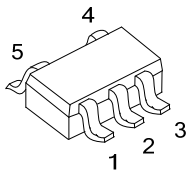
LOW POWER SINGLE OP AMP



SOT-23-5
(JEDEC TO-236)

■ DESCRIPTION

The UTC **LM321**'s quiescent current is only 430μA (5V). The UTC **LM321** brings performance and economy to low power systems, With a high unity gain frequency and a specified 0.4V/μs slew rate. 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.

■ FEATURES

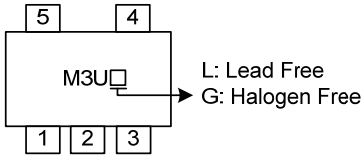
* Low supply current 430μA
* V_{CC}=5V, T_A=25°C. Typical values unless specified.
* Gain-Bandwidth product 1MHz
* Low input bias current 45nA
* Wide supply voltage range +3V~+32V
* Stable with high capacitive loads

■ ORDERING INFORMATION

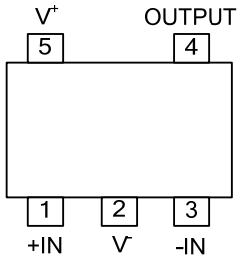
Ordering Number		Package	Packing
Lead Free	Halogen Free		
LM321L-AE5-R	LM321G-AE5-R	SOT-23-5	Tape Reel

LM321G-AE5-R (1)Packing Type (2)Package Type (3)Green Package	(1) R: Tape Reel (2) AE5: SOT-23-5 (3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



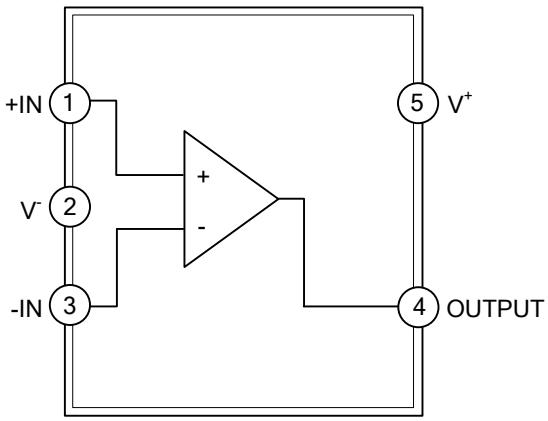
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	+IN	Non-inverting input
2	V^-	Ground
3	-IN	inverting input
4	OUTPUT	Output
5	V^+	Power supply

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage (V^+ - V^-)	V_{CC}	32	V
Differential Input Voltage	$V_{I(DIFF)}$	±Supply Voltage	V
Input Voltage	V_{IN}	-0.3~+32	V
Input Current (V_{IN}<−0.3V) (Note 2)		50	mA
Output Short Circuit to GND, V^+≤15V and T_A=25°C (Note 3)		Continuous	
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	-65~+150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V^+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.36V (at 25°C).

3. Short circuits from the output V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground the maximum output current is approximately 40mA independent of the magnitude of V^+. At values of supply voltage in excess of +15V, continuous short circuits can exceed the power dissipation ratings and cause eventual destruction.

■ OPERATING RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Temperature Range	T_A	-40~85	°C
Supply Voltage	V^+	3~30	V

