Basic Electronics Part 7
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In the previous discussion, we introduced the concept of a decibel (dB). We now want to explore how the dB is used to compare power levels in electronic circuits. Let's begin with a 2-meter transmitter with an output of 10 watts. Suppose we purchase a new amplifier, attach it to our existing transmitter, and measure the output at 100 watts. How many dB increase is this?

We will use the 10-watt signal as the reference and compute the power ratio:

$$ratio = \frac{P_1}{P_0}$$

where P_0 is the reference power level and P_1 is the power level compared to the reference power. The number of dB in this case is

$$\begin{aligned} dB &= 10 \log\left(\frac{100}{10}\right) \\ &= 10 \log(10) \\ &= 10. \end{aligned}$$

This means we have increased the power of the 2-meter signal by 10 dB.

Now suppose we start with the same 10-watt transmitter, but attach an amplifier that increases the power output to 20 watts. In this case the increase in dB is

$$\begin{aligned} dB &= 10 \log\left(\frac{20}{10}\right) \\ &= 10 \log(2) \\ &= 10(0.30) \\ &= 3. \end{aligned}$$

Therefore, we have increased the power of the 2-meter signal by 3dB.

If we start with a transmitter having 100 watts of power output and, using an amplifier, increase the power to 200 watts of output, then the increase in dB is

$$\begin{aligned} dB &= 10 \log\left(\frac{200}{100}\right) \\ &= 10 \log(2) \\ &= 3. \end{aligned}$$

We again have a 3 dB increase in signal. Observe that as we double the power level of a transmitter we have a 3 dB increase in signal. If we were to double the power again we would have a 6 dB increase in signal.

This process also works for loss. For example, suppose we have a 50-watt transmitter on 2 meters and we need a run of 100 feet of coax to reach the antenna. Suppose we find

some RG58 coax and use it. Also, suppose the SWR is such that the total loss in the coax plus the SWR at 146 mHz is 6 dB. Since a 3 dB loss is ½ the power, then a 6 dB loss is ¼ of the power to the antenna or 12.5 watts. Better coax makes a difference.

Any time you calculate a decibel value, you must use some power level as the reference. If we use the same reference level to specify power in several circuits, we have a convenient way to compare those circuits. If the reference power is a milliwatt (0.001 W), then we indicate the result as dBm. This is convenient when measuring power levels in receivers. Therefore,

$$dBm = 10 \log\left(\frac{P_{watts}}{0.001}\right).$$

A signal specified as 3 dBm has twice as much power as a 1-mW signal. This means a 3-dBm signal has a power level of 2-mW.

Now suppose the power in part of a circuit measures 5-mW and in another part of the circuit it measures 40-mW. If we use the 5-mW value as the reference power, how many dB greater is the 40-mW power?

$$\begin{aligned} dB &= 10 \log\left(\frac{40mW}{5mW}\right) \\ &= 10 \log(8) \\ &= 10(0.90) \\ &= 9. \end{aligned}$$