Minimum Average Power

\[ P_1 \rightarrow '1' \text{ bit} \]
\[ P_0 \rightarrow '0' \text{ bit} \]

\[ I_1 = R P_1 \]
\[ I_0 = R P_0 \leftarrow 0 \]

\[ \overline{P_{\text{rec}}} = \text{Av. received power} \]
\[ = \frac{P_1 + P_0}{2} = \frac{P_1}{2} \]

\[ P_1 = 2 \overline{P_{\text{rec}}} \]
Noise:

\[ 6_0^2 = 6_T^2 \]

\[ 6_1^2 = 6_s^2 + 6_T^2 \]

\[ 6_s^2 = 2 q R (2 \bar{P}_{\text{rec}}) B \]

\[ 6_T^2 = \frac{4 k T B}{R_L} \]

\[ Q = \frac{I_1 - I_0}{6_1 + 6_0} = \frac{I_1}{6_1 + 6_0} \]

\[ = \frac{2 R \bar{P}_{\text{rec}}}{(6_s^2 + 6_T^2)^{1/2} + 6_T} \]
\[ \overline{P_{\text{rec}}} = \frac{\sigma}{R} (\nu B \sigma + \delta r) \]

Thermal Noise Dominated
\[ \overline{P_{\text{rec}}} = \frac{\sigma}{R} \delta r \propto \sqrt{B} \]

Short Noise Dominated
\[ \overline{P_{\text{rec}}} = \frac{\nu B \sigma^2}{R} \propto B \]
Quantum Limit of Detection

\[
N = \frac{n}{nf} \int_{0}^{T} P(t) \, dt
\]

\[
P_{\text{prob of } n \text{ e-h pairs}} = N^n \frac{e^{-N}}{n!}
\]

Poisson's Distribution

\[
P(0) = N^0 \frac{e^{-N}}{0!} = e^{-N} = 10^{-9}
\]

\[N \approx 21\]
Fig. 5.20: Principle of eye pattern recording (explanation 1)
Measurement setup for EYE DIAGRAM

Transmitter
PN-sequence generator
Clock
Data

Oscilloscope
Y-input
External trigger

System under examination
EYE DIAGRAM

$5\delta_1$

$I_1$

$I_0$

clock Jitter

$5\delta_0$