Dr · Jordan · Design

AkuLap

Professional Audio Measurement System

www.dr-jordan-design.de

User Manual

Preface

Modern acoustic measurement systems, such as **AkuLap**, offer a variety of sophisticated methods of measurement. These processes are very complex and require normally a long-term training.
Therefore, AkuLap has automatic measuring methods, which allow measuring reliably many acoustic parameters by non - specialists. The experience of our designers and acousticians has been summarized in this automated system. The goal is to require as little as possible user interaction. At the same time, we can prevent operator errors. For experienced users we have many advanced features even for very special use cases.
The measurement results are written in a clear report. Therefore, you can print this report to easily archive or send them by email.

In this Quick Start Guide, the most important information is summarized. For more information, please refer to the general guidance of AkuLap or the advanced literature.

1 General Description 5
2 Content of package 6
3 Installation 6
4 Interface connection 6
5 Start Akulap 7
6 Verify the setup 10
7 Select the measurement range 11
8 Calibration 12
9 Organize your measurements 15
9.1 Use the Room-Manager 15
9.2 Directories 17
9.3 Archive measurements 17
10 Narrow band analysis with FFT 18
11 Weighting Filters 19
12 Signal statistic 20
13 Starting a measurement 22
13.1.1 Analysis of the measurement 23
14 Average level measurements 28
15 Marker 31
15.1 Overview 31
15.2 How to use markers 32
15.2.1 Marker type level 35
15.2.2 Marker overview 36
15.2.3 Report 37
16 Audio recordings 38
17 Directory structure 40
18 Expert mode 41
19 Sample report 42

AkuLap is a professional tool for powerful real-time signal and system analysis.
By using the PC environment, it is not only a cost efficient replacement for classical laboratory equipment. AkuLap offers more powerful features combined with a comfortable user interface. Typical applications are acoustic measurements, room and building acoustics and noise monitoring.
If you run Akulap on a notebook or even a tablet PC, you can easily build a mobile measurement system.

Akulap can use many different front ends. In most cases, you will have the most advanced setup, which consists of a Laptop and a USB measurement microphone.

In addition, we offer other systems with e.g. constant current supply.

1 General Description

With this compact measuring system, you can perform a wide range of acoustic measurements in a simple way.

The system consists of a computer and one measuring interface that you connect via USB. Depending on your requirements and you can connect high-precision type approved measurement microphones.

- By using the PC environment you get a large user interface
- Short learning curve
- Measurement results can be quickly and easily exported for documentation as a graphic or table
- Modular system: You can use different vendors manufacturer for measurement microphones.
- Modern computers provide high computing power. The functions are available for advanced analysis. Today measurements are possible, which could not be offered so far in this price range.

Features

- With the large display it is very user-friendly compared to classic hand held sound level meters
- Measurement of noise according to international standards
- Measure all parameters simultaneously e.g. LCeq, Lceq, LAFmax, Lcpeak,LAFTeq,L95% etc
- Automatic report generator
- Real-time 1/3 octave analyzer according to IEC1260 class 0
- FFT analysis
- Level vs. Time plots
- Signal statistics
- Audio recorder (.wav/ .mp3) synchronous to the signal analysis
- Tonal components IEC 45681
- Supports Marker for post-processing
- Loudness ISO 532B (Sone)
- Easy export of measurement results via graphic or table
- You can use different signal acquiring hardware. E.g. USB class 1 / 2 microphones
- Akulap runs on different PC, notebook, Tablet

2 Content of package

A measurement system with Akulap consists of

- Measurement PC
- USB-Interface
- Measurement microphone
- Product CD
- User manual
- Optional sound level calibrator

3 Installation

Please run setup.exe from the CD and follow the instructions.

