



Fast, Low-Voltage, 4Ω, 4-Channel CMOS Analog Multiplexer

MAX4634

General Description

The MAX4634 fast, low-voltage, 4-channel CMOS analog multiplexer features 4Ω (max) on-resistance (R_{ON}). It offers R_{ON} matching between switches to 0.3Ω (max) and R_{ON} flatness of 1Ω (max) over the specified signal range. Each switch can handle V_+ to GND analog signals. Off-leakage current is only 0.1nA (max) at +25°C. The MAX4634 features fast turn-on (t_{ON}) and turn-off (t_{OFF}) times of 18ns and 11ns, respectively. All this comes in the tiny 10-pin μ MAX and 10-pin, 3mm x 3mm, thin QFN packages.

This low-voltage multiplexer operates from a +1.8V to +5.5V single supply. All digital inputs have +0.8V and +2.4V logic thresholds, ensuring TTL/CMOS-logic compatibility with +5V operation.

Applications

Battery-Operated Equipment
Audio and Video Signal Routing
Low-Voltage Data-Acquisition Systems
Sample-and-Hold Circuits
Communications Circuits

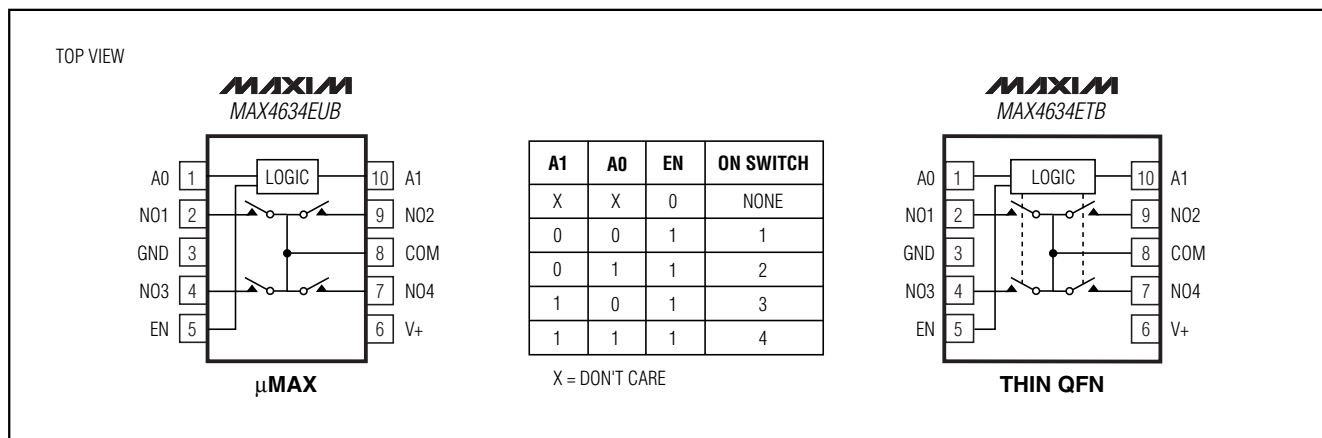
Features

- ◆ **Guaranteed R_{ON}**
2.5Ω (typ) with 5V Supply
4.5Ω (typ) with 3V Supply
- ◆ **0.3Ω (max) Guaranteed R_{ON} Match Between Channels**
- ◆ **1Ω (max) Guaranteed R_{ON} Flatness Over Signal Range**
- ◆ **0.1nA (at +25°C) Guaranteed Low Leakage Currents**
- ◆ **+1.8V to +5.5V Single-Supply Operation**
- ◆ **+1.8V Operation**
 $R_{ON} = 30\Omega$ (typ) Over Temperature
 $t_{ON} = 30\text{ns}$ (typ), $t_{OFF} = 13\text{ns}$ (typ)
- ◆ **V_+ to GND Signal Handling**
- ◆ **TTL/CMOS-Logic Compatible**
- ◆ **-78dB Crosstalk (at 1MHz)**
- ◆ **-80dB Off-Isolation (at 1MHz)**
- ◆ **0.018% Total Harmonic Distortion**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX4634EUB	-40°C to +85°C	10 μ MAX	—
MAX4634ETB	-40°C to +85°C	10 Thin QFN (3mm x 3mm)	AAU

Pin Configuration/Functional Diagram/Truth Table



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ABSOLUTE MAXIMUM RATINGS

(Voltages referenced to GND)

