

**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

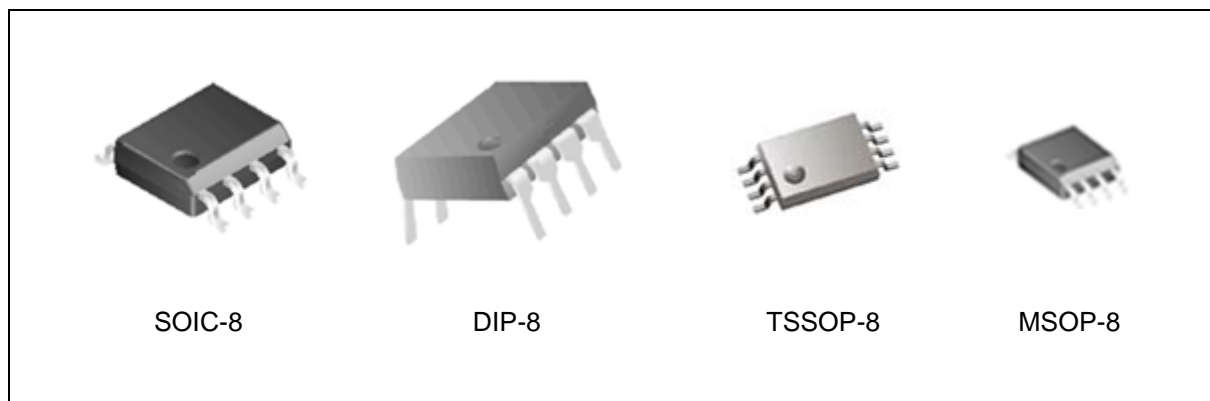


Figure 1. Package Types of AS358/358A



**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Pin Configuration**

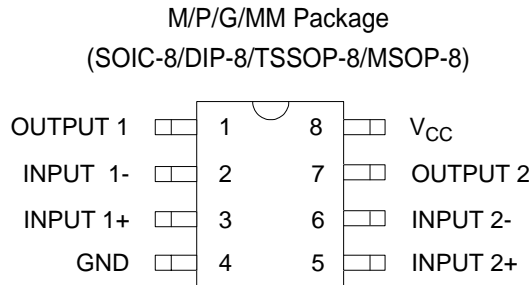


Figure 2. Pin Configuration of AS358/358A (Top View)

