

Low Voltage SPDT Analog Switch 2:1 Mux/Demux Bus Switch

Description

The DIODES PI5A3157B is a high-bandwidth, fast single-pole double-throw (SPDT) CMOS switch. It can be used as an analog switch or as a low-delay bus switch. Specified over a wide operating power supply voltage range, 1.65V to 5.5V, the PI5A3157B has a maximum ON resistance of 12Ω at 1.65V, 9Ω at 2.3V & 6Ω at 4.5V.

Break-before-make switching prevents both switches being enabled simultaneously. This eliminates signal disruption during switching.

The control input, S, is independent of supply voltage.

PI5A3157B is an improved direct replacement for the NC7SB3157.

Application(s)

- Cell Phones
- PDAs
- MP3 Players
- Portable Instrumentation
- Battery Powered Communications
- Computer Peripherals

Features

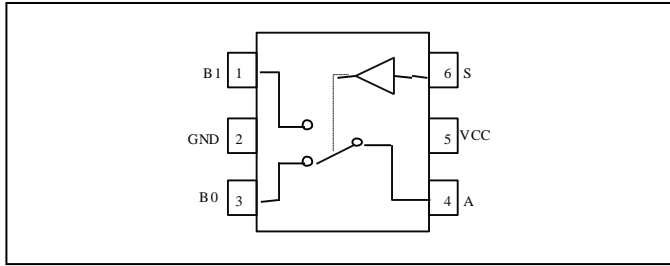
- CMOS Technology for Bus and Analog Applications
- Low On-Resistance: 8Ω at 3.0V
- Wide VCC Range: 1.65V to 5.5V
- Rail-to-Rail Signal Range
- Control Input Overvoltage Tolerance: 5.5V
- Fast Transition Speed: 2ns at 5.0V
- High Off Isolation: -63dB @ 10MHz
- Break-Before-Make Switching
- High Bandwidth: 350MHz
- Extended Industrial Temperature Range: -40°C to 85°C
- The PI5A3157B is an improved direct replacement for the NC7SB3157
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](#) or your local Diodes representative.
<https://www.diodes.com/quality/product-definitions/>
- Packaging (Pb-free & Green):
 - 6-pin, X1DFN 1mm×1mm (XDB)
 - 6-pin, SC70 (C6) (Not Recommended for New Design)
 - 6-Pin, SC70 (C)

Notes:

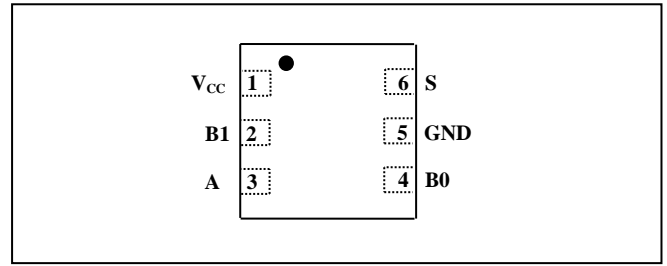
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Pin Configuration

Top Transparent View



SC70



X1DFN

Pin Description

| Pin# | | Pin Name | Description |
|------|-------|----------|--------------------------------|
| SC70 | X1DFN | | |
| 1 | 2 | B1 | Data Port |
| 2 | 5 | GND | Ground |
| 3 | 4 | B0 | Data Port (Normally connected) |
| 4 | 3 | A | Common Output/Data Port |
| 5 | 1 | VCC | Positive Power Supply |
| 6 | 6 | S | Logic Control |

Logic Function Table

| Logic Inputs(S) | Function |
|-----------------|-----------------------------|
| 0 | B ₀ connect to A |
| 1 | B ₁ connect to A |

Maximum Ratings

| | |
|---|------------------------|
| Storage Temperature..... | -65°C to +150°C |
| Ambient Temperature with Power Applied..... | -40°C to +85°C |
| Supply Voltage V_{CC} | -0.5V to +7.0V |
| DC Control Input Voltage V_S | -0.5V to +7.0V |
| DC Input Voltage V_{IN} | -0.5V to $V_{CC}+0.5V$ |
| DC Output Current V_{OUT} | 128mA |
| DC V_{CC} or Ground Current I_{CC} / I_{GND} | $\pm 100mA$ |
| Maximum Junction Temperature..... | 125°C |
| Junction Lead Temperature (TL) (Soldering, 10 seconds) | 260°C |
| Power Dissipation (Pd) @ +85°C | 180mW |
| ESD (HBM)..... | 2000V |

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|------|----------|------|
| V_{CC} | Operating Voltage | | 1.65 | | 5.5 | V |
| V_S | Control Input Voltage | | 0 | | 5.5 | V |
| V_{IN} | Switch Input Voltage | | 0 | | V_{CC} | V |
| V_{OUT} | Output Voltage | | 0 | | V_{CC} | V |
| T_A | Operating Temperature | | -40 | 25 | 85 | °C |
| T_s | | | | | | |
| tr, tf | Input Rise and Fall Time | Control Input $V_{CC} = 2.3V$ to $3.6V$ | 0 | | 10 | ns/V |
| | | Control Input $V_{CC} = 4.5V$ to $5.5V$ | 0 | | 5 | ns/V |

Note: Control input must be held HIGH or LOW; it must not float.

