

# COMMUNICATIONS APPLICATIONS



**P** **PROTEK**  
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*ADVANCED CIRCUIT PROTECTION DEVICES FOR OVERVOLTAGE AND OVERCURRENT TRANSIENT EVENTS*

Communication interfaces are vulnerable to a variety of transient voltage threats such as electrostatic discharge (ESD), cable discharge events (CDE) and lightning surge. These threats provide the system designer with the challenge to incorporate over-voltage protection that meets or exceeds circuit protection standards (see Table 1), while not degrading the transmission rate. Key parameters, such as working voltage, clamping voltage and capacitance, must be taken into consideration when choosing an overvoltage protection device.

TABLE 1 - CIRCUIT PROTECTION STANDARDS				
STANDARD	PEAK SURGE VOLTAGE - V	VOLTAGE WAVEFORM - $\mu$ s	PEAK SURGE CURRENT - A	CURRENT WAVEFORM - $\mu$ S
Bellcore	250	2/10	500	2/10
GR-1089	1000	10/1000	100	10/1000
ITU-T-K20 & K21	4000	10/100	100	5/310
FCC Part 68	1500	10/160	200	10/160
IEC 61000-4-2	$\pm$ 8kV Contact, $\pm$ 15kV Air	1/30ns	30	8/20
IEC 61000-4-4	2kV, 4kV	5/50ns	40	8/20
IEC 61000-4-5	1kV, 2kV, 4kV	1.2/50	24, 48, 95	8/20

Device capacitance is often a decisive factor in higher data rate applications (see Table 2). A TVS diode, like other semiconductors, has an inherent capacitance. Capacitance is dependent on junction area, doping concentration and the voltage across the diode terminals. The reverse bias voltage is inversely related to device capacitance, as reverse bias increases the device capacitance decreases. As the doping concentration increases, the voltage rating of the diode decreases and device capacitance increases. On the other hand, devices with higher voltage values have smaller junction capacitance. Larger junction area relates to higher current handling capability. But as the device or junction size increases the device capacitance increases along with it.

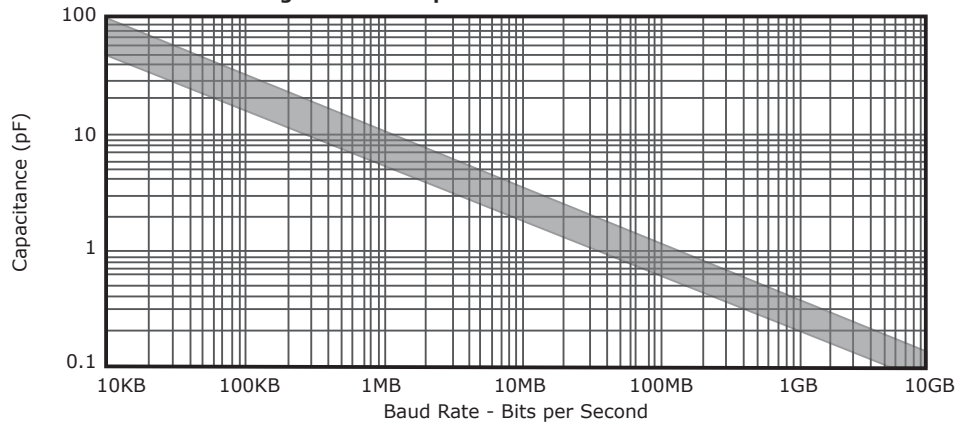
TABLE 2 - DATA TRANSMISSION RATES		
APPLICATION	DATA RATE Mbit/S	CAPACITANCE pF
LinBus	0.20	< 50
RS-232	0.20	
CanBus/Device Net	1.0	<30
T1	1.544	
E2	2.048	
I2C	2.4	
Ethernet	10	
FlexRay	10	
USB 1.1	12	< 20
E3	34.368	
RS-485	35	
T3	44.736	
Fast Ethernet	100	< 5
T5	400.352	< 3
USB 2.0	480	
E5	565.148	
IEEE-1394b	786.432	
GigabitE	1000	
DVI	3960	< 1
USB 3.0	5000	
DisplayPort	5400	
SATA 3.0	6000	
USB 3.1	10000	
HDMI 1.3	10200	
HDMI 2.0	18000	

One of the characteristics of a capacitor is lower impedance to time varying signals. The higher the frequency of a signal, lower the resistance offered to it. So when a TVS diode is used in a high data rate application, the intrinsic device capacitance tends to attenuate the signal. Hence, when the device capacitance is large the attenuation suffered by the high frequency signal is greater.

