19-2382; Rev 0; 4/02

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

General Description

The MAX4736 is a low on-resistance, low-voltage, dual single-pole/double throw (SPDT) analog switch 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 MAX4736 has break-before-make switching.

When powered from a 3V supply, the MAX4736 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 MAX4736 has one normally open (NO) switch and one normally closed (NC) switch, and is available in 12-pin QFN 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

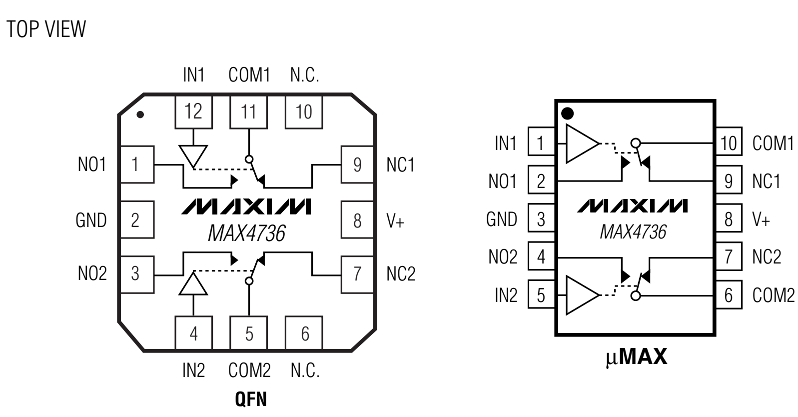
Features

- ♦ **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 and µMAX Packages**
- ♦ **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
MAX4736EUB	-40°C to +85°C	10 µMAX
MAX4736EGC	-40°C to +85°C	12 QFN

Pin Configurations/Functional Diagrams/Truth Table



MAX4736		
IN_	NO_	NC_
0	OFF	ON
1	ON	OFF

SWITCHES SHOWN FOR LOGIC 0 INPUT

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

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
V+, IN_ ....-0.3V to +4V
COM_, NO_, NC_ (Note 1) ....-0.3V to (V+ + 0.3V)
Continuous Current COM_, NO_, NC_ ....±150mA
Continuous Current (all other pins)..................................±20mA
Peak Current COM_, NO_, NC_
(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_, NO_, or NC_ 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	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$			0		V+	V
On-Resistance (Note 4)	R_{ON}	V+ = 2.7V, $I_{COM\_}$ = 100mA; $V_{NO\_}$ or $V_{NC\_}$ = 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; $V_{NO\_}$ or $V_{NC\_}$ = 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; $V_{NO\_}$ or $V_{NC\_}$ = 1V, 1.5V, 2V	+25°C		0.05	0.1	Ω
			T_{MIN} to T_{MAX}		0.2		
NO_ or NC_ Off-Leakage Current (Note 10)	$I_{NO\_(OFF)}$, $I_{NC\_(OFF)}$	V+ = 3.6V, $V_{COM\_}$ = 0.3V, 3.3V; $V_{NO\_}$ or $V_{NC\_}$ = 3.3V, 0.3V	+25°C	-1	±0.002	+1	nA
			T_{MIN} to T_{MAX}	-5		+5	
COM_ On-Leakage Current (Note 10)	$I_{COM\_(ON)}$	V+ = 3.6V, $V_{COM\_}$ = 0.3V, 3.3V; $V_{NO\_}$ or $V_{NC\_}$ = 0.3V, 3.3V, 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}	$V_{NO\_}$, $V_{NC\_}$ = 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}	$V_{NO\_}$, $V_{NC\_}$ = 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 7)	t_{BBM}	$V_{NO\_}$, $V_{NC\_}$ = 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_ or NC_ Off-Capacitance	C_{OFF}	f = 1MHz, Figure 4	+25°C		33		pF
COM_ Off-Capacitance	$C_{COM(OFF)}$	f = 1MHz, Figure 4	+25°C		60		pF
COM_ On-Capacitance	$C_{COM(ON)}$	f = 1MHz, Figure 4	+25°C		85		pF
-3dB On-Channel Bandwidth	BW	Signal = 0, R_{IN} = R_{OUT} = 50Ω, C_L = 5pF, Figure 5			130		MHz
Off-Isolation (Note 8)	V_{ISO}	f = 1MHz, $V_{COM\_}$ = $1V_{P-P}$, R_L = 50Ω, C_L = 5pF, Figure 5	+25°C		-52		dB
Crosstalk (Note 9)	V_{CT}	f = 1MHz, $V_{COM\_}$ = $1V_{P-P}$, R_L = 50Ω, C_L = 5pF, Figure 5	+25°C		-78		dB
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, $V_{COM\_}$ = $2V_{P-P}$, R_L = 32Ω	+25°C		0.018		%
LOGIC INPUT (A_, IN_)							
Input Logic High	V_{IH}			1.4			V
Input Logic Low	V_{IL}					0.5	V
Input Leakage Current	I_{IN}	$V_{IN\_}$ = 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, $V_{IN\_}$ = 0 or V+, all channels on or off			0.006	1	µA

