

**SGM8091/SGM8092****SGM8093/SGM8094**

# 350MHz, Rail-to-Rail Output, CMOS Operational Amplifiers

## GENERAL DESCRIPTION

The SGM8091/3 (single), SGM8092 (dual) and SGM8094 (quad) are low cost, high speed, voltage feedback amplifiers. These devices can operate from 2.5V to 5.5V single supply, and consume 4.3mA low quiescent current per amplifier. And, the supply current of SGM8093 is only 75 $\mu$ A in power-down mode. So SGM8093 is suitable for battery-powered equipment and portable devices, which require low power dissipation. The SGM8091/2/3/4 provide a wide input common mode voltage range and rail-to-rail output voltage swing.

These devices are designed to provide optimal performance in all aspects. They exhibit a wide bandwidth of 350MHz ( $G = +1$ ) and a 0.1dB gain flatness of 125MHz ( $G=+1$ ). The short settling time and low distortion make the operational amplifiers appropriate for buffering high speed ADC and DAC.

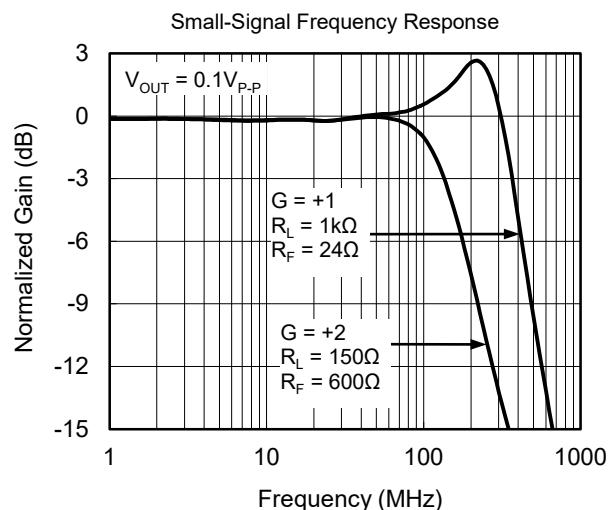
The SGM8091 is available in Green SOT-23-5 and SOIC-8 packages. The SGM8092 is available in Green SOIC-8 and MSOP-8 packages. The SGM8093 is available in Green SOT-23-6 and SOIC-8 packages. The SGM8094 is available in Green SOIC-14 and TSSOP-14 packages. They are specified over the extended -40°C to +125°C temperature range.

## APPLICATIONS

Professional Video  
Photodiode Preamplifier  
ADC  
Filter  
Imaging  
Hand Set  
DVD  
Base Station

## FEATURES

- **High Speed:**  
-3dB Bandwidth ( $G = +1$ ): 350MHz  
Slew Rate: 265V/ $\mu$ s  
Settling Time to 0.1% with 2V Step: 32ns
- **Excellent Video Performance ( $R_L = 150\Omega$ ,  $G = +2$ ):**  
0.1dB Gain Flatness: 70MHz  
Diff Gain Error: 0.004%  
Diff Phase Error: 0.08°
- **Input Offset Voltage: 8mV (MAX)**
- **Input Voltage Range: -0.2V to 3.8V with  $V_S = 5V$**
- **Rail-to-Rail Output**
- **Supply Voltage Range: 2.5V to 5.5V**
- **Low Supply Current:**  
4.3mA/Amplifier (TYP)  
75 $\mu$ A Shutdown Current for SGM8093
- **-40°C to +125°C Operating Temperature Range**
- **Small Packaging:**  
SGM8091 Available in Green SOT-23-5 and SOIC-8 Packages  
SGM8092 Available in Green MSOP-8 and SOIC-8 Packages  
SGM8093 Available in Green SOT-23-6 and SOIC-8 Packages  
SGM8094 Available in Green SOIC-14 and TSSOP-14 Packages



## PACKAGE/ORDERING INFORMATION

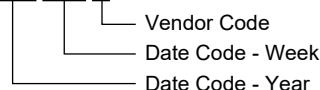
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8091	SOT-23-5	-40°C to +125°C	SGM8091XN5/TR	8091	Tape and Reel, 3000
	SOIC-8	-40°C to +125°C	SGM8091XS/TR	SGM8091XS XXXXX	Tape and Reel, 2500
SGM8092	SOIC-8	-40°C to +125°C	SGM8092XS/TR	SGM8092XS XXXXX	Tape and Reel, 2500
	MSOP-8	-40°C to +125°C	SGM8092XMS/TR	SGM8092 XMS XXXXX	Tape and Reel, 3000
SGM8093	SOT-23-6	-40°C to +125°C	SGM8093XN6/TR	8093	Tape and Reel, 3000
	SOIC-8	-40°C to +125°C	SGM8093XS/TR	SGM8093XS XXXXX	Tape and Reel, 2500
SGM8094	SOIC-14	-40°C to +125°C	SGM8094XS14/TR	SGM8094XS14 XXXXX	Tape and Reel, 2500
	TSSOP-14	-40°C to +125°C	SGM8094XTS14/TR	SGM8094 XTS14 XXXXX	Tape and Reel, 3000

## MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

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

**XXXXX**



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 $-V_S$ .....	7.5V
Input Common Mode Voltage Range .....	( $-V_S$ ) - 0.5V to ( $+V_S$ ) + 0.5V
Package Thermal Resistance @ $T_A = +25^\circ C$	
SOT-23-5, $\theta_{JA}$ .....	190°C/W
SOT-23-6, $\theta_{JA}$ .....	190°C/W
SOIC-8, $\theta_{JA}$ .....	125°C/W
MSOP-8, $\theta_{JA}$ .....	216°C/W
Junction Temperature .....	+150°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (Soldering, 10s) .....	+260°C
ESD Susceptibility	
HBM .....	1000V
MM .....	400V

## **RECOMMENDED OPERATING CONDITIONS**

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

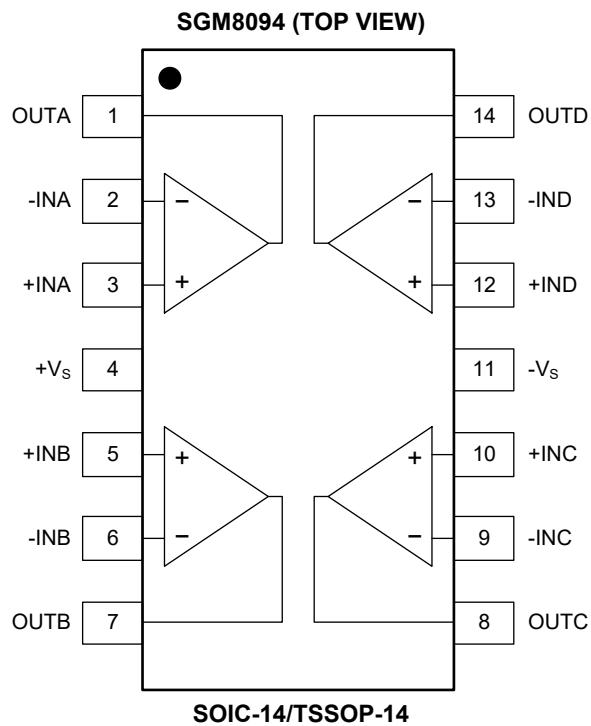
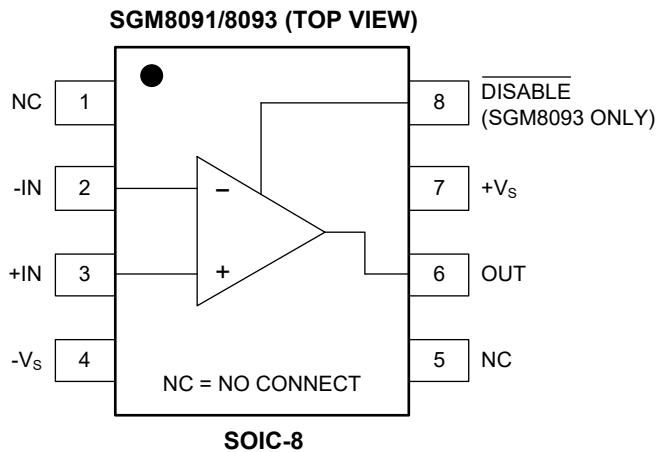
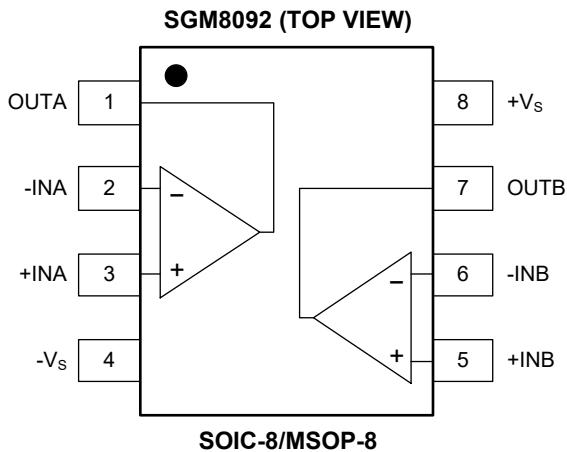
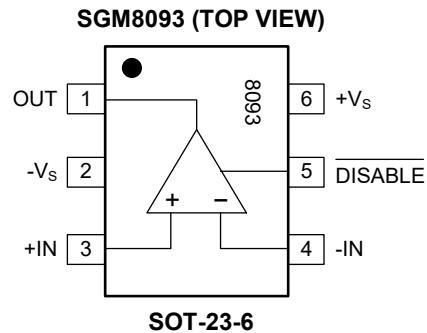
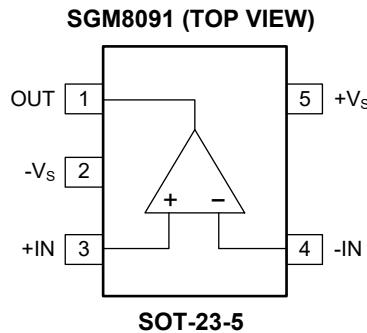
## **ESD SENSITIVITY CAUTION**

