



# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## General Description

The MAX4541–MAX4544 are precision, dual analog switches designed to operate from a single +2.7V to +12V supply. Low power consumption (5μW) makes these parts ideal for battery-powered equipment. These switches offer low leakage currents (100pA max) and fast switching speeds ( $t_{ON}$  = 150ns max,  $t_{OFF}$  = 100ns max).

When powered from a +5V supply, the MAX4541–MAX4544 offer 2Ω max matching between channels, 60Ω max on-resistance ( $R_{ON}$ ), and 6Ω max  $R_{ON}$  flatness.

These switches also offer 5pC max charge injection and a minimum of 2000V ESD protection per Method 3015.7.

The MAX4541/MAX4542/MAX4543 are dual single-pole/single-throw (SPST) devices and the MAX4544 is a single-pole/double-throw (SPDT) device. The MAX4541 has two normally open (NO) switches and the MAX4542 has two normally closed (NC) switches. The MAX4543 has one NO and one NC switch and can be used as an SPDT, while the MAX4544 is an SPDT. The MAX4541/MAX4542/MAX4543 are available in tiny SOT23-8 and 8-pin TDFN packages, and the MAX4544 is available in a SOT23-6 package.

## Applications

|                              |                        |
|------------------------------|------------------------|
| Battery-Operated Systems     | Test Equipment         |
| Sample-and-Hold Circuits     | Communications Systems |
| Heads-Up Displays            | +3V/+5V DACs and ADCs  |
| Guidance and Control Systems | PBX, PABX              |
| Audio and Video Switching    | Cell Phones            |
| Military Radios              | Ultrasound             |
|                              | Pagers                 |

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## Features

- ♦ 60Ω max (33Ω typ) Low  $R_{ON}$
- ♦ 2Ω max  $R_{ON}$  Matching Between Channels
- ♦ 6Ω max  $R_{ON}$  Flatness
- ♦ 5pC max Guaranteed Charge Injection
- ♦ +2.7V to +12V Single-Supply Operation
- ♦ < 5μW Low Power Consumption
- ♦ Low Leakage Current Over Temperature: 10nA max at +85°C
- ♦ Fast Switching:  $t_{ON}$  = 35ns,  $t_{OFF}$  = 25ns
- ♦ Guaranteed Break-Before-Make (MAX4543/MAX4544 Only)
- ♦ TTL/CMOS-Logic Compatible
- ♦ Pin Compatible with MAX323/MAX324/MAX325
- ♦ MAX4541/MAX4542/MAX4543 Available in SOT23-8  
MAX4544 Available in SOT23-6

## Ordering Information

| PART         | TEMP RANGE     | PIN-PACKAGE   | TOP MARK |
|--------------|----------------|---------------|----------|
| MAX4541CUA   | 0°C to +70°C   | 8 μMAX®       | —        |
| MAX4541CSA   | 0°C to +70°C   | 8 SO          | —        |
| MAX4541CPA   | 0°C to +70°C   | 8 Plastic DIP | —        |
| MAX4541C/D   | 0°C to +70°C   | Dice*         | —        |
| MAX4541EKA-T | -40°C to +85°C | 8 SOT23-8     | AAAE     |
| MAX4541ETA   | -40°C to +85°C | 8 TDFN-EP**   | —        |
| MAX4541EUA   | -40°C to +85°C | 8 μMAX        | —        |
| MAX4541ESA   | -40°C to +85°C | 8 SO          | —        |

Ordering Information continued at end of data sheet.

\*Dice are specified at  $T_A$  = +25°C.

\*\*EP = Exposed pad.

## Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW

μMAX/SO/DIP/TDFN

SOT23-6\*

AAAM

N.C. = NOT INTERNALLY CONNECTED  
MAX4541/MAX4542/MAX4543  
APPEAR AT END OF DATA SHEET.

| MAX4544 |     |     |
|---------|-----|-----|
| LOGIC   | NC  | NO  |
| 0       | ON  | OFF |
| 1       | OFF | ON  |

SWITCHES SHOWN FOR "0" INPUT

\*NOTE: SOT23-6 PACKAGE HAS LETTERING NEAREST PIN 6



# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to GND

|                                                                                                           |                           |
|-----------------------------------------------------------------------------------------------------------|---------------------------|
| V+                                                                                                        | .....-0.3V to +13V        |
| IN <sub>-</sub> , COM <sub>-</sub> , NC <sub>-</sub> , NO <sub>-</sub> (Note 1)                           | .....-0.3V to (V+ + 0.3V) |
| Continuous Current (any terminal)                                                                         | .....±10mA                |
| Peak Current, COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub><br>(pulsed at 1ms, 10% duty cycle max) | .....±20mA                |
| ESD per Method 3015.7                                                                                     | .....> 2000V              |
| Continuous Power Dissipation                                                                              |                           |
| SOT23-6 (derate 7.1mW/°C above +70°C)                                                                     | .....571mW                |
| SOT23-8 (derate 5.3mW/°C above +70°C)                                                                     | .....421mW                |

|                                            |                      |
|--------------------------------------------|----------------------|
| TDFN (derate 24.4mW/°C above +70°C)        | .....1951mW          |
| μMAX (derate 4.10mW/°C above +70°C)        | .....330mW           |
| Narrow SO (derate 5.88mW/°C above +70°C)   | .....471mW           |
| Plastic DIP (derate 9.09mW/°C above +70°C) | .....727mW           |
| Operating Temperature Ranges               |                      |
| MAX454_C_                                  | .....0°C to +70°C    |
| MAX454_E_                                  | .....-40°C to +85°C  |
| Storage Temperature Range                  | .....-65°C to +150°C |
| Lead Temperature (soldering, 10s)          | .....+300°C          |

**Note 1:** Signals on NC<sub>-</sub>, NO<sub>-</sub>, COM<sub>-</sub>, or IN<sub>-</sub> 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—Single +5V Supply

(V+ = +5V ±10%, GND = 0, 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.) (Notes 2, 3)

