

Oscillators

Oscillators

- Oscillators are circuits that generate periodic signals
- An oscillator converts DC power from the power supply into AC signal power spontaneously - without the need for an AC input source

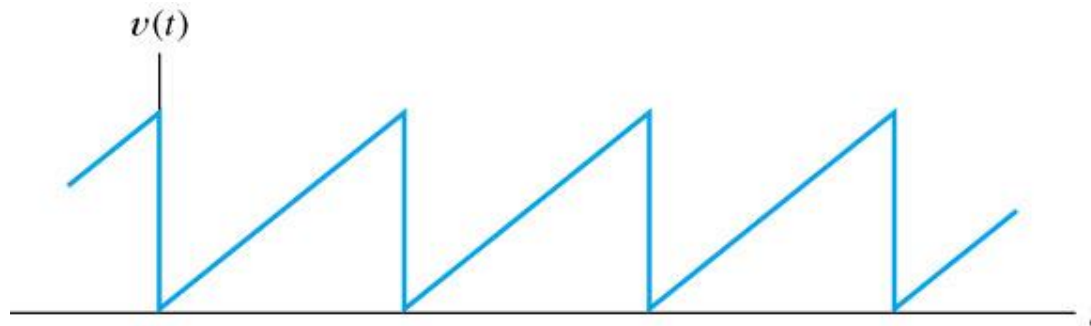


Figure 9.67 Repetitive ramp waveform.

Linear Oscillators

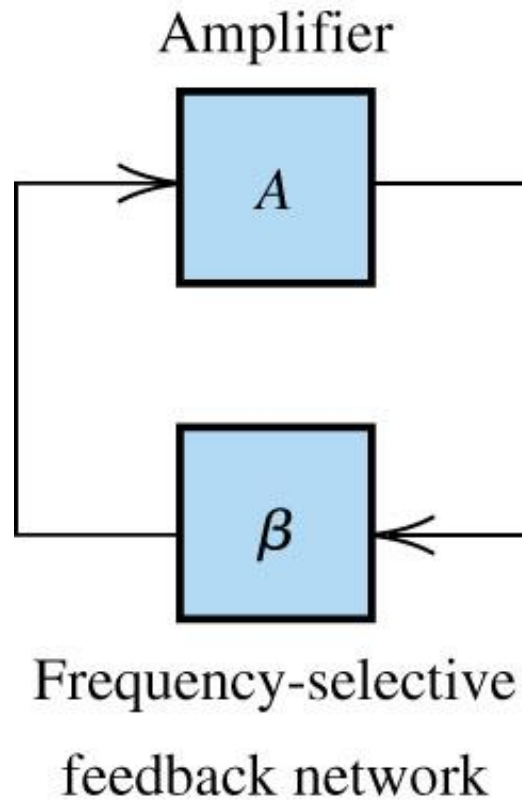


Figure 9.68 A linear oscillator is formed by connecting an amplifier and a feedback network in a loop.

