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FSA4157, FSA4157A Low-Voltage, 1 Ω SPDT Analog Switch

Features

- FSA4157A Features Lower I_{CC} when the S Input is Lower Than V_{CC}
- Maximum 1.15 Ω On Resistance (R_{ON}) at 4.5 V V_{CC}
- 0.3 Ω Maximum R_{ON} Flatness at 4.5 V V_{CC}
- Space-Saving 6-lead, MicroPak™ and SC70 6 Packages
- Broad V_{CC} Operating Range:
 - FSA4157: 1.65 V to 5.5 V
 - FSA4157A: 2.7 V to 5.5 V
- Fast Turn-On and Turn-Off Time
- Break-Before-Make Enable Circuitry
- Over-Voltage Tolerant TTL-Compatible Control Circuitry

Description

FSA4157 and FSA4157A are high performance Single Pole/Double Throw (SPDT) analog switches. Both devices feature ultra low R_{ON} of 1.15 Ω maximum at 4.5 V V_{CC} and operates over the wide V_{CC} range of 1.65 V to 5.5 V for FSA4157, and 2.7 V to 5.5 V for FSA4157A. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL level compatible.

The FSA4157A features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services the mobile handset applications very well allowing for the direct interface with baseband processor general purpose I/Os.

Ordering Information

Part Number	Top Mark	Package Description	Packing Method
FSA4157P6X	A57	6-Lead SC70, EIAJ SC88, 1.25 mm Wide	3000 Units Tape and Reel
FSA4157L6X	EG	6-Lead MicroPak,™ 1.0 mm Wide	5000 Units Tape and Reel
FSA4157AP6X	B57	6-Lead SC70, EIAJ SC88, 1.25 mm Wide	3000 Units Tape and Reel
FSA4157AL6X	EU	6-Lead MicroPak™, 1.0 mm Wide	5000 Units Tape and Reel

Pin Configurations

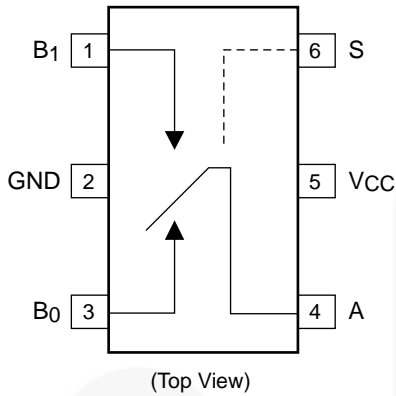


Figure 1. SC70 Pin Assignments

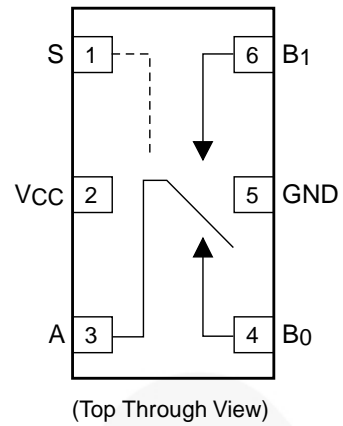


Figure 2. MicroPak™ Pin Assignments

Pin Definitions

Pin# SC70	Pin# MicroPak™	Name	Description
1	6	B1	Data Ports
2	5	GND	Ground
3	4	B0	Data Ports
4	3	A	Data Ports
5	2	V _{CC}	Supply Voltage
6	1	S	Control Input

Truth Table

Control Input (S)	Function
Low	B0 connected to A
High	B1 connected to A

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.	Unit
V _{CC}	Supply Voltage		-0.5	6.0	V
V _S	DC Switch Voltage ⁽¹⁾		-0.5	V _{CC} + 0.5	V
V _{IN}	DC Input Voltage ⁽¹⁾		-0.5	6.0	V
I _{IK}	DC Input Diode Current		-50		mA
I _{SW}	Switch Current			200	mA
I _{SWPEAK}	Peak Switch Current (Pulse at 1 ms duration, <10% Duty Cycle)			400	mA
P _D	Power Dissipation at 85°C	SC70		180	mW
		MicroPak™			
T _{STG}	Storage Temperature Range		-65	+150	°C
T _J	Maximum Junction Temperature			+150	°C
T _L	Lead Temperature (Soldering, 10 seconds)			+260	°C
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114 (FSA4157A)		7500	V

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. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter		Min.	Max.	Unit
V _{CC}	Supply Voltage	FSA4157	1.65	5.50	V
		FSA4157A	2.7	5.5	
V _{CNTRL}	Control Input Voltage ⁽²⁾		0	V _{CC}	V
V _{SW}	Switch Input Voltage		0	V _{CC}	V
T _A	Operating Temperature		-40	+85	°C
θ _{JA}	Thermal Resistance in Still Air	SC70		350	°C/W
		MicroPak™ (Estimated)		330	

Note:

- Control input must be held HIGH or LOW and it must not float.

