

# Measuring Resistance Accurately

by Steve Bodofsky

One of the most common mistakes technicians make during an electrical diagnosis is misreading the resistance measurement. Digital ohmmeters can be a little tricky to read and interpret until you learn what you're looking for.

In this issue of *GEARS*, we'll look at digital ohmmeter readings: We'll examine the display to see how the meter differentiates between various ranges, and we'll look at how to calculate the actual reading. Then we'll discuss a few tips that can make your resistance readings more accurate.

## Look for the Value...

You connect your ohmmeter to a circuit, and it displays 3.120. Okay, so the resistance is 3.120 ohms... or is it?





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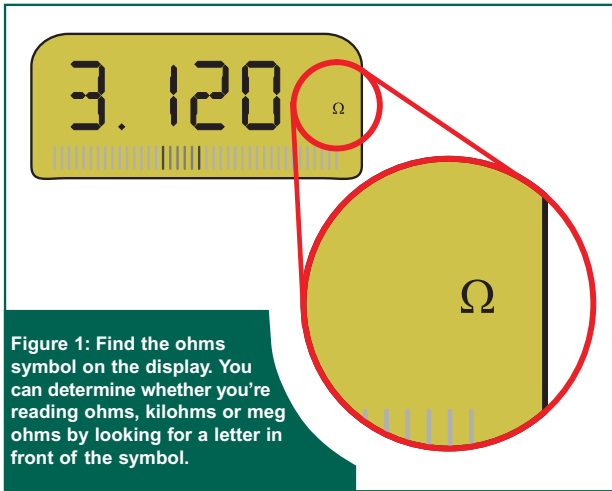


Figure 1: Find the ohms symbol on the display. You can determine whether you're reading ohms, kilohms or megohms by looking for a letter in front of the symbol.

Take a good look at the meter display. Somewhere around the edge of the display you'll see the ohm's symbol (figure 1). Is there a letter along side it? If so, that letter indicates whether you're looking at 3.120 ohms, 3120 ohms, or 3,120,000 ohms. And that could make a real difference in your diagnosis!

If there's no letter in front of the ohm's symbol, you're reading ohms x 1. So the resistance is exactly as it appears on the screen: In this case, 3.120 ohms (figure 2).

If there's a K in front of the ohm's symbol, you're reading kilohms, or ohms x 1000. So the resistance measurement on this display is 3.120 k ohms, or 3120 ohms (figure 3).

If there's an M in front of the ohm's symbol, you're reading megohms, or ohms x 1,000,000. So the resistance measurement on this display is actually 3.120 M ohms, or 3,120,000 ohms (figure 4).

That's really all there is to reading the display, regardless of the number of settings on the meter's dial. The only differ-

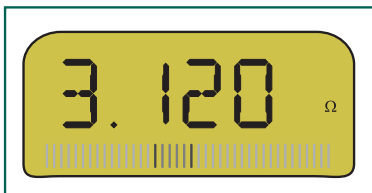


Figure 2: If there's no letter in front of the ohms symbol, the value on the display is ohms x 1. That is, it's displaying the actual value in ohms.



Figure 3: The "k" in front of the ohms symbol indicates that the meter is displaying "kilohms": ohms x 1000. You'll have to multiply the reading on the display by 1000 to determine the actual resistance.



Figure 4: The "M" in front of the ohms symbol means "megohms," or ohms x 1,000,000. To determine the actual resistance, multiply the display by 1,000,000.

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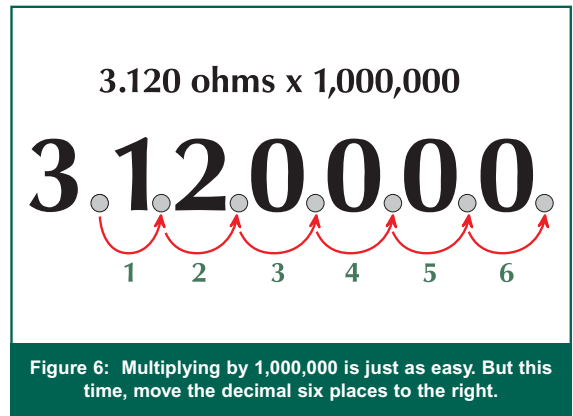
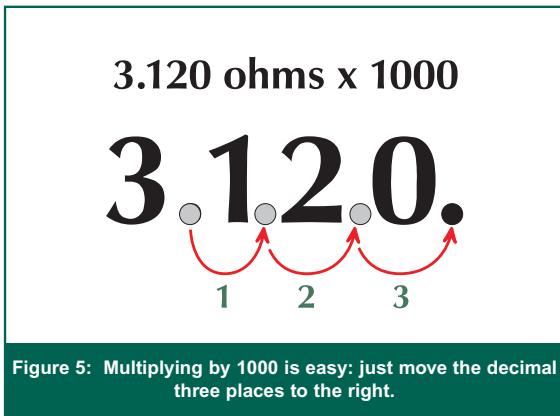
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ences in the resistance displayed are ohms x 1 (ohms), ohms x 1000 (kilohms), and ohms x 1,000,000 (megohms).

