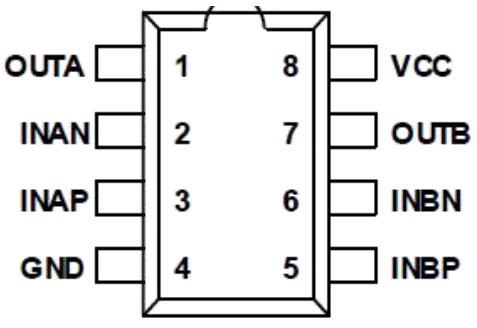
Description

- LM2904 consists of two independent operational amplifiers with high gain and internal frequency compensation.
- It is suitable for single supply operation with a wide range of power supply voltages, as well as dual supply operation.
- The power supply current under recommended operating conditions is independent of the power supply voltage.
- Applications include sensor amplifiers, audio amplifiers, industrial control, DC gain blocks, and all general-purpose operational amplifier circuits.

Features

- Single or dual power supply operation.
- Includes two operational amplifiers.
- Logic circuitry compatibility.
- Low power consumption.
- Internal frequency compensation.
- Low input offset voltage and offset current.
- Wide frequency range.
- High DC voltage gain.
- Wide power supply voltage range: Single supply (3V to 20V); dual supply (±1.5V to ±10V).
- Low power consumption suitable for battery-powered applications.
- Available in DIP 8 or SOP 8 package forms.

Pin definitions



SOP-8/DIP-8

Pin descriptions

Pin Number	Pin Name	Function	Pin Number	Pin Name	Function
1	O_{UTA}	the output terminal of a op-amp	8	V_{CC}	the positive power supply rail
2	I_{NAN}	the negative input of a op-amp	7	O_{UTB}	the output terminal of b op-amp
3	I_{NAP}	the positive input of a op-amp	6	I_{NBN}	the negative input of b op-amp
4	G_{ND}	the negative power supply rail	5	I_{NBP}	the positive input of b op-amp

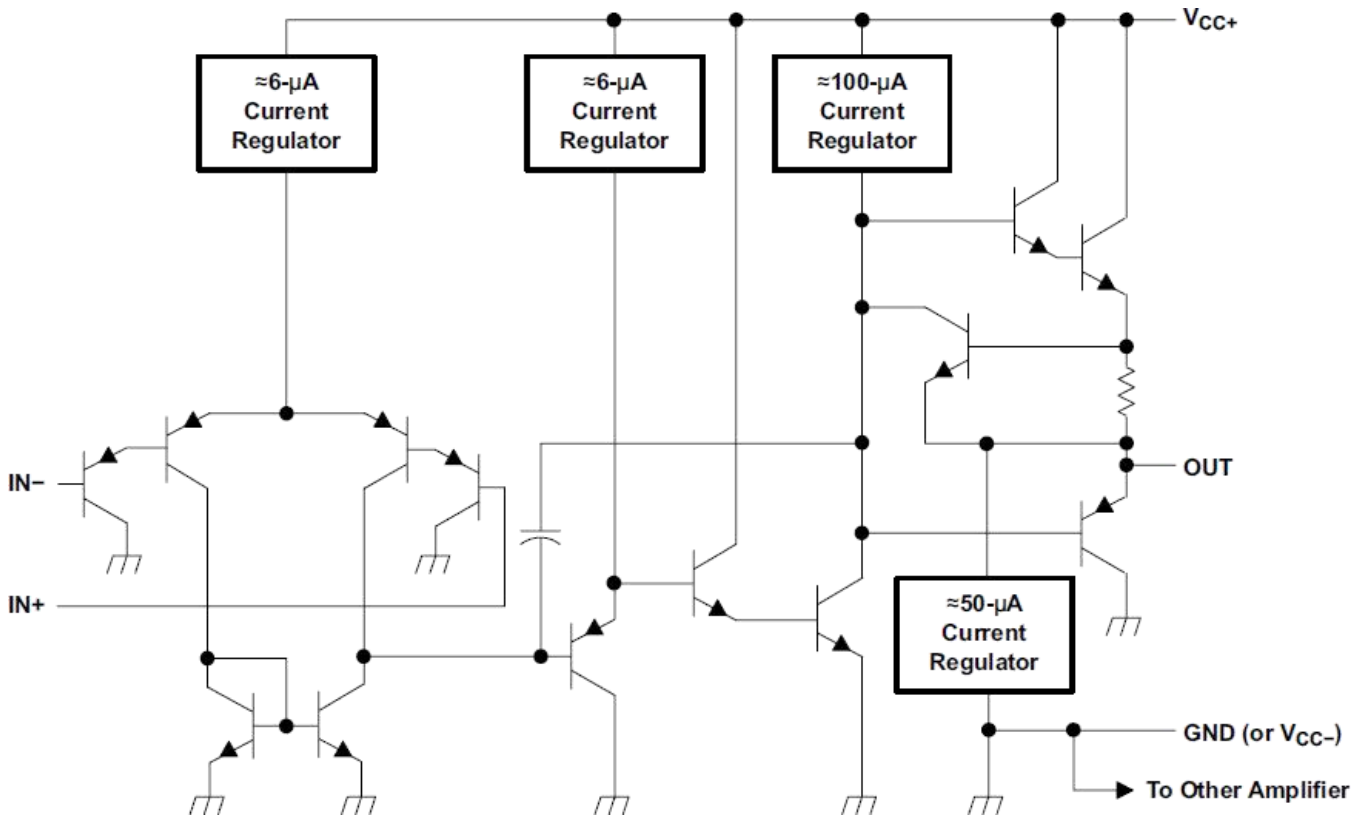
Absolute maximum ratings（Absolute maximum ratings, unless otherwise specified, T_{amb}=25℃）

