Low-Voltage, Single-Supply, 10Ω SPST CMOS Analog Switches

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
V+ .....-0.3V to +6V
Voltage into Any Terminal (Note 1).....-0.3V to (V+ + 0.3V)
Continuous Current into Any Terminal.....±20mA
Peak Current, NO, NC, or COM
(pulsed at 1ms, 10% duty cycle).....±40mA

Continuous Power Dissipation (T_A = +70°C)
5-Pin SC70 (derate 3.1mW/°C above +70°C).....247mW
6-Pin µDFN (derate 2.1mW/°C above +70°C) 168mW
Operating Temperature Range
MAX459_EXK .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Voltages exceeding V+ or GND on any signal terminal are clamped by internal diodes. Limit forward-diode current to maximum current rating.

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—+5V Supply

(V+ = +4.5V to +5.5V, V_{IH} = +2.4V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +5V, T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{COM}, V_{NO}, V_{NC}			0		V+	V
On-Resistance	R_{ON}	V+ = 4.5V, V_{NO}, or V_{NC} = 3.5V; I_{COM} = 10mA	T_A = +25°C		6.5	10	Ω
			T_A = T_{MIN} to T_{MAX}			12	
On-Resistance Flatness (Note 4)	$R_{FLAT(ON)}$	V_{NO} or V_{NC} = 1.5V, 2.5V, 3.5V; V+ = 4.5V; I_{COM} = 10mA	T_A = +25°C		0.5	1.5	Ω
			T_A = T_{MIN} to T_{MAX}			2	
NO or NC Off-Leakage Current	$I_{NO(OFF)}$ $I_{NC(OFF)}$	V+ = 5.5V; V_{COM} = 1V, 4.5V; V_{NO} or V_{NC} = 4.5V, 1V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM Off-Leakage Current	$I_{COM(OFF)}$	V+ = 5.5V; V_{COM} = 1V, 4.5V; V_{NO} or V_{NC} = 4.5V, 1V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM On-Leakage Current	$I_{COM(ON)}$	V+ = 5.5V; V_{COM} = 1V; 4.5V; V_{NO} or V_{NC} = 1V, 4.5V, or floating	T_A = +25°C	-1	0.01	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
DIGITAL I/O							
Input Logic High	V_{IH}			2.4			V
Input Logic Low	V_{IL}					0.8	V
Input Logic Current	I_{IH}, I_{IL}	V_{IN} = V+, 0		-1	0.03	1	µA
DYNAMIC							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Figure 3	T_A = +25°C		20	35	ns
			T_A = T_{MIN} to T_{MAX}			45	
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Figure 3	T_A = +25°C		25	40	ns
			T_A = T_{MIN} to T_{MAX}			50	
On-Channel -3dB Bandwidth	BW	Signal = 0dBm, 50Ω in and out, Figure 4	T_A = +25°C		300		MHz

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ELECTRICAL CHARACTERISTICS—+5V Supply (continued)

(V+ = +4.5V to +5.5V, V_{IH} = +2.4V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +5V, T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX	UNITS
Charge Injection (Note 5)	Q	V_{NO} or V_{NC} = 0, C_L = 1nF, Figure 2	T_A = +25°C			2	5	pC
Off-Isolation (Note 6)	V_{ISO}	V_{NO} or V_{NC} = $1V_{RMS}$, R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 4	T_A = +25°C	MAX4594/ MAX4595		80		dB
				MAX4596/ MAX4597		83		
NO or NC Off-Capacitance	$C_{NO(OFF)}$, $C_{NC(OFF)}$	V_{NO} or V_{NC} = 0, f = 1MHz, Figure 5	T_A = +25°C			8		pF
COM Off-Capacitance	$C_{COM(OFF)}$	V_{COM} = 0, f = 1MHz, Figure 5	T_A = +25°C			8		pF
COM On-Capacitance	$C_{COM(ON)}$	V_{COM} = 0, f = 1MHz, Figure 5	T_A = +25°C			20		pF
Total Harmonic Distortion Plus Noise	THD	V = 5Vp-p, R_L = 600Ω, f = 20Hz to 20kHz	T_A = +25°C			0.05		%
POWER SUPPLY								
Power-Supply Range	V+				2.0		5.5	V
V+ Supply Current	I+	V+ = 5.5V, V_{IN} = 0 or V+	T_A = T_{MIN} to T_{MAX}		-1		1	µA