Barkhausen Criterion

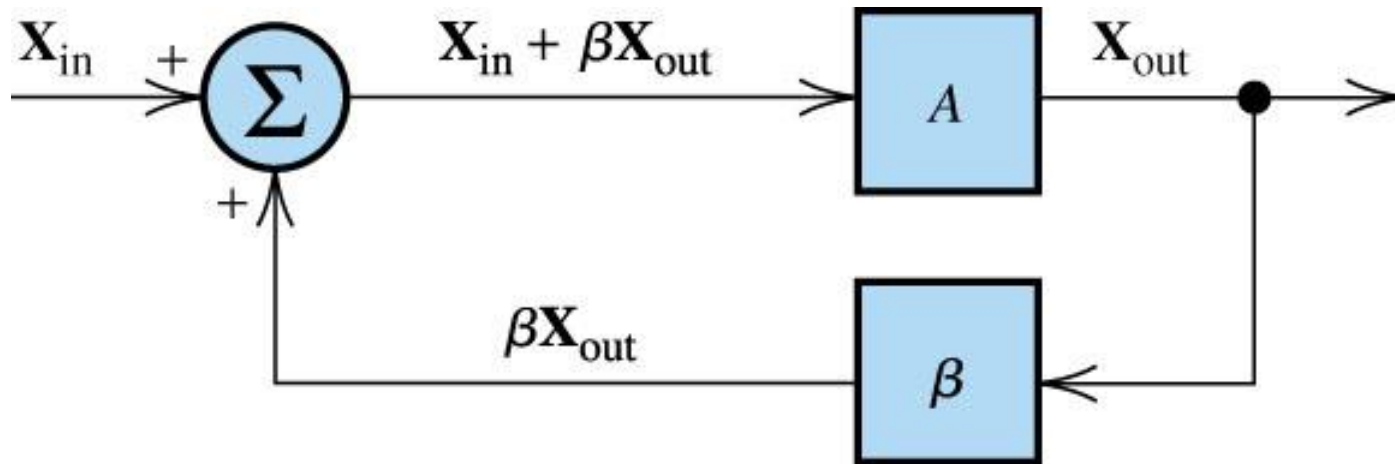


Figure 9.69 Linear oscillator with external signal X_{in} injected.

Barkhausen Criterion



How does the oscillation get started?

- Noise signals and the transients associated with the circuit turning on provide the initial source signal that initiate the oscillation

Practical Design Considerations

- Usually, oscillators are designed so that the loop gain magnitude is slightly higher than unity at the desired frequency of oscillation
- This is done because if we designed for unity loop gain magnitude a slight reduction in gain would result in oscillations that die to zero
- The drawback is that the oscillation will be slightly distorted (the higher gain results in oscillation that grows up to the point that will be clipped)

Example of Oscillator circuit (1)

