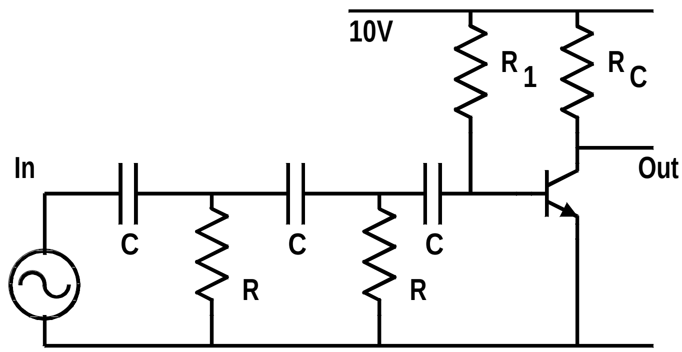
- Sinusoidal voltage waveforms are obtained by using an amplifier
  - In positive feedback,
  - A loop gain of 1 and
  - A frequency selective feedback network.

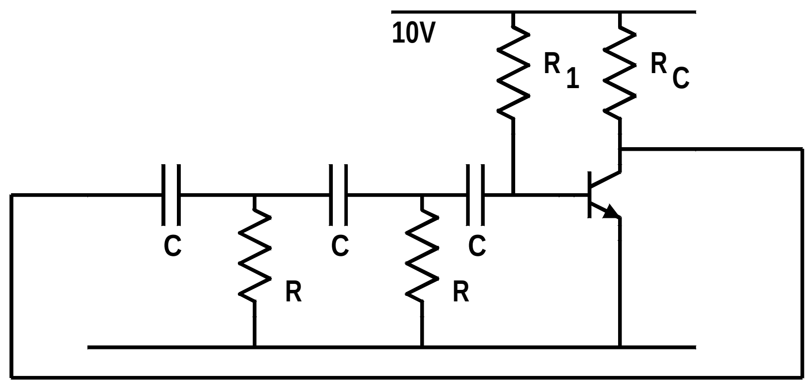


Phase shift network and amplifier. A sinusoidal signal applied to the input is phase shifted and attenuated in each of the three CR filters.

$$\phi_1 = \tan^{-1}\left(\frac{1}{2\pi f C R}\right)$$

Inversion corresponds to a phase shift of 180^o.

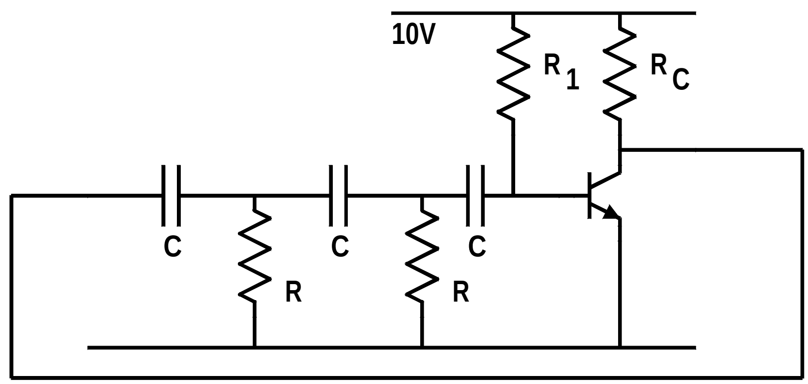
$$\phi_{total} = 3\phi_1 + 180^o$$



Phase shift oscillator.