4 Interface connection

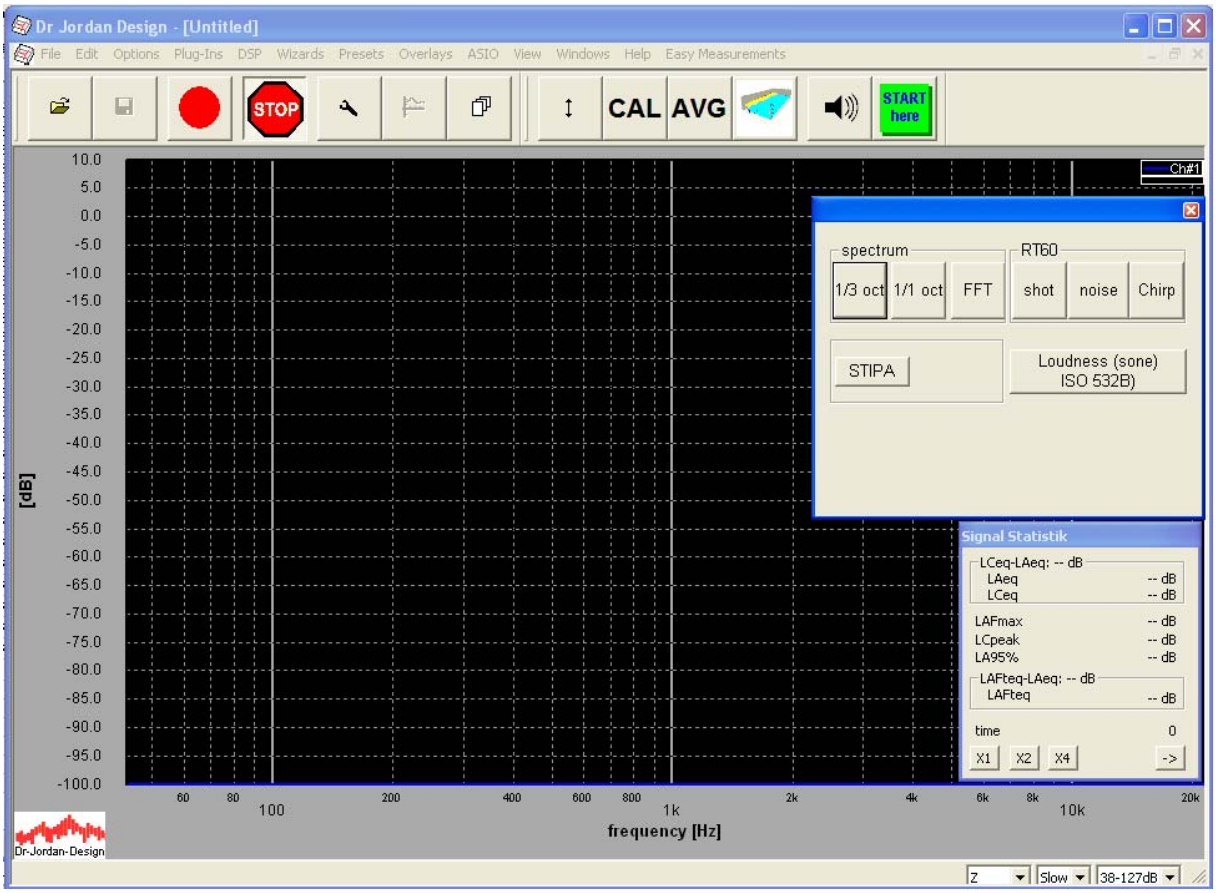
USB measurement microphone

Simply connect the USB microphone to one USB port. That's all. No driver, no external power supplies. Simply start the measurement.

USB measurement interface

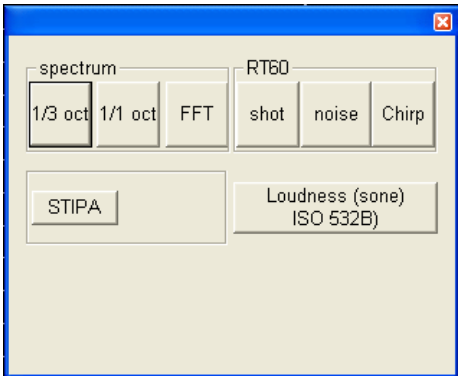
Simply connect the USB interface to one USB port and connect the interface to the microphone.

5 Start Akulap

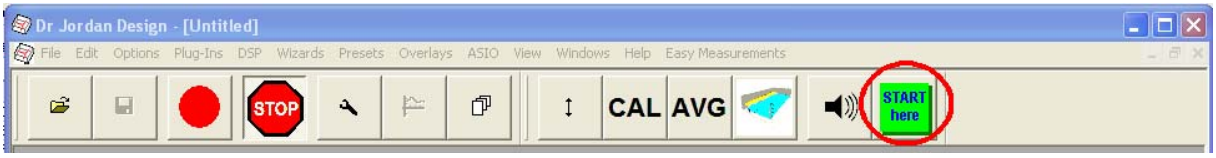


You will see the main window, the predefined measurements and the signal statistics.

