

**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

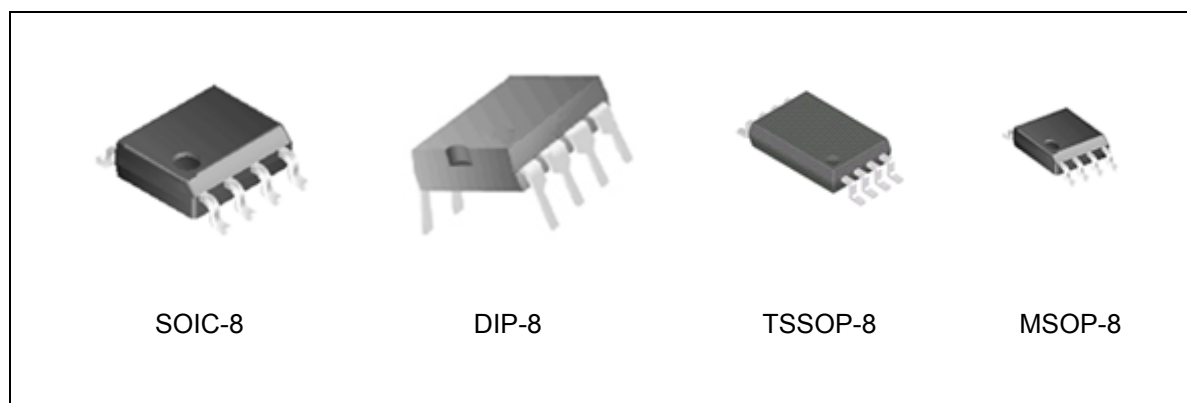


Figure 1. Package Types of AS358/358A

**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Pin Configuration**

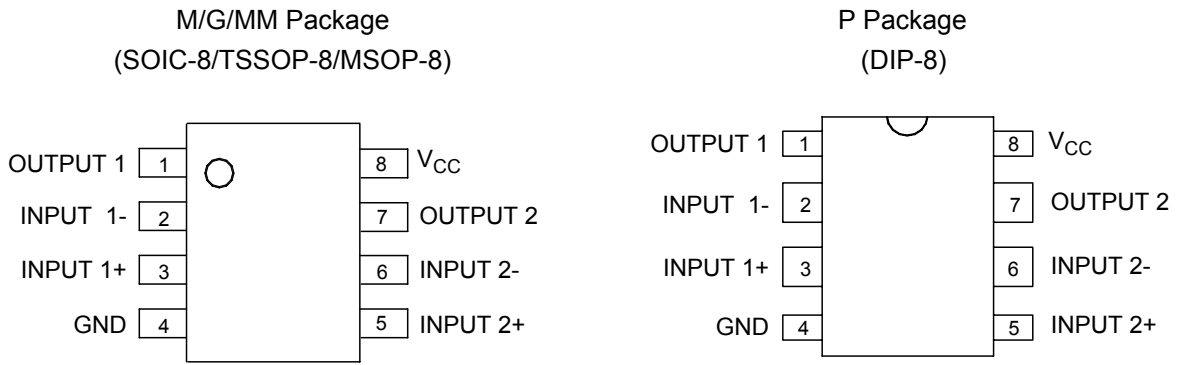


Figure 2. Pin Configuration of AS358/358A (Top View)

