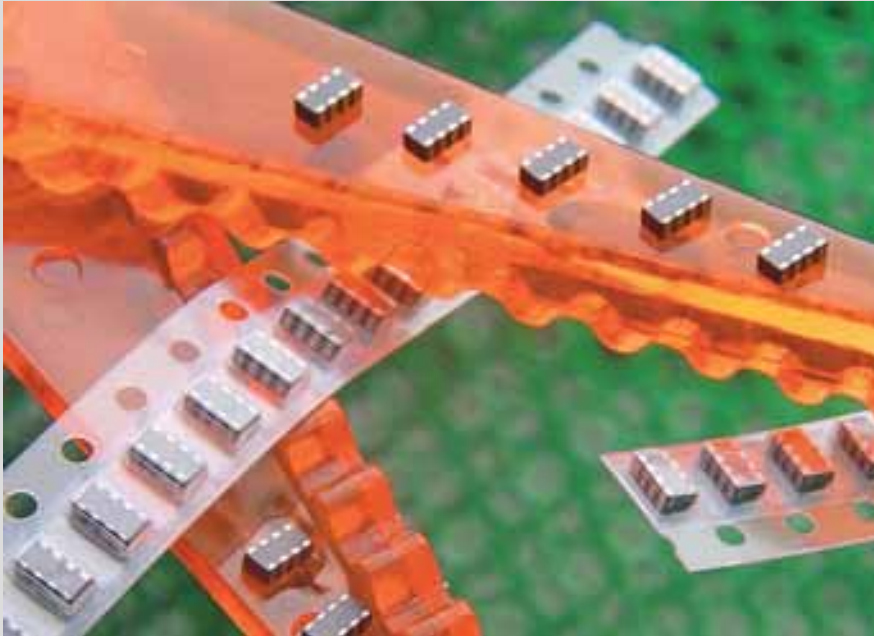


Technical Notes



high speed transfer of high volumes of digital image data. DVI can transfer high quality images with considerably less degradation than the VGA approach, which is based on the analogue transmission of waveforms. In an analogue system, such as VGA, as signal transmission speeds increase, picture quality deteriorates as waveforms deform in transit and unwanted ghost effects are introduced.

DVI, meanwhile, deals with purely digital data and uses a technique called Transmission Minimised Differential Signalling (TMDS) which allows for faster communication with less likelihood of image degradation. As a result, DVI has started making significant inroads in such devices as personal computers, digital displays and projectors.

The TMDS image transmission format, developed by Silicon Image Inc, is also used in the High Definition Multimedia Interface (HDMI) standard, published last year. HDMI is already widely used in consumer audio-video equipment and is increasingly being adopted for use in set-top boxes, DVD players and digital TV's.

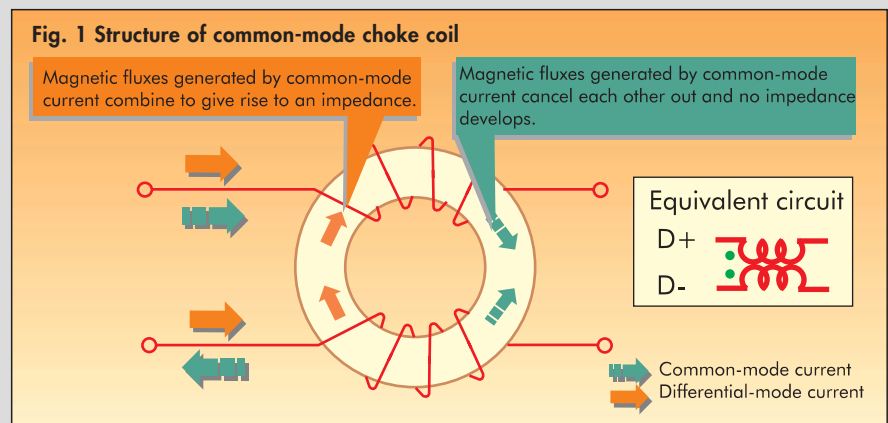
However, as with most equipment based on high speed digital circuitry, DVI based systems are prone to electromagnetic interference (EMI) problems. Designers are finding that even with the incorporation of conventional EMI suppression tech-

EMI suppression for DVI interfaces

Digital video imaging involves the transmission of high speed digital signals, and introduces attendant EMI challenges for circuit designers.