supply voltage	24 or ±12	V
differential input voltage	24	V
input voltage	-0.3～24	V
output-to-ground short-circuit current (amplifier 1)（V≤15V、T_a=25℃）	continue	
input current（V_{IN} < -0.3V）	50	mA
operating ambient temperature	0～70	℃
storage temperature	-65～150	℃

Electrical characteristics

Symbol	Parameter	Test Condictions		Value			Unit
				Min	Typ	Max	
V_{IO}	input offset voltage	V_{CC}=5Vtomax, V_{IC}=V_{ICR}min, V_O=1.4V, T_a=25℃			3	5	mV
		V_{CC}=5V_{to}max, V_{IC}=V_{ICR}min, V_O=1.4V, T_a=0～70℃				7	mV
ΔV_{IO}	input offset voltage drift				7		μV/℃
I_{IB}	input bias current	T_a=25℃, IIN(+) or IIN(-), V_{CM}=0V			45	300	nA
I_{IO}	input offset current	T_a=25℃, IIN(+)-IIN(-), V_{CM}=0V			5	50	nA
V_{ICR}	input common-mode voltage range	T_a=25℃, V_{CC}=24V		0		VCC-1.5	V
I_{CC}	supply current	throughout the entire temperature range, with R_L = ∞, on all operational amplifiers.	V_{CC}=24V		1	2	mA
			V_{CC}=5V		0.5	1.2	
A_{VD}	large-signal voltage gain	V_{CC}=15V,T_a=25℃,R_L≥2kΩ（about Vo=1~11V）			50	100	V/mV
C_{MRR}	common-mode rejection ratio	DC,T_a=25℃,V_{CM}=0~V_{CC}-1.5V			65	90	dB
P_{SRR}	power supply rejection ratio	DC,T_a=25℃,V_{CC}=5～24V			65	100	dB
	coupling between amplifiers coefficient	DC, T_a=25℃, V_{CM}=0～2V_{CC}-1.5V			-120		dB
I_{Source}	output source current	V_{IN}(+)=1V,V_{IN}(-)=0V,V_{CC}=15V,V_o=2V, T_a=25℃			20	40	mA
I_{Sink}	output sink current	V_{IN}(-)=1V,V_{IN}(+)=0V,V_{CC}=15V, Vo=2V,T_a=25℃			10	20	mA
I_{Sink}		V_{IN}(-)=1V,V_{IN}(+)=0V,V_{CC}=15V, Vo=200mV,T_a=25℃			12	50	mA
I_{OS}	ground short-circuit-current	V_{CC}=15V,V_O=0V,T_a=25℃			40	60	mA
V_{OH}	output high level	V_{CC}=24V	R_L=2KΩ				V
			R_L=10KΩ				V
V_{OL}	output low level	V_{CC}=24V, R_L=10KΩ			5	20	mV

