19-2381; Rev 0; 4/02

MAXIM

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 4µW 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 QFN (3mm x 3mm) and 10-pin µMAX 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

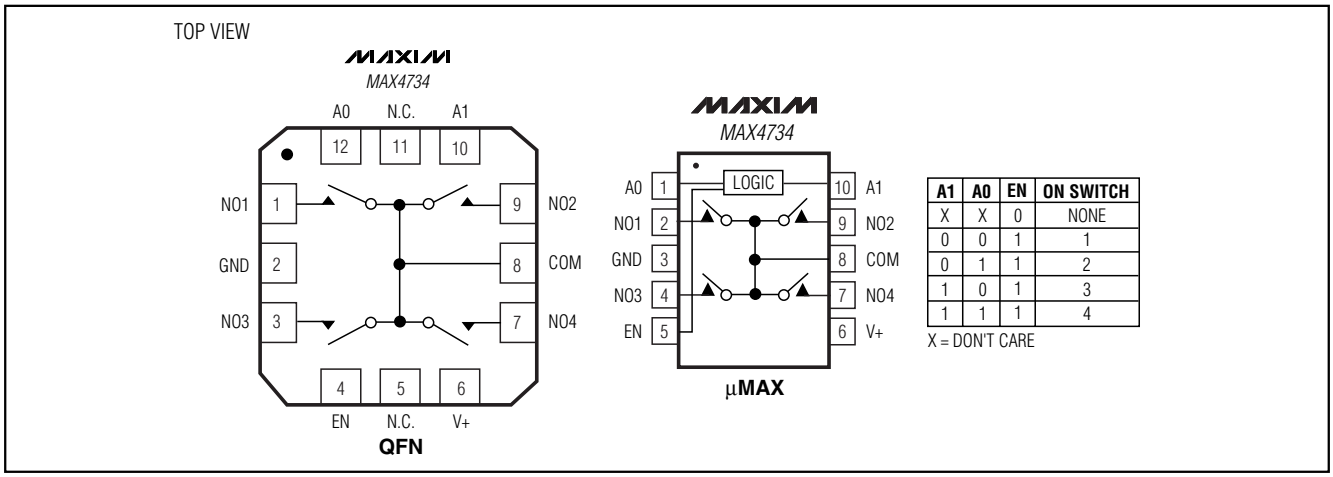
Features

- **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 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 µMAX
MAX4734EGC	-40°C to +85°C	12 QFN (3mm x 3mm)

Pin Configurations/Functional Diagrams/Truth Table



A1	A0	EN	ON SWITCH
X	X	0	NONE
0	0	1	1
0	1	1	2
1	0	1	3
1	1	1	4

X = DON'T CARE

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

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 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—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 ΔR_{ON} matching specifications for 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.

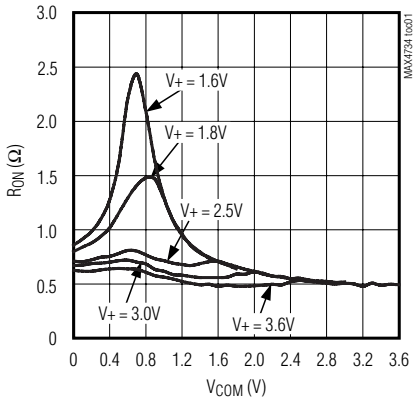
Note 9: Off-Isolation = $20\log_{10}(V_{COM}/V_{NO\_})$, V_{COM} = output, $V_{NO\_}$ = input to off switch.

Note 10: Between two switches.

