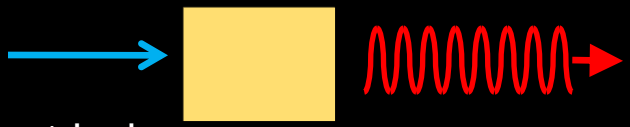
ECE 6323

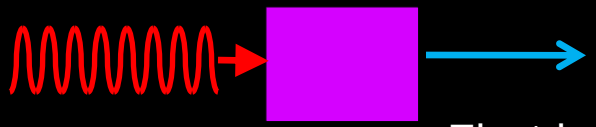
RECEIVERS

Functional concept

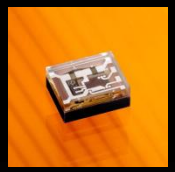
Transmitter
(Transmitter Optical Sub-Assembly – TOSA)



Receiver
(Receiver Optical Sub-Assembly – ROSA)

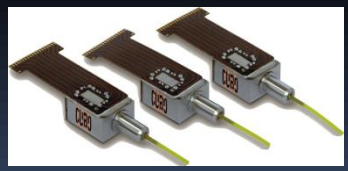






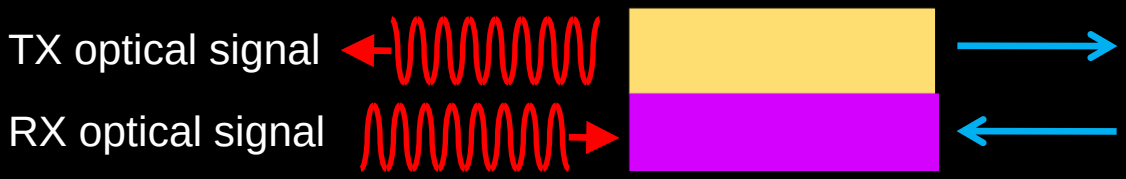




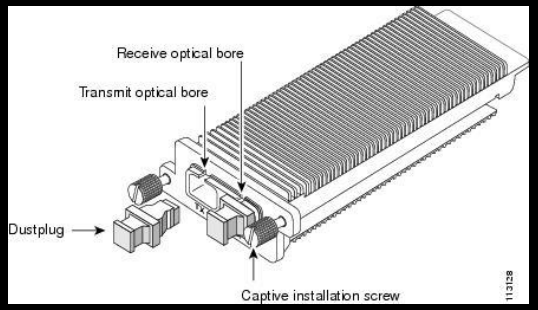




Functional concept

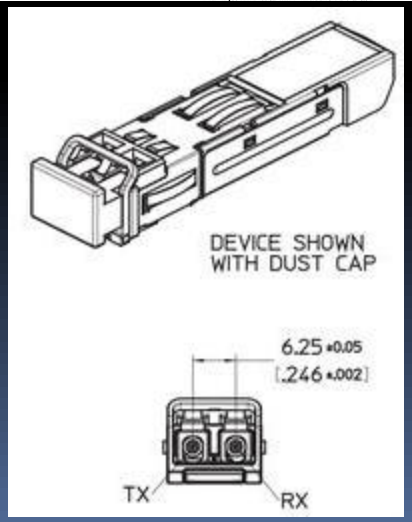
Transceiver (transponder)
(TOSA-ROSA)



