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

FEATURES

- **Low Voltage Operation Range: 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 Packages**
  - **SGM3001 Available in a Green SC70-6 Package**
  - **SGM3002 Available in a Green 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

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3001	SC70-6	-40℃ to +125℃	SGM3001XC6/TR	3001	Tape and Reel, 3000
SGM3002	MSOP-10	-40℃ to +125℃	SGM3002XMS/TR	SGM3002 XMS XXXXX	Tape and Reel, 3000

NOTE: XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

V_+ to GND .... -0.3V to 6V
Analog, Digital Voltage Range [1] .... -0.3V to (V_+) + 0.3V
Continuous Current NO, NC, or COM .... ±150mA
Peak Current NO, NC, or COM .... ±250mA
Package Thermal Resistance @ T_A = +25℃
SC70-6, θ_{JA} .... 333℃/W
MSOP-10, θ_{JA} .... 205℃/W
Junction Temperature .... +150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) .... +260℃
ESD Susceptibility
HBM 2000V
MM 400V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range .... -40℃ to +125℃

NOTE:
1. Signals on NC, NO, or COM or IN exceeding V_+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY 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.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS

SGM3001 (TOP VIEW)

SC70-6

SGM3002 (TOP VIEW)
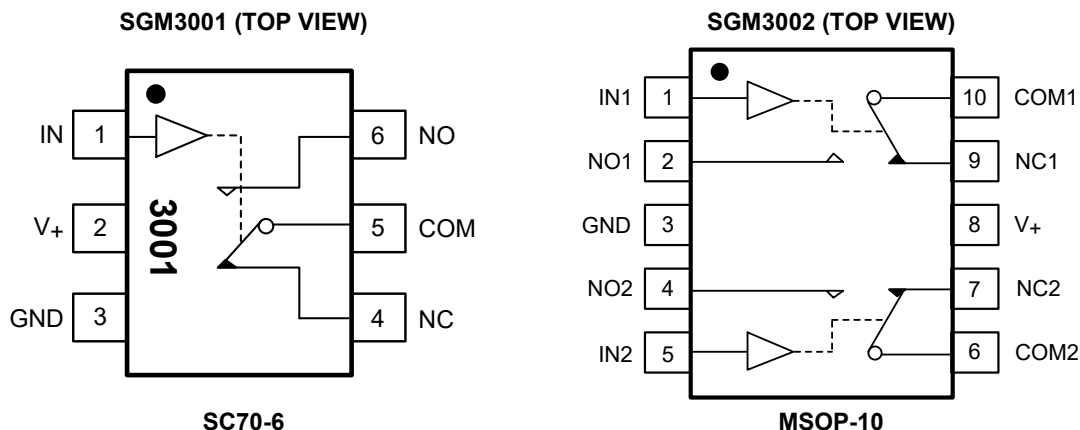
MSOP-10

PIN DESCRIPTION

PIN		NAME	FUNCTION
SC70-6	MSOP-10		
1	1, 5	IN (IN1, IN2)	Digital Control Pin to Connect the COM Terminal to the NO or NC Terminals.
2	8	V$_+$	Power Supply.
3	3	GND	Ground.
4	7, 9	NC (NC1, NC2)	Normally-Closed Terminal.
5	6, 10	COM (COM1, COM2)	Common Terminal.
6	2, 4	NO (NO1, NO2)	Normally-Open Terminal.

