MAXIM

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
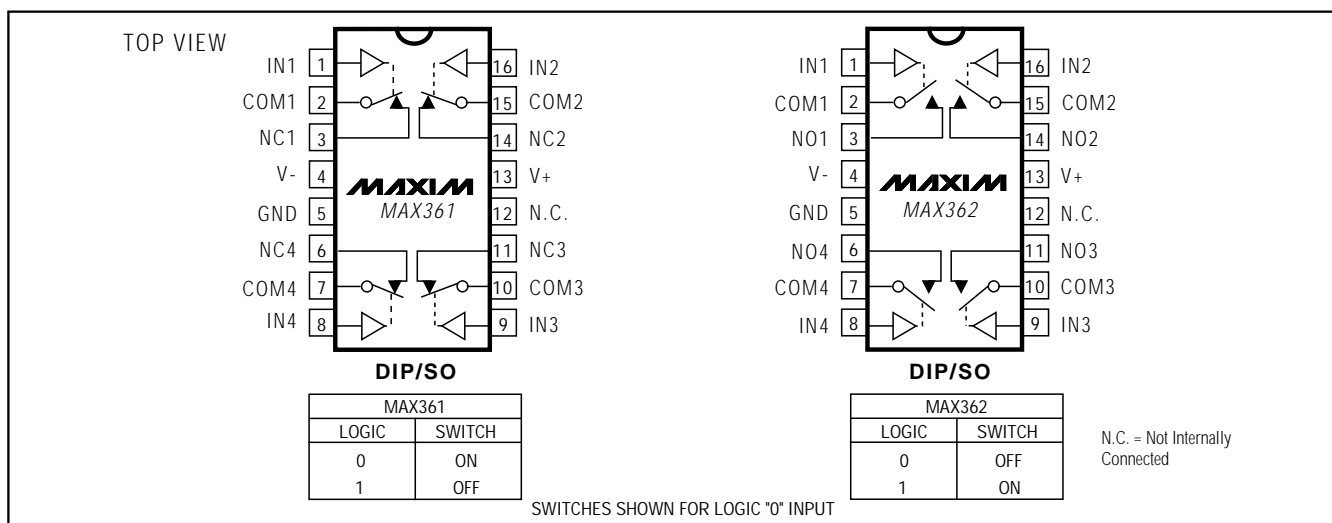
Battery-Operated Systems

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*
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*
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 DIP/SO

IN1	1		16	IN2
COM1	2		15	COM2
NC1	3		14	NC2
V-	4	*MAXIM* MAX361	13	V+
GND	5		12	N.C.
NC4	6		11	NC3
COM4	7		10	COM3
IN4	8		9	IN3

MAX362 DIP/SO

IN1	1		16	IN2
COM1	2		15	COM2
NO1	3		14	NO2
V-	4	*MAXIM* MAX362	13	V+
GND	5		12	N.C.
NO4	6		11	NO3
COM4	7		10	COM3
IN4	8		9	IN3

MAX361	
LOGIC	SWITCH
0	ON
1	OFF

MAX362	
LOGIC	SWITCH
0	OFF
1	ON

N.C. = Not Internally Connected

SWITCHES SHOWN FOR LOGIC "0" INPUT

Call toll free 1-800-998-8800 for free samples or literature.

Precision, Quad, SPST Analog Switches

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$_A$ = +70°C) (Note 1)
 Plastic DIP (derate 10.53mW/°C above +70°C)..........842mW
 Narrow SO (derate 8.70mW/°C above +70°C)............696mW
 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+ = 15V, V- = -15V, GND = 0V, V$_{INH}$ = 2.4V, V$_{INL}$ = 0.8V, T$_A$ = T$_{MIN}$ to T$_{MAX}$, unless otherwise noted.)

