



## 4.5Ω Quad SPST Analog Switches in UCSP

### General Description

The MAX4737/MAX4738/MAX4739 low-voltage, low on-resistance ( $R_{ON}$ ), quad single-pole/single throw (SPST) analog switches operate from a single +1.8V to +5.5V supply. These devices are designed for USB 1.1 and audio switching applications.

The MAX4737/MAX4738/MAX4739 feature 4.5Ω  $R_{ON}$  (max) with 1.2Ω flatness and 0.4Ω matching between channels. These new switches feature guaranteed operation from +1.8V to +5.5V and are fully specified at 3V and 5V. These switches offer break-before-make switching (1ns) with  $t_{ON} < 80ns$  and  $t_{OFF} < 40ns$  at +2.7V. The digital logic inputs are +1.8V logic compatible with a +2.7V to +3.6V supply.

These switches are packaged in a chip-scale package (UCSP™), significantly reducing the required PC board area. The chip occupies only a 2mm x 2mm area and has a 4 x 4 bump array with a bump pitch of 0.5mm. These switches are also available in a 14-pin TSSOP and a 16-pin thin QFN (4mm x 4mm) package.

### Applications

Battery-Operated Equipment  
Audio/Video-Signal Routing  
Low-Voltage Data-Acquisition Systems  
Sample-and-Hold Circuits  
Data-Acquisition Systems  
Communications Circuits

### Features

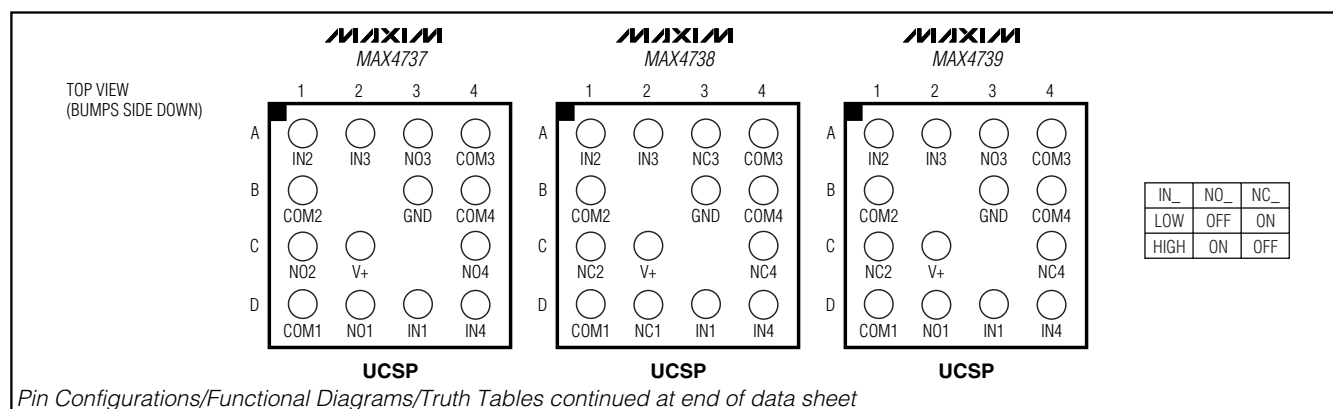
- ◆ USB 1.1 Signal Switching
- ◆ 2ns (max) Differential Skew
- ◆ -3dB Bandwidth: >300MHz
- ◆ Low 20pF On-Channel Capacitance
- ◆ Low  $R_{ON}$ 
  - 4.5Ω (max) (+3V Supply)
  - 3Ω (max) (+5V Supply)
- ◆ 0.4Ω (max)  $R_{ON}$  Match (+3V Supply)
- ◆ 1.2Ω (max)  $R_{ON}$  Flatness (+3V Supply)
- ◆ <0.5nA Leakage Current at +25°C
- ◆ High Off-Isolation: -55dB (10MHz)
- ◆ Low Crosstalk: -80dB (10MHz)
- ◆ Low Distortion: 0.03%
- ◆ +1.8V CMOS-Logic Compatible
- ◆ Single-Supply Operation from +1.8V to +5.5V
- ◆ Rail-to-Rail Signal Handling

### Ordering Information

| PART         | TEMP RANGE     | PIN/BUMP-PACKAGE | TOP MARK |
|--------------|----------------|------------------|----------|
| MAX4737EUD   | -40°C to +85°C | 14 TSSOP         | —        |
| MAX4737ETE   | -40°C to +85°C | 16 Thin QFN      | —        |
| MAX4737EBE-T | -40°C to +85°C | 16 UCSP-16       | 4737     |
| MAX4738EUD   | -40°C to +85°C | 14 TSSOP         | —        |
| MAX4738ETE   | -40°C to +85°C | 16 Thin QFN      | —        |
| MAX4738EBE-T | -40°C to +85°C | 16 UCSP-16       | 4738     |
| MAX4739EUD   | -40°C to +85°C | 14 TSSOP         | —        |
| MAX4739ETE   | -40°C to +85°C | 16 Thin QFN      | —        |
| MAX4739EBE-T | -40°C to +85°C | 16 UCSP-16       | 4739     |

UCSP is a trademark of Maxim Integrated Products, Inc.

### Pin Configurations/Functional Diagrams/Truth Tables



## 4.5Ω Quad SPST Analog Switches in UCSP

### ABSOLUTE MAXIMUM RATINGS

(All Voltages Referenced to GND)

|                                                       |                           |
|-------------------------------------------------------|---------------------------|
| V+, IN_                                               | .....-0.3V to +6.0V       |
| COM_, NO_, NC_ (Note 1)                               | .....-0.3V to (V+ + 0.3V) |
| Continuous Current COM_, NO_, NC_                     | .....±100mA               |
| Peak Current COM_, NO_, NC_                           | .....±200mA               |
| (pulsed at 1ms, 10% duty cycle)                       |                           |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                           |
| 14-Pin TSSOP (derate 6.3mW/°C above +70°C)            | .....500mW                |
| 16-Bump UCSP (derate 8.3mW/°C above +70°C)            | .....659mW                |
| 16-Pin Thin QFN (derate 25mW/°C above +70°C)          | .....2000mW               |

|                                   |                      |
|-----------------------------------|----------------------|
| ESD Method 3015.7                 | .....>2kV            |
| Operating Temperature Range       | .....-40°C to +85°C  |
| Junction Temperature              | .....+150°C          |
| Storage Temperature Range         | .....-65°C to +150°C |
| Lead Temperature (soldering, 10s) | .....+300°C          |
| Bump Temperature (soldering)      |                      |
| Infrared (15s)                    | .....+220°C          |
| Vapor Phase (60s)                 | .....+215°C          |

**Note 1:** Signals on COM\_, NO\_, or NC\_ exceeding V+ or GND 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 +3.6V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3.0V, T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 3, 4)

| PARAMETER                                            | SYMBOL                                                     | CONDITIONS                                                                                                      | T <sub>A</sub>                          | MIN  | TYP   | MAX  | UNITS |
|------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|-------|------|-------|
| Analog Signal Range                                  | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> , V <sub>NC_</sub> |                                                                                                                 |                                         | 0    |       | V+   | V     |
| <b>ANALOG SWITCH</b>                                 |                                                            |                                                                                                                 |                                         |      |       |      |       |
| On-Resistance (Note 5)                               | R <sub>ON</sub>                                            | V+ = 2.7V, I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                             | +25°C                                   |      | 3.0   | 4.5  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |       | 5    |       |
| On-Resistance Match Between<br>Channels (Notes 5, 6) | ΔR <sub>ON</sub>                                           | V+ = 2.7V, I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                             | +25°C                                   |      | 0.1   | 0.4  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |       | 0.5  |       |
| On-Resistance Flatness (Note 7)                      | R <sub>FLAT(ON)</sub>                                      | V+ = 2.7V, I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.0V, 1.5V, 2.0V                 | +25°C                                   |      | 0.6   | 1.2  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |       | 1.5  |       |
| NO_, NC_ Off-Leakage Current<br>(Note 8)             | I <sub>NO_(OFF)</sub> ,<br>I <sub>NC_(OFF)</sub>           | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 3.3V, 0.3V                 | +25°C                                   | -0.5 | +0.01 | +0.5 | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -1   |       | +1   |       |
| COM_ Off-Leakage Current<br>(Note 8)                 | I <sub>COM_(OFF)</sub>                                     | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 3.3V, 0.3V                 | +25°C                                   | -0.5 | +0.01 | +0.5 | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -1   |       | +1   |       |
| COM_ On-Leakage Current<br>(Note 8)                  | I <sub>COM_(ON)</sub>                                      | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 0.3V, 3.3V, or<br>floating | +25°C                                   | -1   | +0.01 | +1   | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -2   |       | +2   |       |

