



General Description

The AS324/324A consist of four independent, high gain and internally frequency compensated operational amplifiers. They are specifically designed to operate from a single power supply. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Typical applications include transducer amplifiers, DC gain blocks and most conventional operational amplifier circuits.

The AS324/324A series are compatible with industry standard 324. AS324A has more stringent input offset voltage than AS324.

The AS324 is available in SOIC-14, DIP-14 and TSSOP-14 packages, AS324A is available in SOIC-14 package.

Features

- Internally Frequency Compensated for Unity Gain
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Low Supply Current: 0.5mA (Typical)
- Wide Power Supply Voltage Range:
Single Supply: 3V to 36V
Dual Supplies: $\pm 1.5V$ to $\pm 18V$
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to $V_{CC} - 1.5V$
- Power Drain Suitable for Battery Operation

Application

- Battery Charger
- Cordless Telephone
- Switching Power Supply



Figure 1. Package Types of AS324/324A



LOW POWER QUAD OPERATIONAL AMPLIFIERS AS324/324A

Pin Configuration

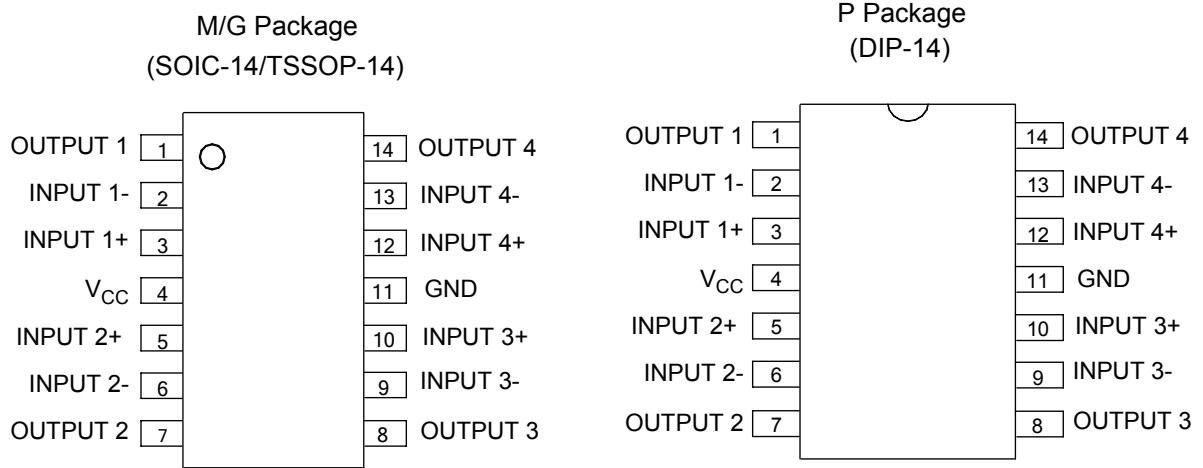


Figure 2. Pin Configuration of AS324/324A (Top View)

Functional Block Diagram

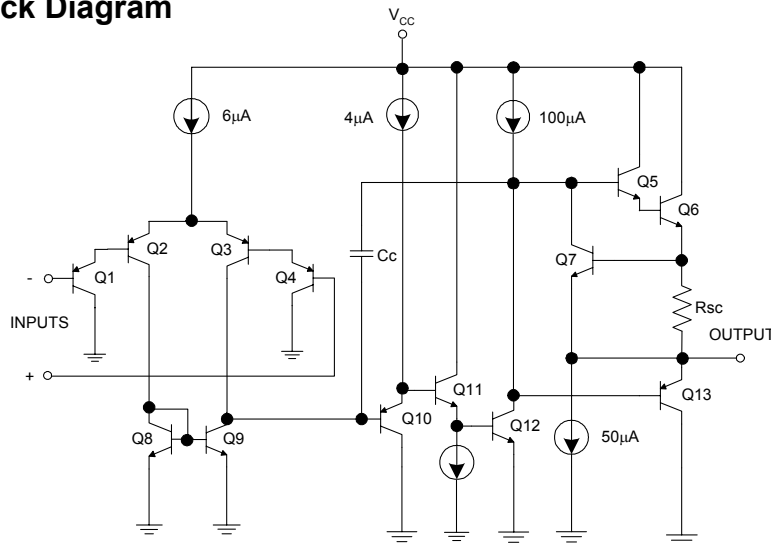
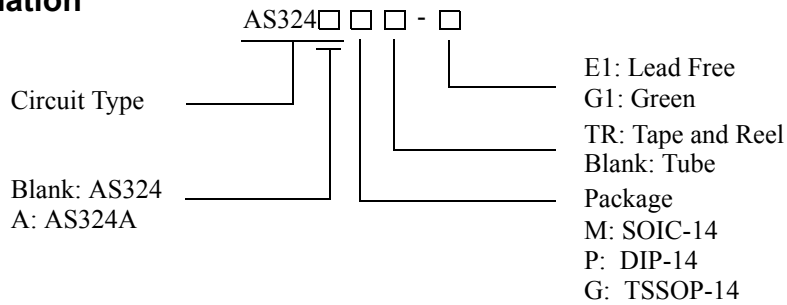


