

## Monitoring load current with a DMM

### Application Note

A digital multimeter (DMM) has become a necessity for electrical system measurements, and most electricians and electronic technicians would feel lost without one. The features available in today's meters make them versatile enough to find most problems in electrical and electronic circuits.

There are, however, some measurement tasks that make a technician think twice about his DMM.

Take for instance load currents. Many DMMs are designed to safely measure current up to 2, 10, or 20 amps depending on the DMM. Yet load currents found in most industrial environments are much higher and backed by high energy. On the surface it is not an attractive match.

That's where a DMM accessory called a current transformer comes in handy. A current transformer, like the Fluke 80i-400, can be employed to overcome the DMM's limitations for measuring ac current. Like a power transformer, the current clamp uses windings around a laminated core to step down the circuit current within the measurement range of the DMM. The step-down ratio is commonly 1,000 to 1. So measuring 100 amps in a load circuit through a current clamp will apply 100 mA to the DMM's current input. That's well within the DMMs capability and, conveniently, a direct reading from the DMM display. Just switch the DMM to mA ac mode and think "amps" when reading the display.

The current clamp is designed to clamp around a single conductor and uses the fluctuating magnetic field around the conductor to induce a current. Because it uses a transformer action, the current transformer is only usable on ac circuits. However, there are other clamps like the Fluke i410 designed to use the "Hall Effect" sensor which allows them to be used on both ac and dc circuits.

As long as the DMM is safety rated for the environment in which you will be making the measurement, say CAT III for electrical panels and switch gear, you can safely attach an appropriately rated current clamp to your DMM and make the measurement. Just remember that when you are using a DMM/current transformer combination you need to combine the measurement specifications of the current transformer and the DMM to get overall measurement accuracy.

Using the current clamp to overcome the current limitations of the DMM allows you to use a number of DMM features to analyze load currents.

#### Recording minimum and maximum current

Some DMMs are capable of recording the maximum and minimum measurement over time. The Fluke 170 Series, for instance, has this capability in its min/max mode. After setting the DMM up for a measurement, attach the clamp accessory to the DMM and place the clamp around the conductor to be measured. Then simply press the min/max button and the recording begins. During that time



period, the meter will constantly update built-in storage registers with the latest minimum and maximum measured value. As an example, let's say you want to determine the maximum load current drawn on a branch circuit for a 24-hour period of time. Connect the current clamp leads to the current inputs of a DMM. In the case of the Fluke 179, one lead goes to the mA input and the other lead to the COM input. Turn on the meter and place it in the mA ac function. Clamp the current clamp around the single conductor carrying the current you want to measure. Activate the min/max function by press-

ing the button and let the DMM sit clamped to the circuit. Twenty- four hours later, you can return to the meter and read both the maximum and the minimum current measured by the meter by simply pressing the min/max button. As an extra bonus, the Fluke 179 will also display the average of all readings during the measurement period.

This type of measurement is fine for monitoring changing load currents lasting 200 ms or longer. A special form of min/max is needed for capturing faster changes in current such as inrush current from fractional horsepower motors.

### Capturing fast changes in current

Some DMMs have a function that can measure the value of signals as short as 250 microseconds. In the Fluke 180 Series for example, the fast min/max function will capture both the positive and negative peak of an ac signal. This feature comes in handy when you need to capture the value of circuit transients. To measure the start current of a motor, attach a current clamp to the COM and mA inputs of the

DMM. Place the clamp around the lead of a motor, turn the DMM function switch to the ac mA/A function and activate the fast min/max by pressing the corresponding buttons. Turn on the motor and let it come to full speed. Shut down the motor and recall the maximum value recorded in the DMM.

If you are using a 189, these readings can be stored in the DMM's memory and recalled later or downloaded to a PC for further analysis or record storage.

### Logging

The Fluke 189 Logging Meter can be used to capture a series of readings over time using either interval or event triggers. In either case, the logging function stores the highest, lowest, and average values measured over time. In addition, the logging process "time stamps" each start and stop time of the measurement period in real time. It is the triggering of the measurement period that differentiates interval logging from event logging. To view all the data from these measurement periods however, you must have access to a PC and use FlukeView® Forms software.

