19-1747; Rev 0; 7/00

MAXIM

3Ω Single SPST Analog Switches

General Description

The MAX4675/MAX4676 single analog switches feature 3Ω (max) on-resistance (R_{ON}) and 0.7Ω flatness when operating from dual ±5V supplies. These switches can handle Rail-to-Rail® analog signals. Off-leakage current is 0.1nA at T_A = +25°C. The MAX4675/MAX4676 are ideal in low-distortion applications and are the preferred solution over mechanical relays in automated test equipment or applications where current switching is required. They are more reliable than mechanical relays, have low power requirements (<1µA), and are available in a space-saving 6-pin SOT23 package.

The MAX4675 has a single normally open (NO) switch, and the MAX4676 has a single normally closed (NC) switch.

The MAX4675/MAX4676 operate from either a single +2.7V to +5.5V or dual ±2.7V to ±5.5V supplies, making them ideal for use in digital card applications and single-ended 75Ω systems.

Applications

Reed Relay Replacement

Test Equipment

Communications Systems

PBX, PABX Systems

Audio Signal Routing

Avionics

ADC Systems

Data-Acquisition Systems

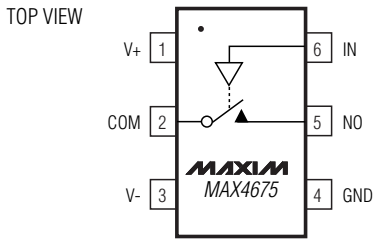
Features

- **3Ω (max) R_{ON}**
- **0.7Ω (max) R_{ON} Flatness**
- **Dual ±2.7V to ±5.5V or Single +2.7V to +5.5V Supply Range**
- **Off-Isolation**
  - **-75dB at 1MHz, Dual Supply**
  - **-65dB at 1MHz, Single Supply**
- **-3dB Bandwidth 250MHz**
- **Rail-to-Rail Signal Handling**

Ordering Information

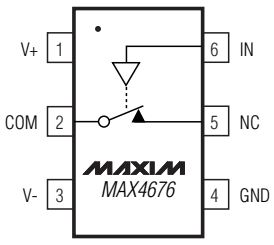
PART	TEMP. RANGE	PIN-PACKAGE	SOT MARK
MAX4675EUT-T	-40°C to +85°C	6 SOT23-6	AAND
MAX4676EUT-T	-40°C to +85°C	6 SOT23-6	AANE

Pin Configurations/Functional Diagrams/Truth Tables



SOT23

MAX4675	
IN	**SWITCH**
0	OFF
1	ON



SOT23

MAX4676	
IN	**SWITCH**
0	ON
1	OFF

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

For free samples and the latest literature, visit www.maxim-ic.com or phone 1-800-998-8800. For small orders, phone 1-800-835-8769.

3Ω Single SPST Analog Switches

ABSOLUTE MAXIMUM RATINGS

V+ to GND .....-0.3V to +6V
V- to GND .....+0.3V to -6V
V+ to V- 12V
IN to GND .....-0.3V to (V+ + 0.3V)
All Other Pins (Note 1) .....(V- - 0.3V) to (V+ + 0.3V)
Continuous Current (NO, NC, COM) .....±100mA
Peak Current (NO, NC, COM, pulsed at 1ms (10% duty cycle).....±200mA

Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23 (derate 8.7mW/°C above +70°C).....691mW
Operating Temperature Range .....-40°C to +85°C
Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

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.

Note 1: Signals on NO, NC, COM, or IN exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current rating.

ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0, V_{IH} = +2.4V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Input Voltage Range	V_{COM}, V_{NO}, V_{NC}			V-		V+	V
On-Resistance	R_{ON}	V+ = 4.5V, V- = -4.5V, I_{COM} = 50mA; V_{NO} or V_{NC} = ±3.3V	T_A = +25°C		2.4	3	Ω
			T_A = T_{MIN} to T_{MAX}			4	
On-Resistance Flatness (Note 4)	R_{FLAT}	V+ = 4.5V, V- = -4.5V, I_{COM} = 50mA; V_{NO} or V_{NC} = ±3.3V, 0	T_A = +25°C		0.4	0.7	Ω
			T_A = T_{MIN} to T_{MAX}			1.0	
NC or NO Off-Leakage Current	$I_{N_(OFF)}$	V+ = 5.5V, V- = -5.5V, V_{COM} = 4.5V; V_{NO} or V_{NC} = ±4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM Off-Leakage Current	$I_{COM(OFF)}$	V+ = 5.5V, V- = -5.5V, V_{COM} = +4.5V; V_{NO} or V_{NC} = ±4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM On-Leakage Current	$I_{COM(ON)}$	V+ = 5.5V, V- = -5.5V, V_{COM} = ±4.5V; V_{NO} or V_{NC} = ± 4.5V or floating	T_A = +25°C	-2	0.1	2	nA
			T_A = T_{MIN} to T_{MAX}	-20		20	
LOGIC INPUT							
Input Low Voltage	V_{IL}					0.8	V
Input High Voltage	V_{IH}			2.4			V
Input Leakage Current	I_{IN}			-1	0.005	1	µA
DYNAMIC							
Turn-On Time	t_{ON}	V+ = +4.5V, V- = -4.5V; V_{NO} or V_{NC} = 3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		135	300	ns
			T_A = T_{MIN} to T_{MAX}			375	
Turn-Off Time	t_{OFF}	V+ = +4.5V, V- = -4.5V; V_{NO} or V_{NC} = 3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		50	110	ns
			T_A = T_{MIN} to T_{MAX}			125	

ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES (continued)

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0, V_{IH} = +2.4V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Charge Injection	Q	R_{GEN} = 0Ω, C_L = 1nF, V_{GEN} = 0, Figure 3	T_A = +25°C		87		pC
Off-Isolation	V_{ISO}	R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 4	T_A = +25°C		-75		dB
On-Channel Bandwidth (-3dB)	BW	R_S = 50Ω, R_L = 50Ω			250		MHz
NC or NO Off-Capacitance	$C_{(N_OFF)}$	f = 1MHz, Figure 5	T_A = +25°C		85		pF
COM Off-Capacitance	$C_{(COMOFF)}$	f = 1MHz, Figure 5	T_A = +25°C		85		pF
On-Capacitance	$C_{(ON)}$	f = 1MHz, Figure 5	T_A = +25°C		350		pF
POWER SUPPLY							
Supply Voltage	V+, V-			±2.7		±5.5	V
Positive Supply Current	I+	V_{IN} = 0 or 5.5V, V+ = 5.5V, V- = -5.5V	T_A = +25°C		0.002	1	µA
			T_A = T_{MIN} to T_{MAX}			10	
Negative Supply Current	I-	V_{IN} = 0 or 5.5V, V+ = 5.5V, V- = -5.5V	T_A = +25°C	-1	-0.002		µA
			T_A = T_{MIN} to T_{MAX}	-10			

ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY

(V+ = +5V ±10%, V- = 0, GND = 0, V_{IH} = +2.4V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Input Voltage Range	V_{COM}, V_{NO}, V_{NC}			0		V+	V
On-Resistance	R_{ON}	V+ = 4.5V; I_{COM} = 50mA; V_{NO} or V_{NC} = 3.3V	T_A = +25°C		3.5	5.75	Ω
			T_A = T_{MIN} to T_{MAX}			7.5	
On-Resistance Flatness (Note 4)	R_{FLAT}	V+ = 4.5V; I_{COM} = 50mA; V_{NO} or V_{NC} = 1.5V, 2.5V, 3.3V	T_A = +25°C		0.4	1.6	Ω
			T_A = T_{MIN} to T_{MAX}			2	
NC or NO Off-Leakage Current	$I_{N_(OFF)}$	V+ = 5.5V; V_{NO} or V_{NC} = 4.5V or 0; V_{COM} = 0 or 4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM Off-Leakage Current	$I_{COM(OFF)}$	V+ = 5.5V; V_{NO} or V_{NC} = 4.5V or 0; V_{COM} = 0 or 4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	

ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY (continued)