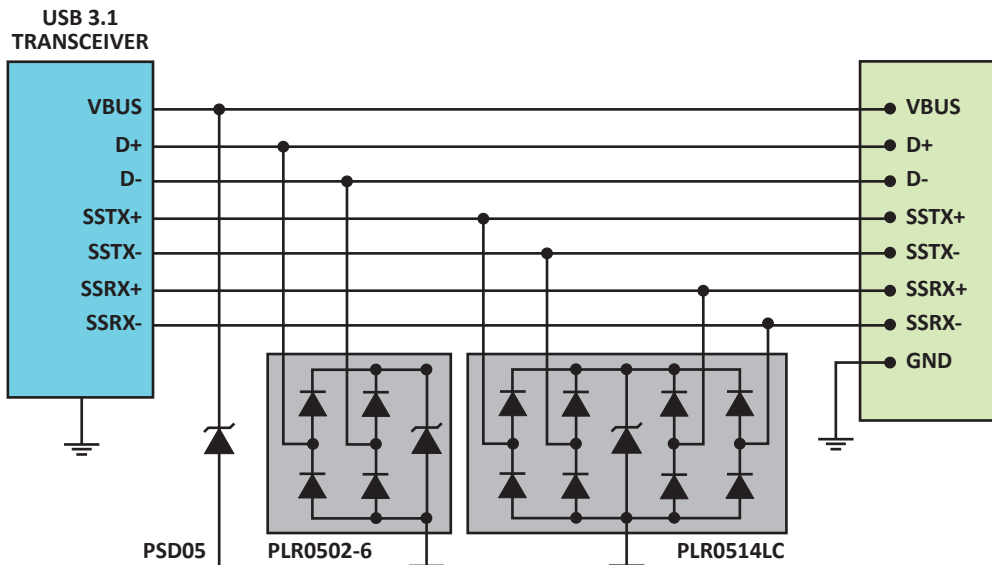
Figure 1 is a very good approximation of device capacitance and the data rate it can support. The curve represents the approximate limiting frequency for the capacitance(y-axis). A device with a capacitance value below the curve should not have any appreciable attenuation for a given signal.

To satisfy an ever-demanding market for greater safety and reliability of electronics, ProTek Devices continues to work with the major electronic equipment manufactures to develop next generation products that are protected with ProTek Devices circuit protection components. ProTek Devices offers low profile, space saving devices that provide low working voltage, lower clamping voltages and ultra low capacitance for high-speed communication applications.

**Figure 1. TVS Capacitance vs. Transmission Rate**



SELECTION GUIDE			
APPLICATION	PREFERRED MULTI-LINE DEVICES	PREFERRED SINGLE-LINE DEVICES	ALTERNATE DEVICES
CanBus/Device Net	PAM1CAN		PAM2CAN
DVI	PLR0502, PLR0508, PLR4045	GBLCxxCI Series, PLR0521	PLR0504F, PLR0506, PLR0524
eSATA	PLR0504F	GBLCxxCI Series, PLR0521	PLR0506, PLR0524
Ethernet	PLRxx12 Series, PLR2210		PLR3311
Fast Ethernet	PLC03-6, SMP6LLCxx-2P Series, SRV05-4	GBLCxxC Series	PLR3304, SRV05-4M, SRV05-4LC
FlexRay		PAM1FLEX	
Gigabit Ethernet	PAZC099, PLR0504F, PLR2210, PLR3343, PLR4045, SRV05-4, SRV05-4-A, SRV25-4, SRV3.3-4	GBLCxxCI Series, GBLC03CIHP	PLR0524, PLR3311, SLUV2.8-4
HDMI 1.3	PAZC099, PLR0506	GBLCxxCI Series, PLR0521	PLR0504F, PLR0524
HDMI 2.0	PLR0514LC, PLR05214LC, PTB05-8ULC		PLR0524
LINBus		PAM1LIN	PAM2LIN
RS-485	PSLCxxC Series, PSM712	PSDxx Series, PSOTxxC Series	485ELC
Smart Battery (I2C)	DSOT0502, VSMF05LC	GBLCxxCI Series, PLR0521, PSDxx Series, PSOTxxC Series	VSMF05LCC
T1/E1 - T3/E3	PLR03-3.3/PLR3304	GBLCxxC Series	PLC03-6/SRV05-4
USB 2.0	PLR0502, PLR0504F, PLR0506	GBLCxxCI Series, PLR0521	PLR0502-6, PLR0524, SRV05-4LC
USB 3.0	PLR0506, PLR0506LP, PLR0524	GBLCxxCI Series, PLR0521	PLR0502, SRV05-4LC
USB 3.1	PLR0502-6/PLR0514LC		SRV05-4LC
xDSL	DSL03-24	GBLCxxCI Series, PLR0521	DSL03-24T



