

# Precision, Quad, SPST Analog Switches

## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-		Continuous Power Dissipation (T <sub>A</sub> = +70°C) (Note 1)
V+ .....	44V	Plastic DIP (derate 10.53mW/°C above +70°C).....842mW
GND .....	25V	Thin QFN (derate 33.3mW/°C above +70°C).....2667mW
VL .....	(GND - 0.3V) to (V+ + 0.3V)	Narrow SO (derate 8.70mW/°C above +70°C) .....696mW
IN_, COM_, NO_, or NC_ .....	(V- - 2V) to (V+ + 2V) or 30mA (whichever occurs first)	Operating Temperature Ranges:
Continuous Current (any terminal) .....	30mA	MAX36_C_ .....
Peak Current COM_, NO_, or NC_ .....	100mA (pulsed at 1ms, 10% duty cycle max)	MAX36_E_ .....
ESD .....	2000V	Storage Temperature Range .....
		Lead Temperature (soldering, 10s) .....

**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, VL = 5V, 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	R <sub>ON</sub>	COM_ to NO_ or NC, I <sub>COM</sub> = -10mA, V <sub>COM</sub> = 8.5V or -8.5V, V+ = 13.5V, V- = -13.5V	T <sub>A</sub> = +25°C		50	85	
			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>COM</sub> = -10mA, V <sub>COM</sub> = 10V or -10V, V+ = 15V, V- = -15V	T <sub>A</sub> = +25°C			2	
			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>COM</sub> = -10mA, V <sub>COM</sub> = 5V or -5V, V+ = 15V, V- = -15V	T <sub>A</sub> = +25°C			9	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			15	
NC_ or NO_ Leakage Current	I <sub>NO_</sub> , I <sub>NC</sub>	NO_ or NC_ terminal, V <sub>COM</sub> = ±15.5V, V <sub>NO</sub> or V <sub>NC</sub> = ±15.5V, V+ = 16.5V, V- = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.01	0.50
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		-4		4
COM_ Off Leakage Current	I <sub>NO</sub> , I <sub>NC</sub>	COM_ terminal, V <sub>NO</sub> or V <sub>NC</sub> = ±15.5V, V <sub>COM</sub> = ±15.5V, V+ = 16.5V, V- = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.01	0.50
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		-4		4
COM_, NC_ or NO_ On Leakage Current	I <sub>COM</sub> or I <sub>NO</sub> , I <sub>NC</sub>	COM_ to NC_ or NO_ V <sub>COM</sub> = ±15.5V, V <sub>NO</sub> or V <sub>NC</sub> = ±15.5V, V+ = 16.5V, V- = -16.5V	T <sub>A</sub> = +25°C		-0.50	0.08	0.50
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		-6		6
<b>INPUT</b>							
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN_</sub> = 2.4V, all others = 0.8V	-0.5	-0.00001	0.5	αA	
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN_</sub> = 0.8V, all others = 2.4V	-0.5	-0.00001	0.5	αA	

