Accessories after the fact: Getting the most from your meter

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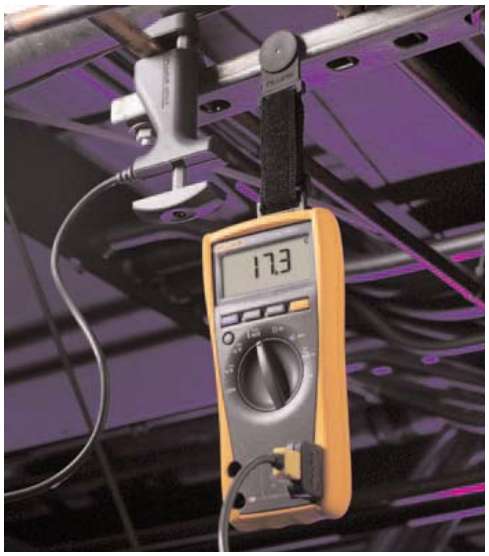

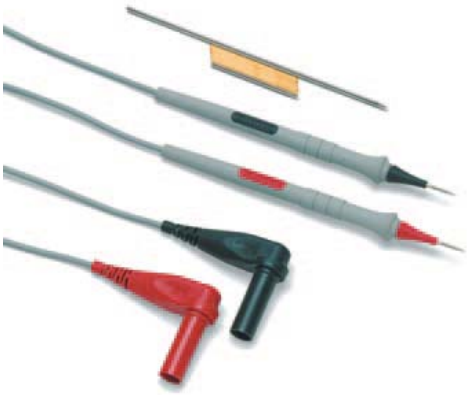

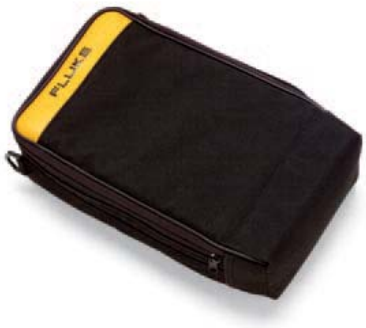

Choosing the right digital multimeter requires some thought and research, but once you've made a decision there's something else you need to carefully consider — accessories. A complement of accessories can bring out the versatility of a digital multimeter, instantly changing it from a voltage meter to a current meter to a thermometer – and more. The key to getting the most out of your instrument is selecting the accessories that best fit your workload. And, just as you took pains to choose a high-quality digital multimeter, you'll want to select high-quality accessories to gain the most from your instrument investment.

Many categories of accessories exist, from different types of test probes to a variety of protective cases and carrying devices. The specific accessories you need depend both on what you're going to test and the environment in which you plan to use your instrument. This article provides an overview of the types of accessories available and explains which ones are best suited for different types of workloads.

What are you going to test?

The first question to ask when choosing multimeter accessories is what parameters you need to test. For each parameter (voltage, temperature, etc.), a wide range of test probes is available, each designed for a specific type of test environment. Following is an overview of the types of probes available for each type of multimeter functionality.

Voltage

Test probes for measuring voltage are available in a wide spectrum of forms. The best choices depend on the nature of your particular workload.

Voltage level

The first question is: With what kinds of voltage levels are you working? For example, if your work environment includes high-energy systems in an industrial plant, you'll require a robust probe capable of measuring high voltages (600 V or higher) while withstanding the high energy present in these environments. For these high

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energy measurements you'll want to use probes rated for CAT III environments to 600 or 1000 V, whatever your situation dictates. On the other hand, if you work with low-energy electronic circuits, a less-robust probe may be better suited to your needs. For these measurements probes rated for CAT I or CAT II environments would suffice.

Frequency

Another factor to consider is whether you need to measure frequency as well as voltage. For example, when working with low-voltage electronics operating at high frequencies, you may need a probe that is capable of accurately measuring both voltage and frequency. Standard duty probes would be suitable for voltage measurements or frequency measurements up to about 1 MHz. If you need to make frequency measurements at higher frequencies, a more specialized probe would be required.

