SGM2904
Dual Operational Amplifier

GENERAL DESCRIPTION

The SGM2904 is a dual operational amplifier, which is optimized for high voltage operation from 3.3V to 26V single supply or ±1.65V to ±13V dual power supplies. It provides a wide input common mode voltage range and rail-to-rail output voltage swing.

Furthermore, the SGM2904 provides low noise, low bias current, low offset current, low offset voltage and high slew rate.

The SGM2904 is available in Green SOIC-8 and MSOP-8 packages. It is specified over the extended -40℃ to +125℃ temperature range.

FEATURES

- **Low Offset Voltage: 4mV (MAX)**
- **Low Input Bias Current**
- **Low Input Offset Current**
- **Low Noise: 40nV/$\sqrt{Hz}$ at 1kHz**
- **Wide Input Common Mode and Differential Voltage Ranges**
- **High Input Impedance**
- **Output Short-Circuit Protection**
- **Gain-Bandwidth Product: 2MHz**
- **Slew Rate: 0.6V/μs**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOIC-8 and MSOP-8 Packages**

APPLICATIONS

High Impedance Sensor

Photodiode Amplifier

Professional Audio Instrument

DAC Output Amplifier

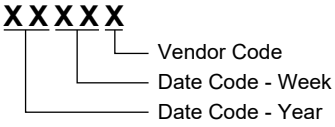
Medical Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2904	SOIC-8	-40℃ to +125℃	SGM2904XS8G/TR	SGM 2904XS8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40℃ to +125℃	SGM2904XMS8G/TR	SGM2904 XMS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

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

Supply Voltage, $+V_S$ to $-V_S$ 26V
Input/Output Voltage Range ..... $(-V_S)$ - 0.3V to $(+V_S)$ + 0.3V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 6000V
MM 400V
CDM 2000V

RECOMMENDED OPERATING CONDITIONS

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

NOTE:
1. It is recommended that CMOS device adopts the proper power supply sequence. Always sort the V_S first, followed by the inputs and outputs.

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

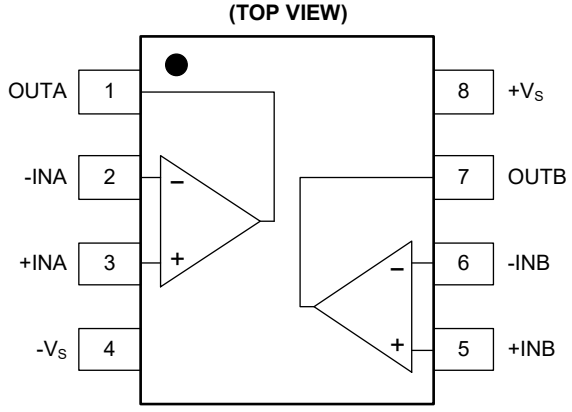
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

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

PIN CONFIGURATIONS

(TOP VIEW)



