

## SOTiny™ Low Voltage Dual SPDT Analog Switch 2:1 Mux/DeMux Bus Switch

### Features

- CMOS Technology for Bus and Analog Applications
- Low On-Resistance: 8Ω at 3.0V
- Wide  $V_{DD}$  Range: 1.65V to 5.5V
- Rail-to-Rail Signal Range
- Control Input Overvoltage Tolerance: 5.5V min.
- Fast Transition Speed: 5.2ns max. at 5V
- High Off Isolation: 57dB at 10MHz
- 54dB (10MHz) Crosstalk Rejection Reduces Signal Distortion
- Break-Before-Make Switching
- High Bandwidth: 250 MHz
- Extended Industrial Temperature Range: -40°C to 85°C
- Improved Direct Replacement for NC7SB3157
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- Packaging (Pb-free & Green available):
  - 6-pin SC70 (C)

### Pin Description

| Pin Number | Name            | Description                 |
|------------|-----------------|-----------------------------|
| 1          | B <sub>1</sub>  | Data port                   |
| 2          | GND             | Ground                      |
| 3          | B <sub>0</sub>  | Data port (Normally Closed) |
| 4          | A               | Common Output/Data port     |
| 5          | V <sub>CC</sub> | Positive Power Supply       |
| 6          | S               | Logic Control               |

### Logic Function Table

| Logic Input(s) | Function                       |
|----------------|--------------------------------|
| 0              | B <sub>0</sub> Connection to A |
| 1              | B <sub>1</sub> Connected to A  |

#### 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.

### Description

The PI5A3157 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 PI5A3157 has a maximum ON resistance of 12-ohms at 1.65V, 9-ohms at 2.3V & 6-ohms at 4.5V.

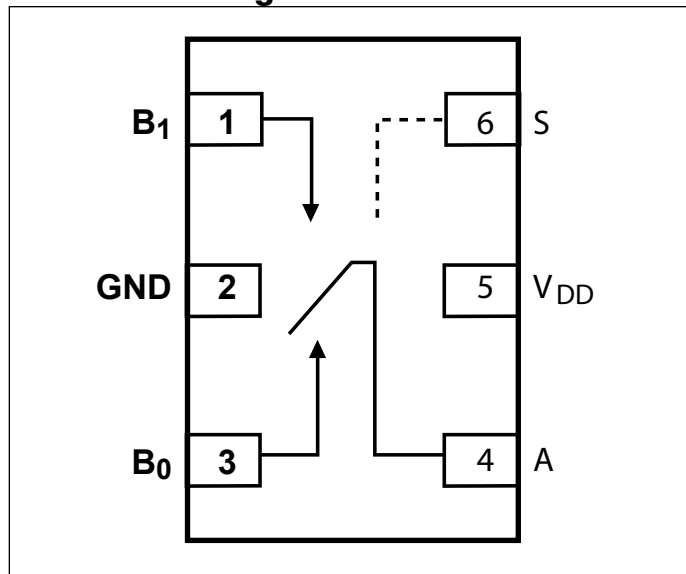
Break-before-make switching prevents both switches being enabled simultaneously. This eliminates signal disruption during switching. The control input, S, tolerates input drive signals up to 5.5V, independent of supply voltage.

PI5A3157 is an improved direct replacement for the NC7SB3157.

### Applications

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

### Connection Diagram



### Absolute Maximum Ratings<sup>(1)</sup>

|                                                    |                               |
|----------------------------------------------------|-------------------------------|
| Supply Voltage $V_{DD}$                            | ..... -0.5V to +7V            |
| DC Switch Voltage ( $V_S$ ) <sup>(2)</sup>         | ..... -0.5V to $V_{DD}$ +0.5V |
| DC Input Voltage ( $V_{IN}$ ) <sup>(2)</sup>       | ..... -0.5V to +7.0V          |
| DC Output Current ( $V_{OUT}$ )                    | ..... 128mA                   |
| DC $V_{DD}$ or Ground Current ( $I_{CC}/I_{GND}$ ) | ..... $\pm 100$ mA            |
| Storage Temperature Range ( $T_{STG}$ )            | ..... -65°C to +150°C         |
| Junction Temperature under Bias ( $T_J$ )          | ..... 150°C                   |
| Junction Lead Temperature ( $T_L$ )                |                               |
| (Soldering, 10 seconds)                            | ..... 260°C                   |
| Power Dissipation ( $P_D$ ) @ +85°C                | ..... 180mW                   |