Other considerations

Voltage probes come in many different styles. Keeping this in mind, choose a probe that is most appropriate for the type of measurement being conducted. For example, if you plan to take readings over time or will wait to take a measurement until after a particular event occurs, a clip to attach to the test point is very useful. For small-gauge wires or test points, you'll need a small alligator clip; for larger-gauge wires or terminals, a large alligator clip is handy. If you need to reach deep into a recessed panel to contact a terminal strip, you'll need a long probe; if the terminals are closely spaced, you'll need a narrow probe. And if you need to pierce through dirt or corrosion to take your measurement, you'll require a sharp probe. These are just a few of the form factors to consider when choosing the proper voltage probe for your specific task.

Temperature

Temperature measurements are another common use of digital multimeters. But in order to turn your multimeter into a thermometer, you will require the right temperature probe.

Contact vs. non-contact

The first question is whether you'll be able to make physical contact with the item being measured or will need to take measurements without touching the item. In most electrical workloads involving temperature measurements, the item being measured is also electrically "hot" and therefore dangerous to touch. In such a case, choosing a non-contact probe that uses an infrared sensor is wise. For example, a non-contact probe is appropriate for measuring the temperature of such electrically hot devices as transformers, circuit breakers or electrical connections. Conversely, if you're able to touch the probe to the item being measured, you may want a contact probe. Immersion probes for measuring liquids or pipe clamps for measuring the temperature of pipes are two examples of contact probes.

Gas/liquid/surface

If you are measuring non-energized items, your choice of probe depends on whether you are measuring a gas, a liquid or a surface. For example, if you're measuring the temperature of exhaust gases, you'll want an air probe; for measuring the temperature of liquids in a process plant, you'll need an immersion probe; and for measuring the temperature of equipment surfaces, such as the door of an electrical panel, you'll use a surface probe.

Range, accuracy, and response time

A final set of questions deals with what temperature range you are likely to measure, how accurately you need to measure it, and how rapidly you need a response. Probes differ in each of these factors, so it's important to pick the probe that's right for your workload. If you aren't measuring extremes of temperature and standard accuracy is enough, you'll probably do fine with a general-purpose temperature probe that can measure a broad range of temperatures. Such a probe would be appropriate, for example, for taking general atmospheric temperatures (for instance, to make sure a heating system is working properly). On the other hand, if your work requires more accurate readings within a narrower range, you might need a more specialized probe. If you deal with refrigerants, for example, you will need a temperature probe capable of reading below 0 °F; and if you measure exhaust gases in a furnace, you will require a probe capable of withstanding high temperatures as well as measuring them.

Current

Measuring current can be more difficult than measuring voltage because the measuring instrument typically needs to be placed in series with the current being measured – a step that may require the electrical circuit to be opened. Yet in many cases, shutting down a plant or a process to measure current may not be an option. That's where current clamps become a handy alternative. By using a current clamp, you can measure electrical current without interrupting the circuit. As with other types of measurements, the specifics of your individual workload determine the necessary type of current clamp.

AC or DC

The first question is whether you will be measuring ac or dc current – or both? Since both ac and dc currents are found in industrial plants, maintenance personnel really need to be prepared to measure both, which presents somewhat of a dilemma. DC current measurements in the plant typically comprise less than 10 percent of the workload. The ac-dc style clamps are approximately twice the cost of a clamp that measures only ac current. Also the jaw openings for these combination clamps usually are not large enough to fit around multiple conductors. So, to cover most plant applications you'll end up needing two types of clamps, one for dc measurements and another to cover the wider variety of ac current measurements found in the plant.

