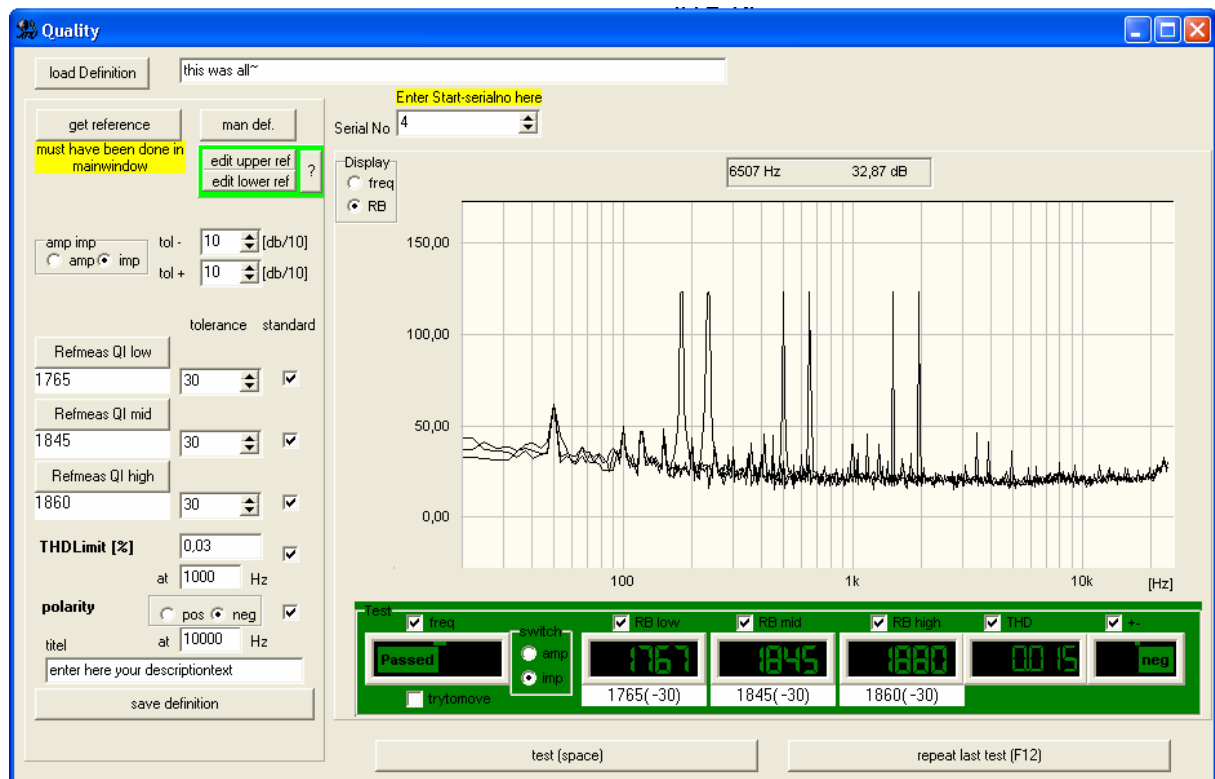




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# 1. The introduction of the system

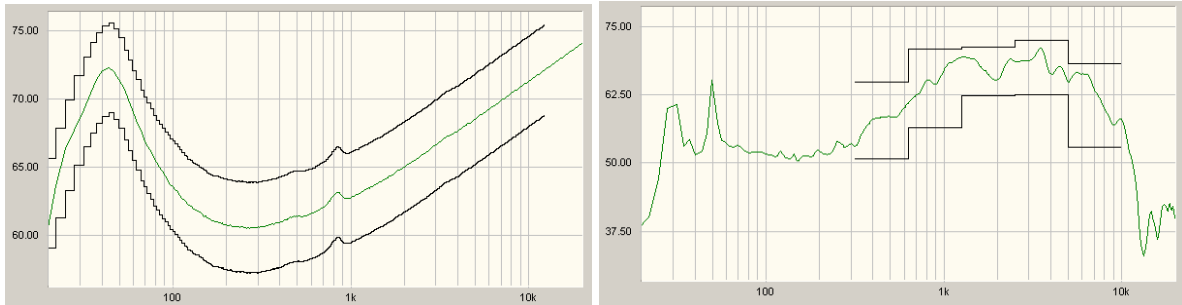


The QC program is for the speaker industry for an automatic quality test. It is also for the automotive industry to test mounting of the speakers for undisturbed music reproduction. The test systems consist of the ATB QC program, the PC with a soundcard and a test box with a power amplifier for the connection of the speaker. There are several measurements in the test cycle. For the automatically passed or failed decision, each measurement has its own tolerance mask. One test cycle can include up to four measurements. These are the acoustic or electrical frequency response and three Rub&Buss measurements for woofer, mid and tweeter. The frequency response is tested with the M-PN stimulus. For the automatically and manual setting of the tolerance mask there is no need of an uncomfortable script. The Rub&Buss measurement tests the distortion and noise of the speaker. The stimulus for measurement is the signal 13. The Signal 13 is a combination of two sine waves with the frequency ratio of 1:1,3. This ratio makes that the signal is very good for the test of resonance. The signal also avoids the main problem of the acoustic Rub&Buss measurement. The surrounding noise normally disturbs the measurement. For the passed and failed decision there is the Q-index. The Q-Index includes all distortion and noise of the speaker. An other measurement for the quality testing is the THD. The right wiring is tested with the polarity test. For reporting and documentation the program writes a report file.

