

1.1MHz, Precision, Rail-to-Rail I/O CMOS Operational Amplifier

FEATURES

- **HIGH GAIN BANDWIDTH:1.1MHz**
- **RAIL-TO-RAIL INPUT AND OUTPUT**
±4.5mV 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**
- **PACKAGES: SOIC-14、 TSSOP-14**

APPLICATIONS

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

DESCRIPTION

The RS324A products offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (1.1MHz) and slew rate of 0.5V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The RS324A has lower offset, which is guaranteed not upper than ±4.5mV at 25°C with Vs = 5V, V_{CM} = Vs/2.

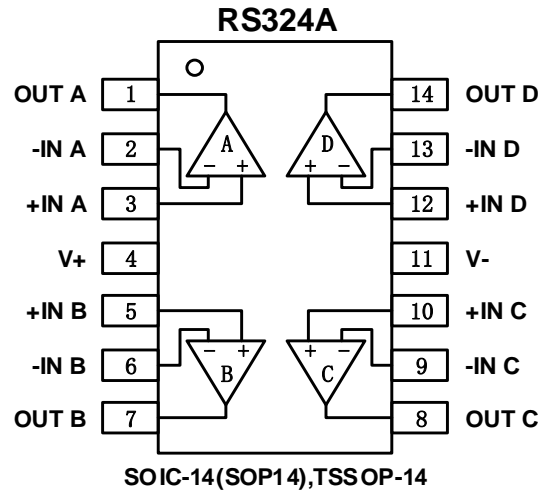
The devices are ideal for sensor interfaces, active filters and portable applications. The RS324A families of operational amplifiers are specified at the full temperature range of -40°C to +125°C under single or dual power supplies of 2.5V to 5.5V.

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS324A	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.

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) ⁽¹⁾

		MIN	MAX	UNIT
Voltage	Supply, $V_s=(V+) - (V-)$		7	V
	Signal input pin ⁽²⁾	(V-)-0.5	(V+)+0.5	
	Signal output pin ⁽³⁾	(V-)-0.5	(V+)+0.5	
Current	Signal input pin ⁽²⁾	-10	10	mA
	Signal output pin ⁽³⁾	-140	140	mA
	Output short-circuit ⁽⁴⁾	Continuous		
Temperature	Operating range, T_A	-40	125	°C
	Junction, T_J		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 ± 140 mA or less.

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

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	3000	V
		Machine Model (MM)	200	

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	± 1.25		± 2.75	
Specified temperature		-40		125	°C

Thermal Information:RS324A

THERMAL METRIC ⁽¹⁾		RS324A		UNIT
		14PINS		
		SOIC-14(SOP14)	TSSOP-14	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	83.8	205.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	70.7	106.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	59.5	133.9	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	11.6	34.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	37.7	132.6	°C/W
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	°C/W

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS324A	RS324AXP	-40°C ~125°C	SOIC-14(SOP14)	RS324A	Tape and Reel,2500
	RS324AXQ	-40°C ~125°C	TSSOP-14	RS324A	Tape and Reel,3000

