Advanced Analog Circuits

Data Sheet

LOW POWER QUAD OPERATIONAL AMPLIFIERS AS324/324A

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 and DIP-14 packages.

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: ±1.5V to ±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

Pin Configuration

M/P/G Package
(SOIC-14/DIP-14/TSSOP-14)

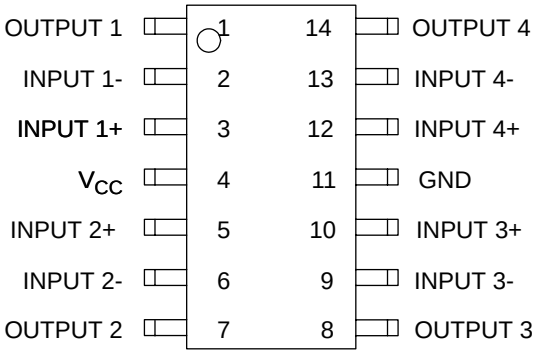


Figure 2. Pin Configuration of AS324/324A (Top View)

Functional Block Diagram

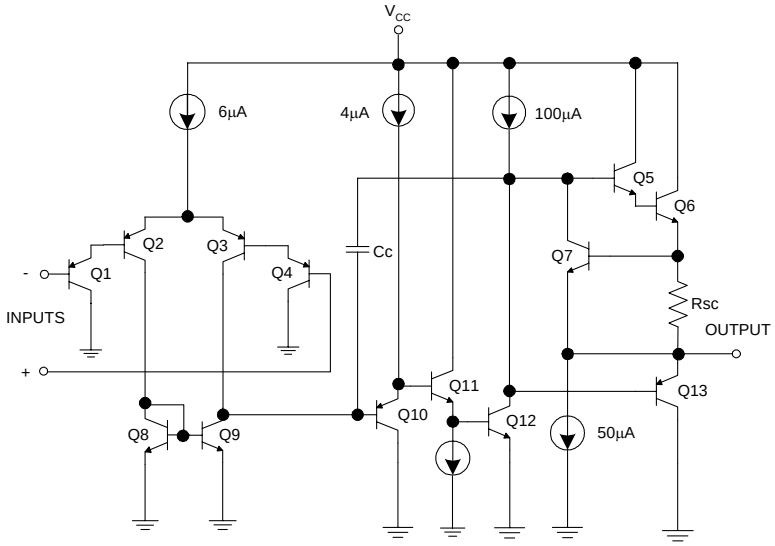
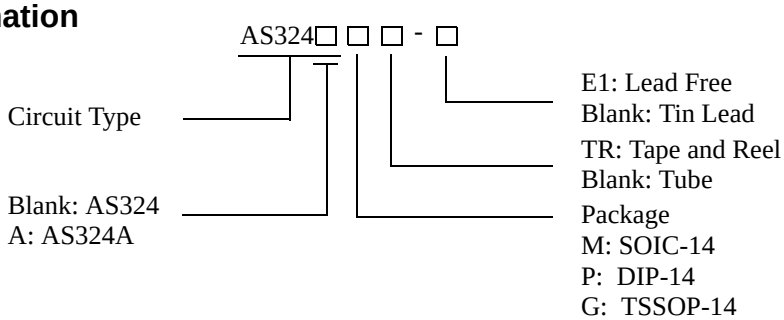


Figure 3. Functional Block Diagram of AS324/324A (Each Amplifier)

Ordering Information



Ordering Information (Continuation)

Package	Temperature Range	Part Number		Marking ID		Packing Type
		Tin Lead	Lead Free	Tin Lead	Lead Free	
SOIC-14	-40 to 85°C	AS324M	AS324M-E1	AS324M	AS324M-E1	Tube
		AS324MTR	AS324MTR-E1	AS324M	AS324M-E1	Tape & Reel
			AS324AM-E1		AS324AM-E1	Tube
			AS324AMTR-E1		AS324AM-E1	Tape & Reel
DIP-14		AS324P	AS324P-E1	AS324P	AS324P-E1	Tube
			AS324AP-E1		AS324AP-E1	Tube
TSSOP-14			AS324GTR-E1		EGS324	Tape & Reel
			AS324G-E1		EGS324	Tube

