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
- Lead-free version available

Applications

- ESD protection and termination of USB port
- All USB peripherals (PC printers, scanners, zip drives, etc.)
- PDAs / handheld PCs
- Digital cameras
- Wireless Handets
- 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 1.5kΩ pull-up resistor to $V_{3.3}$ (R2).

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

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

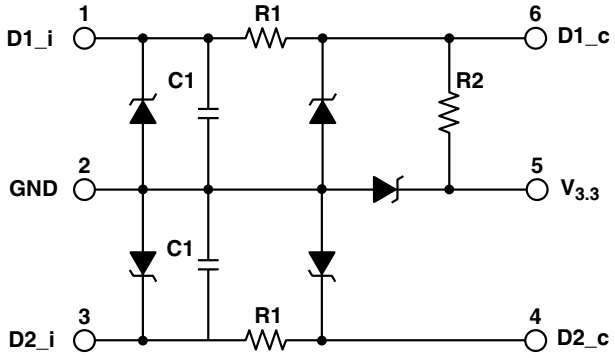
This series resistance plus the USB driver output resistance must be close to the USB cable's characteristic impedance of 45Ω (90Ω balanced) to minimize transmission line reflections.

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.

The PACUSB-U1/U2/U3 is housed in either a 6-pin SC70 or 6-pin SOT23 package and is available with optional lead-free finishing.

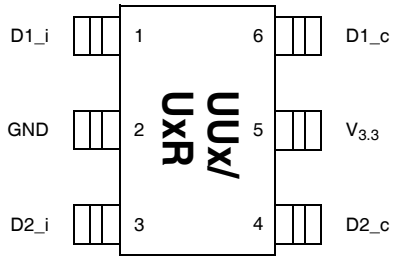
Electrical Schematic



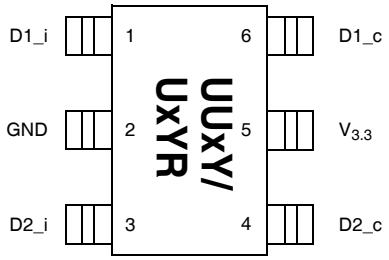
i = input
c = connector

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PACKAGE / PINOUT DIAGRAMS



6-pin SC70



6-pin SOT23

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

PART NUMBERING INFORMATION

			Standard FInish		Lead-free Finish	
R1 Value (Ω)	Pins	Package	Ordering Part Number[1]	Part Marking	Ordering Part Number[1]	Part Marking
15	6	SC70-6	PACUSB-U1	UU1	PACUSB-U1R	U1R
15	6	SOT23-6	PACUSB-U1Y6	UU1Y	PACUSB-U1Y6R	U1YR
33	6	SC70-6	PACUSB-U2	UU2	PACUSB-U2R	U2R
33	6	SOT23-6	PACUSB-U2Y6	UU2Y	PACUSB-U2Y6R	U2YR
22	6	SC70-6	PACUSB-U3	UU3	PACUSB-U3R	U3R
22	6	SOT23-6	PACUSB-U3Y6	UU3Y	PACUSB-U3Y6R	U3YR

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

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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

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Specifications (con't)

ELECTRICAL OPERATING CHARACTERISTICS						
SYMBOL	**PARAMETER**	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNITS**
R1	Resistance R1 (PACUSB-U1 only)	Measured at T_A = 25°C	12	15	18	Ω
R1	Resistance R1 (PACUSB-U2 only)	Measured at T_A = 25°C	26	33	40	Ω
R1	Resistance R1 (PACUSB-U3 only)	Measured at T_A = 25°C	18	22	26	Ω
R2	Resistance R2	Measured at T_A = 25°C	1.2	1.5	1.8	kΩ
C1	Capacitance C1	Measured at 1 MHz, 2.5VDC, T_A =25°C	38	47	56	pF
I_{LEAK}	Diode Leakage Current to GND	At 3.3VDC and T_A = 25°C		1	100	nA
V_{D1}	Diode Reverse-biased Stand-off Voltage	I = 10μA,T_A = 25°C	5.5			V
V_{D2}	Signal Clamp Voltage Positive Clamp Negative Clamp	 @ 10mA, T_A = 25°C @ 10mA, T_A = 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.

