## Reading ECH$_2$O Temperature Sensors with a Datalogger

The ECH$_2$O ECT temperature sensor consists of a 10 KΩ precision resistor and a 10 KΩ thermistor in a waterproof over mold. The resistor and thermistor form a three wire half bridge. Three wires come from the sensor: ground, excitation, and output. These are connected to a stereo connector. The base (sleeve) of the connector is ground, the tip is excitation, and the ring is output. When the connector is plugged into the ECH$_2$O pigtail adapter, the white wire of the adapter is excitation, and the red wire is output.

The output of the half bridge is

$$\frac{v}{v_o} = \frac{R_o}{R_T + R_o} \qquad (1)$$

where $v/v_o$ is the ratio of output voltage to applied voltage for the half bridge, $R_o$ is the pickoff resistor value (10 KΩ, which is also the thermistor resistance at 25 C), and $R_T$ is the thermistor resistance. Rearranging, we obtain

$$\frac{R_T}{R_o} = \frac{v_o}{v} - 1 \qquad (2)$$

The relationship between the natural logarithm of the ratio of thermistor resistance to resistance at 25C and temperature is well fit by a third order polynomial. Departures of the fit from actual values are less than the thermistor accuracy (0.2C) from –40 to +60 C.

If we let

$$x = ln( (V_0/V)-1) \qquad (3)$$

where $V_0$ is the excitation voltage and $V$ is the measured output, then

$$T = -0.1087\, x^3 + 1.6066\, x^2 - 22.801\, x + 25.0 \qquad (4)$$

T is temperature in °C.

This sensor is ratiometric so the above equations are appropriate for excitation voltages up to 5V (more than 5V excitation will cause the thermistor to self-heat).