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

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°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

Electrical Characteristics

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

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

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

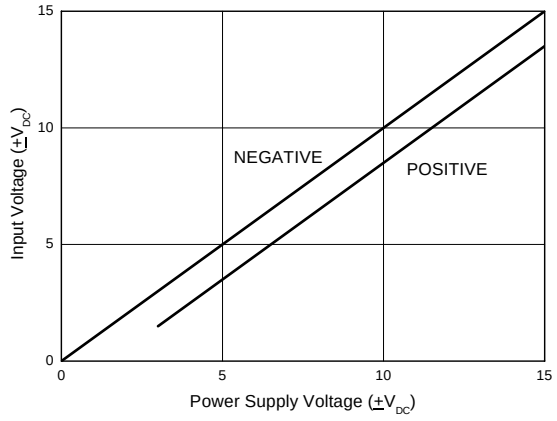


Figure 4. Input Voltage Range

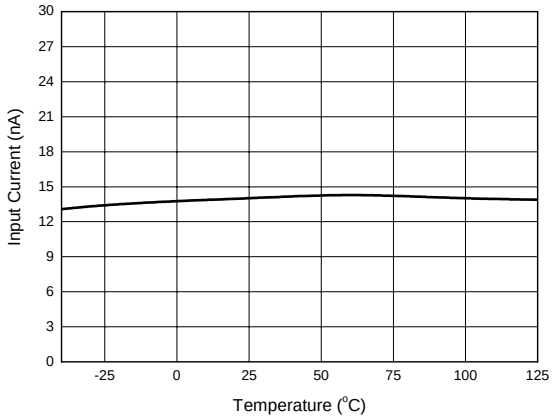


Figure 5. Input Current

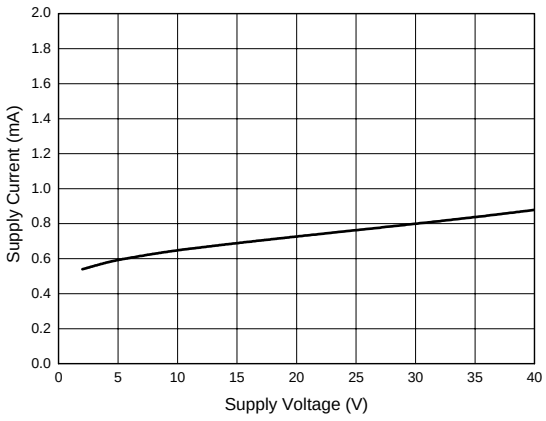


Figure 6. Supply Current

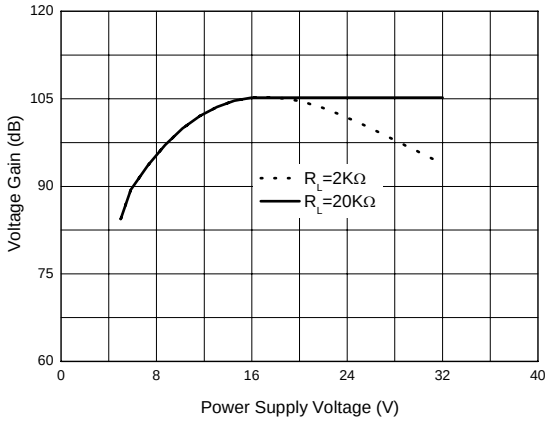


Figure 7. Voltage Gain

Typical Performance Characteristics (Continued)

