

Features

- General Purpose, Low Cost
- Gain Bandwidth Product: 1MHz
- Low Quiescent Current: 40 μ A/Amplifier
- Offset Voltage: 5.0mV Maximum
- Offset Voltage Temperature Drift: 2 μ V/ $^{\circ}$ C
- Input Bias Current: 10pA
- Unity Gain Stable
- Rail-to-Rail Input and Output
- No Phase Reversal for Overdriven Inputs
- Supply Voltage Range: 2.2V to 5.5V
- Operating Temperature: -40 $^{\circ}$ C ~ +125 $^{\circ}$ C
- Type Package: SOT23-5

Applications

- Audio Output
- Battery and Power Supply Control
- Smoke/Gas/Environment Sensors
- Medical Equipment
- Portable Instruments and Mobile Device
- Active Filters
- Piezo Electrical Transducer Amplifier
- Sensor Interface
- ASIC Input or Output Amplifier

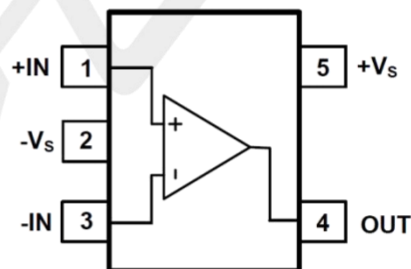
General Description

TP321 are general purpose single, CMOS op-amps with low offset, high frequency response, low power, low supply voltage, and rail-to-rail inputs and outputs. with low cost among all micro-power CMOS amplifiers.

The TP321 are unity gain stable with a constant 1MHz gain-bandwidth product, 1V/ μ s slew rate while consuming only 45 μ A of supply current per amplifier. The rail-to-rail input and output characteristics allow the full power-supply voltage to be used for signal range.

The TP321 are ideal choices for battery-powered applications because they minimize errors due to power supply voltage variations over the lifetime of the battery and maintain high CMRR even for a rail-to-rail input op-amp.

Pinout (top view)



Pin Configurations

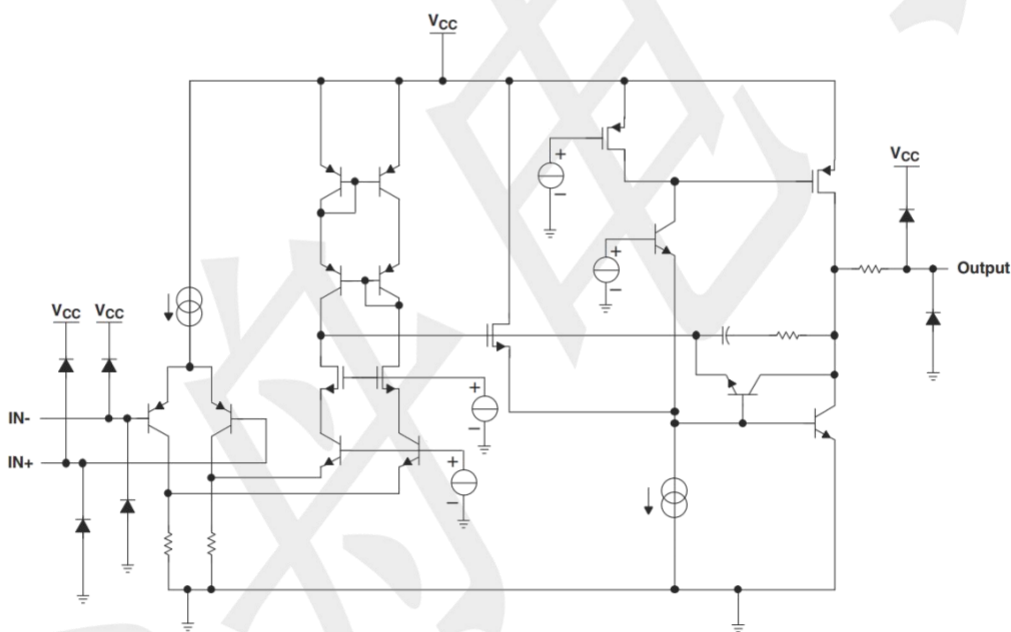
Pin Number	Pin Name	Pin Function
1	+IN	In-phase input
2	-Vs	Chip Supply Voltage(Negative)/GND
3	-IN	Reverse input
4	OUT	Output
5	+Vs	Chip Supply Voltage(Positive)/VDD

