SGM8931/2/3/4
1.5MHz, Rail-to-Rail Output Operational Amplifiers

PRODUCT DESCRIPTION

The SGM8931 (single), SGM8932 (dual), SGM8933 (single with shutdown) and SGM8934 (quad) are rail-to-rail output operational amplifiers that are optimized and fully specified for 5V operation.

The SGM8931/2/3/4 have a wide input common-mode voltage range and output voltage swing, and take the minimum operating supply voltage down to 1.8V. The maximum recommended supply voltage is 5.5V.

The SGM8931/2/3/4 provide excellent overall performance. They exhibit low noise, distortion and low offset, making these devices an excellent choice for high quality, low voltage or battery powered systems.

The SGM8931/2/3/4 are specified over the extended -40℃ to +85℃ temperature range. The SGM8931 single is available in Green SOT-23-5, SC70-5, MSOP-8 and SOIC-8 packages. The SGM8932 dual is available in Green SOIC-8 and MSOP-8 packages. The SGM8933 single with shutdown is available in Green SOT-23-6, MSOP-8 and SOIC-8 packages. The SGM8934 quad is available in Green SOIC-14 and TSSOP-14 packages.

FEATURES

- **Rail-to-Rail Output**
- **Low Noise: 30nV/$\sqrt{Hz}$**
- **Low Distortion**
- **Supply Voltage Range: 1.8V to 5.5V**
- **Low Input Offset Voltage: 0.9mV (MAX)**
- **Gain Bandwidth Product: 1.5MHz**
- **Slew Rate: 0.8V/μs**
- **Low Supply Current**
  80μA/Amplifier (TYP)
  0.1μA Shutdown Current for SGM8933
- **Small Packaging:**
  SGM8931 Available in SOT-23-5, SC70-5, SOIC-8 and MSOP-8
  SGM8932 Available in MSOP-8 and SOIC-8
  SGM8933 Available in SOT-23-6, SOIC-8 and MSOP-8
  SGM8934 Available in TSSOP-14 and SOIC-14

APPLICATIONS

Data Acquisition
Process Control
Active Filters
Test Equipment
Mobile Phone
Audio Processing
Portable Equipment

PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8931	SGM8931AYN5G/TR	SOT-23-5	Tape and Reel, 3000	SAAXX
	SGM8931BYN5G/TR	SOT-23-5	Tape and Reel, 3000	SB1XX
	SGM8931YC5G/TR	SC70-5	Tape and Reel, 3000	SABXX
	SGM8931YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM8931YS8
	SGM8931YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8931YMS8
SGM8932	SGM8932YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8932YMS8
	SGM8932YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM8932YS8
SGM8933	SGM8933YN6G/TR	SOT-23-6	Tape and Reel, 3000	SA8XX
	SGM8933YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM8933YS8
	SGM8933YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8933YMS8
SGM8934	SGM8934YS14G/TR	SOIC-14	Tape and Reel, 2500	SGM8934YS14
	SGM8934YTS14G/TR	TSSOP-14	Tape and Reel, 3000	SGM8934YTS14

NOTE: Package marking is defined as the follow:

MARKING INFORMATION

SYY X X

Date code - Month ("A" = Jan. "B" = Feb. ⋯ "L" = Dec.)

Date code - Year ("A" = 2010, "B" = 2011 ⋯)

Chip I.D.

For example: SAABA (2011, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$.....6V

Common-Mode Input Voltage.....-0.1V to $(+V_S)$ - 1.3V

Storage Temperature Range.....-65℃ to +150℃

Junction Temperature .....150℃

Operating Temperature Range..... -40℃ to +85℃

Lead Temperature Range (Soldering 10 sec)

.....260℃

ESD Susceptibility

HBM (SGM8931/2/4).....8000V

HBM (SGM8933).....4000V

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.

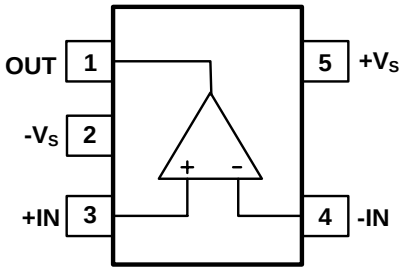
CAUTION

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.