**Functional Block Diagram**

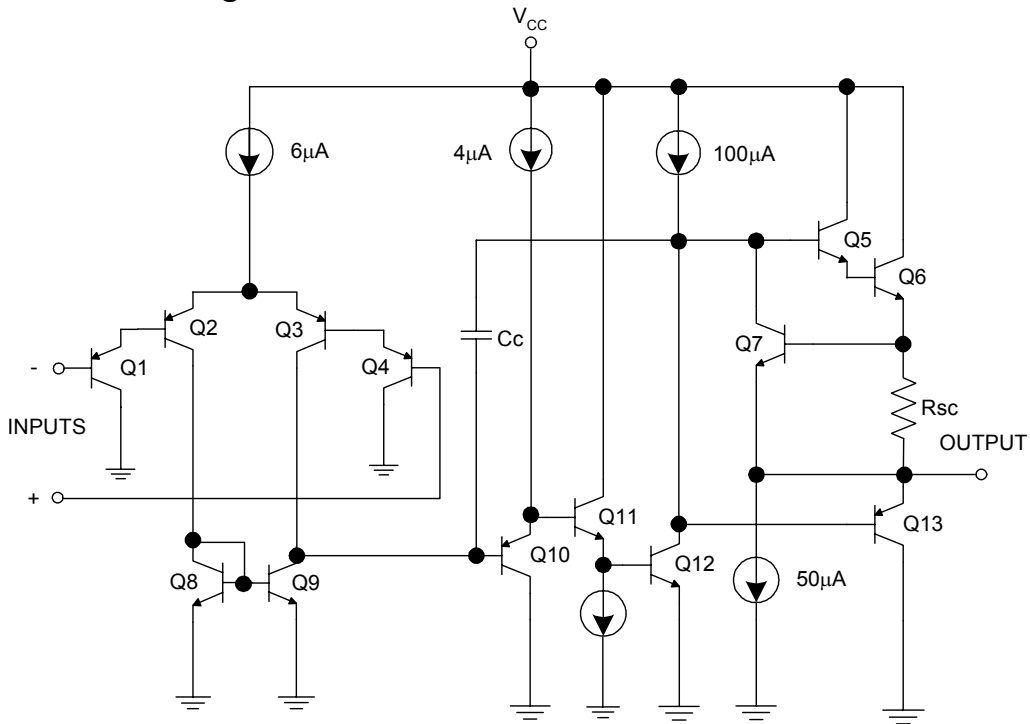


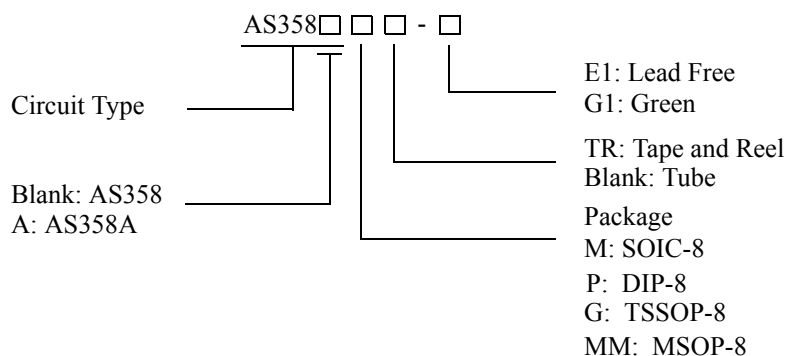
Figure 3. Functional Block Diagram of AS358/358A  
(Each Amplifier)



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



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

**Electrical Characteristics**

Limits in standard typeface are for  $T_A=25^{\circ}\text{C}$ , **bold** typeface applies over  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (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 $30\text{V}$	AS358		2	5	mV
						<b>7</b>	
			AS358A		2	3	
						<b>5</b>	
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	$T_A=-40$ to $85^{\circ}\text{C}$		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	
					<b>200</b>		
Input Offset Current	$I_{IO}$	$I_{IN+} - I_{IN-}$ , $V_{CM}=0\text{V}$		5	30	nA	
					<b>100</b>		
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 $85^{\circ}\text{C}$ , $R_L=\infty$ , $V_{CC}=30\text{V}$		0.7	2	mA	
		$T_A=-40$ to $85^{\circ}\text{C}$ , $R_L=\infty$ , $V_{CC}=5\text{V}$		0.5	1.2		
Large Signal Voltage Gain	$G_V$	$V_{CC}=15\text{V}$ , $V_O=1\text{V}$ to $11\text{V}$ , $R_L \geq 2\text{k}\Omega$	85	100		dB	
			<b>80</b>				
Common Mode Rejection Ratio	CMRR	DC, $V_{CM}=0\text{V}$ to $(V_{CC}-1.5)\text{V}$	60	70		dB	
			<b>60</b>				
Power Supply Rejection Ratio	PSRR	$V_{CC}=5\text{V}$ to $30\text{V}$	70	100		dB	
			<b>60</b>				
Channel Separation	CS	$f=1\text{kHz}$ to $20\text{kHz}$		-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	
				<b>20</b>			
	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	
				<b>5</b>			
			$V_{IN+}=0\text{V}$ , $V_{IN-}=1\text{V}$ , $V_{CC}=15\text{V}$ , $V_O=0.2\text{V}$	12	50	$\mu\text{A}$	
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	
			<b>26</b>				
		$V_{CC}=30\text{V}$ , $R_L=10\text{k}\Omega$	27	28			
			<b>27</b>				
$V_{OL}$	$V_{CC}=5\text{V}$ , $R_L=10\text{k}\Omega$		5	20	mV		
				<b>30</b>			
Thermal Resistance (Junction to Case)	$\theta_{JC}$	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.



