

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 ($\pm 3V$ to $\pm 8V$) Operation
- Improved Second Sources for MAX381/MAX383/MAX385
- On-Resistance Matching Between Channels, 0.2Ω typ
- On-Resistance Flatness, 1Ω typ
- Low Off-Channel Leakage, $<2.5nA$ @ $+85^\circ C$
- TTL/CMOS Logic Compatible
- Rail-to-Rail Analog Signal Dynamic Range
- Low Power Consumption $<1\mu A$

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 $\pm 8V$ power supplies.

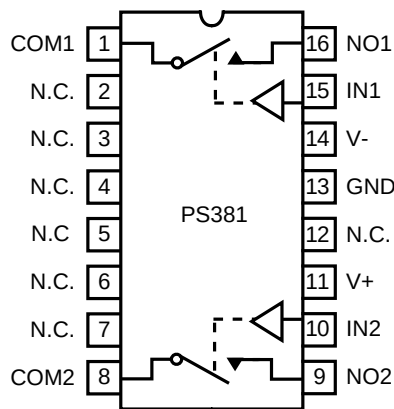
The PS381 has two normally open (NO) switches. The PS383 is a dual, single-pole double-throw (SPDT) switch. The PS385 is a dual, double-pole single-throw (DPST) function. Each switch conducts current equally well in either direction when on. In the off state each switch blocks voltages up to the power-supply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

With $\pm 5V$ power supplies, the PS381/PS383/PS385 guarantee $<30\Omega$ 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 ($<2pA$ @ $25^\circ C$, $<2.5nA$ @ $+85^\circ C$) 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 $<45\Omega R_{ON}$, $<2\Omega R_{ON}$ match, and $<4\Omega R_{ON}$ flatness.

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

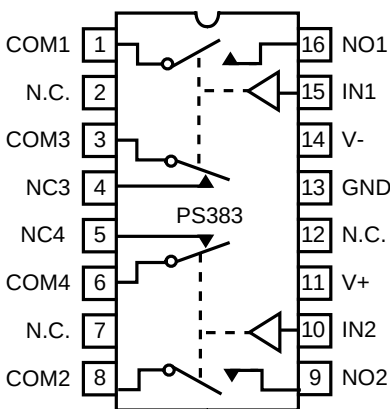
Functional Diagrams, Pin Configurations, and Truth Tables



Top View

N.C. = No Connect.

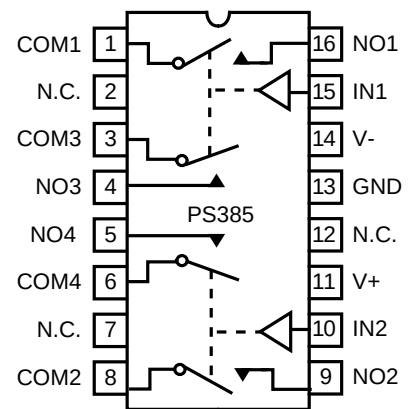
PS381	
Logic	Switch
0	OFF
1	ON



Top View

Switches shown for logic "0" input

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



Top View

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/°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

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	
			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	nA
			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	
			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	
			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} = ±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:

- The algebraic convention, where the most negative value is a minimum and the most positive is a maximum, is used in this data sheet.
- Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
- Guaranteed by design
- $\Delta R_{ON} = \Delta R_{ON \text{ max}} - \Delta R_{ON \text{ min}}$
- Flatness is defined as the difference between the maximum and minimum value of on-resistance measured.
- Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25°C.
- Off Isolation = $20 \log_{10} [V_{COM} / (V_{NO} \text{ or } V_{NO})]$. See figure 5.
- 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