V+	-0.3V to +6V
A ₋ , EN, COM, NO ₋ (Note 1)	-0.3V to (V+ + 0.3V)
Continuous Current (all other pins)	±20mA
Continuous Current (COM, NO ₋)	±50mA
Peak Current (COM, NO ₋ pulsed at 1ms, 10% duty cycle)	±100mA

Continuous Power Dissipation (T_A = +70°C)

10-Pin μMAX (derate 4.1mW/°C above +70°C)	330mW
10-Pin Thin QFN (derate 24.4mW/°C above +70°C)	1951mW

Operating Temperature Range

MAX4634EUB	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10s)	+300°C

Note 1: Signals on NO₋, COM, EN, or A₋ 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 +5V Supply

(V+ = +4.5V to +5.5V, V_{IH} = 2.4V, V_{IL} = 0.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = +5V, T_A = +25°C.) (Notes 2, 9)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{COM} , V _{NO_}			0		V+	V
On-Resistance	R _{ON}	V+ = 4.5V, I _{COM} = 10mA, V _{NO_} = 0 to V+	T _A = +25°C	2.5		4	Ω
			T _A = T _{MIN} to T _{MAX}			4.5	
On-Resistance Match Between Channels (Notes 3, 8)	ΔR _{ON}	V+ = 4.5V, I _{COM} = 10mA, V _{NO_} = 0 to V+	T _A = +25°C	0.1		0.3	Ω
			T _A = T _{MIN} to T _{MAX}			0.4	
On-Resistance Flatness (Note 4)	R _{FLAT(ON)}	V+ = 4.5V, I _{COM} = 10mA, V _{NO_} = 0 to V+	T _A = +25°C	0.75		1	Ω
			T _A = T _{MIN} to T _{MAX}			1.2	
NO_ Off-Leakage Current (Note 5)	I _{NO_(OFF)}	V+ = 5.5V; V _{COM} = 1V, 4.5V; V _{NO_} = 4.5V, 1V	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.3		0.3	
COM Off-Leakage Current (Note 5)	I _{COM(OFF)}	V+ = 5.5V; V _{COM} = 1V, 4.5V; V _{NO_} = 4.5V, 1V	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.65		0.65	
COM On-Leakage Current (Note 5)	I _{COM(ON)}	V+ = 5.5V; V _{COM} = 1V, 4.5V; V _{NO_} = 1V, 4.5V, or floating	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.65		0.65	
DIGITAL I/O (A_ , EN)							
Input Logic High	V _{IH}			2.4			V
Input Logic Low	V _{IL}					0.8	V
Input Logic Current				-100	5	100	nA

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ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V₊ = +4.5V to +5.5V, V_{IH} = 2.4V, V_{IL} = 0.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V₊ = +5V, T_A = +25°C.) (Notes 2, 9)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DYNAMIC						
Turn-On Time (Note 5)	t _{ON}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Figure 2	T _A = +25°C	14	18	ns
			T _A = T _{MIN} to T _{MAX}		20	
Turn-Off Time (Note 5)	t _{OFF}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Figure 2	T _A = +25°C	6	11	ns
			T _A = T _{MIN} to T _{MAX}		13	
Break-Before-Make Time (Note 5)	t _{BBM}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Figure 3	T _A = +25°C	8		ns
			T _A = T _{MIN} to T _{MAX}	1		
Charge Injection	Q	V _{GEN} = 2V, R _{GEN} = 0, C _L = 5pF, Figure 4		2		pC
Off-Isolation (Note 6)	V _{ISO}	C _L = 5pF, R _L = 50Ω, Figure 5	f = 10MHz	-57		dB
			f = 1MHz	-80		
Crosstalk (Note 7)	V _{CT}	C _L = 5pF, R _L = 50Ω, Figure 5	f = 10MHz	-52		dB
			f = 1MHz	-78		
NO_ Off-Capacitance	C _{NO_(OFF)}	Figure 6		13		pF
COM Off-Capacitance	C _{COM(OFF)}	Figure 6		52		pF
COM On-Capacitance	C _{COM(ON)}	C _L = 5pF, Figure 6		68		pF
Total Harmonic Distortion	THD	R _L = 600Ω, f = 20Hz to 20kHz		0.018		%
POWER SUPPLY						
Power-Supply Range	V ₊		1.8		5.5	V
Positive Supply Current	I ₊	V ₊ = 5.5V, V _{IH} = V ₊ , V _{IL} = 0		0.001	1.0	μA

ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V₊ = +2.7V to +3.3V, V_{IH} = 2.0V, V_{IL} = 0.4V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V₊ = +3V, T_A = +25°C.) (Notes 2, 9)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ANALOG SWITCH						
Analog Signal Range	V _{COM_} , V _{NO_}		0		V ₊	V
On-Resistance	R _{ON}	V ₊ = 2.7V, I _{COM} = 10mA, V _{NO_} = 0 to V ₊	T _A = +25°C	4.5	7	Ω
			T _A = T _{MIN} to T _{MAX}		8	
On-Resistance Match Between Channels (Notes 3, 8)	ΔR _{ON}	V ₊ = 2.7V, I _{COM} = 10mA, V _{NO_} = 0 to V ₊	T _A = +25°C	0.1	0.3	Ω
			T _A = T _{MIN} to T _{MAX}		0.4	

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ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +2.7V to +3.3V, V_{IH} = 2.0V, V_{IL} = 0.4V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = +3V, T_A = +25°C.) (Notes 2, 9)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
On-Resistance Flatness (Note 4)	R _{FLAT(ON)}	V ₊ = 2.7V, I _{COM} = 10mA, V _{NO_} = 0 to V ₊	T _A = +25°C	1.2		2.5	Ω
			T _A = T _{MIN} to T _{MAX}	3			
NO_ Off-Leakage Current (Note 5)	I _{NO_(OFF)}	V ₊ = 3.3V; V _{COM} = 1V, 3V; V _{NO_} = 3V, 1V	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.3		0.3	
COM Off-Leakage Current (Note 5)	I _{COM_(OFF)}	V ₊ = 3.3V; V _{COM} = 1V, 3V; V _{NO_} = 3V, 1V	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.65		0.65	
COM On-Leakage Current (Note 5)	I _{COM_(ON)}	V ₊ = 3.3V; V _{COM} = 1V, 3V; V _{NO_} = 1V, 3V, or floating	T _A = +25°C	-0.1	±0.01	0.1	nA
			T _A = T _{MIN} to T _{MAX}	-0.65		0.65	
DIGITAL I/O (A_, EN)							
Input High	V _{IH}			2.0			V
Input Low	V _{IL}					0.4	V
Input Logic Current				-100	5	100	nA
DYNAMIC							
Turn-On Time (Note 5)	t _{ON}	V _{NO_} = 2V, C _L = 35pF, R _L = 300Ω, Figure 2	T _A = +25°C	16		22	ns
			T _A = T _{MIN} to T _{MAX}	24			
Turn-Off Time (Note 5)	t _{OFF}	V _{NO_} = 2V, C _L = 35pF, R _L = 300Ω, Figure 2	T _A = +25°C	8		14	ns
			T _A = T _{MIN} to T _{MAX}	16			
Break-Before-Make Time (Note 5)	t _{BBM}	V _{NO_} = 2V, C _L = 35pF, R _L = 300Ω, Figure 3	T _A = +25°C	9			ns
			T _A = T _{MIN} to T _{MAX}	1			
Charge Injection	Q	V _{GEN} = 1.5V, R _{GEN} = 0, C _L = 5pF, Figure 4		2			pC
Off-Isolation (Note 6)	V _{ISO}	C _L = 5pF, R _L = 50Ω, Figure 5	f = 10MHz	-57			dB
			f = 1MHz	-80			
Crosstalk (Note 7)	V _{CT}	C _L = 5pF, R _L = 50Ω, Figure 5	f = 10MHz	-52			dB
			f = 1MHz	-78			

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ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V₊ = +2.7V to +3.3V, V_{IH} = 2.0V, V_{IL} = 0.4V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V₊ = +3V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
NO_ Off-Capacitance	C _{NO(OFF)}	V _{NO_} = GND, f = 1MHz, Figure 6		13		pF
COM Off-Capacitance	C _{COM(OFF)}	V _{COM} = GND, f = 1MHz, Figure 6		52		pF
COM On-Capacitance	C _(ON)	V _{COM} = V _{NO_} = GND, f = 1MHz, Figure 6		68		pF
Total Harmonic Distortion	THD	R _L = 600Ω, f = 20Hz to 20kHz		0.018		%
POWER SUPPLY						
Positive Supply Current	I ₊	V ₊ = 3.3V, V _{IH} = V ₊ , V _{IL} = 0		0.001	1	μA

Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

Note 3: ΔR_{ON} = R_{ON(MAX)} - R_{ON(MIN)}.

Note 4: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Note 5: Guaranteed by design.

Note 6: Off-Isolation = 20log₁₀ (V_{COM} / V_{NO}), where V_{COM} = output and V_{NO} = input to off switch.