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

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	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$			0		V+	V
On-Resistance	R_{ON}	$I_{COM\_} = 10mA$; $V_{NO\_}$ or $V_{NC\_} = 1V$	+25°C		1.5	2	Ω
			T_{MIN} to T_{MAX}			3	
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	$V_{NO\_}$ or $V_{NC\_} = 1V$; $R_L = 50Ω$, $C_L = 35pF$, Figure 1	+25°C		25	30	ns
			T_{MIN} to T_{MAX}			35	
Turn-Off Time	t_{OFF}	$V_{NO\_}$ or $V_{NC\_} = 1V$; $R_L = 50Ω$, $C_L = 35pF$, Figure 1	+25°C		18	25	ns
			T_{MIN} to T_{MAX}			28	
Break-Before-Make (Note 7)	t_{BBM}	$V_{NO\_}$ or $V_{NC\_} = 1V$; $R_L = 50Ω$, $C_L = 35pF$, 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 8)	V_{ISO}	f = 1MHz, $V_{NO\_} = V_{NC\_} = 1V_{P-P}$, $R_L = 50Ω$, $C_L = 5pF$, Figure 5	+25°C		-52		dB
Crosstalk (Note 9)	V_{CT}	f = 1MHz, $V_{COM\_} = 1V_{P-P}$, $R_L = 50Ω$, $C_L = 5pF$, Figure 5	+25°C		-78		dB
LOGIC INPUT (IN_)							
Input Logic High	V_{IH}			1			V
Input Logic Low	V_{IL}					0.4	V
Input Leakage Current	I_{IN}	$V_{IN\_} = 0$ or 3.6V				1	µA

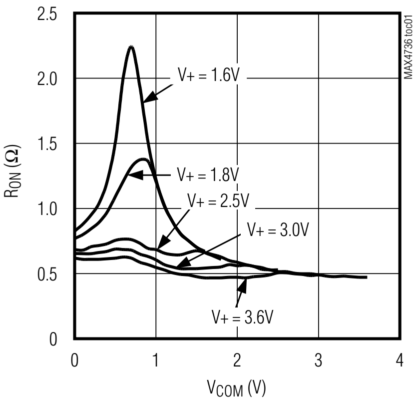
Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value is a maximum, is used in this data sheet.
Note 3: -40°C specifications are guaranteed by design.
Note 4: R_{ON} and ΔR_{ON} matching specifications for QFN packaged parts are guaranteed by design.
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: Guaranteed by design.
Note 8: Off-Isolation = $20\log_{10}(V_{COM\_}/V_{NO\_})$, $V_{COM\_}$ = output, $V_{NO\_}$ = input to OFF switch.
Note 9: Between two switches.
Note 10: Leakage parameters are 100% tested at hot temperature and guaranteed by correlation at room.