Figure 3. Functional Block Diagram of AS324/324A (Each Amplifier)

Ordering Information



**LOW POWER QUAD OPERATIONAL AMPLIFIERS****AS324/324A****Ordering Information (Continued)**

Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
SOIC-14	-40 to 85°C	AS324M-E1	AS324M-G1	AS324M-E1	AS324M-G1	Tube
		AS324MTR-E1	AS324MTR-G1	AS324M-E1	AS324M-G1	Tape & Reel
		AS324AM-E1	AS324AM-G1	AS324AM-E1	AS324AM-G1	Tube
		AS324AMTR-E1	AS324AMTR-G1	AS324AM-E1	AS324AM-G1	Tape & Reel
DIP-14		AS324P-E1	AS324P-G1	AS324P-E1	AS324P-G1	Tube
TSSOP-14		AS324GTR-E1	AS324GTR-G1	EGS324	GG324	Tape & Reel
	AS324G-E1	AS324G-G1	EGS324	GG324	Tube	

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Supply Voltage	V_{CC}	40		V
Differential Input Voltage	V_{ID}	40		V
Input Voltage	V_{IN}	-0.3 to 40		V
Total Power Dissipation ($T_A=25^\circ\text{C}$)	P_D	DIP-14	1130	mW
		SOIC-14	800	
		TSSOP-14	710	
Operating Junction Temperature	T_J	150		°C
Storage Temperature Range	T_{STG}	-65 to 150		°C
Lead Temperature (Soldering, 10 Seconds)	T_{LEAD}	260		°C

Note 1: Stresses greater than 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	3	36	V
Ambient Operating Temperature Range	T_A	-40	85	°C



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AS324/324A

Electrical Characteristics

Limits in standard typeface are for $T_A=25^{\circ}\text{C}$, **bold** typeface applies over $T_A=-40^{\circ}\text{C}$ to 85°C (Note 2), $V_{CC}=5\text{V}$, $\text{GND}=0\text{V}$, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Input Offset Voltage	V_{IO}	$V_O=1.4\text{V}$, $R_S=0\ \Omega$, $V_{CC}=5\text{V}$ to 30V	AS324		2	5	mV
			AS324A		2	3	
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	$T_A=-40$ to 85°C		7		$\mu\text{V}/^{\circ}\text{C}$	
Input Offset Current	I_{IO}	$I_{IN^+} - I_{IN^-}$, $V_{CM}=0\text{V}$		5	30	nA	
					100		
Input Bias Current	I_{BIAS}	I_{IN^+} or I_{IN^-} , $V_{CM}=0\text{V}$		20	100	nA	
					200		
Input Common Mode Voltage Range (Note 3)	V_{IR}	$V_{CC}=30\text{V}$	0		$V_{CC}-1.5$	V	
Supply Current	I_{CC}	$T_A=-40$ to 85°C , $R_L=\infty$	$V_{CC}=30\text{V}$		1.0	3	mA
			$V_{CC}=5\text{V}$		0.7	1.2	
Large Signal Voltage Gain	G_V	$V_{CC}=15\text{V}$, $R_L \geq 2\text{k}\Omega$, $V_O=1\text{V}$ to 11V	85	100		dB	
			80				
Common Mode Rejection Ratio	CMRR	DC, $V_{CM}=0$ to $(V_{CC}-1.5)\text{V}$	60	70		dB	
			60				
Power Supply Rejection Ratio	PSRR	$V_{CC}=5$ to 30V	70	100		dB	
			60				
Channel Separation	CS	$f=1\text{kHz}$ to 20kHz		-120		dB	
Output Current	Source	I_{SOURCE}	$V_{IN^+}=1\text{V}$, $V_{IN^-}=0\text{V}$, $V_{CC}=15\text{V}$, $V_O=2\text{V}$	20	40	mA	
				20			
	Sink	I_{SINK}	$V_{IN^+}=0\text{V}$, $V_{IN^-}=1\text{V}$, $V_{CC}=15\text{V}$, $V_O=2\text{V}$	10	15	mA	
				5			
			$V_{IN^+}=0\text{V}$, $V_{IN^-}=1\text{V}$, $V_{CC}=15\text{V}$, $V_O=0.2\text{V}$	12	50	μA	
Output Short Circuit Current to Ground	I_{SC}	$V_{CC}=15\text{V}$		40	60	mA	
Output Voltage Swing	V_{OH}	$V_{CC}=30\text{V}$, $R_L=2\text{k}\Omega$	26			V	
			26				
		$V_{CC}=30\text{V}$, $R_L=10\text{k}\Omega$	27	28			
			27				
V_{OL}	$V_{CC}=5\text{V}$, $R_L=10\text{k}\Omega$		5	20	mV		
				30			
Thermal Resistance (Junction to Case)	θ_{JC}	DIP-14		24.78		$^{\circ}\text{C}/\text{W}$	
		SOIC-14		36.78			