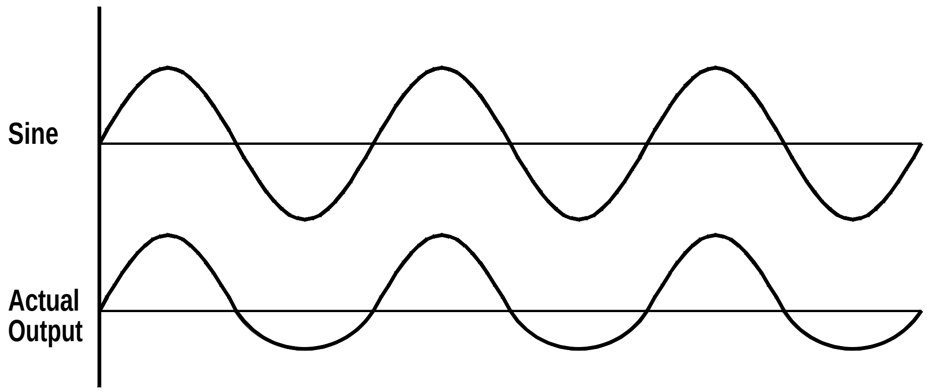
Loop gain greater than 1

Oscillation at $f_o = \frac{1}{2\sqrt{3}\pi CR}$



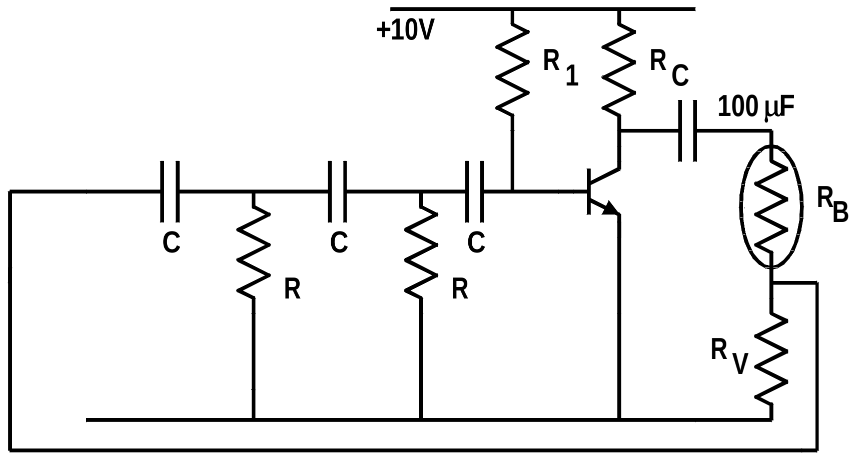
Positive feedback causes the circuit to go into oscillation.

Loop gain greater than 1
Barkhausen Criterion.



Distortion due to saturation nonlinearity.

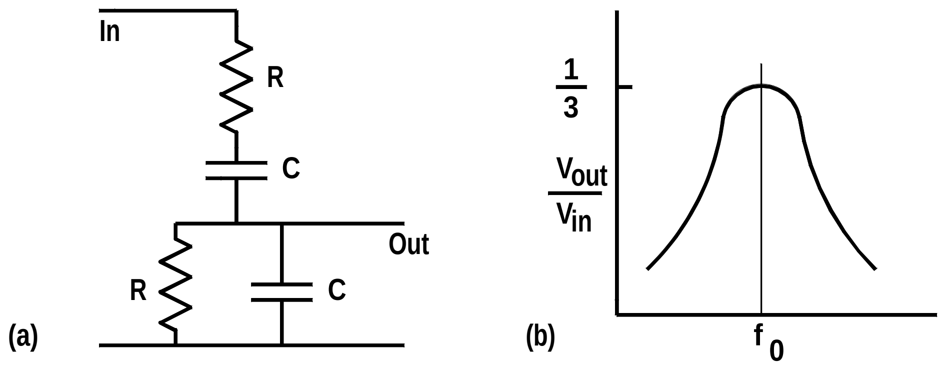
Transistor amplifier ceases to be fully linear when large signals are present.
Reduce the gain to give a loop gain of 1.
This is called amplitude stabilization.



Amplitude stabilization by control of feedback.

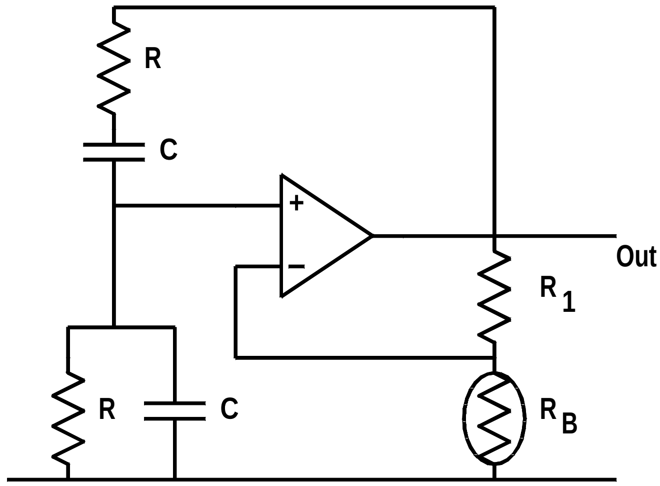
Use a nonlinear device such as a bulb or thermistor.