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



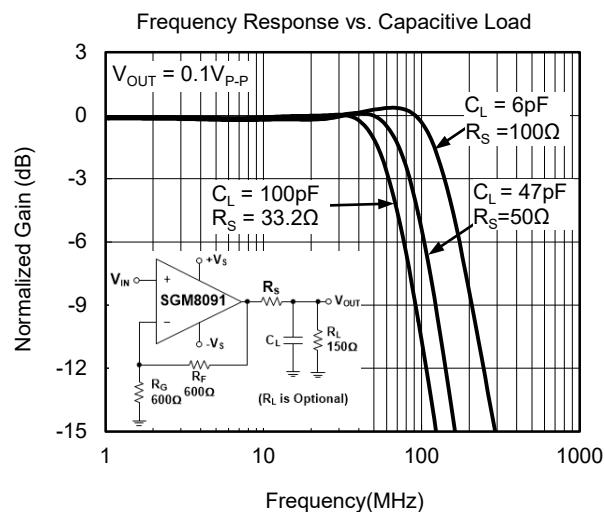
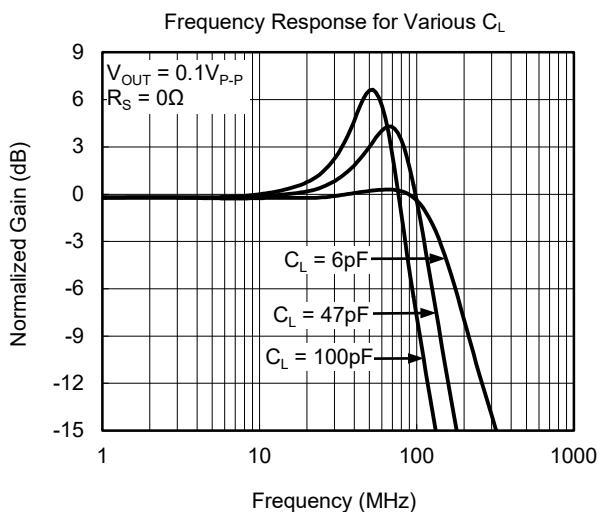
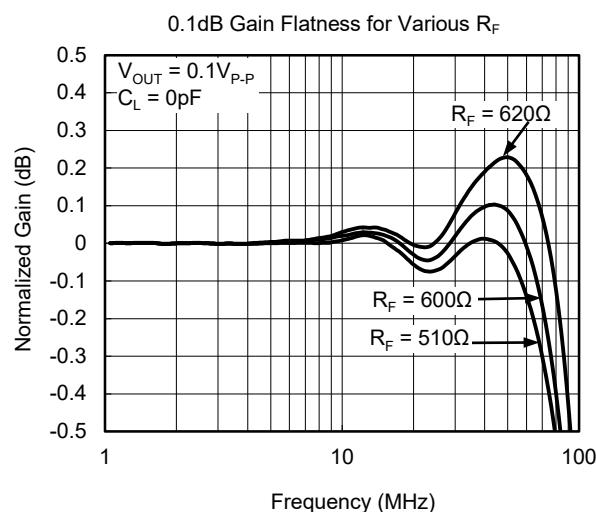
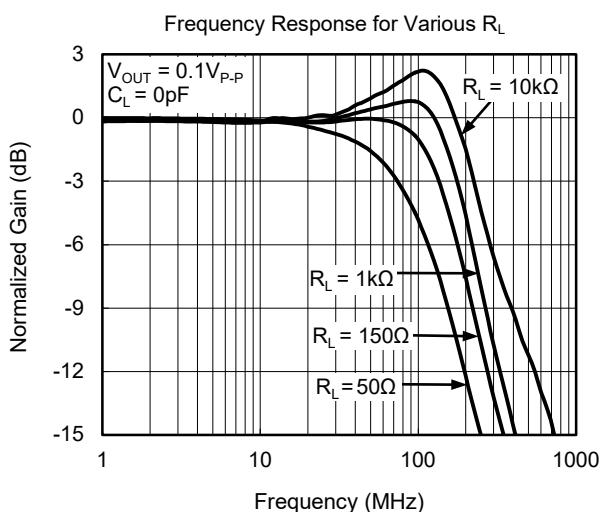
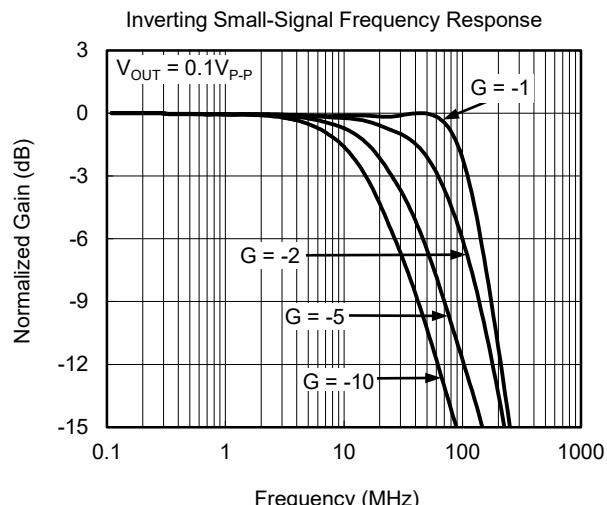
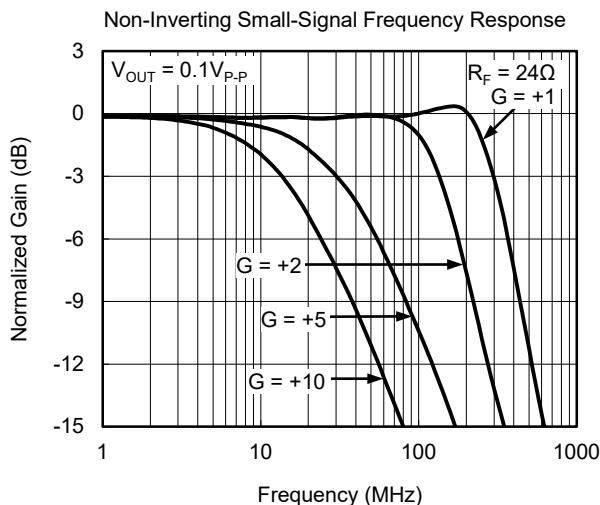
## ELECTRICAL CHARACTERISTICS

