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ON Semiconductor®

# FSA2268 / FSA2268T Low-Voltage Dual-SPDT (0.4Ω) Analog Switch with 16kV ESD

## Features

- 0.4Ω Typical On Resistance ( $R_{ON}$ ) for +3.0V Supply
- 0.25Ω Maximum  $R_{ON}$  Flatness for +3.0V Supply
- -3db Bandwidth: > 50MHz
- Low  $I_{CCT}$  Current Over an Expanded Control Input Range
- Packaged in Pb-free 10-Lead  $\mu$ MLP (1.4 x 1.8mm)
- Power-Off Protection on Common Ports
- Broad  $V_{CC}$  Operating Range: 1.65 to 4.3V
- HBM JEDEC: JESD22-A114
  - I/O to GND: 13.5kV
  - Power to GND: 16.0kV
- Noise Immunity Termination Resistors in FSA2268T

## Description

The FSA2268 is a high-performance, dual Single Pole Double Throw (SPDT) analog switch that features ultra-low  $R_{ON}$  of 0.4Ω (typical) at 3.0V  $V_{CC}$ . The FSA2268 operates over a wide  $V_{CC}$  range of 1.65V to 4.3V and is designed for break-before-make operation. The select input is TTL-level compatible.

The FSA2268 features very low quiescent current even when the control voltage is lower than the  $V_{CC}$  supply. This feature suits mobile handset applications by allowing direct interface with baseband processor general-purpose I/Os with minimal battery consumption.

The FSA2268T includes termination resistors that improve noise immunity during overshoot excursions, off-isolation coupling, or "pop-minimization."

## Applications

- Cell Phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

## Ordering Information

Part Number	Top Mark	Package Description
FSA2268UMX	GF	10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm, 0.4mm Pitch
FSA2268TUMX	GH	10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm, 0.4mm Pitch
FSA2268L10X	GH	10-Lead, MicroPak™, 1.6mm Wide

## Analog Symbols

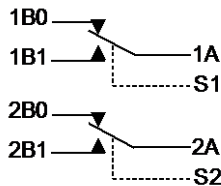


Figure 1. FSA2268

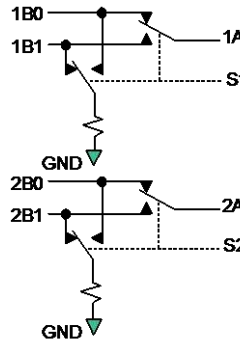


Figure 2. FSA2268T (with Noise Termination Resistors)

## Pin Configuration

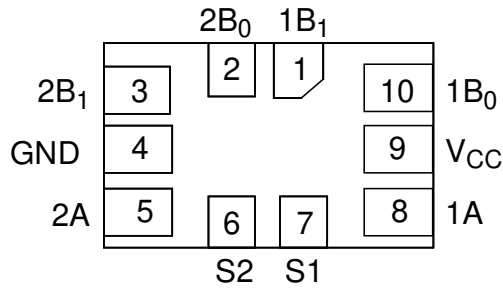


Figure 3. Pin Assignment 10-Pin UMLP (Top-Through View)

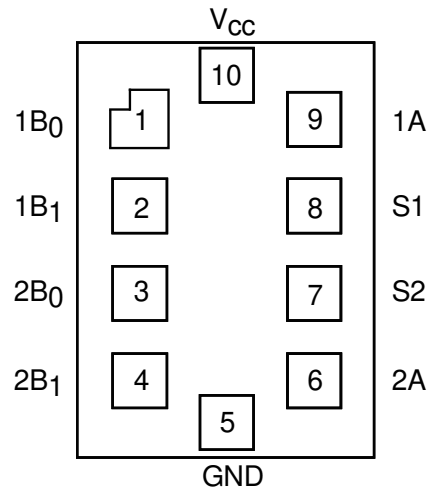


Figure 4. 10-Lead MicroPak™

## Pin Descriptions

Pin # UMLP	Pin # MicroPak™	Name	Description
1	2	1B <sub>1</sub>	Data Ports
2	3	2B <sub>0</sub>	Data Ports
3	4	2B <sub>1</sub>	Data Ports
4	5	GND	Ground
5	6	2A	Data Ports
6	7	S2	Switch Select Pins
7	8	S1	Switch Select Pins
8	9	1A	Data Ports
9	10	V <sub>CC</sub>	Supply Voltage
10	1	1B <sub>0</sub>	Data Ports

