LOUDSOFT

FINE QC™/ Headphone

Quality Control System for Headphones
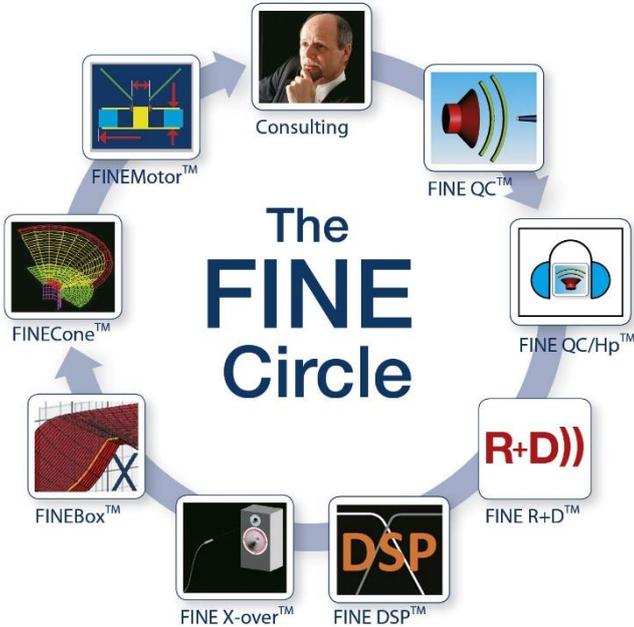
Contents

1. Getting started

1.1. How to install FINE QC / Headphone

- Download the installation files from Dropbox or from link
    - If installing from a CD, remember to also install Autorun
- Run Setup.exe to do a normal installation. **Make sure FINE Hardware2 is disconnected.**
- Go to programs and right-click on the symbol of the program. Click "Run as Administrator". You need to be on the internet for Windows to download drivers.
- Click OK on the first dialog
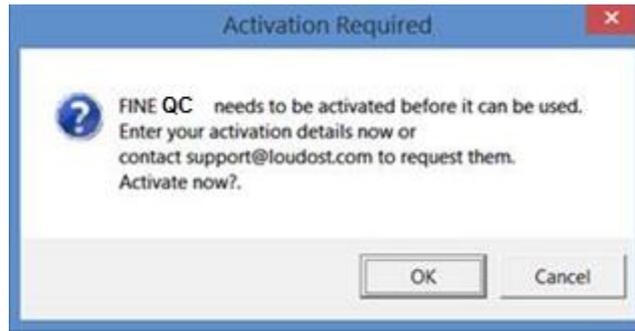
- Click YES on the second dialog
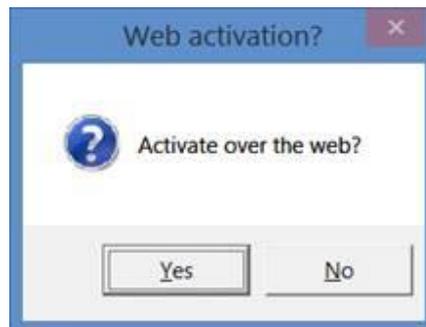
- Fill in your license ID and password in the next dialog. Your license ID is XXXXXXXX and your password is PPPPPPPP

- Click OK. The software is now ready for use.

After the activation, the FINE QC / Headphone will be fixed to your computer, and you can only use it on that computer. However, you can deactivate the license on your computer and

then install and activate it on another computer. For more information, go to "Help / Deactivate".

1.2. How to setup FINE Hardware2

Figure 1 - FINE Hardware 2 for measuring headphones, including Noise Cancel test.

1.2.1. L / R Microphones

Connect the two microphones for Left (L) and Right (R) to Mic 1 and Mic 2 XLR inputs as shown in the above picture. Use the supplied Phantom converter(s) with BCD connector for direct connection without preamps for GRAS and CRY Microphones with CCP (Constant Current Power). See section 3 for recommended GRAS and CRY Test Fixtures with Artificial Ears.

1.2.2. Headphone

Connect the headphone to the 3.5mm stereo jack input, shown as the blue cable in Figure 1

1.2.3. Noise Test Speaker(s)

Connect the speaker(s) to be used for the Noise Cancel test to the red/black banana plugs (or Speak-on connector). It is advisable using two speakers connected in parallel for playing the Noise test signal, so the noise can reach both Left and Right ear phones. Ideally a diffuse sound field should be used, however, for QC testing a normal room or test both may be used by keeping the environment noise low.

If there is moderate factory noise, you may get acceptable Noise Cancel testing by placing the noise speakers close to the headphones and setting the noise signal quite high, see Figure 2.

We recommend using two Dynaudio Emit M10 speakers connected in parallel from the main output as the noise source. These speakers can be delivered from LOUDSOFT.

However, if the noise speaker(s) are active, you must use the Line Out XLR output. The signal on this is normal line level. Selecting an output voltage reading in the 1 – 10 V range will usually give a good, high Noise Level for the Noise Cancel test.

Note: Please find the full specifications for the FINE Hardware2 in section 2.

Figure 2 – Noise Cancel Testing using two Dynaudio Emit M10 speakers

1.3.   Initial start-up

- Connect the power to the FINE Hardware2. **Make sure the ground is connected in your power plug.**
- Connect the FINE Hardware2 to your computer with a USB2 cable. The Windows PC will automatically load the proper driver.
- Start FINEQC for the first time.
- You can log in as Engineer (no password needed until you set that; see 2.6 page 20)
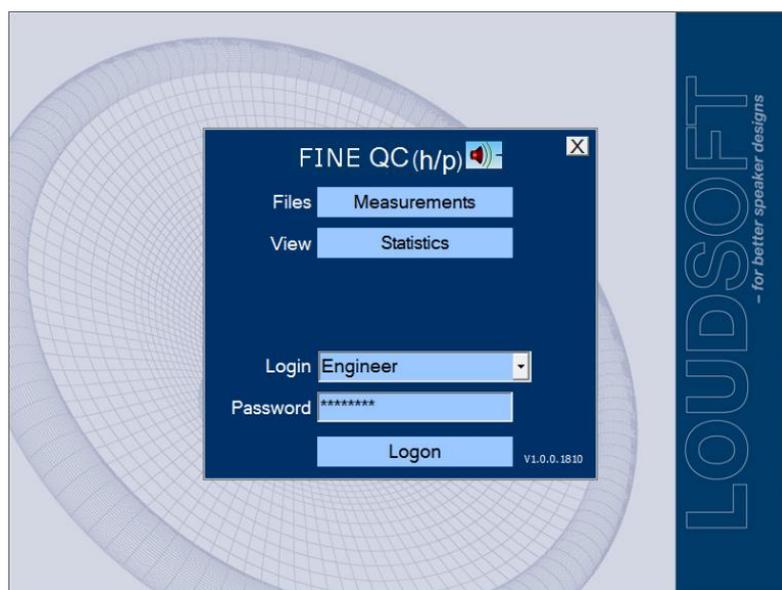
Figure 3 - FINE QC Headphone start screen with login

- The FINE Hardware2 is factory-calibrated and you do not need to do anything. However, you may calibrate the Mic1 (L) and Mic2 (R) sensitivities, see below.
- Pressing Help / Tutorial will show this document as PDF.

You may go on with testing on the next page.

1.4. Microphone L and R Calibration

If you want to calibrate the microphones in the Artificial Ears in the system with your exact microphone sensitivities, go to the main and select Calibration. Then select Microphone L and Microphone R in turn:
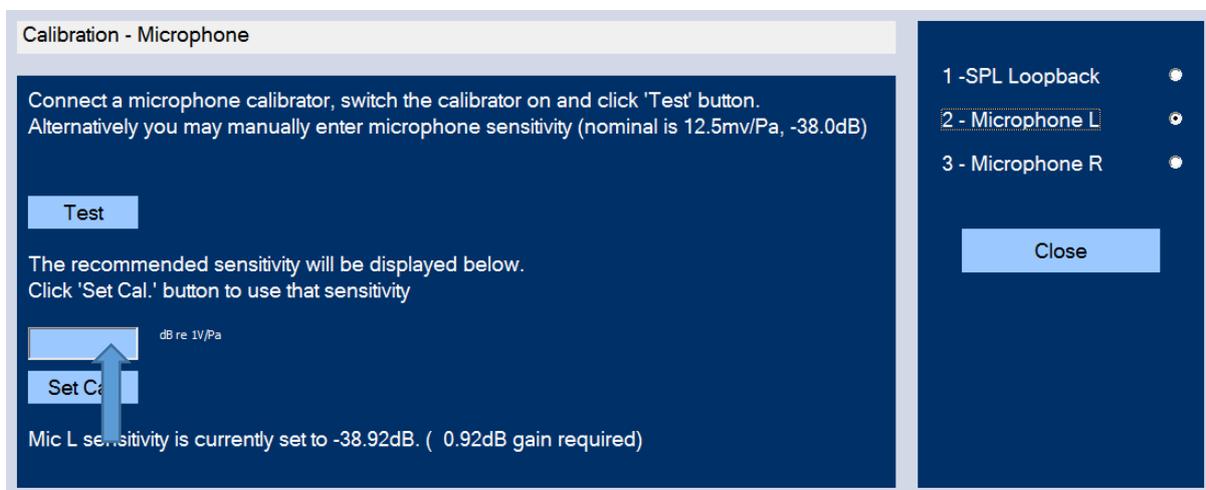
Figure 4 - Admin page

The default sensitivity is -12.5mV re. 1V/Pa (-38 dB re. 1V), which fits most Artificial ears. You may input the actual sensitivities from the spec sheet into "Sensitivity" field (Blue Arrow) in the Microphone Calibration page shown above.

If you have a microphone calibrator giving 1 Pa (94 dB SPL) you can directly calibrate both Microphone L and Microphone R.