## 1.1 Frequency response test

The frequency response is tested with the M-PN signal. The measurement with this periodic noise gives the highest accuracy.

The tolerance mask can be set automatically or manually.



The picture shows the impedance test of a speaker for the test of the Thiele-Small parameter test of a speaker

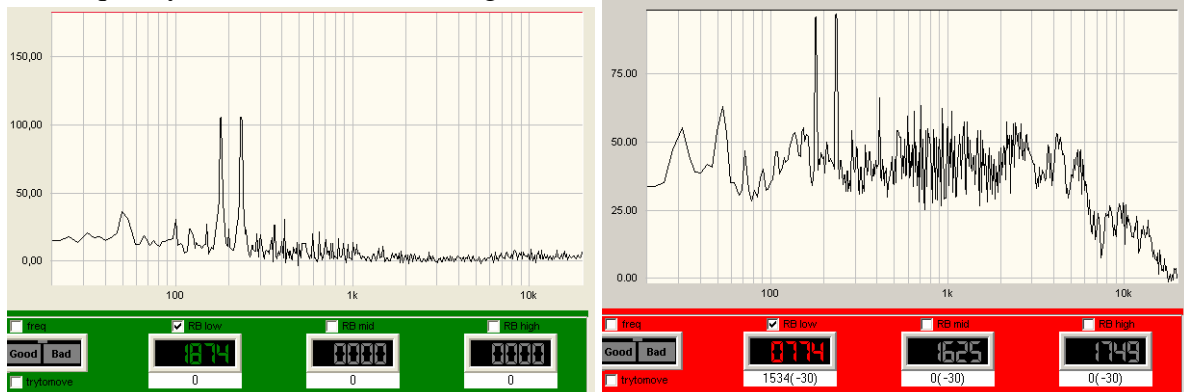
For the definition of the tolerance mask the frequency range and the upper and lower tolerance curve is set in.

For the automatic setting the program calculates the tolerance curves. This tolerance mask is for the electrical measurement.

For the manual setting the tolerance curves are set with the mouse click. This tolerance mask is for the acoustic measurement.

## 1.2 Rub&Buss test

The Rub&Buss is tested with the signal 13. The signal 13 consists of two sine-sweeps with the frequency ratio of 1 : 1.3. This signal is showing all resonances of the unit under test.



Electrical test of the signal 13

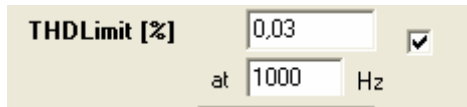
Test of a broken speaker

For the passed and failed decision the Q-Index is calculated. The index is calculated from all frequencies higher than the second frequency of the test Signal 13. The account is set into proportion to the amplitude of the test signal. The best speaker has the highest Q-index.

The Rub&Buss measurement has following tests.

Calculation of	error
1. THD, K2,.....K10	The test is for the controlling of the placement of the voice coil.
2. IMD	The test is for the controlling the gluing, loose particle and if there are cone touching of connection wires.
3. Frequencies > K5	The test is for the controlling of voice coil rubbing the magnet.

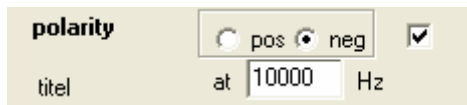
### 1.3 THD test



The screenshot shows a configuration panel for a THD test. It features a label 'THDLimit [%]' followed by a text input field containing '0,03' and a checked checkbox. Below this, the word 'at' is followed by a text input field containing '1000' and the unit 'Hz'.

The THD test tested the harmonic distortion. The test signal is a sine wave with frequency is to select. Because this test is including in the Rub&Buss test it is only for the special demand of the manufacturer. In the definition there is to set the maximum THD and the frequency.

### 1.4 Polarity test



The screenshot shows a configuration panel for a polarity test. It features a label 'polarity' followed by two radio buttons: 'pos' (unselected) and 'neg' (selected), and a checked checkbox. Below this, the word 'titel' is followed by 'at', a text input field containing '10000', and the unit 'Hz'.

The polarity test is for testing the wiring. It is for speakers, headphones and microphones. The test signal is a half sine wave. In the time response the program calculated if the positive or negative amplitude is the greatest value.