## 4.5Ω Quad SPST Analog Switches in UCSP

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

(V<sub>+</sub> = +2.7V to +3.6V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>+</sub> = +3.0V, T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 3, 4)

| PARAMETER                                               | SYMBOL                                           | CONDITIONS                                                                                                                    | T <sub>A</sub>                       | MIN  | TYP | MAX  | UNITS |
|---------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------|-----|------|-------|
| <b>DYNAMIC CHARACTERISTICS</b>                          |                                                  |                                                                                                                               |                                      |      |     |      |       |
| Turn-On Time                                            | t <sub>ON</sub>                                  | V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 1                         | +25°C                                | 40   | 80  | 100  | ns    |
|                                                         |                                                  |                                                                                                                               | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     |      |       |
| Turn-Off Time                                           | t <sub>OFF</sub>                                 | V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 1                         | +25°C                                | 20   | 40  | 50   | ns    |
|                                                         |                                                  |                                                                                                                               | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     |      |       |
| Break-Before-Make Time Delay<br>(MAX4739 Only) (Note 8) | t <sub>BBM</sub>                                 | V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2                         | +25°C                                | 8    |     | 1    | ns    |
|                                                         |                                                  |                                                                                                                               | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     |      |       |
| Skew (Note 8)                                           | t <sub>SKEW</sub>                                | R <sub>S</sub> = 39Ω, C <sub>L</sub> = 50pF, Figure 3                                                                         | T <sub>MIN</sub> to T <sub>MAX</sub> | 0.15 |     | 2    | ns    |
| Charge Injection                                        | Q                                                | V <sub>GEN</sub> = 2V, R <sub>GEN</sub> = 0Ω,<br>C <sub>L</sub> = 1.0nF, Figure 4                                             | +25°C                                | 5    |     |      | pC    |
| Off-Isolation (Note 9)                                  | V <sub>ISO</sub>                                 | f = 10MHz; V <sub>NO_</sub> , V <sub>NC_</sub> = 1V <sub>P-P</sub> ;<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5a | +25°C                                | -55  |     |      | dB    |
|                                                         |                                                  | f = 1MHz; V <sub>NO_</sub> , V <sub>NC_</sub> = 1V <sub>P-P</sub> ;<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5a  |                                      | -80  |     |      |       |
| Crosstalk (Note 10)                                     | V <sub>CT</sub>                                  | f = 10MHz; V <sub>NO_</sub> , V <sub>NC_</sub> = 1V <sub>P-P</sub> ;<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5b | +25°C                                | -80  |     |      | dB    |
|                                                         |                                                  | f = 1MHz; V <sub>NO_</sub> , V <sub>NC_</sub> = 1V <sub>P-P</sub> ;<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5b  |                                      | -110 |     |      |       |
| On-Channel -3dB Bandwidth                               | BW                                               | Signal = 0dBm, C <sub>L</sub> = 5pF, 50Ω<br>in and out, Figure 5a                                                             | +25°C                                | 300  |     |      | MHz   |
| Total Harmonic Distortion                               | THD                                              | R <sub>L</sub> = 600Ω                                                                                                         | +25°C                                | 0.03 |     |      | %     |
| NO_, NC_ Off-Capacitance                                | C <sub>NO_(OFF)</sub> ,<br>C <sub>NC_(OFF)</sub> | f = 1MHz, Figure 6                                                                                                            | +25°C                                | 9    |     |      | pF    |
| Switch On-Capacitance                                   | C <sub>ON</sub>                                  | f = 1MHz, Figure 6                                                                                                            | +25°C                                | 15   |     |      | pF    |
| <b>DIGITAL I/O</b>                                      |                                                  |                                                                                                                               |                                      |      |     |      |       |
| Input Logic High Voltage                                | V <sub>IH</sub>                                  |                                                                                                                               | T <sub>MIN</sub> to T <sub>MAX</sub> | 1.4  |     |      | V     |
| Input Logic Low Voltage                                 | V <sub>IL</sub>                                  |                                                                                                                               | T <sub>MIN</sub> to T <sub>MAX</sub> |      |     | 0.5  | V     |
| Input Leakage Current                                   | I <sub>IN</sub>                                  | V <sub>+</sub> = 3.6V, V <sub>IN_</sub> = 0 or 5.5V                                                                           | T <sub>MIN</sub> to T <sub>MAX</sub> | -0.1 |     | +0.1 | μA    |

## 4.5Ω Quad SPST Analog Switches in UCSP

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

(V+ = +2.7V to +3.6V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3.0V, T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 3, 4)

| PARAMETER               | SYMBOL | CONDITIONS                            | T <sub>A</sub>                       | MIN | TYP | MAX | UNITS |
|-------------------------|--------|---------------------------------------|--------------------------------------|-----|-----|-----|-------|
| <b>SUPPLY</b>           |        |                                       |                                      |     |     |     |       |
| Supply Voltage Range    | V+     |                                       | T <sub>MIN</sub> to T <sub>MAX</sub> | 1.8 |     | 5.5 | V     |
| Positive Supply Current | I+     | V+ = 5.5V, V <sub>IN</sub> = 0V or V+ | T <sub>MIN</sub> to T <sub>MAX</sub> |     |     | 1   | μA    |

### ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V+ = +4.2V to +5.5V, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +5.0V, T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 3, 4)

| PARAMETER                                            | SYMBOL                                                     | CONDITIONS                                                                                                      | T <sub>A</sub>                          | MIN  | TYP  | MAX  | UNITS |
|------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------|------|-------|
| Analog Signal Range                                  | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> , V <sub>NC_</sub> |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 0    |      | V+   | V     |
| ANALOG SWITCH                                        |                                                            |                                                                                                                 |                                         |      |      |      |       |
| On-Resistance (Note 5)                               | R <sub>ON</sub>                                            | V+ = 4.2V; I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 3.5V                             | +25°C                                   |      | 1.7  | 3.0  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |      | 3.5  |       |
| On-Resistance Match Between<br>Channels (Notes 5, 6) | ΔR <sub>ON</sub>                                           | V+ = 4.2V; I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 3.5V                             | +25°C                                   |      | 0.1  | 0.3  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |      | 0.4  |       |
| On-Resistance Flatness (Note 7)                      | R <sub>FLAT(ON)</sub>                                      | V+ = 4.2V; I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.0V, 2.0V, 3.5V                 | +25°C                                   |      | 0.4  | 1.2  | Ω     |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |      | 1.5  |       |
| NO_, NC_ Off-Leakage Current<br>(Note 8)             | I <sub>NO_(OFF)</sub> ,<br>I <sub>NC_(OFF)</sub>           | V+ = 5.5V; V <sub>COM_</sub> = 1.0V, 4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 4.5V, 1.0V                 | +25°C                                   | -0.5 | 0.01 | +0.5 | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -1   |      | +1   |       |
| COM_ Off-Leakage Current<br>(Note 8)                 | I <sub>COM_(OFF)</sub>                                     | V+ = 5.5V; V <sub>COM_</sub> = 1V, 4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 4.5V, 1V                     | +25°C                                   | -0.5 | 0.01 | +0.5 | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -1   |      | +1   |       |
| COM_ On-Leakage Current<br>(Note 8)                  | I <sub>COM_(ON)</sub>                                      | V+ = 5.5V; V <sub>COM_</sub> = 1.0V, 4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = 1.0V, 4.5V, or<br>floating | +25°C                                   | -1   | 0.01 | +1   | nA    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -2   |      | +2   |       |
| DYNAMIC CHARACTERISTICS                              |                                                            |                                                                                                                 |                                         |      |      |      |       |
| Turn-On Time                                         | t <sub>ON</sub>                                            | V <sub>NO_</sub> , V <sub>NC_</sub> = 3.0V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 1           | +25°C                                   |      | 30   | 80   | ns    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |      | 100  |       |
| Turn-Off Time                                        | t <sub>OFF</sub>                                           | V <sub>NO_</sub> , V <sub>NC_</sub> = 3.0V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 1           | +25°C                                   |      | 20   | 40   | ns    |
|                                                      |                                                            |                                                                                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |      | 50   |       |

