HVAC/R THERMISTORS

QUALITY THERMISTOR, INC

www.thermistor.com

TEMPERATURE SENSOR EXPERTS

Surface PROBES

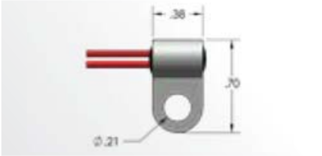
CUSTOM SOLUTIONS:

With QTI Probes you have the flexiblilty of applying a variety of sensor options with the housing of your choice.

THERMISTOR USB RTD HERMETICALLY SEALED SENSOR

FLAG RING LUG PROBES

- Available in a variety of sizes with or without insulation
- Standard lug sizes #4 to #12 with additional styles available
- Recommended wire sizes #24-28 AWG
- Material: Tinned Copper or Ni plated steel



RING LUG PROBES

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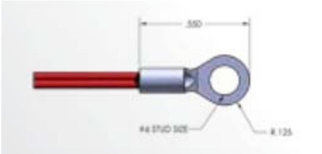
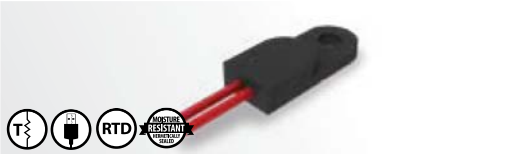


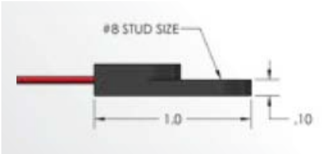
FLAT DISC PROBES

- Versatile, multi-purpose surface sensor
- Standard sizes are 0.33" and 0.21"
- Recommended wire sizes #24-28 AWG
- Can be overmolded
- Material: Stainless Steel, Copper, Aluminum

MOLDED RING LUG PROBES

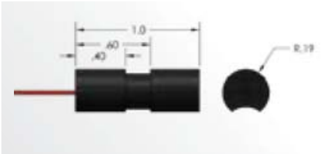


- Ideal for high humidity environments
- Operating Temp range: -40°C - to 80°C
- Recommended wire sizes #22 AWG
- Material: Molded Plastic



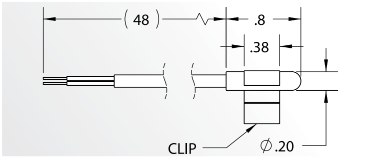
PIPE MOUNT PROBES

- Ideal for high humidity environments
- Operating Temp range: -40°C - to 80°C
- Recommended wire sizes #22 AWG
- Material: Molded Plastic



WATERPROOF IP68 PROBE WITH CLIP

- Double insulated thermoplastic rubber
- Ruggedized housing and corrosion resistant cable
- Waterproof rating to IP68
- Based on the most common curves in the industry
- Available with 1/4" to 7/8" clip sizes



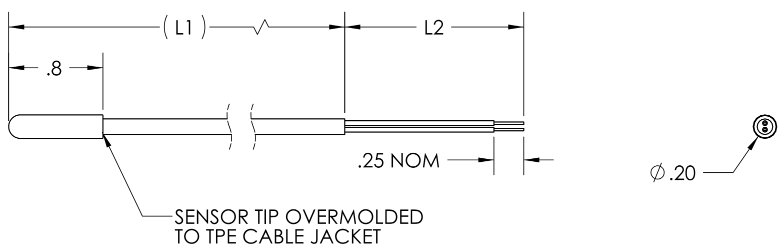
Waterproof Temperature SENSOR

IP68 RATED PRODUCT

QTI's Hydroguard IP68 Series of parts combines a highly stable precision thermistor encapsulated with an extremely durable waterproof housing. The temperature sensor offers excellent performance during harsh freeze thaw/cycles. The over molded probes are a great solution where a waterproof seal and moisture resistance is critical.

