



**LOW POWER SINGLE OPERATIONAL AMPLIFIER**

**AS321**

**General Description**

The AS321 is a high gain and internally frequency compensated operational amplifier 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 battery charger, active filters, general purpose controllers and most conventional operational amplifier circuits.

The AS321 is compatible with industry standard 321.

The AS321 is available in SOT-23-5L packages.

**Features**

- Excellent Phase Margin: 60 deg.
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Low Supply Current: 0.35mA at  $V_{CC}=5V$
- Wide Power Supply Voltage:  
Single Supply: 3V to 36V  
Dual Supplies:  $\pm 1.5V$  to  $\pm 18V$
- Wide Input Common Mode Voltage Range: 0V to  $V_{CC}-1.5V$

**Applications**

- Battery Charger
- Active Filters
- General Purpose Controllers, Instruments

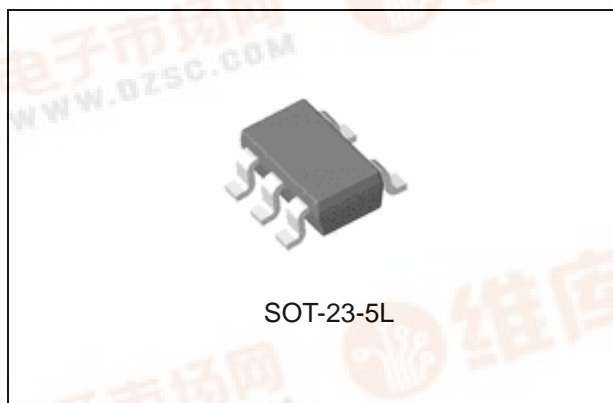


Figure 1. Package Type of AS321





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**Pin Configuration**

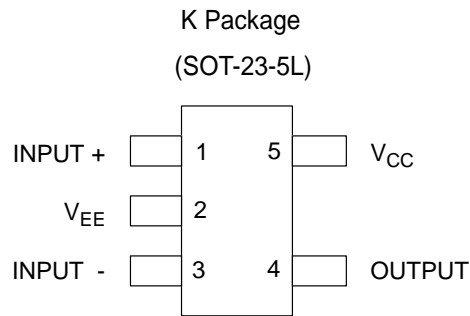


Figure 2. Pin Configuration of AS321 (Top View)

**Functional Block Diagram**

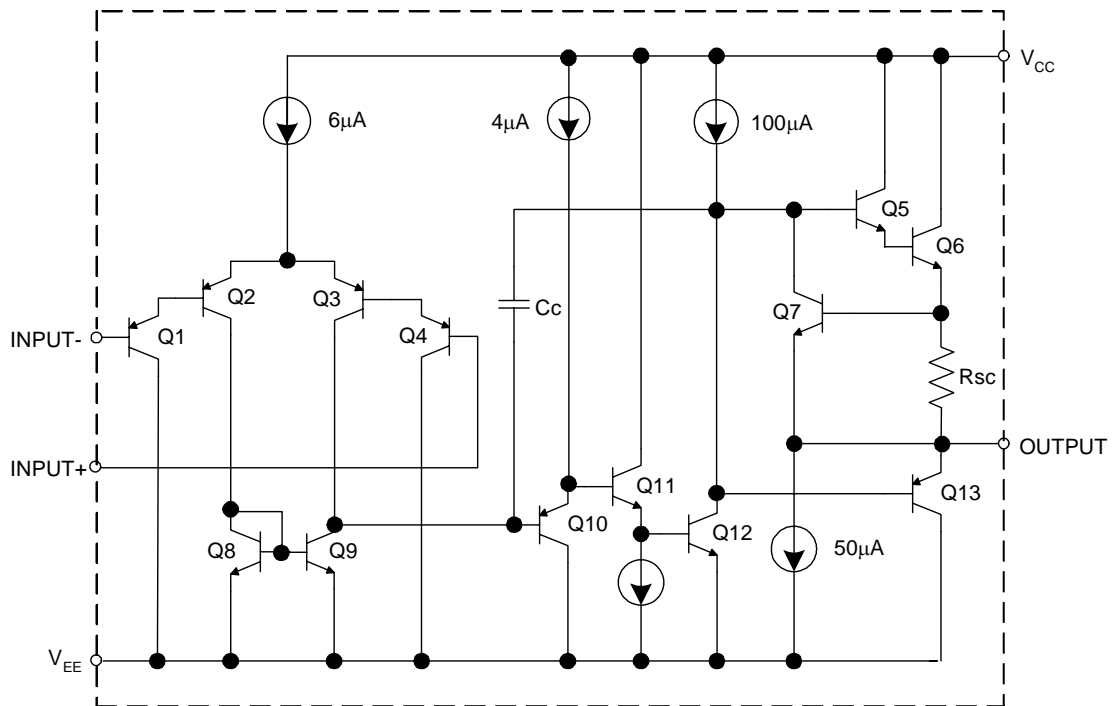
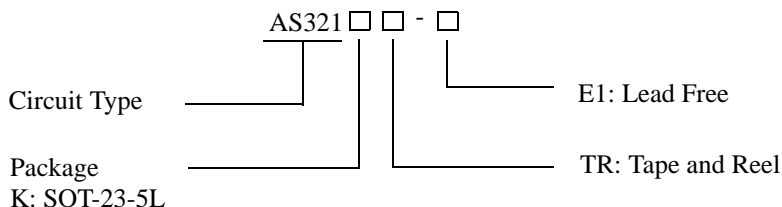


