MAXIM

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 µMAX 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

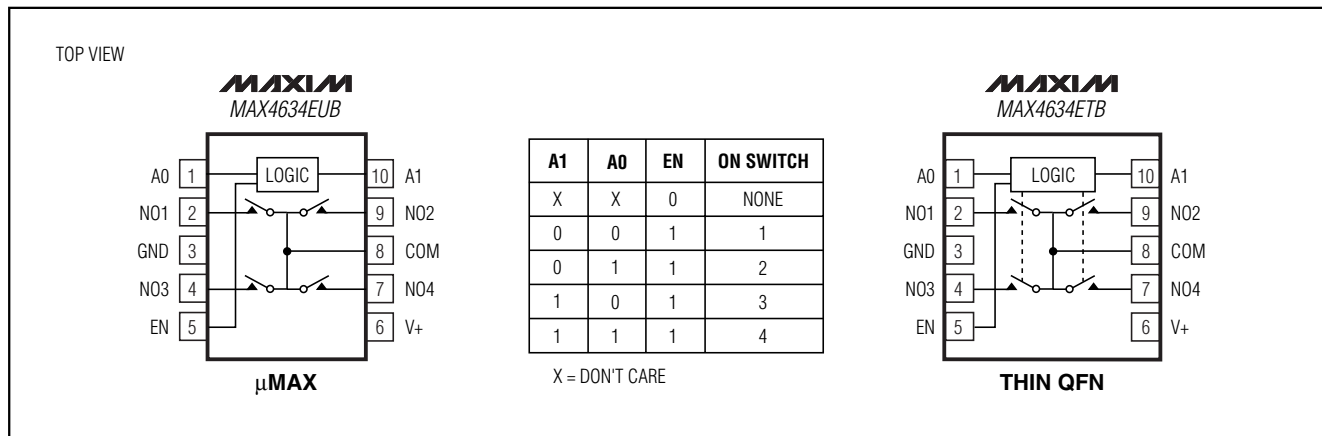Sample-and-Hold Circuits

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} = 30Ω (typ) Over Temperature
    t_{ON} = 30ns (typ), t_{OFF} = 13ns (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 µMAX	—
MAX4634ETB	-40°C to +85°C	10 Thin QFN (3mm x 3mm)	AAU

_____Pin Configuration/Functional Diagram/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

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.