**Functional Block Diagram**

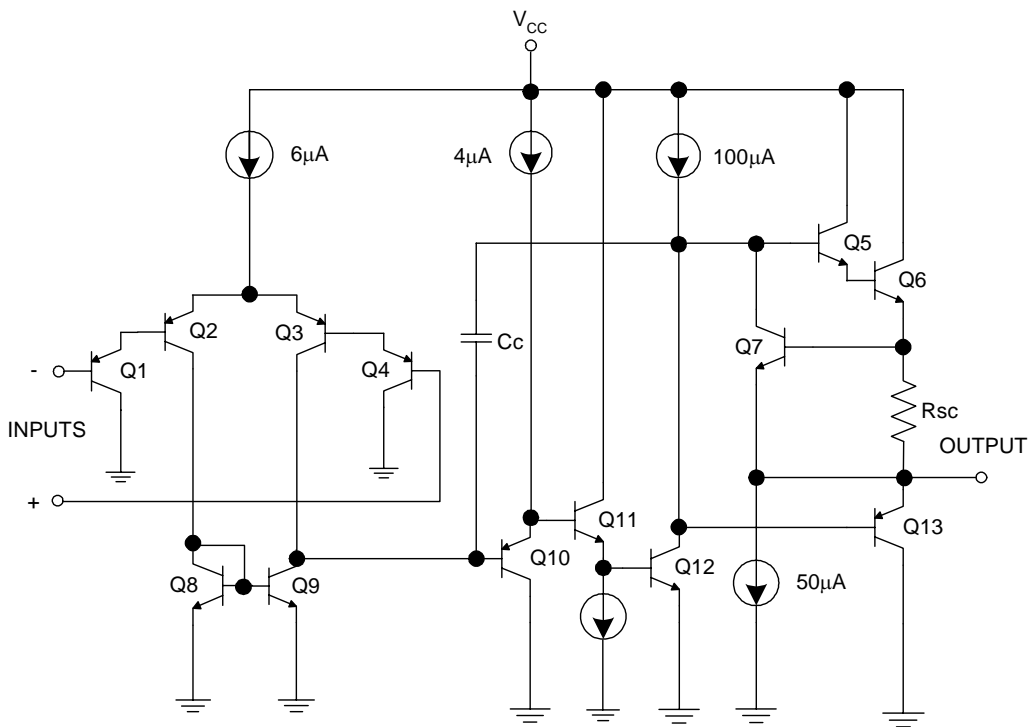


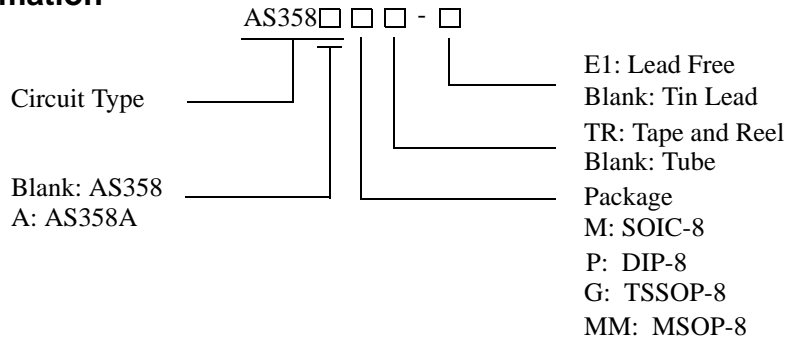
Figure 3. Functional Block Diagram of AS358/358A  
(Each Amplifier)



**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Ordering Information**



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

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

**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  $-40^{\circ}\text{C}$  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>			

