Basic Electronics Part 6
by
Thomas Atchison W5TV

What does dB mean? This is the abbreviation for decibel. Deci is the metric prefix that means one-tenth, so we are talking about 1/10 of a bel. The bel compares the loudness of two sounds with each other. One of these sounds serves as a reference for the comparison. To calculate how many bels louder or softer the second sound is, simply divide the reference intensity into the other value. Then find the logarithm of that result.

$$bels = \log(\frac{I_1}{I_0})$$

where I_0 is the intensity (or loudness) of the reference sound and

I_1 is the intensity of the sound compared to the reference.

If the quieter sound intensity (smaller number) is used as a reference sound, then the ratio is larger than 1 and the logarithm is positive. On the other hand, if the louder sound intensity is used as a reference sound, the ratio is less than 1 and the logarithm is negative. The numerical value of the log of the ratios would be the same, but one would be positive and the other negative. This means that a positive value of bels indicates a sound is louder than the reference sound and a negative value of bels indicates a sound is quieter than the reference.

Sound intensity is similar to sound power, so we can apply the bel to power levels in electronics. The bel is a rather large unit, so we normally use the decibel. It takes 10 decibels to make one bel. This means that the equation to compare two power levels in decibels is 10 times the equation to calculate bels.

$$dB = 10\log(\frac{P_1}{P_0})$$

where P_0 is the reference power level and

P_1 is the power level compared to the reference.

As an example, suppose we measure the output power from a transmitter and find that it is 15 watts. Now suppose we use a power amplifier after the transmitter and measure the power from the amplifier to be 1500 watts. What is the gain or power increase provided by this amplifier? If we use the 15 watts as reference, then the gain would be calculated as follows:

$$dB = 10\log(\frac{P_1}{P_0}) = 10\log(\frac{1500w}{15w}) = 10\log(100) = 20.$$

The amplifier provides a 20 dB increase in power.

Now suppose we feed the output of our 1500 watt amplifier into some coax that feeds an antenna. Suppose we measure the power at the antenna and discover that we have 150 watts there. We now compare the power at the antenna with the amplifier power. In this case P_0 is 1500 watts and P_1 is 150 watts. Therefore,

$$dB = 10\log(\frac{P_1}{P_0}) = 10\log(\frac{150w}{1500w}) = 10\log(0.10) = -10.$$

The negative sign says we have less power than our reference.

If you have a piece of coax with a loss of 10 dB in any reasonable length, then you might conclude that your coax is not good.