

**LOW POWER QUAD OPERATIONAL AMPLIFIERS****AZ324****General Description**

The AZ324 consists of four independent, high gain and internally frequency compensated operational amplifiers. It is specifically designed to operate from a single power supply. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltages.

The AZ324 series are compatible with industry standard 324.

The AZ324 series are available in 2 Packages: DIP-14 and SOIC-14.

**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 18V
  - Dual Supplies:  $\pm 1.5V$  to  $\pm 9V$
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to  $V_{CC}-1.5V$
- Power Drain Suitable for Battery Operation

**Applications**

- Battery Charger
- Cordless Telephone
- Switching Power Supply

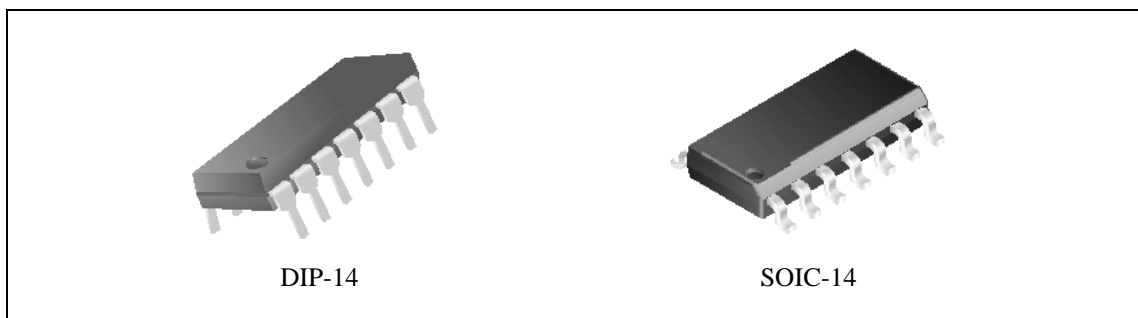


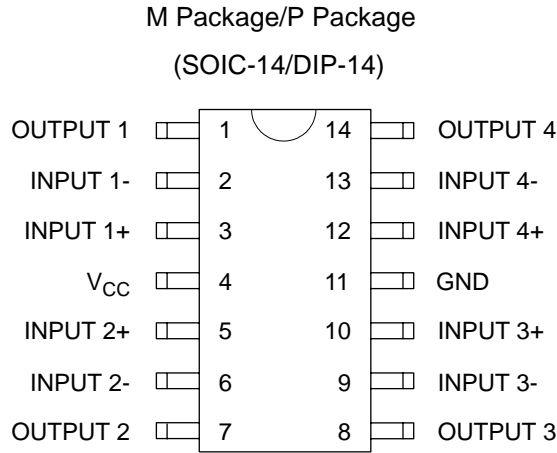
Figure 1. Package Types of AZ324



**LOW POWER QUAD OPERATIONAL AMPLIFIERS**

**AZ324**

**Pin Configuration**



Top View

Figure 2. Pin Configuration of AZ324

**Functional Block Diagram**

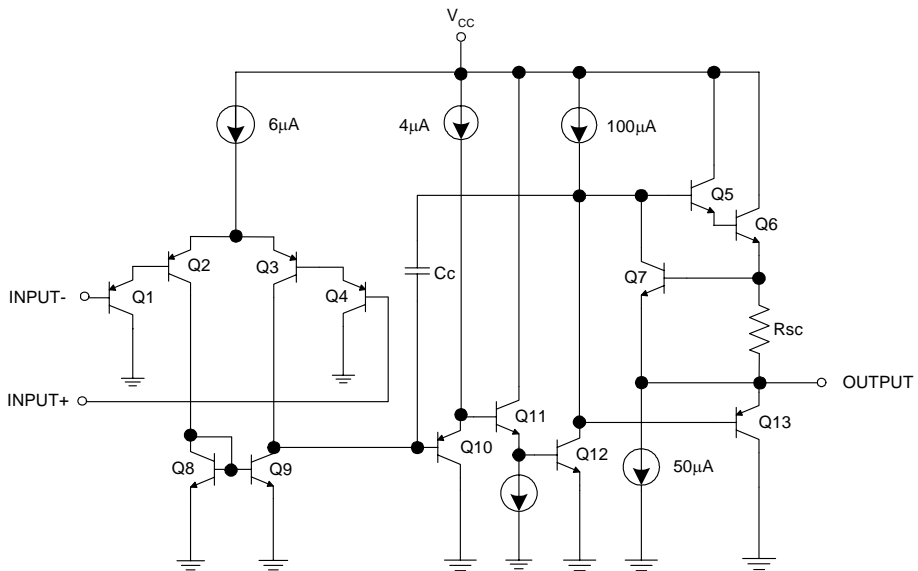


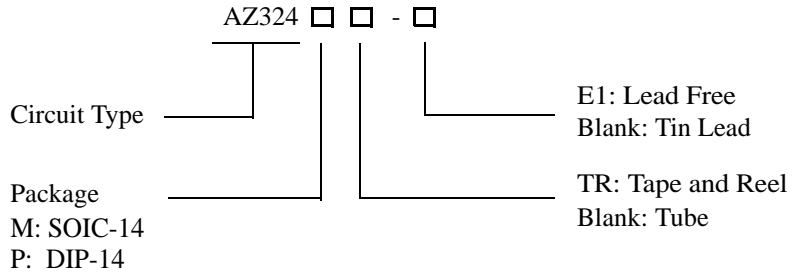
Figure 3. Functional Block Diagram of AZ324  
(Each Amplifier)



**LOW POWER QUAD OPERATIONAL AMPLIFIERS**

**AZ324**

**Ordering Information**



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Tin Lead	Lead Free	Tin Lead	Lead Free	
SOIC-14	-40 to 85 °C	AZ324M	AZ324M-E1	AZ324M	AZ324M-E1	Tube
		AZ324MTR	AZ324MTR-E1	AZ324M	AZ324M-E1	Tape & Reel
