

1.Description

The LM321 brings performance and economy to low power systems. With a high unity gain frequency and a guaranteed $0.4\text{V}/\mu\text{s}$ slew rate, the quiescent current is only $430\mu\text{A}/\text{amplifier}$ (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-23-5L package. Overall the LM321 is a low power, wide supply range performance opamp that can be designed into a wide range of applications at an economical price without sacrificing valuable board space.

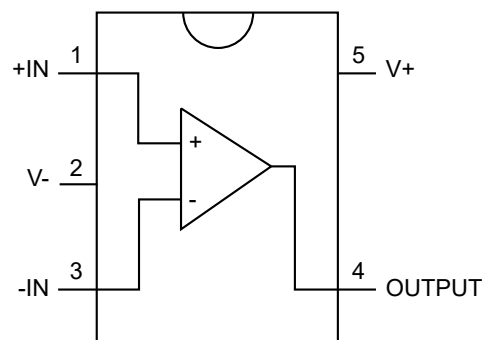
2.Features

- Gain - Bandwidth product: 1MHz
- Low supply current: $430\mu\text{A}$
- Low input bias current: 45nA
- Wide supply voltage range: +3V to +32V

3.Applications

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

4.Pinning Information



SOT23-5



5. Absolute Maximum Ratings (Note 1)

Parameter	Value	Units
Supply Voltage, ($V^+ - V^-$)	32	V
Input Voltage	-0.3 ~ 32	V
Output Short Circuit to GND $V^+ \leq 15V$ and $T_A=25^\circ C$ (Note2)	Continuous	
Junction Temperature (Note3)	150	$^\circ C$
Thermal Resistance to Ambient (θ_{JA})	265	$^\circ C$
Operating Temperature Range	-40 ~ 85	$^\circ C$
Storage Temperature Range	-65 ~ 150	$^\circ C$

6. Electrical Characteristics (Unless otherwise specified: $V^+=5.0V$)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Offset Voltage	V_{OS}	$T_A=25^\circ C$ (Note 4)		2	5	mV
Input Bias Current	I_B	$T_A=25^\circ C$, $I_{IN(+)}$ or $I_{IN(-)}$, $V_{CM}=0V$ (Note5)		45	250	nA
Input Offset Current	I_{OS}	$T_A=25^\circ C$, $I_{IN(+)} - I_{IN(-)}$, $V_{CM}=0V$		3	50	nA
Input Common Mode Voltage Range	V_{CM}	$T_A=25^\circ C$, $V^+=30V$ (Note 6)	0		$V^+-1.5$	V
Supply Current	I_S	Over the entire temperature range, $R_L=\infty$ on all operational amplifiers	$V^+=30V$	0.66	2	mA
			$V^+=5V$	0.43	1.2	mA
Large Signal Voltage Gain	A_V	$V^+=15V$, $T_A=25^\circ C$, $R_L \geq 2k\Omega$ (for $V_O=1\sim 11V$)	50	100		V/mV
Common-Mode Rejection Ratio	CMRR	DC, $T_A=25^\circ C$, $V_{CM}=0\sim V^+-1.5V$	70	90		dB
Power Supply Rejection Ratio	PSRR	DC, $T_A=25^\circ C$, $V^+=5\sim 30V$	75	100		dB
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



Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output Voltage Swing	V_{OH}	$V^+=30V$	$R_L=2K\Omega$	26		V
			$R_L=10K\Omega$	27	28	V
	V_{OL}	$V^+=5V, R_L=10K\Omega$		5	20	mV
Output Short Circuit to Ground	I_O	$V^+=15V$		40	85	mA
Slew Rate	SR	$V^+=15V, R_L=2k\Omega, V_{IN}=0.5$ to $3V$ $C_L=100pF$, Unity Gain		0.4		V/ μs
Gain Bandwidth Product	GBW	$V^+=30V, f=100kHz, V_{IN}=10mV$ $R_L=2k\Omega, C_L=100pF$		1		MHz
Phase Margin	ϕ_m			60		degrees
Total Harmonic Distortion	THD	$f=1kHz, A_v=20dB, R_L=2k\Omega$ $V_O=2V_{PP}, C_L=100pF, V^+=30V$		0.015%		
Equivalent Input Noise Voltage	e_n	$f=1kHz, R_s=100\Omega, V^+=30V$		40		nV/ $\sqrt{Hz}$

Note 1 Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2 : Shortcircuits from the output to 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. Destructive dissipation can result from simultaneous shorts on all amplifiers.

