



# SGM3005

## Ultra Low On-Resistance, Low Voltage, Dual, SPDT Analog Switch

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### GENERAL DESCRIPTION

The SGM3005 is a dual, low on-resistance, low voltage, bidirectional, single-pole/double-throw (SPDT) CMOS analog switch designed to operate from a single 1.8V to 5.5V power supply. Targeted applications include battery powered equipment that benefit from low  $R_{ON}$  ( $0.5\Omega$ ) and fast switching speeds ( $t_{ON} = 50ns$ ,  $t_{OFF} = 15ns$ ).

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 SGM3005 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 SGM3005 is available in Green TDFN-3×3-10L and MSOP-10 packages.

### FEATURES

- **Low Voltage Operation Range: 1.8V to 5.5V**
- **Low On-Resistance:  $0.5\Omega$  (TYP)**
- **Low On-Resistance Flatness**
- **-3dB Bandwidth: 15MHz**
- **Fast Switching Times**
  - $t_{ON}$  50ns
  - $t_{OFF}$  15ns
- **Rail-to-Rail Operation**
- **Typical Power Consumption ( $< 0.01\mu W$ )**
- **TTL/CMOS Compatible**
- **Available in Green TDFN-3×3-10L and MSOP-10 Packages**

### 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
SGM3005	MSOP-10	-40°C to +125°C	SGM3005XMS/TR	SGM3005 XMS XXXXXX	Tape and Reel, 4000
	TDFN-3x3-10L	-40°C to +125°C	SGM3005XD/TR	SGM 3005D XXXXXX	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<sub>+</sub> to GND ..... -0.3V to 6V  
 Analog, Digital Voltage Range <sup>(1)</sup> ..... -0.3V to (V<sub>+</sub>) + 0.3V  
 Continuous Current NO, NC, or COM ..... ±300mA  
 Peak Current NO, NC, or COM ..... ±500mA  
 Package Thermal Resistance @ T<sub>A</sub> = +25°C  
 TDFN-3x3-10L, θ<sub>JA</sub> ..... 33°C/W  
 MSOP-10, θ<sub>JA</sub> ..... 205°C/W  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature (Soldering, 10s) ..... +260°C  
 ESD Susceptibility  
 HBM ..... 2000V  
 MM ..... 400V

NOTE:

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.

**RECOMMENDED OPERATING CONDITIONS**

Operating Temperature Range ..... -40°C to +125°C

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

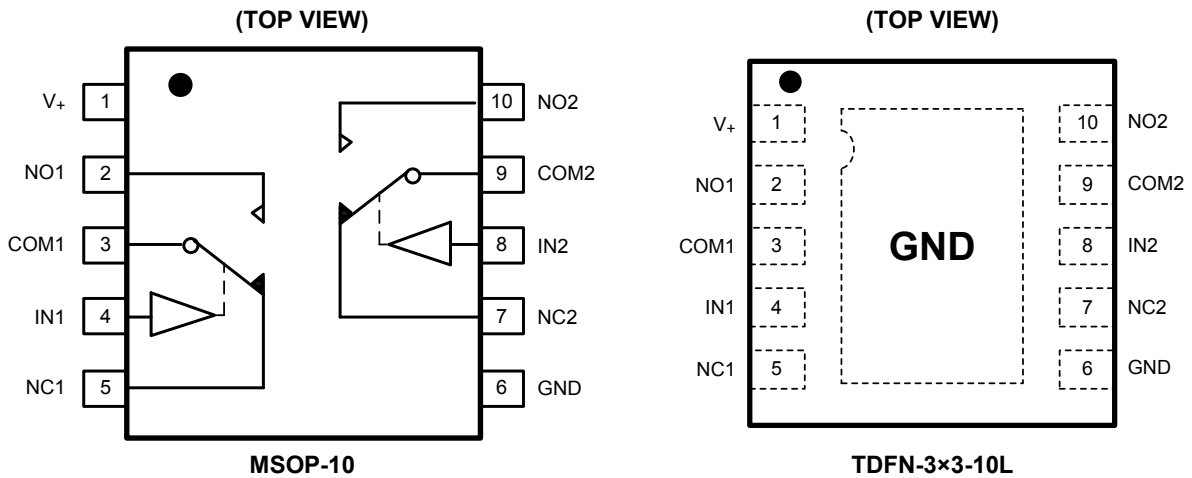
**ESD SENSITIVITY CAUTION**

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, specification or other related things if necessary without notice at any time.

