

## 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  $t_{ON} < 80\text{ns}$  and  $t_{OFF} < 40\text{ns}$  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

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## Benefits and 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

# MAX4737/MAX4738/ MAX4739

## 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_ (pulsed at 1ms, 10% duty cycle) | ±200mA               |
| 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> , 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; V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                          | +25°C                                |      | 3.0   | 4.5  | Ω     |
|                                                   |                                                         |                                                                                                           | T <sub>MIN</sub> to T <sub>MAX</sub> |      |       | 5    |       |
| On-Resistance Match Between Channels (Notes 5, 6) | ΔR <sub>ON</sub>                                        | V+ = 2.7V, I <sub>COM_</sub> = 10mA; V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V                          | +25°C                                |      | 0.1   | 0.4  | Ω     |
|                                                   |                                                         |                                                                                                           | T <sub>MIN</sub> to T <sub>MAX</sub> |      |       | 0.5  |       |
| On-Resistance Flatness (Note 7)                   | R <sub>FLAT(ON)</sub>                                   | V+ = 2.7V, I <sub>COM_</sub> = 10mA; 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 T <sub>MAX</sub> |      |       | 1.5  |       |
| NO_, NC_ Off-Leakage Current (Note 8)             | I <sub>NO_(OFF)</sub> , I <sub>NC_(OFF)</sub>           | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V; 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 T <sub>MAX</sub> | -1   |       | +1   |       |
| COM_ Off-Leakage Current (Note 8)                 | I <sub>COM_(OFF)</sub>                                  | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V; 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 T <sub>MAX</sub> | -1   |       | +1   |       |
| COM_ On-Leakage Current (Note 8)                  | I <sub>COM_(ON)</sub>                                   | V+ = 3.6V, V <sub>COM_</sub> = 0.3V, 3.3V; V <sub>NO_</sub> or V <sub>NC_</sub> = 0.3V, 3.3V, or floating | +25°C                                | -1   | +0.01 | +1   | nA    |
|                                                   |                                                         |                                                                                                           | T <sub>MIN</sub> to T <sub>MAX</sub> | -2   |       | +2   |       |

### 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 |
|---------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------|-----|-------|
| DYNAMIC CHARACTERISTICS                                 |                                                  |                                                                                                                               |                                         |      |      |     |       |
| 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   | 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> = 1.5V;<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   |      |     |       |
| 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    |      | 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  |       |
| 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 in<br>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  |       |
| DIGITAL I/O                                             |                                                  |                                                                                                                               |                                         |      |      |     |       |
| Input Logic High Voltage                                | V <sub>IH</sub>                                  |                                                                                                                               | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 1.4  |      | V   |       |
| Input Logic Low Voltage                                 | V <sub>IL</sub>                                  |                                                                                                                               | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 0.5  |      | V   |       |
| Input Leakage Current                                   | I <sub>IN</sub>                                  | V+ = 3.6V, V <sub>IN_</sub> = 0 or 5.5V                                                                                       | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1 | +0.1 | μA  |       |

### 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>INL</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   |       |

**Electrical Characteristics—Single +5V Supply (continued)**

(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 |
|---------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------|------|-------|
| 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    |
| <b>DIGITAL I/O</b>                                      |                   |                                                                                                       |                                         |      |      |      |       |
| 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    |
| <b>POWER SUPPLY</b>                                     |                   |                                                                                                       |                                         |      |      |      |       |
| 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(MAX)</sub> - R<sub>ON(MIN)</sub>.