| PARAMETER                                        | SYMBOL                                                           | CONDITIONS                                                                                                          |                                                          |      | MIN  | TYP   | MAX  | UNITS |
|--------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------|------|-------|------|-------|
| ANALOG SWITCH                                    |                                                                  |                                                                                                                     |                                                          |      |      |       |      |       |
| Analog Signal Range                              | V <sub>COM_-</sub> ,<br>V <sub>NO_-</sub> ,<br>V <sub>NC_-</sub> | (Note 4)                                                                                                            |                                                          |      | 0    |       | V+   | V     |
| On-Resistance                                    | R <sub>ON</sub>                                                  | V+ = 4.5V,<br>I <sub>COM_-</sub> = 1.0mA,<br>V <sub>NO_-</sub> or V <sub>NC_-</sub> = 3.5V                          | T <sub>A</sub> = +25°C                                   |      | 30   | 60    | Ω    |       |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>    |      |      | 75    |      |       |
| On-Resistance Match<br>Between Channels (Note 5) | ΔR <sub>ON</sub>                                                 | V+ = 5V,<br>I <sub>COM_-</sub> = 1.0mA,<br>V <sub>NO_-</sub> or V <sub>NC_-</sub> = 3.5V                            | T <sub>A</sub> = +25°C                                   |      | 0.8  | 2     | Ω    |       |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>    |      |      | 4     |      |       |
| On-Resistance Flatness<br>(Note 6)               | R <sub>FLAT(ON)</sub>                                            | V+ = 5V;<br>I <sub>COM_-</sub> = 1.0mA; V <sub>NO_-</sub> or<br>V <sub>NC_-</sub> = 1V, 2V, 3V                      | T <sub>A</sub> = +25°C                                   |      | 2    | 6     | Ω    |       |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>    |      |      | 8     |      |       |
| NO_- or NC_- Off-Leakage<br>Current (Note 7)     | I <sub>NO(OFF)</sub><br>or<br>I <sub>NC(OFF)</sub>               | V+ = 5.5V;<br>V <sub>COM_-</sub> = 1V, 4.5V;<br>V <sub>NO_-</sub> or V <sub>NC_-</sub> = 4.5V, 1V                   | T <sub>A</sub> = +25°C                                   |      | -0.1 | ±0.01 | +0.1 | nA    |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub><br>to T <sub>MAX</sub> | C, E | -5   |       | +5   |       |
| COM_- Off-Leakage Current<br>(Note 7)            | I <sub>COM(OFF)</sub>                                            | V+ = 5.5V;<br>V <sub>COM_-</sub> = 4.5V, 1V;<br>V <sub>NO_-</sub> or V <sub>NC_-</sub> = 1V, 4.5V                   | T <sub>A</sub> = +25°C                                   |      | -0.1 |       | +0.1 | nA    |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub><br>to T <sub>MAX</sub> | C, E | -5   |       | +5   |       |
| COM_- On-Leakage Current<br>(Note 7)             | I <sub>COM(ON)</sub>                                             | V+ = 5.5V;<br>V <sub>COM_-</sub> = 1V, 4.5V or<br>V <sub>NO_-</sub> or V <sub>NC_-</sub> = 1V,<br>4.5V, or floating | T <sub>A</sub> = +25°C                                   |      | -0.2 |       | +0.2 | nA    |
|                                                  |                                                                  |                                                                                                                     | T <sub>A</sub> = T <sub>MIN</sub><br>to T <sub>MAX</sub> | C, E | -10  |       | +10  |       |

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## 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 |
|---------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----|---------|-----|-------|
| DYNAMIC                               |                       |                                                                                                      |                                                       |     |         |     |       |
| Turn-On Time                          | t <sub>ON</sub>       | V <sub>NO_</sub> or V <sub>NC_</sub> = 3V, Figure 2                                                  | T <sub>A</sub> = +25°C                                |     | 35      | 100 | ns    |
|                                       |                       |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |         | 240 |       |
| Turn-Off Time                         | t <sub>OFF</sub>      | V <sub>NO_</sub> or V <sub>NC_</sub> = 3V, Figure 2                                                  | T <sub>A</sub> = +25°C                                |     | 25      | 75  | ns    |
|                                       |                       |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |         | 150 |       |
| Break-Before-Make Time Delay (Note 4) | t <sub>D</sub>        | MAX4543/MAX4544 only, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF                                   |                                                       | 2   | 10      |     | ns    |
| Charge Injection (Note 4)             | Q                     | C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, T <sub>A</sub> = +25°C, Figure 4 |                                                       |     | 1       | 5   | pC    |
| Off-Isolation (Note 8)                | OIRR                  | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, T <sub>A</sub> = +25°C, Figure 5               |                                                       |     | -76     |     | dB    |
| Crosstalk (Note 9)                    |                       | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, T <sub>A</sub> = +25°C, Figure 6               |                                                       |     | -90     |     | dB    |
| NC_ or NO_ Capacitance                | C <sub>OFF</sub>      | f = 1MHz, T <sub>A</sub> = +25°C, Figure 7                                                           |                                                       |     | 8       |     | pF    |
| COM_ Off-Capacitance                  | C <sub>COM(OFF)</sub> | f = 1MHz, T <sub>A</sub> = +25°C, Figure 7                                                           |                                                       |     | 8       |     | pF    |
| COM_ On-Capacitance                   | C <sub>COM(ON)</sub>  | f = 1MHz, T <sub>A</sub> = +25°C, Figure 7                                                           | MAX4541/MAX4542/ MAX4543                              |     | 13      |     | pF    |
|                                       |                       |                                                                                                      | MAX4544                                               |     | 20      |     |       |
| SUPPLY                                |                       |                                                                                                      |                                                       |     |         |     |       |
| Power-Supply Range                    | V+                    |                                                                                                      |                                                       | 2.7 |         | 12  | V     |
| Positive Supply Current               | I+                    | V+ = 5.5V, V <sub>IN</sub> = 0 or V+, all channels on or off                                         |                                                       | -1  | ±0.0001 | +1  | μA    |
| LOGIC INPUT                           |                       |                                                                                                      |                                                       |     |         |     |       |
| Input-Voltage Low                     | V <sub>INL</sub>      |                                                                                                      |                                                       |     |         | 0.8 | V     |
| Input-Voltage High                    | V <sub>INH</sub>      |                                                                                                      |                                                       | 2.4 |         |     | V     |

MAX4541-MAX4544

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## ELECTRICAL CHARACTERISTICS—Single +3.3V Supply

(V+ = +3.0V to +3.6V, GND = 0, 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.) (Notes 2, 3)

| PARAMETER                             | SYMBOL                                                        | CONDITIONS                                                                                 |                                                       | MIN | TYP | MAX | UNITS |
|---------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------|-----|-----|-----|-------|
| ANALOG SWITCH                         |                                                               |                                                                                            |                                                       |     |     |     |       |
| Analog Signal Range                   | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> ,<br>V <sub>NC_</sub> | (Note 3)                                                                                   |                                                       | 0   |     | V+  | V     |
| Channel On-Resistance                 | R <sub>ON</sub>                                               | V+ = 3V,<br>I <sub>COM_</sub> = 1.0mA,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V      | T <sub>A</sub> = +25°C                                | 50  | 125 | Ω   |       |
|                                       |                                                               |                                                                                            | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 275 |     |       |
| DYNAMIC                               |                                                               |                                                                                            |                                                       |     |     |     |       |
| Turn-On Time (Note 3)                 | t <sub>ON</sub>                                               | V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                                                | T <sub>A</sub> = +25°C                                | 80  | 400 | ns  |       |
|                                       |                                                               |                                                                                            | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 500 |     |       |
| Turn-Off Time (Note 3)                | t <sub>OFF</sub>                                              | V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                                                | T <sub>A</sub> = +25°C                                | 50  | 125 | ns  |       |
|                                       |                                                               |                                                                                            | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 175 |     |       |
| Break-Before-Make Time Delay (Note 3) | t <sub>D</sub>                                                | MAX4543/MAX4544 only, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, T <sub>A</sub> = +25°C |                                                       | 2   | 30  | ns  |       |
| Charge Injection (Note 3)             | Q                                                             | C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, T <sub>A</sub> = +25°C |                                                       |     | 1   | 5   | pC    |
| SUPPLY                                |                                                               |                                                                                            |                                                       |     |     |     |       |
| Positive Supply Current               | I+                                                            | V+ = 3.6V, V <sub>IN</sub> = 0 or V+, all channels on or off                               |                                                       | -1  |     | +1  | μA    |

**Note 2:** QFN and SOT-packaged parts are 100% tested at +25°C only and guaranteed by correlation at the full hot rated temperature.

