

## Precision Wide Bandwidth Analog Switches

### Features

- Single-Supply Operation (+2V to +6V)
- Rail-to-Rail Analog Signal Dynamic Range
- Low On-Resistance ( $8\Omega$  typ with 5V supply)  
Minimizes Distortion and Error Voltages
- $R_{ON}$  Matching Between Channels,  $0.9\Omega$  typ
- On-Resistance Flatness,  $3\Omega$  typ
- Low Charge Injection Reduces Glitch Errors.  $Q = 7pC$  typ
- High Speed.  $t_{ON} = 8ns$  typ
- Very Good Off-Isolation:  $-55dB$  @ 10 MHz
- Wide -3dB Bandwidth: 230 MHz
- High-Current Channel Capability:  $>100mA$
- TTL/CMOS Logic Compatible
- Low Power Consumption ( $0.5\mu W$  typ)
- Pin-compatible with DG40X, MAX38X

### Applications

- Audio, Video Switching and Routing
- Battery-Powered Communication Systems
- Computer Peripherals
- Telecommunications
- Portable Instrumentation
- Replaces Mechanical Relays

### Description

The PI5A381/383/385A are dual monolithic analog switches designed for single-supply operation. These high-precision devices are ideal for low-distortion audio, video signal switching and routing.

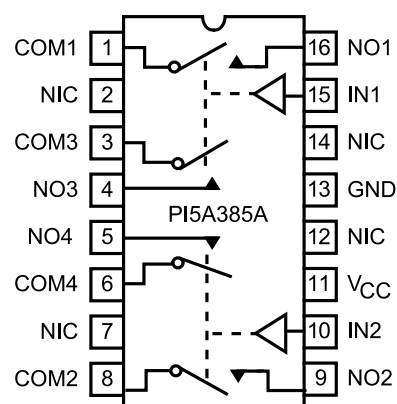
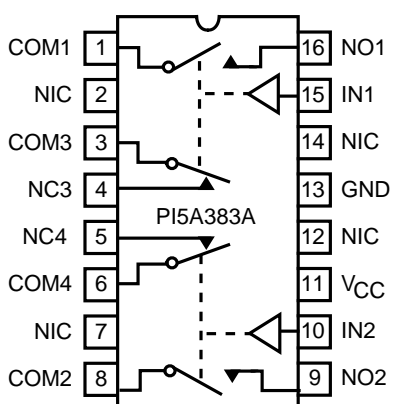
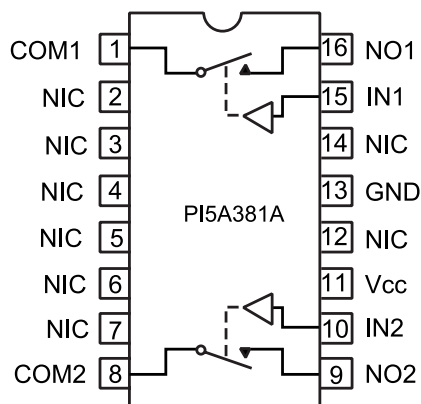
The PI5A381 is a dual single-pole single-throw (SPST), normally open (NO) switch. The PI5A383 is a dual single-pole double-throw (SPDT) switch. The PI5A385 is a dual double-pole single-throw (DPST), normally open (NO) function.

Each switch conducts current equally well in either direction when on. When off they block voltages up to the power-supply rails.

The PI5A381/383/385 are fully specified with +5V, and +3.3V supplies. With +5V, they guarantee  $<10\Omega$  on-resistance. On-resistance matching between channels is within  $2\Omega$ . On-resistance flatness is less than  $4\Omega$  over the specified range. The PI5A38X family guarantees fast switching speeds ( $t_{ON} < 15ns$ ).

These products are available in the 16-pin narrow-body SOIC, QSOP, and PDIP packages for operation over the industrial ( $-40^{\circ}C$  to  $+85^{\circ}C$ ) temperature range.

