

USB Oscilloscope Integrated with Circuit Simulator Software

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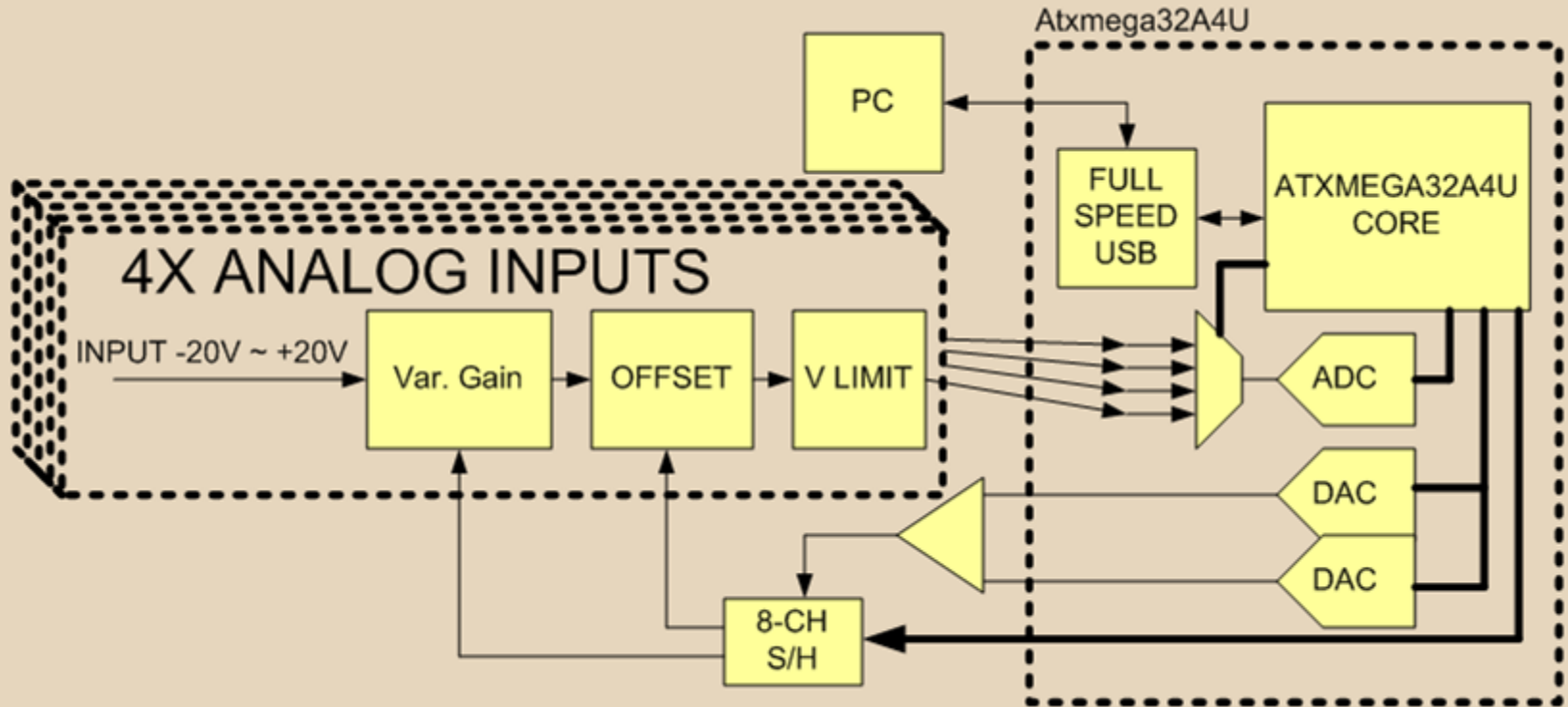
Project Overview / Goals

- ❖ Implement cost-effective USB Oscilloscope
- ❖ Create duality between hardware & circuit simulator software
- ❖ Everything in real-time

