100kHz, Rail-to-Rail I/O CMOS Operational Amplifier

FEATURES

- **GAIN BANDWIDTH:100kHz**
- **RAIL-TO-RAIL INPUT AND OUTPUT**
  0.8mV Max Vos
- **INPUT VOLTAGE RANGE: -0.1V to +5.6V with Vs = 5.5V**
- **SUPPLY RANGE: +2.5V to +5.5V**
- **SPECIFIED UP TO +125°C**
- ***Micro*SIZE PACKAGES: SOT23-5**

APPLICATIONS

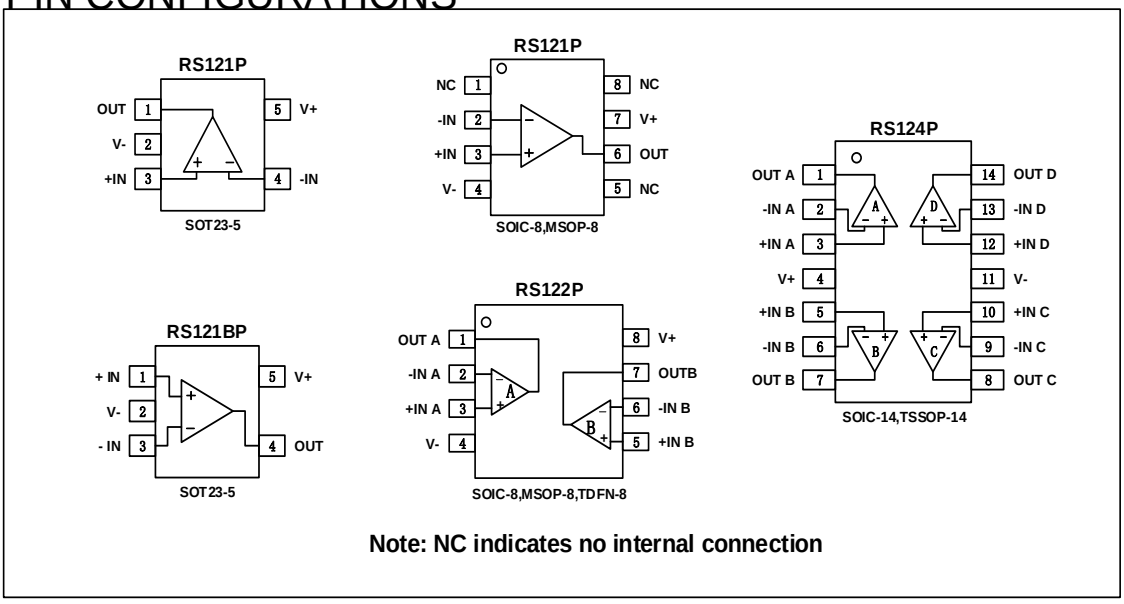
- **SENSORS**
- **PHOTODIODE AMPLIFICATION**
- **ACTIVE FILTERS**
- **TEST EQUIPMENT**
- **DRIVING A/D CONVERTERS**

DESCRIPTION

The RS121P, RS122P, RS124P families of products offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (100kHz) and slew rate of 0.04V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The RS121P, RS122P, RS124P families of operational amplifiers are specified at the full temperature range of −40°C to +125°C under single or dual power supplies of 2.5V to 5.5V.

PIN CONFIGURATIONS



Note: NC indicates no internal connection

ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage, V+ to V-	7.0V
Input Terminals, Voltage (2)	– 0.5 to (V+) + 0.5V
Current (2)	±10mA
Storage Temperature	−65°C to +150°C
Operating Temperature	−40°C to +125°C
Junction Temperature	150°C
Package Thermal Resistance @ T_A = +25°C	
SOT23-5, SOT23-6	200°C/W
MSOP-10, SOIC-8	150°C/W
SOIC-14, TSSOP-14	100°C/W
Lead Temperature (Soldering, 10s)	260°C
ESD Susceptibility	
HBM	3000V
MM	200V

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

ESD SENSITIVITY CAUTION

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.

