



THE DATASHEET OF PACUSB1Y5





PACUSB-D1/D2/D3

Features

- A low-capacitance USB downstream port terminator, EMI filter, and transient over-voltage (ESD) protector in a single surface-mounted package
- ESD protection to $\pm 20\text{kV}$ contact discharge, per MIL-STD-883D, Method 3015
- ESD protection to $\pm 15\text{kV}$ contact discharge, per IEC 61000-4-2 International Standard
- Compact SOT23-5 and SC70-5 package options save board space and lower manufacturing costs compared to discrete solutions
- Capacitors matched to a precision exceeding the USB specification
- Pin-compatible with ST Microelectronics USBDFxxW5 USB Downstream Port Terminator
- Lead-free versions available

Applications

- ESD protection and termination of USB downstream ports
- Desktop PCs
- Notebooks
- Set-top boxes
- USB hubs

Product Description

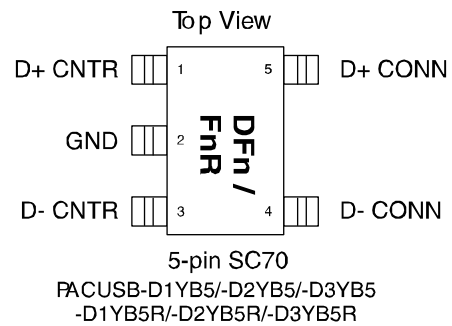
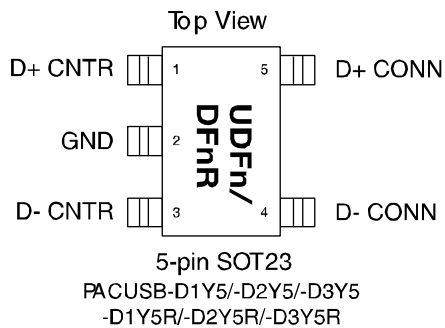
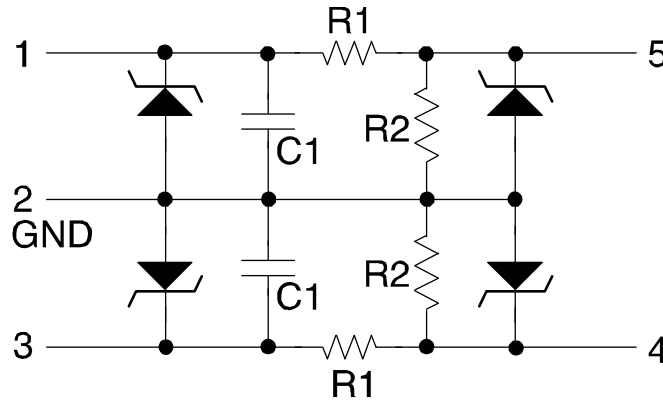
The PACUSB-D1/D2/D3 is a single-channel USB downstream-port termination network. It integrates EMI/RFI filter components R1 and C1, as recommended by the USB specification as well as the required 15k Ω pull-down resistors (R2) to GND. In addition, PACUSB-D1/D2/D3 provides a very high level of protection for sensitive electronic components that may be subjected to electrostatic discharge (ESD). The device pins will safely dissipate ESD strikes of $+15\text{kV}$, exceeding 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 from contact discharges to $+20\text{kV}$.

There are three options for the value of the series resistor R1: 15 Ω , 22 Ω , and 33 Ω . This series resistance, plus the USB driver output resistance, must be close to the USB cable's characteristic impedance of 45 Ω (each side) to minimize transmission line reflections.

The PACUSB-D1/D2/D3 is manufactured in a 5-pin SC70 or a 5-pin SOT23 package and is available with optional lead-free finishing..

PACUSB-D1/D2/D3

Electrical Schematic



Note 1: The "n" shown in part markings above represents either the digit "1," "2," or "3."

Note 2: SOT23 and SC70 package sizes may differ. These drawings are not to scale.