## 2. How to set the definitions

For one test cycle there are up to four measurements. This is the frequency range and three Rub&Buss measurements for low, mid and high range.

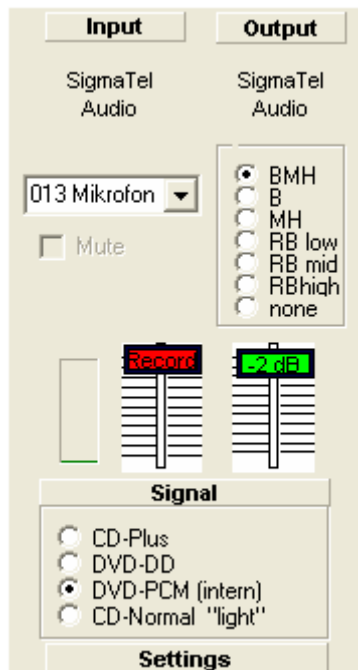
For editing the definition it is easy to switch from the definition-mood to test-measurement.

### 2.1 The frequency response definition

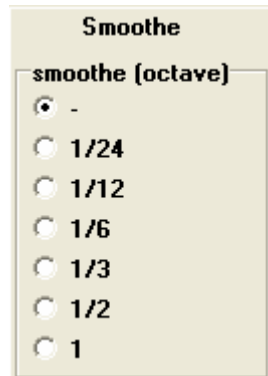
#### 2.1.1 The automatic tolerance mask setting

The automatic mask setting is to use for an electric measurement like the impedance test. At first there is to do a frequency response measurement in the main program. For the description of the measurement refer to the ATB PC Pro manual. For the QC measurement the intern signal mood is used.

Following parameters are to be set:



The BMH signal is set  
DV-PCM (intern)  
The out level to 0dB  
The input level to 1/3 of the level meter



The smoothing is depending on the quality of the speaker. For high quality speaker there is the smooth of 1/24 octave and for low quality speakers 1/3 octave.

The parameters will be automatically set in the new definition.

Also the in- and out level are parameters of the new definition.

After the setting with the M+ measurement up to 32 speakers are measured. The plots will show the characteristic of the speaker. There will be one representing speaker. This plot is used for setting the definition.

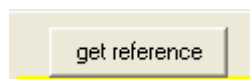
Then there is to open the Quality menu in the main program.



After a click at

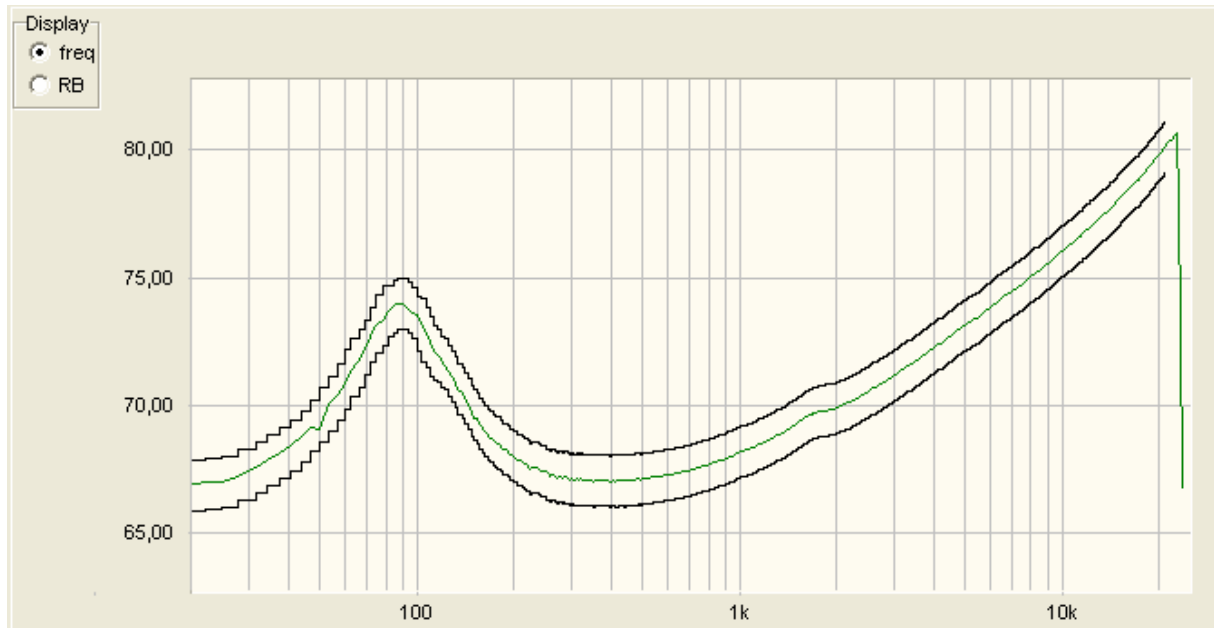


the



is to activate.

