

## 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:  $8\Omega$  typical @ 5V
- Tight match between channels:  $0.9\Omega$  typical
- $R_{ON}$  flatness:  $3\Omega$  typical
- Low power consumption:  $0.5\mu\text{-ohm}$  typical
- High Speed,  $T_{ON} = 8\text{ns}$  typical
- High-current channel capability:  $>100\text{mA}$
- Wide bandwidth:  $>200\text{ MHz}$
- 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 Semiconductor'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.

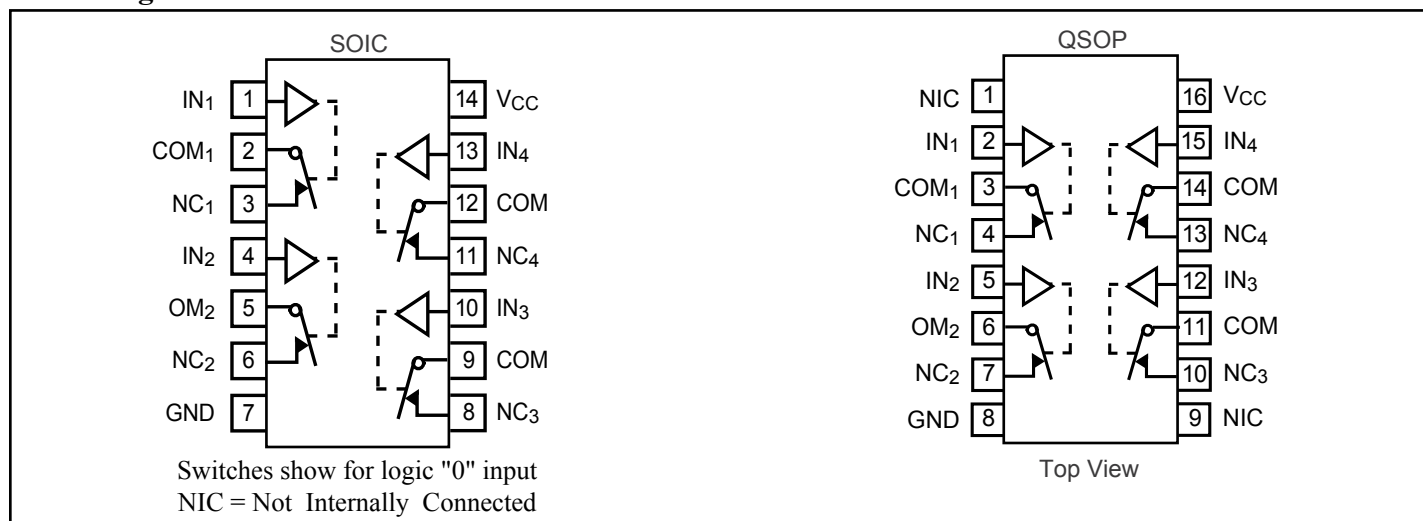
When on, each switch conducts current equally well in either direction. When off, they block voltages up to the power-supply rails.

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

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

The PI5A101 is available in the narrow-body 14-pin small SOIC and 16-pin QSOP packages for operation over the industrial ( $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ) temperature range.

### Pin Configurations



### Truth Table

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

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

| Parameter                                           | Symbol                                       | Conditions                                                                                              | Temp.(°C) | Min. <sup>(1)</sup> | Typ. <sup>(2)</sup> | Max. <sup>(1)</sup> | Units |    |
|-----------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------|---------------------|---------------------|---------------------|-------|----|
| Analog Switch                                       |                                              |                                                                                                         |           |                     |                     |                     |       |    |
| Analog Signal Range <sup>(3)</sup>                  | V <sub>ANALOG</sub>                          |                                                                                                         | Full      | 0                   |                     | V <sub>CC</sub>     | V     |    |
| On-Resistance                                       | R <sub>ON</sub>                              | V <sub>CC</sub> = 4.5V,<br>I <sub>COM</sub> = -30mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = +2.5V      | 25        |                     | 8                   | 10                  | Ω     |    |
|                                                     |                                              |                                                                                                         | Full      |                     |                     | 18                  |       |    |
| On-Resistance Match Between Channels <sup>(4)</sup> | ΔR <sub>ON</sub>                             |                                                                                                         | 25        |                     | 0.9                 | 2                   |       |    |
|                                                     |                                              |                                                                                                         | Full      |                     |                     | 4                   |       |    |
| On-Resistance Flatness <sup>(5)</sup>               | R <sub>FLAT(ON)</sub>                        | V <sub>CC</sub> = 5V,<br>I <sub>COM</sub> = -30mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1V, 2.5V, 4V | 25        |                     | 3                   | 4                   |       |    |
|                                                     |                                              |                                                                                                         | Full      |                     |                     | 5                   |       |    |
| NO or NC Off Leak-age Current <sup>(6)</sup>        | I <sub>NO(OFF)</sub> or I <sub>NC(OFF)</sub> | V <sub>CC</sub> = 5.5V,<br>V <sub>COM</sub> = 0V,<br>V <sub>NO</sub> or V <sub>NC</sub> = 4.5V          | 25        |                     | 0.05                |                     | nA    |    |
|                                                     |                                              |                                                                                                         | Full      | -80                 |                     | 80                  |       |    |
| COM Off Leakage Current <sup>(6)</sup>              | I <sub>COM(OFF)</sub>                        | V <sub>CC</sub> = 5.5V,<br>V <sub>COM</sub> = + 4.5V,<br>V <sub>NO</sub> or V <sub>NC</sub> = ± 0V      | 25        |                     | 0.05                |                     |       |    |
|                                                     |                                              |                                                                                                         | Full      | -80                 |                     | 80                  |       |    |
| COM On Leakage Current <sup>(6)</sup>               | I <sub>COM(ON)</sub>                         | V <sub>CC</sub> = 5.5V,<br>V <sub>COM</sub> = +4.5V<br>V <sub>NO</sub> or V <sub>NC</sub> = +4.5V       | 25        |                     | 0.07                |                     |       |    |
|                                                     |                                              |                                                                                                         | Full      | -80                 |                     | 80                  |       |    |
| Logic Input                                         |                                              |                                                                                                         |           |                     |                     |                     |       |    |
| Input High Voltage                                  | V <sub>IH</sub>                              | Guaranteed logic High Level                                                                             | Full      | 2                   |                     |                     | V     |    |
| Input Low Voltage                                   | V <sub>IL</sub>                              | Guaranteed logic Low Level                                                                              |           |                     |                     |                     |       |    |
| Input Current with Voltage High                     | I <sub>INH</sub>                             | V <sub>IN</sub> = 2.4V, all others = 0.8V                                                               |           |                     |                     |                     | 0.8   | μA |
| Input Current with Voltage Low                      | I <sub>INL</sub>                             | V <sub>IN</sub> = 0.8V, all others = 2.4V                                                               |           |                     | -1                  | 0.005               | 1     |    |