PIN DESCRIPTIONS

| PINS | NAME | DESCRIPTION |
|------|---------|---|
| 1 | D+ CNTR | D+ Data to the USB controller circuitry |
| 2 | GND | Ground Pin |
| 3 | D- CNTR | D- Data to the USB controller circuitry |
| 4 | D- CONN | D- Data to the USB connector |
| 5 | D+ CONN | D+ Data to the USB connector |

Ordering Information

| PART NUMBERING INFORMATION | | | | | | |
|----------------------------|----------|---------|-----------------------------------|--------------|-----------------------------------|--------------|
| Pins | R1 Value | Package | Standard Finish | | Lead-free Finish | |
| | | | Ordering Part Number ¹ | Part Marking | Ordering Part Number ¹ | Part Marking |
| 5 | 15 Ω | SOT23-5 | PACUSB-D2Y5 | UDF2 | PACUSB-D2Y5R | DF2R |
| | 22 Ω | | PACUSB-D3Y5 | UDF3 | PACUSB-D3Y5R | DF3R |
| | 33 Ω | | PACUSB-D1Y5 | UDF1 | PACUSB-D1Y5R | DF1R |
| 5 | 15 Ω | SC70-5 | PACUSB-D2YB5 | DF2 | PACUSB-D2YB5R | F2R |
| | 22 Ω | | PACUSB-D3YB5 | DF3 | PACUSB-D3YB5R | F3R |
| | 33 Ω | | PACUSB-D1YB5 | DF1 | PACUSB-D1YB5R | F1R |

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

Specifications

| ABSOLUTE MAXIMUM RATINGS | | |
|--------------------------------|-------------|-------|
| PARAMETER | RATING | UNITS |
| Storage Temperature Range | -65 to +150 | °C |
| Power Dissipation per Resistor | 100 | mW |
| Package Power Dissipation | 200 | mW |
| Voltage on any pin (DC) | 6 | V |

| STANDARD OPERATING CONDITIONS | | |
|-------------------------------|------------|-------|
| PARAMETER | RATING | UNITS |
| Operating Temperature | -40 to +85 | °C |

PACUSB-D1/D2/D3

ELECTRICAL OPERATING CHARACTERISTICS (SEE NOTE 1)

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------|---|---|----------|------------|---------|-----------------------|
| R1 | Resistance of R1 Resistor (PACUSB-D2Y5/Y5R, -D2YB5/YB5R) | $T_A = 25^\circ\text{C}$ | 12 | 15 | 18 | Ω |
| R1 | Resistance of R1 Resistor (PACUSB-D3Y5/Y5R, -D3YB5/YB5R) | $T_A = 25^\circ\text{C}$ | 17.6 | 22 | 26.4 | Ω |
| R1 | Resistance of R1 Resistor (PACUSB-D1Y5/Y5R, -D1YB5/YB5R) | $T_A = 25^\circ\text{C}$ | 26.4 | 33 | 39.6 | Ω |
| R2 | Resistance of R2 Resistor | $T_A = 25^\circ\text{C}$ | | 15 | | $k\Omega$ |
| TCR | Temperature Coefficient of Resistance | Note 1 | | ± 1300 | | ppm/ $^\circ\text{C}$ |
| C1 | Capacitance of C1 Capacitor | 0 VDC; 30 mVAC; 1MHz; 25°C | 37.6 | 47 | 56.4 | pF |
| | | 2.5 VDC; 30 mVAC; 1MHz; 25°C | 25.6 | 32 | 38.4 | pF |
| TOL _{CM} | Matching Tolerance of C1 Capacitors | 1MHz; 25°C | | | ± 2 | % |
| I _{LEAK} | Diode Leakage Current to GND | Measured at 3.3 VDC, 25°C | | 1 | 100 | nA |
| V _{RB} | Diode Reverse Bias Voltage | I _{LOAD} = 10 μA ; $T_A = 25^\circ\text{C}$ | 5.5 | | | V |
| V _{SIG} | Signal Voltage: Positive Clamp Negative Clamp | I _{LOAD} = 10mA; $T_A = 25^\circ\text{C}$ | 5.6 | 6.8 | 9.0 | V |
| | | I _{LOAD} = 10mA; $T_A = 25^\circ\text{C}$ | -0.4 | -0.8 | -1.5 | V |
| V _{ESD} | In-system ESD Withstand Voltage MIL-STD-883D, Method 3015 (HBM) IEC 61000-4-2 Contact Discharge | Pins 1, 3; Notes 2 and 3 | ± 4 | | | kV |
| | | Pins 4, 5; Note 2 | ± 20 | | | kV |
| | | Pins 4, 5; Notes 2 | ± 15 | | | kV |
| V _{CL} | Clamping voltage under ESD discharge | MIL-STD-883D, Method 3015 +8kV; Note 4 | | 12 | | V |
| | | MIL-STD-883D, Method 3015 - 8kV; Note 4 | | -7 | | V |

Note 1: Electrical operating characteristics guaranteed over standard operating conditions unless specified otherwise.