DIP-14	-40 to 85 °C	AZ324P	AZ324P-E1	AZ324P	AZ324P-E1	Tube

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

**LOW POWER QUAD OPERATIONAL AMPLIFIERS****AZ324****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	20	V
Differential Input Voltage	$V_{ID}$	20	V
Input Voltage	$V_{IC}$	-0.3 to 20	V
Input Current ( $V_{IN} < -0.3V$ ) (Note 2)		50	mA
Output Short Circuit to Ground (One Amplifier) $V_{CC} \leq 12V$ and $T_A = 25^\circ C$ (Note 3)		Continuous	
Power Dissipation ( $T_A = 25^\circ C$ )	$P_D$	DIP	1130
		SOIC	800
Operating Junction Temperature	$T_J$	150	$^\circ C$
Storage Temperature Range	$T_{STG}$	-65 to 150	$^\circ C$
Lead Temperature (Soldering, 10 Seconds)	$T_{LEAD}$	260	$^\circ C$

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 under these conditions is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Note 2: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the  $V_{CC}$  voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3V (at  $25^\circ C$ )

Note 3: Short circuits from the output to  $V_{CC}$  can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 40mA independent of the magnitude of  $V_{CC}$ . At values of supply voltage in excess of +12V, continuous short circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

**Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{CC}$	3	18	V
Ambient Operating Temperature Range	$T_A$	-40	85	$^\circ C$



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**Electrical Characteristics**

