TOTAL HARMONIC DISTORTION
in LED lighting

What does Total Harmonic Distortion (THD) mean?

Total harmonic distortion (THD) is an important aspect in power systems and it should be kept as low as possible. Lower THD in power systems means higher power factor, lower peak currents, and higher efficiency. THD and PF (power factor = the difference between Apparent Power and Active Power) are closely related, and as you improve the quality of the luminaires to achieve a PF above 0.9, THD typically improves and becomes less of an issue.

Harmonics have existed on power systems from the time of the very first generators. However, the harmonic components were so small that their effects on systems were negligible. This was due to the lack of non-linear loads before the 1960s. This was the beginning of the era of non-linear loads which now include electronics ballasts, computer power supplies, fax machines, arc furnaces and variable frequency drives (VFDs).[1]

Total harmonic distortion (THD) refers to the sum of all harmonic components to the power of the fundamental frequency existing in non-linear electrical and electronic devices. It is expressed as a percentage [%]. In lighting, THD refers to the Harmonic Distortion present with most electrical equipment, and more specifically, the distortion present with electronic ballasts. THD is the measurement of the distortion created from the equipment's current draw. True resistive loads, such as an incandescent light bulb, do not have THD. Equipment containing coils and capacitors, such as motors, drives, fluorescent lighting and HID lighting, have some measure of THD.[2]

THD is a numeric representation of distortion in the current waveform relative to the sinusoidal voltage waveform on the AC mains. Distortion indicates how much harmonic current is flowing in the power lines. Harmonics are unwanted currents at multiples of the fundamental line frequency (e.g., 50 or 60 Hz).

Problems caused by harmonics

Harmonic distortion can have detrimental effects on electrical equipment. Unwanted distortion can increase the current in power systems which results in higher temperatures in neutral conductors and distribution transformers. Higher frequency harmonics cause additional core loss in motors which results in excessive heating of the motor core. These higher order harmonics can also interfere with communication transmission lines since they oscillate at the same frequencies as the transmit frequency. If left unchecked, increased temperatures and interference can greatly shorten the life of electronic equipment and cause damage to power systems.[1]

Electronic ballasts

It is a common misconception that electronic ballasts increase THD. Currently available electronic ballasts actually decrease the THD on an electrical system compared to a system applying magnetic ballasts. ANSI C82.11 requires that the maximum THD of electronic ballasts not exceed 32 percent and the maximum triplens not exceed 30 percent. Electronic ballasts today are rated at less than 20 percent, 15 percent, or less than 10 percent THD. The magnetic ballast is rated in the 20 to 28 percent range.[2]

THD in I-Valo LED luminaires

I-Valo uses ballasts and drivers only from well-known quality manufacturers in Europe. All of the drivers I-Valo uses follow the International standard IEC 61000-3-2 Electromagnetic compatibility (EMC) - Part 3 - 2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase). In drivers used by I-Valo THD is efficiently mitigated and is less than 10%. THD percent in devices used by I-valo are typically somewhere between 6% - <10%. More precise information of values of specific devices may be requested separately from our R&D if needed.

[1] Associated Power Technologies. Total Harmonic Distortion and Effects in Electrical Power Systems.

[2] Jerry Cassel, Total Harmonic Distortion (THD): A Lesson for Lighting Harmony