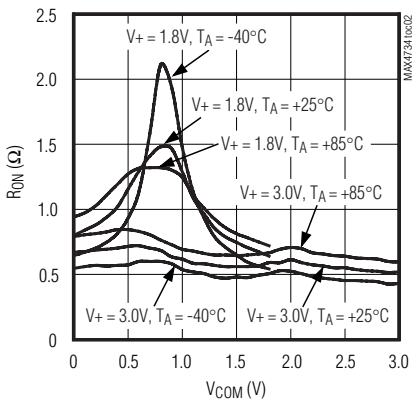
Typical Operating Characteristics

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

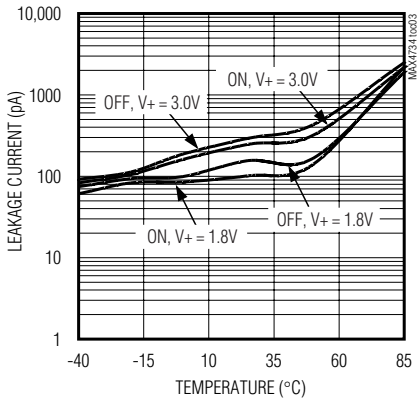
ON-RESISTANCE vs. V_{COM}



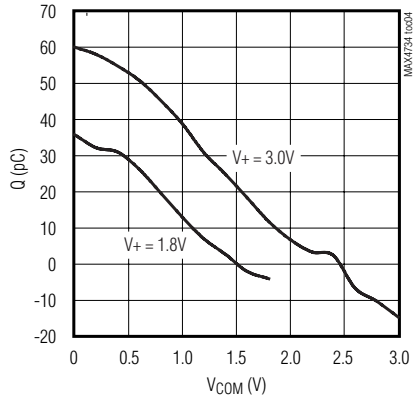
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE



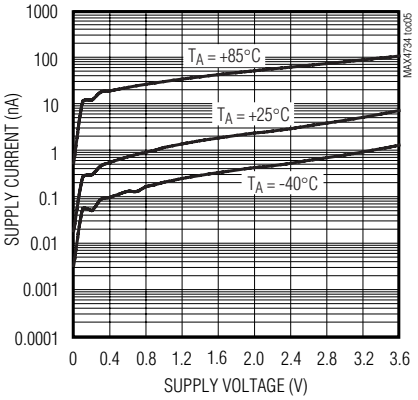
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



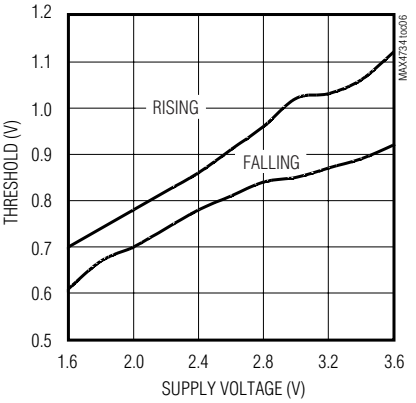
CHARGE INJECTION vs. V_{COM}



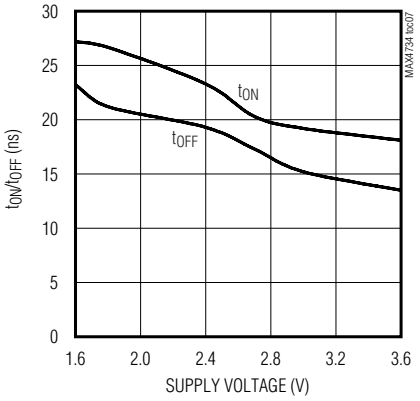
SUPPLY CURRENT vs. SUPPLY VOLTAGE AND TEMPERATURE



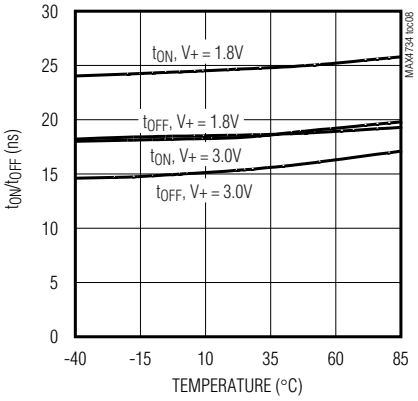
LOGIC-LEVEL THRESHOLD vs. SUPPLY VOLTAGE



TURN-ON/OFF TIME vs. SUPPLY VOLTAGE



TURN-ON/OFF TIME vs. TEMPERATURE

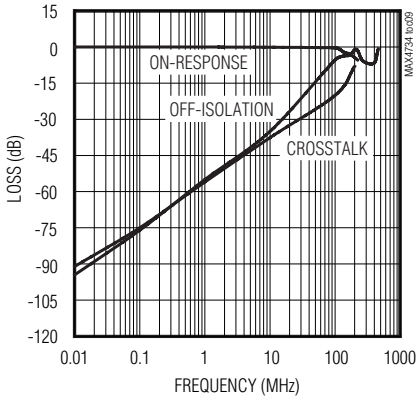


0.8Ω, Low-Voltage, 4-Channel Analog Multiplexer

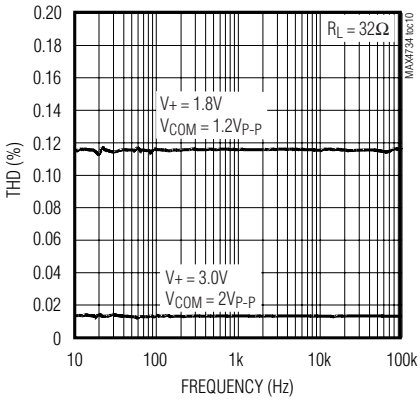
Typical Operating Characteristics (continued)

