SGM721/SGM722/SGM723/SGM724 11MHz, Rail-to-Rail I/O CMOS Operational Amplifiers

GENERAL DESCRIPTION

The SGM721/2/3/4 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 2.1V to 5.5V single supply, while consuming low quiescent current. The supply current of SGM723 is less than 1μA in power-down mode.

The SGM721/2/3/4 feature a 4mV 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 11MHz and a slew rate of 8.5V/μs. These specifications make the operational amplifiers appropriate for various applications.

The SGM721 is available in Green SC70-5, SOT-23-5 and SOIC-8 packages. The SGM722 is available in Green SOIC-8, MSOP-8 and TSSOP-8 packages. The SGM723 is available in Green SOT-23-6 and SOIC-8 packages. The SGM724 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: 4mV (MAX)**
- **High Gain-Bandwidth Product: 11MHz**
- **High Slew Rate: 8.5V/μs**
- **Settling Time to 0.1% with 2V Step: 0.21μs**
- **Overload Recovery Time: 0.6μs**
- **Low Noise: 8.5nV/$\sqrt{Hz}$ at 10kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.1V to 5.5V**
- **Input Voltage Range: -0.1V to 5.6V with V_S = 5.5V**
- **Low Power:**
  SGM721/3: 1.2mA (TYP)
  SGM722/4: 1.1mA/Amplifier (TYP)
  SGM723 Less than 1μA when Disabled
- **-40℃ to +125℃ Operating Temperature Range**
- **Small Packaging:**
  SGM721 Available in Green SC70-5, SOT-23-5 and SOIC-8 Packages
  SGM722 Available in Green MSOP-8, SOIC-8 and TSSOP-8 Packages
  SGM723 Available in Green SOT-23-6 and SOIC-8 Packages
  SGM724 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
SGM721	SC70-5	-40℃ to +125℃	SGM721XC5/TR	721	Tape and Reel, 3000
	SOT-23-5	-40℃ to +125℃	SGM721XN5/TR	721	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM721XS/TR	SGM721XS XXXXX	Tape and Reel, 2500
SGM722	MSOP-8	-40℃ to +125℃	SGM722XMS/TR	SGM722 XMS XXXXX	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM722XS/TR	SGM722XS XXXXX	Tape and Reel, 2500
	TSSOP-8	-40℃ to +125℃	SGM722XTS8G/TR	SGM722 XTS8 XXXXX	Tape and Reel, 4000
SGM723	SOT-23-6	-40℃ to +125℃	SGM723XN6/TR	723	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM723XS/TR	SGM723XS XXXXX	Tape and Reel, 2500
SGM724	SOIC-14	-40℃ to +125℃	SGM724XS14/TR	SGM724XS14 XXXXX	Tape and Reel, 2500
	TSSOP-14	-40℃ to +125℃	SGM724XTS14/TR	SGM724 XTS14 XXXXX	Tape and Reel, 3000

MARKING INFORMATION

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

(1) XXXXX = Date Code and Vendor Code.

XXXXX
- Vendor Code
- Date Code - Week
- Date Code - Year

SGM722: SOIC-8

(2) XXXXX = Date Code, Trace Code and Vendor Code.

XXXXX
- Vendor Code
- Trace Code
- 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 $-V_S$ 7V
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
TSSOP-8, θ_{JA}.. 170℃/W
Junction Temperature...+150℃
Storage Temperature Range ....-65℃ to +150℃
Lead Temperature (Soldering, 10s)............................+260℃
ESD Susceptibility
HBM (SGM721/2/4) 8000V
HBM (SGM723) 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

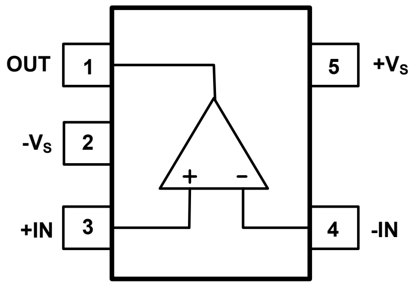
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

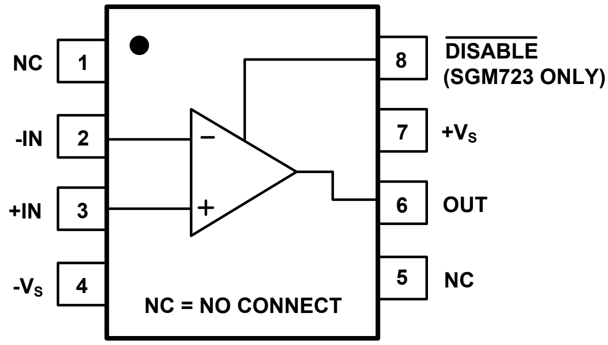
PIN CONFIGURATIONS

SGM721 (TOP VIEW)



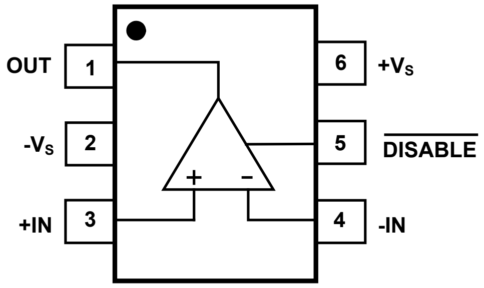
SC70-5/SOT-23-5

SGM721/723 (TOP VIEW)



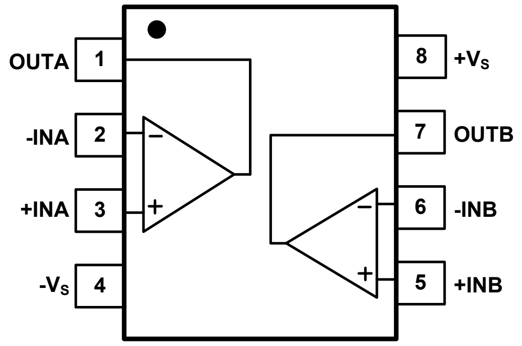
SOIC-8

SGM723 (TOP VIEW)



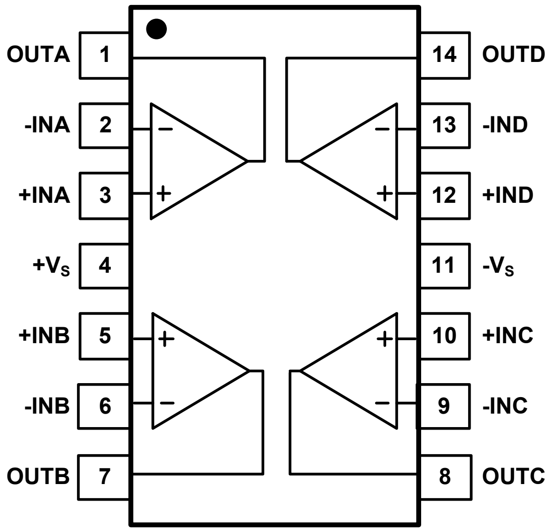
SOT-23-6

SGM722 (TOP VIEW)



SOIC-8/MSOP-8/TSSOP-8

SGM724 (TOP VIEW)



