

# TVS Diode Arrays

## Upstream USB Port Terminator with ESD Suppression & EMI Filtering

### SPUSB1 Series

The Littelfuse SPUSB1 Series is a multifunctional USB port protection network designed to provide ESD protection, EMI/RFI filtering and line termination for a single USB 1.1 port. The SPUSB1 can replace a minimum of ten typically larger “discrete” devices resulting in inventory and placement cost savings.

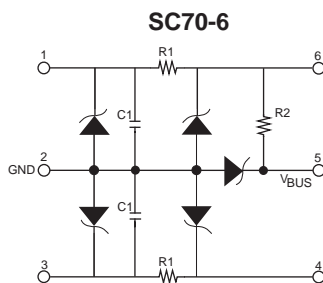
The SPUSB1 Series combines Transient Voltage Suppression (TVS) avalanche diodes, EMI/RFI filtering components (R1 and C1), and a 1.5kΩ termination resistor (R2). The filtering components are included to satisfy recommendations in the USB 1.1 specification, and the 1.5kΩ resistor (R2) is included as a pull-up resistor to VBUS.

The SPUSB1 Series can be used for termination and protection of “upstream” USB devices such as PDAs, digital cameras, scanners and hubs which are often at risk from transient voltage surges and electromagnetic interference from both internal and external sources.

To support a wide range of circuit conditions, Littelfuse offers three resistance values for the series resistor (R1). The series resistance plus the USB driver output resistance must be close to the USB cable’s characteristic impedance of 45Ω (90Ω balanced) to minimize transmission line reflections.



#### Circuit Diagram



#### Ordering Information

PART NUMBER	R1 (Ohm)	R2 (KOhm)	C1 (pF)	DEVICE BRAND	PKG TYPE	#/REEL
SPUSB1AJT	12	1.5	47	UFA	SC70-6	3000
SPUSB1BJT	22	1.5	47	UFB	SC70-6	3000
SPUSB1CJT	33	1.5	47	UFC	SC70-6	3000

#### Features

- One upstream USB port terminator, EMI filter and transient overvoltage protector in a single surface-mount package
- Compact SC70 package saves board space and lowers manufacturing costs compared to discrete solutions
- ESD protection to 30kV contact discharge per MIL-STD- 883D, method 3015
- ESD protection to 15kV contact discharge per IEC 61000-4-2 international standard

#### Applications

- Desktop/Laptop PCs
- USB peripherals (printers, scanners, zip drives)
- PDAs / wireless handsets
- Digital cameras
- MP3 Players
- Cable Modems

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Absolute Maximum Ratings		
Parameter	Rating	Unit
Supply Voltage $V_{BUS}$	5.5	V
DC Power per Resistor	100	mW
Package Power	200	mW
Temperature Range:		°C
Operating	-40 to +85	
Storage	-65 to +150	

Specifications (at 25°C unless specified otherwise)					
Standard	Parameter	MIN	TYP	MAX	Unit
	Resistance R1 (SPUSB1AJT only)	6%	12	14%	$\Omega$
	Resistance R1 (SPUSB1CJT only)	26%	33	40%	$\Omega$
	Resistance R1 (SPUSB1BJT only)	18%	22	26%	$\Omega$
	Resistance R2	1.2%	1.5	18%	k $\Omega$
	Capacitance C1 @ 2.5 v DC, 1MHz	38%	47	56%	pF
	Diode Leakage at 3.3V		1	100	nA
	Diode Reverse Bias Stand-off Voltage, $I = 10\mu A$	5.5			V
	Signal Clamp Voltage:				
	Positive Clamp, 10mA	5.6	6.8	8.0	V
	Negative Clamp, 10mA	-1.2	-0.8	-0.4	V
	In-system ESD Withstand Voltage <sup>(1)</sup>				
	Human Body Model (MIL-STD-883D, method 3015)	$\pm 30$			kV
	IEC 81000-4-2, contact discharge method (I/O pins)	$\pm 15$			kV
	IEC 81000-4-2, contact discharge method ( $V_{BUS}$ pin)	$\pm 25$			kV
	Clamping Voltage During ESD Discharge <sup>(1)</sup>				
	MIL-STD-883D (Method 3015), 8kV		10		V
			Negative	-5	V

Note:

(1) ESD applied to input/output  $V_{DD}$  pins with respect to GND, one at a time.

Clamping Voltage is measured at the opposite side of the EMI filter to the ESD pin (ie: if ESD is applied to pin1 then clamping voltage is measured at pin 6). Unused pins are open.

These parameters guaranteed by design.