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

MAXIM

Precision, Quad, SPST Analog Switches

ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = 15V, V- = -15V, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
SUPPLY							
Power-Supply Range	V+, V-			±4.5		±20.0	V
Positive Supply Current	I+	All channels on or off, V_{IN} = 0V or 5V, V+ = 16.5V, V- = -16.5V			15	100	µA
Negative Supply Current	I-	All channels on or off, V_{IN} = 0V or 5V, V+ = 16.5V, V- = -16.5V	T_A = +25°C	-1	-0.0001	1	µA
			$T_A = T_{MIN}$ to T_{MAX}	-5		5	
Ground Current	I_{GND}	All channels on or off, V_{IN} = 0V or 5V, V+ = 16.5V, V- = -16.5V		-100	-15		µA
DYNAMIC							
Turn-On Time	t_{ON}	Figure 1, V_S = ±10V, R_L = 1kΩ	T_A = +25°C		150	250	ns
Turn-Off Time	t_{OFF}	MAX361, Figure 1, V_{COM} = ±10V	T_A = +25°C		90	120	ns
		MAX362, Figure 1, V_{COM} = ±10V	T_A = +25°C		110	170	ns
Charge Injection	Q	C_L = 1nF, V_{GEN} = 0V, R_{GEN} = 0Ω, Figure 2	T_A = +25°C		5	10	pC
Off Isolation (Note 5)	OIRR	R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 3	T_A = +25°C		60		dB
Crosstalk (Note 6)		R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 4	T_A = +25°C		-100		dB
Off Capacitance NC or NO	$C_{(OFF)}$	f = 1MHz, Figure 5	T_A = +25°C		4		pF
Off Capacitance COM_	$C_{COM(OFF)}$	f = 1MHz, Figure 5	T_A = +25°C		4		pF
Channel-On Capacitance	$C_{COM(ON)}$	f = 1MHz, Figure 5	T_A = +25°C		16		pF

MAX361/MAX362

ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = 12V, V- = 0V, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
SWITCH							
Analog-Signal Range	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$	(Note 3)		0		12	V
On Resistance (COM_ to NO_ or COM_ to NC_ terminals)	R_{ON}	$I_{(NC\ or\ NO)}$ = 1.0mA, $V_{COM\_}$ = 3V, 8V, V+ = 10.8V	T_A = +25°C		100	160	Ω
			$T_A = T_{MIN}$ to T_{MAX}			200	
SUPPLY							
Power-Supply Range	V+			10		30	V
Positive Supply Current	I+	All channels on or off, V_{IN} = 0V or 5V			15	100	µA
Negative Supply Current	I-	All channels on or off, V_{IN} = 0V or 5V	T_A = +25°C	-1	-0.0001	1	µA
			$T_A = T_{MIN}$ to T_{MAX}	-5		+5	µA
Ground Current	I_{GND}	All channels on or off, V_{IN} = 0V or 5V		-100	-15		
DYNAMIC							
Turn-On Time	t_{ON}	Figure 1, V_S = 8V	T_A = +25°C		300	400	ns
Turn-Off Time	t_{OFF}	Figure 1, V_S = 8V	T_A = +25°C		60	200	ns
Charge Injection	Q	C_L = 1nF, V_{GEN} = 0V,	T_A = +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 = $20 \log_{10} \left(\dfrac{V_{COM}}{V_{NC\_\ or\ V_{NO\_}}} \right)$, V_{COM} = output, $V_{NC\ or\ NO}$ = input to off switch.

