



# Low-Voltage, Single-Supply Analog Multiplexers/Switches

MAX4524L/MAX4525L

## General Description

The MAX4524L/MAX4525L are low-voltage, single-supply CMOS analog switches configured as a 4-channel multiplexer/demultiplexer (MAX4524L) and a double-pole/double-throw (DPDT) switch (MAX4525L). The MAX4524L/MAX4525L have an inhibit input to simultaneously open all switches.

These devices operate from a single supply of +2V to +12V. They are optimized for operation with a +12V supply. The on-resistance is 100Ω with a +12V supply. Each switch can handle Rail-to-Rail® analog signals. Off-leakage current measures only 2nA at +25°C. All digital inputs have 0.8V to 2.0V logic thresholds to ensure TTL/CMOS-logic compatibility when using a +12V supply.

## Features

- ◆ +3V Logic-Compatible Inputs ( $V_{IH} = 2.0V$ ,  $V_{IL} = 0.8V$ )
- ◆ +2V to +12V Supply Operation
- ◆ 100Ω On-Resistance with +12V Supply
- ◆ Guaranteed 10Ω On-Resistance Match at +12V
- ◆ Guaranteed 2nA Maximum Off-Leakage at +12V
- ◆ TTL/CMOS-Logic Compatible
- ◆ Tiny 10-Pin TDFN (3mm × 3mm) and 10-Pin μMAX Packages

## Applications

- Audio and Video Signal Routing
- Data-Acquisition Systems
- Communications Circuits
- Automotive
- DSL Modems

## Ordering Information

| PART        | TEMP RANGE     | PIN-PACKAGE         | TOP MARK |
|-------------|----------------|---------------------|----------|
| MAX4524LEUB | -40°C to +85°C | 10 μMAX             | —        |
| MAX4524LETB | -40°C to +85°C | 10 TDFN (3mm x 3mm) | AAL      |
| MAX4525LEUB | -40°C to +85°C | 10 μMAX             | —        |
| MAX4525LETB | -40°C to +85°C | 10 TDFN (3mm x 3mm) | AAM      |

## Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW

| MAX4524L |      |      |           |
|----------|------|------|-----------|
| INH      | ADDB | ADDA | ON SWITCH |
| 1        | X    | X    | NONE      |
| 0        | 0    | 0    | COM-NO0   |
| 0        | 0    | 1    | COM-NO1   |
| 0        | 1    | 0    | COM-NO2   |
| 0        | 1    | 1    | COM-NO3   |

| MAX4525L |      |                    |
|----------|------|--------------------|
| INH      | ADDB | ON SWITCH          |
| 1        | X    | NONE               |
| 0        | 0    | COMA-NCA, COMB-NCB |
| 0        | 1    | COMA-NOA, COMB-NOB |

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



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

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## ABSOLUTE MAXIMUM RATINGS

(All Voltages Referenced to GND, Unless Otherwise Noted.)

|   |                      |
|---|----------------------|
| V+  | -0.3V to +13V        |
| Voltage at Any Pin (Note 1)   | -0.3V to (V+ + 0.3V) |
| Continuous Current into Any Terminal  | ±20mA                |
| Peak Current NO <sub>-</sub> , NC <sub>-</sub> or COM <sub>-</sub><br>(pulsed at 1ms, 10% duty cycle) | ±40mA                |
| ESD per Method 3015.7   | >2000V               |

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

|  |                 |
|--|-----------------|
| 10-Pin μMAX (derate 5.6mW/°C above +70°C)  | 444mW           |
| 10-Pin TDFN (derate 24.4mW/°C above +70°C) | 1951mW          |
| Operating Temperature Range                |                 |
| MAX452_E_                                  | -40°C to +85°C  |
| Storage Temperature Range                  | -65°C to +150°C |
| Junction Temperature                       | +150°C          |
| Lead Temperature (soldering, 10s)          | +300°C          |

**Note 1:** Voltages exceeding V+ or GND on any signal terminal 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 +12V Supply

(V+ = 12V ±5%, GND = 0V, 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 T<sub>A</sub> = +25°C.)  
(Notes 2, 3)