Absolute Maximum Ratings

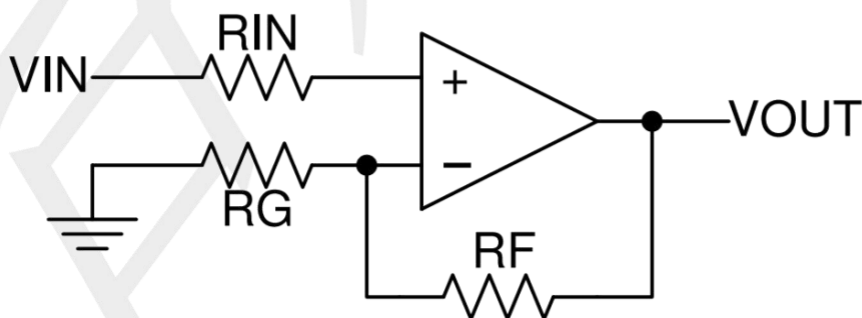
(@TA = +25°C, unless otherwise specified.)

Condition		Rating		UNIT
VDD to GND	Power Supply Voltage	-0.5~+7V		V
IN+ or IN-	Analog Input Voltage	GND-0.5V~VDD+0.5V		V
PDB	PDB Input Voltage	GND-0.5V~7V		V
θ_{JA}	Thermal Resistance Junction-to Ambient	190		°C/W
LT	Lead Temperature (Soldering, 10 sec.)	260		°C
Temperature	Junction Temperature, TJ	-40	125	
	Storage, Tstg	-55	150	