## Truth Table

Control Input, S <sub>n</sub>	Function
LOW Logic Level	nB <sub>0</sub> connected to nA (FSA2268/2268T); nB <sub>1</sub> terminated to GND (FSA2268T only)
HIGH Logic Level	nB <sub>1</sub> connected to nA (FSA2268/2268T); nB <sub>0</sub> terminated to GND (FSA2268T only)

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min.	Max.	Units	
$V_{CC}$	Supply Voltage	-0.5	5.5	V	
$V_{SW}$	Switch I/O Voltage <sup>(1)</sup>	1B0, 1B1, 2B0, 2B1, 1A, 2A Pins	-0.5	$V_{CC} + 0.3$	V
		T Version nBn Pin Off	0	1.4	
$V_{IN}$	Control Input Voltage <sup>(1)</sup>	-0.5	5.5	V	
$I_{IK}$	Input Clamp Diode Current		-50	mA	
$I_{SW}$	Switch I/O Current (Continuous)		350	mA	
$I_{SWPEAK}$	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)		500	mA	
$T_{STG}$	Storage Temperature Range	-65	+150	°C	
$T_J$	Maximum Junction Temperature		+150	°C	
$T_L$	Lead Temperature (Soldering, 10 seconds)		+260	°C	
MSL	Moisture Sensitivity Level (JEDEC J-STD-020A)		1	Level	
ESD	Human Body Model, JEDEC: JESD22-A114	I/O to GND		13.5	kV
		Power to GND		16.0	
		All Other Pins		9.0	
	Charged Device Model, JEDEC: JESD22-C101			2.0	kV

**Note:**

- Input and output negative ratings may be exceeded if input and output diode current ratings are observed.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Units
$V_{CC}$	Supply Voltage	1.65	4.30	V
$V_{IN}$	Control Input Voltage	0	$V_{CC}$	V
$V_{SW}$	Switch I/O Voltage	0	$V_{CC}$	V
$T_A$	Operating Temperature	-40	+85	°C

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Unit
				Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	Input Voltage High		3.6 to 4.3				1.7		V
			2.7 to 3.6				1.5		
			2.3 to 2.7				1.4		
			1.65 to 1.95				0.9		
V <sub>IL</sub>	Input Voltage Low		3.6 to 4.3					0.7	V
			2.7 to 3.6					0.5	V
			2.3 to 2.7					0.4	
			1.65 to 1.95					0.4	
I <sub>IN</sub>	Control Input Leakage (S1,S2)	V <sub>IN</sub> =0 to V <sub>CC</sub>	1.65 to 4.30				-0.5	0.5	μA
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub> FSA22268	Off Leakage Current of Port nB0 and nB1	nA=0.3V, V <sub>CC</sub> =0.3V nB0 or nB1=V <sub>CC</sub> -0.3V, 0.3V, or Floating Figure 6	1.95 to 4.30	-10		10	-50	50	nA
I <sub>NC(OFF)</sub> FSA2268T	Off Leakage Current of Port nB0 and nB1 (with Termination Resistors)	nA=0.3V, nB0 or nB1=0V or Floating Figure 6	1.95 to 4.30	-10		10	-50	50	μA
I <sub>A(ON)</sub>	On Leakage Current of Port nA	nA=0.3V, V <sub>CC</sub> =0.3V nB0 or nB1=V <sub>CC</sub> -0.3V, 0.3V, or Floating Figure 7	1.95 to 4.30	-20		20	-100	100	nA
I <sub>OFF</sub> FSA2268	Power-Off Leakage Current (Common Port Only 1A, 2A)	Common Port (1A, 2A), V <sub>IN</sub> =0V to 4.3V, V <sub>CC</sub> =0V nB0, nB1=Floating	0V					±1	μA
I <sub>OFF</sub> FSA2268T	Power-Off Leakage Current (Common Port Only 1A, 2A)	Common Port (1A, 2A), V <sub>IN</sub> =0V to 4.3V, V <sub>CC</sub> =0V nB0, nB1=0V or Floating	0V					±40	μA
R <sub>ON</sub>	Switch On Resistance <sup>(2)(5)</sup>	I <sub>ON</sub> =100mA, nB0 or nB1=0.7V, 3.6V Figure 5	4.30		0.30			0.50	Ω
		I <sub>ON</sub> =100mA, nB0 or nB1=0.7V, 2.3V Figure 5	3.00		0.40			0.55	
		I <sub>ON</sub> =100mA, nB0 or nB1=0V, 0.7V, 1.6V, 2.3V Figure 5	2.30		0.52				
		I <sub>ON</sub> =100mA, nB0 or nB1=0V, 0.7V, 1.65V Figure 5	1.65		1.00				
ΔR <sub>ON</sub>	On Resistance Matching Between Channels <sup>(3)(5)</sup>	I <sub>ON</sub> =100mA, nB0 or nB1=0.7V	4.30		0.04			0.13	Ω
			3.00		0.06			0.13	
			2.30		0.12				
			1.65		1.00				

