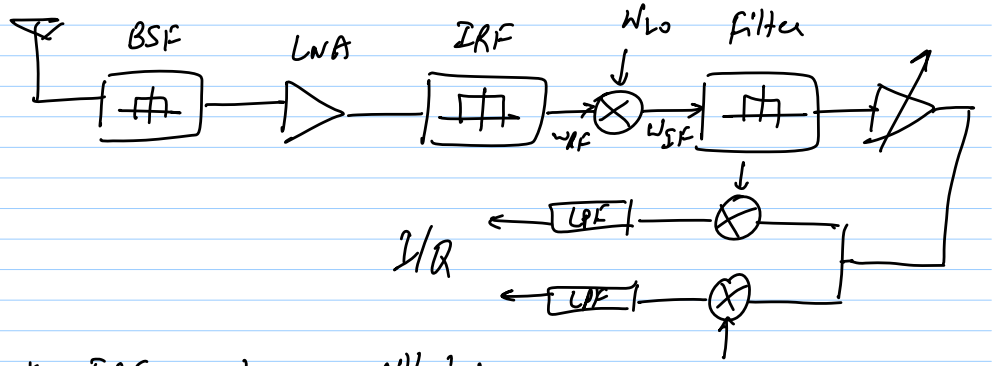
18/10/13

Lec 31

II Heterodyne Rx



* IRF - image filtering
* No DC offset / 1/f noise problems

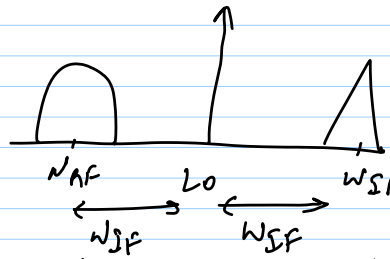
* high IF — easy IRF
  IF stage design is difficult

  low IF — easy IF design
  IRF is difficult (high Q)

trade-off between:
image rejection (sensitivity)
and channel selection (selectivity)

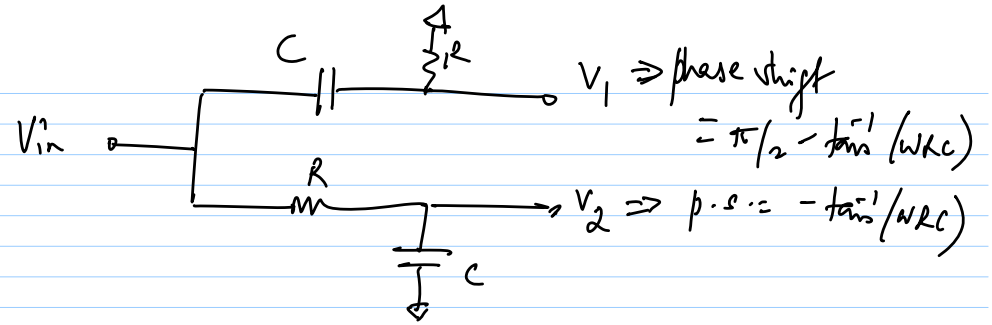
III Image-Reject Rx

* IRF - off-chip, bonding, 50Ω interface
* You want to process ω_{RF} & ω_{IM} differently



shift-by-$-90°$ = Hilbert Xfm

$x(t) = \sin\omega t \Longrightarrow -\cos\omega t$

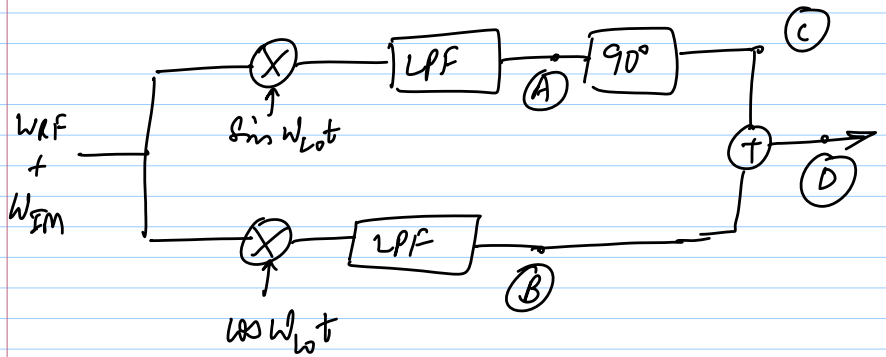


$V_1 \Rightarrow$ phase shift $= \pi/2 - \tan^{-1}(\omega RC)$

$V_2 \Rightarrow$ p.s. $= -\tan^{-1}(\omega RC)$

* V_1 & V_2 will have $\pm 45°$ phase shift
* Ampl. of V_1 & V_2 are equal only @ $\omega = \frac{1}{RC}$

1) Hartley Architecture



$x_{RF}(t) = A_{RF} \cos \omega_{RF} t$; $x_{IM}(t) = A_{IM} \cos \omega_{IM} t$

$x_A(t) = -\frac{A_{RF}}{2} \sin(-\omega_{LO} + \omega_{RF})t + \frac{A_{IM}}{2} \sin(\omega_{LO} - \omega_{IM})t$

$x_B(t) = \frac{A_{RF}}{2} \cos(\omega_{LO} - \omega_{RF})t + \frac{A_{IM}}{2} \cos(\omega_{LO} - \omega_{IM})t$

$x_C(t) = +\frac{A_{RF}}{2} \cos(\omega_{RF} - \omega_{LO})t - \frac{A_{IM}}{2} \cos(\omega_{LO} - \omega_{IM})t$

$x_D(t) = x_B(t) + x_C(t)$

$= A_{RF} \cos(\omega_{LO} - \omega_{RF})t$

* 90° phase shift distinguishes between RF & IM (polarity)

Issues:

* Amplitude matching
* 90° has to apply to ω_{RF} & ω_{IM}
* Mismatches

LO inputs $A_{LO} \sin \omega_{LO} t$

$(A_{LO} + \epsilon) \cos(\omega_{LO} t + \theta)$

* Image to signal Ratio $= \frac{\text{image power}}{\text{signal power}}$ @ some point in the ckt.

Image Rejection Ratio

$IRR = \frac{\text{image to signal ratio @ output}}{\text{" @ input}}$

2) Weaver Architecture