Features

- Precision NTC Thermistor
- Long term stability
- Double insulated thermoplastic rubber
- Ruggedized housing and corrosion resistant cable
- Waterproof rating to IP68
- Based on the most common curves in the industry



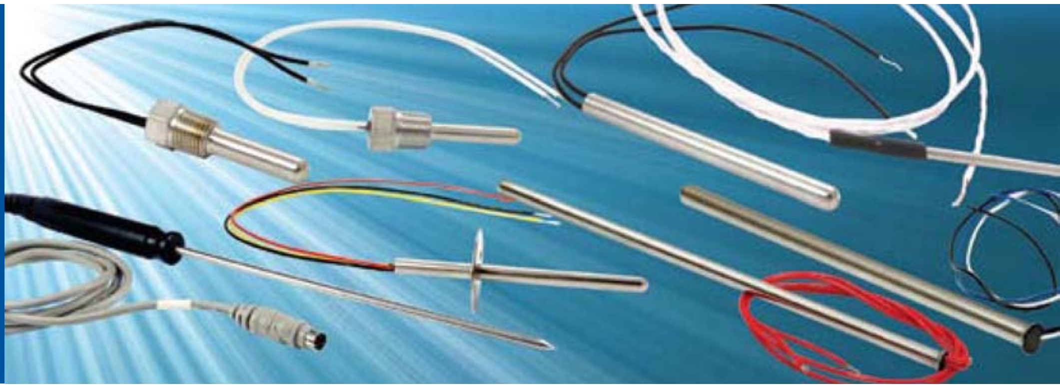
Applications

- Refrigeration and freezer applications
- Air-conditioning
- Under floor heating
- Climate control systems
- High humidity environments
- Maximizing refrigerator equipment life

TEMPERATURE RANGE	-55°C to 105°C (-67°F to 221°F) continuous **Also avialable up to 150° C (302°F)**
CABLE	2', 5', 10', 25' **(custom lengths available)** #22 AWG stranded copper, VDE Approved **Insulation Resistance 100MOhm at 1000 VDC** Color coded wire available
RESISTANCE VALUES @ 25°C	2.25k, 5k, 10k, 20k, 100k, Other values available.
DIELECTRIC STRENGTH	3750 VAC
ACCURACY	Point Matched: +/- 1%, 2%, 5% and 10% **Interchangeable 0°-70°C (32-158°F): +/- 0.2°C**
MOISTURE RESISTANCE	Meets or exceeds IP68

RoHS COMPLIANT

Liquid
PROBES



PIPE & SAE THREADED FITTING WITH TUBE

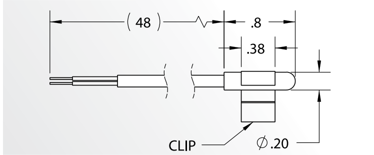
- General purpose, rugged high pressure design
- Recommended wire sizes #22-28 AWG
- Material: Stainless Steel, Brass, Titanium
- Straight thread option with or without O-rings.

CLOSED END TUBE

- Versatile, multi-purpose sensor
- Standard sizes are 0.040" to .250" in diameter
- Recommended wire sizes #22-32 AWG
- Material: Stainless Steel, Brass, Titanium, Inconel, Hastelloy

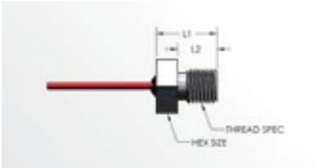
WATERPROOF IP68 PROBE WITH CLIP

- Double insulated thermoplastic rubber
- Ruggedized housing and corrosion resistant cable
- Waterproof rating to IP68
- Based on the most common curves in the industry
- Available with 1/4" to 7/8" clip sizes



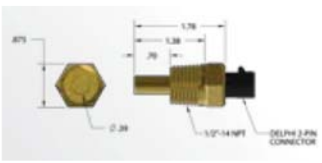
HEX NUT PROBES

- Available in a variety of sizes .060" to 0.50"
- General purpose, rugged high pressure design
- Recommended wire sizes #26-28 AWG
- Material: Stainless Steel, Brass, Titanium, Aluminum
- Available with or without O-rings.
- Available in Metric and reverse threads.