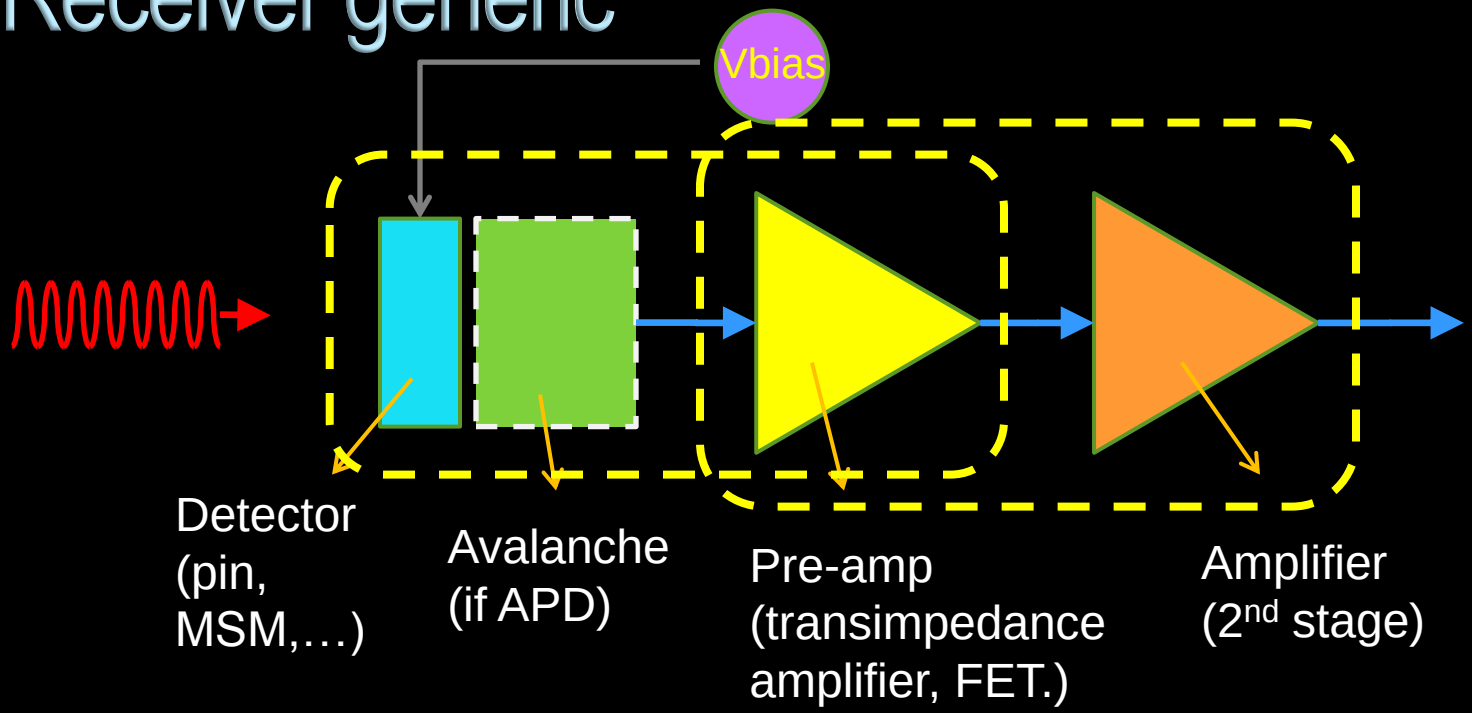
XFP



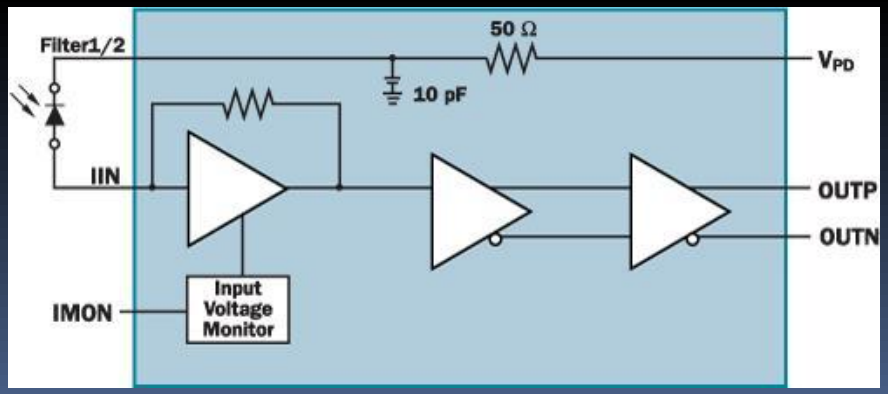
SFP



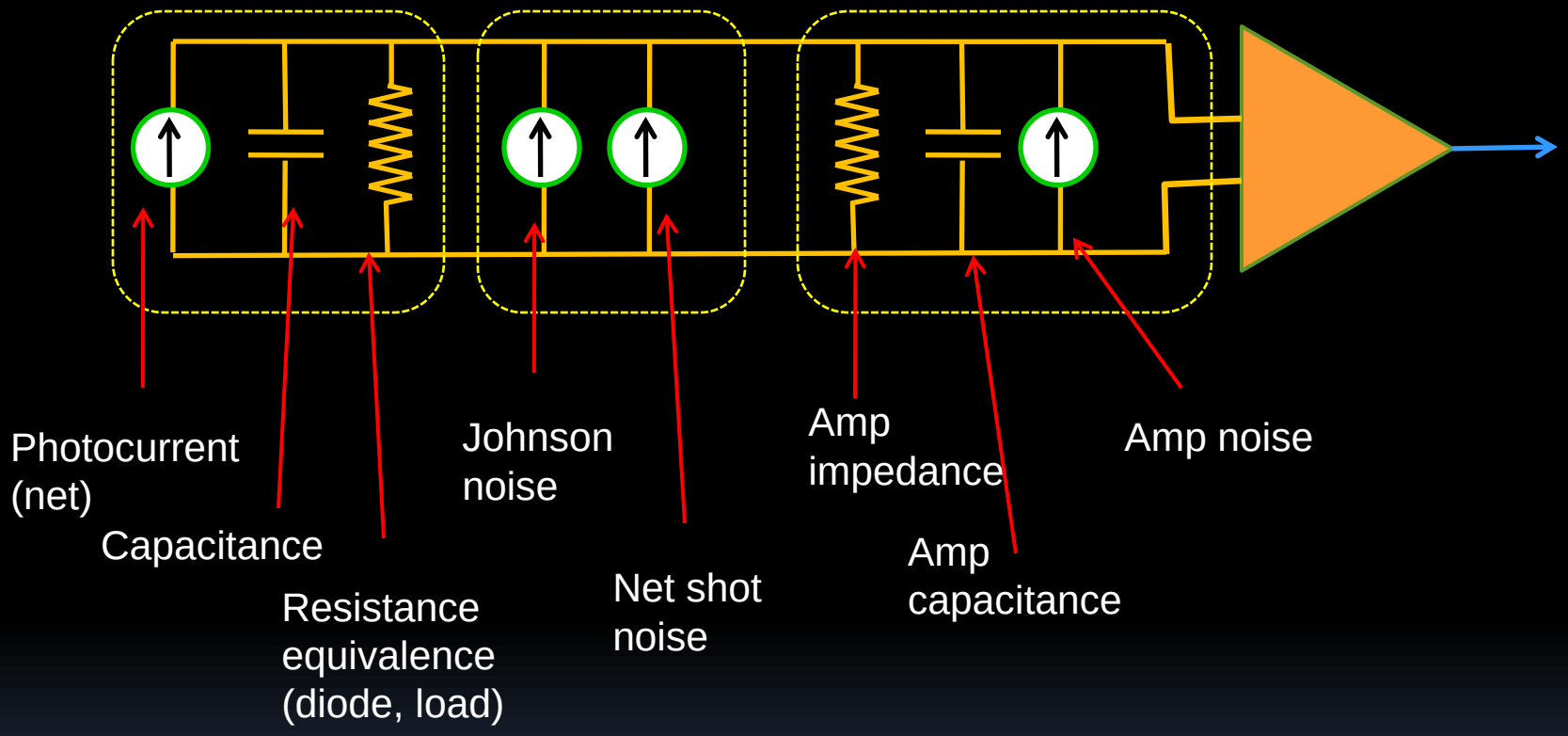
