RightMark Audio Analyzer

Version 2.5

2001

http://audio.rightmark.org

Tests description

Contents

For linear systems (or close to them analogue devices) there are lots of methods for measuring performance. And all the methods give similar results. But when there are non-linear elements at the signal path, different measurement methods yield substantially different results. Digital devices are such non-linear systems (especially DACs and ADCs).

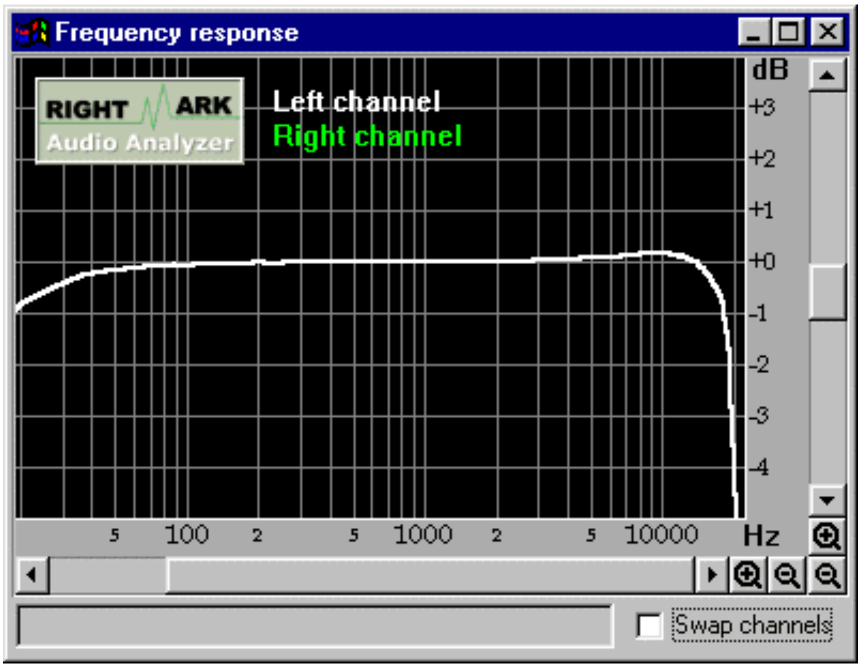
Authors of this program recommend users not to draw conclusions from comparing results obtained by different measurement methods or in different conditions.

Frequency response test

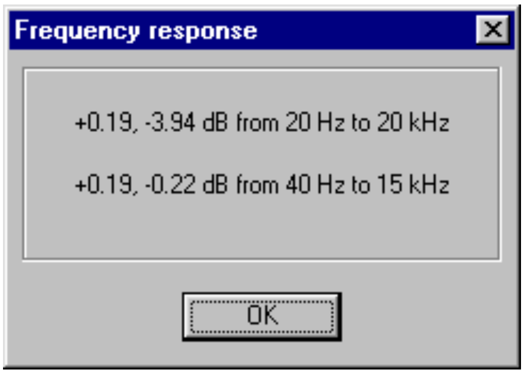
*There are many different methods for testing the frequency response of sound devices. The most common method is to play through the system, one by one, a set of sine waves with different frequencies and constant amplitudes (say, -20 dB), and to measure deviations in amplitude of sinusoids at the output of the system. Another method uses sine wave with continuously varying frequency ("swept sine"). There are methods using delta function or white noise as test signals. All these methods are frequently used but most of them are ineffective and give results far from accurate (esp. last 2 methods). Most methods take a long to complete (especially when a good resolution in amplitude and in frequency is required). The common feature of all these tests is that the test signals are far from real musical signals. Our method uses a test signal which is close to real music. Therefore we test a sound device in **real working conditions**.*

So, our **test signal** has a complex spectrum similar to "average" music record with bass and drums. It contains harmonics from 5 Hz to the half of a sampling rate. Duration of the signal is 80000 samples.