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

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 = $20\log_{10}$ (V_{COM} / V_{NO}), where V_{COM} = output and V_{NO} = input to off switch.
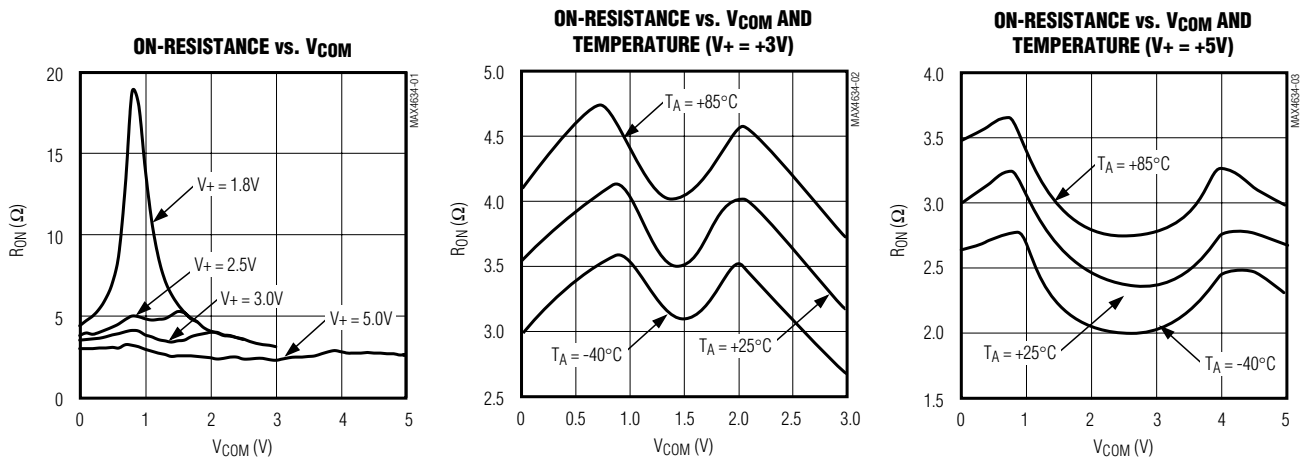**Note 7:** Between any two switches.
Note 8: R_{ON} and ΔR_{ON} matching specifications for QFN-packaged parts are guaranteed by design.
Note 9: Thin QFN parts are tested at +25°C and guaranteed by design and correlation over the entire temperature range.
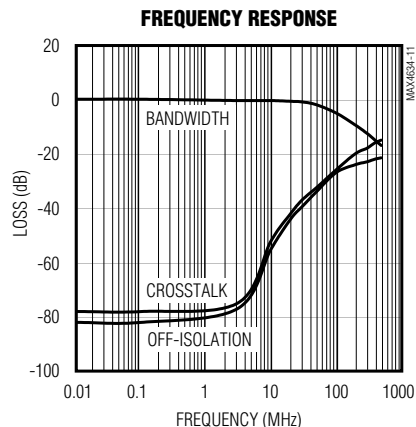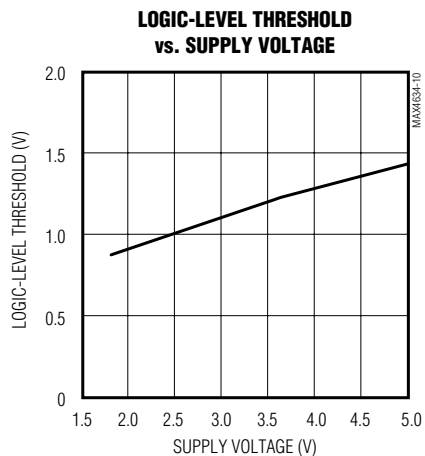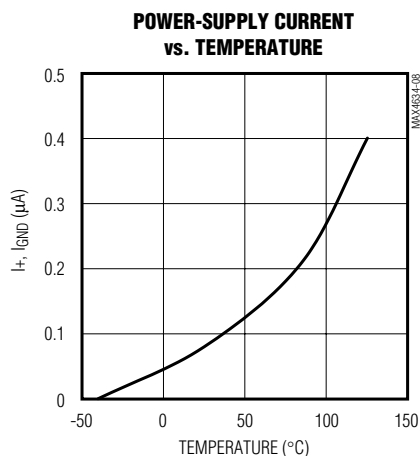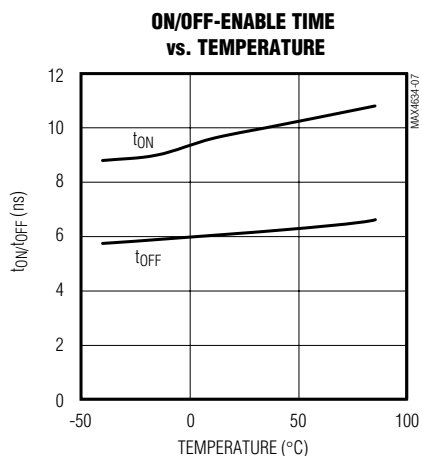
Typical Operating Characteristics

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

ON-RESISTANCE vs. V_{COM}

ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (V+ = +3V)

ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (V+ = +5V)