Operating Conditions:  $V_{CC}=5V$ ,  $GND=0V$ ,  $T_A=25\text{ }^\circ\text{C}$  unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Input Offset Voltage	$V_{IO}$	$V_O=1.4V$ , $R_S=0\Omega$ , $V_{CC}=5V$ to $15V$		2	5	mV	
Input Bias Current (Note 4)	$I_{BIAS}$	$I_{IN+}$ or $I_{IN-}$ , $V_{CM}=0V$		20	200	nA	
Input Offset Current	$I_{IO}$	$I_{IN+} - I_{IN-}$ , $V_{CM}=0V$		5	50	nA	
Input Common Mode Voltage Range (Note 5)	$V_{IR}$	$V_{CC}=15V$	0		$V_{CC}-1.5$	V	
Supply Current	$I_{CC}$	$R_L=\infty$ , Over full temperature range on all OP Amps	$V_{CC}=15V$	1	2	mA	
			$V_{CC}=5V$	0.5	1.2		
Large Signal Voltage Gain	$G_V$	$V_{CC}=15V$ , $R_L \geq 2k\Omega$ , $V_O=1V$ to $11V$	85	100		dB	
Common Mode Rejection Ratio	CMRR	DC, $V_{CC}=15V$ , $V_{CM}=0V$ to $(V_{CC}-1.5)V$	65	85		dB	
Power Supply Rejection Ratio	PSRR	$V_{CC}=5V$ to $15V$	70	90		dB	
Channel Separation (Note 6)	CS	$f=1KHz$ to $20KHz$ (Input Referred)		-120		dB	
Output Current	Source	$I_{SOURCE}$	$V_{IN+}=1V$ , $V_{IN-}=0V$ , $V_{CC}=15V$ , $V_O=2V$	20	45		mA
	Sink	$I_{SINK}$	$V_{IN+}=0V$ , $V_{IN-}=1V$ , $V_{CC}=15V$ , $V_O=2V$	10	20		mA
$V_{IN+}=0V$ , $V_{IN-}=1V$ , $V_{CC}=15V$ , $V_O=0.2V$			12	50		$\mu A$	
Output Short Circuit to Ground	$I_{SC}$	$V_{CC}=15V$		45	60	mA	
Output Voltage Swing	$V_{OH}$	$V_{CC}=15V$ , $R_L=2k\Omega$	12			V	
		$V_{CC}=15V$ , $R_L=10k\Omega$	12.5	13.5			
	$V_{OL}$	$V_{CC}=5V$ , $R_L=10k\Omega$		5	20	mV	

Note 4: The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.

Note 5: 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 +18V without damages, independent of the magnitude of the  $V_{CC}$ .

Note 6: Due to proximity of external components, insure that coupling is not originating via stray capacitors between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.