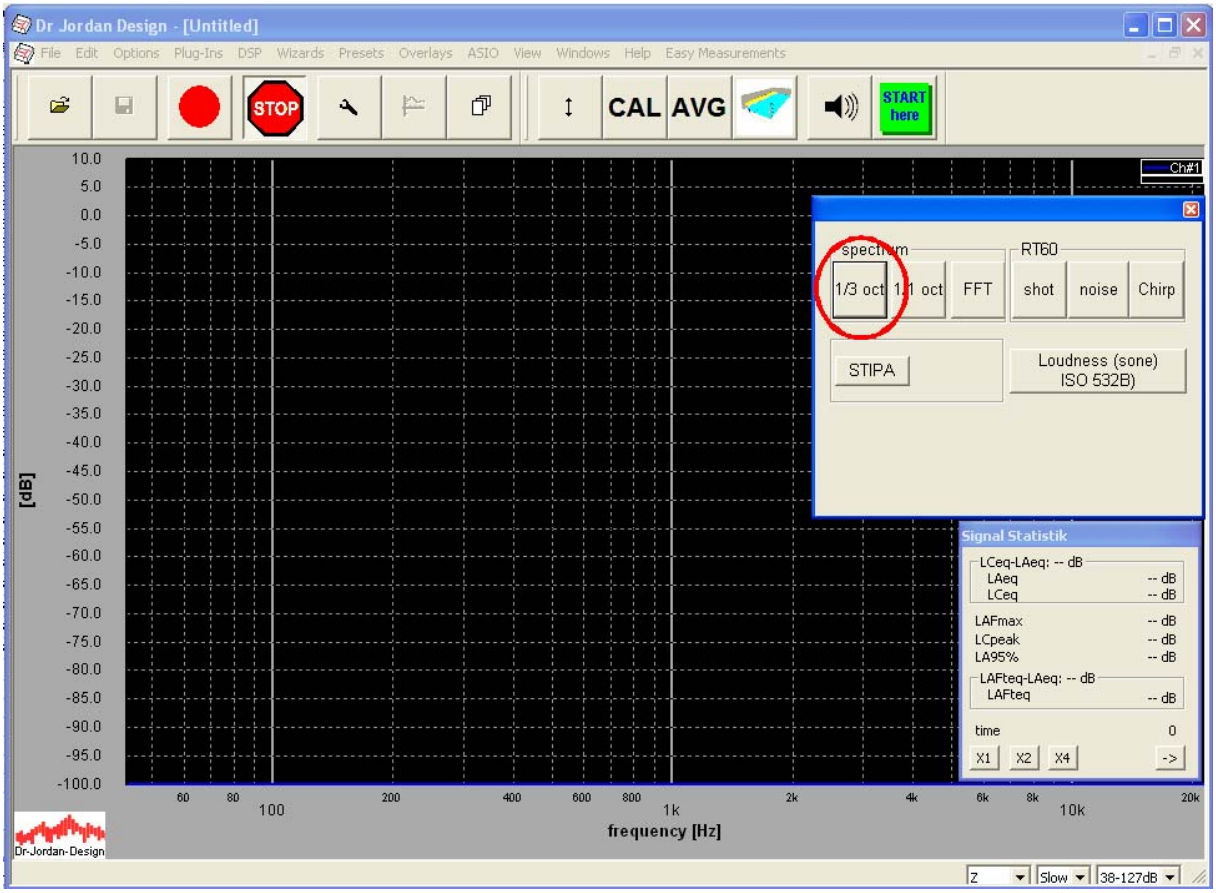
The window with predefined measurements allows you to perform several measurements easily with one click. The program will be reset automatically.

