



# SGM8941/2

## 1.5MHz, Rail-to-Rail Input and Output Operational Amplifiers

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### PRODUCT DESCRIPTION

The SGM8941 and SGM8942 are high-performance CMOS operational amplifiers optimized for low supply operation. These amplifiers are designed to operate on single supplies from 1.8V to 5.5V. Applications include sensor amplification and signal conditioning in battery-powered systems.

The SGM8941 and SGM8942 offer excellent CMRR without the crossover distortion associated with traditional complimentary input stages. This results in excellent linearity performance. The input common mode range includes both the negative and positive supplies.

The SGM8941/2 provide excellent overall performance. They exhibit low noise and offset, making these devices an excellent choice for high quality, low voltage or battery powered systems.

The SGM8941 single is available in Green SOT-23-5 and SOIC-8 packages. The SGM8942 dual is available in Green SOIC-8 and MSOP-8 packages. They are specified over the extended -40°C to +85°C temperature range.

### FEATURES

- Rail-to-Rail Input and Output
- Low Noise:  $38\text{nV}/\sqrt{\text{Hz}}$
- Supply Voltage Range: 1.8V to 5.5V
- Low Input Offset Voltage: 0.15mV (TYP)
- Gain Bandwidth Product: 1.5MHz
- Slew Rate: 0.8V/ $\mu\text{s}$
- Low Supply Current: 120 $\mu\text{A}$ /Amplifier (TYP)
- Small Packaging:
  - SGM8941 Available in SOT-23-5 and SOIC-8 Packages
  - SGM8942 Available in MSOP-8 and SOIC-8 Packages

### APPLICATIONS

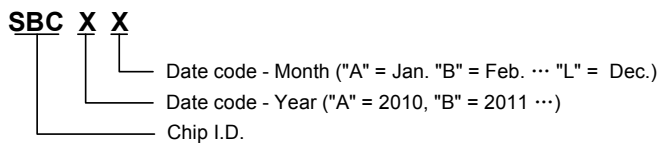
Data Acquisition  
Process Control  
Active Filters  
Test Equipment  
Mobile Phone  
Audio Processing  
Video Processing  
Headphone Amplifier  
Portable Equipment  
Broadband Communications

**PACKAGE/ORDERING INFORMATION**

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8941	SGM8941YN5G/TR	SOT-23-5	Tape and Reel, 3000	SBCXX
	SGM8941YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM 8941YS8 XXXXX
SGM8942	SGM8942YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8942 YMS8 XXXXX
	SGM8942YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM 8942YS8 XXXXX

NOTE: **XX** = Date Code. **XXXXXX** = Date Code and Vendor Code.

**MARKING INFORMATION**



For example: SBCCA (2012, January)

**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, +V <sub>S</sub> to -V <sub>S</sub> .....	6V
Input Common Mode Voltage Range .....	(-V <sub>S</sub> ) - 0.1V to (+V <sub>S</sub> ) + 0.1V
Storage Temperature Range.....	-65°C to +150°C
Junction Temperature .....	150°C
Operating Temperature Range.....	-40°C to +85°C
Lead Temperature Range (Soldering 10sec) .....	260°C
ESD Susceptibility	
HBM.....	8000V
MM .....	400V