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**

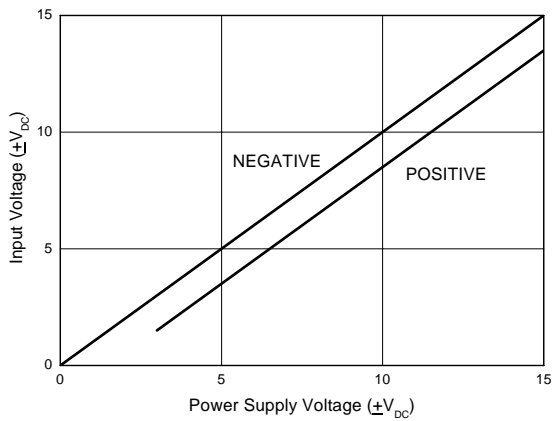


Figure 4. Input Voltage Range

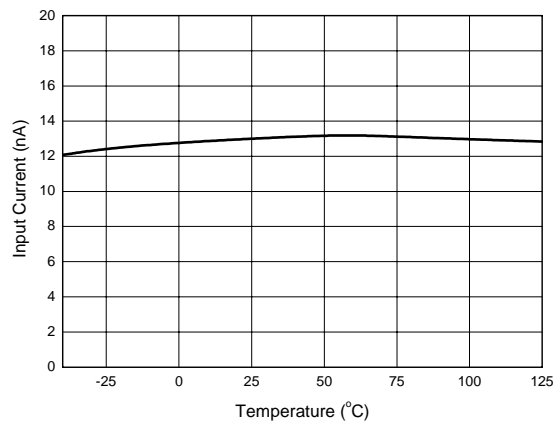


Figure 5. Input Current

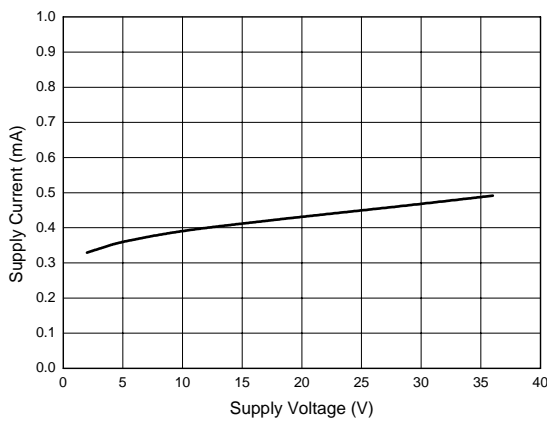


Figure 6. Supply Current

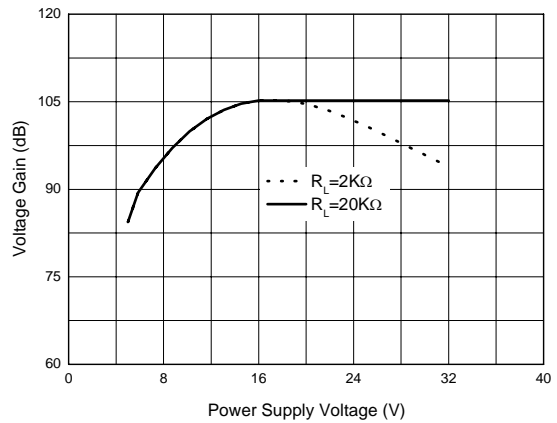


Figure 7. Voltage Gain



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**Typical Performance Characteristics (Continued)**

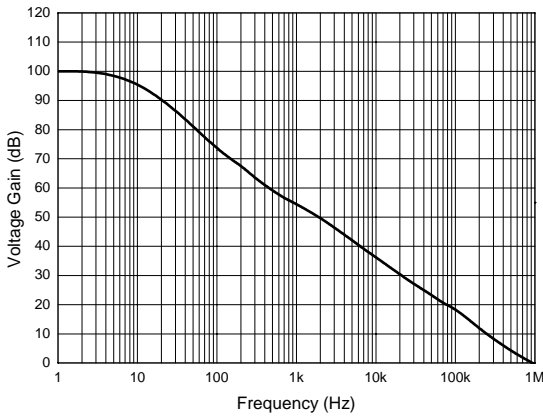


Figure 8. Open Loop Frequency Response

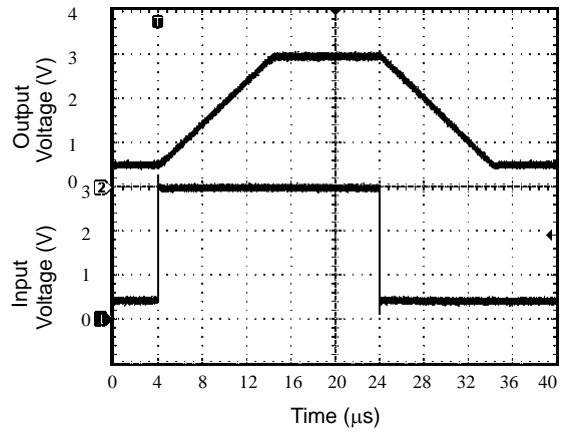


Figure 9. Voltage Follower Pulse Response

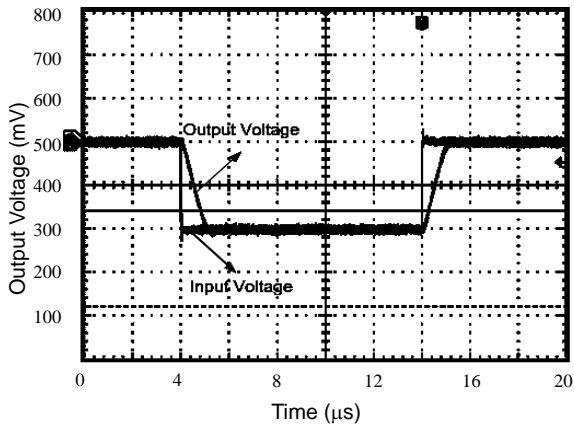


Figure 10. Voltage Follower Pulse Response (Small Signal)