In the menu the display is set to freq.  
 The both plots for the thresholds are to be seen.

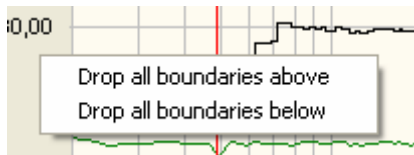


To fit the plots to the measurement there is following function:

tol - 40 [db/10]  
 tol + 40 [db/10]

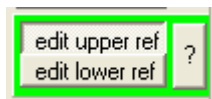
The width is set with these commands

In the edit-mood there is to set the frequency range and an individual form.  
 The frequency range is set by a click with the right mouse button at the curve.



Here is to decide with a left mouse click to set the lower or upper limit.

The individual form with differs from the measurement curve is to set by first activating the

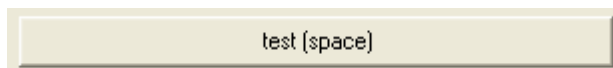


upper or lower curve


Then click with the left mouse key at the curve and drag it with holding the key.

After the setting it is easy to make a test measurement.

To make the test measurement and see the frequency range plot selecting freq in the cycle box and starting the measure with the



function.

After the measurement the edit-mood is to open with the  button. After the return you get the definition you work on.

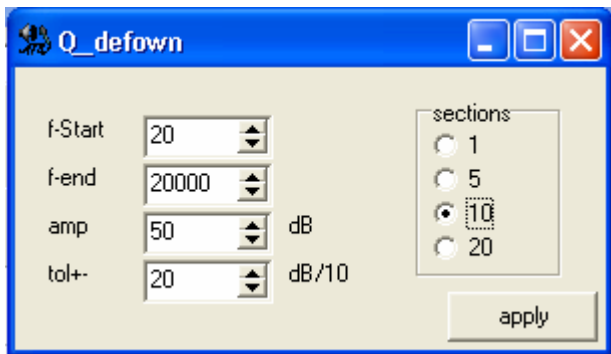
## 2.1.2 The manual tolerance setting

The manual tolerance setting is for the acoustic frequency response test.

The Quality menu is to open and the  is to activate.



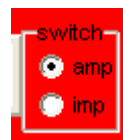
After a click at the  button Q\_defown menu is shown.



Here is to set the frequency range for the tolerance curves with f-start and F-end. The level for expected measurement curve is to set at amp, and at tol+- there is to set the width of the tolerance mask. In sections is to set the number of section for the varying of the curve.

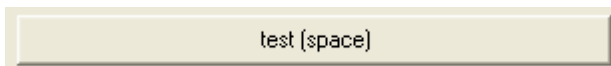
After the setting it is easy to make a test measurement.

To make the test measurement and see the frequency range selecting freq in the cycle box



Here is also to set if there is an Amplitude or Impedance measurement.

Starting the measure with the



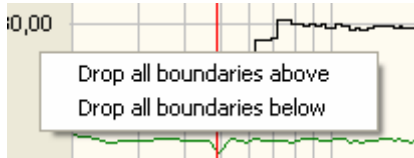
Function.

After the measurement the edit-mood is to open with the  button

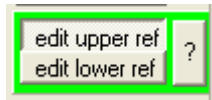
In the edit-mood there is to set the frequency range and an individual form.

The frequency range is set by a click with the right mouse button at the curve.