| PARAMETER                                      | SYMBOL                                       | CONDITIONS  | TEMP           | MIN | TYP | MAX | UNITS |
|--|--|---|----------------|-----|-----|-----|-------|
| <b>ANALOG SWITCH</b>                           |  |   |                |     |     |     |       |
| Analog Signal Range                            | V <sub>COM</sub> , V <sub>NO</sub>           |   | -40°C to +85°C | 0   |     | V+  | V     |
| COM-NO/NC On-Resistance                        | R <sub>ON</sub>                              | V+ = 11.4V, I <sub>COM</sub> = 1mA, V <sub>COM</sub> = 10V                      | +25°C          |     | 45  | 80  | Ω     |
|  |  |   | -40°C to +85°C |     |     | 100 |       |
| COM-NO/NC On-Resistance Match Between Channels | ΔR <sub>ON</sub>                             | V+ = 11.4V, I <sub>COM</sub> = 1mA, V <sub>COM</sub> = 10V (Note 4)             | +25°C          |     | 2   | 10  | Ω     |
|  |  |   | -40°C to +85°C |     |     | 15  |       |
| COM-NO/NC On-Resistance Flatness               | R <sub>FLAT</sub>                            | V+ = 11.4V, I <sub>COM</sub> = 1mA, V <sub>COM</sub> = 1.5V, 6.0V, 10V (Note 5) | +25°C          |     | 5   | 12  | Ω     |
| NO/NC Off-Leakage                              | I <sub>NO(OFF)</sub><br>I <sub>NC(OFF)</sub> | V+ = 12.6V, V <sub>NO</sub> = 1.0V, 10V, V <sub>COM</sub> = 10V, 1.0V (Note 6)  | +25°C          | -2  |     | +2  | nA    |
|  |  |   | -40°C to +85°C | -10 |     | +10 |       |
| COM Off-Leakage                                | I <sub>COM(OFF)</sub>                        | V+ = 12.6V, V <sub>NO</sub> = 1V, 10V; V <sub>COM</sub> = 10V, 1V (Note 6)      | +25°C          | -2  |     | +2  | nA    |
|  |  | MAX4524L  | -40°C to +85°C | -50 |     | +50 |       |
|  |  | MAX4525L  | +25°C          | -2  |     | +2  |       |
|  |  | MAX4525L  | -40°C to +85°C | -25 |     | +25 |       |
| COM ON-Leakage                                 | I <sub>COM(ON)</sub>                         | V+ = 12.6V, V <sub>COM</sub> = 10V, 1V (Note 6)                                 | +25°C          | -2  |     | +2  | nA    |
|  |  | MAX4524L  | -40°C to +85°C | -50 |     | +50 |       |
|  |  | MAX4525L  | +25°C          | -2  |     | +2  |       |
|  |  | MAX4525L  | -40°C to +85°C | -25 |     | +25 |       |
| <b>DIGITAL I/O (INH, ADD<sub>-</sub>)</b>      |  |   |                |     |     |     |       |
| Logic-Input Threshold High                     | V <sub>IH</sub>                              |   | -40°C to +85°C |     | 1.5 | 2.0 | V     |
| Logic-Input Threshold Low                      | V <sub>IL</sub>                              |   | -40°C to +85°C | 0.8 | 1.5 |     | V     |
| Input Current High                             | I <sub>IH</sub>                              | V <sub>ADD<sub>-</sub></sub> = V <sub>INH</sub> = 2.0V                          | +25°C          | -1  |     | +1  | μA    |
| Input Current Low                              | I <sub>IL</sub>                              | V <sub>ADD<sub>-</sub></sub> = V <sub>INH</sub> = 0.8V                          | +25°C          | -1  |     | +1  | μA    |

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

MAX4524L/MAX4525L

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

(V+ = 12V ±5%, GND = 0V, 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 T<sub>A</sub> = +25°C.)  
(Notes 2, 3)

| PARAMETER                               | SYMBOL                | CONDITIONS  | TEMP           | MIN | TYP  | MAX  | UNITS |
|---|-----------------------|---|----------------|-----|------|------|-------|
| <b>SWITCH DYNAMIC CHARACTERISTICS</b>   |                       |   |                |     |      |      |       |
| Inhibit Turn-On Time                    | t <sub>ON</sub>       | V <sub>NO_</sub> = 10V, R <sub>L</sub> = 300Ω,<br>C <sub>L</sub> = 35pF, Figure 1   | +25°C          | 90  | 150  | 200  | ns    |
|   |                       |   | -40°C to +85°C |     |      |      |       |
| Inhibit Turn-Off Time                   | t <sub>OFF</sub>      | V <sub>NO_</sub> = 10V, R <sub>L</sub> = 300Ω,<br>C <sub>L</sub> = 35pF, Figure 1   | +25°C          | 40  | 120  | 180  | ns    |
|   |                       |   | -40°C to +85°C |     |      |      |       |
| Address Transition Time                 | t <sub>TRANS</sub>    | V <sub>NO_</sub> = 10V, R <sub>L</sub> = 300Ω,<br>C <sub>L</sub> = 35pF, Figure 2   | +25°C          | 90  | 150  | 200  | ns    |
|   |                       |   | -40°C to +85°C |     |      |      |       |
| Break-Before-Make Time                  | t <sub>BBM</sub>      | V <sub>NO</sub> = 10V, R <sub>L</sub> = 300Ω,<br>C <sub>L</sub> = 35pF, Figure 3    | +25°C          |     | 20   |      | ns    |
| Charge Injection                        | Q                     | C = 1nF, Figure 4 (Note 7)  | +25°C          |     | 0.8  |      | pC    |
| NO/NC Off-Capacitance                   | C <sub>NO(OFF)</sub>  | V <sub>NO_</sub> = 0V, f = 1MHz, Figure 5   | +25°C          |     | 4    |      | pF    |
| COM Off-Capacitance                     | C <sub>COM(OFF)</sub> | V <sub>NO_</sub> = 0V, f =<br>1MHz, Figure 5  | MAX4524L +25°C |     | 14   |      | pF    |
|   |                       |   | MAX4525L +25°C |     | 6    |      |       |
| COM On-Capacitance                      | C <sub>COM(ON)</sub>  | V <sub>NO_</sub> = 0V, f =<br>1MHz, Figure 5  | MAX4524L +25°C |     | 20   |      | pF    |
|   |                       |   | MAX4525L +25°C |     | 12   |      |       |
| Off-Isolation                           | V <sub>ISO</sub>      | R <sub>L</sub> = 50Ω, f = 1MHz, Figure 6  | +25°C          |     | 92   |      | dB    |
| Channel-to-Channel Crosstalk (MAX4525L) | V <sub>CT</sub>       | R <sub>L</sub> = 50Ω, f = 1MHz, Figure 6  | +25°C          |     | 96   |      | dB    |
| On-Channel -3dB Bandwidth               | BW                    | Figure 6  | +25°C          |     | 200  |      | MHz   |
| Total Harmonic Distortion               | THD                   | R <sub>L</sub> = 600Ω, V <sub>COM</sub> = 2.5V <sub>P-P</sub> ,<br>20Hz to 20kHz BW | +25°C          |     | 0.02 |      | %     |
| <b>POWER SUPPLY</b>                     |                       |   |                |     |      |      |       |
| Power-Supply Range                      | V+                    |   | -40°C to +85°C | 2   |      | 12.6 | V     |
| Power-Supply Current                    | I+                    | V+ = 12.6V,<br>V <sub>ADD_</sub> = V <sub>INH</sub> = V+ or 0V                      | +25°C          | -1  |      | +1   | μA    |
|   |                       |   | -40°C to +85°C | -10 |      | +10  |       |

**Note 2:** The TDFN package is production tested at T<sub>A</sub> = +25°C. Limits over temperature are guaranteed by design.