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

| Parameter                       | Symbol                | Conditions                                                                              | Temp.(°C) | Min. <sup>(1)</sup> | Typ. <sup>(2)</sup> | Max. <sup>(1)</sup> | Units |
|---------------------------------|-----------------------|-----------------------------------------------------------------------------------------|-----------|---------------------|---------------------|---------------------|-------|
| Dynamic                         |                       |                                                                                         |           |                     |                     |                     |       |
| Turn-On Time                    | t <sub>ON</sub>       | V <sub>CC</sub> = 5V, see figure 1                                                      | 25        |                     | 8                   | 15                  | ns    |
|                                 |                       |                                                                                         | Full      |                     |                     | 20                  |       |
| Turn-Off Time                   | t <sub>OFF</sub>      |                                                                                         | 25        |                     | 3.5                 | 7                   |       |
|                                 |                       |                                                                                         | Full      |                     |                     | 10                  |       |
| Charge Injection <sup>(3)</sup> | Q                     | C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0V, Figure 2            | 25        |                     | 7                   | 10                  | pC    |
| Off Isolation                   | O <sub>IRR</sub>      | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 10MHz, see figure 3                     |           |                     | -55                 |                     | dB    |
| Crosstalk <sup>(8)</sup>        | I <sub>COM(OFF)</sub> | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 10MHz, see figure 4                     |           |                     | -92                 |                     |       |
| NC or NO Capacitance            | C <sub>(OFF)</sub>    | f = 1kHz, see figure 5                                                                  |           |                     | 8                   |                     | pF    |
| COM Off Capacitance             | C <sub>COM(OFF)</sub> |                                                                                         |           |                     | 8                   |                     |       |
| COM On Capacitance              | C <sub>COM(ON)</sub>  | f = 1kHz, see figure 6                                                                  |           |                     | 14                  |                     |       |
| 3-dB Bandwidth                  | BW                    | R <sub>L</sub> = 10kΩ                                                                   | Full      |                     | 230                 |                     | MHz   |
| Distortion <sup>(9)</sup>       | D                     |                                                                                         |           |                     | 0.03                |                     | %     |
| Supply                          |                       |                                                                                         |           |                     |                     |                     |       |
| Power-Supply Range              | V <sub>CC</sub>       |                                                                                         | Full      | 2                   |                     | 6                   | V     |
| Positive Supply Current         | I <sub>CC</sub>       | V <sub>CC</sub> = 3.6V, V <sub>IN</sub> = 0V or V <sup>+</sup> , All Channels on or off |           |                     |                     | 1                   | μA    |

## Absolute Maximum Ratings

|                                                                           |                              |
|---------------------------------------------------------------------------|------------------------------|
| Voltages Referenced to GND                                                |                              |
| V <sub>CC</sub> .....                                                     | -0.5V to +7V                 |
| V <sub>IN</sub> , V <sub>COM</sub> , V <sub>NC</sub> <sup>(1)</sup> ..... | -0.5V to V <sub>CC</sub> +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<sub>CC</sub> 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.