Note 3: The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any ambient temperature is $P_D=(T_{J(MAX)}-T_A)/\theta_{JA}$. All numbers apply for packages soldered directly onto a PC board.

Note 4 : $V_O=1.4V$, $R_s=0$, with V^+ from 5V to 30V; and over the full input common -mode range (0V to $V^+-1.5V$) at 25°C.

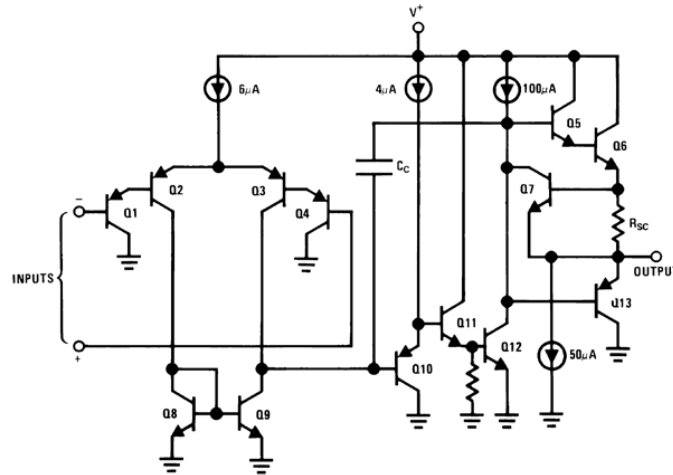
Note 5: The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.

Note 6: 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^+ .

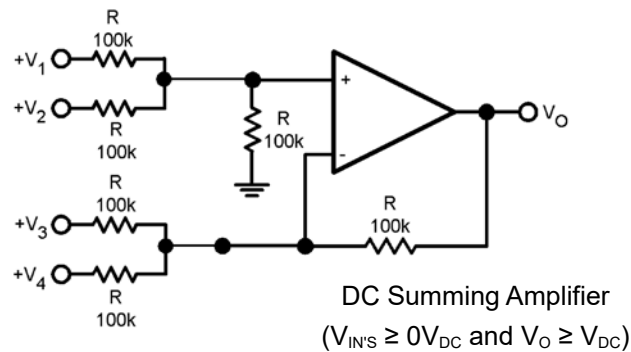
Note 7: Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.