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

MAXIM

MAX361/MAX362

_____Typical Operating Characteristics

(T$_A$ = +25°C, unless otherwise noted.)
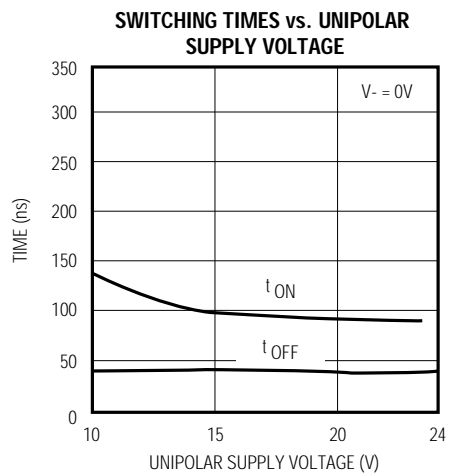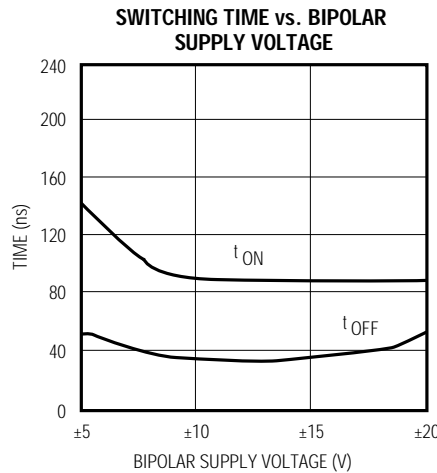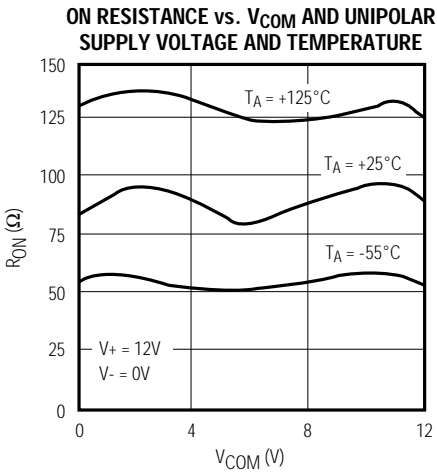