1.5.   Headphone QC Testing

You can log in as a tester or an engineer (no password for engineer is needed at first, but you can define one in Admin).

Select a predefined test:
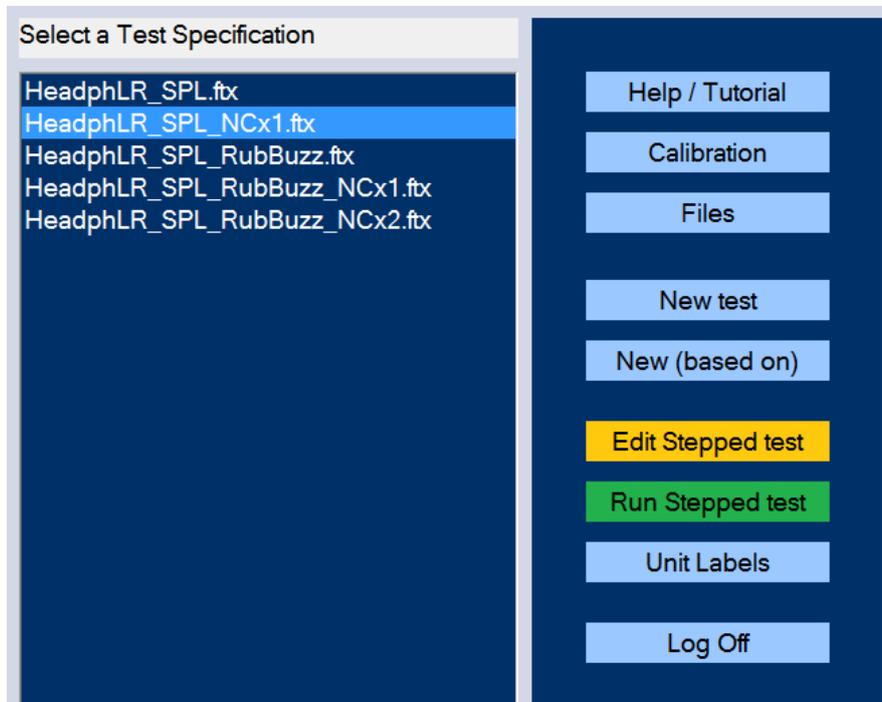
Figure 5 - Select a Test Spec

Selecting "Run Stepped test" and one of the following screen appears:
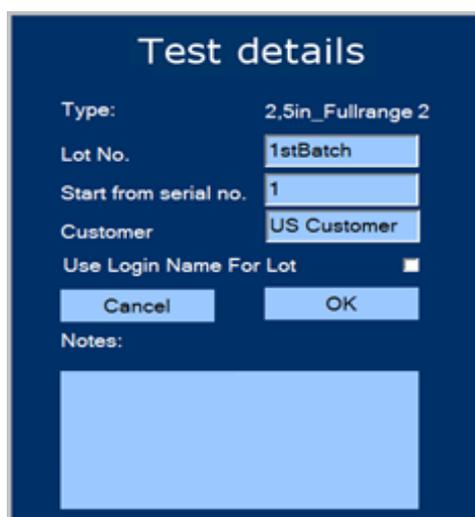
Figure 6 – FINE QC Test Details

After filling in the Batch Number and Customer Name, the series will start with #1 and automatically count up as you test. If you enter the last tested number instead, FINE QC will count up from that.

If you are testing individual units, you can specify the serial number each time, see Figure 10 on page 10. To do this, insert a [v] in "User Ser. No.". It is possible to use a USB barcode reader to avoid having to type the entire serial number each time.

Below is the screen after testing the headphone using the **"HeadphLR_SPL_RubBuzz_NCx2.ftx"**
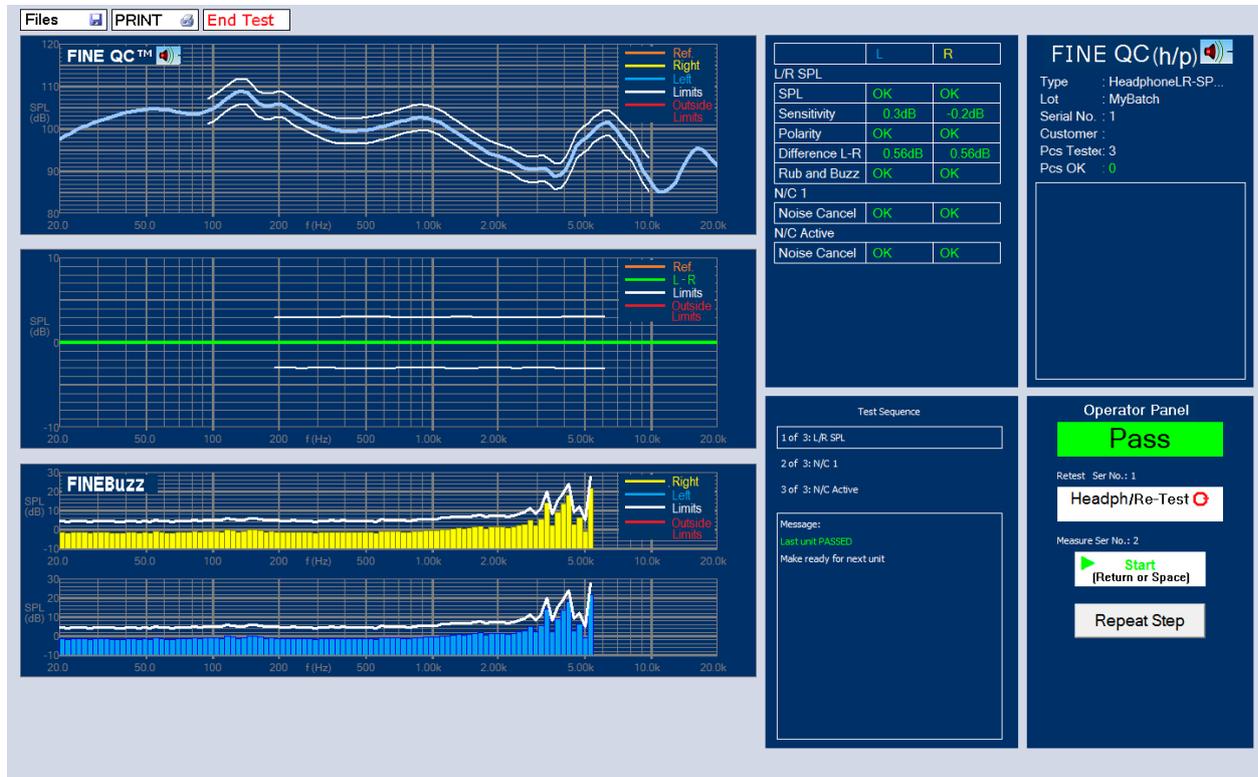
Figure 7 - Main Test Screen

The upper left graphs are the L (Blue) and R (Yellow) responses with limits (White). The center graph shows the difference L – R and is well within the limits.

The two curves at the lower left is the Rub & Buzz of L and R, also below the limits. Further results are Sensitivity of L and R and Polarity. All is within the defined limits and the headphone is OK, shown as the green "Pass".

During testing it is possible to re-test the current test step by pressing "Repeat Step", or for repeating the total headphone test sequence by pressing "Sing/Re-test", in both cases the original numbering will be kept. The number of tested headphones and approved units is reported in the upper right window.

1.5.1.   New Test / Edit Limits

When you want to make a new headphone test you have two options:

A)   Choosing "New Based on". Here you can easily create a new test by only changing a few details. Note that there are tests having 4 steps, where each step may be edited. Go to 2.1.2

B)   Pressing "New Test" means starting from scratch based on the following:
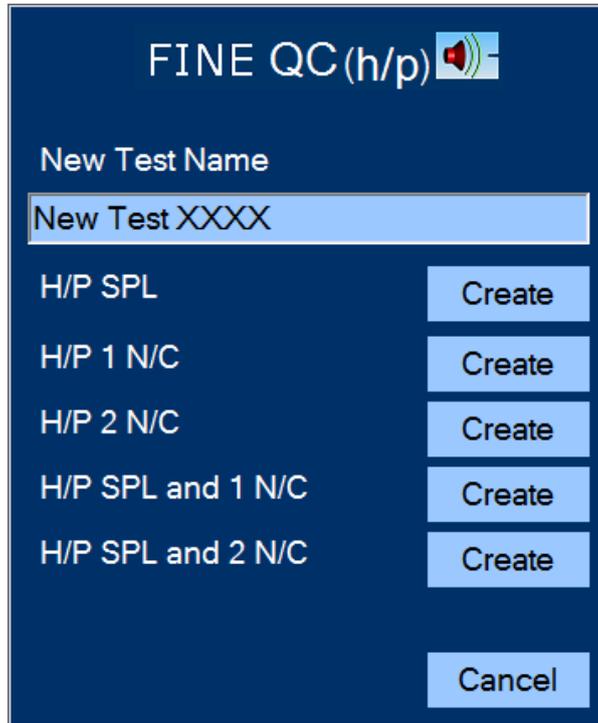
Figure 8 - Define New Test Choices. N/C is Noise Cancel

1.5.2.   New **Based on**

When you need to make another test similar to one of you existing tests, you can save time by choosing "New Based On", which will load your existing test so you can modify it and save the new test.

1.5.3.   New Test

Create your new test from one of the choices. H/P means Headphone, and N/C means Noise Cancel. Select the most suitable option. 2 N/C is two Noise Cancel tests, for example Passive N/C test followed by Active N/C test.