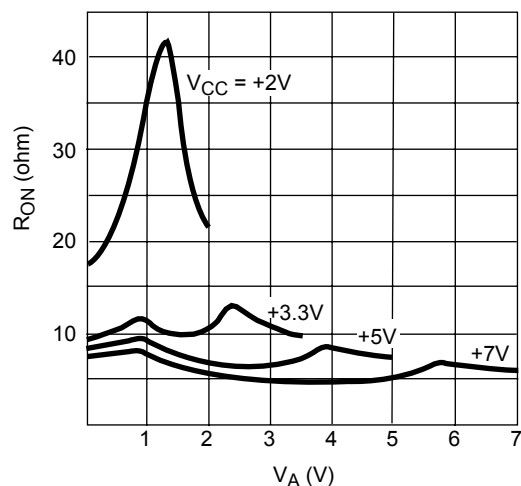
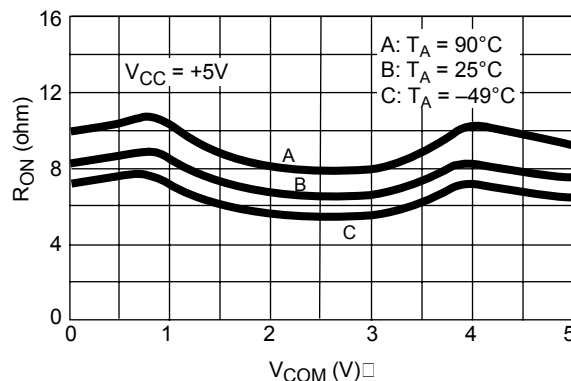
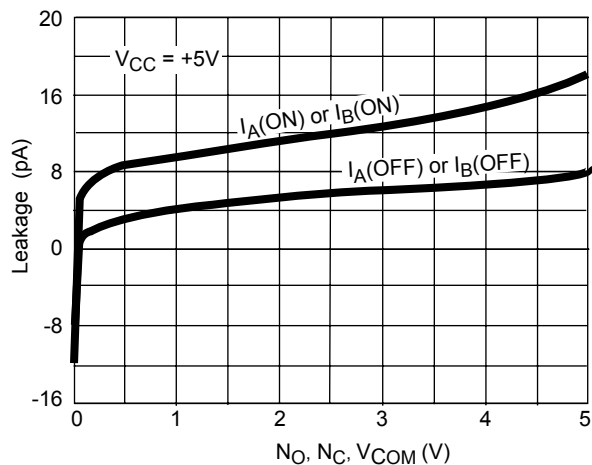
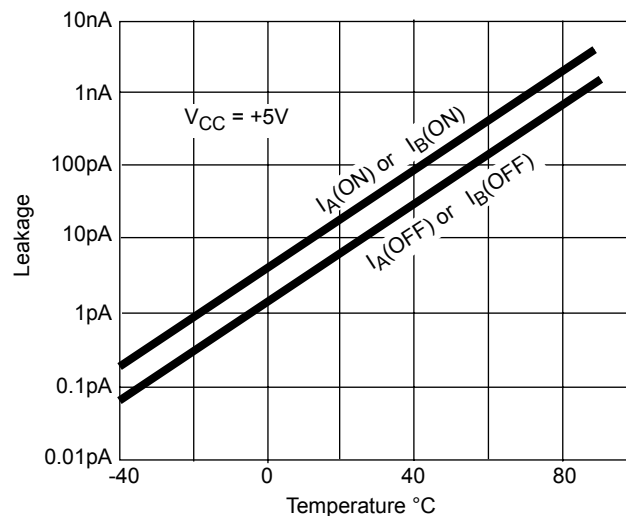
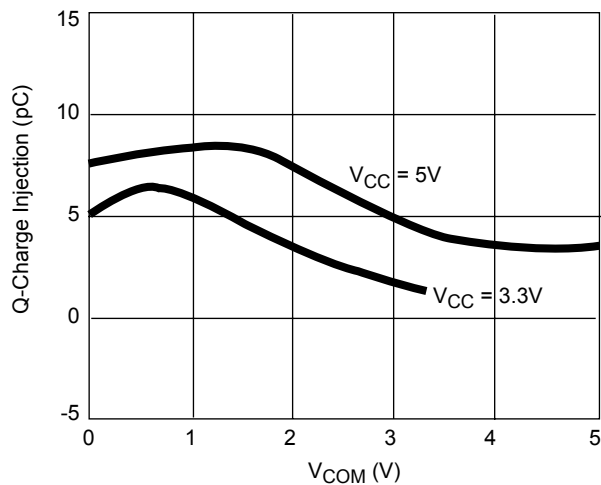
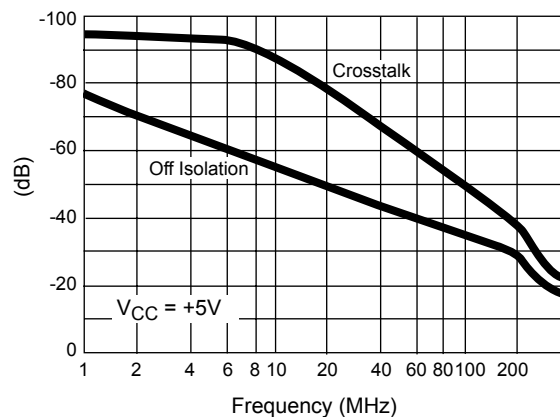
## Electrical Specifications-Single +3.3V Supply (V<sub>CC</sub> = +3.3V ± 10%, GND = 0V, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V)