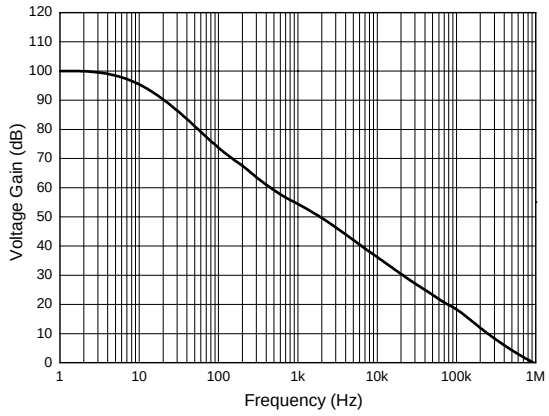


Figure 8. Open Loop Frequency Response

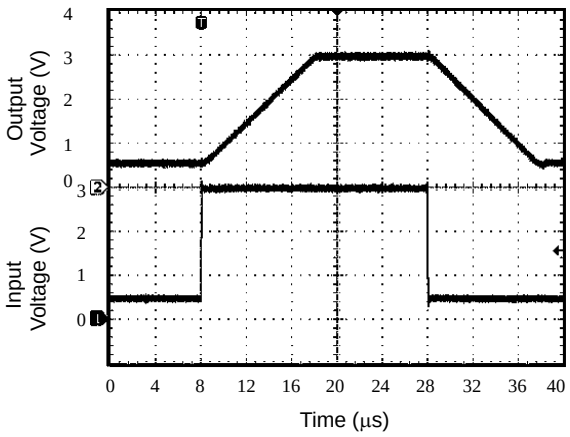


Figure 9. Voltage Follower Pulse Response

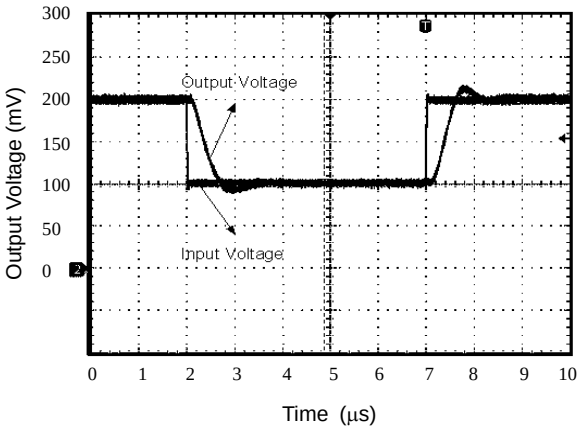


Figure 10. Voltage Follower Pulse Response (Small Signal)

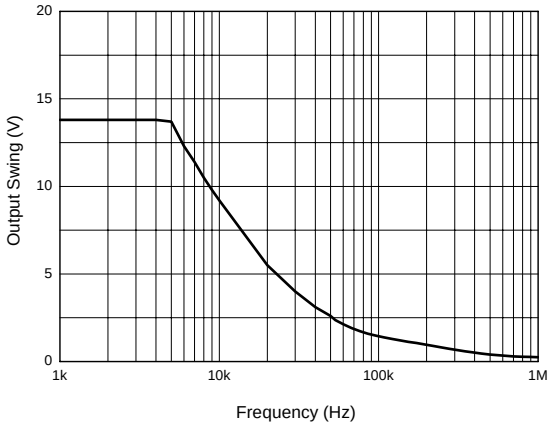


Figure 11. Large Signal Frequency Response

Typical Performance Characteristics (Continued)