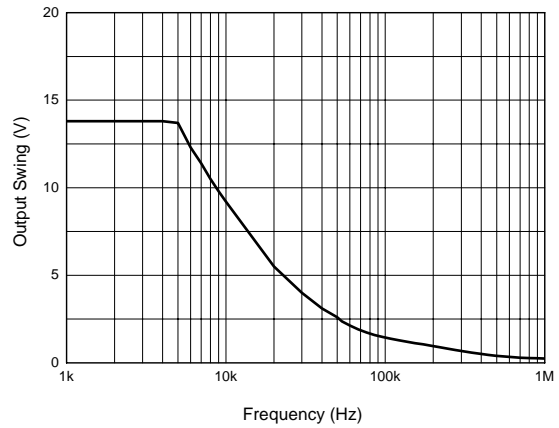


Figure 11. Large Signal Frequency Response



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**Typical Performance Characteristics (Continued)**

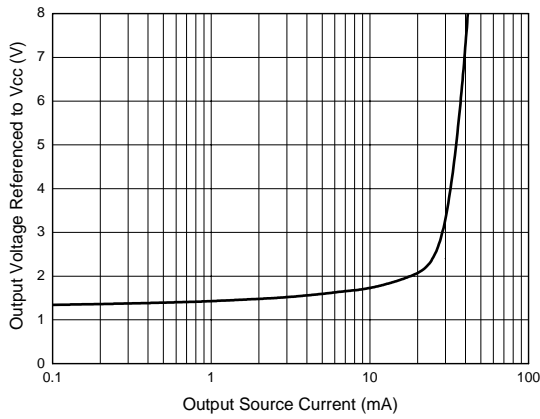


Figure 12. Output Characteristics: Current Sourcing

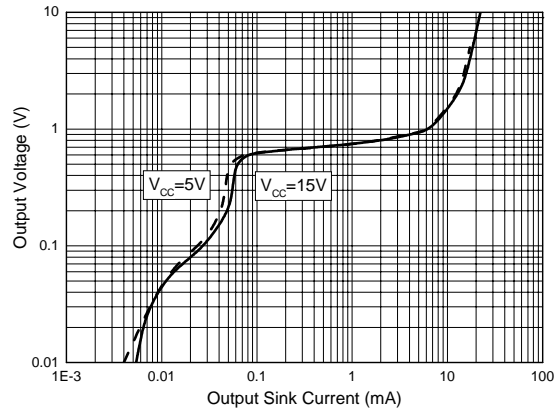


Figure 13. Output Characteristics: Current Sinking

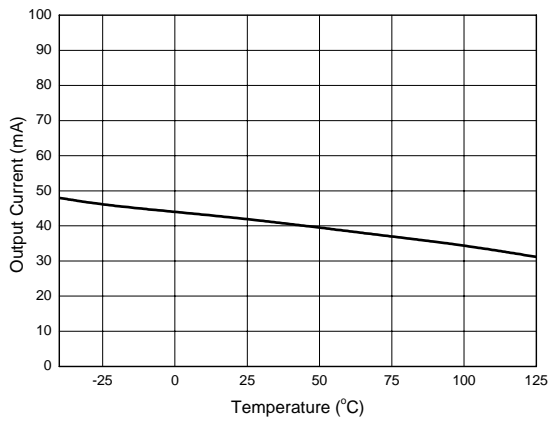