No matter if you have created a completely new test or only want to edit a test here is how:

In the following we will edit the Test specification: **"HeadphLR_SPL_RubBuzz_NCx2"**. Pressing
Edit Stepped test in the main menu you will get this display, which shows there are 4 steps in this test sequence. (Here you can also specify using individual numbers, see red arrow in Figure 9)
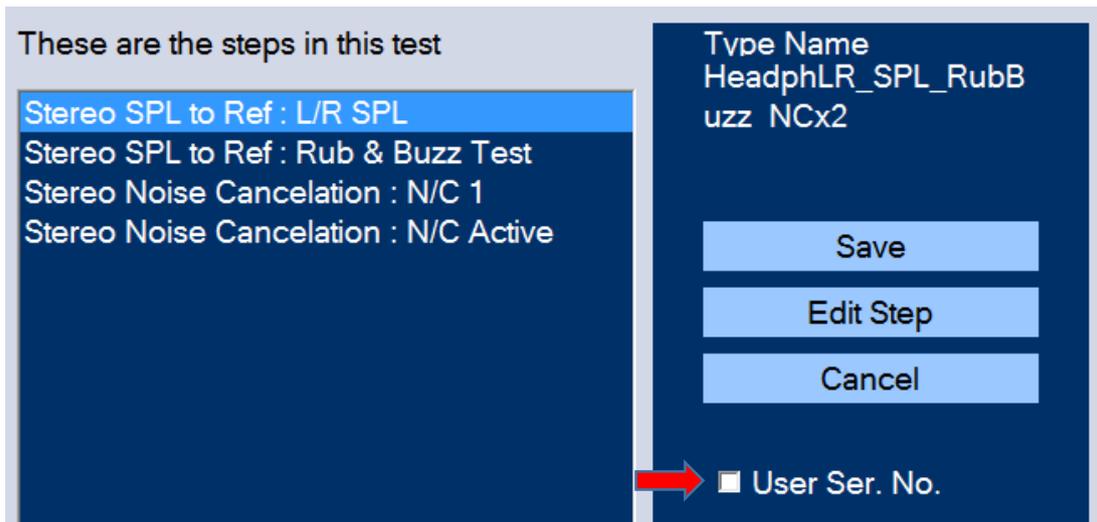
Figure 9 - Select Test Step to Edit

The first step "Stereo SPL to Ref: L/R SPL" measures the headphone's SPL responses with limits, Sensitivity, Polarity and L – R difference. Pressing "Edit Step" will get this screen:
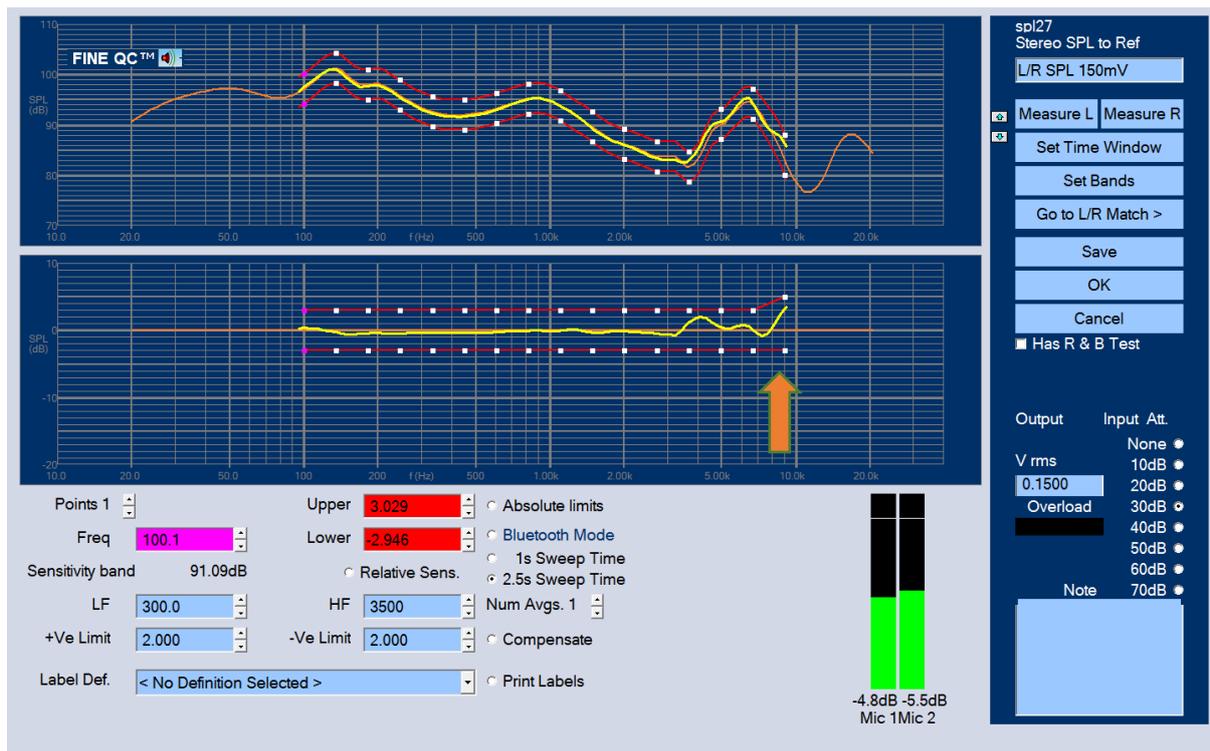
Figure 10 - Edit SPL Test. Arrow indicating dragged limit

First measure the SPL by pressing either "Measure L" or "Measure R". Both buttons will actually measure both L and R channels, but using the indicated one as reference. Be sure to check the SPL level on the VU-meters (Black/Green). Keep the reading below -10dB using the input attenuator.

Pressing "Set Time Window" shows the display below, which is the time response (Impulse) calculated by (inverse) FFT.
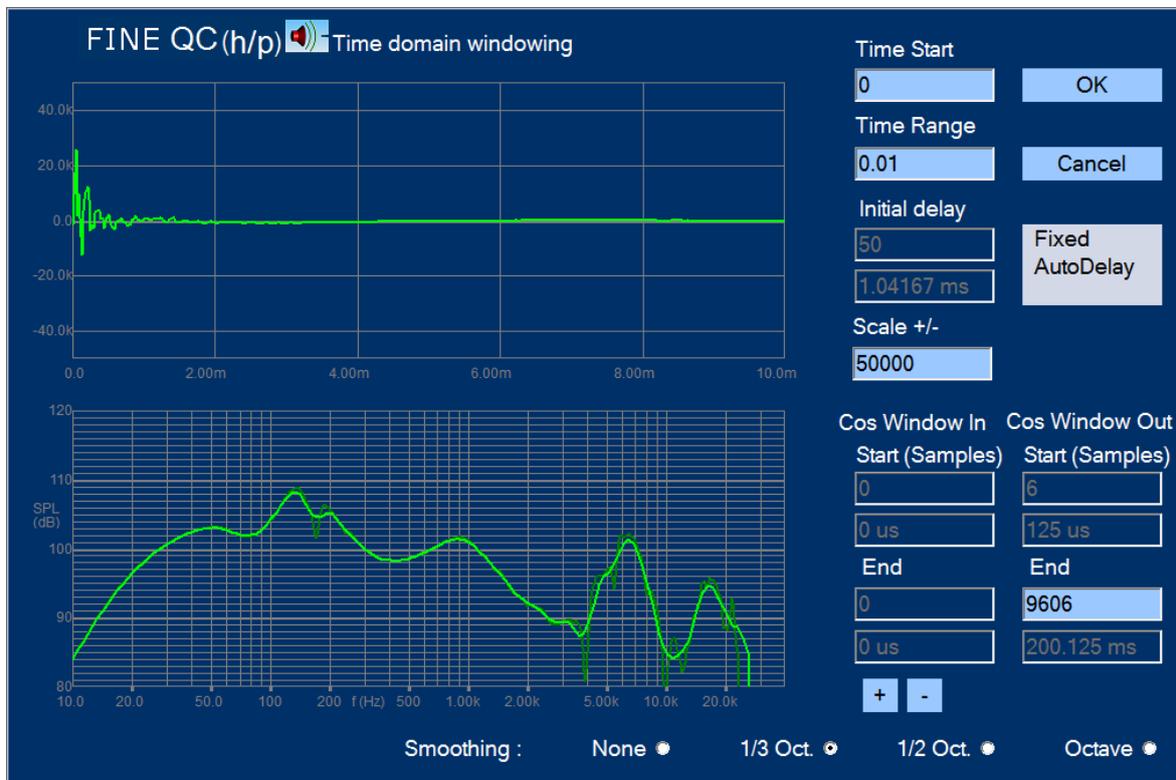
Figure 11 - Time Window

Because the headphone is measured directly in the artificial ear there are no real reflections, and therefore we simply use the full window (9606samples ~200mS).

Since headphones very often have some very narrow dips and peaks, it is recommended to use smoothing, like a 1/3 octave smoothing used in this example.

After OK we select "Set Bands" with the following display:
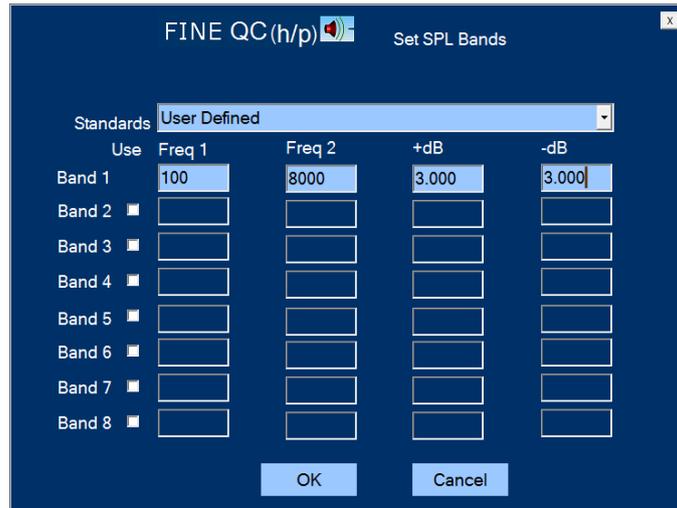
Figure 12 - Set (Frequency) Bands

Here is chosen one frequency band from 100 – 8000 Hz +/- 3dB (Figure 12), which produced the red limit lines 3dB offset from the orange reference curve shown in Figure 13 on page 13. The yellow response is the Right (R) channel in the same display.