**NOTE:**

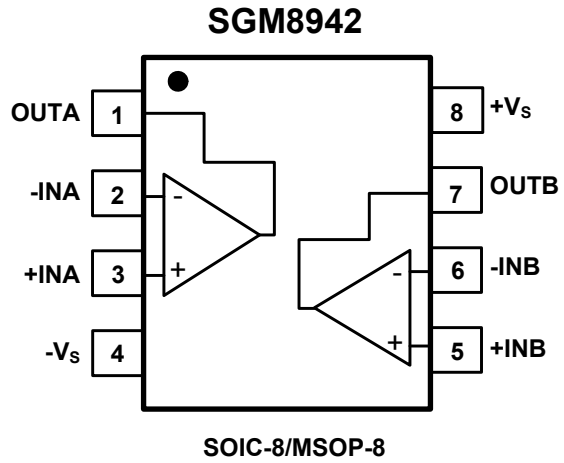
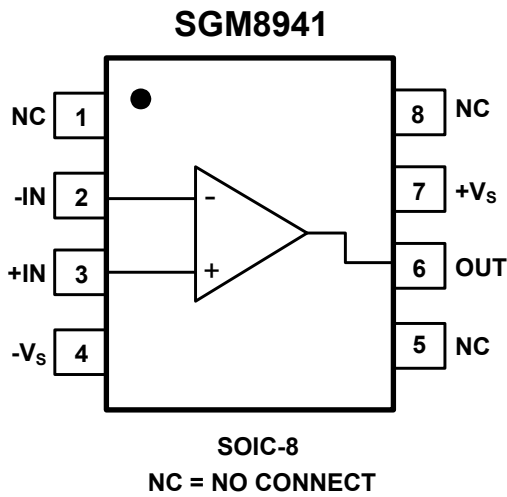
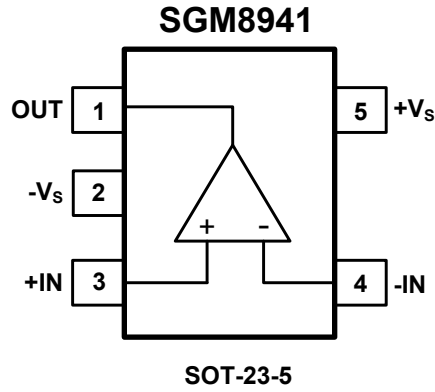
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure 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)



**ELECTRICAL CHARACTERISTICS:  $V_S = +5V$** (At  $T_A = +25^\circ\text{C}$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC PERFORMANCE</b>					
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = V_S/2$		0.15	0.9	mV
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$			1.6	
Input Bias Current ( $I_B$ )			3		pA
Input Offset Current ( $I_{OS}$ )			3		pA
Input Offset Voltage Drift	$V_{CM} = V_S/2$		3		$\mu\text{V}/^\circ\text{C}$
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 2\text{k}\Omega$ , $V_{OUT} = 0.2\text{V to } 4.8\text{V}$	79	88		dB
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	76			
	$R_L = 10\text{k}\Omega$ , $V_{OUT} = 0.1\text{V to } 4.9\text{V}$	80	90		
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	77			
<b>INPUT CHARACTERISTICS</b>					
Input Common Mode Voltage Range ( $V_{CM}$ )		-0.1		5.1	V
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1\text{V to } 5.1\text{V}$	74	90		dB
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	71			
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Swing from Rail	$R_L = 2\text{k}\Omega$		75	90	mV
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$			110	
	$R_L = 10\text{k}\Omega$		17	35	mV
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$			55	
Output Short-Circuit Current ( $I_{SC}$ )	$R_L = 10\Omega$ to $V_S/2$	26.5	35.0		mA
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	19.0			
<b>POWER SUPPLY</b>					
Quiescent Current (per Amplifier)	$I_{OUT} = 0\text{mA}$		120	178	$\mu\text{A}$
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$			205	
Power Supply Rejection Ratio (PSRR)	$V_S = +1.8\text{V to } +5.5\text{V}$ , $V_{CM} = 0.5\text{V}$	77	85		dB
	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	72			
<b>DYNAMIC PERFORMANCE <sup>(1)</sup></b>					
Gain-Bandwidth Product (GBP)	$C_L = 100\text{pF}$ , $R_L = 2\text{k}\Omega$		1.5		MHz
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ , $A_V = 1$		0.8		$\text{V}/\mu\text{s}$
Crosstalk	$f = 1\text{kHz}$		110		dB
Settling Time to 0.1% ( $t_S$ )	$V_{OUT} = 200\text{mV}_{PP}$ , $f = 1\text{kHz}$ , $A_V = 1$ , $C_L = 100\text{pF}$ , $R_L = 2\text{k}\Omega$		2		$\mu\text{s}$
Overload Recovery Time	$R_L = 2\text{k}\Omega$ , $A_V = -50$		3.5		$\mu\text{s}$
<b>NOISE/DISTORTION PERFORMANCE</b>					
Input Voltage Noise ( $e_n$ )	$f = 1\text{kHz}$		38		$\text{nV}/\sqrt{\text{Hz}}$

**ELECTRICAL CHARACTERISTICS:  $V_S = +1.8V$** (At  $T_A = +25^\circ C$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.)