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**AZ324**

**Typical Performance Characteristics**

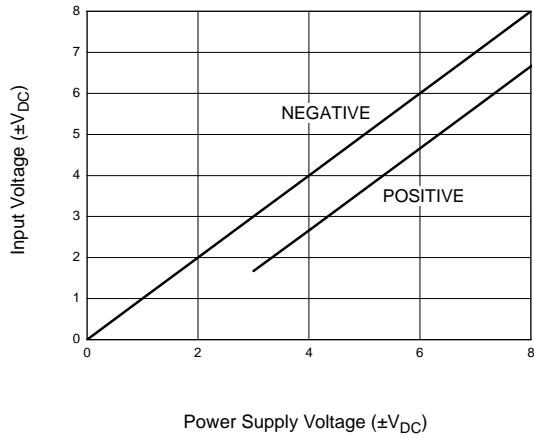


Figure 4. Input Voltage Range

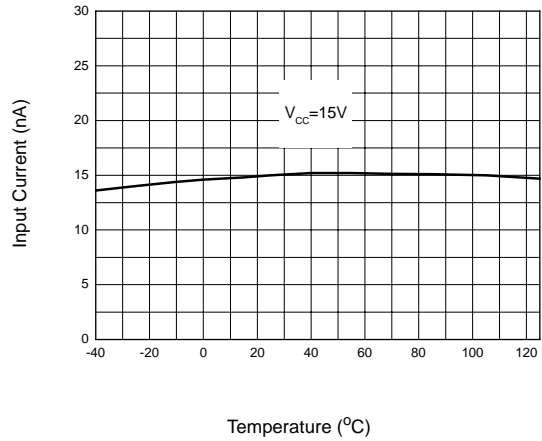


Figure 5. Input Current

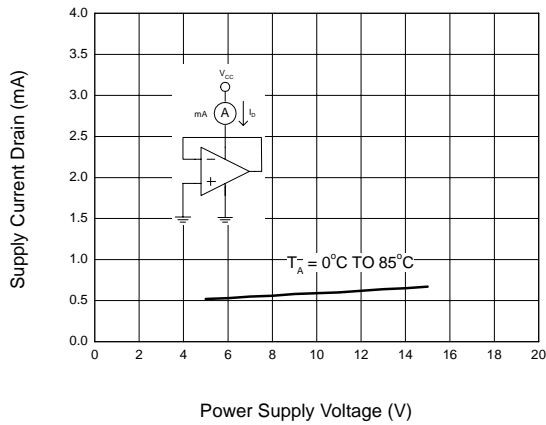


Figure 6. Supply Current

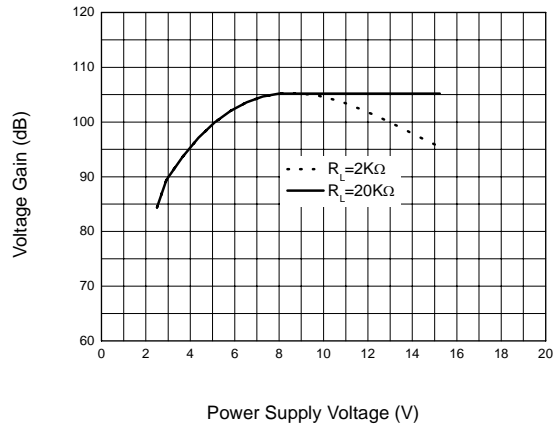


Figure 7. Voltage Gain



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**Typical Performance Characteristics (Continued)**

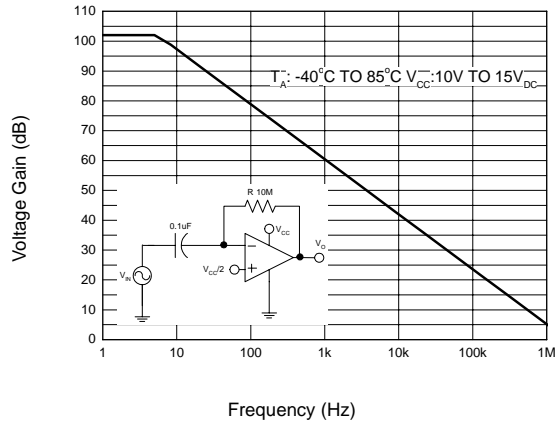


Figure 8. Open Loop Frequency Response

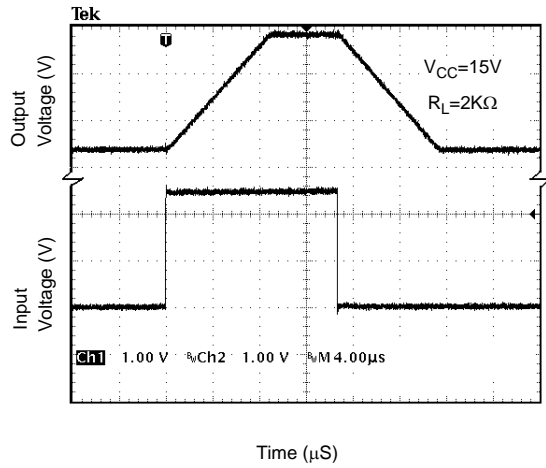


Figure 9. Voltage Follower Pulse Response

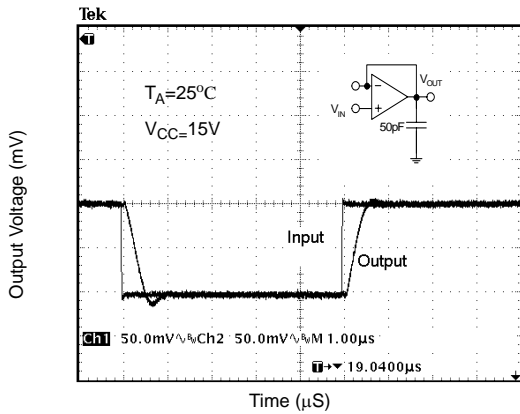


Figure 10. Voltage Follower Pulse Response (Small Signal)

