LM321MFX/NOPB

Low Power Single Op Amp

General Description

The LM321MFX/NOPB brings performance and economy to low power systems. With a high unity gain frequency and a guaranteed 0.4V/us slew rate, the quiescent current is only 430μA/amplifier (5V). The input common mode range in-cludes ground and therefore the device is able to operate in single supply applications as well as in dual supply applica-tions. It is also capable of comfortably driving large capaci- tive loads.

The LM321MFX/NOPB is available in the SOT-23-5L package. Overall the LM321MFX/NOPB 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.

Application Circuit

DC Summing Amplifier
(VIN's ≥ 0 VDC and VO ≥ VDC)

Feature

- VCC = 5V, TA = 25˚C.
  Typical values unless specified
- Gain-Bandwidth product 1MHz
- Low supply current 430μA
- Low input bias current 45nA
- Wide supply voltage range +3V to +32V
- Stable with high capacitive loads
- Single version of LM324

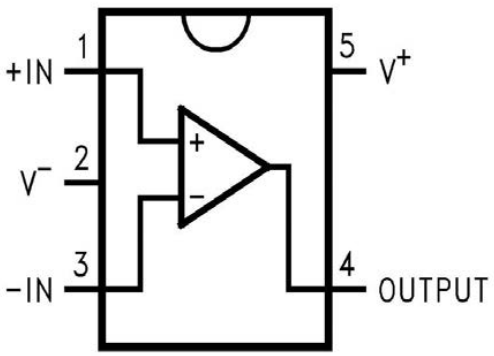
Applications

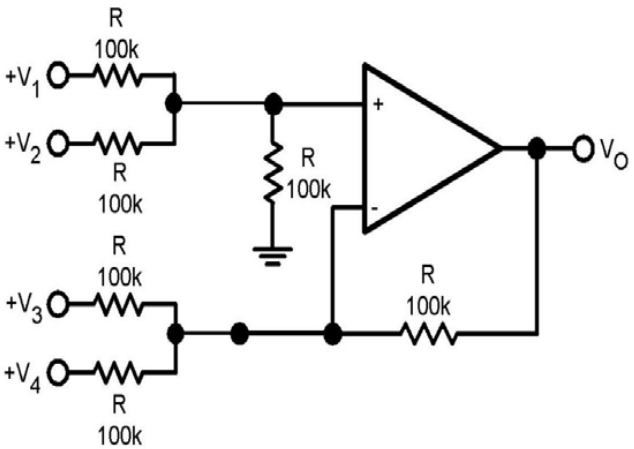
- Chargers
- Power supplies
- Industrial: controls, instruments
- Desktops
- Communications infrastructure

Ordering Information

Part Number	Package	Package Marking
LM321	SOT-23-5L	A63 A

Connection Diagram





Where: V0 = V1 + V2 - V3 - V4, (V1+ V2) ≥ (V3 + V4) to keep VO > 0 VDC

Absolute Maximum Ratings (Note 1)

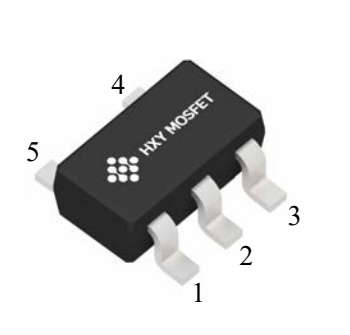
If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Parameter	Symbol	Ratings	Unit
Supply Voltage (V+ - V−)	VCC	32	V
Differential Input Voltage	VI (DIFF)	±Supply Voltage	V
Input Current (VIN < −0.3V) (Note 6)	IC	50	mA
Input Voltage		−0.3V to +32V	V
Output Short Circuit to GND, $V^+ \leq 15V$ and TA = 25˚C(Note 2)		Continuous	W
Thermal Resistance to Ambient	RθJA	265	℃/W
Junction Temperature (Note 3)	TJ	150	℃
Storage Temperature Range	TSTG	-65~+150	℃
ESD Tolerance (Note 10)		300	V
Mounting Temperature Lead Temp (Soldering, 10 sec)		260	℃
Infrared (10 sec)		215	℃

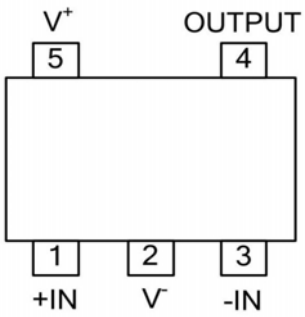
Operating Ratings (Note 1)

Parameter	Symbol	Ratings	Unit
Temperature Range	TA	-40~85	℃
Supply Voltage	V+	3~30	V

Pin Configurtion



SOT-23-5L



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

Electrical Characteristics (Ta = 25 ℃ Unless Otherwise specified)

Unless otherwise specified, all limits guaranteed for at TA = 25˚C; V+ = 5V, V− = 0V, VO = 1.4V. Boldface limits apply at temperature extremes.