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

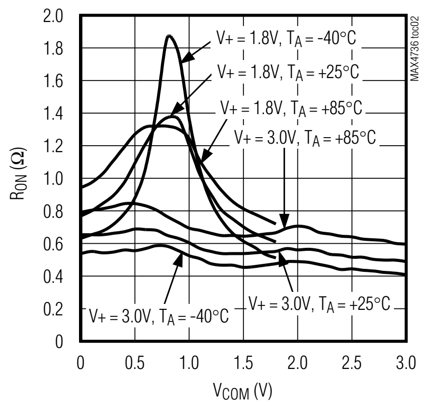
Typical Operating Characteristics

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

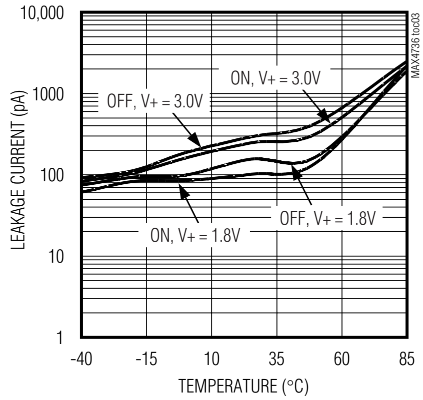
ON-RESISTANCE vs. V_{COM}



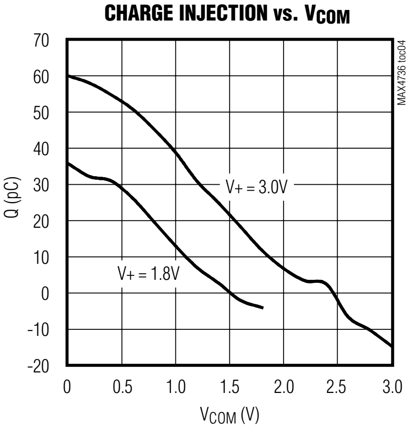
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE



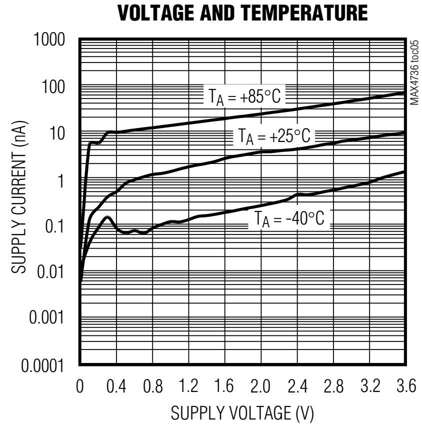
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



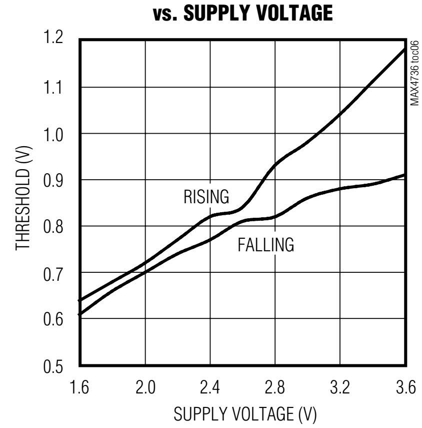
CHARGE INJECTION vs. V_{COM}



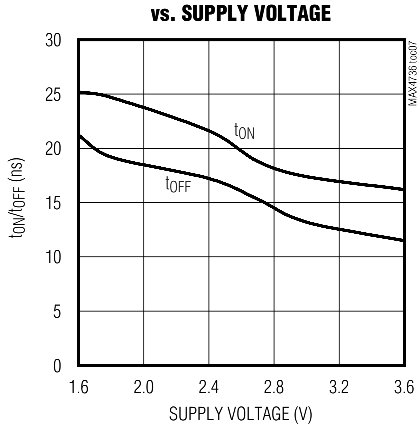
SUPPLY CURRENT vs. SUPPLY VOLTAGE AND TEMPERATURE



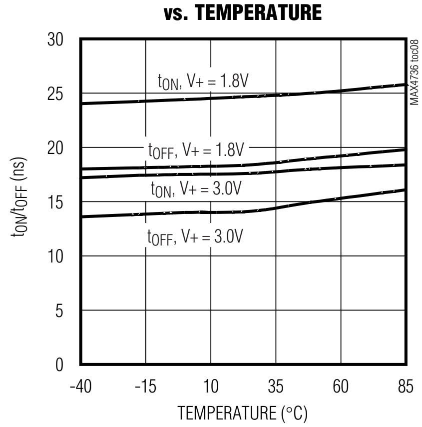
LOGIC-LEVEL THRESHOLD vs. SUPPLY VOLTAGE



