

## Single Operational Amplifiers

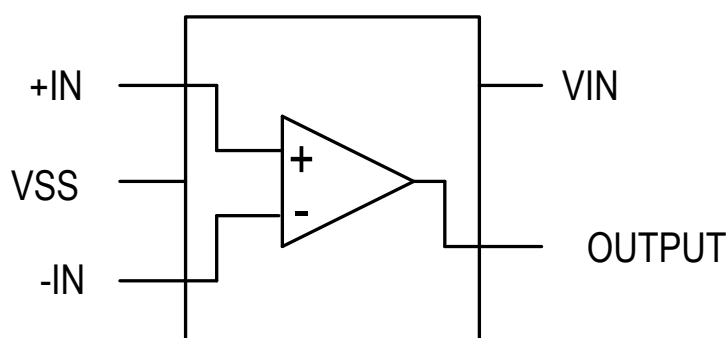
### ❖ GENERAL DESCRIPTION

These devices consist of two independent, high gain, internally frequency-compensated operational amplifiers designed operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3V to 36V, and  $V_{CC}$  is at least 1.5V more positive than the input common-mode voltage, the low supply-current drain is independent of the magnitude of the power supply voltage.

### ❖ FEATURES

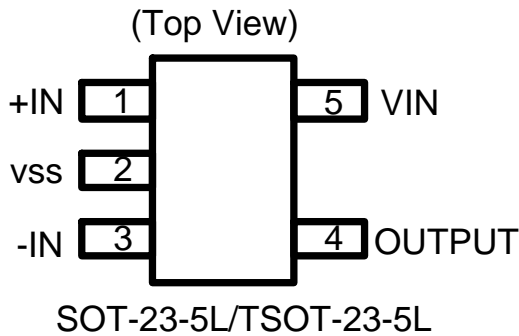
- One internally compensated OP amps
- Wide power supply range: 3V to 36V
- Large output voltage swing: 0V to  $V_{CC}-1.5V$
- Low input bias current
- Low input offset voltage and offset current
- Internally frequency compensated for unity gain
- Short Circuit Protected Outputs
- Input common-mode voltage range includes ground
- SOT-23-5L and TSOT-23-5L Pb-Free packages

### ❖ BLOCK DIAGRAM



❖ PIN ASSIGNMET

The packages of AX321 are SOT-23-5L and TSOT-23-5L; the pin assignment is given by:



Pin	Description
1	Non inverting input (+IN)
2	VSS
3	Inverting input (-IN)
4	Output (Vo)
5	VCC

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
<p><b>AX321 XX X</b></p> <pre>                 Package Type   Packing        ----- -----         B: SOT-23-5L  Blank : Bag         BT: TSOT-23-5L A : Taping                     </pre>	<p><b>RDY WX</b> → ID code:internal</p> <pre>                 WW:01~26 (A~Z)         27~52 (a~z)                 Year: A=2010                  1=2011                     </pre> <p>AX321</p>

❖ ABSOLUTE MAXIMUM RATINGS (at T<sub>A</sub>=25°C)

Characteristics	Symbol	Rating	Unit
Power Supply Voltage (Single Supply)	V <sub>CC</sub>	40	V
Power Supply Voltage (Split Supplies)	V <sub>CC</sub> , V <sub>SS</sub>	±20	V
Input Differential Voltage Range	V <sub>IDR</sub>	±20	V
Input Common Mode Voltage Range	V <sub>ICR</sub>	-0.3 to V <sub>CC</sub>	V
Output Short Circuit Duration	T <sub>SC</sub>	Continuous	
Power Dissipation	PD	500	mW
Storage Temperature Range	T <sub>ST</sub>	-55 to +165	°C
Operating Junction Temperature	T <sub>OPJ</sub>	-40 to +125	°C
Junction Temperature Range	T <sub>J</sub>	150	°C
Thermal Resistance from Junction to case	θ <sub>JC</sub>	110	°C/W
Thermal Resistance from Junction to ambient	θ <sub>JA</sub>	250	°C/W

