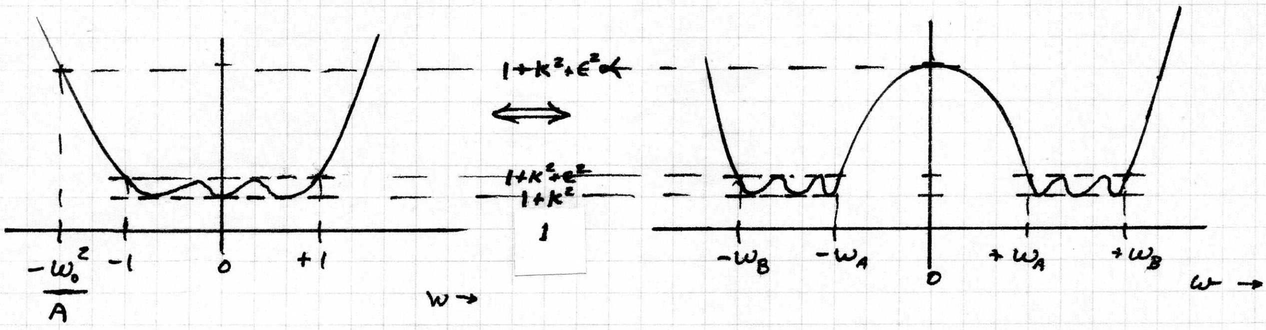
PSEUDO-BANDPASS : QUASI-LOWPASS / QUASI-HIGHPASS

CONSIDER THE MAPPING : $S = -j\left(\frac{s^2+\omega_0^2}{A}\right)$



LP	⇔	PSEUDO-BANDPASS (QUASI-LOWPASS CASE)
-1	⇔	$\pm\omega_A$
$+1$	⇔	$\pm\omega_B$
0	⇔	ω_0
$-\frac{\omega_0^2}{A}$	⇔	0

$s = \pm j\omega_A$

$$-j = -j\left(\frac{-\omega_A^2+\omega_0^2}{A}\right)$$

$$A - \omega_0^2 = -\omega_A^2$$

$$\omega_A^2 = \omega_0^2 - A \qquad \text{eq. 1.}$$

$s = \pm j\omega_B$

$$+j = -j\left(\frac{-\omega_B^2+\omega_0^2}{A}\right)$$

$$-A - \omega_0^2 = -\omega_B^2$$

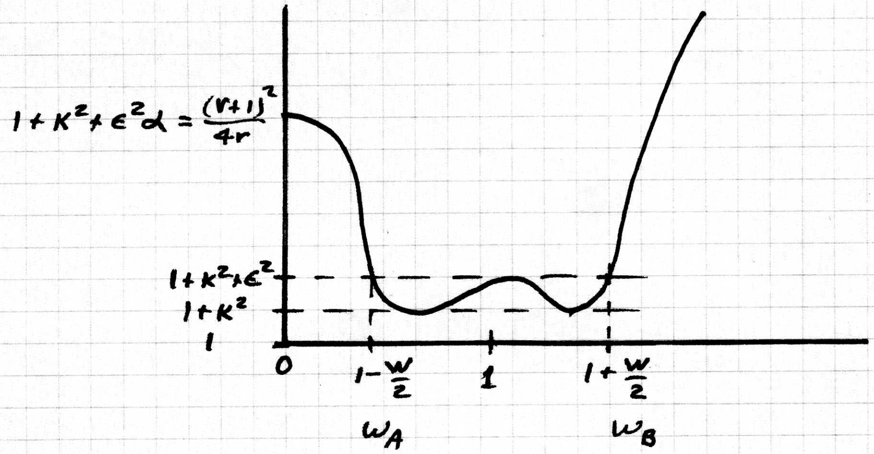
$$\omega_B^2 = \omega_0^2 + A \qquad \text{eq. 2.}$$

eq 1 + eq. 2 $\Rightarrow$ $\omega_0^2 = \frac{\omega_A^2+\omega_B^2}{2}$

eq. 2 − eq 1 $\Rightarrow$ $A = \frac{\omega_B^2-\omega_A^2}{2}$

$$\frac{\omega_A+\omega_B}{2}=1 \quad\Rightarrow\quad \omega_A = 1-\frac{W}{2}, \qquad \omega_B = 1+\frac{W}{2},$$

where $W = \dfrac{f_b - f_a}{\bar{f}}$, $\quad \bar{f} = \dfrac{f_a + f_b}{2}$.