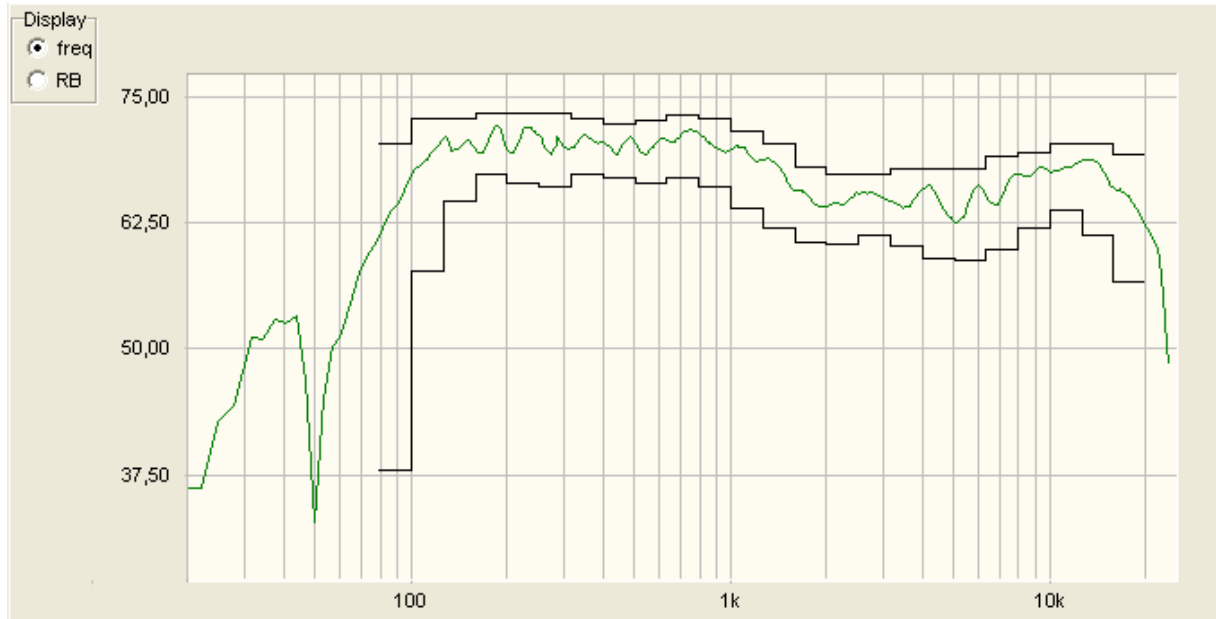




Here is to decide with a left mouse click whether it is the lower or upper limit. The individual form which differs from the measurement curve is to set by first activating the



upper or lower curve and a with a click at the curve it is to drag.



The figure shows the edited tolerance mask with the setting of sections = 30.

### 2.1.3 Automatically adoption of curve

The reference curves could be set absolute or relative to the amplitude of the speaker under test. The relative tolerance mask is for the test of the characteristic of the frequency response curve. If there is the need of a very accurate test of the characteristic of the frequency curve the try to move function is set.



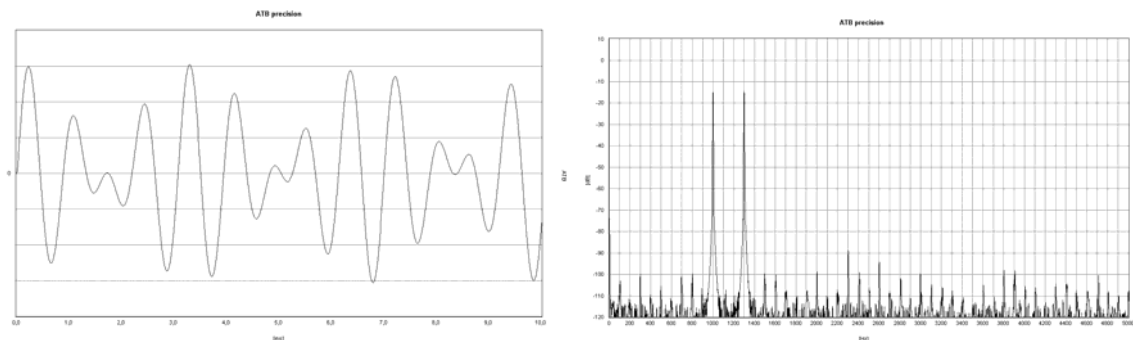
If the function is set the program tries to place the measured curve in the tolerance mask.



The window shows the db for fitting the curve.

## 2.2 The Rub&Buss definition

The Rub&buss measurement is to test the mechanical quality of the speaker. In production line the speakers tend to have defects. These defects are cone displacement, rubbing voice coil and loose particles. The defect speaker produces an unwanted noise. An analysis of the noise shows short time and magnitude distortion. In former time the noise was tested with a THD measurement with analysing the energy of a high-order harmonics group. These are K13, K14,.....K20. For a real test there is the need of a non-static signal. Therefore, the newer systems used a sine-sweep or a combination of step and sine. The measurement with these signals has a problem with the surrounding noise. Therefore, the Signal 13 was developed from the Kirchner elektronik company. The signal consisting of the heterodyne of two sine waves with the ratio of 1:1,3 gives a non-static signal.



The time domain of the Signal 13

The frequency spectrum of the Signal 13

The time domain of the signal shows an always-varying wave. The signal excited all resonances of the unit under test. The resonances and the nonlinear transfer function show a spectrum with a great number of distortion frequencies.

For the calculation of the Q-index the amplitude of distortion frequencies are added and set into proportion to the amplitudes of the Signal 13. This is a very good test for the quality of a device.

For acoustic test of the speaker a quiet room is necessary. With the Signal 13 the Rub&Buss measurement is not so disturbed from the surrounding noise as other measurements. Because the frequencies below the Signal 13 are not considered, a HPF (High pass filter) suppresses low frequencies.

