LM321 Low Power Single Op Amp

FEATURES

- (V_{CC} = 5V, T_A = 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

SOT-23-5

ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
LM321MF	SOT-23-5	M321,A63A	REEL	3000pcs/reel

DESCRIPTION

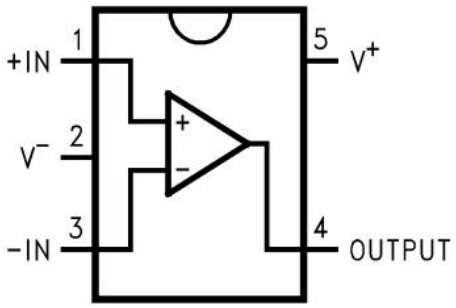
The LM321 brings performance and economy to low power systems. With a high unity gain frequency and a specified 0.4V/μs slew rate, the quiescent current is only 430μA/amplifier (5V). The input common mode range includes ground and therefore the device is able to operate in single supply applications 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.

APPLICATIONS

- Chargers
- Power Supplies
- Industrial: Controls, Instruments
- Desktops
- Communications Infrastructure

Connection Diagram

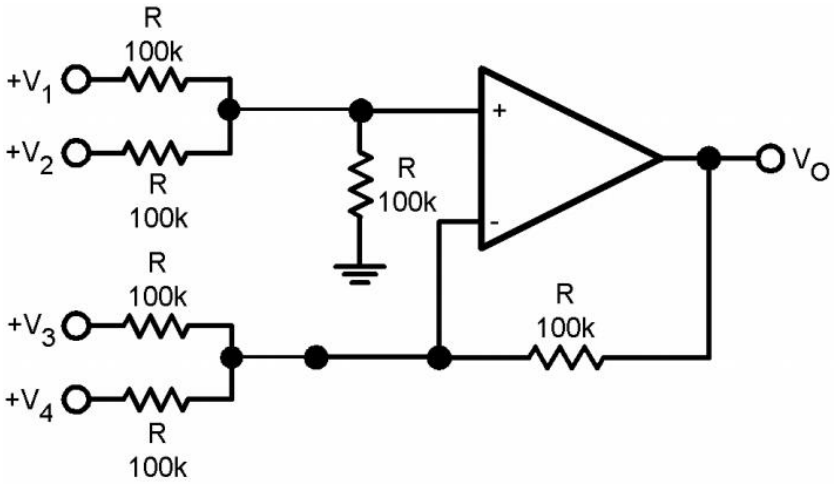
SOT23-5



Application Circuit

DC Summing Amplifier

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



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

Absolute Maximum Ratings (1)

Differential Input Voltage	±Supply Voltage
Input Current (V_{IN} < −0.3V) (2)	50mA
Supply Voltage (V^+ - V^-)	32V
Input Voltage	−0.3V to +32V
Output Short Circuit to GND,V^+ ≤ 15V and T_A = 25°C (3)	Continuous
Storage Temperature Range	−65°C to 150°C
Junction Temperature (4)	150°C
Mounting Temperature	
Lead Temp (Soldering, 10 sec) Infrared (10 sec)	260°C 215°C
Thermal Resistance to Ambient (θ_{JA})	265°C/W
ESD Tolerance (5)	300V

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 ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
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 andnormal 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 themaximum 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.
4. 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.
5. Human Body Model, 1.5kΩ in series with 100pF.

Operating Ratings (1)

Temperature Range	−40°C to 85°C
Supply Voltage	3V to 30V

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 ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.

