



# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## General Description

The MAX4699/MAX4701/MAX4702 are low-voltage, single-supply CMOS analog switches. The MAX4699/MAX4701 are dual double-pole/double-throw (DPDT) switches with two control inputs that control two single-pole/double-throw (SPDT) switches each. The MAX4702 is a quad SPDT switch with one control input and one low-voltage digital logic power supply.

These devices operate from a single +1.8V to +5.5V power supply. When powered from a +2.7V supply the MAX4699/MAX4701/MAX4702 offer a 75Ω on-resistance ( $R_{ON}$ ), with 12Ω max  $R_{ON}$  flatness and 4Ω max matching between channels. Each switch has Rail-to-Rail® signal handling, fast switching speeds of  $t_{ON} = 35ns$ ,  $t_{OFF} = 20ns$ , and a maximum 1nA of leakage current.

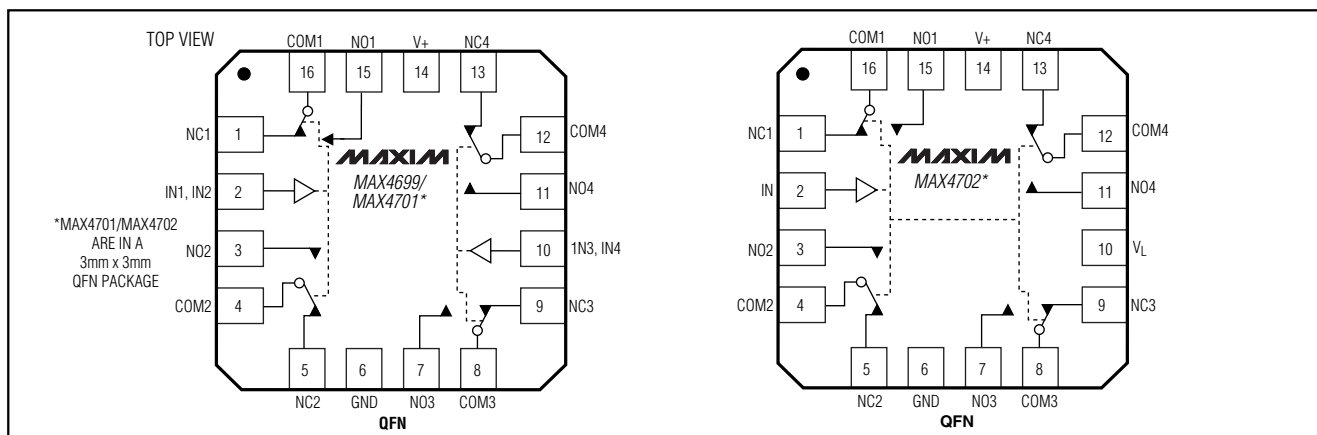
The MAX4699/MAX4701 digital inputs are 1.8V-logic compatible when operated from a +3V supply. The MAX4702's digital inputs feature a 1.0V threshold when powered with a 1.5V logic supply.

The MAX4699 is available in a space-saving 16-lead 4mm x 4mm QFN package. The MAX4701/MAX4702 are available in space-saving 16-lead 3mm x 3mm QFN and 16-pin TSSOP packages.

## Applications

Audio and Video Signal Routing  
Cellular Phones  
Battery-Operated Equipment  
Communications Circuits  
Modems

## Pin Configurations



Pin Configurations continued at end of data sheet.

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

## Features

- ◆ 3mm x 3mm and 4mm x 4mm 16-Pin QFN Package
- ◆ Guaranteed On-Resistance:  
75Ω (max) (+3V Supply)  
40Ω (max) (+5V Supply)
- ◆ Guaranteed Match Between Channels:  
4Ω max
- ◆ Guaranteed Flatness Over Signal Range:  
12Ω max
- ◆ Low Leakage Currents Over Temperature:  
1nA Max at +85°C
- ◆ Fast Switching:  $t_{ON} = 35ns$ ,  $t_{OFF} = 20ns$
- ◆ Guaranteed Break-Before-Make
- ◆ Single-Supply Operation from +1.8V to +5.5V
- ◆ Rail-to-Rail Signal Handling
- ◆ -3dB Bandwidth: 250MHz
- ◆ Low Crosstalk: -79dB (1MHz)
- ◆ High Off-Isolation: -76dB (1MHz)

## Ordering Information

| PART       | TEMP. RANGE    | PIN-PACKAGE        |
|------------|----------------|--------------------|
| MAX4699EGE | -40°C to +85°C | 16 QFN (4mm x 4mm) |
| MAX4701EUE | -40°C to +85°C | 16 TSSOP           |
| MAX4701EGE | -40°C to +85°C | 16 QFN (3mm x 3mm) |
| MAX4702EUE | -40°C to +85°C | 16 TSSOP           |
| MAX4702EGE | -40°C to +85°C | 16 QFN (3mm x 3mm) |

MAX4699/MAX4701/MAX4702



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For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)

|   |                      |
|---|----------------------|
| V+  | -0.3V to +6V         |
| V <sub>L</sub> , IN <sub>-</sub> , COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> (Note 1)  | -0.3V to (V+ + 0.3V) |
| Continuous Current COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub>                           | ±20mA                |
| Peak Current COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> (pulsed at 1ms, 10% duty cycle) | ±40mA                |
| ESD per Method 3015.7   | >2.5kV               |

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

|  |                 |
|--|-----------------|
| TSSOP (derate 5.6mW/°C above +70°C)        | 444mW           |
| QFN (3 x 3) (derate 16.9mW/°C above +70°C) | 1349mW          |
| QFN (4 x 4) (derate 18.5mW/°C above +70°C) | 1481mW          |
| Operating Temperature Range                | -40°C to +85°C  |
| Storage Temperature Range                  | -65°C to +150°C |
| Lead Temperature (soldering, 10s)          | +300°C          |

**Note 1:** Signals on IN<sub>-</sub>, COM<sub>-</sub>, NO<sub>-</sub>, and NC<sub>-</sub> exceeding 0 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 +3V Supply

