

Document Title: Description, AN, Reading ECH2O probe with CR10X dataloggers		Part # and Rev. 13400-00	
		Release Date: 1-12-07	
Rev.	Description	Revision By	Date

Production Filename: 13400 (In Product Library)

Path to Working Files: DecaDoc\Application Notes\Master

Dimensions: 8.5 inch wide, 11 inch tall

Material: Paper, 92 Bright White or better, 75g/m² or heavier

Colors: Color Print on White

Printer: HP Color LaserJet 8550-PS

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale **



Application Note

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 hose 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

$$\frac{V_o}{V_e} = \frac{R_T}{R_T + R_p} \quad (1)$$

where v_o/v_e is the ratio of output voltage to applied voltage for the half bridge, R_p 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

$$\frac{R_T}{R_p} = \frac{V_o}{V_e} - 1 \quad (2)$$

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 $x = \ln(R_T/R_p)$ then

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

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

```

1: Excite-Delcay (SE) (P4)
2: 1 Reps
3: 2.5 RV Slow Range
4: 1 EE Channel
5: Excite all reps w/techn 1
6: 0000 Delay (units 0.01 sec)
7: 25 RV Excitation
8: 1 Loc 1 x
9: .04 Wait
10: 0.0 Offmt

2: S-I/X (P42)
3: 1 X Loc 1 x
4: 1 X Loc 1 x

3: S-R/F (P34)
4: 1 X Loc 1 x
5: 1 F
6: 1 X Loc 1 x

4: S-IM(X) (P40)
5: 1 X Loc 1 x
6: 1 X Loc 1 x

5: Polynomial (P35)
7: 1 Reps
8: 1 X Loc 1 x
9: 2 F(R) loc 1 Temp
10: 25 C0
11: -0.1087 C1
12: 1.6066 C2
13: -22.801 C3
14: 25.0 C4
15: 0.0 C5

```

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