ENGR 3280L and NI Academy Control Lab Project

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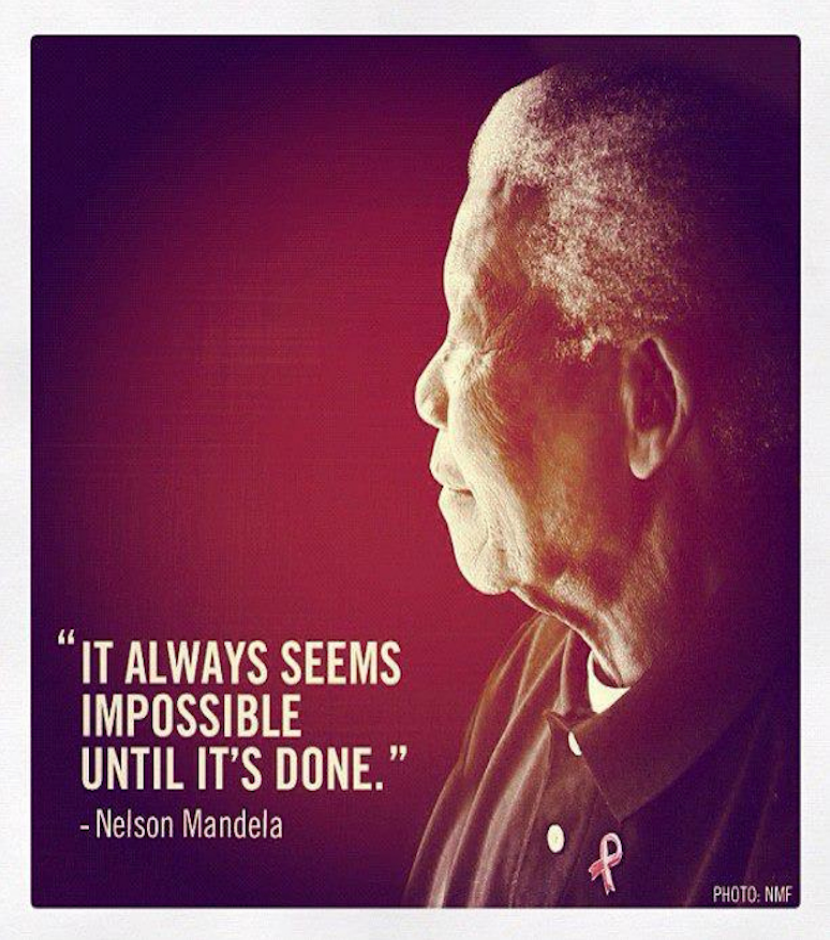
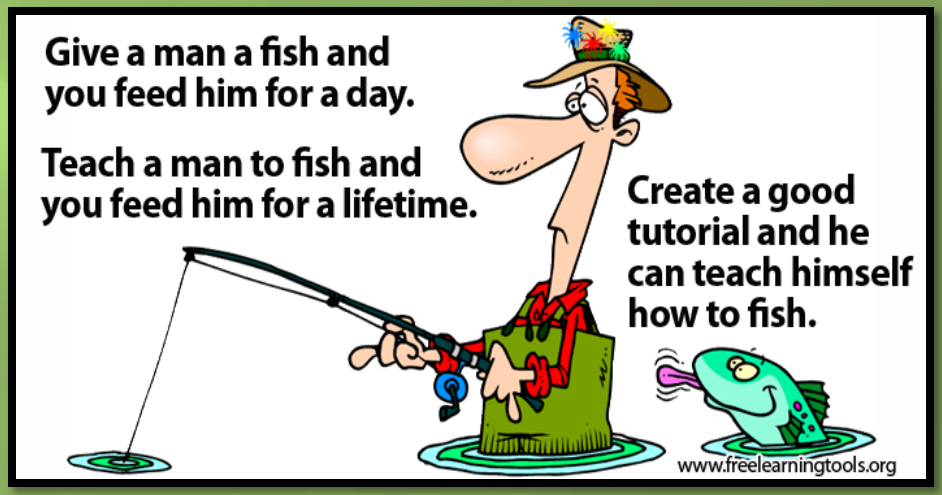
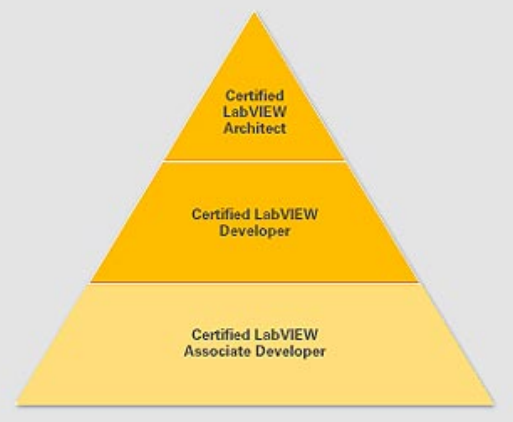




