

**Precision, 16-Channel/Dual 8-Channel,
17V Analog Multiplexers**

Features

- Low On-Resistance (100 Ohm Max.) Minimizes Distortion and Error Voltages
- Low Glitching Reduces Step Errors and Improves Settling Times. Charge Injection: 5pC Max.
- Dual-Supply Operation ($\pm 2.7V$ to $\pm 8V$)
- Single-Supply Operation (+2.7V to +16V)
- Improved Second Sources for MAX396/MAX397
- On-Resistance Matching Between Channels: < 6 Ohm
- On-Resistance Flatness: 10 Ohm (Max.)
- Low Off-Channel Leakage, $I_{NO(OFF)} < 1nA @ +85^{\circ}C$, $I_{COM(ON)}, < 2.5nA @ +85^{\circ}C$
- TTL/CMOS Logic Compatible (w/ +5V or $\pm 5V$ supplies)
- Fast Switching Speed, $t_{TRANS} < 250ns$
- Break-Before-Make action eliminates momentary crosstalk
- Rail-to-Rail Analog Signal Range
- Low Power Consumption, 10 μ W
- Narrow SOIC and QSOP Packages Minimize Board Area

Description

The PS396/PS397 low-voltage, CMOS analog multiplexers offer low on-resistance (100 Ohm max.), which is matched to within 6 Ohm between switches and remains flat over the specified signal range (10 Ohm max). They also offer low leakage over temperature (input off-leakage current less than 1nA at +85°C) and fast switching speeds (transition time less than 250ns). The PS396 is a 16-channel device, and the PS397 is a dual 8-channel device.

The PS396/PS397 are fabricated using Pericom's 17V silicon gate process. Design improvements yield extremely low charge injection (5pC max) and guarantee electrostatic-discharge (ESD) protection greater than 2000V.

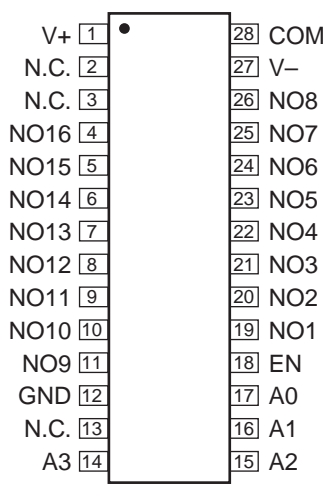
These multiplexers operate with a single +2.7V to +16V supply or with $\pm 2.7V$ to $\pm 8V$ dual supplies, while retaining CMOS-logic input compatibility and fast switching. The PS396/PS397 are pin compatible with MAX306/MAX307.

Applications

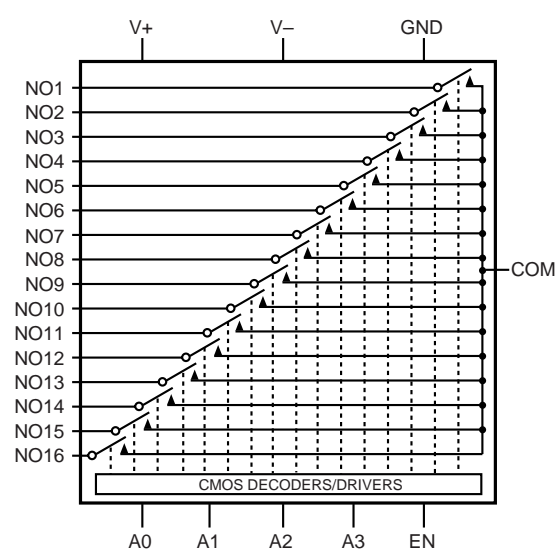
- Data Acquisition Systems
- Audio Switching and Routing
- Test Equipment
- PBX, PABX
- Telecommunication Systems
- Battery-Powered Systems