### Recommended Operating Conditions<sup>(3)</sup>

|                                        |                       |
|----------------------------------------|-----------------------|
| Supply Voltage Operating ( $V_{DD}$ )  | ..... 1.65V to 5.5V   |
| Control Input Voltage ( $V_{IN}$ )     | ..... 0V to $V_{DD}$  |
| Switch Input Voltage ( $V_{IN}$ )      | ..... 0V to $V_{DD}$  |
| Output Voltage ( $V_{OUT}$ )           | ..... 0V to $V_{DD}$  |
| Operating Temperature ( $T_A$ )        | ..... -40°C to +85°C  |
| Input Rise and Fall Time ( $t_{r,f}$ ) |                       |
| Control Input $V_{DD} = 2.3V - 3.6V$   | ..... 0ns/V to 10ns/V |
| Control Input $V_{DD} = 4.5V - 5.5V$   | ..... 0ns/V to 5ns/V  |
| Thermal Resistance ( $\theta_{JA}$ )   | ..... 350°C/W         |

#### Notes:

1. Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied.
2. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.
3. Control input must be held HIGH or LOW; it must not float.

### DC Electrical Characteristics (Over the Operating temperature range, $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ )

| Parameters       | Description                  | Test Conditions                                 | Supply Voltage  | Temp                                  | Min. | Typ. | Max.            | Units |
|------------------|------------------------------|-------------------------------------------------|-----------------|---------------------------------------|------|------|-----------------|-------|
| V <sub>IAR</sub> | Analog Input Signal Range    |                                                 | V <sub>DD</sub> | T <sub>A</sub> = 25°C & -40°C to 85°C | 0    |      | V <sub>DD</sub> | V     |
| R <sub>ON</sub>  | On-Resistance <sup>(4)</sup> | I <sub>O</sub> = 30mA, V <sub>IN</sub> = 0V     | 4.5V            | T <sub>A</sub> = 25°C                 |      | 4    | 6               | Ω     |
|                  |                              | I <sub>O</sub> = -30mA, V <sub>IN</sub> = 2.4V  |                 |                                       |      | 5    | 8               |       |
|                  |                              | I <sub>O</sub> = -30mA, V <sub>IN</sub> = 4.5V  |                 |                                       |      | 8    | 13              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 30mA, V <sub>IN</sub> = 0V     | 4.5V            | T <sub>A</sub> = -40°C to 85°C        |      |      | 6               |       |
|                  |                              | I <sub>O</sub> = -30mA, V <sub>IN</sub> = 2.4V  |                 |                                       |      |      | 8               |       |
|                  |                              | I <sub>O</sub> = -30mA, V <sub>IN</sub> = 4.5V  |                 |                                       |      |      | 13              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 3.0V            | T <sub>A</sub> = 25°C                 |      | 5    | 8               |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 3.0V  |                 |                                       |      | 12   | 19              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 3.0V            | T <sub>A</sub> = -40°C to 85°C        |      |      | 8               |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 3.0V  |                 |                                       |      |      | 19              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 2.3V            | T <sub>A</sub> = 25°C                 |      | 6    | 9               |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 2.3V  |                 |                                       |      | 16   | 24              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 2.3V            | T <sub>A</sub> = -40°C to 85°C        |      |      | 9               |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 2.4V  |                 |                                       |      |      | 24              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 1.65V           | T <sub>A</sub> = 25°C                 |      | 8    | 12              |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 1.65V |                 |                                       |      | 27   | 39              |       |
| R <sub>ON</sub>  |                              | I <sub>O</sub> = 24mA, V <sub>IN</sub> = 0V     | 1.65V           | T <sub>A</sub> = -40°C to 85°C        |      |      | 12              |       |
|                  |                              | I <sub>O</sub> = -24mA, V <sub>IN</sub> = 1.65V |                 |                                       |      |      | 39              |       |

