

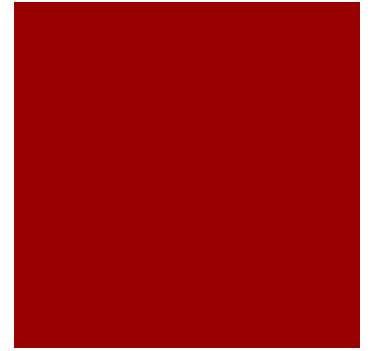


Depth Sensor

Alex Burwell

Outline

- Brief Review
 - Water Pressure
 - Piezoresistive effect
- Circuit
- Data Logger
- Data Reader
- Conclude

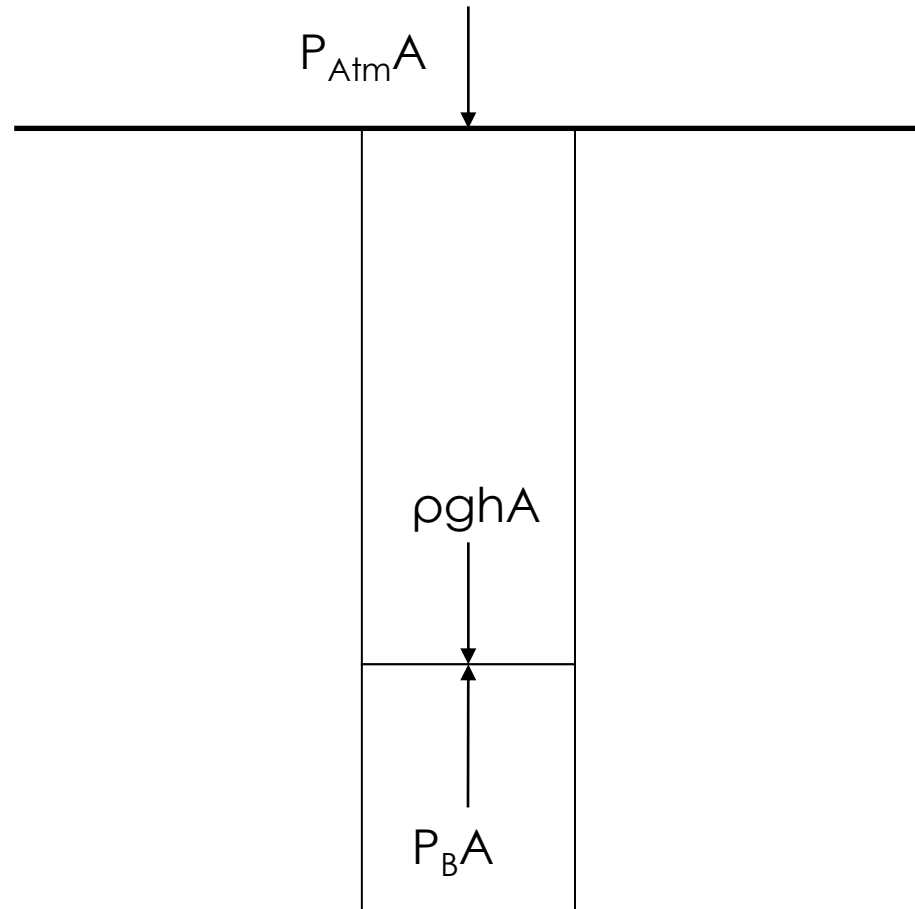


Pressure

$$P = \text{Force} / \text{Area}$$

$$P_B A - \rho g h A - P_T A = 0$$

$$P_B = P_T + \rho g h$$



Piezoresistive Effect

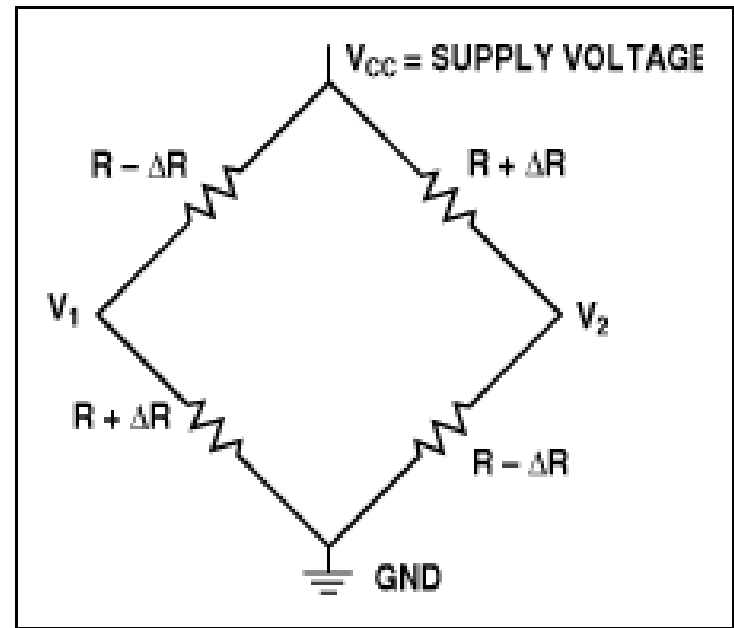
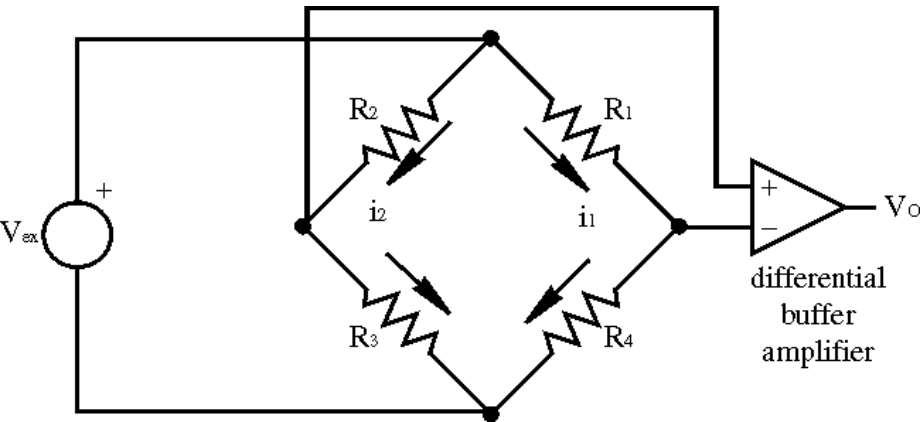
- Changing resistivity of a semiconductor due to mechanical stress applied
 - Silicon
- Different from Piezoelectric Effect
- Linear relationship between pressure and resistance



