SGM8545
1.1MHz, 42μA, Rail-to-Rail I/O CMOS Operational Amplifier

PRODUCT DESCRIPTION

The SGM8545 is rail-to-rail input and output voltage feedback amplifier offering low cost. It has a wide input common-mode voltage range and output voltage swing, and take the minimum operating supply voltage down to 2.1V and the maximum recommended supply voltage is 5.5V. It is specified over the extended –40℃ to +125℃ temperature range.

The SGM8545 provides 1.1MHz bandwidth at a low current consumption of 42μA. Very low input bias currents of 0.5pA, enable SGM8545 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail inputs and outputs are useful to designers buffering ASIC in single-supply systems.

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

The SGM8545 is available in the tiny SOT23-5 package.

APPLICATIONS

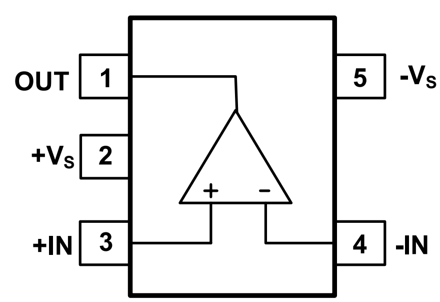
ASIC Input or Output Amplifier
Sensor Interface
Piezo Electric Transducer Amplifier
Medical Instrumentation
Mobile Communication
Audio Output
Portable Systems
Smoke Detectors
Mobile Telephone
Notebook PC
PCMCIA cards
Battery –Powered equipment

FEATURES

- **Low Cost**
- **Rail-to-Rail Input and Output**
  0.8mV Typical V_{OS}
- **Unity Gain Stable**
- **Gain Bandwidth Product: : 1.1MHz**
- **Very low input bias currents : 0.5pA**
- **Operates on 2.1V to 5.5V Supplies**
- **Input Voltage Range = - 0.1V to +5.6V with V_S = 5.5V**
- **Low Supply Current: 42μA**
- **Small Packaging**
  SGM8545 Available in SOT23-5

PIN CONFIGURATION (Top View)

SGM8545



SOT23-5

PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8545	SGM8545XN5/TR	SOT23-5	Tape and Reel, 3000	8545

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V- . . . . 7.5 V
Common-Mode Input Voltage. . . . . .(–V_S)– 0.5 V to (+V_S) +0.5V
Storage Temperature Range . . . .–65℃ to +150℃
Junction Temperature . . . . .150℃
SOT23-5, θ_{JA}. . . . . .190°C/W
Operating Temperature Range . . . . –40℃ to +125℃
Lead Temperature Range (Soldering 10 sec). . . . . 260℃
ESD (HBM) 4KV

NOTES
1. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification 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.

ELECTRICAL CHARACTERISTICS : V_S = +5V

(At R_L = 100kΩ connected to Vs/2, and V_{OUT} = Vs/2, unless otherwise noted)

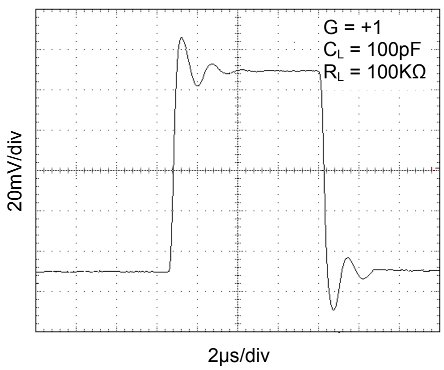
PARAMETER	CONDITIONS	SGM8545						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to70℃	-40℃ to 85℃	-40℃ to125℃	UNITS	MIN/ MAX
INPUT CHARACTERISTICS								
Input Offset Voltage (V_{OS})		±0.8	±3.5	±3.7	±4.1	±5.4	mV	MAX
Input Bias Current (I_B)		0.5					pA	TYP
Input Offset Current (I_{OS})		0.5					pA	TYP
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 4 V	88	72	72	72	72	dB	MIN
	V_S = 5.5V, V_{CM} = - 0.1V to 5.6 V	78	60	59	59	57	dB	MIN
Open-Loop Voltage Gain(A_{OL})	R_L = 5KΩ ,Vo = 0.1V to 4.9V	90	80	80	80	78	dB	MIN
	R_L =100KΩ ,Vo = 0.035V to 4.965V	94	85	85	85	82	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta_T$)		2.7					μV/℃	TYP
OUTPUT CHARACTERISTICS								
Output Voltage Swing from Rail	R_L = 100KΩ	0.008					V	TYP
Output Current (I_{OUT})		23	20	19.1	18.8	18	mA	MIN
Short-Circuit Current (I_{SC})							mA	TYP
POWER SUPPLY								
Operating Voltage Range			2.1	2.5	2.5	2.5	V	MIN
			5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_s = +2.5V to + 5.5V							
	V_{CM} = (-V_S) + 0.5	92	76	74	71	70	dB	MIN
Quiescent Current (I_Q)	I_{OUT} = 0	42	54	59	60	64	μA	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 = Vs	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

Specifications subject to change without notice.

