

350 WATT LOW CAPACITANCE TVS ARRAY



DESCRIPTION

The USB04xx and USBxxC Series of devices are low capacitance TVS arrays available in a SOT-143 package. These devices are designed to protect Ethernet data I/O ports against the damaging effects of ESD and EFT transient threats.

The USB04xx series are unidirectional devices used for common mode protection from line to ground. The USB04xxC series are bidirectional devices typically used for differential mode on balanced lines.

Voltages range from 3.3 to 24 volts for both configurations. Each series provides ESD protection to > 25 kilovolts with a peak pulse power rating of 350 Watts for an 8/20 μ s waveshape. The USB04xx and USBxxC series are designed to meet and exceed the IEC 61000-4-2 and IEC 61000-4-4 requirements.

FEATURES

- Compatible with IEC 61000-4-2 (ESD): Air 15kV, Contact 8kV
- Compatible with IEC 61000-4-4 (EFT): 40A, 5/50ns
- Compatible with IEC 61000-4-5 (Surge): 12A, 8/20 μ s - Level 1(Line-Gnd) & Level 2(Line-Line)
- 350 Watts Peak Pulse Power per Line ($t_p = 8/20\mu$ s)
- Unidirectional and Bidirectional Configurations
- Available in Multiple Voltages Ranging from 3V to 24V
- Protects 1 Line
- Low Leakage Current
- Low Capacitance: 5pF per Line Pair
- RoHS Compliant
- REACH Compliant

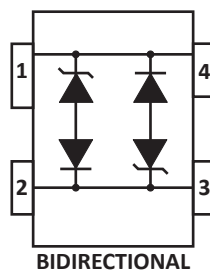
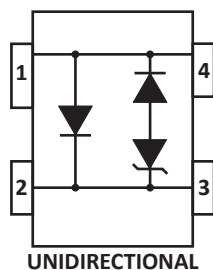
APPLICATIONS

- Ethernet - 10/100/1000 Base T
- Cellular Phones
- Audio/Video Inputs
- FireWire, SCSI & USB Interfaces

MECHANICAL CHARACTERISTICS

- Molded JEDEC SOT-143 Package
- Approximate Weight: 9 milligrams
- Lead-Free Pure-Tin Plating (Annealed)
- Solder Reflow Temperature:
Pure-Tin - Sn, 100: 260-270°C
- 8mm Tape and Reel Per EIA Standard 481
- Flammability Rating UL 94V-0

PIN CONFIGURATIONS



TYPICAL DEVICE CHARACTERISTICS

MAXIMUM RATINGS @ 25°C Unless Otherwise Specified

PARAMETER	SYMBOL	VALUE	UNITS
Operating Temperature	T_J	-55 to 150	°C
Storage Temperature	T_{STG}	-55 to 150	°C
Peak Pulse Power ($t_p = 8/20\mu s$) - See Figure 1	P_{PP}	350	Watts
Power Dissipation	P_d	400	mW
Thermal Resistance Junction to Ambient (Note 1)	$R_{\theta JA}$	312	°C/W
Thermal Resistance Junction to Case	$R_{\theta JC}$	250	°C/W

NOTE

Device mounted on a FR-4 PCB with the minimum suggested pad layout.