**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:** Guaranteed by design.

**Note 5:** ΔR<sub>ON</sub> = ΔR<sub>ON</sub> max - ΔR<sub>ON</sub> min.

**Note 6:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

**Note 7:** Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at +25°C.

**Note 8:** Off-isolation = 20 × log<sub>10</sub> [V<sub>COM</sub> / (V<sub>NC</sub> or V<sub>NO</sub>)], V<sub>COM</sub> = output, V<sub>NC</sub> or V<sub>NO</sub> = input to off switch.

**Note 9:** Between the two switches, MAX4541/MAX4542/MAX4543 only.

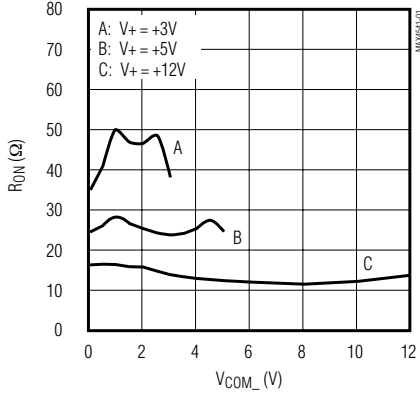
# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Typical Operating Characteristics

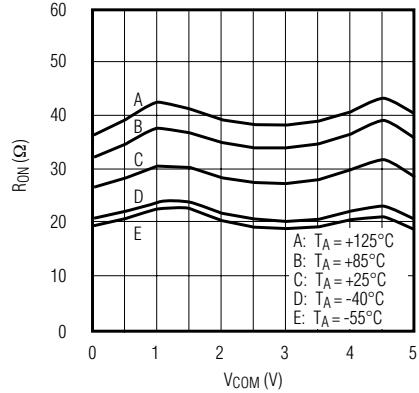
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

MAX4541-MAX4544

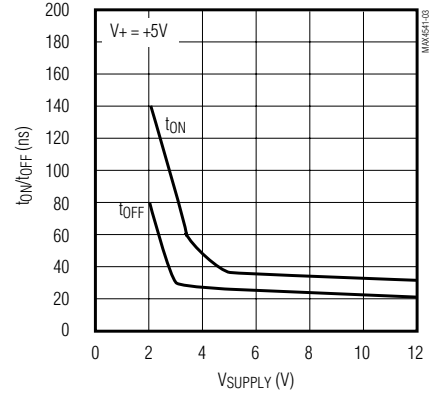
ON-RESISTANCE vs. COM\_ VOLTAGE



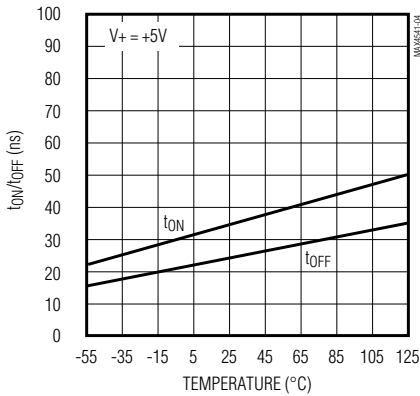
ON-RESISTANCE vs.  
COM VOLTAGE OVER TEMPERATURE



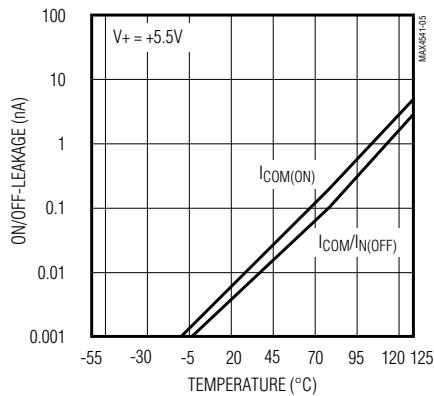
TURN-ON/OFF TIMES vs.  
SUPPLY VOLTAGE



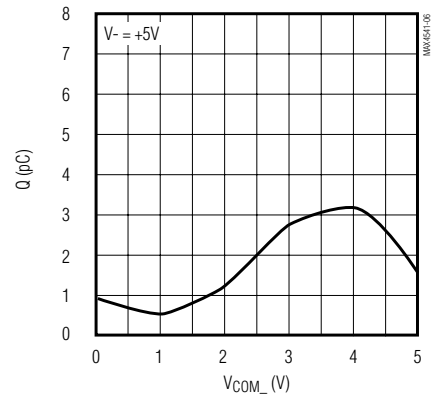
TURN-ON/OFF TIMES  
vs. TEMPERATURE



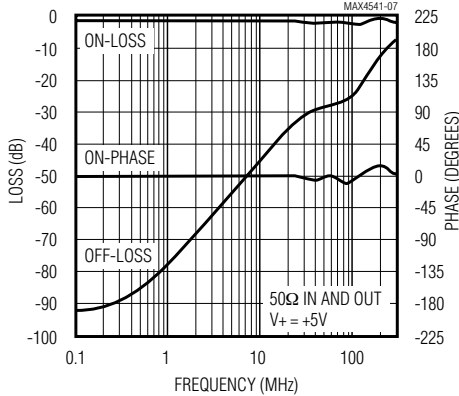
ON/OFF-LEAKAGE CURRENT  
vs. TEMPERATURE



