Lab Practical Notes

Arduinos have Digital and Analog Pins

Digital - Two possible outputs; 0 and 1 Discrete Pin

Analog - Continuous Pin, good for voltage readings

Turbidity is a measure of waters cleanliness or quality

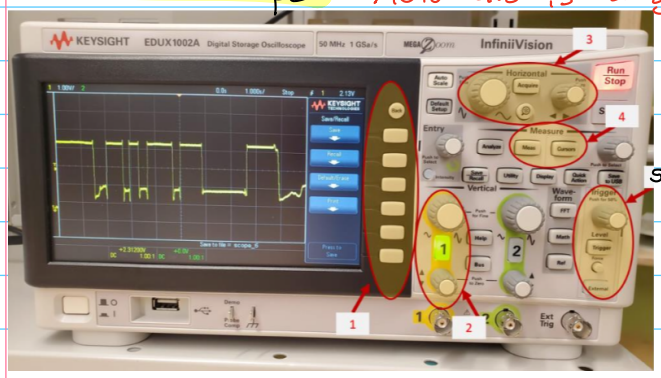
How? Turbidity sensors measure suspended particles floating in water

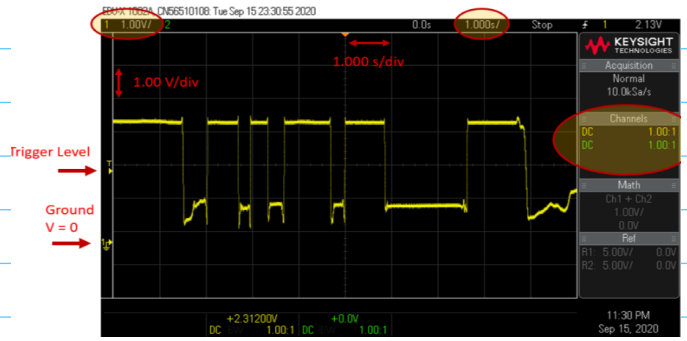
↳ Can include microbes, soil or metals. Can Cause illnesses and clog pipes

Readings - Higher Turbidity reads lower voltage (less light making it across the sensor).

Interpret - Voltage readings can be converted to NTU. The lower NTU the better

The Oscilloscope Auto Scale is a good Place to Start if Lost in the Source

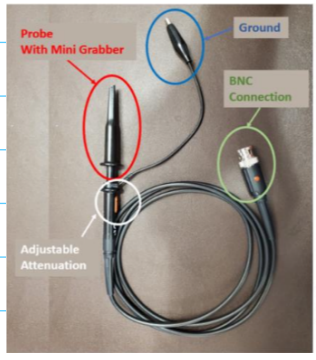




1. Keys to Manipulate Oscilloscope
2. Vertical Settings
   - Big Knob makes Signal Taller/Shorter
   - Small Knob Adjusts Ground Level
3. Horizontal Settings
   - Big Knob Stretches/Shrinks Signal
   - Small Knob All seconds/division
4. Cursor Options
5. 'Trigger' Toggles Trigger Display
   - Knob alters voltage Trigger

Trigger Level - Voltage Level where Signal will Freeze

'div' - unit for gridlines



Alligator Clip is the Ground Clip. Its much Thicker, often connected to an Arduino.

Probe receives the actual Signal and sends it to the Scope

Electrical Components p.1

Piezoelectric Films - Output Voltage Based on vibrations inflicted

Zener Diodes - Limits negative Itage received by the arduino - which is harmful

Resistor - Prevents an excess amount of Voltage to protect components

Active Buzzer / Passive Buzzer - Plays tones, Constant or programmable, respectively

LEDs - Light emitting Diodes: have short side (Cathode) and long side (Anode). These are negative and positive, respectively.

Note: Short end usually means negative corresponds to ground

Basics of a Fourier Transform

Time Domain- Most Signals are in this realm, with time on the x-axis

Frequency Domain- Uses a mathematical method to decomposes a periodic function into its component sines and cosines.

MATLAB's 'stem' function displays this nicely

Collecting Oscilloscope Data

- Run/Stop- Freezes Current Display
- Aquire Button- Set to roll to see constant signal over time
- Save- Opens options of saving. Should be .CSV. Can rename, but its painful
  - ↳ Save to USB works, but may result in an incorrect filetype

Electrical Components p.2

Electrocardiogram (ECG/EKG)- outputs voltage gathered from heart's electrical signal
↳ constructs waveform that displays heartrate. Used in hospitals frequently

We measured slow, fast, irregular, extreme HR using this and photoplethysmography

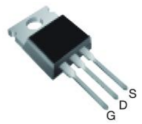


Figure 4: FET pinout

FET - G is gate, D is drain, S is source.
↳ Voltage applied to the gate allows current to flow through drain and source pins

We used this to construct a PID system controller

PID control

Steady State Value- Long Term value of System Output

Maximum Overshoot Percent- Maximum value of system output minus steadystate
↳ often represented as a percentage. $OS\% = \frac{ex - steady}{steady} \times 100$

Think of percent Error

Delay Time- Time required for response to reach 50% of its final value

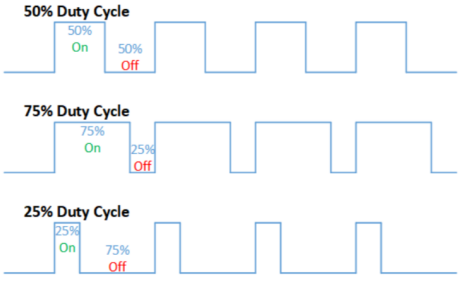
Rise Time- Time required for response to rise from 10% to 90% of its final

Settling Time- Time required for response to remain within 5% of its final value

Proportional (P)- System will run when below desired value

Integral (I)- System will attempt to remain around desired value

Derivative (D) - System will alter how fast it approaches its desired value



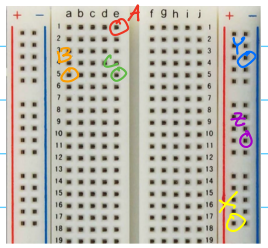
The Duty Cycle- Percentage of the time the system is running. Pulses increase the longer the system is on, resulting in an increased duty cycle.

Pulse width increases with Duty Cycle

Frequency does not change with Duty Cycle

Electrical Components p. 3

Breadboards - help regulate and organize complex circuits



Connection Rules

A and C are not connected
B and C are connected
Y and Z are connected
X and Z are not connected

For this orientation of the board...
Outside is connected up and down.
Inside connected left to right

PID controller - Sets P, I, and D levels for system control
↳ Display includes PID levels and sensor voltage output
Takes in input and feeds it to a pre programmed Arduino