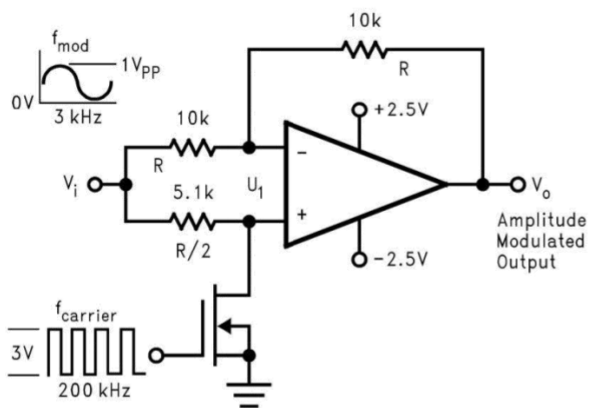
BLOCK DIAGRAM



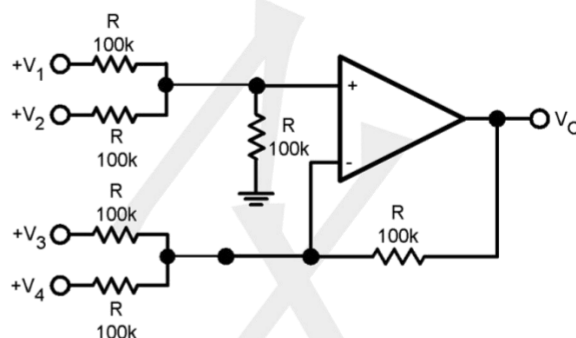
Power Supply Bypassing



Typical Application Circuit



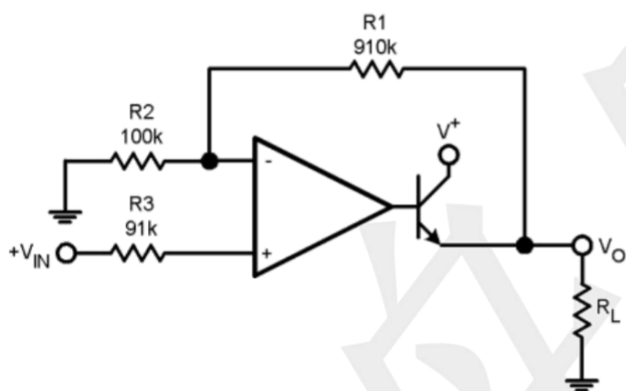
Amplitude modulator circuit



Note: $V_o = V_1 + V_2 - V_3 - V_4, (V_1 + V_2) \geq (V_3 + V_4)$ for $V_o \geq 0V_{DC}$

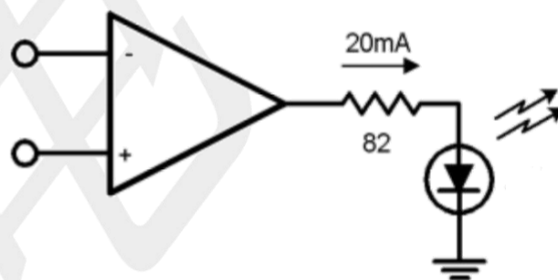
DC adder amplifier

($V_{IN'S} \geq 0V_{DC}, V_o \geq V_{DC}$)

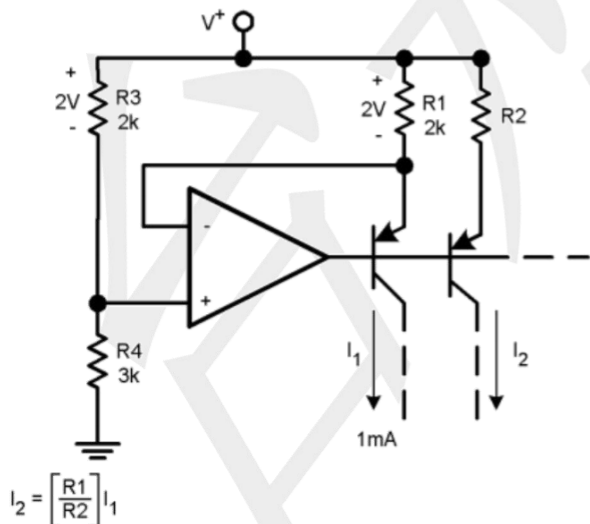


$V_o = 0V_{DC}$ for $V_{IN} = 0V_{DC}$, $A_v = 10$

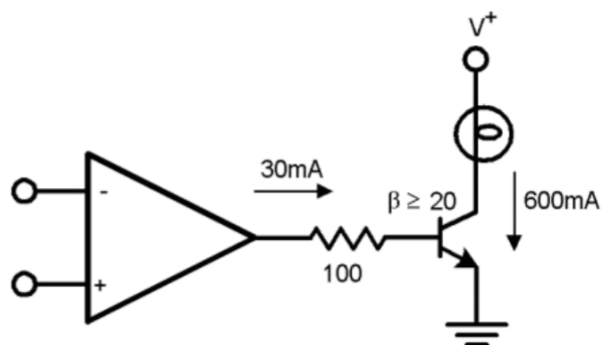
Power Amplifier



LED Driver



Fixed current source



Lamp Driver

Electrical Characteristics

(At $V_S = +5V$, $V_{CM} = 0V$, $C_L = 15pF$, and $T_A = +25^\circ C$, unless otherwise noted.)