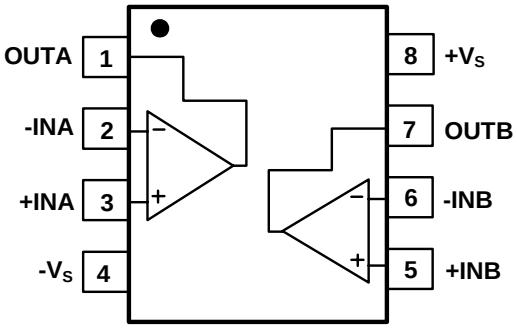
PIN CONFIGURATIONS (TOP VIEW)

SGM8931YC5G
SGM8931AYN5G



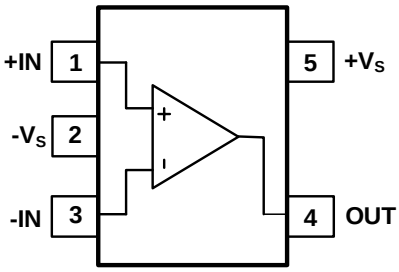
SOT-23-5/SC70-5

SGM8932



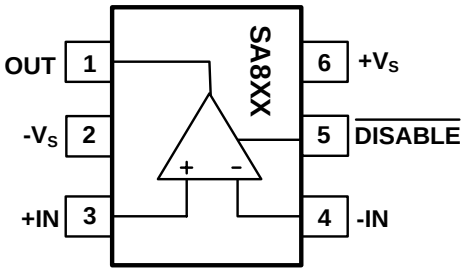
SOIC-8/MSOP-8

SGM8931BYN5G



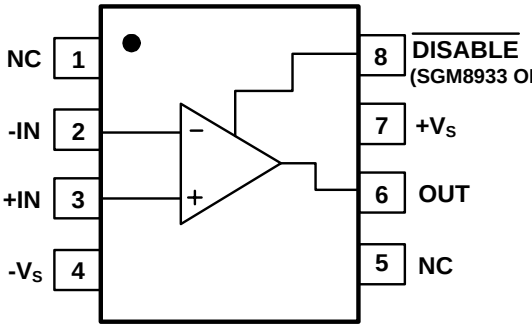
SOT-23-5

SGM8933



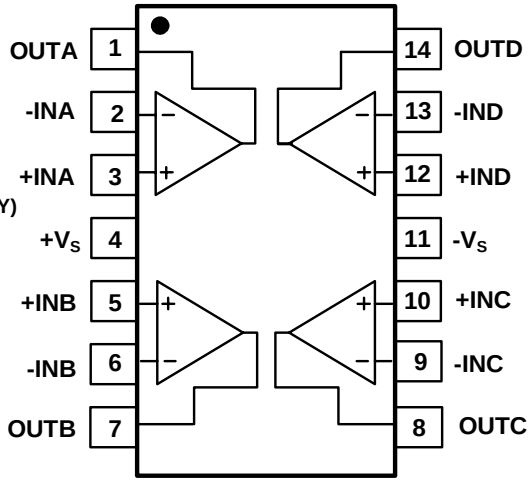
SOT-23-6

SGM8931/3



SOIC-8/MSOP-8
NC = NO CONNECT

SGM8934



TSSOP-14/SOIC-14

NOTE: The location of pin 1 on the SOT-23-6 is determined by orienting the package marking as shown.