**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**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**

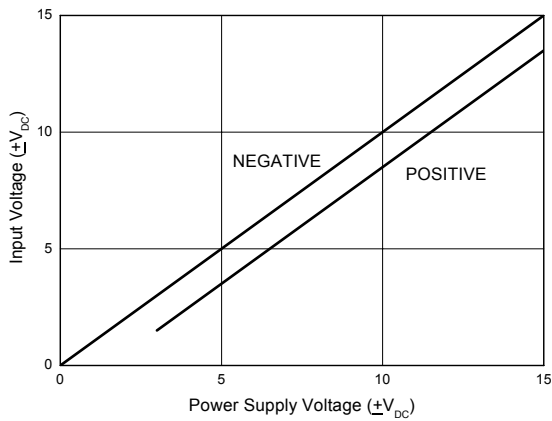


Figure 4. Input Voltage Range

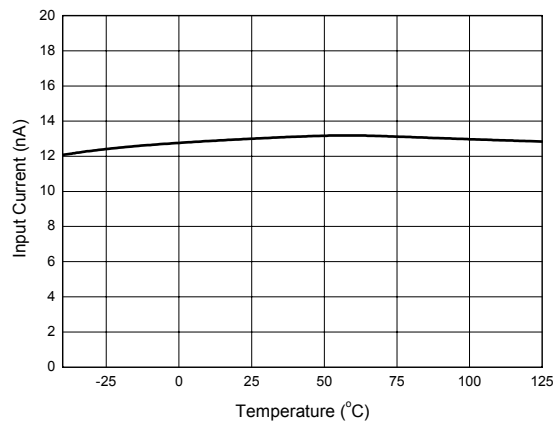


Figure 5. Input Current

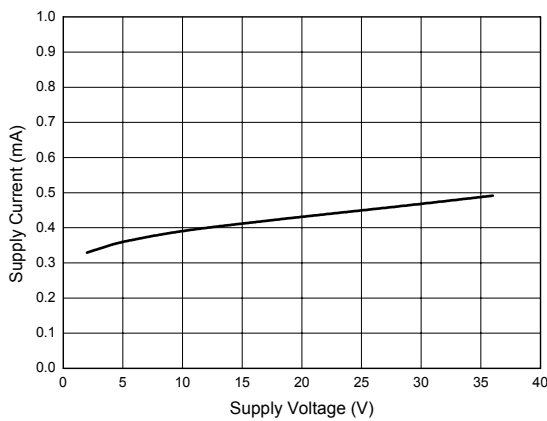


Figure 6. Supply Current

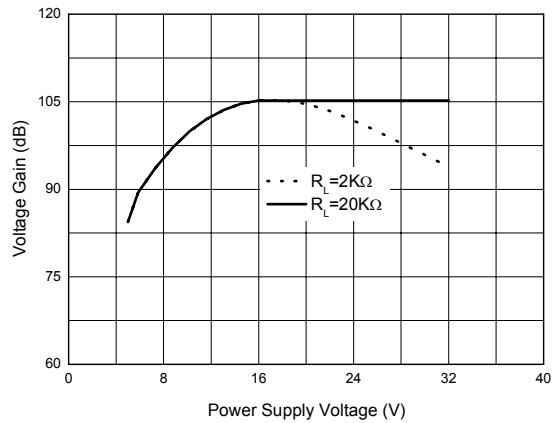


Figure 7. Voltage Gain



Typical Performance Characteristics (Continued)

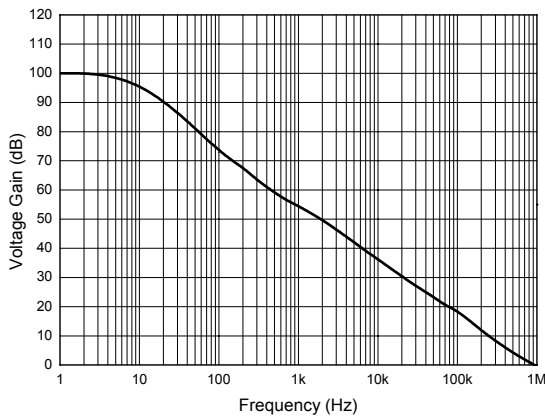


Figure 8. Open Loop Frequency Response

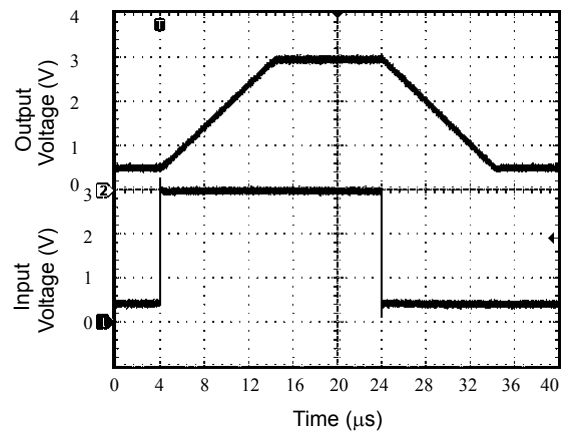


Figure 9. Voltage Follower Pulse Response

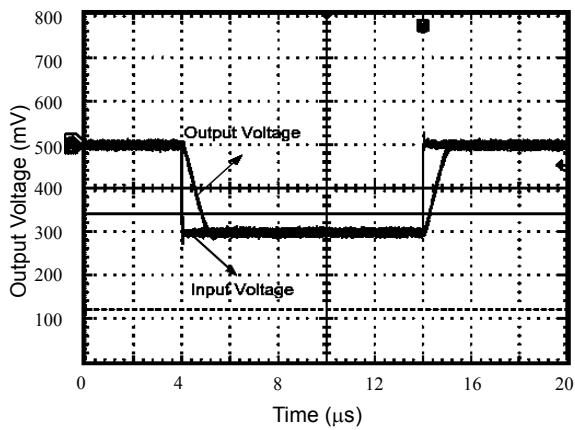


Figure 10. Voltage Follower Pulse Response (Small Signal)

