ECEN4730 Lab9&Lab10 Report

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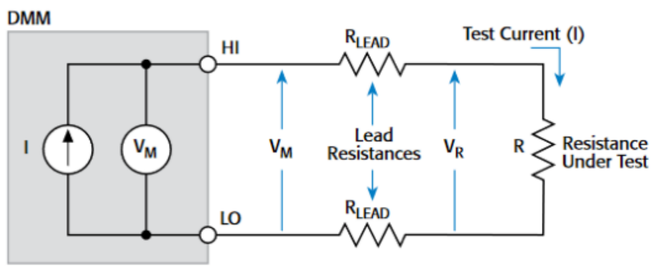
Lab9

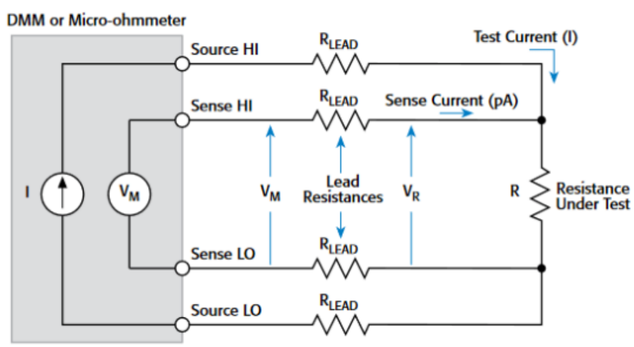
1. 2-wire method

In the two-wire method, there are two connections to the DUT. The current flows through the leads, and the voltage is measured at the end of the leads. These voltage measurements include the series resistance of the wire leads and the contact resistance of the leads to the DUT at each end.



2. 4-wire method

The four-wire method separates the leads and contacts that measure the voltage across the DUT from the forced current. The lead resistance and contact resistance are still present in the circuit with the forced current. But the voltage measurement includes the voltage drop across the DUT, not across the lead or contact resistance. Any lead or contact resistance in the voltage measurement path does not affect the voltage measurement.



3. Resistance estimation and measurement using the 2-wire method and 4-wire method

Line Width	Estimate	2-wire	4-wire with 1A current
6 mil	83.5m ohm	0.168 ohm	90m ohm
10mil	50m ohm	0.126 ohm	48m ohm
20mil	25m ohm	0.101 ohm	22m ohm

100mil	5m ohm	0.083 ohm	4.3m ohm

As shown in the table, the 4-wire method makes a good resistance measurement, but the 2-wire method measurement does not make an accurate measurement, even worst than that. My conclusion is that the 4-wire method is an excellent tool to measure the DUT with 1 ohm or less because the lead or contact resistance is not negligible. However, the 2-wire method is an excellent tool to measure the DUT with 1 ohm or more since the lead or contact resistance is negligible.

Lab 10

1. Measuring the max current through 6 mil and 20 mil trace

The estimation of max current through 6 mil is 1A and through 20 mil is 2A. Then, an experiment is conducted to measure the maximum current through the trace without blowing up the trace. The experiment is divided into three parts, noticeably warm to the touch, hot to the touch, and smoking. The experiment starts with a 1A constant current setting in the power generator and connects the power to the 6 mil trace. And I touch the trace to sense the temperature. At 1A, there is no noticeable warm on the trace. Then, increasing the current to 1.25, I still don't feel the noticeable warm. The experiment step is sweeping through the current setting of 0.25A at each step. At 2A, the trace starts to warm, but touching the trace is still okay. At 2.75, the trace begins to get hot to touch. At 4A, the trace starts to smoke, which is higher than the estimation of the maximum current 6 mil can hold.

They are repeated the above steps when measuring the 20 mil trace's current capacity. At 4A-4.5A, the trace starts to get noticeably warm. At 5A, the trace begins to get hot to touch. Finally, at the 9A, the trace starts to smoke very quickly.

Based on the measurements in this experiment, the current capacity is about 2 times the current when it starts to get noticeably warm.

In common sense, we use a 6 mil trace for signal in the PCB design and a 20 mil trace for power in the PCB design. I want to recommend that putting 1A-2A through the 6 mil trace is a safe choice. And for the 20 mil trace, I recommend placing 3A-4A through the trace as a safe choice.