APPLICATION NOTE

The Use of a DLRO (Digital Low Resistance Ohmmeter) versus a DMM (Digital Multi-Meter)

One of the simplest and most common electrical tests performed by electricians and test technicians today is the continuity test. This test option is featured on most multi-meters and insulation testers. The continuity test is simple to perform – connect two leads across opposite ends of the item under test (IUT), press the test button, and the instrument quickly provides a resistance reading. A low reading is considered good and a high reading bad. In fact, this test is so simple that it is often used for applications that actually require a more demanding performance from the test instrument. In this note we'll look at some of these applications and the resulting requirements that highlight the differences between a low resistance ohmmeter (DLRO) and a digital multi-meter (DMM) – and the importance of using a DLRO to find issues that a DMM cannot.

When testing low resistance, voltage is not a critical consideration. A DLRO and a DMM both operate with only a few volts. The decisive factors are the level of current and the range and resolution of reading. The average DMM provides about 5 mA of test current and some go to 200 mA. The most common test current for a DLRO is 10 Amps though some models can output 100 A, 200 A or even 600 A. A DMM will read down to a tenth of an ohm or perhaps a hundredth of an ohm. However, a DLRO will read in micro-ohms and a quality tester down to 0.1 micro-ohms.

So why do these differences matter? As the name implies, the purpose of an electrical continuity test is to establish that the circuit is continuous. Electricians use this test to make certain that there are no wiring mistakes at a junction box and that all connections are correct and tight. There are a large number of similar applications for assuring that electrical continuity has been established or maintained. Similarly, diodes and other components are readily tested. In many cases an actual measurement isn't necessary because the test instrument has an audible beeper or buzzer activated by a pre-set value. The handheld DMM will likely never be replaced for this type of testing.

The value in using a DLRO becomes apparent for measurements that are below 1 Ω. At this lower resistance level, just checking continuity is not sufficient. There must be certainty that the circuit or joint being tested can perform without overheating or burning up. Some example applications include grounding for lightning protection, fault clearance, mating of contact surfaces for maximum transfer of energy without heating, and maintenance of bolted connections and solder joints. For demanding applications like these, a change of just a few micro ohms in resistance can indicate an existing problem – or even a developing problem that can be corrected before any damage occurs. Following is just one example (of hundreds!) that will highlight the value of using a DLRO versus a DMM.

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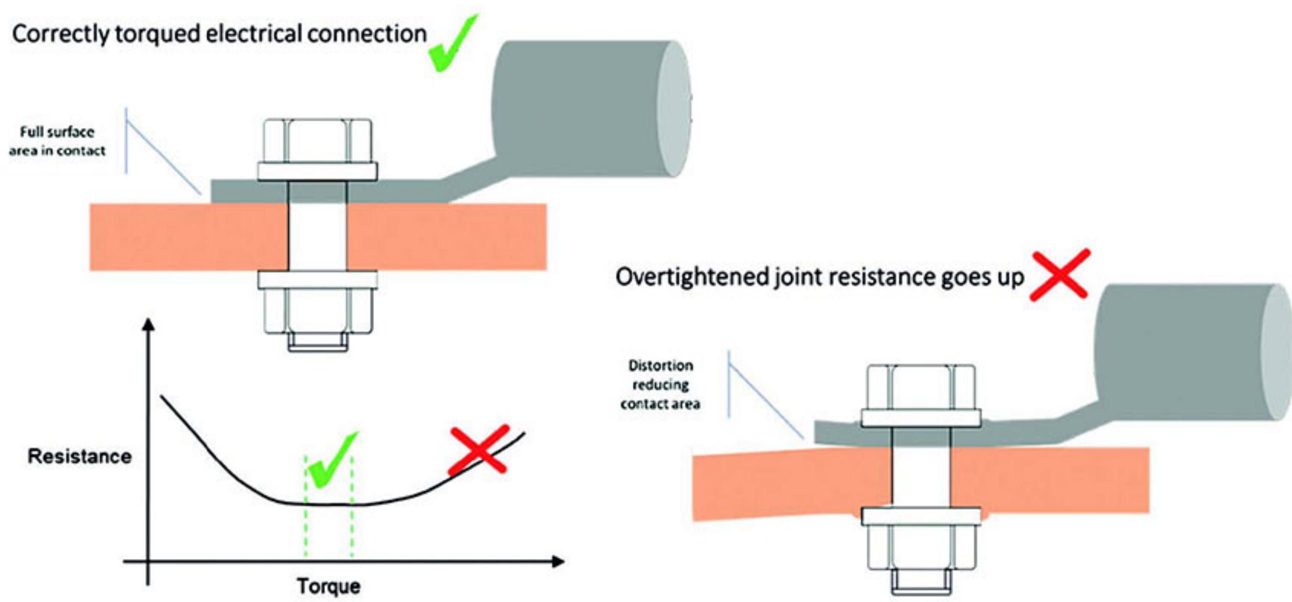
One practical application can be illustrated in the torqueing of bolts. It is common practice to say "the tighter, the better". But this is not the case when electrical current is involved. Over-tightening can cause the connection to become distorted, resulting in less surface contact and higher resistance. Although the amounts can be small, the additional heat generated over time is a stress point that will eventually fail. A DLRO will detect these as higher resistance readings compared to similar connections and will allow for preventative maintenance.