THINKACHIEVE

UTC NI LabVIEW Academy

- LabVIEW is industrial monitoring & control software
- 30 hours classroom instruction/20 hours of HW exercises
- 20 hours of LabVIEW projects (PID Project)
- Culminates in professional certification (CLAD)
- Part of ChE remote lab program to reach around world
- Recent $115,000 in gifts w/matching to promote program
- ThinkAchieve helped trigger in part these donations



http://www.ni.com/academic/labview_academy.htm

Overview

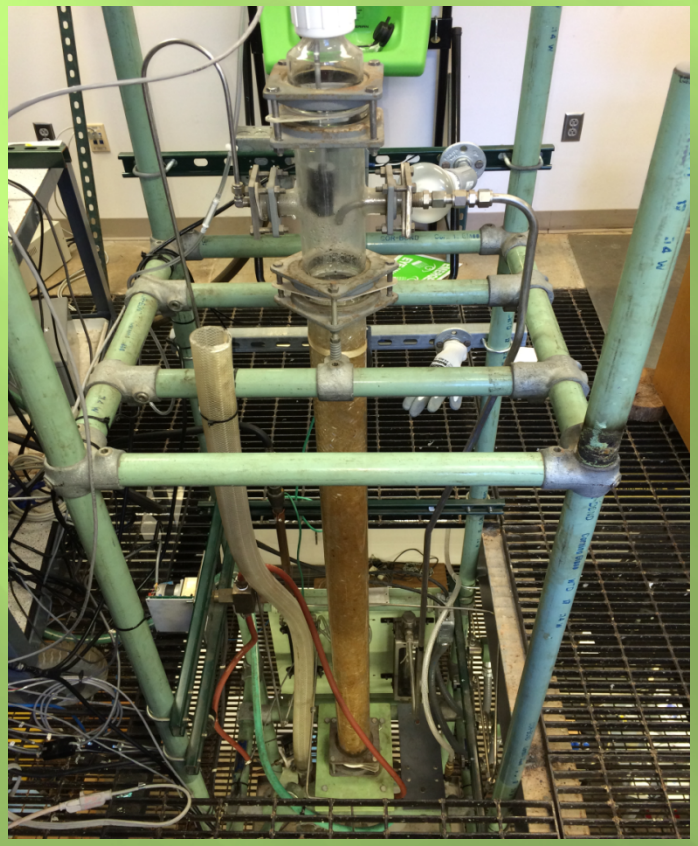
- Traditional ENGR 3280 Control Course
  - Steady state operating curve
  - Step responses
  - Frequency response
  - Controller design
  - Regular student presentations of lab outcomes

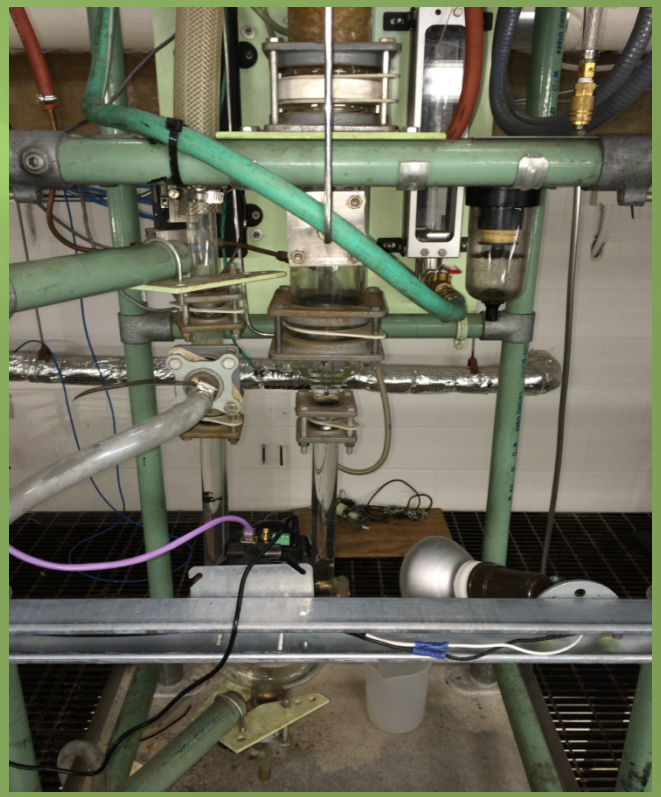
Overview

- LabVIEW Academy/ThinkAchieve Extension
  - PID Control Project
  - Central Energy Plant (CEP) Tour
  - Control room operation shadowing
  - To provide an immersive learning experience
  - Consistent with design & team outcomes of ABET

Engineering Controls Laboratory
Absorption Column (Water)