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	θ_{JA}	265	°C/W

■ ELECTRICAL CHARACTERISTICS

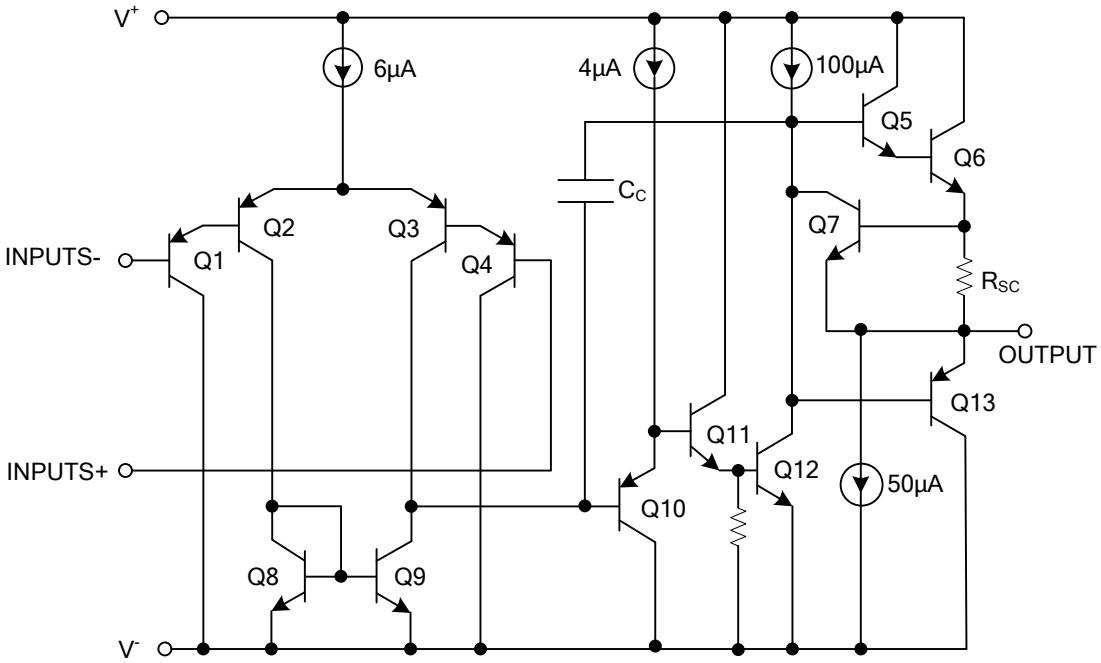
(Unless otherwise specified, all limits guaranteed for T_A=25°C, V^+=5V, V^-=0V, V_O=1.4V.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN (Note 1)	TYP (Note 2)	MAX (Note 1)	UNIT
Input Offset Voltage	V_{OS}	(Note 3)		2	7	mV
Input Bias Current (Note 4)	I_B			45	250	nA
Input Offset Current	I_{OS}			5	50	nA
Input Common-Mode Voltage Range	V_{CM}	V^+=30V (Note 5) For CMRR>=50dB	0		V^+ -1.5	V
Large Signal Voltage Gain	A_V	(V^+=15V, R_L=2kΩ	25	100		V/mV
		V_O=1.4V~11.4V)	15			V/mV
Power Supply Rejection Ratio	PSRR	R_S≤10kΩ, V^+≤5V~30V	65	100		dB
Common Mode Rejection Ratio	CMRR	R_S≤10kΩ	65	85		dB
Output Swing	V_{OH}	V^+=30V, R_L=2kΩ	26			V
		V^+=30V, R_L=10kΩ	27	28		V
	V_{OL}	V^+=5V, R_L=10kΩ		5	20	mV
Supply Current, No Load	I_S	V^+=5V		0.430	1.15	mA
		V^+=30V		0.660	2.85	mA
Output Current Sourcing	I_{SOURCE}	V_{ID}=+1V, V^+=15V, V_O=2V	20	40		mA
Output Current Sinking	I_{SINK}	V_{ID}=-1V, V^+=15V, V_O=2V	10	20		mA
		V_{ID}=-1V, V^+=15V, V_O=0.2V	12	100		μA
Output Short Circuit to Ground (Note 6)	I_O	V^+=15V		40	85	mA
Slew Rate	SR	V^+=15V, R_L=2kΩ, V_{IN}=0.5~3V, C_L=100pF, Unity Gain		0.4		V/μs
Gain Bandwidth Product	GBW	V^+=30V, f=100kHz, V_{IN}=10mV, R_L=2kΩ, C_L=100pF		1		MHz
Phase Margin	φm			60		deg
Total Harmonic Distortion	THD	f=1kHz, A_V=20dB, R_L=2kΩ, V_O=2V_{PP}, C_L=100pF, V^+=30V		0.015		%
Equivalent Input Noise Voltage	e_n	f=1kHz, R_S=100Ω, V^+=30V		40		nV $\sqrt{Hz}$

Notes: 1. All limits are specified by testing or statistical analysis.

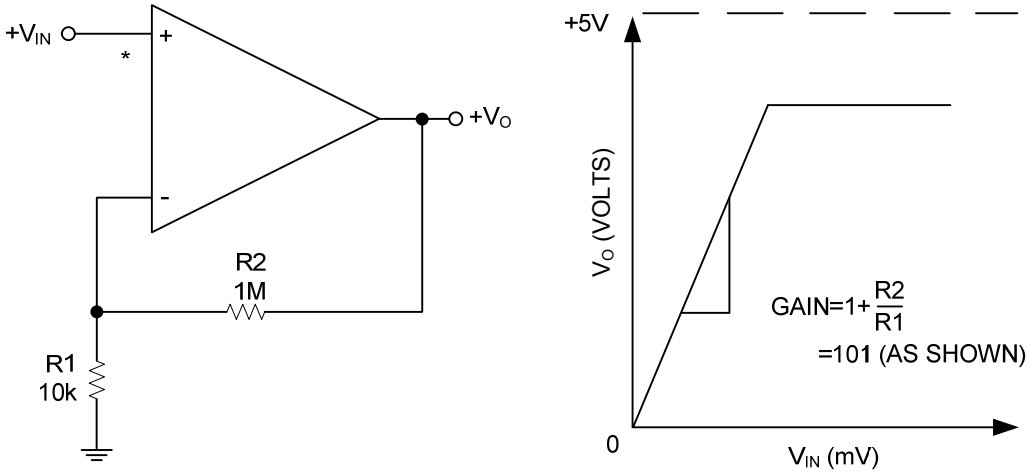
2. Typical values represent the most likely parametric norm.
3. $V_O \cong$ 1.4V, R_S=0Ω with V^+ from 5V to 30V; and over the full input common-mode range (0V~V^+ -1.5V) at 25°C.
4. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
5. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V (at 25°C). The upper end of the common-mode voltage range is V^+-1.5V at 25°C, but either or both inputs can go to +32V without damage, independent of the magnitude of V^+.
6. Short circuits from the output V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground the maximum output current is approximately 40mA independent of the magnitude of V^+. At values of supply voltage in excess of +15V, continuous short circuits can exceed the power dissipation ratings and cause eventual destruction.

