

**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

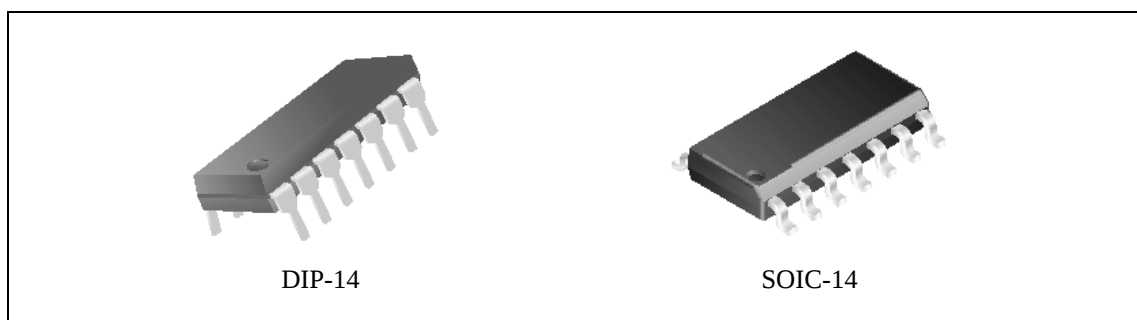


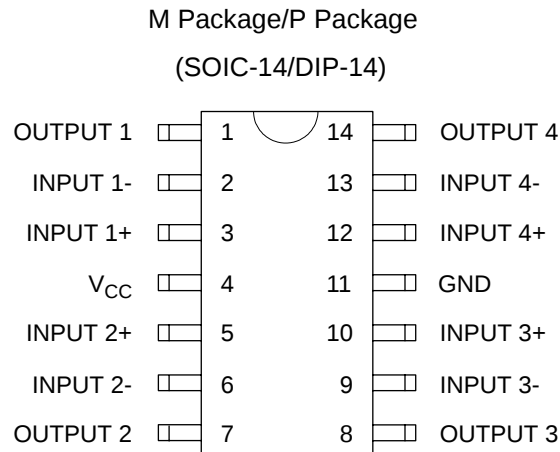
Figure 1. Package Types of AZ324



# LOW POWER QUAD OPERATIONAL AMPLIFIERS

**AZ324**

## Pin Configuration



Top View

Figure 2. Pin Configuration of AZ324

## Functional Block Diagram

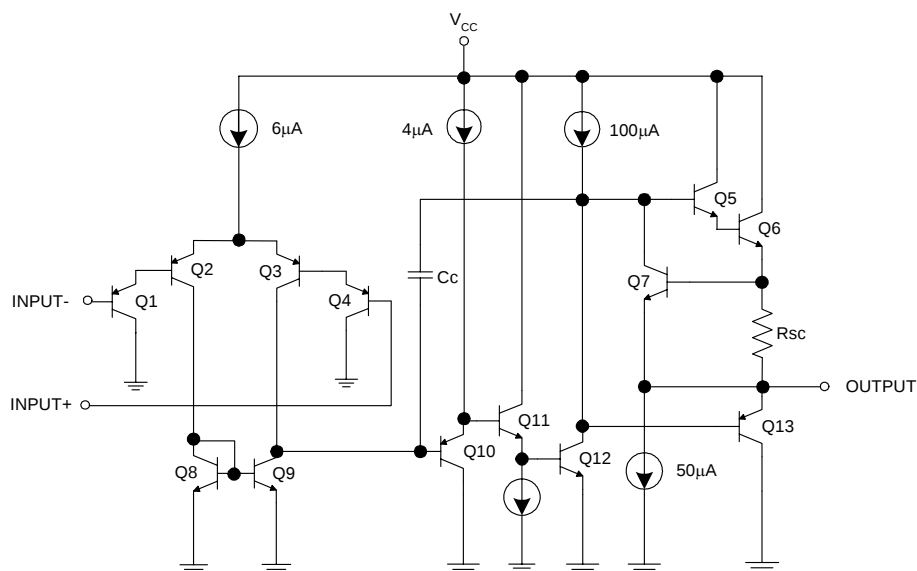
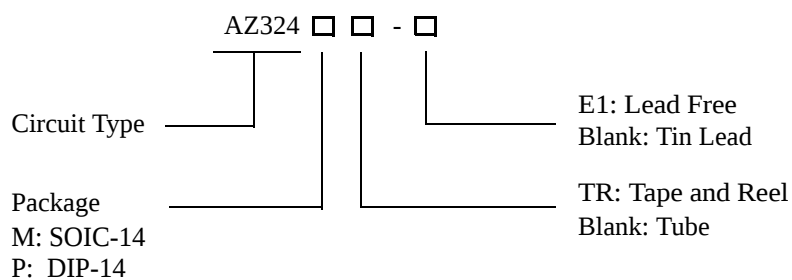


