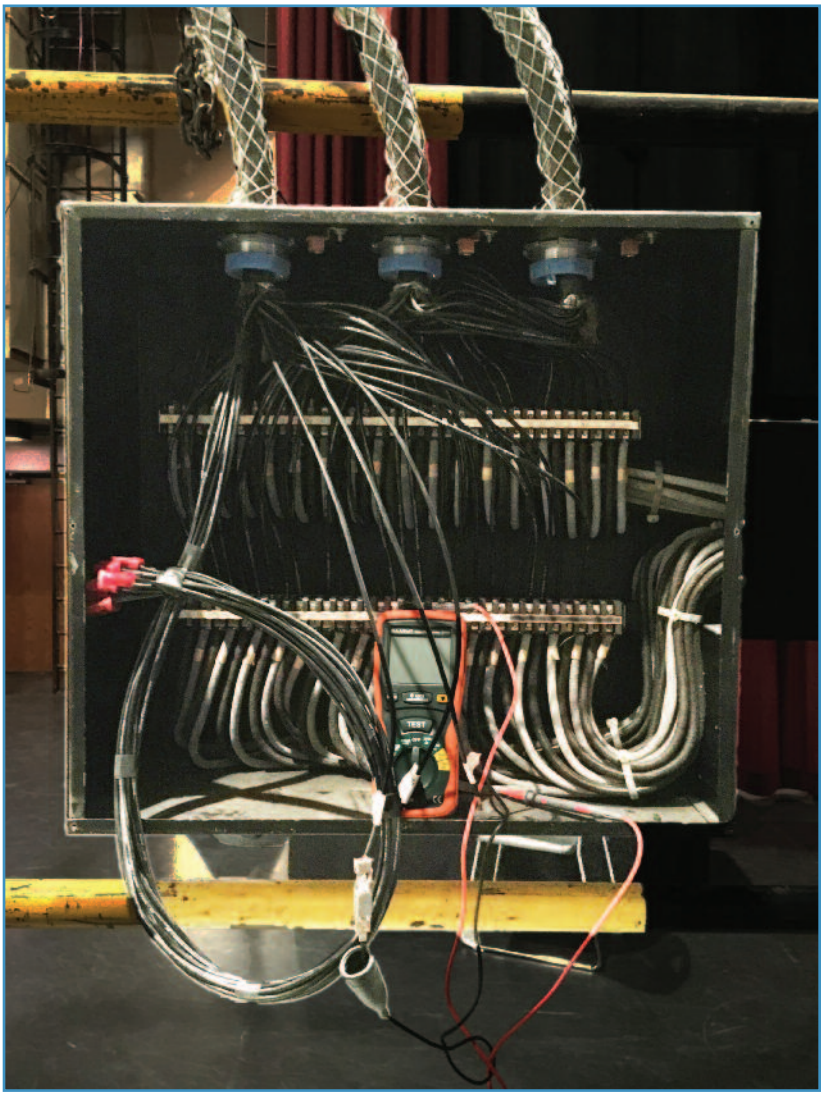
What is a Megohmmeter?

By: Richard Cadena

I have a new meter, and it goes to 11. It looks like an ohmmeter, and in a lot of ways it acts like an ohmmeter, and in fact, it is a type of ohmmeter, except it's designed to measure resistance into the millions of ohms. Can your meter do that?

Ordinary ohmmeters and multimeters have much more limited range. For example, the specifications for my Fluke 323 multimeter say that the ohmmeter function has a range of up to 400.0W or 4,000W, depending on the setting. In the old days of analog meters, you had to select the range from a number of options, because these meters are more accurate in the higher end of the scale than in the lower end. That's still the case for some digital meters but, today, most meters are autoranging, so you don't have to worry about guessing which setting you should use. They still, however, have limited accuracy. I think the 323 will display resistance values higher than the given range but with very limited accuracy. And because it's a digital meter, the resolution is given as 0.1 or 1, again depending on the setting. It also says it has an accuracy of 1% +/-5 digits.

