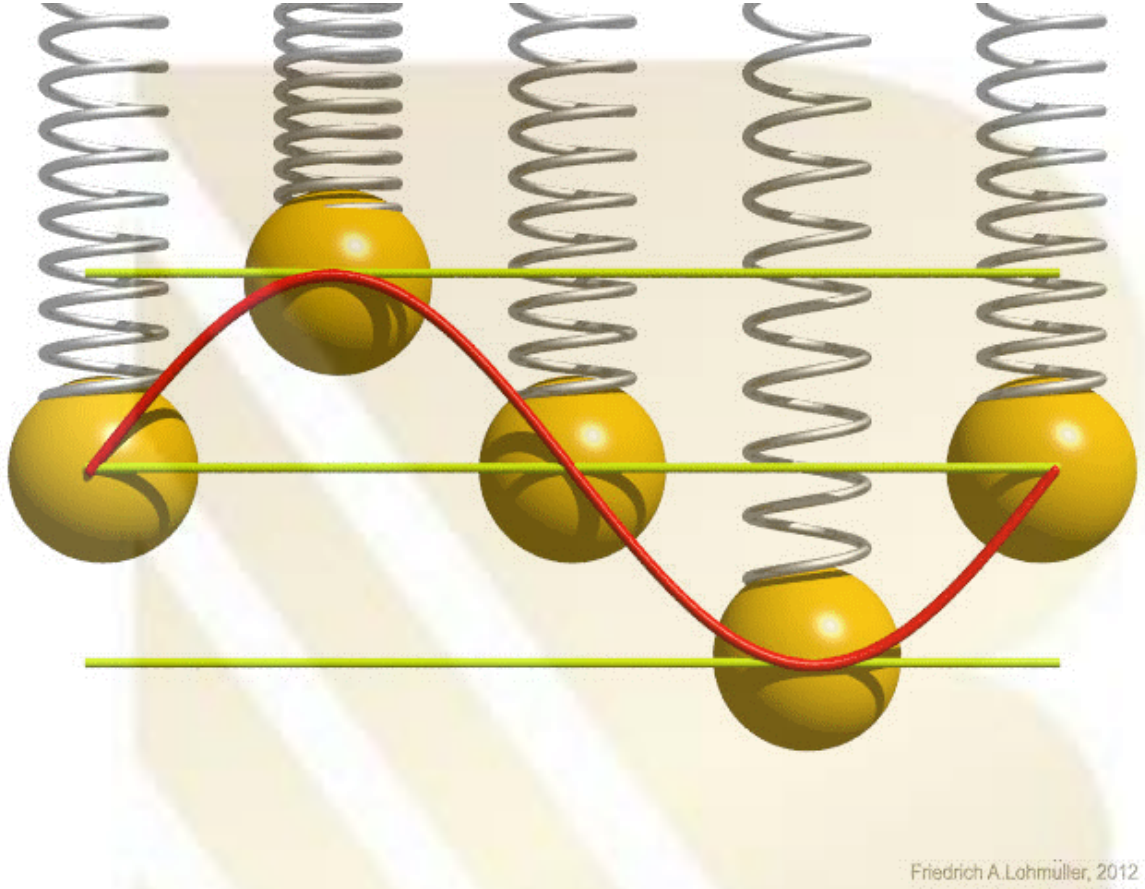


RF Components and Basic Concepts

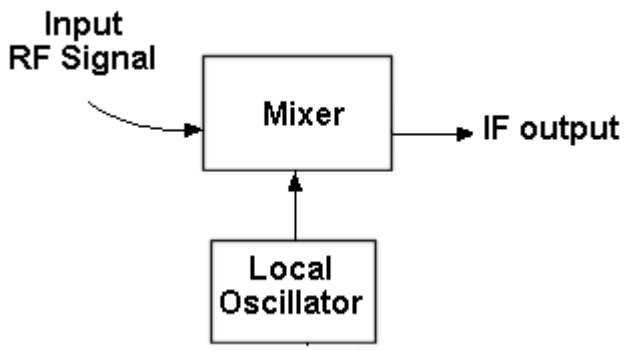
1.10 - Oscillator and Voltage Controlled Oscillator (VCO)

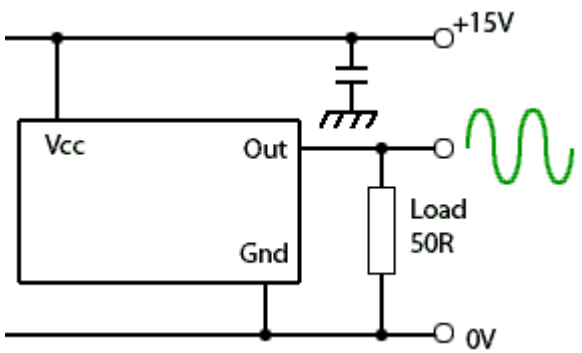
Oscillator

- An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a **sine wave** or a square wave.

- Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. They are widely used in many electronic devices.

We can view an oscillator as an amplifier that produces an output when there is no input.





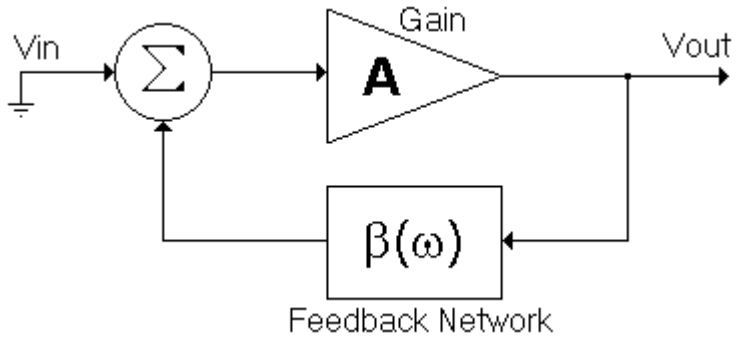
RF Oscillator Types

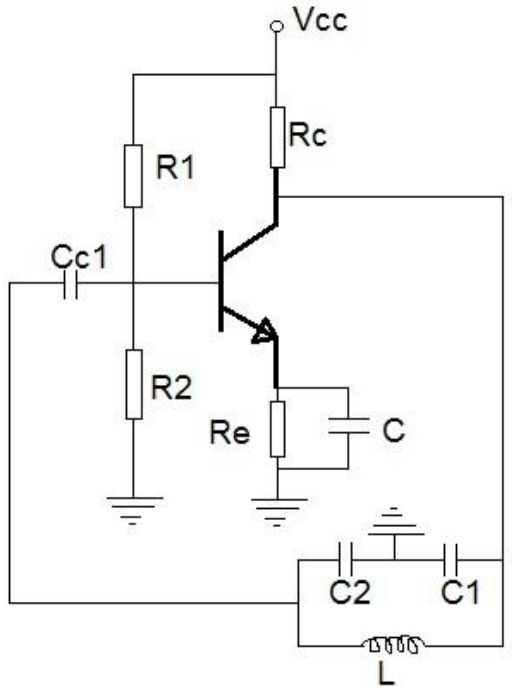
• Harmonic oscillators are used as RF oscillators and this class of circuits are capable of producing stable sinusoidal waveform with low phase noise.

1) Tuned Circuit Oscillators
2) RC oscillators
3) Crystal Oscillators
4) Negative resistance oscillators

Tuned Circuit Oscillators

A tuned oscillator uses a frequency-selective or tuned-circuit in the feedback path and is generally sinusoidal.

