



# SGM3001/SGM3002 Low ON-Resistance, Low Voltage, SPDT Analog Switch

## GENERAL DESCRIPTION

The SGM3001 (single) and SGM3002 (dual) are bidirectional, low on-resistance, low voltage, single-pole/double-throw (SPDT) CMOS analog switches designed to operate from a single +1.8V to +5.5V supply. Targeted applications include battery powered equipment that benefit from low  $R_{ON}$  (2.5Ω) and fast switching speeds SGM3001 ( $t_{ON} = 11ns$ ,  $t_{OFF} = 30ns$ ) and SGM3002 ( $t_{ON} = 11ns$ ,  $t_{OFF} = 8ns$ ).

The on-resistance profile is very flat over the full analog signal range. This ensures excellent linearity and low distortion when switching audio signals.

The SGM3002 is a committed dual single-pole/double-throw (SPDT) that consist of two normally open (NO) and two normally close (NC) switches. This configuration can be used as a dual 2-to-1 multiplexer.

The single version SGM3001 is available in a SC70-6 package. The dual version SGM3002 is available in a MSOP-10 package.

## APPLICATIONS

Battery powered, Handheld, and Portable Equipment

Cellular/mobile Phones

Laptops, Notebooks, Palmtops

Communication Systems

Sample-and-Hold Circuits

Audio Signal Routing

Audio and Video Switching

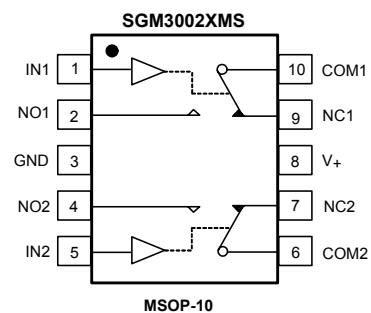
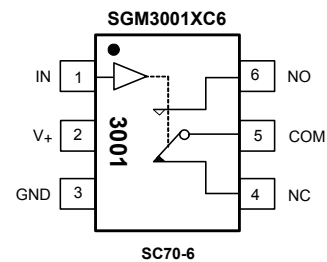
Portable Test and Measurement

Medical Equipment

## FEATURES

- Low Voltage Operation : 1.8V to 5.5V
- Low On-Resistance: 2.5Ω (TYP)
- Low On-Resistance Flatness
- -3dB Bandwidth: 120MHz
- Fast Switching Times
  - $t_{ON}$  11ns
  - $t_{OFF}$  30ns (SGM3001)
  - $t_{OFF}$  8ns (SGM3002)
- Rail-to-Rail Operation
- Typical Power Consumption (<0.01μW)
- TTL/CMOS Compatible
- Microsize Package

## PIN CONFIGURATIONS (TOP VIEW)



## FUNCTION TABLE

LOGIC	NO, NO1, NO2	NC, NC1, NC2
0	OFF	ON
1	ON	OFF

**ORDERING INFORMATION**

MODEL	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM3001	SC70-6	- 40°C to +125°C	SGM3001XC6/TR	3001	Tape and Reel, 3000
SGM3002	MSOP-10	- 40°C to +125°C	SGM3002XMS/TR	SGM3002XMS	Tape and Reel, 3000

Note: SC70-6 package is same as SOT-363 package.

**ABSOLUTE MAXIMUM RATINGS**

V <sub>+</sub> to GND.....	-0.3V to 6V	Operating Temperature Range.....	-40°C to +125°C
Analog, Digital voltage range <sup>(1)</sup> .....	-0.3V to (V <sub>+</sub> ) + 0.3V	Junction Temperature .....	150°C
Continuous Current NO, NC, or COM.....	±150mA	Storage Temperature.....	-65°C to +150°C
Peak Current NO, NC, or COM .....	±250mA	Lead Temperature (soldering, 10s).....	260°C
Package Thermal Resistance @ T <sub>A</sub> = 25°C		ESD Susceptibility	
SC70-6, θ <sub>JA</sub> .....	333°C/W	HBM.....	2000V
MSOP-10, θ <sub>JA</sub> .....	205°C/W	MM.....	400V

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. (1) Signals on NC, NO, or COM or IN exceeding V<sub>+</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

**CAUTION**

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

**PIN DESCRIPTION**

NAME	SC70-6 PIN	MSOP-10 PIN	FUNCTION
V <sub>+</sub>	2	8	Power supply
GND	3	3	Ground
IN(IN1, IN2)	1	1,5	Digital control pin to connect the COM terminal to the NO or NC terminals
COM(COM1, COM2)	5	6,10	Common terminal
NO(NO1, NO2)	6	2,4	Normally-open terminal
NC(NC1, NC2)	4	7,9	Normally-closed terminal

Note: NO, NC and COM terminals may be an input or output.

