

**Features**

- Low On-resistance: 60Ω typ, with ±5V Supplies, Minimizes Distortion
- On-Resistance Matching between channels better than 6Ω
- Guaranteed Low Leakage Currents: <0.1nA at +25°C
- Rail-to-Rail Analog Signal Range
- Low Distortion: <0.04% (600Ω)
- Low Crosstalk: -90dB @100kHz
- TTL/CMOS Compatible (with +5V or ±5V Supplies)
- Low Power Consumption.
- 16-pin Narrow SOIC and QSOP Packages save board area
- Pin-compatible upgrades for 74HC4051/4052/4053

**Applications**

- Audio and Video Switching and Routing
- Lab and Medical Instrumentation
- Low-Voltage Data-Acquisition and Process Control Systems
- Battery-Powered Communication Systems

**Description**

The PS4051/PS4052/PS4053 are precision low-voltage CMOS analog multiplexers/switches.

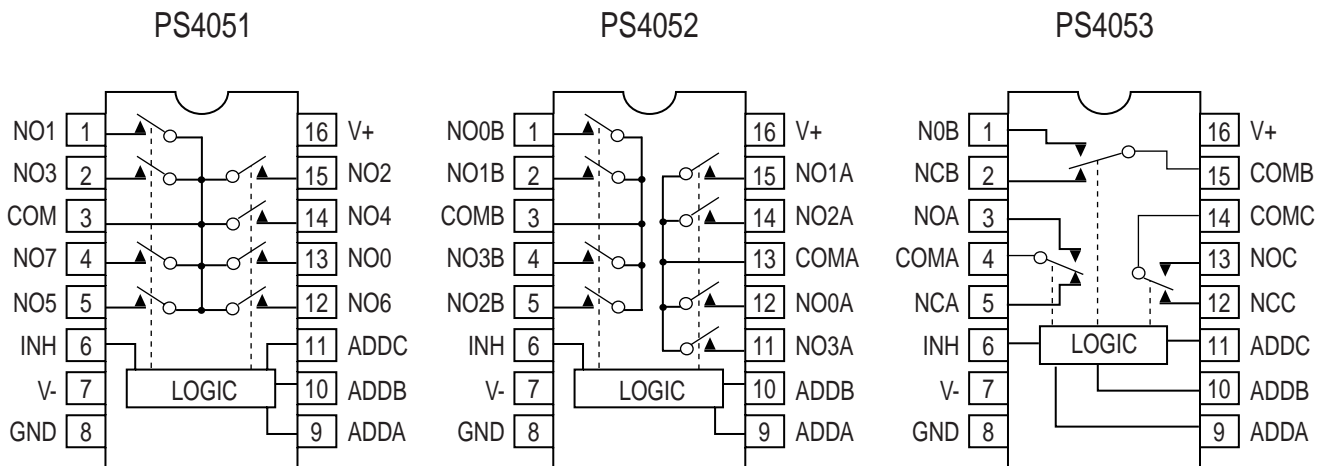
The PS4051 is an eight-channel single-ended mux designed to select one of eight inputs to a common output. What input is selected depends on the status of three address bits (ADDA-ADDC). The PS4052 is a differential four-channel mux, controlled by two address bits: ADDA, and ADDB. The PS4053 is a triple 2-to-1 mux (or triple SPDT, single-pole double-throw, switch).

The INH (inhibit) pin can be driven high, to open all switches regardless of address bit status. All control inputs are TTL compatible when V+ = +5V.

These devices are designed to operate with power supplies from ±2.7V to ±8V. Single-supply operation is possible from +2.7V to +16V.

When on, each switch conducts current equally well in either direction and can handle rail-to-rail analog signals. In the off-state each switch blocks voltages up to the power-supply rails. Off-leakage current is guaranteed to be less than 0.1nA at +25°C, and <2.5nA at +85°C.

These devices are available in 16-pin DIP, Narrow SOIC, and QSOP packages for operation over the -40°C to +85°C temperature range.