TSSOP-14/SOIC-14

ELECTRICAL CHARACTERISTICS

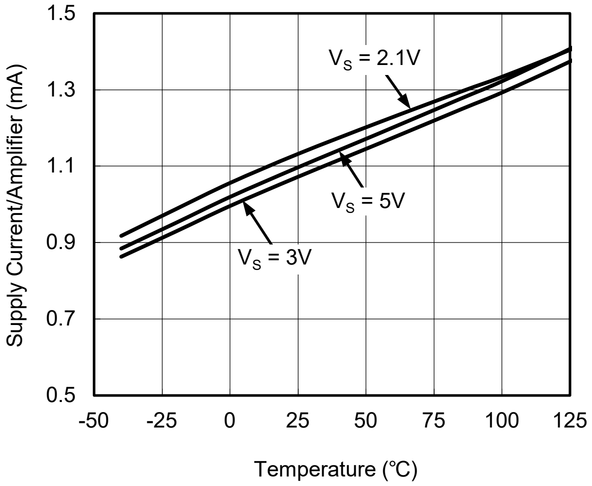
(At T_A = +25℃, V_S = +5V, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER		CONDITIONS	SGM721/2/3/4					
			TYP	MIN/MAX OVER TEMPERATURE				
			+25℃	+25℃	-40℃ to +85℃	-40℃ to +125℃	UNITS	MIN/ MAX
Input Characteristics								
Input Offset Voltage (V_{OS})			1.5	4	4.3	4.6	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	83	67	66	65	dB	MIN
		V_S = 5.5V, V_{CM} = -0.1V to 5.6V	75	60	59	56	dB	MIN
Open-Loop Voltage Gain (A_{OL})		R_L = 600Ω ,V_{OUT} = 0.15V to 4.85V	89	82	74	71	dB	MIN
		R_L = 10kΩ ,V_{OUT} = 0.05V to 4.95V	102	96	85	83	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)			2.1				μV/℃	TYP
Output Characteristics								
Output Voltage Swing from Rail		R_L = 600Ω	0.076				V	TYP
		R_L = 10kΩ	0.006				V	TYP
Output Current (I_{OUT})			67	52	42	36	mA	MIN
Closed-Loop Output Impedance		f = 1MHz, G = 1	8.5				Ω	TYP
Power-Down Disable (SGM723 Only)								
Turn-On Time			1.1				μs	TYP
Turn-Off Time			0.3				μs	TYP
$\overline{\text{DISABLE}}$ Voltage-Off				0.8			V	MAX
$\overline{\text{DISABLE}}$ Voltage-On				2			V	MIN
Power Supply								
Operating Voltage Range			2.1	2.1	2.1	2.1	V	MIN
			5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)		V_S = 2.1V to 5.5V, V_{CM} = (-V_S) + 0.5V	82	68	67	64	dB	MIN
Quiescent Current/Amplifier (I_Q)	SGM722/4	I_{OUT} = 0	1.10	1.40	1.60	1.75	mA	MAX
	SGM721/3	I_{OUT} = 0	1.2	1.5	1.7	1.85	mA	MAX
Supply Current when Disabled (SGM723 only)			0.5	8	9	10	μA	MAX
Dynamic Performance								
Gain-Bandwidth Product (GBP)			11				MHz	TYP
Phase Margin (φ_O)			62				°	TYP
Full-Power Bandwidth (BW_P)		< 1% distortion	400				kHz	TYP
Slew Rate (SR)		G = 1, 2V output step	8.5				V/μs	TYP
Settling Time to 0.1% (t_S)		G = 1, 2V output step	0.21				μs	TYP
Overload Recovery Time		V_{IN} × G = V_S	0.6				μs	TYP
Noise Performance								
Input Voltage Noise Density (e_n)		f = 1kHz	12.5				$nV/\sqrt{Hz}$	TYP
		f = 10kHz	8.5				$nV/\sqrt{Hz}$	TYP

