SGM2324

1MHz, Quad, General Purpose CMOS Operational Amplifier

PRODUCT DESCRIPTION

The SGM2324 has quad rail-to-rail output voltage feedback amplifiers in one package. It takes the minimum operating supply voltage down to 3V and the maximum recommended supply voltage is 5.5V. SGM2324 is specified over the extended -40°C to +85°C temperature range.

The amplifier in SGM2324 provides 1MHz bandwidth; very low input bias currents of 10pA, these features enable SGM2324 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail output feature is useful for designers to buffer ASIC in single-supply systems.

Applications of SGM2324 include safety monitoring, portable equipment, battery and power supply control, signal conditioning and interfacing for transducers in low power systems.

The SGM2324 is offered in SO-16, TSSOP-16, TSSOP-14 and SO-14 packages.

APPLICATIONS

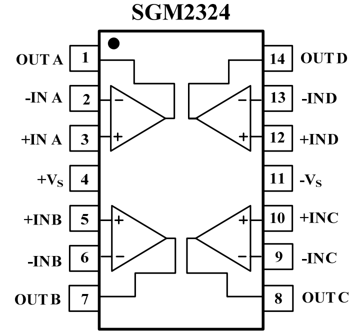
ASIC Input or Output Amplifier
Sensor Interface
Piezo Electric Transducer Amplifier
Medical Instrumentation
Mobile Communication
Portable Systems
Smoke Detectors
Notebook PC
PCMCIA Cards
Battery–Powered Equipment
DSP Interface

FEATURES

- **Low Cost**
- **Rail-to-Rail Output**
  1.7mV Typical V_{OS}
- **Unity Gain Stable**
- **Gain Bandwidth Product: 1MHz**
- **Very Low Input Bias Currents: 10pA**
- **Input Common-Mode Voltage Range Includes Ground**
- **Operates from 3V to 5.5V**
- **Lead (Pb) Free Packages:**
  SO-16, TSSOP-16, SO-14 and TSSOP-14

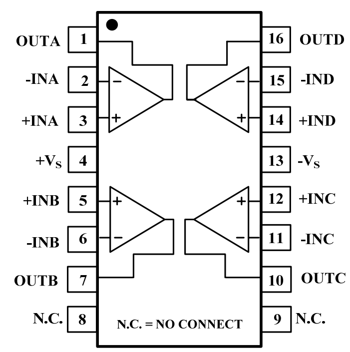
PIN CONFIGURATIONS (Top View)

SGM2324



TSSOP-14/SO-14

SGM2324



TSSOP-16/SO-16

ELECTRICAL CHARACTERISTICS: V_S = +5V

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

PARAMETER	CONDITIONS	SGM2324				
		TYP	MIN/MAX OVER TEMPERATURE			
		+25℃	+25℃	-40℃ to +85℃	UNITS	MIN / MAX
INPUT CHARACTERISTICS						
Input Offset Voltage (V_{OS})		1.7	10	12	mV	MAX
Input Bias Current (I_B)		10			pA	TYP
Input Offset Current (I_{OS})		10			pA	TYP
Common-Mode Rejection Ratio(CMRR)	V_S = 5V, V_{CM} = - 0.1V to 3.3V	88	65	50	dB	MIN
Open-Loop Voltage Gain(A_{OL})	R_L = 2KΩ ,Vo = 0.1V to 4.9V	100	85	80	dB	MIN
	R_L =10KΩ ,Vo = 0.035V to 4.965V	110	90	85	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta_T$)		3.5			μV/°C	TYP
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	R_L = 2KΩ	0.8			V	TYP
	R_L = 10KΩ	0.008			V	TYP
Output Current (I_{OUT})		43	28	24	mA	MIN
POWER SUPPLY						
Operating Voltage Range			3.0	3.0	V	MIN
			5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_s = +3V to + 5.5V					
	V_{CM} = ($-V_S$) + 0.5V	80	75	70	dB	MIN
Quiescent Current / Amplifier (I_Q)	I_{OUT} = 0	0.65	1.2	1.3	mA	MAX
DYNAMIC PERFORMANCE						
Gain-Bandwidth Product (GBP)		1			MHz	TYP
Slew Rate (SR)	G = +1 , 2V Output Step	0.65			V/μs	TYP
Settling Time to 0.1%(t_S)	G = +1, 2 V Output Step	9.0			μs	TYP
Overload Recovery Time	V_{IN} ·Gain = Vs	4.0			μs	TYP
Crosstalk	1kHz	-80			dB	TYP
	1MHz	-65			dB	TYP
NOISE PERFORMANCE						
Voltage Noise Density (e_n)	f = 1kHz	42.0			nV/ $\sqrt{Hz}$	TYP
	f = 10kHz	38.0			nV/ $\sqrt{Hz}$	TYP

Specifications subject to changes without notice.

PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM2324	SGM2324YS/TR	SO-16	Tape and Reel, 2500	SGM2324YS
	SGM2324YTS/TR	TSSOP-16	Tape and Reel, 3000	SGM2324YTS
	SGM2324YS14/TR	SO-14	Tape and Reel, 2500	SGM2324YS14
	SGM2324YTS14/TR	TSSOP-14	Tape and Reel, 3000	SGM2324YTS14

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V- 6V
Storage Temperature Range . . . . -65℃ to +150℃
Junction Temperature . . . . 160℃
Operating Temperature Range . . . . -40℃ to +85℃
Package Thermal Resistance @ T_A = 25℃
SO-16, θ_{JA} . . . . 82℃/W
TSSOP-16, θ_{JA} . . . . 105℃/W
Lead Temperature Range (Soldering 10 sec)
. . . . 260℃
ESD Susceptibility
HBM 4000V
MM 400V

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.

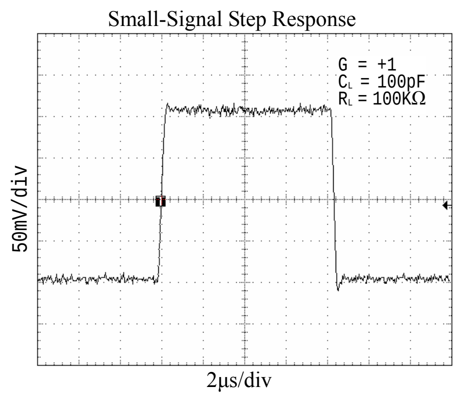
CAUTION

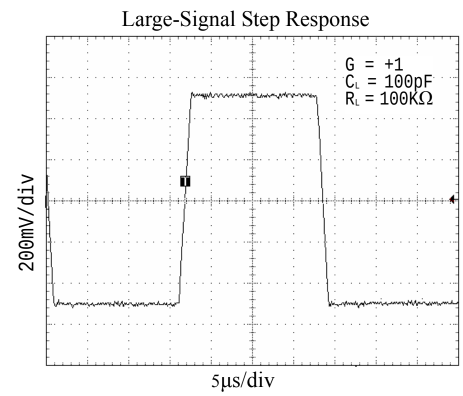
This integrated circuit can be damaged by ESD. SG Micro-electronics recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

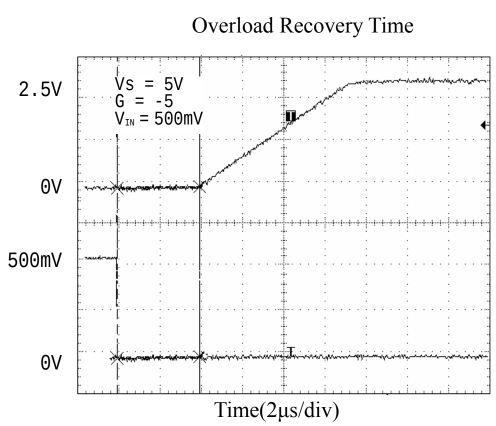
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