**Note 3:** The algebraic convention used in this data sheet is where the most negative value is a minimum column.

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

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

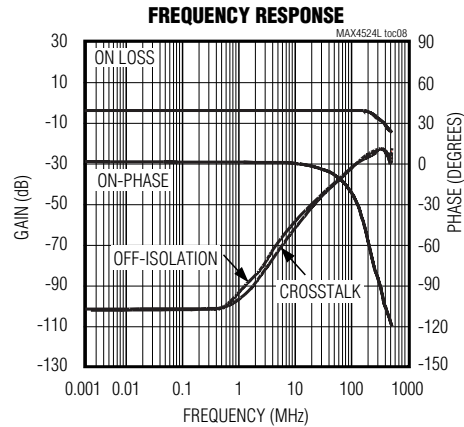
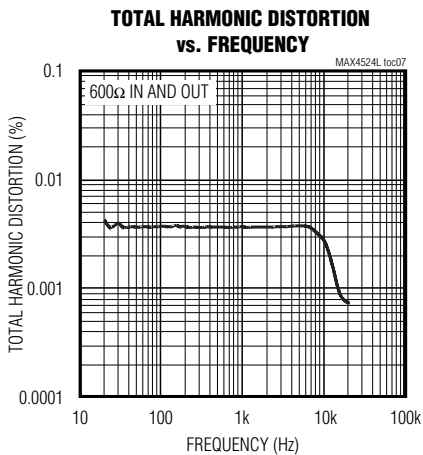
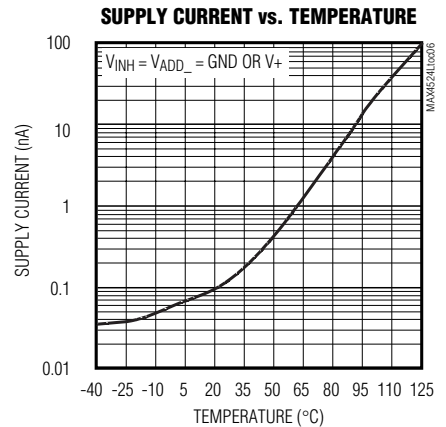
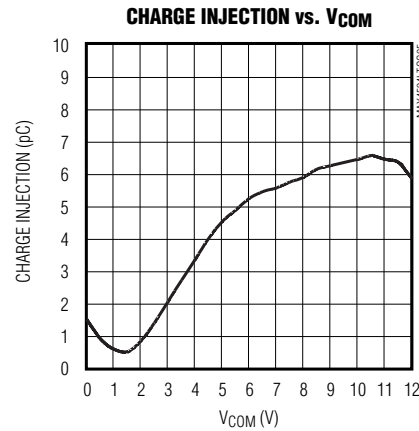
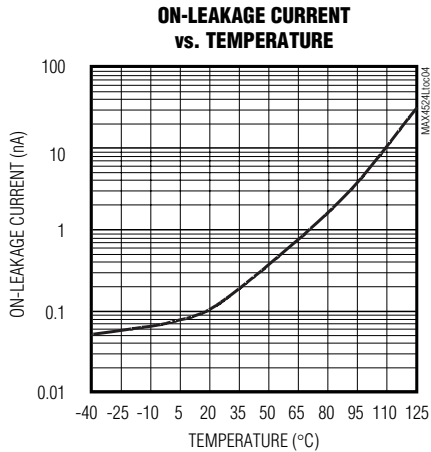
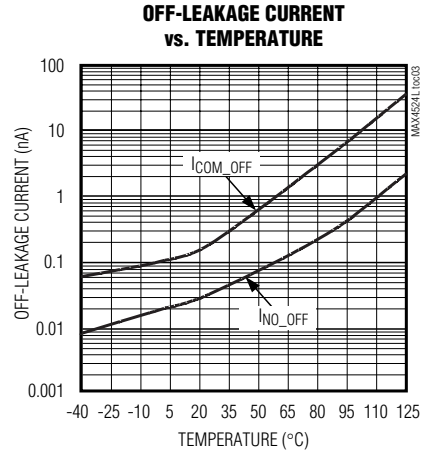
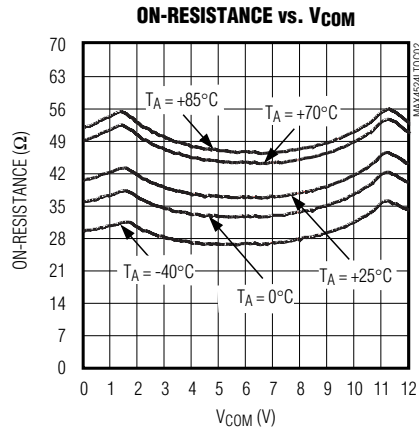
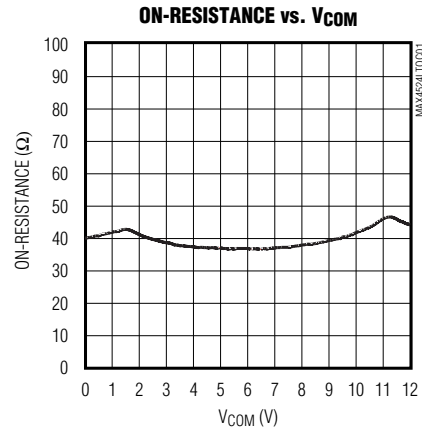
**Note 6:** Leakage parameters are 100% tested at maximum-rated hot operating temperature and guaranteed by design at T<sub>A</sub> = +25°C.