Figure 3. Functional Block Diagram of AS321



**LOW POWER SINGLE OPERATIONAL AMPLIFIER AS321**

**Ordering Information**



Package	Temperature Range	Part Number	Marking ID	Packing Type
		Lead Free	Lead Free	
SOT-23-5L	-40 to 85°C	AS321KTR-E1	E6T	Tape & Reel

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

**Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit
Power Supply Voltage	$V_S$ ( $V_{CC}-V_{EE}$ )	40	V
Differential Input Voltage	$V_{ID}$	40	V
Input Voltage	$V_{IN}$	-0.3 to 40	V
Thermal Resistance to Ambient	$R_{\theta JA}$	260	°C/W
Operating Junction Temperature	$T_J$	150	°C
Storage Temperature Range	$T_{STG}$	-65 to 150	°C
Lead Temperature (Soldering, 10 Seconds)	$T_{LEAD}$	260	°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	°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),  $V_{CC}=5\text{V}$ ,  $V_{EE}=0\text{V}$ ,  $V_O=1.4\text{V}$  unless otherwise specified.

Parameter	Symbol	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 $30\text{V}$ (Note 3)		2	5	mV
					<b>7</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	100	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 4)	$V_{CM}$	$V_{CC}=30\text{V}$ , $\text{CMRR} \geq 50\text{dB}$	0		$V_{CC}-1.5$	V
Supply Current	$I_{CC}$	$R_L=\infty$ , $V_{CC}=5\text{V}$		0.35	0.80	mA
				<b>0.45</b>	<b>1.0</b>	
		$R_L=\infty$ , $V_{CC}=30\text{V}$		0.45	1.2	mA
				<b>0.65</b>	<b>1.5</b>	
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	$V_{CM}=0\text{V}$ to $(V_{CC}-1.5)\text{V}$ , $R_S \leq 10\text{k}\Omega$	60	70		dB
			<b>60</b>			
Power Supply Rejection Ratio	PSRR	$V_{CC}=5\text{V}$ to $30\text{V}$ , $R_S \leq 10\text{k}\Omega$	70	100		dB
			<b>60</b>			
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		V
			<b>27</b>			
$V_{OL}$	$V_{CC}=5\text{V}$ , $R_L=10\text{k}\Omega$		5	20	mV	
				<b>30</b>		



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**Electrical Characteristics (Continued)**

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),  $V_{CC}=5\text{V}$ ,  $V_{EE}=0\text{V}$ ,  $V_O=1.4\text{V}$  unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Total Harmonic Distortion	THD	$f=1\text{kHz}$ , $A_V=20\text{dB}$ , $R_L=2\text{k}\Omega$ , $V_O=2\text{Vp-p}$ , $C_L=100\text{pF}$ , $V_{CC}=30\text{V}$		0.015		%
Phase Margin	$\phi_M$			60		Deg

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

Note 3: Over the full input common-mode range  $0\text{V}$  to  $V_{CC}-1.5\text{V}$  (at  $25^{\circ}\text{C}$ ).

