



Upstream USB Port Terminator

Features

- One upstream USB port terminator, EMI filter and transient overvoltage protector in a single surface-mount package
- Compact SC70 or SOT23 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

- ESD protection and termination of USB port
- All USB peripherals (PC printers, scanners, zip drives, etc.)
- PDAs / handheld PCs
- Digital cameras
- Wireless Handsets
- MP3 Players
- Cable Modems

Product Description

The PACUSB-U1, PACUSB-U2, and PACUSB-U3 are single-channel USB upstream-port termination networks.

The PACUSB-U1/U2/U3 integrate EMI/RFI filter components R1 and C1, as recommended by the USB specification. Because these are upstream USB devices, they are terminated with a single 1.5k Ω pull-up resistor to V_{3.3} (R2).

There are three options for the value of the series resistor R1:

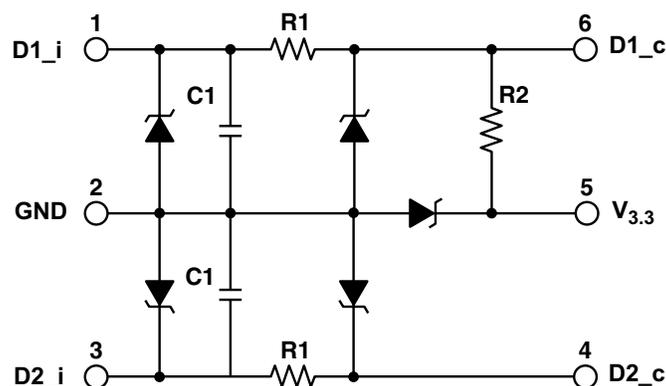
- For PACUSB-U1, R1=15 Ω
- For PACUSB-U2, R1=33 Ω
- For PACUSB-U3, R1=22 Ω

This series resistance plus the USB driver output resistance must be close to the USB cable's characteristic impedance of 45 Ω (90 Ω balanced) to minimize transmission line reflections.

In addition, these parts provide a very high level of protection for sensitive electronic components that may be subjected to electrostatic discharge (ESD). The input and output pins are designed and characterized to dissipate ESD strikes of 15kV safely, a level well beyond the maximum requirements of the IEC 61000-4-2 international standard.

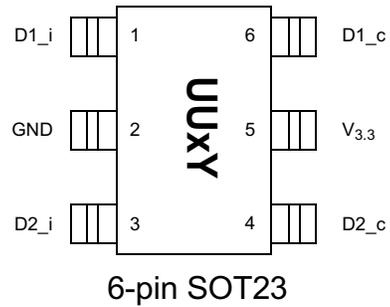
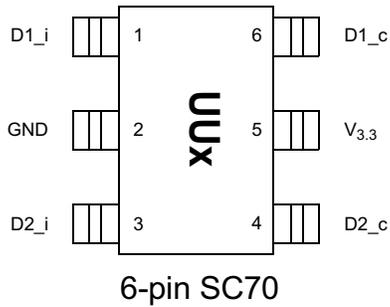
Using the MIL-STD-883D (Method 3015) specification for Human Body Model (HBM) ESD, all pins are protected for contact discharges to greater than 30kV.

Electrical Schematic





PACKAGE / PINOUT DIAGRAMS



Note: Drawings are not to scale.

PIN DESCRIPTIONS

PIN	NAME	DESCRIPTION
1	D1_i	The USB Controller side of the D+ or D- bidirectional transmission line of the differential pair defined by USB standards.
2	GND	The ground reference for the PACUSB-U1/U2/U3 device.
3	D2_i	The USB Controller side of the D- or D+ bidirectional transmission line of the differential pair defined by USB standards.
4	D2_c	The connector side of the D- or D+ bidirectional transmission line of the differential pair defined by USB standards.
5	V _{3.3}	The 3.3V supply voltage for the PACUSB-U1/U2/U3 device.
6	D1_c	The connector side of the D+ or D- bidirectional transmission line of the differential pair defined by USB standards.

Ordering Information

STANDARD VALUES

Part Designator	R1 Value (Ω)
PACUSB-U1	15
PACUSB-U2	33
PACUSB-U3	22

**Ordering Information (continued)**

PART NUMBERING INFORMATION				
R1 Value (Ω)	Pins	Package	Ordering Part Number¹	Part Marking
15	6	SC70-6	PACUSBU1	UU1
15	6	SOT23-6	PACUSBU1Y6	UU1Y
33	6	SC70-6	PACUSBU2	UU2
33	6	SOT23-6	PACUSBU2Y6	UU2Y
22	6	SC70-6	PACUSBU3	UU3
22	6	SOT23-6	PACUSBU3Y6	UU3Y

Note 1: Parts are shipped in Tape & Reel form unless otherwise specified.