(V+ = +5V ±10%, V- = 0, GND = 0, V_{IH} = +2.4V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
COM On-Leakage Current	$I_{COM\ (ON)}$	V+ = 5.5V; V_{NO} or V_{NC} = 0, 4.5V, or floating; V_{COM} = 0 or 4.5V	T_A = +25°C	-2	0.2	2	nA
			T_A = T_{MIN} to T_{MAX}	-20		20	
LOGIC INPUT							
Input Low Voltage	V_{IL}					0.8	V
Input High Voltage	V_{IH}			2.4			V
Input Leakage Current	I_{IN}			-1	0.005	1	µA
DYNAMIC							
Turn-On Time	t_{ON}	V+ = +4.5V; V_{NO} or V_{NC} = +3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		350	700	ns
			T_A = T_{MIN} to T_{MAX}			850	
Turn-Off Time	t_{OFF}	V+ = +4.5V; V_{NO} or V_{NC} = +3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		55	150	ns
			T_A = T_{MIN} to T_{MAX}			160	
Charge Injection	Q	R_{GEN} = 0Ω, C_L = 1nF, V_{GEN} = 2.5V, Figure 3	T_A = +25°C		31		pC
Off-Isolation	V_{ISO}	R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 4	T_A = +25°C		-65		dB
On-Channel Bandwidth (-3dB)		R_S = 50Ω, R_L = 50Ω			150		MHz
NC or NO Off-Capacitance	$C_{(N_OFF)}$	f = 1MHz, Figure 5	T_A = +25°C		85		pF
COM Off-Capacitance	$C_{(COMOFF)}$	f = 1MHz, Figure 5	T_A = +25°C		85		pF
On-Capacitance	$C_{(ON)}$	f = 1MHz, Figure 5	T_A = +25°C		350		pF
POWER SUPPLY							
Supply Voltage	V+			2.7		5.5	V
Positive Supply Current	I+	V_{IN} = 0 or 5V, V+ = 5.5V	T_A = +25°C		0.002	1	µA
			T_A = T_{MIN} to T_{MAX}			10	

Note 2: Parameters are 100% tested at +25°C only and guaranteed by correlation through the full-rated temperature range.

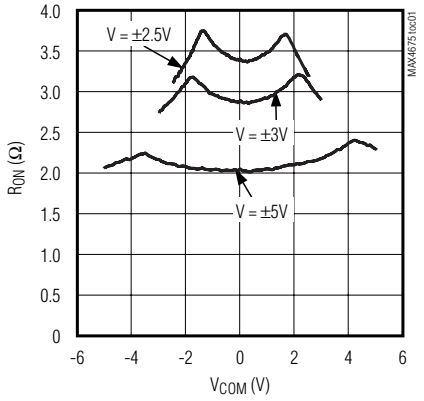
Note 3: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

Note 4: Flatness is defined as the difference between the maximum and minimum value of R_{ON} as measured over the specified analog signal ranges.

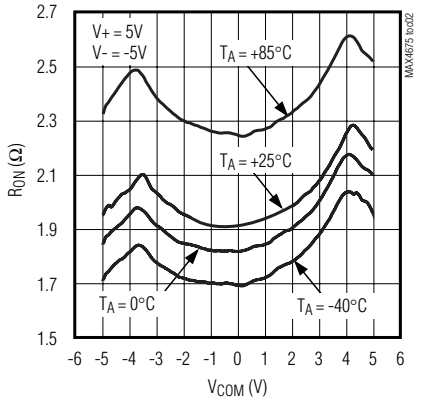
Typical Operating Characteristics

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

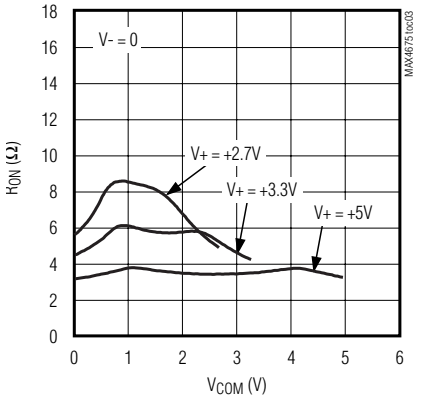
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



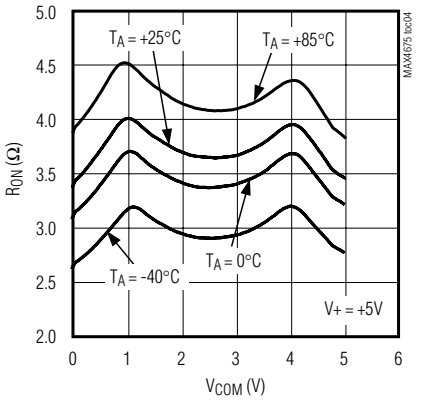
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (DUAL SUPPLIES)