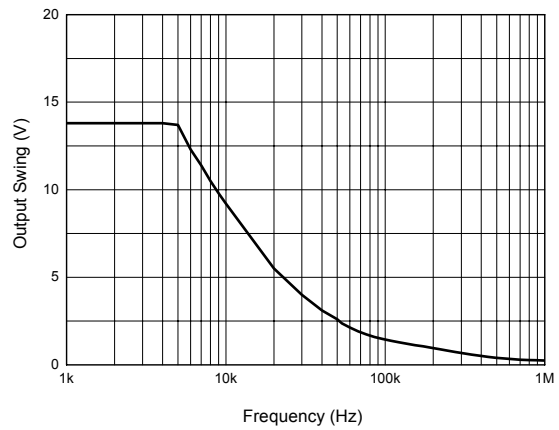


Figure 11. Large Signal Frequency Response



Typical Performance Characteristics (Continued)

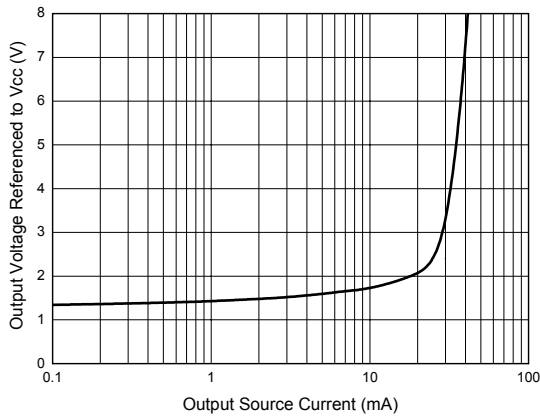


Figure 12. Output Characteristics: Current Sourcing

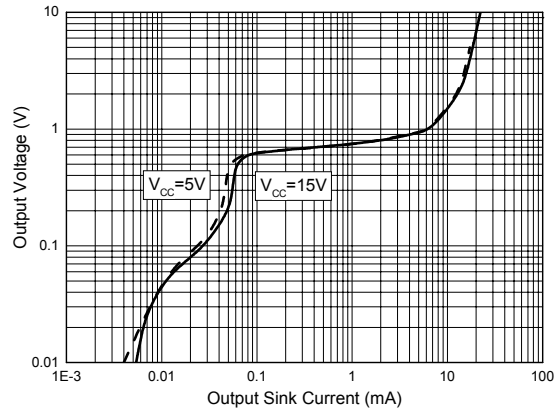


Figure 13. Output Characteristics: Current Sinking

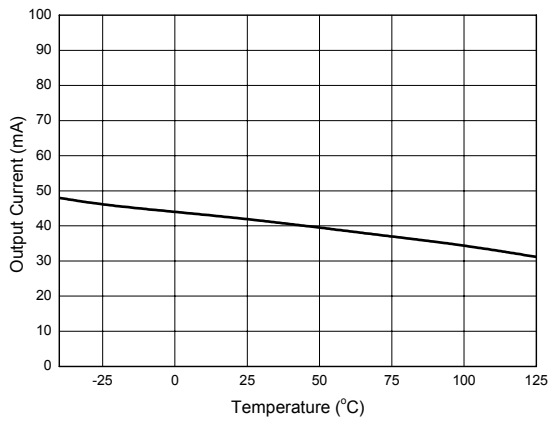


