LISTA 2

1) $p(l) = \frac{0 - Z_0}{0 + Z_0} = -1$ $\qquad Z_0 Y_{in} = \frac{1 - p(0)}{1 + p(0)} = j0,5 = \frac{1 + e^{-j4\pi l}}{1 - e^{-j4\pi l}}$

$p(0) = -e^{-j2\beta l}$ $\qquad l = \frac{2\pi n - j\ln\left(-\frac{3}{5} - \frac{4}{5}j\right)}{4\pi}$, $n \in \mathbb{Z}$

$l \approx 0,079577\,5\,(6,28319(n+1) - 0,2143) \approx \left(0,3238 + \frac{n}{2}\right) m$, $n \in \mathbb{Z}$

2) $V_1 = V_2^+ e^{\gamma L} + V_2^- e^{-\gamma L}$

$I_1 = \frac{1}{Z_0}\left[V_2^+ e^{\gamma L} - V_2^- e^{-\gamma L}\right]$

$$\begin{bmatrix} V_2 \\ I_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1/Z_0 & -1/Z_0 \end{bmatrix} \begin{bmatrix} V_2^+ \\ V_2^- \end{bmatrix} \Leftrightarrow \begin{bmatrix} V_2^+ \\ V_2^- \end{bmatrix} = \begin{bmatrix} 1/2 & Z_0/2 \\ 1/2 & -Z_0/2 \end{bmatrix} \begin{bmatrix} V_2 \\ I_2 \end{bmatrix}$$

$V_1 = e^{\gamma L}\left(V_2/2 + Z_0 I_2/2\right) + e^{-\gamma L}\left(V_2/2 - Z_0 I_2/2\right)$

$I_1 = e^{\gamma L}\left(\frac{V_2}{2Z_0} + \frac{I_2}{2}\right) + e^{-\gamma L}\left(\frac{I_2}{2} - \frac{V_2}{2Z_0}\right)$

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} e^{\gamma L} + e^{-\gamma L} & Z_0\left(e^{\gamma L} - e^{-\gamma L}\right) \\ \frac{1}{Z_0}\left(e^{\gamma L} - e^{-\gamma L}\right) & e^{\gamma L} + e^{-\gamma L} \end{bmatrix} \begin{bmatrix} V_2 \\ I_2 \end{bmatrix} = \begin{bmatrix} \cosh(\gamma L) & Z_0 \sinh(\gamma L) \\ \frac{\sinh(\gamma L)}{Z_0} & \cosh(\gamma L) \end{bmatrix} \times \begin{bmatrix} V_2 \\ I_2 \end{bmatrix}$$

3) a) $z_e = \frac{225}{75} = 3$ $\qquad p(l) = 0,5$ $\qquad COE = 3$

b) $z_e = 1$ $\qquad p(l) = 0$ $\qquad COE = 1$

c) $z_e = 0,2$ $\qquad p(l) = -0,65$ $\qquad COE = 5$

d) $z_e = j0,6$ $\qquad |p(l)| = 1$ $\qquad COE = \infty$

e) $z_e = j3$ $\qquad |p(l)| = 1$ $\qquad COE = \infty$

f) $z_e = 0,6 + j1,6$ $\qquad |p(l)| = 0,71$ $\qquad COE = 6$

4) $z_e = 1 + j1$ $\qquad |p(l)| = 0,45$ $\qquad COE = 2,6$

a) $z_0 = 2 + j1$ $\qquad Z_0 = 150 + j75\ \Omega$

4) b) $z_0 = 0,5 + j0,5$ $\quad Z_0 = 37,5 + j37,5\ \Omega$

c) $z_0 = 0,6 + j0,65$ $\quad Z_0 = 45 + j48,75\ \Omega$

d) $z_0 = 1 + j1$ $\quad Z_0 = 75 + j75\ \Omega$

e) idem acima

f) $L = \frac{\lambda}{4}(n+1) - 0,162\lambda = 0,088\lambda + \frac{\lambda}{4}n, \quad n \in \mathbb{Z}$