**PI5A3157**
**DC Electrical Characteristics Cont.** (Over the Operating temperature range,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ )

| Parameters      | Description                                               | Test Conditions                                                 | Supply Voltage                              | Temp                                                                       | Min.          | Typ. | Max.          | Units         |
|-----------------|-----------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------|---------------|------|---------------|---------------|
| $\Delta R_{ON}$ | On-Resistance Match Between Channels <sup>(4, 5, 6)</sup> | $I_A = -30\text{mA}$ , $V_{BN} = 3.15\text{V}$                  | 4.5V                                        | $T_A = 25^{\circ}\text{C}$                                                 |               | 0.15 |               | $\Omega$      |
|                 |                                                           | $I_A = -24\text{mA}$ , $V_{BN} = 2.1\text{V}$                   | 3.0V                                        |                                                                            |               | 0.2  |               |               |
|                 |                                                           | $I_A = -8\text{mA}$ , $V_{BN} = 1.6\text{V}$                    | 2.3V                                        |                                                                            |               | 0.3  |               |               |
|                 |                                                           | $I_A = -4\text{mA}$ , $V_{BN} = 1.15\text{V}$                   | 1.65V                                       |                                                                            |               | 0.3  |               |               |
| $R_{ONF}$       | On-Resistance Flatness <sup>(4, 5, 7)</sup>               | $I_A = -30\text{mA}$ , $0 \leq V_{BN} \leq V_{DD}$              | 5.0V                                        | $T_A = 25^{\circ}\text{C}$                                                 |               | 6    |               | $\Omega$      |
|                 |                                                           | $I_A = -24\text{mA}$ , $0 \leq V_{BN} \leq V_{DD}$              | 3.3V                                        |                                                                            |               | 12   |               |               |
|                 |                                                           | $I_A = -8\text{mA}$ , $0 \leq V_{BN} \leq V_{DD}$               | 2.5V                                        |                                                                            |               | 22   |               |               |
|                 |                                                           | $I_A = -4\text{mA}$ , $0 \leq V_{BN} \leq V_{DD}$               | 1.8V                                        |                                                                            |               | 90   |               |               |
| $V_{IH}$        | Input High Voltage                                        | Logic High Level                                                | $V_{CC} = 1.65\text{V}$ to $1.95\text{V}$   | $T_A = 25^{\circ}\text{C}$ & $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$ | $0.75 V_{CC}$ |      |               | V             |
|                 |                                                           |                                                                 | $V_{CC} = 2.3\text{V}$ to $5.5\text{V}$     |                                                                            | $0.7 V_{CC}$  |      |               |               |
| $V_{IL}$        | Input Low Voltage                                         | Logic LowLevel                                                  | $V_{CC} = 1.65\text{V}$ to $1.95\text{V}$   |                                                                            |               |      | $0.25 V_{CC}$ | V             |
|                 |                                                           |                                                                 | $V_{CC} = 2.3\text{V}$ to $5.5\text{V}$     |                                                                            |               |      | $0.25 V_{CC}$ |               |
|                 | Input Leakage Current                                     | $0 \leq V_{IN} \leq 5.5\text{V}$                                | $V_{CC} \leq 0\text{V} \leq 5.5\text{V}$    | $T_A = 25^{\circ}\text{C}$                                                 |               |      | $\pm 0.1$     | $\mu\text{A}$ |
|                 |                                                           |                                                                 |                                             | $T_A = -40^{\circ}\text{C}$ to $85^{\circ}\text{C}$                        |               |      | $\pm 1.0$     |               |
| $I_{OFF}$       | OFF State Leakage Current                                 | $0 \leq V_{IN} \leq 5.5\text{V}$                                | $V_{CC} \leq 1.65\text{V} \leq 5.5\text{V}$ | $T_A = 25^{\circ}\text{C}$                                                 |               |      | $\pm 0.1$     |               |
|                 |                                                           |                                                                 |                                             | $T_A = -40^{\circ}\text{C}$ to $85^{\circ}\text{C}$                        |               |      | $\pm 10$      |               |
| $I_{CC}$        | Quiescent Supply Current                                  | All Channels ON or OFF, $V_{IN} = V_{DD}$ or GND, $I_{OUT} = 0$ | $V_{CC} = 5.5\text{V}$                      | $T_A = 25^{\circ}\text{C}$                                                 |               |      | 1             | $\mu\text{A}$ |
|                 |                                                           |                                                                 |                                             | $T_A = -40^{\circ}\text{C}$ to $85^{\circ}\text{C}$                        |               |      | 10            |               |