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

FUNCTION TABLE

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

ELECTRICAL CHARACTERISTICS

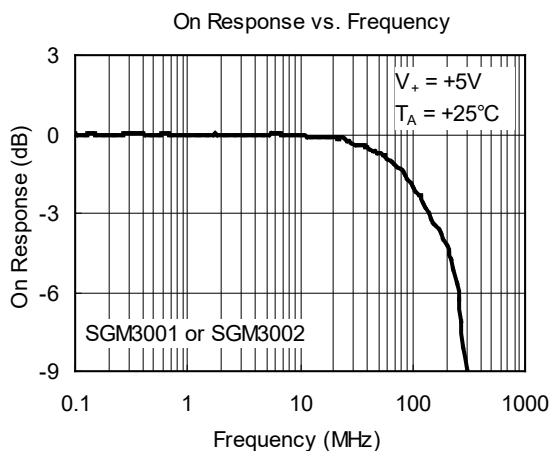(V_+ = 5V ± 10%, GND = 0V, Full = -40℃ to +125℃. Typical values are at T_A = +25℃, unless otherwise noted.)

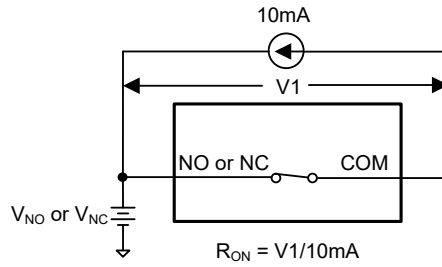| PARAMETER	SYMBOL	CONDITIONS	SGM3001/SGM3002			UNITS	MIN/MAX
			+25℃	-40℃ to +125℃			
Analog Switch							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			0		V	MIN
				V_+		V	MAX
On-Resistance	R_{ON}	$0 \leq V_{NO}$ or $V_{NC} \leq V_+$, I_{COM} = -10mA, Test Circuit 1	2.5			Ω	TYP
			3.7	4.5		Ω	MAX
On-Resistance Match between Channels	ΔR_{ON}	$0 \leq V_{NO}$ or $V_{NC} \leq V_+$, I_{COM} = -10mA, Test Circuit 1	0.1			Ω	TYP
			0.8	0.9		Ω	MAX
On-Resistance Flatness	$R_{FLAT(ON)}$	$0 \leq V_{NO}$ or $V_{NC} \leq V_+$, I_{COM} = -10mA, Test Circuit 1	0.75			Ω	TYP
			0.85	0.9		Ω	MAX
Leakage Currents							
Source Off Leakage Current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NO} or V_{NC} = 4.5V/1V, V_{COM} = 1V/4.5V, V_+ = 5.5V ,Test Circuit 2	±5			nA	TYP
			±11	±1000		nA	MAX
Channel On Leakage Current	$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$	V_{NO} or V_{NC} = V_{COM} = 1V or 4.5V, V_+ = 5.5V , Test Circuit 3	±5			nA	TYP
			±11	±1000		nA	MAX
Digital Inputs							
Input High Voltage	V_{INH}			2.4		V	MIN
Input Low Voltage	V_{INL}			0.8		V	MAX
Input Current	I_{INL} or I_{INH}	V_{IN} = V_{INH} or V_{INL}	±0.01			μA	TYP
			±0.1	±1		μA	MAX
Dynamic Characteristics							
Turn-On Time		t_{ON}	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 4	11		ns	TYP
Turn-Off Time	SGM3001	t_{OFF}	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 4	30		ns	TYP
	SGM3002			8		ns	TYP
Charge Injection		Q	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, Test Circuit 5	3		pC	TYP
Break-Before-Make Time Delay		t_D	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 6	10		ns	TYP
Off Isolation		O_{ISO}	R_L = 50Ω, C_L = 5pF, Test Circuit 7, f = 10MHz	-45		dB	TYP
			f = 1MHz	-65		dB	TYP
Channel-to-Channel Crosstalk (SGM3002 Only)		X_{TALK}	R_L = 50Ω, C_L = 5pF, Test Circuit 8, f = 10MHz	-35		dB	TYP
			f = 1MHz	-55		dB	TYP
Total Harmonic Distortion		THD	f = 20Hz to 20kHz, V_{COM} = 3.5V_{P-P}, R_L = 600Ω, C_L = 50pF	0.006		%	TYP
-3dB Bandwidth		BW	R_L = 50Ω, C_L = 5pF, Test Circuit 9	120		MHz	TYP
Source Off Capacitance		$C_{NC(OFF)}$, $C_{NO(OFF)}$		14		pF	TYP
Channel On Capacitance		$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$		53		pF	TYP
Power Requirements							
Power Supply Current		I_+	V_+ = 5.5V, V_{IN} = 0V or 5V	0. 001		μA	TYP
				1		μA	MAX

