Sound Card Analyzer

Version 2.0

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User manual

Contents

About the program

This program performs various tests of electroacoustical performance of sound cards and other real-time audio devices. Testing is accomplished by playing the test signals and recording them after they pass through the testing chain. Because of this, your sound card must allow full-duplex operation (see “Full-duplex operation”).

In the simplest case the testing chain includes the DAC of your sound card, line or speakers output, line input, and ADC. In order to test some other devices you must connect them between the output and the input of your sound card. It is assumed that you have a high quality sound card, because otherwise poor performance of the sound card will mask the performance of the external device.

You can use external A/D and D/A converters or digital inputs and outputs of your sound card.

System requirements: CPU: Pentium or higher, operating system: Windows 95/98/2000.

Preparation for testing

1. In the simplest case – connect the line or speakers output of your sound card to the line input.
2. Using the mixer of your sound card select only “wave out” source for playback and only “line in” source for recording.

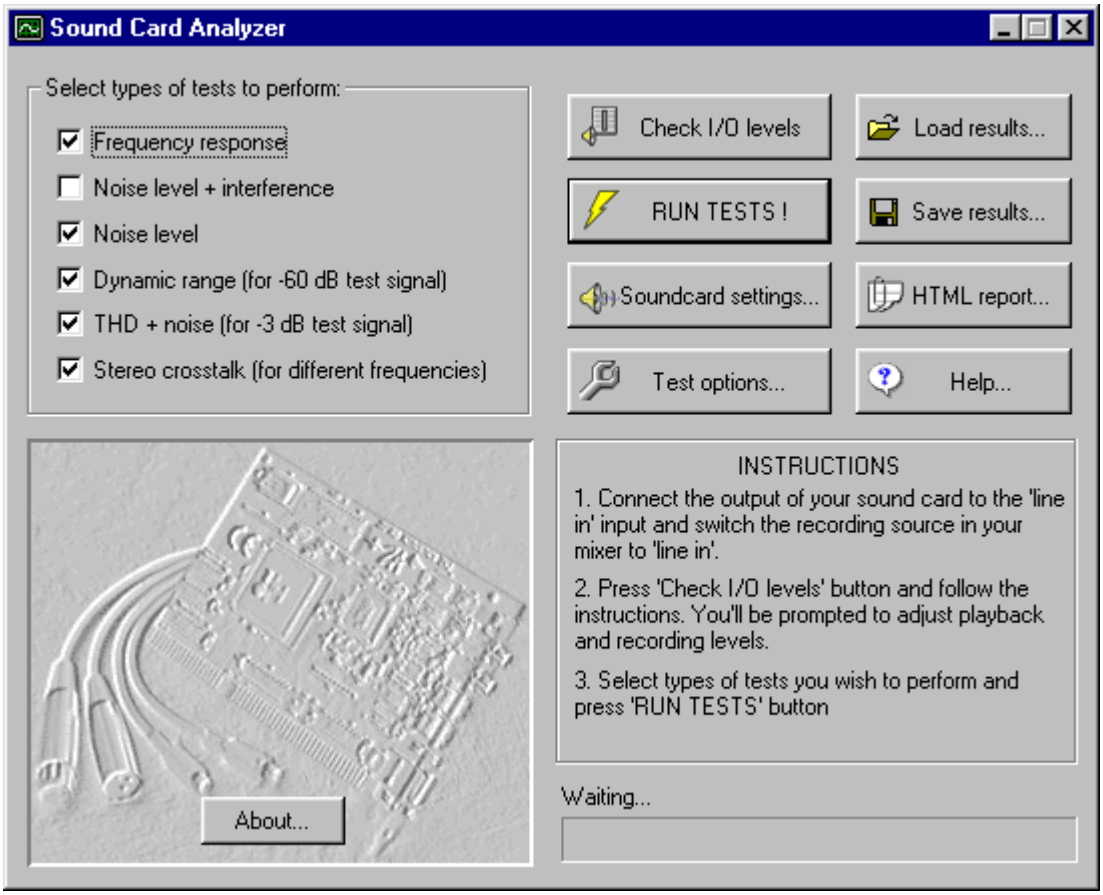

Fig. 1: *The main window of the program.*

3. Run the Sound Card Analyzer. If you run it for the first time, you will be prompted to select your sound card settings (audio device, sampling rate, and resolution): see fig. 2.

