SGM8621/SGM8622/SGM8623/SGM8624
3MHz, Rail-to-Rail I/O
CMOS Operational Amplifiers

GENERAL DESCRIPTION

The SGM8621/2/3/4 are a family of single, dual and quad operational amplifiers, which are optimized for low voltage, low noise and low power operation. These devices can operate from 2V to 5.5V single supply, and consume low quiescent current. The supply current of SGM8623 is less than 1µA in power-down mode.

The SGM8621/2/3/4 feature a 3mV maximum input offset voltage. The minimum input common mode voltage is within 0.1V below the negative rail, and the output swing is rail-to-rail with heavy loads. They exhibit a high gain-bandwidth product of 3MHz and a slew rate of 1.7V/µs. These specifications make the operational amplifiers appropriate for various applications.

The SGM8621 is available in Green SC70-5, SOT-23-5 and SOIC-8 packages. The SGM8622 is available in Green SOIC-8 and MSOP-8 packages. The SGM8623 is available in Green SOT-23-6 and SOIC-8 packages. The SGM8624 is available in Green SOIC-14 and TSSOP-14 packages. They are specified over the extended industrial temperature range (-40℃ to +125℃).

FEATURES

- **Input Offset Voltage: 3mV (MAX)**
- **High Gain-Bandwidth Product: 3MHz**
- **High Slew Rate: 1.7V/µs**
- **Settling Time to 0.1% with 2V Step: 0.5µs**
- **Overload Recovery Time: 2.3µs**
- **Low Noise: 17.5nV/$\sqrt{Hz}$ at 1kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2V to 5.5V**
- **Input Voltage Range: -0.1V to 5.6V with V_S = 5.5V**
- **Low Supply Current:**
  SGM8621/3: 270µA (TYP)
  SGM8622/4: 210µA/Amplifier (TYP)
  SGM8623 Less than 1µA when Disabled
- **-40℃ to +125℃ Operating Temperature Range**
- **Small Packaging:**
  SGM8621 Available in Green SC70-5, SOT-23-5 and SOIC-8 Packages
  SGM8622 Available in Green MSOP-8 and SOIC-8 Packages
  SGM8623 Available in Green SOT-23-6 and SOIC-8 Packages
  SGM8624 Available in Green TSSOP-14 and SOIC-14 Packages

APPLICATIONS

Sensors

Audio

Active Filters

A/D Converters

Communications

Test Equipment

Cellular and Cordless Phones

Laptops and PDAs

Photodiode Amplification

Battery-Powered Instrumentation

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8621	SC70-5	-40℃ to +125℃	SGM8621XC5/TR	8621	Tape and Reel, 3000
	SOT-23-5	-40℃ to +125℃	SGM8621XN5/TR	8621	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM8621XS/TR	SGM8621XS XXXXX	Tape and Reel, 2500
SGM8622	MSOP-8	-40℃ to +125℃	SGM8622XMS/TR	SGM8622 XMS XXXXX	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM8622XS/TR	SGM8622XS XXXXX	Tape and Reel, 2500
SGM8623	SOT-23-6	-40℃ to +125℃	SGM8623XN6/TR	8623	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM8623XS/TR	SGM8623XS XXXXX	Tape and Reel, 2500
SGM8624	SOIC-14	-40℃ to +125℃	SGM8624XS14/TR	SGM8624XS14 XXXXX	Tape and Reel, 2500
	TSSOP-14	-40℃ to +125℃	SGM8624XTS14/TR	SGM8624 XTS14 XXXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

SOIC-8/MSOP-8/SOIC-14/TSSOP-14

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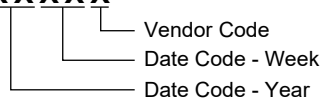
Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, +V_S to -V_S...6V

Input Common Mode Voltage Range

.... (-V_S) - 0.3V to (+V_S) + 0.3V

Package Thermal Resistance @ T_A = +25℃

SC70-5, θ_{JA}.. 333℃/W

SOT-23-5, θ_{JA} .... 190℃/W

SOT-23-6, θ_{JA} .... 190℃/W

SOIC-8, θ_{JA} .... 125℃/W

MSOP-8, θ_{JA} .... 216℃/W

Junction Temperature ....+150℃

Storage Temperature Range........................-65℃ to +150℃

Lead Temperature (Soldering, 10s) ....+260℃

ESD Susceptibility

HBM (SGM8621/2/4) 8000V

HBM (SGM8623) 4000V

MM...400V

CDM 1000V

RECOMMENDED OPERATING CONDITIONS

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

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.
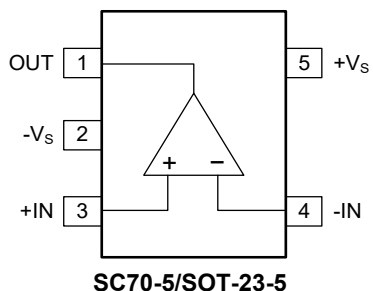
ESD SENSITIVITY CAUTION

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.
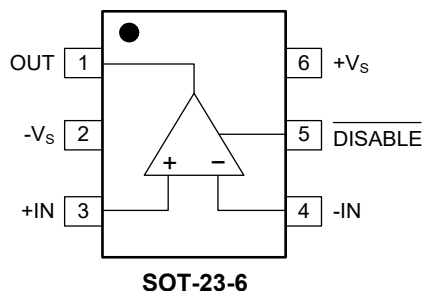
DISCLAIMER

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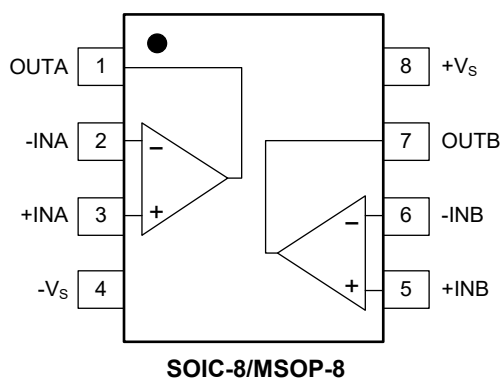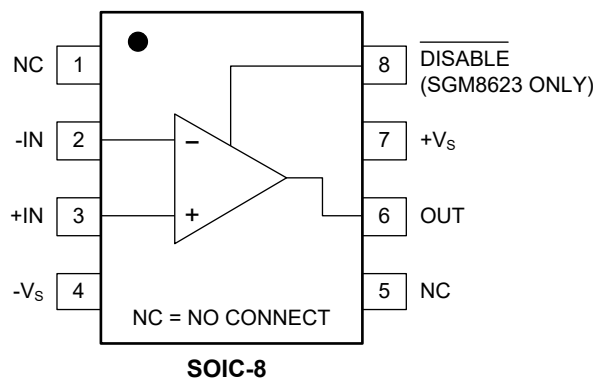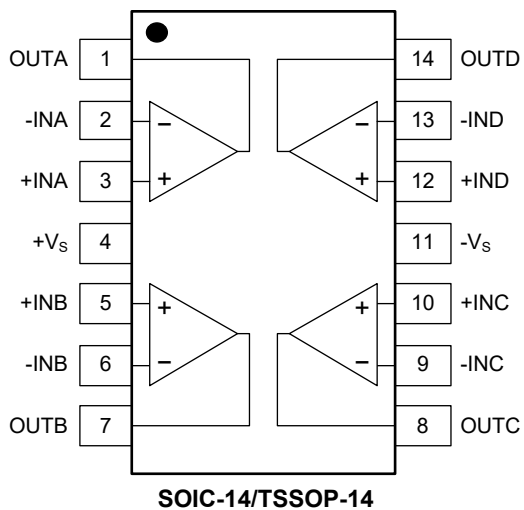
PIN CONFIGURATIONS

SGM8621 (TOP VIEW)

OUT [1] ... [5] +V_S
-V_S [2] ... [4] -IN
+IN [3] ...