## 4.5Ω Quad SPST Analog Switches in UCSP

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

(V<sub>+</sub> = +4.2V to +5.5V, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>+</sub> = +5.0V, T<sub>A</sub> = +25°C, unless otherwise noted.) (Notes 3, 4)

| PARAMETER                                               | SYMBOL            | CONDITIONS                                                                                            | T <sub>A</sub>                          | MIN  | TYP | MAX  | UNITS |
|---------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------|------|-----|------|-------|
| Break-Before-Make Time Delay<br>(MAX4739 Only) (Note 8) | t <sub>BBM</sub>  | V <sub>NO_</sub> , V <sub>NC_</sub> = 3.0V;<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Figure 2 | +25°C                                   | 8    |     | ns   |       |
|                                                         |                   |                                                                                                       | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 1    |     |      |       |
| Skew (Note 8)                                           | t <sub>SKEW</sub> | R <sub>S</sub> = 39Ω, C <sub>L</sub> = 50pF, Figure 3                                                 | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 0.15 |     | 2    | ns    |
| DIGITAL I/O                                             |                   |                                                                                                       |                                         |      |     |      |       |
| Input Logic High Voltage                                | V <sub>IH</sub>   |                                                                                                       | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 2.0  |     |      | V     |
| Input Logic Low Voltage                                 | V <sub>IL</sub>   |                                                                                                       | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |     | 0.8  | V     |
| Input Leakage Current                                   | I <sub>IN</sub>   | V+ = 5.5V, V <sub>IN_</sub> = 0V or V+                                                                | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1 |     | +0.1 | μA    |
| POWER SUPPLY                                            |                   |                                                                                                       |                                         |      |     |      |       |
| Power-Supply Range                                      | V+                |                                                                                                       | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 1.8  |     | 5.5  | V     |
| Positive Supply Current                                 | I+                | V+ = 5.5V, V <sub>IN_</sub> = 0V or V+                                                                | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |      |     | 1    | μA    |

**Note 3:** UCSP parts are 100% tested at +25°C only, and guaranteed by design over the specified temperature range. TSSOP and thin QFN parts are 100% tested at T<sub>MAX</sub> and guaranteed by design over the specified temperature range.

**Note 4:** The algebraic convention used in this data sheet is where the most negative value is a minimum and the most positive value is a maximum.

**Note 5:** Guaranteed by design for UCSP and thin QFN parts.

**Note 6:** ΔR<sub>ON</sub> = R<sub>ON</sub>(MAX) - R<sub>ON</sub>(MIN).

**Note 7:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

**Note 8:** Guaranteed by design.

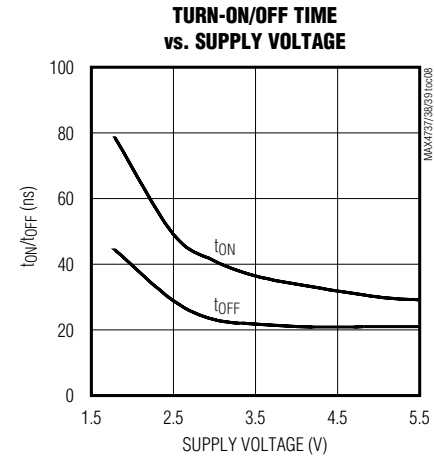
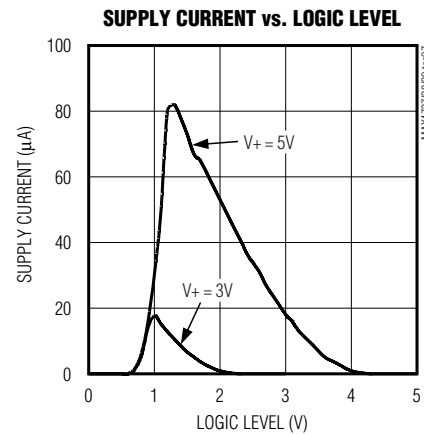
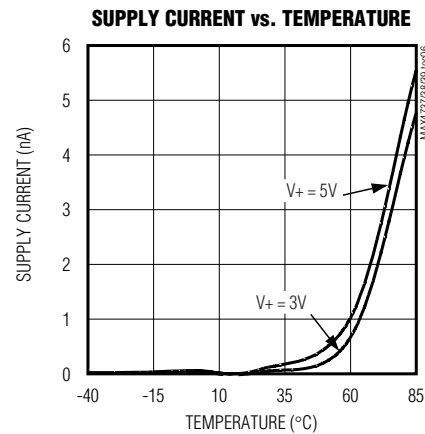
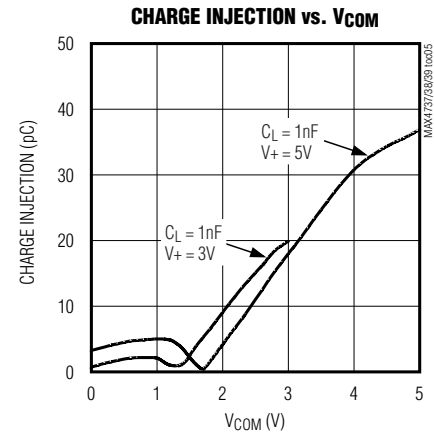
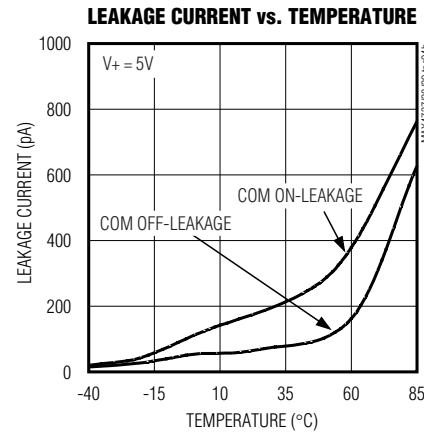
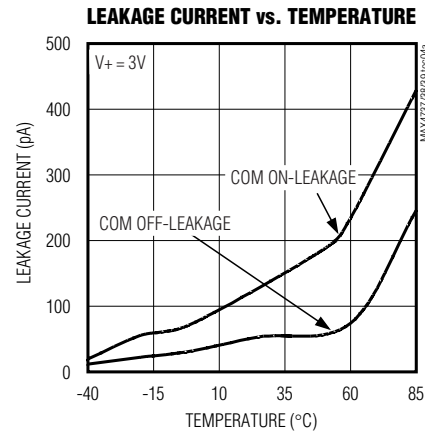
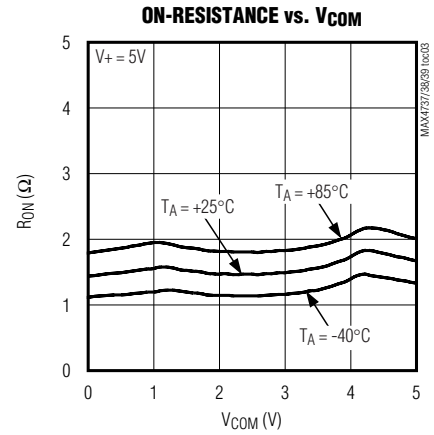
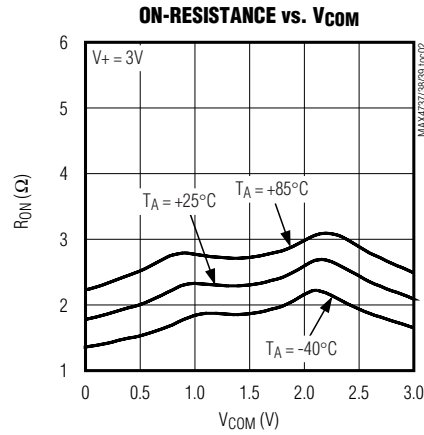
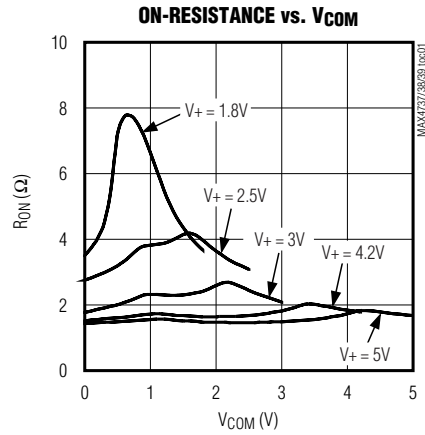
**Note 9:** Off-Isolation = 20log<sub>10</sub> (V<sub>COM</sub> / V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

