# Bringing harmony to harmonics: The standards and the challenges

*With the rapid increase in both plant floor computers and sophisticated electronics, harmonics are getting a lot of attention. Chris Jaszczolt of Yaskawa's Matrix drives management team looks at the IEEE 519 standards as well as the practical challenges of harmonics:*

**Q: Harmonics have always been an issue for manufacturers, but it seems to be a more critical issue in today's plants. Why?**

**JASZCZOLT:** Electric motors make up over 45% of the world's electrical energy usage. In the past, only a small portion of a plant used drives to control their motors. More and more of these motors are being controlled by drives for their ener-gy savings and process control benefits. Having more drives on a system means they will have a bigger harmonic impact to the overall system.

Harmonic currents lead to conductor heating, transformer heating and sizing issues, power factor reductions, and lower efficiency. Also, high harmonic currents leads to the distortion of the input voltage, which is what the recommended practices outlined in IEEE 519 is trying to mitigate. More recently, utility companies are starting to fine their customers for high harmonic currents, citing non-compliance with IEEE 519.

**Q: Is there such a thing as an IEEE 519 compliant device?**

**JASZCZOLT:** Non-linear loads like drives are neither compliant nor non-compliant with IEEE 519. IEEE 519 is a "recommended practice to be used for guidance in the design of power systems with non-linear loads." In other words, the entire system dictates whether or not a system is compliant. However, it can be stated that a drive facilitates IEEE 519 compliance.

This means that the current harmonics at the input of the drive is very low, usually less than 5% iTHD (total harmonic current distortion) at rated power. If these drives are replacing an existing drive system, they will reduce total harmonic current draw for the system. For new installations, using drives that facilitate IEEE 519 compliance virtually guarantees that the new device will not be the cause to a system non-compliance. In other words, they will add much more good load than bad (harmonic) load to the system, which will reduce the percent harmonic content of the overall system.

However, adding these devices does not guarantee system compliance because they do not correct harmonic content of the pre-existing system. To obtain system compliance, the entire system should be analyzed to determine what devices will need harmonic mitigation to bring the entire system into compliance.

**Q: Where should plant managers begin to look for solutions to address harmonic concerns?**

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**JASZCZOLT:** All drives should be looked at to see if they can benefit from harmonic mitigation. The focus should be on the higher horsepower drive loads since they will have the biggest impact on total harmonic distortion for the system. Smaller horsepower drives may not need high level mitigation, since they have little impact to the overall system distortion levels. Typically smaller horsepower drives can benefit from a simple, low cost addition of an input AC line reactor or DC reactor.

Adding a reactor can improve harmonic content from over 80% iTHD to less than 40% iTHD at the input of the drive. Most large horsepower drives already have reactors built into the drive, which means higher level harmonic mitigation solutions would be needed to reduce the total system harmonic distortion levels. Finally, be aware that drives are not the only non-linear load on a system.

Electric ballasts (lighting), arc furnaces, and all other switch mode power supplies (servers, computers, etc) also draw non-linear current and will affect total system harmonic distortion levels.

**Q: What tools are available to assist plant managers in identifying and managing their harmonics issues?**

**JASZCZOLT:** Many drive manufacturers understand the need for harmonic mitigation. Many submittals require a harmonic report on the drive before being quoted. Therefore, these drive manufactures offer harmonic estimation software to provide estimated harmonic content of a specific device or an entire system.

Since the true harmonic content is affected by more than just the load (wire type, wire size, wire routing practices, grounding practices, etc.), these tools can only offer an estimate.