**Functional Block Diagrams and Pin Configurations**
**Top Views**


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### Truth Tables

PS4051				
INH	ADDC	ADDB	ADDA	On Switch
1	X	X	X	None
0	0	0	0	NO0
0	0	0	1	NO1
0	0	1	0	NO2
0	0	1	1	NO3
0	1	0	0	NO4
0	1	0	1	NO5
0	1	1	0	NO6
0	1	1	1	NO7

PS4053						
INH	ADDC	ADDB	ADDA	On Switches		
1	X	X	X	None		
0	0	0	0	NOC	NOB	NOA
0	0	0	1	NOC	NOB	NCA
0	0	1	0	NOC	NCB	NOA
0	0	1	1	NOC	NCB	NCA
0	1	0	0	NCC	NOB	NOA
0	1	0	1	NCC	NOB	NCA
0	1	1	0	NCC	NCB	NOA
0	1	1	1	NCC	NCB	NCA

PS4052			
INH	ADDB	ADDA	On Switch
1	X	X	None
0	0	0	NO0A,B
0	0	1	NO1A,B
0	1	0	NO2A,B
0	1	1	NO3A,B

Logic "0",  $V_{AL} \leq 0.8V$   
 Logic "1",  $V_{IH} \geq 2.4V$

### Absolute Maximum Ratings

Voltages Referenced to V-

V+	-0.3V to +17V
GND	-0.3V to +17V
GND	-0.3V to (V+) + 0.3V
$V_{IN}, V_{COM}, V_{NO}^{(1)}$	(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

Plastic DIP (derate 10.5mW/°C above +70°C)	800mW
Narrow SO and 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 NO, COM, or logic inputs exceeding V+ or V- 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 Specifications - Dual Supplies

( $V_{\pm} = \pm 5V \pm 10\%$ ,  $GND = 0V$ ,  $V_{AH} = V_{IH} = 2.4V$ ,  $V_{AL} = V_{IL} = 0.8V$ )

Parameter	Symbol	Conditions	Temp.(°C)	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	
<b>Analog Switch</b>								
Analog Signal Range <sup>(3)</sup>	$V_{ANALOG}$		Full	$V_{-}$		$V_{+}$	V	
On Resistance	$R_{ON}$	$V_{+} = 5V, V_{-} = -5V,$ $V_{COM} = \pm 3V,$ $I_{NO} = 1mA$	25		60	100	$\Omega$	
			Full			125		
On-Resistance Match Between Channels <sup>(4)</sup>	$\Delta R_{ON}$	$V_{COM}$ or $V_{NC} = \pm 3V,$ $I_{NO} = 1mA,$ $V_{+} = 5V, V_{-} = -5V$	25			12	$\Omega$	
			Full			18		
On-Resistance Flatness <sup>(5)</sup>	$R_{FLAT} (ON)$	$V_{+} = 5V, V_{-} = -5V,$ $I_{NO} = 1mA,$ $V_{COM} = \pm 3V, 0V$	25			10	$\Omega$	
			Full			15		
NO Off Leakage Current <sup>(6)</sup>	$I_{NO} (OFF)$	$V_{+} = 5.5V, V_{-} = -5.5V,$ $V_{COM} = \pm 4.5V,$ $V_{NO} = \mp 4.5V$	25	-0.1		50	$\Omega$	
			Full	-1.0		100		
COM-Off Leakage Current <sup>(6)</sup>	$I_{COM} (OFF)$	$V_{+} = 5.5V,$ $V_{-} = -5.5V,$ $V_{COM} = \pm 4.5V,$ $V_{NO} = \mp 4.5V$	PS4051	25	-0.1		50	nA
				Full	-2.5		100	
			PS4052 PS4053	25	-0.1		50	
				Full	-1.5		100	
COM On Leakage Current <sup>(7)</sup>	$I_{COM} (ON)$	$V_{COM} = \mp 4.5V$	PS4051	25	-0.1		50	
				Full	-5		100	
			PS4052 PS4053	25	-0.1		50	
				Full	-2.5		100	
<b>Logic Input</b>								
Logic High Input Voltage	$V_{AH}, V_{IH}$		Full	2.4			V	
Logic Low Input Voltage	$V_{AL}, V_{IL}$					0.8		
Input Current with Input Voltage High or Low	$I_{IH}, I_{IL}$	$V_A = V_I = V_{+}, 0V$			-0.1		0.1	$\mu A$

**Electrical Specifications - Dual Supplies** (continued)

( $V_{\pm} = \pm 5V \pm 10\%$ ,  $GND = 0V$ ,  $V_{AH} = V_{IH} = 2.4V$ ,  $V_{AL} = V_{IL} = 0.8V$ )