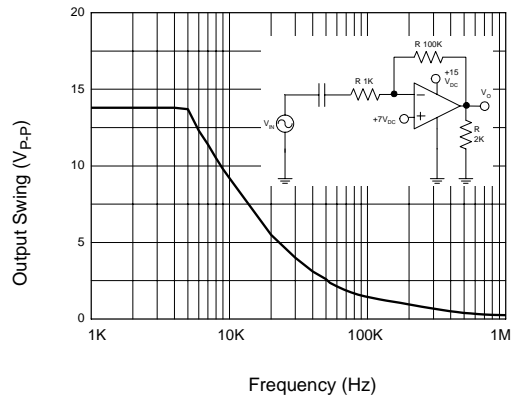


Figure 11. Large Signal Frequency Response



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**Typical Performance Characteristics (Continued)**

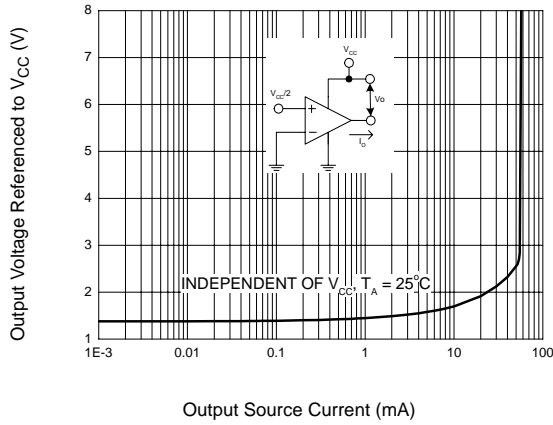


Figure 12. Output Characteristics Current Sourcing

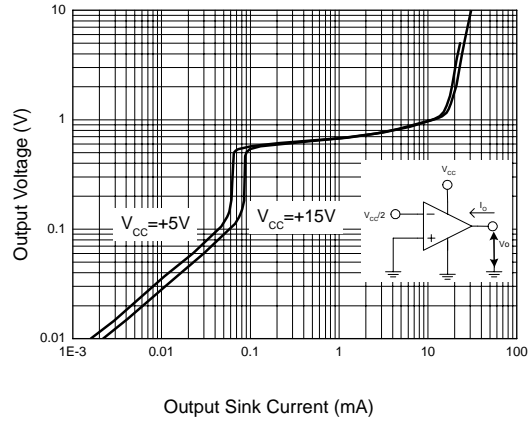


Figure 13. Output Characteristics Current Sinking

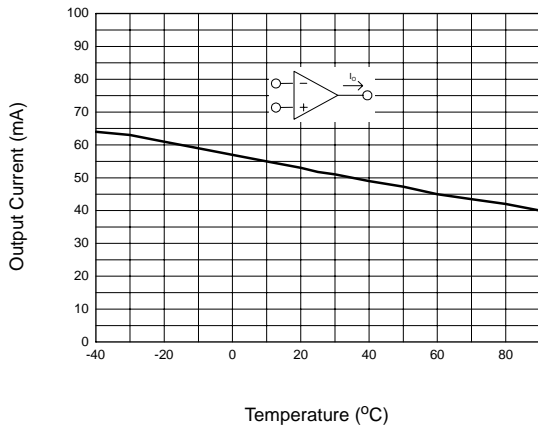