**❖ ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 5V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified)

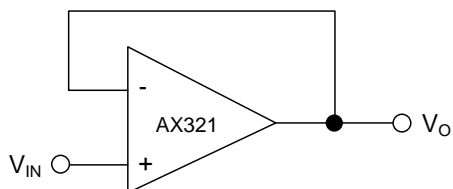
Characteristics	Symbol	Conditions (Note1)	Min	Typ	Max	Units
Input offset voltage(Note2)	$V_{IO}$	$V_{CC}=5V$ to Max, $V_{IC}=V_{ICR}$ min, $V_O=1.4V$	1	5	11	mV
Average temperature coefficient of input offset voltage	$\alpha V_{IO}$		-	7	-	$\mu V/^{\circ}C$
Input offset current	$I_{IO}$	$V_O=1.4V$	-	2	50	nA
Average temperature coefficient of input offset current	$\alpha I_{IO}$		-	10	-	$\mu A/^{\circ}C$
Input bias current	$I_{IB}$	$I_{IN+}$ or $I_{IN-}$	-	-20	-250	nA
Common-mode input voltage range	$V_{ICR}$	$V_{CC}=5V$ to Max	0 to $V_{CC}-1.5$	-	-	V
High-level output voltage	$V_{OH}$	$V_{CC}=\text{Max}$ , $R_L=2K\Omega$	26	-	-	V
		$V_{CC}=\text{Max}$ , $R_L \geq 10K\Omega$	27	28	-	
Low-level output voltage	$V_{OL}$	$R_L \geq 10K\Omega$	-	5	20	mV
Large-signal differential voltage amplification	$A_{VD}$	$V_{CC}=15V$ , $V_O=1V$ to $11V$ , $R_L \geq 2K\Omega$	25	100	-	V/mV
Common-mode rejection ratio	CMRR	$V_{CC}=5V$ to Max, $V_{IC}=V_{ICR}$ min.	65	80	-	dB
Supply voltage rejection ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )	$K_{SVR}$	$V_{CC}=5V$ to Max	65	100	-	dB
Crosstalk attenuation	$V_{OUT}$	$F=1KHz$ to $20KHz$	-	120	-	dB
Output current	$I_O$	$V_{CC}=15V$ , $V_{ID}=1V$ , $V_O=0V$	-20	-30	-	mA
		$V_{CC}=15V$ , $V_{ID}= -1V$ , $V_O=2V$	10	20	-	
		$V_{ID}= -1V$ , $V_O=200mV$	12	30	-	$\mu A$
Short-circuit output current	$I_{OS}$	$V_{CC} =15V$ , $V_O=0V$	-	40	-	mA
Supply current	$I_{CC}$	$V_O=2.5V$ , No Load	-	0.7	1.2	mA
		$V_{CC}=\text{Max}$ , $V_O=0.5V_{CC}$ , No Load	-	1	2	

Note1: All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. "MAX" VCC for testing purposes is 36 V. Full range is 0 °C to 70 °C.

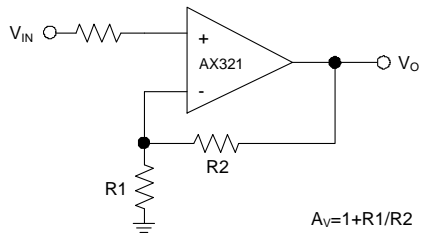
Note2:  $(V_{IN+}) - (V_{IN-}) > +1mV$  (min.) for  $V_O=1.4V$ .

