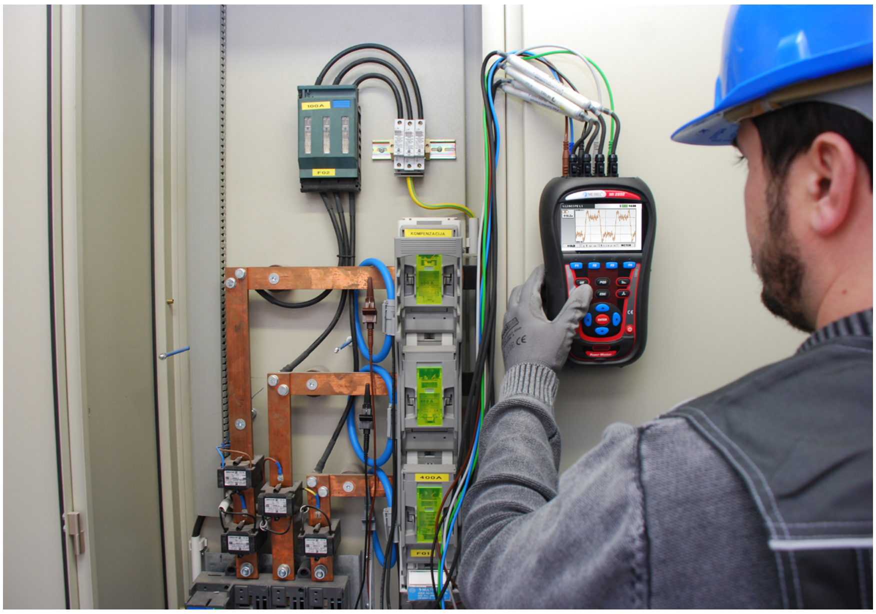
METREL®

Application Note

Current harmonics

Problem - The influence of current harmonics on equipment connected to electrical supply systems can cause serious problems.

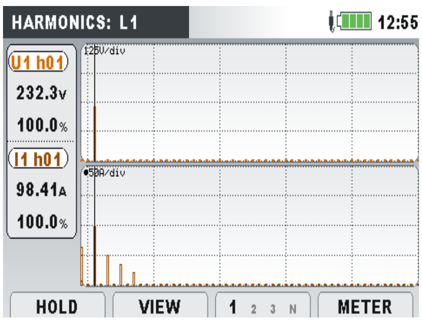


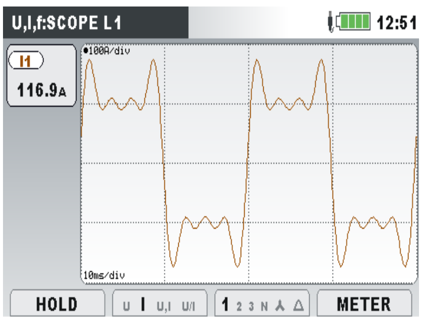
What is a Harmonic

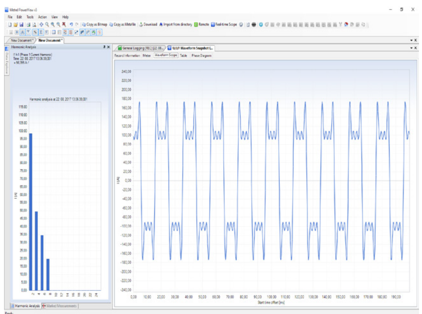
The typical definition for a harmonic is: a sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency.

Consequences of high current harmonics

- Harmonics cause circuit breakers tripping at no apparent overload.
- Voltage waveforms to other loads can be distorted and interference can be inductively coupled between power and low-voltage communication lines if they are placed close to each other.
- Harmonics that flows back to the supply network can have various negative effects. In case 5th harmonic is highly present 3-phase inductive motors can ex perience “torque fight” as this component cause the negative torque that tends to turn the motor backwards. Consequently more power is consumed and the motor gets gradually overheated.
- High harmonics reduce the “transmission” capacity of the supply network, as they do not perform any useful work.
- High neutral conductor currents are also a consequence of high current harmonics. Thus a neutral conductor cross-section has to be larger or there is a significant risk of fire.
- High current harmonics supplied back to the network may influence the harmonics content on the supply voltage, which in the next step result on unwanted current harmonics on the end-user equipment.