Specifications

ABSOLUTE MAXIMUM RATINGS		
PARAMETER	RATING	UNITS
V _{3.3} (Supply Voltage)	5.5	V
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-65 to +150	°C
DC Power to Resistor	100	mW
Package Power	200	mW

STANDARD OPERATING CONDITIONS		
PARAMETER	RATING	UNITS
V _{3.3} (Supply Voltage)	3.3	V
Ambient Operating Temperature	-40 to +85	°C



Specifications (continued)

ELECTRICAL OPERATING CHARACTERISTICS						
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
R1	Resistance R1 (PACUSB-U1 only)	Measured at 25°C	-20%	15	+20%	Ω
R1	Resistance R1 (PACUSB-U2 only)	Measured at 25°C	-20%	33	+20%	Ω
R1	Resistance R1 (PACUSB-U3 only)	Measured at 25°C	-20%	22	+20%	Ω
R2	Resistance R2	Measured at 25°C	-20%	1.5k	+20%	Ω
C1	Capacitance C1	Measured at 1 MHz, 2.5VDC, 25°C	-20%	47	+20%	pF
I _{LEAK}	Diode Leakage	At 3.3VDC and 25°C		1	100	nA
V _{D1}	Diode Reverse-biased Stand-off Voltage	I = 10μA, 25°C	5.5			V
V _{D2}	Signal Clamp Voltage Positive Clamp Negative Clamp	@ 10mA, 25°C @ 10mA, 25°C	5.6 -1.2	6.8 -0.8	8.0 -0.4	V V
V _{ESD}	In-system ESD Withstand Voltage Human Body Model, MIL-STD-883, Method 3015 IEC 61000-4-2, contact discharge method (I/O pins) IEC 61000-4-2, contact discharge method (V _{3,3} pin)	Notes 1,2 Notes 1,2 Notes 1,2	±30 ±15 ±25			kV kV kV
V _{CLAMP}	Clamping Voltage during ESD Discharge Positive Negative	MIL-STD-883, Method 3015, 8kV; Notes 1,2		10 -5		V V

Note 1: ESD applied to input/output/V_{3,3} 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 (i.e., if ESD is applied to pin 1, then clamping voltage is measured at pin 6). Unused pins are open.

Note 2: These parameters guaranteed by design.

Application Information

The PACUSB-U1/U2/U3 is targeted for upstream USB ports (peripherals). It provides series termination, EMI filtering, and ESD protection for the two USB data lines D+ and D-.

The USB Specification revision 1.1 provides for two data rates:

- The Full Speed signaling bit rate at 12 Mbps per second, and
- The Low Speed signaling bit rate at 1.5 Mbps per second.

The speed is selected by connecting one of the data lines (D+ or D-) through the 1.5kΩ pull-up resistor (R2) to a 3.3V supply voltage.

Connections for Full Speed Operation

Full Speed devices have the pull-up resistor (R2) connected to the D+ data line, as shown in Figure 1. Pin 1 is tied to the D+ line of the USB controller. Pin 6 is connected to D+ line on the USB connector.

Connections for Low Speed Operation

Low Speed devices have the pull-up resistor (R2) connected to the D- data line, as shown in Figure 2. Pin 1 is tied to the D- line of the USB controller; pin 6 is connected to the D- line on the USB connector.

