

## 500kHz, Rail-to-Rail I/O CMOS Operational Amplifier

### FEATURES

- **GAIN BANDWIDTH: 500kHz**
- **RAIL-TO-RAIL INPUT AND OUTPUT**  
**±0.8mV Typical Vos**
- **INPUT VOLTAGE RANGE: -0.1V to +5.6V**  
**with Vs = 5.5V**
- **SUPPLY RANGE: +2.5V to +5.5V**
- **SHUTDOWN: RS221S/RS222S**
- **SPECIFIED UP TO +125°C**
- **Micro SIZE PACKAGES: SOT23-5, SOT23-6**

### APPLICATIONS

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

### DESCRIPTION

The RS221, RS222, RS224, RS221S, RS222S 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 (500kHz) and slew rate of 0.18V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The devices are ideal for sensor interfaces, active filters and portable applications. The RS221S, RS222S include a shutdown mode. Under logic control, the amplifiers can be switched from normal operation to a standby current that is less than 1uA. The RS221, RS222, RS224, RS221S, RS222S 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.

### Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS221	SOT23-5	2.90mm×1.60mm
	SOIC-8(SOP8)	4.90mm×3.90mm
	MSOP-8	3.00mm×3.00mm
RS221S	SOT23-6	2.90mm×1.60mm
	SOIC-8(SOP8)	4.90mm×3.90mm
RS222	SOIC-8(SOP8)	4.90mm×3.90mm
	MSOP-8	3.00mm×3.00mm
	TDFN3×3-8L	3.00mm×3.00mm
RS222S	MSOP-10	3.00mm×3.00mm
RS224	SOIC-14(SOP14)	8.65mm×3.90mm
	TSSOP-14	5.00mm×4.40mm

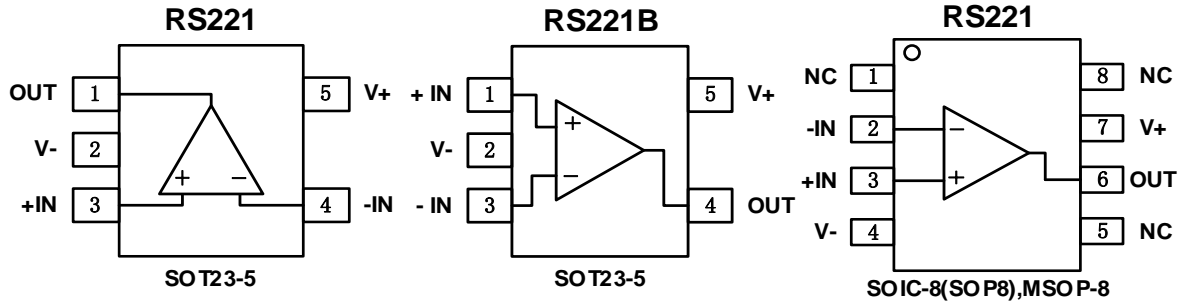
(1) For all available packages, see the orderable addendum at the end of the data sheet.

## Revision History

Note: Page numbers for previous revisions may differ from page numbers in the current version.

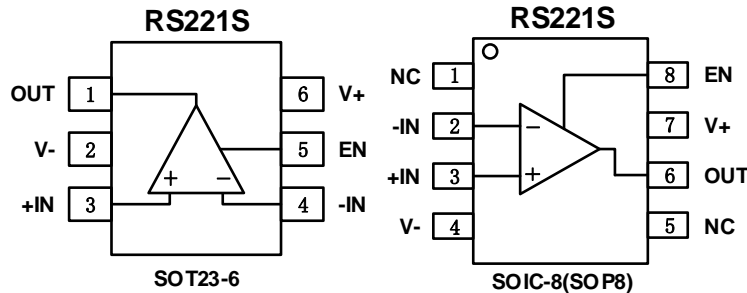
Version	Change Date	Change Item
C.1	2022/04/21	1. Update Package Qty on Page 2 @RevB.2 2. Added the TAPE AND REEL INFORMATION

## Pin Configuration and Functions (Top View)



### Pin Description

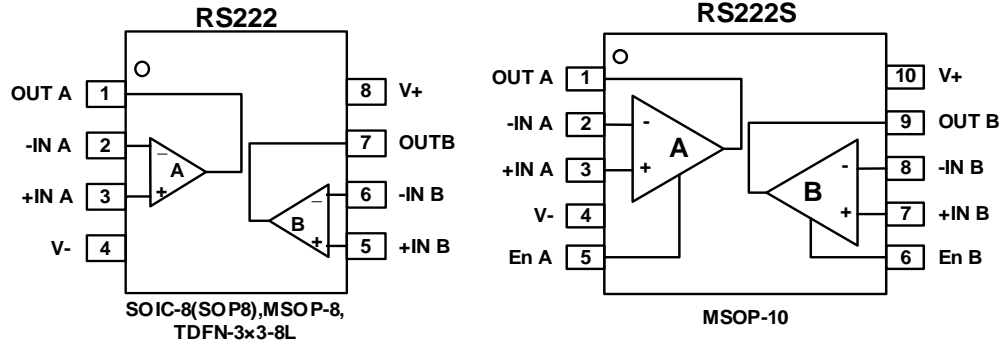
NAME	PIN			I/O	DESCRIPTION
	RS221	RS221B	RS221		
	SOT23-5	SOT23-5	SOIC-8(SOP8)/MSOP-8		
-IN	4	3	2	I	Negative (inverting) input
+IN	3	1	3	I	Positive (noninverting) input
NC	-	-	1,5,8	-	No internal connection (can be left floating)
OUT	1	4	6	O	Output
V-	2	2	4	-	Negative (lowest) power supply
V+	5	5	7	-	Positive (highest) power supply