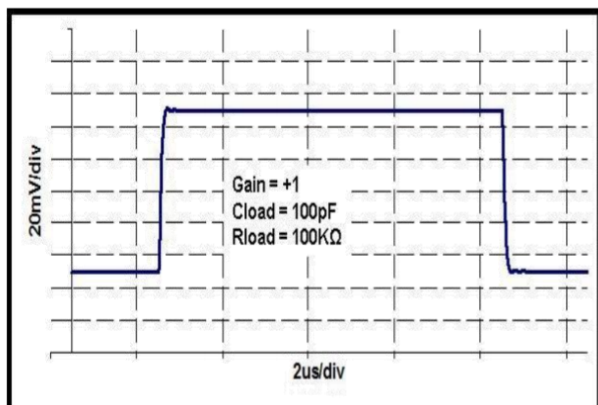
PARAMETER	SYMBOL	TEST Conditions	MIN	TYP	MAX	UNIT
Supply-Voltage Range	V_{DD}	Guaranteed by the PSRR test	2.2	--	5.5	V
Quiescent Supply Current (per Amplifier)	I_Q	$V_{DD} = 5V$	30	40	60	μA
Input Offset Voltage	V_{OS}		--	± 0.5	± 5	mV
Input Offset Voltage Tempco	$\Delta V_{OS}/\Delta T$		--	2	--	$\mu V/^\circ C$
Input Bias Current	I_B	(Note 2)	--	10	--	PA
Input Offset Current	I_{OS}	(Note 2)	--	10	--	PA
Common-Mode Voltage Range	V_{CM}		-0.1	--	$V_{DD} + 0.1$	V
Common-Mode Rejection Ratio	CMRR	$V_{DD}=5.5V$ $V_{SS}=0.1V$ V_{CM} $V_{DD}+0.1V$	55	65	--	dB
		$V_{SS} \leq V_{CM} \leq 5V$	60	80	--	dB
Power-Supply Rejection Ratio	PSRR	$V_{DD} = +2.5V$ to $+5.5V$	75	94	--	dB
Open-Loop Voltage Gain ($0.05V \leq V_O \leq 4.95V$)	A_V	$V_{DD}=5V$, $R_L=100k\Omega$	100	110	--	dB
		$V_{DD}=5V$, $R_L=5k\Omega$	70	80	--	dB
Output Voltage Swing	V_{OUT}	$ V_{IN+}-V_{IN-} \leq 10mV$ $V_{DD}-V_{OH}$	--	6	--	mV
		$R_L = 100k\Omega$ to $V_{DD}/2$ $V_{OL}-V_{SS}$	--	6	--	mV
		$ V_{IN+}-V_{IN-} \leq 10mV$ $V_{DD}-V_{OH}$	--	60	--	mV
		$R_L = 5k\Omega$ to $V_{DD}/2$ $V_{OL}-V_{SS}$	--	60	--	mV
Output Short-Circuit Current	I_{SC}	Sinking or Sourcing	--	± 20	--	mA
Gain Bandwidth Product	GBW	$A_V = +1V/V$	--	1	--	MHz
Slew Rate	SR	$A_V = +1V/V$	--	0.6	--	V/ μs
Settling Time	t_s	To 0.1%, $V_{OUT} = 2V$ step $A_V = +1V/V$	--	5	--	μs
Over Load Recovery Time		$V_{IN} \times \text{Gain} = V_S$	--	2	--	μs
Input Voltage Noise Density	e_n	$f = 10kHz$	--	20	--	$nV/\sqrt{Hz}$

Notes: 1: All devices are 100% production tested at $T_A = +25^\circ C$; all specifications over the automotive temperature range is guaranteed by design, not production tested.

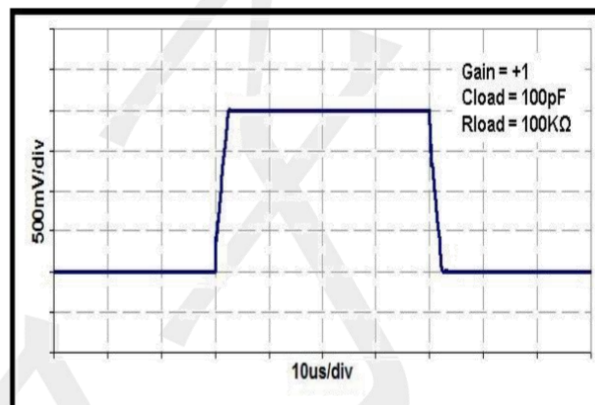
2: Parameter is guaranteed by design.

