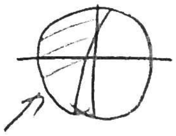
464 HW6

② $C_L = 8 \angle -15^\circ$
$r_L = 8.3$



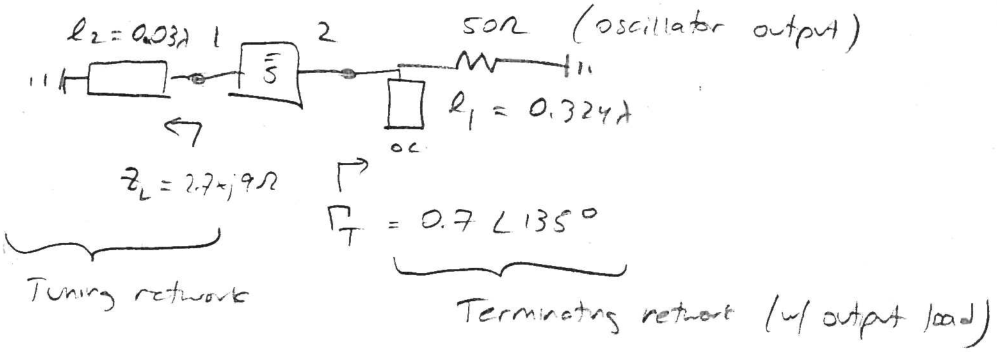
unstable region for Γ_T

→ Any Γ_T in this region will work. Let's choose a value on the $1+jb$ circle, so we can match with just a stub: $\Gamma_L = 0.7 \angle 135^\circ$ (other values ok)

With this Γ_T, $Z_{in} = -8 - j9\,\Omega$

$\Rightarrow \quad Z_L = 2.7 + j9\,\Omega$

Final circuit:

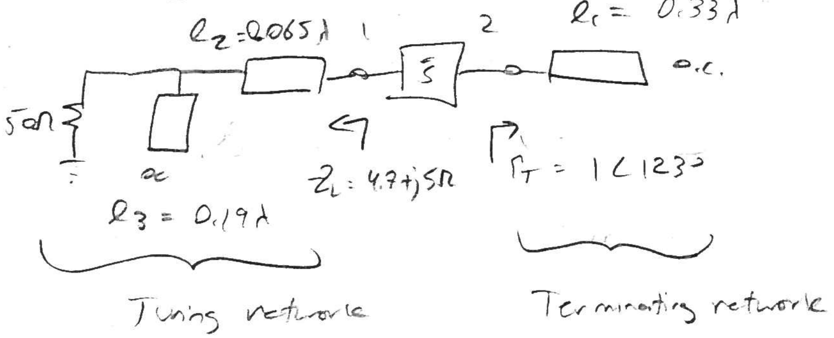


③ Γ_{in} circle for $|\Gamma_T| = 1 \Rightarrow C_{in} = 1.07 \angle -167^\circ$
$r_{in} = 0.7$
$\rightarrow \Gamma_{in,max} = 1.8 \angle -170^\circ$

$\Rightarrow \Gamma_T = 1 \angle 123^\circ$

With this Γ_T, $Z_{in} = -14 - j5\,\Omega$

$\Rightarrow Z_L = 4.7 + j5\,\Omega$



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④ $$I = \underbrace{I_0 + v/R_j}_{\text{unwanted}} + \underbrace{v^2\,\alpha/2R_j}_{\text{mixing term}}$$

$$\frac{\alpha}{2R_j}\left(A(1+m\cos\omega_m t)\cos\omega_0 t\right)^2$$

$$= \text{"} \quad \text{"} + \frac{\alpha}{2R_j}A^2\left(1 + 2m\cos\omega_m t + m^2\cos\omega_m t\right)\left(\tfrac{1}{2} + \tfrac{1}{2}\cos 2\omega_0 t\right)$$

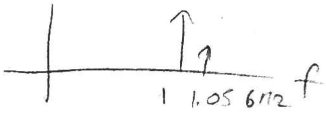
this product is the demodulated signal

⑤ Lo = 1800 ± 87 MHz

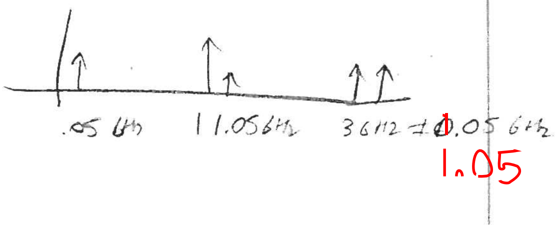
Image for 1887 MHz = 1887 + 87 MHz

Image for 1800 − 87 MHz = 1800 − 2·87 MHz

⑥ Input:

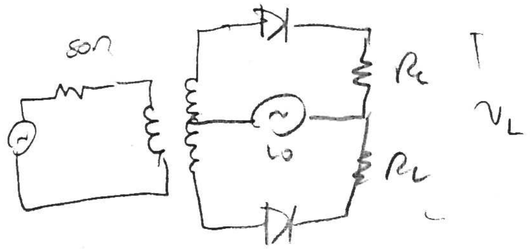


Output:



444 HW6

⑦



Output

$v_L > 0$

Diodes on

$v_L = 2v_i$

$$\rightarrow \quad S(t) = \begin{cases} 1 & v_L \geq 0 \\ 0 & v_L < 0 \end{cases}$$

$v_L < 0$

Diodes off

$v_L = 0$

$$v_L = 2V_i \cos\omega_i t \; S(t)$$

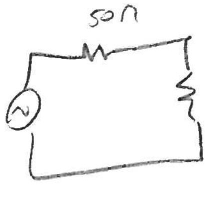
$$= 2V_i \cos\omega_i t \left[\frac{1}{2} + \frac{2}{\pi}\sum_{n=1}^{\infty} \frac{1}{n} \sin\frac{n\pi}{2} \cos n\omega_L t \right]$$

$$= \frac{2v_i}{2}\cos\omega_i t + \frac{4v_i \cos\omega_i t}{\pi} \sum \frac{1}{n} \sin\frac{n\pi}{2} \cos n\omega_L t$$

$$= \quad " \quad + \overbrace{\frac{2v_i}{\pi}\cos(\omega_L - \omega_i)t}^{\text{desired mixer output}} + \overbrace{\cdots}^{\text{other terms}}$$

$$\Rightarrow P_o = \frac{|v_L|^2}{2(2R_L)} = \frac{|2v_i/\pi|^2}{4R_L} = \frac{|v_i|^2}{\pi^2 R_L} \rightarrow$$ power to load for desired term

Input



$$R_{in} = \frac{v_i}{i_i} = \frac{v_i}{\frac{n_2}{n_1}\frac{v_i}{R_L}} = \frac{v_i}{2\frac{v_i}{R_L}} = \frac{R_L}{2}$$

(equivalent resistance looking into transformer primary)

$$P_{in} = \frac{|v_i|^2}{2 \cdot \frac{R_L}{2}}$$

Conversion loss

$$\frac{P_o}{P_{in}} = \frac{\frac{|v_i|^2}{\pi^2 R_L}}{\frac{|v_i|^2}{R_L}} = \frac{1}{\pi^2} \rightarrow -10 \text{ dB}$$