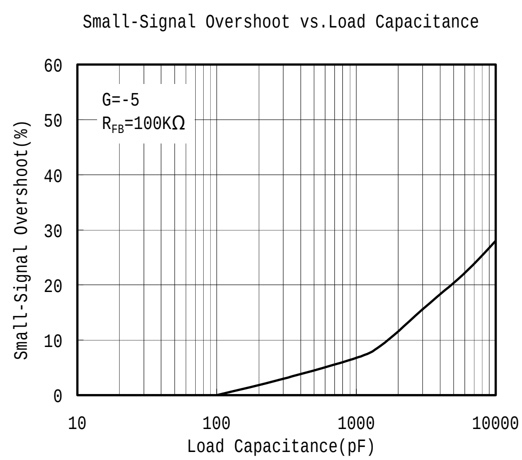
TYPICAL PERFORMANCE CHARACTERISTICS

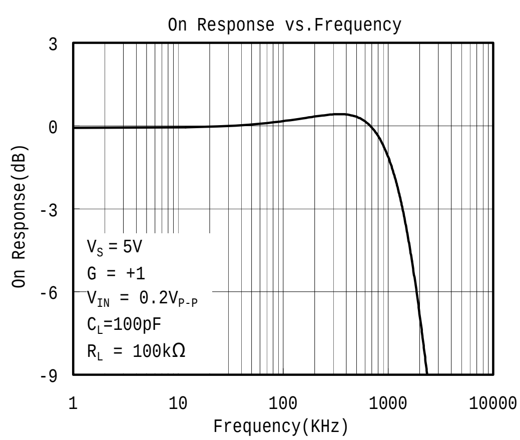
At T_A = +25°C, V_S = +5V, and R_L = 100KΩ connected to Vs/2, unless otherwise noted.

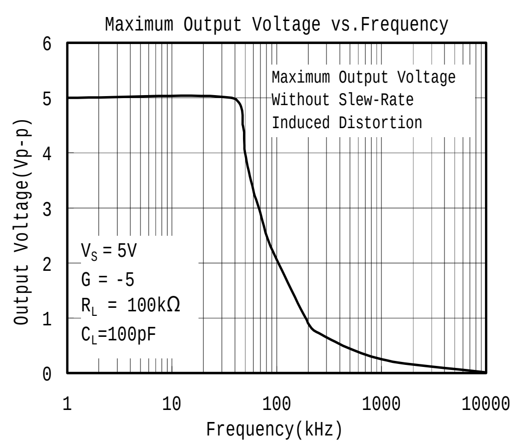








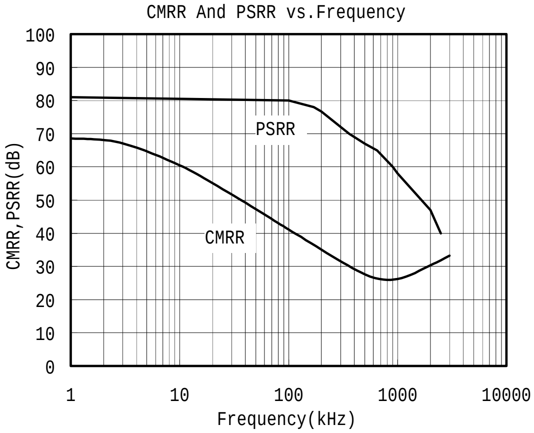




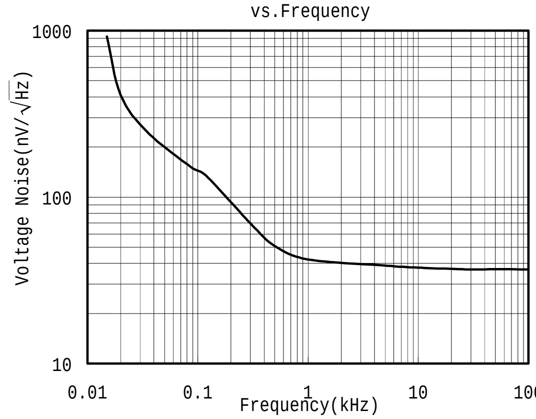
TYPICAL PERFORMANCE CHARACTERISTICS

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

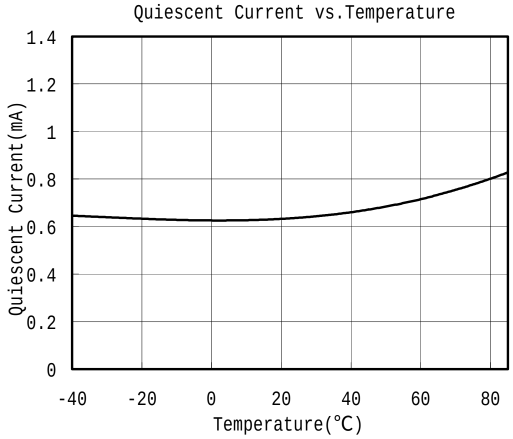
CMRR And PSRR vs.Frequency



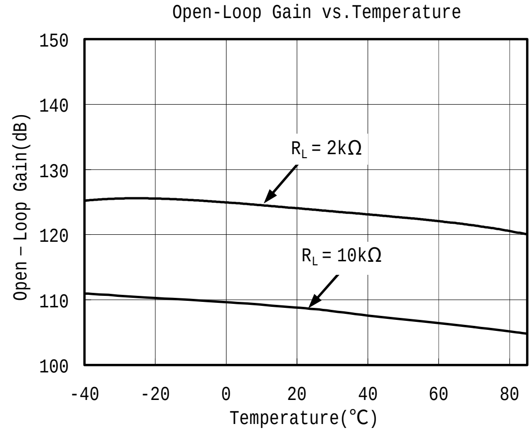
Input Voltage Noise Spectral Density vs.Frequency