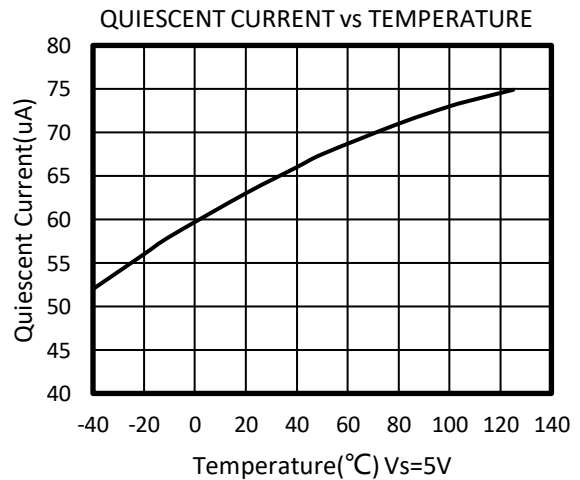
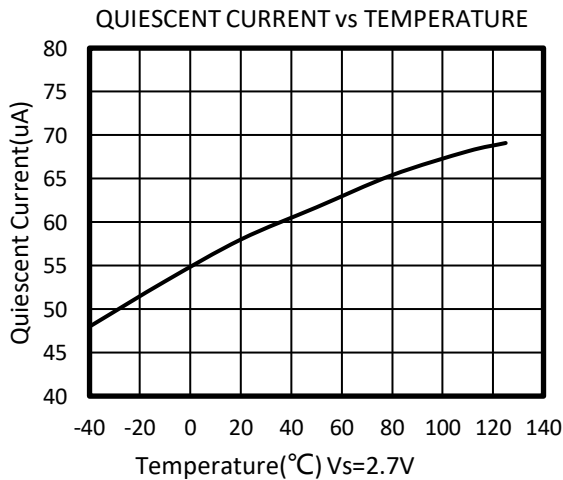
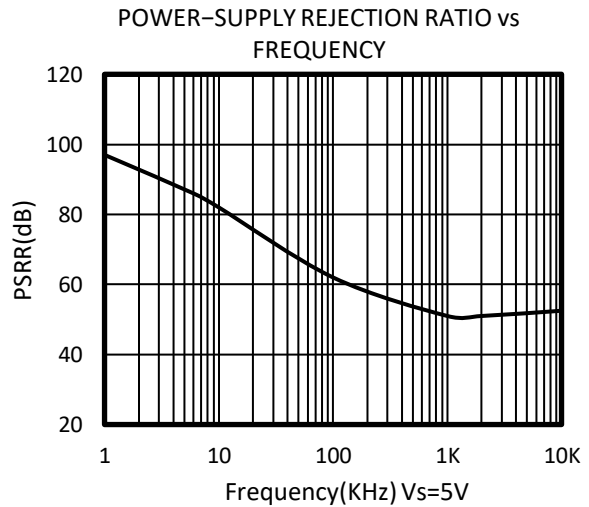
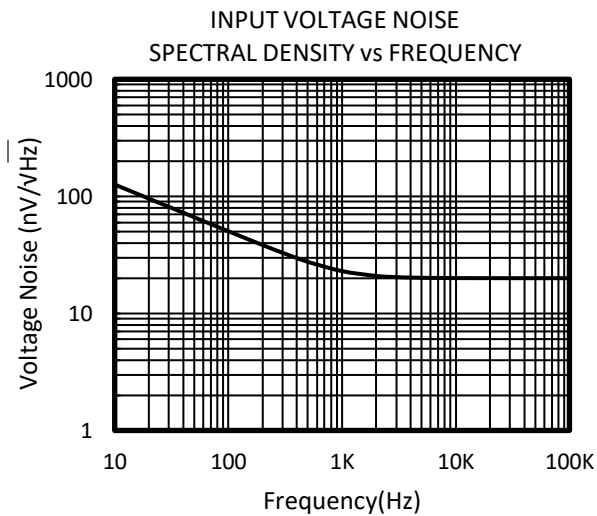
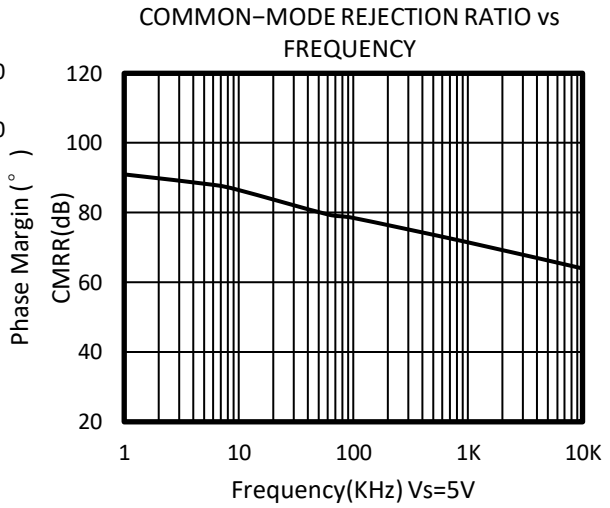
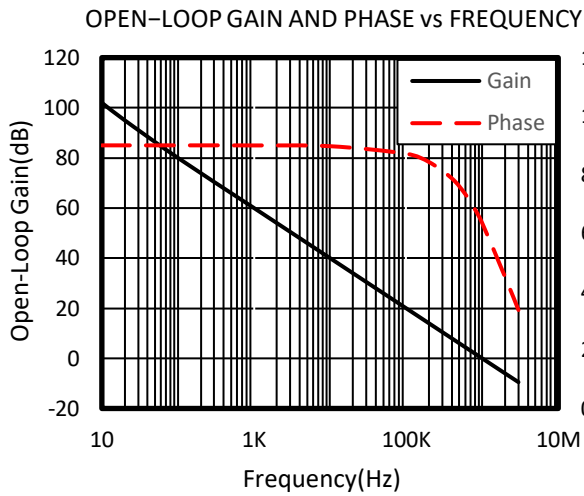
ELECTRICAL CHARACTERISTICS