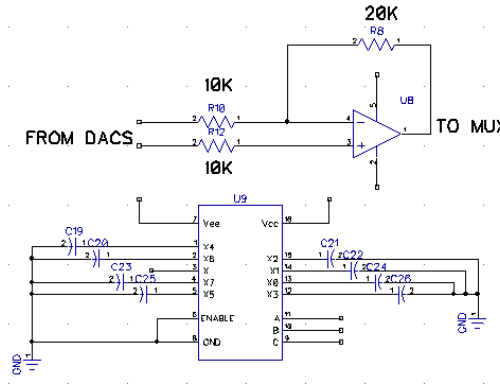
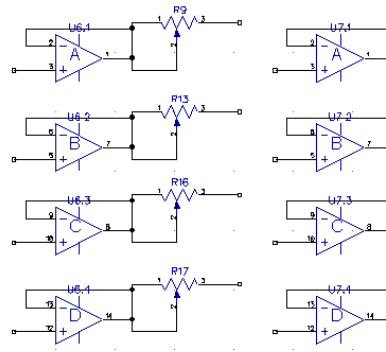
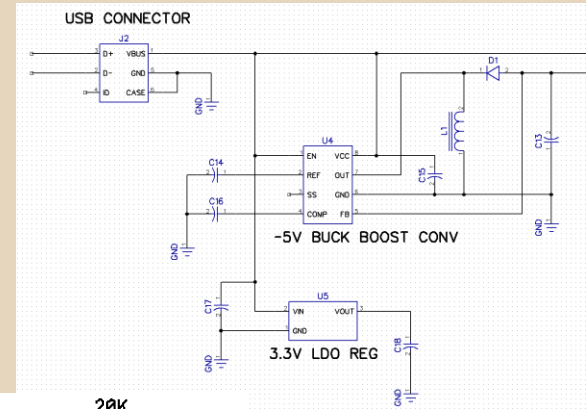
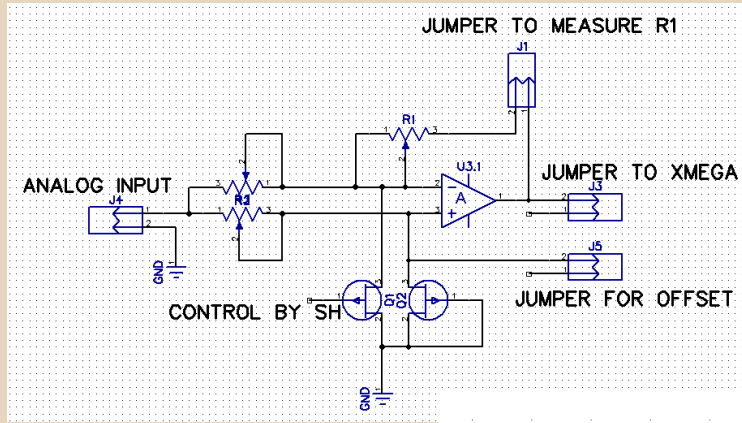
Achieved thus far

- ❖ Utilized on-chip ADC and DACs
- ❖ USB Generic HID Connectivity (Driver-less)
- ❖ Real-time oscilloscope display in circuit simulator
- ❖ Preliminary triggering system

Hardware Structure



Circuit Schematics



Hardware Specs

- ❖ 12-Bit Res. (1mV ~ 10mV) Sampling Accuracy
- ❖ Adjustable Front-end gain and offset
- ❖ Over-voltage protection (resistive divider)
- ❖ ~30-40mA Current Consumption from USB port
- ❖ Designed in DipTrace
- ❖ Fabricated by Bay Area Circuits

Hardware Costs

Price for components for one board, excluding tuning trimmers ~\$33

\$30 for two far-too-large boards.

