

# Decibels in the context of ADSL

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## The decibel

The decibel is a logarithmic unit which specifies the ratio of two powers. It was devised for transmission systems. The original unit was the Bel, and they derived this as:  $\text{Number of Bels} = \log_{10}(\text{Output Power} / \text{Input Power})$ . The decibel is one-tenth of a Bel. There are some advantages for specifying decibel and adding the power ratios of each stage. This is a lot easier than multiplying in the beginning and having negative dB values. If the input and output powers are equal, the gain is 0 dB.

### Some example values

Decibel value	Arithmetic equivalent
-6 dB	0.25
-3 dB	0.5
0 dB	1
3 dB	2
6 dB	4
10 dB	10
20 dB	100
30 dB	1000

## Attenuation

On the system side, what a line lawyer or engineer would like to know is the loss between the exchange and the user. What may surprise you is just how much gets lost. In September 2002, the limiting attenuation figure for a full-rate ADSL installation was of about 32 million. Lower levels of attenuation are obviously preferable. A power ratio

## Signal-to-noise ratio

just to make life even more complicated for the rest of us, a wideband signal is called the signal-to-noise ratio, or SNR. The greater this ratio is, the better the signal. The limiting ratio of SNR is given by the Shannon limit of 1.44 dB. This is a very low value. ADSL signals with lower values of SNR will make it very difficult to separate out a clear signal. It should be noted that ADSL modems and routers normally report a noise margin. If a measured SNR was 40 dB, then the modem/router would report a noise margin of 4 dB.

## Decibels used as power measurement

Another common way of specifying power is in dBm, which is a number divided by 1000, and then the power is specified as that number of dBm. For example, converted

Power	dBm equivalent
1 mW	0 dBm
2 mW	3 dBm
10 mW	10 dBm

100 mW	20 dBm
1 W (1000 mW)	30 dBm
100 W (100,000 mW)	50 dBm

What is the power level in dBm for the following power levels? (Note: dBm is a unit of power level, not a unit of power. It is the power level relative to 1 mW. For example, 100 mW is 20 dBm, 1 W is 30 dBm, and 100 W is 50 dBm.)

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