Result calculation. The testing is performed only for the left channel. The recorded test signal is transformed into Fourier series; FFT window size is 65536 points (before the transform the signal is multiplied by weighting windows giving sufficient amplitude resolution). Afterwards input and output amplitudes of each harmonics present in the original signal are compared. The difference gives us a frequency response curve. When displaying the curve graph on a screen, it is centered to have 0 dB amplitude at 1 kHz.



The detailed report shows the amplitude deviation limits across two frequency ranges: from 40 Hz to 15 kHz and from 20 Hz to 20 kHz.

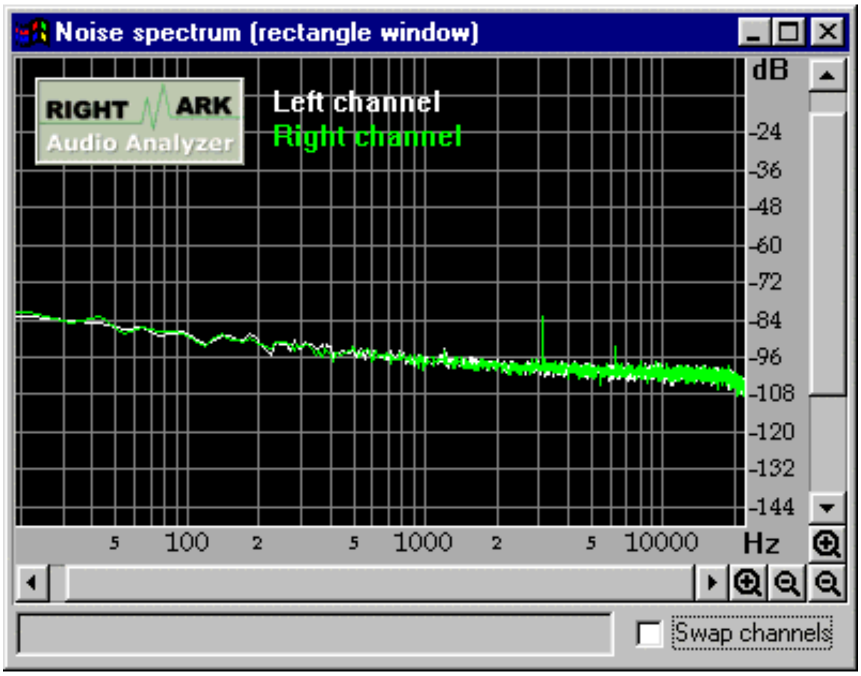


Noise level test

*This test estimates the noise level **during silence** in the testing chain. The graph of the noise spectrum helps to locate frequencies of interference caused by AC circuits, CRT displays and other electronic devices.*

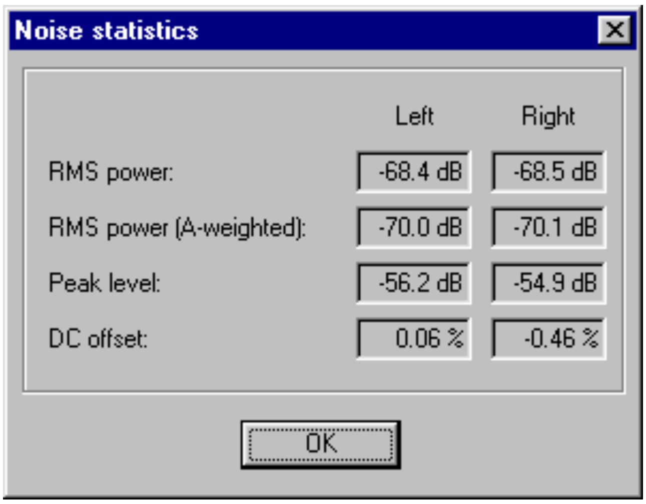
The **test signal** is a digital silence (or a dithering noise). Duration of the test signal is 80000 samples.

Result calculation. After DC elimination, the recorded test signal is transformed into Fourier series. FFT window size is 4096 points. The transform window is moving through the signal with a step of 4096 samples and 16 calculated spectrums are averaged and output on a screen.



