

# 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  $R_{ON}$  ( $2.5\Omega$ ) and fast switching speeds SGM3001 ( $t_{ON} = 11\text{ ns}$ ,  $t_{OFF} = 30\text{ ns}$ ) and SGM3002 ( $t_{ON} = 11\text{ ns}$ ,  $t_{OFF} = 8\text{ ns}$ ).

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 Equipments

Cellular/mobile Phones

Laptops, Notebooks, Palmtops

Communication Systems

Sample-and-Hold Circuits

Audio Signal Routing

Audio and Video Switching

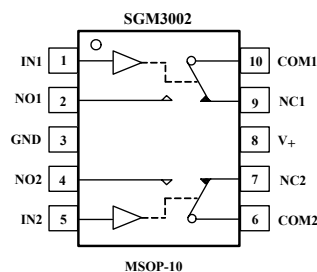
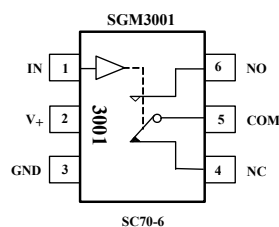
Portable Test and Measurement

Medical Equipment

## FEATURES

- Low Voltage Operation : 1.8 V to 5.5 V
- Low On-Resistance:  $2.5\Omega$ (TYP)
- Low On-Resistance Flatness
- $-3\text{ dB}$  Bandwidth: 120 MHz
- Fast Switching Time
  - $t_{ON}$  11 ns
  - $t_{OFF}$  30 ns (SGM3001)
  - $t_{OFF}$  8 ns(SGM3002)
- Rail-to-Rail Operation
- Typical Power Consumption (<0.01  $\mu\text{W}$ )
- 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

## ABSOLUTE MAXIMUM RATINGS

V <sub>+</sub> to GND.....	- 0.3V to +6V	Operating Temperature Range.....	- 40°C to +125°C
Analog, Digital voltage range(1).....	- 0.3V to V <sub>+</sub> + 0.3V	Junction Temperature.....	+150°C
Continuous Current NO, NC, or COM.....	± 300mA	Storage Temperature.....	- 65°C to +150°C
Peak Current NO, NC, or COM.....	± 500mA	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.

## 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 terminal may be an input or output.

# ELECTRICAL CHARACTERISTICS

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

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> = -10 mA, 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> = -10 mA, 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> = -10 mA, 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> = 0, 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
Bandwidth -3 dB	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 change without notice.

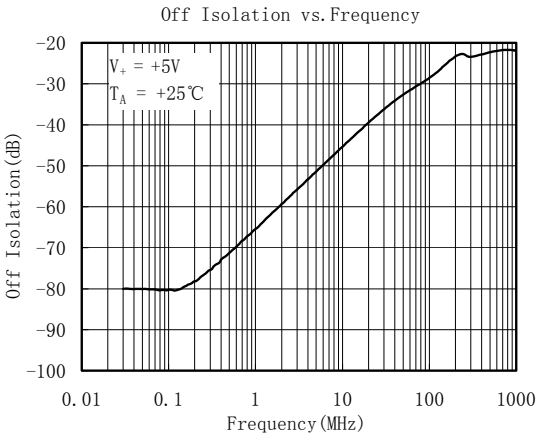
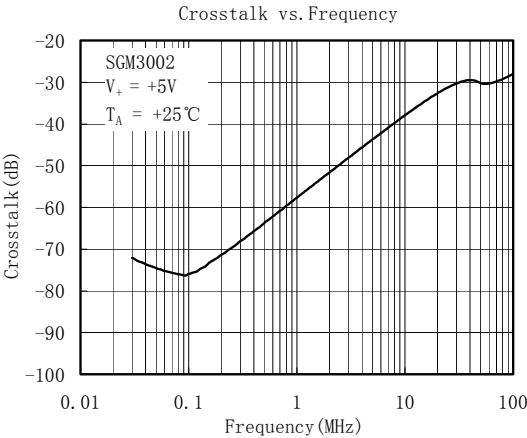
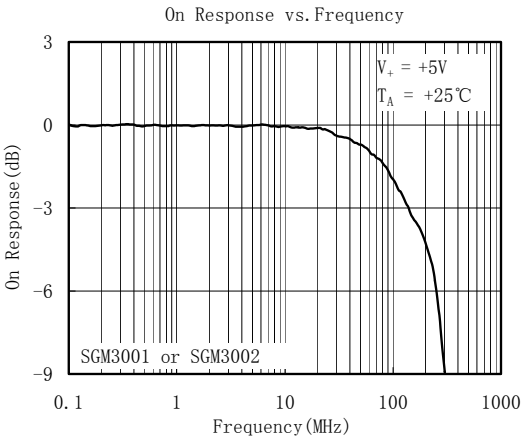
# ELECTRICAL CHARACTERISTICS

