# 0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

## ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
V+, A_, EN_ .....-0.3V to +4V
COM, NO_ (Note 1) .....-0.3V to (V+ + 0.3V)
Continuous Current COM, NO_ .....±150mA
Continuous Current (all other pins).....±20mA
Peak Current COM, NO_
(pulsed at 1ms 10% duty cycle).....±300mA

Continuous Power Dissipation ($T_A$ = +70°C)
10-Pin µMAX (derate 5.6mW/°C above +70°C).....444mW
12-Pin Thin QFN (derate 14.7mW/°C above +70°C) ..1176mW
Operating Temperature Range .....-40°C to +85°C
Maximum Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

**Note 1:** Signals on COM or NO_ exceeding V+ or GND are clamped by internal diodes. Limit forward 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, $V_{IH}$ = 1.4V, $V_{IL}$ = 0.5V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise specified. Typical values are at V+ = 3.0V, $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | $T_A$ | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog Signal Range | $V_{COM}$, $V_{NO\_}$ | | | 0 | | V+ | V |
| On-Resistance (Note 4) | $R_{ON}$ | V+ = 2.7V, $I_{COM}$ = 100mA, $V_{NO\_}$ = 1.5V | +25°C | | 0.6 | 0.8 | Ω |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 1 | |
| On-Resistance Match Between Channels (Notes 4, 5) | $\Delta R_{ON}$ | V+ = 2.7V, $I_{COM}$ = 100mA, $V_{NO\_}$ = 1.5V | +25°C | | 0.1 | 0.2 | Ω |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 0.3 | |
| On-Resistance Flatness (Note 6) | $R_{FLAT(ON)}$ | V+ = 2.7V, $I_{COM\_}$ = 100mA, $V_{NO\_}$ = 1V, 1.5V, 2V | +25°C | | 0.05 | 0.1 | Ω |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 0.2 | |
| NO_ Off-Leakage Current (Note 7) | $I_{NO\_(OFF)}$ | V+ = 3.6V, $V_{COM}$ = 0.3V, 3.3V, $V_{NO\_}$ = 3.3V, 0.3V | +25°C | -1 | ±0.002 | +1 | nA |
| | | | $T_{MIN}$ to $T_{MAX}$ | -5 | | +5 | |
| COM Off-Leakage Current (Note 7) | $I_{COM(OFF)}$ | V+ = 3.6V, $V_{COM}$ = 0.3V, 3.3V, $V_{NO\_}$ = 3.3V, 0.3V | +25°C | -1 | ±0.002 | +1 | nA |
| | | | $T_{MIN}$ to $T_{MAX}$ | -5 | | +5 | |
| COM On-Leakage Current (Note 7) | $I_{COM(ON)}$ | V+ = 3.6V, $V_{COM}$ = 3.3V, 0.3V, $V_{NO\_}$ = 3.3V, 0.3V, or floating | +25°C | -2 | ±0.002 | +2 | nA |
| | | | $T_{MIN}$ to $T_{MAX}$ | -10 | | +10 | |