ELECTRICAL CHARACTERISTICS—+3V Supply

(V+ = +2.7V to +3.6V, V_{IH} = +2.0V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +3.0V, T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{COM}, V_{NO}, V_{NC}			0		V+	V
On-Resistance	R_{ON}	V_{NO} or V_{NC} = 1.5V, I_{COM} = 10mA, V+ = 2.7V	T_A = +25°C		10	20	Ω
			T_A = T_{MIN} to T_{MAX}			25	
DIGITAL I/O							
Input Logic High	V_{IH}			2.0			V
Input Logic Low	V_{IL}					0.8	V
Input Logic Current	I_{IH}, I_{IL}	V_{IN} = V+, 0		-1	0.03	1	µA
DYNAMIC							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Figure 3	T_A = +25°C		25	45	ns
			T_A = T_{MIN} to T_{MAX}			55	
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Figure 3	T_A = +25°C		30	50	ns
			T_A = T_{MIN} to T_{MAX}			60	
Charge Injection (Note 5)	Q	V_{NO} or V_{NC} = 0, C_L = 1nF, Figure 2	T_A = +25°C		2	4	pC

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ELECTRICAL CHARACTERISTICS—+3V Supply (continued)

(V+ = +2.7V to +3.6V, V_{IH} = +2.0V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +3.0V, T_A = +25°C.) (Notes 2, 3)

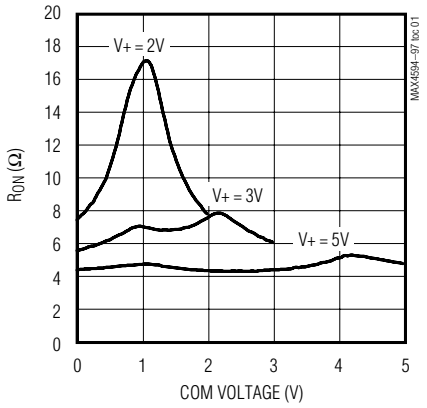
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
POWER SUPPLY							
V+ Supply Current	I+	V+ = 3.6V, V_{IN} = 0 or V+	T_A = T_{MIN} to T_{MAX}	-1		1	µA

Note 2: Parameters are 100% tested at +25°C only, and guaranteed by correlation at the full-rated temperature.
Note 3: Algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.
Note 4: Flatness is defined as the difference between the maximum and minimum values of on-resistance as measured over the specified analog signal ranges.
Note 5: Guaranteed by design.
Note 6: Off-Isolation = $20\log_{10}$ (V_{COM} / V_{NO}), V_{COM} = output, V_{NO} = input to off switch.

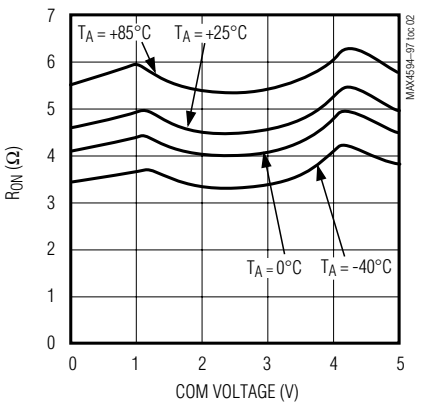
Typical Operating Characteristics

(V+ = +5V, T_A = +25°C, unless otherwise noted.)

