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Features

- Low On-Resistance (16Ω typ) Minimizes Distortion and Error Voltages
- Low Glitching Reduces Step Errors in Sample-and-Holds. Charge Injection, 3pC typ
- Single Supply (+3V to +15V) or Split-Supply (±3V to ±8V) Operation
- Improved Second Sources for MAX381/MAX383/MAX385
- On-Resistance Matching Between Channels, 0.2 Ω typ
- On-Resistance Flatness, 1Ω typ
- Low Off-Channel Leakage, <2.5nA @ +85°C
- TTL/CMOS Logic Compatible
- Rail-to-Rail Analog Signal Dynamic Range
- Low Power Consumption <1μA

Applications

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

Description

The PS381/PS383/PS385 are improved high precision, medium voltage analog switches designed to operate with +3V to ±8V power supplies.

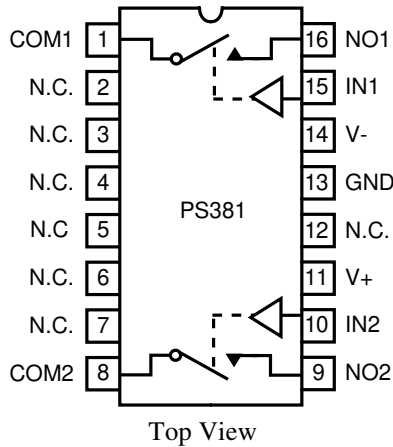
The PS381 has two normally open (NO) switches. The PS383 is a dual, single-pole double-throw (SPDT) switch. The PS385 is a dual, double-pole single-throw (DPST) function. Each switch conducts current equally well in either direction when on. In the off state each switch blocks voltages up to the power-supply rails.

With ±5V power supplies, the PS381/PS383/PS385 guarantee <30Ω on-resistance. On-resistance matching between channels is within 2Ω. On-resistance flatness is less than 4Ω over the specified range. All three devices feature low leakage currents (<2 pA @ 25°C, <2.5nA @ +85°C) and fast switching speeds (t_{ON} <130ns). Break-before-make switching action protects against momentary crosstalk (PS383).

These switches are fully specified for single +5V operation, with <45Ω R_{ON}, <2Ω R_{ON} match, and <4Ω R_{ON} flatness.

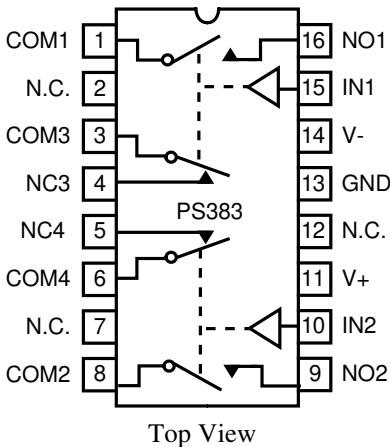
For operation below 5V the PI5A381A/PI5A383A/PI5A385A are also recommended.

Functional Diagrams, Pin Configurations, and Truth Tables



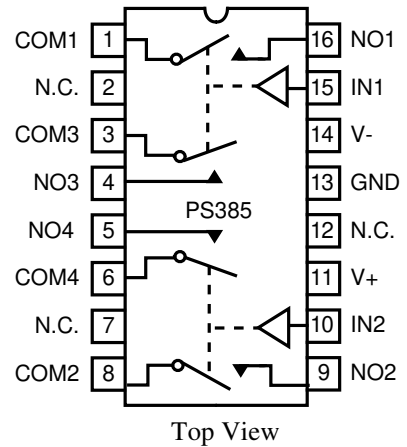
N.C. = No Connect.

| PS381 | |
|-------|--------|
| Logic | Switch |
| 0 | OFF |
| 1 | ON |



Switches shown for logic "0" input

| PS383 | | |
|-------|----------|----------|
| Logic | SW3, SW4 | SW1, SW2 |
| 0 | ON | OFF |
| 1 | OFF | ON |



| PS385 | |
|-------|--------|
| Logic | Switch |
| 0 | OFF |
| 1 | ON |

Absolute Maximum Ratings

Voltages Referenced to V-

| | |
|---|---|
| V+ | -0.3V to +17V |
| GND | -0.3V to +17V |
| GND | -0.3V to (V+) +0.3V |
| V _{IN} , V _{COM} , V _{NC} , V _{NO} (Note 1) | (V-) -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 _A = +70°C) | |
| Plastic DIP (derate 10.5mW/°C above +70°C) | 800mW |
| Narrow SO (derate 8.7mW/°C above +70°C) | 650mW |
| Storage Temperature | -65°C to +150°C |
| Lead Temperature (soldering, 10s) | +300°C |

Note 1: Signals on NC, NO, COM, or IN exceeding V+ or V- are clamped by internal diodes. Limit forward diode current to maximum current rating