Piezoresistive Technology



- Piezoresistors buried into the surface of a thin circular silicon diaphragm
- Flex of the thin diaphragm due to the force or pressure applied changes the resistance of these piezoresistors
- Half-Bridge or Full Wheatstone Bridge



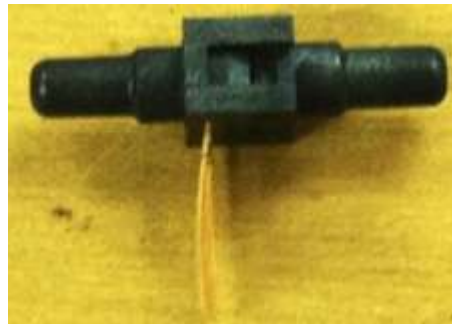
$$V_1 = \frac{R_3}{R_2 + R_3} V = \frac{1}{2} \left(1 + \frac{\Delta R}{R}\right) V$$

$$V_2 = \frac{R_4}{R_1 + R_4} V = \frac{1}{2} \left(1 - \frac{\Delta R}{R}\right) V$$

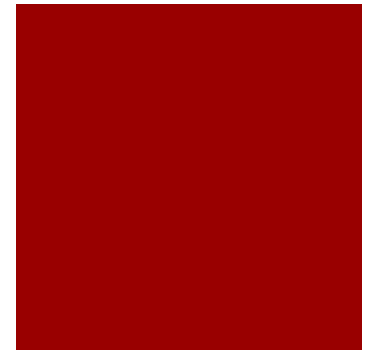
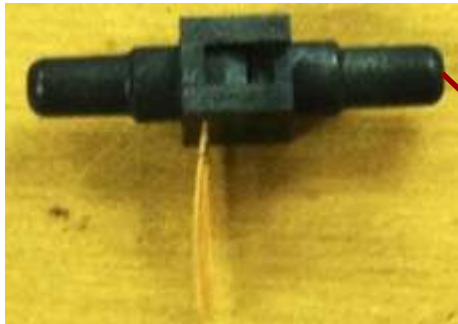
$$V_1 - V_2 = \frac{\Delta R}{R} V$$