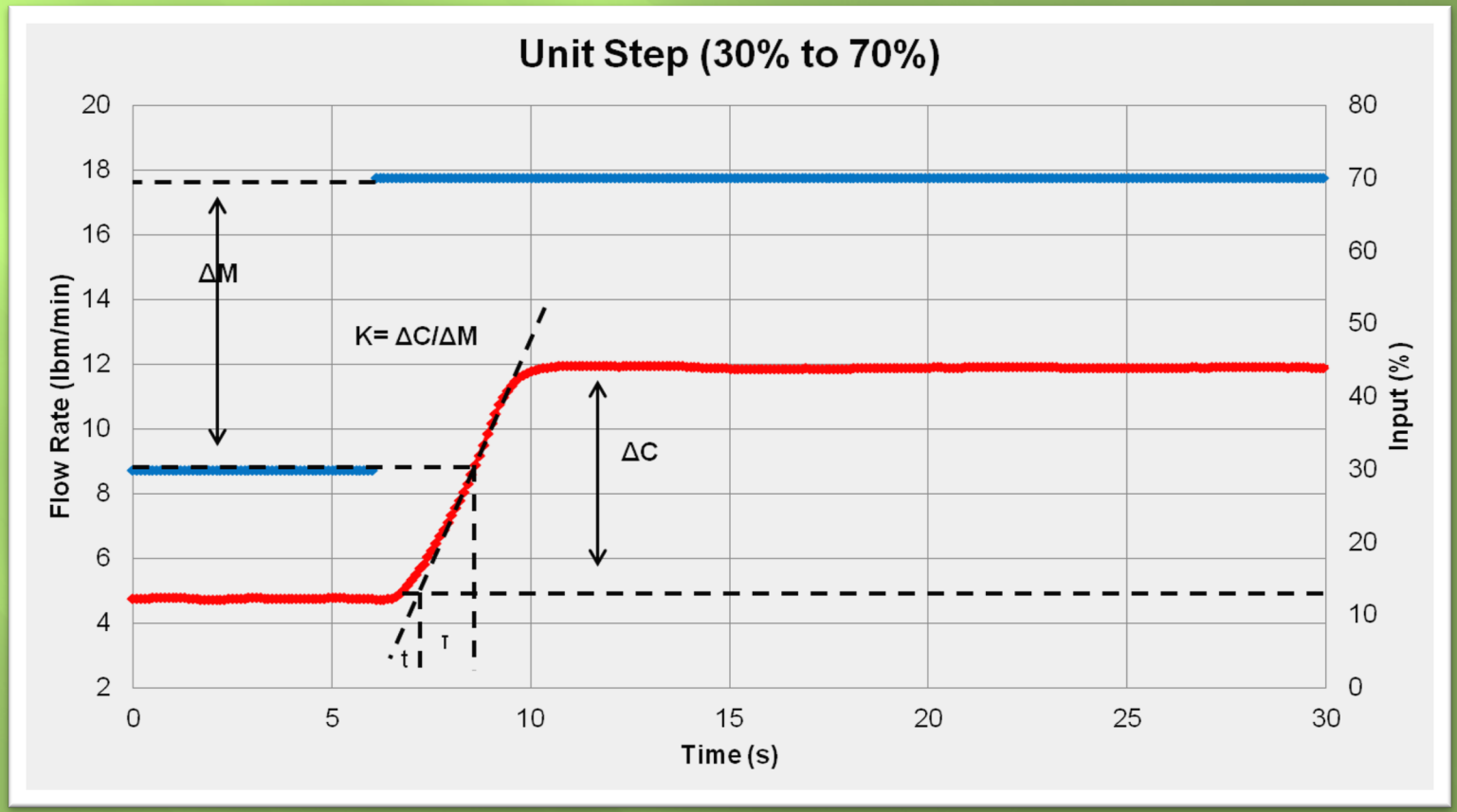
- Example controls stations for a set of staged experiments leading to controller design:
- Flow, cooling, pressure, heat transfer, absorption, multi-tank, distillation





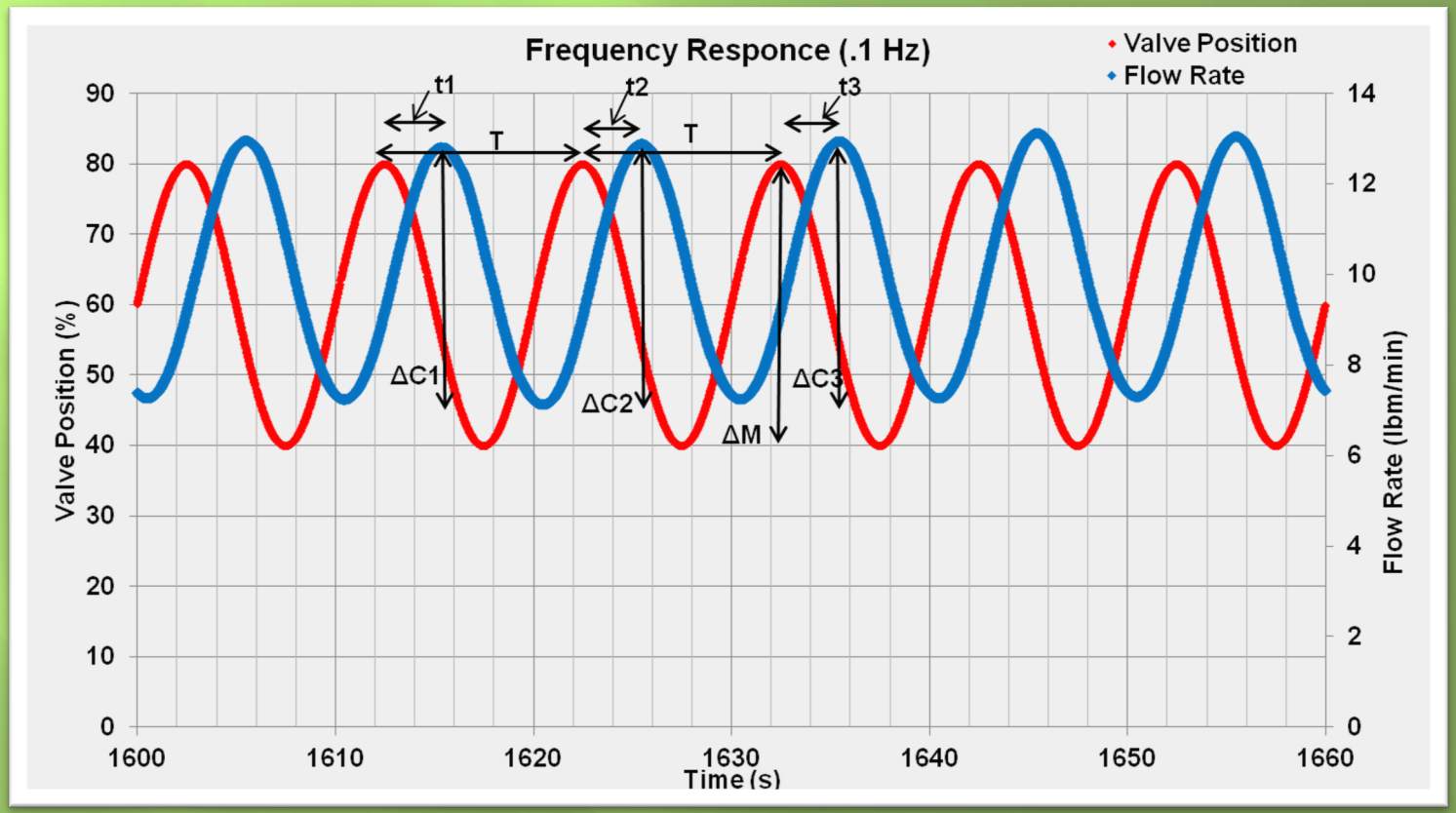
Engineering Controls Laboratory
Step Response

