

### APPLICATIONS

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

### IEC COMPATIBILITY (EN61000-4)

- ✓ 61000-4-2 (ESD): Air - 15kV, Contact - 8kV
- ✓ 61000-4-4 (EFT): 40A - 5/50ns
- ✓ 61000-4-5 (Surge): 12A, 8/20 $\mu$ s - Level 1(Line-Gnd) & Level 2(Line-Line)

### FEATURES

- ✓ 500 Watts Peak Pulse Power per Line ( $t_p=8/20\mu$ s)
- ✓ Unidirectional & Bidirectional Configurations
- ✓ Available in Multiple Voltage Types Ranging From 3V to 24V
- ✓ Protects One Line
- ✓ ESD Protection > 40 kilovolts
- ✓ Low Leakage
- ✓ Low Capacitance: 5pF per Line Pair
- ✓ RoHS Compliant in Lead-Free Versions

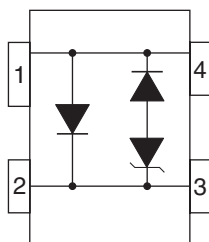
### MECHANICAL CHARACTERISTICS

- ✓ Molded JEDEC SOT-143 Package
- ✓ Weight 9 milligrams (Approximate)
- ✓ Available in Tin-Lead or Lead-Free Pure-Tin Plating(Annealed)
- ✓ Solder Reflow Temperature:
  - Tin-Lead - Sn/Pb, 85/15: 240-245°C
  - Pure-Tin - Sn, 100: 260-270°C
- ✓ Flammability Rating UL 94V-0
- ✓ 8mm Tape and Reel Per EIA Standard 481
- ✓ Marking: Marking Code

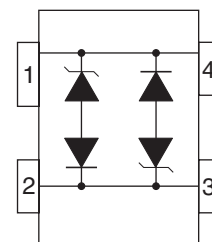


## PIN CONFIGURATIONS

UNIDIRECTIONAL



BIDIRECTIONAL



# USB0403 thru USB0424C

## DEVICE CHARACTERISTICS

### MAXIMUM RATINGS @ 25°C Unless Otherwise Specified

PARAMETER	SYMBOL	VALUE	UNITS
Peak Pulse Power ( $t_p = 8/20\mu s$ ) - See Figure 1	$P_{PP}$	500	Watts
Operating Temperature	$T_J$	-55°C to 150°C	°C
Storage Temperature	$T_{STG}$	-55°C to 150°C	°C

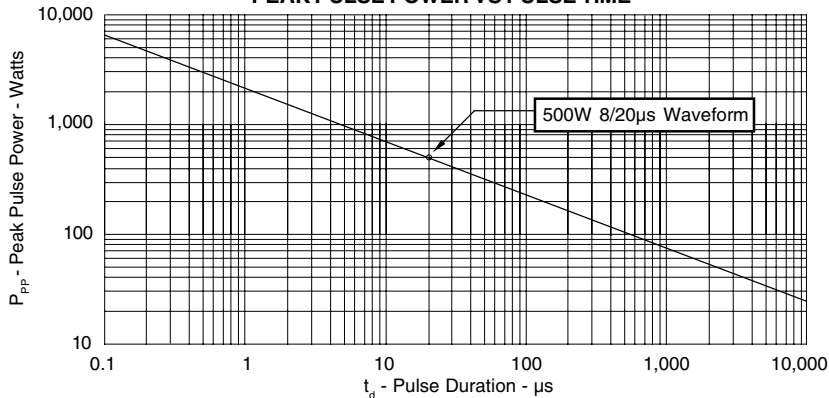
### ELECTRICAL CHARACTERISTICS PER LINE @ 25°C Unless Otherwise Specified