❖ APPLICATION CIRCUIT

Volgate Follower

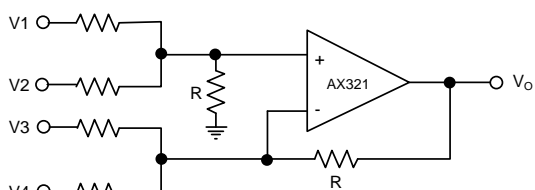


Non Inverting DC Amplifier



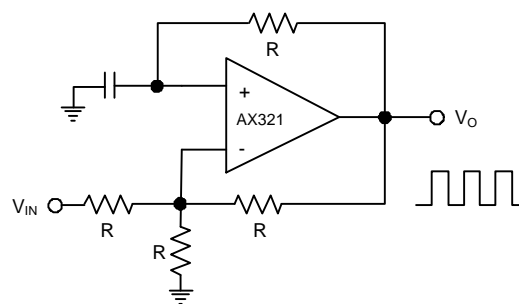
$A_v = 1 + R1/R2$

DC Summing Amplifier

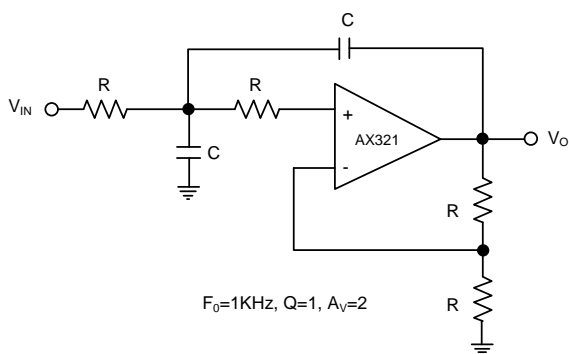


$V_o = V1 + V2 - V3 - V4$   
Where  $(V1 + V2) \geq (V3 + V4)$   
To Keep  $V_o \geq 0V$