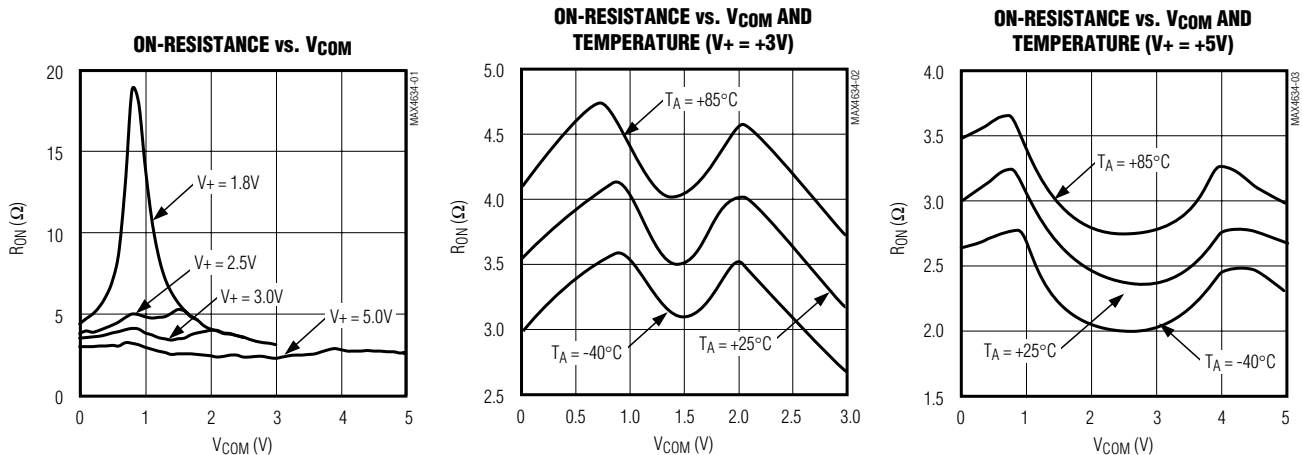
Note 7: Between any two switches.

Note 8: R_{ON} and ΔR_{ON} matching specifications for QFN-packaged parts are guaranteed by design.

Note 9: Thin QFN parts are tested at +25°C and guaranteed by design and correlation over the entire temperature range.