**PIN CONFIGURATIONS**



**PIN DESCRIPTION**

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

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

**FUNCTION TABLE**

LOGIC	NC1, NC2	NO1, NO2
0	ON	OFF
1	OFF	ON

## ELECTRICAL CHARACTERISTICS

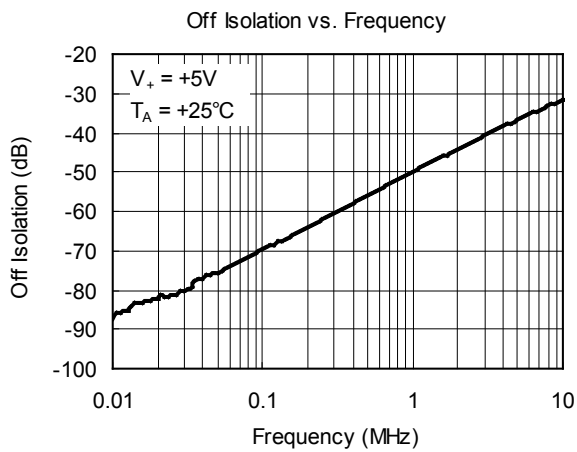
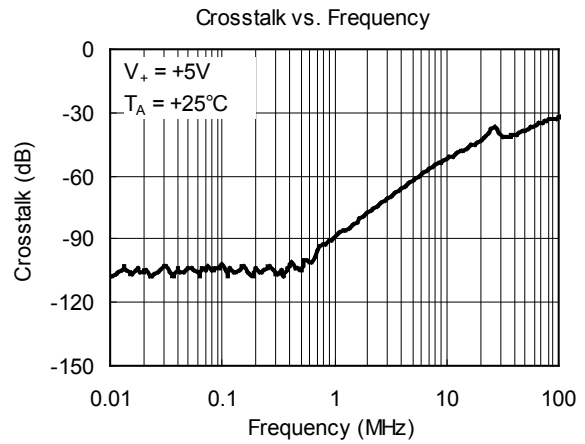
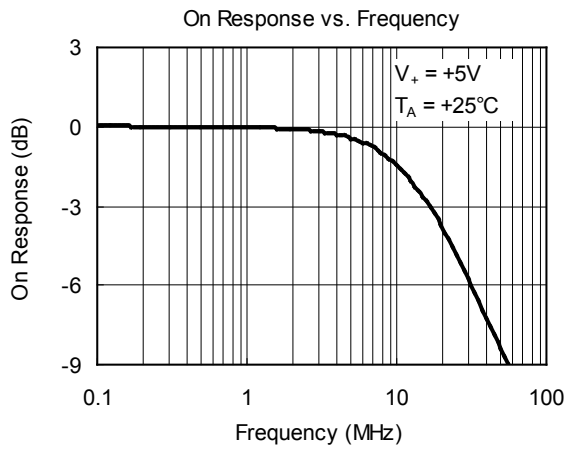
(V<sub>+</sub> = 5V ± 10%, GND = 0V, Full = -40°C to +125°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	SGM3005			
			+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	0.5		Ω	TYP
			0.9	1.1	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	0.05		Ω	TYP
			0.09	0.12	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	0.25		Ω	TYP
			0.3	0.4	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	±4		nA	TYP
			±10	±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	±4		nA	TYP
			±10	±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	50		ns	TYP
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	15		ns	TYP
Charge Injection	Q	C <sub>L</sub> = 1.0nF, V <sub>G</sub> = 0V, R <sub>G</sub> = 0Ω, Test Circuit 5	20		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 = 100kHz	-69		dB
			f = 10kHz	-85		dB
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 8	f = 100kHz	-90		dB
			f = 10kHz	-105		dB
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	0.065		%	TYP
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 9	15		MHz	TYP
Source Off Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>		82		pF	TYP
Channel On Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>		380		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

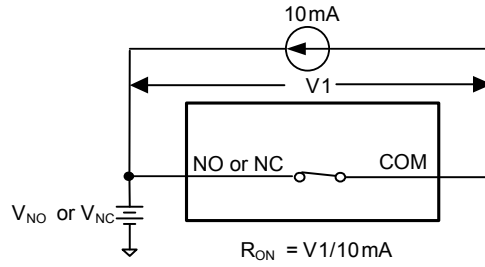
**ELECTRICAL CHARACTERISTICS (continued)**(V<sub>+</sub> = 3V ± 10%, GND = 0V, Full = -40°C to +125°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	SGM3005			
			+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	0.6		Ω	TYP
			1.0	1.3	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	0.05		Ω	TYP
			0.1	0.13	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	0.25		Ω	TYP
			0.3	0.4	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	±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 3V, V <sub>+</sub> = 3.3V, Test Circuit 3	±5		nA	TYP
			±11	±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	50		ns	TYP
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	17		ns	TYP
Charge Injection	Q	C <sub>L</sub> = 1.0nF, V <sub>G</sub> = 0V, R <sub>G</sub> = 0Ω, Test Circuit 5	25		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 = 100kHz	-69	dB	TYP
			f = 10kHz	-85	dB	TYP
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 8	f = 100kHz	-90	dB	TYP
			f = 10kHz	-105	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	0.06		%	TYP
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 9	15		MHz	TYP
Source Off Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>		82		pF	TYP
Channel On Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>		380		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