(V+ = +2.7V to +3.3V, GND = 0, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, (V<sub>L</sub> = +1.5V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V for MAX4702 only), T<sub>A</sub> = -40°C to +85°C. Typical values are at V+ = +3V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 2, 3)

| PARAMETER  | SYMBOL   | CONDITIONS  | T <sub>A</sub>                       | MIN  | TYP | MAX  | UNITS |
|--|--|---|--------------------------------------|------|-----|------|-------|
| <b>ANALOG SWITCH</b>   |  |   |                                      |      |     |      |       |
| Analog Signal Range  | V <sub>COM<sub>-</sub></sub> , V <sub>NO<sub>-</sub></sub> , V <sub>NC<sub>-</sub></sub> |   |                                      | 0    |     | V+   | V     |
| On-Resistance  | R <sub>ON</sub>  | V+ = +2.7V, I <sub>COM<sub>-</sub></sub> = 10mA; V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +1.5V                     | +25°C                                |      | 60  | 75   | Ω     |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 85   |       |
| On-Resistance Match Between Channels (Note 4)                  | ΔR <sub>ON</sub>   | V+ = +2.7V, I <sub>COM<sub>-</sub></sub> = 10mA; V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +1.5V                     | +25°C                                |      | 2   | 4    | Ω     |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 5    |       |
| On-Resistance Flatness (Note 5)                                | R <sub>FLAT (ON)</sub>   | V+ = +2.7V, I <sub>COM<sub>-</sub></sub> = 10mA; V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +1V, +1.5V, +2V           | +25°C                                |      | 8   | 12   | Ω     |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 14   |       |
| NO <sub>-</sub> , NC <sub>-</sub> Off-Leakage Current (Note 6) | I <sub>NO<sub>-</sub>(OFF)</sub> , I <sub>NC<sub>-</sub>(OFF)</sub>                      | V+ = +3.3V, V <sub>COM<sub>-</sub></sub> = +1V, +3V; V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +3V, +1V              | +25°C                                | -0.5 |     | +0.5 | nA    |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> | -1   |     | 1    |       |
| COM <sub>-</sub> On-Leakage Current (Note 6)                   | I <sub>COM<sub>-</sub>(ON)</sub>   | V+ = +3.3V, V <sub>COM<sub>-</sub></sub> = +1V, +3V; V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +1V, +3V, or floating | +25°C                                | -0.5 |     | +0.5 | nA    |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> | -1   |     | 1    |       |
| <b>DYNAMIC</b>   |  |   |                                      |      |     |      |       |
| Turn-On Time   | t <sub>ON</sub>  | V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +2V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2                | +25°C                                |      | 27  | 35   | ns    |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 45   |       |
| Turn-Off Time  | t <sub>OFF</sub>   | V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +2V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2                | +25°C                                |      | 15  | 20   | ns    |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 25   |       |
| Break-Before-Make (Note 6)                                     | t <sub>BBM</sub>   | V <sub>NO<sub>-</sub></sub> or V <sub>NC<sub>-</sub></sub> = +2V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2                | +25°C                                |      | 15  |      | ns    |
|  |  |   | T <sub>MIN</sub> to T <sub>MAX</sub> | 1    |     |      |       |
| On-Channel -3dB Bandwidth                                      | BW   | Signal = 0, 50Ω in and out, Figure 5  |                                      |      | 250 |      | MHz   |
| Off-Isolation (Note 7)   | V <sub>ISO</sub>   | f = 1MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5  | +25°C                                |      | -76 |      | dB    |

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

MAX4699/MAX4701/MAX4702

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

(V+ = +2.7V to +3.3V, GND = 0, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, (V<sub>L</sub> = +1.5V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V for MAX4702 only), T<sub>A</sub> = -40°C to +85°C. Typical values are at V+ = +3V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 2, 3)

| PARAMETER   | SYMBOL  | CONDITIONS  | T <sub>A</sub>                       | MIN | TYP  | MAX | UNITS |
|---|---|---|--------------------------------------|-----|------|-----|-------|
| Crosstalk (Note 8)                                  | V <sub>CT</sub>                               | f = 1MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5                | +25°C                                |     | -79  |     | dB    |
| Charge Injection                                    | Q   | V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0Ω, C <sub>L</sub> = 1.0nF, Figure 4 | +25°C                                |     | 0.5  |     | pC    |
| NO <sub>-</sub> , NC <sub>-</sub> , Off-Capacitance | C <sub>NO_(OFF)</sub> , C <sub>NC_(OFF)</sub> | f = 1MHz, V <sub>NO_-</sub> , V <sub>NC_-</sub> = GND, Figure 6               | +25°C                                |     | 8    |     | pF    |
| Switch On-Capacitance                               | C <sub>(ON)</sub>                             | f = 1MHz, Figure 6  | +25°C                                |     | 20   |     | pF    |
| Total Harmonic Distortion                           | THD   | f = 20Hz to 20kHz, 2.5Vp-p, R <sub>L</sub> = 600Ω                             | +25°C                                |     | 0.02 |     | %     |
| <b>DIGITAL I/O</b>                                  |   |   |                                      |     |      |     |       |
| Input Logic High                                    | V <sub>IH</sub>                               | MAX4699/MAX4701   |                                      | 1.4 |      |     | V     |
|   |   | MAX4702 (V <sub>L</sub> = +1.5V)  |                                      | 1.0 |      |     |       |
| Input Logic Low                                     | V <sub>IL</sub>                               | MAX4699/MAX4701   |                                      |     |      | 0.8 | V     |
|   |   | MAX4702 (V <sub>L</sub> = +1.5V)  |                                      |     |      | 0.4 |       |
| Input Leakage Current                               | I <sub>IH</sub> , I <sub>IL</sub>             | V <sub>IN</sub> = 0 to V+   |                                      | -1  |      | 1   | μA    |
| <b>SUPPLY</b>                                       |   |   |                                      |     |      |     |       |
| Power-Supply Range                                  | V+  |   |                                      | 1.8 |      | 5.5 | V     |
| Logic Power-Supply Input                            | V <sub>L</sub>                                |   |                                      | 1.5 |      | V+  | V     |
| Positive Supply Current                             | I+  | V+ = +3.3V, V <sub>IN</sub> = 0 or V+   | T <sub>MIN</sub> to T <sub>MAX</sub> | -1  |      | 1   | μA    |

## ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V+ = +5V ±10%, GND = 0, V<sub>IH</sub> = +2.4V, V<sub>IL</sub> = +0.8V, (V<sub>L</sub> = +1.5V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V for MAX4702 only), T<sub>A</sub> = -40°C to +85°C. Typical values are at V+ = +5V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 2, 3)

| PARAMETER                                     | SYMBOL   | CONDITIONS   | T <sub>A</sub>                       | MIN | TYP | MAX | UNITS |
|---|--|--|--------------------------------------|-----|-----|-----|-------|
| Analog Signal Range                           | V <sub>COM_-</sub> , V <sub>NO_-</sub> , V <sub>NC_-</sub> |  |                                      | 0   |     | V+  | V     |
| On-Resistance                                 | R <sub>ON</sub>  | V+ = +4.5V, I <sub>COM_-</sub> = 10mA; V <sub>NO_-</sub> or V <sub>NC_-</sub> = +3.5V                | +25°C                                |     | 30  | 40  | Ω     |
|   |  |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     | 50  |       |
| On-Resistance Match Between Channels (Note 4) | ΔR <sub>ON</sub>   | V+ = +4.5V, I <sub>COM_-</sub> = 10mA; V <sub>NO_-</sub> or V <sub>NC_-</sub> = +3.5V                | +25°C                                |     | 1   | 3   | Ω     |
|   |  |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     | 5   |       |
| On-Resistance Flatness (Note 5)               | R <sub>FLAT (ON)</sub>                                     | V+ = +4.5V, I <sub>COM_-</sub> = 10mA; V <sub>NO_-</sub> or V <sub>NC_-</sub> = +2.0V, +2.25V, +3.5V | +25°C                                |     | 5   | 8   | Ω     |
|   |  |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     | 10  |       |
| <b>DYNAMIC</b>                                |  |  |                                      |     |     |     |       |
| Turn-On Time                                  | t <sub>ON</sub>  | V <sub>NO_-</sub> or V <sub>NC_-</sub> = +3V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2 | +25°C                                |     | 15  | 18  | ns    |
|   |  |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     | 20  |       |

