

**LOW POWER DUAL OPERATIONAL AMPLIFIERS****AS358/358A****General Description**

The AS358/358A consist of two independent, high gain and internally frequency compensated operational amplifiers, they are 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. Typical applications include transducer amplifiers, DC gain blocks and most conventional operational amplifier circuits.

The AS358/358A series are compatible with industry standard 358. AS358A has more stringent input offset voltage than AS358.

The AS358 is available in DIP-8, SOIC-8, TSSOP-8 and MSOP-8 packages, AS358A is available in DIP-8 and SOIC-8 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:
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 $V_{CC}-1.5V$

Applications

- Battery Charger
- Cordless Telephone
- Switching Power Supply

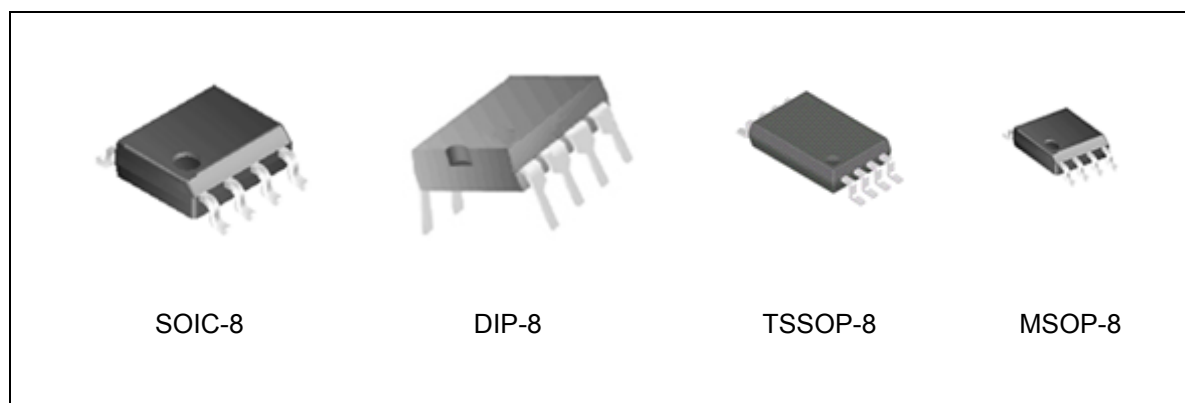


Figure 1. Package Types of AS358/358A

LOW POWER DUAL OPERATIONAL AMPLIFIERS

AS358/358A

Pin Configuration

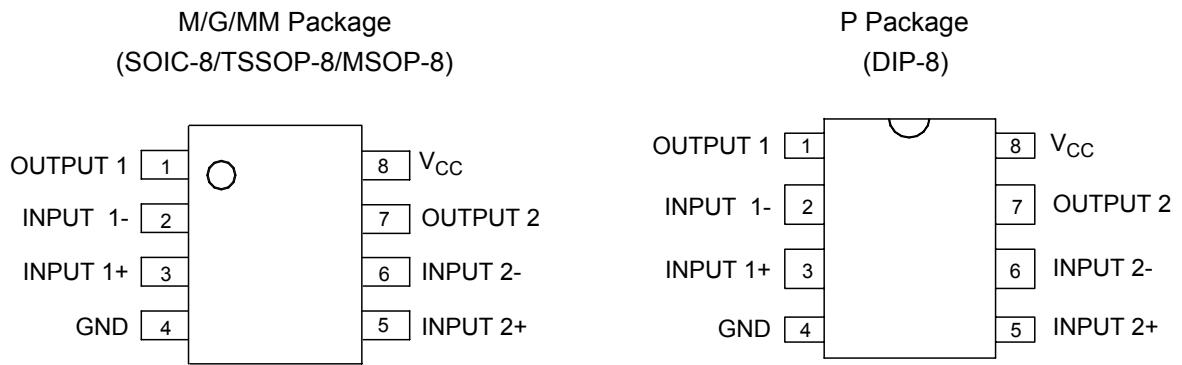


Figure 2. Pin Configuration of AS358/358A (Top View)