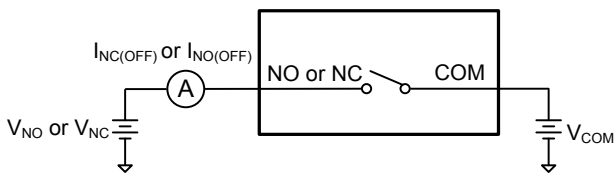
TYPICAL PERFORMANCE CHARACTERISTICS



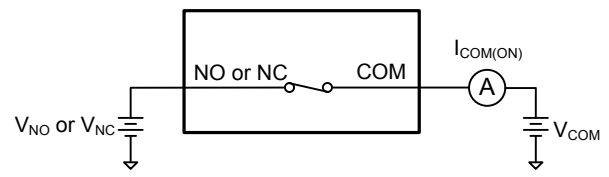
TEST CIRCUITS



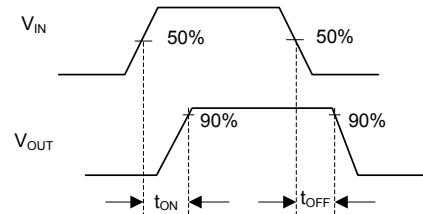
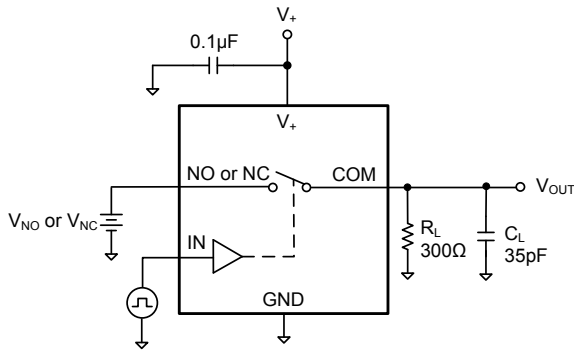
Test Circuit 1. On-Resistance



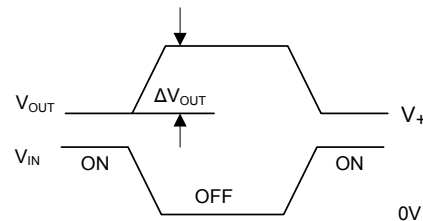
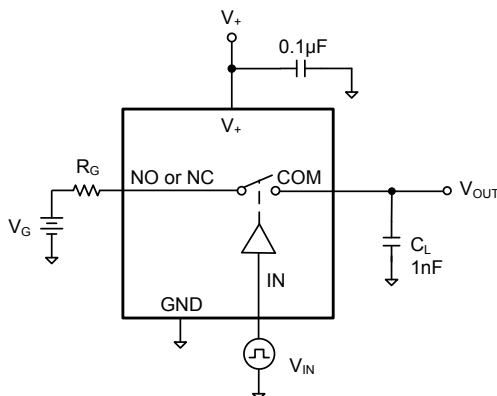
Test Circuit 2. Off Leakage



