



Deerfield Illinois Power Quality Frequently Asked Questions

By Benjamin D. Miller, PE

What is “power quality”?

Think of power quality as being similar to water quality. You expect the water at your home or business to be clear, taste good, have adequate pressure, and be free of bacteria or harmful chemicals. Ideally, we expect our electrical power to be consistent, within voltage and frequency limits, free of transients or surges, and free of unwanted signals such as noise or harmonics. The closer we get to this ideal condition, the better our power quality.

What is the power quality problem in Deerfield?

The voltage supply in parts of Deerfield and some surrounding areas has a high level of harmonic distortion.

What is harmonic distortion?

Our AC voltage alternates 60 times a second. We refer to this as a fundamental frequency of 60 hertz (Hz). An ideal voltage contains only this frequency. When viewed on test equipment, the waveform has the shape of a perfect sine wave, as shown in Figure 1.

Harmonics are voltages that alternate at multiples of the fundamental frequency. Power systems generally only contain odd harmonics. For example, the third harmonic frequency is 180 Hz; fifth harmonic is 300 Hz, etc. A voltage that contains harmonics has harmonic distortion. When viewed on test equipment, the waveform has a distorted shape. Figure 2 shows a typical Deerfield voltage waveform.

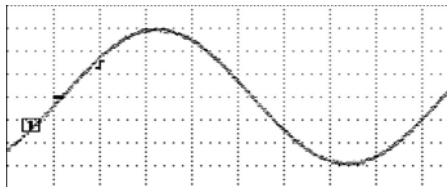


Figure 1 – Pure sine wave with no harmonics

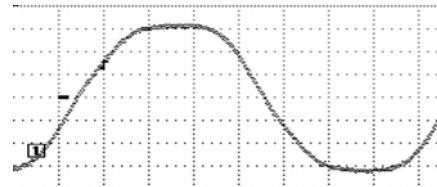


Figure 2 – Distorted sine wave with harmonics

Why should I care about excessive harmonics?

Harmonics in the voltage supply can cause various problems in electrical systems, appliances, and equipment, which are well documented in industry literature. Some are simply nuisances, but others can create a serious potential hazard. Harmonics also cost you money in the form of wasted energy that you pay for but that provides no benefit!

Typical Harmonic Problems

- Overheating of motors, such as those found in refrigerators, air conditioners, furnaces, and appliances. This can significantly reduce the life of the motor, and failure of some motors could create a possible fire or shock hazard, not to mention the cost of replacement. The extra heat also represents wasted energy.
- Additional heat in transformers used in appliances or “wall wart” power supplies for answering machines, telephones, battery chargers, etc. Just as with motors, the extra heat represents wasted energy, and can reduce the life of the device.
- Additional power in lamps and heaters. While this is useful energy, which you pay for, it can shorten light bulb life.
- Erratic operating problems in computers, printers, faxes and some other electronic equipment.
- Unexplained tripping of circuit breakers or blown fuses.
- Noise in stereo or computer sound systems
- Inaccurate timekeeping in some types of digital clocks.
- Overheated neutral wiring in some three-phase electrical systems, which can create a possible fire hazard. Multi-tenant residential buildings and commercial facilities such as offices, retail stores, restaurants, etc. often use this type of system. This does not affect single-family homes.

While these are examples of some possible problems, there can be others. You may not experience any at all. The cause of some of these problems is not always obvious until the presence of harmonics has been diagnosed.

What causes harmonics in the supply voltage?

Several factors contribute to the problem. Certain types of loads draw harmonic current from the supply. This, in turn, can affect the voltage, which then goes to all of the other customers fed by that supply. Typical loads of this type include the high intensity lighting used in many factories, parking lots, warehouses, and offices; various types of industrial equipment used in factories including motor drives and welders; fluorescent lighting; computers, faxes, and printers; large TVs and other electronic appliances; small uninterruptible power supplies (UPSs) used on individual computers; or large UPS systems for commercial data centers.

