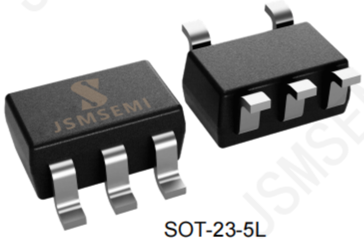
Description

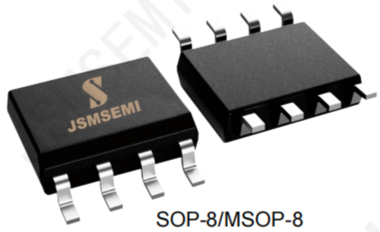
The AD8628/AD8629/AD8630(dual version & shutdown)series of CMOS operational amplifiers use auto-zero techniques to simultaneously provide very low offset voltage (5μV max) and near-zero drift over time and temperature. This family of amplifiers has ultralow noise, offset and power.

This miniature, high-precision operational amplifiers offset high input impedance and rail-to-rail input and rail-to-rail output swing. With high gain-bandwidth product of 4.5MHz and slew rate of 2.7V/μs. Single or dual supplies as low as +2.7V(±1.35V) and up to +5.5V (±2.75V) may be used.

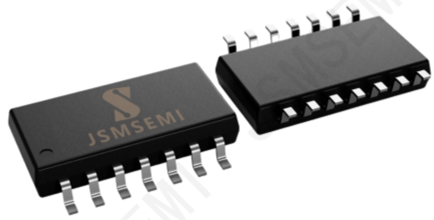
The AD8628/AD8629/AD8630(dual version with shutdown) are specified for the extended industrial and automotive temperature range (-40°C to 125°C). The AD8628 single amplifier is available in 5-lead SOT23 and 8-lead SOIC packages, The AD8629 dual amplifier is available in 8-lead SOIC and 8-lead TSSOP narrow surface mount packages. The AD8630 quad is available in 14-lead SOIC and 14-lead narrow TSSOP packages.



SOT-23-5L



SOP-8/MSOP-8



SOP-14/TSSOP-14

Features

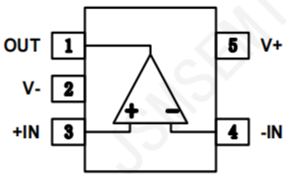
- Low Offset Voltage: 1uV
- Input Offset Drift: 0.005μV/°C
- High Gain Bandwidth Product: 4.5MHz
- Rail-to-Rail Input and Output
- High Gain, CMRR, PSRR:130dB
- High Slew Rate: 2.7V/μs
- Low Noise: 0.75uVp-p (0.01~10Hz)
- Low Power Consumption: 640μA /op amp
- Overload Recovery Time:1us
- Low Supply Voltage: +2.7 V to +5.5 V
- No External Capacitors Required
- Extended Temperature: -40°C to +125°C

Applications

- Temperature Sensors
- Medical/Industrial Instrumentation
- Pressure Sensors
- Battery-Powered Instrumentation
- Active Filtering
- Weight Scale Sensor
- Strain Gage Amplifiers
- Power Converter/Inverter