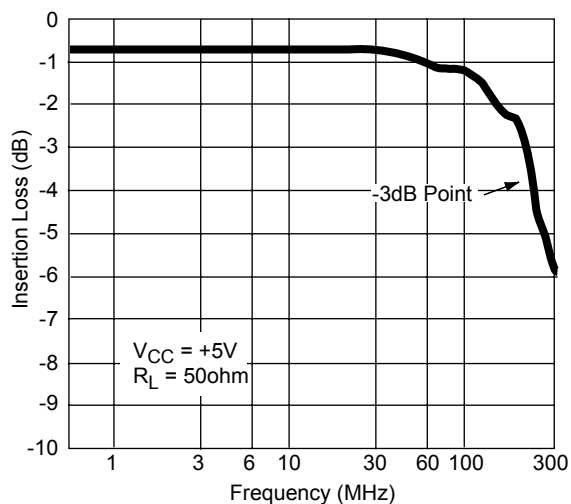
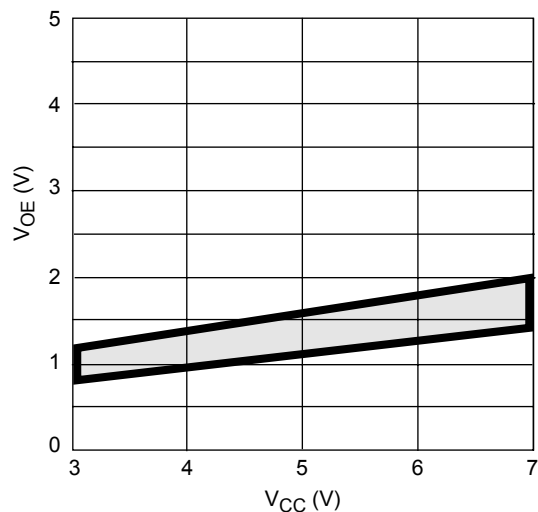
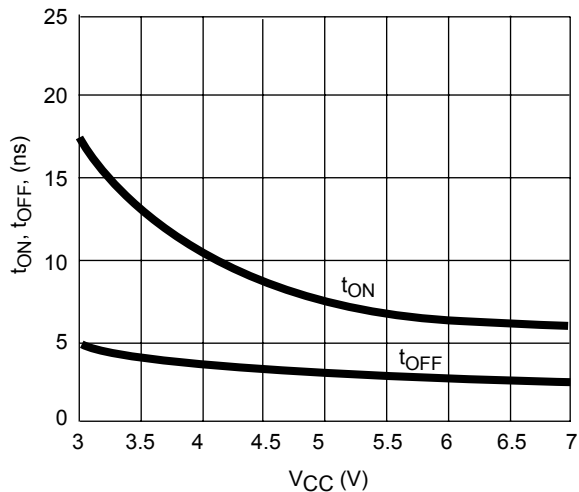
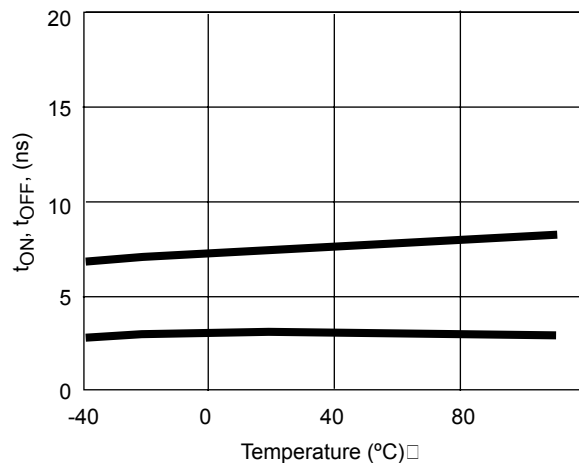
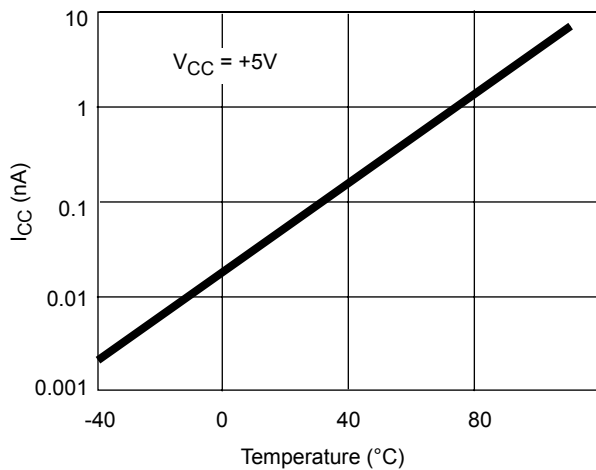
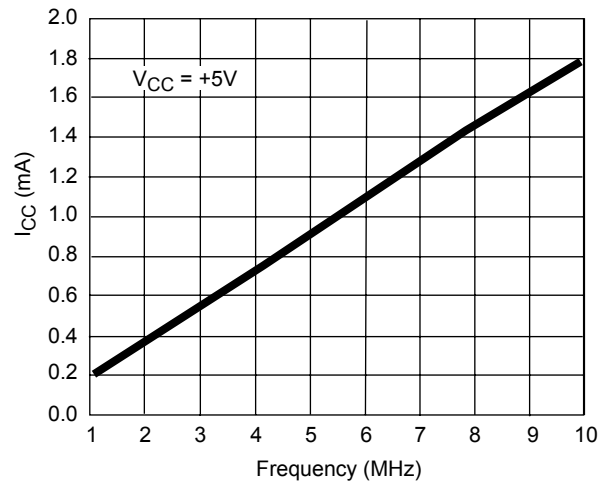
| Parameter                                           | Symbol                | Conditions                                                                                              | Temp.(°C) | Min. <sup>(1)</sup> | Typ. <sup>(2)</sup> | Max. <sup>(1)</sup> | Units |
|-----------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------|-----------|---------------------|---------------------|---------------------|-------|
| Analog Switch                                       |                       |                                                                                                         |           |                     |                     |                     |       |
| Analog Signal Range <sup>(3)</sup>                  | V <sub>ANALOG</sub>   |                                                                                                         | Full      | 0                   |                     | V <sub>CC</sub>     | V     |
| On-Resistance                                       | R <sub>ON</sub>       | V <sub>CC</sub> = 3V,<br>I <sub>COM</sub> = -30mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1.5V         | 25        |                     | 7.2                 | 18                  | Ω     |
| On-Resistance Match Between Channels <sup>(4)</sup> | ΔR <sub>ON</sub>      |                                                                                                         | Full      |                     |                     | 28                  |       |
|                                                     |                       |                                                                                                         | 25        |                     | 0.2                 | 2                   |       |
|                                                     |                       |                                                                                                         | Full      |                     |                     | 4                   |       |
| On-Resistance Flatness <sup>(3,5)</sup>             | R <sub>FLAT(ON)</sub> | V <sub>CC</sub> = 3.3V,<br>I <sub>COM</sub> = -30mA,<br>V <sub>NO</sub> or V <sub>NC</sub> = 0.8V, 2.5V | 25        |                     | 2.72                | 10                  |       |
