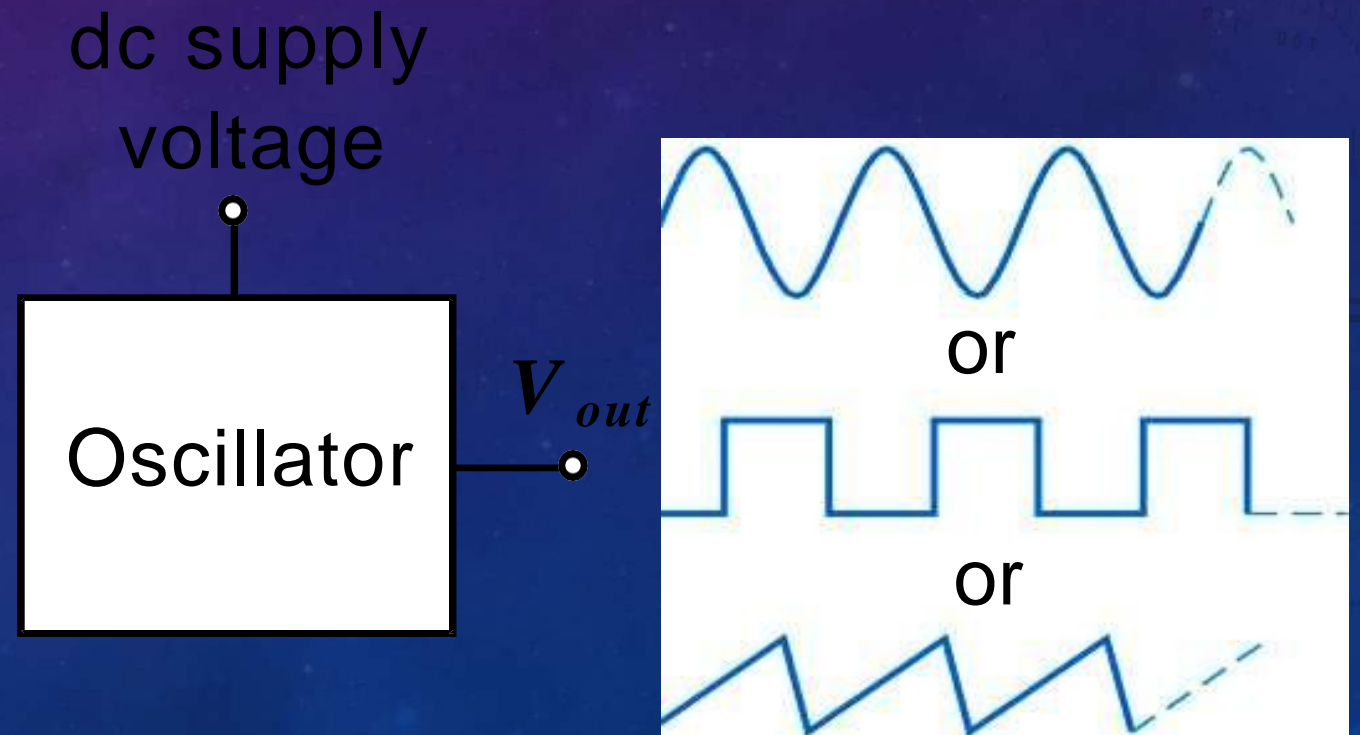


The background features a dark blue gradient with faint, semi-transparent technical diagrams of gears and mechanical parts. The text is centered in a white, serif font.