### Functional Diagram, Pin Configurations and Truth Tables



Switches shown for Logic "0" input  
NC = Normally Closed, NO = Normally Open, NIC = Not internally Connected

PI5A381A	
Logic	Switch
0	OFF
1	ON

PI5A383A		
Logic	SW1, SW2	SW3, SW4
0	OFF	ON
1	ON	OFF

PI5A385A	
Logic	Switch
0	OFF
1	ON

## Absolute Maximum Ratings

Voltages Referenced to GND

$V_{CC}$ .....	-0.5V to +7V
$V_{IN}, V_{COM}, V_{NC}, V_{NO}$ (Note 1) .....	-0.5V to $V_{CC}+2V$ or 30mA, whichever occurs first
Current (any terminal except COM, NO, NC) .....	30mA
Current, COM, NO, NC .....	100 mA
(pulsed at 1ms, 10% duty cycle) .....	120mA

## Thermal Information

Continuous Power Dissipation	
PDIP (derate 10.5mW/°C above 70°C) .....	800mW
Narrow SO & QSOP	
(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  $V_{CC}$  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 Characteristics-Single 5.0V Supply

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

Parameter	Symbol	Test Conditions	Temp(°C)	Min. <sup>(2)</sup>	Typ. <sup>(2)</sup>	Max. <sup>(2)</sup>	Unit
Analog Switch							
Analog Signal Range <sup>(3)</sup>	V <sub>ANALOG</sub>		Full	0		V <sub>CC</sub>	V
ON-Resistance	R <sub>ON</sub>	V <sub>CC</sub> = 4.5V, I <sub>COM</sub> = -30mA V <sub>NO</sub> or V <sub>NC</sub> = +2.5V	25		8	10	Ω
On-Resistance Match Between Channels <sup>(4)</sup>	ΔR <sub>ON</sub>		Full			12	
			25		0.9	2	
			Full			4	
On-ResistanceFlatness <sup>(5)</sup>	R <sub>FLAT(ON)</sub>	V <sub>CC</sub> = 5V, I <sub>COM</sub> = -30mA V <sub>NO</sub> or V <sub>NC</sub> = 1V, 2.5V, 4V	25		3	4	
			Full			5	
NO or NC Off LeakageCurrent <sup>(6)</sup>	I <sub>NO(OFF)</sub> I <sub>NC(OFF)</sub>	V <sub>CC</sub> = 5.5V, V <sub>COM</sub> = 0V V <sub>NO</sub> or V <sub>NC</sub> = 4.5V	25		0.05		nA
			Full	-80		80	
COM Off Leakage Current <sup>(6)</sup>	I <sub>COM(OFF)</sub>	V <sub>+</sub> = 5.5V, V <sub>COM</sub> = +4.5V V <sub>NO</sub> or V <sub>NC</sub> = ±0V	25		0.05		
			Full	-80		80	
COM On Leakage Current <sup>(6)</sup>	I <sub>COM(ON)</sub>	V <sub>CC</sub> = 5.5V, V <sub>COM</sub> = +4.5V V <sub>NO</sub> or V <sub>NC</sub> = +4.5V	25		0.07		
			Full	-80		80	

**Electrical Characteristics-Single 5.0V Supply** (continued)

(V<sub>CC</sub> = 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>	Unit
Logic Input							
Input High Voltage	V <sub>INH</sub>	Guaranteed logic High Level	Full	2			V
Input Low Voltage	V <sub>INL</sub>	Guaranteed logic Low Level				0.8	
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN</sub> = 2.4V, all others = 0.8V		-1	0.005	1	μA
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN</sub> = 0.8V, all others = 2.4V		-1	0.005	1	
Dynamic							
Turn-On Time	t <sub>ON</sub>	V <sub>CC</sub> = 5V, Figure 1	25		8	15	ns
			Full			20	
Turn-Off Time	t <sub>OFF</sub>		25		3.5	7	
			Full			10	
Charge Injection <sup>(3)</sup>	Q	C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω Figure 2	25		7	10	pC
Off Isolation	OIRR	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 10MHz, Figure 3			-55		dB
Crosstalk <sup>(8)</sup>	I <sub>COM(OFF)</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 10MHz, Figure 4			-92		
NC or NO Capacitance	C <sub>(OFF)</sub>	f = 1kHz, Figure 5			8		pF
COM Off Capacitance	C <sub>COM(OFF)</sub>				8		
COM On Capacitance	C <sub>COM(ON)</sub>	f = 1kHz, Figure 6			14		
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, Figure 7	Full		230		MHz
Distortion <sup>(9)</sup>	D	R <sub>L</sub> = 10kΩ			0.03		%
Supply							
Power-Supply Range	V <sub>CC</sub>		Full	2		6	V
Positive Supply Current	I <sub>CC</sub>	V <sub>CC</sub> = 5.5V, V <sub>IN</sub> = 0V or V <sub>CC</sub> , all channels on or off				1	μA

