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What Do You Want to Measure – Peak or Average?

Power measurements are fundamental when it comes to RF/microwave product design and production, however, communication between the customer and test equipment provider is equally as important. The terms “average power” and “peak power” are often used when expressing desired power measurements, but these terms frequently carry different meanings for different people. Therefore, let’s take some time to clear the confusion and set up terminology that we all can use in common.

A basic type of measurement that is highly sought after is peak power. However, it may not be clear if the peak power desired is a single value that is the maximum amplitude of a device-under-test’s envelope power or if it is the envelope power itself. Envelope power is the amplitude change due to modulation or distortion as a function of time averaged over one or a few cycles of the RF carrier signal. Envelope power versus time and its maximum (or peak envelope power, known as PEP) are illustrated in Figure 1 below.

Communicating that you want the average power of a pulsed signal can also be a bit tricky since average power can have two distinct definitions. Some may seek the average power over the pulse repetition interval (PRI), which includes both the signal burst and the time interval between the next pulse. Alternatively, others may desire the average power of just the signal burst, which we’ll refer to as pulse average power.

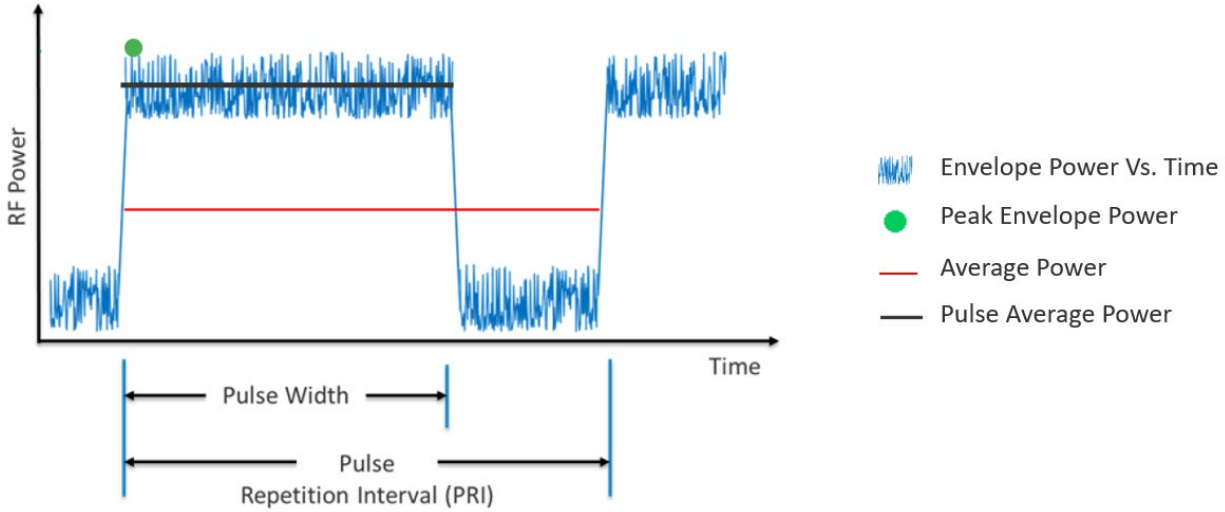

Figure 1: The distinctions between envelope power (blue), PEP (green), average power (red), and pulse average power (black).

Using agreed-upon terminology for peak and average power measurements will also positively influence the accuracy of related calculations. For example, crest factor is a parameter of interest for modulated signals and is defined as the peak-to-average power ratio (PAPR). In other words, crest factor is the ratio of the PEP to either the average power over the PRI (Crest Factor = PEP/Average Power) or only the pulse (Crest Factor = PEP/Pulse Average Power).

Generally, average power sensors are used to calculate the average power of a signal over the entire waveform. Peak power sensors, on the other hand, have triggering capabilities, which allows them to make measurements related to the pulse, such as PEP and pulse average power. It is possible, however, to obtain the pulse average power of a signal using an average power sensor through a two-step calculation process. First, the duty cycle is obtained by taking the ratio of the pulse width and the PRI, which is often a known quantity (Duty Cycle = Pulse Width/PRI). Using this information, the pulse average power can be calculated by taking the average power and dividing it by the duty cycle (Pulse Average Power = Average Power/Duty Cycle).

Satisfying regulatory specifications, safety limits, system efficiency, and component protection in RF design all relies upon accurate RF power measurements, which heightens the importance of communicating with common terminology. A leader in high performance RF and microwave test equipment, Boonton enables a wide range of RF power measurements and signal analysis with a product portfolio that includes peak and average RF power meters as well as real-time and connected USB power sensors. Find the perfect test instrument that suits your specific requirements at www.boonton.com.