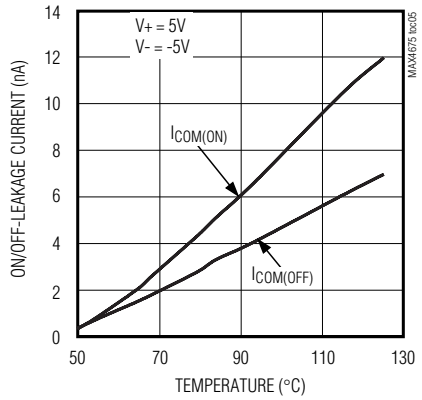
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



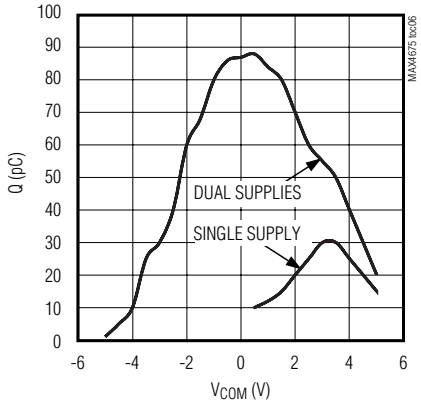
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (SINGLE SUPPLY)



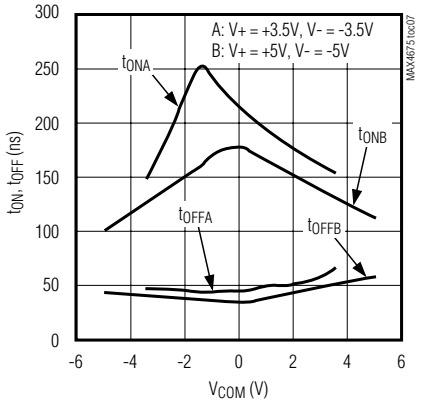
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



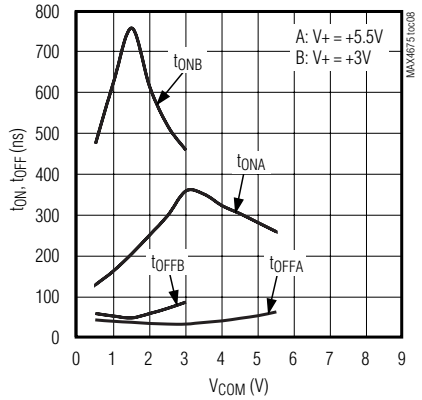
CHARGE INJECTION vs. V_{COM}



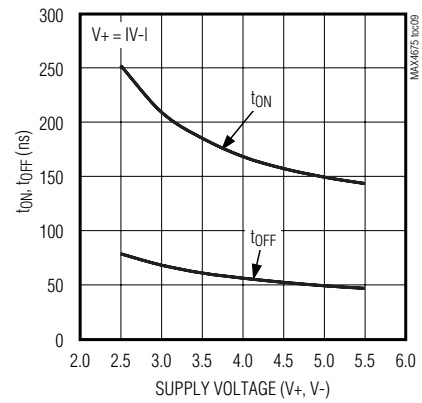
TURN-ON/TURN-OFF TIMES vs. V_{COM} (DUAL SUPPLIES)



TURN-ON/TURN-OFF TIMES vs. V_{COM} (SINGLE SUPPLY)



TURN-ON/TURN-OFF TIMES vs. SUPPLY VOLTAGE (DUAL SUPPLIES)

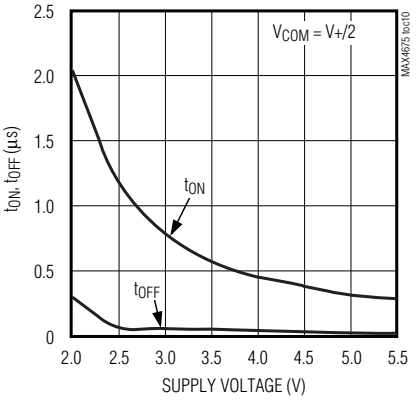


3Ω Single SPST Analog Switches

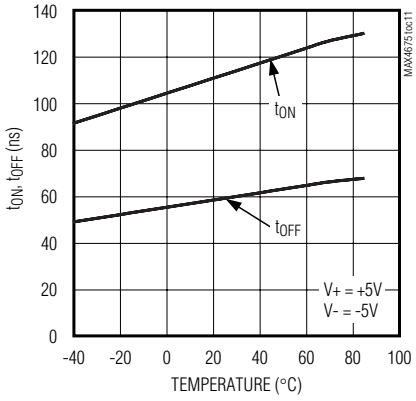
Typical Operating Characteristics (continued)