Typical Operating Characteristics

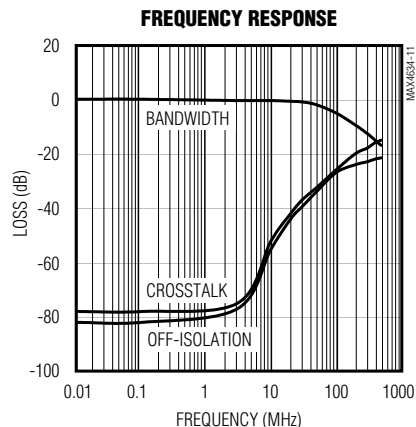
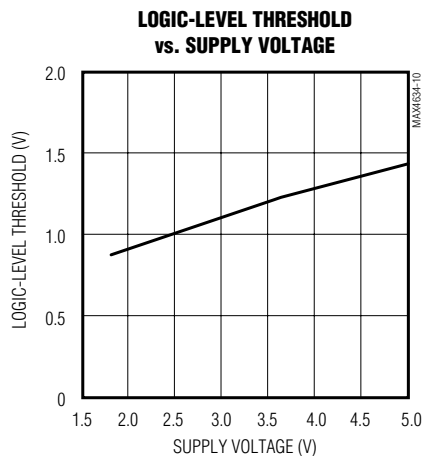
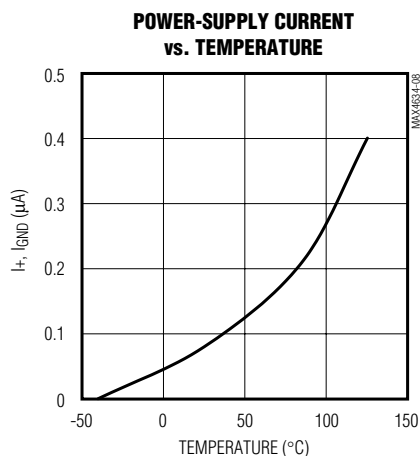
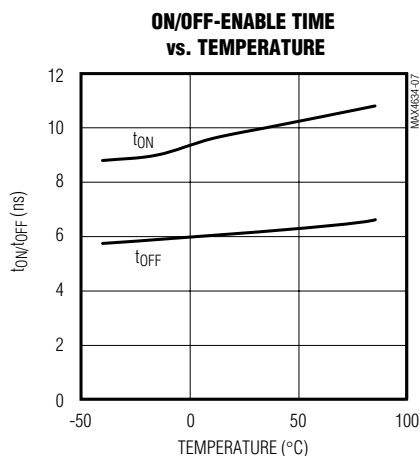
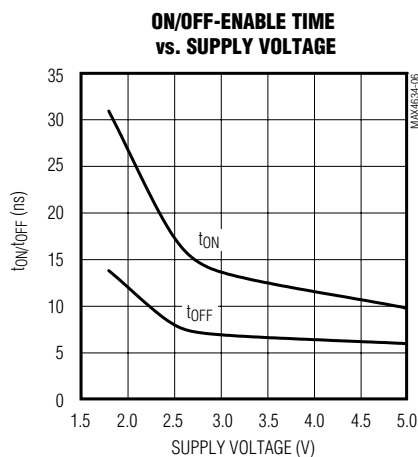
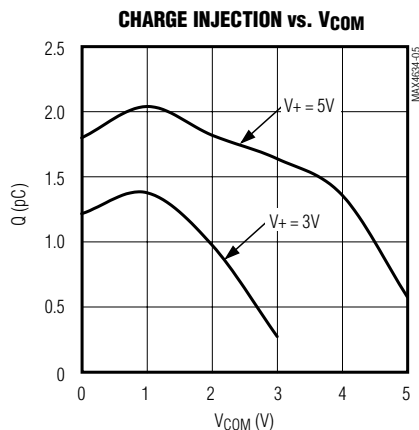
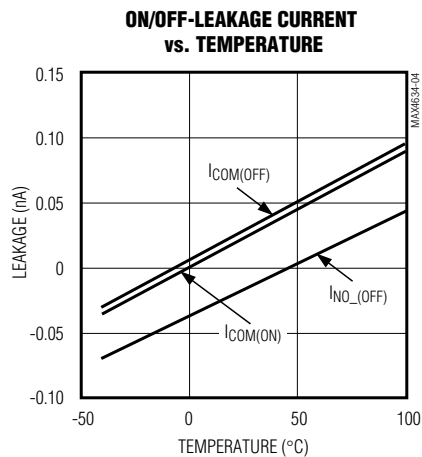
(T_A = +25°C, unless otherwise noted.)



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Typical Operating Characteristics (continued)

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



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Pin Description

PIN	NAME	FUNCTION
μMAX/ THIN QFN		
1	A0	Address Input
2	NO1	Normally Open Switch 1
3	GND	Ground
4	NO3	Normally Open Switch 3
5	EN	Enable Logic Input
6	V+	Positive Supply Voltage
7	NO4	Normally Open Switch 4
8	COM	Analog Switch Common Terminal
9	NO2	Normally Open Switch 2
10	A1	Address Input

Detailed Description

The MAX4634 is a low-on-resistance, low-voltage analog multiplexer that operates from a +1.8V to +5.5V single supply. CMOS switch construction allows processing of analog signals that are within the supply voltage range (GND to V+).

To disable all switch channels, drive EN low. All four inputs and COM become high impedance during this state. If the disable feature is not needed, connect EN to V+.

Applications Information

Power-Supply Sequencing and Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Always apply V+ before applying analog signals or logic inputs, especially if the analog or

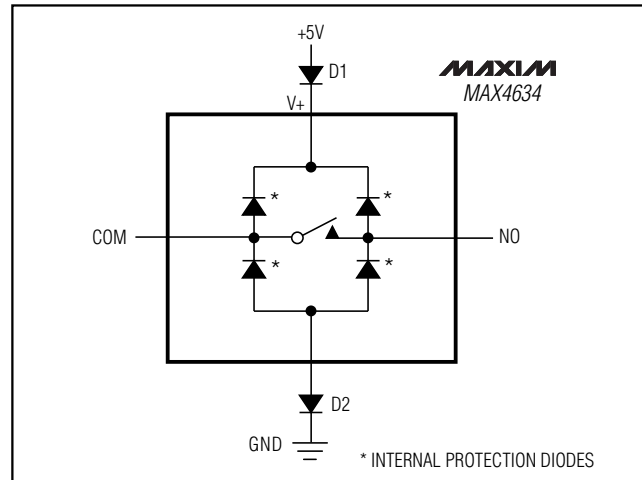


Figure 1. Overvoltage Protection Using External Blocking Diodes

logic signals are not current limited. If this sequencing is not possible, and if the analog or logic inputs are not current limited to < 20mA, add a small-signal diode (D1) as shown in Figure 1. If the analog signal can dip below GND, add D2. Adding protection diodes reduces the analog signal range to a diode drop (about 0.7V) below V+ for D1 or to a diode drop above ground for D2. The addition of diodes does not affect leakage. On-resistance increases by a small amount at low supply voltages. Maximum supply voltage (V+) must not exceed 6V.