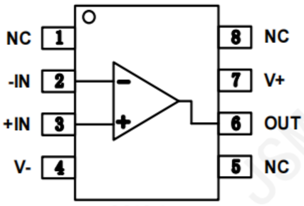
PIN Configurations

AD8628



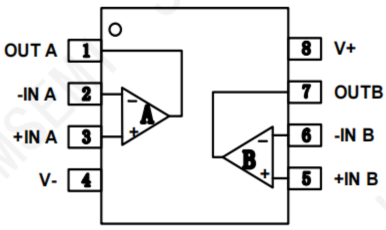
SOT23-5

AD8628



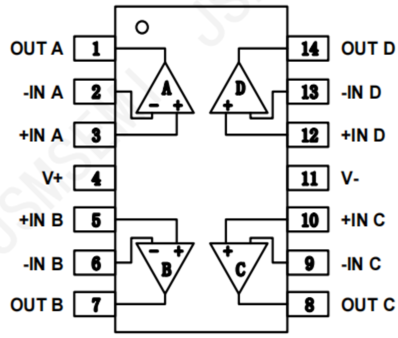
SOIC-8

AD8629



SOIC-8,MSOP-8

AD8630



SOIC-14,TSSOP-14

Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
AD8628ARTZ-REEL7-JSM	SOT-23-5L	AOL	-40 to 125°C	3	TR&3000	Rohs
AD8628ARZ-REEL7-JSM	SOP-8	JSM8628A	-40 to 125°C	3	TR&2500	Rohs
AD8629ARMZ-REEL-JSM	MSOP-8	JSM8629	-40 to 125°C	3	TR&3000	Rohs
AD8629ARZ-REEL7-JSM	SOP-8	JSM8629A	-40 to 125°C	3	TR&2500	Rohs
AD8630ARUZ-REEL-JSM	TSSOP-14	JSM8630A	-40 to 125°C	3	TR&3000	Rohs
AD8630ARZ-REEL7-JSM	SOP-14	JSM8630A	-40 to 125°C	3	TR&2500	Rohs

Absolute Maximum Ratings

Symbol	Definition		MIN.	MAX.	Units
VCC	Supply Voltage, V+ to V-		-	7	V
VIN	Input Terminals, Voltage		-0.5	VCC+0.5	V
	Input Terminals, Current		-10	10	mA
T_S	Storage Temperature		-65	150	°C
T_A	Operating Temperature		-40	125	°C
T_J	Junction Temperature		-	150	°C
Rth_{JA}	Thermal Resistance, Junction to Ambient	SOT-23-5L	-	200	°C/W
		SOP-8 MSOP-8	-	150	
		SOP-14 TSSOP-14	-	100	
T_L	Lead Temperature (Soldering, 10s)		-	260	°C

ESD rating

Symbol	Definition	MIN.	MAX.	Units
ESD	HBM Model		5000	V
	Machine Model		500	V

ELECTRICAL CHARACTERISTICS

Boldface limits apply over the specified temperature range, **T_A = –40°C to +125°C.**
(At T_A = +25°C, V_s=5V, R_L = 10kΩ connected to $V_S/2$, and V_{OUT} = $V_S/2$, unless otherwise noted.)

PARAMETER		CONDITION	AD8628/AD8629/AD8630			UNIT
			MIN	TYP	MAX	
OFFSET VOLTAGE						
Input Offset Voltage	V_{os}	V_{CM} = $V_s/2$		1	5	µV
VS Temperature	**dV_{os}/dT**			**0.005**	**0.05**	**µV/°C**
VS Power Supply	**PSRR**	**VS = +2.7V to +5.5V, VCM = 0**	**110**	**130**		**dB**
Channel Separation, dc				0.1		µV/V
INPUT BIAS CURRENT						
Input Bias Current	I_B	VCM = Vs/2		50		pA
Input Offset Current	I_{os}			10		pA
NOISE PERFORMANCE						
Input Voltage Noise	e_np-p	f=0.01Hz to 10Hz		0.75		µVpp
Input Voltage Noise	e_np-p	f=0.01Hz to 1Hz		0.22		µVpp
Input Voltage Noise Density	e_n	f=1KHz		35		$nV/\sqrt{Hz}$
Input Current Noise Density	i_n	f=10Hz		1.5		$fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		(V-)-0.1		(V+)+0.1	V
Common-Mode Rejection Ratio	**CMRR**	**(V–) – 0.1V < V_{CM} < (V+)+ 0.1V**	**110**	**130**		**dB**
INPUT CAPACITANCE						
Differential				1		pF
Common-Mode				5		pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	**A_{OL}**	**RL=10KΩ, VO=0.3V to 4.7V, -40°C~125°C**	**110**	**130**		**dB**
DYNAMIC PERFORMANCE						
Slew Rate	SR	G=+1		2.7		V/µs
Gain-Bandwidth Product	GBW			4.5		MHz
Overload Recovery Time				1		us
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	RL=100 KΩ to GND	4.99	4.998		V
		RL=10 KΩ to GND	4.95	4.98		V
Output Voltage Low	V_{OL}	RL=100 KΩ to V+		1	10	mV
		RL=10 KΩ to V+		10	30	mV
Short-Circuit Current	I_{SC}			50		mA
POWER SUOOLY						
Operating Voltage Range			2.7		5.5	V
Quiescent Current/ Amplifier	I_Q			640	870	uA
SHUTDOWN						
t_{OFF}				2		µs
t_{ON}				150		us
V_L (shutdown)			0		+0.8	V
V_H (amplifier is active)			0.75(V+)		V+	V
Input Bias Current of Enable Pin				50		pA
I_{QSD}				1	5	uA

