



# Precision, Quad, SPST Analog Switches

MAX361/MAX362

## General Description

The MAX361/MAX362 are precision, quad, single-pole single-throw (SPST) analog switches. The MAX361 has four normally closed (NC) switches, and the MAX362 has four normally open (NO) switches. Both parts offer low channel on resistance (less than 85Ω), guaranteed to match within 3Ω between channels and to remain flat over the analog signal range (Δ9Ω max). Both parts also offer low leakage (less than 500pA at +25°C and less than 4nA at +85°C) and fast switching (turn-on time less than 250ns and turn-off time less than 170ns).

The MAX361/MAX362 are fabricated with Maxim's new improved 44V silicon-gate process. Design improvements guarantee extremely low charge injection (10pC), low power consumption (35μW), and electrostatic discharge (ESD) greater than 2000V. The 44V maximum breakdown voltage allows rail-to-rail analog signal handling capability.

These monolithic switches operate with a single positive supply (+10V to +30V) or with split supplies (±4.5V to ±20V) while retaining CMOS-logic input compatibility and fast switching. CMOS inputs provide reduced input loading.

## Applications

- Sample-and-Hold Circuits
- Guidance and Control Systems
- Heads-Up Displays
- Test Equipment
- Communications Systems
- Battery-Operated Systems
- PBX, PABX

## Features

- ◆ Low On Resistance: < 45Ω Typical (85Ω Max)
- ◆ Guaranteed Matched On Resistance Between Channels: < 2Ω
- ◆ Guaranteed Flat On Resistance over Analog Signal Range: Δ9Ω Max
- ◆ Guaranteed Charge Injection: < 10pC
- ◆ Guaranteed Off-Channel Leakage: <4nA at +85°C
- ◆ ESD Guaranteed > 2000V per Method 3015.7
- ◆ Single-Supply Operation (+10V to +30V)  
Bipolar-Supply Operation (±4.5V to ±20V)
- ◆ TTL-/CMOS-Logic Compatible
- ◆ Rail-to-Rail Analog Signal Handling Capability

## Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX361CPE	0°C to +70°C	16 Plastic DIP
MAX361CSE	0°C to +70°C	16 Narrow SO
MAX361C/D	0°C to +70°C	Dice*
MAX361EGE	-40°C to +85°C	16 QFN
MAX361EPE	-40°C to +85°C	16 Plastic DIP
MAX361ESE	-40°C to +85°C	16 Narrow SO
MAX361EJE	-40°C to +85°C	16 CERDIP
MAX361MJE	-55°C to +125°C	16 CERDIP
MAX362CPE	0°C to +70°C	16 Plastic DIP
MAX362CSE	0°C to +70°C	16 Narrow SO
MAX362C/D	0°C to +70°C	Dice*
MAX362EGE	-40°C to +85°C	16 QFN
MAX362EPE	-40°C to +85°C	16 Plastic DIP
MAX362ESE	-40°C to +85°C	16 Narrow SO
MAX362EJE	-40°C to +85°C	16 CERDIP
MAX362MJE	-55°C to +125°C	16 CERDIP

\* Contact factory for dice specifications.

## Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW

MAX361	
LOGIC	SWITCH
0	ON
1	OFF

MAX362	
LOGIC	SWITCH
0	OFF
1	ON

SWITCHES SHOWN FOR LOGIC '0' INPUT

N.C. = Not Internally Connected

Pin Configurations continued at end of data sheet.



**For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).**

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## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-

V+ .....	44V
GND .....	25V
IN_, COM_, NO_, NC_ .....	(V- - 2V) to (V+ + 2V) or 30mA (whichever occurs first)
Continuous Current (any terminal) .....	30mA
Peak Current COM, NO, NC (pulsed at 1ms, 10% duty cycle max) .....	100mA
ESD .....	2000V
Continuous Power Dissipation (T <sub>A</sub> = +70°C) (Note 1)	

Plastic DIP (derate 10.53mW/°C above +70°C) .....	842mW
Narrow SO (derate 8.70mW/°C above +70°C) .....	696mW
QFN (derate 19.2mW/°C above +70°C) .....	1538mW
CERDIP (derate 10.00mW/°C above +70°C) .....	800mW
Operating Temperature Ranges:	
MAX36_C_ .....	0°C to +70°C
MAX36_E_ .....	-40°C to +85°C
MAX36_MJE .....	-55°C to +125°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (soldering, 10sec) .....	+300°C