|                                                     |                       |                                                                                                         | Full      |                     |                     | 12                  |       |
| Dynamic                                             |                       |                                                                                                         |           |                     |                     |                     |       |
| Turn-On Time                                        | t <sub>ON</sub>       | V <sub>CC</sub> = 3.3V,<br>V <sub>NO</sub> or V <sub>NC</sub> = 1.5V,<br>see figure 1                   | 25        |                     | 7                   | 25                  | ns    |
|                                                     |                       |                                                                                                         | Full      |                     |                     | 40                  |       |
| Turn-Off Time                                       | t <sub>OFF</sub>      |                                                                                                         | 25        |                     | 1                   | 12                  |       |
|                                                     |                       |                                                                                                         | Full      |                     |                     | 20                  |       |
| Charge Injection <sup>(3)</sup>                     | Q                     | C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V,<br>R <sub>GEN</sub> = 0Ω, Figure 2                         | 25        |                     | 1.6                 | 10                  | pC    |
| Supply                                              |                       |                                                                                                         |           |                     |                     |                     |       |
| Positive Supply Current                             | I <sub>CC</sub>       | V <sub>CC</sub> = 3.6V, V <sub>IN</sub> = 0V or V <sub>CC</sub> ,<br>All Channels on or off             | Full      |                     |                     | 1                   | μA    |

