



## PS4066/PS4066A

### Low-Cost, Quad, SPST, CMOS Analog Switches

#### Features

- Low On-Resistance, 12 Ohm typ.
- On-Resistance Matching Between Channels, 0.2Ohm typ
- On-Resistance Flatness, <2Ohm typ
- Low Off-Channel Leakage, <100pA @ +25°C
- TTL/CMOS Logic Compatible
- GND-to-V+ Analog Signal Dynamic Range
- Low Power Consumption (<12μW)
- Low Crosstalk: -86dB @ 1MHz
- Low Off-Isolation: -58dB @ 1 MHz
- Wide Bandwidth: > 100 MHz
- Small QSOP-16 Package Saves Board Area

#### Applications

- Instrumentation, ATE
- Sample-and-Holds
- Audio Switching and Routing
- Telecommunication Systems
- PBX, PABX
- Battery-Powered Systems

#### Description

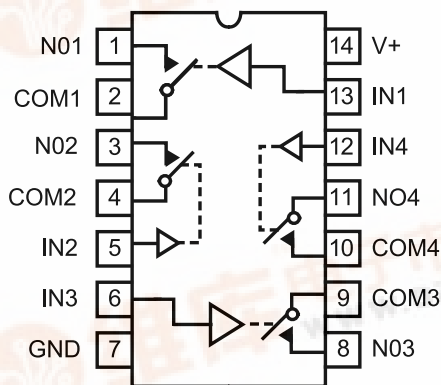
The PS4066/PS4066A are improved SPST CMOS analog switches ideal for low-distortion audio switching. These high precision, medium voltage switches were designed to operate with single-supplies from +3V to 16V. They are fully specified with +12V, +5V, and +3V supplies. The PS4066/PS4066A has four normally open (NO) switches. Each switch conducts current equally well in either direction when on. In the off state each switch blocks voltages up to the power-supply rails.

With +12V power supply, the PS4066/PS4066A guarantee <45Ohm on-resistance. On-resistance matching between channels is within 20Ohm (PS4066). On-resistance flatness is less than 4Ohm (PS4066A) over the specified range. The PS4066A guarantees low leakage currents (<100pA @ 25°C, <6nA @ +85°C) and fast switching speeds ( $t_{ON} < 175ns$ ). ESD sensitivity rating is >2,000V per MIL-STD 883, Method 3015.7

Both devices are available in PDIP-14, narrow-body SOIC-14, and QSOP-16 packages. Available temperature ranges are: commercial (0°C to 70°C), and industrial (-40°C to +85°C).

For operation below 5V, the PI5A101/PI5A391/PI5A392 are also recommended.

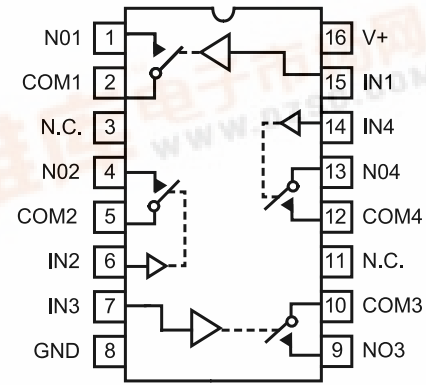
#### Functional Diagrams, Pin Configurations, and Truth Table



Top View  
PDIP/SO

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

N.C. = No Internal Connection  
Switches shown for logic "0" input



Top View  
QSOP



PS4066/PS4066A

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## Absolute Maximum Ratings

Voltages Referenced to GND

V+ ..... -0.3V to +17V

V<sub>IN</sub>, V<sub>COM</sub>, V<sub>NC</sub>, V<sub>NO</sub> (Note 1) ..... -2V to (V+) +2V  
or 30mA, whichever occurs first

Current (any terminal) ..... 30mA

Peak Current, COM, NO, NC

(pulsed at 1ms, 10% duty cycle) ..... 100mA

ESD per Method 3015.7 ..... >2000V

## Thermal Information

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

Plastic DIP (derate 10.5mW/°C above +70°C) ..... 800mW

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

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

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

### Note

Signals on NC, NO, COM, or IN exceeding V+ or GND are clamped by internal diodes. Limit forward diode current to 30mA.