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 - Dual Supplies

(V_± = ± 5V ±10%, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V)

| Parameter | Symbol | Conditions | Temp. (°C) | Min ⁽²⁾ | Typ ⁽¹⁾ | Max ⁽²⁾ | Units |
|--|---|---|------------|--------------------|--------------------|--------------------|-------|
| Analog Switch | | | | | | | |
| Analog Signal Range ⁽³⁾ | V _{ANALOG} | | Full | V- | | V+ | V |
| On Resistance | R _{ON} | V+ = 4.5V, V- = -4.5V, V _{NO} or V _{NC} = ±3.5V I _{COM} = -10mA, | 25 | | 16 | 30 | Ω |
| | | | Full | | | 40 | |
| On-Resistance Match Between Channel ⁽⁴⁾ | ΔR _{ON} | V _{NO} or V _{NC} = ±3V, I _{COM} = -10mA, V+ = 5V, V- = -5V | 25 | | 0.2 | 2 | Ω |
| | | | Full | | | 4 | |
| On-Resistance Flatness ⁽⁵⁾ | R _{FLAT(ON)} | V+ = 5V, V- = -5V, I _{COM} = -10mA, V _{NO} or V _{NC} = ±3.5V | 25 | | 1 | 4 | Ω |
| | | | Full | | | 6 | |
| NO or NC Off Leakage Current ⁽⁶⁾ | I _{NO(OFF)} or I _{NC(OFF)} | V+ = 5.5V, V- = -5.5V, V _{COM} = ± 4.5V, V _{NC} or V _{NO} = +4.5V | 25 | -0.1 | -0.001 | 0.1 | nA |
| | | | Full | -2.5 | | 2.5 | |
| COM Off Leakage Current ⁽⁶⁾ | I _{COM(OFF)} | V+ = 5.5V, V- = -5.5V V _{COM} = ± 4.5V, V _{NO} or V _{NC} = +4.5V | 25 | -0.1 | -0.001 | 0.1 | nA |
| | | | Full | -2.5 | | 2.5 | |
| COM On Leakage Current ⁽⁷⁾ | I _{COM(ON)} | V+ = 5.5V, V- = -5.5V, V _{COM} = ±4.5V V _{NO} or V _{NC} = ±4.5V | 25 | -0.2 | 0.002 | 0.2 | nA |
| | | | Full | -5 | | 5 | |

Electrical Specifications - Dual Supplies (continued)

($V \pm \pm 5V \pm 10\%$, GND = 0V, $V_{INH} = 2.4V$, $V_{INL} = 0.8V$)

| Parameter | Symbol | Conditions | Temp (°C) | Min ⁽¹⁾ | Typ ⁽²⁾ | Max ⁽¹⁾ | Units |
|---------------------------------------|----------------|---|-----------|--------------------|--------------------|--------------------|---------|
| Logic Input | | | | | | | |
| Input Current with Input Voltage High | I_{INH} | $V_{IN} = 2.4V$, all others = 0.8V | Full | -0.5 | 0.005 | 0.5 | μA |
| Input Current with Input Voltage Low | I_{INL} | $V_{IN} = 0.8V$, all others = 2.4V | | -0.5 | 0.005 | 0.5 | |
| Logic High Input Voltage | V_{AH} | | | 2.4 | | | V |
| Logic Low Input Voltage | V_{AL} | | | | | 0.8 | |
| Dynamic | | | | | | | |
| Turn-On Time | t_{ON} | $V_{COM} = \pm 3V$, Figure 2 | 25 | | 51 | 130 | ns |
| | | | Full | | | 175 | |
| Turn-Off Time | t_{OFF} | | 25 | | 29 | 75 | |
| | | | Full | | | 100 | |
| Break-Before-Make Time Delay | t_D | PS383 only, Figure 3 | 25 | 10 | 20 | | |
| Charge Injection | Q | $C_L = 1nF$, $V_{GEN} = 0V$, $R_{GEN} = 0\Omega$, Figure 4 | 25 | | 2 | 5 | pC |
| Off Isolation ⁽⁷⁾ | OIRR | $R_L = 50\Omega$, $C_L = 5pF$, $f = 1MHz$, Figure 5 | | | -65 | | dB |
| Crosstalk ⁽⁸⁾ | X_{TALK} | $R_L = 50\Omega$, $C_L = 5pF$, $f = 1MHz$, Figure 6 | | | -90 | | |
| NC or NO Off Capacitance | $C_{(OFF)}$ | $f = 1MHz$, Figure 7 | | | | 12 | pF |
| COM Off Capacitance | $C_{COM(OFF)}$ | $f = 1MHz$, Figure 7 | | | | 12 | |
| COM On Capacitance | $C_{COM(ON)}$ | $f = 1MHz$, Figure 8 | | | | 25 | |
| Supply | | | | | | | |
| Power-Supply Range | V+, V- | | | ± 3 | | ± 8 | V |
| Positive Supply Current | I+ | $V+ = 5.5V$, $V- = -5.5V$, $V_{IN} = 0V$ or $V+$, all channels on or off | Full | -1 | | 1 | μA |
| Negative Supply Current | I- | | | -1 | | 1 | |

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 = $20 \log_{10} [V_{COM} / (V_{NO} \text{ or } V_{NO})]$. See figure 5.
8. Between any two switches. See figure 6.