Figure 14. Current Limiting



**Typical Application**

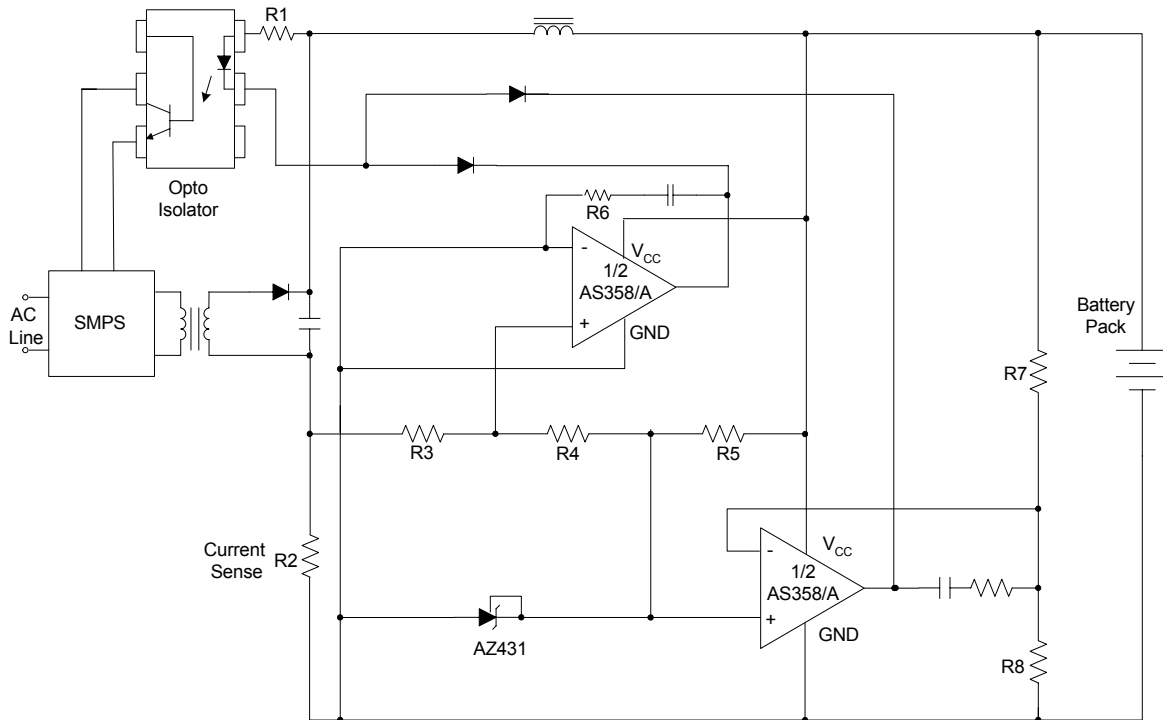


Figure 15. Battery Charger

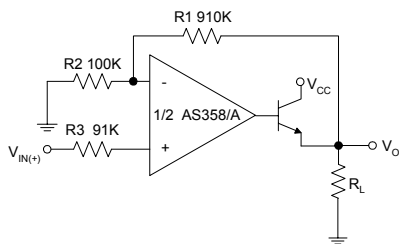


Figure 16. Power Amplifier

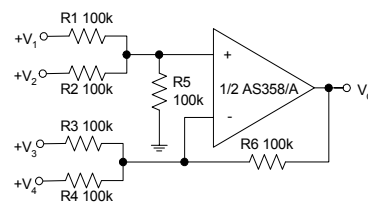


Figure 17. DC Summing Amplifier

**Typical Application (Continued)**

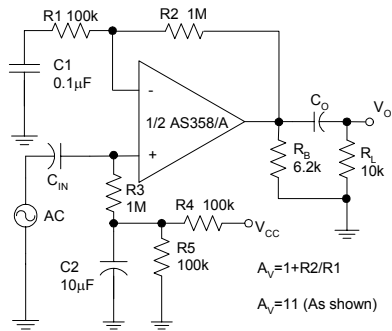