ELECTRICAL CHARACTERISTICS PER LINE @ 25°C Unless Otherwise Specified

PART NUMBER (Notes 1 - 2)	DEVICE MARKING	RATED STAND-OFF VOLTAGE V_{WM} VOLTS	MINIMUM BREAKDOWN VOLTAGE @ 1mA $V_{(BR)}$ VOLTS	MAXIMUM CLAMPING VOLTAGE (Fig. 2) @ $I_p = 5A$ V_c VOLTS	MAXIMUM CLAMPING VOLTAGE (See Fig. 2) @ 8/20 μs $V_c @ I_{PP}$ VOLTS	MAXIMUM LEAKAGE CURRENT @ V_{WM} I_D μA	TYPICAL CAPACITANCE @ 0V, 1MHz C pF
USB0403	3U	3.3	4.0	9.0	19.0V @ 20.0A	125	5
USB0403C	3B	3.3	4.0	9.0	19.0V @ 20.0A	125	5
USB0405	5U	5.0	6.0	11.0	18.3V @ 17.0A	20	5
USB0405C	5B	5.0	6.0	11.0	18.3V @ 17.0A	20	5
USB0408	8U	8.0	8.5	16.6	18.5V @ 17.0A	10	5
USB0408C	8B	8.0	8.5	16.6	18.5V @ 17.0A	10	5
USB0412	12U	12.0	13.3	24.0	28.6V @ 11.0A	1	5
USB0412C	12B	12.0	13.3	24.0	28.6V @ 11.0A	1	5
USB0415	15U	15.0	16.6	30.0	31.8V @ 10.0A	1	5
USB0415C	15B	15.0	16.6	30.0	31.8V @ 10.0A	1	5
USB0424	24U	24.0	26.7	N/A	56.0V @ 6.0A	1	5
USB0424C	24B	24.0	26.7	N/A	56.0V @ 6.0A	1	5

NOTES

- Part numbers with an additional "C" suffix are bidirectional devices, i.e., USB0405C.
- Unidirectional Only: Positive potential is applied from pin 2 to 1 or pin 3 to 4.