Figure 3. Functional Block Diagram of AZ324  
(Each Amplifier)

**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 | mW         |
|                                                                                                  |            | 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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**AZ324**

## Electrical Characteristics

Operating Conditions:  $V_{CC}=5V$ ,  $GND=0V$ ,  $T_A=25^{\circ}C$  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<br>(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 |                                                         |      |              | mA      |
|                                          |            | $V_{CC}=15V$                                              |                                                         | 1    | 2            |         |
|                                          |            | $V_{CC}=5V$                                               |                                                         | 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<br>(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  $25^{\circ}C$ ). The upper end of the common-mode voltage range is  $V_{CC}-1.5V$  (at  $25^{\circ}C$ ), but either or both inputs can go to +18V without damages, independent of the magnitude of the  $V_{CC}$ .

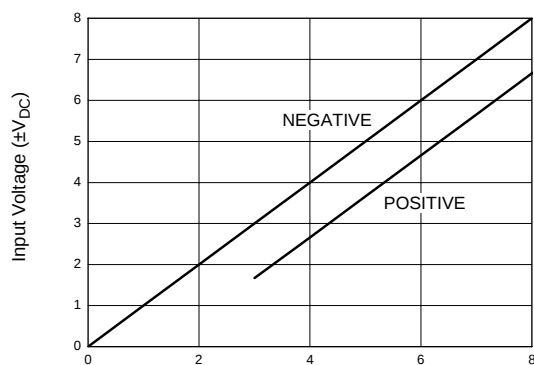
Note 6: Due to proximity of external components, insure that coupling is not originating via stray capacitors between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.



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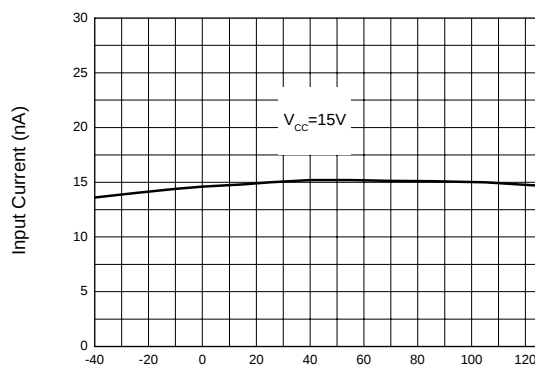
AZ324

## Typical Performance Characteristics



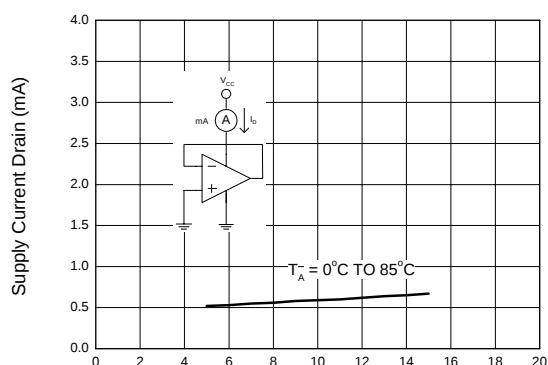
Power Supply Voltage ( $\pm V_{DC}$ )

Figure 4. Input Voltage Range



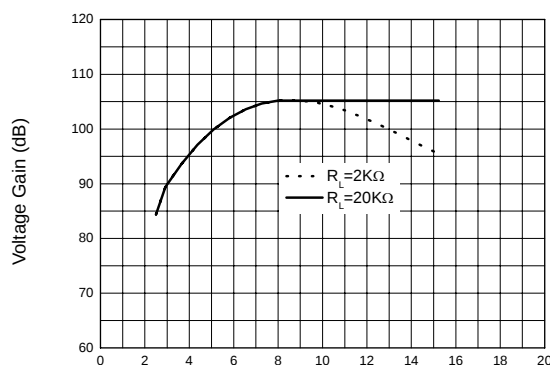
Temperature ( $^{\circ}\text{C}$ )