ELECTRICAL CHARACTERISTICS: V_S = +5V

(At T_A = +25℃, V_{OUT} = V_S/2, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
DC PERFORMANCE					
Input Offset Voltage (V_{OS})	V_{CM} = V_S/2		0.2	0.9	mV
	-40℃ ≤ T_A ≤ +85℃			1.4	
Input Bias Current (I_B)			3		pA
Input Offset Current (I_{OS})			3		pA
Input Offset Voltage Drift	V_{CM} = V_S/2		1.5		μV/℃
Open-Loop Gain (A_{OL})	R_L = 2kΩ, V_{OUT} = 0.2V to 4.8V	80	90		dB
	-40℃ ≤ T_A ≤ +85℃	76			
	R_L = 100kΩ, V_{OUT} = 0.035V to 4.965V	82	100		
	-40℃ ≤ T_A ≤ +85℃	78			
INPUT CHARACTERISTICS					
Input Common Mode Voltage Range (V_{CM})		-0.1		3.7	V
Common Mode Rejection Ratio (CMRR)	V_{CM} = -0.1V to 3.7V	70	86		dB
	-40℃ ≤ T_A ≤ +85℃	67			
OUTPUT CHARACTERISTICS					
Output Voltage Swing from Rail	R_L = 2kΩ		80	110	mV
	-40℃ ≤ T_A ≤ +85℃			120	
Output Short Circuit Current (I_{SC})		19	35		mA
	-40℃ ≤ T_A ≤ +85℃	15			
POWER-DOWN (SGM8933 only)					
Logic Low Voltage (V_{IL})				0.8	V
Logic High Voltage (V_{IH})		2			
POWER SUPPLY					
Quiescent Current (per Amplifier)	I_{OUT} = 0mA		80	130	μA
	-40℃ ≤ T_A ≤ +85℃			150	
Supply Current when Disabled (SGM8933 only)			0.1	6	μA
Power Supply Rejection Ratio (PSRR)	V_S = +1.8V to +5.5V, V_{CM} = 0.5V	68	80		dB
	-40℃ ≤ T_A ≤ +85℃	64			
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	R_L = 2kΩ, C_L = 100pF		1.5		MHz
Slew Rate	V_{OUT} = $2V_{PP}$, A_V = 1		0.8		V/μs
Crosstalk	f = 1kHz		110		dB
Settling Time to 0.1% (t_S)	V_{OUT} = $2V_{PP}$, f = 1kHz, A_V = 1, R_L = 2kΩ, C_L = 100pF		3.5		μs
Overload Recovery Time	R_L = 2kΩ, A_V = -50		7		μs
NOISE PERFORMANCE					
Input Voltage Noise (e_n)	f = 1kHz		30		nV/$\sqrt{Hz}$

ELECTRICAL CHARACTERISTICS: V_S = +1.8V

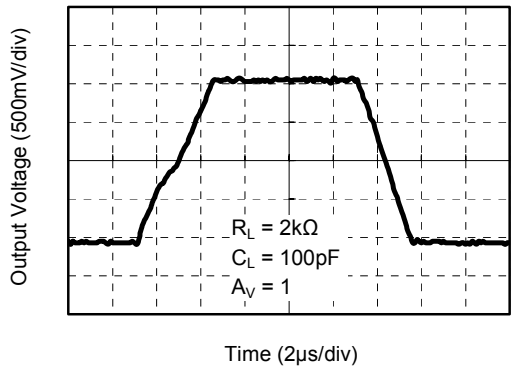
(At T_A = +25℃, V_{OUT} = V_S/2, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
DC PERFORMANCE					
Input Offset Voltage (V_{OS})	V_{CM} = 0.5V		0.3	0.9	mV
	-40℃ ≤ T_A ≤ +85℃			1.3	
Input Bias Current (I_B)			3		pA
Input Offset Current (I_{OS})			3		pA
Input Offset Voltage Drift	V_{CM} = 0.5V		1.5		μV/℃
Open-Loop Gain (A_{OL})	R_L = 2kΩ, V_{OUT} = 0.2V to 1.6V	75	85		dB
	-40℃ ≤ T_A ≤ +85℃	70			
	R_L = 100kΩ, V_{OUT} = 0.035V to 1.765V	82	105		dB
	-40℃ ≤ T_A ≤ +85℃	78			
INPUT CHARACTERISTICS					
Input Common Mode Voltage Range (V_{CM})		-0.1		0.5	V
Common Mode Rejection Ratio (CMRR)	V_{CM} = -0.1V to 0.5V	65	80		dB
	-40℃ ≤ T_A ≤ +85℃	62			
OUTPUT CHARACTERISTICS					
Output Voltage Swing from Rail	R_L = 2kΩ		55	75	mV
	-40℃ ≤ T_A ≤ +85℃			95	
Output Short Circuit Current (I_{SC})		2	5		mA
	-40℃ ≤ T_A ≤ +85℃	1.5			
POWER-DOWN (SGM8933 only)					
Logic Low Voltage (V_{IL})				0.4	V
Logic High Voltage (V_{IH})		1.3			
POWER SUPPLY					
Quiescent Current (per Amplifier)	I_{OUT} = 0mA		75	125	μA
	-40℃ ≤ T_A ≤ +85℃			145	
Supply Current when Disabled (SGM8933 only)			0.01	2	μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	R_L = 2kΩ, C_L = 100pF		1.3		MHz
Slew Rate	V_{OUT} = 0.5V_{PP}, A_V = 1		0.7		V/μs
Crosstalk	f = 1kHz		110		dB
Settling Time to 0.1% (t_S)	V_{OUT} = 0.5V_{PP}, f = 1kHz, A_V = 1, R_L = 2kΩ and C_L = 100pF		2.5		μs
Overload Recovery Time	R_L = 2kΩ, A_V = -50		6		μs
NOISE PERFORMANCE					
Input Voltage Noise (e_n)	f = 1kHz		35		nV/$\sqrt{Hz}$