( $V_S = 5V$ ,  $G = +2$ ,  $R_F = 600\Omega$ ,  $R_L = 150\Omega$ , unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8091/2/3/4							
		TYP	MIN/MAX OVER TEMPERATURE						UNITS
		+25°C	+25°C	0°C to +70°C	-40°C to +70°C	-40°C to +125°C	MIN/ MAX		
<b>Dynamic Performance</b>									
-3dB Small-Signal Bandwidth	$G = +1$ , $V_{OUT} = 0.1V_{P,P}$ , $R_F = 24\Omega$ , $R_L = 150\Omega$	300							MHz TYP
	$G = +1$ , $V_{OUT} = 0.1V_{P,P}$ , $R_F = 24\Omega$ , $R_L = 1k\Omega$	350							MHz TYP
	$G = +2$ , $V_{OUT} = 0.1V_{P,P}$ , $R_L = 50\Omega$	70							MHz TYP
	$G = +2$ , $V_{OUT} = 0.1V_{P,P}$ , $R_L = 150\Omega$	140							MHz TYP
	$G = +2$ , $V_{OUT} = 0.1V_{P,P}$ , $R_L = 1k\Omega$	170							MHz TYP
	$G = +2$ , $V_{OUT} = 0.1V_{P,P}$ , $R_L = 10k\Omega$	230							MHz TYP
Gain-Bandwidth Product	$G = +10$ , $R_L = 150\Omega$	135							MHz TYP
	$G = +10$ , $R_L = 1k\Omega$	170							MHz TYP
Bandwidth for 0.1dB Flatness	$G = +1$ , $V_{OUT} = 0.1V_{P,P}$	125							MHz TYP
	$G = +2$ , $V_{OUT} = 0.1V_{P,P}$ , $R_F = 600\Omega$	70							MHz TYP
Slew Rate	$G = +1$ , 2V output step	194/-204							V/μs TYP
	$G = +2$ , 2V output step	236/-170							V/μs TYP
	$G = +2$ , 4V output step	265/-218							V/μs TYP
Rise-and-Fall Time	$G = +2$ , $V_{OUT} = 0.2V_{P,P}$ , 10% to 90%	3.8							ns TYP
	$G = +2$ , $V_{OUT} = 2V_{P,P}$ , 10% to 90%	7.8							ns TYP
Settling Time to 0.1%	$G = +2$ , 2V output step	32							ns TYP
Overload Recovery Time	$V_{IN} \cdot G = +V_S$	14.5							ns TYP
<b>Noise/Distortion Performance</b>									
Input Voltage Noise	$f = 1MHz$	5.9							nV/√Hz TYP
Differential Gain Error (NTSC)	$G = +2$ , $R_L = 150\Omega$	0.004							% TYP
Differential Phase Error (NTSC)	$G = +2$ , $R_L = 150\Omega$	0.08							degree TYP
<b>DC Performance</b>									
Input Offset Voltage ( $V_{OS}$ )		±2							mV MAX
Input Offset Voltage Drift		3.7							μV/°C TYP
Input Bias Current ( $I_B$ )		6							pA TYP
Input Offset Current ( $I_{OS}$ )		2							pA TYP
Open-Loop Gain ( $A_{OL}$ )	$V_{OUT} = 0.3V$ to $4.7V$ , $R_L = 150\Omega$	80	75	74	74	73	73		dB MIN
	$V_{OUT} = 0.2V$ to $4.8V$ , $R_L = 1k\Omega$	104	92	91	91	80	80		dB MIN
<b>Input Characteristics</b>									
Input Common Mode Voltage Range ( $V_{CM}$ )		-0.2 to 3.8							V TYP
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1V$ to $3.5V$	80	66	66	65	64	64		dB MIN
<b>Output Characteristics</b>									
Output Voltage Swing from Rail	$R_L = 150\Omega$	0.12							V TYP
	$R_L = 1k\Omega$	0.03							V TYP
Output Current		115	98	97	94	88	88		mA MIN
Closed-Loop Output Impedance	$f < 100kHz$	0.02							Ω TYP
<b>Power-Down Disable</b>									
Turn-On Time		108							ns TYP
Turn-Off Time		60							ns TYP
DISABLE Voltage-Off		0.8							V MAX
DISABLE Voltage-On		2							V MIN
<b>Power Supply</b>									
Operating Voltage Range		2.5							V MIN
		5.5							V MAX
Quiescent Current/Amplifier Supply Current when Disabled (SGM8093 only)		4.3	7.5	8.0	8.0	8.1	8.1		mA MAX
Power Supply Rejection Ratio (PSRR)	$\Delta V_S = 2.7V$ to $5.5V$ , $V_{CM} = (-V_S) + 0.5V$	75	120	127	130	137	137		μA MAX

## TYPICAL PERFORMANCE CHARACTERISTICS

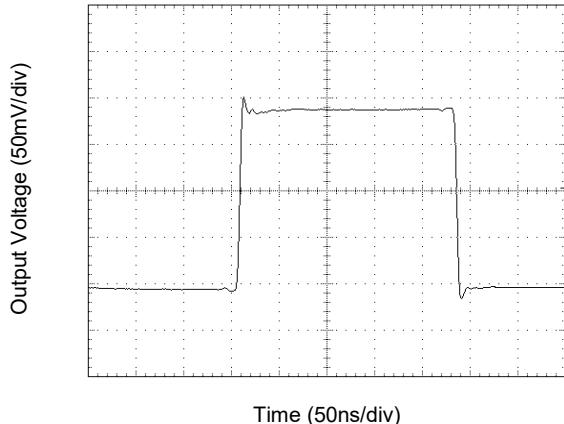
At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $G = +2$ ,  $R_F = 600\Omega$ ,  $R_G = 600\Omega$  and  $R_L = 150\Omega$  connected to  $V_S/2$ , unless otherwise noted.



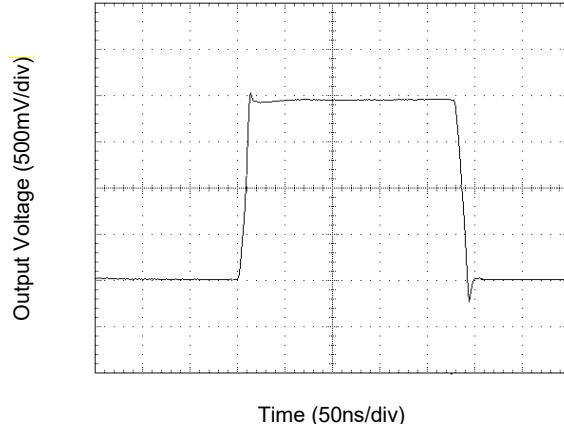
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $G = +2$ ,  $R_F = 600\Omega$ ,  $R_G = 600\Omega$  and  $R_L = 150\Omega$  connected to  $V_S/2$ , unless otherwise noted.

