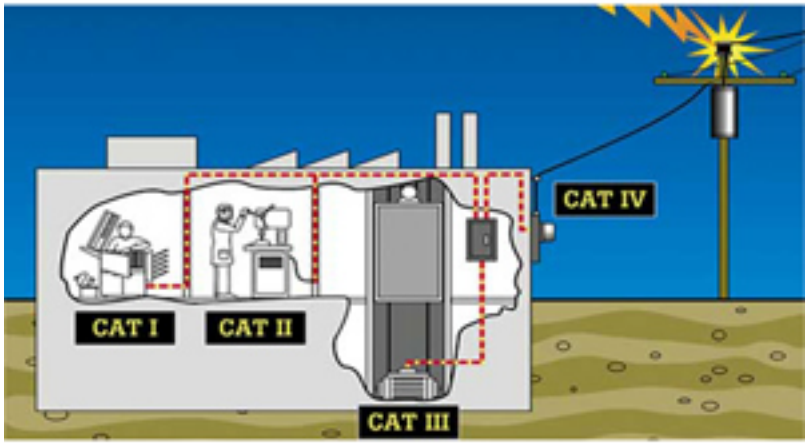
Working Safely with Digital Multimeters, Part 2



This is part two of a two-part piece. Part one can be found here *[1].*

Overload Protection

Fuses protect against over*current*. The high input impedance of the volts/ohms terminals ensures that an overcurrent condition is unlikely, so fuses aren't necessary. Over*voltage* protection, on the other hand, *is* required. It is provided by a protection circuit that clamps high voltages to an acceptable level. In addition, a thermal protection circuit detects an overvoltage condition, protects the meter until the condition is removed, and then automatically returns to normal operation. The most common benefit is to protect the multimeter from overloads when it is in ohms mode. In this way, overload protection with automatic recovery is provided for all measurement functions as long as the leads are in the voltage input terminals. **V189** *R E RMS M T METER*

Shortcuts to Understanding Categories

Here are some quick ways to apply the concept of categories to your everyday work:The general rule-of-thumb is that the closer you are to the power source, the higher the category number, and the greater the potential danger from transients.

1. It also follows that the greater the *short-circuit current* available at a

particular point, the higher the CAT number.
2. Another way of saying the same thing is the greater the *source impedance*, the *lower* the CAT number. Source impedance is simply the total impedance, including the impedance of the wiring, between the point where you are measuring and the power source. This impedance is what dampens transients.
3. Finally, if you have any experience with the application of transient voltage surge suppression (TVSS) devices, you understand that a TVSS device installed at a panel must have higher energy handling capacity than one installed right at the computer. In CAT terminology, the panelboard TVSS is a CAT III application, and the computer is a receptacle connected load and therefore, a CAT II installation.

As you can see, the concept of categories is not new and exotic. It is simply an extension of the same common-sense concepts that people who work with electricity professionally apply every day.

Multiple Categories
There's one scenario that sometimes confuses people trying to apply categories to real-world applications. In a single piece of equipment, there is often more than one category. For example, in office equipment, from the 120 V/240 V side of the power supply back to the receptacle is CAT II. The electronic circuitry, on the other hand, is CAT I. In building control systems, such as lighting control panels, or industrial control equipment such as programmable controllers, it is common to find electronic circuits (CAT I) and power circuits (CAT III) existing in close proximity.

What do you do in these situations? As in all real-world situations, use common sense. In this case, that means using the meter with the higher category rating. In fact, it's not realistic to expect people to go through the category defining process all the time. What is realistic, and highly recommended, is to **select a multimeter rated to the highest category in which it could possibly be used**. In other words, err on the side of safety.

Understanding Voltage Withstand Ratings
IEC 61010 test procedures take into account three main criteria: steady-state voltage, peak impulse transient voltage and source impedance. These three criteria together will tell you a multimeter's *true voltage withstand value*.

When Is 600 V More than 1000 V?
The measurement category chart can help you understand an instrument's true voltage withstand rating:

1. *Within* a category, a higher "working voltage" (steady-state voltage) is associated with a higher transient, as would be expected. For example, a CAT III-600 V meter is tested with 6000 V transients while a CAT III-1000 V meter is tested with 8000 V transients. So far, so good.
2. What is not as obvious is the difference between the 6000 V transient for CAT III-600 V and the 6000 V transient for CAT II-1000 V. They are *not* the

> same. This is where the source impedance comes in. Ohm's Law (amps = volts/ohms) tells us that the 2 Ω test source for CAT III has *six times the current* of the 12 Ω test source for CAT II.

The CAT III-600 V meter clearly offers superior transient protection compared to the CAT II-1000 V meter, even though its so-called "voltage rating" could be perceived as being lower. **It is the combination of the steady-state voltage (called the working voltage), and the category that determines the total voltage withstand rating of the test instrument, including the all-important transient voltage withstand rating.**
A note on CAT IV: Test values and design standards for CAT IV voltage testing are addressed in IEC 61010 second edition.

Creepage and Clearance
In addition to being tested to an actual overvoltage transient value, multimeters are required by IEC 61010 to have minimum "creepage" and "clearance" distances between internal components and circuit nodes. Creepage measures distance across a surface. Clearance measures distances through the air. The higher the category and working voltage level, the greater the internal spacing requirements. One of the main differences between the old IEC 348 and IEC 61010 is the increased spacing requirements in the latter.

The Bottom Line
If you are faced with the task of replacing your multimeter, do one simple task before you start shopping: Analyze the worst-case scenario of your job and determine what category your use or application fits into. *First* choose a meter rated for the highest *category* you could be working in. Then, look for a multimeter with a voltage rating for that category matching your needs. While you're at it, don't forget the test leads. IEC 61010 applies to test leads too: They should be certified to a category and voltage as high or higher than the meter. When it comes to your personal protection, don't let test leads be the weak link.

**Some multimeters have an input alert which gives a warning beep if the meter is in this configuration.*

For more information, please visit www.fluke.com *[2].*

Links:
[1] http://chem.info/Articles/2013/03/Instrumentation-Working-Safely-with-Digital-Multimeters-Part-1/
[2] http://www.fluke.com