Note 2: ESD voltage applied to pins with respect to GND, one at a time; unused pins are left open.

Note 3: Pins 1 and 3 are not connected to the USB port connector, and therefore are not exposed to external ESD hazards. Thus, they do not require the high ESD protection levels provided for pins 4 and 5.

Note 4: ESD Clamping Voltage is measured at the opposite end of R1 from the pin to which the ESD discharge is applied (e.g., if ESD is applied to pin 6, then the clamping voltage is measured at pin 1).

Performance Information

Capacitance vs. Voltage

The C1 capacitance value as a function of DC voltage across it is presented in [Figure 1](#). The curve is normalized to a capacitance of 1.0 capacitance units at 2.5 VDC.

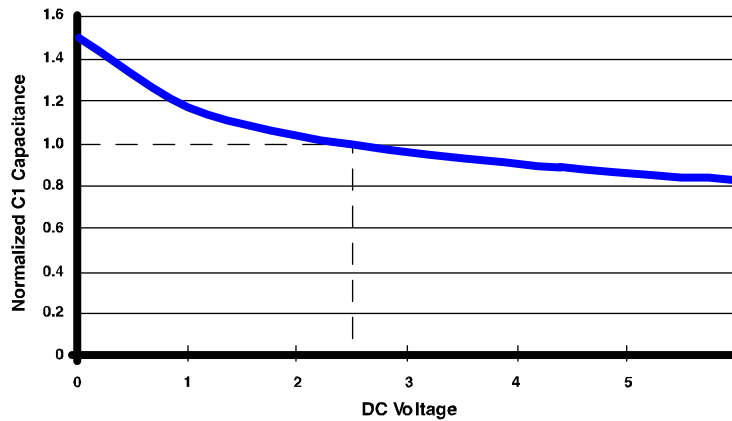


Figure 1. Diode Capacitance vs. DC Voltage (Normalized)

Insertion Loss vs. Frequency Characteristics

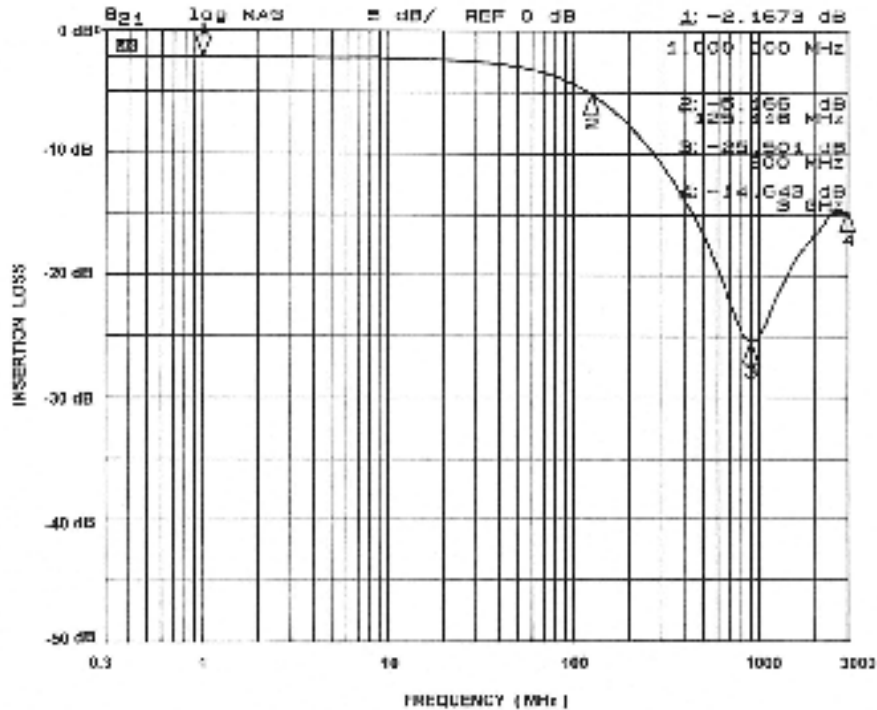


Figure 2. Insertion Loss vs. Frequency Performance Curve, PACUSB-D1(SOT23-6)

PACUSB-D1/D2/D3

Performance Information (cont'd)