DC Electrical Characteristics

($T_A = -40^\circ C$ to $85^\circ C$, unless otherwise noted.)

| Parameter | Description | Test Conditions | Temperature ($T_A:^\circ C$) | Min. | Typ. | Max. | Units |
|--|-------------------------------|--|--------------------------------|-------------------------------|------|----------|----------|
| V_{IAR} | Analog Input Signal Range | V_{CC} | $-40^\circ C$ to $85^\circ C$ | 0 | | V_{CC} | V |
| R_{ON} | ON Resistance ⁽¹⁾ | $V_{CC} = 4.5V, I_O = 30mA, V_{IN} = 0V$ | 25°C | | 4 | 6 | Ω |
| | | $V_{CC} = 4.5V, I_O = -30mA, V_{IN} = 2.4V$ | | | 5 | 8 | |
| | | $V_{CC} = 4.5V, I_O = -30mA, V_{IN} = 4.5V$ | | | 7 | 11 | |
| | | $V_{CC} = 4.5V, I_O = 30mA, V_{IN} = 0V$ | $-40^\circ C$ to $85^\circ C$ | | | 6 | |
| | | $V_{CC} = 4.5V, I_O = -30mA, V_{IN} = 2.4V$ | | | | 8 | |
| | | $V_{CC} = 4.5V, I_O = -30mA, V_{IN} = 4.5V$ | | | | 11 | |
| | | $V_{CC} = 3.0V, I_O = 24mA, V_{IN} = 0V$ | 25°C | | 5 | 8 | |
| | | $V_{CC} = 3.0V, I_O = -24mA, V_{IN} = 3.0V$ | | | 10 | 15 | |
| | | $V_{CC} = 3.0V, I_O = 24mA, V_{IN} = 0V$ | | $-40^\circ C$ to $85^\circ C$ | | | |
| | | $V_{CC} = 3.0V, I_O = -24mA, V_{IN} = 3.0V$ | | | | 15 | |
| | | $V_{CC} = 2.3V, I_O = 8mA, V_{IN} = 0V$ | 25°C | | | 6 | |
| | | $V_{CC} = 2.3V, I_O = -8mA, V_{IN} = 2.3V$ | | | 13 | 20 | |
| | | $V_{CC} = 2.3V, I_O = 8mA, V_{IN} = 0V$ | | $-40^\circ C$ to $85^\circ C$ | | | |
| | | $V_{CC} = 2.3V, I_O = -8mA, V_{IN} = 2.3V$ | | | | 20 | |
| | | $V_{CC} = 1.65V, I_O = 4mA, V_{IN} = 0V$ | 25°C | | | 8 | |
| | | $V_{CC} = 1.65V, I_O = -4mA, V_{IN} = 1.65V$ | | | 20 | 30 | |
| $V_{CC} = 1.65V, I_O = 4mA, V_{IN} = 0V$ | $-40^\circ C$ to $85^\circ C$ | | | | 12 | | |
| $V_{CC} = 1.65V, I_O = -4mA, V_{IN} = 1.65V$ | | | | 30 | | | |