Note 4: The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than  $0.3\text{V}$  (at  $25^{\circ}\text{C}$ ). The upper end of the common-mode voltage range is  $V_{CC}-1.5\text{V}$  (at  $25^{\circ}\text{C}$ ), but either or both inputs can go to  $+36\text{V}$  without damages, independent of the magnitude of the  $V_{CC}$ .

**Typical Performance Characteristics**

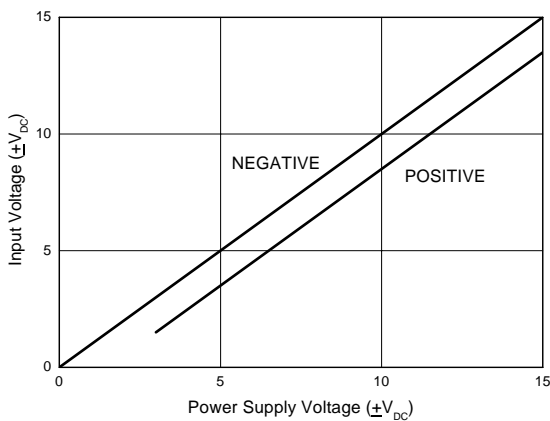


Figure 4. Input Voltage Range

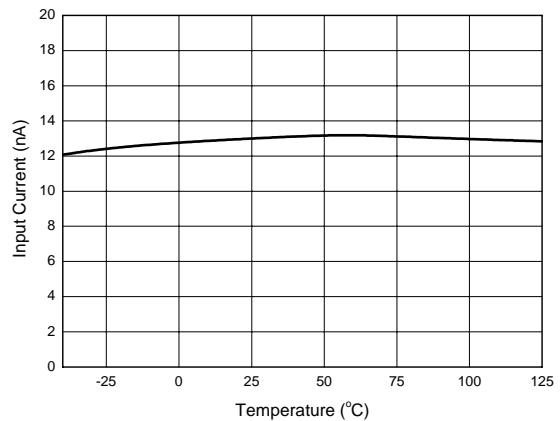


Figure 5. Input Current



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**Electrical Characteristics (Continued)**