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

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

(V+ = +5V ±10%, GND = 0, V<sub>IH</sub> = +2.4V, V<sub>IL</sub> = +0.8V, (V<sub>L</sub> = +1.5V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V for MAX4702 only), T<sub>A</sub> = -40°C to +85°C. Typical values are at V+ = +5V and T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 2, 3)

| PARAMETER                  | SYMBOL                            | CONDITIONS   | T <sub>A</sub>                       | MIN | TYP | MAX | UNITS |
|----------------------------|-----------------------------------|--|--------------------------------------|-----|-----|-----|-------|
| Turn-Off Time              | t <sub>OFF</sub>                  | V <sub>NO_</sub> or V <sub>NC_</sub> = +3V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2 | +25°C                                | 7   | 12  | 15  | ns    |
|                            |                                   |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     |     |       |
| Break-Before-Make (Note 6) | t <sub>BBM</sub>                  | V <sub>NO_</sub> or V <sub>NC_</sub> = +3V; R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2 | +25°C                                | 10  |     | 2   | ns    |
|                            |                                   |  | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     |     |       |
| Charge Injection           | Q                                 | V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1.0nF, Figure 4                       | +25°C                                | 0.5 |     |     | pC    |
| <b>DIGITAL I/O</b>         |                                   |  |                                      |     |     |     |       |
| Input Logic High           | V <sub>IH</sub>                   | MAX4699/MAX4701  |                                      | 2.4 |     | 1.0 | V     |
|                            |                                   | MAX4702 (V <sub>L</sub> = +1.5V)   |                                      |     |     |     |       |
| Input Logic Low            | V <sub>IL</sub>                   | MAX4699/MAX4701  |                                      | 0.8 |     | 0.4 | V     |
|                            |                                   | MAX4702 (V <sub>L</sub> = +1.5V)   |                                      |     |     |     |       |
| Logic Input Current        | I <sub>IH</sub> , I <sub>IL</sub> | V <sub>IN</sub> = 0 to V+  |                                      | -1  | 1   |     | μA    |

**Note 2:** 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 3:** -40°C specifications are guaranteed by design.

**Note 4:** ΔRON = RON(MAX) - RON(MIN).

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

**Note 6:** Guaranteed by design.

**Note 7:** Off-Isolation = 20log<sub>10</sub> (V<sub>COM\_</sub> / V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

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

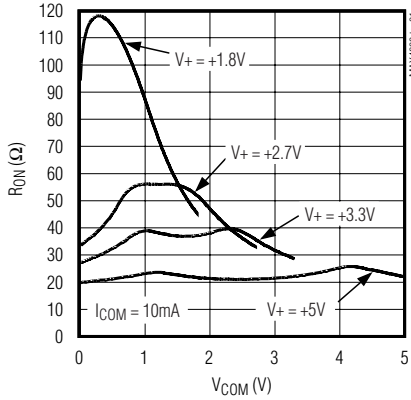
# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Typical Operating Characteristics

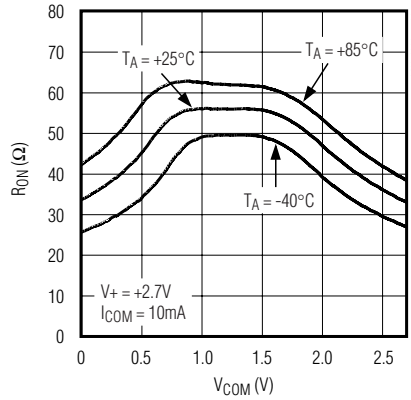
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.  $V_L = +1.5\text{V}$  for MAX4702 only)

MAX4699/MAX4701/MAX4702

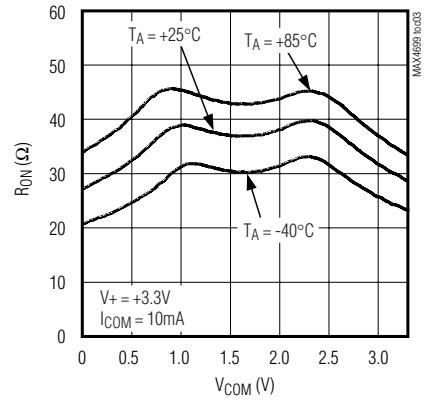
**ON-RESISTANCE vs. COM VOLTAGE OVER SUPPLY VOLTAGE**



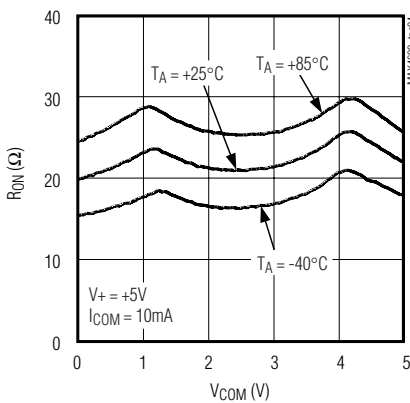
**ON-RESISTANCE vs. COM VOLTAGE OVER TEMPERATURE ( $V_+ = +2.7\text{V}$ )**



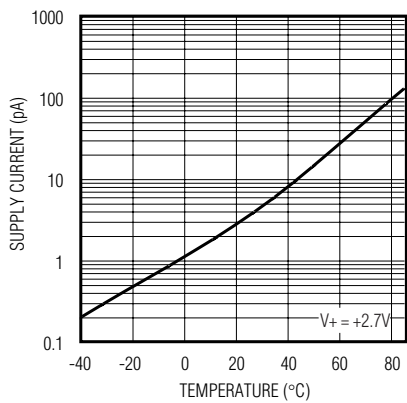
**ON-RESISTANCE vs. COM VOLTAGE OVER TEMPERATURE ( $V_+ = +3.3\text{V}$ )**



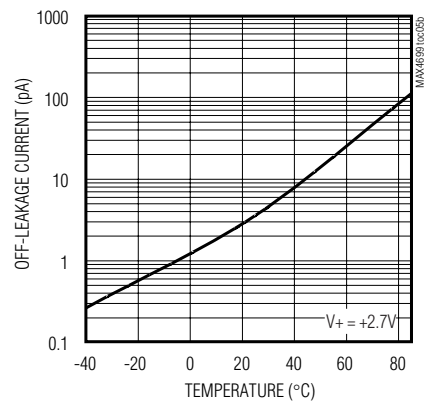
**ON-RESISTANCE vs. COM VOLTAGE OVER TEMPERATURE ( $V_+ = +5\text{V}$ )**



