

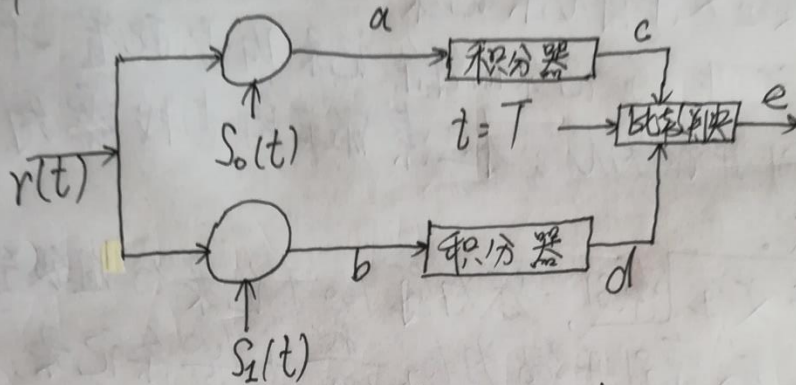
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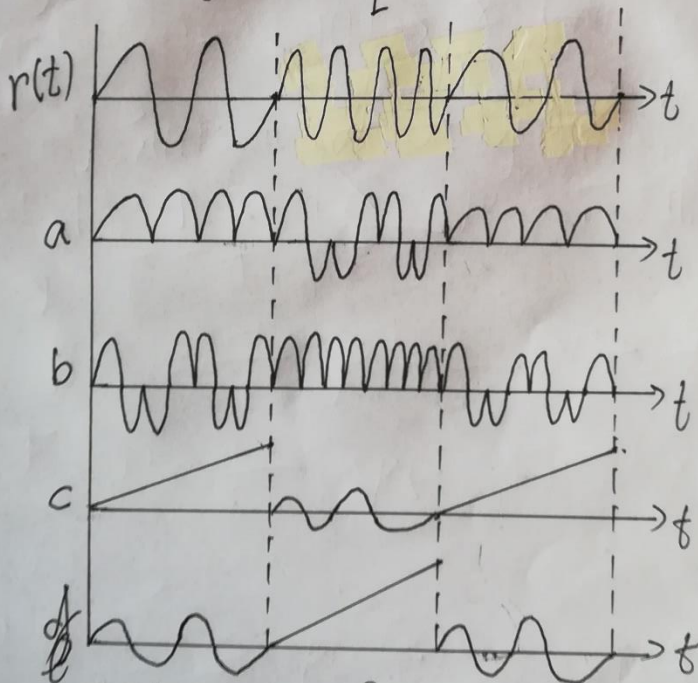
物联网 17-2

P276. 9-3.

解: (1) 2FSK 相关接收机:



(2) 发送码元 010, 各点时间波形:



(3) 2FSK 码元能量: $E_b = E_1 = E_0 = \int_0^{T_b} S_i^2(t) dt$
 $= \int_0^{T_b} S_0^2(t) dt = \frac{A^2 T_b}{2}$

误码率: $P_e = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{E_b}{2n_0}} = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{A^2 T_b}{4n_0}}$

9-5. 解: 二进制双极性信号互相关系数 $\rho = -1$.

\therefore 误码率: $P_e = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{E}{n_0}} = 10^{-5}$

$\operatorname{erfc} \left(\sqrt{\frac{E}{n_0}} \right) = 2 \times 10^{-5} = 1 - \operatorname{erf} \left(\sqrt{\frac{E}{n_0}} \right)$

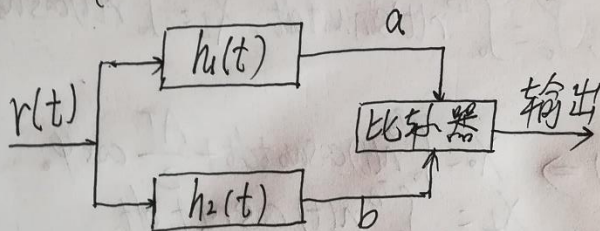
$\Rightarrow \operatorname{erf} \left(\sqrt{\frac{E}{n_0}} \right) = 1 - 2 \times 10^{-5} = 0.99998$

对幅度为 1、持续时间为 T_B 的矩形脉冲 $S(t)$, 其能量

$E = \int_0^{T_B} S^2(t) dt = \int_0^{T_B} 1^2 dt = T_B$

\therefore 最高码元传输速率: $R_B = \frac{1}{T_B} = 5.55 \times 10^4 \text{ Baud}$

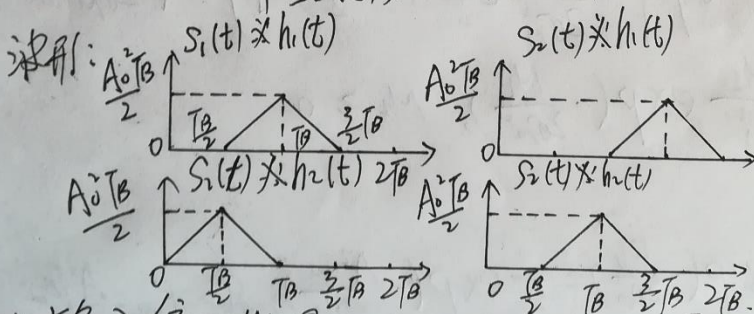
9-10. 解: (1) 最佳接收结构:



(2) 单位冲激响应: $h_1(t) = S_1(T_B - t)$, $h_2(t) = S_2(T_B - t)$

输入码元: $S_1(t)$ 或 $S_2(t)$

\therefore $a \begin{cases} S_1(t) \otimes h_1(t) \\ S_2(t) \otimes h_1(t) \end{cases} \quad b \begin{cases} S_1(t) \otimes h_2(t) \\ S_2(t) \otimes h_2(t) \end{cases}$

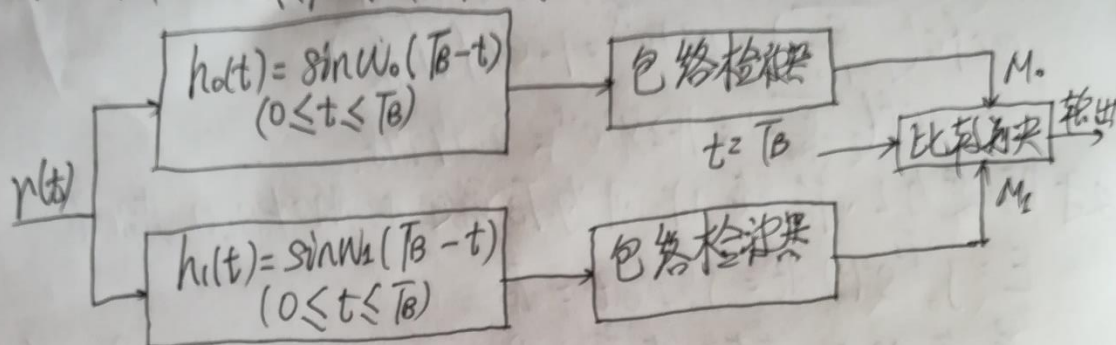


(3) 输入信号能量: $E_1 = E_2 = E_b = \int_0^{T_B} S_1^2(t) dt = \int_0^{T_B} S_2^2(t) dt = \frac{A_0^2 T_B}{2}$

两波形相关系数 $\rho = 0$

\therefore 误码率: $P_e = \frac{1}{2} \operatorname{erfc} \left[\sqrt{\frac{E_b(1-\rho)}{2n_0}} \right] = \frac{1}{2} \operatorname{erfc} \left[\sqrt{\frac{A_0^2 T_B}{4n_0}} \right]$

9-11. 解: (1) 最佳接收机构:



(2) 抽样输入分别为:

$$M_0 = \sqrt{X_0^2 + Y_0^2}, \quad M_1 = \sqrt{X_1^2 + Y_1^2}$$

$$X_0 = \int_0^{T_B} r(t) \cos w_0 t dt, \quad Y_0 = \int_0^{T_B} r(t) \sin w_0 t dt, \quad X_1 = \int_0^{T_B} r(t) \cos w_1 t dt$$

$$Y_1 = \int_0^{T_B} r(t) \sin w_1 t dt.$$

$$r(t) = s(t) + n(t) \Rightarrow X_0 = \int_0^{T_B} s(t) \cos w_0 t dt + \frac{AT}{2} \cos \varphi$$

$$X_1 = \int_0^{T_B} n(t) \cos w_1 t dt$$

$Y_0 = \int_0^{T_B} n(t) \sin w_0 t dt, \quad Y_1 = \int_0^{T_B} n(t) \sin w_1 t dt,$
 M_0 相当于正被 [被弦] 加 窄带高斯噪声合成网络,
 M_1 为窄带高斯噪声包络.

$$\therefore f(M_0) = \frac{1}{\sigma_M^2} \exp \left\{ -\frac{1}{2\sigma_M^2} \left[M_0^2 + \left(\frac{AT}{2} \right)^2 \right] \right\} I_0 \left(\frac{AT}{2\sigma_M^2} M_0 \right), M_0 \geq 0$$

$$f(M_1) = \frac{1}{\sigma_M^2} \exp \left(-\frac{M_1^2}{2\sigma_M^2} \right), M_1 \geq 0$$

$$\text{其中, } \sigma_M^2 = \frac{n_0 T_B}{4}$$

$$(3) P_{e,2FSK} = \frac{1}{2} \exp \left(-\frac{E_b}{2n_0} \right) = \frac{1}{2} \exp \left(-\frac{A^2 T_B}{4n_0} \right), \text{ 其中 } E_b = \frac{A^2 T_B}{2}$$