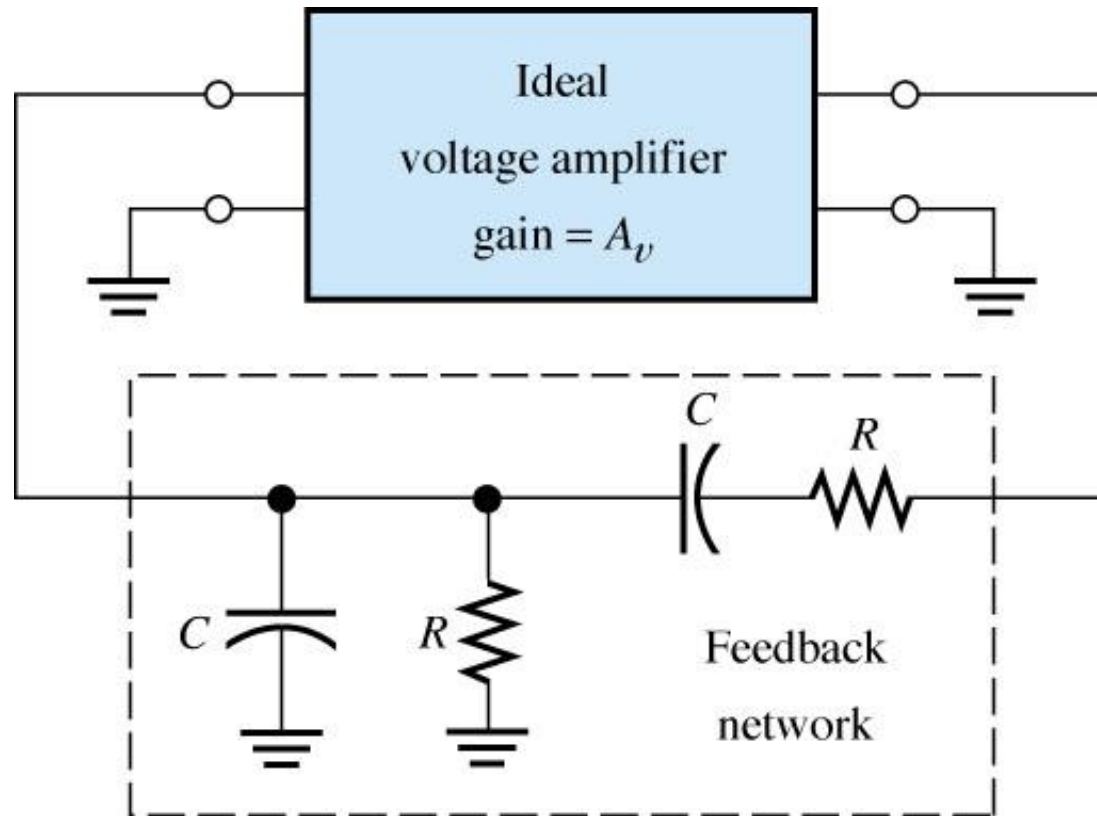


Figure 9.70 Typical linear oscillator.

Example of Oscillator circuit (2)

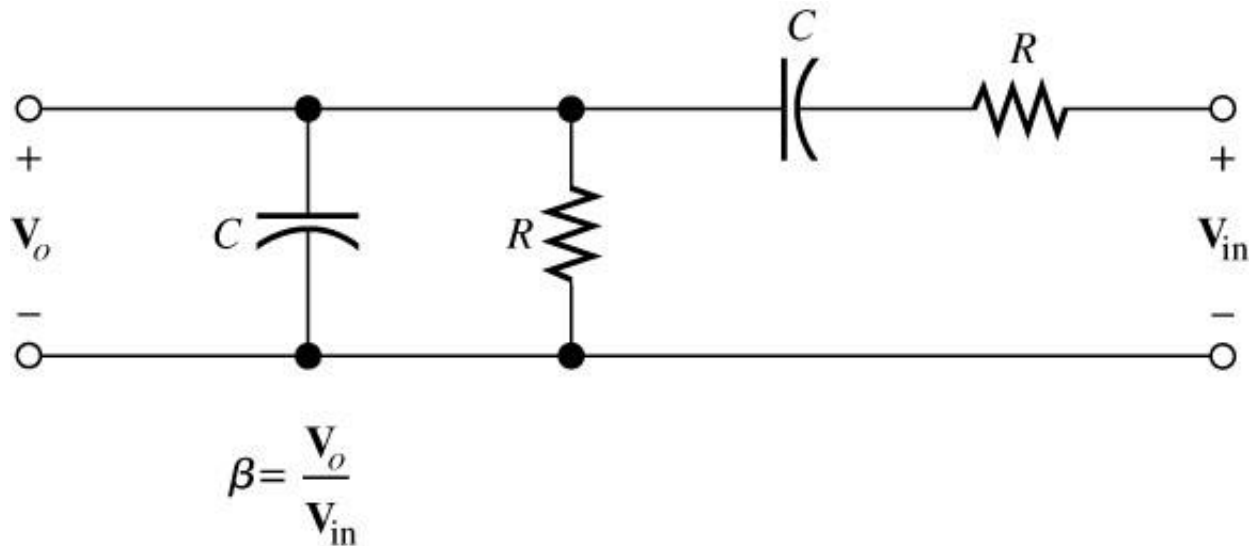


Figure 9.71 Feedback network. Note that the input to the network is on the right-hand side and the response is on the left-hand side.

