

**Watson Capstone Projects
Project Proposal Form**

Computer, Electrical, and Mechanical Engineering
Thomas J. Watson School of Engineering and Applied Science
Binghamton University

1. Project Title

USB Gain/Phase Analyzer

2. Organization Name and Address

Binghamton University
Department of Electrical and Computer Engineering
4400 Vestal Pkwy E
Binghamton, N.Y. 13902-6000

3. Contact Names, Phone, Email Address

a. Sponsor Management Representative:

Prof. Kyle Temkin

b. Sponsor Technical Representative:

Prof. Kyle Temkin

4. Project Description

A Gain/Phase Analyzer is an instrument used to plot the frequency response of a network or amplifier. These instruments are generally considered to be expensive, specialized pieces of equipment, with units from major manufacturers costing tens of thousands of dollars. However, these instruments could be very useful in a less expensive, more compact form, and particularly valuable in the educational sector.

I propose a small, USB-driven gain/phase analyzer for low-frequency to mid-VHF bands (from around 1 kHz to 100+ MHz). The gain-phase analyzer shall be a low-cost instrument targeted at education, and should be open-source to allow students to see how it works. It shall be able to produce accurate and precise Bode plots of filters, amplifiers, control systems, and so on, for experimentation, circuit design, and circuit analysis.

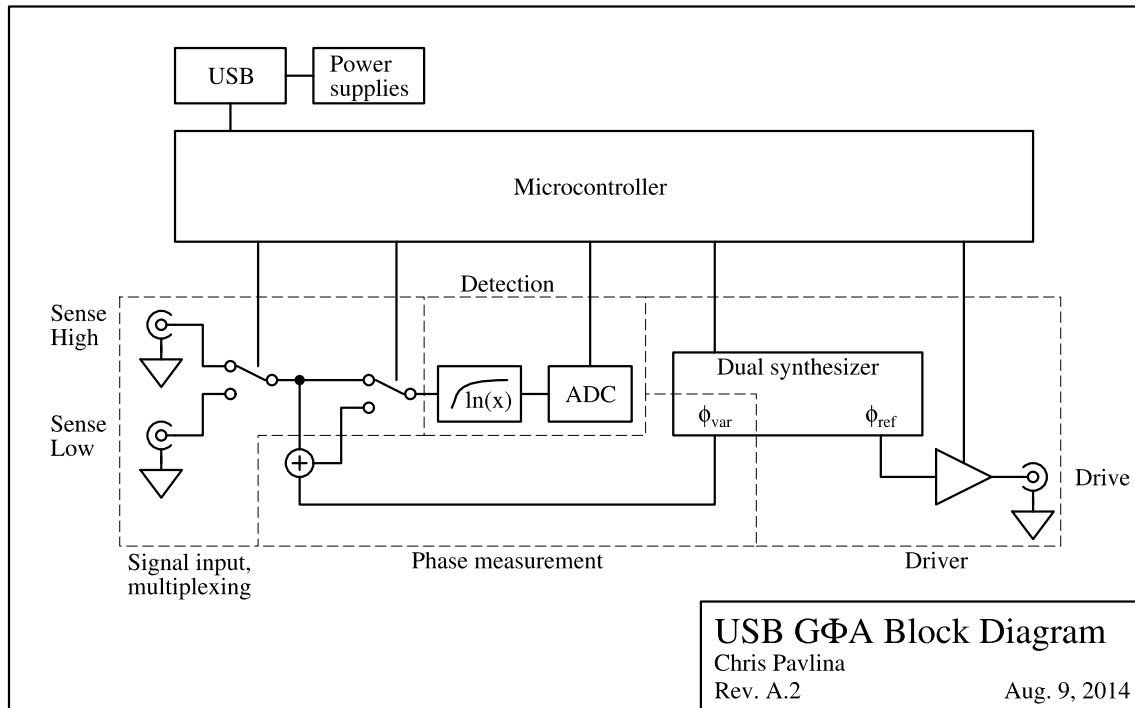
5. Project Requirements

- The analyzer shall be able to display data to the operator in the form of a standard Bode plot, using a PC interface.
- The analyzer shall be capable of sourcing test signals between 1 kHz and 100 MHz, and able to detect them down to at least 50 dB below the output amplitude.
- The analyzer should be able to detect signals down to at least 80 dB below the output amplitude.
- Amplitude accuracy shall be within 2.5 dB, and phase accuracy within 5 degrees.
- Amplitude accuracy should be within 1 dB, and phase accuracy within 1 degree, for frequencies less than 20 MHz.
- The analyzer shall be capable of performing most analysis functions directly, allowing the PC software to be simple.
- The analyzer should use an easily-scripted, text-driven interface, for example, USB-CDC.
- The interface should expose direct control of the hardware functions, allowing additional features to be implemented.
- The user shall not be able to damage the hardware by its remote interface, unless an “unlock” command has been issued.
- The PCB shall be compact, and the enclosure should be no larger than what is required to contain this.
- The PCB shall be produced using surface-mount technology as much as is reasonable.

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- The analyzer shall use standard connectors, either SMA or BNC, to allow the use of existing test equipment in a larger setup.

6. Project Graphic



7. Budget

Major components:

Item	Proposed part number	Total cost
High-frequency synthesizer	AD9958	\$35.48
PCB, 4-layer, two revisions	N/A	\$120.00

The project will operate with a fixed budget of \$500.

8. Deliverables and Meetings

Deliverables:

- Schematics and PCB artwork
- Enclosure drawings
- On-board firmware
- One working gain/phase analyzer
- Open-source PC companion software (command line-only is acceptable)

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- Operator's manual including:
 - Theory of Operation explaining the function of the system.
 - Instructions explaining the use of each function.
 - Example test setup for filter characterization.
 - Example test setup for control loop characterization; for example, stability analysis of a voltage regulator.

Meetings:

We will meet weekly to discuss project plans and work which is to be completed.

9. Recommended Team Composition

Mechanical Engr:	Electrical Engr:	Computer Engr:
0	2	2

10. Citizenship Requirements

None.

11. Team Members

Christopher Pavlina (EE)