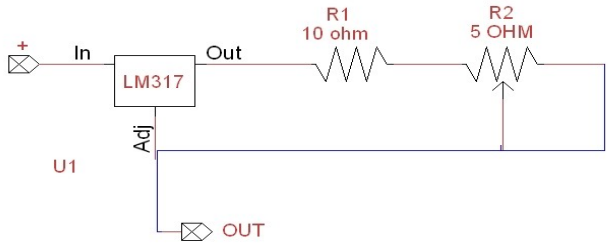
Milliohmeter

Here's an easy way to track down those low resistance faults; Apply a regulated current (in this case 100 ma. or less) to the area in question and use your voltmeter to track it. If you are using 100 ma. then a 10 milli-ohm fault will show as a one millivolt. Most digital multimeters read down to .1 millivolt so you will be able to read to 1 milliohm easily. Since printed circuit traces have fairly substantial resistance you can "walk" your way to the problem. Even point-to-point wiring has enough resistance to allow this sort of testing.

Use a constant-current regulator circuit if you don't have a stable current limited supply. An LM317T with a TO220 package will do the job. Tie a 12.5 ohm resistor from output pin to reference pin. There's your new tool! Put this 2-terminal circuit in series with your power supply, positive lead to the "input" pin of the '317 and use the "reference" pin of the '317 as the output to feed your "+" input of your circuit.



If you insert an ammeter anywhere in line you will see that you measure 100 ma. Even with a dead short the current remains constant as the regulator adjusts the voltage drop to compensate. Thus "constant-current" regulator.

I use a 10 ohm resistor and a 5 ohm multi-turn rheostat in a small box with two 5-way binding posts (one red, one black). I can just grab it and insert in my positive lead of the variable power supply when I need a milliohm meter or to locate a short. I use the 10 ohm resistor to prevent me from adjusting the current too high. The multi-turn trimmer allows me to precisely adjust the current so that I can accurately measure resistance when I need to. Most meters and bridges are not accurate below 1 ohm. This method is very accurate.

Care must be exercised, however, not to exceed the applied voltage rating of the circuit components of the parts being tested. Keep in mind that this circuit is just minding the current passing through it, not the voltage. In other words, don't use a 12 volt source to troubleshoot a 5 volt circuit. Do not try to measure a 100 ohm ¼ watt resistor because you could be applying 10 volts across it which amounts to 1 full watt that the little resistor must dissipate.

Often called a "Kelvin" measurement, it's also called a "four lead" test since the metering leads, no longer tied to the supplies, are free to independently measure voltage drops. Metering probe resistances are not critical since the input impedance of the voltmeter is many millions of ohms.

To troubleshoot a short circuit just measure the voltage drop of the conductor. With your voltmeter probes both on the same conductor you can easily determine which way the current is flowing. If a power bus is fed from one point then you can measure the voltage to ground down that conductor until you reach the lowest voltage point. That's your short. Past that point the voltage will remain the same or very slightly decrease, depending upon other loads. The short circuit point will show up dramatically.

You could build this into your bench supply and add another binding post so that you could move the positive lead to that position for a constant, regulated 100 ma. current source. I keep mine separate so that I can use it elsewhere with just a battery. Great tool for checking connections and such. If you are building a magnetic loop antenna this is an invaluable tool for testing your loop bonding.

de ND6T