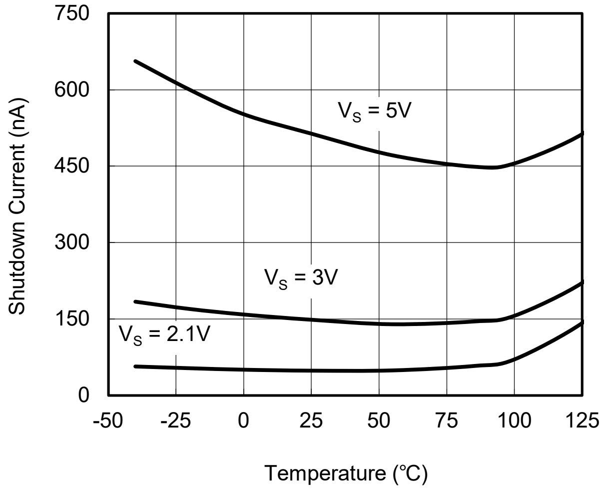
TYPICAL PERFORMANCE CHARACTERISTICS

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

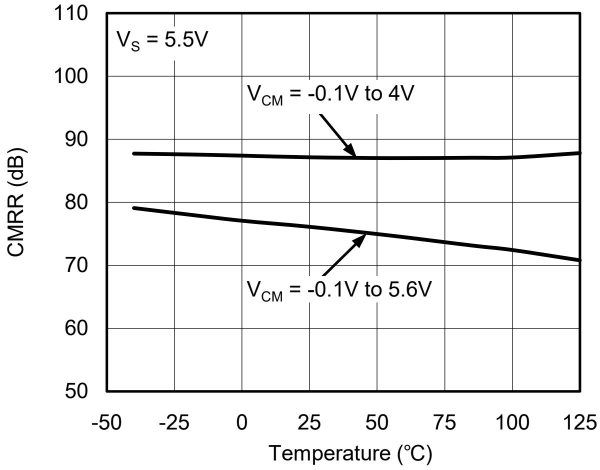
Supply Current vs. Temperature



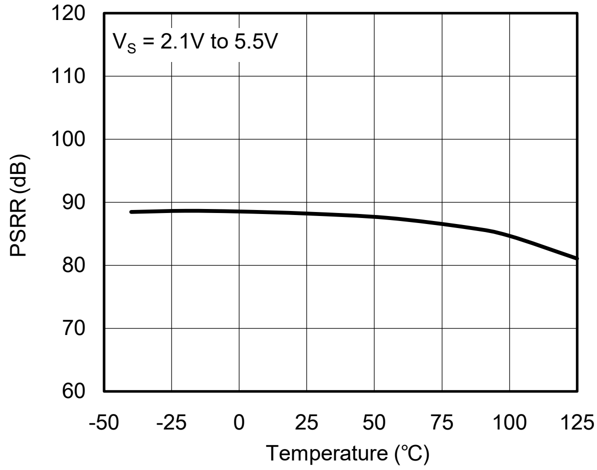
Shutdown Current vs. Temperature



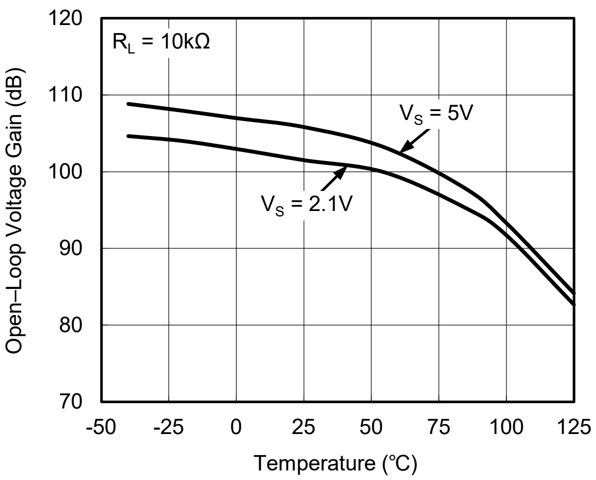
CMRR vs. Temperature



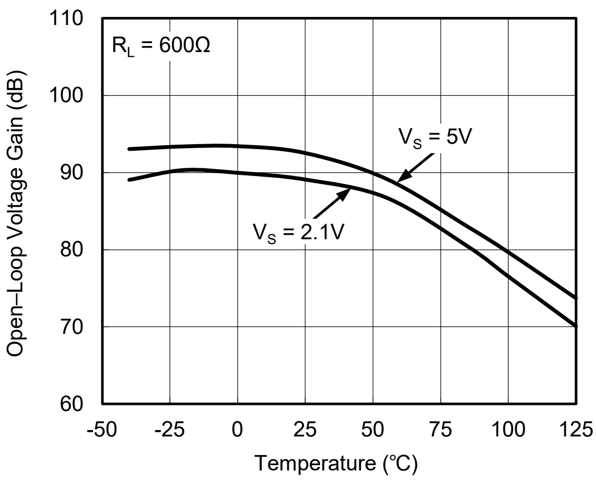
PSRR vs. Temperature



Open-Loop Voltage Gain vs. Temperature



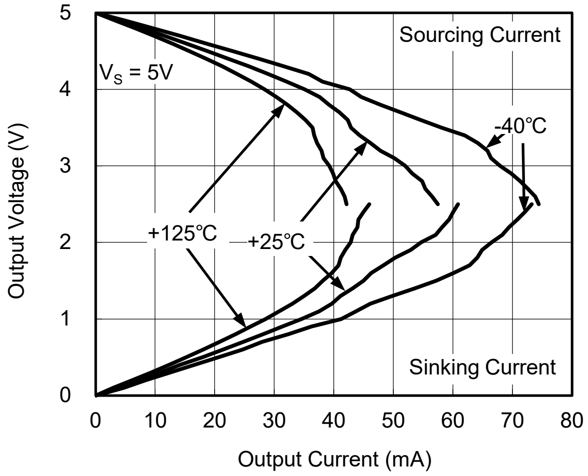
Open-Loop Voltage Gain vs. Temperature



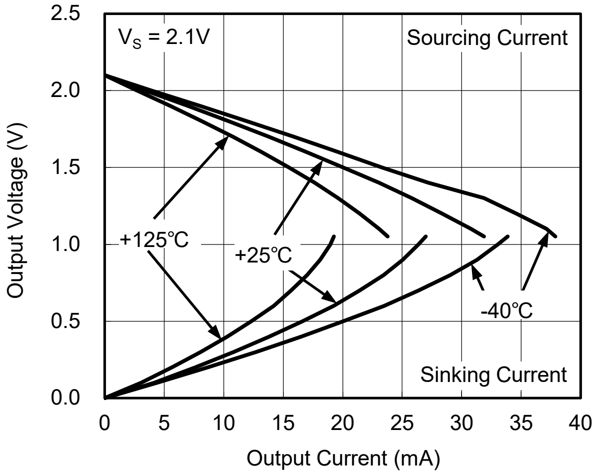
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

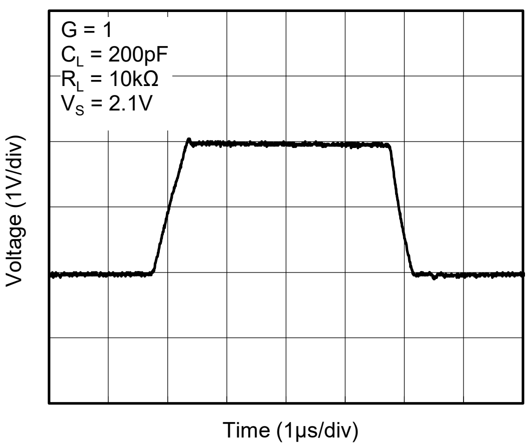
Output Voltage Swing vs. Output Current



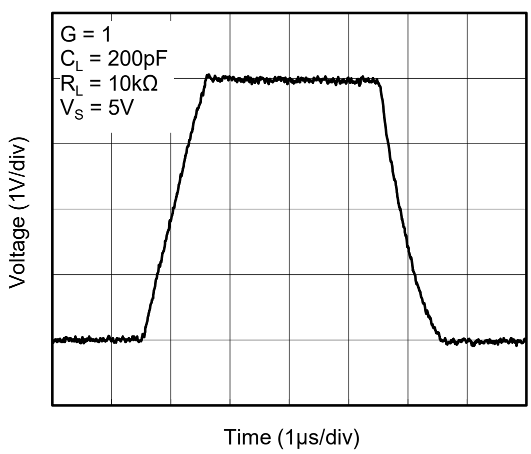
Output Voltage Swing vs. Output Current



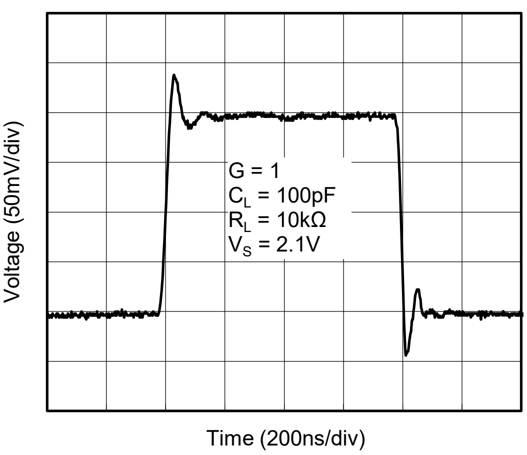
Large-Signal Step Response



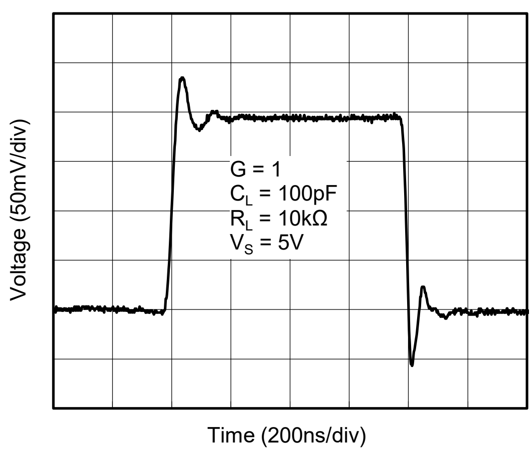
Large-Signal Step Response



Small-Signal Step Response



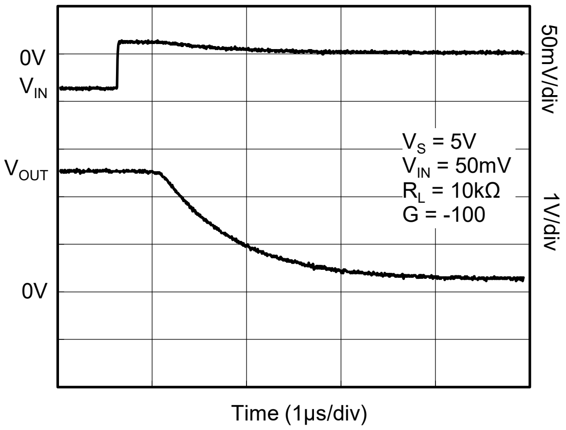
Small-Signal Step Response



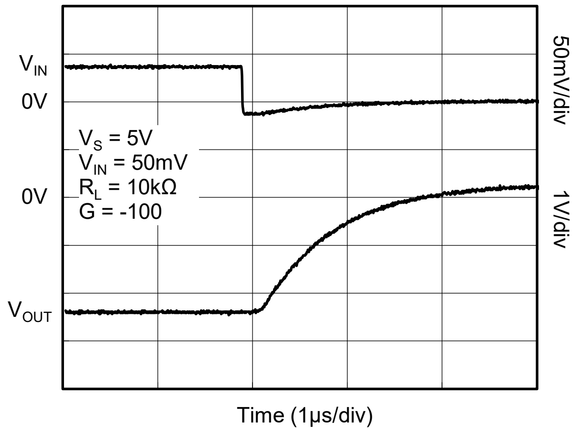
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