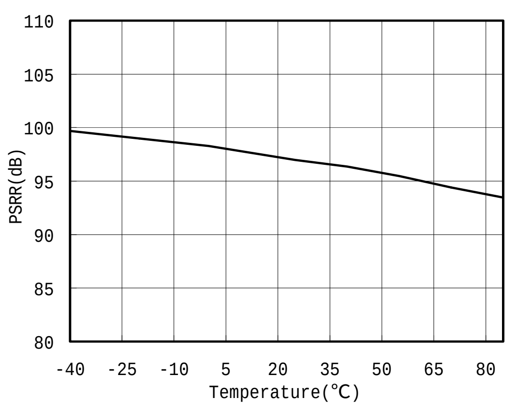
Quiescent Current vs.Temperature



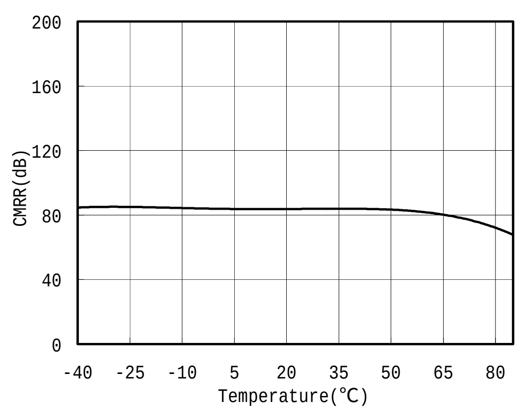
Open-Loop Gain vs.Temperature



PSRR vs.Temperature

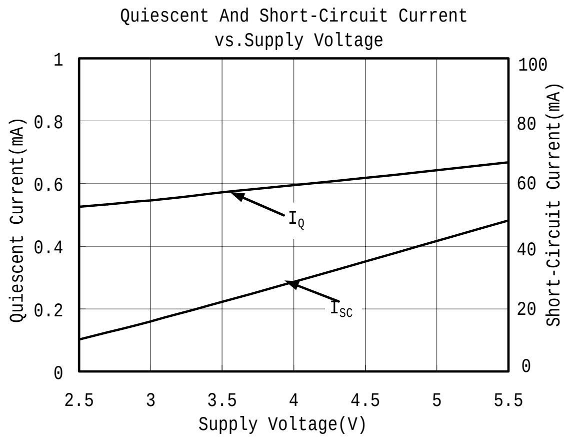


CMRR vs.Temperature



TYPICAL PERFORMANCE CHARACTERISTICS

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



APPLICATION NOTES

Driving Capacitive Loads

The SGM2324 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}.

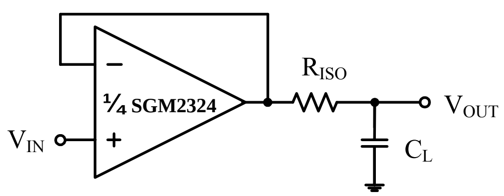


Figure 1. Indirectly Driving Heavy Capacitive Load

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.

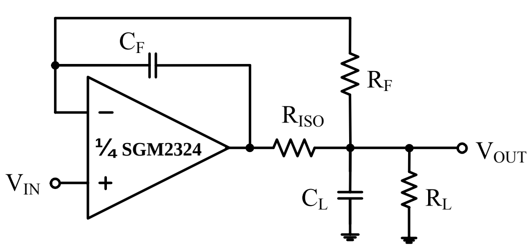


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

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 SGM2324 operates from a single +3V to +5.5V supply or dual ±1.5V 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.