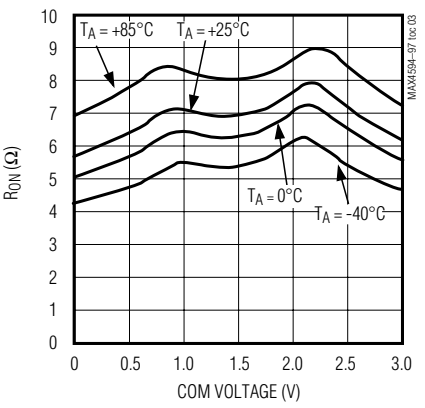
ON-RESISTANCE vs. COM VOLTAGE



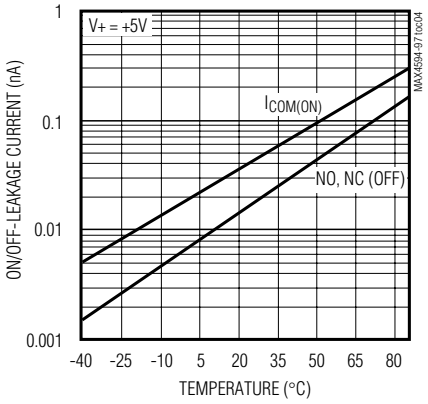
ON-RESISTANCE vs. COM VOLTAGE (V+ = 5V)



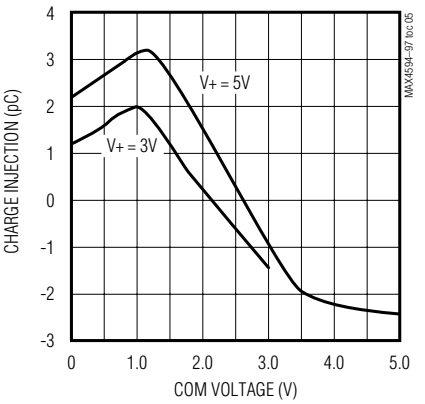
ON-RESISTANCE vs. COM VOLTAGE (V+ = 3V)



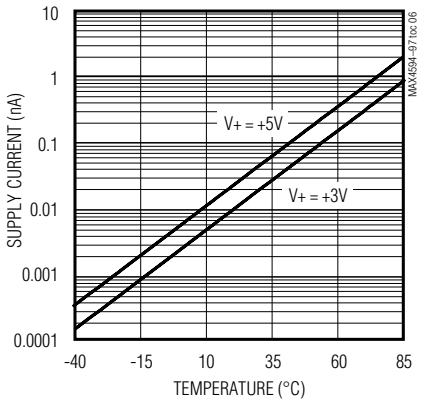
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



CHARGE INJECTION vs. COM VOLTAGE



SUPPLY CURRENT vs. TEMPERATURE



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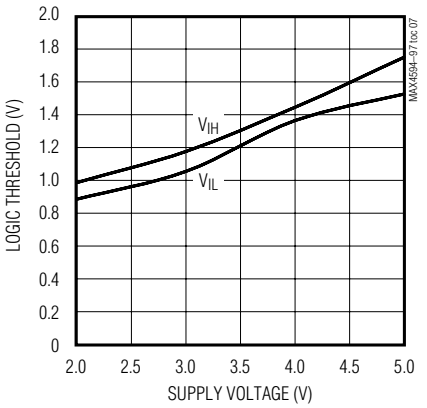
Low-Voltage, Single-Supply, 10Ω SPST CMOS Analog Switches

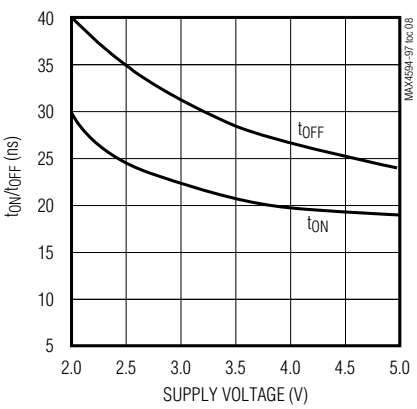
Typical Operating Characteristics (continued)

(V+ = +5V, T_A = +25°C, unless otherwise noted.)

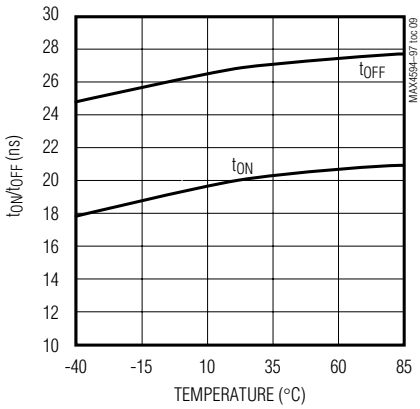
LOGIC THRESHOLD vs. SUPPLY VOLTAGE



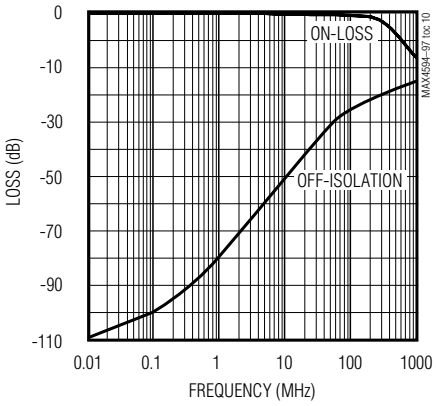
TURN-ON/TURN-OFF TIME vs. SUPPLY VOLTAGE



