19-1880; Rev 1; 1/07

MAXIM

25Ω SPST Analog Switches in SOT23-6

General Description

The MAX4647/MAX4648 are dual-supply single-pole/single-throw (SPST) switches. On-resistance is 25Ω max and flat (2Ω max) over the specified signal range. Each switch can handle rail-to-rail analog signals. Off-leakage current is only 1nA max at +25°C. They conduct analog or digital signals equally well in either direction. The primary application areas are in the switching and routing of signals in telecommunications and test equipment.

The MAX4647/MAX4648 are single SPST analog switches. The MAX4647 has one normally closed (NC) switch, and the MAX4648 has one normally open (NO) switch. These devices operate from a single +9V to +36V supply or from dual ±4.5V to ±20V supplies. The MAX4647/MAX4648 are available in tiny 6-pin SOT23 packages.

Applications

PBX, PABX Systems
Communication Systems
DSL
Test Equipment
Avionics
Audio Systems
Redundant Systems
Relay Replacement
PC Multimedia Boards

Features

- **Low On-Resistance 25Ω max (±15V Supplies)**
- **Guaranteed R_{ON} Flatness Over Specified Signal Range (2Ω max)**
- **V_L Logic Supply Not Required**
- **Rail-to-Rail Signal Handling**
- **±15V and Single 12V Supply Operation**
- **Low Leakage (1nA max)**
- **Fast Switching Speeds**
  t_{ON} = 100ns
  t_{OFF} = 100ns

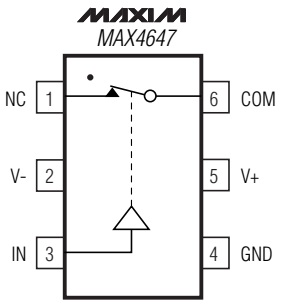
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK	PKG CODE
MAX4647EUT-T+	-40°C to +85°C	6 SOT23	AARV	U6SN-1
MAX4648EUT-T+	-40°C to +85°C	6 SOT23	AARW	U6SN-1

+Denotes a lead-free package.

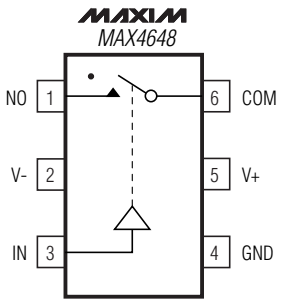
Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW



SOT23-6

LOGIC	SWITCH
0	ON
1	OFF



SOT23-6

LOGIC	SWITCH
0	OFF
1	ON

25Ω SPST Analog Switches in SOT23-6

ABSOLUTE MAXIMUM RATINGS

(Voltages referenced to GND)
V+ .....-0.3V, +44.0V
V- .....-44.0V, +0.3V
V+ to V-.....-0.3V to +44.0V
All Other Pins (Note 1).....V- - 0.3V to V+ + 0.3V
Continuous Current into Any Terminal.....±60mA
Peak Current into Any Terminal
(pulsed at 1ms, 10% duty cycle).....±100mA

Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23 (derate 8.7mW/°C above +70°C).....696mW
Operating Temperature Ranges
MAX464_EUT.....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature.....+150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Signals on NO, NC, COM, or IN exceeding V+ or V- 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—Dual ±15V Supplies

(V+ = +15V, V- = -15V, 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	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{NO},V_{NC}, V_{COM}			V-		V+	V
On-Resistance	R_{ON}	I_{COM} = 10mA; V_{NO} or V_{NC} = ±10V	+25°C		18	25	Ω
			T_{MIN} to T_{MAX}			30	
On-Resistance Flatness (Note 4)	$R_{FLAT(ON)}$	I_{COM} = 10mA; V_{NO} or V_{NC} = +5V, 0, -5V	+25°C		0.8	2	Ω
			T_{MIN} to T_{MAX}			3	
NO or NC Off-Leakage Current	$I_{NO(OFF)}$ or $I_{NC(OFF)}$	V_{NO} or V_{NC} = +14V, -14V; V_{COM} = -14V, +14V	+25°C	-1	0.01	1	nA
			T_{MIN} to T_{MAX}	-10		10	
COM Off-Leakage Current	$I_{COM(OFF)}$	V_{COM} = -14V, +14V; V_{NO} or V_{NC} = +14V, -14V	+25°C	-1	0.01	1	nA
			T_{MIN} to T_{MAX}	-10		10	
COM On-Leakage Current	$I_{COM(ON)}$	V_{COM} = +14V, -14V; V_{NO} or V_{NC} = +14V, -14V or floating	+25°C	-2		2	nA
			T_{MIN} to T_{MAX}	-20		20	
LOGIC INPUT							
Input Logic High	V_{IH}		T_{MIN} to T_{MAX}	2.4			V
Input Logic Low	V_{IL}		T_{MIN} to T_{MAX}			0.8	V
Input Leakage Current	I_{IN}	V_{IN} = 0 or +5V	T_{MIN} to T_{MAX}	-1		1	µA
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = ±10V; R_L = 300Ω; C_L = 35pF; Figure 2	+25°C		68	100	ns
			T_{MIN} to T_{MAX}			125	
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = ±10V; R_L =300Ω; C_L = 35pF; Figure 2	+25°C		62	100	ns
			T_{MIN} to T_{MAX}			125	
Charge Injection	Q	COM = 0; R_S = 0; C_L = 1nF; Figure 3	+25°C		4		pC

ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V, V- = -15V, 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	T_A	MIN	TYP	MAX	UNITS
Off-Isolation	V_{ISO}	C_L = 5pF; R_L = 50Ω; f = 1MHz; V_{COM} = $1V_{RMS}$; Figure 4	+25°C		-92		dB
Total Harmonic Distortion	THD	R_L = 600Ω, 5Vp-p, f = 20Hz to 20kHz	+25°C		0.006		%
V_{NO} or V_{NC} Off-Capacitance	$C_{NO(OFF)}$, $C_{NC(OFF)}$	f = 1MHz; Figure 5	+25°C		6		pF
COM Off-Capacitance	$C_{COM(OFF)}$	f = 1MHz; Figure 5	+25°C		6		pF
COM On-Capacitance	$C_{COM(ON)}$	f = 1MHz; Figure 6	+25°C		19		pF
POWER SUPPLY							
Power Supply Range			T_{MIN} to T_{MAX}	±4.5		±20	V
Positive Supply Current	I+	V_{IN} = 5V	+25°C		45	100	µA
			T_{MIN} to T_{MAX}			150	
		V_{IN} = 0 or V+	+25°C		0.001	1	
			T_{MIN} to T_{MAX}			10	
Negative Supply Current	I-	V_{IN} = 0 or 5V	+25°C		0.001	1	µA
			T_{MIN} to T_{MAX}			10	

ELECTRICAL CHARACTERISTICS—Single +12V Supply

(V+ = +12V, V- = 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	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			0		V+	V
On-Resistance	R_{ON}	I_{COM} = 10mA; V_{NO} or V_{NC} = +10V	+25°C		36	45	Ω
			T_{MIN} to T_{MAX}			60	
On-Resistance Flatness (Note 4)	$R_{FLAT(ON)}$	I_{COM} = 10mA; V_{NO} or V_{NC} = +2V, +6V, +10V	+25°C		4	6	Ω
			T_{MIN} to T_{MAX}			8	
DYNAMIC							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = +10V; R_L = 300Ω; C_L = 35pF; Figure 2	+25°C		100	175	ns
			T_{MIN} to T_{MAX}			225	
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = +10V; R_L = 300Ω; C_L = 35pF; Figure 2	+25°C		68	150	ns
			T_{MIN} to T_{MAX}			200	
Charge Injection	Q	COM = 0; R_S = 0; C_L = 1nF; Figure 3	+25°C		-5		pC

25Ω SPST Analog Switches in SOT23-6

ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(V+ = +12V, V- = 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	T_A	MIN	TYP	MAX	UNITS
Power Supply Range			T_{MIN} to T_{MAX}	+9		+36	V
Positive Supply Current	I+	V_{IN} = 5V	+25°C		20	50	µA
			T_{MIN} to T_{MAX}			75	
		V_{IN} = 0 or V+	+25°C		0.001	1	
			T_{MIN} to T_{MAX}			10	

Note 2: The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

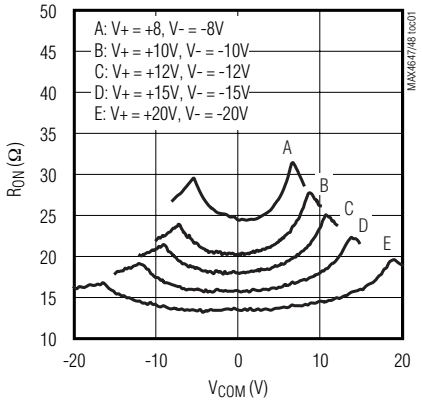
Note 3: SOT packaged parts are 100% tested at +25°C. Limits across the full temperature range are guaranteed by design and correlation.

