

Reading Echo Temperature Sensors with a CR10X Datalogger

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The ECH₂O temperature sensor consists of a 10K precision resistor and a 10K 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 of the connector is ground, the tip is excitation, and the ring is output. When the connector is plugged into the Echo pigtail adapter, the white wire of the adapter is excitation, and the red wire is output.

The output of the half bridge is

$$\frac{V}{V_o} = \frac{R_o}{R_T + R_o} \quad (1)$$

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

$$\frac{R_T}{R_o} = \frac{V_o}{V} - 1 \quad (2)$$

The relationship between the 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 $x = \ln(R_T/R_o)$ then

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

The following code fragment for a Campbell Scientific CR10X implements these equations, giving a temperature output from an ECH₂O temperature sensor. The sensor is assumed to be connected to excitation 1 and single ended input channel 1.

CR10X Code Fragment for Echo Temperature Sensor

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1: Excite-Delay (SE) (P4)
  1: 1      Reps
  2: 3      25 mV Slow Range
  3: 1      SE Channel
  4: 1      Excite all reps w/Exchan 1
  5: 0000   Delay (units 0.01 sec)
  6: 25     mV Excitation
  7: 1      Loc [ x      ]
  8: .04    Mult
  9: 0.0    Offset

2: Z=1/X (P42)

1: 1      X Loc [ x      ]
2: 1      Z Loc [ x      ]

3: Z=X+F (P34)
  1: 1      X Loc [ x      ]
  2: -1     F
  3: 1      Z Loc [ x      ]

4: Z=LN(X) (P40)
  1: 1      X Loc [ x      ]
  2: 1      Z Loc [ x      ]

5: Polynomial (P55)
  1: 1      Reps
  2: 1      X Loc [ x      ]
  3: 2      F(X) Loc [ Temp ]
  4: 25     C0
  5: -22.801 C1
  6: 1.6066 C2
  7: -.1087 C3
  8: 0.0    C4
  9: 0.0    C5

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