5) a) $\rho_L = \frac{50 + j162,5 - 125}{50 + j162,5 + 125} = 0,2329 + j0,7123 = 0,7494 \angle 71,9°$

b) $COE = \frac{1 + |\rho|}{1 - |\rho|} = 6,98$

6) $\lambda = \frac{v}{f} = 2\,m \quad L = 0,17\lambda \quad z_L = 0,25$

$z_0 = 0,9 + j1,45 \quad R_0 = 45 + j72,5$

$G_0 = 1/Z_0 = 6,3685 - j10,048\,mS$

7) $\frac{\lambda}{2} = 8\,cm \quad L_{min} = 0,09375\lambda$

$z_{min} = \frac{1}{COE} = 0,5 \quad z_L = 0,65 - j0,45$

$Z_L = 32,5 - j22,5\ \Omega$

8) a) $\frac{\lambda}{4} = 30\,cm \quad \lambda = 120\,cm \quad f = \frac{v}{\lambda} = \frac{3.10^8}{1,2} = 250\,MHz$

b) $COE = \frac{V_{MAX}}{V_{MIN}} = 3 \quad |\rho| = \frac{COE - 1}{COE + 1} = 1/2$

c) $Z_{MÁX} = \frac{V_{MÁX}^2}{P_{en}} = 150\,\Omega \quad Z_{MÍN} = \frac{100^2}{600} = 16,67\,\Omega$

d) $Z_0 = \frac{Z_{MÁX}}{COE} = Z_{MÍN}\,COE = 50\,\Omega$

e) Maior defasagem → máximas fases em $Z(z)$

$\angle\rho = \pm 90° \rightarrow \angle Z_0 \frac{1 \pm j|\rho|}{1 \mp j|\rho|} = \pm 53,13°$

($\angle(\cdot) \equiv$ argumento de $(\cdot)$)

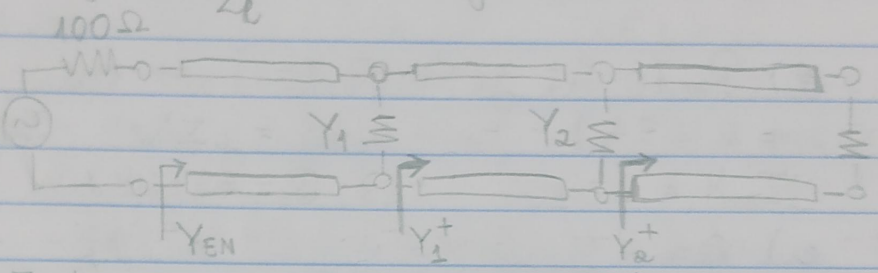
9) a) $|\rho| = 1/6$ $P_{en} = P_i(1-|\rho|^2) = 486{,}11$ mW

b) $Z_{max} = Z_0 \cdot ROE = 70\,\Omega$ $Z_{min} = Z_0/ROE = 35{,}7\,\Omega$

c) $V_{max} = \sqrt{P_{en} Z_{max}} = 5{,}833$ Vef $V_{min} = 4{,}167$ Vef

$Z_0 = \frac{V_{max}}{I_{max}} = \frac{V_{min}}{I_{min}}$ → $I_{max} = 116{,}67$ mAef $I_{min} = 83{,}33$ mAef

10) a) $y_L = \frac{Z_0}{Z_L} = 0{,}46 - j0{,}7$ $(0{,}392\lambda)$



$y_1 = Z_0/Z_1 = -j1{,}15$ $y_2 = Z_0/Z_2 = 0{,}2$

$y_2^+ = (y_L + 0{,}132\lambda = 0{,}524\lambda) = 0{,}32 + j0{,}14$

$y_2 + y_2^+ = 0{,}52 + j0{,}14$ $(0{,}03\lambda)$

$y_1^+ = (0{,}162\lambda) = 1{,}09 + j0{,}76$

$y_1 + y_1^+ = 1{,}5 - j0{,}39$ $(0{,}344\lambda)$

$y_{en} = (0{,}476\lambda) = 0{,}7 - j0{,}07$

$Z_{en} = Z_0/y_{EN} = 141{,}44 + j14{,}14\,\Omega$

b) $|I_{en}| = \frac{10}{\sqrt{141{,}44^2 + 14{,}14^2}} = 41{,}35$ mAef

$P_{en} = |I_{en}|^2 R_{en} = 241{,}8$ mW

11) $z_L = 1 + j3$ rodo $0{,}077\lambda$ → $(0{,}203\lambda + 0{,}077\lambda = 0{,}28\lambda)$