| Parameter | Description | Test Conditions | Temperature (T _A :°C) | Min. | Typ. | Max. | Units |
|------------------|---|--|----------------------------------|------|------|------|-------|
| ΔR _{ON} | ON Resistance Match Between Channels ^(1,2,3) | V _{CC} = 4.5V, I _A = -30mA, V _{IN} = 3.15V | 25°C | | 0.15 | | Ω |
| | | V _{CC} = 3.0V, I _A = -24mA, V _{IN} = 2.1V | | | 0.2 | | |
| | | V _{CC} = 2.3V, I _A = -8mA, V _{IN} = 1.6V | | | 0.3 | | |
| | | V _{CC} = 1.65V, I _A = -4mA, V _{IN} = 0V | | | 0.5 | | |
| R _{ONF} | ON Resistance Flatness ^(1,2,4) | V _{CC} = 5.0V, I _A = -30mA, 0 ≤ V _{IN} ≤ V _{CC} | 25°C | | 6 | | Ω |
| | | V _{CC} = 3.3V, I _A = -24mA, 0 ≤ V _{IN} ≤ V _{CC} | | | 12 | | |
| | | V _{CC} = 2.5V, I _A = -8mA, 0 ≤ V _{IN} ≤ V _{CC} | | | 22 | | |
| | | V _{CC} = 1.8V, I _A = -4mA, 0 ≤ V _{IN} ≤ V _{CC} | | | 90 | | |
| V _{IH} | Input High Voltage (Logic High Level) | V _{CC} = 1.65V | -40°C to 85°C | 1 | | | V |
| | | V _{CC} = 2.3V | | 1.2 | | | |
| | | V _{CC} = 3V | | 1.3 | | | |
| | | V _{CC} = 4.2V | | 1.5 | | | |
| | | V _{CC} = 5.5V | | 1.8 | | | |
| V _{IL} | Input Low Voltage (Logic Low Level) | V _{CC} = 1.65V | -40°C to 85°C | | | 0.4 | V |
| | | V _{CC} = 2.3V | | | | 0.6 | |
| | | V _{CC} = 3V | | | | 0.8 | |
| | | V _{CC} = 4.2V | | | | 1 | |
| | | V _{CC} = 5.5V | | | | 1.2 | |
| I _{LKC} | Input Leakage Current | 0 ≤ V _{IN} ≤ 5.5V, V _{CC} = 0V to 5.5V | 25°C | | | ±0.1 | μA |
| | | | -40°C to 85°C | | | ±1.0 | |
| I _{OFF} | OFF State Leakage Current | 0 ≤ V _{IN} ≤ 5.5V, V _{CC} = 1.65V to 5.5V | 25°C | | | ±0.1 | μA |
| | | | -40°C to 85°C | | | ±10 | |
| I _{CC} | Quiescent Supply Current | All channels ON or OFF, V _{IN} = V _{CC} or GND, I _{OUT} = 0, V _{CC} = 5.5V | 25°C | | | 1 | μA |
| | | | -40°C to 85°C | | | 5 | |

Notes:

- Measured by voltage drop between A and B pins at the indicated current through the device. ON resistance is determined by the lower of the voltages on two ports (A or B).
- Parameter is characterized but not tested in production.
- DR_{ON} = R_{ON} max – R_{ON} min. measured at identical V_{CC}, temperature and voltage levels.
- Flatness is defined as difference between maximum and minimum value of ON resistance over the specified range of conditions. Guaranteed by design.

Capacitance

 (T_A = 25°C, unless otherwise noted.)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---------------------|------------------------|--|------|------|------|-------|
| C _{IN} | Control Input | V _{CC} = 5.0V, f = 1 MHz ⁽¹⁾ | | 2.5 | | pF |
| C _{IO-B} | For B Port, Switch OFF | | | 5.0 | | |
| C _{IOA-ON} | For A Port, Switch ON | | | 15.0 | | |

Notes:

- Capacitance is characterized but not tested in production

Switch and AC Characteristics

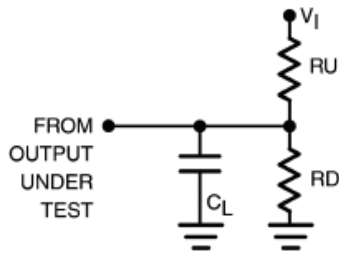
| Parameter | Description | Test Conditions | Supply Voltage | Temperature (T _A : °C) | Min | Typ | Max | Units |
|--------------------------------------|-----------------------------|---|----------------------------------|-----------------------------------|-----|-----|-----|-------|
| t _{PLH} t _{PHL} | Propagation Delay: A to Bn | See test circuit diagrams 1 and 2. V _I Open ⁽²⁾ | V _{CC} = 1.65V to 1.95V | -40 to 85°C | | | 3.5 | ns |
| | | | V _{CC} = 2.3V to 2.7V | | | | 1.1 | |
| | | | V _{CC} = 3.0V to 3.6V | | | | 0.9 | |
| | | | V _{CC} = 4.5V to 5.5V | | | | 0.6 | |
| t _{PZL} t _{PZH} | Output Enable Turn ON Time: | See test circuit diagrams 1&2. | V _{CC} = 1.65V to 1.95V | -40 to 85°C | 6 | | 13 | |
| | | | V _{CC} = 2.3V to 2.7V | | 3.5 | | 8.0 | |