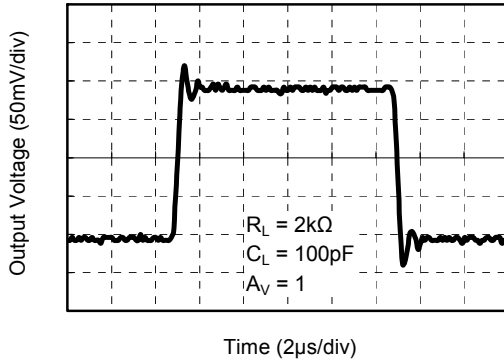
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC PERFORMANCE</b>					
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = V_S/2$		0.22	0.9	mV
	$-40^\circ C \leq T_A \leq +85^\circ C$			1.55	
Input Bias Current ( $I_B$ )			3		pA
Input Offset Current ( $I_{OS}$ )			3		pA
Input Offset Voltage Drift	$V_{CM} = V_S/2$		3.4		$\mu V/^\circ C$
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 2k\Omega$ , $V_{OUT} = 0.2V$ to $1.6V$	76	88		dB
	$-40^\circ C \leq T_A \leq +85^\circ C$	73			
	$R_L = 10k\Omega$ , $V_{OUT} = 0.1V$ to $1.7V$	83	105		
	$-40^\circ C \leq T_A \leq +85^\circ C$	80			
<b>INPUT CHARACTERISTICS</b>					
Input Common Mode Voltage Range ( $V_{CM}$ )		-0.1		1.9	V
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1V$ to $1.9V$	69	85		dB
	$-40^\circ C \leq T_A \leq +85^\circ C$	66			
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Swing from Rail	$R_L = 2k\Omega$		42	62	mV
	$-40^\circ C \leq T_A \leq +85^\circ C$			72	
	$R_L = 10k\Omega$		9	25	mV
	$-40^\circ C \leq T_A \leq +85^\circ C$			45	
Output Short-Circuit Current ( $I_{SC}$ )	$R_L = 10\Omega$ to $V_S/2$	2.0	5.0		mA
	$-40^\circ C \leq T_A \leq +85^\circ C$	1.1			
<b>POWER SUPPLY</b>					
Quiescent Current (per Amplifier)	$I_{OUT} = 0mA$		105	168	$\mu A$
	$-40^\circ C \leq T_A \leq +85^\circ C$			200	
<b>DYNAMIC PERFORMANCE <sup>(1)</sup></b>					
Gain-Bandwidth Product (GBP)	$C_L = 100pF$ , $R_L = 2k\Omega$		1.4		MHz
Slew Rate (SR)	$V_{OUT} = 1V_{PP}$ , $A_V = 1$		0.8		V/ $\mu s$
Crosstalk	$f = 1kHz$		110		dB
Settling Time to 0.1% ( $t_s$ )	$V_{OUT} = 200mV_{PP}$ , $f = 1kHz$ , $A_V = 1$ , $C_L = 100pF$ , $R_L = 2k\Omega$		2		$\mu s$
Overload Recovery Time	$R_L = 2k\Omega$ , $A_V = -50$		2.5		$\mu s$
<b>NOISE/DISTORTION PERFORMANCE</b>					
Input Voltage Noise ( $e_n$ )	$f = 1kHz$		36		$nV/\sqrt{Hz}$

NOTE 1: Correct power supply bypassing is very important for optimizing SGM8941/2 performance. A 0.1 $\mu F$  and a 10 $\mu F$  capacitors are always used to bypass  $V_S$  pin of SGM8941/2. Please place these two capacitors as close to the SGM8941/2  $V_S$  pin as possible. A large ground plane is also needed to ensure optimum performance.

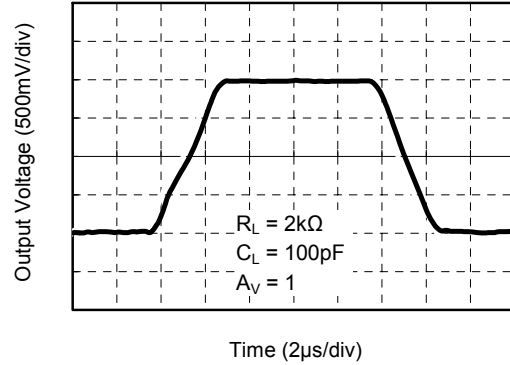
TYPICAL PERFORMANCE CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = +5\text{V}$ , unless otherwise noted.