- Response of the station to an input
- Used to find important system constants
- Based on theory learned in Lecture



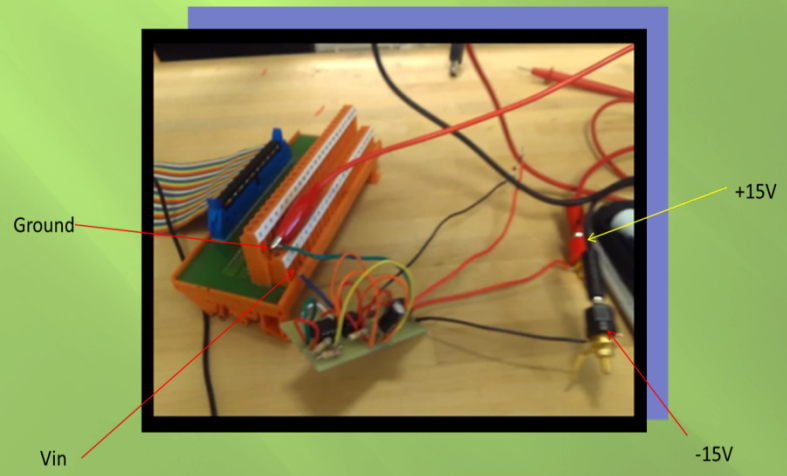
Engineering Controls Laboratory
Frequency Response

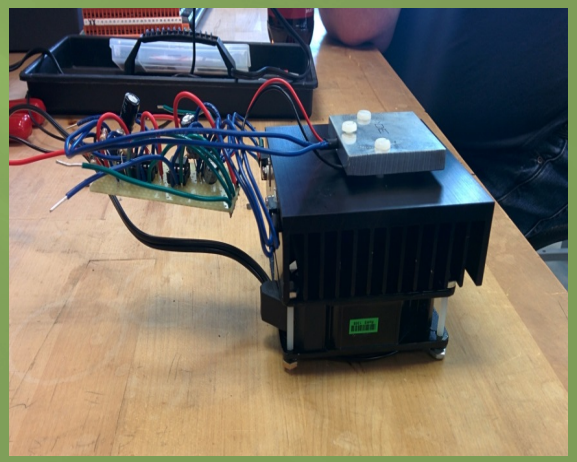
- Response of continual input of a SIN wave
- Based on theory from Lecture and simulations run in MatLab
- System parameters used to design controller



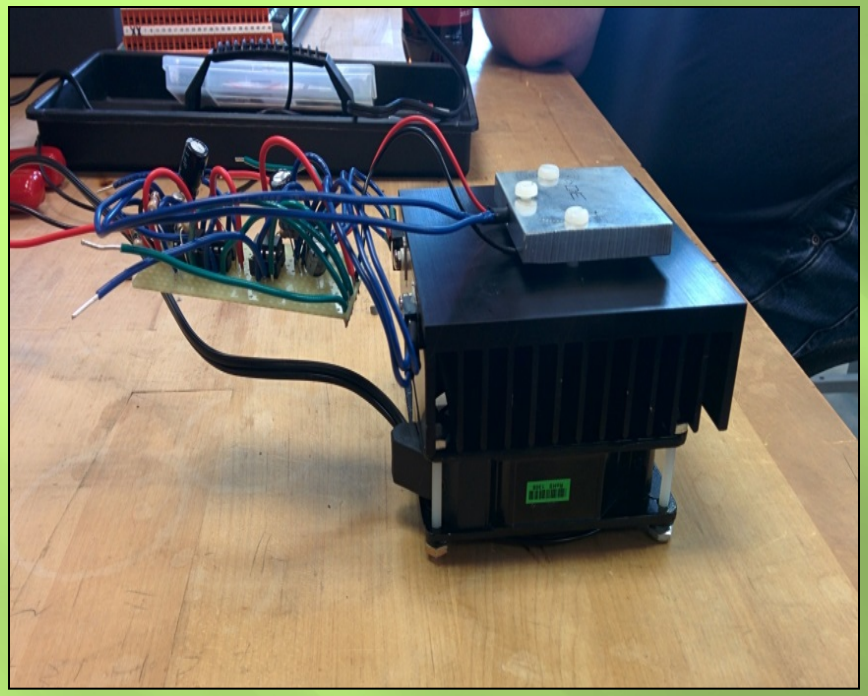
PID Temperature Control Project

- A “from-scratch” project combining all learnings from lecture/lab
- To create a temperature control system with a TE module and programming from LabVIEW
- Open-ended project: framework/goal/resources are provided; teams take charges of themselves to complete