**Figure 1. USB 3.1 Interface Protection Using PLR0502-6, PLR0514LC and PSD05**



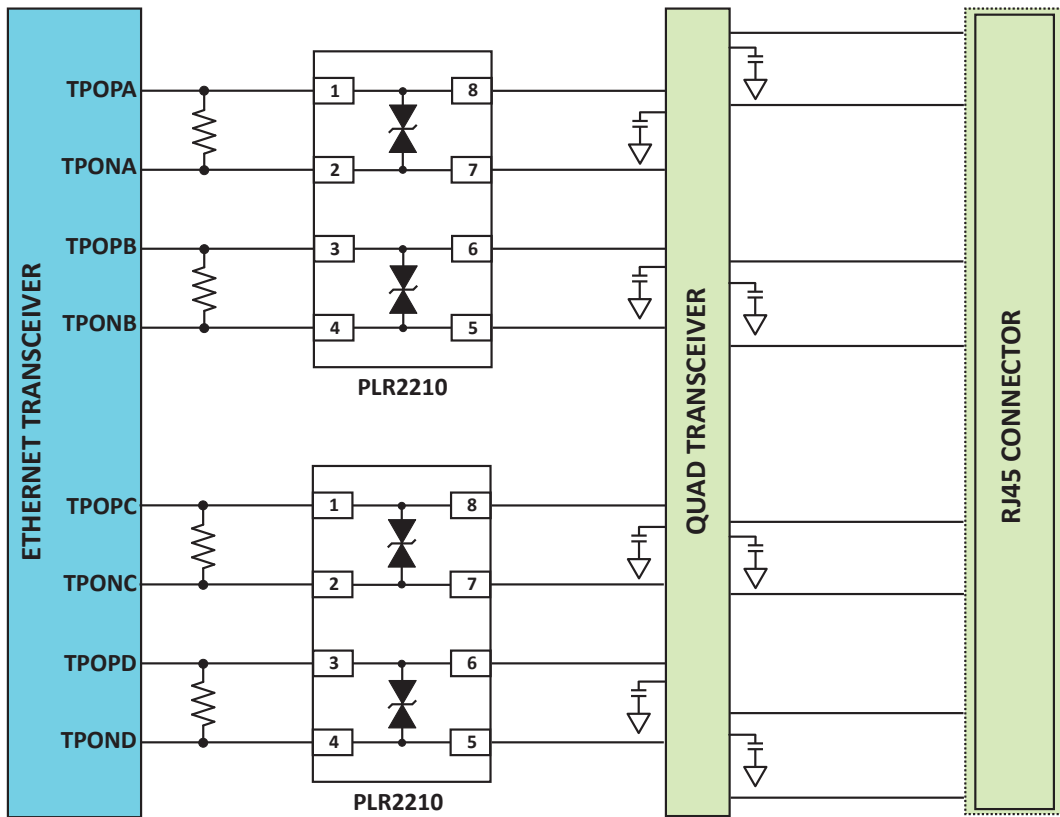


Figure 2. GigabitE Interface Protection Using PLR2210

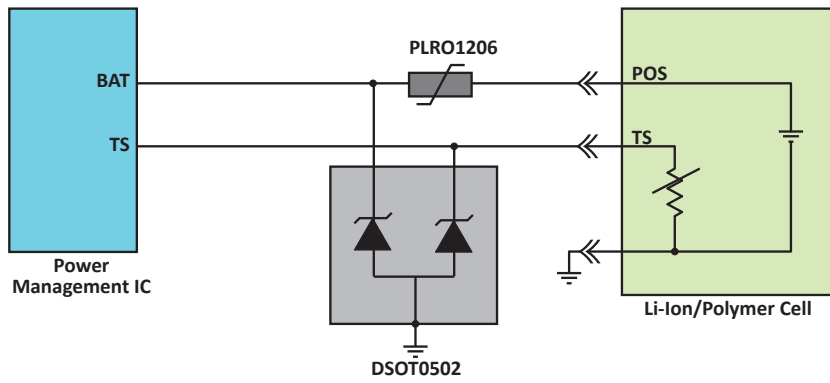


Figure 3. Smart Battery Protection Using DSOT0502 and PLR01206(for Overcurrent Protection)