Parameter	Symbol	Conditions	Temp (°C)	Min <sup>(1)</sup>	Typ <sup>(2)</sup>	Max <sup>(1)</sup>	Units	
<b>Dynamic</b>								
Transition Time	$t_{TRANS}$	Figure 1	25		75	250	ns	
Break-Before-Make TimeDelay	$t_{OPEN}$	Figure 3		2	10			
Turn-OnTime	$t_{ON}$	Figure 2		Full	50	175		
Turn-Off Time	$t_{OFF}$	Figure 2	25		40	150		
			Full			200		
Charge Injection <sup>(3)</sup>	Q	$C_L = 1nF$ , $V_S = 0V$ , $R_S = 0\Omega$ ,	25		2	10	pC	
Off Isolation <sup>(7)</sup>	OIRR	$C_L = 15pF$ , $V_{INH} = 5V$ , $R_L = 50\Omega$ , $f = 100kHz$ , $V_{NO} = 1V_{RMS}$			-90		dB	
Crosstalk	$X_{TALK}$	$C_L = 15pF$ , $R_L = 50\Omega$ , $f = 100kHz$ , Figure 6, $V_{NO} = 1V_{RMS}$			-92			
Logic Input Capacitance	$C_{IN}$	$f = 1MHz$			8		pF	
NO Off Capacitance	$C_{NO(OFF)}$	$f = 1MHz$ , $V_{NO} = 0V$			2			
COM Off Capacitance	$C_{COM(OFF)}$	$f = 1MHz$ , $V_{COM} = 0V$		PS4051	2			
				PS4052 PS4053	2			
COM On Capacitance	$C_{COM(ON)}$	$f = 1MHz$ , $V_{COM} = 0V$	PS4051	8				
			PS4052 PS4053	8				
<b>Supply</b>								
Power-Supply Range			Full	$\pm 2.7$		$\pm 8$	V	
Positive Supply Current	I+	$V_{INH} = V_A = 0V$ or $V_+$ , $V_+ = 5.5V$ , $V_- = -5.5V$					10	$\mu A$
Negative Supply Current	I-				-10			

**Notes:**

1. The algebraic convention, where most negative value is a minimum and 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.  $\Delta R_{ON} = R_{ON \max} - R_{ON \min}$
5. Flatness is defined as the difference between the maximum and minimum values of on-resistance measured over the specific analog signal range, i.e.,  $V_{NO} = 3V$  to  $0V$  and  $0V$  to  $-3V$ .
6. Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at  $+25^\circ C$ .
7. Off Isolation =  $20 \log_{10} V_{COM} / V_{NO}$ . See Figure 5.

### Electrical Characteristics - Single 5V Supply

(V+ = +5V ±10%, V- = 0V, GND = 0V, V<sub>AH</sub> = V<sub>IH</sub> = 2.4V, V<sub>AL</sub> = V<sub>IL</sub> = 0.8V)

Parameter	Symbol	Conditions	Temp (°C)	Min <sup>(1)</sup>	Typ <sup>(2)</sup>	Max <sup>(1)</sup>	Units	
<b>Switch</b>								
Analog Signal Range <sup>(3)</sup>	V <sub>ANALOG</sub>		Full	0		V+	V	
On Resistance	R <sub>ON</sub>	I <sub>NO</sub> = 1mA, V <sub>COM</sub> = 3.5V, V+ = 4.5V	25		125	225	Ω	
			Full			280		
NO-Off Leakage Current <sup>(8)</sup>	I <sub>NO (OFF)</sub>	V <sub>NO</sub> = 0V, V <sub>COM</sub> = 4.5V, V+ = 5.5V	25	-0.1		50		
			Full	-10		100		
COM-Off Leakage Current <sup>(8)</sup>	I <sub>COM (OFF)</sub>	V+ = 5.5V, V <sub>COM</sub> = 4.5V, V <sub>NO</sub> = 0V, or V <sub>COM</sub> = 0V, V <sub>NO</sub> = 4.5V	PS4051	25	-1		50	nA
				Full	-10		100	
			PS4052 PS4053	25	-1		50	
				Full	-5		100	
COM-On Leakage Current <sup>(8)</sup>	I <sub>COM (ON)</sub>	V <sub>COM</sub> = V <sub>NO</sub> = 4.5V, V+ = 5.5V	PS4051	25	-1		50	
				Full	-10		100	
			PS4052 PS4053	25	-1		50	
				Full	-10		100	
<b>Digital Logic Input</b>								
Logic High Input Voltage	V <sub>AH</sub> , V <sub>IH</sub>		Full	2.4			V	
Logic Low Input Voltage	V <sub>AL</sub> , V <sub>IL</sub>					0.8		
Input Current with Input Voltage High or Low	I <sub>IH</sub> , I <sub>IL</sub>	V <sub>A</sub> = V <sub>I</sub> = V+, 0V			-1		1	μA
<b>Supply</b>								
Positive-Supply Current	I+	V <sub>A</sub> = V <sub>I</sub> = 0V or V+	25	-1.0		1.0	μA	
			Full			10		