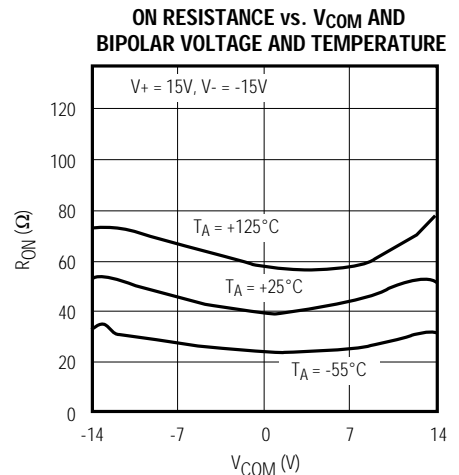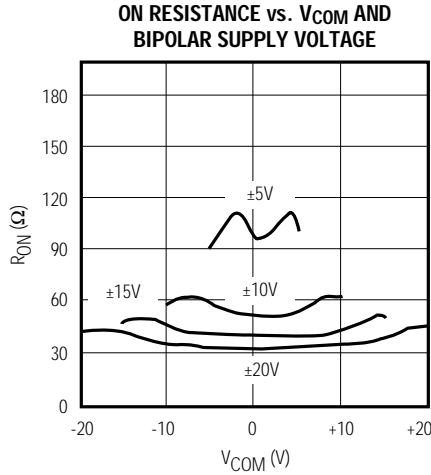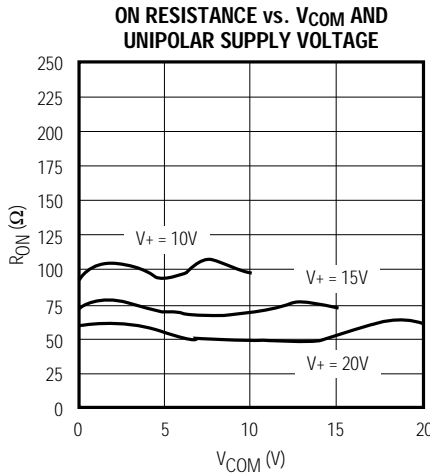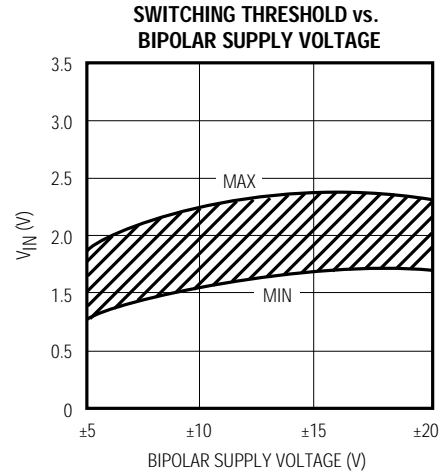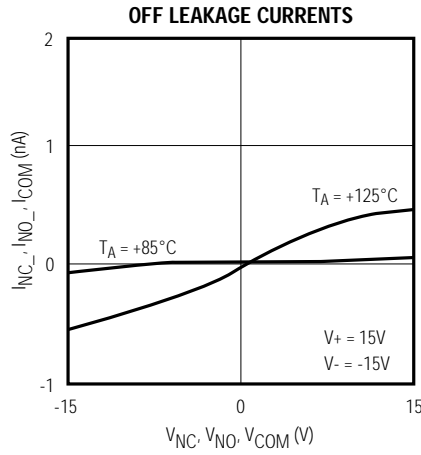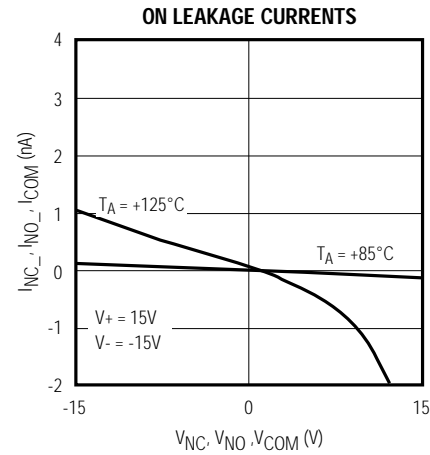
ON LEAKAGE CURRENTS