ELECTRICAL CHARACTERISTICS (continued)

(V_+ = 3V ± 10%, GND = 0V, Full = -40℃ to +125℃. Typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS	SGM3001/SGM3002			
				+25℃	-40℃ to +125℃	UNITS	MIN/MAX
Analog Switch							
Analog Signal Range		V_{NO}, V_{NC}, V_{COM}			0	V	MIN
					V_+	V	MAX
On-Resistance		R_{ON}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = -10mA, Test Circuit 1	2.9	3	Ω	TYP
				4.4	6	Ω	MAX
On-Resistance Match between Channels		ΔR_{ON}	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = -10mA, Test Circuit 1	0.1		Ω	TYP
				0.8	0.9	Ω	MAX
On-Resistance Flatness		$R_{FLAT(ON)}$	$0 \le V_{NO}$ or $V_{NC} \le V_+$, I_{COM} = -10mA, Test Circuit 1	0.9		Ω	TYP
				1	1.2	Ω	MAX
Leakage Currents							
Source Off Leakage Current		$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NO} or V_{NC} = 3V/1V, V_{COM} = 1V/3V, V_+ = 3.3V ,Test Circuit 2	±7		nA	TYP
				±13	±1000	nA	MAX
Channel On Leakage Current		$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$	V_{NO} or V_{NC} = V_{COM} = 1V or 3V, V_+ = 3.3V , Test Circuit 3	±7		nA	TYP
				±13	1000	nA	MAX
Digital Inputs							
Input High Voltage		V_{INH}			2.0	V	MIN
Input Low Voltage		V_{INL}			0.4	V	MAX
Input Current		I_{INL} or I_{INH}	V_{IN} = V_{INH} or V_{INL}	±0.01		µA	TYP
				±0.1	±1	µA	MAX
Dynamic Characteristics							
Turn-On Time		t_{ON}	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 4	12		ns	TYP
Turn-Off Time	SGM3001	t_{OFF}	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 4	31		ns	TYP
	SGM3002			9		ns	TYP
Charge Injection		Q	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, Test Circuit 5	3		pC	TYP
Break-Before-Make Time Delay		t_D	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 6	11		ns	TYP
Off Isolation		O_{ISO}	R_L = 50Ω, C_L = 5pF, Test Circuit 7	f = 10MHz	-45		dB	TYP
				f = 1MHz	-65		dB	TYP
Channel-to-Channel Crosstalk (SGM3002 Only)		X_{TALK}	R_L = 50Ω, C_L = 5pF, Test Circuit 8	f = 10MHz	-35		dB	TYP
				f = 1MHz	-55		dB	TYP
Total Harmonic Distortion		THD	f = 20Hz to 20kHz, V_{COM} = 2V_{P-P}, R_L = 600Ω, C_L = 50pF	0.005		%	TYP
-3dB Bandwidth		BW	R_L = 50Ω, C_L = 5pF, Test Circuit 9	120		MHz	TYP
Source Off Capacitance		$C_{NC(OFF)}$, $C_{NO(OFF)}$		14		pF	TYP
Channel On Capacitance		$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$		53		pF	TYP
Power Requirements							
Power Supply Current		I_+	V_+ = 3.3V, V_{IN} = 0V or 3V	0. 001		µA	TYP
					1	µA	MAX