**Electrical Characteristics - Single 5V**(continued)

(V+ = +5V ±10%, V- = 0V, GND = 0V, V<sub>AH</sub> = V<sub>IH</sub> = 2.4V, V<sub>AL</sub> = V<sub>IL</sub> = 0.8V)

Parameter	Symbol	Conditions	Temp (°C)	Min <sup>(1)</sup>	Typ <sup>(2)</sup>	Max <sup>(1)</sup>	Units
<b>Dynamic</b>							
Turn-OnTime	t <sub>ON</sub>		25		90	200	ns
			Full			275	
Turn-Off Time	t <sub>OFF</sub>		25		60	125	
			Full			175	
Break-Before-Make Interval	t <sub>OPEN</sub>		25		30		
Charge Injection <sup>(3)</sup>	Q	C <sub>L</sub> = 1nF, V <sub>S</sub> = 0V, R <sub>S</sub> = 0Ω			1.5	5	pC

**Electrical Characteristics - Single 3V Supply**

(V+ = +3.3V ±10%, V- = 0V, GND = 0V, V<sub>AH</sub> = V<sub>IH</sub> = +2.4V, V<sub>AL</sub> = V<sub>IL</sub> = +0.8V)

Parameter	Symbol	Conditions	Temp (°C)	Min <sup>(1)</sup>	Typ <sup>(2)</sup>	Max <sup>(1)</sup>	Units
<b>Switch</b>							
Analog Signal Range <sup>(3)</sup>	V <sub>ANALOG</sub>		Full	0		V+	V
On-Resistance	R <sub>ON</sub>	I <sub>NO</sub> = 1mA, V <sub>COM</sub> = 1.5V, V+ = 3V	25		250	525	Ω
			Full			700	
<b>Dynamic</b>							
Transition Time <sup>(3)</sup>	t <sub>TRANS</sub>	Figure 1, V <sub>IN</sub> = 2.4V V <sub>NO1</sub> = 1.5V, V <sub>NO8</sub> = 0V	25		230	575	ns
Turn-OnTime <sup>(3)</sup>	t <sub>ON</sub>	Figure 2, V <sub>INH</sub> = 2.4V V <sub>INL</sub> = 0V, V <sub>NO1</sub> = 1.5V			200	500	
Turn-Off Time <sup>(3)</sup>	t <sub>OFF</sub>	Figure 2, V <sub>INH</sub> = 2.4V V <sub>INL</sub> = 0V, V <sub>NO1</sub> = 1.5V			75	400	
Charge Injection <sup>(3)</sup>	Q	C <sub>L</sub> = 10nF, V <sub>S</sub> = 0V, R <sub>S</sub> = 0Ω				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. ΔR<sub>ON</sub> = R<sub>ON</sub> max - R<sub>ON</sub> 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. Worst-case isolation is on channel 4 because of its proximity to the COM pin. Off isolation = 20log V<sub>COM</sub>/V<sub>NO</sub>.  
V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch
8. Leakage testing at single supply is guaranteed by testing with dual supplies.