DC Electrical Characteristics

Typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V _{CC} (V)	Ambient Temperature					Unit
				-25°			-40 to +85°C		
				Min.	Typ.	Max.	Min.	Max.	
V _{IH}	Input Voltage High	FSA4157 Only	1.8 to 2.7				1.0		V
			2.7 to 3.6				2.0		
			4.5 to 5.5				2.4		
V _{IL}	Input Voltage Low	FSA4157 Only	1.8 to 2.7					0.4	V
		FSA4157A Only	2.7 to 3.6					0.4	
			2.7 to 3.6					0.6	
			4.5 to 5.5					0.8	
I _{IN}	Control Input Leakage	V _{IN} =0 V to V _{CC}	2.7 to 3.6				-1.0	1.0	μA
			4.5 to 5.5				-1.0	1.0	
I _{NO(OFF)} , I _{NC(OFF)}	Off Leakage Current of Port B0 and B1	A=1 V, 4.5 V, B ₀ or B ₁ =4.5, 1 V	5.5		±2		-20	20	nA
I _{A(ON)}	On Leakage Current of Port A	A=1 V, 4.5V, B ₀ or B ₁ =4.5, 1 V, 4.5 V or Floating	5.5		±4		-40	40	nA
R _{ON}	Switch On Resistance	I _{OUT} =100 mA, B ₀ or B ₁ =1.5 V	2.7		2.6	4.0		4.3	Ω
		I _{OUT} =100mA, B ₀ or B ₁ =3.5V	4.5		0.95	1.15		1.30	
ΔR _{ON}	On Resistance Matching Between Channels ⁽⁴⁾	I _{OUT} =100 mA, B ₀ or B ₁ =1.5 V	4.5		0.06	0.12		0.15	Ω
R _{FLAT(ON)}	On Resistance Flatness ⁽⁴⁾	I _{OUT} =100 mA, B ₀ or B ₁ =0 V, 0.75 V, 1.5 V	2.7		1.4				Ω
		I _{OUT} =100 mA, B ₀ or B ₁ =0 V, 1 V, 2 V	4.5		0.2	0.3		0.4	
I _{CC}	Quiescent Supply Current	V _{IN} =0 V or V _{CC} , I _{OUT} =0 V	3.6		0.1	0.5		1.0	μA
			5.5		0.1	0.5		1.0	
ΔI _{CC}	Increase in I _{CC} per Input	One Input at 2.7 V, others at V _{CC} or GND (FSA4157A Only)	4.3		0.2			10.0	μA

Notes:

- Measured by the voltage drop between the A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (A or B ports).
- ΔR_{ON} = R_{ON max} – R_{ON min} measured at identical V_{CC}, temperature, and voltage.
- Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.

AC Electrical Characteristics

Typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V _{CC} (V)	Ambient Temperature					Unit	Figure
				-25°			-40 to +85°C			
				Min.	Typ.	Max.	Min.	Max.		
t _{ON}	Turn-On Time	B ₀ or B ₁ =1.5 V, R _L =50 Ω, C _L =35 pF (FSA4157A Only)	2.7 to 3.6			60		65	ns	Figure 8
		B ₀ or B ₁ =1.5 V, R _L =50Ω, C _L =35pF	2.7 to 3.6			50		60		
		B ₀ or B ₁ =1.5 V, R _L =50 Ω, C _L =35pF	4.5 to 5.5			35		40		
t _{OFF}	Turn-Off Time	B ₀ or B ₁ =1.5 V, R _L =50 Ω, C _L =35 pF	2.7 to 3.6			20		30	ns	Figure 8
		B ₀ or B ₁ =1.5 V, R _L =50 Ω, C _L =35 pF	4.5 to 5.5			15		20		
t _{BBM}	Break-Before-Make Time	FSA4157	2.7 to 3.6						ns	Figure 9
			4.5 to 5.5		20					
		FSA4157A Only	4.5 to 5.5		25					
Q	Charge Injection	C _L =1.0 nF, V _{GE} =0 V, R _{GEN} =0 Ω	2.7 to 3.6		10			pC	Figure 11	
			4.5 to 5.5		20					
OIRR	Off Isolation	f=1 MHz, R _L =50 Ω	2.7 to 3.6		-70			dB	Figure 10	
			4.5 to 5.5		-70					
Xtalk	Crosstalk	f=1 MHz, R _L =50 Ω	2.7 to 3.6		-70			dB	Figure 10	
			4.5 to 5.5		-70					
BW	-3db Bandwidth	R _L =50 Ω	2.7 to 3.6			300		MHz	Figure 13	
			4.5 to 5.5			300				
THD	Total Harmonic Distortion	R _L =600 Ω, V _{IN} =0.5, f=20 Hz to 20 kHz	2.7 to 3.6		0.002			%	Figure 14	
			4.5 to 5.5		0.002					

