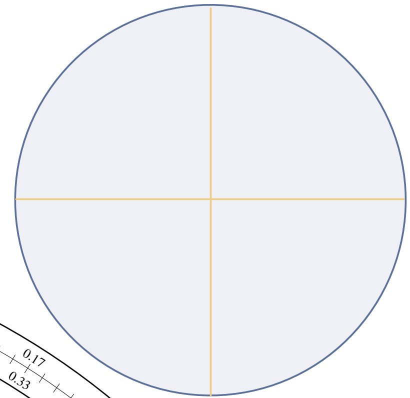
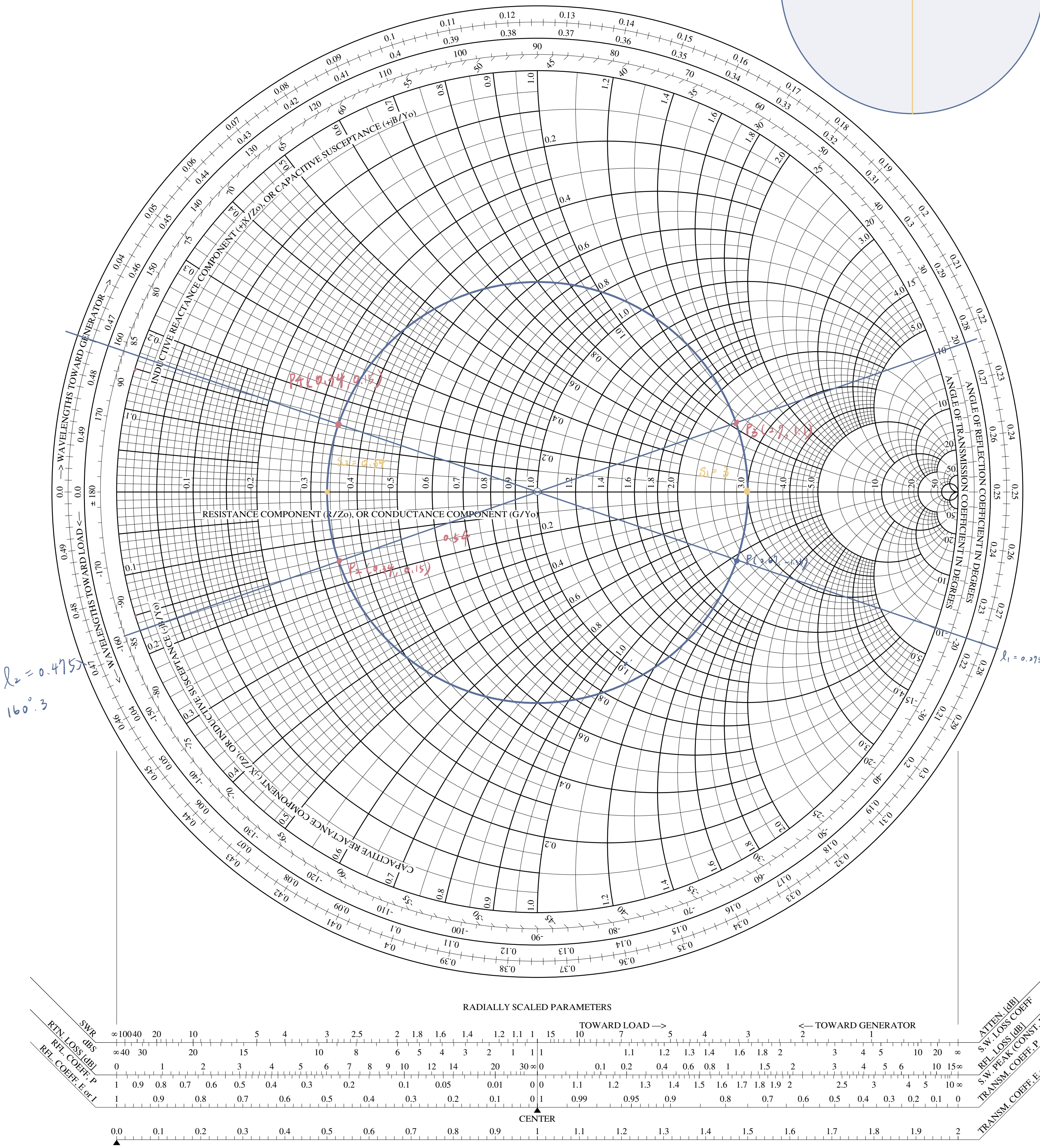
The Complete Smith Chart