Figure 5. Input Current



Power Supply Voltage (V)

Figure 6. Supply Current



Power Supply Voltage (V)

Figure 7. Voltage Gain



# LOW POWER QUAD OPERATIONAL AMPLIFIERS

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## Typical Performance Characteristics (Continued)

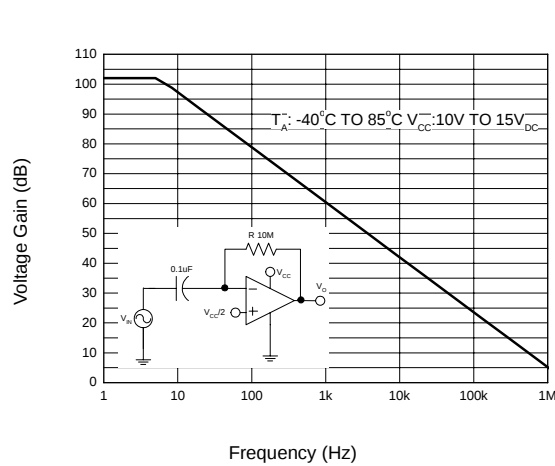


Figure 8. Open Loop Frequency Response

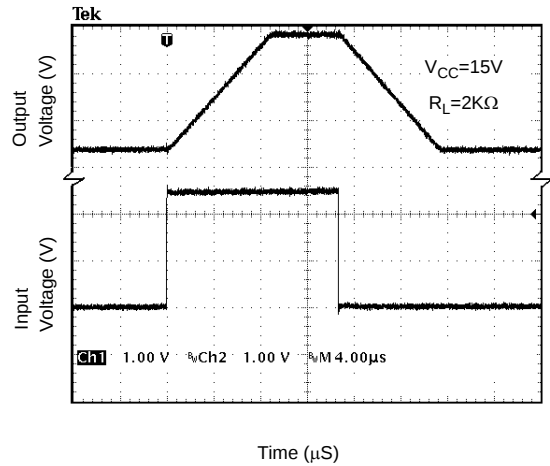


Figure 9. Voltage Follower Pulse Response

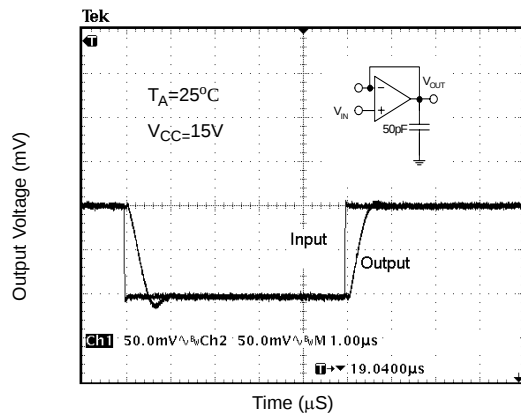


Figure 10. Voltage Follower Pulse Response (Small Signal)

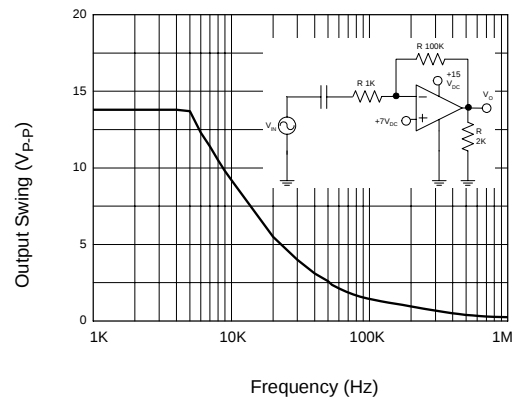


Figure 11. Large Signal Frequency Response

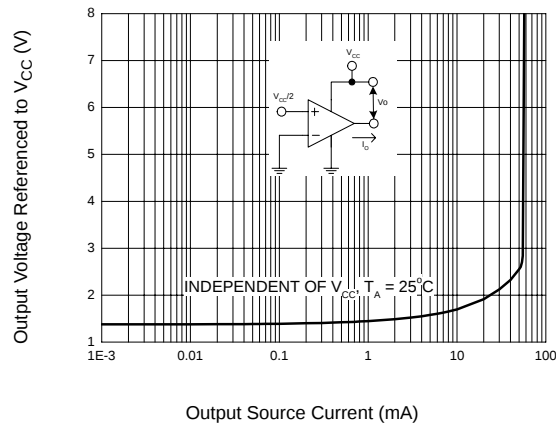
**LOW POWER QUAD OPERATIONAL AMPLIFIERS****AZ324****Typical Performance Characteristics (Continued)**