# Precision, Quad, SPST Analog Switches

MAX364/MAX365

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = 15V, V- = -15V, VL = 5V, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, 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, VIN = 0V or 5V, V+ = 16.5V, V- = -16.5V	TA = +25°C	-1	0.001	1	µA
			TA = TMIN to TMAX	-5		5	
Negative Supply Current	I-	All channels on or off, VIN = 0V or 5V, V+ = 16.5V, V- = -16.5V	TA = +25°C	-1	-0.0001	1	µA
			TA = TMIN to TMAX	-5		5	
Logic Supply Current	IL	All channels on or off, VIN = 0V or 5V, V+ = 16.5V, V- = -16.5V	TA = +25°C	-1	0.001	1	µA
			TA = TMIN to TMAX	-5		5	
Ground Current	IGND	All channels on or off, VIN = 0V or 5V, V+ = 16.5V, V- = -16.5V	TA = +25°C	-1	-0.0001	1	µA
			TA = TMIN to TMAX	-5		5	
<b>DYNAMIC</b>							
Turn-On Time	ton	VNO or VNC = ±10V, Figure 2	TA = +25°C		150	250	ns
Turn-Off Time	toff	MAX364, VNO or VNC = ±10V, Figure 2	TA = +25°C		90	120	ns
		MAX365, VNO or VNC = ±10V, Figure 2	TA = +25°C		110	170	ns
Charge Injection	Q	CL = 1nF, VGEN = 0V, RGEN = 0Ω, Figure 3	TA = +25°C		5	10	pC
Off Isolation (Note 5)	OIRR	RL = 50Ω, CL = 5pF, f = 1MHz, Figure 4	TA = +25°C		60		dB
Crosstalk (Note 6)		RL = 50Ω, CL = 5pF, f = 1MHz, Figure 5	TA = +25°C		100		dB
NC_ or NO_ Off Capacitance	C(OFF)	f = 1MHz, Figure 6	TA = +25°C		4		pF
COM_ Off Capacitance	CCOM(OFF)	f = 1MHz, Figure 6	TA = +25°C		4		pF
Channel-On Capacitance	CCOM(ON)	f = 1MHz, Figure 6	TA = +25°C		16		pF

# Precision, Quad, SPST Analog Switches

MAX364/MAX365

## ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = 12V, V- = 0V, VL = 5V, GND = 0V, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
<b>ANALOG</b>							
Analog Signal Range	VCOM_, VNO_, VNC_	(Note 3)		0		12	V
On Resistance	RON	COM_ to NO_ or NC_, INC or INO = -10mA, VL = 5.25V, VCOM = 3V, 8V, V+ = 10.8V	TA = +25°C		100	160	Ω
			TA = TMIN to TMAX			200	
<b>SUPPLY</b>							
Power-Supply Range	V+, V-			10.8		24.0	V
Power-Supply Current	I+	All channels on or off, VIN = 0V or 5V	TA = +25°C	-1	0.001	1	μA
			TA = TMIN to TMAX	-5		5	
Negative Supply Current	I-	All channels on or off, VIN = 0V or 5V	TA = +25°C	-1	-0.0001	1	μA
			TA = TMIN to TMAX	-5		5	
Logic Supply Current	IL	All channels on or off, VIN = 0V or 5V	TA = +25°C	-1	0.001	1	μA
			TA = TMIN to TMAX	-5		5	
Ground Current	IGND	All channels on or off, VIN = 0V or 5V	TA = +25°C	-1	-0.0001	1	μA
			TA = TMIN to TMAX	-5		5	
<b>DYNAMIC</b>							
Turn-On Time	tON	VNC or VNO = 8V, Figure 2	TA = +25°C		300	400	ns
Turn-Off Time	tOFF	VNC or VNO = 8V, Figure 2	TA = +25°C		60	200	ns
Charge Injection	Q	CL = 1nF, VGEN = 0V, RGEN = 0Ω, Figure 3	TA = +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 2. Off Isolation =  $20 \log_{10} \left( \frac{V_{COM}}{V_{NC} \text{ or } V_{NO}} \right)$ , VCOM = output, VNO or VNC = input to off switch.