PS396 16-Channel Single-Ended Multiplexer

Functional Block Diagrams and Pin Configurations



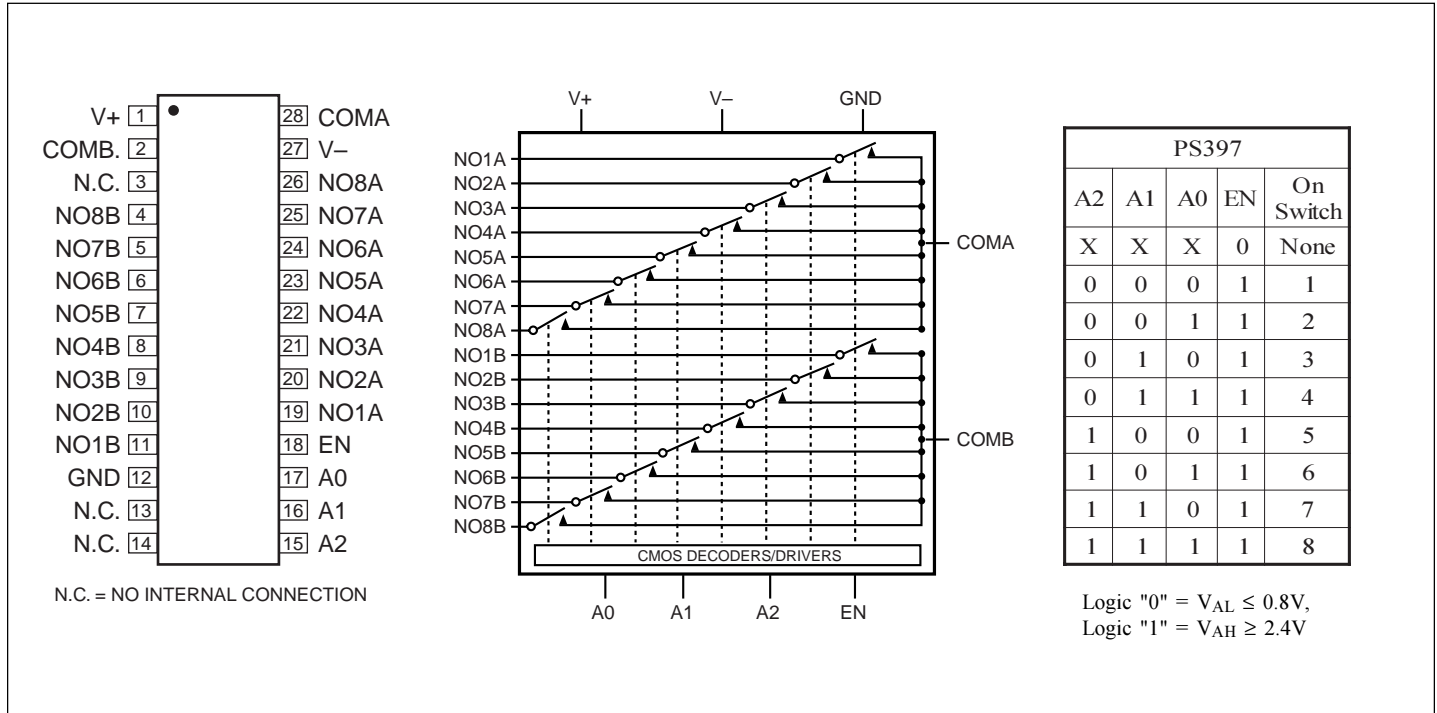
N.C. = NO INTERNAL CONNECTION



PS396					On Switch
A3	A2	A1	A0	EN	
x	x	x	x	0	None
0	0	0	0	1	1
0	0	0	1	1	2
0	0	1	0	1	3
0	0	1	1	1	4
0	1	0	0	1	5
0	1	0	1	1	6
0	1	1	0	1	7
0	1	1	1	1	8
1	0	0	0	1	9
1	0	0	1	1	10
1	0	1	0	1	11
1	0	1	1	1	12
1	1	0	0	1	13
1	1	0	1	1	14
1	1	1	0	1	15
1	1	1	1	1	16

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

PS397 8-Channel Differential Multiplexer
Functional Block Diagrams and Pin Configurations



Pin Description

Pin		Name	Function
PS396	PS397		
1	1	V+	Positive Supply-Voltage Input
2, 3, 13		N.C.	No Internal Connection
	2	COMB	Analog Signal B Output* (bidirectional)
	3, 13, 14	N.C.	No Internal Connection
4-11		NO16-NO9	Analog Signal Inputs* (bidirectional)
	4-11	NO8B-NO1B	Analog Signal B Inputs* (bidirectional)
12	12	GND	Logic Ground
14-17		A3-A0	Logic Address Inputs
	15, 16, 17	A2, A1, A0	Logic Address Inputs
18	18	EN	Logic enable Input
19-26		NO1-NO8	Analog Signal Inputs* (bidirectional)
	19-26	NO1A-NO8A	Analog Signal A Inputs* (bidirectional)
27	27	V-	Negative Supply-Voltage Input
28		COM	Analog Signal Output* (bidirectional)
	28	COMA	Analog Signal A Output* (bidirectional)

Absolute Maximum Ratings

Voltages Referenced to GND	
V+	-0.3V to +17V
V-	+0.3V to -17V
V+ to V-	-0.3V to +17V
Voltage into any terminal ⁽¹⁾	(V- - 2V) to (V+ + 2V) or 30mA, whichever occurs first
Current into any terminal	±30mA
Peak current into any terminal	±50mA
Continuous power Dissipation (T _A = +70°C)	
Plastic DIP (derate 14.29mW/°C above +70°C) ...	1143mW
Wide SO (derate 12.50mW/°C above +70°C)	1000mW
SSOP (derate 9.52mW/°C above +70°C)	762mW
Operating Temperature Ranges	
PS39C_I	0°C to +70°C
PS39E_I	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C

Note 1:

Signals on any terminal exceeding V+ or V- are clamped by internal diodes. Limit forward 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.