SC70-5/SOT-23-5

SGM8623 (TOP VIEW)

OUT [1] ... [6] +V_S
-V_S [2] ... [5] $\overline{DISABLE}$
+IN [3] ... [4] -IN

SOT-23-6

SGM8622 (TOP VIEW)

OUTA [1] ... [8] +V_S
-INA [2] ... [7] OUTB
+INA [3] ... [6] -INB
-V_S [4] ... [5] +INB

SOIC-8/MSOP-8

SGM8621/SGM8623 (TOP VIEW)

NC [1] ... [8] $\overline{DISABLE}$ (SGM8623 ONLY)
-IN [2] ... [7] +V_S
+IN [3] ... [6] OUT
-V_S [4] ... [5] NC

NC = NO CONNECT

SOIC-8

SGM8624 (TOP VIEW)

OUTA [1] ... [14] OUTD
-INA [2] ... [13] -IND
+INA [3] ... [12] +IND
+V_S [4] ... [11] -V_S
+INB [5] ... [10] +INC
-INB [6] ... [9] -INC
OUTB [7] ... [8] OUTC

SOIC-14/TSSOP-14

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_S = 5V, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8621/2/3/4					
		TYP	MIN/MAX OVER TEMPERATURE				
		+25℃	+25℃	-40℃ to +85℃	-40℃ to +125℃	UNITS	MIN/ MAX
Input Characteristics							
Input Offset Voltage (V_{OS})		0.9	3	3.2	3.4	mV	MAX
Input Bias Current (I_B)		1				pA	TYP
Input Offset Current (I_{OS})		1				pA	TYP
Input Common Mode Voltage Range (V_{CM})	V_S = 5.5V	-0.1 to 5.6				V	TYP
Common Mode Rejection Ratio (CMRR)	V_S = 5.5V, V_{CM} = -0.1V to 4V	82	65	64	63	dB	MIN
	V_S = 5.5V, V_{CM} = -0.1V to 5.6V	71	62	61	60	dB	MIN
Open-Loop Voltage Gain (A_{OL})	R_L = 600Ω, V_{OUT} = 0.15V to 4.85V	90	80	75	68	dB	MIN
	R_L = 10kΩ , V_{OUT} = 0.05V to 4.95V	100	89	85	83	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)		2.7				µV/℃	TYP
Output Characteristics							
Output Voltage Swing from Rail	R_L = 600Ω	0.081				V	TYP
	R_L = 10kΩ	0.007				V	TYP
Output Current (I_{OUT})		52	38	28	24	mA	MIN
Closed-Loop Output Impedance	f = 100kHz, G = 1	10.8				Ω	TYP
Power-Down Disable (SGM8623 Only)							
Turn-On Time		1.3				µs	TYP
Turn-Off Time		0.3				µs	TYP
$\overline{DISABLE}$ Voltage-Off			0.8			V	MAX
$\overline{DISABLE}$ Voltage-On			2			V	MIN
Power Supply							
Operating Voltage Range		2	2	2	2	V	MIN
		5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_S = 2V to 5.5V, V_{CM} = $(-V_S)$ + 0.5V	85	68	66	65	dB	MIN
Quiescent Current/ Amplifier (I_Q)	SGM8622/4 I_{OUT} = 0mA	210	300	340	360	µA	MAX
	SGM8621/3 I_{OUT} = 0mA	270	370	420	450	µA	MAX
Supply Current when Disabled (SGM8623 only)		0.47	8	9	10	µA	MAX
Dynamic Performance							
Gain-Bandwidth Product (GBP)		3				MHz	TYP
Phase Margin (φ_O)		73				°	TYP
Full Power Bandwidth (BW_P)	<1% distortion	50				kHz	TYP
Slew Rate (SR)	G= 1, 2V output step	1.7				V/µs	TYP
Settling Time to 0.1% (t_S)	G= 1, 2V output step	0.5				µs	TYP
Overload Recovery Time	V_{IN} × G = V_S	2.3				µs	TYP
Noise Performance							
Input Voltage Noise Density (e_n)	f = 1kHz	17.5				nV/$\sqrt{Hz}$	TYP

TYPICAL PERFORMANCE CHARACTERISTICS
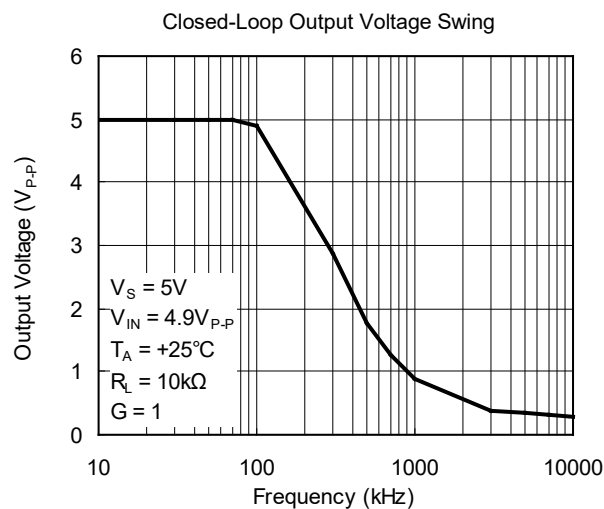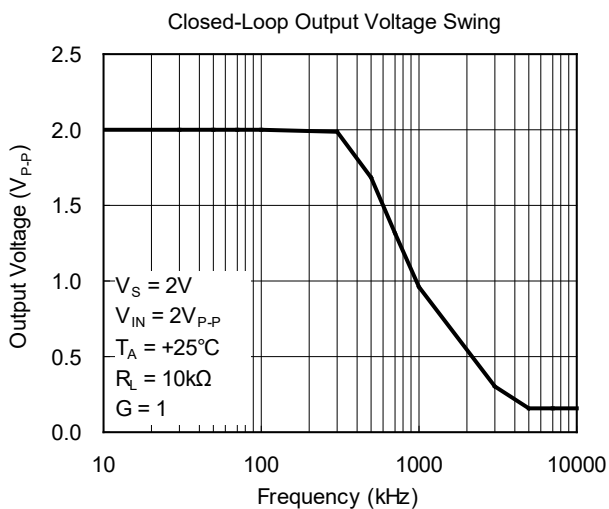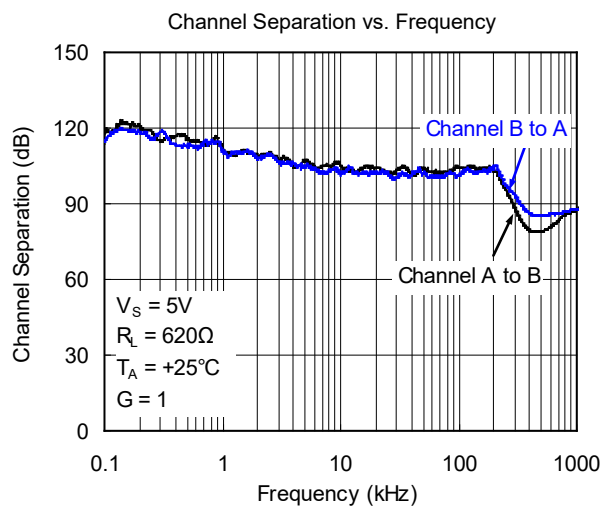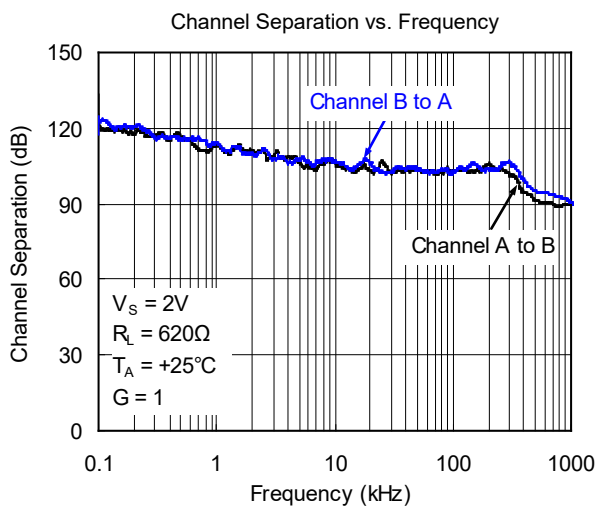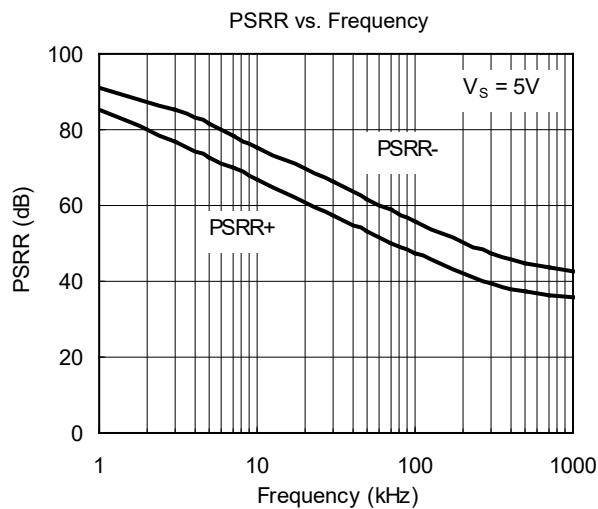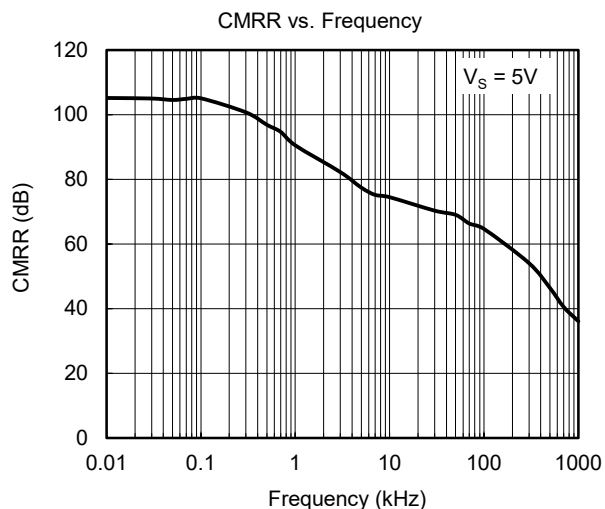
At T_A = +25℃, V_{CM} = $V_S/2$, R_L = 600Ω, unless otherwise noted.