OFF LEAKAGE CURRENTS

SWITCHING THRESHOLD vs. BIPOLAR SUPPLY VOLTAGE

ON RESISTANCE vs. V$_{COM}$ AND UNIPOLAR SUPPLY VOLTAGE

ON RESISTANCE vs. V$_{COM}$ AND BIPOLAR SUPPLY VOLTAGE

ON RESISTANCE vs. V$_{COM}$ AND BIPOLAR VOLTAGE AND TEMPERATURE

ON RESISTANCE vs. V$_{COM}$ AND UNIPOLAR SUPPLY VOLTAGE AND TEMPERATURE

SWITCHING TIME vs. BIPOLAR SUPPLY VOLTAGE

SWITCHING TIMES vs. UNIPOLAR SUPPLY VOLTAGE

MAXIM

MAX361/MAX362

(T_A = +25°C, unless otherwise noted.)

CHARGE INJECTION vs. V_{COM} VOLTAGE

V+ = 15V
V- = -15V
C_L = 1nF

Q (pC)

V_{COM} (V)

CHARGE INJECTION vs. V_{COM} VOLTAGE

V+ = 12V
V- = 0V
C_L = 1nF

Q (pC)

V_{COM} (V)
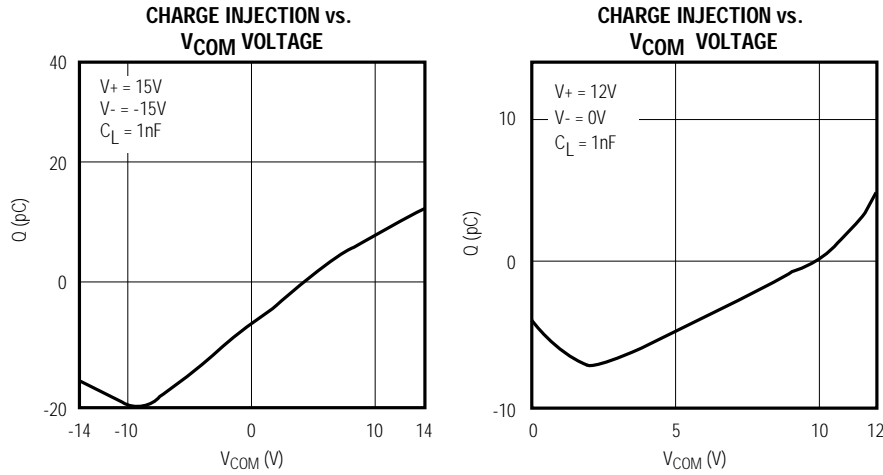
_____Pin Description

PIN	NAME		FUNCTION
	MAX361	MAX362	
1, 16, 9, 8	IN1-IN4	IN1-IN4	Logic-level input
2, 15, 10, 7	COM1-COM4	COM1-COM4	Analog switch common terminal
3, 14, 11, 6	NC1-NC4	NO1-NO4	NC (normally closed, MAX361) NO (normally open, MAX362) Analog switch terminal
4	V-	V-	Negative supply voltage input
5	GND	GND	Ground
12	N.C.	N.C.	Not internally connected
13	V+	V+	Positive supply voltage input—connected to substrate.

_____Applications Information

Operation with Supply Voltages Other Than ±15V$_O$

Using supply voltages other than ±15V is reduces the analog signal range. The MAX361/MAX362 switches operate with bipolar supplies of ±4.5V to ±20V. Typical operating characteristic graphs show typical on resistance for ±15V, ±10V, and ±5V supplies. Switching times increase by a factor of two or more for ±5V operation. The MAX361/MAX362 can also operate from +10V to +30V unipolar supplies. Both parts can also be powered from unbalanced supplies such as +24V and -5V. Connect V- to 0V 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 +44V.