Electrical Specifications - Single +5V Supply

(V+ = +5V ±10%, V- = 0V, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V)

| Parameter | Symbol | Conditions | Temp°C | Min. ⁽²⁾ | Typ. ⁽²⁾ | Max. ⁽²⁾ | Units |
|---|---|--|--------|---------------------|---------------------|---------------------|-------|
| Analog Switch | | | | | | | |
| Analog Switch Range ⁽³⁾ | V _{ANALOG} | | Full | 0 | | V+ | V |
| On-Resistance | R _{ON} | V+ = 5.0V, V- = 0V I _{COM} = -10mA, V _{NO} or V _{NC} = 3.5V | 25 | | 25 | 45 | Ω |
| | | | Full | | | 60 | |
| On-Resistance Match Between Channels ⁽⁴⁾ | ΔR _{ON} | V+ = 5V, V _{COM} = -10mA, V _{NO} or V _{NC} = 3V | 25 | | 0.5 | 2 | |
| | | | Full | | | 4 | |
| On-Resistance Flatness ⁽⁵⁾ | | V+ = 5V, V- = 0V, I _{COM} = -10mA, V _{NO} or V _{NC} = 1V, 4V | 25 | | 1 | 4 | |
| | | | Full | | | 6 | |
| NO or NC Off Leakage Current ⁽⁹⁾ | I _{NO(OFF)} or I _{NC(OFF)} | V+ = 5.5V, V _{COM} = 0V, V _{NO} or V _{NC} = 4.5V | 25 | -0.1 | 0.001 | 0.1 | nA |
| | | | Full | -2.5 | | 2.5 | |
| COM Off Leakage Current ⁽⁹⁾ | I _{COM(OFF)} | V+ = 5.5V, V _{COM} = 4.5V, V _{NO} or V _{NC} = 0V | 25 | -01 | 0.001 | 0.1 | |
| | | | Full | -2.5 | | 2.5 | |
| COM On Leakage Current ⁽⁹⁾ | I _{COM(ON)} | V _{COM} = 4.5V, V _{NO} or V _{NC} = 4.5V, V+ = 5.5V | 25 | -0.2 | -0.002 | 0.2 | |
| | | | Full | -5 | | 5 | |
| Dynamic | | | | | | | |
| Turn-On-Time ⁽³⁾ | t _{ON} | V _{COM} = 3V, Figure 2 | 25 | | 63 | 170 | ns |
| | | | Full | | | 240 | |
| Turn-Off-Time ⁽³⁾ | t _{OFF} | | 25 | | 34 | 50 | |
| | | | Full | | | 100 | |
| Break-Before-Make Time Delay ⁽³⁾ | t _D | PS383 only | 25 | 10 | 20 | | |
| Charge Injection ⁽³⁾ | Q | C _L = 1nF, V _{GEN} = 0V, R _{GEN} = 0Ω, Figure 4 | 25 | | 0 | 5 | pC |
| Supply | | | | | | | |
| Positive Supply Current | I+ | All channels on or off, V _{IN} = 0V or V+, V+ = 3.6V, V- = 0V | Full | -1 | | 1 | μA |
| Negative Supply Current | I- | | | -1 | | 1 | |

Electrical Specifications - Single +3.3V Supply

(V+ = +3V to 3.6V, V- = 0V, GND = 0V, V_{NH} = 2.4V, V_{INL} = 0.8V)

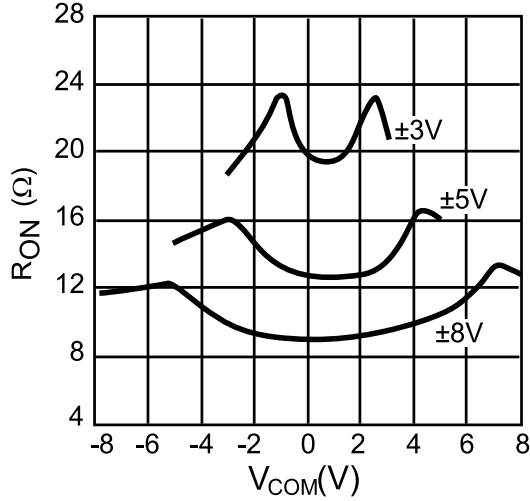
| Parameter | Symbol | Conditions | Temp (°C) | Min. ⁽¹⁾ | Typ. ⁽²⁾ | Max. ⁽¹⁾ | Units |
|------------------------------------|---------------------|---|-----------|---------------------|---------------------|---------------------|-------|
| Analog Switch | | | | | | | |
| Analog Switch Range ⁽³⁾ | V _{ANALOG} | | Full | 0 | | V+ | V |
| Channel On-Resistance | R _{ON} | V+ = 3V, I _{COM} = -10mA V _{NO} = V _{NC} = 1.5V | 25 | | 62 | 150 | Ω |
| | | | Full | | | 200 | |
| Dynamic | | | | | | | |
| Turn-On Time ⁽³⁾ | t _{ON} | V _{COM} = 1.5V, Figure 2 | 25 | | | 400 | ns |
| Turn-Off Time ⁽³⁾ | t _{OFF} | | | | | 150 | |
| Break-Before-Make Time Delay | t _D | PS383 only | 25 | 10 | 20 | | |
| Charge Injection | Q | C _L = 1nF, V _{GEN} = 0V, R _{GEN} = 0Ω | 25 | | | 5 | pC |
| Supply | | | | | | | |
| Power-Supply Range | V+ | | Full | 2.7 | | 16 | V |
| Positive Supply Current | I+ | All channels on or off, V _{IN} = 0V or V+, V+ = 3.6V, V- = 0.5V | | -1 | | 1 | μA |
| Negative Supply Current | I- | | | -1 | | 1 | |