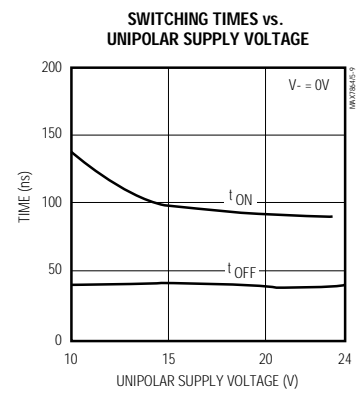
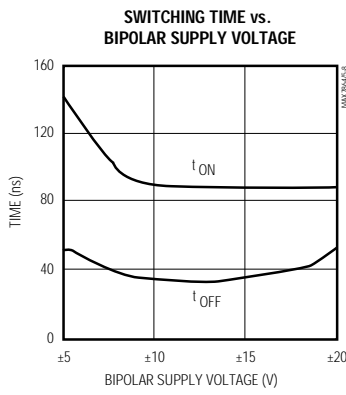
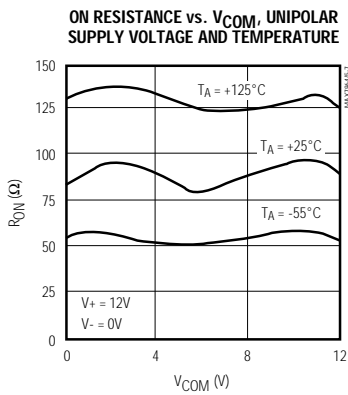
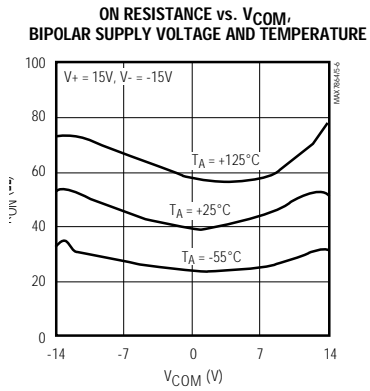
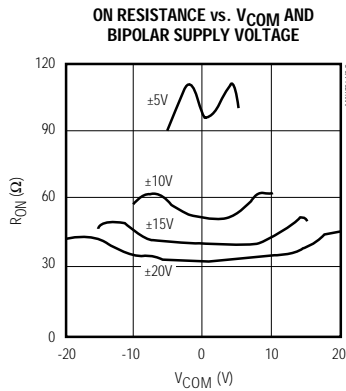
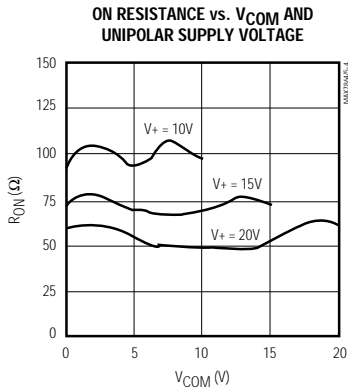
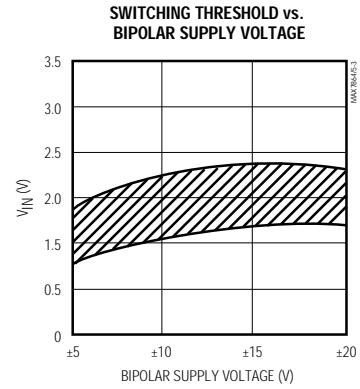
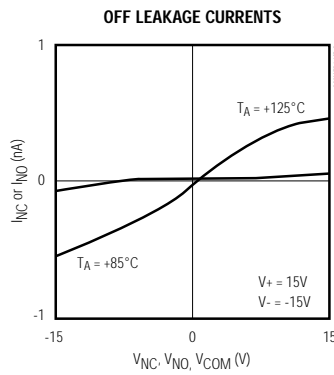
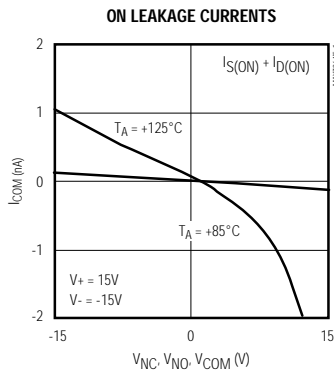
**Note 6:** Between any two switches. See Figure 5.

# Precision, Quad, SPST Analog Switches

## Typical Operating Characteristics

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

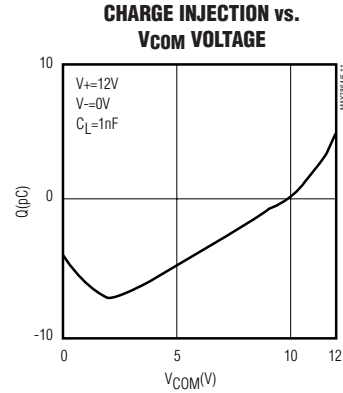
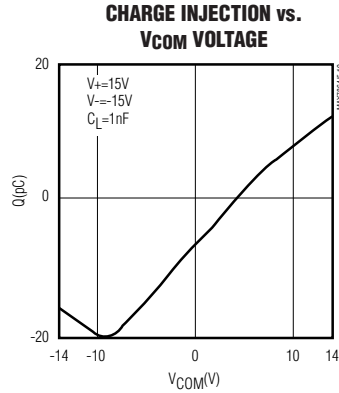
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# Precision, Quad, SPST Analog Switches

## Typical Operating Characteristics

(T<sub>A</sub> = +25°C, unless otherwise noted.)