**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 +12V Supply

(V+ = 12V ±10%, GND = 0V, V<sub>INH</sub> = 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 |
|-----------------------------------------------------|----------------------------------------------------|--------------------------------------------------------------------|------------|--------------------|--------------------|--------------------|-------|
| <b>Analog Switch</b>                                |                                                    |                                                                    |            |                    |                    |                    |       |
| Analog Signal Range <sup>(3)</sup>                  | V <sub>ANALOG</sub>                                |                                                                    | Full       | 0                  |                    | V+                 | V     |
| On Resistance                                       | R <sub>ON</sub>                                    | V+ = 12V, I <sub>COM</sub> = 2mA,<br>V <sub>NO</sub> = 10V         | 25         |                    | 12                 | 45                 | Ohm   |
|                                                     |                                                    |                                                                    | Full       |                    |                    | 55                 |       |
| On-Resistance Match Between Channels <sup>(4)</sup> | ΔR <sub>ON</sub>                                   | V+ = 12V, I <sub>COM</sub> = 2mA<br>V <sub>NO</sub> = 10V          | 25         |                    | 0.5<br>0.5         | 4<br>2             |       |
|                                                     |                                                    |                                                                    | Full       |                    |                    | 6                  |       |
| On-Resistance Flatness <sup>(5)</sup>               | R <sub>FLAT(ON)</sub>                              | V+ = 12V, I <sub>COM</sub> = 2mA,<br>V <sub>NO</sub> = 10V, 5V, 1V | 25         |                    | 2                  | 4                  | nA    |
|                                                     |                                                    |                                                                    | Full       |                    |                    | 6                  |       |
| NO or NC Off Leakage Current <sup>(6)</sup>         | I <sub>NO(OFF)</sub><br>OR<br>I <sub>NC(OFF)</sub> | V+ = 12V, V <sub>COM</sub> = 0V,<br>V <sub>NO</sub> = 10V          | 25         | -1<br>-0.1         |                    | 1<br>0.1           |       |
|                                                     |                                                    |                                                                    | Full       | -6                 |                    | 6                  |       |
| COM Off Leakage Current <sup>(6)</sup>              | I <sub>COM(OFF)</sub>                              | V+ = 12V, V <sub>COM</sub> = 0V,<br>V <sub>NO</sub> = 10V          | 25         | -1<br>-0.1         |                    | 1<br>0.1           | nA    |
|                                                     |                                                    |                                                                    | Full       | -6                 |                    | 6                  |       |
| COM On Leakage Current <sup>(6)</sup>               | I <sub>COM(ON)</sub>                               | V+ = 12V, V <sub>COM</sub> = 10V,<br>V <sub>NO</sub> = 10V         | 25         | -2<br>-0.2         |                    | 2<br>0.2           |       |
|                                                     |                                                    |                                                                    | Full       | -12                |                    | 12                 |       |



**Electrical Specifications - Single +12V Supply** (continued)  
(V+ = 12V ±10%, GND = 0V, V<sub>INH</sub> = 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 |
|---------------------------------------|-----------------------|-----------------------------------------------------------------------------------|-----------|--------------------|--------------------|--------------------|-------|
| Logic Input                           |                       |                                                                                   |           |                    |                    |                    |       |
| Input Current with Input Voltage High | I <sub>INH</sub>      | IN =5V, all others = 0.8V                                                         | Full      | -0.5               | 0.005              | 0.5                | μA    |
| Input Current with Input Voltage Low  | I <sub>INL</sub>      | IN = 0.8V, all others =5V                                                         |           | -0.5               | 0.005              | 0.5                |       |
| Dynamic                               |                       |                                                                                   |           |                    |                    |                    |       |
| Turn-On Time                          | t <sub>ON</sub>       | V <sub>COM</sub> = 10V, Figure 2                                                  | 25        |                    | 45                 | 100                | ns    |
|                                       |                       |                                                                                   | Full      |                    |                    | 150                |       |
| Turn-Off Time                         | t <sub>OFF</sub>      |                                                                                   | 25        |                    | 17                 | 75                 |       |
|                                       |                       |                                                                                   | Full      |                    |                    | 100                |       |
| On-Channel Bandwidth                  | BW                    | Signal = 0dbm<br>Figure 4, 50Ohm in and out                                       | 25        |                    | 100                |                    | MHz   |
| Charge Injection <sup>(3)</sup>       | Q                     | C <sub>L</sub> =1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 00Ohm,<br>Figure 3 |           |                    | 2                  | 10                 | pC    |
| Off Isolation                         | OIRR                  | R <sub>L</sub> = 50Ohm, C <sub>L</sub> = 5pF, f= 1 MHz, Figure 4                  |           |                    | -58                |                    | dB    |
| Crosstalk <sup>(8)</sup>              | X <sub>TALK</sub>     | R <sub>L</sub> = 50Ohm, C <sub>L</sub> = 5pF, f= 1 MHz, Figure 5                  |           |                    | -86                |                    |       |
| NO Capacitance                        | C <sub>(OFF)</sub>    | f=1 MHz, Figure 6                                                                 |           |                    | 9                  |                    | pF    |
| COM Off Capacitance                   |                       | f=1 MHz, Figure 6                                                                 |           |                    | 9                  |                    |       |
| COM On Capacitance                    | C <sub>COM(O-N)</sub> | f=1MHz, Figure 7                                                                  |           |                    | 22                 |                    |       |
| Supply                                |                       |                                                                                   |           |                    |                    |                    |       |
| Positive Supply Current               | I+                    | V <sub>IN</sub> = 0V or V+,<br>all channels on or off                             | Full      | -1                 | 0.001              | 1                  | μA    |
| Total Harmonic Distortion             | THD                   |                                                                                   |           |                    | 0.03               |                    | %     |

**Notes:**

1. The algebraic convention, where the most negative value is a minimum and the 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> = ΔR<sub>ON</sub> max - ΔR<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>COM</sub> / (V<sub>NO</sub> or V<sub>NO</sub>) ], V<sub>COM</sub> = Output, V<sub>NC</sub> / V<sub>NO</sub> = input to off switch
8. Between any two switches.



