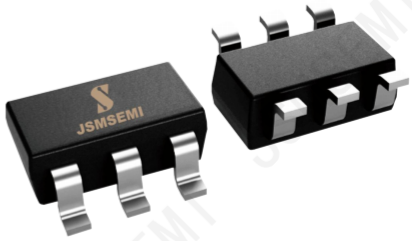
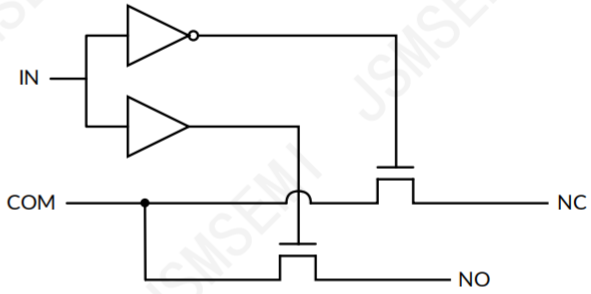
Description

This single channel single-pole double-throw (SPDT) analog switch is designed for 1.65V to 5.5V Vcc operation.The FSA3157 device handles both analog and digital signals. The FSA3157 device allows signals with amplitudes of up to Vcc (peak) to be transmitted in either direction.
Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.



Features

- ESD protection exceeds JESD 22
  - 2000V Human Body Model
  - 1000V Charged-Device Model
- 1.65V to 5.5V V_{CC} operation
- Qualified for 125°C operation
- Specified break-before-make switching
- Rail-to-rail signal handling
- Operating frequency typically 340MHz at room temperature
- High speed, typically 2ns (V_{CC} = 3V, C_L = 50pF)
- Low ON-state resistance, typically approximately 4.5Ω
- Small package and footprint
  -SOT23-6L and SOT-363
- RoSH compatible



Simplified Schematic

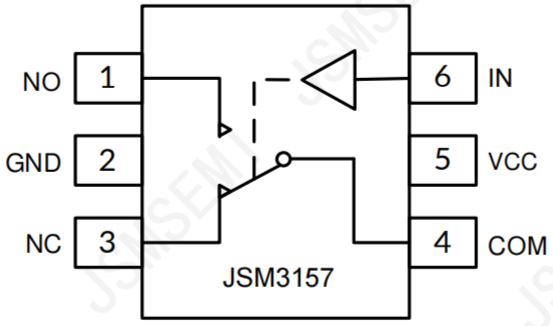
Applications

- Wearables and mobile devices
- Portable computing
- Internet of things (IoT)
- Audio signal routing
- Remote radio unit
- Portable medical equipment
- Surveillance
- Home automation
- I2C/SPI/UART bus multiplexing
- Wireless charging

Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship, Quantity	Green
FSA3157M6X-JSM	SOT-23-6L	3157	-40 to125°C	3	T&R,3000	Rohs
FSA3157P6X-JSM	SOT-363	3157	-40 to125°C	3	T&R,3000	Rohs

Pin Configuration and Functions



Top View

Pin Functions

PIN NAME		TYPE(1)	DESCRIPTION
NO	1	I/O	Switch I/O. Set S high to enable.
GND	2	P	Ground
NC	3	I/O	Switch I/O. Set S low to enable.
COM	4	I/O	Common terminal
V_{CC}	5	P	Power supply
IN	6	I	Select

(1) I = input, O = output, P = power

Specifications

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_+	Supply Voltage		-0.5	6	V
V_{IN}	Input Voltage		-0.5	6	
	Analog, Digital Voltage Range (2)		-0.5	$(V_+)+0.5$	
	Continuous Current NO, NC, or COM		-50	50	mA
I_+	Supply current			100	
I_{GND}	Ground current		-100		
θ_{JA}	Package thermal impedance (3)	SOT23-6		235	°C/W
		SC70-6		270	
T_J	Junction Temperature (4)			150	°C
T_{stg}	Storage temperature		-65	150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 100mA or less.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