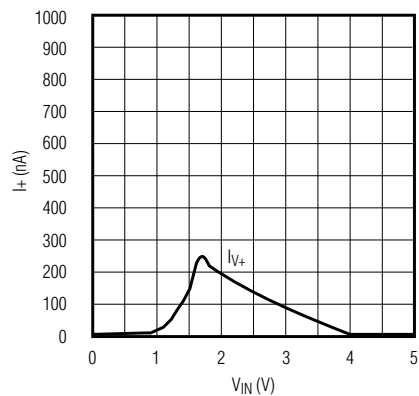
CHARGE INJECTION vs. COM\_ VOLTAGE



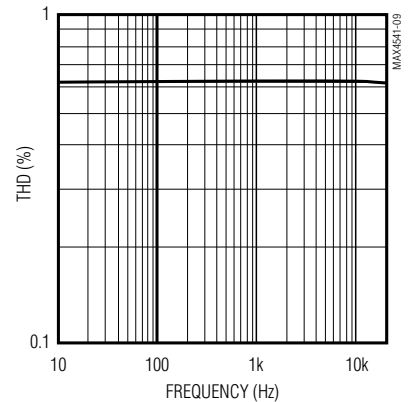
FREQUENCY RESPONSE



INPUT VOLTAGE vs. SUPPLY CURRENT



TOTAL HARMONIC DISTORTION  
vs. FREQUENCY



# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Pin Description

| PIN                      |         |                          |         |                          |         |                          |         | NAME | FUNCTION                        |
|--------------------------|---------|--------------------------|---------|--------------------------|---------|--------------------------|---------|------|---------------------------------|
| MAX4541                  |         | MAX4542                  |         | MAX4543                  |         | MAX4544                  |         |      |                                 |
| DIP/SO/<br>μMAX/<br>TDFN | SOT23-8 | DIP/SO/<br>μMAX/<br>TDFN | SOT23-8 | DIP/SO/<br>μMAX/<br>TDFN | SOT23-8 | DIP/SO/<br>μMAX/<br>TDFN | SOT23-6 |      |                                 |
| 1                        | 1       | —                        | —       | 1                        | 1       | —                        | —       | NO1  | Analog Switch 1—Normally Open   |
| 2                        | 8       | 2                        | 8       | 2                        | 8       | —                        | —       | COM1 | Analog Switch 1—Common          |
| 3                        | 3       | 3                        | 3       | 3                        | 3       | —                        | —       | IN2  | Digital Control Input 2         |
| 4                        | 6       | 4                        | 6       | 4                        | 6       | 4                        | 3       | GND  | Ground—Negative Supply Input    |
| 5                        | 5       | —                        | —       | —                        | —       | —                        | —       | NO2  | Analog Switch 2—Normally Open   |
| 6                        | 4       | 6                        | 4       | 6                        | 4       | —                        | —       | COM2 | Analog Switch 2—Common          |
| 7                        | 7       | 7                        | 7       | 7                        | 7       | —                        | —       | IN1  | Digital Control Input 1         |
| 8                        | 2       | 8                        | 2       | 8                        | 2       | 8                        | 2       | V+   | Positive Supply Voltage Input   |
| —                        | —       | 1                        | 1       | —                        | —       | —                        | —       | NC1  | Analog Switch 1—Normally Closed |
| —                        | —       | 5                        | 5       | 5                        | 5       | —                        | —       | NC2  | Analog Switch 2—Normally Closed |
| —                        | —       | —                        | —       | —                        | —       | 1                        | 6       | NO   | Analog Switch—Normally Open     |
| —                        | —       | —                        | —       | —                        | —       | 2                        | 5       | COM  | Analog Switch—Common            |
| —                        | —       | —                        | —       | —                        | —       | 3                        | 4       | NC   | Analog Switch—Normally Closed   |
| —                        | —       | —                        | —       | —                        | —       | 5, 6                     | —       | N.C. | Not Connected (Open Circuit)    |
| —                        | —       | —                        | —       | —                        | —       | 7                        | 1       | IN   | Digital Control Input           |
| EP                       | —       | EP                       | —       | EP                       | —       | EP                       | —       | EP   | Exposed Pad. Connect EP to V+.  |

## Applications Information

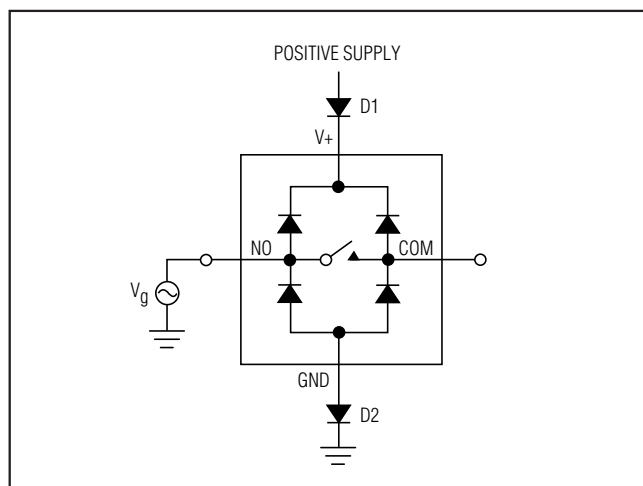


Figure 1. Overvoltage Protection Using Two External Blocking Diodes

## Logic Levels

The MAX4541–MAX4544 are TTL compatible when powered from a single +5V supply. When powered from other supply voltages, TTL compatibility is guaranteed and the logic inputs can be driven rail-to-rail. For example, with a +12V supply, IN1 and IN2 can be driven low to 0 and high to 12V. With a +3.3V supply, IN1 and IN2 should be driven low to 0 and high to 3.3V.

Driving IN1 and IN2 rail-to-rail minimizes power consumption.

## Analog Signal Levels

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

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Power-Supply Sequencing and Overvoltage Protection

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 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  $< 10\text{mA}$ , 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  $0.7\text{V}$ ) below  $V+$  (for D1), and to a diode drop above ground (for D2). Leakage is unaffected by adding the diodes. On-resistance increases by a small amount at low supply voltages. Maximum supply voltage ( $V+$ ) must not exceed  $13\text{V}$ .

Adding protection diodes causes the logic thresholds to be shifted relative to the power-supply rails. This can be significant when low supply voltages ( $+5\text{V}$  or less) are used. With a  $+5\text{V}$  supply, TTL compatibility is not guaranteed when protection diodes are added. Driving IN1 and IN2 all the way to the supply rails (i.e., to a diode drop higher than the  $V+$  pin, or to a diode drop lower than the GND pin) is always acceptable.

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.

MAX4541-MAX4544

## Test Circuits/Timing Diagrams

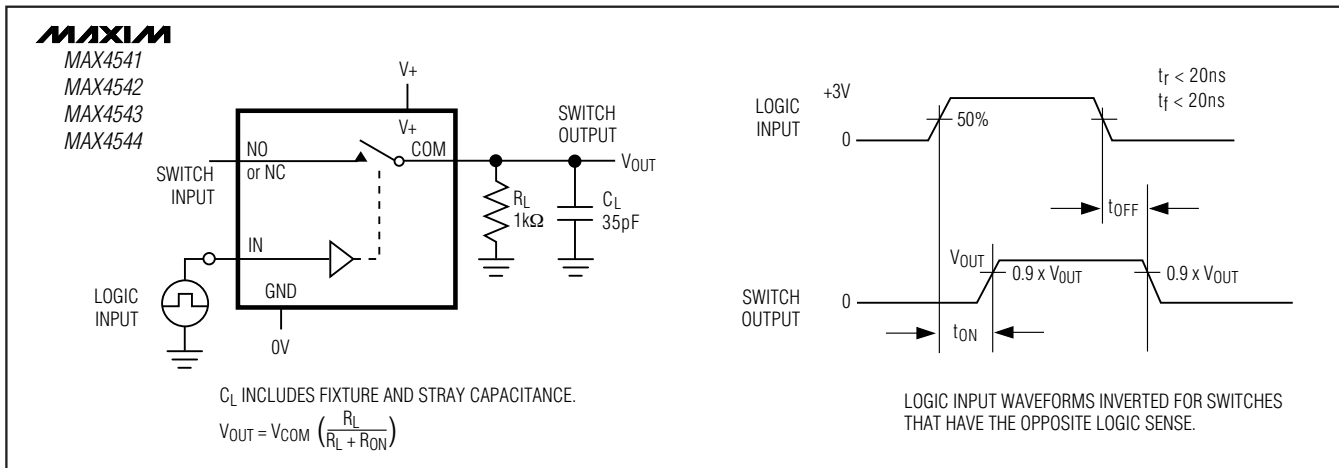


Figure 2. Switching Time

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Test Circuits/Timing Diagrams (continued)