Applications Information

Operation with Supply Voltages Other than ±5V

Using supply voltages less than ±5V reduces the analog signal range. The PS396/PS397 multiplexers (muxes) operate with ±3V to ±8V bipolar supplies or with a +3V to +15V single supply. Connect V- to GND when operating with a single supply. Both devices can also operate with unbalanced supplies, such as +10V and -5V. The Typical Operating Characteristics graphs show typical on-resistance with ±3V, ±5V, +3V, and +5V supplies. (Switching times increase by a factor of two or more for operation at 5V or below.) These muxes operate with a single supply as low as 1V, although on resistance and switching times become extremely high. Performance is not guaranteed below 2.7V. This is useful information only because it assures proper switch state while power supplies ramp up or down slowly. Overvoltage Protection Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, then V-, followed by the logic inputs, NO, or COM. If power-supply sequencing is not possible, add two small-signal diodes (D1, D2) in series with supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog-signal range to one diode drop below V+ and one diode drop above V-, but does not affect the devices’ low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and V- should not exceed 17V. These protection diodes are not recommended when using a single supply.

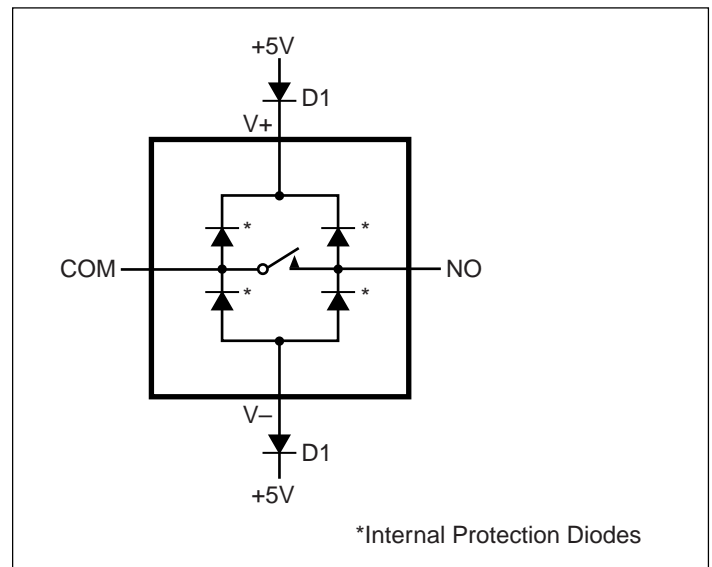


Figure 1. Overvoltage Protection using Blocking Diodes

Electrical Characteristics — Dual Supplies

($V_+ = +5V \pm 10\%$, $V_- = -5V \pm 10\%$, $GND = 0V$, $V_{AH} = V_{ENH} = 2.4V$, $V_{AL} = V_{ENL} = 0.8V$, $T_A = T_{Min}$ to T_{Max} , unless otherwise noted.)

Parameter	Symbol	Conditions		Temp. Range	Min. ⁽²⁾	Typ. ⁽²⁾	Max. ⁽²⁾	Units		
Switch										
Analog Signal Range	V_{COM}, V_{NO}	(note 3)			V_-		V_+	V		
Channel On-Resistance	R_{ON}	$I_{NO} = 1mA, V_{COM} = \pm 3.5V$		$T_A = +25^\circ C$		60	100	Ohm		
				$T_A = T_{MIN}$ to T_{MAX}			125			
On-Resistance Matching Between Channels ⁽⁴⁾	ΔR_{ON}	$I_{NO} = 1mA, V_{COM} = \pm 3.5V, V_+ = 5V, V_- = -5V$		$T_A = +25^\circ C$		1.8	6			
				$T_A = T_{MIN}$ to T_{MAX}			8			
On-Resistance Flatness ⁽⁵⁾	$R_{FLAT(ON)}$	$I_{NO} = 1mA, V_{COM} = \pm 3.0V, V_+ = 5V, V_- = -5V$		$T_A = +25^\circ C$		5	10			
				$T_A = T_{MIN}$ to T_{MAX}			13			
NO Off-Leakage Current ⁽⁶⁾	$I_{NO(OFF)}$	$V_{NO} = \pm 4.5V, V_{COM} = \pm 4.5V, V_+ = 5.5V, V_- = -5.5V$		$T_A = +25^\circ C$		-0.1	-0.03		0.1	
				$T_A = T_{MIN}$ to T_{MAX}		C, E	-1.0		1.0	
COM Off-Leakage Current ⁽⁶⁾	$I_{COM(OFF)}$	$V_{COM} = \pm 4.5V, V_{NO} = \pm 4.5V, V_+ = 5.5V, V_- = -5.5V$		PS396	$T_A = +25^\circ C$		-0.2		0.05	0.2
					$T_A = T_{MIN}$ to T_{MAX}		C, E		-2.5	2.5
				PS397	$T_A = +25^\circ C$		-1.0	0.03	0.1	
					$T_A = T_{MIN}$ to T_{MAX}		C, E	-2.5	2.5	
COM On-Leakage Current ⁽⁶⁾	$I_{COM(ON)}$	$V_{COM} = \pm 4.5V, V_{NO} = 4.5V$		PS396	$T_A = +25^\circ C$		-0.4	0.09	0.4	
					$T_A = T_{MIN}$ to T_{MAX}		C, E	-5	5	
				PS397	$T_A = +25^\circ C$		-0.2	0.05	0.2	
					$T_A = T_{MIN}$ to T_{MAX}		C, E	-2.5	2.5	
Digital Logic Input										
Logic High Input Voltage	V_{AH}, V_{ENH}				2.4			V		
Logic Low Input Voltage	V_{AL}, V_{ENL}						0.8			
Input Current with Input Voltage High	I_{AH}, I_{ENH}	$V_A = V_{EN} = 2.4V$			-0.1		0.1	μA		
Input Current with Input Voltage Low	I_{AL}, I_{ENL}	$V_A = V_{EN} = 0.8V$			-0.1		0.1			

Electrical Characteristics — Dual Supplies (continued)

(V+ = +5V ± 10%, V- = -5V ± 10%, GND = 0V, V_{AH} = V_{ENH} = 2.4V, V_{AL} = V_{ENL} = 0.8V, T_A = T_{Min} to T_{Max}, unless otherwise noted.)