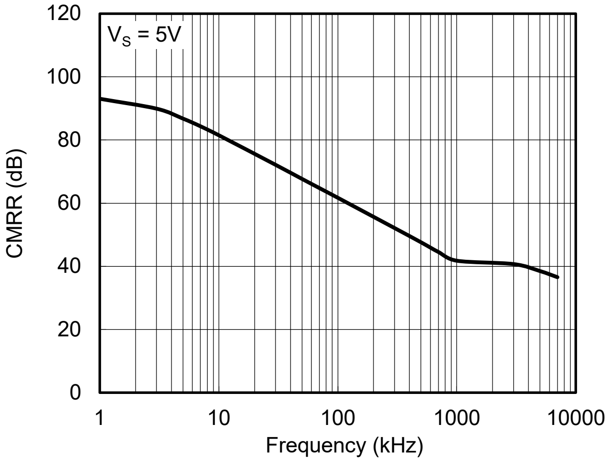
Positive Overload Recovery



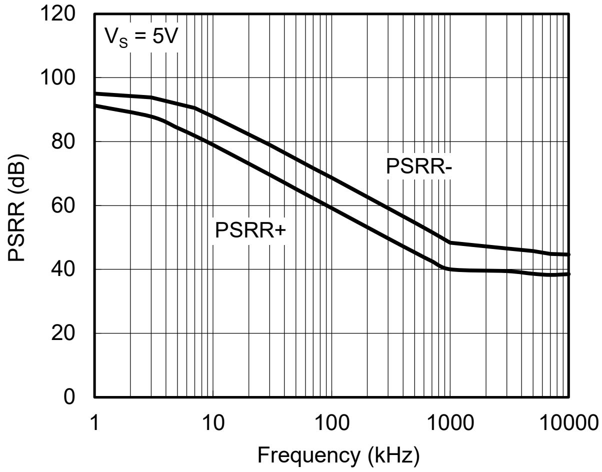
Negative Overload Recovery



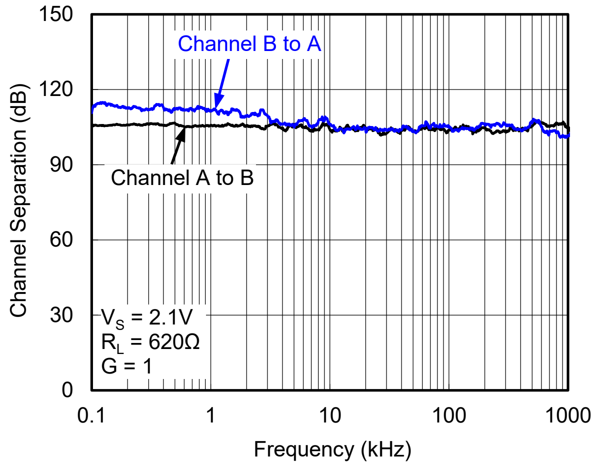
CMRR vs. Frequency



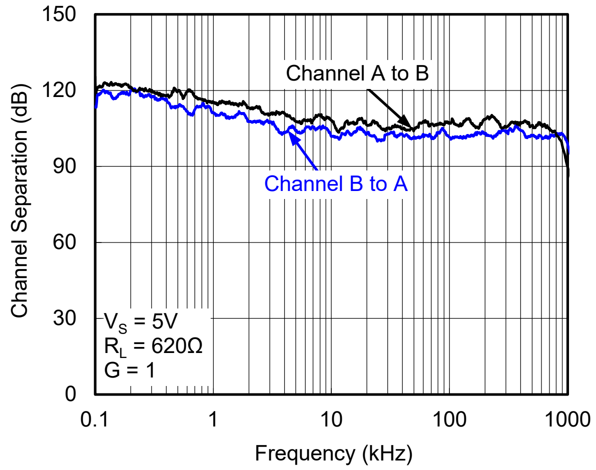
PSRR vs. Frequency



Channel Separation vs. Frequency

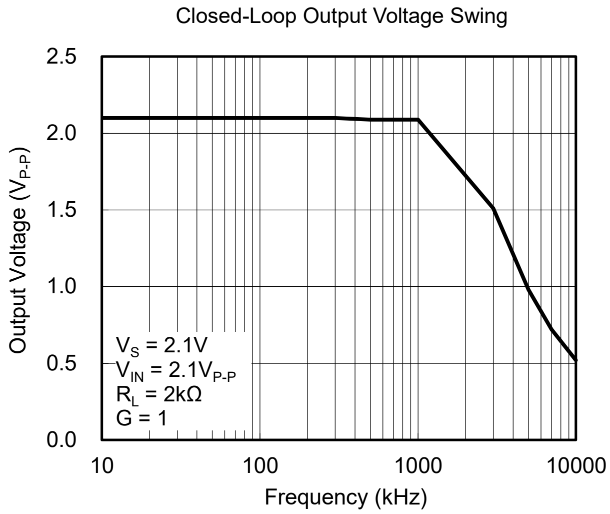


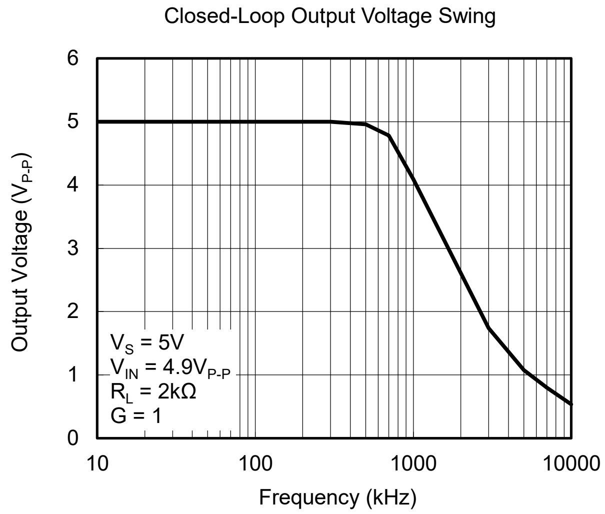
Channel Separation vs. Frequency

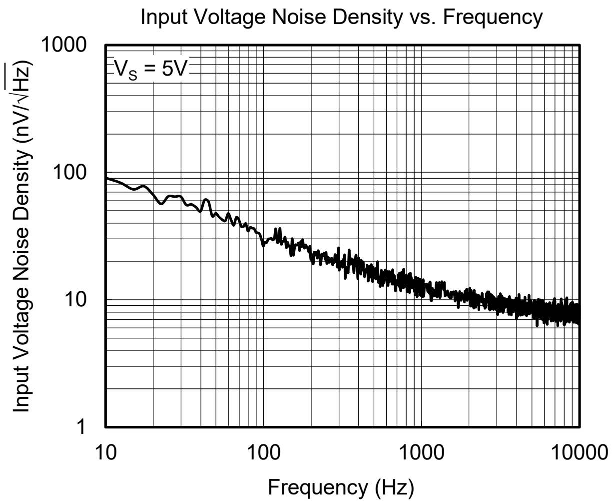


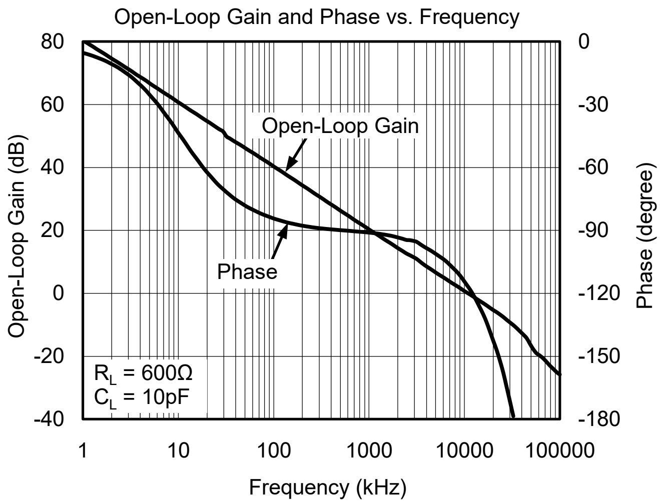
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