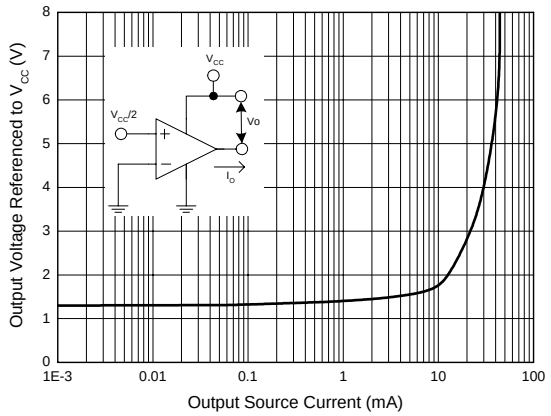


Figure 12. Output Characteristics: Current Sourcing

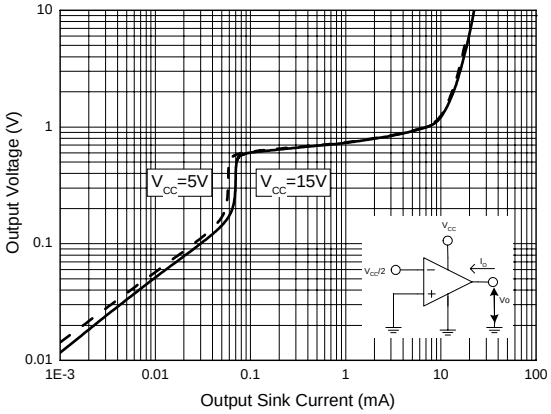


Figure 13. Output Characteristics: Current Sinking

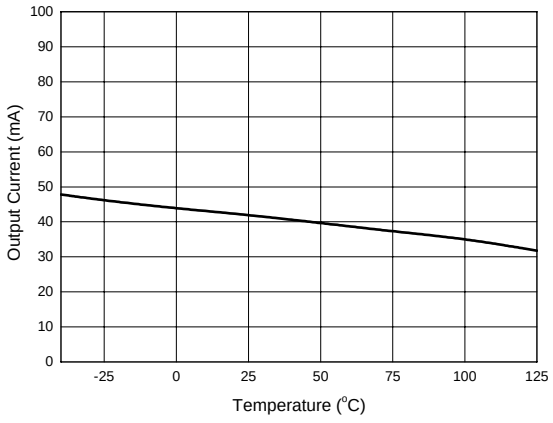


Figure 14. Current Limiting

