



# 1 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switches

## General Description

The MAX4624/MAX4625 are low-on-resistance, low-voltage single-pole/double-throw (SPDT) analog switches that operate from a single +1.8V to +5.5V supply. The MAX4624 has break-before-make switching; the MAX4625 has make-before-break switching. These devices also have fast switching speeds ( $t_{ON} = 50\text{ns}$  max,  $t_{OFF} = 50\text{ns}$  max).

When powered from a +5V supply, the MAX4624/MAX4625 offer 1 $\Omega$  max on-resistance ( $R_{ON}$ ), with 0.12 $\Omega$  max  $R_{ON}$  matching and flatness. The digital logic inputs are TTL compatible when using a single +5V supply. These switches also feature overcurrent protection to prevent damage from short circuits and excessive loads.

The MAX4624/MAX4625 are pin compatible with the MAX4544 and are available in space-saving 6-pin SOT23 packages.

## Applications

Power Routing  
Battery-Operated Equipment  
Audio and Video Signal Routing  
Low-Voltage Data-Acquisition Systems  
Communications Circuits  
PCMCIA Cards  
Cellular Phones  
Modems  
Hard Drives

## Features

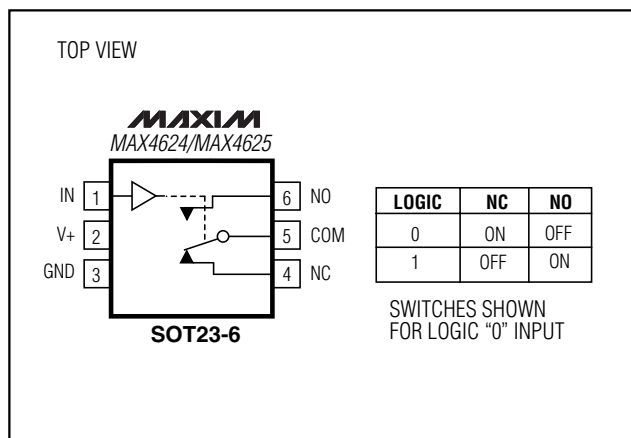
- ◆ Low  $R_{ON}$   
1 $\Omega$  max (+5V Supply)  
2 $\Omega$  max (+3V Supply)
- ◆ 0.12 $\Omega$  max  $R_{ON}$  Flatness (+5V Supply)
- ◆ Overcurrent Protection
- ◆ +1.8V to +5.5V Single-Supply Operation
- ◆ Available in SOT23 Packages
- ◆ Fast Switching:  $t_{ON} = 50\text{ns}$  max,  $t_{OFF} = 50\text{ns}$  max
- ◆ TTL-Logic Compatible (+5V Supply)
- ◆ Pin Compatible with MAX4544
- ◆ Guaranteed Break-Before-Make (MAX4624)
- ◆ Guaranteed Make-Before-Break (MAX4625)

MAX4624/MAX4625

## Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE	TOP MARK
MAX4624EUT-T	-40°C to +85°C	6 SOT23-6	AADL
MAX4625EUT-T	-40°C to +85°C	6 SOT23-6	AADM

## Pin Configuration/ Functional Diagram/Truth Table



# 1Ω, Low-Voltage, Single-Supply SPDT Analog Switches

## ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND

V+, IN .....	-0.3V to +6V
COM, NC, NO (Note 1) .....	-0.3V to (V+ + 0.3V)
Continuous Current NO, NC to COM .....	±200mA
Peak Current NO, NC to COM (pulsed at 1ms, 10% duty cycle max) .....	±400mA

Continuous Power Dissipation

6-Pin SOT23-6 (derate 7.1mW/°C above +70°C) .....	571mW
Operating Temperature Range	
MAX462_EUT .....	-40°C to +85°C
Junction Temperature .....	+150°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (soldering, 10s) .....	+300°C

