

## Features

- 8-ohm max. ON-Resistance
- 1.0-ohm max. ON-Resistance Flatness
- Fast Switching  
 $t_{ON} = 28\text{ns max.}$   
 $t_{OFF} = 35\text{ns max.}$
- Guaranteed 5pC max. Charge Injection
- +2.0V to +5.5V Single-Supply Operation
- 300 MHz -3dB Bandwidth at +25°C
- TTL/CMOS-Logic Compatible
- 80dB Off-Isolation at 1MHz
- 0.5nA max. Off-Leakage
- 0.05% THD
- Package: SC-70

## Description

PI5A4594A/PI5A4596A are single-pole/single-throw (SPST) analog switches that operate from a single +2.0V to +5.5V supply. The PI5A4594A/PI5A4596A switches are normally open (NO), and the PI5A4595A/PI5A4597A are normally closed (NC). The PI5A4596A/PI5A4597A pinouts are optimized for the highest SC70 package off-isolation available.

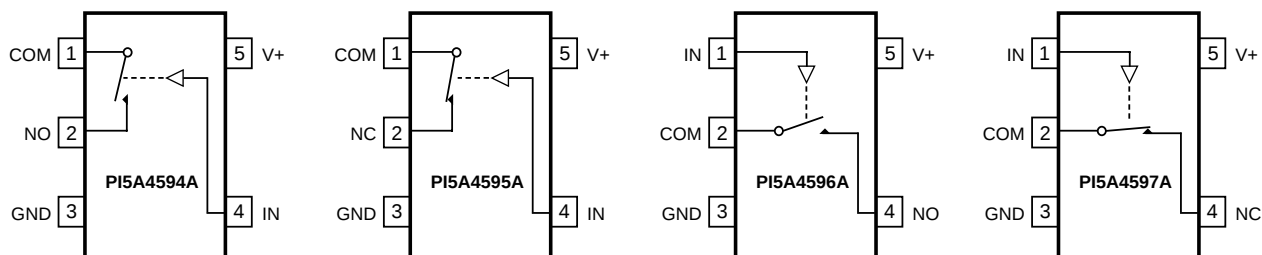
These switches have 10-ohms max ON-resistance ( $R_{ON}$ ), with 1.5-ohms max  $R_{ON}$  flatness over the analog signal range when powered from a +5V supply. Leakage currents are 0.5nA and fast switching times are less than 40ns. They are packaged in a compact 5-pin SC70 package.

## Applications

- Cellular Phones • Communications Circuits
- Battery-Operated Equipment • DSL Modems
- Audio and Video Signal Routing • PCMCIA Cards

## Functional Block Diagrams/Pin Configurations/Truth Table

### Top Views



Switches shown for Logic "0" input.

| Input | Switch State        |                     |
|-------|---------------------|---------------------|
|       | PI5A4594A/PI5A4596A | PI5A4595A/PI5A4597A |
| LOW   | OFF                 | ON                  |
| HIGH  | ON                  | OFF                 |

## Pin Description

| Pin       |           |           |           | Name | Function                       |
|-----------|-----------|-----------|-----------|------|--------------------------------|
| PI5A4594A | PI5A4595A | PI5A4596A | PI5A4597A |      |                                |
| 1         | 1         | 2         | 2         | COM  | Analog Switch, Common          |
| 2         | —         | 4         | —         | NO   | Analog Switch, Normally Open   |
| 3         | 3         | 3         | 3         | GND  | Ground                         |
| 4         | 4         | 1         | 1         | IN   | Digital Control Input          |
| 5         | 5         | 5         | 5         | V+   | Positive Supply Voltage        |
| —         | 2         | —         | 4         | NC   | Analog Switch, Normally Closed |

**Note:** NO, NC, and COM pins are identical and interchangeable. Any pin may be considered as an input or an output; signals pass



### Absolute Maximum Ratings

Voltages Referenced to GND

|                                                                 |                      |
|-----------------------------------------------------------------|----------------------|
| V+                                                              | −0.3V to +6V         |
| Voltage into Any Terminal (Note 1)                              | −0.3V to (V+ + 0.3V) |
| Continuous Current into Any Terminal                            | ±20mA                |
| Peak Current, NO, NC, or COM<br>(pulsed at 1ms, 10% duty cycle) | ±40mA                |

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

|                                          |                 |
|------------------------------------------|-----------------|
| 5-Pin SC70 (derate 3.1mW/°C above +70°C) | 247mW           |
| Operating Temperature Range              |                 |
| PI5A459_EXK                              | −40°C to +85°C  |
| Storage Temperature Range                | −65°C to +150°C |
| Lead Temperature (soldering, 10s)        | +300°C          |

### Note

1. Voltages exceeding V+ or GND on any signal terminal are clamped by internal diodes. Limit forward-diode current to maximum current rating.

*Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

**Electrical Characteristic - +5V Supply** (V+ = +4.5V to +5.5V, V<sub>IH</sub> = +2.4V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +5V, T<sub>A</sub> = +25°C.)<sup>(2,3)</sup>

| Parameter                                | Symbol                                         | Conditions                                                                                             |                                                       | Min. | Typ. | Max. | Units |
|------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------|------|------|-------|
| Analog Switch                            |                                                |                                                                                                        |                                                       |      |      |      |       |
| Analog Signal Range                      | V <sub>COM</sub> , V <sub>NO</sub> ,<br>CNC    |                                                                                                        |                                                       | 0    |      | V+   | V     |
| On Resistance                            | R <sub>ON</sub>                                | V+ = 4.5V, V <sub>NO</sub> , or<br>V <sub>NC</sub> = 3.5V, I <sub>COM</sub> = 10mA                     | T <sub>A</sub> = +25V                                 |      | 5    | 8    | Ω     |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |      |      | 10   |       |
| On-Resistance<br>Flatness <sup>(4)</sup> | R <sub>FLAT</sub> (ON)                         | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V, 2.5V, 3.5V;<br>V+ = 4.5V; I <sub>COM</sub> = 10mA           | T <sub>A</sub> = +25V                                 |      | 0.5  | 1.0  |       |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |      |      | 1.5  |       |
| NO or NC Off<br>Leakage Current          | I <sub>NO</sub> (OFF)<br>I <sub>NO</sub> (OFF) | V+ = 5.5V; V <sub>COM</sub> = 1V, 4.5V;<br>V <sub>NO</sub> or V <sub>NC</sub> = 4.5V, 1V               | T <sub>A</sub> = +25V                                 | −0.5 | 0.01 | 0.5  | nA    |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | −5   |      | 5    |       |
| COM-Off Leakage<br>Current               | I <sub>COM</sub> (OFF)                         | V+ = 5.5V; V <sub>COM</sub> = 1V, 4.5V;<br>V <sub>NO</sub> or V <sub>NC</sub> = 4.5V, 1V               | T <sub>A</sub> = +25V                                 | −0.5 | 0.01 | 0.5  |       |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | −5   |      | 5    |       |
| COM On Leakage<br>Current                | I <sub>COM</sub> (ON)                          | V+ = 5.5V; V <sub>COM</sub> = 1V, 4.5V;<br>V <sub>NO</sub> or V <sub>NC</sub> = 1V, 4.5V, or floating  | T <sub>A</sub> = +25V                                 | −1   | 0.01 | 1    |       |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | −10  |      | 10   |       |
| Digital I/O                              |                                                |                                                                                                        |                                                       |      |      |      |       |
| Input Logic High                         | V <sub>IH</sub>                                |                                                                                                        |                                                       | 2.4  |      |      | V     |
| Input Logic Low                          | V <sub>IH</sub>                                |                                                                                                        |                                                       |      |      | 0.8  |       |
| Input Logic Current                      | I <sub>IH</sub> , I <sub>IL</sub>              | V <sub>IN</sub> = V+, 0                                                                                |                                                       | −1   |      | 1    | μA    |
| Dynamic                                  |                                                |                                                                                                        |                                                       |      |      |      |       |
| Turn-On Time                             | t <sub>ON</sub>                                | V <sub>NO</sub> or V <sub>NC</sub> = 3V, R <sub>L</sub> = 300 ohms,<br>C <sub>L</sub> = 35pF, Figure 3 | T <sub>A</sub> = +25V                                 |      | 20   | 28   | ns    |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |      |      | 38   |       |
| Turn-Off Time                            | t <sub>OFF</sub>                               | V <sub>NO</sub> or V <sub>NC</sub> = 3V, R <sub>L</sub> = 300 ohms,<br>C <sub>L</sub> = 35pF, Figure 3 | T <sub>A</sub> = +25V                                 |      | 25   | 35   |       |
|                                          |                                                |                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |      |      | 42   |       |
| On-Channel −3dB<br>Bandwidth             | BW                                             | Signal = 0dBm,<br>50 ohms in and out, Figure 4                                                         | T <sub>A</sub> = +25V                                 |      | 300  |      | MHz   |