TYPICAL DEVICE CHARACTERISTICS

FIGURE 1
PEAK PULSE POWER VS PULSE TIME

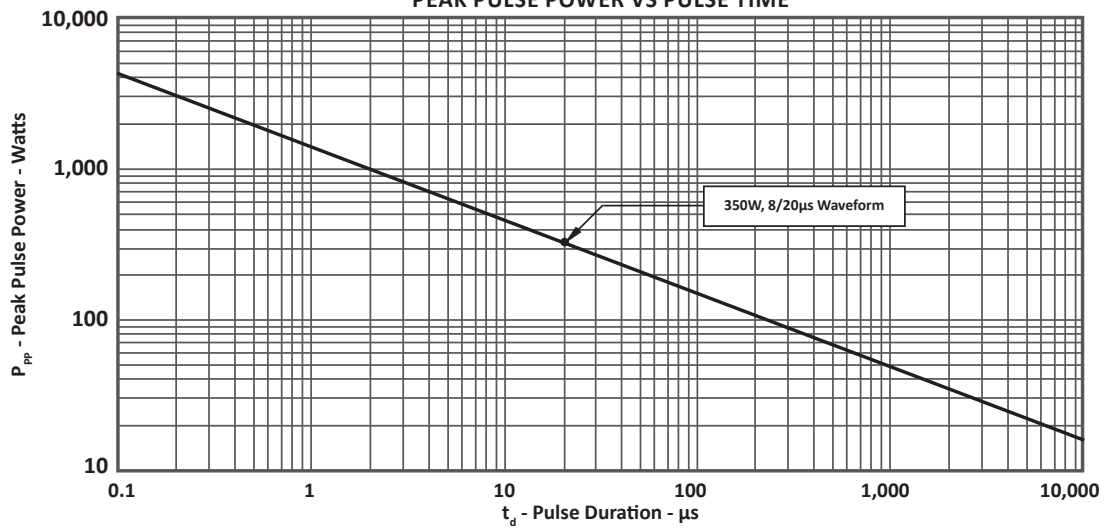


FIGURE 2
PULSE WAVE FORM

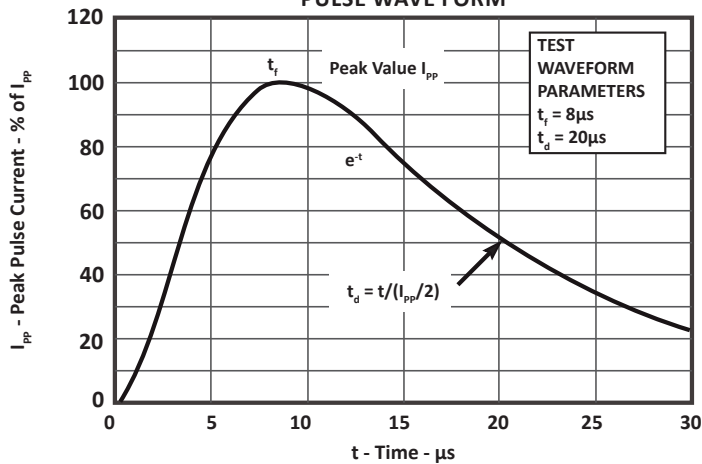
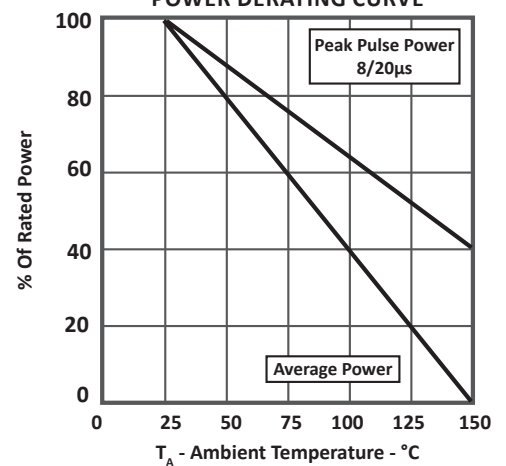