**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.

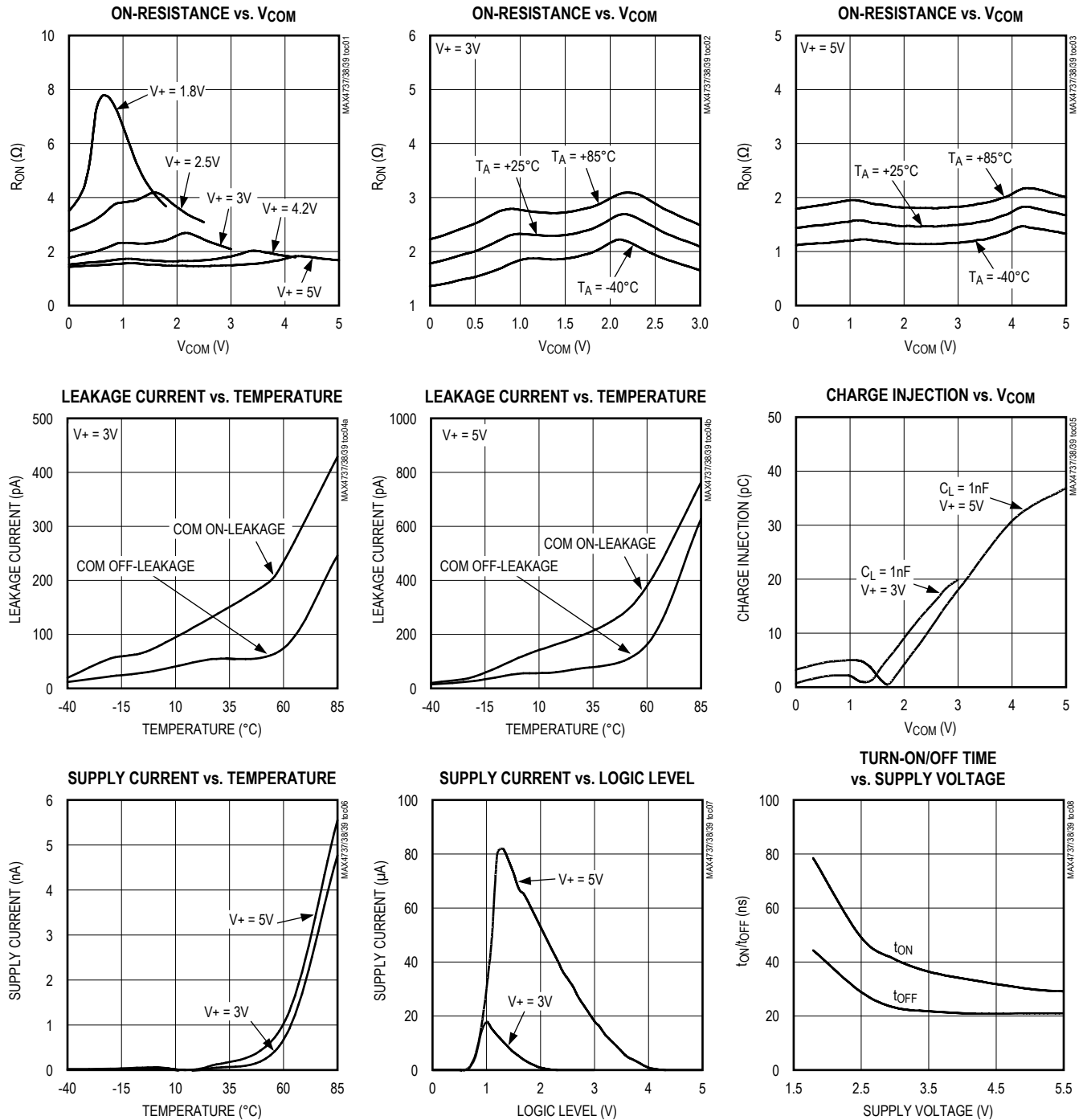
**Note 8:** Guaranteed by design.