Continued on following page...

### DC Electrical Characteristics (Continued)

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Unit
				Min.	Typ.	Max.	Min.	Max.	
R <sub>FLAT(ON)</sub>	On Resistance Flatness <sup>(4)(5)</sup>	I <sub>OUT</sub> =100mA, nB0 or nB1=0V to V <sub>CC</sub>	4.30					0.25	Ω
			3.00					0.25	
			2.30		0.5				
			1.65		0.6				
R <sub>TERM</sub>	Internal Termination Resistors <sup>(6)</sup>				200				Ω
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> =0 or V <sub>CC</sub> , I <sub>OUT</sub> =0	4.30	-100		100	-500	500	nA
I <sub>CC</sub> T	Increase in I <sub>CC</sub> per Input	Input at 2.6V	4.30		3			7	μA
		Input at 1.8V			7			15	

**Notes:**

2. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
3.  $\Delta R_{ON} = R_{ON\ max} - R_{ON\ min}$  measured at identical V<sub>CC</sub>, temperature, and voltage.
4. Flatness is defined as the difference between the maximum and minimum value of on resistance (R<sub>ON</sub>) over the specified range of conditions.
5. Guaranteed by characterization, not production tested, for V<sub>CC</sub>=1.65-3.00V.
6. Guaranteed by characterization, not production tested.

## AC Electrical Characteristics

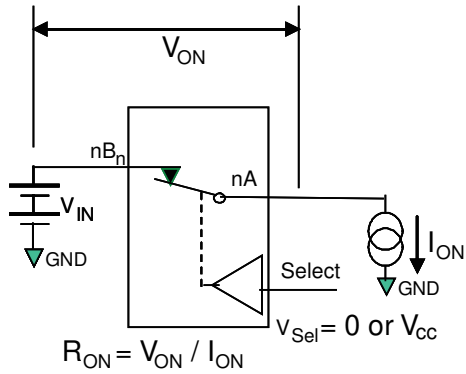
All typical value are for  $V_{CC}=3.3V$  at  $25^{\circ}C$  unless otherwise specified.

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A=+25^{\circ}C$			$T_A=-40$ to $+85^{\circ}C$		Unit	Figure
				Min.	Typ.	Max.	Min.	Max.		
$t_{ON}$	Turn-On Time	nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$	3.6 to 4.3			55	15	60	ns	Figure 8 Figure 9
			2.7 to 3.6			60	15	65		
			2.3 to 2.7			65	15	70		
			1.65 to 1.95		70					
$t_{OFF}$	Turn-Off Time	nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$	3.6 to 4.3			30	5	35	ns	Figure 8 Figure 9
			2.7 to 3.6			35	5	40		
			2.3 to 2.7			40	5	45		
			1.65 to 1.95		40					
$t_{BBM}$	Break-Before-Make Time	nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$	3.6 to 4.3		15		2		ns	Figure 10
			2.7 to 3.6		15		2			
			2.3 to 2.7		15		2			
			1.65 to 1.95		16		2			
Q	Charge Injection	$C_L=1.0nF$ , $V_S=0V$ , $R_S=0\Omega$	1.65 to 4.30		25				pC	Figure 14
OIRR	Off Isolation	$f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$	1.65 to 4.30		-70				dB	Figure 12
Xtalk	Crosstalk	$f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$	1.65 to 4.30		-70				dB	Figure 13
BW	-3db Bandwidth	$R_L=50\Omega$ , $C_L=0pF$	1.65 to 4.30		>50				MHz	Figure 11
THD	Total Harmonic Distortion	$f=20Hz$ to $20kHz$ , $R_L=32\Omega$ , $V_{IN}=2V_{pp}$	1.65 to 4.30		.06				%	Figure 17