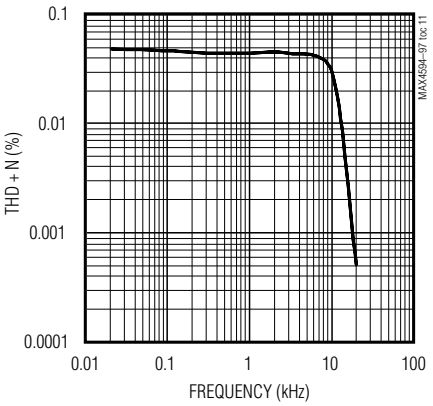
TURN-ON/TURN-OFF TIME vs. TEMPERATURE



FREQUENCY RESPONSE



TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



Pin Description

PIN								NAME	FUNCTION
MAX4594		MAX4595		MAX4596		MAX4597			
SC70	µDFN	SC70	µDFN	SC70	µDFN	SC70	µDFN		
1	1	1	1	2	2	2	2	COM	Analog Switch, Common
2	2	—	—	4	4	—	—	NO	Analog Switch, Normally Open
3	3	3	3	3	3	3	3	GND	Ground
4	4	4	4	1	1	1	1	IN	Digital Control Input
5	6	5	6	5	6	5	6	V+	Positive Supply Voltage
—	—	2	2	—	—	4	4	NC	Analog Switch, Normally Closed
—	5	—	5	—	5	—	5	N.C.	No Connection. Not internally connected.
EP	EP	EP	EP	EP	EP	EP	EP	PAD	Exposed Pad. Connect to GND (µDFN only.)

Note: NO, NC, and COM pins are identical and interchangeable. Any pin may be considered as an input or an output; signals pass equally well in both directions.

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Low-Voltage, Single-Supply, 10Ω SPST CMOS Analog Switches

Applications Information

Analog Signal Levels

Analog signals can range over the supply voltage (V+ to GND) with on-resistance changing very little over the entire range (see *Typical Operating Characteristics*). The MAX4594–MAX4597 are bidirectional, so the NO, NC, and COM pins can be used either as inputs or outputs.

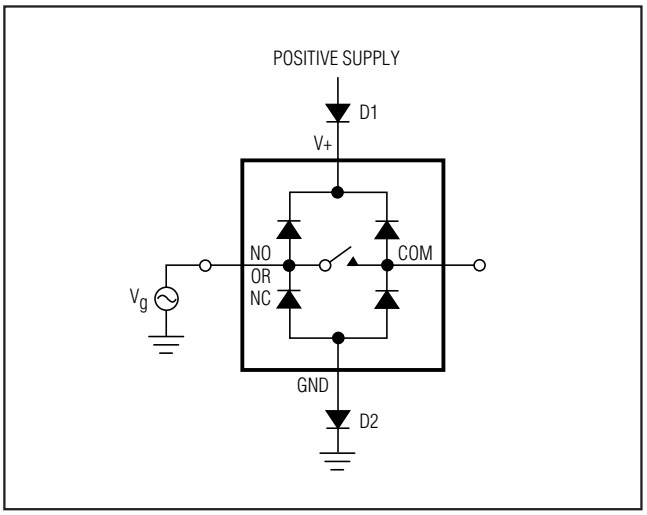

Figure 1. Overvoltage Protection Using Two External Blocking Diodes

Power-Supply Sequencing and Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Always apply V+ before applying analog signals or logic inputs, especially if the analog or logic signals are not current limited. If this sequencing is not possible, and if the analog or logic inputs are not current limited to <20mA, add a small-signal diode (D1) as shown in Figure 1. If the analog signal can dip below GND, add D2. Adding protection diodes reduces the analog signal range to a diode drop (about 0.7V) below V+ for D1 or to a diode drop above ground for D2. The addition of diodes does not affect leakage. On-resistance increases by a small amount at low supply voltages. Maximum supply voltage (V+) must not exceed 6V.