Electronic Pressure Transducers

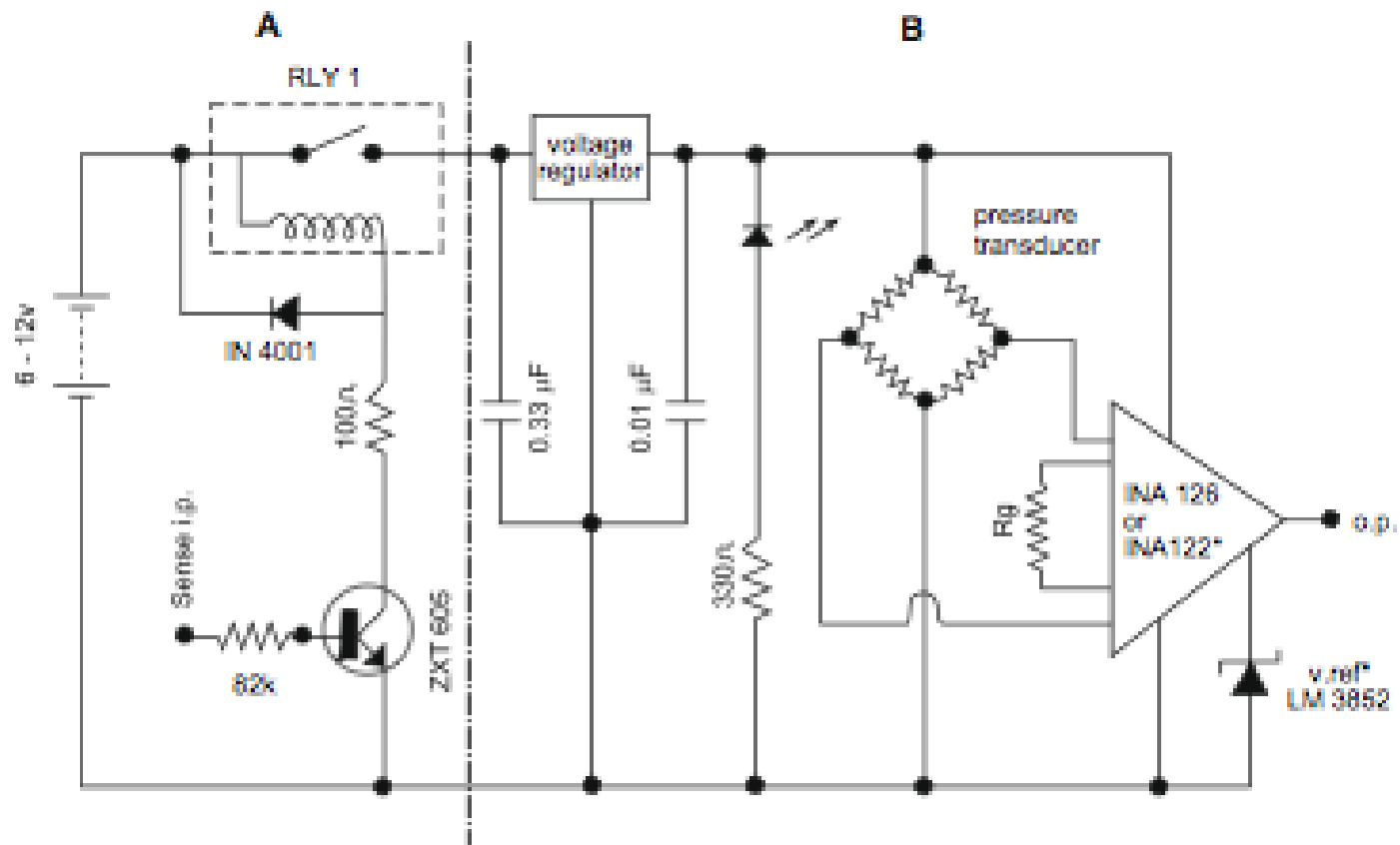
- Produces a voltage output proportional to pressure applied
 - 10.0 mV/psi for 0-5 psi (\cong 0-353 cm H₂O)
- Amplifier Circuit
 - Used to boost the output of the transducer