**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.
- $\Delta R_{ON} = R_{ON \text{ max}} - R_{ON \text{ min}}$ , measured at identical  $V_{DD}$ , 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<sup>(12)</sup>**

| Parameters   | Description            | Test Conditions            | Supply Voltage         | Temp                       | Min. | Typ. | Max. | Units |
|--------------|------------------------|----------------------------|------------------------|----------------------------|------|------|------|-------|
| $C_{IN}$     | Controll Input         | $f = 1 \text{ MHz}^{(12)}$ | $V_{CC} = 5.0\text{V}$ | $T_A = 25^{\circ}\text{C}$ |      | 2.3  |      | pF    |
| $C_{IO-B}$   | For B Port, Switch OFF |                            |                        |                            |      | 6.5  |      |       |
| $C_{IOA-ON}$ | For A Port, Switch ON  |                            |                        |                            |      | 18.5 |      |       |

## Switch and AC Characteristics

| Parameters                           | Description                           | Test Conditions                                                                                                                     | Supply Voltage                                                                                                                         | Temp                                  | Min.                     | Typ.              | Max.                    | Units |
|--------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------|-------------------|-------------------------|-------|
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay: A to Bn            | See test circuit diagram 1 and 2 V <sub>I</sub> Open <sup>(10)</sup>                                                                | V <sub>CC</sub> = 2.3V to 2.7V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V                                     | T <sub>A</sub> = 25°C & -40°C to 85°C |                          | 1.2<br>0.8<br>0.3 |                         | ns    |
| t <sub>PZL</sub><br>t <sub>PZH</sub> | Output Enable Turn ON Time: A to Bn   | See test circuit diagram 1 and 2 V <sub>I</sub> = 2 V <sub>CC</sub> for t <sub>PZL</sub> , V <sub>I</sub> = 0V for t <sub>PZH</sub> | V <sub>CC</sub> = 1.65V to 1.95V<br>V <sub>CC</sub> = 2.3V to 2.7V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V | T <sub>A</sub> = 25°C                 | 7<br>3.5<br>2.5<br>1.7   |                   | 23<br>13<br>6.9<br>5.2  |       |
| t <sub>PZL</sub><br>t <sub>PHZ</sub> | Output Enable Turn ON Time: A to Bn   | See test circuit diagram 1 and 2 V <sub>I</sub> = 2 V <sub>CC</sub> for t <sub>PZL</sub> , V <sub>I</sub> = 0V for t <sub>PHZ</sub> | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.3V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V                   | T <sub>A</sub> = 25°C & -40°C to 85°C |                          |                   | 24<br>14<br>7.6<br>5.7  |       |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable-Turn OFF Time: A to Bn | See test circuit diagram 1 and 2 V <sub>I</sub> = 2 V <sub>CC</sub> for t <sub>PLZ</sub> , V <sub>I</sub> = 0V for t <sub>PHZ</sub> | V <sub>CC</sub> = 1.65V to 1.95V<br>V <sub>CC</sub> = 2.3V to 2.7V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V | T <sub>A</sub> = 25°C                 | 3<br>2<br>1.5<br>0.8     |                   | 12.5<br>7<br>5<br>3.5   |       |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable-Turn OFF Time: A to Bn | See test circuit diagram 1 and 2 V <sub>I</sub> = 2 V <sub>CC</sub> for t <sub>PLZ</sub> , V <sub>I</sub> = 0V for t <sub>PHZ</sub> | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.3V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V                   | T <sub>A</sub> = 25°C & -40°C to 85°C |                          |                   | 13<br>7.5<br>5.3<br>3.8 |       |
| t <sub>BM</sub>                      | Break Before Make Time                | See Test Circuit diagram 9. <sup>(9)</sup>                                                                                          | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.3V<br>V <sub>CC</sub> = 3.0V to 3.6V<br>V <sub>CC</sub> = 4.5V to 5.5V                   | T <sub>A</sub> = 25°C & -40°C to 85°C | 0.5<br>0.5<br>0.5<br>0.5 |                   |                         |       |
| Q                                    | Charge Injection                      | C <sub>L</sub> = 0.1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, See test circuit 4                                            | V <sub>CC</sub> = 5.0V<br>V <sub>CC</sub> = 3.3V                                                                                       | T <sub>A</sub> = 25°C                 |                          | 7<br>3            |                         | pC    |
| O <sub>IRR</sub>                     | Off Isolation                         | R <sub>L</sub> = 50Ω, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, See test circuit 5 <sup>(11)</sup>                              | V <sub>CC</sub> = 1.65V to 5.5V                                                                                                        | T <sub>A</sub> = 25°C                 |                          | -57               |                         | dB    |
| X <sub>TALK</sub>                    | Crosstalk Isolation                   | See test circuit 6                                                                                                                  | V <sub>CC</sub> = 1.65V to 5.5V                                                                                                        | T <sub>A</sub> = 25°C                 |                          | -54               |                         |       |
| f <sub>3dB</sub>                     | -3dB Bandwidth                        | See test circuit 9                                                                                                                  | V <sub>CC</sub> = 1.65V to 5.5V                                                                                                        | T <sub>A</sub> = 25°C                 |                          | 250               |                         | MHz   |