Square-wave Oscillator

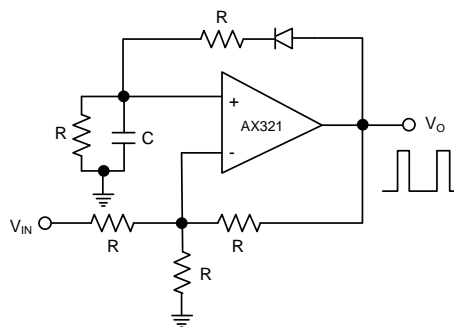


DC Coupled Low-Pass RC Active Filter

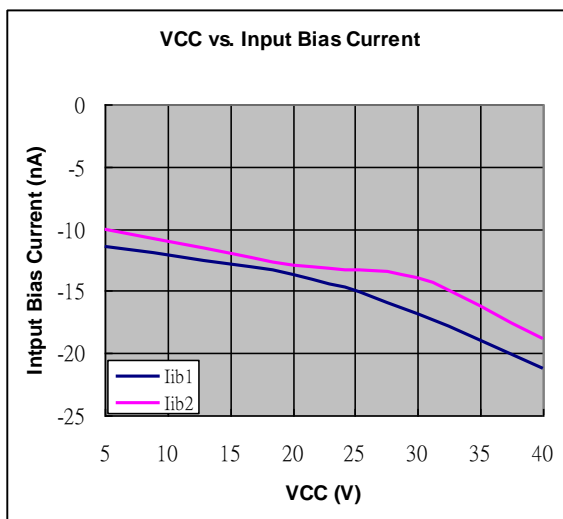
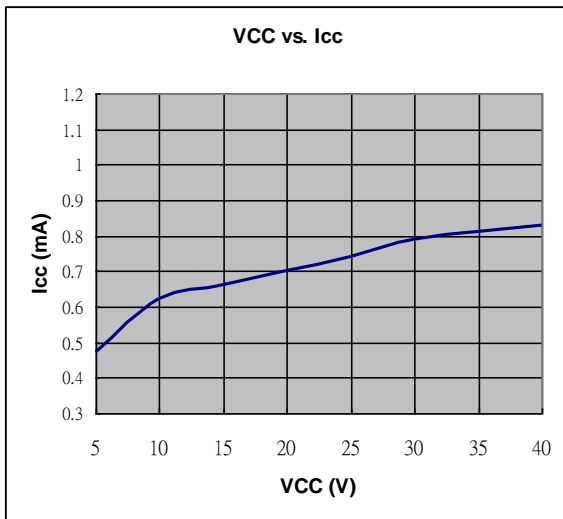
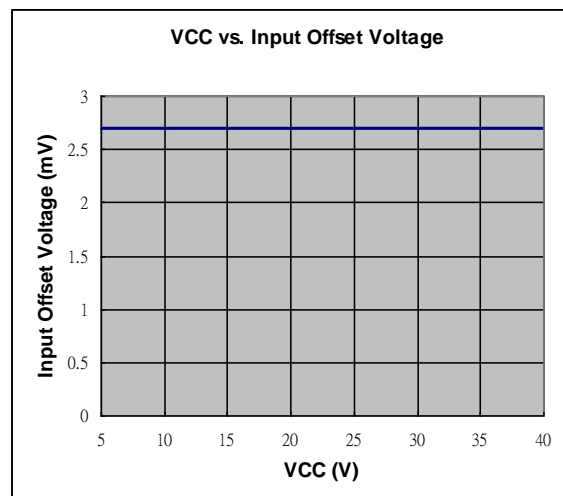
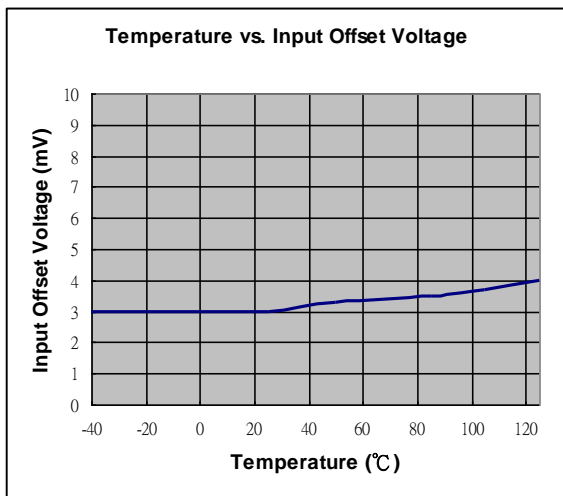


