

Low Power Single Op Amp

General 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 SOT23-5 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.

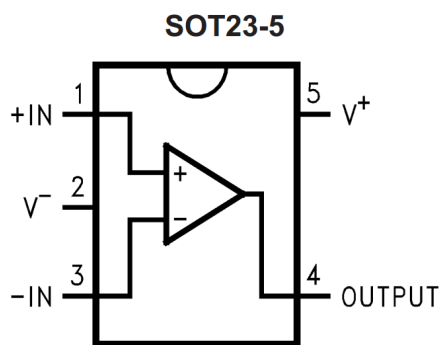
Features

- (VCC = 5V, TA = 25°C. Typical values unless specified).
- Gain-Bandwidth product 1MHz
- Low supply current 430 μA
- Low input bias current 45nA
- Wide supply voltage range
- Stable with high capacitive loads

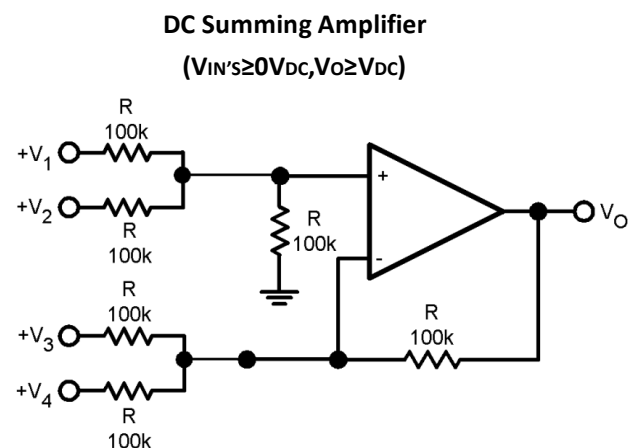
Applications

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

Connection Diagram



Application Circuit



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

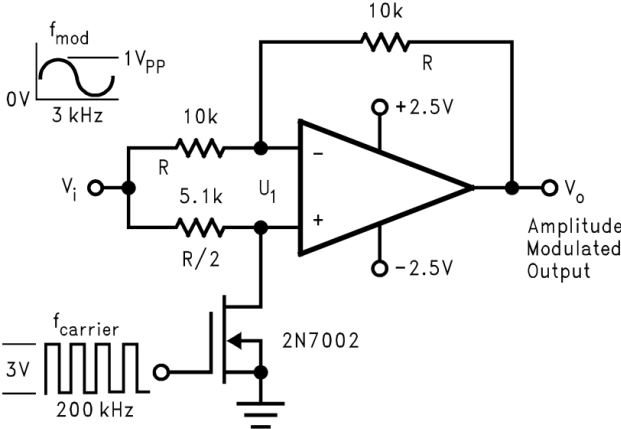
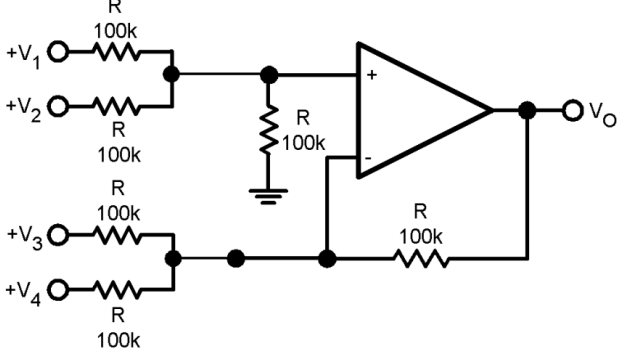
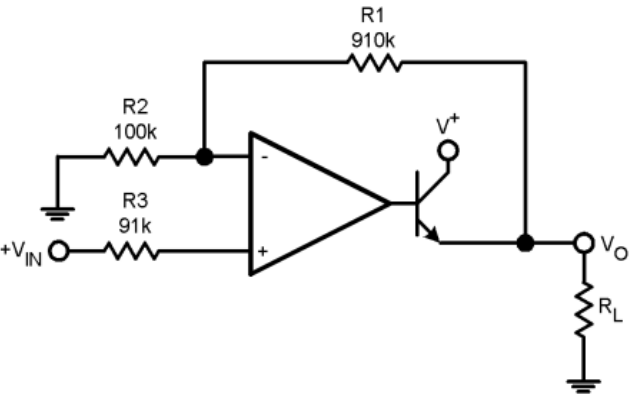
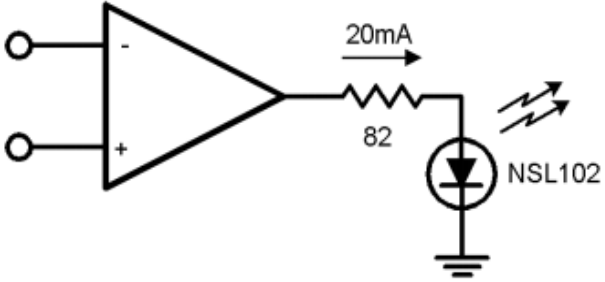
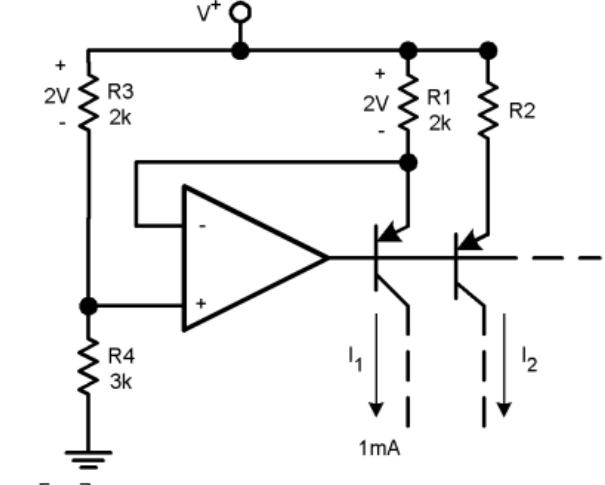
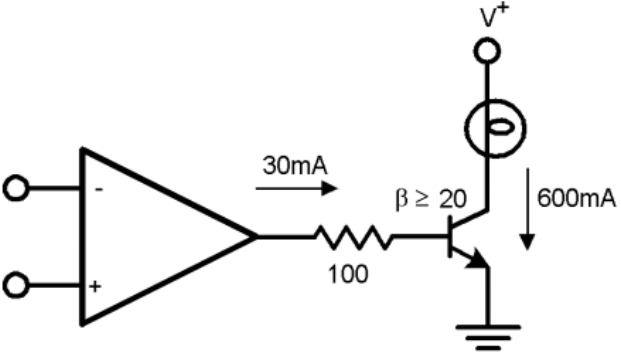
Absolute Maximum Ratings (Unless otherwise specified, all limits guaranteed for at Tamb=25℃)