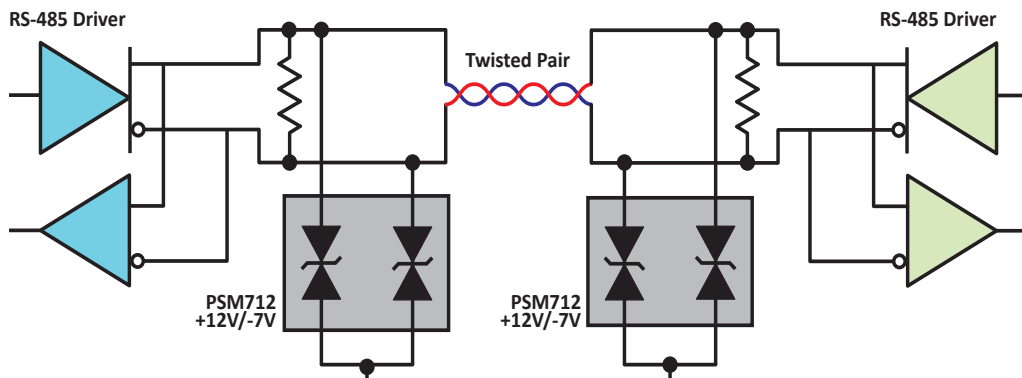


Figure 4. RS-485 Driver Application Using 2 PSM712 Devices

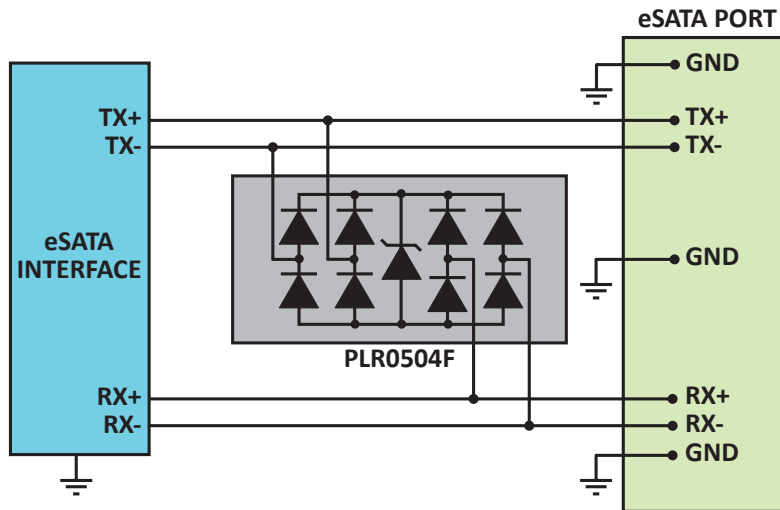


Figure 5. eSata Interface Protection Using PLR0504F

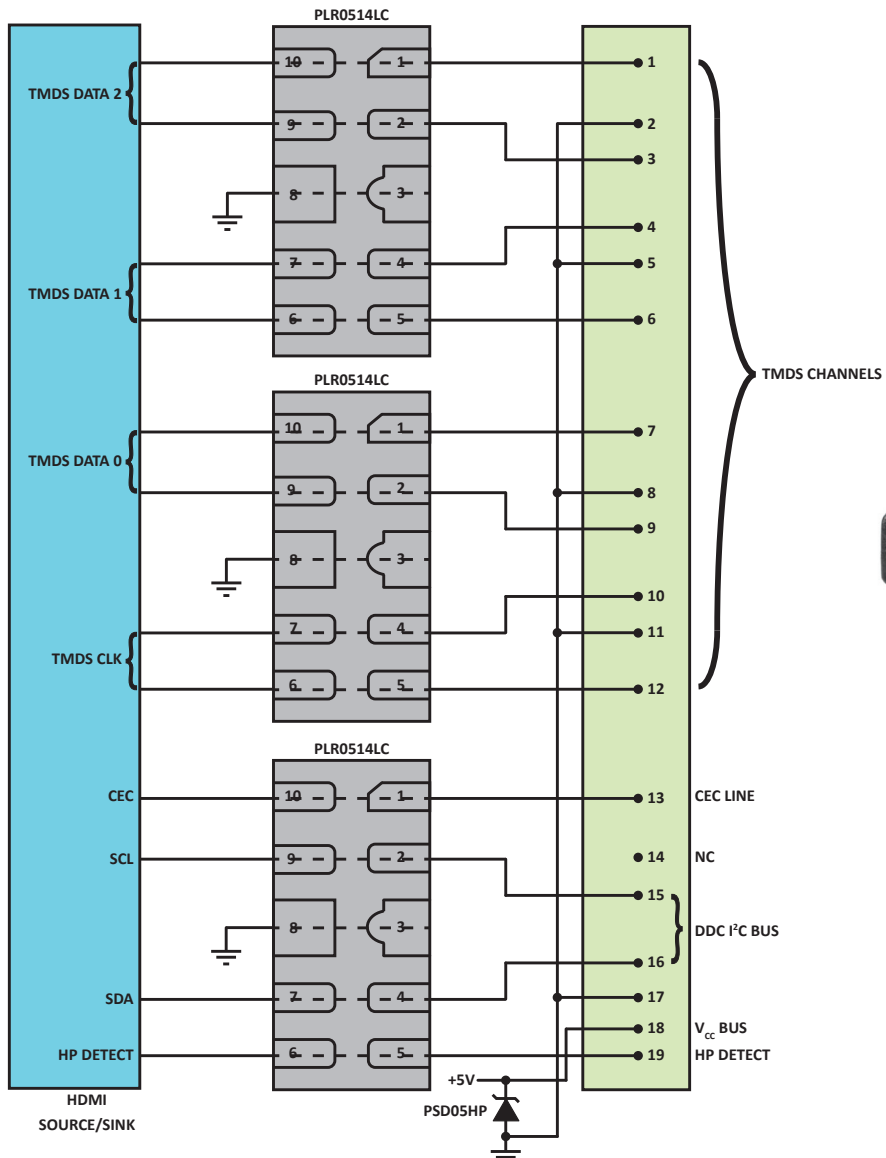


Figure 6. HDMI 2.0 Interface Protection Using PLR0514LC and PSD05HP for VCC Bus Protection