Wien-Bridge Oscillator

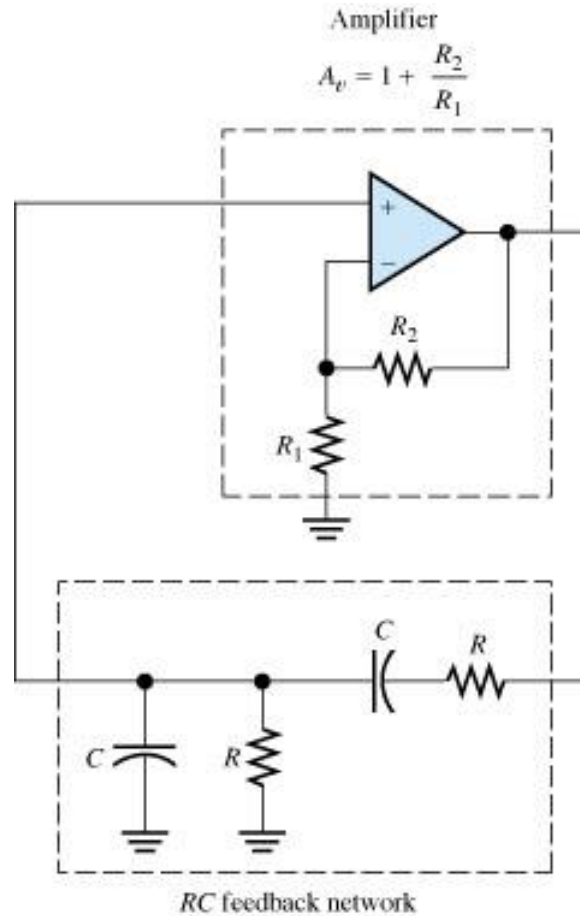
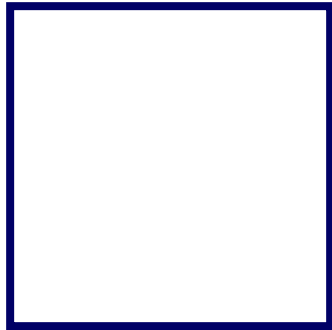


Figure 9.73 Wien-bridge oscillator.