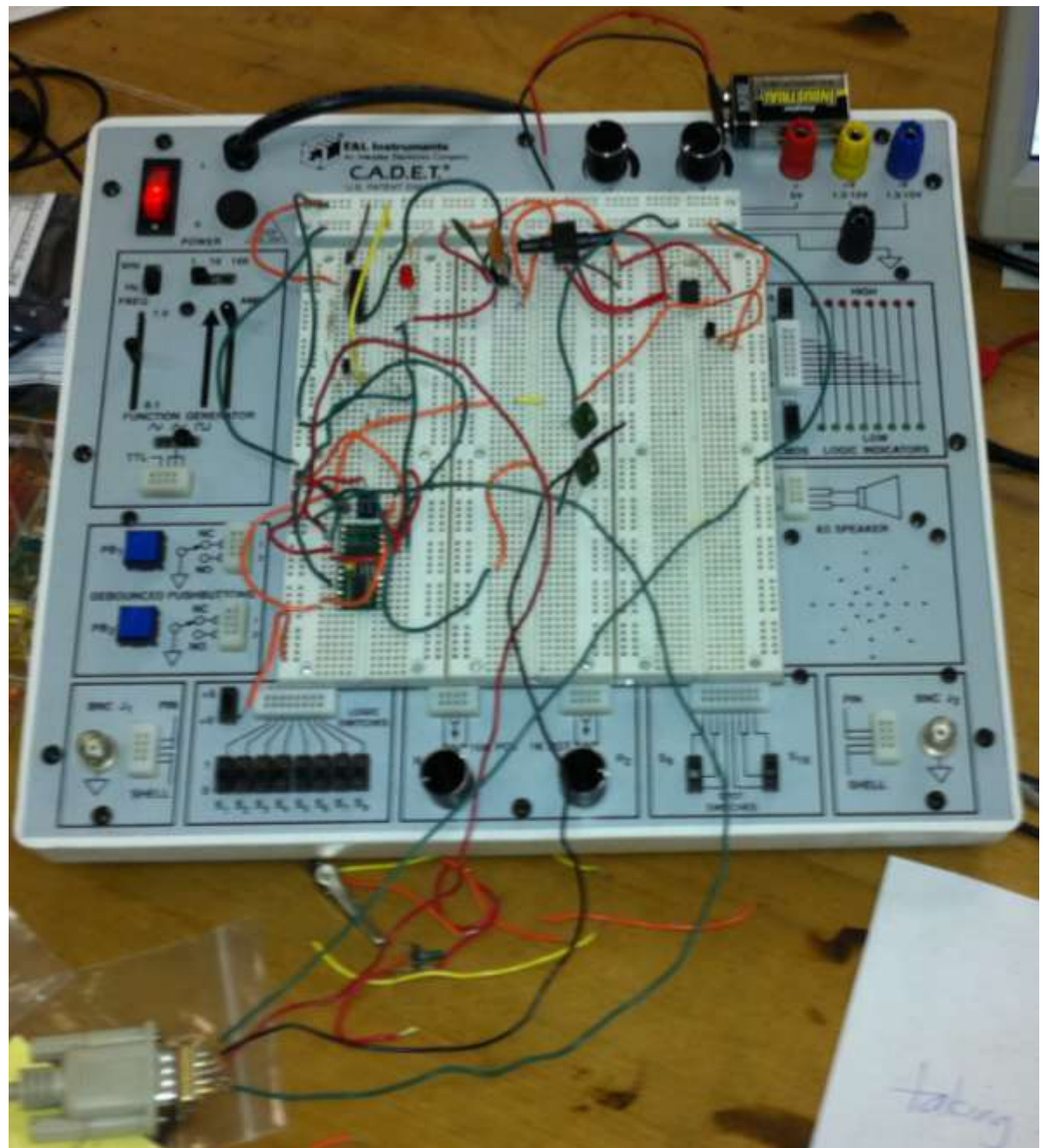
Lab Setup



Sensor



Sensor

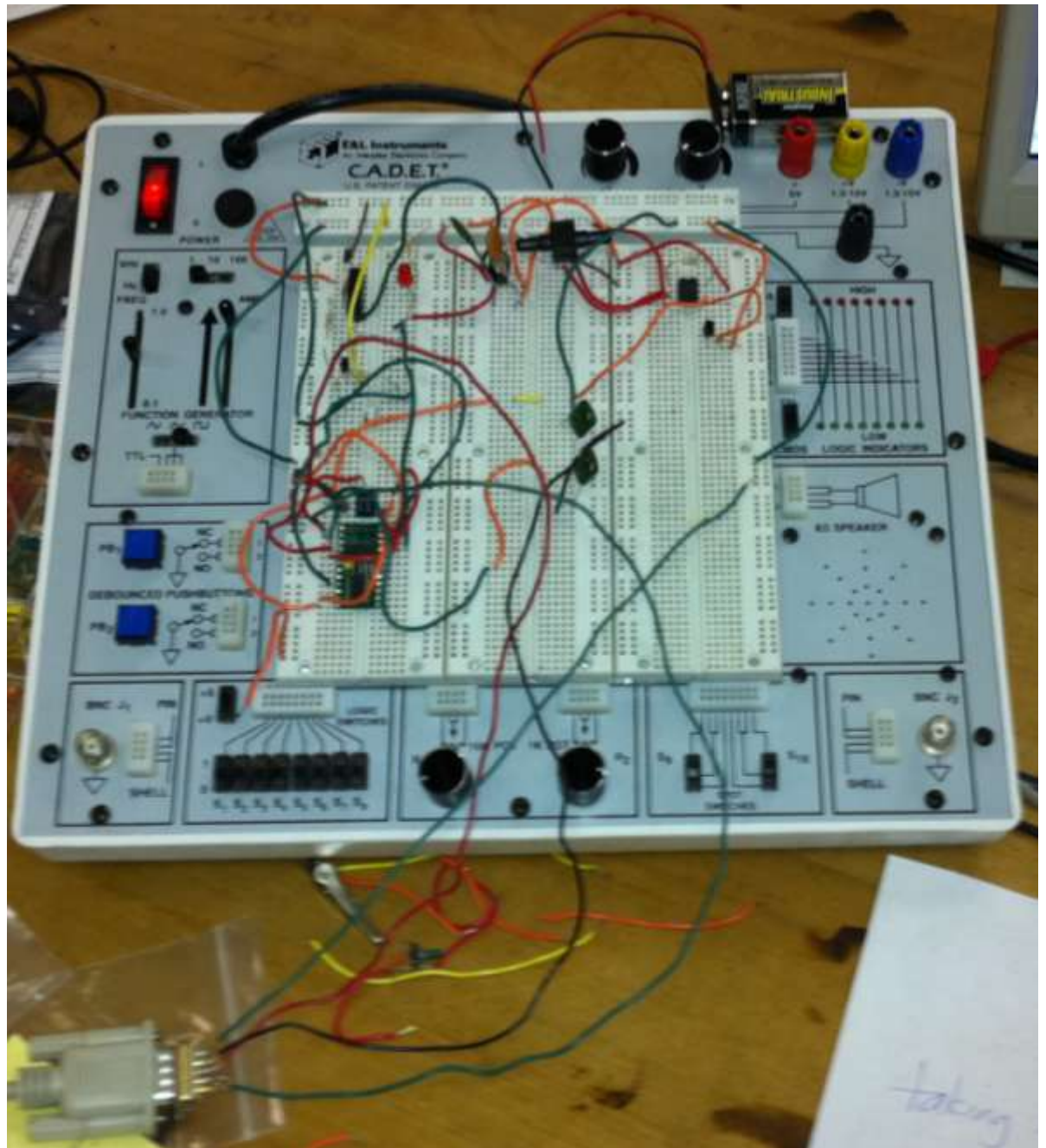


Data Logger

- BASIC Stamp 2
- Digitizes and stores data from the sensor
 - Over 4000 digital readings
- Adaptable to many sensors
- Inexpensive
- 8-bit microcontroller chip
- EEPROM memory chip



