PERICOM

PS381/PS383/PS385

Precision, 17V Analog Switches

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.

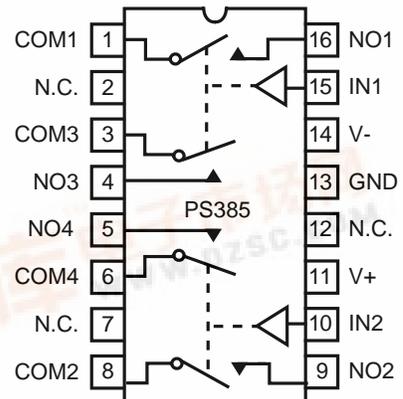## Functional Diagrams, Pin Configurations, and Truth Tables

PS381 — Top View

PS383 — Top View
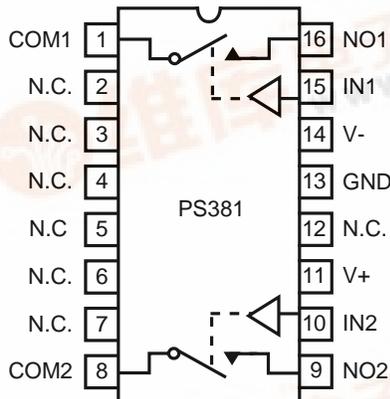
PS385 — Top View

N.C = No Connect.

Switches shown for logic "0" input

PS381	
Logic	Switch
0	OFF
1	ON

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

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.

Thermal Information

Continuous Power Dissipation (T_A= +70°C)

Plastic DIP (derate 10.5mW/$^\circ$C above +70°C) 800mW

Narrow SO (derate 8.7mW/$^\circ$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

Electrical Specifications - Dual Supplies

($V\pm = \pm 5V \pm10\%$, 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 Channe[4]	ΔR_{ON}	V_{NO} or V_{NC} = ±3V, I_{COM} = -10mA, V+ = 5V, V- = -5V	25		0.2	2	
			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	
			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	
			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	
			Full	-5		5	

Electrical Specifications - Dual Supplies (continued)

(V ± = ± 5V ±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} = ±3V, Figure 2	25		51	130	ns
			Full			175	
Turn-Off Time	t_{OFF}		25		29	75	
			Full			100	
Break-Before-Make TimeDelay	t_D	PS383 only, Figure 3	25	10	20		
Charge Injection	Q	C_L=1nF, V_{GEN} = 0V, R_{GEN} = 0Ω, Figure 4	25		2	5	pC
Off Isolation[7]	OIRR	R_L = 50Ω, C_L= 5pF, f = 1MHz, Figure 5			-65		dB
Crosstalk [8]	X_{TALK}	R_L = 50Ω, 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
NegativeSupply 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. $\Delta R_{ON} = \Delta R_{ON}$ max - ΔR_{ON} min
5. Flatness is defined as the difference between the maximum and minimum value of on-resistance measured.
6. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25°C.
7. Off Isolation = $20\log_{10}$ [V_{COM} / (V_{NO} 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}		25			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- = 05V		-1		1	μA
NegativeSupply 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. $\Delta R_{ON} = \Delta R_{ON}$ max - ΔR_{ON} min
5. Flatness is defined as the difference between the maximum and minimum value of on-resistance measured.
6. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25ºC.
7. Off Isolation = $20\log_{10}$ [V_{COM} / (V_{NO} or V_{NO})]. See figure 5.
8. Between any two switches. See figure 6.
9. Leakage testing at single-supply is guaranteed by testing with dual supplies.

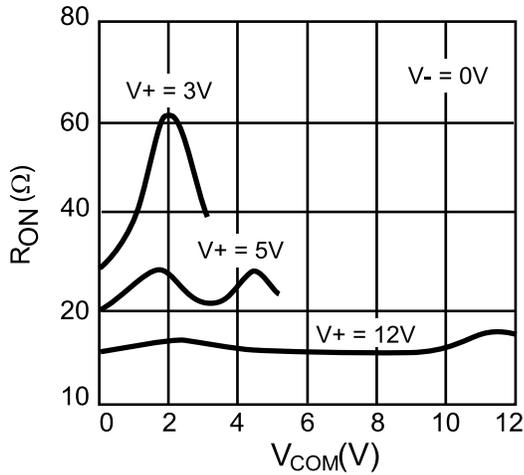**Typical Operating Characteristics** ($T_A = + 25^\circ C$, unless otherwise noted)
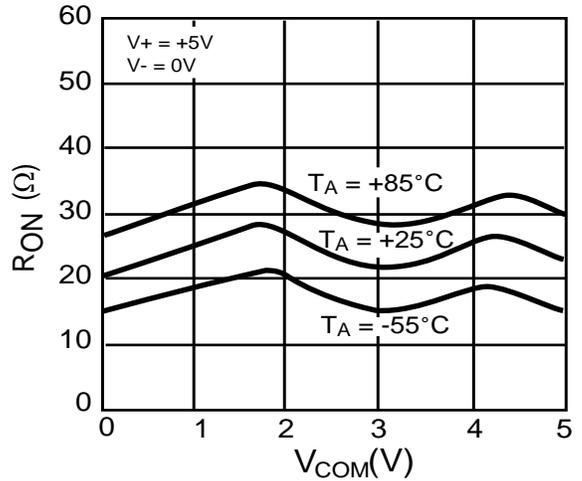
R$_{ON}$ vs. V$_{COM}$ & Supply Voltages
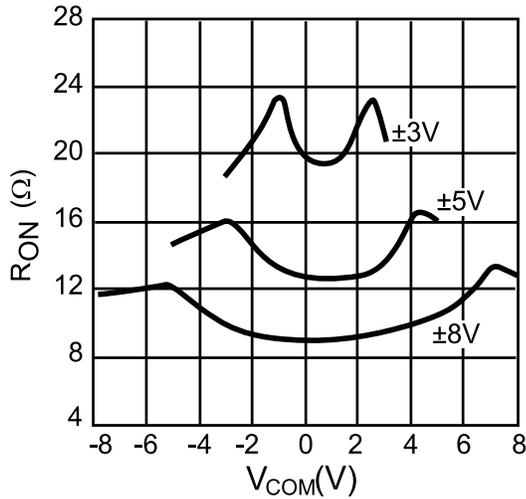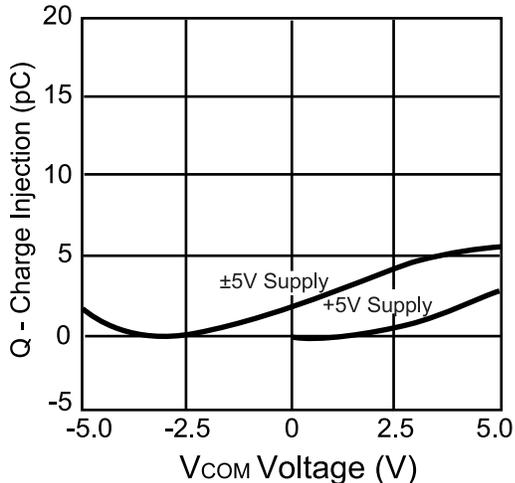

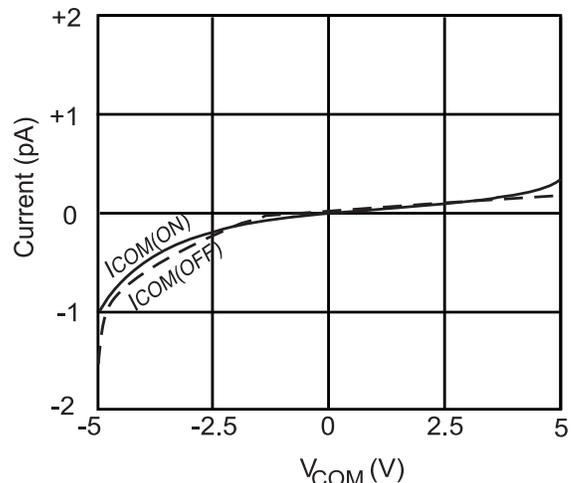R$_{ON}$ vs. V$_{COM}$ & Supply Voltages
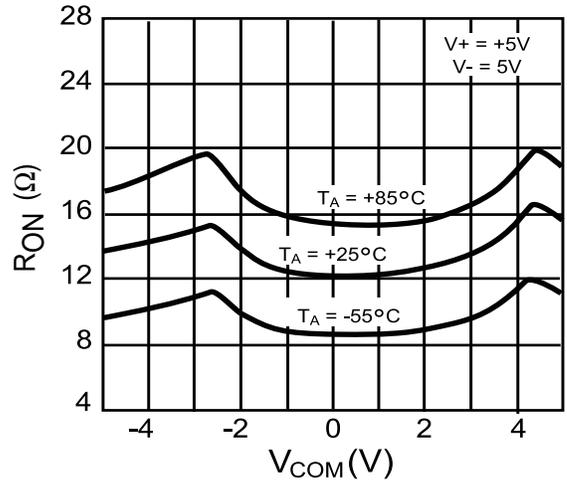
R$_{ON}$ vs. V$_{COM}$ (Single Supply)

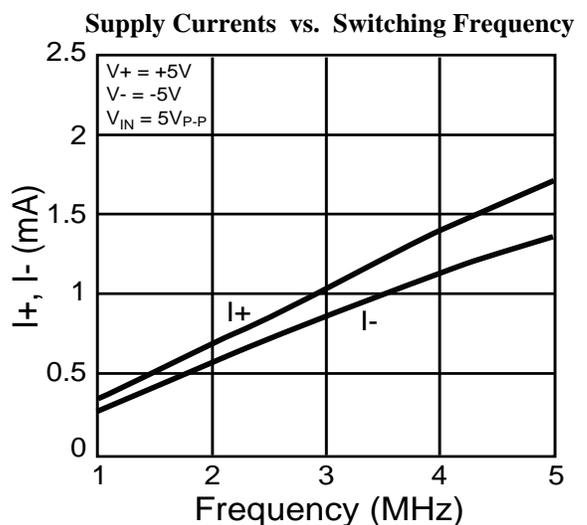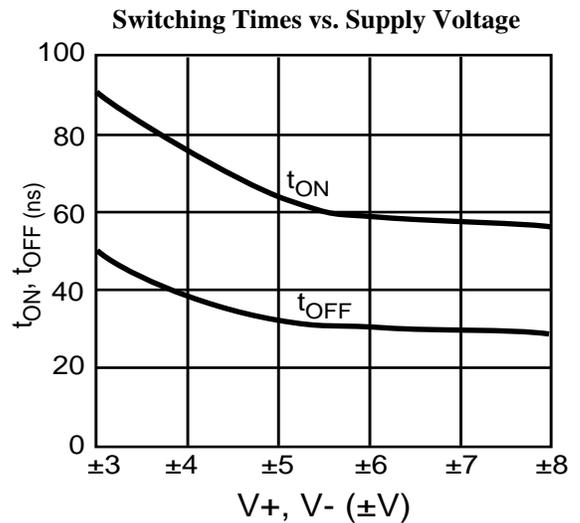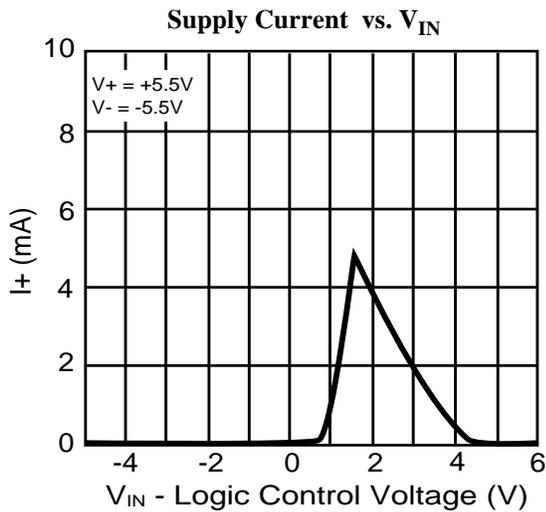
R$_{ON}$ vs. V$_{COM}$ and Temperature (Single Supply)
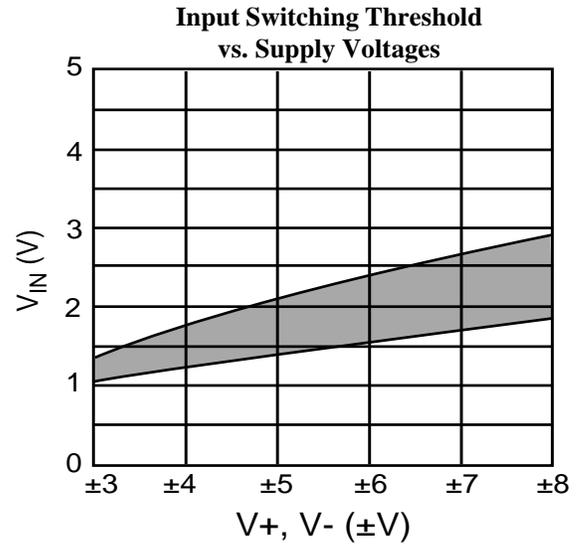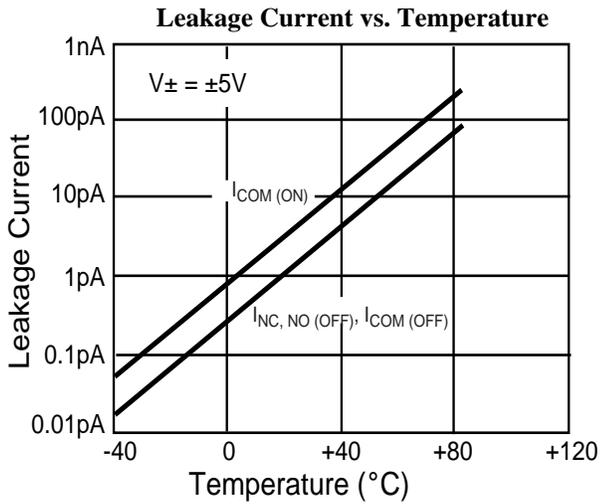

Charge Injection vs. Analog Voltage

Leakage Current vs. V$_{COM}$

Typical Operating Characteristics (continued)

Leakage Current vs. Temperature

Input Switching Threshold vs. Supply Voltages

Supply Current vs. V_{IN}

Switching Times vs. Supply Voltage

Switching Times vs. Temperature

Supply Currents vs. Switching Frequency

Test Circuits/Timing Diagrams

C_L INCLUDES FIXTURE AND STRAY CAPACITANCE

$$V_{OUT} = V_{COM}\left(\frac{R_L}{R_L + R_{ON}}\right)$$

LOGIC INPUT WAVEFORMS INVERTED FOR
SWITCHES THAT HAVE OPPOSITE LOGIC

Figure 2. Switching Time

C_L INCLUDES FIXTURE AND STRAY CAPACITANCE

$R_L = 300\Omega$
$C_L = 35pF$
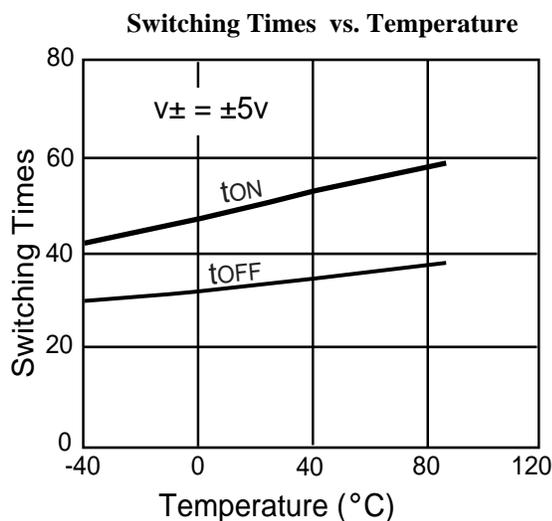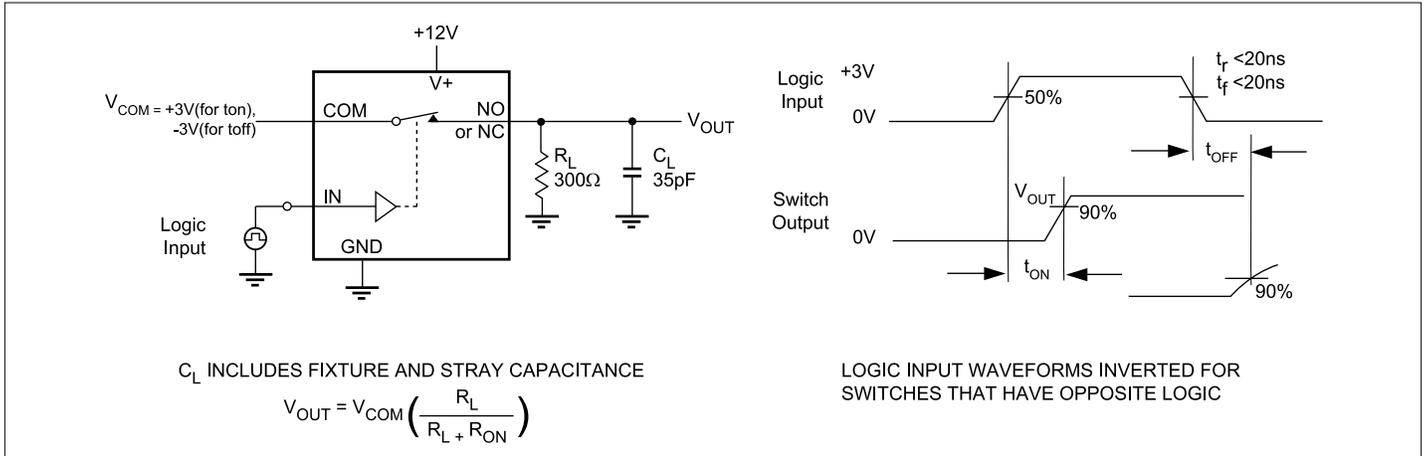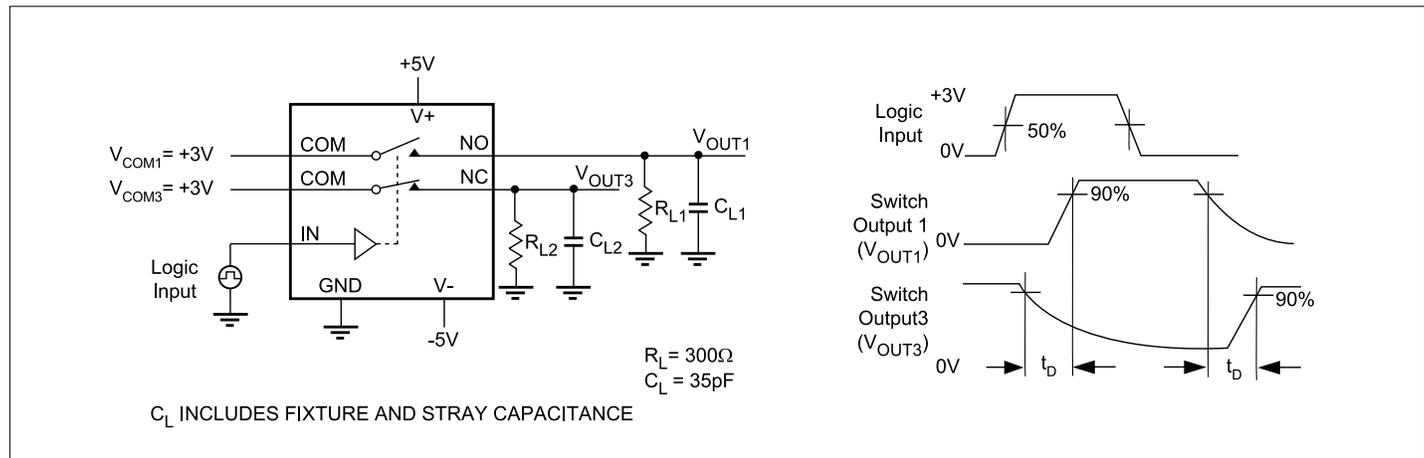
Figure 3. Break-Before-Make Interval (PS383 only)

$$Q = (DV_{OUT})(C_L)$$
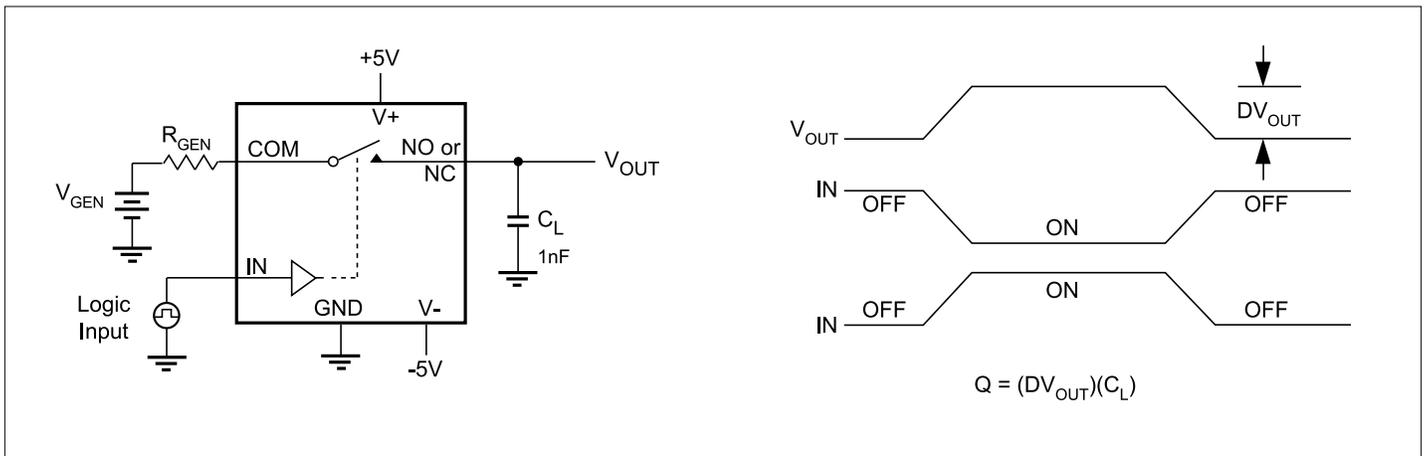
Figure 4. Charge Injection

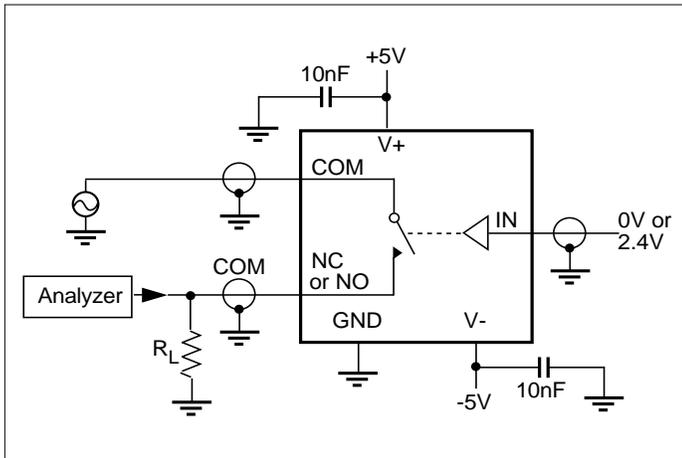## Test Circuits/Timing Diagrams (continued)

Figure 5. Off Isolation
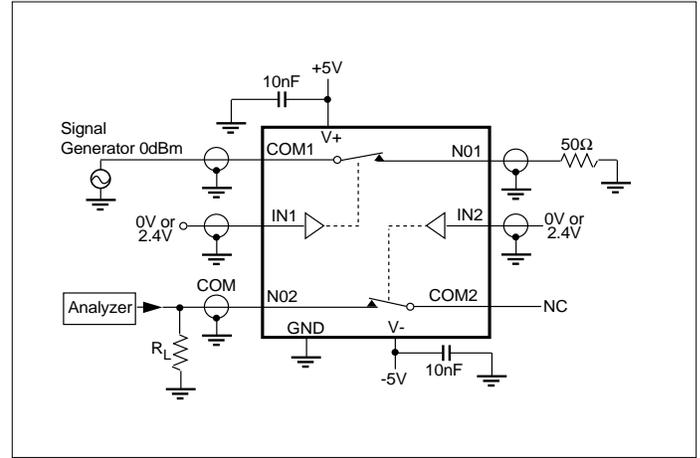

Figure 6. Crosstalk
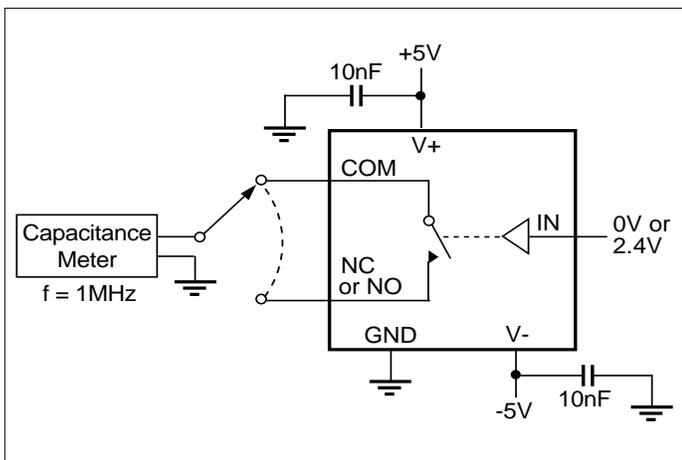
Figure 7. Channel-Off Capacitance
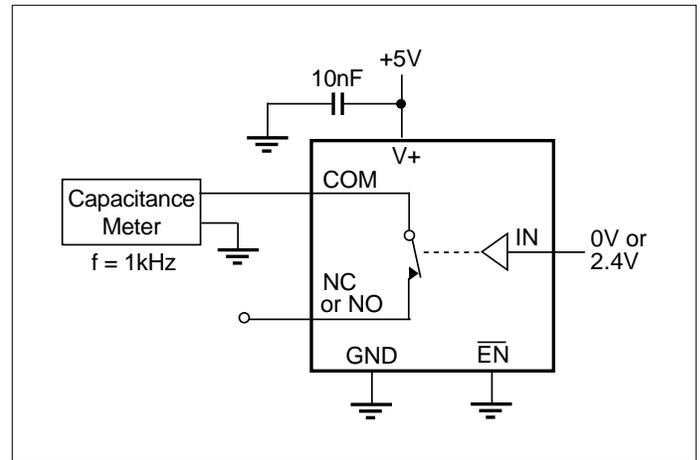
Figure 8. Channel-On Capacitance

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