Schematic Diagram



Characteristic Curve

Fig.1 Input Voltage Range

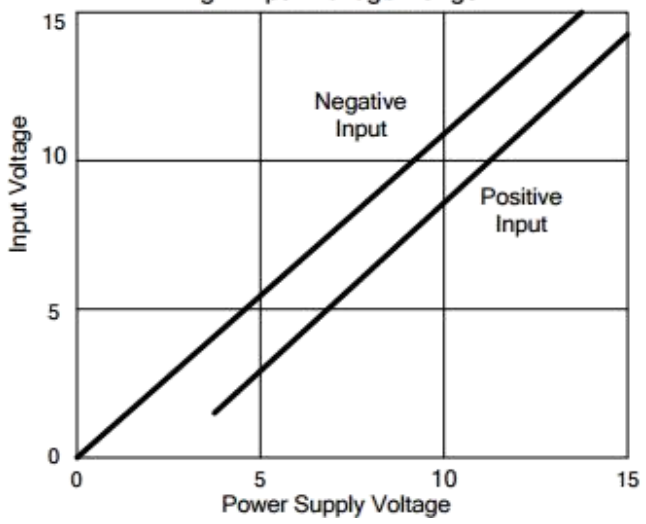


Fig.2 Input Current vs Temperature

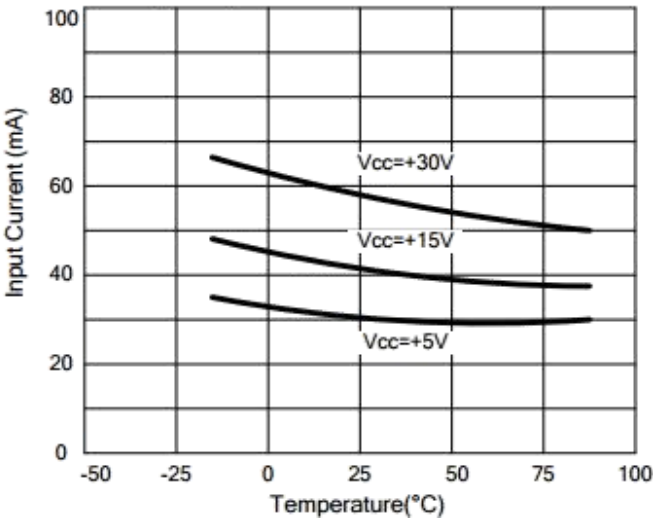


Fig.3 Supply Current vs Supply Voltage

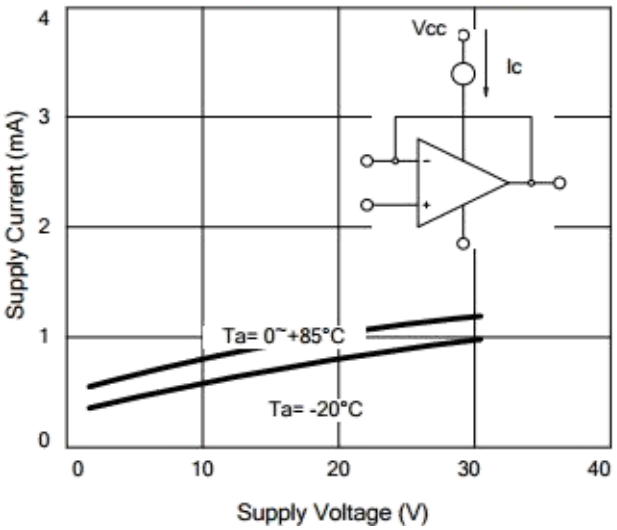


