Logarithmic Units

Electrical engineers often use a logarithmic unit, the decibel, when they want to discuss signals or spectra with a wide dynamic range (and sometimes even when they don't).

Decibel. The bel (named after Alexander Graham Bell) is a ratio of powers expressed in log units. For example, if one signal carries 10 times less power than another, we say its power is –1 B [log(0.1)] less than the other, or that it is 1 B down from the other. Similarly, if 100 times less power, 2 B down; if 1000 times less power, 3 B down, and so on.

Engineers prefer the decibel to the bel, and the bel is rarely used. A decibel is 1/10 of a bel, so if one signal carries 10 times less power than another, we say its power is –10 dB less than the other, or that it is 10 dB down. Similarly, if 100 times less power, 20 dB down; if 1000 times less power, 30 dB down, and so on. If a signal carries 1/2 the power of another, it is 3 dB down; 1/3 the power, 5 dB down. What if it carries 1/20 the power? 1/30? 10 times more power? 2 times more?

dBm. The decibel is a relative unit—a ratio of powers. We may express power quantitatively in decibels, however, provided that we refer the power to a specific value. That value is commonly taken to be 1 mW; power referred to 1 mW is measured in dBm, or decibels with respect to 1 mW. Thus, 1 mW –> 0 dBm, 0.1 mW –> –10 dBm, and so on.

The spectrum analyzer defaults to dBV, or decibels below 1 V. Because the volt is not a unit of power, measuring power in dBV is problematic, and we recommend that you set the spectrum analyzer to dBm as soon as you want to take quantitative data.