Figure 14. Current Limiting





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**Typical Application**

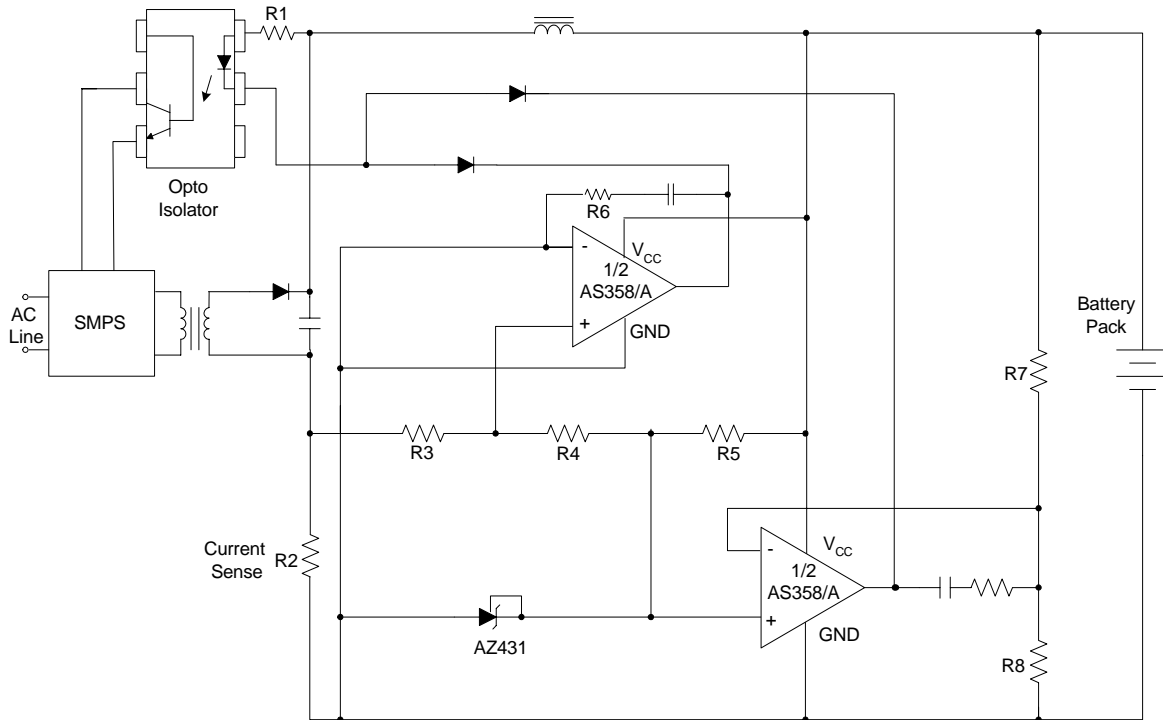


Figure 15. Battery Charger

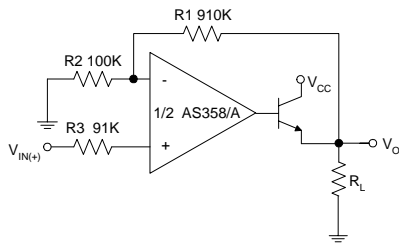


Figure 16. Power Amplifier

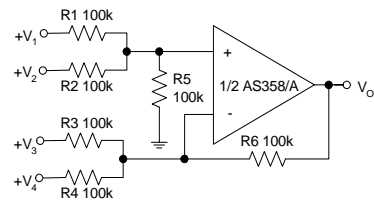


Figure 17. DC Summing Amplifier



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**Typical Application (Continued)**