Fig. 4 Voltage Gain vs Supply Voltage

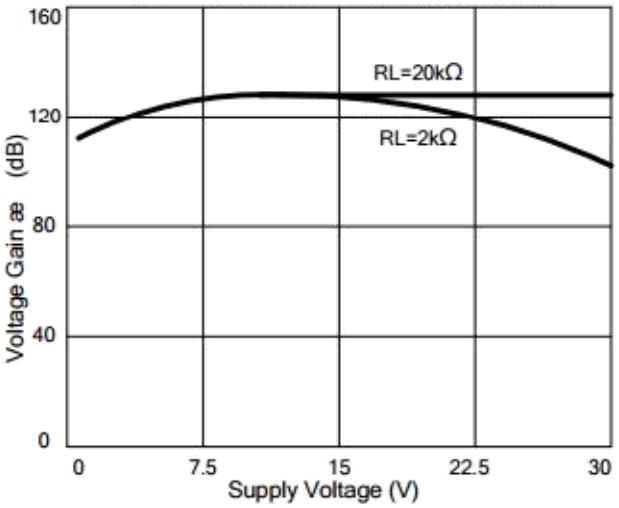


Fig. 5 Open Loop Gain vs Frequency

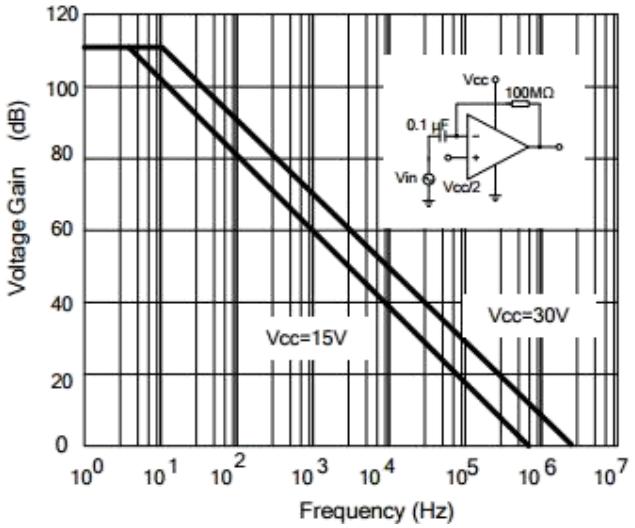
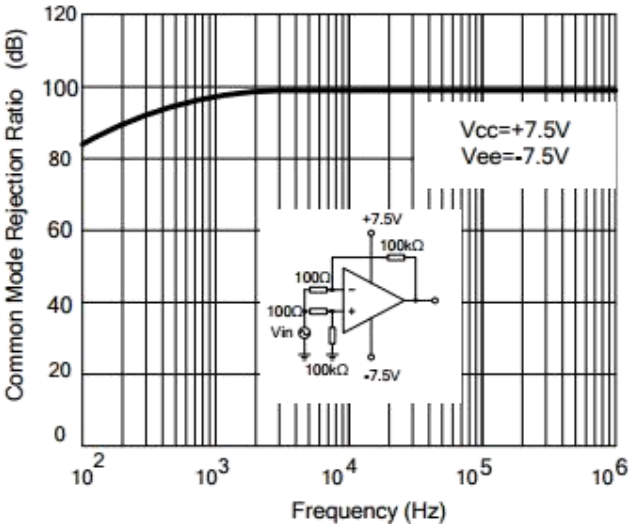
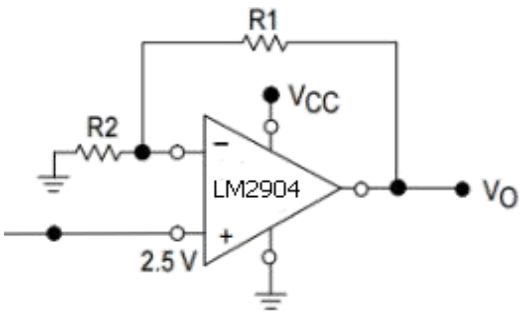