### Notes:

- Guaranteed by design.
- Guaranteed by design but not production tested. 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 Log<sub>10</sub> [ V<sub>A</sub> / V<sub>Bn</sub> ] and is measured in dB.
- T<sub>A</sub> = 25°C, f = 1MHz. Capacitance is characterized but not tested in production.

## Test Circuits and Timing Diagrams

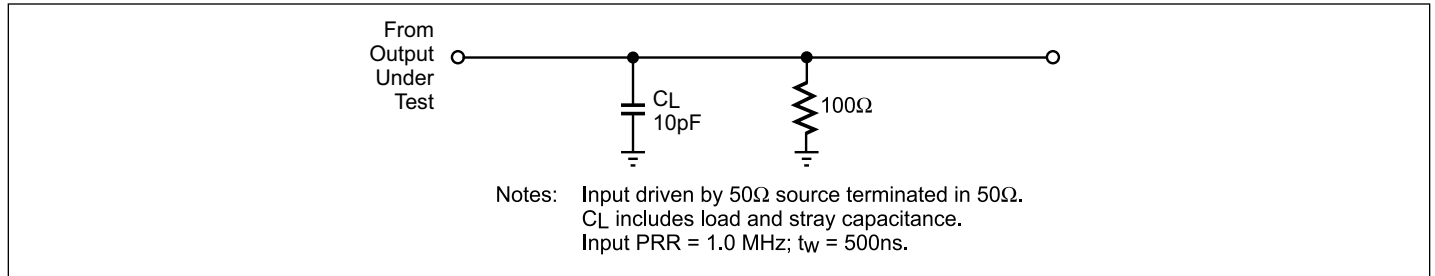


Figure 1. AC Test Circuit

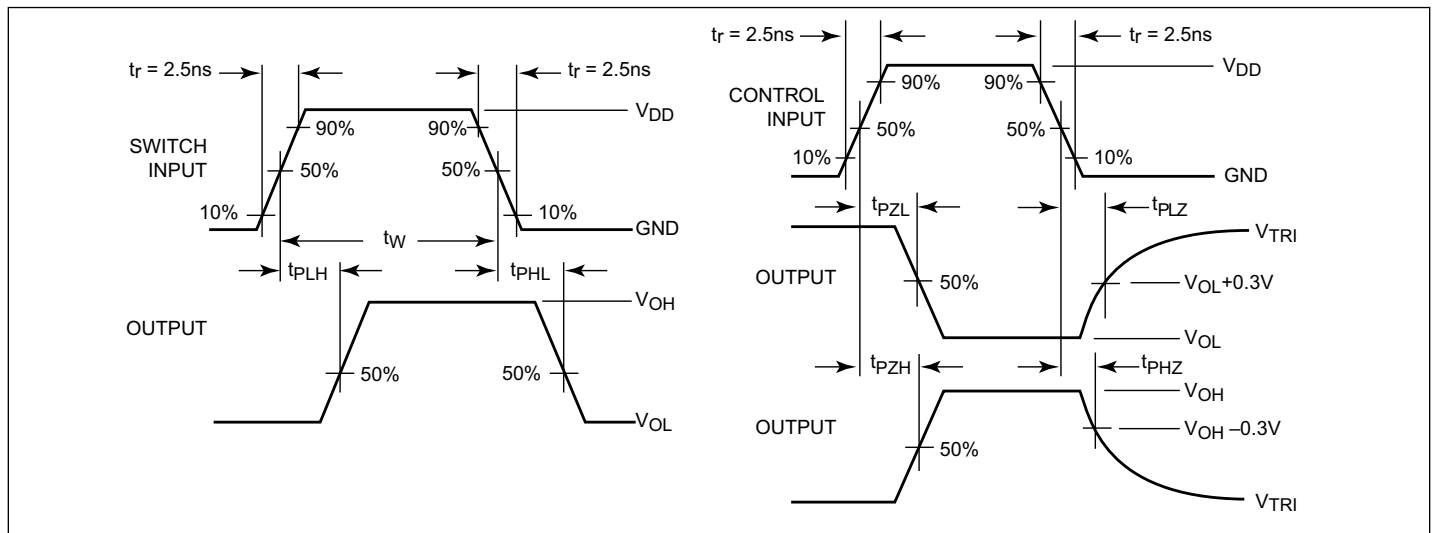


Figure 2. AC Waveforms

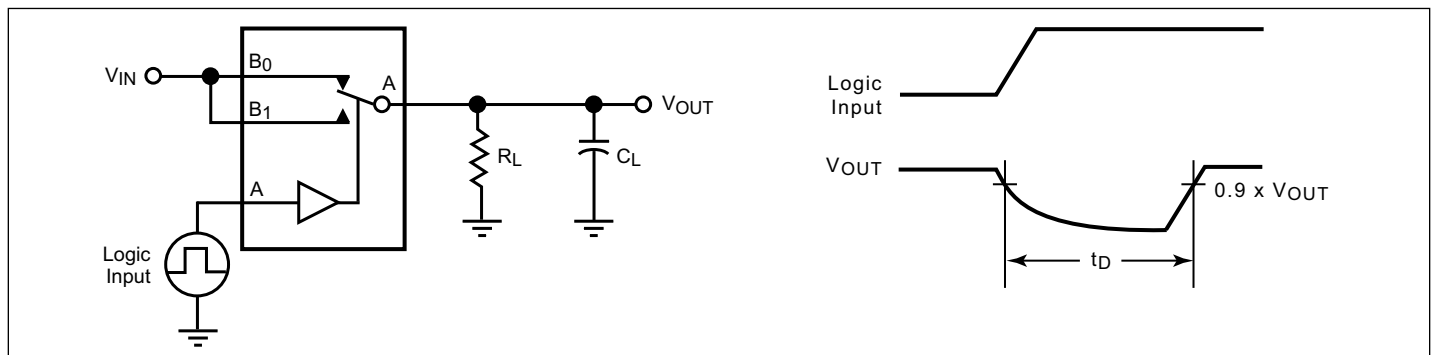


Figure 3. Break Before Make Interval Timing