Figure 12. Output Characteristics Current Sourcing

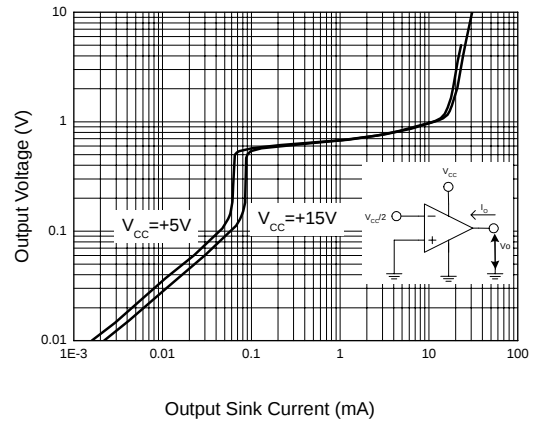


Figure 13. Output Characteristics Current Sinking

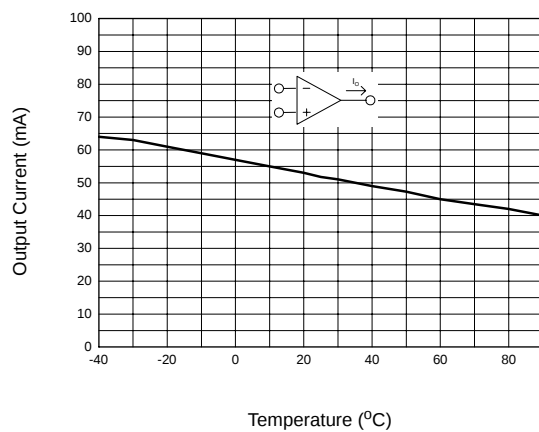


Figure 14. Current Limiting





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## Typical Applications (Continued)