Capacitance

Symbol	Parameter	Conditions	V _{CC} (V)	Ambient Temperature			Unit	Figure
				-25°				
				Min.	Typ.	Max.		
C _{IN}	Control Pin Input Capacitance	f=1 MHz	0		3.5		pF	Figure 12
C _{OFF}	B Port Off Capacitance	f=1 MHz	4.5		12.0		pF	Figure 12
C _{ON}	On Capacitance	f=1 MHz	4.5		40.0		pF	Figure 12

Typical Performance Characteristics

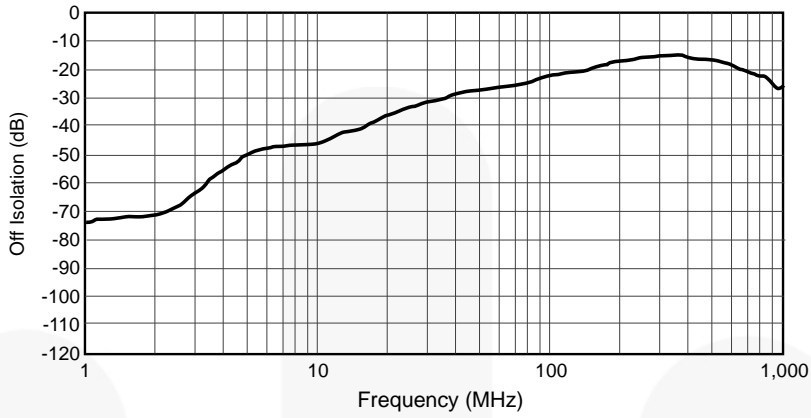


Figure 3. Off Isolation, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

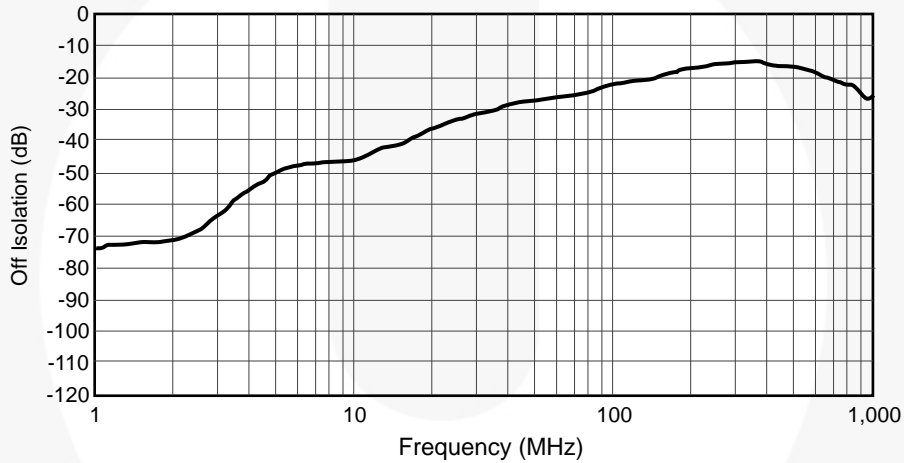


Figure 4. Crosstalk, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

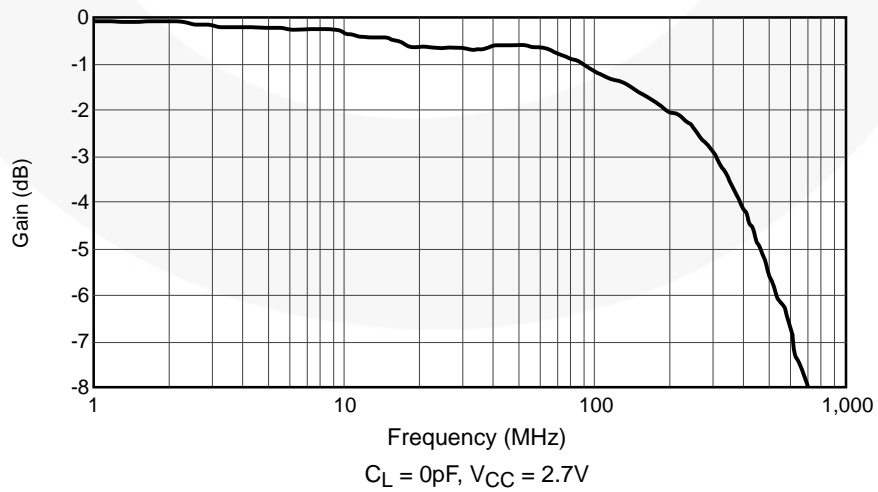


Figure 5. Bandwidth, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

Typical Performance Characteristics (Continued)