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

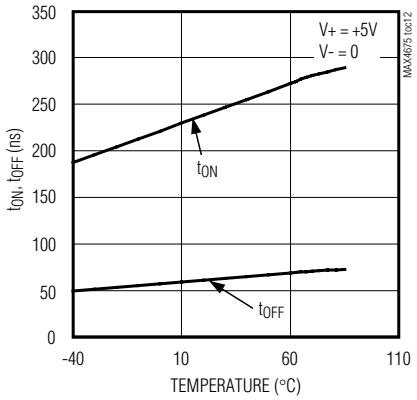
TURN-ON/TURN-OFF TIMES vs. SUPPLY VOLTAGE (SINGLE SUPPLY)



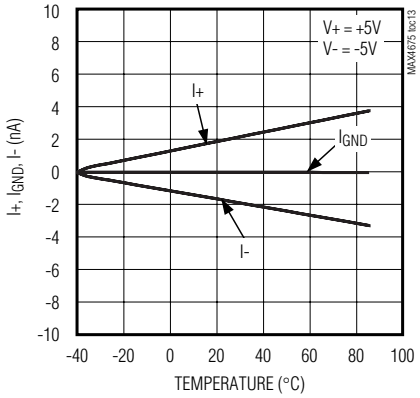
TURN-ON/TURN-OFF TIMES vs. TEMPERATURE (DUAL SUPPLIES)



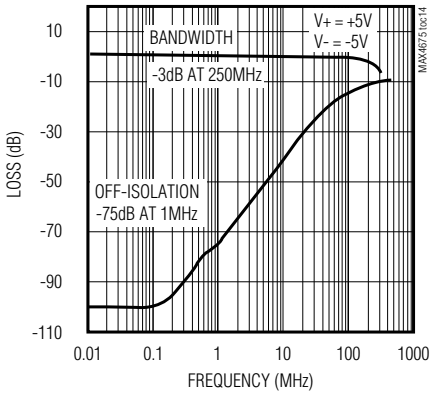
TURN-ON/TURN-OFF TIMES vs. TEMPERATURE (SINGLE SUPPLY)



POWER-SUPPLY CURRENT vs. TEMPERATURE



FREQUENCY RESPONSE



Pin Description

PIN		NAME	FUNCTION
MAX4675	MAX4676		
1	1	V+	Positive Supply
2	2	COM	Analog Switch Common Terminals
3	3	V-	Negative Supply
4	4	GND	Ground
5	—	NO	Analog Switch Normally Open Terminal
—	5	NC	Analog Switch Normally Closed Terminal
6	6	IN	Logic Input

Applications Information

Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, then V-, followed by the logic inputs, NO, NC, or COM. If proper power-supply sequencing is not possible, add two small-signal diodes (D1, D2) in series with the supply pins (Figure 1). Adding diodes reduces the analog signal range to one diode drop below V+ and one diode drop above V- but does not affect the devices' low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and V- should not exceed 12V.

Power-supply bypassing improves noise margin and prevents switching noise from propagating from the V+ supply to other components. A 0.1µF capacitor connected from V+ to GND is adequate for most applications.