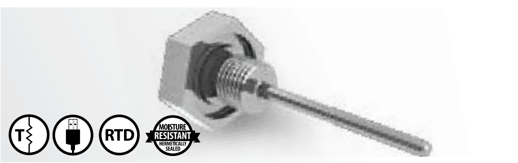


THREADED BRASS HOUSING

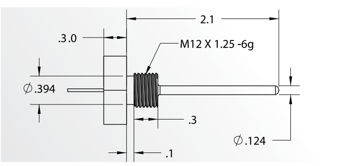
- Durable brass design available in a variety of probe sizes
- Fast thermal time response
- Unique one piece design allows for ease of installation
- Standard Delphi connector
- Gasket sealed housing for harsh environments

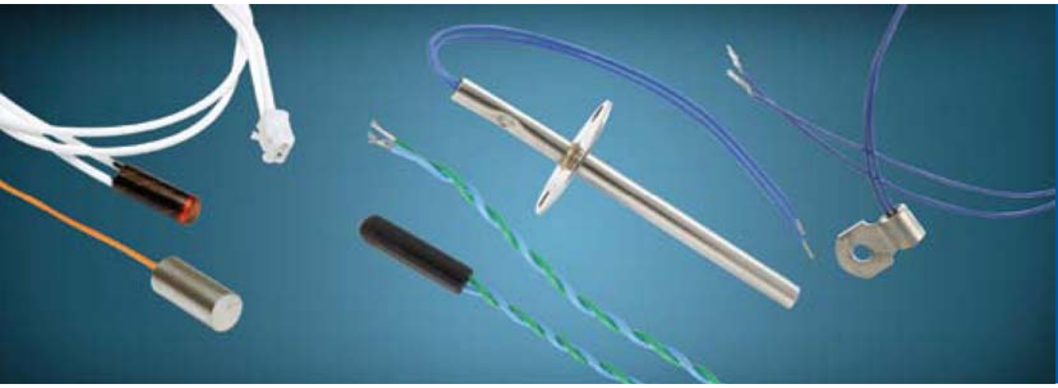


THREADED HOUSINGS WITH O-RING SEAL



- Straight wall probe with recess for O-ring gasket seal
- Fast thermal time response
- Material: Stainless Steel, Brass, Titanium, Inconel



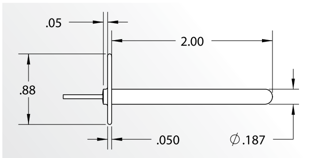


Air-Gas

PROBES

FLANGED, TRIANGLE

- Low cost durable housing with a precision temperature sensor
- Ruggedized housing and available with corrosion resistant cable
- Material: Stainless Steel
- Available in a variety of sizes
- Fast thermal response time



FLANGED, OPEN TIP

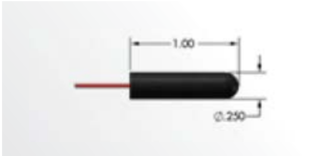
- Available in a variety of sizes with or without brazed flange
- Flange can be screwed or riveted in place
- Recommended wire sizes #22-28 AWG
- Material: Stainless Steel

FLANGED, RECTANGLE

- Low cost durable housing with a precision temperature sensor
- Ruggedized housing and available with corrosion resistant cable
- Material: Stainless Steel
- Available in a variety of sizes

MOLDED TUBE PROBES

- Ideal for high humidity environments
- Operating Temp range: -40°C - to 80°C
- Recommended wire sizes #22 AWG
- Material: Molded Plastic



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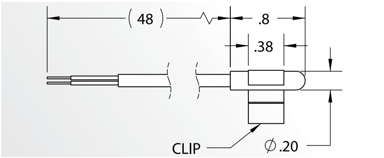


RTD

PROBES

PLATINUM RTD TEMPERATURE PROBES

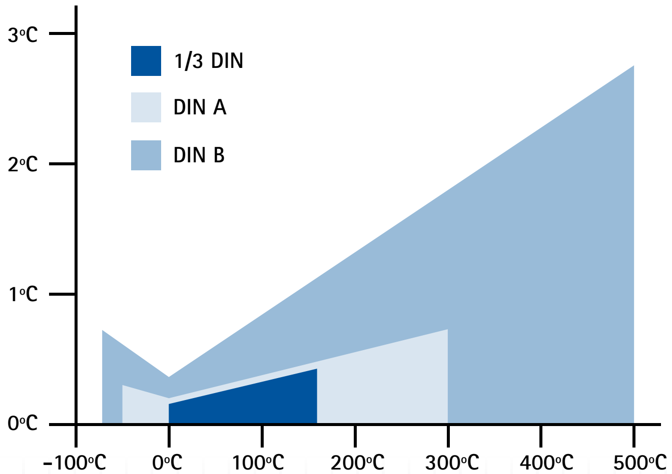
QTI Platinum Thin Film RTD Temperature Probes are manufactured with state of the art thin film Platinum RTD elements and materials designed to give superior temperature measurement and exceptional stability.