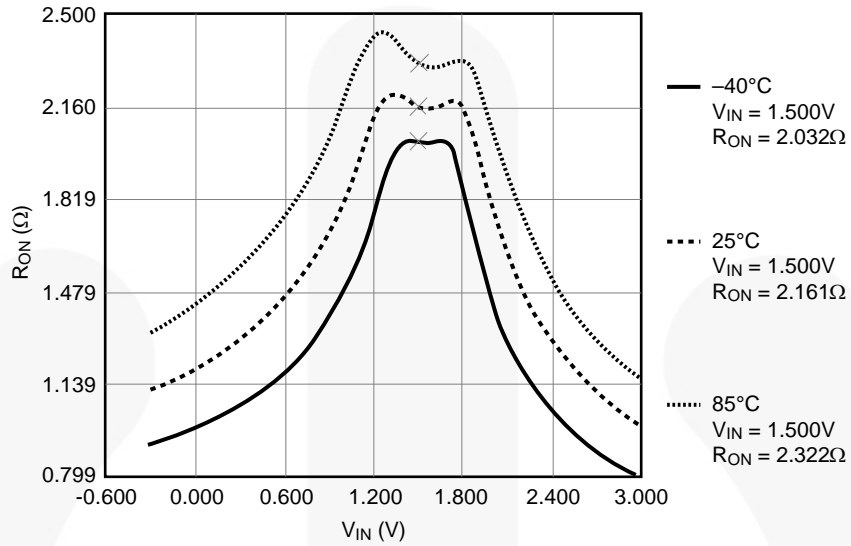


Figure 6. RON Switch On Resistance, I_{ON} = 100 mA, V_{CC} = 2.7

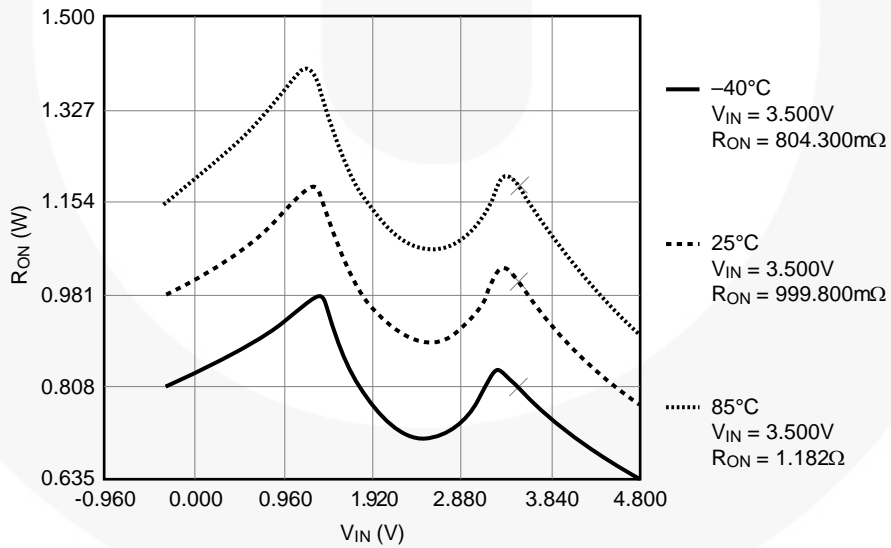


Figure 7. RON Switch On Resistance, I_{ON} = 100 mA, V_{CC} = 4.5 V

AC Loadings and Waveforms

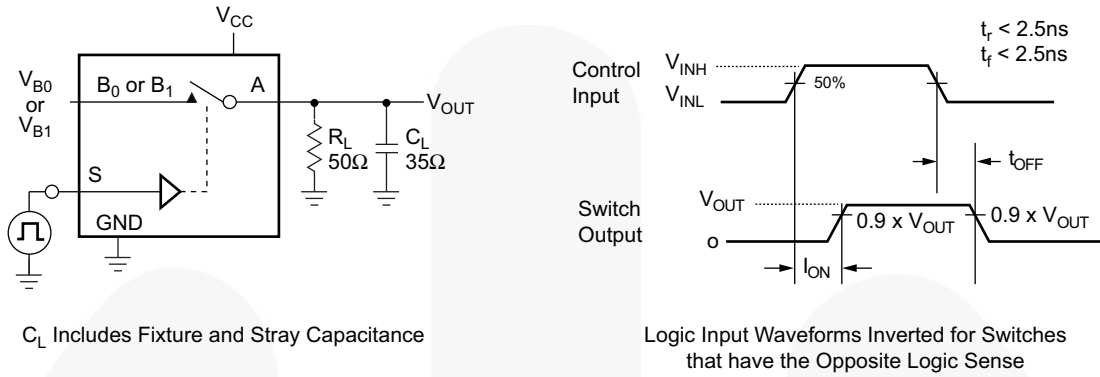


Figure 8. Turn On / Off Timing

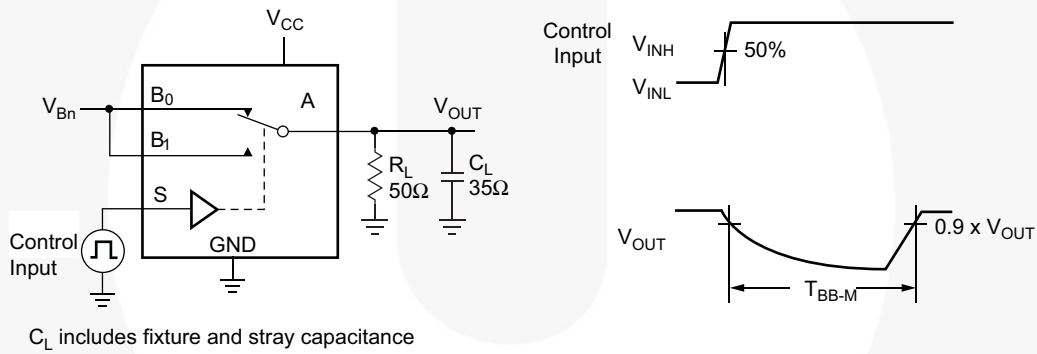


Figure 9. Break Before Make Timing

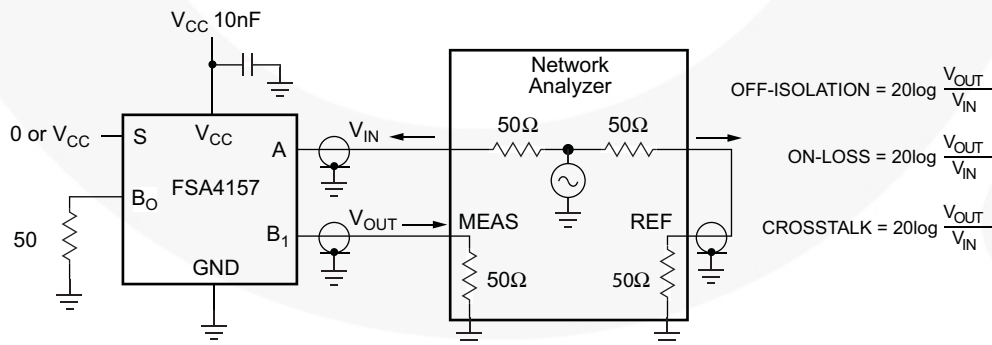


Figure 10. Off Isolation and Crosstalk

AC Loadings and Waveforms (Continued)