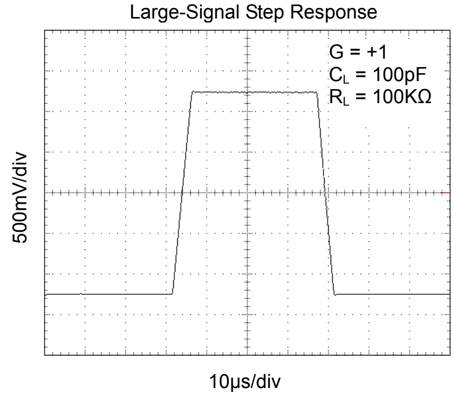
TYPICAL PERFORMANCE CHARACTERISTICS

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

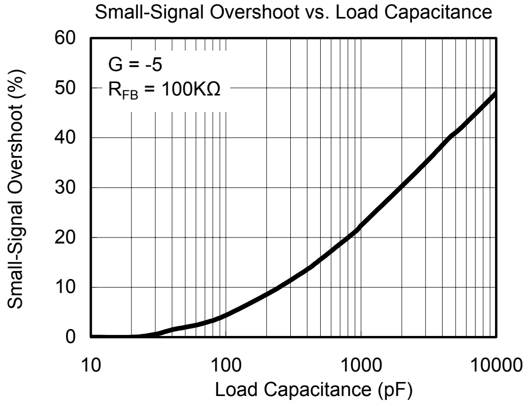
Small-Signal Step Response



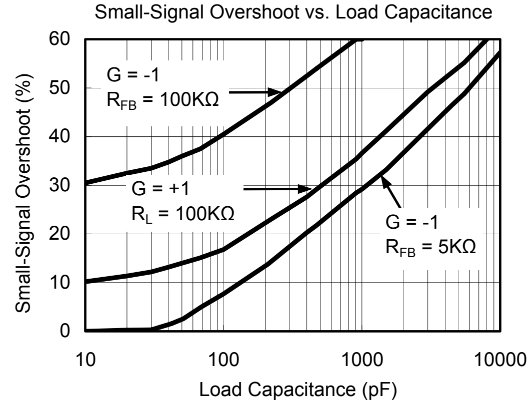
Large-Signal Step Response



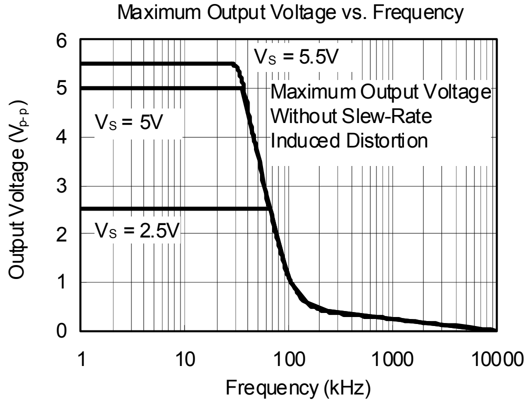
Small-Signal Overshoot vs. Load Capacitance



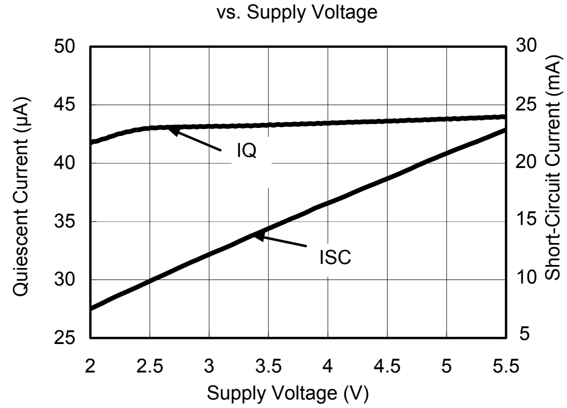
Small-Signal Overshoot vs. Load Capacitance