Feedback fraction is changed.

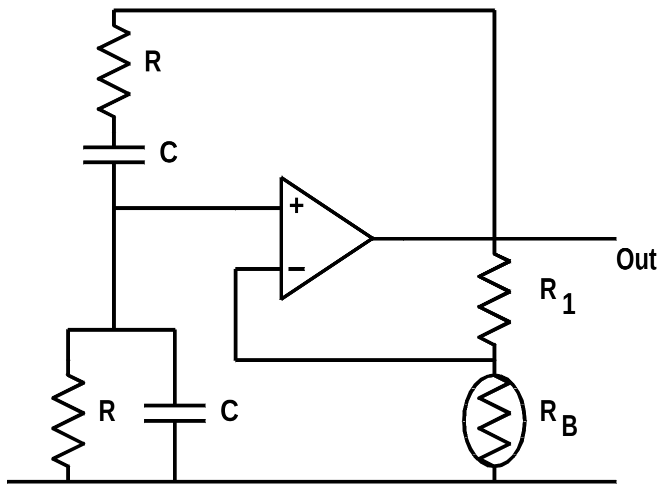


Wein bridge and response.

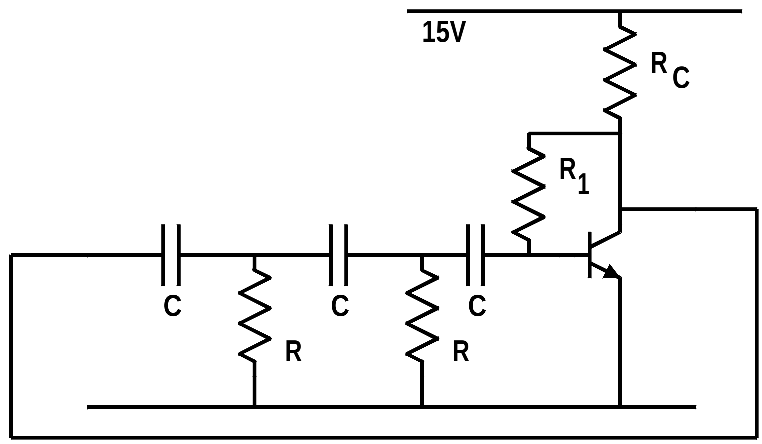
First consider a Wein bridge
This is a bandpass filter which has the response curve shown.
The frequency at the peak of the passband is $f_o = \frac{1}{2\pi RC}$.



Wein bridge oscillator.
The attenuation at the peak of the Wein bridge response is $\frac{1}{3}$
Gain of amplifier must be at least 3 for oscillation to take place



Frequency control with a twin ganged potentiometer for the two Wein bridge resistors. Decade changes of frequency are obtained by switching in pairs of capacitors



Design a transistor phase shift oscillator for a fixed frequency of $300Hz$.

We then require $V_C \approx 9V$ so

$$I_C = \frac{15-9}{4700} = 1.28mA$$

$$\text{then} \quad I_B = \frac{0.00128}{300} = 4.2\mu A$$

$$\text{which gives} \quad R_B = \frac{9-0.7}{4.2\mu A} = 1.9M\Omega$$

Given $f_o = 300Hz$ then

$$300 \times 2 \times \sqrt{3}CR = 1$$

If we take $C = 0.01\mu F$ we get $R = 980\Omega$.

Design a Wein bridge oscillator for a fixed frequency of oscillation of 2000Hz using the circuit in Figure 53.6.

The essential equation is $f_o = \frac{1}{2\pi CR}$.

We guess a reasonable value $C = 0.1\mu F$. which gives $R = \frac{1}{2\pi f_o C} = 796\Omega$

Determine the value of R_B and then choose R_1 to get a loop gain of 1, that is, set the gain to at least

$$A_V = 1 + \frac{R_1}{R_B} = 3$$