**Note 1:** All leads are soldered or welded to PC board.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS—Dual Supplies

(V<sub>+</sub> = 15V, V<sub>-</sub> = -15V, GND = 0V, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Note 2)	MAX	UNITS		
<b>ANALOG</b>								
Analog-Signal Range	V <sub>COM_</sub> , V <sub>NO_</sub> , V <sub>NC_</sub>	(Note 3)	-15		15	V		
On Resistance (COM_ to NO_ or COM_ to NC_ terminals)	R <sub>ON</sub>	I <sub>(NO or NC)</sub> = -10mA, V <sub>COM_</sub> = 8.5V or -8.5V, V <sub>+</sub> = 13.5V, V <sub>-</sub> = -13.5V	T <sub>A</sub> = +25°C		50	85	Ω	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			100		
On Resistance Match Between Channels (Note 4)	R <sub>ON</sub>	I <sub>(NO or NC)</sub> = -10mA, V <sub>COM_</sub> = 10V or -10V, V <sub>+</sub> = 15V, V <sub>-</sub> = -15V	T <sub>A</sub> = +25°C			2	Ω	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			4		
On Resistance Flatness (Note 4)	R <sub>ON</sub>	I <sub>(NO or NC)</sub> = -10mA, V <sub>COM_</sub> = 5V or -5V, V <sub>+</sub> = 15V, V <sub>-</sub> = -15V	T <sub>A</sub> = +25°C			9	Ω	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			15		
Off Leakage Current (NO_ or NC_ terminal)	I <sub>NO_</sub> , I <sub>NC_</sub>	V <sub>COM_</sub> = ±15.5V, V <sub>NC_</sub> or V <sub>NO_</sub> = ∓15.5V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.01	0.50	nA
		T <sub>A</sub> = T <sub>MAX</sub>		C, E	-4	4		
				M	-20	20		
Off Leakage Current (COM_ terminal)	I <sub>COM</sub>	V <sub>NC_</sub> or V <sub>NO_</sub> = ±15.5V, V <sub>COM_</sub> = ∓15.5V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.01	0.50	nA
		T <sub>A</sub> = T <sub>MAX</sub>		C, E	-4	4		
				M	-20	20		
On Leakage Current (COM_ and NC_ or NO_ terminal)	I <sub>COM</sub> or I <sub>NO</sub> , I <sub>NC</sub>	V <sub>COM_</sub> = ±15.5V, V <sub>NC_</sub> or V <sub>NO_</sub> = ±15.5V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.08	0.50	nA
		T <sub>A</sub> = T <sub>MAX</sub>		C, E	-6	6		
				M	-40	40		
<b>DIGITAL</b>								
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>INH</sub> = 2.4V	-500	0.01	500	nA		
Input Current with Input Voltage Low	I <sub>INH</sub>	V <sub>INH</sub> = 0.8V	-500	0.01	500	nA		

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**MAX361/MAX362**

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = 15V, V- = -15V, GND = 0V, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
<b>SUPPLY</b>							
Power-Supply Range	V+, V-			±4.5		±20.0	V
Positive Supply Current	I+	All channels on or off, V <sub>IN</sub> = 0V or 5V, V+ = 16.5V, V- = -16.5V			15	100	μA
Negative Supply Current	I-	All channels on or off, V <sub>IN</sub> = 0V or 5V, V+ = 16.5V, V- = -16.5V	T <sub>A</sub> = +25°C	-1	-0.0001	1	μA
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-5		5	
Ground Current	I <sub>GND</sub>	All channels on or off, V <sub>IN</sub> = 0V or 5V, V+ = 16.5V, V- = -16.5V		-100	-15		μA
<b>DYNAMIC</b>							
Turn-On Time	t <sub>ON</sub>	Figure 1, V <sub>S</sub> = ±10V, R <sub>L</sub> = 1kΩ	T <sub>A</sub> = +25°C		150	250	ns
Turn-Off Time	t <sub>OFF</sub>	MAX361, Figure 1, V <sub>COM</sub> = ±10V	T <sub>A</sub> = +25°C		90	120	ns
		MAX362, Figure 1, V <sub>COM</sub> = ±10V	T <sub>A</sub> = +25°C		110	170	ns
Charge Injection	Q	C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, Figure 2	T <sub>A</sub> = +25°C		5	10	pC
Off Isolation (Note 5)	OIRR	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, Figure 3	T <sub>A</sub> = +25°C		60		dB
Crosstalk (Note 6)		R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, Figure 4	T <sub>A</sub> = +25°C		-100		dB
Off Capacitance NC or NO	C <sub>(OFF)</sub>	f = 1MHz, Figure 5	T <sub>A</sub> = +25°C		4		pF
Off Capacitance COM <sub>-</sub>	C <sub>COM(OFF)</sub>	f = 1MHz, Figure 5	T <sub>A</sub> = +25°C		4		pF
Channel-On Capacitance	C <sub>COM(ON)</sub>	f = 1MHz, Figure 5	T <sub>A</sub> = +25°C		16		pF