SOIC-8/MSOP-8

ELECTRICAL CHARACTERISTICS

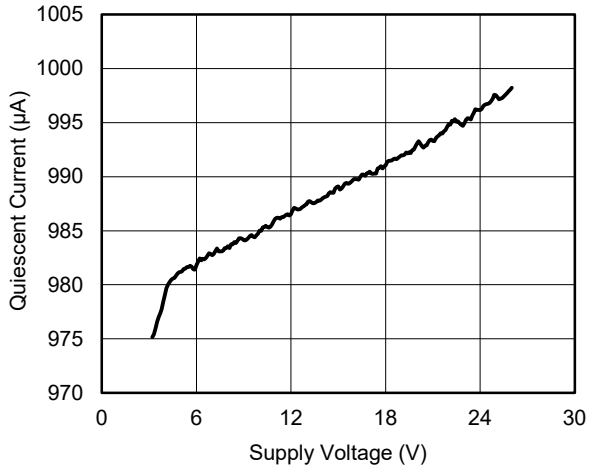
(V_S = 3.3V to 26V and R_L = 2kΩ connected to V_S/2, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage	V_{OS}	V_{CM} = V_S/2	+25℃		3	4	mV
			Full			5	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		2		μV/℃
Input Bias Current	I_B	V_{CM} = V_S/2	+25℃		20		nA
Input Offset Current	I_{OS}	V_{CM} = V_S/2	+25℃		2		nA
Maximum Differential Input Voltage	$\|V_{ID}\|$		Full			V_S	V
Maximum Input Difference Bias Current	$\|I_{ID}\|$	V_{ID} = 26V	+25℃		2	3	μA
			Full			4	
Input Common Mode Voltage Range	V_{CM}		Full	0		V_S - 1.5	V
Common Mode Rejection Ratio	CMRR	V_S = 5V to 26V, 0V < V_{CM} < V_S - 1.5V	+25℃	70	80		dB
			Full	65			
Open-Loop Voltage Gain	A_{OL}	V_S = 15V, V_{OUT} = 1V to 11V	+25℃	30	100		V/mV
			Full	20			
Output Characteristics							
High-Level Output Voltage	V_{OH}	V_S = 26V, R_L = 10kΩ	+25℃		60	80	mV
			Full			120	
		V_S = 26V, R_L = 2kΩ	+25℃		300	400	
			Full			540	
Low-Level Output Voltage	V_{OL}	V_S = 26V, R_L = 10kΩ	+25℃		20	35	mV
			Full			60	
		V_S = 26V, R_L = 2kΩ	+25℃		110	160	
			Full			280	
Output Short-Circuit Current	I_{SC}	V_S = 5V to 26V	+25℃	±28	±40		mA
Power Supply							
Operating Voltage Range	V_S		Full	3.3		26	V
Quiescent Current	I_Q	I_{OUT} = 0A	+25℃		1	1.24	mA
			Full			1.5	
Power Supply Rejection Ratio	PSRR	V_S = 5V to 26V	+25℃	90	100		dB
			Full	85			
Dynamic Performance							
Gain-Bandwidth Product	GBP	C_L = 50pF	+25℃		2		MHz
Slew Rate	SR	G = +1	+25℃		0.6		V/μs
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		40		nV/√Hz

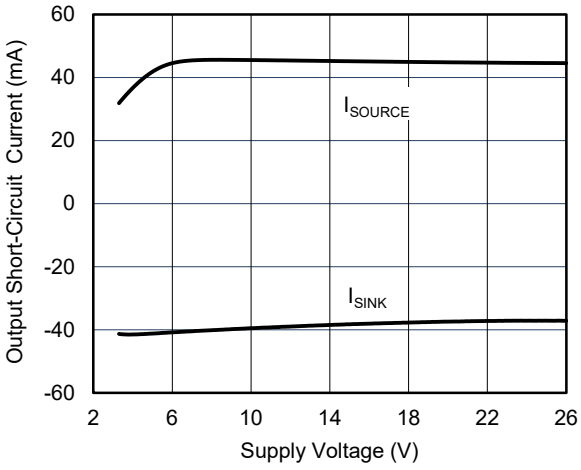
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = 26V and R_L = 2kΩ, unless otherwise noted.