**PS4066/PS4066A**  
**Low-Cost, Quad, SPST, CMOS Analog Switches**

**Electrical Specifications - Single +5V Supply**  
(V+ = +5V ±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+                 | V     |
| On-Resistance                                       | R <sub>ON</sub>       | V+ = 4.5V, I <sub>COM</sub> = -1mA,<br>V <sub>NO</sub> = 3.5V                   | 25                |                    | 22                 | 75                 | Ohm   |
|                                                     |                       |                                                                                 | Full              |                    |                    | 100                |       |
| On-Resistance Match Between Channels <sup>(4)</sup> | ΔR <sub>ON</sub>      | V+ =5V, I <sub>COM</sub> = -1mA,<br>V <sub>NO</sub> = 3V                        | 25                |                    | 0.3                | 4                  |       |
|                                                     |                       |                                                                                 | Full              |                    |                    | 12                 |       |
| On-Resistance Flatness <sup>(3,5)</sup>             | R <sub>FLAT(ON)</sub> | V+ = 5V, I <sub>COM</sub> = -1mA,<br>V <sub>NO</sub> = 1V, 3V                   | 25                |                    | 4                  | 6                  |       |
|                                                     |                       |                                                                                 | Full              |                    |                    | 8                  |       |
| NO Off Leakage Current <sup>(9)</sup>               | I <sub>NO(OFF)</sub>  | V+ = 5.5V, V <sub>COM</sub> = 0V,<br>V <sub>NO</sub> = 4.5V                     | PS4066<br>PS4066A | 25                 | -1<br>-0.1         | 1<br>0.1           | nA    |
|                                                     |                       |                                                                                 |                   | Full               | -6                 |                    |       |
| COM Off Leakage Current <sup>(9)</sup>              | I <sub>COM(OFF)</sub> | V+ = 5.5V, V <sub>COM</sub> = 0V,<br>V <sub>NO</sub> = 4.5V                     | PS4066<br>PS4066A | 25                 | -1<br>-0.1         | 1<br>0.1           |       |
|                                                     |                       |                                                                                 |                   | Full               | -6                 |                    |       |
| COM On Leakage Current <sup>(6)</sup>               | I <sub>COM(ON)</sub>  | V+ = 5.5V, V <sub>COM</sub> = 5V<br>V <sub>NO</sub> = 4.5V                      | PS4066<br>PS4066A | 25                 | -2<br>-0.2         | 2<br>0.2           |       |
|                                                     |                       |                                                                                 |                   | Full               | -12                |                    |       |
| Dynamic                                             |                       |                                                                                 |                   |                    |                    |                    |       |
| Turn-On Time                                        | t <sub>ON</sub>       | V <sub>NO</sub> = 3V                                                            | 25                |                    | 65                 | 125                | ns    |
|                                                     |                       |                                                                                 | Full              |                    |                    | 175                |       |
| Turn-Off Time                                       | t <sub>OFF</sub>      |                                                                                 | 25                |                    | 30                 | 75                 |       |
|                                                     |                       |                                                                                 | Full              |                    |                    | 125                |       |
| On-Channel Bandwidth                                | BW                    | Signal = 0dBm, 50Ohm in and out<br>Figure 4                                     | 25                |                    | 100                |                    | MHz   |
| Charge Injection <sup>(3)</sup>                     | Q                     | C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V,<br>R <sub>GEN</sub> = 0V, Figure 3 | 25                |                    | 1                  | 10                 | pC    |
| Supply                                              |                       |                                                                                 |                   |                    |                    |                    |       |
| Positive Supply Current                             | I+                    | V+ = 5.5V, V <sub>IN</sub> = 0V or V+,<br>all channels on or off                | Full              | -1                 |                    | 1                  | μA    |