Thermal Information

THERMAL METRIC		FSA3157		UNIT
		SOT-23-6L	SOT-363	
		6 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	258.2	286.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	182.8	224.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	142.8	143.7	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	118.4	124.5	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	142.2	142.8	°C/W

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM)	±2000	V
		Charged device model (CDM)	±1000	V

Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)(1)

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		1.65		5.5	V
$V_{I/O}$	Switch input or output voltage (Max of V_{CC})		0		V_{CC}	V
V_{IN}	Control input voltage		0		5.5	V
V_{IH}	High-level input voltage, control input	V_{CC} = 1.65V to 1.95V	V_{CC} * 0.75			V
		V_{CC} = 2.3V to 5.5V	V_{CC} * 0.7			V
V_{IL}	Low-level input voltage, control input	V_{CC} = 1.65V to 1.95V			V_{CC} * 0.25	V
		V_{CC} = 2.3V to 5.5V			V_{CC} * 0.3	V
Δt/Δv	Input transition rise or fall rate	V_{CC} = 1.8 ± 0.15V			20	ns/V
		V_{CC} = 2.5 ± 0.2V			20	
		V_{CC} = 3.3V ± 0.3V			10	
		V_{CC} = 5V ± 0.5V			10	
T_A	Operating free-air temperature	All other packages	-40		125	°C

(1) All unused inputs of the device must be held at VCC or GND to ensure proper device operation. See the application report, Implications of Slow or Floating CMOS Inputs

Electrical Characteristics

Over operating free-air temperature range (unless otherwise noted)(1)

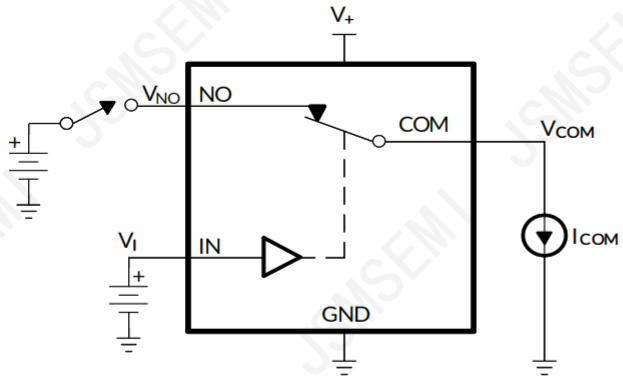
PARAMETER	SYMBOL	CONDITIONS	V+	TA	MIN(2)	TYP(3)	MAX(2)	UNIT
ANALOG SWITCH								
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			FULL	0		V+	V
On-Resistance	R_{ON}	V_{NO} or V_{NC} = 0V to V+, I_{COM} = -10mA, Switch ON, See Figure 1	1.65V	+25°C		60	65	Ω
				FULL			70	Ω
			1.8V	+25°C		42	50	Ω
				FULL			60	Ω
			2.7V	+25°C		11	15	Ω
				FULL			18	Ω
			3.3V	+25°C		7.5	10	Ω
				FULL			10.5	Ω
			5V	+25°C		4.5	7.5	Ω
				FULL			8.5	Ω
On-Resistance Match Between Channels	ΔR_{ON}	V_{NO} or V_{NC} = 0V to V+, I_{COM} = -10mA, Switch ON, See Figure 1	1.65V	+25°C		1	1.2	Ω
				FULL			1.5	Ω
			1.8V	+25°C		0.8	1	Ω
				FULL			1.3	Ω
			2.7V	+25°C		0.25	0.35	Ω
				FULL			0.5	Ω
			3.3V	+25°C		0.15	0.3	Ω
				FULL			0.4	Ω
			5V	+25°C		0.15	0.3	Ω
				FULL			0.4	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{NO} or V_{NC} = 0V to V+, I_{COM} = -10mA, Switch ON, See Figure 1	1.65V	+25°C		51	53	Ω
				FULL			55	Ω
			1.8V	+25°C		38	46	Ω
				FULL			57	Ω
			2.7V	+25°C		6	7	Ω
				FULL			8	Ω
			3.3V	+25°C		3	4	Ω
				FULL			4.3	Ω
			5V	+25°C		2	3	Ω
				FULL			3.3	Ω
NC, NO OFF Leakage Current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NO} or V_{NC} = 0.3V, V+/2 V_{COM} = V+/2, 0.3V See Figure 2	1.65V to 5.5V	FULL			1	μA
NC, NO,COM ON Leakage Current	$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$	V_{NO} or V_{NC} = 0.3V, Open V_{COM} = Open, 0.3V See Figure 3	1.65V to 5.5V	FULL			1	μA
Input Leakage Current	I_{IN}	V_{IN} = V+ or 0	1.65V to 5.5V	FULL			1	μA

