

Total harmonic distortion (THD)

Figure 13 illustrates an example waveform for VFD input current harmonics of 42 percent THD. Measurements are typically captured with harmonic spectrum, shown on the right.

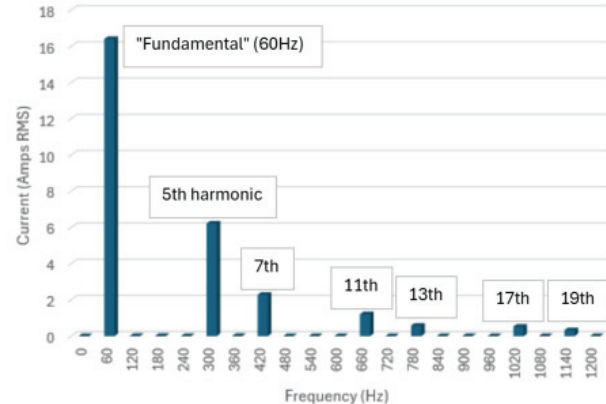
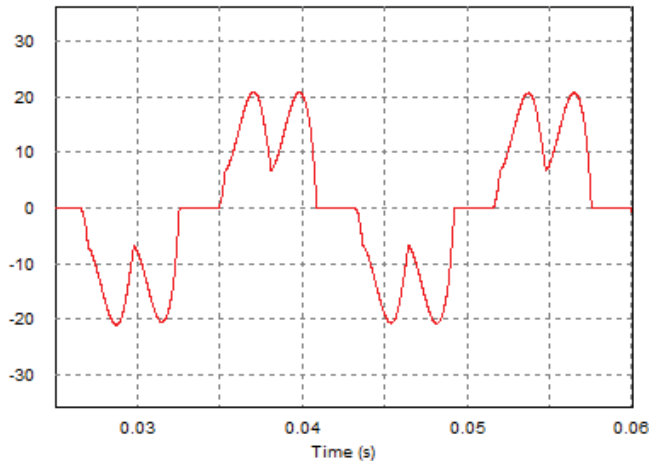
Causes: VFDs without harmonic filtering

Effects: Transformer heating/noise or interference with other equipment (refer to *Engineers Newsletter* 47-1, "Harmonic Distortion in Electrical Systems").

Potential solutions: Install a harmonic filter. Passive harmonic filters can be installed on individual VFD loads. Active harmonic filters can be installed on individual loads or for multiple loads combined on a feeder. Passive harmonic filters use inductors and capacitors to "trap" the harmonics and dissipate them.

Active harmonic filters measure the distorted current and inject a compensating current, which is the opposite value (think of noise-canceling headphones). Harmonic currents do not have to be completely eliminated. Refer to IEEE-519 to find the acceptable level of harmonics current.

Figure 13. Example of a THD waveform



Voltage brownout or blackout

Causes: Utility provider supply voltage issues (brownout typically refers to a partial loss of voltage, whereas blackout means complete loss of voltage)

Effects: Brownouts and blackouts will typically trigger the undervoltage diagnostic, causing equipment to shut down. Refer to voltage sag and momentary power loss.

Potential solutions: Contact the utility provider or consider adding an uninterruptable power supply (UPS) or backup generator.

Electromagnetic interference (EMI)

Causes: Grounding issues, signal routing (communication wire routed next to power wires), or shielded wires not used

Effects: EMI noise may be conducted through power wires or ground wires, or radiated through air like an antenna. High frequency noise from one device can cause control circuits to malfunction as the communication signals are sensitive. EMI problems are often intermittent and difficult to troubleshoot.

Potential solutions: Check ground connections on the trouble equipment, as well as neighboring equipment (especially VFDs). Route communication wires in shielded cable, away from power wires. Install common mode cores on sensitive communication wires. If the problems are linked to noise from a specific piece of equipment, consider adding an EMI filter on that equipment.

Conclusion

Electrical power quality is important to reliable operation of HVAC equipment. Measuring the quality of electrical power can be challenging. However, specialized equipment is available to make the job much easier.

This *Engineers Newsletter* described several types of power quality events (electrical transients), along with potential causes, effects, and potential solutions to mitigate those effects. Continuous-monitoring equipment can be installed at the feeder to quickly find and resolve power quality issues.

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