Receiver generic



Example



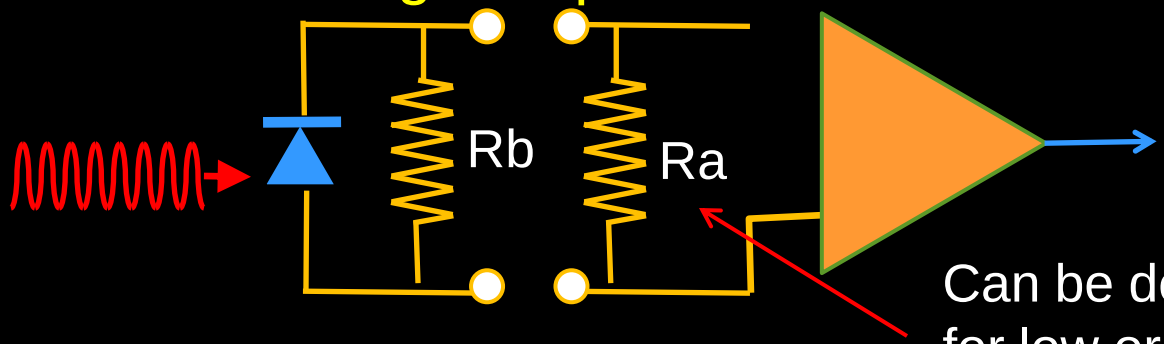
Equivalent circuit (generic model)