**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.

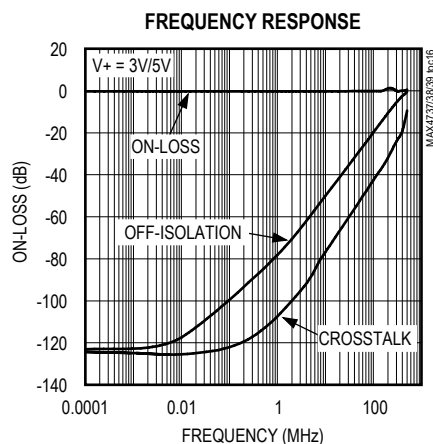
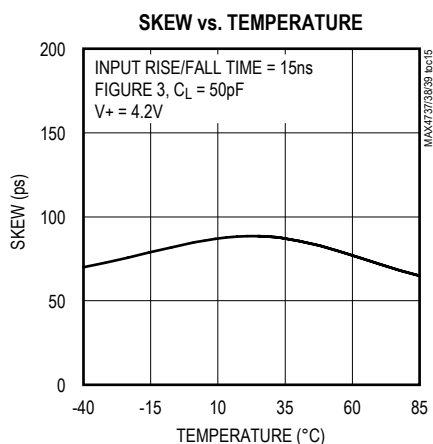
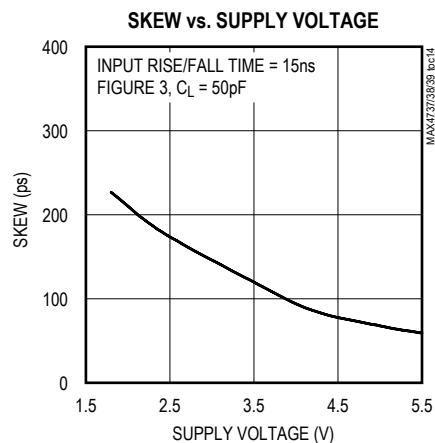
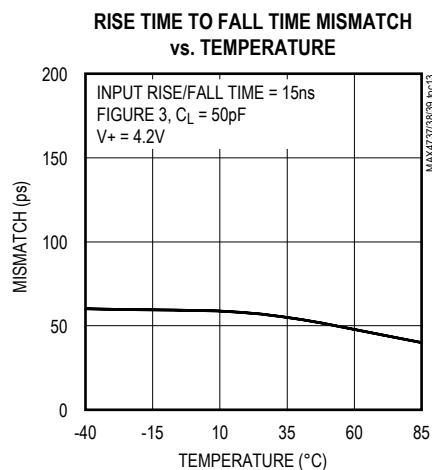
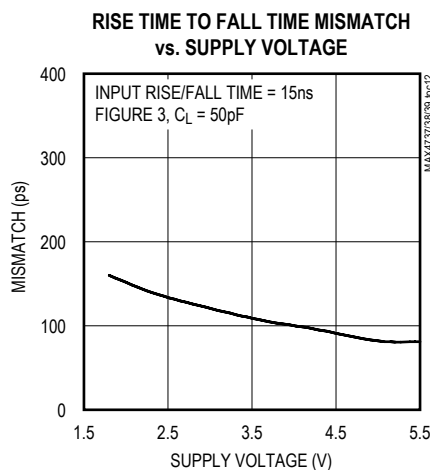
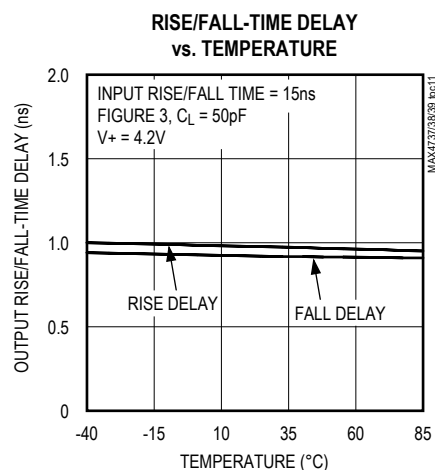
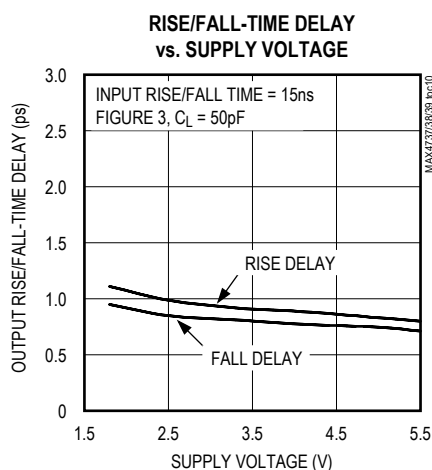
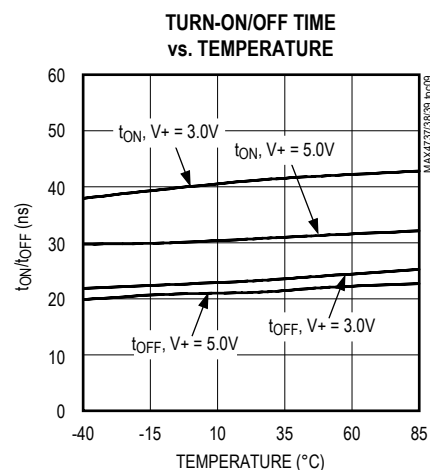
## Typical Operating Characteristics