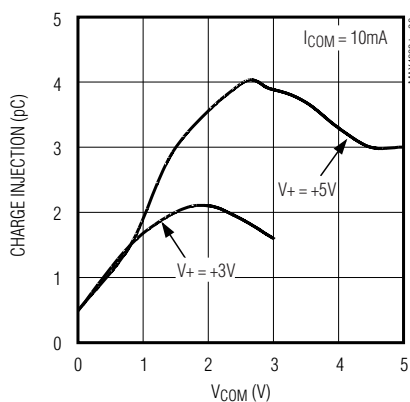
**ON-LEAKAGE CURRENT vs. TEMPERATURE**



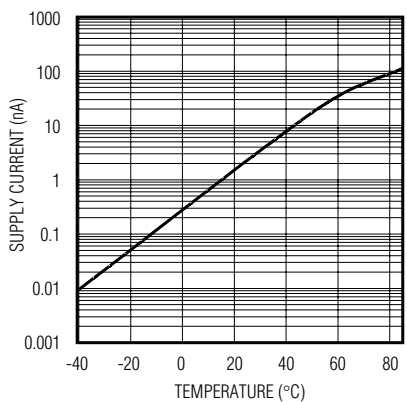
**OFF-LEAKAGE CURRENT vs. TEMPERATURE**



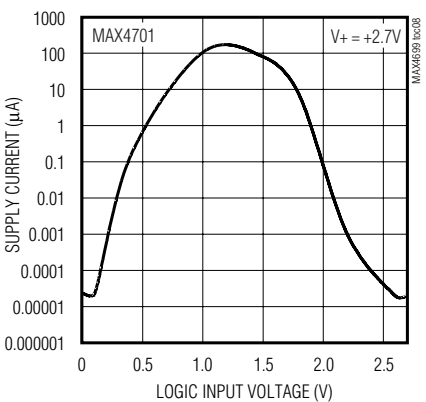
**CHARGE INJECTION vs. COM VOLTAGE OVER SUPPLY VOLTAGE**



**SUPPLY CURRENT vs. TEMPERATURE**



**SUPPLY CURRENT vs. LOGIC INPUT VOLTAGE**

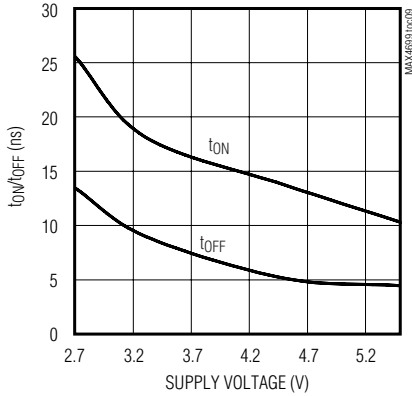


# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

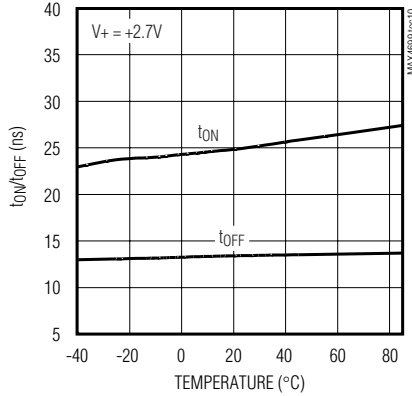
## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.  $V_L = +1.5\text{V}$  for MAX4702 only)