Typical Applications

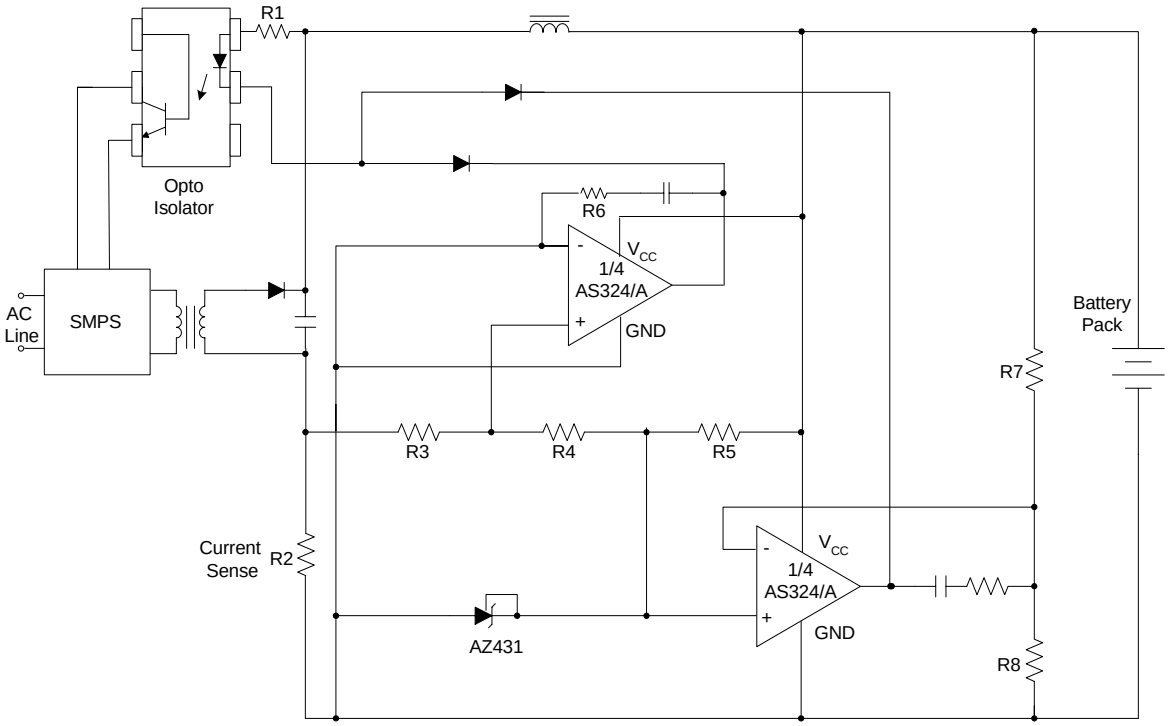


Figure 15. Battery Charger

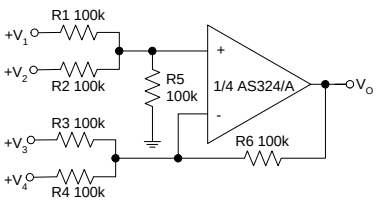


Figure 16. DC Summing Amplifier

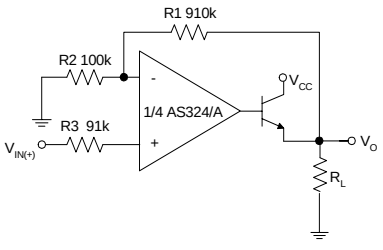


Figure 17. Power Amplifier

Typical Applications (Continued)

