

# MAXIM

## 2.5Ω, Quad, SPST, CMOS Analog Switches

### General Description

The MAX4601/MAX4602/MAX4603 quad analog switches feature low on-resistance of 2.5Ω max. On-resistance is matched between switches to 0.5Ω max and is flat (0.5Ω max) over the specified signal range. Each switch can handle Rail-to-Rail® analog signals. The off-leakage current is only 2.5nA maximum at T<sub>A</sub> = +85°C. These analog switches are ideal in low-distortion applications and are the preferred solution over mechanical relays in automatic test equipment or applications where current switching is required. They have low power requirements, require less board space, and are more reliable than mechanical relays.

The MAX4601 has four normally closed (NC) switches, the MAX4602 has four normally open (NO) switches, and the MAX4603 has two NC and two NO switches.

These switches operate from a single supply of +4.5V to +36V or from dual supplies of ±4.5V to ±20V. All digital inputs have +0.8V and +2.4V logic thresholds, ensuring TTL/CMOS-logic compatibility when using ±15V or a single +12V supply.

### Applications

Reed Relay Replacement  
Test Equipment  
Communication Systems  
PBX, PABX Systems  
Audio-Signal Routing  
Avionics

### Features

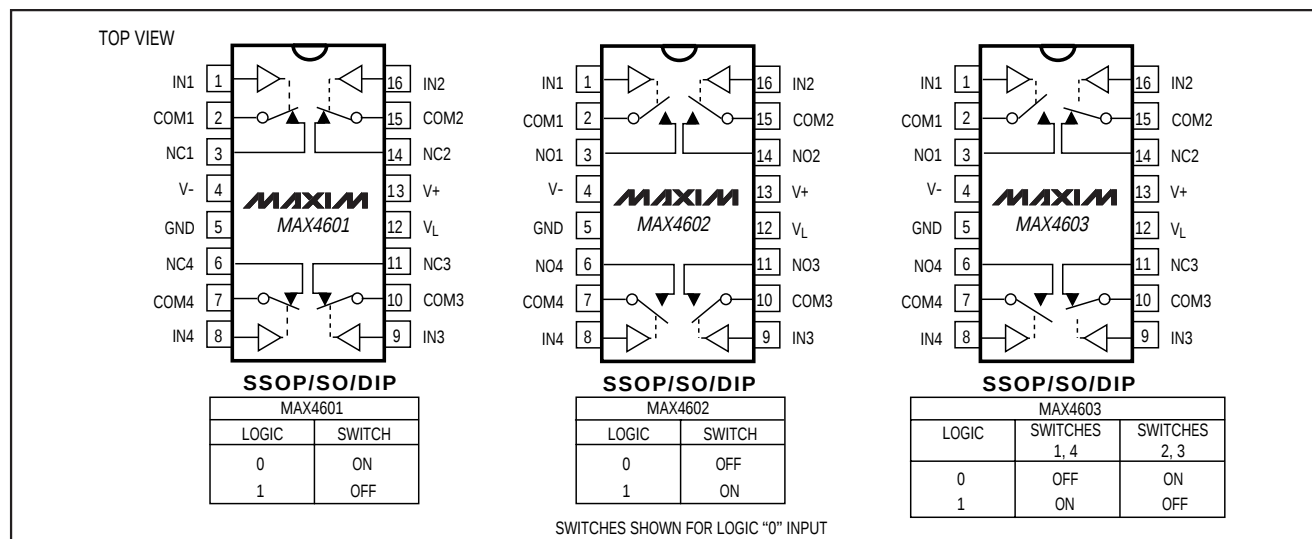
- ♦ Low On-Resistance (2.5Ω max)
- ♦ Guaranteed R<sub>ON</sub> Match Between Channels (0.5Ω max)
- ♦ Guaranteed R<sub>ON</sub> Flatness over Specified Signal Range (0.5Ω max)
- ♦ Rail-to-Rail Signal Handling
- ♦ Guaranteed ESD Protection > 2000V per Method 3015.7
- ♦ Single-Supply Operation: +4.5V to +36V  
Dual-Supply Operation: ±4.5V to ±20V
- ♦ TTL/CMOS-Compatible Control Inputs

### Ordering Information

| PART       | TEMP. RANGE    | PIN-PACKAGE    |
|------------|----------------|----------------|
| MAX4601CAE | 0°C to +70°C   | 16 SSOP        |
| MAX4601CWE | 0°C to +70°C   | 16 Wide SO     |
| MAX4601CPE | 0°C to +70°C   | 16 Plastic DIP |
| MAX4601EAE | -40°C to +85°C | 16 SSOP        |
| MAX4601EWE | -40°C to +85°C | 16 Wide SO     |
| MAX4601EPE | -40°C to +85°C | 16 Plastic DIP |

Ordering Information continued at end of data sheet.

### Pin Configurations/Functional Diagrams/Truth Tables



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

MAXIM

Maxim Integrated Products 1

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For small orders, phone 1-800-835-8769.

MAX4601/MAX4602/MAX4603

# 2.5Ω, Quad, SPST, CMOS Analog Switches

## ABSOLUTE MAXIMUM RATINGS

|                                           |                             |
|-------------------------------------------|-----------------------------|
| V+ to GND .....                           | -0.3V to +44V               |
| V- to GND .....                           | +0.3V to -44V               |
| V+ to V- .....                            | -0.3V to +44V               |
| V <sub>L</sub> to GND .....               | (GND - 0.3V) to (V+ + 0.3V) |
| All Other Pins to DGND (Note 1) .....     | (V- - 0.3V) to (V+ + 0.3V)  |
| Continuous Current (COM_, NO_, NC_) ..... | ±200mA                      |
| Peak Current (COM_, NO_, NC_) .....       | ±300mA                      |
| (pulsed at 1ms, 10% duty cycle)           |                             |

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                 |
| 16 SSOP (derate 7.1mW/°C above +70°C) .....           | 571mW           |
| 16 Wide SO (derate 9.52mW/°C above +70°C) .....       | 762mW           |
| 16 Plastic DIP (derate 10.53mW/°C above +70°C) .....  | 842mW           |
| Operating Temperature Ranges                          |                 |
| MAX460_C_E .....                                      | 0°C to +70°C    |
| MAX460_E_E .....                                      | -40°C to +85°C  |
| Storage Temperature Range .....                       | -65°C to +160°C |
| Lead Temperature (soldering, 10sec) .....             | +300°C          |