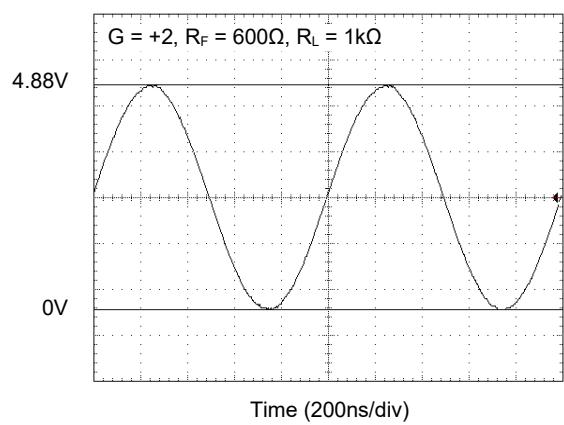
Non-Inverting Small-Signal Step Response



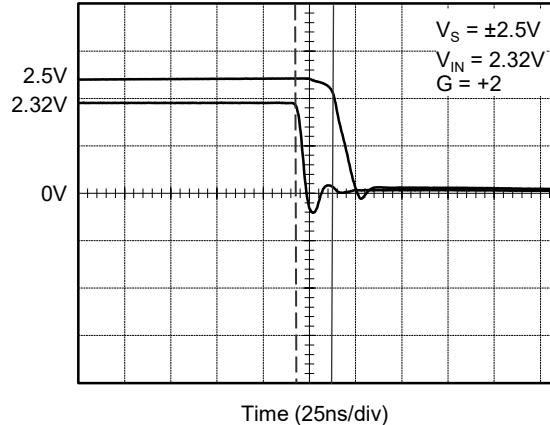
Non-Inverting Large-Signal Step Response



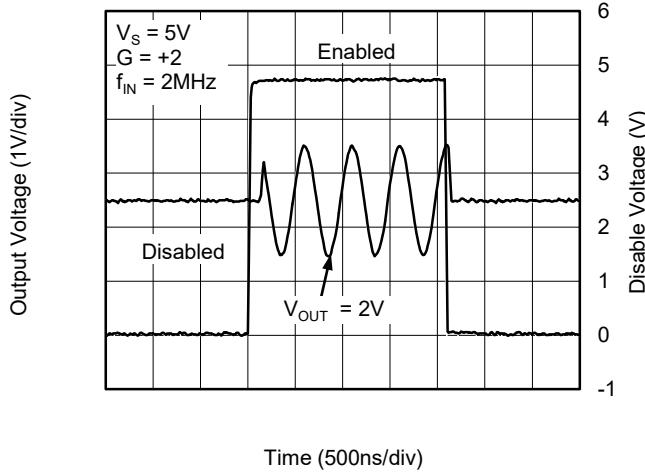
Rail-to-Rail



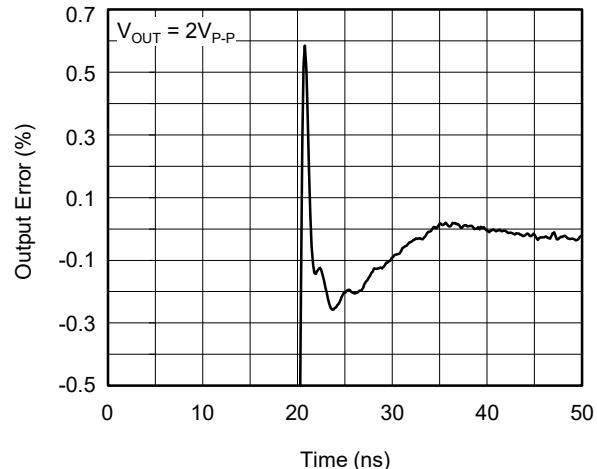
Overload Recovery Time



Large-Signal Disable/Enable Response

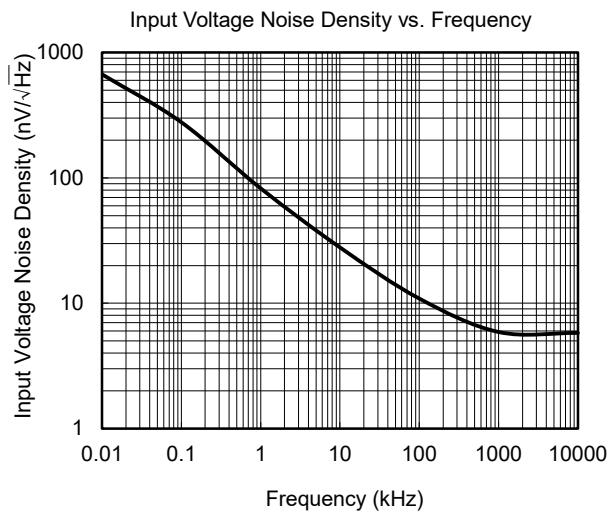
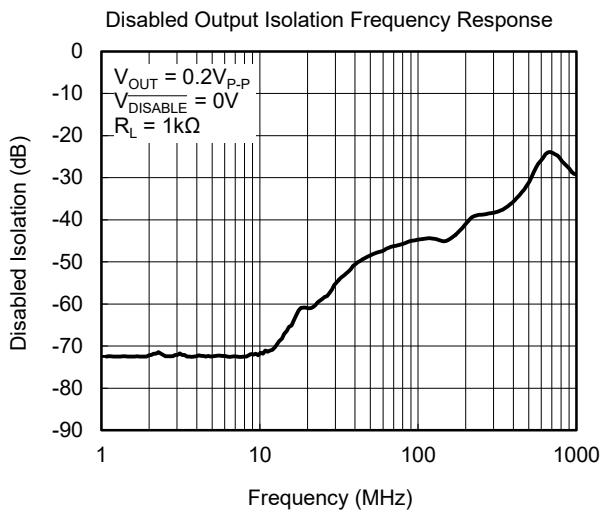
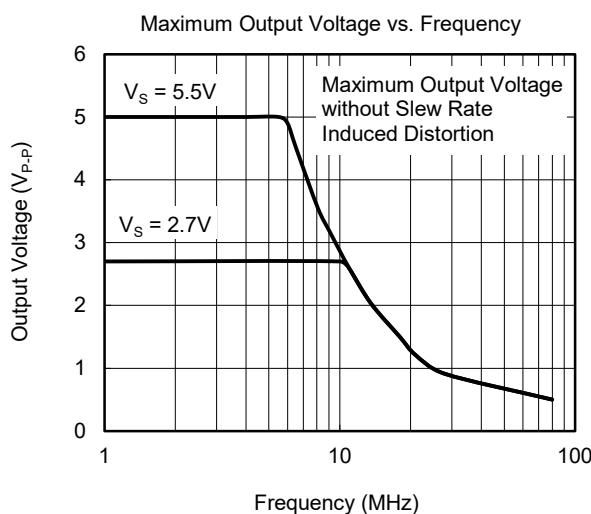
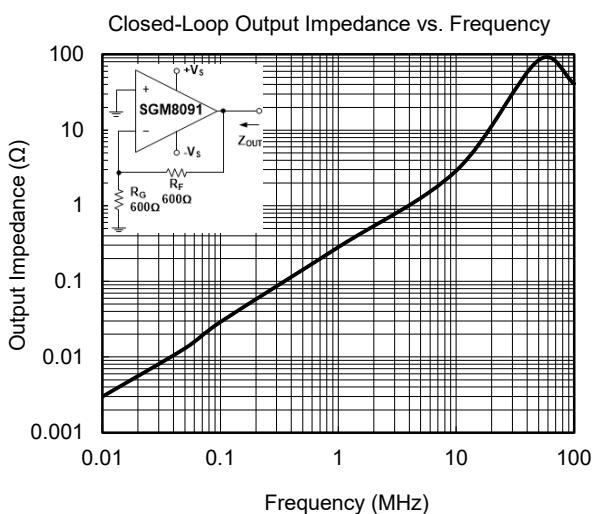
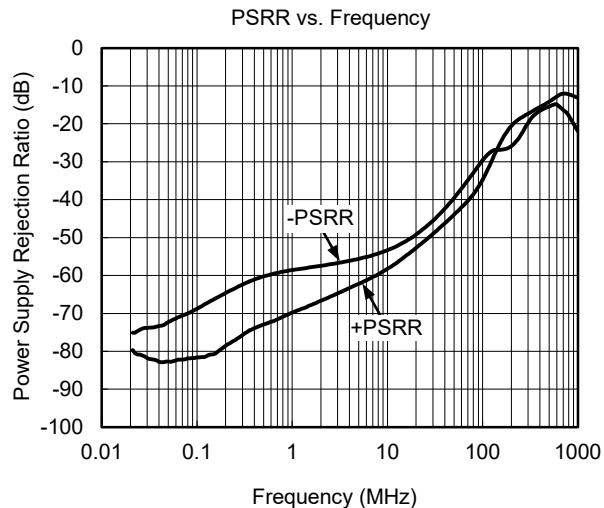
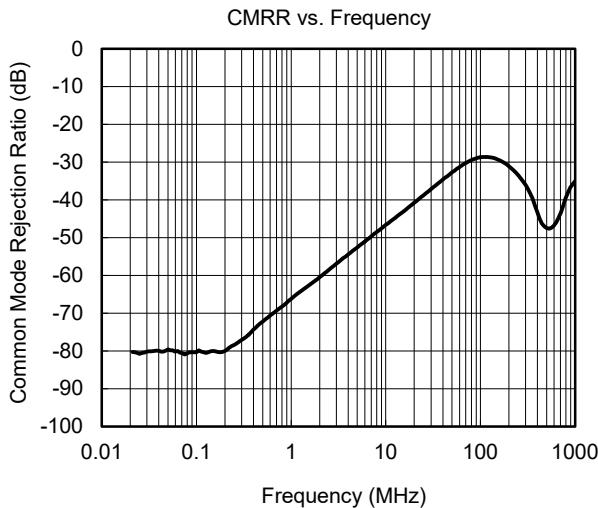