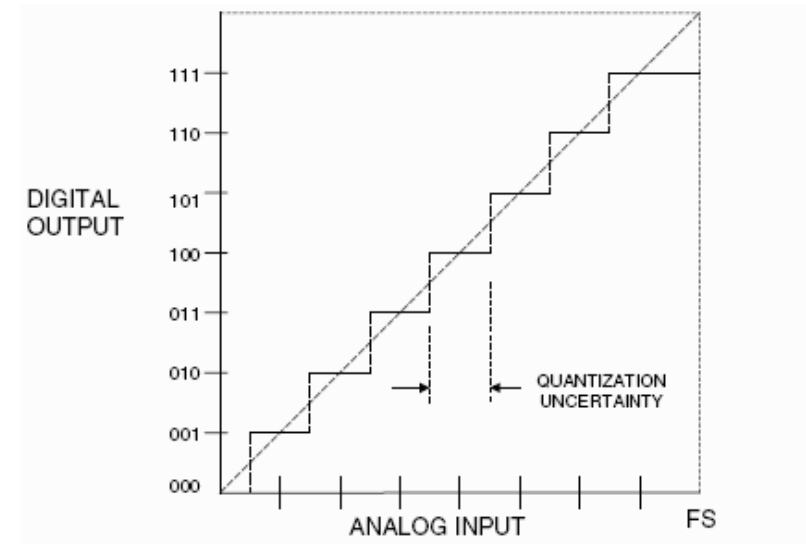
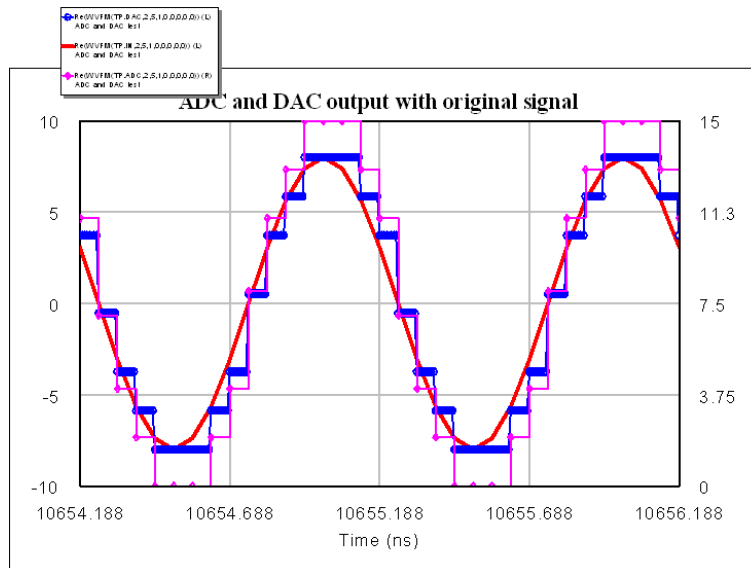
Logger



