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Using the Fluke 430 series Power Quality Analyzers for checking EN 50160 compliance

Application Note

Fluke recently introduced a new series of three-phase power analyzers for troubleshooting power-supply problems. The 430 power quality analyzer series offers advanced features to help test engineers locate, predict, prevent and correct problems. The new meters, moreover, offer exceptional ease of use and portability, with battery power and an integrated display that eliminates the need for a PC monitor or laptop computer. As such, the series is fast becoming regarded by test engineers as a valuable tool for maintaining and troubleshooting power-supply and distribution systems.

Simple operation and excellent user navigation, moreover, make for easy measurements according to standards. In particular, the meters have been provided with specific functionality for checking conformity to limits specified by EN 50160 – defining the quality of the voltage to be delivered by utility companies. It was for this reason that Essent, one of the Netherlands' leading energy providers, recently took a serious look at expanding its range of analytical tools with instruments from the Fluke 430 series.

The Netherlands' leading utility company

With origins in The Netherlands, Essent provides its customers, both in the private and business sectors, with energy plus many additional products and services. Apart from electricity, gas and heat, these include maintenance of central heating and hot-water equipment, as well as a range of cable communication products such as cable TV and radio, broadband internet access and telephony.

The company generates most of the energy it supplies using conventional methods such as coal-fired plants alongside waste incinerators and, to an increasing degree, sustainable sources such as wind energy and biomass. While regarding the Netherlands as its home market, in which it is the leading energy supplier, Essent also operates in the neighboring countries of Germany and Belgium.

EN 50160 and the challenges facing energy providers

Like all utility companies, Essent is required to submit reliability performance statistics to its regulators on the full range of power quality characteristics that are important to its commercial and industrial customers. This includes the expected number of voltage dips and interruptions, harmonic distortion levels, voltage unbalance and voltage variations. The quality of supply (QOS) requirements can be divided into two categories: steady-state characteristics and disturbances.
The first category refers to the quality of the normal voltage supplied to a facility. It is basically a measure of the magnitude by which the voltage may vary from

the nominal value, plus voltage distortion and the degree of unbalance between the 3-phases. The limits have all been quantified and enshrined in international standards including the European standard EN 50160. This provides minimum performance requirements for the electrical supply in all of the steady-state power-quality categories. The seven parameters required by EN 50160 to determine QOS compliance are: power frequency, supply-voltage variations, flicker, supply- voltage unbalance, harmonic voltage, interharmonic voltage and mains signaling. The monitoring site is said to be in compliance if the statistical value over one week for the specified parameters is 95% or greater.

When Essent engineers are called out to investigate power-quality problems, their first priority is to establish where the cause for the problem lies. As a starting point they will attempt to establish whether or not the supply complies with EN 50160. If it does, the problem lies most likely not with Essent but with the customer's equipment. If this is the case they can be of further assistance to the customer by using their power quality measuring equipment to locate the cause of the problem.

Using the Fluke 430 series for measuring EN 50160 compliance

The Fluke 430 series can check for EN 50160 compliance using its Power Quality Monitoring function, and subsequently assist in locating the cause of any problems. The Power Quality Monitoring function shows whether important Power Quality parameters meet requirements, including:

- RMS voltages
- Harmonics
- Flicker
- Dips/interruptions/rapid voltage changes/swells
- Unbalance/frequency

Simply pressing the Monitor button selects the function and brings up the menu for Immediate or Timed start selection (Figure 1).

Figure 1 *– Selecting Power Quality Monitoring to check for EN50160 compliance*

Having made the selection, simply pressing the START button on the front of the meter brings up the Bar Graph screen shown in Figure 2. This gives a single screen summary updated live of RMS voltage, harmonic voltages, voltage interruptions, rapid voltage changes, swells, unbalance and frequency. It shows for each parameter compliance with EN 50160 limits or with other limits selected by the user.
Color-coded bars clearly show which parameters are within limits and which fall outside the limits.

For investigating EN 50160 compliance, Power Quality Monitoring is performed for an observation period of 1 week with the instrument connected to the output of the mains transformer supplying the customer's facility. The parameters RMS voltage, harmonics and flicker all have a bar for each phase: L1, L2 and L3 measured from left to right. The parameters dips/interruptions/rapid voltage changes/swells and balance/frequency all have a single bar for each parameter representing performance across the three phases.
Some of the Bar Graphs in Figure 2 have a wide base indicating adjustable limits – for example, for EN 50160, 95% of the time within limit – and a narrow top indicating a fixed 100% limit. If either limit is violated, the related bar changes from green to red. Dotted horizontal lines on the display indicate the 100% and the 95% limits. The bars for dips/interruptions/rapid voltage changes/swells are all narrow and indicate the number of violations that occurred during the observation period.
The allowed number is adjustable (for instance 20 dips/week). The bar turns to red if the adjusted limit is violated.