Note 4: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

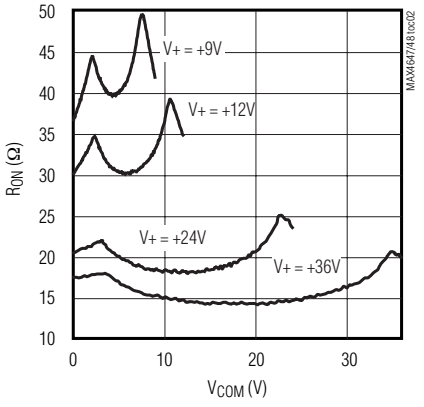
Typical Operating Characteristics

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

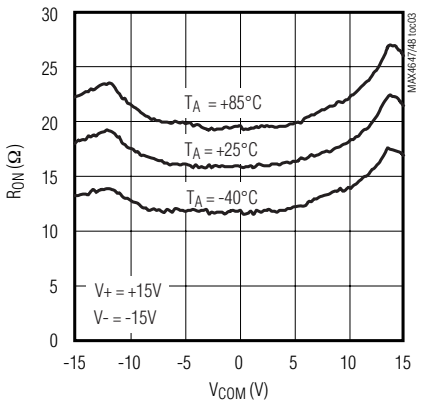
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



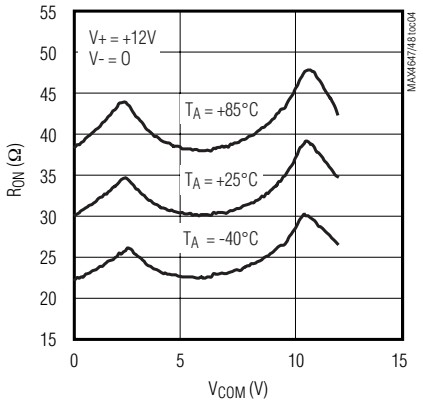
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



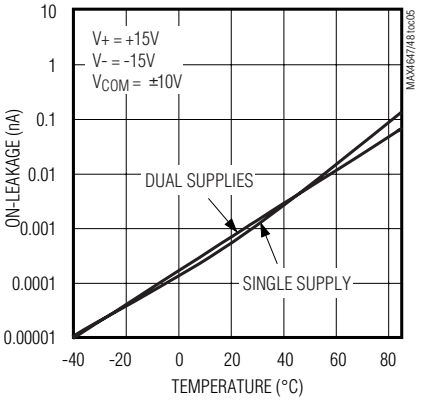
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (DUAL SUPPLIES)



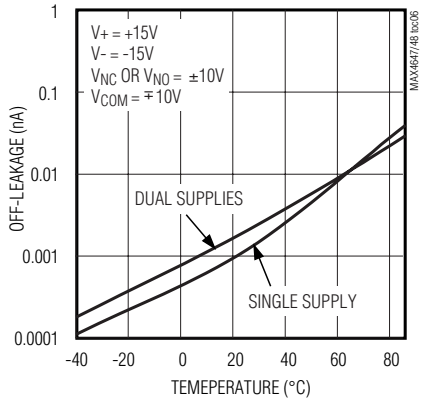
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (SINGLE SUPPLY)



ON-LEAKAGE CURRENT vs. TEMPERATURE



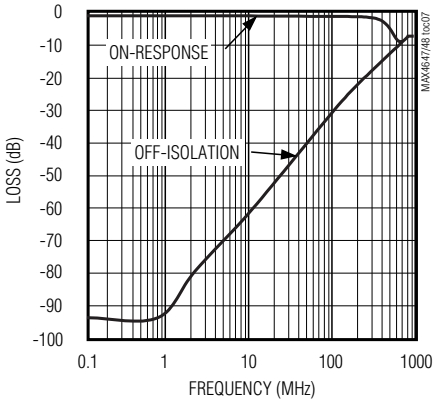
OFF-LEAKAGE CURRENT vs. TEMPERATURE



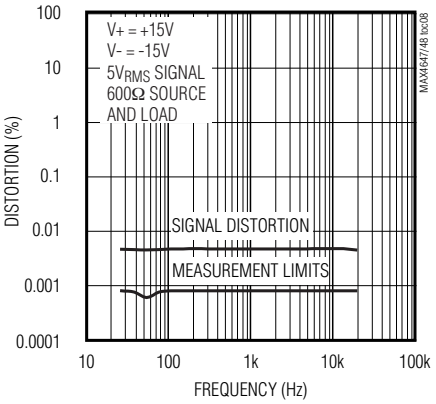
Typical Operating Characteristics (continued)