Notes:

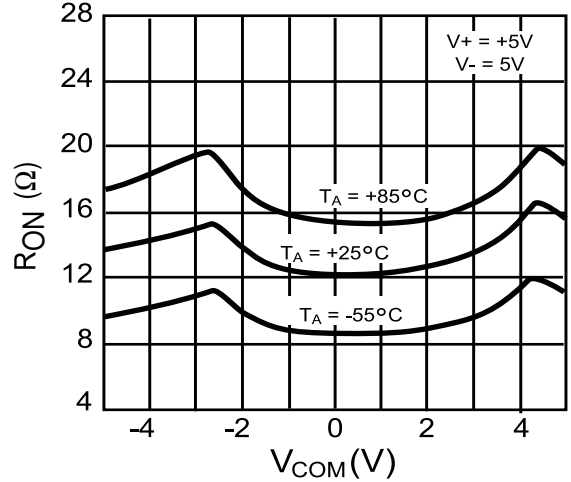
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3. Guaranteed by design
4. $\Delta R_{ON} = \Delta R_{ON \text{ max}} - \Delta R_{ON \text{ min}}$
5. Flatness is defined as the difference between the maximum and minimum value of on-resistance measured.
6. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25°C.
7. Off Isolation = $20 \log_{10} [V_{COM} / (V_{NO} \text{ or } V_{NC})]$. See figure 5.
8. Between any two switches. See figure 6.
9. Leakage testing at single-supply is guaranteed by testing with dual supplies.

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

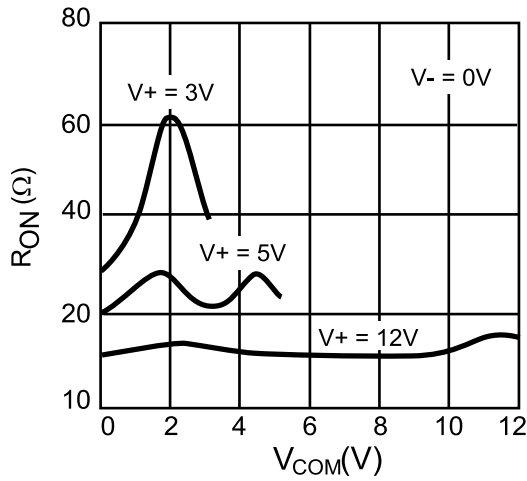
R_{ON} vs. V_{COM} & Supply Voltages



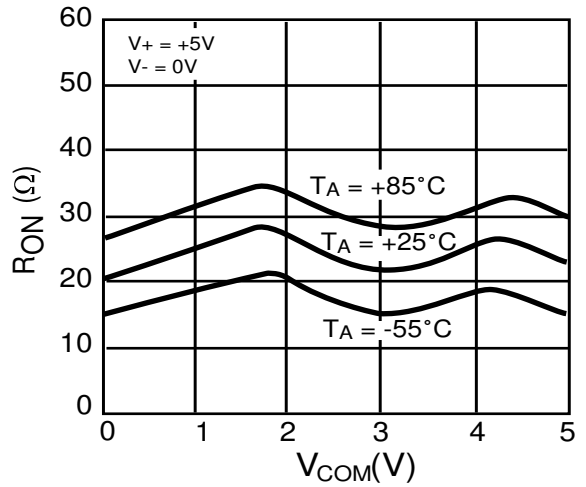
R_{ON} vs. V_{COM} & Supply Voltages



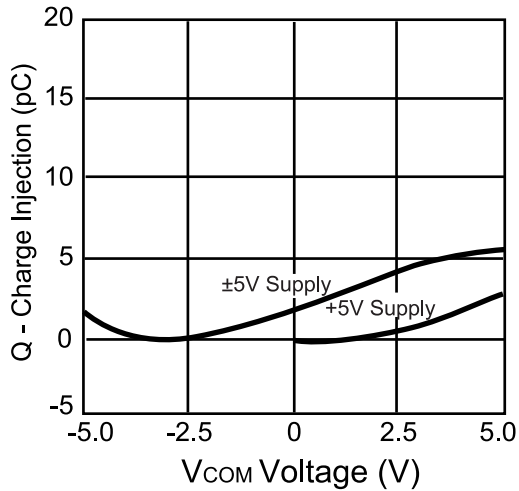
R_{ON} vs. V_{COM} (Single Supply)