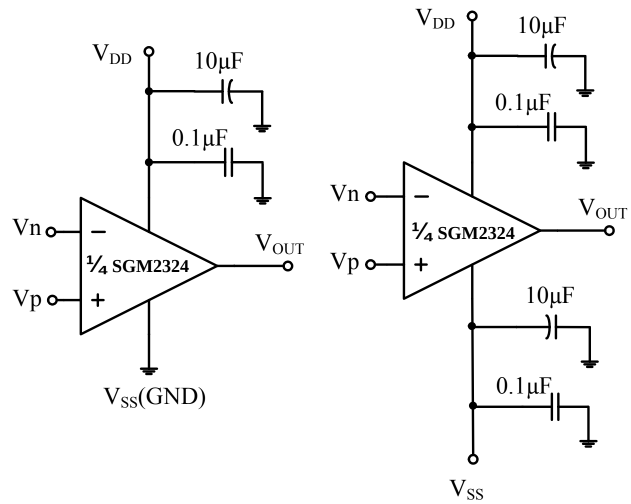


Figure 3. Amplifier with Bypass Capacitors

Typical Application Circuits

Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistors ratios are equal (R4 / R3 = R2 / R1), then V_{OUT} = (Vp – Vn) × R_2 / R_1 + Vref.

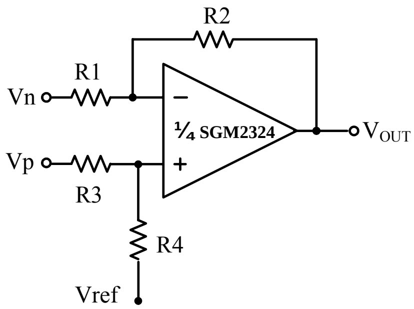


Figure 4. Differential Amplifier

Instrumentation Amplifier

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

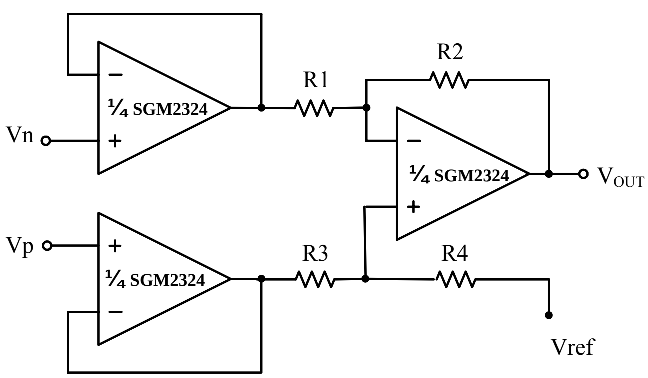


Figure 5. Instrumentation Amplifier

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 $1/2\pi R_2 C$. 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.

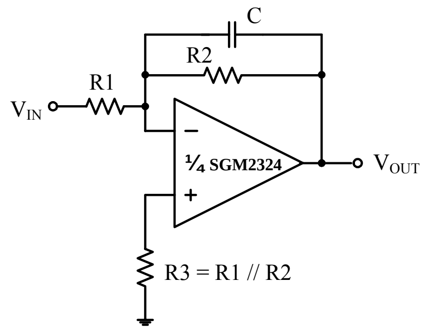
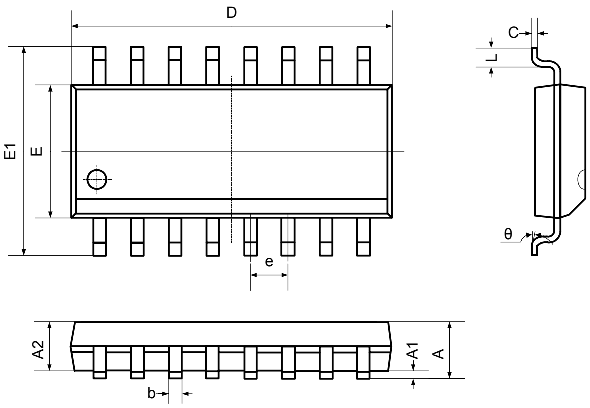