| Parameter | Description | Test Conditions | Supply Voltage | Temperature (T _A : °C) | Min | Typ | Max | Units |
|--------------------------------------|---|---|--|--------------------------------------|----------------------|--------------------------|-----------------------|-------|
| | A to Bn | V _I = 2V _{CC} for t _{PZL} , V _I = 0V for t _{PZH} | V _{CC} = 3.0V to 3.6V V _{CC} = 4.5V to 5.5V | | 2.5 1.7 | | 6.9 5.2 | |
| t _{PLZ} t _{PHZ} | Output Disable Turn OFF Time: A to Bn | See test circuit diagrams 1 and 2. V _I = 2V _{CC} for t _{PLZ} , V _I = 0V for t _{PHZ} | V _{CC} = 1.65V to 1.95V V _{CC} = 2.3V to 2.7V V _{CC} = 3.0V to 3.6V V _{CC} = 4.5V to 5.5V | -40 to 85°C | 3 2 1.5 0.8 | | 13 9 7.0 4.5 | |
| t _{BM} | Break Before Make Time | See test circuit diagram 3. | V _{CC} = 1.65V to 1.95V V _{CC} = 2.3V to 2.7V V _{CC} = 3.0V to 3.6V V _{CC} = 4.5V to 5.5V | -40 to 85°C | | 3.7 2.5 2.5 1.6 | | |
| Q | Charge Injection | C _L = 0.1nF, V _{GEN} = 0V, R _{GEN} = 0Ω. See test circuit 4. | V _{CC} = 5.0V V _{CC} = 3.3V | 25°C | | 10 6 | | pC |
| OIRR | Off Isolation | R _L = 50Ω, V _{GEN} = 0V, R _{GEN} = 0Ω, f = 10MHz. See test circuit 5 ⁽³⁾ | V _{CC} = 1.65V to 5.5V | 25°C | | -63 | | dB |
| X _{TALK} | Crosstalk Isolation | See test circuit 6 ⁽⁴⁾ | V _{CC} = 1.65V to 5.5V | 25°C | | -64 | | |
| f _{3dB} | -3dB Bandwidth | See test circuit 9 | V _{CC} = 1.65V to 5.5V | 25°C | | 350 | | MHz |
| T _{HD} | Total Harmonic Distortion | R _L = 600Ω, V _{IN} = 0.5V _{pp} , f = 20Hz to 20kHz | V _{CC} = 5.0V | 25°C | | 0.012 | | % |

Notes:

- Guaranteed by design.
- The device contributes no other propagation delay other than the RC delay of the switch ON resistance and the 50pF load capacitance, when driven by an ideal voltage source with zero output impedance.
- Off Isolation = 20 Log₁₀ [V_{Bn}/V_A] and is measured in dB.
- Crosstalk Isolation = 20 Log₁₀ [V_{B1}/V_{B0}] and is measured in dB.

Test Circuits and Timing Diagrams



Note: Input driven by 50ohm source terminated in 500ohm
 Note: C_L Includes load and stray capacitance
 Note: Input PRR=1.0MHz, $t_w = 500\text{nS}$