Output Settling Time to 0.1%



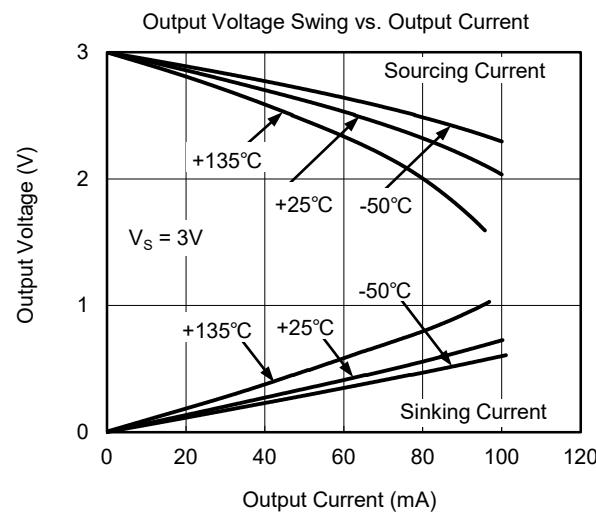
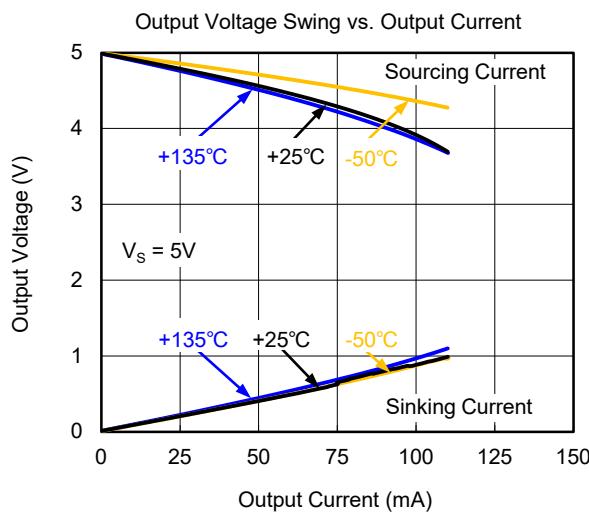
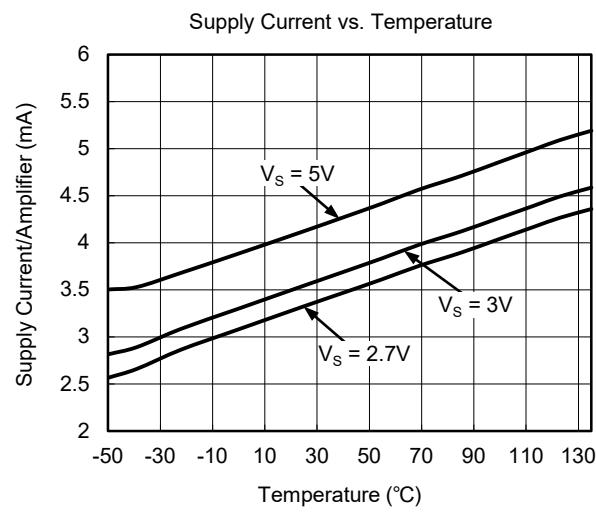
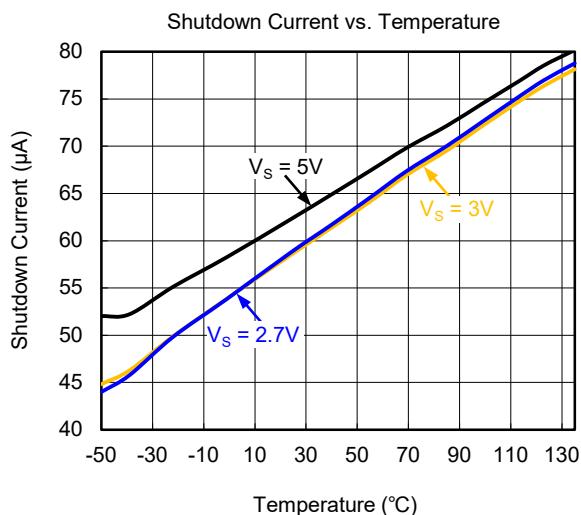
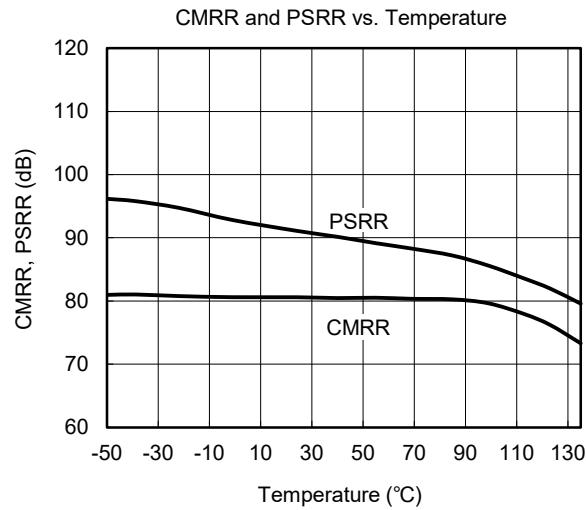
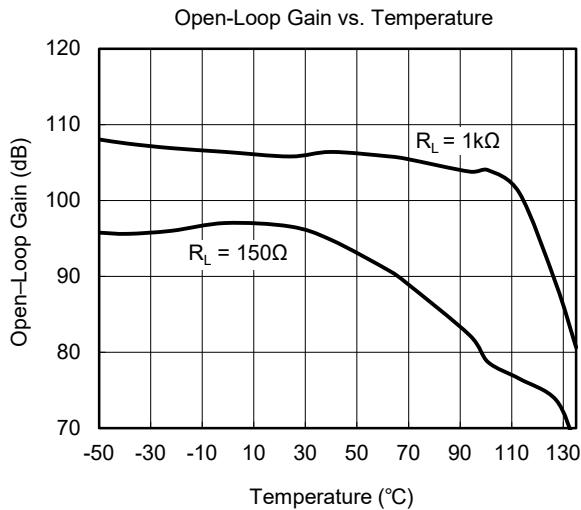
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $G = +2$ ,  $R_F = 600\Omega$ ,  $R_G = 600\Omega$  and  $R_L = 150\Omega$  connected to  $V_S/2$ , unless otherwise noted.