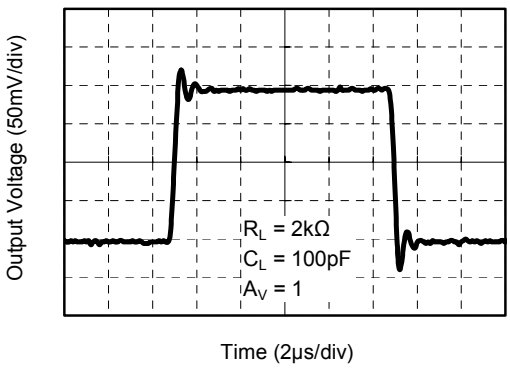
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = +5V, unless otherwise noted.

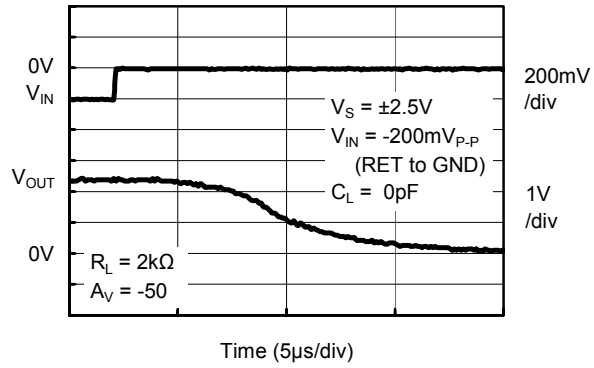
Large Signal Step Response



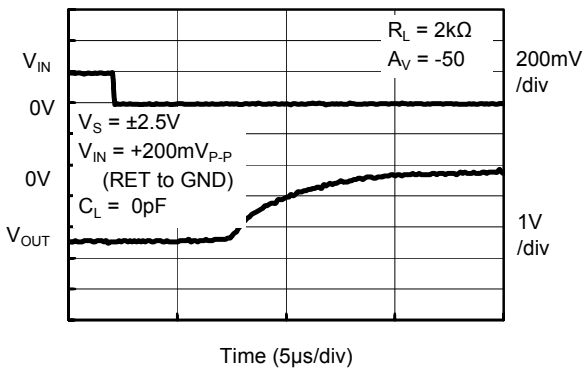
Small Signal Step Response



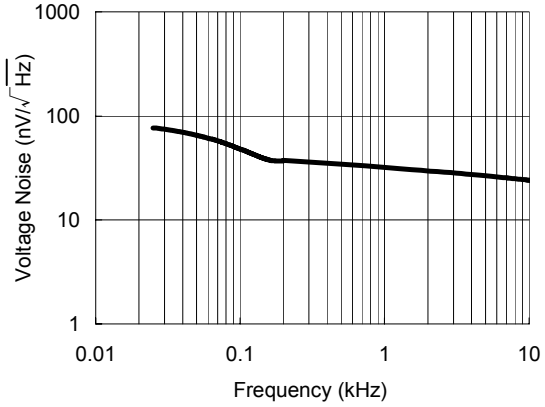
Positive Overvoltage Recovery



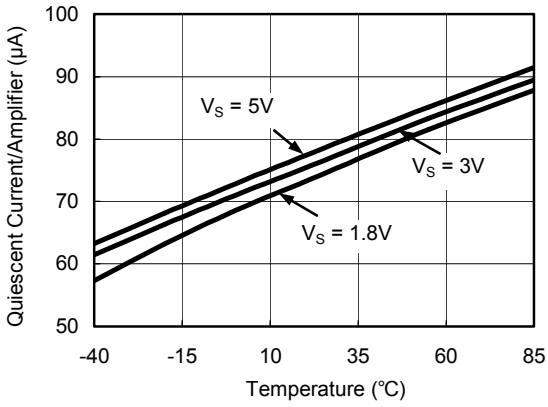
Negative Overvoltage Recovery