MAXIM

_____ 5

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

_____Typical Operating Characteristics (continued)

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

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

CHARGE INJECTION vs. V_{COM}

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

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

**POWER-SUPPLY CURRENT
vs. TEMPERATURE**

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

FREQUENCY RESPONSE

MAX4634
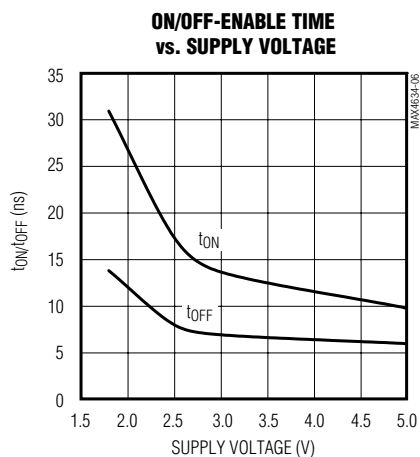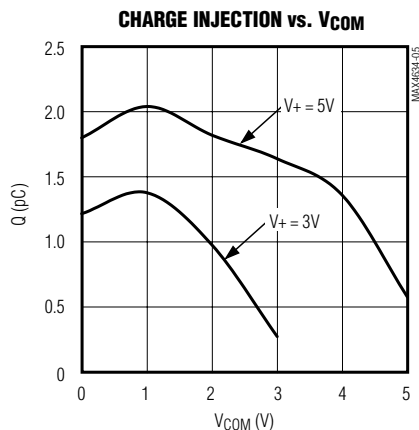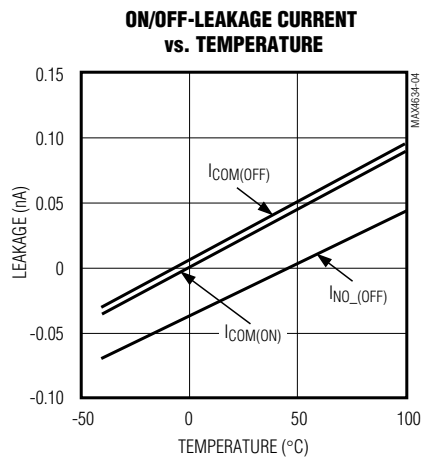
Pin Description

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

Figure 1. Overvoltage Protection Using External Blocking Diodes

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

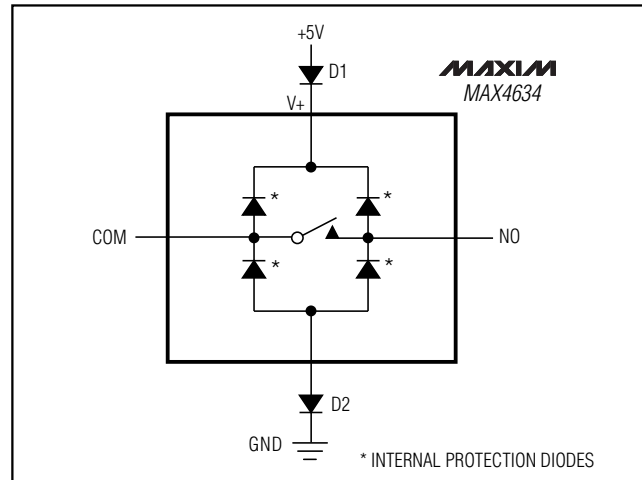Proper power-supply sequencing is recommended for all CMOS devices. Always apply V+ before applying analog signals or logic inputs, especially if the analog or logic signals are not current limited. If this sequencing is not possible, and if the analog or logic inputs are not current limited to < 20mA, 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.