### Notes:

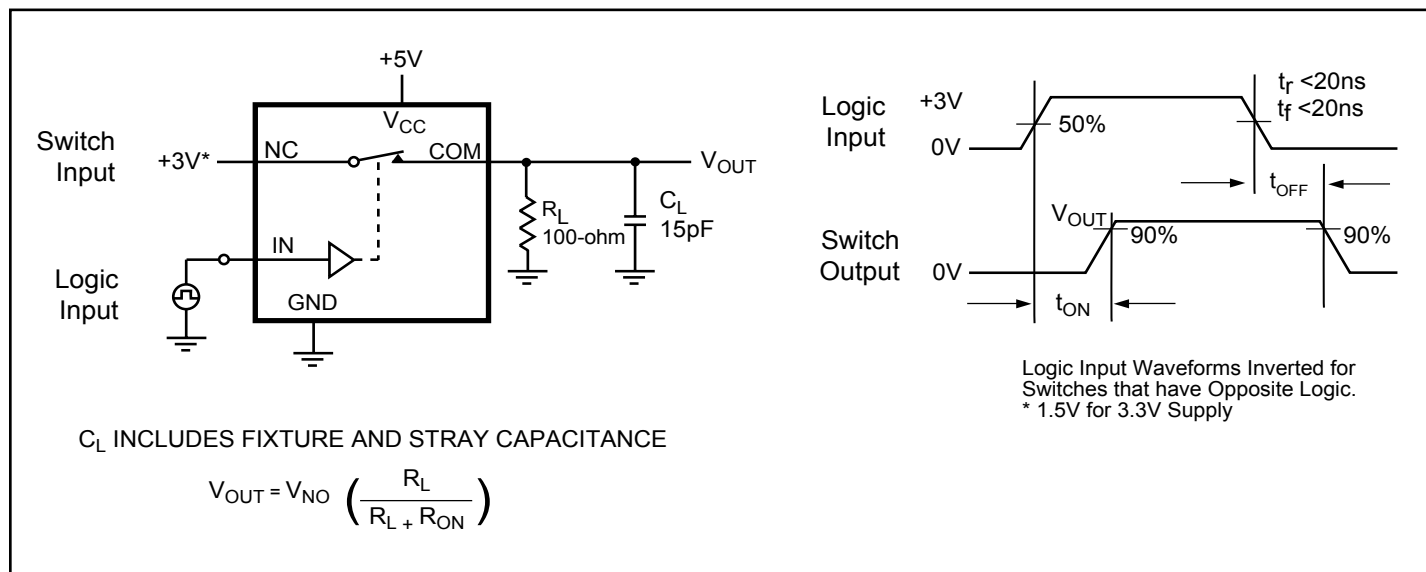
1. The algebraic convention, where most negative value is a minimum and most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design
4. ΔR<sub>ON</sub> = R<sub>ON</sub> MAX - R<sub>ON</sub> 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 +25°C.
7. Off Isolation = 20log<sub>10</sub> V<sub>B</sub> / V<sub>A</sub>. See Figure 3.
8. Between any two switches. See Figure 4.
9. D = R<sub>FLAT(ON)</sub>/R<sub>L</sub>.