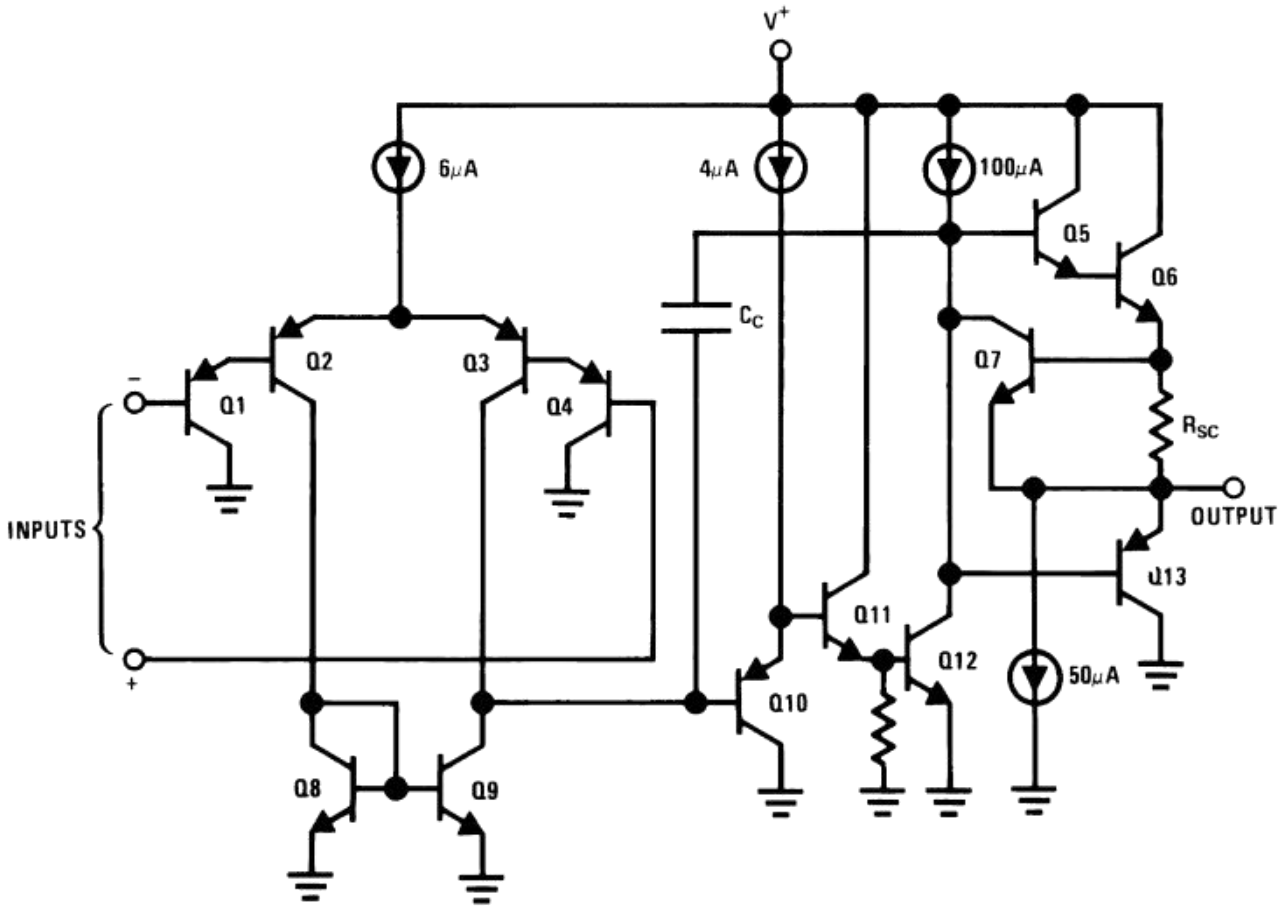
Electrical Characteristics

Unless otherwise specified, all limits specified for at T_A = 25°C; V+ = 5V, V− = 0V, V_O = 1.4V. **Boldface** limits apply at temperature extremes.