**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.
- ΔR<sub>ON</sub> = R<sub>ON</sub> max - R<sub>ON</sub> 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 = 20log<sub>10</sub> [V<sub>COM</sub> / (V<sub>NO</sub> or V<sub>NC</sub>)]. See figure 3.
- Between any two switches. See figure 4.
- D = R<sub>FLAT(ON)</sub>/R<sub>L</sub>.

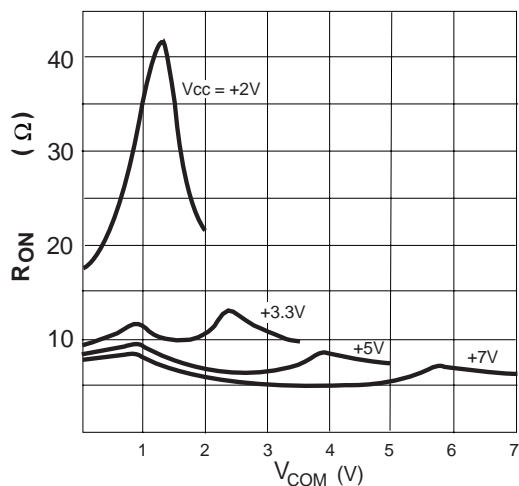
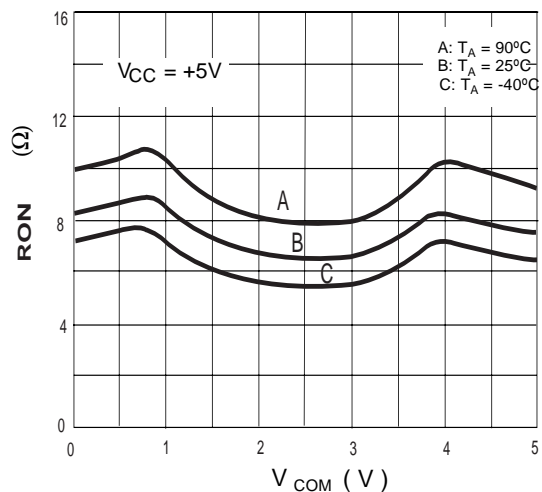
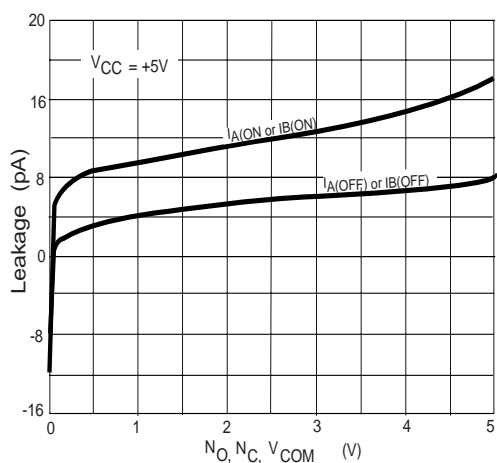
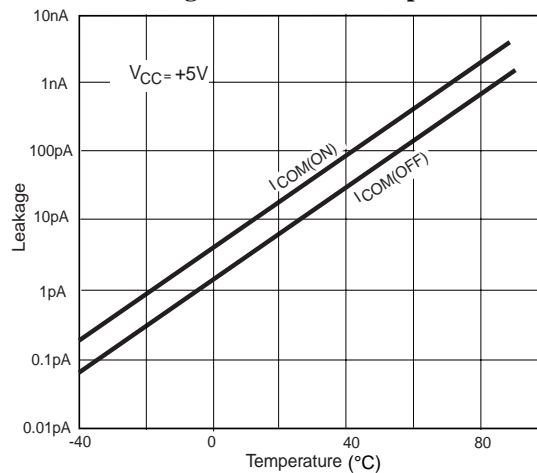
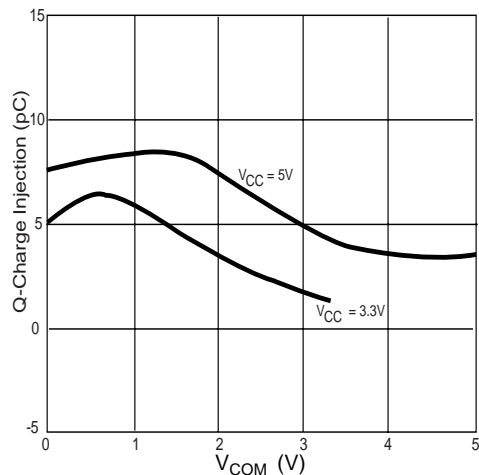
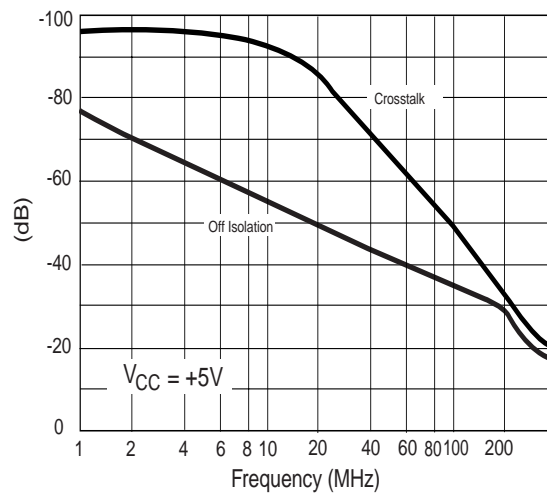
### Electrical Specifications - Single +3.3V Supply

