SGM8543
1.1MHz, 48μA, Rail-to-Rail I/O, CMOS Operational Amplifier with Shutdown

PRODUCT DESCRIPTION

The SGM8543 is a low cost, single rail-to-rail input and output voltage feedback amplifier with shutdown function. It has a wide input common mode voltage range and output voltage swing, and takes the minimum operating supply voltage down to 2.1V. The maximum recommended supply voltage is 5.5V. It is specified over the extended -40℃ to +125℃ temperature range.

The SGM8543 provides 1.1MHz bandwidth at a low current consumption of 48μA. Very low input bias current of 0.5pA enables the SGM8543 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail input and output are useful to designers for buffering ASIC in single-supply systems.

Applications for this amplifier include safety monitoring, portable equipment, battery and power supply control, and signal conditioning and interfacing for transducers in very low power systems.

The SGM8543 is available in the Green SOIC-8 and SOT-23-6 packages.

APPLICATIONS

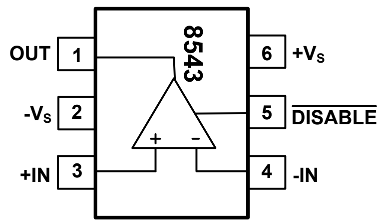
ASIC Input or Output Amplifier
Sensor Interface
Piezoelectric Transducer Amplifier
Medical Instrumentation
Mobile Communication
Audio Output
Portable Systems
Smoke Detectors
Mobile Telephone
PCMCIA Cards
Battery-Powered Equipment

FEATURES

- **Low Cost**
- **Rail-to-Rail Input and Output**
  0.8mV Typical V_{OS}
- **Unity Gain Stable**
- **Very Low Input Bias Current: 0.5pA**
- **Supply Voltage Range: 2.1V to 5.5V**
- **Input Voltage Range:**
  -0.1V to +5.6V with V_S = 5.5V
- **Gain-Bandwidth Product: 1.1MHz**
- **Low Supply Current: 48μA**
  Supply Current is 10nA When Disabled
- **Small Packaging**
  SGM8543 Available in SOT-23-6 and SOIC-8

PIN CONFIGURATIONS (TOP VIEW)

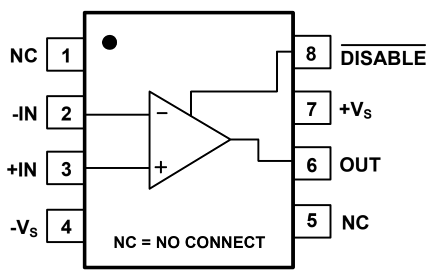
SGM8543XN6



SOT-23-6

Note: The location of pin 1 on the SGM8543XN6 is determined by orienting the package marking as shown.

SGM8543XS



SOIC-8

PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8543	SGM8543XN6/TR	SOT-23-6	Tape and Reel, 3000	8543
	SGM8543XS/TR	SOIC-8	Tape and Reel, 2500	SGM8543XS

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$...6V
Common Mode Input Voltage
....($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Storage Temperature Range..............................-65℃ to +150℃
Junction Temperature .... 150℃
Operating Temperature Range ....-40℃ to +125℃
Lead Temperature (Soldering 10sec)................................260℃
ESD Susceptibility
HBM..3000V
MM..400V