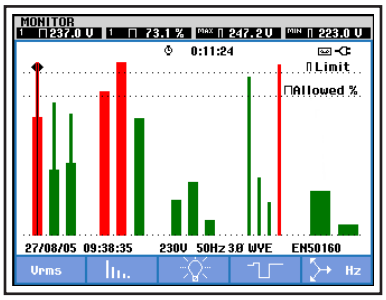


Figure 2 *– The Monitor overview clearly shows which parameters fall outside the EN50160 limits*

In the measurement shown in Figure 2, voltage on one phase, harmonic distortion on two of the phases, and number of swells are seen not to comply with EN 50160. Looking at harmonics, the main display shows the worst harmonic for each of the three phases. To determine precisely which harmonics are violating the limits, the cursor is moved over the bar of say phase L1 and ENTER pressed to bring up the Bar Graph screen shown in Figure 3. This gives the total harmonic distortion and the percentage of time the phase spends within limits for the first 25 harmonics.

In this example, Figure 3 clearly shows that the 15th harmonic is responsible for the violation. Pressing the TREND key brings up the Trends Display showing the harmonics trend over the whole week. Another button allows the phase trend to be displayed. The trends for all variables, such as RMS voltage and the current are available via the main monitoring screen. It is only necessary to choose the variable and press the TREND button.

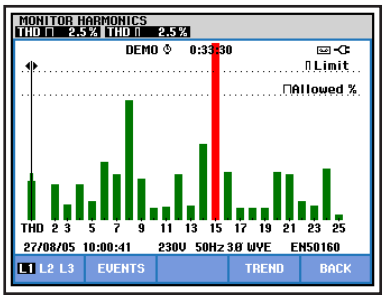
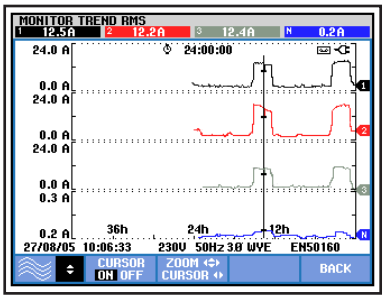
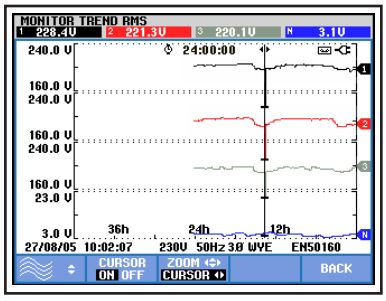


Figure 3 *– Bar Graph screen showing first 25 harmonics*

The trend function can also be used to analyze the quality of supplied power, and to determine the possible direction of a violation of the limits.
In the present example, Figures 4(a) and (b) show a current rise and an accompanying voltage drop every 12 hours.



a



b

Figure 4 *– Trend Display (a) current (b) voltage*

The measurements were taken on the output of the mains transformer and the presence of a

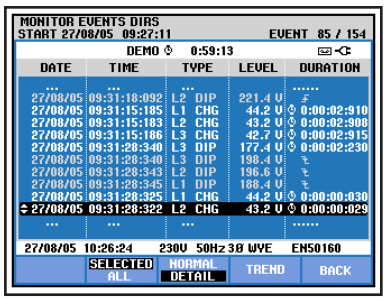


Figure 5 *– Events table*

current rise and an accompanying voltage drop indicates that the normal user's load on the transformer is responsible for the accompanying drop in voltage. If the cursor were instead placed on an event where there is a short sharp drop in voltage and also a simultaneous drop in the current, this would clearly indicate that the problem originates on the other side of the transformer and is then the responsibility of the utility company.
If it is known approximately when an event occurs that may be causing a problem, the Events Table shown in Figure 5 can also be brought up from the screen of Figure 3 by pressing the EVENTS key

Conclusion

Measurement to standards such as EN 50160 used to be complicated and above all, expensive. This problem is solved by the Fluke 430 series Power Quality Analyzers with their simple operation, excellent user navigation and attractive price for performance. A comprehensive overview provides immediate insight into quality of supply, checks conformity with EN 50160 and instantly shows which parameters fall outside the limits. Complying with EN50160 however does not mean the connected customer is without power quality problems. Even when the energy supplier has proven the quality of the product it delivers, other unique and powerful features of the 430 series, such as Autotrend and Autoscaling, can be used to further investigate the problem at the customer's site. The 430 series are therefore an ideal addition to the armory of quality of supply measuring tools used by utility companies such as Essent.

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