Figure 18. AC Coupled Non-Inverting Amplifier

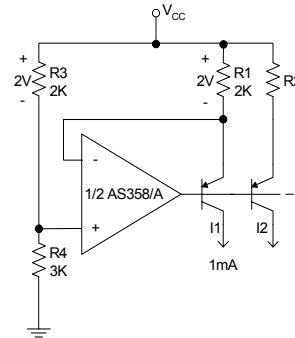


Figure 19. Fixed Current Sources

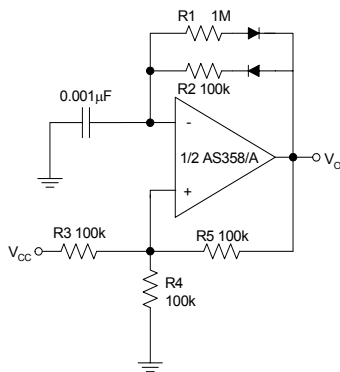


Figure 20. Pulse Generator

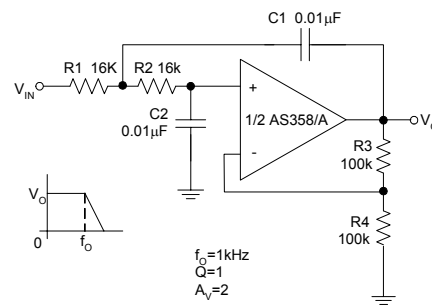


Figure 21. DC Coupled Low-Pass Active Filter



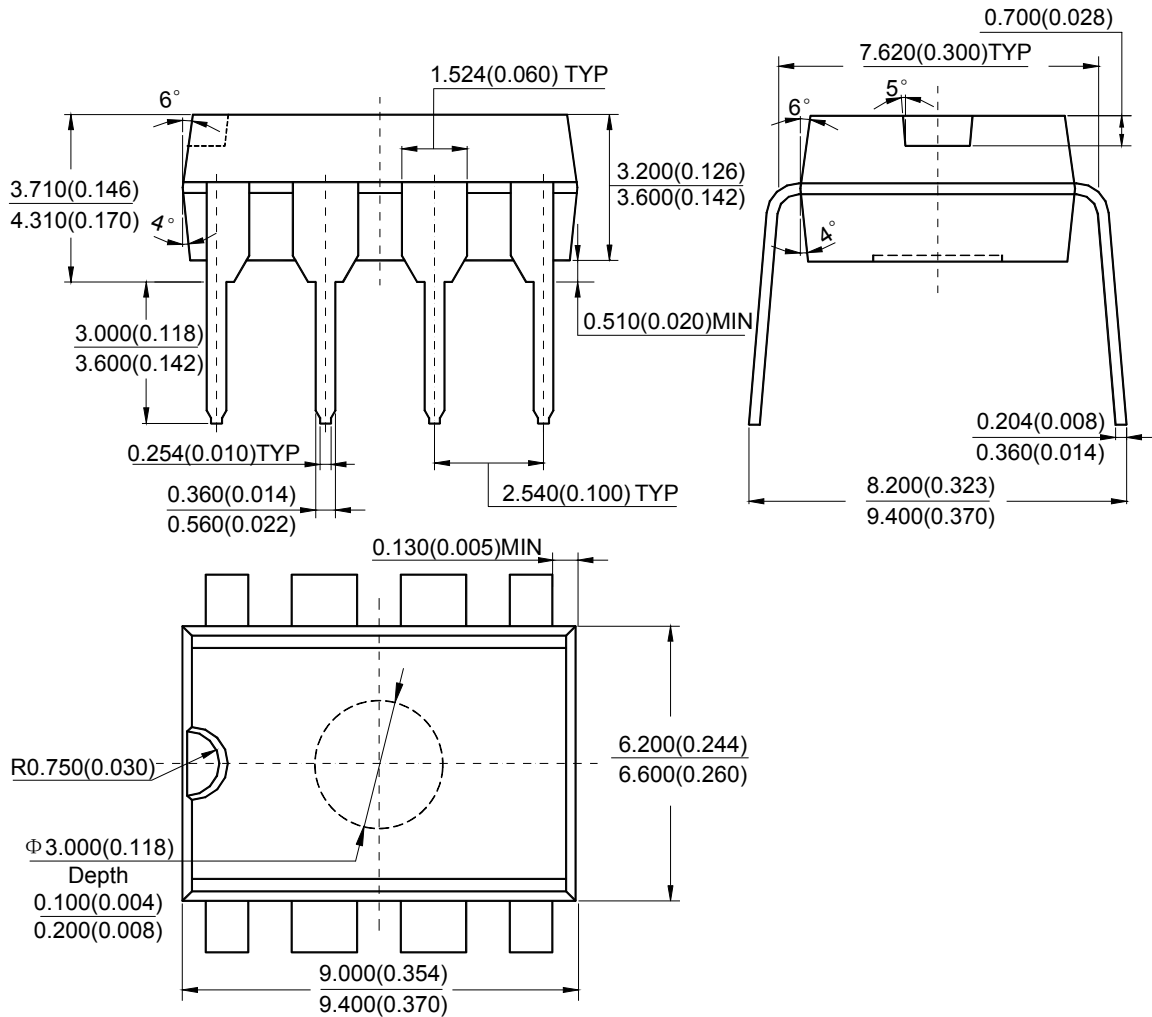
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions**