Protection diodes D1 and D2 also protect against some overvoltage situations. A fault voltage up to the absolute maximum rating at an analog signal input does not damage the device, even if the supply voltage is below the signal voltage.

Test Circuits/Timing Diagrams

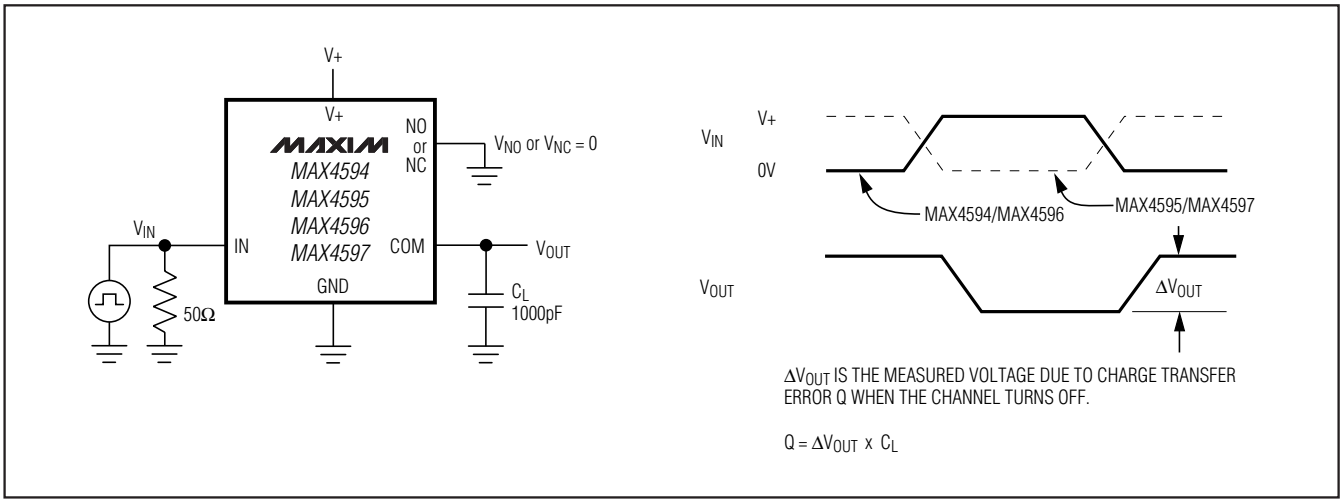

Figure 2. Charge Injection

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Test Circuits/Timing Diagrams (continued)