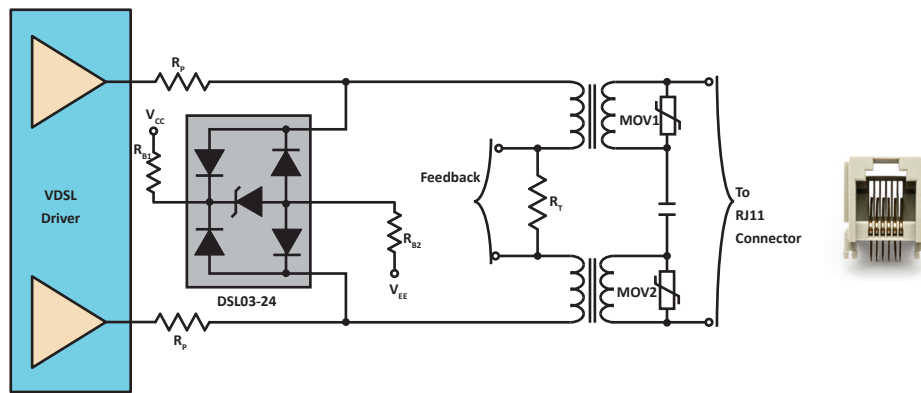


Figure 7. xDSL Interface Protection Using DSL03-24

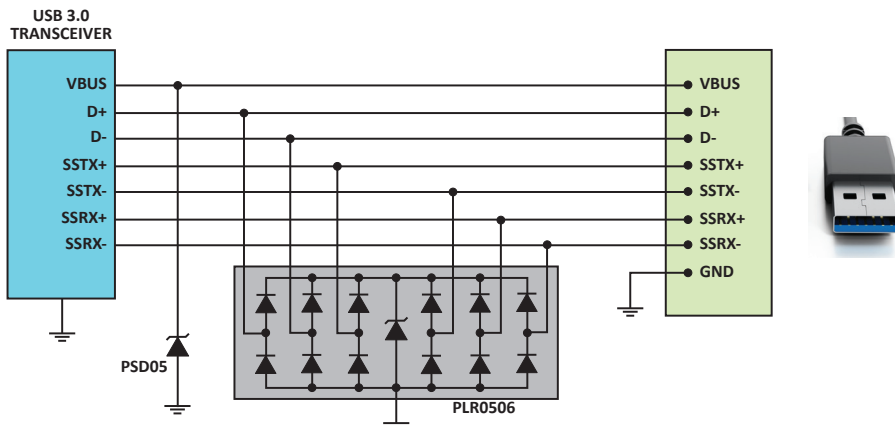


Figure 8. USB 3.0 Interface Protection Using PLR0506 with PSD05 for VCC Bus Protection