The detailed report shows noise statistics (calculated from the 65536 sample points):

- ✓ *RMS power* (with 0 dB corresponding to the power of a square waveform with peak values of 0 dB FS).
- ✓ *RMS power (A-weighted)* – is a RMS value of A-weighted noise equivalent.
- ✓ *Peak level* – is a maximal value of noise amplitude (dB FS).
- ✓ *DC offset* – amount of direct current in the recorded audio signal (in percents of maximal amplitude).

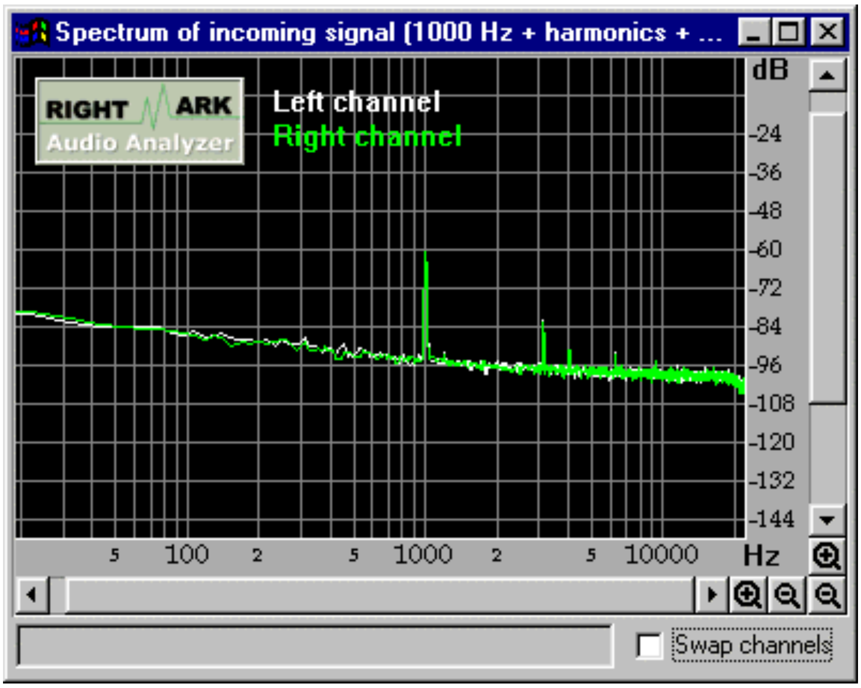


Dynamic range test

This test estimates the noise level ***in the presence of weak signal****, and also the linearity of a sound device operating at low signal levels (which is very important for high-quality sound recording and playback).*

The **test signal** is a sine wave at 1 kHz and -60 dB FS. Duration of the test signal is 80000 samples.

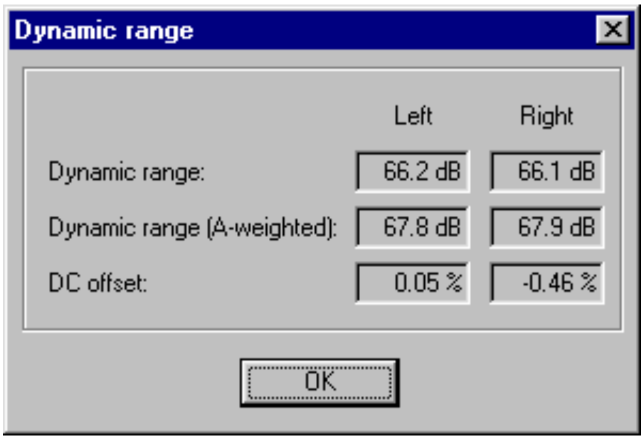
Result calculation. After DC elimination, the recorded signal is transformed into Fourier series (Kaiser weighting window is used, beta = 8). The transform window is moving through the signal with a step of 2048 samples and 31 calculated spectrums are averaged and output on a screen.



To calculate the dynamic range value, the sine 1 kHz harmonics is filtered out from the signal and the rest signal is measured (actually we do not use filtering, but we make all calculations with a spectrum of the test signal).

