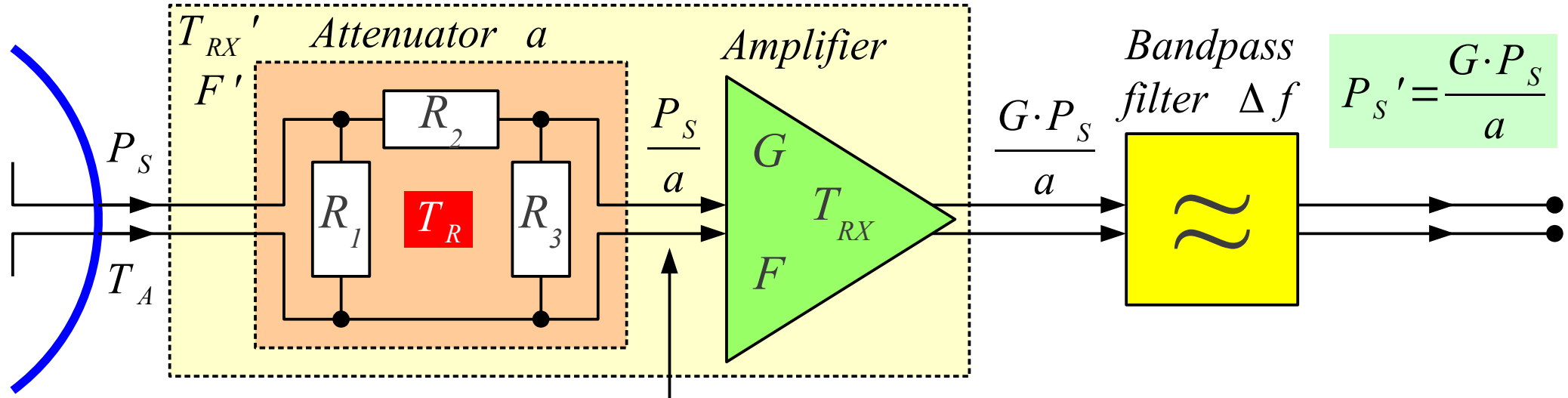

$$P_N' = G \cdot \Delta f \cdot k_B \cdot \left[\frac{T_A}{a} + T_R\left(1 - \frac{1}{a}\right) + T_{RX} \right]$$

$$\left(\frac{S}{N} \right)_{output} = \frac{P_S'}{P_N'} = \frac{P_S}{\Delta f \cdot k_B \cdot \left[T_A + T_R(a-1) + a\,T_{RX} \right]}$$

$$T_{RX}' = T_R(a-1) + a\,T_{RX}$$

$$F' = 1 + \frac{T_{RX}'}{T_0} = 1 + \frac{T_R}{T_0}(a-1) + a\frac{T_{RX}}{T_0}$$

Frequent case $T_R \approx T_0 = 290\text{K}$

$$F' \approx a + a\frac{T_{RX}}{T_0} = a\left(1 + \frac{T_{RX}}{T_0}\right) = a \cdot F$$

$$F_{dB}' \approx a_{dB} + F_{dB}$$

Attenuator examples $T_R \approx T_0 = 290\text{K}$

$F' \approx a \cdot F$ $\quad F_{dB}' \approx a_{dB} + F_{dB}$

(1) *lossy antenna* $a_{dB} = -10\log_{10}\eta$

(2) *lossy transmission line* a_{dB}

(3) *lossy bandpass filter* a_{dB}

(4) *passive−mixer loss* a_{dB}