MAXIM
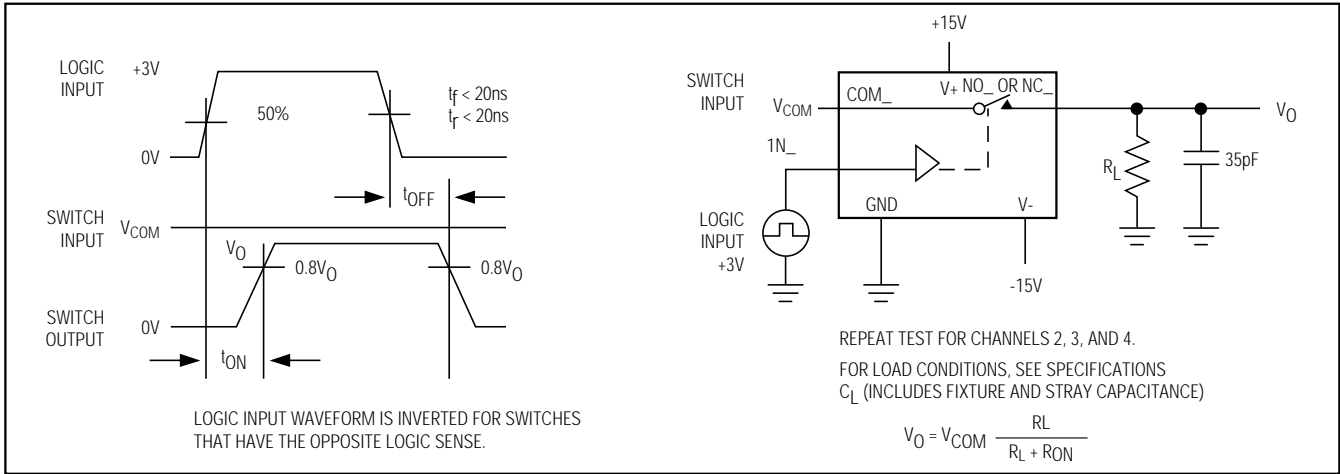
Precision, Quad, SPST Analog Switches
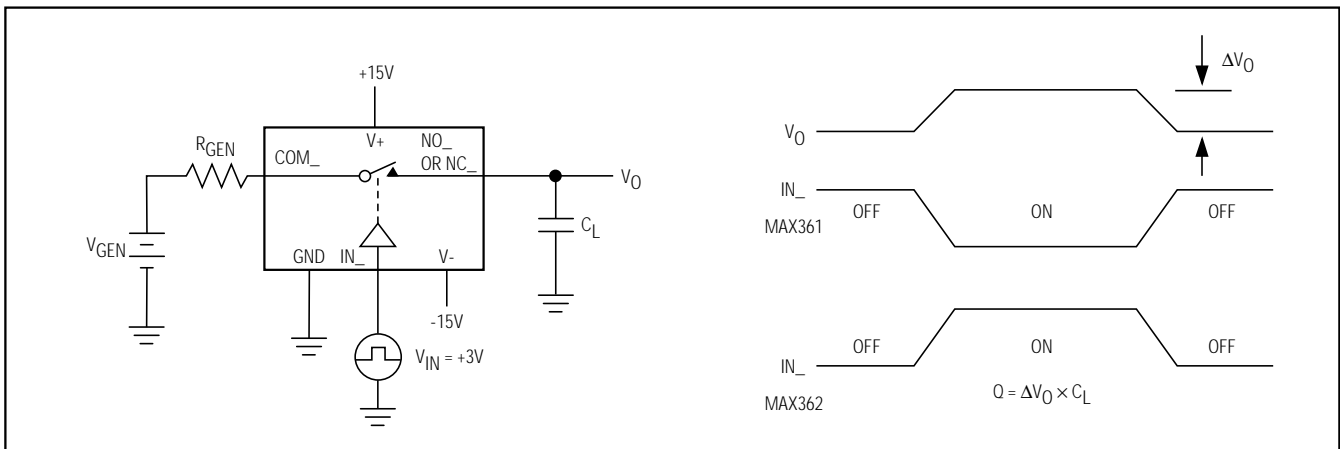
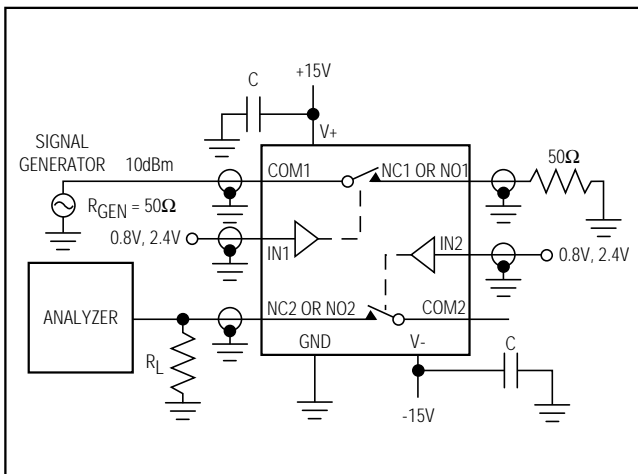Figure 1. Switching-Time Test Circuit

Figure 2. Charge-Injection Test Circuit

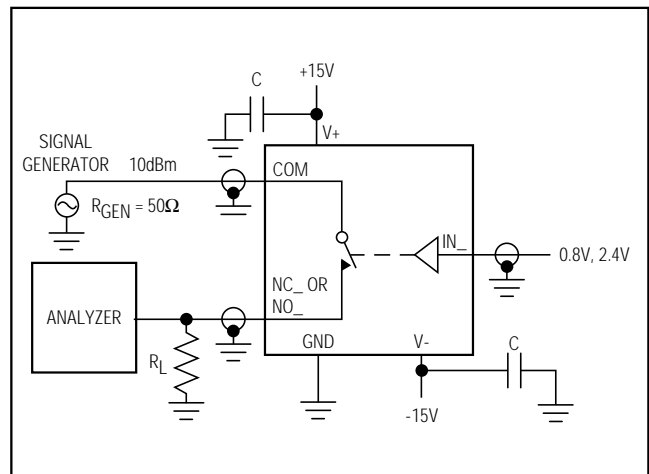Figure 3. Crosstalk Test Circuit (repeat for channels 3 and 4)

