근사화면 $\sqrt{1-(\frac{v}{c})^2} = 1$ $\frac{c}{c+v} = \frac{1}{1+\frac{v}{c}}$

$f' = \frac{1}{1+\frac{v}{c}} f$

$\Delta f = f' - f = \frac{1}{1 \pm \frac{v}{c}} f - f = \frac{1 - 1 \pm \frac{v}{c}}{1+\frac{v}{c}} f$

$\Delta f = \frac{-v}{c+v} f$ $c \gg v$ $\Delta f = \frac{\pm v}{c} f = v/\lambda$

원래 주파수 (λ)를 알고 속도를 알면 Δf를 계산 가능

⇒ Δf를 측정하면 λ를 확인하여 v를 측정.

* ~~LC~~ Inductive ~~Sensing~~ Sensing

⇒ LC 회로 (병렬) 공진을 활용하여 metal 재료 감지. Eddy's Current 활용

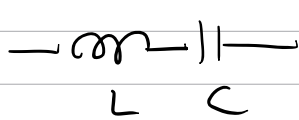
◦ 공진 (Reasonance) : 주파수 선택 특성

Band Pass or Band Rejection 특성

임피던스, 어드미턴스를 생각하수 있으나

임피던스를 기준으로 해야 보관성 유지

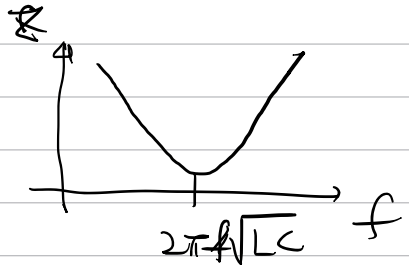
$Z = V/I$: 전압위상에서 전류위상으로 빼줌

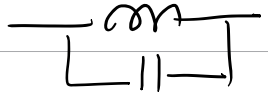


직렬연결 $j\omega L + \frac{1}{j\omega C} = 0$

$Z \to 0$ $\omega L = \frac{1}{\omega C}$ 이면 $0 =$

$\omega = \frac{1}{\sqrt{LC}} = 2\pi f$ $f = \frac{1}{2\pi\sqrt{LC}}$

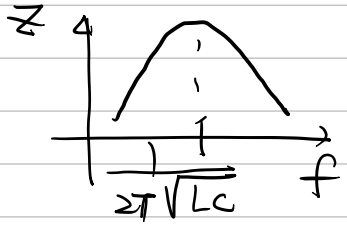




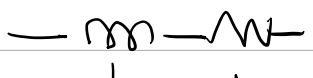
병렬연결 $\frac{1}{Z} = \frac{1}{j\omega L} + j\omega C$

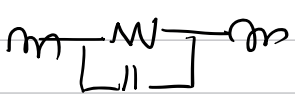
$= j\left(-\frac{1}{\omega L} + \omega C\right)$

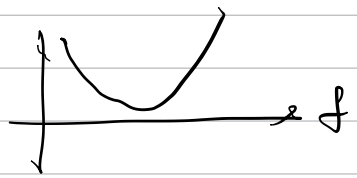
$\omega C - \frac{1}{\omega L} = 0$ $Z \to \infty$ $\omega = \frac{1}{\sqrt{LC}}$ $f = \frac{1}{2\pi\sqrt{LC}}$

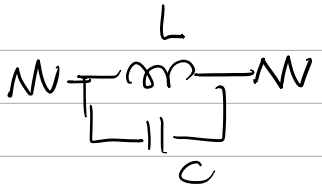


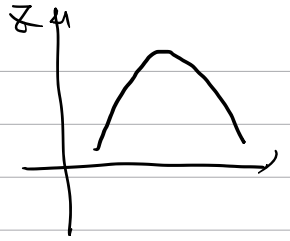
- 저주파 → 고주파로 변경시 회로특성 변경됨
  (lumped → distributed)
  (집중) (분포)