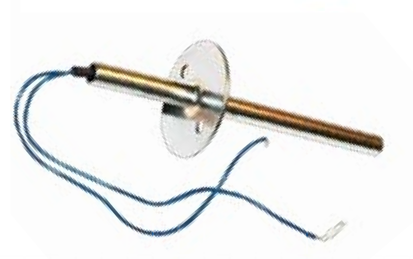
Common applications include Automotive, White goods, HVACR, Industrial Medical, Military and Aerospace.

SPECIFICATIONS

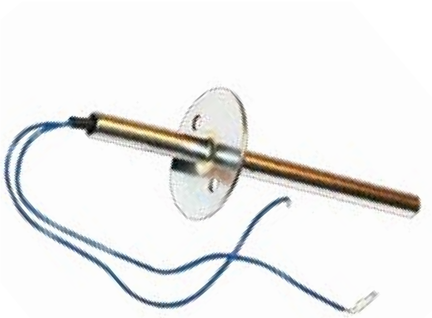
- Made from Class 1/3 DIN, Class A, Class B, or Class 2B thin film platinum RTD elements
- 100 ohm, 500 ohm and 1,000 ohm RTD elements available
- 3,850 ppm Temperature Coefficient @ 0°C
- Operating temperature range –70°C to 500°C depending on model
- 1/3 DIN Class B = +/-.1°C at 0°C
- Class A = +/-.15°C at 0°C
- Class B = +/-.3°C at 0°C
- Class 2B = +/-.6°C at 0°C

Platinum thin-film sensors can also be selected in tolerance groups with a maximum $\triangle t$ = 0.1 K over a range of 0°C to 100°C.
For applications with high price sensitivity, other accuracy tolerances are also available





HOW DO I USE A THERMISTOR?



Closed end tube with flange, ideal for rivet mounting.

WHAT IS MEANT BY "INTERCHANGEABILITY" OR "CURVE TRACKING"?

A thermistor can be defined as having an interchangeability tolerance of ±0.1°C over the range from 0° to 70°C. This means that all points between 0° and 70°C are within 0.1°C of the nominal resistance values for that particular thermistor curve. This feature results in temperature measurements accurate to ±0.1°C no matter how many different thermistors are substituted in the application.

WHAT IS MEANT BY '"POINT MATCHED"?

A standard thermistor is calibrated and tested at 25°C to a tolerance of ± 1%, 2%, 5% or 10%. Since these thermistors only have one controlled point of reference or 'point matched' temperature, the resistance at other temperatures are given by the "Resistance vs. Temperature Conversion Tables" for the appropriate material curve. The resistance value at any temperature is the ratio factor times the resistance at 25°C.
In addition to the industry standard of point matching thermistors at 25°C, Quality Thermistor can point match to a specific temperature range. Examples of this would be the freezing point of water (0°C) or human body temperature (37°C).

AVAILABLE INTERCHANGEABLE TOLERANCES

-20C° to +50°C	0C° to +70°C
A2 = +/- 1°C	A3 = +/- 1°C
B2 = +/- 0.5°C	B3 = +/- 0.5°C
C2 = +/- 0.2°C	C3 = +/- 0.2°C
	D3 = +/- 0.1°C

0C° to 100°C	+20C° to +90°C
A4 = +/- 1°C	A5 = +/- 1°C
B4 = +/- 0.5°C	B5 = +/- 0.5°C
C4 = +/- 0.2°C	C5 = +/- 0.2°C

+20C° to +50°C
A6 = +/- 1°C
B6 = +/- 0.5°C
C6 = +/- 0.2°C
D6 = +/- 0.1°C

WHAT IS THERMAL DISSIPATION?