**Note 1:** Signals on NC, NO, and COM exceeding V+ or GND are clamped by internal diodes.

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—Single +5V Supply

(V+ = +5V ±10%, GND = 0, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>						
Analog Signal Range	VCOM, VNO, VNC		0		V+	V
On-Resistance	RON	V+ = 4.5V, VNO or VNC = 3.5V, ICOM = 100mA	TA = +25°C TA = TMIN to TMAX	0.65 1.2	1	Ω
On-Resistance Match Between Channels (Note 4)	ΔRON	V+ = 4.5V, ICOM = 100mA, VNO or VNC = 3.5V	TA = +25°C TA = TMIN to TMAX	0.06 0.15	0.12	Ω
On-Resistance Flatness (Note 5)	RFLAT(ON)	V+ = 4.5V; ICOM = 100mA; VNO or VNC = 0, 1V, 2V	TA = +25°C TA = TMIN to TMAX	0.08 0.15	0.12	Ω
NO or NC Off-Leakage Current	INO(OFF), INC(OFF)	V+ = 5.5V; VCOM = 1V, 4.5V; VNO or VNC = 4.5V, 1V	TA = +25°C TA = TMIN to TMAX	-2 -20	0.01 20	nA
COM On-Leakage Current	ICOM(ON)	V+ = 5.5V; VCOM = 1V, 4.5V; VNO or VNC = 1V, 4.5V, or floating	TA = +25°C TA = TMIN to TMAX	-4 -40	0.3 40	nA
Overcurrent-Protection Current Threshold		TA = +25°C		1.2		A
<b>DYNAMIC</b>						
Turn-On Time	tON	VNO or VNC = 3V, Figure 2	TA = +25°C TA = TMIN to TMAX	40 60	50	ns
Turn-Off Time	tOFF	VNO or VNC = 3V, Figure 2	TA = +25°C TA = TMIN to TMAX	40 60	50	ns
Break-Before-Make Delay (Note 6)	tBBM	MAX4624 only, Figure 3a	TA = +25°C TA = TMIN to TMAX	1 1	20	ns
Make-Before-Break Delay (Note 6)	tMBB	MAX4625 only, Figure 3b	TA = +25°C TA = TMIN to TMAX	1 1	6	ns

# 1Ω, Low-Voltage, Single-Supply SPDT Analog Switches

MAX4624/MAX4625

## ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V+ = +5V ±10%, GND = 0, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Charge Injection	Q	CL = 1.0nF, VGEN = 0, RGEN = 0, TA = +25°C, Figure 4		65		pC
Off-Isolation (Note 7)	OIRR	RL = 50Ω, CL = 5pF, f = 1MHz, TA = +25°C, Figure 5		-57		dB
Crosstalk (Note 8)		RL = 50Ω, CL = 5pF, f = 1MHz, TA = +25°C, Figure 5		-57		dB
NC or NO Off-Capacitance	COFF	f = 1MHz, TA = +25°C, Figure 6		32		pF
COM On-Capacitance	CCOM(ON)	f = 1MHz, TA = +25°C, Figure 6		100		pF
<b>LOGIC INPUT</b>						
Input Voltage Low	VINL				0.8	V
Input Voltage High	VINH		2.4			V
Logic Input Current	IIN		-1		1	μA
<b>SUPPLY</b>						
Power-Supply Range	V+		1.8		5.5	V
Positive Supply Current	I+	V+ = 5.5V, VIN = 0 or V+			10	μA

## ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V+ = +2.7V to +3.6V, GND = 0, VINH = 2.0V, VINL = 0.6V, TA = TMIN to TMAX, unless otherwise noted.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>						
Analog Signal Range	VCOM, VNO, VNC		0		V+	V
On-Resistance	RON	V+ = 2.7V, VNO or VNC = 1.5V, ICOM = 100mA	TA = +25°C		1.2	2.0
			TA = TMIN to TMAX			2.5
On-Resistance Flatness (Note 6)	RFLAT(ON)	V+ = 2.7V; ICOM = 100mA; VNO or VNC = 0, 0.75V, 1.5V; TA = +25°C		0.25		Ω
<b>DYNAMIC</b>						
Turn-On Time	tON	VNO or VNC = 1.5V, Figure 2	TA = +25°C		65	80
			TA = TMIN to TMAX			100
Turn-Off Time	tOFF	VNO or VNC = 1.5V, Figure 2	TA = +25°C		62	80
			TA = TMIN to TMAX			100
Break-Before-Make Time Delay (Note 4)	tBBM	MAX4624 only, Figure 3a	1	40		ns
Make-Before-Break Time Delay (Note 4)	tMBB	MAX4625 only, Figure 3b	1	8		ns
Charge Injection	Q	CL = 1.0nF, Figure 4, VGEN = 0, RGEN = 0, TA = +25°C		40		pC