Note 2: Limits over the full temperature are guaranteed by design, but not tested in production.



Electrical Characteristics (Continued)

Note 3: The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at 25°C). The upper end of the common-mode voltage range is $V_{CC} - 1.5V$ (at 25°C), but either or both inputs can go to +36V without damages, independent of the magnitude of the V_{CC} .

Typical Performance Characteristics

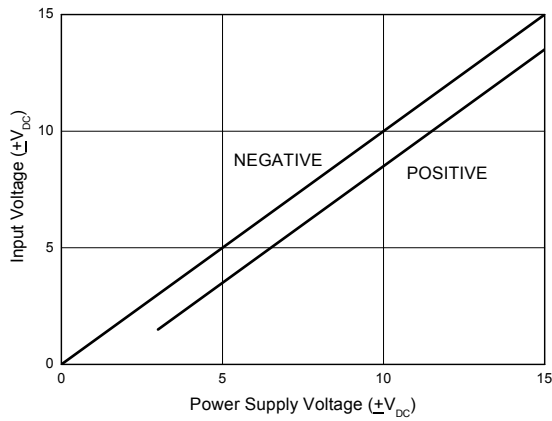


Figure 4. Input Voltage Range

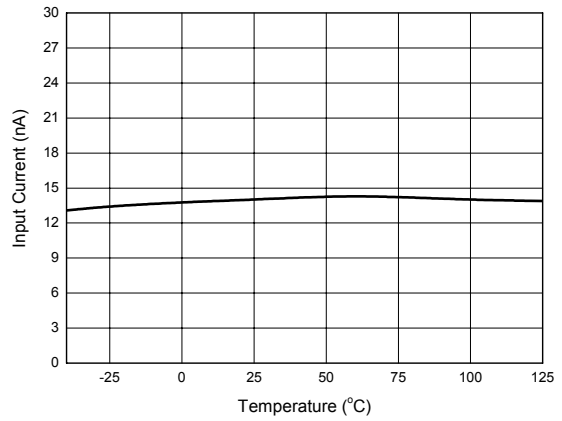


Figure 5. Input Current

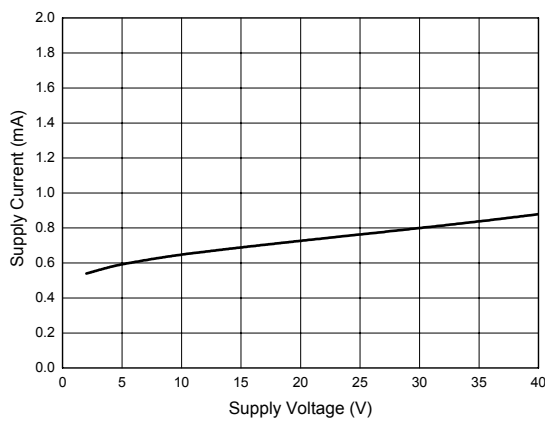


Figure 6. Supply Current

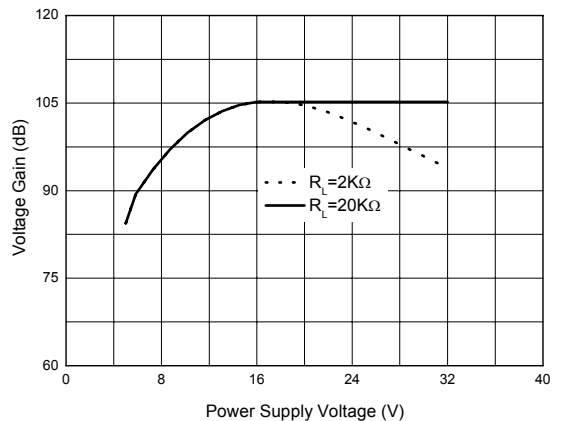


Figure 7. Voltage Gain



Typical Performance Characteristics (Continued)