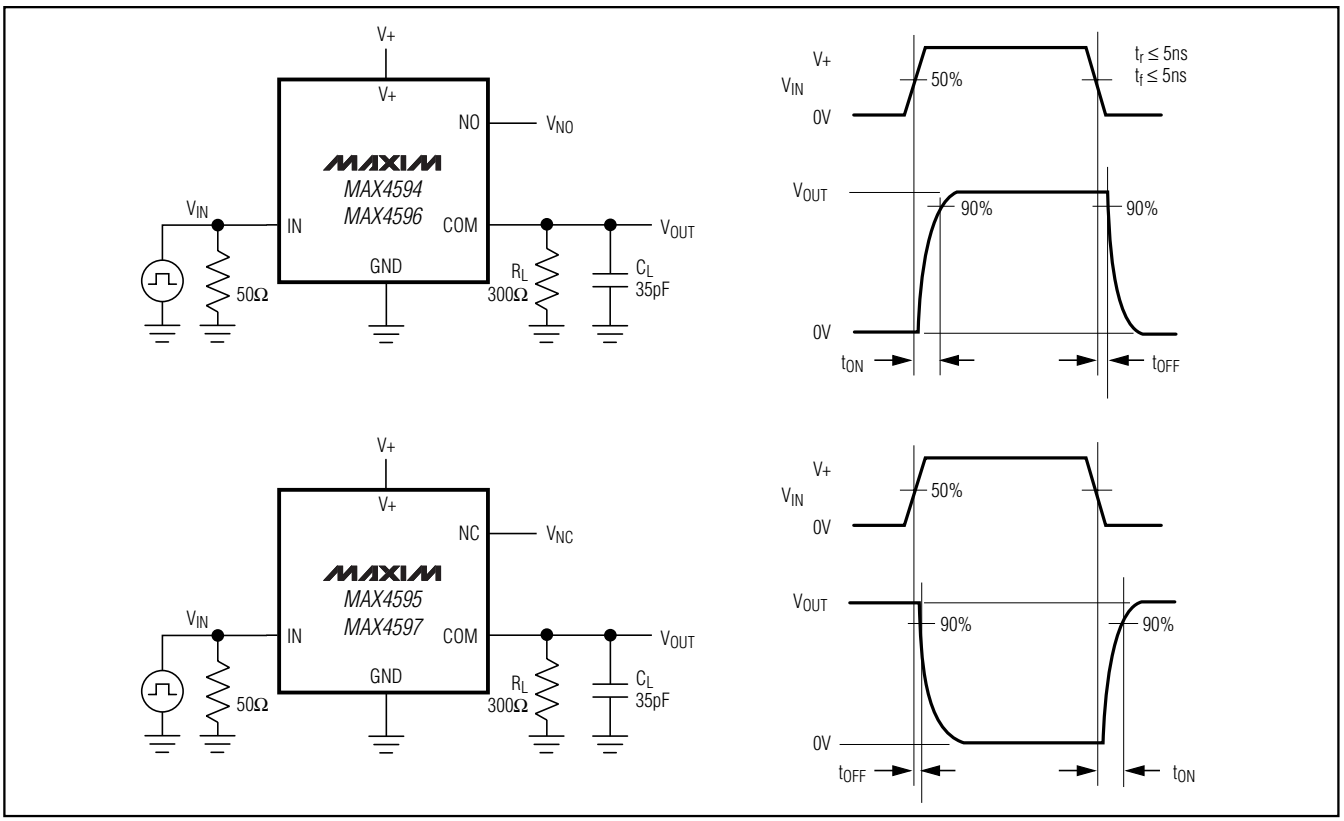

Figure 3. Switching Times

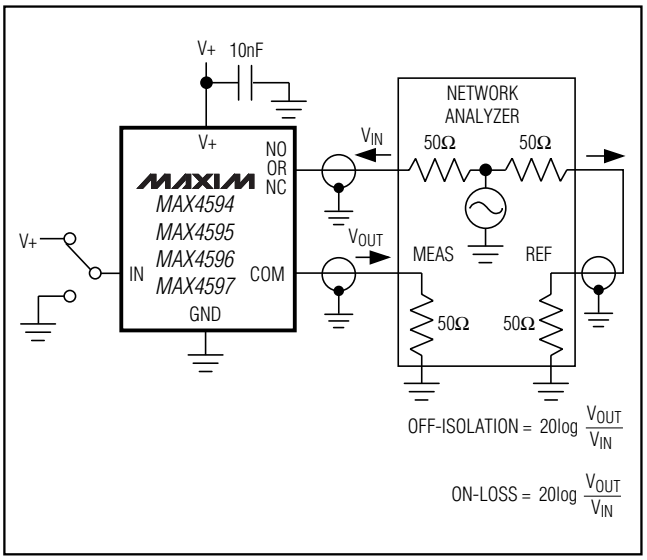

Figure 4. Off-Isolation and On-Channel Bandwidth

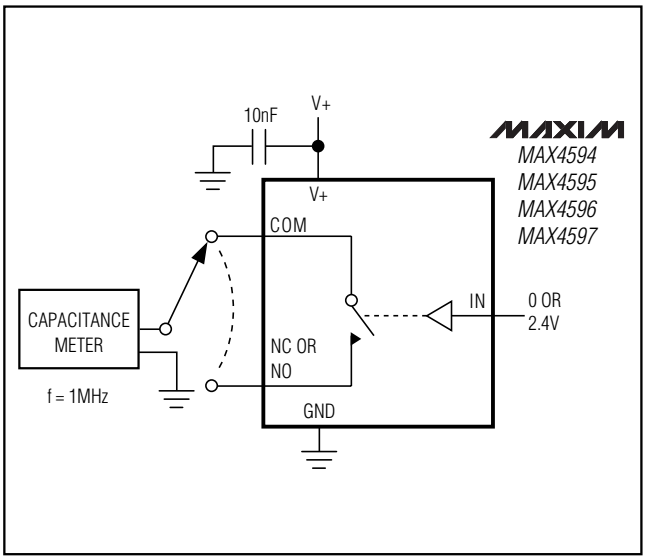

Figure 5. Channel On-/Off-Capacitance

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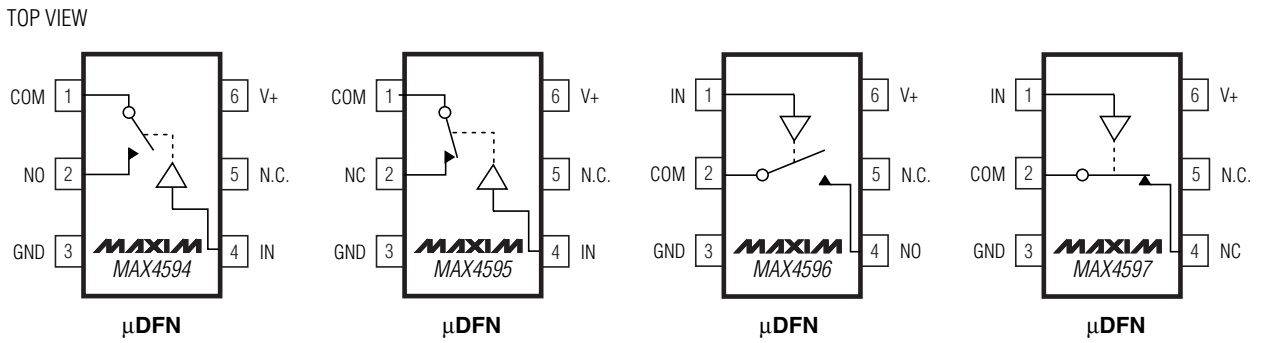
Low-Voltage, Single-Supply, 10Ω SPST CMOS Analog Switches

Pin Configurations/Functional Diagrams/Truth Table (continued)