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

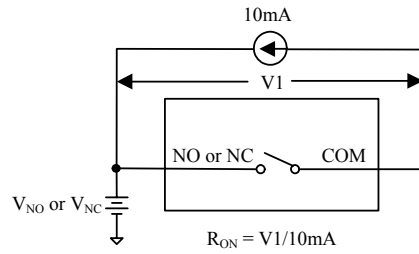
PARAMETER	SYMBOL	CONDITIONS	SGM3001/3002			
			+25°C	- 40°C to +125°C	UNITS	MIN/ MAX
<b>ANALOG SWITCH</b>						
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>			0	V	MIN
				V <sub>+</sub>	V	MAX
On-Resistance	R <sub>ON</sub>	0 ≤ V <sub>NO</sub> or V <sub>NC</sub> ≤ V <sub>+</sub> , I <sub>COM</sub> = -10 mA, 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> = -10 mA, 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> = -10 mA, 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> = 0, 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
Bandwidth -3 dB	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 change without notice.

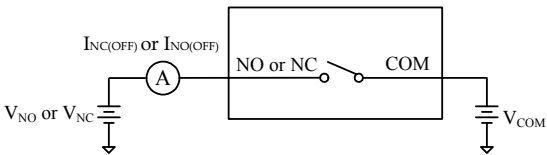
# TYPICAL PERFORMANCE CHARACTERISTICS



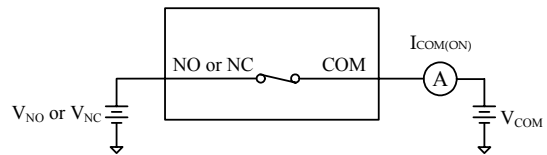
# TEST CIRCUITS



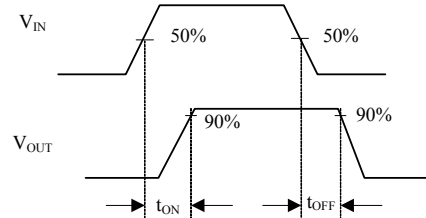
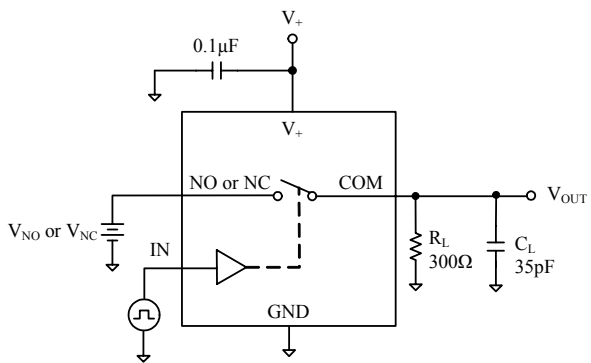
Test Circuit 1. On Resistance



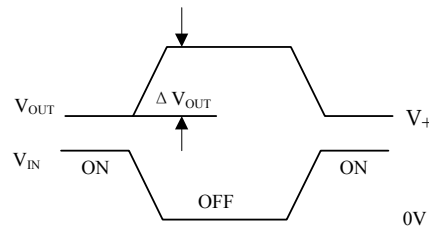
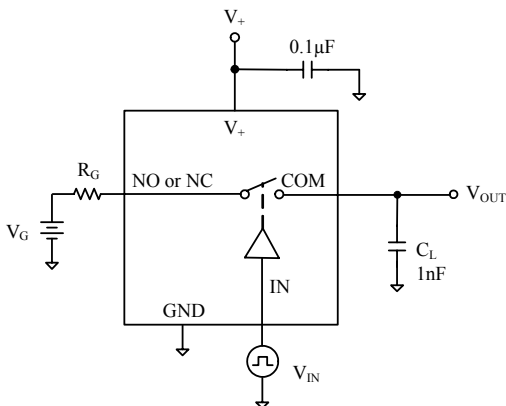
Test Circuit 2: Off Leakage