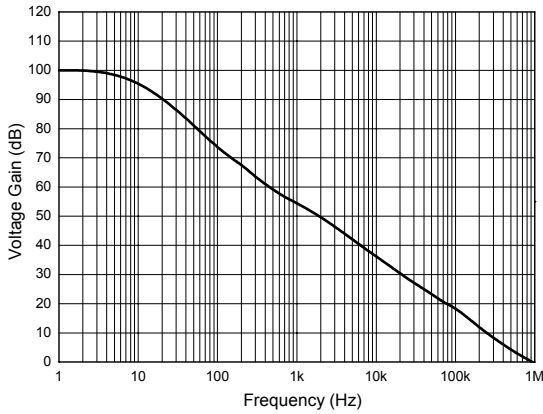


Figure 8. Open Loop Frequency Response

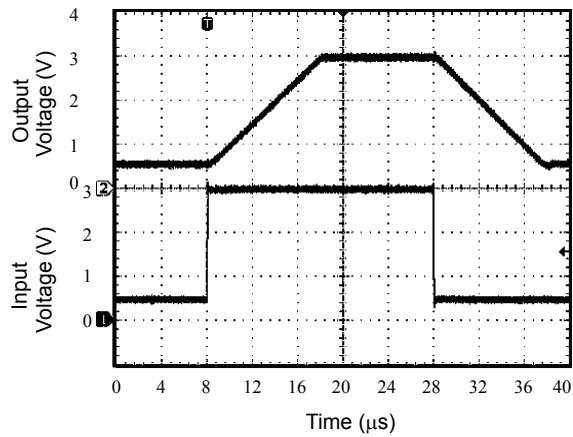


Figure 9. Voltage Follower Pulse Response

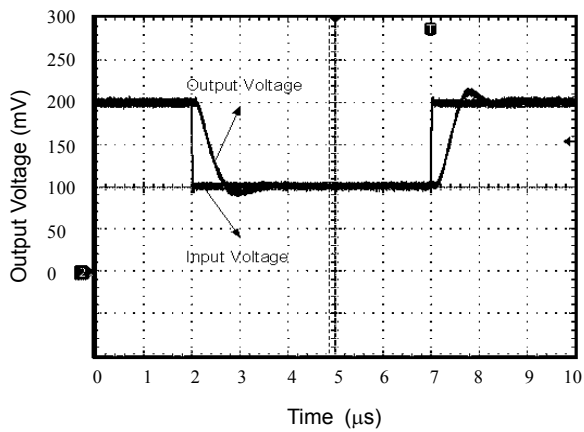


Figure 10. Voltage Follower Pulse Response (Small Signal)

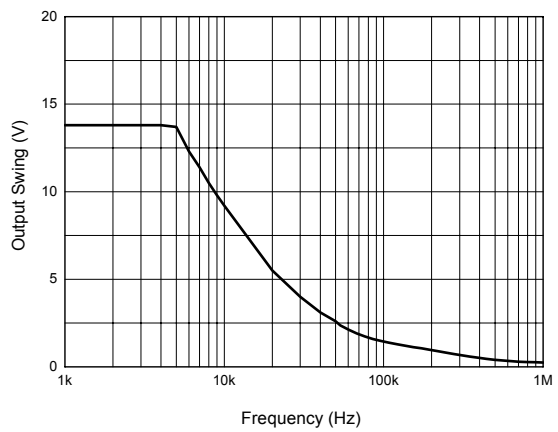


Figure 11. Large Signal Frequency Response

Typical Performance Characteristics (Continued)