Fig. 6 Common Mode Rejection Ratio vs Frequency



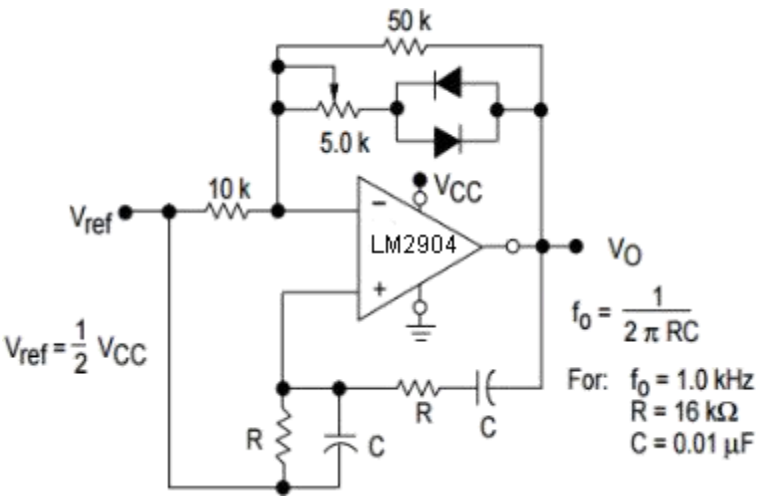
Application Circuit

DC-coupled non-inverting amplifier



$$V_O = 2.5\,V\left(1 + \frac{R1}{R2}\right)$$

Oscillator

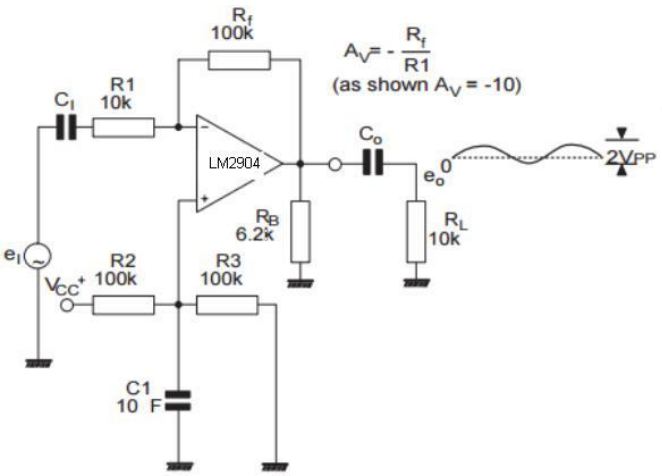


$$V_{ref} = \frac{1}{2} V_{CC}$$

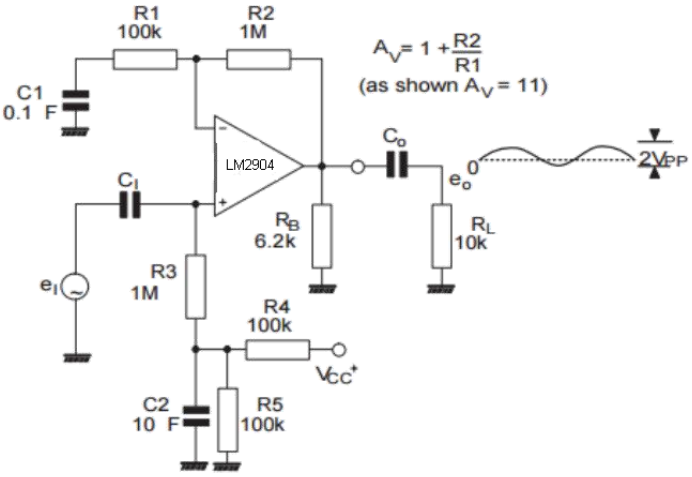
$$f_o = \frac{1}{2\pi RC}$$

For: f_o = 1.0 kHz
R = 16 kΩ
C = 0.01 μF

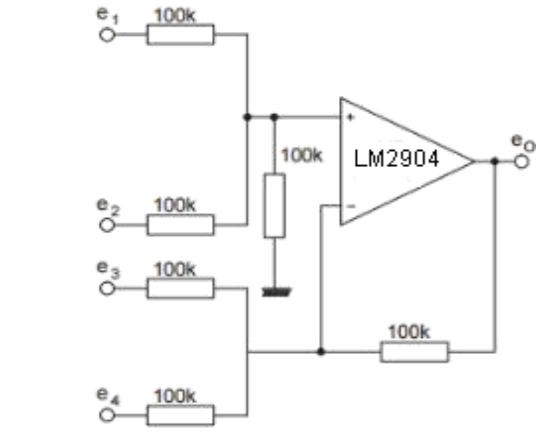
AC-coupled inverting amplifier



AC-coupled non-inverting amplifier

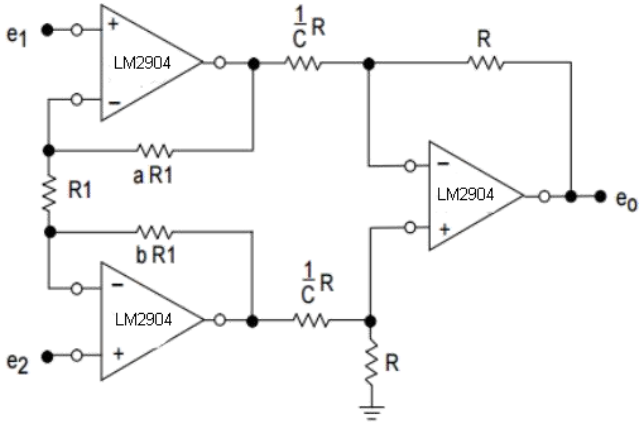


Adder



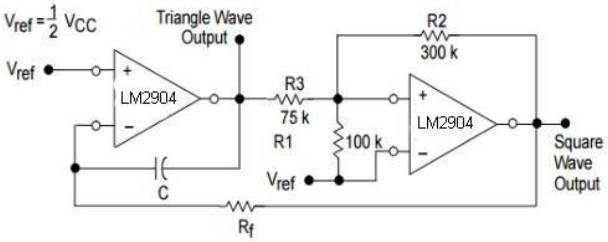
$e_o = e_1 + e_2 - e_3 - e_4$
where $(e1 + e_2) \geq (e_3 + e_4)$
to keep $e_o \geq 0V$