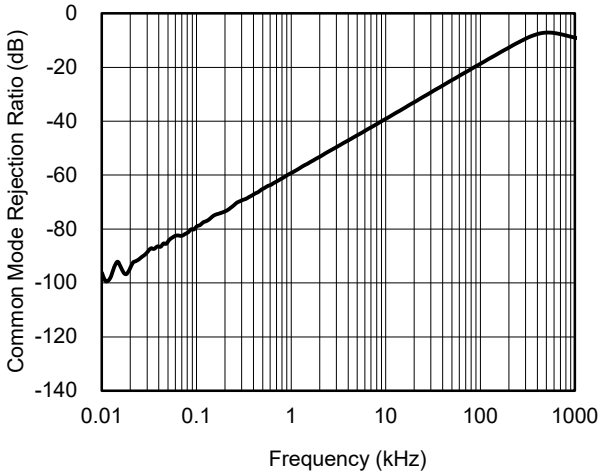
Quiescent Current vs. Supply Voltage



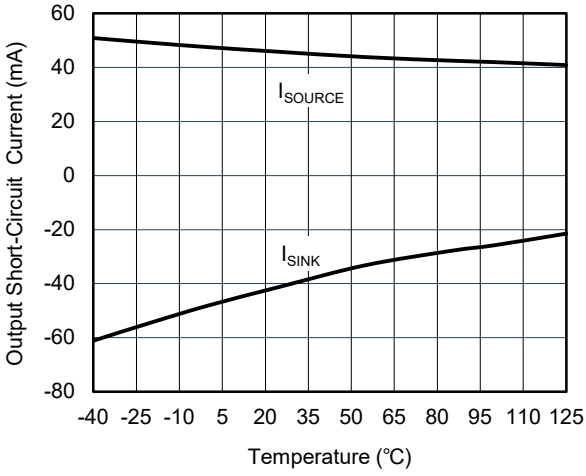
Output Short-Circuit Current vs. Supply Voltage



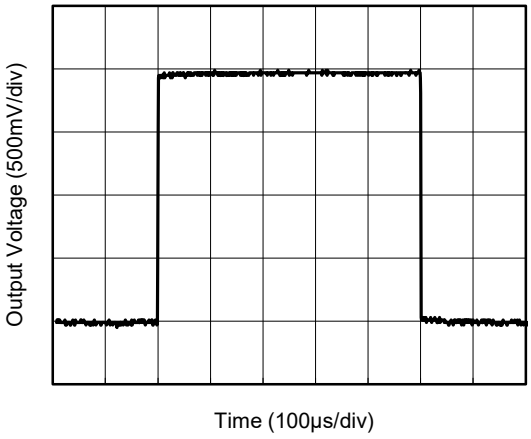
CMRR vs. Frequency



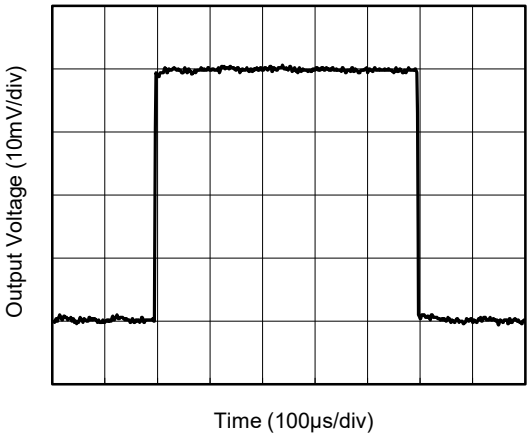
Output Short-Circuit Current vs. Temperature



Large-Signal Step Response



Small-Signal Step Response



APPLICATION INFORMATION

The SGM2904 can be widely used for various signal processing purposes.

Typical Application

The following circuit is an application of an inverting amplifier. To explain, the input is positive while the output is negative. However, if the input signal is negative, the output will be positive as well.

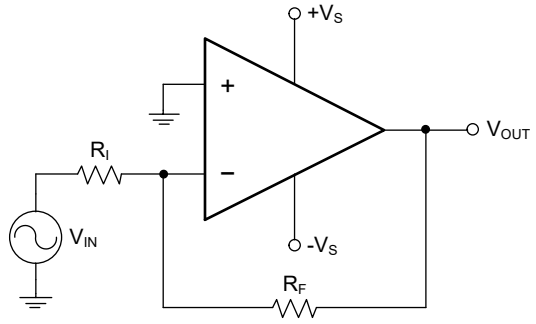


Figure 1. Application Schematic

The supply voltage range should always be larger than the input and the output range. The following example scales a signal with ±0.5V to ±1.8V, which means that the ±12V of the supply voltage is sufficient.