Fast, Low-Voltage, 4Ω, 4-Channel CMOS Analog Multiplexer
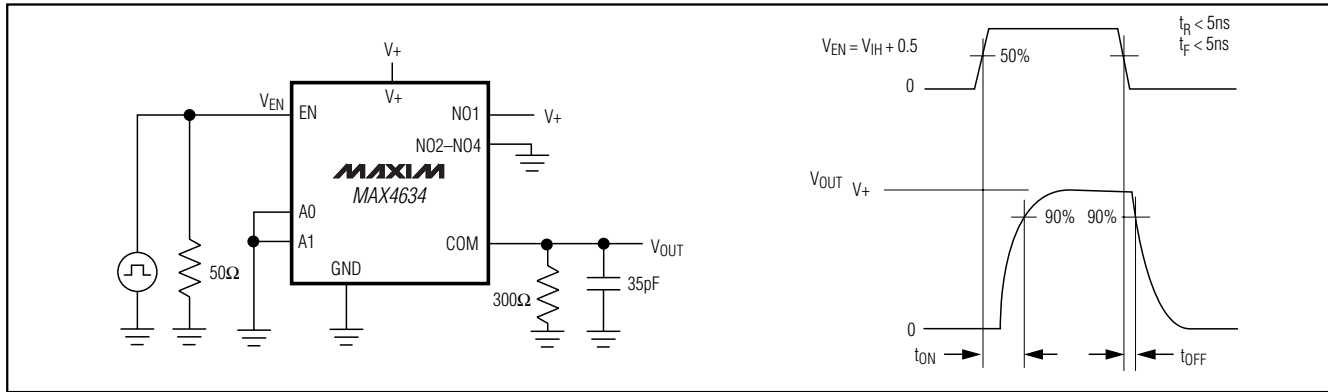
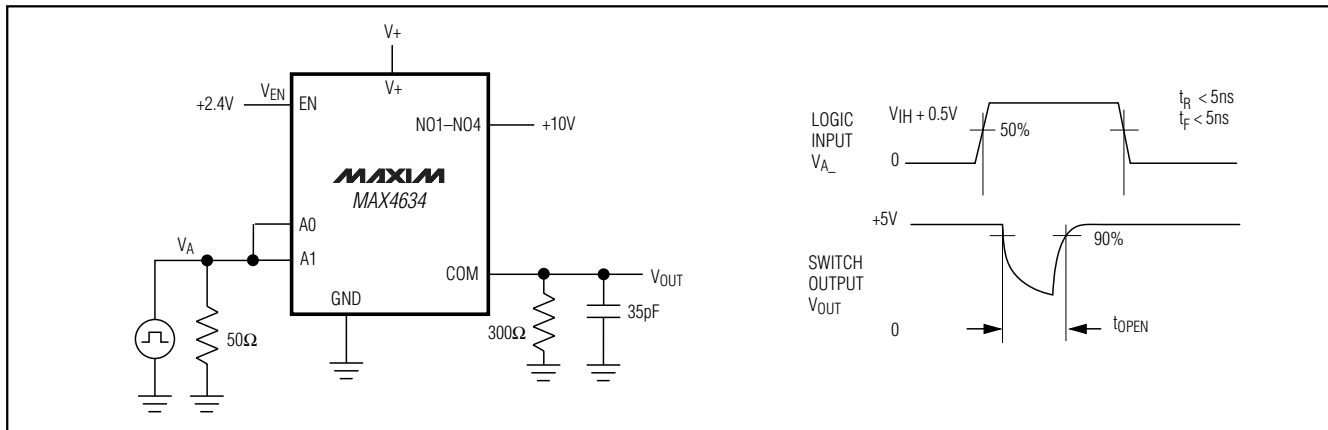*Test Circuits/Timing Diagrams*

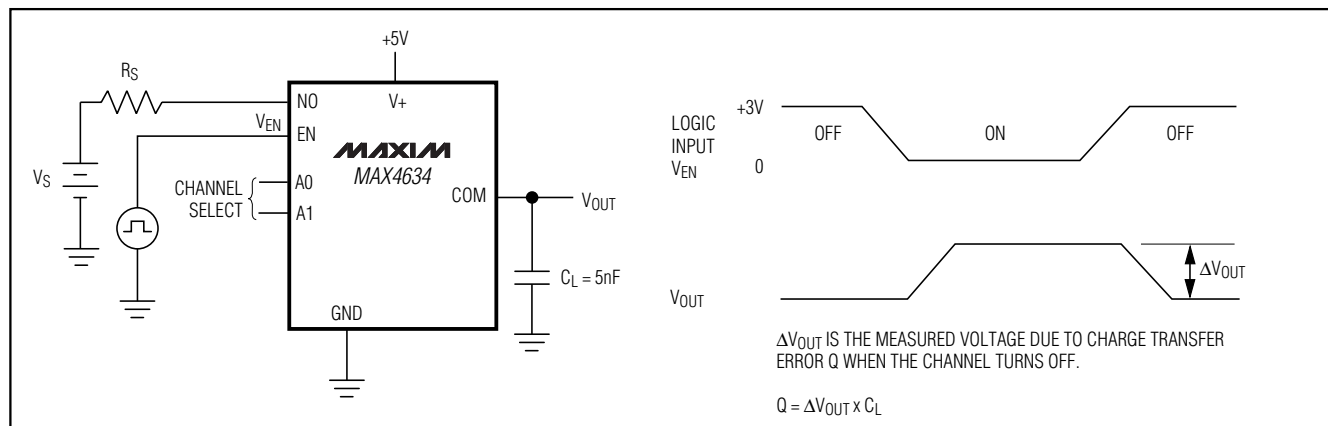Figure 2. Switching Time

Figure 3. Break-Before-Make Interval

Figure 4. Charge Injection

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Test Circuits/Timing Diagrams (continued)

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

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

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

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.