CMRR vs. Frequency

PSRR vs. Frequency

Channel Separation vs. Frequency

Channel Separation vs. Frequency
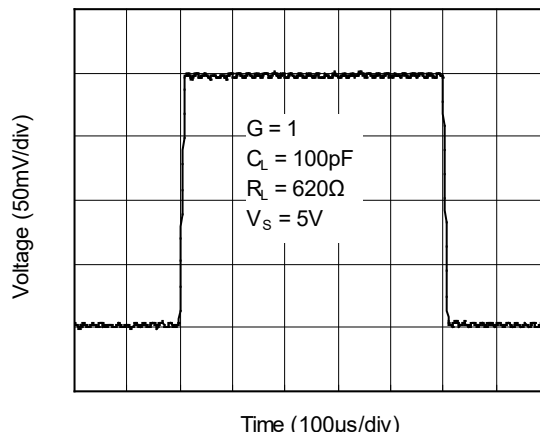
Closed-Loop Output Voltage Swing

Closed-Loop Output Voltage Swing

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

Small-Signal Overshoot vs. Load Capacitance

V_S = 2V
R_L = 10kΩ
T_A = +25℃
G = 1

Small-Signal Overshoot vs. Load Capacitance

V_S = 5V
R_L = 10kΩ
T_A = +25℃
G = 1

Output Impedance vs. Frequency

V_S = 2V

G = 10
G = 100
G = 1

Output Impedance vs. Frequency

V_S = 5V

G = 10
G = 100
G = 1

Large-Signal Step Response

G = 1
C_L = 100pF
R_L = 620Ω
V_S = 2V

Time (100μs/div)

Large-Signal Step Response

G = 1
C_L = 100pF
R_L = 620Ω
V_S = 5V

Time (100μs/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

Small-Signal Step Response

G = 1
C_L = 100pF
R_L = 620Ω
V_S = 2V

Voltage (50mV/div)

Time (100µs/div)

Small-Signal Step Response

G = 1
C_L = 100pF
R_L = 620Ω
V_S = 5V

Voltage (50mV/div)

Time (100µs/div)

Positive Overload Recovery

V_S = 5V
V_{IN} = 50mV
R_L = 620Ω
G = -100

Time (2µs/div)