Parameter		Symbol	Test Condition	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Unit
Input Offset Voltage		VOS	(Note 7)		2	5	mV
Input Offset Current		IOS			3	30	nA
Input Bias Current (Note 8)		IB			45	150	nA
Input Common-Mode Voltage Range		VCM	V+ = 30V (Note 9) For CMRR > = 50dB	0		V+ - 1.5 V+ -2	V
Large Signal Voltage Gain		AV	V+ = 15V, RL = 2kΩ VO = 1V to 11V	50	100		V/mV
Power Supply Rejection Ratio		PSRR	RS ≤ 10kΩ, V^+ ≤ 5V to 30V	75	100		dB
Common Mode Rejection Ratio		CMRR	RS ≤ 10kΩ,	70	90		dB
Output Swing	VOH	VO	V+ = 30V, RL = 2kΩ	21	23		V
			V+ = 30V, RL = 10kΩ	22	24		V
	VOL		V+ = 50V, RL = 10kΩ		5	20	mV
Supply Current, No Load		IS	V+ = 5V,		0.1	0.3	mA
			V+ = 30V,		0.16	0.5	mA
Output Current Sourcing		I_{SOURCE}	VID = +1V, V+ = 15V, VO = 2V	20	40		mA
Output Current Sinking		I SINK	VID = −1V V+ = 15V, VO = 2V		15		mA
			VID = −1V V+ = 15V, VO = 0.2V		50		μA
Output Short Circuit to Ground (Note 2)		IO	V+ = 15V		40	85	mA
Slew Rate		SR	V+ = 15V, RL = 2kΩ, VIN = 0.5 to 3V CL = 100pF, Unity Gain		0.4		V/μs
Gain Bandwidth Product		GBM	V+ = 30V, f = 100kHz, VIN = 10mV, RL = 2kΩ, CL = 100pF		1		MH_Z

Electrical Characteristics (Ta = 25 °C Unless Otherwise specified)

Unless otherwise specified, all limits guaranteed for at TA = 25˚C; V+ = 5V, V− = 0V, VO = 1.4V. Boldface limits apply at temperature extremes.

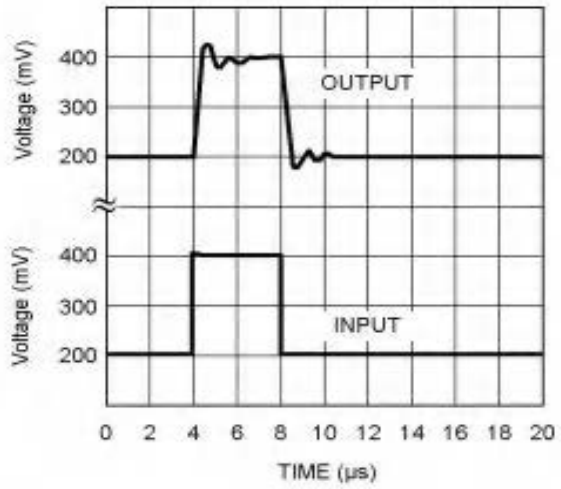
Parameter	Symbol	Test Condition	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Unit
Phase Margin	φm			60		deg
Total Harmonic Distortion	THD	f = 1kHz, AV = 20dB RL = 2kΩ, VO = 2VPP, CL = 100pF, V+ = 30V		0.015		%
Equivalent Input Noise Voltage	en	f = 1kHz, RS = 100Ω V+ = 30V		40		nV/√Hz

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: 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.
Note 3: The maximum power dissipation is a function of TJ(MAX), qJA , and TA. The maximum allowable power dissipation at any ambient temperature is PD = (TJ(MAX) - TA)/ qJA . All numbers apply for packages soldered directly onto a PC board.
Note 4: Typical values represent the most likely parametric norm.
Note 5: All limits are guaranteed by testing or statistical analysis.
Note 6: 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).
Note 7: VO @ 1.4V, RS = 0W with V+ from 5V to 30V; and over the full input common-mode range (0V to V+ - 1.5V) at 25˚C.
Note 8: 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 9: 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 10: Human Body Model, 1.5kW in series with 100pF.