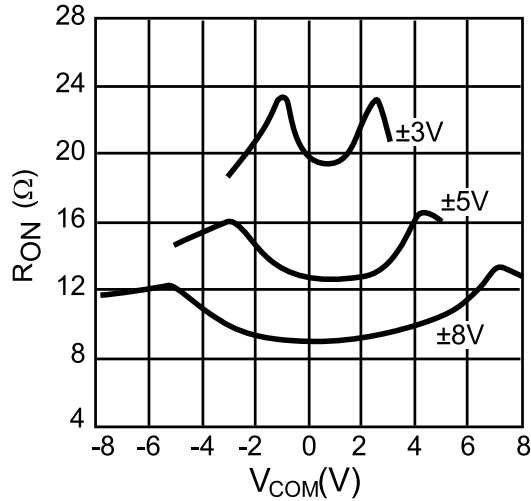
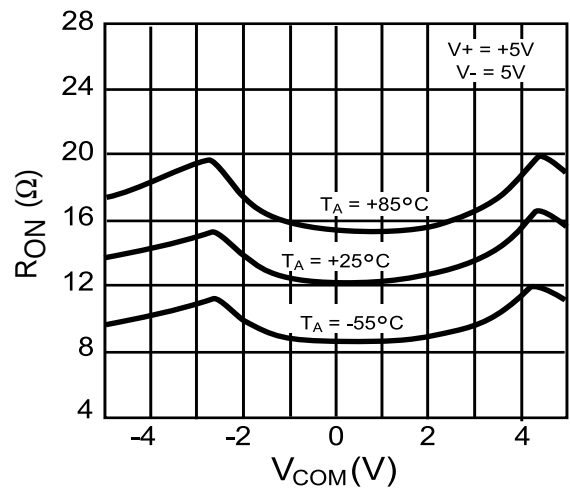
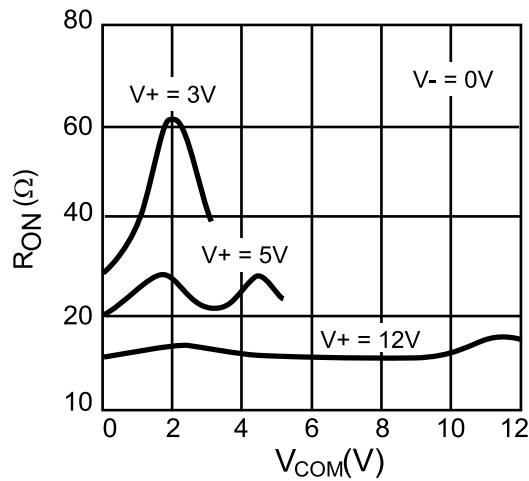
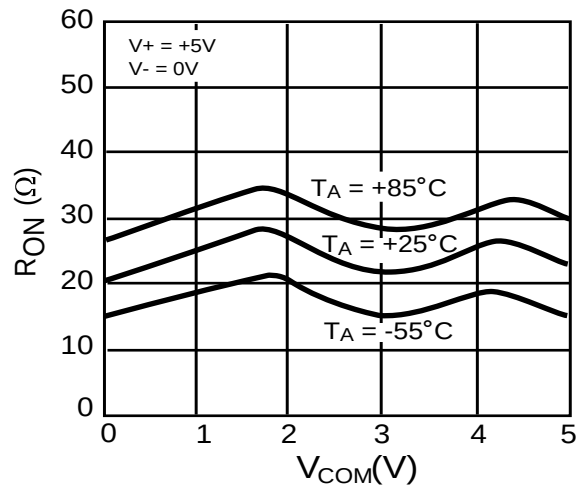
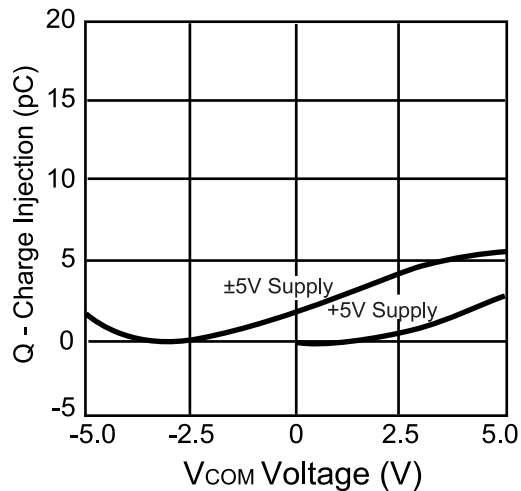
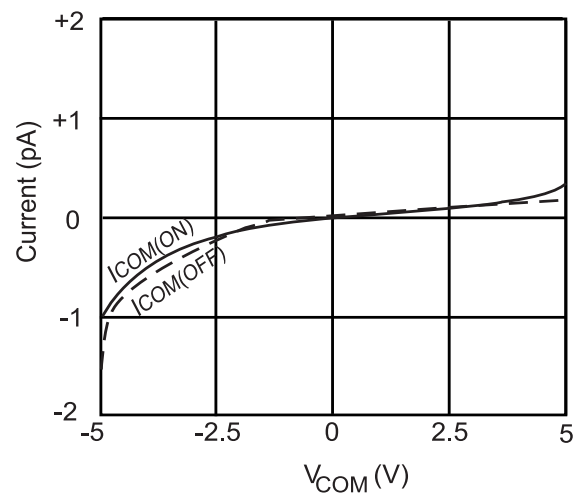
(V+ = +3V to 3.6V, V- = 0V, GND = 0V, V_{NH} = 2.4V, V_{INL} = 0.8V)