# 1 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switches

## ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

( $V_+ = +2.7V$  to  $+3.6V$ ,  $GND = 0$ ,  $V_{INH} = 2.0V$ ,  $V_{INL} = 0.6V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>LOGIC INPUT</b>						
Input Voltage Low	$V_{INL}$				0.6	V
Input Voltage High	$V_{INH}$		2.0			V
Logic Input Current	$I_{IN}$		-1		1	$\mu A$
<b>SUPPLY</b>						
Positive Supply Current	$I_+$	$V_+ = 3.6V$ , $V_{IN} = 0$ or $V_+$			10	$\mu A$

**Note 2:** The algebraic convention, where the most negative value is a minimum and the most positive value is a maximum, is used in this data sheet.

**Note 3:** SOT-packaged parts are 100% tested at  $+25^\circ C$ . Limits across the full temperature range are guaranteed by design and correlation.

**Note 4:**  $\Delta R_{ON} = R_{ON}(MAX) - R_{ON}(MIN)$ .

**Note 5:** Flatness is defined as the difference between the maximum and minimum values of on-resistance as measured over the specified analog signal range.

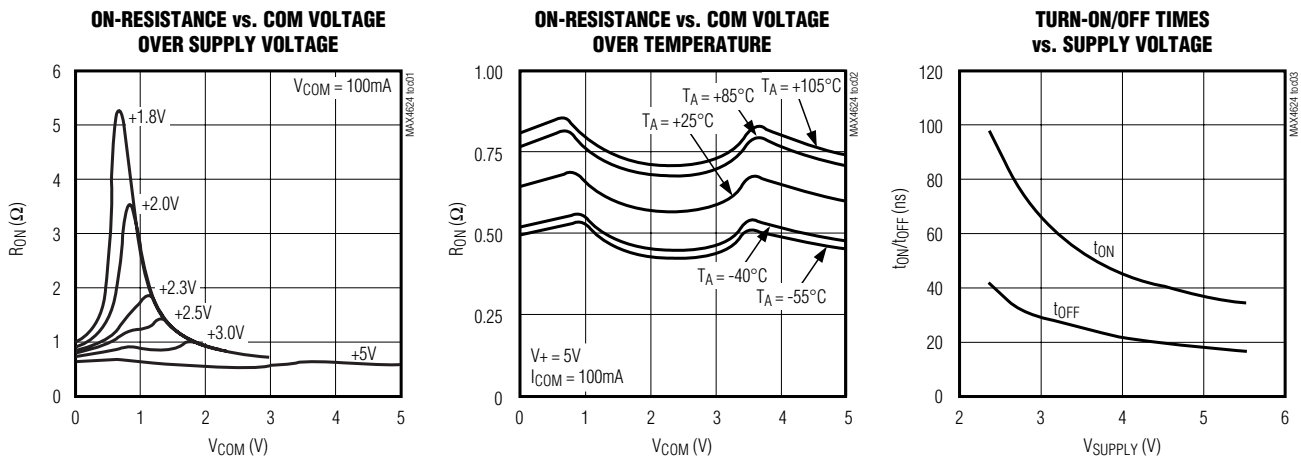
**Note 6:** Guaranteed by design.

**Note 7:** Off-Isolation =  $20\log_{10} [V_{COM} / (V_{NC} \text{ or } V_{NO})]$ ,  $V_{COM}$  = output,  $V_{NC}$  or  $V_{NO}$  = input to off switch.

**Note 8:** Between the two switches.

## Typical Operating Characteristics

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



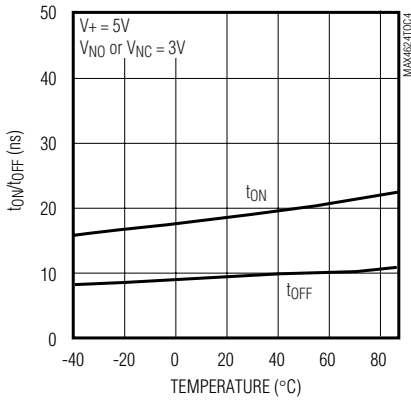
# 1 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switches