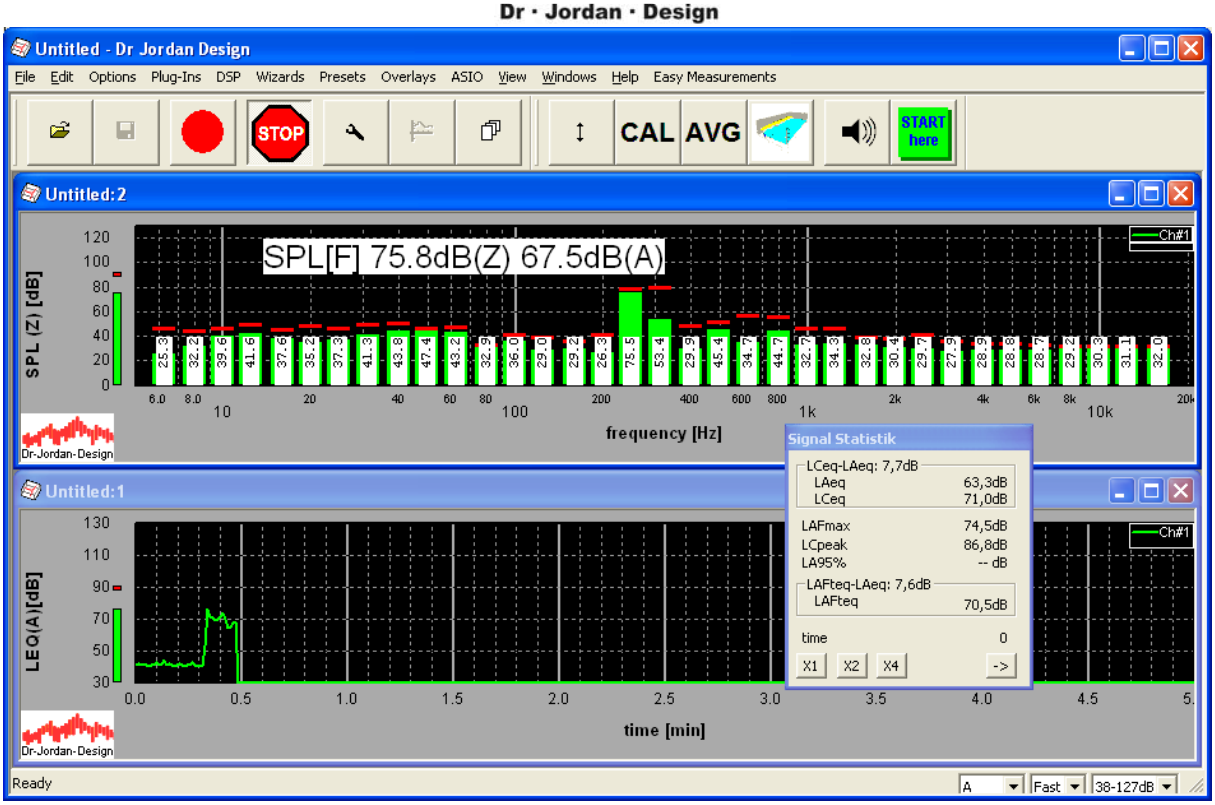


You can always put this window to foreground by pressing the green button.



Select one measurement e.g. 1/3 octave RTA



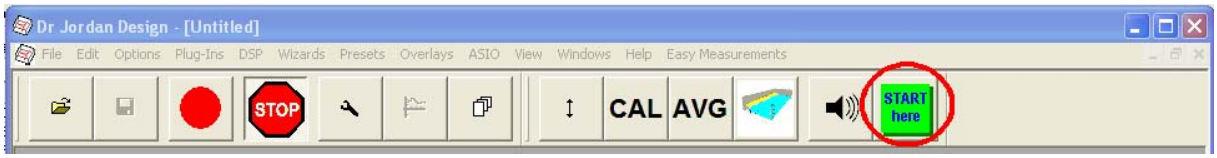


The upper window shows a 1/3 octave RTA. For each band you get the corresponding SPL, The red lines mark the peak SPL. The spectrum is always without weighting.

The lower window shows the SPL vs. time. By default, we display a range of 5minutes.