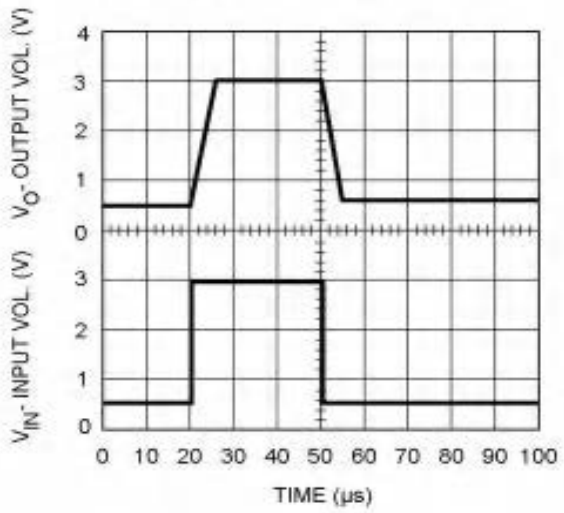
Typical Performance Characteristics

Unless otherwise specified,VS = +5V, single supply,TA = 25˚C.

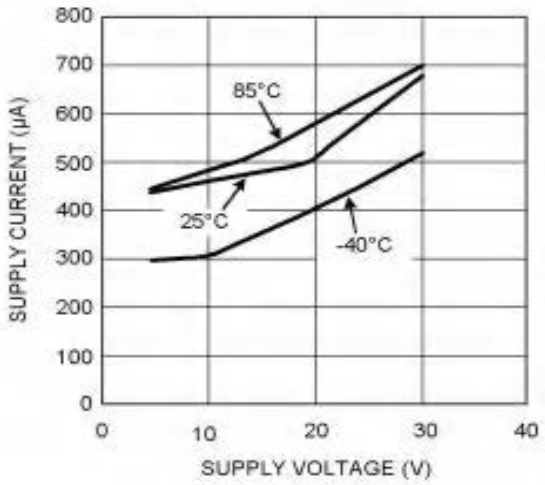
Small Signal Pulse Response



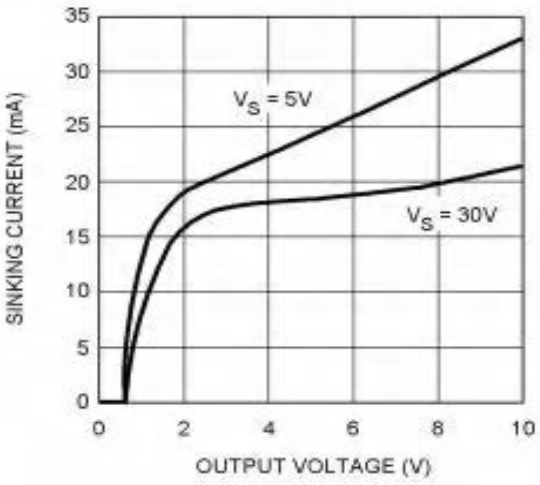
Large Signal Pulse Response