## Typical Operating Characteristics (continued)

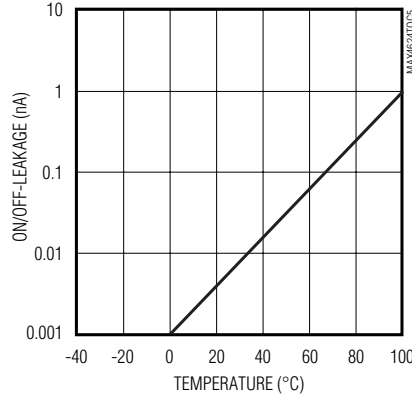
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

MAX4624/MAX4625

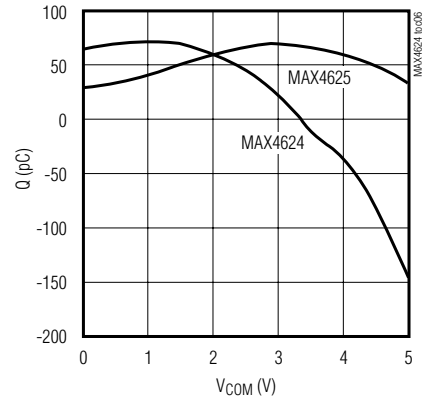
TURN-ON/OFF TIMES vs. TEMPERATURE



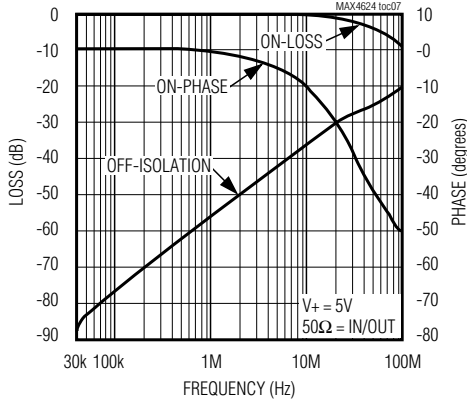
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



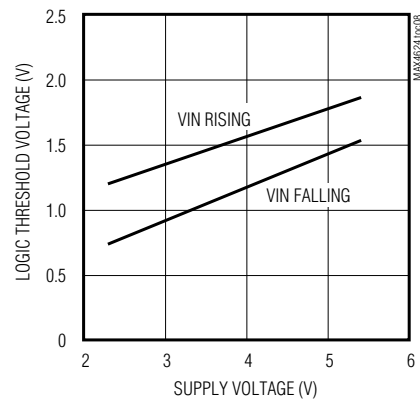
CHARGE INJECTION vs. COM VOLTAGE



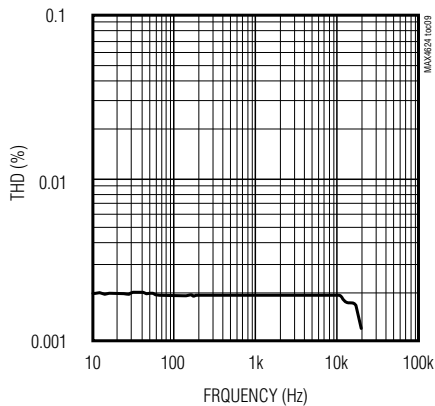
FREQUENCY RESPONSE



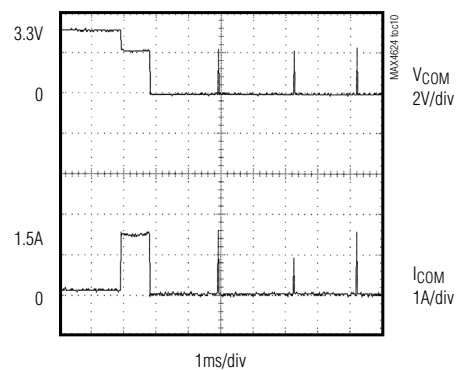
LOGIC THRESHOLD VOLTAGE vs. SUPPLY VOLTAGE



TOTAL HARMONIC DISTORTION vs. FREQUENCY



OVERCURRENT RESPONSE



# 1 $\Omega$ , Low-Voltage, Single-Supply SPDT Analog Switches

## Pin Description

PIN	NAME	FUNCTION
1	IN	Digital Control Input
2	V+	Positive Supply Voltage Input
3	GND	Ground
4	NC	Analog Switch—Normally Closed
5	COM	Analog Switch—Common
6	NO	Analog Switch—Normally Open

## Detailed Description

The MAX4624/MAX4625 are low-on-resistance ( $R_{ON}$ ), low-voltage, single-pole/double-throw (SPDT) analog switches that operate from a +1.8V to +5.5V supply. The MAX4624 has break-before-make switching, and the MAX4625 has make-before-break switching. These devices also have fast switching speeds ( $t_{ON} = 50\text{ns}$  max,  $t_{OFF} = 50\text{ns}$  max).