### APPLICATIONS INFORMATION

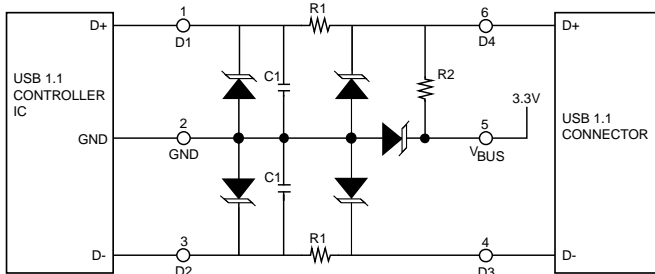


Figure 1. Full-Speed Devices (12Mbps per second)

For full speed operation the pull-up resistor R2 is connected to the D+ pin.

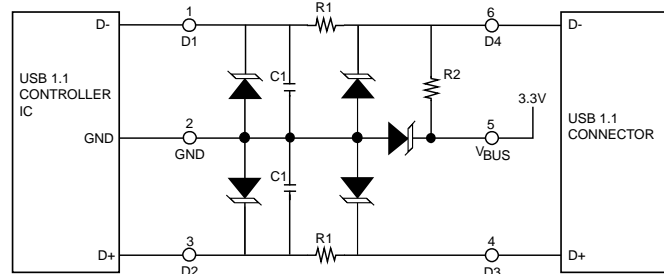


Figure 2. Low-Speed Devices (1.5Mbps per second)

Low speed connection requires the pull-up resistor R2 to be connected to the D- pin. Please note the reversal of the D- and D+ pins on Figure 2 versus Figure 1.

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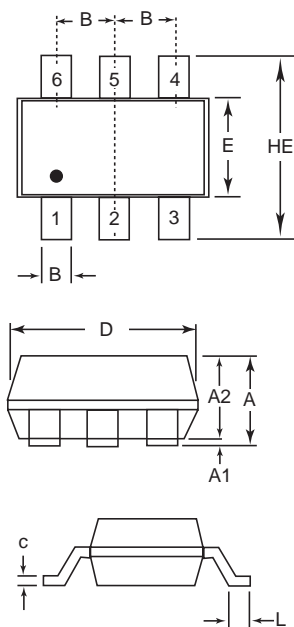
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## SPUSB1 Series

### PACKAGING INFORMATION

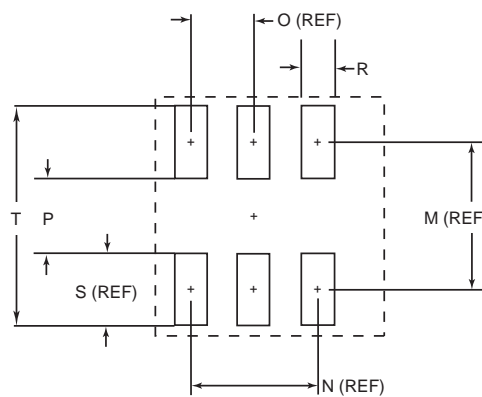
Mechanical Specifications	
Lead Plating	Tin-Lead
Lead Material	Copper Alloy
Lead Coplanarity	0.004 inches (0.102mm)
Substitute Material	Silicon
Body Material	Molded Epoxy
Flammability	UL94-V-0

### Outline Drawings



SPUSB1AJT - SC70-6  
 SPUSB1BJT - SC70-6  
 SPUSB1CJT - SC70-6

### Recommended Pad Layout



Package	SC70-6			
Pins	6			
JEDEC	MO-203 Issue A			
	mm		inches	
	min	max	min	max
<b>A</b>	0.80	1.10	0.031	0.043
<b>A1</b>	0.00	0.10	0.000	0.004
<b>A2</b>	0.70	1.00	0.028	0.039
<b>B</b>	0.15	0.30	0.006	0.012
<b>c</b>	0.08	0.25	0.003	0.010
<b>D</b>	1.85	2.25	0.073	0.089
<b>E</b>	1.15	1.35	0.045	0.053
<b>e</b>	0.65 BSC		0.026 BSC	
<b>HE</b>	2.00	2.40	0.079	0.094
<b>L</b>	0.26	0.46	0.010	0.018
<b>M</b>	-	1.60	-	0.063
<b>N</b>	-	1.30	-	0.052
<b>O</b>	-	0.65	-	0.026
<b>P</b>	-	0.70	-	0.058
<b>R</b>	-	0.35	-	0.014
<b>S</b>	-	0.90	-	0.035
<b>T</b>	-	2.50	-	0.098
<b>P<sub>D</sub>@70°C</b>	<b>0.2W</b>			
<b># / bag</b>	<b>1000 pcs</b>			
<b># / tape &amp; reel</b>	<b>3,000 pcs</b>			

\*See device brand for marking information.