**Note 10:** Between any two switches.

# 4.5Ω Quad SPST Analog Switches in UCSP

## Typical Operating Characteristics

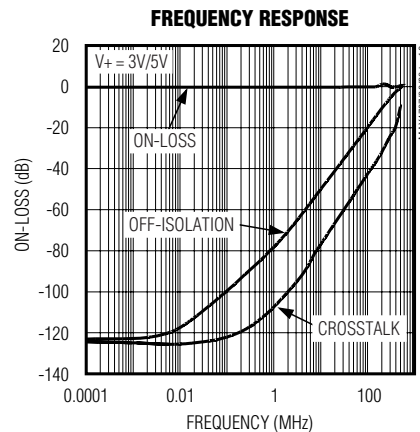
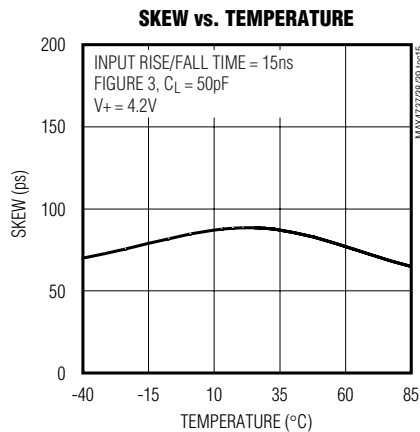
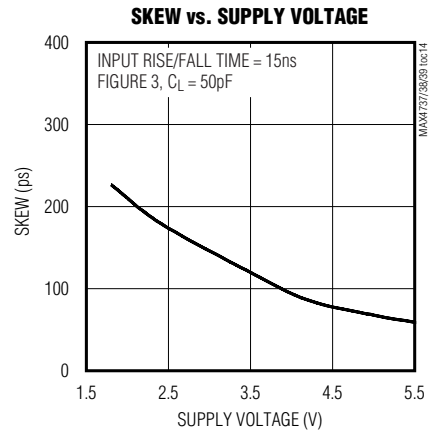
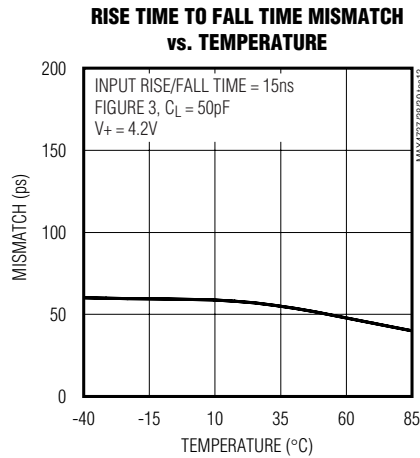
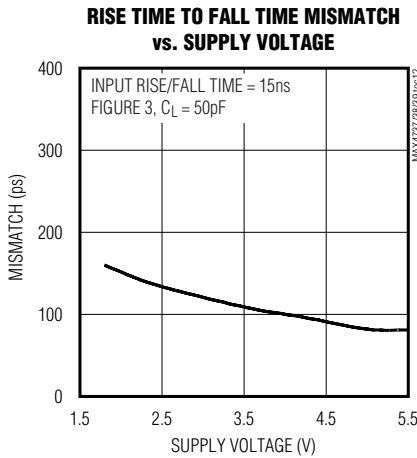
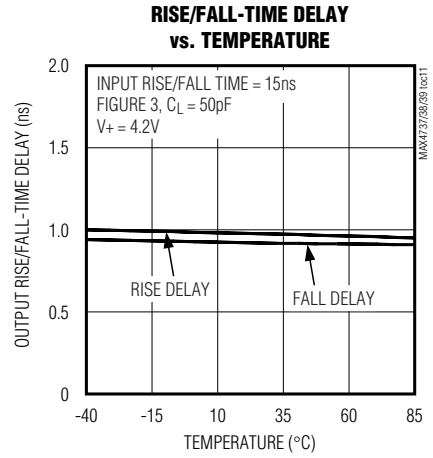
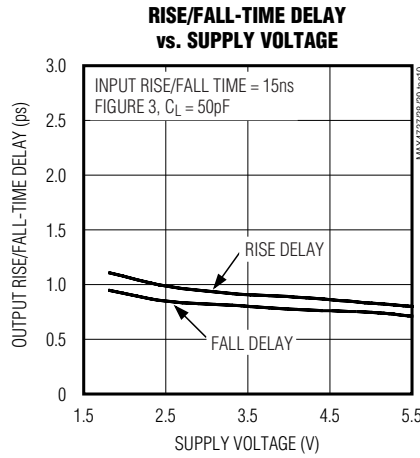
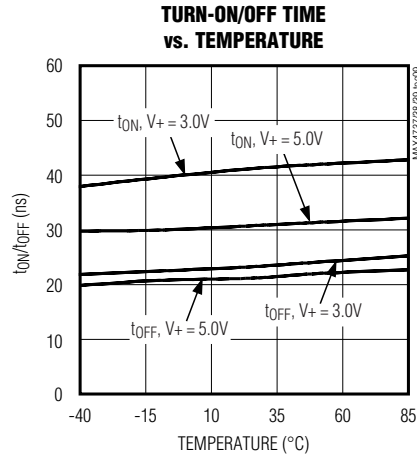
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



# 4.5Ω Quad SPST Analog Switches in UCSP

## Typical Operating Characteristics (continued)

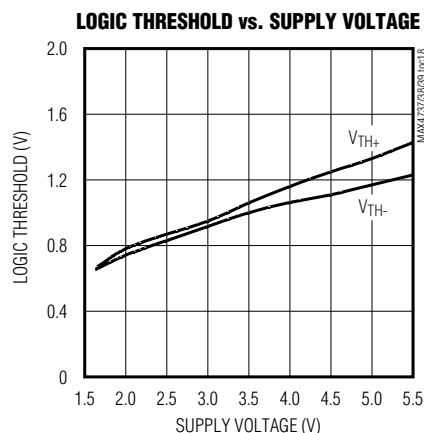
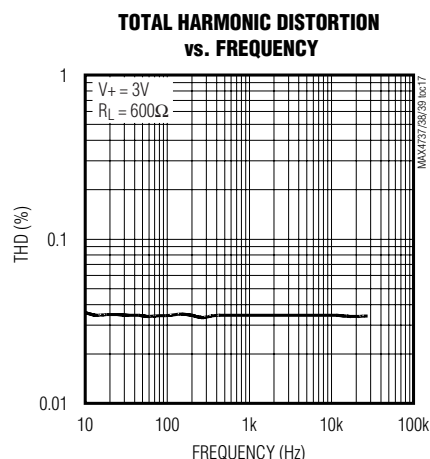
(T<sub>A</sub> = +25°C, unless otherwise noted.)