TYPICAL PERFORMANCE CHARACTERISTICS

On Response vs. Frequency

$V_+ = +5V$
$T_A = +25°C$

SGM3001 or SGM3002

Crosstalk vs. Frequency

SGM3002
$V_+ = +5V$
$T_A = +25°C$

Off Isolation vs. Frequency

$V_+ = +5V$
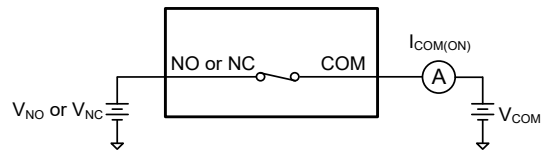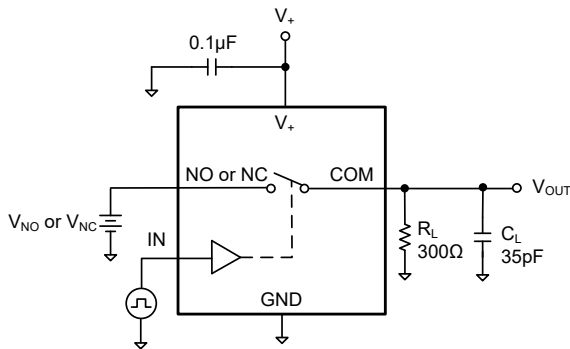$T_A = +25°C$
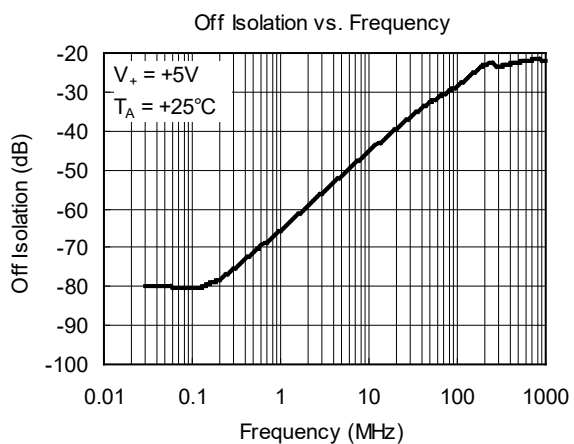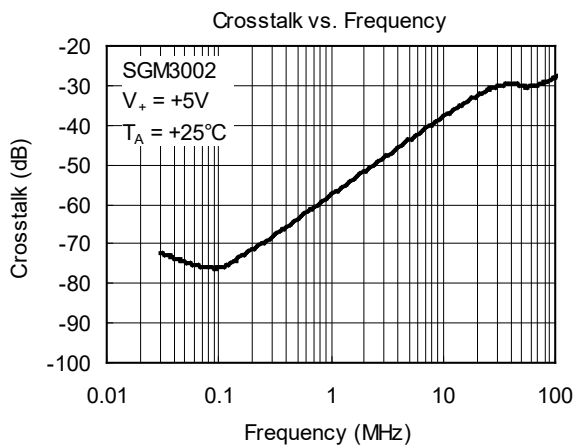
TEST CIRCUITS
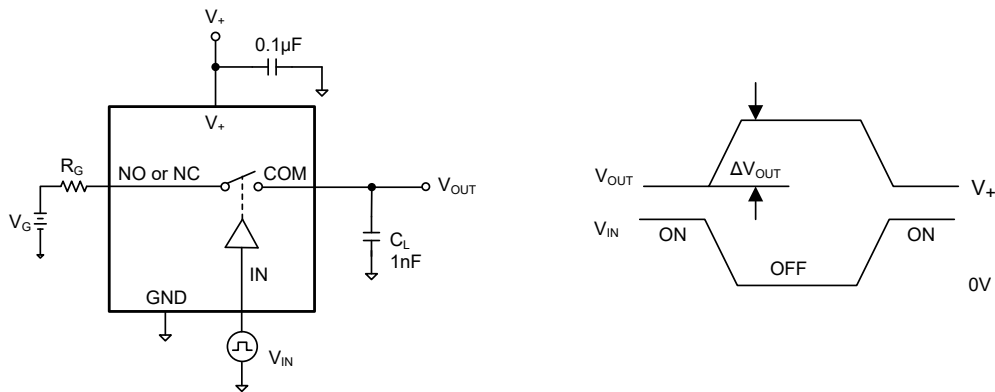