When powered from a +5V supply, their 1 $\Omega$  max  $R_{ON}$  allows high continuous currents to be switched in a variety of applications. In an overcurrent condition, these switches provide both current-limit and thermal-shutdown protection.

## Current-Limit Protection

The MAX4624/MAX4625 feature current-limit protection circuitry. When the voltage drop across the on switch reaches 0.6V typ, the internal circuitry activates. The current limit is not instantaneous, but rather integrates

over time, so current limiting will not activate when the switch output charges a small 0.1 $\mu\text{F}$  capacitor. For sustained overload conditions, the switch turns off (opens). The switch turns on after 5ms. If the overload persists, the switch cycles off and on to produce a pulsed output. A direct short circuit will be detected immediately, and the switch will pulse on for 1 $\mu\text{s}$ , then remain off for 5ms.

## Applications Information

### Logic Inputs

The MAX4624/MAX4625 logic inputs can be driven up to +5.5V regardless of the supply voltage. For example, with a +3.3V supply, IN may be driven low to 0V and high to 5.5V. Driving IN Rail-to-Rail® minimizes power consumption.

### Analog Signal Levels

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

## Power-Supply Sequencing and Overvoltage Protection

**Caution:** Do not exceed the absolute maximum ratings because stresses beyond the listed ratings may cause permanent damage to the devices.

Proper power-supply sequencing is recommended for all CMOS devices. Always apply  $V+$  before applying analog signals, especially if the analog signal is not current limited. If this sequencing is not possible, and if the analog inputs are not current limited to <20mA, add

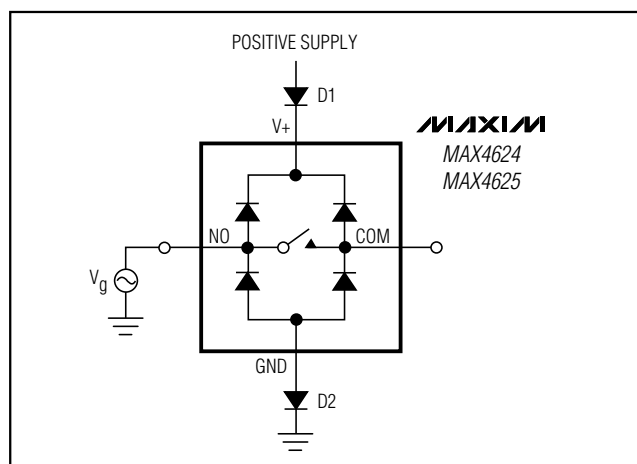


Figure 1. Overvoltage Protection Using Two External Blocking Diodes

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

# 1Ω, Low-Voltage, Single-Supply SPDT Analog Switches

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 range to a diode drop (about 0.7V) below V+ (for D1), and a diode drop above ground (for D2). On-resistance increases slightly at low supply voltages. Maximum supply voltage (V+) must not exceed +6V.

Adding protection diode D2 causes the logic threshold to be shifted relative to GND. TTL compatibility is not guaranteed when D2 is added.

Protection diodes D1 and D2 also protect against some overvoltage situations. With Figure 1's circuit, if the supply voltage is below the absolute maximum rating, and if a fault voltage up to the absolute maximum rating is applied to an analog signal pin, no damage will result.

