

MAX4734

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

General Description

The MAX4734 is a low on-resistance, low-voltage, 4-channel CMOS analog multiplexer that operates from a single 1.6V to 3.6V supply. This device has fast switching speeds ($t_{ON} = 25ns$, $t_{OFF} = 20ns$ max), handles rail-to-rail analog signals, and consumes less than $4\mu W$ of quiescent power. The MAX4734 has break-before-make switching.

When powered from a 3V supply, the MAX4734 features low 0.8Ω (max) on-resistance (R_{ON}), with 0.2Ω (max) R_{ON} matching and 0.1Ω R_{ON} flatness. The digital logic input is 1.8V CMOS compatible when using a single 3V supply.

The MAX4734 is available in space-saving 12-pin TQFN (3mm x 3mm) and 10-pin μ MAX packages.

Applications

- Power Routing
- Battery-Powered Systems
- Audio and Video Signal Routing
- Low-Voltage Data-Acquisition Systems
- Communications Circuits
- PCMCIA Cards
- Cellular Phones
- Modems
- Hard Drives

Features

- Low R_{ON}
 - 0.8Ω (max) (3V Supply)
 - 2Ω (max) (1.8V Supply)
- 0.1Ω (max) R_{ON} Flatness (3V Supply)
- 1.6V to 3.6V Single-Supply Operation
- Available in Thin QFN (3mm x 3mm) Package
- High-Current Handling Capacity (150mA Continuous)
- 1.8V CMOS-Logic Compatible (3V Supply)
- Fast Switching: $t_{ON} = 25ns$, $t_{OFF} = 20ns$

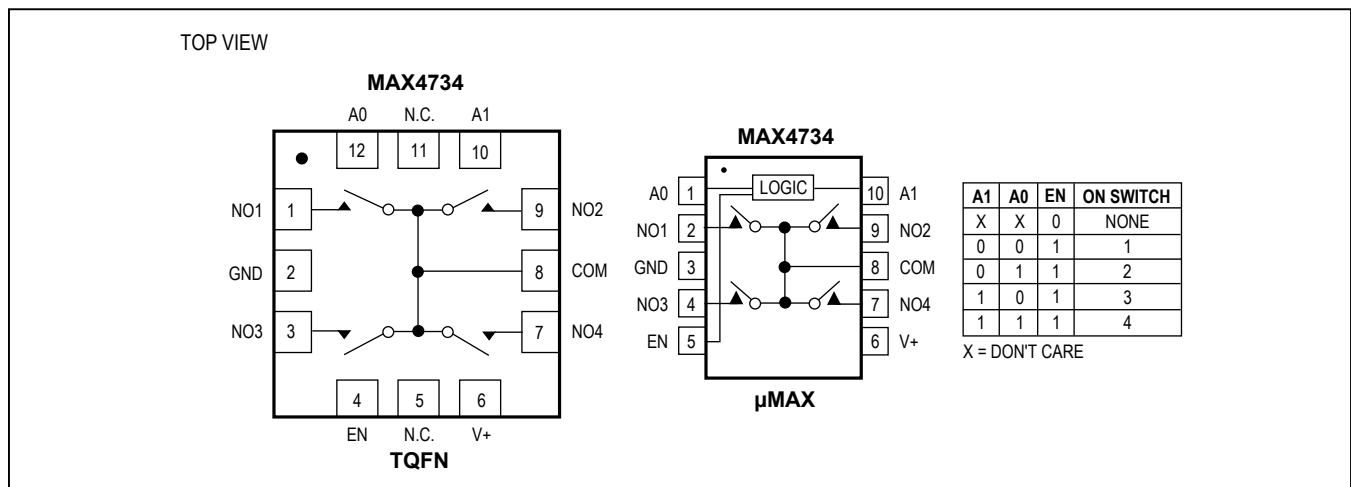
Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|--------------|----------------|---------------------|
| MAX4734EUB+ | -40°C to +85°C | 10 μ MAX |
| MAX4734EUB+T | -40°C to +85°C | 10 μ MAX |
| MAX4734ETC+ | -40°C to +85°C | 12 TQFN (3mm x 3mm) |
| MAX4734ETC+T | -40°C to +85°C | 12 TQFN (3mm x 3mm) |

T = Tape and reel.

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

Pin Configurations/Functional Diagrams/Truth Table



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) | ΔR _{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 (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} = 1 V _{P-P} , R _L = 50Ω, C _L = 5pF, Figure 5 | +25°C | -56 | | dB | |
| Crosstalk (Note 10) | V _{CT} | f = 1MHz, V _{COM} = 1 V _{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 |

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 ΔR_{ON} matching specifications for thin QFN packaged parts are guaranteed by design.

Note 5: ΔR_{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.

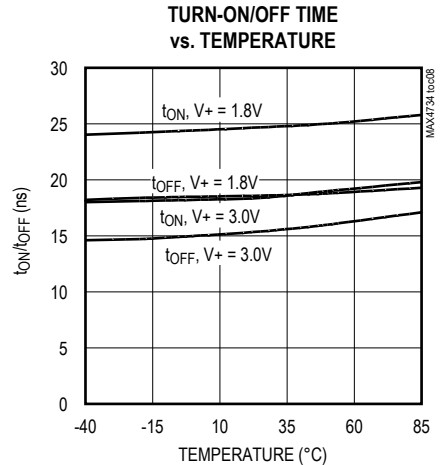
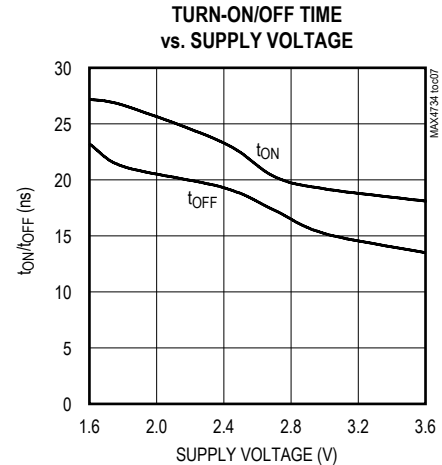
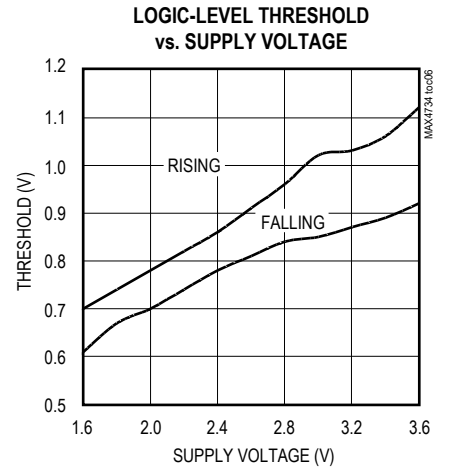
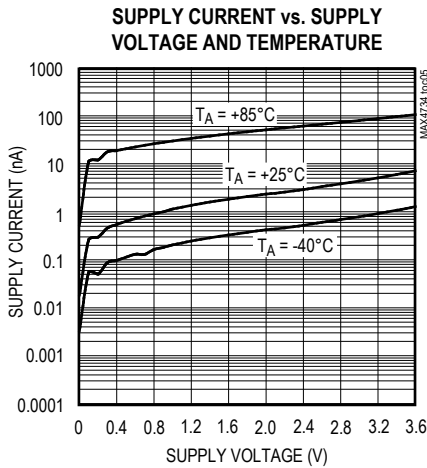
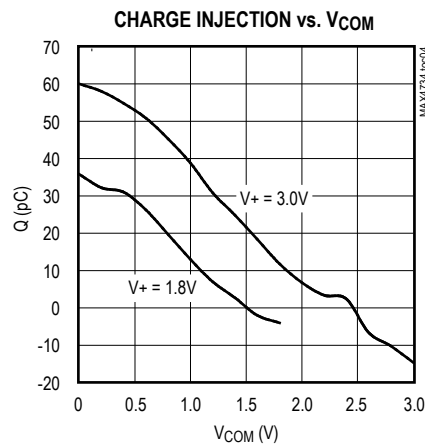
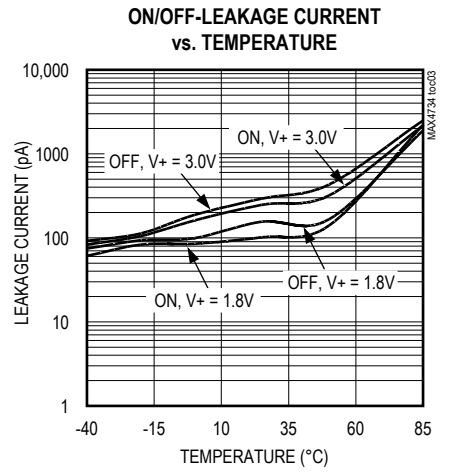
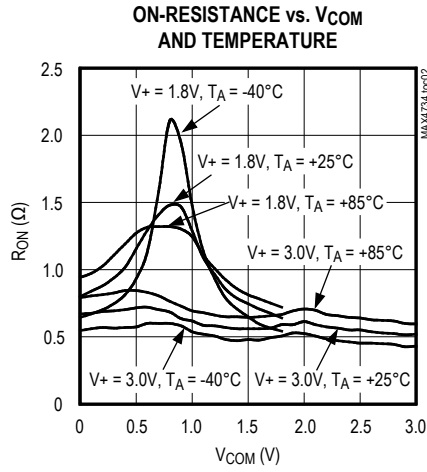
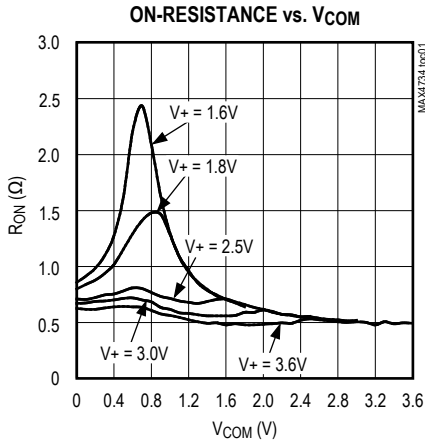
Note 8: Guaranteed by design.

Note 9: Off-Isolation = 20log₁₀(V_{COM}/V_{NO_}), V_{COM} = output, V_{NO_} = input to off switch.

Note 10: Between two switches.

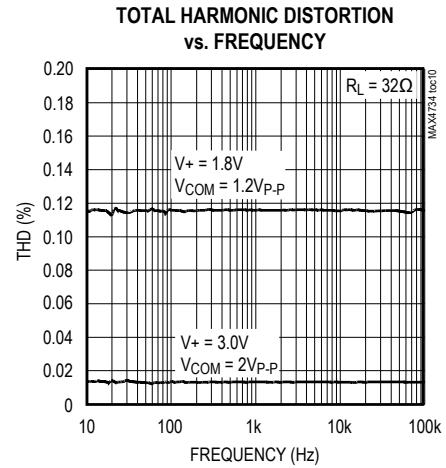
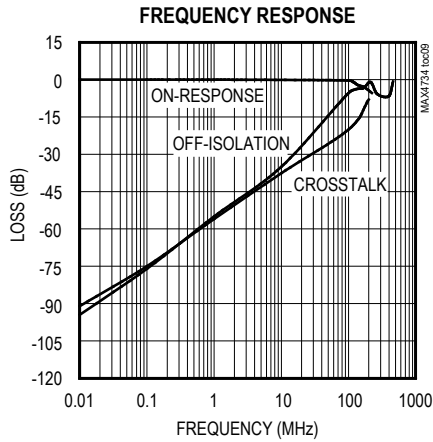
Typical Operating Characteristics

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



Typical Operating Characteristics (continued)

(TA = +25°C, unless otherwise noted.)



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

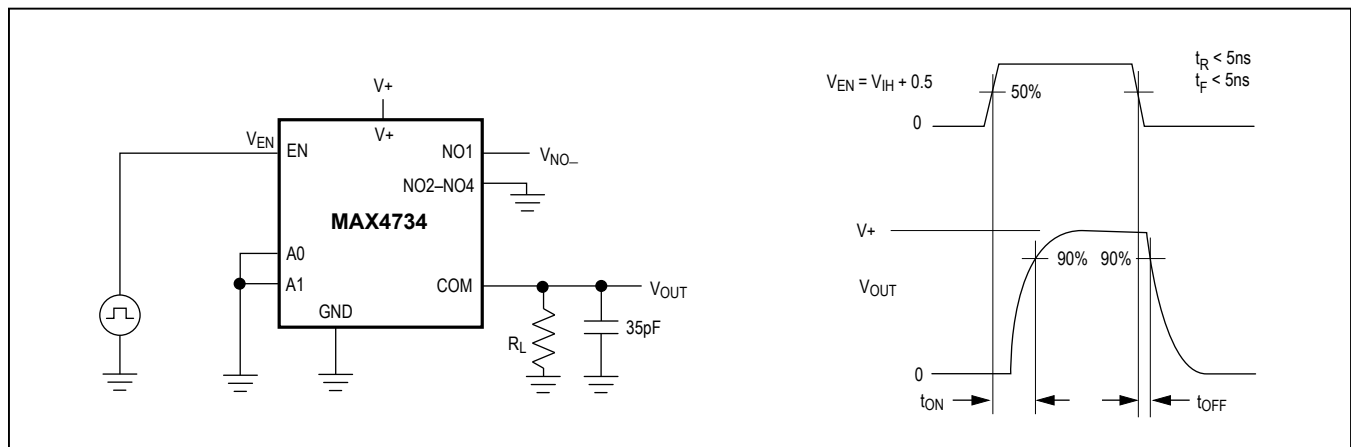


Figure 1. Switching Time

Test Circuits/Timing Diagrams (continued)

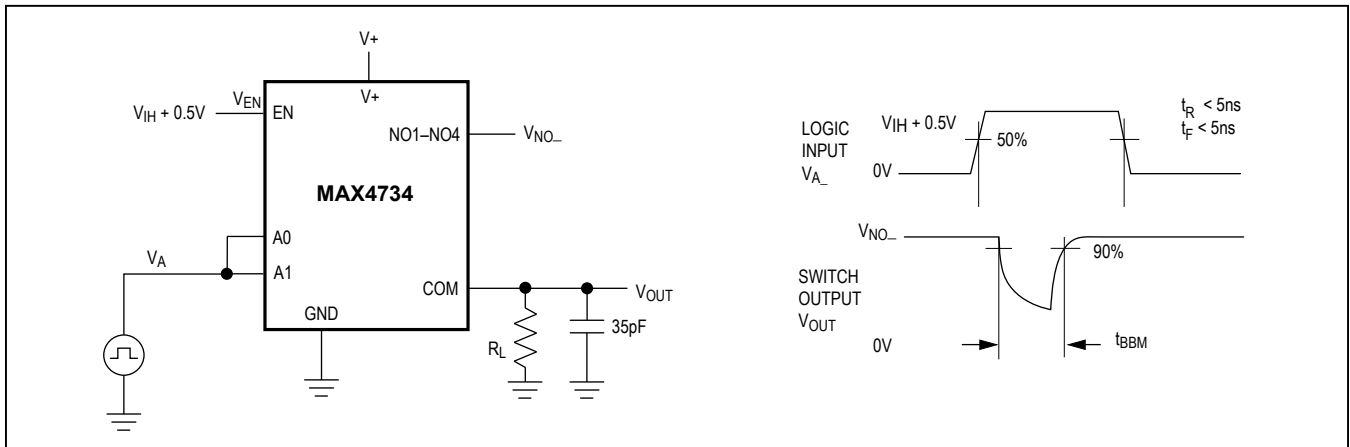


Figure 2. Break-Before-Make Interval

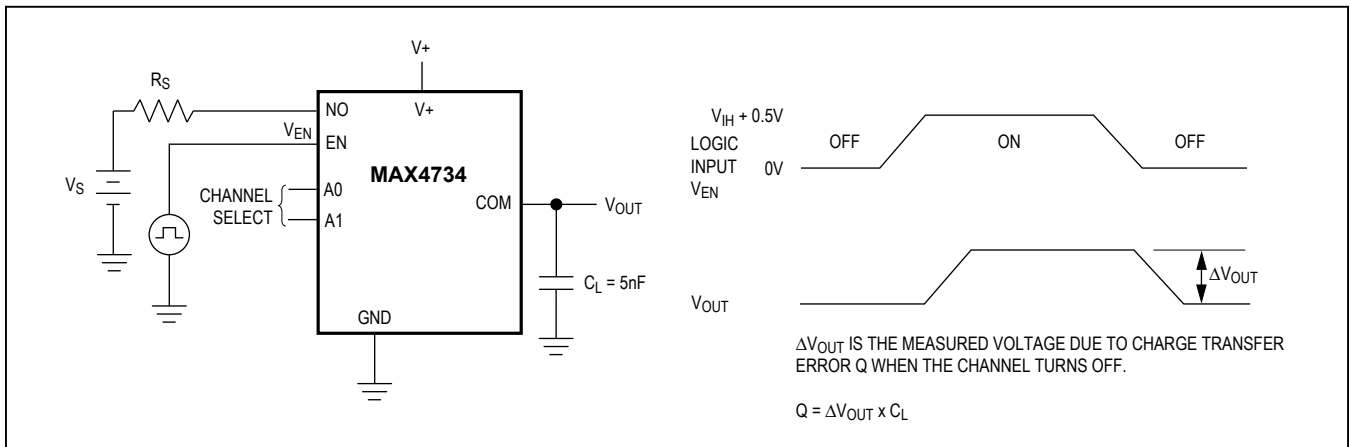


Figure 3. Charge Injection

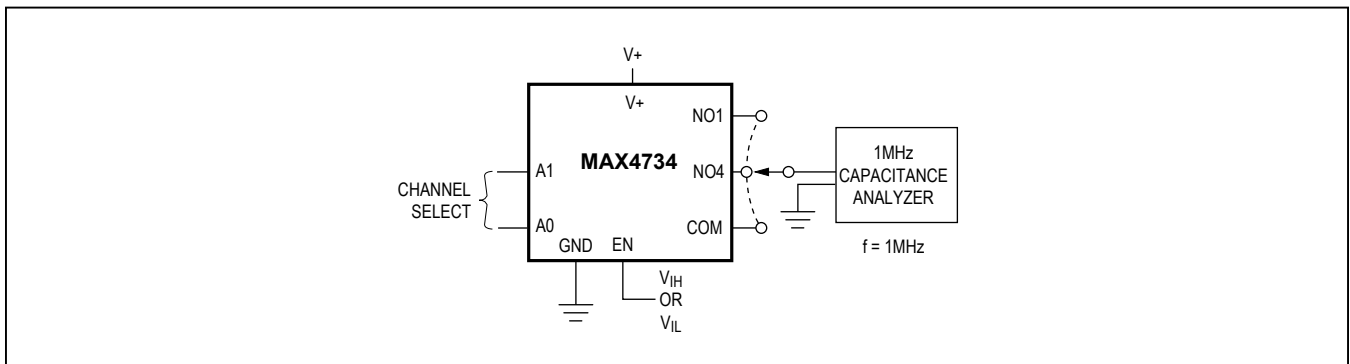


Figure 4. Channel Off/On-Capacitance

Test Circuits/Timing Diagrams (continued)

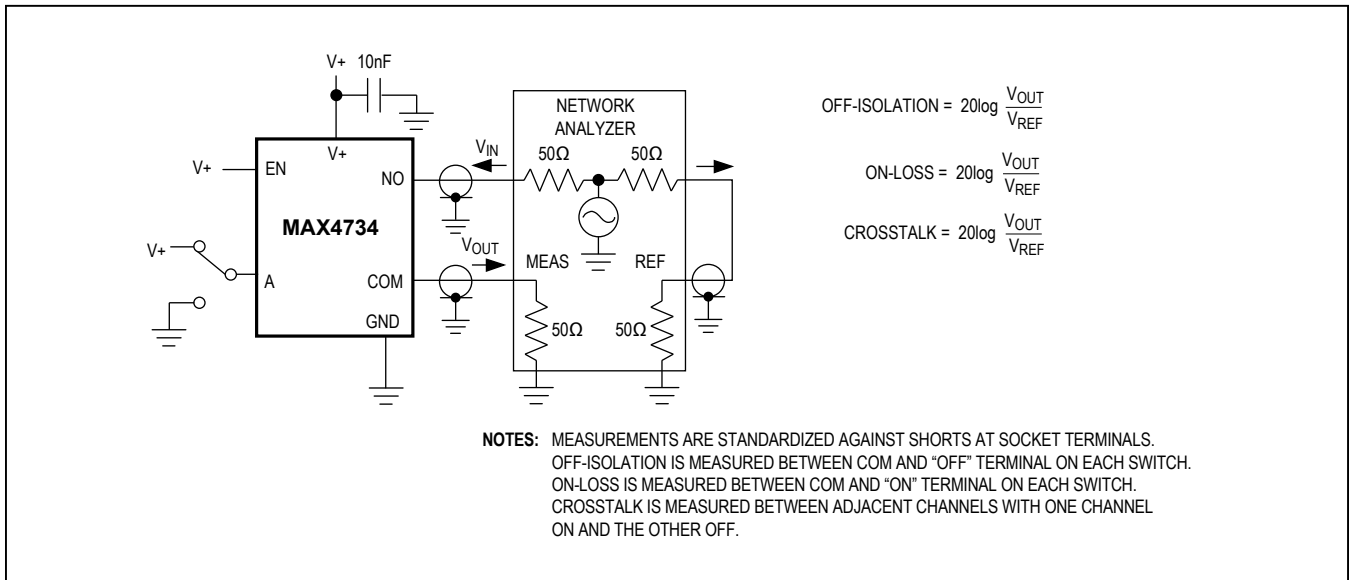


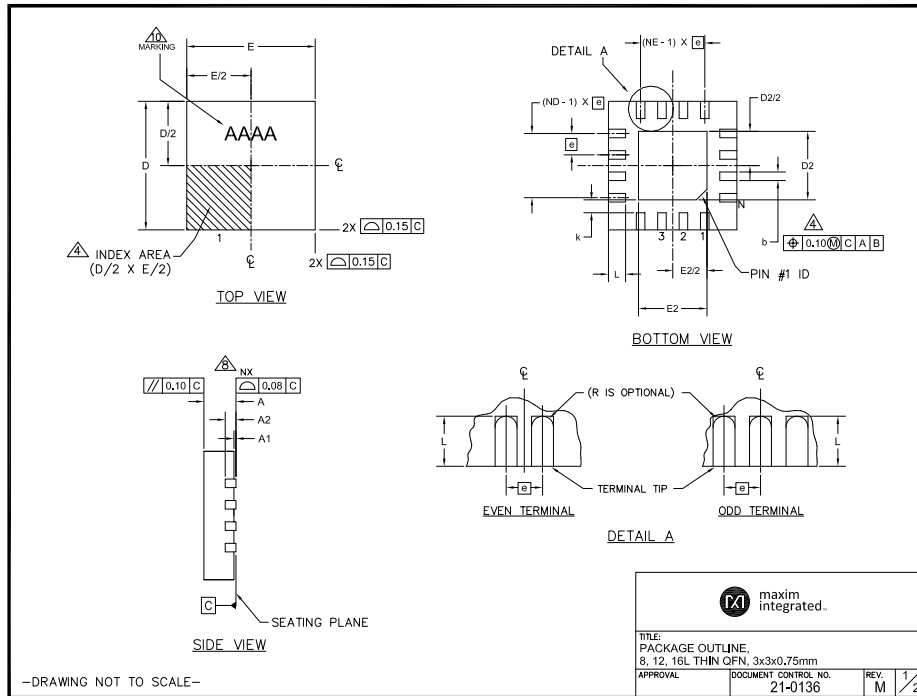
Figure 5. Off-Isolation/On-Channel/Crosstalk Bandwidth

Chip Information

TRANSISTOR COUNT: 379
 PROCESS: CMOS

Package Information

For the latest package outline information and land patterns (footprints), go to 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.



| PKG | 8L 3x3 | | | 12L 3x3 | | | 16L 3x3 | | |
|------|-----------|------|------|-----------|------|------|-----------|------|------|
| REF. | 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 |
| b | 0.25 | 0.30 | 0.35 | 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 | 2.90 | 3.00 | 3.10 |
| E | 2.90 | 3.00 | 3.10 | 2.90 | 3.00 | 3.10 | 2.90 | 3.00 | 3.10 |
| e | 0.65 BSC. | | | 0.50 BSC. | | | 0.50 BSC. | | |
| L | 0.35 | 0.55 | 0.75 | 0.45 | 0.55 | 0.65 | 0.30 | 0.40 | 0.50 |
| N | 8 | | | 12 | | | 16 | | |
| ND | 2 | | | 3 | | | 4 | | |
| NE | 2 | | | 3 | | | 4 | | |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 |
| A2 | 0.20 REF | | | 0.20 REF | | | 0.20 REF | | |
| k | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - |

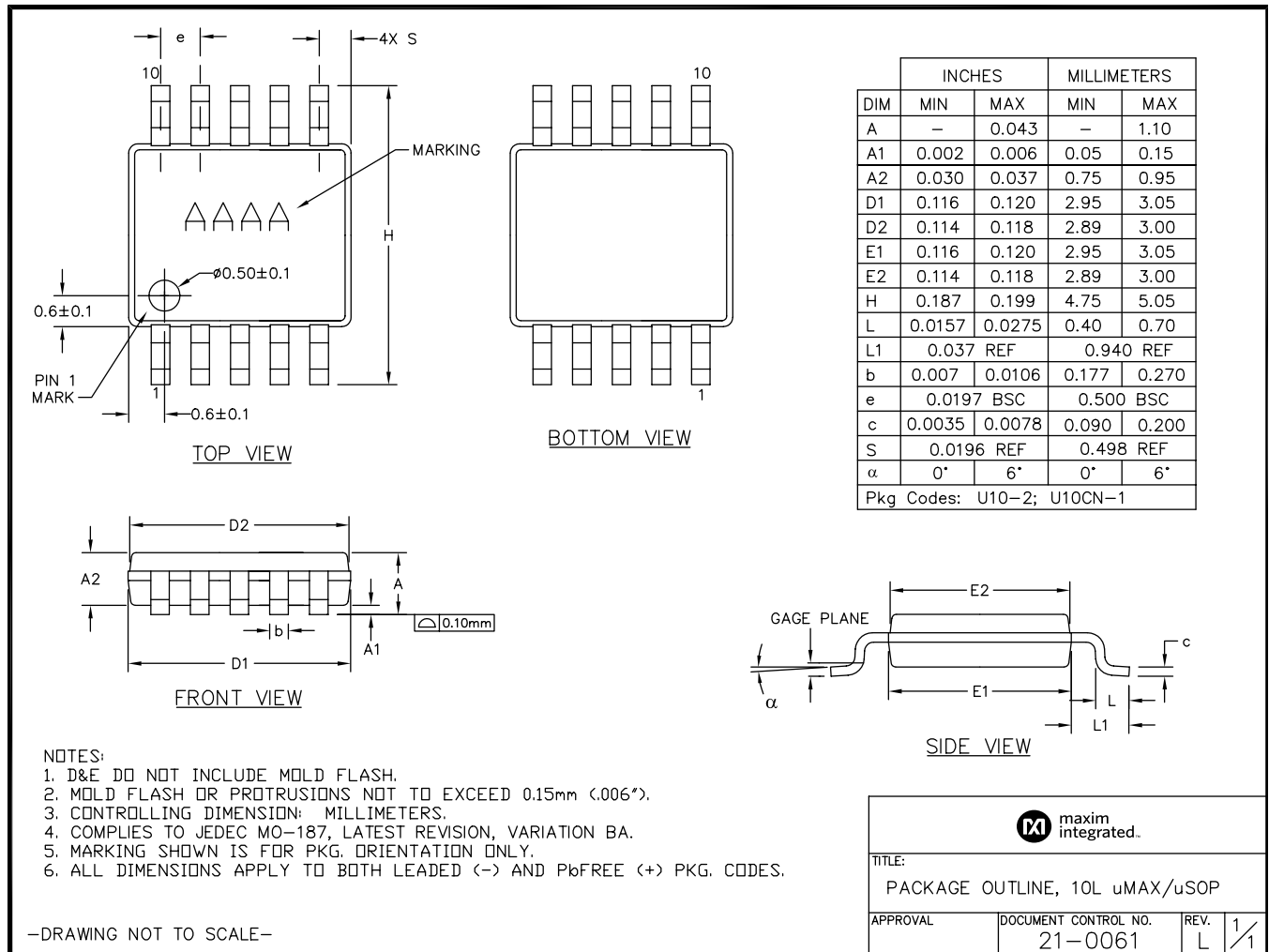
| PKG. CODES | D2 | | | E2 | | | PIN ID | JEDEC |
|------------|------|------|------|------|------|------|-------------|--------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | | |
| TO833-1 | 0.25 | 0.70 | 1.25 | 0.25 | 0.70 | 1.25 | 0.35 x 45° | WEEC |
| T1233-1 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-1 |
| T1233-3 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-1 |
| T1233-4 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-1 |
| T1633-2 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 |
| T1633F-3 | 0.65 | 0.80 | 0.95 | 0.65 | 0.80 | 0.95 | 0.225 x 45° | WEED-2 |
| T1633FH-3 | 0.65 | 0.80 | 0.95 | 0.65 | 0.80 | 0.95 | 0.225 x 45° | WEED-2 |
| T1633-4 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 |
| T1633-4C | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 |
| T1633-5 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 |
| T1633MK-5 | 0.95 | 1.10 | 1.25 | 0.95 | 1.10 | 1.25 | 0.35 x 45° | WEED-2 |

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 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.
- DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.20 mm AND 0.25 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 REVISION C.
- MARKING SHOWN IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
- NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
- WARPAGE NOT TO EXCEED 0.10mm.
- ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND Pb FREE (+) PARTS.

Package Information (continued)

For the latest package outline information and land patterns (footprints), go to 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.



Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|-----------------|---------------|---|---------------|
| 2 | 10/16 | Updated <i>Ordering Information</i> table and clarified package options | 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.

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