(At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, and $V_{OUT} = V_S/2$, unless otherwise noted.)

PARAMETER	CONDITIONS	T_J	RS324A			UNITS	
			MIN	TYP	MAX		
POWER SUPPLY							
V_S	Operating Voltage Range	25°C	2.5		5.5	V	
I_Q	Quiescent Current/Amplifier	25°C		60	110	μA	
PSRR	Power-Supply Rejection Ratio	$V_S = 2.5\text{V to } 5.5\text{V}$, $V_{CM} = (V_-) + 0.5\text{V}$	25°C	74	90	dB	
		$-40^\circ\text{C to } 125^\circ\text{C}$	65				
INPUT							
V_{OS}	Input Offset Voltage	$V_{CM} = 0\text{V to } 3.5\text{V}$	25°C	-4.5	± 0.8	4.5	mV
$V_{OS\ TC}$	Input Offset Voltage Average Drift	$-40^\circ\text{C to } 125^\circ\text{C}$			2		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current		25°C		10	100	pA
I_{OS}	Input Offset Current		25°C		1	10	pA
V_{CM}	Common-Mode Voltage Range	$V_S = 5.5\text{V}$	25°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°C	74	90	dB	
			$-40^\circ\text{C to } 125^\circ\text{C}$	68			
		$V_S = 5.5\text{V}$, $V_{CM} = -0.1\text{V to } 5.6\text{V}$	25°C	63	80		
			$-40^\circ\text{C to } 125^\circ\text{C}$	57			
OUTPUT							
AOL	Open-Loop Voltage Gain	$R_L = 2\text{k}\Omega$, $V_O = 0.15\text{V to } 4.85\text{V}$	25°C	85	105	dB	
			$-40^\circ\text{C to } 125^\circ\text{C}$	80			
		$R_L = 10\text{k}\Omega$, $V_O = 0.05\text{V to } 4.95\text{V}$	25°C	88	110		
			$-40^\circ\text{C to } 125^\circ\text{C}$	83			
	Output Swing From Rail	$R_L = 2\text{k}\Omega$ $R_L = 10\text{k}\Omega$	25°C		25	mV	
					8		
I_{out}	Output Short-Circuit Current		25°C		130	mA	
FREQUENCY RESPONSE							
SR	Slew Rate		25°C		0.5	V/ μs	
GBP	Gain-Bandwidth Product		25°C		1.1	MHz	
PM	Phase Margin		25°C		64	$^\circ$	
t_s	Setting Time, 0.1%				1.3	μs	
	Overload Recovery Time	$V_{IN} \cdot \text{Gain} \geq V_S$			2.3	μs	
NOISE							
e_n	Input Voltage Noise Density	$f = 1\text{KHz}$	25°C		22	$\text{nV}/\sqrt{\text{Hz}}$	
		$f = 10\text{KHz}$	25°C		20	$\text{nV}/\sqrt{\text{Hz}}$	