Parameter	Symbol	Conditions	Temp. Range	Min. ⁽²⁾	Typ. ⁽²⁾	Max. ⁽²⁾	Units		
Dynamic									
Transition Time	t _{TRANS}	Figure 2	T _A = +25°C			95	150		
			T _A = T _{MIN} to T _{MAX}				250		
Break-Before-Make Interval	t _{OPEN}	Figure 4	T _A = +25°C	5	70		ns		
Enable Turn-On Time	t _{ON(EN)}	Figure 3	T _A = +25°C			100		150	
			T _A = T _{MIN} to T _{MAX}					250	
Enable Turn-Off Time	t _{OFF(EN)}	Figure 3	T _A = +25°C			55		150	
			T _A = T _{MIN} to T _{MAX}				200		
Charge Injection ⁽³⁾	V _{CTE}	C _L = Inf V _{NO} = 0V, Figure 5	T _A = +25°C			2	5	pC	
Off Isolation ⁽⁷⁾	V _{ISO}	V _{EN} = 0V, R _L = 1k Ohm, f = 100kHz	T _A = +25°C			-75		dB	
Crosstalk Between Channels	V _{CT}	V _{EN} = 2.4V, f = 100kHz, V _{NO} = 1Vp-p, R _L = 1kOhm, Figure 7	T _A = +25°C			-92			
Logic Input Capacitance	C _{IN}	f = 1MHz	T _A = +25°C			8		pF	
NO Off Capacitance	C _{NO(OFF)}	f = 1 MHz V _{EN} = V _{COM} = 0V	T _A = +25°C			11			
COM Off Capacitance	C _{COM(OFF)}	f = 1 MHz V _{EN} = V _{COM} = 0V	PS396	T _A = +25°C			80		
			PS397	T _A = +25°C			40		
COM On Capacitance	C _{COM(ON)}	f = 1 MHz, Figure 4	PS396	T _A = +25°C			90		
			PS397	T _A = +25°C			68		
Supply									
Power-Supply Range				±3		±8	V		
Positive Supply Current	I ₊	V _{EN} = V _A = 0V/V+, V+ = 5.5V, V- = -5.5V,	T _A = +25°C	-1.0		1.0	μA		
Negative Supply Current	I ₋	V _{EN} = V _A = 0V/V+, V+ = 5.5V, V- = -5.5V		-1.0		1.0			
Ground Current	I _{GND}	V _{EN} = V _A = 0V/V+, V+ = 5.5V, V- = -5.5V	T _A = +25°C	-1.0		1.0			
			T _A = T _{MIN} to T _{MAX}	-1.0		1.0			

Electrical Characteristics — Single +5V Supply

(V+ = +5V ±10%, V- = 0V, GND = 0V, V_{AH} = V_{ENH} = 2.4V, V_{AL} = V_{ENL} = 0.8V, T_A = T_{Min} to T_{Max}, unless otherwise noted.)

Parameter	Symbol	Conditions		Temp. Range	Min. ⁽²⁾	Typ. ⁽²⁾	Max. ⁽²⁾	Units
Switch								
Analog Signal Range	V _{COM} , V _{NO} , V _{NC}	(note 3)			V-		V+	V
On-Resistance	R _{ON}	I _{NO} = 1mA, V _{COM} = 3.5V, V+ = 4.5V	T _A = +25°C			120	225	Ohm
			T _A = T _{MIN} to T _{MAX}				280	
On-Resistance Matching Between Channels ⁽⁴⁾	ΔR _{ON}	I _{NO} = 1mA, V _{COM} = 3.5V, V+ = 4.5V	T _A = +25°C			2	10	
			T _A = T _{MIN} to T _{MAX}				12	
On-Resistance Flatness	R _{FLAT}	I _{NO} = 1mA, V _{COM} = 3V, 2V, 1V; V+ = 5V	T _A = +25°C			5	16	
			T _A = T _{MIN} to T _{MAX}				20	
NO Off Leakage Current ⁽⁸⁾	I _{NO(OFF)}	V _{NO} = 4.5V, V _{COM} = 0V, V+ = 5.5V	T _A = +25°C		-0.1	0.03	0.1	nA
			T _A = T _{MIN} to T _{MAX}	C, E	-1.0		1.0	
COM Off-Leakage Current ⁽⁸⁾	I _{COM(OFF)}	V _{NO} = 0V, V _{COM} = 4.5V, V+ = 5.5V	PS396	T _A = +25°C		-0.2	0.05	nA
				T _A = T _{MIN} to T _{MAX}	C, E	-2.5		
		V _{NO} = 0V, V _{COM} = 4.5V, V+ = 5.5V	PS397	T _A = +25°C		-0.2	0.02	0.2
				T _A = T _{MIN} to T _{MAX}	C, E	-2.5		2.5
COM On-Leakage Current ⁽⁸⁾	I _{COM(ON)}	V _{NO} = 4.5V, V _{COM} = 4.5V, V+ = 5.5V	PS396	T _A = +25°C		-0.4	0.09	nA
				T _A = T _{MIN} to T _{MAX}	C, E	-5.0		
		V _{NO} = 4.5V, V _{COM} = 4.5V, V+ = 5.5V	PS397	T _A = +25°C		-0.2	0.04	0.2
				T _A = T _{MIN} to T _{MAX}	C, E	-2.5		2.5
Digital Logic Input								
Logic High Input Voltage	V _{AH} , V _{ENH}				2.4			V
Logic Low Input Voltage	V _{AL} , V _{ENL}						0.8	
Input Current with Input Voltage High	I _{AH} , I _{ENH}	V _A = V _{EN} = 2.4V			-0.1	0.001	0.1	μA
Input Current with Input Voltage Low	I _{AL} , I _{ENL}	V _A = 0V, V _{EN} = 0.8V			-0.1	0.001	0.1	