### 2.2.1 The setting of the tolerance

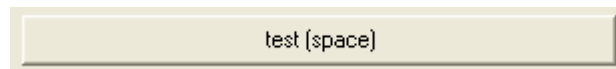
After the frequency measurement is to start the Rub&Buss test. First, there is to mark the Rub&Buss test for the test cycle. For a woofer is to mark “RBlow”, for a mid speaker “RBmid” and for a tweeter “RBhigh”. If there is a full range speaker box to test, mark all. Therefore, the test cycle includes four measurements.

	tolerance	standard
Refmeas QI low 1169	30	<input checked="" type="checkbox"/>
Refmeas QI mid 1345	30	<input checked="" type="checkbox"/>
Refmeas QI high 1515	30	<input checked="" type="checkbox"/>

The measurement is started with “Refmeas QI low”.

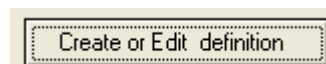
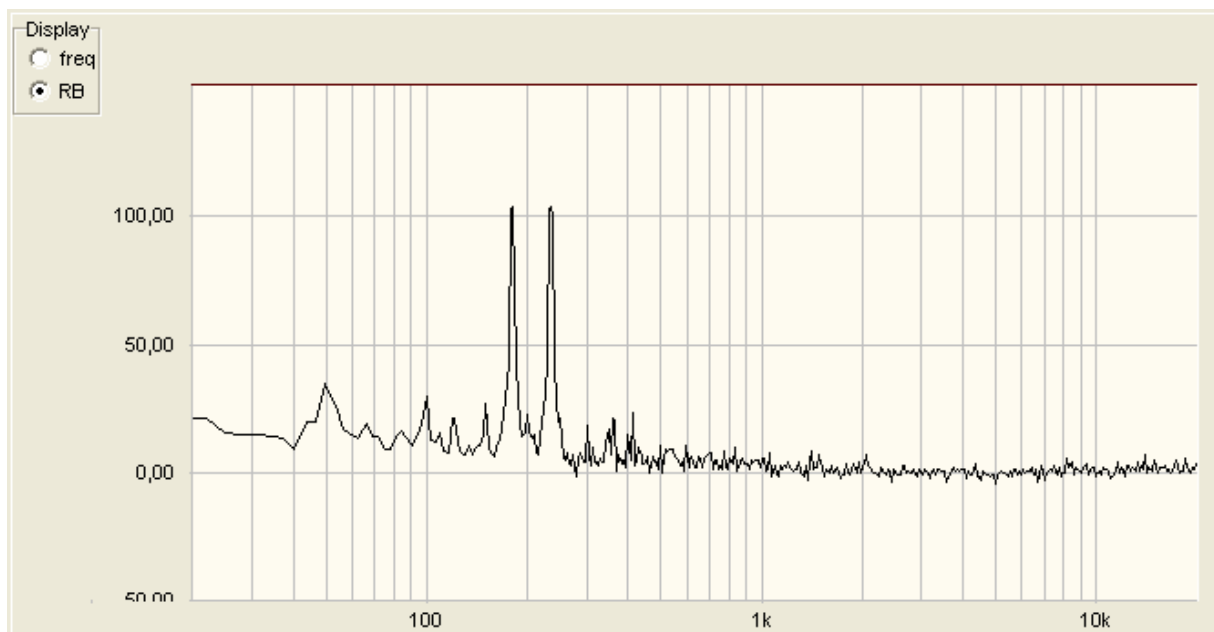
After the measure there is a numeral shown in the test window. This numeral is the Q-index. After the test of many speakers, the numeral will differ in a range. According to this range there is to set the tolerance.

To see the frequency range a measurement could be done by selecting Rblow in the cycle box and starting the measure with the



function.

To see the curve do mark in the display menu “RB”.

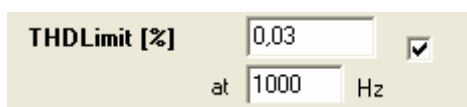


After the measurement the edit-mood is to open with the

When the definitions are set the next step is to save it.

## 2.3 The THD definition

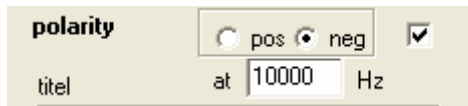
For the THD definition is to set the distortion in % and the frequency.



The distortion of the device is to measure in the main menu or with the test measurement in the QC menu.

## 2.4 The Polarity definition

For the definition there is to set if + or – and the test frequency.

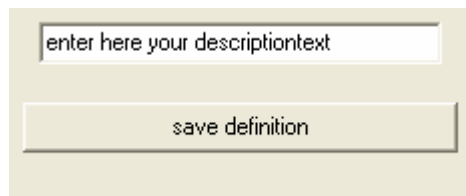


The screenshot shows a dialog box titled "polarity". It contains two radio buttons: "pos" and "neg". The "neg" radio button is selected, indicated by a small black dot. To the right of the radio buttons is a checked checkbox. Below the radio buttons, there is a text input field containing the number "10000", followed by the text "Hz". The label "titel" is positioned to the left of the frequency input field.

Please mark that most of the soundcard MIC inputs inverting the signal. Please try to find the right frequency in the test of the QC menu.