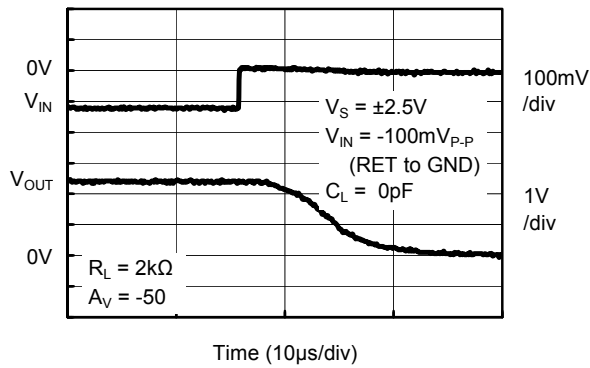
Small Signal Step Response



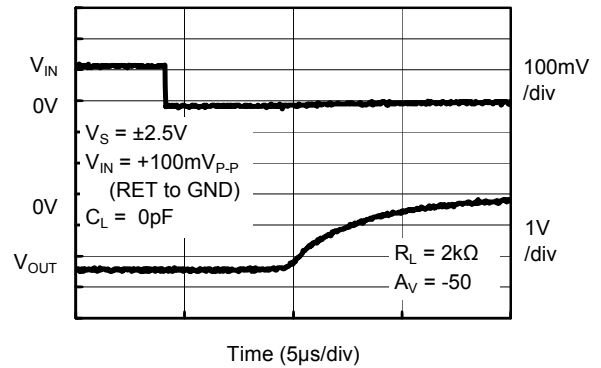
Large Signal Step Response



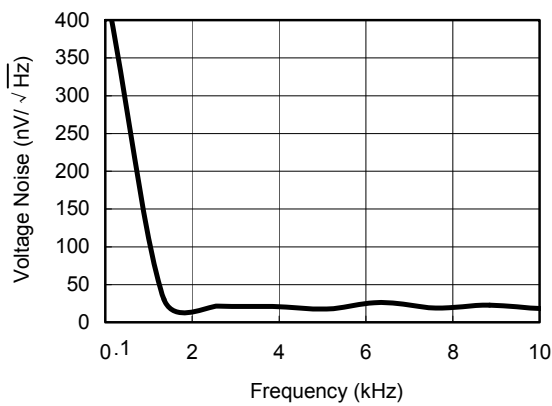
Positive Overload Recovery Time



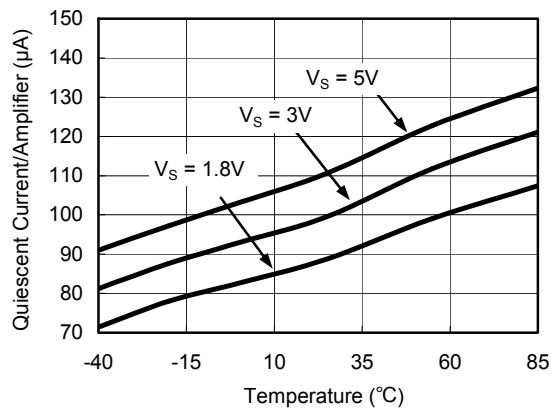
Negative Overload Recovery Time



Input Voltage Noise Spectral Density vs. Frequency

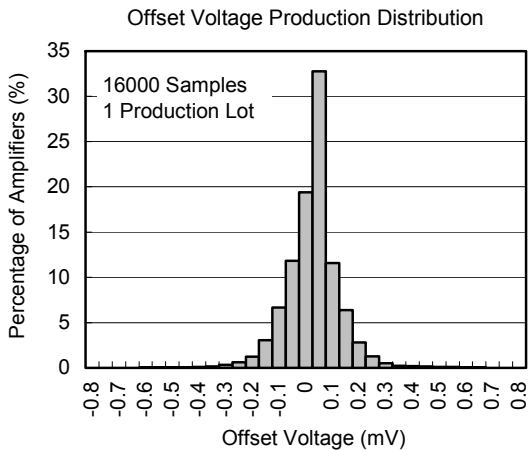