Negative Overload Recovery

V_S = 5V
V_{IN} = 50mV
R_L = 620Ω
G = -100

Time (2µs/div)
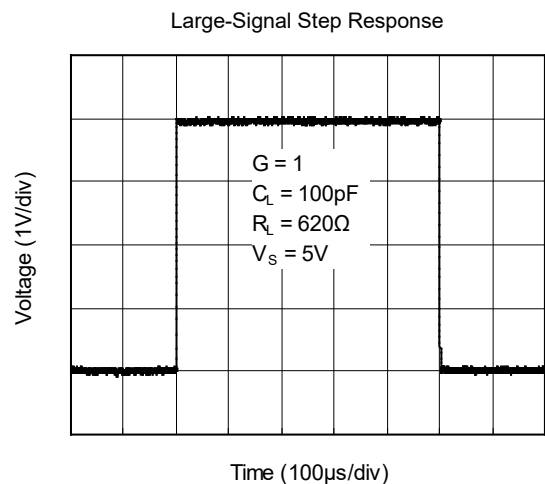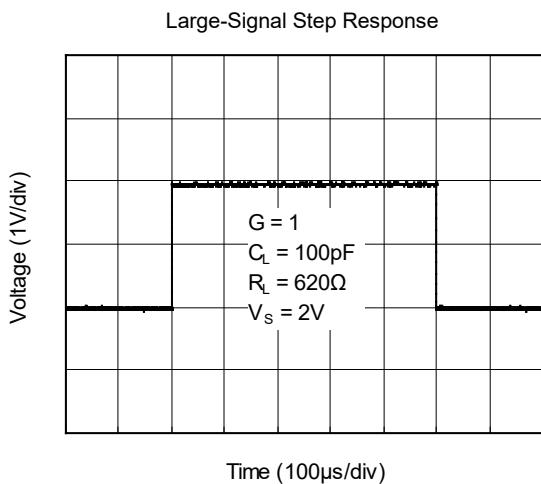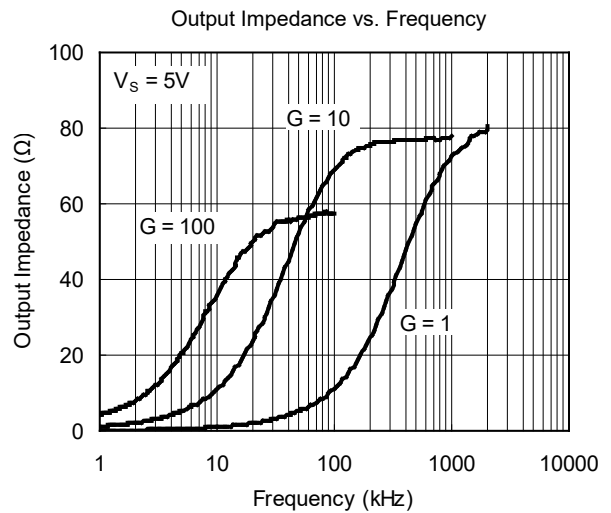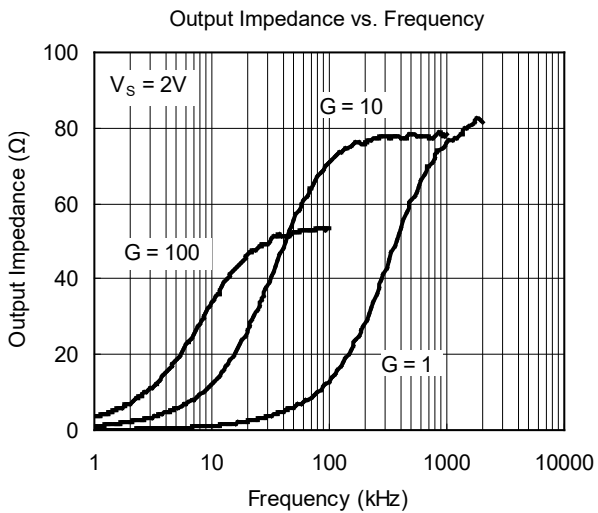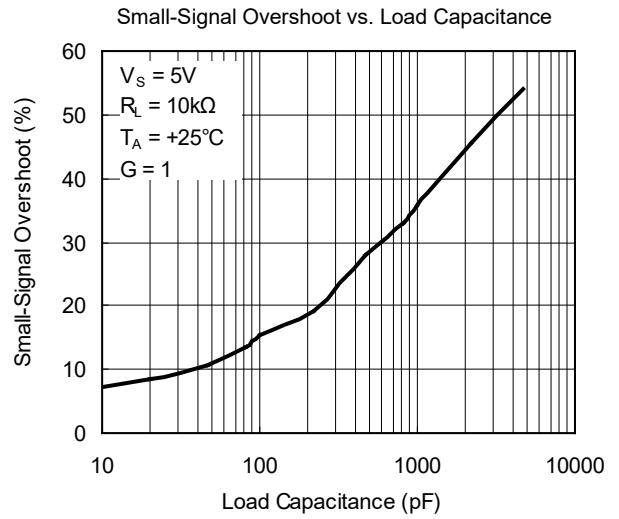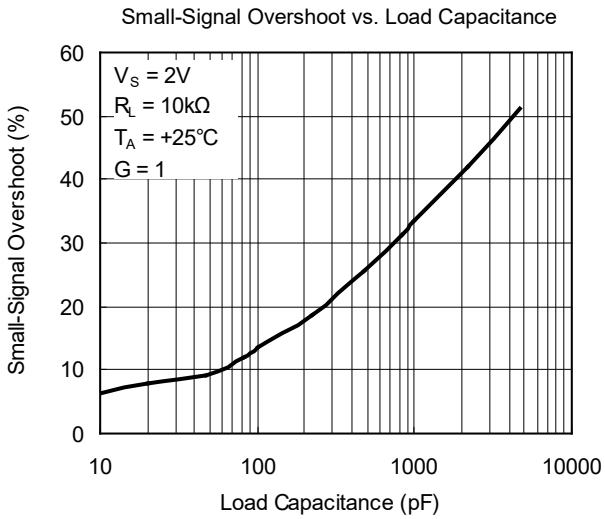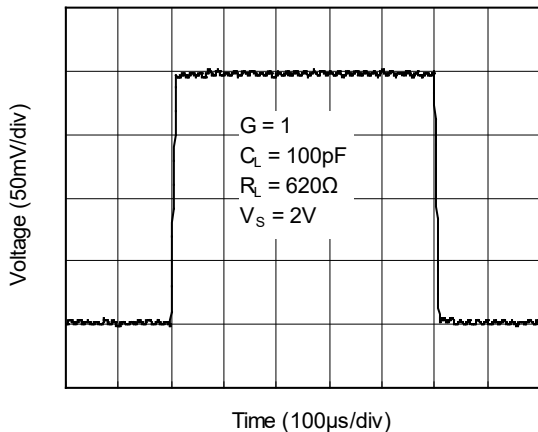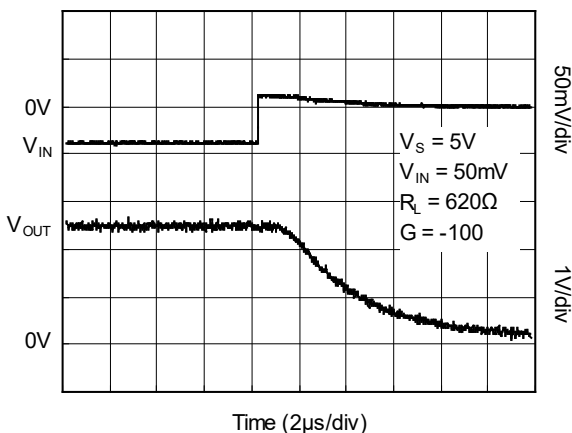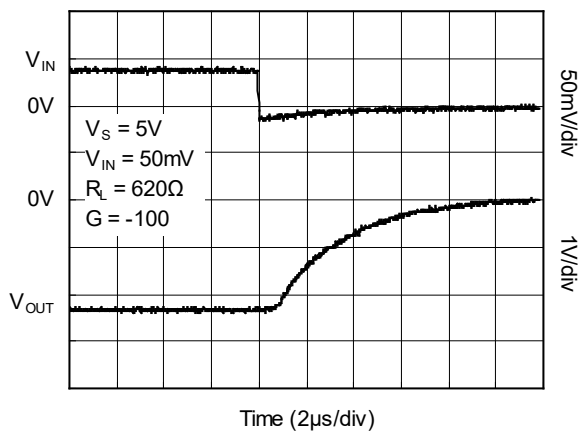
Supply Current vs. Temperature

V_S = 2V
V_S = 3V
V_S = 5V

Supply Current (mA)
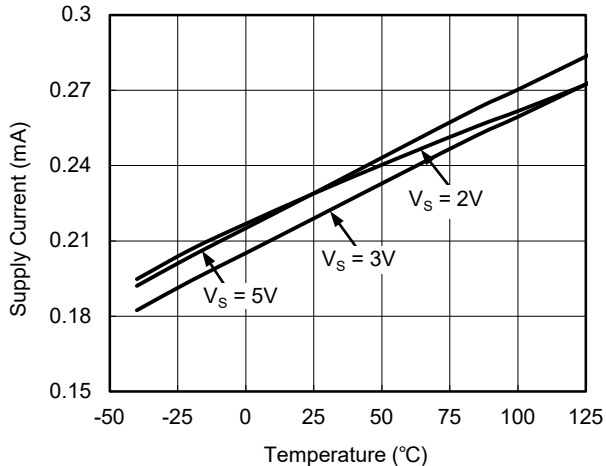
Temperature (℃)

Shutdown Current vs. Temperature
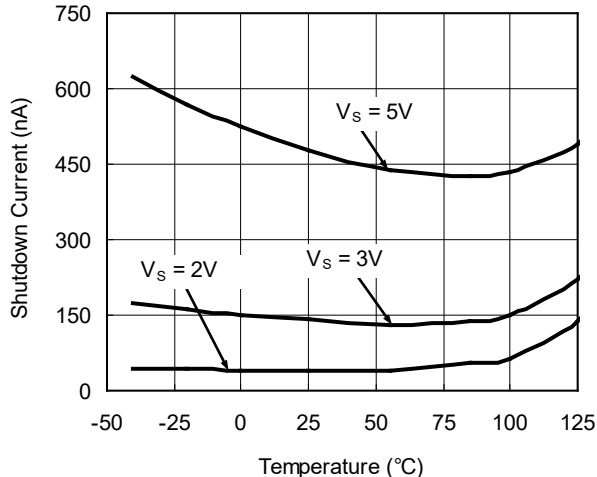
V_S = 5V
V_S = 2V
V_S = 3V