## 2.3 Saving the definition

After the setting of the definition there is menu for a description of the definition. Here is to set in company's name, the user's name and the session designation. In addition, there is to set in the designation of the units (device under test).



The screenshot shows a dialog box with a text input field at the top containing the placeholder text "enter here your descriptiontext". Below the input field is a button labeled "save definition".

After the definition is saved with "save definition button".

### 3. The QC measurement session

#### 3.1 Start of the session

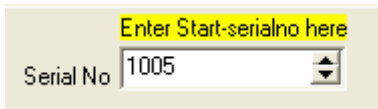
The quality control measurement is to start with loading the definition.



There are following parameters set:

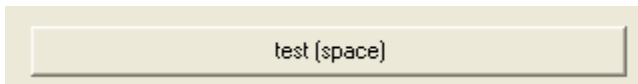
- Signal, BMH or RB
- Output level
- Input level
- Smoothing
- Tolerance mask
- Test cycle
- Try to move
- Description text

Before the start there is to set the number of the first device under test.

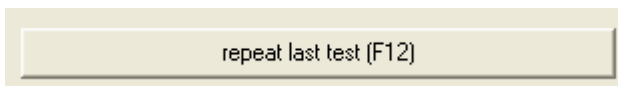


#### 3.2 The measurement

After the connection of the speaker and the placement of the microphone the first measurement is started. The measurement is started with a mouse click on test button



alternatively, with the space key. If there was a problem with the measurement and it failed, there is a second function to start a new measurement without counting the failed one.



This measure could also start with the F12 key.

If there is the need of varying the test cycle, the marks for activating the measures could be set.



After each measurement of the cycle there is the message if it is good or bad.

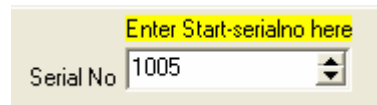
### 3.3 The report

For the session the program writes a report.

```
18.04.2007 17:54:33
1000 BMH : BAD - first error at 21,97
1000 RB low : OK (Qindex=1663 from 1594)
1000 :overall BAD-BAD-BAD-BAD-BAD-BAD
1001 BMH : BAD - first error at 21,97
1001 RB low : OK (Qindex=1666 from 1594)
1001 :overall BAD-BAD-BAD-BAD-BAD-BAD
1002 BMH : BAD - first error at 20253,00
1002 RB low : OK (Qindex=1667 from 1594)
1002 :overall BAD-BAD-BAD-BAD-BAD-BAD
1003 BMH : OK
1003 RB low : OK (Qindex=1671 from 1594)
1003 :complete OK-OK-OK-OK-OK-OK
1004 BMH : OK
1004 RB low : OK (Qindex=1672 from 1594)
1004 :complete OK-OK-OK-OK-OK-OK
```

The first line is date and the time for the start of the session.

The first number is the number of the part. It is to set in the Serial No. menu for the part number.

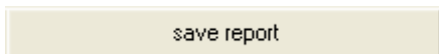


Enter Start-serialno here

Serial No 1005

After the number there is the name of the measurement and the result of the test. It is followed by a documentation of the test.

At the end of the session the report is saved with the save report button.



## 4. Example: Quality test measurement SPL

To make the definition for the SPL measurement.

1. Connecting the 701 box to the PC with USB.
2. Open the ATB 701 QC programme.

3. Open the input Menu with **input** **input** **outp**. There click at



4. Open the input Menu with **ure** **input** **outp**. There click at



In the WAVE IN menu select

5. Open the output Menu with **out** **output** **sett**. There click at



6. Open the output menu with **out** **output** **sett**. There click at



In the SPEAKER menu disable LINE

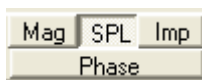


7. Make the **System-correction** if there is no one already.

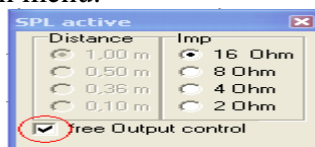
8. Connecting the speaker to COM of the ATB 701 box. The speaker shall be in the test box.


9. Connecting the microphone to the ATB 701 box. Place the microphone in front of the speaker.

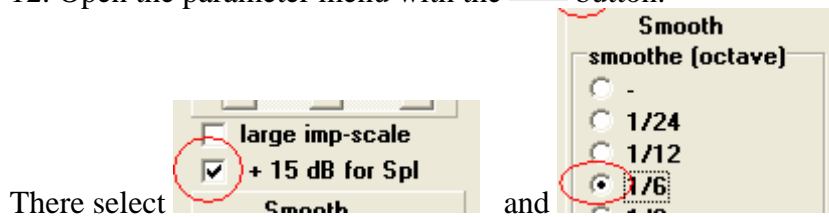
10. Select **Phase** in the main menu.