Maximum Output Voltage vs. Frequency

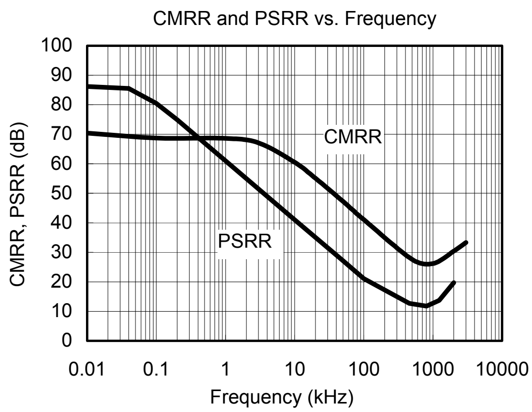


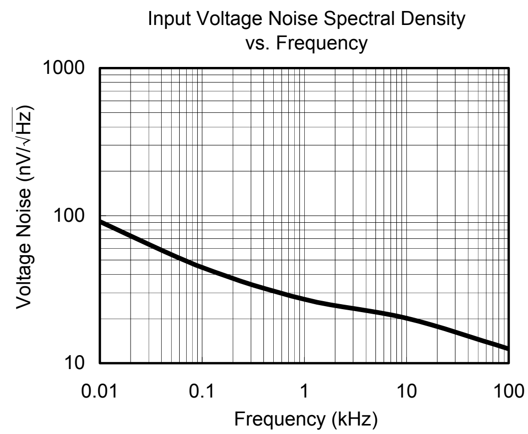
Quiescent And Short-Circuit Current vs. Supply Voltage

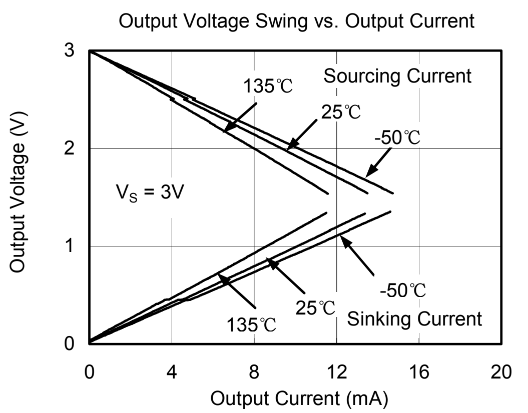


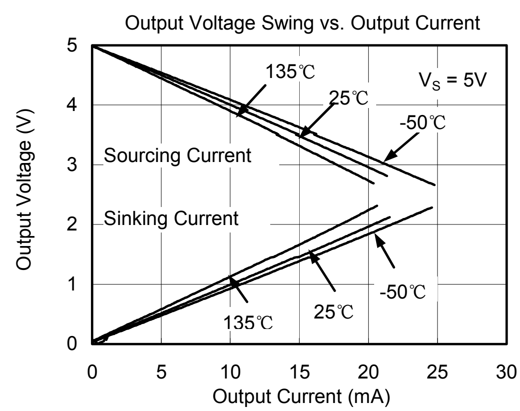
TYPICAL PERFORMANCE CHARACTERISTICS

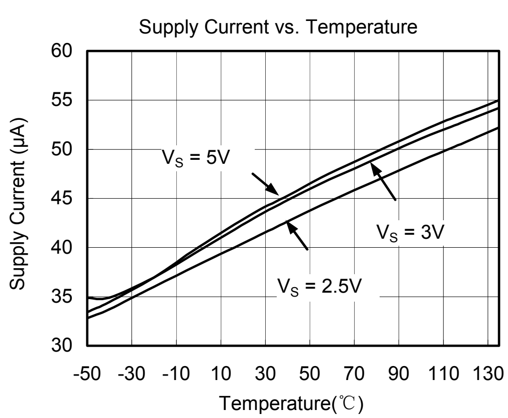
At T_A = +25℃, V_S = +5V, and R_L = 100KΩ connected to Vs/2, unless otherwise noted.