Symbol	Parameter		Conditions	Min(1)	Typ(2)	Max(1)	Units
V_{OS}	Input Offset Voltage				5	7 **9**	mV
I_{OS}	Input Offset Current				5	50 **150**	nA
I_B	Input Bias Current (4)				45	250 **500**	nA
V_{CM}	Input Common-Mode Voltage Range		V^+ = 30V (5) For CMRR > = 50dB	0		V^+ - 1.5 **V^+ -2**	V
A_V	Large Signal Voltage Gain		(V^+ = 15V, R_L = 2kΩ V_O = 1.4V to 11.4V)	25 **15**	100		V/mV
PSRR	Power Supply Rejection Ratio		R_S ≤ 10kΩ, V^+ ≤ 5V to 30V	65	100		dB
CMRR	Common Mode Rejection Ratio		R_S ≤ 10kΩ	65	85		dB
V_O	Output Swing	V_{OH}	V^+ = 30V, R_L = 2kΩ	**26**			V
			V^+ = 30V, R_L = 10kΩ	**27**	**28**		
		V_{OL}	V^+ = 5V, R_L = 10kΩ		**5**	**20**	mV
I_S	Supply Current, No Load		V^+ = 5V		0.43 **0.7**	1.15 **1.2**	mA
			V^+ = 30V		0.660 **1.5**	2.85 **3**	
I_{SOURCE}	Output Current Sourcing		V_{ID} = +1V, V^+ = 15V, V_O = 2V	20 **10**	40 **20**		mA
I_{SINK}	Output Current Sinking		V_{ID} = −1V V^+ = 15V, V_O = 2V	10 **5**	20 **8**		mA
			V_{ID} = −1V V^+ = 15V, V_O = 0.2V	12	100		µA
I_O	Output Short Circuit to Ground (6)		V^+ = 15V		40	85	mA
SR	Slew Rate		V^+ = 15V, R_L = 2kΩ, V_{IN} = 0.5 to 3V C_L = 100pF, Unity Gain		0.4		V/µs
GBW	Gain Bandwidth Product		V^+ = 30V, f = 100kHz, V_{IN} = 10mV, R_L =2kΩ, C_L = 100pF		1		MHz
φm	Phase Margin				60		deg
THD	Total Harmonic Distortion		f = 1kHz, A_V = 20dB R_L = 2kΩ, V_O = $2V_{PP}$, C_L = 100pF, V^+ = 30V		0.015		%
e_n	Equivalent Input Noise Voltage		f = 1kHz, R_S = 100Ω V^+ = 30V		40		$nV\sqrt{Hz}$

(1) All limits are specified by testing or statistical analysis.
(2) Typical values represent the most likely parametric norm.
(3) VO ≅ 1.4V, RS = 0Ω with V + from 5V to 30V; and over the full input common-mode range (0V to 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.

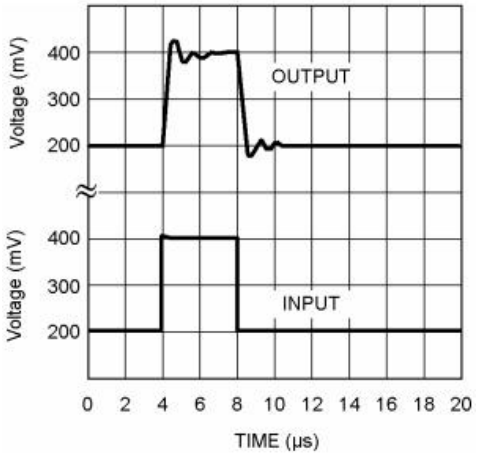
Simplified Schematic



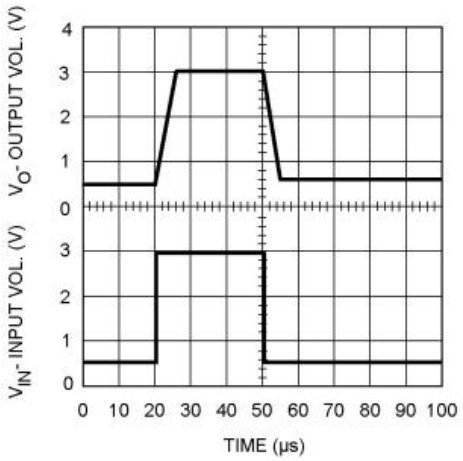
Typical Performance Characteristics

Unless otherwise specified, V_S = +5V, single supply, T_A = 25°C.