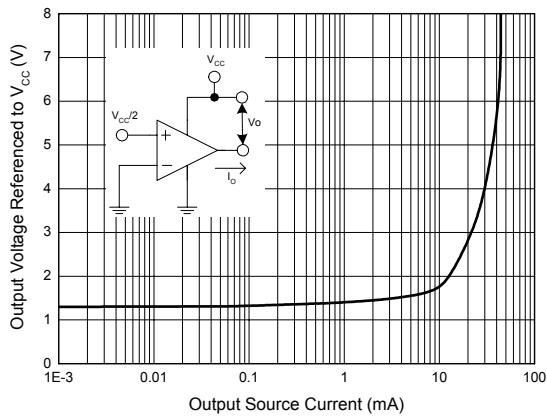


Figure 12. Output Characteristics: Current Sourcing

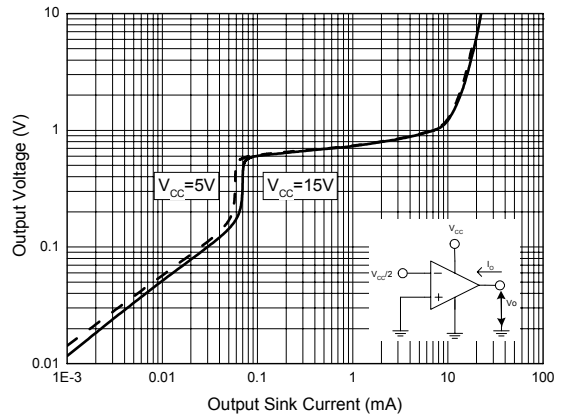


Figure 13. Output Characteristics: Current Sinking

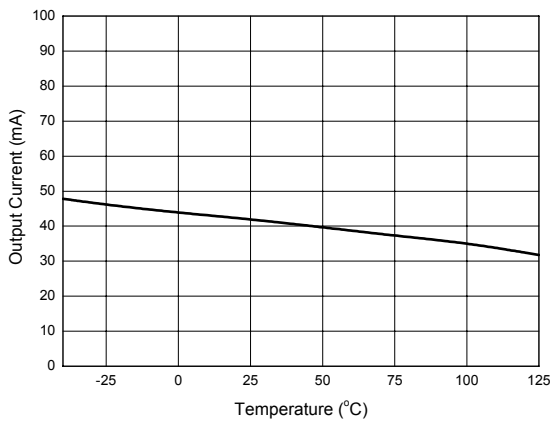


Figure 14. Current Limiting

Typical Applications

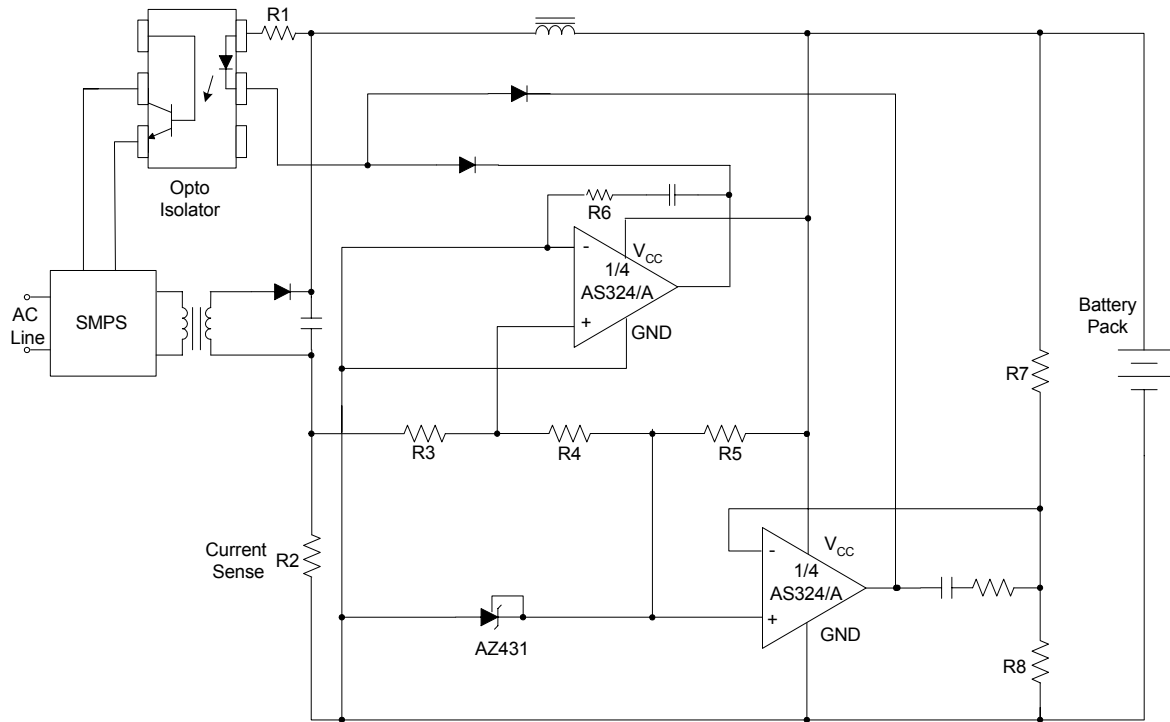


Figure 15. Battery Charger

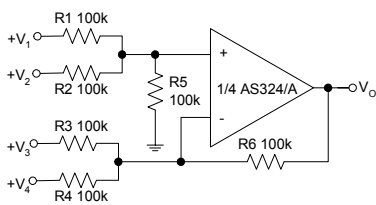


Figure 16. DC Summing Amplifier

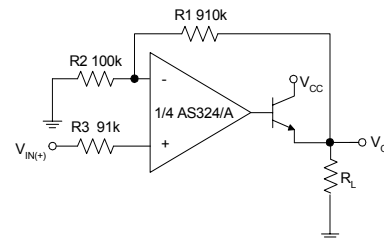


Figure 17. Power Amplifier

Typical Applications (Continued)