### Electrical Specifications - Single +3V Supply

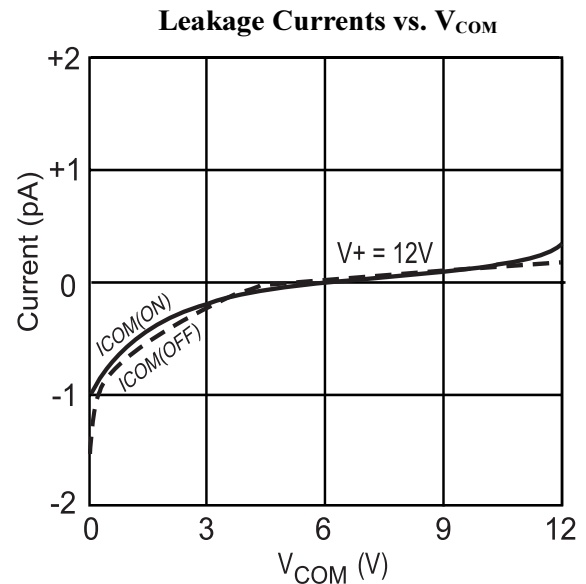
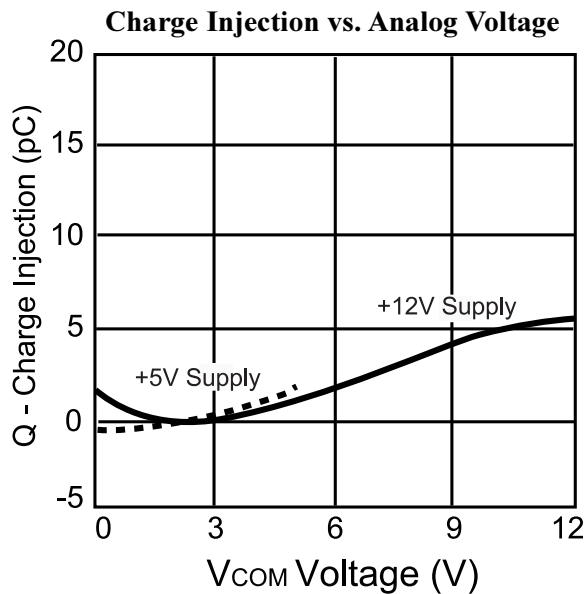
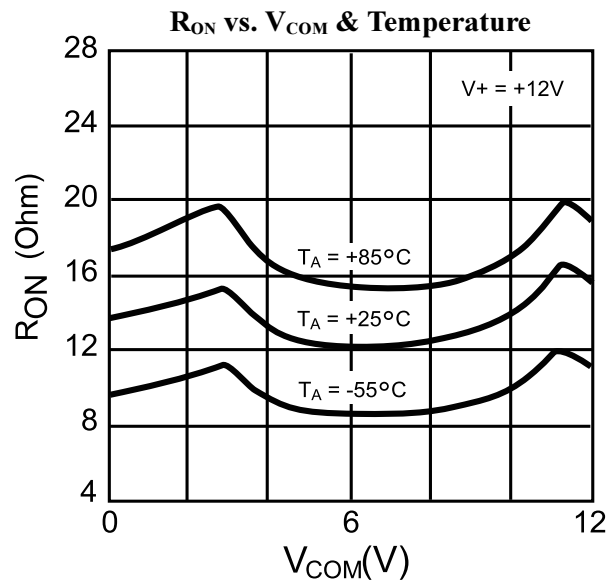
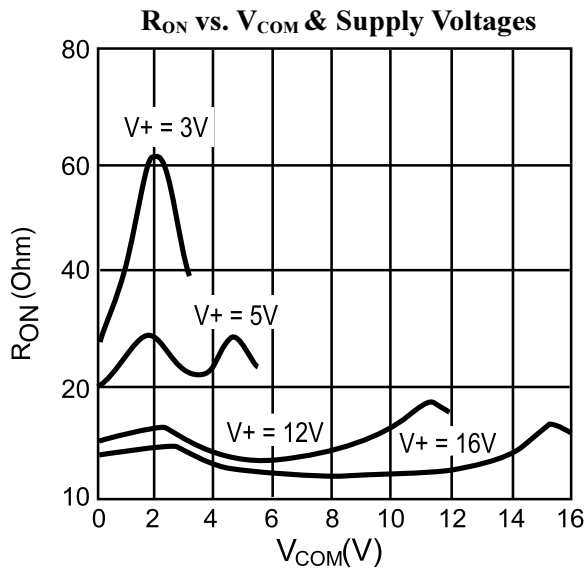
(V+ = +2.7V to 3.3V, GND = 0V, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V)

