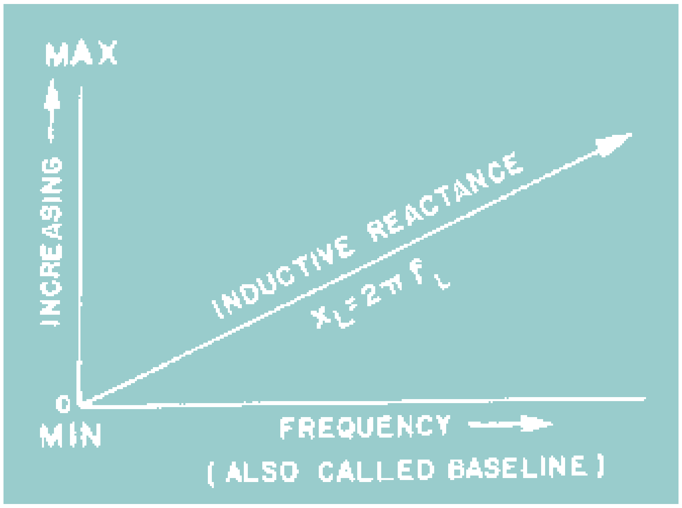
Summary of Series and Parallel LC Resonant Circuits



Effect of Frequency on Inductive Reactance (X_L)

When the inductive reactance:

$$X_L = 2\pi f L$$

Where:

X_L = the inductive reactance in ohms
f = the frequency in hertz
L = the inductance in henries
π = 3.1416

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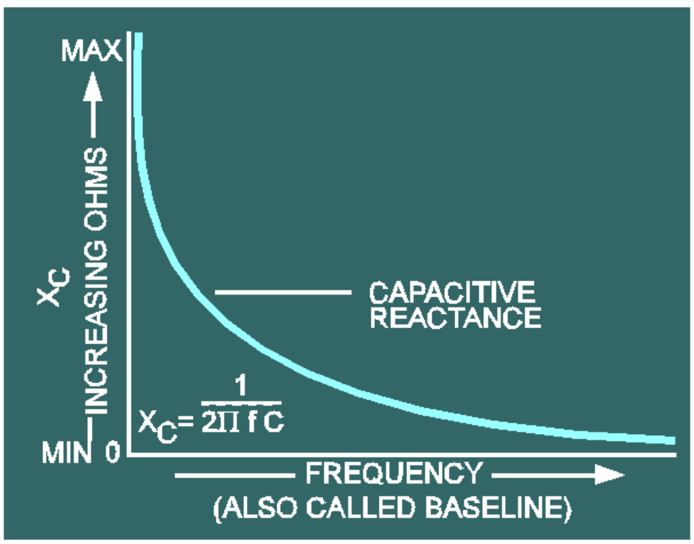

Effect of Frequency on Capacitive Reactance (X_C)

equals the capacitive reactance:

$$X_C = \frac{1}{2\pi f C}$$

Where:

X_C = the capacitive reactance in ohms
f = the frequency in hertz
C = the capacitance in farads
π = 3.1416

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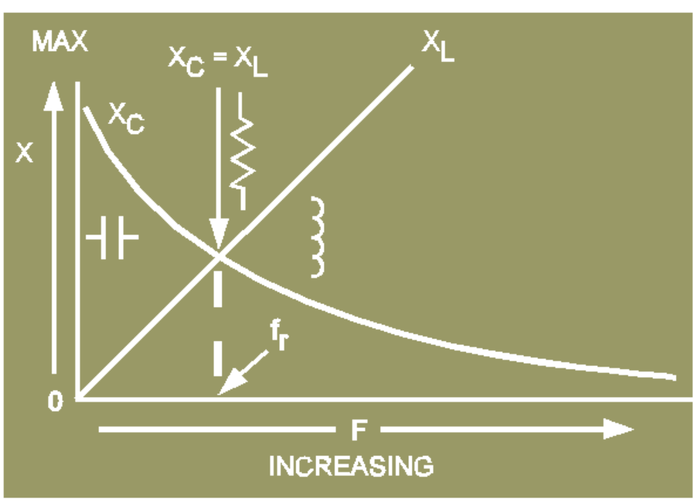
the impedance (X_L - X_C = Z)
Where: Z = Impedance in ohms.