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS121P	RS121PXK	-40℃~125℃	SOIC-8	RS121P	Tape and Reel,2500
	RS121PXF	-40℃~125℃	SOT23-5	121P	Tape and Reel,3000
	RS121BPXF	-40℃~125℃	SOT23-5	121BP	Tape and Reel,3000
	RS121PXM	-40℃~125℃	MSOP-8	RS121P	Tape and Reel,3000
RS122P	RS122PXK	-40℃~125℃	SOIC-8	RS122P	Tape and Reel,2500
	RS122PXM	-40℃~125℃	MSOP-8	RS122P	Tape and Reel,3000
	RS122PXT	-40℃~125℃	TDFN-8	RS122P	Tape and Reel,3000
RS124P	RS124PXP	-40℃~125℃	SOIC -14	RS124P	Tape and Reel,2500
	RS124PXQ	-40℃~125℃	TSSOP-14	RS124P	Tape and Reel,3000

ELECTRICAL CHARACTERISTICS

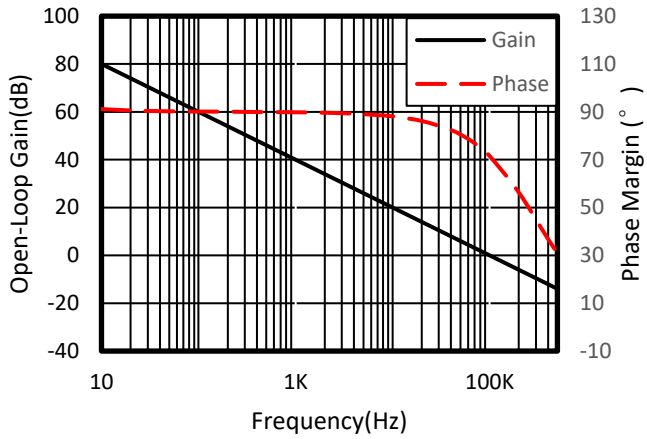
(At T_A = +25°C, Vs=5V, R_L = 500kΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted.)

PARAMETER		CONDITIONS	T_J	RS121P,RS122P, RS124P			
				MIN	TYP	MAX	UNIT
POWER SUPPLY							
Vs	Operating Voltage Range		25°C	2.5		5.5	V
I_Q	Quiescent Current/Amplifier		25°C		8	12	uA
PSRR	Power-Supply Rejection Ratio	Vs= 2.5V to 5.5V Vcm =(V-)+0.5V	25°C	73	85		dB
INPUT							
Vos	Input Offset Voltage		25°C	-0.8	0.3	0.8	mV
I_B	Input Bias Current		25°C		1	10	pA
Ios	Input Offset Current		25°C		1	10	pA
Vcm	Common-Mode Voltage Range	Vs=5.5V	25°C	-0.1		5.6	V
CMRR	Common-Mode Rejection Ratio	Vs = 5.5V, Vcm =-0.1V to 4V	25°C	78	95		dB
		Vs = 5.5V, Vcm = -0.1V to 5.6V	25°C	65	92		
OUTPUT							
A_{OL}	Open-Loop Voltage Gain	RL =500KΩ, Vo = 0.015V to 4.985V	25°C	92	110		dB
		RL = 100kΩ, Vo = 0.1V to 4.9V	25°C	90	110		
	Output Swing From Rail	R_L = 2KΩ	25°C		3		mV
I_{out}	Output Short-Circuit Current		25°C		25		mA
FREQUENCY RESPONSE							
SR	Slew Rate		25°C		0.04		V/us
GBP	Gain-Bandwidth Product		25°C		0.1		MHz
NOISE							
e_n	Input-Referred Voltage Noise	f = 1 kHz	25°C		77		nV/√Hz
		f = 10 kHz	25°C		39		nV/√Hz