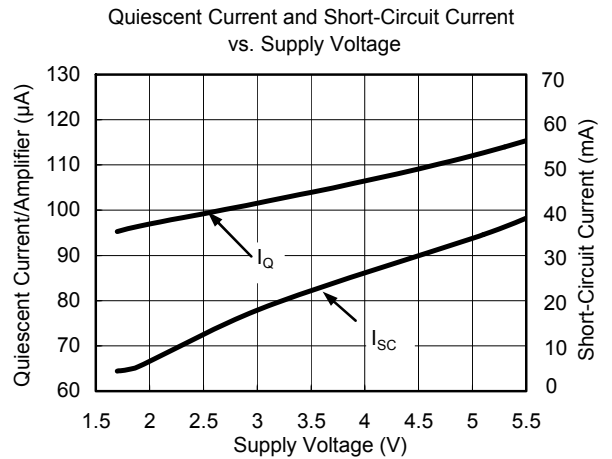
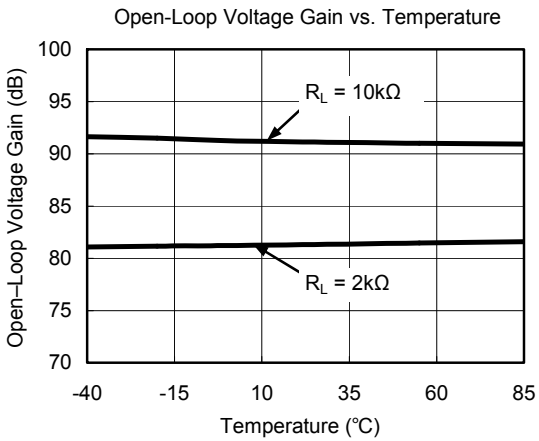
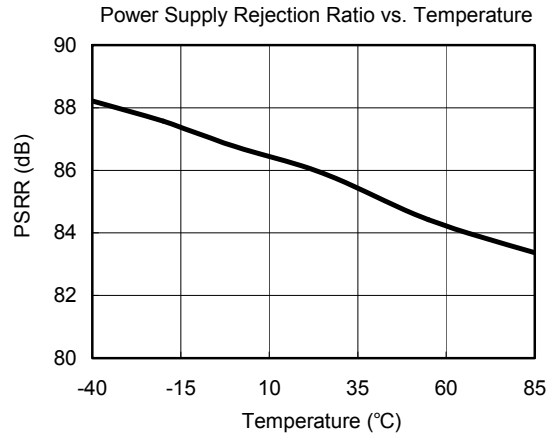
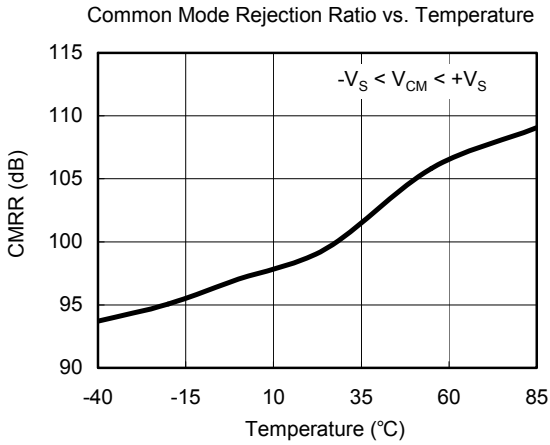


Quiescent Current vs. Temperature



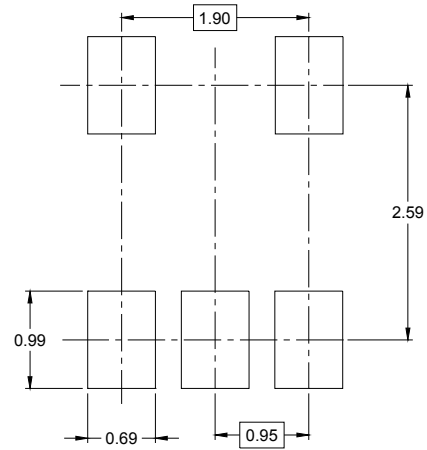
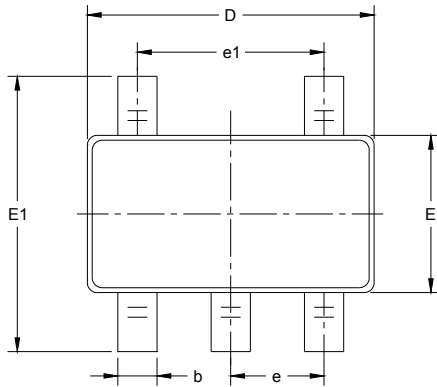
TYPICAL PERFORMANCE CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = +5\text{V}$ , unless otherwise noted.