NOTE:
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

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

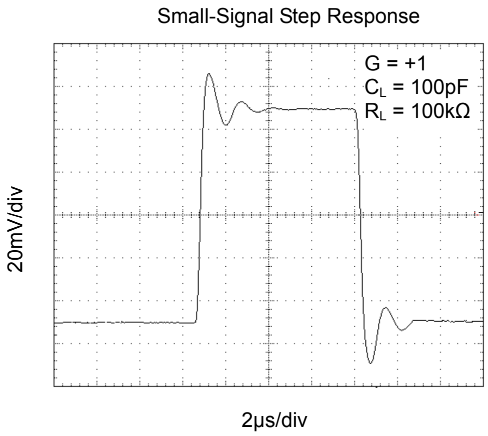
ELECTRICAL CHARACTERISTICS

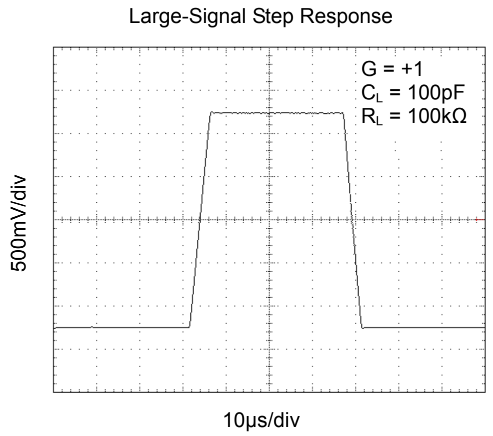
(At V_S = +5V, R_L = 100kΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted.)

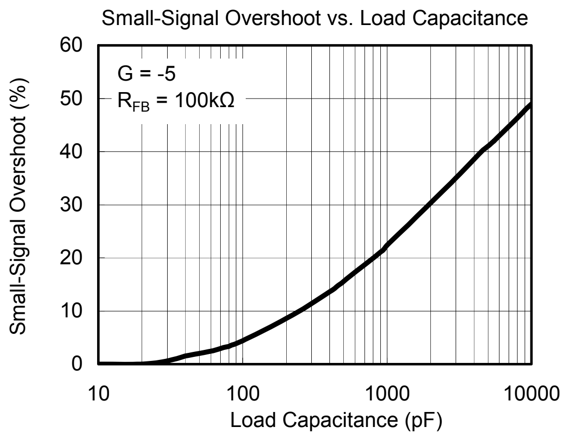
PARAMETER	SYMBOL	CONDITIONS	TYP	MIN/MAX OVER TEMPERATURE			
			+25℃	+25℃	-40℃ to +125℃	UNITS	MIN/MAX
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	V_{CM} = V_S/2	0.8	3.5	8.6	mV	MAX
Input Bias Current	I_B		0.5			pA	TYP
Input Offset Current	I_{OS}		0.5			pA	TYP
Logic Low Voltage	V_{IL}			0.8		V	MAX
Logic High Voltage	V_{IH}			2		V	MIN
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	88	71	62	dB	MIN
		V_S = 5.5V, V_{CM} = -0.1V to +5.6V	76	60	58		
Open-Loop Voltage Gain	A_{OL}	R_L = 5kΩ, V_O = +0.1V to +4.9V	100	80	75	dB	MIN
		R_L = 100kΩ, V_O = +0.035V to +4.965V	105	85	76		
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta_T$		2.7			μV/℃	TYP
OUTPUT CHARACTERISTICS							
Output Voltage Swing	V_{OH}	R_L = 100kΩ	4.997	4.980	4.970	V	MIN
	V_{OL}	R_L = 100kΩ	5	20	30	mV	MAX
	V_{OH}	R_L = 10kΩ	4.992	4.970	4.960	V	MIN
	V_{OL}	R_L = 10kΩ	8	30	40	mV	MAX
Output Current	I_{SOURCE}	R_L = 10Ω to V_S/2	84	60	45	mA	MIN
	I_{SINK}		75	60	45		
POWER SUPPLY							
Operating Voltage Range				2.1	2.5	V	MIN
				5.5	5.5	V	MAX
Power Supply Rejection Ratio	PSRR	V_S = +2.5V to +5.5V, V_{CM} = +0.5V	86	70	67	dB	MIN
Quiescent Current	I_Q		48	69	84	μA	MAX
Supply Current when Disabled	I_{SD}	$\overline{DISABLE}$ = V_{IL}	10	3000		nA	MAX
DYNAMIC PERFORMANCE (C_L = 100pF)							
Gain-Bandwidth Product	GBP		1.1			MHz	TYP
Slew Rate	SR	G = +1, 2V Output Step	0.52			V/μs	TYP
Settling Time to 0.1%	t_S	G = +1, 2V Output Step	5.3			μs	TYP
Overload Recovery Time		V_{IN} ·Gain = V_S	2.6			μs	TYP
NOISE PERFORMANCE							
Voltage Noise Density	e_n	f = 1kHz	27			nV/$\sqrt{Hz}$	TYP
		f = 10kHz	20			nV/$\sqrt{Hz}$	TYP