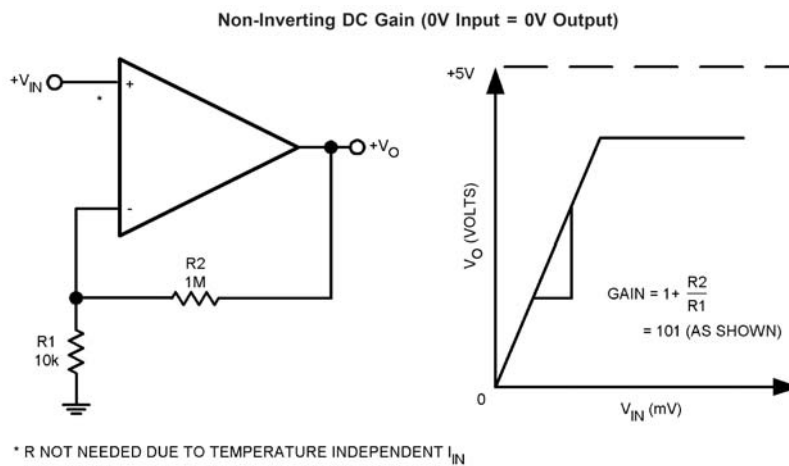
7.Simplified Schematic



8.Application Circuit



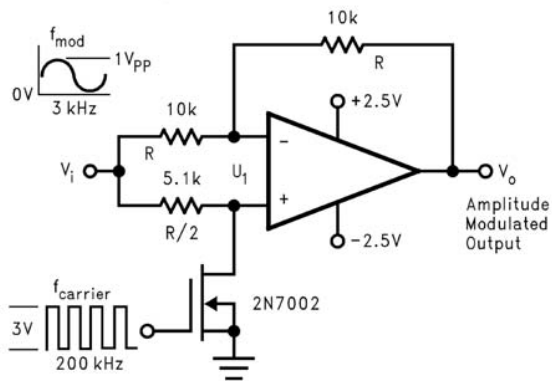
Where: $V_O = V_1 + V_2 - V_3 - V_4$, $(V_1 + V_2) \geq (V_3 + V_4)$ to keep $V_O > 0V_{DC}$



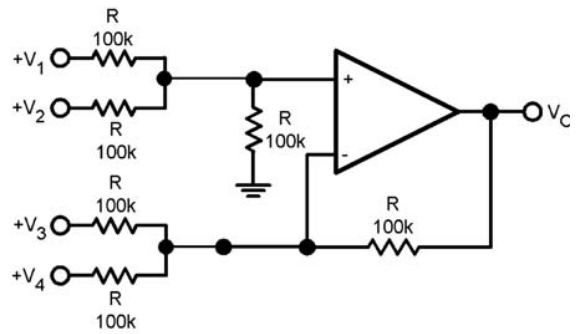


9. Typical Application

Amplitude Modulator Circuit

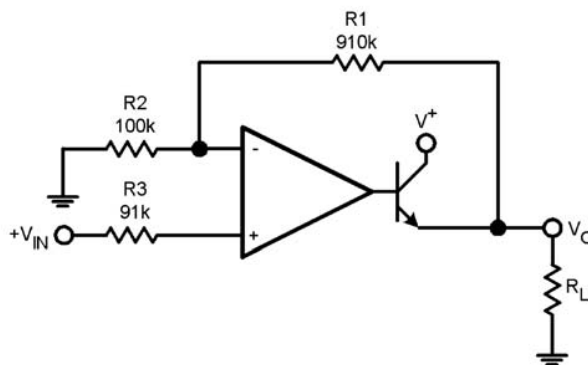


DC Summing Amplifier
($V_{IN's} \geq 0$ V_{DC} and $V_O \geq V_{DC}$)



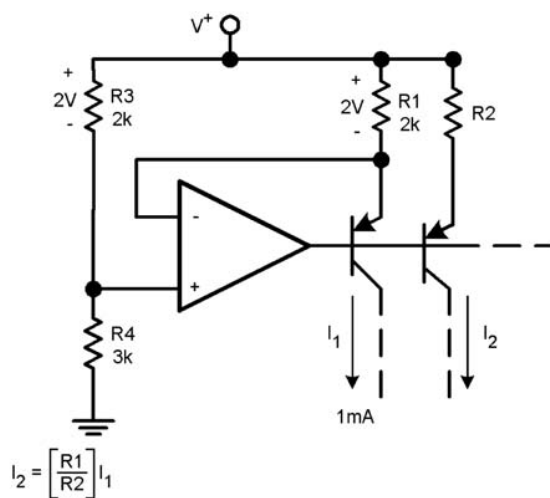
Where: $V_O = V_1 + V_2 - V_3 - V_4$, $(V_1 + V_2) \geq (V_3 + V_4)$ to keep $V_O > 0$ V_{DC}