$(0{,}3\lambda) = 2{,}2 - j4{,}2$ ⇝ $110 - j210\,\Omega$

Ien rel. a Z_{02} I $= 0{,}88 - j1{,}68$ $(0{,}322\lambda)$

rodo $0{,}291\lambda$ → $(0{,}613\lambda \equiv 0{,}113\lambda)$ $z_{en} = 0{,}35 + j0{,}8$

$Z_{en} = 43{,}75 + j100\,\Omega$

12) a) $z_L = 1,4 - j0,4$ $\lambda_2 = 3\,m$ $L_2 = 0,2006\lambda$

$z_{en_2} = 0,62$ $Z_{en_2} = 31\,\Omega$ $\rho_{en_2} = -0,2346$

b) Impedância vista pela linha 1 ($75\,\Omega$) =

$$\frac{1}{1/(31-9)+1/360} = 36\,\Omega \quad z = 0,48 \ (0\lambda)$$

$\lambda_1 = 2\,m$

→ rodando $100\,cm = 0,5\lambda$ $Z_A = 36\,\Omega$ $\rho_A = -0,3514$

c) $z_{en_2} = 0,62 \ (0,5\lambda) \rightarrow (0,2993\lambda) = 1,4 - j0,4$

$Z_L = 70 - j20\,\Omega$

d) Ponto A: $z_A = 0,48 \ (0\lambda)$ → roda-se 25 cm $(0\lambda + 0,125\lambda)$ $z_{en} = 0,78 + j0,625$ $Z_{en} = 58,5 + j46,9\,\Omega$

$|I_{en}| = 0,07$ $P_{en} = 0,292\,W$

e) $V_{en} = \frac{10\,Z_{en}}{75 + Z_{en}} = 5,3 \angle 19,36°\ V_{ef}$

Ao final da linha 1: $V = V_{en}\, e^{j\frac{4\pi}{\lambda}(0,625\lambda)}\,(1 - 0,3514)$

$V = 3,438 \angle 109,36°\ V_{ef}$

f) $|V_{en_2}| = 2,66\ V_{ef}$ $P_{en_2} = P_L = \frac{2,66^2}{31} = 0,23\,W$

13) a) $|\rho(z=0)| = 1/2$ $|\rho(z=2,4\lambda)| = 3/5$

$$\frac{1/2}{3/5} = \frac{5}{6} = 10^{-\frac{\alpha_{dB} L}{10}}$$

$$A_{dB} = \alpha_{dB} L + 10 \log\left(\frac{1 - |\rho(z=0)|^2}{1 - |\rho(z=2,4\lambda)|^2}\right) = 0,7918 + 0,6888\ dB$$

b) Primeiro mínimo: $\angle\rho_{min} = 180° = \pi$

$$\angle\rho(z=2,4\lambda) = \pi + 2\beta \times 0,1\lambda = \pi + 4\pi 0,1 = 1,4\pi = 252° \ (-108°)$$

$$\rho(z=2,4\lambda) = \rho_{min} \times 10^{\frac{\alpha_{dB} 0,1\lambda}{10}} \times e^{2j\beta 0,1\lambda} = |\rho(z=2,4\lambda)|\, e^{2j\beta 0,1\lambda}\, e^{j\pi}$$

$$\rho(z=2,4\lambda) = 0,6 \angle -108°$$

$$Z(z=2,4\lambda) = Z_0 \frac{1+\rho}{1-\rho} = (37 - j65,9)\,\Omega$$

c) $\rho(z=0) = |\rho(z=0)|\, e^{j0,5\pi}\, e^{-2j\beta 2,4\lambda} = 0,5 \angle -36°$

$$Z(z=0) = (170 - j133,3)\,\Omega$$

máximo de corrente a 0°
+ 2β(0,35λ − 0)