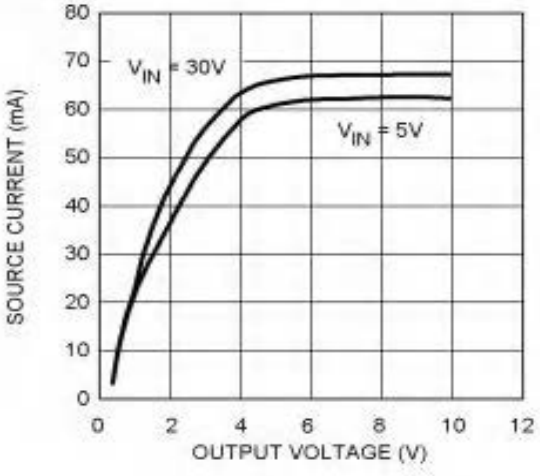
Supply Current vs. Supply Voltage



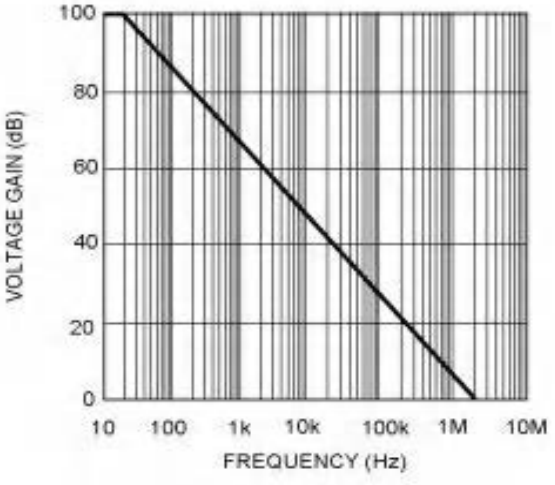
Sinking Current vs. Output Voltage



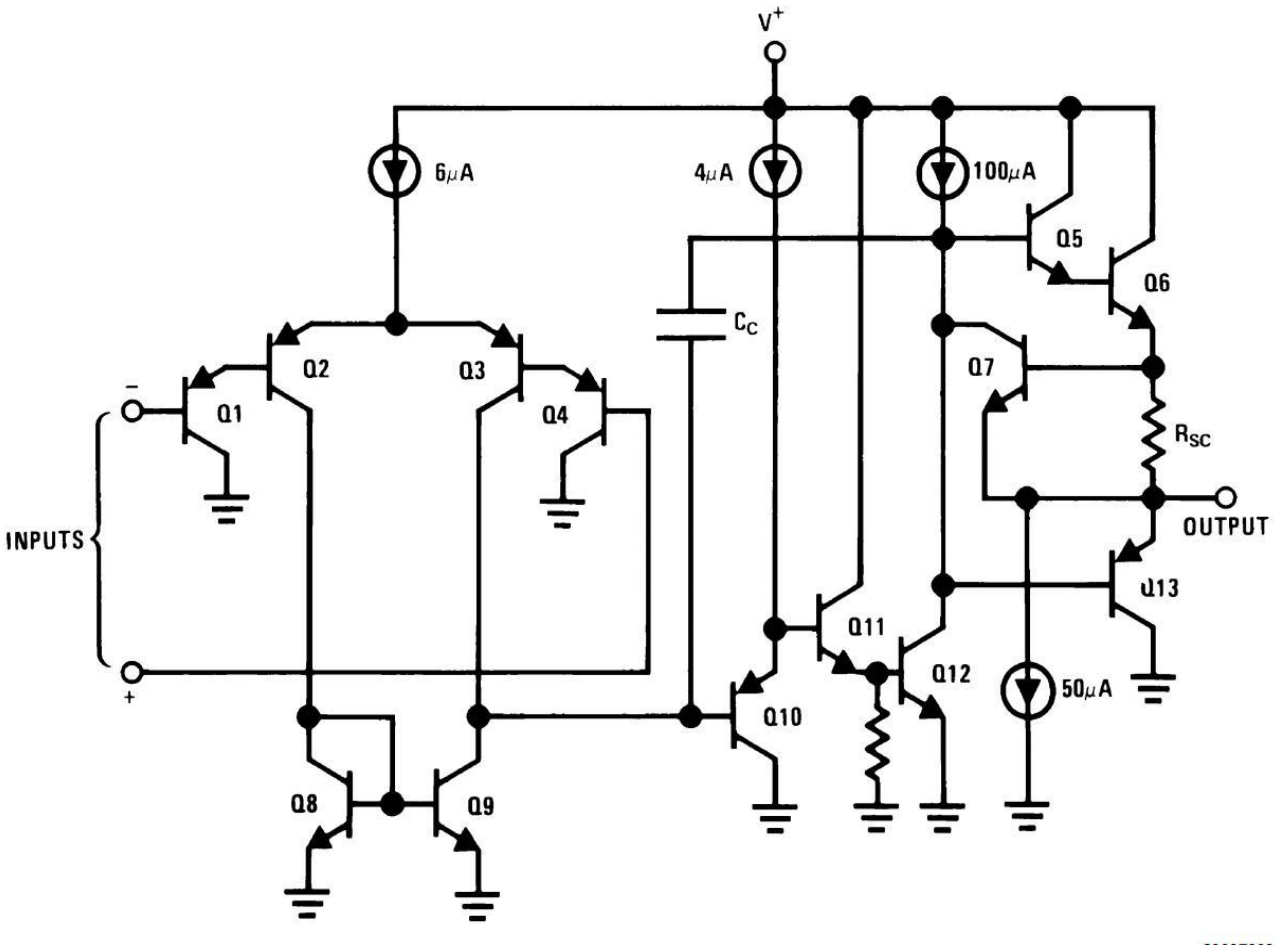
Source Current vs. Output Voltage



Open Loop Frequency Response