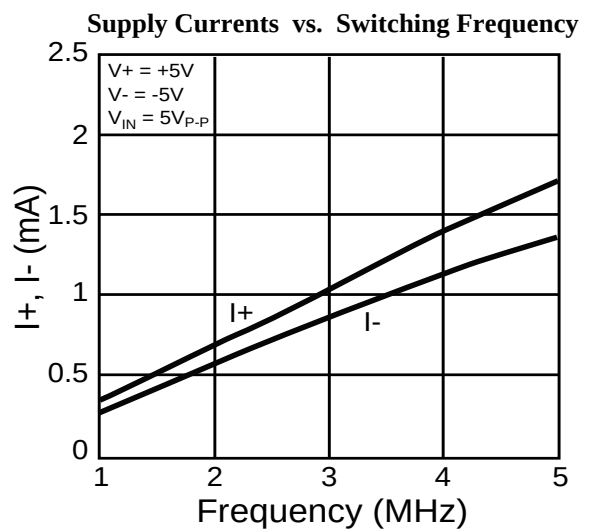
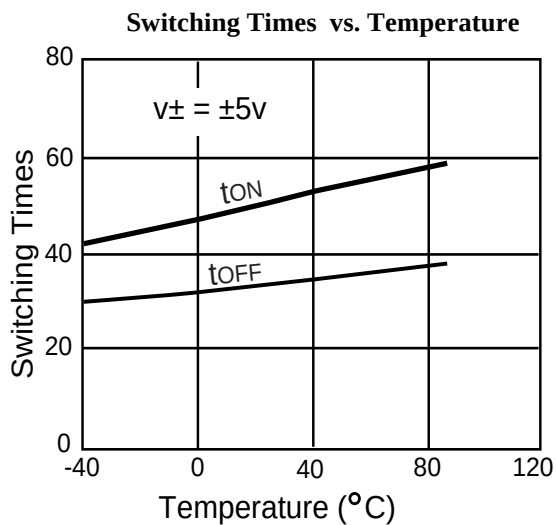
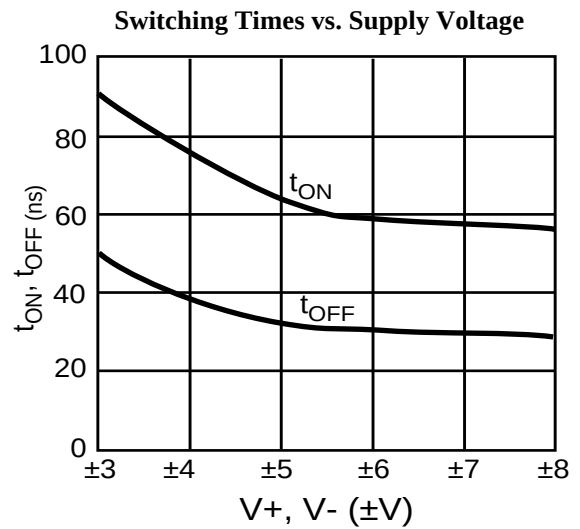
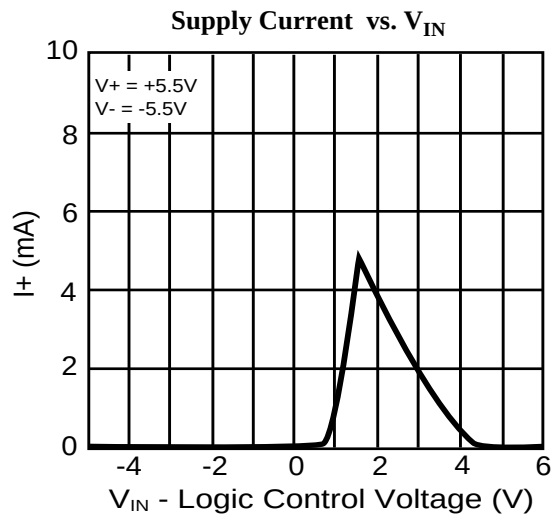
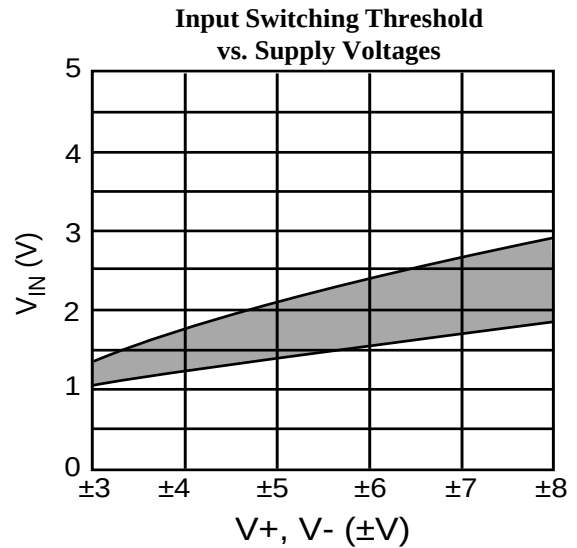
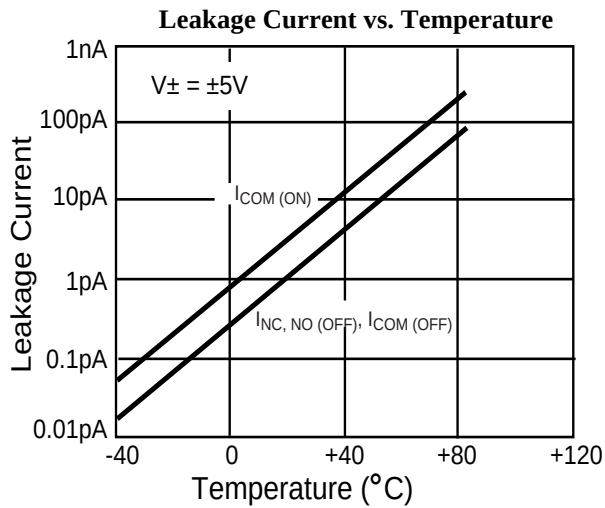
Parameter	Symbol	Conditions	Temp (°C)	Min. ⁽¹⁾	Typ. ⁽²⁾	Max. ⁽¹⁾	Units
Analog Switch							
Analog Switch Range ⁽³⁾	V _{ANALOG}		Full	0		V+	V
Channel On-Resistance	R _{ON}	V+ = 3V, I _{COM} = -10mA V _{NO} = V _{NC} = 1.5V	25		62	150	Ω
			Full			200	
Dynamic							
Turn-On Time ⁽³⁾	t _{ON}	V _{COM} = 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
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. $\Delta R_{ON} = \Delta R_{ON \text{ max}} - \Delta R_{ON \text{ min}}$
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