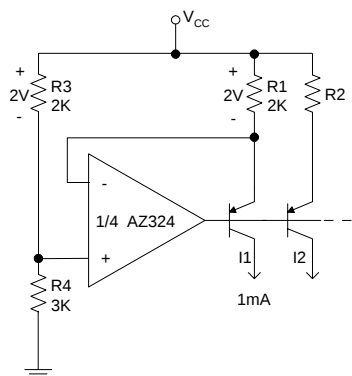


Figure 18. Fixed Current Sources

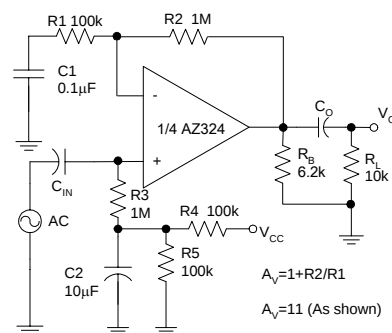


Figure 19. AC Coupled Non-Inverting Amplifier

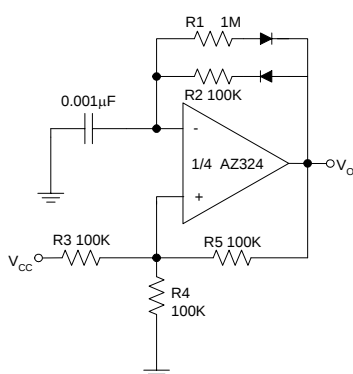


Figure 20. Pulse Generator

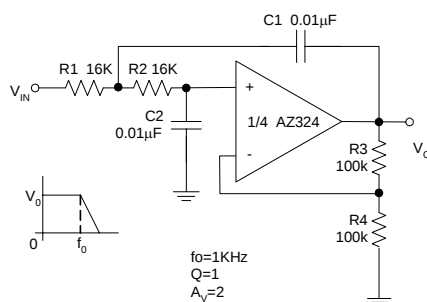
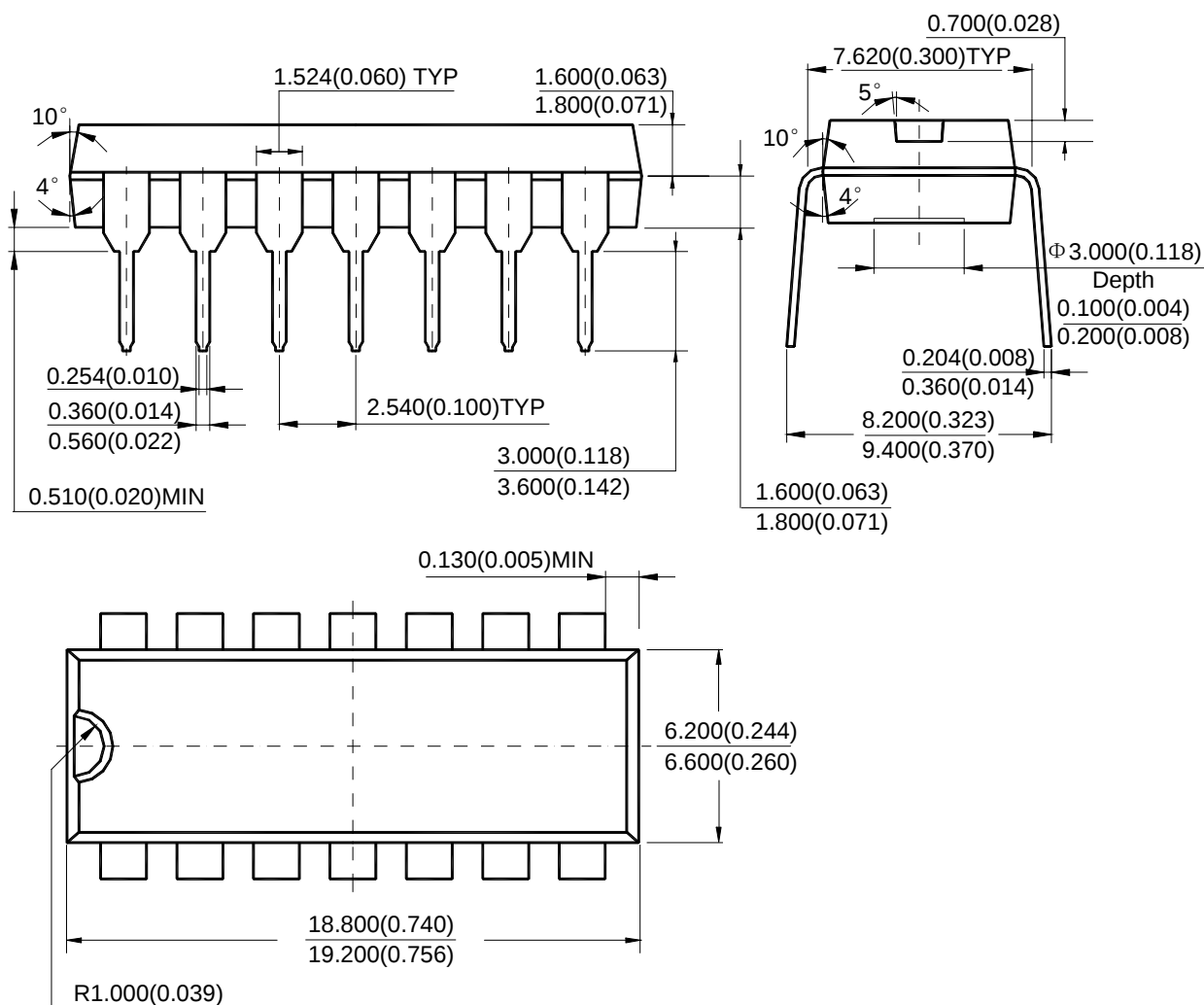


Figure 21. DC Coupled Low-Pass RC Active Filter



**DIP-14**

Unit: mm(inch)