(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

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

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 *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

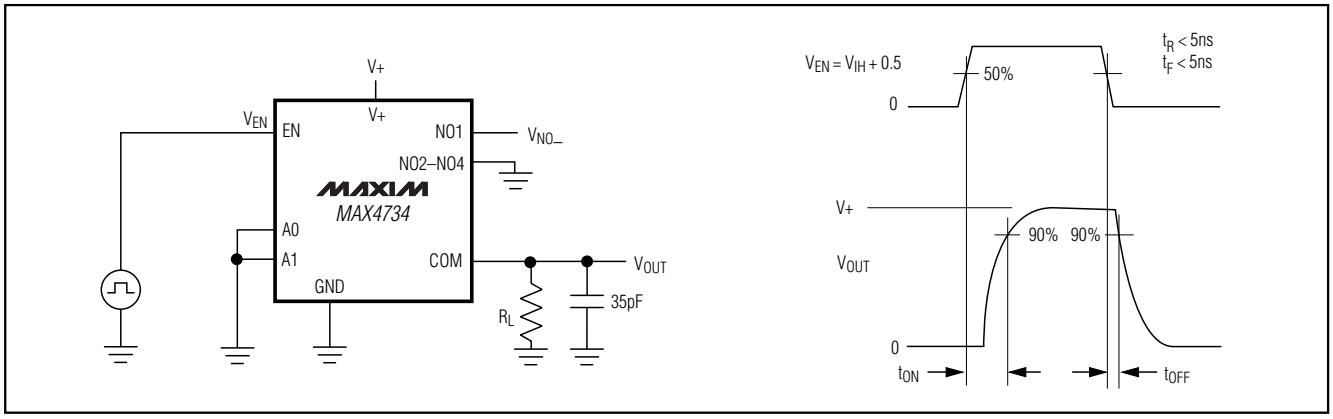


Figure 1. Switching Time

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

Test Circuits/Timing Diagrams (continued)