**Note 1:** Signals on NC\_, NO\_, COM\_, or IN\_ exceeding V+ or V- will be 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 Supplies

(V+ = +15V, V- = -15V, V<sub>L</sub> = 5V, V<sub>IN\_H</sub> = 2.4V, V<sub>IN\_L</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                                                              | SYMBOL                                                     | CONDITIONS                                                                              |                                                                                 | MIN    | TYP<br>(Note 2) | MAX   | UNITS |
|------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------|-----------------|-------|-------|
| ANALOG SWITCH                                                          |                                                            |                                                                                         |                                                                                 |        |                 |       |       |
| Input Voltage Range                                                    | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> , V <sub>NC_</sub> | (Note 3)                                                                                |                                                                                 | V-     |                 | V+    | V     |
| COM_ to NO or NC_<br>On-Resistance                                     | R <sub>ON</sub>                                            | I <sub>COM_</sub> = 10mA,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = ±10V                | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 1.7    | 2.5             |       | Ω     |
| COM_ to NO_ or NC_<br>On-Resistance Match Between<br>Channels (Note 4) | ΔR <sub>ON</sub>                                           | I <sub>COM_</sub> = 10mA, V <sub>NO_</sub><br>or = V <sub>NC_</sub> = ±10V              | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 0.1    |                 | 0.5   | Ω     |
| COM_ to NO_ or NC_<br>On-Resistance Flatness (Note 5)                  | R <sub>FLAT(ON)</sub>                                      | I <sub>COM_</sub> = 10mA; V <sub>NO_</sub><br>or V <sub>NC_</sub> = -5V, 0, 5V          | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 0.1    | 0.4             |       | Ω     |
| Off-Leakage Current<br>(NO_ or NC_) (Note 6)                           | I <sub>NO_</sub> , I <sub>NC_</sub>                        | V <sub>COM_</sub> = ±10V,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = ∓10V                | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.5   | 0.01            | 0.5   | nA    |
| COM Off-Leakage Current<br>(Note 6)                                    | I <sub>COM_(OFF)</sub>                                     | V <sub>COM_</sub> = ±10V,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = ∓10V                | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.5   | 0.01            | 0.5   | nA    |
| COM On-Leakage Current<br>(Note 6)                                     | I <sub>COM_(ON)</sub>                                      | V <sub>COM_</sub> = ±10V,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = ±10V<br>or floating | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -1     | 0.2             | 1     | nA    |
| LOGIC INPUT                                                            |                                                            |                                                                                         |                                                                                 |        |                 |       |       |
| Input Current with Input Voltage<br>High                               | I <sub>IN_H</sub>                                          | IN_ = 2.4V, all others = 0.8V                                                           |                                                                                 | -0.500 | 0.001           | 0.500 | μA    |
| Input Current with Input Voltage<br>Low                                | I <sub>IN_L</sub>                                          | IN_ = 0.8V, all others = 2.4V                                                           |                                                                                 | -0.500 | 0.001           | 0.500 | μA    |
| Logic Input High Voltage                                               | V <sub>IN_H</sub>                                          |                                                                                         |                                                                                 | 2.4    | 1.7             |       | V     |
| Logic Input Low Voltage                                                | V <sub>IN_L</sub>                                          |                                                                                         |                                                                                 |        | 1.7             | 0.8   | V     |

# 2.5Ω, Quad, SPST, CMOS Analog Switches

MAX4601/MAX4602/MAX4603

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +15V, V- = -15V, V<sub>L</sub> = 5V, V<sub>IN\_H</sub> = 2.4V, V<sub>IN\_L</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                      | SYMBOL             | CONDITIONS                                                                                           |                                                       | MIN  | TYP   | MAX   | UNITS |
|--------------------------------|--------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------|-------|-------|-------|
| POWER SUPPLY                   |                    |                                                                                                      |                                                       |      |       |       |       |
| Power-Supply Range             |                    |                                                                                                      |                                                       | ±4.5 |       | ±20.0 | V     |
| Positive Supply Current        | I+                 | All channels on or off, V <sub>IN</sub> = 0 or 5V                                                    | T <sub>A</sub> = +25°C                                | -0.5 | 0.001 | 0.5   | μA    |
|                                |                    |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -5   |       | 5     |       |
| Negative Supply Current        | I-                 | All channels on or off, V <sub>IN</sub> = 0 or 5V                                                    | T <sub>A</sub> = +25°C                                | -0.5 | 0.001 | 0.5   | μA    |
|                                |                    |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -5   |       | 5     |       |
| Logic Supply Current           | I <sub>L</sub>     | All channels on or off, V <sub>IN</sub> = 0 or 5V                                                    | T <sub>A</sub> = +25°C                                | -0.5 | 0.001 | 0.5   | μA    |
|                                |                    |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -5   |       | 5     |       |
| Ground Current                 | I <sub>GND</sub>   | All channels on or off, V <sub>IN</sub> = 0 or 5V                                                    | T <sub>A</sub> = +25°C                                | -0.5 | 0.001 | 0.5   | μA    |
|                                |                    |                                                                                                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -5   |       | 5     |       |
| SWITCH DYNAMIC CHARACTERISTICS |                    |                                                                                                      |                                                       |      |       |       |       |
| Turn-On Time                   | t <sub>ON</sub>    | Figure 2, V <sub>COM_</sub> = ±10V, T <sub>A</sub> = +25°C                                           |                                                       |      | 160   | 250   | ns    |
| Turn-Off Time                  | t <sub>OFF</sub>   | Figure 2, V <sub>COM_</sub> = ±10V, T <sub>A</sub> = +25°C                                           |                                                       |      | 190   | 350   | ns    |
| Charge Injection               | Q                  | C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, Figure 3, T <sub>A</sub> = +25°C |                                                       |      | 120   |       | pC    |
| Off-Isolation (Note 7)         | V <sub>ISO</sub>   | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, Figure 4, T <sub>A</sub> = +25°C               |                                                       |      | -56   |       | dB    |
| Crosstalk (Note 8)             | V <sub>CT</sub>    | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, Figure 5, T <sub>A</sub> = +25°C               |                                                       |      | -59   |       | dB    |
| NC_ or NO_ Capacitance         | C <sub>(OFF)</sub> | f = 1MHz, Figure 6, T <sub>A</sub> = +25°C                                                           |                                                       |      | 55    |       | pF    |
| COM Off-Capacitance            | C <sub>(COM)</sub> | f = 1MHz, Figure 6, T <sub>A</sub> = +25°C                                                           |                                                       |      | 55    |       | pF    |
| On-Capacitance                 | C <sub>(COM)</sub> | f = 1MHz, Figure 7, T <sub>A</sub> = +25°C                                                           |                                                       |      | 250   |       | pF    |