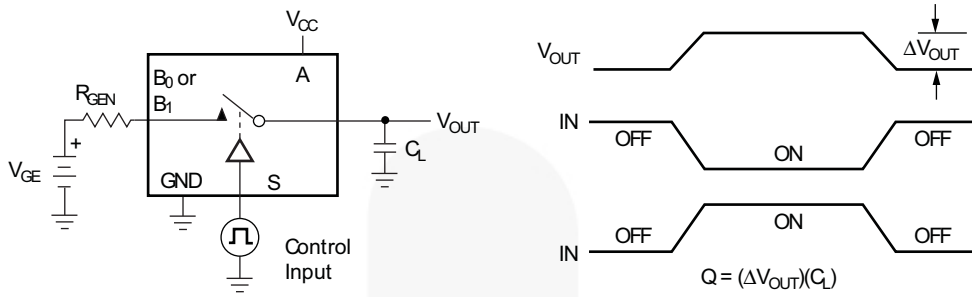


Figure 11. Charge Injection

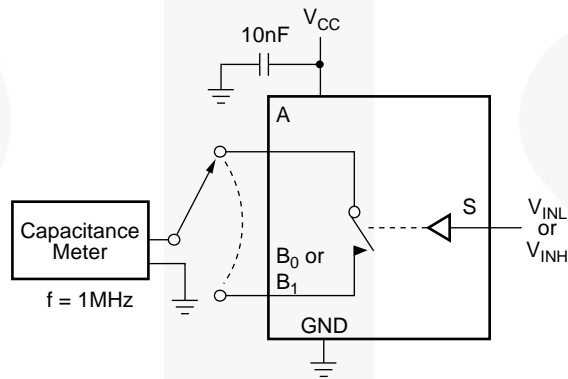


Figure 12. On / Off Capacitance Measurement Setup

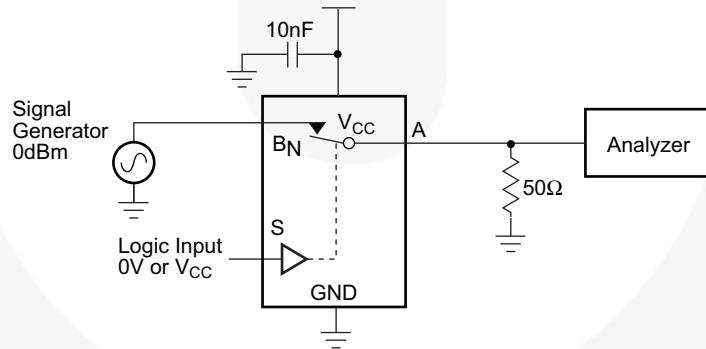