## Pin Description

PIN		NAME	FUNCTION
DIP/SO	QFN		
1, 16, 9, 8	15, 14, 7, 6	IN1–N4	Logic Control Input
2, 15, 10, 7	16, 13, 8, 5	COM1–COM4	Analog-Switch Common Terminal
3, 14, 11, 6	1, 12, 9, 4	NC1–NC4 or NO1–NO4	NC (normally closed, MAX364) NO (normally closed, MAX365) Analog-Switch Terminal
4	2	V-	Negative-Supply Voltage Input
5	3	GND	Ground
12	10	V <sub>L</sub>	Logic-Supply Voltage Input
13	11	V+	Positive-Supply Voltage Input—Connected to Substrate
—	EP	PAD	Exposed Pad. Connect PAD to V+

# Precision, Quad, SPST Analog Switches

## Applications Information

### Application Hints

1. Switches are open when power is off.
2. IN<sub>-</sub>, COM<sub>-</sub>, NO<sub>-</sub>, and NC<sub>-</sub> should not exceed V<sub>+</sub> or V<sub>-</sub>, even with the power off.
3. Switch leakage is from each analog switch terminal to V<sub>+</sub> or V<sub>-</sub>, not to the other switch terminal.

### Operation with Supply Voltages Other than ±15V

The main limitation of supply voltages other than ±15V is reduction in the analog signal range. The MAX364/MAX365 switches operate with ±5V to ±20V bipolar supplies. The *Typical Operating Characteristics* 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 MAX364/MAX365 operate from unipolar supplies of +10V to +24V. Both parts can be powered from a single +10V to +24V supply, as well as from unbalanced supplies, such as +24V and -5V. Connect V<sub>-</sub> to 0V when operating with a single supply. VL must be connected to +5V to be TTL compatible or to V<sub>+</sub> for CMOS logic input levels.

### Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. It is important not to exceed the absolute maximum ratings, because stresses beyond those listed may cause permanent damage to the devices. Always sequence V<sub>+</sub> on first, followed by VL, V<sub>-</sub>, and logic inputs. If power-supply sequencing is not possible, protect the devices from overvoltage by

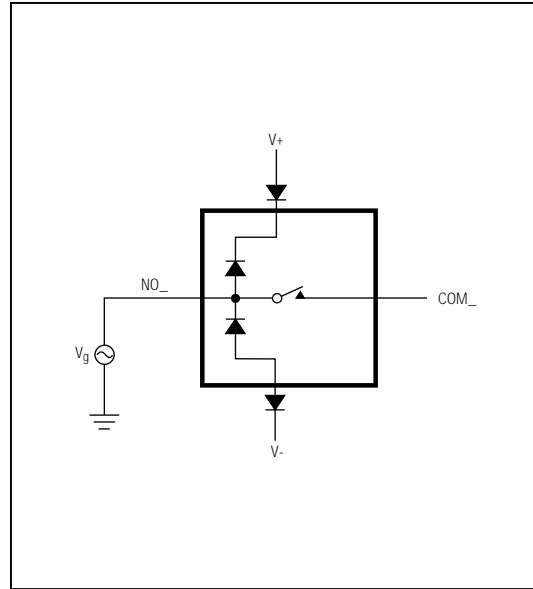


Figure 1. Overvoltage Protection Using Blocking Diodes

adding two small signal diodes in series with the supply pins (Figure 1). Adding the diodes reduces the analog signal range to 1V below V<sub>+</sub> and 1V below V<sub>-</sub>, but low switch resistance and low leakage characteristics are unaffected. Device operation is unchanged, and the difference between V<sub>+</sub> to V<sub>-</sub> should not exceed +44V.