■ SIMPLIFIED SCHEMATIC



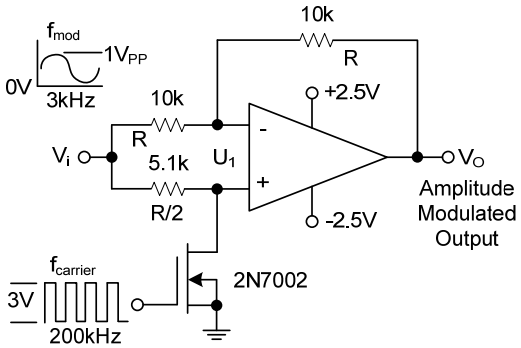
■ TYPICAL APPLICATION CIRCUIT

Non-Inverting DC Gain (0V Input = 0V Output)

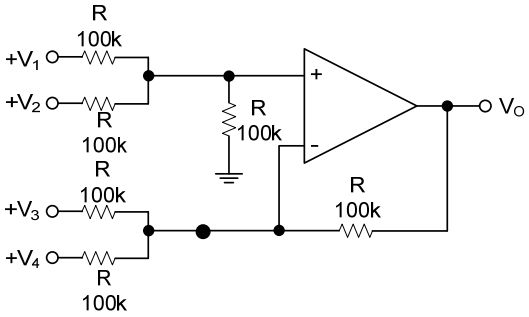


* R NOT NEEDED DUE TO TEMPERATURE INDEPENDENT I_{IN}

Amplitude Modulator Circuit

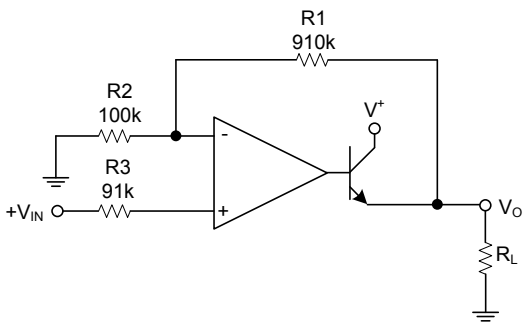


DC Summing Amplifier
(V_{IN}, $_S \geqslant 0\ V_{DC}$ and $V_O \geqslant V_{DC}$)



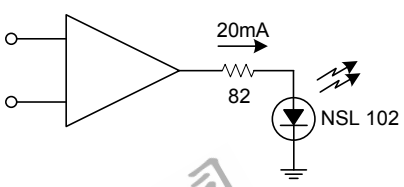
Where: $V_0=V_1+V_2-V_3-V_4$, $(V_1+V_2) \geqslant (V_3+V_4)$ to keep $V_O>0\ V_{DC}$

Power Amplifier



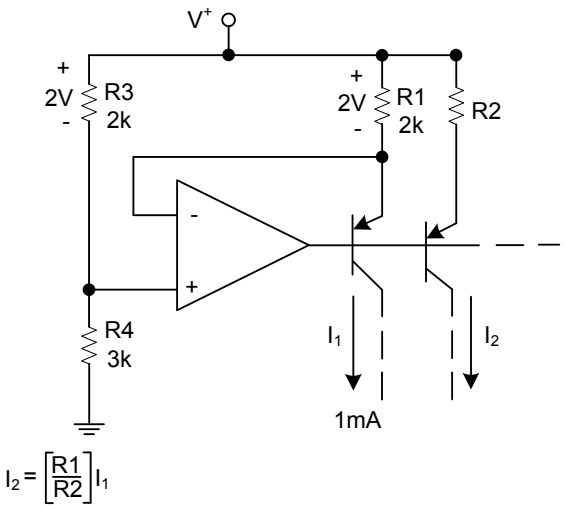
$V_0=0\ V_{DC}$ for $V_{IN}=0\ V_{DC}$, $A_V=10$

LED Driver



■ TYPICAL APPLICATION CIRCUIT(Cont.)

Fixed Current Sources



$I_2 = \left[\frac{R1}{R2}\right] I_1$

Lamp Driver