TYPICAL CHARACTERISTICS

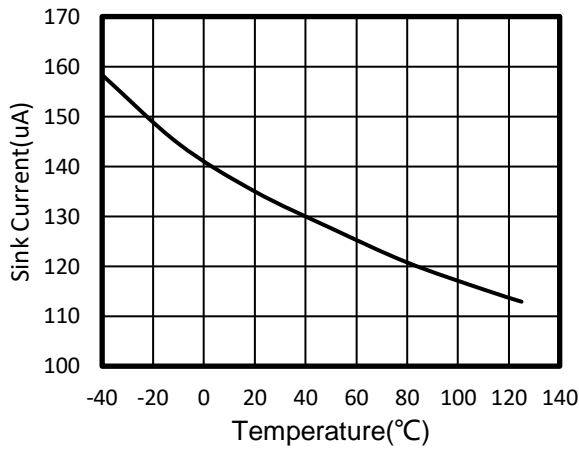
At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.



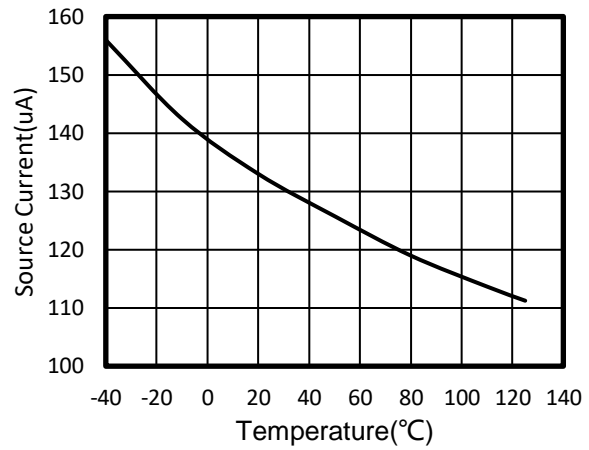
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.