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

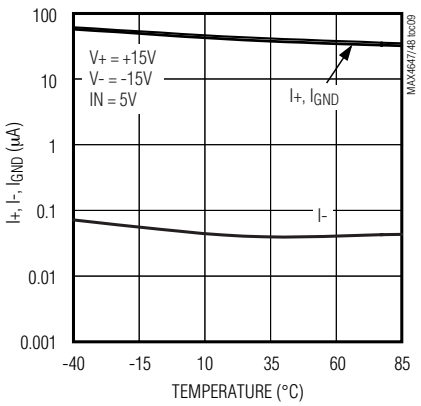
FREQUENCY RESPONSE



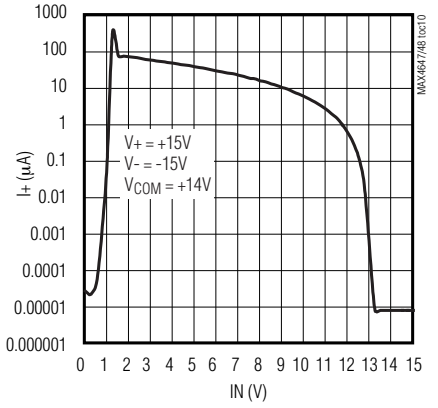
TOTAL HARMONIC DISTORTION vs.FREQUENCY



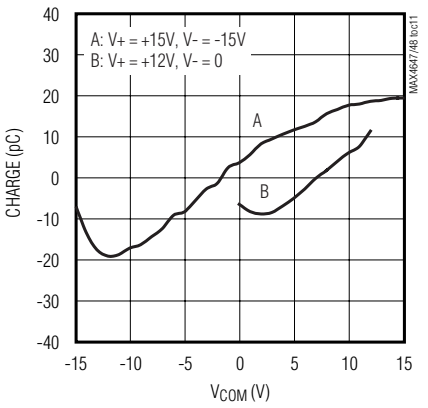
SUPPLY CURRENT vs. TEMPERATURE



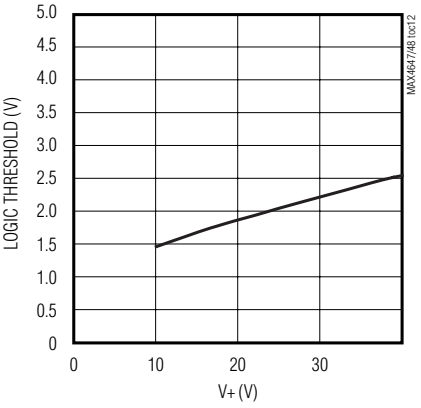
SUPPLY CURRENT vs. LOGIC THRESHOLD



CHARGE INJECTION vs. V_{COM}



LOGIC THRESHOLD vs. SUPPLY VOLTAGE



Pin Description

MAX4647	MAX4648	PIN NAME	FUNCTION
1	—	NC	Normally Closed Switch Terminal
—	1	NO	Normally Open Switch Terminal
2	2	V-	Negative Supply Voltage Input
3	3	IN	Digital Control Input
4	4	GND	Ground
5	5	V+	Positive Supply Voltage Input
6	6	COM	Analog Switch Common

25Ω SPST Analog Switches in SOT23-6

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 power-supply sequencing is not possible, add two small signal diodes (D1, D2) in series with 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 44V. These protection diodes are not recommended when using a single supply.

Off-Isolation at High Frequencies

In 50Ω systems, the high-frequency on-response of these parts extends from DC to above 300MHz, with a typical loss of -2dB. When the switch is turned off, however, it behaves like a capacitor, and off-isolation decreases with increasing frequency. This effect is more pronounced with higher source and load impedances. Above 5MHz, circuit board layout becomes critical. The graphs shown in the *Typical Operating Characteristics* were taken using a 50Ω source and load connected with BNC connectors.