Power Amplifier

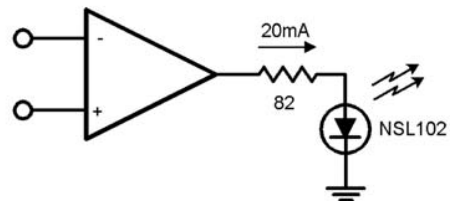


$V_O = 0$ V_{DC} for $V_{IN} = 0$ V_{DC} , $A_V = 10$

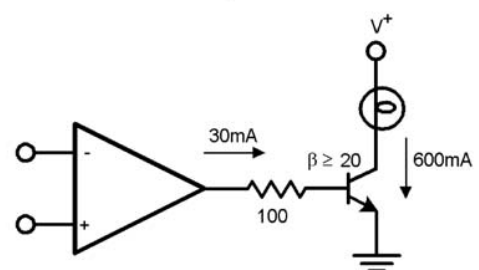
Fixed Current Sources



LED Driver

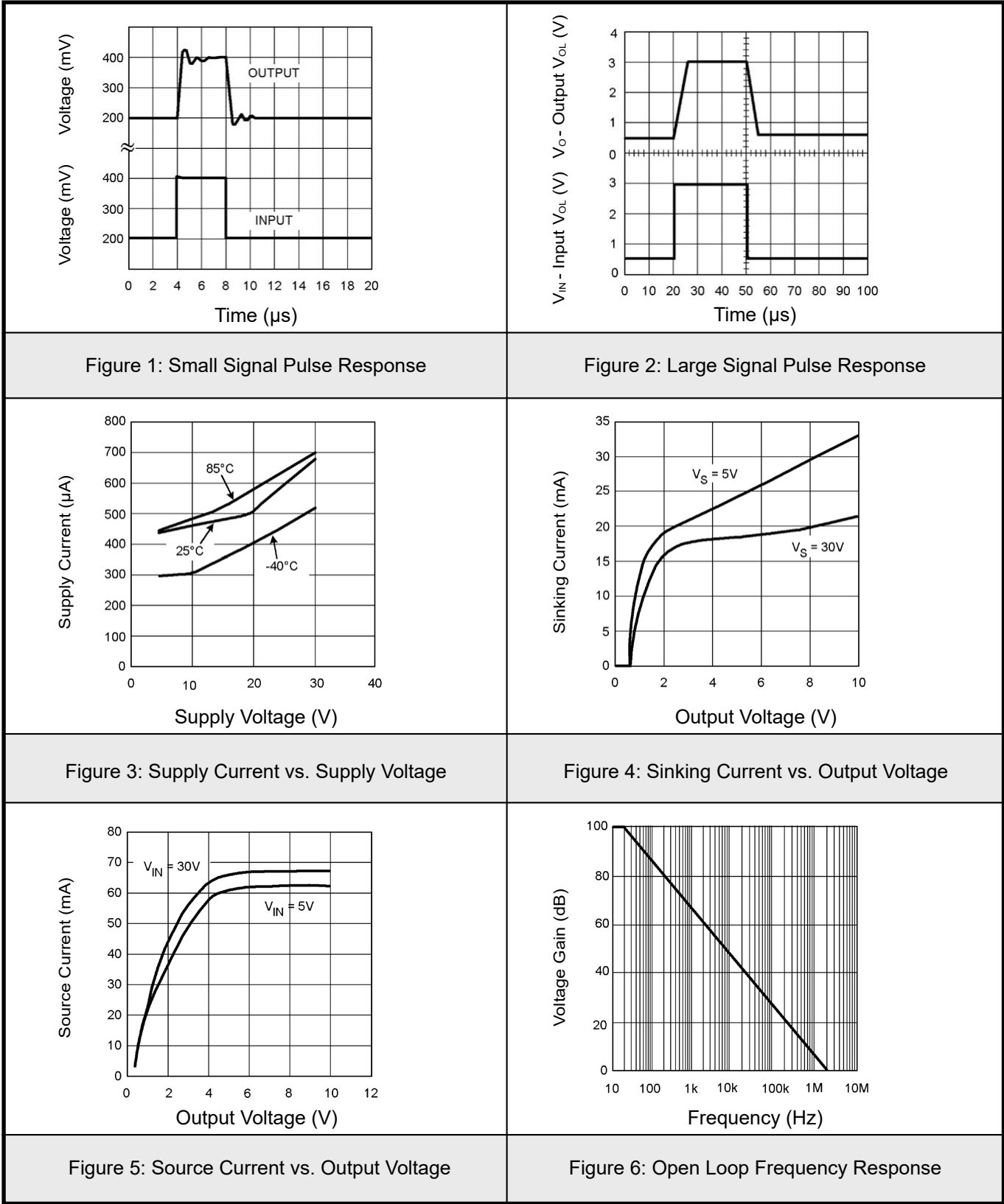


Lamp Driver



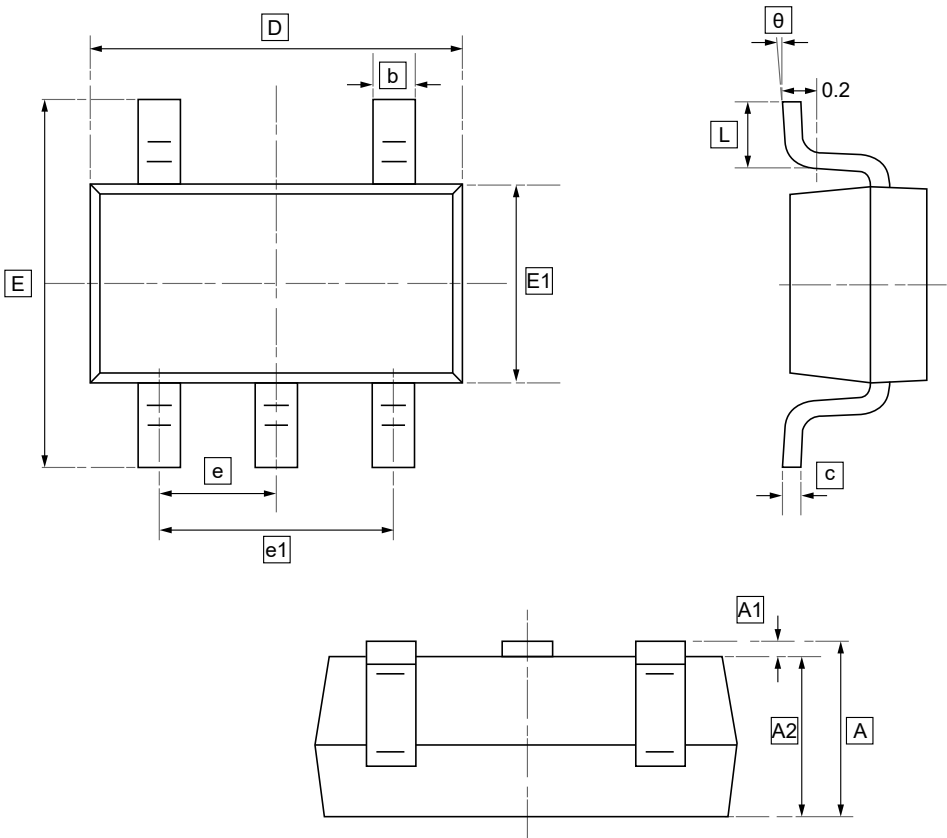


10. Typical Characteristics





11.SOT-23-5 Package Outline Dimensions

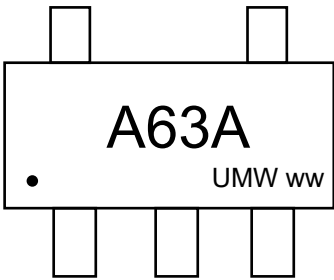


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°



12.Ordering Information



ww: Batch Code

Order Code	Package	Base QTY	Delivery Mode
UMW LM321MF	SOT23-5	3000	Tape and reel



13.Disclaimer

UMW reserves the right to make changes to all products, specifications. Customers should obtain the latest version of product documentation and verify the completeness and currency of the information before placing an order.

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