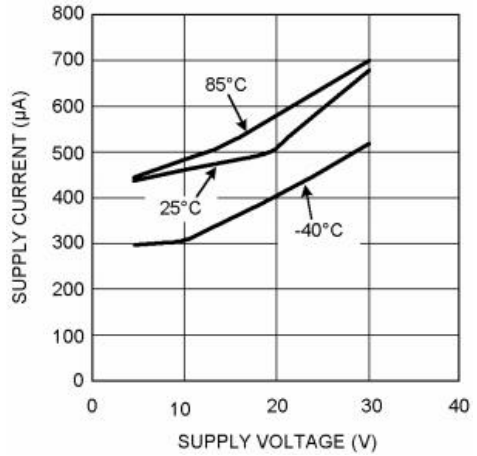
Small Signal Pulse Response



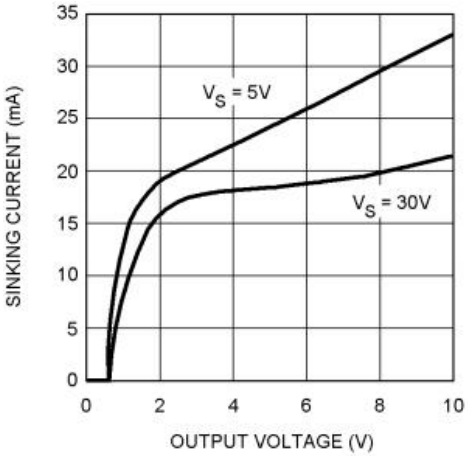
Large Signal Pulse Response



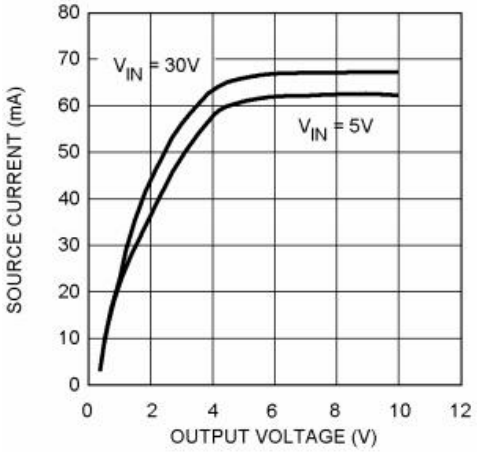
Supply Current vs. Supply Voltage



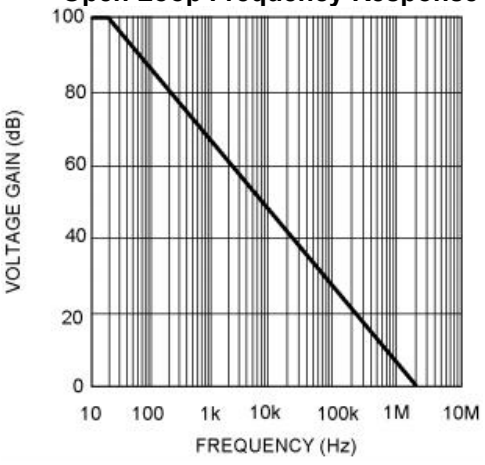
Sinking Current vs. Output Voltage



Source Current vs. Output Voltage

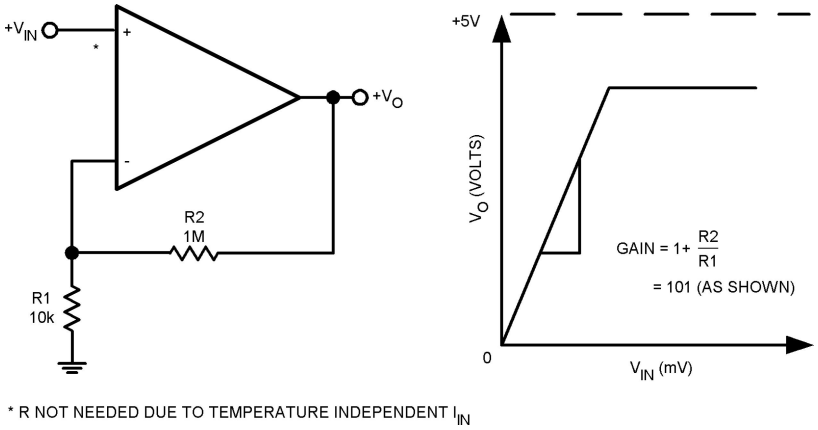


Open Loop Frequency Response



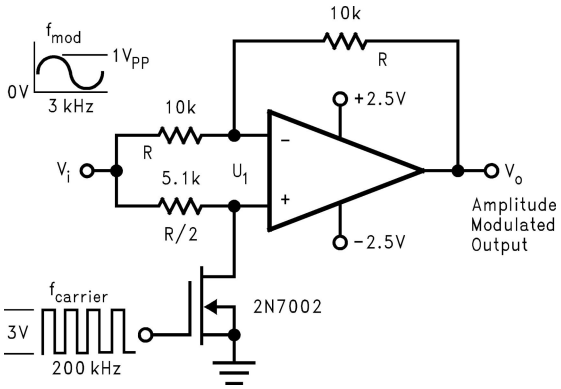