Typical Performance Characteristics (@TA = +25°C, unless otherwise specified.)

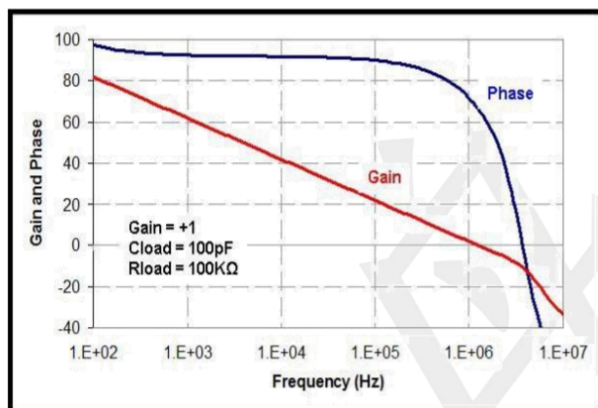
Small-Signal Step Response, 100mV Step



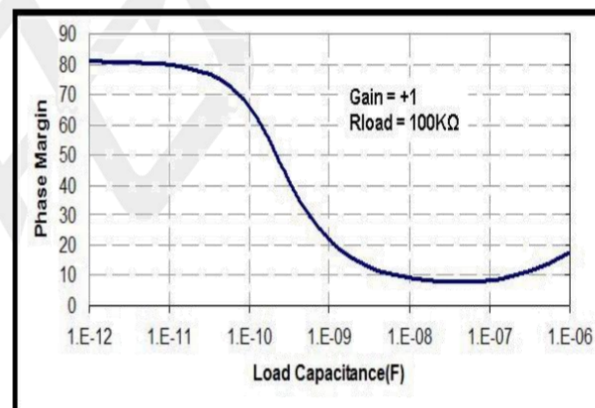
Large-Signal Step Response, 2V Step



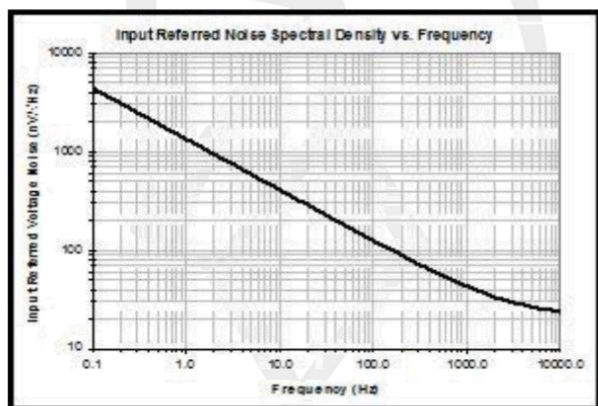
Open-Loop Gain and Phase



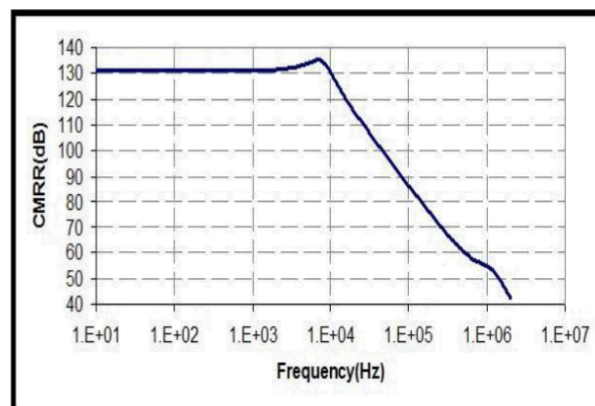
Phase Margin vs. C_{LOAD} (Stable for Any C_{LOAD})