Figure 1. AC Test Circuit

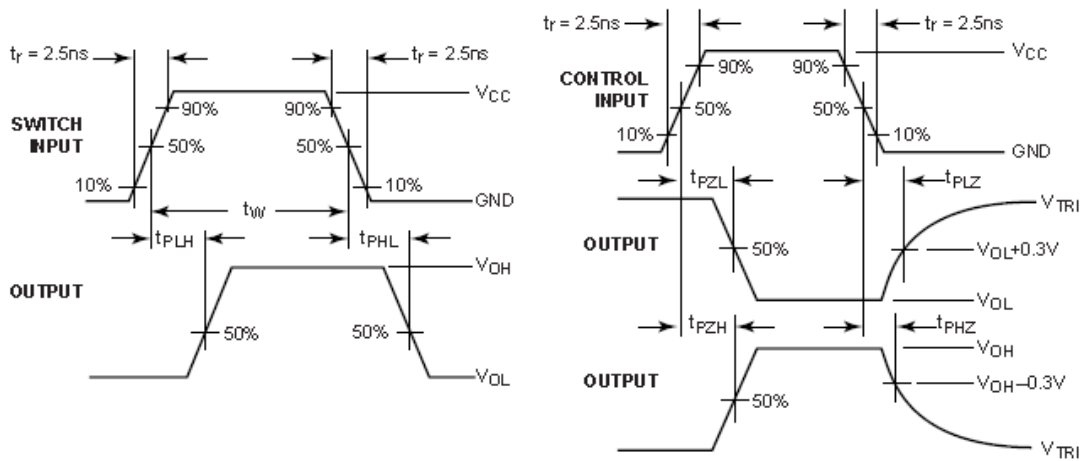


Figure 2. AC Waveforms

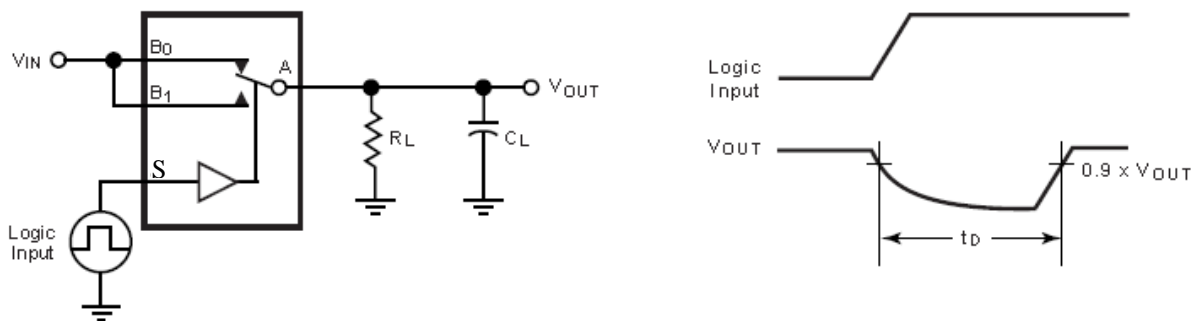


Figure 3. Break Before Make Interval Timing

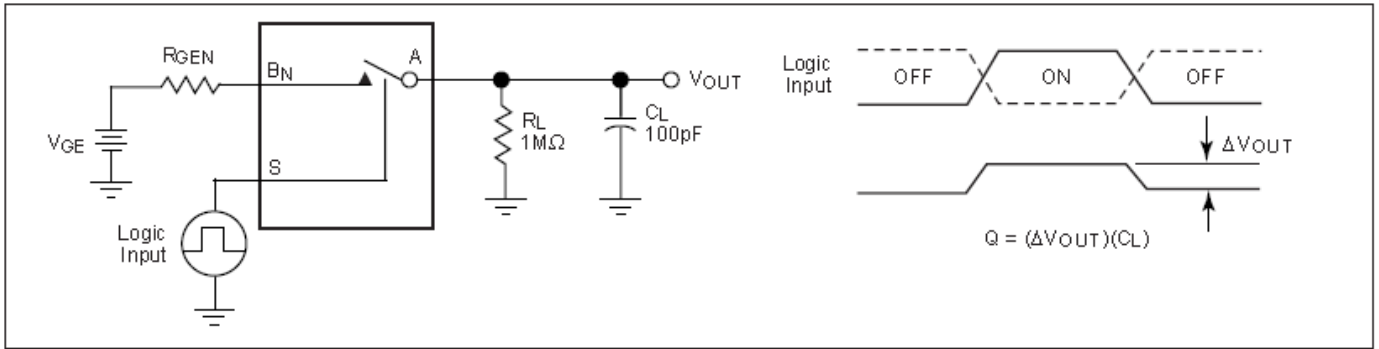


Figure 4. Charge Injection Test

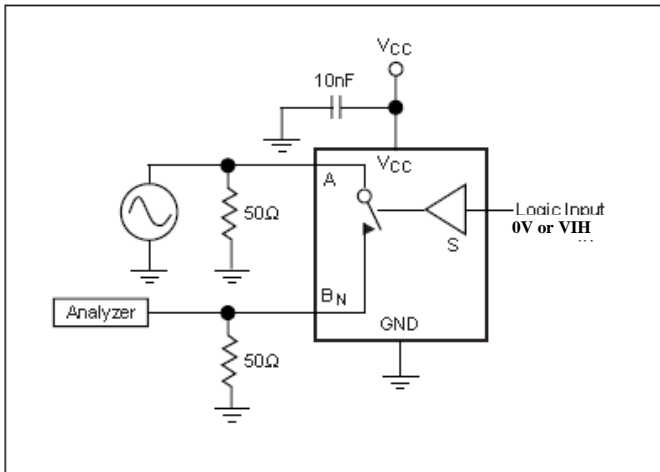


Figure 5. Off Isolation