TYPICAL APPLICATIONS

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



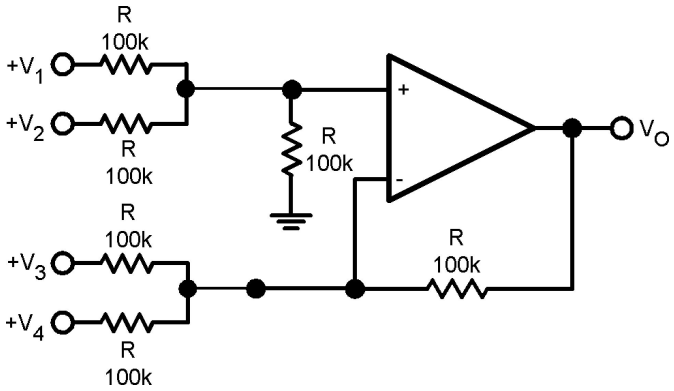
* R NOT NEEDED DUE TO TEMPERATURE INDEPENDENT I_{IN}

Amplitude Modulator Circuit



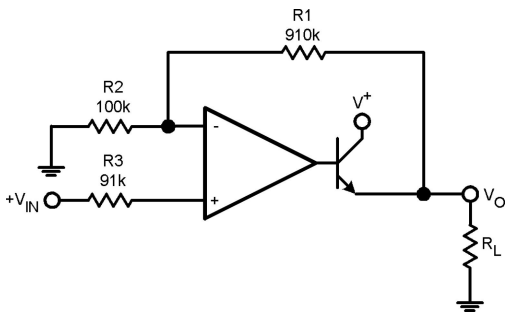
DC Summing Amplifier (V)

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

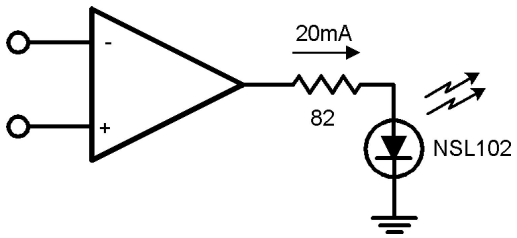


Where: $V_0 = V_1 + V_2 - V_3 - V_4$, $(V_1+V_2) \geq (V_3 + V_4)$ to keep $V_O > 0\ V_{DC}$