(1) All unused digital inputs of the device must be held at VIO or GND to ensure proper device operation.
(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

Over operating free-air temperature range (unless otherwise noted)(1)

PARAMETER	SYMBOL	CONDITIONS		V_+	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS									
Propagation delay	t_{pd}	t_{PLH} & t_{PHL}, R_L=500Ω, C_L=50pF, See Figure 6		1.65V to 1.95V	FULL		6	9	ns
				2.3V to 5.5V	FULL		2	2.4	
Turn-On Time	t_{ON}	t_{PZH} & t_{PZL}, R_L=500Ω, C_L=50pF, See Figure 7		1.65V	+25°C		14.5	17	ns
					FULL	6		28	
				1.8V	+25°C		12.5	13	
					FULL	5		20	
				2.7V	+25°C		7	8	
					FULL	2.5		12	
				3.3V	+25°C		5.5	6.5	
					FULL	2		10	
				5V	+25°C		4	5	
					FULL	1.5		7.5	
Turn-Off Time	t_{OFF}	t_{PLZ} & t_{PHZ}, R_L=500Ω, C_L=50pF, See Figure 7		1.65V	+25°C		10	13	ns
					FULL	5		21	
				1.8V	+25°C		8.5	12	
					FULL	4		18	
				2.7V	+25°C		5	7.5	
					FULL	2		12	
				3.3V	+25°C		4	6	
					FULL	1.5		9	
				5V	+25°C		3.5	4	
					FULL	1.5		6	
Break-Before-Make Time Delay	t_{BBM}	R_L=50Ω, C_L=50pF, See Figure 8		1.65V to 1.95V	FULL		9		ns
				2.3V to 5.5V	FULL		6		
Off Isolation	O_{ISO}	R_L = 50Ω, Switch OFF, See Figure 10	f = 10MHz		+25°C		-58		dB
			f = 1MHz		+25°C		-75		dB
Cross talk	X_{TALK}	R_L = 50Ω, Switch OFF, See Figure 11	f = 10MHz		+25°C		-59		dB
			f = 1MHz		+25°C		-76		dB
-3dB Bandwidth	BW	Switch ON, R_L = 50Ω, See Figure 9		1.65V to 1.95V	+25°C		340		MHz
				2.3V to 5.5V	+25°C		340		MHz
Charge injection	Q_{INJ}	C_L = 0.1nF, See Figure 12		1.65V	+25°C		3.3		pC
				1.8V	+25°C		3.5		pC
				2.7V	+25°C		4		pC
				3.3V	+25°C		5		pC
				5V	+25°C		8		pC
NC, NO OFF Capacitance	$C_{NC(OFF)}$, $C_{NO(OFF)}$	V_{NC} or V_{NO}=V+/2 or GND, Switch OFF, See Figure 4			+25°C		9		pF
NC, NO, COM ON Capacitance	$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$	V_{NC} or V_{NO}=V+/2 or GND, Switch ON, See Figure 4			+25°C		16		pF
POWER REQUIREMENTS									
Power Supply Range	V_+				FULL	1.65		5.5	V
Power Supply Current	I_+	V_{IN} = GND or V_+		5.5V	FULL			1	μA