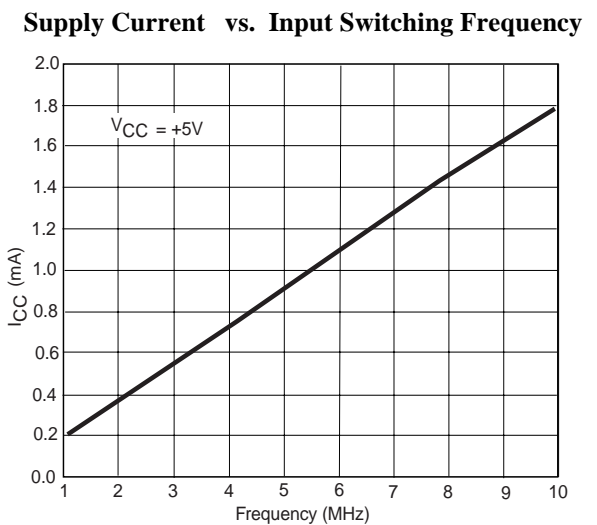
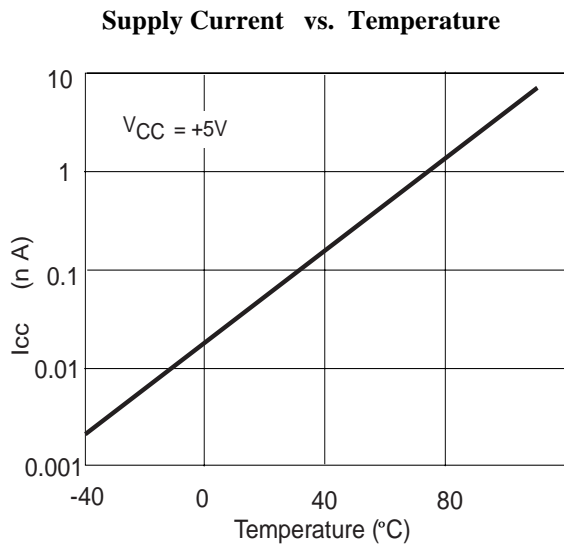
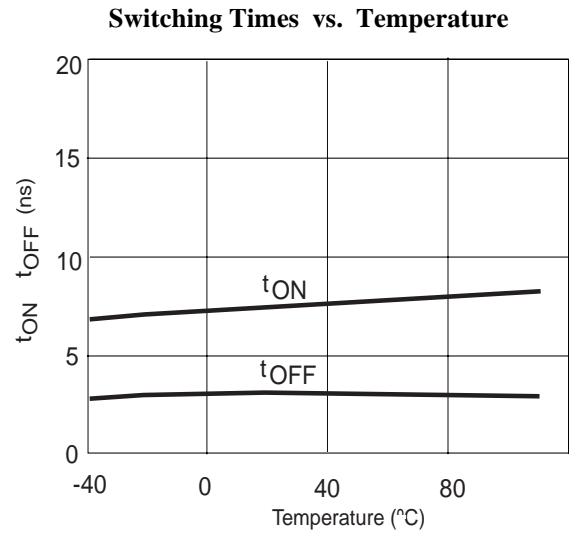
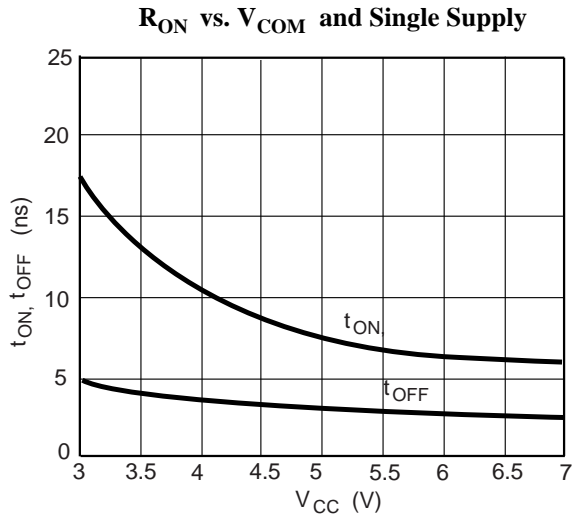
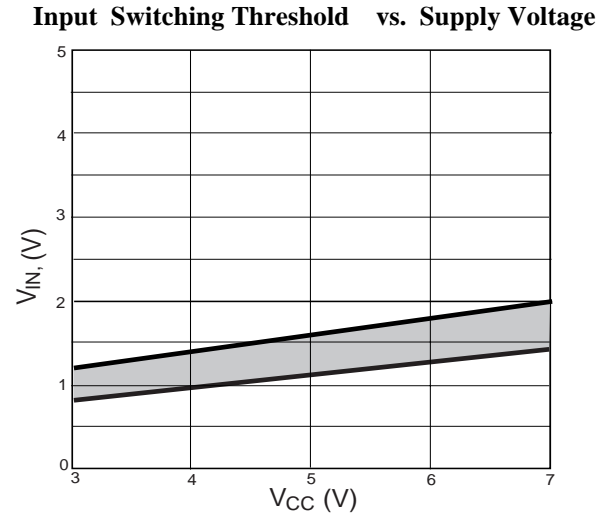
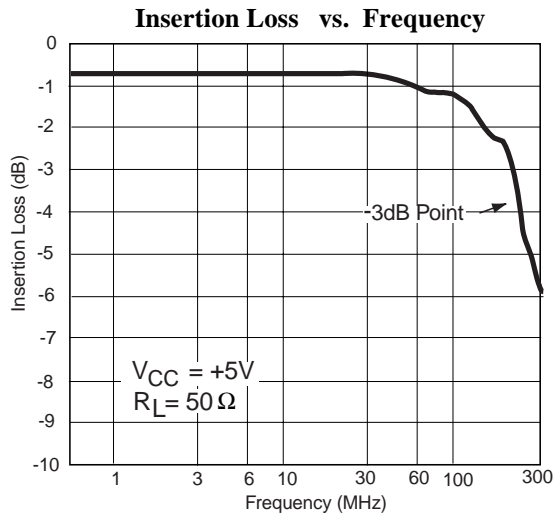
( $V_{CC} = +3.3V \pm 10\%$ ,  $GND = 0V$ ,  $V_{INH} = 2.4V$ ,  $V_{INL} = 0.8V$ )