Wien-Bridge oscillator output

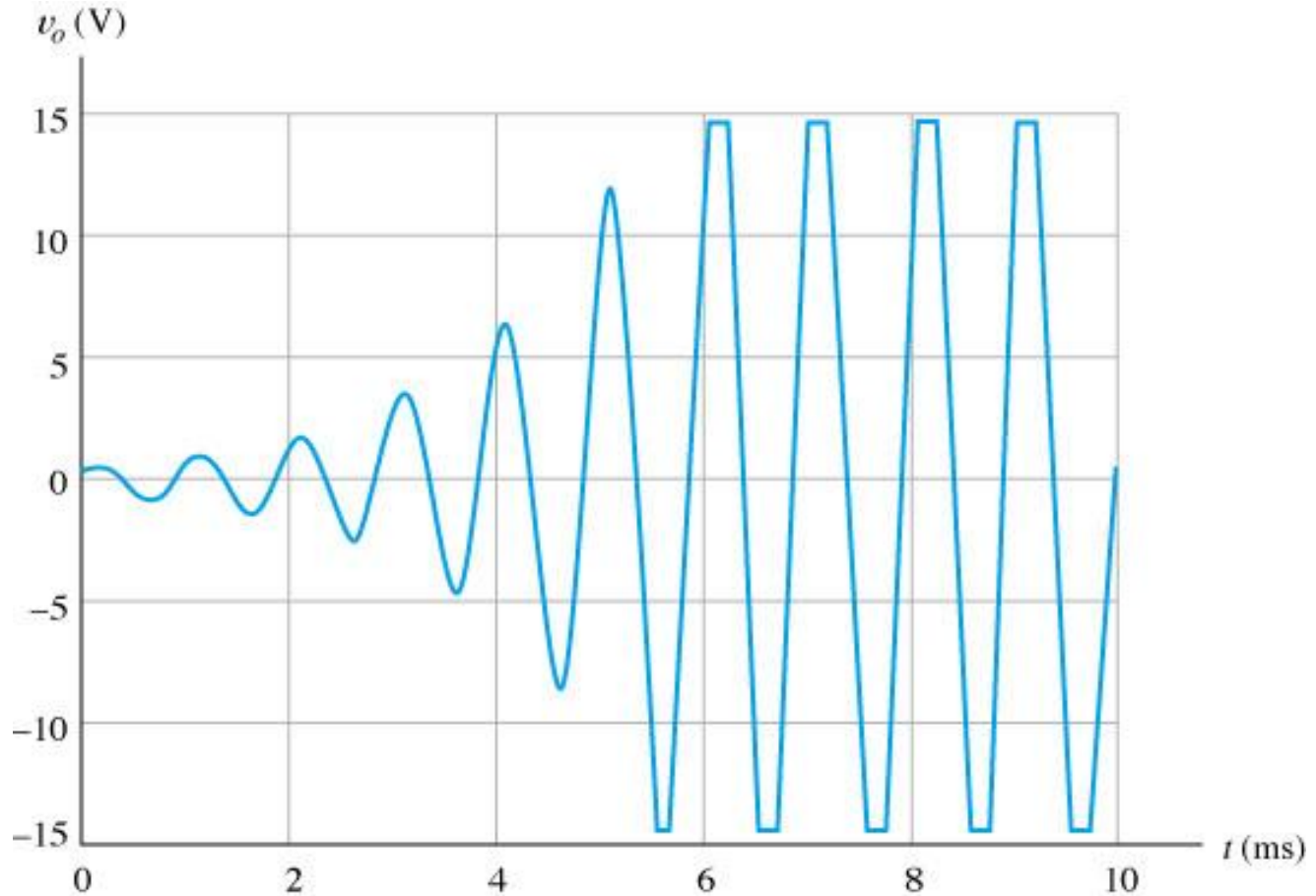


Figure 9.75 Example of output voltage of the oscillator.

Methods for Amplitude Stabilization

- In a linear oscillator, amplitude stabilization below the amplifier clipping level is needed to reduce distortion
- We can reduce the amount of distortion by reducing the amplifier gain
- However, if the gain becomes too small the oscillations die out
- Several approaches can be used to resolve the conflict
- The easiest approach is to make the gain adjustable by using a potentiometer in place of the resistors that determine the gain

