

Electrotek Power Quality Harmonic Studies & Solutions

Understand, Identify, Solve & Prevent Voltage & Current Harmonic Problems with Electrotek's Expert PQ Engineering Staff & Software

Harmonic voltages and currents originate because non-linear electronic loads (e.g. switch-mode power supplies, variable frequency drives (VFDs), inverters and converters) are required to operate on traditional electricity grids and customer electrical systems.

The adage in PQ, "While the voltage may belong to the utility, the current belongs to the customer" is very true. Customer loads require the generation and delivery of harmonic currents to operate their loads. The power system at the grid and customer level wasn't designed to provide harmonic currents, but it has to. In order for harmonic currents to be provided, specific modifications and

upgrading of the grid and power systems are required.

Harmonic currents are currents that flow at frequencies other than 50 or 60 Hertz. The 2nd harmonic frequency is at 120 Hertz, which is 2×60 Hertz. One of the problematic harmonic currents is the 3rd, operating at 180 Hertz. In most situations, even order (2nd, 4th, 6th, ...) don't cause PQ problems except in specific situations. However, the odd harmonics (3rd, 5th, 7th, etc.) cause many traditional PQ problems that have occurred in the past 20 years.

Harmonic problems will never disappear as there are always new non-linear loads being added to the grid and

customer power systems. The growth of distributed generation technologies on the grid and in customer facilities is causing a growth in harmonic problems. Customers who upgrade their plants to include more energy-efficient equipment such as VFDs will experience changes in their harmonic voltage and current profiles. Some customers will experience over-heated transformers and neutral conductors and bus bars. Some customers will experience malfunctioning and failing electronic equipment when their voltage distortion increases.

Electrotek expert PQ engineers developed state-of-the-art PQ software addressing harmonic voltage and cur-

rent problems. Our software, *SuperHarm*® and *HarmFlo*® are designed to generate models of harmonic loads on systems and run harmonic simulations—all for *HarmFlo* as well as edit data files; view, compare and integrate power system data; derate transformers, cables, motors and capacitors; conduct IEEE 519-1992 & 2014 harmonic analyses and design harmonic filters.

Our engineers can also determine the risks associated with not managing harmonic voltages and currents as well as the increased system performance by managing them.

What is Electrotek's *SuperHarm*® Expert Harmonic Software?

SuperHarm® evaluates harmonics on electric power systems. *SuperHarm* enables development of a computer model of a utility or customer power system to explore variations on system loads and configurations, along with the resulting impact on system frequency response and distortion lev-

els. *SuperHarm* is available with a wide variety of device and source models. The software package contains

- generic harmonic voltage and current source model,
- long-line corrected pi model,
- simple RL branch model,
- capacitor model and

- balanced three-phase coupled line model.

It also includes models for the modal representation of geometrically specified lines and cables, advanced non-linear load representations, induction and synchronous machines, and three-phase equivalents.

SuperHarm can solve both balanced and unbalanced three-phase systems, accomplished by using phase domain nodal admittance matrix techniques rather than sequence component solution methods. *SuperHarm* is a state-of-the-art software for solving all harmonics problems.

Electrotek Concepts, Inc.
Software Development Center
100 Cummings Center
Suite 130G
Beverly, MA 01915-6177
United States of America
Telephone: +1-978-927-8755
Fax: +1-617-848-0088
E-mail: pqview@electrotek.com
Website: www.electrotek.com

Electrotek Concepts, Inc.
Engineering Services Center
9041 Executive Park Blvd.
Suites 136 & 142
Knoxville, TN 37923-4664
United States of America
Telephone: +1-865-470-9222
Fax: +1-865-247-5984
E-mail:
pqengineering@electrotek.com
Website:
pqengineering.electrotek.com

Electrotek's Power Quality Engineering Services Center is a world-renowned center for power systems and power quality engineering. Our Center includes an Advanced Power Quality Testing & Research Laboratory.

Learn about our Center by visiting: www.pqengineering.com

Email: pqengineering@electrotek.com for more information.

General Manager: Brian Todd, btodd@electrotek.com; Telephone: +1-732-248-4281

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Benefits of Using Electrotek's *SuperHarm®* to Solve Harmonics Problems

When conducting a harmonics study, it is important to address all of the possible scenarios that could develop to cause harmonics to increase and how to control them. Electrotek's approach for conducting these studies uses a specially designed set of PQ instruments and software tools to provide study results that are statistically relevant to the system.

- Determining the different harmonic-related impacts of making changes to a power system beforehand along with the level of risk associated with the different PQ harmonic phenomena that can adversely affect the PQ of other circuits on that system.
- Investigate the ranges of power system and power quality operating conditions to determine if harmonic conditions will cause the system to experience increases or decreases in the risk of power system disturbances and instabilities which may cause malfunction or damage to electrical and electronic equipment.
- Determine if planned changes to a utility power system or customer power distribution network increase or decrease the probability of causing PQ harmonic problems with sensitive electronic equipment in customer facilities.
- Determine the degree of non-linear load a plant electrical system can support before critical power quality thresholds, such as harmonic voltage distortion, are exceeded, thus compromising power quality across the plant.
- Provide a risk assessment regarding power quality to an insurance company to demonstrate a customer is pro-actively engaged in managing the power quality of their plant.

About Electrotek

Founded in 1984, Electrotek Concepts, Inc. is world renowned for its research, developmental, applications and problem-solving work in understanding, identifying, analyzing and preventing power quality (PQ) problems. Our expertise extends from the utility generators to inside the electrical/electronic load inside a customers' facility. The experience of Electrotek's team of PQ engineers extends from experts in utility power systems to participants on IEEE and IEC standards boards regarding PQ standards and to designers of end-use electronic equipment. Our engineers are armed to address any PQ problem at any level. The future of reliable and available power and customer equipment in today's modern technological society depends on compatibility between utility power, the customer's facility electrical system and the end-use equipment customers depend on to carry out their day-to-day business activities.