FIGURE 3
POWER DERATING CURVE



TYPICAL DEVICE CHARACTERISTICS

FIGURE 4
OVERSHOOT & CLAMPING VOLTAGE FOR USB0405C

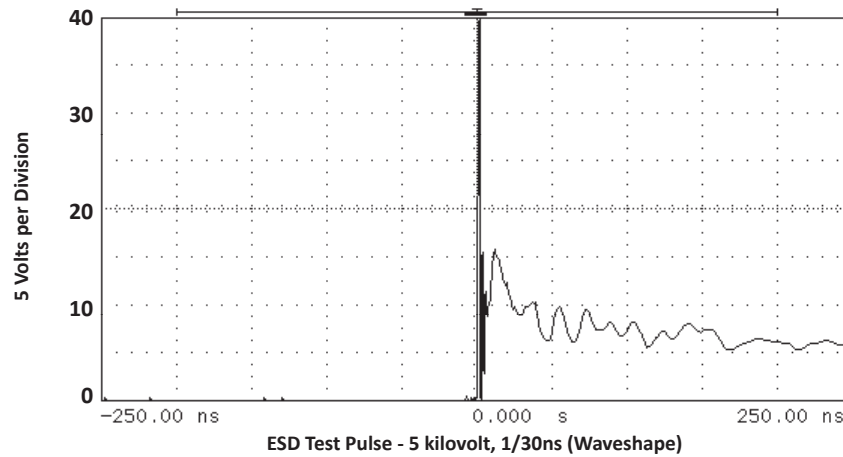


FIGURE 5
INSERTION LOSS - USB0405C

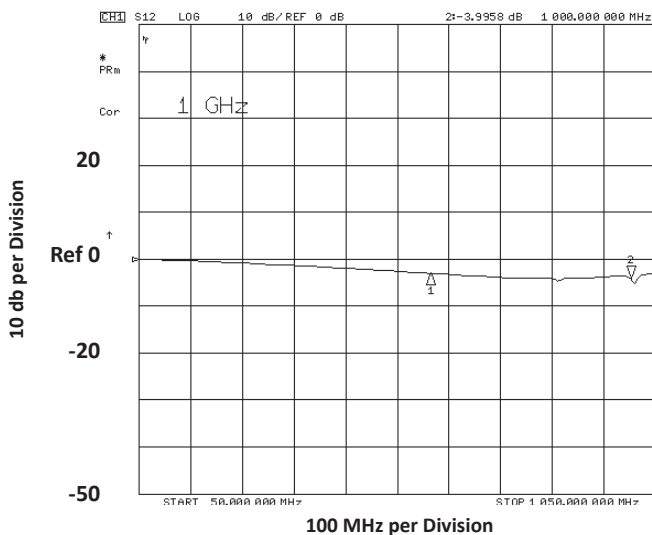
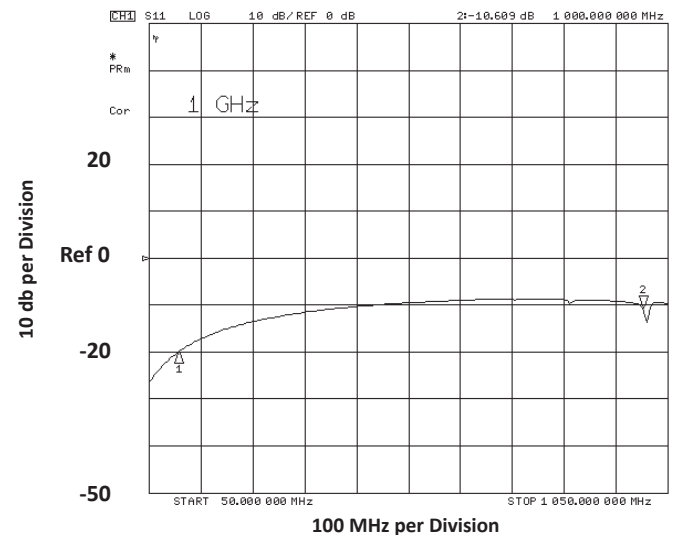
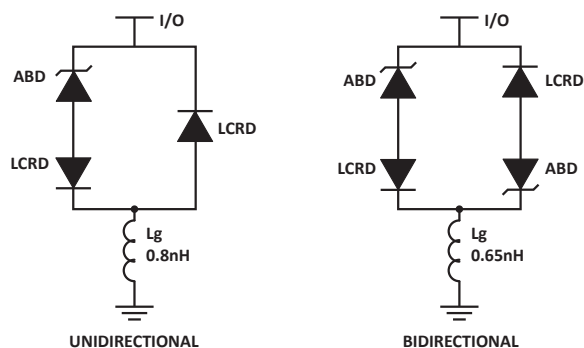


FIGURE 6
RETURN LOSS - USB0405C



SPICE MODEL

FIGURE 1
SPICE MODEL


ABD - Avalanche Breakdown Diode (TVS)
 LCRD: Low Capacitance Rectifier Diode
 Lg - Lead Inductance

TABLE 1 - SPICE PARAMETERS

PARAMETER	UNIT	ABD(TVS)	LCRD
BV	V	See Table 2	200
IBV	μA	1	0.01
C_{jo}	pF	See Table 2	5
I_s	A	See Table 2	1E-13
Vj	V	0.6	0.6
M	-	0.33	0.33
N	-	1	1
R_s	Ohms	See Table 2	0.31
TT	s	1E-8	1E-9
EG	eV	1.11	1.11

TABLE 2 - ABD SPECIFIC SPICE PARAMETERS

PART NUMBER	B_v (VOLTS)	C_{jo} (pF)	I_s (AMPS)	R_s (OHMS)
USB0403	4.5	200	1E-11	0.22
USB0405	6.0	140	1E-11	0.18
USB0408	8.5	67	1E-11	0.12
USB0412	13.3	55	1E-13	1.10
USB0415	16.7	47	1E-13	1.43
USB0424	26.7	28	1E-13	4.24
USB0403C	4.5	200	1E-11	0.22
USB0405C	6.0	140	1E-11	0.18
USB0408C	8.5	67	1E-11	0.12
USB0412C	13.3	55	1E-13	1.10
USB0415C	16.7	47	1E-13	1.43
USB0424C	26.7	28	1E-13	4.24