Shutdown Current (nA)

Temperature (℃)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

CMRR vs. Temperature
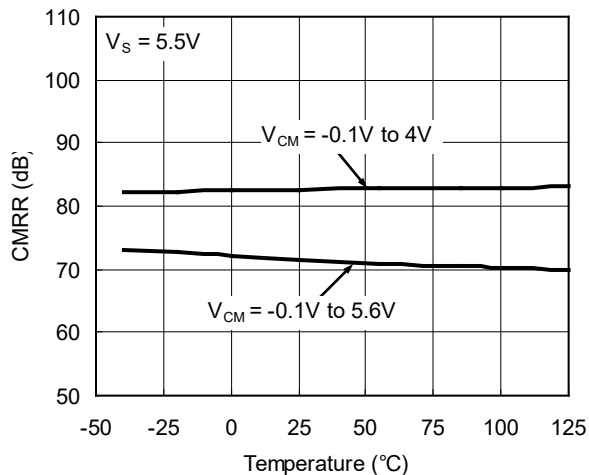
PSRR vs. Temperature
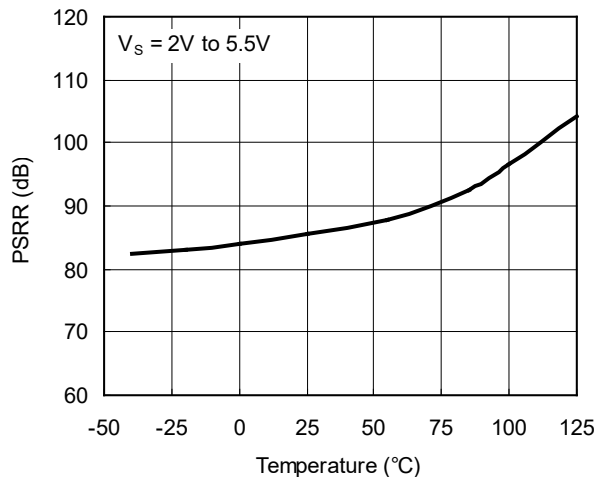
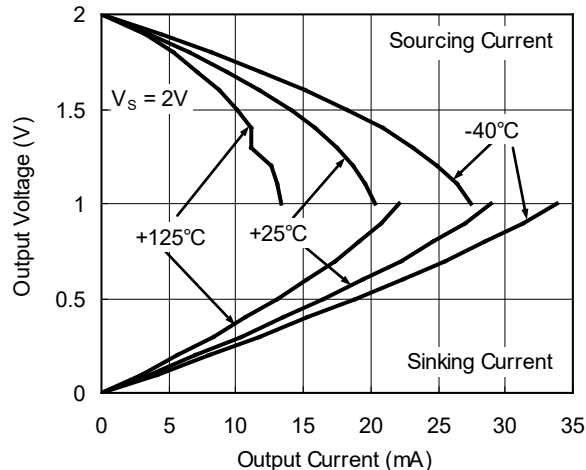Open-Loop Voltage Gain vs. Temperature
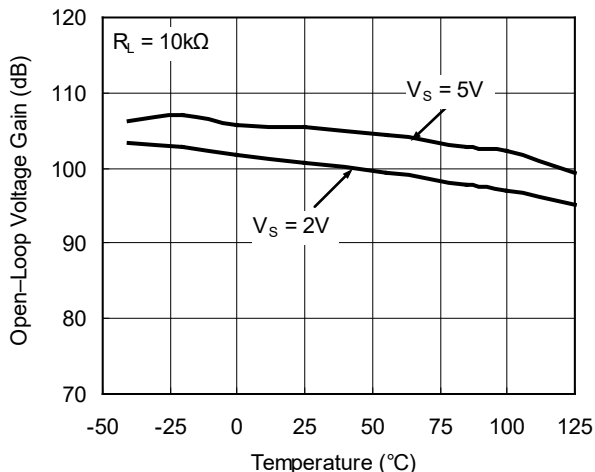
Open-Loop Voltage Gain vs. Temperature
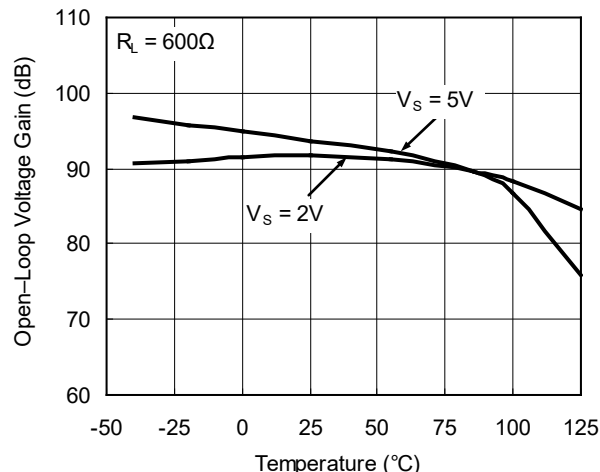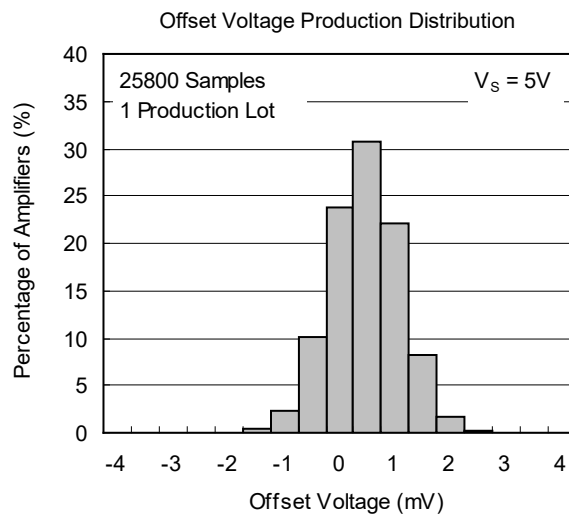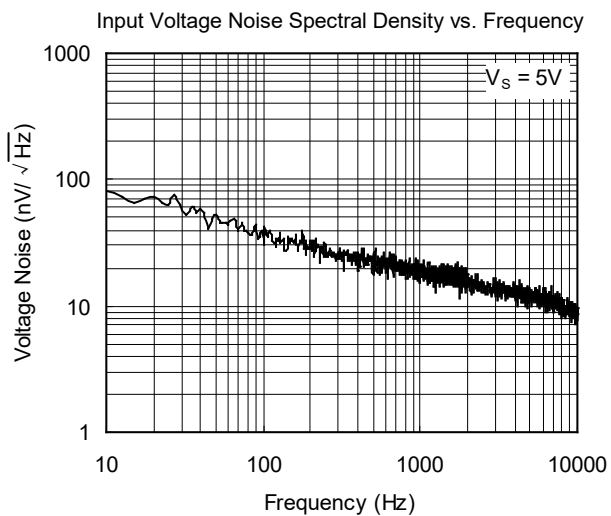