Test Circuits/Timing Diagrams

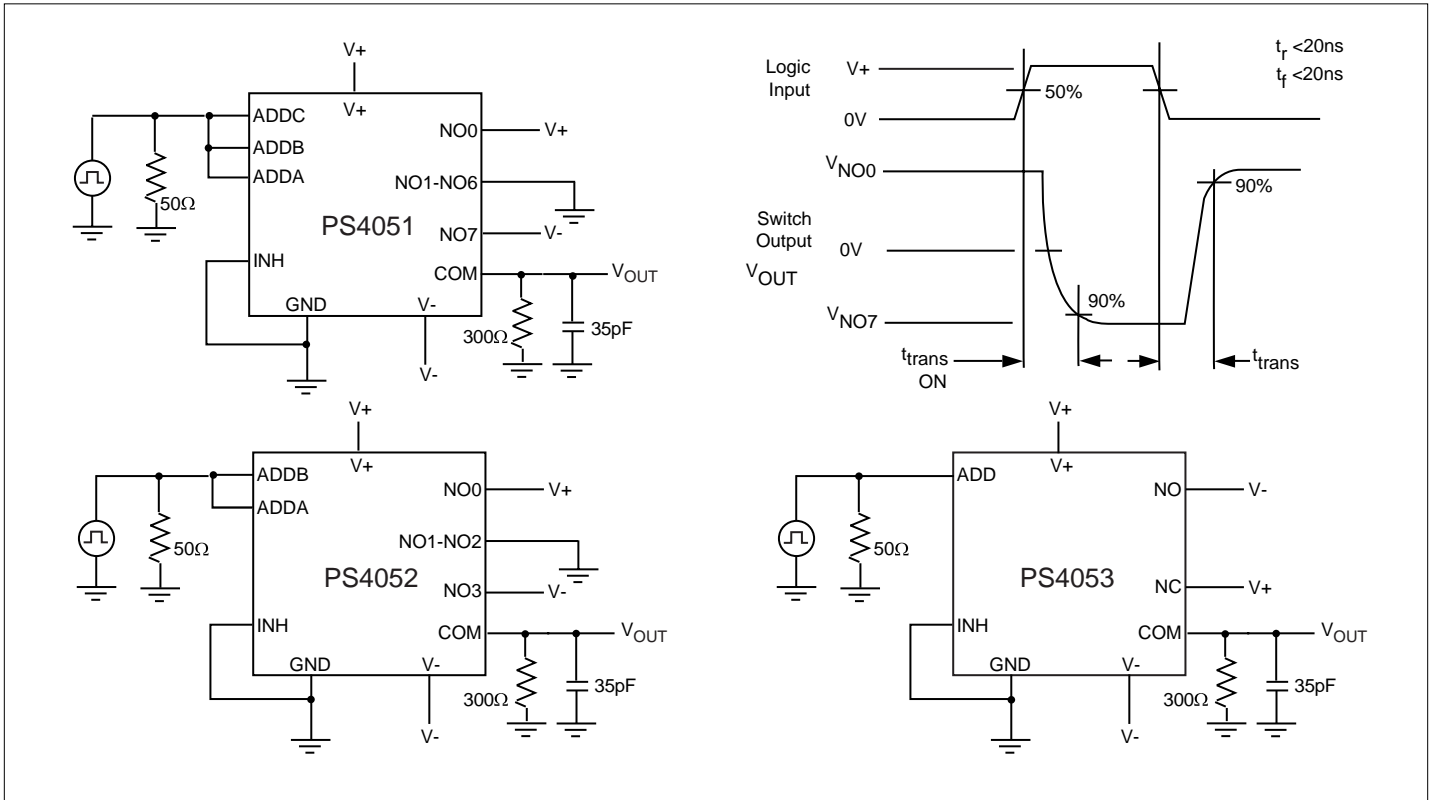


Figure 1. Transition Time

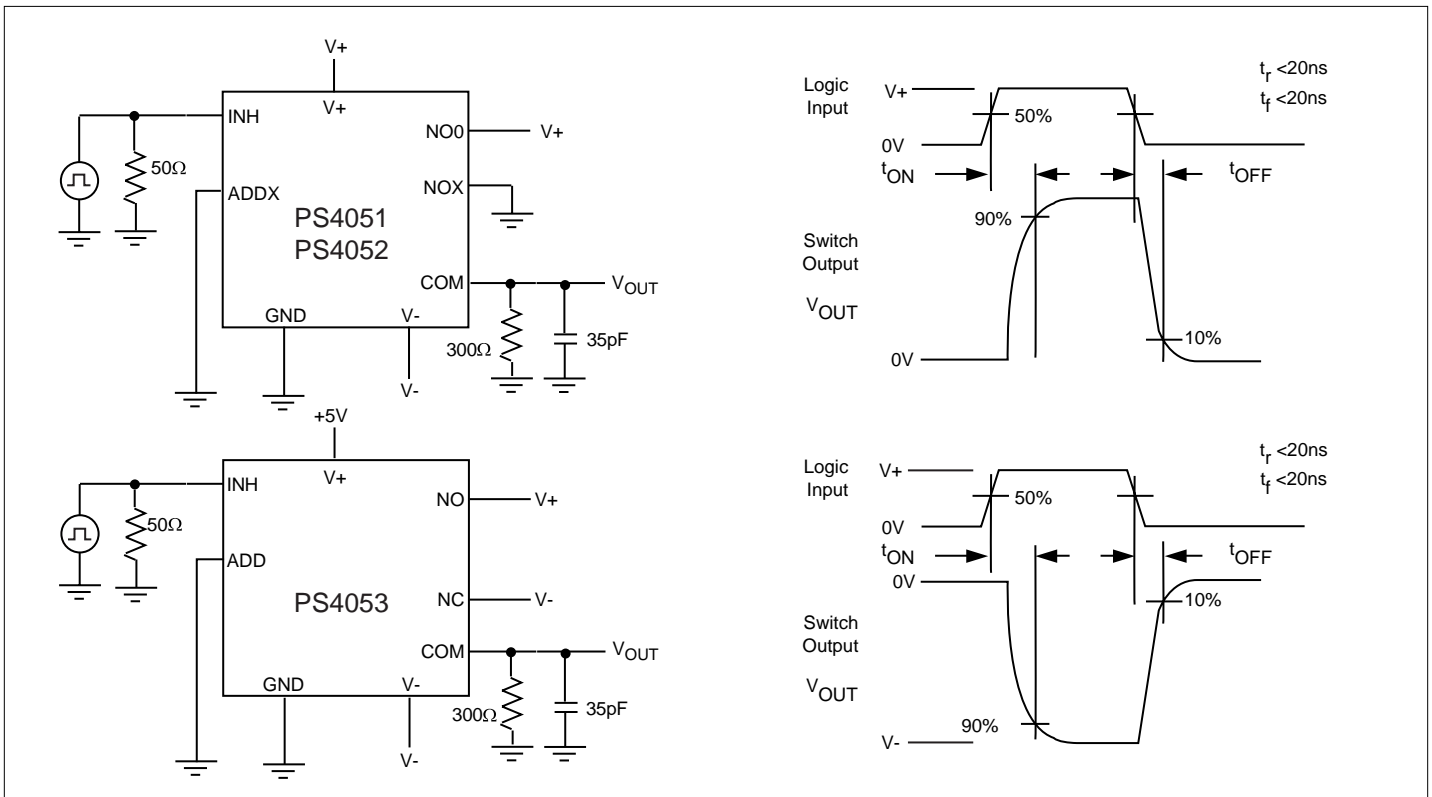


Figure 2. Switching Times

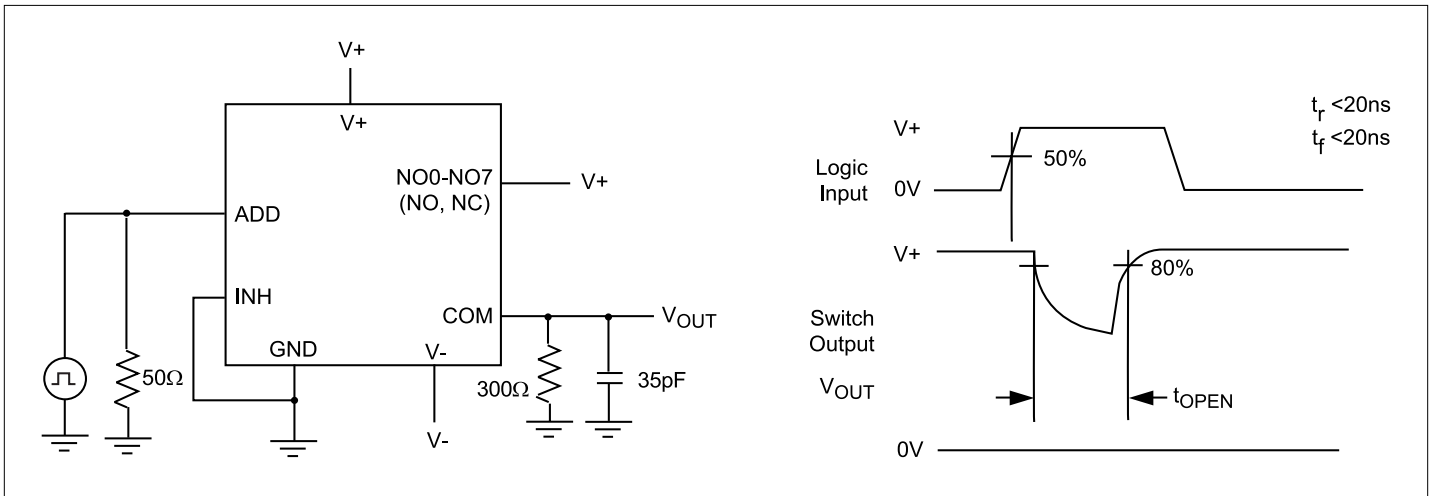


Figure 3. Break-Before-Make Interval

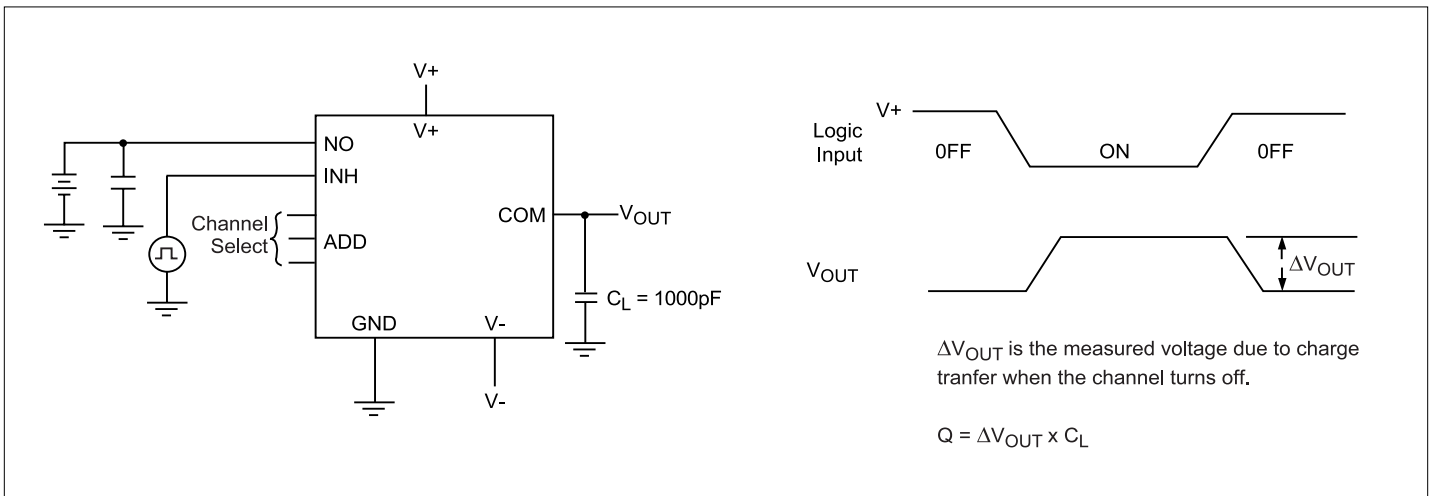


Figure 4. Charge Injection