**ELECTRICAL CHARACTERISTICS**(V<sub>+</sub> = +5V ± 10%, GND = 0V, all Specifications -40°C to +125°C. Typical values are at T<sub>A</sub> = + 25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	SGM3001/3002			
			+25°C	-40°C to +125°C	UNITS	MIN/MAX
<b>ANALOG SWITCH</b>						
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>			0	V	MIN
				V <sub>+</sub>	V	MAX
On-Resistance	R <sub>ON</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	2.5		Ω	TYP
			3.7	4.5	Ω	MAX
On-Resistance Match Between Channels	ΔR <sub>ON</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	0.1		Ω	TYP
			0.8	0.9	Ω	MAX
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	0.75		Ω	TYP
			0.85	0.9	Ω	MAX
<b>LEAKAGE CURRENTS</b>						
Source OFF Leakage Current	I <sub>NC(OFF)</sub> , I <sub>NO(OFF)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 4.5V/1V, V <sub>COM</sub> = 1V/4.5V, V <sub>+</sub> = +5.5V, Test Circuit 2	±5		nA	TYP
			±11	±1000	nA	MAX
Channel ON Leakage Current	I <sub>NC(ON)</sub> , I <sub>NO(ON)</sub> , I <sub>COM(ON)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = V <sub>COM</sub> = 1V or 4.5V, V <sub>+</sub> = +5.5V, Test Circuit 3	±5		nA	TYP
			±11	±1000	nA	MAX
<b>DIGITAL INPUTS</b>						
Input High Voltage	V <sub>INH</sub>			2.4	V	MIN
Input Low Voltage	V <sub>INL</sub>			0.8	V	MAX
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = V <sub>INH</sub> or V <sub>INL</sub>	±0.01		μA	TYP
			±0.1	±1	μA	MAX
<b>DYNAMIC CHARACTERISTICS</b>						
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	11		ns	TYP
Turn-Off Time	SGM3001	V <sub>NO</sub> or V <sub>NC</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	30		ns	TYP
	SGM3002		8		ns	TYP
Charge Injection	Q	C <sub>L</sub> = 1.0nF, V <sub>G</sub> = 0V, R <sub>G</sub> = 0Ω, Test Circuit 5	3		pC	TYP
Break-Before-Make Time Delay	t <sub>D</sub>	V <sub>NO1</sub> or V <sub>NC1</sub> = V <sub>NO2</sub> or V <sub>NC2</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 6	10		ns	TYP
Off Isolation	O <sub>ISO</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 7	f = 10MHz	-45	dB	TYP
			f = 1MHz	-65	dB	TYP
Channel-to-Channel Crosstalk (SGM3002 Only)	X <sub>TALK</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 8	f = 10MHz	-35	dB	TYP
			f = 1MHz	-55	dB	TYP
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, V <sub>COM</sub> = 3.5V <sub>P-P</sub> , R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF	0.006		%	TYP
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 9	120		MHz	TYP
Source OFF Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>		14		pF	TYP
Channel ON Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>		53		pF	TYP
<b>POWER REQUIREMENTS</b>						
Power Supply Current	I <sub>+</sub>	V <sub>+</sub> = +5.5V, V <sub>IN</sub> = 0V or 5V	0.001		μA	TYP
				1	μA	MAX