Test Circuit 1. On-Resistance
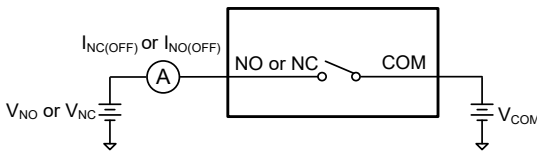
Test Circuit 2. Off Leakage

Test Circuit 3. On Leakage

Test Circuit 4. Switching Times

Test Circuit 5. Charge Injection

TEST CIRCUITS (continued)
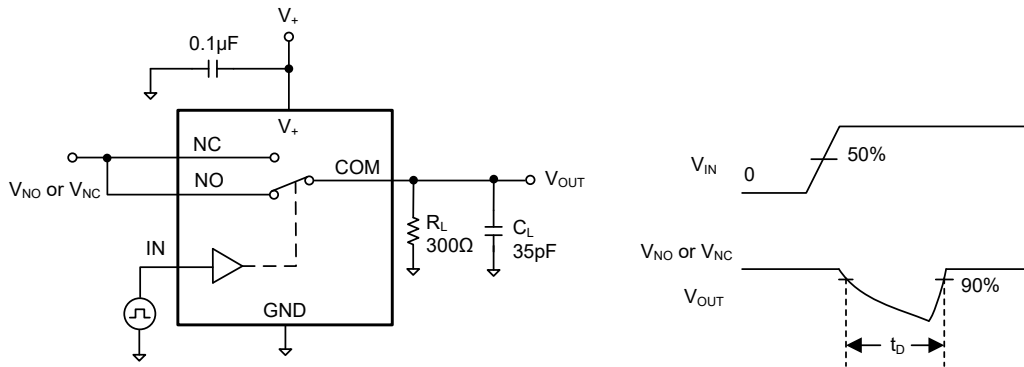
Test Circuit 6. Break-Before-Make Time Delay, t_D
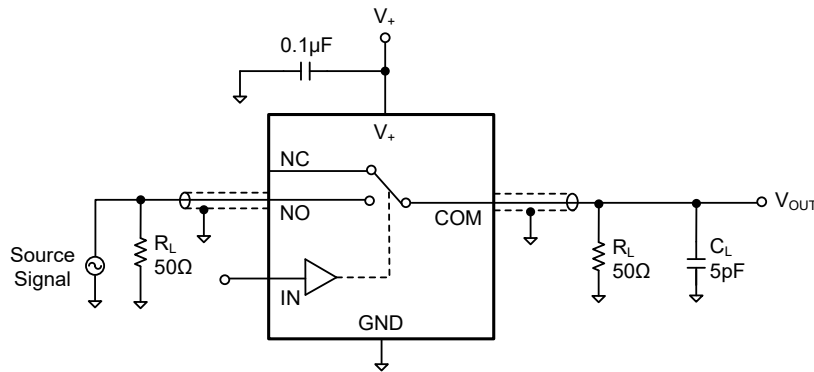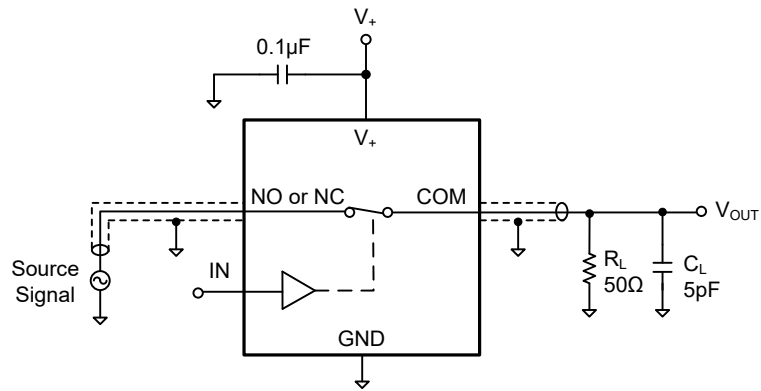