**Typical Operating Characteristics** ( $T_A = +25^\circ\text{C}$ , unless otherwise noted)

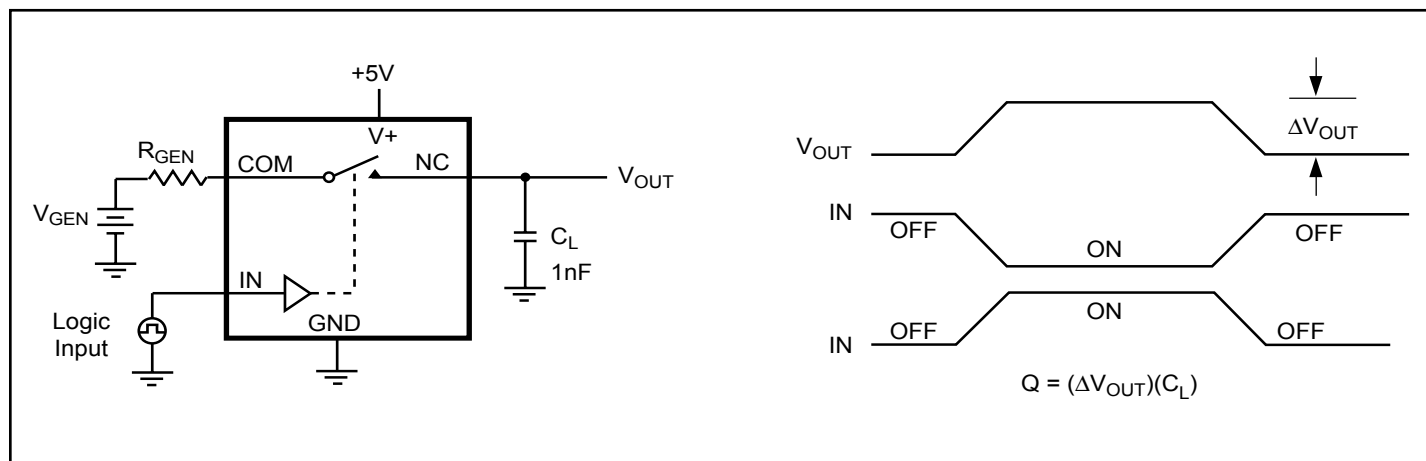
 **$R_{ON}$  vs.  $V_{COM}$** 

 **$R_{ON}$  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**


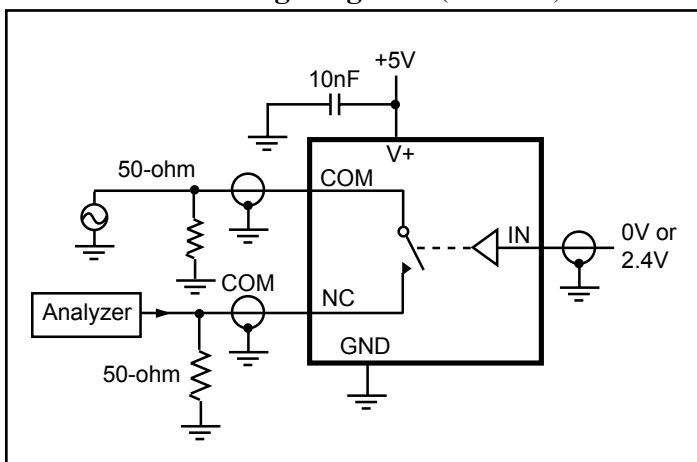
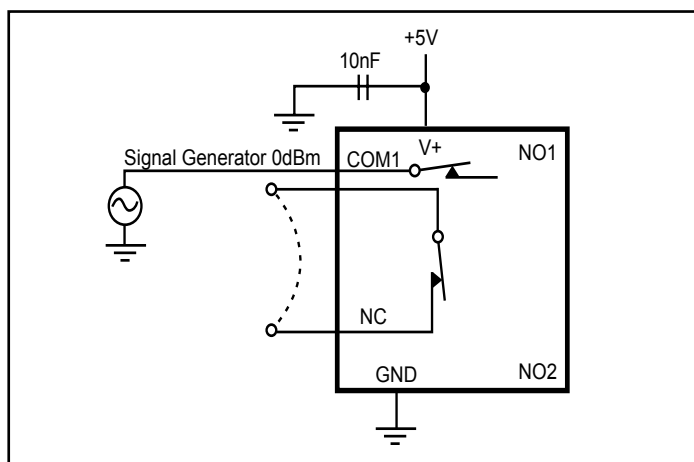
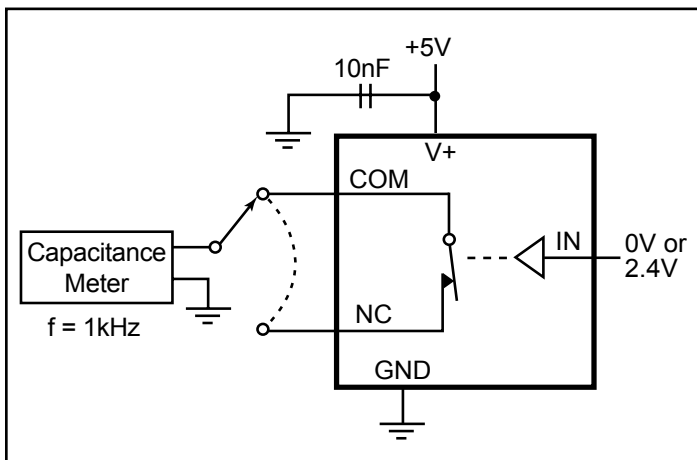
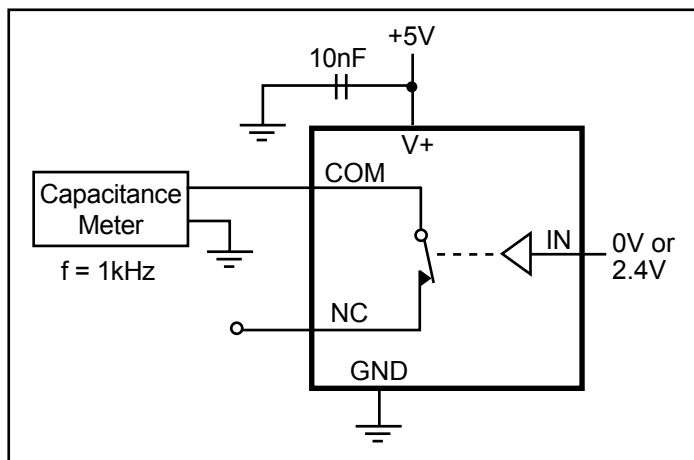
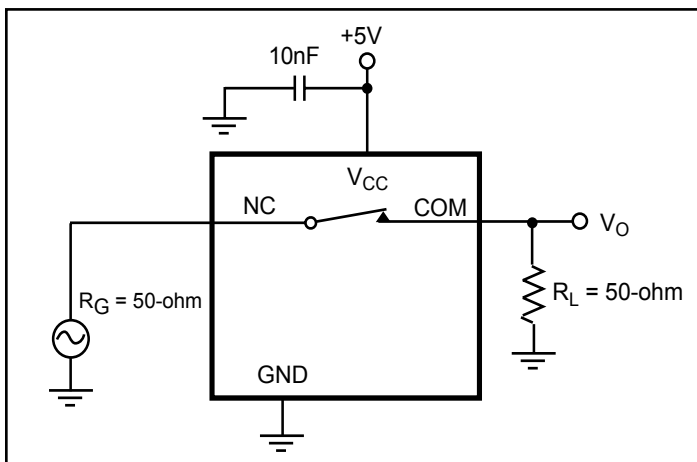
## Test Circuits/Timing Diagrams

