

The principle of operation is to measure the resistance of a platinum element. The most common type (PT100) has a resistance of 100 ohms at 0 °C and 138.4 ohms at 100 °C. There are also PT1000 sensors that have a resistance of 25 ohms and 1000 ohms respectively at 0 °C.

The relationship between temperature and resistance is approximately linear over a small temperature range: for example, if you assume that it is linear over the 0 to 100 °C range, the error at 50 °C is 0.4 °C. For precision measurement, it is necessary to linearise the resistance to give an accurate temperature. The most recent definition of the relationship between resistance and temperature is International Temperature Standard 90 (ITS-90).

For a PT100 sensor, a 1 °C temperature change will cause a 0.384 ohm change in resistance, so even a small error in measurement of the resistance (for example, the resistance of the wires leading to the sensor) can cause a large error in the measurement of the temperature. For precision work, sensors have four wires- two to carry the sense current, and two to measure the voltage across the sensor element.

The current through the sensor will cause some heating: for example, a sense current of 1 mA through a 100 ohm resistor will generate 100 μ W of heat. If the sensor element is unable to dissipate this heat, it will report an artificially high temperature. This effect can be reduced by either using a large sensor element, or by making sure that, it is in good thermal contact with its environment.

Using a 1 mA sense current will give a signal of only 100 mV. Because the change in resistance for a degree Celsius is very small, even a small error in the measurement of the voltage across the sensor will produce a large error in the temperature measurement. For example, a 100 μ V voltage measurement error will give a 0.4 °C error in the temperature reading. Similarly, a 1 μ A error in the sense current will give 0.4 °C temperature error.