Figure 13. Bandwidth

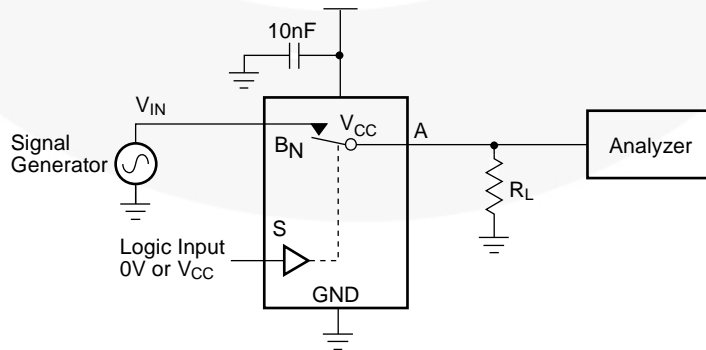
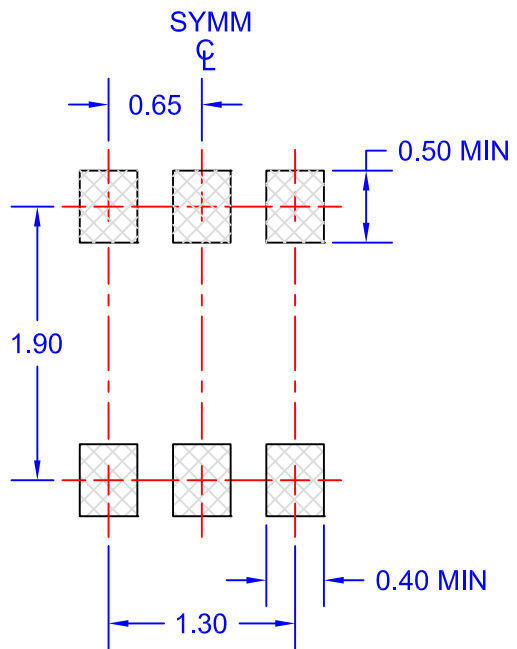
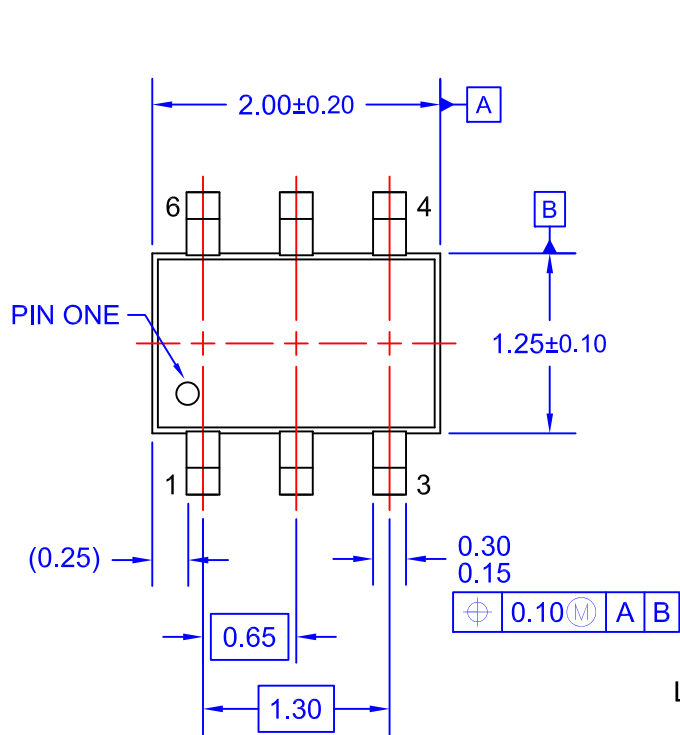
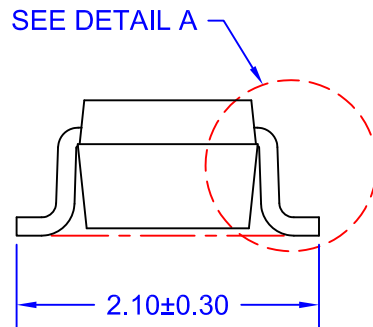
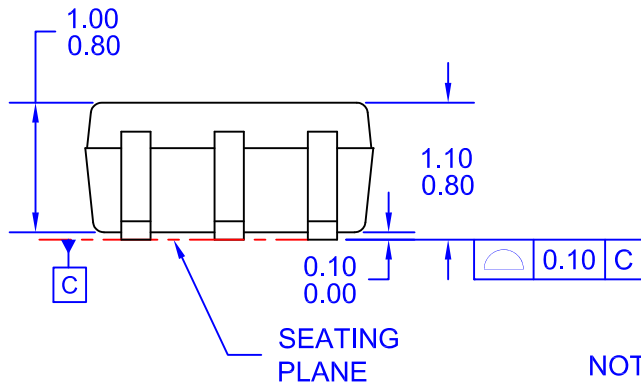