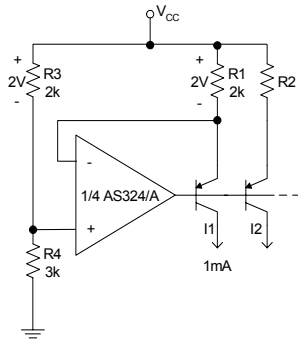


Figure 18. Fixed Current Sources

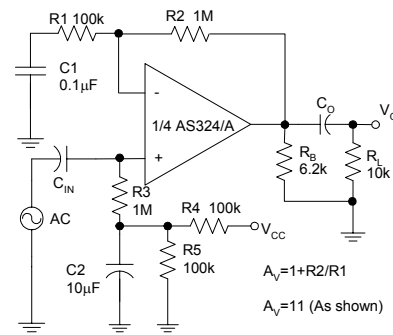


Figure 19. AC Coupled Non-Inverting Amplifier

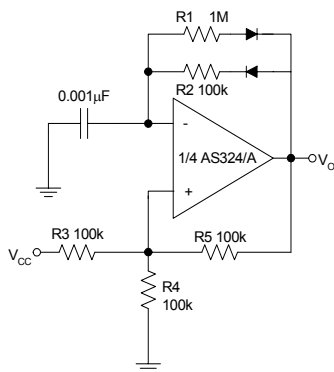


Figure 20. Pulse Generator

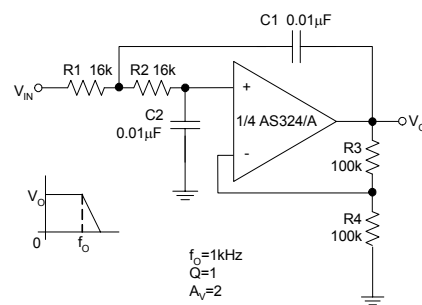


Figure 21. DC Coupled Low-Pass RC Active Filter



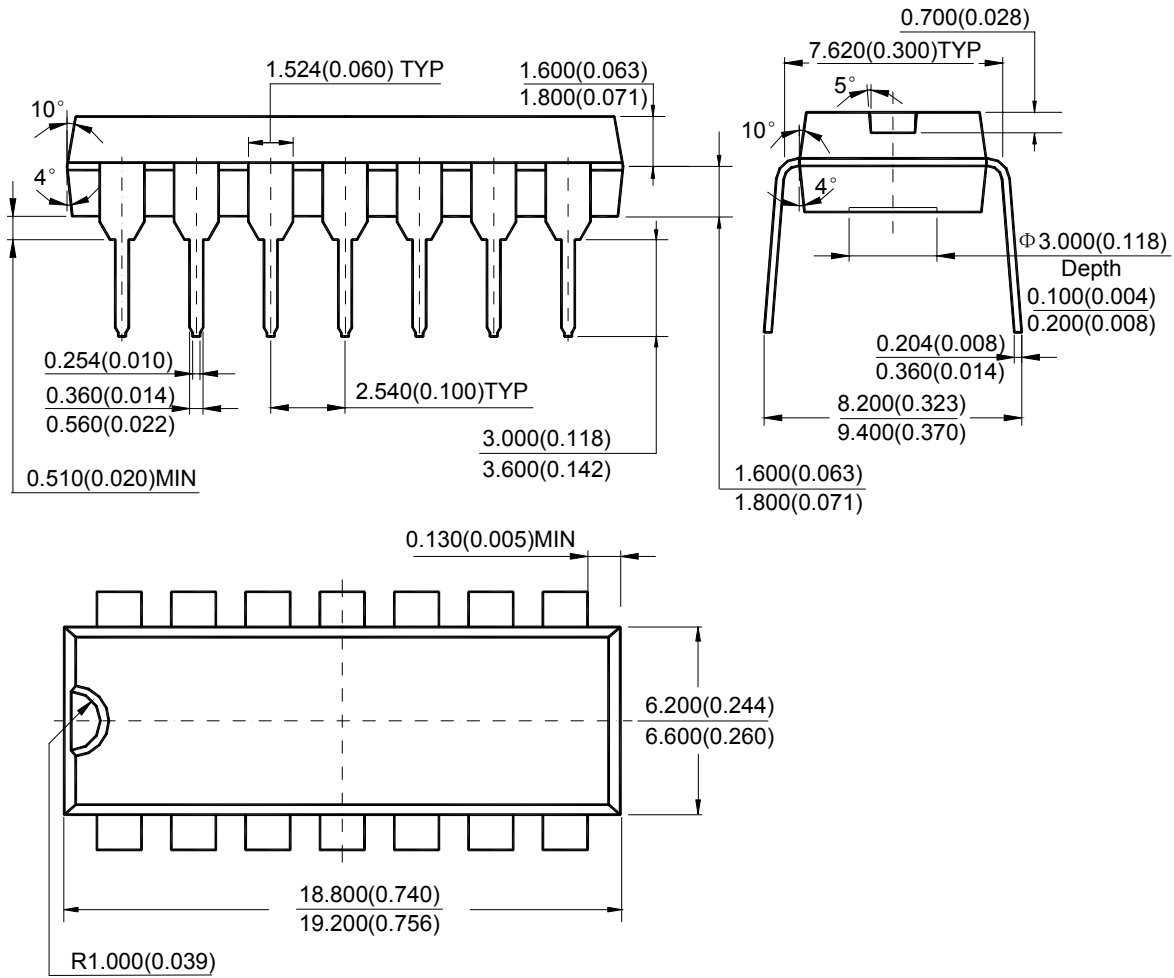