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## ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = 12V, V- = 0V, GND = 0V, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
<b>SWITCH</b>							
Analog-Signal Range	V <sub>COM_</sub> , V <sub>NO_</sub> , V <sub>NC_</sub>	(Note 3)		0		12	V
On Resistance (COM_ to NO_ or COM_ to NC_ terminals)	R <sub>ON</sub>	I <sub>(NC or NO)</sub> = 1.0mA, V <sub>COM_</sub> = 3V, 8V, V+ = 10.8V	T <sub>A</sub> = +25°C	100	160		Ω
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		200		
<b>SUPPLY</b>							
Power-Supply Range	V+			10		30	V
Positive Supply Current	I+	All channels on or off, V <sub>IN</sub> = 0V or 5V			15	100	μA
Negative Supply Current	I-	All channels on or off, V <sub>IN</sub> = 0V or 5V	T <sub>A</sub> = +25°C	-1	-0.0001	1	μA
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-5		+5	
Ground Current	I <sub>GND</sub>	All channels on or off, V <sub>IN</sub> = 0V or 5V		-100	-15		
<b>DYNAMIC</b>							
Turn-On Time	t <sub>ON</sub>	Figure 1, V <sub>S</sub> = 8V	T <sub>A</sub> = +25°C		300	400	ns
Turn-Off Time	t <sub>OFF</sub>	Figure 1, V <sub>S</sub> = 8V	T <sub>A</sub> = +25°C		60	200	ns
Charge Injection	Q	C <sub>L</sub> = 1nF, V <sub>GEN</sub> = 0V,	T <sub>A</sub> = +25°C		5	10	pC

**Note 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.

**Note 3:** Guaranteed by design.

**Note 4:** On resistance match between channels and flatness are guaranteed only with bipolar-supply operation.

**Note 5:** See Figure 3. Off Isolation =  $20 \log_{10} \left( \frac{V_{COM}}{V_{NC\_} \text{ or } V_{NO\_}} \right)$ , V<sub>COM</sub> = output, V<sub>NC</sub> or V<sub>NO</sub> = input to off switch.