Figure 14. Harmonic Distortion



LAND PATTERN RECOMMENDATION

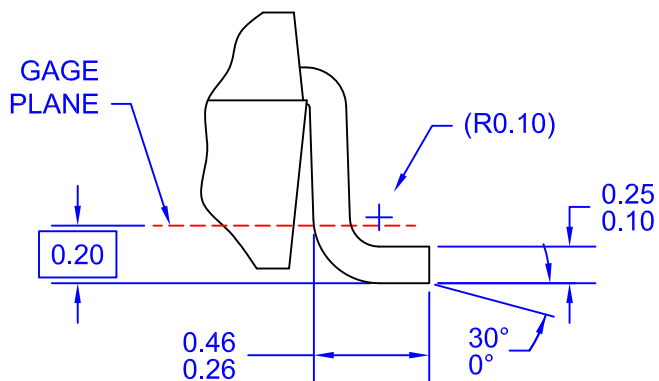


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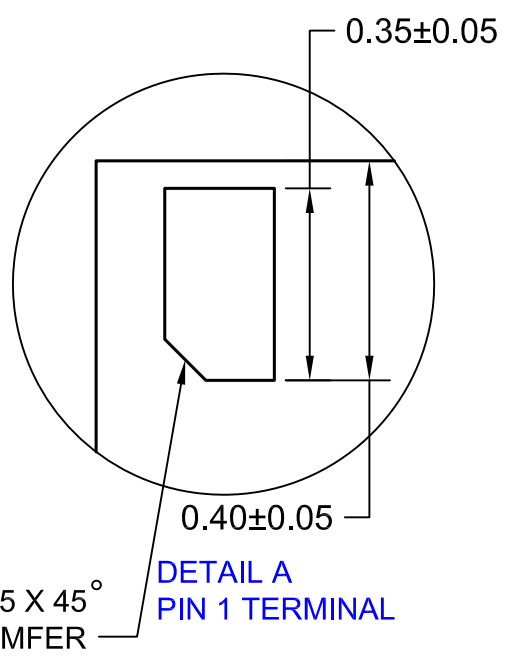
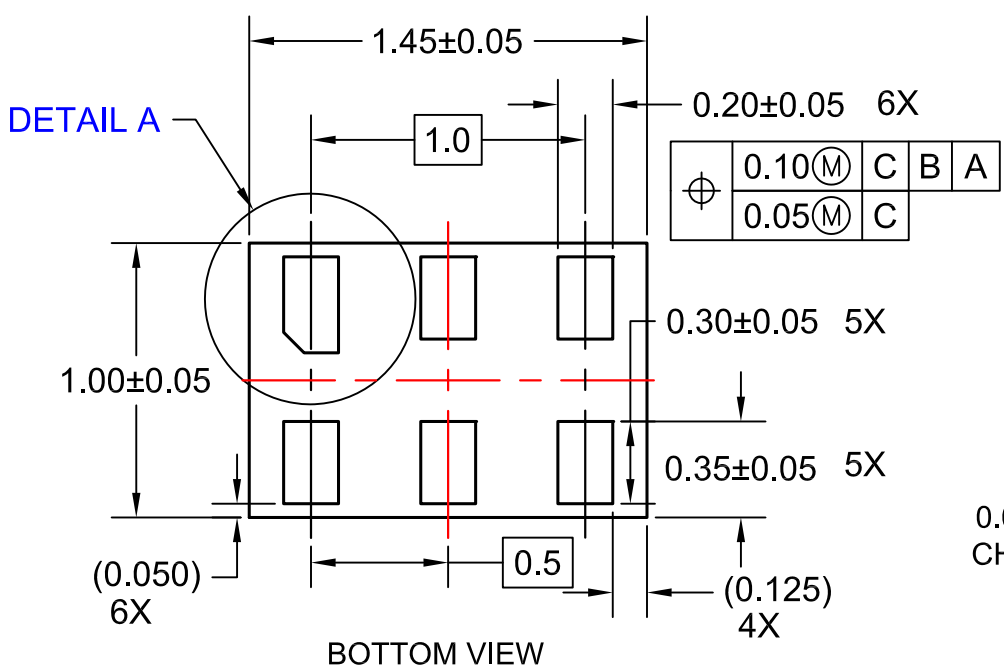