Electrical Characteristics—Single +5V Supply (continued)

(V+ = +5V ± 10%, V- = 0V, GND = 0V, V_{AH} = V_{ENH} = 2.4V, V_{AL} = V_{ENL} = 0.8V, T_A = T_{Min} to T_{Max}, unless otherwise noted.)

Parameter	Symbol	Conditions	Temp. Range	Min. ⁽²⁾	Typ. ⁽²⁾	Max. ⁽²⁾	Units
Dynamic							
Transition Time ⁽³⁾	t _{TRANS}	V _{NO} = 3V, Figure 2	T _A = +25°C		105	245	ns
			T _A = T _{MIN} to T _{MAX}			350	
Break-Before-Make Time Delay	t _{OPEN}	(note 3)	T _A = +25°C	10	65		
Enable Turn-On-Time ⁽³⁾	t _{ON(EN)}		T _A = +25°C		125	200	
			T _A = T _{MIN} to T _{MAX}			275	
Enable Turn-Off-Time ⁽³⁾	t _{OFF(EN)}		T _A = +25°C		100	125	
			T _A = T _{MIN} to T _{MAX}			200	
Charge Injection ⁽³⁾	V _{CTE}	C _L = Inf, V _{NO} = 0V, Figure 5	T _A = +25°C		1.5	5	pC
Supply							
Power-Supply Range	V+			2.7		15	V
Positive Supply Current	I+	V _{EN} = V _A = 0V, V+, V+ = 5.5V, V- = 0V		-1.0	0.06	1.0	μA
Negative Supply Current	I-	V _{EN} = V _A = 0V, V+, V+ = 5.5V, V- = 0V		-1.0	0.08	1.0	
Ground Supply Current	I _{GND}	V _{EN} = V+, 0V; V+, V _A = 5.5V, V- = 0V	T _A = +25°C	-1.0	0.08	1.0	
			T _A = T _{MIN} to T _{MAX}	-1.0		1.0	

Electrical Characteristics—Single+3.3V Supply

(V+ = 3.0V to 3.6V, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V, T_A = T_{Min} to T_{Max}, unless otherwise noted.)

Parameter	Symbol	Conditions	Min. ⁽²⁾	Typ. ⁽²⁾	Max. ⁽²⁾	Units	
Switch							
Analog Signal Range	V _{ANALOG}	(note 3)	V-		V+	V	
On-Resistance	R _{ON}	I _{NO} = 1mA, V _{COM} = 1.5V, V+ = 3V	T _A = +25°C		315	550	Ohm
			T _A = T _{MIN} to T _{MAX}			650	
Dynamic							
Transition Time ⁽³⁾	t _{TRANS}	V _{IN} = 2.4V, V _{NO1} = 1.5V, V _{NO8} = 0V, Figure 2	T _A = +25°C		230	575	ns
			T _A = T _{MIN} to T _{MAX}			750	
Enable Turn-On-Time ⁽³⁾	t _{ON(EN)}	V _{INH} = 2.4V, V _{INL} = 0V, V _{NO1} = 1.5V, Figure 3	T _A = +25°C		260	500	
Enable Turn-Off-Time ⁽³⁾	t _{OFF(EN)}	V _{INH} = 2.4V, V _{INL} = 0V, V _{NO1} = 1.5V, Figure 3	T _A = +25°C		135	400	
Charge Injection ⁽³⁾	V _{CTE}	C _L = 1.0nF, V _{GEN} = 0V, R _{GEN} = 0 Ohm Figure 6	T _A = +25°C		1	5	pC

Notes:

2. The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.
3. Guaranteed by design
4. $\Delta R_{ON} = \Delta R_{ON(MAX)} - R_{ON(MIN)}$
5. Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges. 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°C.
6. See Figure 6. Off isolation = 20log₁₀ V_{COM}/V_{NC} or V_{NO}, V_{COM} = output, V_{NC} or V_{NO} = input to off switch
7. Worst-case isolation is on channel 4 because of its proximity to the COM pin. Off-isolation - 20log V_{COM}/V_{NO}, V_{COM} = output, V_{NO} = input to off switch.
8. Leakage testing at single supply is guaranteed by correlation testing with dual supplies.