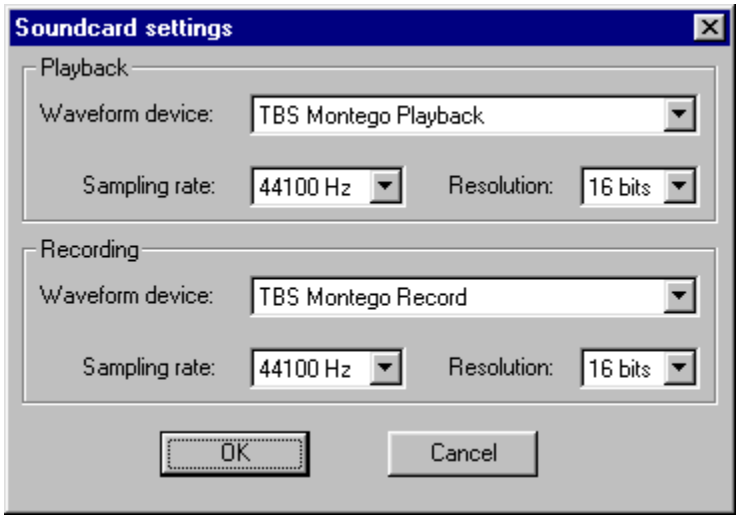

Fig. 2: *Sound card settings dialog.*

4. Press *"Check I/O levels"* button. The sound card calibration will start. Two testing signals will be played back repeatedly: 0 dB FS and -6 dB FS. Adjust playback and recording levels in your mixer to make input levels approximately equal to output levels (precise equality is not needed, a difference of 1 or 2 dB can be tolerated).

Testing

Select the desired types of tests at the main window (see fig. 1) and press the *"RUN TESTS"* button. All the tests take about 1 minute to complete. The longest test is a test of interference. It takes about 30 seconds to complete.

After tests are complete you can view the results in the "Test results" window or perform tests that were not selected.

Viewing the results

In the “Test results” window you can see the information on results of all the tests that were performed (see fig. 3).

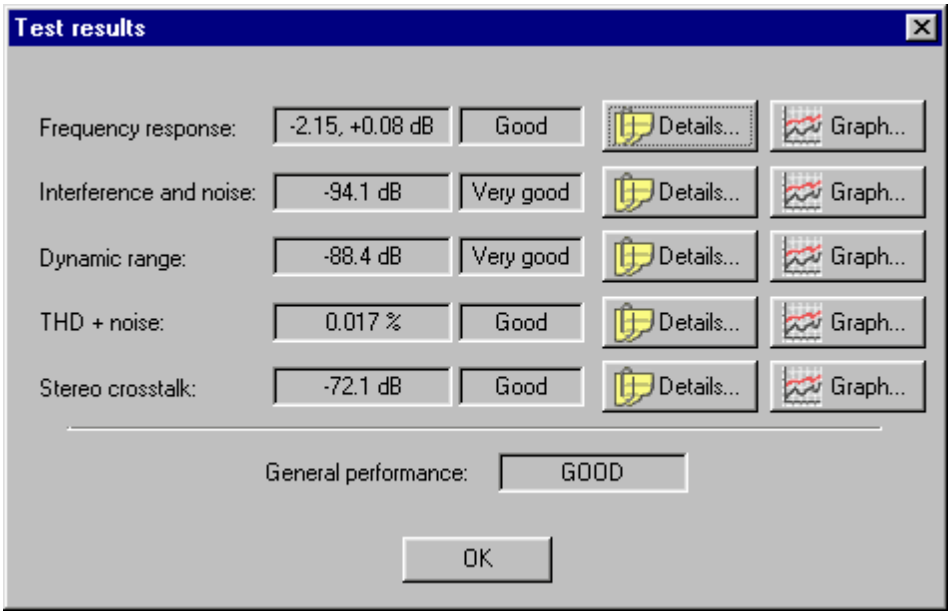

Fig. 3: *“Test results” window*

For each test a brief result and a conclusion is displayed. If conclusions are “Excellent” then your sound card is suitable for professional sound recording. If conclusions are “Good” then you can use your sound card for home recording. Lower marks mean that there are some significant drawbacks and you shouldn’t use this card for serious musical work.

For each test you can view detailed report *(“Details”* button) or graph (*“Graph”* button).

Details window

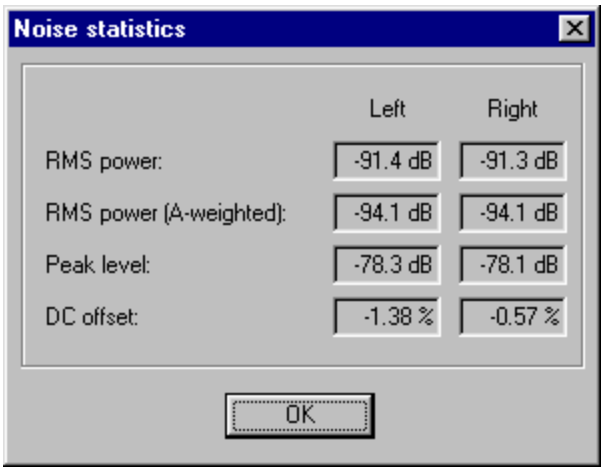

Fig.4: *Details window (for noise level test)*

In the “Details” window (see fig. 4) you can see a numerical report on the performance of your sound card in that particular test. Results are displayed separately for left and right stereo channels.

