TECHNICAL PAPER

Discovering hidden breaker functions

Emax 2 Network Analyzer capability

We often fail to take advantage of powerful features in our electronic devices, usually because we didn t know they were there. Managers at facilities equipped with ABB s Emax 2 breaker are excited when they discover it includes a full-function Network Analyzer.

Darryl Moser
Business Development Manager, DEM Sales

ABB Electrification Products Division

The Emax 2 enables extensive power-quality analytics and alarms that help protect plant equipment from power-related problems like voltage sags, spikes, and harmonics.

Much of the technology we use every day includes features that go unused. This is often because devices have become so feature-rich that it's difficult to know all of the capabilities available. In other cases, users are accustomed to devices having a certain feature set and are simply unaware that new features have been added. When a particularly useful feature is discovered, device owners are greatly dismayed that they hadn't discovered it sooner.

Low voltage breakers, for example, have moved far beyond simply interrupting current when there's a fault. Modern breakers may now incorporate a number of power-quality-analysis tools to help facility operators not just protect their power network and connected assets, but also monitor and improve power quality. ABB's SACE Emax 2 provides a perfect example of this modern, multi-function breaker.

The Emax 2's added features aren't options; they are included as standard functions in the Ekip Hi-Touch trip unit. Unfortunately, most facility operators are unaware of these features and, therefore, fail to reap their benefits.

Power problems

Electrical equipment is designed for optimum operation when powered at a constant voltage that is as close as possible to the rated value. Beyond voltage stability, there are many other metrics describing power quality. For example, industrial equipment powered by a three-phase supply requires the three-phase voltage levels to be equal (balanced).

Deviations from perfect power quality can damage or destroy connected assets, causing costly downtime in manufacturing and process industries. Poor power quality also reduces the efficiency of your network. Increased awareness of the importance of power quality, combined with an ever-smarter grid, will make power users increasingly interested in identifying and correcting power defects.

One of the key features of the Emax 2 breaker is its Network Analyzer capability, which is in alignment with IEC 61000-4-30 and IEEE's 1250 *Guide for Identifying and Improving Voltage Quality in Power*

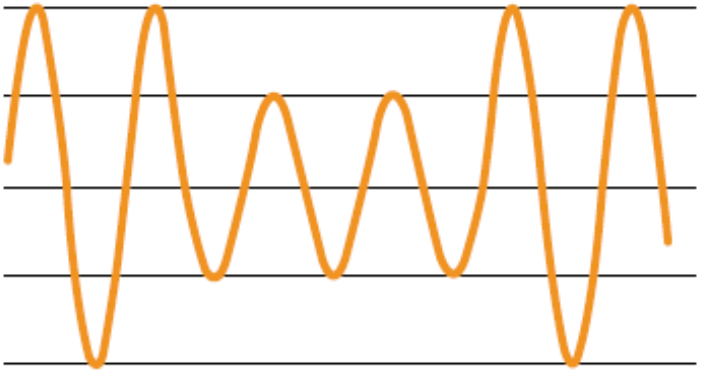

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Figure 1

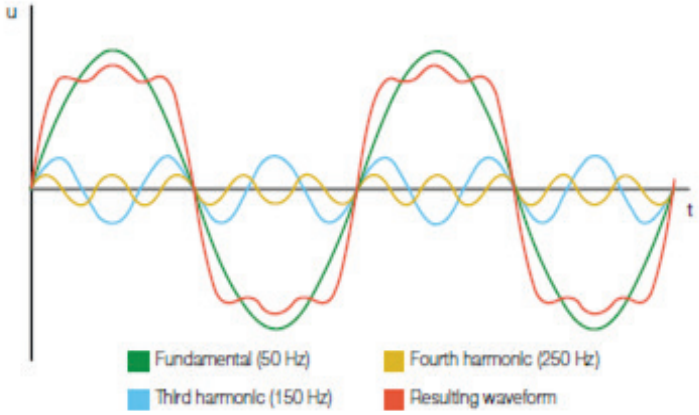

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Figure 2

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Figure 1: Example of voltage sag