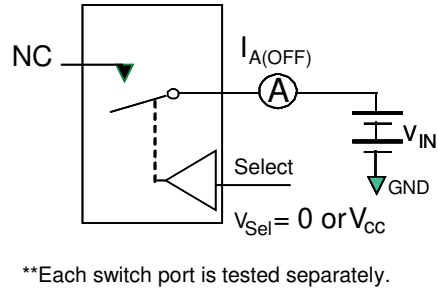
## Capacitance

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A=+25^{\circ}C$			Unit	Figure
				Min.	Typ.	Max.		
$C_{IN}$	Control Pin Input Capacitance	$f=1MHz$	0		1.5		pF	Figure 15
$C_{OFF}$	B Port Off Capacitance	$f=1MHz$	3.3		30		pF	Figure 15
$C_{ON}$	A Port On Capacitance	$f=1MHz$	3.3		120		pF	Figure 16

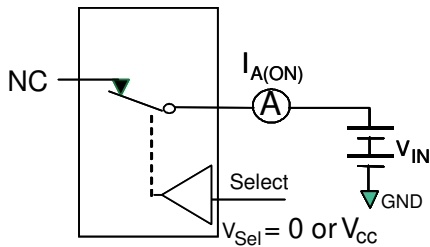
### Test Diagrams



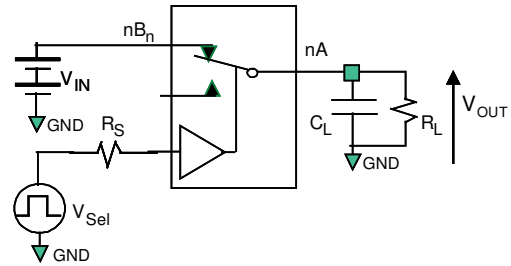
**Figure 5. On Resistance**



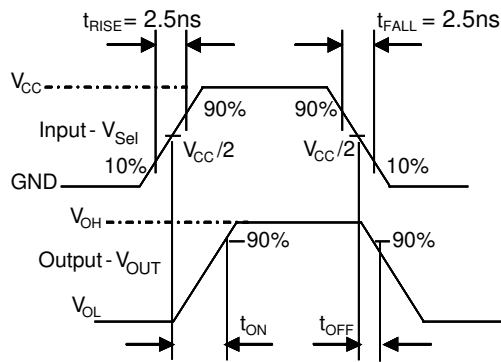
**Figure 6. Off Leakage (Ports tested separately)**