**PI5A3157**

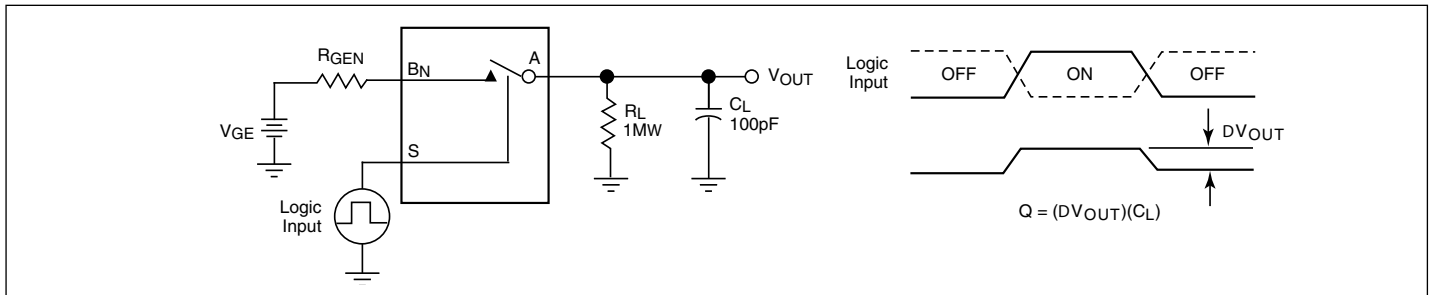


Figure 4. Charge Injection Test

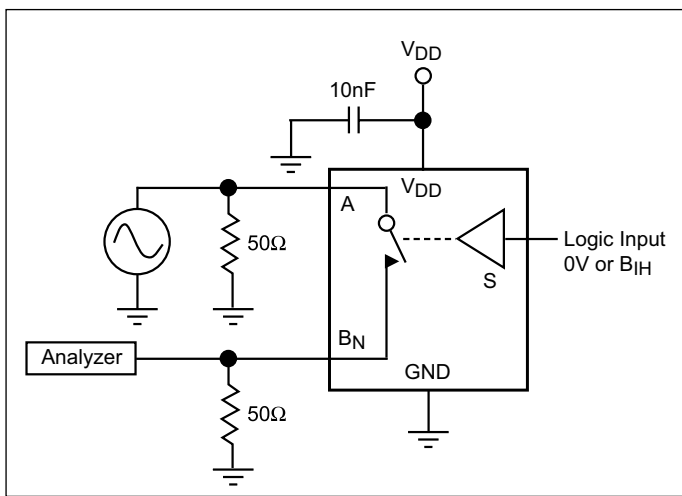


Figure 5. Off Isolation

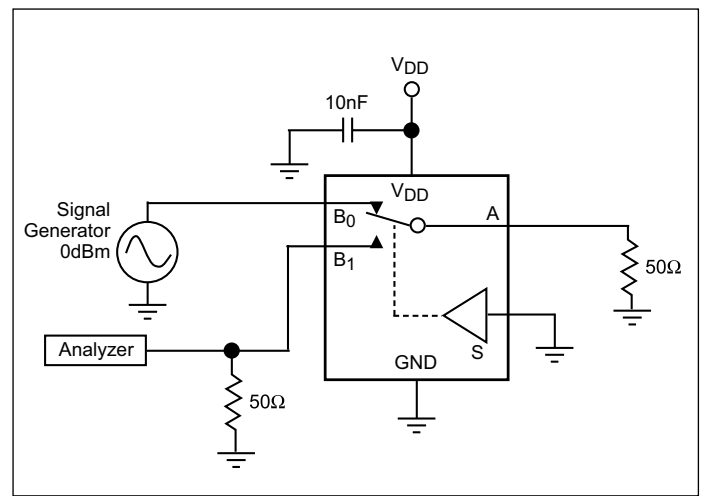


Figure 6. Crosstalk

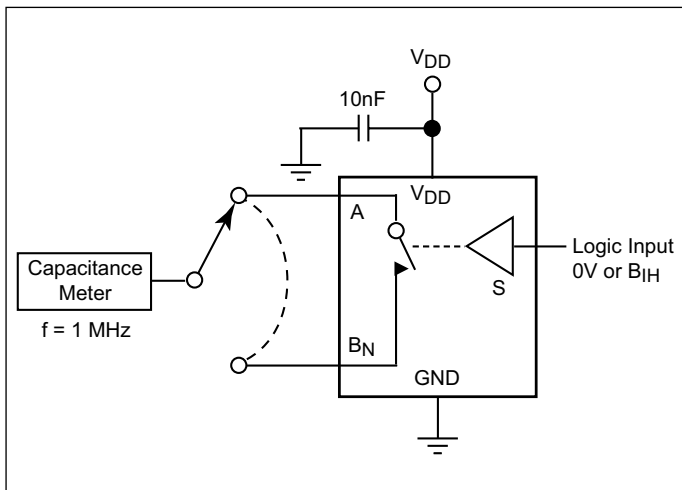


Figure 7. Channel Off Capacitance

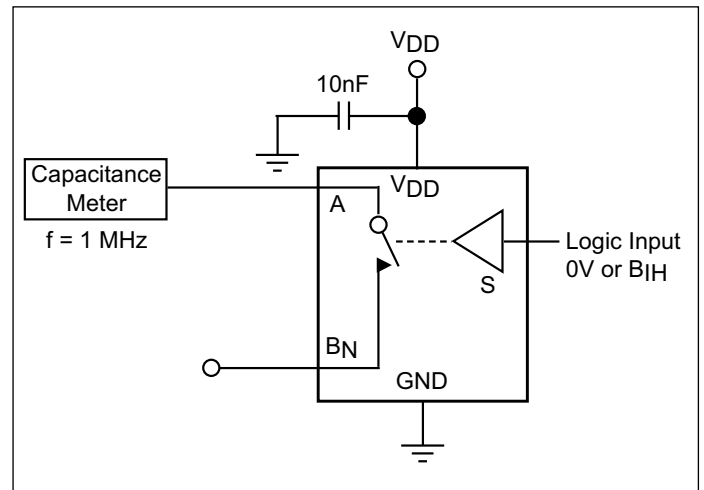


Figure 8. Channel On Capacitance

**PI5A3157**

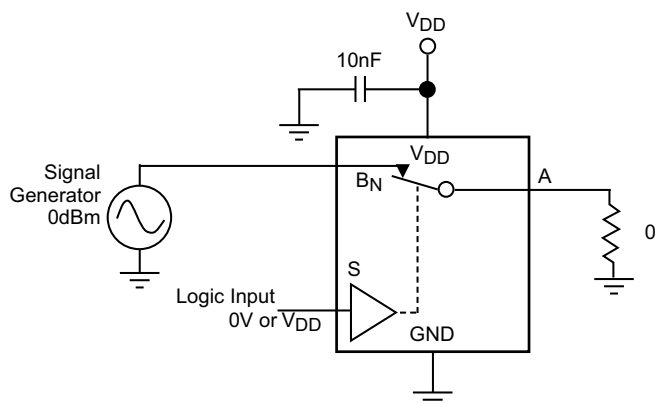
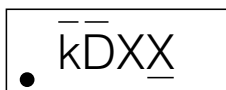


Figure 9. Bandwidth

## Part Marking

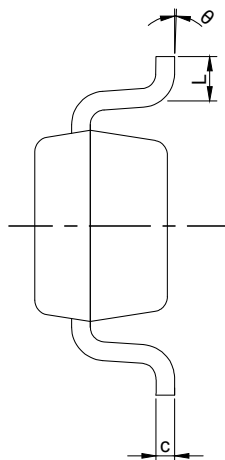
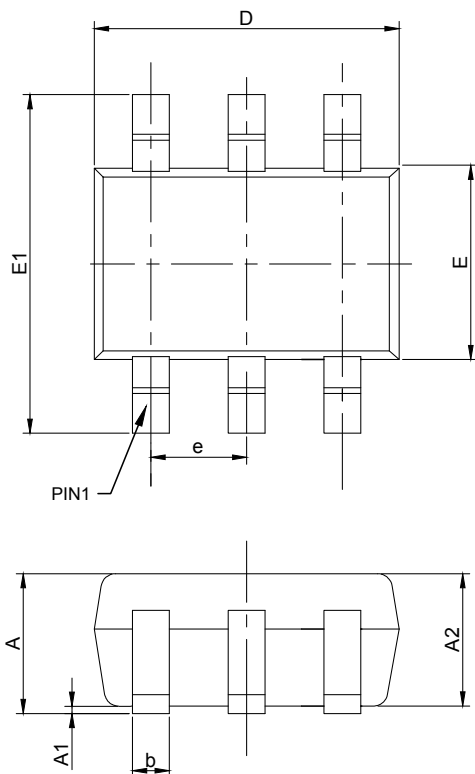
C Package



kD: PI5A3157BC6E

XX: Date Code (Year & Workweek)

The Bar of "D" means Fab3 of Magnachip

**PI5A3157**
**Packaging Mechanical: 6-SC70 (C)**


| 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     | 2.40 |
| e                   | 0.65 BSC |      |
| L                   | 0.26     | 0.46 |
| θ                   | 0°       | 8°   |

**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



DATE: 03/29/16

**DESCRIPTION: 6-Pin, SOT363 (SC70)**
**PACKAGE CODE: C (C6)**
**DOCUMENT CONTROL#: PD-1902**
**REVISION: B**

16-0078

**For latest package info.**

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

| Ordering Code | Packaging Code | Package Description  | Top Mark |
|---------------|----------------|----------------------|----------|
| PI5A3157CEX   | C              | 6-pin, SOT363 (SC70) | ZM       |

**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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1. are intended to implant into the body, or

2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

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Электрон  
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