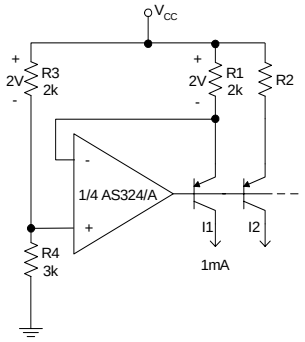


Figure 18. Fixed Current Sources

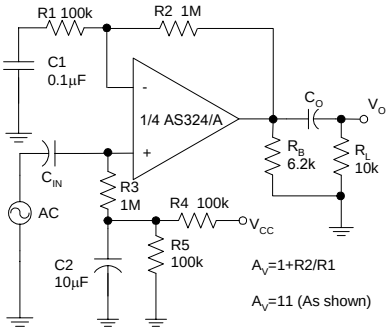


Figure 19. AC Coupled Non-Inverting Amplifier

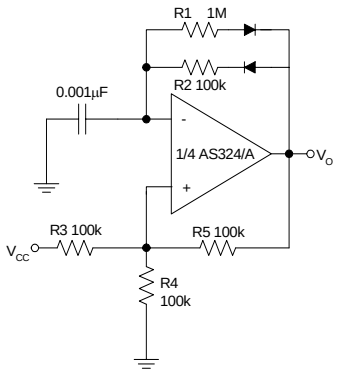


Figure 20. Pulse Generator

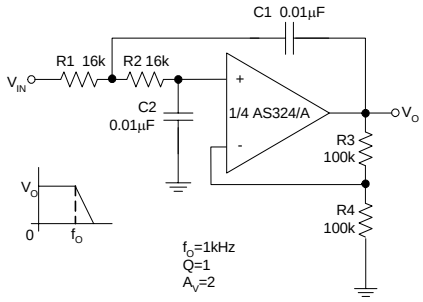
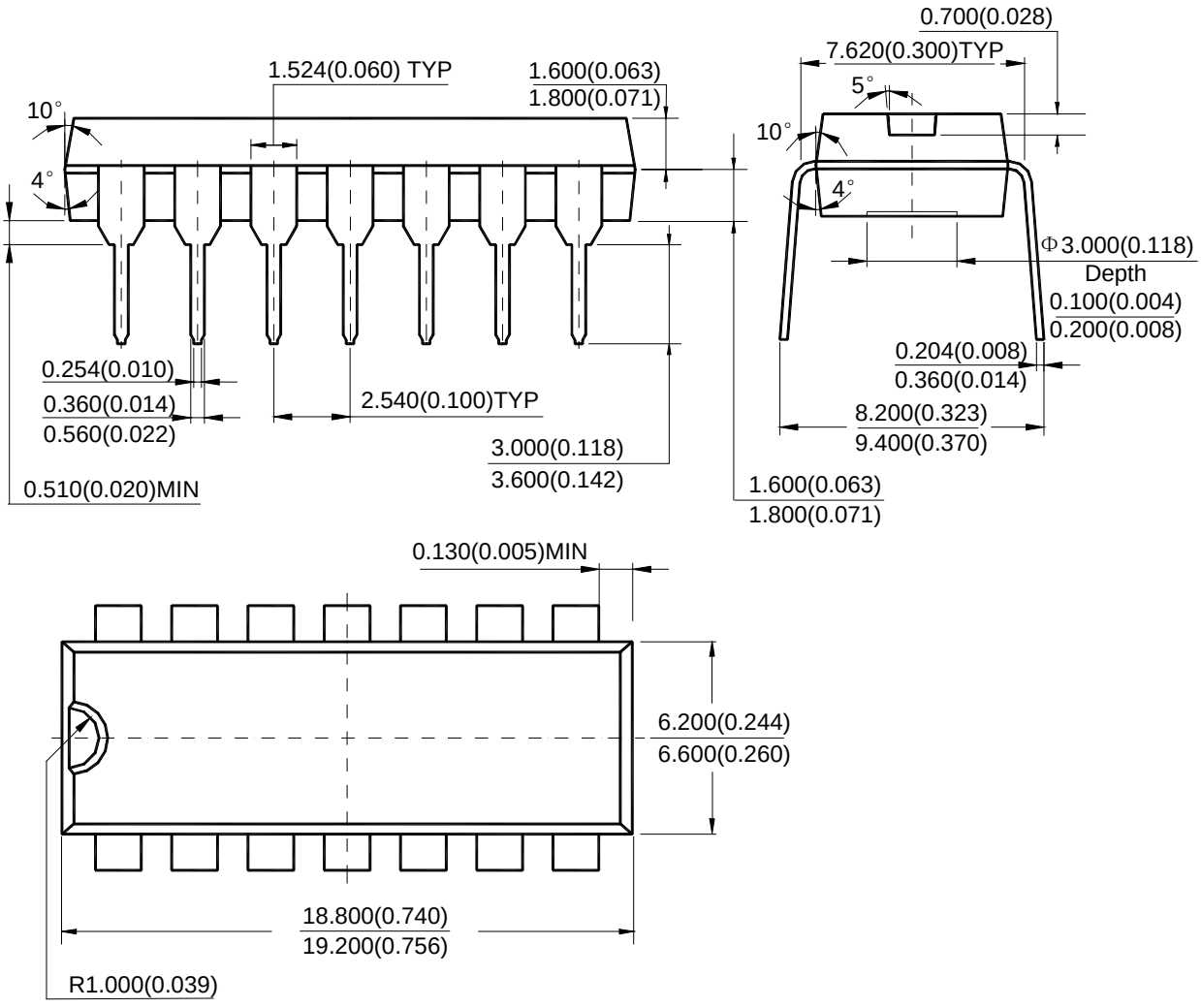