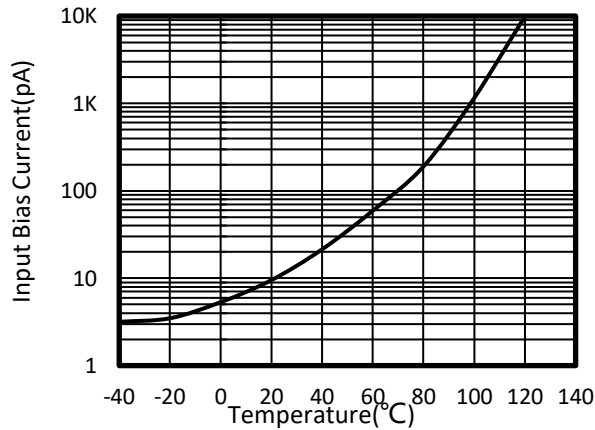
SINK CURRENT vs TEMPERATURE



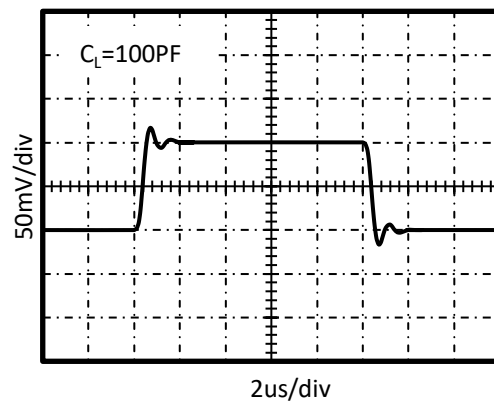
SOURCE CURRENT vs TEMPERATURE



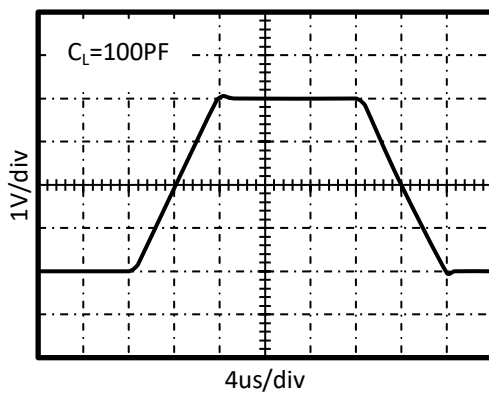
INPUT BIAS CURRENT vs TEMPERATURE



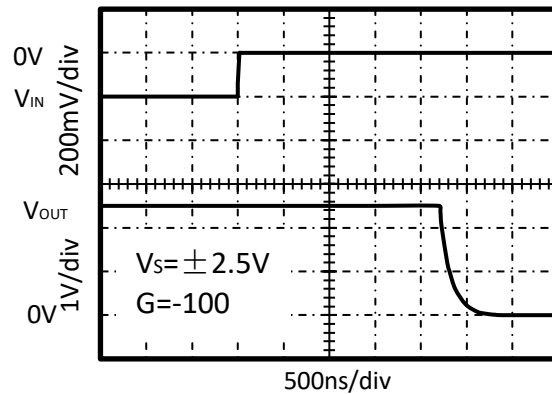
SMALL-SIGNAL STEP RESPONSE



LARGE-SIGNAL STEP RESPONSE

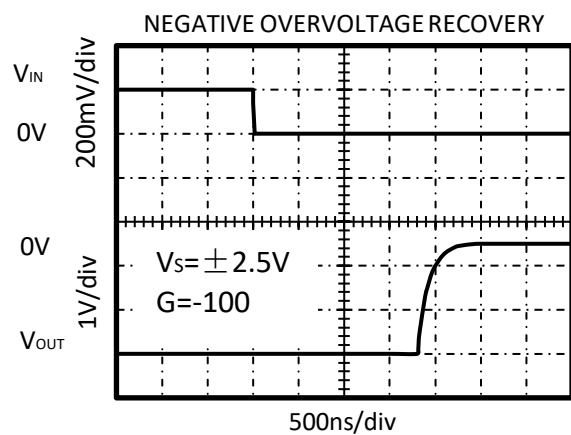


POSITIVE OVERVOLTAGE RECOVERY



TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.



APPLICATION NOTES

The RS324A 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 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.