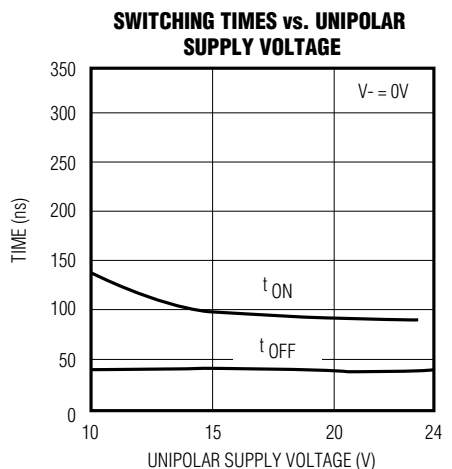
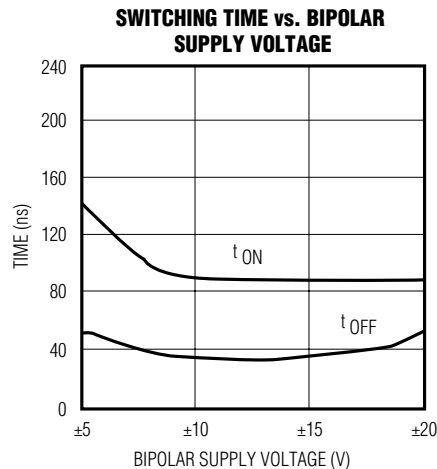
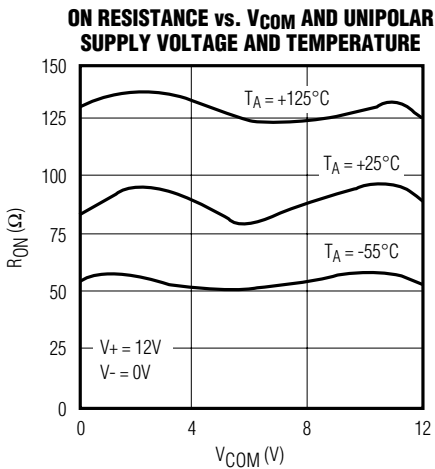
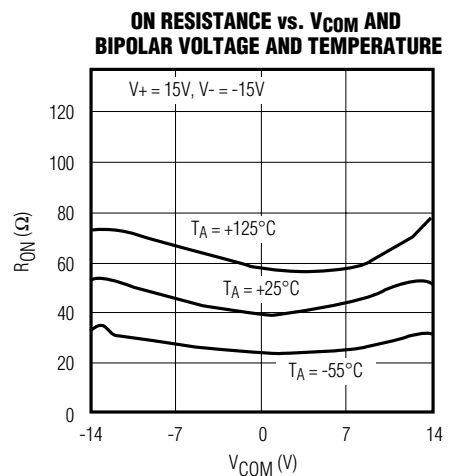
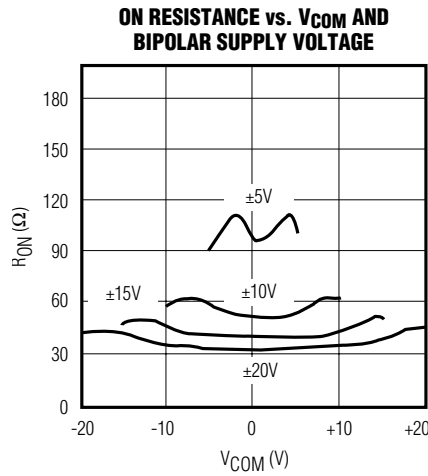
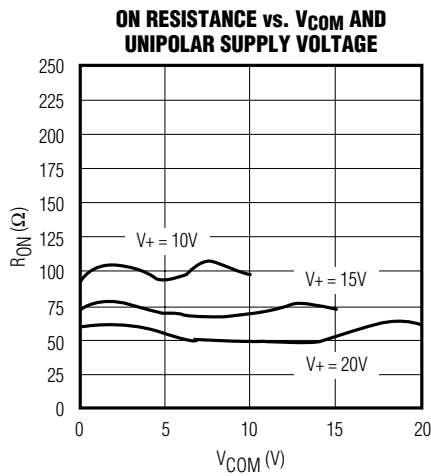
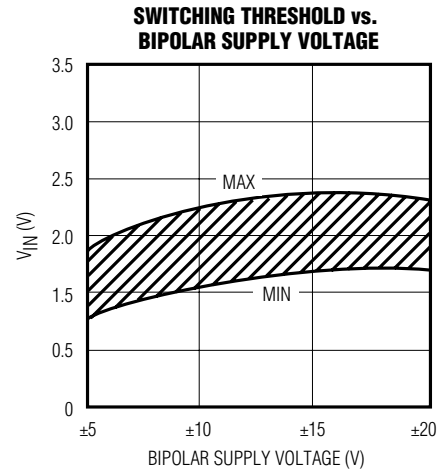
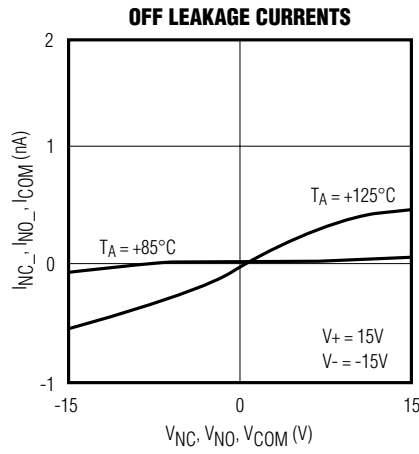
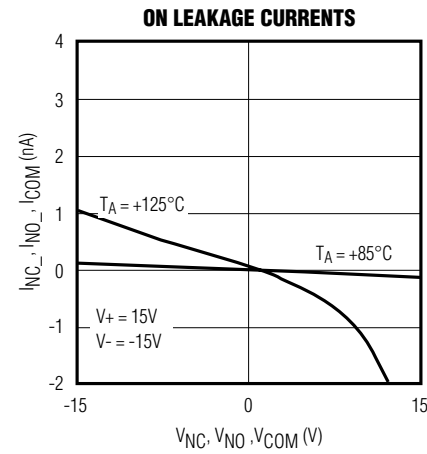
**Note 6:** Between any two switches. See Figure 4.