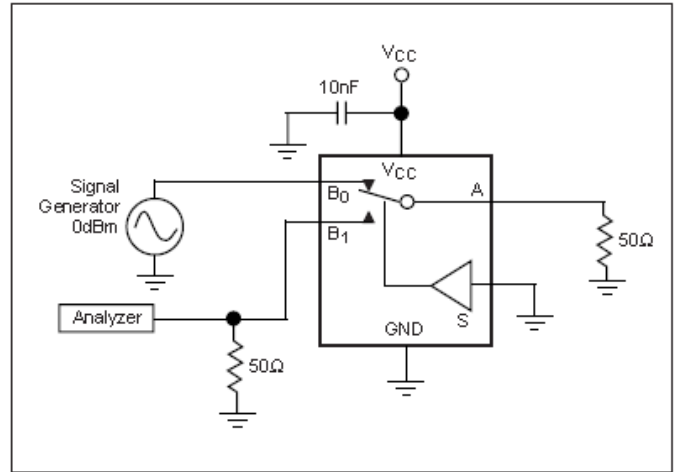


Figure 6. Crosstalk

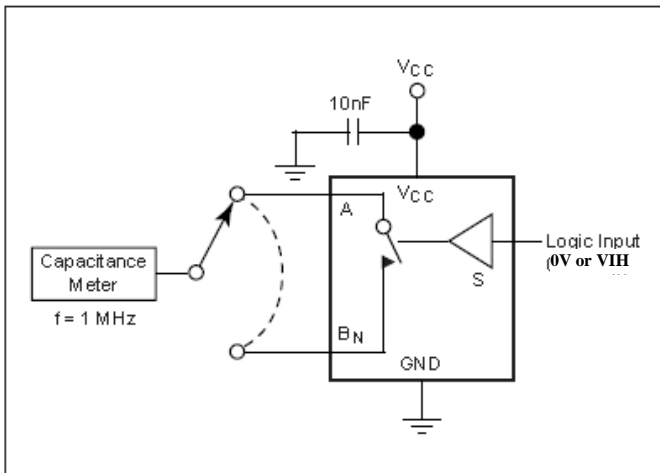


Figure 7. Channel Off Capacitance

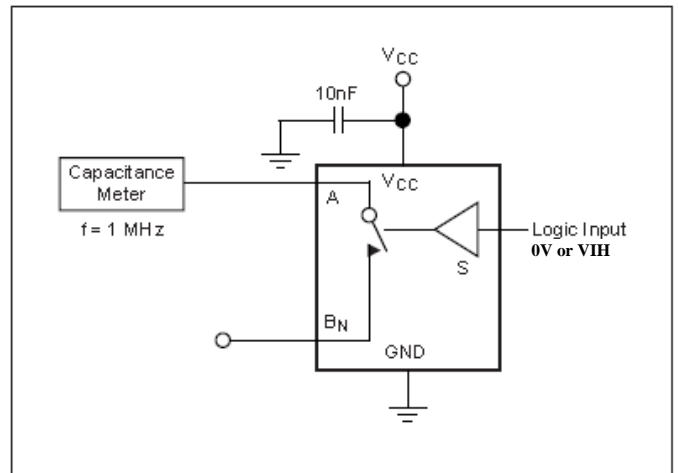


Figure 8. Channel On Capacitance

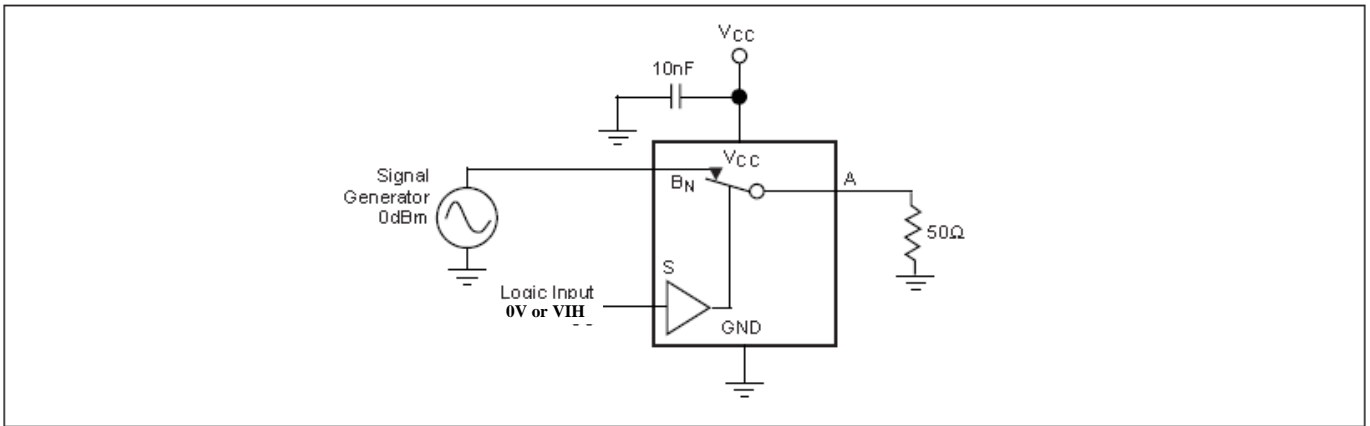
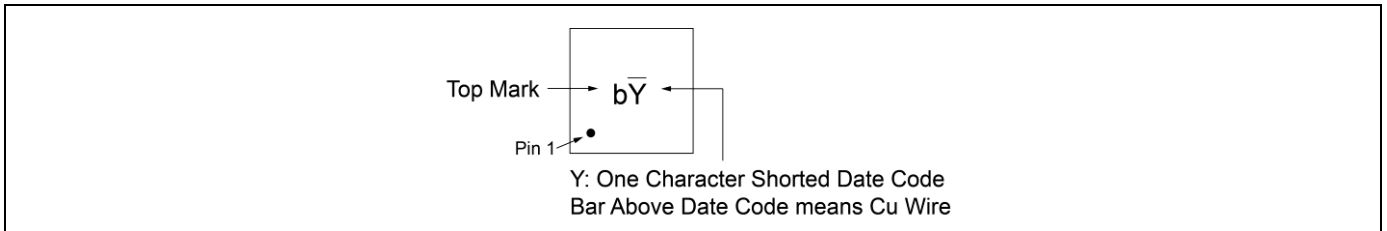