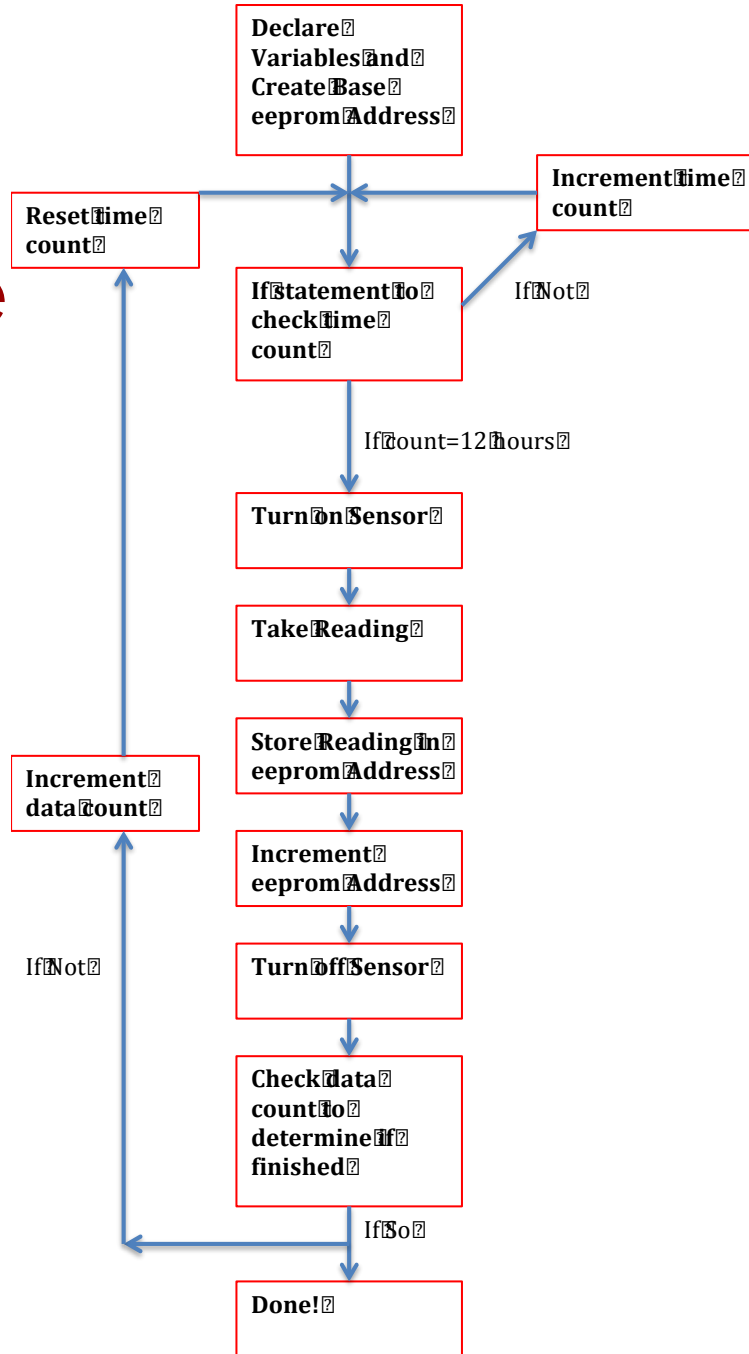
8-bit ADC

- Analog to digital converter

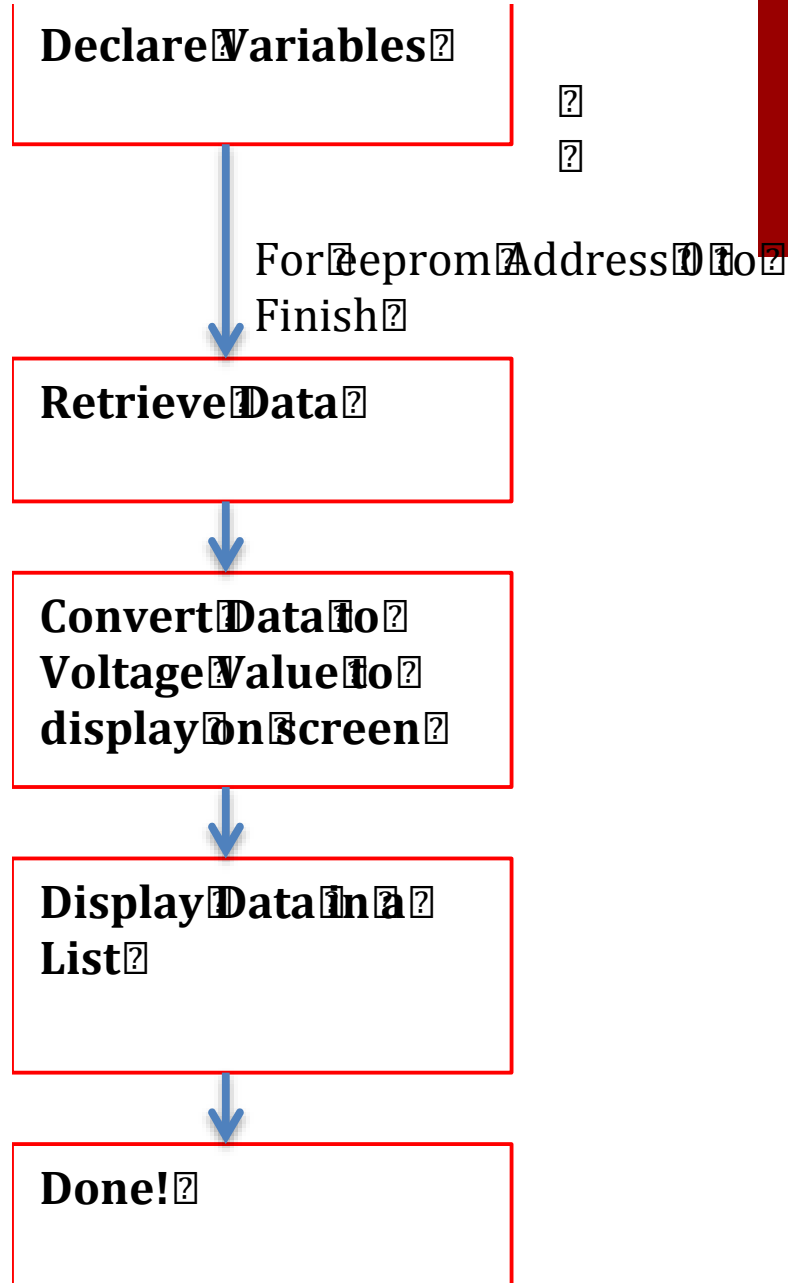
$$\text{Digital Value} = (V_{\text{out}}/V_{\text{ref}})255$$