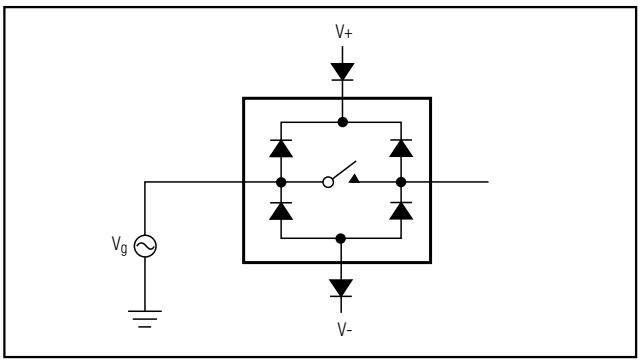


Figure 1. Overvoltage Protection Using External Blocking Diodes

Timing Diagrams/Test Circuits

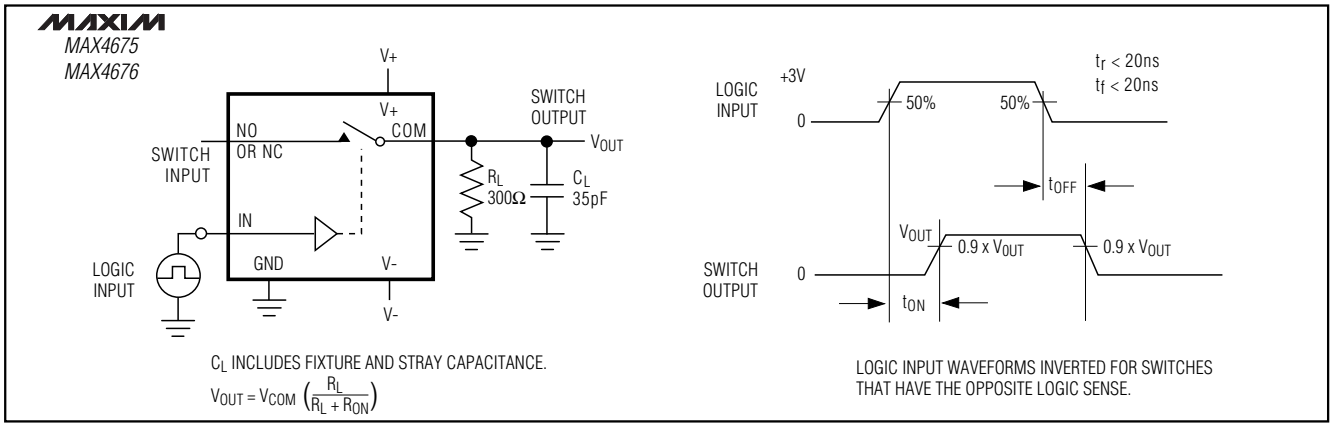


Figure 2. Switching Time

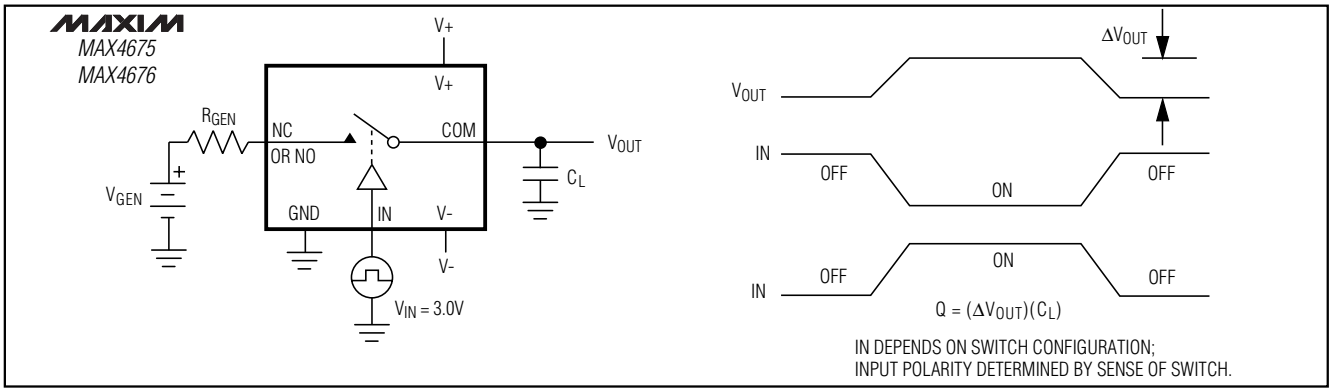


Figure 3. Charge Injection

3Ω Single SPST Analog Switches

Timing Diagrams/Test Circuits (continued)