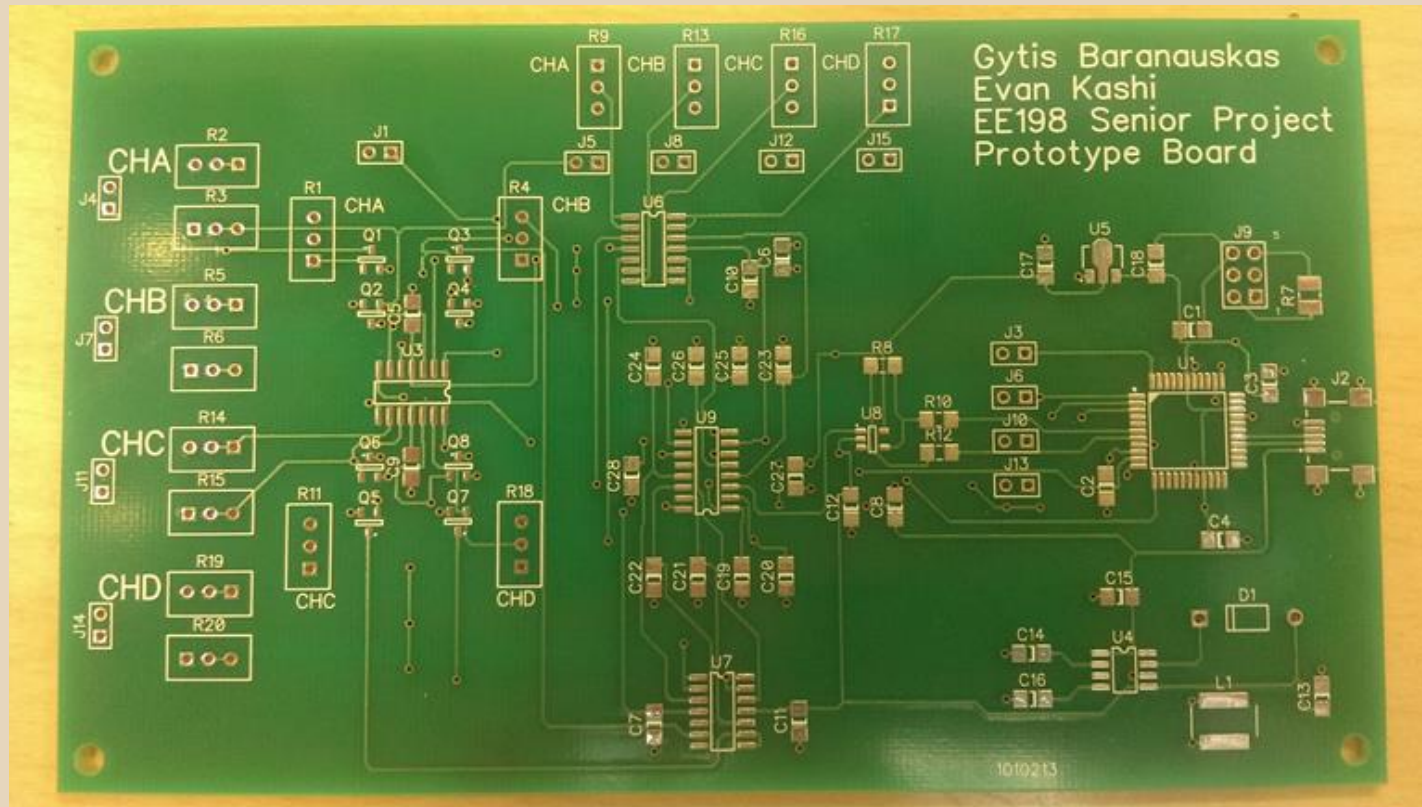
Current Board Cost

Front-end Analog parts	\$14.11
Digital Interface parts	\$10.47
Power Management parts	\$8.30
Board Fabrication	\$15.00
Total	\$47.88