THERMAL DISSIPATION

The thermal dissipation of a thermistor is the power required to raise the thermistor's body temperature by 1°C. The dissipation is expressed in units of mW/°C (milliwatts per degree Celcius).

Dissipation can be affected by:

- ✔ Mass of the thermistor probe
- ✔ How the probe and sensor are mounted
- ✔ Thermal dynamics of the environment

The dissipation is an important factor in applications that are based on the self-heating effect of thermistors. Specifically, the change in resistance of the thermistor due to change in dissipation can be used to monitor levels or flow rates of liquids or gasses. As an example, as the flow rate increases, the dissipation of the thermistor in a fluid path will increase and the resistance will change and can be correlated to the flow rate.

Stated another way, the dissipation is a measure of the thermal connection of the thermistor to its surroundings. It is generally given for the thermistor in still air, but sometimes in well-stirred oil.

WHAT IS SELF-HEATING?

SELF-HEATING EFFECTS

When current flows through a thermistor, it generates heat, which raises the temperature of the thermistor above that of its environment. If this effect is not compensated, it will cause an error in measurement. Typically, the smaller the thermistor, the lower the amount of current needed to self-heat.

The electrical power input to the thermistor is just PE = IV

where I is current and V is the voltage drop across the thermistor. This power is converted to heat, and this heat energy is transferred to the surrounding environment. The rate of transfer is well described by Newton's law of cooling: PT = K(T(R) - T0)

where T(R) is the temperature of the thermistor as a function of its resistance R, T0 is the temperature of the surroundings, and K is the dissipation constant, usually expressed in units of milliwatts per °C. At equilibrium, the two rates must be equal.
PE = PT

The current and voltage across the thermistor will depend on the particular circuit configuration. As a simple example, if the voltage across the thermistor is held fixed, then by Ohm's Law we have I = V / R and the equilibrium equation can be solved for the ambient temperature as a function of the measured resistance of the thermistor:

$$T0 = T(R) - \frac{V^2}{KR}$$

The dissipation constant is a measure of the thermal connection of the thermistor to its surroundings. It is generally given for the thermistor in still air, and in well-stirred oil. Typical values for a small glass bead thermistor are 1.5 mw/°C in still air and 6.0 mw/°C in stirred oil. If the temperature of the environment is known beforehand, then a thermistor may be used to measure the value of the dissipation constant. For example, the thermistor may be used as a flow rate sensor, since the dissipation constant increases with the rate of flow of a fluid past the thermistor.

PRECISION USB THERMOMETER

Accurate. Easy. Direct.

DirecTemp°™

PRECISION TEMPERATURE ACQUISITION SYSTEM

- Accuracy +/- 0.1°C (0-100°C) or +/- 0.5°C (0-70°)
- Custom probe and cable configuration
- NIST Traceable - Certification available
- Data logging and alert notification software included
- Able to run multiple sensors

"UNLIMITED POSSIBILITIES IN TERMS OF CALIBRATION, PROBE DESIGN AND APPLICATION USE."