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



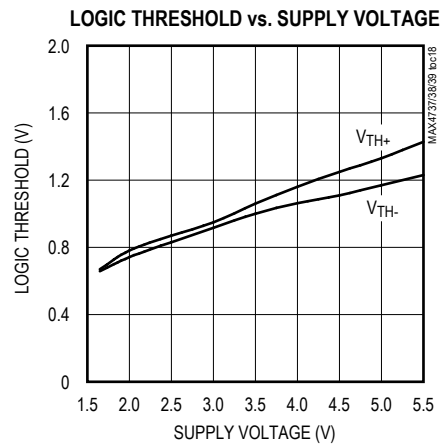
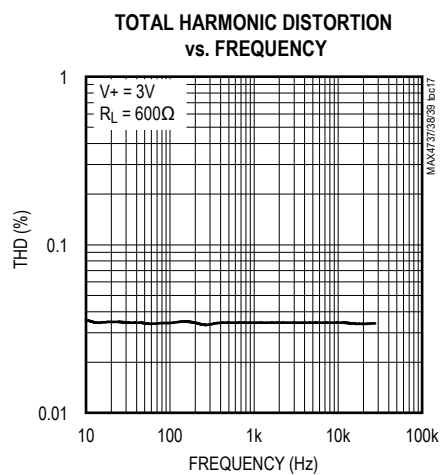
## Typical Operating Characteristics (continued)

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



## Typical Operating Characteristics (continued)

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



MAX4737/MAX4738/  
MAX4739

4.5Ω Quad SPST Analog Switches in UCSP

Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW  
(BUMPS SIDE DOWN)

MAX4737

1
2
3
4

A
IN2
IN3
NO3
COM3

B
COM2
GND
COM4

C
NO2
V+
NO4

D
COM1
NO1
IN1
IN4

UCSP

MAX4738

1
2
3
4

A
IN2
IN3
NC3
COM3

B
COM2
GND
COM4

C
NC2
V+
NC4

D
COM1
NC1
IN1
IN4

UCSP

MAX4739

1
2
3
4

A
IN2
IN3
NO3
COM3

B
COM2
GND
COM4

C
NC2
V+
NC4

D
COM1
NO1
IN1
IN4

UCSP

|                 |                 |                 |
|-----------------|-----------------|-----------------|
| IN <sub>-</sub> | NO <sub>-</sub> | NC <sub>-</sub> |
| LOW             | OFF             | ON              |
| HIGH            | ON              | OFF             |