Test Circuit 7. Off Isolation
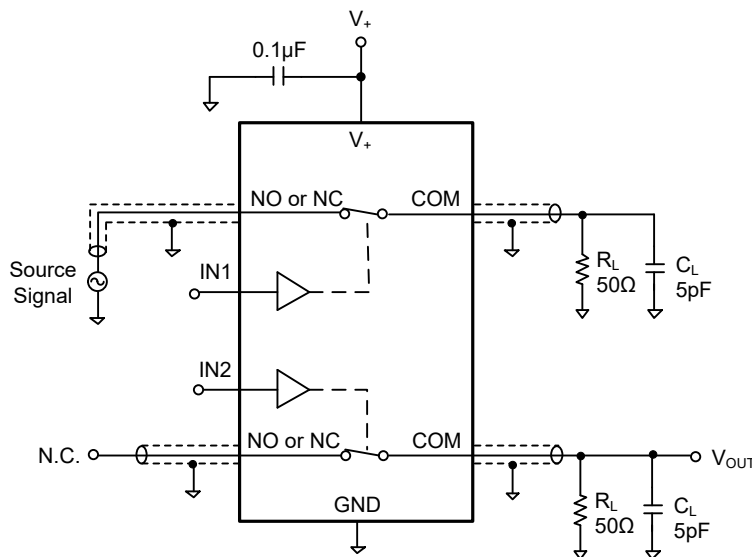
Channel-to-Channel Crosstalk = $-20 \times \log \dfrac{V_{NO} \text{ or } V_{NC}}{V_{OUT}}$
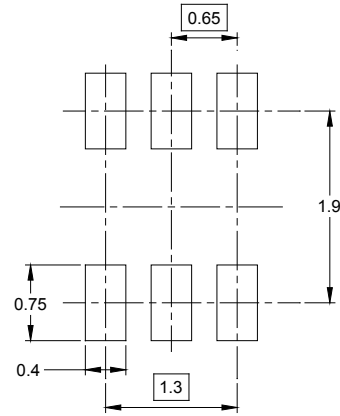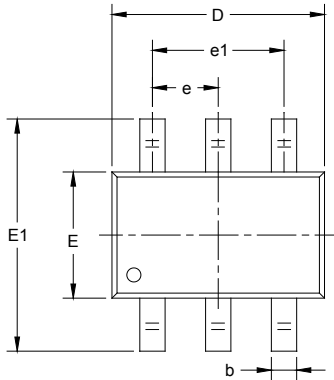
Test Circuit 8. Channel-to-Channel Crosstalk
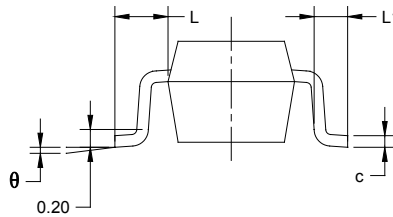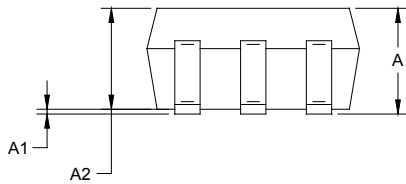
TEST CIRCUITS (continued)