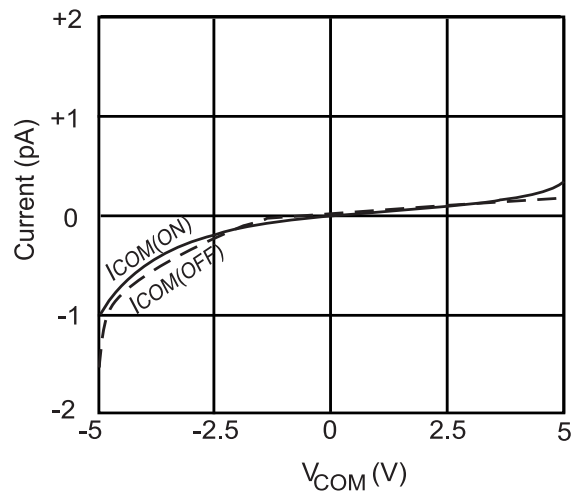
R_{ON} vs. V_{COM} and Temperature (Single Supply)

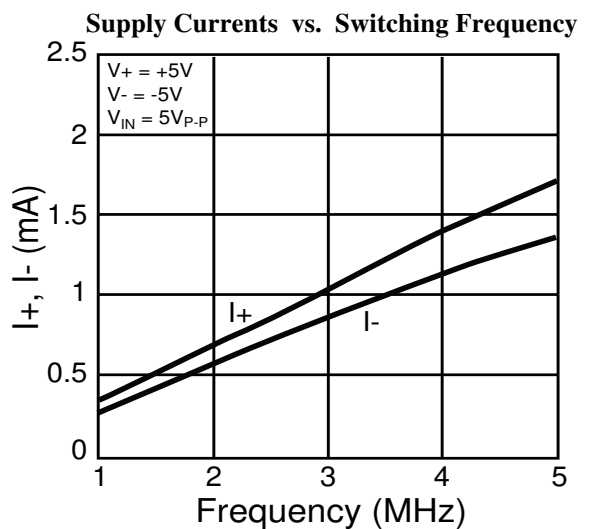
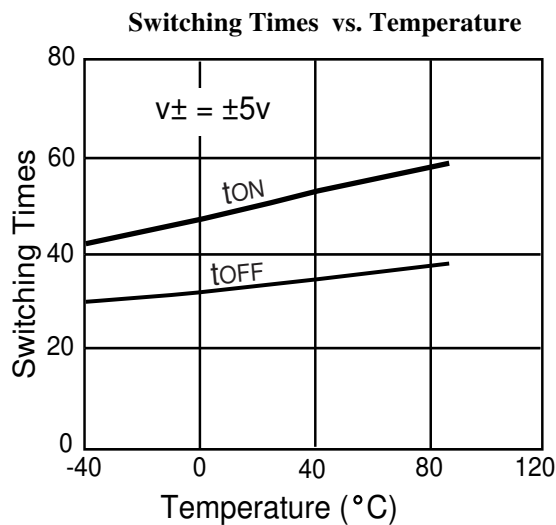