Figure 4. Off-Isolation Test Circuit

MAXIM _____ 7
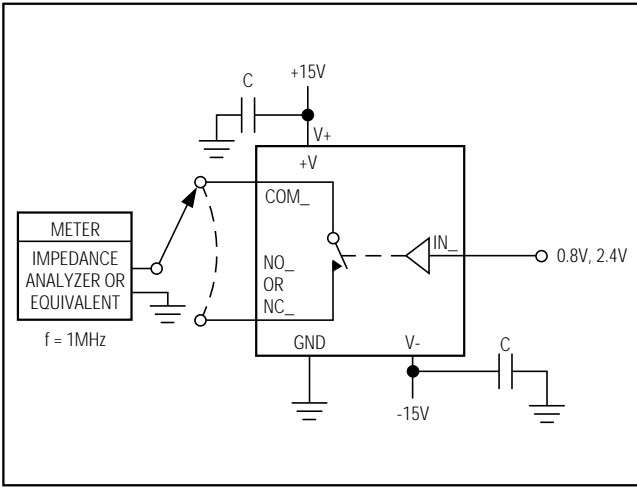
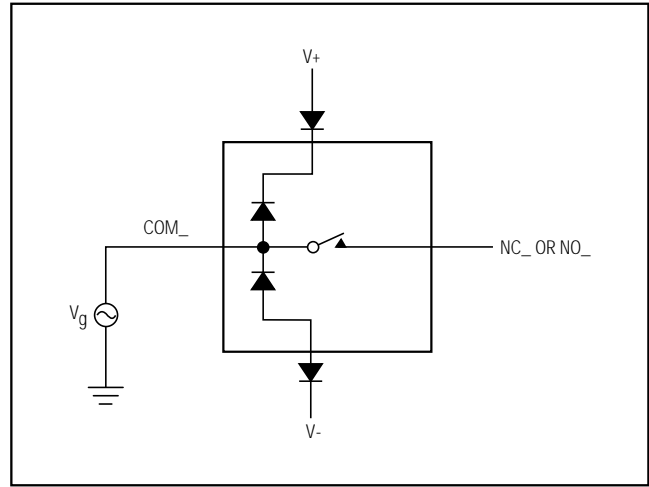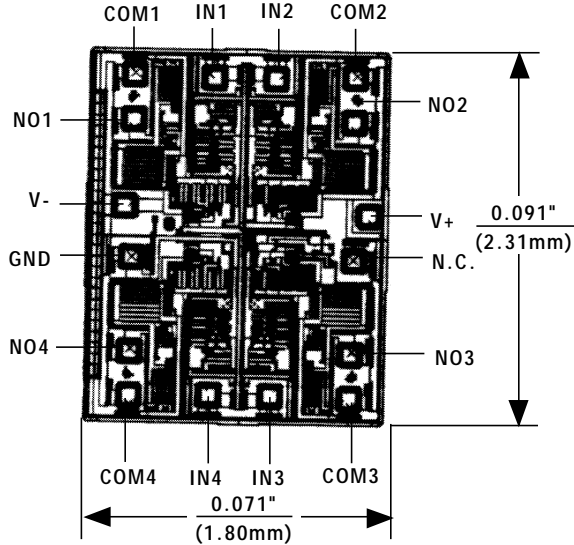# Precision, Quad, SPST Analog Switches

Figure 5. Channel Capacitance Test Circuit

Figure 6. Overvoltage Protection Using Blocking Diodes

_____Chip Topography

TRANSISTOR COUNT: 126;

SUBSTRATE CONNECTED TO V+.