Note

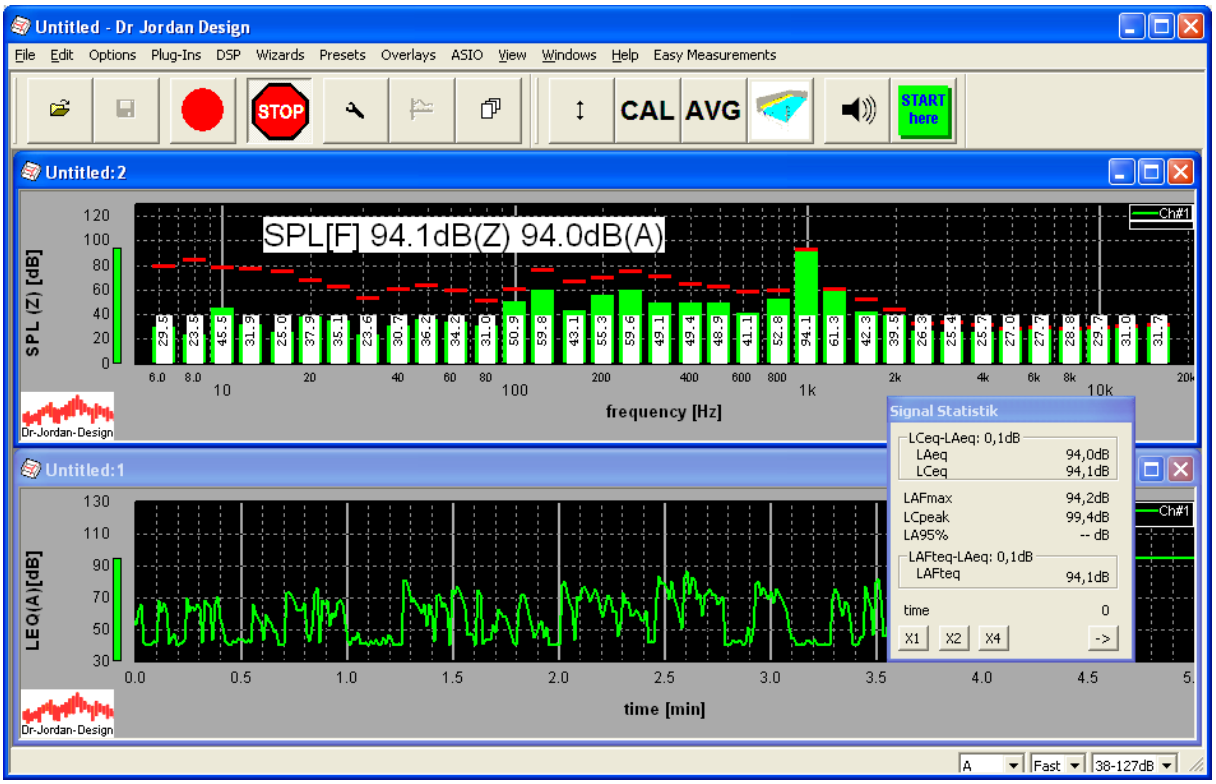
With the green button you will always get the predefined measurements.



During a measurement, this window is hidden to save room for the measurements results.

6 Verify the setup

Connect a sound level calibrator carefully to the microphone and power on the calibrator. In this example, we use a calibrator with 1kHz and 94dB.