14) a) $|\rho_L| = 1/3$ $\quad \theta_{\rho_L} = \frac{4}{\lambda} \cdot 180° \cdot 0{,}35\lambda = 252° \equiv -108°$

$Z_L = Z_0 \frac{1+\rho_L}{1-\rho_L} = (33{,}8 - j24{,}1)\,\Omega$

b) $\rho_0 = \rho_L \cdot 10^{\frac{-0{,}1 \cdot 9{,}5\lambda}{10\lambda}} \cdot e^{-j\frac{4\pi}{\lambda} 9{,}5\lambda} = 0{,}268 \angle -108°$

$Z_L = (37{,}51 - j20{,}59)\,\Omega$

c) $A_{dB} = \frac{0{,}1}{\lambda} \cdot 9{,}5\lambda + 10 \log\left(\frac{1-|\rho_0|^2}{1-|\rho_L|^2}\right) = 0{,}95 + 0{,}188 = 1{,}138$ dB

15) a) $\rho_L = \frac{300-50}{300+50} = 5/7 \angle 0°$ $\quad COE_L = 6$

$\rho_{en} = \rho_L \, 10^{\frac{-0{,}02 \cdot 200}{10}} e^{-j\frac{4\pi}{\lambda} \cdot 200}$ $\quad L = 200\,m = 400\lambda \; (\lambda = 50cm)$

$\rho_{en} = 0{,}28436$ $\quad COE_{en} = 1{,}79471$

b) $Z_{en} = 89{,}74\,\Omega$

$I_{en} = \frac{10}{139{,}73} = 0{,}0716\,A$ $\quad P_{en} = 0{,}4596\,W$

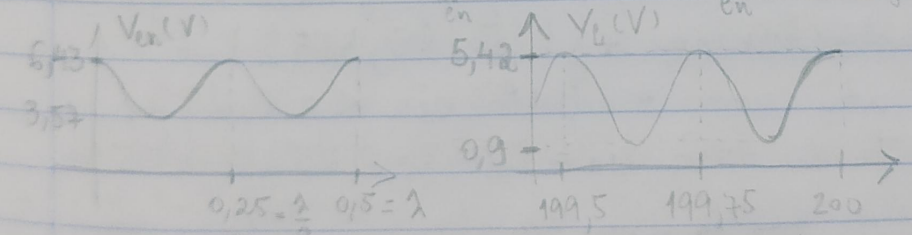
c) $A_{dB} = 0{,}02 \cdot 200 + 10 \log\left(\frac{1-0{,}284^2}{1-(5/7)^2}\right) = 6{,}735$ dB

$P_L = P_{en} \cdot 10^{\frac{-A_{dB}}{10}} = 0{,}0975\,W$

d) GERADOR: $Z_{MAX_L} = Z_0 \, COE = 90\,\Omega$ → ptos de V_{max} em $z = 0$ e $z = 200$

$V_{MAX_L} = \sqrt{P_L \cdot Z_{MAX_L}} = 6{,}43\,V_{ef}$ $\quad V_{MIN} = \frac{V_{MAX}}{COE} = 3{,}57\,V_{ef}$

CARGA: $Z_{MAX_{en}} = 300\,\Omega$ $\quad V_{MAX_{en}} = 5{,}42\,V_{ef}$ $\quad V_{MIN_{en}} = 0{,}9\,V_{ef}$



e) Para uma frequência diferente, ocorrerá defasagem nos valores de entrada (menor λ, maior fase). A atenuação permanece igual. $\lambda' = 0{,}4995\,m$

$\rho_{en} = 0{,}284 \angle 0 - 4 \cdot 180° \cdot \frac{200}{0{,}4995} = 0{,}284 \angle +72°$