Figure 5. Off-Isolation/On-Channel Bandwidth

Figure 6. Channel Off/On-Capacitance

Chip Information

TRANSISTOR COUNT: 231

MAX4634

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**.

6, 8, &10L, QFN THIN.EPS

TOP VIEW

SIDE VIEW

BOTTOM VIEW

DETAIL A

EVEN TERMINAL   ODD TERMINAL

SIDE VIEW

NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY

DALLAS **MAXIM**
SEMICONDUCTOR
PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE, 6, 8 & 10L,
TDFN, EXPOSED PAD, 3x3x0.80 mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0137	D	1/2
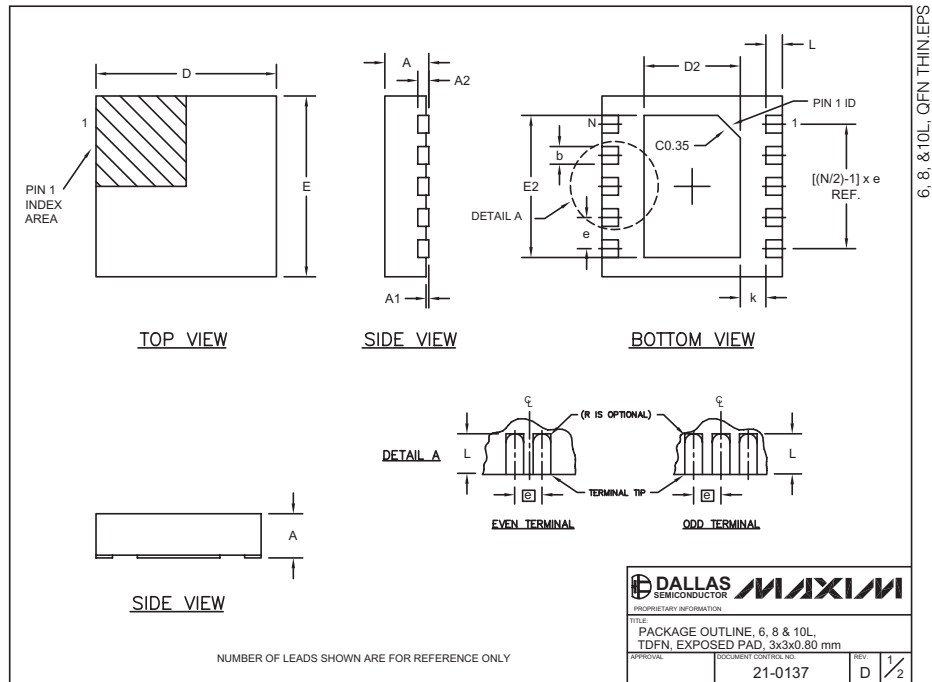
COMMON DIMENSIONS		
SYMBOL	MIN.	MAX.
A	0.70	0.80
D	2.90	3.10
E	2.90	3.10
A1	0.00	0.05
L	0.20	0.40
k	0.25 MIN.	
A2	0.20 REF.	

