

Understanding the Kelvin Method of Measuring Resistance

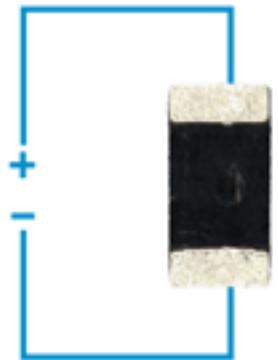
The Kelvin Method, also known as Kelvin Probing or 4-wire measurement, is a technique used in circuitry to measure the resistance values of electrical components. This method helps eliminate the impact of transition resistances on the measurement to provide more accurate and reliable results, especially in situations where the resistance being measured is very low. The Kelvin Method is commonly employed in applications where precision resistance measurements and high accuracy are essential. It is a more accurate method of testing than the 2-Wire Method.

2-Wire Method vs 4-Wire Method

2-Wire Method

The 2-Wire Method is a basic technique for measuring electrical resistance in a circuit. Using two leads, a voltage is applied across the resistor, and the resulting current is measured using the same pair of leads. The voltage drop across the resistor and the current flowing through it are used to calculate the resistance using Ohm's Law ($V=I/R$).

While the 2-Wire Method is straightforward and easy to implement, it has limitations, especially when measuring low resistances. The resistance of the connecting wires, or test leads, cause a significant voltage drop across the component. Due to this reason the true value of voltage across the component cannot be seen.

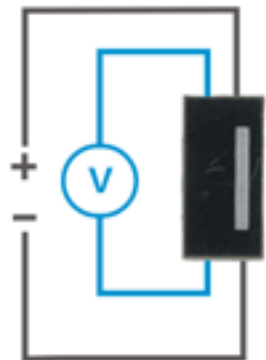


4-Wire Method

The 4-wire method, also known as the Kelvin method or 4-point probe method, is a technique used to measure electrical resistance with high accuracy, particularly in situations where low-resistance measurements are crucial. This method eliminates the impact of lead resistance, providing more accurate results compared to the simpler 2-wire method.

Here is how the 4-wire method works:

1. Measurement Process:
 - **Current Leads (Injectors):** Two leads are used to apply a known current to the resistor under test. These leads are typically heavy and have low resistance.
 - **Voltage Leads (Sensing):** Another set of two leads, separate from the current leads, is used to measure the voltage across the resistor. These leads are connected close to the resistor where the voltage is being measured.
 - The voltage drop is measured without including the resistance of the connecting leads, as they are separate from the current-carrying leads.
2. Calculation of Resistance: The resistance (R) is calculated using Ohm's Law: $R = V/I$, where V is the voltage across the resistor, and I is the current flowing through it.



The key advantage of the 4-wire method is that it eliminates the contact resistance of the leads. This is particularly important when dealing with low-resistance components, where the resistance of the leads can significantly impact the measurement accuracy. The 4-wire method is commonly used in precision measurements, calibration, and applications where highly accurate resistance values are essential.

Current Sensing Resistors and the 4-Wire Method

Current Sensing Resistors (CSR) are particularly adept for measuring current in applications involving high amounts of power. This is especially true of CSRs designed with four terminals. Two lead terminals allow current to flow through the resistor while the two voltage terminals, or Kelvin terminals, connect to the measurement instrument. The voltage measured across the voltage terminals provides an accurate view of the voltage drop across the resistor without being influenced by the lead terminals.

The accuracy of this testing is vital in a range of fields from battery management systems to DC/DC converters to motor controllers where high-power currents are involved. TFT provides a variety of high precision, low resistance CSRs to support any project's testing needs.