Test Circuit 3. On Leakage

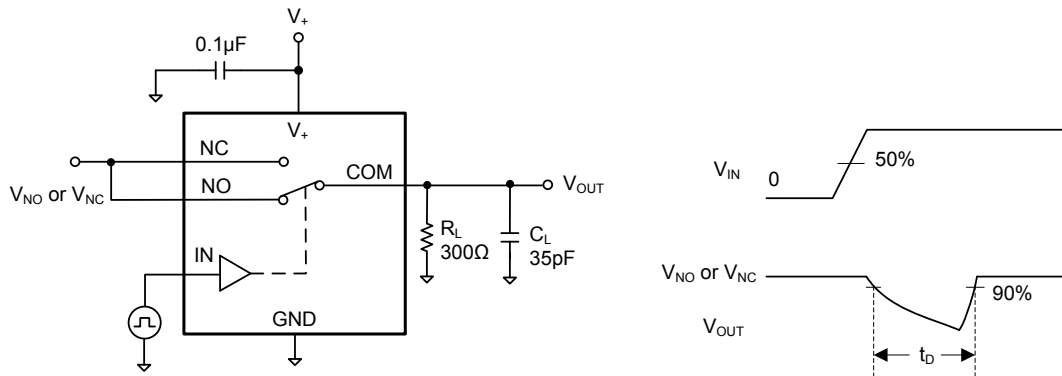


Test Circuit 4. Switching Times

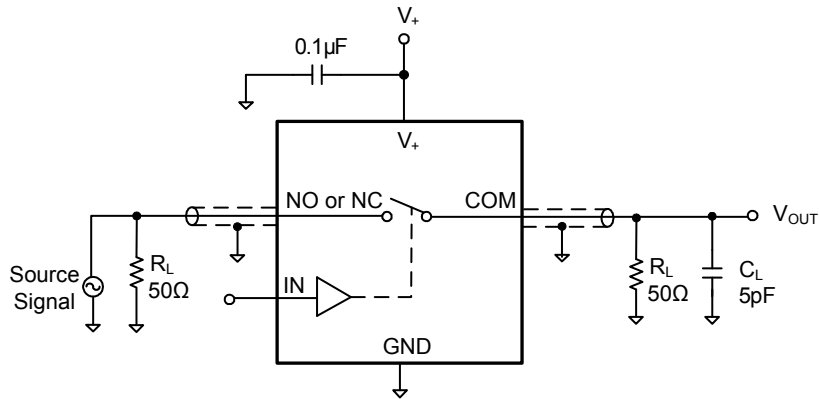


Test Circuit 5. Charge Injection

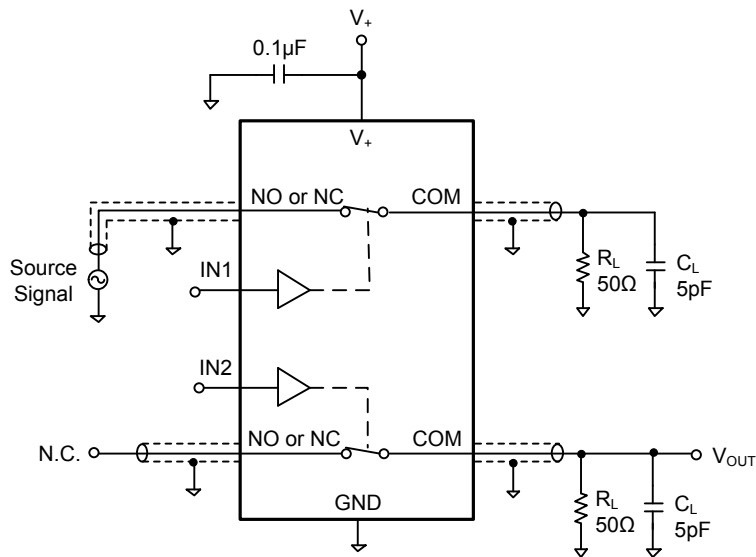
TEST CIRCUITS (continued)



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



Test Circuit 7. Off Isolation

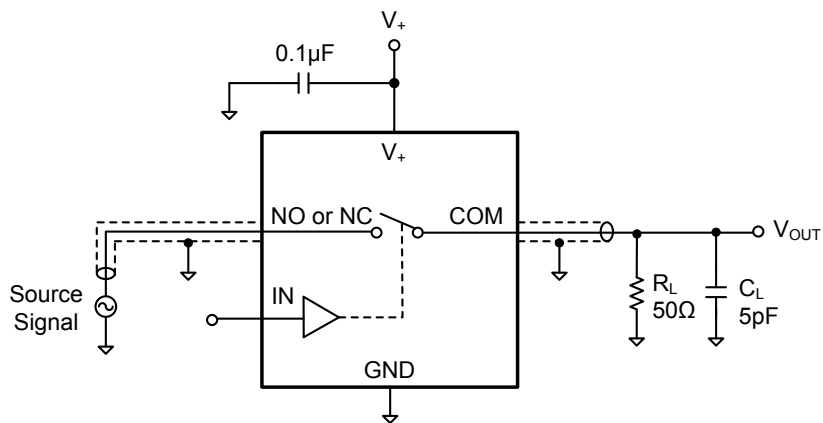


$$\text{Channel-to-Channel Crosstalk} = -20 \times \log \frac{V_{NO \text{ or } V_{NC}}}{V_{OUT}}$$