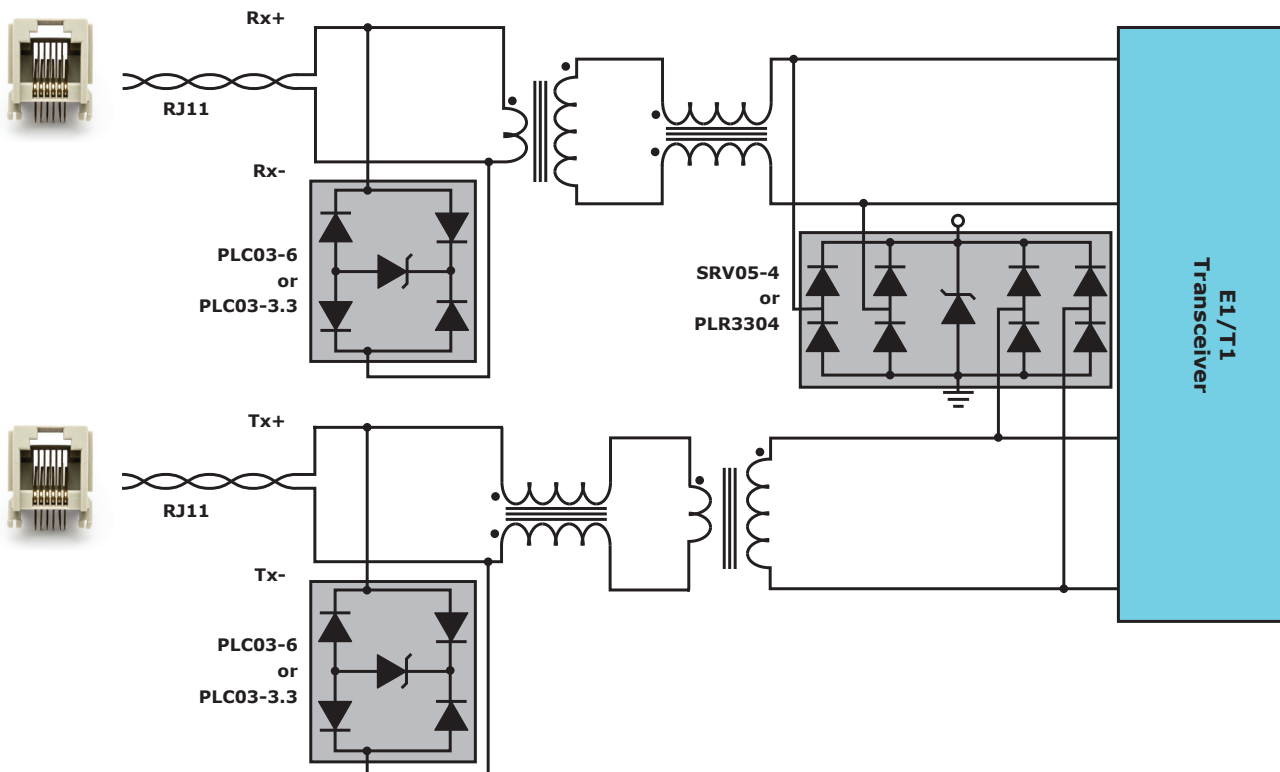


Figure 9. T1/E1 Protection Using SRV05-4/PLC03-6 or PLR3304/PLC03-3.3

## OVERVOLTAGE PART SPECIFICATIONS

PART NUMBER	STAND-OFF VOLTAGE	BREAKDOWN VOLTAGE	CLAMPING VOLTAGE	PEAK PULSE CURRENT 8/20µs	MAXIMUM LEAKAGE CURRENT	TYPICAL CAPACITANCE	NO. OF LINES	POWER 8/20µs	PACKAGE
	V <sub>WM</sub> VOLTS	V <sub>(BR)</sub> VOLTS	V <sub>C</sub> VOLTS	I <sub>PP</sub> AMPS	I <sub>D</sub> µA	C pF		WATTS	
485ELC	±7.0	-	20.0	500	10	25	1	-	Module
DSL03-24	24.0	26.0	55.0	15.0	0.1	1.4	2	500	SOT-23-6
DSL03-24T	19.0	-	-	-	0.01	3	2	-	SOT-23-6
DSOT0502	5.0	6.0	12.5	2.0	2	9	1	25	SOT-883
GBLCxxC	3.3 - 24.0	4.0 - 26.7	7.0 - 43.0	1.0	5 - 1	3	1	350	SOD-323
GBLCxxCI	3.0 - 24.0	4.0 - 26.7	7.0 - 43.0	1.0	5 - 1	0.6	1	250	SOD-323
GBLC03CIHP	3.0	4.0	24.0	20.0	5	0.6	1	500	SOD-323
PAM1CAN	24.0	25.4	46.0	3.0	0.002	11	2	200	SOT-23
PAM1FLEX	24.0	25.4	70.0	3.0	0.05	11	2	200	SOT-23
PAM1LIN	15.0/24.0	17.2/25.5	25.0/40.0	1.0	0.001	14	1	200	SOD-323
PAM2CAN	24.0	25.4	60.0	4.0	0.05	11	2	230	SOT-23
PAM2LIN	24.0	26.7	57.0	3.5	0.001	3	1	200	SOD-323
PAZC099	5.0	6.0	12.0	1.0	0.5	0.5	4	100	SOT-23-6
PLC03-3.3	3.0	2.8	18.0	100.0	2	8	2	1800	SO-8
PLC03-6	6.0	6.8	20.0	100.0	25	8	2	2000	SO-8
PLR0502	5.0	6.0	20.0	10.0	1	0.6	2	200	SOT-543
PLR0502-6	5.0	6.0	17.0	3.0	1	0.7	2	50	SC-89
PLR0504F	5.0	6.0	25.0	5.0	3	1.9	4	200	SC70-6L
PLR0506	5.0	6.0	18.0	4.0	3	0.8	6	72	DFN-8