Test Circuit 9. -3dB Bandwidth
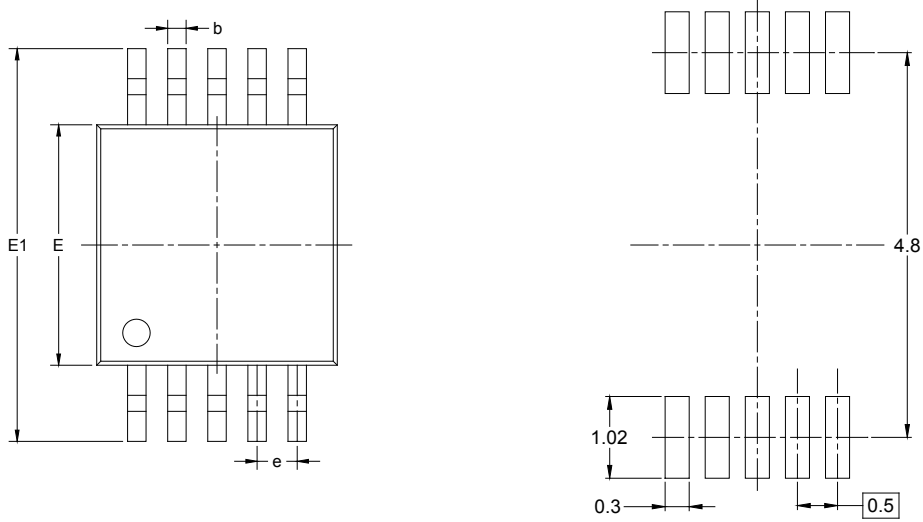
PACKAGE OUTLINE DIMENSIONS

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	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

MSOP-10

RECOMMENDED LAND PATTERN (Unit: mm)
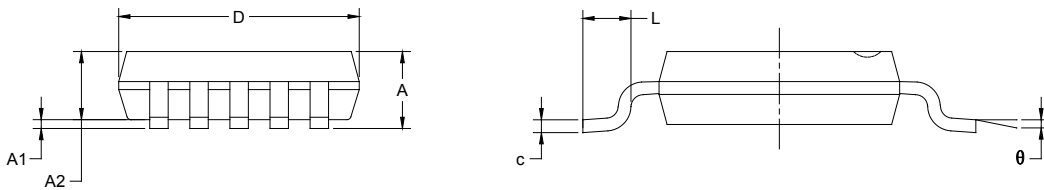
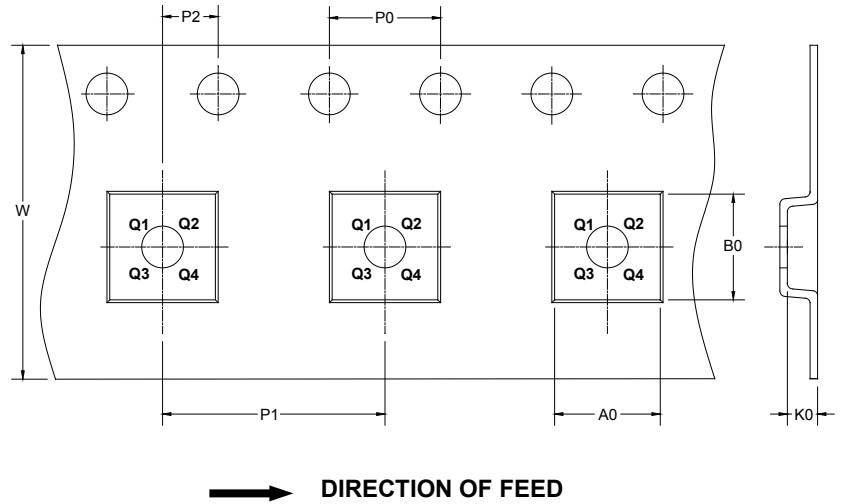| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

DIRECTION OF FEED

NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SC70-6	7″	9.5	2.40	2.50	1.20	4.0	4.0	2.0	8.0	Q3
MSOP-10	13″	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1

DD0001

CARTON BOX DIMENSIONS

NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18
13″	386	280	370	5

DD0002