PART NUMBER (See Notes 1-2)	DEVICE MARKING	RATED STAND-OFF VOLTAGE  $V_{WM}$ VOLTS	MINIMUM BREAKDOWN VOLTAGE  @ 1mA $V_{(BR)}$ VOLTS	MAXIMUM CLAMPING VOLTAGE (See Fig. 2)  @ $I_p = 5A$ $V_C$ VOLTS	MAXIMUM CLAMPING VOLTAGE (See Fig. 2)  @ 8/20 $\mu s$ $V_C @ I_{PP}$	MAXIMUM LEAKAGE CURRENT  @ $V_{WM}$ $I_b$ $\mu A$	MAXIMUM CAPACITANCE  0V @ 1 MHz 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

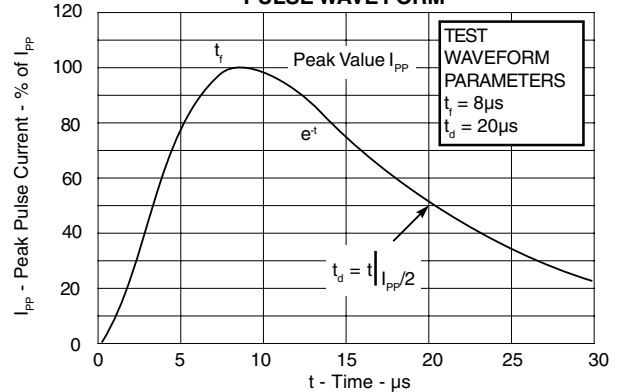
**Note 1:** Part numbers with an additional "C" suffix are bidirectional devices, i.e., USB0405C.

**Note 2:** *Unidirectional Only:* Positive potential is applied from pin 2 to 1 or pin 3 to 4.

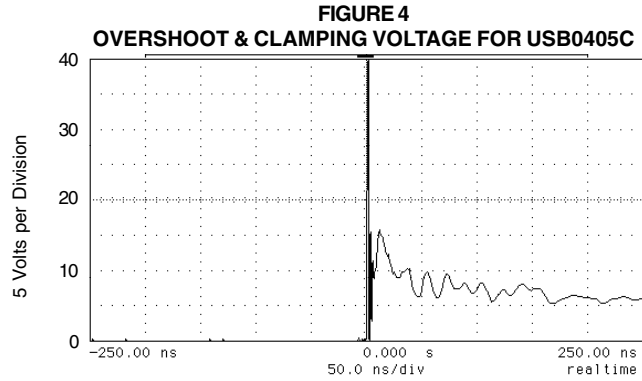
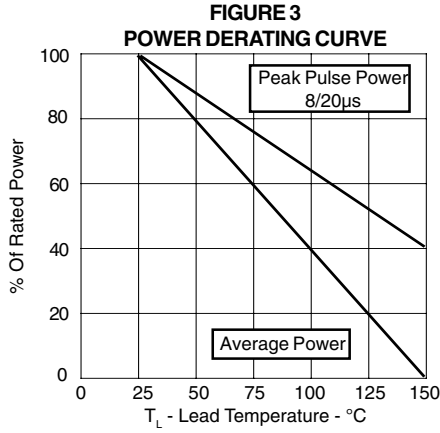
**FIGURE 1**  
PEAK PULSE POWER VS PULSE TIME