## 4.5Ω Quad SPST Analog Switches in UCSP

### Typical Operating Characteristics (continued)

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



### Pin Description

| PIN     |       |          |         |       |          |         |       |          | NAME | FUNCTION                               |
|---------|-------|----------|---------|-------|----------|---------|-------|----------|------|----------------------------------------|
| MAX4737 |       |          | MAX4738 |       |          | MAX4739 |       |          |      |                                        |
| UCSP    | TSSOP | THIN QFN | UCSP    | TSSOP | THIN QFN | UCSP    | TSSOP | THIN QFN |      |                                        |
| D2      | 1     | 15       | —       | —     | —        | D2      | 1     | 15       | NO1  | Analog-Switch Normally Open Terminal   |
| —       | —     | —        | D2      | 1     | 15       | —       | —     | —        | NC1  | Analog-Switch Normally Closed Terminal |
| D1      | 2     | 1        | D1      | 2     | 1        | D1      | 2     | 1        | COM1 | Analog-Switch Common Terminal          |
| C1      | 3     | 2        | —       | —     | —        | —       | —     | —        | NO2  | Analog-Switch Normally Open Terminal   |
| —       | —     | —        | C1      | 3     | 2        | C1      | 3     | 2        | NC2  | Analog-Switch Normally Closed Terminal |
| B1      | 4     | 3        | B1      | 4     | 3        | B1      | 4     | 3        | COM2 | Analog-Switch Common Terminal          |
| A1      | 5     | 4        | A1      | 5     | 4        | A1      | 5     | 4        | IN2  | Logic-Control Digital Input            |
| A2      | 6     | 5        | A2      | 6     | 5        | A2      | 6     | 5        | IN3  | Logic-Control Digital Input            |
| B3      | 7     | 6        | B3      | 7     | 6        | B3      | 7     | 6        | GND  | Ground. Connect to digital ground.     |
| A3      | 8     | 7        | —       | —     | —        | A3      | 8     | 7        | NO3  | Analog-Switch Normally Open Terminal   |
| —       | —     | —        | A3      | 8     | 7        | —       | —     | —        | NC3  | Analog-Switch Normally Closed Terminal |
| A4      | 9     | 9        | A4      | 9     | 9        | A4      | 9     | 9        | COM3 | Analog-Switch Common Terminal          |
| B4      | 10    | 10       | B4      | 10    | 10       | B4      | 10    | 10       | COM4 | Analog-Switch Common Terminal          |



## 4.5Ω Quad SPST Analog Switches in UCSP

### Pin Description (continued)

| PIN     |       |          |         |       |          |         |       |          | NAME | FUNCTION                                 |
|---------|-------|----------|---------|-------|----------|---------|-------|----------|------|------------------------------------------|
| MAX4737 |       |          | MAX4738 |       |          | MAX4739 |       |          |      |                                          |
| UCSP    | TSSOP | THIN QFN | UCSP    | TSSOP | THIN QFN | UCSP    | TSSOP | THIN QFN |      |                                          |
| C4      | 11    | 11       | —       | —     | —        | —       | —     | —        | NO4  | Analog-Switch Normally Open Terminal     |
| —       | —     | —        | C4      | 11    | 11       | C4      | 11    | 11       | NC4  | Analog-Switch Normally Closed Terminal   |
| D4      | 12    | 12       | D4      | 12    | 12       | D4      | 12    | 12       | IN4  | Logic-Control Digital Input              |
| D3      | 13    | 13       | D3      | 13    | 13       | D3      | 13    | 13       | IN1  | Logic-Control Digital Input              |
| C2      | 14    | 14       | C2      | 14    | 14       | C2      | 14    | 14       | V+   | Positive Analog Supply                   |
| —       | —     | 8, 16    | —       | —     | 8, 16    | —       | —     | 8, 16    | N.C. | No Connection. Not internally connected. |

### Detailed Description

The MAX4737/MAX4738/MAX4739 quad SPST analog switches operate from a single +1.8V to +5.5V supply. The MAX4737/MAX4738/MAX4739 offer excellent AC characteristics, <0.5nA leakage current, less than 1ns differential skew, and 15pF on-channel capacitance. All of these devices are CMOS-logic compatible with V+ to GND signal handling capability.

The MAX4737/MAX4738/MAX4739 are USB-complaint switches that provide 4.5Ω (max) on-resistance and 15pF on-channel capacitance to maintain signal integrity. At 12Mbps (USB full-speed data rate specification), the MAX4737/MAX4738/MAX4739 introduce less than 2ns propagation delay between input and output signals and less than 0.5ns change in skew for the output signals (see Figure 4).

The MAX4737 has four normally open (NO) switches, the MAX4738 has four normally closed (NC) switches, and the MAX4739 has two NO switches and two NC switches.

### Applications Information

#### Digital Control Inputs

The MAX4737/MAX4738/MAX4739 logic inputs accept up to +5.5V regardless of supply voltage. For example, with a +3.3V supply, IN<sub>-</sub> can be driven low to GND and high to +5.5V allowing for mixing of logic levels in a system. Driving the control logic inputs rail-to-rail minimizes power consumption. For a +1.8V supply voltage, the logic thresholds are 0.5V (low) and 1.4V (high); for a +5V supply voltage, the logic thresholds are 0.8V (low) and 2.0V (high).

#### Analog Signal Levels

Analog signals that range over the entire supply voltage (V+ to GND) are passed with very little change in on-resistance (see *Typical Operating Characteristics*). The switches are bidirectional, so the NO<sub>-</sub>, NC<sub>-</sub>, and COM<sub>-</sub> pins can be either inputs or outputs.

#### Power-Supply Bypassing

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

### UCSP Applications Information

For the latest application details on UCSP construction, dimensions, tape carrier information, PC board techniques, bump-pad layout, and recommended reflow temperature profile, as well as the latest information on reliability testing results, refer to the Application Note: *UCSP—A Wafer-Level Chip-Scale Package* on Maxim's web site at [www.maxim-ic.com/ucsp](http://www.maxim-ic.com/ucsp).