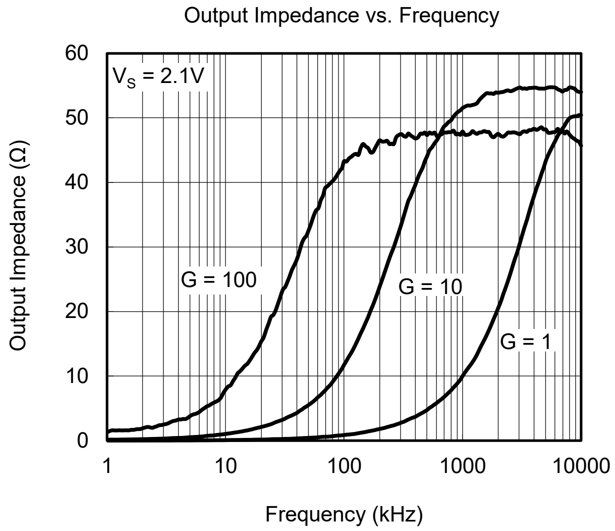
At T_A = +25°C, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

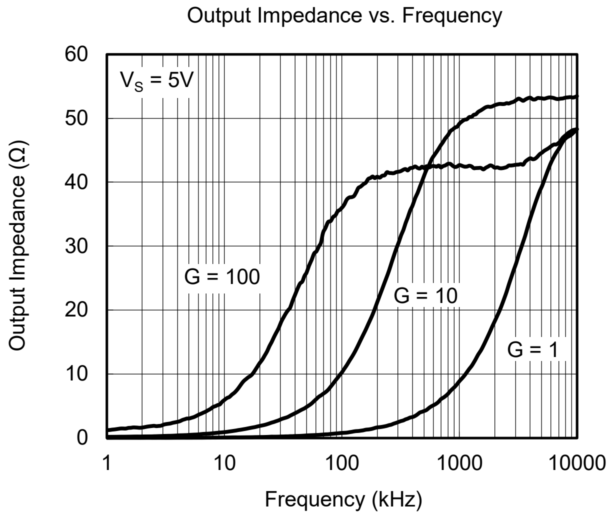












TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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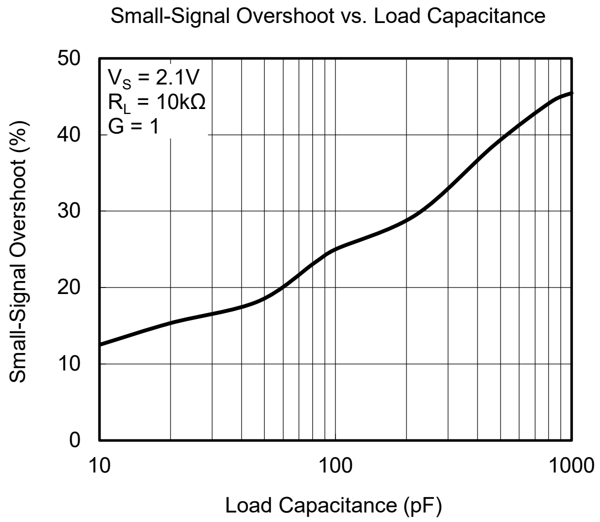
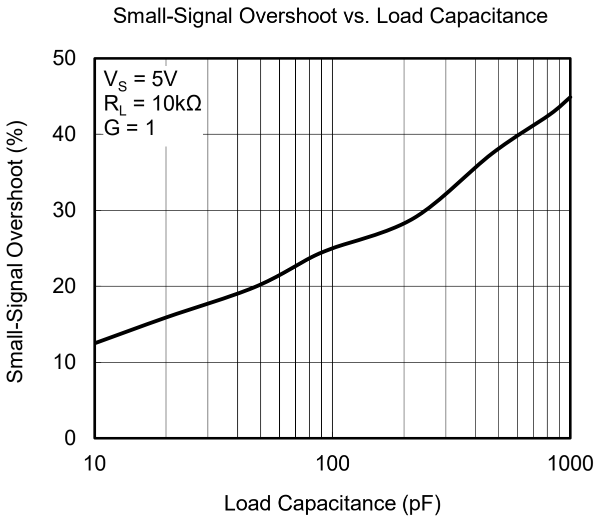
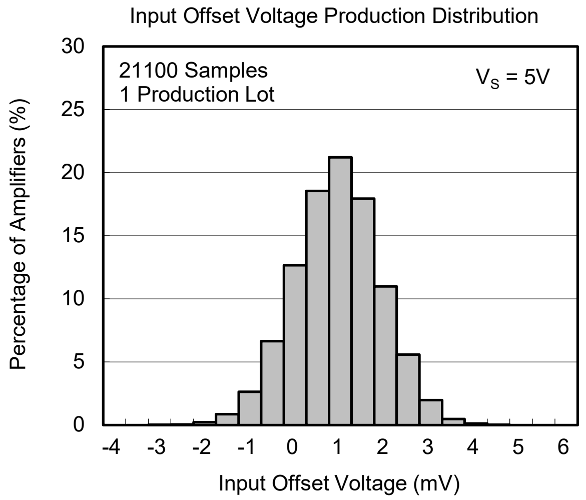






APPLICATION INFORMATION

Rail-to-Rail Input

When SGM721/2/3/4 work at the power supply between 2.1V 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.

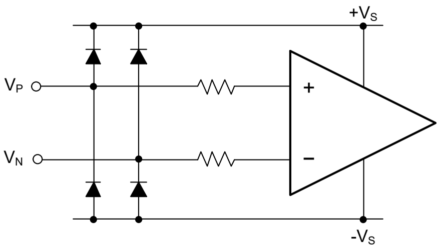


Figure 1. Input Equivalent Circuit

Input Current-Limit Protection

For ESD diode clamping protection, when the current flowing through ESD diode exceeds the maximum rating value, the ESD diode and amplifier will be damaged, so current-limit protection will be added in some applications. One resistor is selected to limit the current not to exceed the maximum rating value. In Figure 2, a series input resistor is used to limit the input current to less than 10mA, but the drawback of this current-limit resistor is that it contributes thermal noise at the amplifier input. If this resistor must be added, its value must be selected as small as possible.

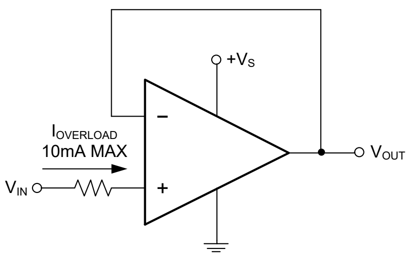


Figure 2. Input Current-Limit Protection

Rail-to-Rail Output

The SGM721/2/3/4 support rail-to-rail output operation. In single power supply application, for example, when $+V_S$ = 5V, $-V_S$ = GND, 10kΩ load resistor is tied from OUT pin to ground, the typical output swing range is from 0.006V to 4.994V.

Driving Capacitive Loads

The SGM721/2/3/4 are designed for unity-gain stable for capacitive load up to 4700pF. If greater capacitive load must be driven in application, the circuit in Figure 3 can be used. In this circuit, the IR drop voltage generated by R_{ISO} is compensated by feedback loop.

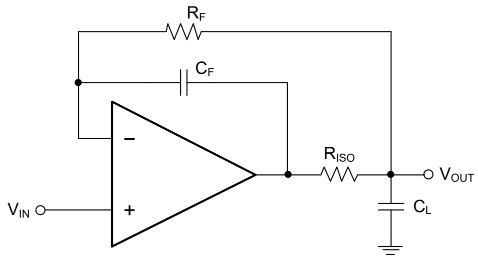


Figure 3. Circuit to Drive Heavy Capacitive Load

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 4. The ceramic capacitors should be placed as close as possible to $+V_S$ and $-V_S$ power supply pins.