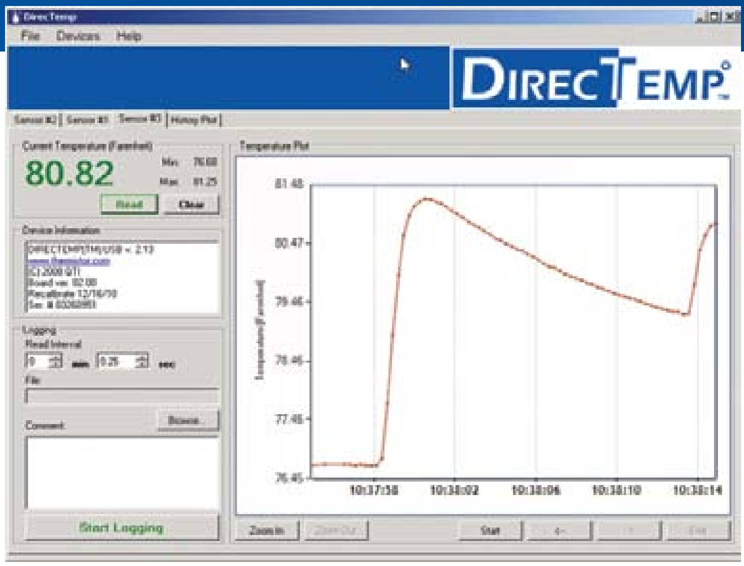
DESCRIPTION

A high precision thermistor is combined with a 14 bit analog to digital converter and a simple USB communication interface to capture real-time temperature data. The DIRECTEMP°™ device can communicate either as a Human Interface Device which auto installs to interface with the DIRECTEMP°™ data logging software, or as a virtual serial port with which custom or third party software may be used. DIRECTEMP°™ probes are calibrated in QTI's metrology laboratory and can be recalibrated and returned to service for extended life. The absolute accuracy and repeatable precision of the DIRECTEMP°™ USB temperature acquisition system will become invaluable to your most critical application.

TOLERANCE	± 0.1° C: 0 °C to 100 °C or +/- 0.5°C (0-70°) ± 1.5° C: -55 °C to 150 °C
RESOLUTION	0.01 °C
RoHS COMPLIANT	Yes
CURRENT DRAW	< 100mA

See next page for
AVAILABLE INTERFACE OPTIONS
and CUSTOMIZABLE PROBE DESIGNS

PRECISION USB THERMOMETER



DirecTemp°™ Software (HID configuration only)

Choose from a variety of probe options

Available Interface Options

HID Configuration
(Plug & Play, DirecTemp°™ Software Included)

- Automatic driver installation in MS Windows
- DirecTemp data logging software included for Windows
- Stream data to a plot and record to file for future analysis
- Compatible with Windows 2000 and newer 32 bit systems

USB-Serial Configuration
(Virtual Com Port, For OEM & Proprietary Software Applications)

- Virtual serial device
- Designed for integration with custom third party software applications
- Free demo software & LabVIEW VI included
- Communication protocol information available upon request
- Compatible with Linux, Windows, and MacOS systems
- Additional programming language examples available.

Cable Options

- Coiled
- High Temperature
- Multiple lengths available

*Windows 32 bit versions work with included DirecTemp°™ software
**User specified single point temperatures and tolerances available
Warning: Do not use in human life support applications.
This device is not designed nor intended to operate in situations where human injury will result in the event of a failure.

DirectRH™

DESCRIPTION

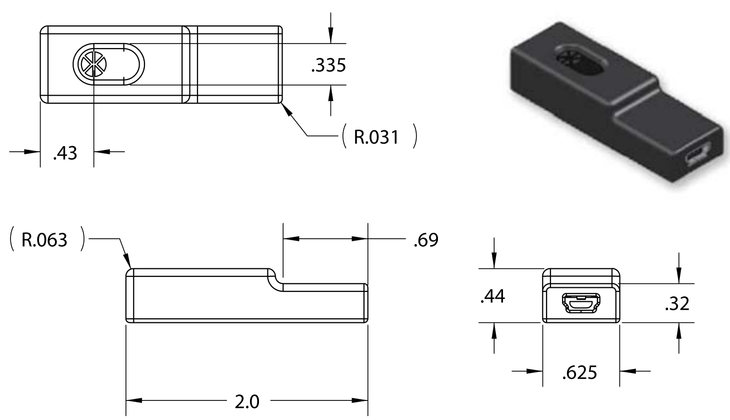
The DIRECTRH™ sensor platform combines a stable temperature sensor and a sensitive humidity sensor for monitoring your critical infrastructure environment. DIRECTRH™ is USB powered to provide temperature and humidity data while your system is on. Most operating systems including Windows and Linux varieties are compatible with the plug and play HID interface enabling you to easily integrate the device into your custom monitoring system. Communication details, a simple example software program for Windows, and a script for Linux are supplied to help you get running quickly.

SPECIFICATIONS

	ACCURACY	RANGE	RESOLUTION	SURVIVABLE LIMITS
RELATIVE HUMIDITY	±5 % ±3 % ±3 %	10 % - 35 % 35 % - 75 % 75% - 95 %	0.1 % 0.1 % 0.1 %	Condensing atmosphere
TEMPERATURE	0.5 °C	0° C – 70°	0.01 °C	-20 °C - 100 °C

FEATURES

- User selectable wire length with standard USB cables
- Temperature/relative humidity sensor
- Software supports multiple sensors



INCLUDED COMMUNICATION

- Communication API
- Example script for Linux
- Sysfs driver for 2.6 kernel available (tested in Ubuntu)
- Code for Windows included

CUSTOM SOFTWARE INTEGRATION SERVICES AVAILABLE

HOW DO I DESIGN A PROBE?