Test Circuit 3: On Leakage

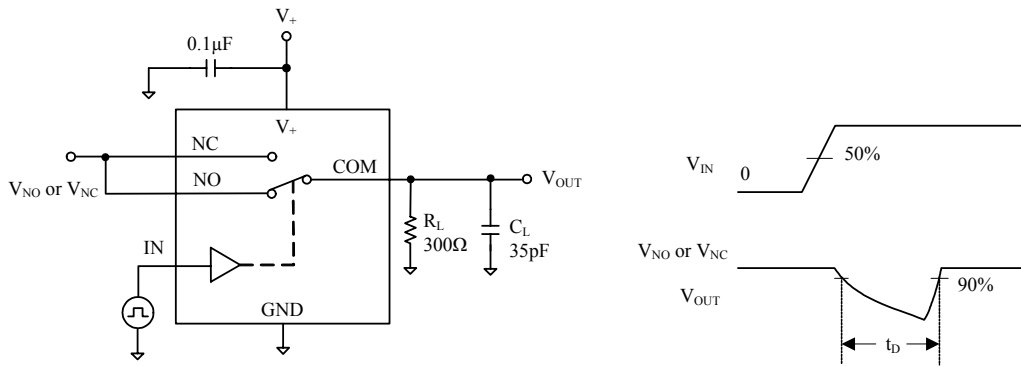


Test Circuit 4: Switching Times

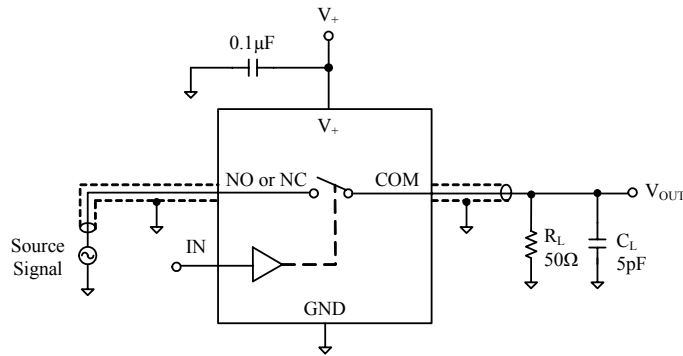


Test Circuit 5: Charge Injection

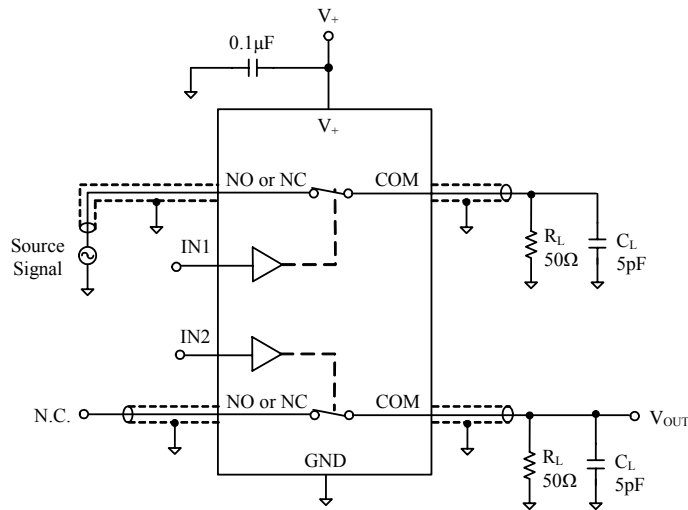
## TEST CIRCUITS(Cont.)