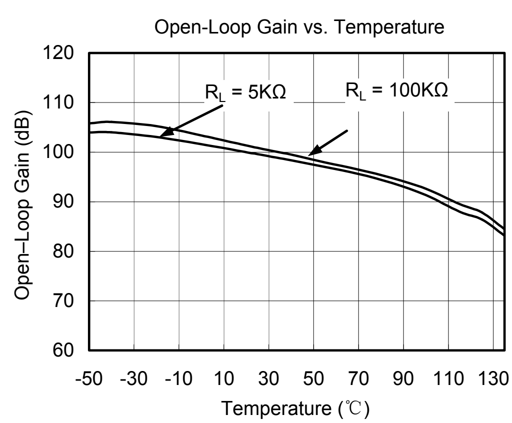








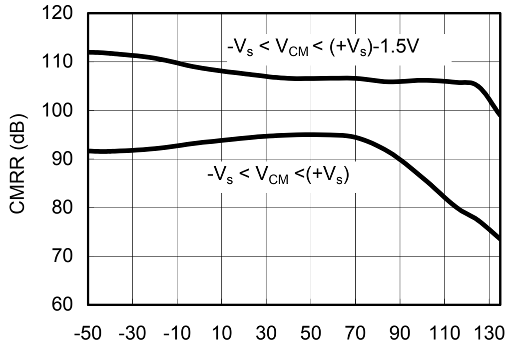




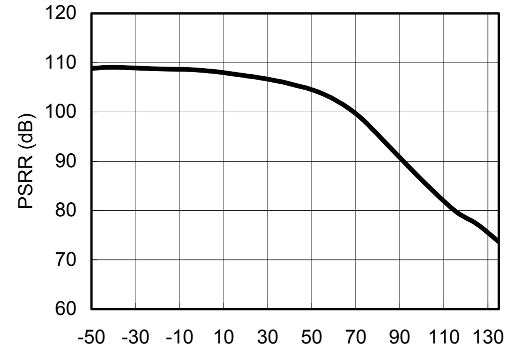
TYPICAL PERFORMANCE CHARACTERISTICS

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

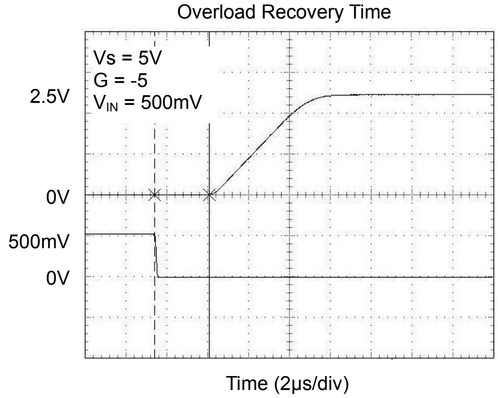
Common-Mode Rejection Ratio vs. Temperature



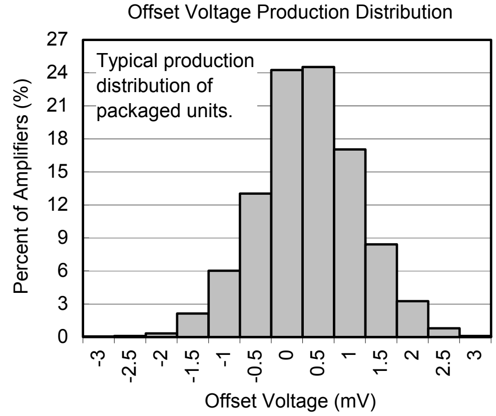
Power-Supply Rejection Ratio vs. Temperature



Overload Recovery Time



Offset Voltage Production Distribution



APPLICATION NOTES

Driving Capacitive Loads

The SGM8545 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 drive 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}.

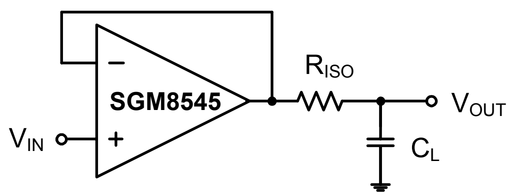


Figure 1. Indirectly Driving Heavy Capacitive Load

An improvement 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.

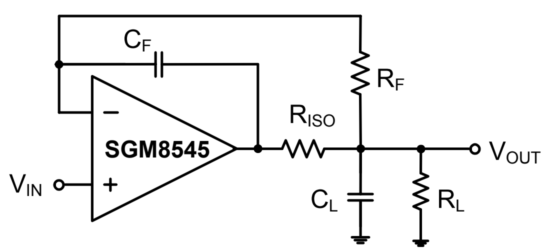


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For no-buffer configuration, there are two others 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 SGM8545 operates from either a single +2.5V to +5.5V supply or dual ±1.25V to ±2.75V supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1μF ceramic capacitor which should be placed close to the V_{DD} pin. For dual-supply operation, both the V_{DD} and the V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