Protection diodes D1 and D2 also protect against some overvoltage situations. A fault voltage up to the absolute maximum rating at an analog signal input does not damage the device, even if the supply voltage is below the signal voltage.

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Test Circuits/Timing Diagrams

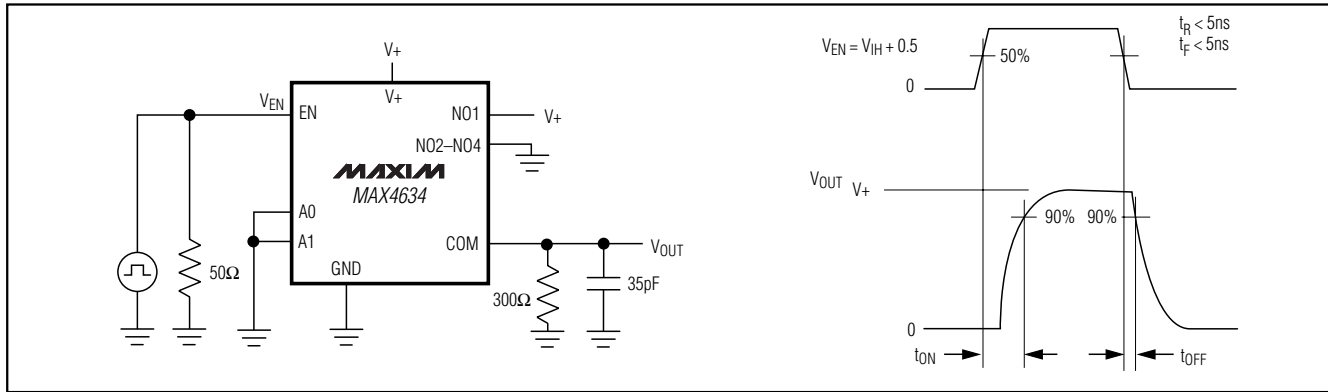


Figure 2. Switching Time

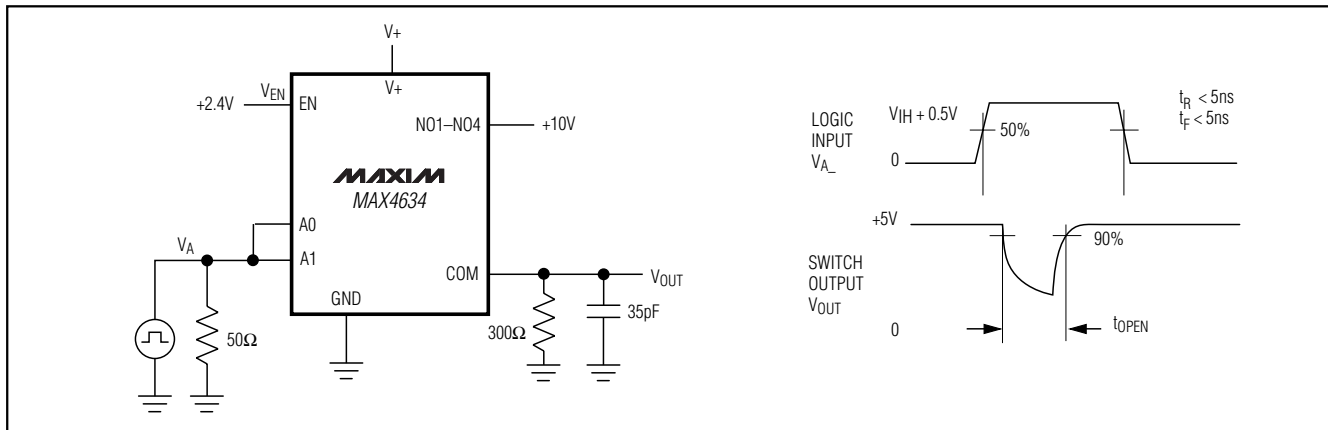


Figure 3. Break-Before-Make Interval

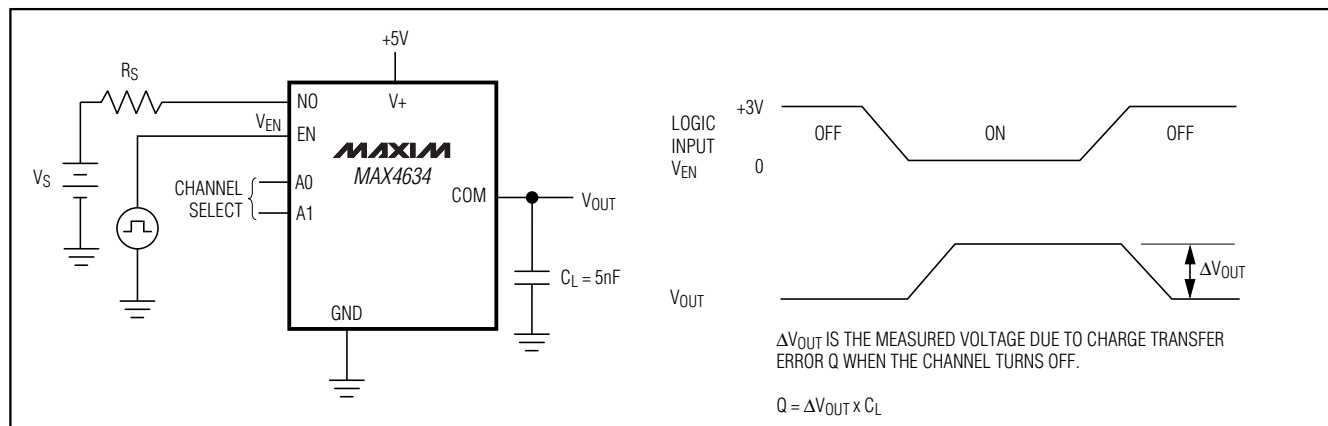


Figure 4. Charge Injection

MAX4634

The schematic shows a MAX4634 switch IC connected to a Network Analyzer. The IC's EN pin is tied to V+, and its A pin is controlled by a switch receiving V+ input. The NO and COM pins are connected to the Network Analyzer's MEAS and REF ports, respectively. The GND pin is grounded. The