**Figure 7. On Leakage**



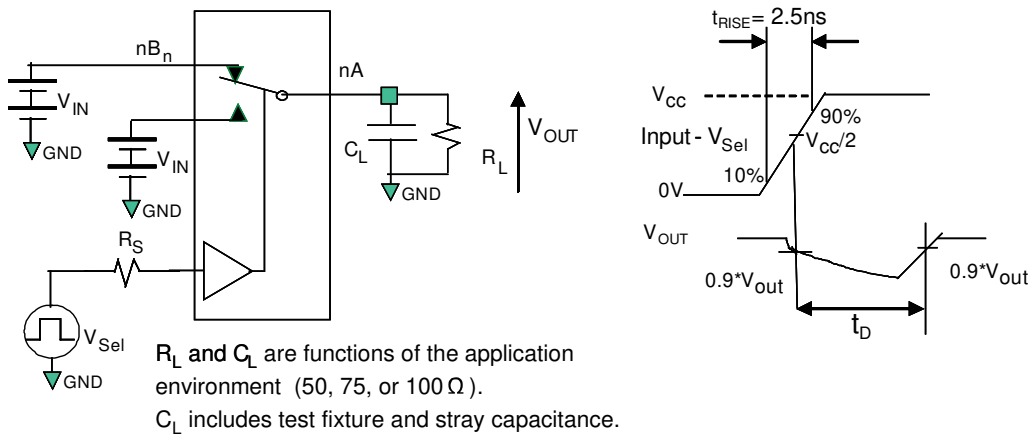
**Figure 8. Test Circuit Load**



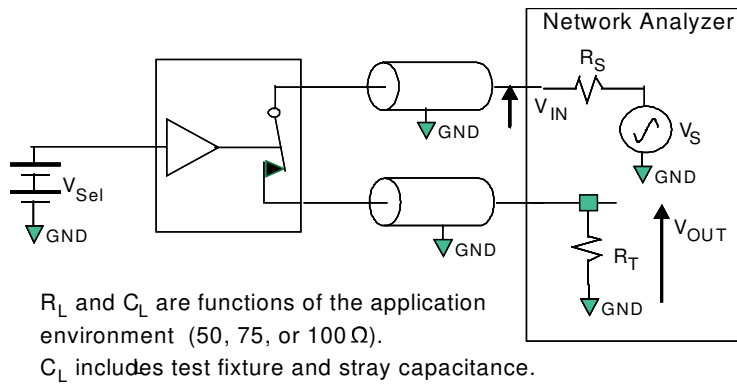
**Figure 9. Turn-On / Turn-Off Waveforms**



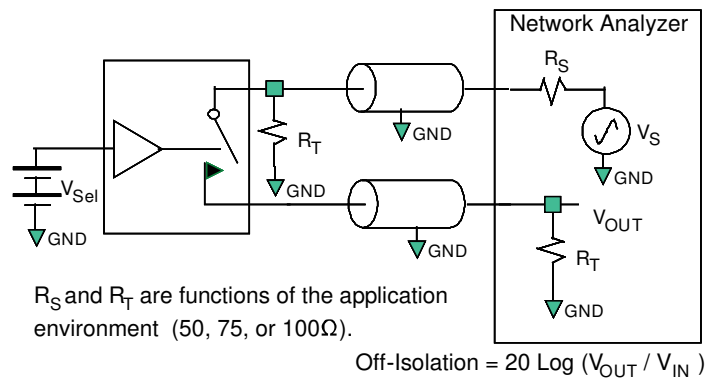
**Test Diagrams** (Continued)



**Figure 10. Break-Before-Make Interval Timing**

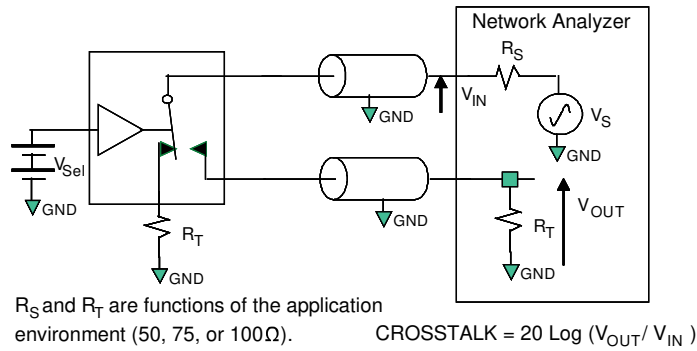


**Figure 11. Bandwidth**

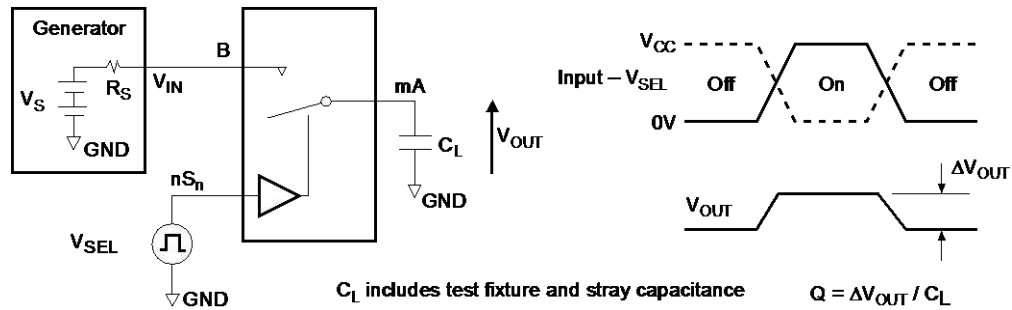


**Figure 12. Channel Off Isolation**

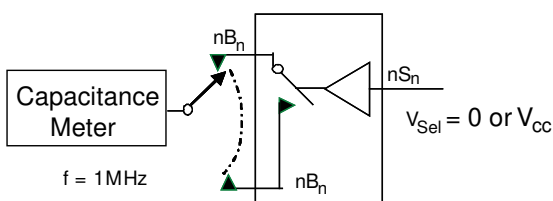
**Test Diagrams** (Continued)