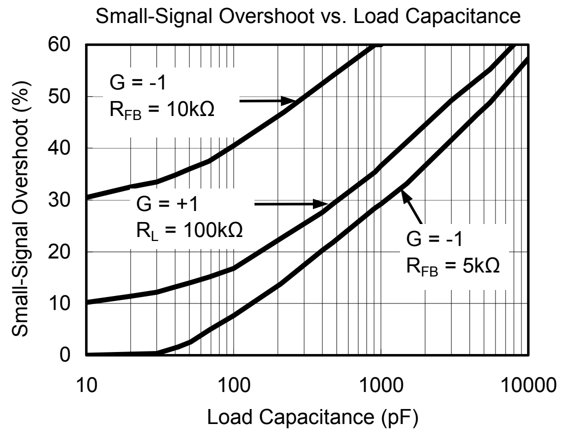
TYPICAL PERFORMANCE CHARACTERISTICS

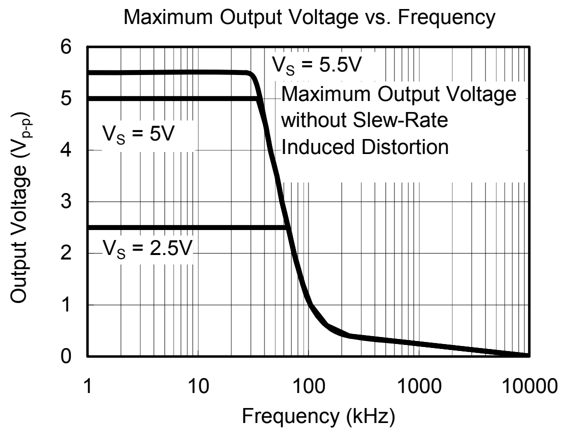
At T_A = +25℃, V_S = +5V, and R_L = 100kΩ connected to V_S/2, unless otherwise noted.