## Test Circuits/Timing Diagrams

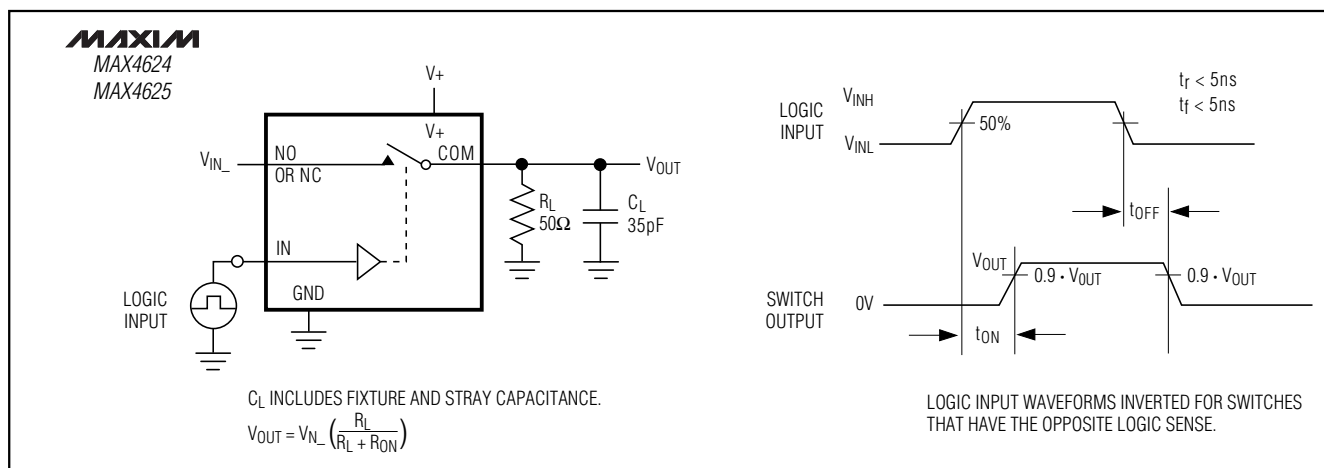


Figure 2. Switching Time

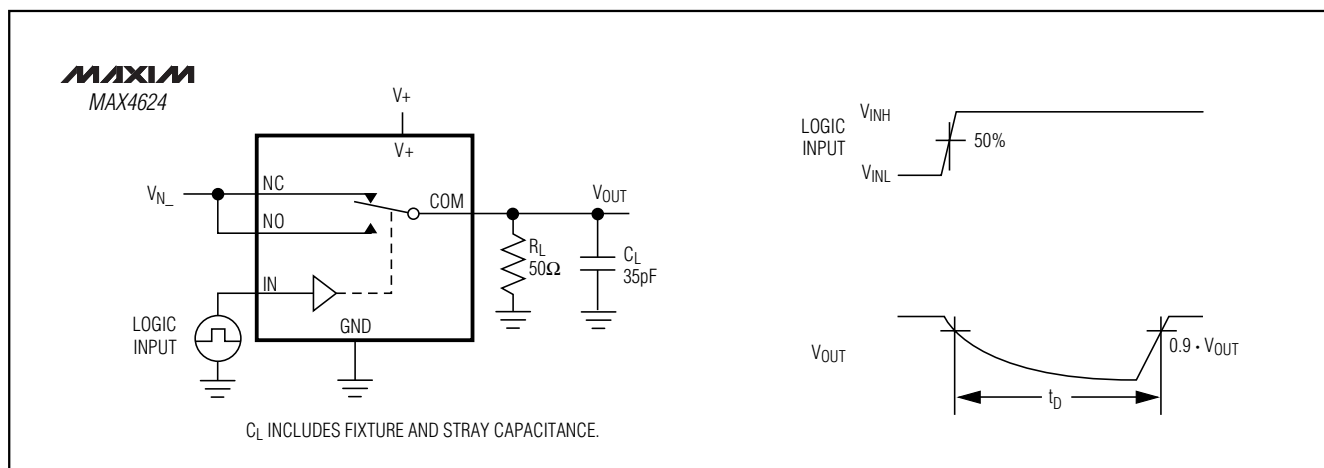


Figure 3a. Break-Before-Make Interval (MAX4624 only)

