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Temperature control for the mixers

Q: What is NTC thermistor?

What is TE cooler?

How to build the temperature control system for the mixers?

A:

1. NTC Thermistor:

NTC thermistor is an element that the resistance decreases with the temperature, which has been commonly used in the temperature sensing field. There are two methods to calculate the sensing temperature from the measured resistance.

A. Beta parameter equation

B. Steinhart-Hart equation

For the beta parameter equation [1], the relation between the resistance and temperature has been written as the function below

$$\frac{1}{T} = \frac{1}{T_0} + \frac{1}{B}\ln\left(\frac{R}{R_0}\right),$$

$$R = R_0 e^{-B\left(\frac{1}{T_0} - \frac{1}{T}\right)}$$

Where T is the temperature in Kelvins, R_0,T_0 are the base values for a known resistance at a specific temperature, and B is the beta constant. For example, the thermistor used in HCP's mixer usually has a beta value, B=3478 and 10kOhm resistance at 25 deg. C. The result of $R(T)$ therefore can be derived by the equation above and the figure has been shown below.

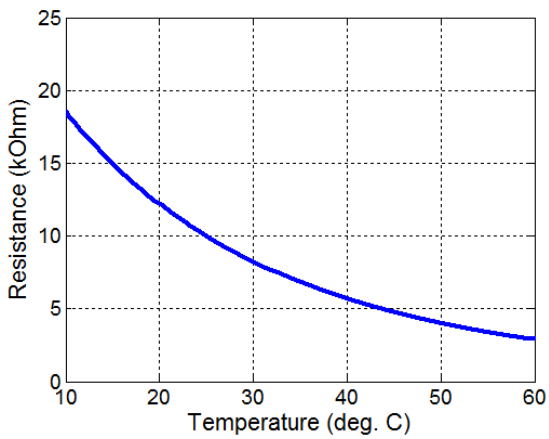

Fig 1. Temperature versus thermistor resistance under the condition of B=3478 and 10kOhm @ 25 deg. C.

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The Steinhart-Hart equation is a more accurate estimation method, and the equation is shown below:

$$\frac{1}{T} = a + b\ln(R) + c(\ln(R))^3$$

Three data points for the resistance versus temperature have to be measured in advance, and the corresponding *a*, *b*, *c* coefficient can be calculated accordingly. For the details about how to derive a, b, c coefficients, please refer to the reference [1].

2. TE cooler

TE cooler is a flat element which has been used for temperature control in many fields. It utilizes the Peltier effect to generate a heat flux between the up and down surface, which allows to heat-up or cool-down the elements on its upside. To drive the TE cooler, forward or reverse current is applied to manage the direction of heat flow. For more detail, please refer to [2].

3. How to build the temperature control system for the mixers?

It is recommended to buy the temperature controller from HCP directly. The mixers can be controlled by conventional TE cooler driver, just following the steps:

Step1: Choose the proper driving instrument according to the maximum voltage / current information provided by HCP's mixer datasheet.

Step2: Select the correct thermistor type and set it to the controller according to the values provided by HCP's mixer datasheet.

Step3: Testing the temperature controlling result in practical. Adjust the PID setting in the temperature controller or contact HCP for further help if the controlling characteristics are abnormal (e.g. overheating, oscillating ... etc).

Reference

[1] https://en.wikipedia.org/wiki/Thermistor

[2] https://en.wikipedia.org/wiki/Thermoelectric_effect