What is a decibel?

A **decibel** is a ratio between two numbers. For the Technician test, you will need to know these ratios:

10:1 is 10 dB	1/10 is -10 dB
2:1 is 3 dB	1/2 is -3 dB

So where do these **decibel** numbers come from? Decibels are the exponent of powers of 10. The 10:1 ratio is equal to 10/1. In terms of powers of 10,

$$10/1 = 10^{1}/1$$

The 1 is the exponent of 10. That is 1 **bel**. But a bel is too large so it is divided into decibels, tenths of bels, so that

$$1 \text{ B} = 10 \text{ dB}$$

The 2:1 ratio is 2/1. In terms of powers of 10,

$$2/1 = 10^{0.3}/1 = 0.3 \text{ B} = 3 \text{ dB}$$

The 0.3 is the approximate exponent of 10. That is, 0.3 B = 3 dB. So a test question would be "What is the approximate amount of change, measured in decibels, of a power *increase* from 5 watts to 10 watts?" The answer is 10/5 = 2/1 = 3 dB.

Negative dB work the same way except that it is the reciprocal ratio.

$$1/2 = 10^{-0.3}/1 = -0.3 \text{ B} = -3 \text{ dB}$$

Another test question could be, "What is the approximate amount of change, measured in decibels, of a power *decrease* from 10 watts to 5 watts?" The answer is 5/10 = 1/2 = -3 dB.

Remember that positive dB, an increase, is a ratio greater than 1 and that a negative dB, a decrease, is a ratio less than 1.

Since a decibel is a ratio, it needs to be compared to some standard. Two common decibels you will in see in amateur radio are the **dBi** and the **dBm**.

The **dBi** is used to indicate the **gain** of an antenna compared to the ideal point source **isotropic** antenna. The isotropic antenna has a gain of 0 dBi, namely one, since it radiates radio frequency energy equally in all directions. The dipole antenna, a practical simple antenna that can be built, has a gain of about 2 dBi since the energy not radiated parallel to the dipole is instead radiated in the other directions with most of that energy radiating in the perpendicular direction. A four element Yagi antenna has a gain of about 10 dBi since most of the energy is radiated out the front of the antenna.

The **dBm** is unit of power that is used to indicate the amount radio frequency power coming out of a transmitter. A power of 0 dBm is 1 milli-watt (1 mW), the reference power. Some handie-talkie radios have a power settings of 100 mW = 20 dBm, 1/2 W = 500 mW = 27 dBm and 5 W = 5000 mW = 37 dBm.

The **effective radiated power** (ERP) of a transmitting station is the actual power that is radiated from a transmitting antenna. It is the product of the transmitter output power and the gain of the antenna and can be obtained by simply *adding* the dBm of the transmitter power and the dBi of antenna gain. For example, a 5 W handie-talkie using a four element Yagi antenna has an ERP of 37 dBm + 10 dBi = 47 dBm = 50 W.

David, W2LNX

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