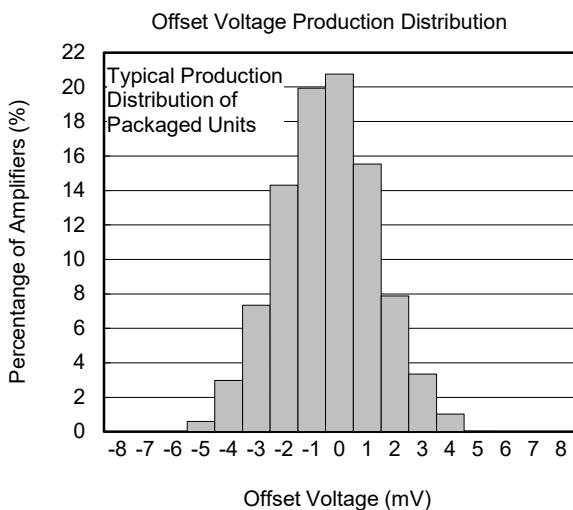
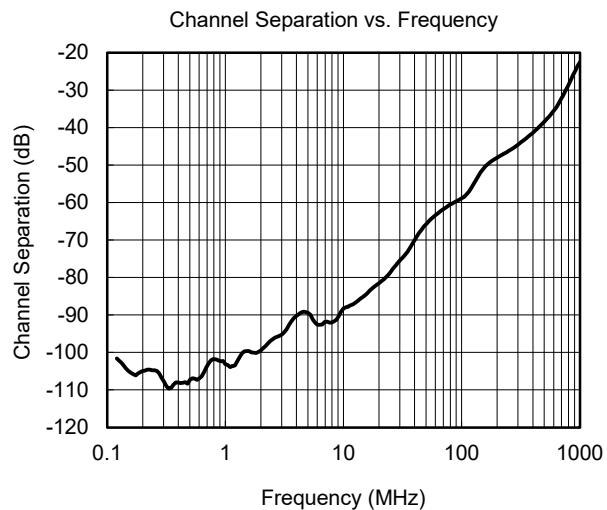
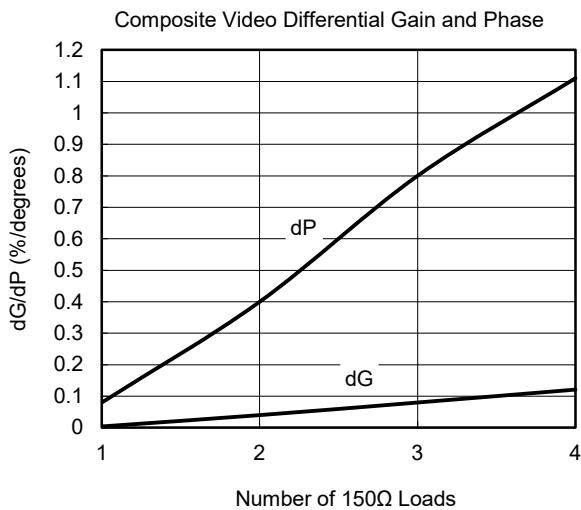
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $G = +2$ ,  $R_F = 600\Omega$ ,  $R_G = 600\Omega$  and  $R_L = 150\Omega$  connected to  $V_S/2$ , unless otherwise noted.



## APPLICATION INFORMATION

### Rail-to-Rail Output

The SGM8091/2/3/4 support rail-to-rail output operation. In single power supply application, for example, when  $+V_S = 5V$ ,  $-V_S = GND$ ,  $1k\Omega$  load resistor is tied from OUT pin to ground, the typical output swing range is from 0.03V to 4.97V.

### Driving Capacitive Loads

The SGM8091/2/3/4 are not designed for driving heavy capacitive load. If greater capacitive load must be driven in application, the circuit in Figure 1 can be used. In this circuit, the IR drop voltage generated by  $R_{ISO}$  is compensated by feedback loop.

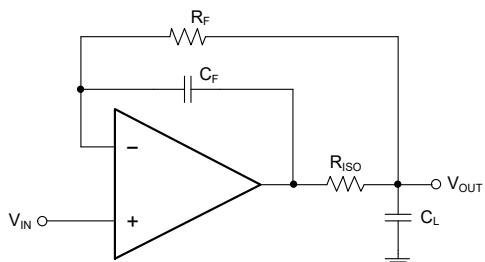


Figure 1. Circuit to Drive Heavy Capacitive Load

### 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,  $10\mu F$  ceramic capacitor paralleled with  $0.1\mu F$  or  $0.01\mu F$  ceramic capacitor is used in Figure 2. The ceramic capacitors should be placed as close as possible to  $+V_S$  and  $-V_S$  power supply pins.

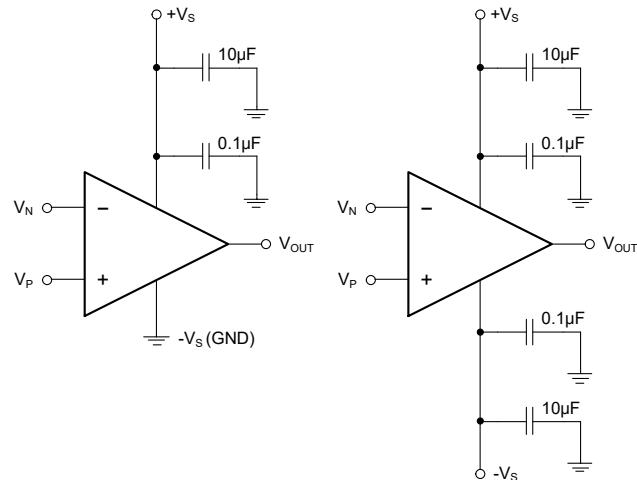


Figure 2. Amplifier Power Supply Bypassing

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

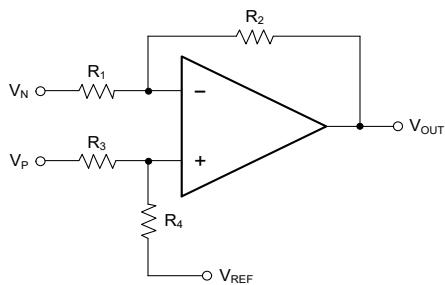


Figure 3. Difference Amplifier

#### Active Low-Pass Filter

The circuit in Figure 4 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, and the resistor values must be selected as low as possible to reduce ringing or oscillation generated by the parasitic parameters in PCB layout.

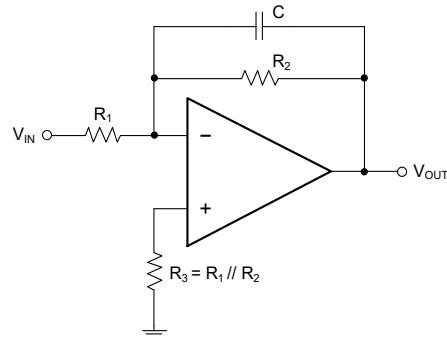


Figure 4. Active Low-Pass Filter

#### Driving Video

The SGM8091/2/3/4/5 can be used in video applications as shown in Figure 5.

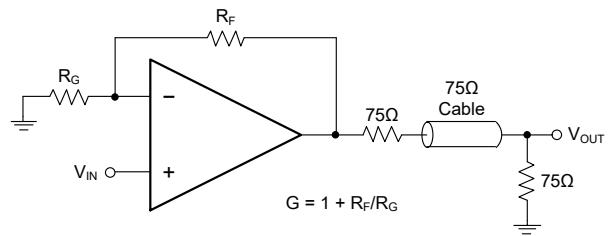


Figure 5. Typical Video Driving

## **REVISION HISTORY**

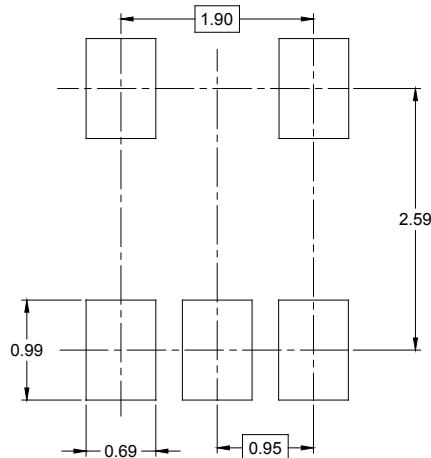
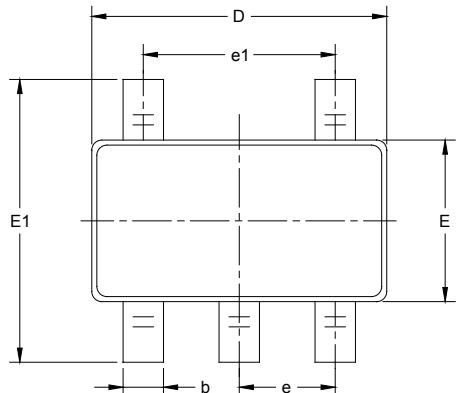
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<b>JANUARY 2013 – REV.B.3 to REV.B.4</b>	<b>Page</b>
Updated Package Outline Dimensions section .....	14~19
Added Tape and Reel Information section .....	20, 21
<b>MAY 2011 – REV.B.2 to REV.B.3</b>	<b>Page</b>
Changed packages' name .....	All
<b>JUNE 2010 – REV.B.1 to REV.B.2</b>	<b>Page</b>
Changed Electrical Characteristics section .....	3
Changed Package Outline Dimensions section .....	11~16
<b>APRIL 2009 – REV.B to REV.B.1</b>	<b>Page</b>
Changed 16pin packages to 14pin packages.....	All
<b>AUGUST 2008 – REV.A to REV.B</b>	<b>Page</b>
Changed Absolute Maximum Ratings section.....	3
<b>Changes from Original (NOVEMBER 2006) to REV.A</b>	<b>Page</b>
Changed from product preview to production data.....	All

