Basic power quality measurements on the go with the Fluke 345

Application Note

During your day-to-day measurement activities, there may be situations where you need to know more than what voltage or current is present. When that happens, the standard clamp meter isn't going to get the job done. The solution may be a power quality clamp meter such as the Fluke 345.

The Fluke 345 combines a clamp meter, power quality meter, oscilloscope, and data logger in one. This combination of functions, coupled with high quality digital filtering, makes it ideal for working with variable frequency motor drives, high efficiency lighting, and other loads using switching electronics.

The basics

Of course, the Fluke 345 will make the basic measurements of voltage and current to determine if there is something seriously wrong with the circuit under test. It's rated for use at the service entrance with a 600 Volt CAT IV rating.

Measuring voltage is as simple as using a clamp meter: Connect the test leads up to the voltage inputs, select voltage, and then read the rms voltage. Current measurement is just as easy. Select current, open the jaw, clamp around the wire, and measure. With the 2000 A range and large jaw opening, you can evaluate most of the circuits in the building.

The Fluke 345 can also measure both ac and dc voltage and current simultaneously, and identify the magnitude of each separately and combined as ac+dc true-rms. That's helpful for checking a UPS, battery, and output, to make sure that the circuits are working correctly and the batteries are in good condition. A dc voltage component on the output of a UPS, or even an adjustable frequency motor drive, may even be a quick indicator of a developing problem. For example, waveform non-symmetry will cause an apparent dc voltage component and may indicate impending failure of system output electronics.

Waveform view

The world runs on ac voltage, be it at home, shopping center, hospital, factory, or industrial complex. Sometimes valuable troubleshooting information can be gained by "viewing" the ac waveforms behind the action. Turn the Fluke 345 switch to and you can view the voltage and current waveforms. From there, select either of the waveforms and use the arrow keys to measure voltage at a specific point on the waveform, as well as the time between two points on the waveform.

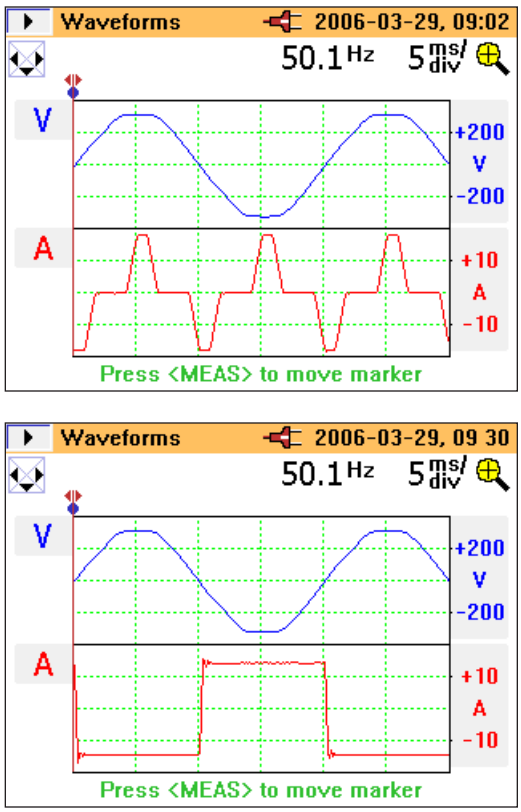

Figure 1. The dual waveform display on the Fluke 345 shows both voltage and current waveforms.

Armed with the waveform and harmonics data, you have a good chance of understanding why the electrical system, and the equipment connected to it, are behaving the way they are. For example, if the voltage waveform is flattened on top, you may find some equipment will reset or operate erratically, because its electronic power supplies aren't functioning properly. If the current is drawn in short pulses instead of a sine wave, it's likely that you have an electronic load and potential harmonics problems.