# Precision, Quad, SPST Analog Switches

## Typical Operating Characteristics

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

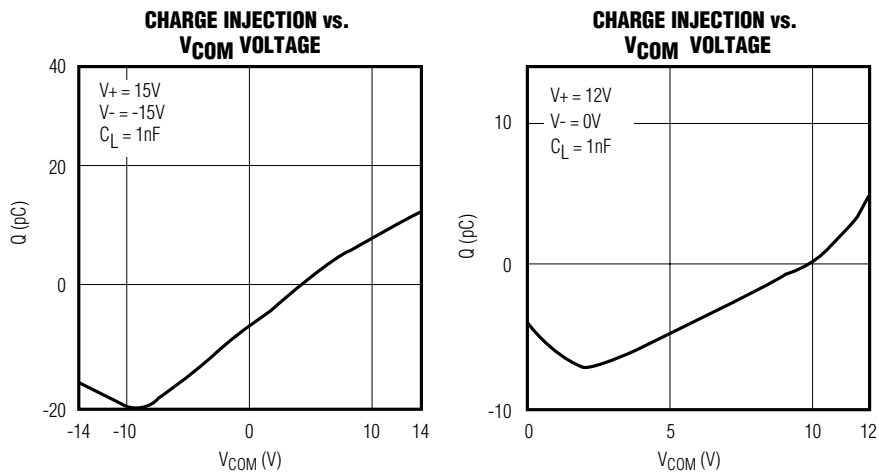
MAX361/MAX362



# Precision, Quad, SPST Analog Switches

## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



## Pin Description

PIN	NAME	NAME	FUNCTION
DIP/SO	QFN		
1, 16, 9, 8	15, 14, 7, 6	IN1–IN4	Logic Control Input
2, 15, 10, 7	16, 13, 8, 5	COM1–COM4	Analog-Switch Drain Terminal
3, 14, 11, 6	1, 12, 9, 4	NO1–NO4 or NC1–NC4	NC (normally closed, MAX361) NO (normally open, MAX362) Analog-Switch Terminal
4	2	V-	Negative-Supply Voltage Input
5	3	GND	Ground
12	10	N.C.	No Connection. Not internally connected
13	11	V+	Positive-Supply Voltage Input—Connected to Substrate

## Applications Information

### Operation with Supply Voltages Other Than $\pm 15\text{V}_0$

Using supply voltages other than  $\pm 15\text{V}$  is reduces the analog signal range. The MAX361/MAX362 switches operate with bipolar supplies of  $\pm 4.5\text{V}$  to  $\pm 20\text{V}$ . Typical operating characteristic graphs show typical on resistance for  $\pm 15\text{V}$ ,  $\pm 10\text{V}$ , and  $\pm 5\text{V}$  supplies. Switching times increase by a factor of two or more for  $\pm 5\text{V}$  operation. The MAX361/MAX362 can also operate from  $+10\text{V}$  to  $+30\text{V}$  unipolar supplies. Both parts can also be powered from unbalanced supplies such as  $+24\text{V}$  and  $-5\text{V}$ . Connect V- to  $0\text{V}$  when operating with a single supply.

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings may cause permanent damage to the devices. Always sequence V+ on first, followed by V-, and logic inputs. If power-supply sequencing is not possible, add two small signal diodes in series with the supply pins for overvoltage protection (Figure 6). Adding the diodes reduces the analog signal range to 1V below V+ and 1V below V-, but low switch resistance and low leakage characteristics are unaffected. Device operation is unchanged, and the difference from V+ to V- should not exceed  $+44\text{V}$ .