### Pin Description

NAME	PIN		I/O	DESCRIPTION
	RS221S			
	SOT23-6	SOIC-8(SOP8)		
-IN	4	2	I	Inverting input
+IN	3	3	I	Noninverting input
OUT	1	6	O	Output
EN	5	8	I	Enable pin. This pin turns the regulator on or off. Low = disabled, high = normal operation (pin must be driven)
NC	-	1,5	-	No internal connection (can be left floating)
V-	2	4	-	Negative (lowest) power supply
V+	6	7	-	Positive (highest) power supply

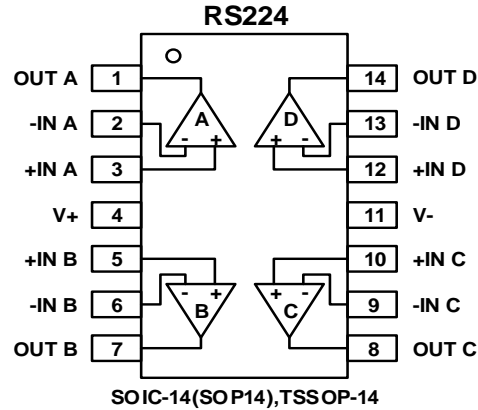
## Pin Configuration and Functions (Top View)



## Pin Description

NAME	PIN		I/O	DESCRIPTION
	RS222	RS222S		
	SOIC-8(SOP8)/ MSOP-8/ TDFN3x3-8L	MSOP-10		
-INA	2	2	I	Inverting input, channel A
+INA	3	3	I	Noninverting input, channel A
-INB	6	8	I	Inverting input, channel B
+INB	5	7	I	Noninverting input, channel B
OUTA	1	1	O	Output, channel A
OUTB	7	9	O	Output, channel B
EnA	-	5	I	Enable pin, channel A. This pin turns the regulator on or off. Low = disabled, high = normal operation (pin must be driven)
EnB	-	6	I	Enable pin, channel B. This pin turns the regulator on or off. Low = disabled, high = normal operation (pin must be driven)
V-	4	4	-	Negative (lowest) power supply
V+	8	10	-	Positive (highest) power supply

## Pin Configuration and Functions (Top View)



### Pin Description

NAME	PIN	I/O	DESCRIPTION
	SOIC-14(SOP14)/TSSOP-14		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
-INC	9	I	Inverting input, channel C
+INC	10	I	Noninverting input, channel C
-IND	13	I	Inverting input, channel D
+IND	12	I	Noninverting input, channel D
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
OUTC	8	O	Output, channel C
OUTD	14	O	Output, channel D
V-	11	-	Negative (lowest) power supply
V+	4	-	Positive (highest) power supply

## SPECIFICATIONS

### Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

		MIN	MAX	UNIT
Voltage	Supply, $V_s=(V+) - (V-)$		7	V
	Signal input pin <sup>(2)</sup>	(V-)-0.5	(V+) +0.5	
	Signal output pin <sup>(3)</sup>	(V-)-0.5	(V+) +0.5	
Current	Signal input pin <sup>(2)</sup>	-10	10	mA
	Signal output pin <sup>(3)</sup>	-50	50	mA
	Output short-circuit <sup>(4)</sup>	Continuous		
Temperature	Operating range, $T_A$	-40	125	°C
	Junction, $T_J$	-40	150	
	Storage, $T_{stg}$	-65	150	

(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.

(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to  $\pm 50$ mA or less.

(4) Short-circuit to ground, one amplifier per package.

### ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	$\pm 5000$	V
		Machine Model (MM)	$\pm 400$	

### Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
Supply voltage , $V_s=(V+) - (V-)$	Single-supply	2.5		5.5	V
	Dual-supply	$\pm 1.25$		$\pm 2.75$	

### Thermal Information: RS221

THERMAL METRIC		RS221				UNIT
		5PINS		8PINS		
		SOT23-5	SOT23-6	SOIC-8	MSOP-8	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	273.8	187.3	116	165	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	126.8	126.5	60	53	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	85.9	32.6	56	87	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	10.9	24.1	12.8	4.9	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	84.9	32.1	98.3	85	°C/W
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	N/A	N/A	°C/W

**Thermal Information: RS222**

THERMAL METRIC		RS222				UNIT
		8PINS				
		SOIC-8 (SOP8)	MSOP-8	MSOP-10	TDFN3x3-8L	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	116	165	169.5	66.9	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	60	53	84.1	54.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	56	87	113	40.4	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	12.8	4.9	15.8	1.9	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	98.3	85	111.6	40.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	N/A	10.8	°C/W

**Thermal Information: RS224**

THERMAL METRIC		RS224		UNIT
		14PINS		
		SOIC-14(SOP14)	TSSOP-14	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	83.8	120.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	70.7	34.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	59.5	62.8	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	11.6	1	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	37.7	56.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	°C/W

**PACKAGE/ORDERING INFORMATION**

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking <sup>(1)</sup>	Package Qty
RS221XF	SOT23-5	5	1	-40°C ~125°C	221	Tape and Reel,3000
RS221BXF	SOT23-5	5	1	-40°C ~125°C	221B	Tape and Reel,3000
RS221XK	SOIC-8(SOP8)	8	1	-40°C ~125°C	RS221	Tape and Reel,4000
RS221XM	MSOP-8	8	1	-40°C ~125°C	RS221	Tape and Reel,4000
RS221SXK	SOIC-8(SOP8)	8	1	-40°C ~125°C	RS221S	Tape and Reel,4000
RS221SXH	SOT23-6	6	1	-40°C ~125°C	221S	Tape and Reel,3000
RS222XK	SOIC-8(SOP8)	8	2	-40°C ~125°C	RS222	Tape and Reel,4000
RS222XM	MSOP-8	8	2	-40°C ~125°C	RS222	Tape and Reel,4000
RS222XT	TDFN3x3-8L	8	2	-40°C ~125°C	RS222	Tape and Reel,5000
RS222SXN	MSOP-10	10	2	-40°C ~125°C	RS222S	Tape and Reel,4000
RS224XP	SOIC-14(SOP14)	14	4	-40°C ~125°C	RS224	Tape and Reel,4000
RS224XQ	TSSOP-14	14	4	-40°C ~125°C	RS224	Tape and Reel,4000

**NOTE:**

- (1) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.



