# PI5A101

## Precision Wide-Bandwidth Analog Switch

### Features

- Rail-To-Rail operation
- Pin-compatible with 3125 Bus Switch & 74 series 125
- Single-Supply operation: 2V to 6V
- Low On-Resistance: 8Ω typical @ 5V
- Tight match between channels: 0.9Ω typical
- $R_{ON}$ flatness: 3Ω typical
- Low power consumption: 0.5µ-ohm typical
- High Speed, $T_{ON}$ = 8ns typical
- High-current channel capability: >100mA
- Wide bandwidth: >200 MHz
- Packaging (Pb-free & Green available):
  -14-pin SOIC (W)
  -16-pin QSOP (Q)

### Applications

- Instrumentation, ATE
- Audio Switching and Routing
- Telecommunications Systems
- Data Communications
- Battery-Powered Systems
- Replaces Mechanical Relays

### Description

Pericom Semiconducto's PI5A101 is an all-purpose analog switch designed for single-supply operation from +2V to +6V. This switch is ideal for audio, video, and data switching and routing.

The PI5A101 is a quad SPST (single-pole, single-throw) NC (normally closed) function.

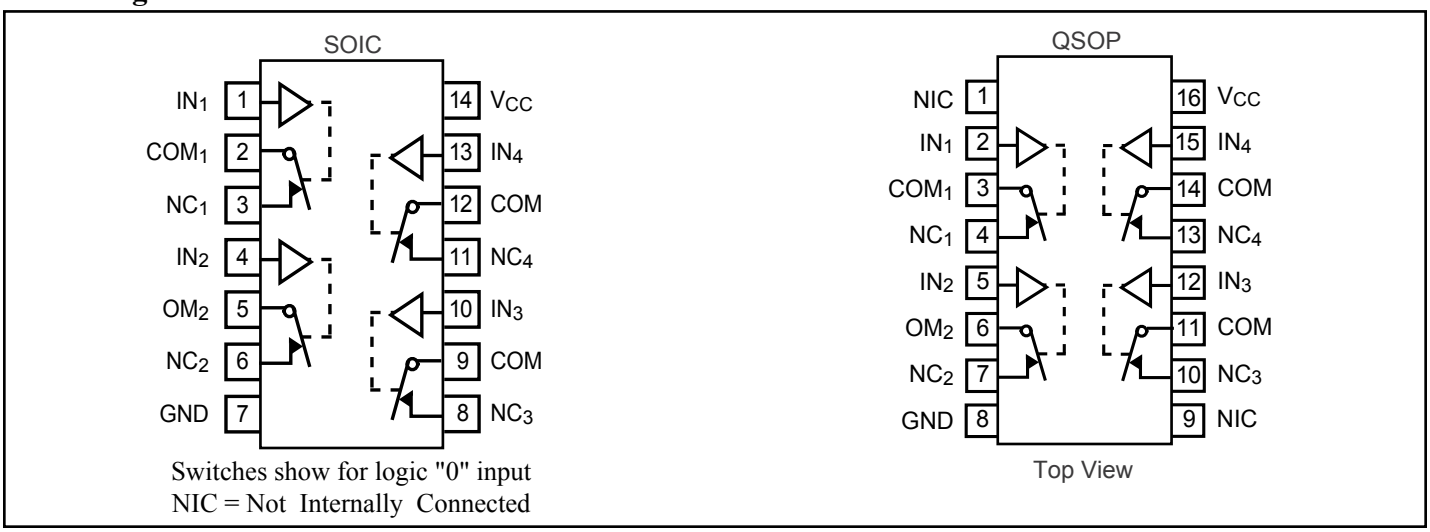
When on, each switch conducts current equally well in either direction. When off, they block voltages up to the power-supply rails.

The PI5A101 is fully specified with +5V and +3.3V supplies. With +5V the $R_{ON}$ is 8Ω typical, making it ideal for replacing mechanical relays in data communications, test equipment, and instrumentation applications. Matching between channels is better than 2Ω. $R_{ON}$ flatness is better than 4Ω over the specified range.

These analog switches also offer wide bandwidth (>200 MHz high speed ($T_{ON}$ >15ns), and low charge injection (Q >10pC).

The PI5A101 is available in the narrow-body 14-pin small SOIC and 16-pin QSOP packages for operation over the industrial (–40°C to +85°C) temperature range.