Parameter Measurement Information

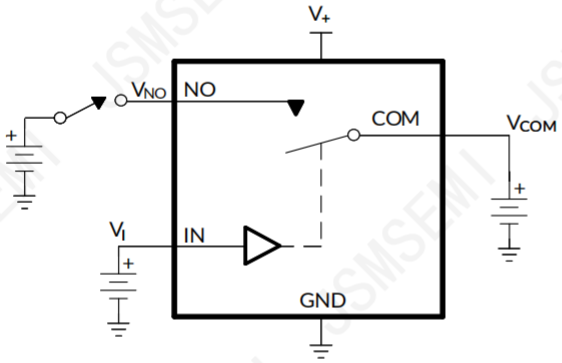


Channel ON

$r_{on} = \frac{V_{COM} - V_{NO}}{I_{COM}}$ Ω

$V_I = V_{IH}$ or V_{IL}

Figure 1. ON-State Resistance (R_{on})

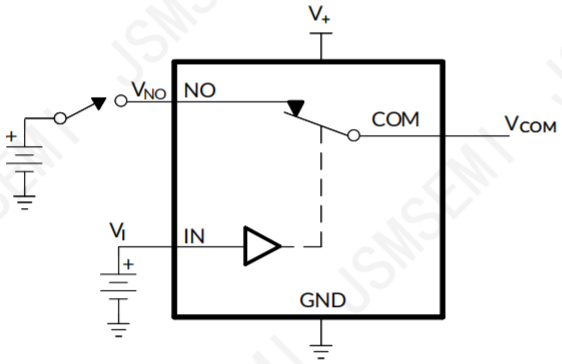


OFF-State Leakage Current

Channel OFF

$V_I = V_{IH}$ or V_{IL}

Figure 2. OFF-State Leakage Current ($I_{COM\ (OFF)}$, $I_{NO\ (OFF)}$)

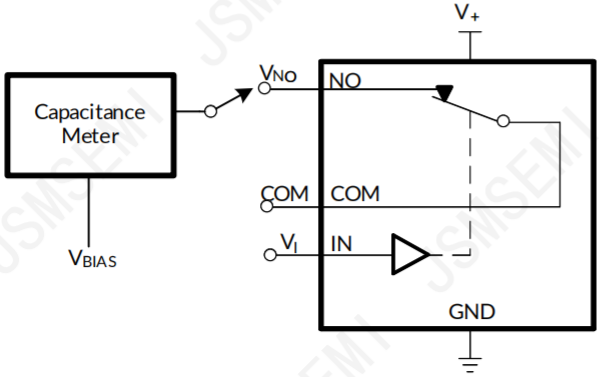


ON-State Leakage Current

Channel ON

$V_I = V_{IH}$ or V_{IL}

Figure 3. ON-State Leakage Current ($I_{COM\ (ON)}$, $I_{NO\ (ON)}$)

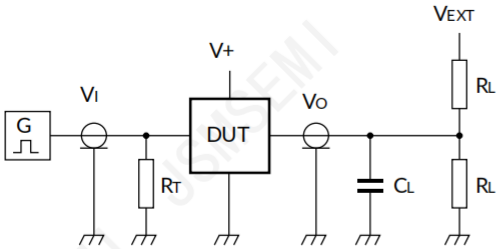


V_{BIAS} = V_+, V_{IO}, or GND and

V_I = V_{IO} or GND

Capacitance is measured at NO, COM, and IN inputs during ON and OFF conditions.

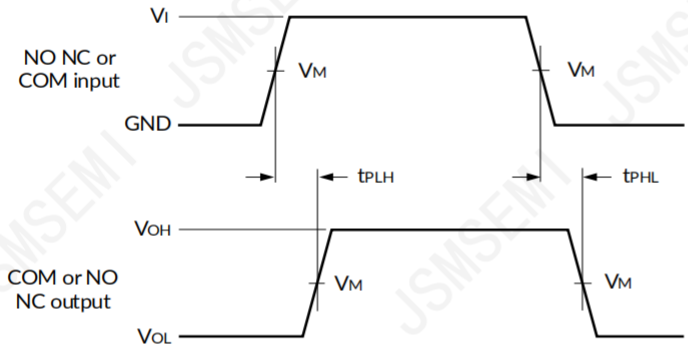
Figure 4. Capacitance (C_I, $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NO(OFF)}$, $C_{NO(ON)}$)