Chip Information

TRANSISTOR COUNT: 50

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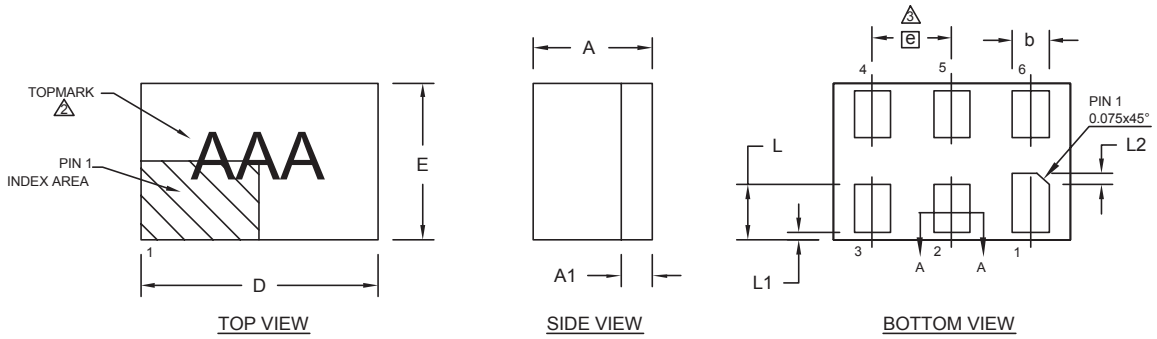
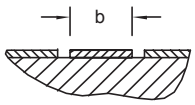
Package Information

(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**.)

6L UDFN.EPS





SECTION A-A

SYMBOL	COMMON DIMENSIONS		
	MIN.	NOM.	MAX.
A	0.64	0.72	0.80
A1	--	0.20	--
D	1.45	1.50	1.55
E	0.95	1.00	1.05
L	0.30	0.35	0.40
L1	--	--	0.08
L2	--	--	0.05
b	0.17	0.20	0.23
e	0.50 BSC.		