### Pin Configurations




Switches show for logic "0" input
NIC = Not Internally Connected

### Truth Table

| Logic | Switch |
|---|---|
| 0 | ON |
| 1 | OFF |

## 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) | $V_{ANALOG}$ | | Full | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 4.5V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = +2.5V | 25 | | 8 | 10 | Ω |
| | | | Full | | | 18 | |
| On-Resistance Match Between Channels(4) | $\Delta R_{ON}$ | | 25 | | 0.9 | 2 | |
| | | | Full | | | 4 | |
| On-Resistance Flatness(5) | $R_{FLAT(ON)}$ | $V_{CC}$ = 5V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = 1V, 2.5V, 4V | 25 | | 3 | 4 | |
| | | | Full | | | 5 | |
| NO or NC Off Leakage Current(6) | $I_{NO(OFF)}$ or $I_{NC(OFF)}$ | $V_{CC}$ = 5.5V, $V_{COM}$ = 0V, $V_{NO}$ or $V_{NC}$ = 4.5V | 25 | | 0.05 | | nA |
| | | | Full | -80 | | 80 | |
| COM Off Leakage Current(6) | $I_{COM(OFF)}$ | $V_{CC}$ = 5.5V, $V_{COM}$ = + 4.5V, $V_{NO}$ or $V_{NC}$ = ± 0V | 25 | | 0.05 | | |
| | | | Full | -80 | | 80 | |
| COM On Leakage Current(6) | $I_{COM(ON)}$ | $V_{CC}$ = 5.5V, $V_{COM}$ = +4.5V $V_{NO}$ or $V_{NC}$ = +4.5V | 25 | | 0.07 | | |
| | | | Full | -80 | | 80 | |
| **Logic Input** | | | | | | | |
| Input High Voltage | $V_{IH}$ | Guaranteed logic High Level | Full | 2 | | | V |
| Input Low Voltage | $V_{IL}$ | Guaranteed logic Low Level | | | | | |
| Input Current with Voltage High | $I_{INH}$ | $V_{IN}$ = 2.4V, all others = 0.8V | | | | 0.8 | µA |
| Input Current with Voltage Low | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 2.4V | | -1 | 0.005 | 1 | |

**Electrical Specifications - Single +5V Supply** ($V_{CC}$ = +5V ± 10%, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V) (continued)

| Parameter | Symbol | Conditions | Temp.(°C) | Min.(1) | Typ.(2) | Max.(1) | Units |
|---|---|---|---|---|---|---|---|
| **Dynamic** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{CC}$ = 5V, see figure 1 | 25 | | 8 | 15 | ns |
| | | | Full | | | 20 | |
| Turn-Off Time | $t_{OFF}$ | | 25 | | 3.5 | 7 | |
| | | | Full | | | 10 | |
| Charge Injection(3) | Q | $C_L$ = 1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0V, Figure 2 | 25 | | 7 | 10 | pC |
| Off Isolation | $O_{IRR}$ | $R_L$ = 50Ω, $C_L$ = 5pF, f = 10MHz, see figure 3 | | | -55 | | dB |
| Crosstalk(8) | $I_{COM(OFF)}$ | $R_L$ = 50Ω, $C_L$ = 5pF, f = 10MHz, see figure 4 | | | -92 | | |
| NC or NO Capacitance | $C_{(OFF)}$ | f = 1kHz, see figure 5 | | | 8 | | pF |
| COM Off Capacitance | $C_{COM(OFF)}$ | | | | 8 | | |
| COM On Capacitance | $C_{COM(ON)}$ | f = 1kHz, see figure 6 | | | 14 | | |
| 3-dB Bandwidth | BW | $R_L$ = 10kΩ | Full | | 230 | | MHz |
| Distortion(9) | D | | | | 0.03 | | % |
| **Supply** | | | | | | | |
| Power-Supple Range | $V_{CC}$ | | Full | 2 | | 6 | V |
| Positve Supply Current | $I_{CC}$ | $V_{CC}$ = 3.6V, $V_{IN}$ = 0V or V+, All Channels on or off | | | | 1 | µA |

## Absolute Maximum Ratings

Voltages Referenced to GND

$V_{CC}$ .....–0.5V to +7V

$V_{IN}$, $V_{COM}$, $V_{NC}$(1) ..... –0.5V to $V_{CC}$ +2V

.....or 30mA, whichever occurs first

Current (any terminal except COM, NO, NC).....30mA

Current: COM, NO, NC (pulsed at 1ms, 10% duty cycle) .....120mA

## Thermal Information

Continuous Power Dissipation

Narrow SO & QSOP (derate 8.7mW/°C above +70°C) .....650mW

Storage Temperature ..... -65°C to +150°C

Lead Temperature (soldering, 10s) ..... +300°C

**Notes**

1. Signals on NC, COM, or IN exceeding $V_{CC}$ or GND are clamped by internal diodes. Limit forward diode current to 30mA.
2. 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.