# 1Ω, Low-Voltage, Single-Supply SPDT Analog Switches

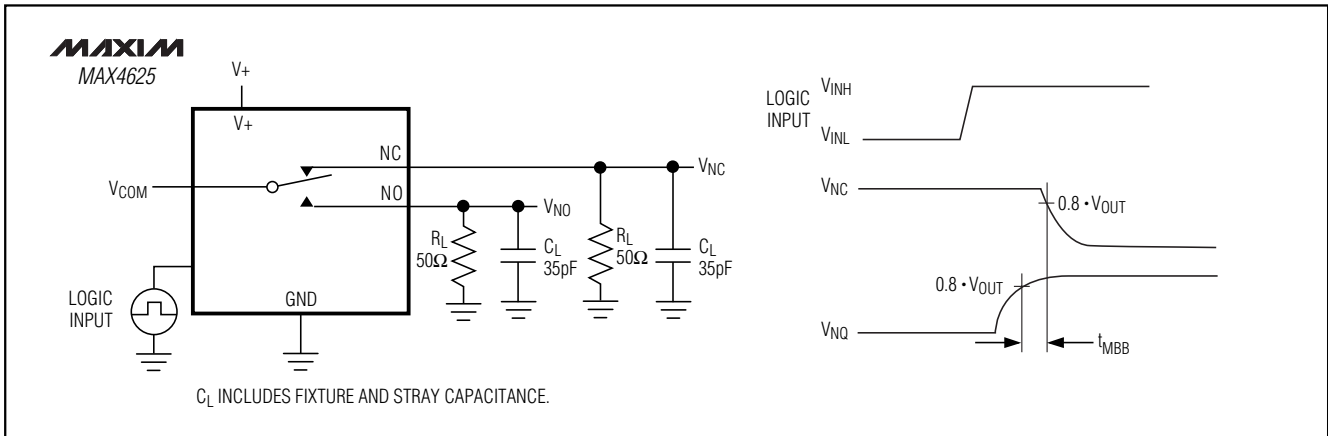


Figure 3b. Make-Before-Break Interval (MAX4625 only)