APPLICATION NOTES

The AD8628/AD8629/AD8630 series op amps are unity-gain stable and free from unexpected output phase reversal. They use auto-zeroing techniques to provide low offset voltage and very low drift over time and temperature. Good layout practice mandates use of a 0.1μF capacitor placed closely across the supply pins. For lowest offset voltage and precision performance, circuit layout and mechanical conditions should be optimized. Avoid temperature gradients that create thermoelectric (Seebeck) effects in thermocouple junctions formed from connecting dissimilar conductors. These thermally-generated potentials can be made to cancel by assuring that they are equal on both input terminals.

- Use low thermoelectric-coefficient connections (avoid dissimilar metals).
- Thermally isolate components from power supplies or other heat-sources.
- Shield op amp and input circuitry from air currents, such as cooling fans.

Following these guidelines will reduce the likelihood of junctions being at different temperatures, which can cause thermoelectric voltages of 0.1μV/°C or higher, depending on materials used.

OPERATING VOLTAGE

The AD8628/AD8629/AD8630 series op amps operate over a power-supply range of +2.7V to +5.5V (±1.35V to ±2.75V). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier. Parameters that vary over supply voltage or temperature are shown in the Typical Characteristics section of this data sheet.

INFRARED SENSORS

Infrared (IR) sensors, particularly thermopiles, are increasingly being used in temperature measurement for applications as wide ranging as automotive climate control, human ear thermometers, home insulation analysis, and automotive repair diagnostics. The relatively small output signal of the sensor demands high gain with very low offset voltage and drift to avoid dc errors. If interstage ac coupling is used, as in Figure 1 , low offset and drift prevent the output of the input amplifier from drifting close to saturation. The low input bias currents generate minimal errors from the output impedance of the sensor. As with pressure sensors, the very low amplifier drift with time and temperature eliminate additional errors once the temperature measurement is calibrated. The low 1/f noise improves SNR for dc measurements taken over periods often exceeding one-fifth of a second. Figure 1 shows a circuit that can amplify ac signals from 100 μV to 300 μV up to the 1 V to 3 V levels, with a gain of 10,000 for accurate analog-to-digital conversion.

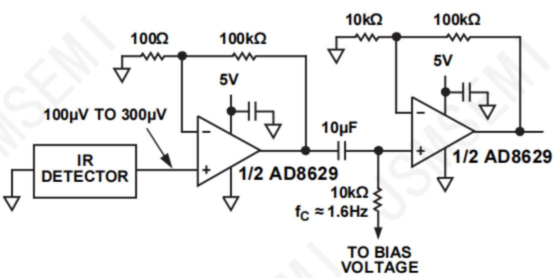


Figure 1. AD8629 Used as Preamplifier for Thermopile

PRECISION CURRENT SHUNT SENSOR

A precision current shunt sensor benefits from the unique attributes of auto-zero amplifiers when used in a differencing configuration, as shown in Figure 2. Current shunt sensors are used in precision current sources for feedback control systems. They are also used in a variety of other applications, including battery fuel gauging, laser diode power measurement and control, torque feedback controls in electric power steering, and precision power metering