The growth in home entertainment systems is expected to be a major electronics industry driver over the next decade. It is fuelled by the increasing availability of high speed broadband internet access enabling efficient downloading of video data, home networking and the convergence of computer, communications and consumer devices. Whatever the ultimate nature of electronics systems in the home, whether it be a home server, a personal computer with TV incorporated or TV with PC incorporated, the need for larger format display screens is assured. In addition, the increased handling of higher resolution data, is driving the need for faster refresh rates and higher speed data transmission. But today's customers will no longer

tolerate the loss of image quality. For this reason, digital video imaging (DVI) is fast replacing the traditional VGA standard, and is becoming the de facto standard interface for the



niques, which have been effective in conventional differential transmission circuitry, noise is still a problem. A major issue is that the addition of an EMI filter, for example, can cause waveforms to lose their shape, making faithful data transmission impossible.

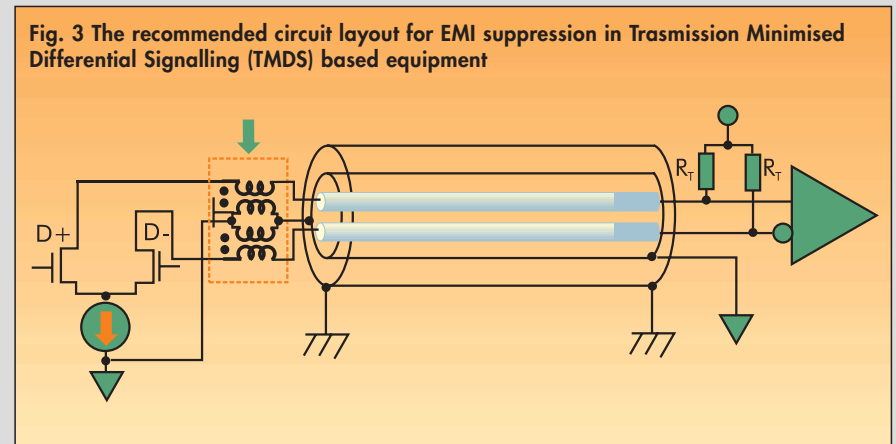
Choking out interference

Certainly, ferrite beads are no longer a viable solution. For relatively slow speed differential transmissions, such as full speed USB (at 12Mbps) and low speed USB (at 1.5Mbps), it is possible to suppress noise by using low pass filters such as ferrite beads. Such an approach continues to be effective for high frequency noise components travelling along signal lines.

However, DVI transmission rates are in excess of 1.6Gbps, and if ferrite beads are added to signal lines, not only is the extraneous noise component eliminated, but also the frequency components that make up the signals to be transmitted!

For high speed differential signals, such as those passing through DVI based systems, Murata has found that common mode choke coils are an effective method of eliminating noise because they focus on signal transmission mode differences rather than frequency differences.

The construction of a common mode choke coil is illustrated in Figure 1. Note the pair of signal lines wound on its ferrite core. Typically, on one side, common mode noise (common mode current) is generated via the



surrounding circuitry. This then combines with magnetic fluxes which are also generated, and impedance is developed as a result. Conversely, on the other side, magnetic fluxes generated by a differential transmission signal cancel each other out and no impedance develops. Based on this principle, it is possible to attenuate common mode noise without weakening differential signals while in differential mode.

For typical high speed differential transmission interfaces, the most effective approach is to employ a common mode choke coil between paired differential transmission lines.

This has certainly proved to be a satisfactory technique for LVDS (low voltage differential signalling) interface circuitry. However, there may still be cases in DVI and HDMI based circuits where this approach will not work sufficiently well, primarily because of the differences in the method of transmission.

It has been found that when pulse current alternately flows through two coils of the common mode choke coil, multiple reflections tend to develop on a PCB, between the transmitter and the common mode choke coil, due to impedance mismatches. The end result, once again, is that wave-