Parameter	value	Units
Supply Voltage	24 or ±12	V
Differential Input Voltage	24	V
Input Voltage	-0.3 ~ VCC	V
Output Short Circuit to GND (V≤15V、Ta=25℃)	Continuous	
Input Current (VIN<-0.3V)	50	mA
Junction Temperature	150	℃
Temperature Range	0 ~ 70	℃
Storage Temperature Range	-65 ~ 150	℃

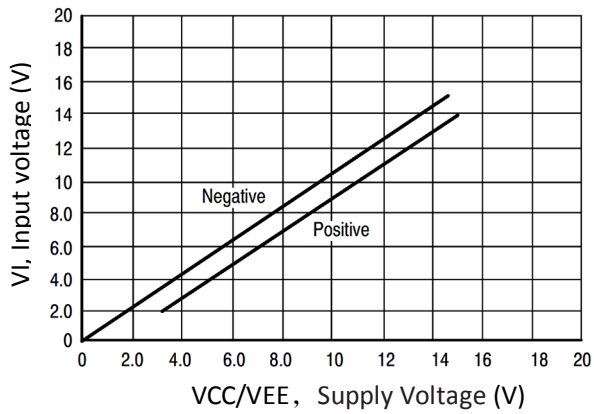
Electrical Characteristics (Unless otherwise specified, all limits guaranteed for at Tamb=25℃, Vcc=5V)

Parameter	Conditions	value			Units
		Min	Typ	Max	
Input Offset Voltage			±2	±5	mV
Input Bias Current	IIN(+) or IIN(-), VCM=0V		±45	±250	nA
Input Offset Current	IIN(+) - IIN(-), VCM=0V		±3	±50	nA
Input Common-Mode Voltage Range	Ta=25℃, 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℃, RL≥2kΩ (Vo=1~11V)	25	100		V/mV
Common Mode Rejection Ratio	DC, Ta=25℃, VCM=0~Vcc-1.5V	65	90		dB
Power Supply Rejection Ratio	DC, Ta=25℃, 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		μA
Output Short Circuit to Ground	Vcc=15V		40	60	mA
Slew Rate	V+ = 15V, RL = 2kΩ, VIN = 0.5 to 5V CL = 100pF		0.4		V/μs
Output voltage swing	VOH	Vcc=24V, RL=2kΩ	22		V
		Vcc=24V, RL=10kΩ	22		V
	VOL	Vcc=5V, RL=10kΩ		5	20