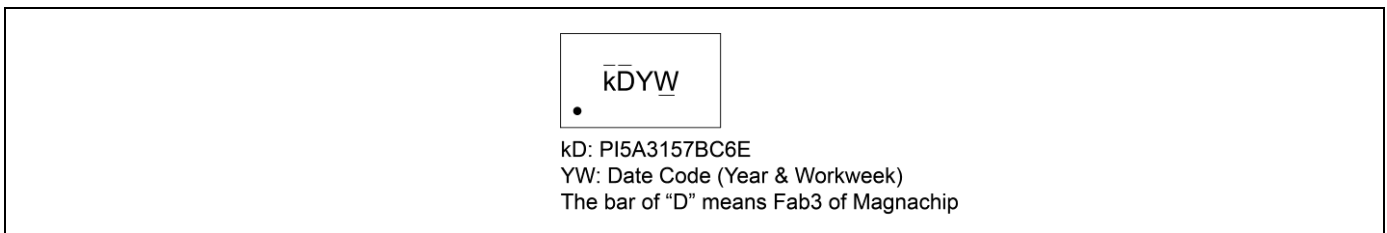
Figure 9. Bandwidth

Part Marking

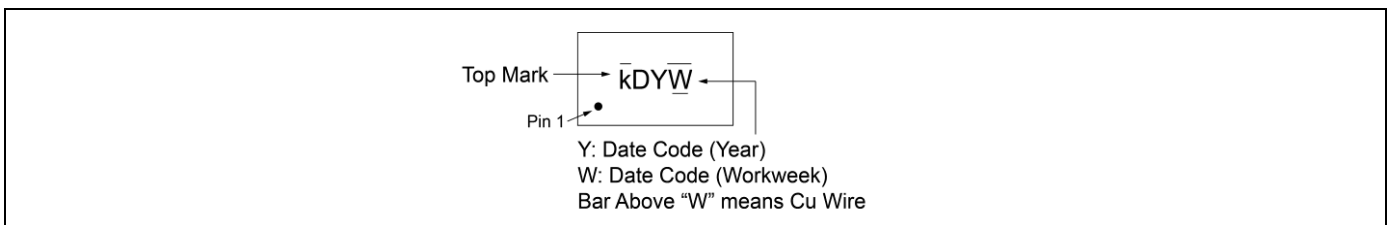
XDB Package



C6 Package



C Package



Packaging Mechanical
6-X1DFN (XDB)

TOP VIEW

BOTTOM VIEW

RECOMMENDED LAND PATTERN(Unit:mm)

SIDE VIEW

| PKG. DIMENSIONS(MM) | | |
|---------------------|----------|------|
| SYMBOL | Min | Max |
| A | - | 0.40 |
| A1 | 0.00 | 0.05 |
| A3 | 0.13 REF | |
| D | 0.95 | 1.05 |
| E | 0.95 | 1.05 |
| b | 0.14 | 0.20 |
| L | 0.35 | 0.45 |
| e | 0.35 BSC | |

Notes:
1. Ref: JEDEC MO-287A
2. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.

| | | |
|---------------------------------------|---|-----------------------|
| DIODES INCORPORATED | PERICOM A PRODUCT LINE OF DIODES INCORPORATED ENABLING SERIAL CONNECTIVITY | DATE: 04/28/16 |
| DESCRIPTION: 6-Pin, X2DFN, 1X1 | | |
| PACKAGE CODE: XDB (XDB6) | | |
| DOCUMENT CONTROL #: PD2206 | REVISION: - | |

16-0041

PI5A3157B

6-SC70 (C6)

TOP VIEW

BOTTOM VIEW

RECOMMENDED LAND PATTERN (unit:mm)

| PKG. DIMENSIONS(MM) | | |
|---------------------|----------|------|
| SYMBOL | Min | Max |
| A | - | 1.10 |
| A1 | 0.00 | 0.10 |
| A2 | 0.70 | 1.00 |
| b | 0.15 | 0.40 |
| c | 0.08 | 0.22 |
| D | 1.80 | 2.20 |
| E | 1.10 | 1.40 |
| E1 | 1.80 | 2.45 |
| e | 0.65 BSC | |
| L | 0.26 | 0.46 |
| θ | 0° | 8° |

SIDE VIEW

Notes:

1. Comply with MO-203C/AB, except b Max, D Min and D Max.
2. PACKAGE OUTLINE DIMENSIONS DO NOT INCLUDE MOLD FLASH AND METAL BURR
3. LAND PATTERN REFERENCE DIODES SOT363 PACKAGE INFORMATION.