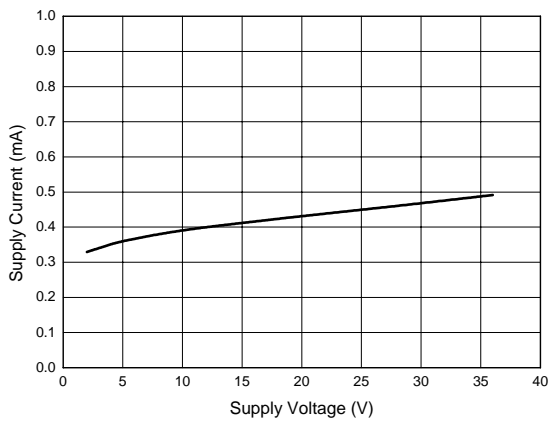


Figure 6. Supply Current

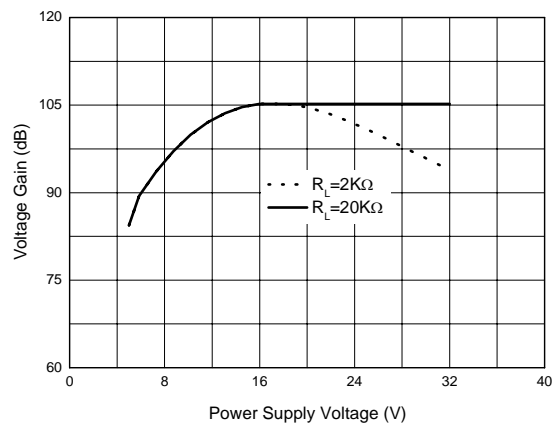


Figure 7. Voltage Gain

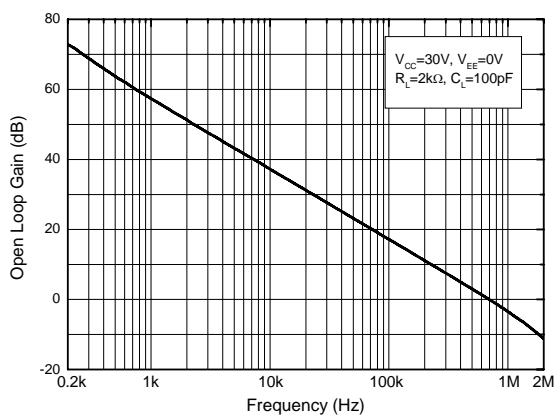


Figure 8. Open Loop Gain vs. Frequency

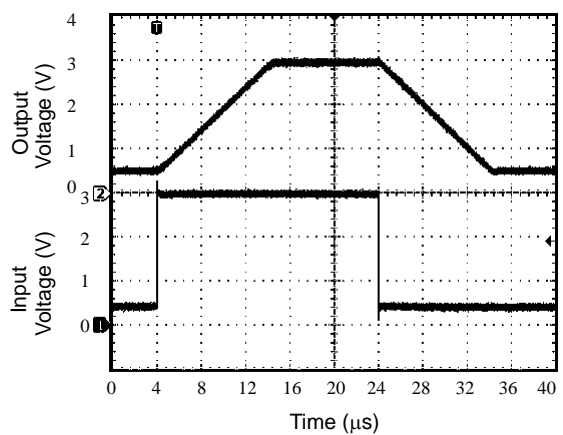


Figure 9. Voltage Follower Pulse Response



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**Typical Performance Characteristics (Continued)**

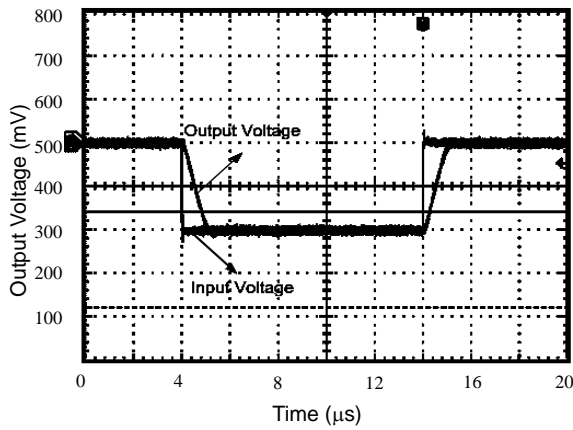


Figure 10. Voltage Follower Pulse Response (Small Signal)