Test Circuit 8. Channel-to-Channel Crosstalk



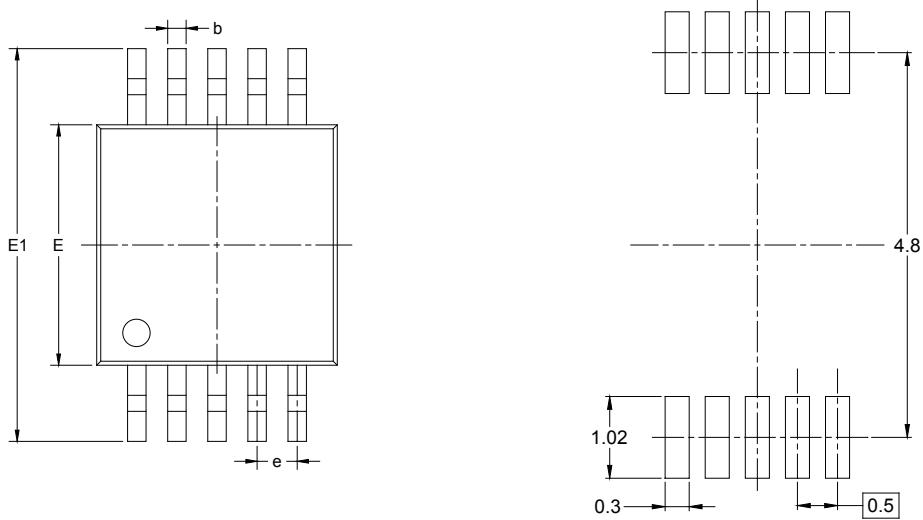
TEST CIRCUITS (continued)



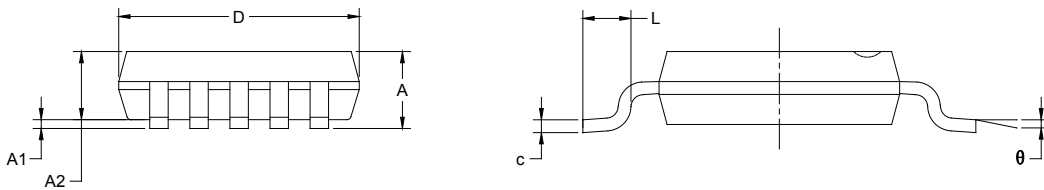
Test Circuit 9. -3dB Bandwidth

PACKAGE OUTLINE DIMENSIONS

MSOP-10



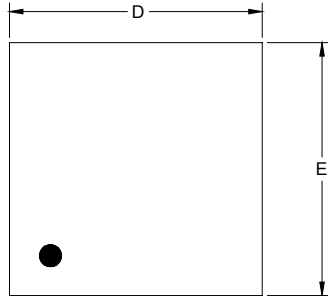
RECOMMENDED LAND PATTERN (Unit: mm)



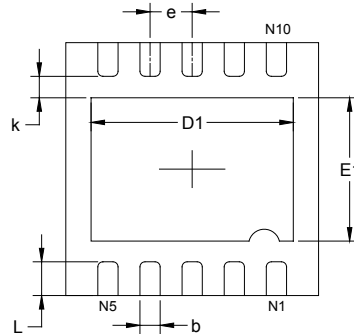
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020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

PACKAGE OUTLINE DIMENSIONS

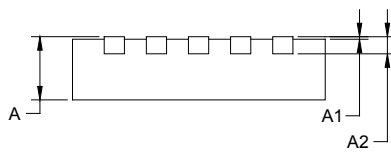
TDFN-3x3-10L



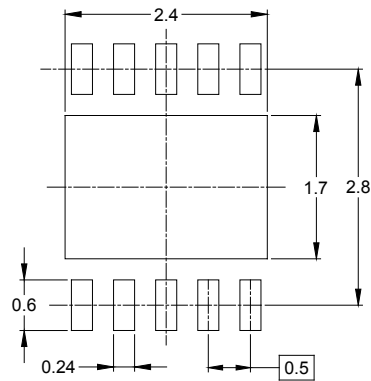
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	2.300	2.600	0.091	0.103
E	2.900	3.100	0.114	0.122
E1	1.500	1.800	0.059	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



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
MSOP-10	13"	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1
TDFN-3×3-10L	13"	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1

DD0001

# PACKAGE INFORMATION

## 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
13"	386	280	370	5

DD0002