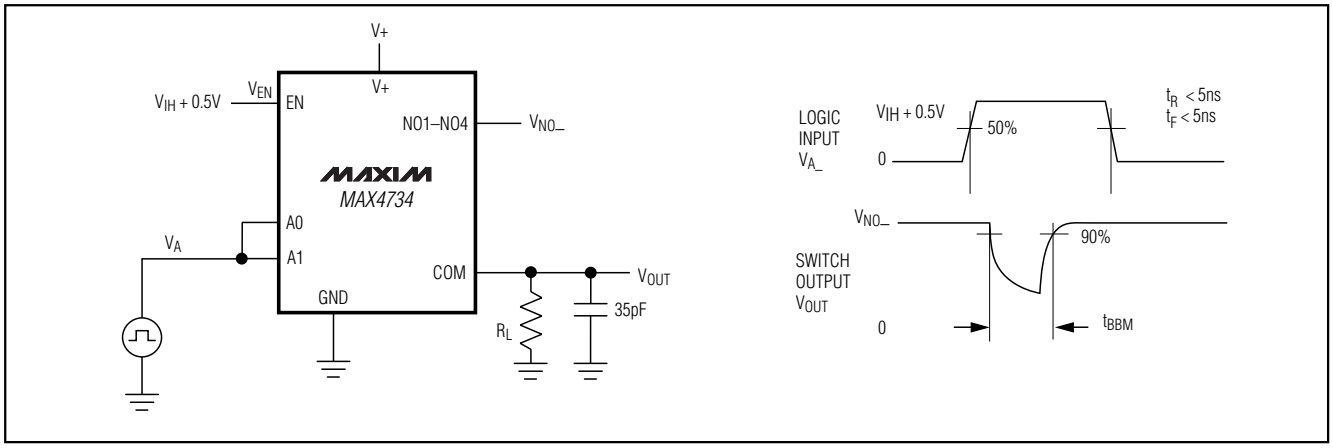


Figure 2. Break-Before-Make Interval

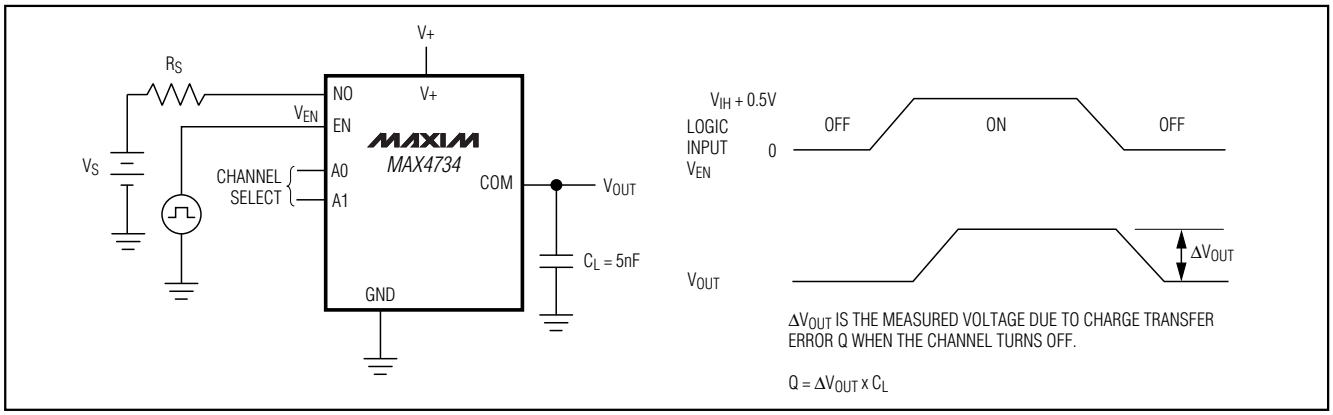


Figure 3. Charge Injection

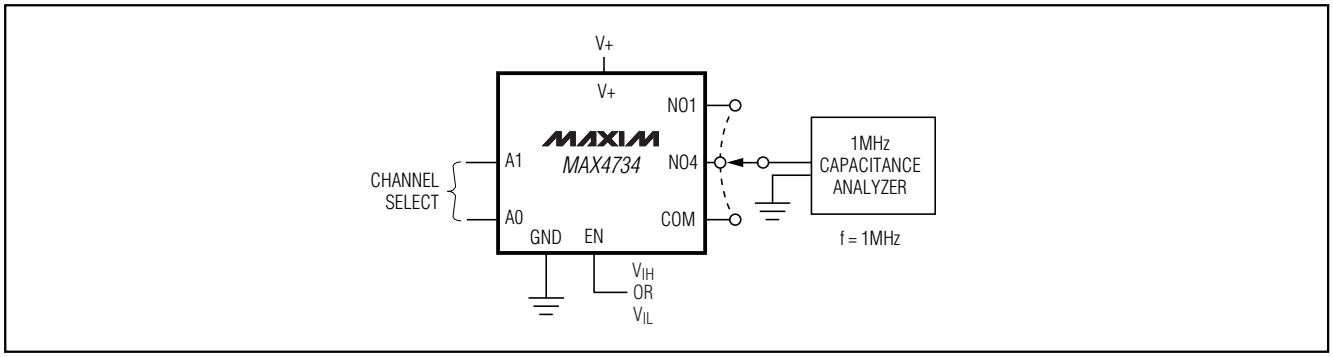
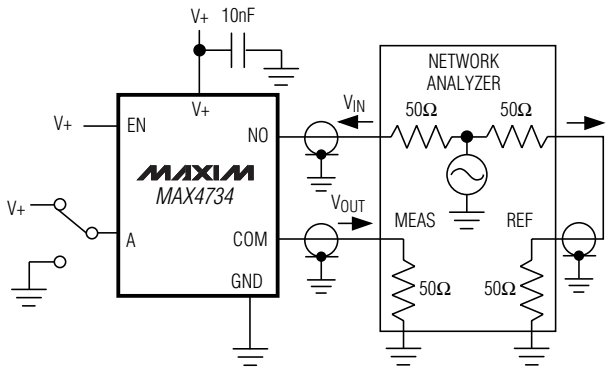