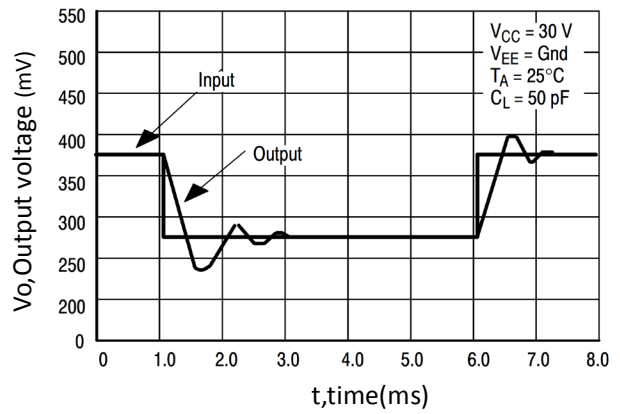
Typical Applications

 <p>The diagram shows an LM321 op-amp configured as an amplitude modulator. The non-inverting input (+) is connected to a 2N7002 transistor's emitter, which is driven by a 3V, 200 kHz carrier signal. The inverting input (-) is connected to an input terminal V_i through a resistor R and a 5.1k resistor. A feedback network consisting of a 10k resistor and a resistor R is connected between the output V_o and the inverting input. The op-amp is powered by +2.5V and -2.5V. A graph shows a 1V_{pp} modulated signal at 3 kHz.</p> <p style="text-align: center;">Amplitude Modulator Circuit</p>	 <p>The diagram shows an LM321 op-amp configured as a DC summing amplifier in an inverting configuration. The non-inverting input (+) is connected to ground through a 100k resistor. The inverting input (-) is connected to four input terminals: $+V_1$, $+V_2$, $+V_3$, and $+V_4$. Each input is connected through a resistor R (100k). A feedback resistor R (100k) is connected between the output V_o and the inverting input.</p> <p style="text-align: center;">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 ($V_{IN's} \geq 0V_{DC}, V_o \geq 0V_{DC}$)</p>
 <p>The diagram shows an LM321 op-amp configured as a power amplifier. The non-inverting input (+) is connected to an input terminal $+V_{IN}$ through a 91k resistor R_3. The inverting input (-) is connected to the output V_o through a feedback resistor R_1 (910k) and to ground through a resistor R_2 (100k). The op-amp's output is connected to the base of a 2N7002 transistor, which is configured as an emitter follower. The transistor's emitter is connected to ground, and its collector is connected to the output terminal V_o through a load resistor R_L.</p> <p style="text-align: center;">$V_o = 0V_{DC}$ for $V_{IN} = 0V_{DC}$, $A_v = 10$ Power Amplifier</p>	 <p>The diagram shows an LM321 op-amp configured as an LED driver. The non-inverting input (+) is connected to ground. The inverting input (-) is connected to an input terminal. The op-amp's output is connected to an 82 resistor, which is in series with the anode of an NSL102 LED. The cathode of the LED is connected to ground. A current of 20mA is indicated flowing through the LED.</p> <p style="text-align: center;">LED Driver</p>
 <p>The diagram shows an LM321 op-amp configured as a fixed current source. The non-inverting input (+) is connected to ground through a 3k resistor R_4. The inverting input (-) is connected to the base of a 2N7002 transistor. The transistor's emitter is connected to ground, and its collector is connected to a 2V source through a 2k resistor R_1. The collector is also connected to the non-inverting input (+) through a 2k resistor R_3. The output of the op-amp is connected to the base of a second 2N7002 transistor, which is configured as an emitter follower. The emitter of this transistor is connected to ground, and its collector is connected to a 2V source through a 2k resistor R_2. Currents I_1 and I_2 are indicated at the bases of the two transistors, with $I_1 = 1mA$.</p> <p style="text-align: center;">$I_2 = \left[\frac{R_1}{R_2} \right] I_1$ Fixed Current Sources</p>	 <p>The diagram shows an LM321 op-amp configured as a lamp driver. The non-inverting input (+) is connected to ground. The inverting input (-) is connected to an input terminal. The op-amp's output is connected to a 100 resistor, which is in series with the base of a 2N7002 transistor. The transistor's emitter is connected to ground, and its collector is connected to a lamp. A current of 30mA is indicated flowing through the base resistor, and a current of 600mA is indicated flowing through the lamp. The transistor's $\beta \geq 20$.</p> <p style="text-align: center;">Lamp Driver</p>

