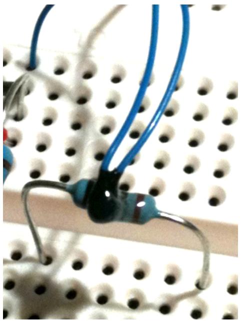
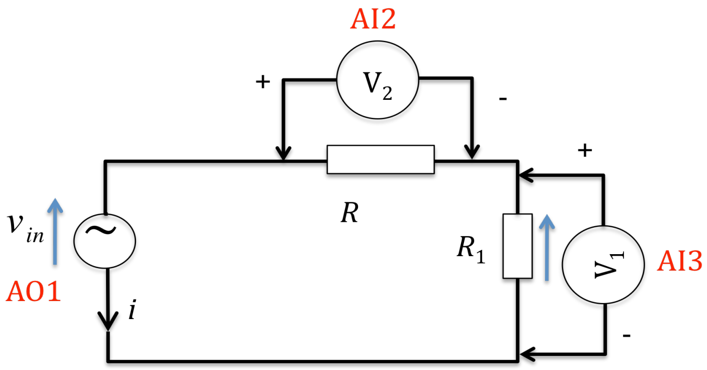
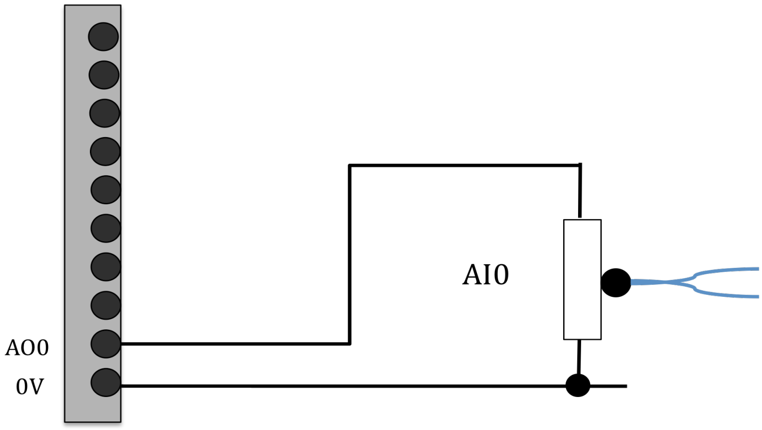
Lab 6 FYSS 385

In this lab we investigate some simple LabVIEW-based control systems. The systems are single input, single output controllers. For this we use the mini-oven where a thermistor is glued to a 100 Ω resistor. You will need to use the generic PC or Mac Vis from the web site and your thermometer VI.





Wire up the thermistor thermometer as shown and check it is working with your thermometer VI. The resistor that heats the thermistor is connected as shown.



Check that when you apply a voltage to the resistor the temperature of the thermistor increases.

1. ***Threshold Controller without hysteresis***
   Set-up a VI that is a simple threshold controller with no hysteresis. This should switch between 0 V and 5 V on the AO0 line. Use a waveform chart to follow the evolution of the temperature with time. Investigate its performance when (i) the setpoint is abruptly changed and (ii) a disturbance is introduced by cooling with the Air Duster jet.

2. ***PID controller***
   The PID controller is a common controller used for high performance precise control. In this part of the lab we use a ready made VI. Download the generic PID controller, heater actuator and themistor and thermistor calibration VIs from the course web site. The controller follows the following law. $C(t) = K_p E(t) + K_d \frac{\mathrm{d}E(t)}{\mathrm{d}t} + K_i \int_0^t E(\tau)\,\mathrm{d}t$

Where, K_p, K_d and K_i are the coefficients of the proportional, differential and integral of the error signal $E(t)$ contribute to the output. This controller VI is somewhat more complex than the one demonstrated in the lecture as it allows the r.m.s. contributions to $C(t)$ to be monitored and also turned on or off. The controller changes the power applied to the heater resistor about the 50% power level. If $e(t) < 0$ then $P < 2.5$ units and if $e(t) > 0$ then $P > 2.5$.

Turning K_i and K_d off gives a P-controller and turning just K_d off gives a PI controller. The controller is set up to behave in stable way as it is loaded.

(i) Start the PID controller and check it is working, (the power should oscillate randomly without going to the extreme max and minimum values of 0 and 5).
(ii) Turn the K_i and K_d terms off to make it function as a a P-controller.
(iii) Turn K_p to 0.001 and let the circuit stabilise. Observe what happens when a cooling disturbance is introduced with an air duster and suggest why?
(iv) Increase K_p to 30. What happens and why?
(v) Set the value of K_p to between 1.0-1.5, let the circuit stabilise. What is happening and why?
(vi) Use an air duster to introduce a disturbance. What happens?
(vii) Turn on K_i and set to 1.0, what happens?
(viii) Turn on K_d and adjust K_i and K_d so the circuit is stable. Try to optimise so that the overshoot is minimal.

Report

This should be brief.
You need only use a few words to describe what happened in 1. and 2. under the points (i)-(viii).