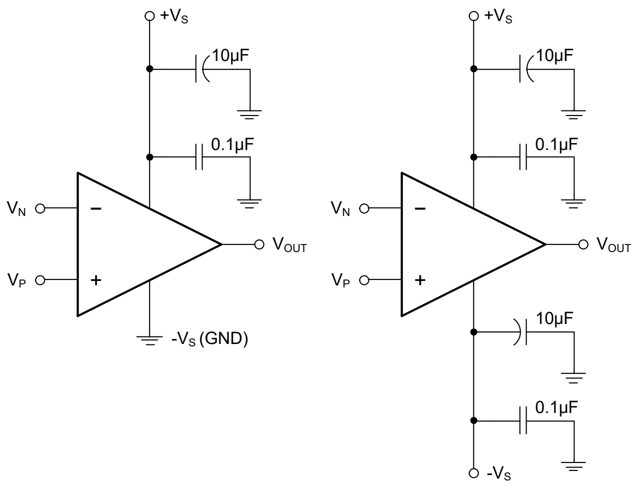


Figure 4. Amplifier Power Supply Bypassing

APPLICATION INFORMATION (continued)

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.

Typical Application Circuits

Difference Amplifier

The circuit in Figure 5 is a design example of classical difference amplifier. If $R_4/R_3 = R_2/R_1$, then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

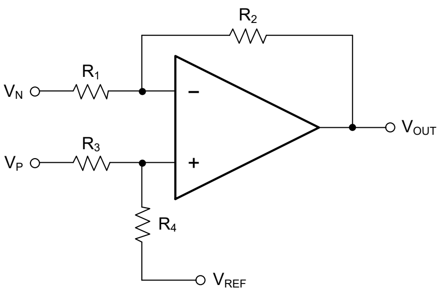


Figure 5. Difference Amplifier

High Input Impedance Difference Amplifier

The circuit in Figure 6 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 5.

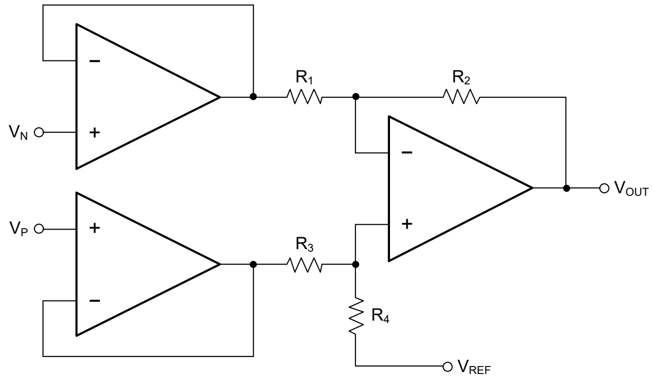


Figure 6. High Input Impedance Difference Amplifier

Active Low-Pass Filter

The circuit in Figure 7 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 $1/2\pi R_2C$. 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.

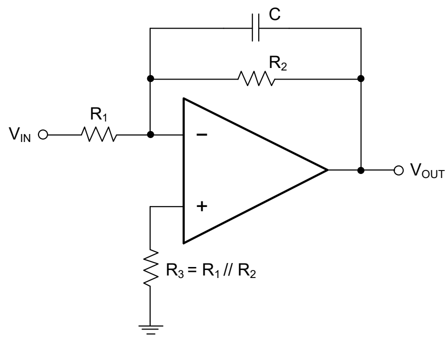


Figure 7. Active Low-Pass Filter

REVISION HISTORY

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

NOVEMBER 2020 – REV.C.3 to REV.C.4	Page
Updated Marking Information section	2

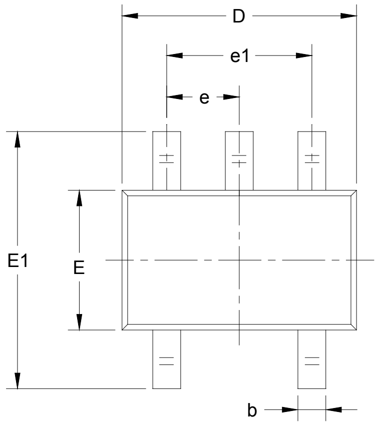
NOVEMBER 2019 – REV.C.2 to REV.C.3	Page
Updated Absolute Maximum Ratings section	3

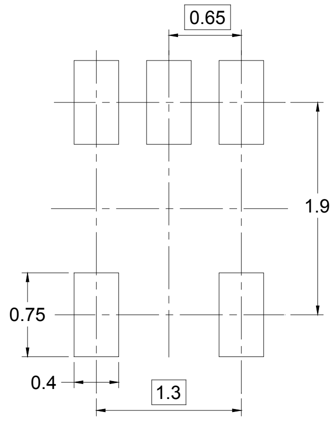
JANUARY 2018 – REV.C.1 to REV.C.2	Page
Added Open-Loop Gain and Phase vs. Frequency	9

SEPTEMBER 2017 – REV.C to REV.C.1	Page
Changed Supply Voltage	2

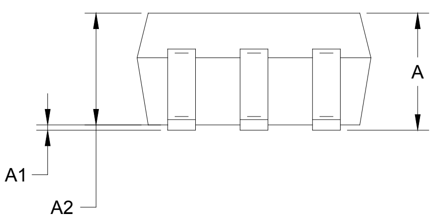
PACKAGE OUTLINE DIMENSIONS

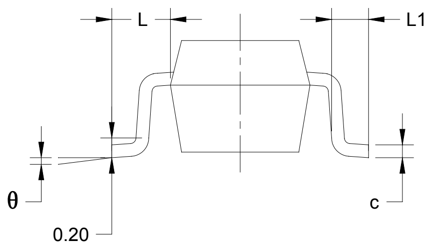
SC70-5





RECOMMENDED LAND PATTERN (Unit: mm)

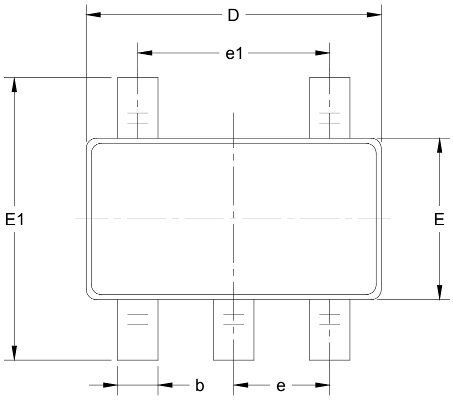


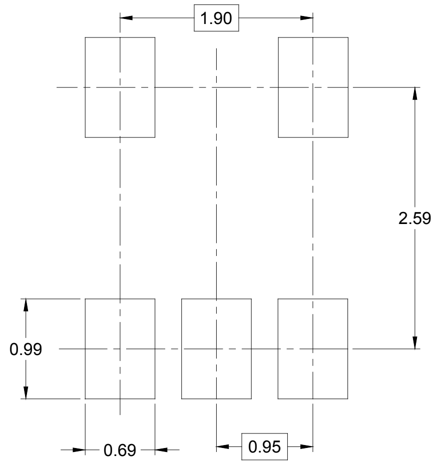


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 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°

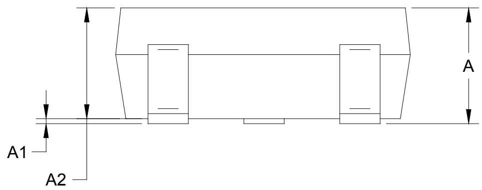
PACKAGE OUTLINE DIMENSIONS

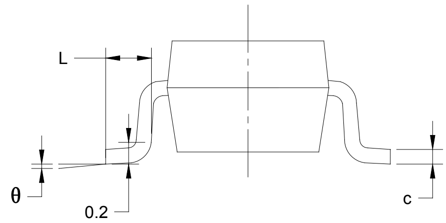
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