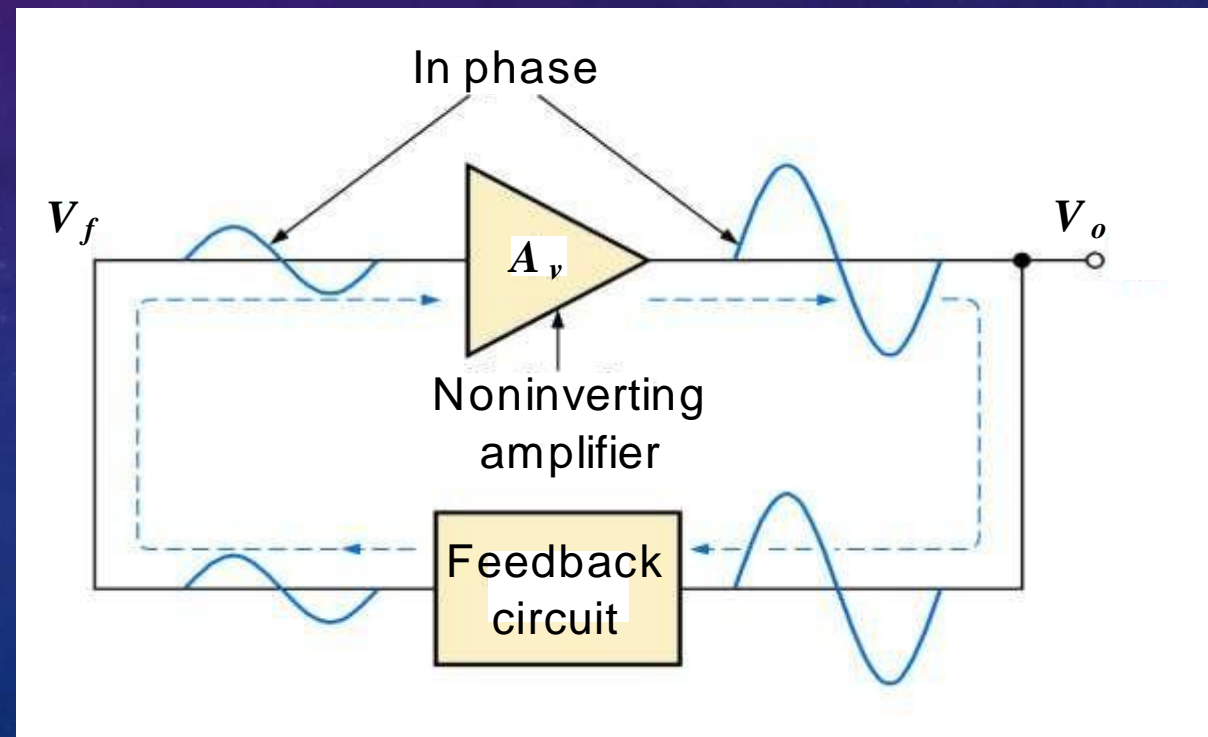
# OSCILLATORS WITH RC FEEDBACK CIRCUIT

**Oscillator** is an electronic circuit that generates a periodic waveform on its output ***without an external signal source.*** It is used to convert dc to ac. The waveform can be sine wave, square wave, triangular wave, and sawtooth wave.



The **feedback oscillator** is widely used for generation of sine wave signals. The positive (in phase) feedback maintains the oscillations

If the feedback circuit returns the signal out of phase, an inverting amplifier produces positive feedback.