Supply voltage	Input		Load		VEXT		
V+	VI	tr, tf	CL	RL	tPLH,tPHL	tPZH,tPHZ	tPZL,tPLZ
1.65V to 1.95V	V+	≤2.0ns	50pF	500Ω	open	GND	2×V+
2.3V to 2.7V	V+	≤2.0ns	50pF	500Ω	open	GND	2×V+
2.7V	V+	≤2.5ns	50pF	500Ω	open	GND	2×V+
3V to 3.6V	V+	≤2.5ns	50pF	500Ω	open	GND	2×V+
4.5V to 5.5V	V+	≤2.5ns	50pF	500Ω	open	GND	2×V+

Definitions test circuit:
RT = Termination resistance should be equal to output impedance Zo of the pulse generator;
CL = Load capacitance including jig and probe capacitance;
RL = Load resistance;
VEXT = External voltage for measuring switching times.

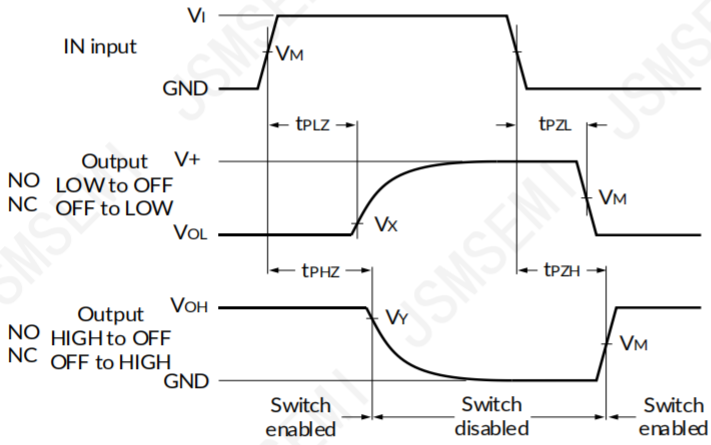
Figure 5. Test circuit for measuring switching times



Supply voltage	V+	1.65 V to 5.5 V
Input	VM	0.5 × V+
Output	VM	0.5 × V+
	VX	VOL + 0.3V
	VY	VOH - 0.3V

Logic levels: VOL and VOH are typical output voltage levels that occur with the output load.

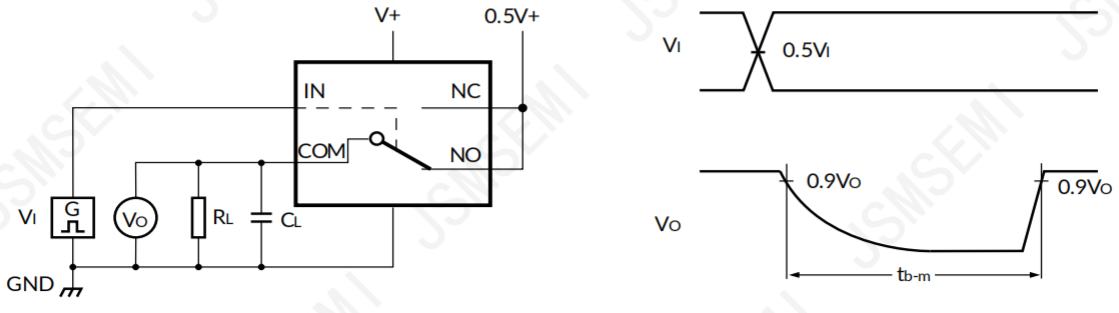
Figure 6. Propagation delay (t_{pd})



Supply voltage	V+	1.65 V to 5.5 V
Input	VM	0.5 × V+
Output	VM	0.5 × V+
	VX	VOL + 0.3V
	VY	VOH - 0.3V

Logic levels: VOL and VOH are typical output voltage levels that occur with the output load.

