

Power Quality Counts

In an era of soaring fuel costs and environmental issues, power quality is more important than ever

By Jarek Bras, Business Unit Manager,
Amprobe Test Tools

Until the early 1980s, power quality for the most part was not an issue. With the advent of the electronic era of non-linear loads such as personal computers, photocopiers and electronic lighting ballasts, power became "dirty" very quickly. Today, more than 95 percent of all 120/208V power panel loads in office and data center environments are electronic and variable-frequency drive motors are commonplace in plant operations.

Other examples of non-linear loads include:

- Electronics (radios, VCRs, computers, TV sets, etc.)
- Light dimmers
- Variable frequency drives (VFDs)
- 6-pulse converters
- Power rectifiers (e.g. plating systems)
- Uninterruptible power supplies (UPSs)
- Fluorescent and energy saving lights
- DC servo drives (Robots)

There are many problems that "dirty" harmonics polluted power can cause, such as: failed power factor correction capacitors, blown fuses (no apparent fault), misfiring of AC and DC drives, overheated transformers and conductors, tripped circuit breakers, voltage distortions, high neutral currents, high neutral to ground voltages, rotating and electronic equipment failures and reduced power factor due to THD.

The harmonics created heat causes premature insulation deterioration, which compromises safety of humans, electric equipment and wiring. At the same time, overall system efficiency and reliability are negatively affected.

Efficiency is even more important now with fuel prices rising exponentially and increasing concerns over greenhouse gases and their

effect on global warming. Good power quality increases the efficiency of equipment and reduces fuel consumption and emissions, so it makes good business sense to make power quality analysis part of regular plant maintenance.

Equipping all maintenance technicians with the tools needed to perform complete PQ analysis has been a very costly proposition. It has also meant carrying several large devices to be able to complete all the analysis necessary on site. With the Amprobe DM-III Multitest—which combines a True RMS power quality analyzer and data logger with a megohmmeter and ground resistance tester in one device—companies can afford to equip all their technicians with one tool that performs every power quality function necessary to dramatically improve operational efficiency.

Analyzing power issues

The Superior Group, an electrical contracting company based in Columbus, Ohio, uses the Amprobe DM-III as a regular part of its business. The company works on a wide variety of projects, from very large data centers, to public works and even voice and data through its data division.

"We are probably one of the larger electrical contractors in the area," said Rich Hartman, vice president of service and small projects for The Superior Group. "We employ approximately 150 people at this time and electrical construction makes up 60-70 percent of our business. We have 13 service trucks that will do anything from a one-hour service call to \$100,000 projects."

Because of its diverse customer base, which includes Coca-Cola, Chase Bank and Abercrombie and Fitch, The Superior Group needed a flexible tool that could troubleshoot a wide variety of problems.



"The biggest thing we use the DM-III for are power issues with our industrial customers and even some of the new construction projects," Hartman said. "A lot of times we're looking at voltage problems, at motors or drives dropping out, so we'll go in and record for a week to see if the issues are power company related or if it's something with the plant."

"Power quality has always been an issue. We have done harmonics readings on some equipment for one of our clients. They were having harmonics issues on their drives, which we ended up putting on some capacitors to correct."

The trouble with power

Current delivered from power utilities is a clean, linear voltage sinewave that has a relatively constant amplitude and frequency. Modern electronic motors and equipment are non-linear devices, which break up the linear sinewave and create a 3rd harmonic.

These harmonics cause heat that can overheat wires and transformers. A 3rd harmonic creates a current in the neutral line and rather than cancel each other out, they actually add up—in fact, you can end up with more current on the neutral conductor than on phase conductors.

For example, you have a three-phase motor with a 100-amp phase on each leg, and you have 50 percent 3rd harmonic content on each of the phases. The 50 amps on each phase adds up on the neutral, so you have 150 amps running back through the neutral wire.

Exacerbating the problem is, that to save money on copper wire decades ago, they made the neutral thinner, so now you're conducting much higher currents in a much smaller wire.

So harmonics create heat, which over a period of time, raises the temperature of the neutral. This increase in temperature can overheat the surrounding conductors, cause insulation failure and overheat the transformer sources, which supply the power system. Other problems include:

- nuisance tripping of circuit breakers
- malfunctioning of UPS and generator systems
- metering issues
- computer malfunctions
- overvoltage issues

"Usually if we get a harmonics request it's because they have a lot of frequency drives," Hartman said. "The most common problem we see is low voltage. When plants are running full speed in the middle of the day, their voltage will dip below the drive's minimum required voltage input and shut down. So we use a DM-III to get a good look at it."

The data recorder functionality gives technicians the ability to analyze power over a wide variety of time segments.

"If someone is having the same problem everyday, we hook it up for the day," Hartman said. "If our customers daily business routine requires different activities each day or one department or production line doesn't work everyday, we'll do it for a week so we can see the entire picture."

Troubleshooting insulation, ground

If a harmonics problem has caused overheating over a long period of time, an insulation check is the next logical step. Insulation will deteriorate from absorbing the heat over time as well as from pollution (dirt, chemicals, etc.). The megohmmeter function in the DM-III allows technicians to test the insulation integrity of wire, cables, transformers and electric motors with selectable test voltages up to 1000V.

Finally, if the power quality analysis shows that a large amount of current has been running through the neutral, the current is going to the ground. The ground resistance and resistivity functions on the DM-III makes it easy to perform 2 point continuity/resistance, 3 point fall of potential and 4 point earth resistivity tests with the same device. It can accumulate the average of multiple tests and display the individual test results and the number of tests.

Easy reporting and set-up

Downloading the data and reporting it are the last step of a PQ analysis. Amprobe's Download Suite, a free software package that works with every Amprobe product, makes the task easy.

"I use the Download Suite to print the graphs in PDF format and email them to our customers so they can look at them," Hartman said. "They like to be able to take a quick look at the graph and see where they're at."

I can add a line on it and say 'Here's where you don't want to go below and you can obviously see you're going below that.'"

The Download Suite also makes setting up the device easy.

"I plug the DM-III into the computer and it connects immediately," Hartman said. "It's very quick to get it set up and out the door. The connectivity to get the DM-III to your PC and get it set up for the field is very easy. Same with downloading the information. You don't have to be a rocket scientist to understand it."



DM-III Multitest F with Flex CT's

Improving plant efficiency

Including power quality analysis as a regular part of plant maintenance improves safety, saves energy as fuel prices skyrocket, and helps companies meet increasing emissions regulations. The Amprobe DM-III gives technicians a single, affordable tool with complex testing capabilities to take a global look at systems and run them efficiently.

"The thing I like about the Amprobe DM-III is it's compact and easy to use," Hartman said. "It's a no-brainer to take out in the field and set up. Everything about it is more user friendly than what we used in the past."

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