

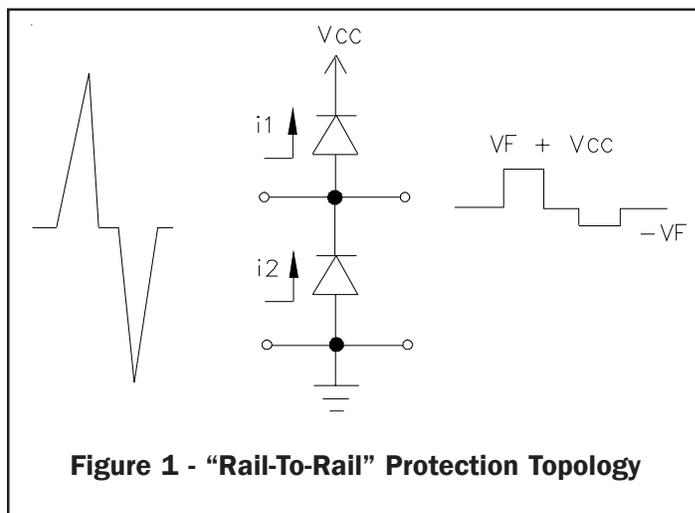
**PROTECTION PRODUCTS**

**RailClamp™ TVS Diodes  
for High-Speed Interfaces**

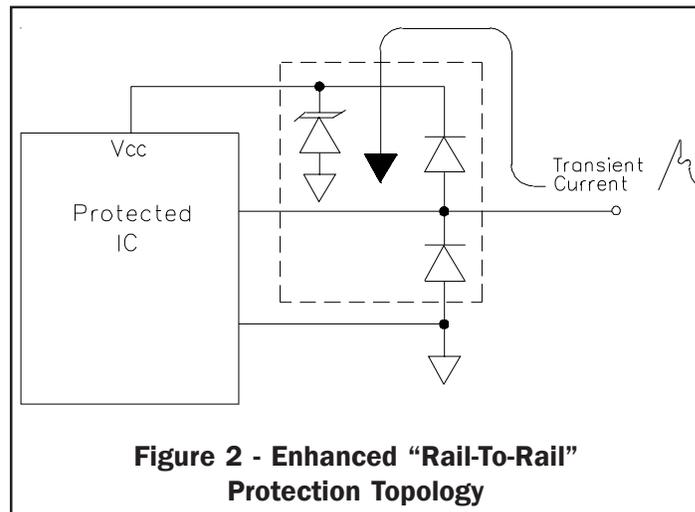
A popular low capacitance protection method is the “rail-to-rail” technique. In this configuration, low capacitance steering diodes are connected between the protected line and two fixed voltage references such as  $V_{CC}$  and ground (Figure 1). During a positive duration transient, the top diode will be forward biased, conducting the surge to the power rail. The voltage seen by the protected circuit will be one diode drop ( $V_F$ ) above the supply voltage. During a negative duration transient, the bottom diode will conduct, clamping the voltage to one diode drop below ground. Since it is not advisable to dump the surge into an unprotected supply rail, a standard TVS diode is often connected between the references to protect downstream components and keep the supply rail within the limits of the device clamping voltage (Figure 2).

While this type of protection is often achieved with discrete components, it is not advisable. First, discrete rectifiers are not rated for high transient currents normally associated with ESD and lightning events. The small junction area results in poor forward voltage characteristics at high current densities. As such, damage may occur to the protected component or even the protection diodes. Second, interconnections between discrete components increases the parasitic inductance in the conduction path of the transient current, thus reducing the overall effectiveness of the protection circuit.

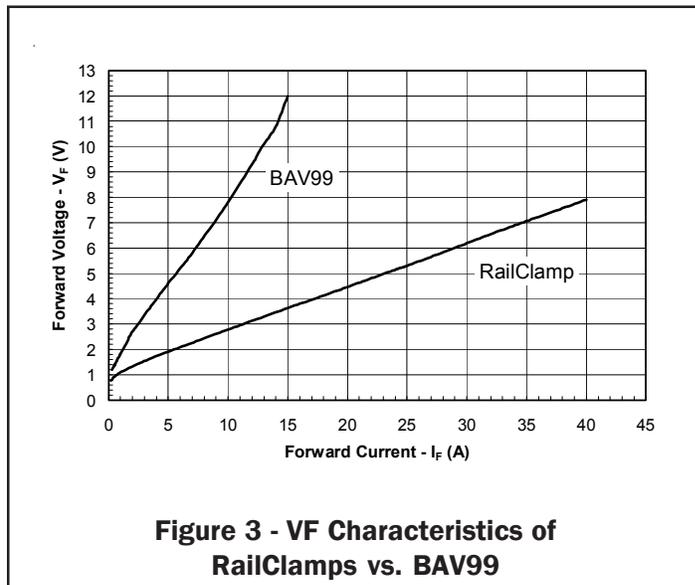
The Semtech family of RailClamp™ TVS diodes virtually eliminates these problems. These devices integrate surge rated, low capacitance steering diodes and a TVS diode in the same package. They are designed to protect multiple high-speed lines and the power supply line. Figure 3 illustrates the superior  $V_F$  characteristics of the RailClamp as compared to a BAV99 (commonly used in rail-to-rail protection circuits). Note the rapid increase in  $V_F$  of the BAV99 relative to the RailClamp. This causes increased stress on the protected device possibly leading to premature failure. At higher currents, the power handling capability of the BAV99 is exceeded, resulting in failure of the device itself. RailClamps are commonly utilized in WAN/LAN, video and USB applications.



**Figure 1 - “Rail-To-Rail” Protection Topology**



**Figure 2 - Enhanced “Rail-To-Rail”  
Protection Topology**



**Figure 3 -  $V_F$  Characteristics of  
RailClamps vs. BAV99**