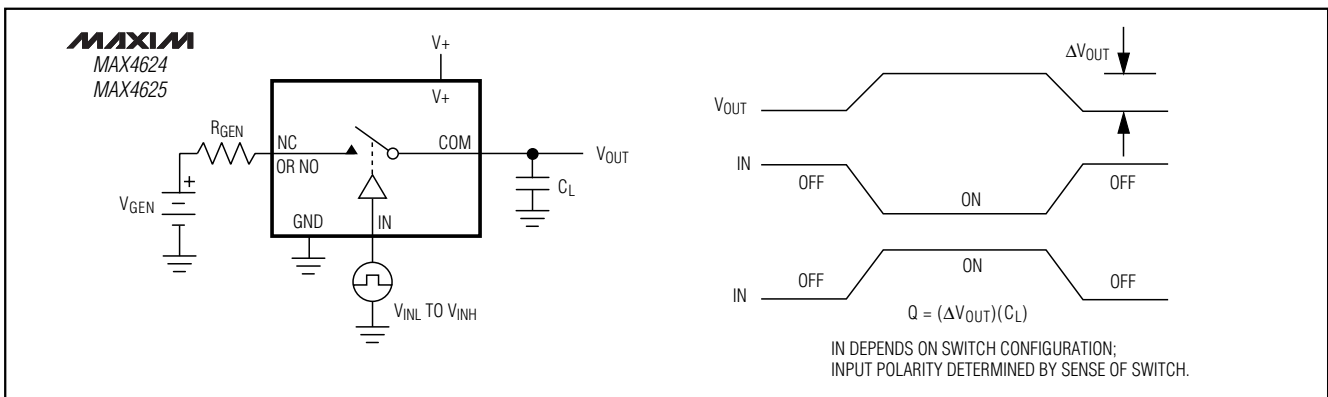


Figure 4. Charge Injection

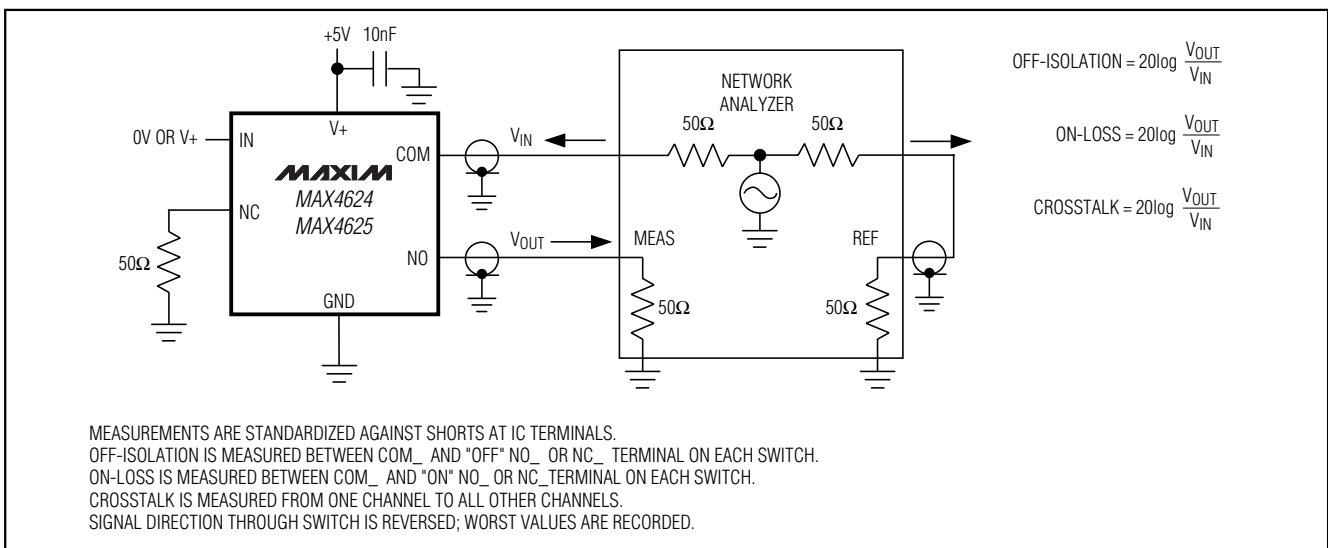


Figure 5. On-Loss, Off-Isolation, and Crosstalk



# 1Ω, Low-Voltage, Single-Supply SPDT Analog Switches

## Chip Information

TRANSISTOR COUNT: 186

MAX4624/MAX4625

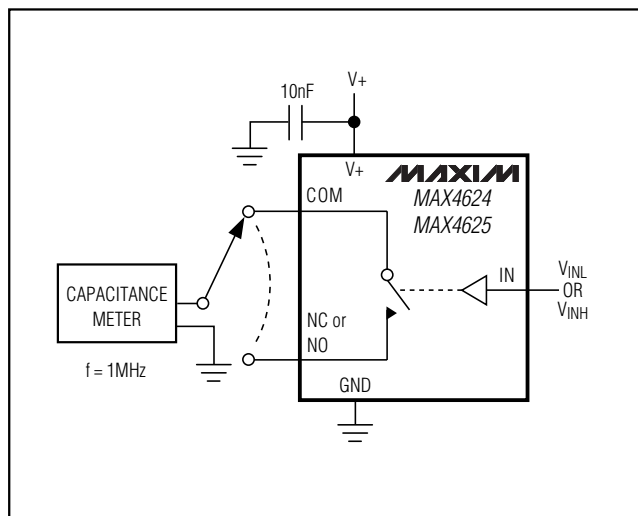
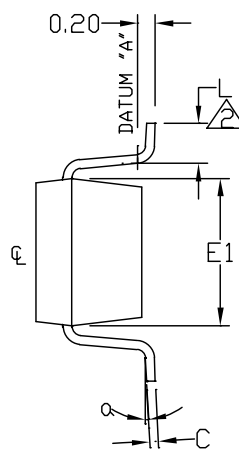



Figure 6. Channel Off/On-Capacitance

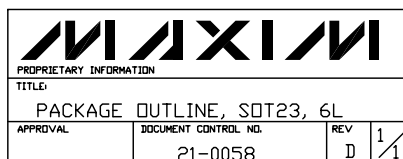
## 6LSOT.EPS



SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.95 REF	
o	0°	10°

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2.  FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT. (SEE EXAMPLE TOP MARK)
6. PIN 1 I.D. DOT IS 0.3 MM Ø MIN. LOCATED ABOVE PIN 1.



# ***1Ω, Low-Voltage, Single-Supply SPDT Analog Switches***

NOTES

**MAX4624/MAX4625**

# **1Ω, Low-Voltage, Single-Supply SPDT Analog Switches**

## **NOTES**

*Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.*

**12 \_\_\_\_\_ Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600**