



# SGM3003

## Ultra Low ON-Resistance, Low Voltage, SPDT Analog Switch

### GENERAL DESCRIPTION

The SGM3003 is a single, 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 supply. Targeted applications include battery powered equipment that benefit from low  $R_{ON}$  ( $0.5\Omega$ ) and fast switching speeds ( $t_{ON} = 21ns$ ,  $t_{OFF} = 9ns$ ).

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

SGM3003 has one normally open switch and one normally closed switch, Each switch conducts equally well in both directions when on.

SGM3003 is available in a Green MSOP-8 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

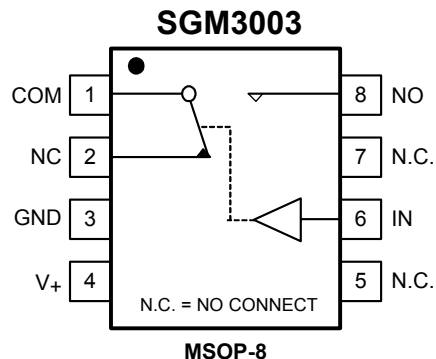
Portable Test and Measurement

Medical Equipment

### FEATURES

- Low Voltage Operation: 1.8V to 5.5V
- Low On-Resistance:  $0.5\Omega$  (TYP)
- Low On-Resistance Flatness
- -3dB Bandwidth: 30MHz
- Fast Switching Times ( $V_+ = 5V$ )
  - $t_{ON} 21ns$
  - $t_{OFF} 9ns$
- Rail-to-Rail Operation
- Typical Power Consumption ( $<0.01\mu W$ )
- TTL/CMOS Compatible
- Microsize Package

### PIN CONFIGURATION (TOP VIEW)



### FUNCTION TABLE

LOGIC	NC	NO
0	ON	OFF
1	OFF	ON

## PACKAGE/ORDERING INFORMATION

MODEL	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM3003	MSOP-8	-40°C to +125°C	SGM3003XMS/TR	SGM3003XMS	Tape and Reel, 3000

## ABSOLUTE MAXIMUM RATINGS

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

Package Thermal Resistance @  $T_A = 25^\circ C$

MSOP-8,  $\theta_{JA}$ .....216°C/W

Lead Temperature (soldering, 10s).....260°C

ESD Susceptibility

HBM.....2000V

MM.....400V

## NOTES:

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.
2. 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.

## 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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the last datasheet.

## PIN DESCRIPTION

NAME	PIN	FUNCTION
$V_+$	4	Power supply
GND	3	Ground
IN	6	Digital control pin to connect the COM terminal to the NO or NC terminals
COM	1	Common terminal
NO	8	Normally-open terminal
NC	2	Normally-closed terminal
N.C.	5, 7	No internal connection

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



## ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	CONDITIONS	SGM3003			
			+25°C	-40°C to +125°C	UNITS	MIN/MAX
ANALOG SWITCH						
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 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	0.13		Ω	TYP
			0.2	0.4	Ω	MAX
LEAKAGE CURRENTS						
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
DIGITAL INPUTS						
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
DYNAMIC CHARACTERISTICS						
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	21		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	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	5		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	-55	dB	TYP
			f = 10kHz	-75	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	0.065		%	TYP
-3dB Bandwidth	BW	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 8	30		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
POWER REQUIREMENTS						
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

# SGM3003

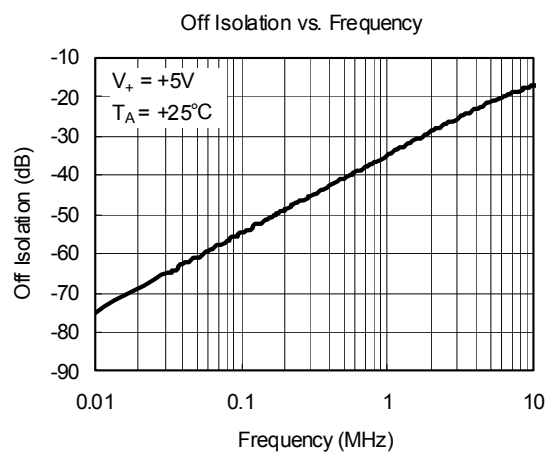
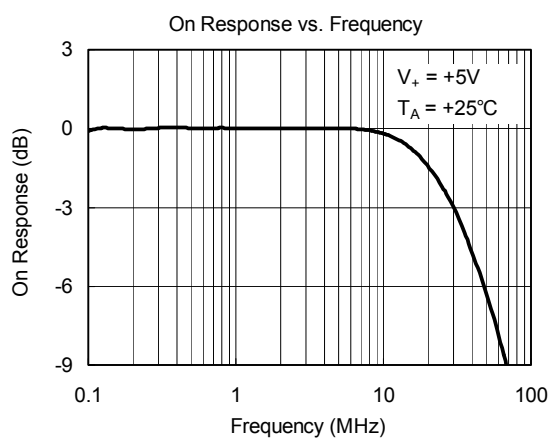
## Ultra Low ON-Resistance, Low Voltage, SPDT Analog Switch