Figure 14. Current Limiting





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**Typical Applications**

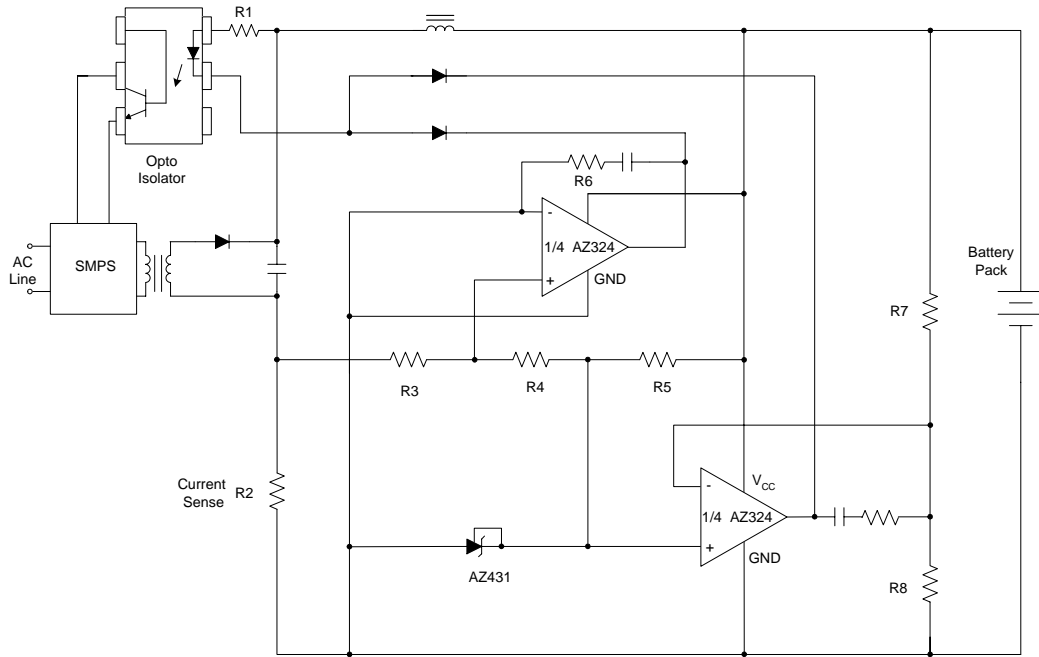


Figure 15. Battery Charger

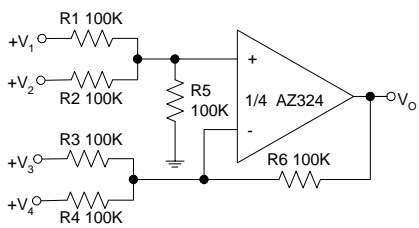


Figure 16. DC Summing Amplifier

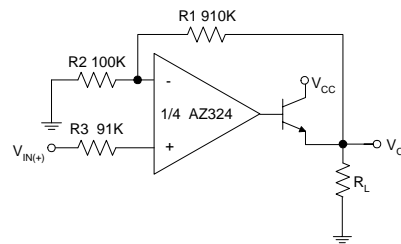


Figure 17. Power Amplifier



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**Typical Applications (Continued)**