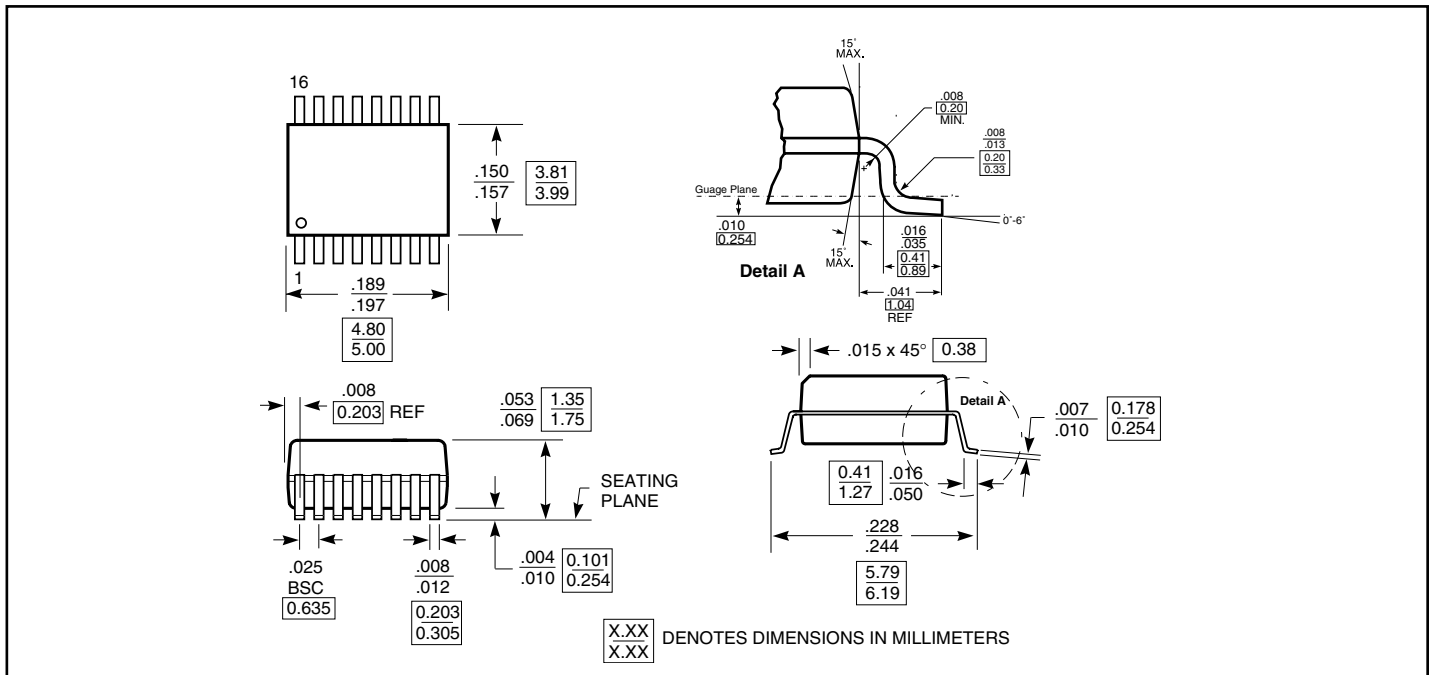
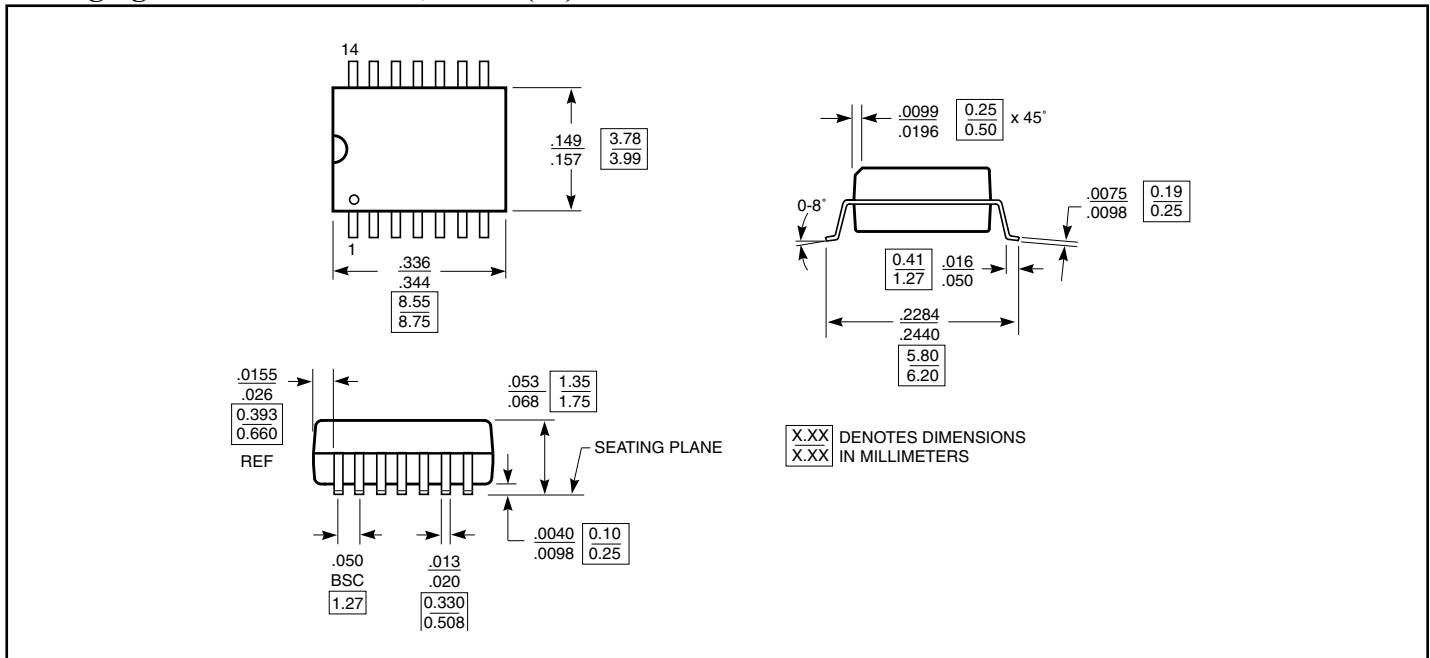


**Figure 1. Switching Time**



**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**

| Ordering 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/](http://www.pericom.com/packaging/)