### ELECTRICAL CHARACTERISTICS

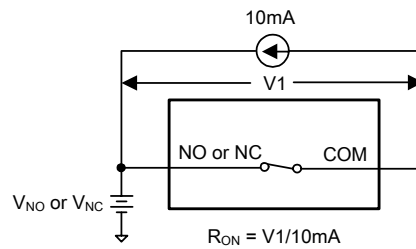
( $V_+ = +3V \pm 10\%$ ,  $GND = 0V$ ,  $T_A = -40^\circ C$  to  $+125^\circ C$ . Typical values are at  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	SGM3003			
			+25°C	-40°C to +125°C	UNITS	MIN/MAX
ANALOG SWITCH						
Analog Signal Range	$V_{NO}, V_{NC}, V_{COM}$			0	V	MIN
				$V_+$	V	MAX
On-Resistance	$R_{ON}$	$0 \leq V_{NO} \text{ or } V_{NC} \leq V_+, I_{COM} = -10\text{mA}$ , Test Circuit 1	0.6		$\Omega$	TYP
			1.0	1.3	$\Omega$	MAX
On-Resistance Flatness	$R_{FLAT(ON)}$	$0 \leq V_{NO} \text{ or } V_{NC} \leq V_+, I_{COM} = -10\text{mA}$ , Test Circuit 1	0.18		$\Omega$	TYP
			0.3	0.4	$\Omega$	MAX
LEAKAGE CURRENTS						
Source OFF Leakage Current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NO} \text{ or } V_{NC} = 3\text{V}/1\text{V}, V_{COM} = 1\text{V}/3\text{V}$ , $V_+ = +3.3\text{V}$ , Test Circuit 2	$\pm 5$		nA	TYP
			$\pm 11$	$\pm 1000$	nA	MAX
Channel ON Leakage Current	$I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$	$V_{NO} \text{ or } V_{NC} = V_{COM} = 1\text{V} \text{ or } 3\text{V}$ , $V_+ = +3.3\text{V}$ , Test Circuit 3	$\pm 5$		nA	TYP
			$\pm 11$	$\pm 1000$	nA	MAX
DIGITAL INPUTS						
Input High Voltage	$V_{INH}$			2.0	V	MIN
Input Low Voltage	$V_{INL}$			0.4	V	MAX
Input Current	$I_{INL} \text{ or } I_{INH}$	$V_{IN} = V_{INH} \text{ or } V_{INL}$	$\pm 0.01$		$\mu\text{A}$	TYP
			$\pm 0.1$	$\pm 1$	$\mu\text{A}$	MAX
DYNAMIC CHARACTERISTICS						
Turn-On Time	$t_{ON}$	$V_{NO} \text{ or } V_{NC} = 2\text{V}, R_L = 300\Omega, C_L = 35\text{pF}$ , Test Circuit 4	32		ns	TYP
Turn-Off Time	$t_{OFF}$	$V_{NO} \text{ or } V_{NC} = 2\text{V}, R_L = 300\Omega, C_L = 35\text{pF}$ , Test Circuit 4	20		ns	TYP
Charge Injection	Q	$C_L = 1.0\text{nF}, V_G = 0\text{V}, R_G = 0\Omega$ , Test Circuit 5	10		pC	TYP
Break-Before-Make Time Delay	$t_D$	$V_{NO1} \text{ or } V_{NC1} = V_{NO2} \text{ or } V_{NC2} = 2\text{V}$ , $R_L = 300\Omega, C_L = 35\text{pF}$ , Test Circuit 6	12		ns	TYP
Off Isolation	$O_{ISO}$	$R_L = 50\Omega, C_L = 5\text{pF}$ , Test Circuit 7	f = 100kHz	-55	dB	TYP
			f = 10kHz	-75	dB	TYP
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, $V_{COM} = 2V_{P-P}$ , $R_L = 600\Omega, C_L = 50\text{pF}$	0.06		%	TYP
-3dB Bandwidth	BW	$R_L = 50\Omega, C_L = 5\text{pF}$ , Test Circuit 8	30		MHz	TYP
Source OFF Capacitance	$C_{NC(OFF)}, C_{NO(OFF)}$		82		pF	TYP
Channel ON Capacitance	$C_{NC(ON)}, C_{NO(ON)}, C_{COM(ON)}$		380		pF	TYP
POWER REQUIREMENTS						
Power Supply Current	$I_+$	$V_+ = +3.3\text{V}, V_{IN} = 0\text{V} \text{ or } 3\text{V}$	0.001		$\mu\text{A}$	TYP
				1	$\mu\text{A}$	MAX