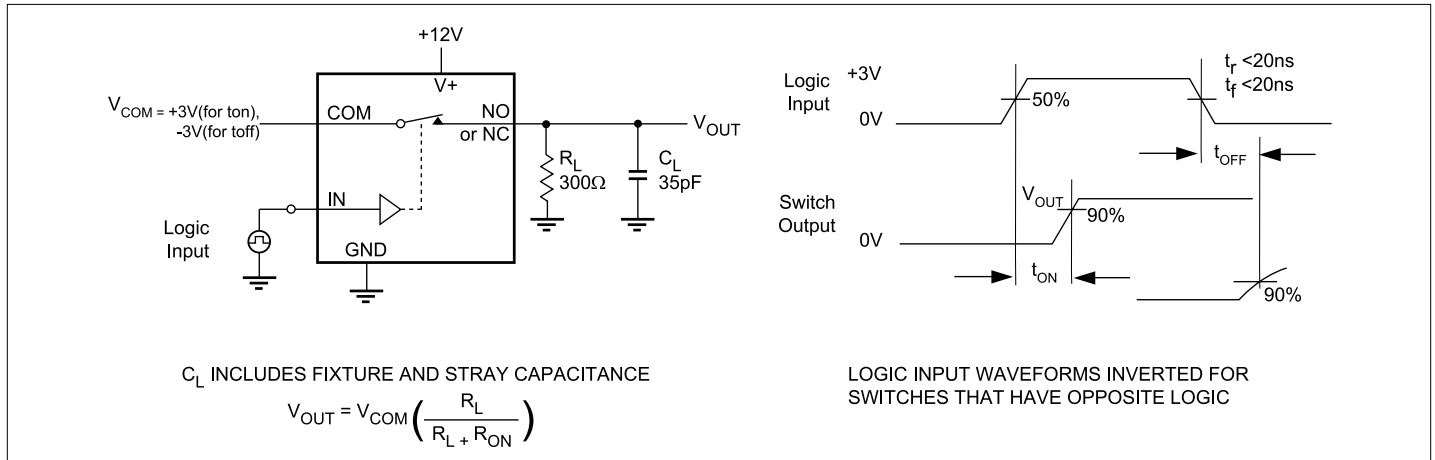


Figure 2. Switching Time

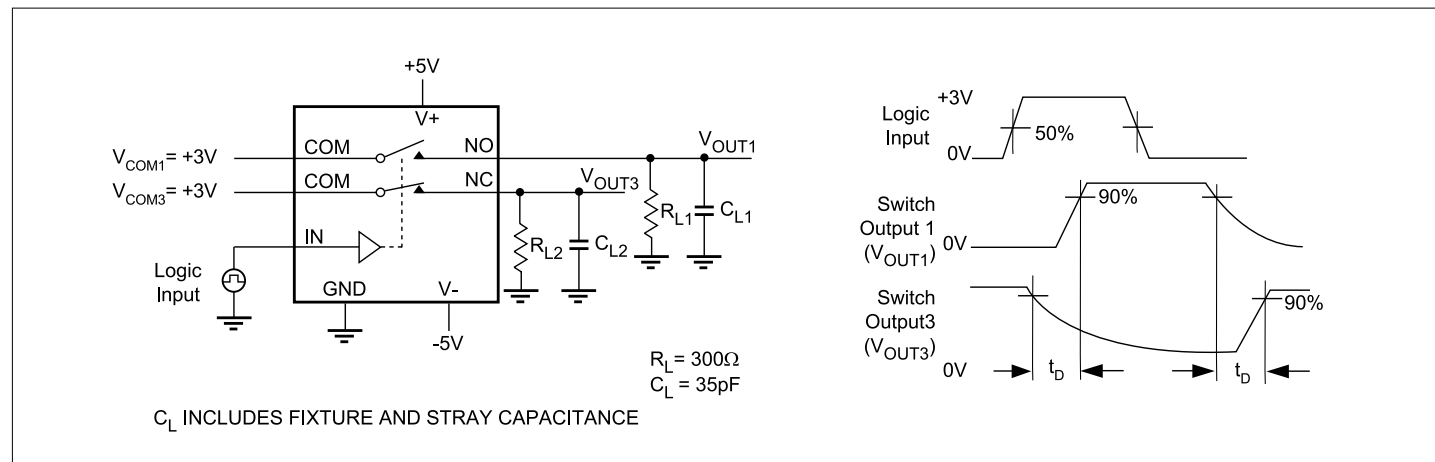


Figure 3. Break-Before-Make