Chapter 14 solutions

1. According to Equation (14.7b), the turn on threshold power of the tag should be:

[DISP]

$$P_{TH} = (1-\Gamma)P_T G_T (\frac{c}{2\omega r})^2 = 10\lg\left[-1/2 \times \left(\frac{3\times 10^8}{2\times 2\times \pi \times 2.5\times 10^9 \times 10} \right)^2 \right] + 3 + 20$$

= -40.4 (dBm)

[DISPX]

2. According to Equation (14.14a):

[DISP]

$$SNR_{MIN} = \frac{\Gamma \xi G_T^2 G_R^2}{2\psi} \left(\frac{c}{2\omega r} \right)^4 \frac{\int_{f_L}^{f_H} S_S(t)\, df}{\int_{f_L}^{f_H} S_{\theta_P}(t)\, df},$$

[DISPX]

[FT]in which:

[DISP]

$$\left(\frac{c}{2\omega r} \right)^4 = -26dB,$$

[DISPX]

[FT]we substitute the known values into it and obtain:

[DISP]

$$G_R = 12.1dB.$$

[DISPX]

3 According to Equation (14.14b), we get:

[DISP]

$$SNR_{MIN} = \frac{\Gamma \xi G_T^2 G_R^2}{\psi} \left(\frac{c}{2\omega r} \right)^4 \frac{\int_{f_L}^{f_H} \mathbf{S}_{\theta_M}(f) \cos^2[\pi/4 + \theta_M[S(t)]]\, df}{\int_{f_L}^{f_H} \mathbf{S}_{\theta_P}(t)\, df}$$

$$= (20 + 3*2 + 15*2 - 6.8 + 39.9 + 37.5) + 10\lg\left[\left(\frac{3*10^8}{2*2*\pi*0.95*10^9*10} \right)^4 / 2 \right]$$

=19.6 Db

[DISPX]

4. The relation between gain and angle θ of a dipole is:

[DISP]

$$G = 1.64 \times \left\{ \frac{\cos[(\pi/2)\cos(\theta)]}{\sin(\theta)} \right\}^2.$$

[DISPX]

[FT]Substitute it into the formula (14.15a):

[DISP]

$$r_{READER} = \frac{c}{2\omega} \left(\frac{\Gamma \xi G_T^2 G_R^2}{2\psi SNR_{USER}} \frac{\int_{f_L}^{f_H} \mathbf{S}_S(t)\, df}{\int_{f_L}^{f_H} \mathbf{S}_{\theta_P}(t)\, df} \right)^{1/4},$$

[DISPX]

[FT]we get:

[DISP]

$$r_{READER} = 11 \times G^{1/4} = 11 \times 1.64^{1/4} \times \left\{ \frac{\cos[(\pi/2)\cos(\theta)]}{\sin(\theta)} \right\}^{1/2}$$

$$= 12.4 \times \left\{ \frac{\cos[(\pi/2)\cos(\theta)]}{\sin(\theta)} \right\}^{1/2}$$

[DISPX]

5.This is an open problem, any answer that agrees with the analysis in Section 14.2 and Section 14.3 is appropriate.