MAX4737

NO1
COM1
NO2
COM2
IN2
IN3
GND

1
2
3
4
5
6
7

14
13
12
11
10
9
8

V+
IN1
IN4
NO4
COM4
COM3
NO3

TSSOP

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

MAX4738

NC1
COM1
NC2
COM2
IN2
IN3
GND

1
2
3
4
5
6
7

14
13
12
11
10
9
8

V+
IN1
IN4
NC4
COM4
COM3
NC3

TSSOP

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

MAX4739

NO1
COM1
NC2
COM2
IN2
IN3
GND

1
2
3
4
5
6
7

14
13
12
11
10
9
8

V+
IN1
IN4
NC4
COM4
COM3
NO3

TSSOP

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

MAX4737

N.C.
NO1
V+
IN1

16
15
14
13

COM1
NO2
COM2
IN2

1
2
3
4

12
11
10
9

IN4
NO4
COM4
COM3

QFN

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

MAX4738

N.C.
NC1
V+
IN1

16
15
14
13

COM1
NC2
COM2
IN2

1
2
3
4

12
11
10
9

IN4
NC4
COM4
COM3

QFN

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

MAX4739

N.C.
NO1
V+
IN1

16
15
14
13

COM1
NC2
COM2
IN2

1
2
3
4

12
11
10
9

IN4
NC4
COM4
COM3

QFN

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

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## Pin Descriptions

| 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          |

## 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.maximintegrated.com/ucsp](http://www.maximintegrated.com/ucsp).

## Test Circuits/Timing Diagrams

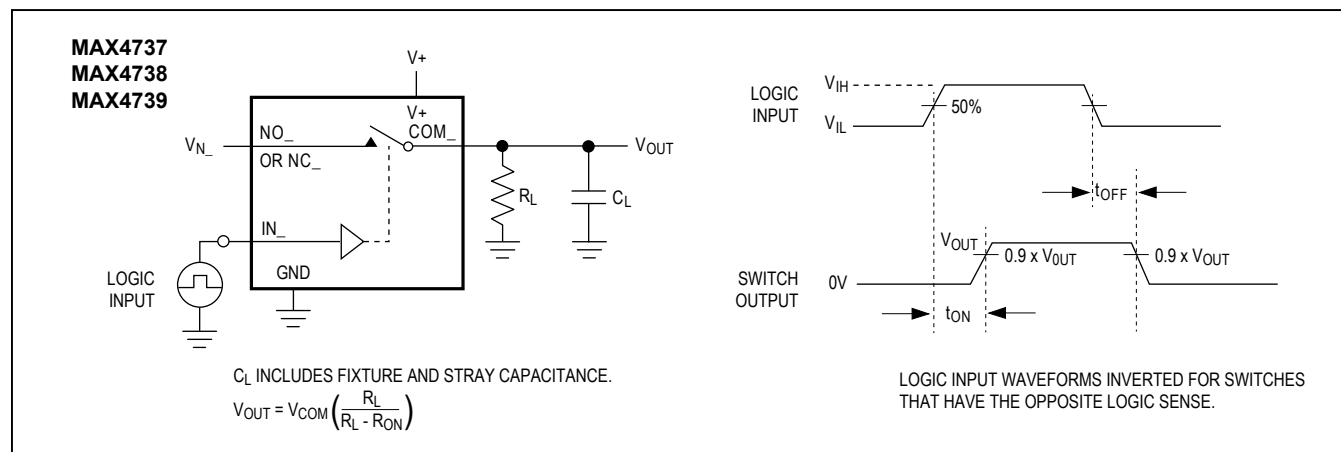


Figure 1. Switching Time

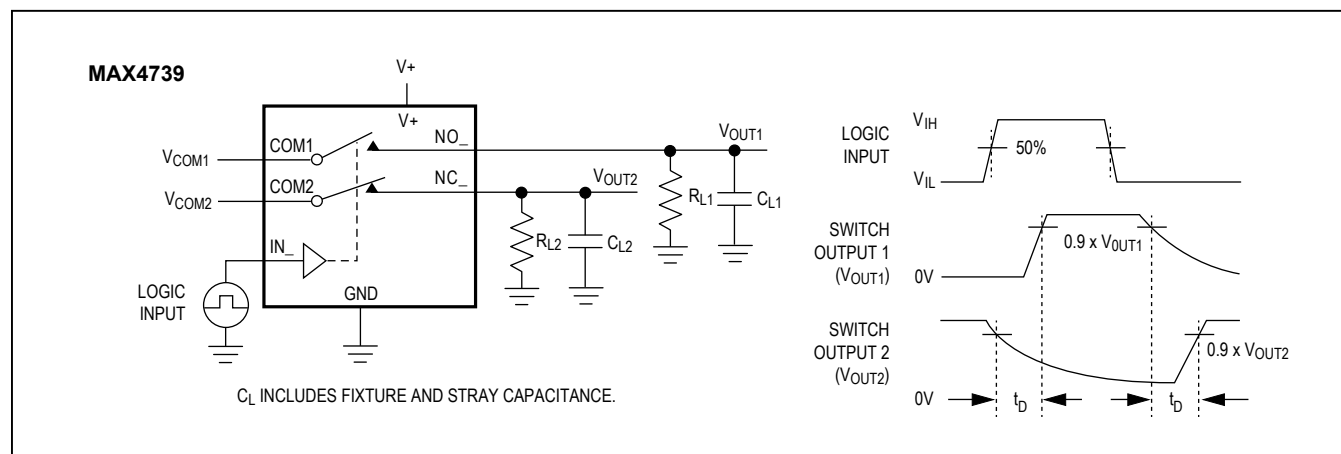


Figure 2. Break-Before-Make Interval

## Test Circuits/Timing Diagrams (continued)

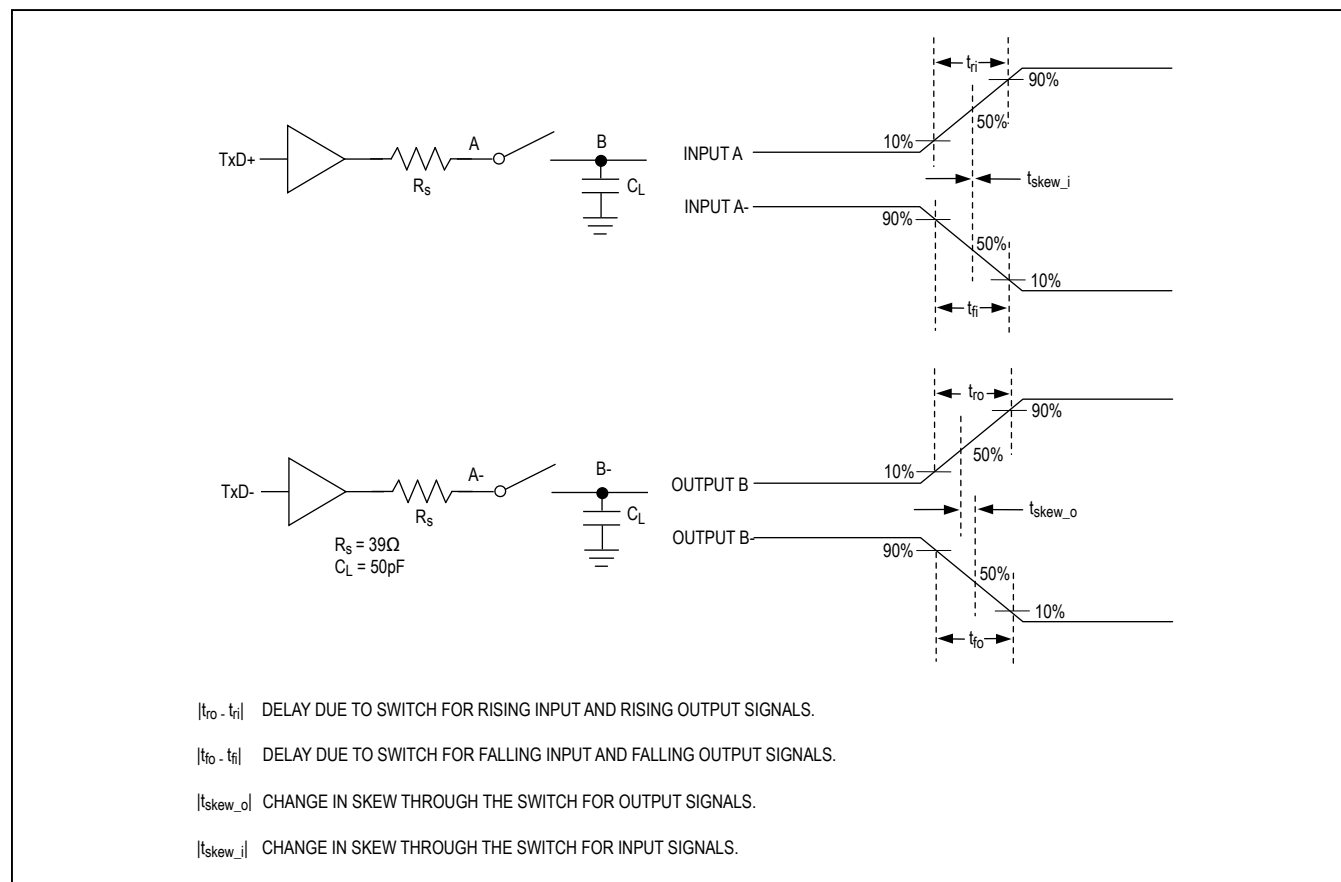


Figure 3. Input/Output Skew Timing Diagram

