

**Introduction**

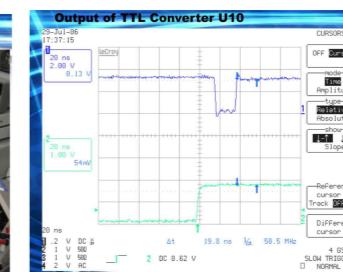
- Single Photon Avalanche Diodes used to detect a single photons
- SPAD Modules used in quantum info to detect entangled photons
- Single Photon Avalanche Diodes reversed biased into Geiger Mode

**Applications**

- Basic Quantum Mechanics
- Cryptography
- Astronomy
- Single Molecule Detection
- Luminescence Microscopy
- Fluorescent Decays
- Imaging in Physics, Chemistry, Biology, and Material Sciences
- Diode Laser Characterization
- Optical Fiber Testing in communications and sensor applications
- Ranging in space applications and telemetry
- Photon Correlation Techniques in laser velocimetry

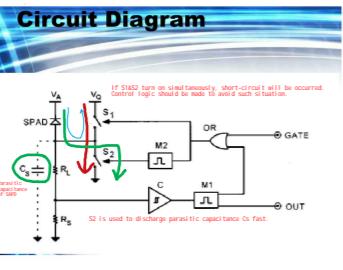
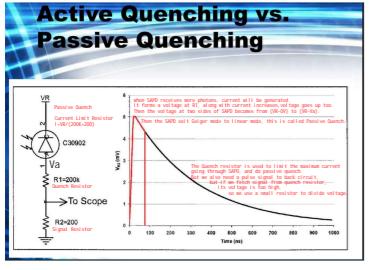


**Functionality Tests**



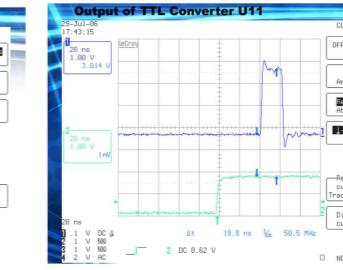
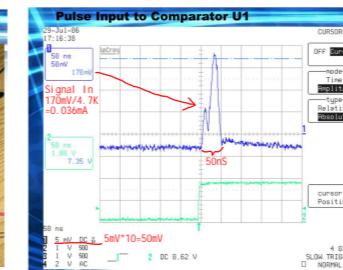
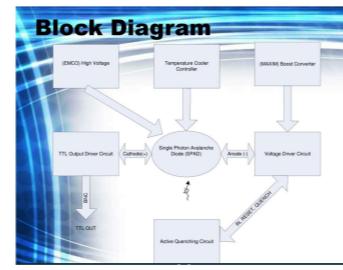
**Successes and Challenges**

- Active quenching circuit works with a SPAD, but it stopped working and is not repeatable
- Circuit performs exactly as specified in the design guidelines
- Every part of the circuit is tunable
- Hard to troubleshoot because of price of diodes



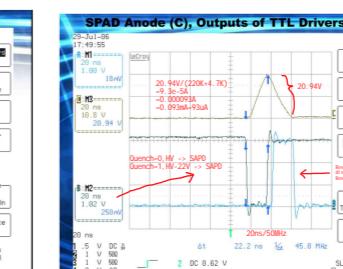
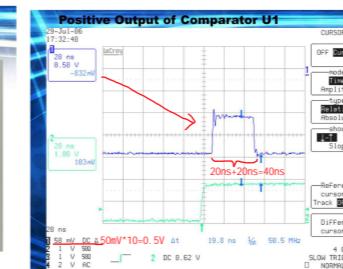
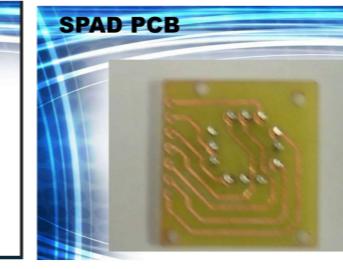
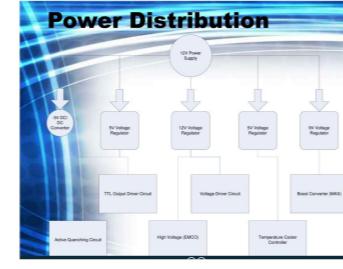
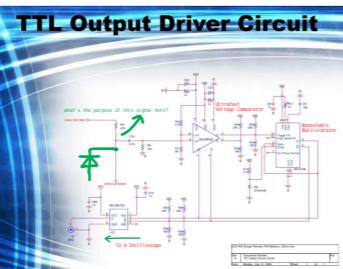
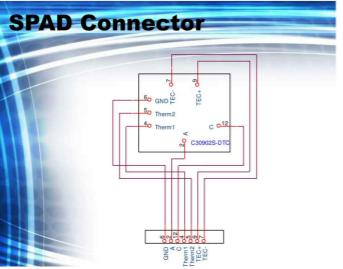
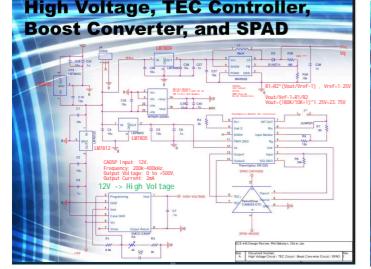
**Objectives**

