



Receiver Sensitivity

Objective:

Determine the sensitivity of a PIN photodiode based optical receiver by determining the minimum received power necessary to achieve a given Q factor. Compare the results of simulation with the results of an analytic approach.

Theory:

If we include only the effect of thermal noise, the sensitivity of a PIN photodiode-based receiver is

$$S = \frac{Q\sigma_T}{R}$$

where

- S = sensitivity (W)
- Q = desired Q factor (related to the desired bit error rate or BER)
- R = photodiode responsivity (A/W)
- σ_T = rms thermal noise current (A)

The rms thermal noise current σ_T is given by

$$\sigma_T^2 = S_T B$$

where

- S_T = thermal noise spectral density (A^2/Hz)
- B = receiver bandwidth (Hz)

Calculations:

The table below lists the receiver specifications:

Operating bit rate	2.5 Gb/s
Bandwidth	1.65 x bit rate
Thermal noise spectral density	X.Y x 10^{-22} A^2/Hz
Desired Q factor	6
PIN photodiode responsivity	1 A/W



X and Y are the last two digits of your student ID number. For example, if your ID number ends with 43, then us $S_T = 4.3 \times 10^{-22}$. Determine the receiver sensitivity using the formulas given above.

Layout:

The layout consists of:

1. CW laser source
2. Modulator with a non-return to zero modulator
3. Optical attenuator
4. PIN photodiode with an electrical filter

The PIN photodiode has the responsivity left as its default value, 1 A/W. The dark current is set to 0. The ASE noise parameter is turned off. The thermal noise parameter is available for you to edit.

Power meters have been placed at the output of the modulator and after the attenuator to allow you to determine the optical power at the output of the transmitter and the input to the receiver.

Simulation:

Adjust the output power to obtain a transmission output power 0dBm. Set the attenuator to 20dB. Run the simulation. Adjust the attenuator until the Q factor is 6.00 ± 0.05 .

Report:

- A neat, well-presented summary of your pre-lab calculations (attach any hand-written calculations).
- Screen shots or other displays of the results of your simulation including power readings BER analyzer display (including eye diagram).
- Discussion of any differences between the calculation and the simulation results.