

Thermistor Probes & Thermistor Strings

Applications

The Model 3800 Thermistors are designed for measuring temperatures in rock, soil and concrete dams.

The Model 3810 Thermistor String is designed for profiling temperatures in...

- Boreholes
- Tundra soils
- Glaciers
- Landfills



• Model 3800-1-1 (top) and Model 3800-2-1 (bottom) Thermistors.



• Close-up of an encapsulated sensor (Model 3810 Thermistor String).



• Model 3810 Thermistor String.

Operating Principle

Thermistors are semiconductors, which behave as thermal resistors—that is, resistors with a high (usually negative) temperature coefficient of resistance. Thermistor beads are made from a mixture of metal oxides encased in epoxy or glass. The beads are small in size and extremely robust with a high degree of stability over a long life span. Because their resistance change is so great, it is unusual for cable effects to be significant. However, for high accuracy work, and when long cables are used, the cable resistance must be taken into account. Standard temperature ranges are -50° to 150°C .

The Model 3800-1-1 and Model 3800-2-1 Thermistors are supplied inside a housing already potted on the end of a cable ready to be attached to a structure, or buried in concrete or in the ground. The potting chamber is made from PVC for low temperature models or from stainless steel for the high temperature models. They are particularly well suited for measuring the heat of hydration in concrete and RCC dams.

The Model 3810 Thermistor String comprises a number of individual 3800 sensors encapsulated in a rugged, direct burial, multiconductor cable for multiple measurements in a single borehole. Thermistor strings are manufactured according to customer requirements for overall length, number of sensors and accuracy. Thermistor strings are typically used for profiling temperatures in boreholes, landfills, tundra soils, and glaciers.

Advantages and Limitations

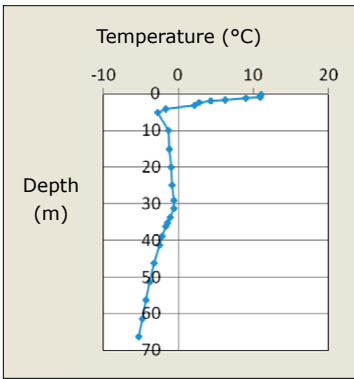
Thermistors have a negative temperature coefficient (NTC) where their resistance decreases with increasing temperature. The NTC can be as large as several percent per degree C, which allows the thermistor to detect minute changes in temperature. Thermistors are very small, which means they will respond quickly to temperature changes.



• Summer view of the Geokon Model 8025 Data Acquisition Station measuring a 70 m deep Thermistor String in mine tailings, located in northern Canada.*



• Winter view of the above installation.*



• Typical temperature plot.*

Thermistors have a non-linear output that can be represented by the Steinhart-Hart Equation:

$$1/T = A + B (\ln R) + C (\ln R)^3 - 273.2$$

Where T is the temperature in degrees Centigrade and R is the resistance in ohms.

Due to manufacturing variations only those thermistors are selected at the factory which conform with this equation either to a standard accuracy of $\pm 0.5^\circ\text{C}$ or, by a more discriminating selection, to an accuracy of $\pm 0.2^\circ\text{C}$.

The correspondence between the resistance output in ohms and the equivalent temperature in degrees Centigrade is presented in tabular form with each thermistor or thermistor string.

The high resistance of the thermistor affords it a distinct measurement advantage inasmuch as a four-wire resistance measurement to compensate for cable effects is not required, as may be the case with RTDs (Resistance Thermal Devices).

Thermistor output is nominally 3000 ohms at 25°C and around this temperature the rate of change of resistance is approximately 130 ohms/ $^\circ\text{C}$. For greater accuracy the resistance of the cable leading to the thermistor can be taken into account.

Readout

Thermistors can be read using either a GK-403 or GK-404 Readout Box, which both display the temperature directly in degrees Celsius. Alternatively, a digital ohmmeter can be used in conjunction with look-up tables. For remote unattended applications, thermistors can be connected to data acquisition systems which can provide automatic data collection at pre-determined intervals, and data transmission via wireless methods. For these applications, connectors can be attached to the thermistor strings to facilitate rapid connection.

Technical Specifications

Thermistor Probes	3800-1-1	3800-2-1
Standard Range ¹	-50°C to $+150^\circ\text{C}$	-50°C to $+150^\circ\text{C}$
Resolution	0.1°C	0.1°C
Accuracy ²	$\pm 0.5^\circ\text{C}$	$\pm 0.5^\circ\text{C}$
Temperature Range	-20°C to $+80^\circ\text{C}$	-20°C to $+80^\circ\text{C}$
Length x Diameter	50×12 mm	50×12 mm

¹High temperature versions available on request.

²Accuracy of $\pm 0.2^\circ\text{C}$ available on request.

Thermistor String	3810
Standard Range	-50°C to $+150^\circ\text{C}$
Resolution	0.1°C
Accuracy ¹	$\pm 0.5^\circ\text{C}$
Measurement Points	2-24 (please specify at time of order)
Temperature Range	-20°C to $+80^\circ\text{C}$

¹Accuracy of $\pm 0.2^\circ\text{C}$ available on request.

*Plot and photos courtesy of GKM Consultants, Inc. (www.gkmconsultants.com).



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