HP way to Amplitude Stabilization

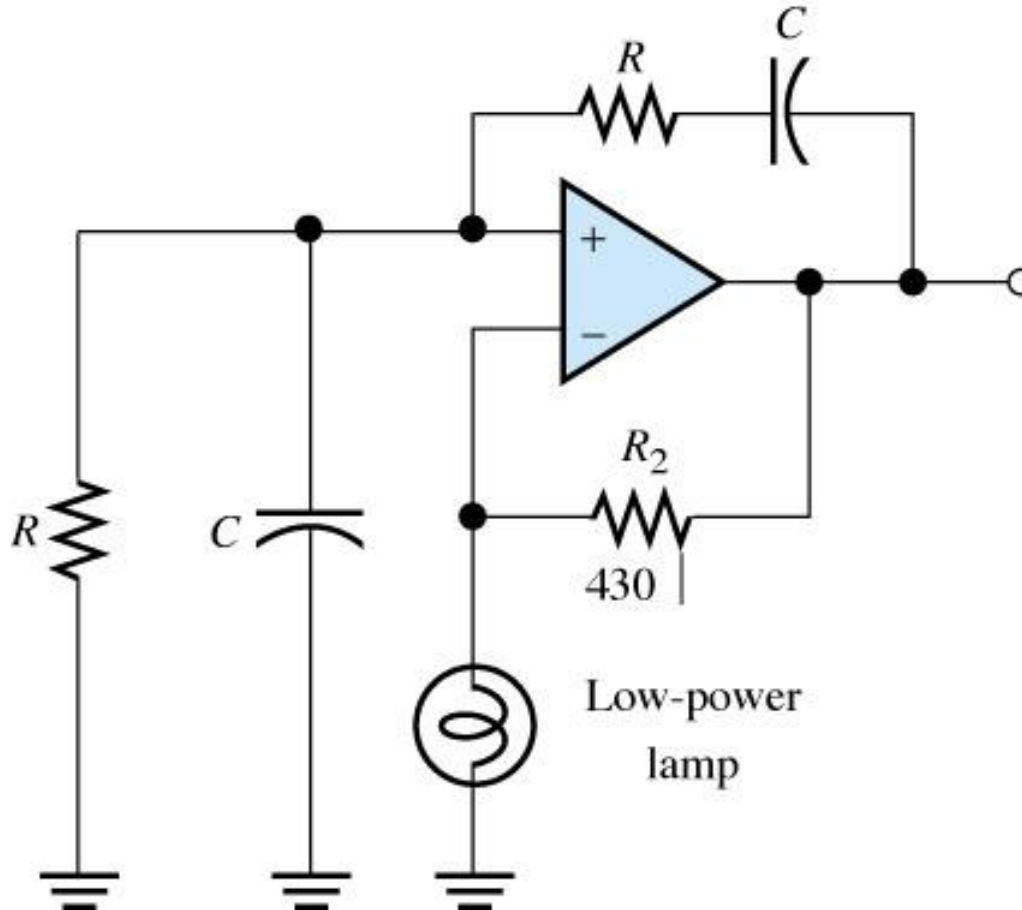


Figure 9.76 Oscillation amplitude can be stabilized within the linear range of the op amp by substituting a low-power lamp for R_1 .

Amplitude Stabilization with diodes

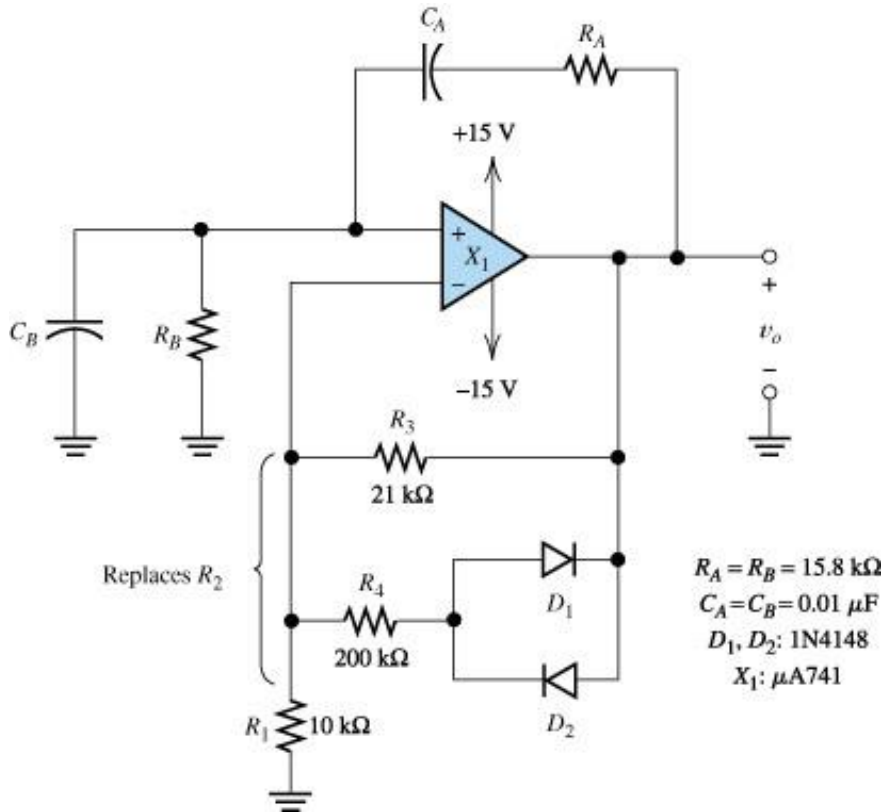


Figure 9.77 Amplitude stabilized Wien-bridge oscillator.