Functional Block Diagram

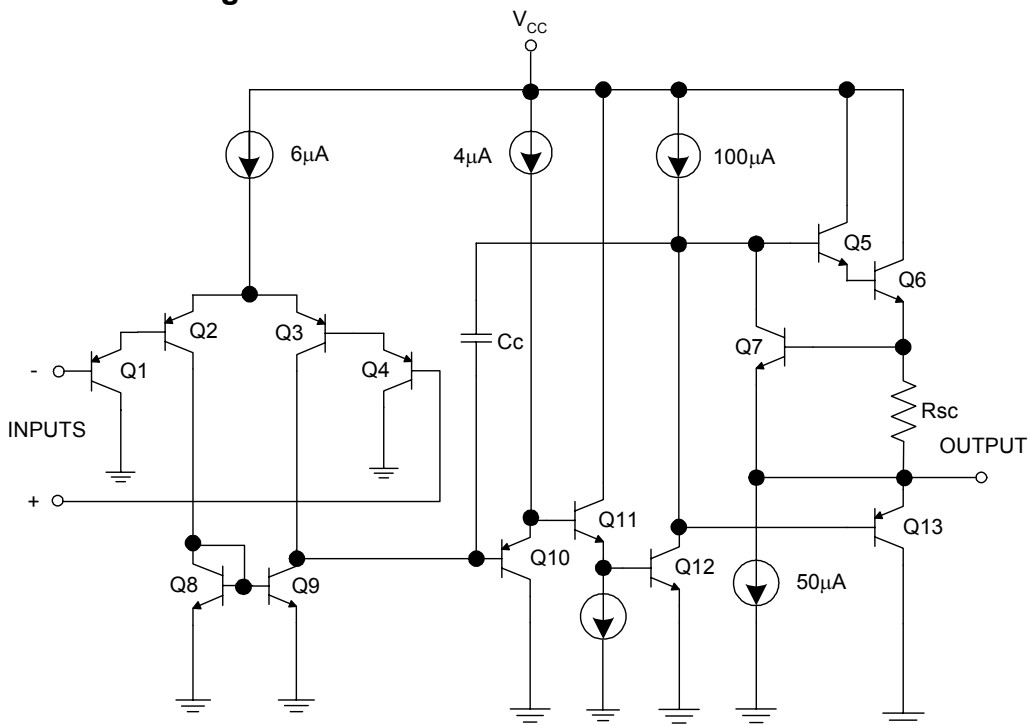
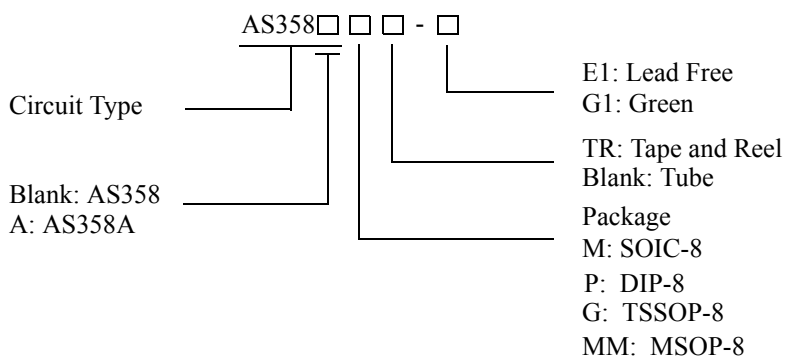


Figure 3. Functional Block Diagram of AS358/358A
(Each Amplifier)



LOW POWER DUAL OPERATIONAL AMPLIFIERS AS358/358A

Ordering Information



| Package | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---------|-------------------|--------------|--------------|------------|------------|--------------|
| | | Lead Free | Green | Lead Free | Green | |
| SOIC-8 | -40 to 85°C | AS358M-E1 | AS358M-G1 | AS358M-E1 | AS358M-G1 | Tube |
| | | AS358MTR-E1 | AS358MTR-G1 | AS358M-E1 | AS358M-G1 | Tape & Reel |
| | | AS358AM-E1 | AS358AM-G1 | AS358AM-E1 | AS358AM-G1 | Tube |
| | | AS358AMTR-E1 | AS358AMTR-G1 | AS358AM-E1 | AS358AM-G1 | Tape & Reel |
| DIP-8 | -40 to 85°C | AS358P-E1 | AS358P-G1 | AS358P-E1 | AS358P-G1 | Tube |
| | | AS358AP-E1 | AS358AP-G1 | AS358AP-E1 | AS358AP-G1 | Tube |
| TSSOP-8 | -40 to 85°C | AS358G-E1 | AS358G-G1 | EG3A | GG3A | Tube |
| | | AS358GTR-E1 | AS358GTR-G1 | EG3A | GG3A | Tape & Reel |
| MSOP-8 | -40 to 85°C | AS358MM-E1 | AS358MM-G1 | AS358MM-E1 | AS358MM-G1 | Tube |
| | | AS358MMTR-E1 | AS358MMTR-G1 | AS358MM-E1 | AS358MM-G1 | Tape & Reel |

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.

**LOW POWER DUAL OPERATIONAL AMPLIFIERS****AS358/358A****Absolute Maximum Ratings (Note 1)**

| Parameter | Symbol | Value | Unit | |
|--|------------|------------|------------------|----|
| Power Supply Voltage | V_{CC} | 40 | V | |
| Differential Input Voltage | V_{ID} | 40 | V | |
| Input Voltage | V_{IC} | -0.3 to 40 | V | |
| Power Dissipation ($T_A=25^\circ\text{C}$) | P_D | DIP-8 | 830 | mW |
| | | SOIC-8 | 550 | |
| | | TSSOP-8 | 500 | |
| | | MSOP-8 | 470 | |
| Operating Junction Temperature | T_J | 150 | $^\circ\text{C}$ | |
| Storage Temperature Range | T_{STG} | -65 to 150 | $^\circ\text{C}$ | |
| Lead Temperature (Soldering, 10 Seconds) | T_{LEAD} | 260 | $^\circ\text{C}$ | |