The curve in the center is the relative response, using the Reference (L) channel as the straight horizontal line. This way it is much easier to see how well the other channel (here R) falls within the chosen limits.

Actually, there is a problem indicated by the orange arrow: The R channel curve did not fit within the +/- 3dB limits! But the limit curve was easily changed to include the R curve, just by dragging the little white square with the left mouse button. This way you can also make room for a peak which will change in frequency during production.

The sensitivity can be defined as an average over a frequency range, in this case 100.28dB +/-2 dB (100-2000Hz), lower left in Figure 10.

The next line is (Limits-) Compensation: This is a kind of Sensitivity Controlled Floating Limits. When active, the measured response is allowed to move within the limits as determined by the sensitivity tolerance.

Press [Go to L/R Match >] to show the screen for matching the L and R channels:
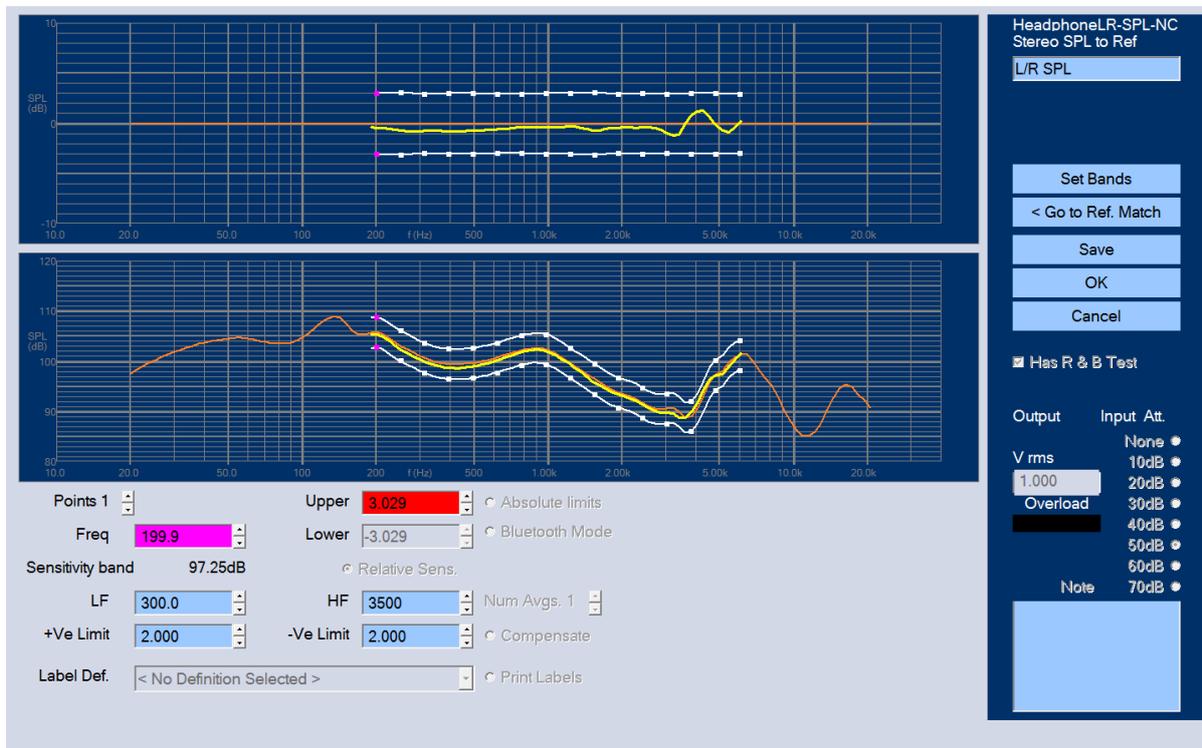
Figure 13 - Left-Right Difference L-R

Using the reference L (orange) the difference L – R is shown both as deviation and directly.

Using "Set Bands" like before you can now attach a specific tolerance limit for this L – R difference. The white squares can be dragged like before if necessary. Here the limits are set at +/- 3dB in three different bands. You can set up to 8 different bands.

Figure 14 - Set L-R Bands

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1.6.   Rub & Buzz Setup

On the production line it is necessary to check all units for bad sound. This might be due to a defective driver unit or rattle from the headphone itself. This is shown as the 2nd step:

The new FINEBuzz detection method is based on the latest Danish research on hearing mechanisms, and uses a completely new algorithm to find the annoying sounds that cannot be detected with conventional methods like THD, high harmonics or IM distortion. The new method is extremely sensitive and can detect even the smallest buzzing tinsel in a small driver.
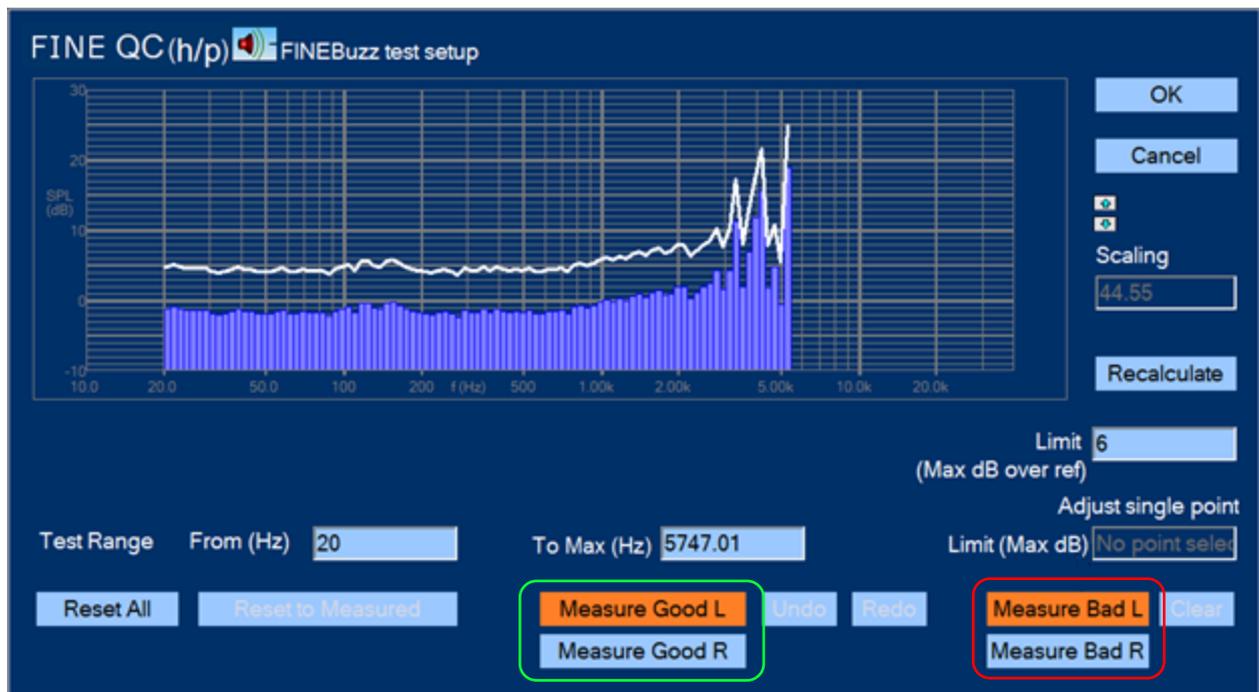
Figure 15 – FINEBuzz Rub & Buzz set up

Press "Setup R&B Test" to get Figure 15. The rub and buzz is normally concentrated at low frequencies where the driver excursion is high. These annoying sounds typically contains high harmonics where the ear is most sensitive, especially around 1- 3 kHz.

FINEBuzz has a sweeping filter to pick up the rub and buzz, which is measuring higher harmonics and all other kinds of distortion. So already when the frequency reads 6 kHz, all distortion components are measured up to 24 kHz. Therefore, the max Test range is ~5.75kHz.

1.7.   Automatic Rub & Buzz Limit

This new feature can save a lot of time: First measure some good sounding headphones by clicking the [Measure Good L] and/or the [Measure Good R] button. Each will show as a yellow line, and each measurement will automatically update the maximum Rub & Buzz limit.

Note: You can undo any wrong measurement!

Then measure a few bad ones with [Measure Bad], showing up as a red maximum line. Check that the red lines are clearly above the white line! Set the Limit so that the white limit line is centered between good and bad measurements. The limit was in this example set as 6 (Max dB over ref).

Press "Recalculate" to reset the white limit. By clicking OK, you have automatically set the Rub & Buzz limit to approve the good and reject the bad units!

You can adjust the white limit line for each blue column individually by clicking it and adjusting the level with the mouse wheel, or entering the number in the field at lower right.

Note: Setting the FINEBuzz limit to a few dB requires silent test conditions! Avoid noise sources like air guns, fans, bumping carts and pallets. A separate test booth may be necessary. Artificial Ears with microphones are closed, but there may be noise coming in through the headphone (cushions etc.)

FINE QC is ideal for measuring headphones in high speed production. A full test can be done with a 1 sec or 2.5 sec sweep. Quite often the 1 sec sweep is enough to find all Rub and Buzz.