Figure 6. Low Pass Active Filter

PACKAGE OUTLINE DIMENSIONS

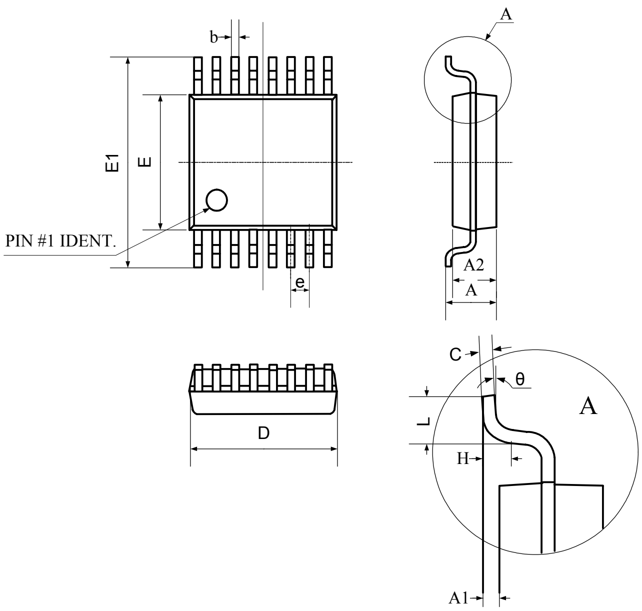
SO-16



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	0.007	0.010
D	9.800	10.20	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

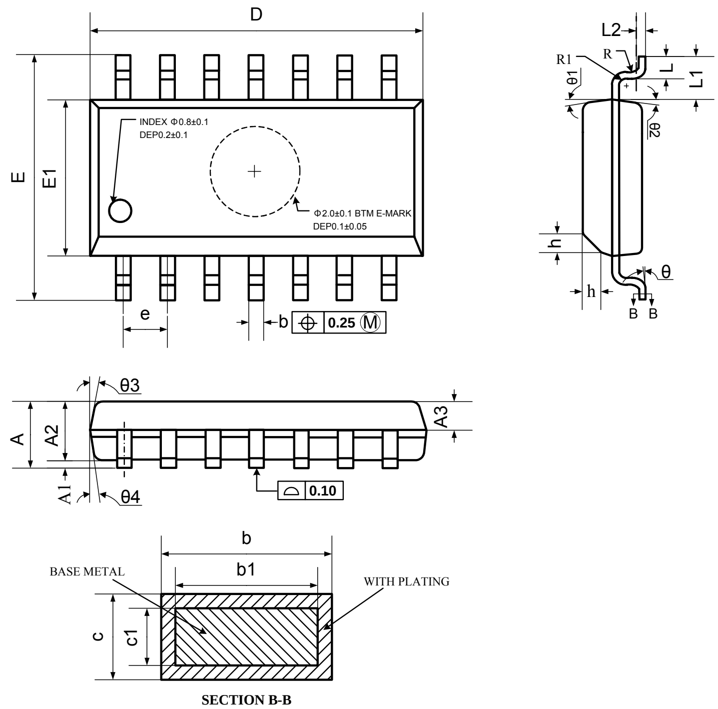
TSSOP-16



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.100		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65 (BSC)		0.026 (BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

PACKAGE OUTLINE DIMENSIONS

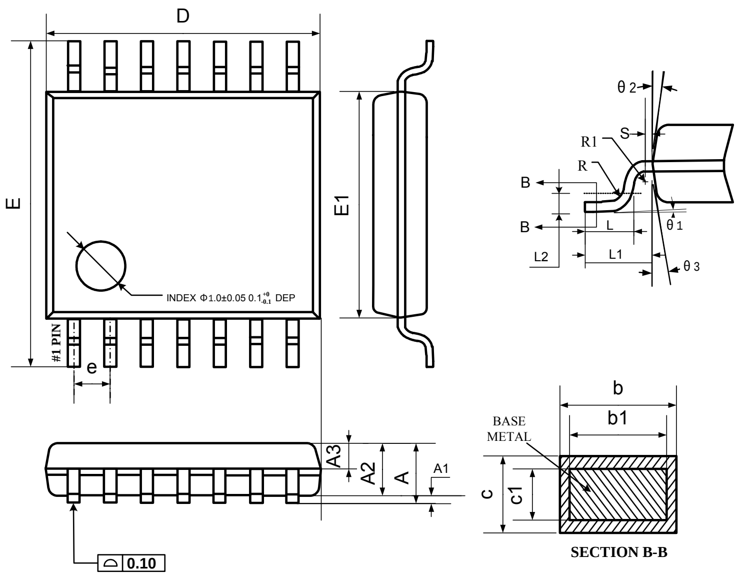
SO-14



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
c	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
c	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

REVISION HISTORY

Location	Page
10/2007— Data Sheet REV.A	
02/2008— Data Sheet changed from REV. A to REV. B	
Added SO-14 and TSSOP-14 Packages	1, 3, 11, 12

SG Micro Ltd.
A2608, NO.72 North Road
Xisanhuan, Haidian District,
Beijing, China 100037
Tel: 86-10-51798160/80
Fax: 86-10-51798180-803
www.sg-micro.com