Input Voltage Noise Spectral Density vs. Frequency



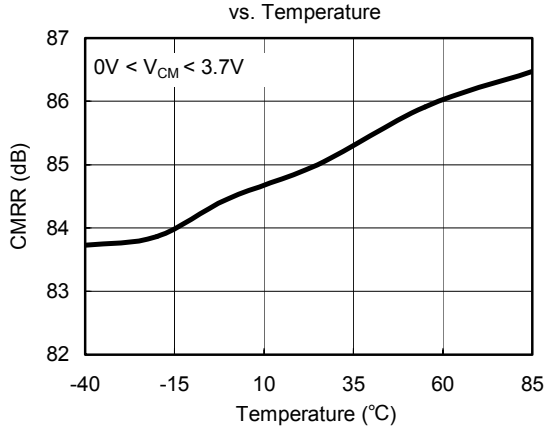
Quiescent Current vs. Temperature



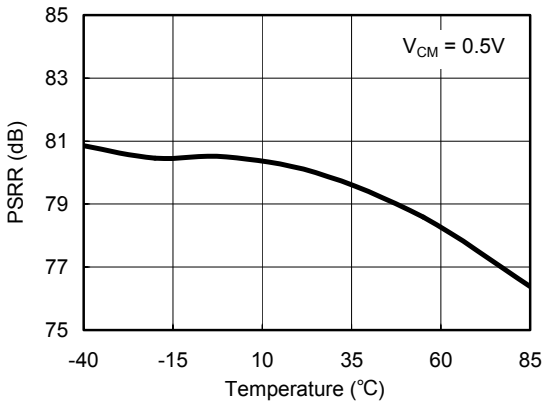
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = +5V, unless otherwise noted.

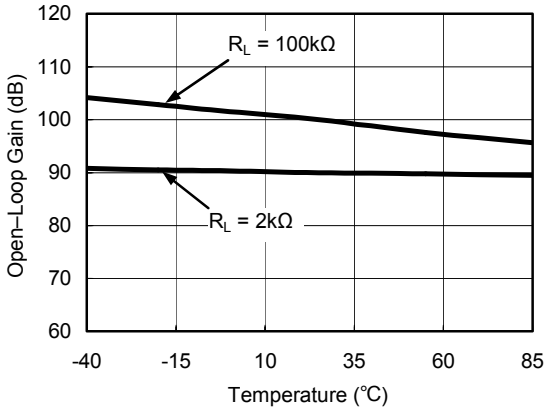
Common-Mode Rejection Ratio vs. Temperature



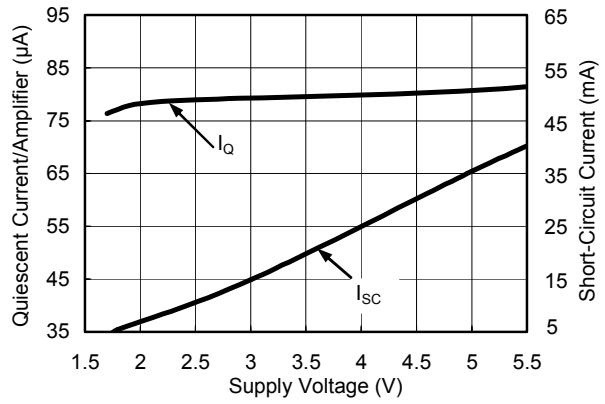
Power-Supply Rejection Ratio vs. Temperature



