# ⊙Ɑ PERICOM®

PI5A3159

## SOTᴵᴺʸ™ 1Ω Low-Voltage SPDT Analog Switch

## Features

- CMOS Technology for Bus and Analog Applications
- Low On-Resistance: 2Ω at 3.0V
- Wide $V_{CC}$ Range: +1.8V to +5.5V
- Low Power Consumption : 5µW
- Rail-to-Rail switching throughout Signal Range
- Fast Switching Speed: 30ns max. at 5V
- High Off Isolation: –24dB at 10MHz
- –57dB (1 MHz) Crosstalk Rejection Reduces Signal Distortion
- Break-Before-Make Switching
- Extended Industrial Temperature Range: –40°C to 85°C
- Low On-Resistance Replacement for NC7SB3157
- Packaging (Pb-free & Green available):
- 6-pin SOT-23 (T)

## Applications

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

## Pin Description

| SOT23 | TDFN | Name | Description |
|-------|------|------|-------------|
| 1 | 3 | NO | Data Port |
| 2 | 2 | GND | Ground |
| 3 | 1 | NC | Data Port (Normally Closed) |
| 4 | 6 | COM | Common Output/Data Port |
| 5 | 5 | $V_{CC}$ | Positive Power Supply |
| 6 | 4 | IN | Logic Control |

## Logic Function Table

| Logic Input(s) | Function |
|----------------|----------|
| 0 | NC Connected to COM |
| 1 | NO Connected to COM |

## Description

The PI5A3159 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, 1.8V to 5.5V, the PI5A3159 has a maximum On-Resistance of  4Ω at 1.8V, 2.4Ω at 2.3V &  1Ω at 4.5V.

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

Control input, S, tolerates input drive signals up to 5.5V, independent of supply voltage.

PI5A3159 is a low On-Resistance replacement for the PI5A3157 and NC7SB3157.

## Connection Diagrams



SOT-23



TDFN
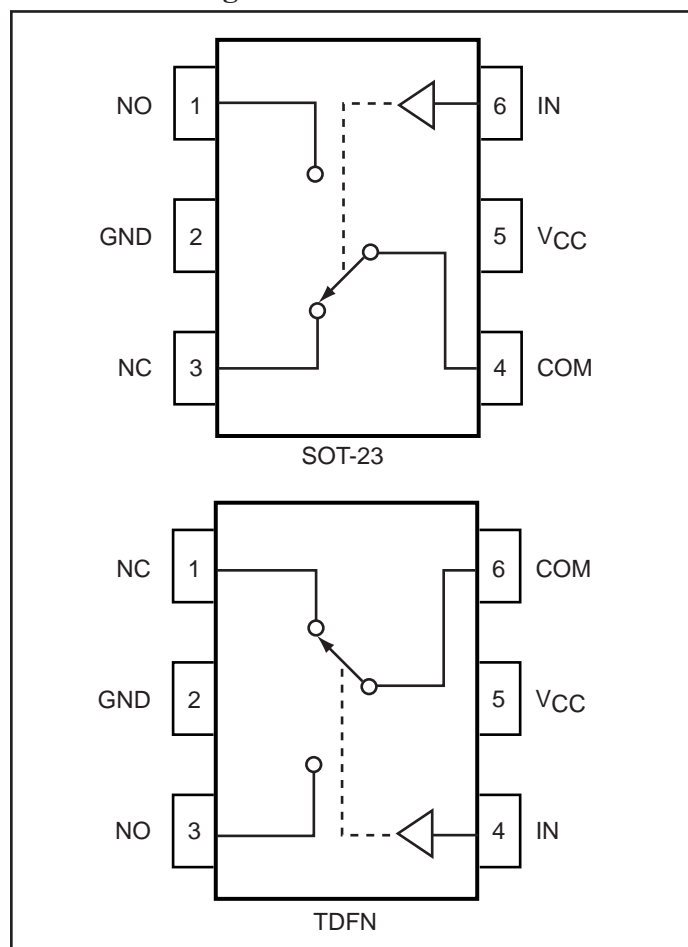
## Absolute Maximum Ratings

Voltages Referenced to GND

$V_{CC}$ ....................................................................... –0.5V to +5.5V

$V_{IN}$, $V_{COM}$, $V_{NC}$, $V_{NO}$ [1] ........................–0.5V to $V_+$ +0.3V
or 30mA, whichever occurs first

Current (any terminal)................................................ ±200mA

Peak Current, COM, NO, NC
(Pulsed at 1ms, 10% duty cycle).................................. ±400mA

*Caution*: *Stresses beyond those listed under "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.*

## Thermal Information

Continuous Power Dissipation

SOT23 (derate 7.1mW/ºC above +70ºC)............................ 0.5W

Storage Temperature ......................................... –65ºC to +150ºC

Lead Temperature (soldering, 10s) ................................ +300ºC

**Note:**

1. Signals on NC, NO, COM, or IN exceeding $V_{CC}$ or GND are clamped by internal diodes. Limit forward diode current to 30mA.

## Electrical Specifications - Single +5V Supply

($V_{CC}$ = +5V ± 10%, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V)

| Parameter | Symbol | Conditions | Temp(°C) | Min[1] | Typ[2] | Max[1] | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[3, 4] | $V_{ANALOG}$ | | Full | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 4.5V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = +2.5V | 25 | | 0.70 | 0.90 | Ω |
| | | | Full | | | 1.1 | |
| On-Resistance Match Between Channels[5] | $\Delta R_{ON}$ | | 25 | | 0.03 | 0.05 | |
| | | | Full | | | 0.10 | |
| On-Resistance Flatness[6] | $R_{FLAT(ON)}$ | $V_{CC}$ = 4.5V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = 1V, 1.5V, 2.5V | 25 | | 0.08 | 0.12 | |
| | | | Full | | | 0.15 | |
| NO or NC Off Leakage Current [7] | $I_{NO(OFF)}$ or $I_{NC(OFF)}$ | $V_{CC}$ = 5.5V, $V_{COM}$ = 0V, $V_{NO}$ or $V_{NC}$ = 4.5V | 25 | 2 | 0.01 | 2 | nA |
| | | | Full | -20 | | 20 | |
| COM On Leakage Current[7] | $I_{COM(ON)}$ | $V_{CC}$ = 5.5V, $V_{COM}$ = 4.5V, $V_{NO}$ or $V_{NC}$ = 4.5V | 25 | -4 | | 4 | |
| | | | Full | -40 | 0.3 | 40 | |

## Electrical Specifications - Single +5V Supply (continued)

($V_{CC}$ = + 5V ± 10%, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V)

| Parameter | Symbol | Conditions | Temp(°C) | Min[1] | Typ[2] | Max[1] | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Input HIGH Voltage | $V_{IH}$ | Guaranteed Logic HIGH level | | 2.0 | | | V |
| Input LOW Voltage | $V_{IL}$ | Guaranteed Logic LOW level | | | | 0.8 | |
| Input Current with HIGH Voltage | $I_{INH}$ | $V_{IN}$ = 2.4V, all others = 0.8V | | -1 | 0.005 | 1 | μA |
| Input Current with LOW Voltage | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 2.4V | | -1 | 0.005 | 1 | |
| **Dynamic** | | | | | | | |
| Turn-On-Time | $t_{ON}$ | $V_{CC}$ = 5V, See Fig. 1 | 25 | | 20 | 35 | ns |
| | | | Full | | | 40 | |
| Turn-Off-Time | $t_{OFF}$ | | 25 | | 15 | 20 | |
| | | | Full | | | 35 | |
| Break-Before-Make | $t_{BBM}$ | See Fig. 3 | 25 | 1 | 12 | 14.5 | |
| | | | Full | 1 | 17.5 | | |
| Charge Injection[3] | Q | $C_L$ -1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0V, See Fig 2 | 25 | | 40 | | pC |
| Off Isolation | $O_{IRR}$ | $R_L$ = 50Ω, f = 1MHz, See Fig 4 | | | -57 | | dB |
| CrossTalk[9] | $X_{TALK}$ | $R_L$ = 50Ω, f = 1MHz, See Fig 4 | | | 36 | | |
| NC or NO Capacitance | $C_{NC/NO(OFF)}$ | f = 1MHz, See Fig 6 | | | 42 | | pF |
| COM On Capacitance | $C_{COM(ON)}$ | f = 1MHz, See Fig 7 | | | 98 | | |
| **Supply** | | | | | | | |
| Power-Supply Range | $V_{CC}$ | | Full | 1.8 | | 5.5 | V |
| Positive Supply Current | $1_{CC}$ | $V_{CC}$ = 5.5V, $V_{IN}$ = 0V or $V_{CC}$, All Channels ON or OFF | Full | | 0.5 | 1 | μA |

**Notes:**
1. The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design.
4. Device is NOT guaranteed to function per the datasheet specification outside of 0 to $V_{CC}$ range.
5. $\Delta R_{ON} = R_{ON}$ max. - $R_{ON}$ min.
6. Flatness is defined as the difference between the maximum and minimum value of On-resistance measured.
7. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25ºC.
8. Off Isolation = $20\log_{10}$ [ $V_{COM}$ / ($V_{NO}$ or $V_{NC}$) ]. See Figure 4.
9. Between any two switches. See Figure 5.

## Electrical Specifications - Single +3.3V Supply

($V_{CC}$ = +3.3V ± 10%, GND = 0V, $V_{INH}$ = 2.0V, $V_{INL}$ = 0.6V)

| Parameter | Symbol | Conditions | Temp(°C) | Min[1] | Typ[2] | Max[1] | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[3] | $V_{ANALOG}$ | | | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 3V, $I_{COM}$ = -24mA, $V_{NO}$ or $V_{NC}$ = 2.0V | 25 | | 1.4 | 1.8 | Ω |
| | | | Full | | | 2.2 | |
| On-Resistance Match Between Channels[4] | $\Delta R_{ON}$ | $V_{CC}$ = 3.3V, $I_{COM}$ = -24mA, $V_{NO}$ or $V_{NC}$ = 0.8V, 2.0V | 25 | | 0.04 | 0.05 | |
| | | | Full | | 0.11 | | |
| On-Resistance Flatness | $R_{FLAT(ON)}$ | | 25 | | 0.17 | 0.2 | |
| | | | Full | | 0.25 | | |
| **Dynamic** | | | | | | | |
| Turn-On-Time | $t_{ON}$ | $V_{CC}$ = 5V, See Fig. 1 | 25 | | 30 | 40 | ns |
| | | | Full | | | 55 | |
| Turn-Off-Time | $t_{OFF}$ | | 25 | | 20 | 25 | |
| | | | Full | | | 40 | |
| Break-Before-Make | $t_{BBM}$ | See Fig. 3 | 25 | 1 | 21 | 29 | |
| Charge Injection[3] | Q | $C_L$ -1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0V, See Fig 2 | 25 | | 30 | | pC |
| **Supply** | | | | | | | |
| Positive Supply Current | $1_{CC}$ | $V_{CC}$ = 3.6V, $V_{IN}$ = 0V or $V_{CC}$, All Channels ON or OFF | Full | | 0.5 | 1 | μA |
| **Logic Input** | | | | | | | |
| Input HIGH Voltage | $V_{IH}$ | Guaranteed Logic HIGH level | Full | 2 | | | V |
| Input LOW Voltage | $V_{IL}$ | Guaranteed Logic LOW level | Full | | | 0.6 | |
| Input HIGH Current | $I_{INH}$ | $V_{IN}$ = 2.4V, all others = 0.8V | Full | -1 | | 1 | μA |
| Input LOW Current | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 2.4V | Full | -1 | | 1 | |

**Notes:**
1.   The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2.   Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3.   Guaranteed by design.
4.   $\Delta R_{ON}$ = $R_{ON}$ max. - $R_{ON}$ min.
5.   Flatness is defined as the difference between the maximum and minimum value of On-Resistance  measured.

## Electrical Specifications - Single +2.5V Supply

($V_{CC}$ = +2.5V ± 10%, GND = 0V, $V_{INH}$ = 1.8V, $V_{INL}$ = 0.6V)

| Parameter | Symbol | Conditions | Temp(°C) | Min[1] | Typ[2] | Max[1] | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[3] | $V_{ANALOG}$ | | | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 1.8V, $I_{COM}$ = -2mA, $V_{NO}$ or $V_{NC}$ = 1.5V | 25 | | 1.6 | 2 | Ω |
| | | | Full | | | 2.7 | |
| On-Resistance Match Between Channels[4] | $\Delta R_{ON}$ | $V_{CC}$ = 1.8V, $I_{COM}$ = -2mA, $V_{NO}$ or $V_{NC}$ = 0.8V, 1.5V | 25 | | 0.13 | 0.16 | |
| | | | Full | | 0.2 | | |
| On-Resistance Flatness | $R_{FLAT(ON)}$ | | 25 | | 0.25 | 0.3 | |
| | | | Full | | 0.45 | | |
| **Dynamic** | | | | | | | |
| Turn-On-Time | $t_{ON}$ | $V_{CC}$ = 2.5V, $V_{NO}$ or $V_{NC}$ = 1.8V, See Fig. 1 | 25 | | 40 | 55 | ns |
| | | | Full | | | 70 | |
| Turn-Off-Time | $t_{OFF}$ | | 25 | | 30 | 40 | |
| | | | Full | | | 55 | |
| Break-Before-Make | $t_{BBM}$ | See Fig. 3 | 25 | 1 | 33 | 39 | |
| Make-Before-Break | $t_{MBB}$ | See Fig. 4 | 25 | 1 | 9 | 13 | |
| Charge Injection[3] | Q | $C_L$ -1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0V, See Fig 2 | 25 | | 20 | | pC |
| **Supply** | | | | | | | |
| Positive Supply Current | $1_{CC}$ | $V_{CC}$ = 2.75V, $V_{IN}$ = 0V or $V_{CC}$, All Channels ON or OFF | Full | | 0.5 | 1 | µA |
| **Logic Input** | | | | | | | |
| Input HIGH Voltage | $V_{IH}$ | Guaranteed Logic HIGH level | Full | 1.8 | | | V |
| Input LOW Voltage | $V_{IL}$ | Guaranteed Logic LOW level | Full | | | 0.6 | |
| Input HIGH Current | $I_{INH}$ | $V_{IN}$ = 2.0V, all others = 0.8V | Full | -1 | | 1 | µA |
| Input LOW Current | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 2.0V | Full | -1 | | 1 | |

**Notes:**
1. The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design.
4. $\Delta R_{ON}$ = $R_{ON}$ max. - $R_{ON}$ min.
5. Flatness is defined as the difference between the maximum and minimum value of On-Resistance measured.

## Electrical Specifications - Single +1.8V Supply

($V_{CC}$ = +1.8V ± 10%, GND = 0V, $V_{INH}$ = 1.5V, $V_{INL}$ = 0.6V)

| Parameter | Symbol | Conditions | Temp(°C) | Min[1] | Typ[2] | Max[1] | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[3] | $V_{ANALOG}$ | | | | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 1.8V, $I_{COM}$ = -2mA, $V_{NO}$ or $V_{NC}$ = 1.5V | 25 | | 2.8 | 4 | Ω |
| | | | Full | | | 5 | |
| On-Resistance Match Between Channels[4] | $\Delta R_{ON}$ | $V_{CC}$ = 1.8V, $I_{COM}$ = -2mA, $V_{NO}$ or $V_{NC}$ = 0.6V, 1.5V | 25 | | 0.44 | 0.6 | Ω |
| | | | Full | | 0.7 | | |
| On-Resistance Flatness | $R_{FLAT(ON)}$ | | 25 | | 0.5 | 0.6 | |
| | | | Full | | 0.9 | | |
| **Dynamic** | | | | | | | |
| Turn-On-Time | $t_{ON}$ | $V_{CC}$ = 1.8V, $V_{NO}$ or $V_{NC}$ = 1.5V, See Fig. 1 | 25 | | 65 | 70 | ns |
| | | | Full | | | 95 | |
| Turn-Off-Time | $t_{OFF}$ | | 25 | | 40 | 55 | |
| | | | Full | | | 70 | |
| Break-Before-Make | $t_{BBM}$ | See Fig. 3 | 25 | 1 | 60 | 72 | |
| Charge Injection[3] | Q | $C_L$ -1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0V, See Fig 2 | 25 | | 10 | | pC |
| **Supply** | | | | | | | |
| Positive Supply Current | $I_{CC}$ | $V_{CC}$ = 2.0, $V_{IN}$ = 0V or $V_{CC}$, All Channels ON or OFF | Full | | 0.5 | 1 | µA |
| **Logic Input** | | | | | | | |
| Input HIGH Voltage | $V_{IH}$ | Guaranteed Logic HIGH level | Full | 1.8 | | | V |
| Input LOW Voltage | $V_{IL}$ | Guaranteed Logic LOW level | Full | | | 0.6 | |
| Input HIGH Current | $I_{INH}$ | $V_{IN}$ = 1.5V, all others = 0.8V | Full | -1 | | 1 | µA |
| Input LOW Current | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 1.5V | Full | -1 | | 1 | |

**Notes:**
1. The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design.
4. $\Delta R_{ON}$ = $R_{ON}$ max. - $R_{ON}$ min.
5. Flatness is defined as the difference between the maximum and minimum value of On-Resistance measured.
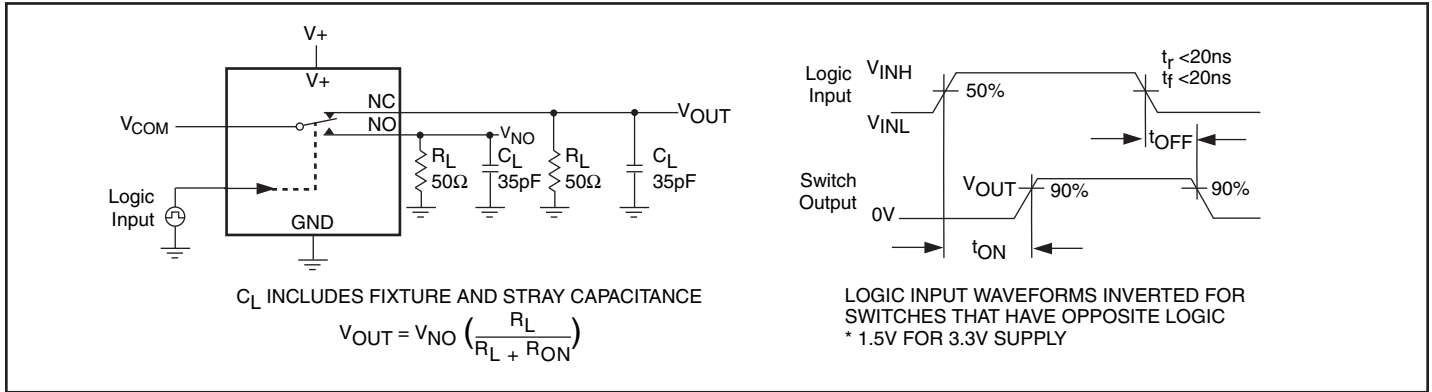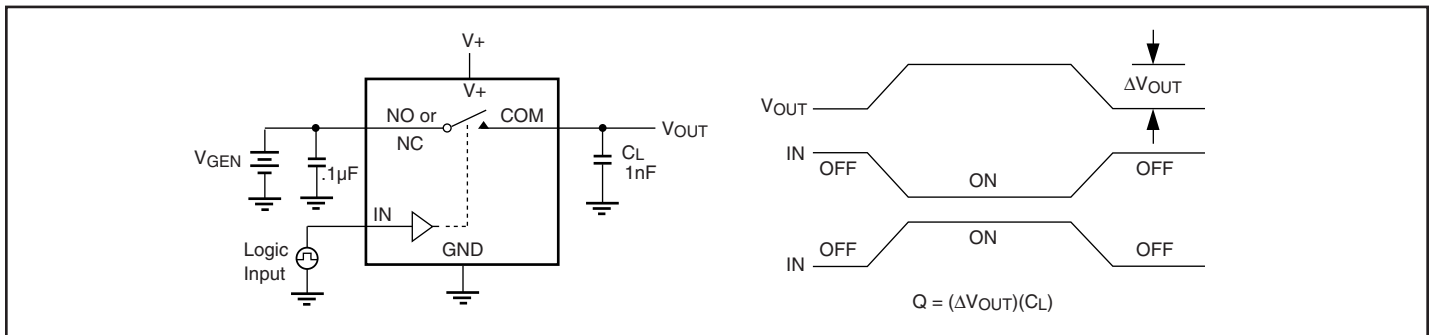
## Test Circuits/Timing Diagrams



$C_L$ INCLUDES FIXTURE AND STRAY CAPACITANCE

$$V_{OUT} = V_{NO} \left( \frac{R_L}{R_L + R_{ON}} \right)$$

LOGIC INPUT WAVEFORMS INVERTED FOR
SWITCHES THAT HAVE OPPOSITE LOGIC
* 1.5V FOR 3.3V SUPPLY

**Figure 1. Switching Time**



$Q = (\Delta V_{OUT})(C_L)$

**Figure 2. Charge Injection**



$C_L$ INCLUDES FIXTURE AND STRAY CAPACITANCE
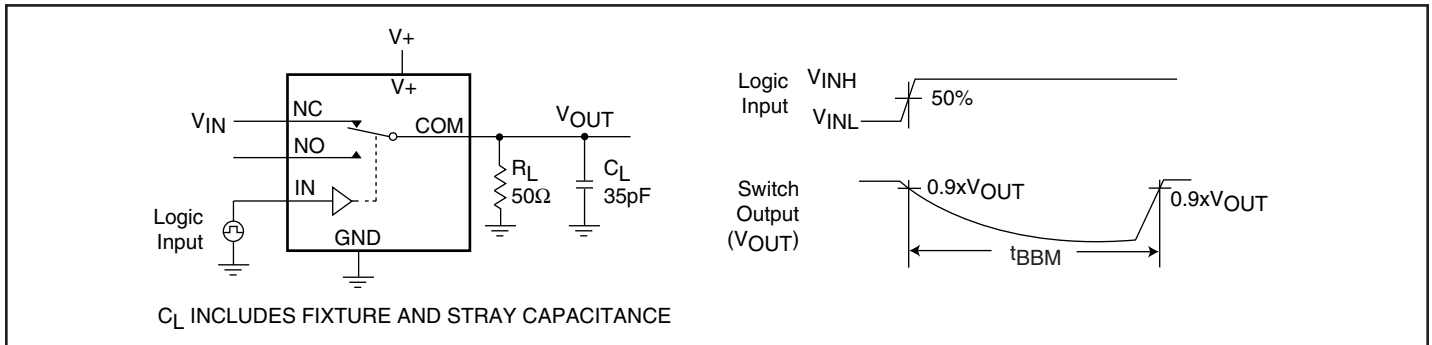
**Figure 3. Break-Before-Make Interval**

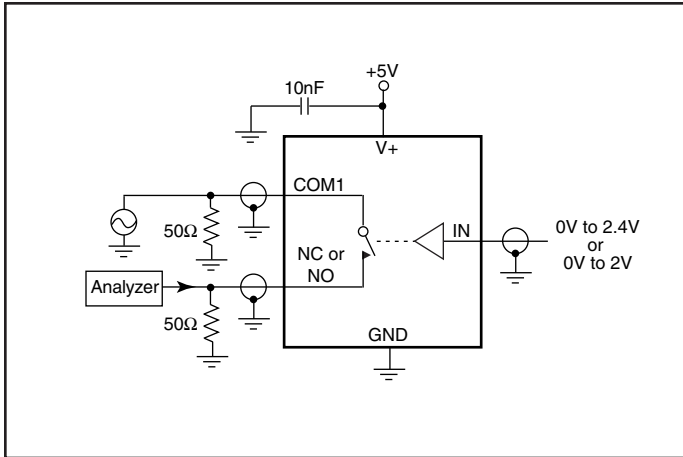## Test Circuits/Timing Diagrams (continued)



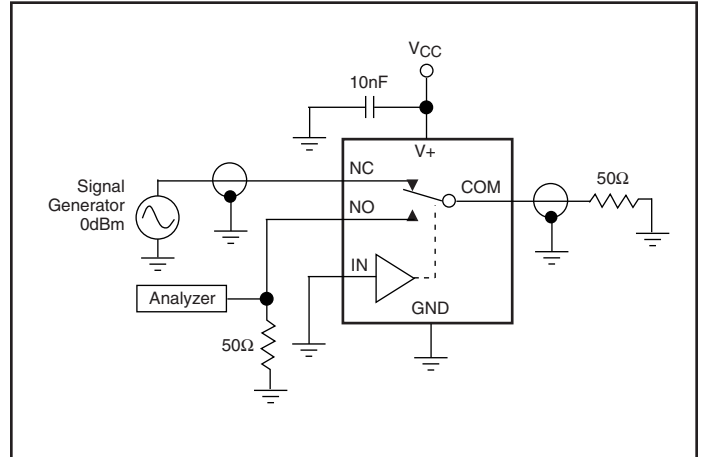**Figure 4. Off Isolation/On-Channel Bandwidth**
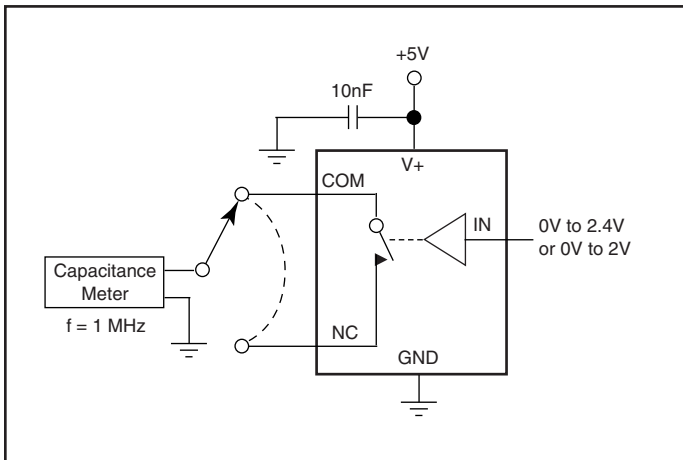


**Figure 5. Crosstalk**



**Figure 6. Channel-Off Capacitance**
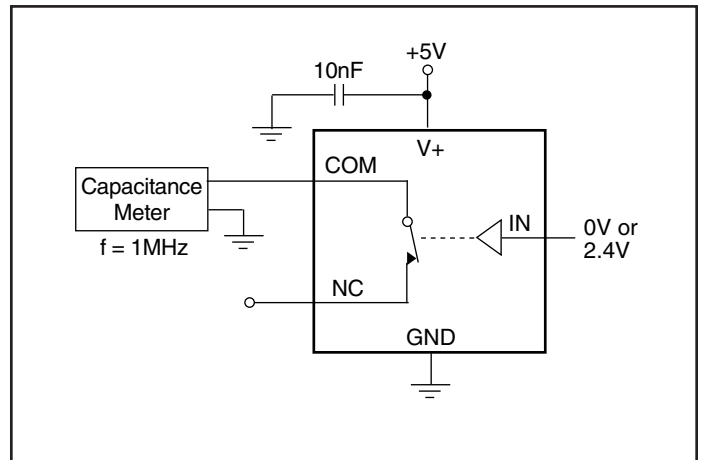


**Figure 7. Channel-On Capacitance**
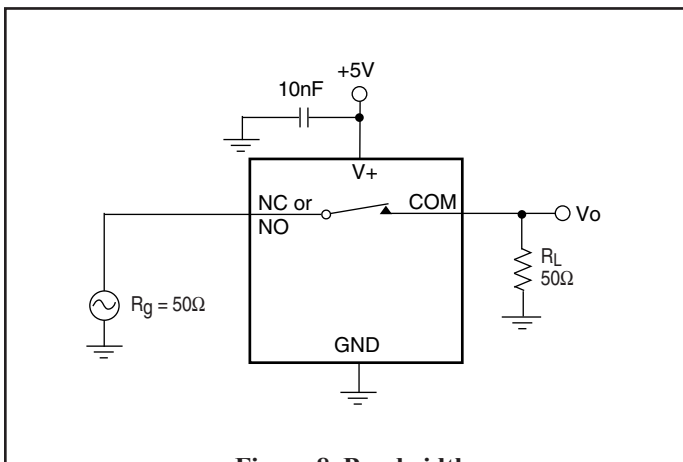


**Figure 8. Bandwidth**
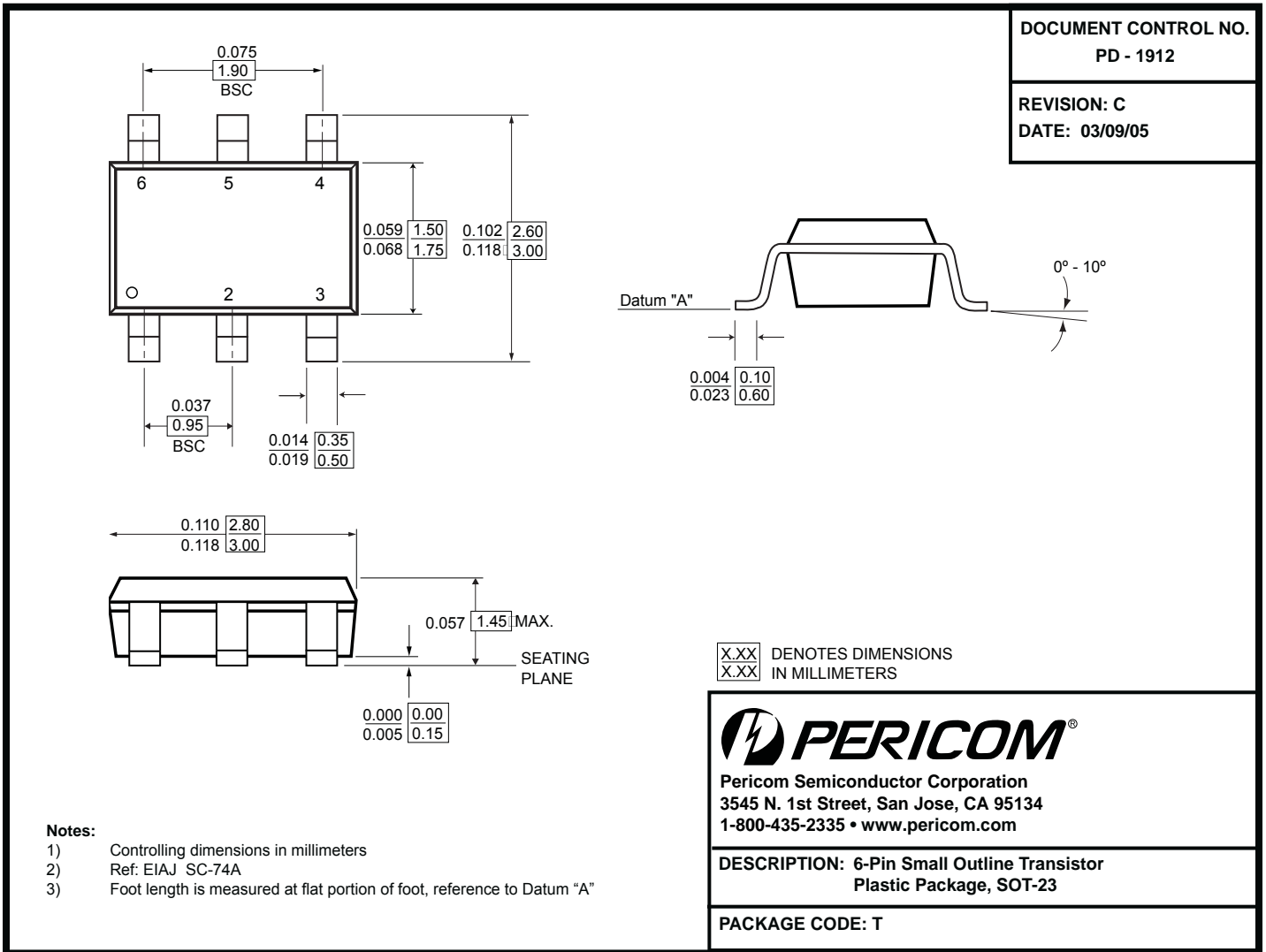
## Packaging Mechanical: 6-Pin SOT-23(T)

| | |
|---|---|
| **DOCUMENT CONTROL NO.** | **PD - 1912** |

**REVISION: C**
**DATE: 03/09/05**

0.075 / 1.90 BSC

6  5  4

2  3

0.059 / 0.068 | 1.50 / 1.75     0.102 / 0.118 | 2.60 / 3.00

0.037 / 0.95 BSC

0.014 / 0.019 | 0.35 / 0.50

Datum "A"

0° - 10°

0.004 / 0.023 | 0.10 / 0.60

0.110 / 0.118 | 2.80 / 3.00

0.057 | 1.45 MAX.

SEATING PLANE

0.000 / 0.005 | 0.00 / 0.15

X.XX / X.XX  DENOTES DIMENSIONS IN MILLIMETERS

**Pericom Semiconductor Corporation**
**3545 N. 1st Street, San Jose, CA 95134**
**1-800-435-2335 • www.pericom.com**

**DESCRIPTION: 6-Pin Small Outline Transistor**
**Plastic Package, SOT-23**

**PACKAGE CODE: T**

**Notes:**
1) Controlling dimensions in millimeters
2) Ref: EIAJ SC-74A
3) Foot length is measured at flat portion of foot, reference to Datum "A"

## Ordering Information

| Ordering Code | Package Code | Package Description | Top Marking |
|---|---|---|---|
| PI5A3159TX | T | 6-pin SOT-23 | ZL |
| PI5A3159TEX | T | 6-pin SOT-23 | ZL |

**Notes**:
1. This product has always shipped as only a lead free product, but since it was introduced prior to Pericom's strategy of adding an E to all Green/Lead free parts many customers order it without the E suffix. Please migrate new designs and qualification to include the E suffix. Pericom at this point in time will continue to offer devices marked both ways, but may at a later date eliminate the non-E part number.
2. Thermal Characteristics can be found on the world wide web at www.pericom.com/packaging/
3. Number of transistors : 753
4. X = Tape and reel