LOUDSOFT recommends GRAS test fixtures with Artificial Ears for the ultimate accuracy. For good production testing CRY test fixtures with Artificial Ears are recommended, see section 3.

The output drive level from the built-in headphone amplifiers is here set to 0.5Vrms (500mV), which is producing a reasonably high SPL without overloading the headphone. When there is overload (Red), the attenuator should be lowered one or more step(s).

If there is casual noise close to the test, you can specify a number of averages. This way the test will automatically repeat the specified number of times, and use the average for testing.

1.8.   Noise Cancel Measurement

Testing Noise cancelling headphones ideally requires a diffuse sound field, however, for QC testing a normal room or test booth may be used by keeping the environment noise low.

If there is moderate factory noise, you may get acceptable Noise Cancel testing by placing the noise speakers close to the headphones and setting the noise signal quite high, see Figure 2.

Noise cancelling headphones can be measured fully in both passive and active mode in very short time. You can build your own test sequence by choosing "New based on this" and then selecting for example: "**HeadphLR_SPL_RubBuzz_NCx2**".

This setup has R / L SPL test, and two Noise Cancel tests that can be chosen as first passive, followed by an active Noise Cancel (N/C) test.
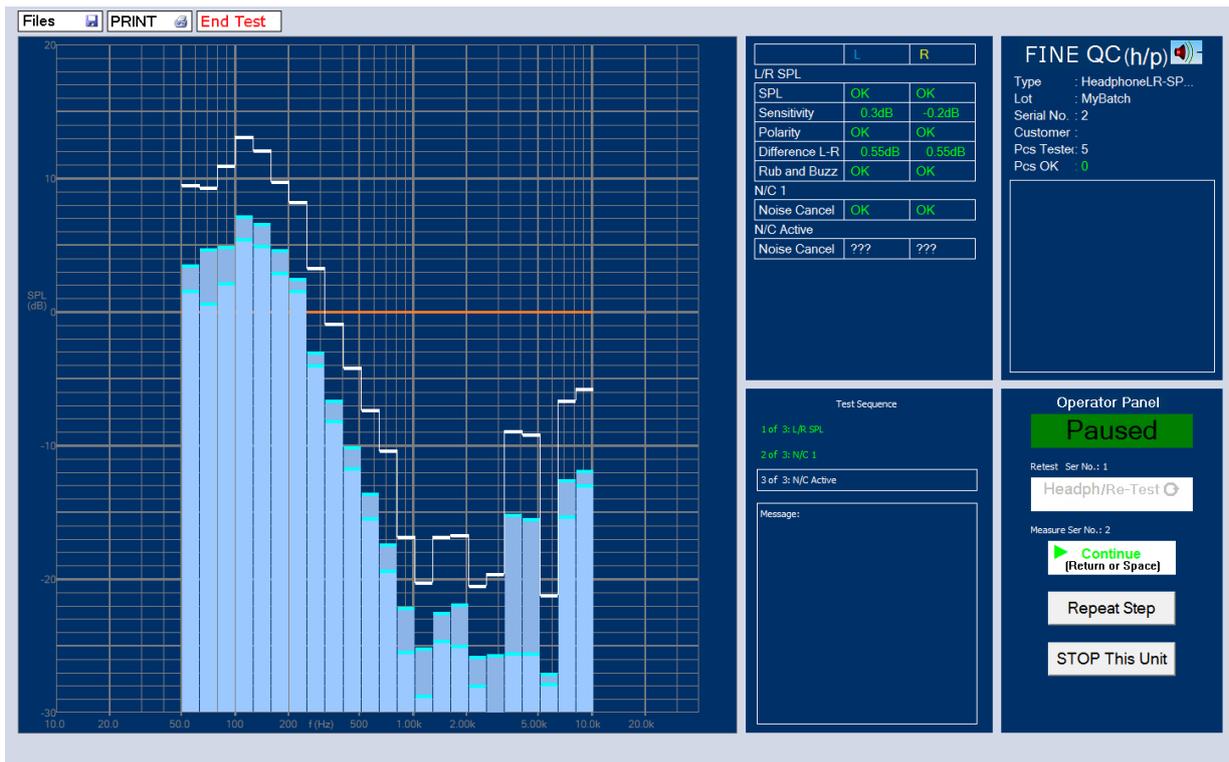
Figure 16 - Noise Cancel Test Screen

Figure 16 shows a noise cancel test of a normal headphone using only passive noise cancelling. The Columns / Histogram is showing the damping in 1/3 octaves 50 Hz -10 kHz. The passive noise cancelling is only effective at high frequencies. The white lines above the columns is the limit, here set to 6 dB.

The upper center field is reporting all the measurement results for this headphone L / R test sequence, including SPL, Sensitivity, Difference L –R, Polarity and Rub & Buzz, for both (L) and (R) channels.

Figure 17 shows the result of the second NC test using the active Noise Cancelling. Now we also see very good damping of the low frequencies due to the active NC circuit.
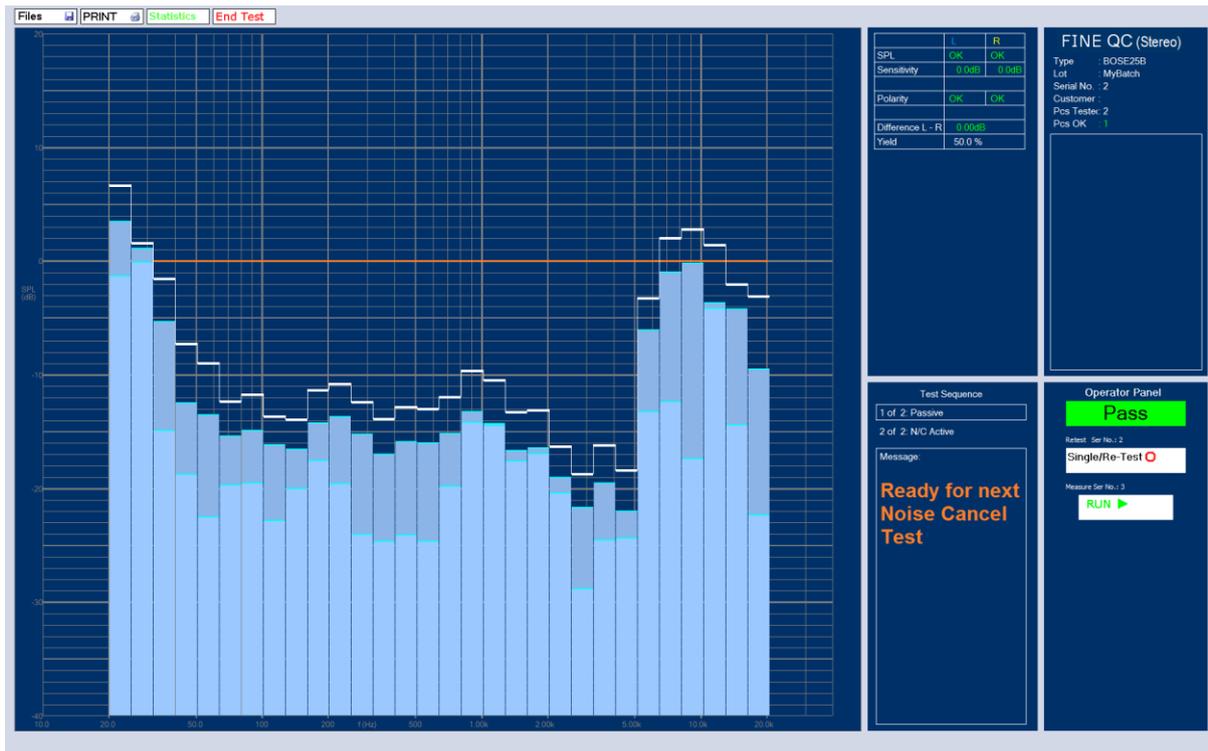
Figure 17 - Result of both Passive and Active Noise Cancel