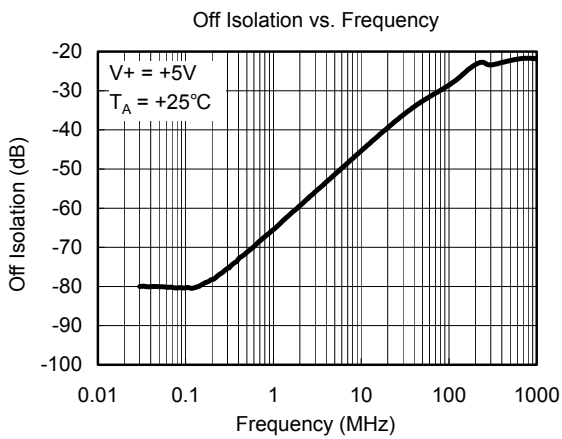
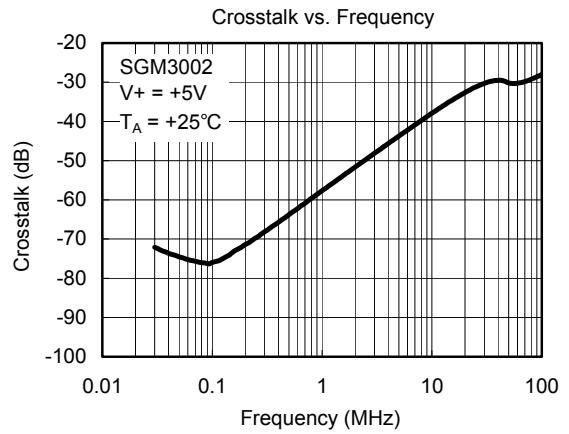
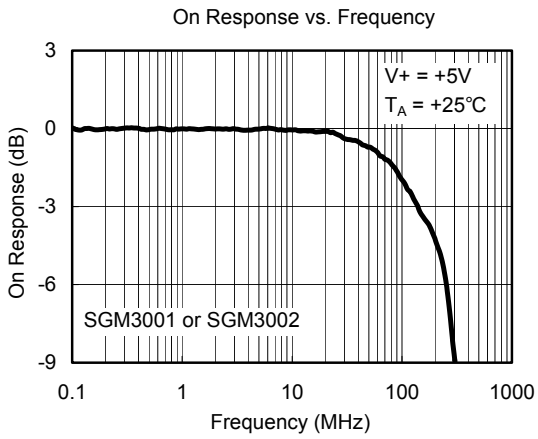
Specifications subject to changes without notice.

**ELECTRICAL CHARACTERISTICS**(V<sub>+</sub> = +3V ± 10%, GND = 0V, all Specifications -40°C to +125°C. Typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

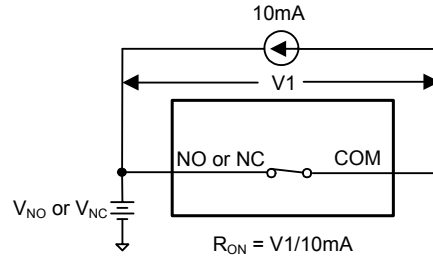
PARAMETER	SYMBOL	CONDITIONS	SGM3001/3002			
			+25°C	-40°C to +125°C	UNITS	MIN/MAX
<b>ANALOG SWITCH</b>						
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>			0	V	MIN
				V <sub>+</sub>	V	MAX
On-Resistance	R <sub>ON</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	2.9	3	Ω	TYP
			4.4	6	Ω	MAX
On-Resistance Match Between Channels	ΔR <sub>ON</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	0.1		Ω	TYP
			0.8	0.9	Ω	MAX
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10mA, Test Circuit 1	0.9		Ω	TYP
			1	1.2	Ω	MAX
<b>LEAKAGE CURRENTS</b>						
Source OFF Leakage Current	I <sub>NC(OFF)</sub> , I <sub>NO(OFF)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3V/1V, V <sub>COM</sub> = 1V/3V, V <sub>+</sub> = +3.3V, Test Circuit 2	±7		nA	TYP
			±13	±1000	nA	MAX
Channel ON Leakage Current	I <sub>NC(ON)</sub> , I <sub>NO(ON)</sub> , I <sub>COM(ON)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = V <sub>COM</sub> = 1V or 3V, V <sub>+</sub> = +3.3V, Test Circuit 3	±7		nA	TYP
			±13	1000	nA	MAX
<b>DIGITAL INPUTS</b>						
Input High Voltage	V <sub>INH</sub>			2.0	V	MIN
Input Low Voltage	V <sub>INL</sub>			0.4	V	MAX
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = V <sub>INH</sub> or V <sub>INL</sub>	±0.01		μA	TYP
			±0.1	±1	μA	MAX
<b>DYNAMIC CHARACTERISTICS</b>						
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	12		ns	TYP
Turn-Off Time	SGM3001	V <sub>NO</sub> or V <sub>NC</sub> = 2V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	31		ns	TYP
	SGM3002		9		ns	TYP
Charge Injection	Q	C <sub>L</sub> = 1.0nF, V <sub>G</sub> = 0V, R <sub>G</sub> = 0Ω, Test Circuit 5	3		pC	TYP
Break-Before-Make Time Delay	t <sub>D</sub>	V <sub>NO1</sub> or V <sub>NC1</sub> = V <sub>NO2</sub> or V <sub>NC2</sub> = 2V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 6	11		ns	TYP
Off Isolation	O <sub>ISO</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 7	f = 10MHz	-45	dB	TYP
			f = 1MHz	-65	dB	TYP
Channel-to-Channel Crosstalk (SGM3002 Only)	X <sub>TALK</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 8	f = 10MHz	-35	dB	TYP
			f = 1MHz	-55	dB	TYP
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, V <sub>COM</sub> = 2V <sub>P-P</sub> , R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF	0.005		%	TYP
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 9	120		MHz	TYP
Source OFF Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>		14		pF	TYP
Channel ON Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>		53		pF	TYP
<b>POWER REQUIREMENTS</b>						
Power Supply Current	I <sub>+</sub>	V <sub>+</sub> = +3.3V, V <sub>IN</sub> = 0V or 3V	0.001		μA	TYP
				1	μA	MAX