# 4.5Ω Quad SPST Analog Switches in UCSP

## Test Circuits/Timing Diagrams

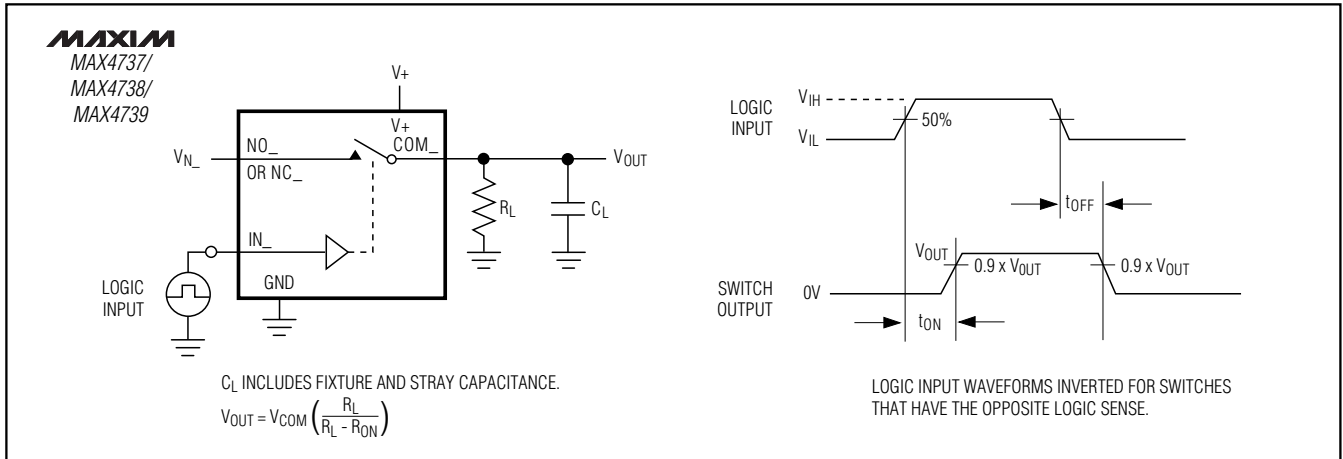


Figure 1. Switching Time

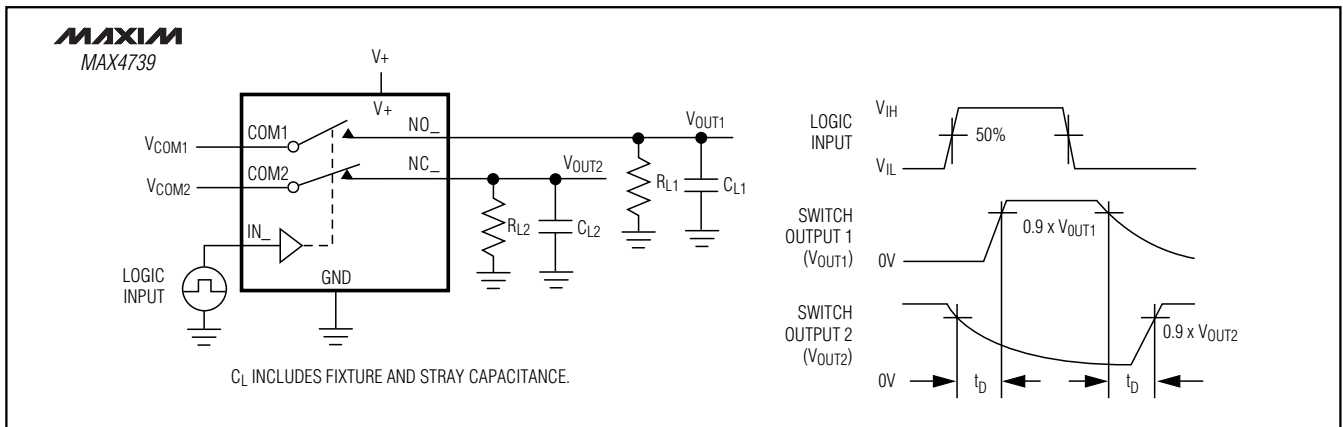


Figure 2. Break-Before-Make Interval

## 4.5Ω Quad SPST Analog Switches in UCSP

### Test Circuits/Timing Diagrams (continued)

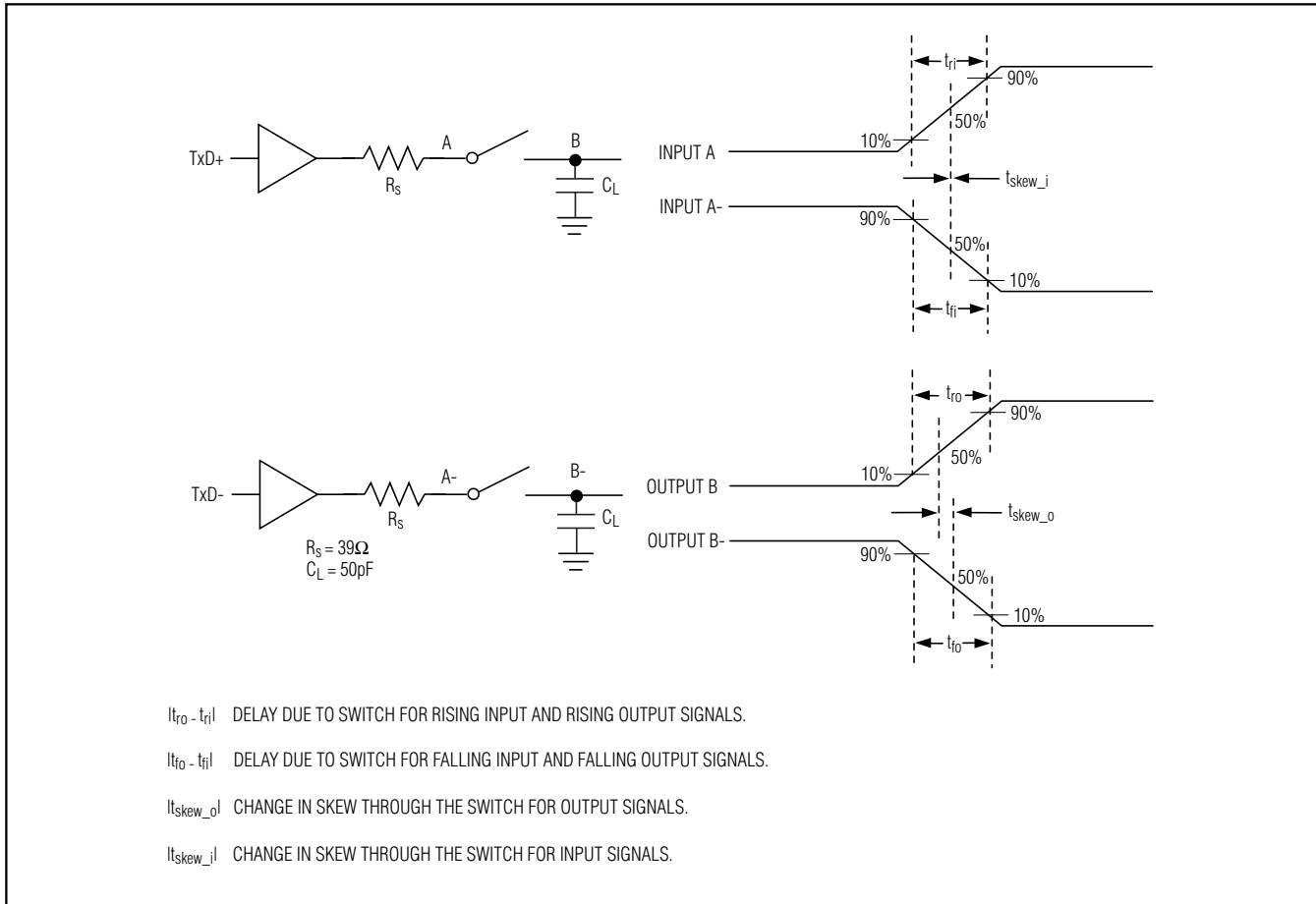


Figure 3. Input/Output Skew Timing Diagram

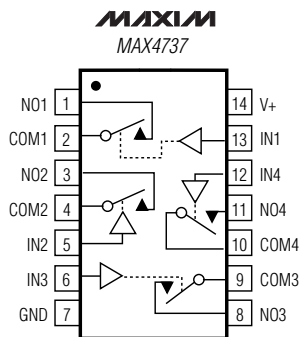


# 4.5Ω Quad SPST Analog Switches in UCSP

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

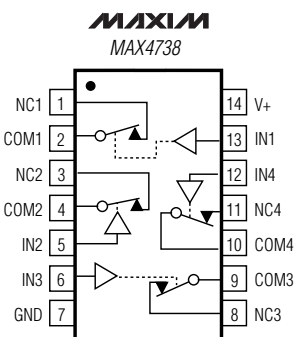
MAX4737/MAX4738/MAX4739

TOP VIEW



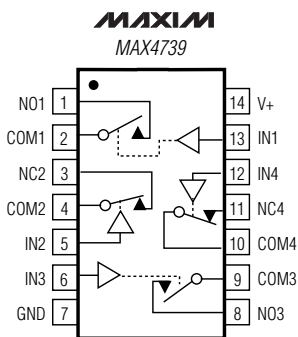
TSSOP

| INPUT | SWITCH STATE |
|-------|--------------|
| LOW   | OFF          |
| HIGH  | ON           |



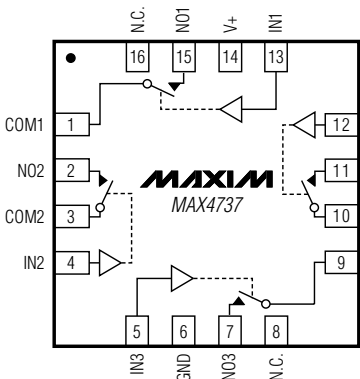
TSSOP

| INPUT | SWITCH STATE |
|-------|--------------|
| LOW   | ON           |
| HIGH  | OFF          |



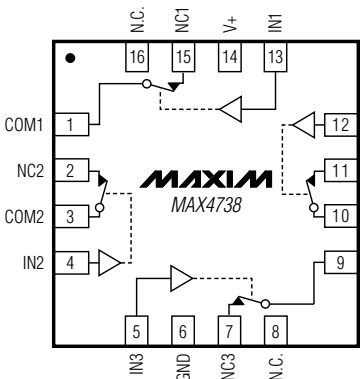
TSSOP

| INPUT | NO1, NO3 | NC2, NC4 |
|-------|----------|----------|
| LOW   | OFF      | ON       |
| HIGH  | ON       | OFF      |



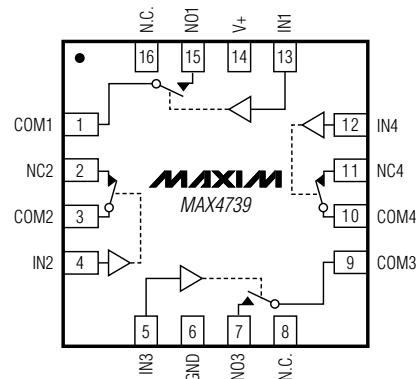
QFN

| INPUT | SWITCH STATE |
|-------|--------------|
| LOW   | OFF          |
| HIGH  | ON           |



QFN

| INPUT | SWITCH STATE |
|-------|--------------|
| LOW   | ON           |
| HIGH  | OFF          |



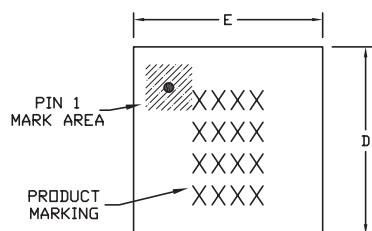
QFN

| INPUT | NO1, NO3 | NC2, NC4 |
|-------|----------|----------|
| LOW   | OFF      | ON       |
| HIGH  | ON       | OFF      |

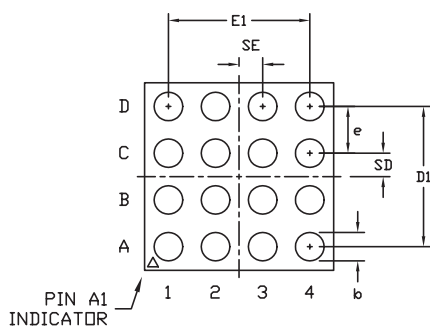
# 4.5Ω Quad SPST Analog Switches in UCSP

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



TOP VIEW



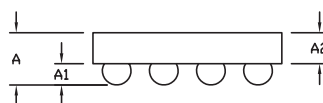
BOTTOM VIEW

| COMMON DIMENSIONS |                |
|-------------------|----------------|