- To make a module to drive a Single Photon Avalanche Diode
- To lower the cost of production compared to commercially available modules
- To use modern components



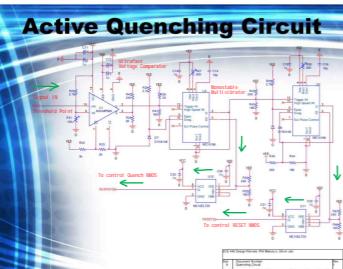
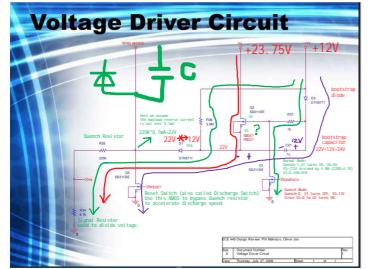
**Cost Analysis**

- A commercial module costs \$5000
- Our module cost \$500 to build and includes a \$700 SPAD
- Our module is much cheaper; total cost of \$1200, or about 25% the total cost of a commercial module



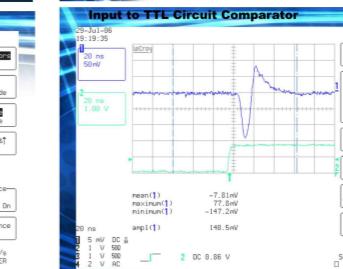
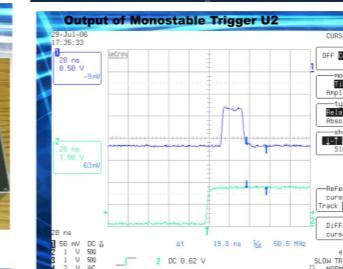
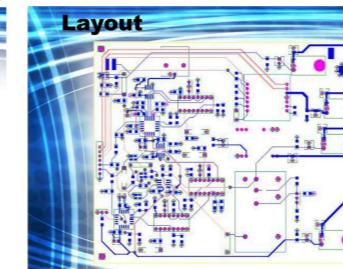
**Other tests**

- Verified EMCO High Voltage
- Verified ThermOptics TEC Controller
- Verified Boost Converter



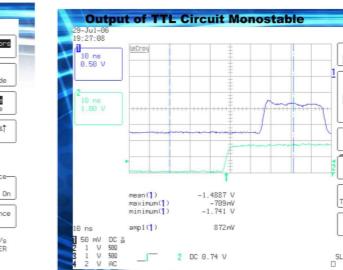
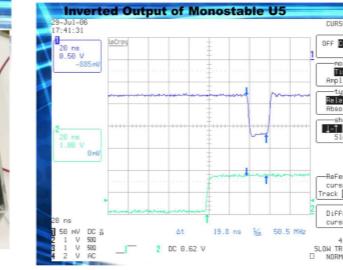
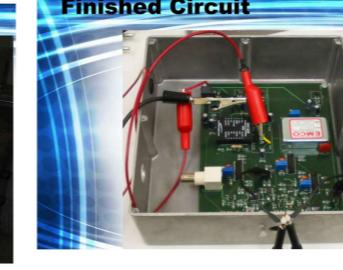
**Project Build**

- PCB Design
  - Done in OrCad
- PCB Fabrication
  - Outsourced to PCBFabExpress
  - Pick and Place
  - Reflow Oven
  - Through Hole Soldering
  - SPAD PCB
  - Metal Casing



**Recommendations**

- Disconnect Voltage Driver from the circuit and try to observe passive quenching
- Increase Bias Voltage until passive quenching is observed and record



**Thanks to**

- Professor Swenson
- Professor Kwiat
- Austin Kirchhoff
- Alex Spektor
- Mike Thompson
- Mark Smart
- Scott McDonald
- Greg Cler
- Wally Smith
- Professor Franke
- Professor Haken