Specifications subject to changes without notice.

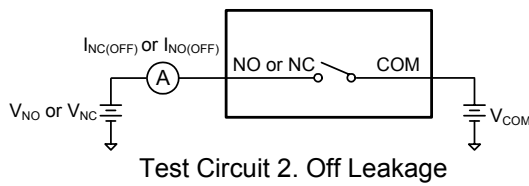
TYPICAL PERFORMANCE CHARACTERISTICS



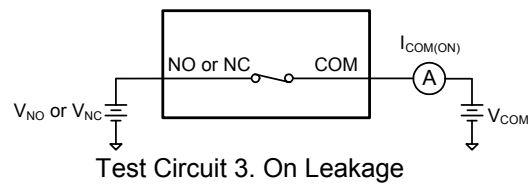
TEST CIRCUITS



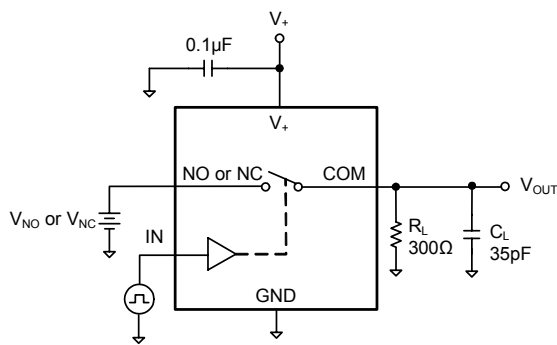
Test Circuit 1. On Resistance



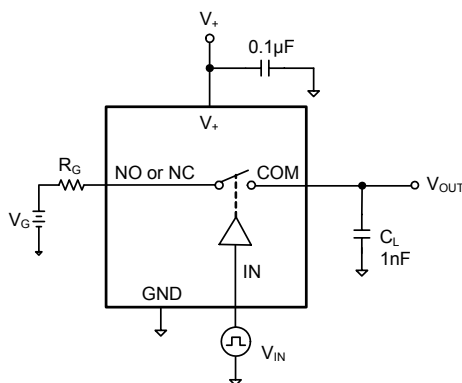
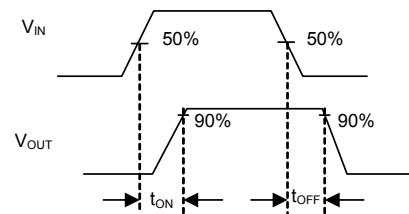
Test Circuit 2. Off Leakage