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 | $^\circ\text{C}$ |



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Electrical Characteristics

Limits in standard typeface are for $T_A=25^{\circ}\text{C}$, **bold** typeface applies over -40°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 | AS358 | | 2 | 5 | mV |
| | | | | | | 7 | |
| | | | AS358A | | 2 | 3 | |
| | | | | | | 5 | |
| 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 Bias Current | I_{BIAS} | I_{IN+} or I_{IN-} , $V_{CM}=0\text{V}$ | | 20 | 200 | nA | |
| | | | | | 200 | | |
| Input Offset Current | I_{IO} | $I_{IN+} - I_{IN-}$, $V_{CM}=0\text{V}$ | | 5 | 30 | nA | |
| | | | | | 100 | | |
| 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 , $R_L=\infty$, $V_{CC}=30\text{V}$ | | 0.7 | 2 | mA | |
| | | $T_A=-40$ to 85°C , $R_L=\infty$, $V_{CC}=5\text{V}$ | | 0.5 | 1.2 | | |
| Large Signal Voltage Gain | G_V | $V_{CC}=15\text{V}$, $V_O=1\text{V}$ to 11V , $R_L \geq 2\text{k}\Omega$ | 85 | 100 | | dB | |
| | | | 80 | | | | |
| Common Mode Rejection Ratio | CMRR | DC, $V_{CM}=0\text{V}$ to $(V_{CC}-1.5)\text{V}$ | 60 | 70 | | dB | |
| | | | 60 | | | | |
| Power Supply Rejection Ratio | PSRR | $V_{CC}=5\text{V}$ 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-8 | | 53 | | $^{\circ}\text{C}/\text{W}$ | |
| | | SOIC-8 | | 78 | | | |

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



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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

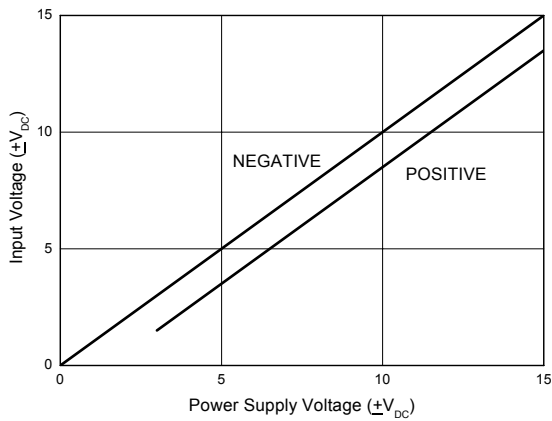


Figure 4. Input Voltage Range

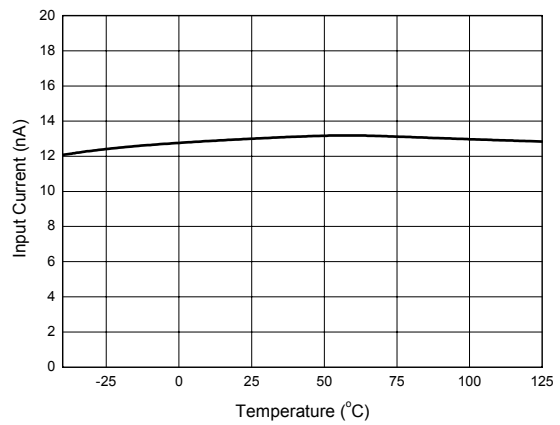


Figure 5. Input Current

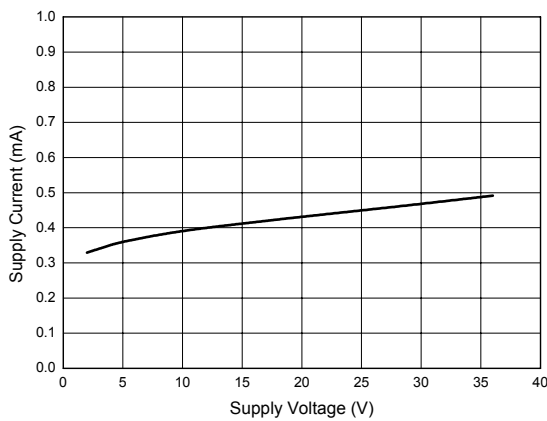


Figure 6. Supply Current

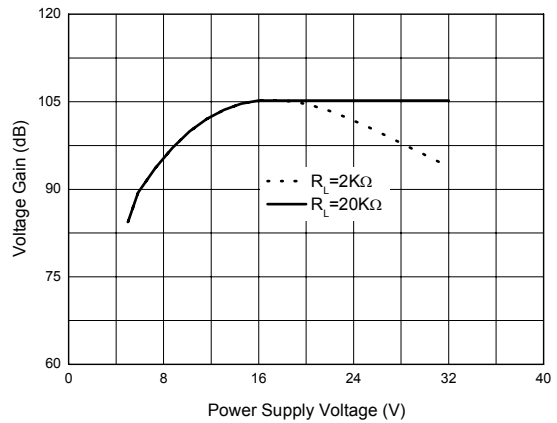


Figure 7. Voltage Gain



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Typical Performance Characteristics (Continued)