# Types of oscillators

1. RCoscilators
  - Wien Bridge
  - Phase Shift
2. LCoscillators
  - Hartley
  - Colpitts
3. Relaxation oscilators

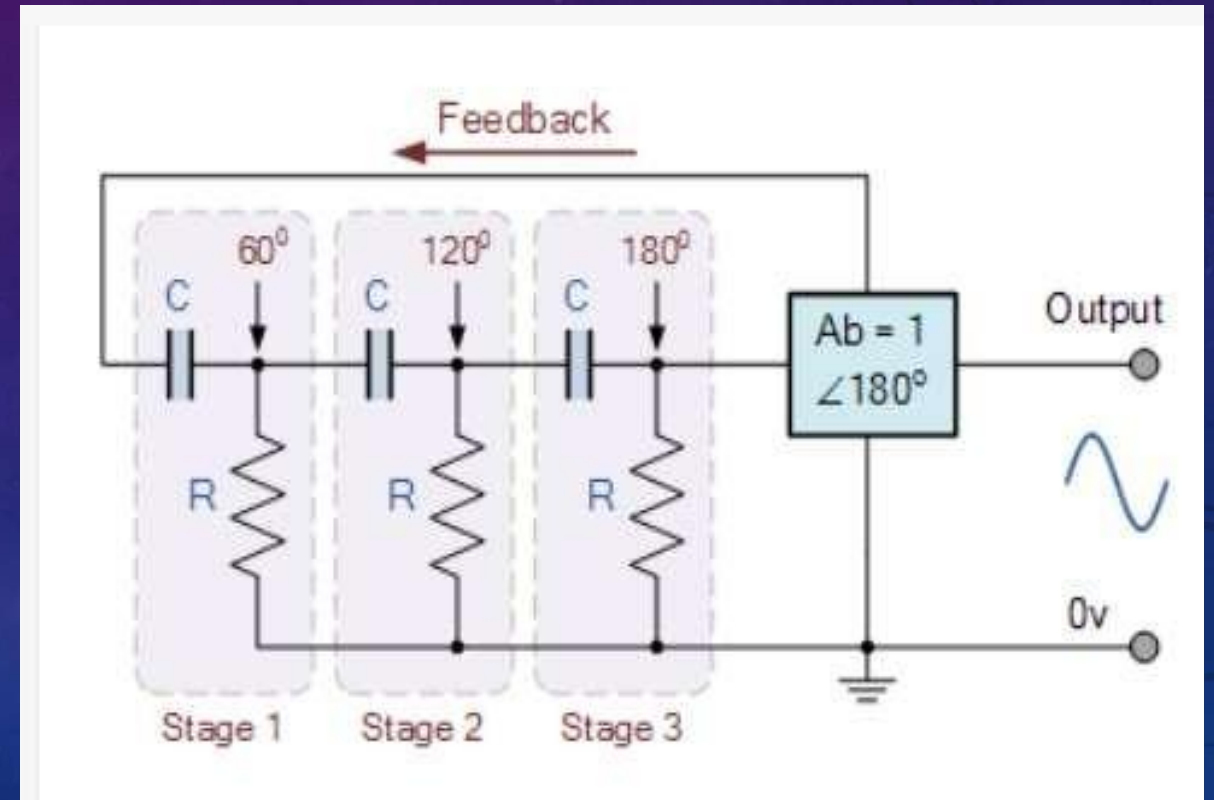
## *Rc Oscillators*

RC feedback oscillators are generally limited to frequencies of 1 MHz or less.

The types of RC oscillators that we will discuss are the **Wien-bridge** and the **phase-shift**

# The RC Oscillator Circuit

RC Oscillators use a combination of an amplifier and an RC network to produce oscillations due to the phase shift between the stages

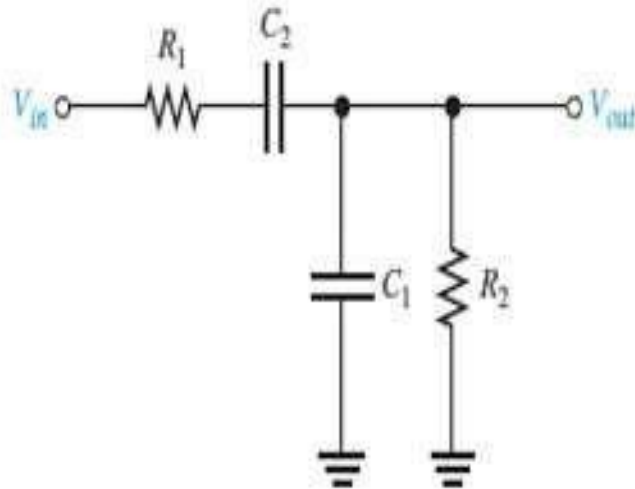


# WEIN BRIDGE OSCILLATOR

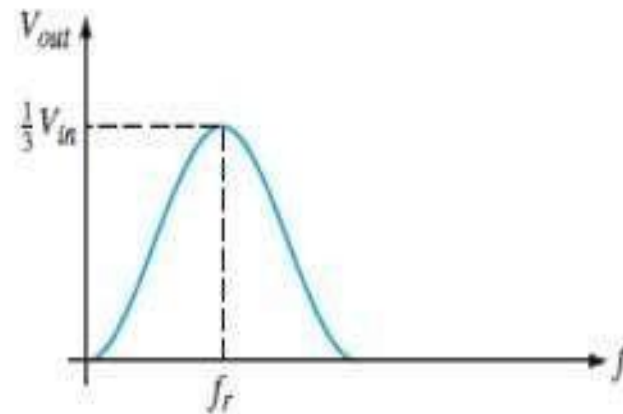
A **Wien bridge oscillator** is a type of electronic oscillator that generates sine waves. It can generate a large range of frequencies. The oscillator is based on a bridge circuit originally developed by Max Wien in 1891.<sup>[1]</sup> The bridge comprises four resistors and two capacitors. The oscillator can also be viewed as a positive gain amplifier combined with a band pass filter that provides positive feedback.