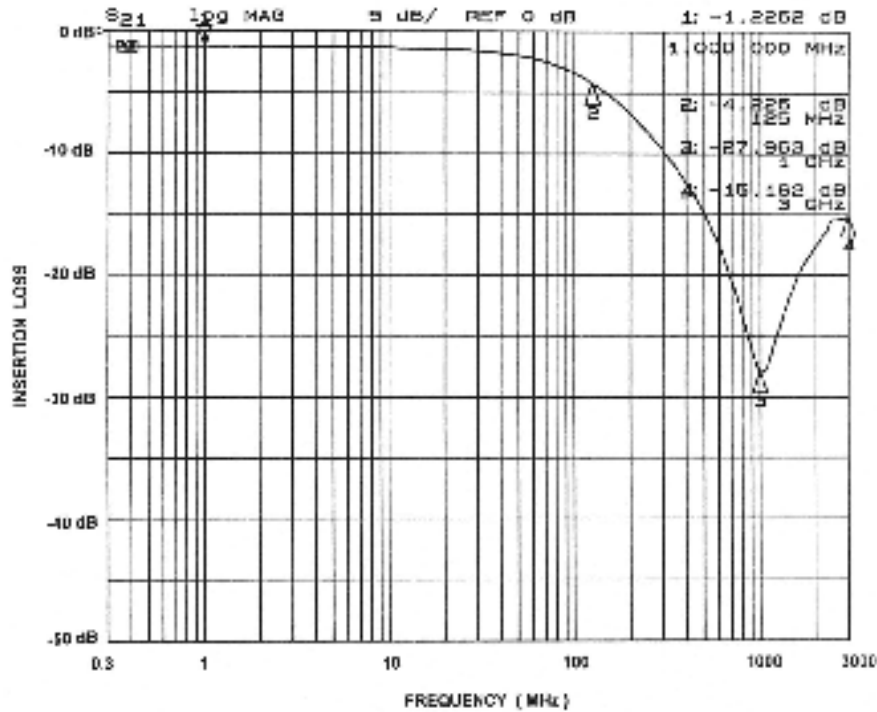
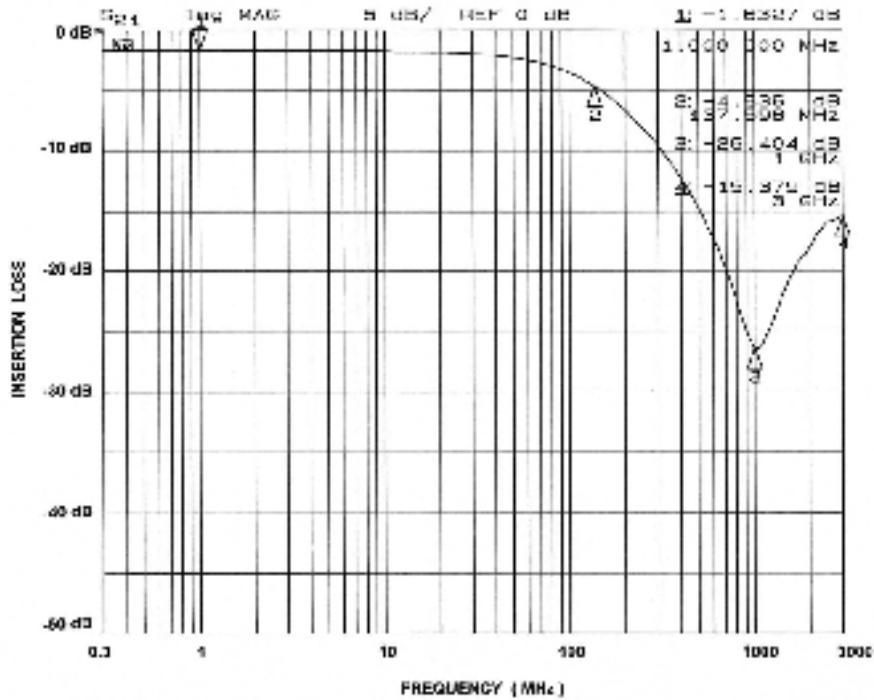


Figure 3. Insertion Loss vs. Frequency Performance Curve, PACUSB-D2(SOT23-)



6)

Figure 4. Insertion Loss vs. Frequency Performance Curve, PACUSB-D3(SOT23-6)

Application Information

The PACUSB-D1/D2/D3 provides a complete interface for a single downstream USB port typically found in computers and USB hubs. It integrates the series resistors (R1) and the 15kΩ pull-down resistors (R2) for both USB data lines (D+ and D-) as well as the capacitors to ground for EMI suppression. Zener diodes provide ESD protection up to 15kV contact discharge per the IEC 61000-4-2 standard and protect the USB controller on both data lines.