Open-Loop Gain vs. Temperature

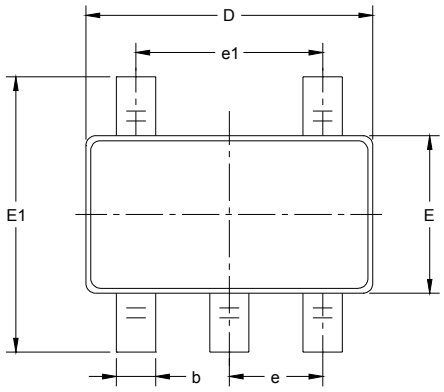


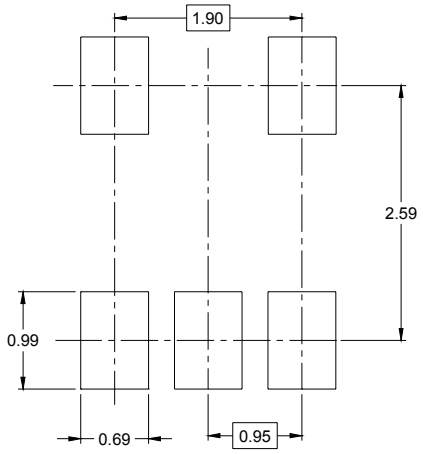
Quiescent Current and Short-Circuit Current vs. Supply Voltage



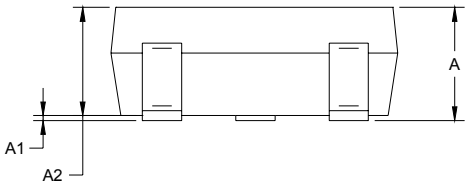
PACKAGE OUTLINE DIMENSIONS

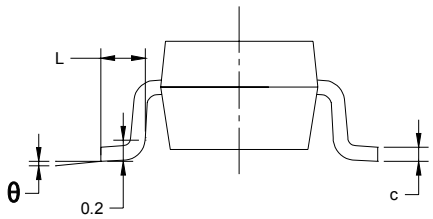
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

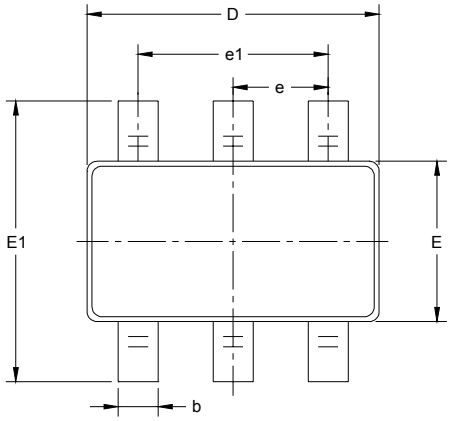


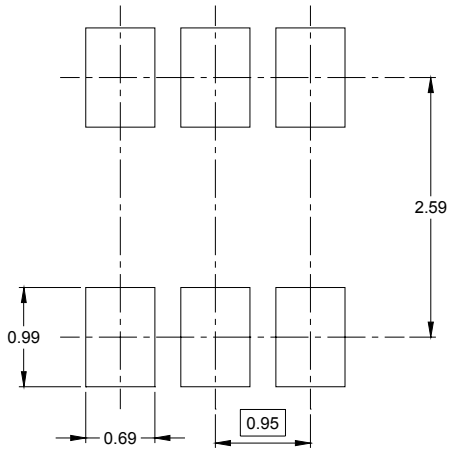


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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





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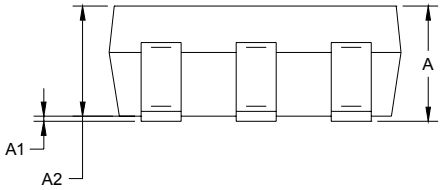

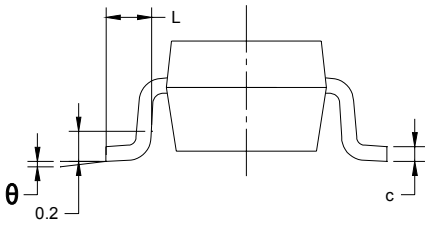

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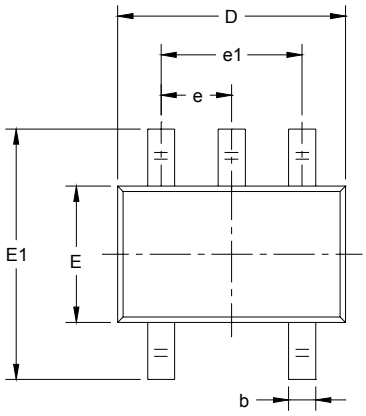
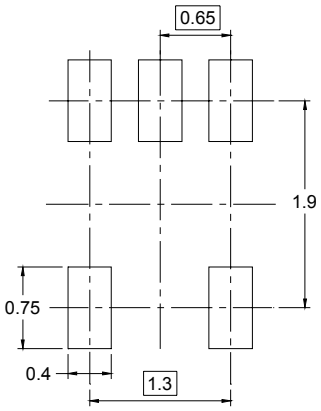
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