Interval (PS383 only)

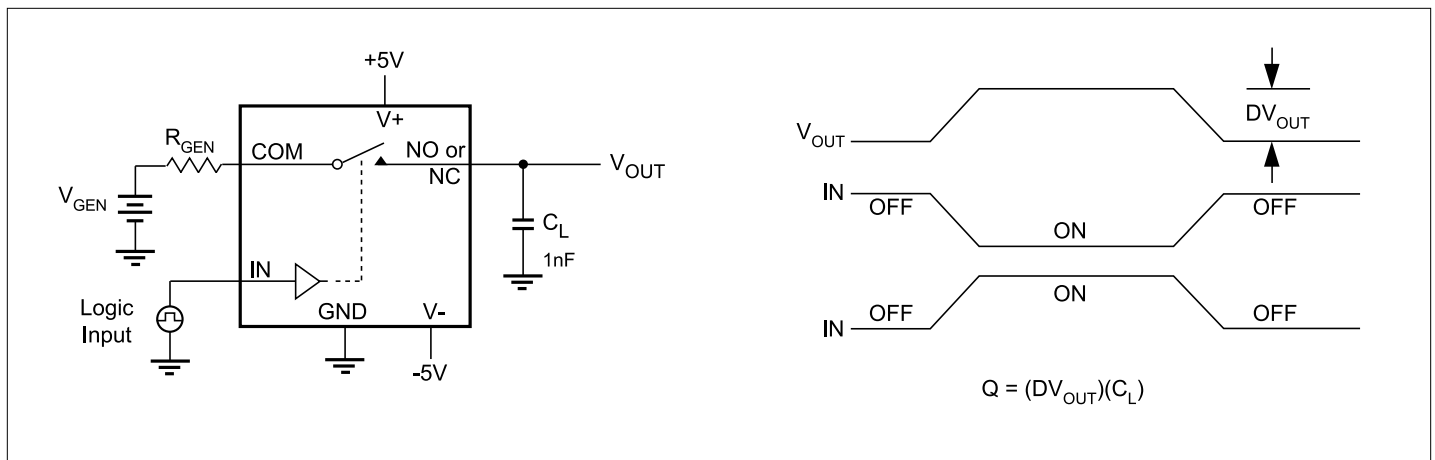


Figure 4. Charge Injection

Test Circuits/Timing Diagrams (continued)