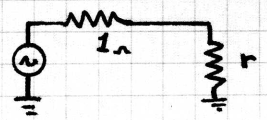


DC MISMATCH LOSS $\quad \lambda=0$

$$S = -j\,\frac{\omega_o^2}{A}$$

$$1+K^2+\epsilon^2\alpha = \left|IL_{LP}\left(\frac{-\omega_o^2}{A}\right)\right|^2 \;\underset{\text{MUST}}{=}\; \left|IL_{P.BP}(0)\right|^2$$

@ $\lambda=0$



$$\rho_{P.BP} = \frac{r-1}{r+1} \Rightarrow |\rho_{P.BP}|^2 = \frac{r^2-2r+1}{r^2+2r+1}.$$

$$|IL_{P.BP}|^2 = \frac{1}{1-|\rho|^2} = \frac{r^2+2r+1}{r^2+2r+1-r^2+2r-1} = \frac{r^2+2r+1}{4r}$$

$$|IL_{P.BP}|^2 = \frac{(r+1)^2}{4r}$$

$$1+K^2+\epsilon^2\alpha = \frac{(r+1)^2}{4r}$$

$$\epsilon^2\alpha = \frac{(r+1)^2}{4r} - K^2 - 1 = \frac{(r+1)^2-4r-4K^2r}{4r}$$

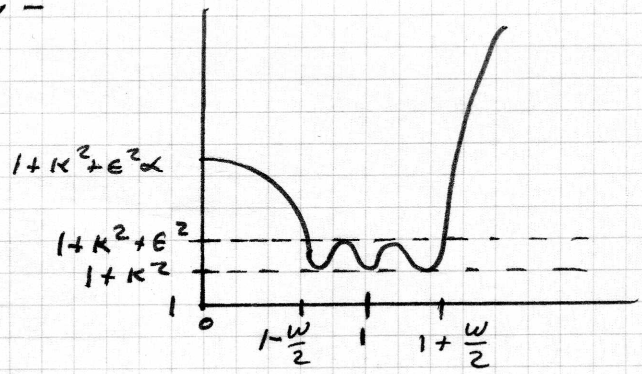
$$\epsilon^2 = \frac{(r-1)^2}{\alpha 4r} - \frac{K^2}{\alpha} \quad\Rightarrow\quad \epsilon \text{ is a function of } K.$$

(ie offset and ripple are not independent.)

NOTE THAT $\alpha = T_N^2\left(\frac{\omega_o^2}{A}\right) = \cosh^2\left(N\cosh^{-1}\left(\frac{\omega_o^2}{A}\right)\right)$.

So, $\epsilon = \sqrt{\left[\frac{(r-1)^2}{4r} - K^2\right] \Big/ \cosh^2\left(N\cosh^{-1}\left(\frac{\omega_o^2}{A}\right)\right)}$.

QUASI-LOWPASS RESPONSE – SUMMARY –



MAPPING : $S = -j\left(\dfrac{s^2+\omega_0^2}{A}\right)$

$A = \dfrac{\omega_B^2 - \omega_A^2}{2}$

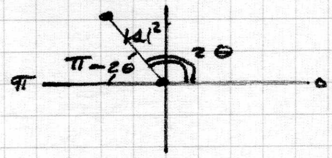
$\omega_0 = \sqrt{\dfrac{\omega_A^2+\omega_B^2}{2}}$

$W = \dfrac{f_b - f_a}{\bar{f}}$, $\bar{f} = \dfrac{f_b+f_a}{2}$ $\Rightarrow$ $W = \dfrac{2(f_b - f_a)}{f_b+f_a}$

$$\left.\begin{aligned}\omega_A &= 1 - \frac{W}{2}\\ \omega_B &= 1 + \frac{W}{2}\end{aligned}\right\} \quad \omega_{MEAN} = \frac{\omega_A+\omega_B}{2} = 1$$

