



Compliance to 40th Harmonic Measurement Requirements in Recent 10 CFR 429 and 431 Revisions

The Department of Energy (DoE) issued changes to the requirements for determining pump energy for equipment driven by electric motors (10 CFR 429 and 431). The DoE issued a Notice of Proposed Rulemaking (NOPR EERE-2014-BT-TP-0054)¹ therefore making a similar revision to the standards for electrically driven air-compressors. OSI has been the test provider of choice for a number of manufacturers in both these arenas and has recently received numerous questions regarding the necessary measurement capability. The new requirements and complying to these changes can be explained in the following report.

The new standard requires accurate measurement of the input power up to at least the 40th harmonic of 60 Hz. The measurements are to be made at the input terminals of the device and include continuous or non-continuous controls, as applicable.

Quantities to be measured include:

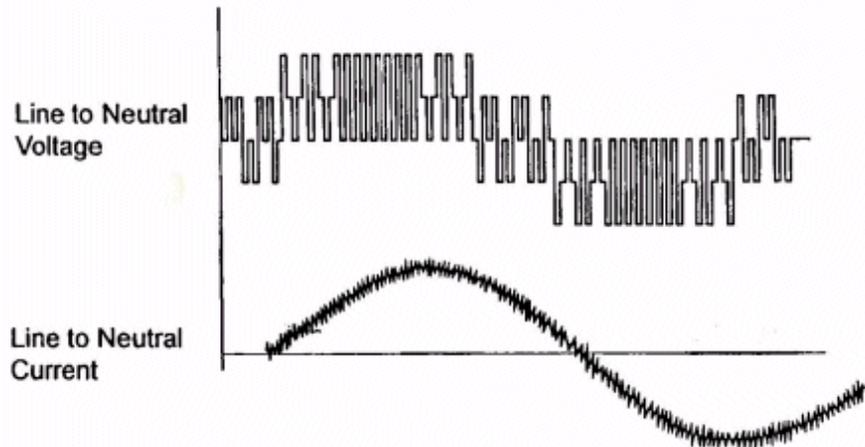
- True RMS Voltage
- True RMS Current
- Real Power
- Up to the 40th harmonic
- $\pm 2.0\%$ accuracy, apparently to reading.
- The standard requires taking 16 samples within a 15-minute block and averaging them.

The test stand will also be required to measure the supply or input characteristics:

- Voltage
- Frequency
- Voltage Imbalance
- THD

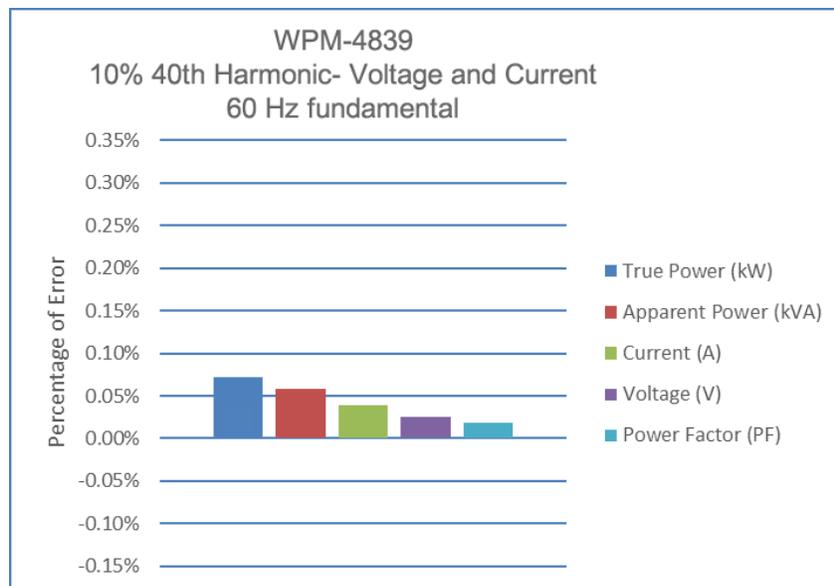
OSI understands that the new ruling is a recognition of the application of variable speed drives to both categories of equipment. The drives can generate measurable energy in the higher harmonics, which the standard intends to capture as part of the efficiency calculation. The following graph of line-to-neutral voltage and current illustrate this need:

¹. The proposed rule serves as the final rule (EERE-2014-BT-TP-0054) effective February 3, 2017. The final rule changes will be mandatory for representations starting July 3, 2017.



Accurately measuring higher harmonics requires more careful design of the system to deliver the greater bandwidth and response speed required. It also requires more careful selection of the components, as well as the external voltage and current transformers to operate as a system.

OSI has conducted actual evaluations of its higher response products to determine their suitability for these measurements. While several units passed easily, the WPM-4839 was tested with 40th harmonic energy equal to 10% of the total energy with no significant deterioration in measurement accuracy (<http://www.ohiosemitronics.com/media/library/Spec%20Sheets/WPM.pdf>). This was achieved by impressing 40th harmonic equal to 10% of total on both the current and voltage signals. This is believed to be much more strenuous than what would be experienced in actual use.





In all cases, the WPM-4839 system exceeded the DoE requirements by a wide safety margin.

DoE requirements can be met with existing Ohio Semitronics, Inc. commercial technology and will not require extensive test equipment development. Please contact the author for further details on the test setup and any application specific questions.