## ELECTRICAL CHARACTERISTICS

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 200\text{k}\Omega$  connected to  $V_S/2$ , and  $V_{OUT} = V_S/2$ , unless otherwise noted.)

PARAMETER		CONDITIONS	$T_J$	RS221S, RS222S, RS221, RS222, RS224			
				MIN	TYP	MAX	UNIT
<b>POWER SUPPLY</b>							
$V_S$	Operating Voltage Range		$25^\circ\text{C}$	2.5		5.5	V
$I_Q$	Quiescent Current/Amplifier		$25^\circ\text{C}$		26	40	$\mu\text{A}$
PSRR	Power-Supply Rejection Ratio	$V_S = 2.5\text{V to } 5.5\text{V}$ $V_{CM} = (V_-) + 0.5\text{V}$	$25^\circ\text{C}$	73	90		dB
			$-40^\circ\text{C to } 125^\circ\text{C}$	67			
<b>INPUT</b>							
$V_{OS}$	Input Offset Voltage		$25^\circ\text{C}$	-3.5	$\pm 0.8$	3.5	mV
$V_{OS\ T_C}$	Input Offset Voltage Average Drift		$-40^\circ\text{C to } 125^\circ\text{C}$		$\pm 2.9$		$\mu\text{V}/^\circ\text{C}$
$I_B$	Input Bias Current		$25^\circ\text{C}$		$\pm 1$	10	pA
$I_{OS}$	Input Offset Current		$25^\circ\text{C}$		$\pm 1$	10	pA
$V_{CM}$	Common-Mode Voltage Range	$V_S = 5.5\text{V}$	$25^\circ\text{C}$	-0.1		5.6	V
CMRR	Common-Mode Rejection Ratio	$V_S = 5.5\text{V}$ $V_{CM} = -0.1\text{V to } 4\text{V}$	$25^\circ\text{C}$	74	90		dB
			$-40^\circ\text{C to } 125^\circ\text{C}$	70			
		$V_S = 5.5\text{V}$ $V_{CM} = -0.1\text{V to } 5.6\text{V}$	$25^\circ\text{C}$	62	75		
			$-40^\circ\text{C to } 125^\circ\text{C}$	60			
<b>OUTPUT</b>							
$A_{OL}$	Open-Loop Voltage Gain	$R_L = 2\text{k}\Omega$ , $V_O = 0.15\text{V to } 4.85\text{V}$	$25^\circ\text{C}$	88	98		dB
			$-40^\circ\text{C to } 125^\circ\text{C}$	82			
		$R_L = 10\text{k}\Omega$ , $V_O = 0.05\text{V to } 4.95\text{V}$	$25^\circ\text{C}$	92	110		
			$-40^\circ\text{C to } 125^\circ\text{C}$	88			
	Output Swing From Rail	$R_L = 2\text{k}\Omega$	$25^\circ\text{C}$		26		mV
		$R_L = 10\text{k}\Omega$			6		
$I_{OUT}$	Output Short-Circuit Current		$25^\circ\text{C}$		27		mA
<b>FREQUENCY RESPONSE</b>							
SR	Slew Rate		$25^\circ\text{C}$		0.18		V/ $\mu\text{s}$
GBP	Gain-Bandwidth Product		$25^\circ\text{C}$		500		kHz
PM	Phase Margin		$25^\circ\text{C}$		64		$^\circ$
$t_s$	Setting Time, 0.1%		$25^\circ\text{C}$		14		$\mu\text{s}$
	Overload Recovery Time	$V_{IN} \cdot \text{Gain} \geq V_S$	$25^\circ\text{C}$		5		$\mu\text{s}$
<b>NOISE</b>							
$e_n$	Input Voltage Noise Density	$f = 1\text{KHz}$	$25^\circ\text{C}$		30		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10\text{KHz}$	$25^\circ\text{C}$		20		$\text{nV}/\sqrt{\text{Hz}}$
<b>ENABLE/SHUTDOWN(RS221S,RS222S)</b>							
$I_{Q(OFF)}$	Supply Current in Shutdown		$25^\circ\text{C}$		<1		$\mu\text{A}$
$t_{OFF}$			$25^\circ\text{C}$		3		$\mu\text{s}$
$t_{ON}$			$25^\circ\text{C}$		20		$\mu\text{s}$
$V_L$	Shut Down		$25^\circ\text{C}$	$V_-$		$(V_-) + 0.8$	V
$V_H$	Amplifier Is Active		$25^\circ\text{C}$	$(V_-) + 2$		$V_+$	V

## TYPICAL CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 200\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.