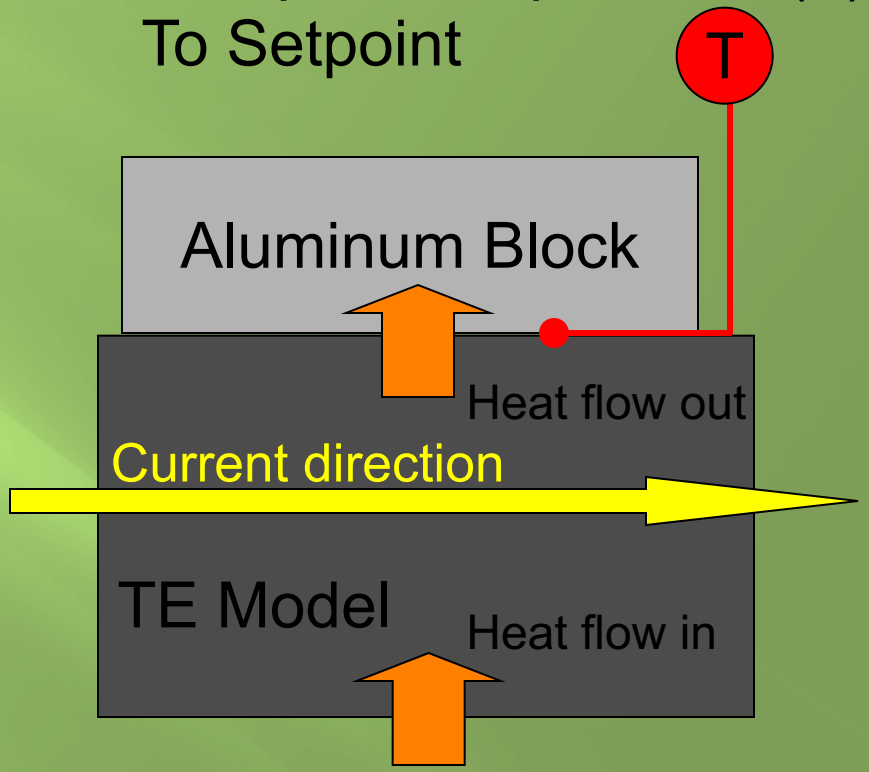




PID Circuits



Compare temperature (T)
To Setpoint

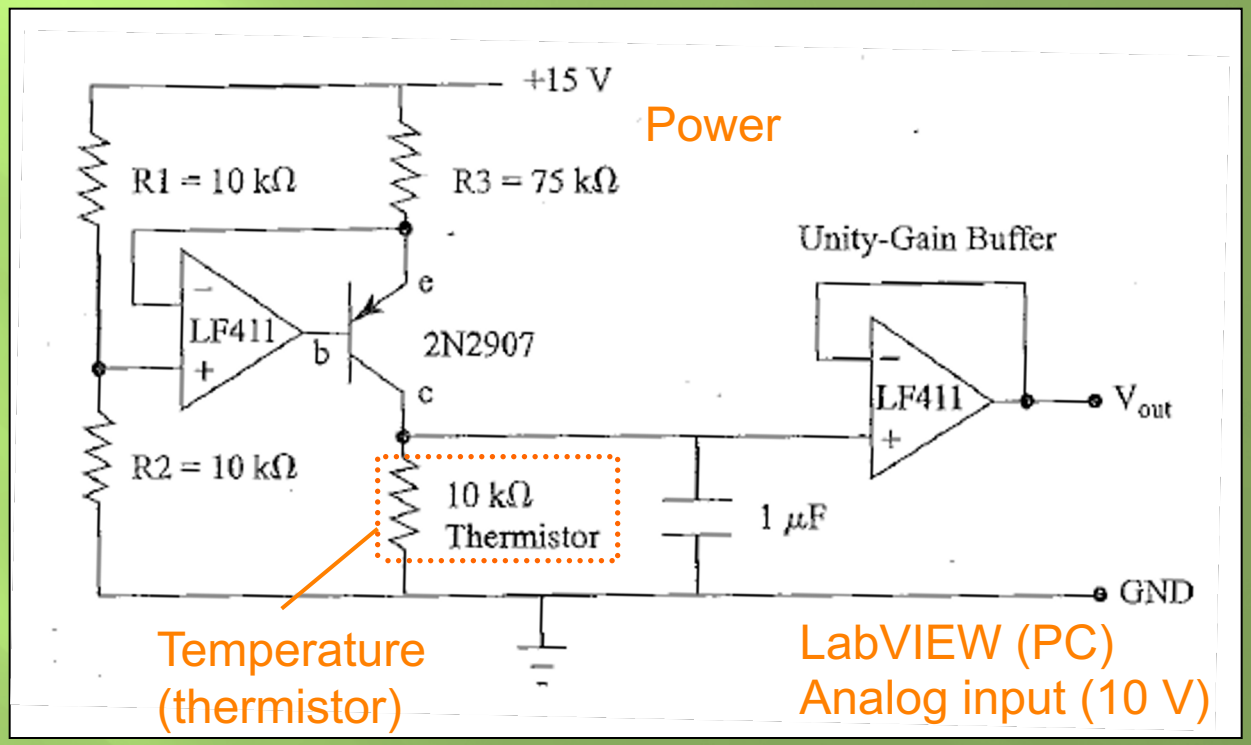


Bi-direction current:

- Shown for heating block
- Reversing current gives cooling

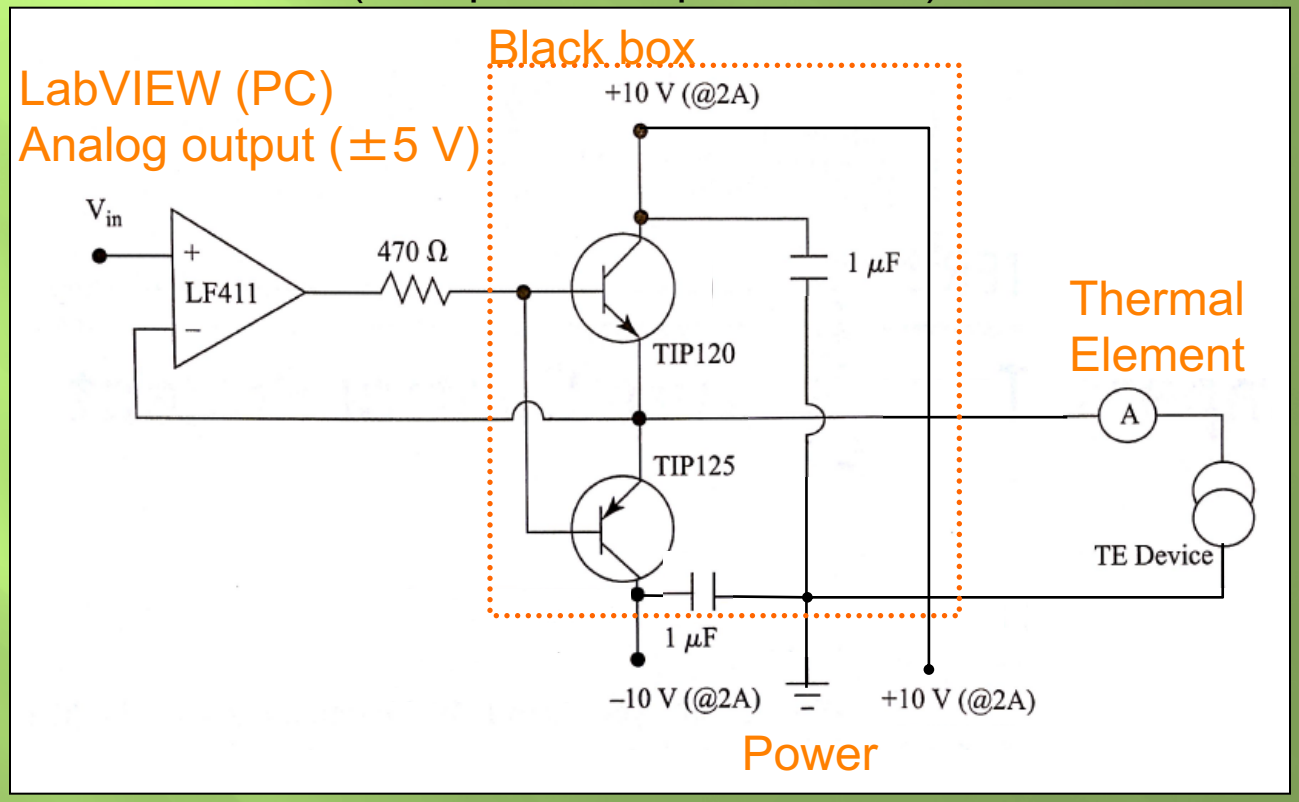
PID Circuitry

Digital Thermometer (output, controlled variable)



PID Circuitry

Thermal Circuit (Manipulated input variable)

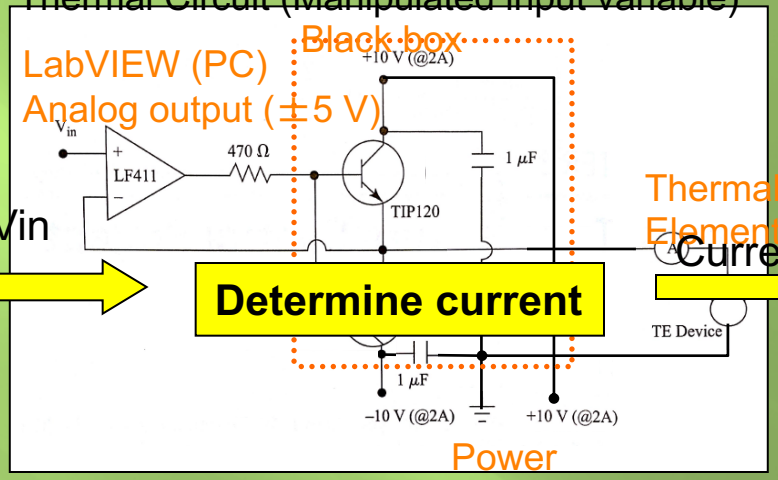


PID Circuitry

Thermal Circuit (Manipulated input variable)