Figure 7. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})



a. Test circuit

b. Input and output measurement points

Figure 8. Break-Before-Make Time (t_{BBM})

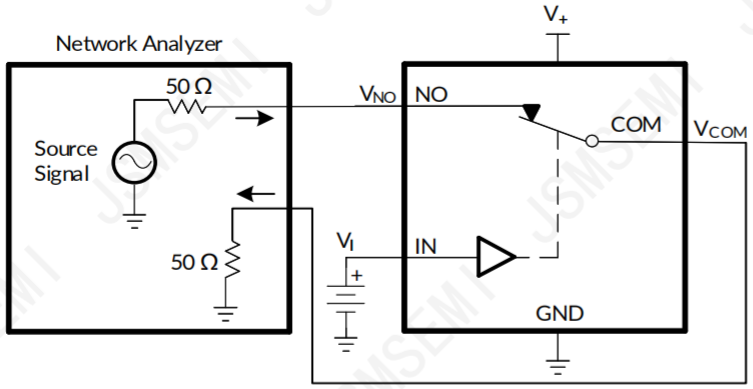


Figure 9. Bandwidth (BW)

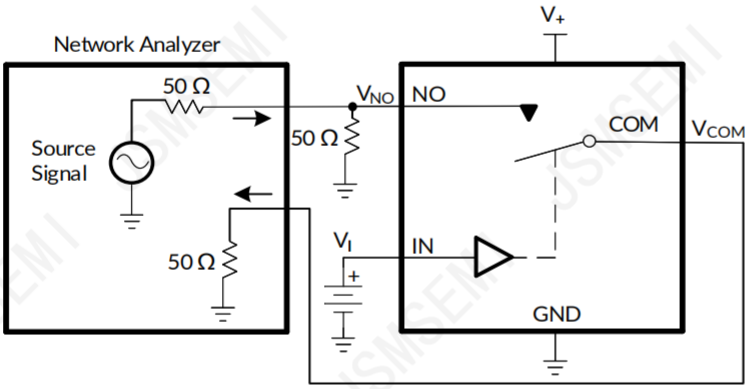


Figure 10. OFF Isolation (O_{ISO})

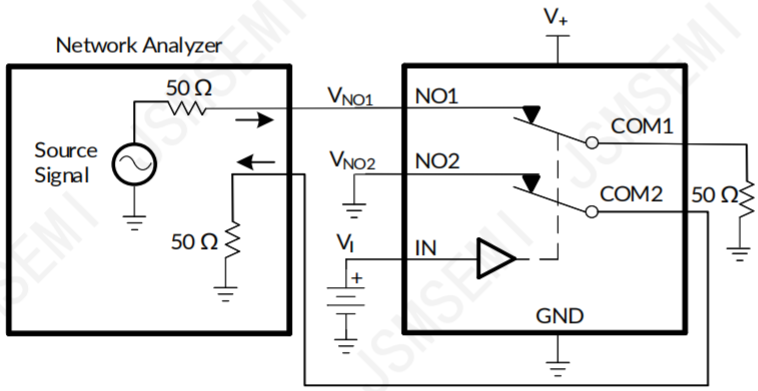


Figure 11. Crosstalk (X_{TALK})