Harmonics

One of the most talked about problems in the electrical systems today is harmonics, due to the proliferation of computers, variable frequency motor drives, and electronic lighting. A power quality clamp meter is ideal for troubleshooting these types of problems. Set the switch of the Fluke 345 to harmonics ( )to see voltage and distortion factor (% THD rms). Once the clamp meter is in harmonics mode, it's a simple matter to switch to a view of the fundamental voltage and THD, and to evaluate the individual harmonics, up to the 40th, using a bar graph. All of the same information is available for current also.

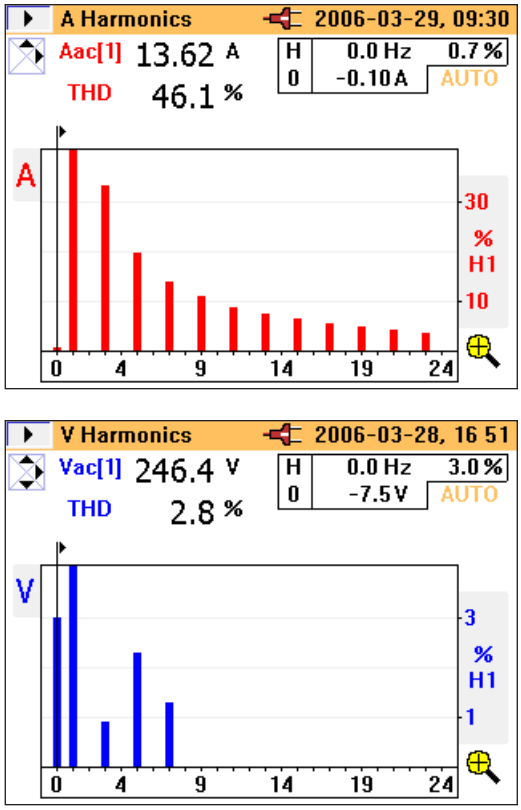

Figure 2. Graph harmonics for voltage and current.

What are harmonics and what causes them? The electrical system that we use generates an ac voltage at a frequency of 60 Hz (Hertz) or 50 Hz in some parts of the world. This is called the fundamental frequency of the system, or the first harmonic. Distortion results from the introduction of additional frequencies into the electrical system. These additional frequencies occur at multiples of the line frequency, i.e. 2, 3, 4, 5, etc, times the utility generated frequency. Most often, you'll see odd harmonics, such as the third (180 Hz), 5th (300 Hz), 7th (420 Hz), and possibly others above the seventh harmonic.

The waveform in Figure 3 would only exist in a perfect world, without harmonics. Since that's unlikely to exist it's more often that something similar to the the distorted waveform in Figure 4 will be present.

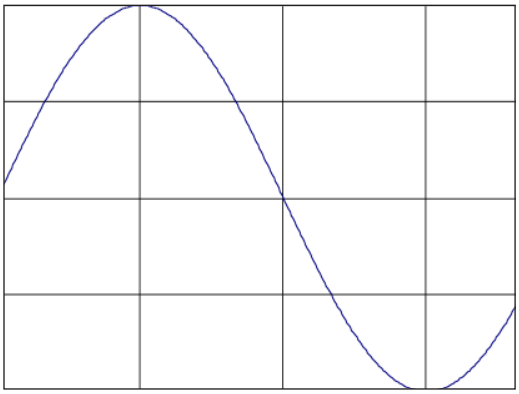

Figure 3. Clean sine wave.

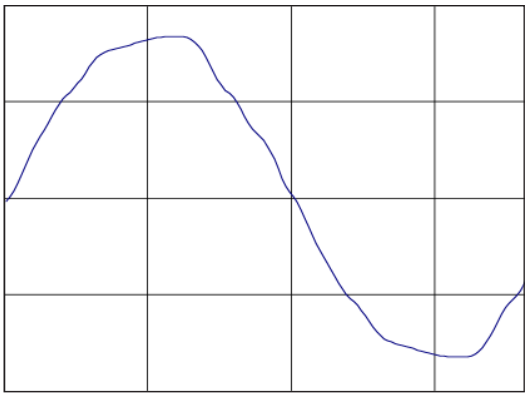

Figure 4. "Real world" distorted sine wave.