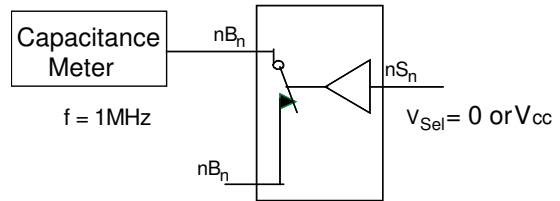
**Figure 13. Adjacent Channel Crosstalk**



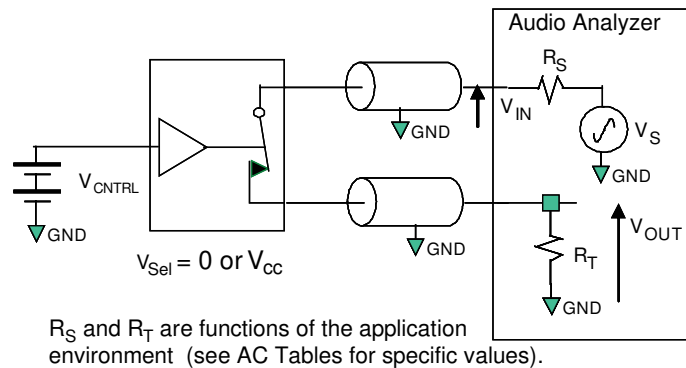
**Figure 14. Charge Injection Test**



**Figure 15. Channel Off Capacitance**

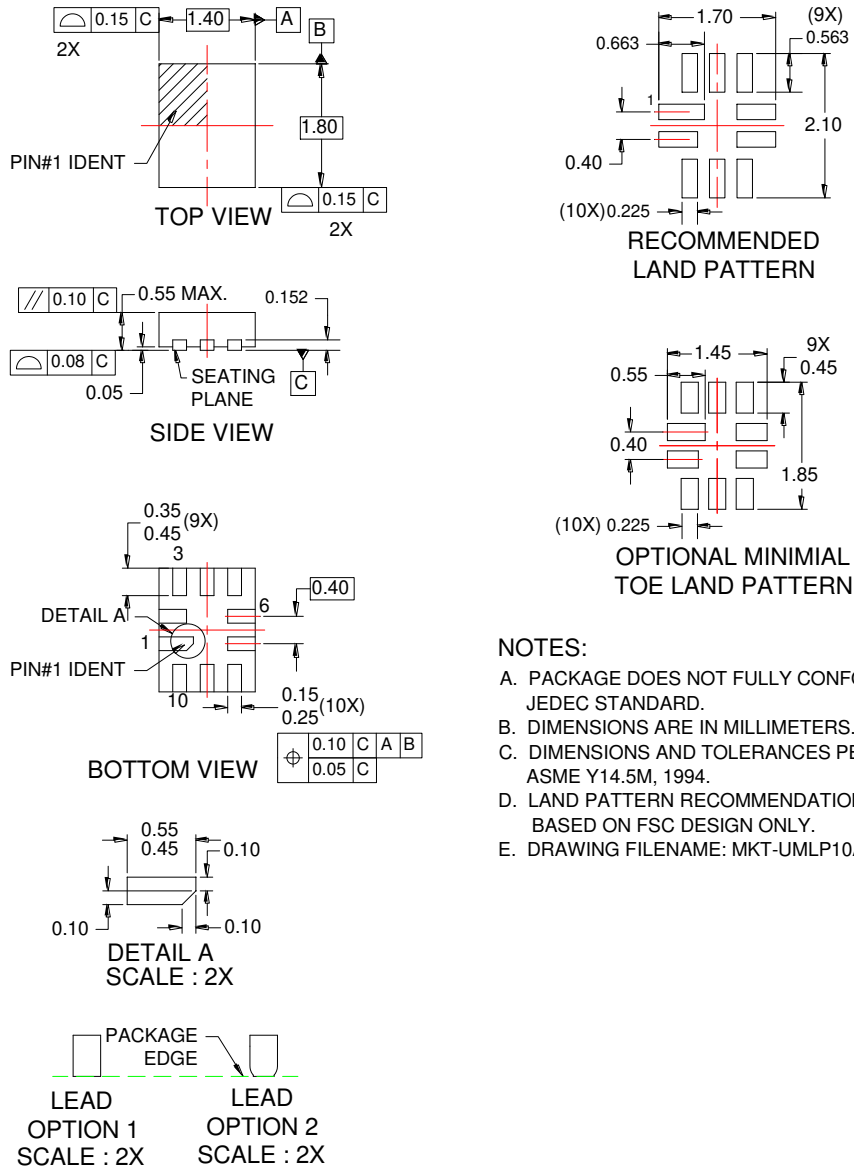


**Figure 16. Channel On Capacitance**



**Figure 17. Total Harmonic Distortion**

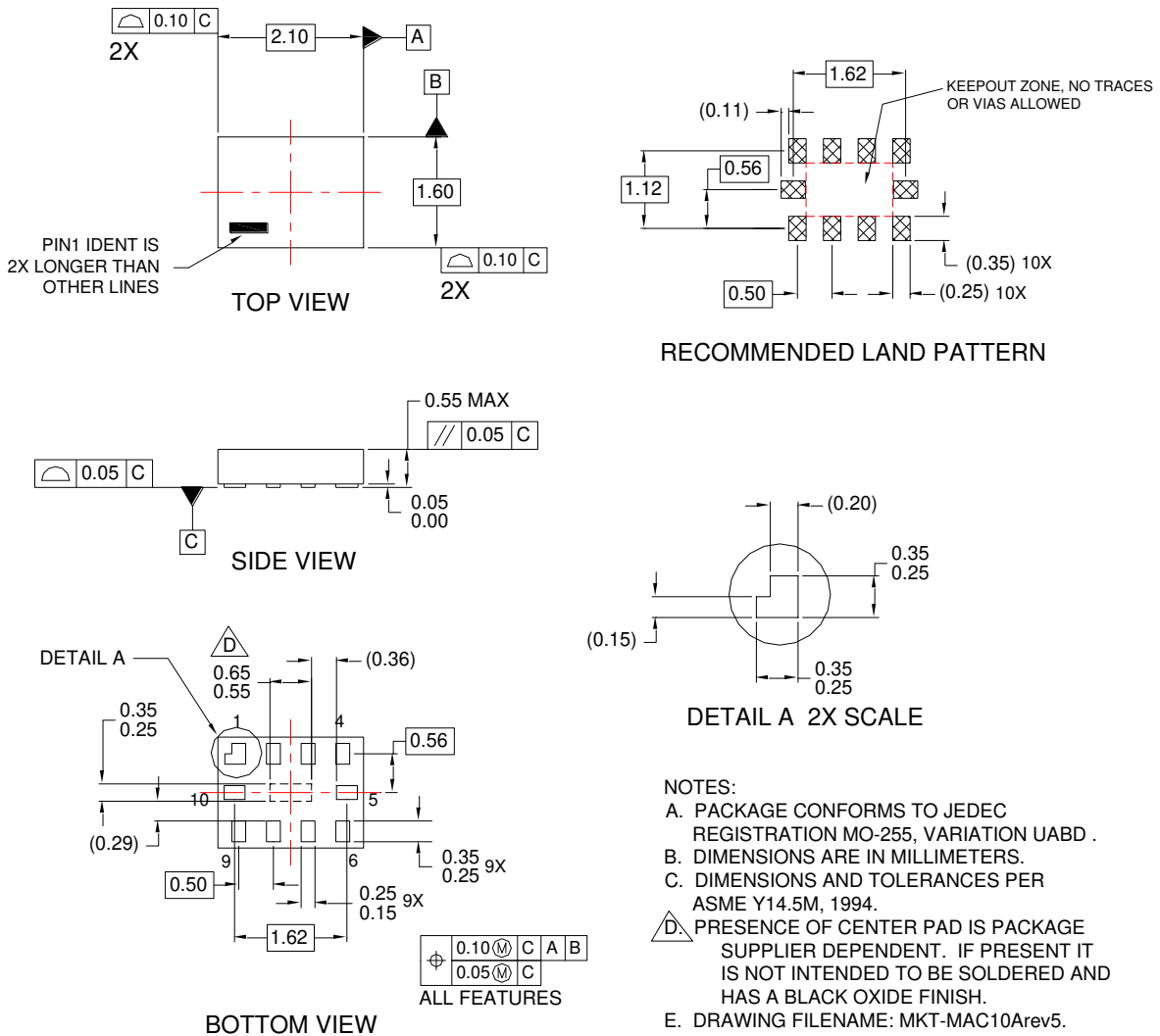
## Physical Dimensions



**Figure 18. 10-Lead Quad Ultrathin Molded Leadless Package (UMLP)**


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**Physical Dimensions** (Continued)



**Figure 19. 10-Lead, MicroPak™, 1.6mm Wide**

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