TTI-7 PLUS Buyers Guide

High Accuracy PRT and Thermocouple Thermometer

Why Choose the TTI-7 PLUS?

Essential Features
The TTI-7 has the features required for precision temperature measurement, it doesn't have unnecessary gimmicks. Designed with the needs of the calibration laboratory it can store the calibration coefficients of up to twenty standard probes.

Expandable
Can be expanded with an *internal* scanner option to a maximum of ten channels.

Supports the Calibration Lab Thermometers
The TTI-7PLUS can be used with 25 Ohm SPRTS and 100 Ohm IPRTS. Either ITS-90 or IEC 751 (CvD) coefficients.

Further thirteen thermocouple types are supported including Pt / Ag.

Resistance Thermometers
Instrument specifications for resistance thermometers relate to the instruments ability to measure electrical resistance.

A manufacturer will specify the accuracy for resistance thermometers in terms of the ability of the instrument to read electrical resistance.

For Pt100 thermometers at 500°C a change of 0.01°C is equal to a resistance change of 0.0033Ω. The excitation current for Pt100 thermometers is most usually 1mA. From ohms law,
V = IR the voltage change for a 0.01°C temperature change at a measuring current of 1mA will be

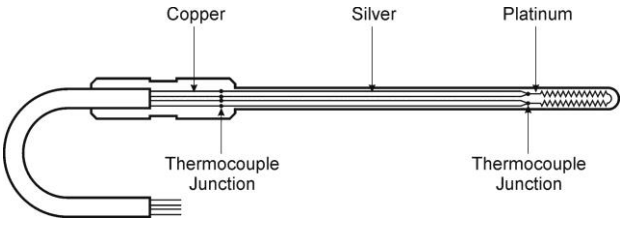
$$V = 0.001A \times 0.0033\Omega = 0.0000033V, 3.3\mu V$$

Now consider a platinum resistance thermometer, the temperature sensing element will have its platinum wire joined to an other metal. In the head of the thermometer copper lead wires are generally used. These junctions of dissimilar metal types will generate a thermal EMF if there is a temperature difference between them. The EMF of a copper to platinum junction is typically 7µV /°C.

The temperature error caused by thermoelectric errors is

$$Te = Ve/S$$

Where Ve is the voltage error and S the sensitivity of the instrument.



For an example of a 1°C difference across a platinum / copper junction and a measuring current of 1mA at 550°C

Te = 7/3.3 = 0.02°C

It is seen that a gradient of just 1°C across a platinum / copper junction will introduce an error greater than 0.02°C. In practice there can be other metals (further junctions) in the construction of industrial PRTs making the error worse. Further if the excitation current is less than 1mA, then again the error gets larger.

Now consider a DC instrument with an uncertainty specified as 0.01°C, in practise the measurement error can be much higher than the instrument accuracy due to the thermal EMF errors. The TTI-7 can be set to take two measurements with the measuring current first in a forward then in the reverse direction. The thermal EMF is then cancelled by computing and then displaying the mean of the two measurements. By selecting the AVE (Average) mode of the TTI-7 this is accomplished automatically.

When selecting an instrument remember this feature can reduce measurement error significantly. Many other instruments in this price bracket lack this or equivalent features. It can easily be forgotten when comparing specifications, yet the effect itself as shown can introduce significant errors.

Further the measuring current through a Pt100, usually 1mA, will introduce self heating of the temperature sensing element, the Measuring Current Squared x The Resistance of the Temperature Sensor; I^2R. This self heating causes an error of unknown magnitude.

Again the TTI-7 has a feature to eliminate this error, this is achieved by reducing the power dissipated by half so that the probe self heating can be determined and corrected for. This is what we mean by having “Essential Features” for good measurements, ensure that your chosen instrument has these features, not all do.

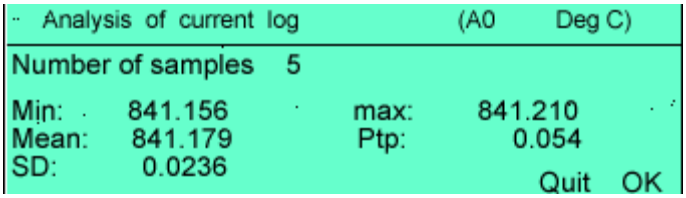
Thermocouples
When it comes to thermocouples the TTI-7 continues to offer real advantages. Thirteen types are supported – not just the common and standard types but also Platinum / Gold thermocouples and less common base types like Type L. With Cold Junction Compensation great care has been taken, each thermocouple connector has its own precision temperature sensor. This gives performance to better than 0.1C at 20°C. Other instruments lack this precision and require external ice points to get the best performance. The TTI-7 can also be used with external referencing and it can even measure its own reference temperature using an external PRT.

Performance
The TTI-7 specification is for a single measurement, single pair of measurements in AVE mode, it doesn’t need to take a large number of measurements or extended sample rate to get the published performance.

PC Use
The instrument includes an RS232 interface for connection to a PC. Windows software is included, simply unpack, attach the supplied cable and load the software. Again check you get this when comparing instruments. Compatible with I-cal EASY for fully automatic temperature calibration.

Battery Power
The instrument will run for a whole 10 hours from the internal sealed lead acid battery with no memory effects. The power supply and charger is built in. This allows a whole working day plus to use the instrument in the field.

Statistical Analysis
The TTI-7 includes an inbuilt data logger internally storing up to 4,000 date and time stamped readings. The powerful maths function enables statistical analysis of the capture data, mean, max, min, peak and standard deviation. If you don’t have a



computer handy you can review the data from the front panel, with a PC you can download the data or connect to a printer. A rolling mean allows the mean and standard deviation of the last 1 to 50 readings to be displayed.

Laboratory Thermometer Check List

Pt25, Pt100 and Thermocouple Support	TTI-7 Included
Ability to Eliminate Thermal EMF Errors	TTI-7 Included
Self Heating Test	TTI-7 Included
Thirteen Thermocouple Types	TTI-7 Included
Statistical Analysis and Logging	TTI-7 Included
High CJC Performance	TTI-7 Included
PC Interface and Software	TTI-7 Included
Internal Scanner	Option