# Precision, Quad, SPST Analog Switches

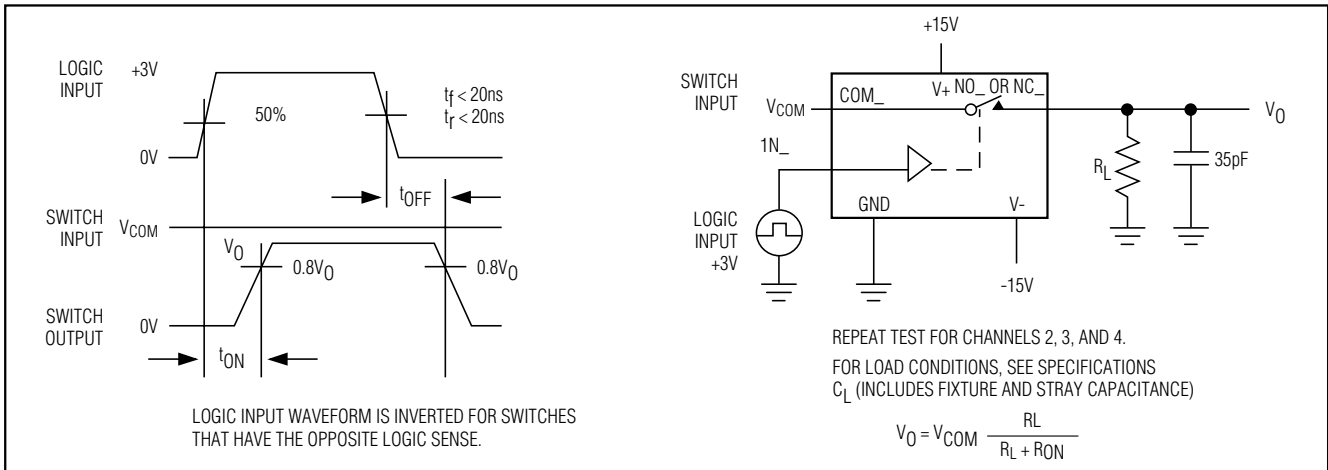


Figure 1. Switching-Time Test Circuit

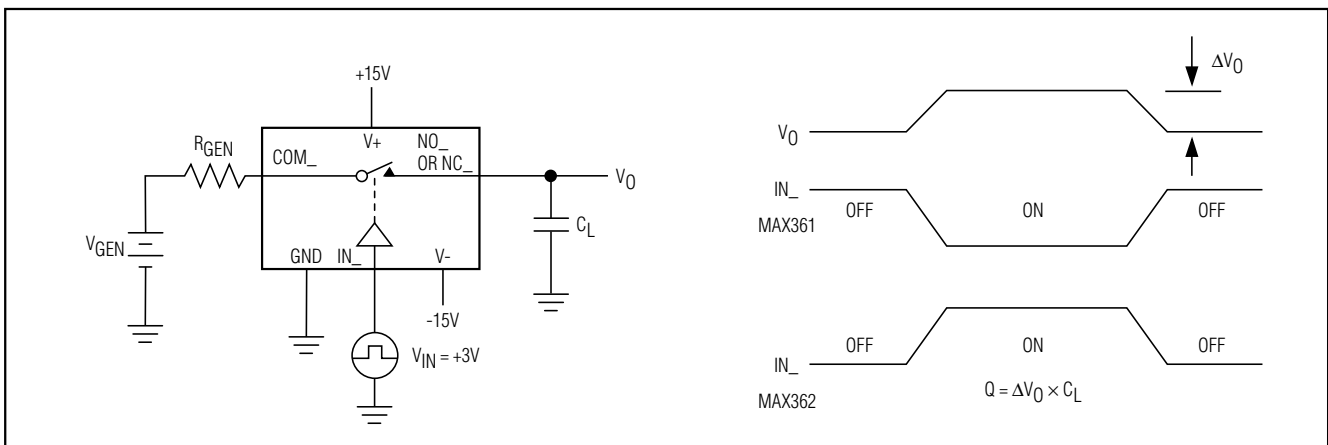


Figure 2. Charge-Injection Test Circuit

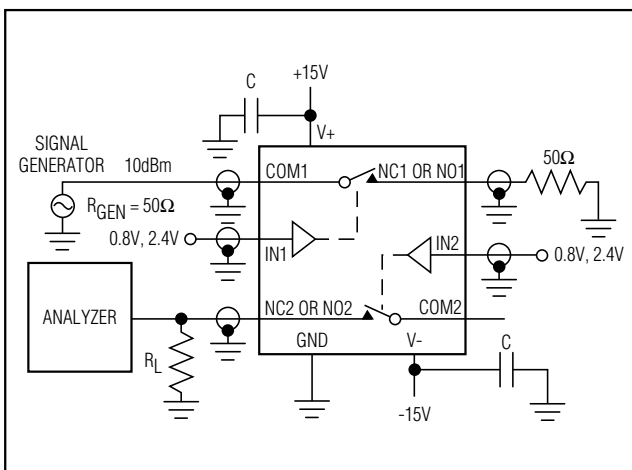


Figure 3. Crosstalk Test Circuit (repeat for channels 3 and 4)

