C

Prob. 6.1 Recei

System

1.4125 (3.9811 − 1)

100 × 3.9811.

10 + 1787.8

a) Ov

...DEBAND vs. DOUBLE-SIDEBAND

...m noise figures and equivalent noise temperatures.

NOISE FIGURE DEFINED AS $F = \frac{P_{SI}}{P_{SO}} \cdot \frac{P_{NO}}{P_{NI}}$

$P_{SO} = G\, P_{SI}$

$P_{NO} = G P_{NI} + \Delta P_{NO}$

where ΔP_{NO} IS THE ADDITIONAL NOISE DUE TO THE SYSTEM, SPECIFICALLY THE MIXER-PREAMP.

FOR SSB (system bandwidth = B)

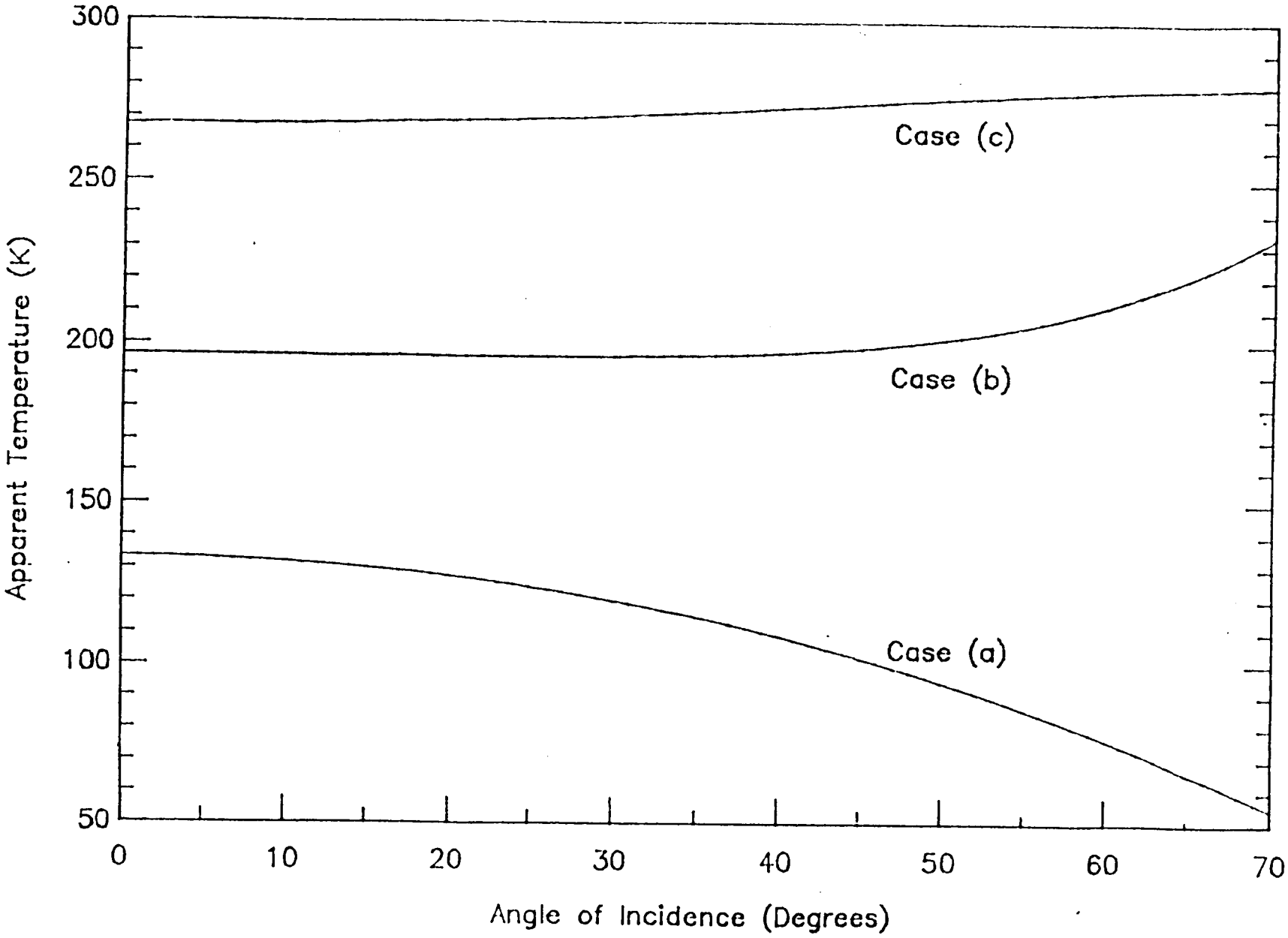
$P_{NI} = K T_o B$

$P_{NO} = G K T_o B + \Delta P_{NO}$

FOR DSB (system bandwidth = 2B)

