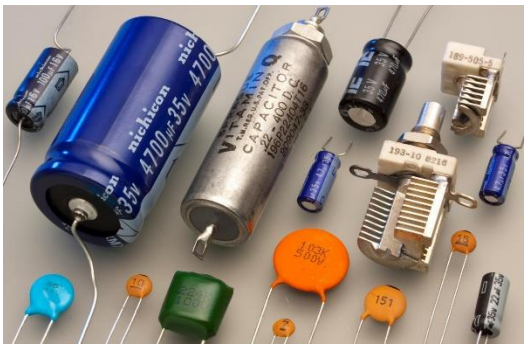
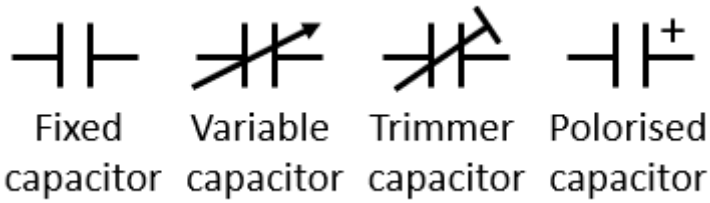
Chapter 2

Capacitors, Inductance and Resonance

Capacitors

Energy can be stored in an electrostatic field. This is called capacitance, and the device is a capacitor. Capacitor symbols are shown below. Capacitors are measured in Farads.





A capacitor is comprised of two conducting plates parallel to each other. These plates are separated by a non-conducting material called a dielectric. If a voltage potential is placed across these plates, the plates will achieve the same voltage as the power source. If the voltage source is removed. The capacitor will retain the charge and discharge over time. A capacitor blocks DC current,

The capacitance is dependent on the plate sizes, the separation of the plates and the dielectric material between the plates. Dielectrics can be any material such as paper, air, plastic, etc. These all impact the capacitance of the product.

Capacitor sizes

Prefix Name	Abbreviation	Weight	Equivalent Farads
Picofarad	pF	10-12	0.000000000001 F
Nano farad	nF	10-9	0.000000001 F
Microfarad	µF	10-6	0.000001 F
Milifarad	mF	10-3	0.001 F
Kilofarad	kF	103	1000 F

Types of capacitors

Ceramic capacitors –	The dielectric is ceramic and the plates are metal.
Electrolytic capacitors -	Electrolytic capacitors are polarized and must be connected to the voltage supply correctly.
Film capacitors -	Most common capacitor and are non-polarized.
Variable capacitors -	The capacitance is variable through a defined range.

Caution: Large capacitors in a circuit can hold a charge for a long period. Before handling large capacitors, short the terminals. Same applies to capacitors outside of a circuit.

Inductors

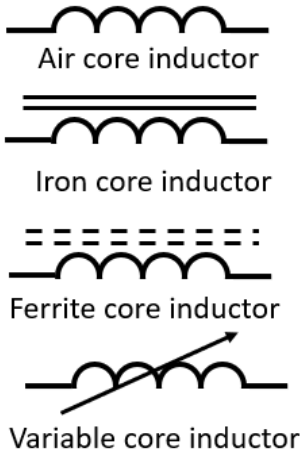
A coil can store electrical energy in a magnetic field and the device is an inductor, also called a coil, choke, or reactor. The inductance (L) of the device is measured in Henries (H). An inductor inhibits AC current.

The inductance of a coil depends on several factors.

- Coil diameter.
- Cross sectional area
- Number of turns
- Magnetic density
- Type of material at the core.

Symbols

Inductor symbols are shown below.



Back EMF

When the power to large inductors or coils is turned off, the field around the inductor collapses causing a large voltage in the opposite direction. This back voltage can be dangerous and is called Back EMF.

Reactance

Is the resistance a device imposes on the passage of alternating current and is measured in Ohms.

Capacitive Reactance (XC) is the opposition to the electric field in a capacitor.

Inductive Reactance (XL) is the opposition to the changing magnetic field in an inductor.

Impedance

All electric devices have some form of DC resistance. Impedance is the combination of the DC resistance and the reactance.

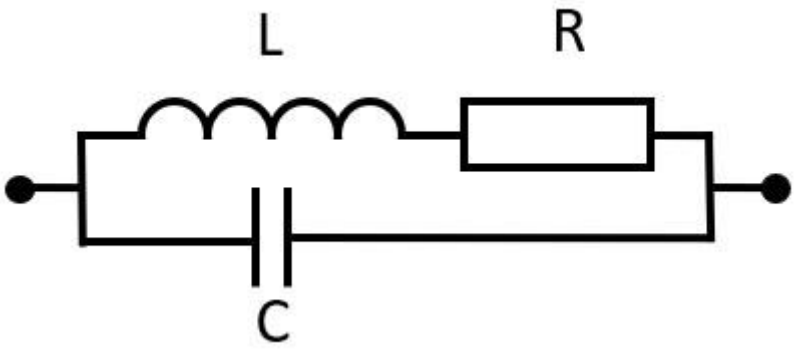
Resonance

Resonance occurs in an electric circuit at a particular frequency called the resonant frequency. Same as you strike a bell, the bell will resonate at the frequency of the bell.