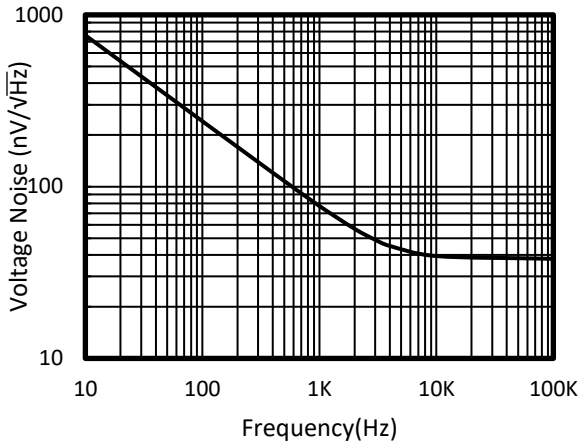
TYPICAL CHARACTERISTICS

At T_A = +25°C, Vs=5V, R_L = 500kΩ connected to V_S/2, V_{OUT} = V_S/2, unless otherwise noted.

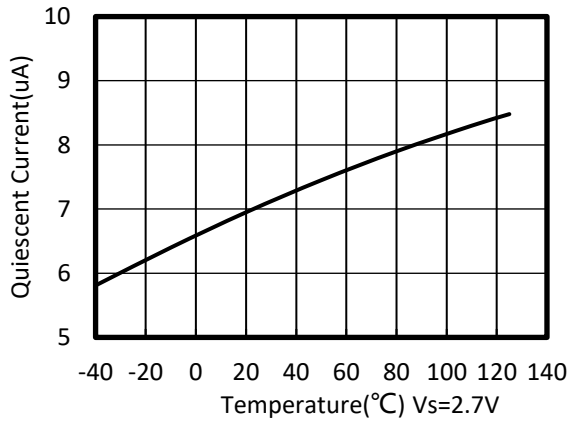
OPEN−LOOP GAIN AND PHASE vs FREQUENCY



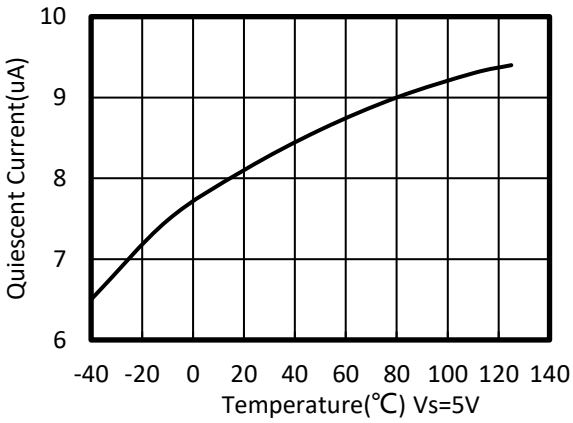
INPUT VOLTAGE NOISE
SPECTRAL DENSITY vs FREQUENCY