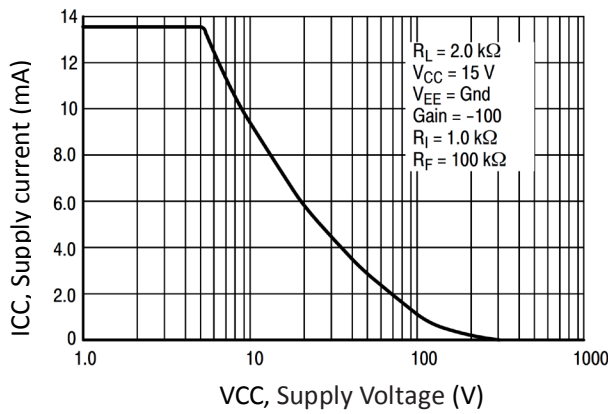
Typical Performance Characteristics



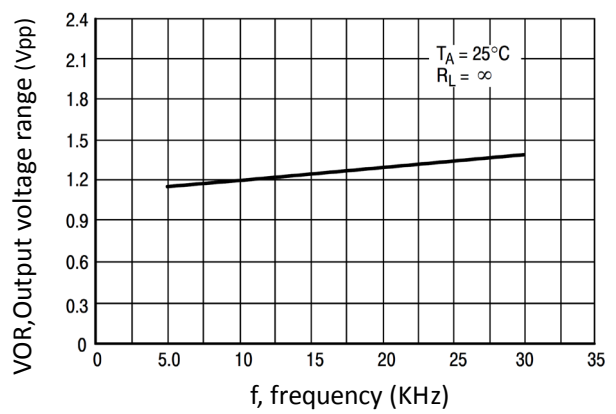
Input voltage range



Small signal voltage follower impulse response
(same direction)

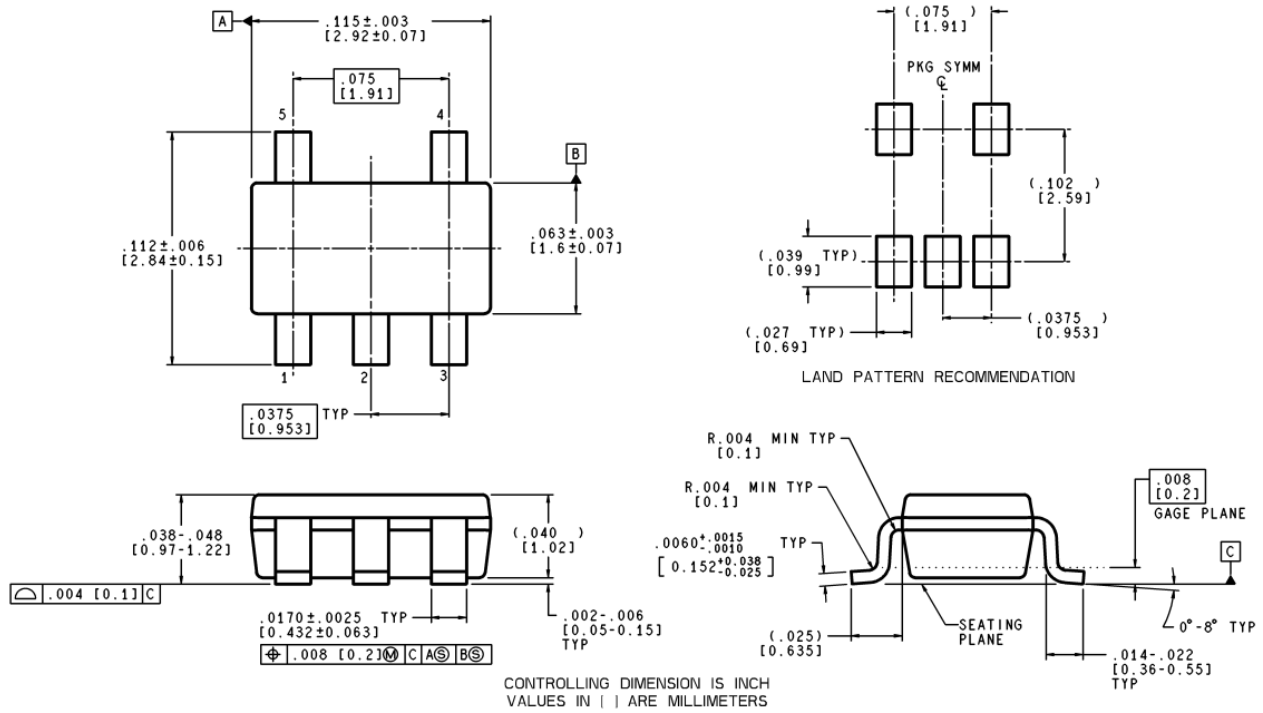


Supply current (static power consumption)



Large signal frequency response

Physical Dimensions



5-Pin SOT23
NS Package Number MF05A