

What is a dB?

A Tenth of a Bel?

The decibel (abbreviated dB) is one of the most misunderstood measurements. Although the term decibel always means the same thing, it may be calculated in several ways, and there are many confusing explanations of what decibels are. The term decibel is sometimes used in conjunction with sound levels: having a muffler louder than 85 dB will warrant a ticket, listening to music at 110 dB will damage hearing.

So what exactly is a decibel? It's a logarithmic way of expressing the ratio of two power levels (or sound levels or voltage levels or any other kind of level). The decibel is not a unit in the same sense as a meter or a pound. Meters and pounds are defined quantities that never change. A decibel is a relationship between two levels, usually power or pressure (voltage).

Decibels are used for talking about numbers of greatly different magnitude, such as 23 vs. 4,700,000,000,000. With such vast differences between the numbers, the most difficult problem is getting the number of zeros right. A scientific notation could be used, but a comparison between 2.3×10 and 4.7×10^{12} is still awkward. For convenience, find the **RATIO** between the two numbers and convert that into a logarithm. This gives a number like 11.3. To keep this simple, drop the decimal and multiply the number times ten. If one value is measure as 23 hp and another as 4.7 trillion hp, then the latter is 113 dB greater than the other.

$$\text{Power Ratio in dB} = 10 \text{ LOG } \frac{\text{Power A}}{\text{Power B}}$$

The usefulness of all this becomes apparent when referencing how the ear perceives loudness. The ear is exceptionally sensitive. The softest audible sound has a power of about 0.000000000001 watt/sq. meter and the threshold of pain is around 1 watt/sq. meter, giving a total range of 120 dB. In addition, a human's judgment of relative levels of loudness is somewhat logarithmic. If a sound has 10 times the power of a reference (10 dB) a person would hear it as twice as loud. If the power is doubled (3 dB), the difference will be just noticeable.

Converting Voltage Ratios To Decibels

Remember that the dB is used to describe relationships of **POWER**. Power is not often conveniently measured, especially in electronic devices. Most often voltage is measured and the formula $P=E^2/R$ to get power. Squaring a value doubles its logarithm, so the dB formula becomes:

$$\text{Power Ratio in dB} = 20 \text{ LOG } \frac{\text{Power A}}{\text{Power B}}$$

So does it matter if a cable is better by only 3 dB? A new 2003 Ford Taurus has 155 horsepower engine and a new F350 Superduty 32 valve V8 turbo diesel has 325 horsepower. See the equation below. Therefore, if the F350 is only 3 dB better would YOU use it or the Taurus to tow a 12,000 lb trailer?

$$\text{Power Ratio in dB} = 10 \text{ LOG } \frac{325}{155} = 3 \text{ dB}$$

Now let's compare the F350 to something powerful like the space shuttle with 36,000 horsepower engines. I'll make this one easy and give you the answer which is 50 dB. While this may seem like a ridiculous comparison, a simple upgrade from standard Category 3 at 16 MHz, to CommScope's premier UltraPipe, Category 6e is a 45 dB improvement.

As noted, the decibel is a useful tool used in many different disciplines to compare many different levels. The simple rule is to always compare similar signals. No matter how large or small, the decibel makes comparison relatively easy.