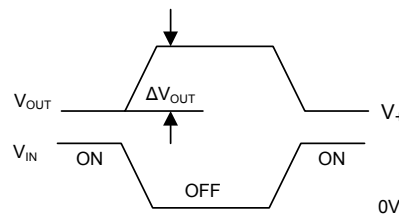
Test Circuit 3. On Leakage



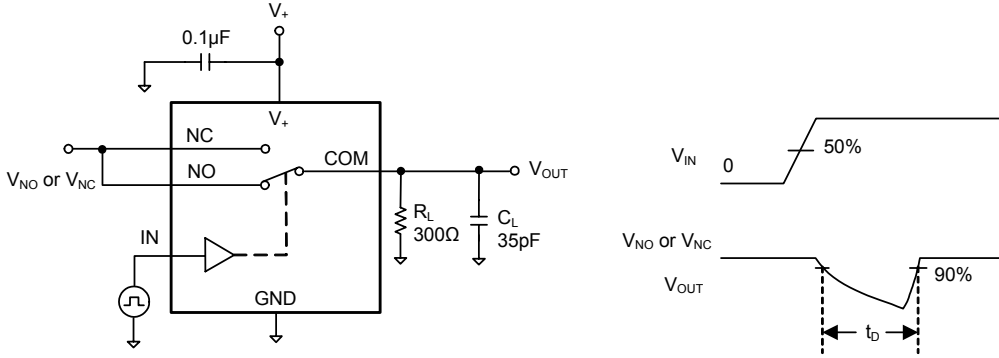
Test Circuit 4. Switching Times



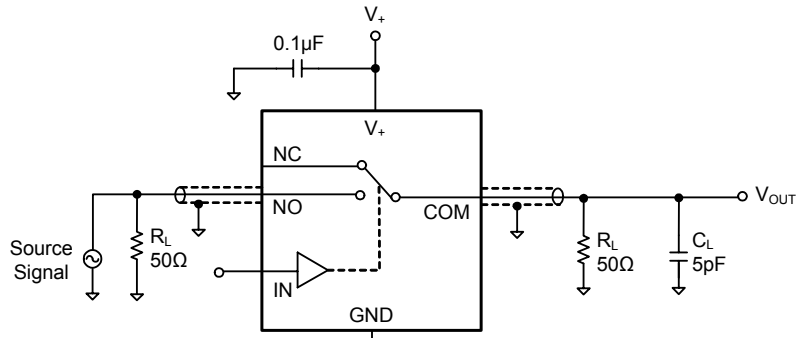
Test Circuit 5. Charge Injection



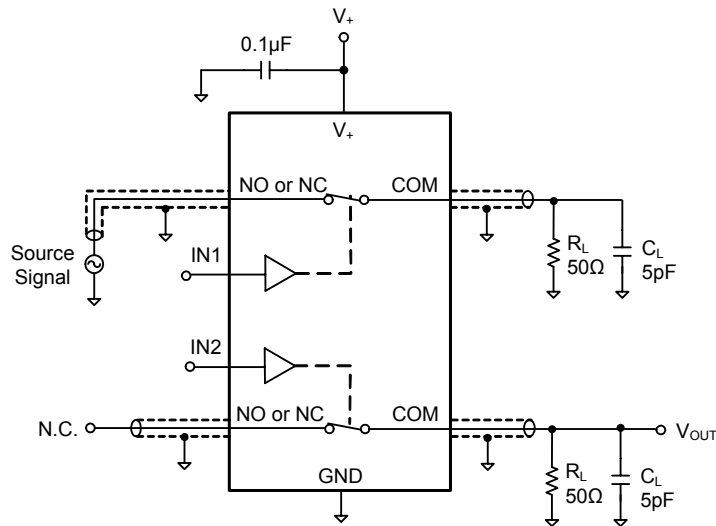
TEST CIRCUITS (Cont.)



Test Circuit 6. Break-Before-Make Time Delay,  $t_b$



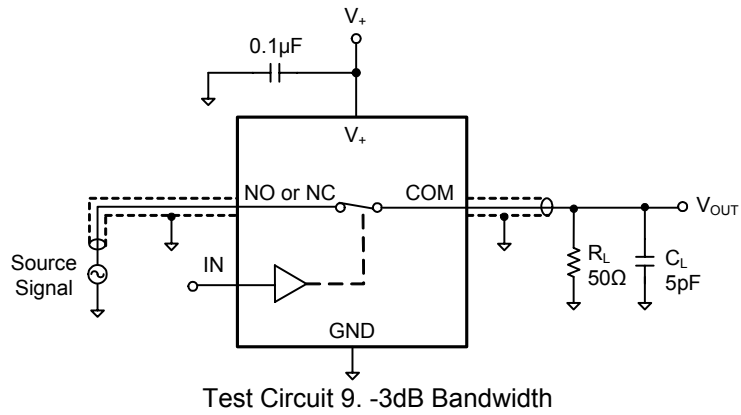
Test Circuit 7. Off Isolation



$$\text{Channel To Channel Crosstalk} = -20 \times \log \frac{V_{NO \text{ or } V_{NC}}}{V_{OUT}}$$

Test Circuit 8. Channel-to-Channel Crosstalk

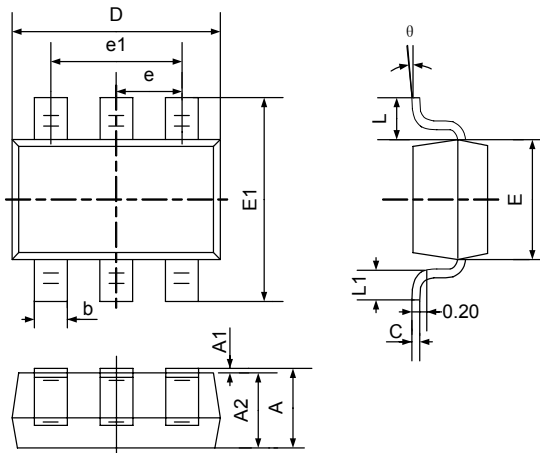
TEST CIRCUITS (Cont.)