$F_0 = 1KHz, Q = 1, A_v = 2$

Pulse Generator

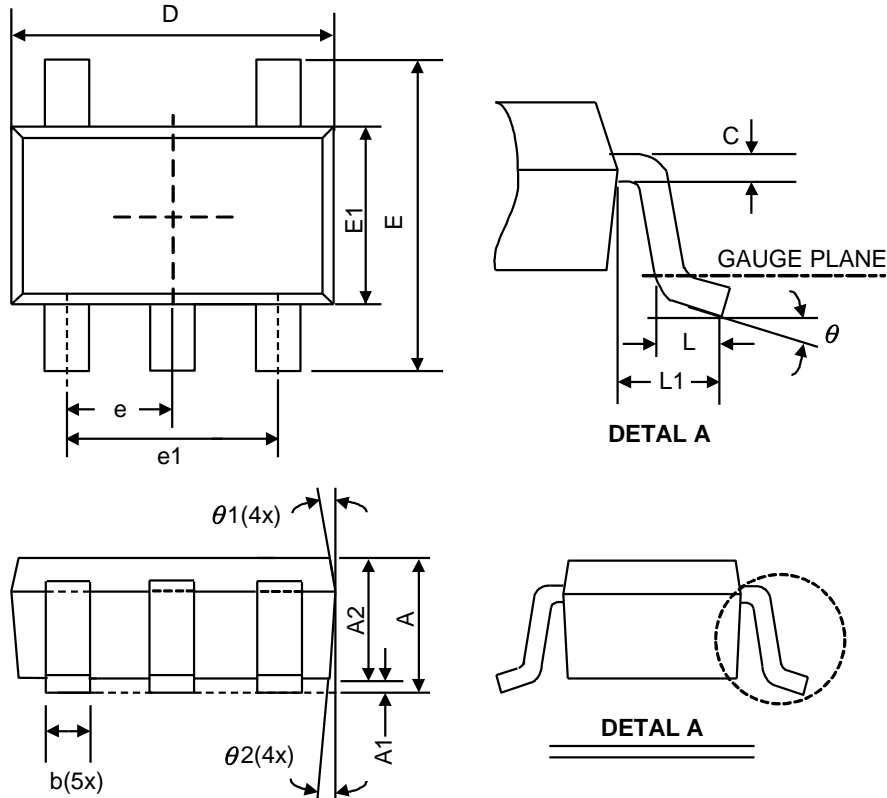


❖ TYPICAL CHARACTERISTICS



❖ PACKAGE OUTLINES

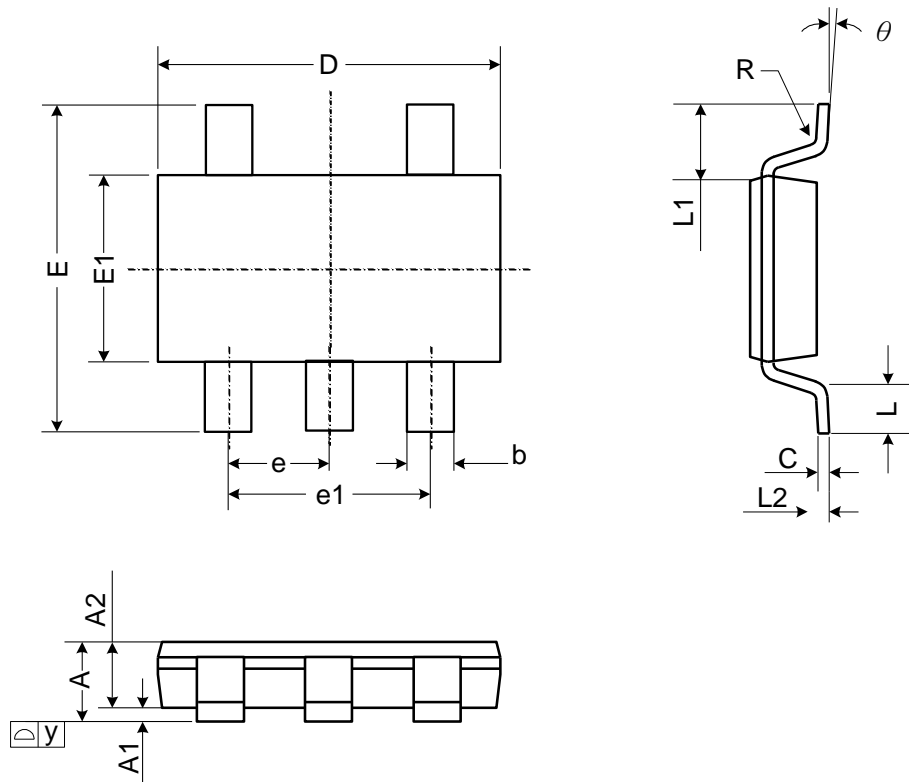
(1) SOT-23-5L



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.45	-	-	0.057
A1	0.00	0.08	0.15	0	0.003	0.006
A2	0.90	1.10	1.30	0.035	0.043	0.051
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.15	0.22	0.003	0.006	0.009
D	2.70	2.90	3.10	0.106	0.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.9 BSC			0.075 BSC		
e	0.95 BSC			0.037 BSC		
$\theta$	0°	4°	8°	0°	4°	8°
$\theta 1$	5°	10°	15°	5°	10°	15°
$\theta 2$	5°	10°	15°	5°	10°	15°

JEDEC outline: MO-178 AA

(2) TSOT-23-5L



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.10	-	-	0.043
A1	0.00	-	0.10	0	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
theta	0°	-	8°	0°	-	8°

JECED outline: MO-193 AB