Network Analyzer is configured with 50Ω terminations at all four ports. It includes a signal source and two output measurement points labeled VIN and VOUT.

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

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

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

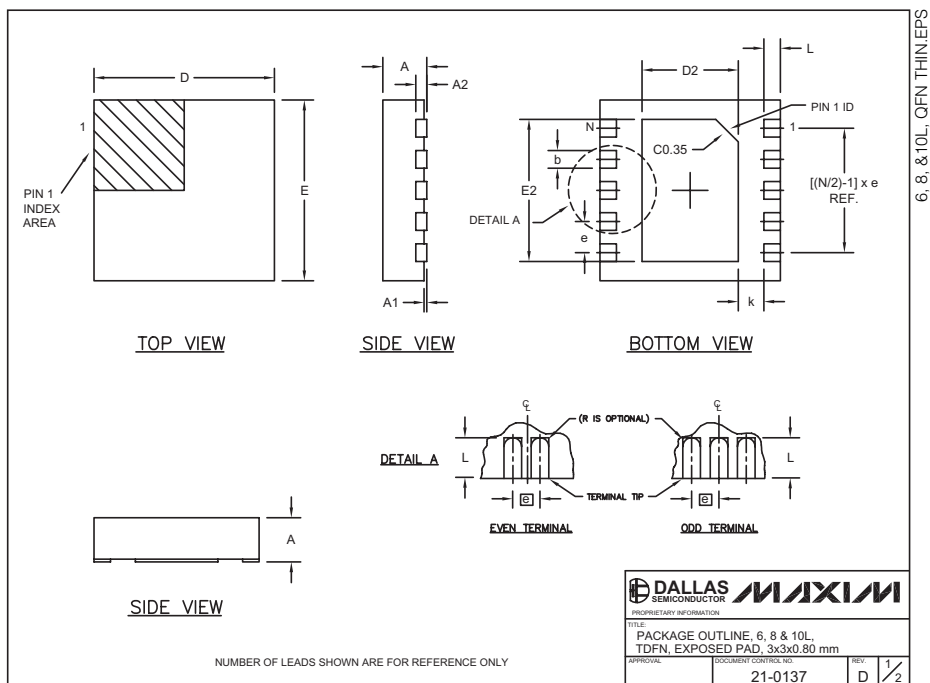
NOTES: MEASUREMENTS ARE STANDARDIZED AGAINST SHORTS AT SOCKET TERMINALS.
 OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" TERMINAL ON EACH SWITCH.
 ON-LOSS IS MEASURED BETWEEN COM AND "ON" TERMINAL ON EACH SWITCH.
 CROSSTALK IS MEASURED BETWEEN COMA AND COMB TERMINALS ON EACH DEVICE.
 SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

TRANSISTOR COUNT: 231

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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.



