2.111 The effective antenna temperature of an antenna looking toward zenith is approximately 5 K. Assuming that the temperature of the transmission line (waveguide) is 72°F, find the effective temperature at the receiver terminals when the attenuation of the transmission line is 4 dB/100 ft and its length is
(a) 2 ft (b) 100 ft
Compare it to a receiver noise temperature of about 54 K.

- Modified so the transmission line temperature is 88°F and attenuation is 3 dB/100 ft. You may assume the effective antenna temperature incorporates both the antenna noise temperature as well as that due to the antenna physical temperature at the terminals.

Given effective antenna temperature $= T_A + T_{AP} = 5\,K$

Given transmission line temp $= T_0 = 88°F = 304.261\,K$

Given trans. line attenuation constant $= \alpha = \frac{3\,dB}{100\,ft}\left(\frac{1\,Np}{20\log_{10} e}\right)$

$$= 0.003453878\ Np/ft$$

Per (2-140), the effective antenna temperature at the receiver terminals is

$$T_a = T_A e^{-2\alpha l} + T_{AP} e^{-2\alpha l} + T_0\left(1 - e^{-2\alpha l}\right)$$

$$= \left(T_A + T_{AP}\right) e^{-2\alpha l} + T_0\left(1 - e^{-2\alpha l}\right)$$

a) When $l = 2\,ft$

$$T_a = (5\,K)\, e^{-2(0.00345)2} + 304.261\left(1 - e^{-2(0.00345)2}\right)$$

$$T_a = 4.9314 + 4.17462 \Rightarrow \underline{\underline{T_a(l = 2ft) = 9.106\,K}}$$

much less than $T_r = 54K$

b) when $l = 100\,ft$

$$T_a = (5\,K)\, e^{-2(0.00345)100} + 304.261\left[1 - e^{-2(0.00345)100}\right]$$

$$= 2.50594 + 151.7693 \Rightarrow \underline{\underline{T_a(l = 100ft) = 154.275\,K}}$$

much bigger than $T_r = 54K$