- Specific design needs specific circuit model
- Many models can approximated with generic model with appropriated reduction and equivalent values
- Noise simulation results can be modeled with generic

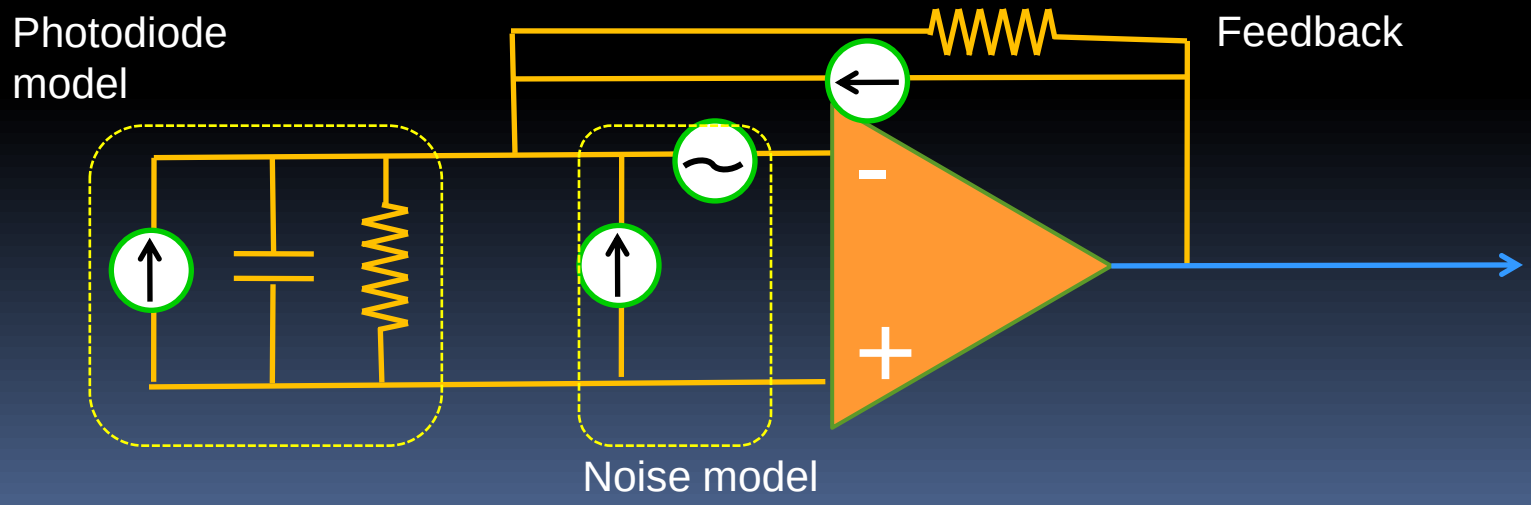
Some pre-amp configurations

Voltage amplifier



Can be design for low or high input impedance

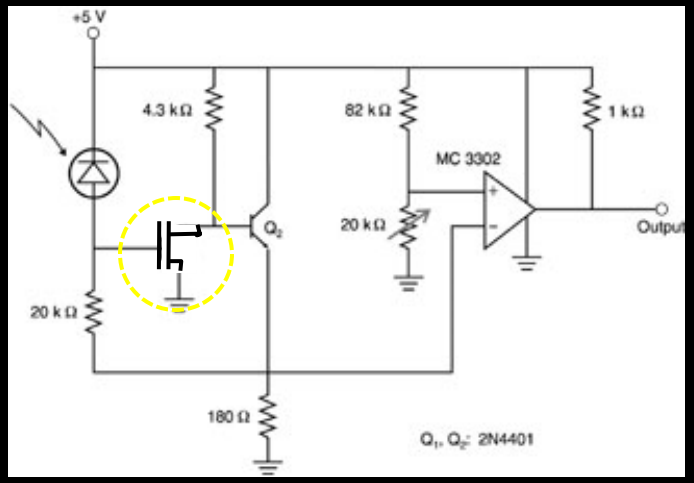
Transimpedance amplifier



Integrated FET (or bipolar transistors)