TURN-ON/OFF TIME vs. SUPPLY VOLTAGE



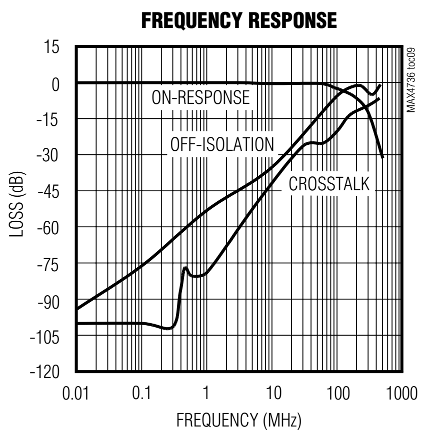
TURN-ON/OFF TIMES vs. TEMPERATURE

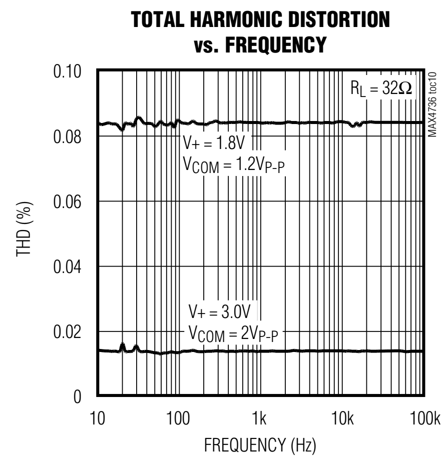


0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

Typical Operating Characteristics (continued)

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





Pin Description

PIN		NAME	FUNCTION
µMAX	QFN		
1	12	IN1	Digital Control Input Switch 1
2	1	NO1	Analog Switch 1—Normally Open Terminal
3	2	GND	Ground
4	3	NO2	Analog Switch 2—Normally Open Terminal
5	4	IN2	Digital Control Input Switch 2
6	5	COM2	Analog Switch 2—Common Terminal
7	7	NC2	Analog Switch 2—Normally Closed Terminal
8	8	V+	Positive-Supply Voltage Input
9	9	NC1	Analog Switch 1—Normally Closed Terminal
10	11	COM1	Analog Switch 1—Common Terminal
—	6, 10	N.C.	No Connection

Detailed Description

The MAX4736 is a low 0.8Ω max (at V+ = 2.7V) on-resistance, low-voltage, dual SPDT analog switch 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; stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, followed by NO_, NC_, 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 MAX4736 logic inputs can be driven up to 3.6V, regardless of the supply voltage. For example, with a 1.8V supply, IN_ can be driven low to GND and high to 3.6V. Driving IN_ 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_, NC_, 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

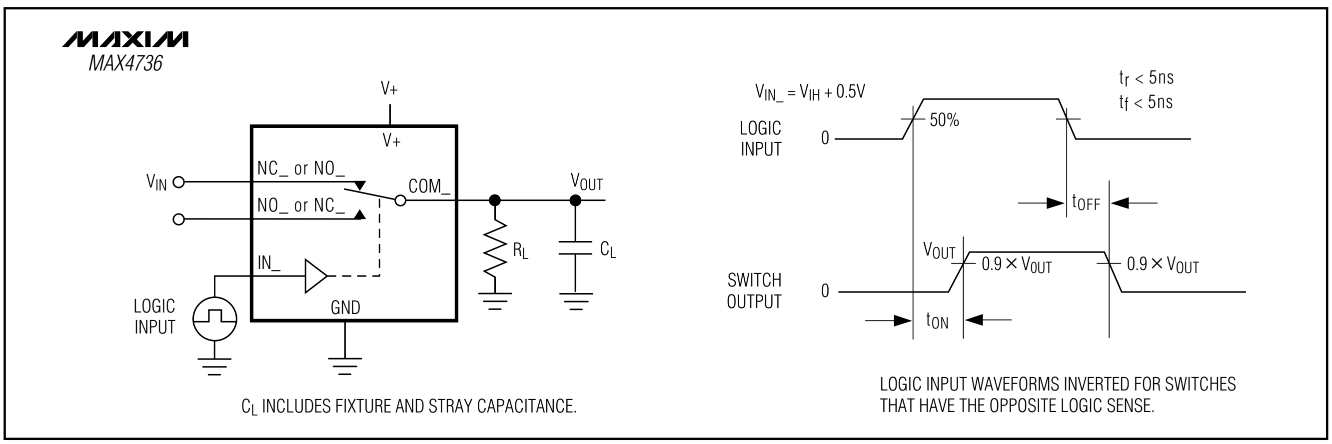


Figure 1. Switching Time

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

Test Circuits/Timing Diagrams (continued)