High-impedance differential amplifier



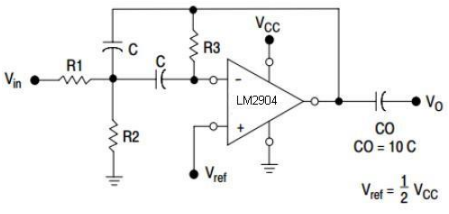
$e_0 = C\,(1 + a + b)\,(e_2 - e_1)$

Signal generator



$f = \frac{R1 + R_C}{4\,CR_f\,R1}$ if, $R3 = \frac{R2\,R1}{R2 + R1}$

Bandpass filter



Given: f_o = center frequency
$A(f_o)$ = gain at center frequency

Choose value f_o, C

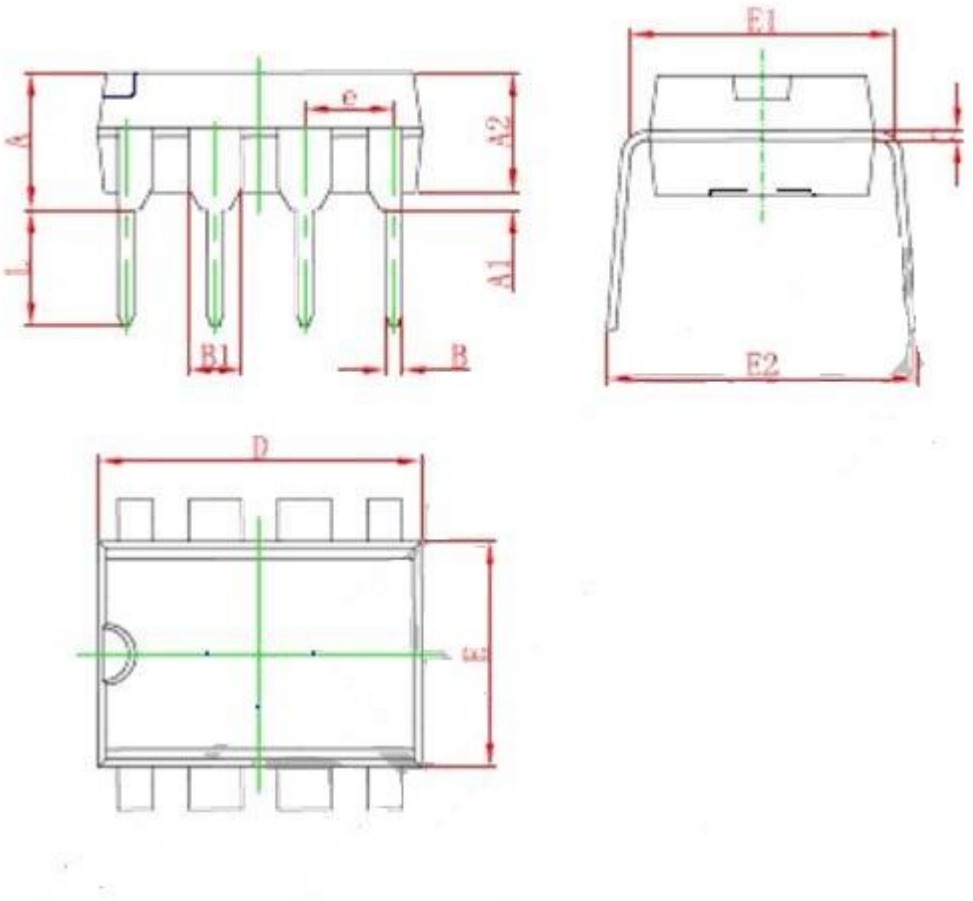
Then: $R3 = \frac{Q}{\pi\, f_o\, C}$

$R1 = \frac{R3}{2\,A(f_o)}$