- FET is used as 1st element of the preamp stage
- Can use multiple FETs
- Can be FET – transimpedance combo
- Variation in circuit designs, but all based on the same idea: low-noise FET is directly integrated with photodetector: PIN or APD

FET preamp concept



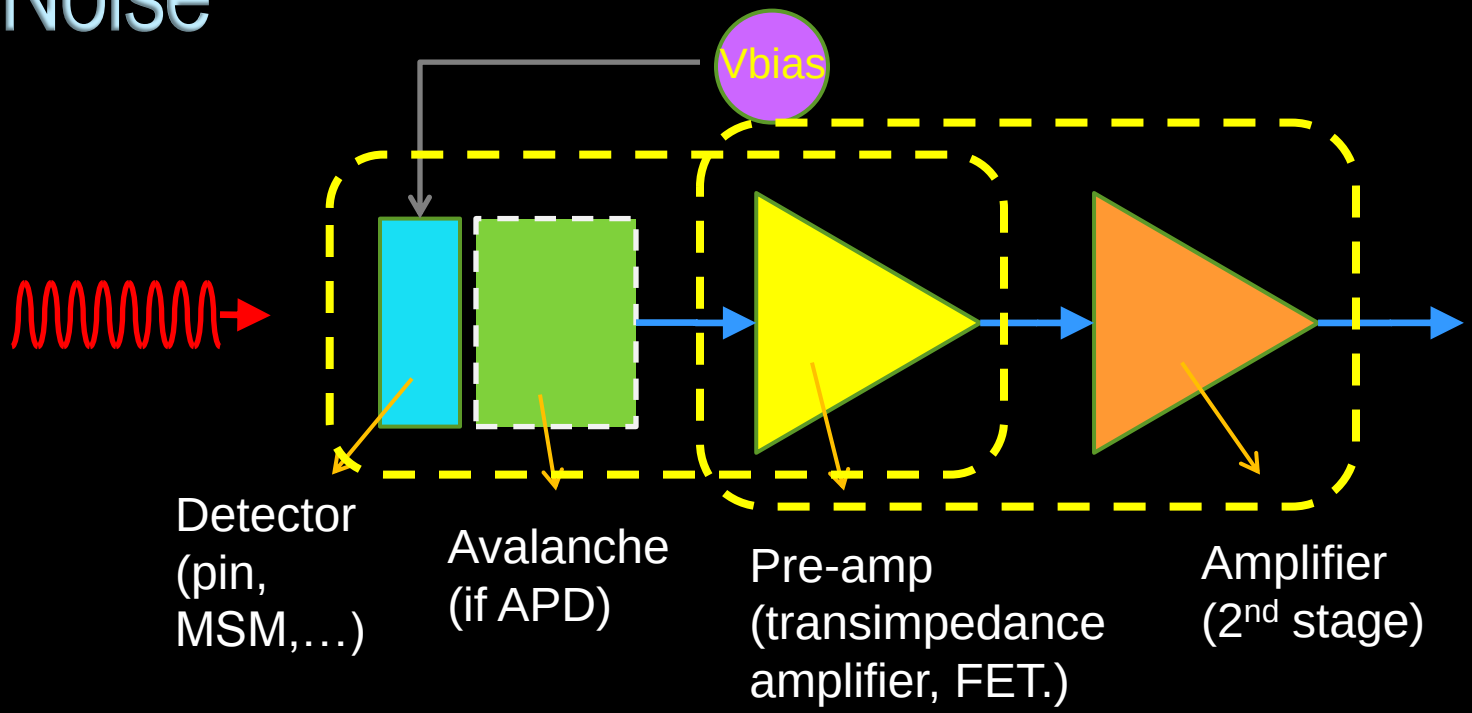
- MESFET, JFET, HEMT
- More complex optimization can be done for (with trade-off):
  - Speed, sensitivity, frequency response (flatness)
  - Noise