Estimate Bulk production

Parts	\$20
Board	\$5
Assembly	\$5
Total Board Cost	\$30

Bare PCB



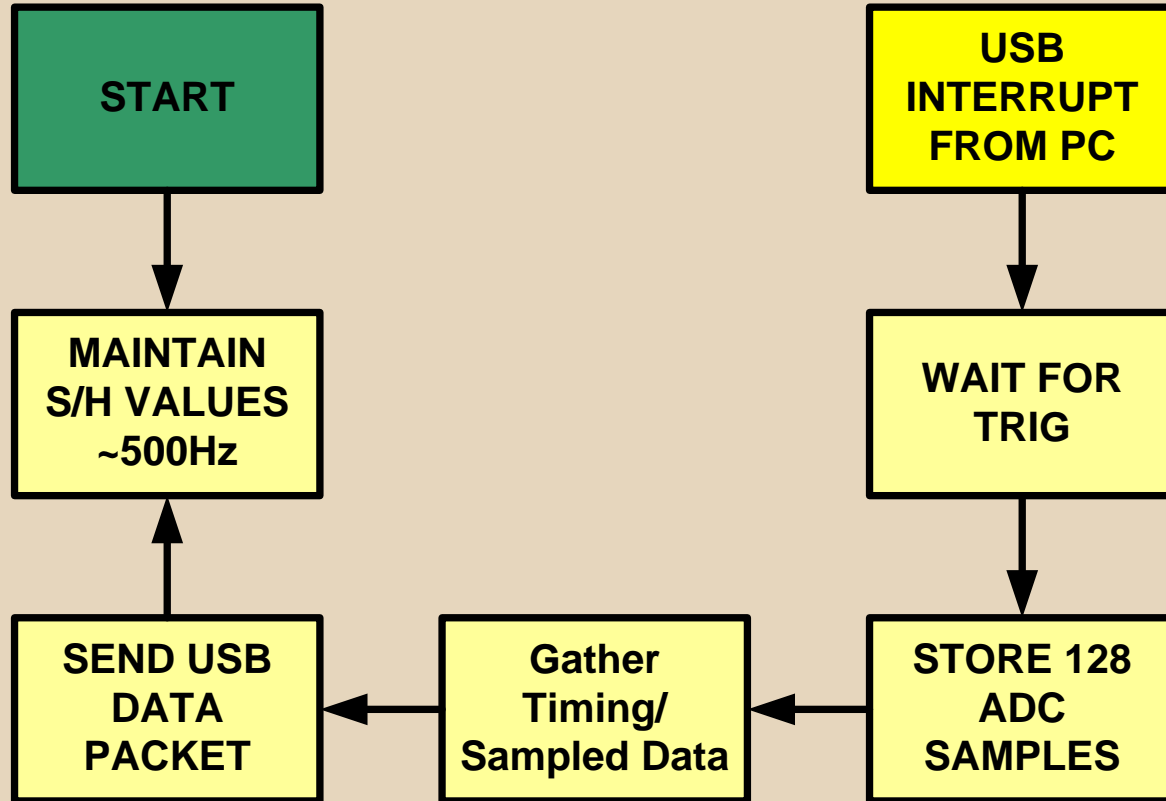
Fabricated PCB



Firmware Specs

- ❖ Built in Atmel Studio, written mostly in C, some critical functions written in Assembler.
- ❖ UI Generated from Atmel's Software Framework (ASF)
- ❖ Programmed through PDI(2W) using AVR Dragon