Graph window

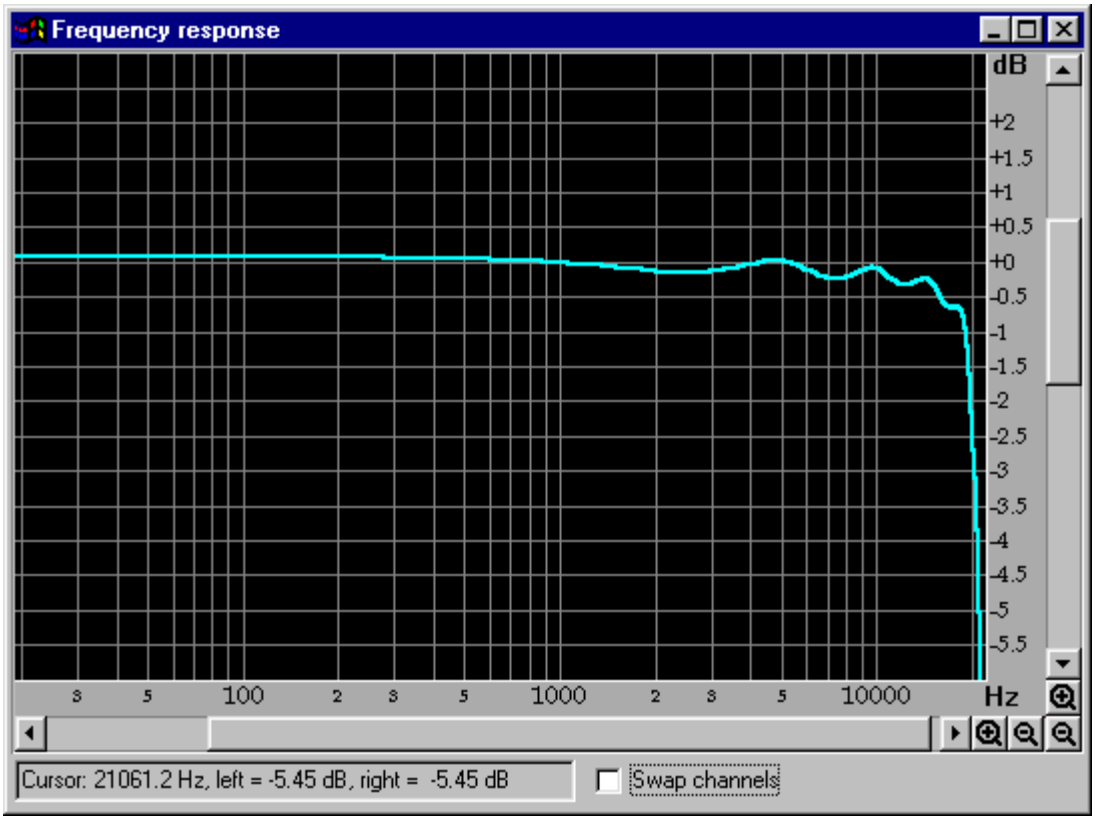

Fig. 5: *Graph window (for frequency response test)*

Control buttons:

- zoom in

- zoom out

Swap stereo channels – draws the graph for left channel in front of the one for right channel (default setting is vice versa).

Mouse controls:

Left button – selects the horizontal range and performs “zoom in”.

Right button – performs “zoom out”.

Loading and saving the results

Three buttons for loading and saving the results are available at the main window (see fig. 1).

"Load results" button enables you to load previously saved results from SAV file into the "Test results" window.

"*Save results"* button enables you to save results from "Test results" window into the SAV file.

"HTML report" button enables you to create HTML report with test results. All the details and graphs are included into HTML file.

Tests description

Frequency response test

This test estimates the frequency response across the whole frequency range.

The test signal resembles some "average" musical recording by its spectrum and amplitude. It helps to estimate the frequency response in real conditions.

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.

Graph shows the frequency response curve.

Interference and noise level test

This test estimates the noise level during silence in the testing chain. The test of interference 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, see "Dithering"). For the test of interference the duration of the test signal is 20 seconds because the process of finding interference frequencies requires the calculation of averaged spectrum from a very long time period.

The *detailed report* shows noise statistics:

- RMS power.
- RMS power (A-weighted) – is a RMS value of A-weighted noise equivalent (see "A-weighting").
- 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).