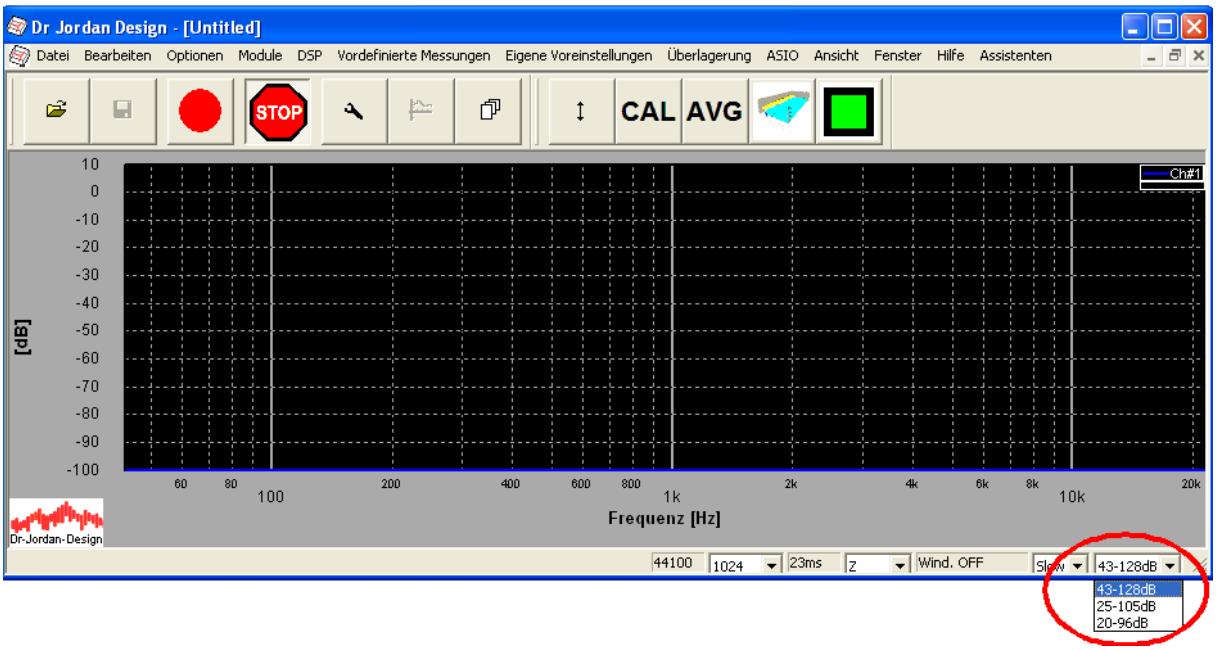


The SPL meter should display 94dB. It is important that you see a peak at 1kHz. The A and Z weighted level should have a deviation of max 0.3dB. A small mismatch between the two

values might be caused by a frequency deviation of the calibrator. At exact 1kHz, both values are identical.

7 Select the measurement range

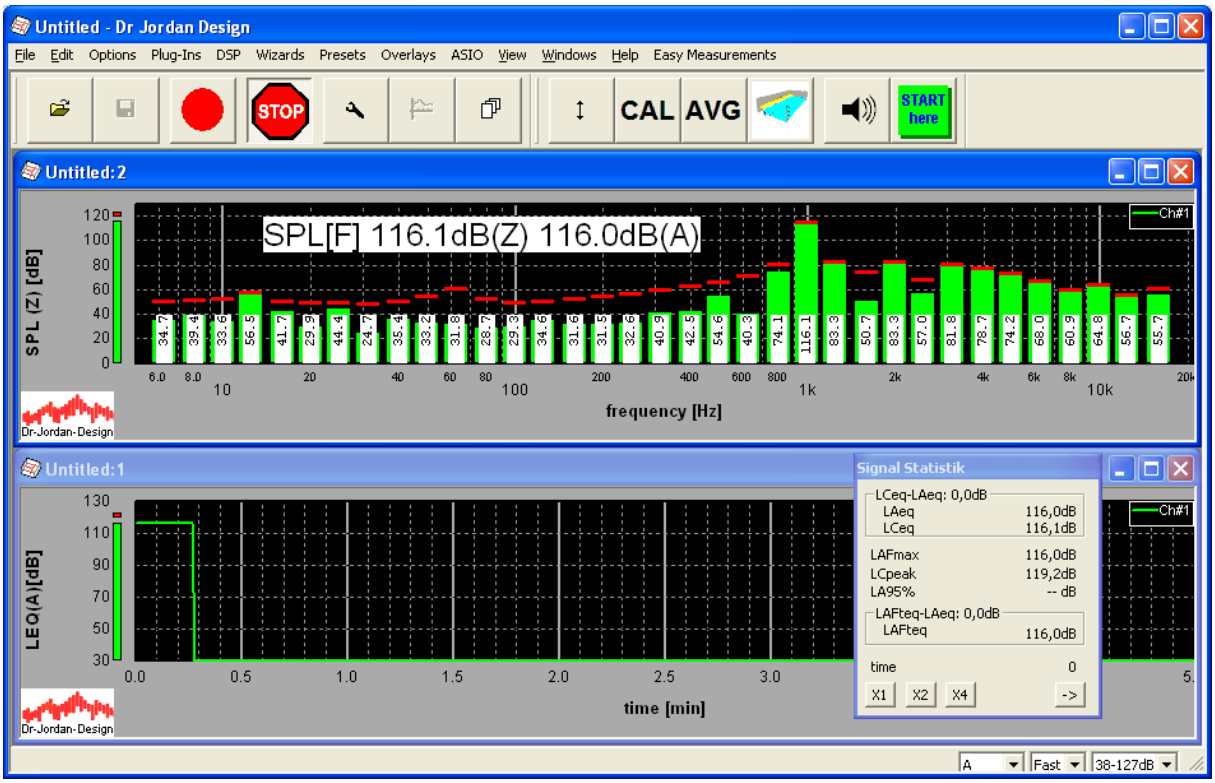
Some types of USB measurement systems have different measurement ranges. You will find the available ranges in the lower right corner. Select the desired range with a mouse click.