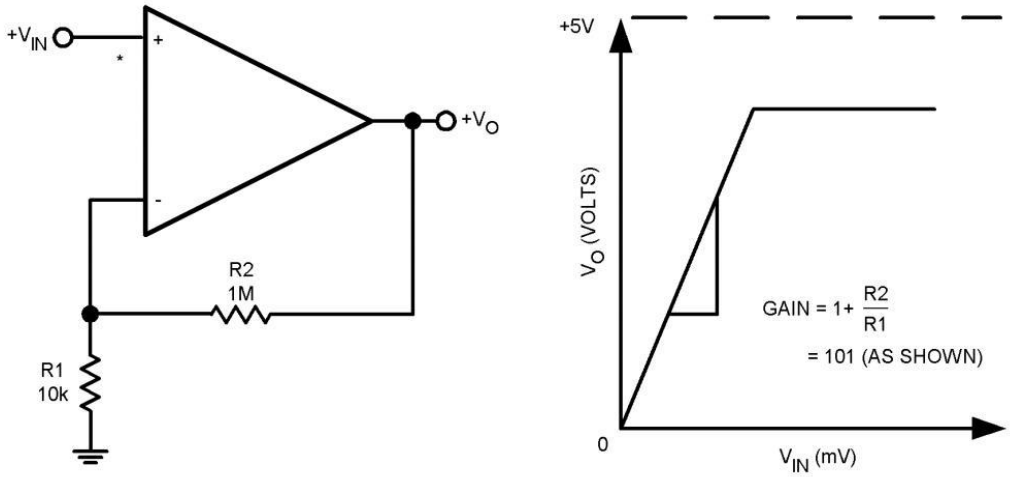


Simplified Schematic



Typical Applications

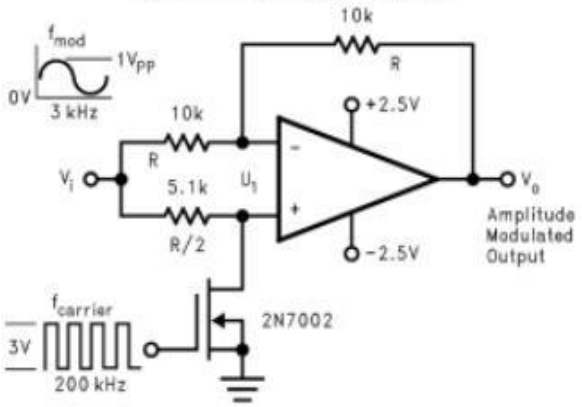
Non-Inverting DC Gain (0V Input = 0V Output)



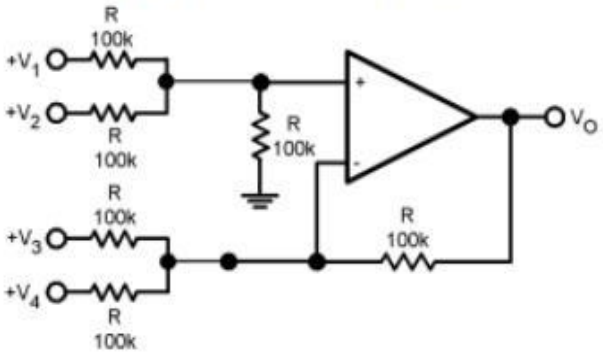
* R NOT NEEDED DUE TO TEMPERATURE INDEPENDENT I_{IN}

