

ESD Protection of high-speed data lines



DVI/HDMI High speed data rates

Communication data lines continue to be increasingly vulnerable to ESD transients. The ever-increasing bandwidth of the faster data lines such as the 10/100 or Gigabit Ethernet, USB 2.0, IEEE-1394b, make the traditional ESD protection schemes such as silicon based devices, or multilayer varistors less desirable, due to signal distortion from the relatively high capacitance of these components.

Voltage Variable Material (VVM) ESD Suppressors

Eaton's VVM ESD suppressors (0402ESDA-MLP, 0603ESDA-MLP, PS04LTVA1 or 0603ESDA2-TR2) have a typical measured capacitance below 0.15 pF, in a range of 0.1 kHz to nearly 2 GHz (Figure 1). The low capacitance throughout this wide frequency range makes these devices suitable for ESD protection of low analog signals to fast digital data lines.

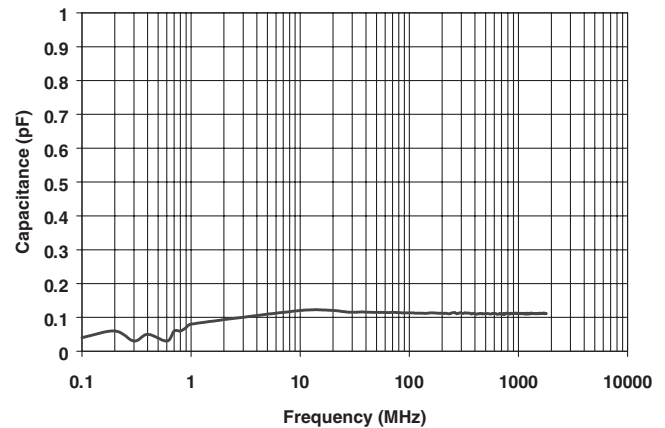


Figure 1. Capacitance of a VVM ESD suppressor from 0.1 MHz to 1.8 GHz

Another special characteristic of the VVM ESD suppressor is that it is virtually invisible to the circuit at normal operation. The off-state resistance of the device is over 10^{13} Ohms, and the typical current leakage of the device is a negligible, 0.01 nA at 12 Vdc. Figure 2 shows the additional attenuation in a 50 ohm circuit measured at frequencies up to 6 GHz is less than -0.2 dB.

Example of end product devices that the VVM families can protect from ESD are:

- Network interface cards for desktops
- PC cards for laptops
- Computers and peripherals
- Blu-Ray/DVD players/Satellite and HD radio
- Set top Boxes/HDTV Equipment
- Mobile phones

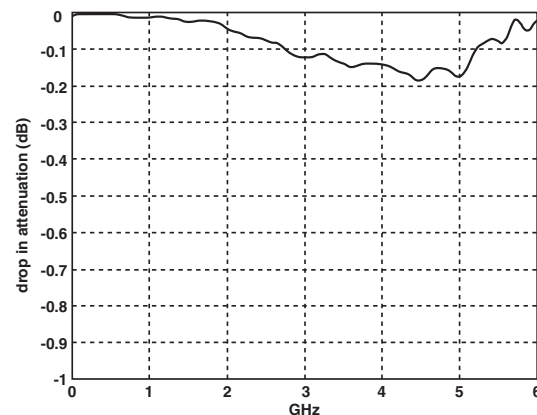


Figure 2. Additional attenuation in a 50 Ohm system due to the VVM ESD suppressor

Selected protection applications

Ethernet ports: The RJ-45 is the most common Ethernet connection. The typical 10Base-T/100Base-TX uses 4 out of 8 lines. Each line in use can be protected with one VVM ESD suppressor installed between the data line and the ground. For the best performance, place the devices at the closest location to the RJ-45 port (Figure 3).

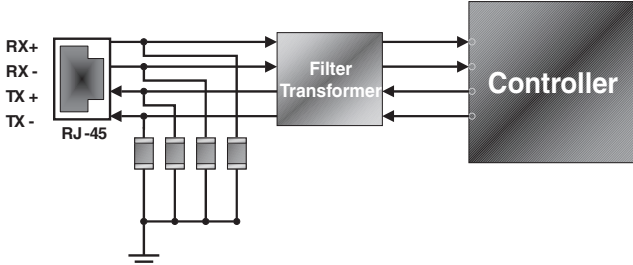


Figure 3. ESD Protection of 10 / 100 Ethernet (RJ-45) device with a VVM ESD suppressor

Firewire: The IEEE-1394 (Firewire) series are the newest serial ports for computer and other instruments with data transfer rates up to 1,600 Mbps (1394a is 400 Mbps, and 1394b will be 800~1,600 Mbps.) This higher transfer speed data is more easily subject to distortion (Figure 4). The VVM ESD suppressor can protect data lines from ESD without distorting the high speed signal possible from IEEE-1394 connection. All data lines should be protected individually. (Figure 5).

