Electrotek CONCEPTS

Electromagnetic Interference (EMI) Investigations: Finding the Sources & Solving EMI Problems

Equipment Malfunctions at Higher Frequencies: 3 kHz to 10 GHz—Understanding, Identifying, Solving & Preventing EMI Problems

A growing number of mysterious equipment malfunctions occur each year in customer facilities as a result of electromagnetic interference (EMI) problems. The electromagnetic environment we live in is rapidly becoming more energetic as we use more electronic equipment and wireless devices. Almost all products are electronic nowadays, and use some form of switching power supply—even the battery operated products. Cluttering our airwaves with IEEE 802.11X (WiFI), Bluetooth® and devices that operate under other wireless protocols further increases the likelihood of EMI problems.

Wireless devices are intentional radiators of radiated emissions. Radiated and conducted emissions from switching power supplies are unintentional radiators. Operating both types of radiators can cause EMI problems. EMI problems caused by both radiator types can cost customers thousands to millions of dollars is lost revenue. Moreover, both types of EMI problems can be difficult to identify and solve.

The probability of a customer experiencing an EMI problem also increases as more renewable resources—wind mills and farms, solar PV stations and farms, microturbines, and fuel cells (also called distributed generation) are deployed. These devices also have switching power supplies called inverters. Inverters convert AC to DC energy, or vice versa. In DG equipment, inverting DC to AC causes very high emissions. Unfortunately, manufacturers include little filtering and shielding devices to control emissions.

As more DG equipment is deployed as individual installations, and in farms, conducted emissions on power line will increase. Radiated emissions in our airwaves will also increase, causing a higher unmanaged risk of causing customers EMI problems. Manufacturers choose to limit the application of filters and shields, because they think emissions from DG equipment will never be strong enough to cause customer EMI problems. On the average, emission add collectively, which raises their magnitude.

Other equipment and devices internal to customer facilities cause EMI problems. Variable frequency drives (VFDs), electronic lighting, computer power supplies, two -way radios, etc.

Products use internal EMI filters upstream of the AC line cord to reduce conducted emissions. Such filters are designed for 1950's electrical systems and may not filter well. Power quality (PQ) disturbances may also damage filters, causing them not to work at all.

Growing Low-Frequency EMI Concerns: 2– to 150-kHz Conducted Emissions

Conducted emissions concerns originated from sources in the 450 kHz to 30 MHz range. Forward-thinking European engineers extended that down to 150 kHz. US and international engineers extended it further to 2 kHz. PQ harmonics range from frequencies just above DC, to 3 kHz—the 50th harmonic. With 2– to 150-kHz being the new "PQ" concern, there's a 1-kHz overlap with harmonic frequencies. 150 kHz equates to the 2,500th harmonic—way up there. Some call these *SupraHarmonics*.

DG equipment use's inverters. Inverters generate radiated and conducted emissions. Solar PV inverters are typically the strongest source of emissions in the 2 – to 150-kHz range. Wind turbines and fuel cells are included, as well as battery chargers—they have inverters too.

These low-frequency emissions can burnout capacitors, cause communications problems with SmartGrid equipment (including DG equipment). They can also interfere with street lighting controls. This concern will grow as more SmartGrid and DG equipment are deployed on utility and customer power systems.

Power Systems and Power Quality Engineering Services Center

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

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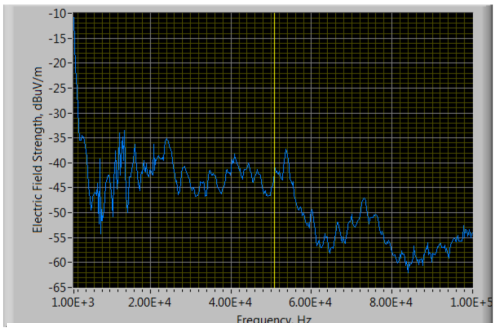
The Key is Electrotek's Investigative & Measurement Techniques

Most EMI problems are intermittent, making it difficult to detect and trace them to their source. Using a spectrum analyzer to build emissions envelopes doesn't provide enough data to determine the characteristics important to finding the source. Engineers at Electrotek have unique investigative and measurement techniques which can locate EMI sources in much shorter investigation times. Locating advanced sensors in specific locations while invoking advanced measurement techniques narrows down the area where the source is located.



Radiated emissions (2 to 150 kHz) from a solar PV farm at 2:30 pm one clear sky afternoon.

Depending on the EMI problem and how the emissions energy gets into the malfunctioning equipment, the source can be affecting the equipment at multiple frequencies. Combining this information in Electrotek's analysis allows the source to be located with a much higher degree of confidence.

The figure to the left shows radiated emissions from a solar PV farm at a distance of 30 meters from the nearest PV module. Emissions from 1 to about 5 kHz are significantly higher than from about 5 to 100 kHz. This is caused by the PV inverters at this farm operating at 2.2 kHz. CISPR 11 (Ed. 6)-2015 imposes no limits below 150 kHz. Emissions in this band will increase, and begin to cause EMI problems.

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 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, and 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.

PQView®