1.1)

$$k\frac{h_m^2 h_b^2}{r_1^4 f_1^2} = k\frac{h_m^2 h_b^2}{r_2^4 f_2^2} \qquad f_2 = 2f_1$$

$$4r_2^4 = r_1^4$$

$r_2 = \frac{X_2}{\pi r}$

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$$VSWR = \frac{1+|\rho|}{1-|\rho|}$$

$$|\rho| = \frac{VSWR-1}{VSWR+1} = \frac{2-1}{2+1} = \frac{1}{3}$$

$$P_r = \frac{P_i}{9}$$

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4.4)

$$VSWR = \frac{1+|\rho|}{1-|\rho|} = 2,16$$

$$\rho = \frac{Z_a - Z_s}{Z_a + Z_s} = \frac{73+j42,5 \quad -50}{73+j42,5+50}$$

$|\rho| = 0,37$

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$$A_e = \frac{G}{4\pi}\lambda^2 \iff G = \frac{4\pi A_e}{\lambda^2} \qquad A_e = 0,65\,\pi r^2$$

$$= 0,65\frac{4\pi^2 r^2}{(c/f)^2}$$

2.7

$$G_{dB} = 10\log_{10}\left(0,65\left(\frac{2\pi r f}{c}\right)^2\right) = 20\log\left(\sqrt{0,65}\frac{2\pi r f}{c}\right)$$

$f = 14\,GHz$: $G \approx 50$

$f = 12\,GHz$: $G \approx 48.7$

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