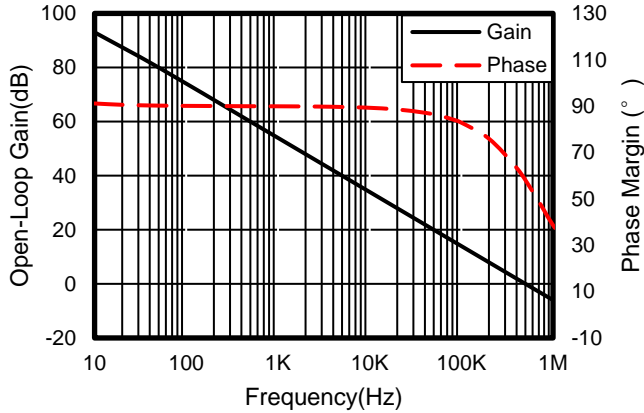


Figure 1. Open-Loop Gain and Phase vs Frequency

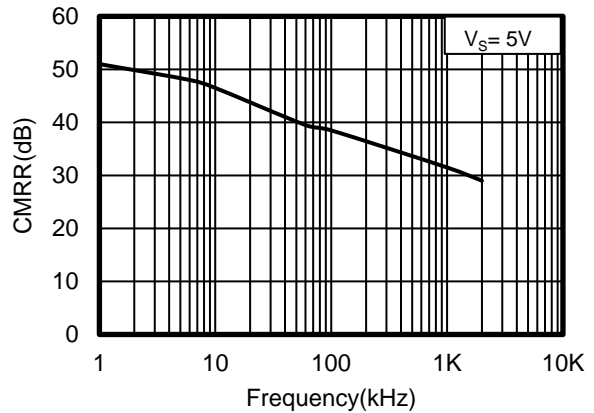


Figure 2. Common-Mode Rejection Ratio vs Frequency

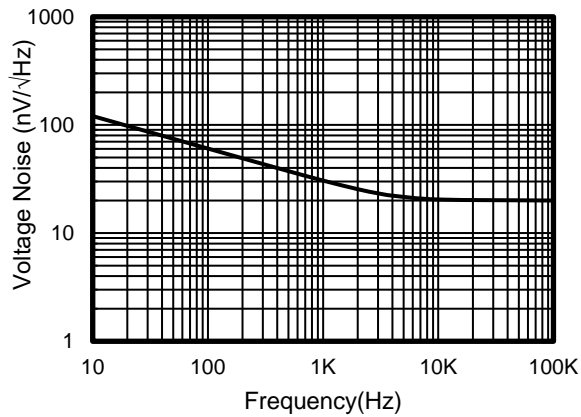


Figure 3. Input Voltage Noise Spectral Density vs Frequency

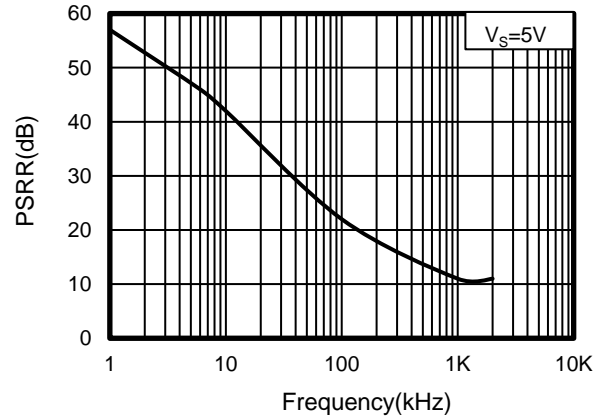


Figure 4. Power-Supply Rejection Ratio vs Frequency

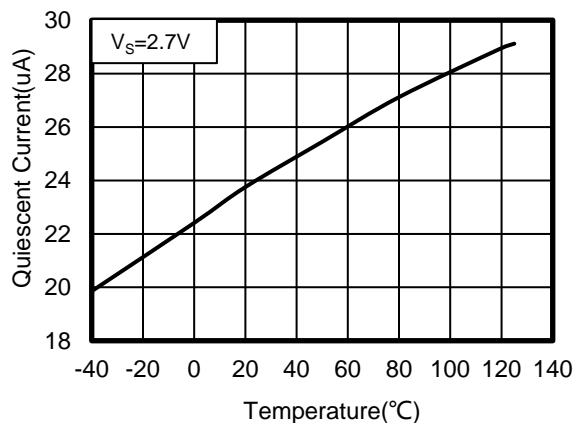


Figure 5. Quiescent Current vs Temperature

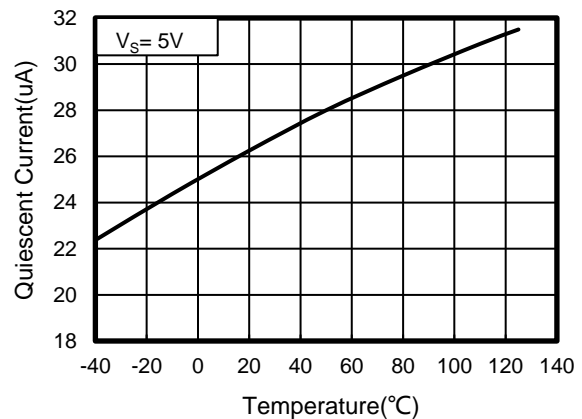


Figure 6. Quiescent Current vs Temperature

## TYPICAL CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 200\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.