**Note 7:** Guaranteed by design, not production tested.

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Typical Operating Characteristics

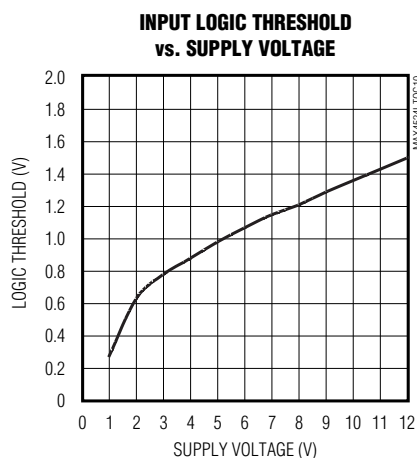
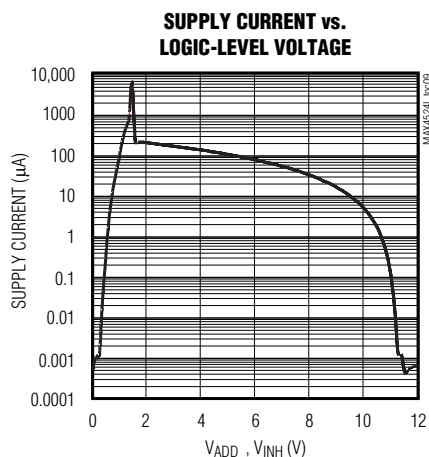
( $V_+ = 12V$ ,  $V_{INH} = GND$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Typical Operating Characteristics (continued)

(V+ = 12V, V<sub>INH</sub> = GND, T<sub>A</sub> = +25°C, unless otherwise noted.)



## Pin Description

| PIN      |          | NAME        | FUNCTION   |
|----------|----------|-------------|--|
| MAX4524L | MAX4525L |             |  |
| 1        | —        | NO2         | Analog Switch Normally Open Input 2  |
| —        | 1        | NOA         | Analog Switch A Normally Open Input  |
| 2        | —        | NO3         | Analog Switch Normally Open Input 3  |
| —        | 2        | COMA        | Analog Switch A Common   |
| 3        | —        | NO1         | Analog Switch Normally Open Input 1  |
| —        | 3        | NCA         | Analog Switch A Normally Closed Input  |
| 4        | 4        | INH         | Inhibit. Drive INH low or connect to GND for normal operation. Drive INH high or connect to V+ to turn all switches off. |
| 5        | 5        | GND         | Ground. Connect to digital ground (analog signals have no ground reference, but are limited to V+ and GND).              |
| 6        | —        | ADDB        | Logic-Level Address Input (see <i>Truth Tables</i> )   |
| —        | 6        | ADD         | Logic-Level Address Input (see <i>Truth Tables</i> )   |
| 7        | —        | ADDA        | Logic-Level Address Input (see <i>Truth Tables</i> )   |
| —        | 7        | NCB         | Analog Switch B Normally Closed Input  |
| 8        | —        | NO0         | Analog Switch Normally Open Input 0  |
| —        | 8        | NOB         | Analog Switch B Normally Open Input  |
| 9        | —        | COM         | Analog Switch Common   |
| —        | 9        | COMB        | Analog Switch A Common   |
| 10       | 10       | V+          | Positive Analog and Digital Supply Voltage. Bypass with a 0.1µF capacitor to GND.  |
| EP       | EP       | Exposed PAD | The bottom of the IC (TDFN package only) contains an exposed pad that must be tied externally to V+.                     |

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Detailed Description

The MAX4524L/MAX4525L are low-voltage, single-supply CMOS analog switches that operate from a single supply of +2V to +12V. Operation with a +12V supply optimizes the performance by reducing their on-resistance to 100Ω. The MAX4524L is configured as a 4-channel multiplexer/demultiplexer and the MAX4525L is a double-pole/double-throw (DPDT) switch. These devices have an inhibit input (INH) to simultaneously open all signal paths. Each switch can handle rail-to-rail analog signals. The off-leakage current is typically only 0.1nA at +25°C and 10nA (max) over temperature. All digital inputs have 0.8V to 2.0V logic-level thresholds, ensuring TTL/CMOS-logic compatibility when using a single +12V supply.

## Applications Information

### Power-Supply Considerations

The MAX4524L/MAX4525L's construction is typical of most CMOS analog switches. The supply input, V+, is used to power the internal CMOS switches and set the limits of the analog voltage on any switch. Reverse ESD protection diodes are internally connected between each analog signal pin and both V+ and GND. If any

analog signal exceeds V+ or goes below GND, one of these diodes conducts. During normal operation, these reverse-biased ESD diodes leak, forming the only current drawn from V+ or GND. Virtually all the analog leakage current comes from the ESD diodes. Although the ESD diodes on a given signal pin are identical, and therefore fairly well balanced, they are reverse biased differently. Each is biased by either V+ or GND and the analog signal. This means that leakage varies as the signal varies. The difference in the two diode leakages to the V+ and GND pins constitutes the analog signal-path leakage current. All analog leakage current flows between each pin and one of the supply terminals, not to the other switch terminal. This is why both sides of a given switch can show leakage currents of either the same or opposite polarity.

There is no connection between the analog signal paths and GND. V+ and GND power the internal logic and logic-level translators, and set both the input and output logic limits. The logic-level translators convert the logic levels into switched V+ and GND signals to drive the gates of the analog signals. This drive signal is the only connection between the logic supplies (and signals) and the analog supplies.