## 2.5Ω, Quad, SPST, CMOS Analog Switches

### ELECTRICAL CHARACTERISTICS—Single +12V Supply

(V<sub>+</sub> = 12V, V<sub>-</sub> = 0, V<sub>L</sub> = 5V, V<sub>IN\_H</sub> = 2.4V, V<sub>IN\_L</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                                                              | SYMBOL                          | CONDITIONS                                                                                          |                                                             | MIN      TYP<br>(Note 2)      MAX |                   |               | UNITS |
|------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------|-------------------|---------------|-------|
| ANALOG SWITCH                                                          |                                 |                                                                                                     |                                                             |                                   |                   |               |       |
| Input Voltage Range                                                    | $V_{COM\_}, V_{NO\_}, V_{NC\_}$ | (Note 3)                                                                                            |                                                             | GND                               | V+                | V             |       |
| COM_ to NO or NC_<br>On-Resistance                                     | $R_{ON}$                        | $I_{COM\_} = 10\text{mA}$ ,<br>$V_{NO\_}$ or $V_{NC\_} = 10\text{V}$                                | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | 3                                 | 4<br>5            | $\Omega$      |       |
| COM_ to NO_ or NC_<br>On-Resistance Match Between<br>Channels (Note 4) | $\Delta R_{ON}$                 | $I_{COM\_} = 10\text{mA}$ , $V_{NO\_}$<br>or $V_{NC\_} = 10\text{V}$                                | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | 0.03                              | 0.4<br>0.5        | $\Omega$      |       |
| COM_ to NO_ or NC_<br>On-Resistance Flatness<br>(Note 5)               | $R_{FLAT(ON)}$                  | $I_{COM\_} = 10\text{mA}$ ; $V_{NO\_}$<br>or $V_{NC\_} = 3\text{V}, 6\text{V}, 9\text{V}$           | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | 0.1                               | 0.4<br>0.5        | $\Omega$      |       |
| Off-Leakage Current<br>(NO_ or NC_) (Notes 6, 9)                       | $I_{NO\_}$<br>$I_{NC\_}$        | $V_{COM\_} = 1\text{V}, 10\text{V}$ ;<br>$V_{NO\_}$ or $V_{NC\_} = 10\text{V}$ ,<br>1V              | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -0.5<br>-2.5                      | 0.01<br>2.5       | nA            |       |
| COM Off-Leakage Current<br>(Notes 6, 9)                                | $I_{COM\_ (OFF)}$               | $V_{NO\_}$ or $V_{NC\_} = 10\text{V}$ ,<br>1V; $V_{COM\_} = 1\text{V}, 10\text{V}$                  | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -0.5<br>-2.5                      | 0.01<br>2.5       | nA            |       |
| COM On-Leakage Current<br>(Notes 6, 9)                                 | $I_{COM\_ (ON)}$                | $V_{COM\_} = 1\text{V}, 10\text{V}$ ;<br>$V_{NO\_}$ or $V_{NC\_} = 1\text{V}$ ,<br>10V, or floating | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -1<br>-10                         | 0.01<br>10        | nA            |       |
| LOGIC INPUT                                                            |                                 |                                                                                                     |                                                             |                                   |                   |               |       |
| Input Current with Input Voltage<br>High                               | $I_{IN\_H}$                     | $IN\_ = 2.4\text{V}$ , all others = 0.8V                                                            |                                                             | -0.500                            | 0.001    0.500    | $\mu\text{A}$ |       |
| Input Current with Input Voltage<br>Low                                | $I_{IN\_L}$                     | $IN\_ = 0.8\text{V}$ , all others = 2.4V                                                            |                                                             | -0.500                            | 0.001    0.500    | $\mu\text{A}$ |       |
| Logic Input High Voltage                                               | $V_{IN\_H}$                     |                                                                                                     |                                                             | 2.4                               |                   | V             |       |
| Logic Input Low Voltage                                                | $V_{IN\_L}$                     |                                                                                                     |                                                             |                                   | 0.8               | V             |       |
| POWER SUPPLY                                                           |                                 |                                                                                                     |                                                             |                                   |                   |               |       |
| Power-Supply Range                                                     |                                 |                                                                                                     |                                                             | 4.5                               |                   | 36.0    V     |       |
| Positive Supply Current                                                | $I_+$                           | All channels on or off,<br>$V_{IN} = 0$ or 5V                                                       | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -0.5<br>-5                        | 0.001    0.5<br>5 | $\mu\text{A}$ |       |
| Logic Supply Current                                                   | $I_L$                           | All channels on or off,<br>$V_{IN} = 0$ or 5V                                                       | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -0.5<br>-5                        | 0.001    0.5<br>5 | $\mu\text{A}$ |       |
| Ground Current                                                         | $I_{GND}$                       | $V_{IN} = 0$ or 5V                                                                                  | $T_A = +25^{\circ}\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | -0.5<br>-5                        | 0.001    0.5<br>5 | $\mu\text{A}$ |       |