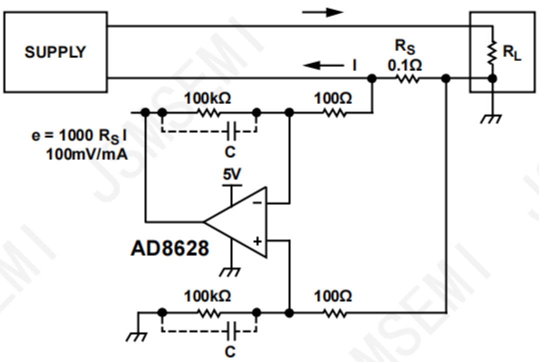


Figure 2. Low-Side Current Sensing

In such applications, it is desirable to use a shunt with very low resistance to minimize the series voltage drop; this minimizes wasted power and allows the measurement of high currents while saving power. A typical shunt might be 0.1 Ω. At measured current values of 1 A, the output signal of the shunt is hundreds of millivolts, or even volts, and a mplifier error sources are not critical.

However, at low measured current values in the 1 mA range, the 100 µV output voltage of the shunt demands a very low offset voltage and drift to maintain absolute accuracy. Low input bias currents are also needed, so that injected bias current does not become a significant percentage of the measured current. High open-loop gain, CMRR, and PSRR help to maintain the overall circuit accuracy. As long as the rate of change of the current is not too fast, an auto -zero amplifier can be used with excellent results.

LAYOUT GUIDELINES

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1µF capacitor closely across the supply pins. These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI (electromagnetic-interference) susceptibility.

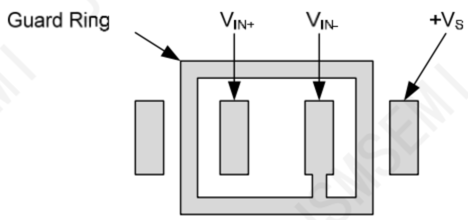
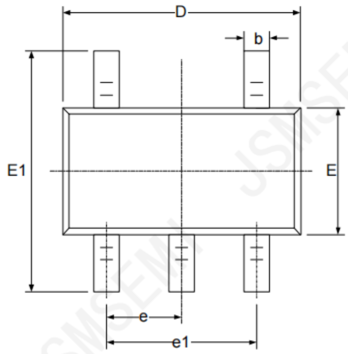
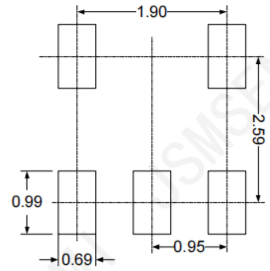


Figure 3. The Layout of Guard Ring

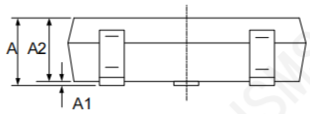
Package Information

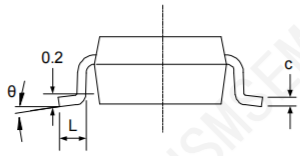
SOT-23-5L





RECOMMENDED LAND PATTERN (Unit: mm)