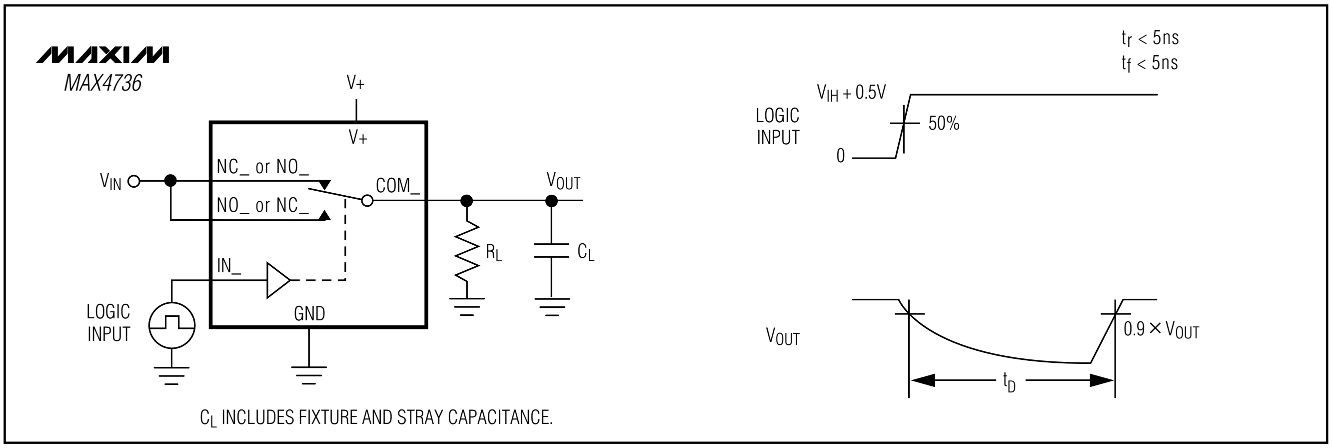


Figure 2. Break-Before-Make Interval

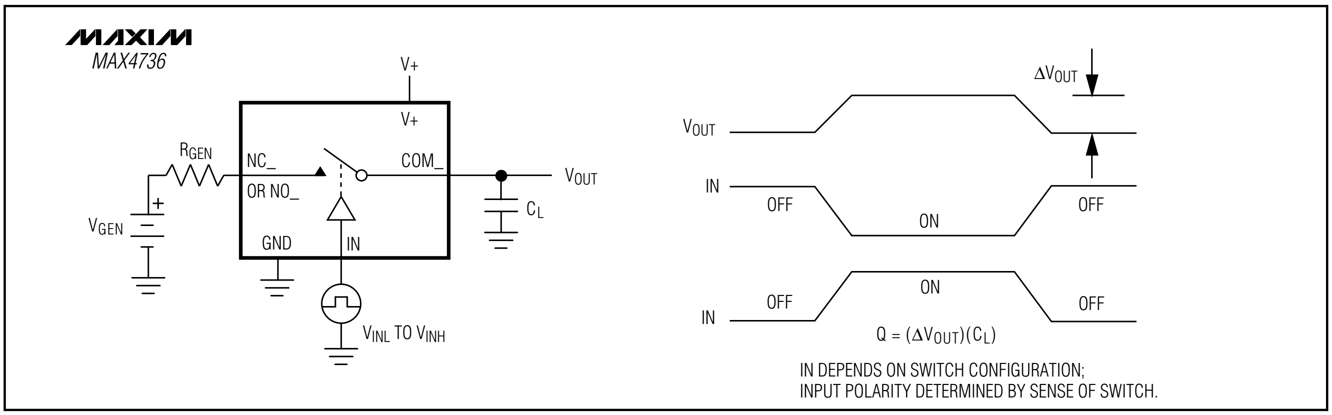


Figure 3. Charge Injection

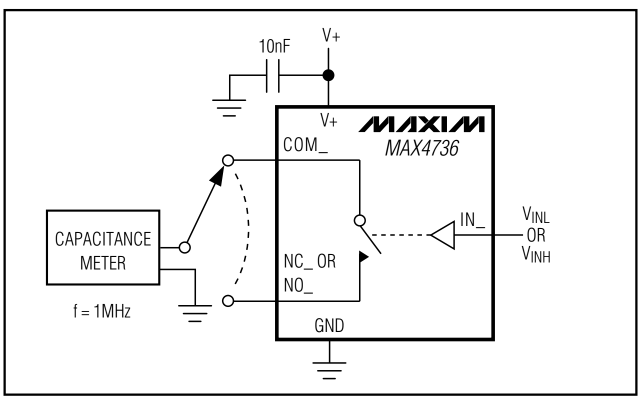