1.8.1.   Edit / Define Noise Cancel Test

From the "Edit" menu select the "Stereo Noise Cancellation: NC1" or "Stereo Noise Cancellation: NC Active", and press "Edit Step":
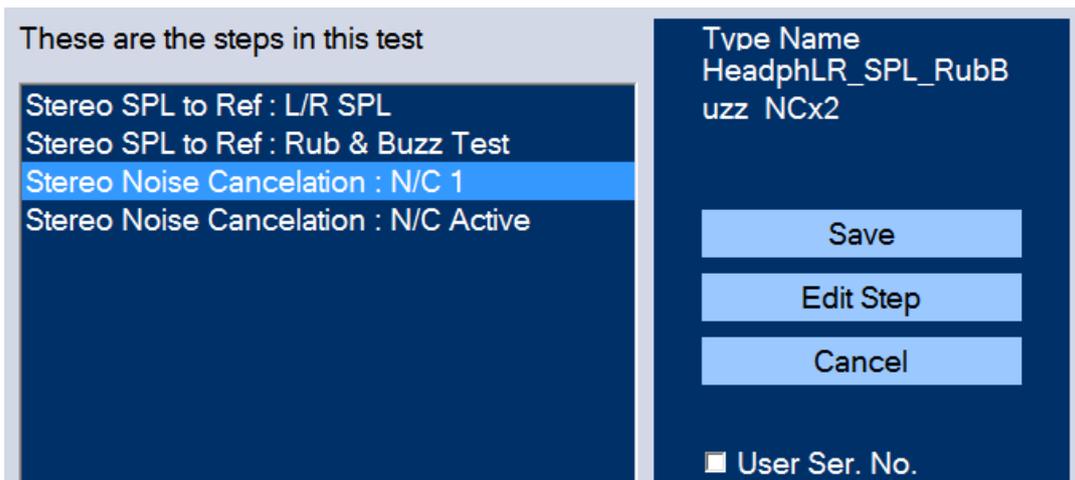
Figure 18 - Select N/C Step to Edit
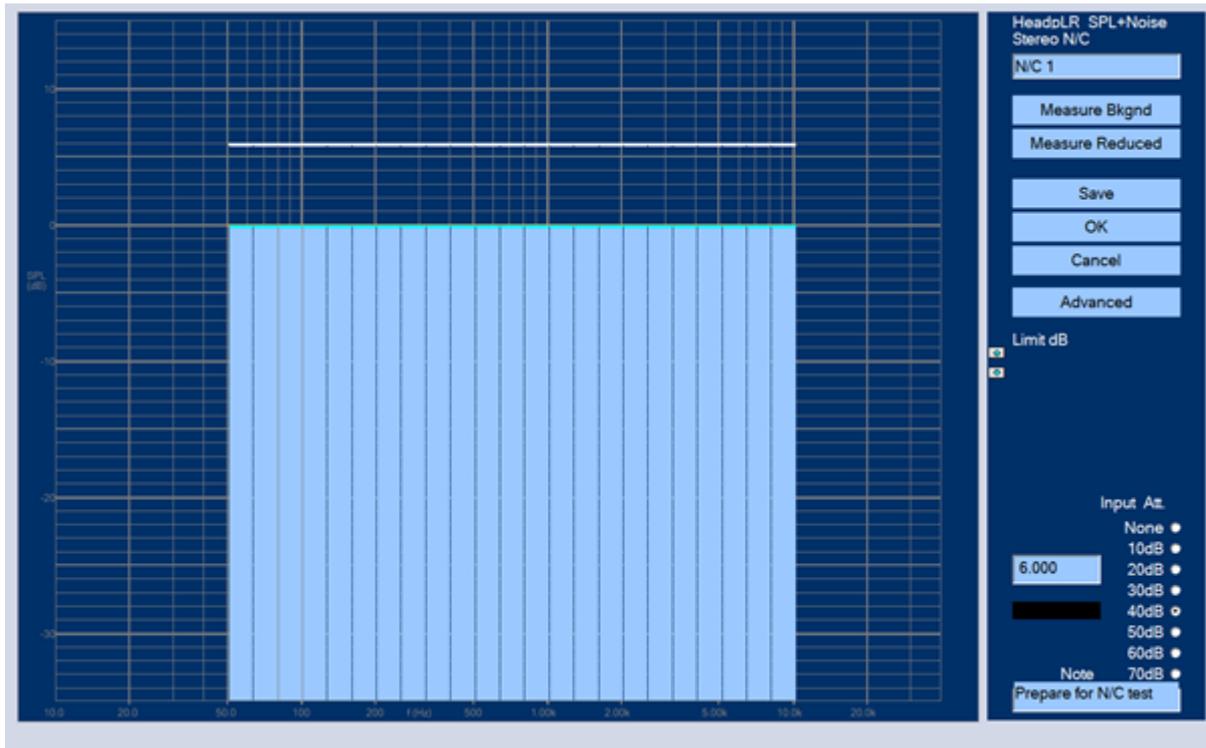
Figure 19 - Measure Background Noise SPL as REF

First press [Measure Bkgnd] to measure the direct (Pink) noise input from the noise speakers WITHOUT the headphone placed on the test fixture, and using the default 6Vp output from the main amplifier. This measurement is now defining the reference (0dB) level, shown as the flat horizontal line

Then place the headphone on the test fixture and press [Measure Reduced] to measure the Noise Cancelling, which is the difference from the previous measurement. If you plan to make 2 N/C measurements, then press OK and go on with the next N/C step. Remember to switch the active N/C on, if that is what you want to measure.

It is a good idea to set the Limit dB, so that the white line is some dB higher than the current Pink Noise measurement, which fluctuates a little. The default is 6 dB. If there is factory noise you may need to increase the limit. However, you may lower this limit if you have very silent conditions.

You can also just measure one N/C curve WITH the active Noise Cancelling (N/C) on, which will show the combined result of the both the passive and active noise cancelling. In that case you should select "**HeadphLR_SPL_RubBuzz_NCx1**" and press "New based on". Write a suitable name for the test like "**HeadphoneABC_NC**" so you can find the test later.

Note: You can view the above as curves by pressing [Advanced] and unchecking the [ ] "Display as histogram (setup only)", see Figure 21. The absolute levels can be seen and verified by checking [x] "Display absolute levels (setup only)"

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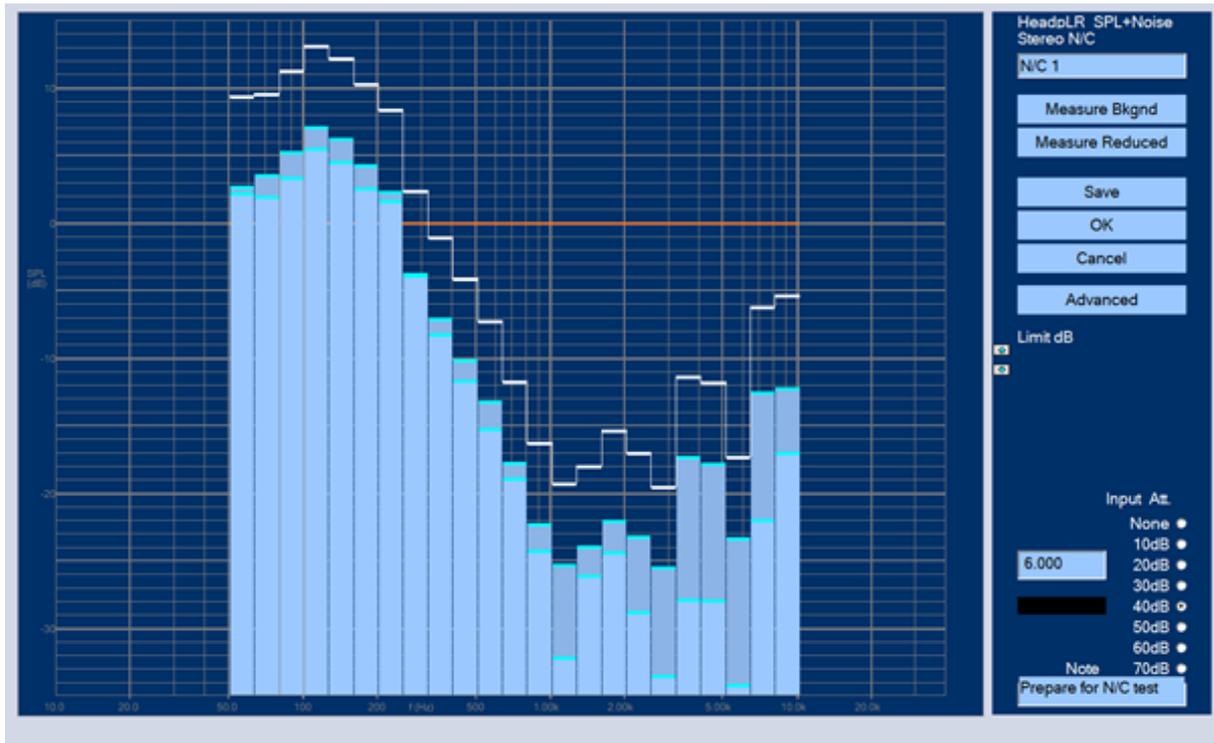
Figure 20 - Noise Cancel Test Setup

1.8.2.   Advanced

Pressing [Advanced] you can select a larger measuring range. The default (standard) is 50-10.000Hz. But you may select the extended range if your Noise Speaker has a much extended frequency range and you have a separate room for the Noise Cancel test.

During setup you may also select curves instead of histogram. And absolute levels can be shown.
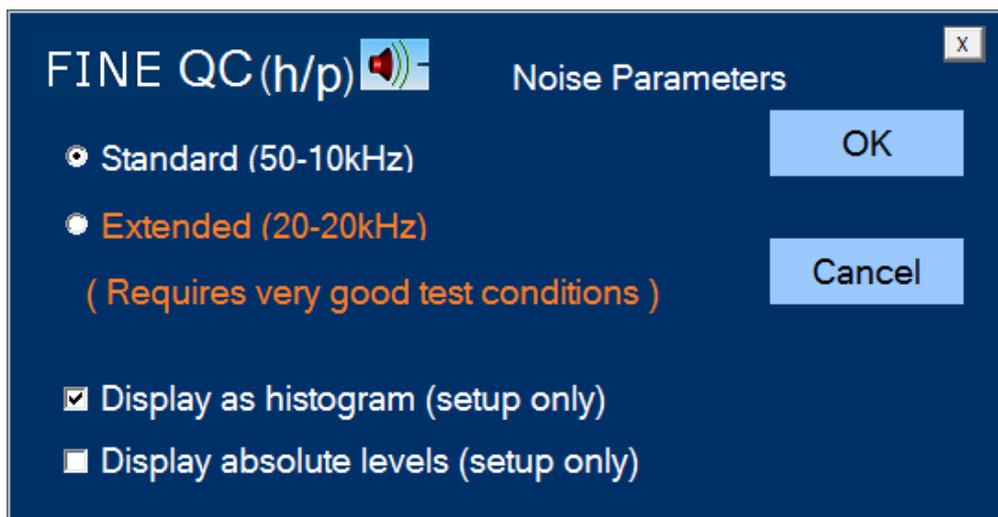
Figure 21 - Select Standard or Extended N/C Range & Absolute SPL / Curves

1.9.   Testing Bluetooth Headphones

It is possible to test Bluetooth headphones in FINE QC (h/p). This is done by using a Bluetooth dongle that plugs into the mini-jack, and then connect the headphones to the dongle.