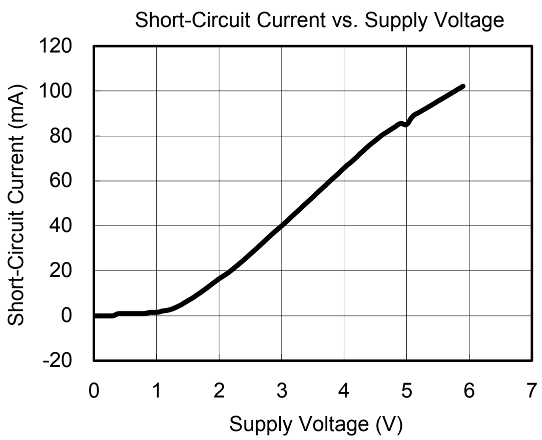






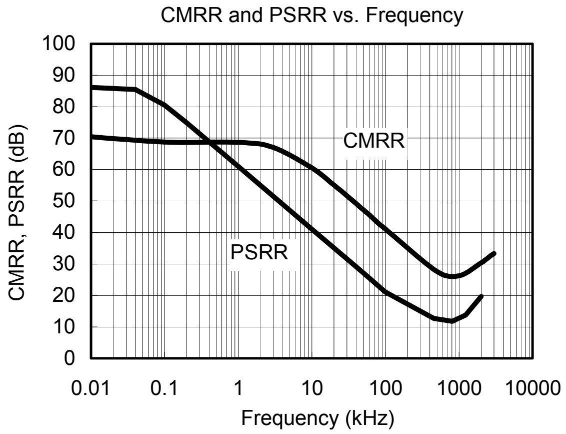


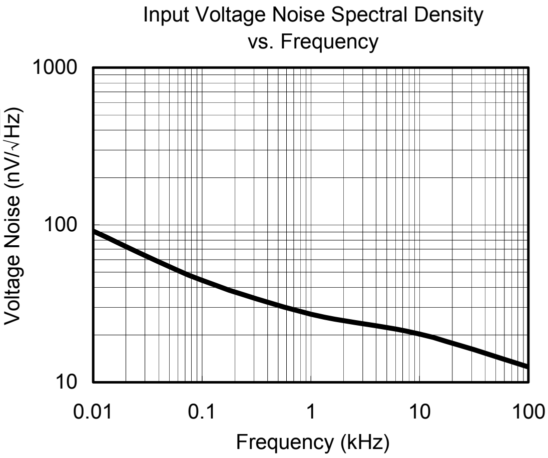


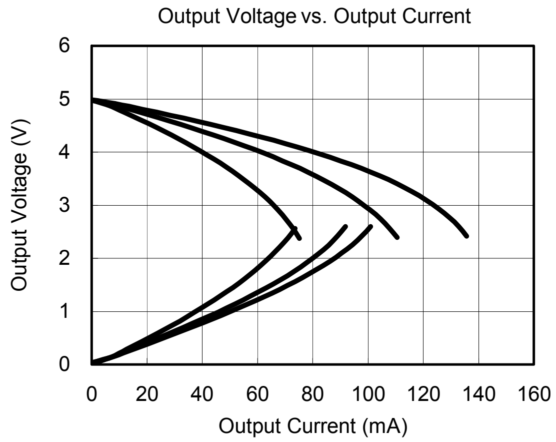


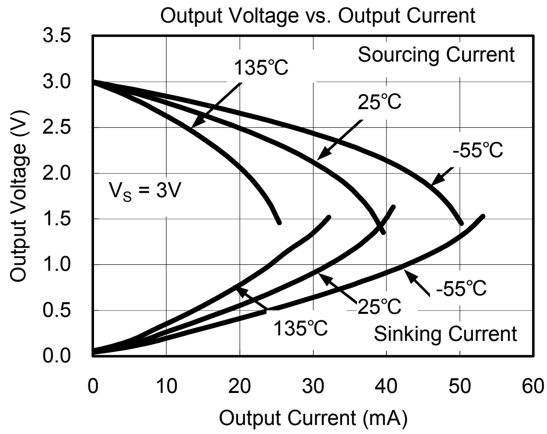
TYPICAL PERFORMANCE CHARACTERISTICS

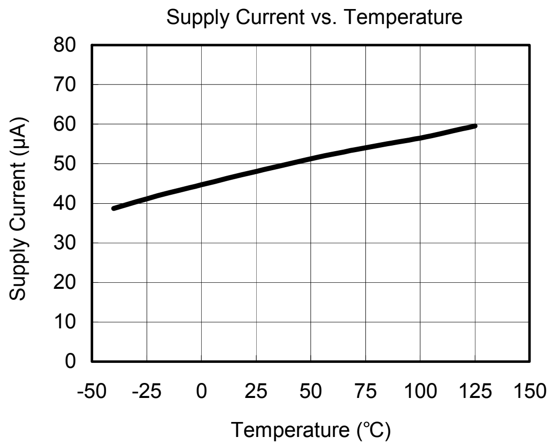
At T_A = +25℃, V_S = +5V, and R_L = 100kΩ connected to V_S/2, unless otherwise noted.