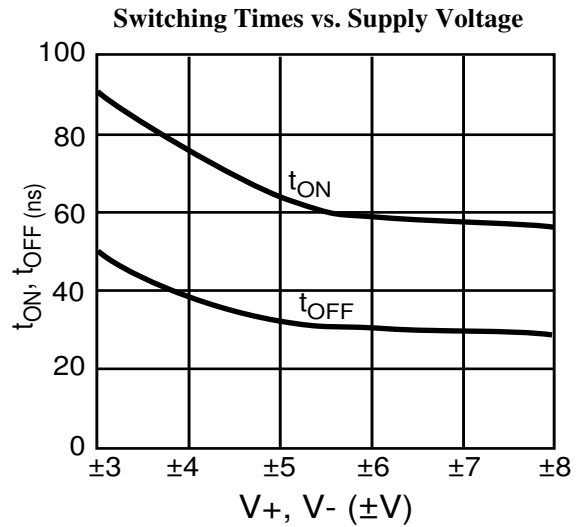
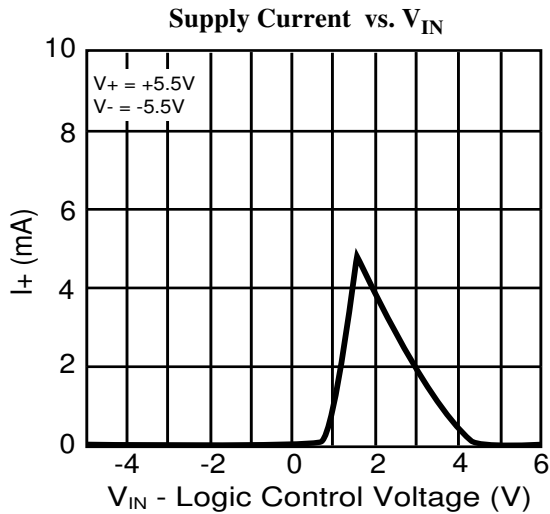
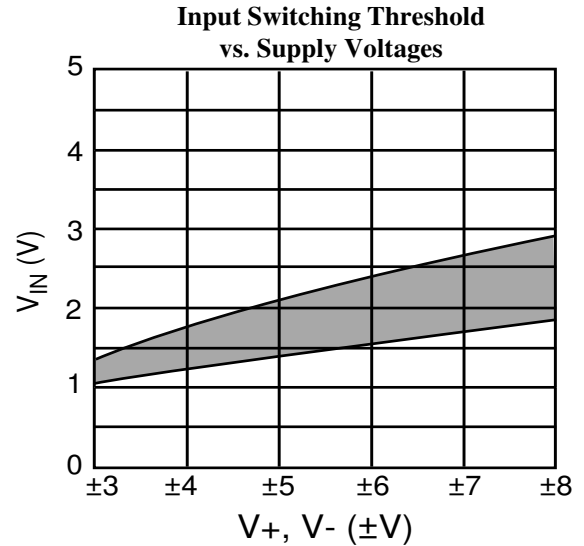
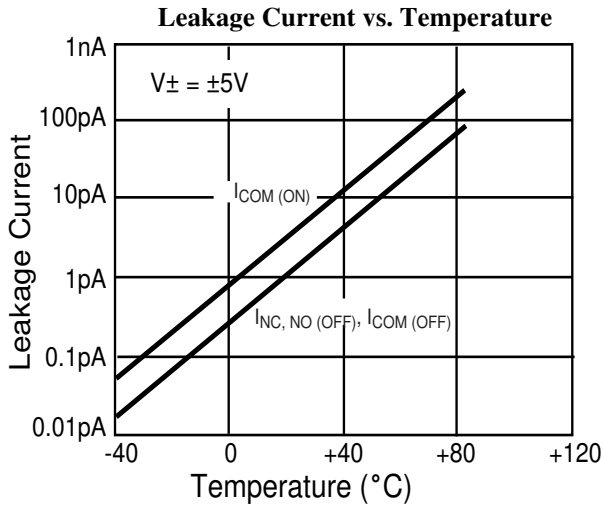