**DIP-8**

**Unit: mm(inch)**



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



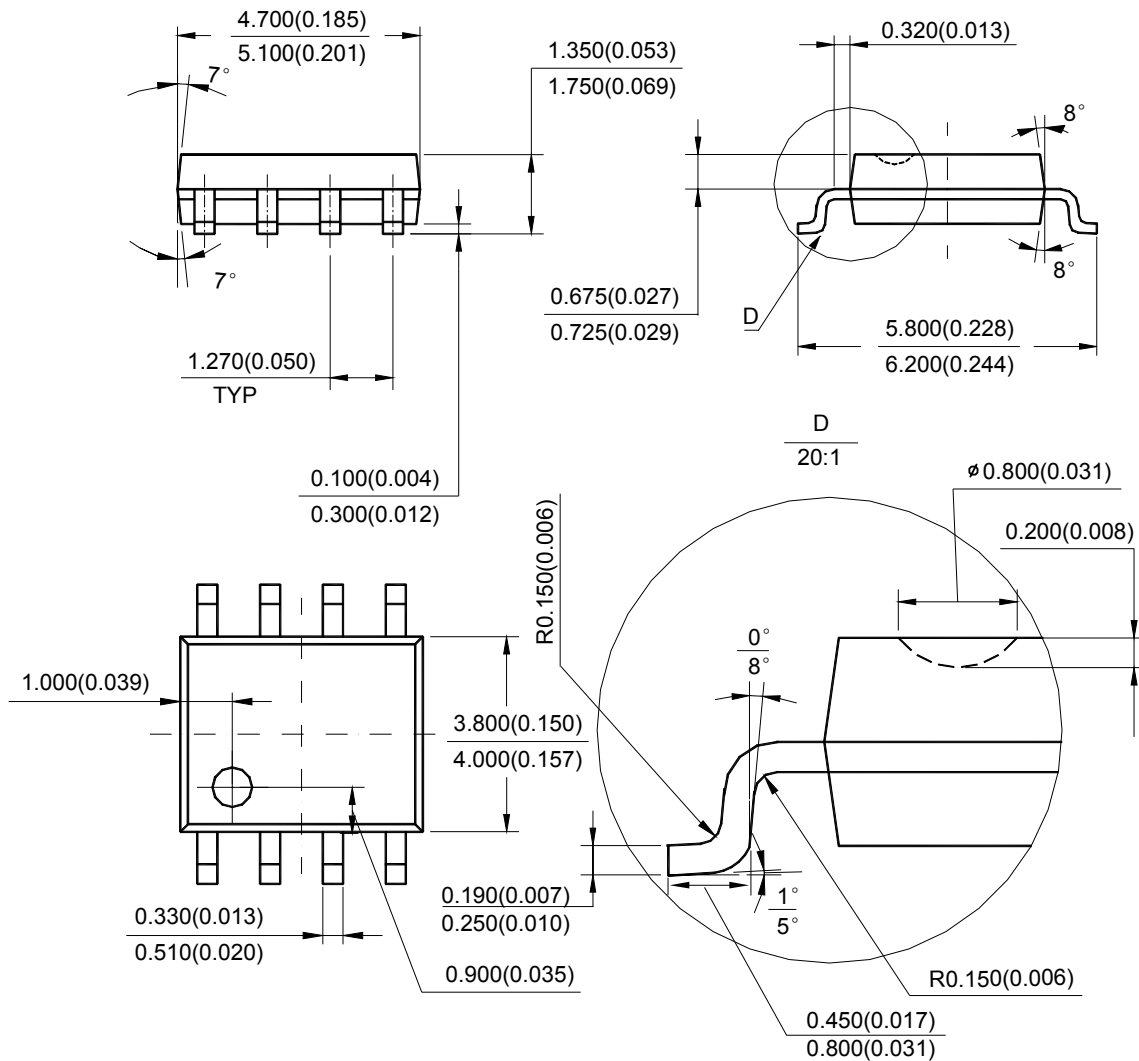
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**



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



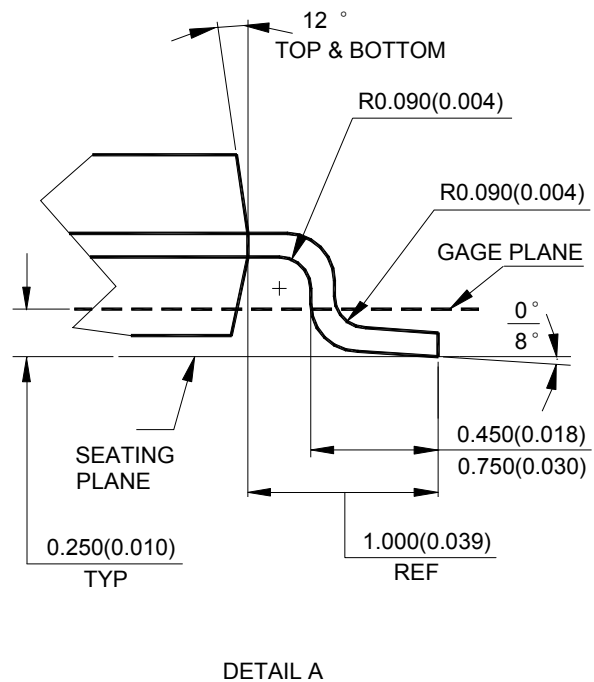
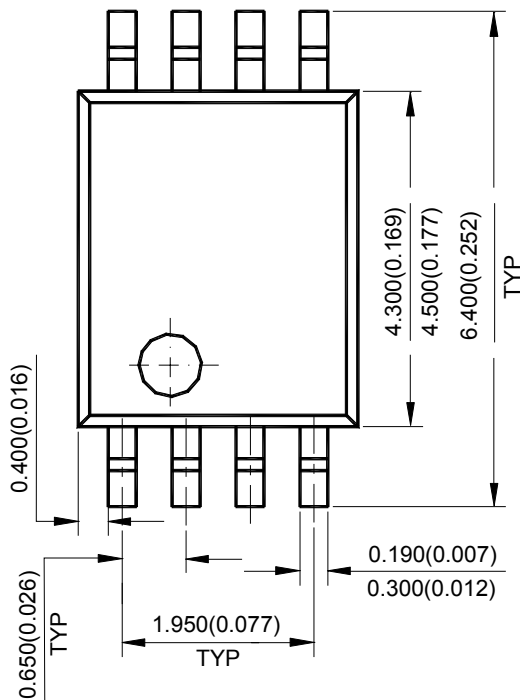
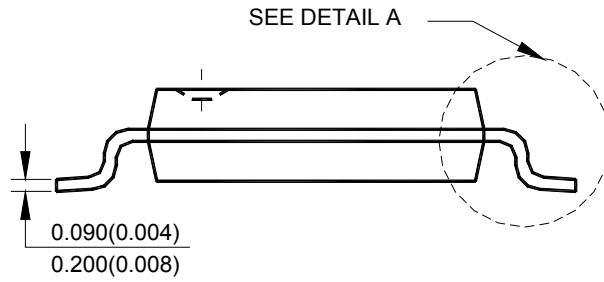
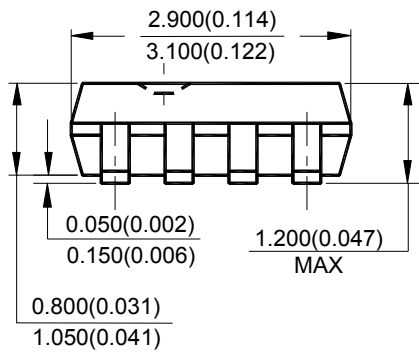
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions (Continued)**