When testing Bluetooth headphones there is going to be a time delay from hitting the play button to the sound being played by the headphones. This delay can interfere with the testing; however, FINE QC (h/p) can take this delay into account, thus eliminating delay errors in the measurements.

To enable this feature you must click in the box saying Bluetooth Mode, see the arrow in Figure 22
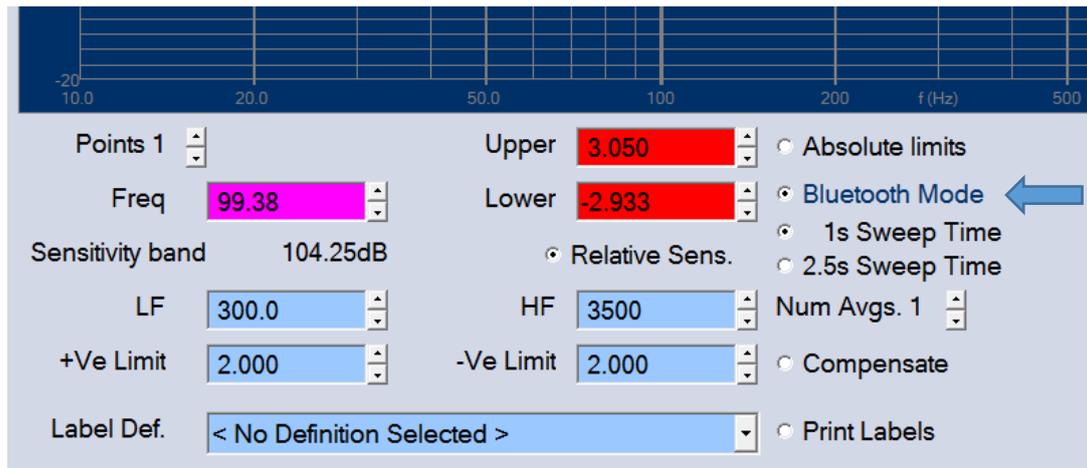
Figure 22 - Bluetooth Mode set

1.10.   View Saved Measurement Files

Without logging in all users can directly load Measurement Files saved automatically from all Headphone QC test series. Press the button Measurements at login or Files in the main menu.

The measurements are stored in the FINELabBatchdata folder, for example:

C:\FINELabBatchData\NewTest\Engineer

Likewise, the test setup files are saved in this folder:

C:\FINELabTestInformation\testspecifications

Load for example ResultSet0001.flabx shown below.
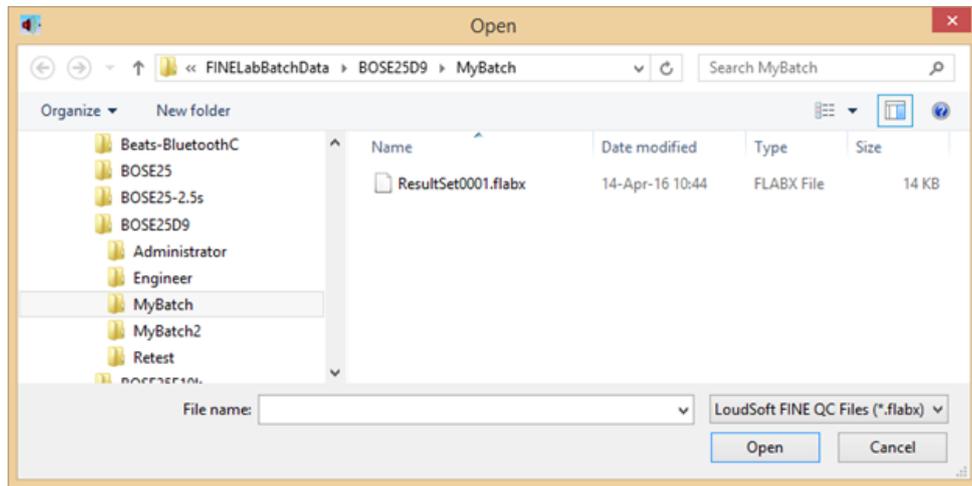
Figure 23 - Load Measurement Files
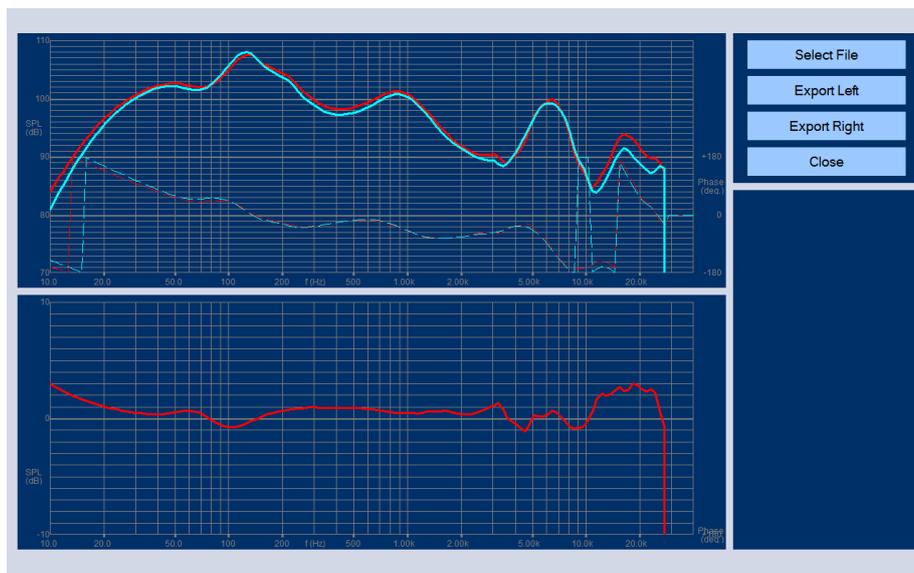
Figure 24 - Result of Automatically Saved L / R Responses

This is the result of a previous test series with L and R responses in the upper graph and the difference L – R below. Both responses can be exported as (LOUDSOFT) *.Lab files or *.txt files.

The middle window shows the same responses as above, but now plotted relative to the reference (blue). For example, a change in sensitivity is very easy to see this way.

1.11. Administrating users
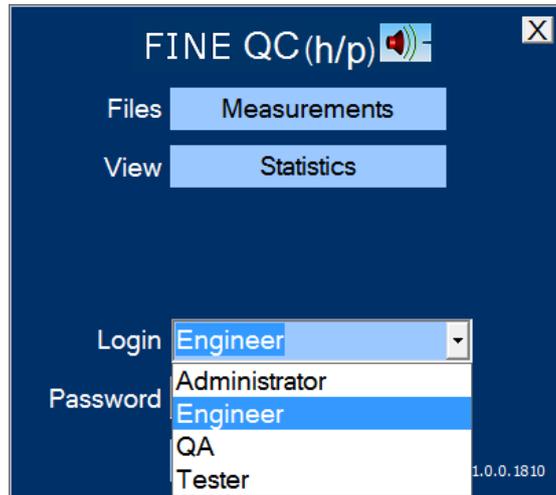
Figure 25 - FINE QC start screen

You can login the first time as Engineer without a password. To setup Users you need to login as "Administrator" and go to Admin/Users. The default password is "FINELAB" (Capital letters!).

There are 4 default user levels: Administrator/Engineer/QA/Tester. Each has limited access, except the Administrator. You can setup User Passwords and change all as Administrator: [Admin Options/Users].

Figure 26 - Manage Users and Passwords in Admin

1.12. Printing Labels in FINE QC / Headphone

You can print labels to a standard serial matrix label printer. (Loudsoft can make customer versions to fit your specific printer)

Go to "Admin Options" to select the right Port, Speed, and Parity. (Password: FINELAB)
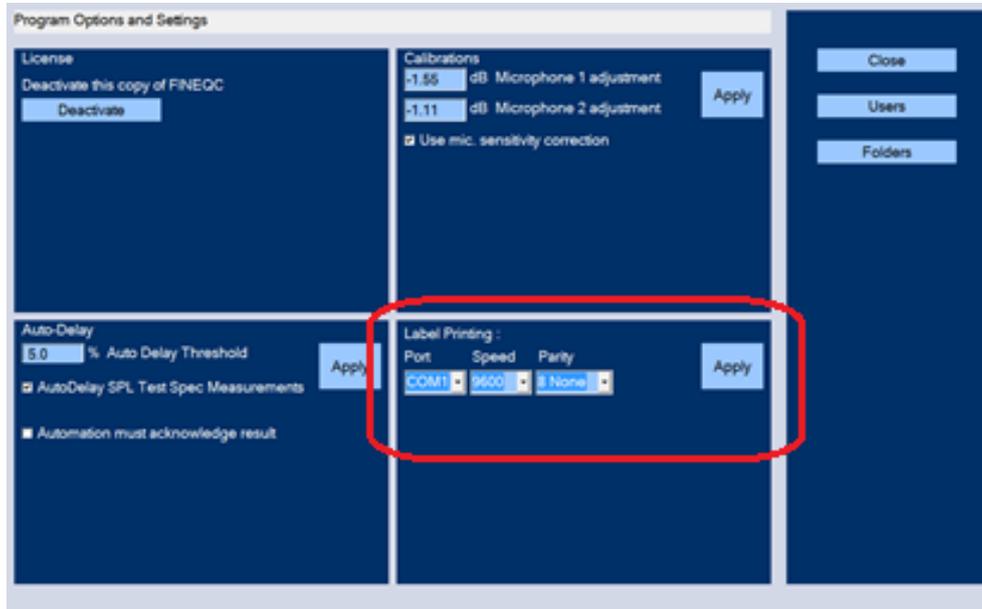
Figure 27 - Label Printing Setup in Admin