PLR0506LP	5.0	6.0	18.0	4.0	3	0.8	6	72	DFN-8
PLR0508	5.0	6.0	13.0	5.0	1	1.6	8	200	DFN-10
PLR0514LC	5.0	6.0	12.0	1.0	1	0.35	4	-	DFN-10
PLR0521	5.0	6.0	20.0	4.0	1	0.4	1	80	DFN-2
PLR05214LC	5.0	6.0	13.0	1.0	0.5	0.35	8	100	DFN-10
PLR0524	5.0	6.0	12.0	1.0	0.5	0.7	4	150	DFN-10
PLRxx12	2.5 - 3.3	2.7 - 3.5	10.2 - 11.0	10.0	0.05	3	2	100	DFN-8
PLR2210	2.5	2.7	6.0	2.0	0.05	0.6	2	170	DFN-8
PLR3304	3.3	3.5	10.0	10.0	0.1	4	4	400	DFN-10
PLR3311	3.3	4.5	8.0	5.0	0.05	5	1	40	DFN-2
PLR3343	3.3	5.6	10.0	1.0	1	0.25	4	150	DFN-10
PLR4045	3.3	4.0	20.0	30.0	0.1	1.6	4	600	MSOP-10
PSDxx	3.3 - 36.0	4.0 - 40.0	6.5 - 60.0	1.0	125 - 1	500 - 35	1	500	SOD-323
PSLCxxC	3.3 - 24.0	4.0 26.7	19.0 - 56.0	20.0 - 6.0	125 - 1	3	1	350	SOT-143
PSM712	7.0, 12.0	7.5, 13.3	11.0, 19.0	1.0	20, 1	75	1	600	SOT-23
PSOTxxC	3.3 - 36.0	4.0 - 40.0	6.5 - 51.0	1.0	125 - 1	500 - 60	1	500	SOT-23
PTB05-8ULC	5.0	5.5	11.5	5.0	1	0.15	8	-	DFN-18
SLVU2.8-4	2.8	3.0	21.0	30.0	1	3	2	600	SO-8
SMP6LLCxx-2P	5.0 - 15.0	6.0 - 16.7	26.0 - 50.0	150.0-110.0	300 - 2	5	2	3900	SO-16
SRV05-4	5.0	6.0	15.0	5.0	5	2.5	4	500	SOT-23-6
SRV05-4-A	5.0	6.0	12.5	1.0	1	3	4	250	SOT-23-6
SRV05-4LC	5.0	6.0	15.0	5.0	5	0.7	4	500	SOT-23-6
SRV05-4M	5.0	6.0	14.0	5.0	5	2.5	4	400	SOT-23-6
SRV25-4	2.5	3.0	7.4	10.0	0.5	1.7	4	800	DFN-10
VSMF05LC	5.0	6.0	12.0	2.0	1	9	4	25	SOT-953
VSMF05LCC	5.0	6.0	12.0	2.0	1	9	4	25	SOT-963