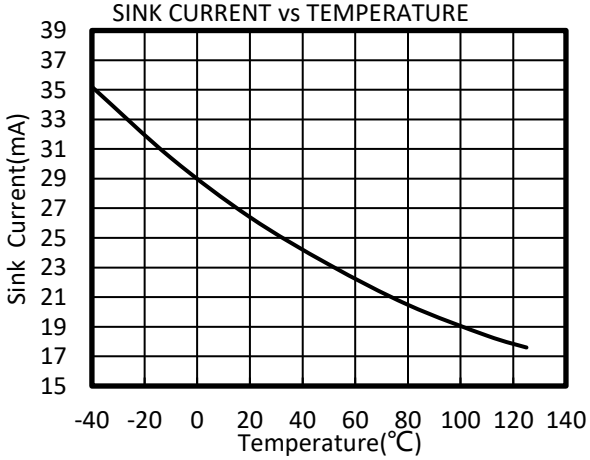
QUIESCENT CURRENT vs TEMPERATURE



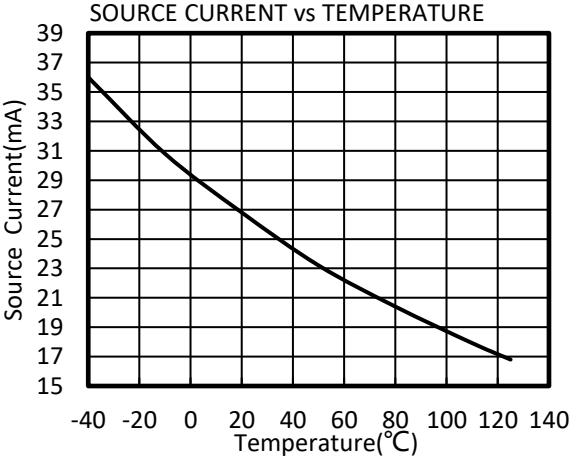
QUIESCENT CURRENT vs TEMPERATURE



SINK CURRENT vs TEMPERATURE



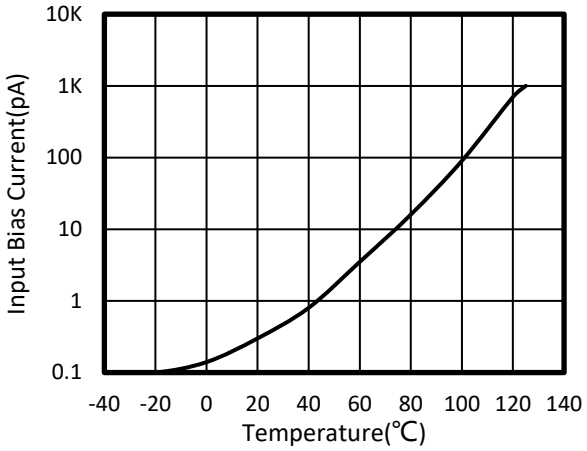
SOURCE CURRENT vs TEMPERATURE



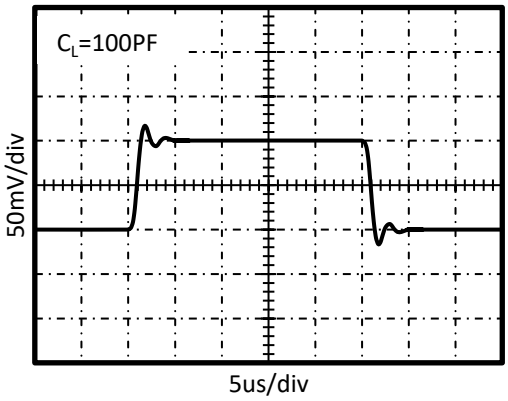
TYPICAL CHARACTERISTICS

At T_A = +25°C, Vs=5V, R_L = 500kΩ connected to $V_S/2$, V_{OUT} = $V_S/2$, unless otherwise noted.

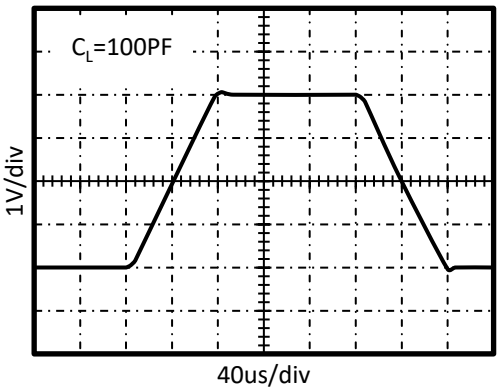
INPUT BIAS CURRENT vs TEMPERATURE



SMALL−SIGNAL STEP RESPONSE



LARGE−SIGNAL STEP RESPONSE



APPLICATION NOTES

The RS121P, RS122P, RS124P are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V (±1.25V to ±2.75V). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications.

Good layout practice mandates use of a 0.1uF capacitor place closely across the supply pins.

LAYOUT GUIDELINS

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 0.1uF 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 susceptibility.