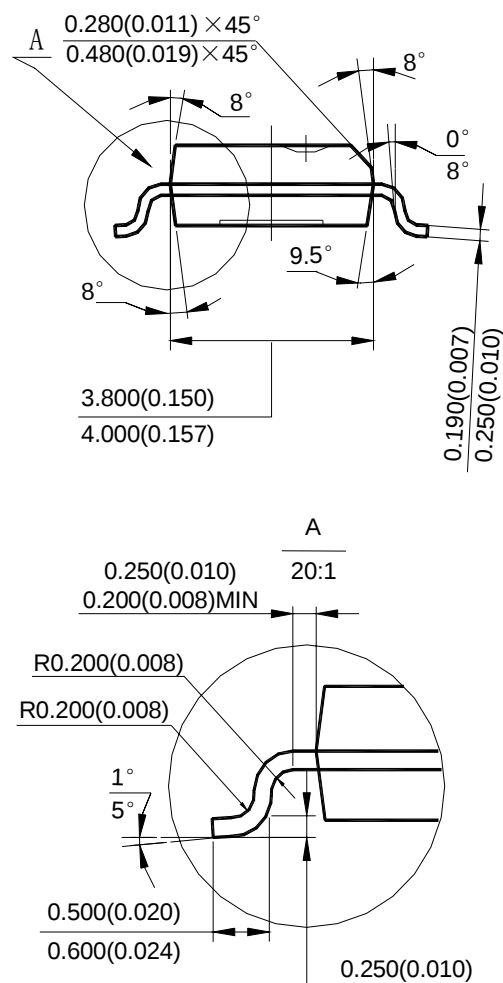
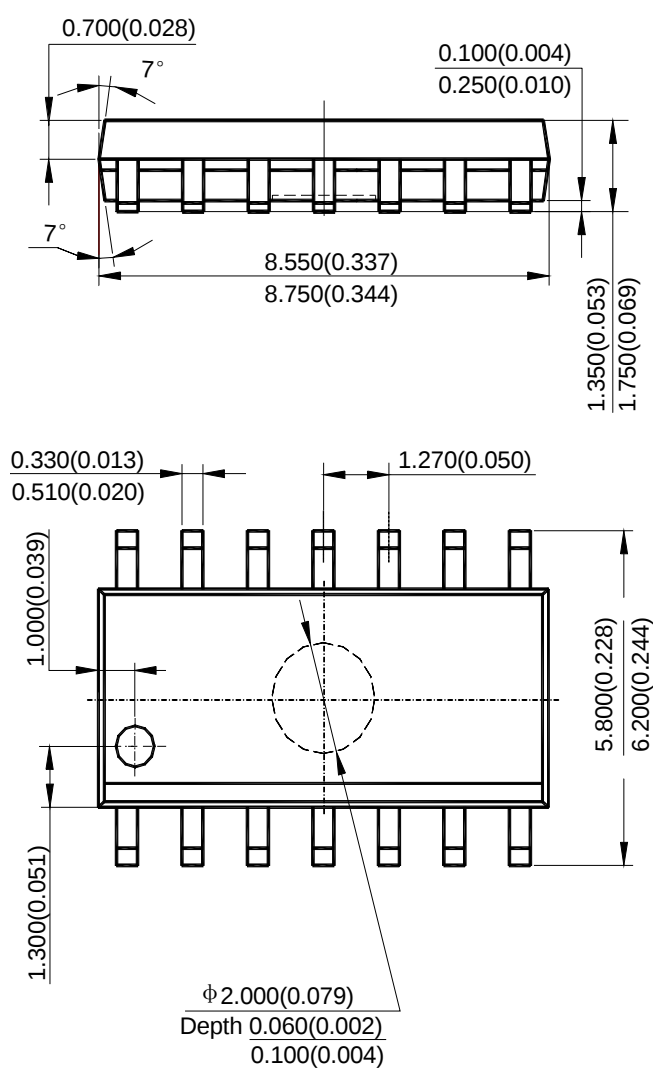




### Mechanical Dimensions (Continued)

**SOIC-14**

Unit: mm(inch)





BCD Semiconductor Manufacturing Limited

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#### MAIN SITE

**BCD Semiconductor Manufacturing Limited**  
- Wafer Fab  
**Shanghai SIM-BCD Semiconductor Manufacturing Limited**  
800, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

**BCD Semiconductor Manufacturing Limited**  
- IC Design Group  
**Advanced Analog Circuits (Shanghai) Corporation**  
8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

#### REGIONAL SALES OFFICE

**Shenzhen Office**  
**Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office**  
**Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office**  
27B, Tower C, 2070, Middle Shen Nan Road, Shenzhen 518031, China  
Tel: +86-755-8368 3987, Fax: +86-755-8368 3166

**Taiwan Office**  
**BCD Semiconductor (Taiwan) Company Limited**  
4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei, Taiwan  
Tel: +886-2-2656 2808, Fax: +886-2-2656 2806

**USA Office**  
**BCD Semiconductor Corporation**  
3170 De La Cruz Blvd., Suite 105, Santa Clara, CA 95054-2411, U.S.A  
Tel: +1-408-988 6388, Fax: +1-408-988 6386