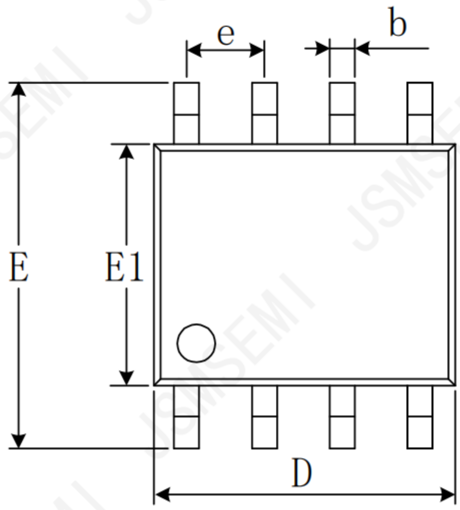


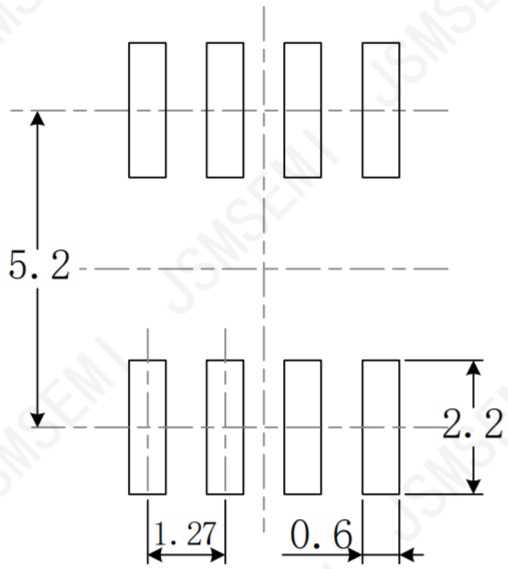


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Package Information

SOP-8





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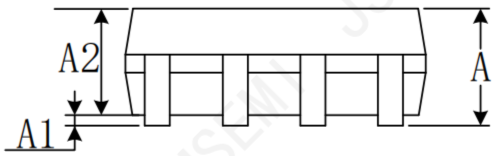
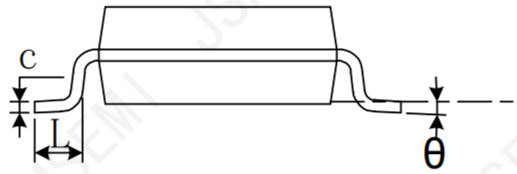
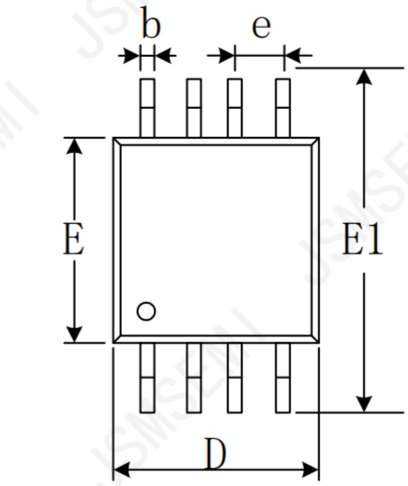