## Electrical Specifications-Single +3.3V Supply ($V_{CC}$ = +3.3V ± 10%, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V)

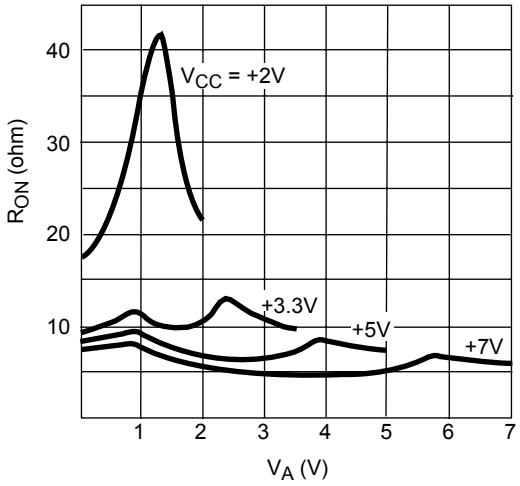
| Parameter | Symbol | Conditions | Temp.(°C) | Min.(1) | Typ.(2) | Max.(1) | Units |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range(3) | $V_{ANALOG}$ | | Full | 0 | | $V_{CC}$ | V |
| On-Resistance | $R_{ON}$ | $V_{CC}$ = 3V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = 1.5V | 25 | | 7.2 | 18 | Ω |
| | | | Full | | | 28 | |
| On-Resistance Match Between Channels(4) | $\Delta R_{ON}$ | | 25 | | 0.2 | 2 | |
| | | | Full | | | 4 | |
| On-Resistance Flatness(3,5) | $R_{FLAT(ON)}$ | $V_{CC}$ = 3.3V, $I_{COM}$ = -30mA, $V_{NO}$ or $V_{NC}$ = 0.8V, 2.5V | 25 | | 2.72 | 10 | |
| | | | Full | | | 12 | |
| **Dynamic** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{CC}$ = 3.3V, $V_{NO}$ or $V_{NC}$ = 1.5V, see figure 1 | 25 | | 7 | 25 | ns |
| | | | Full | | | 40 | |
| Turn-Off Time | $t_{OFF}$ | | 25 | | 1 | 12 | |
| | | | Full | | | 20 | |
| Charge Injection(3) | Q | $C_L$ = 1nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω, Figure 2 | 25 | | 1.6 | 10 | pC |
| **Supply** | | | | | | | |
| Positve Supply Current | $I_{CC}$ | $V_{CC}$ = 3.6V, $V_{IN}$ = 0V or $V_{CC}$, All Channels on or off | Full | | | 1 | µA |

**Notes:**

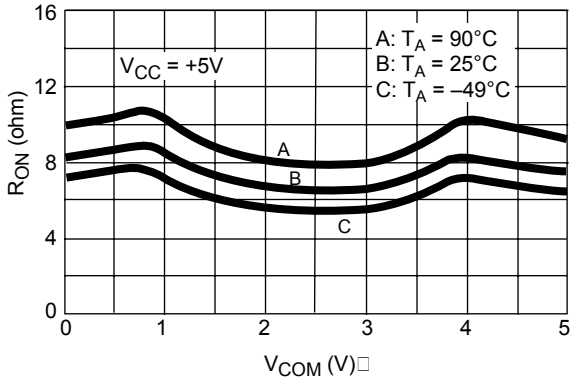
1. The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design
4. $\Delta R_{ON} = R_{ON}$ MAX - $R_{ON}$ MIN
5. Flatness is defined as the difference between the maximum and minimum value of On-Resistance measured.
6. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25ºC.
7. Off Isolation = $20\log_{10} V_B / V_A$. See Figure 3.
8. Between any two switches. See Figure 4.
9. $D = R_{FLAT(ON)}/R_L$.