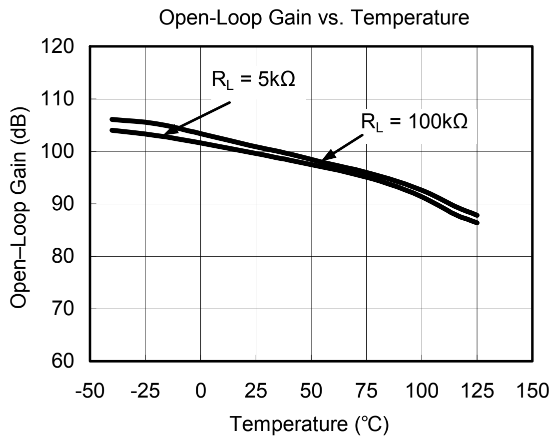








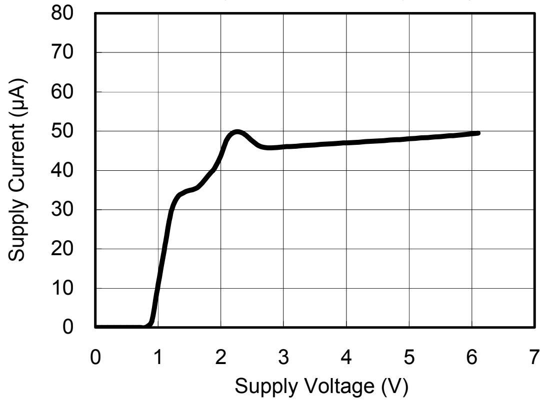




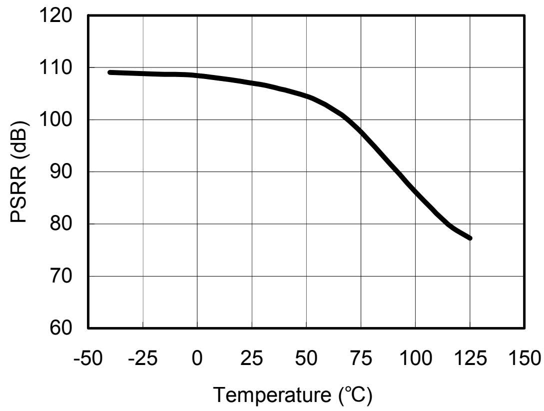
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = +5V, and R_L = 100kΩ connected to V_S/2, unless otherwise noted.

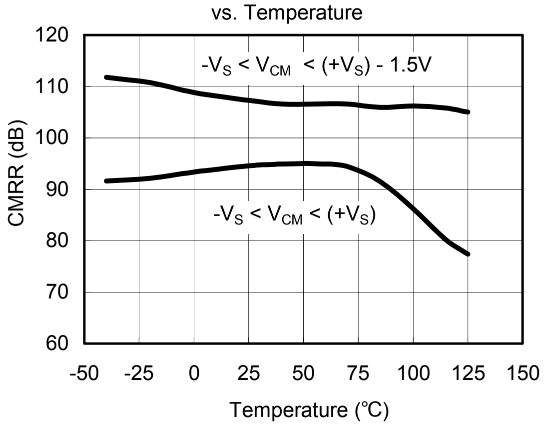
Supply Current vs. Supply Voltage



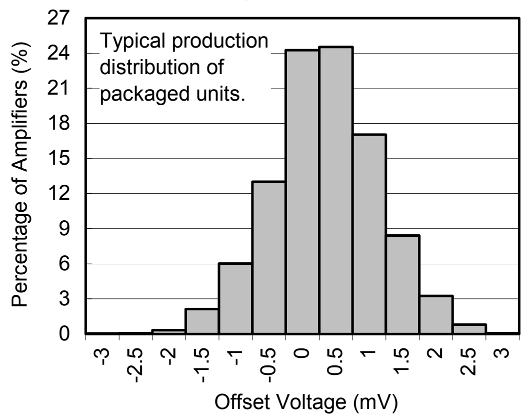
Power Supply Rejection Ratio vs. Temperature



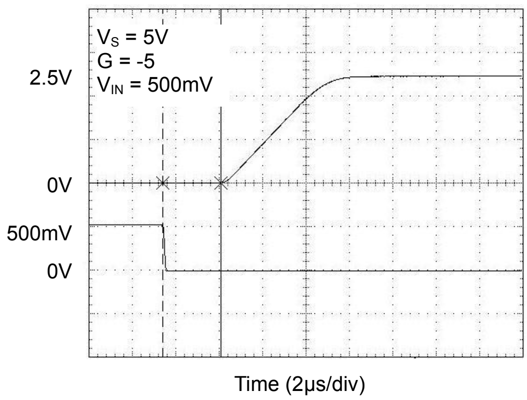
Common Mode Rejection Ratio vs. Temperature



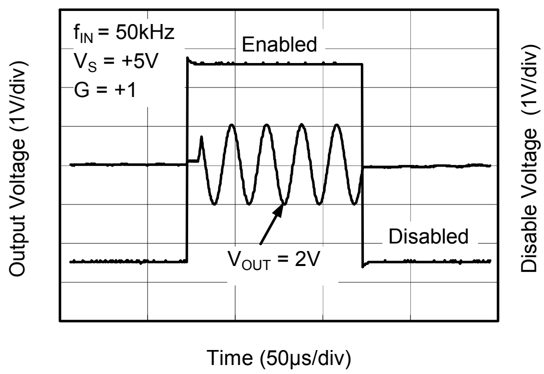
Offset Voltage Production Distribution



Overload Recovery Time



Small-Signal Disable/Enable Response



APPLICATION NOTES

Driving Capacitive Loads

The SGM8543 can directly drive 250pF in unity-gain without oscillation. The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation. Applications that require greater capacitive driving capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 1. The isolation resistor R_{ISO} and the load capacitor C_L form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD}.