| 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> |                                                                       |        | 0                   |                    | V+                  | V     |
| Channel On-Resistance              | R <sub>ON</sub>     | V+ = 3V, I <sub>COM</sub> = -1mA,<br>V <sub>NO</sub> = 1.5V           | 25     |                     |                    | 170                 | Ohm   |
|                                    |                     |                                                                       | Full   |                     |                    | 225                 |       |
| Dynamic                            |                     |                                                                       |        |                     |                    |                     |       |
| Turn-On-Time <sup>(3)</sup>        | t <sub>ON</sub>     | V+ =3V, V <sub>NO</sub> = 1.5V                                        | 25     |                     | 80                 | 185                 | ns    |
|                                    |                     |                                                                       | Full   |                     |                    | 230                 |       |
| Turn-Off-Time <sup>(3)</sup>       | t <sub>(OFF)</sub>  | V+ =3V, V <sub>NO</sub> = 1.5V                                        | 25     |                     | 40                 | 150                 |       |
|                                    |                     |                                                                       | Full   |                     |                    | 200                 |       |
| Charge Injection <sup>(3)</sup>    | Q                   | C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V,<br>R <sub>GEN</sub> = 0V | 25     |                     | 2                  | 10                  | pC    |
| Supply                             |                     |                                                                       |        |                     |                    |                     |       |
| Positive Supply Current            | I+                  | V+ = 3.3V, V <sub>IN</sub> = 0V or V+,<br>all channels on or off      | Full   | -1                  | 0.001              | 1                   | μA    |

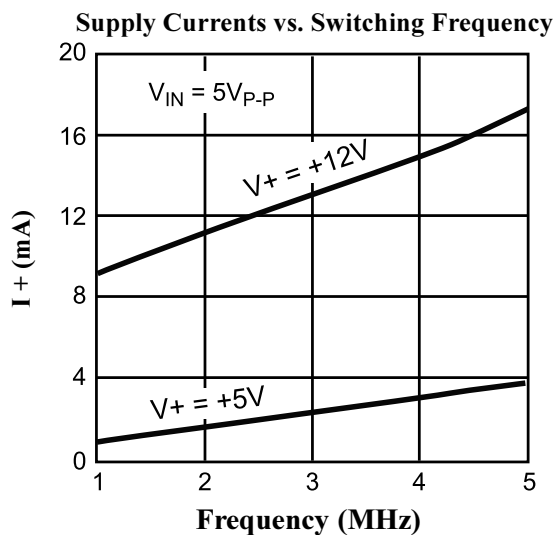
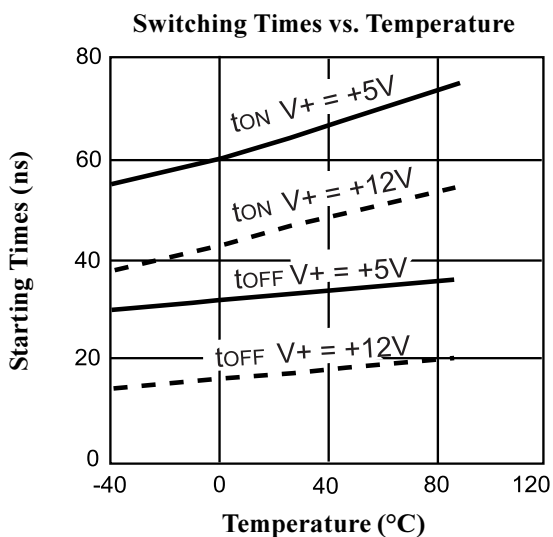
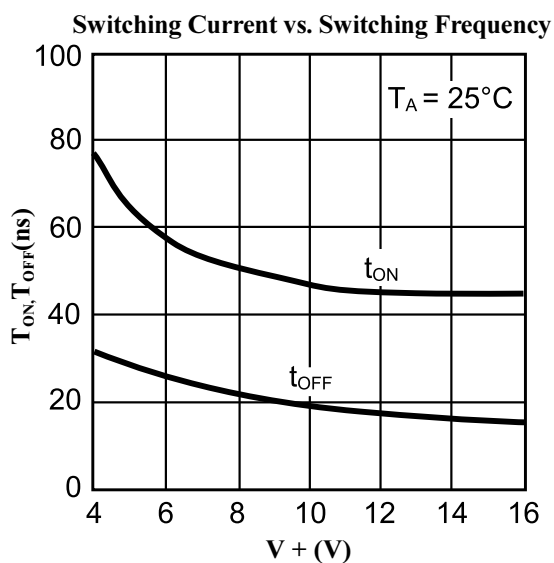
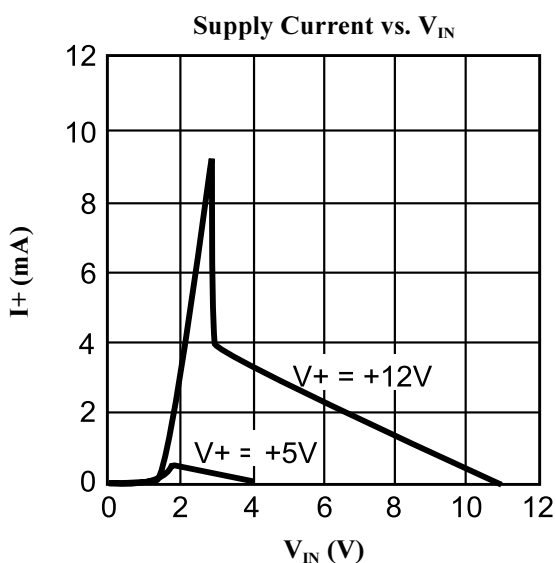
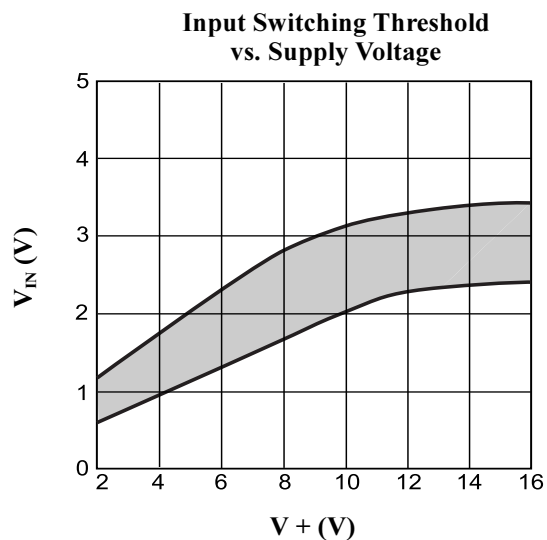
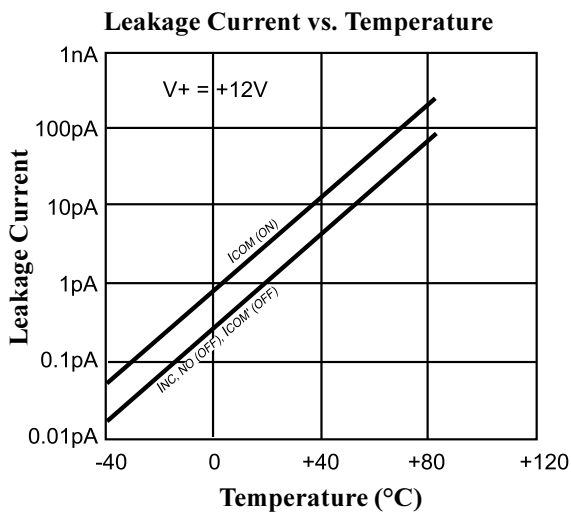
#### Notes:

1. The algebraic convention, where the most negative value is a minimum and the 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.  $\Delta R_{ON} = \Delta R_{ON \text{ max}} - \Delta R_{ON \text{ min}}$
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 =  $20\log_{10} [ V_{COM} / (V_{NO} \text{ or } V_{NO}) ]$ , V<sub>COM</sub> = Output, V<sub>NC</sub>/V<sub>NO</sub> = input to off switch
8. Between any two switches.

Typical Operating Characteristics (TA = +25°C, unless otherwise noted)



Typical Operating Characteristics (TA = +25°C, unless otherwise noted)



## Pin Description

## Applications Information

### Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings may cause permanent damage to the devices. Always sequence V+ on first, and then the logic inputs. If power-supply sequencing is not possible, add a small signal diode or current limiting resistor in series with the supply pin for overvoltage protection (Figure 1). Adding a diode reduces the analog signal range, but low switch resistance and low leakage characteristics are unaffected.

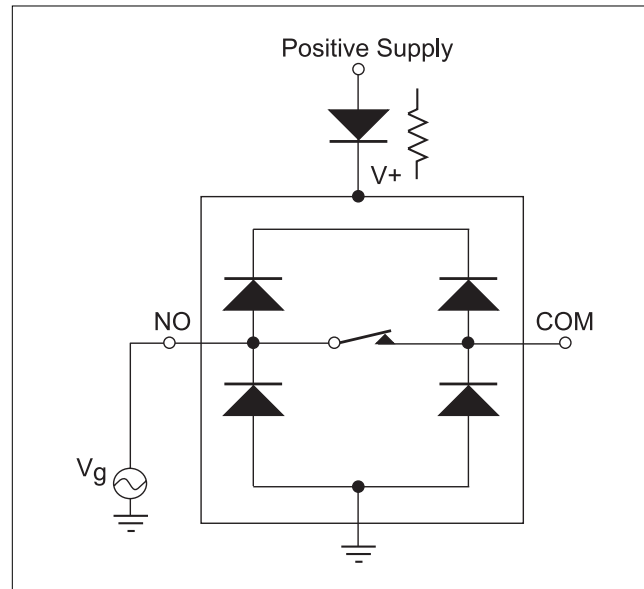


Figure 1. Overvoltage protection is accomplished using an external blocking diode or a current limiting resistor .