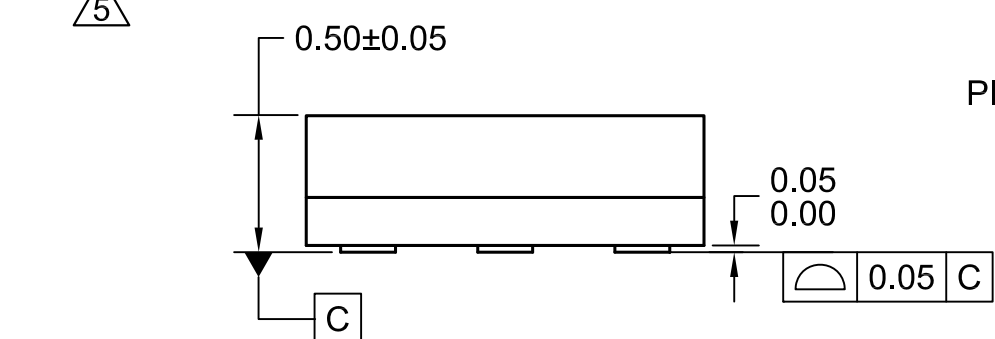
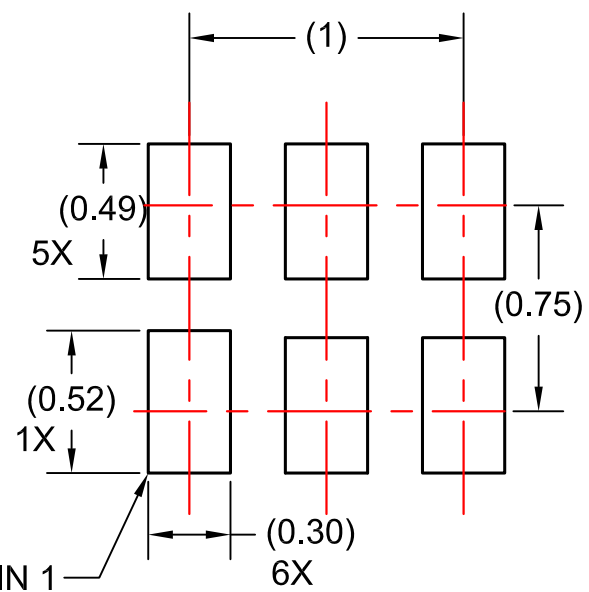
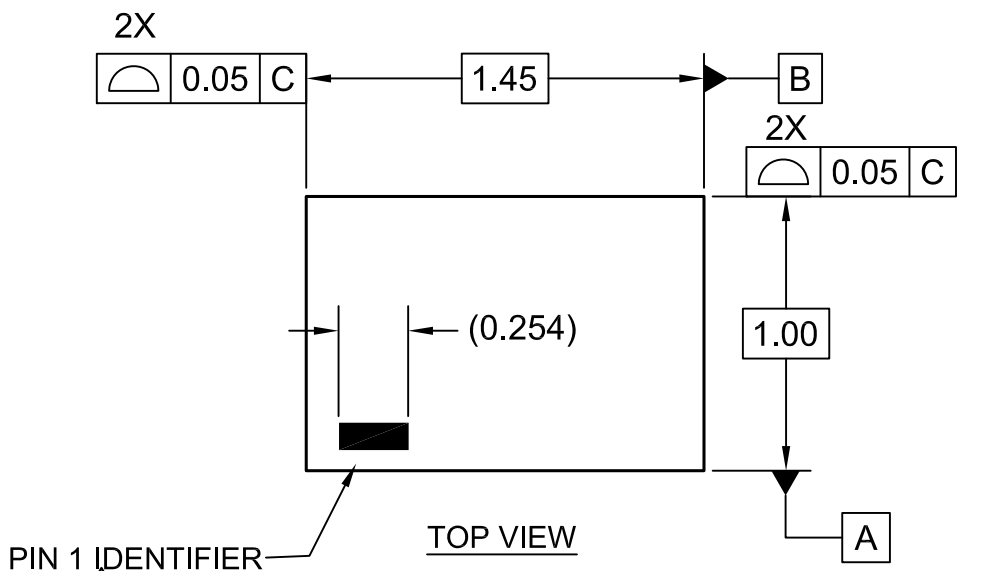
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DETAIL A
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