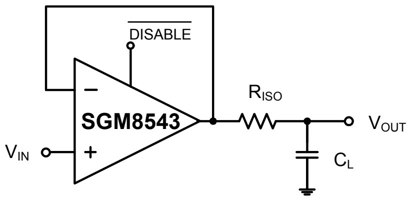


Figure 1. Indirectly Driving Heavy Capacitive Load

An improved circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. R_F provides the DC accuracy by connecting the inverting signal with the output. C_F and R_{Iso} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving phase margin in the overall feedback loop.

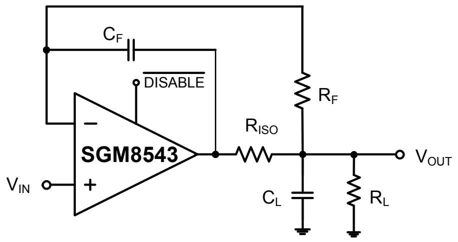


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For non-buffer configuration, there are two other ways to increase the phase margin: (a) by increasing the amplifier's gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

Power-Supply Bypassing and Layout

The SGM8543 operates from either a single +2.1V to +5.5V supply or dual ±1.05V to ±2.75V supplies. For single-supply operation, bypass the power supply $+V_S$ with a 0.1μF ceramic capacitor which should be placed close to the $+V_S$ pin. For dual-supply operation, both the $+V_S$ and the $-V_S$ supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

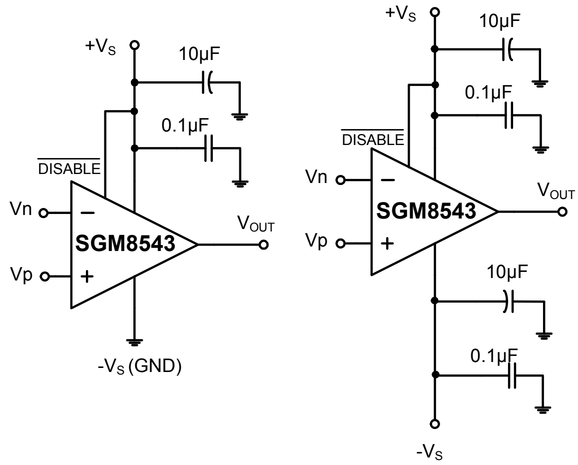


Figure 3. Amplifier with Bypass Capacitors

TYPICAL APPLICATION CIRCUITS

Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistor ratios are equal to (R_4 / R_3 = R_2 / R_1), then V_{OUT} = (Vp - Vn) × R_2 / R_1 + V_{REF}.

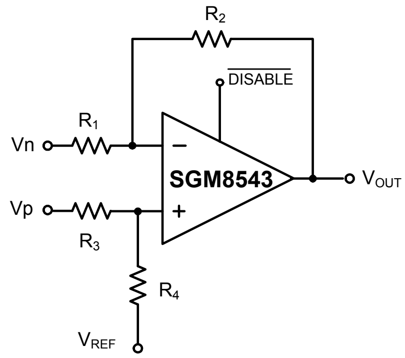


Figure 4. Differential Amplifier

Instrumentation Amplifier

The circuit in Figure 5 performs the same function as that in Figure 4 but with a high input impedance.

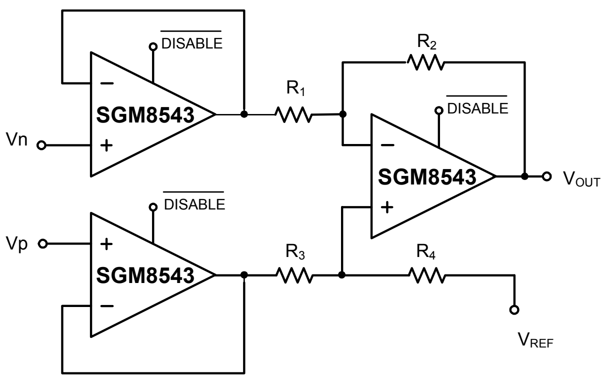


Figure 5. Instrumentation Amplifier

Low Pass Active Filter

The low pass filter shown in Figure 6 has a DC gain of (-R_2 / R_1) and the -3dB corner frequency is 1/2πR_2C. Make sure the filter bandwidth is within the bandwidth of the amplifier. The large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistor values as low as possible and consistent with output loading consideration.