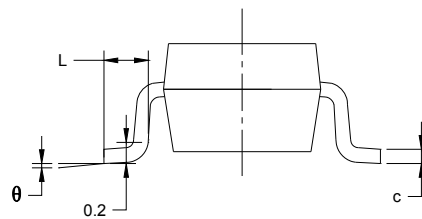
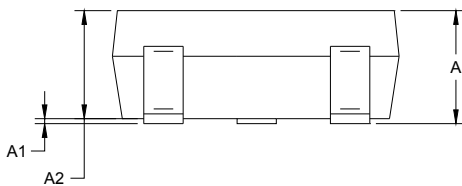


PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

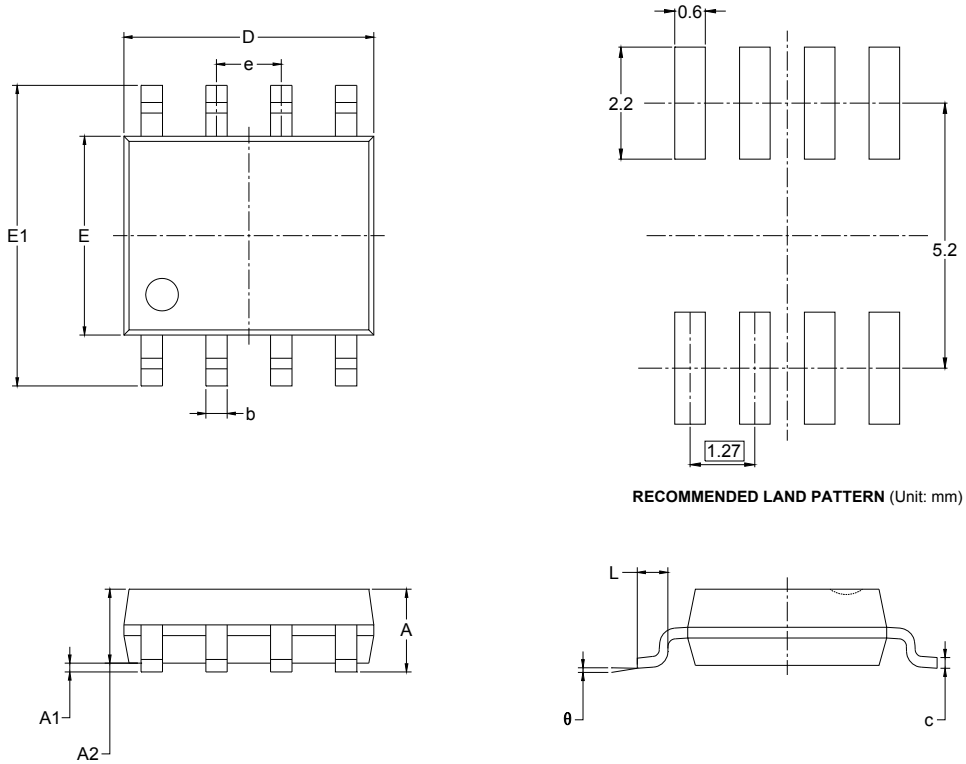


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

SOIC-8

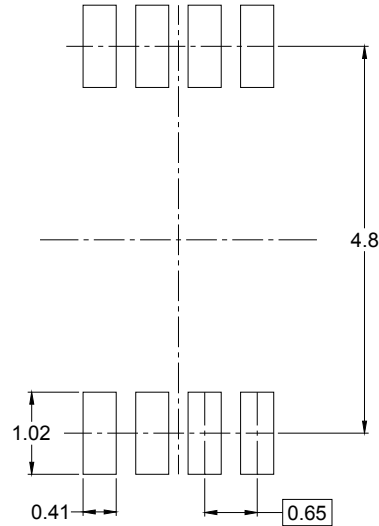
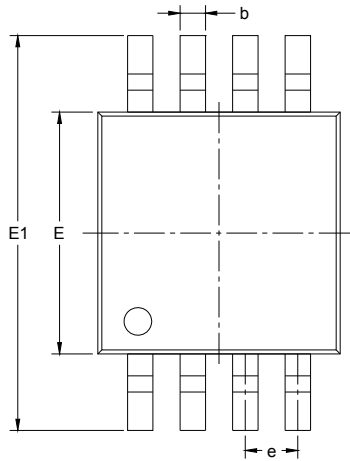


RECOMMENDED LAND PATTERN (Unit: mm)