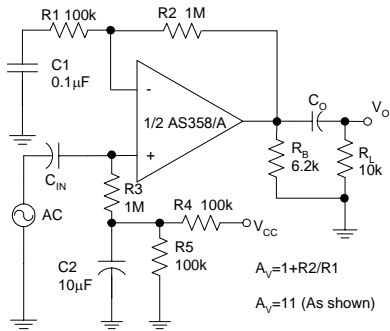


Figure 18. AC Coupled Non-Inverting Amplifier

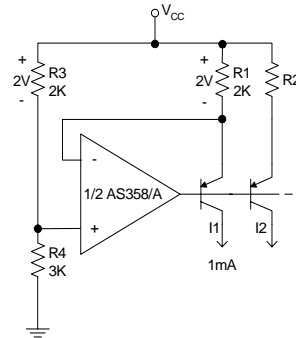


Figure 19. Fixed Current Sources

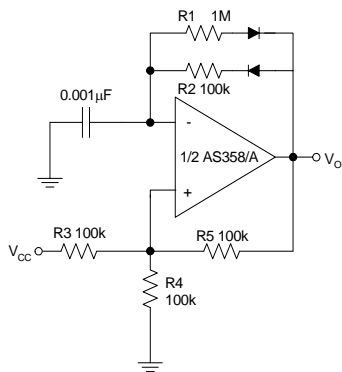


Figure 20. Pulse Generator

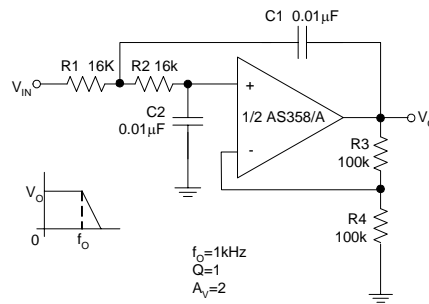


Figure 21. DC Coupled Low-Pass Active Filter





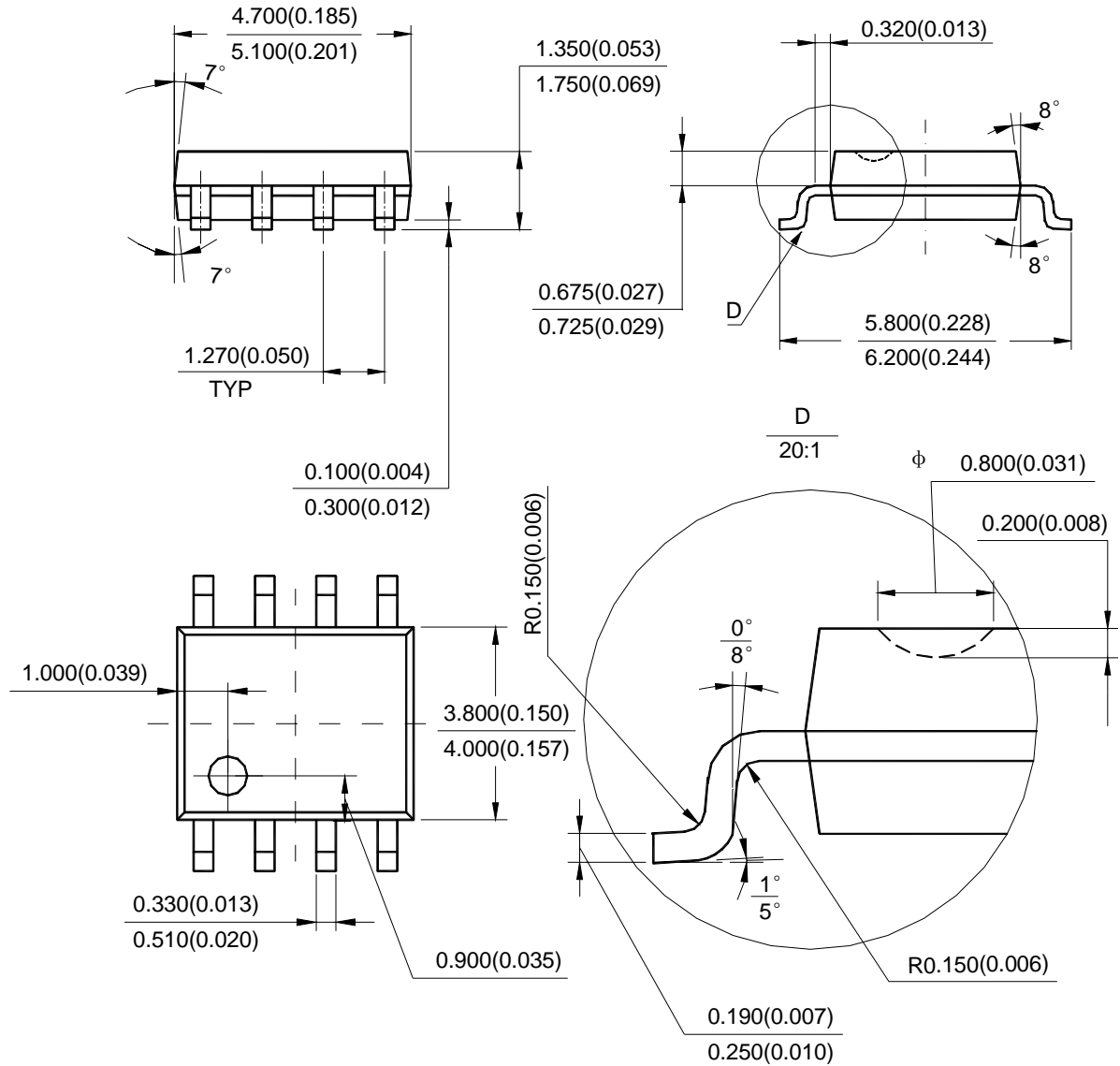
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**