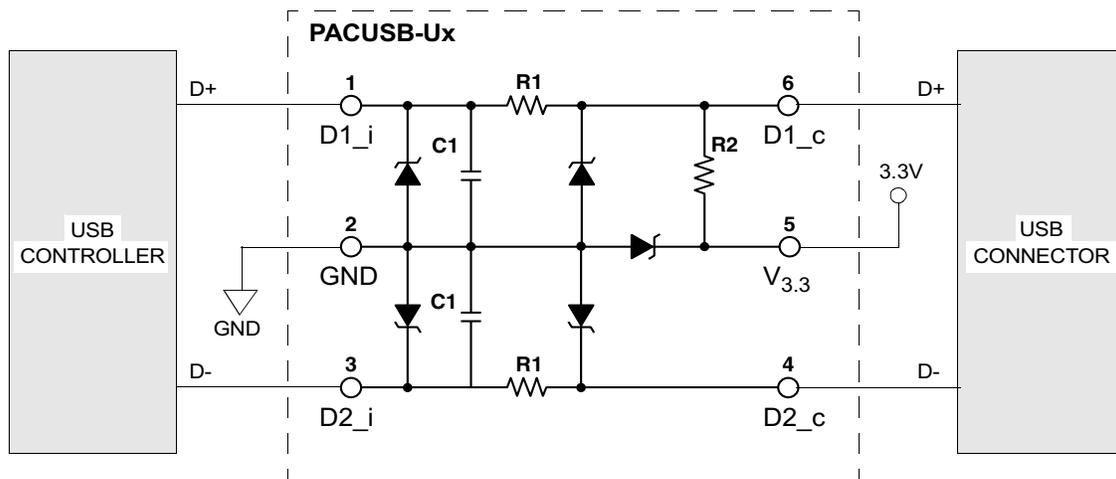


Figure 1. Full Speed Connection

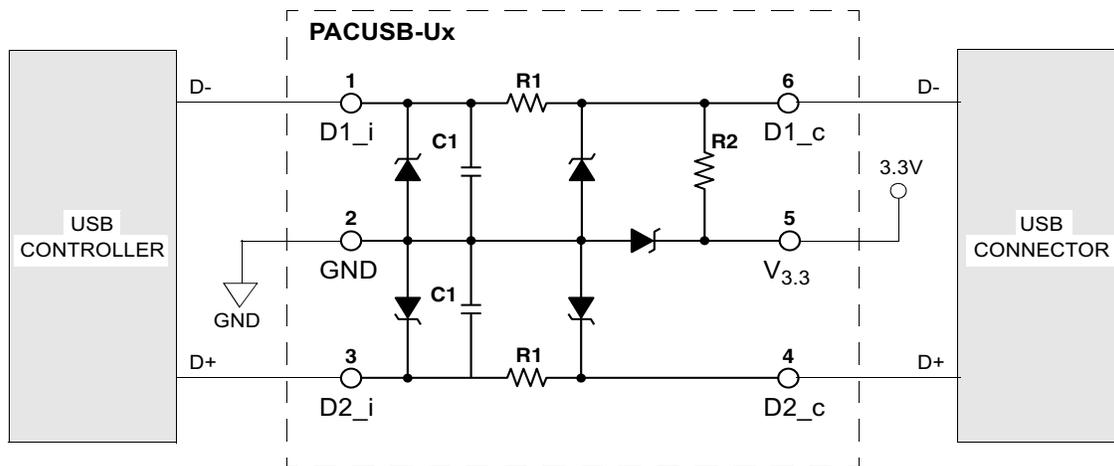


Figure 2. Low Speed Connection



Mechanical Details

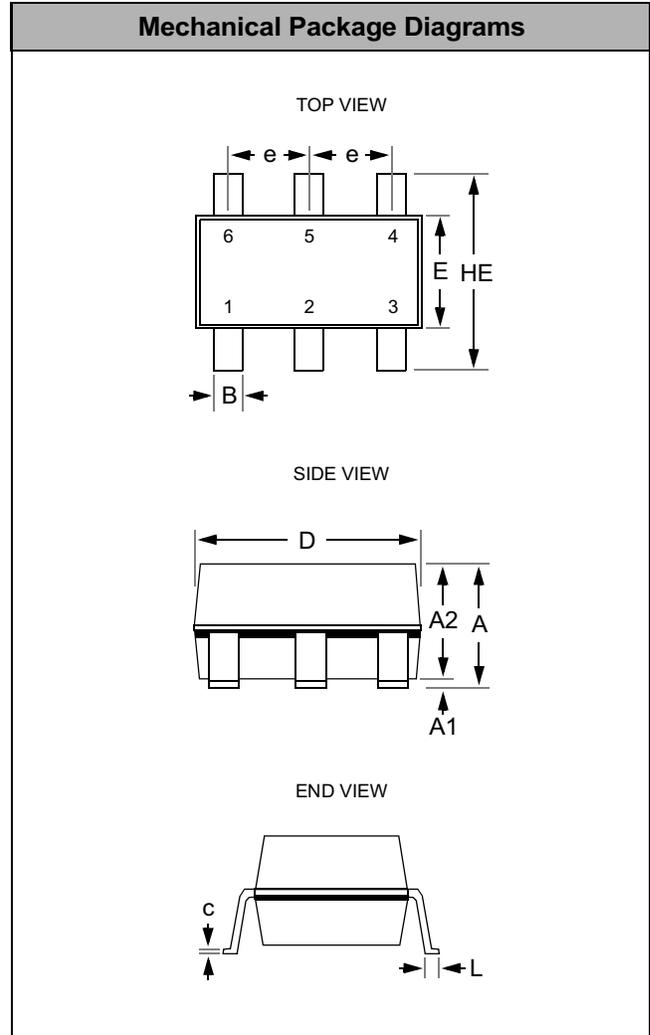
PACUSB-U1/U2/U3 devices are packaged in 6-pin SC70 and 6-pin SOT23 packages.