## Test Circuits/Timing Diagrams

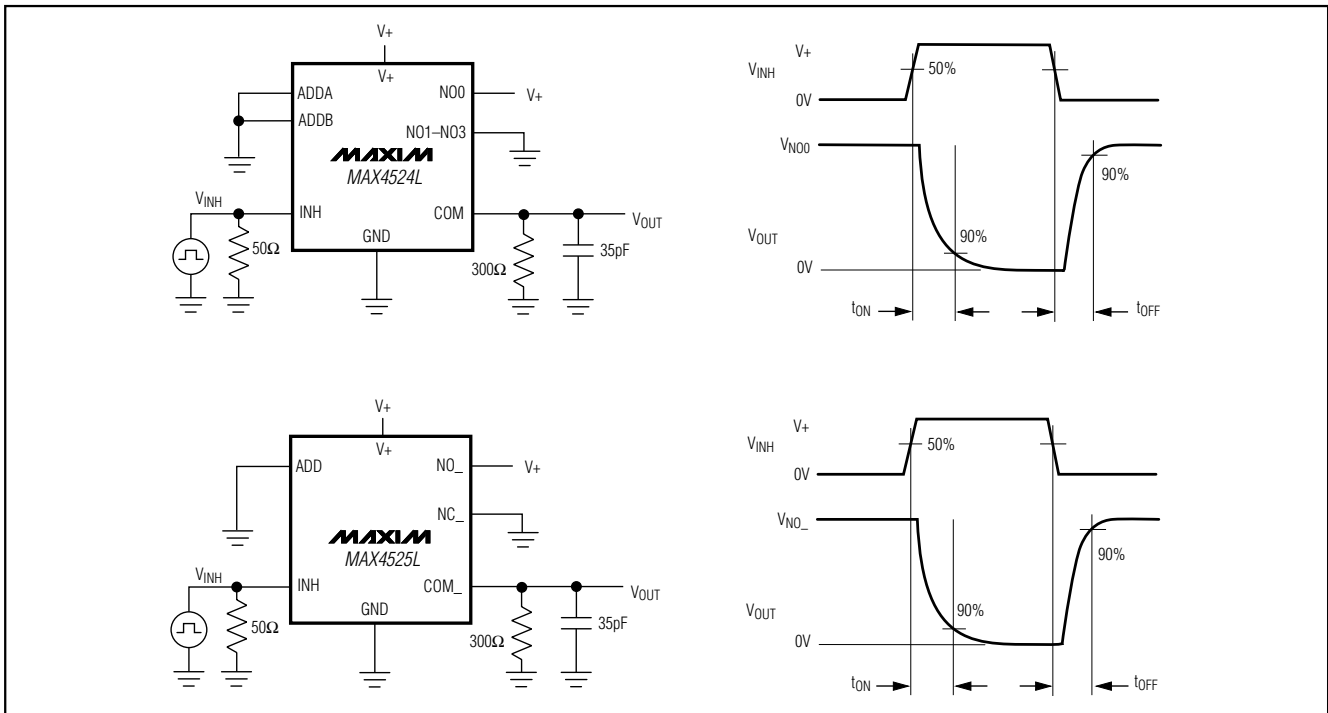


Figure 1. Inhibit Switching Times

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Test Circuits/Timing Diagrams (continued)