## Typical Operating Characteristics ($T_A$ = +25ºC, unless otherwise noted)

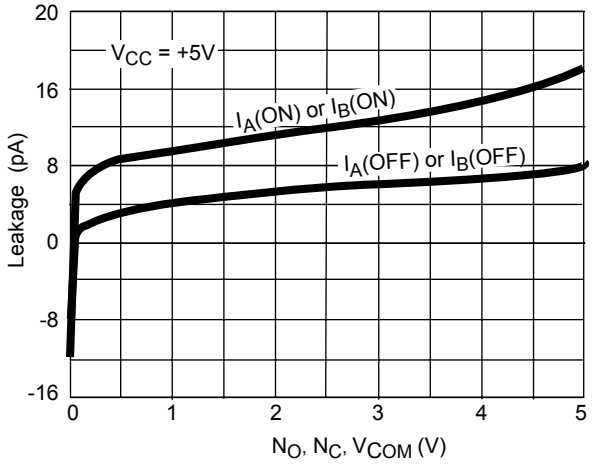
**$R_{ON}$ vs. $V_{COM}$**



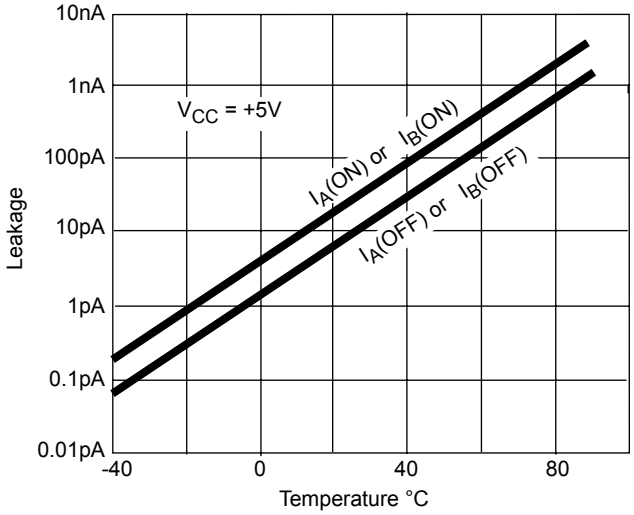

**$R_{ON}$ vs. $V_{COM}$ and Temperature**



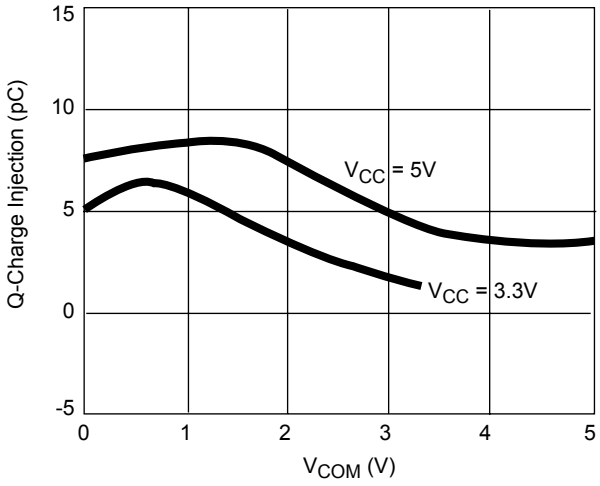

**Leakage Currents vs. Analog Voltage**



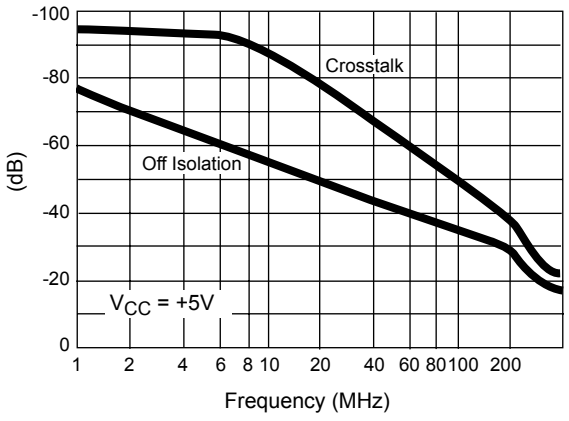

**Leakage Current vs. Temperature**



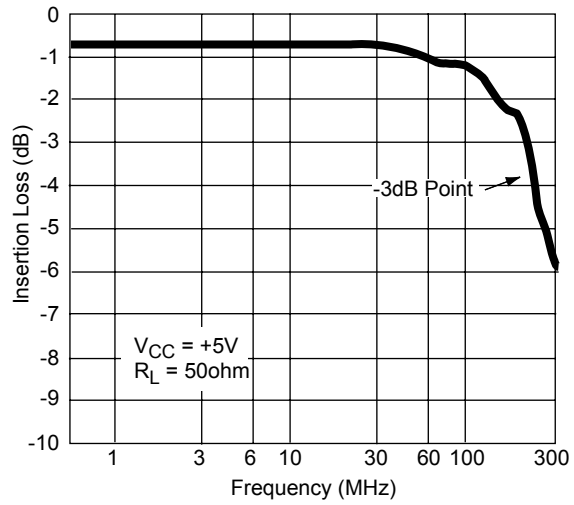