The PACUSB-D1/D2/D3 should be placed on the PCB between the USB controller and the USB connector, as shown on the Connection Diagram, Figure 5.

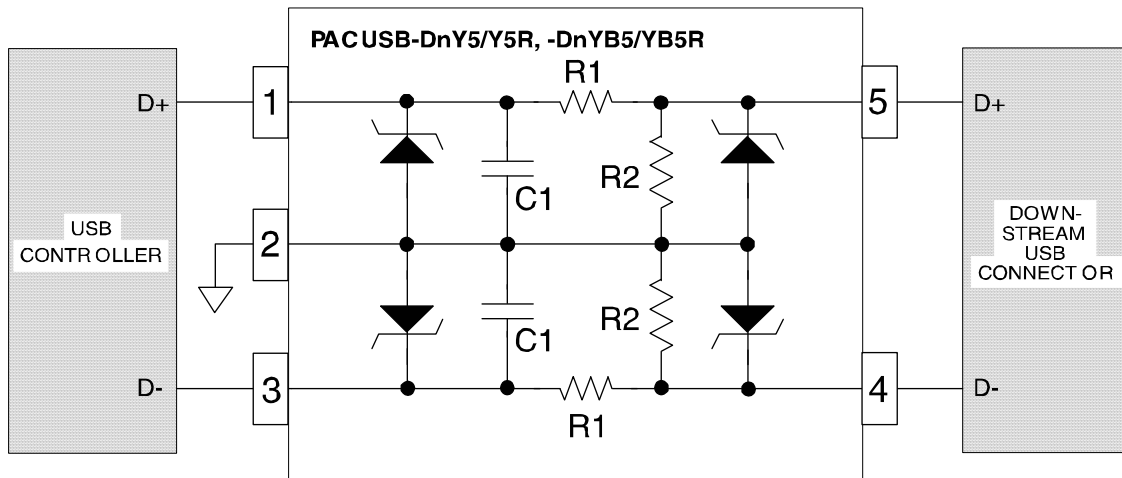


Figure 5. Connection Diagram for PACUSB-D1/D2/D3 Devices

To guarantee the best ESD and filtering performance, it is recommended to physically locate the PACUSB-D1/D2/D3 close to the USB connector. Also, the trace lengths between the PACUSB-D1/D2/D3 and the USB controller should be kept as short as possible.

PACUSB-D1/D2/D3

Mechanical Details

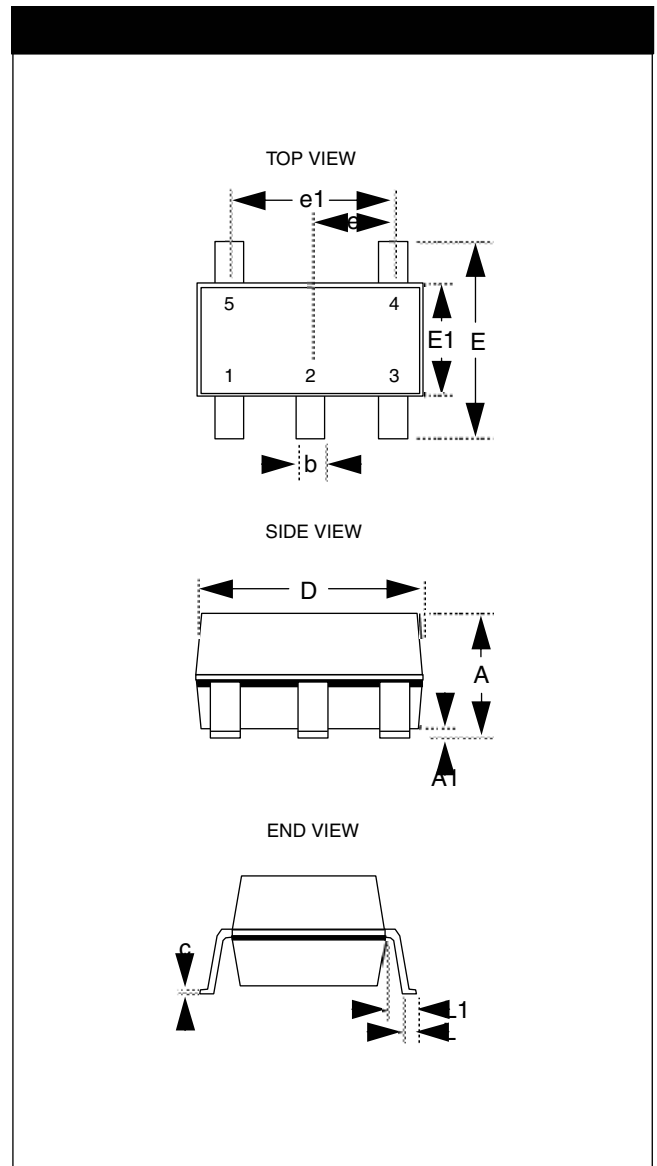
PACUSB-D1/D2/D3 devices are packaged in SOT23-5 and SC70-5 packages.