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 <sub>CC</sub>	V
On-Resistance	R <sub>ON</sub>	V <sub>CC</sub> = 3V, I <sub>COM</sub> = -30mA, V <sub>NO</sub> or V <sub>NC</sub> = 1.5V	25		12	18	Ω
			Full			22	
On-Resistance Match Between Channels <sup>(4)</sup>	ΔR <sub>ON</sub>	V <sub>CC</sub> = 3.3V, I <sub>COM</sub> = -30mA, V <sub>NO</sub> or V <sub>NC</sub> = 0.8V, 2.5V	25		1	2	
			Full			4	
On-Resistance Flatness <sup>(3,5)</sup>	R <sub>FLAT(ON)</sub>		25		4	10	
			Full			12	
Dynamic							
Turn-On Time	t <sub>ON</sub>	V <sub>CC</sub> = 3.3V, V <sub>NO</sub> or V <sub>NC</sub> = 1.5V Figure 1	25		14	25	ns
			Full			40	
Turn-Off Time	t <sub>OFF</sub>		25		5	12	
			Full			20	
Charge Injection <sup>(3)</sup>	Q	C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0V, Figure 2	25		5	10	pC
Supply							
Positive Supply Current	I <sub>CC</sub>	V <sub>cc</sub> = 3.6V, V <sub>IN</sub> = 0V or V <sub>CC</sub> , all channels on or off	Full			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.  $\Delta R_{ON} = R_{ON \text{ max}} - R_{ON \text{ min}}$
5. Flatness is defined as the difference between the maximum and minimum value of on-resistance measured.