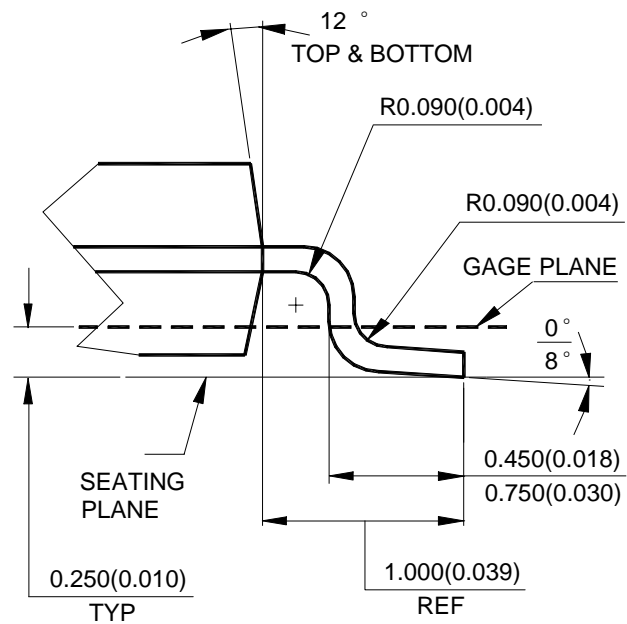
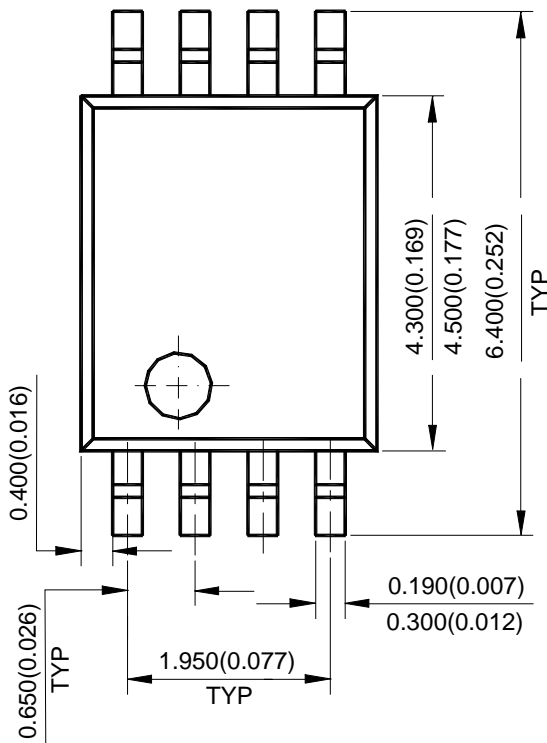
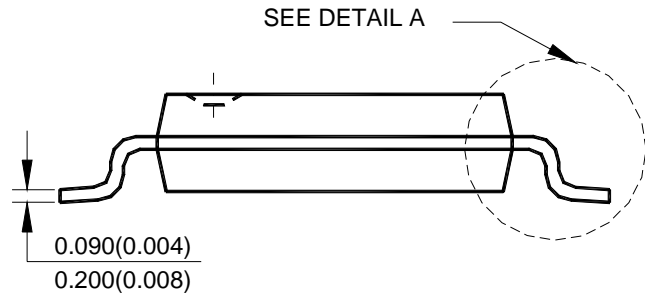
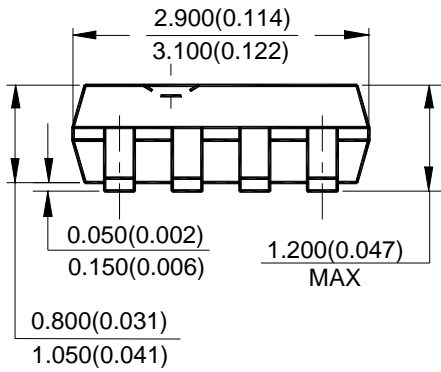
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions (Continued)**