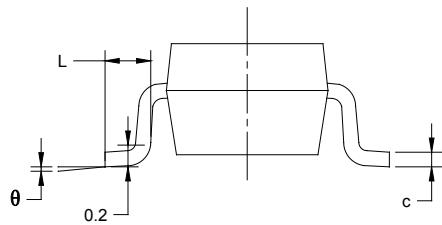
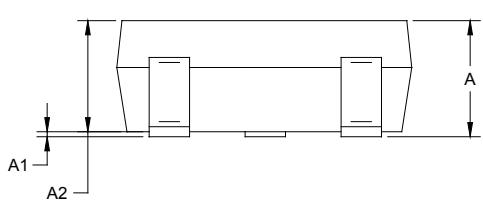
## PACKAGE INFORMATION

### PACKAGE OUTLINE DIMENSIONS

**SOT-23-5**



RECOMMENDED LAND PATTERN (Unit: mm)

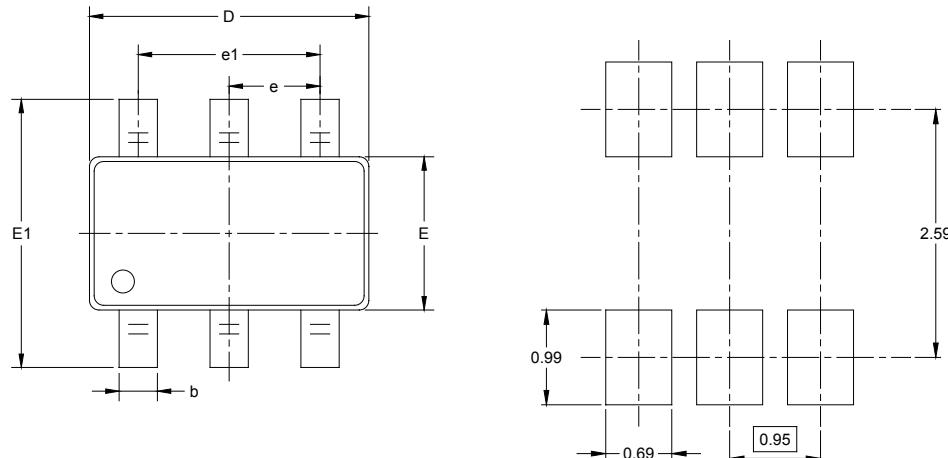


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

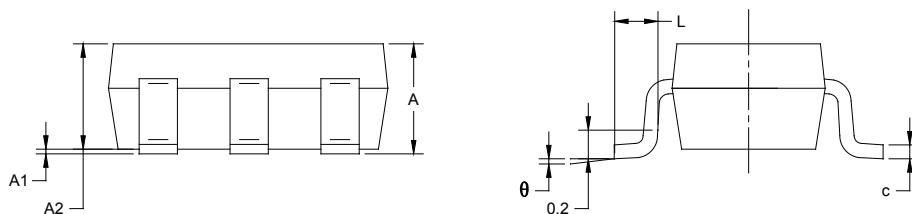
## PACKAGE INFORMATION

### PACKAGE OUTLINE DIMENSIONS

**SOT-23-6**



RECOMMENDED LAND PATTERN (Unit: mm)

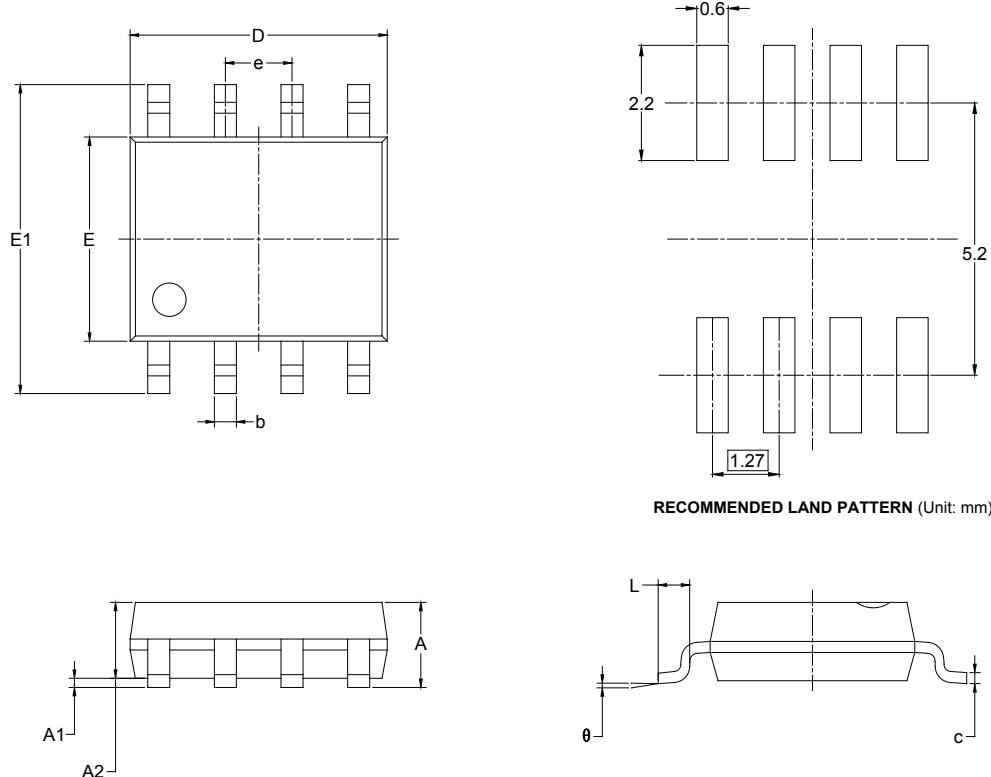


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOIC-8



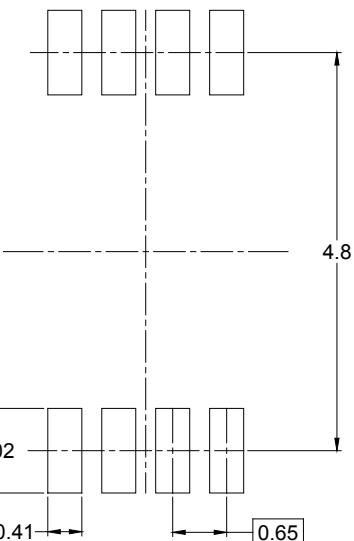
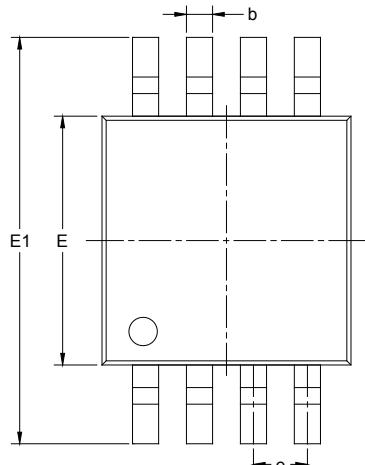
RECOMMENDED LAND PATTERN (Unit: mm)