$Z_{en} = (50{,}8 + j29{,}8)\,\Omega$ $\quad |I_{en}| = 0{,}09514\,A$ $\quad P_{en} = 0{,}4598\,W$

$P_L = 0{,}0975\,W$

⑥

16) a) $\rho_L = 5/7 \angle 0°$ $\cos\theta_L = 6$ $\lambda = \frac{v}{f} = 25\ cm$

$L = 40,1\ m = 160,4\lambda$ $\rho_{en} = \rho_L 10^{\frac{-2\alpha L}{10}} e^{-j\frac{4\pi}{\lambda} \cdot 160,4\lambda}$

$\rho_{en} = 0,2837 \angle 72°$ $\cos\theta_{en} = 1,792$

b) $Z_{en} = 50\,\frac{1+\rho_{en}}{1-\rho_{en}} = (50,8 + j29,8)\ \Omega$

c) $A_{dB} = 0,1 \cdot 40,1 + 10 \log\left(\frac{1-0,2837^2}{1-(5/7)^2}\right) = 6,745\ dB$

$P_L = 20 \cdot 10^{\frac{-A_{dB}}{10}} = 4,2314\ W$

d) Para uma linha com perdas, uma maior distância carga-gerador causa maior atenuação no módulo do coef. de reflexão. Quando o mesmo tende p/ 0, a impedância $Z(z=0) = Z_0 \frac{1+\rho(z)}{1-\rho(z)} \to$ vale $\approx Z_0 \times 1$

e) A atenuação é em base no ganho de potência da carga em relação a de entrada.

17) $y_L = Z_0/Z_L = 1,25 + j1,25$ $(0,182\lambda)$

rodando até admitância unitária $\to (0,167\lambda) = 1 + j1,15$

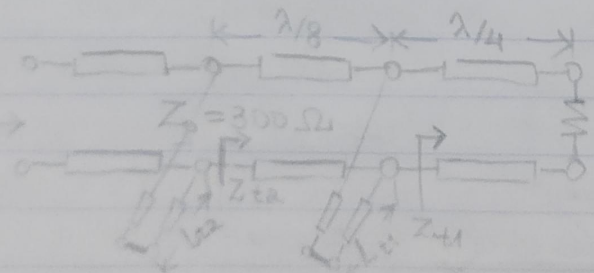
• distância do toco $d_1 = 0,167 - 0,182\lambda + 0,5\lambda = 0,485\lambda$

toco de admitância $-j1,15$ $(0,365\lambda)$

girando até curto $\equiv$ admitância $\infty \equiv 0,25\lambda$

• comprimento do toco $L_1 = 0,365\lambda - 0,25\lambda = 0,115\lambda$

18)



$y_L = 2,4 + j1,2$ $(0,22\lambda) > \lambda/4$

$y_{t1} = 0,33 - j0,17$ $(0,47\lambda)$

Na circunferência de admit. unitária deslocada: $0,33 + j0,25$

• $y_{toco1} = +j0,42 = 0,064\lambda$ $L_{t1} = 0,064 + \frac{\lambda}{4} = 0,314\lambda$

rodando $\lambda/8$

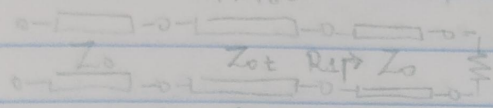
$0,33 + j0,25$ $(0,045\lambda) \longrightarrow 1 + j1,25$ $(0,17\lambda)$

- $y_{Toco} = -j1,25 = 0,35\angle\lambda$ $L_{t2} = 0,35\lambda - \frac{\lambda}{4} = 0,10\lambda$

19) $\rho_L = 0,6\angle 62,0°$ $\lambda = \frac{3 \cdot 10^8}{300 \cdot 10^6} = 1\ m$

$L_1 = \frac{62°}{4 \cdot 180°}\lambda = 0,086\lambda$ $R_1 = 300\ \Omega$

$Z_{ot} = \sqrt{R_1 Z_0} = 150\ \Omega$



$L_1 = 8,6\ cm$

$L_t = \lambda/4 = 25\ cm$

Linha casada, $COE = 1$

- Para $f = 272,5\ MHz$ $\lambda = 1,101\ m$

Saída do transformador: $\rho_1 = \rho_L e^{-j\theta 0,312\pi} = 0,6\angle 5,76°$