MAX364/MAX365

# Precision, Quad, SPST Analog Switches

## Test Circuits/Timing Diagrams

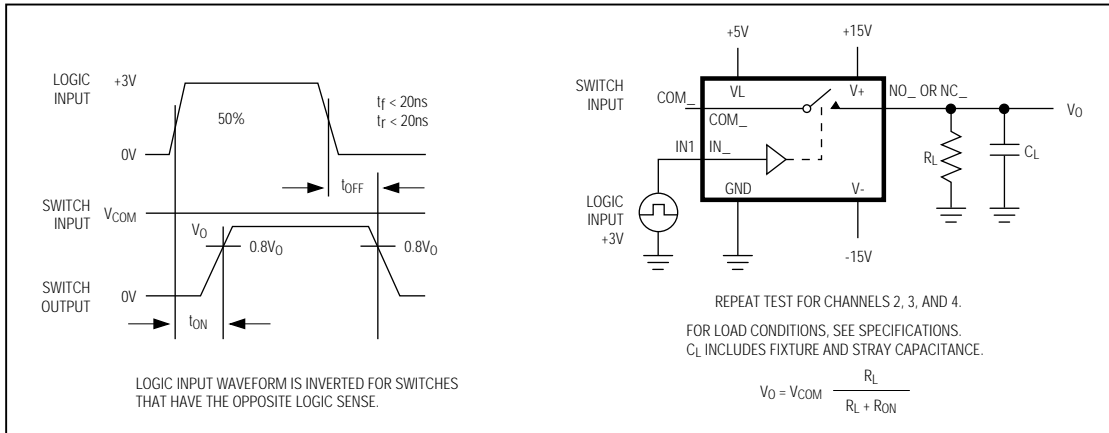


Figure 2. Switching-Time Test Circuit

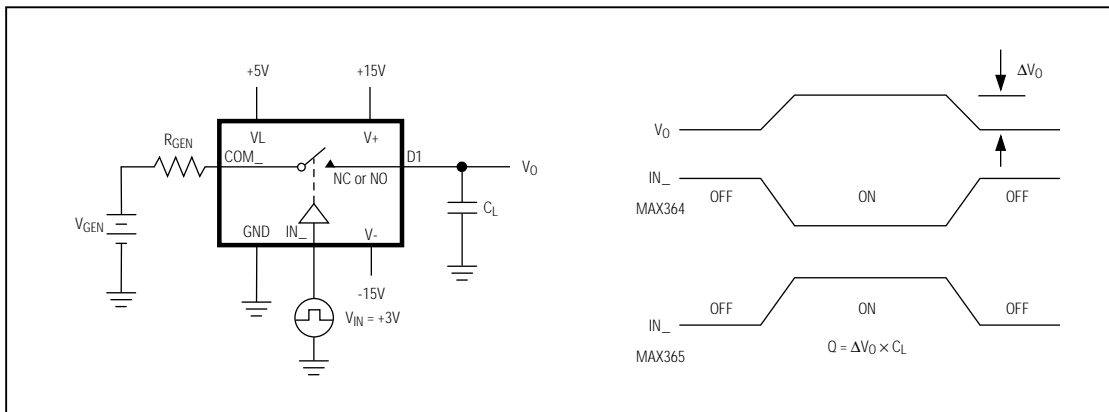


Figure 3. Charge-Injection Test Circuit

# Precision, Quad, SPST Analog Switches

Test Circuits/Timing Diagrams (continued)

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FREQUENCY TESTED	SIGNAL GENERATOR	ANALYZER
100Hz to 13MHz	AUTOMATIC SYNTHESIZER	SPECTRUM ANALYZER