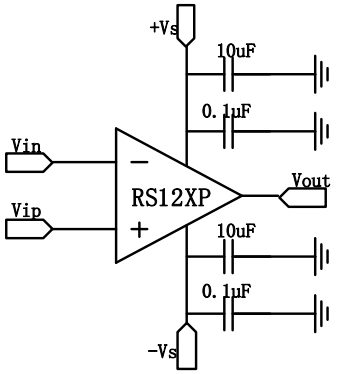


Figure1. Amplifier with Bypass Capacitors

INSTRUMENTATION AMPLIFIER

In the three-op amp, instrumentation amplifier configuration shown in Figure2,

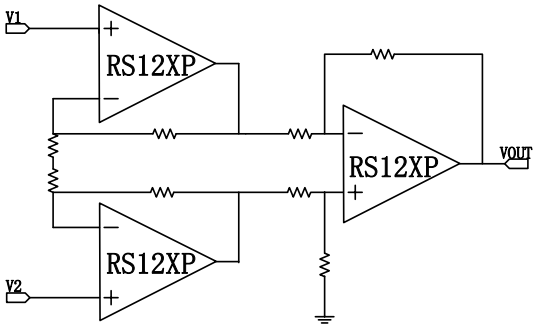
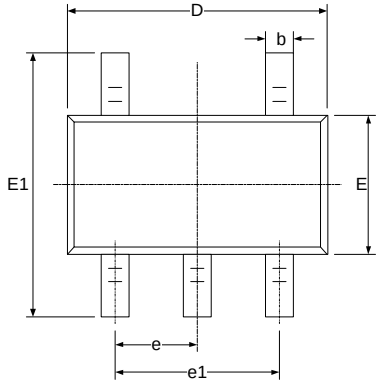
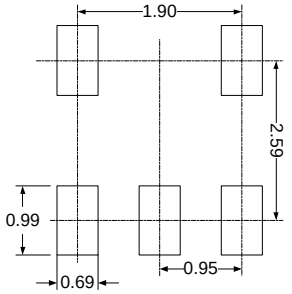


Figure2. Amplifier instrumentation amplifier

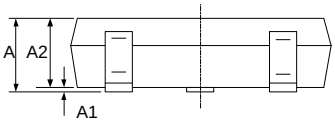
PACKAGE OUTLINE DIMENSIONS

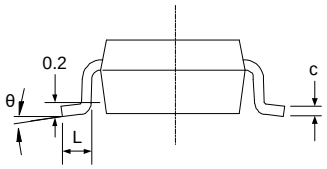
SOT23-5





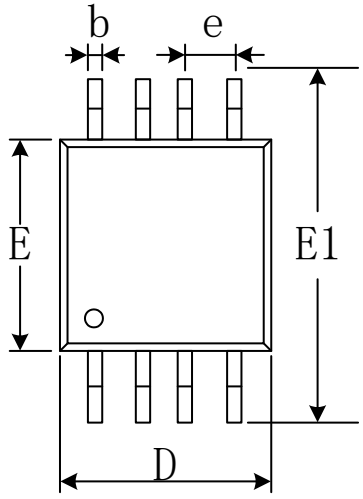
RECOMMENDED LAND PATTERN (Unit: mm)

