Can a waveform measuring instrument, like an oscilloscope, be used to measure power?

The simple answer is yes, but you do need to consider what accuracy you are achieving and whether the measurement is repeatable

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Using an oscilloscope to measure power relies on the basic principle of sampling the voltage and current waveforms simultaneously, multiplying the pairs together after the acquisition, integrating the resultant instantaneous power readings over a whole number of fundamental waveform cycles and then dividing by the time.

The advantages of oscilloscopes are that they are commonly available and are usable for many other waveform related measurement and analysis tasks. They are also capable of measuring power at frequencies higher than those achievable by specialised power meters (For example, to measure the switching loss of active components in switch mode power supplies using a Yokogawa digital oscilloscope).

Unlike a power meter or analyser, where all factors which can affect the accuracy of your power measurements are fully specified, an oscilloscope is generally only specified at DC. Sometimes the 'effective number of bits' (ENOB) is used to describe the dynamic performance of the analogue to digital converters, but this still does not quantify the actual AC accuracy. Other factors which need to be considered are the accuracy of the different probes used to input the voltage and current signals and the resultant phase shift or skew between them. Also what is the additional error due to common mode voltage factors, particularly on multi-phase wiring systems? What is the additional error due to changes in temperature? What is the additional error if the phase angle between the voltage and current waveforms is large or if a waveform has a high crest factor?

It is possible to reduce the influence of phase shift between the probes by using automatic de-skew if available. A special source is used which has in-phase voltage and current outputs. With the voltage and current probes attached to these, any phase shift seen on the oscilloscope can be 'de-skewed' which will then minimise the skew error when the probes are attached to the device under test (DUT).

Oscilloscopes can certainly be used for power measurements during the early stages of product development when it is sufficient to get a feeling of the power consumption and overall accuracy is not important. For verification or validation purposes, a power meter or power analyser needs to be used as not only is it fully specified, it can also be calibrated. An ISO 17025 calibration can prove that the actual accuracy of a power analyser is much better than its specification. At this point the long term stability of the measuring instrument is also more important as measurements also need to be repeatable and trustworthy tomorrow or next month.

It is possible to improve the repeatability of power measurements using an oscilloscopes by using a calibrated reference source alongside your DUT, however the characteristics of the reference source will need to match those of the DUT to ensure that any changes in measurement reading are only due to changes in your circuit and not due to the oscilloscope and the probing system interacting differently with the reference source and the DUT.

Which type of instrument is the most suitable for your power measurement? Contact Yokogawa for expert and impartial advice.

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