$Z_1 = (289,1 + j54,4)\ \Omega$ $\rho_{t1} = 0,338\angle 14,3°$

Entrada do trafo: $\rho_{t2} = \rho_{t1} \cdot e^{-j\theta 0,908\pi} = 0,338\angle -149,19°$

$Z_2 = (78,4 - j30,6)\ \Omega$ $\rho_{en} = 0,197\angle -72,38°$

$COE_{272,5} = 1,49$

- Para $f = 327,5\ MHz$ $\lambda = 0,916\ m$

Saída do trafo: $\rho_1 = 0,6\angle 62° - \frac{4 \cdot 180° \cdot 0,086}{0,916} = 0,6\angle -5,596°$

$Z_1 = (289,65 - j53)\ \Omega$ $\rho_{t1} = 0,337\angle -13,9°$

Entrada: $\rho_{t2} = 0,337\angle -13,9° - \frac{4 \cdot 180° \cdot 0,25}{0,916} = 0,337\angle -210,4°$

$Z_2 = (78,45 + j30,2)\ \Omega$ $\rho_{en} = 0,194\angle 72,35°$

$COE_{327,5} = 1,48$

20) a) $\rho_L = 0,62017\angle 7,125°$ $\lambda = \frac{2 \cdot 10^8}{300 \cdot 10^6} = 2/3\ m$

$d_1 = \frac{7,125°}{4 \cdot 180°}\lambda = 6,597\ mm$ $z_1 = L - d_1 = 49,9934\ m$

$Z_1 = Z_0 \frac{1+\rho}{1-\rho} = 319,92\ \Omega$

b) $L_{1t} = \lambda/4 = 1/6 = 16,667\ cm$

$Z_0' = \sqrt{R_1 Z_0} = 154,9\ \Omega$

c) $y_L = 0,235 - j0,059$ rodando até $1 + j1,6$ $(0,178\lambda)$

$(0,5\lambda - 0,49\lambda + 0,178\lambda) = 0,188\lambda$ $d_2 = 0,1253\ cm$

$z_2 = L - d_2 = 49,87467\ m$

$Y_{d2} = \frac{1}{Z_0}(1 + j1,6) = (13,33 + j21,33)\ mS$

d) Admitância de entrada do toco = $-j21,33\ mS$

Normalizada = $-j1,0667$ $(0,37\lambda_t)$

→ rodando até $0,25\lambda_t$ ($Y_{final\ toco} \to \infty$) = $0,37\lambda_t - 0,25\lambda_t =$

$\ell_t = 0,12\lambda_t$

e) $\lambda_t = \frac{3 \cdot 10^8}{300 \cdot 10^6} = 1\ m$ $\quad \ell_t = 12\ cm$

f) Carga casada → $Z_{en} = 75\ \Omega$

$P_{en} = P_{máx} = \frac{E_{ef}^2}{4 \cdot R_g} = \frac{10^2}{4 \cdot 75} = 0,333\ W$

g) $I_{ef} = \sqrt{\frac{I_T}{300}} = 33,333\ mA_{ef}$

21) a) $z_L = 0,8 - j0,4$ $(0,395\lambda)$ → (145λ) $1 + j0,5$

$0,5\lambda - 0,395\lambda + 0,145\lambda = 0,25\lambda$ $\quad d = 75\ cm$

b) Impedância do componente = $+j600\ \Omega$

$j\omega L = j2\pi f L = j600$ $\quad L = \frac{600}{200\pi \cdot 10^6} = 954,93\ nH$

c) $z_t = j2$ $(0,176\lambda)$ → (0λ) $j0$ (curto)

$L_t = 52,8\ cm$

d) $V_{en} = \frac{10 \times 300}{600} = 5\ V_{ef}$ $\quad \rho_{en} = \rho_L e^{-2j\beta L}$

