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KEYSIGHT 3458A NOISE PERFORMANCE

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Motivation

When 3458A is used for sampling, different sources of noise are added to the sampled signal. 3458A will add the following noises:

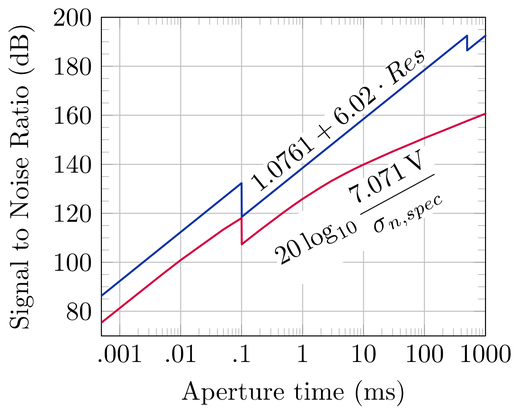
- quantization noise,
- input front-end noise,
- IADC noise.

In this paper measuring and modeling of those noises are presented.

The 3458A noise specification

DINT model:

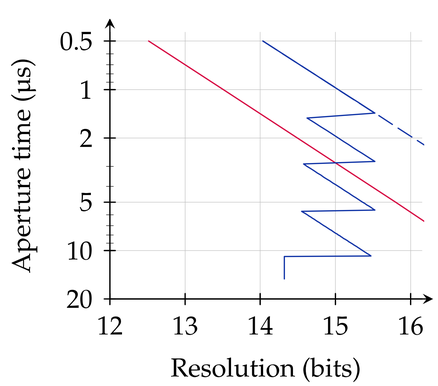
- Resolution specification (red line) is actual combined 3458A SNR for a given range.
- Quantization noise (blue line) represents actual internal 3458A quantization.



$$\sigma_{n,spec} = k_{n,R}\sqrt{\left(\frac{S_n}{\sqrt{2T_a}}\right)^2 + \left(5\frac{2R_{10V}}{\sqrt{12}\cdot 2^{Res}}\right)^2}$$

SINT mode:

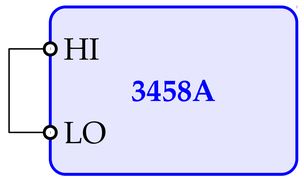
- Resolution is limited to 16 bits.
- Quantization noise prevails over resolution spec. for aperture time > 2.8 µs.



Measurement setup

The preferred method to measure the 3458A noise in DCV mode would be to apply a pure large signal sine wave with much lower noise content and any spurious signals than the noise contributed by the 3458A itself. This would require an extremely clean signal. Instead, a short circuit on the input of the 3458A was used. Measurements were confirmed using PTB spectrally pure JAWS system.

Short circuit noise measurement would not include noise sources like differential linearity noise and time jitter noise.

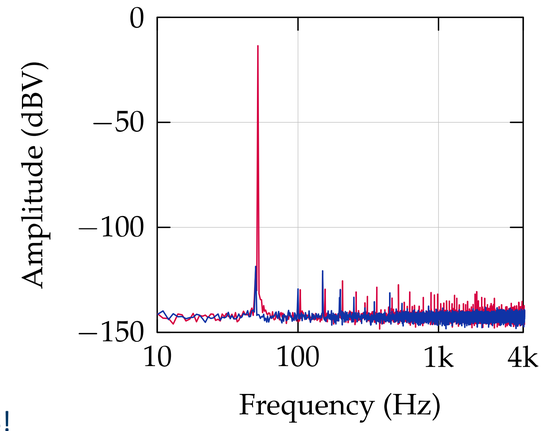


Results

- 3458A input referred noise can be measured using a short circuit (for DINT mode)
- SINT mode does not allow this measurement due to prevailing quantisation noise
- Jitter noise is insignificant in the whole audio band when internal clock is used
- Differential non-linearity is insignificant to generate additional noise

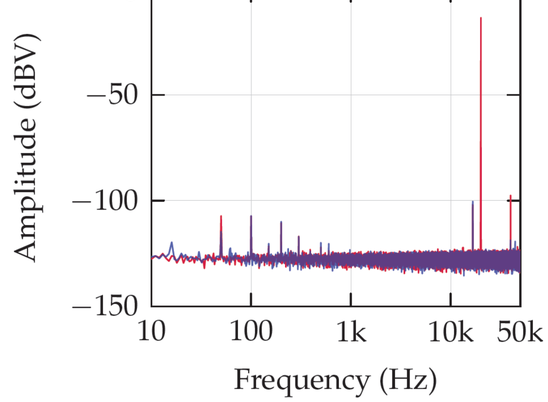
Measuring the 3458A noise with JAWS

Ts = 122.1 µs
Ta = 100.1 µs
U = 150 mV
f = 52 Hz
N = 4095
AZERO OFF



AZERO ON would reduce SNR by 3 dB!

Ts = 10 µs
Ta = 1 µs
U = 150 mV
f = 20 kHz
N = 50.000
AZERO OFF



Discussion of results and conclusion