**Electrical Characteristic - +5V Supply** (continued) – (Typical values are at  $V_+ = +5V$ ,  $T_A = +25^\circ C$ .) <sup>(2,3)</sup>  
 $(V_+ = +4.5V \text{ to } +5.5V, V_{IH} = +2.4V, V_{IL} = +0.8V, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted.})$

| Parameter                               | Symbol                           | Conditions                                                                                                   |                                     | Min.                  | Typ. | Max. | Units   |
|-----------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------|------|------|---------|
| Charge Injection <sup>(5)</sup>         | Q                                | $V_{NO} \text{ or } V_{NC} = 0, C_L = 1nF, \text{ Fig. 2}$                                                   | $T_A = +25^\circ C$                 |                       | 2    | 5    | pC      |
| Off Isolation <sup>(6)</sup>            | $V_{ISO}$                        | $V_{NO} \text{ or } V_{NC} = 1V_{RMS},$<br>$R_L = 50 \text{ ohms},$<br>$C_L = 5pF, f = 1MHz, \text{ Fig. 4}$ | $T_A = +25^\circ C$                 | PI5A4594/<br>PI5A4595 | 80   |      | dB      |
|                                         |                                  |                                                                                                              |                                     | PI5A4596/<br>PI5A4597 | 83   |      |         |
| NO or NC<br>Off Capacitance             | $C_{NO (OFF)},$<br>$C_{NC(OFF)}$ | $V_{NO} \text{ or } V_{NC} = 0,$<br>$f = 1MHz, \text{ Fig. 5}$                                               | $T_A = +25^\circ C$                 |                       | 8    |      | pF      |
| COM Off Capacitance                     | $C_{COM (OFF)}$                  | $V_{COM} = 0V, f = 1MHz, \text{ Fig. 5}$                                                                     | $T_A = +25^\circ C$                 |                       | 8    |      |         |
| COM On Capacitance                      | $C_{COM(ON)}$                    | $V_{COM} = 0V, f = 1MHz, \text{ Fig. 5}$                                                                     | $T_A = +25^\circ C$                 |                       | 20   |      |         |
| Total Harmonic<br>Distortion Plus Noise | THD                              | $V = 5V_{p-p}, R_L = 600 \text{ ohms},$<br>$f = 20Hz \text{ to } 20kHz$                                      | $T_A = +25^\circ C$                 |                       | 0.05 |      | %       |
| <b>Power Supply</b>                     |                                  |                                                                                                              |                                     |                       |      |      |         |
| Power-Supply Range                      | $V_+$                            |                                                                                                              |                                     | 2.0                   |      | 5.5  | V       |
| $V_+$ Supply Current                    | $I_+$                            | $V_+ = 5.5V, V_{IN} = 0 \text{ or } V_+$                                                                     | $T_A = T_{MIN} \text{ to } T_{MAX}$ |                       |      | 1    | $\mu A$ |

**Electrical Characteristics - Single 3V Supply** ( $V_+ = +3V \pm 10\%, V_- = 0V, GND = 0V, V_{AH} = V_{IH} = +2.0V, V_{AL} = V_{IL} = +0.5V$ )