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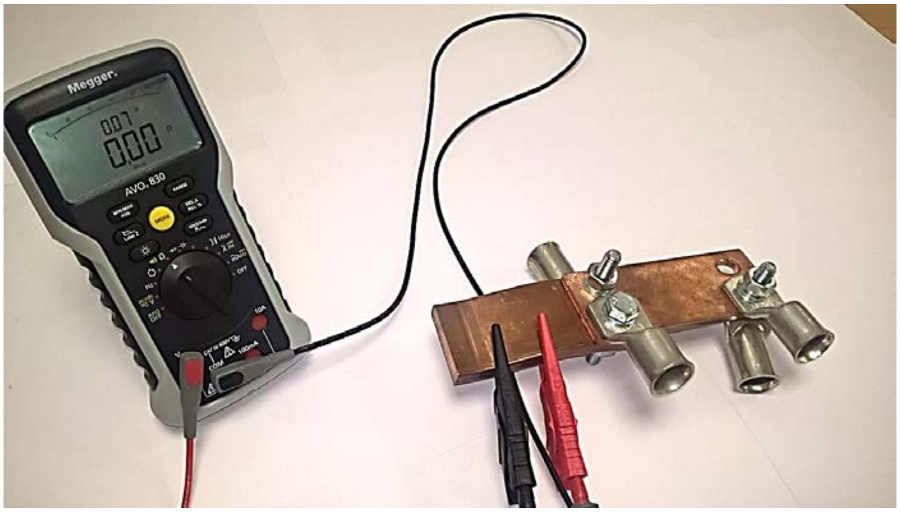
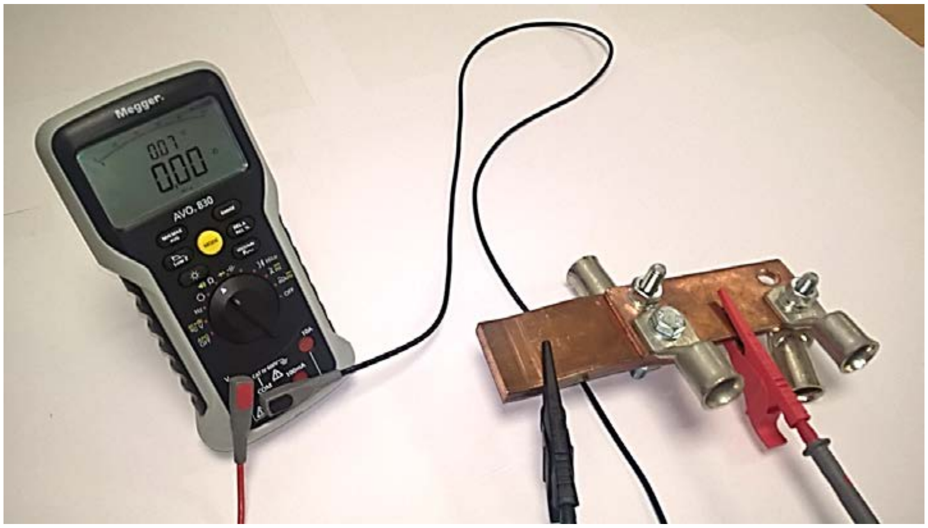
To highlight this example further, here are some sample readings taken on a short piece of copper buss bar. Even a good quality DMM would read 0.00 Ω at 200 mA when connected across a short span of the buss bar:



If we spread the leads wider on the buss bar with a bolted connection in between, the reading is still 0.00 Ω.



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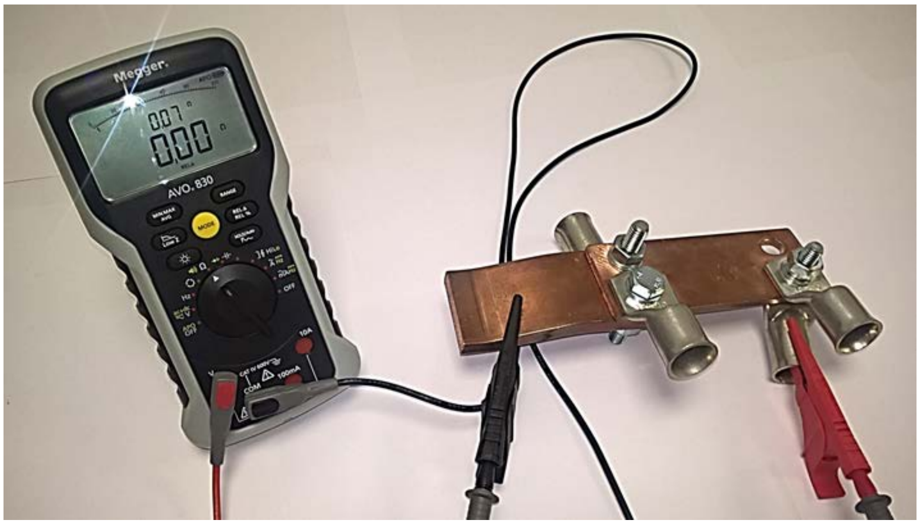
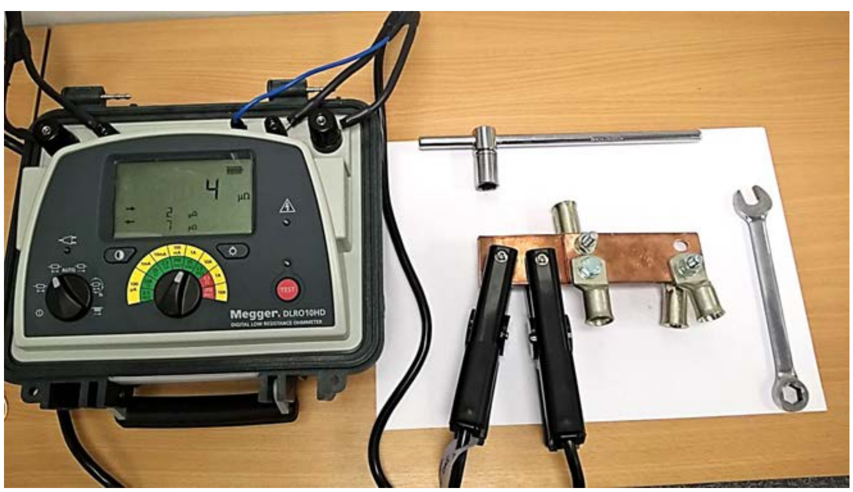
Now connecting from the buss to a bolted termination which is distorted by improper tightening of the bolt, the reading remains at 0.00 Ω.



We now connect a DLRO to the same sample across a short span of the copper buss bar. Even at just 1 A, the reading is 4 µΩ.