Fig. 2 Equivalent circuit of Murata DLP31D series

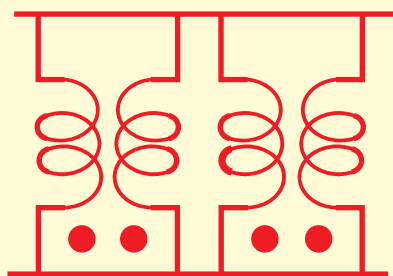
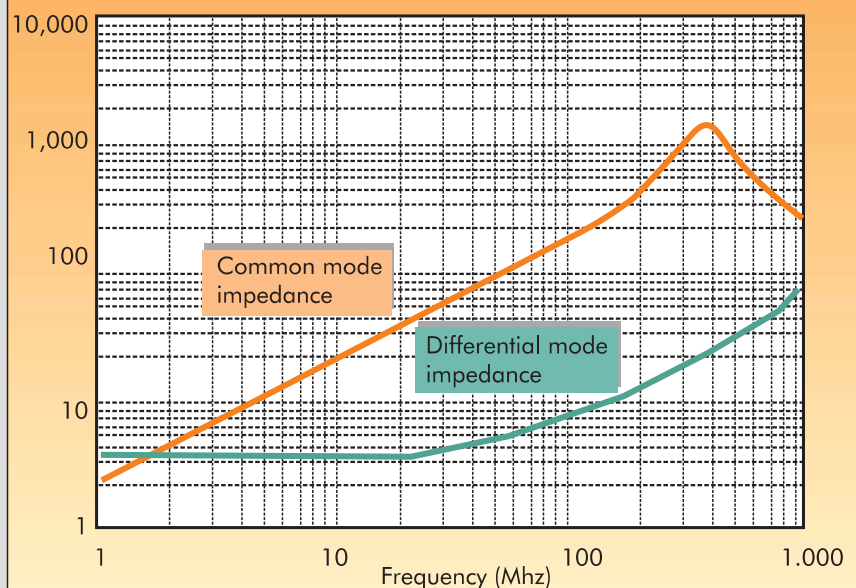


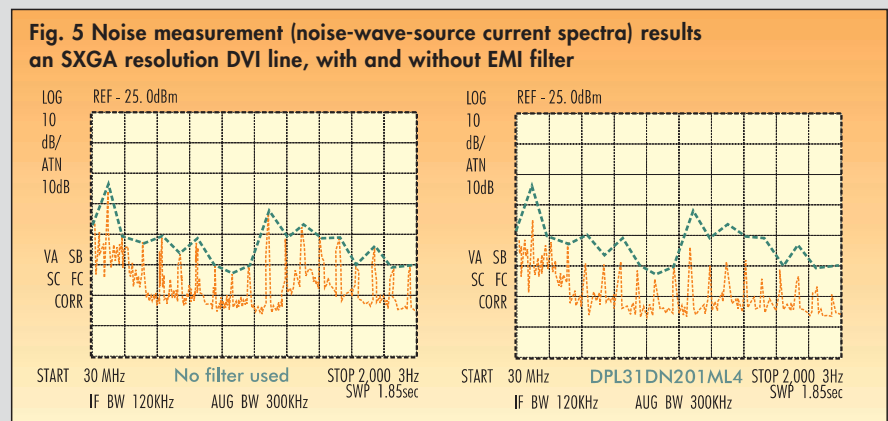
Fig. 4 Impedance vs. Frequency Characteristics of Murata DLP31D series



form quality is degraded. In such cases, the solution is to apply common mode choke coils where ground lines are combined with D+ and D- wires. Using this method, impedance can be generated only with respect to common mode current, resulting in radiated noise which is comparatively straightforward to reduce. Figure 3 shows the recommended EMI suppression method for TMDS circuitry, such as that adopted for DVI and HDMI based equipment. Note the use of the two circuit filters.

Arrayed solution

The EMI filter recommended for this approach is Murata's DLP31DN201ML4 common mode choke coil array. Each DLP31D series array is a two circuit filter block incorporating two common mode choke coils. This is a far more cost effective and space saving approach than using two discrete single circuit filters. The common mode impedance of the choke coil array at 100MHz is specified at 200ohms. Rated voltage is 10Vdc and rated current 100mA. DC resistance is less than 2.2ohms



while insulation resistance is greater than 100Mohms.

Consider a typical DVI line (SXGA resolution), at a clock frequency of 108MHz. The results of using and not using a DLP31D series common mode choke coil array can be clearly seen in Figure 5.

The combination of the common mode choke coil array and the ground lines effectively reduces noise without disturbing the waveform. Murata has considerable applications expertise in the use of EMI suppression measures for DVI and HDMI

circuitry. The company supplies a variety of components designed to eliminate the problems of EMI in high speed digital and differential transmission environments. Such techniques are already becoming widely adopted in a various systems requiring the fast transmission of high resolution images. Murata is continuing to develop and improve its component range, and current efforts are concentrated on enhancing performance while miniaturising the components still further.

Ref. Tech12a