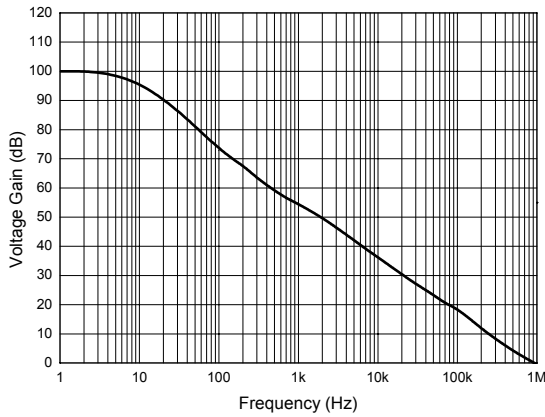


Figure 8. Open Loop Frequency Response

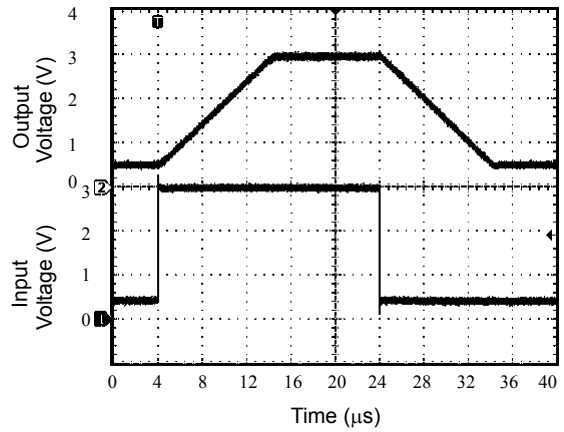


Figure 9. Voltage Follower Pulse Response

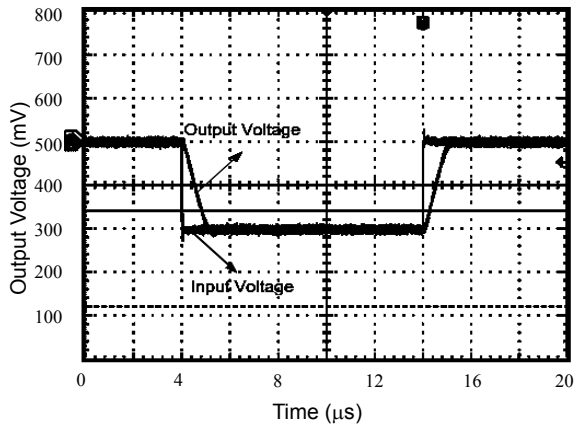


Figure 10. Voltage Follower Pulse Response (Small Signal)

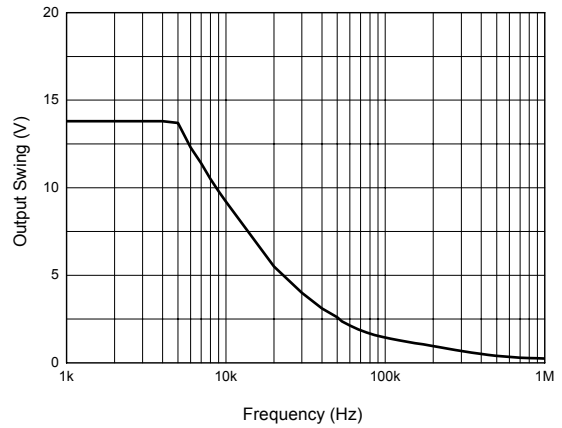


Figure 11. Large Signal Frequency Response



Typical Performance Characteristics (Continued)