### Interval logging

A specific measurement period, such as one second or 15 minutes, is the characteristic that sets interval logging apart from event logging in the Fluke 189. Through the DMM's setup function, you can configure the measurement interval from one second to 99 minutes 59 seconds in one-second increments. Setting the interval to 00 minutes and 00 seconds turns off interval logging.

If, for example, you wanted to monitor the current drawn on a branch circuit for a 24-hour period, you could set up the Fluke 189 to perform logging in five minute intervals. After 24-hours, the DMM would collect 288 measurement periods of high, low and average measurement data. This data would be extracted from the DMM through FlukeView Forms and displayed on a PC.

### Event logging

Triggering a new measurement period when the measured value appears unstable or becomes stable is the differentiating characteristic of event logging in the Fluke 189. "Stable" is defined as a measured value that stays within  $\pm 4$  percent for one second or more. If the measurement increases or decreases more than four percent, an unstable period is triggered. The unstable period ends when the signal meets the criteria for a stable value.

So, in our 24-hour branch current measurement example, each time the load current changes more than four percent, the DMM will start a new measurement period. If the jump is quick enough, there will not be a recorded "unstable" period, just a new stable period with new values. For current measurements, the unstable period must last 50 milliseconds or more to be recorded by the DMM.



**FlukeView Forms**

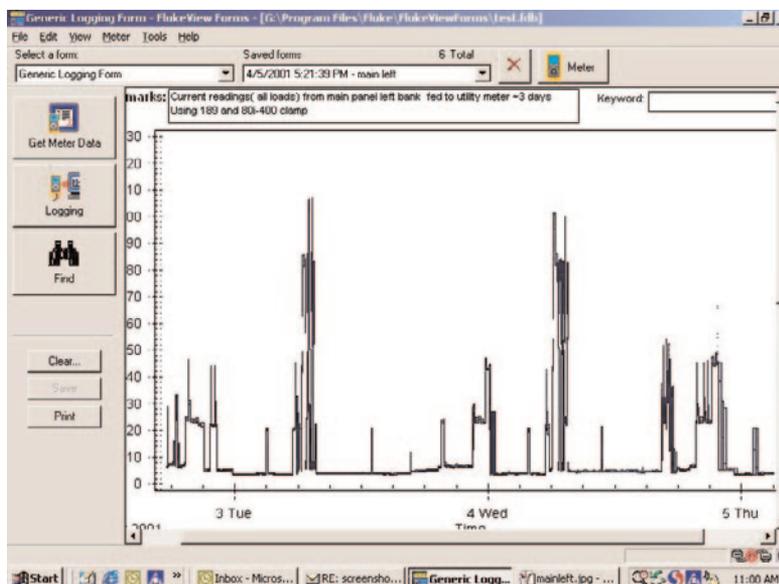
FlukeView Forms is a very powerful software package that provides access to stored information in a 180 Series DMM, as well as other Fluke products. With FlukeView Forms loaded on a PC, you can transfer logging and measurement data from DMMs to a PC and display that data in a graphical as well as tabular form.

As can be seen in Figure 1, the monitoring of the branch circuit resulted in both stable and unstable periods. This can be expected with equipment coming on and off during the day. If this were a circuit of a motor running constantly, then we might be detecting a problem with the unstable readings. Such conclusions of course, will depend on the application. But the branch circuit activity can be clearly seen in the graphical display and further analyzed with the measurement periods shown in tabular form.

**In conclusion**

Combining a DMM with a current clamp accessory enables accurate measurement and analysis of load currents.

Fluke has a wide range of current measurement accessories to fit just about any application. Current clamps with a maximum current rating ranging from 200 to 2,000 amps are available at your nearest Fluke distributor. These same distributors stock a collection of Fluke DMMs with varying feature sets so you can purchase the features you specifically need in your work.



**Figure 1.**

*Fluke. Keeping your world up and running.*

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