

Resolving Power Quality Problems with Medical Imaging Systems

Improve Medical Imaging System Performance: Characterize the Power Quality Delivered to Your System—Good PQ Enhances Image Quality

Hospitals, clinics, and imaging centers rely on imaging systems 24 hours a day, 365 days per year. When a system is down, patients in need of imaging can't receive the care they need in a timely manner. Magnetic resonance imaging (MRI), computed tomography (CT), digital X-ray, and ultrasound, to name a few modalities, all rely on quality power to produce quality images. Healthcare providers rely on systems that work to help meet budgetary requirements for operating imaging departments.

Imaging system problems are frequently reported to manufacturers and service contract companies. Many

problems are found to be caused by poor PQ. The PQ in hospitals and clinics is often a problem, because of the number of non-linear loads operating in one facility. Utility PQ often causes problems for hospitals as well.

New imaging system designs, which produce images with higher resolution, also require higher power levels and better PQ. Voltage anomalies like capacitor switching transients, impulsive transients, high distortion, and notching are likely to cause serious system problems ranging from burning out gradient amplifiers, burning out power supplies, and introducing artifacts in

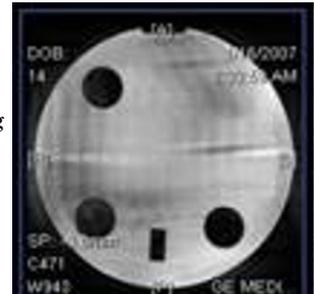
images that physicians won't accept as quality images.

The imaging artifact below shows vertical bars across the phantom test image when a voltage sag of 75% of nominal voltage (480 volts) was applied to an MRI system in a PQ test laboratory.

Voltage sags, the most common PQ disturbance, were injected into this MRI system to determine its response to sags. Imaging artifacts showed up at a 90% sag voltage and were more pronounced as the sags were deeper, with increased duration.

Imaging technicians often report unresolvable artifacts in their images as well as system shutdowns and re-

boots. In one hospital in New Mexico, an MRI system was rendered inoperable for over 30 days due to sags generated internally at a new hospital. A sag mitigation technology was installed to solve the problems.



Vertical artifact bars in image caused by an A to C voltage sag to 75% of nominal voltage.

Imaging Systems also Require Exceptional Grounding for Good Performance

Electronic equipment not only requires good PQ, but also requires a low-impedance ground to operate correctly. Imaging systems require grounds that are even lower than the low impedance of 25 ohms at 60 Hz. This is because they require low-impedance grounds even at high frequencies above 1

MHz. High-frequency currents that try to flow out of the system must find an easy path back to Earth ground. If not, transient voltages are reflected back into the systems power distribution unit (PDU), and cause problems with the digital circuitry in the system.

Electrotek's approach for conducting a PQ audit on an electrical system powering imaging systems not only characterizes the PQ delivered to each system, but we also characterize the wiring and grounding system from the switchgear to each system modality—MRI, CT, digital X-ray, and ultra-

sound, among others. Electrotek typically finds five to 10 electrical problems each time it visits a hospital or clinic, reporting poor imaging system performance. Our audit includes identification of loads that can cause imaging system problems and shorten the life of their critical components.

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 Characterizing Power Quality for Medical Imaging Systems

Electrotek PQ monitoring and investigation approach, customized for resolving PQ problems in hospitals and clinics with medical imaging departments, has improved the technical and economical performance of 100's of imaging centers. This offers multiple financial and technical benefits including:

- Minimize imaging system downtime to avoid cancellation of patient scans and physicians having to re-schedule patients at competing hospitals and clinics.
- Minimize use of service calls and spare parts from Service Contract, making it available for service when PQ is not the problem.
- Maintain image quality and avoid image artifacts caused by PQ disturbances and wiring and grounding problems—eliminate repeat scans.
- Maximize life of critical imaging system components by ensuring acceptable PQ is delivered to power distribution unit (PDU) and other imaging support equipment.
- Allow expert Electrotek PQ engineers to identify needed maintenance of feeder to imaging suite and AC circuitry to and from PDU to avoid imaging artifacts and imaging system downtime.
- Ensure good scoring on Joint Commission on Accreditation of Healthcare Organizations.

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, participants on IEEE and IEC standards boards regarding PQ standards, to designers of end-use electronic equipment. Our engineers are armed to address any PQ problem at any level. The future of reliable, 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.

