The Effective Number Of Bits.

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The resolution of a 10, 12,14 or 16 bits ADC should represent the ability theoretical to distinguish one part in 1024, 4096, 16384 or 65536, respectively.

Resolution is often taken as an indication of measurements accuracy however, overall accuracy can be one of the most difficult specifications to determined from specifications presented on a data sheet

N IDEAL BITS	RESOLUTION	VALUE OF ERROR Q	IDEAL SNR
	$1/2^N$	For a FS= 2.5 Vpp	dB
10	1/ 1024	2.44 mV	61.96
12	1/ 4096	0.61 mV	74
14	1/ 16384	0.15 mV	86.04
16	1/ 65536	38.1 uV	98.08

But a resolution value quoted as " bits" include only quantization's error and does not include any indication of the thermal noise or distortions levels that effectively diminish a ADC 's ability to distinguish between discrete levels.
A correct and better evaluation of ADC performance is provided by the " Effective Number of Bits", ENOB.
A good 16 bit board digitizer operating under real-world conditions has at most 12,5 bits of accuracy.

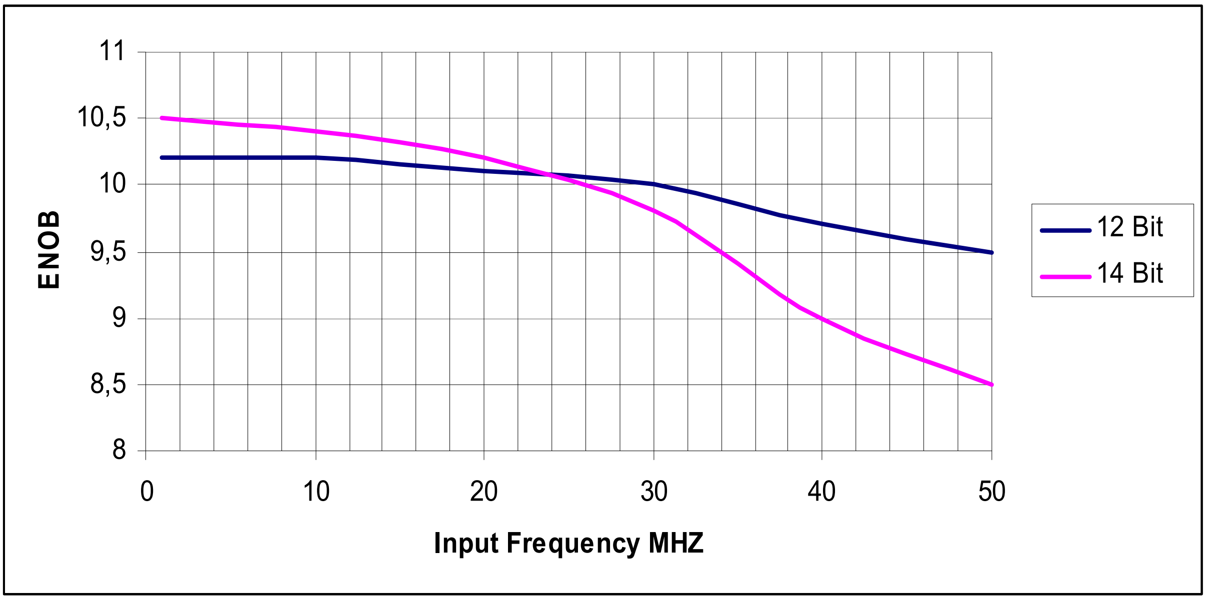

Fig. 1

What's more a poorly designed 14 bit board may perform less accurately than a well -designed 12 bit system. This is especially true when the value ENOB is a function of input signal frequency.

From example shown in figure 1. If quoted until 24 MHz the 14 bit digitizer shows more effective bits than 12 bit digitizer quoted at 50 MHz. This clearly misleading because the 12 bit system shows better performances from about 25 MHz and beyond.

SINAD

The true SNR of the ADC system is the ratio of rms value of the input signal at the output to the rms value of the sum of all other spectral components, expressed in decibels. The SINAD includes both noise and distortion
it can be used to directly calculate the effective numbers of bits.
But you need to do attention compared SINAD specification because the value can be highly dependent on amplitude and frequency.
The ENOB value can be calculated from the signal to noise and distortion, S/(N+D).

$$ENOB = \frac{SINAD - 1.76}{6.02}$$

Acronyms used:
ADC -Analog to Digital Converter
dB - Decibels
ENOB - Effective Number Of Bits.
FS - Full Scale ADC
rms - root mean square.
SNR- Signal to Noise Ratio
Vpp- Volt peak to peak

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