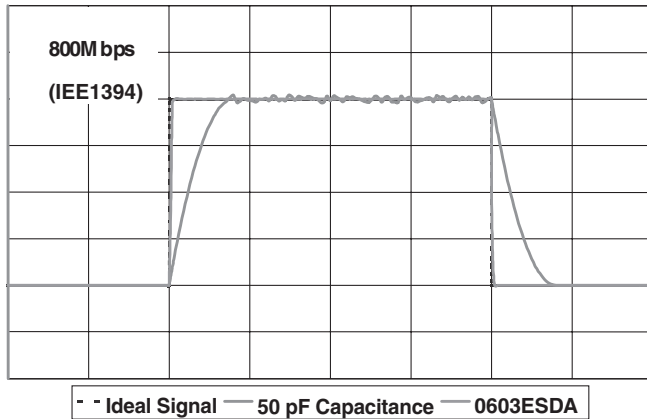


Figure 4. Signal distortion comparisons at 800 Mbps

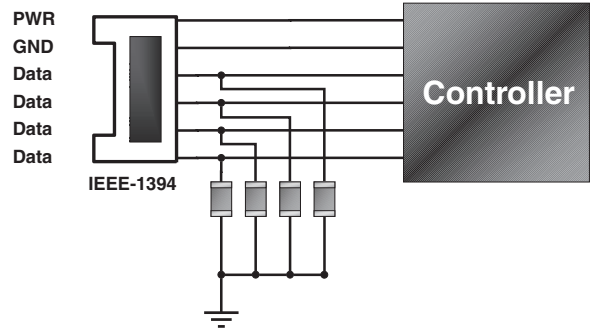


Figure 5. ESD Protection of typical IEEE-1394a device with a VVM ESD suppressor

USB 2.0: USB 2.0 has a fast data transfer rate of 400 Mbps. A device equipped with USB 2.0 will give the best performance when protected with the ultra low capacitance VVM ESD suppressor. This will result in much less data distortion than if zener diodes or multilayer varistors are used for ESD protection (Figure 6).

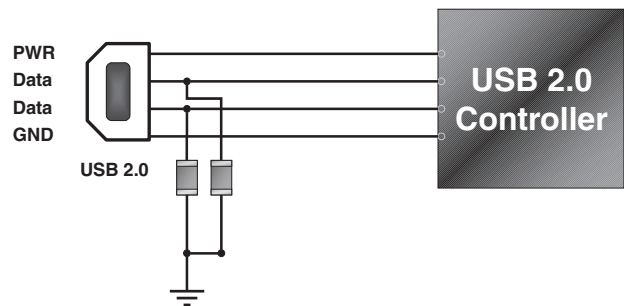


Figure 6. ESD Protection of USB 2.0 devices with a VVM ESD Suppressor

Special applications: When the unused data port is connected to a higher operating voltage such as 24 V or higher for special applications, the VVM ESD Suppressor can be installed in series for ESD protection on the higher voltage line (Figure 7). The operating voltage capability will be increased without changing total capacitance or the current leakage of the devices.

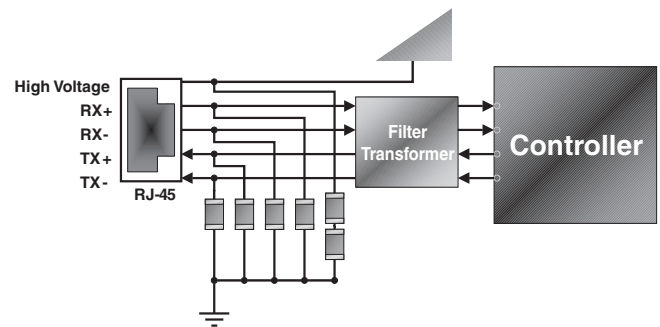


Figure 7. High voltage line protection using a VVM ESD device on RJ-45.

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
www.eaton.com/electronics

© 2017 Eaton
All Rights Reserved
Printed in USA
Publication No.
December 2017