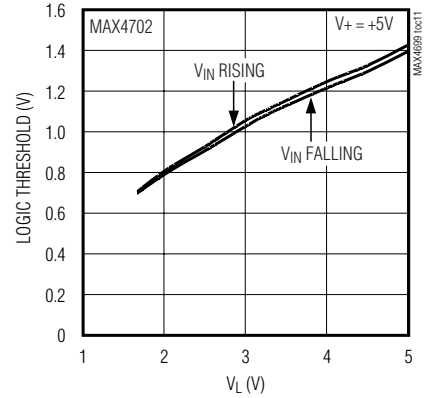
**TURN-ON/OFF TIME vs. SUPPLY VOLTAGE**



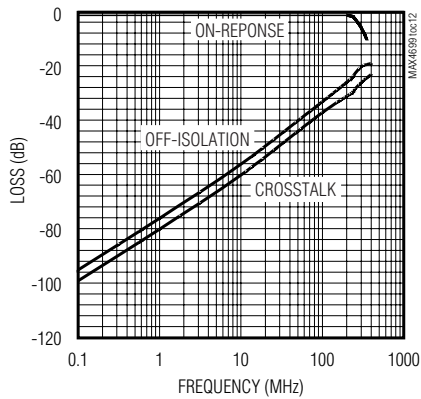
**TURN-ON/OFF TIME vs. TEMPERATURE**



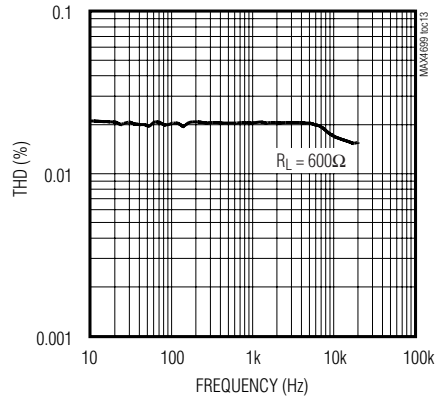
**LOGIC THRESHOLD vs.  $V_L$**



**FREQUENCY RESPONSE**



**TOTAL HARMONIC DISTORTION vs. FREQUENCY**



# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Pin Description

| QFN PIN             |         | TSSOP PIN |         | NAME           | FUNCTION                                    |
|---------------------|---------|-----------|---------|----------------|---|
| MAX4699/<br>MAX4701 | MAX4702 | MAX4701   | MAX4702 |                |   |
| 1                   | 1       | 3         | 3       | NC1            | Analog Switch 1—Normally Closed Terminal    |
| —                   | 2       | —         | 4       | IN             | Digital Control Input Switch 1, 2, 3, and 4 |
| 2                   | —       | 4         | —       | IN1, IN2       | Digital Control Input Switch 1 and 2        |
| 3                   | 3       | 5         | 5       | NO2            | Analog Switch 2—Normally Open Terminal      |
| 4                   | 4       | 6         | 6       | COM2           | Analog Switch 2—Common Terminal             |
| 5                   | 5       | 7         | 7       | NC2            | Analog Switch 2—Normally Closed Terminal    |
| 6                   | 6       | 8         | 8       | GND            | Ground                                      |
| 7                   | 7       | 9         | 9       | NO3            | Analog Switch 3—Normally Open Terminal      |
| 8                   | 8       | 10        | 10      | COM3           | Analog Switch 3—Common Terminal             |
| 9                   | 9       | 11        | 11      | NC3            | Analog Switch 3—Normally Closed Terminal    |
| —                   | 10      | —         | 12      | V <sub>L</sub> | Logic Power-Supply Input                    |
| 10                  | —       | 12        | —       | IN3, IN4       | Digital Control Input Switch 3 and 4        |
| 11                  | 11      | 13        | 13      | NO4            | Analog Switch 4—Normally Open Terminal      |
| 12                  | 12      | 14        | 14      | COM4           | Analog Switch 4—Common Terminal             |
| 13                  | 13      | 15        | 15      | NC4            | Analog Switch 4—Normally Closed Terminal    |
| 14                  | 14      | 16        | 16      | V+             | Positive Supply Voltage Input               |
| 15                  | 15      | 1         | 1       | NO1            | Analog Switch 1—Normally Open Terminal      |
| 16                  | 16      | 2         | 2       | COM1           | Analog Switch 1—Common Terminal             |

MAX4699/MAX4701/MAX4702

## Detailed Description

The MAX4699/MAX4701 are low-voltage CMOS analog switches that operate from a single +1.8V to +5.5V power supply. The MAX4702 requires an additional logic supply that allows for setting lower logic thresholds. The MAX4699/MAX4701 are double-pole/double-throw (DPDT) devices. The MAX4702 is a quad single-pole/double-throw (SPDT) device. These devices feature a break-before-make switching, fast switching speeds (with V<sub>+</sub> = 5V: t<sub>ON</sub> = 18ns max, t<sub>OFF</sub> = 9ns max and with V<sub>+</sub> = 3V: t<sub>ON</sub> = 35ns, t<sub>OFF</sub> = 20) and rail-to-rail signal handling. A logic input on the MAX4702 allows for logic thresholds as low as 1.0V.

## Applications Information

### Analog Signal Levels

Analog signals that range over the entire supply voltage (V<sub>+</sub> 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.

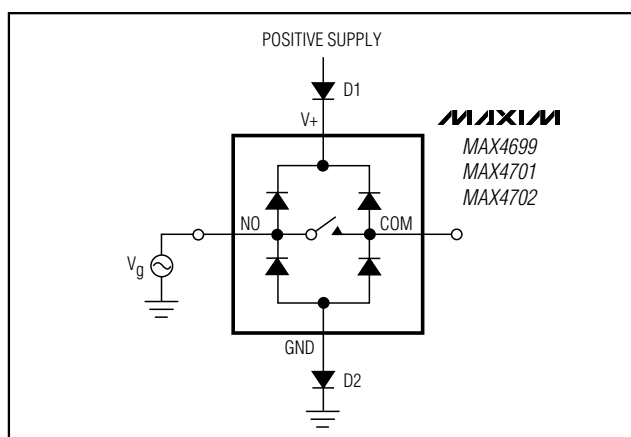


Figure 1. Overvoltage Protection Using Two External Blocking Diodes

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## 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 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.

### V<sub>L</sub> Logic Input (MAX4702)

The MAX4702 features a V<sub>L</sub> logic input that allows for lower logic input thresholds down to 1.0V min for V<sub>IH</sub> in the quad SPDT configuration. Power-up V<sub>L</sub> after V+ has been powered with a minimum of 1.5V to ensure proper operation of the device.

## Test Circuits/Timing Diagrams

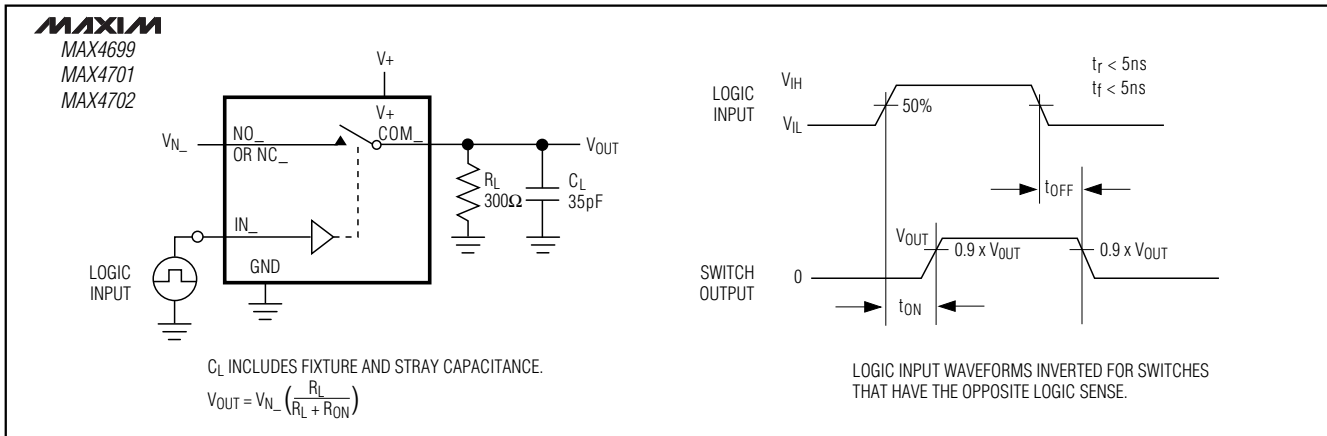


Figure 2. Switching Time

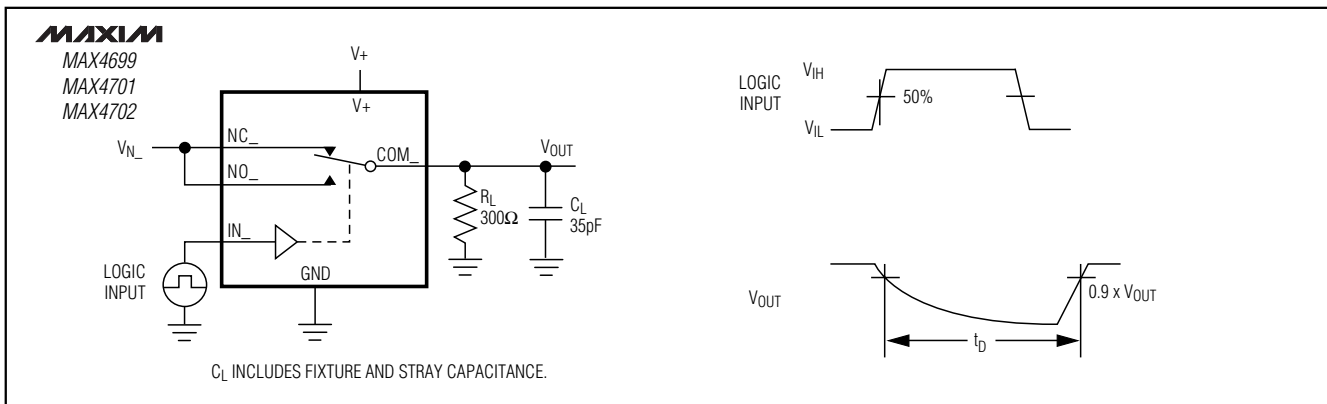


Figure 3. Break-Before-Make Interval



# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Test Circuits/Timing Diagrams (continued)

