Power and Decibels

The **decibel** is one unit that you will hear used (and misused) quite often in electronics. Just what does this term mean? First we'll define the term, and then we'll take a look at some of the ways we use decibels in electronics.

You have probably recognized *deci* as the metric prefix that means one tenth. So the unit we are really talking about here is the *bel*, and a decibel is just 1/10 of a bel. We often use a capital B to abbreviate bel. Since the lower case d is the abbreviation for deci, the proper abbreviation for a decibel is dB. The bel is named for Alexander Graham Bell. Most people remember Bell for his invention of the telephone. Bell was also very interested in working with deaf people and studying the way we hear sounds.

In electronics, we use the decibel as a comparison of power levels. A decibel is ten times the logarithm of a ratio of two power levels. We aren't going to get too technical or go into a lot of math here, so don't panic. A couple of examples will make this easier to understand. Suppose you are operating a transmitter with a power output of 5 watts. Now increase that output power to 10 watts. Find the ratio of these power levels by dividing the new (higher) power by the original value:

$$\text{Power Ratio} = \frac{10\text{ W}}{5\text{ W}} = 2$$

If you have a scientific calculator, you can find the logarithm (log) of 2, and the answer is 0.3. Now if we multiply that result by ten, we have our answer of 3 dB. So by going from 5 W to 10 W, we have increased our transmitter power by 3 dB.

Suppose you increased the power from 10 W to 20 W. Well, the ratio of those power levels is 2, so that is another 3 dB-increase in power.

Now you may be wondering how we would describe the change from 5 W to 20 W. Well in that case the ratio of output powers is:

$$\text{Power Ratio} = \frac{20\text{ W}}{5\text{ W}} = 4$$

Using your scientific calculator again, you can find that the log of 4 is 0.6. Multiply that answer by ten to find that this represents a 6-dB increase in power.

There is one more example that will give an answer worth remembering. Suppose we increase that transmitter power from 5 W to 50 W. That new power is 10 times larger than the first power. The log of 10 is 1. So we have a 10-dB increase in power for this last example.

Every time you increase the power by a factor of 2 times, you have a 3-dB increase of power. Every 4 times increase of power is a 6-dB increase of power. When you increase the power by 10 times, you have a power increase of 10 dB. You can also use these same values for a decrease in power. Cut the power in half for a 3-dB loss of power. Reduce the power to ¼ the original value for a 6-dB loss in power. If you reduce the power to 1/10 of the original value you will have a 10-dB loss. The power-loss values are often written as negative values: –3, –6 or –10 dB. **Table 7.2** shows these common decibel values and power ratios.

Table 7.2

Some Common Decibel Values and Power Level Ratios

P_2/P_1	*dB*
0.1	–10
0.25	–6
0.5	–3
1	0
2	3
4	6
10	10