**TSSOP-8**

**Unit: mm(inch)**



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



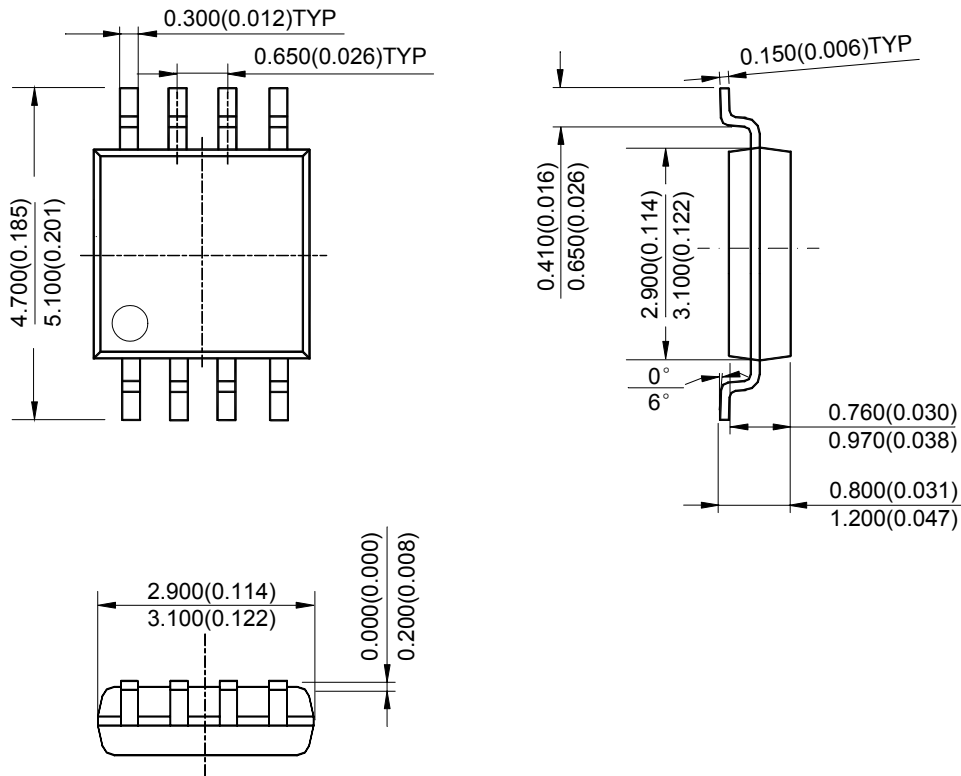
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions**

**MSOP-8**

**Unit: mm(inch)**



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



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#### MAIN SITE

##### - Headquarters

##### BCD Semiconductor Manufacturing Limited

No. 1600, Zi Xing Road, Shanghai Zizhu Science-based Industrial Park, 200241, China  
Tel: +86-21-24162266, Fax: +86-21-24162277

##### - Wafer Fab

##### Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.

800 Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

#### REGIONAL SALES OFFICE

##### Shenzhen Office

##### Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd., Shenzhen Office

Unit A Room 1203, Skyworth Bldg., Gaoxin Ave. 1.S., Nanshan District, Shenzhen, China  
Tel: +86-755-8826 7951  
Fax: +86-755-8826 7865

##### 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 Corp.

30920 Huntwood Ave. Hayward, CA 94544, USA  
Tel : +1-510-324-2988  
Fax: +1-510-324-2788