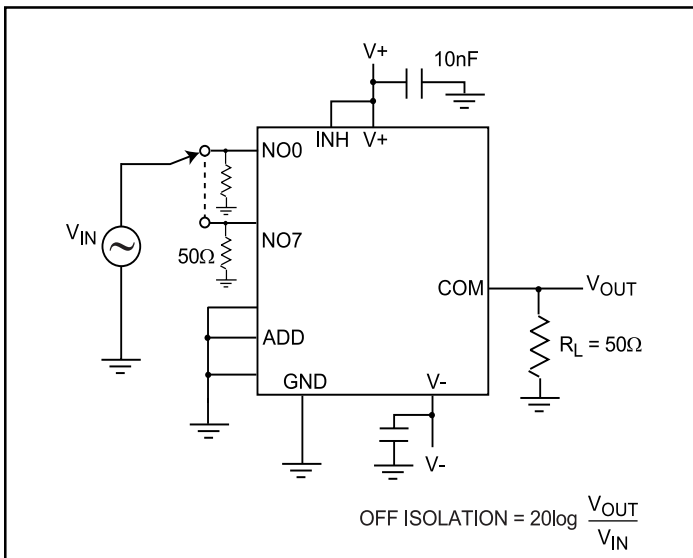


Figure 5. Off Isolation

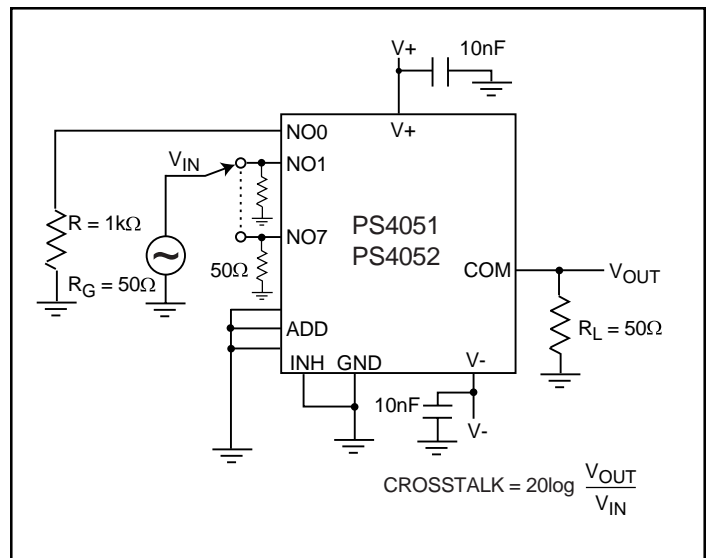


Figure 6. Crosstalk



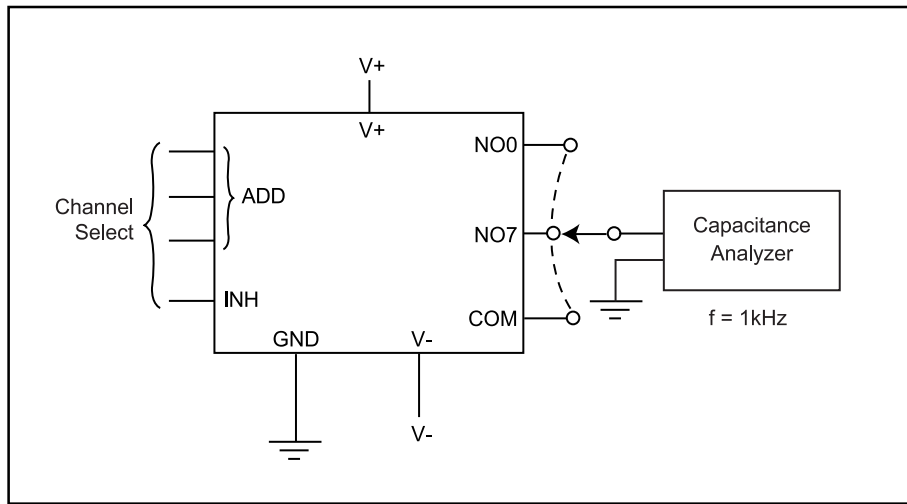


Figure 8. NO/COM Capacitance

### Ordering Information

Part Number	Temperature	Package
PS4051CPE	0°C to +70°C	PDIP-16
PS4051CSE	0°C to +70°C	Narrow SOIC-16
PS4051CEE	0°C to +70°C	QSOP-16
PS4051EPE	-40°C to +85°C	PDIP-16
PS4051ESE	-40°C to +85°C	Narrow SOIC-16
PS4051EEE	-40°C to +85°C	QSOP-16
PS4052CPE	0°C to +70°C	PDIP-16
PS4052CSE	0°C to +70°C	Narrow SOIC-16
PS4052CEE	0°C to +70°C	QSOP-16

Part Number	Temperature	Package
PS4052EPE	-40°C to +85°C	PDIP-16
PS4052ESE	-40°C to +85°C	Narrow SOIC-16
PS4052EEE	-40°C to +85°C	QSOP-16
PS4053CPE	0°C to +70°C	PDIP-16
PS4053CSE	0°C to +70°C	Narrow SOIC-16
PS4053CEE	0°C to +70°C	QSOP-16
PS4053EPE	-40°C to +85°C	PDIP-16
PS4053ESE	-40°C to +85°C	Narrow SOIC-16
PS4053EEE	-40°C to +85°C	QSOP-16