Figure 4. Channel Off/On-Capacitance

Chip Information

TRANSISTOR COUNT: 379

PROCESS: CMOS

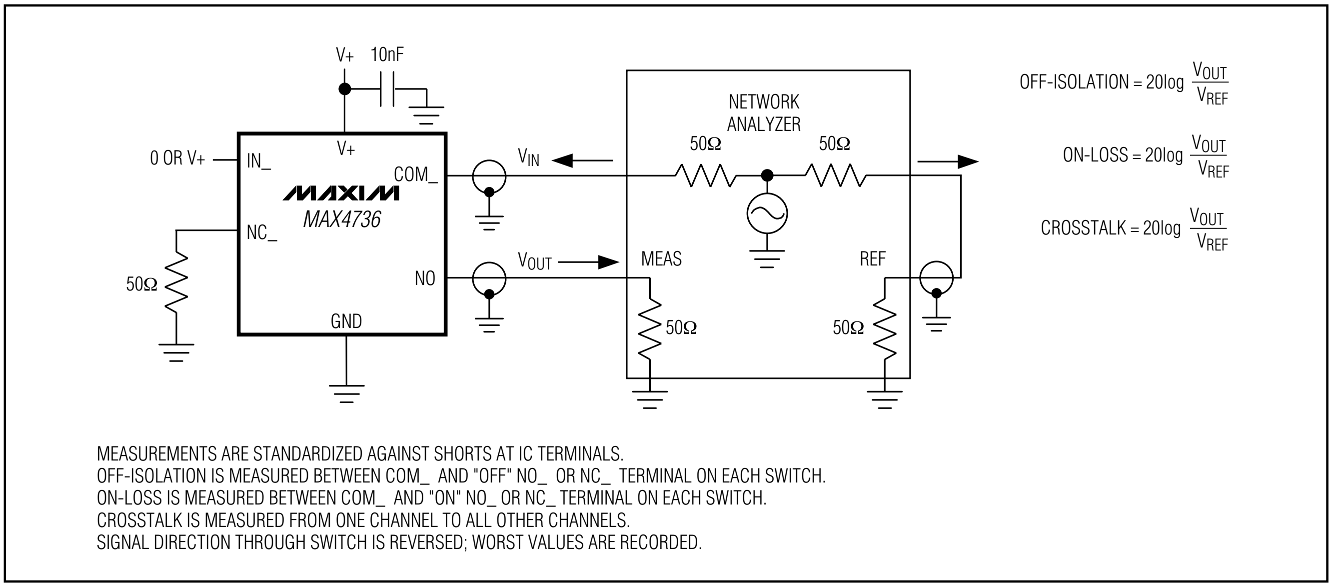
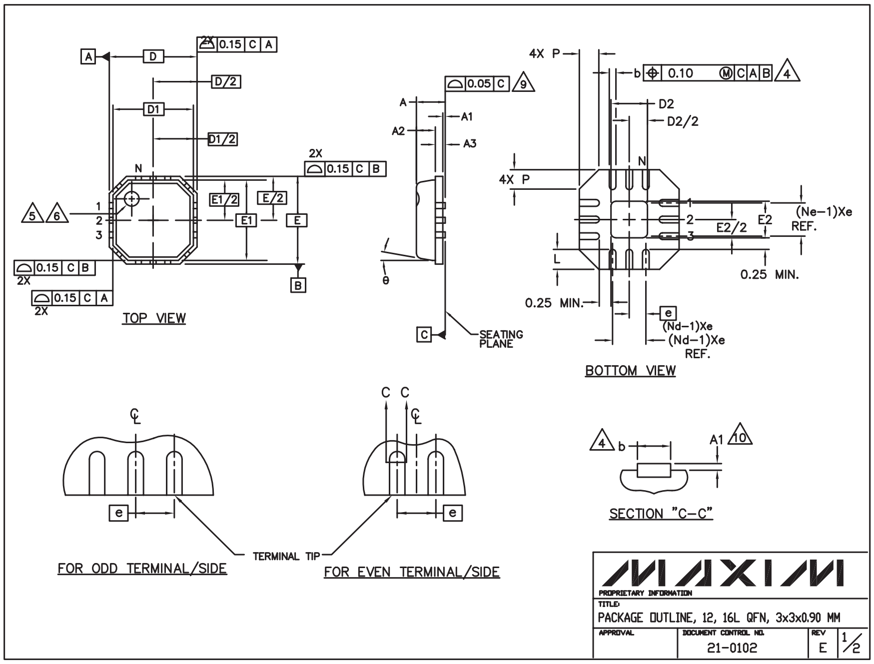