Output Voltage Swing vs. Output Current
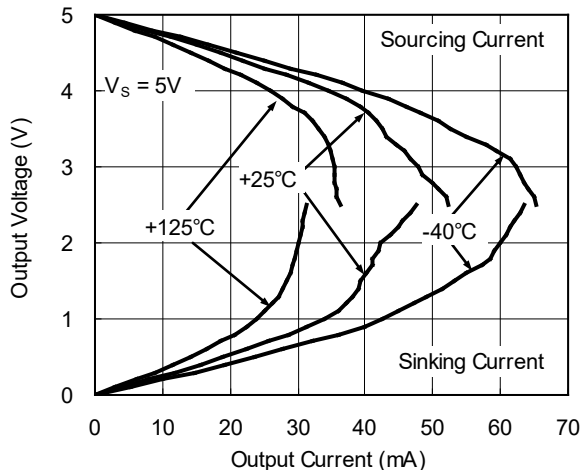
Output Voltage Swing vs. Output Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

Input Voltage Noise Spectral Density vs. Frequency

Offset Voltage Production Distribution

APPLICATION INFORMATION

Rail-to-Rail Input

When SGM8621/2/3/4 work at the power supply between 2V and 5.5V, the input common mode voltage range is from $(-V_S) - 0.1V$ to $(+V_S) + 0.1V$. In Figure 1, the ESD diodes between the inputs and the power supply rails will clamp the input voltage not to exceed the rails.
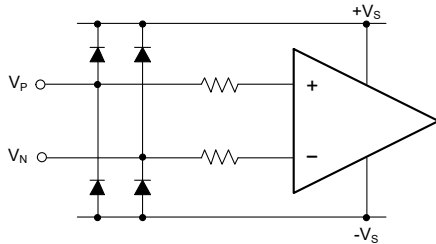

Figure 1. Input Equivalent Circuit

Rail-to-Rail Output

The SGM8621/2/3/4 support rail-to-rail output operation. In single power supply application, for example, when $+V_S = 5V$, $-V_S = GND$, $10k\Omega$ load resistor is tied from OUT pin to ground, the typical output swing range is from 0.007V to 4.993V.

Driving Capacitive Loads

The SGM8621/2/3/4 are designed for driving the 1000pF capacitive load with unity-gain stable. If greater capacitive load must be driven in application, the circuit in Figure 2 can be used. In this circuit, the IR drop voltage generated by R_{ISO} is compensated by feedback loop.
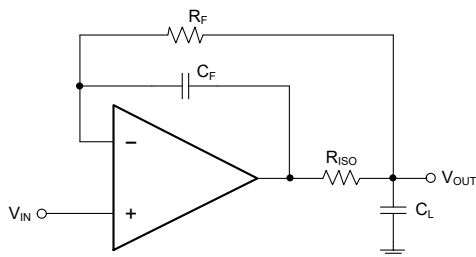
Figure 2. Circuit to Drive Heavy Capacitive Load

Power Supply Decoupling and Layout

A clean and low noise power supply is very important in amplifier circuit design, besides of input signal noise, the power supply is one of important source of noise to the amplifiers through $+V_S$ and $-V_S$ pins. Power supply bypassing is an effective method to clear up the noise at power supply, and the low impedance path to ground of decoupling capacitor will bypass the noise to GND. In application, 10µF ceramic capacitor paralleled with 0.1µF or 0.01µF ceramic capacitor is used in Figure 3. The ceramic capacitors should be placed as close as possible to $+V_S$ and $-V_S$ power supply pins.
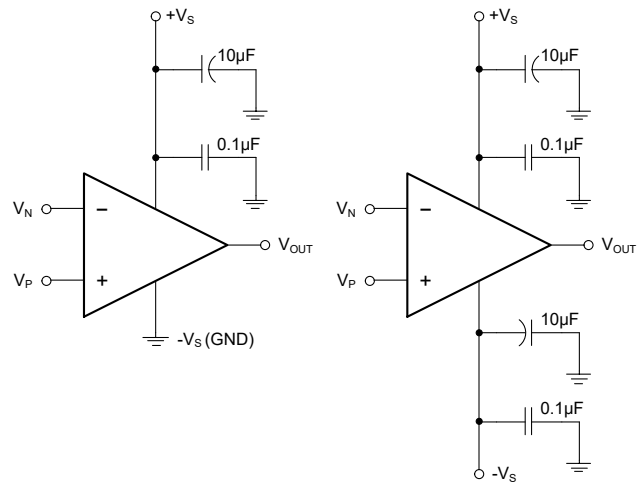
Figure 3. Amplifier Power Supply Bypassing

Grounding

In low speed application, one node grounding technique is the simplest and most effective method to eliminate the noise generated by grounding. In high speed application, the general method to eliminate noise is to use a complete ground plane technique, and the whole ground plane will help distribute heat and reduce EMI noise pickup.

## Reduce Input-to-Output Coupling

To reduce the input-to-output coupling, the input traces must be placed as far away from the power supply or output traces as possible. The sensitive trace must not be placed in parallel with the noisy trace in same layer. They must be placed perpendicularly in different layers to reduce the crosstalk. These PCB layout techniques will help to reduce unwanted positive feedback and noise.

APPLICATION INFORMATION (continued)

Typical Application Circuits

Difference Amplifier

The circuit in Figure 4 is a design example of classical difference amplifier. If $R_4/R_3 = R_2/R_1$, then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.
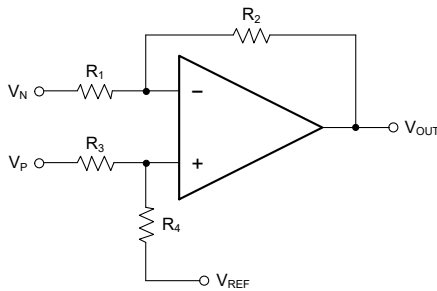
Figure 4. Difference Amplifier

High Input Impedance Difference Amplifier

The circuit in Figure 5 is a design example of high input impedance difference amplifier, the added amplifiers at the input are used to increase the input impedance and eliminate drawback of low input impedance in Figure 4.
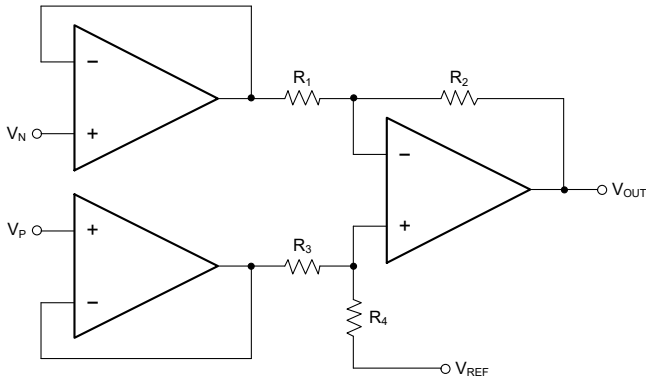
Figure 5. High Input Impedance Difference Amplifier

Active Low-Pass Filter

The circuit in Figure 6 is a design example of active low-pass filter, the DC gain is equal to $-R_2/R_1$ and the -3dB corner frequency is equal to $1/2\pi R_2 C$. In this design, the filter bandwidth must be less than the bandwidth of the amplifier, the resistor values must be selected as low as possible to reduce ringing or oscillation generated by the parasitic parameters in PCB layout.
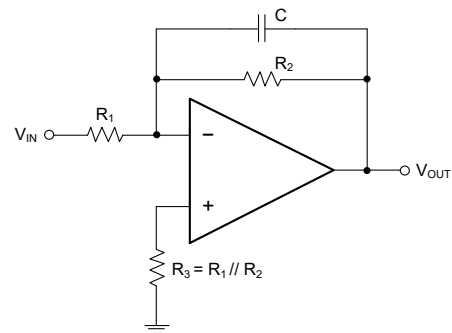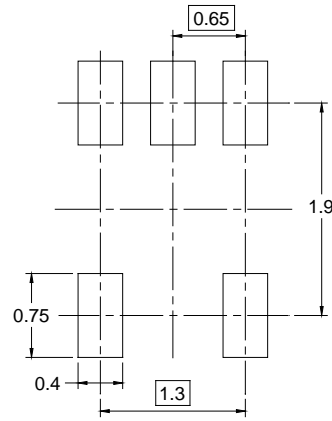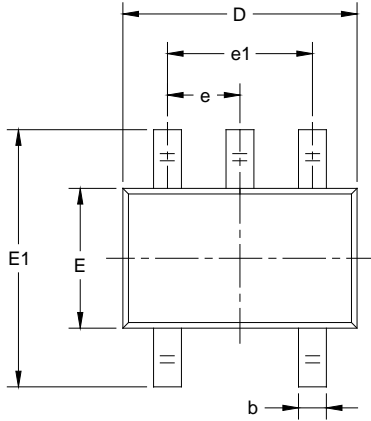