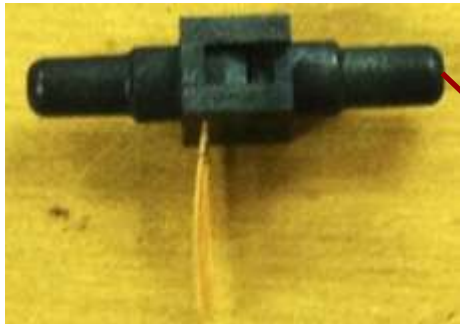


Logger Code



Reader Code

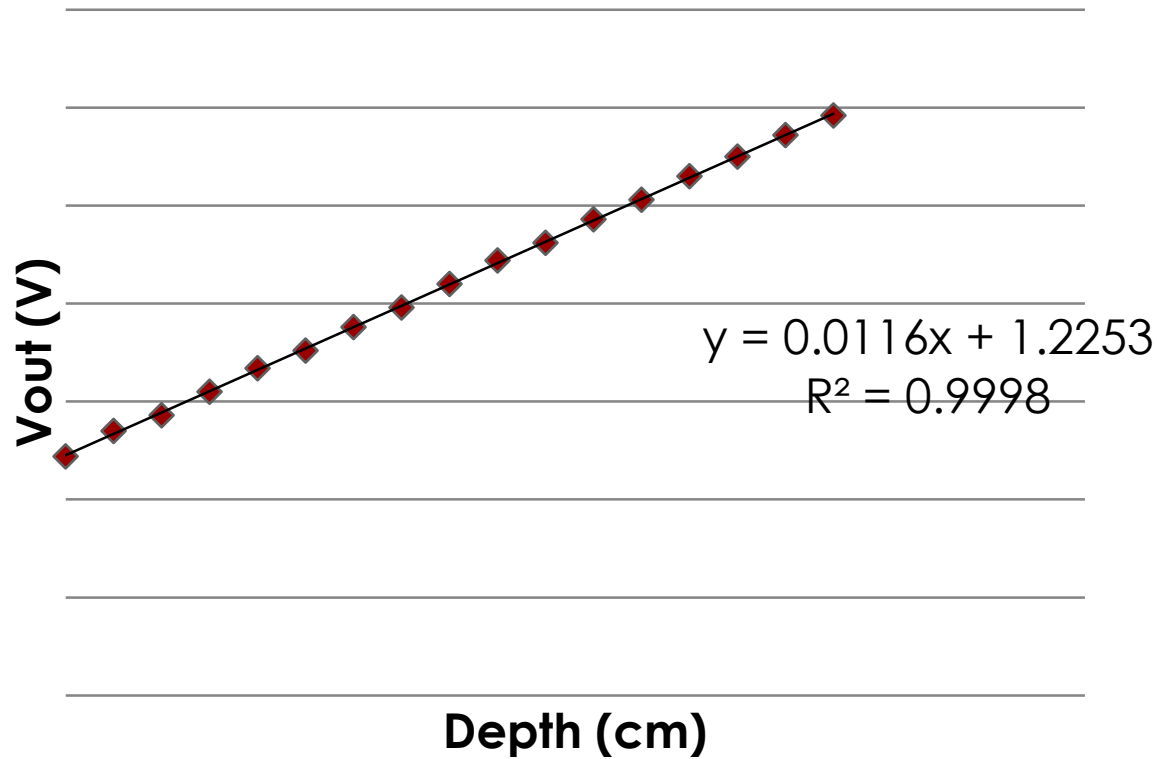




Calibration Curve



Voltage vs Depth



Total Cost

- Pressure sensor- \$30
- Basic Stamp 2 module- \$49
- Amplifier- \$4
- Miscellaneous (relay, power transistor, voltage regulator, capacitors, resistors, etc.)- \$5



Conclusion

- Benefits
- Where to go
 - Quick Fixes
 - Battery Life
 - Using AA in Series
 - Sleep command
 - BASIC Stamp 2pe
 - Housing
 - Testing



Acknowledgements



Dr. George, Wittenberg University Physics Department

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Questions