The detailed report shows:

- ✓ *Dynamic range* - RMS power of the rest signal (with “+” sign).
- ✓ *Dynamic range (A-weighted)* – RMS value of A-weighted equivalent of the rest signal (with “+” sign).
- ✓ *DC offset* – amount of direct current in the recorded audio signal (in percents of maximal amplitude).

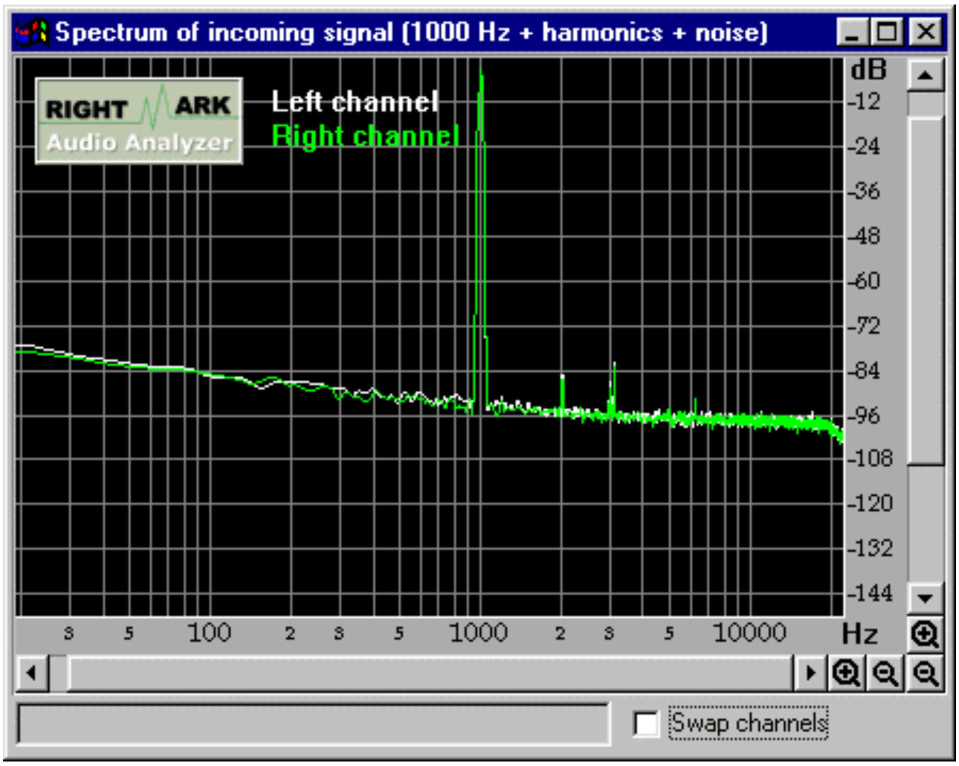


Total harmonic distortion test

*This test estimates amount of harmonic distortion that occurs when a signal with **large** (close to maximal) **amplitude** passes the testing chain. The musicality and transparency of sound depend on amount of distortion and on its spectrum. The most important details on a graph of spectrum are the ratio of even and odd harmonics, and the presence of harmonics with unwanted frequencies.*

The **test signal** is a sine wave at 1 kHz and -3 dB FS. Duration of the test signal is 80000 samples.

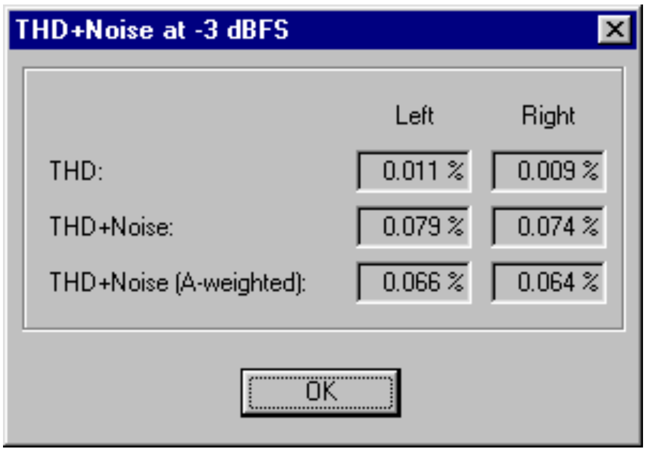
Result calculation. The recorded signal is transformed into Fourier series (Kaiser weighting window is used, beta = 16). The transform window is moving through the signal with a step of 2048 samples and 31 calculated spectrums are averaged and output on a screen.