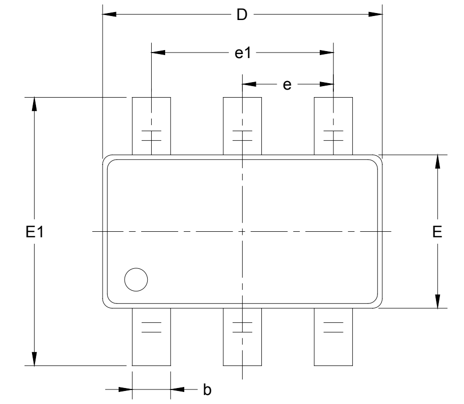


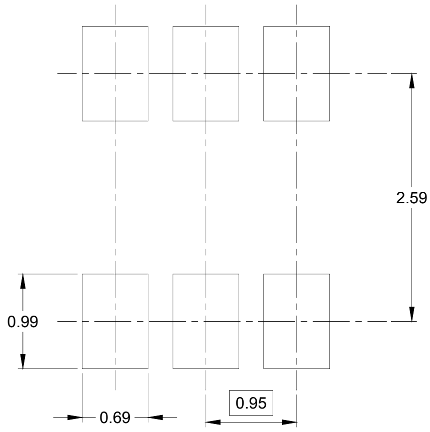


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

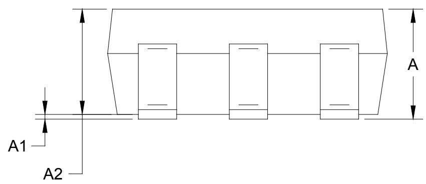
PACKAGE OUTLINE DIMENSIONS

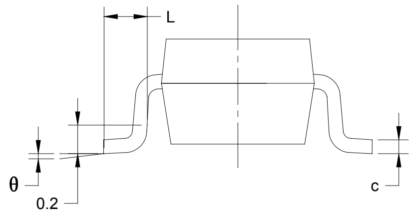
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)

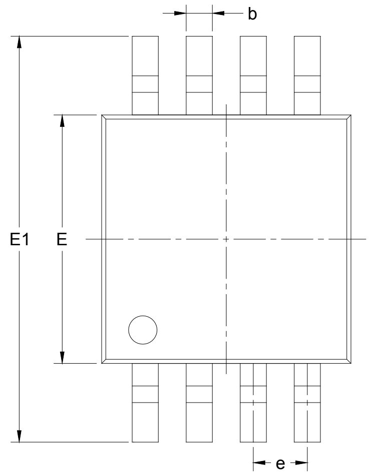


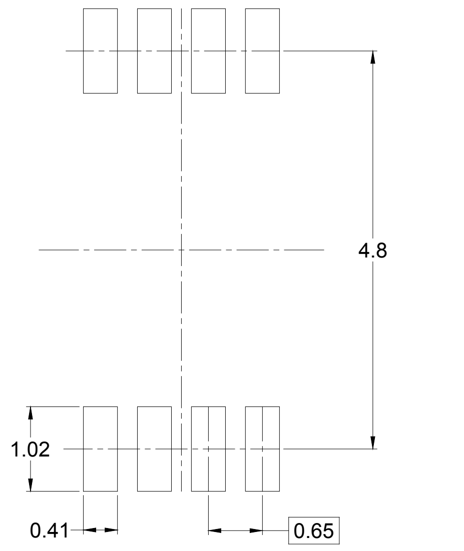


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

PACKAGE OUTLINE DIMENSIONS

MSOP-8





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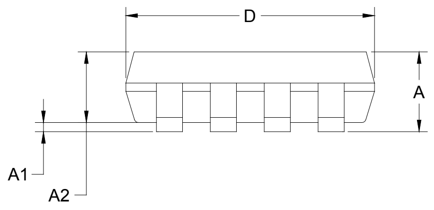
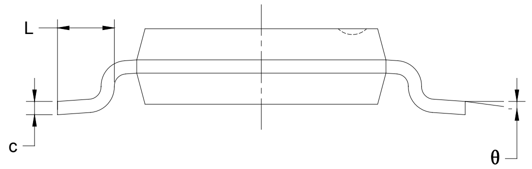
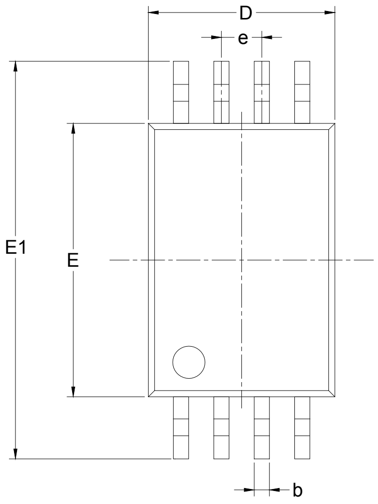


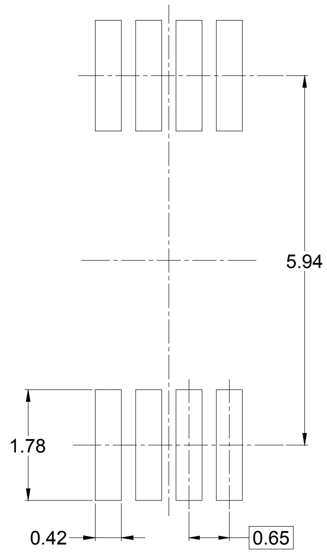


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

PACKAGE OUTLINE DIMENSIONS

TSSOP-8





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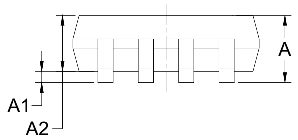
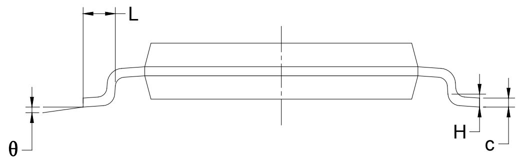
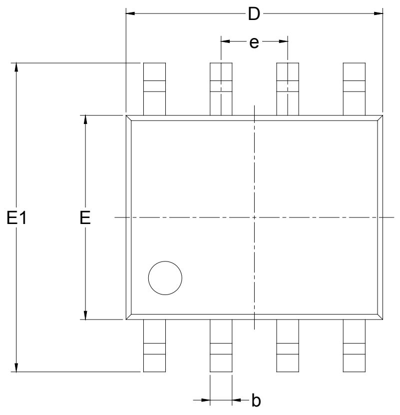


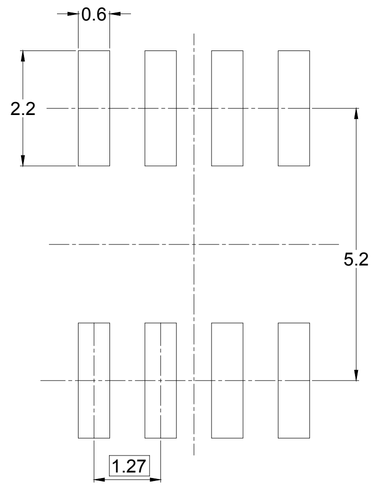


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

PACKAGE OUTLINE DIMENSIONS

SOIC-8





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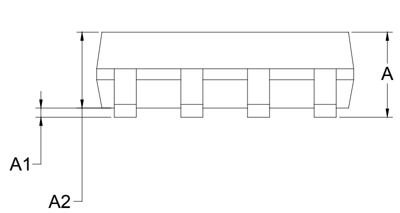
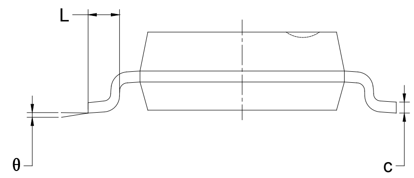
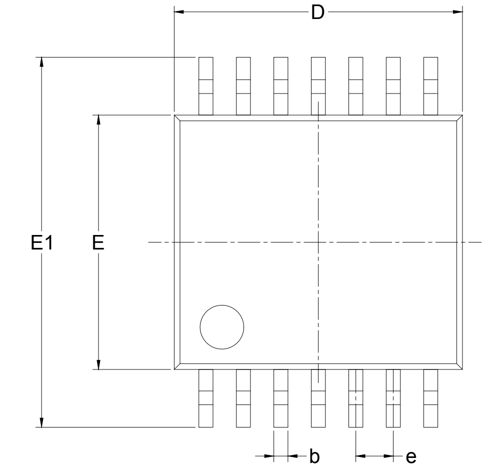