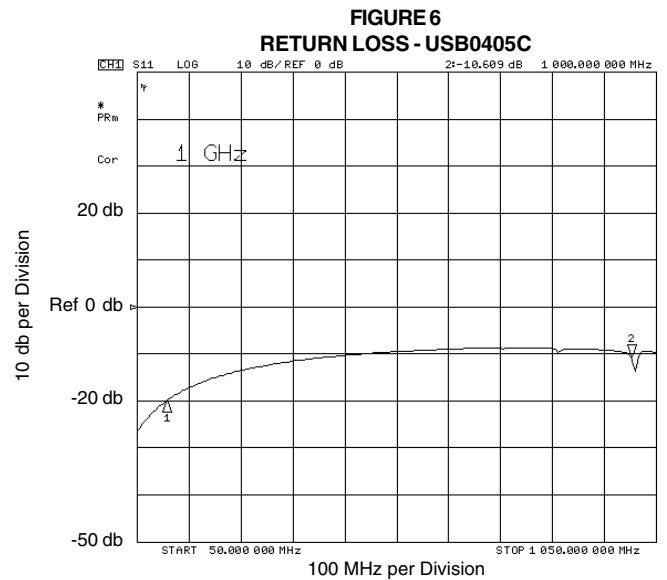
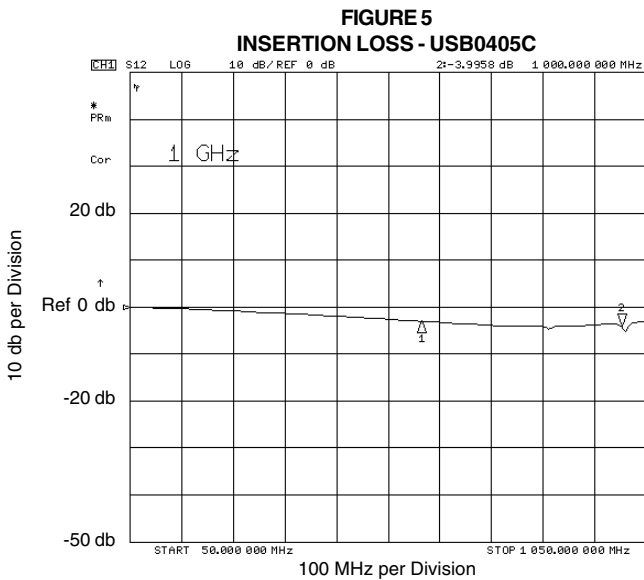
**FIGURE 2**  
PULSE WAVE FORM



## GRAPHS



ESD Test Pulse: 5 kilovolt, 1/30ns (waveform)



## APPLICATIONS

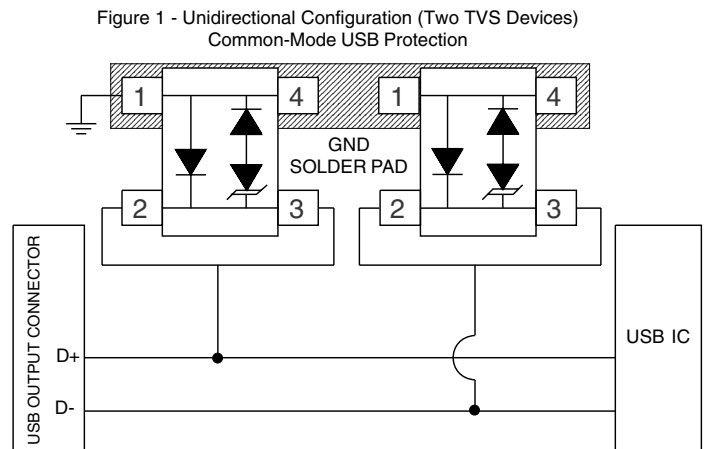
The USB04 Series are TVS arrays designed to protect I/O or data lines from the damaging effects of ESD and EFT. This product series provides both unidirectional and bidirectional protection, with a surge capability of 500 Watts  $P_{PP}$  per line for an 8/20 $\mu$ s waveform and ESD protection > 40kV.

### UNIDIRECTIONAL COMMON-MODE CONFIGURATION (Figure 1)

The two USB04 Series devices provide protection in a common-mode configuration as depicted in Figure 1.

Circuit connectivity is as follows:

- ✓ TVS Device 1: Line 1 (D+) is connected to Pins 2 & 3.
- ✓ TVS Device 2: Line 2 (D-) is connected to Pins 2 & 3.
- ✓ Both TVS Devices: Pins 1 & 4 connected to ground.