The following equations determine the voltage gain of the inverting amplifier circuit.

$$G = \frac{V_{OUT}}{V_{IN}} \quad (1)$$

$$G = \frac{1.8}{-0.5} = -3.6 \quad (2)$$

After setting the voltage gain, the value of the gain and feedback resistors should be determined as well. Since the operating current inside the circuit is in the mA range, the R_I and R_F should be at the level of kΩ. In this example, the R_I is 10kΩ and the R_F is 36kΩ.

$$G = -\frac{R_F}{R_I} \quad (3)$$

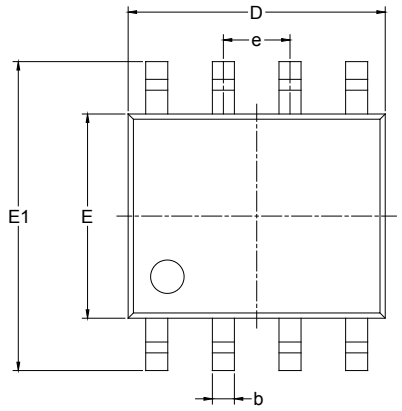
REVISION HISTORY

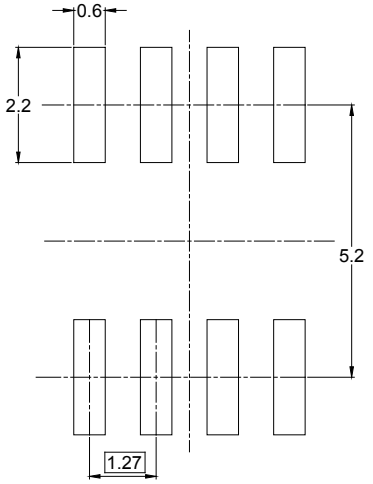
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (DECEMBER 2017) to REV.A	Page
Changed from product preview to production data	All

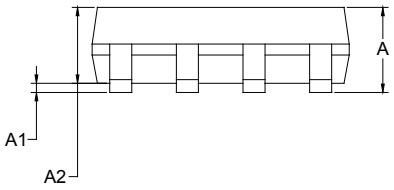
PACKAGE OUTLINE DIMENSIONS

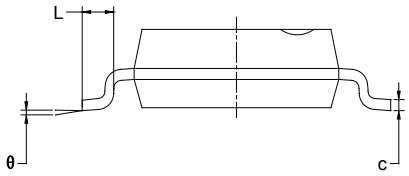
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

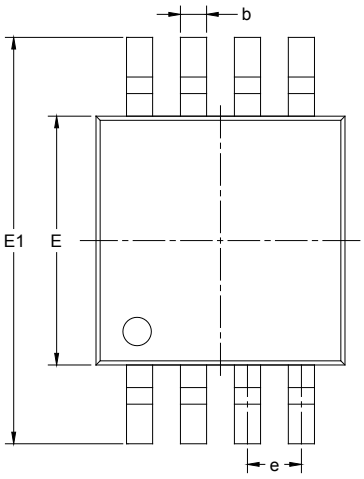


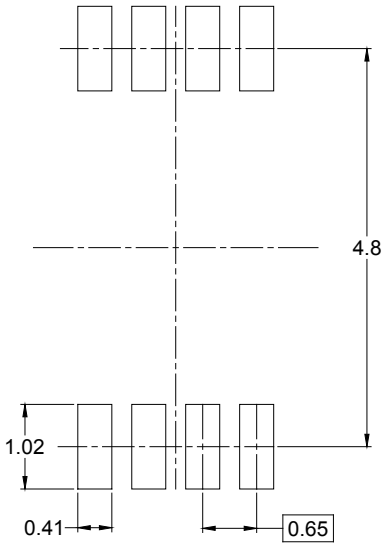


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

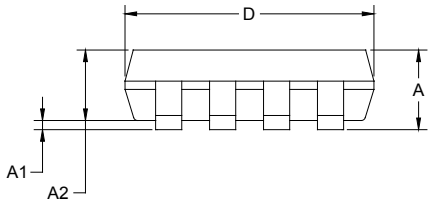
PACKAGE OUTLINE DIMENSIONS

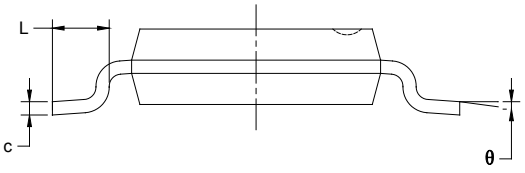
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