## Test Circuits/Timing Diagrams

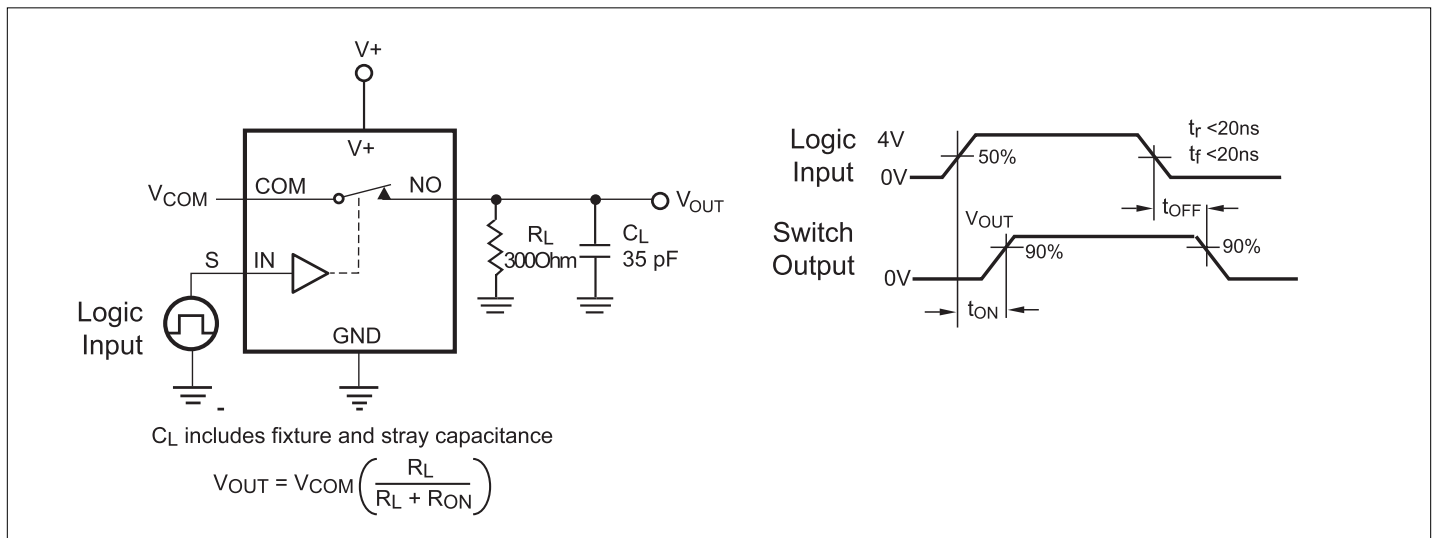


Figure 2. Switching Times

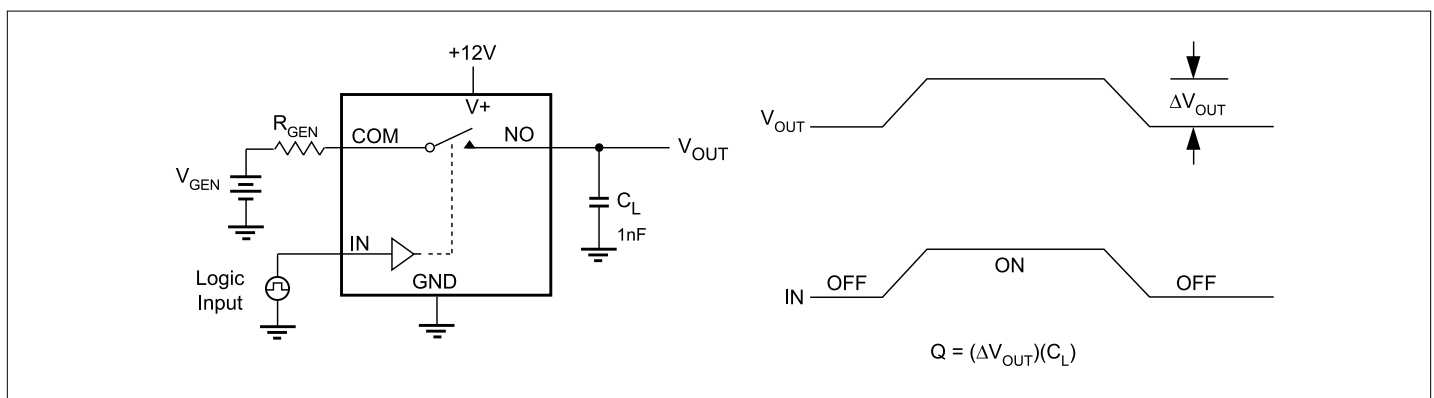


Figure 3. Charge Injection

### Test Circuits/Timing Diagrams (continued)

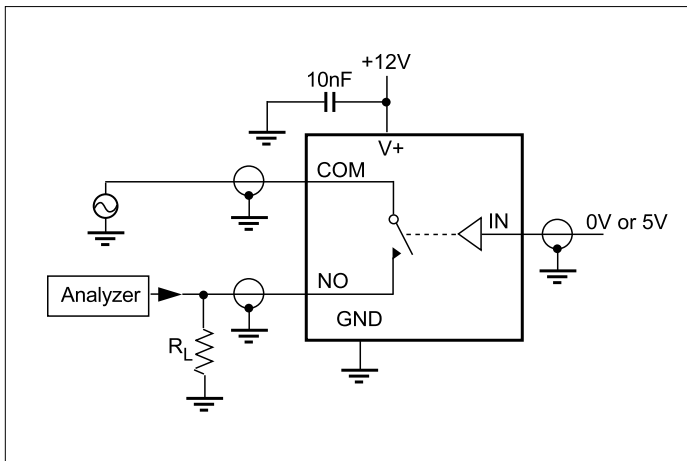


Figure 4. Off Isolation, BW

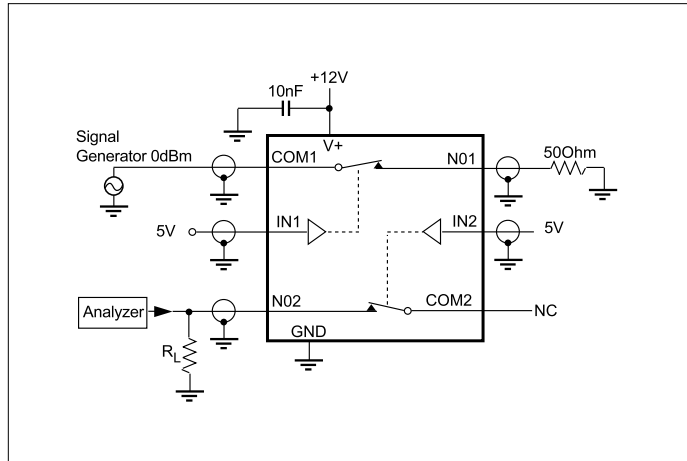


Figure 5. Crosstalk

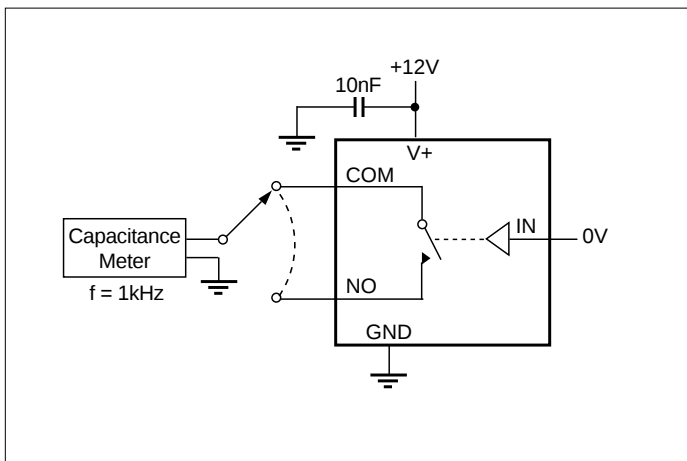


Figure 6. Channel-Off Capacitance

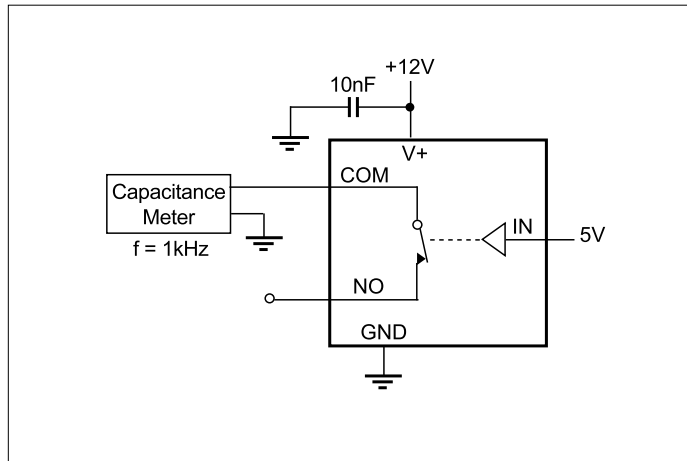


Figure 7. Channel-On Capacitance

### Ordering Information

| Part Number | Temperature - Range | Package        |
|-------------|---------------------|----------------|
| PS4066CPD   | 0°C to + 70°C       | 14 Plastic DIP |
| PS4066CSD   | 0°C to + 70°C       | 14 Narrow SO   |
| PS4066CEE   | 0°C to + 70°C       | 16 QSOP        |
| PS4066EPD   | -40°C to + 85°C     | 14 Plastic DIP |
| PS4066ESD   | -40°C to + 85°C     | 14 Narrow SO   |
| PS4066ACPD  | 0°C to + 70°C       | 14 Plastic DIP |
| PS4066ACSD  | 0°C to + 70°C       | 14 Narrow SO   |
| PS4066ACEE  | 0°C to + 70°C       | 16 QSOP        |
| PS4066AEPD  | -40°C to + 85°C     | 14 Plastic DIP |
| PS4066AESD  | -40°C to + 85°C     | 14 Narrow SO   |
| PS4066AEED  | -40°C to + 85°C     | 16 QSOP        |