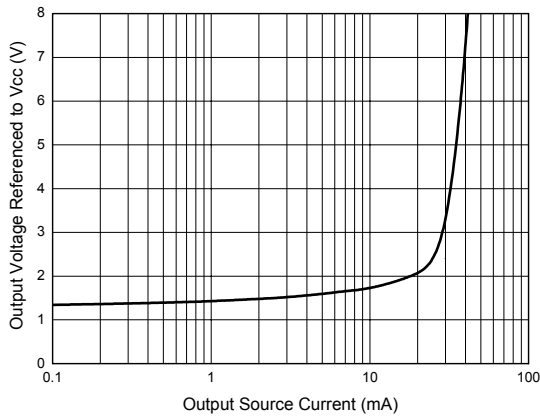


Figure 12. Output Characteristics: Current Sourcing

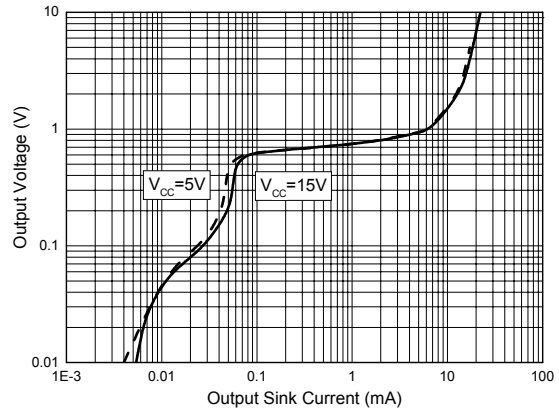


Figure 13. Output Characteristics: Current Sinking

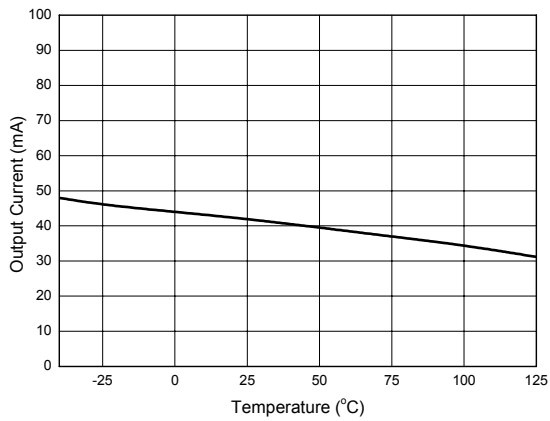


Figure 14. Current Limiting

Typical Application

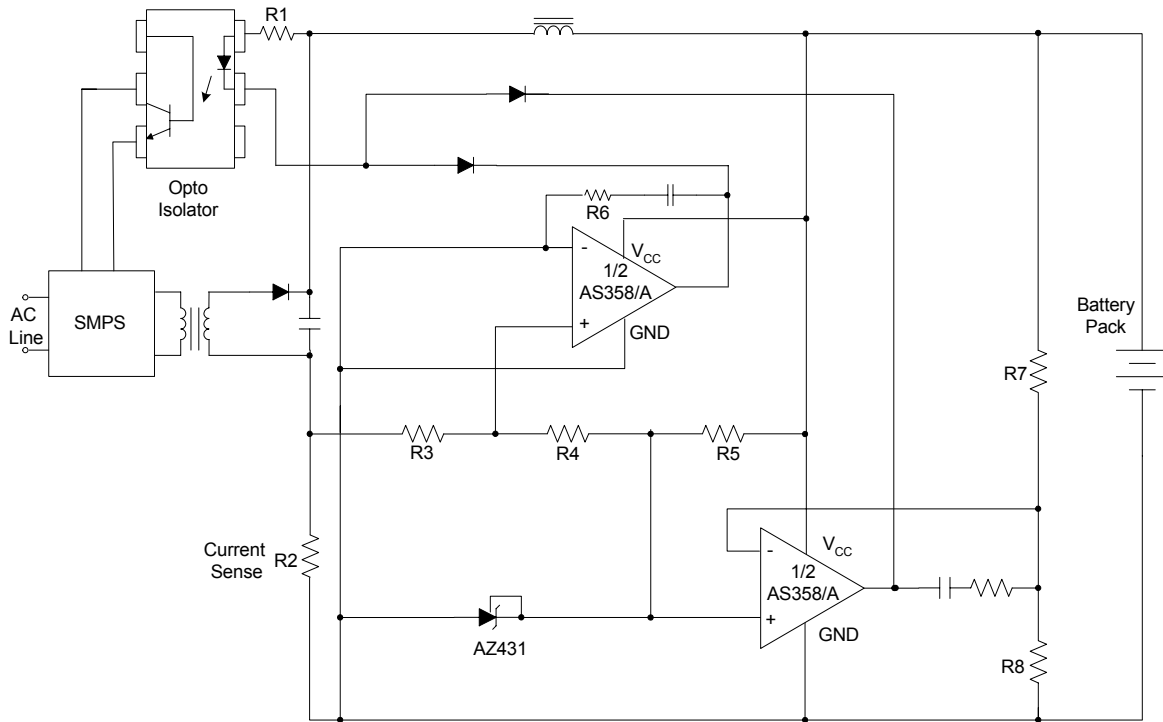


Figure 15. Battery Charger

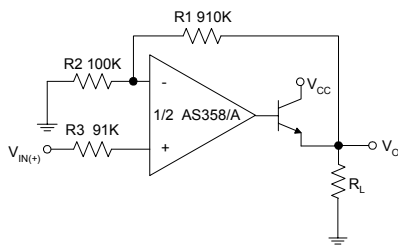


Figure 16. Power Amplifier

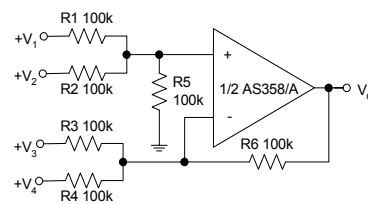


Figure 17. DC Summing Amplifier

Typical Application (Continued)