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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 Mbits per second, and
- The Low Speed signaling bit rate at 1.5 Mbits per second.

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

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. Pin1 is tied to the D+ line of the USB controller. Pin 6 is connected to the 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.

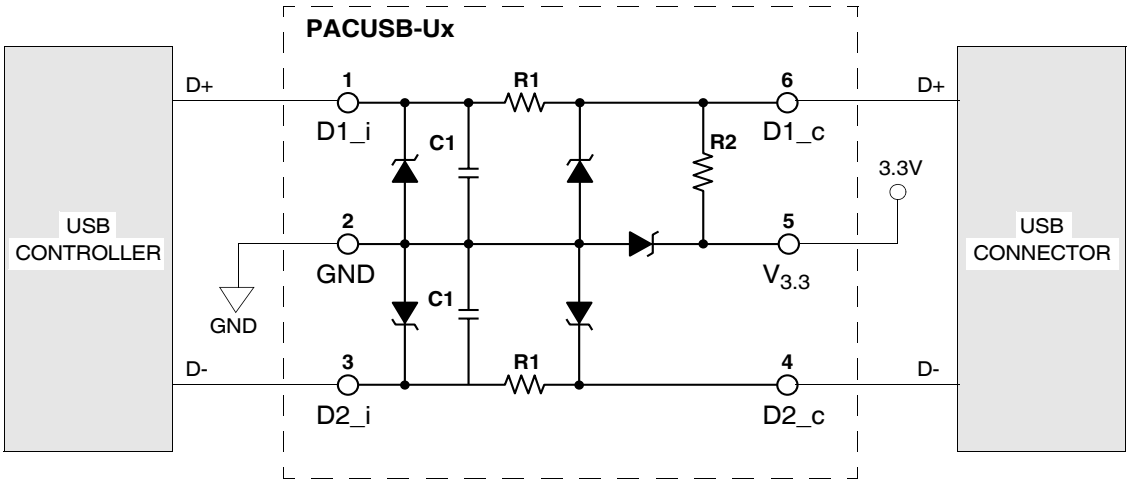


Figure 1. Full Speed Connection

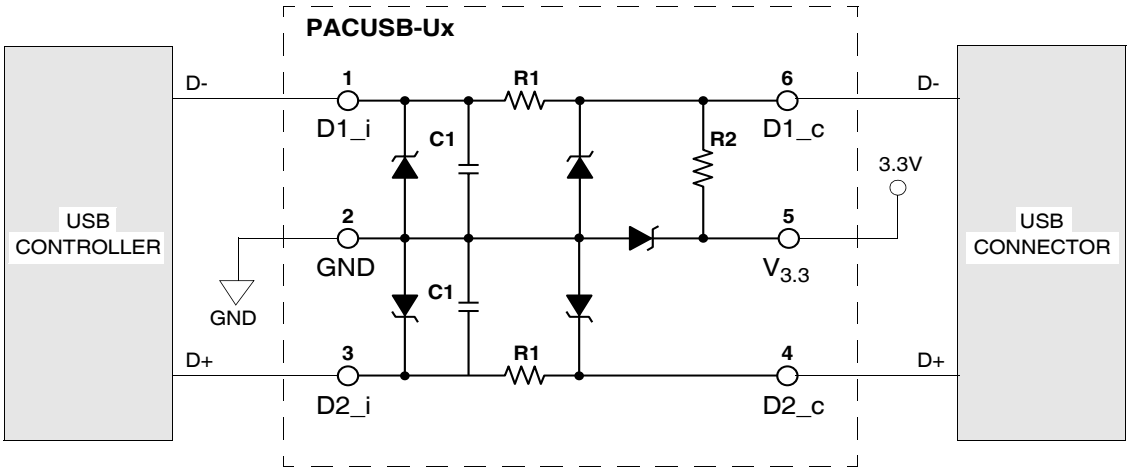


Figure 2. Low Speed Connection

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Mechanical Details

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

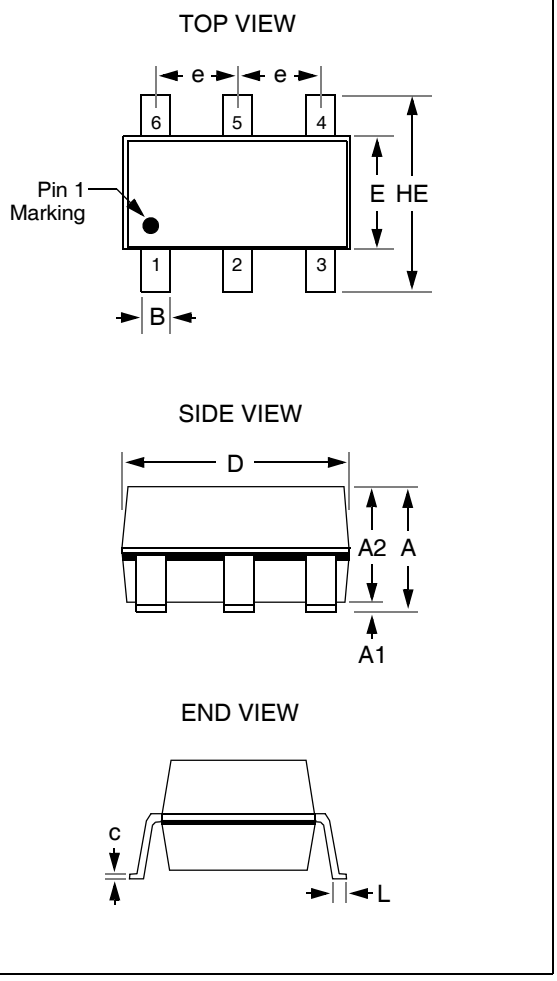