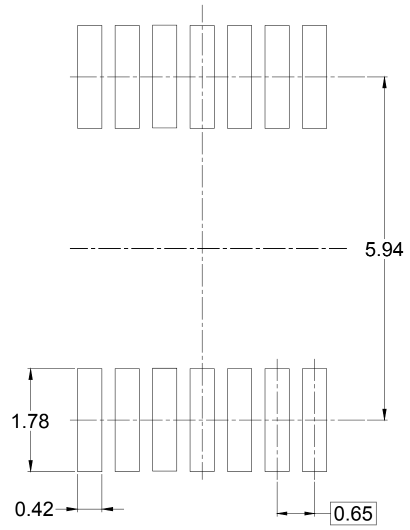


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

TSSOP-14





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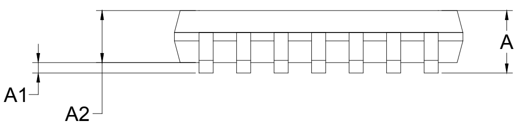
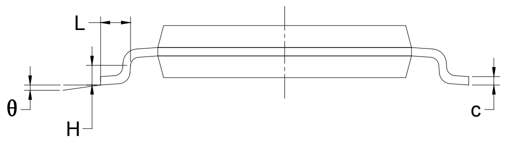
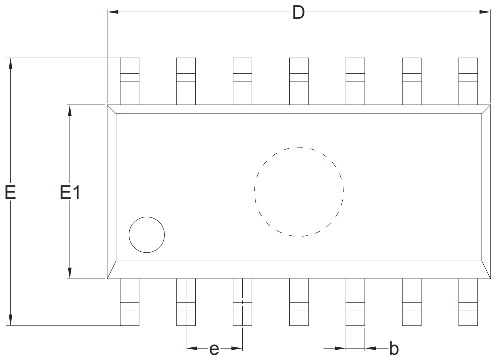


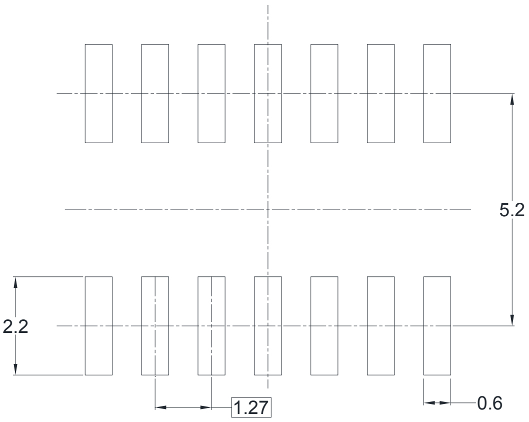


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

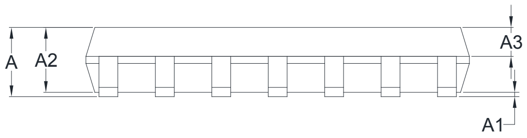
PACKAGE OUTLINE DIMENSIONS

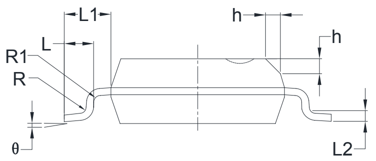
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)

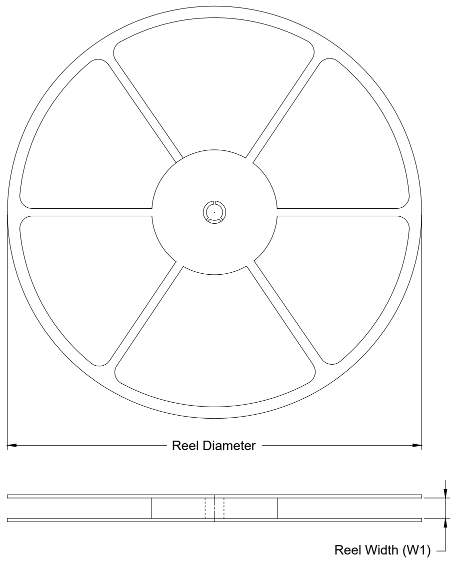




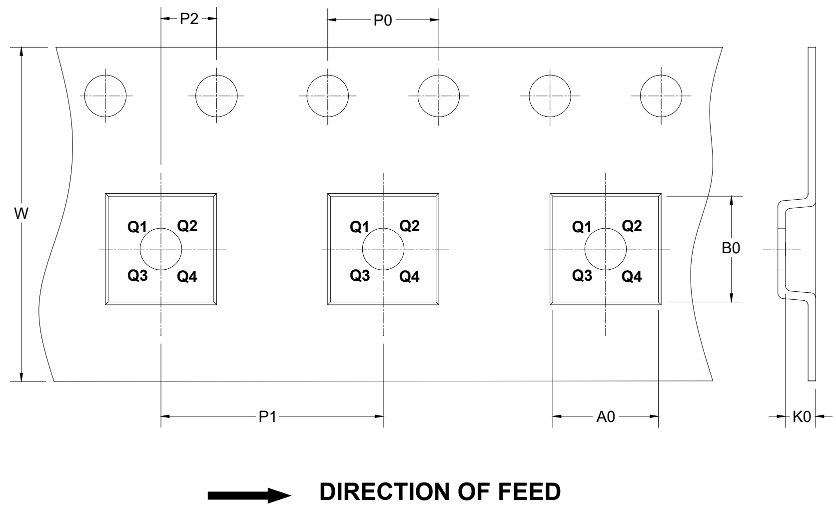
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	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°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



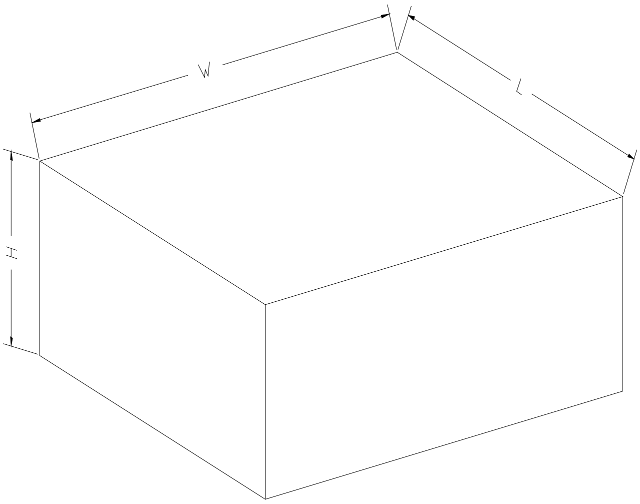
NOTE: The picture is only for reference. Please make the object as the standard.

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
SC70-5	7″	9.5	2.25	2.55	1.20	4.0	4.0	2.0	8.0	Q3
SOT-23-5	7″	9.5	3.2	3.2	1.4	4.0	4.0	2.0	8.0	Q3
SOT-23-6	7″	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
SOIC-8	13″	12.4	6.4	5.4	2.1	4.0	8.0	2.0	12.0	Q1
MSOP-8	13″	12.4	5.2	3.3	1.5	4.0	8.0	2.0	12.0	Q1
TSSOP-8	13″	12.4	6.76	3.3	1.8	4.0	8.0	2.0	12.0	Q1
TSSOP-14	13″	12.4	6.95	5.6	1.2	4.0	8.0	2.0	12.0	Q1
SOIC-14	13″	16.4	6.6	9.3	2.1	4.0	8.0	2.0	16.0	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