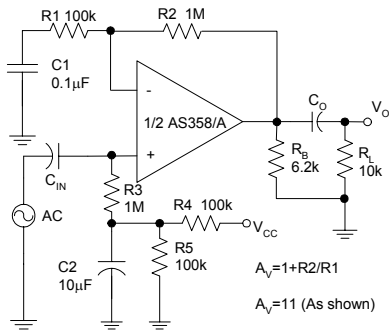


Figure 18. AC Coupled Non-Inverting Amplifier

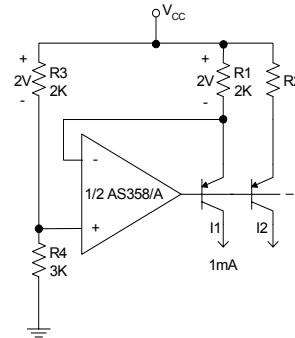


Figure 19. Fixed Current Sources

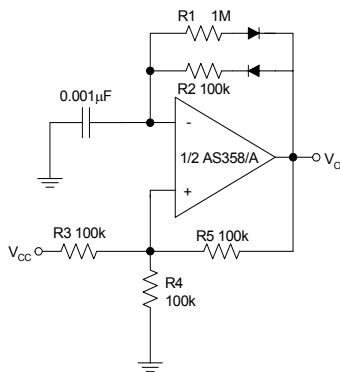


Figure 20. Pulse Generator

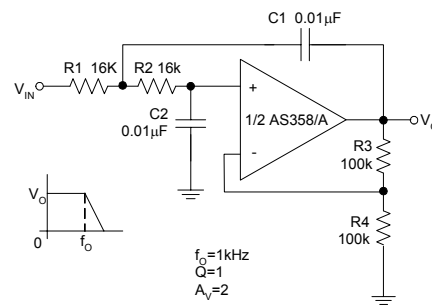


Figure 21. DC Coupled Low-Pass Active Filter



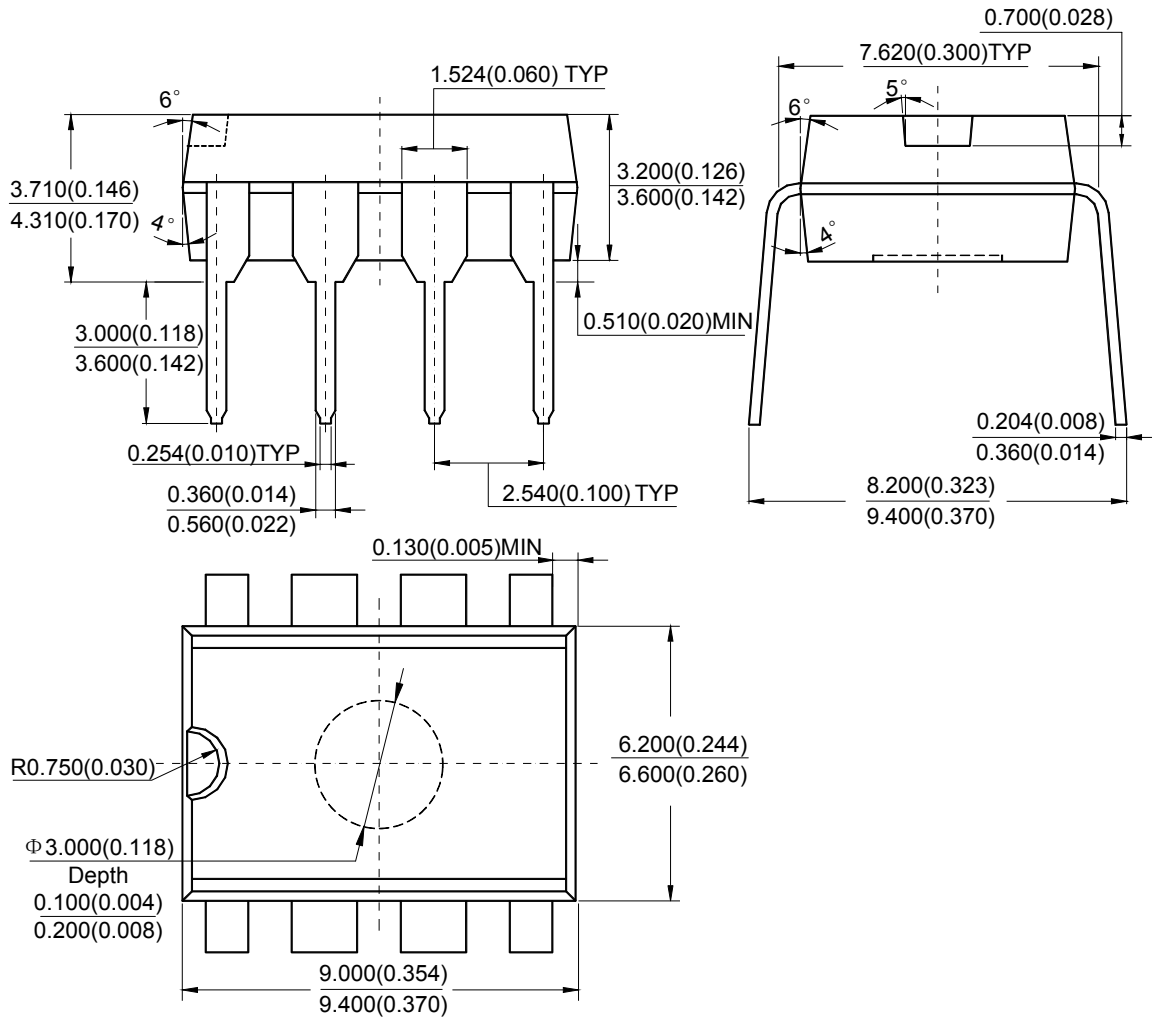
LOW POWER DUAL OPERATIONAL AMPLIFIERS

AS358/358A

Mechanical Dimensions

DIP-8

Unit: mm(inch)



