2023 EP3BB4 Design Project

PID Temperature Controller

Your project objective is to design and build a miniature temperature-controlled oven/cooler, hypothetically to be used to study the effect of temperature on such things as micro-organisms and semiconductor devices and sensors.

The oven/cooler will consist of two electrical elements, a thermo-electric cooler (TEC) and a temperature sensor. The heater/cooler will consist of a TEC based on the Peltier effect. The temperature will be monitored using an NTC (negative temperature coefficient) thermistor.

The TEC and thermistor will be interfaced to the MSP430 microcontroller unit (MCU). Control and temperature information will be relayed between the MCU and PC via a USB-to-UART serial bridge. A graphical user interface (GUI) is to be implemented in MATLAB which will allow the user to set the target temperature and monitor the current temperature. A graph of temperature versus time is to be displayed using MATLAB.

Power to the TEC shall not exceed 12V.

Specifications

TEC: 12V 60W, model TEC1-12706
Thermistor: 10KΩ @25°C NTC, model muRata NCP21XV103J0RA
Thermal time constant: 10 seconds
Performance objectives
Target temperature: 0 – 40°C
Accuracy: 0.1°C

References

TEC1-12706 Data Sheet

What's all this P-I-D stuff anyhow? – Bob Pease

Thermistor Resistance vs Temperature

Manufacturer: muRata
Model: NCP21XV103J0RA
Nominal resistance at 25°C is 10 kΩ

Temp. (°C)	Resistance (kΩ)
-40	328.996
-35	237.387
-30	173.185
-25	127.773
-20	95.327
-15	71.746
-10	54.564
-5	41.813
0	32.330
5	25.194
10	19.785
15	15.651
20	12.468
25	10.000
30	8.072
35	6.556
40	5.356
45	4.401
50	3.635
55	3.019
60	2.521
65	2.115
70	1.781
75	1.509
80	1.284
85	1.097
90	0.941
95	0.810
100	0.701
105	0.608
110	0.530
115	0.463
120	0.406
125	0.358