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



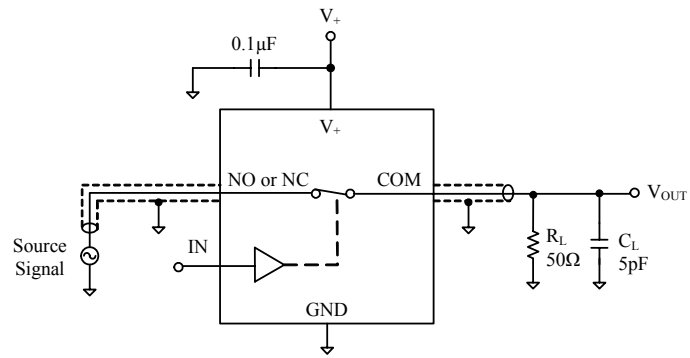
Test Circuit 7. Off Isolation



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

Test Circuit 8. Channel-to-Channel Crosstalk

## TEST CIRCUITS (Cont.)

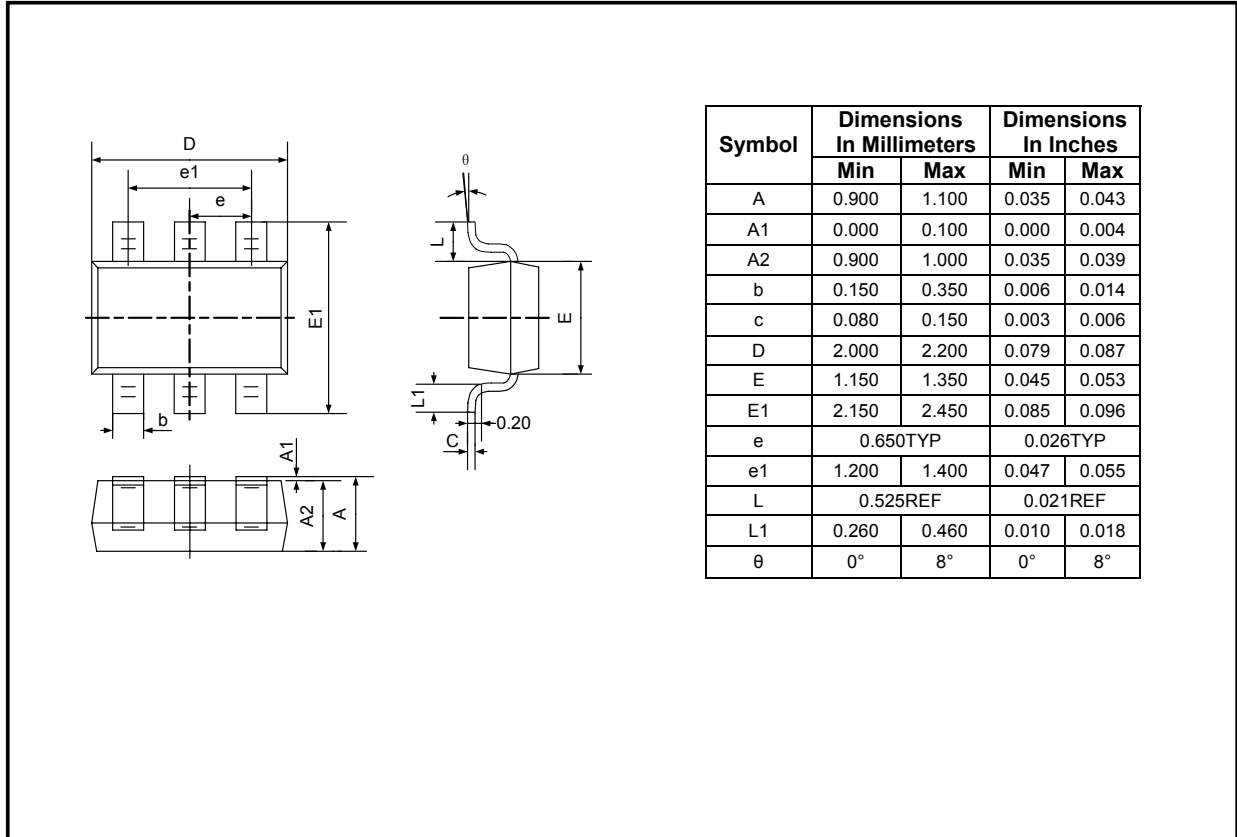


Test Circuit 9. Bandwidth



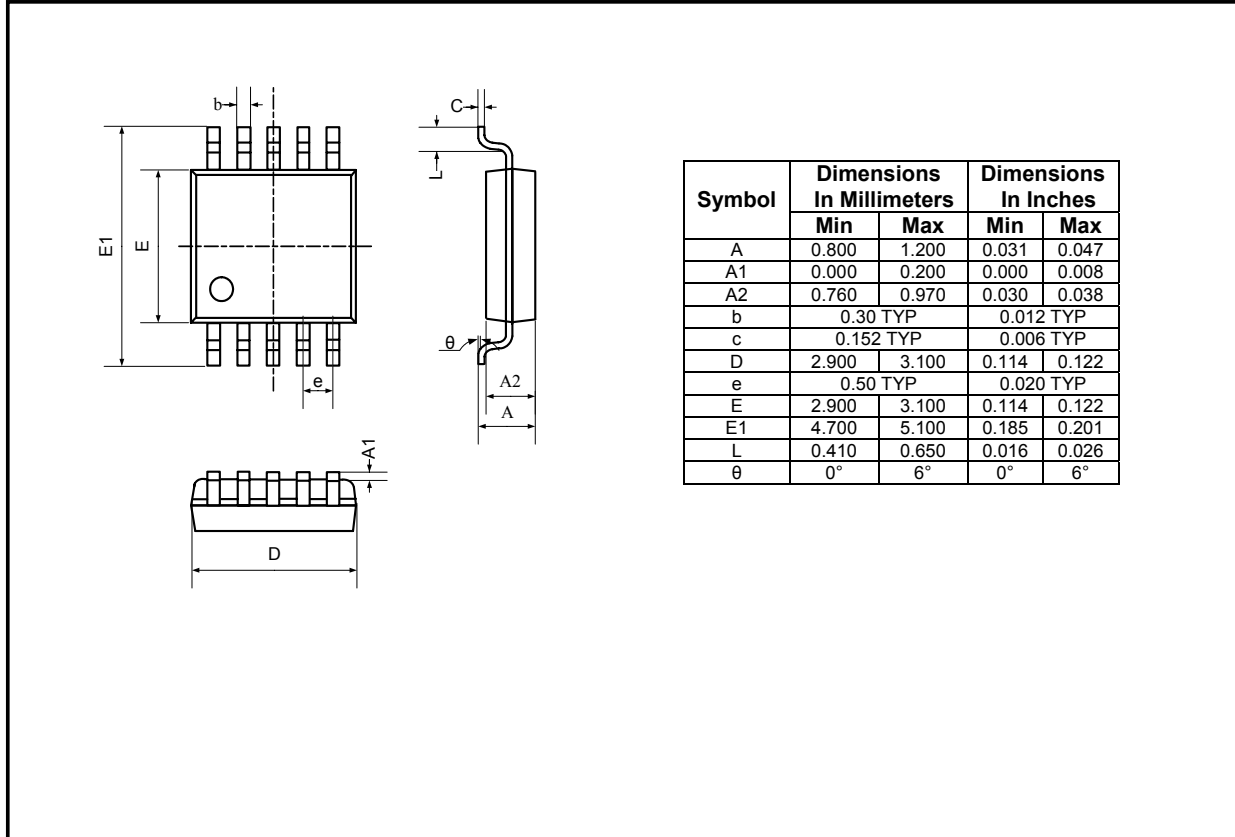
# PACKAGE OUTLINE DIMENSIONS

## SC70-6



# PACKAGE OUTLINE DIMENSIONS

## MSOP-10



## REVISION HISTORY

Location	Page
<b>11/06— Data Sheet changed from REV.A to REV.B</b>	
Changes to ABSOLUTE MAXIMUM RATINGS .....	2
<b>10/07— Data Sheet changed from REV.B to REV.C</b>	
Deletes to TYPICAL PERFORMANCE CHARACTERISTICS .....	5

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