MAX4699/MAX4701/MAX4702

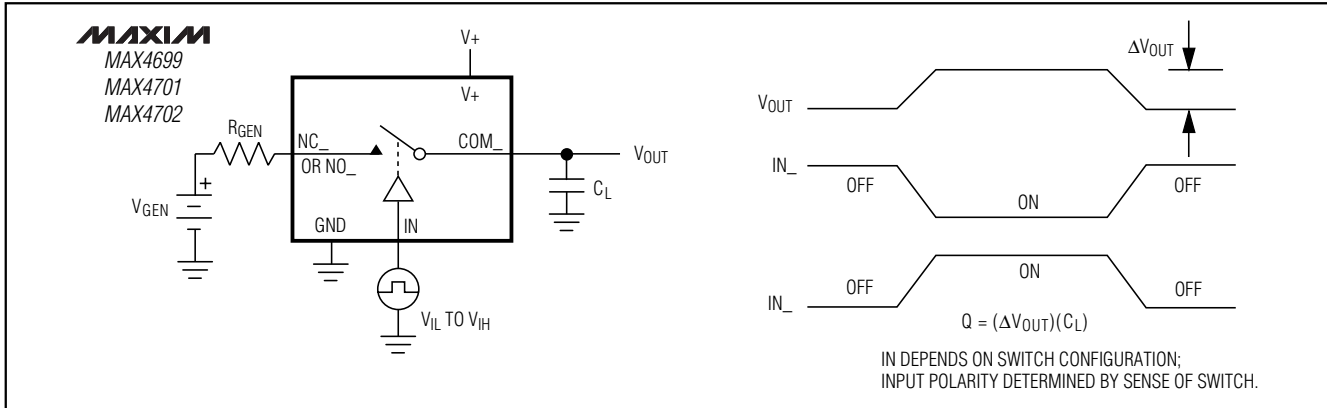


Figure 4. Charge Injection

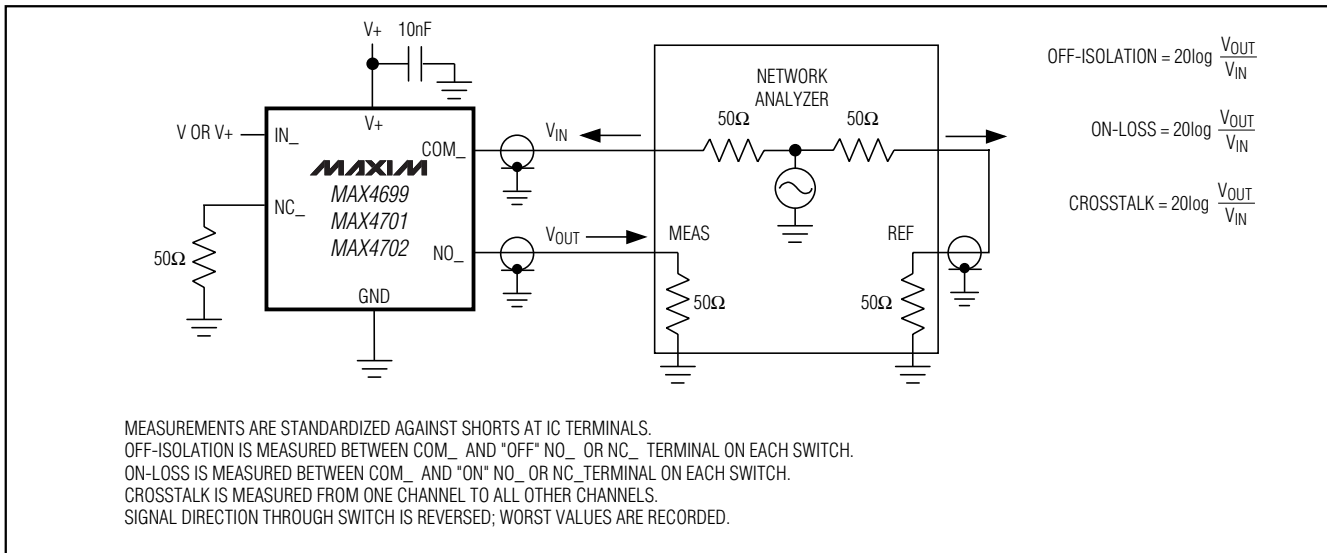


Figure 5. On-Loss, Off-Isolation, and Crosstalk

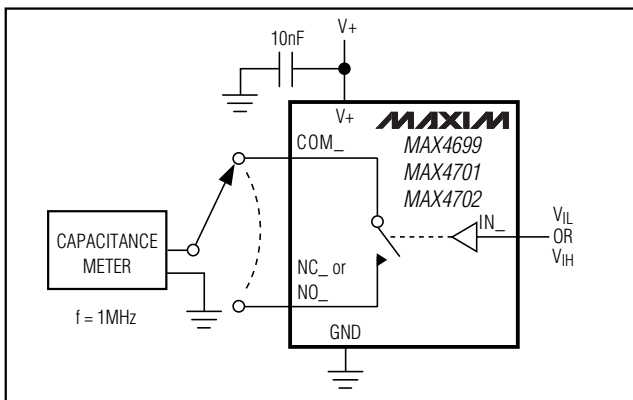


Figure 6. Channel Off/On-Capacitance

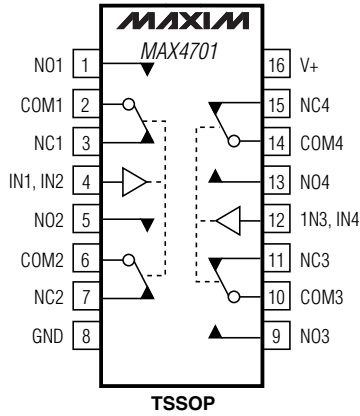
## Chip Information

TRANSISTOR COUNT: 269  
Substrate connected to GND

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

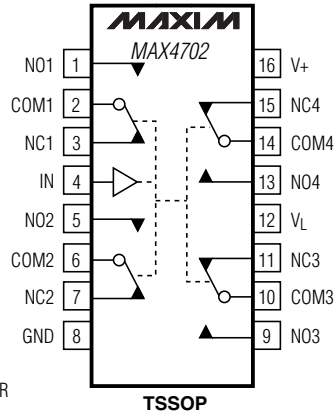
## Pin Configurations (continued)

TOP VIEW



| IN1,<br>IN2 | IN3,<br>IN4 | ON SWITCHES        |
|-------------|-------------|--------------------|
| L           | —           | NC1-COM1, NC2-COM2 |
| H           | —           | NO1-COM1, NO2-COM2 |
| —           | L           | NC3-COM3, NC4-COM4 |
| —           | H           | NO3-COM3, NO4-COM4 |

SWITCHES SHOWN FOR LOGIC "0" INPUTS

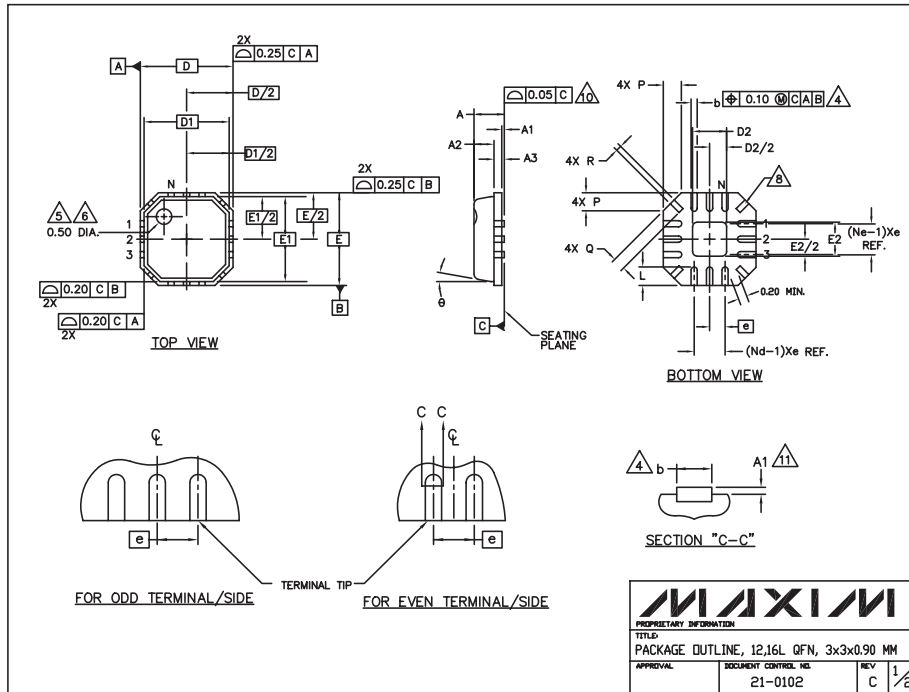


| IN | ON SWITCHES                              |
|----|--|
| L  | NC1-COM1, NC2-COM2<br>NC3-COM3, NC4-COM4 |
| H  | NO1-COM1, NO2-COM2<br>NO3-COM3, NO4-COM4 |

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Package Information

MAX4699/MAX4701/MAX4702



### NOTES:

- DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
- DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
- N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
- DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
- THE PIN #1 IDENTIFIER MUST EXIST ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
- EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- ALL DIMENSIONS ARE IN MILLIMETERS.
- THE SHAPE SHOWN ON FOUR CORNERS ARE NOT ACTUAL I/O.
- PACKAGE WARPAGE MAX 0.05mm.
- APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
- APPLIED ONLY FOR TERMINALS.
- MEETS JEDEC MO220.

| SYMBOL | COMMON DIMENSIONS |      |      | SYMBOL |
|--------|-------------------|------|------|--------|
|        | MIN.              | NOM. | MAX. |        |
| A1     | 0.00              | 0.01 | 0.05 | 11     |
| A2     | -                 | 0.65 | 0.80 |        |
| A3     | 0.20 REF.         |      |      |        |
| D      | 3.00 BSC          |      |      |        |
| D1     | 2.75 BSC          |      |      |        |
| E1     | 3.00 BSC          |      |      |        |
| E1     | 2.75 BSC          |      |      |        |
| θ      | 12°               |      |      |        |
| P      | 0.24              | 0.42 | 0.60 |        |
| R      | 0.13              | 0.17 | 0.23 |        |

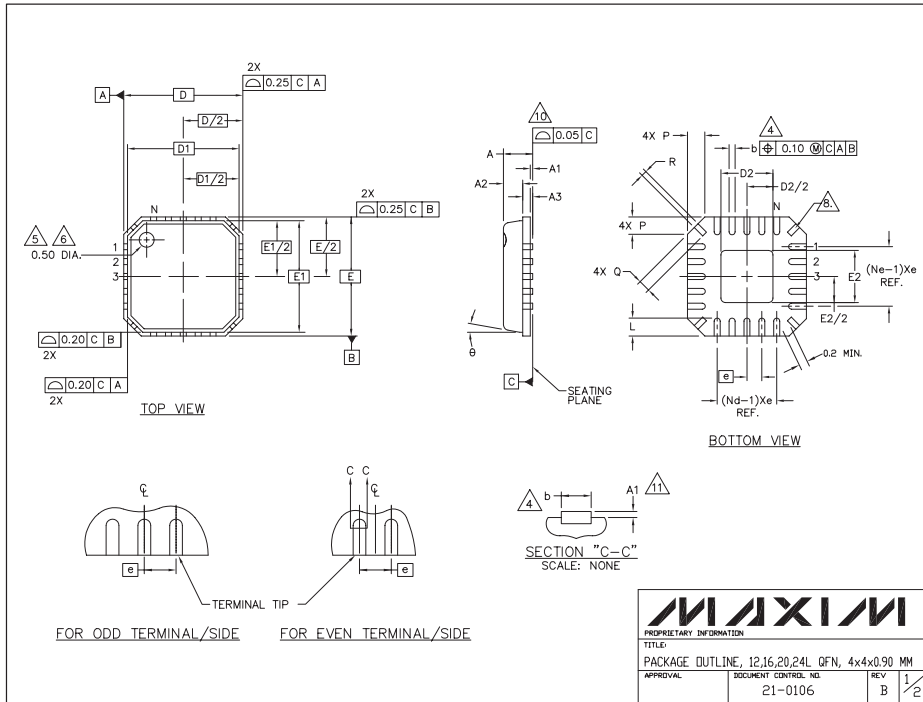
| SYMBOL | PITCH VARIATION C            |      |      | SYMBOL | PITCH VARIATION D            |      |      |
|--------|------------------------------|------|------|--------|------------------------------|------|------|
|        | MIN.                         | NOM. | MAX. |        | MIN.                         | NOM. | MAX. |
| Ⓞ      | 0.50 BSC                     |      |      | Ⓞ      | 0.50 BSC                     |      |      |
| N      | 12                           |      |      | N      | 16                           |      |      |
| Nd     | 3                            |      |      | Nd     | 4                            |      |      |
| Ne     | 3                            |      |      | Ne     | 4                            |      |      |
| L      | 0.50                         | 0.60 | 0.75 | L      | 0.30                         | 0.40 | 0.55 |
| b      | 0.18                         | 0.23 | 0.30 | b      | 0.18                         | 0.23 | 0.30 |
| Q      | 0.30                         | 0.40 | 0.65 | Q      | 0.00                         | 0.20 | 0.45 |
| D2     | SEE EXPOSED PAD VARIATION: A |      |      | D2     | SEE EXPOSED PAD VARIATION: A |      |      |
| E2     | SEE EXPOSED PAD VARIATION: A |      |      | E2     | SEE EXPOSED PAD VARIATION: A |      |      |

| SYMBOLS                | D2 | E2 | NOTE |      |      |      |      |      |
|------------------------|----|----|------|------|------|------|------|------|
|                        |    |    | MIN  | NOM  | MAX  |      |      |      |
| EXPOSED PAD VARIATIONS | A  | A  | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 |



# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Package Information (continued)



12, 16, 20, 24L QFNLEFS

### NOTES:

- DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
- DIMENSIONING & TOLERANCES CONFORM MUST TO ASME Y14.5M. - 1994.
- N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
- DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
- THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
- EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- ALL DIMENSIONS ARE IN MILLIMETERS.
- THE SHAPE SHOWN ON FOUR CORNERS ARE NOT ACTUAL 1/0.
- PACKAGE WARPAGE MAX 0.05mm.
- APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
- APPLIED ONLY FOR TERMINALS.
- MEETS JEDEC MO220.

| SYMBOL | PITCH VARIATION A               |      |      | PITCH VARIATION B               |      |      | PITCH VARIATION C               |      |      | PITCH VARIATION D            |      |      |
|--------|---------------------------------|------|------|---------------------------------|------|------|---------------------------------|------|------|------------------------------|------|------|
|        | MIN.                            | NOM. | MAX. | MIN.                            | NOM. | MAX. | MIN.                            | NOM. | MAX. | MIN.                         | NOM. | MAX. |
| N      | 12                              | 16   | 20   | 3                               | 4    | 5    | 3                               | 4    | 5    | 3                            | 4    | 5    |
| Nd     | 3                               | 4    | 5    | 3                               | 4    | 5    | 3                               | 4    | 5    | 3                            | 4    | 5    |
| Ne     | 3                               | 4    | 5    | 3                               | 4    | 5    | 3                               | 4    | 5    | 3                            | 4    | 5    |
| L      | 0.50                            | 0.60 | 0.75 | 0.50                            | 0.60 | 0.75 | 0.50                            | 0.60 | 0.75 | 0.30                         | 0.40 | 0.55 |
| b      | 0.28                            | 0.33 | 0.40 | 0.23                            | 0.28 | 0.35 | 0.18                            | 0.23 | 0.30 | 0.18                         | 0.23 | 0.30 |
| q      | 0.30                            | 0.40 | 0.65 | 0.30                            | 0.40 | 0.65 | 0.30                            | 0.40 | 0.65 | 0.00                         | 0.20 | 0.45 |
| D2     | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A |      |      |
| E2     | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A, B |      |      | SEE EXPOSED PAD VARIATION: A |      |      |

| SYMBOLS                | D2  |      |      | E2   |      |      | NOTE |
|------------------------|-----|------|------|------|------|------|------|
|                        | MIN | NOM  | MAX  | MIN  | NOM  | MAX  |      |
| EXPOSED PAD VARIATIONS | A   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
|                        | B   | 1.55 | 1.70 | 1.85 | 1.55 | 1.70 | 1.85 |

EXAMPLE: WE CAN CALL VARIATION "BB" FOR 16 TERMINAL QFN WITH 1.70x1.70 mm NOMINAL EXPOSED PAD DIMENSION. THE FORMER ONE IN VARIATION IS FOR PITCH VARIATION AND THE LATTER ONE IS FOR EXPOSED PAD VARIATION.

**MAXIM**  
 PROPRIETARY INFORMATION  
 TITLE: PACKAGE OUTLINE, 12,16,20,24L QFN, 4x4x0.90 MM  
 APPROVAL: \_\_\_\_\_ DOCUMENT CONTROL NO. 21-0106 REV B 2/2

# Low-Voltage, Dual DPDT/Quad SPDT Analog Switches in QFN

## Package Information (continued)

MAX4699/MAX4701/MAX4702

| Symbol         | COMMON DIMENSIONS |       |                |       |
|----------------|-------------------|-------|----------------|-------|
|                | MILLIMETERS       |       | INCHES         |       |
|                | MIN.              | MAX.  | MIN.           | MAX.  |
| A              | —                 | 1.10  | —              | .043  |
| A <sub>1</sub> | 0.05              | 0.15  | .002           | .006  |
| A <sub>2</sub> | 0.85              | 0.95  | .033           | .037  |
| b              | 0.19              | 0.30  | .007           | .012  |
| b <sub>1</sub> | 0.19              | 0.25  | .007           | .010  |
| c              | 0.090             | 0.20  | .0035          | .008  |
| c <sub>1</sub> | 0.090             | 0.135 | .0035          | .0053 |
| D              | SEE VARIATIONS    |       | SEE VARIATIONS |       |
| E              | 4.30              | 4.50  | .169           | .177  |
| e              | 0.65 BSC          |       | .026 BSC       |       |
| H              | 6.25              | 6.50  | .246           | .256  |
| L              | 0.50              | 0.70  | .020           | .028  |
| N              | SEE VARIATIONS    |       | SEE VARIATIONS |       |
| α              | 0°                | 8°    | 0°             | 8°    |

| JEDEC | N  | VARIATIONS  |      |        |      |      |
|-------|----|-------------|------|--------|------|------|
|       |    | MILLIMETERS |      | INCHES |      |      |
|       |    | MIN.        | MAX. | MIN.   | MAX. |      |
| AB-1  | 14 | D           | 4.90 | 5.10   | .193 | .201 |
| AB    | 16 | D           | 4.90 | 5.10   | .193 | .201 |
| AC    | 20 | D           | 6.40 | 6.60   | .252 | .260 |
| AD    | 24 | D           | 7.70 | 7.90   | .303 | .311 |
| AE    | 28 | D           | 9.60 | 9.80   | .378 | .386 |

**NOTES:**

- DIMENSIONS D AND E DO NOT INCLUDE FLASH
- MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
- CONTROLLING DIMENSION: MILLIMETER
- MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE.
- 'N' REFERS TO NUMBER OF LEADS

**△** THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-], THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED.

|  |                      |     |     |
|--|----------------------|-----|-----|
| <b>MAXIM</b>                                   |                      |     |     |
| PROPRIETARY INFORMATION                        |                      |     |     |
| TITLE:<br>PACKAGE OUTLINE, TSSOP, 4.40 MM BODY |                      |     |     |
| APPROVAL                                       | DOCUMENT CONTROL NO. | REV | 1/1 |
|  | 21-0066              | E   |     |

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