# Øving 3

## Oppgave 1

$G = 35 dB$,    $B = 5 MHz$,    $NF = 2 dB$.
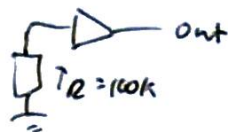


$$N_{out} = k_B G B \left( T_R + 290 \left( 10^{2/10} - 1 \right) \right) = 5.88 \cdot 10^{-11} W$$
$$= 5.88 \cdot 10^{-8} mW$$
$$= -72.3 dBm$$

$R = 100 \Omega$.    $U_{p-p} = 12 \mu V$,    $V_{RMS} = \frac{U_{p-p}}{2\sqrt{2}}$
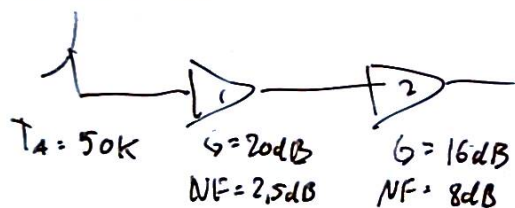
$$P_{inn} = \frac{V_{RMS}^2}{R} = \frac{\left( \frac{12 \mu}{2\sqrt{2}} \right)^2}{100} = 1.8 \cdot 10^{-13} W = 1.8 \cdot 10^{-10} mW$$

$$P_{inn,dBm} = -97.45 dBm$$
$$S_{out} = P_{inn} + G = -62.45 dBm$$
$$SNR = S_{out} - N_{out} = 9.85 dB$$

## Oppgave 2



$T_A = 50k$    $G = 20 dB$    $G = 16 dB$
         $NF = 2.5 dB$    $NF = 8 dB$

$B = 5 MHz$

$$T_{e_1} = 290 \left( 10^{2.5/10} - 1 \right) = 225.7 K$$
$$T_{e_2} = 290 \left( 10^{8/10} - 1 \right) = 1539.8 K$$

$$T_{cas} = T_{e_1} + \frac{T_{e_2}}{G_1} = 241.1 k$$

$$P_{inn} = -95 dBM$$

$$N_{out} = k_B B G_1 G_2 \left( T_A + T_{cas} \right) = k_B \cdot 5 \cdot 10^6 \cdot 10^2 \cdot 10^{1.6} \cdot (50 + 241.1)$$
$$= 7.99 \cdot 10^{-11} W \hat{=} 8 \cdot 10^{-8} mW = -70.9 dBm$$

$$S_{out} = -95 dBm + 20 + 16 = -59 dBm$$
$$SNR = S_{out} - N_{out} = 11.9 dB$$

## Oppgave 3



$l = 50m$     $B = 5MHz$

$T_A = 50$

$G = 20dB$     $G = -10dB$     $G = 16dB$

$NF = 2,5dB$     $NF = 10dB$     $NF = 8dB$
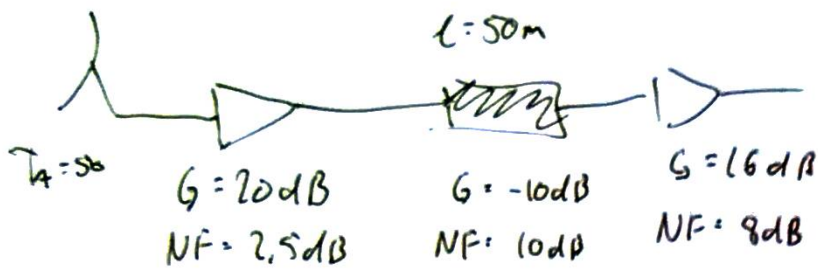
$T_{e_1} = 225,7k$,   $T_{e_3} = 1539,8k$

$T_{e_2} = 290(10^{10/10} - 1) = 2610 k$

$T_{cas} = T_{e_1} + \dfrac{T_{e_2}}{G_1} + \dfrac{T_{e_3}}{G_1 G_2} = 405,8 K$

$N_{out} = k_B B G_1 G_2 G_3 (T_A + T_{cas}) = 1,25 \cdot 10^{-11} W = 1,25 \cdot 10^{-8} mW$

$\qquad = -79 dBm$

$S_{out} = -95 dBm + 20 - 10 + 16 = -69$

$SNR = S_{out} - N_{out} = \underline{10 dB}$