$P_{NI} = 2 K T_o B$

$P_{NO} = G 2 K T_o B + \Delta P_{NO}$


300
250
200
150
100
50
Apparent Temperature (K)
Case (c)
Case (b)
Case (a)
0
10
20
30
40
50
60
70
Angle of Incidence (Degrees)

Prob. 6.5 (cont.) $T_N = (ENR + 1)\,T_o$ from Eq. (6.110)

$$T_{oN}' = \frac{(199.5+1)320}{1.5849} + \left(1 - \frac{1}{1.5849}\right)320$$

$$T_{oN}' = 40600 \text{ K}$$

$$f_R = \frac{(100-1)(320 - T_A')}{40\times10^{-6}(40600-320)}$$

when $T_A' = 50$ K $\rightarrow$ $f_R = 16590$ Hz

$T_A' = 300$ K $\rightarrow$ $f_R = 1229$ Hz

$\therefore$ to observe values of T_A' ranging from 50k to 300k in a balanced mode, f_R should range from 16.59 kHz to 1.23 kHz

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Prob. 6.6 1 GHz ($\lambda = 30$ cm)

balanced DICKE RADIOMETER

$B = 100$ MHz

$h = 600$ km

$v_g = 7.5$ km s^{-1}

$d = 10$ m

$T_{REC}' = 1000$ K

$T_{REF} = T_o = 300$K

$\tau = 0.1\tau_d$

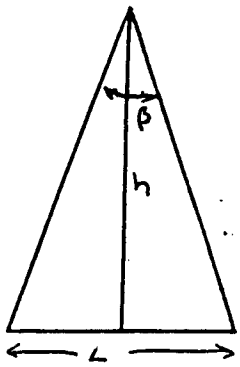
Prob. 6.6 (cont.) Nadir looking

Antenna beamwidth, $\beta = k\frac{\lambda}{d}$ Eq. (6.142)

let $k = 1.5$ (high main-beam efficiency)

$$\beta = 1.5\ \frac{(0.30)}{10} = 0.045 \text{ rad} = 2.578^\circ$$

$$L = 2h\tan(\beta/2) = 27.00 \text{ km}$$



Dwell time, $\tau_d = \frac{L}{V_g} = 3.6$ sec

$$\tau = 0.1\,\tau_d = 0.36 \text{ sec}$$

DICKE RADIOMETER (BALANCED) HAS A SENSITIVITY GIVEN BY Eq. (6.75)

$$\Delta T = \frac{2(T_A' + T_{REC})}{\sqrt{B\tau}}$$

BALANCED MODE $\rightarrow T_A' = T_{REF}$

$$\Delta T = \frac{2(300+1000)}{\sqrt{100\times10^6\times0.36}} = 0.433 \text{ K}$$

Prob. 6.7 Same as 6.6 except scanning between $+20°$ and $-20°$

dwell time, $\tau_d = \frac{t_1 \beta}{2\theta_s}$ Eq. (6.146)

where $\theta_s = 20° = 0.349$ radians

$t_1 = 3.6$ sec (from Prob 6.6)

$\beta = 2.578° = 0.045$ radians (from Prob. 6.6)

$\tau_d = \frac{(3.6)(2.578)}{2(20)} = 0.232$ sec

$\tau = 0.1\, \tau_d = 0.0232$ sec

$$\Delta T = \frac{2(T_A' + T_{REC}')}{\sqrt{B\tau}}$$ Eq. (6.75)

$T_A' = T_{REF} = T_0$ (balanced mode)

$$\Delta T = \frac{2(300 + 1000)}{\sqrt{100 \times 10^6 \times 0.0232}}$$

$\Delta T = 1.71$ K