Thermal Chamber Temperature Control System Features.

Chamber

- Small volume chamber 100mmx68mmx50mm
- Heater Temperature sensor affixed to resistive heater
- Air temperature sensor
- 2 resistive heaters (30 and 36 ohms), 12 VDC supply to heaters
- Maximum heater temperature approx. 135 deg C
- Maximum air temp about 60 deg C
- 2 distinctly different sets of process dynamics

PID Controller

- Standard (sometimes called Mixed) algorithm
    - Most commonly used in industry
- Select Reverse or Forward (Direct) acting
    - Reverse uses heater as final control element
    - Forward uses fan as final control element
- 2 sets of PID tuning constants for 2 different process dynamic cases
- Auto/Manual selection

Display

Runs independently with LCD display or along with Arduino Serial Plotter

- LCD
    - Heater temperature deg C
    - Air temperature deg C
    - Setpoint in deg C
    - Fan or Heater manual setting 0 to 100%
    - PID components displayed in real time
        - Proportional component
        - Integral component
        - Derivative component
        - Cout - total of three PID components
- Plotting
    - Uses Arduino IDE serial plotter
    - Plots Heater and air temperatures
    - Plots Setpoint or Manual setting
    - Generates the following commands
        - Auto – sets PID controller to automatic
        - Manual – sets system to manual open loop operation
        - Reverse – sets PID to reverse acting using heater as controller output
        - Forward – sets PID to forward acting using fan as controller output
        - LM35_1 – sets PID controlled variable to heater temperature sensor
        - LM35_2 – sets PID controlled variable to air temperature sensor

Electronics

- Arduino Nano microcontroller
  - Connects to LCD Display via I2C bus
  - Generates 2 PWM outputs to Power Mosfet Interface board
  - C Code generated from Arduino IDE

- Setpoint and disturbance generated from 2 potentiometers connected to Nano analog inputs
- Temperature sensors – LM35 – generate 0 to 1.5 volts for 0 to 150 deg C
- Power Mosfets IRF540N are switched at 490 Hz and operate via Pulse Width Modulation to vary the voltage on the heaters