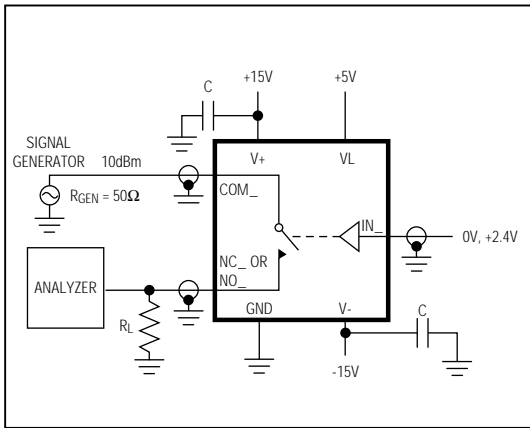


Figure 4. Off Isolation Test Circuit

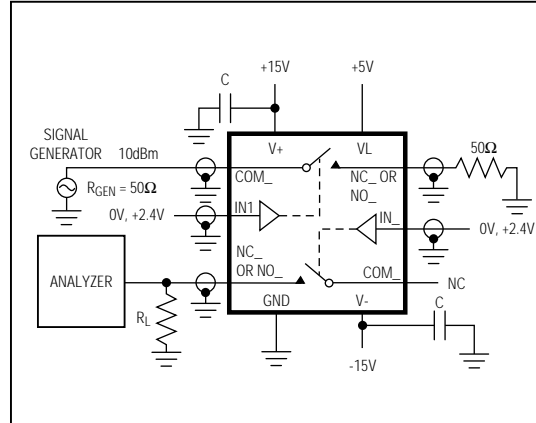


Figure 5. Crosstalk Test Circuit

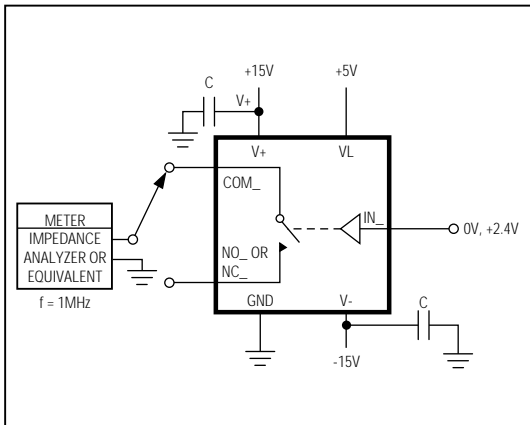


Figure 6. COM\_, NC\_, NO\_ Off Capacitance

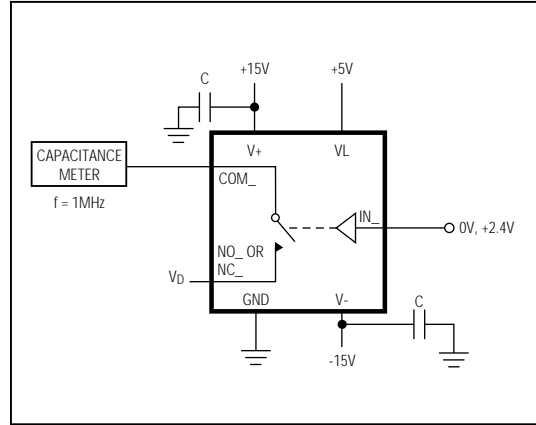


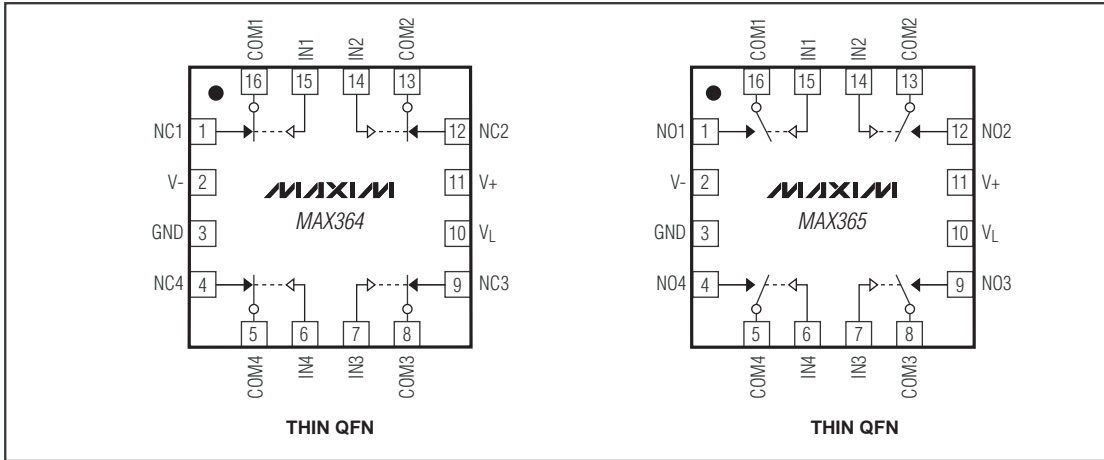
Figure 7. COM\_, NC\_, NO\_ On Capacitance



