

Low Power Single Op Amp

**LM321**

**PRODUCT DESCRIPTION**

The LM321 brings performance and economy to low power systems. With a high unity gain frequency and a guaranteed  $0.4V/\mu s$  slew rate, the quiescent current is only  $430\mu A$ /amplifier (5V). The input common mode range includes ground and therefore the device is able to operate in single supply applications as well as in dual supply applications. It is also capable of comfortably driving large capacitive loads. The LM321 is available in the SOT package. Overall the LM321 is a low power, wide supply range performance op amp that can be designed into a wide range of applications at an economical price without sacrificing valuable board space.

**FEATURES**

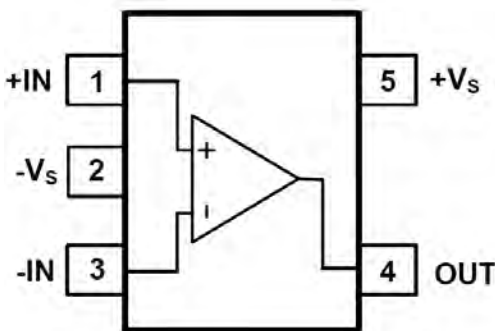
- Gain-Bandwidth product: 1MHz
- ( $V_{CC} = 5V, T_A = 25^\circ C$ . Typical values unless specified).
- Low supply current:  $430\mu A$
- Low input bias current:  $45nA$
- Wide supply voltage range
- Operates on 24V or  $\pm 12V$  Supplies
- Stable with high capacitive loads
- Small Packaging: LM321 Available in SOT-23-5L.

**APPLICATIONS**

- Chargers
- Power supplies
- Industrial: controls, instruments
- Desktops
- Communications infrastructure

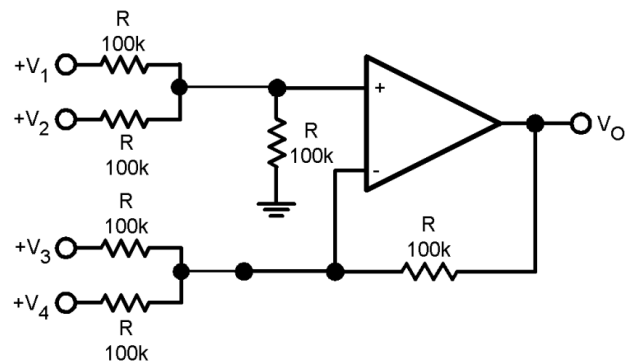
**PIN CONFIGURATIONS**

LM321  
(Top View)



**APPLICATION Circuit**

DC Summing Amplifier  
( $V_{IN's} \geq 0V_{DC}, V_O \geq V_{DC}$ )



Where:  $V_O = V_1 + V_2 - V_3 - V_4, (V_1 + V_2) \geq (V_3 + V_4)$  to keep  $V_O \geq 0V_{DC}$

## ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V-	24V or $\pm 12V$
Input Voltage	- 0.3V to Vcc
Input Current (VIN<-0.3V)	50mA
Output Short Circuit to GND (V $\leq$ 15V、Ta=25 $^{\circ}$ C)	Continuous
Storage Temperature Range	-65 $^{\circ}$ C to +150 $^{\circ}$ C
Junction Temperature	150 $^{\circ}$ C
Operating Temperature Range	0 $^{\circ}$ C to +70 $^{\circ}$ C
Lead Temperature Range (Soldering 10 sec)	260 $^{\circ}$ C

#### NOTE:

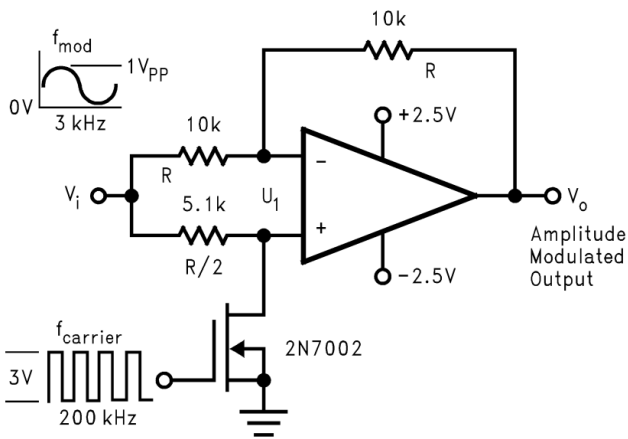
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ELECTRICAL CHARACTERISTICS