APPLICATION INFORMATION

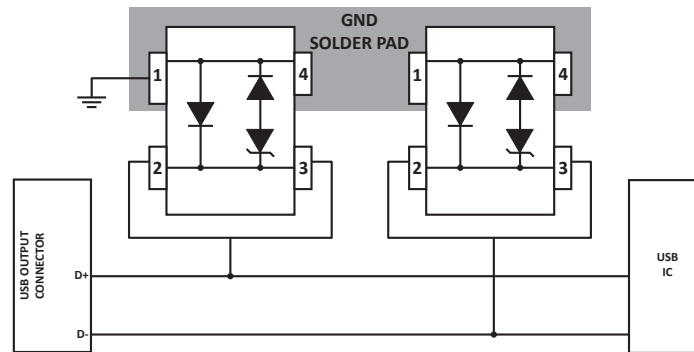


FIGURE 1 - USB PROTECTION

Two USB04xx (Unidirectional) in a Common-Mode configuration. Circuit connectivity is as follows:

- Device 1: Line 1(D+) is connected to pins 2 and 3.
- Device 2: Line 2(D-) is connected to pins 2 and 3.
- Device 1 and 2: Pins 1 and 4 connected to ground

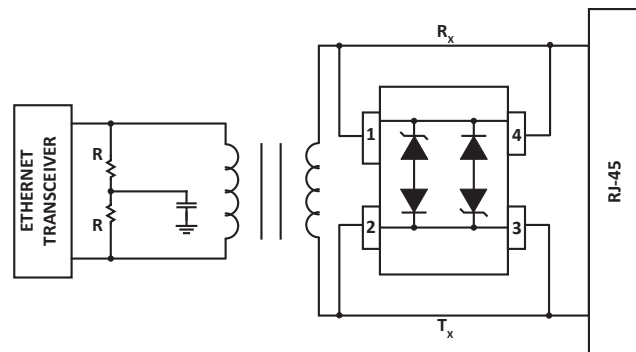


FIGURE 2 - ETHERNET PROTECTION

One USB04xxC (Bidirectional) in a Differential-Mode configuration. Circuit connectivity is as follow:

- Line 1 (R_x) is connected to pins 1 and 4.
- Line 2 (T_x) is connected to pins 2 and 3.

CIRCUIT BOARD RECOMMENDATIONS

Circuit board layout is critical for electromagnetic compatibility protection. The following guidelines are recommended:

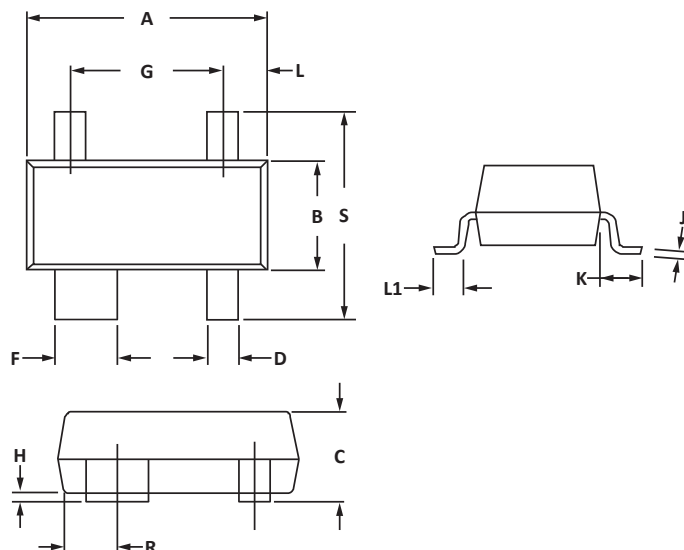
- The protection device should be placed near the input terminals or connectors, the device will divert the transient current immediately before it can be coupled into the nearby traces.
- The path length between the TVS device and the protected line should be minimized.
- All conductive loops including power and ground loops should be minimized.
- The transient current return path to ground should be kept as short as possible to reduce parasitic inductance.
- Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

SOT-143 PACKAGE INFORMATION

OUTLINE DIMENSIONS				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.80	3.04	0.110	0.120
B	1.20	1.39	0.047	0.055
C	0.84	1.14	0.033	0.045
D	0.39	0.50	0.015	0.020
F	0.79	0.93	0.031	0.037
G	1.78	2.03	0.070	0.080
J	0.08	0.15	0.003	0.006
K	0.46	0.60	0.018	0.024
L	0.445	0.60	0.0175	0.024
L1	0.40	0.60	0.016	0.024
R	0.72	0.83	0.028	0.033
S	2.11	2.48	0.083	0.098

