

MEASURING OF EFFECTIVE RESOLUTION OF S-D ADC

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Abstract: Measurement and testing methodology for S-D Analog-to-Digital converters with nominal resolution 16 (24) bits is presented. The dependancies of effective resolution on the first notch frequency and gain are given.

Keywords: ADC, testing, S-D modulation

1 EFFECTIVE RESOLUTION MEASUREMENT

Statistic method for effective resolution evaluation is used. It is based on the measurement of quantizing noise of the tested AD converter that has a known steady-state voltage on its input. Imponderable noise of the voltage source is expected. Histogram of the occurred code words is generated using large amount of samples. Variance RMS_{NOISE} of quantizing noise is determined from the code words histogram.

Effective resolution of the ADC is then given by

$$ENOB = \log_2 \frac{FS}{RMS_{NOISE}} \quad (1)$$

where FS means Full Scale Voltage on the input of ADC.

The accuracy of ENOB determining depends on the amount of statistically independent samples. The distribution of code words is theoretically binomial that can be approximated by Gaussian one for large amount for samples.

Measuring system for ADC effective resolution determination has been developed. It consists of the group etalon Stanard Cell Battery TINSLEY 5644B with 10 Weston cells that provides nominal voltage 1,0187 V each. Lower voltages are derived using passive divider based on manganine resistors.

Measurements have been done for the gain settings 1 to 8 on the input voltages in 0, 1/4, 1/2, 3/4 of FS. The range of notch frequency cover the interval from 10 Hz to 1 kHz. The dependancy of effective resolution on the gain and frequency of the notch filter is shown at the Fig.1 and Tab.I.

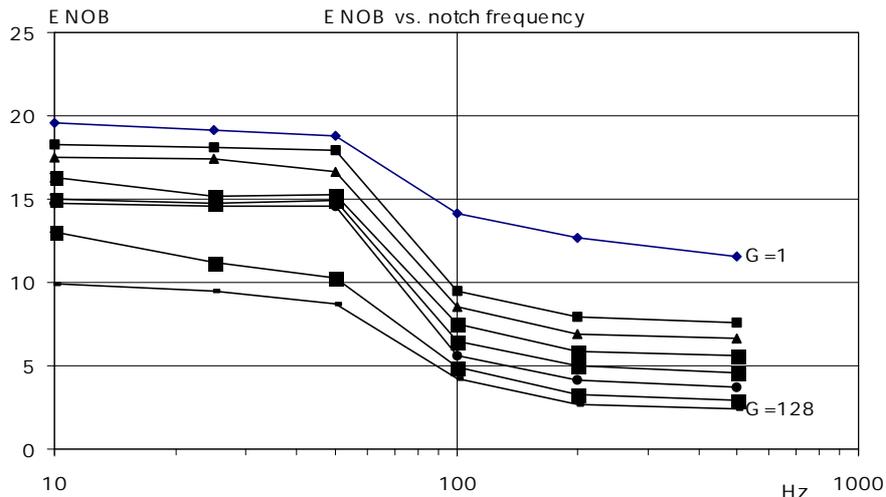


Fig.1 Effective Number of bits versus First Notch Frequency
 (gain G=1, 2, 4, 8, 16, 32, 64, 128)

f_{notch} [Hz]	$f_{-3\text{dB}}$ [Hz]	G=1	G=2	G=4	G=8	G=16	G=32	G=64	G=128
10	2,62	19,6	18,3	17,5	16,3	15,0	14,7	13,0	9,9
25	5,6	19,1	18,1	17,5	15,2	14,7	14,6	11,2	9,5
50	13,1	18,8	17,9	16,6	15,3	14,9	14,6	10,3	8,7
100	26,2	14,1	9,5	8,5	7,5	6,5	5,6	4,9	4,2
200	52,4	12,6	7,9	6,9	5,9	5,1	4,1	3,3	2,7
500	13,1	11,6	7,6	6,6	5,6	4,6	3,7	2,9	2,4

Tab. 1. Results of ENOB measurements

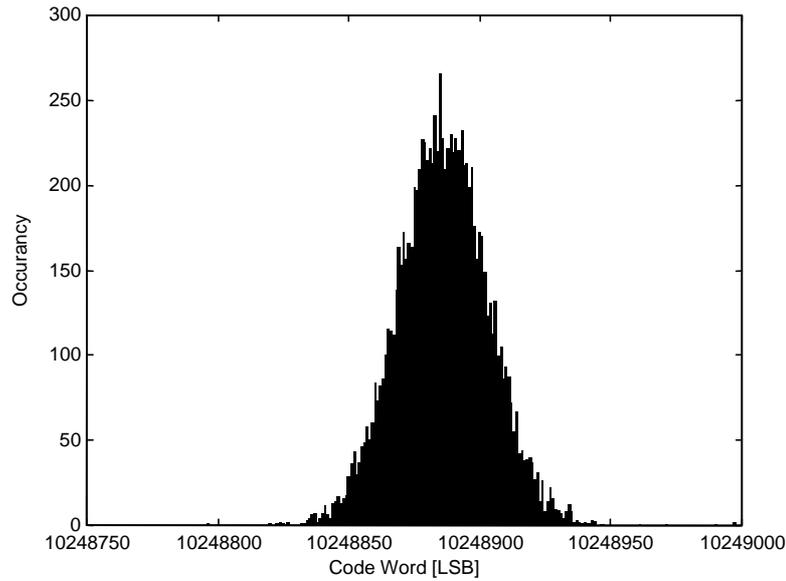


Fig.2 Histogram example : $U_{\text{IN}} = 1,5272\text{V}$, $f_{\text{notch}} = 10\text{Hz}$, $G = 1$, $\sigma = 17,31\text{ LSB}$, 10^4 samples

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