## COMPANY INFORMATION

In business more than 20 years, ProTek Devices™ is a privately held semiconductor company. The company offers a product line of overvoltage protection and overcurrent protection components. These include transient voltage suppressor array (TVS arrays) avalanche breakdown diode, steering diode TVS array and electronics SMD chip fuses. These components deliver circuit protection in electronic systems from numerous overvoltage and overcurrent events. They include lightning; electrostatic discharge (ESD); nuclear electromagnetic pulses (NEMP); inductive switching; and electromagnetic interference (EMI) / radio frequency interference (RFI).

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### ROHS & REACH COMPLIANCE

All devices, with the exception the PAM16AL30A (RoHS, exemption #7) are Lead-Free, RoHS & REACH compliant. These products are designated as "lead free" and meet the requirements of the European Union's restriction on the use of hazardous substances in electrical equipment as stated in (RoHS) direction, 2002/95/EC. ProTek Devices defines "lead free" as products that are compatible with current RoHS requirements for the 6 "banned" substances: Lead (Pb, <1000ppm), Cadmium (Cd, <100ppm), Mercury (Hg, <1000ppm), Hexavalent Chromium (Cr6+, <1000ppm), Poly Brominated Biphenyls (PBB, <1000ppm), Poly Brominated Diphenyl Ethers (PBDE, <1000ppm). This includes the requirements that lead not exceed 0.1% by weight in homogeneous materials.

### STANDARD TAPE & REEL NOMENCLATURE

-T7 for 7" Reels  
-T13 for 13" Reels  
-TS for sample size Reels

Not all products are available in 7" or 13" reels. Quantities per reel vary depending upon package size. Please consult product data sheet or the factory for ordering information regarding a specific part series. All data sheets can be found on ProTek Devices website: [www.protekdevices.com](http://www.protekdevices.com)

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