Combine an inductor with a capacitor to make a potential resonant circuit. All combinations of capacitor sizes and inductor sizes in either series or parallel will resonate at their frequency.

In the circuit, the capacitor or the inductor can be variable to allow tuning across a range of frequencies.

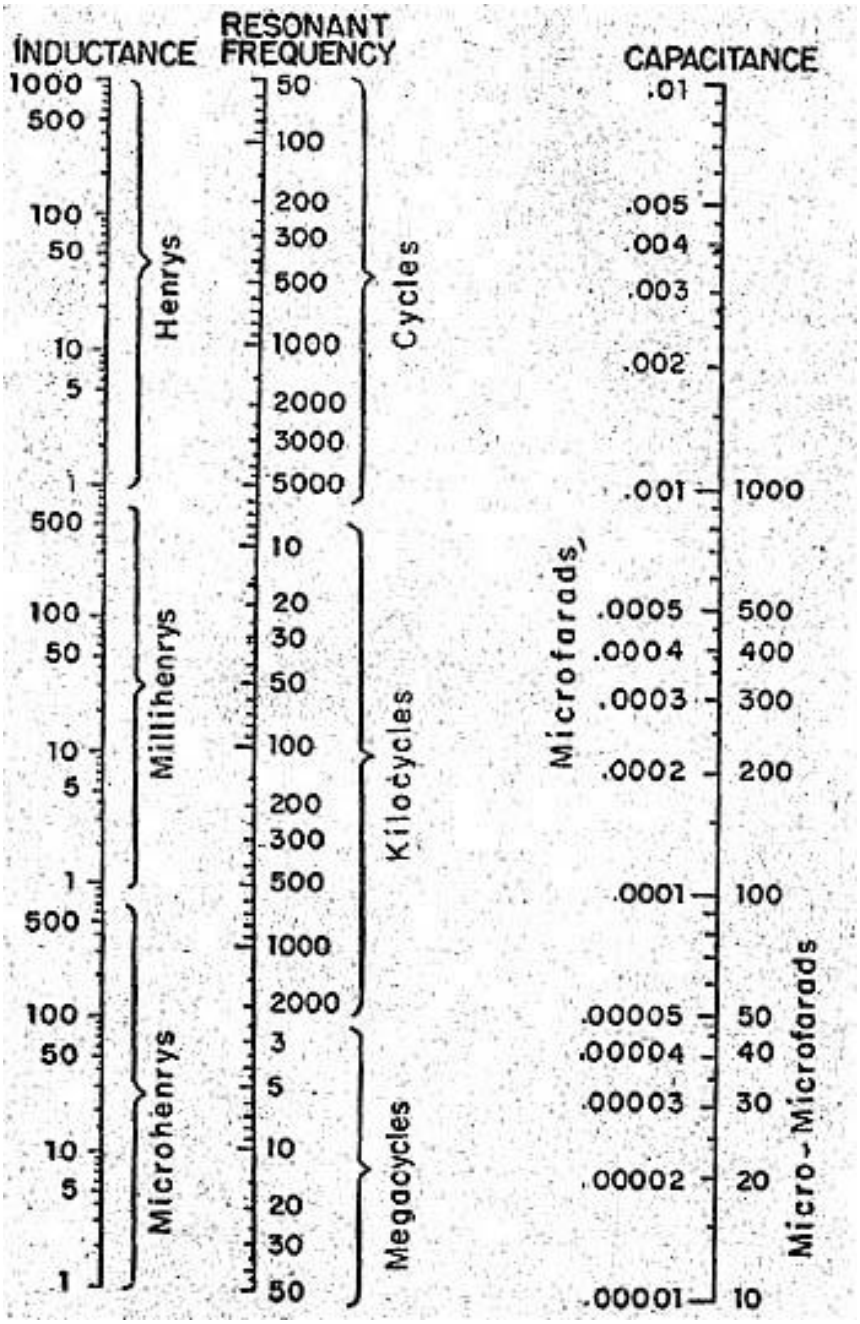
Voltages in tuned circuits can be high at resonant frequencies.



Parallel Tuned Circuit

Series Tuned Circuit

I found the following table in Coyne's Television and Radio Handbook P183. This gives a good starting point to match L and C for a particular frequency. Draw a straight line between the inductance and the capacitance. The approximate resonant frequency of these two devices is shown where the line crosses the frequency.



Go to Chapter 2 Questions.

Have fun and stay safe.