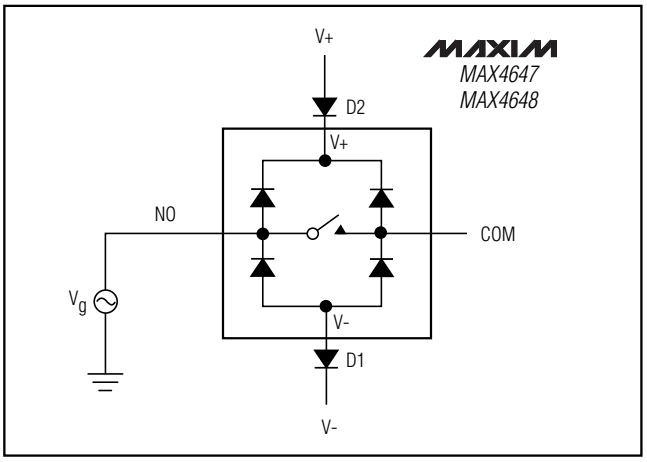


Figure 1. Overvoltage Protection Using External Blocking Diodes

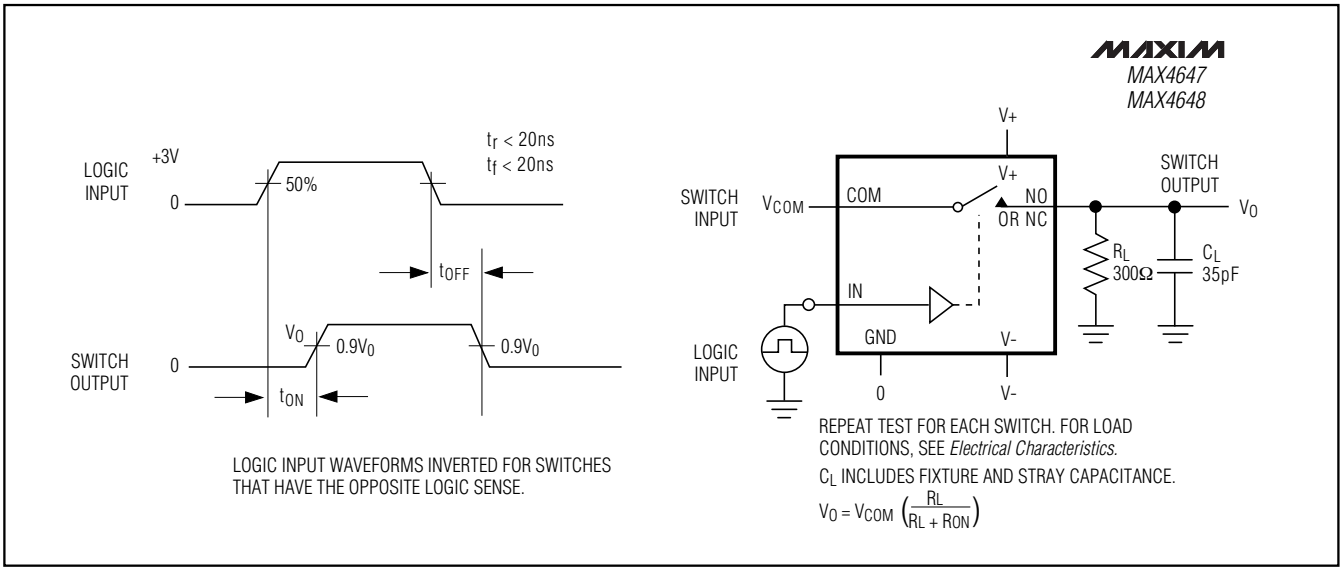


Figure 2. Switching-Time Test Circuit

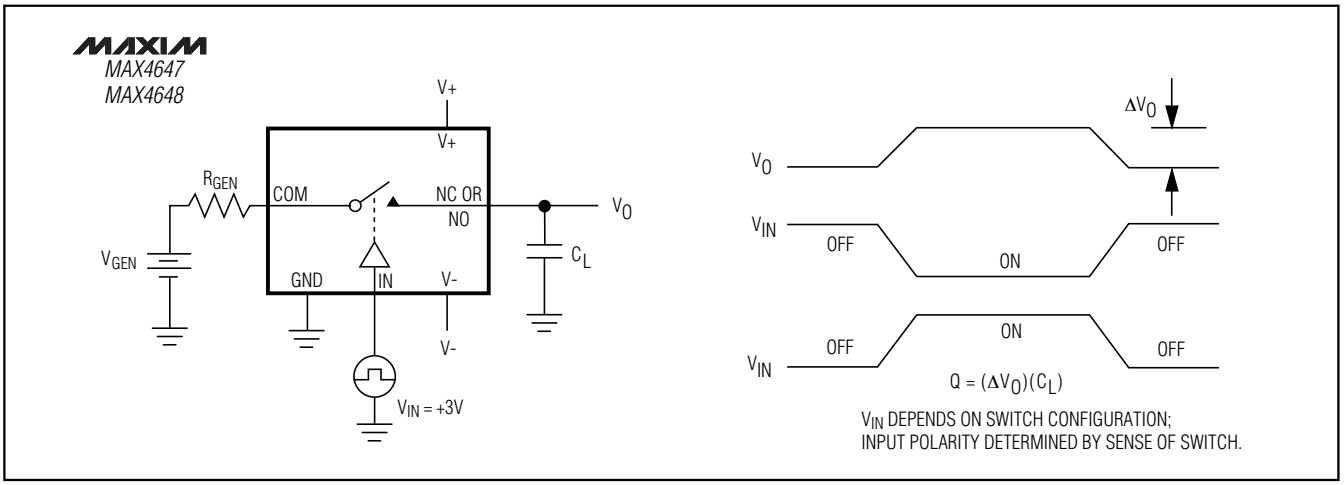


Figure 3. Charge Injection Test Circuit

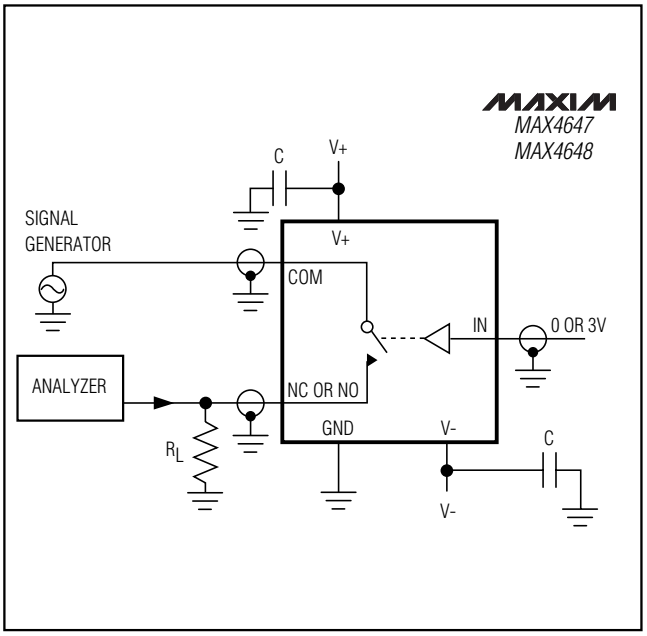


Figure 4. Off-Isolation Test Circuit

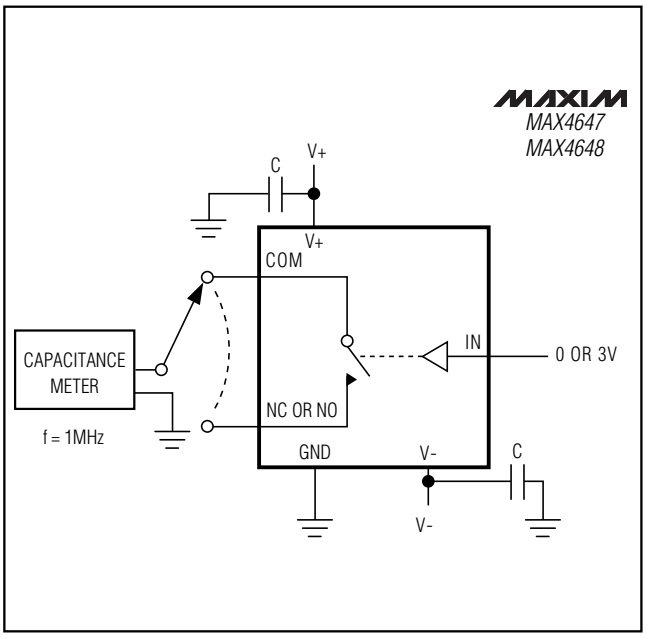


Figure 5. Channel-Off Capacitance Test Circuit

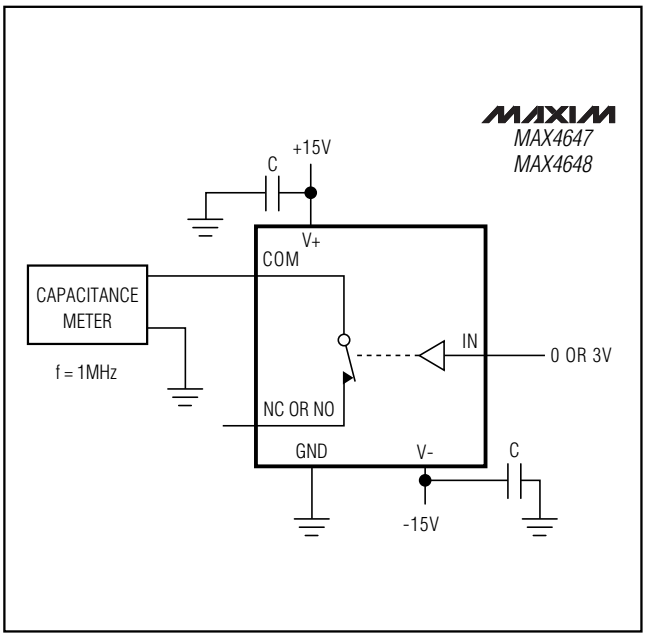


Figure 6. Channel-On Capacitance Test Circuit