$\Rightarrow$ DENORMALIZE WRT $2\pi\dfrac{(f_b+f_a)}{2} = \pi(f$

INVERSE MAPPING :



$$AjS = s^2 + \omega_0^2$$
$$Aj(\sigma + jW) = s^2 + \omega_0^2$$
$$jA\sigma - AW - \omega_0^2 = s^2$$
$$s^2 = jA\sigma - (AW + \omega_0^2)$$

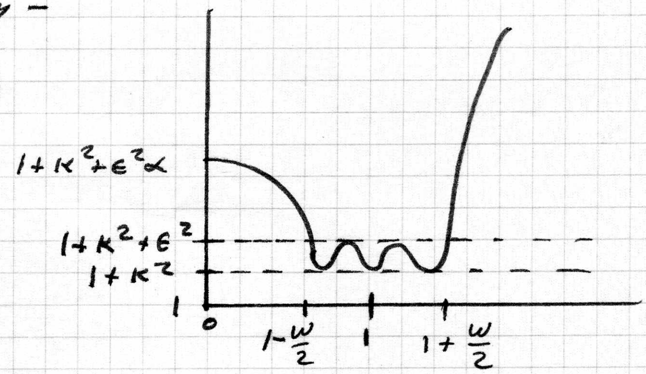
NOTE: SECOND QUADRAN

$$|s^2| = \sqrt{(A\sigma)^2 + (AW+\omega_0^2)^2}\ .$$
$$|s| = \sqrt[4]{(A\sigma)^2 + (AW+\omega_0^2)^2}\ .$$

$$2\theta = \tan^{-1}\left[\frac{A\sigma}{-(AW+\omega_0^2)}\right] + \pi$$

$$\theta = -\frac{1}{2}\tan^{-1}\left(\frac{A\sigma}{AW+\omega_0^2}\right) + \frac{\pi}{2}$$

QUASI · LOWPASS RESPONSE – SUMMARY –



MAPPING :

$$S = -j\left(\frac{s^2+\omega_0^2}{A}\right)$$

$$A = \frac{\omega_B^2-\omega_A^2}{2}$$

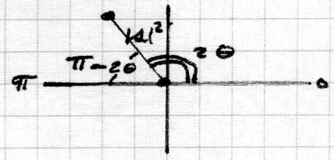
$$\omega_0 = \sqrt{\frac{\omega_A^2+\omega_B^2}{2}}$$

$$W = \frac{f_b-f_a}{\bar{f}}\ , \quad \bar{f} = \frac{f_b+f_a}{2} \Rightarrow W = \frac{2(f_b-f_a)}{f_b+f_a}$$

$$\left.\begin{aligned} \omega_A &= 1-\frac{W}{2} \\ \omega_B &= 1+\frac{W}{2} \end{aligned}\right\} \quad \omega_{MEAN} = \frac{\omega_A+\omega_B}{2} = 1$$

$\Rightarrow$ DENORMALIZE WRT $2\pi\frac{(f_b+f_a)}{2} = \pi(f_b$

INVERSE MAPPING :



$$AjS = s^2+\omega_0^2$$

$$Aj(\sigma+j\omega) = s^2+\omega_0^2$$

$$jA\sigma - A\omega - \omega_0^2 = s^2$$

$$s^2 = jA\sigma - (A\omega+\omega_0^2)$$

$$|s^2| = \sqrt{(A\sigma)^2+(A\omega+\omega_0^2)^2}\ .$$

$$|s| = \sqrt[4]{(A\sigma)^2+(A\omega+\omega_0^2)^2}\ .$$

NOTE: SECOND QUADRAN

$$2\theta = \tan^{-1}\left[\frac{A\sigma}{-(A\omega+\omega_0^2)}\right] + \pi$$

$$\theta = -\frac{1}{2}\tan^{-1}\left(\frac{A\sigma}{A\omega+\omega_0^2}\right) + \frac{\pi}{2}$$