| A                 | 0.62±0.05-0.08 |
| A1                | 0.29±0.02      |
| A2                | 0.33 REF.      |
| b                 | 0.35±0.03      |
| D1                | 1.50 BASIC     |
| E1                | 1.50 BASIC     |
| e                 | 0.50 BASIC     |
| SD                | 0.25 BASIC     |
| SE                | 0.25 BASIC     |

| PKG. CODE | VARIABLE DIMENSIONS |           | DEPOPULATED SOLDER BALLS |
|-----------|---------------------|-----------|--------------------------|
|           | D                   | E         |                          |
| B16-1     | 2.02±0.05           | 2.02±0.05 | NONE                     |
| B16-2     | 2.02±0.05           | 2.02±0.05 | B3, C3                   |
| B16-3     | 2.02±0.05           | 2.02±0.05 | B3, C2                   |
| B16-4     | 2.02±0.05           | 2.02±0.05 | B2, C3                   |
| B16-5     | 2.02±0.05           | 2.02±0.05 | B2, B3, C2, C3           |
| B16-6     | 2.02±0.05           | 2.02±0.05 | C3                       |

### NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. PRODUCT MARKING: NUMBER OF CHARACTERS AND LINES VARY PER PRODUCT.



SIDE VIEW

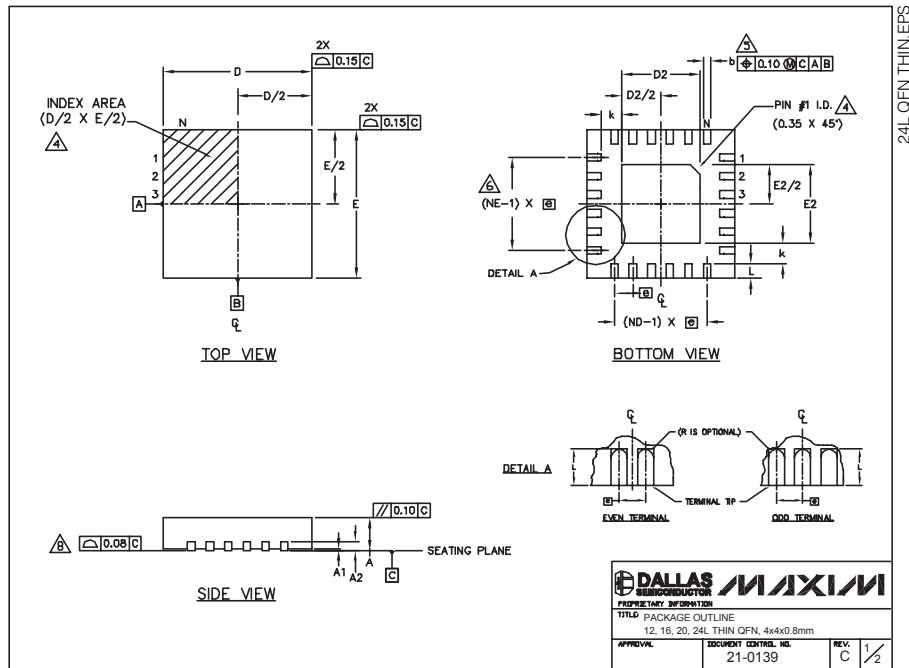
|                                        |                                 |
|----------------------------------------|---------------------------------|
|                                        |                                 |
| <b>MAXIM</b>                           |                                 |
| <small>PROPRIETARY INFORMATION</small> |                                 |
| TITLE:<br>PACKAGE OUTLINE, 4x4 UCSP    |                                 |
| APPROVAL:                              | DOCUMENT CONTROL NO.<br>21-0101 |
| REV.<br>H                              | 1/1                             |