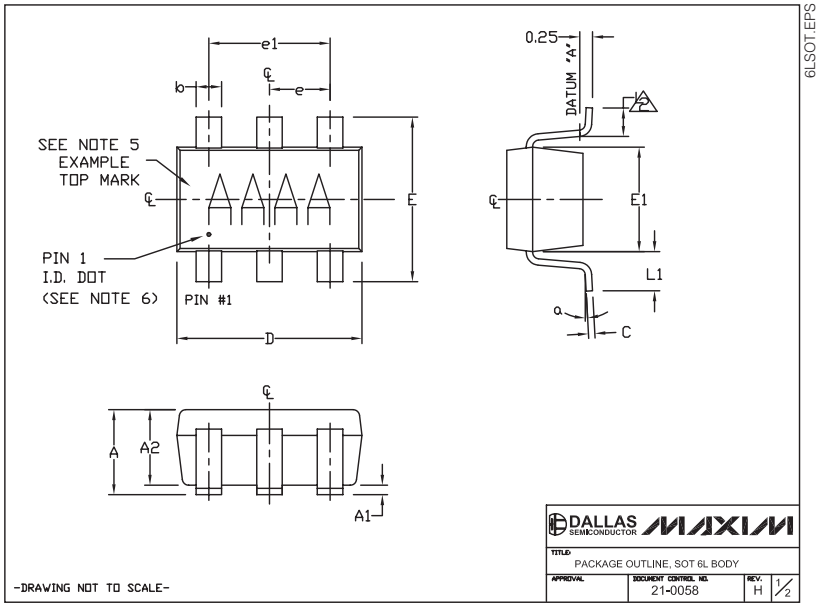
Chip Information

TRANSISTOR COUNT: 24

PROCESS TECHNOLOGY: CMOS

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**.)



NOTES:
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. MOLD FLASH, PROTRUSION OR METAL BURR SHOULD NOT EXCEED 0.25 MM.
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.
7. MEETS JEDEC MO178, VARIATION AB.
8. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEADTIP.
9. LEAD TO BE COPLANAR WITHIN 0.1 MM.
10. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.

SYMBOL	MIN	NOMINAL	MAX
A	0.90	1.25	1.45
A1	0.00	0.05	0.15
A2	0.90	1.10	1.30
b	0.35	0.40	0.50
C	0.08	0.15	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.625	1.75
L	0.35	0.45	0.60
L1		0.60 REF.	
e1		1.90 BSC.	
e		0.95 BSC.	
a	0°	2.5°	10°

PKG CODES:
U6-1, U6-2, U6-4, U6C-8, U6CN-1, U6CN-2, U6S-3, U6F-5, U6F-6, U6FH-5, U6FH-6

-DRAWING NOT TO SCALE-
DALLAS SEMICONDUCTOR MAXIM
TITLE: PACKAGE OUTLINE, SOT 6L BODY
APPROVAL
DOCUMENT CONTROL NO. 21-0058
REV. H
2/2

Revision History

Pages changed at Rev 1: 1, 9

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.