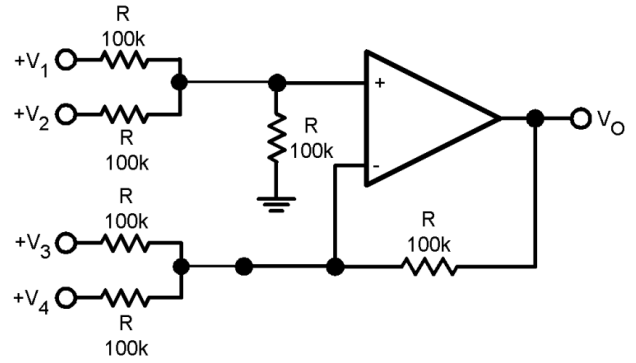
(Unless otherwise specified, all limits guaranteed for at Tamb=25 $^{\circ}$ C, Vcc=5V)

Parameter	Conditions	value			Units	
		Min	Typ	Max		
Input Offset Voltage			$\pm 2$	$\pm 5$	mV	
Input Bias Current	IIN(+) or IIN(-), VCM=0V		$\pm 45$	$\pm 250$	nA	
Input Offset Current	IIN(+) - IIN(-), VCM=0V		$\pm 3$	$\pm 50$	nA	
Input Common-Mode Voltage Range	Ta=25 $^{\circ}$ C, V $^+$ =24V	0		Vcc -1.5	V	
Supply Current	Iout=0	Vcc =24V		1	2	mA
		Vcc =5V		0.5	1.2	mA
Large Signal Voltage Gain	Vcc =15V, Ta=25 $^{\circ}$ C, RL $\geq$ 2k $\Omega$ (Vo=1~11V)	25	100		V/mV	
Common Mode Rejection Ratio	DC, Ta=25 $^{\circ}$ C, VCM=0~Vcc-1.5V	65	90		dB	
Power Supply Rejection Ratio	DC, Ta=25 $^{\circ}$ C, Vcc =5~24V	65	100		dB	
Output Current Sourcing	VIN(+)=1V, VIN(-)=0V, Vcc=15V, Vo=2V	20	40		mA	
Output Current Sinking	VIN(-)=1V, VIN(+)=0V, Vcc=15V, Vo=2V	10	15		mA	
	VIN(-)=1V, VIN(+)=0V, Vcc=15V, Vo=200mV	12	50		$\mu$ A	
Output Short Circuit to Ground	Vcc=15V		40	60	mA	
Slew Rate	V+ = 15V, RL = 2k $\Omega$ , VIN = 0.5 to 5V CL = 100pF		0.4		V/ $\mu$ s	
Output voltage swing	VOH	Vcc=24V	RL=2k $\Omega$	22		V
		Vcc=24V	RL=10k $\Omega$	22		V
	VOL	Vcc=5V, RL=10k $\Omega$		5	20	mV

# TYPICAL APPLICATIONS



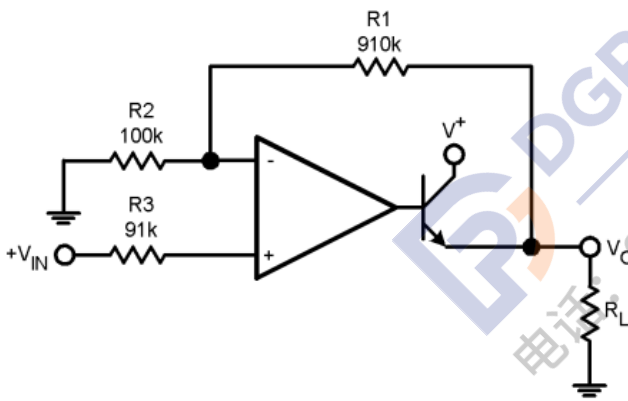
Amplitude Modulator Circuit



Where:  $V_o = V_1 + V_2 - V_3 - V_4, (V_1 + V_2) \geq (V_3 + V_4)$  to keep  $V_o \geq 0V_{dc}$