# Wien-bridge oscillator

- A fundamental part of the Wien-bridge oscillator is a lead-lag circuit like that shown in Figure 16–6(a).
- $R_1$  and  $C_1$  together form the lag portion of the circuit:  $R_2$  and  $C_2$  form the lead portion.



(a) Circuit



(b) Response curve

**FIGURE 16–6**

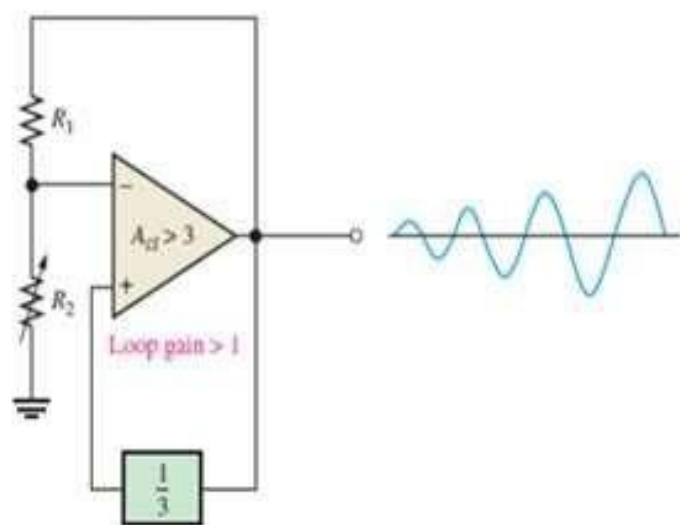
A lead-lag circuit and its response curve.



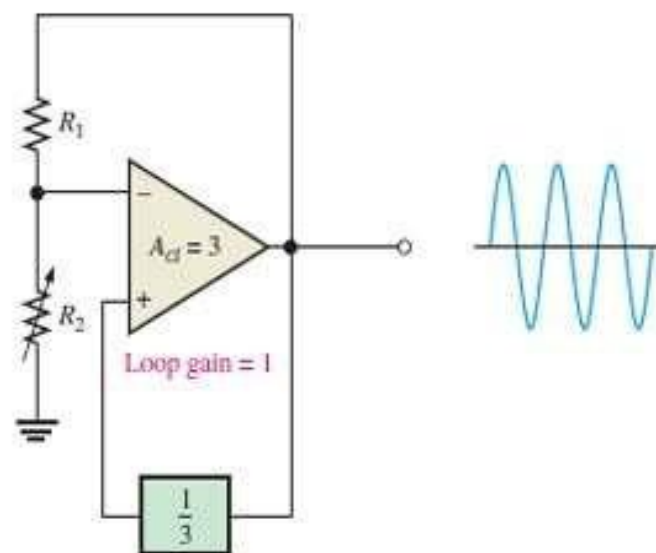
# Wien-bridge oscillator

- For the circuit to produce a sustained sinusoidal output (oscillate), the phase shift around the positive feedback loop must be  $0^\circ$  and the gain around the loop must be equal to unity (1).
- The  $0^\circ$  phase-shift condition is met when the frequency is  $f_r$  because the phase shift through the lead-lag circuit is  $0^\circ$  and there is no inversion from the noninverting (+) input of the op-amp to the output.
- This is shown in Figure 16–8(a).
- The unity-gain condition in the feedback loop is met when
$$A_{cl} = 3$$
- This offsets the 1/3 attenuation of the lead-lag circuit, thus making the total gain around the positive feedback loop equal to 1.

## Wien-bridge oscillator



(a) Loop gain greater than 1 causes output to build up.