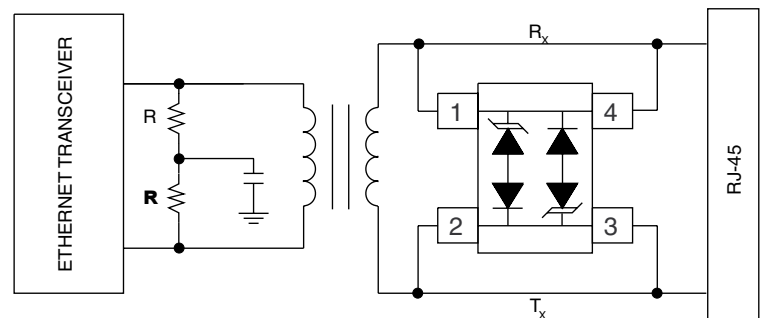
### BIDIRECTIONAL DIFFERENTIAL-MODE CONFIGURATION (Figure 2)

The USB04xxC Series provides protection in a differential-mode configuration as depicted in Figure 2.

Circuit connectivity is as follows:

- ✓ Line 1 ( $R_x$ ) is connected to Pins 1 & 4.
- ✓ Line 2 ( $T_x$ ) is connected to Pins 2 & 3.

Figure 2 - Bidirectional Configuration  
Differential-Mode Ethernet Protection



### CIRCUIT BOARD LAYOUT RECOMMENDATIONS

Circuit board layout is critical for Electromagnetic Compatibility (EMC) 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.

# USB0403 thru USB0424C

## SOT-143 PACKAGE OUTLINE & DIMENSIONS

PACKAGE OUTLINE		SOT-143			
PACKAGE 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	
H	0.013	0.10	0.0005	0.004	
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	
R	0.72	0.83	0.028	0.033	
S	2.11	2.48	0.083	0.098	

MOUNTING PAD				NOTES
TYPICAL				
DIM	Millimeters	Inches		
1	2.85	0.112		
2	2.00	0.079		
3	1.80	0.071		
4	1.90	0.075		
5	1.05	0.041		
6	2.75	0.108		
7	1.20	0.047		
8	0.80	0.031		
9	0.85	0.033		
10	0.85	0.033		
11	0.85	0.033		

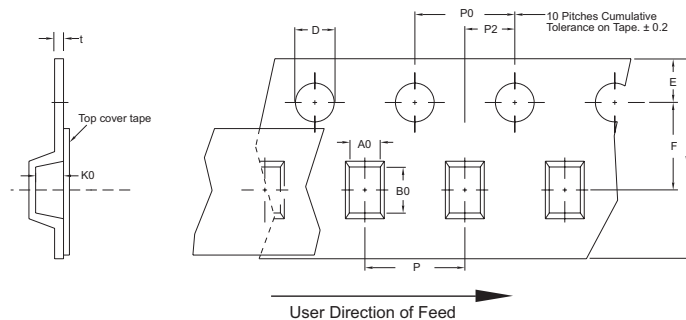
  

TAPES					NOTES	
DIM	Millimeters	Inches				
1	2.85	0.112			1. Dimensioning and tolerances per ANSI Y14.5M, 1985.	
2	2.00	0.079			2. Controlling Dimension: Inches	
3	1.80	0.071			3. Dimensions are exclusive of mold flash and metal burrs.	
<b>TAPE &amp; REEL ORDERING NOMENCLATURE</b>						
1. Surface mount product is taped and reeled in accordance with EIA-481.						
2. Suffix-T7 = 7 Inch Reel - 3,000 pieces per 8mm tape, i.e., <i>USB0405C-T7</i> .						
3. Suffix-T13 = 13 Inch Reel - 10,000 pieces per 8mm tape, i.e., <i>USB0405C-T13</i> .						
4. Suffix -LF = Lead-Free, Pure-Tin Plating, i.e., <i>USB0405C-LF-T7</i> .						

**Outline & Dimensions: Rev 2 - 6/06, 06011**

### Tape & Reel Specifications (Dimensions in millimeters)

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



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