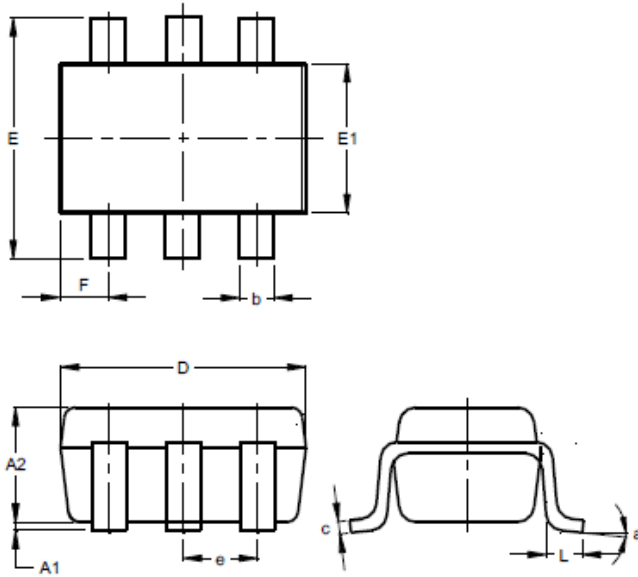
| | | |
|--|-------------|----------------|
| DIODES PERICOM INCORPORATED | | DATE: 12/16/21 |
| DESCRIPTION: 6-Pin, SOT363 (SC70) | | |
| PACKAGE CODE: C (C6) | | |
| DOCUMENT CONTROL#: PD-1902 | REVISION: D | |

21-1534

6-SC70 (C)

Package Outline Dimensions

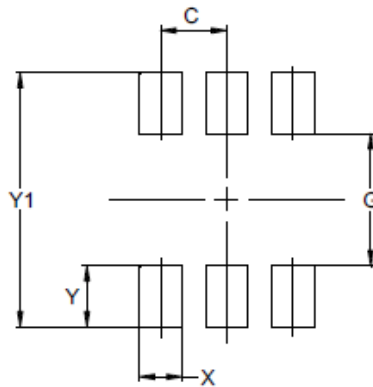
SOT363



| SOT363 | | | |
|----------------------|-----------|------|-------|
| Dim | Min | Max | Typ |
| A1 | 0.00 | 0.10 | 0.05 |
| A2 | 0.90 | 1.00 | 0.95 |
| b | 0.10 | 0.30 | 0.25 |
| c | 0.10 | 0.22 | 0.11 |
| D | 1.80 | 2.20 | 2.15 |
| E | 2.00 | 2.20 | 2.10 |
| E1 | 1.15 | 1.35 | 1.30 |
| e | 0.650 BSC | | |
| F | 0.40 | 0.45 | 0.425 |
| L | 0.25 | 0.40 | 0.30 |
| a | 0° | 8° | -- |
| All Dimensions in mm | | | |

Suggested Pad Layout

SOT363



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.650 |
| G | 1.300 |
| X | 0.420 |
| Y | 0.600 |
| Y1 | 2.500 |

Note: The suggested land pattern dimensions have been provided for reference only, as actual pad layouts may vary depending on application. These dimensions may be modified based on user equipment capability or fabrication criteria. A more robust pattern may be desired for wave soldering and is calculated by adding 0.2 mm to the 'Z' dimension. For further information, please reference document IPC-7351A, Naming Convention for Standard SMT Land Patterns, and for International grid details, please see document IEC, Publication 97.

Note: For high voltage applications, the appropriate industry sector guidelines should be considered with regards to creepage and clearance distances between device Terminals and PCB tracking.

For latest package info.

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

Ordering Information

| Part Number | Package Code | Package Description | Top Marking |
|----------------|--------------|---|---|
| PI5A3157BXDBEX | XDB | 6-Pin, 1x1 (X1DFN) | b \overline{Y} |
| PI5A3157BC6EX | C6 | 6-Pin, SOT363 (SC70) (Not Recommended for New Design) | \overline{k} \overline{D} \overline{YW} |
| PI5A3157BCEX | C | 6-Pin, SOT363 (SC70) | \overline{k} \overline{DY} \overline{W} |

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

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