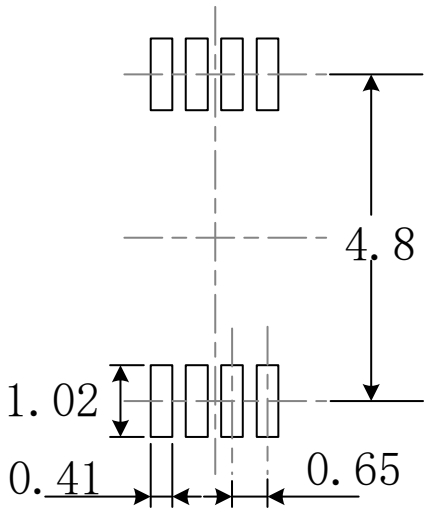




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

MSOP-8





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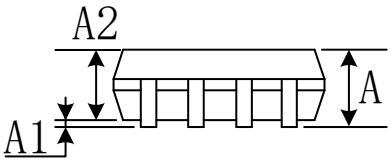
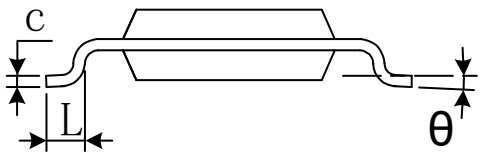
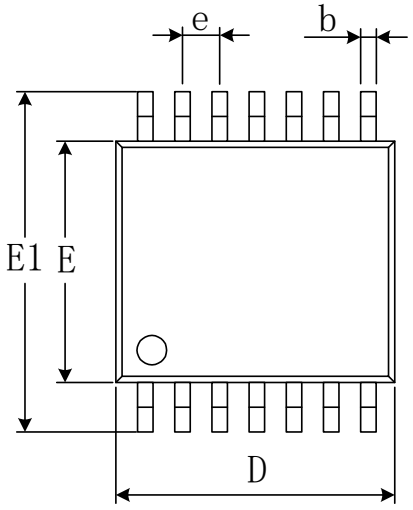
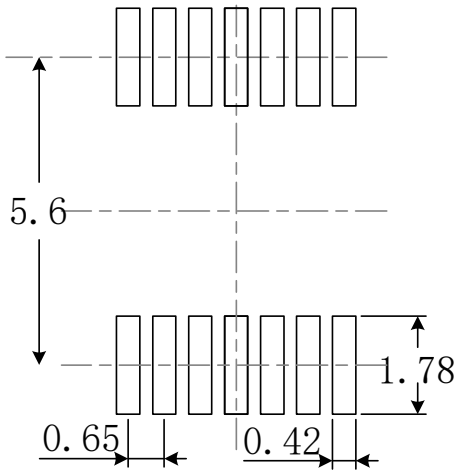




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187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

TSSOP-14





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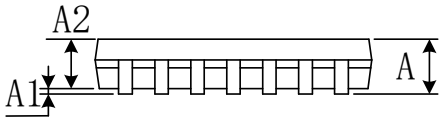
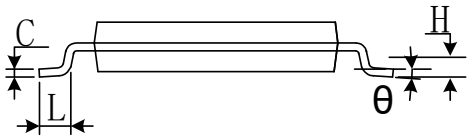
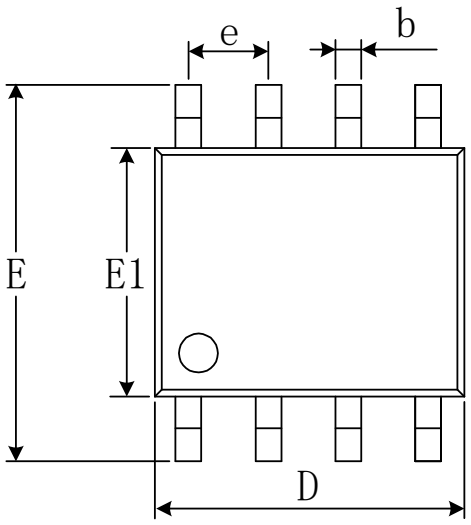
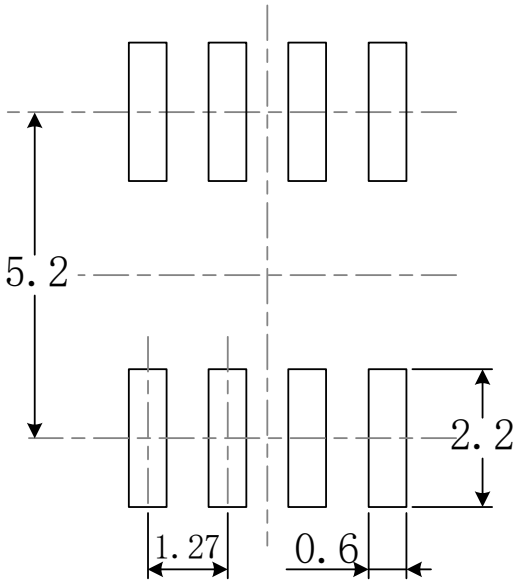




