

THE HONG KONG POLYTECHNIC UNIVERSITY
Department Of Electronic and Information Engineering

The Wien Bridge Oscillator

Objective: To measure the amplitude and phase response of the Wien Network and to use the network to form an oscillator.

Apparatus: 1 - audio signal generator
 1 - C.R.O
 1 - 10k Ω decade box
 1 - dual power supply $\pm 6V$

Theory:

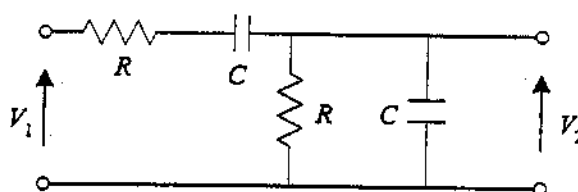


Fig. 1

The Wien network is shown in fig 1. It is easily shown that the transfer function V_2/V_1 is

$$\beta = \frac{V_2}{V_1} = \frac{j\omega RC}{(1 - \omega^2 R^2 C^2) + j\omega 3RC}$$

from this we deduce that when

$$1 - \omega^2 R^2 C^2 = 0$$

i.e.

$$\omega = \frac{1}{RC}$$

or

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

then

$$\beta = \frac{V_2}{V_1} = \frac{1}{3}$$

i.e. V_2 is in phase with V_1 and attenuated by a factor 1/3.

The Wien Oscillator

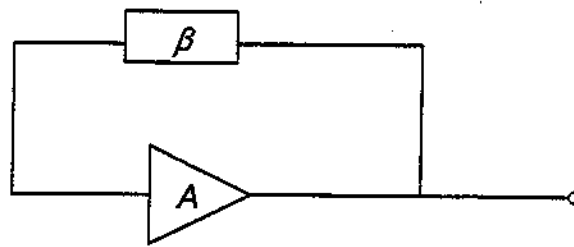


Fig. 2

The condition for oscillation is $|A\beta|=1$

$\angle(A\beta)=0^\circ$

These conditions are fulfilled if β is the Wien Network when

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

and $A = 3$

The Amplifier

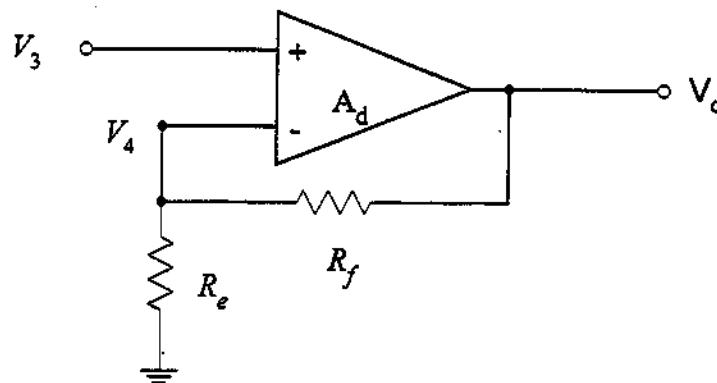


Fig. 3

For the positive gain OP AMP configuration shown in Fig. 3.

$V_3 \approx V_4$ as $A_d \rightarrow \infty$ if V_o is finite

$$\therefore V_3 = V_o \frac{R_e}{R_e + R_f}$$

$$\therefore A = \frac{V_o}{V_3} = \frac{R_e + R_f}{R_e}$$

Procedure

1) Open-loop gain-phase Response

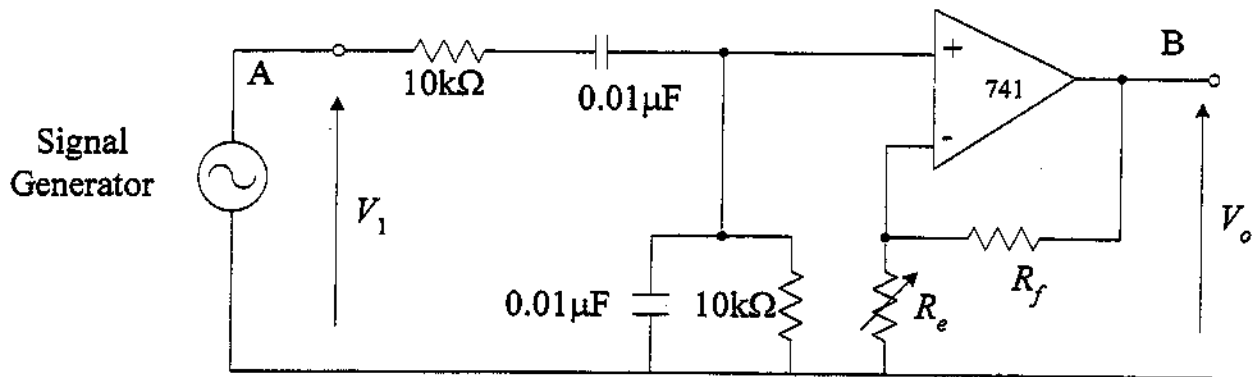


Fig. 4

Connect the circuit as shown in Fig. 4 putting:

$$R_e = 5k\Omega \text{ and } R_f = 10k\Omega$$

Plot the magnitude, $\left| \frac{V_o}{V_1} \right|$, and phase angle $\angle \left(\frac{V_o}{V_1} \right)$, of $\frac{V_o}{V_1}$ as a function of frequency from 100Hz to 10kHz.

Note the frequency at which $\angle \left(\frac{V_o}{V_1} \right) = 0^\circ$ and magnitude of $\left| \frac{V_o}{V_1} \right|$ at this frequency.

2) Closed-loop Response.

- a) Disconnect the signal generator from the input. Complete the feedback loop in the circuit of Fig. 4 by connecting point A and Point B.

Record the output waveform with values of $R_e = 10k\Omega, 6k\Omega, 5k\Omega$ and $4.5k\Omega$.

- b) Replace R_f by the thermistor. The resistance of the thermistor falls as its temperature rises, and the temperature rise is caused by self-heating due to the applied voltage.

Observe the output voltage and explain why a thermistor is usually used for R_f .