**Typical Operating Characteristics ( $T_A = +25^\circ\text{C}$ , unless otherwise noted)**
 **$R_{ON}$  vs.  $V_{COM}$** 

 **$R_{ON}$  vs.  $V_{COM}$  and Temperature**

**Leakage Currents vs. Analog Voltage**

**Leakage Current vs. Temperature**

**Charge Injection vs. Analog Voltage**

**Crosstalk and Off-Isolation vs. Frequency**




## Test Circuits/Timing Diagrams

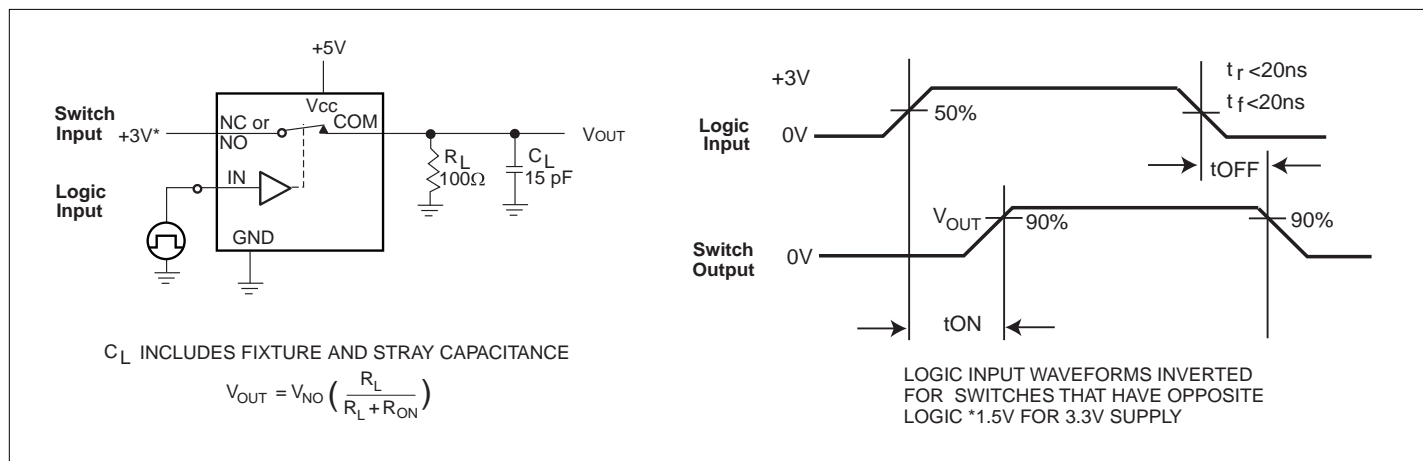