Black Magic Design





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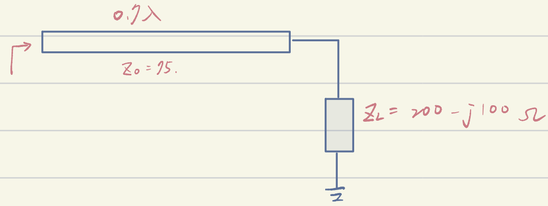
Problem 6

[Using Smith chart] Given a series RC load with an impedance $Z_L = 200 - j100\ \Omega$ and to a 75-Ω, 0.7λ transmission line at a frequency of 500 MHz. "Use Smith chart" to evaluate (describe all the steps in details): (a) VSWR and the reflection coefficient at input of the line, (b) the input impedance Z_{in} looking into this line and its corresponding Y_{in} at the input, (c) the distance of first voltage minimum from the load. (d) inserted a shunt short-circuited stub at the load to make a 'real' reflection coefficient (no imaginary part), find the minimum required length of the stub section and (e) the corresponding VSWR.

Answers:
(a) VSWR = 3.42; Γ_{IN} =… (b) Z_{IN} =… - j10.4 Ω ; Y_{IN} = …;
(c) 0.224λ; (d) …; (e) VSWR = 10/3



a. 1° $z_n = \frac{Z_L}{Z_0} = \frac{200-j100}{75} = 2.67 - 1.33j \Rightarrow P_1(2.67, -1.33j)$.

2° By smith chart：以 P_1 為圓心，$\overline{OP_1}$ 為半徑的圓交實軸於 $\begin{cases} S_1(3, 0) \\ S_2(0.34, 0) \end{cases}$

∴ VSWR ≒ 3.4

$0.275\lambda + 0.7\lambda \Rightarrow \underbrace{0.475\lambda}_{l_2} + 0.5\lambda$

3° By smith chart：O 連線至 l_2 處，交 P_2 ⇒ $\Gamma_{in} = \overline{OP_2} \angle 160.3^\circ$

4° From 比例尺：$\overline{OP_2} = 0.54 \Rightarrow \Gamma_{in} = 0.54 \angle 160.3^\circ$

b 1° $P_2(0.34, -0.15) \Rightarrow Z_{in} = Z_0(0.34, -0.15) = 25.5 - j11.25\ (\Omega)$

2° By smith chart：$P_3(2.7, 1.1) \Rightarrow Y_{in} = (2.7 + j1.1) Z_0 = 202.5 + 82.5j\ (S)$

c. $0.5\lambda - 0.275\lambda = 0.225\lambda$

shunt stub 提供 $-j0.15$

d. By smith chart：$P_4(0.34, 0.15) \Rightarrow Y = (0.34, 0) = \overrightarrow{OP_4} + (0, -0.15)$

length of $-j0.15$：$0.475 \Rightarrow d_{min} = 0.475\lambda - 0.25\lambda = 0.225\lambda$

e. $VSWR(-0.7\lambda) = \frac{|1+\Gamma(-0.7\lambda)|_{max}}{|1-\Gamma(-0.7\lambda)|_{min}} = \frac{1}{0.3} = \frac{10}{3}$

↓

$\frac{1+|\Gamma_L'|}{1-|\Gamma_L'|}$