11. In the SPL ACTIVE menu select

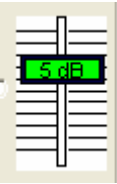


12. Open the parameter menu with the  button.

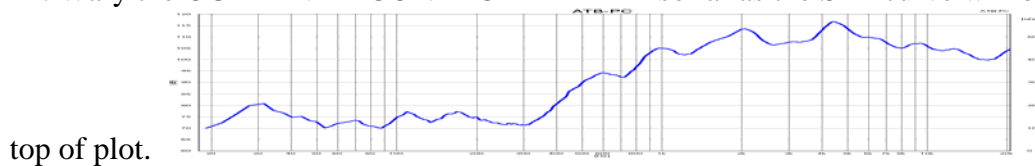


There select


13. Start the first measurement with the  button.



14. Wary the OUT LEVEL CONTROL so far as the SPL curve will be seen at the

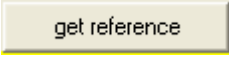


top of plot.

15. Open the QC measurement with the  button.

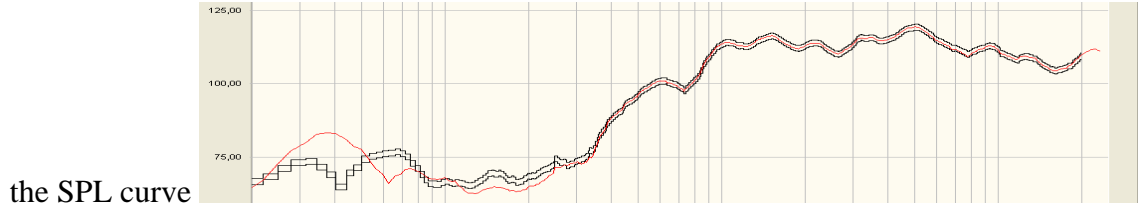
16. In the QC menu select  at the left top in the QC menu.

17. Click at . Then there is the definition menu at the left.

18. Click at . You will see the thresholds for the measured SPL curve.

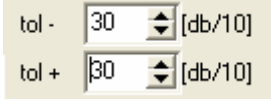
19. To see the SPL curve select  in the Display in the bottom of the

menu. After click at the  button. You will see



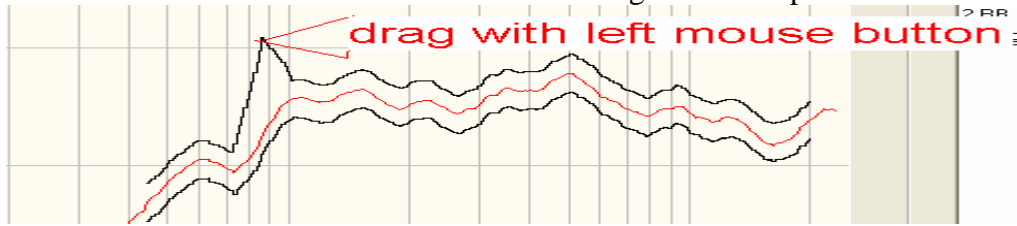
the SPL curve

20. Click at  to open the definition menu again.

21. Expand the threshold with the  function in the definition menu. Set 30 for tol- and tol+.



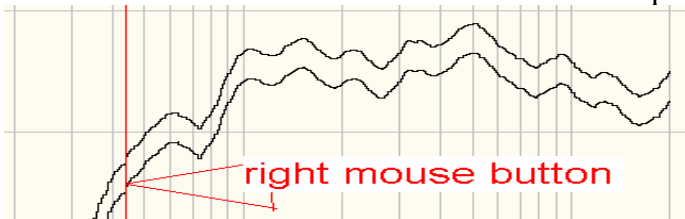
22. To edit the threshold click at **edit upper ref** in the definition menu. After click at the upper threshold curve with the left mouse button. While letting the button pushed down draw the



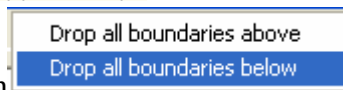
curve.

23. Click at **edit lower ref** in the definition menu to edit the lower threshold curve.

24. There is to select the frequency range for the thresholds. For it click with the right mouse button at on of the threshold curve. Make the click at the frequency the SPL curve will drop



for 15dB.



25. In the top of the menu you will see a display with **Drop all boundaries above** and **Drop all boundaries below**. For low frequencies select **BELOW** and for lower frequencies **ABOVE**.

26 After this do make some test measurements with changing different speakers. Starting the

measurement with the **test [space]** button by clicking at the button with the mouse or use the SPACE key.

27. If the result display at the bottom of the menu get read, please expand the threshold at the point the SPL curve touching the threshold.

28. Click at **Create or Edit definition** to open the definition menu again.

29. To save the definition first set in the **titel**  field the name of the speaker.

30. Click at the **save definition** button. Set in a name for the definition file and save it.

31. For the test measurements open the definition with the **load Definition** button.