$V_L = V_{en}^+ \cdot (1 + \rho_L) \cdot e^{-2j\beta L} = \frac{V_{en}(1+\rho_L)}{(1+\rho_{en})} e^{-j\frac{4\pi}{\lambda}L}$

Linha casada = $\rho(z = 32,7) = 0$ $\quad$ e $V(z = 32,7) = V_{en}$

$\rho_L = 0,2425 \angle 75,964°$ $\quad V_L = 5,4232 \angle -167,5°\ V_{ef}$

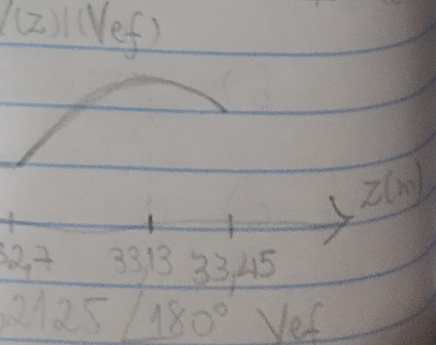
e) $\rho_{max} = |\rho_L| \angle 0°$

$d_{max} = \frac{75,964°}{4 \times 180°}\lambda = 0,3165\ m$

Pto de máximo = $32,7 + (0,75 - d_{max})$

$= 33,13\ m$

$V(33,13) = V_{en}\frac{(1 + |\rho_L|)}{(1 + \rho_{en})} e^{-j\frac{4\pi}{\lambda}L} = 6,2125 \angle 180°\ V_{ef}$



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22) a) $A_{dB} = 0,01 \cdot 150 + 10\log\left(\frac{1-|\rho_{ent}|^2}{1-|\rho_L|^2}\right)$ $\rho_L = 0,4152\angle -41,6°$ $|\rho_{ent}| = 0,294$

$A_{dB} = 1,929$ dB

b) $\eta = \frac{P_{carga}}{P_{suprimida}} \cdot 100\% = \frac{P_{ent} \cdot A}{P_d} \cdot 100\% = (1-|\rho_{ent}|^2) 10^{\frac{-A_{dB}}{10}} \cdot 100\%$

$\eta = 58,59\%$

c) $z_L = 0,46 + j0,31$ $(0,058\lambda) \rightarrow (0,16\lambda)$ $1 + j0,95$

$d_T = 0,102\lambda = 2,04$ cm

$z_{in} = -j0,95$ $(Z_{0T} = Z_0)$ $(0,380\lambda) \rightarrow (0,25\lambda) j\infty$

$L_T = 0,130\lambda = (\lambda_T = \lambda)$ 2,60 cm

d) $A_{dB} = \alpha_{dB}(L - d_T) = 1,5$ dB

$P_{carga} = P(z = 49,93796) = P_d(1-|\rho_{ent}|^2) A$ $\eta = (1-|\rho_{ent}|^2) 10^{\frac{-A_{dB}}{10}} \cdot 100\%$

$\eta = 70,8\%$

e) $\rho_{ent} = 0,294\angle -41,6°$ $d_T = \frac{41,6°}{4 \times 180°}\lambda = 0,058\lambda = 1,16$ cm

$L_T = \lambda/4 = 5$ cm $Z(d_T) = 92,5\ \Omega$ $Z_{0T} = 68\ \Omega$

f) $A_{dB} = 0,01 \cdot 150,0 + 10\log\left(\frac{1-|\rho(d_T)|^2}{1-|\rho_L|^2}\right) = 1,93$ dB

$\eta = \frac{P_d(1-|\rho_{ent}|^2) 10^{-A_{dB}/10}}{P_d} \cdot 100\% = 64,12\%$ → (linha casada)