Graph of test results shows the averaged spectrum of incoming signal (noise spectrum). FFT window size is 4096 points. For the test of interference there is a sepa-

rate graph showing the averaged noise spectrum for a long time period. This spectrum reveals frequencies of interference.

Dynamic range test

This test estimates the noise level in the presence of signal.

The test signal is a sine wave at 1 kHz and –60 dB. The signal is rather weak to prevent large harmonic distortion. After the signal passes the testing chain, the sine 1 kHz harmonics is filtered out from the signal and the rest signal is measured.

The *detailed report* shows:

- Dynamic range – RMS value of the rest signal.
- Dynamic range (A-weighted) – RMS value of A-weighted equivalent of the rest signal (see "A-weighting").
- DC offset – amount of direct current in the recorded audio signal (in percents of maximal amplitude).

Graph of test results shows the averaged spectrum of incoming signal, including the 1 kHz harmonic. FFT window size is 4096 points.

Total harmonic distortion test

This test estimates amount of harmonic distortion that occurs when a signal with a large amplitude passes the testing chain.

The test signal is a sine wave at 1 kHz and –3 dB (amplitude can be changed at the *"Test options"* window). After the signal passes the testing chain, the sine 1 kHz harmonics is filtered out from the signal and the rest signal is measured.

The *detailed report* shows:

- THD – amount of harmonic distortion – amplitude of the sum of harmonics of the test signal.
- THD + Noise – RMS value of the rest signal.
- THD + Noise (A-weighted) – RMS value of A-weighted equivalent of the rest signal (see "A-weighting").
- DC offset – amount of direct current in the recorded audio signal (in percents of maximal amplitude).

Graph of test results shows the averaged spectrum of incoming signal, including the 1 kHz harmonic. FFT window size is 4096 points.

Stereo channels crosstalk test

This test estimates the leakage of information from one channel to another for various frequencies.

The test signal is a set of harmonics of different frequencies in different stereo channels with amplitude of –20 dB. When signal passes one stereo channel, the measurement is performed in other stereo channel.

The *detailed report* shows amounts of leakage between stereo channels (i.e. amplitudes of leaked signal plus 20 dB) for different frequencies: 100 Hz, 1 kHz and 10 kHz.

Graph shows how crosstalk depends on frequency.

Test options

This dialog selects some options for various tests:

- *THD test signal amplitude* can be selected in the range from –90 dB to 0 dB. Default value is –3 dB. By varying this parameter you can turn the THD test into a dynamic range test. Also you can detect the maximal level beyond which THD starts to grow rapidly.
- *Apply dithering to test signals* checkbox turns on dithering during the generation of test signals (see “Dithering”).

Soundcard settings

This dialog selects devices for digital audio playback and recording, and mode of operation: sampling rate and resolution.

In this version of program the sampling rates for playback and recording need to be equal. Audio devices and resolutions may differ.

After closing the dialog with the “OK” button the program tries to test selected devices and the selected modes of operation and reports on failure.

Glossary

A-weighting. Human hearing is unequally sensitive to sounds of different frequencies. For example the maximum of our sensitivity to quiet sounds lies around 3 kHz. Sounds of these frequencies we perceive as louder ones. Because of this we need to modify the technique of spectral measurements to make them closer to our hearing perception. Such modifications are known as A-weighting. They are widely used in audio measurements (for example, when estimating the noise level or dynamic range). As a result we get inaudible frequencies attenuated and the most audible ones contribute more to the final results.

Dynamic range is a ratio of the maximal signal amplitude to the noise level (RMS value) in the presence of weak signal.

Dithering is a process of adding noise to the signal which was generated with a high precision. Usually dithering is performed before quantization to eliminate correlation between the signal and quantization error. As a result the noise of quantization becomes white and more pleasant than the “dirty” quantisized signal. Although we add some noise, the dynamic range becomes subjectively higher.

Full-duplex mode is an ability of sound card to record and playback digital audio simultaneously. Almost all of modern soundcards support this mode, but some of them need to be tuned up in the Control Panel.

THD (total harmonic distortion) is a level of (usually unwanted) harmonics generated in the sound device. Usually high quality devices have a low THD value (lower than 0.002%), but there are exceptions. Many tube devices have rather high THD level, which makes their sound “warm”. But transistor devices must have low THD, because their (odd) harmonics don’t make the sound pleasant.

Feedback and future work

In the next versions of this program I plan to make a database for comparison of different sound cards. The set of tests will be extended (tests of phase errors and frequency accuracy will be added).

All your comments and suggestions on this program will help me in development of next versions. Your questions are also welcome at lukin_a@mail.ru