Figure 6. Active Low-Pass Filter

REVISION HISTORY

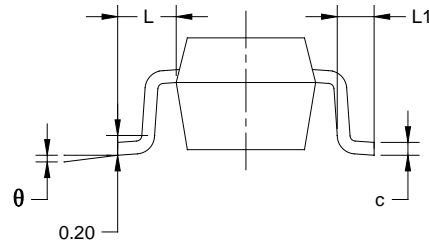NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

PACKAGE OUTLINE DIMENSIONS

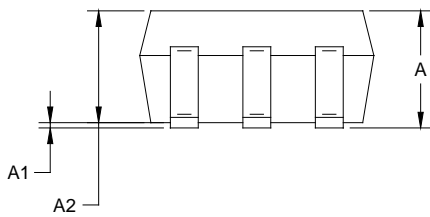### SC70-5

RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.220	0.003	0.009
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°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TX00043.001

PACKAGE OUTLINE DIMENSIONS

SOT-23-5

RECOMMENDED LAND PATTERN (Unit: mm)

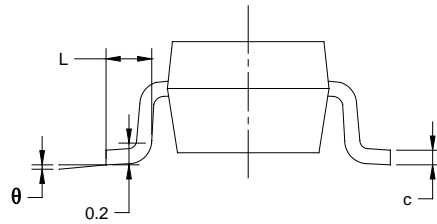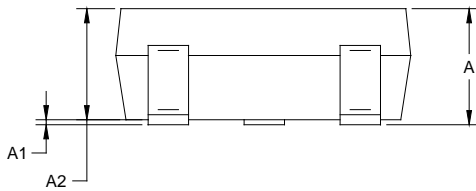| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	**MAX**	**MIN**	**MAX**
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SOT-23-6

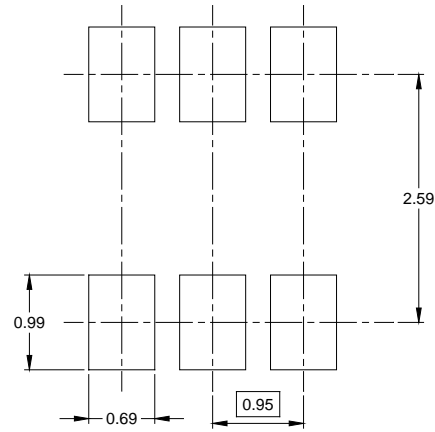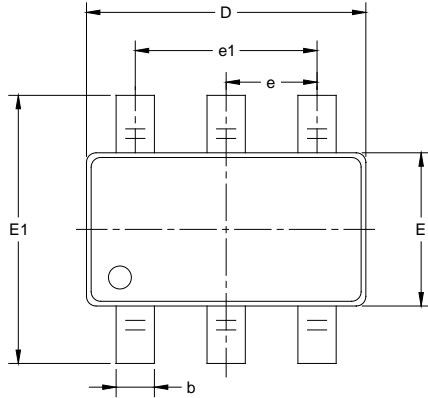**RECOMMENDED LAND PATTERN** (Unit: mm)

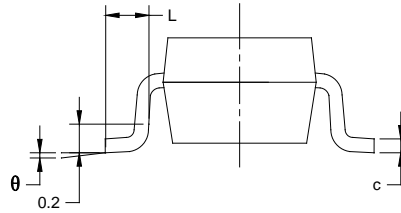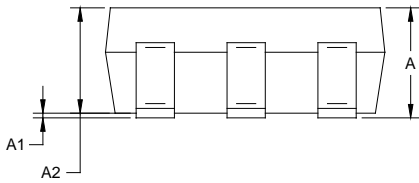| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	**MAX**	**MIN**	**MAX**
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SOIC-8

RECOMMENDED LAND PATTERN (Unit: mm)

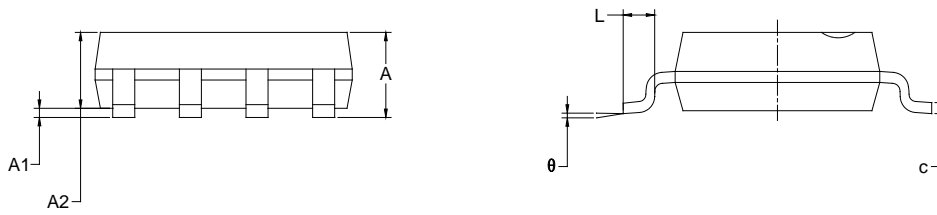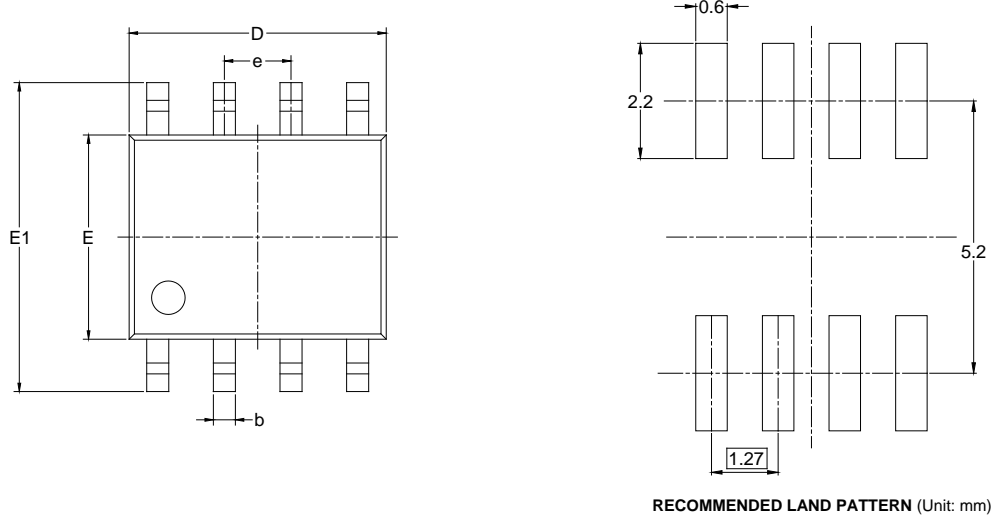| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