The utility’s distribution system also plays a part. Malfunctioning, improperly designed, undersized or overloaded equipment or lines increase the effect of the harmonic current from those loads on the supply voltage. An ideal power system would deliver perfect voltage, unaffected by the loads. In the real world, there is always some harmonic distortion.

How much harmonic distortion is acceptable?

The Institute of Electrical and Electronic Engineers publishes IEEE Standard 519–1992, *IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems*. This standard recommends a maximum total harmonic distortion (THD) of 5% on the supply voltage, measured at the point where the utility service conductors connect to your home or business. It also

recommends a maximum of 3% distortion of any single frequency harmonic. A wealth of industry literature indicates that higher levels cause problems, and require mitigation.

How much harmonic distortion does the Deerfield area have?

The THD ranges from 7% - 10% in parts of Deerfield and surrounding areas, with almost all of it third harmonic. It varies over a 24-hour period. ComEd engineers have measured 8%-9% THD at the sub-station.

Who is affected?

ComEd found similar distortion levels on all of the feeders leaving the sub-station. Therefore, it affects every customer who receives power from that sub-station. I do not know the full extent of the affected area. I have confirmed it in several locations within Deerfield, Northbrook, and in the Thorngate sub-division of Riverwoods (See Appendix A).

How much harmonic distortion is typical in other areas?

Appendix B shows a sampling of the measured THD in various other locations. Levels under 2% are common, and most of them are under 5%.

Are there ways to reduce harmonic distortion?

Yes, various methods are available for utilities to reduce the level of voltage harmonics in their system. The first step is to identify the cause or causes, then select the appropriate mitigation techniques. If one particular customer has significant harmonic loads, then a utility may require that customer to take corrective action as well.

Isn't there a law?

The Illinois code does not contain any power quality limits with respect to harmonics. A few states do. Unlike some electrical providers in the US, ComEd has not voluntarily committed to meet the IEEE 519 voltage harmonic levels. IEEE 519 is a widely referenced recommended standard, but it is not law.

What have you done about this?

I have filed complaints with both ComEd and the Illinois Commerce Commission (ICC). Through the informal process at the ICC, ComEd has investigated the problem and submitted a response.

What is ComEd's response?

ComEd responded to the ICC that while they agree that the harmonics exist, it is a result of our combined computers, large screen TVs, and other loads, and they do not feel that it is necessary to do anything about it. They did not explain how other areas can have much lower THD, while the residents in those areas also enjoy the use of those same appliances.

Have other people complained about this?

According to ComEd, another electrical engineer in Deerfield recognized this problem and complained to them. I do not know his identity. It requires special equipment to actually measure harmonic distortion. A typical consumer would not recognize the symptoms of harmonic distortion or be able to measure it, and therefore would not be in a position to complain about it.

If you have questions or want to discuss your power quality, please email me at information@bmillerengineering.com and put "Deerfield power" in the subject line. You may also phone me at 847-948-7746.

APPENDIX A

Deerfield area power quality measurements Jan – Mar, 2006

<u>Location</u>	<u>Type of facility</u>	<u>THD</u>
Riverwoods - Thorngate	Residence	10.0%
Deerfield - Laurel & Pine	Residence	9.5%
Deerfield – Birchwood & Sprucewood	Residence	8.2%
Northbrook -	Residence	7.9%
Deerfield	South Park School	1.8%

APPENDIX B

Power quality measurements in other areas Jan – Mar, 2006

<u>Location</u>	<u>Type of facility</u>	<u>THD</u>
Highland Park	Residence	4.6%
Arlington Heights	Industrial facility *	4.1%
Skokie	Oakton College	1.8%
Des Plaines	Residence	1.7%
Northbrook	Underwriters Labs office	1.5%
Bellwood	Industrial office	0.6%

* Measured prior to 2006