**MAX4737**  
**MAX4738**  
**MAX4739**

The diagram illustrates the internal switch and output node of the MAX4737, MAX4738, and MAX4739. The switch is controlled by the **IN** input. The output node is connected to **VOUT** through a load capacitor  $C_L$ . The timing diagram shows the relationship between **VOUT**, **IN**, and **IN\_** (the inverted **IN** signal). The output voltage change is labeled  $\Delta V_{OUT}$ . The formula  $Q = (\Delta V_{OUT})(C_L)$  is shown.

LOGIC INPUT WAVEFORMS INVERTED FOR SWITCHES THAT HAVE THE OPPOSITE LOGIC SENSE.

Diagram illustrating the pin configuration for the MAX4737, MAX4738, and MAX4739 devices during an off-isolation test. The device is shown with its pins connected to a test setup:

- V+**: Connected to a capacitor  $C = 0.1\mu F$  and ground.
- NC\_ or NO\_**: Connected to a **SIGNAL GENERATOR** (0dBm) through a  $50\Omega^*$  resistor. The signal generator is also connected to ground.
- COM\_**: Connected to an **ANALYZER**.
- IN\_**: Connected to a test point labeled **0V OR V+**.
- GND**: Ground connection.

\*USED ONLY FOR OFF-ISOLATION TEST.

[illegible]

Circuit diagram for measuring the input capacitance of a MAX4737, MAX4738, or MAX4739. The circuit includes a 0.1µF capacitor connected to the V+ pin, a capacitance meter connected to the NC\_ or NO\_ pin and ground, and an input signal source connected to the IN\_ pin. The frequency of the input signal is specified as  $f = 1\text{MHz}$ .

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## MAX4737/MAX4738/ MAX4739