MAX4524L/MAX4525L

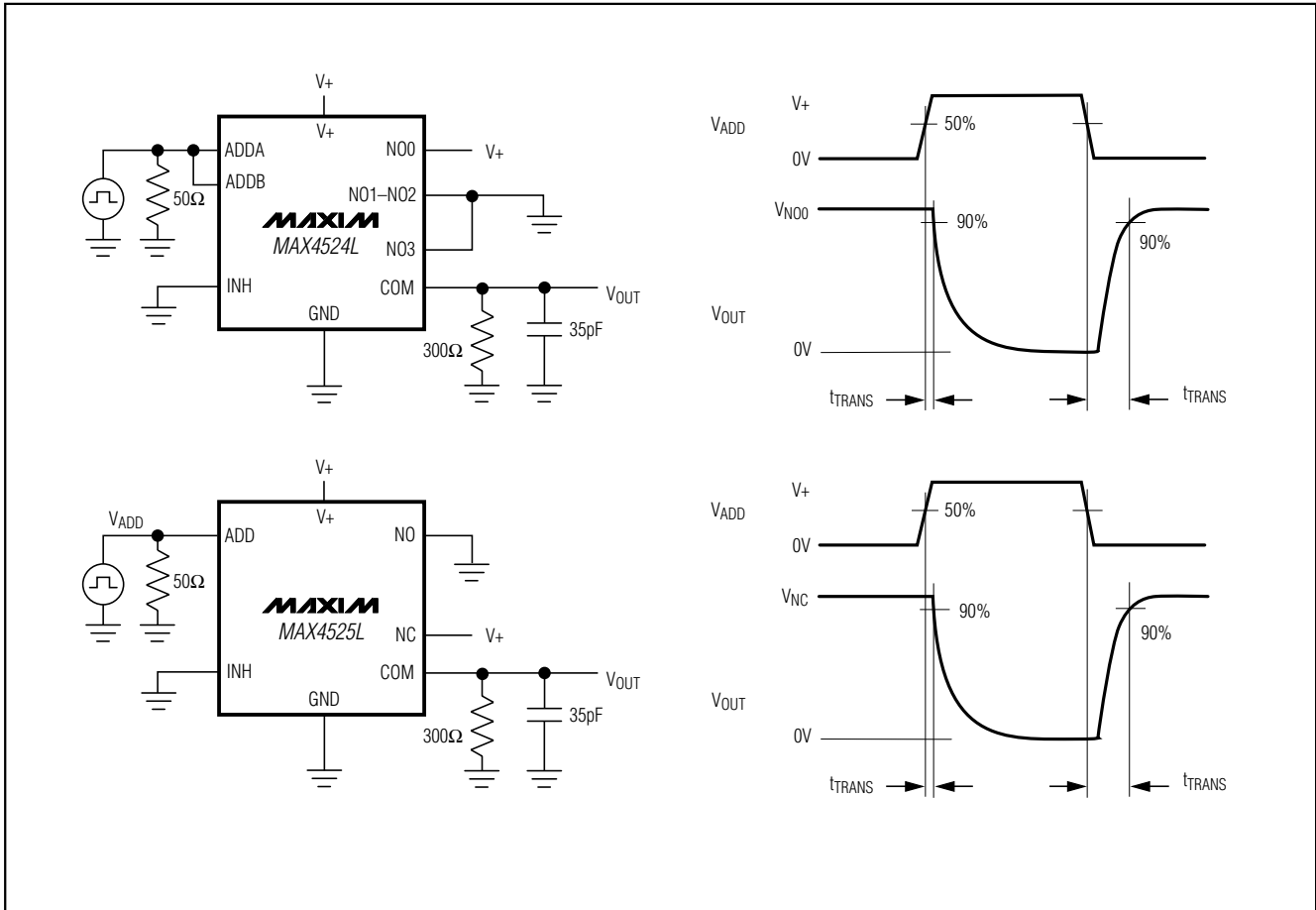


Figure 2. Address Transition Time

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Test Circuits/Timing Diagrams (continued)