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°

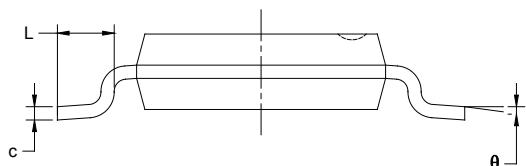
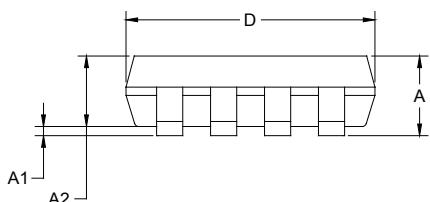
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### MSOP-8



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

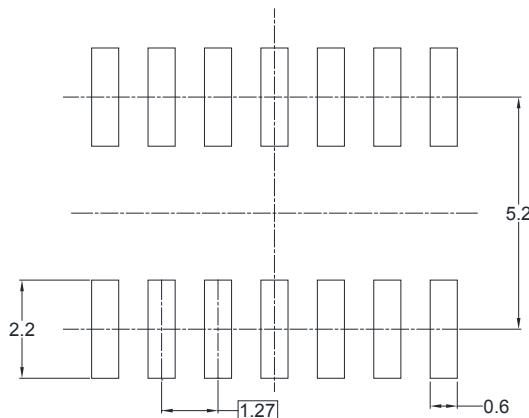
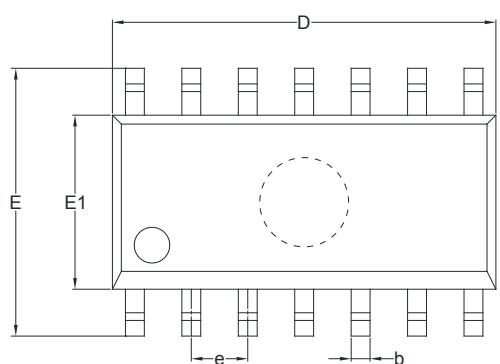


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

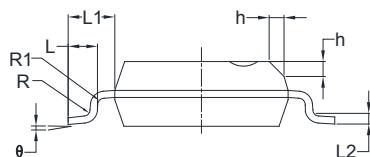
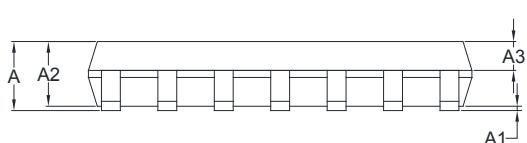
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

**SOIC-14**



RECOMMENDED LAND PATTERN (Unit: mm)

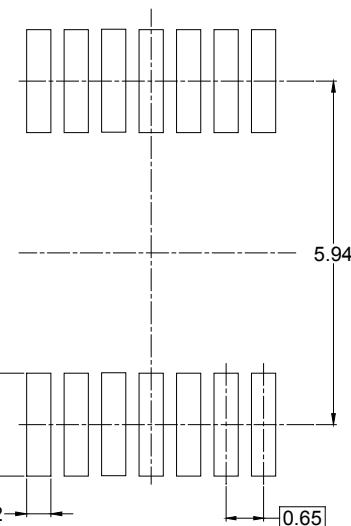
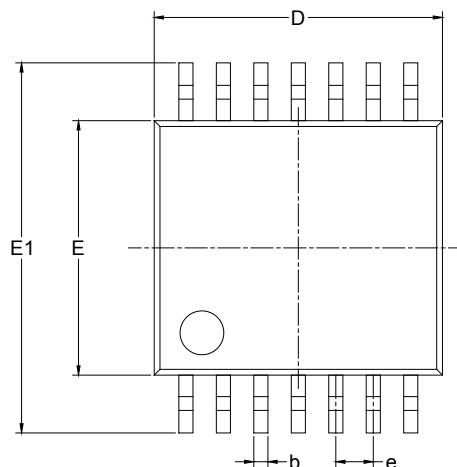


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80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

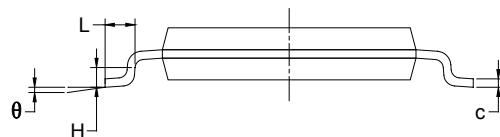
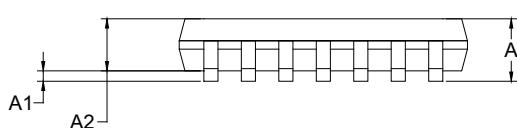
## PACKAGE INFORMATION

### PACKAGE OUTLINE DIMENSIONS

#### TSSOP-14



RECOMMENDED LAND PATTERN (Unit: mm)

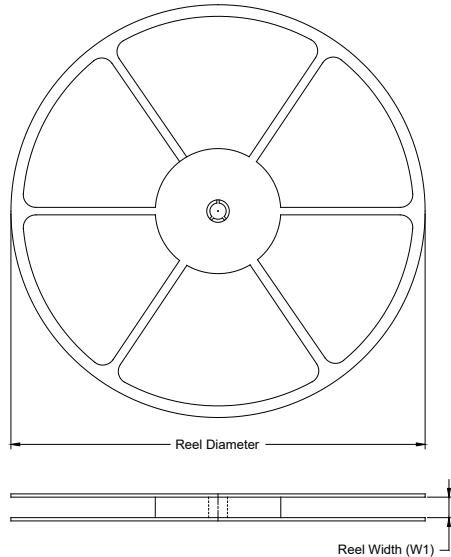


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

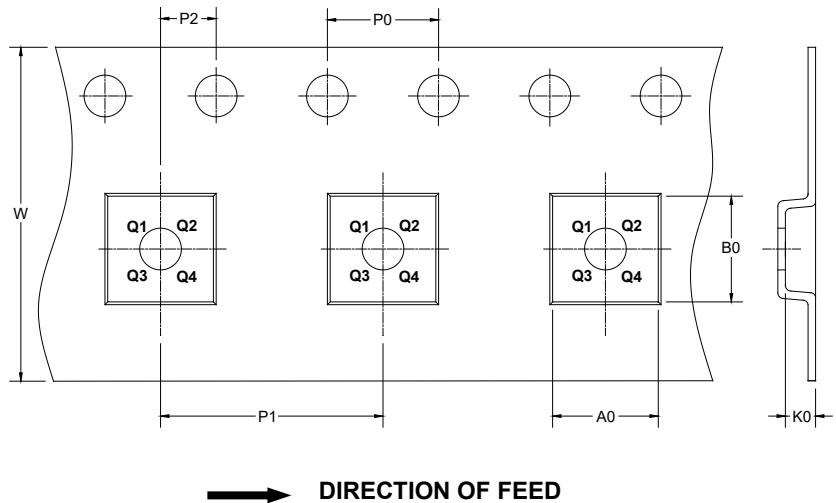
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



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

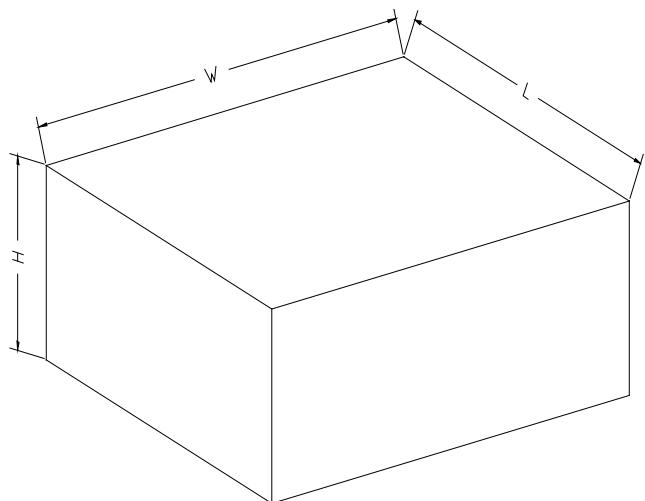
### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
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	3.17	3.23	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	6.95	5.60	1.20	4.0	8.0	2.0	12.0	Q1

D0000

## 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
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

DD0002