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

(V+ = 2.7V to 3.6V, $V_{IH}$ = 1.4V, $V_{IL}$ = 0.5V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise specified. Typical values are at V+ = 3.0V, $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | $T_A$ | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **SWITCH DYNAMIC CHARACTERISTICS** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{NO\_}$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 1 | +25°C | | 20 | 25 | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 30 | |
| Turn-Off Time | $t_{OFF}$ | $V_{NO\_}$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 1 | +25°C | | 15 | 20 | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 25 | |
| Break-Before-Make (Note 8) | $t_{BBM}$ | $V_{NO\_}$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 2 | +25°C | | 5 | | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | 1 | | | |
| Charge Injection | Q | $V_{GEN}$ = 0, $R_{GEN}$ = 0, $C_L$ = 1.0nF, Figure 3 | +25°C | | 60 | | pC |
| NO_ Off-Capacitance | $C_{OFF}$ | f = 1MHz, Figure 4 | +25°C | | 33 | | pF |
| COM Off-Capacitance | $C_{COM(OFF)}$ | f = 1MHz, Figure 4 | +25°C | | 117 | | pF |
| COM On-Capacitance | $C_{COM(ON)}$ | f = 1MHz, Figure 4 | +25°C | | 171 | | pF |
| -3dB On-Channel Bandwidth | BW | Signal = 0, $R_{IN}$ = $R_{OUT}$ = 50Ω, $C_L$ = 5pF, Figure 5 | | | 90 | | MHz |
| Off-Isolation (Note 9) | $V_{ISO}$ | f = 1MHz, $V_{COM}$ = $1V_{P-P}$, $R_L$ = 50Ω, $C_L$ = 5pF, Figure 5 | +25°C | | -56 | | dB |
| Crosstalk (Note 10) | $V_{CT}$ | f = 1MHz, $V_{COM}$ = $1V_{P-P}$, $R_L$ = 50Ω, $C_L$ = 5pF, Figure 5 | +25°C | | -56 | | dB |
| Total Harmonic Distortion | THD | f = 20Hz to 20kHz, $V_{COM}$ = $2V_{P-P}$, $R_L$ = 32Ω | +25°C | | 0.018 | | % |
| **LOGIC INPUT (A_, EN)** | | | | | | | |
| Input Logic High | $V_{IH}$ | | | 1.4 | | | V |
| Input Logic Low | $V_{IL}$ | | | | | 0.5 | V |
| Input Leakage Current | $I_{IN}$ | $V_{EN}$ = 0 or 3.6V, $V_{A\_}$ = 0 or 3.6V | | -1 | 0.005 | +1 | µA |
| **POWER SUPPLY** | | | | | | | |
| Power-Supply Range | V+ | | | 1.6 | | 3.6 | V |
| Positive Supply Current | I+ | V+ = 3.6V, $V_{EN, A\_}$ = 0 or V+, all channels on or off | | | 0.004 | 1 | µA |

# 0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

## ELECTRICAL CHARACTERISTICS—Single 1.8V Supply

(V+ = 1.8V, $V_{IH}$ = 1.0V, $V_{IL}$ = 0.4V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise specified. Typical values are at $T_A$ = +25°C.) (Notes 2, 3)

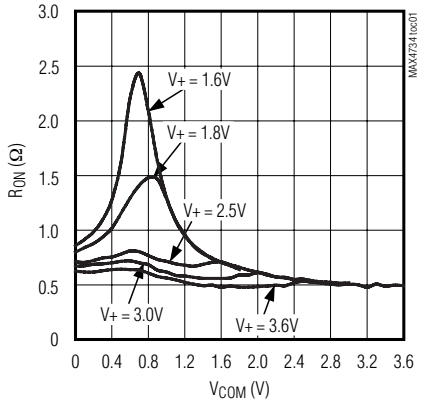
| PARAMETER | SYMBOL | CONDITIONS | $T_A$ | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog Signal Range | $V_{COM}$, $V_{NO\_}$ | | | 0 | | V+ | V |
| On-Resistance | $R_{ON}$ | $I_{COM\_}$ = 10mA, $V_{NO\_}$ = 1V | +25°C | | 1.5 | 2 | Ω |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 3 | |
| **SWITCH DYNAMIC CHARACTERISTICS** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{NO\_}$ = 1V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 1 | +25°C | | 25 | 30 | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 35 | |
| Turn-Off Time | $t_{OFF}$ | $V_{NO\_}$ = 1V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 1 | +25°C | | 18 | 25 | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | | | 28 | |
| Break-Before-Make (Note 8) | $t_{BBM}$ | $V_{NO\_}$ = 1V, $R_L$ = 50Ω, $C_L$ = 35pF, Figure 2 | +25°C | | 7 | | ns |
| | | | $T_{MIN}$ to $T_{MAX}$ | 1 | | | |
| Charge Injection | Q | $V_{GEN}$ = 0, $R_{GEN}$ = 0, $C_L$ = 1nF, Figure 3 | +25°C | | 35 | | pC |
| Off-Isolation (Note 9) | $V_{ISO}$ | f = 1MHz, $V_{NO\_}$ = $1V_{P-P}$, $R_L$ = 50Ω, $C_L$ = 5pF, Figure 5 | +25°C | | -56 | | dB |
| Crosstalk (Note 10) | $V_{CT}$ | f = 1MHz, $V_{COM}$ = $1V_{P-P}$, $R_L$ = 50Ω, $C_L$ = 5pF, Figure 5 | +25°C | | -56 | | dB |
| **LOGIC INPUT (A_, EN)** | | | | | | | |
| Input Logic High | $V_{IH}$ | | | 1 | | | V |
| Input Logic Low | $V_{IL}$ | | | | | 0.4 | V |
| Input Leakage Current | $I_{IN}$ | $V_{EN}$ = 0 or 3.6V, $V_{A\_}$ = 0 or 3.6V | | | | 1 | µA |