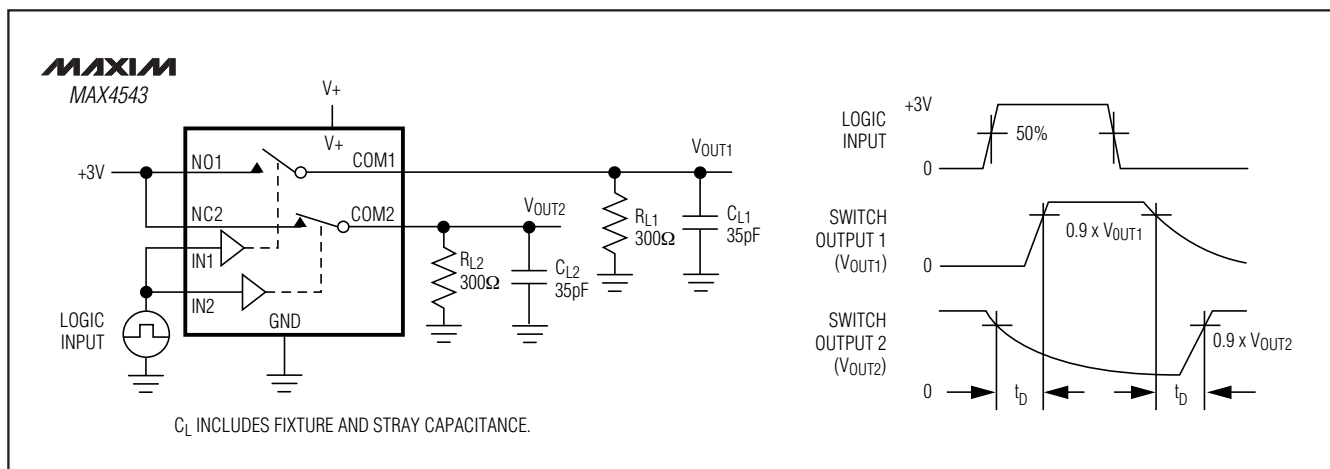


Figure 3a. Break-Before-Make Interval (MAX4543 Only)

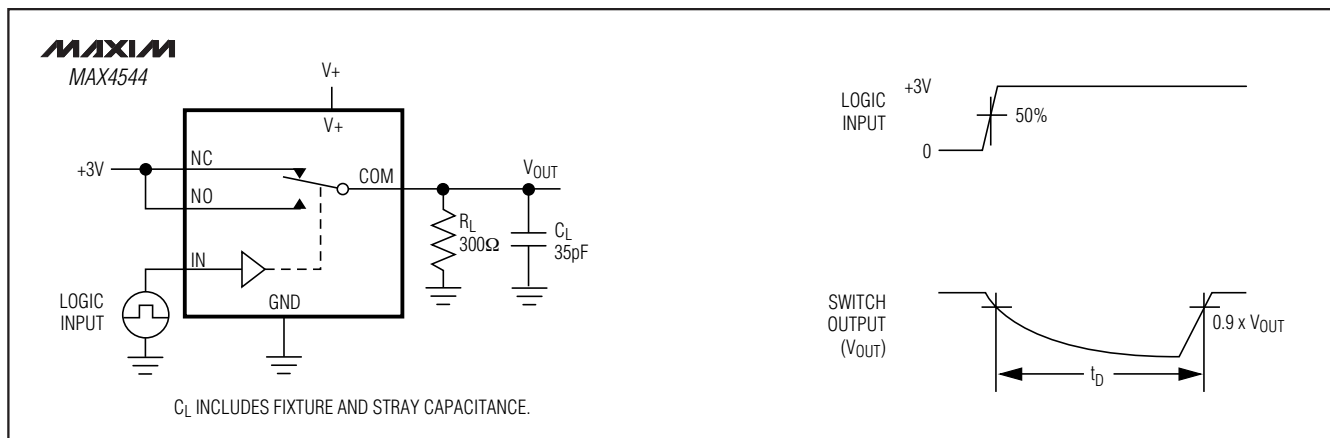


Figure 3b. Break-Before-Make Interval (MAX4544 Only)

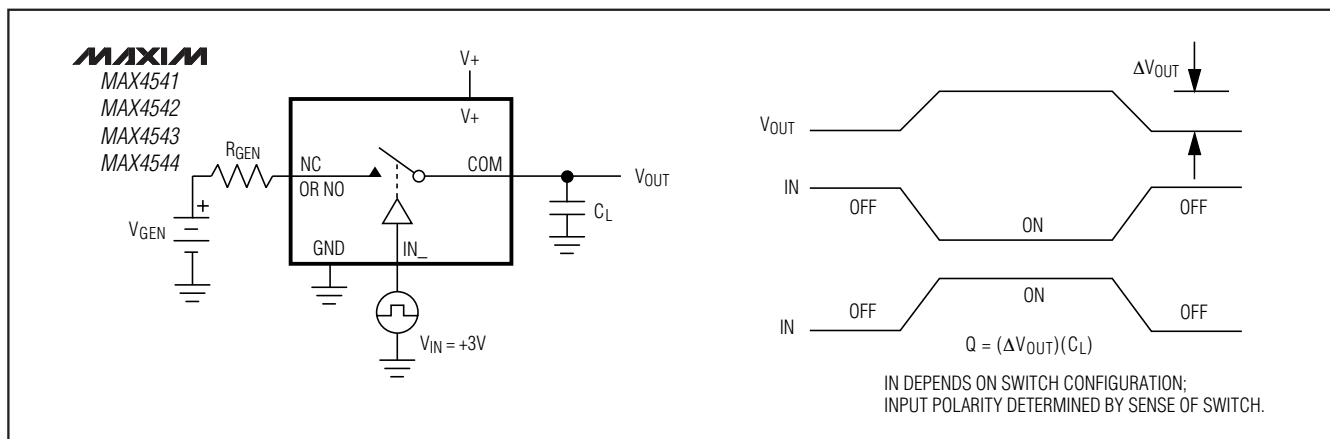


Figure 4. Charge Injection

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Test Circuits/Timing Diagrams (continued)

