# Kelvin Ly

Hi Neocis!

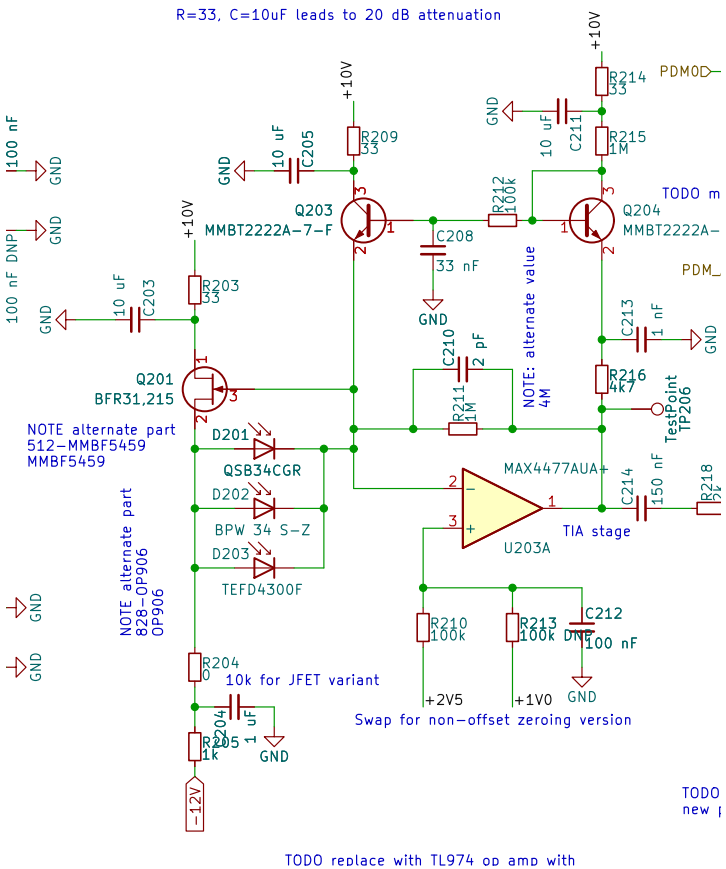
# Introduction

- BSEE and MsEE at University of Central Florida
  - Research work in hardware security
  - PCB design, FPGA work
- Electrical engineer at STERIS IMS
  - Reverse engineering medical devices
  - Design, layout, testing of replacement PCBAs
  - High speed, some high density, FPGA
  - Tons of protocols (SPI, I2C, UART, SWI, SWD, SBW, USB 2.0, JTAG, MIPI CSI-2, HyperRAM, NFC Type V)
  - FPGA stuff, image processing
- Side jobs/projects
  - A little bit of everything
  - Two side jobs
    - Fluorometric Instruments, industrial chemical sensors
    - Cassina Technologies, company one of my coworkers runs on the side
  - Mixed signal design, FPGA, some RF design
  - Working on the mechanical design for a CNC right now

# Optical communications project

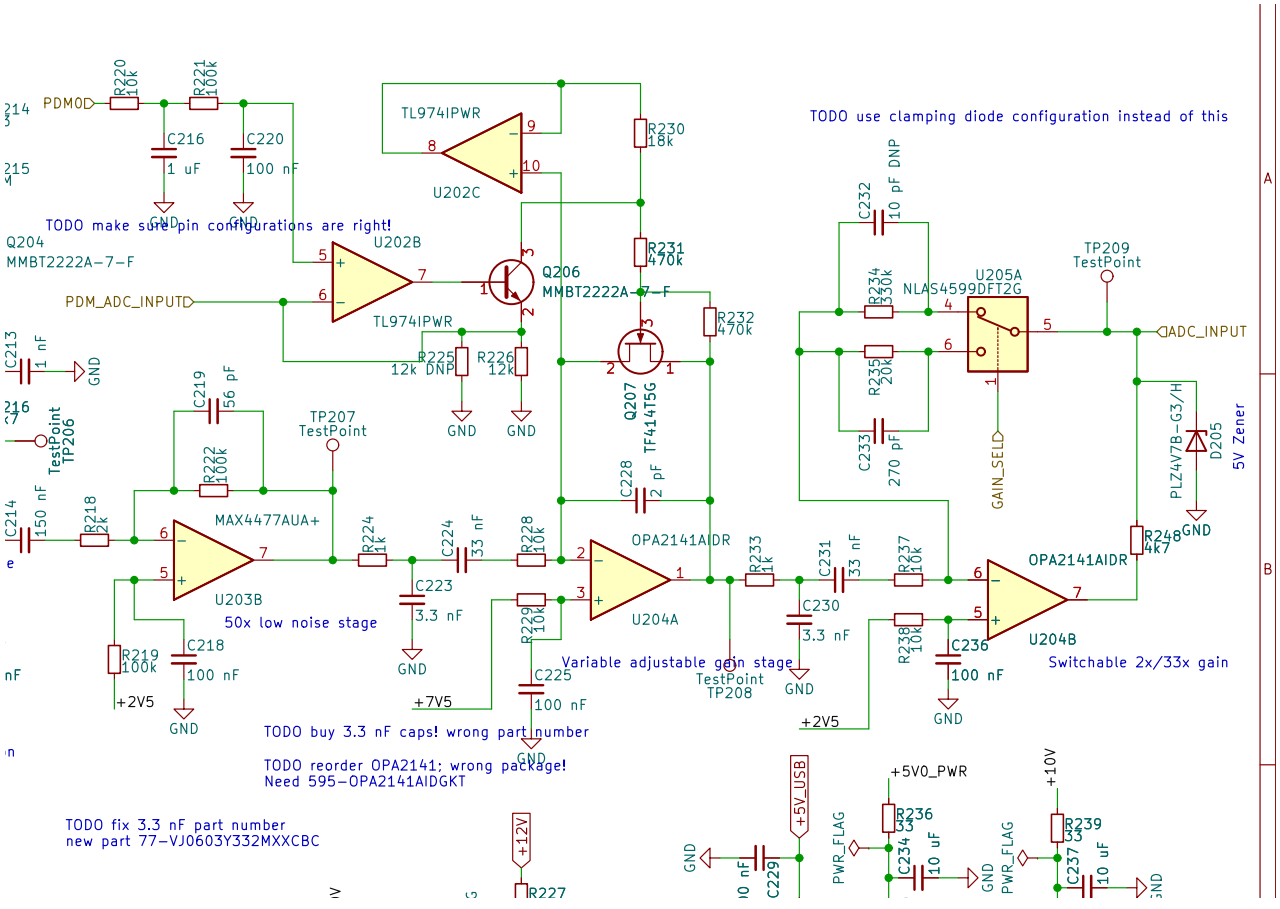
- I designed this years ago, hindsight is 20-20
- Design parameters
  - Low bitrate unidirectional communication
  - Moderate range
  - White LED for transmitter, photodiode as receiver
  - USB interface
- Objectives
  - High dynamic range (want to be very tolerant of beam angle)
  - Huge emphasis on noise analysis
  - Highly flexible (I have no idea what I'm doing and I don't want to pay for a second board spin)
  - Let's do a lot of signal processing because I don't know a lot of that