# Precision, Quad, SPST Analog Switches

**MAX364/MAX365**

## Pin Configurations/Functional Diagrams (continued)

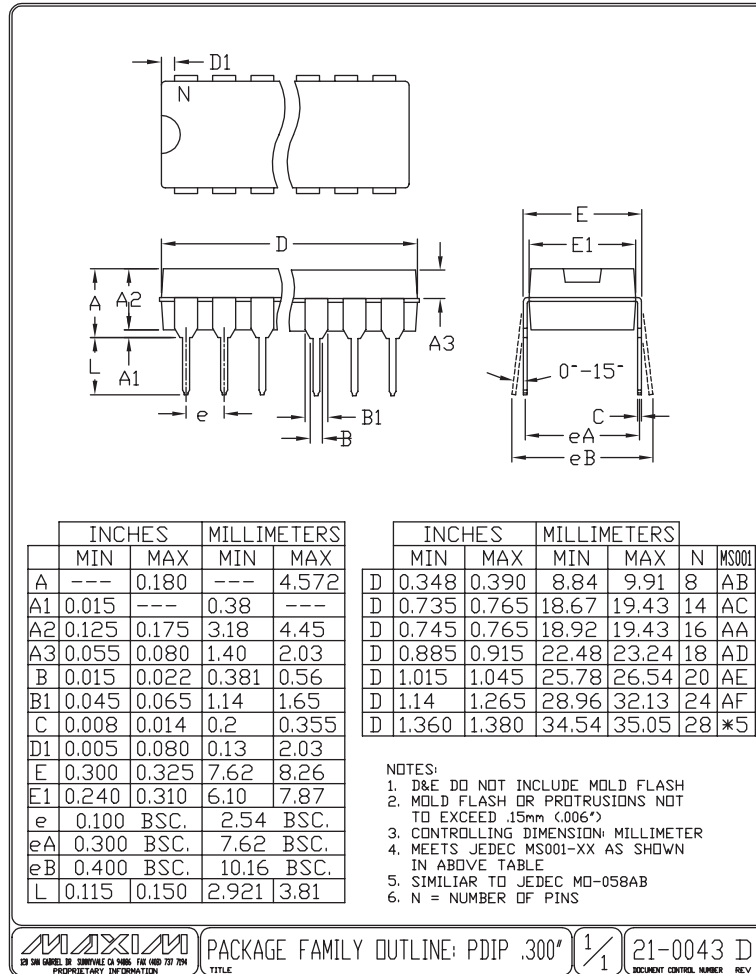


# Precision, Quad, SPST Analog Switches

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

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# Precision, Quad, SPST Analog Switches

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

**TOP VIEW**

**FRONT VIEW**

**SIDE VIEW**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27

VARIATIONS:

DIM	INCHES		MILLIMETERS		N	MS012
	MIN	MAX	MIN	MAX		
D	0.189	0.197	4.80	5.00	8	AA
D	0.337	0.344	8.55	8.75	14	AB
D	0.386	0.394	9.80	10.00	16	AC

**NOTES:**

- D&E DO NOT INCLUDE MOLD FLASH.
- MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
- LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
- CONTROLLING DIMENSION: MILLIMETERS.
- MEETS JEDEC MS012.
- N = NUMBER OF PINS.

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, .150" SOIC

APPROVAL:	DOCUMENT CONTROL NO: 21-0041	REV: B	1/1
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