23) a) $z_{L2} = \frac{50}{50\sqrt{2}} = \sqrt{2}/2 \rightarrow$ girando $\lambda/4 \rightarrow z_{ent_2} = \sqrt{2}$ $Z_{ent_2} = 50\sqrt{2}\ \Omega$

b) $\rho_{L1} = \frac{25\sqrt{2} - 50}{25\sqrt{2} + 50} = -0,1716$ $\rho_{ent_1} = +0,1716$

c) $Z_{ent} = 70,71\ \Omega$ $I_{ent} = 58,58$ mA$_{ef}$ $P_{ent} = 0,243$ W

$P_{L3} = P_{L2} = 0,121$ W

d) $Z_{Th_2} = 50 // 50\sqrt{2} = 29,29\ \Omega$ $E_{Th_2} = 4,14$ V$_{ef} = 5,86$ V

e) $P'_{L2} = 0,114$ W

(10)

24) a) $y_1 = 0,5\ (0\lambda) \rightarrow (0,25\lambda)\ 2 = y_2$ $Z_2 = 600\ \Omega$

$\frac{Z_2}{Z_{01}} = 8\ (0,25\lambda) \rightarrow (0,15\lambda)\ 0,35 + j1,32$ $Z_1 = (26,4 + j98,7)\ \Omega$

b) $V_1 = 3,61 \angle 30,81°$ Vef $V_2 = 1,44 \angle 72°$ Vef

$V_L = V_2^+ (1+\rho_L) e^{-2\beta L_2} = V_2 \frac{(1+\rho_L)}{(1+\rho_{Z_2})} e^{-\frac{4\pi}{\lambda} L_2} = 2,22 \angle -108°$ Vef

c) $y_2 = 1/8\ (0\lambda) \rightarrow (0,196\lambda)\ 1 + j2,5$ $d_t = 0,196\lambda$

$y_t = -j2,5\ (0,311\lambda) \rightarrow (0,25\lambda) \infty$ $L_t = 0,061\lambda$

d) Con toco $\rightarrow Z_1 = 75\ \Omega$ $V_1 = E_g/2 = 2,5$ Vef

$P_{en} = 83,33$ mW

e) $A_{dB} = \alpha_{dB} \cdot L + 10 \log\left(\frac{1 - |\rho(31,704\lambda)|^2}{1 - |\rho(31,9\lambda)|^2}\right)$

$\rho(31,704\lambda) = \frac{7}{9} e^{-\frac{4\pi}{\lambda} d_t} 10^{-\frac{\alpha_{dB} d_t}{10}} = 0,7743 \angle -141,12°$

$A_{dB} = (3,19 + 0,059)$ dB $= 3,249$ dB

$P_L = P_{en}\ 10^{-A_{dB}/10} = 39,44$ mW

25) a) $\rho_{Z_2} = -\frac{157}{443}$ $\rho_L = \rho_{Z_2} e^{\frac{4\pi}{\lambda} L_2} = 0,3544 \angle 150,48°$

$Z_L = (150,55 + j60,13)\ \Omega$

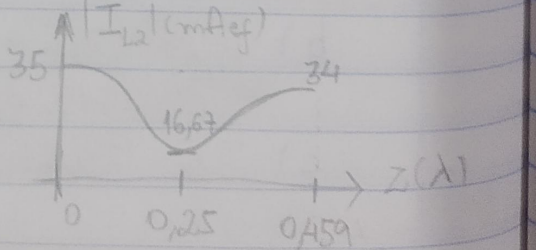
b) $P_{Z_2} = P_L = 0,175$ W $V_L = V_2^+ (1+\rho_L) e^{-\frac{4\pi}{\lambda} L_2}$

$V_{L1} = 5,5244 \angle 43,7°$ Vef

c) Dto de mín. $\Delta\rho_{min} = 0$

$d_{min} = 0,209\lambda$

$Z_{max} = 629,368\ \Omega$ $|I_{min}| = 16,67$ mAef



d) $\rho_{L1} = 93/193 = 0,482$

e) $\rho_{Z1} = 0,184 \angle 144°$ $Z_1 = (36,28 + j8,12)\ \Omega$

f) $A_{dB} = (4,18 + 1)$ dB $P_{Z1} = P_{Z2}\ 10^{A_{dB}/10} = 0,577$ W

g) $L_t = 0,25\lambda$ $Z_{0t} = 84,56\ \Omega$ $A_{dB} = (4,18 + 0,14)$ dB