## 4.5Ω Quad SPST Analog Switches in UCSP

### Ordering Information

| PART               | TEMP RANGE     | PIN/BUMP-<br>PACKAGE | TOP<br>MARK |
|--------------------|----------------|----------------------|-------------|
| <b>MAX4737</b> EUD | -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        |
| <b>MAX4738</b> EUD | -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        |
| <b>MAX4739</b> EUD | -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        |

+Denotes a lead(Pb)-free/RoHS-compliant package.

### Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE<br>TYPE | PACKAGE<br>CODE | OUTLINE<br>NO.          | LAND PATTERN<br>NO.     |
|-----------------|-----------------|-------------------------|-------------------------|
| 14 TSSOP        | U14+1           | <a href="#">21-0066</a> | <a href="#">90-0113</a> |
| 16 QFN          | T1644+4         | <a href="#">21-0139</a> | <a href="#">90-0070</a> |
| 16 UCSP         | B16+4           | <a href="#">21-0101</a> | —                       |

### Chip Information

TRANSISTOR COUNT: 361

PROCESS: CMOS

MAX4737/MAX4738/  
MAX4739

4.5Ω Quad SPST Analog Switches in UCSP

## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                  | PAGES<br>CHANGED |
|--------------------|------------------|------------------------------|------------------|
| 2                  | 1/16             | Pb-free part numbers updated | 1                |

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

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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