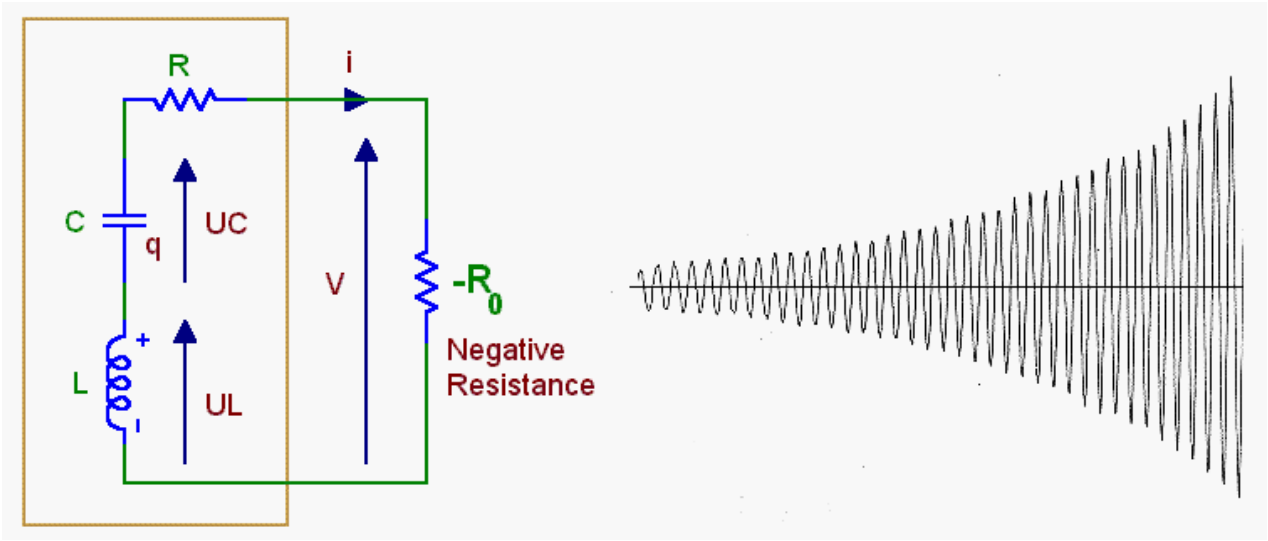


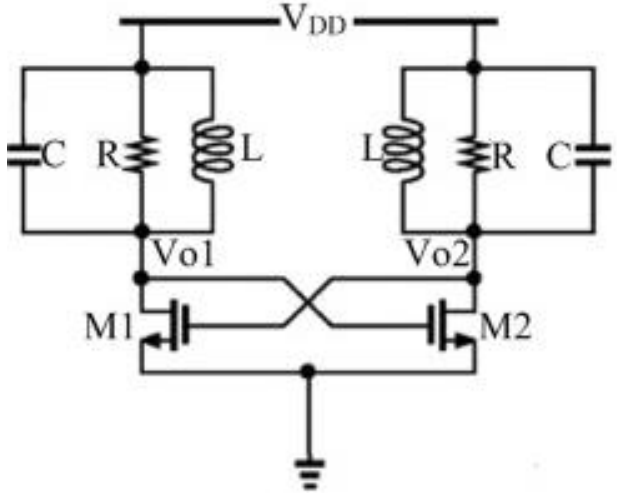


Colpitts Oscillator

Negative resistance oscillators

- Negative Resistance Oscillators





Harmonic oscillator circuits

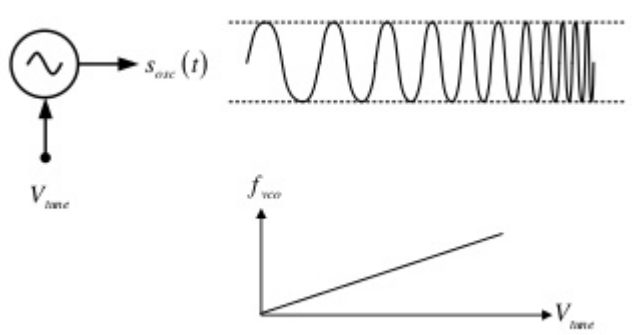
- Armstrong oscillator, a.k.a. Meissner oscillator
- Clapp oscillator
- Colpitts oscillator
- Cross-coupled oscillator
- Dynatron oscillator
- Hartley oscillator
- Opto-electronic oscillator
- Pierce oscillator
- Phase-shift oscillator
- Robinson oscillator
- Tri-tet oscillator
- Vackář oscillator
- Wien bridge oscillator

Device	Frequency
Triode vacuum tube	~1 GHz
Bipolar transistor (BJT)	~20 GHz
Heterojunction Bipolar Transistor (HBT)	~50 GHz
Metal Semiconductor Field Effect Transistor (MESFET)	~100 GHz
Gunn diode, fundamental mode	~100 GHz
Magnetron tube	~100 GHz
High Electron Mobility Transistor (HEMT)	~200 GHz
Klystron tube	~200 GHz
Gunn diode, harmonic mode	~200 GHz
IMPATT diode	~300 GHz
Gyrotron tube	~300 GHz

Voltage Controlled Oscillator

- A **voltage-controlled oscillator** or **VCO** is an electronic **oscillator** whose **oscillation** frequency is **controlled** by a **voltage** input.

- The applied input **voltage** determines the instantaneous **oscillation** frequency.



$$f(t) = f_0 + K_0 \cdot v_{\text{in}}(t)$$