Range

Another question is: What current range will you be measuring? For example, if the measured circuit is carrying less than 200 A, you can use a smaller current clamp. But if you're measuring 600 A, a larger clamp capable of fitting around bigger conductors is needed. The larger the current, the larger the jaw size requirement for the clamp. For measurements up to approximately 1000 A, clamps are available with either circular jaw openings up to 2 inches or rectangular openings of approximately 1.5 by 2.5 inches. These two styles will typically handle up to 2-500 MCM or 1-750 MCM cables. For measurements on larger wire bundles, multiple conductors, or tight spaces where the standard style clamps will not work you may need a "flex clamp." Flex clamps are ac current clamps with a flexible loop conductor which separates so you can wrap the conductor around the cable(s) or bundle then reconnect the loop to make the current measurement.

Voltage

You also need to know the voltage of the circuit you're measuring, since you need to be sure to choose a current clamp that is rated safe for the voltage involved. This issue is discussed further under Safety, below.

Other types of measurements

With the right accessories, a multimeter can be employed to measure a host of other parameters such as gas, pressure and vacuum, and light.

Gas

For gas measurements, the principal question is: What type of gas will be measured? For instance, you might want to measure interior air quality of a work area using a carbon monoxide (CO) sensor accessory for your multimeter. This would be particularly important to ensure worker safety in warehouses or other areas of the plant where forklifts are operated.

Pressure/vacuum

If you work in the process industry, you may need to verify whether the pressure or vacuum of machine control lines are within specifications. By adding a pressure module to your digital multimeter, you can use the meter to take pressure and vacuum measurements. Pressure modules come in a wide variety of ranges, from very low (less than 1 psi) to very high (10,000 psi) – and they also vary in their degree of accuracy. Again, the nature of your individual workload will determine whether you should choose a general-purpose pressure module that is capable of taking a wide variety of measurements with typical accuracy, or whether you need a special-purpose module that handles a narrower range of pressures with higher accuracy.

Light

If fiber-optic cables are part of your work environment, you may need to measure the optical power loss in newly installed or pre-existing fiber optic cable. A cable that has been nicked, bent too sharply, crimped, or broken will not transmit light as it should. A "fiber optic meter" accessory, coupled with a fiber optic light source, can be used to isolate any transmission problems. When choosing a light source, you need to consider the wavelength of light carried by the cable. Some light sources are designed for the higher end of the spectrum (around 850 nm), while others are designed to perform at the lower end (around 1,300 nm).

Which test leads are right for your environment?

Test leads vary according to several parameters: insulation, flexibility, length, and voltage and current rating. In each case, you'll want to choose the type of lead that best fits your work environment.

Insulation

Test leads may be made of either PVC or silicone. PVC leads, which cost less, are appropriate for mild environments – for example, in a lab or on a workbench. Silicone leads, which retain their flexibility in cold environments and won't burn or melt in hot environments, would be a better choice if you work outside in cold weather or around hot industrial equipment.

Flexibility

Test lead flexibility is determined in part by how many conductor wires the lead has and how fine the wires are. A lead with fewer and larger conductor strands will be stiffer but will cost less because it is less expensive to manufacture. A lead with many fine conductor strands

will be more flexible and less prone to tangle – which could save you a considerable amount of time if you store your leads in a toolbox. Another factor affecting flexibility is the type of insulation. Typically, silicone leads are more flexible than PVC leads.

Length

Test lead length can range from two to six feet. If you don't need the extra length, you'll probably find it more convenient to choose a shorter lead. But if your leads are too short for the application, your job will be more difficult. In such a case, you could either buy a new set of longer leads or a set of test lead extensions to lengthen your existing leads.

Voltage and current rating

Finally, you'll need to choose test leads whose voltage and current ratings match those of the item you're measuring. These ratings, described as CAT I through CAT IV, relate directly to energy levels available in different electrical environments, with CAT I being a low-energy environment and CAT IV a very high-energy environment. So, for example, if you're measuring line voltages going to motors in an industrial setting, you may want a lead capable of handling up to 1,000 V and 10 A continuously rated for CAT III environments. On the other hand, if you're testing circuit board components, you may need only a 300 V probe rated for 2 A, a CAT I rated probe.