Black box

LabVIEW (PC)
Analog output (±5 V)



Power

Set Temperature

LabView Controller

Vin

Determine current

Thermal Element

Current

Compare temperature (T) To Setpoint

T

Aluminum Block

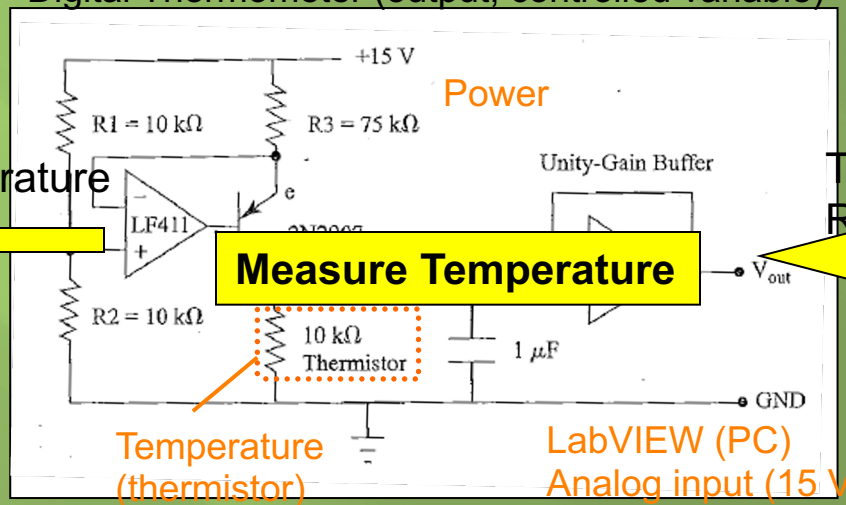
Heat flow out

Heat/Cool Block

TE Model

Heat flow in

Digital Thermometer (output, controlled variable)