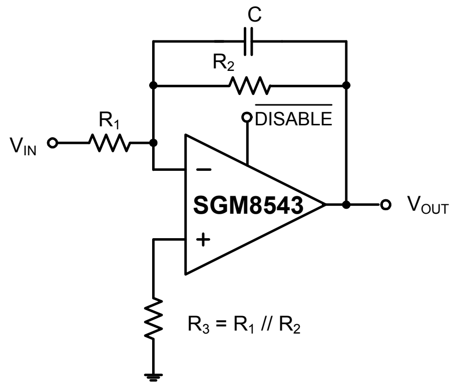
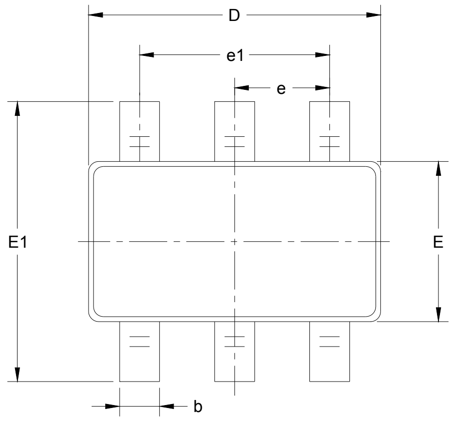
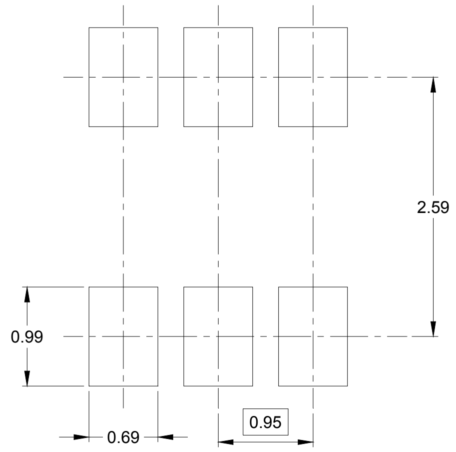


Figure 6. Low Pass Active Filter

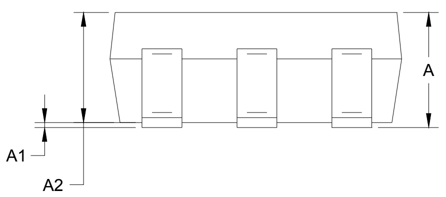
PACKAGE OUTLINE DIMENSIONS

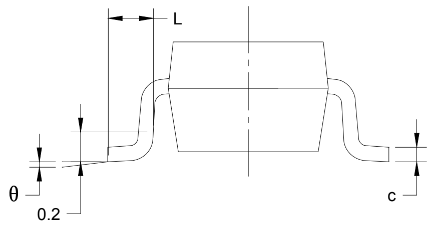
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)