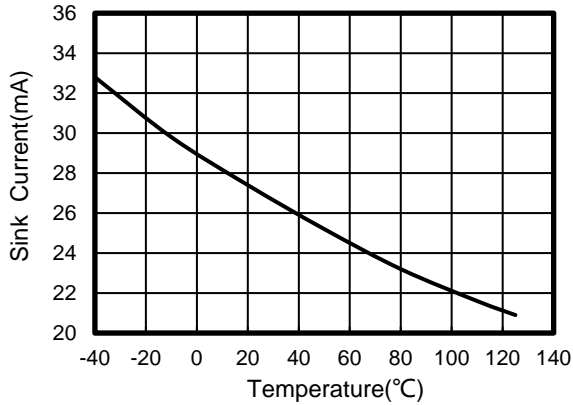


Figure 7. Sink Current vs Temperature

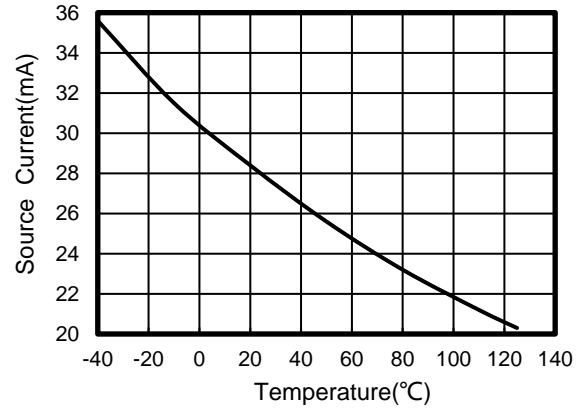


Figure 8. Source Current vs Temperature

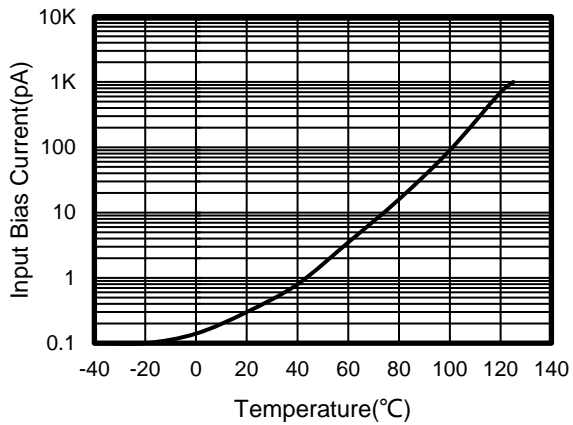


Figure 9. Input Bias Current vs Temperature

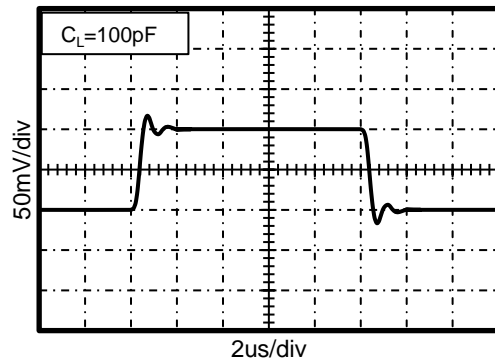


Figure 10. Small-Signal Step Response

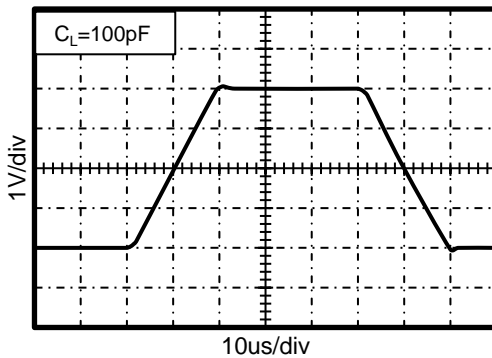


Figure 11. Large-Signal Step Response

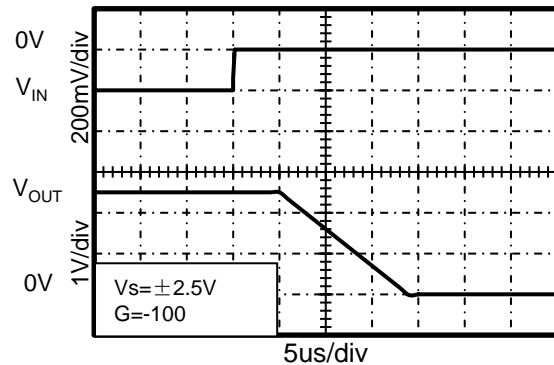


Figure 12. Positive Overtolerance Recovery

## TYPICAL CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 200\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.

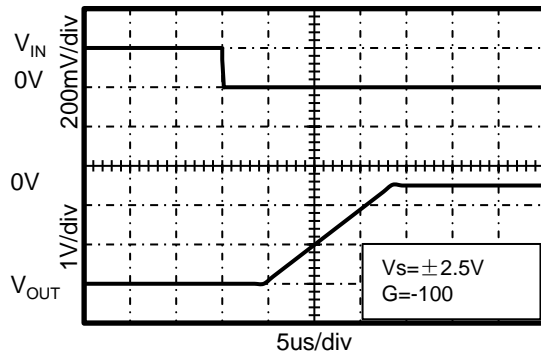


Figure 13. Negative Overvoltage Recovery

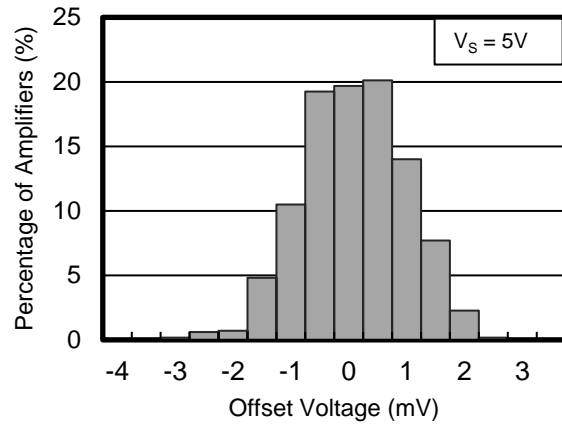


Figure 14. Offset Voltage Production Distribution

## APPLICATION NOTES

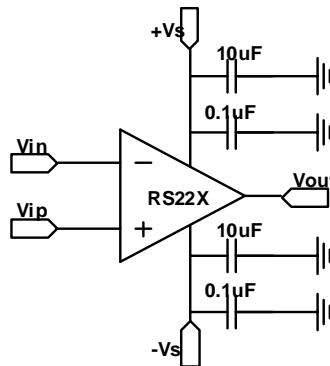
The RS221, RS222, RS224, RS221S, RS222S are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V ( $\pm 1.25V$  to  $\pm 2.75V$ ). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier. Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications. Good layout practice mandates use of a 0.1uF capacitor placed closely across the supply pins.

## RS221S/RS222S ENABLE FUNCTION

The RS221S/RS222S includes a shutdown mode. Under logic control, the amplifiers can be switched from normal mode to a standby current of 1uA. When the Enable pin is connected to high, the amplifier is active. Connecting Enable low disables the amplifier, and places the amplifier, and place the output in a high-impedance state.