# Front end




- Largely based on Chapter 18 of Building Electro-optical Systems by Philips C. D. Hobbs
- Also Analog Devices Design Note 399
- TIA with some extra bells and whistles
- Lots of noise analysis, some stability analysis
- BJTs act to remove voltage offset
- JFET acts as a low noise bootstrap to reduce effect of photodiode capacitance

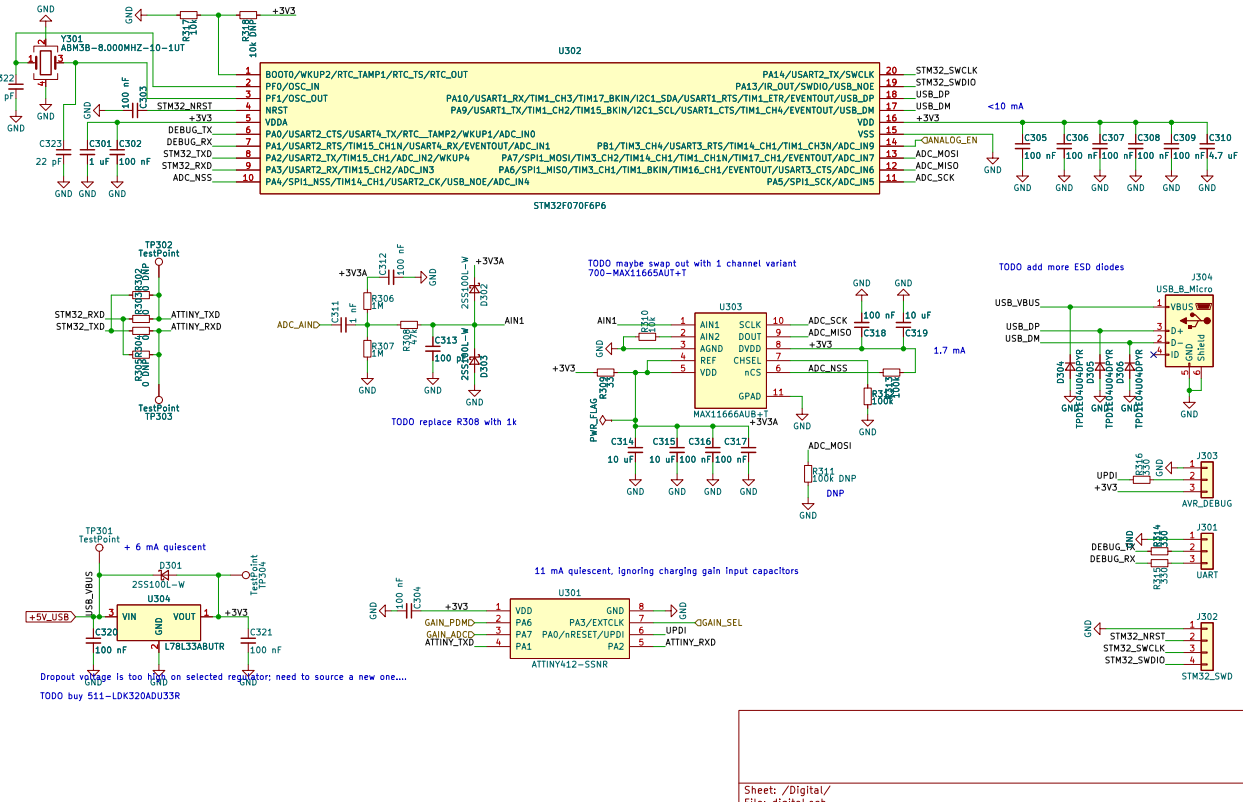
# Way too many amplifier stages



# Way too many amplifier stages

- Lots of gain on the front so that the added noise is minimized
- Lots of adjustable gain and rudimentary bandpass filtering
- ATtiny412 setting gain on the JFET stage

# Digital side




- 12-bit discrete ADC into STM32 micro
- USB interface directly from STM32 micro, useful for high bitrate of ADC channel

# Lessons learned

- Debuggability is an important design factor
- Less is more
- Break projects into smaller steps
- Questions?