| Parameter                          | Symbol                                               | Conditions                                                                                      |                                                       | Min.                                                  | Typ. | Max. | Units |    |
|------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|------|------|-------|----|
| Analog Switch                      |                                                      |                                                                                                 |                                                       |                                                       |      |      |       |    |
| Analog Signal Range <sup>(3)</sup> | V <sub>COM</sub> , V <sub>NO</sub> , V <sub>NC</sub> |                                                                                                 |                                                       | 0                                                     |      | V+   | V     |    |
| On-Resistance                      | R <sub>ON</sub>                                      | V <sub>NO</sub> or V <sub>NC</sub> = 1.5V,<br>I <sub>COM</sub> = 10mA, V+ = 2.7V                | T <sub>A</sub> = +25°C                                |                                                       |      | 15   | Ω     |    |
|                                    |                                                      |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                                                       |      | 20   |       |    |
| Digital I/O                        |                                                      |                                                                                                 |                                                       |                                                       |      |      |       |    |
| Inut Logic High                    | V <sub>IH</sub>                                      |                                                                                                 |                                                       | 2.0                                                   |      |      | V     |    |
| Input Logic Low                    | V <sub>IL</sub>                                      |                                                                                                 |                                                       |                                                       |      | 0.8  |       |    |
| Input Logic Current                | I <sub>IH</sub> , I <sub>IL</sub>                    | V <sub>IN</sub> = V+, 0                                                                         |                                                       | −1                                                    | 0.03 | 1    | μA    |    |
| Dynamic                            |                                                      |                                                                                                 |                                                       |                                                       |      |      |       |    |
| Turn-On Time                       | t <sub>ON</sub>                                      | V <sub>NO</sub> or V <sub>NC</sub> = 2V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Fig.3 | T <sub>A</sub> = +25°C                                |                                                       | 25   | 45   | ns    |    |
|                                    |                                                      |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                                                       |      | 55   |       |    |
| Turn-Off Time                      | t <sub>OFF</sub>                                     | V <sub>NO</sub> or V <sub>NC</sub> = 2V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Fig.3 | T <sub>A</sub> = +25°C                                |                                                       | 30   | 50   |       |    |
|                                    |                                                      |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                                                       |      | 60   |       |    |
| Charge Injection <sup>(5)</sup>    | Q                                                    | V <sub>NO</sub> or V <sub>NC</sub> = 0, C <sub>L</sub> = 1nF, Fig. 2                            |                                                       | T <sub>A</sub> = +25°C                                |      | 2    | 4     | pC |
| Power Supply                       |                                                      |                                                                                                 |                                                       |                                                       |      |      |       |    |
| V+ Supply Current                  | I+                                                   | V+ = 3.6, V <sub>IN</sub> = 0 or V+                                                             |                                                       | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |      |      | 1     | μA |

**Notes:**

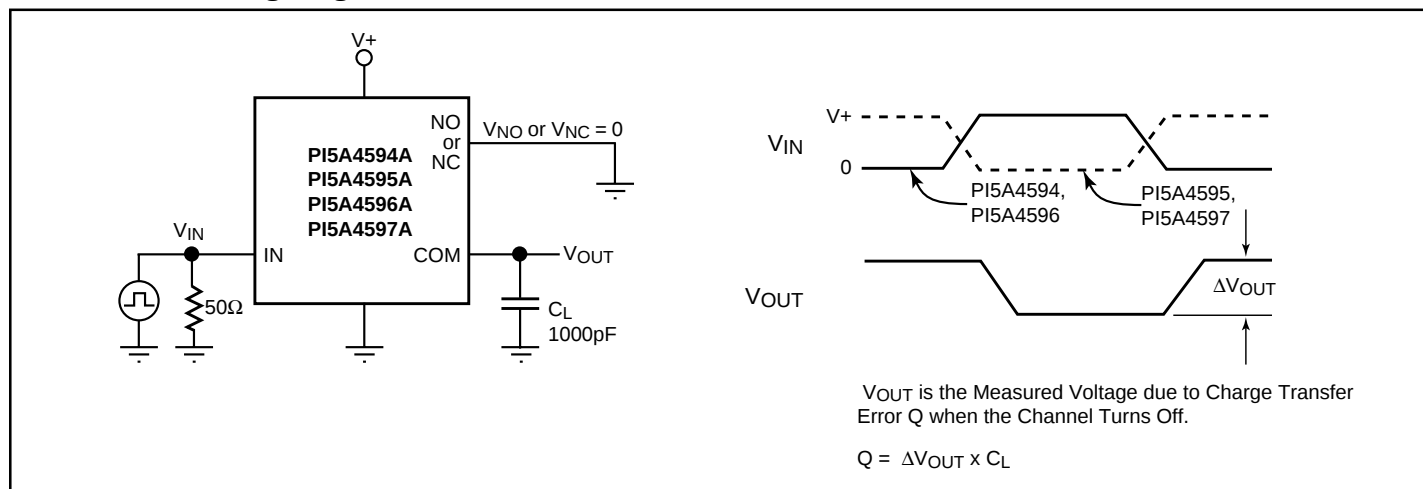
- Parameters are 100% tested at  $+25^\circ C$  only, and guaranteed by correlation at the full-rated temperature.
- Algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.
- Flatness: the difference between maximum & minimum values of ON-resistance measured over specified analog signal ranges.
- Guaranteed by design.
- Off-Isolation =  $20 \log_{10} (V_{COM} / V_{NO}), V_{COM}$  = output,  $V_{NO}$  = input to off switch.