### Doing the Math

Looking at the display, you've determined that you're reading k ohms, or ohms x 1000. Now all you have to do is get out your calculator and multiply the reading on the display x 1000.

Or do you?

Actually, there's a really easy way to multiply by 1000... or by 1,000,000 for that matter. This is something my father taught me years ago, when I was about 8 years old (yes, it *was* a long time ago, thank you very much!). He was helping me with my arithmetic homework, and the problem required me to multiply 17 x 10. I grabbed a pencil and got ready to work it out long-hand.

"Wait a minute," my dad said. "Didn't they teach you how to multiply by 10 in school?" "Sure," I replied, and got ready to show him, with the pencil and paper.

"No, wait," he said again, "you don't need a pencil for this. To multiply anything by 10, just add a zero to the end of the number." "So 17 x 10 equals 170?" I asked. "That's all there is to it," he replied. "And it's just as easy to multiply by 100; just add two zeros to the end. And for 1000, add three zeros."

Of course, this was a bit of an oversimplification of the process. Since we hadn't learned about anything but whole numbers, adding a zero — or two

or three — worked fine. Once we got into decimals, I learned that what we were really doing was moving the decimal to the right: One place for 10, two places for 100, three places for 1000, and so on.

So multiplying by 1000 is simply a matter of moving the decimal three places to the right. In this case, the number we're working with is 3.120, so if we move the decimal three places to the right, the number becomes 3120 (figure 5).

And multiplying by 1,000,000 is just as easy: All you have to do is move the decimal six places to the right. So 3.120 x 1,000,000 is 3,120,000 (figure 6).

Once you have these simple techniques down, you should always be able to read the resistance measurement on the display, regardless of what type of meter you're using.

### Measuring Resistance Accurately

There are several things you need to keep in mind when measuring resistance on a circuit or component. Failure to follow these basic procedures can have a drastic effect on the results of your measurements.

1. Isolate the Component or Circuit — Whenever you're going to measure the resistance of a circuit or component, you must first isolate it from any other circuits or components. That may mean unplugging it, or in some cases you may have to cut one of the legs away from the circuit. This pre-

vents electricity from backflowing through another part of the circuit, measuring an entirely different circuit, in effect. Once you've measured the component's resistance, you'll have to plug it back in, or even resolder it back into the circuit, depending on what you had to do to isolate it.

2. Zero the Leads — All test leads have a certain amount of resistance. To eliminate that resistance from the measurement, you must first zero the leads. Here's how:

- Set the meter to read ohms.
- Connect the leads to one another.
- Press the "zero" or "delta" button.

The meter should display zero ohms. Now you're ready to measure the component's resistance accurately.

If your meter doesn't have a zero or delta button, you'll have to deduct the lead resistance yourself. After you connect the leads, record the resistance on the meter display: That's how much you'll need to subtract from your component measurement to determine the actual component resistance.

Zeroing the leads is particularly important when measuring a component with very low resistance, such as an EPC solenoid. It's not important when measuring high resistance components. Zeroing the meter may put some meters into manual range or lock it into low range. Since zeroing the meter is only important for measuring low resistance circuits or components, that shouldn't cause a problem.

## Measuring Resistance Accurately

3. Never Touch the Test Probes while Measuring Resistance — Your body has some level of electrical conductance. How much depends on a number of variables, but it can be enough to affect your measurements. To keep your hands off the probes, always use some type of clip adapter on the ends of the probes. Then you can keep your hands... and your body's resistance... out of the equation.

4. Replace Worn Leads or Low Batteries — If the reading is changing as you're watching the display, you may be overdue for a new battery. Replace it before continuing your tests. And if every little wiggle or vibration affects the reading, make sure your leads aren't damaged or worn out.

5. Use a Good Quality Meter — Believe it or not, there's a reason that some companies sell meters for \$400, while others can sell a meter "just like it" for only \$29.95. Make sure the meter you're using is a quality product, or you may find yourself working with questionable readings.

6. Verify Your Resistance Measurements with an Amperage Reading (when possible) — A circuit or component can still have a problem, even though the resistance is within specs. For example, a solenoid with a frayed wire that's just holding on by a single strand may still measure as being within resistance specs. But there's no way it'll support the current necessary to energize the solenoid. So how can you be sure the circuit's okay? Follow up your resistance measurement with a current draw test. If current draw isn't within specs, you have a problem... even if the circuit passed the resistance test.

In most cases, resistance measurements provide a quick, easy way to check a circuit or component... provided you follow proper basic test procedures, and interpret the meter display properly.

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