## LAYOUT GUIDELINES

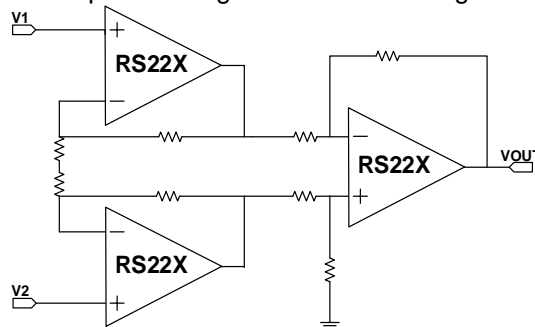
Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF capacitor closely across the supply pins. These guidelines should be applied throughout the analog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



**Figure 15. Amplifier with Bypass Capacitors**

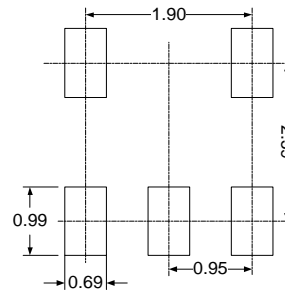
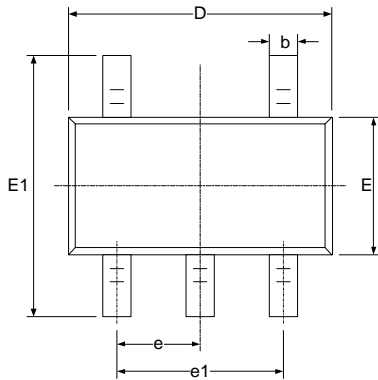
## INSTRUMENTATION AMPLIFIER

In the three-op amp, instrumentation amplifier configuration shown in Figure16,

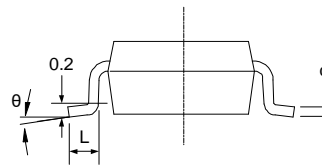
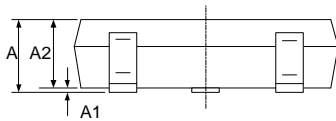


**Figure 16. Amplifier instrumentation amplifier**

## PACKAGE OUTLINE DIMENSIONS SOT23-5

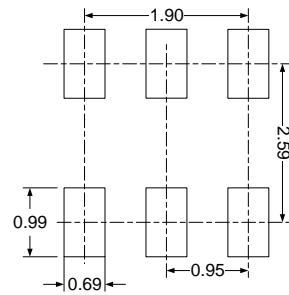
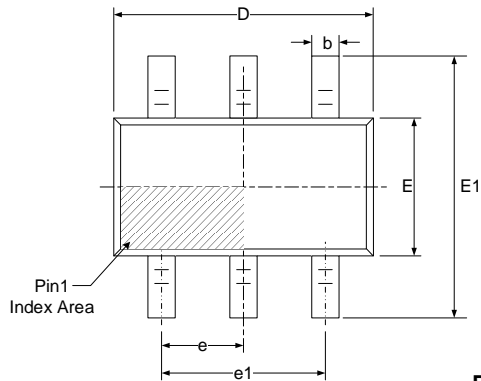


RECOMMENDED LAND PATTERN (Unit: mm)

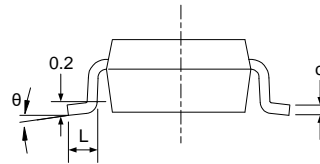
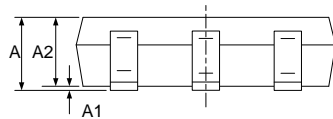


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

SOT23-6

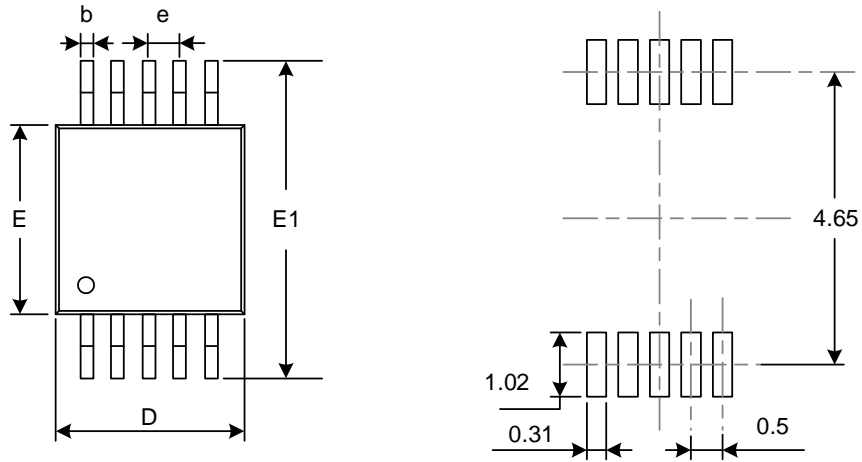


RECOMMENDED LAND PATTERN (Unit: mm)

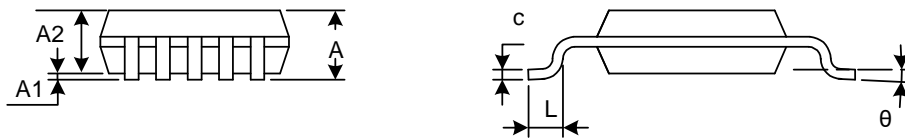


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

MSOP-10



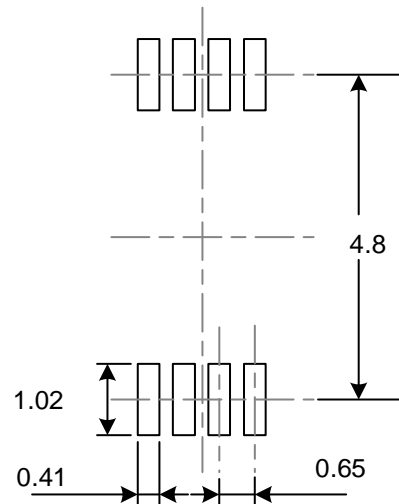
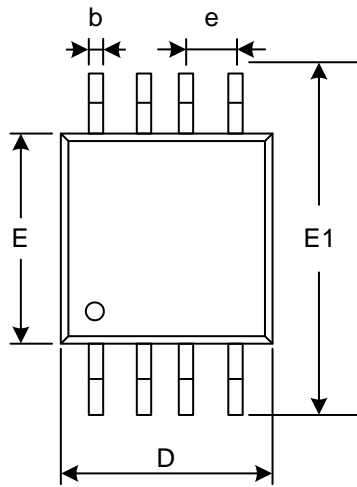
RECOMMENDED LAND PATTERN (Unit: mm)