**Charge Injection vs. Analog Voltage**



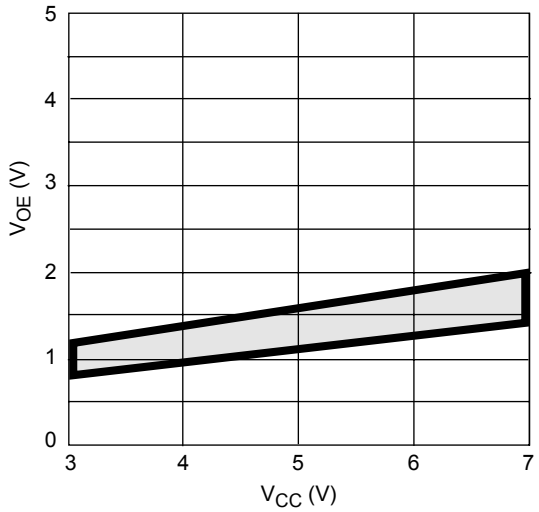

**Crosstalk and Off-Isolation vs. Frequency**



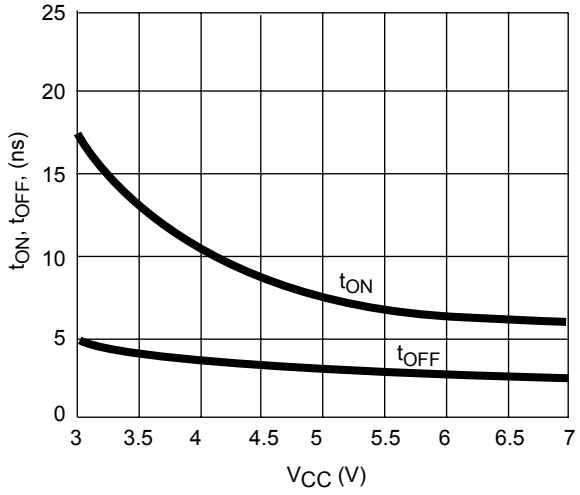
**Insertion Loss vs. Frequency**



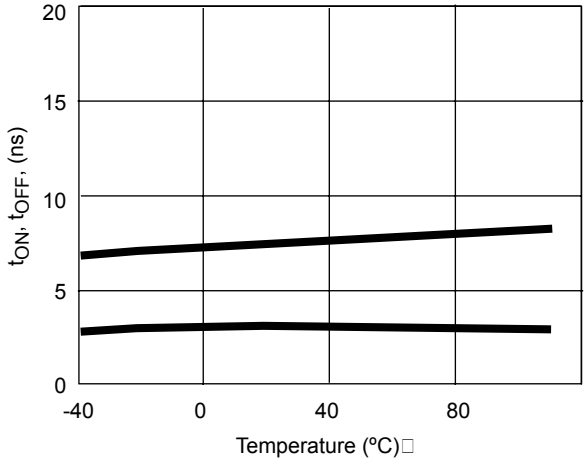

**Input Switching Threshold vs. Supply Voltage**



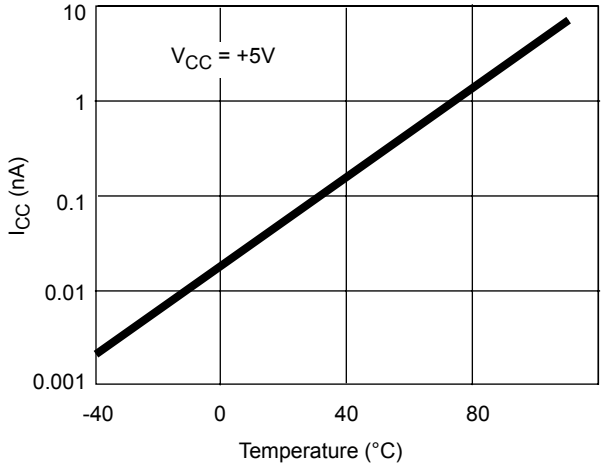

**Switching Times vs. $V_{CC}$**



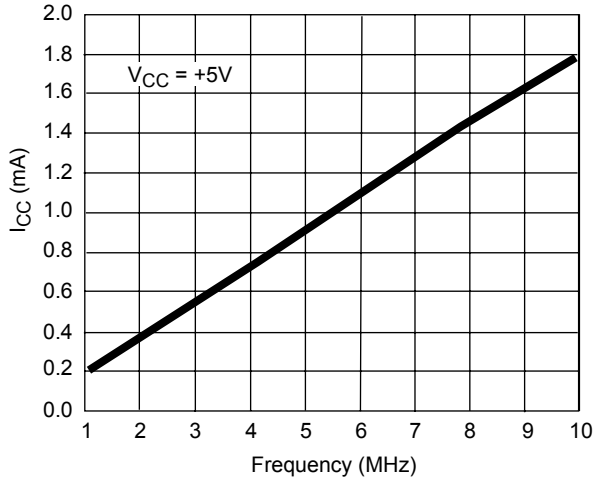

