Digital Word Length

***Although much literature uses the term 'bit-depth' rather then 'word-length', we chose the term 'word-length' simply because we feel it better describes the mathematical aspect, as well as help to visualize the implication of the technology. It is no more correct or incorrect then using 'bit-depth'; the two terms are synonymous.**

Introduction

Word-length (also known as bit-depth) indicates how many digits are used to represent a value in a digital word. For instance, a word-length of 8-bits (8 digits) can only have values from 00000000 to 11111111 (in decimal, 0 to 255). A word-length of 16-bits can have values from 0000000000000000 to 1111111111111111 (0 to 65,536). A digital word doubles in resolution with each bit. For example a 16-bit sample has twice as many possible values (65,536) as a 15-bit word (32,768).

Word-length in digital audio

The word-length of an audio recording determines the amount of noise required to avoid quantization distortion and accurately record and reproduce analog audio signals.

When an analog audio signal is digitally sampled, the voltage on the analog line is sampled several thousand times per second (determined by the sample-rate). Each sample is a 'snap-shot' of the analog waveform at that given moment in time. The sample is a digital word, the value of which is representative of the amplitude of the analog voltage at that moment. With an increase in word-length, the analog voltage can be measured with a finer resolution, making the sample a more accurate description of the value. However, the signal must be dithered to completely avoid quantization distortion.

Common digital audio word-lengths

"Redbook", CD audio: 16-bit< br/> Professional audio: 24-bit

Word-length reduction in digital audio

When digital audio word lengths are reduced, resolution is inherently lost. Also, if the digital audio is not properly dithered during the reduction, severe distortion will be induced (simply removing the least significant bits without dithering is known as truncation).