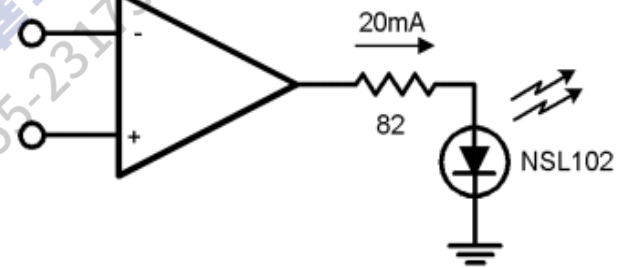
DC Summing Amplifier

( $V_{IN}'s \geq 0V_{dc}, V_o \geq 0V_{dc}$ )

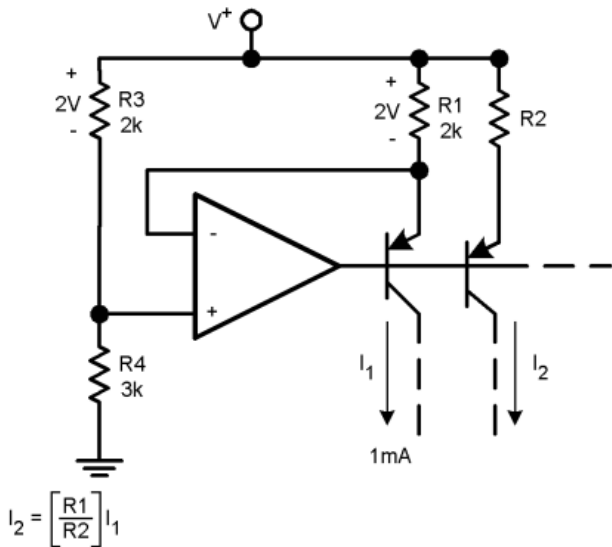


$V_o = 0V_{dc}$  for  $V_{IN} = 0V_{dc}$ ,  $A_v = 10$

Power Amplifier

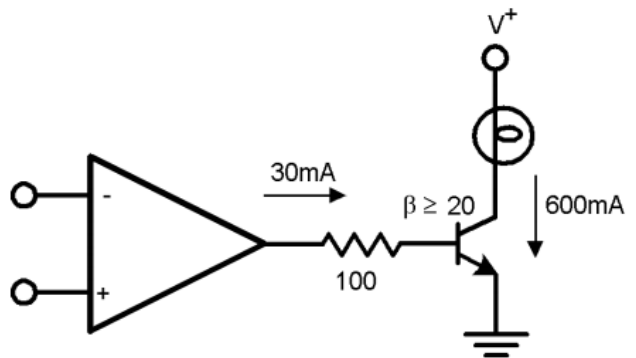


LED Driver



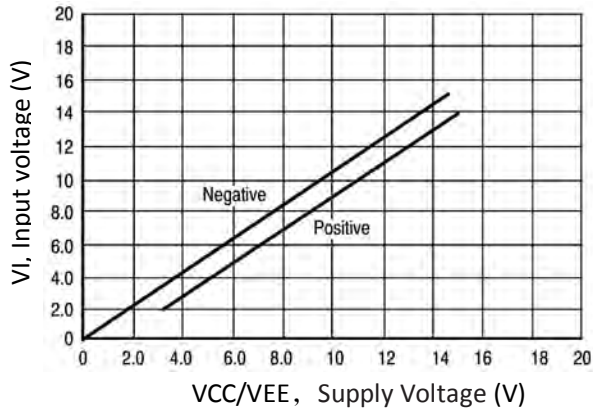
$$I_2 = \left[ \frac{R_1}{R_2} \right] I_1$$