NOTES

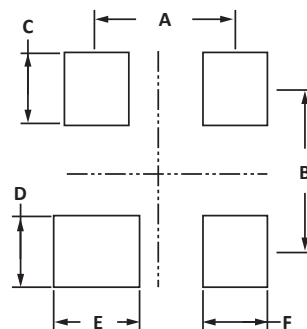
1. Dimensioning and tolerances per ANSI Y14.M, 1985.
2. Controlling dimension: inches.
3. Dimensions are exclusive of mold flash and metal burrs.



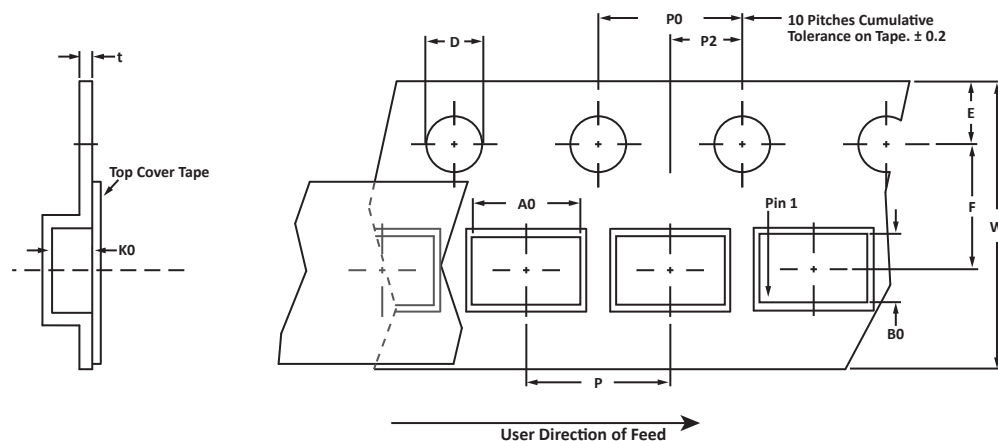
PAD LAYOUT DIMENSIONS				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.88	2.13	0.074	0.084
B	1.80	2.06	0.071	0.081
C	0.71	0.97	0.028	0.038
D	0.76	1.02	0.030	0.040
E	1.07	1.32	0.042	0.052
F	0.71	0.97	0.028	0.038

NOTES

1. Controlling dimension: inches.



TAPE AND REEL



SPECIFICATIONS

REEL DIA.	TAPE WIDTH	A0	B0	K0	D	E	F	W	P0	P2	P	tmax
178mm (7")	8mm	3.10 ± 0.10	2.70 ± 0.10	1.35 ± 0.10	1.50 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	8.00 ± 0.30	4.00 ± 0.10	2.00 ± 0.05	4.00 ± 0.10	0.25

NOTES

1. Dimensions are in millimeters.
2. Surface mount product is taped and reeled in accordance with EIA-481.
3. Suffix - T7 = 7" Reel - 3,000 pieces per 8mm tape.
4. Suffix - T13 = 13" Reel - 10,000 pieces per 8mm tape.
5. Marking on Part - marking code (see page 2) and date code.

ORDERING INFORMATION

BASE PART NUMBER (xx = Voltage)	LEADFREE SUFFIX	TAPE SUFFIX	QTY/REEL	REEL SIZE	TUBE QTY
USB04xx/USB04xxC	-LF	-T7	3000	7"	n/a
USB04xx/USB04xxC	-LF	-T13	10,000	13"	n/a

This device is only available in a Lead-Free configuration.

COMPANY INFORMATION

COMPANY PROFILE

In business more than 25 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). ProTek Devices also offers LED wafer die for ESD protection and related high frequency products. ProTek Devices is ISO 9001:2015 certified.

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