X_L - X_C = Z = 0 = Resonance

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

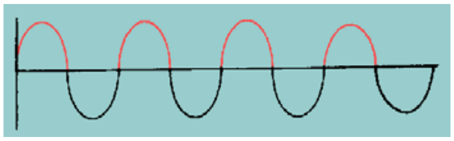
Where:

f_r = the resonant frequency in hertz
L = the inductance in henries
C = the capacitance in farads
π = 3.1416



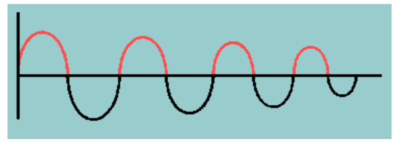
X_L - X_C = Z = 0 = Resonance
Gives the *Ideal* Condition but all circuits have resistance so *Z will never be 0*

Effect of Frequency on Impedance at Resonance where: X_L - X_C = Z = 0 = Resonance



Perfect Ideal Resonant Wave

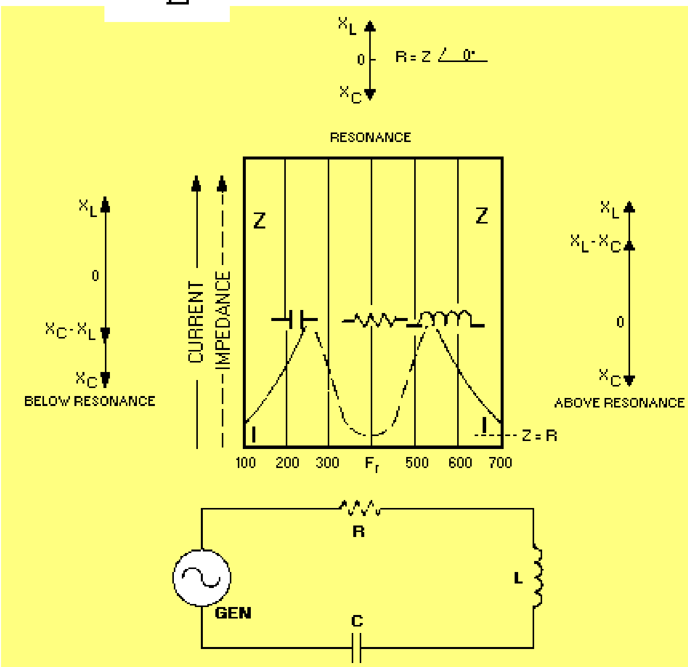
Where $I = \frac{E}{Z}$ and $Z = 0$



$$= \frac{X}{R}$$

Dampened Wave because of Resistance

Where $Q = \frac{X_L}{R}$ because X is mostly inductive



Impedance Curve for Series Resonant LRC Circuit

<u>Ideal</u> Series Resonant LRC= Infinite Voltage

<u>In Reality:</u> $X_L - X_C = Z = R$ = Resonance, where the minimum impedance;