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
3. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 6L uDFN, 1.5x1.0x0.8mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0147	C	1/1

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Package Information (continued)

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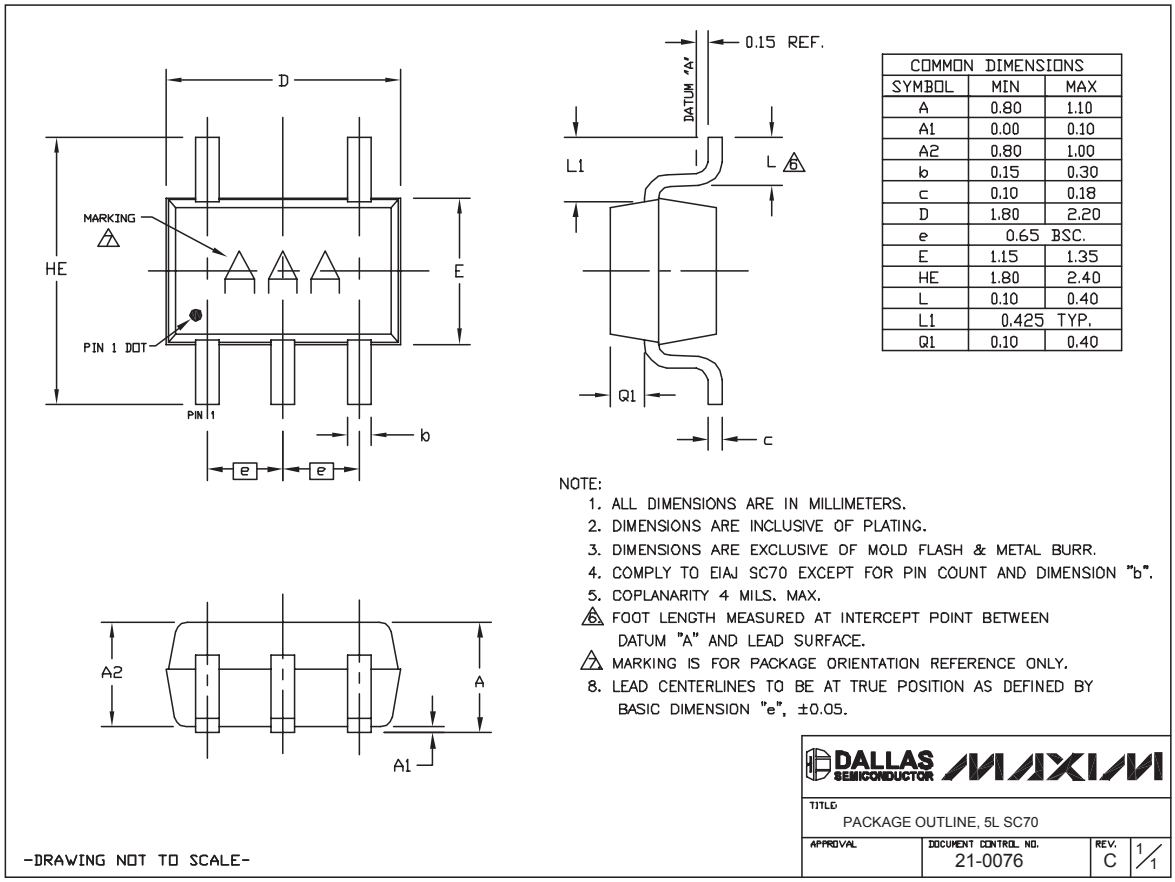

COMMON DIMENSIONS		
SYMBOL	MIN	MAX
A	0.80	1.10
A1	0.00	0.10
A2	0.80	1.00
b	0.15	0.30
c	0.10	0.18
D	1.80	2.20
e	0.65 BSC.	
E	1.15	1.35
HE	1.80	2.40
L	0.10	0.40
L1	0.425 TYP.	
Q1	0.10	0.40

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. COMPLY TO EIAJ SC70 EXCEPT FOR PIN COUNT AND DIMENSION "b".
5. COPLANARITY 4 MILS. MAX.
6. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM "A" AND LEAD SURFACE.
7. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
8. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 5L SC70

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