SOT23-5 Mechanical Specifications:

Dimensions for PACUSB-D1/D2/D3 devices packaged in a 5-pin SOT23 package are presented below. For complete information on the SOT23-5 package, see the California Micro Devices SOT23 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|------------------------------------|--------------------------------|------|------------|-------|
| Package | SOT23-5 (JEDEC name is MO-178) | | | |
| Pins | 5 | | | |
| 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 | 0.30 | 0.60 | 0.0236 | 0.024 |
| L1 | 0.60 REF | | 0.024 REF | |
| # per tape and reel | 3000 pieces* | | | |
| Controlling dimension: millimeters | | | | |

* This is an approximate amount which may vary.



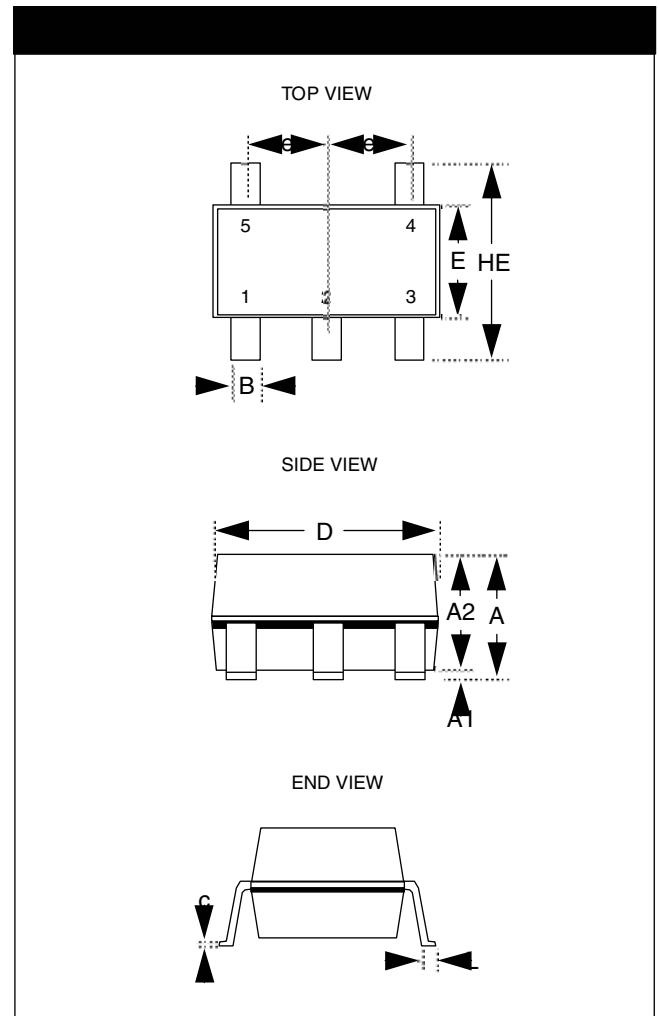
Package Dimensions for SOT23-5.

Mechanical Details (continued)

SC70-5 Mechanical Specifications:

Dimensions for PACUSB-D1/D2/D3 devices packaged in a 5-pin SC70 package are presented below. For complete information on the SC70-5 package, see the California Micro Devices SC70 Package Information document.


| PACKAGE DIMENSIONS | | |
|--------------------|--|------|
| Package | SC70-5 (JEDEC name is MO-203 Issue A) | |
| Pins | 5 | |
| 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 |
| # / bag | 1000 pieces* | |
| # / tape and reel | 3000 pieces* | |



Package Dimensions for SC70-5.

* This is an approximate amount which may vary.

PACUSB-D1/D2/D3

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855
Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View PACUSBD1Y5 on WIN SOURCE](#)

 [ON Semiconductor](#) Information

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management