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.

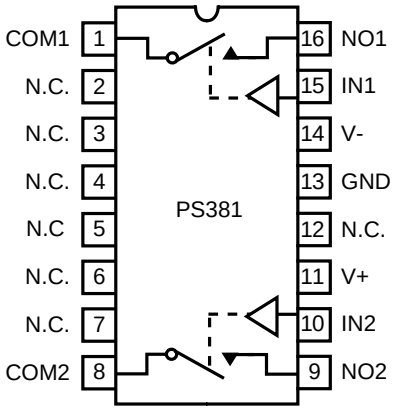
The PS381 has two normally open (NO) switches. The PS383 is a dual, single-pole double-throw (SPDT) switch. The PS385 is a dual, double-pole single-throw (DPST) function. Each switch conducts current equally well in either direction when on. In the off state each switch blocks voltages up to the power-supply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

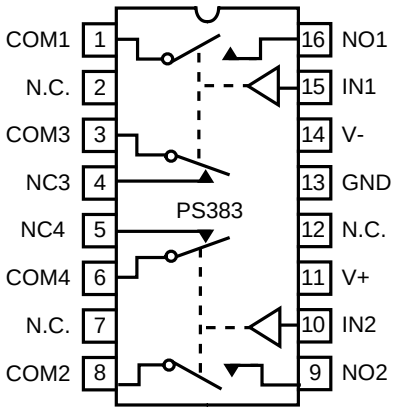
These switches are fully specified for single +5V operation, with <45Ω R_{ON}, <2Ω R_{ON} match, and <4Ω R_{ON} flatness.

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

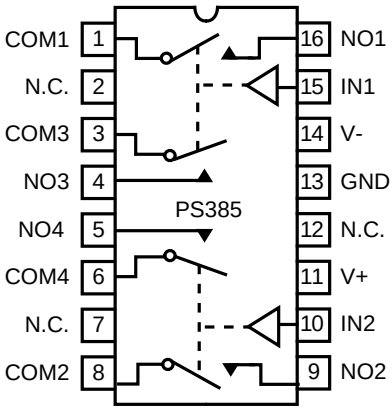
Functional Diagrams, Pin Configurations, and Truth Tables



Top View



Top View



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

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 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 +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.

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)

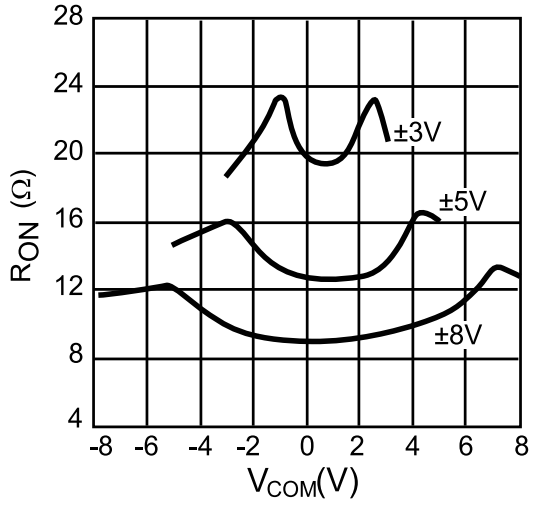
Parameter	Symbol	Conditions	Temp (°C)	Min.(1)	Typ.(2)	Max.(1)	Units
Analog Switch							
Analog Switch Range(3)	V_{ANALOG}		Full	0		V+	V
Channel On-Resistance	R_{ON}	V+ = 3V, I_{COM} = -10mA V_{NO} = V_{NC} = 1.5V	25		62	150	Ω
			Full			200	
Dynamic							
Turn-On Time(3)	t_{ON}	V_{COM} = 1.5V, Figure 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- = 05V		-1		1	µA
NegativeSupply Current	I-			-1		1	

Notes:

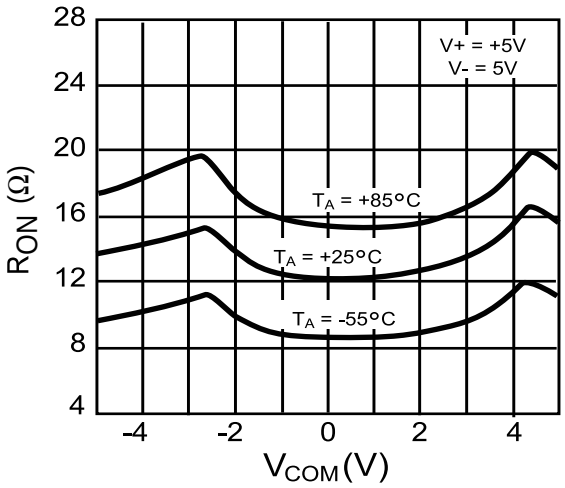
1. The algebraic convention, where the most negative value is a minimum and the most positive is a maximum, is used in this data sheet.
2. Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
3. Guaranteed by design
4. $\Delta R_{ON} = \Delta R_{ON}$ max - ΔR_{ON} 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 = + 25ºC, unless otherwise noted)

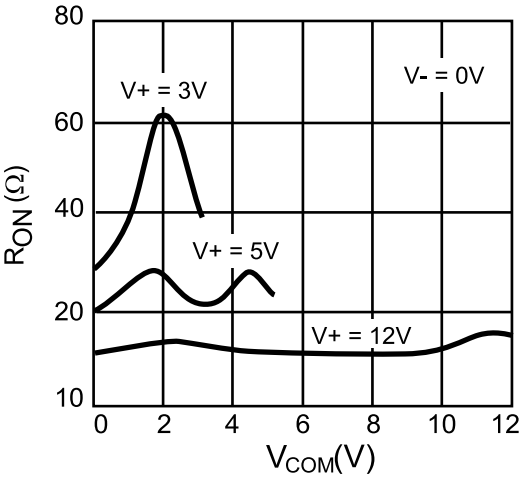
R_{ON} vs. V_{COM} & Supply Voltages



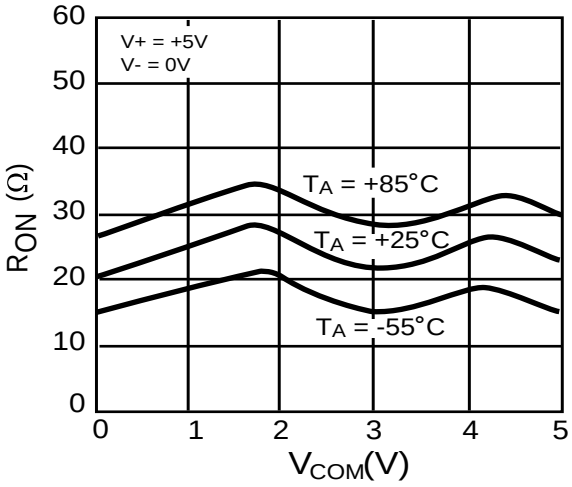
R_{ON} vs. V_{COM} & Supply Voltages



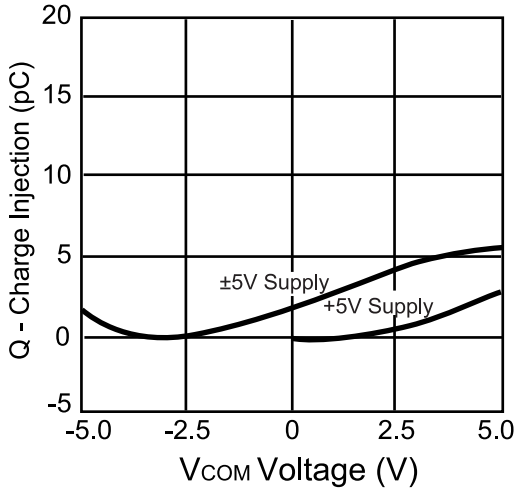
R_{ON} vs. V_{COM} (Single Supply)



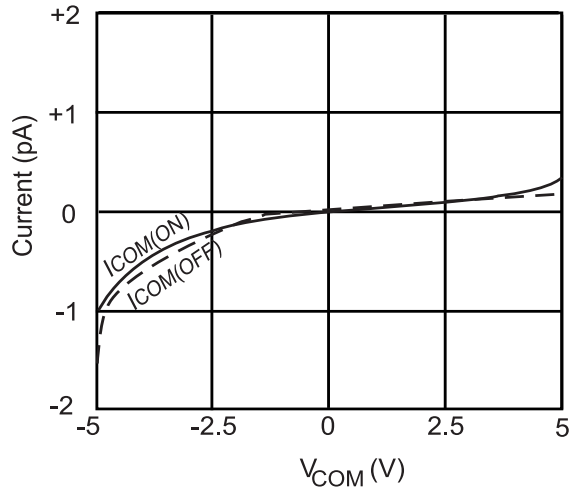
R_{ON} vs. V_{COM} and Temperature (Single Supply)



Charge Injection vs. Analog Voltage

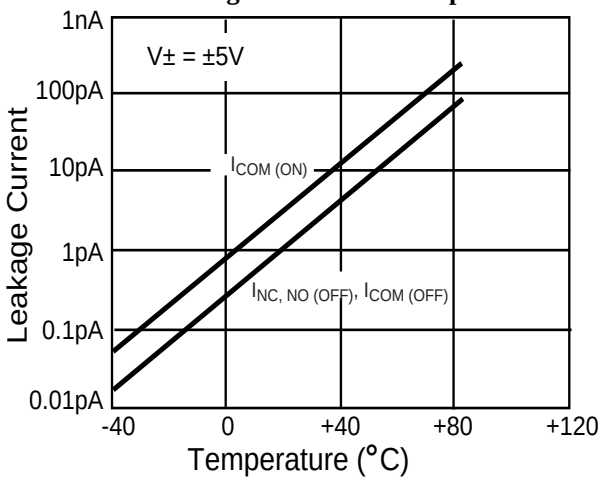


Leakage Current vs. V_{COM}

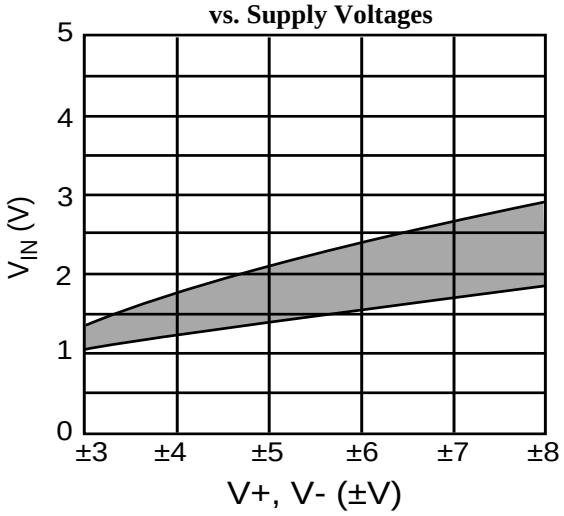


Typical Operating Characteristics (continued)

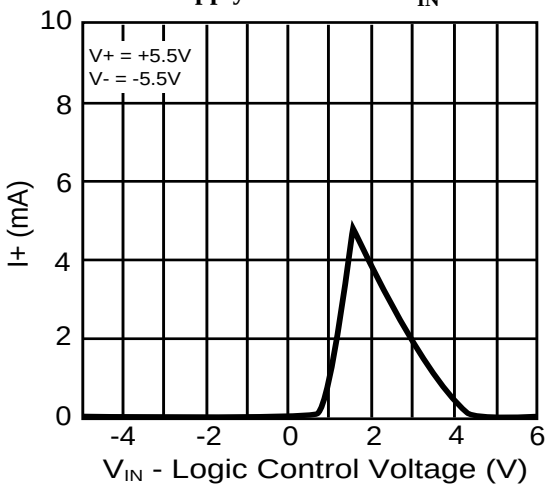
Leakage Current vs. Temperature



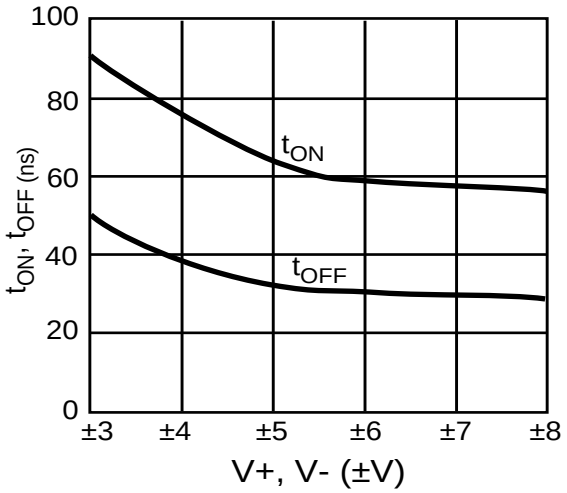
Input Switching Threshold vs. Supply Voltages



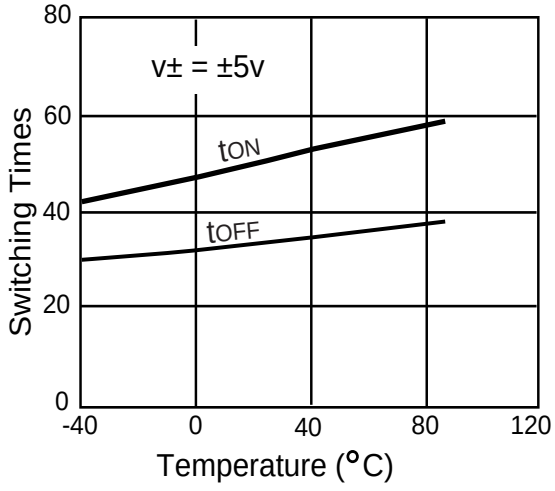
Supply Current vs. V_{IN}



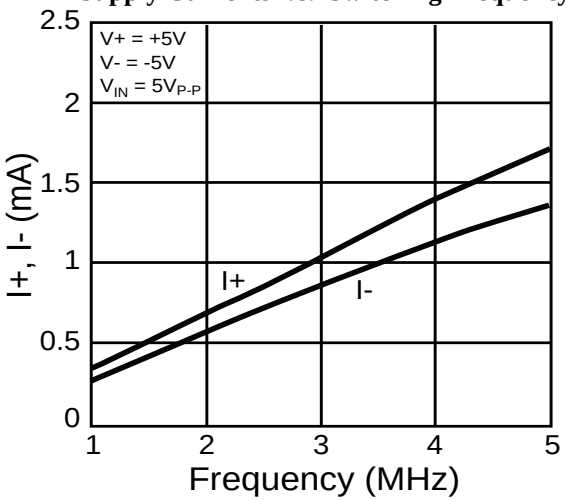
Switching Times vs. Supply Voltage



Switching Times vs. Temperature



Supply Currents vs. Switching Frequency



Test Circuits/Timing Diagrams

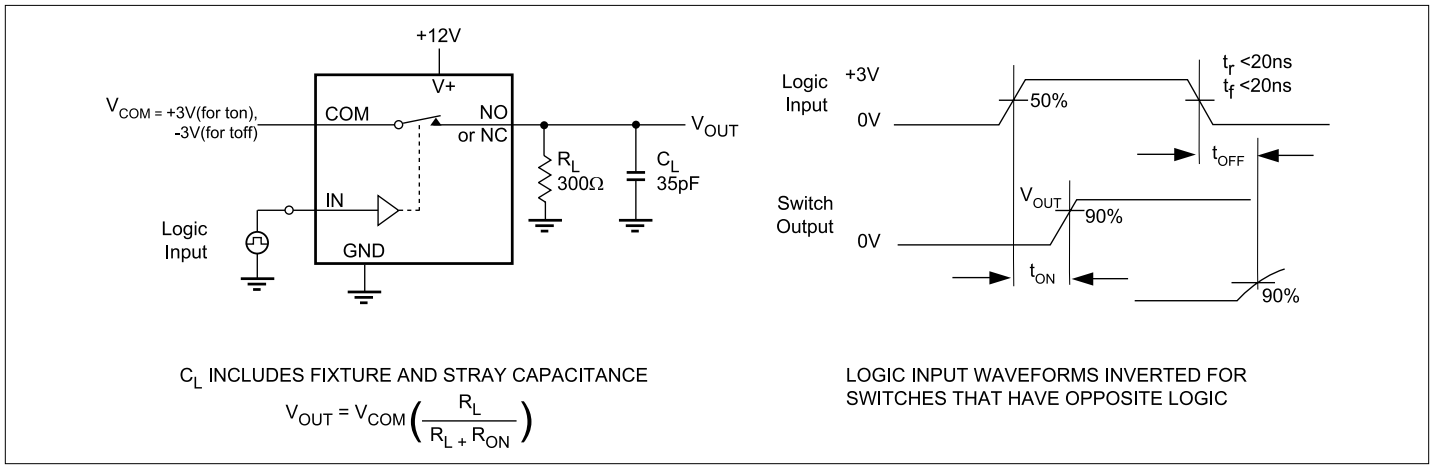


Figure 2. Switching Time

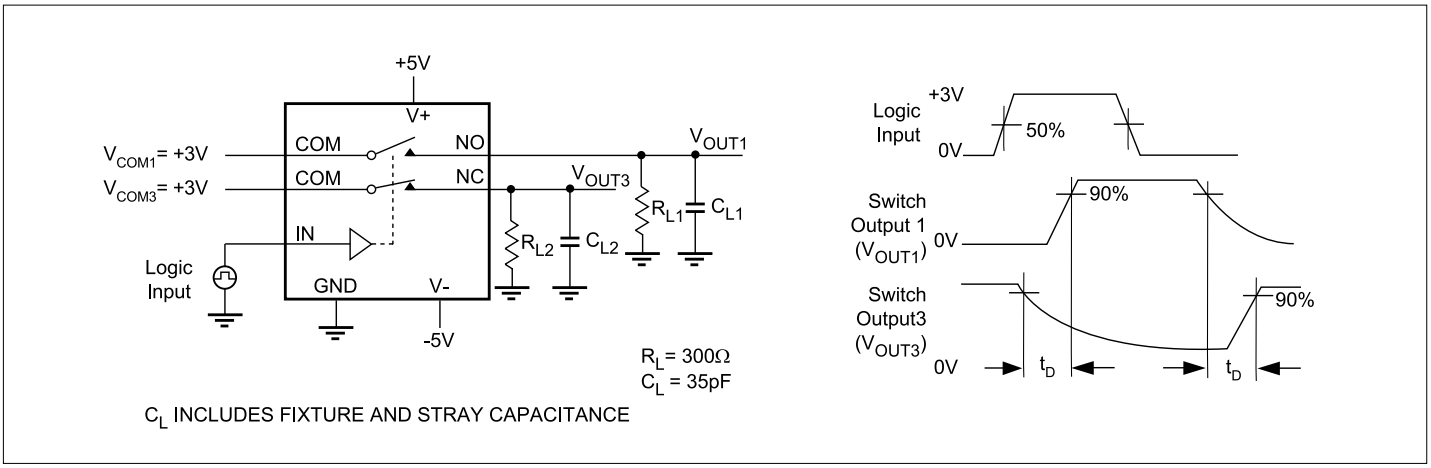


Figure 3. Break-Before-Make Interval (PS383 only)

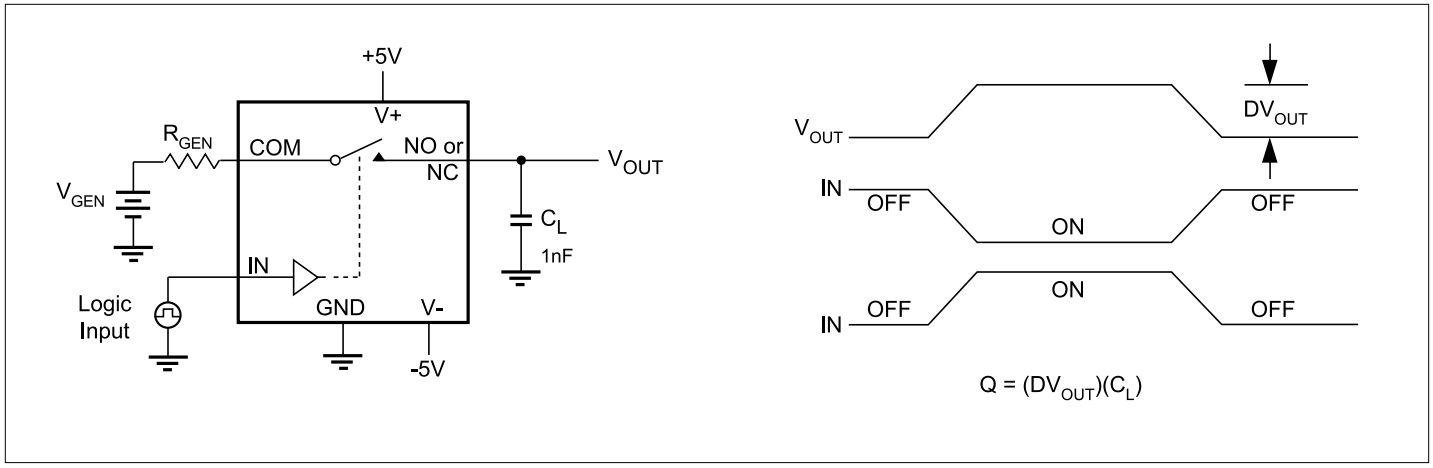


Figure 4. Charge Injection

Test Circuits/Timing Diagrams (continued)

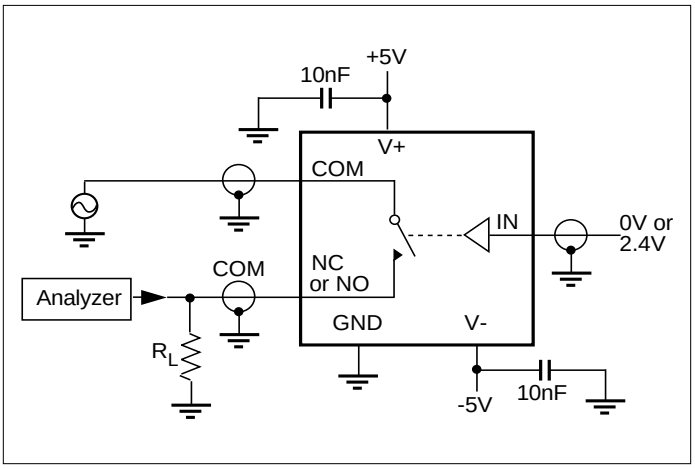


Figure 5. Off Isolation

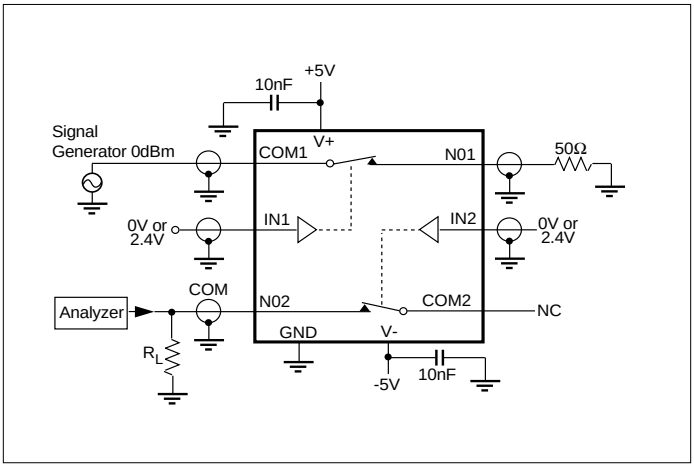


Figure 6. Crosstalk

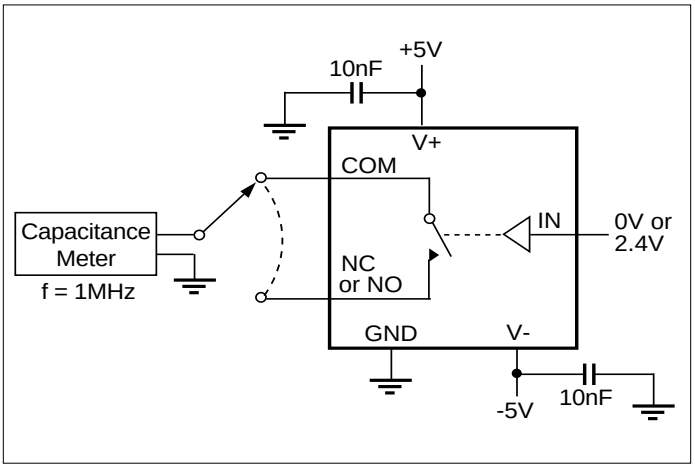


Figure 7. Channel-Off Capacitance

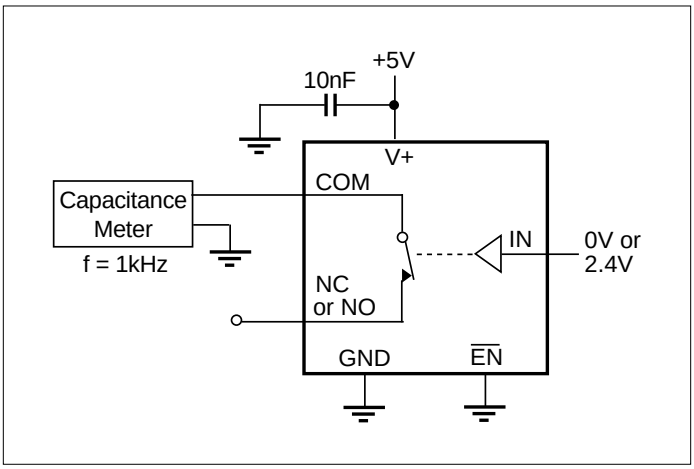


Figure 8. Channel-On Capacitance

Ordering Information

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