NOTES:
1. Body dimensions do not include mode flash or protrusion.
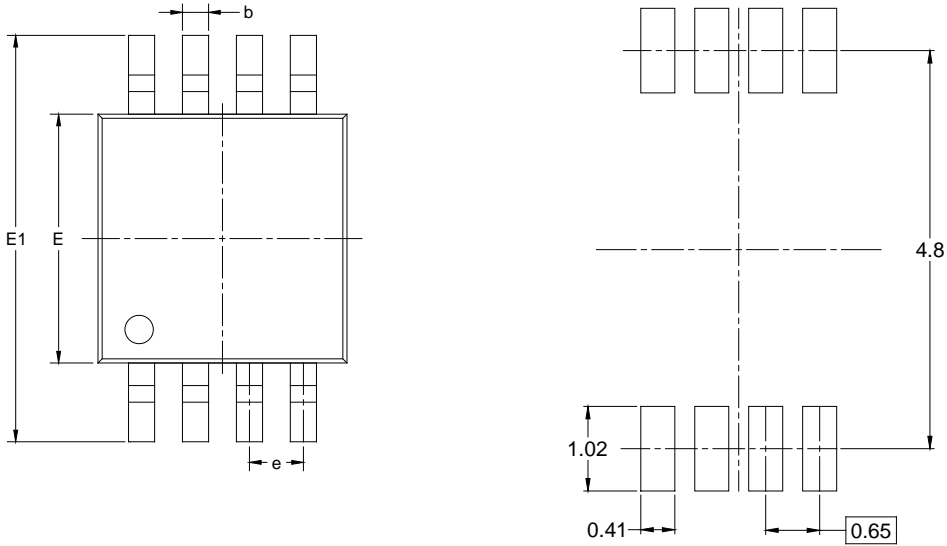2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

MSOP-8

RECOMMENDED LAND PATTERN (Unit: mm)

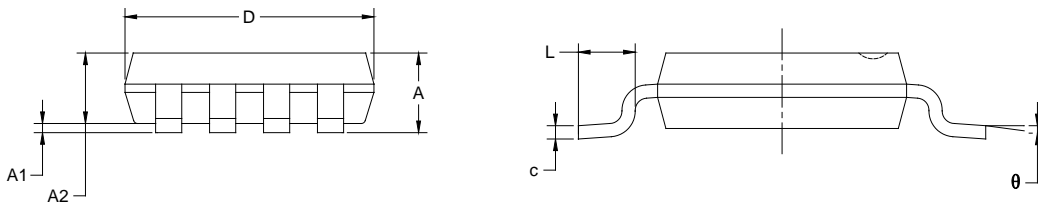| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	**MAX**	**MIN**	**MAX**
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650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

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS
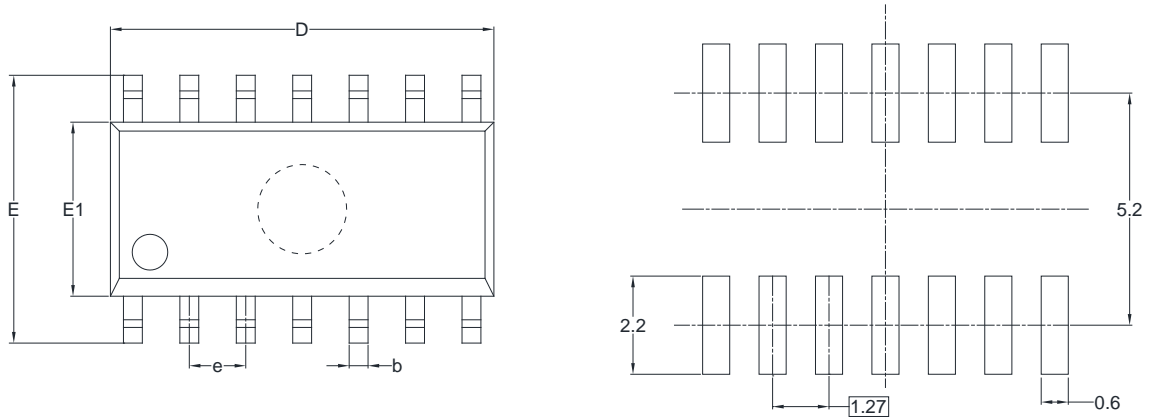
SOIC-14

RECOMMENDED LAND PATTERN (Unit: mm)

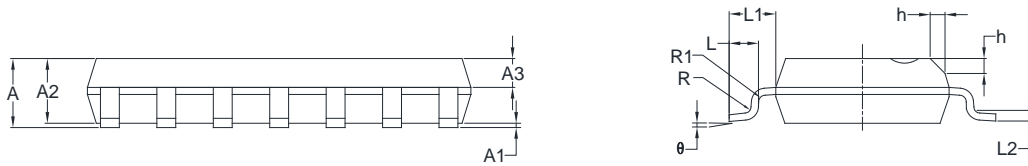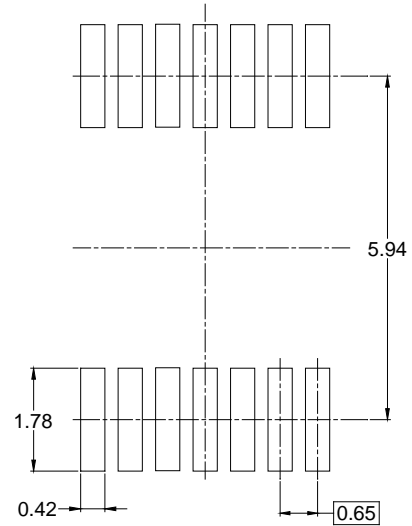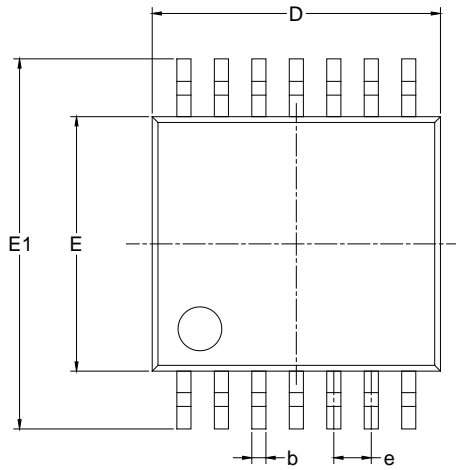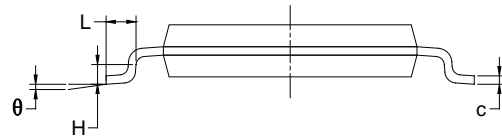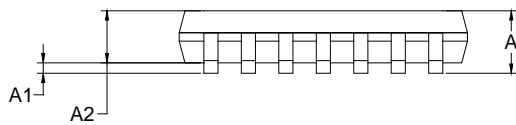| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	0.018	0.032
L1	1.04 REF		0.040 REF	
L2	0.25 BSC		0.01 BSC	
R	0.07		0.003	
R1	0.07		0.003	
h	0.30	0.50	0.012	0.020
θ	0°	8°	0°	8°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

TSSOP-14

RECOMMENDED LAND PATTERN (Unit: mm)

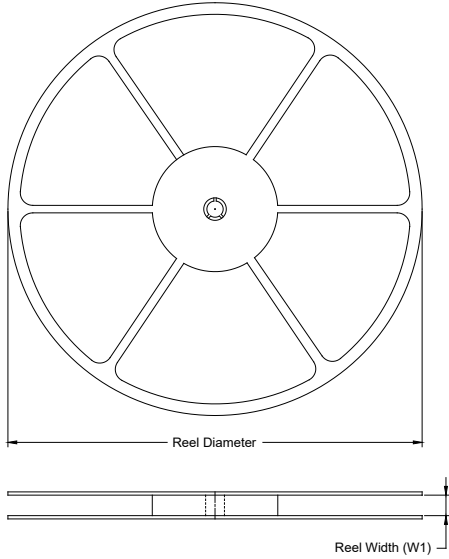| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

Reel Diameter

Reel Width (W1)

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
SC70-5	7″	9.5	2.40	2.50	1.20	4.0	4.0	2.0	8.0	Q3
SOT-23-5	7″	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SOT-23-6	7″	9.5	3.23	3.17	1.37	4.0	4.0	2.0	8.0	Q3
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
SOIC-14	13″	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13″	12.4	6.40	5.40	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
7″ (Option)	368	227	224	8
7″	442	410	224	18
13″	386	280	370	5

DD0002