Test Circuits and Timing Diagrams

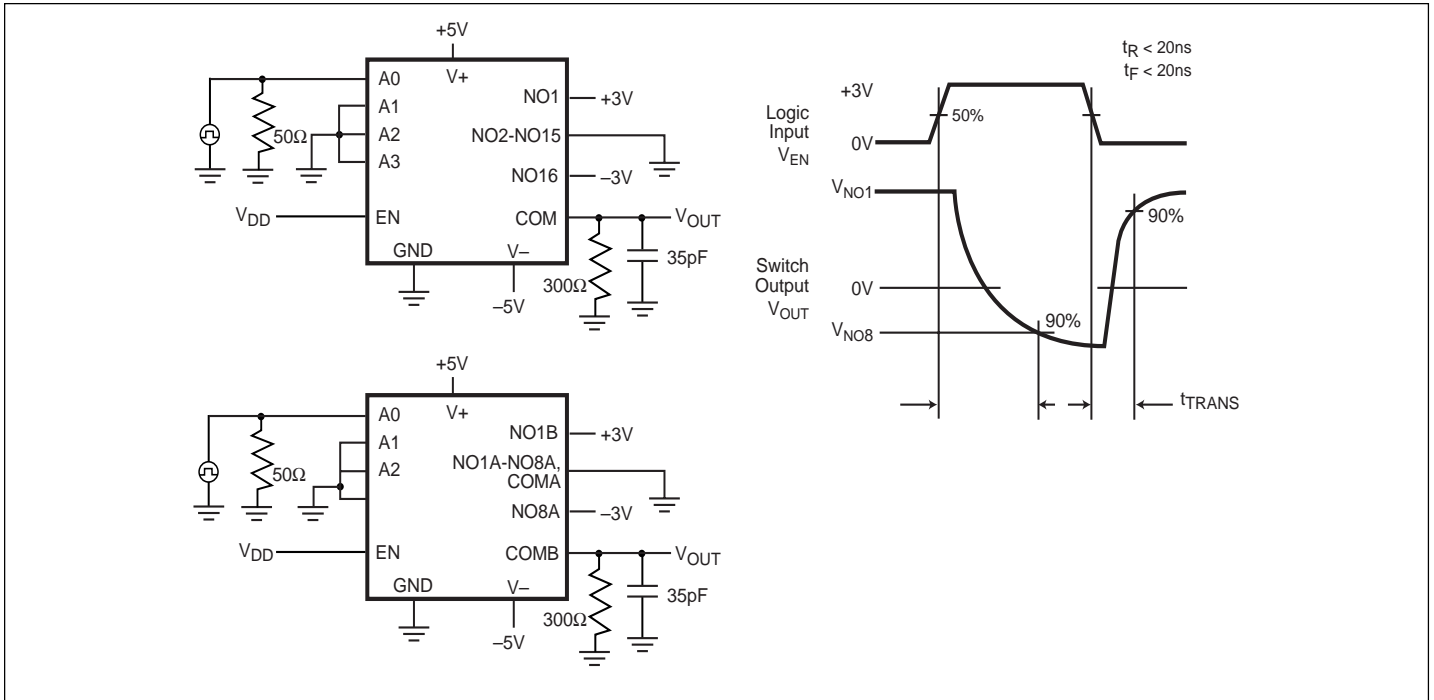


Figure 2. Transition Time

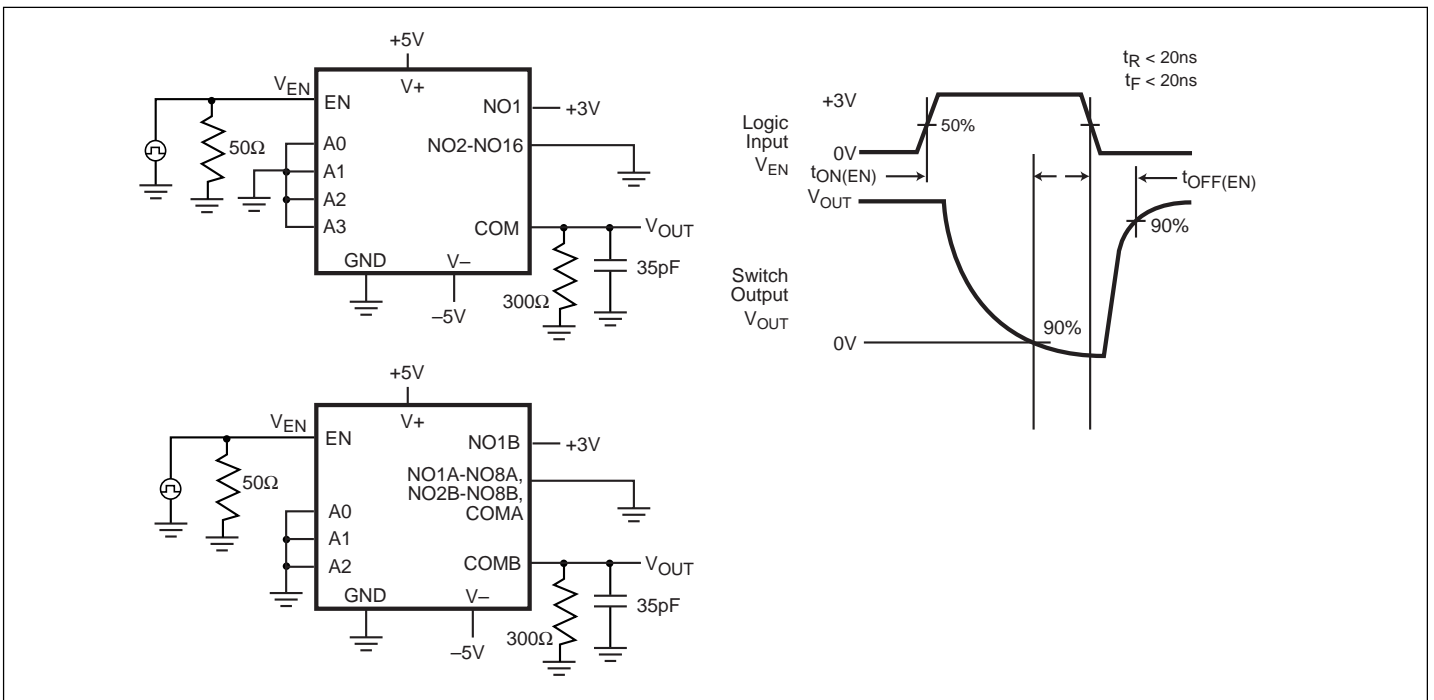


Figure 3. Enable Switching Time