The distorted voltage shown in Figure 4 is still recognizable as a sine wave and contains only about 4 % THD. So, voltage typically isn't the source of today's problems. It's more likely that there will be significant current distortion and a relatively clean voltage. In fact, it's likely that the current waveform will be like the one shown in Figure 5. This comes from a single-phase load. Distortion factor here is 76 %. If this load were drawing a large amount of current this could be a problem, because it may cause overheating of neutrals and transformers in the system. If there is large current draw with significant current distortion, it may even cause added distortion on the voltage due to system impedances.

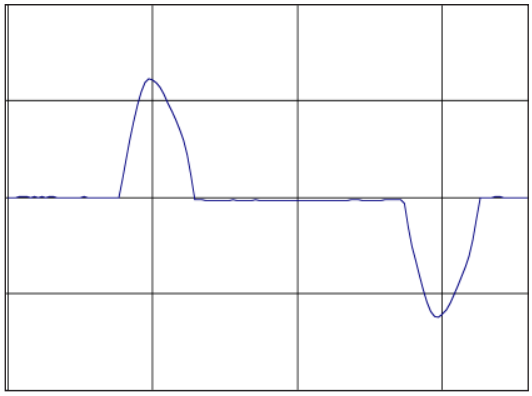

Figure 5. Current for an electronic load.

Using the Fluke 345, you can view waveforms, and, more importantly, distortion measurements and even the level of individual harmonics. The screen in Figure 6 shows a view of individual harmonics. Armed with this information, you can develop a strategy for dealing with the harmonics in your electrical system.

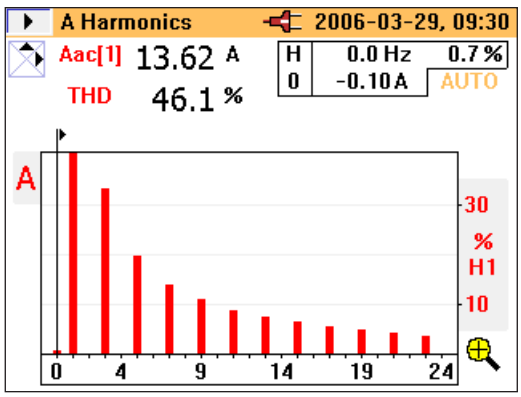

Figure 6. Current harmonics bar graph.

Power measurements

Power measurements—Watts, VA, VAR, Volts, Amps and Power Factor—are the mainstays of any system analysis. The Fluke 345 reads these parameters in both single-phase and balanced three-phase power systems. Taking these measurements will help determine circuit loading, so you can judge whether it's safe to add more load or if a new circuit is required. These parameters are essential for investigating and correcting low power factor, the culprit behind high utility bills.

Inrush current

Sometimes, after performing a power test, the circuit breaker will still open when a load starts up. Usually, that means there is a momentary current surge, called inrush. When that happens, use the Fluke 345 to measure the peak value and duration of the inrush current during load start. With that information, you can determine whether to move the load to another circuit or make other appropriate changes to the existing circuit.

Logging

Very often problems are intermittent—for example a circuit breaker opens occasionally or it looks like a wire has overheated but it isn't hot now. What to do? Use a tool that logs data over a period of time. The logging function on the power quality clamp meter allows it to be set up and left to discover the problem over a couple of hours or several days. Then, upload the logged data to a computer and use the Power Log software to view your findings in graphical format, analyze the information, and generate reports.

Power quality clamp meters like the Fluke 345 offer the ease of use, portability, and flexibility needed to solve most problems in a commercial, industrial and residential setting. With this kind of tool, you can make everyday voltage and current measurements as well as evaluate harmonics, power, inrush current, view waveforms, and log measurements when the standard testers don't provide the answer.

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