# 2.5Ω, Quad, SPST, CMOS Analog Switches

MAX4601/MAX4602/MAX4603

## ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(V<sub>+</sub> = 12V, V<sub>-</sub> = 0, V<sub>L</sub> = 5V, V<sub>IN\_H</sub> = 2.4V, V<sub>IN\_L</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                             | SYMBOL             | CONDITIONS                                                                                           | MIN | TYP<br>(Note 2) | MAX | UNITS |
|---------------------------------------|--------------------|------------------------------------------------------------------------------------------------------|-----|-----------------|-----|-------|
| <b>SWITCH DYNAMIC CHARACTERISTICS</b> |                    |                                                                                                      |     |                 |     |       |
| Turn-On Time                          | t <sub>ON</sub>    | Figure 2, V <sub>COM_</sub> = 10V, T <sub>A</sub> = +25°C                                            |     | 160             |     | ns    |
| Turn-Off Time                         | t <sub>OFF</sub>   | Figure 2, V <sub>COM_</sub> = 10V, T <sub>A</sub> = +25°C                                            |     | 170             |     | ns    |
| Charge Injection                      | Q                  | C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, Figure 3, T <sub>A</sub> = +25°C |     | 20              |     | pC    |
| Crosstalk (Note 8)                    | V <sub>CT</sub>    | R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, f = 1MHz, Figure 5, T <sub>A</sub> = +25°C               |     | -60             |     | dB    |
| NC_ or NO_ Capacitance                | C <sub>(OFF)</sub> | f = 1MHz, Figure 6, T <sub>A</sub> = +25°C                                                           |     | 85              |     | pF    |
| COM Off-Capacitance                   | C <sub>(COM)</sub> | f = 1MHz, Figure 6, T <sub>A</sub> = +25°C                                                           |     | 85              |     | pF    |
| On-Capacitance                        | C <sub>(COM)</sub> | f = 1MHz, Figure 7, T <sub>A</sub> = +25°C                                                           |     | 140             |     | pF    |

**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:** Guaranteed by design.

**Note 4:** ΔR<sub>ON</sub> = R<sub>ON</sub>(MAX) - R<sub>ON</sub>(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 range.

**Note 6:** Leakage parameters are 100% tested at maximum-rated hot temperature and guaranteed by correlation at +25°C.

**Note 7:** 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.

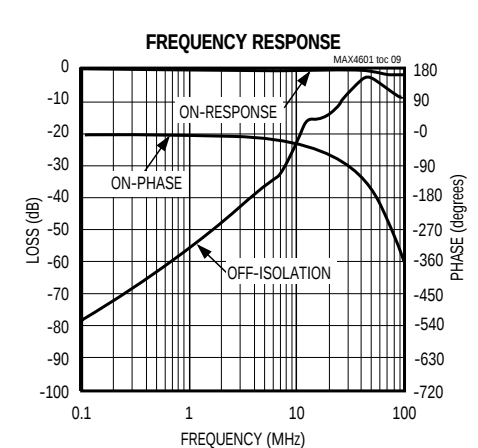
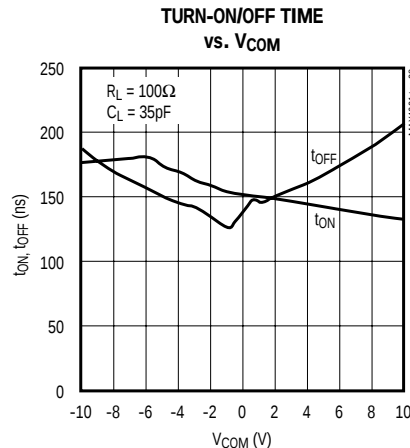
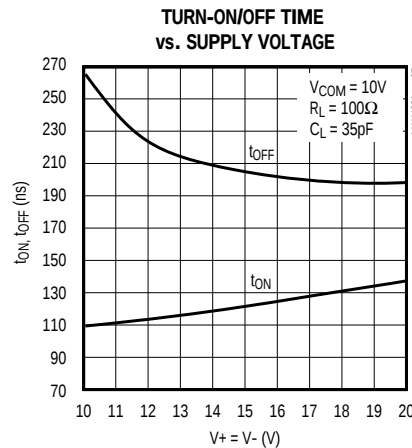
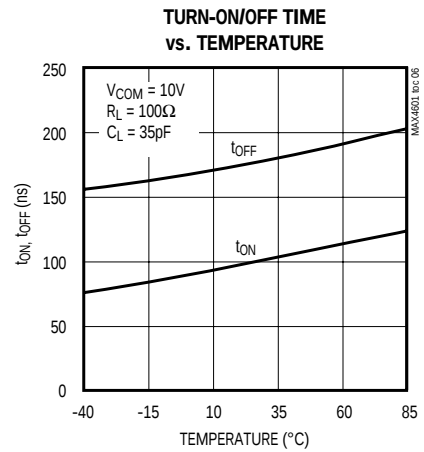
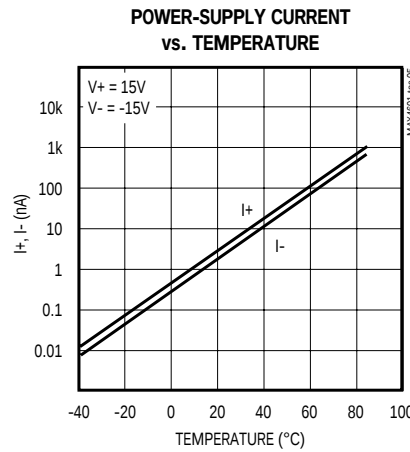
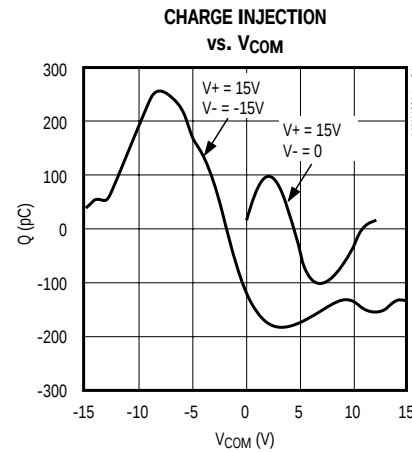
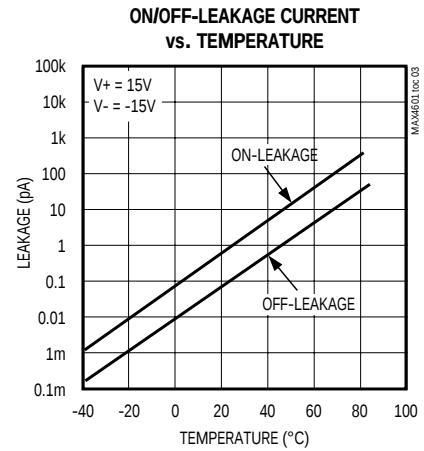
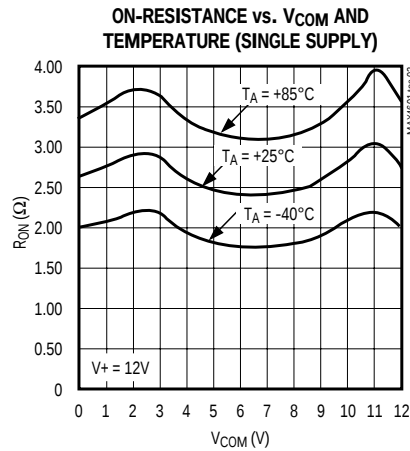
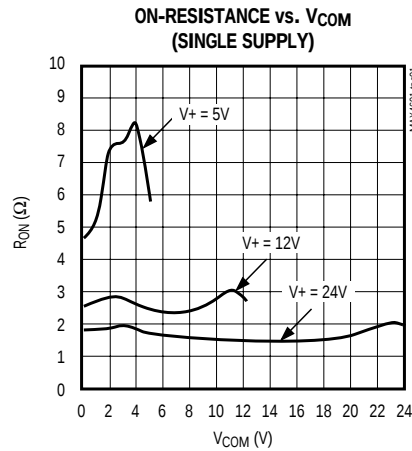
**Note 8:** Between any two switches.