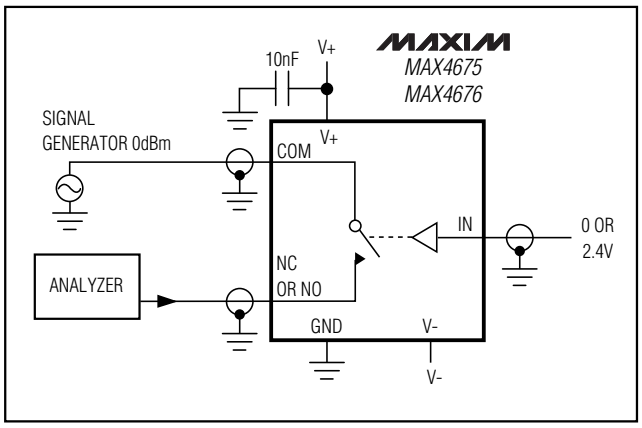


Figure 4. Off-Isolation/On-Channel Bandwidth

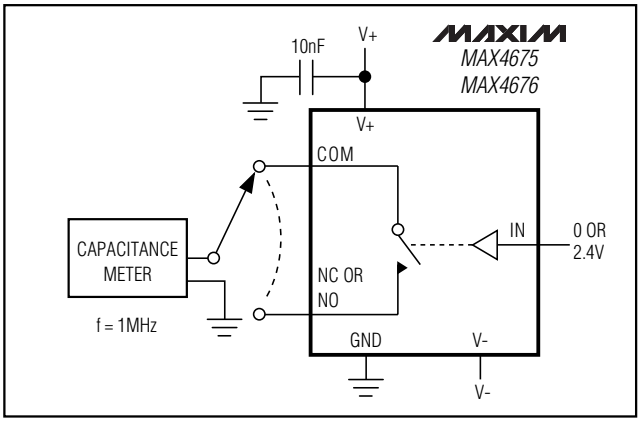
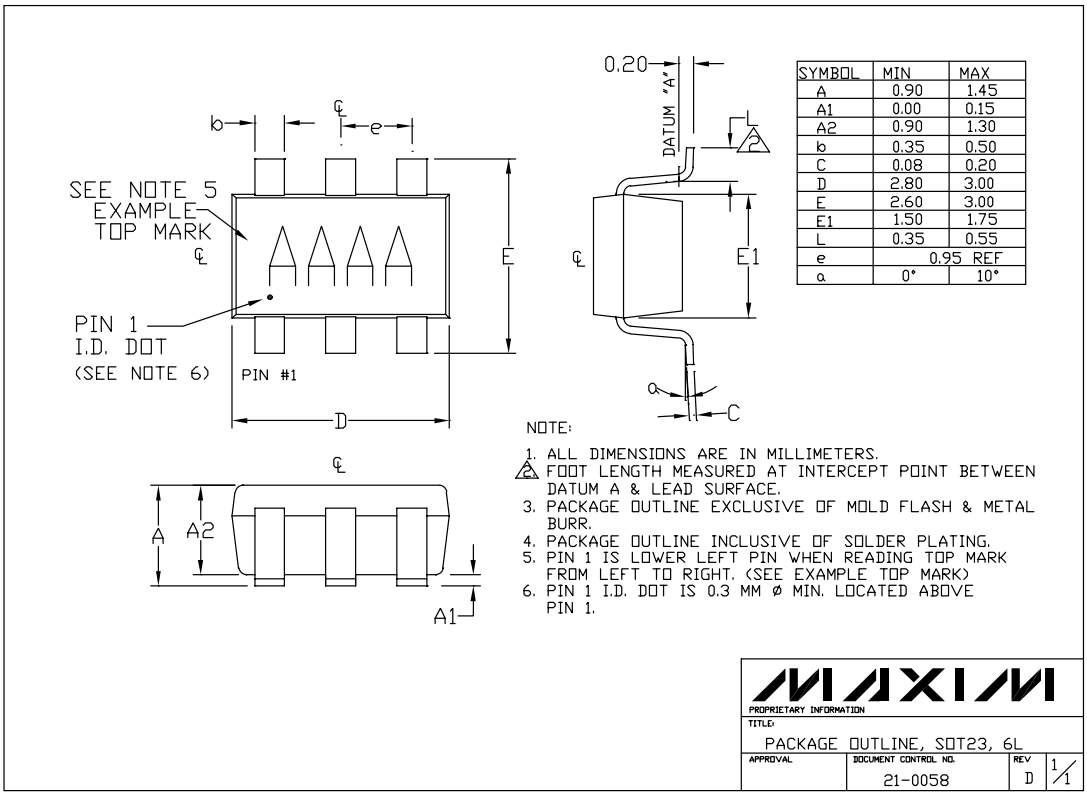


Figure 5. Channel On/Off-Capacitance

Package Information



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	
α	0°	10°

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MAX4675EUT+T MAX4676EUT+T MAX4675EUT