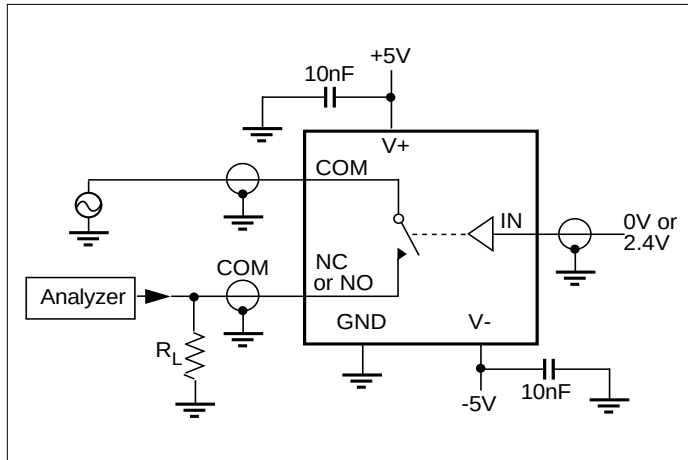


Figure 5. Off Isolation

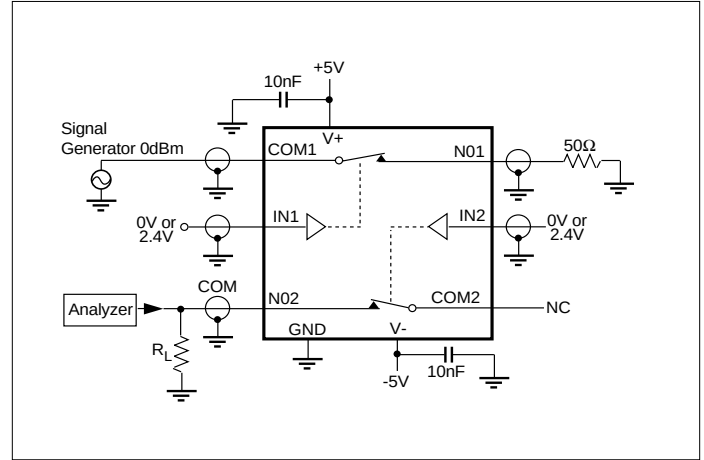


Figure 6. Crosstalk

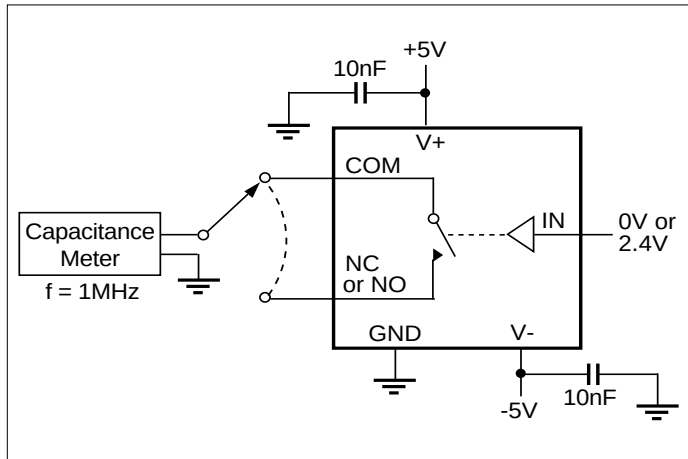


Figure 7. Channel-Off Capacitance

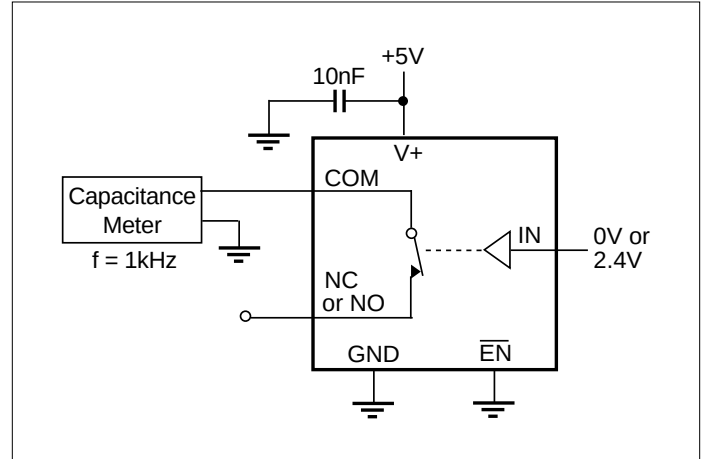


Figure 8. Channel-On Capacitance

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