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



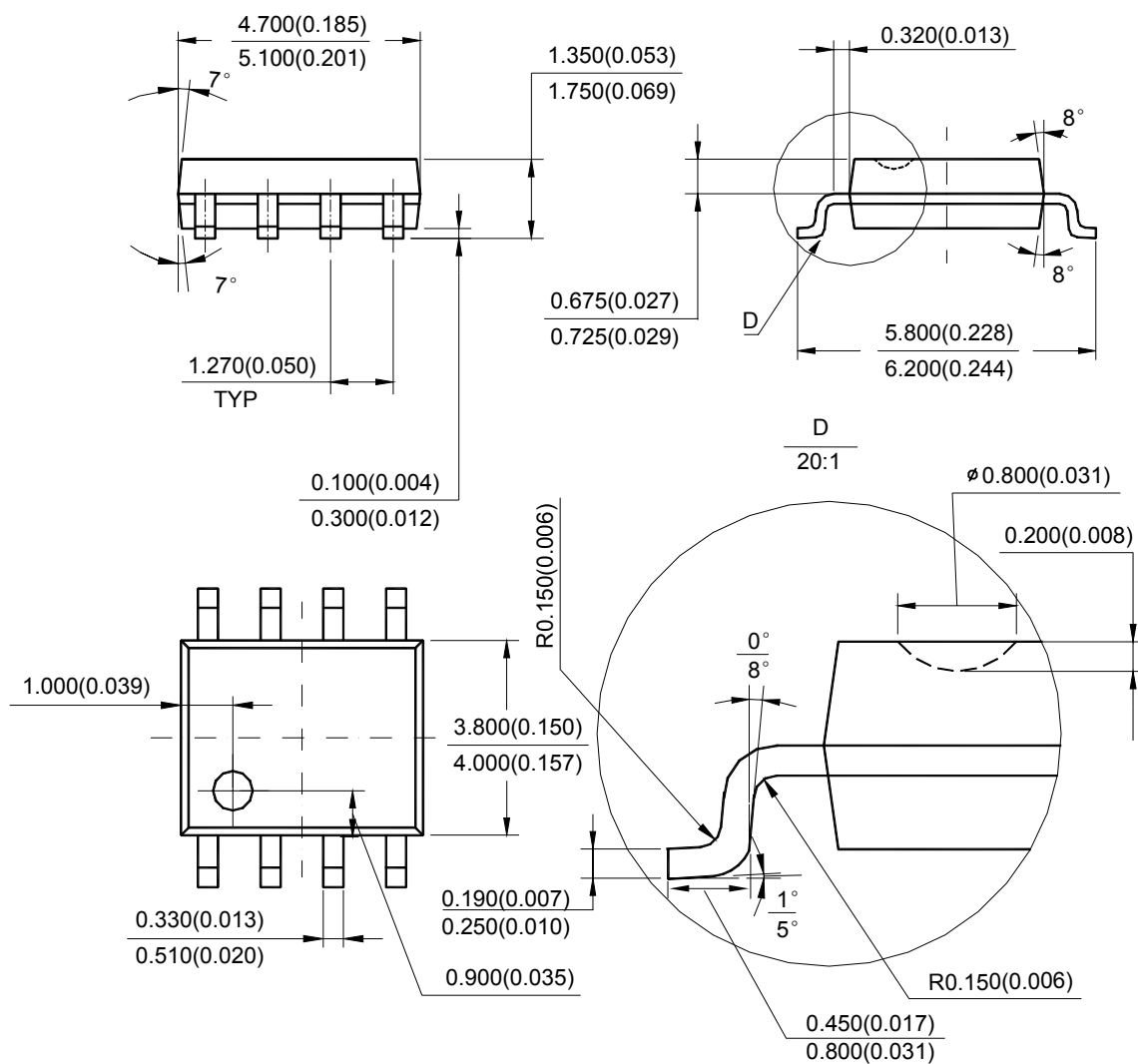
LOW POWER DUAL OPERATIONAL AMPLIFIERS

AS358/358A

Mechanical Dimensions (Continued)

SOIC-8

Unit: mm(inch)



