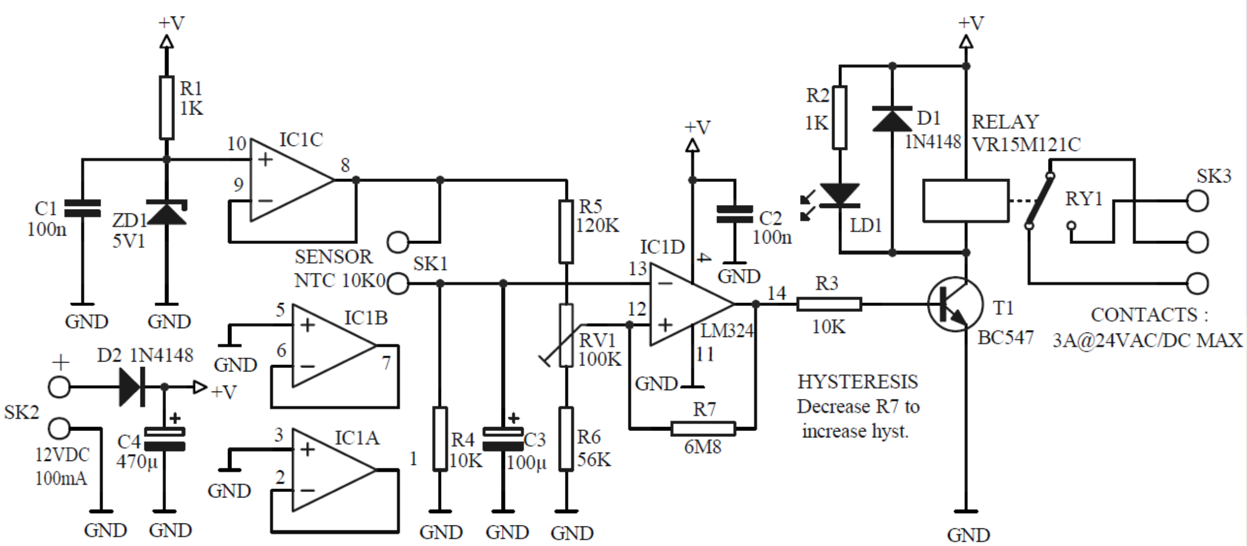
Velleman 138 Demystified

Version 1
May 4th, 2012

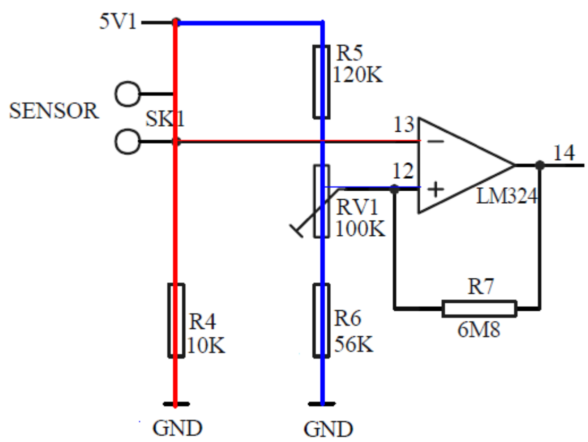
The Velleman 138 schematic is shown below:

SCHEMATIC DIAGRAM



The central component is the comparator, which turns on the relay when the '+' side has less voltage than the '-' side. Let us simplify this to show the 'red' path for the '-' side and the 'blue' path for the '+' side being compared:

SCHEMATIC DIAGRAM



The + and – sides are simple resistor voltage dividers. The thermistor's resistance changes as a function of its temperature, let us call it Rt.

The temperature is controlled by the position of the variable resistor RV1.

The **low temperature equation** is:

$$\frac{(R5 + RV1)}{(R5 + RV1 + R6)} = \frac{Rt}{(Rt + R4)}$$

Where Rt is the resistance of the Thermister, RV1 is the full value of the variable resister.

The **high temperature** equation is:

$$\frac{R5}{(R5 + RV1 + R6)} = \frac{Rt}{(Rt + R4)}$$

How to compute R5 to reach a desired temperature:

Suppose we use the G_1396 high temperature thermistor and the R4 (10K), R6 (56K), and RV1 (100k) resistors that came with the Velleman 138 kit and suppose we want the highest temperature to be 225 degrees C. We refer to the thermistor resistance chart for this temperature at http://www.specsensors.com/pdfs/ntc_radial_glass.pdf and we see Rt = 2339 ohms at 225 degrees C.

Let's rearrange the high temperature equation to solve for R5:

$$R5 = \frac{Rt * (RV1 + R6)}{R4}$$

And we therefore compute R5 = 36488 ohms. We would lower this value a bit to say 35k ohms.

We can now plug R5 = 35k into the low temperature equation to compute Rt, and then look it up to see what temperature it is.

Let's rearrange the low temperature equation to solve for Rt:

$$Rt = \frac{R4 * (RV1 + R5)}{R6}$$

And we therefore compute Rt = 24.1k ohms which is about 130 degrees C.

R5 = 35k yields a temperature control range from 130 degrees C to 225 degrees C.

Notes:

There is NEVER a reason to short R5. Shorting R5 means that the maximum variable resistor setting disables the Velleman control of the temperature and the heaters will no longer be told to turn off.

R7 is the feedback loop which controls the hysteresis of the comparator. This resistor controls how sensitive the comparator is as the temperature strays from the setting. If R7 is removed, once up to temperature the relays will click on and off very frequently trying to control the temperature precisely (and maybe even trying to follow noise in the system).

R6 can be adjusted as well. R6 helps to control the range of temperatures we can set using the variable resistor. In my example above the temperature control range was 130 degrees C to 225 degrees C. If this range is not sufficient for your application you can change R6 to change the range. Suppose we wanted the lower range to go down to 85 degrees C while keeping the upper range 225 degrees C. If we change R6 to 10k ohms and repeat the calculations, we now get R5 at 25k ohms and the range is 85 degrees C to 225 degrees C. Higher values of R6 reduce the difference between the low and high settings while lower values of R6 increases the difference.