Subject: IMPORTANT BASICS OF TOTAL HARMONIC DISTORTIONS [THD.]

THD definition  For a signal $y$, the total harmonic distortion (THD) is defined by the equation:

$$\text{THD} = \sqrt{\sum_{n=2}^{\infty} \frac{y_n^2}{y_1}}$$

This definition complies with that of standard IEC 61000-2-2. Note that the resulting value may exceed one. According to the standard, $h$ can generally be limited to 50. This equation produces a single value indicating the distortion of a voltage or a current flowing at a given point in a distribution system. Harmonic distortion is generally expressed as a percentage.

Definition // THD stands for Total Harmonic Distortion. The level of harmonic distortion is often used to define the degree of harmonic content in an alternating signal.

Current and voltage THD:

When dealing with current harmonics, the equation becomes:

$$\text{THD}_I = \sqrt{\sum_{n=2}^{\infty} \frac{I_n^2}{I_1}}$$

This equation is equivalent to the one shown on side, which is more direct and easier to use when the total rms value is known:

$$\text{THD}_I = \sqrt{\left(\frac{I_{\text{rms}}}{I_1}\right)^2 - 1}$$

When dealing with voltage harmonics, the equation becomes:

$$\text{THD}_U = \sqrt{\sum_{n=2}^{\infty} \frac{U_n^2}{U_1}}$$

Total harmonic factor (THF)

In certain countries with different work habits, a different equation is used to determine harmonic distortion. In this equation, the value of the fundamental voltage $U_1$ or the fundamental current $I_1$ is replaced by the rms values $U_{\text{rms}}$ and $I_{\text{rms}}$ respectively.

To distinguish between the two equations, we will call the second the total harmonic factor (THF). Example of a voltage THF:

$$\text{THF}_U = \sqrt{\sum_{n=2}^{\infty} \frac{U_n^2}{U_{\text{rms}}}}$$

The total harmonic factor, whether for voltage or current, is always less than 100%. It makes analogue measurements of signals easier but is used less and less because the result is very close to the THD defined above when a signal is not significantly distorted.

What is more, it is not well suited to highly distorted signals because it cannot exceed the value of 100%, contrary to the THD defined at the beginning of this technical article.

Importance of Mitigating THD

While there is no national standard dictating THD limits on systems, there are recommended values for acceptable harmonic distortion. IEEE Std 519, "RECOMMENDED PRACTICES AND REQUIREMENTS FOR HARMONIC CONTROL IN ELECTRICAL POWER SYSTEMS" provides suggested harmonic values for power systems.

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