Figure 1. Switching Time

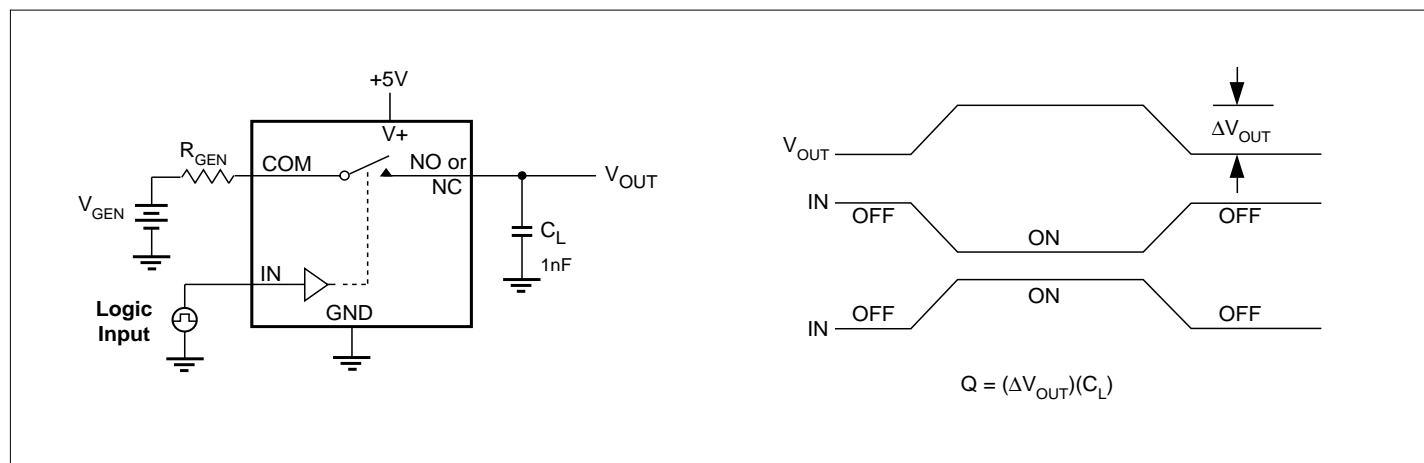


Figure 2. Charge Injection

## Test Circuits/Timing Diagrams (continued)

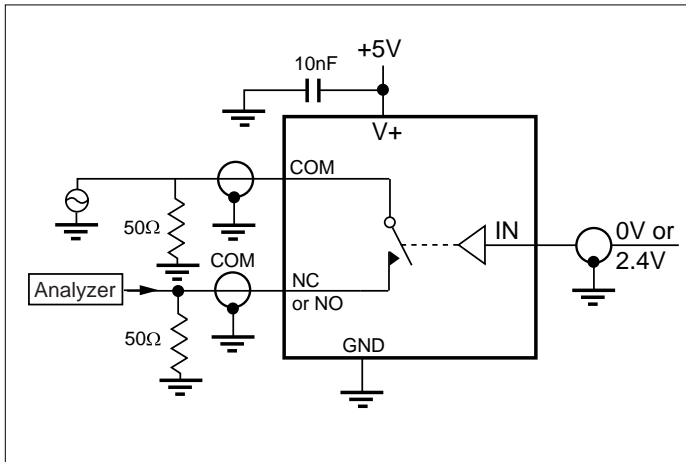


Figure 3. Off Isolation

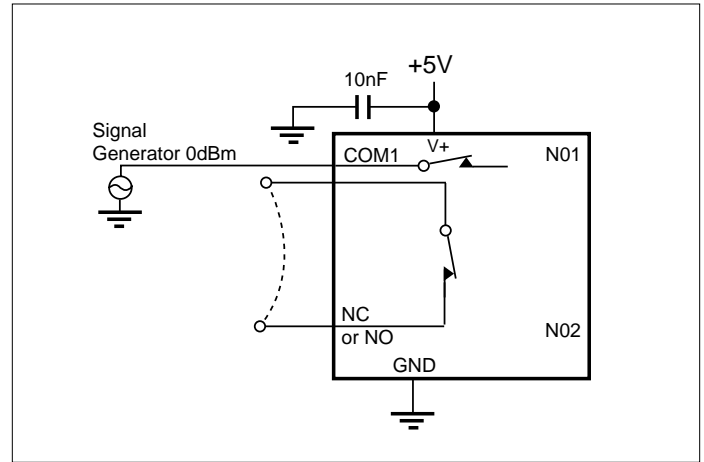


Figure 4. Crosstalk

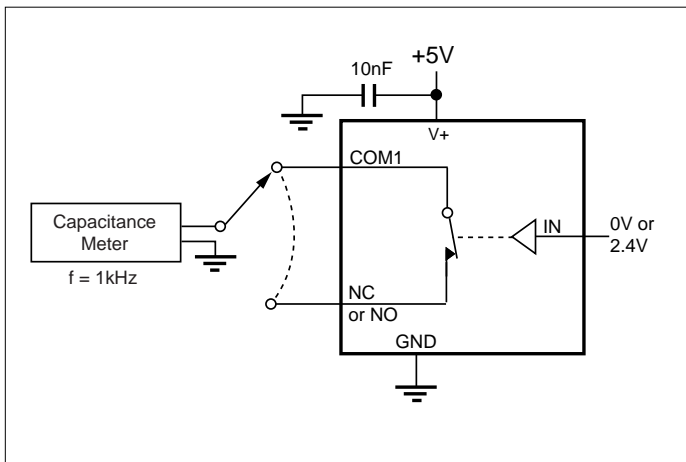


Figure 5. Channel-Off Capacitance