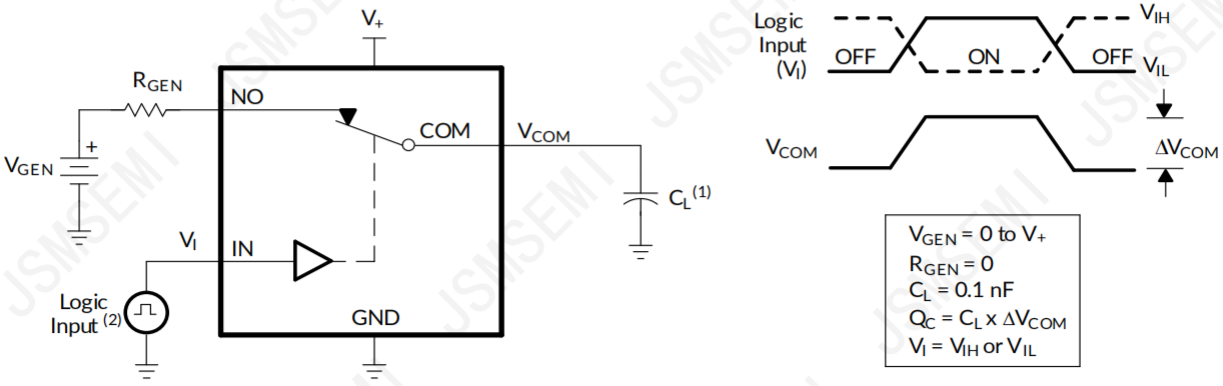


Figure 12. Charge Injection (Q_C)

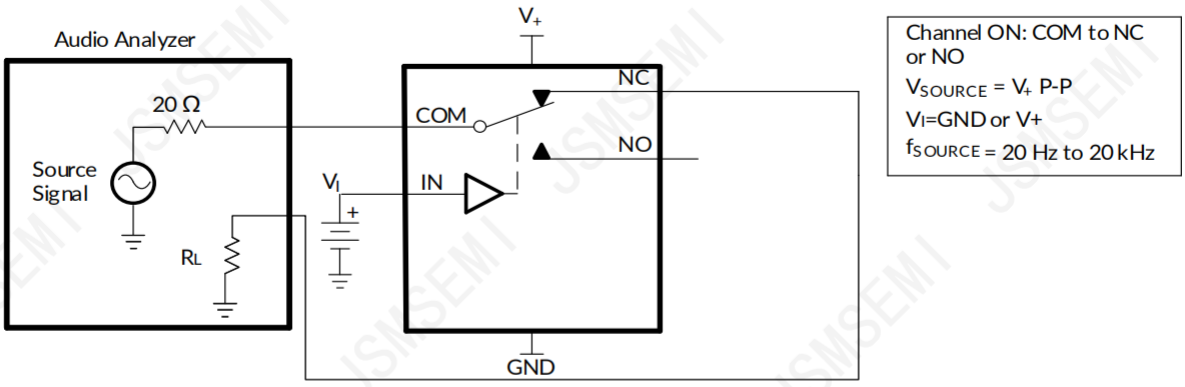


Figure 13. Total Harmonic Distortion (THD)

Application Information

The FSA3157 SPDT analog switch is flexible enough for use in a variety of circuits such as analog audio routing, power-up monitor, memory sharing, and so on.

Typical Application

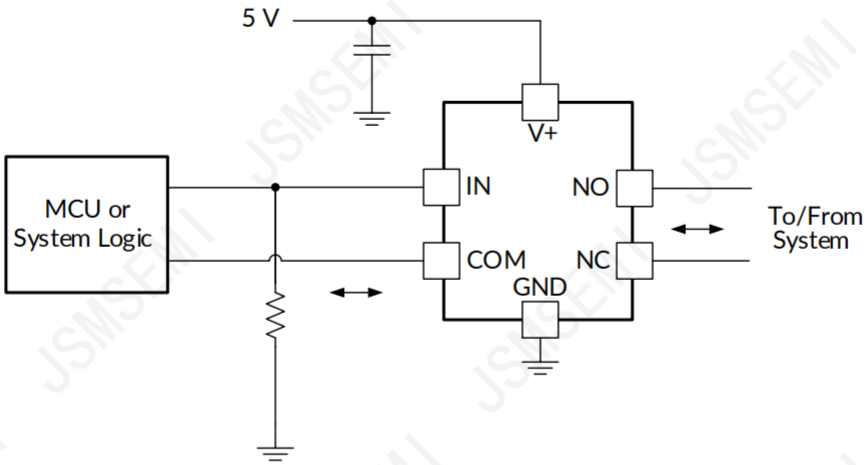


Figure 14. Typical Application Schematic

Design Requirements

The inputs can be analog or digital, but recommends waiting until V_{CC} has ramped to before applying any signals. Appropriate termination resistors should be used depending on the type of signal and specification. The Select pin should not be left floating; either pull up or pull down with a resistor that can be overdriven by a GPIO.

