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SINAD

Signal-to-noise and distortion ratio (**SINAD**) is a measure of the quality of a signal from a communications device, often defined as

$$\mathrm{SINAD} = \frac{P_{\mathrm{signal}} + P_{\mathrm{noise}} + P_{\mathrm{distortion}}}{P_{\mathrm{noise}} + P_{\mathrm{distortion}}},$$

where P is the average power of the signal, noise and distortion components. SINAD is usually expressed in dB and is quoted alongside the receiver RF sensitivity, to give a quantitative evaluation of the receiver sensitivity. Note that with this definition, unlike SNR, a SINAD reading can never be less than 1 (i.e. it is always positive when quoted in dB).

When calculating the distortion, it is common to exclude the DC components.[1]

Due to widespread use, SINAD has collected several different definitions. SINAD is commonly defined as:

1. The ratio of (a) total received power, i.e., the signal to (b) the noise-plus-distortion power. This is modeled by the equation above.[2]
2. The ratio of (a) the power of a test signal, i.e. a sine wave, to (b) the residual received power, i.e. noise-plus-distortion power. With this definition, it is possible to have a SINAD level less than one. This definition is used in the calculation of ENOB for DACs[3] and ADCs.[4]

Information on the relations between SINAD, ENOB, SNR, THD and SFDR can be found in.[5]

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Commercial radio specifications

A typical example, quoted from a commercial hand held VHF or UHF radio, might be:

> Receiver sensitivity: 0.25 µV at 12 dB SINAD.

This is stating that the receiver will produce intelligible speech with a signal at its input as low as 0.25 µV. Radio receiver designers will test the product in a laboratory using a procedure, which is typically as follows:

- With no signal present on the input, the noise and distortion of the receiver are measured at a convenient level.
- A signal is applied to the input such that the output increases by 12 dB.

- The level of the signal needed to produce this is noted. In this case, it was found to be 0.25 microvolts.

According to the radio designer, intelligible speech can be detected 12 dB above the receiver's noise floor (noise and distortion). Regardless of how accurate this output power is regarding intelligible speech, having a standard output SINAD allows easy comparison between radio receiver input sensitivities. This 0.25 μV value is typical for VHF commercial radio, while 0.35 μV is probably more typical for UHF. In the real world, lower SINAD values (more noise) can still result in intelligible speech, but it is tiresome work to listen to a voice in that much noise.

See also

- Signal-to-noise ratio
- Total harmonic distortion (THD+N)

References

1. *Glossary of Frequently Used High-Speed Data Converter Terms* (http://www.maxim-ic.com/app-notes/index.mvp/id/740), Maxim Integrated Products, 17 December 2001, retrieved 5 November 2011
2. "What is SINAD | SINAD Measurements | Electronics Notes" (https://www.electronics-notes.com/articles/radio/radio-receiver-sensitivity/what-is-sinad-signal-to-noise-and-distortion.php). *www.electronics-notes.com*. Retrieved 24 March 2019.
3. "IEEE Standard for Terminology and Test Methods of Digital-to-Analog Converter Devices". *IEEE STD 1658-2011*: 1–126. 1 February 2012. doi:10.1109/IEEESTD.2012.6152113 (https://doi.org/10.1109%2FIEEESTD.2012.6152113). ISBN 978-0-7381-7147-0.
4. "IEEE Standard for Terminology and Test Methods for Analog-to-Digital Converters". *IEEE STD 1241-2010 (Revision of IEEE STD 1241-2000)*: 1–139. 1 January 2011. doi:10.1109/IEEESTD.2011.5692956 (https://doi.org/10.1109%2FIEEESTD.2011.5692956). ISBN 978-0-7381-6239-3.
5. *Understand SINAD, ENOB, SNR, THD, THD + N, and SFDR so You Don't Get Lost in the Noise Floor* (http://www.analog.com/static/imported-files/tutorials/MT-003.pdf) (PDF), Analog Devices, Inc., 2009, retrieved 17 August 2012

External links

- SINAD and SINAD measurements for radio receivers (http://www.radio-electronics.com/info/rf-technology-design/rf-noise-sensitivity/sinad.php)