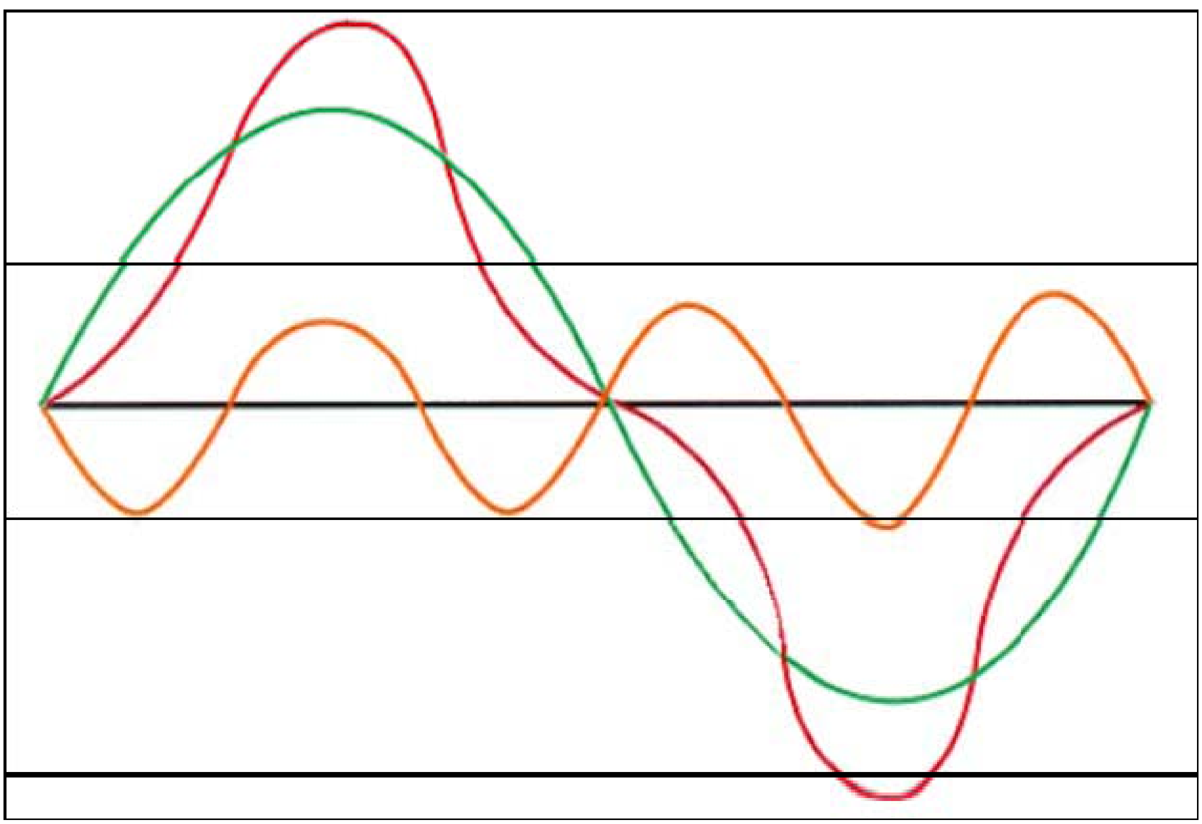
MGM TRANSFORMER COMPANY
5701 SMITHWAY STREET • CITY OF COMMERCE, CALIF. 90040
(323)726-0888 • FAX (323)726-8224

Harmonic Mitigating Transformers:

What are power system harmonics?

In an ideal world voltage and current waveforms are perfectly sinusoidal. However, because of the increased popularity of electronic and other non-linear loads, these waveforms are usually distorted. This deviation from a perfect sine wave can be represented by harmonics—sinusoidal components having a frequency that is an integral multiple of the fundamental frequency (see Figure below). Thus, a pure voltage or current sine wave has no distortion and no harmonics, and a non-sinusoidal wave has distortion and harmonics. To quantify the distortion, the term total harmonic distortion (THD) is used. The term expresses the distortion as a percentage of the fundamental (pure sine) of voltage and current waveforms.



Green – Fundamental @ 60 Hz

Orange – 3rd Harmonic @ (3 X 60 = 180 Hz.)

Red – Actual distorted waveform – Fundamental + 3rd Harmonic

MGM TRANSFORMER COMPANY

5701 SMITHWAY STREET • CITY OF COMMERCE, CALIF. 90040
(323)726-0888 • FAX (323)726-8224

Why is harmonics a problem?

Current harmonics are a problem because they cause increased losses for the customer in turn increasing demand from the utility company. Transformers are especially sensitive to this problem and in certain cases need to be derated to as much as 50% capacity when feeding loads with extremely distorted current waveforms (current total harmonic distortion above 100%).

ANSI/IEEE C57.110-1986 (IEEE Recommended Practice for Establishing Transformer Capacity When Supplying Nonsinusoidal Load Currents) states that a transformer subject to nonsinusoidal load current having more than 5% total harmonics distortion needs to be derated. When current THD exceeds 15%, the transformer capability should be evaluated by professional using IEEE recommendations. It is important to clarify that these IEEE recommendations do not apply to transformers especially designed to feed nonsinusoidal loads. Underwriters Laboratories (UL) tests and rates this special type of transformer, also called a "K-factor" transformer.

Harmonic Mitigating Transformers effect on Harmonics:

Harmonic Mitigating Transformers, or HMT's, are specifically designed to minimize the voltage distortion and power losses that result from the harmonics generated by non-linear loads such as personal computers. K-Rated transformers, on the other hand, are simply designed to prevent their overheating when subjected to heavy non-linear loading but do nothing to reduce the harmonic losses themselves and as for voltage distortion, they perform virtually no better than conventional delta-wye transformers.

Harmonic Mitigating Transformers are used for *reducing* harmonic currents. Treating harmonics has many benefits, including:

- Uses the full capacity of the transformer. There is no need to de-rate the transformer below the nameplate capacity because of the reduction in heat.
- Lower maintenance and replacement costs as a result of reducing the amount of heat harmonics can generate.
- Operation of the transformer at a lower temperature due to less heat, eliminating overheating and excessive operating temperatures.
- Lower cooling cost in the area where the transformer is installed as a result of reduced operating temperatures

MGM TRANSFORMER COMPANY

5701 SMITHWAY STREET • CITY OF COMMERCE, CALIF. 90040
(213)726-0888 • FAX (213)726-8224

MGM HMT Features, Benefits and Functions:

- Any voltage combination available.
- Aluminum and Copper windings and terminals as standard.
- 150°C, 115°C, or 80°C temperature rise
- Electrostatic shield for attenuation of high frequency noise. One is standard and 2 are optional.
- Meet or exceed NEMA TP-1 energy efficiency levels.
- 200% rated neutral.
- 220°C, insulation system.
- Variety of phase-shift options available to treat specific harmonics in a system
- Harmonic cancellation by using Zig-Zag configuration of windings. Phase shifting is either 0(Zero) or 30 degrees which cancels triplen harmonics (3rd, 9th, 15th and so on…)
- Consult factory for other phase-shift options to treat specific harmonics in a system.

Typical vector diagram: