# PI5A3158

## 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
- ESD Protection 2kV HBM + 200V MM
- Break-Before-Make Switching
- High Bandwidth: 250 MHz
- Extended Industrial Temperature Range: –40°C to 85°C
- Packaging (Pb-free & Green available):
  -12-contact TDFN (ZA)

### Applications

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

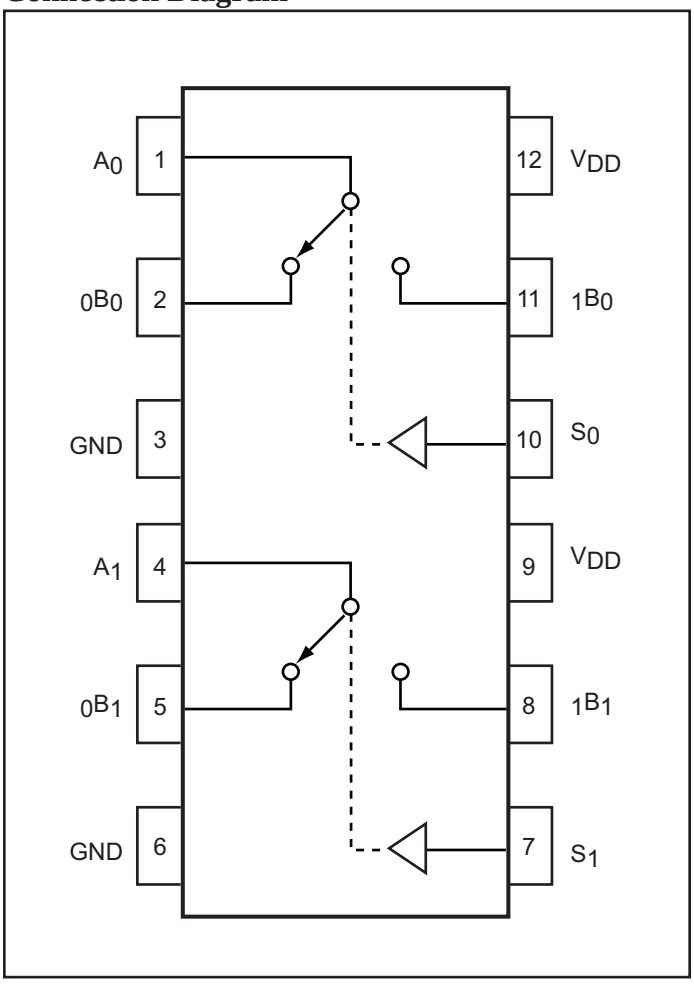
### Description

The PI5A3158 is a dual 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 PI5A3158 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, tolerates input drive signals up to 5.5V, independent of supply voltage.

### Connection Diagram




### Pin Description

| Pin Number | Name | Description |
|---|---|---|
| 8, 11 | $_1B_X$ | Data port (Normally Open) |
| 3, 6 | GND | Ground |
| 2, 5 | $_0B_X$ | Data port (Normally Closed) |
| 1, 4 | $A_X$ | Common Output/data port |
| 9, 12 | $V_{DD}$ | Positive Power Supple |
| 7, 10 | $S_X$ | Logic Controll |

**Notes:**
1. x = 0 or 1

### Logic Function Table

| Logic Input(s) | Function |
|---|---|
| 0 | $_0B_X$ Connection to $A_X$ |
| 1 | $_1B_X$ Connected to $A_X$ |

## Absolute Maximum Ratings(1)

Supply Voltage $V_{DD}$ ..... –0.5V to +7V
DC Switch Voltage ($V_S$)(2) ..... –0.5V to $V_{DD}$ +0.5V
DC Input Voltage ($V_{IN}$)(2) ..... –0.5V to +7.0V
DC Output Current ($V_{OUT}$) ..... 128mA
DC $V_{DD}$ or Ground Current ($I_{CC}$/$I_{GND}$) ..... ±100mA
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(3)

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 ($t_r$,$t_f$)
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 inut 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°C to 85°C)

| Parameters | Description | Test Conditions | Supply Voltage | Temp | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|
| $V_{IAR}$ | Analog Input Signal Range | | $V_{DD}$ | $T_A$ = 25ºC & -40ºC to 85ºC | 0 | | $V_{DD}$ | V |
| $R_{ON}$ | On-Resistance (4) | $I_O$ = 30mA, $V_{IN}$ = 0V | 4.5V | $T_A$ = 25ºC | | 4 | 6 | Ω |
| | | $I_O$ = -30mA, $V_{IN}$ = 2.4V | | | | 5 | 8 | |
| | | $I_O$ = -30mA, $V_{IN}$ = 4.5V | | | | 8 | 13 | |
| $R_{ON}$ | | $I_O$ = 30mA, $V_{IN}$ = 0V | 4.5V | $T_A$ = -40ºC to 85ºC | | | 6 | |
| | | $I_O$ = -30mA, $V_{IN}$ = 2.4V | | | | | 8 | |
| | | $I_O$ = -30mA, $V_{IN}$ = 4.5V | | | | | 13 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 3.0V | $T_A$ = 25ºC | | 5 | 8 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 3.0V | | | | 12 | 19 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 3.0V | $T_A$ = -40ºC to 85ºC | | | 8 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 3.0V | | | | | 19 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 2.3V | $T_A$ = 25ºC | | 6 | 9 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 2.3V | | | | 16 | 24 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 2.3V | $T_A$ = -40ºC to 85ºC | | | 9 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 2.4V | | | | | 24 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 1.65V | $T_A$ = 25ºC | | 8 | 12 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 1.65V | | | | 27 | 39 | |
| $R_{ON}$ | | $I_O$ = 24mA, $V_{IN}$ = 0V | 1.65V | $T_A$ = -40ºC to 85ºC | | | 12 | |
| | | $I_O$ = -24mA, $V_{IN}$ = 1.65V | | | | | 39 | |

## DC Electrical Characteristics (Over the Operating temperature range, $T_A$ = –40°C to 85°C) (continued)

| Parameters | Description | Test Conditions | Supply Voltage | Temp | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|
| $\Delta R_{ON}$ | On-Resistance Match Between Channels(4, 5, 6) | $I_A$ = -30mA, $V_{BN}$ = 3.15V | 4.5V | $T_A$ = 25ºC | | 0.15 | | Ω |
| | | $I_A$ = -24mA, $V_{BN}$ = 2.1V | 3.0V | | | 0.2 | | |
| | | $I_A$ = -8mA, $V_{BN}$ = 1.6V | 2.3V | | | 0.3 | | |
| | | $I_A$ = -4mA, $V_{BN}$ = 1.15V | 1.65V | | | 0.3 | | |
| $R_{ONF}$ | On-Resistance Flatness(4, 5, 7) | $I_A$ = -30mA, 0 ≤ $V_{BN}$ ≤ $V_{DD}$ | 5.0V | $T_A$ = 25ºC | | 6 | | |
| | | $I_A$ = -24mA, 0 ≤ $V_{BN}$ ≤ $V_{DD}$ | 3.3V | | | 12 | | |
| | | $I_A$ = -8mA, 0 ≤ $V_{BN}$ ≤ $V_{DD}$ | 2.5V | | | 22 | | |
| | | $I_A$ = -4mA, 0 ≤ $V_{BN}$ ≤ $V_{DD}$ | 1.8V | | | 90 | | |
| $V_{IH}$ | Input High Voltage | Logic High Level | $V_{DD}$ = 1.65V to 1.95V | $T_A$ = -40ºC to 85ºC | 0.75 $V_{DD}$ | | | V |
| | | | $V_{DD}$ = 2.3V to 5.5V | | 0.7 $V_{DD}$ | | | |
| $V_{IL}$ | Input Low Voltage | Logic LowLevel | $V_{DD}$ = 1.65V to 1.95V | | | | | |
| | | | $V_{DD}$ = 2.3V to 5.5V | | | | | |
| | Input Leakage Curent | 0 ≤ $V_{IN}$ ≤ 5.5V | $V_{DD}$ ≤ 0V ≤ 5.5V | $T_A$ = 25ºC | | | ±0.1 | µA |
| | | | | $T_A$ = -40ºC to 85ºC | | | ±1.0 | |
| $I_{OFF}$ | OFF State Leakage Current | 0 ≤ $V_{IN}$ ≤ 5.5V | $V_{DD}$ ≤ 1.65V ≤ 5.5V | $T_A$ = 25ºC | | | ±0.1 | |
| | | | | $T_A$ = -40ºC to 85ºC | | | ±10 | |
| $I_{CC}$ | Quiescent Supply Current | All Channels ON or OFF, $V_{IN}$ = $V_{DD}$ or GND, $I_{OUT}$ = 0 | $V_{DD}$ = 5.5V | $T_A$ = 25ºC | | | 2 | |
| | | | | $T_A$ = -40ºC to 85ºC | | | 20 | |

**Notes:**

4. 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).
5. Parameter is characterized but not tested in production.
6. $\Delta R_{ON}$ = $R_{ON}$ max – $R_{ON}$ min. measured at identical $V_{DD}$, temperature and voltage levels.
7. Flatness is defined as difference between maximum and minimum value of On-Resistance over the specified range of conditions.
8. Guaranteed by design.

## Capacitance(12)

| Parameters | Description | Test Conditions | Supply Voltage | Temp | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|
| $C_{IN}$ | Controll Input | f = 1 MHz(12) | $V_{DD}$ = 5.0V | $T_A$ = 25ºC | | 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 |
|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay: A to Bn | See test circut diagram 1 and 2 $V_I$ Open(10) | $V_{DD}$ = 2.3V to 2.7V | $T_A$ = 25ºC & -40ºC to 85ºC | | 1.2 | | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | | 0.8 | | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | | 0.3 | | |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Turn ON Time: A to Bn | See test circut diagram 1 and 2 $V_I$ = 2 $V_{DD}$ for $t_{PZL}$, $V_I$ = 0V for $t_{PZH}$ | $V_{DD}$ = 1.65V to 1.95V | $T_A$ = 25ºC | 7 | | 23 | |
| | | | $V_{DD}$ = 2.3V to 2.7V | | 3.5 | | 13 | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | 2.5 | | 6.9 | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | 1.7 | | 5.2 | |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Turn ON Time: A to Bn | See test circut diagram 1 and 2 $V_I$ = 2 $V_{DD}$ for $t_{PZL}$, $V_I$ = 0V for $t_{PZH}$ | $V_{DD}$ = 2.5V | $T_A$ = 25ºC & -40ºC to 85ºC | | | 24 | |
| | | | $V_{DD}$ = 3.3V | | | | 14 | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | | | 7.6 | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | | | 5.7 | |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable-Turn OFF Time: A to Bn | See test circut diagram 1 and 2 $V_I$ = 2 $V_{DD}$ for $t_{PZL}$, $V_I$ = 0V for $t_{PZH}$ | $V_{DD}$ = 1.65V to 1.95V | $T_A$ = 25ºC | 3 | | 12.5 | |
| | | | $V_{DD}$ = 2.3V to 2.7V | | 2 | | 7 | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | 1.5 | | 5 | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | 0.8 | | 3.5 | |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable-Turn OFF Time: A to Bn | See test circut diagram 1 and 2 $V_I$ = 2 $V_{DD}$ for $t_{PZL}$, $V_I$ = 0V for $t_{PZH}$ | $V_{DD}$ = 2.5V | $T_A$ = 25ºC & -40ºC to 85ºC | | | 13 | |
| | | | $V_{DD}$ = 3.3V | | | | 7.5 | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | | | 5.3 | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | | | 3.8 | |
| $t_{BM}$ | Break Before Make Time | See Test Circut diagram 9.(9) | $V_{DD}$ = 2.5V | $T_A$ = 25ºC & -40ºC to 85ºC | 0.5 | | | |
| | | | $V_{DD}$ = 3.3V | | 0.5 | | | |
| | | | $V_{DD}$ = 3.0V to 3.6V | | 0.5 | | | |
| | | | $V_{DD}$ = 4.5V to 5.5V | | 0.5 | | | |
| Q | Charge Injection | $C_L$ = 0.1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω, See test circut 4 | $V_{DD}$ = 5.0V | $T_A$ = 25ºC | | 7 | | pC |
| | | | $V_{DD}$ = 3.3V | | | 3 | | |
| $O_{IRR}$ | Off Isolation | $R_L$ = 50Ω, $V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω, See test circut 5(11) | $V_{DD}$ = 1.65V to 5.5V | $T_A$ = 25ºC | | -57 | | dB |
| $X_{TALK}$ | Crosstalk Isolation | See test circut 6 | $V_{DD}$ = 1.65V to 5.5V | $T_A$ = 25ºC | | -54 | | |
| $f_{3dB}$ | -3dB Bandwidth | See test circut 9 | $V_{DD}$ = 1.65V to 5.5V | $T_A$ = 25ºC | | 250 | | MHz |

**Notes:**

9. Guaranteed by design.
10. 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, whne driven by an ideal voltage source with zero output impedance.
11. Off Isolation = 20 $Log_{10}$ [ $V_A$ / $V_{Bn}$ ] and is measured in dB.
12. $T_A$ = 25°C, f = 1MHz. Capacitance is characterized but not tested in production.

## Test Circuits and Timing Diagrams

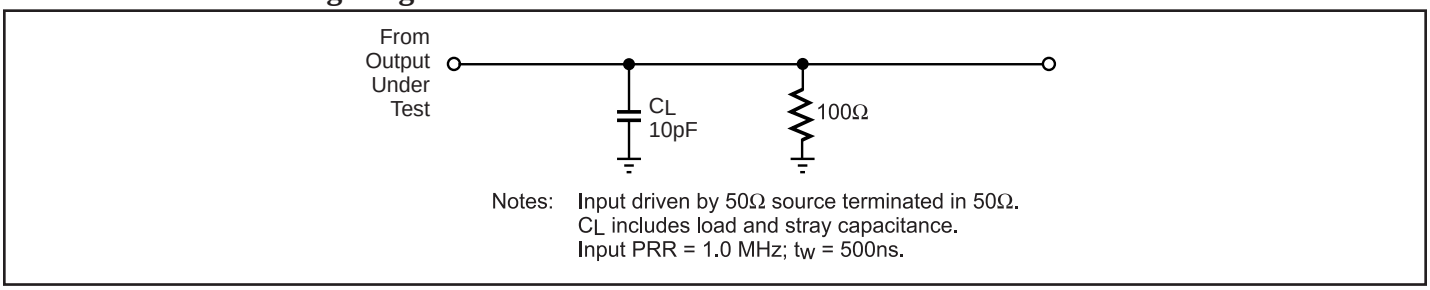



Figure 1. AC Test Circuit

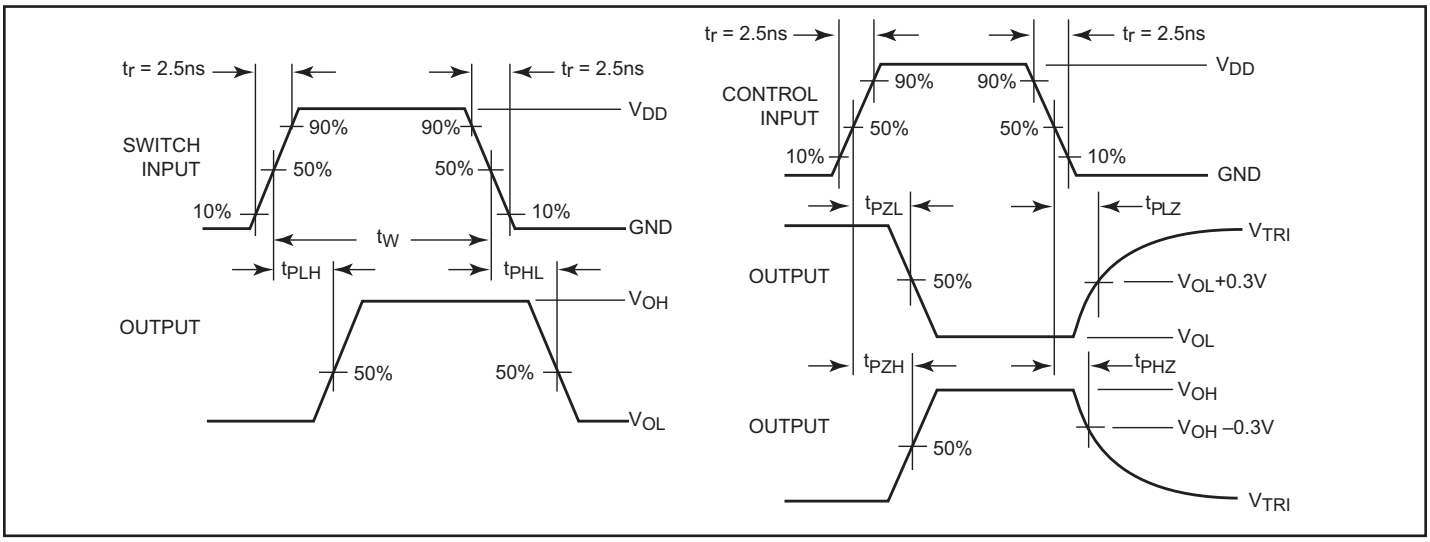



Figure 2. AC Waveforms

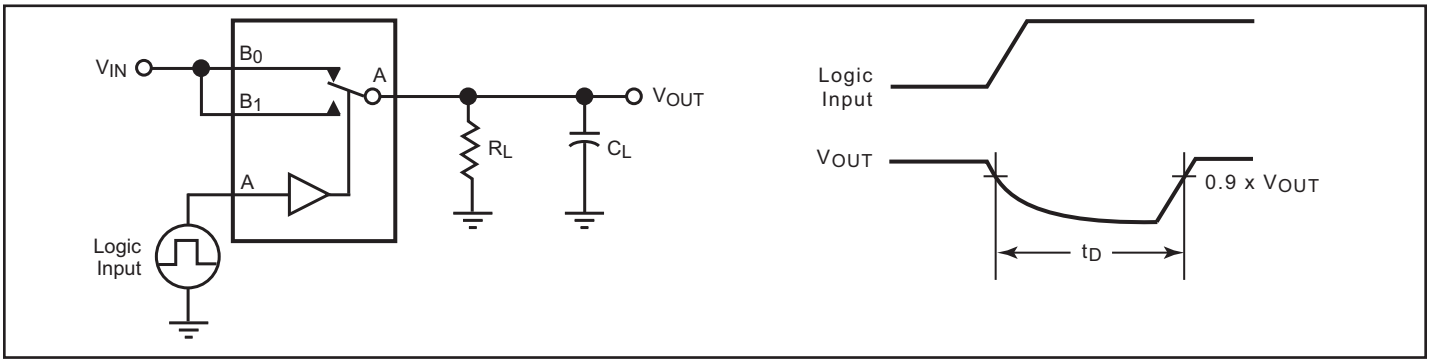



Figure 3. Break Before Make Interval Timing

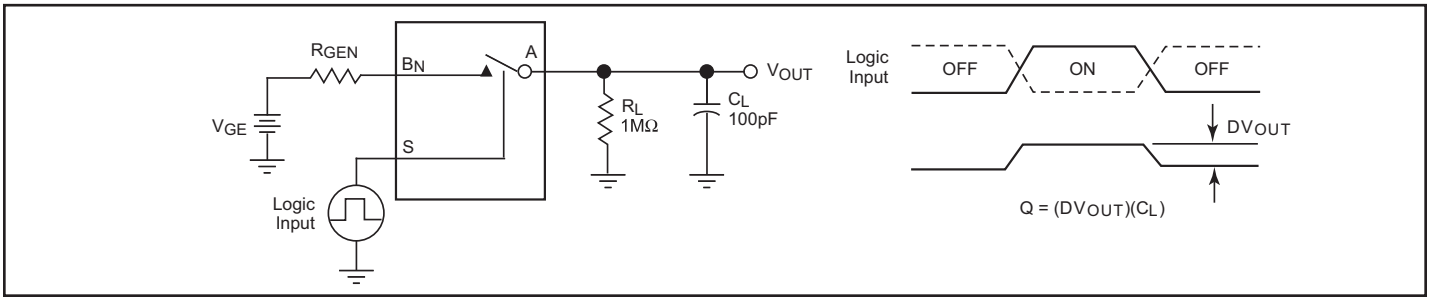



Figure 4. Charge Injection Test

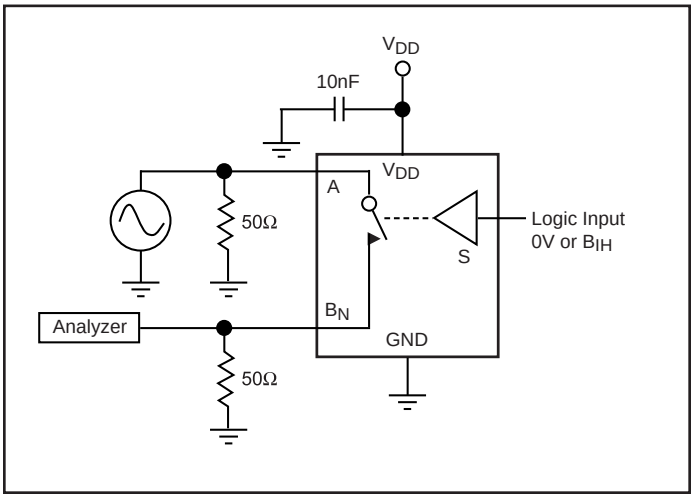



Figure 5. Off Isolation

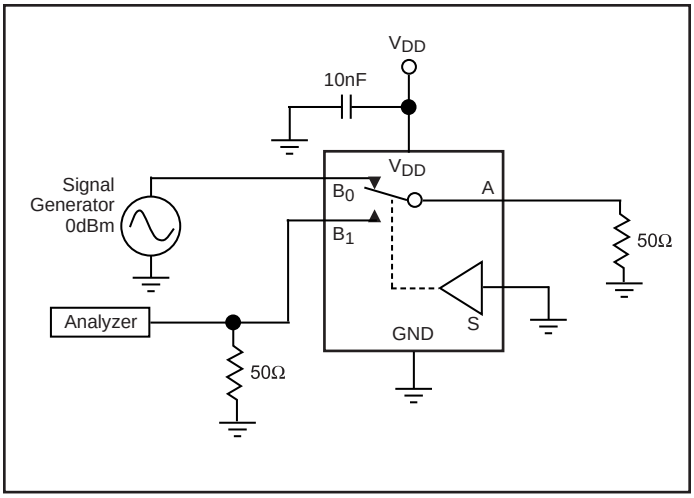



Figure 6. Crosstalk

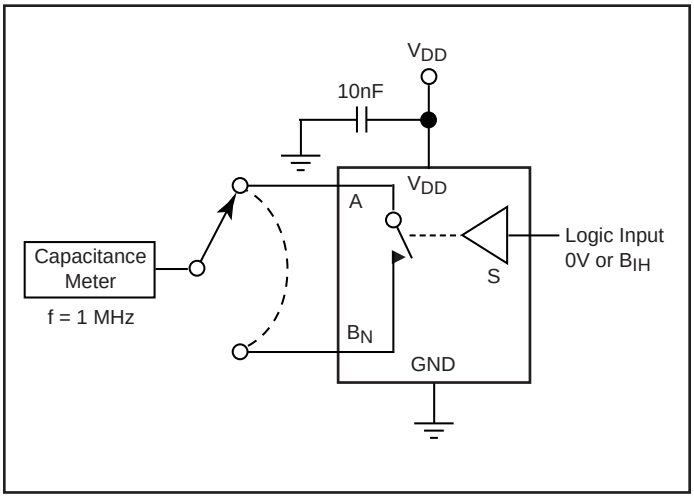



Figure 7. Channel Off Capacitance

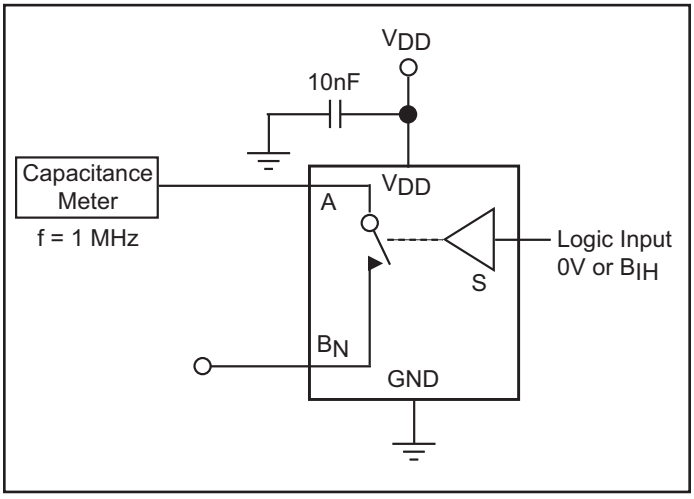



Figure 8. Channel On Capacitance

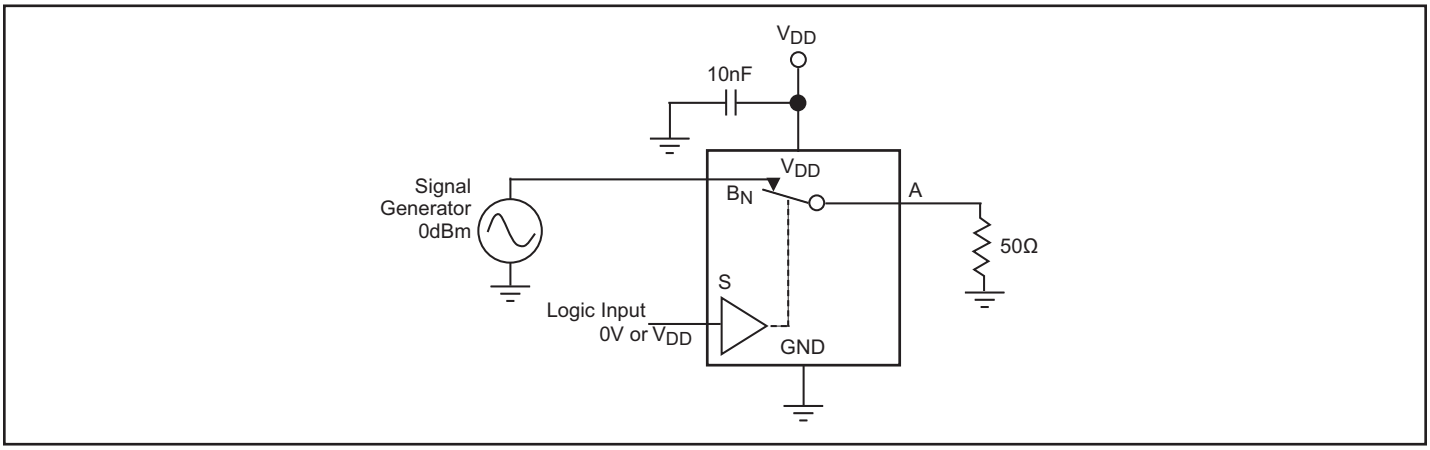
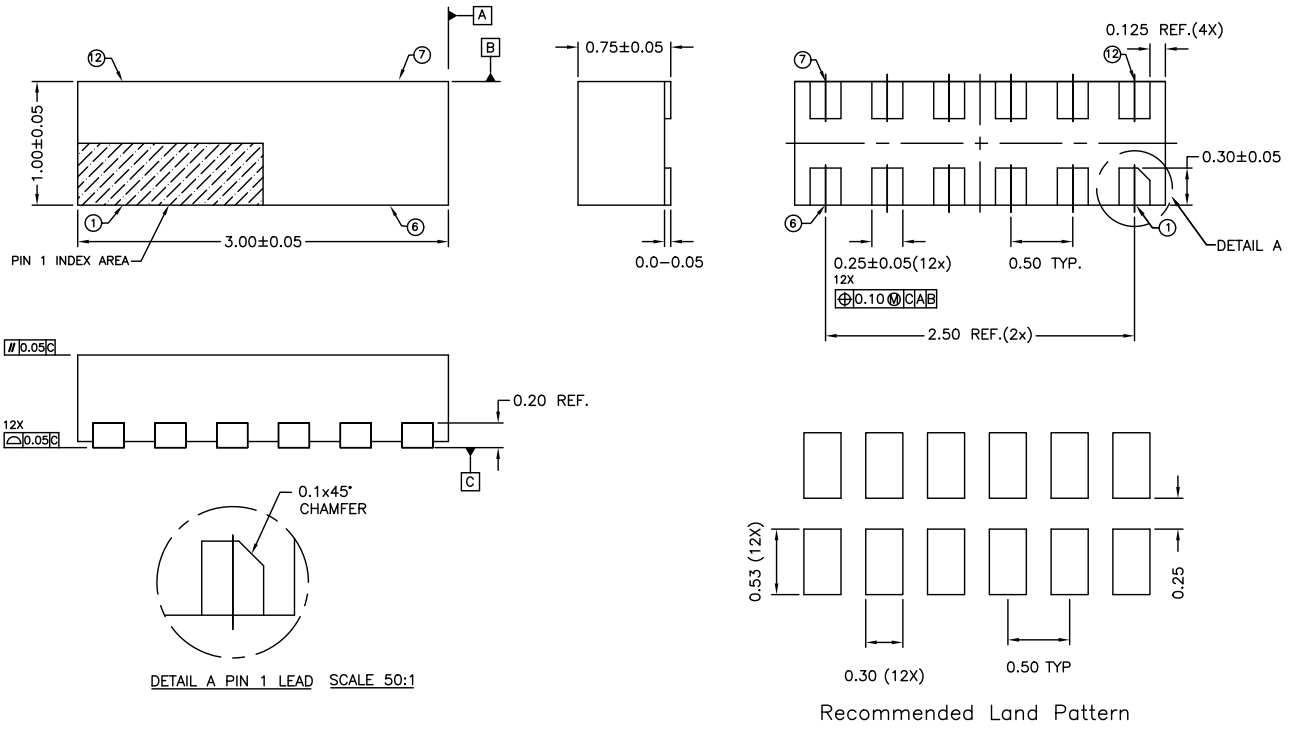



Figure 9. Bandwidth




NOTE :
1. ALL DIMENSION ARE IN mm. ANGLES IN DEGREES.
2. REFER JEDEC MO−229/WBAD (MODIFY)

PERICOM Semiconductor Corporation — DATE: 04/22/08

DESCRIPTION: 12-Contact, Thin Dual-in-line Flat No-Lead, TDFN

PACKAGE CODE: ZA

DOCUMENT CONTROL #: PD-2009 — REVISION: E

08-0286

**Note:**
- For latest package info, please check: http://www.pericom.com/products/packaging/mechanicals.php

## Ordering Information

| Ordering Code | Packaging Code | Package Type | Top Mark |
|---|---|---|---|
| PI5A3158ZAEX | ZA | Pb-free & Green, 12-contact TDFN | A0 |

**Notes:**
- Thermal characteristics can be found on the company web site at www.pericom.com/packaging/
- E = Pb-free and Green
- Adding an X suffix = Tape/Reel