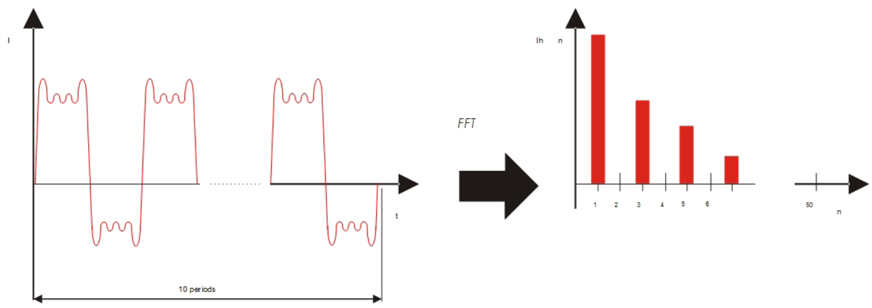




High content of harmonic components

Harmonic components are one of major power quality concerns. Non-linear loads like electronic ballasts, UPS systems, variable frequency drives and switch mode power supplies all create distortion of the sinusoidal waveform. Distorted signal is analysed with Fast Fourier Transformation (FFT) calculation method. Basic signal with a fundamental frequency 50/60Hz is reported together with individual harmonic components.

Current harmonics and THD



There are some representative examples how and when certain harmonics appear.

Computers, printers and other small office IT equipment

High 3rd, a bit lower 5th, 7th, 11th and 13th current harmonics are typical for such loads.

Variable frequency drives (VFD's)

High harmonic components like 5th, 7th, 11th, 13th, 17th and 19th order.

3rd, 6th, 9th, 12th Harmonics

cause high current in a neutral conductor in 3-phase, 4-wire systems.