**Note 9:** Leakage testing at single supply is guaranteed by testing with dual supplies.

# 2.5 $\Omega$ , Quad, SPST, CMOS Analog Switches

## Typical Operating Characteristics

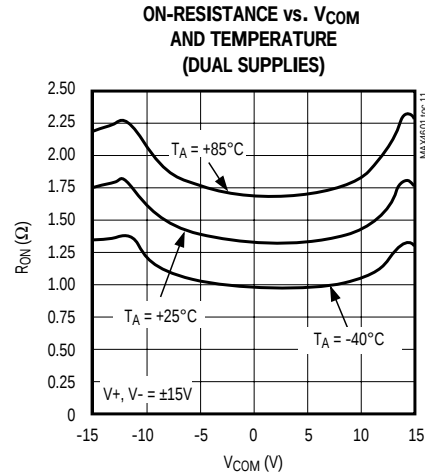
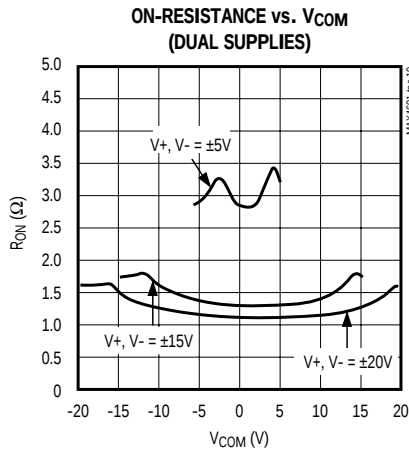
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



# 2.5Ω, Quad, SPST, CMOS Analog Switches

## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)



## Pin Description

| PIN             |                 |                 | NAME                      | FUNCTION                                                                          |
|-----------------|-----------------|-----------------|---------------------------|-----------------------------------------------------------------------------------|
| MAX4601         | MAX4602         | MAX4603         |                           |                                                                                   |
| 1, 16, 9, 8     | 1, 16, 9, 8     | 1, 16, 9, 8     | IN1, IN2,<br>IN3, IN4     | Logic-Control Digital Inputs                                                      |
| 2, 15,<br>10, 7 | 2, 15,<br>10, 7 | 2, 15,<br>10, 7 | COM1, COM2,<br>COM3, COM4 | Analog Switch Common Terminals                                                    |
| 3, 14, 11, 6    | —               | —               | NC1, NC2,<br>NC3, NC4     | Analog Switch Normally Closed Terminals                                           |
| —               | 3, 14, 11, 6    | —               | NO1, NO2,<br>NO3, NO4     | Analog Switch Normally Open Terminals                                             |
| —               | —               | 3, 6            | NO1, NO4                  | Analog Switch Normally Open Terminals                                             |
| —               | —               | 14, 11          | NC2, NC3                  | Analog Switch Normally Closed Terminals                                           |
| 4               | 4               | 4               | V-                        | Negative Analog Supply-Voltage Input. Connect to GND for single-supply operation. |
| 5               | 5               | 5               | GND                       | Ground                                                                            |
| 12              | 12              | 12              | V <sub>L</sub>            | Logic-Supply Input                                                                |
| 13              | 13              | 13              | V+                        | Positive Analog Supply Input                                                      |

## 2.5Ω, Quad, SPST, CMOS Analog Switches

### 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, or COM. If power-supply sequencing is not possible, add two small signal diodes (D1, D2) in series with the supply pins for overvoltage protection (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 100MHz 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. (Above 300MHz, the switch actually passes more signal turned off than turned on.) This effect is more pronounced with higher source and load impedances.

Above 5MHz, circuit board layout becomes critical, and it becomes difficult to characterize the response of the

switch independent of the circuit. The graphs shown in the *Typical Operating Characteristics* were taken using a 50Ω source and load connected with BNC connectors to a circuit board deemed "average;" that is, designed with isolation in mind, but not using strip-line or other special RF circuit techniques. For critical applications above 5MHz, use the MAX440, MAX441, and MAX442, which are fully characterized up to 160MHz.