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:

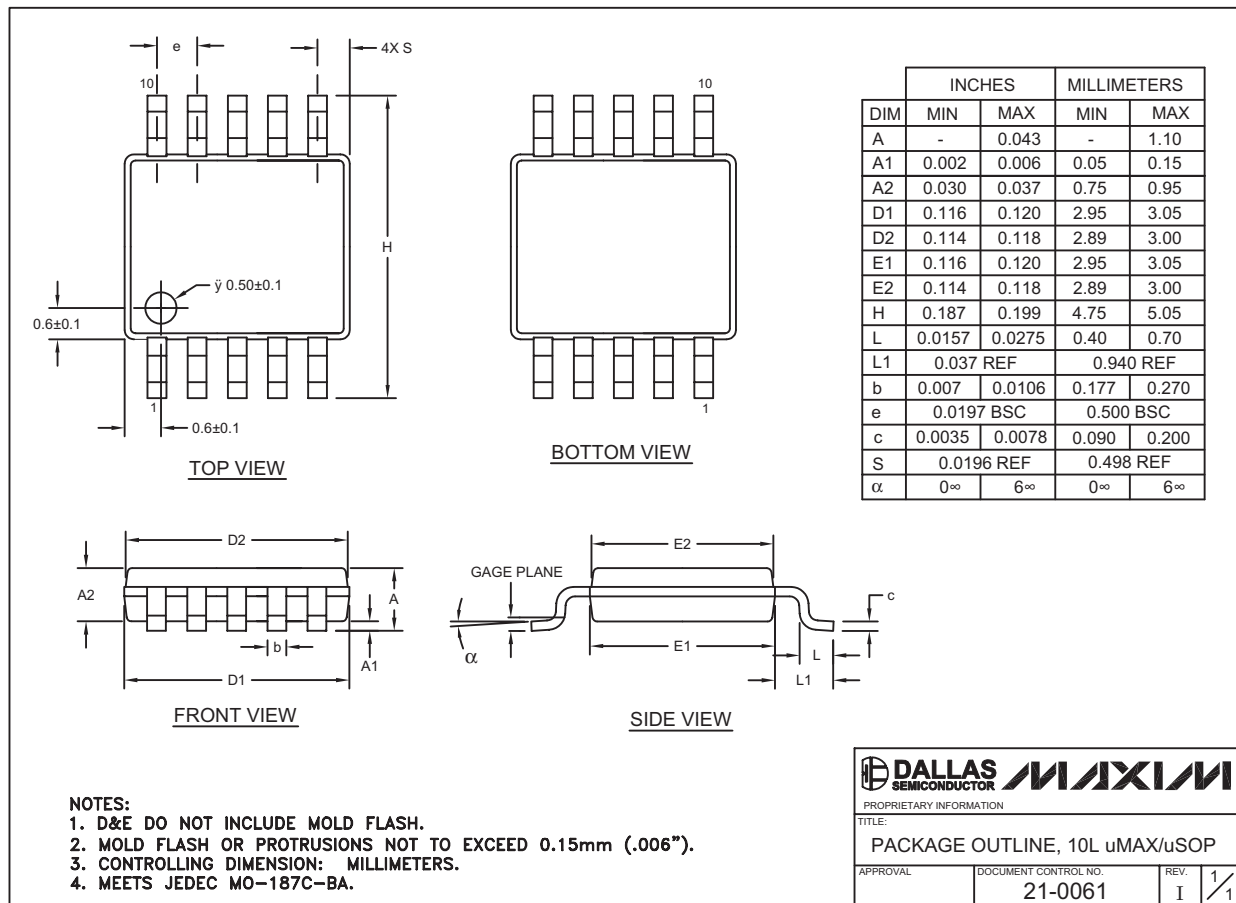
- ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
- COPLANARITY SHALL NOT EXCEED 0.08 mm.
- WARPAGE SHALL NOT EXCEED 0.10 mm.
- PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
- DRAWING CONFORMS TO JEDEC MO229, EXCEPT DIMENSIONS "D2" AND "E2".
- "N" IS THE TOTAL NUMBER OF LEADS.

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

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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.



Note: The MAX4634 package does not have an exposed pad.

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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