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



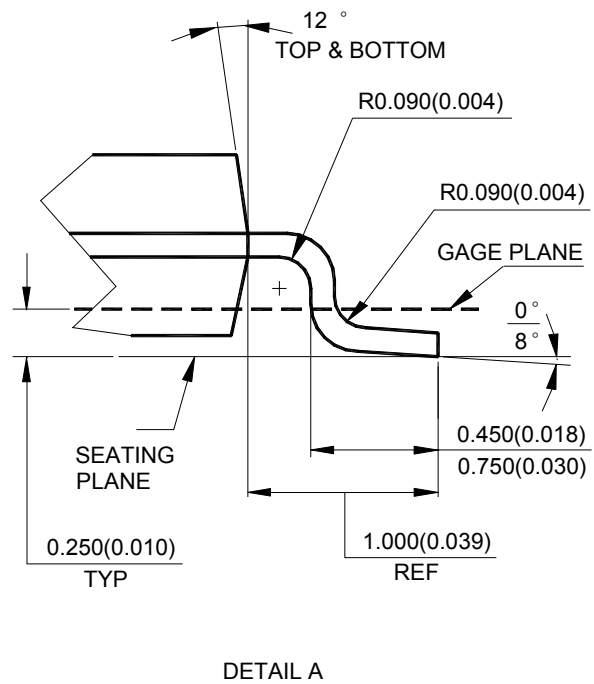
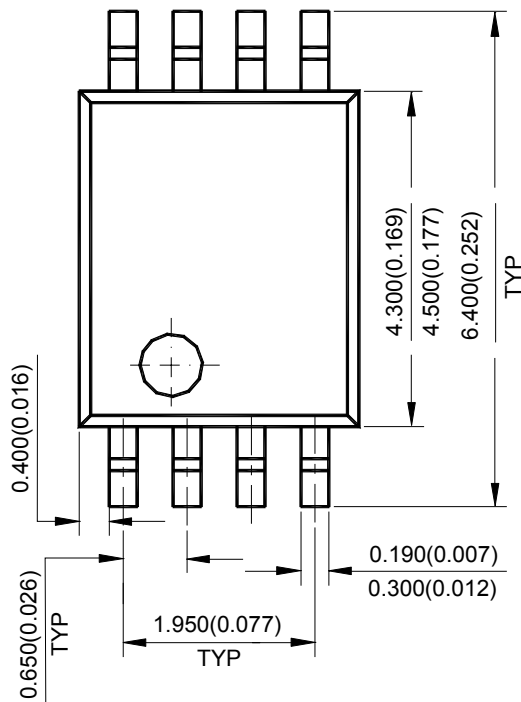
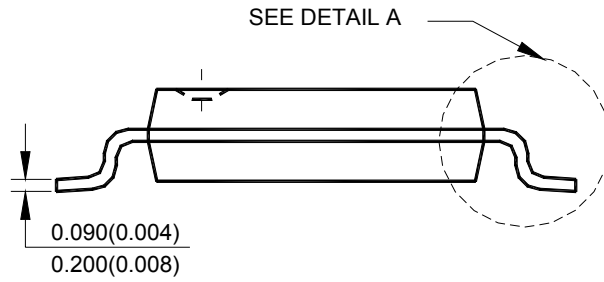
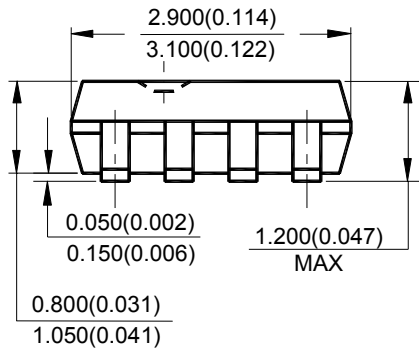
LOW POWER DUAL OPERATIONAL AMPLIFIERS

AS358/358A

Mechanical Dimensions (Continued)

TSSOP-8

Unit: mm(inch)



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



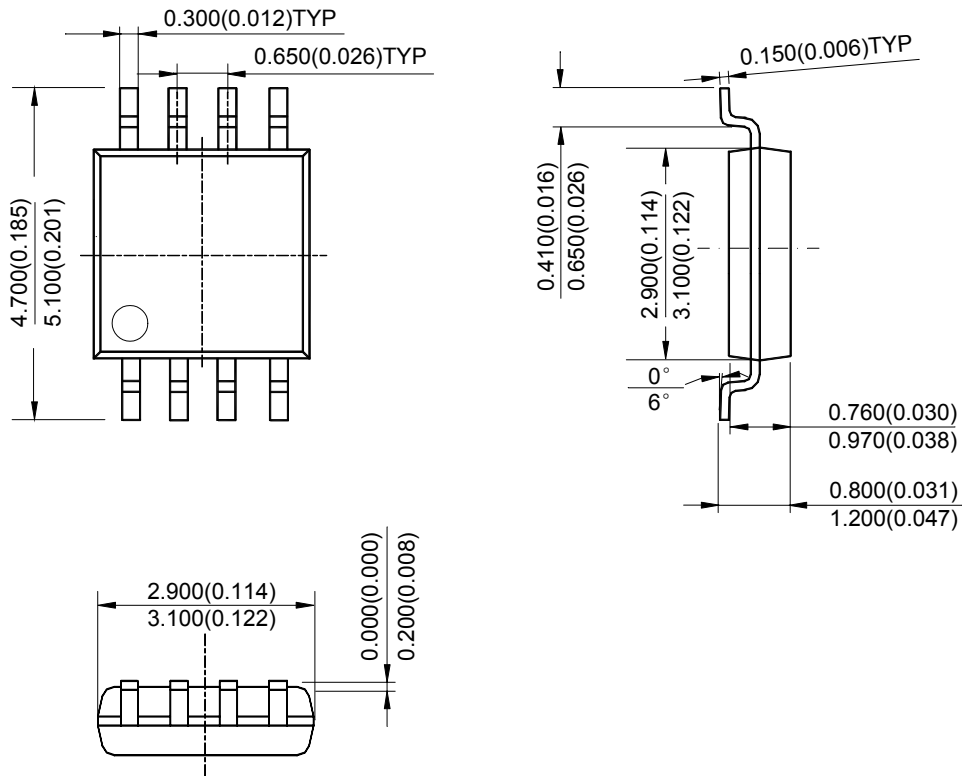
LOW POWER DUAL OPERATIONAL AMPLIFIERS

AS358/358A

Mechanical Dimensions

MSOP-8

Unit: mm(inch)



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



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