Figure 4. Channel Off/On-Capacitance

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

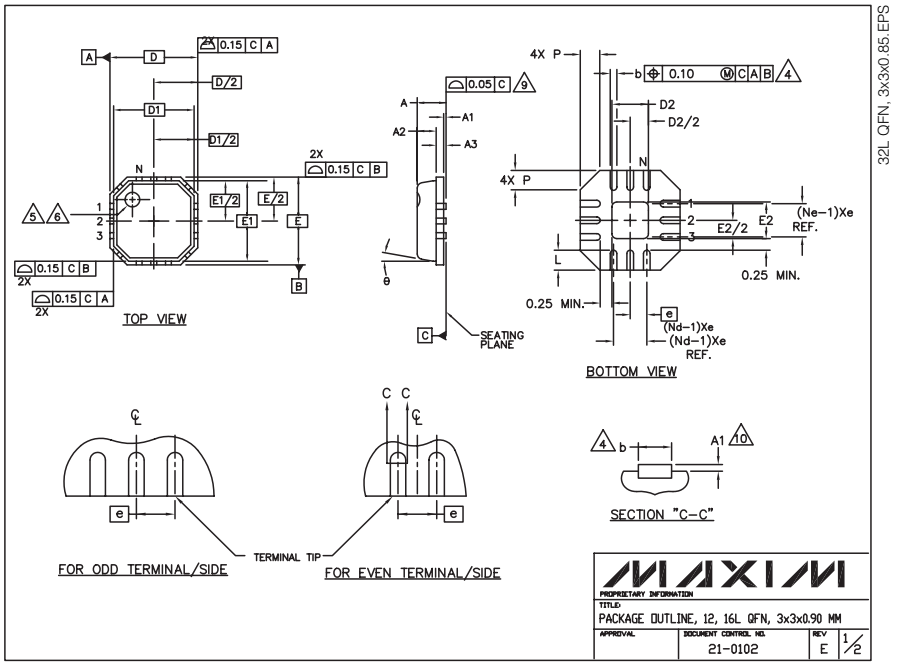
PROCESS: CMOS

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**.)

32L QFN, 3x3x0.85.EPS



NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &
   Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST EXIST ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/ LASER MARKED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220.
11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

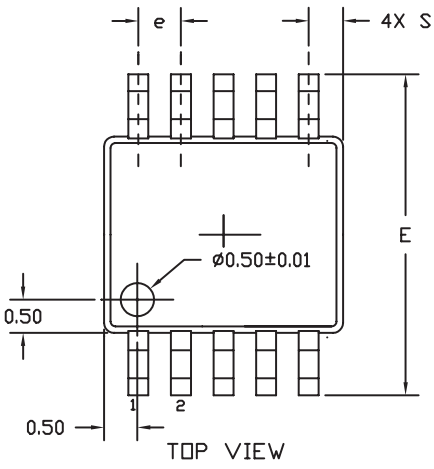
SYMBOL	COMMON DIMENSIONS MIN.	NOM.	MAX.	NOTE
A	0.80	0.90	1.00	
A1	0.00	0.01	0.05	
A2	0.00	0.65	1.00	
A3		0.20 REF.		
D		3.00 BSC		
D1		2.75 BSC		
E		3.00 BSC		
E1		2.75 BSC		
θ	0°		12°	
P	0		0.60	
D2	0.25		1.65	
E2	0.25		1.65	

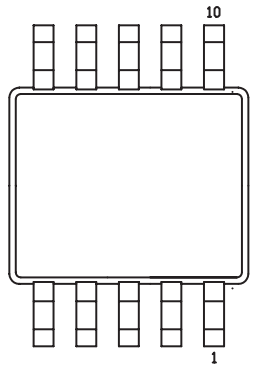
SYMBOL	PITCH VARIATION C MIN.	NOM.	MAX.	NOTE	SYMBOL	PITCH VARIATION D MIN.	NOM.	MAX.	NOTE
e		0.50 BSC			e		0.50 BSC		
N		12		3	N		16		3
Nd		3		3	Nd		4		3
Ne		3		3	Ne		4		3
L	0.35	0.55	0.75		L	0.30	0.40	0.50	
b	0.18	0.23	0.30	4	b	0.18	0.23	0.30	4

Package Information (continued)

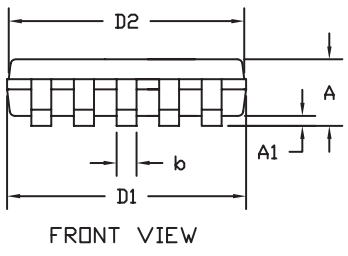
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

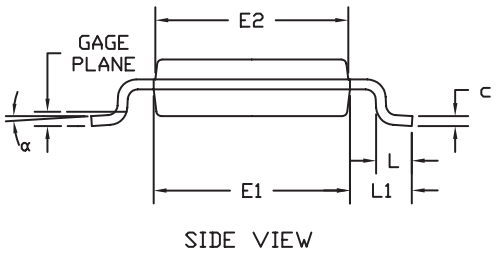
10LUMAX.EPS





	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.037	0.043	0.94	1.10
A1	0.002	0.006	0.05	0.15
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
E	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		.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		.498 REF	
α	0°	6°	0°	6°





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 MO187.

MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 10L uMAX

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0061	H	1/1