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The reading increases to 10 µΩ when connected across the longer span:

Now when connected to a bolted termination which is distorted by improper tightening of the bolt, the reading climbs to 1.131 mΩ:

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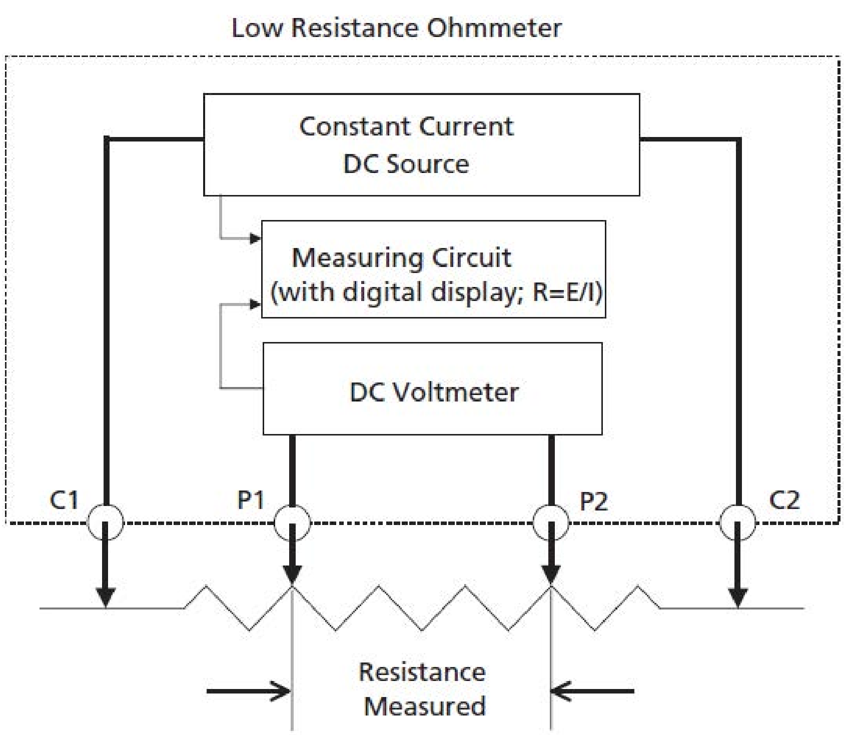
These examples demonstrate that while using a DMM for basic testing (including continuity) has an important place in electrical maintenance, there are many cases where a developing problem would be masked by a “good” reading of 0 ohms on a DMM -- whereas a low resistance test using a Megger DLRO would detect the problem and allow corrective action to be taken.

So how is the DLRO able to provide such precise measurements? We can see from the above examples that a higher test current and the ability to measure in micro-ohms are important differentiators between a DLRO and a DMM. Another feature of the DLRO is the use of a “Kelvin bridge” 4-wire test technique. This is critical in obtaining precise measurements in the micro-ohm range. A DMM uses two leads to connect across the IUT. This introduces the test lead resistance as well as the contact resistance with the surface of the IUT into the measurement. When testing continuity, these resistances are quite small and can be ignored – but when measuring at the micro-ohm level, these resistances significantly affect the measurements. Although some quality DMMs have a null function for removing the lead resistance from the measurement, it does not remove the potential for substantial contact resistance. Using a Kelvin bridge eliminates all of this extraneous resistance from the measurement. The DLRO injects a constant DC current using two ‘C’ connections as shown in the drawing below. It then uses two ‘P’ connections to measure the voltage drop and calculates the resistance between these two points. Now the measurement is of the resistance between the two potential leads *only*. By this precise measurement, even the smallest resistance issues can be detected.



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As we've pointed out, the DMM is a useful tool in a number of applications for finding simple wiring mistakes and assuring that electrical continuity has been established. But for applications where measurements are below 1 Ω and for detecting issues that can lead to costly failures, the DLRO low resistance ohmmeter is the proper instrument for the job.

DLRO10

DLRO10X

Megger DLRO10HD

Megger DLRO10HDX

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