SC70 Mechanical Specifications

Dimensions for the PACUSB-U1/U2/U3 supplied in a SC70-6 package are presented below.

For complete information on the SC70, 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	

Mechanical Package Diagrams



Package Dimensions for SC70-6.

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Mechanical Details (continued)

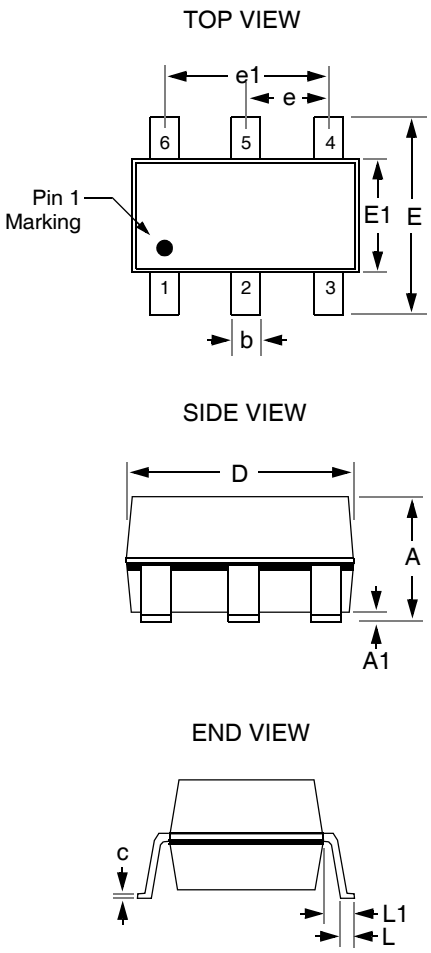
SOT23 Mechanical Specifications

Dimensions for the PACUSB-U1/U2/U3 supplied in a SOT23-6 package are presented below.

For complete information on the SOT23 , 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				

Mechanical Package Diagrams



Package Dimensions for SOT23-6.

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