Test Circuits and Timing Diagrams (continued)

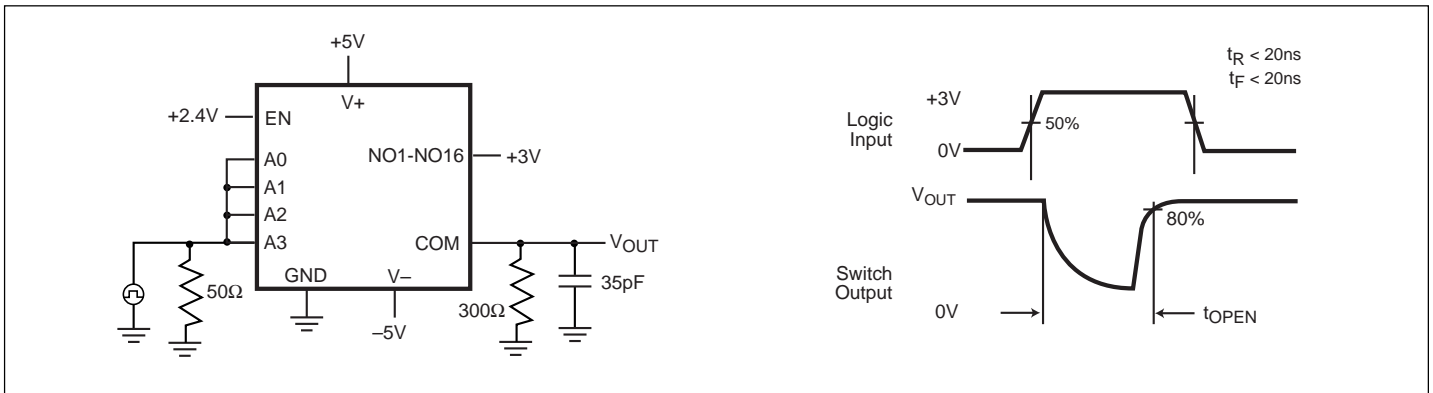


Figure 4. Break-Before-Make Interval

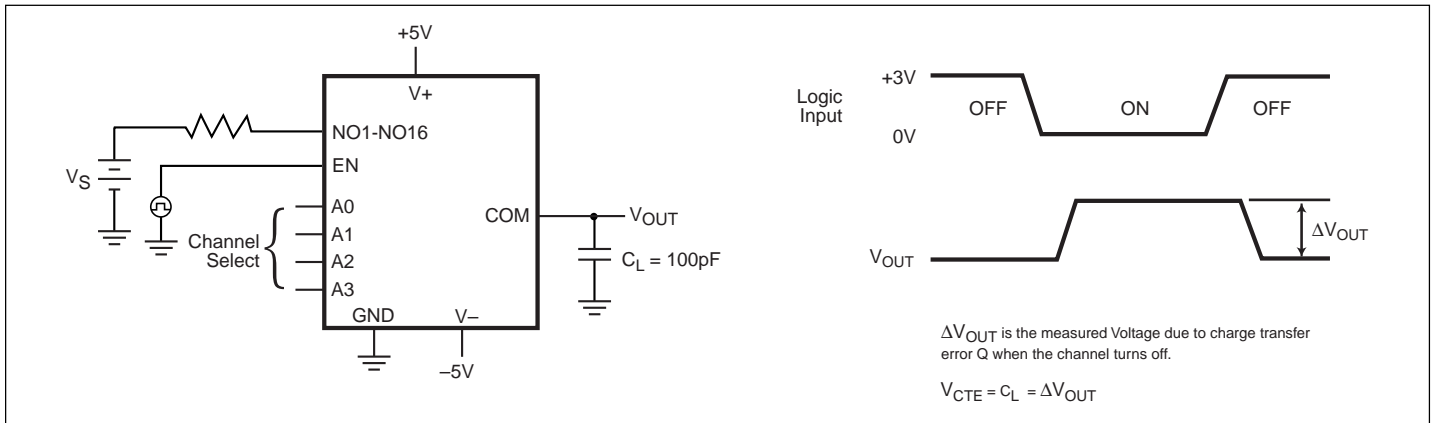


Figure 5. Charge Injection (V_{CTE})