Z = R

E = the input voltage to the tuned circuit

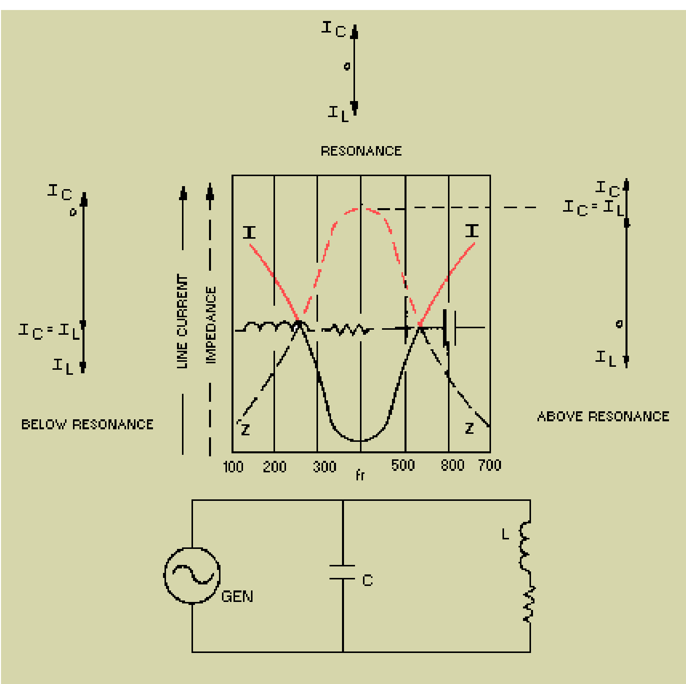
E_L = the voltage drop across the coil at resonance Q.

Q = the Q of the coil

Then:

$$E_L = EQ$$

Series Resonant Circuit = Max. Line Current and Max. Potential Gain.



Impedance Curve for Parallel Resonant LRC Circuit

<u>Ideal</u> Parallel Resonant LRC = Infinite Current

<u>In Reality:</u> $X_L - X_C = Z$ = Resonance, where the maximum impedance;

Z = L/CR

I_{LINE} = current drawn from the source

I_L = current through the coil (or circulating current)

Q = the Q of the coil

Then:

$$I_L = I_{LINE}\, Q$$

Parallel Resonant Circuit = Min. Line Current and Max. Circulating Current.

Qualities of a Series Resonant Circuit

QUANTITY	SERIES CIRCUIT
At resonance: Reactance ($X_L - X_C$)	Zero, because $X_L = X_C$
Resonant frequency	$f_r = \frac{1}{2\pi\sqrt{LC}}$
Impedance	Minimum: $Z = R$
I_{LINE}	Maximum value
I_L	I_{LINE}
I_C	I_{LINE}
E_L	$Q \cdot E_{LINE}$
E_C	$Q \cdot E_{LINE}$
Phase angle between E_{LINE} and I_{LINE}	0°
Angle between E_L & E_C	180°
Angle between I_L & I_C	0°
Desired value of Q	10 or more
Desired value of R	Low
Highest selectivity	High Q, low R, high $\frac{L}{C}$
When f is greater than f_r Reactance	Inductive
Phase angle between I_{LINE} and E_{LINE}	Lagging current
When f is less than f_r Reactance	Capacitive
Phase angle between I_{LINE} and E_{LINE}	Leading current

E = the input voltage to the tuned circuit

E_L = the voltage drop across the coil at resonance Q.

Q = the Q of the coil

Then:

$$E_L = EQ$$

Qualities of a Parallel Resonant Circuit

QUANTITY	PARALLEL CIRCUIT
At resonance : Reactance ($X_L - X_C$)	Zero; because nonenergy currents are equal
Resonant frequency	$f_r = \frac{1}{2\pi\sqrt{LC}}$
Impedance	Maximum: $Z = \frac{L}{CR}$
I_{LINE}	Minimum value
I_L	$Q \cdot I_{LINE}$
I_C	$Q \cdot I_{LINE}$
E_L	E_{LINE}
E_C	E_{LINE}
Phase angle between E_{LINE} and I_{LINE}	0°
Angle between E_L & E_C	0°
Angle between I_L & I_C	180°
Desired value of Q	10 or more
Desired value of R	Low
Highest selectivity	High Q, low R, $\frac{L}{C}$
When f is greater than f_r Reactance	Capacitive
Phase angle between I_{LINE} and E_{LINE}	Leading current
When f is less than f_r Reactance	Inductive
Phase angle between I_{LINE} and E_{LINE}	Lagging current

I_{LINE} = current drawn from the source

I_L = current through the coil (or circulating current)

Q = the Q of the coil

Then:

$$I_L = I_{LINE} Q$$

Extracted from www.tpub.com