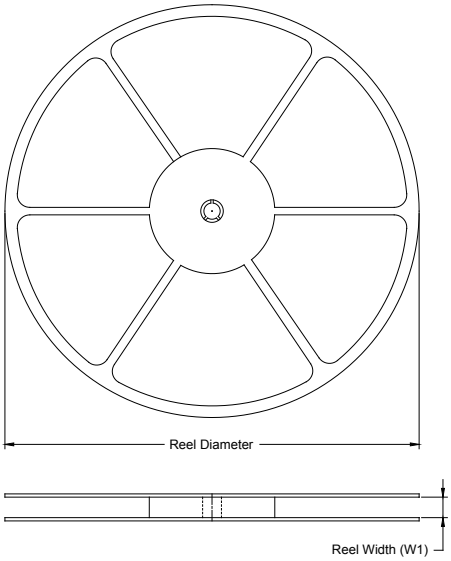




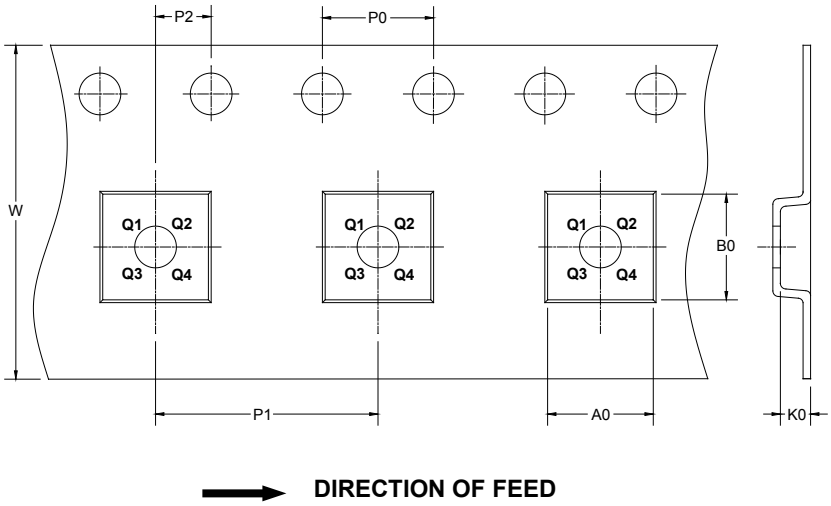
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



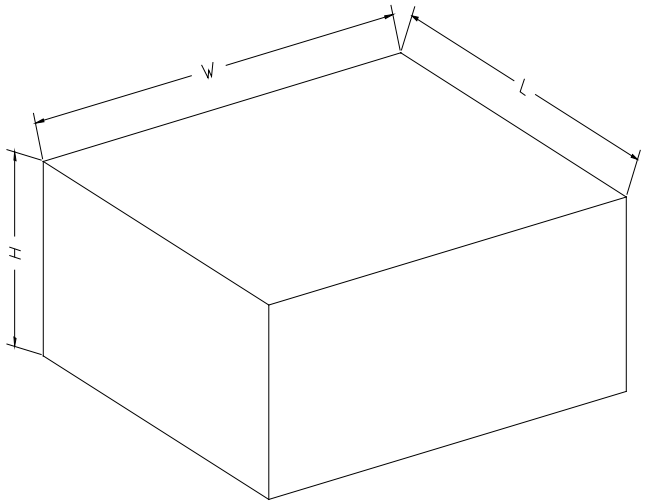
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOIC-8	13″	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP-8	13″	12.4	5.20	3.30	1.50	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
13″	386	280	370	5

DD0002