Power Amplifier

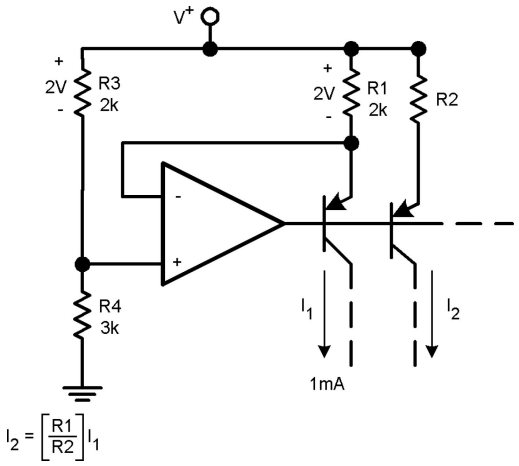


LED Driver



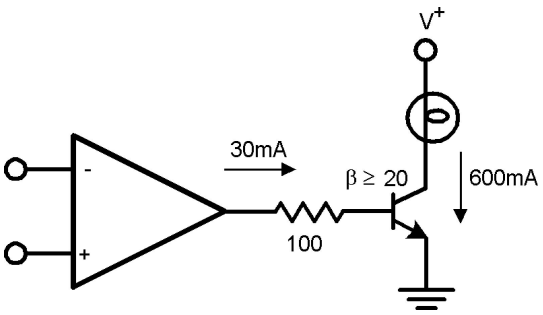
V0 = 0 VD_C for V_{IN} = 0 V_{DC}, A_V = 10

Fixed Current Sources



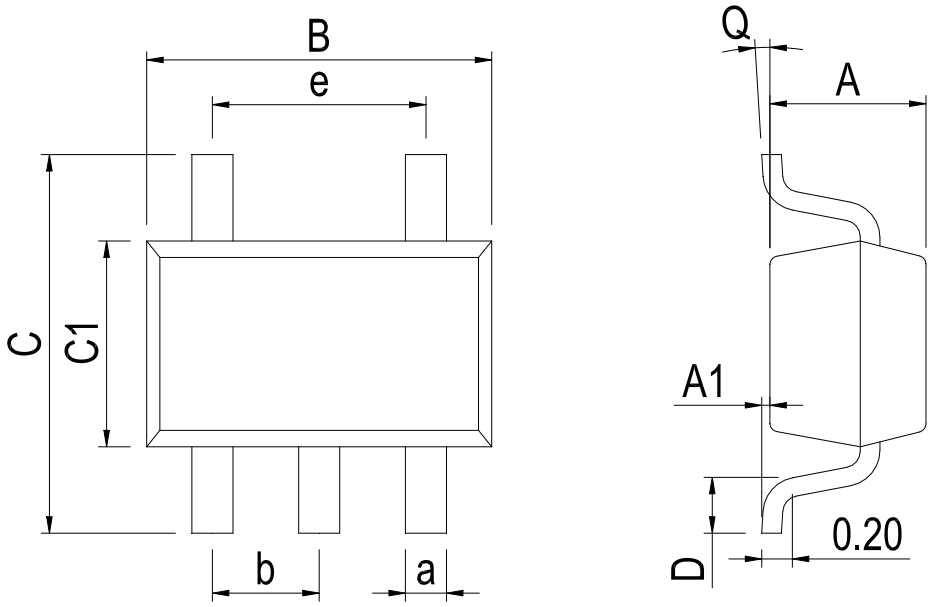
$$I_2 = \left[\frac{R1}{R2}\right] I_1$$

Lamp Driver



Physical Dimensions

SOT23-5



Dimensions In Millimeters(SOT23-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.95 BSC	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40		

Revision History

DATE	REVISION	PAGE
2014-3-20	New	1-12
2023-7-11	Update Update the product marking	1

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