Total Harmonic Distortion (THD)

Definition - Total Harmonic Distortion, or THD, is an instantaneous measurement of the harmonic distortion at an individual piece of equipment or group of loads. Both voltage and current harmonics can be present within a given system written as THVD (or THDV) for total harmonic voltage distortion and THID (or THDI) for total harmonic current distortion. THD is based on the actual fundamental current or voltage that is flowing during the measurement. THD is expressed as a percentage. A lower THD percentage indicates less distortion and a more accurate reproduction of the original signal.

When an electronic device processes a signal, it may introduce additional frequency components that were not present in the original signal. These additional frequencies are harmonics of the original signal and can be undesirable because they can distort the waveform. THD quantifies the extent of this distortion by expressing the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.

Total harmonic current and voltage distortion can be mathematically calculated using the following formulas:

$$THVD = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \cdots}}{V_1} \times 100$$

Where V1 is the RMS value of the fundamental component and Vn is the RMS value of the *n*th harmonic voltage.

$$THID = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + \cdots}}{I_1} \times 100$$

Where I1 is the RMS value of the fundamental component and In is the RMS value of the *n*th harmonic current.

Using an oscilloscope to measure the voltage or current distortion, the resultant waveform is the combination of the different waveforms at each harmonic.