Figure 5. On-Loss, Off-Isolation, and Crosstalk

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

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			NOTE
	MIN.	NOM.	MAX.	
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			NOTE	SYMBOL	PITCH VARIATION D			NOTE
	MIN.	NOM.	MAX.			MIN.	NOM.	MAX.	
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

MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 12, 16L QFN, 3x3x0.90 MM

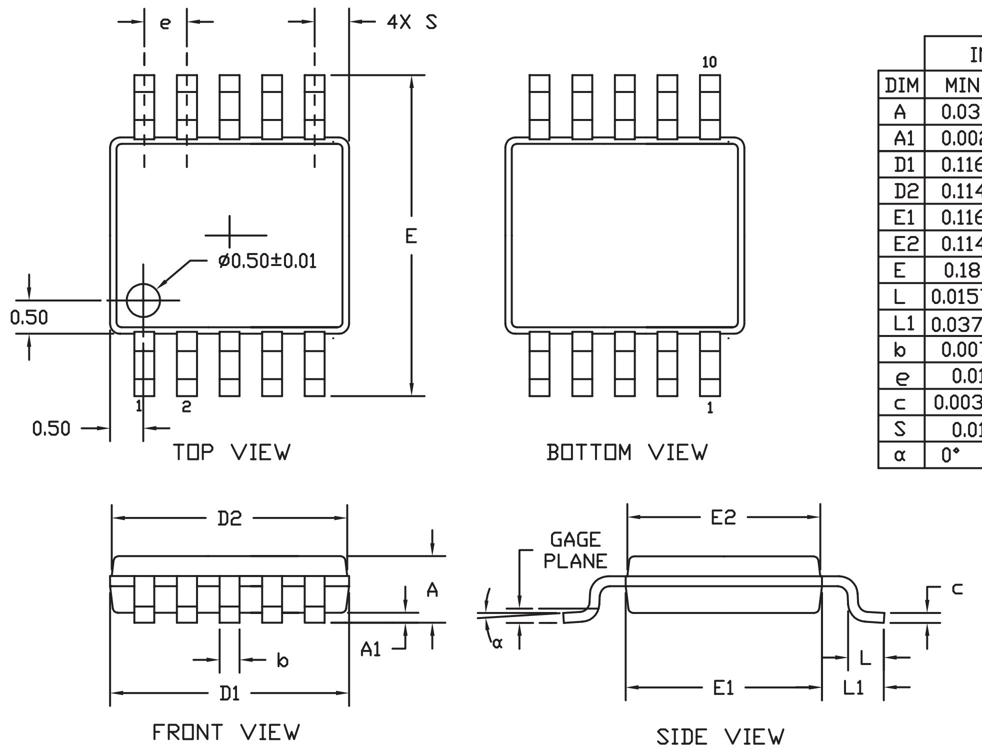
APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0102	E	2/2

0.8Ω, Low-Voltage, Single-Supply, Dual SPDT Analog Switch

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. 21-0061 | REV H | 1/1