SC70 Mechanical Specifications

Dimensions for PACUSB-U1/U2/U3 devices packaged in SC70-6 packages are presented below.

For complete information on the SC70 package, see the California Micro Devices SC70 Package Information document.

PACKAGE DIMENSIONS		
Package	MO-203 Issue A	
Pins	6	
Dimensions	Millimeters	
	Min	Max
A	0.80	1.10
A1	0.00	0.10
A2	0.70	1.00
B	0.15	0.30
c	0.08	0.25
D	1.85	2.25
E	1.15	1.35
e	0.65 BSC	
HE	2.00	2.40
L	0.26	0.46
# per tape and reel	3000 pcs	



Package Dimensions for SC70-6.



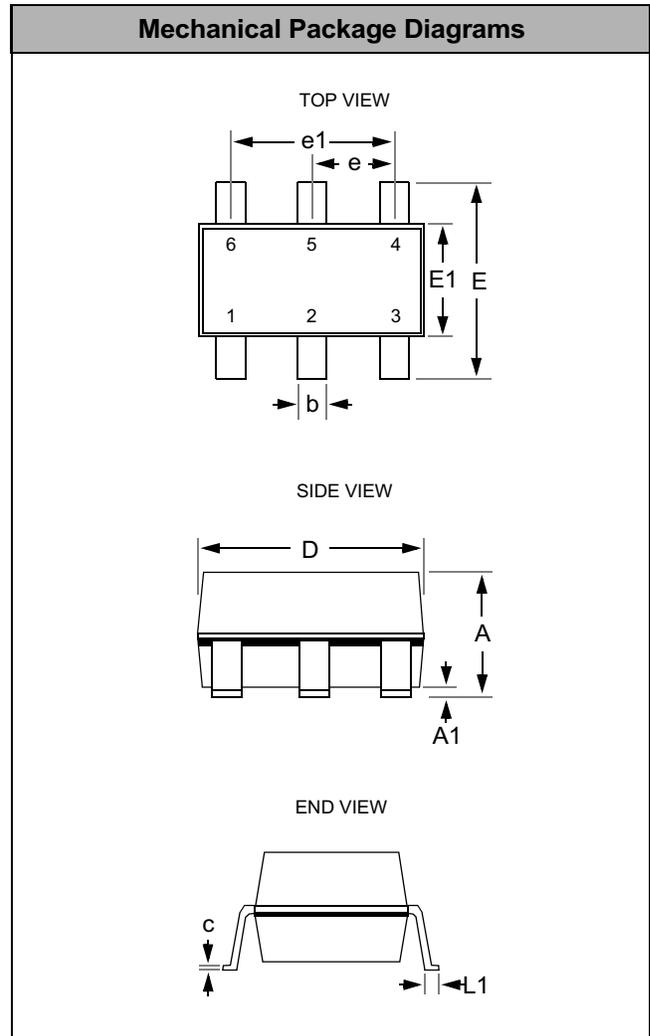
Mechanical Details (continued)

SOT23 Mechanical Specifications

Dimensions for PACUSB-U1/U2/U3 devices packaged in SOT23-6 packages are presented below.

For complete information on the SOT23 package, see the California Micro Devices SOT23 Package Information document.

PACKAGE DIMENSIONS				
Package	MO-178			
Pins	6			
Dimensions	Millimeters		Inches	
	Min	Max	Min	Max
A	--	1.45	--	0.057
A1	0.00	0.15	0.000	0.006
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.75	3.05	0.108	0.120
E	2.60	3.00	0.102	0.118
E1	1.45	1.75	0.057	0.069
e	0.95 BSC		0.0374 BSC	
e1	1.90 BSC		0.0748 BSC	
L	0.60 REF		0.0236 REF	
# per tape and reel	3000 pcs			
Controlling dimension: inches				



Package Dimensions for SOT23-6.