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Figure 2: Effects of harmonic distortion and relevant THD

Systems. This capability is provided by the embedded Ekip Hi-Touch trip unit, providing insights into the following important indicators of power quality:

- Average voltage value
- Voltage interruptions and spikes
- Slow voltage sags and swells
- Voltage unbalance
- Harmonic analysis

Voltage sags and swells

Voltage sags are the most common power-quality problem, and they can create real issues, particularly in process industries. Sags are frequently caused by single line-to-ground faults: a lack of insulation or short-circuit between one phase and ground on the utility system. These faults can be caused by anything from lightning and storms, to downed tree limbs or poles. Even a persistent squirrel can cause damage that would create a network issue resulting in a potentially harmful voltage sag.

Another common voltage-sag cause is the start-up of large loads, inside or outside the facility. The brief dimming of lights that occurs when a piece of equipment starts up is a sure sign of a sag. That dimming warns you that the equipment in your facility just suffered a loss of performance and possibly incurred damage. That damage may be instantaneous, causing a failure, or it may be cumulative damage, weakening the device and increasing the chance of a failure in the future.

Lights dimming are the only indication most people will have of a power problem. Absent a network analyzer or other power-quality-assessment tools, you won't be aware of most power-quality issues until you begin experiencing power-related problems – possibly including catastrophic damage – to other pieces of equipment.

Harmonics

Beyond the RMS value and frequency, the "pureness" of the voltage waveform is also an important point. An ideal waveform should be a perfect sinusoid, but this is something seldom seen. Frequencies other than the fundamental one are always present. These frequencies are called harmonics, which are component frequencies of the wave spectrum that is a multiple of the fundamental frequency.

The harmonic currents can travel in the supply system, creating excessive harmonic voltages and currents that can cause nuisance tripping, transformer losses, or equipment damage. Harmonics in the electrical network also may be the cause of equipment malfunctions, such as overloading of the neutral conductor, an increase of losses in the transformers, disturbances in the torque of motors, and others.

Harmonics are more of an issue today than ever, and the issue will continue to grow, for two reasons.

First, more harmonics are being created. New industrial facilities typically include a significant number of non-linear electric drives to regulate or control rotating equipment such as compressor motors and pumps. The non-linear designation comes from the fact that these devices distort the applied AC voltage wave and generate harmonic currents that basically "pollute" your facility's power.

And second, equipment today is more sensitive to power-quality issues. The continued growth of more-sophisticated and, therefore, sensitive electronic equipment, and the growing number of electronic controls on manufacturing and process machinery, increase the risk of power-quality issues creating problems in your facility.

Summary
Just because your electrically powered equipment starts and runs, that doesn't mean those assets aren't struggling to overcome unseen power problems. In fact, they could already be experiencing damage from unseen power defects. Risk-tolerant facility managers may take a wait, see, and hope approach to power quality. Risk-averse managers may invest in a freestanding network analyzer to examine their power quality and identify possible issues.

But smart facility managers are taking advantage of the hidden network-analyzer features embedded in their ABB Emax 2 breakers. For only a bit more money than a standard breaker, the Emax 2 provides simple but comprehensive network-analysis features. In addition to analyzing power quality, the Emax 2 can be programmed to alert maintenance or operations managers to potential problems.

Current Emax 2 users should explore the network-analyzer features available to them. New breaker buyers should consider the fact that, in addition to advanced breaker technology, they can also add power analysis to their network with a single new asset. Either way, facility managers with an Emax 2 as part of their power-distribution network will benefit from enhanced ability to predict potential equipment problems, implement more effective maintenance practices, and increase the reliability of their operations.

ABB Inc.
Electrification Products
8155 T&B Boulevard
Memphis, TN 38125

abb.com/lowvoltage

Customer Service
800-816-7809
7:00 a.m. - 5:30 p.m., CST, Monday-Friday
elec_custserv@tnb.com
Technical Support
888-385-1221, Option 1
7:00 a.m. - 5:00 p.m., CST, Monday-Friday
lvps.support@us.abb.com

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