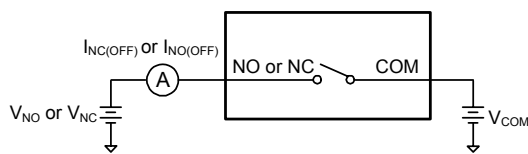
## TYPICAL PERFORMANCE CHARACTERISTICS



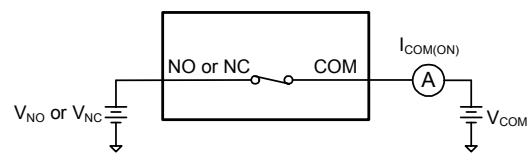
## TEST CIRCUITS



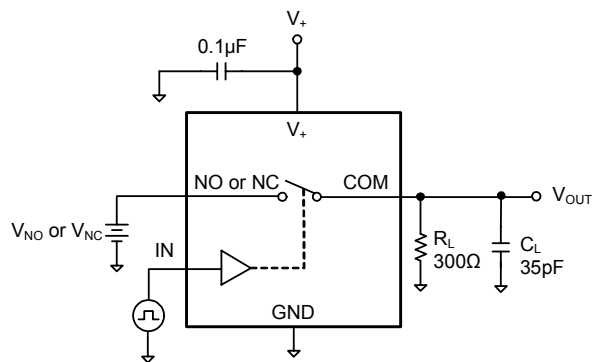
Test Circuit 1. On Resistance



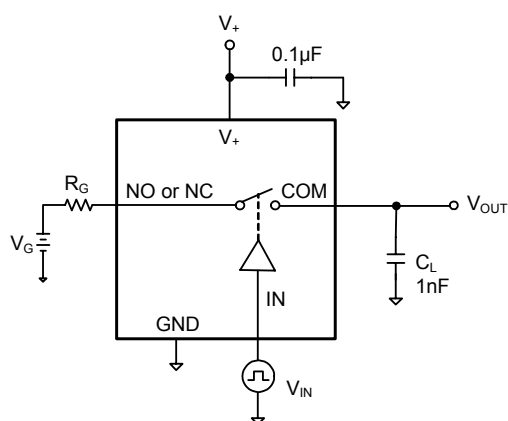
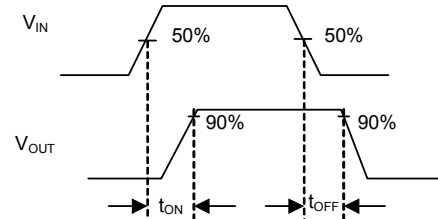
Test Circuit 2. Off Leakage