Then, define a test specification, for example, 2Way.fts. The "2Way" will be used as a type name in the label.
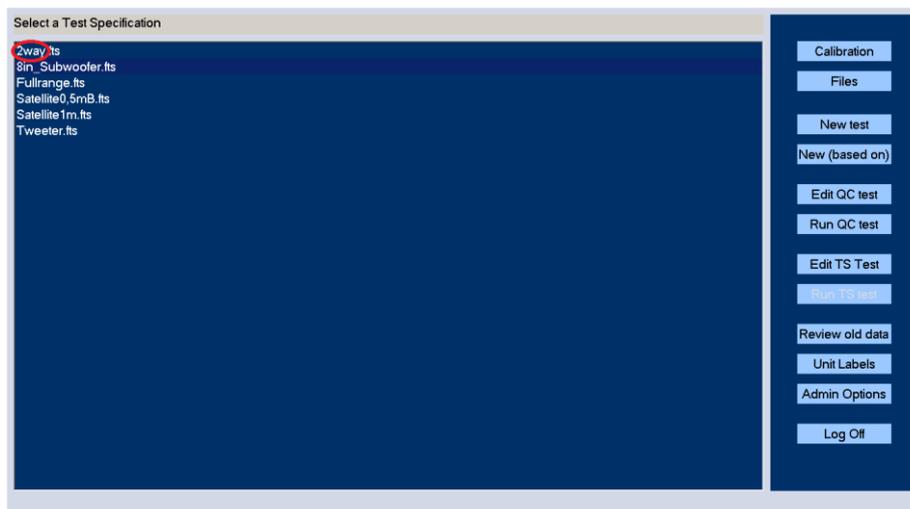
Figure 28 - Unit Labels

In "Unit labels" you can select a label style, as shown in the figure below. There are two more label styles, which may be chosen." Click on "Edit QC test", and the following window will be opened. Here you can choose "Print Labels" (last line):
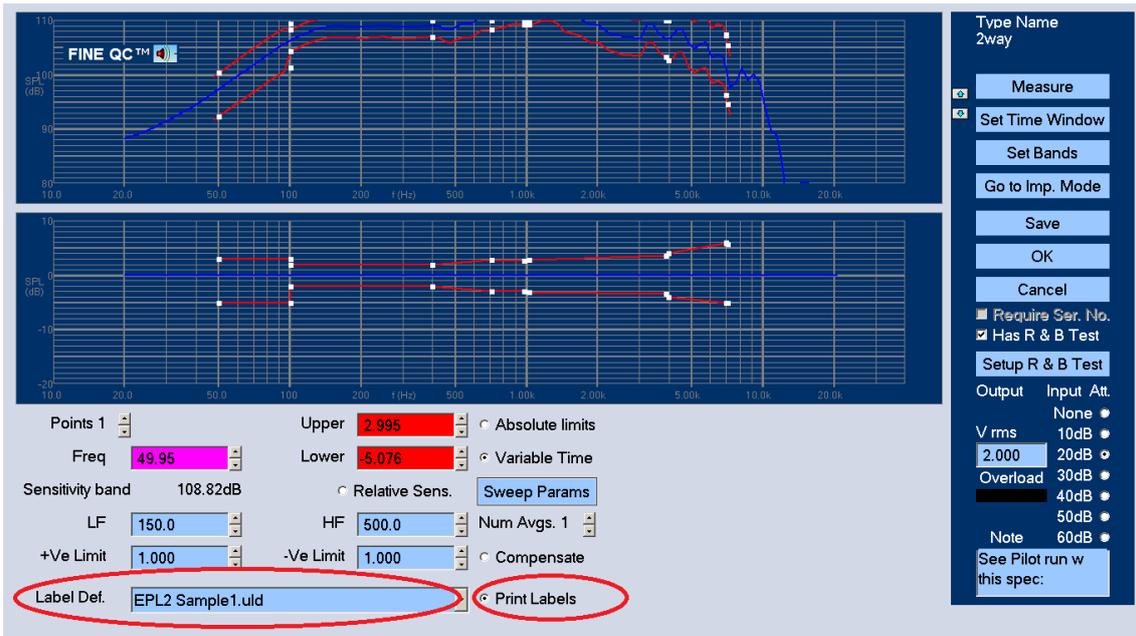
Figure 29 - Selecting a Label Print

After "Save", it is ready for "Run QC test". In the figure below, the starting serial no. will be input by the operator. The number on label will start from this number.

Figure 30 – Start Serial No.
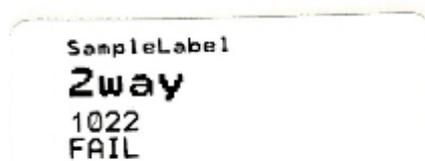
Figure 31 - Example of label for a failed sample

2. FINE Hardware2 Specs
2.1.　Front Panel

USB Yellow LED

When the FINE Hardware is connected to the computer with a USB cable, the yellow USB light LED is on.

Microphone inputs L / R

For connecting L + R microphones in the Artificial Ears use a Phantom converter with BCD connector for mic1 and mic2 inputs. Both GRAS and CRY Microphones with CCP (Constant Current Power) can be connected directly without a preamplifier using the selectable Phantom Power (48 V). A green LED will indicate when switched on.

Amplifier output – For driving a (Pink) Noise Speaker

You can use the parallel Speakon or banana connectors to connect a loudspeaker to be used for giving external (Pink) noise for testing Noise Cancel (N/C) headphones.
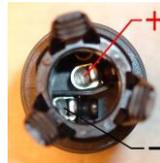
Figure 32 - Speakon rear connections

Line output – Phono/RCA connector (1/10 output)

In case the built-in 25W amplifier is too small for testing your system, you can connect a larger power amplifier from the Line out RCA/Phono output on the FINE Hardware.

Note that the RCA/Phono Line Out level is 1/10 (-20dB) of the main output, so 1V nominal output will be 100mV on the RCA/Phono output.

2.2.　Rear Panel

Power Connector

90-230V AC input with ground connector

USB Input connector

Use the USB cable to connect the FINE hardware2 (Box) to your computer.

TTL and Current Monitor inputs

Not used for headphone testing

2.3.   Main Specifications

Signal Processing

AD/DA Conversion: 24 bits

Sampling Frequency

AD/DA Conversion: 48 kHz for headphone testing

Frequency Response

SPL: 20 Hz to 20 kHz (±0.5 dB)

Nominal Input Level

XLR 0-1000 mV RMS

Interface

USB 2.0

Amplifier

Output Power:

35 W (2 Ω load, Max THD<1%, 1 kHz)

20 W (4 Ω load, Max THD<1%, 1 kHz)

Protection:

Short circuit.

Over temperature shutdown.

3. Test Fixtures (Artificial Ear Simulators)

The recommended method for QC production testing is using two Artificial Ears and a Test Fixture if testing headphones.

3.1. GRAS 45CA Headphone Test Fixture

Figure 33 - GRAS Headphone Test Fixture

For the best performance LOUDSOFT recommends the GRAS 45CA Headphone Test Fixture with IEC Ear Simulators and CCP microphones. These microphones connect directly to the FINE Hardware2 without extra preamplifiers.

This solution is available from LOUDSOFT

3.2. CRY Headphone Test Fixture

Figure 34 - CRY Headphone Test Fixture

For cost-effective production testing LOUDSOFT also recommends the CRY Headphone Test Fixture with IEC Ear Simulators and CCP microphones. These microphones connect directly to the FINE Hardware2 without extra preamplifiers.

This solution is available from LOUDSOFT

3.3.   ARTIFICIAL EARS

For cost-effective production testing of in-ear headphones LOUDSOFT recommends separate CRY IEC Ear Simulators and CCP microphones. These microphones connect directly to the FINE Hardware2 without extra preamplifiers.

Both IEC 318 and IEC711 Artificial Ears are available from LOUDSOFT

Figure 35 - CRY IEC318 Artificial Ear Simulators for in-ear headphone testing

IEC318 Artificial Ear

Meets the following criteria:
IEC 60318-1:2009 Ed. 2.0 Standard electro acoustics - simulation of the human ear and head, part 1: measuring the ear simulator used for ear pressing and ear covering headphones;

GB/T 25498.1-2010 Electro acoustics Head simulator and ear simulator Part 1: calibrated ear simulator used for ear pressing earphones;

ITU-TITU-T Suggested P.57, 1 artificial ear.

IEC711 Artificial Ear

Meets the following standards:
IEC 60318-4:2010 Ed.1.0 (formerly IEC 60711) electro acoustics - the simulation of the human ear and head, part 4: measure ear simulator for plug-in headphones;

SJ/T 10659-1995 measure ear simulator for plug-in headphones;

ITU -T suggested p.57, 2-type artificial ear

4. Frequently Asked Questions

4.1.   Deactivation

You can deactivate the license on your computer and then install and activate it on another computer.

Log in as Administrator (Password: FINELAB) and Go to Admin. In the upper left you can select "Deactivate this copy of FINE QC" on this Computer.

Hereafter you can install and activate the software on another computer.

4.2.   The software will not reinstall

Once you have uninstalled FINE X-over, click the magnifying glass in the taskbar (lower left corner of the screen, Windows 10). Otherwise, open the File Explorer.

Here you type %appdata%, which will bring up a folder. In this folder you find the LOUDSOFT folder, select it and press shift+del. This will ensure that it is completely removed from your computer.

You then reinstall the software as an admin by right-clicking the setup file and choosing run as administrator. After the software has been installed, you run it as administrator again and enter the license ID and password.

4.3.   Hardware Drivers

The FINE Hardware uses FTDI drivers. You must be connected to the internet during installation, and windows will automatically find the proper drivers.

In case that fails you can find the drivers here. Please note that installing drivers manually requires professional assistance.

http://www.ftdichip.com/Drivers/D2XX.htm

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