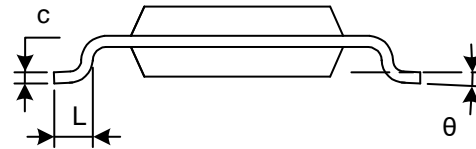
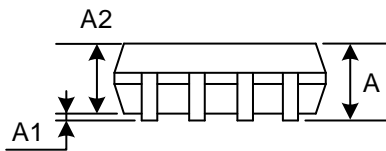
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°



MSOP-8

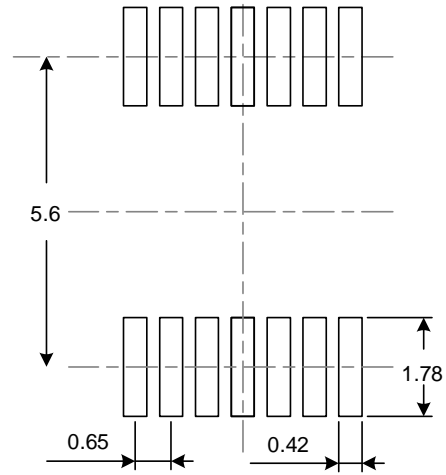
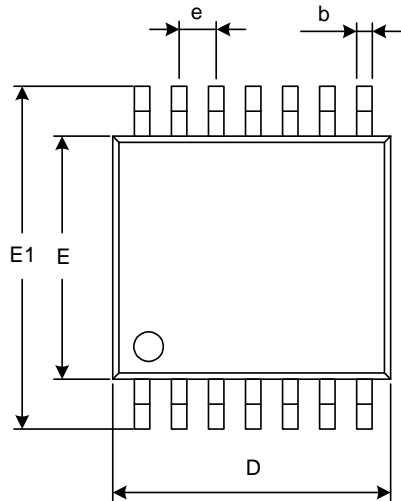


RECOMMENDED LAND PATTERN (Unit: mm)

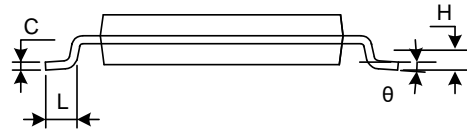
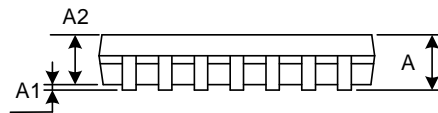


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187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

TSSOP-14

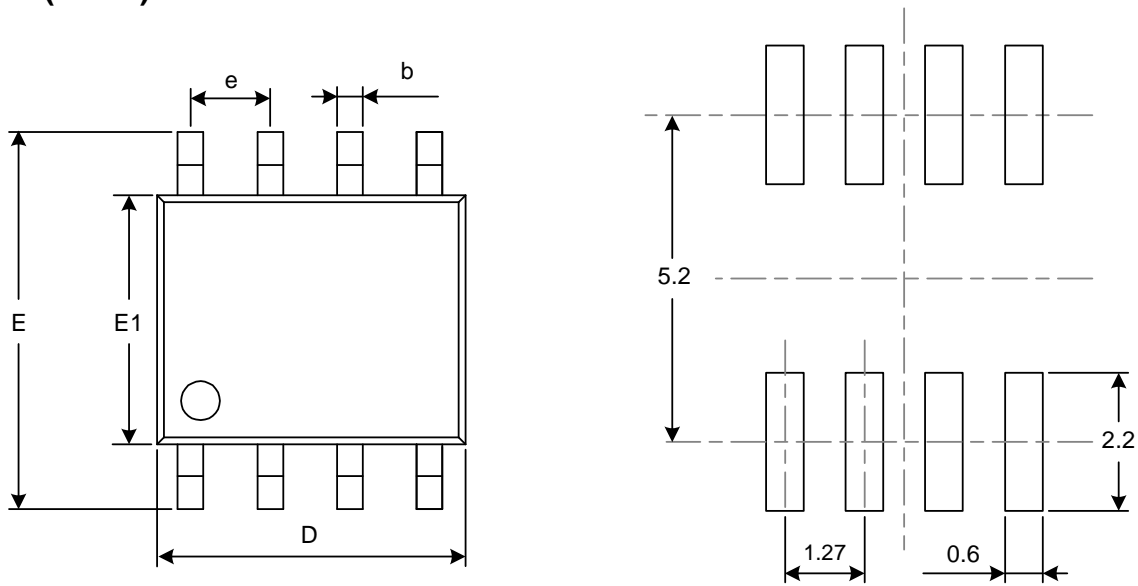


RECOMMENDED LAND PATTERN (Unit: mm)

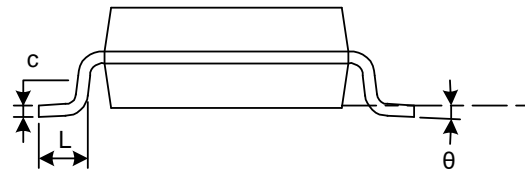
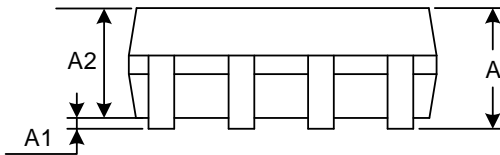


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L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

SOIC-8 (SOP8)