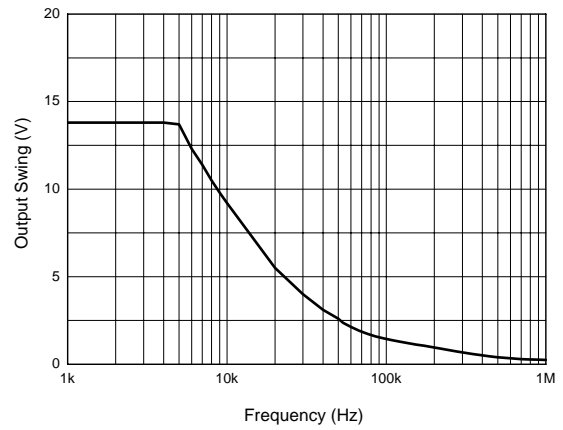


Figure 11. Large Signal Frequency Response

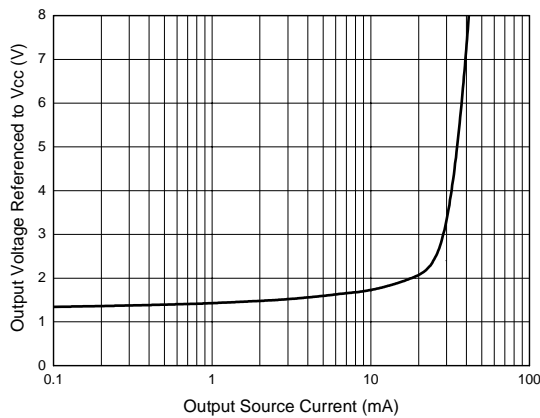


Figure 12. Output Characteristics: Current Sourcing

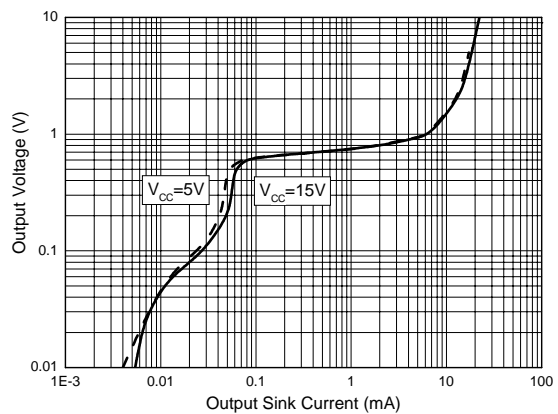


Figure 13. Output Characteristics: Current Sinking



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**Typical Performance Characteristics (Continued)**

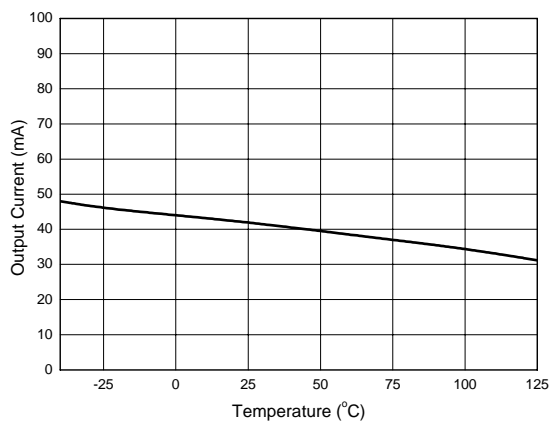


Figure 14. Current Limiting

**Typical Application**

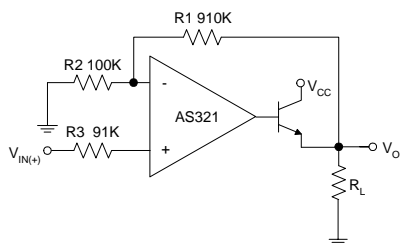


Figure 16. Power Amplifier

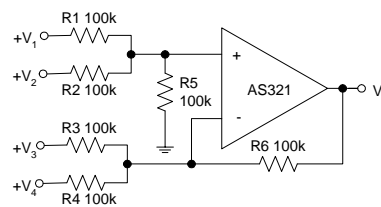


Figure 17. DC Summing Amplifier





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**Typical Application (Continued)**