**Note 2:** The algebraic convention, where the most negative value is a minimum and the most positive value is a maximum, is used in this data sheet.
**Note 3:** -40°C specifications are guaranteed by design.
**Note 4:** $R_{ON}$ and $\Delta R_{ON}$ matching specifications for thin QFN packaged parts are guaranteed by design.
**Note 5:** $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.
**Note 6:** Flatness is defined as the difference between the maximum and the minimum value of on-resistance as measured over the specified analog signal ranges.
**Note 7:** Leakage parameters are 100% tested at hot temperature and guaranteed by correlation at room temperature.
**Note 8:** Guaranteed by design.
**Note 9:** Off-Isolation = $20\log_{10}(V_{COM}/V_{NO\_})$, $V_{COM}$ = output, $V_{NO\_}$ = input to off switch.
**Note 10:** Between two switches.

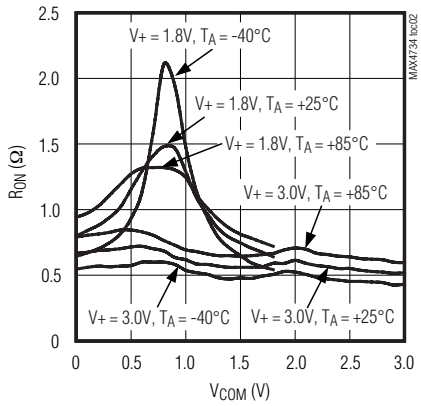
## Typical Operating Characteristics

($T_A$ = +25°C, unless otherwise noted.)

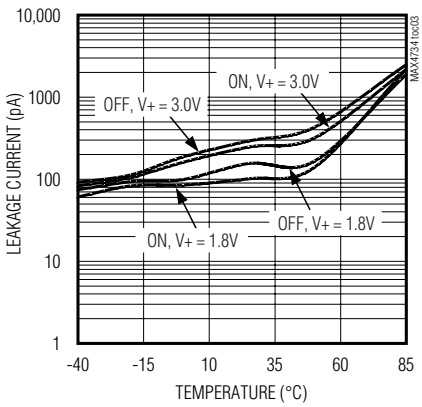
**ON-RESISTANCE vs. $V_{COM}$**



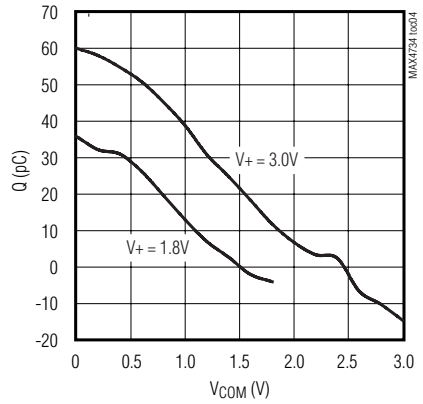

**ON-RESISTANCE vs. $V_{COM}$ AND TEMPERATURE**



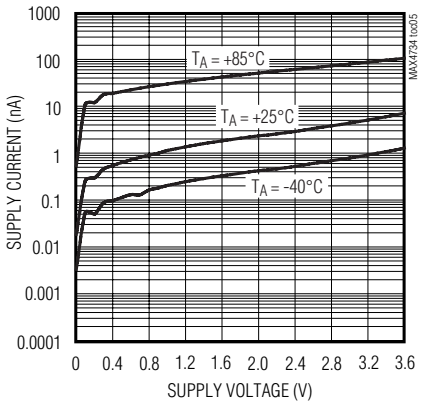

**ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE**



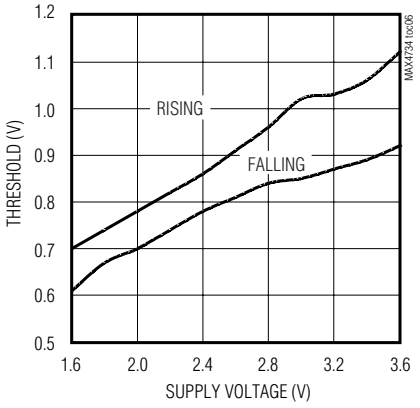

**CHARGE INJECTION vs. $V_{COM}$**



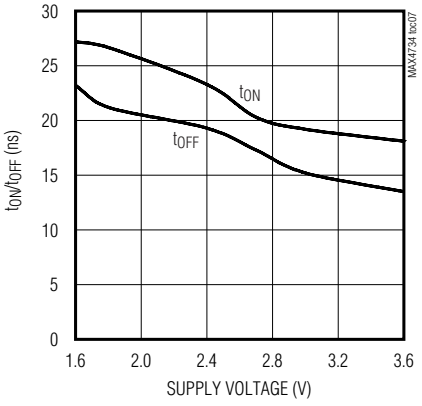

**SUPPLY CURRENT vs. SUPPLY VOLTAGE AND TEMPERATURE**



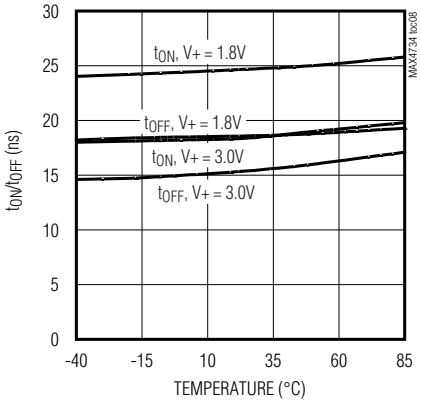

**LOGIC-LEVEL THRESHOLD vs. SUPPLY VOLTAGE**




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




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

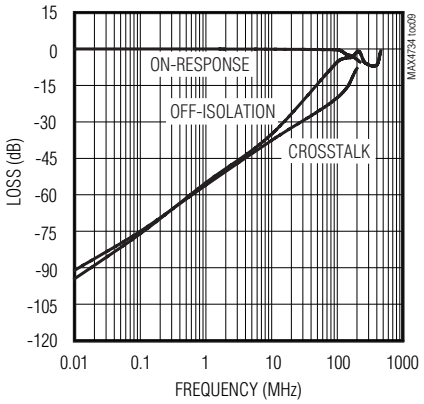


# 0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

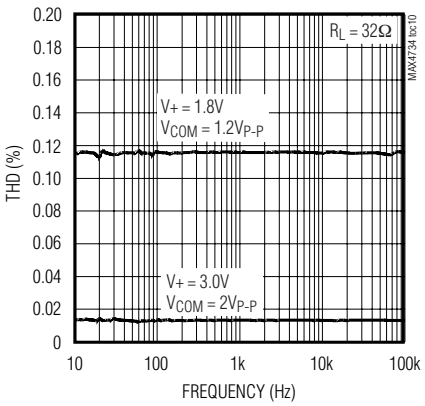
## Typical Operating Characteristics (continued)

($T_A$ = +25°C, unless otherwise noted.)

**FREQUENCY RESPONSE**




**TOTAL HARMONIC DISTORTION vs. FREQUENCY**




## Pin Description

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| μMAX | QFN | | |
| 1 | 12 | A0 | Address 0 Input |
| 2 | 1 | NO1 | Analog Switch 1—Normally Open Terminal |
| 3 | 2 | GND | Ground |
| 4 | 3 | NO3 | Analog Switch 3—Normally Open Terminal |
| 5 | 4 | EN | Enable Logic Input |
| 6 | 6 | V+ | Positive-Supply Voltage Input |
| 7 | 7 | NO4 | Analog Switch 4—Normally Open Terminal |
| 8 | 8 | COM | Analog Switch Common Terminal |
| 9 | 9 | NO2 | Analog Switch 2—Normally Open Terminal |
| 10 | 10 | A1 | Address 1 Input |
| — | 5, 11 | N.C. | No Connection. Not internally connected. |
| — | — | EP | Exposed Pad. Connect to Ground. |

## Detailed Description

The MAX4734 is a low 0.8Ω (max) (at V+ = 2.7V) on-resistance, low-voltage, 4-channel CMOS analog multiplexer that operates from a 1.6V to 3.6V single supply. CMOS switch construction allows switching analog signals that range from GND to V+.

When powered from a 2.7V supply, the 0.8Ω (max) $R_{ON}$ allows high continuous currents to be switched in a variety of applications.

## Applications Information

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, followed by NO_ or COM.

Although it is not required, power-supply bypassing improves noise margin and prevents switching noise propagation from the V+ supply to other components. A 0.1µF capacitor, connected from V+ to GND, is adequate for most applications.

### Logic Inputs

The MAX4734 logic inputs can be driven up to 3.6V regardless of the supply voltage. For example, with a 1.8V supply, A_ and EN may be driven low to GND and high to 3.6V. Driving A_ and EN rail-to-rail minimizes power consumption.

### Analog Signal Levels

Analog signals that range over the entire supply voltage (V+ to GND) can be passed with very little change in on-resistance (see the *Typical Operating Characteristics*). The switches are bidirectional, so the NO_ and COM_ pins can be used as either inputs or outputs.

### Layout

High-speed switches require proper layout and design procedures for optimum performance. Reduce stray inductance and capacitance by keeping traces short and wide. Ensure that bypass capacitors are as close to the device as possible. Use large ground planes where possible.

## Test Circuits/Timing Diagrams

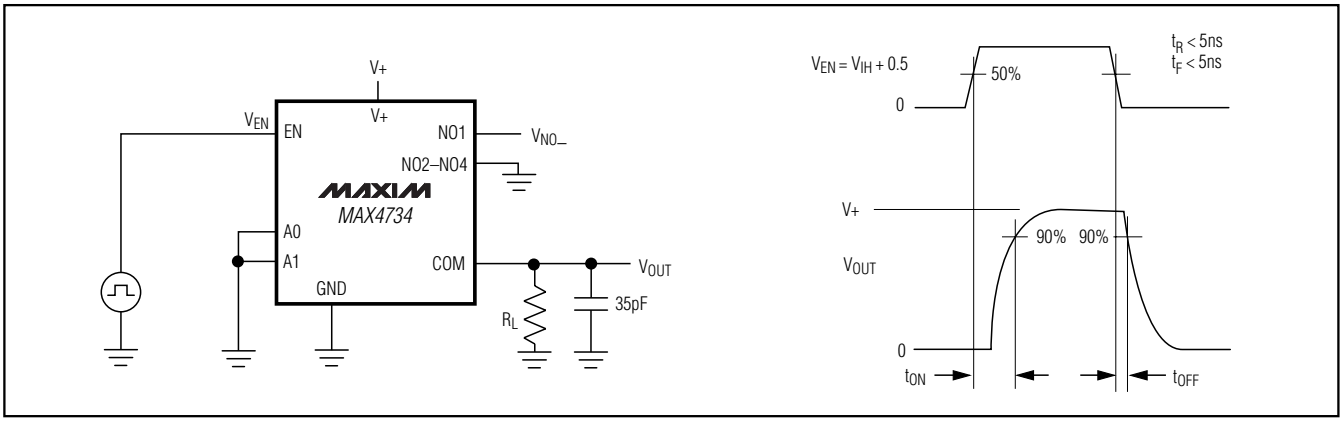



*Figure 1. Switching Time*

# 0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

## Test Circuits/Timing Diagrams (continued)

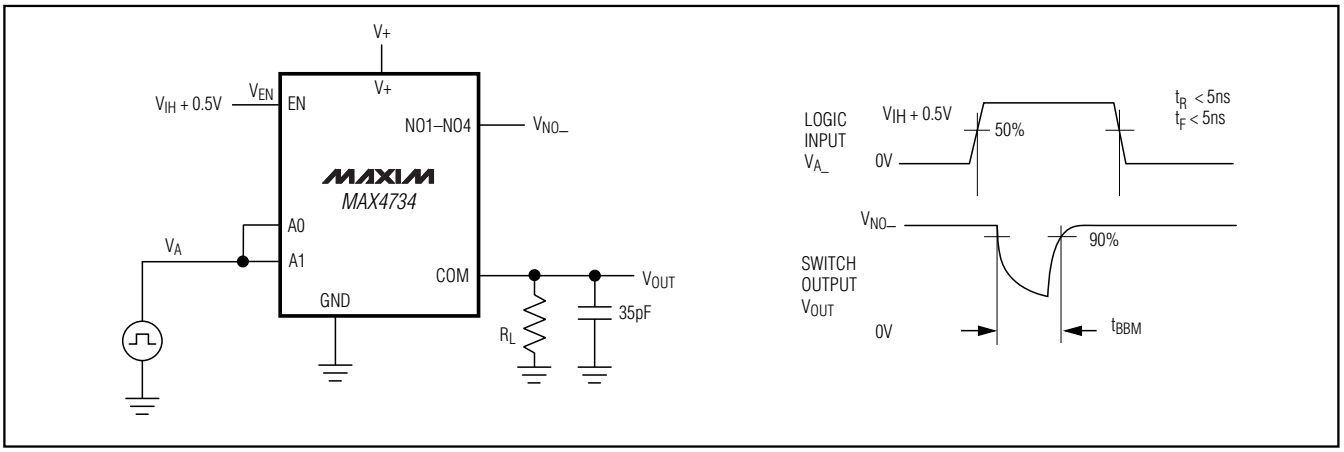



*Figure 2. Break-Before-Make Interval*

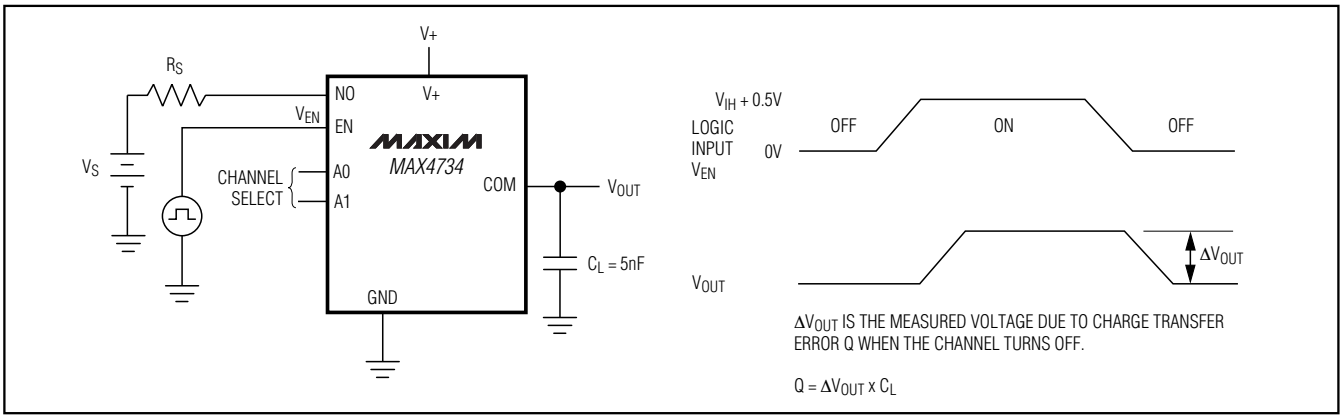



*Figure 3. Charge Injection*

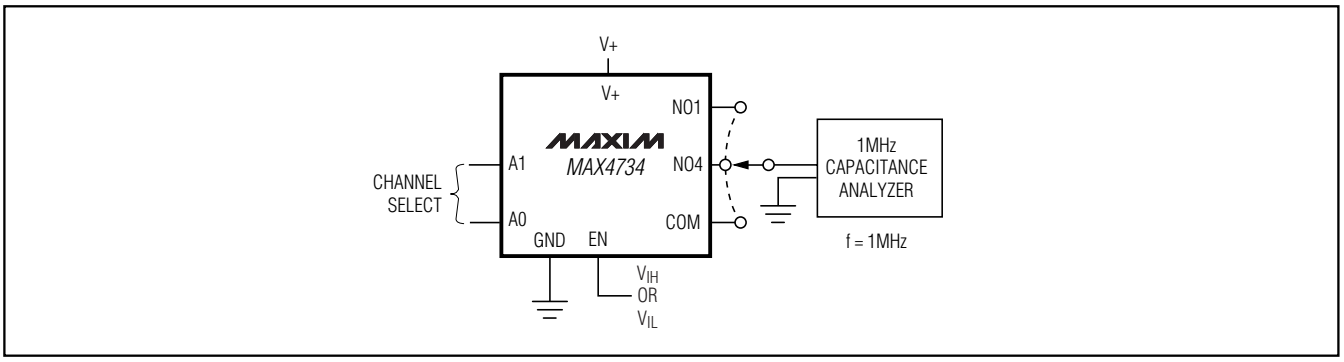
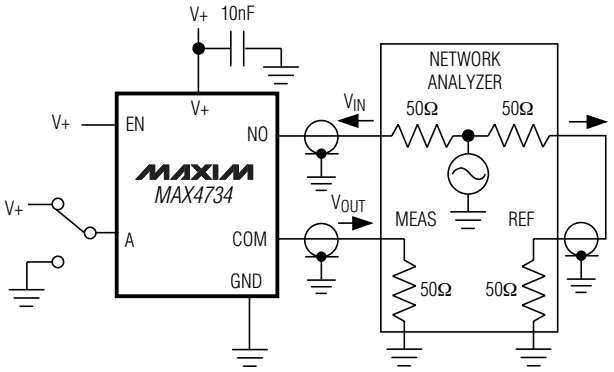



*Figure 4. Channel Off/On-Capacitance*

## Test Circuits/Timing Diagrams (continued)




$$\text{OFF-ISOLATION} = 20\log\frac{V_{OUT}}{V_{REF}}$$

$$\text{ON-LOSS} = 20\log\frac{V_{OUT}}{V_{REF}}$$

$$\text{CROSSTALK} = 20\log\frac{V_{OUT}}{V_{REF}}$$

**NOTES:** MEASUREMENTS ARE STANDARDIZED AGAINST SHORTS AT SOCKET TERMINALS.
OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" TERMINAL ON EACH SWITCH.
ON-LOSS IS MEASURED BETWEEN COM AND "ON" TERMINAL ON EACH SWITCH.
CROSSTALK IS MEASURED BETWEEN ADJACENT CHANNELS WITH ONE CHANNEL ON AND THE OTHER OFF.

*Figure 5. Off-Isolation/On-Channel/Crosstalk Bandwidth*

## Chip Information

TRANSISTOR COUNT: 379

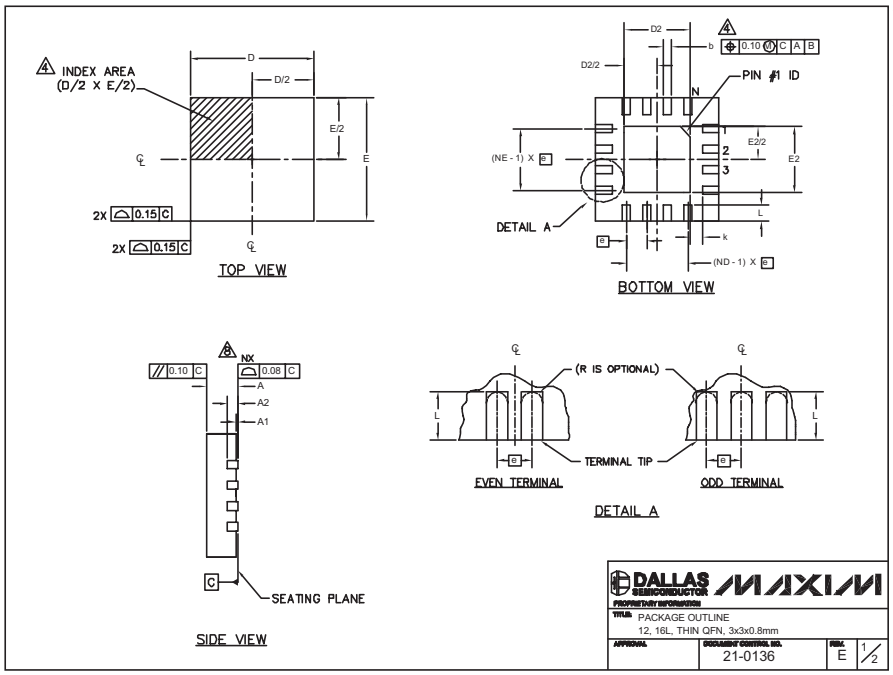
PROCESS: CMOS

# 0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

## 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**.)

12x16L QFN THIN.EPS




| PKG | 12L 3x3 | | | 16L 3x3 | | |
|---|---|---|---|---|---|---|
| REF. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 |
| b | 0.20 | 0.25 | 0.30 | 0.20 | 0.25 | 0.30 |
| D | 2.90 | 3.00 | 3.10 | 2.90 | 3.00 | 3.10 |
| E | 2.90 | 3.00 | 3.10 | 2.90 | 3.00 | 3.10 |
| e | 0.50 BSC. | | | 0.50 BSC. | | |
| L | 0.45 | 0.55 | 0.65 | 0.30 | 0.40 | 0.50 |
| N | 12 | | | 16 | | |
| ND | 3 | | | 4 | | |
| NE | 3 | | | 4 | | |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 |
| A2 | 0.20 REF | | | 0.20 REF | | |
| k | 0.25 | - | - | 0.25 | - | - |

EXPOSED PAD VARIATIONS

| PKG. CODES | D2 | | | E2 | | | PIN ID | JEDEC | DOWN BONDS ALLOWED |
|---|---|---|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | | | |
| T1233-1 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-1 | NO |
| T1233-3 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-1 | YES |
| T1633-1 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 | NO |
| T1633-2 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 | YES |
| T1633F-3 | 0.85 | 0.90 | 0.95 | 0.85 | 0.90 | 0.95 | 0.225 x 45° | WEED-2 | N/A |
| T1633-4 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 | NO |

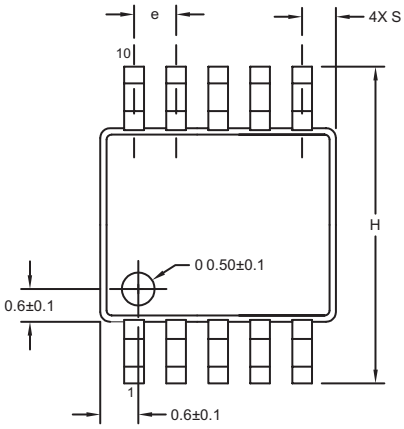
NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-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.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.20 mm AND 0.25 mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
9. DRAWING CONFORMS TO JEDEC MO220 REVISION C.

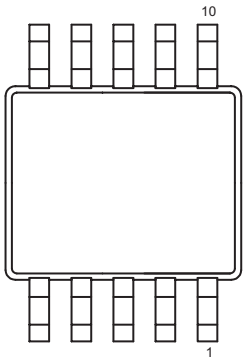
DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE
12, 16L, THIN QFN, 3x3x0.8mm
APPROVAL
DOCUMENT CONTROL NO.
21-0136
REV.
E
2/2

## 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**.)

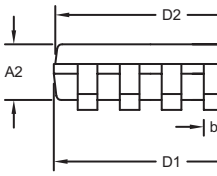



TOP VIEW

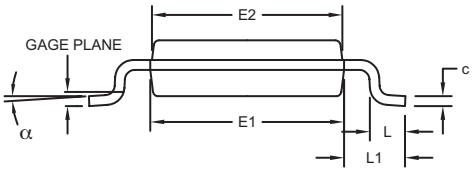



BOTTOM VIEW

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | - | 0.043 | - | 1.10 |
| A1 | 0.002 | 0.006 | 0.05 | 0.15 |
| A2 | 0.030 | 0.037 | 0.75 | 0.95 |
| D1 | 0.116 | 0.120 | 2.95 | 3.05 |
| D2 | 0.114 | 0.118 | 2.89 | 3.00 |
| E1 | 0.116 | 0.120 | 2.95 | 3.05 |
| E2 | 0.114 | 0.118 | 2.89 | 3.00 |
| H | 0.187 | 0.199 | 4.75 | 5.05 |
| L | 0.0157 | 0.0275 | 0.40 | 0.70 |
| L1 | 0.037 REF | | 0.940 REF | |
| b | 0.007 | 0.0106 | 0.177 | 0.270 |
| e | 0.0197 BSC | | 0.500 BSC | |
| c | 0.0035 | 0.0078 | 0.090 | 0.200 |
| S | 0.0196 REF | | 0.498 REF | |
| α | 0° | 6° | 0° | 6° |




FRONT VIEW




SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-BA.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 10L uMAX/uSOP

| APPROVAL | DOCUMENT CONTROL NO. | REV. | |
|---|---|---|---|
| | 21-0061 | I | 1/1 |

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