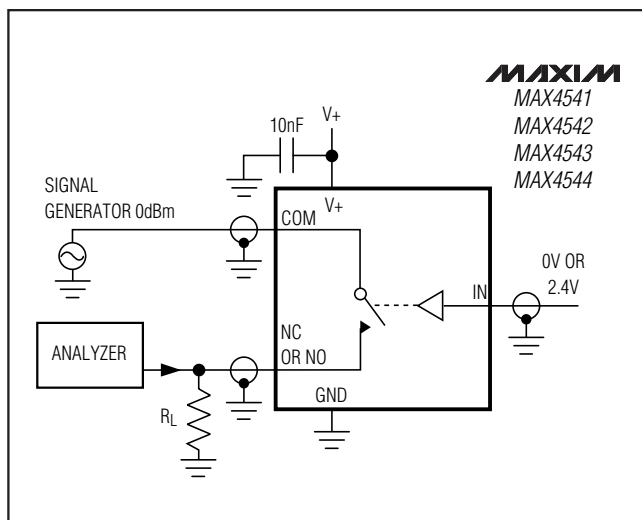


Figure 5. Off-Isolation

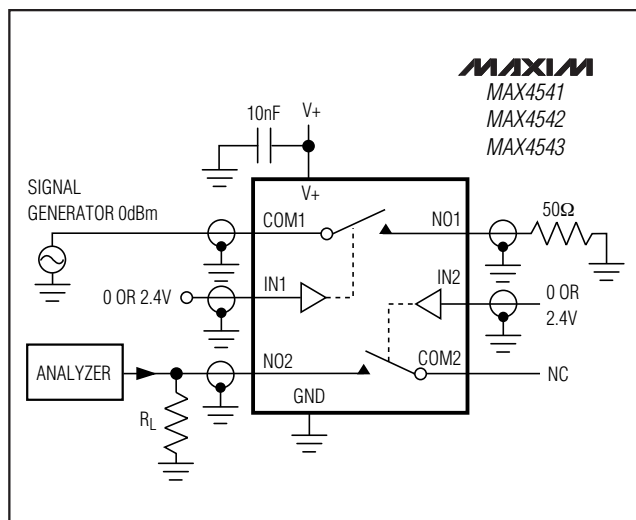


Figure 6. Crosstalk

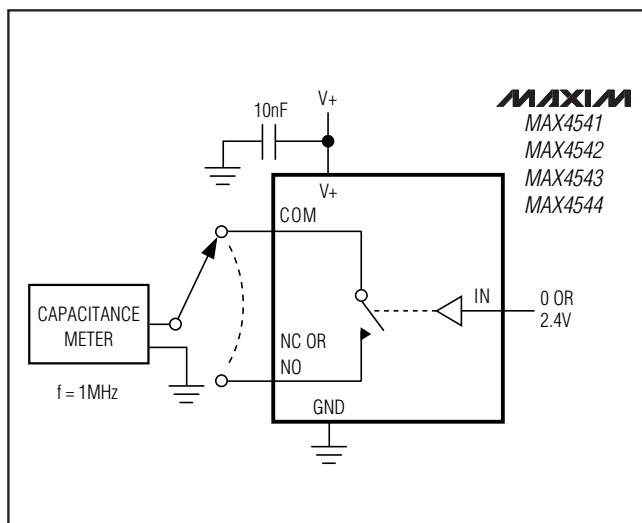


Figure 7. Channel Off/On-Capacitance

MAX4541-MAX4544

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Ordering Information (continued)

| PART              | TEMP RANGE     | PIN-PACKAGE   | TOP MARK |
|-------------------|----------------|---------------|----------|
| MAX4541EPA        | -40°C to +85°C | 8 Plastic DIP | —        |
| <b>MAX4542CUA</b> | 0°C to +70°C   | 8 $\mu$ MAX   | —        |
| MAX4542CSA        | 0°C to +70°C   | 8 SO          | —        |
| MAX4542CPA        | 0°C to +70°C   | 8 Plastic DIP | —        |
| MAX4542C/D        | 0°C to +70°C   | Dice*         | —        |
| MAX4542EKA-T      | -40°C to +85°C | 8 SOT23-8     | AAAF     |
| MAX4542ETA        | -40°C to +85°C | 8 TDFN-EP**   | —        |
| MAX4542EUA        | -40°C to +85°C | 8 $\mu$ MAX   | —        |
| MAX4542ESA        | -40°C to +85°C | 8 SO          | —        |
| MAX4542EPA        | -40°C to +85°C | 8 Plastic DIP | —        |
| <b>MAX4543CUA</b> | 0°C to +70°C   | 8 $\mu$ MAX   | —        |
| MAX4543CSA        | 0°C to +70°C   | 8 SO          | —        |
| MAX4543CPA        | 0°C to +70°C   | 8 Plastic DIP | —        |
| MAX4543C/D        | 0°C to +70°C   | Dice*         | —        |
| MAX4543EKA-T      | -40°C to +85°C | 8 SOT23-8     | AAAG     |
| MAX4543ETA        | -40°C to +85°C | 8 TDFN-EP**   | —        |
| MAX4543EUA        | -40°C to +85°C | 8 $\mu$ MAX   | —        |
| MAX4543ESA        | -40°C to +85°C | 8 SO          | —        |
| MAX4543EPA        | -40°C to +85°C | 8 Plastic DIP | —        |
| <b>MAX4544CUA</b> | 0°C to +70°C   | 8 $\mu$ MAX   | —        |
| MAX4544CSA        | 0°C to +70°C   | 8 SO          | —        |
| MAX4544CPA        | 0°C to +70°C   | 8 Plastic DIP | —        |
| MAX4544C/D        | 0°C to +70°C   | Dice*         | —        |
| MAX4544EUT-T      | -40°C to +85°C | 6 SOT23-6     | AAAM     |
| MAX4544ETA        | -40°C to +85°C | 8 TDFN-EP**   | —        |
| MAX4544EUA        | -40°C to +85°C | 8 $\mu$ MAX   | —        |
| MAX4544ESA        | -40°C to +85°C | 8 SO          | —        |
| MAX4544EPA        | -40°C to +85°C | 8 Plastic DIP | —        |