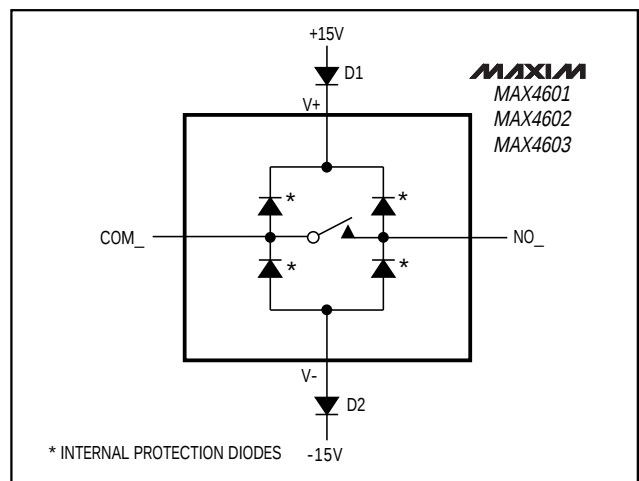


Figure 1. Overvoltage Protection Using External Blocking Diodes

### Timing Diagrams/Test Circuits

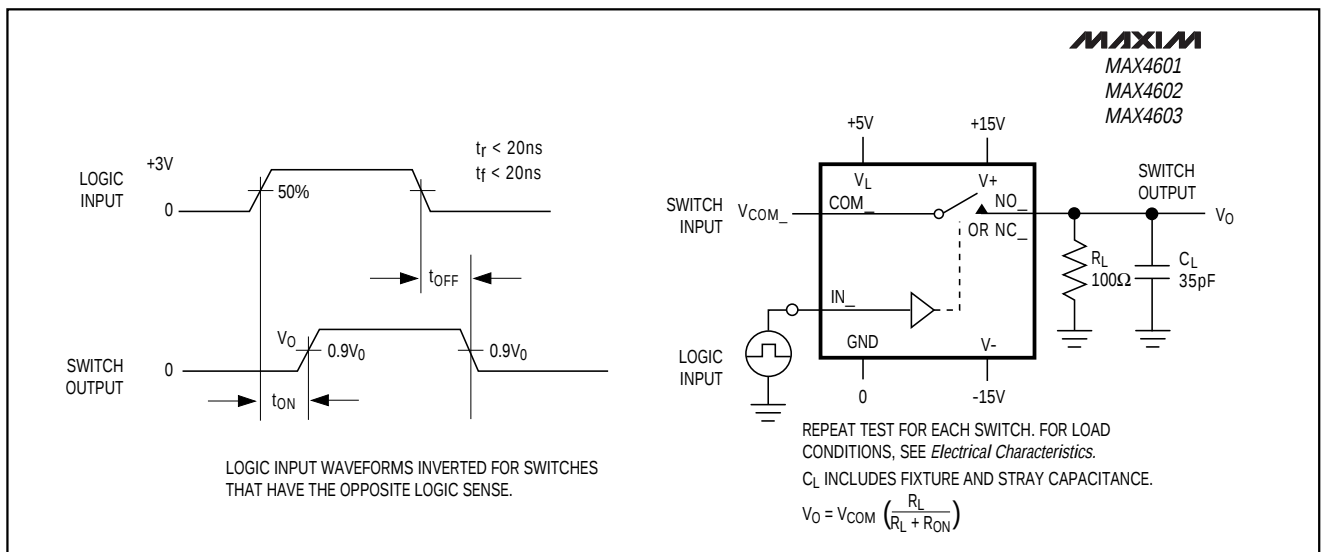


Figure 2. Switching-Time Test Circuit

# 2.5Ω, Quad, SPST, CMOS Analog Switches

Timing Diagrams/Test Circuits (continued)