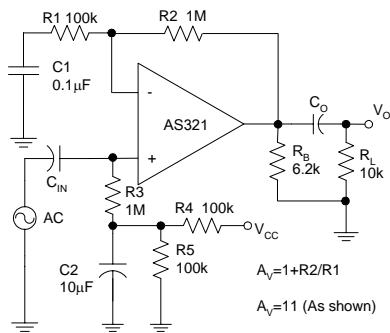


Figure 18. AC Coupled Non-Inverting Amplifier

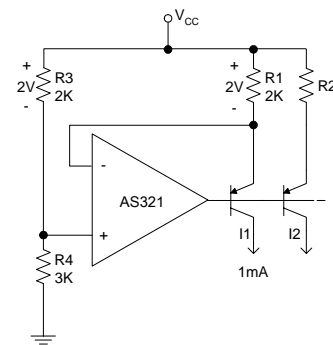


Figure 19. Fixed Current Sources

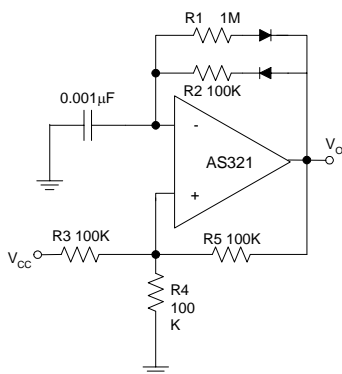


Figure 20. Pulse Generator

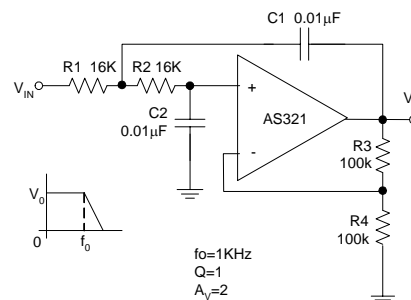


Figure 21. DC Coupled Low-Pass Active Filter



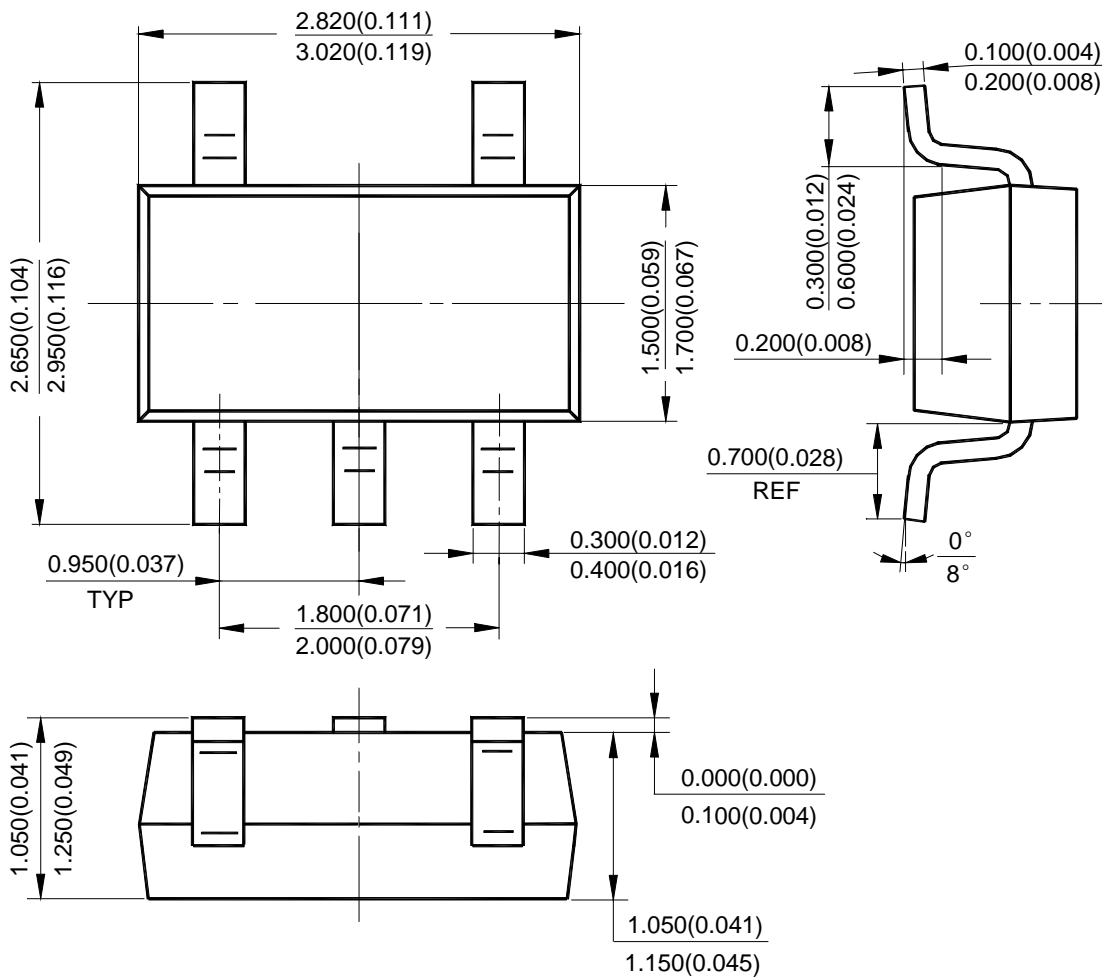
**LOW POWER SINGLE OPERATIONAL AMPLIFIER**

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**Mechanical Dimensions**

**SOT-23-5L**

**Unit: mm(inch)**





BCD Semiconductor Manufacturing Limited

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