METREL®

Application Note

Measuring power with clamp meters

There are times when one would like more from their multimeter than just a basic voltage and current measurement. Modern clamp meters are often equipped with at least some options for measuring power and power quality. They can measure voltage and current in AC or DC, analyse signal waveform through THD or crest factor, and finally even save some measurements for later analysis.

Power measurements

Handheld clamp meters most commonly measure the following:

- Real/active power: net transfer of energy in the direction of the load, measured in watts;
- Reactive power: net transfer of energy in the directions of generator, measured in volt-ampere reactive
- Apparent power: vector sum of the former, whole power in the network, measured in volt-ampere
- Power factor: ratio of real to apparent power, no unit; also called cos φ.

Distortion factors are not immediately part of power measurement, but they can help evaluate losses.

- Crest factor: ratio between highest and RMS value of the signal. Clamp meters often don't show it, but one needs to keep in mind it affects other measurements.
- Total harmonic distortion (THD): ratio between effective values of higher harmonic components and the base one.

Principle of power measurements in clamp meters

Handheld instruments rarely measure power by itself, for example with thermal effect, so this article won't touch this. The clamp can be a current transformer type (only

measures AC), Hall probe (measures both AC and DC) or Rogowski coil (only measures AC, the coil is flexible). The meter adds (almost exclusively digital) signal processing depending on the sensor type to extract the data. The base of processing for power measurement is integration of product of voltage and current over the time of one period. Later it can be broken down to active, reactive and apparent. Some clamps also show the angle φ. The sensor and processing have limited bandwidth, but one needs to keep in mind that the higher it is, the more harmonic components will be used in calculation and the higher will be the shown power. Measuring process for voltage and current is obvious and the same on all models. Depending on the circuit, voltage is measured either parallel to device under test or between phase and neutral lines. Current measurement is a matter of setting the clamp around a live wire, watching the direction (as noted on the clamp). When working in multi-phase system, getting the current direction on one of the phases wrong can cause large errors in system result. Set the clamp as far from neighbouring lines as possible to minimize their effect. Choose AC or DC measurement of voltage or current or go straight for power measurement.

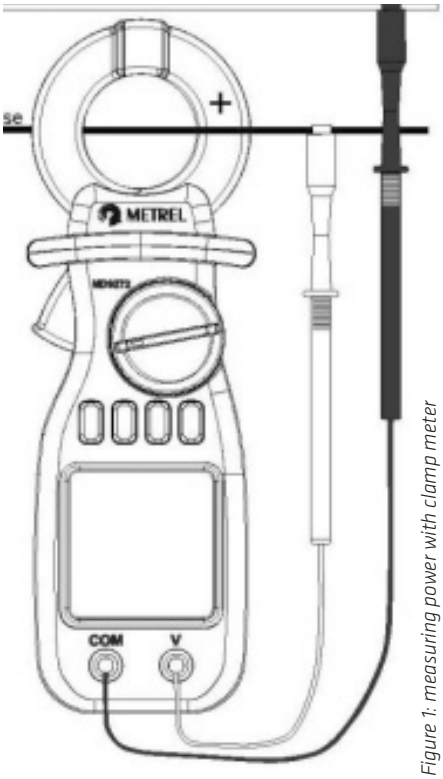

Figure 1: measuring power with clamp meter

Measuring crest factor and THD

Crest factor is the most basic way to estimate power quality, particularly commonly used in audio systems. In case of averaging multimeter (not true RMS), crest factor also estimates the error made. Even some TRMS meters are limited in their measurement by crest factor size.

Total harmonic distortion is important information about network power quality. Higher harmonic content is connected to higher thermal losses, magnetic core losses, high current spikes, and similar. Sometimes, a resonance of a higher components can express itself and causes considerable trouble in the network or even a destruction of smaller components. Few clamp meters can analyse harmonic content, but sometimes it can be glimpsed through difference in measured RMS values between meters with different bandwidths.

Voltage THD can be measured anytime there is a signal on voltage terminals, and current THD anytime there is current through the clamp.

Power measurements in Metrel clamp meters

Metrel clamp meters offer a wide choice of functionality with power measurements, from basic display of active power to a palette of power quality factors and long-term logging with the help of a PC. There are three different models available.

MD 9272 is meant for lower AC currents, up to 100 A, but offers excellent accuracy. The voltage can be measured both AC and DC up to 600 V. This range makes it suitable for leakage current measurement and measuring electrical devices. Its functions include active, reactive and apparent power, THD, power factor, phase difference and crest factor. Intelligent algorithms enable it to guess at source of losses in the system.

MD 9240 measures both AC and DC voltage, but only AC current. It has larger clamp and can measure current up to 1000 A, making it suitable for industrial environment. Its power functions are active, reactive, apparent power and power factor. It can be connected to PC for data logging.

MD 9235 measures both AC and DC voltage, but only AC

current. Its defining features are measuring whole power in an unbalanced three-phase system and measurement and logging of used energy on its own, without the use of PC. It notes the type of load in capacitive/inductive sense.

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