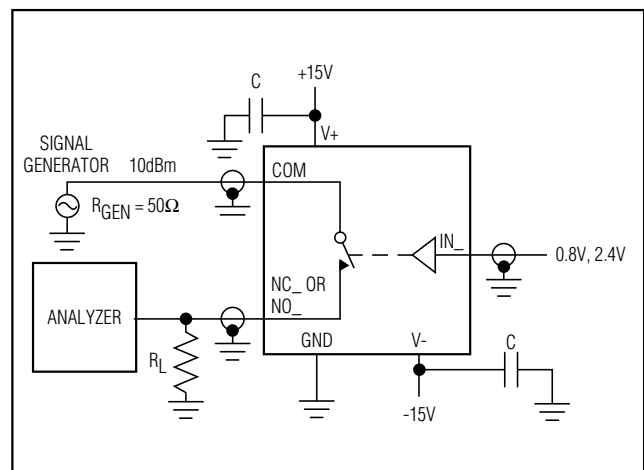


Figure 4. Off-Isolation Test Circuit

# Precision Quad SPST Analog Switches

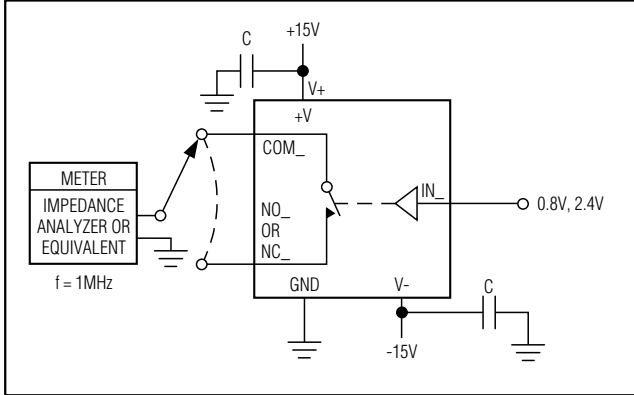


Figure 5. Channel Capacitance Test Circuit

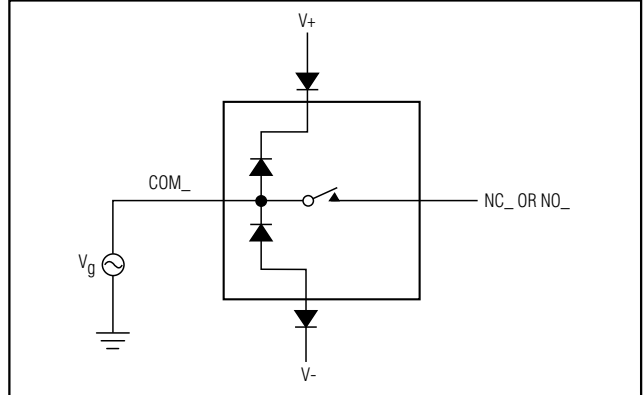
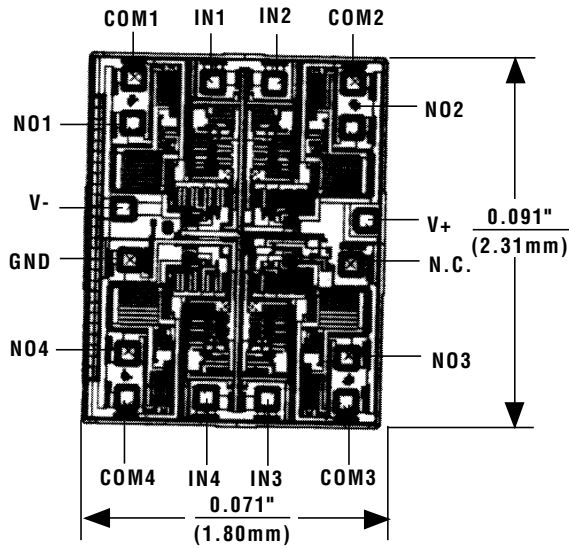