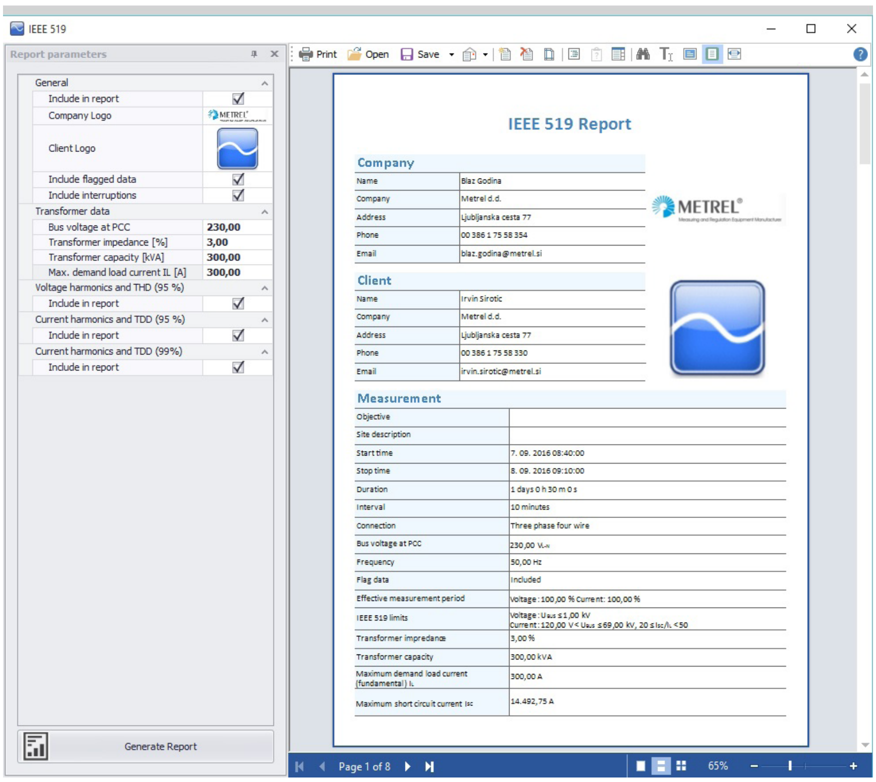
Measurements

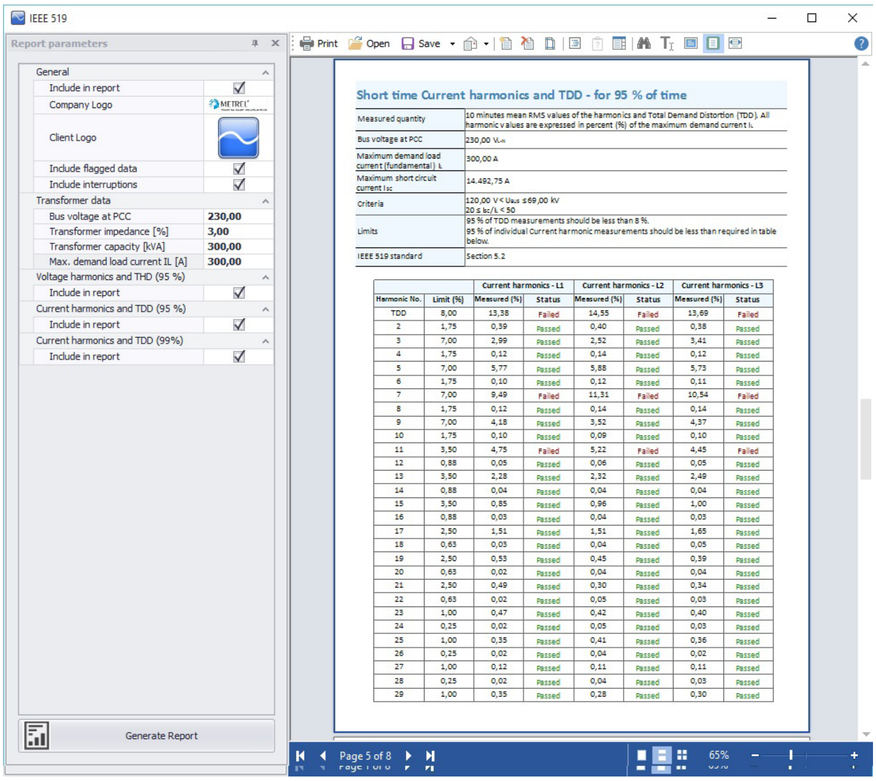
Once we suspect the problem we have to be able to locate it, analyse it and find appropriate solution to eliminate its impact on the system.

To achieve this we have to understand the condition of our electrical system. To have this information we have to perform some measurements or rather say analysis of it, this can be achieved by connecting an appropriate measuring system to the network and monitor the parameters for a period of time, it can be a period of one working week, with selected 10 min integration interval.

The new series of Metrel Master instruments can all record 50 voltage and 50 current harmonics, interharmonics, total harmonic distortion (THD), total demand distortion (TDD), simultaneously for each individual channel. This enables us to receive a detailed information of what is happening on the complete electrical system.

By using PC SW PowerView v3 fully compliant (daily and weekly) "IEEE 519 Report for harmonic control in electric power system" can be generated.





The PQA Master instruments are designed in accordance with the following standards:

IEC 61000-4-30 Class A/S	Part 4-30: Testing and measurement techniques - Power quality measurement methods
IEC 61000-4-7	General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems - Class 1
IEEE 519	IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

Preventive and corrective actions

- When purchasing and installing new equipment it is recommended that the “low content THD” is selected.

- Neutral conductor in a 3-phase system has to be sized in respect with current harmonics content as well. It sometimes means the cross-section of the neutral conductor has to be larger than the phase conductor’s.

- In order to limit current harmonics active or passive filters are used. They will damp unwanted harmonics down to acceptable level.

- Active filters are frequently used together to eliminate harmonics created by variable electronic loads. Their filtering performance adapts automatically based on the existing harmonics spectrum.

- There are some standard versions and sizes of active and passive filters available on the market.

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