## Applications Information

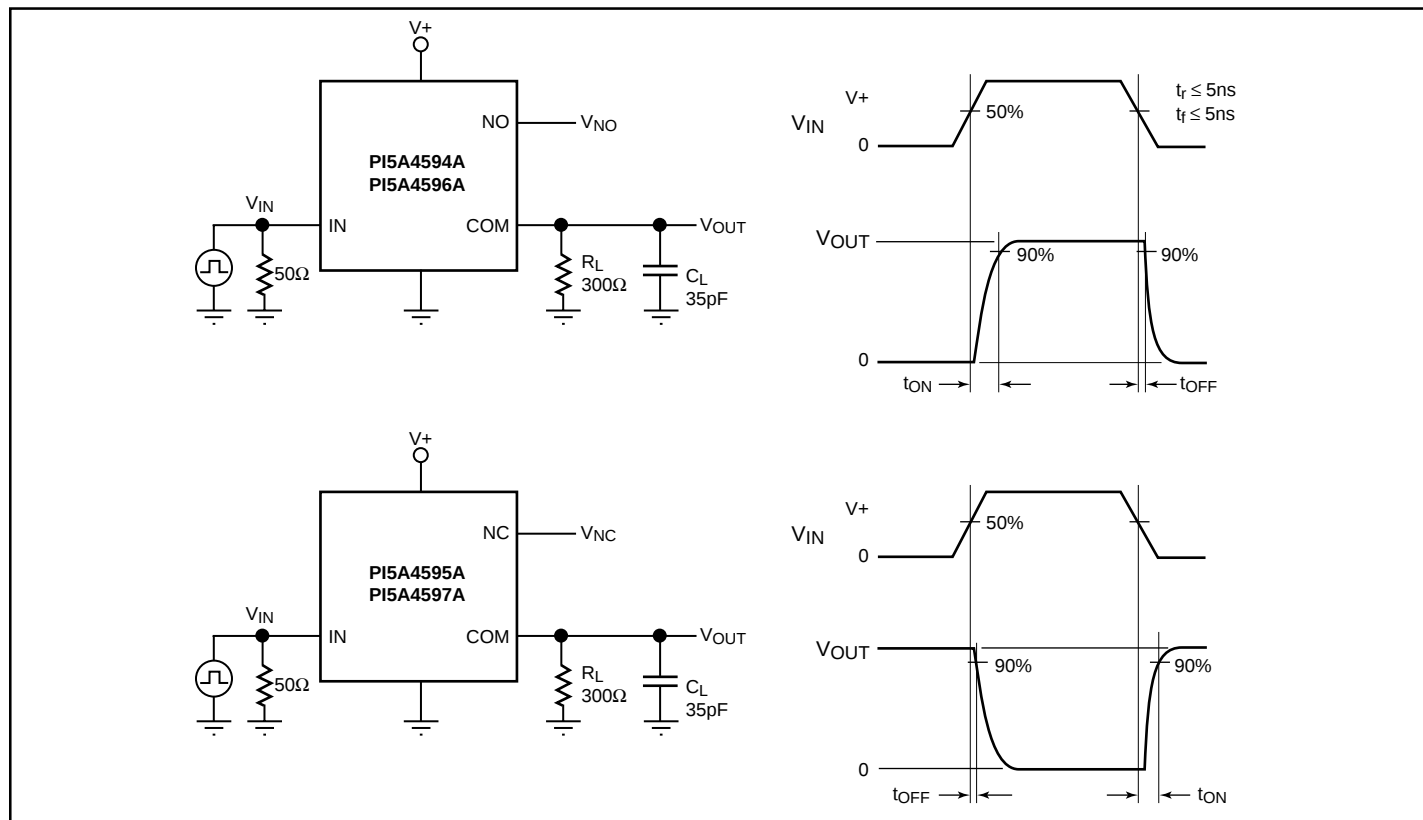
### Analog Signal Levels

Analog signals can range over the supply voltage ( $V^+$  to GND) with ON-resistance changing very little over the entire range. The PI5A4594A–PI5A4597A are bidirectional, so the NO, NC, and COM pins can be used either as inputs or outputs.