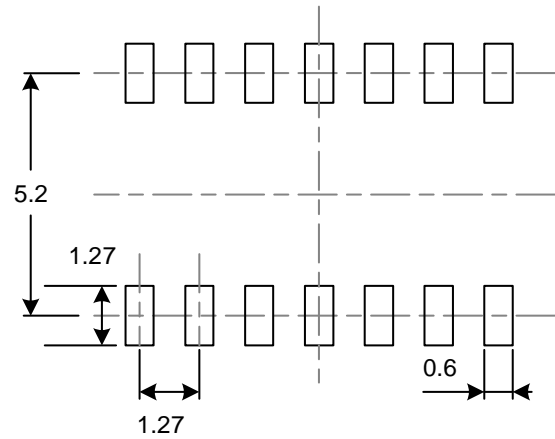
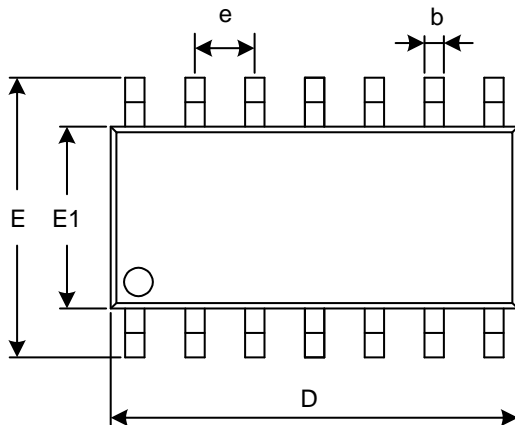


RECOMMENDED LAND PATTERN (Unit: mm)

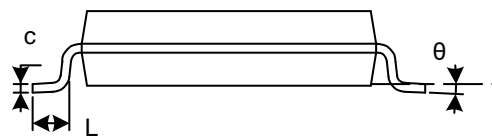
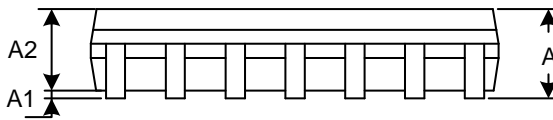


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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

SOIC-14 (SOP14)

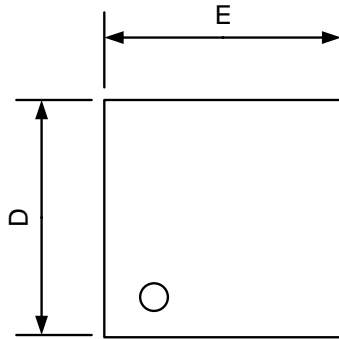


RECOMMENDED LAND PATTERN (Unit: mm)

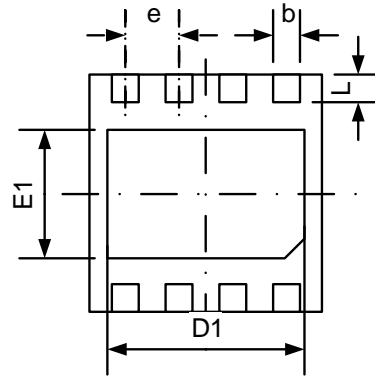


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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

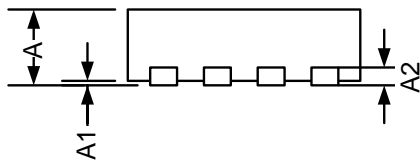
TDFN-3x3-8L



TOP VIEW



BOTTOM VIEW

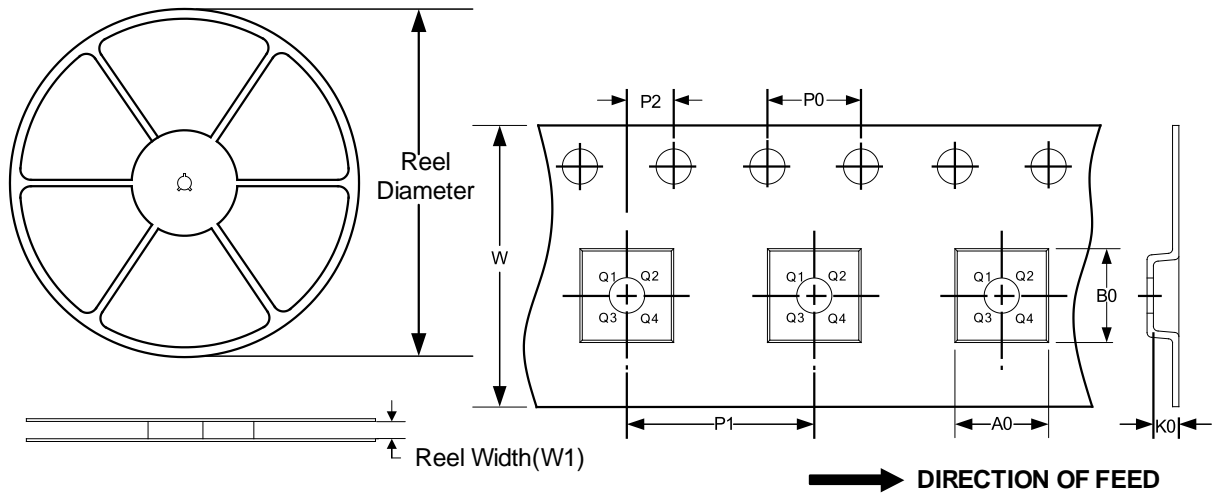


SIDE VIEW

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

## TAPE AND REEL INFORMATION REEL DIMENSIONS

## TAPE DIMENSION



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 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SOT23-6	7"	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
MSOP-10	13"	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1
MSOP-8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1
TSSOP-14	13"	12.4	6.95	5.60	1.20	4.0	8.0	2.0	12.0	Q1
SOIC-8 (SOP8)	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
SOIC-14 (SOP14)	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TDFN3x3-8L	13"	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1