NOW FOR SOME MATHS

Decibels are the logarithmic expression of the measurement of a quantity (for example, signal voltage) relative to a fixed or reference level. For voltages, this logarithm of the ratio is multiplied by 20. So for example, if we measured a voltage of 3 volts and wanted to express that measurement in dB compared to 1 volt, the math would be: dB = 20 x (log 3 volt / 1 volt) which equals 9.54dB. For measurements involving power (Watts) rather than voltages, the logarithm is multiplied by 10 rather than 20.

Because of the logarithmic expression, when a measured quantity is less than the reference it becomes a negative number expressed in dB.

Note that one of the advantages of the logarithmic nature of decibels is that a wide range of voltages can be expressed with a comparatively small range of numbers. We can measure from microvolts (millionths of a volt) to tens of volts with a range of numbers in dB from -120 to 30. One other fundamental aspect of the use of logarithms is that our perception of sound both in terms of frequency (pitch) and loudness is largely logarithmic in nature and so there is an intrinsic relationship between how we measure audio levels in decibels and how we hear them. Perhaps the coolest thing about expressing signal levels in dB is that the maths is simpler – multiplication is replaced with addition. For example, if we measured in voltages, then a signal level of 3.16 millivolts after a gain of 40 times had been applied would be 3.16millivolts x 40 = 126.4millivolts. Once this is presented in dB the multiplication becomes a simple addition: a -72dBm signal with a gain of 32dB gives a signal with a level of -72dBm + 32dB = -40dBm. Simple!