Input Voltage Noise Spectral Density

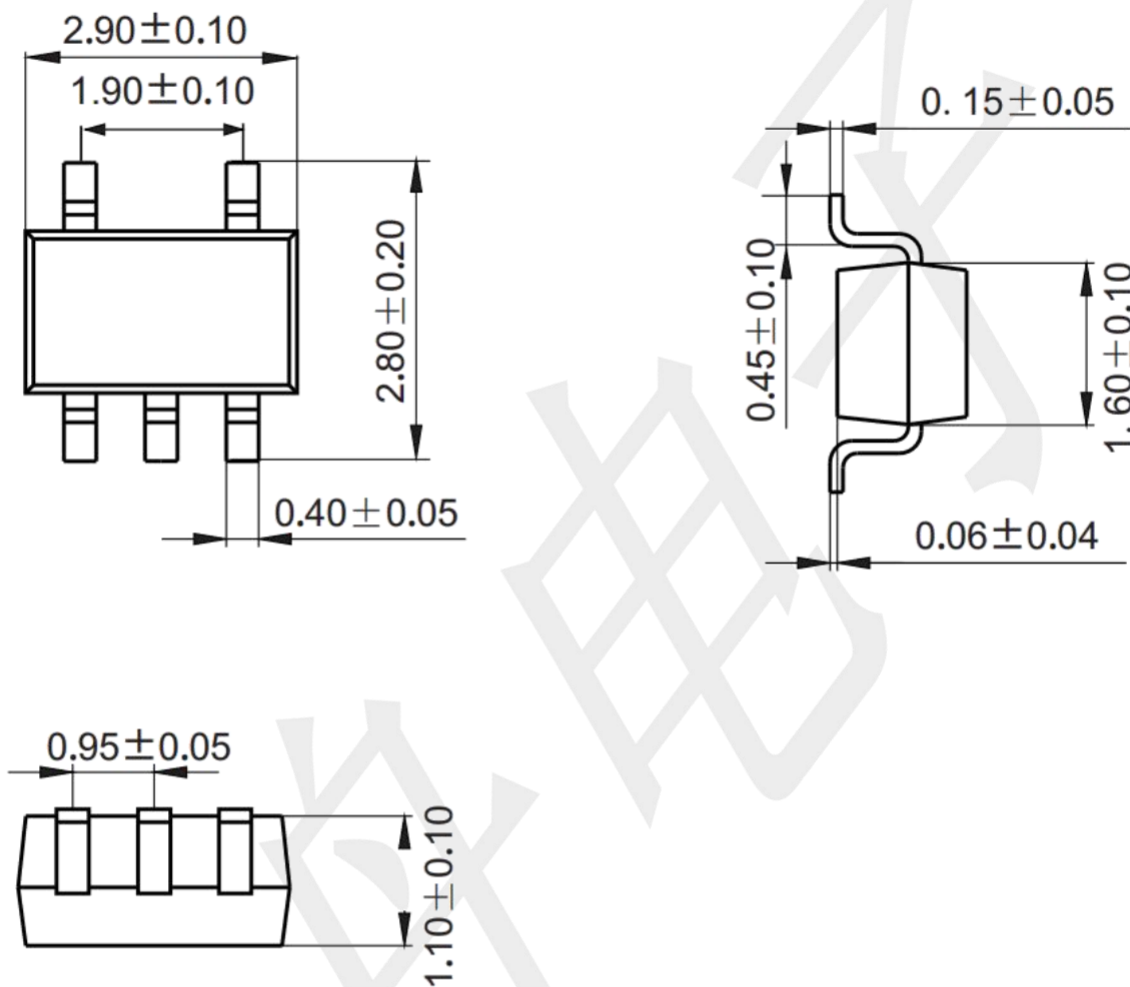


Common-Mode Rejection Ratio



Package information (Unit: mm)

SOT23-5



Mounting Pad Layout (Unit: mm)