Charge Injection vs. Analog Voltage



Leakage Current vs. V_{COM}



Typical Operating Characteristics (continued)


Test Circuits/Timing Diagrams

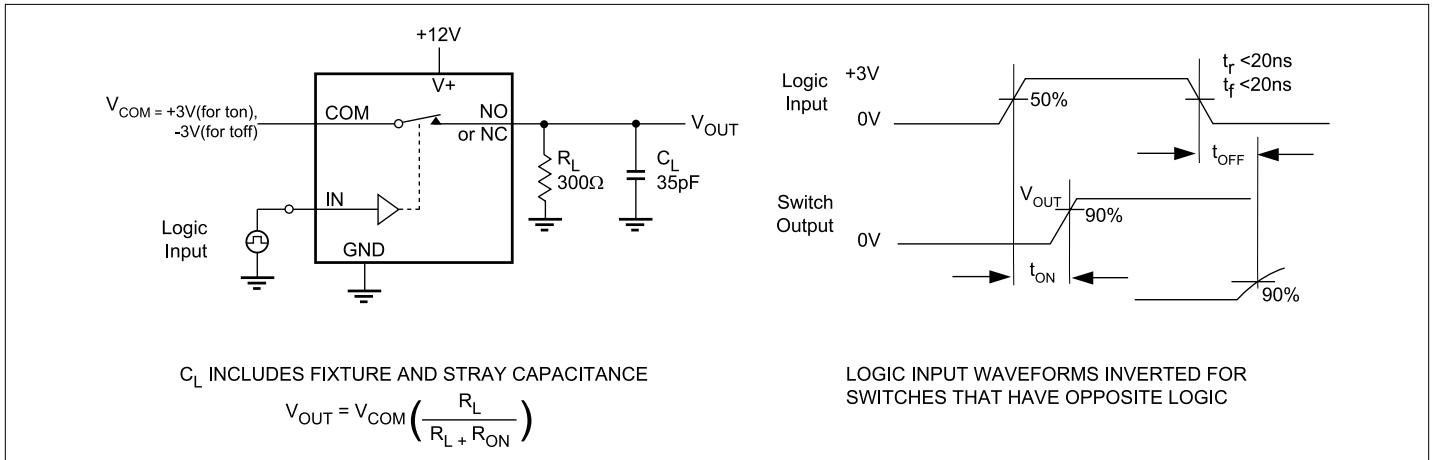


Figure 2. Switching Time

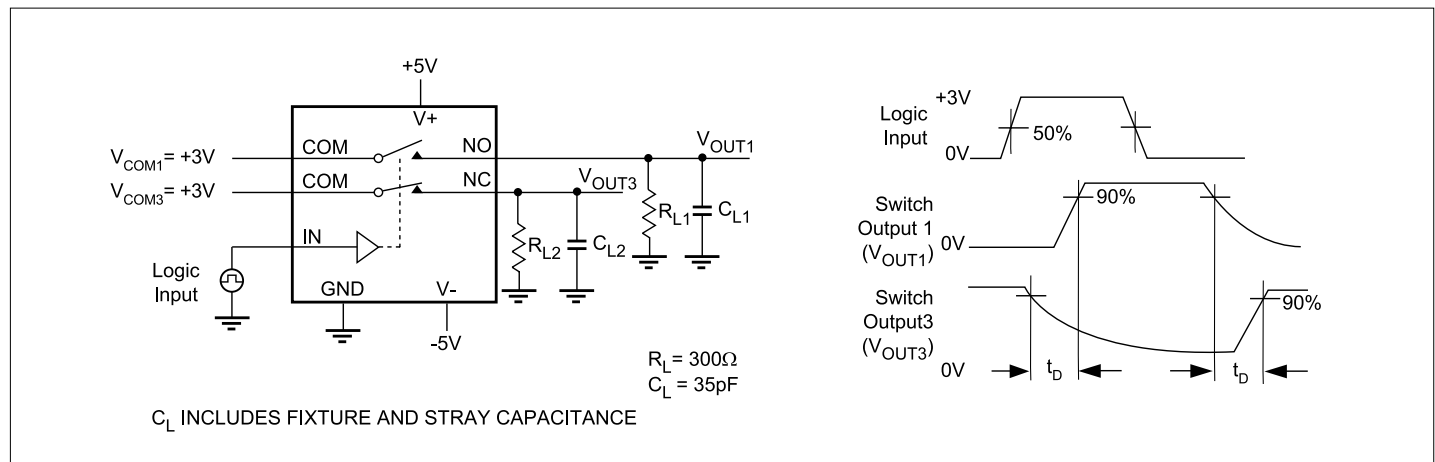


Figure 3. Break-Before-Make Interval (PS383 only)

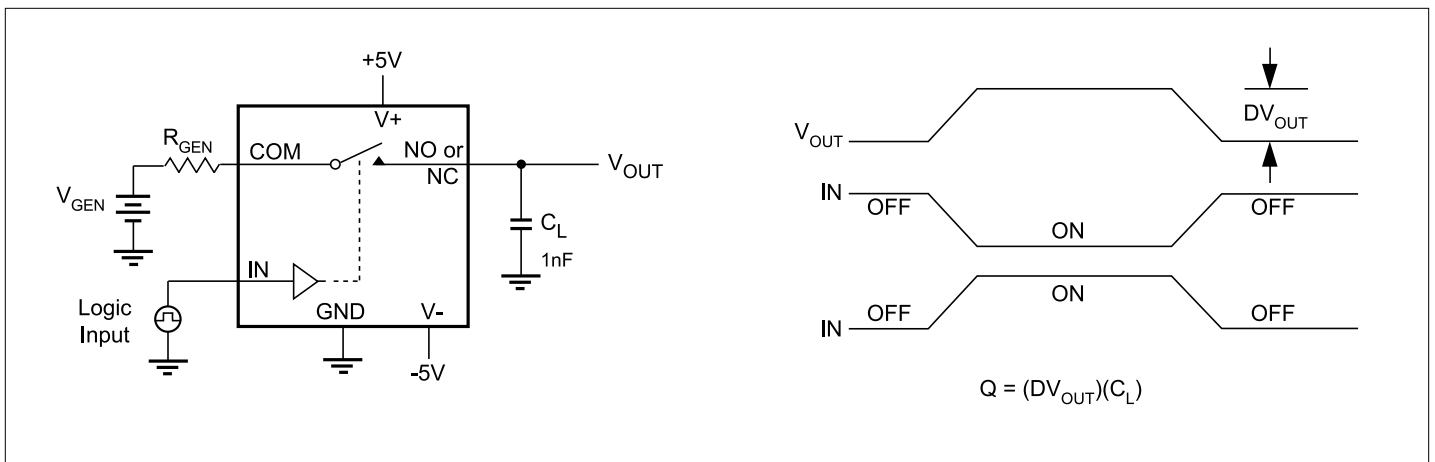


Figure 4. Charge Injection

Test Circuits/Timing Diagrams (continued)