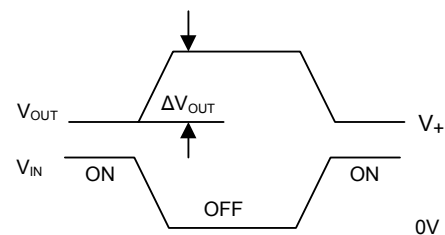
Test Circuit 3. On Leakage



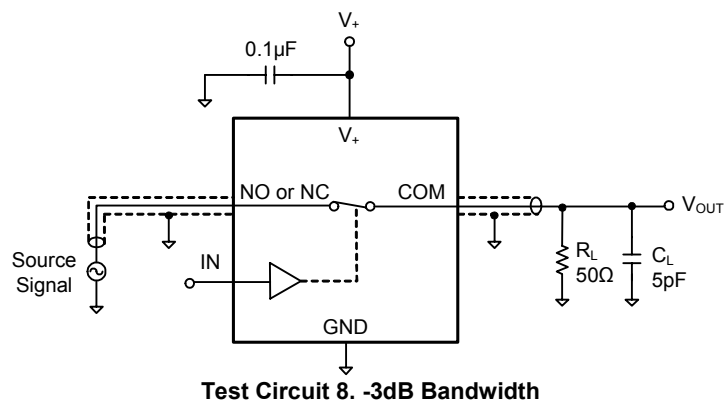
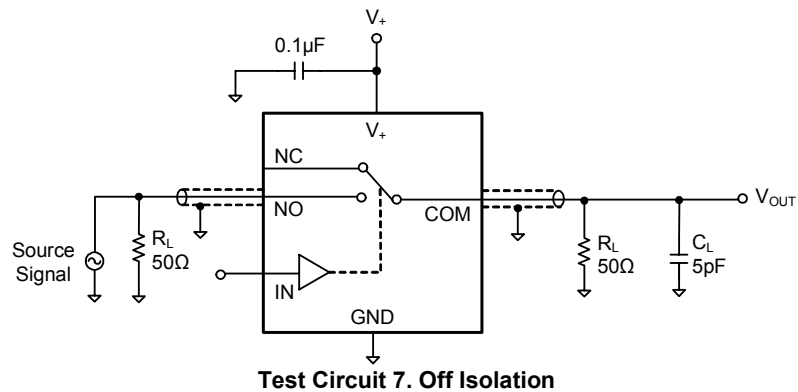
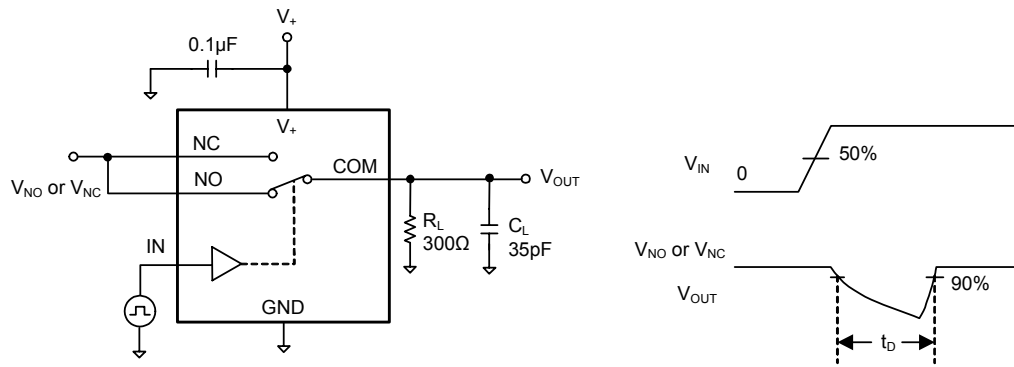
Test Circuit 4. Switching Times



Test Circuit 5. Charge Injection

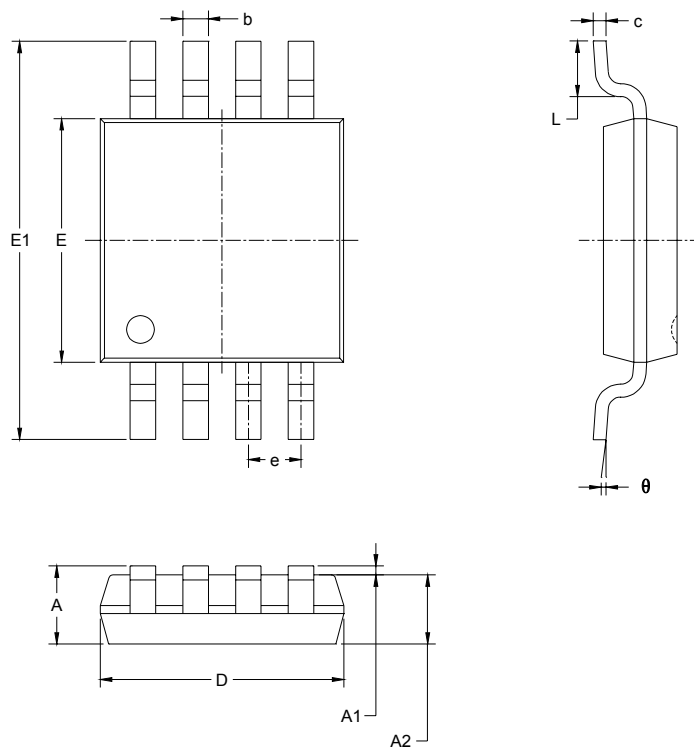


## TEST CIRCUITS (Cont.)



## PACKAGE OUTLINE DIMENSIONS

## MSOP-8



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	0.250	0.380	0.010	0.015
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	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
$\theta$	0°	6°	0°	6°