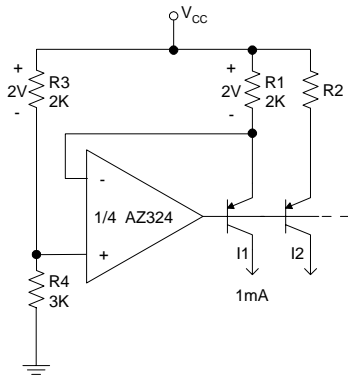


Figure 18. Fixed Current Sources

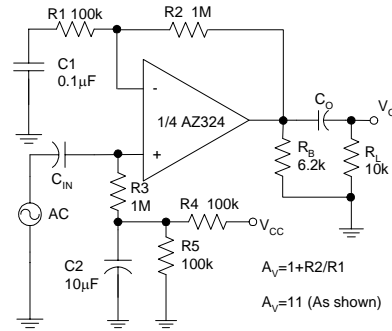


Figure 19. AC Coupled Non-Inverting Amplifier

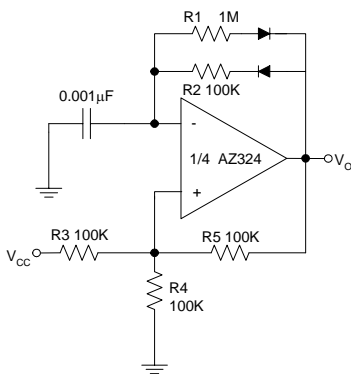


Figure 20. Pulse Generator

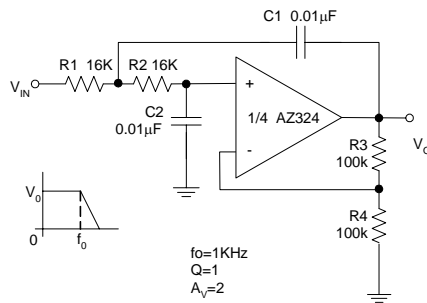


Figure 21. DC Coupled Low-Pass RC Active Filter



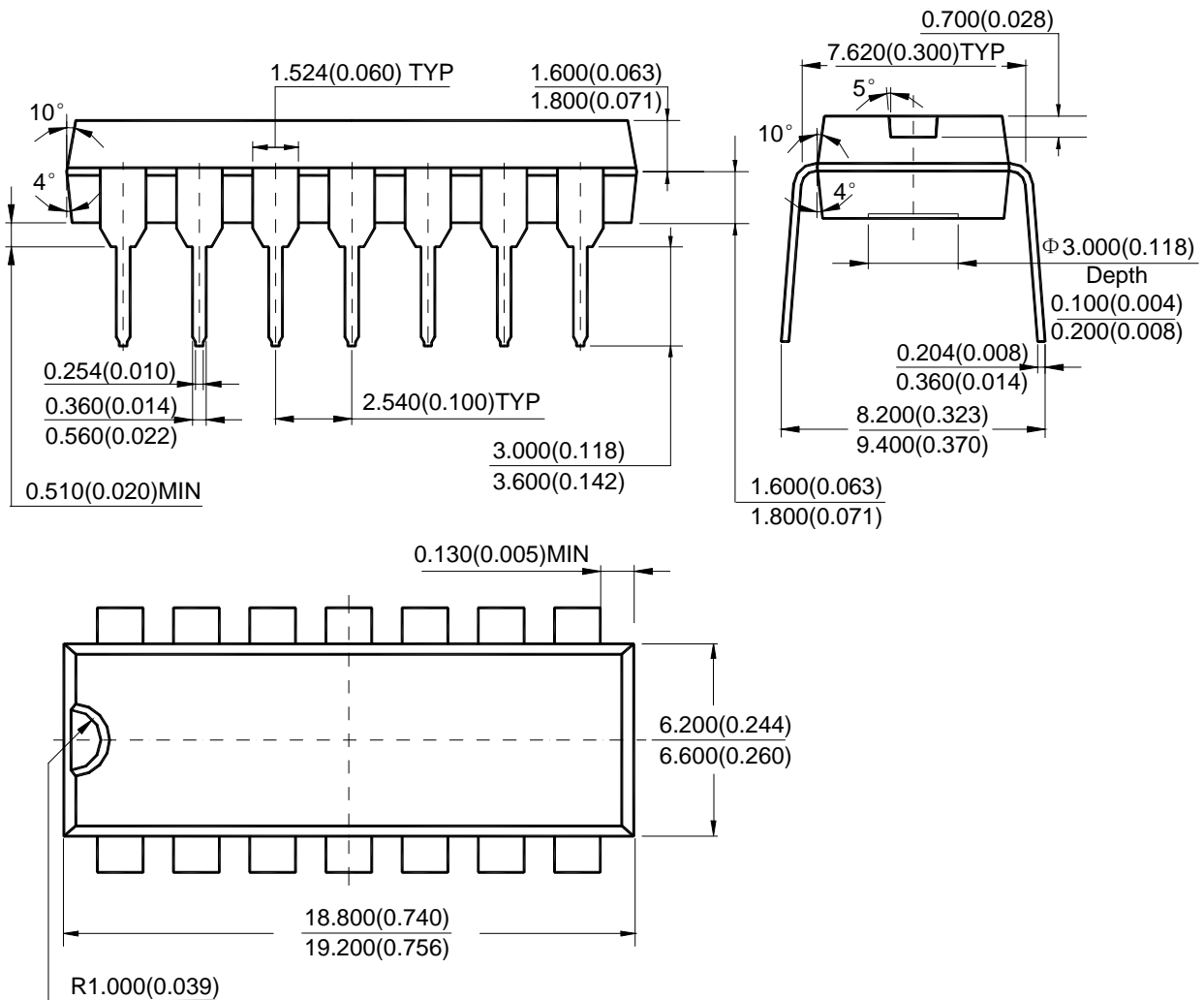
**LOW POWER QUAD OPERATIONAL AMPLIFIERS**