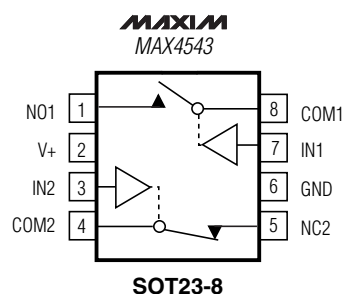
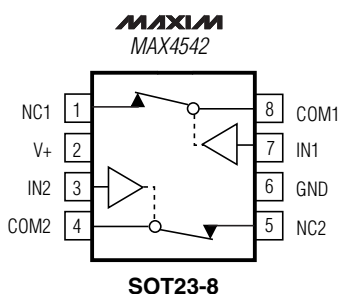
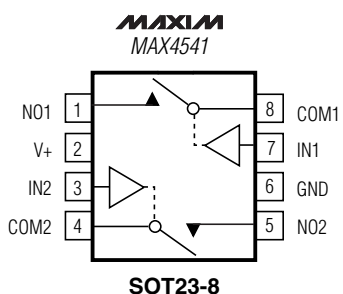
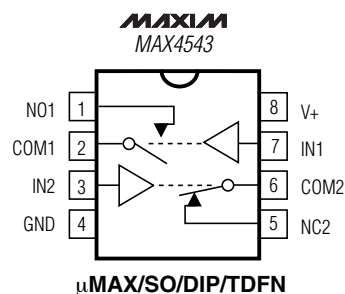
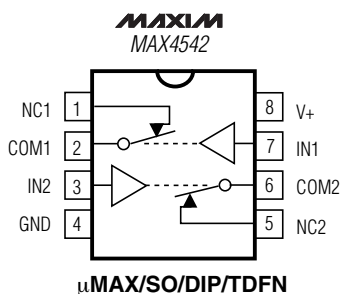
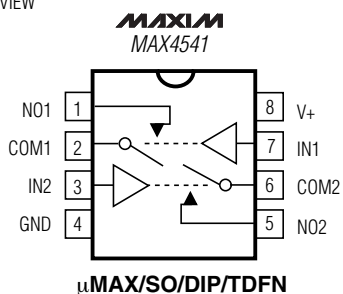
\*Dice are specified at  $T_A = +25^\circ\text{C}$ .

\*\*EP = Exposed pad.

# Low-Voltage, Single-Supply Dual SPST/SPDT Analog Switches

## Pin Configurations/Functional Diagrams/Truth Tables (continued)

TOP VIEW

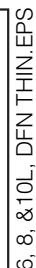


SWITCHES SHOWN FOR LOGIC "0" INPUT

MAX4541-MAX4544

**MAX4541-MAX4544**

(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).)



# Low-Voltage, Single-Supply Dual SPST/SPDT 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).)

MAX4541-MAX4544

| COMMON DIMENSIONS |           |      |
|-------------------|-----------|------|
| SYMBOL            | MIN.      | MAX. |
| A                 | 0.70      | 0.80 |
| D                 | 2.90      | 3.10 |
| E                 | 2.90      | 3.10 |
| A1                | 0.00      | 0.05 |
| L                 | 0.20      | 0.40 |
| k                 | 0.25 MIN. |      |
| A2                | 0.20 REF. |      |

| PACKAGE VARIATIONS |    |           |           |          |                |           |               |  |
|--------------------|----|-----------|-----------|----------|----------------|-----------|---------------|--|
| PKG. CODE          | N  | D2        | E2        | e        | JEDEC SPEC     | b         | [(N/2)-1] x e |  |
| T633-2             | 6  | 1.50±0.10 | 2.30±0.10 | 0.95 BSC | MO229 / WEEA   | 0.40±0.05 | 1.90 REF      |  |
| T833-2             | 8  | 1.50±0.10 | 2.30±0.10 | 0.65 BSC | MO229 / WEEC   | 0.30±0.05 | 1.95 REF      |  |
| T833-3             | 8  | 1.50±0.10 | 2.30±0.10 | 0.65 BSC | MO229 / WEEC   | 0.30±0.05 | 1.95 REF      |  |
| T1033-1            | 10 | 1.50±0.10 | 2.30±0.10 | 0.50 BSC | MO229 / WEED-3 | 0.25±0.05 | 2.00 REF      |  |
| T1033-2            | 10 | 1.50±0.10 | 2.30±0.10 | 0.50 BSC | MO229 / WEED-3 | 0.25±0.05 | 2.00 REF      |  |
| T1433-1            | 14 | 1.70±0.10 | 2.30±0.10 | 0.40 BSC | ----           | 0.20±0.05 | 2.40 REF      |  |
| T1433-2            | 14 | 1.70±0.10 | 2.30±0.10 | 0.40 BSC | ----           | 0.20±0.05 | 2.40 REF      |  |

### NOTES:

1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY SHALL NOT EXCEED 0.08 mm.
3. WARPAGE SHALL NOT EXCEED 0.10 mm.
4. PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
5. DRAWING CONFORMS TO JEDEC MO229, EXCEPT DIMENSIONS "D2" AND "E2", AND T1433-1 & T1433-2.
6. "N" IS THE TOTAL NUMBER OF LEADS.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.