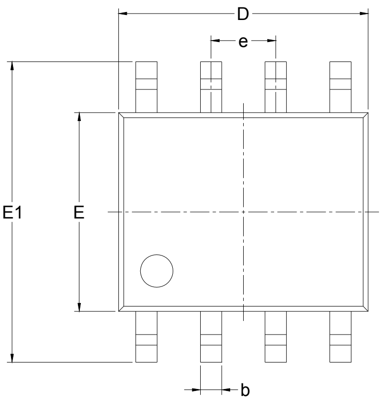


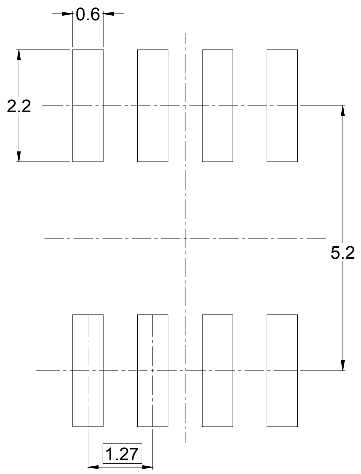


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

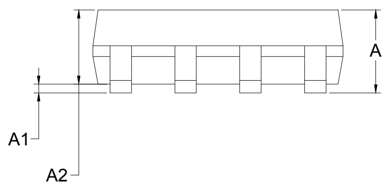
PACKAGE OUTLINE DIMENSIONS

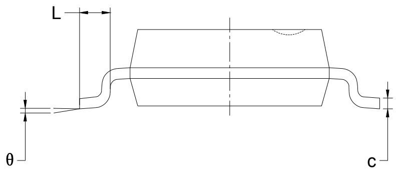
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

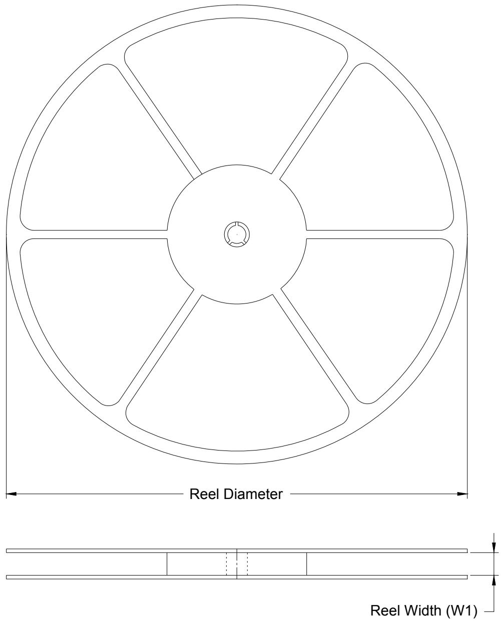




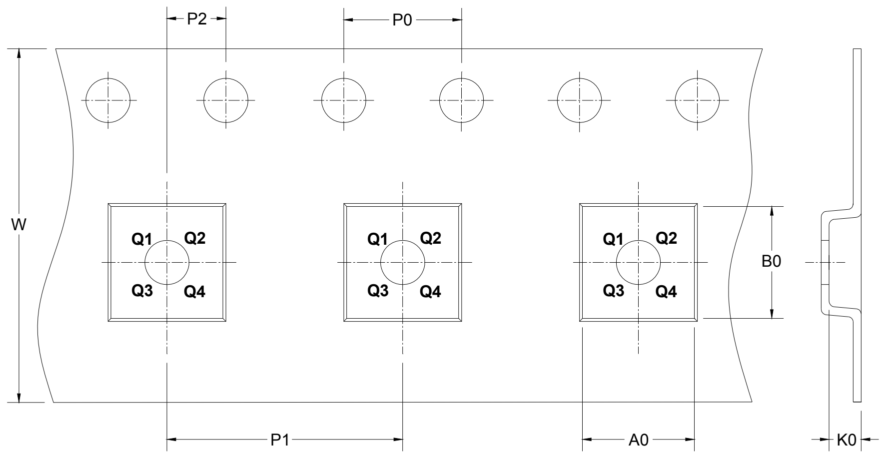
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



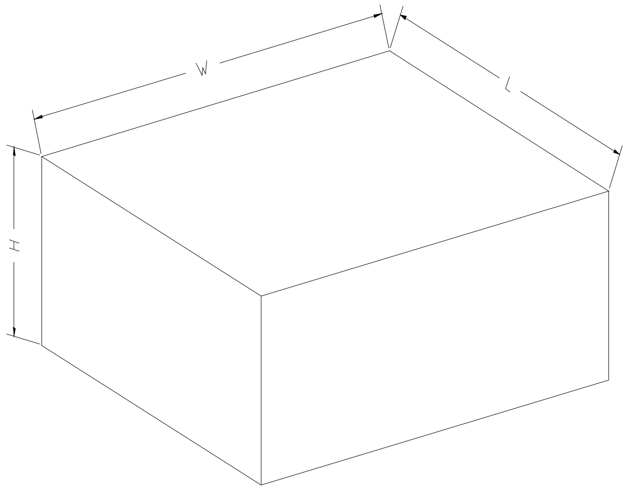
DIRECTION OF FEED

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
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

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