Safety considerations

An important set of considerations when choosing your accessories is safety. The two key factors are 1) the safety rating of the accessory and 2) your work practice. The nature of your work environment will determine both what rating and construction quality you need.

Safety rating

You should make sure that your accessory has a safety rating appropriate for your work environment. In addition to the proper voltage rating, the accessory should also have the proper overvoltage installation category rating; i.e., CAT I, CAT II, CAT III, CAT IV. For more detailed information about accessory safety, see *ABCs of Multimeter Safety*, an informative publication that is available at **www.fluke.com/library**.

Work practice

There is no substitute for safety in the workplace. No tool by itself can guarantee your safety. It's the combination of the right tools and safe work practices that gives you maximum protection. Here are a few tips to help in your work:

- Work on de-energized circuits whenever possible. Use proper lock-out/tag-out procedures. If these procedures are not in place or not enforced, assume that the circuit is live.
- When working on live circuits, use protective gear.
- Use insulated tools.
- Wear safety glasses or a face shield.
- Wear insulated gloves and remove watches or other jewelry.
- Stand on an insulated mat.
- Wear flame-retardant clothing, not ordinary work clothes.

When making measurements on live circuits:

- Hook on the ground clip first, then make contact with the hot lead. Remove the hot lead first and the ground lead last.
- Hang or rest the meter if possible. Try to avoid holding it in your hands to minimize personal exposure to the effects of transients.
- Use the three-point test method, especially when checking to see if a circuit is dead. First, test a known live circuit. Second, test the target circuit. Third, test the live circuit again. This procedure verifies that your meter worked properly before and after the measurement.
- Use the old electrician's trick of keeping one hand in your pocket. This lessens the chance of engaging a closed circuit across your chest and through your heart.

Protecting your instrument

A final set of considerations to keep in mind when choosing accessories is how you will protect your instrument. A variety of cases are available to protect your multimeter and keep it readily accessible. The type of case that's best for you depends on your work environment.

Hard cases

If you drive a service truck, or want an extra level of protection for your equipment you may want to keep your multimeter in an oversized case with other instruments and accessories. If so, a hard protective case with separate compartments may be the best choice.

Soft cases

If you carry a tool bucket or wear a toolbelt, you may prefer a soft case (available with or without a belt loop). Oversized soft cases, which can hold your accessories as well as your multimeter, are also available.

Accessory checklist

1. Probes and modules. What are you testing:
- Voltage?
    - High- or low-level?
    - Voltage + frequency?
    - Need a clip? If yes, large or small?
    - Form factor? (e.g., long, thin, sharp)
- Temperature?
    - Contact or non-contact probe?
    - Gas, liquid or solid?
    - Broad or narrow range?
    - High or normal accuracy?
    - Response time?
- Current?
    - ac or dc (or both)?
    - High or low range?
    - Voltage level?
- Gas?
    - What type?
- Pressure/vacuum?
    - High or low range?
    - High or normal accuracy?
- Light?
    - High or low end of light spectrum?
    - Light volume?

2. Test leads. What are your requirements for:
- Composition?
    - PVC?
    - Silicone?
- Flexibility/tangle resistance?
- Length?
- Voltage, current, and CAT rating?

3. Safety. What does your workload require in terms of:
- Rating?
- Construction quality?

4. Protection. Do you prefer:
    - Hard case?
    - Soft case?

Check out what's available

To get the most out of your multimeter investment, check with the manufacturer of your multimeter to find out which accessories are available, and choose the ones that best fit your particular workload and work environment. Fluke, for example, offers a broad selection of digital multimeter accessories for measuring voltage, temperature, current, and other parameters–as well as solutions for protecting and carrying your multimeter. All are made to the same rigorous, high-quality standards as the Fluke worldclass line of multimeters. For a free guide to Fluke meter accessories, call 1-800-44-FLUKE or e-mail **fluke-info@fluke.com**.

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