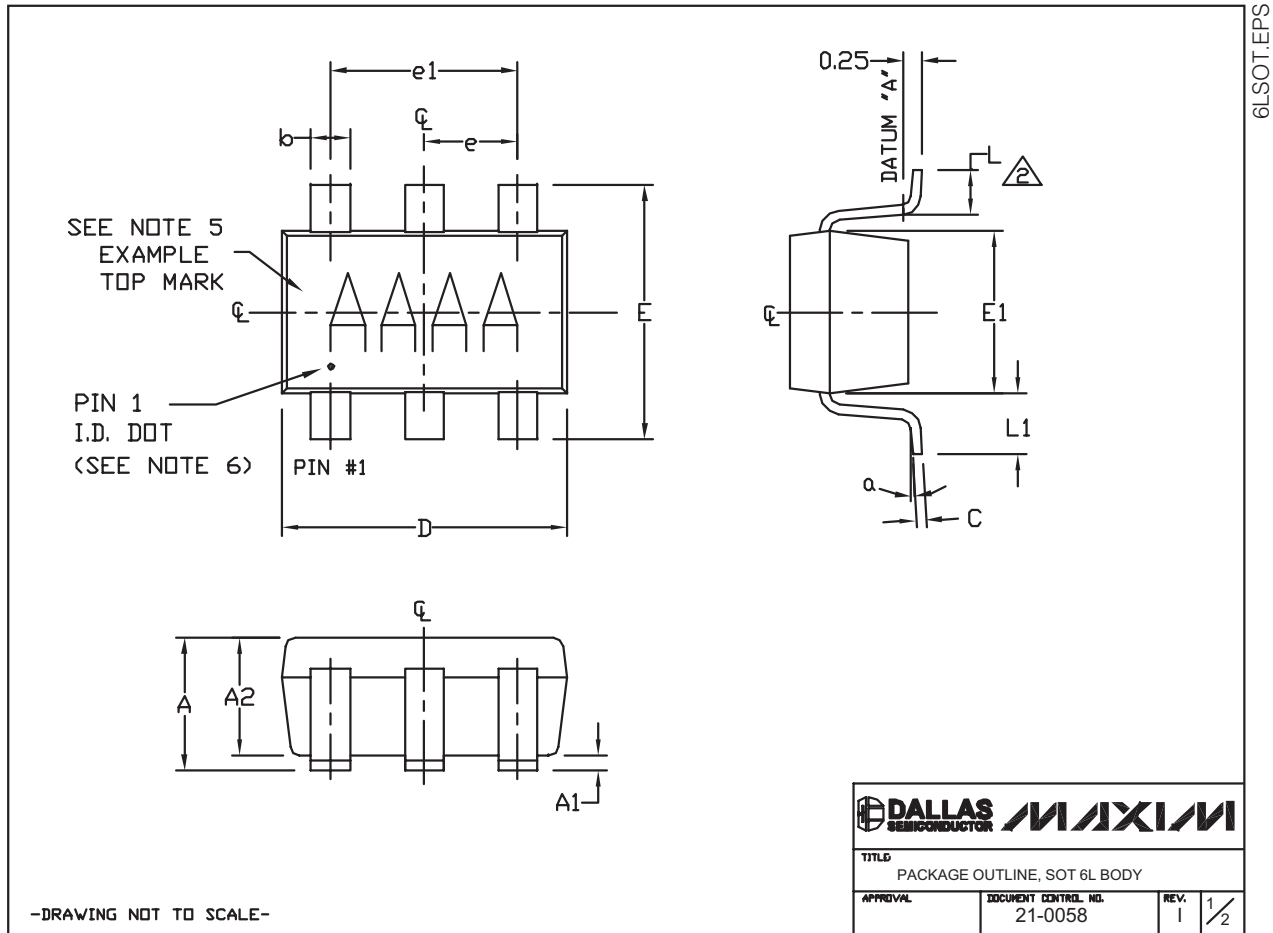
—DRAWING NOT TO SCALE—

|                                                                                       |                      |      |     |
|---------------------------------------------------------------------------------------|----------------------|------|-----|
|  |                      |      |     |
| <b>TITLE:</b><br>PACKAGE OUTLINE, 6,8,10 & 14L,<br>TDFN, EXPOSED PAD, 3x3x0.80 mm     |                      |      |     |
| APPROVAL                                                                              | DOCUMENT CONTROL NO. | REV. |     |
|                                                                                       | 21-0137              | I    | 2/2 |

# Low-Voltage, Single-Supply Dual SPST/SPDT 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).)



6LSOT.EPS

# Low-Voltage, Single-Supply Dual SPST/SPDT 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).)

MAX4541-MAX4544

### 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 0.25mm.
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 0.3mm 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 LEAD TIP.
9. LEAD TO BE COPLANAR WITHIN 0.1mm.
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. |         |      |
| α      | 0°        | 2.5°    | 10°  |

PKG CODES:  
U6-1, U6-2, U6-4, U6C-8,  
U6SN-1, U6CN-2, U6S-3, U6F-5,  
U6F-6, U6FH-5, U6FH-6

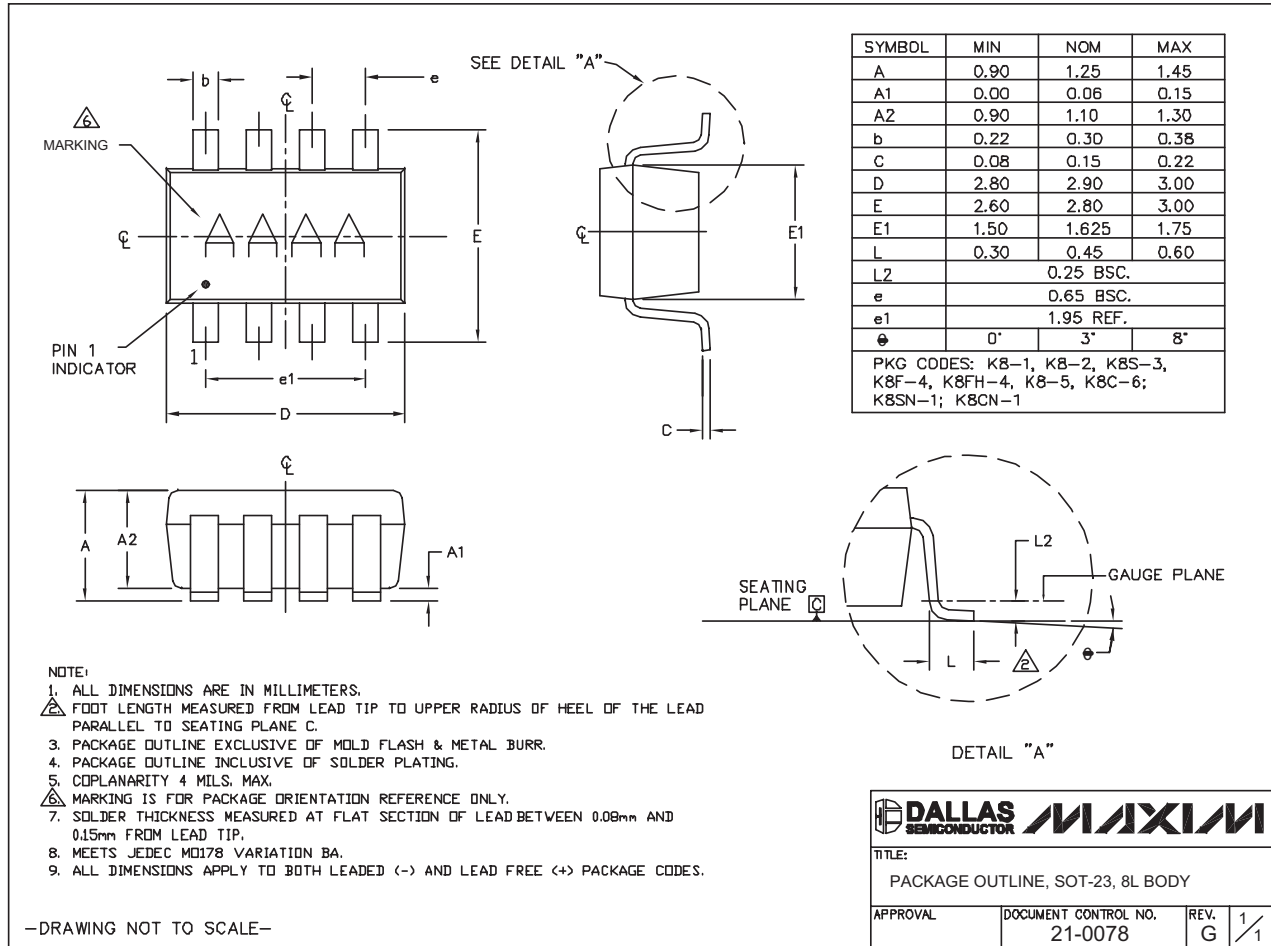
-DRAWING NOT TO SCALE-

|                                                                                       |                                 |           |     |
|---------------------------------------------------------------------------------------|---------------------------------|-----------|-----|
|  |                                 |           |     |
| TITLED<br>PACKAGE OUTLINE, SOT 6L BODY                                                |                                 |           |     |
| APPROVAL                                                                              | DOCUMENT CONTROL NO.<br>21-0058 | REV.<br>1 | 2/2 |

## ***Low-Voltage, Single-Supply Dual SPST/SPDT 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).)



## ***Revision History***

Pages changed at Rev 4: 1–16

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