To calculate the THD value, the sine 1 kHz harmonics is filtered out from the signal and the rest signal is measured (actually we do not use filtering, but we make all calculations with a spectrum of the test signal).

The detailed report shows:

- ✓ *THD* – amount of harmonic distortion – amplitude of the sum of harmonics of the test signal rated to the amplitude of the fundamental (1 kHz).
- ✓ *THD + Noise* – RMS value of the rest signal (rated to the amplitude of the fundamental).
- ✓ *THD + Noise (A-weighted)* – RMS value of A-weighted equivalent of the rest signal (rated to the amplitude of the fundamental).

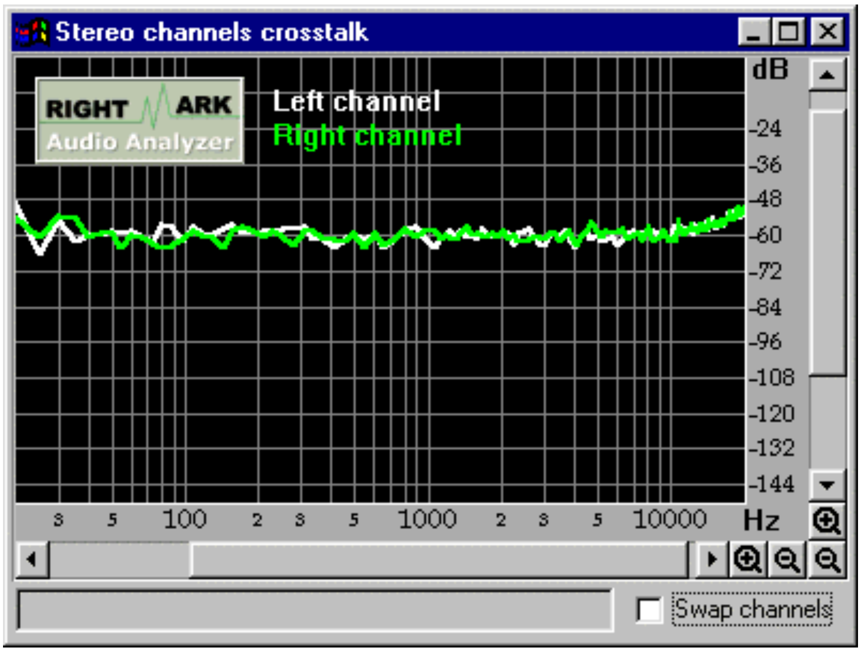


Stereo channels crosstalk test.

This test estimates leakage of signal from one channel to another for various frequencies. If the sound device has poor crosstalk results, then you can't get a good stereo image from your sound recording.

The **test signal** is a set of 136 harmonics of different frequencies with a "musical" spectrum (see frequency response test). First the test signal is fed into the left channel, and then – into the right one.

Result calculation. Let the right channel carry test signal and the left channel carry silence. The recorded signal from the left channel is analyzed similarly to frequency response test. After that the comparison of amplitudes of the source (at the right channel) and the recorded (at the left channel) harmonics is performed for each frequency present at the source signal. The difference in amplitudes gives us the desired curve of crosstalk from the right channel to the left channel. The graph of crosstalk shows how crosstalk depends on frequency.



The detailed report shows amounts of leakage between stereo channels for different frequencies: 100 Hz, 1 kHz and 10 kHz.