Fixed Current Sources

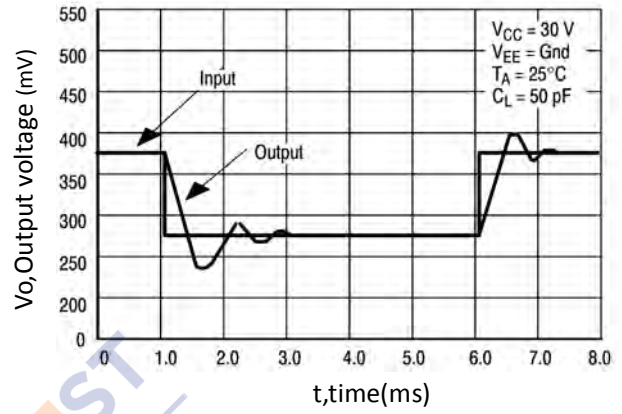


Lamp Driver

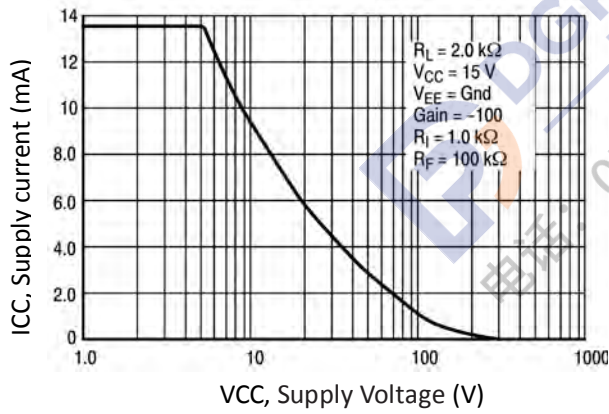
# TYPICAL PERFORMANCE CHARACTERISTICS



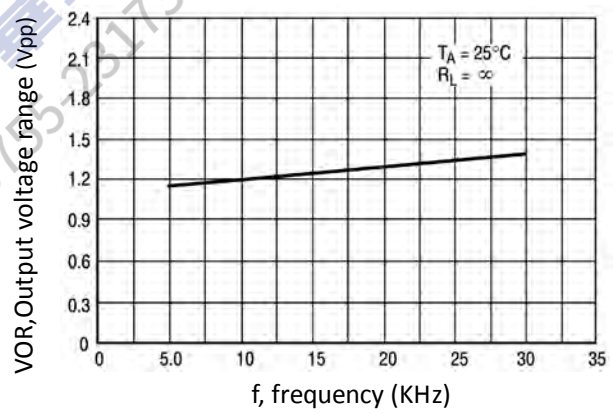
Input voltage range



Small signal voltage follower impulse response  
(same direction)

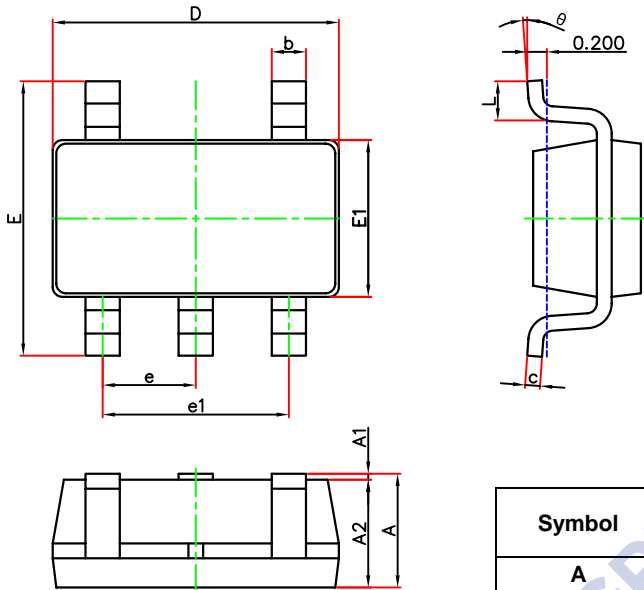


Supply current (static power consumption)



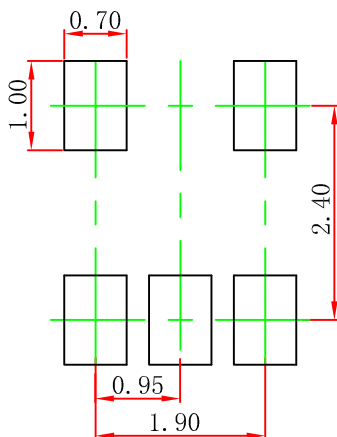
Large signal frequency response

## SOT-23-5L Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.850	2.990	0.112	0.118
E	2.690	2.990	0.106	0.118
E1	1.530	1.670	0.060	0.066
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

## SOT-23-5L Suggested Pad Layout



Note:

1. Controlling dimension; in millimeters.
2. General tolerance:  $\pm 0.05\text{mm}$ .
3. The pad layout is for reference purposes only.

# DISCLAIMER

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