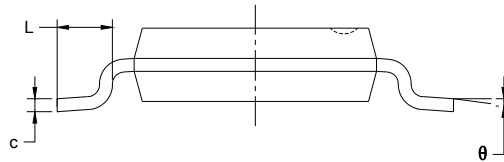
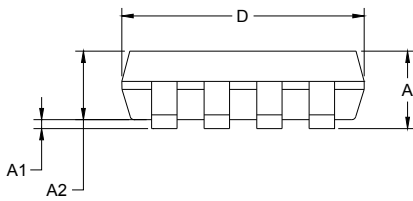
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



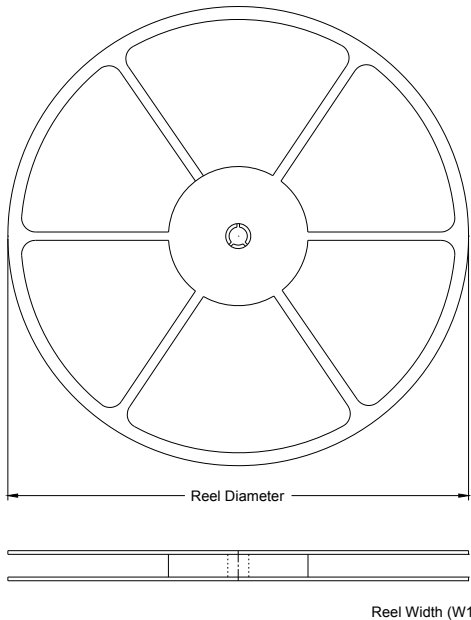
RECOMMENDED LAND PATTERN (Unit: mm)



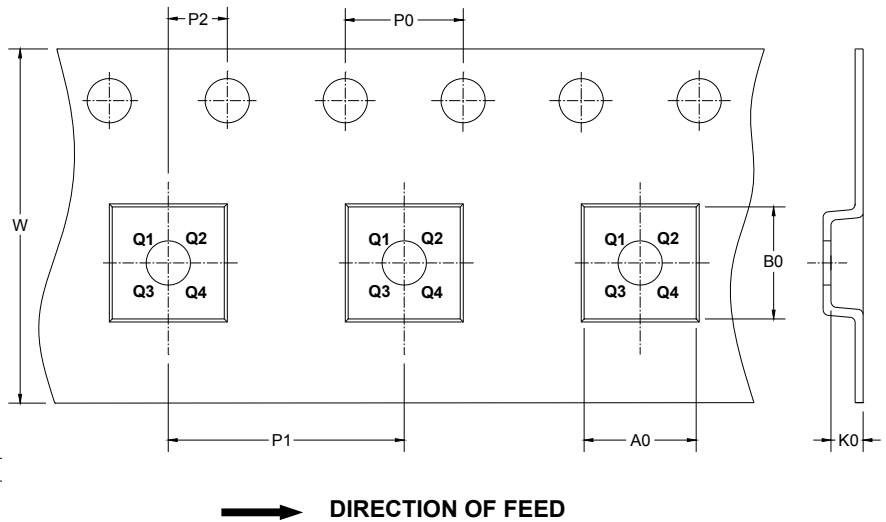
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



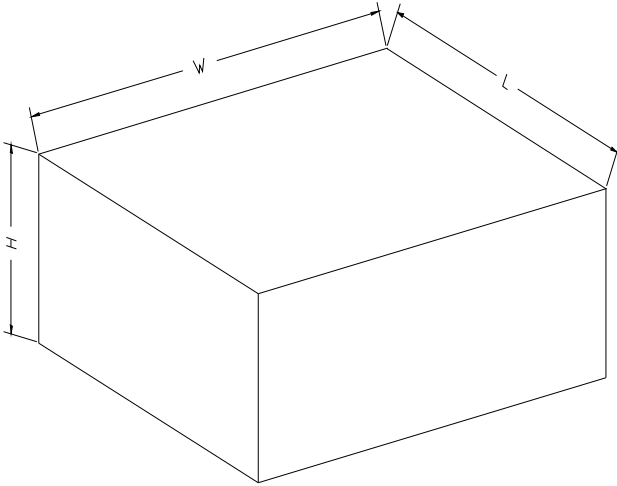
TAPE DIMENSIONS



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	3.17	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
MSOP-8	13"	12.4	5.2	3.3	1.5	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"	448	410	224	18
13"	385	379	280	5