PACKAGE OUTLINE DIMENSIONS

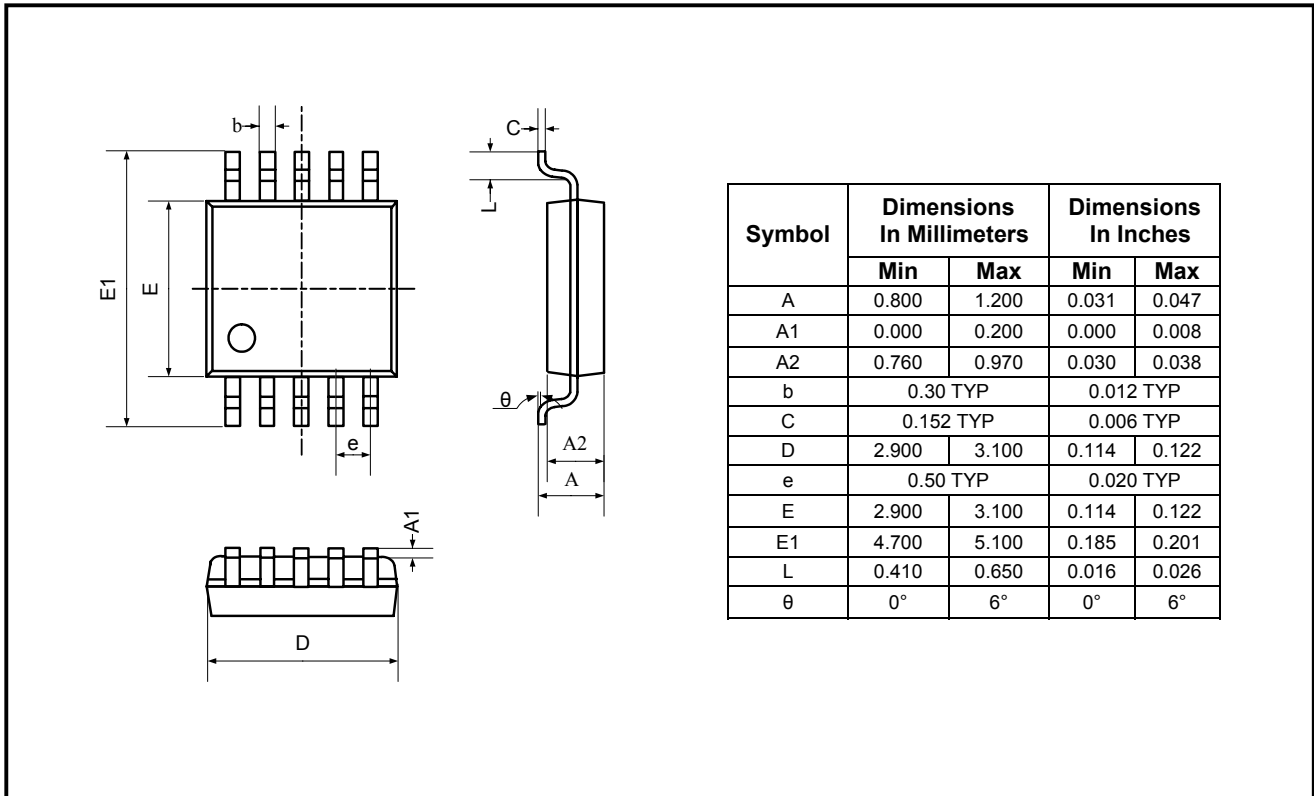
SC70-6 / SOT-363



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	0.650TYP		0.026TYP	
e1	1.200	1.400	0.047	0.055
L	0.525REF		0.021REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

MSOP-10



12/2008 REV. C. 2

SGMICRO is dedicated to provide high quality and high performance analog IC products to customers. All SGMICRO products meet the highest industry standards with strict and comprehensive test and quality control systems to achieve world-class consistency and reliability.

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