The Minimum Detectable Signal

So, the noise power at the output of a receiver is:

$$P_n^{out} = FGkT_oB$$

and the signal power at the receiver output is:

$$P_s^{out} = G P_s^{in}$$

$\therefore$ the SNR at the receiver output is:

$$\boxed{SNR_{out} = \frac{P_s^{out}}{P_n^{out}} = \frac{P_s^{in}}{FkT_oB}}$$

Q: What should the SNR at the output (i.e., at the demodulator) be??

A: It depends!! It depends on modulation type, demodulator design and system accuracy requirements.

Define the smallest SNR that will result in acceptable demodulation as $\underline{SNR_{min}}$.

SNR_{min} is typically:

$$\underline{-20\,dB < SNR_{min} < 40\,dB}$$

but most often $\approx \underline{3\text{-}5\ dB}$

Q: How do we insure that $SNR_{out} > SNR_{min}$??

A: We cannot change K or T_0, and F + B are design parameters.

$\Rightarrow$ SNR_{out} depends on signal power P_s^{in} !!

$\therefore$ for $SNR_{out} > SNR_{min}$,

$$\frac{P_s^{in}}{FKT_0B} > SNR_{min}$$

or $$P_s^{in} > FKT_0B\,(SNR_{min})$$

Define $FKT_0B\,(SNR_{min}) \doteq MDS$

$\doteq$ Minimum Detectable Signal

So for proper receiver operation,

$$P_s^{in} > MDS = F\,k\,T_o\,B(SNR_{min})$$

MDS sets the <u>minimum</u> signal power that can be adequately detected.

$\Rightarrow$ Called receiver <u>sensitivity</u>.