November 8, 2001

COMMENTS from Mr. Ken Boston of L. S. Compliance for THE CONDUCTED OUTPUT POWER OF THE SPECTRALINK PHONE

The conducted power output of the Spectralink phone was also measured using a Gigatronics 8542C power meter, with good correlation of the power readings between the power meter and the Spectrum analyzer. The highest power output seen was on channel 11, at a 11 MB rate. The power meter indicated 20.4 dBm, and the analyzer indicated 19.9 dBm, with standard uncertainties for both instruments. Although the Spectralink phone operates in a burst mode, the units tested had a software feature, which would allow them to operate continuously for various measurements, such as conducted power, density and occupied bandwidth.

Presented on pages 14-20 of the conducted emission report are measurements of integrated channel power. The spectrum analyzer automatically selects the resolution bandwidth and video bandwidth for the measurements. The power contained within the 1 MHz bandwidth shown is measured with a sampling detector. Each of the power spectral density samples across the defined channel width is summed and the value of the integrated power spectral density is indicated. Further, this process is carried out 10 times and the average value of that ensemble is presented as the test indication. The test indication is defined as the total average power contained within the limit lines.

This measurement has good agreement with a power meter. An excerpt from an Agilent Technologies application note is reproduced below for more details on the measurement process

Channel-power measurements

Most modern spectrum analyzers allow the measurement of the power within a frequency range, called the channel bandwidth. The displayed result comes from the computation:

$$P_{ch} = \left(\frac{B_s}{B_n}\right)\left(\frac{1}{N}\right)\sum_{i=n1}^{n2} 10^{(P_i/10)}$$

Pch is the power in the channel, *Bs* is the specified bandwidth (also known as the channel bandwidth), *Bn* is the equivalent noise bandwidth of the RBW used, *N* is the number of data points in the summation, *pi* is the sample of the power in measurement cell *i* in dB units (if *pi* is in dBm, *Pch* is in milliwatts). *n1* and *n2* are the end-points for the index *i* within the channel bandwidth, thus $N=(n2 - n1) + 1$.

The computation works well for CW signals, such as from sinusoidal modulation. The computation is a power-summing computation. Because the computation changes the input data points to a power scale before summing, there is no need to compensate for the difference between the log of the average and the average of the log as explained in Part I, even if the signal has a noise-like PDF (probability density function). But, if the signal starts with noise-like statistics and is averaged in decibel form (typically with a VBW filter on the log scale) before the power summation, some 2.51 dB under-response, as explained in Part I, will be incurred. If we are certain that the signal is of noise-like statistics, and we fully average the signal before performing the summation, we can add 2.51 dB to the result and have an accurate measurement. Furthermore, the averaging reduces the variance of the result.

But if we don't know the statistics of the signal, the best measurement technique is to do no averaging before power summation. Using a VBW ≥ 3RBW is required for insignificant averaging, and is thus recommended. But the bandwidth of the video signal is not as obvious as it appears. In order to not peak-bias the measurement, the *sample* detector must be used. Spectrum analyzers have lower effective video bandwidths in sample detection than they do in peak detection mode, because of the limitations of the sample-and-hold circuit that precedes the A/D converter. Examples include the Agilent 8560E-Series spectrum analyzer family with 450 kHz effective sample-mode video bandwidth, and a substantially wider bandwidth (over 2 MHz) in the Agilent ESA-E Series spectrum analyzer family.

Figure 9 shows the experimentally determined relationship between the VBW:RBW ratio and the under-response of the partially averaged logarithmically processed noise signal.

However, the Agilent PSA is an exception to the relationship illustrated by Figure 9. The Agilent PSA allows us to directly average the signal on a power scale. Therefore, if we are not certain that our signal is of noise-like statistics, we are no longer prohibited from averaging before power summation. The measurement may be taken by either using VBW filtering on a power scale, or using the average detector on a power scale.

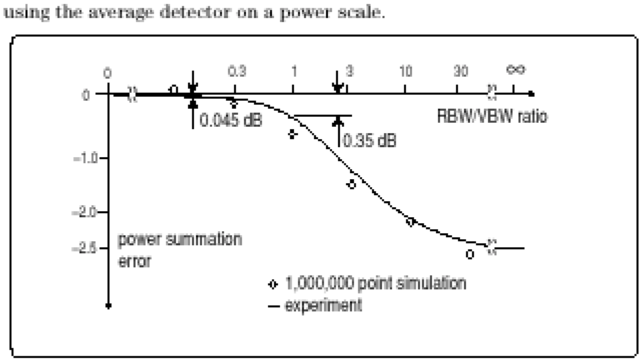

Figure 9. For VBW ≥ 3 RBW, the averaging effect of the VBW filter does not significantly affect power-detection accuracy.

[1] "Agilent Technologies AN 1303 – Spectrum Analyzer Measurements and Noise", Published January 21, 2001.