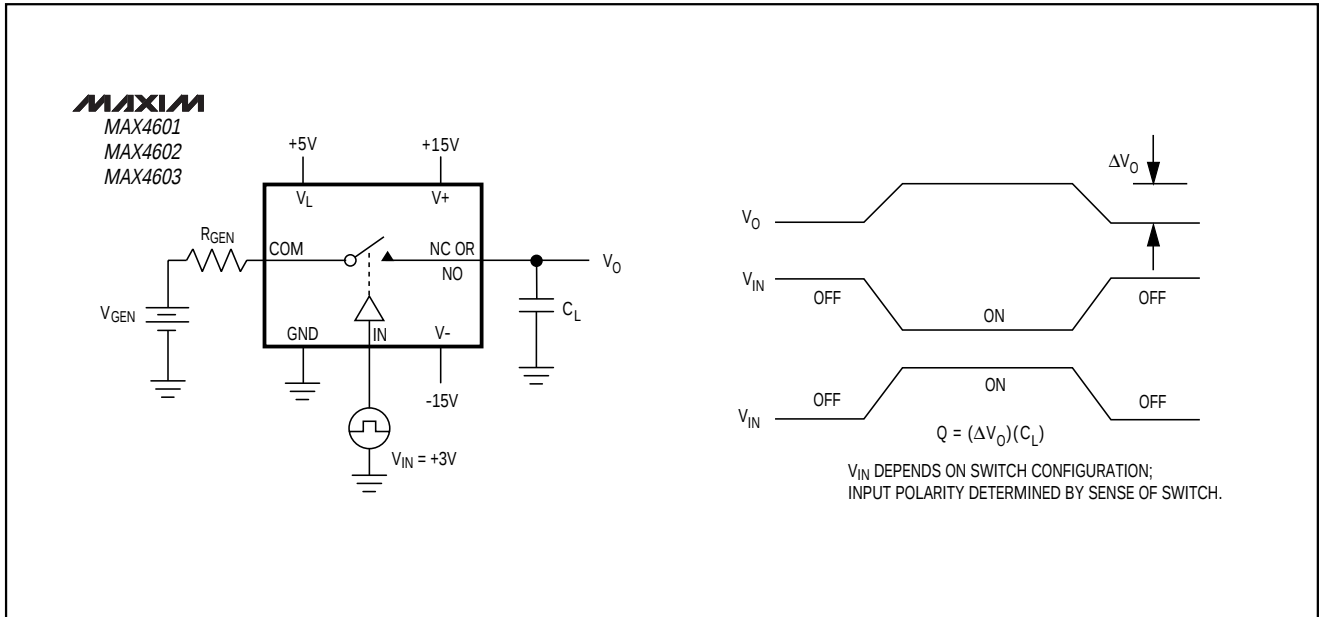


Figure 3. Charge-Injection Test Circuit

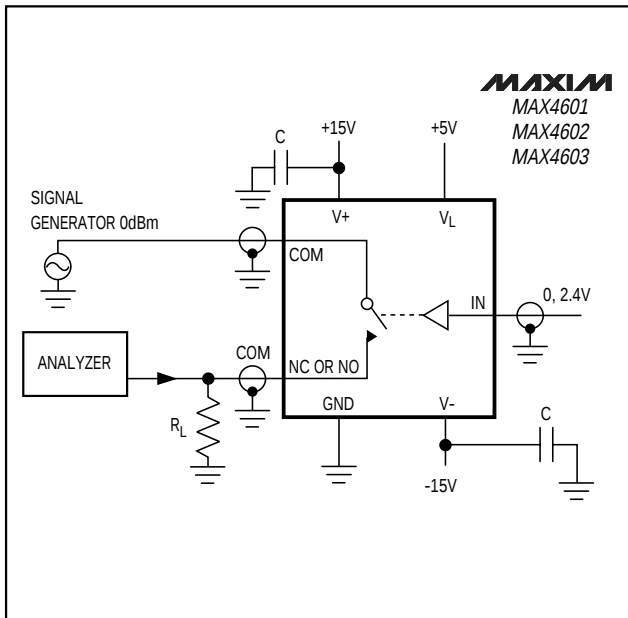


Figure 4. Off-Isolation Test Circuit

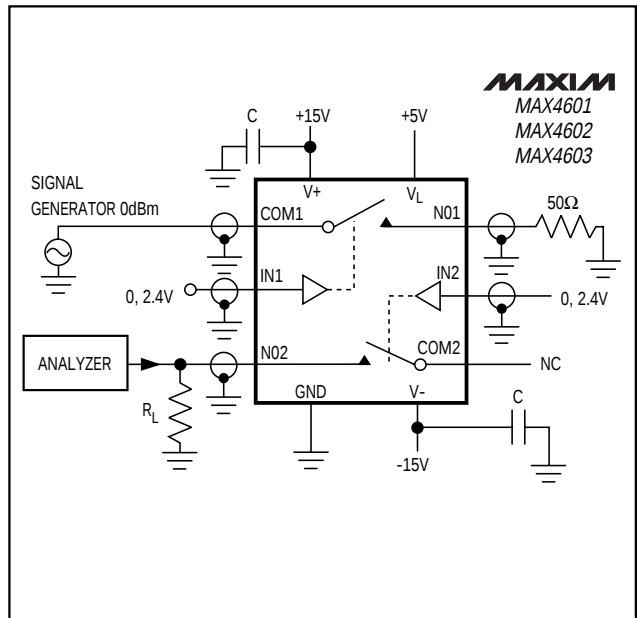


Figure 5. Crosstalk Test Circuit

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## Timing Diagrams/Test Circuits (continued)