**Switching Times vs. Temperature**




**Supply Current vs. Temperature**




**Supply Current vs. Input Switching Frequency**



## Test Circuits/Timing Diagrams

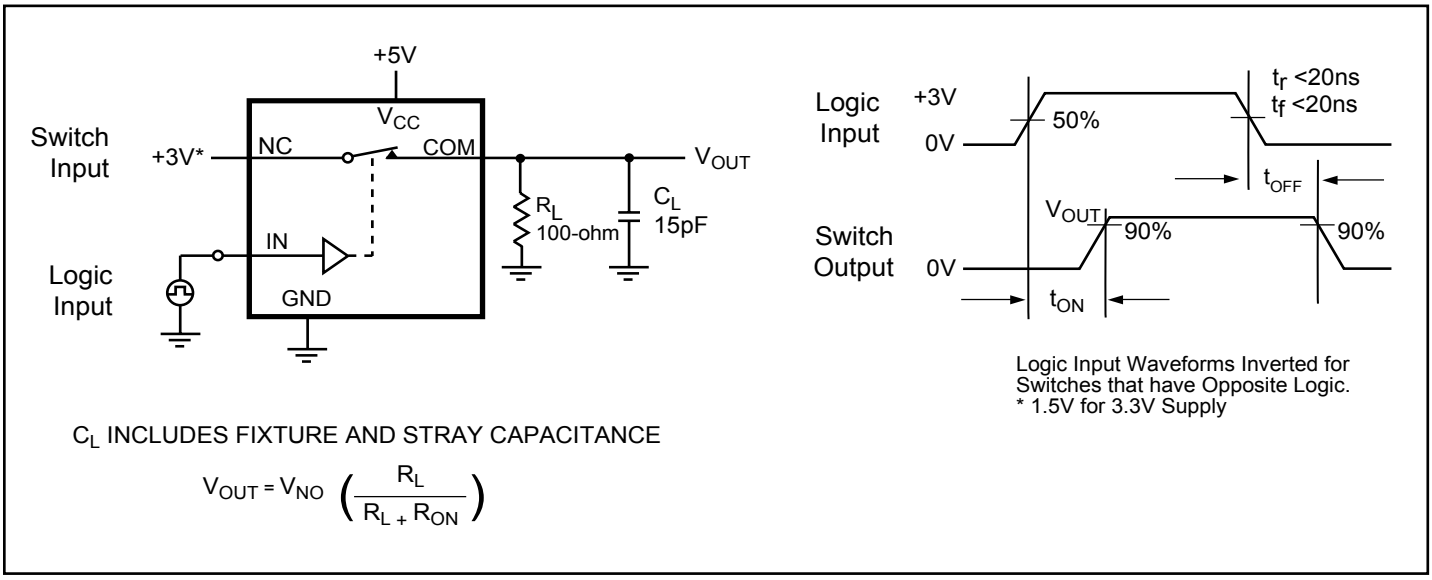



**Figure 1. Switching Time**

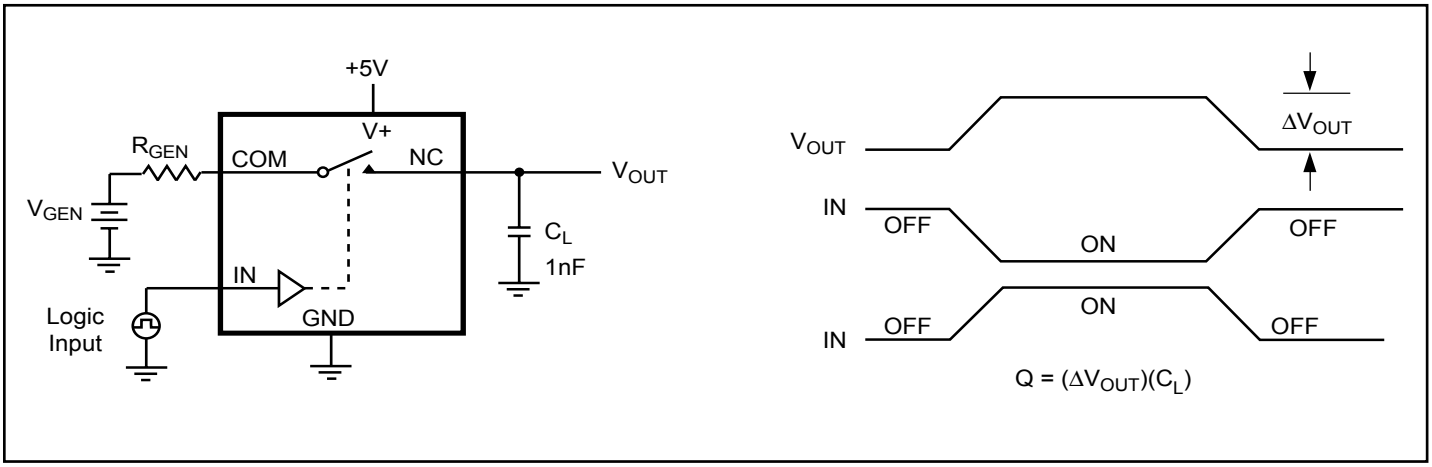



**Figure 2. Charge Injection**

## Test Circuits/Timing Diagrams (continued)

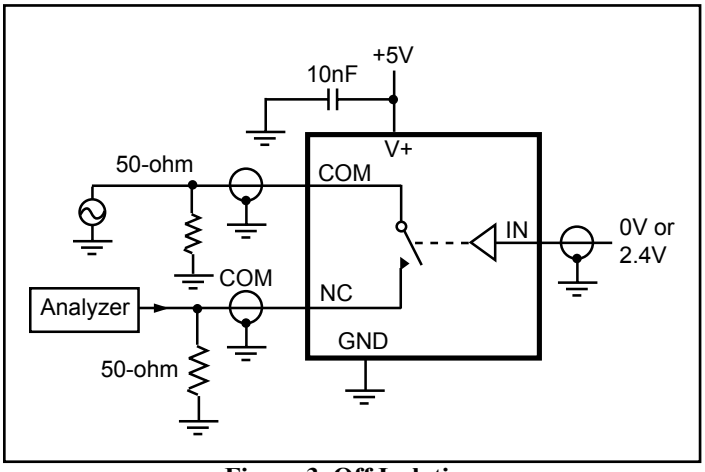