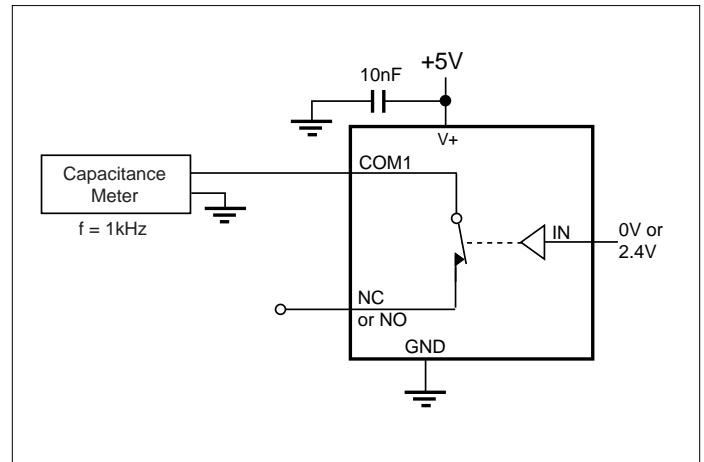


Figure 6. Channel-On Capacitance

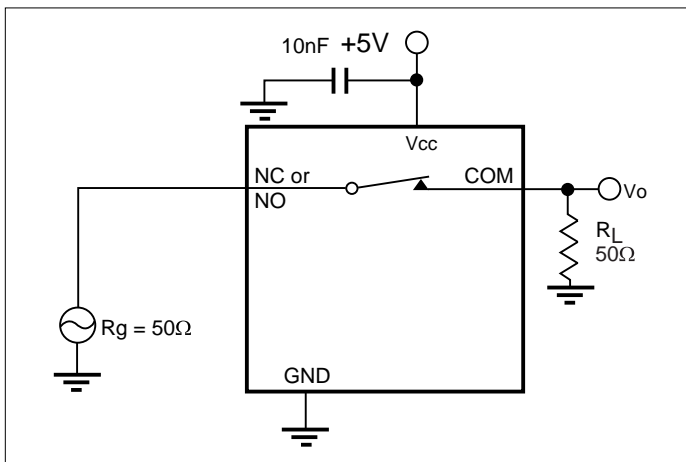


Figure 7. Bandwidth

## Ordering Information

Part Number	Package
PI5A381AP	16-Pin PDIP
PI5A381AW	Narrow Body SOIC-16
PI5A381AQ	16-Pin QSOP
PI5A383AP	16-Pin PDIP
PI5A383AW	Narrow Body SOIC-16
PI5A383AQ	16-Pin QSOP
PI5A385AP	16-Pin PDIP
PI5A385AW	Narrow Body SOIC-16
PI5A385AQ	16-Pin QSOP