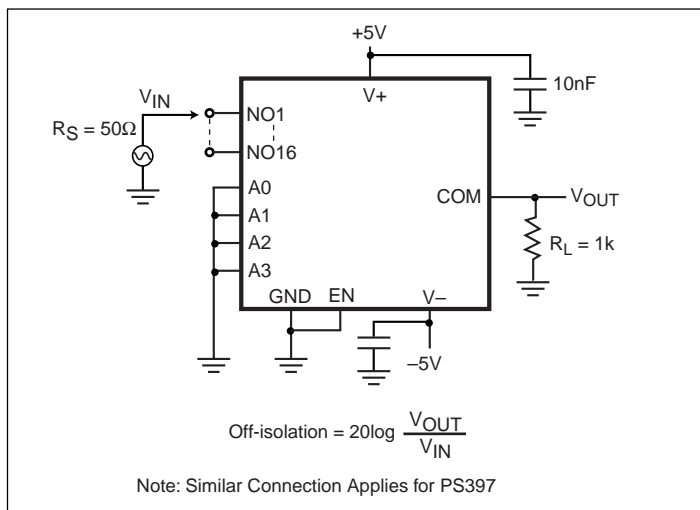


Figure 6. Off-Isolation (V_{ISO})

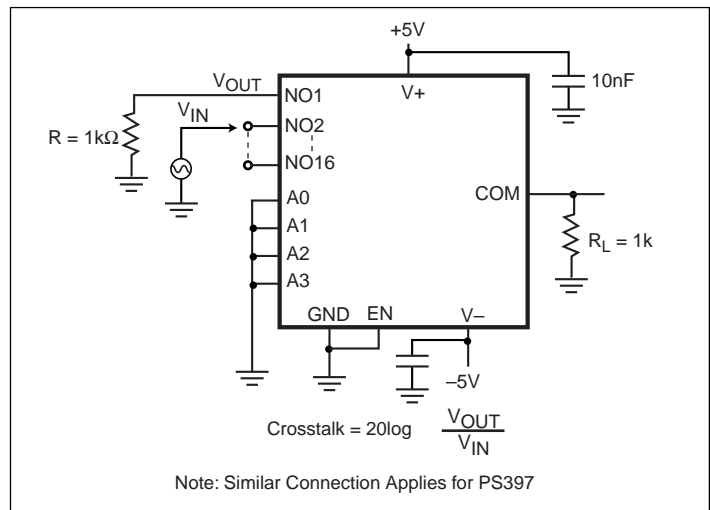


Figure 7. Cross Talk (V_{CT})

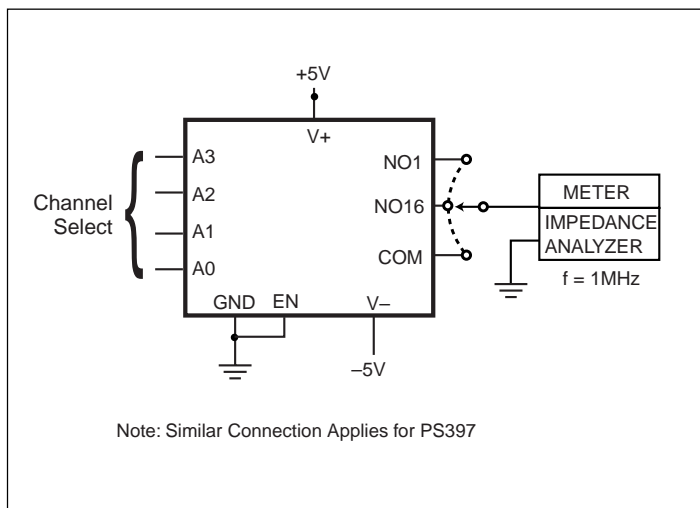


Figure 8. NO/COM Capacitance

Ordering Information

Part Number	Temperature Range	Pin - Package
PS396CPI	0°C to +70°C	28-pin Plastic DIP
PS396CWI	0°C to +70°C	28-pin Wide SO
PS396CAI	0°C to +70°C	28-pin SSOP
PS396EPI	-40°C to +85°C	28-pin Plastic DIP
PS396EWI	-40°C to +85°C	28-pin Wide SO
PS397CPI	0°C to +70°C	28-pin Plastic DIP
PS397CWI	0°C to +70°C	28-pin Wide SO
PS397CAI	0°C to +70°C	28-pin SSOP
PS397EPI	-40°C to +85°C	28-pin Plastic DIP
PS397EWI	-40°C to +85°C	28-pin Wide SO