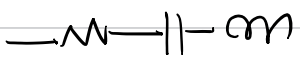
- wire 

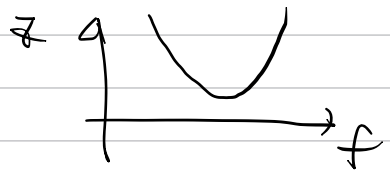
- Resistor 



- Inductor 



- Capacitor 

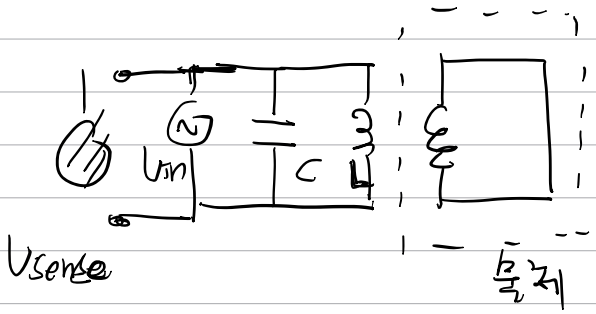


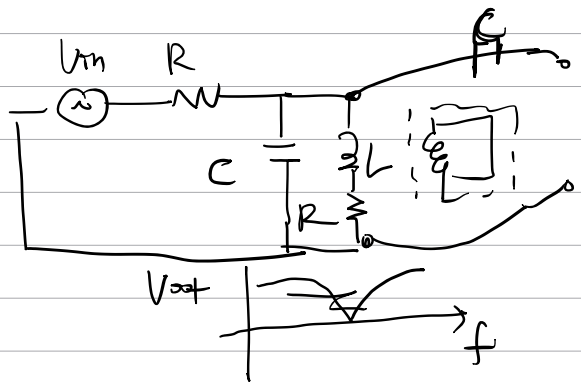
Self Reasonance Frequence 를 확인

L → C SRF 이전에는 Inductor 특성 →

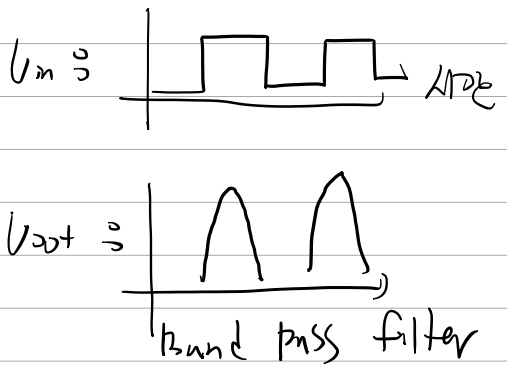
이후에는 Capacitor 특성

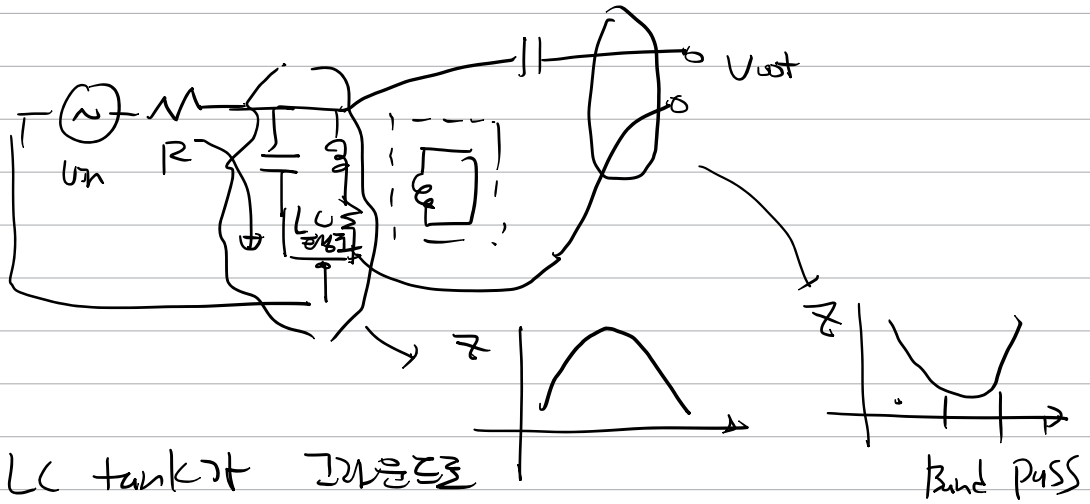
- Inductive Sensing은 LC tank를 활용





주파수 특성 개념





LC tank가 고역통과로

연결되어 있어 Band Pass filter로 동작.