(b) Loop gain of 1 causes a sustained constant output.

**FIGURE 16-9**

Conditions for start-up and sustained oscillations.

## Wien-bridge oscillator

- **Example 16-1:** Determine the resonant frequency for the Wien-bridge oscillator in Figure 16–12. Also, calculate the setting for  $R_f$  assuming the internal drain-source resistance  $r'_{ds}$  of the JFET is  $500 \Omega$  when oscillations are stable.

- Solution:
- For the lead-lag circuit, and  $R_1 = R_2 = R = 10 \text{ k}\Omega$  and  $C_1 = C_2 = C = 0.01 \text{ mF}$ . The frequency is

$$f_r = \frac{1}{2\pi RC} = \frac{1}{2\pi(10 \text{ k}\Omega)(0.01 \mu\text{F})} = 1.59 \text{ kHz}$$

## Wien-bridge oscillator

- The closed-loop gain must be 3.0 for oscillations to be sustained.
- For an inverting amplifier, the gain expression is the same as for a noninverting amplifier.

$$A_v = \frac{R_f}{R_i} + 1$$

- $R_i$  is composed of  $R_3$  and  $r'_{ds}$ . Substituting

$$A_v = \frac{R_f}{R_3 + r'_{ds}} + 1$$

- Rearranging for  $R_f$

$$R_f = (A_v - 1)(R_3 + r'_{ds}) = (3 - 1)(1.0 \text{ k}\Omega + 500 \text{ }\Omega) = 3.0 \text{ k}\Omega$$

## Advantages

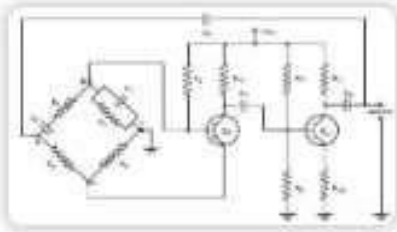
The various advantages of Wien bridge oscillator are,

1. By varying the two capacitor values simultaneously, by mounting them on the common shaft, different frequency ranges can be obtained.
2. The perfect sine wave output is possible.
3. It is useful audio frequency range i.e. 20 Hz to 100 kHz.

## Disadvantages

If instead of op-amp, transistorised amplifier is to be used then more stages are required to obtain  $0^\circ$  phase shift between input and output. This increases the number of components and cost. The frequency stability is poor.

Posted by electroadmin on 23 October 2017, 12:13 am



The wien bridge oscillator is a type of RC oscillator, that produces the sinusoidal output.

It is commonly used in audio and Sub-audio frequency ranges, that is 20- 20KHz. The maximum frequency of the output of a wien bridge oscillator is only about 1MHz. Circuit Diagram explanation of WIEN BRIDGE OSCILLATOR It has two stage RC ...

# Phase shift

Phase shift is any change that occurs in the phase of quantity , or in the phase difference between two or more quantities. Sometimes it referred as Phase-shift or Phase-offset because it represents a “shift” from zero phase.