Power Supply Recommendations

Most systems have a common 3.3V or 5V rail that can supply the V_{CC} pin of this device. If this is not available, a Switch-Mode-Power-Supply (SMPS) or a Linear Dropout Regulator (LDO) can be used to provide supply to this device from another voltage rail.

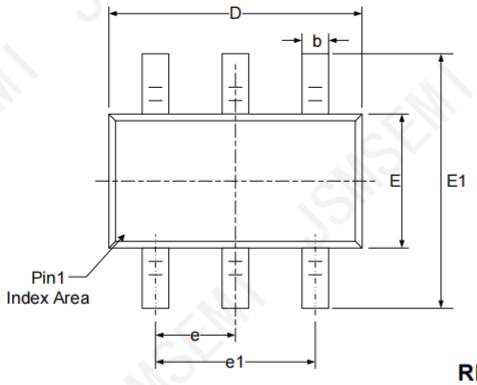
Layout

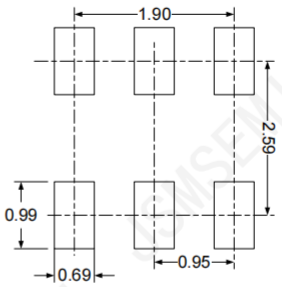
Layout Guidelines

Recommends keeping signal lines as short as possible. also recommends incorporating microstrip or stripline techniques when signal lines are greater than 1 inch in length. These traces must be designed with a characteristic impedance of either 50Ω or 75Ω, as required by the application. Do not place this device too close to high-voltage switching components, as they may interfere with the device.

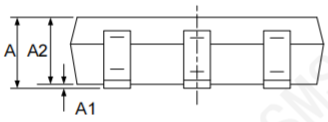
Package Information

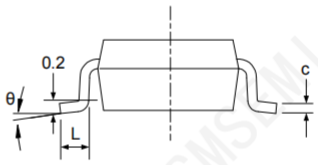
SOT-23-6L





RECOMMENDED LAND PATTERN (Unit: mm)

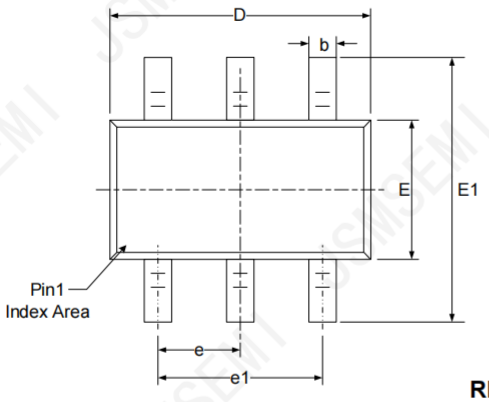


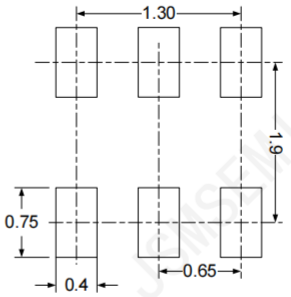


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

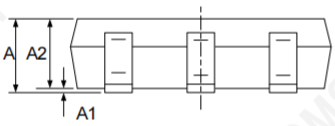
Package Information

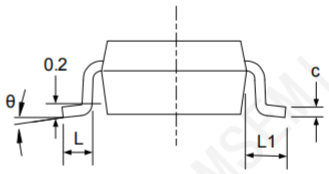
SOT-363(SC70-6)





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650(BSC)		0.026(BSC)	
e1	1.300(BSC)		0.051(BSC)	
L	0.260	0.460	0.010	0.018
L1	0.525		0.021	
θ	0°	8°	0°	8°

Revision History

Rev.	Change	Date
V1.0	Initial version	6/27/2021

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