Figure 21. DC Coupled Low-Pass RC Active Filter

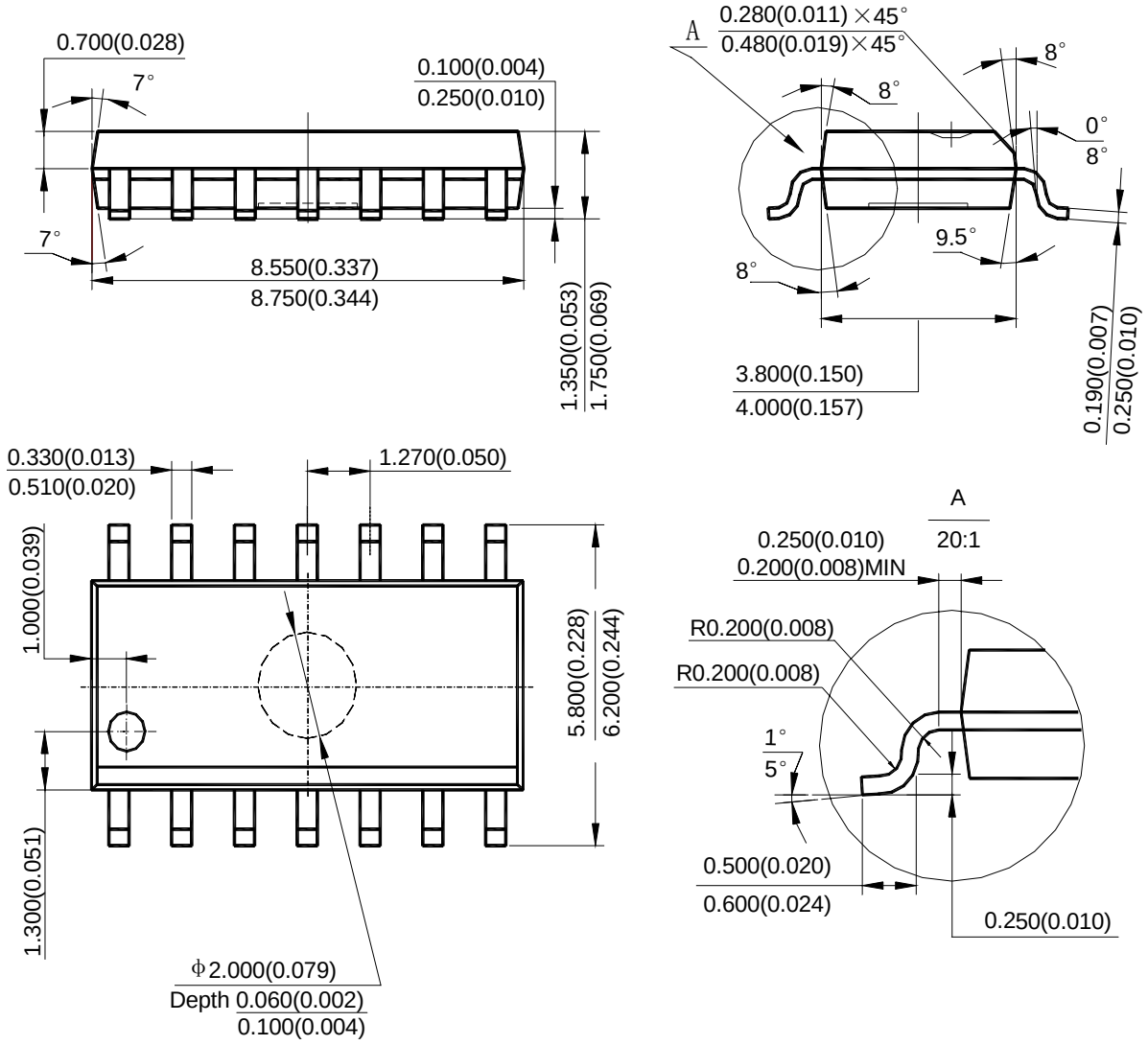
Mechanical Dimension

DIP-14 **Unit: mm(inch)**



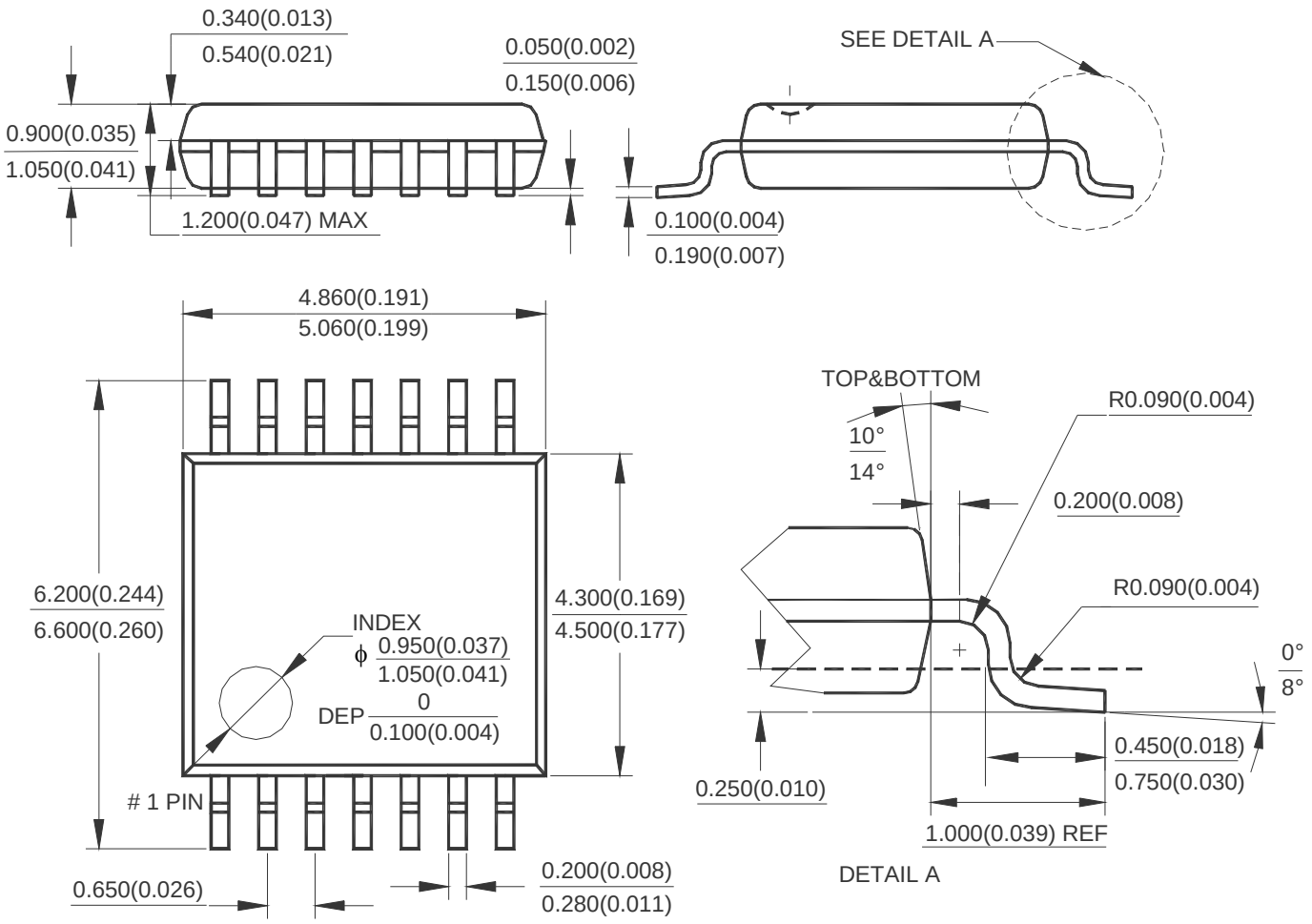
Mechanical Dimension (Continued)

SOIC-14 **Unit: mm(inch)**



Mechanical Dimension (Continued)

TSSOP-14 **Unit: mm(inch)**



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