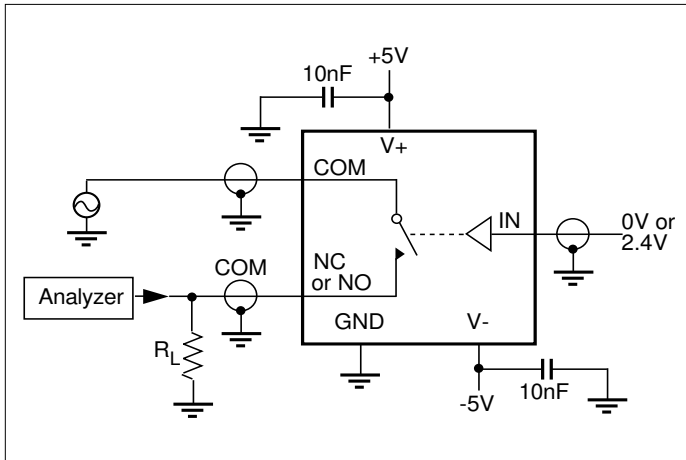


Figure 5. Off Isolation

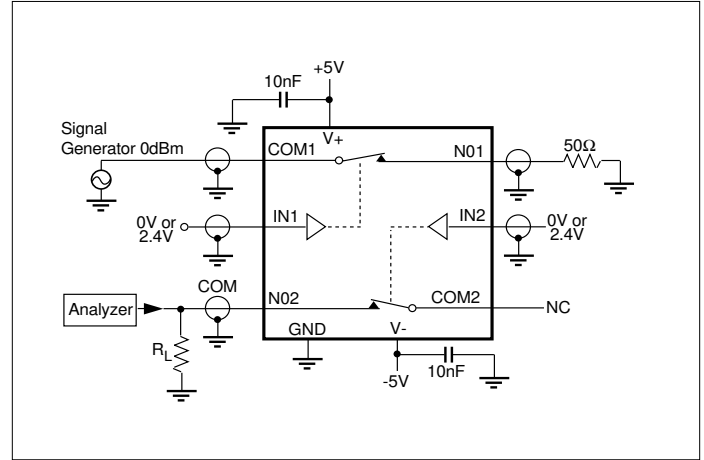


Figure 6. Crosstalk

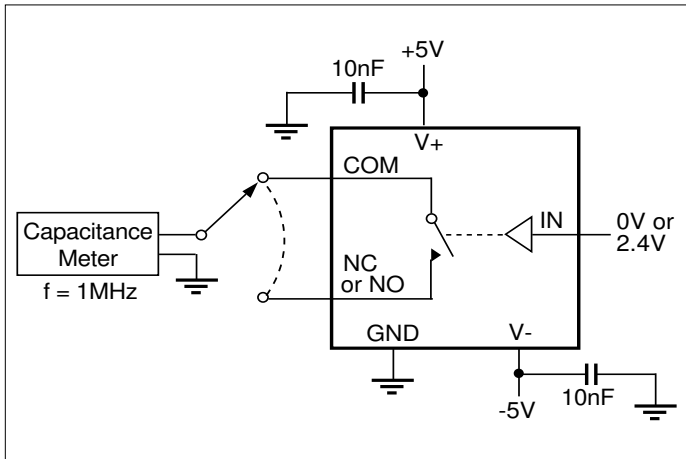


Figure 7. Channel-Off Capacitance

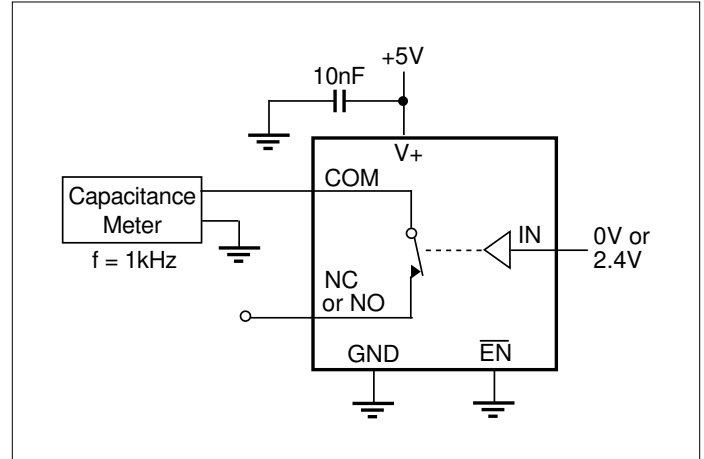


Figure 8. Channel-On Capacitance

Ordering Information

| Part | Temp. Range | Package |
|----------|----------------|----------------|
| PS381CPE | 0°C to +70°C | 16 Plastic DIP |
| PS381CSE | 0°C to +70°C | 16 Narrow SO |
| PS381EPE | -40°C to +85°C | 16 Plastic DIP |
| PS381ESE | -40°C to +85°C | 16 Narrow SO |
| PS383CPE | 0°C to +70°C | 16 Plastic DIP |
| PS383CSE | 0°C to +70°C | 16 Narrow SO |
| PS383EPE | -40°C to +85°C | 16 Plastic DIP |
| PS383ESE | -40°C to +85°C | 16 Narrow SO |
| PS385CPE | 0°C to +70°C | 16 Plastic DIP |
| PS385CSE | 0°C to +70°C | 16 Narrow SO |
| PS385EPE | -40°C to +85°C | 16 Plastic DIP |
| PS385ESE | -40°C to +85°C | 16 Narrow SO |