Basic Response and Noise

Key concepts

- Impulse response, frequency response (sometimes, S-parameters, rare)
- Three approaches:
  - Simulating realistic physical model;
  - Constructing basic model, and fit with empirical parameters (e. g. Norton circuit)
  - Strictly empirical (measurements) and constructing parametrized model
- Usually semi-empirical (approach 2) is most practical
- Noise is usually the most important considerations
- Ultimate figure of merit: receiver sensitivity vs. BER given bit rate

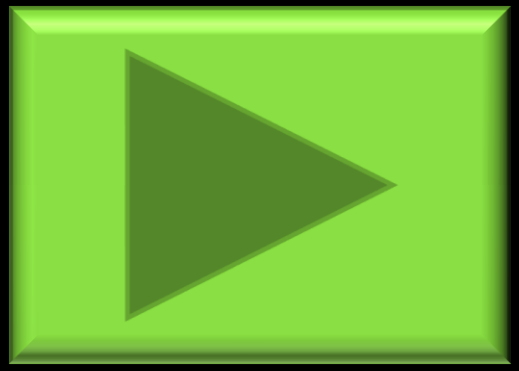
Noise



- Quantum noise
- Shot noise (both signal and dark)
- Bias source noise (inc. thermal noise)

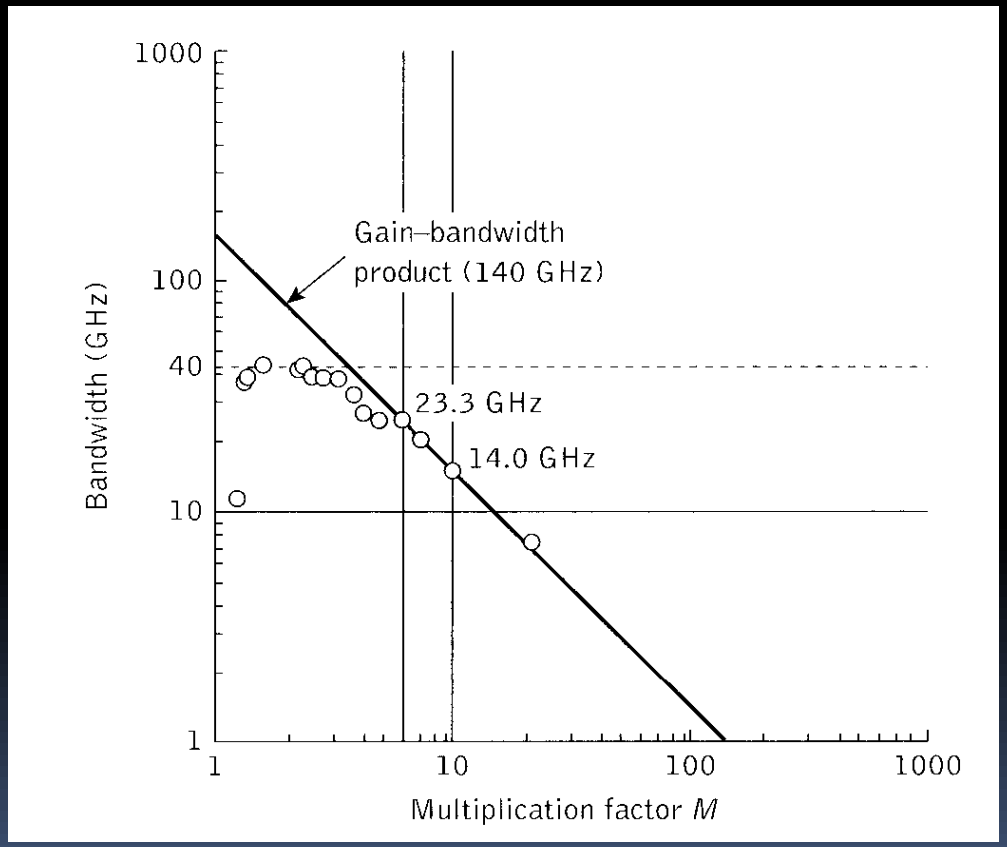
Avalanche excess noise

Electronic noise (inc. thermal noise, transistor noise, amplifier noise

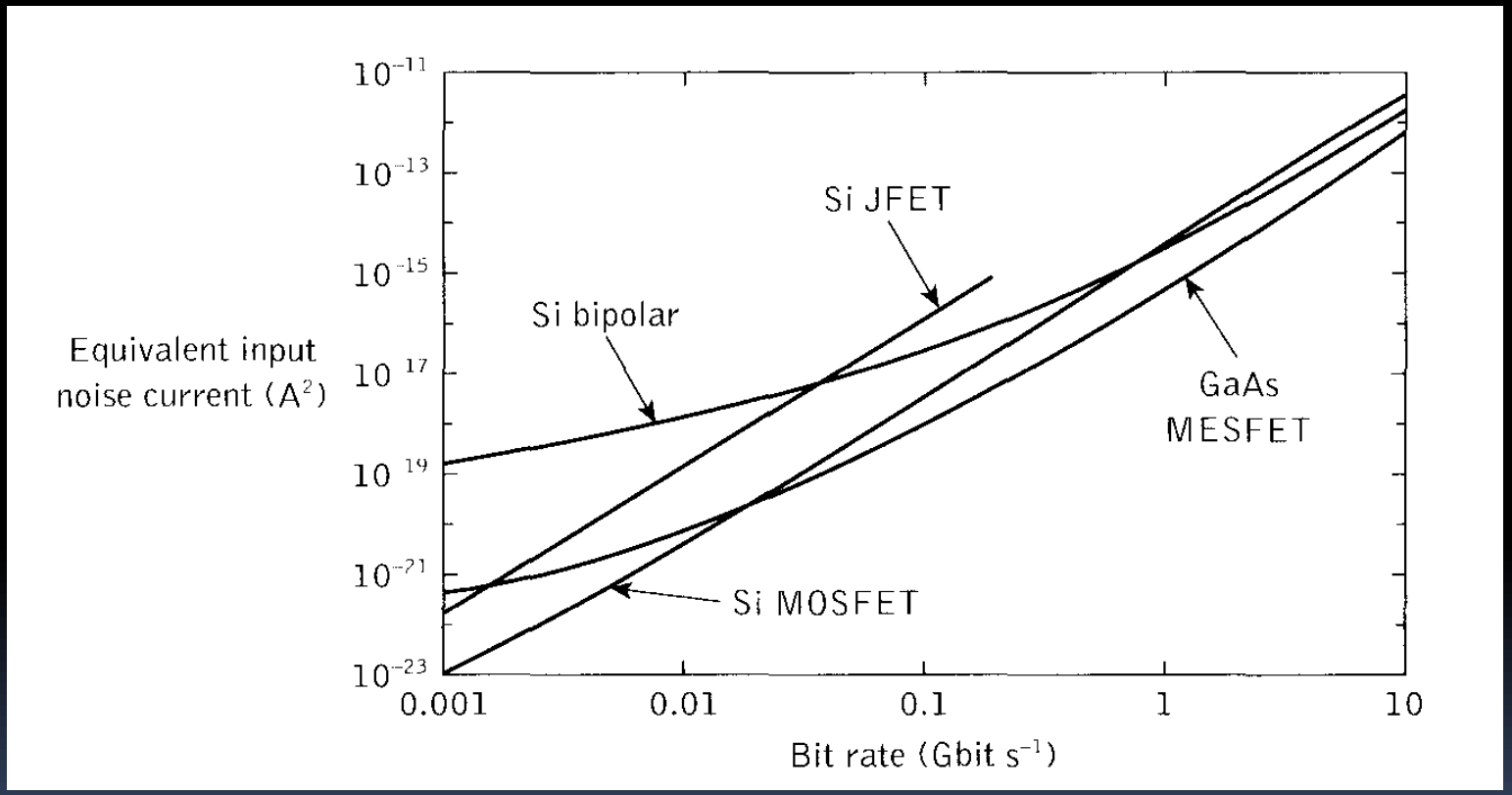


Noise considerations

APD: Gain-Bandwidth Product Limit



Some Representative Noise Data



Some Receiver Performance Data