**AZ324**

**Mechanical Dimensions**

**DIP-14**

**Unit: mm(inch)**





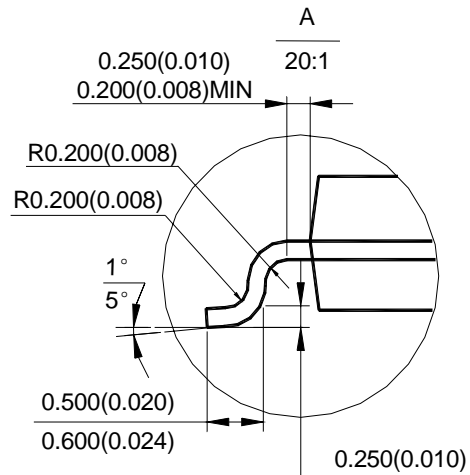
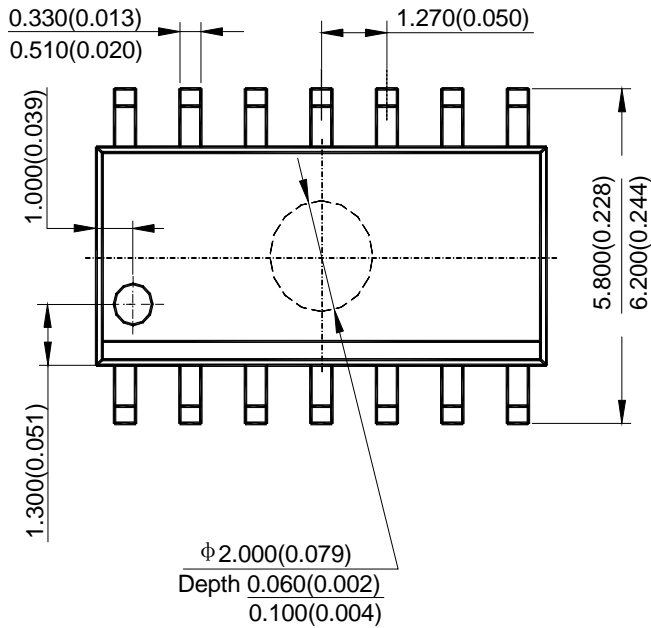
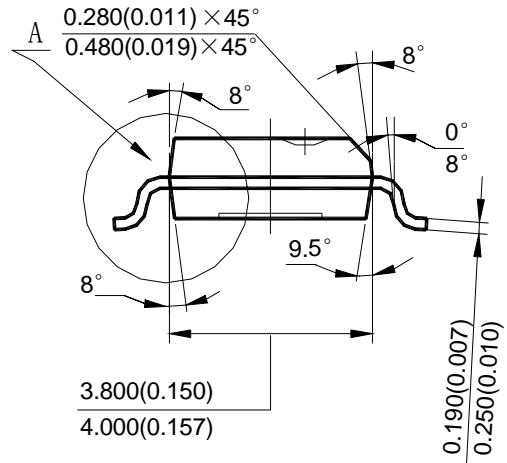
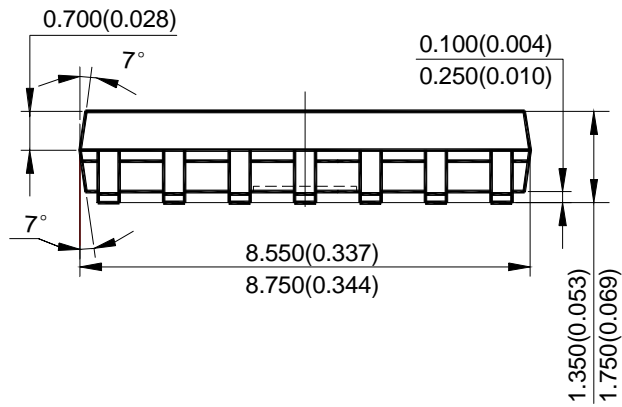
**LOW POWER QUAD OPERATIONAL AMPLIFIERS**

**AZ324**

**Mechanical Dimensions (Continued)**

**SOIC-14**

**Unit: mm(inch)**





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