Amplitude Stabilization with diodes

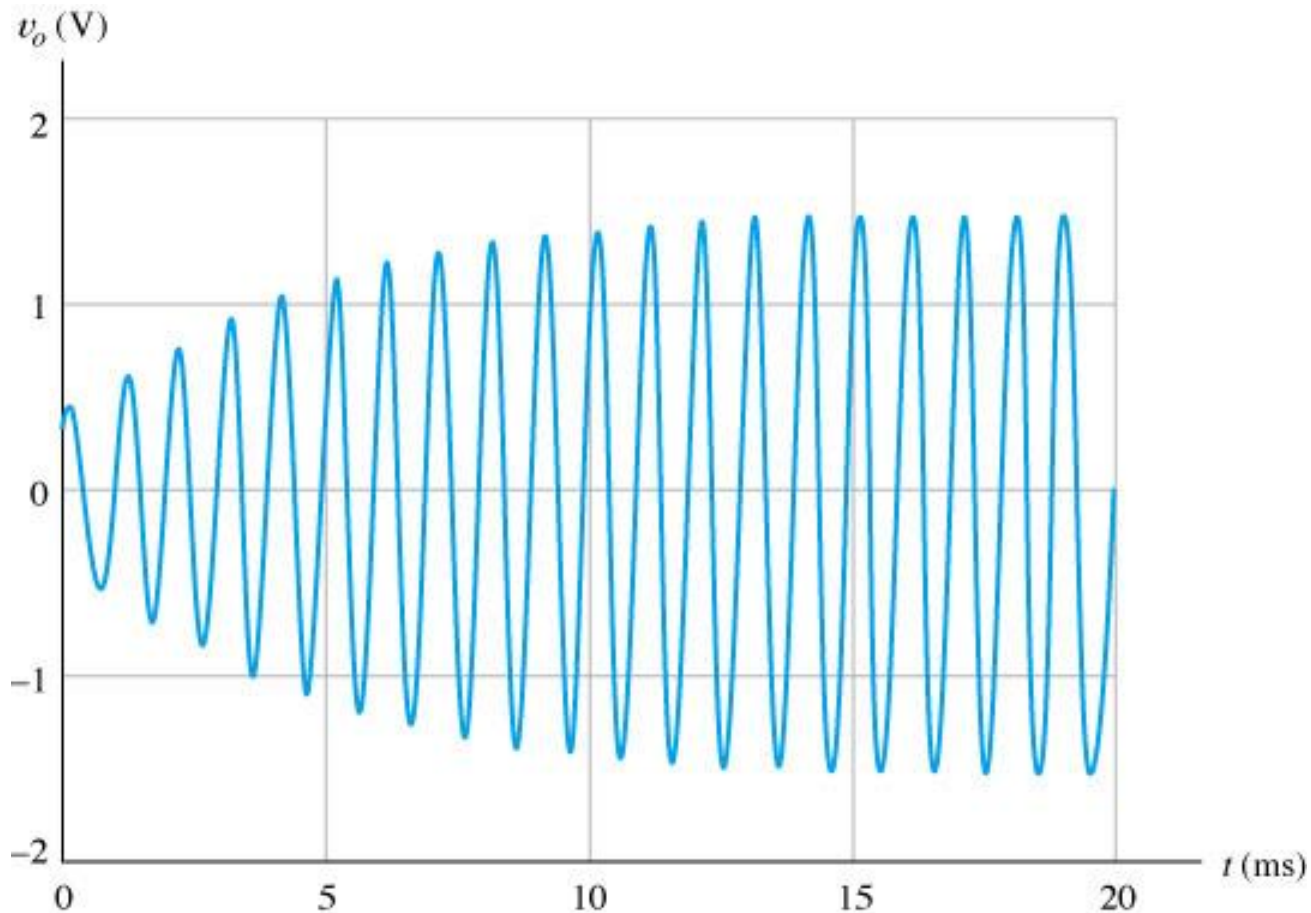


Figure 9.78 Output voltage of the oscillator of Figure 9.77.