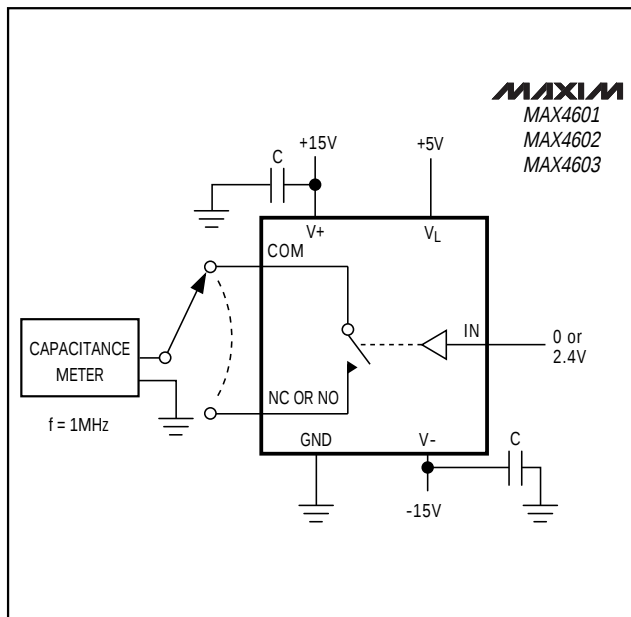


Figure 6. Switch Off-Capacitance Test Circuit

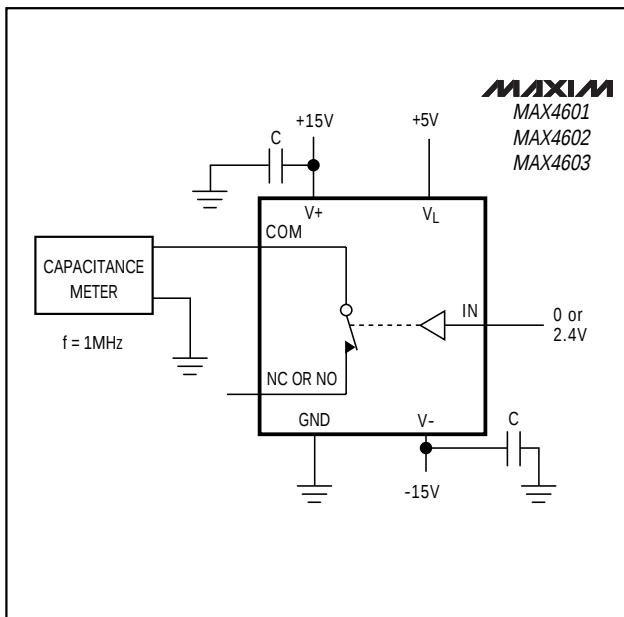


Figure 7. Switch On-Capacitance Test Circuit

## Ordering Information (continued)

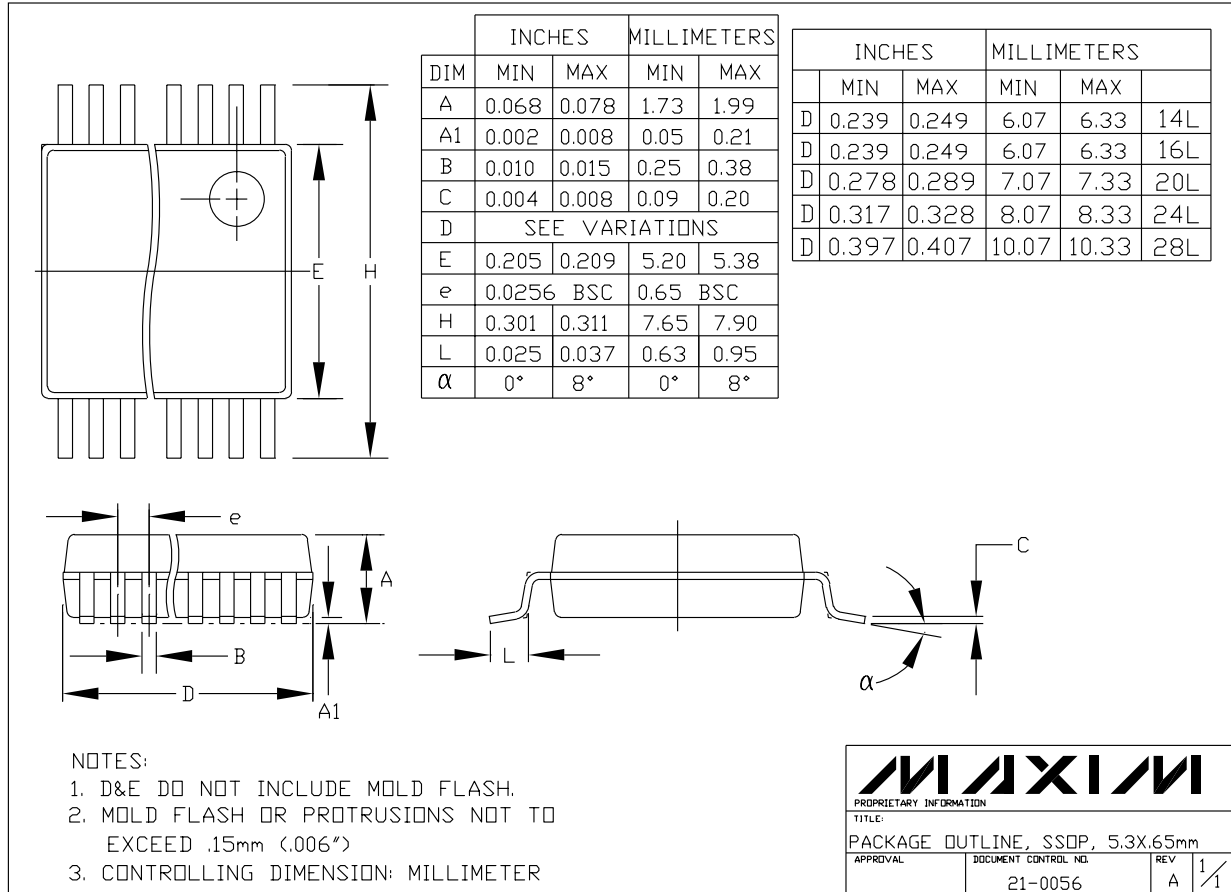
| PART       | TEMP. RANGE    | PIN-PACKAGE    |
|------------|----------------|----------------|
| MAX4602CAE | 0°C to +70°C   | 16 SSOP        |
| MAX4602CWE | 0°C to +70°C   | 16 Wide SO     |
| MAX4602CPE | 0°C to +70°C   | 16 Plastic DIP |
| MAX4602EAE | -40°C to +85°C | 16 SSOP        |
| MAX4602EWE | -40°C to +85°C | 16 Wide SO     |
| MAX4602EPE | -40°C to +85°C | 16 Plastic DIP |
| MAX4603CAE | 0°C to +70°C   | 16 SSOP        |
| MAX4603CWE | 0°C to +70°C   | 16 Wide SO     |
| MAX4603CPE | 0°C to +70°C   | 16 Plastic DIP |
| MAX4603EAE | -40°C to +85°C | 16 SSOP        |
| MAX4603EWE | -40°C to +85°C | 16 Wide SO     |
| MAX4603EPE | -40°C to +85°C | 16 Plastic DIP |

## Chip Information

TRANSISTOR COUNT: 100

# 2.5Ω, Quad, SPST, CMOS Analog Switches

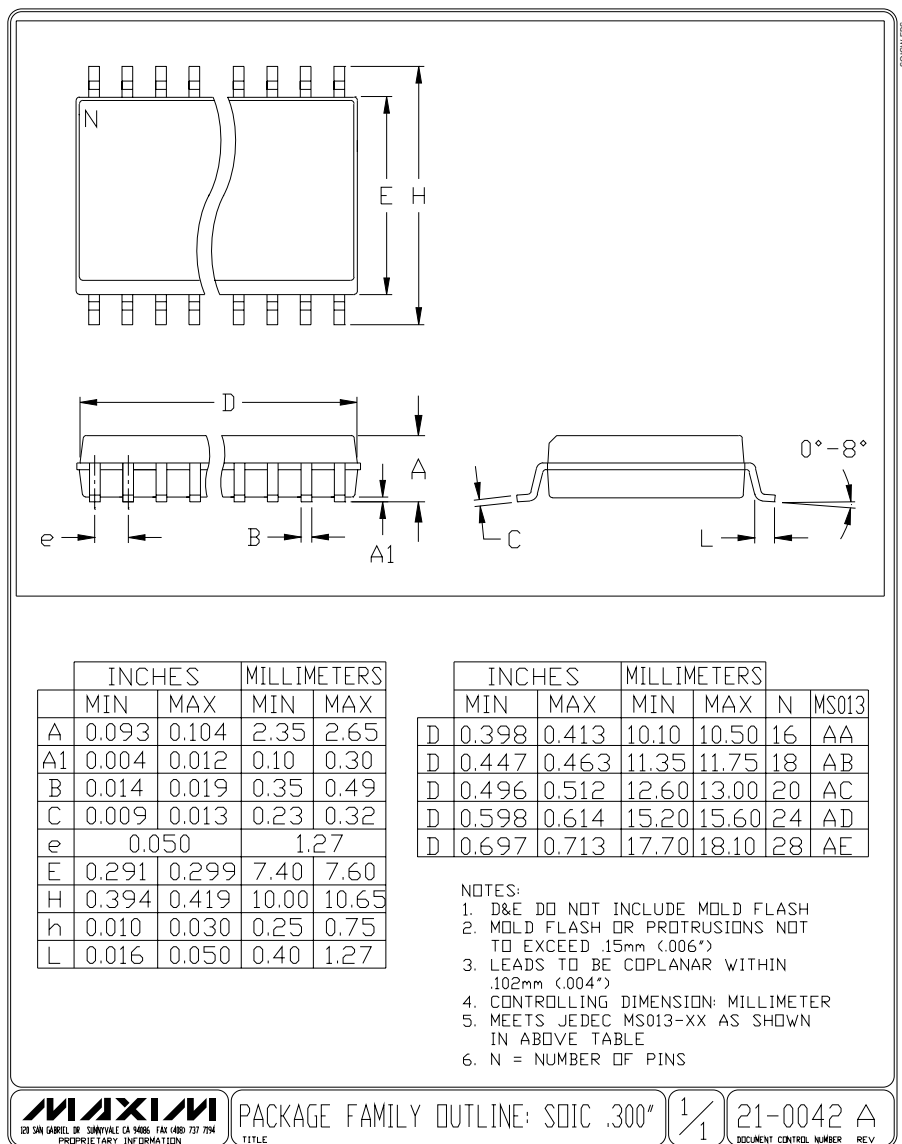
## Package Information



MAX4601/MAX4602/MAX4603

# 2.5Ω, Quad, SPST, CMOS Analog Switches

## Package Information



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.

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