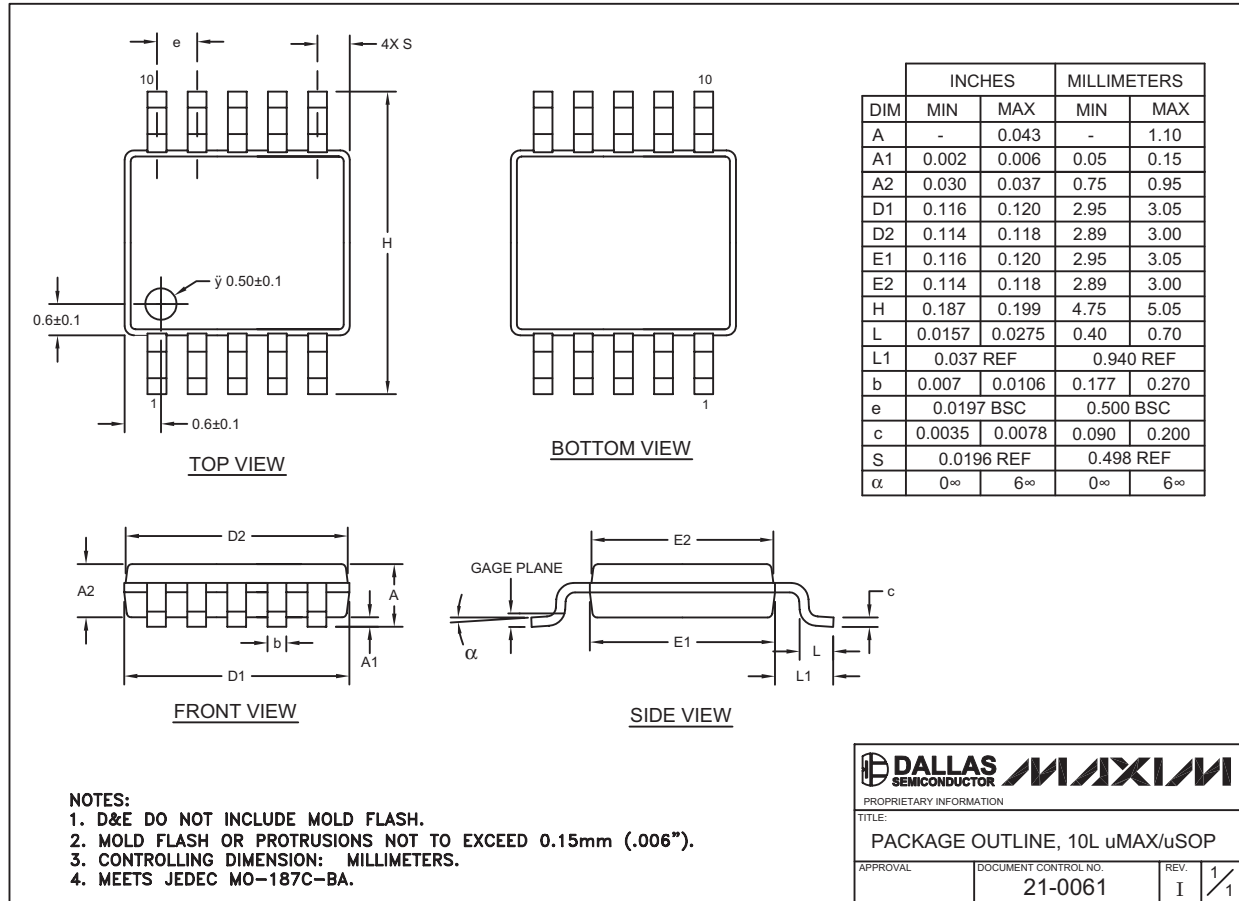| PACKAGE VARIATIONS							
PKG. CODE	N	D2	E2	e	JEDEC SPEC	b	[(N/2)-1] x e
T633-1	6	1.50±0.10	2.30±0.10	0.95 BSC	MO229 / WEEA	0.40±0.05	1.90 REF
T833-1	8	1.50±0.10	2.30±0.10	0.65 BSC	MO229 / WEEC	0.30±0.05	1.95 REF
T1033-1	10	1.50±0.10	2.30±0.10	0.50 BSC	MO229 / WEED-3	0.25±0.05	2.00 REF

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

DALLAS **MAXIM**
SEMICONDUCTOR
PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE, 6, 8 & 10L,
TDFN, EXPOSED PAD, 3x3x0.80 mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0137	D	2/2

MAXIM

MAX4634

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

TOP VIEW

BOTTOM VIEW

FRONT VIEW

SIDE VIEW

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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∞

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. 21-0061 | REV. I | 1/1

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