**TSSOP-8**

**Unit: mm(inch)**





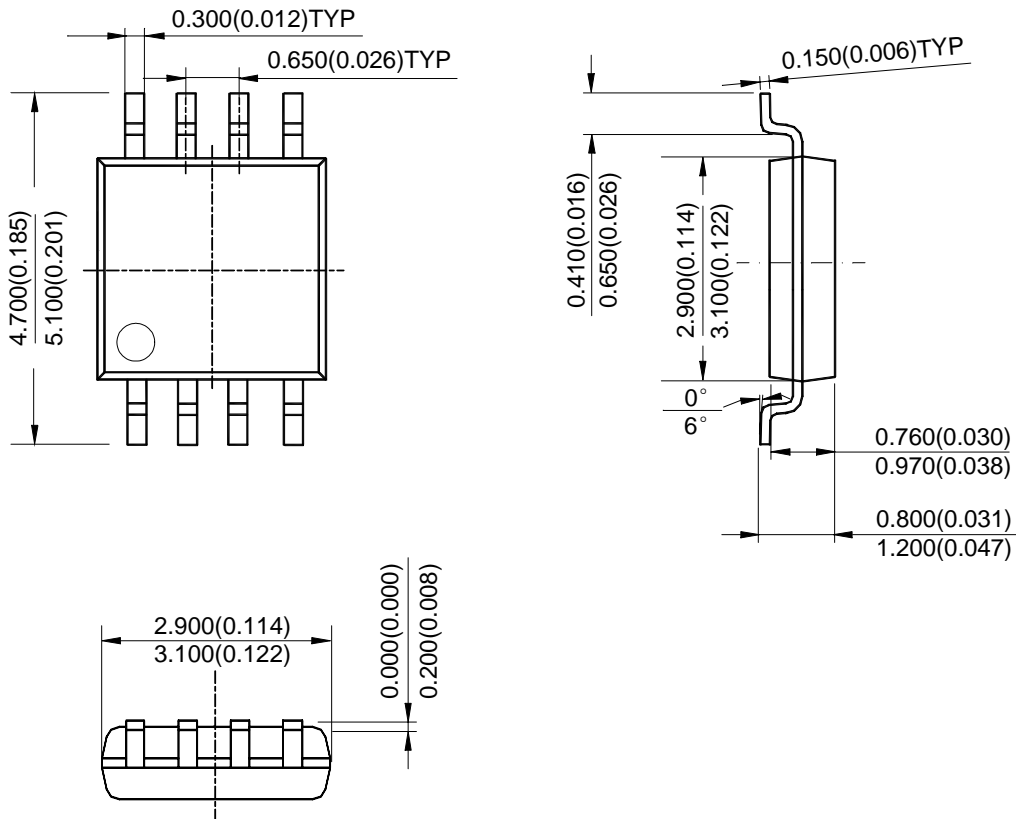
**LOW POWER DUAL OPERATIONAL AMPLIFIERS**

**AS358/358A**

**Mechanical Dimensions**

**MSOP-8**

**Unit: mm(inch)**





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