16L UCSP.EPS

# 4.5Ω Quad SPST Analog Switches in UCSP

## 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).)



| PKG REF.   | 12L 4x4  |      |      |  | 16L 4x4  |      |      |  | 20L 4x4  |      |      |  | 24L 4x4  |      |      |  |
|------------|----------|------|------|--|----------|------|------|--|----------|------|------|--|----------|------|------|--|
|            | MIN.     | NOM. | MAX. |  | MIN.     | NOM. | MAX. |  | MIN.     | NOM. | MAX. |  | MIN.     | NOM. | MAX. |  |
| A          | 0.70     | 0.75 | 0.80 |  | 0.70     | 0.75 | 0.80 |  | 0.70     | 0.75 | 0.80 |  | 0.70     | 0.75 | 0.80 |  |
| AL         | 0.0      | 0.02 | 0.05 |  | 0.0      | 0.02 | 0.05 |  | 0.0      | 0.02 | 0.05 |  | 0.0      | 0.02 | 0.05 |  |
| A2         | 0.20 REF |      |      |  | 0.20 REF |      |      |  | 0.20 REF |      |      |  | 0.20 REF |      |      |  |
| b          | 0.25     | 0.30 | 0.35 |  | 0.25     | 0.30 | 0.35 |  | 0.25     | 0.30 | 0.35 |  | 0.25     | 0.30 | 0.35 |  |
| D          | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  |
| E          | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  | 3.90     | 4.00 | 4.10 |  |
| e          | 0.80 BSC |      |      |  | 0.65 BSC |      |      |  | 0.50 BSC |      |      |  | 0.50 BSC |      |      |  |
| k          | 0.25     | -    | -    |  | 0.25     | -    | -    |  | 0.25     | -    | -    |  | 0.25     | -    | -    |  |
| L          | 0.45     | 0.55 | 0.65 |  | 0.45     | 0.55 | 0.65 |  | 0.45     | 0.55 | 0.65 |  | 0.30     | 0.40 | 0.50 |  |
| N          | 12       |      |      |  | 16       |      |      |  | 20       |      |      |  | 24       |      |      |  |
| ND         | 3        |      |      |  | 4        |      |      |  | 5        |      |      |  | 6        |      |      |  |
| NE         | 3        |      |      |  | 4        |      |      |  | 5        |      |      |  | 6        |      |      |  |
| Upper Var. | WGGB     |      |      |  | WGGB     |      |      |  | WGGB-1   |      |      |  | WGGB-2   |      |      |  |

| PKG CODES | D2   |      |      | E2   |      |      | DOWN BONDS ALLOWED |
|-----------|------|------|------|------|------|------|--------------------|
|           | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |                    |
| T1244-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1244-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T1244-4   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1644-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1644-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T1644-4   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2044-1   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2044-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T2044-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2444-1   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | NO                 |
| T2444-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T2444-3   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | YES                |
| T2444-4   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | NO                 |

### NOTES:

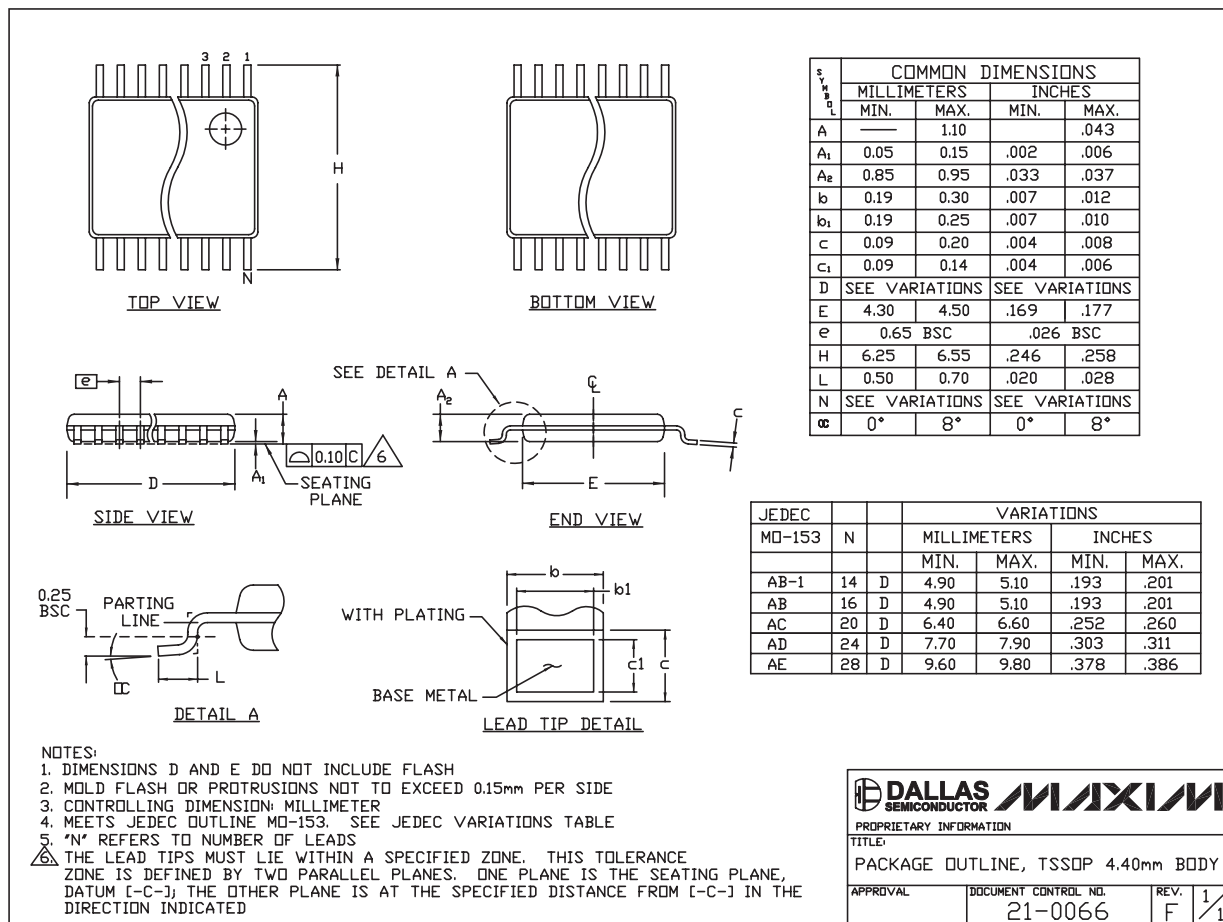
- DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
- ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
- N IS THE TOTAL NUMBER OF TERMINALS.
- THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JEDEC 95-1 SFP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
- DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
- ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
- DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
- COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
- DRAWING CONFORMS TO JEDEC MO220, EXCEPT FOR T2444-1, T2444-3 AND T2444-4.

| PKG CODES | D2   |      |      | E2   |      |      | DOWN BONDS ALLOWED |
|-----------|------|------|------|------|------|------|--------------------|
|           | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |                    |
| T1244-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1244-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T1244-4   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1644-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T1644-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T1644-4   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2044-1   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2044-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T2044-3   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | NO                 |
| T2444-1   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | NO                 |
| T2444-2   | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 | YES                |
| T2444-3   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | YES                |
| T2444-4   | 2.45 | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | NO                 |

# 4.5Ω Quad SPST Analog Switches in UCSP

## 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).)



TSSOP 4.40mm EPSS

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