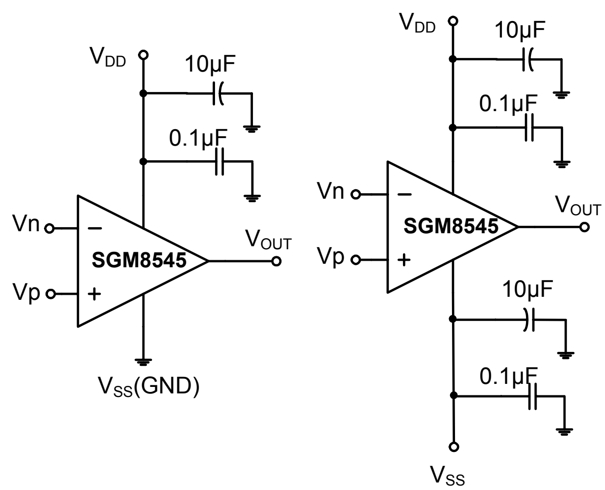


Figure 3. Amplifier with Bypass Capacitors

TYPICAL APPLICATION CIRCUITS

Differential Amplifier

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

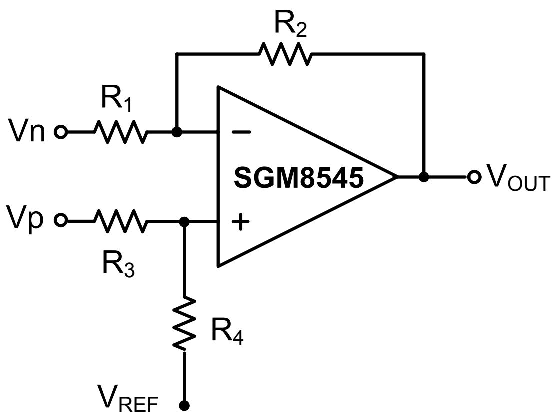


Figure 4. Differential Amplifier

Instrumentation Amplifier

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

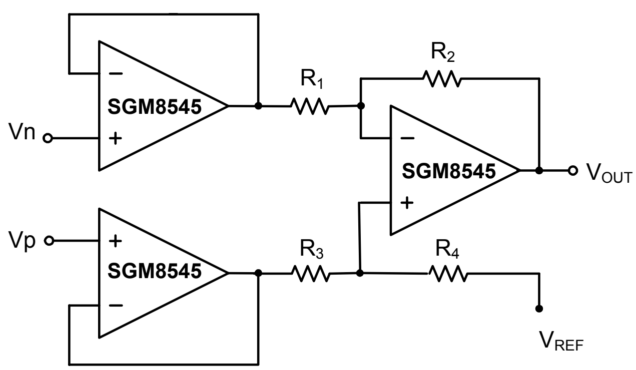


Figure 5. Instrumentation Amplifier

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 $1/2\pi R_2C$. Make sure the filter 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 resistors value as low as possible and consistent with output loading consideration.

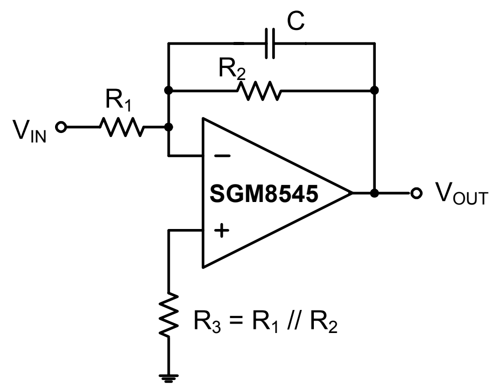
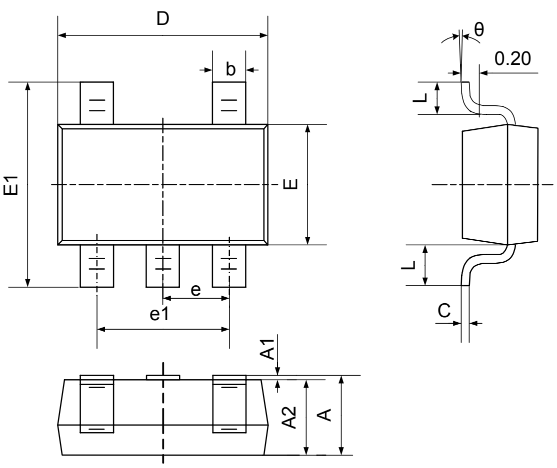


Figure 6. Low Pass Active Filter

PACKAGE OUTLINE DIMENSIONS

SOT23-5



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	0.400	0.012	0.016
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	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

11/2006 REV. B