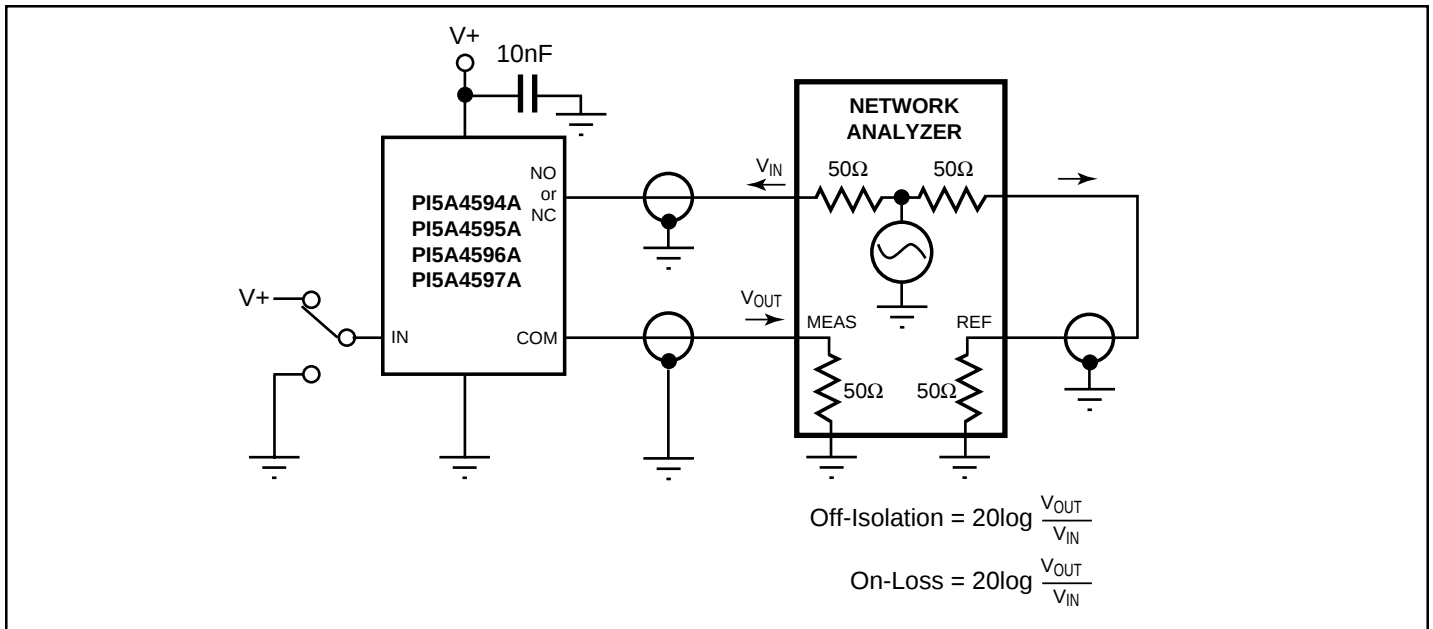
### Test Circuits/Timing Diagrams



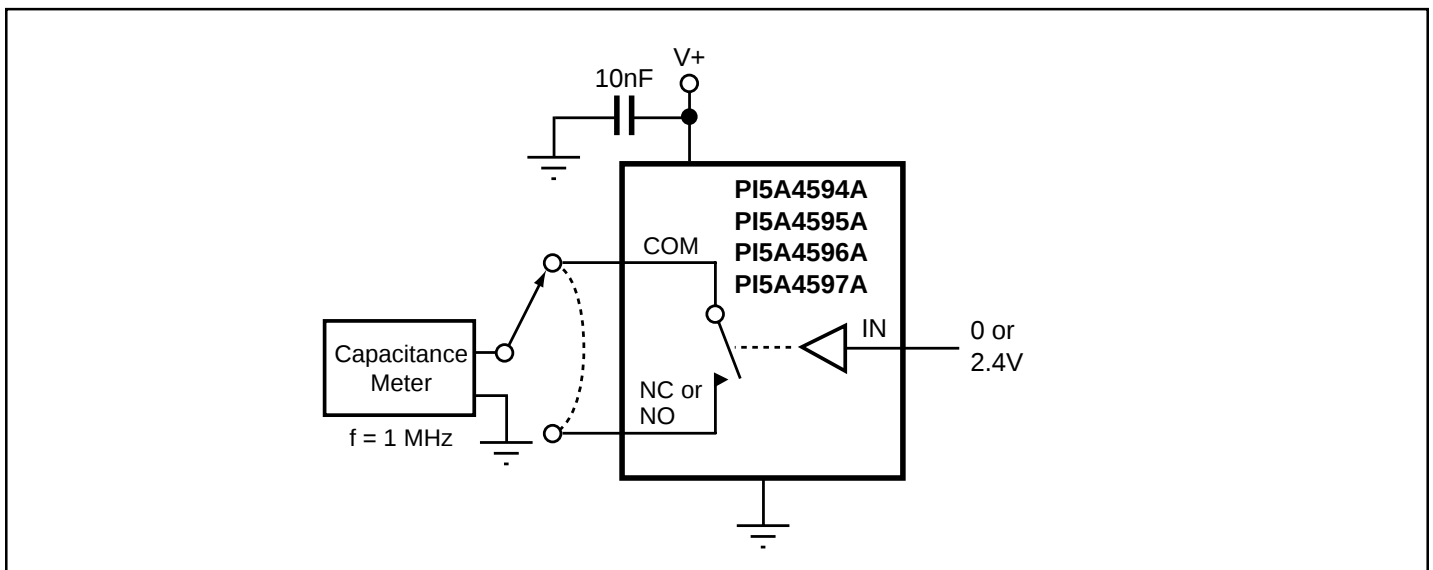
**Figure 2. Charge Injection**



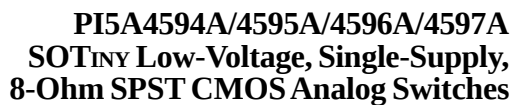
**Figure 3. Switching Times**



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



**Figure 5. Channel On-/Off Capacitance**



Technical drawing of a mechanical part, showing top and side views with dimensions and feature callouts.

**Top View Dimensions:**

- Overall width:  $.079$  BSC
- Overall height:  $.083$  BSC
- Feature 1 (bottom left):  $.026$  BSC
- Feature 2 (bottom center):  $.006$  BSC
- Feature 3 (bottom right):  $.011$  BSC
- Feature 4 (top right):  $.051$  BSC
- Feature 5 (top left):  $.049$  BSC

**Feature Callouts:**

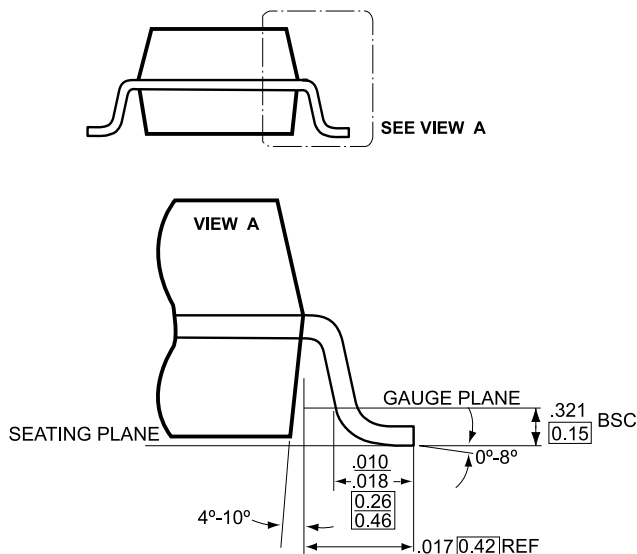
- Feature 1:  $0.10$  BSC
- Feature 2:  $0.15$  BSC
- Feature 3:  $0.30$  BSC
- Feature 4:  $1.30$  BSC
- Feature 5:  $1.25$  BSC

**Side View Dimensions:**

- Overall height:  $.043$  BSC
- Feature 1 (bottom left):  $0.10$  BSC
- Feature 2 (bottom center):  $0.10$  BSC
- Feature 3 (bottom right):  $0.10$  BSC

**SEATING PLANE**

**Notes:**  
1) Controlling dimensions in millimeters  
2) Ref: JEDEC MO-203AA



| Part Number | Temperature Range | Pin/Package | Package Top Mark |
|-------------|-------------------|-------------|------------------|
| PI5A4594ACX | −40°C to +85°C    | SC70-5      | A5E              |
| PI5A4595ACX |                   |             | A5F              |
| PI5A4596ACX |                   |             | A60              |
| PI5A4597ACX |                   |             | A61              |