SC70-5





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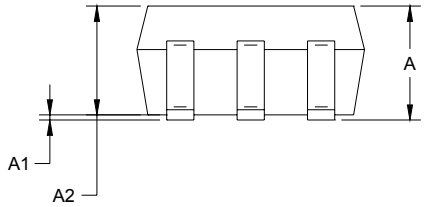
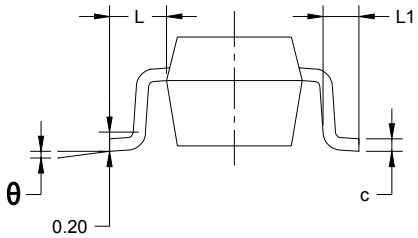
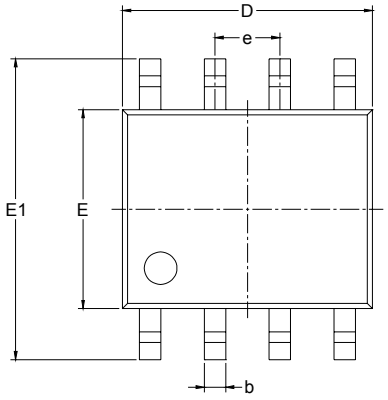


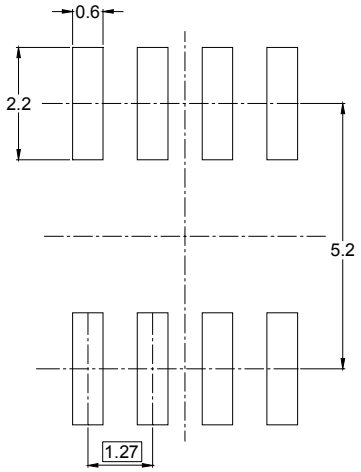


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026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

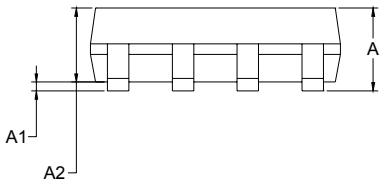
PACKAGE OUTLINE DIMENSIONS

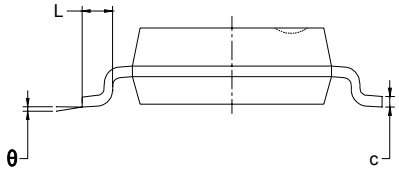
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

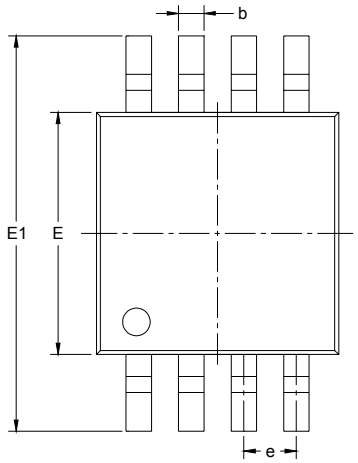


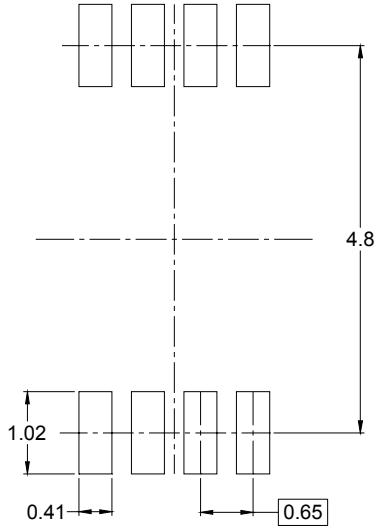


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

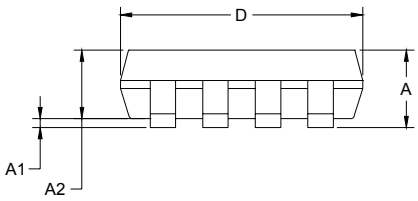
PACKAGE OUTLINE DIMENSIONS

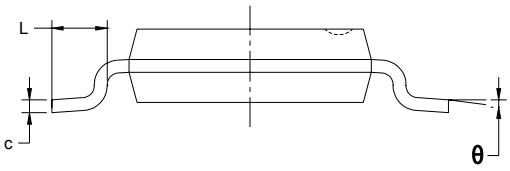
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