# Phase-shift oscillator

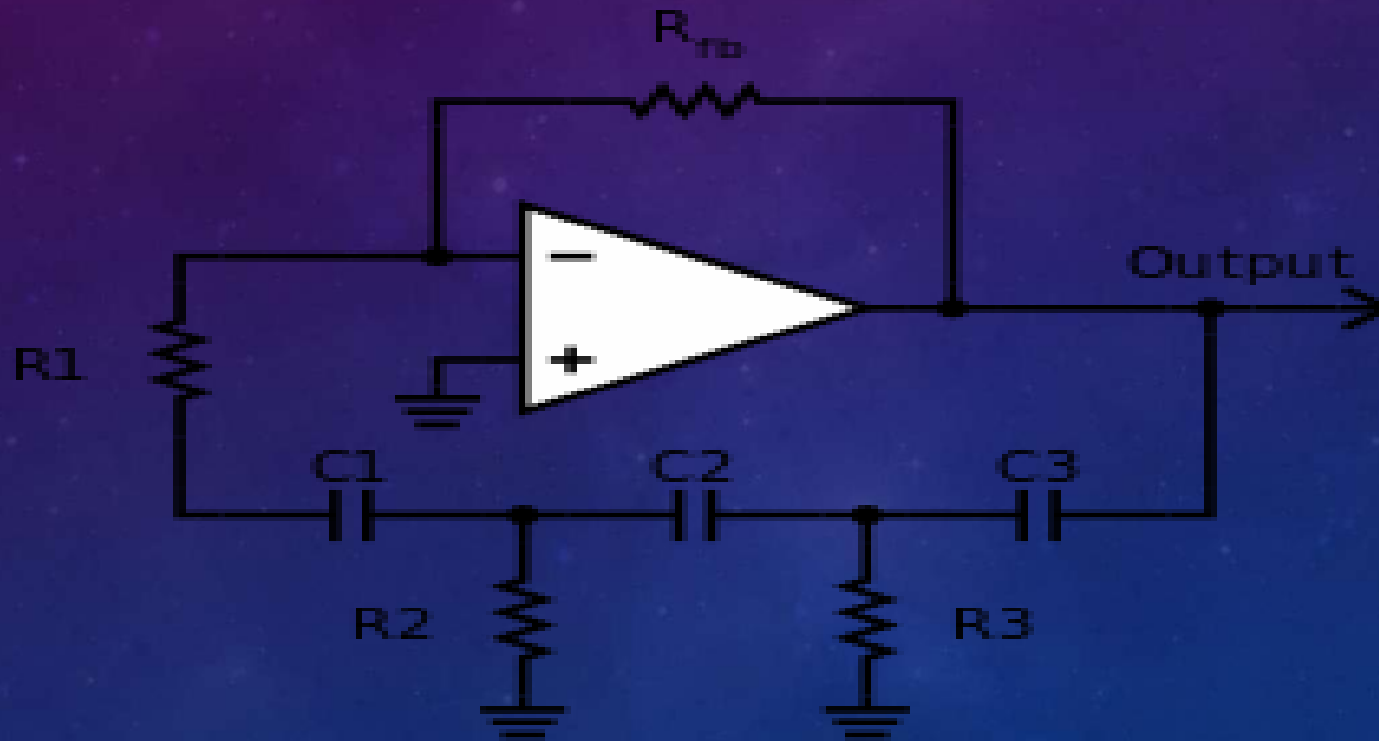
A **phase-shift oscillator** is a linear electronic oscillator circuit that produces a sine wave output. It consists of an inverting amplifier element such as a transistor or op-amp with its output fed back to its input through a phase-shift network consisting of resistors and capacitors in a ladder network.

# PHASE-SHIFT OSCILLATOR USING OP-AMP

The circuit shown below indicates that the feedback is connected to the inverting X input of the **operational amplifier** which produces the required  $180^\circ$  phase shift.

Another  $180^\circ$  phase shift is produced through the three stage RC phase shift network which got combine With feedback phase shift and produces  $360^\circ$  or  $0^\circ$  phase shift which is the required condition for sustained oscillations. RC oscillators with four stages Are generally used because available op-amp came in quad IC packages.

# Phase-shift oscillator using Op-amp



if  $R_1=R_2=R_3=R$  and  $C_1=C_2=C_3=C$ , then:

The equation for the frequency of oscillation given by:

$$f = \frac{1}{2\pi\sqrt{6RC}}$$

## Problem:

Determine the frequency of oscillation of a phase-shift oscillator with a three-section feedback network consisting of  $13\text{-}\Omega$  resistors and  $100\text{-micro F}$  capacitors.

## Data:

$$R = 13\text{-}\Omega$$

$$C = 100\text{-micro F}$$

Using equation for frequency of oscillation we can compute the frequency Of oscillation as

$$f = \frac{1}{2\pi\sqrt{6}RC}$$
$$= \frac{1}{(2\pi\sqrt{6})(13\Omega)(100\mu F)} = 50\text{Hz}$$

# Advantages

It provides good frequency stability.

It is not bulky and expensive.

It is suitable for low frequencies to say as of the order of 1 KHz.

It generates a sinusoidal output which is distortion free.

It is simpler than Wien bridge oscillator because it does not need negative feedback and stabilization arrangements.

Thank you 😊😊😊