

Summary

Track resistance is usually less than an ohm, often less than 0.1 ohm. As the connection between a probe and the track surface can easily reach or exceed the track resistance, certain techniques and precautions must be observed in making the measurement. These will involve the use of a "Four Terminal" or "Kelvin Sensing" ohm meter.

So What's the Problem?

The common Two Wire measurement

Why can't we reliably measure track resistance using a normal two wire ohm meter?

An ohm meter normally determines resistance by measuring the voltage and current passing through the series of the meter, the connectors, the probes, the probe tips-to-DUT contact, and the DUT (Device Under Test.) See Figure 1, below. The meter display is simply calibrated according to Ohm's Law ($R = V/I$) so as to directly display the value of the resistance of the series of the component parts.

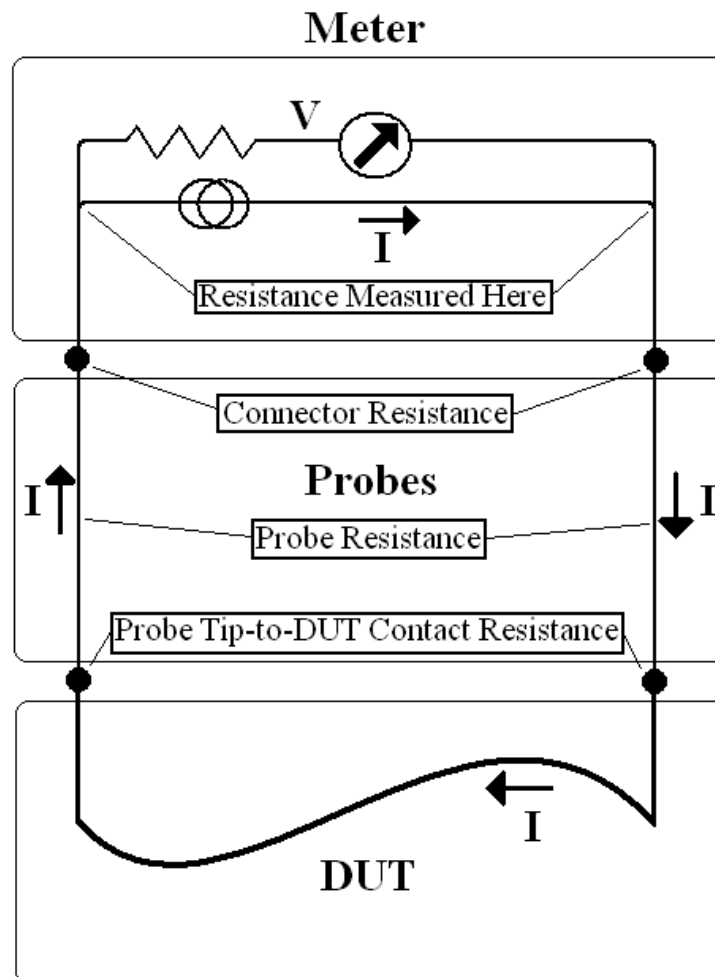


Figure 1

When the DUT resistance is much greater than the sum of the other resistances, then the resulting error may be ignored. Typically, the meter, probe and connection resistances may total a few tenths of an ohm. As the resistance of a typical track of a few inches length is often only a few tenths of an ohm, or even less than one tenth of an ohm, the resistance of the measurement system approaches or exceeds the resistance of the DUT. In this case the error can not be ignored and a different, four wire, approach is required.

The Four Wire measurement

In this technique sometimes called Kelvin Sensing, the meter uses its own dedicated probes and components to connect to the DUT.

A known current is passed through the DUT via two terminals and two probes. See Figure 2, below. As before, the voltmeter, calibrated to read directly in Ohms, is applied to the DUT to measure its resistance. But this time the meter has its own dedicated connectors and probes which connect directly to the DUT test points. In the schematic below, you can see that the applied current does not flow through the meter probes, meter probe-to-DUT connection, or meter connectors at all. Therefore, the resistance of the current probes and connectors is not included in the measurement.

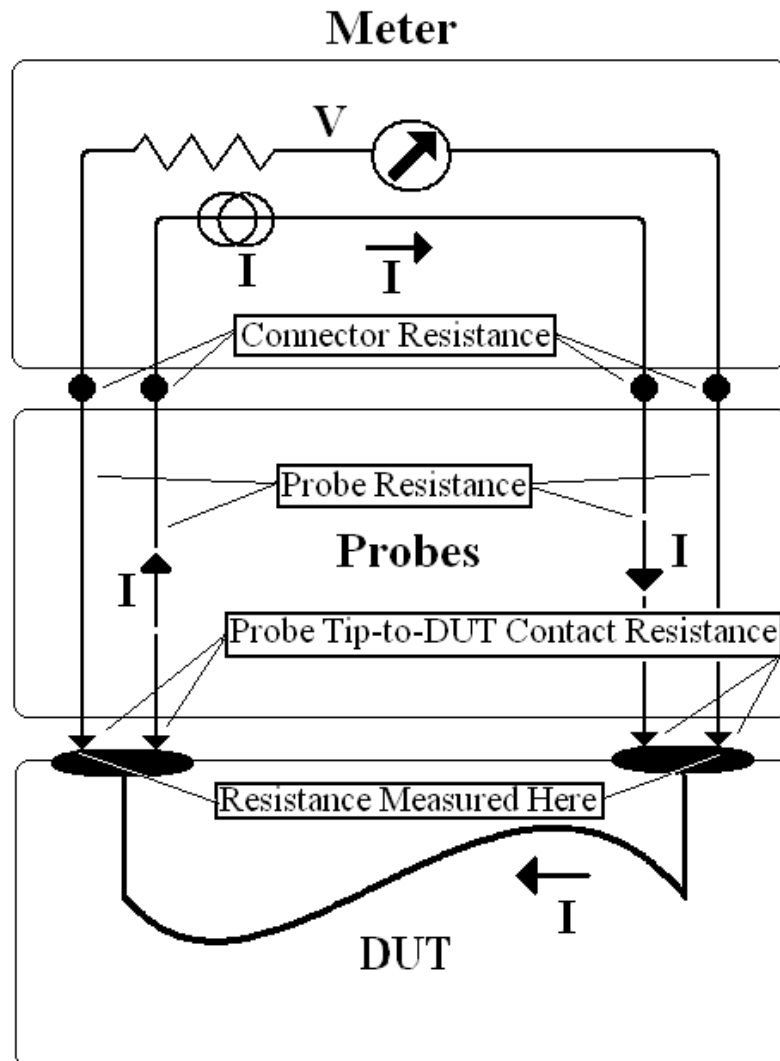


Figure 2

Furthermore, the Voltmeter (Ohm meter) has a very high intrinsic resistance, usually megohms or even hundreds of megohms. Only extremely small currents, in the range of picoamps, pass through it and its connections and probes. This minute current passing through the meter probe resistance causes only an extremely small measurement error compared with the reading produced by the much larger current (often microamps) passing through the DUT. This extremely small error reading is too small to register on the meter display, and may be safely ignored. Thus an accurate value of the DUT resistance may be read directly from the meter display.

Need more help? Got a request or a suggestion?

We welcome your questions, comments and suggestions. Please do contact Ken Taylor at ken.taylor@polarinstruments.com



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