INSTRUMENTATION AMPLIFIER

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

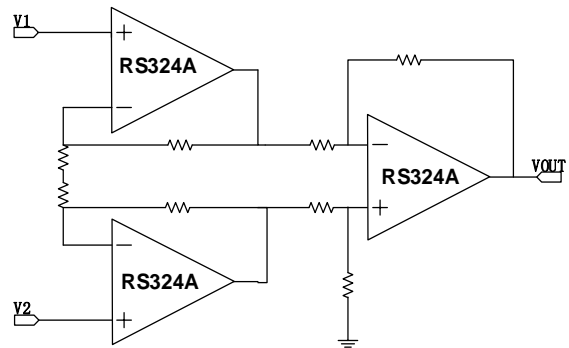


Figure2. Amplifier instrumentation amplifier

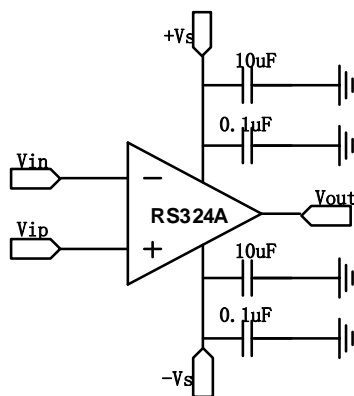
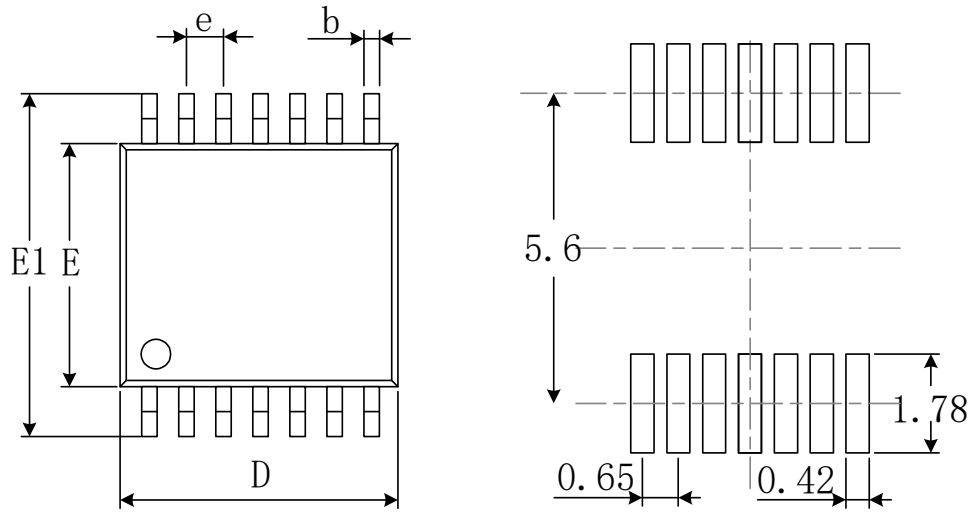
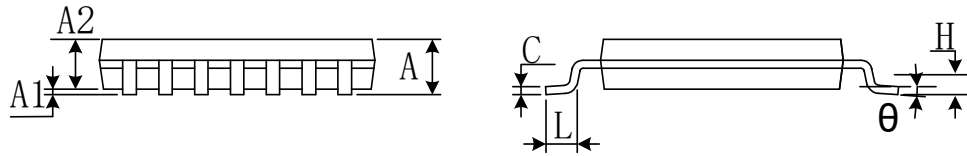


Figure1. Amplifier with Bypass Capacitors

PACKAGE OUTLINE DIMENSIONS TSSOP-14

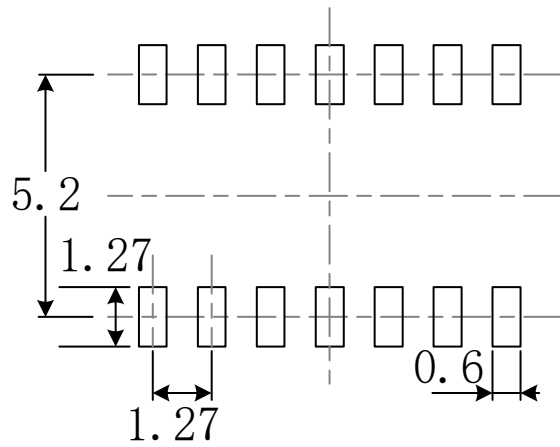
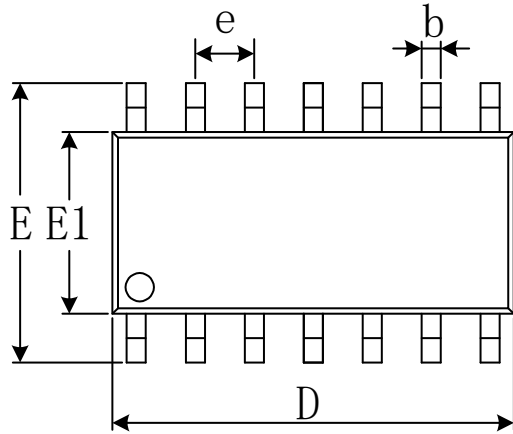


RECOMMENDED LAND PATTERN (Unit: mm)

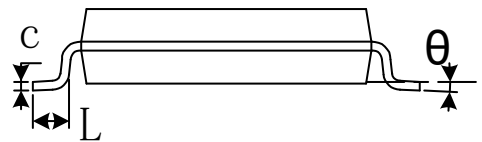
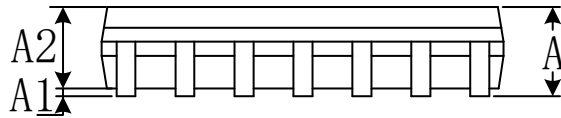


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L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

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
θ	0°	8°	0°	8°