**Figure 3. Off Isolation**

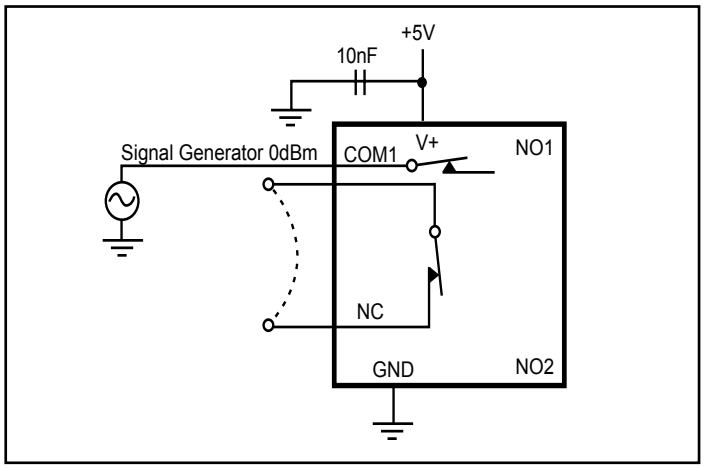



**Figure 4. Crosstalk**

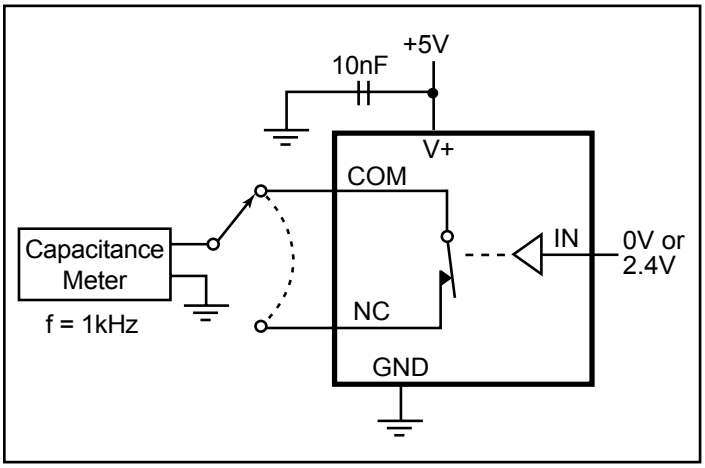



**Figure 5. Channel-Off Capacitance**

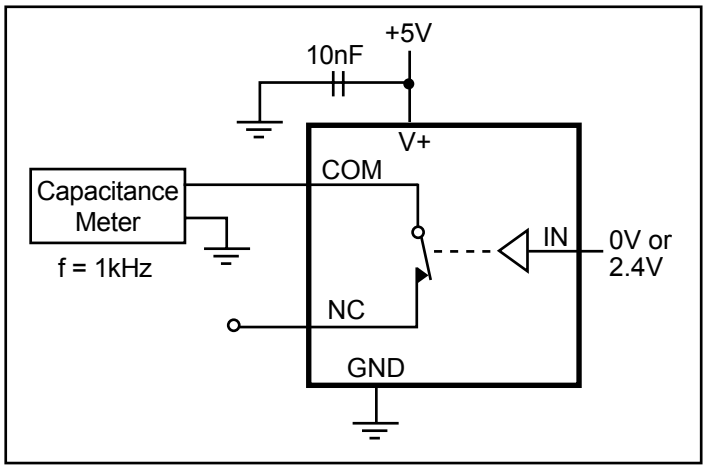



**Figure 6. Channel-On Capacitance**

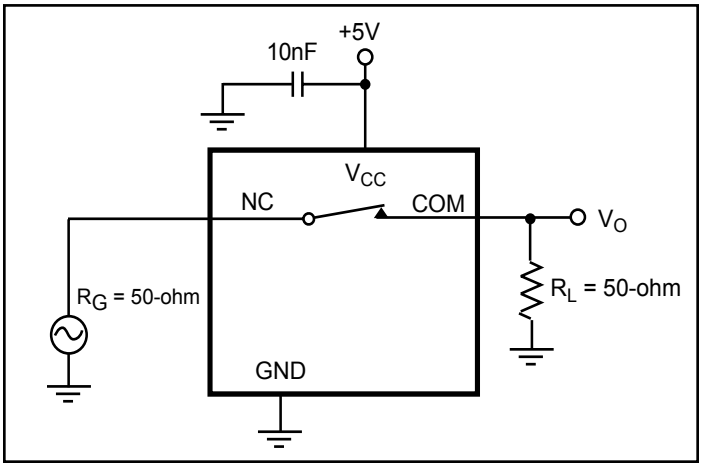
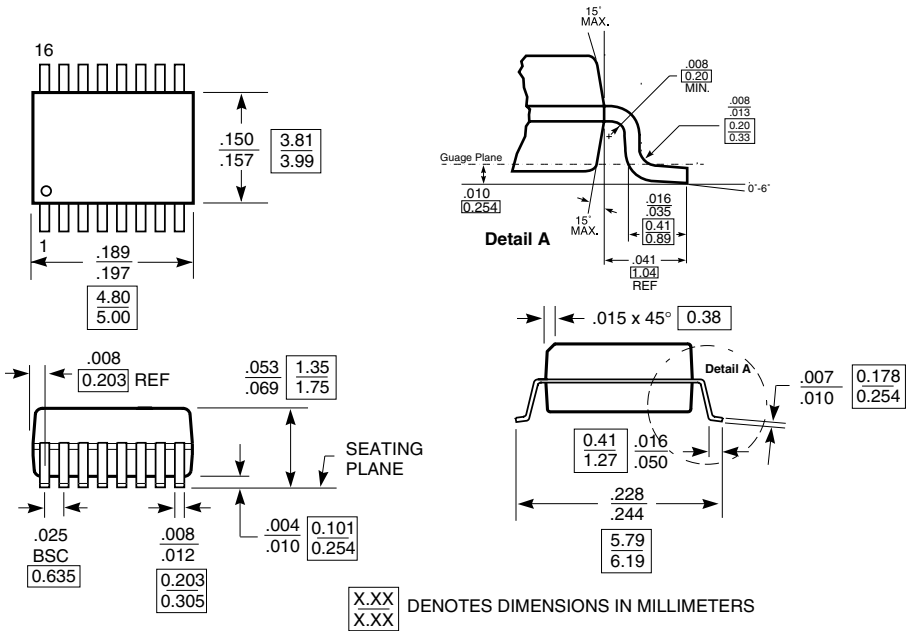
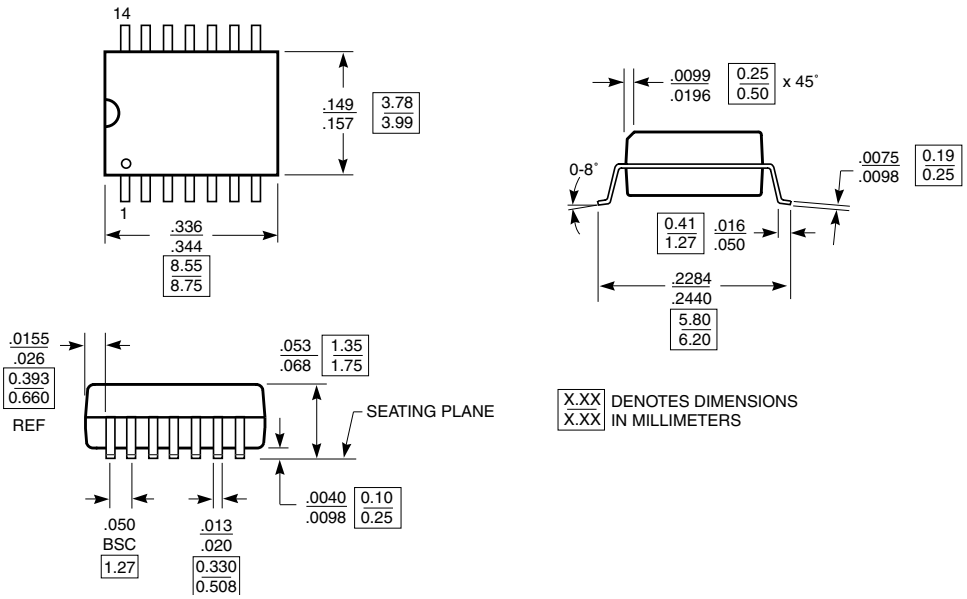



**Figure 7. Bandwidth**

## Packaging Mechanical: 16-Pin, QSOP (Q)




## Packaging Mechanical: 14-Pin, SOIC (W)



## Ordering Information

| Ordeing Code | Package Code | Package Description |
|---|---|---|
| PI5A101Q | Q | 16-pin, QSOP |
| PI5A101QE | Q | Pb-free & Green, 16-pin, QSOP |
| PI5A101W | W | 14-pin SOIC |
| PI5A101WE | W | Pb-free & Green, 14-pin SOIC |

**Notes:**

1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/