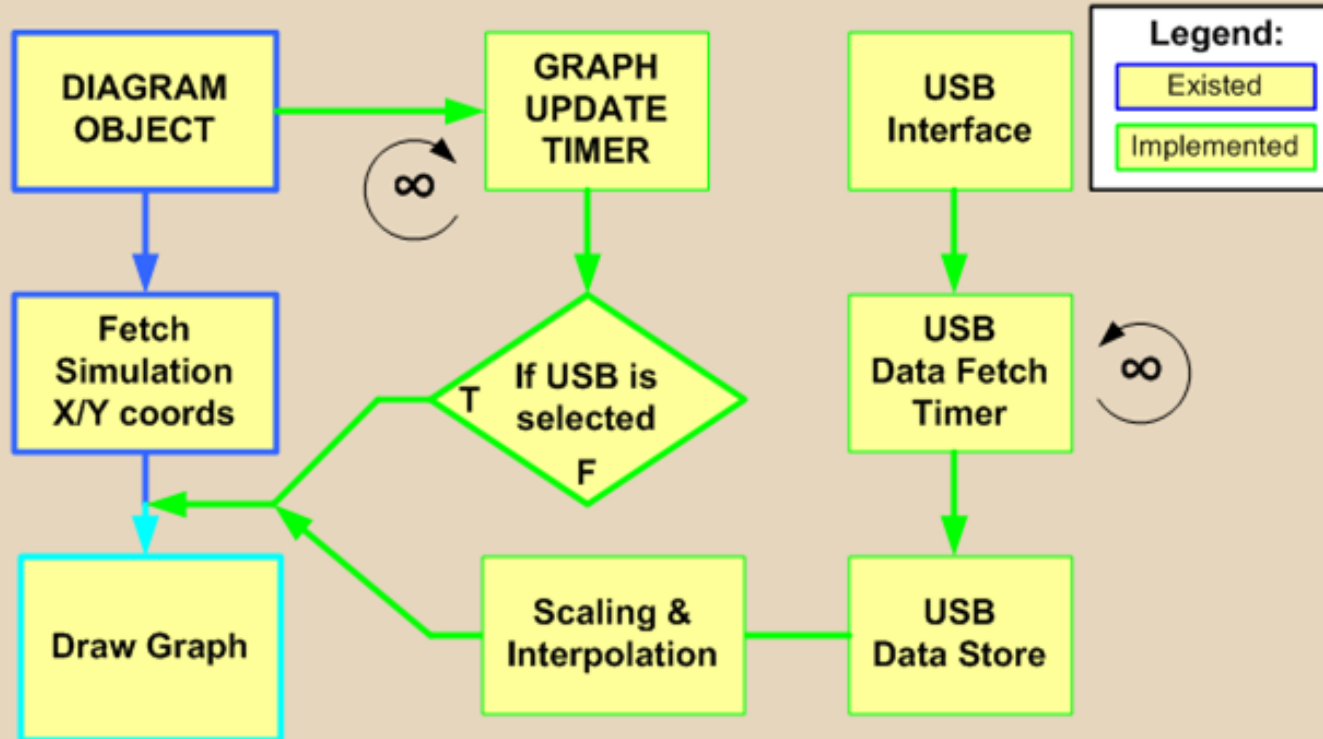
Firmware Structure



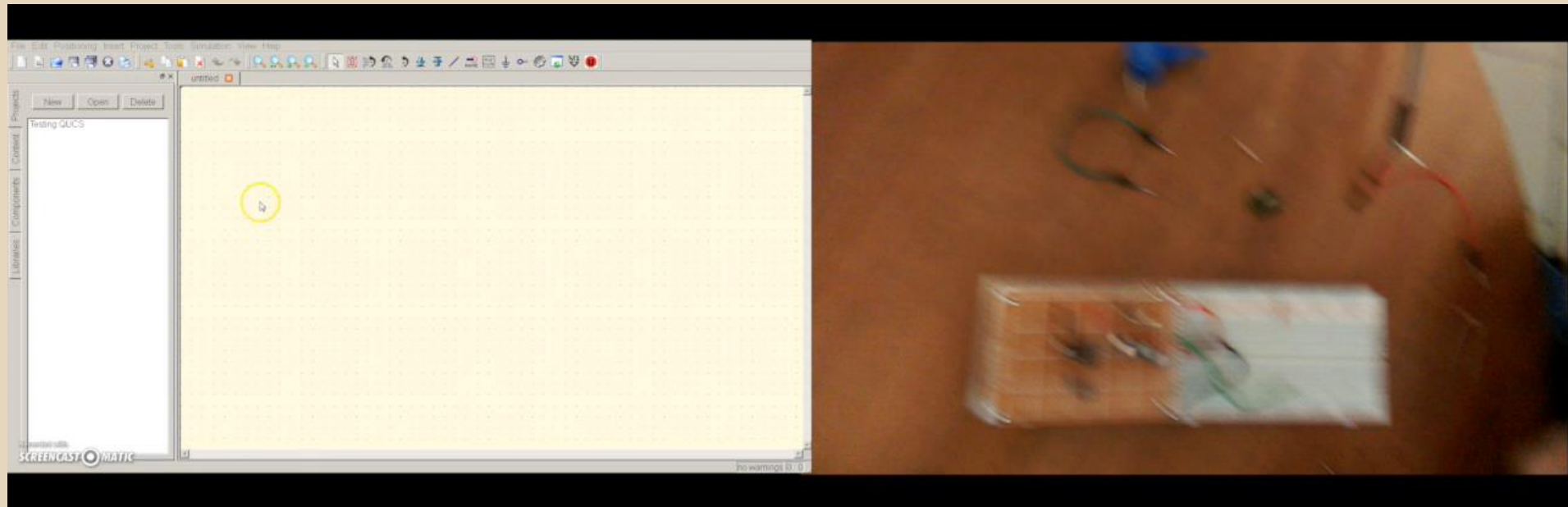
Software Specs

- ❖ Quite Universal Circuit Simulator (QUCS)
- ❖ Written in C++ (Qt Libraries)
- ❖ Built with CMAKE/MinGW Toolchain
- ❖ USB interface Libraries
- ❖ Real-time data injection/plotting

Software Structure

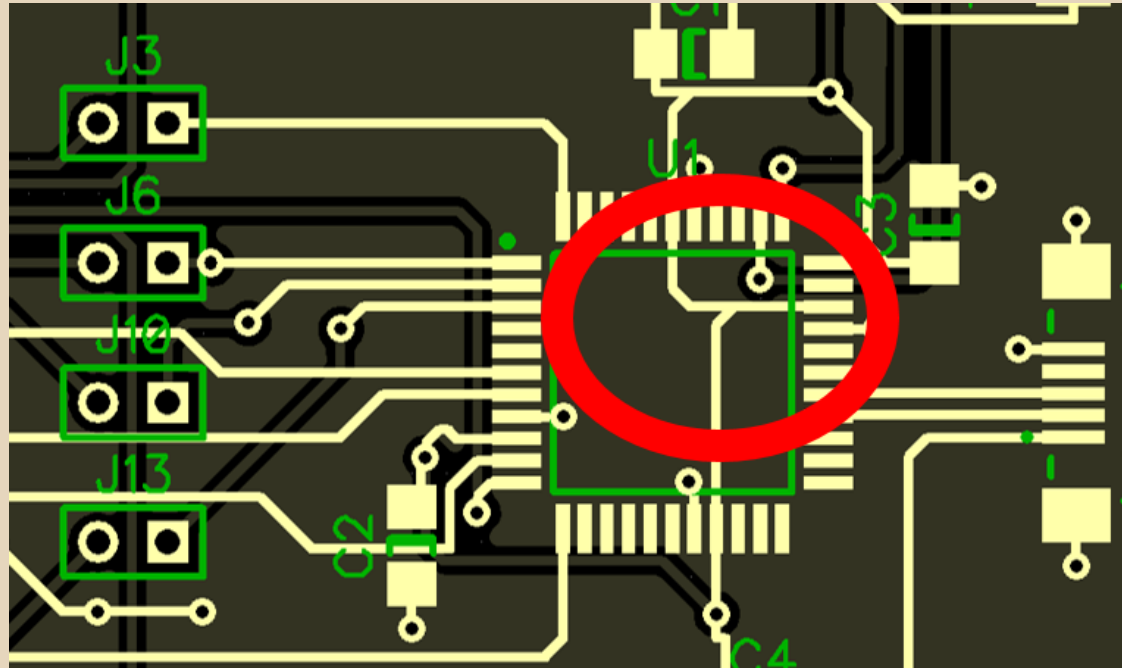


Demo



Issues encountered

- ❖ Malfunctioning Voltage Regulator
- ❖ Broken Trace
- ❖ Trigger stability



Importance

- ❖ Last popular innovation was the digital oscilloscope
- ❖ Prevalence of PCs and technology increasing Y-O-Y
- ❖ PC scopes exist, but are unpopular and expensive

Importance cont.

- ❖ Integration with circuit simulators yet to be done
- ❖ Create all-in-one platform
- ❖ Intuitive interface in single window
- ❖ Perfect low-cost tool for the increasing numbers of engineering students and electronics hobbyists

Looking Forward

Possible Additions:

- ❖ Input resistance 1Meg
- ❖ Current sensing and function generator
- ❖ Res/Cap/Ind measurement
- ❖ Adjustable trigger
- ❖ Integration with different simulators

QUESTIONS?

-Thank You-