I could have paid more money to get the Fluke 325, and a lot of my friends have because I see them a lot, and that would allow me to read resistances up to the range of 40,000W. For the vast majority of my work, I don't need the extra range, resolution, or accuracy. But for certain tasks, like evaluating the effectiveness of the insulation of cables or equipment, not even the extended range of the 325 is enough, so you need specialized equipment, like a megohmmeter.



A megohmmeter is accurate in the millions of ohms, which allows you to test the resistance of insulation and determine whether or not it is doing its job.

Insulation is one of the first lines of defense against the hazards of electricity; it's one of the main things that keeps us safe when we set up power distribution and power a show. Insulation is typically made of thermoset, thermoplastic, or thermoplastic elastomer, all of which are all polymers, and polymers start deteriorating as soon as they are manufactured. Heat, moisture, and mechanical shock all contribute to the aging process, and when it comes to live event production, we are the kings and queens of punishing portable power cable in very creative ways. We heat them by using them for outdoor productions and running lots of current through them; we let them stand in the rain and run them through wet streets and gutters; and we toss them around like we are Olympic hammer throwers. It's a won-

der they last more than a few shows.

The questions are, How long do they last and how long should they last? The answers are probably best achieved by testing the resistance of the insulation. If a power cable has good insulation, it will minimize leakage current between conductors and earth. But as a cable ages, it develops small cracks, pinholes, cuts, and scrapes that contribute to leakage current. If you examined your cable under a microscope, you might be surprised at what you find. Another way of examining it is to read the dielectric strength or the resistance of the insulation.

A megohmmeter looks a lot like a regular ohmmeter—it has a mode selection switch and two leads—but there are some important differences. Besides having the ability to measure resistance into the millions of ohms, it also works much differently than an ordinary ohmmeter. It applies very high voltage between the leads, typically 250VDC, 500VDC, or 1,000VDC, and the current that is generated is then used to calculate the value of resistance. That makes it a bit trick to use than an ordinary ohmmeter because the meter could give you a shock, so you have to be careful not to get your fingers across the leads when you're using it. I always wear leather or rubber gloves when I'm metering power, and I recommend the same when you're using a megohmmeter.

Before you test the conductors, you have to disconnect them from the circuit; otherwise, you can damage the circuit. Besides, you want to measure the resistance between two conductors separated by the insulation, not through the circuit. Then you connect the two leads to the two conductors and press the test button for a minute or more. The meter will then apply the voltage to the conductors, and if there is any capacitance between them, you can watch the voltage rise before the meter yields the final results of the test. You should repeat this procedure with the leads connected between one of the

conductors and the grounding or earthing conductor, and then again with the leads connected between the other conductor and ground/earth.

If you are testing a circuit with an operating voltage in the range of 50VAC to 500VAC, then the insulation resistance should read over 1MW; otherwise, it doesn't meet the requirements for *BS 7671: Requirements for Electrical Installations* (a.k.a., the Regs), which is a British standard. As far as I know, there is not an equivalent standard in the US but it's still valuable to know how well the insulation is doing its job. We typically want to measure the resistance of portable cables when they are new and log the values, then repeat the test annually to monitor the effectiveness of the insulation. At some point, the value will drop low enough that they should be replaced.

The first time I used a megohmmeter was during the Dark Ages, when I was in college. The megohmmeter was hand-operated by turning a crank, which generated high voltage that was applied between conductors. They still make those type of meters but they also make digital ones that do the work for you. The one I bought recently is an Extech 380260 autoranging digital megohmmeter that measures insulation resistance up to 2,000MΩ, and it was just over $200. There are a variety of other megohmmeters that cost as much as $5,000 and up. The main difference between these meters is their range, and if you need to measure into the gigaohms or teraohms, and you're willing to shell out the clams for them, they will gladly take your money. I'm happy knowing whether or not a cable meets the 1MW mark, and I'll save the difference to buy more tools.

Production companies should be testing their feeder cable periodically and repair or replace it when the resistance of the insulation is too low. It's a quick-and-easy thing to do and it could help to avoid serious problems.