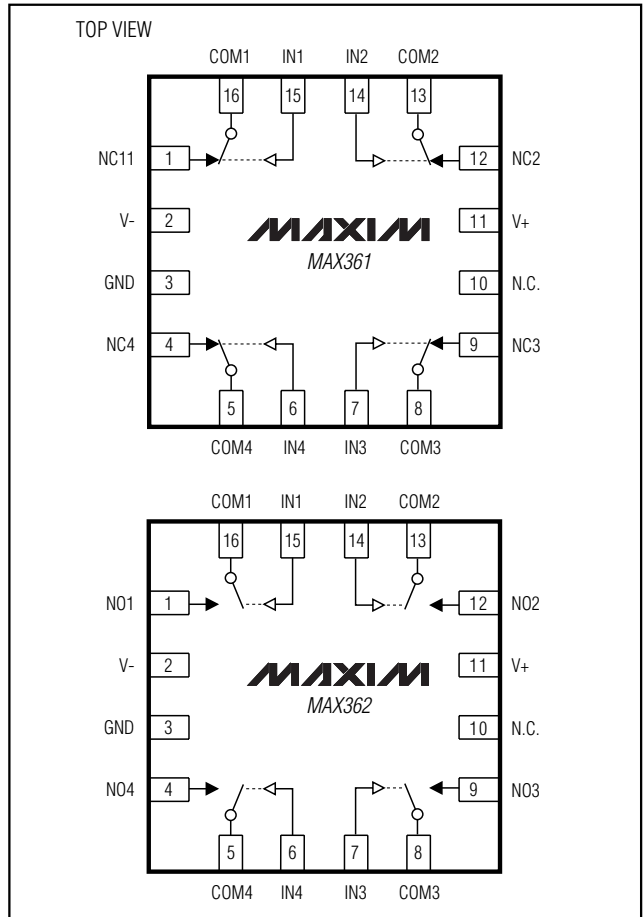
Figure 6. Overtoltage Protection Using Blocking Diodes

## Chip Topography



TRANSISTOR COUNT: 126;  
SUBSTRATE CONNECTED TO V+.

## Pin Configurations (continued)







# Precision Quad SPST Analog Switches

## Package Information (continued)

### NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
3. N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/ LASER MARKED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220.
11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	0.80	0.90	1.00	
A1	0.00	0.01	0.05	
A2	0.00	0.65	1.00	
A3	0.20 REF.			
D	5.00 BSC			
D1	4.75 BSC			
E	5.00 BSC			
E1	4.75 BSC			
θ	0°	-	12°	
P	0	-	0.60	
D2	1.25	-	3.25	
E2	1.25	-	3.25	

SYMBOL	PITCH VARIATION B			NOTE	SYMBOL	PITCH VARIATION B			NOTE	SYMBOL	PITCH VARIATION C			NOTE	SYMBOL	PITCH VARIATION D			NOTE
	MIN.	NOM.	MAX.			MIN.	NOM.	MAX.			MIN.	NOM.	MAX.			MIN.	NOM.	MAX.	
ⓐ	0.80 BSC				ⓐ	0.65 BSC				ⓐ	0.50 BSC				ⓐ	0.50 BSC			
N	16			3 N	N	20			3 N	N	28			3 N	N	32			3
Nd	4			3 Nd	Nd	5			3 Nd	Nd	7			3 Nd	Nd	8			3
Ne	4			3 Ne	Ne	5			3 Ne	Ne	7			3 Ne	Ne	8			3
L	0.35	0.55	0.75		L	0.35	0.55	0.75		L	0.35	0.55	0.75		L	0.30	0.40	0.50	
b	0.28	0.33	0.40	4	b	0.23	0.28	0.35	4	b	0.18	0.23	0.30	4	b	0.18	0.23	0.30	4

PROPRIETARY INFORMATION			
TITLE: PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM			
APPROVAL	DOCUMENT CONTROL NO.	REV	2/2
	21-0091	G	

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