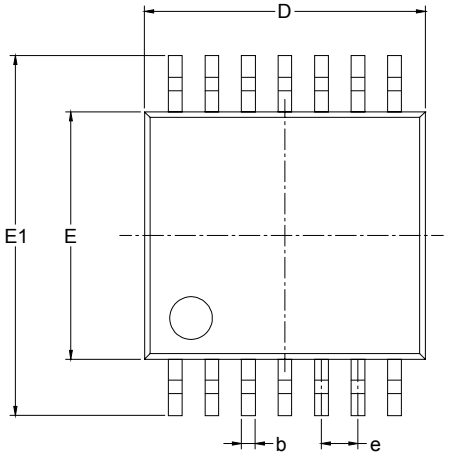


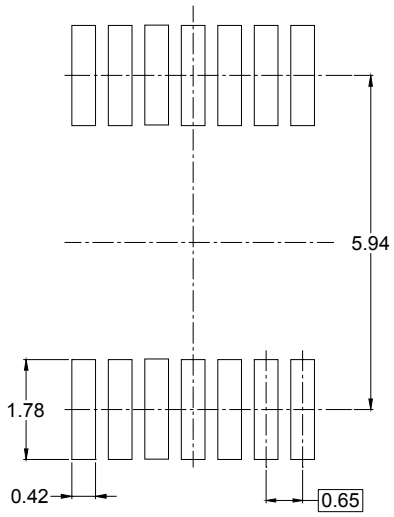


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

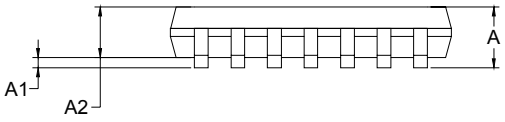
PACKAGE OUTLINE DIMENSIONS

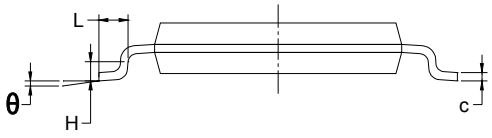
TSSOP-14





RECOMMENDED LAND PATTERN (Unit: mm)

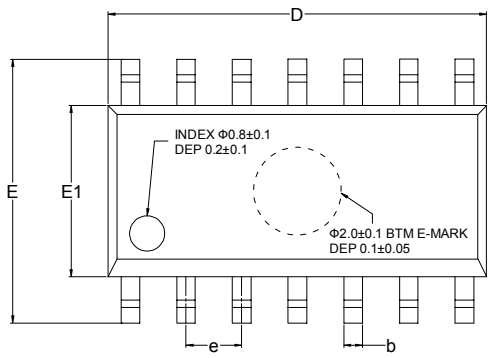


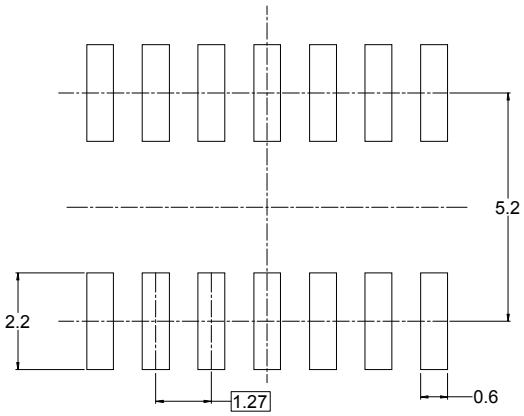


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

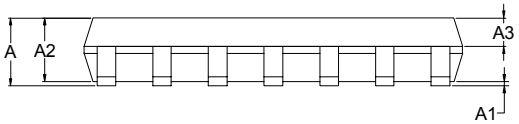
PACKAGE OUTLINE DIMENSIONS

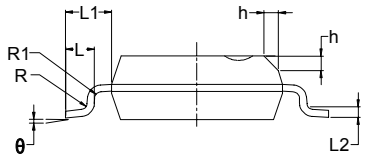
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters			Dimensions In Inches		
	MIN	MOD	MAX	MIN	MOD	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°