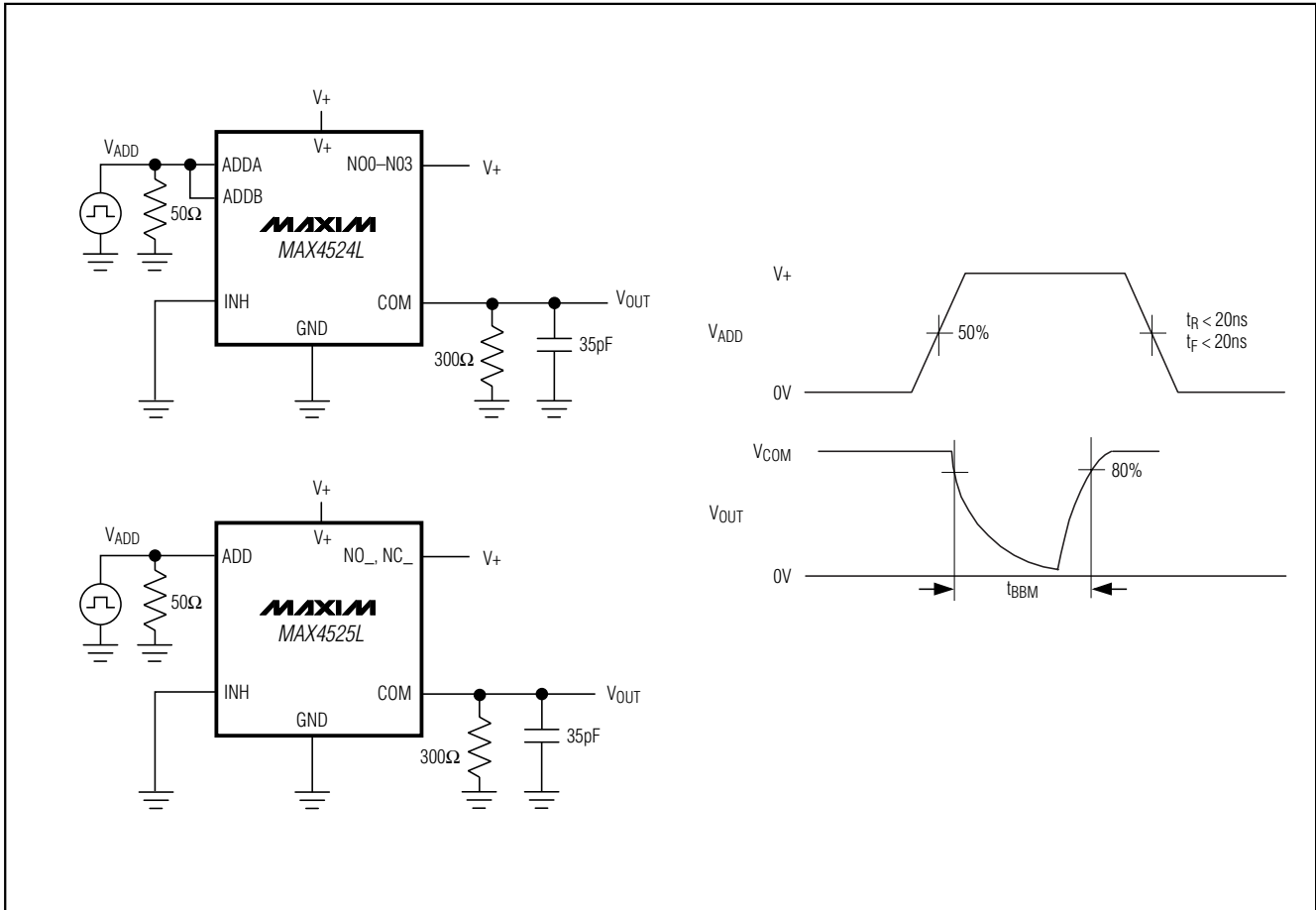


Figure 3. Break-Before-Make Interval

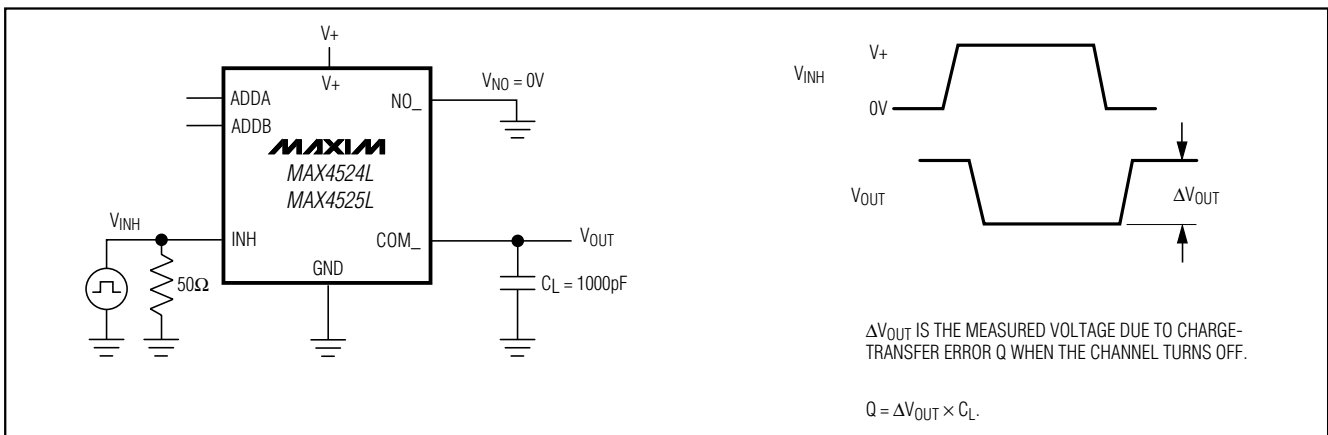


Figure 4. Charge Injection



# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Test Circuits/Timing Diagrams (continued)

MAX4524L/MAX4525L

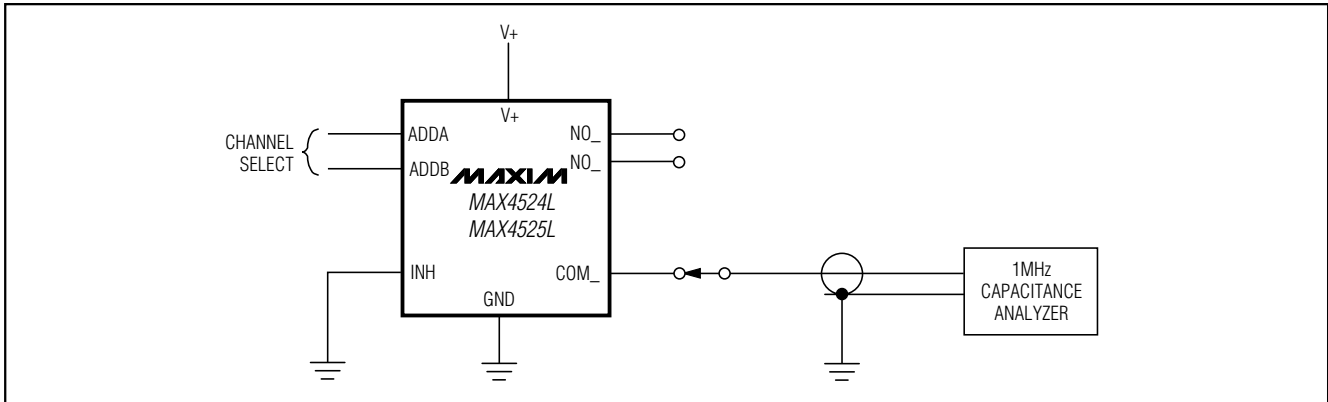


Figure 5. NO/COM Capacitance

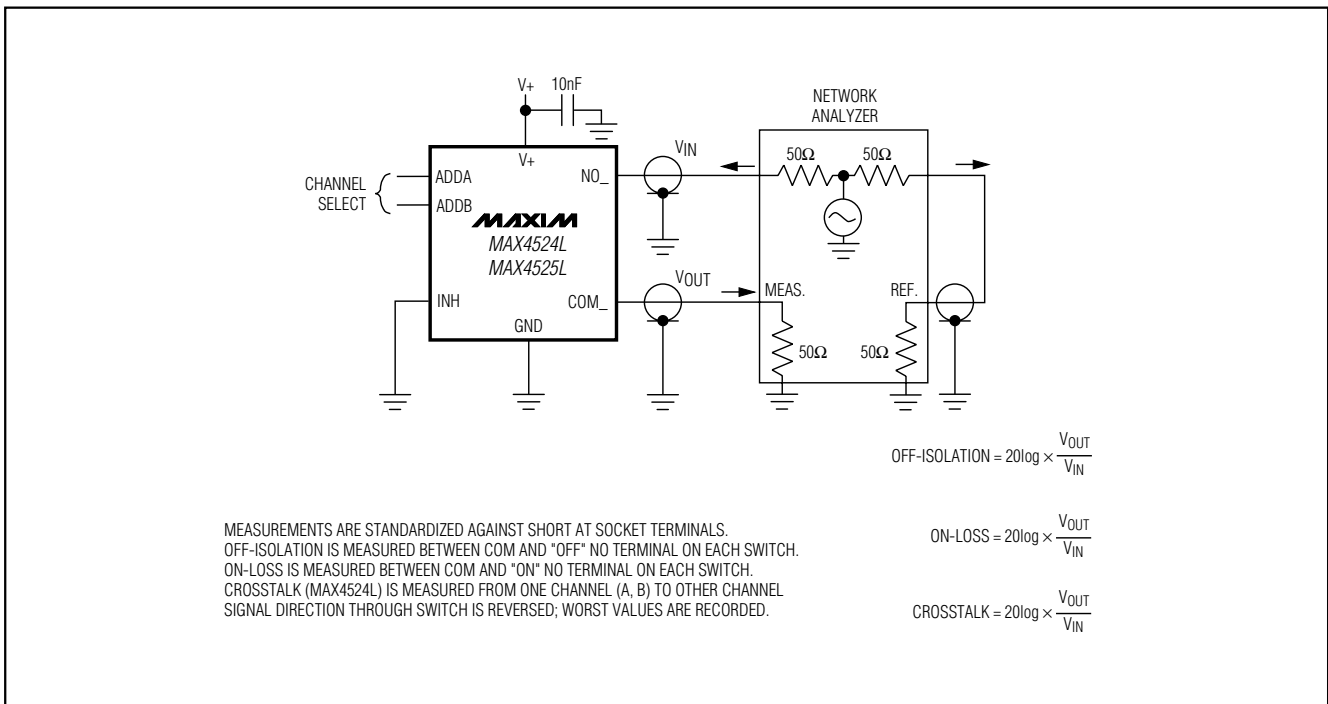


Figure 6. Off-Isolation, On-Loss, and Crosstalk

### Chip Information

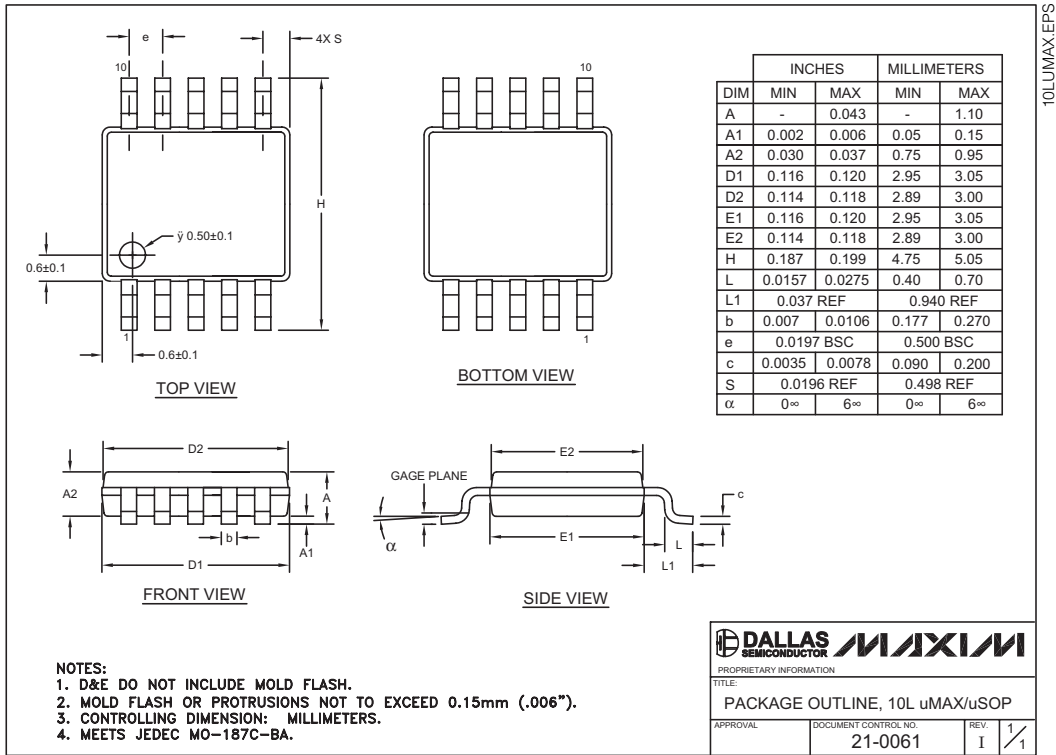
TRANSISTOR COUNT: 219

PROCESS: CMOS

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## 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).)



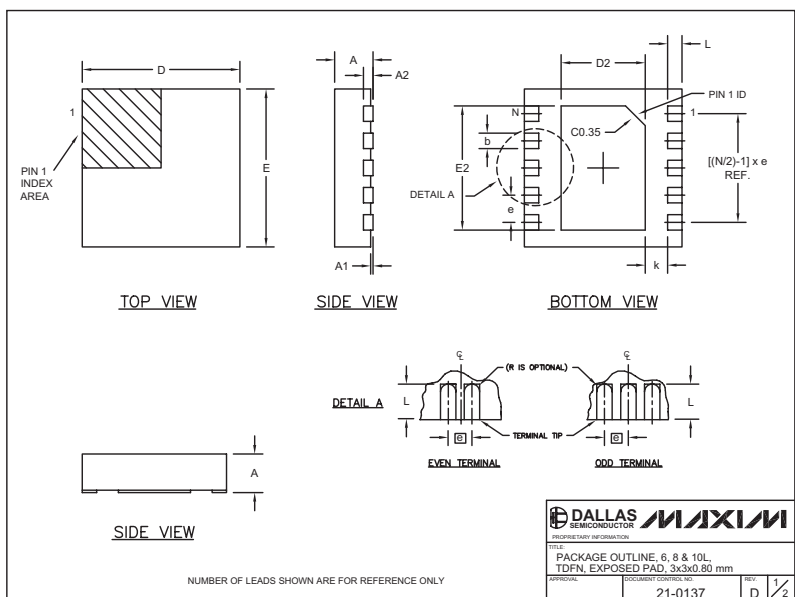
10LUMAXEPS

# Low-Voltage, Single-Supply Analog Multiplexers/Switches

## Package Information (continued)

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

MAX4524L/MAX4525L



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

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

NOTES:

- ALL DIMENSIONS ARE IN mm, ANGLES IN DEGREES.
- COPLANARITY SHALL NOT EXCEED 0.08 mm.
- WARRPAGE SHALL NOT EXCEED 0.10 mm.
- PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
- DRAWING CONFORMS TO JEDEC MO229, EXCEPT DIMENSIONS "D2" AND "E2".
- "N" IS THE TOTAL NUMBER OF LEADS.

|  |                      |       |       |
|--|----------------------|-------|-------|
| DALLAS SEMICONDUCTOR   |                      | MAXIM |       |
| PROPRIETARY INFORMATION  |                      |       |       |
| TITLE: PACKAGE OUTLINE, 6, 8 & 10L, TDFN, EXPOSED PAD, 3x3x0.80 mm |                      |       |       |
| APPROVAL:  | DOCUMENT CONTROL NO: | REV:  | D 2/2 |
| 21-0137  |                      |       |       |

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