$R2 = \frac{R1\,R3}{4Q^2\,R1 - R3}$

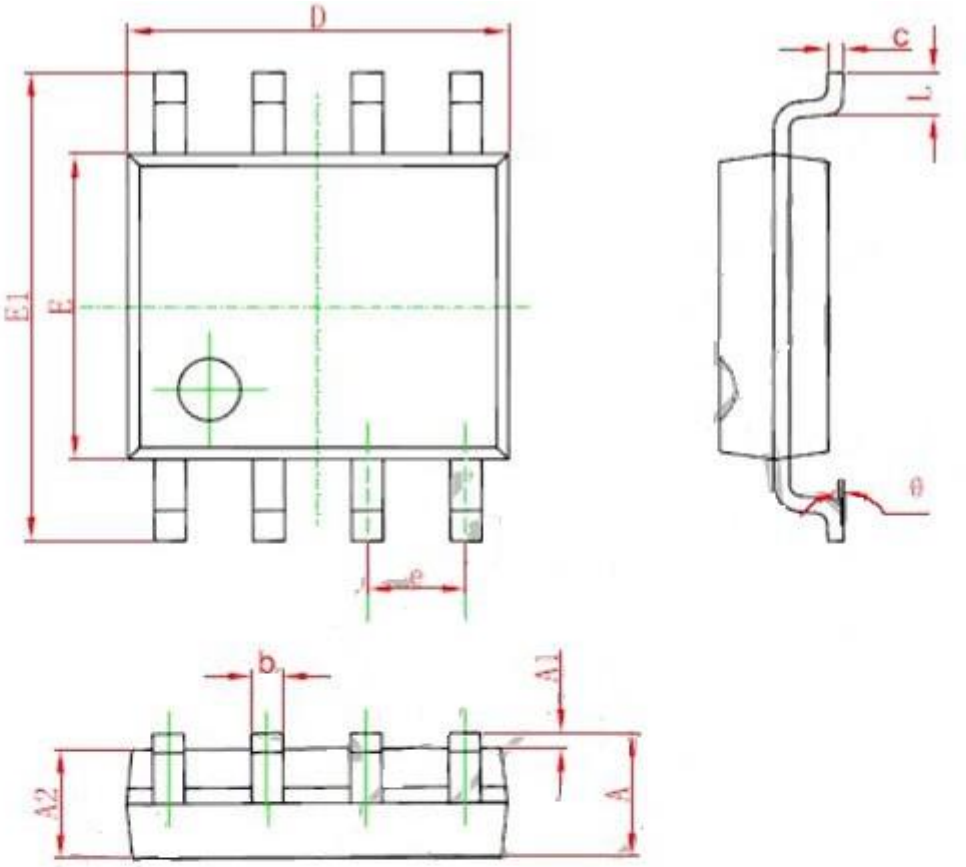
Package Dimensions

DIP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524 (BSC)		0.060 (BSC)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540 (BSC)		0.100 (BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.000	0.331	0.354

SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	0.135	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°