Typical Applications

Amplitude Modulator Circuit

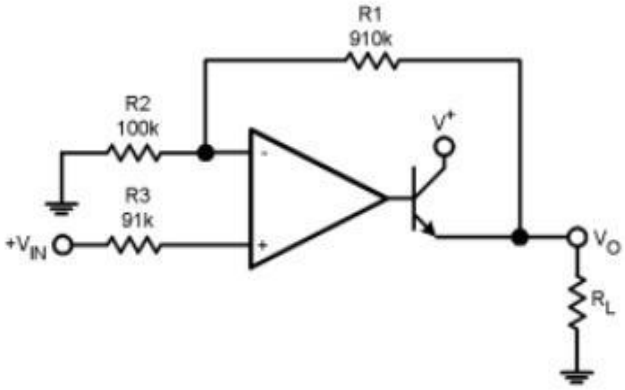


DC Summing Amplifier
(V_{IN}'s ≥ 0 V_{DC} and V_O ≥ V_{DC})



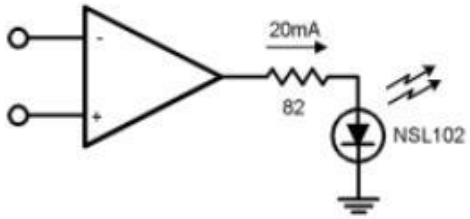
Where: $V_O = V_1 + V_2 - V_3 - V_4$, $(V_1 + V_2) \geq (V_3 + V_4)$ to keep $V_O > 0\ V_{DC}$

Power Amplifier

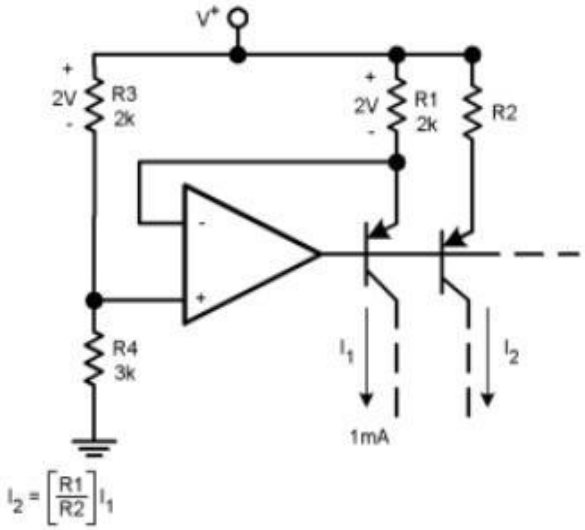


$V_O = 0\ V_{DC}$ for $V_{IN} = 0\ V_{DC}$, $A_V = 10$

LED Driver

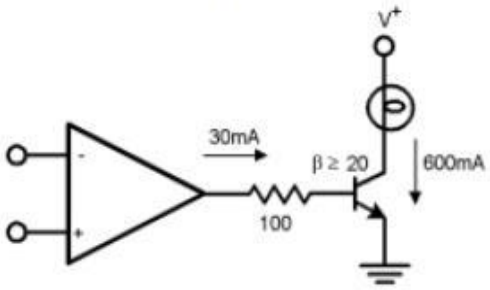


Fixed Current Sources

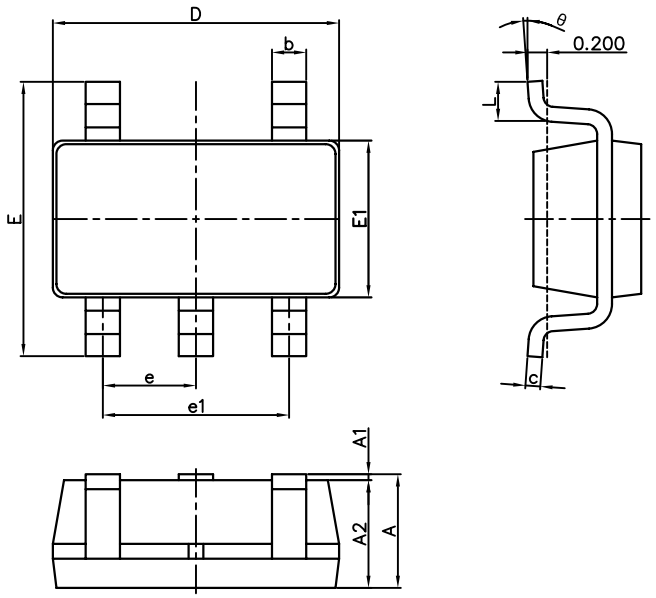


$I_2 = \left[\frac{R1}{R2}\right] I_1$

Lamp Driver



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	2.820	3.020	0.111	0.119
E	2.650	2.950	0.104	0.116
E1	1.500	1.700	0.059	0.067
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°

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