Power

Block Temperature

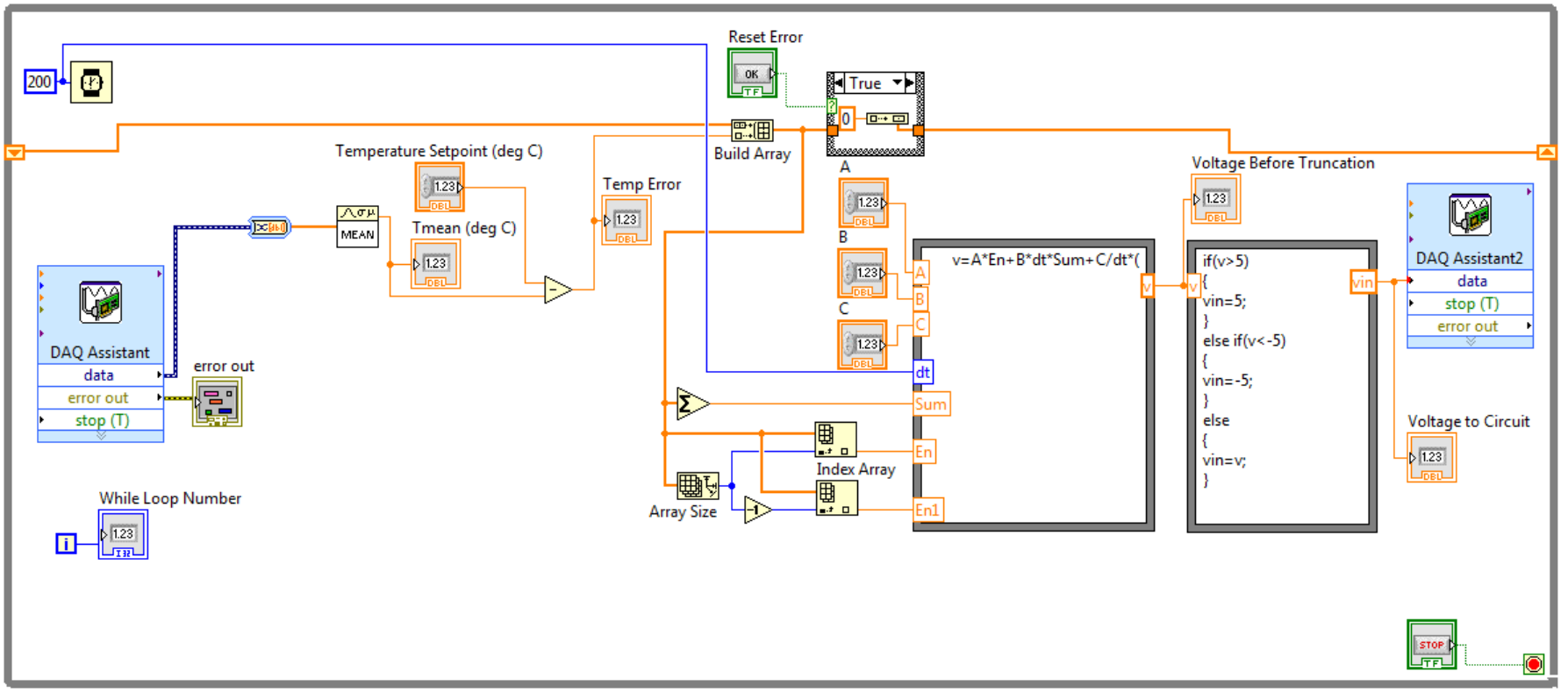
Measure Temperature

Thermistor Resistance

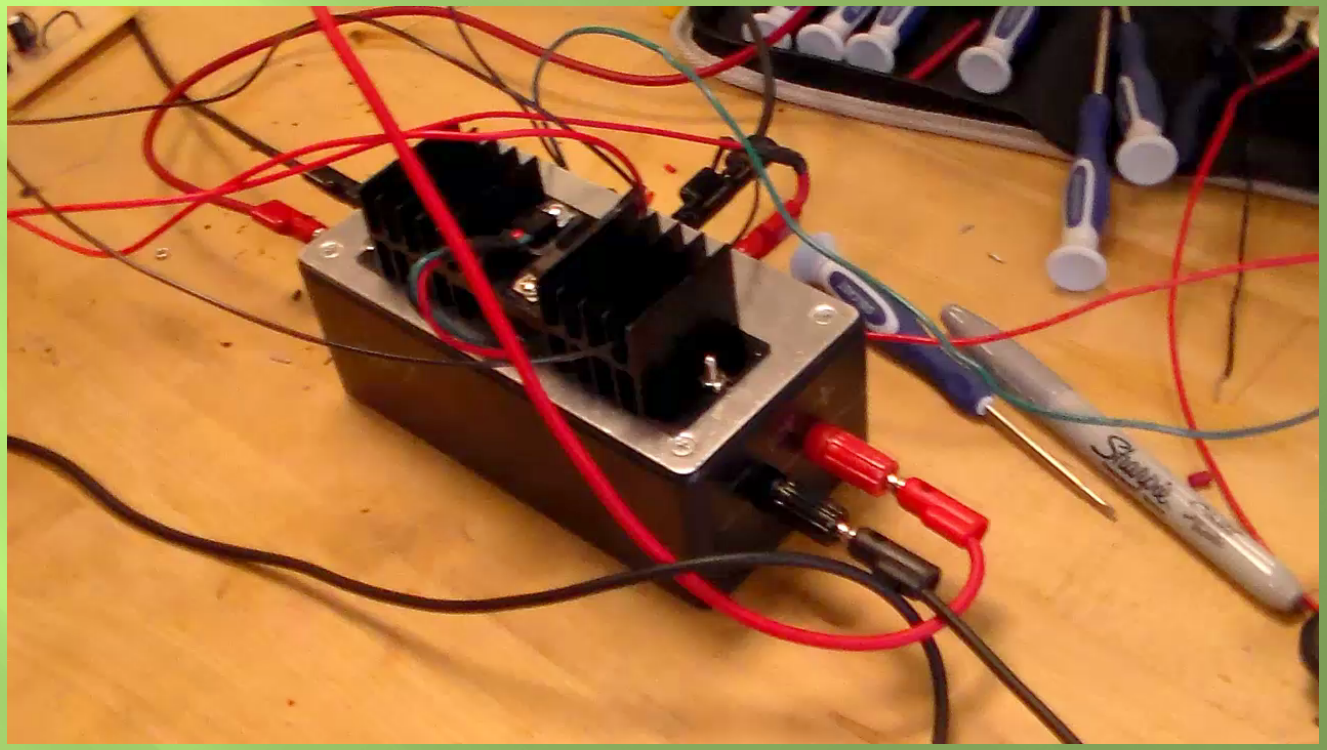
Temperature (thermistor)

LabVIEW (PC)
Analog input (15 V)

LabVIEW Block Diagram (Computer Controller)



Video of PID



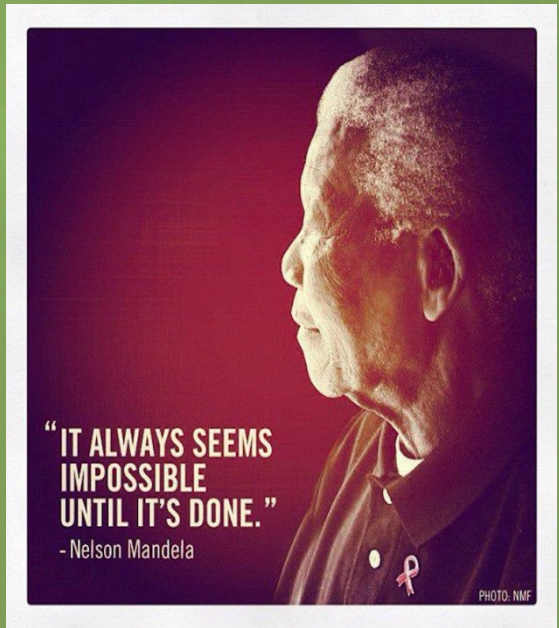
FA13 VS SP14

Metrics:

- FA13 – 17% vs. SP14 – 95% PID Completed
- Improved resources available for help (SP14)
- Project pushed earlier into beginning of semester (parts ordered earlier)
- Significant "passing-on" of team help
- Fantastic quality of some circuits - significant confidence booster
- "Expect" big things from our students, and they will stretch to reach the bar

Hurdles

- “I don’t know how to build a circuit.”
- “I shouldn’t have to build a circuit.”
- Lack of confidence they can complete
- Team dynamics -- especially in dividing work
- Finding ways to trim load, but still leave open ended.
- Expecting others to always have answers



Anna's Shadow Tour Of Central Energy Plant