Another problem with selecting material based on thermal conductivity alone is that the mass of the highly conductive probe housing can actually act like a heat sink and pull additional heat out of the system. This can obviously create measuring inaccuracies.

To offset this, you can combine different materials while designing your probe. A low thermally conductive housing with a small highly conductive probe tip is a good solution.

In some cases, your application may require a slow thermal time response. An example of this would be an outdoor sign that displays the temperature. A large over molded probe will insulate the thermistor and even out quick fluctuations in temperature changes.

CONFINED SPACE

Due to a thermistor's miniature size, it can be potted into almost any size housing. Currently, the smallest available thermistor is 0.020" max diameter. Hollow-tube rivets, set screws, hypodermic needles and direct epoxy attach are some common methods for confined space thermistor applications.

LIQUID

For liquid applications, it's best to use a threaded probe. Possibly, with some type of elastomeric seal like an o-ring. QTI also offers a complete line of NPT probe housings. Some applications require over molding the thermistor into the plastic housing of the product. Another option is to use a glass encapsulated bead. It provides a hermetic seal that is as close to 'waterproof' as Mother Nature will allow. Remember the Titanic?

GAS/AIR

Gas and air applications have a variety of choices. Probes can be surface mounted in the flow stream or they can be projected into the air stream by means of a closed or open-end tube. When measuring gas or air under pressure, we recommend using some type of thread/o-ring combination.

SURFACE

By far the most common method for surface measurement is the ring lug. Due to the small size of the thermistor element, it can be potted into most ring lug barrels. Be careful that the wire gauge does not exceed the inside dimension of the barrel. Another option for surface measurement is direct attachment of a thermistor using a stainless steel disc.

FREQUENTLY ASKED QUESTIONS

HOW DOES AGING AFFECT THERMISTOR STABILITY?

"Thermometric drift" is a specific type of instability in which the deviation in measured temperature is the same at all temperatures to which the thermistor is exposed. For example, a thermistor that exhibits a -0.02°C shift at 0°, 40° and 70°C (even though this is a different percentage change in resistance in each case) would be exhibiting thermometric drift. Thermometric drift: (1) occurs over time at varying rates, based on thermistor type and exposure temperature, and (2) as a general rule, increases as the exposure temperature increases. Most drift is thermometric.

WHAT HAPPENS IF MY APPLICATION EXCEEDS THE TEMPERATURE RATING?

Intermittent temperature incursions above and below the operating range will not affect long-term survivability. Encapsulate epoxy typically begins to break down at 150°C and the solder attaching leads to the thermistor body typically reflows at about 180°C. Either condition could result in failure of the thermistor.

ARE THERMISTORS ESD SENSITIVE?

Per MIL-DTL-39032E, Table 1, thermistors by definition are not ESD sensitive.

WHAT IS THE RESOLUTION OF A THERMISTOR?

There is no limit to the resolution of a thermistor. The limitations are in the electronics needed to measure to a specified resolution. Limitations also exist in determining the accuracy of the measurement at a specified resolution.

ARE QTI THERMISTORS RoHS COMPLIANT?

(What if I don't want a lead free part?)
Quality Thermistor maintains two separate manufacturing lines to meet the specific environmental needs of our customers. One line is dedicated to RoHS compliance and the other is maintained for traditional tin/lead parts for military, aerospace and medical applications.

DOES THE LENGTH OF WIRE IMPACT THE ACCURACY OF A THERMISTOR?

With a thermistor, you have the benefit of choosing a higher base resistance if the wire resistance is a substantial percentage of the total resistance. An example of this would be a 100-ohm thermistor vs a 50,000 ohm thermistor with 10' of 24 AWG wire.

Total wire resistance = 10' x 2 wires x 0.02567 ohms per foot = 0.5134 ohms

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