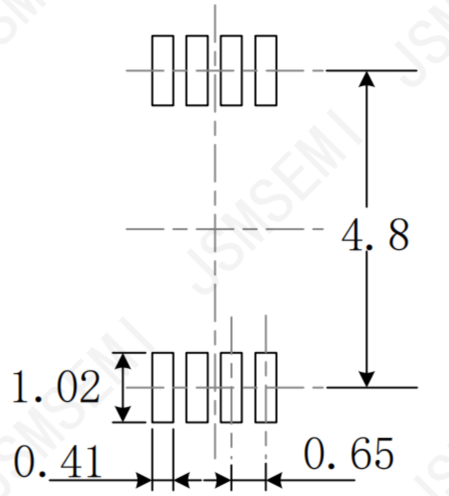


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package Information

MSOP-8





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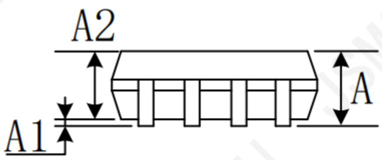
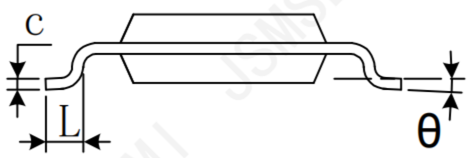
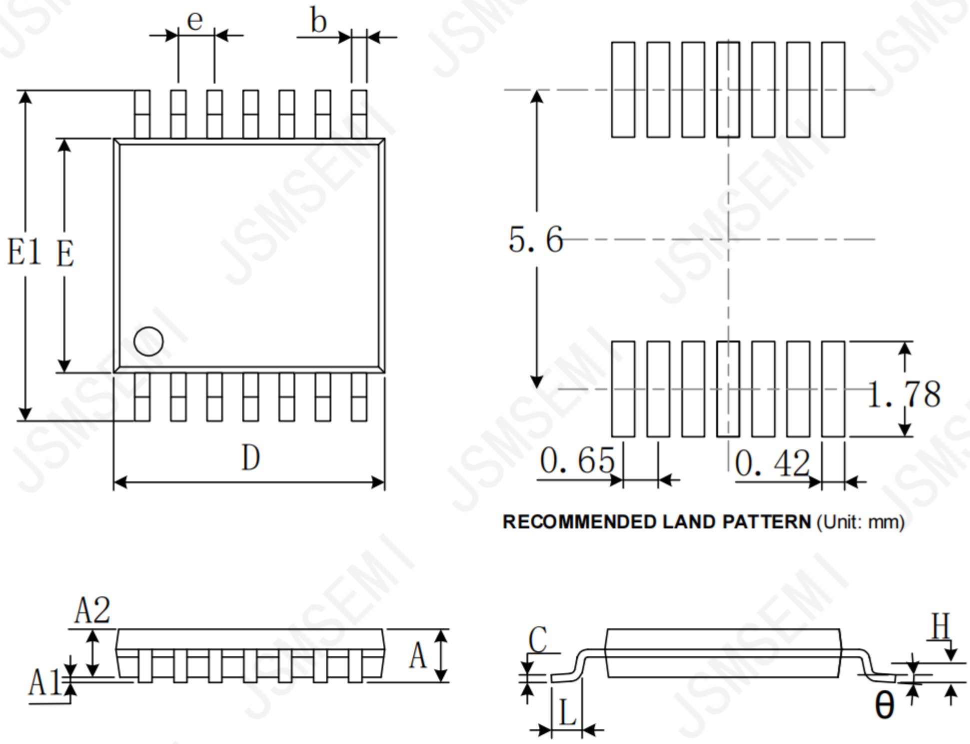




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187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

Package Information

TSSOP-14

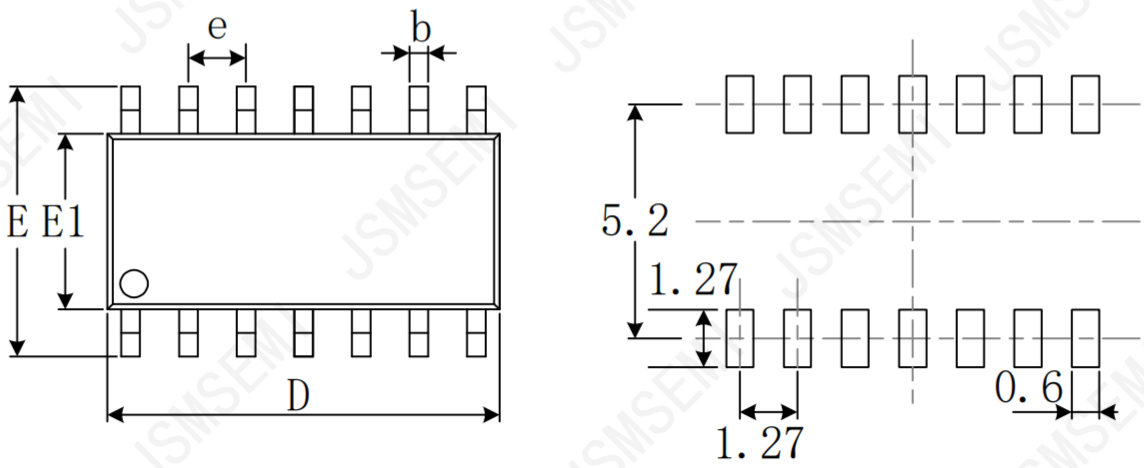


RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	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	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

Package Information

SOP-14



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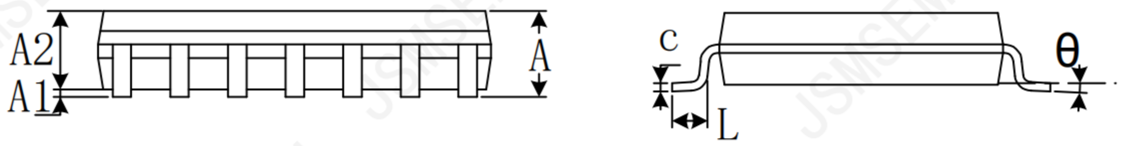

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Revision History

Rev.	Change	Date
V1.0	Initial version	6/17/2022

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