What Are Harmonics?

TPresent-day low voltage networks increasingly have loads installed that draw non-sinusoidal currents from the power supply system. These load currents result in voltage drops through the system impedances which distort the original sinusoidal supply voltage. The frequencies of the harmonics are integral multiples of the basic oscillation and are denoted by the ordinal number 'n'(Example: supply frequency = 60 Hz ⊠ 5th harmonic = 300 Hz).

Linear loads examples are:

✓ Ohmic resistances (resistance heaters, light bulbs, etc.)
✓ Three-phase motors (the motor itself, not the drive)
✓ Capacitors

Non-linear loads (harmonics generators) are:

✓ Transformers and chokes
✓ Electronic power converters
✓ Rectifiers and converters, especially when controlling variable-speed induction motors
✓ Induction and electric arc furnaces, welding equipment
✓ Uninterruptible power supplies (UPS systems)
✓ Single-phase switched-mode power supply units for modern electronic loads such as televisions, VCRs, computers, monitors, printers, telefax machines, electronic ballasts, compact energy-saving lamps

Every periodic signal with a frequency f (regardless of the waveform) consists of the sum of the following:

✓ The sine component of the frequency f, known as the fundamental component or h1
✓ The sine components of the integral multiples of the frequency f, known as the harmonics
✓ In some cases, DC components might also exist

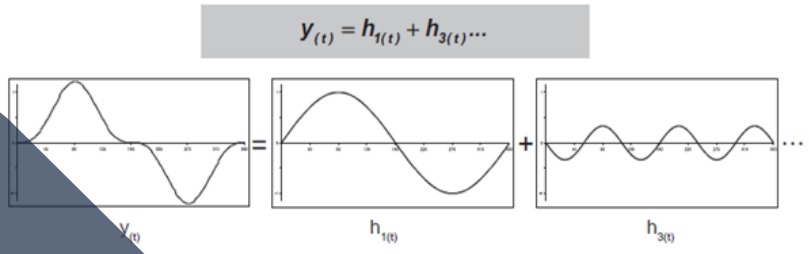

Figure 1: Analysing a periodic signal into its component harmonics

Harmonics can be divided into:
✓ Even harmonics (2nd, 4th, 6th, etc.)
Which only occur due to sudden load variations or faults in converters.
✓ Odd harmonics (3rd, 5th, 7th, etc.)

- Harmonics divisible by 3) 3rd, 9th, 15th, etc.)

  These sorts of harmonics occur due to asymmetrical loads or single-phase sources of harmonics. Typical sources are usually office buildings, hospitals, software companies, banks, factories with -2phase welding equipment, etc. These harmonics might cause major problems as the currents in the neutral conductor are cumulative.

- Harmonics not divisible by 5) 3th, 7th, 11th, 13th, etc.)

  They occur due to -3phase sources of harmonics or pulse converters.

  These harmonics are transmitted via the transformer!

The total harmonic distortion THD is the result of the vector addition of all existing harmonics and is commonly expressed as a proportion of the fundamental frequency, thus providing a quick overview of network power quality.

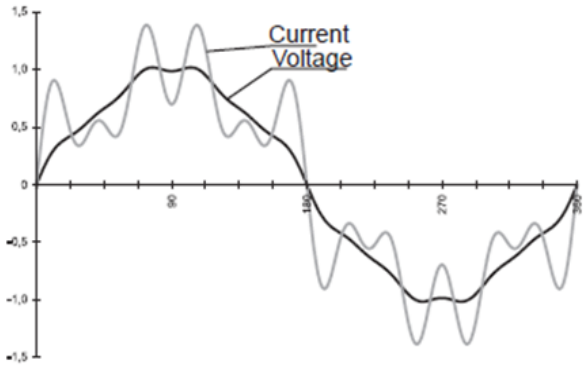

Figure 2: Generic network current & voltage with 5th, 7th and 11th harmonic

Please go through our next whitepaper titled "How Might Poor Power Quality Harm Your Business?" to figure out the probable defects these harmonics might cause for your facility. Don't hesitate to contact us for a system audit followed by a comprehensive report.

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