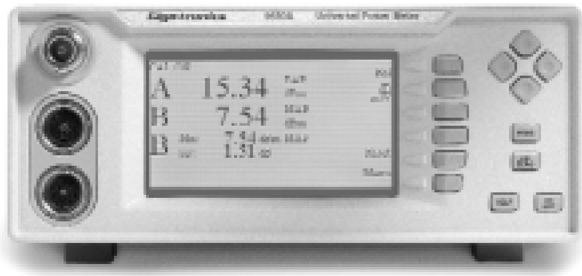
STANDARD DEVIATION FUNCTION OF 8650A UNIVERSAL POWER METER

OVERVIEW



Excessive cost can prove as detrimental to the success of communications equipment as poor performance. The 8650A Universal Power Meter provides a range of statistical power measurement analysis features that help you optimize your designs to prevent inadequate performance due to under design or excessive cost due to over design. The standard deviation function is one way to analyze the variability or dispersion between the average and peak power of a signal over a period of time.

DESCRIPTION OF OPERATION

Standard deviation indicates dispersion around the mean and compares each sampled power point to the mean for variability. It is calculated using the equation

$$\sigma = \sqrt{\frac{\sum_{n}(x-\mu)^2}{n}}$$

where σ = the standard deviation

x = the power level of an individual sample

μ = the average of all samples

n = the number of samples

The Giga-tronics 8650A Power Meter accumulates the samples of peak power during measurement, applies the equation to the data, and displays the standard deviation.

Standard deviation works in conjunction with crest factor to accurately evaluate complex modulated communication signals. While crest factor provides the ratio of the worse case peak to average power measured, standard deviation infers how often the maximum peaks are encountered. Figures 1 and 2 (on the opposite side) are examples of two different modulation scenarios.

While the overall power distribution appears to be quite different, both signals represent an average power of 5 dBm with peaks to +16 dBm, or a crest factor of 11 dB. An analysis of the data for the modulated signal in figure 1 yields a standard deviation of 4.86 dB, while analysis of the data for the modulated signal in figure 2 yields a standard deviation of 2.55 dB. This confirms the expectation that a signal with fewer extreme peak-power excursions will have a smaller standard deviation.

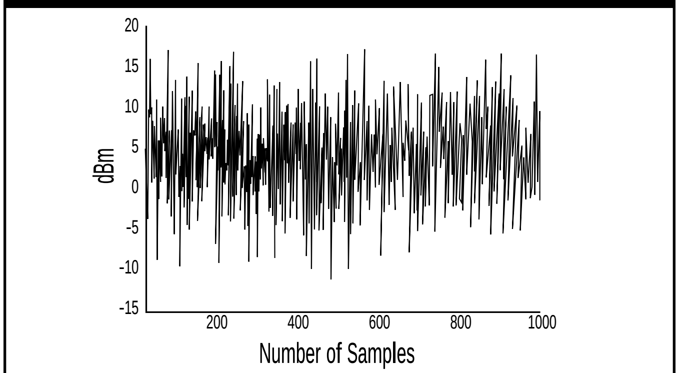
Given a normal distribution of power, standard deviation can be used to estimate the probability of occurrence for a given range. A standard deviation of ± 1 from the mean represents approximately 68%

Giga-tronics

Giga-tronics Incorporated ■ 4650 Norris Canyon Road ■ San Ramon, California USA 94583 ■ Telephone: 925-328-4650 ■ Telefax: 925-328-4700

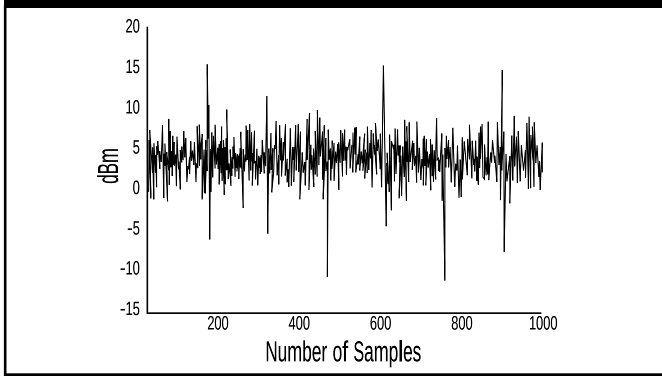
probability of occurrence within the range. Likewise, standard deviations of ± 2 and ± 3 represent approximately 95% and 99% probability of occurrence, respectively. Thus, if the concern is the percent occurrence at maximum values, then the probability is one-half of the area outside the range.

FIGURE 1



For example, 5% of occurrences lie greater than 2 standard deviation from the mean. Thus, 2.5% of occurrences represented in figure 1 will have excursions greater than +14.72 dBm (5 dBm + 2 x 4.86 dB).

FIGURE 2



For the signal represented by figure 2, 97.5% of the occurrences will be below 10.1 dBm. If the requirement allows a 2.5% error rate, then an engineer designing a system represented in figure 2 can provide 10 dBm capability when considering standard deviation instead of 16 dBm capability which crest factor might dictate.

CONFIGURING THE 8650A FOR STANDARD DEVIATION

The Giga-tronics 8650A Power Meter lets you configure the 4-line display to include standard deviation so that you can monitor the spread of power distribution without having to switch to a graphical display, and thereby lose the display of other important information. The meter is configured for standard deviation by selecting the *Display Setup* soft key of the main menu, selecting the line where you want standard deviation displayed, and selecting *Mean & SD* within the Data group.

Figure 3 shows the standard deviation display of the 8650A for channel B on line 3, with the average power levels of channel A on line 1 and channel B on line 2.

FIGURE 3

Giga-tronics Incorporated ■ 4650 Norris Canyon Road ■ San Ramon, California USA 94583 ■ Telephone: 925-328-4650 ■ Telefax: 925-328-4700