LOW POWER QUAD OPERATIONAL AMPLIFIERS

AS324/324A

Mechanical Dimension

DIP-14

Unit: mm(inch)



Note: Eject hole, oriented hole and mold mark is optional.



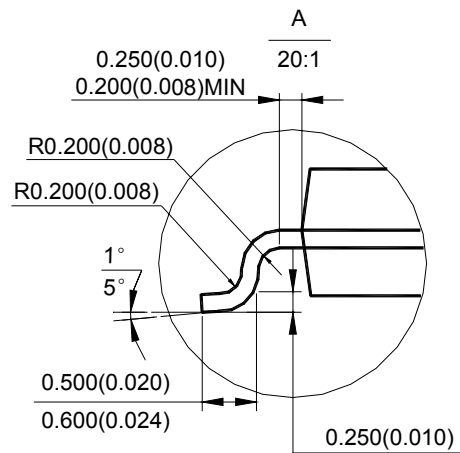
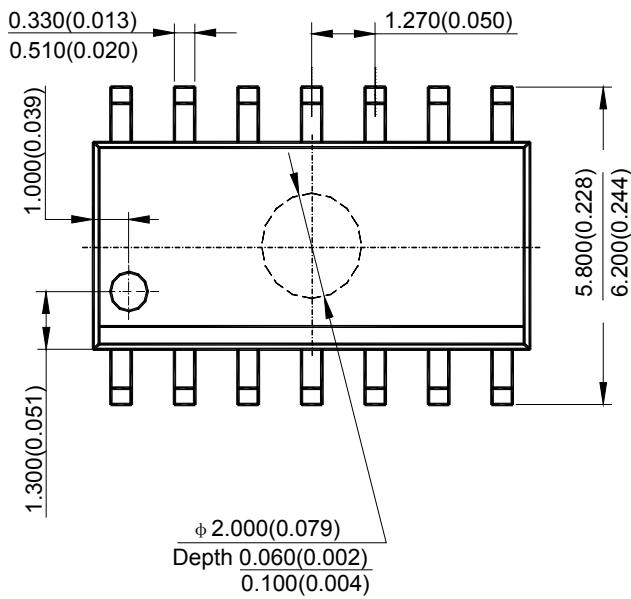
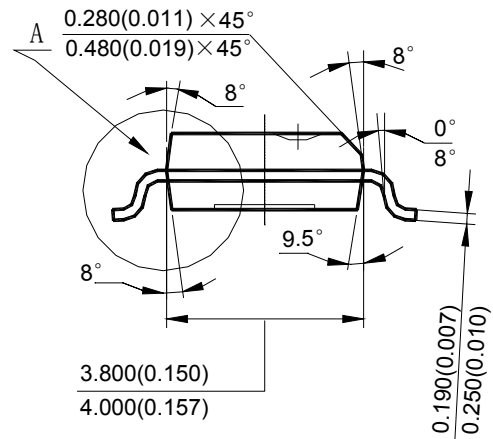
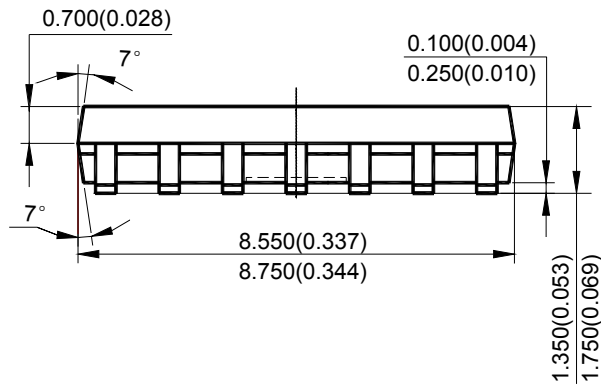
LOW POWER QUAD OPERATIONAL AMPLIFIERS

AS324/324A

Mechanical Dimension (Continued)

SOIC-14

Unit: mm(inch)



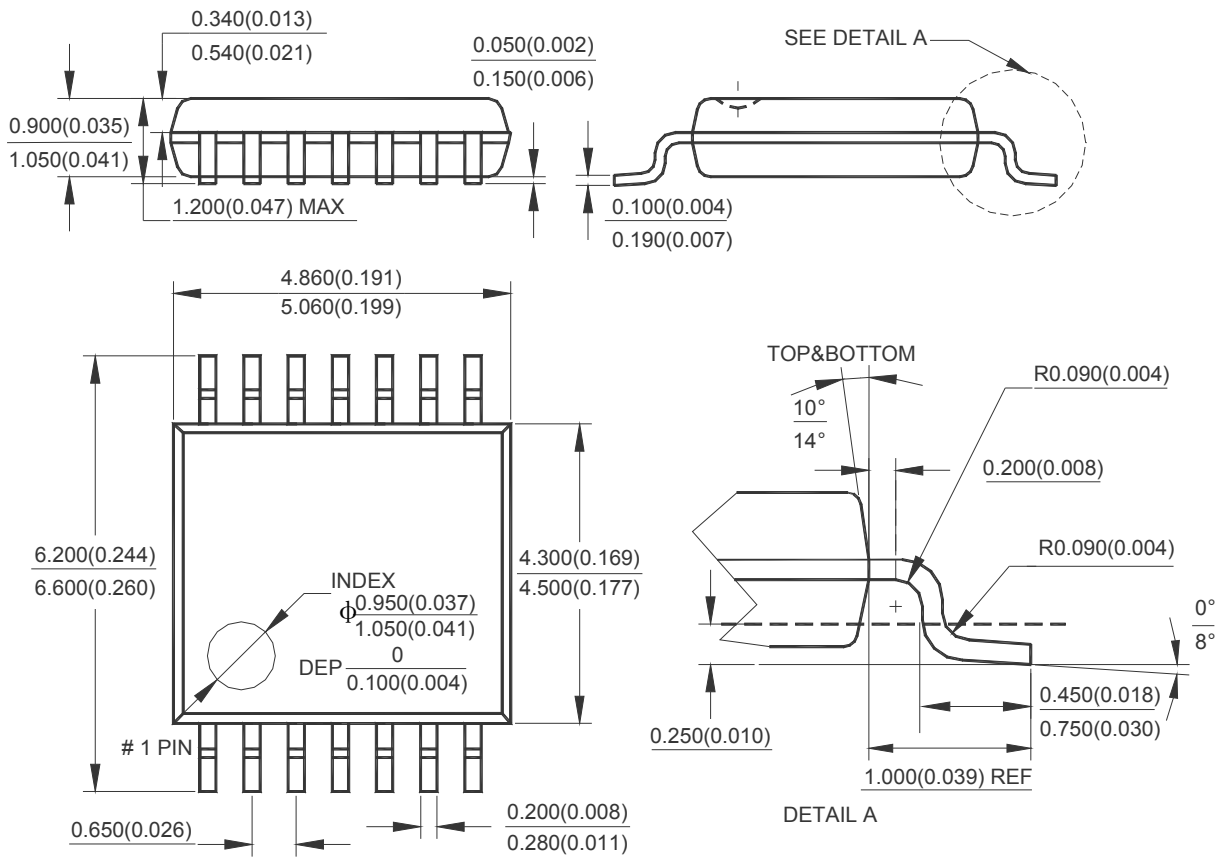
Note: Eject hole, oriented hole and mold mark is optional.



Mechanical Dimension (Continued)

TSSOP-14

Unit: mm(inch)



Note: Eject hole, oriented hole and mold mark is optional.



BCD Semiconductor Manufacturing Limited

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