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

SOIC-8





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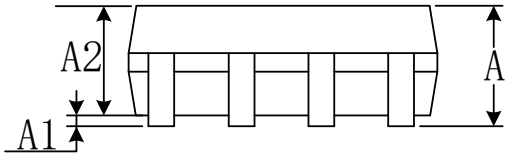
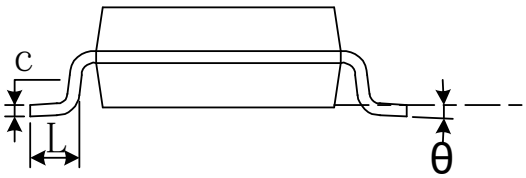
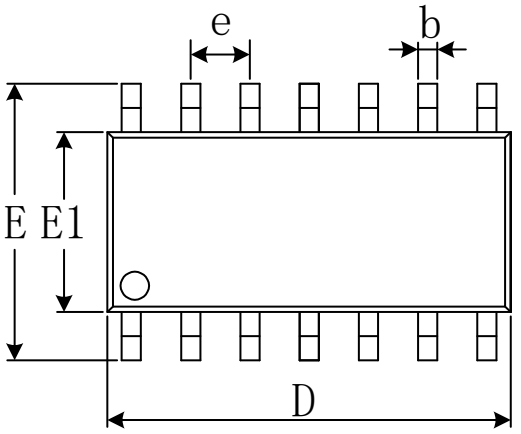
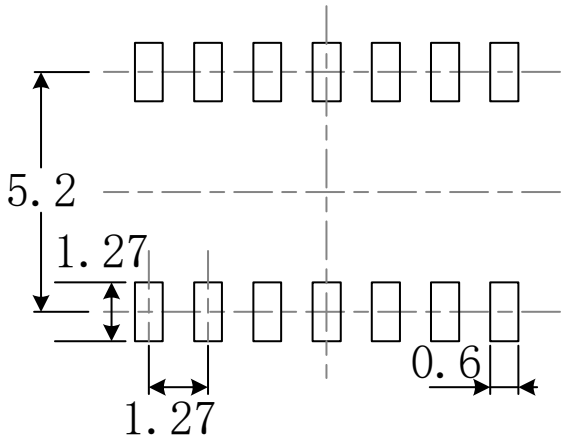




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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

SOIC-14





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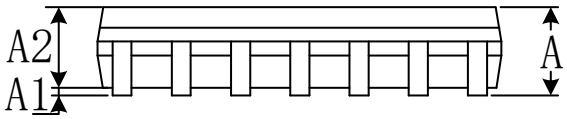
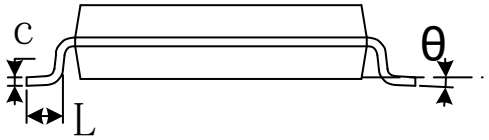
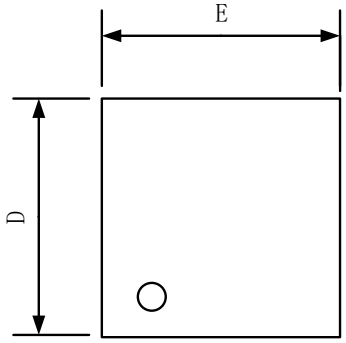


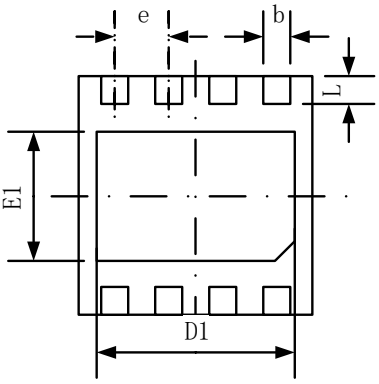


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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

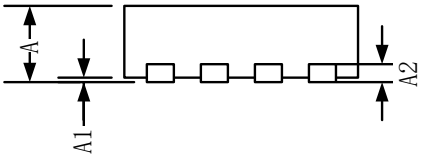
TDFN-3x3-8L



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203		0.008	
b	0.300	0.400	0.012	0.016
D	2.900	3.100	0.114	0.122
D1	2.510	2.610	0.099	0.103
E	2.900	3.100	0.114	0.122
E1	1.550	1.650	0.061	0.065
e	0.650 TYP		0.026 TYP	
L	0.350	0.450	0.014	0.018

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