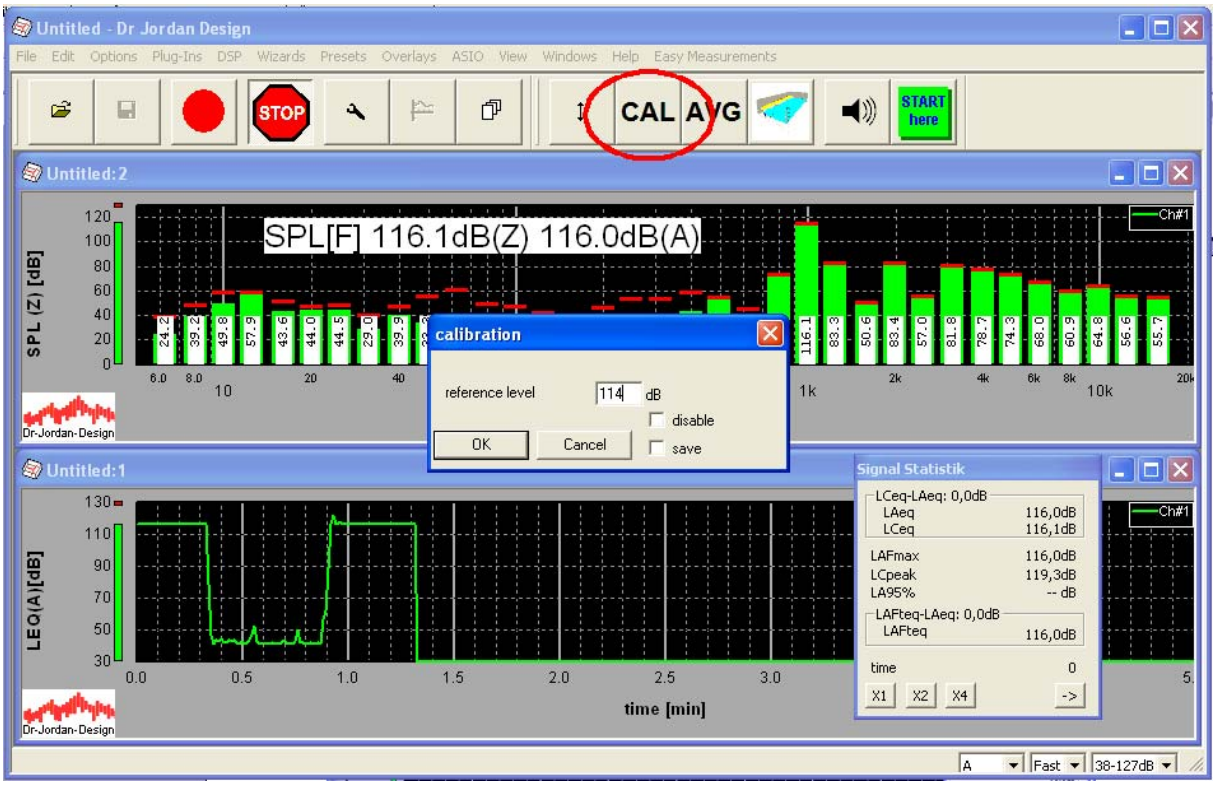


The calibration does not change, if you select a different range.

8 Calibration

In this example we use a calibrator with 114dB. When we connect the calibrator, we get a SPL reading of 116dB. Therefore, the system requires calibration.





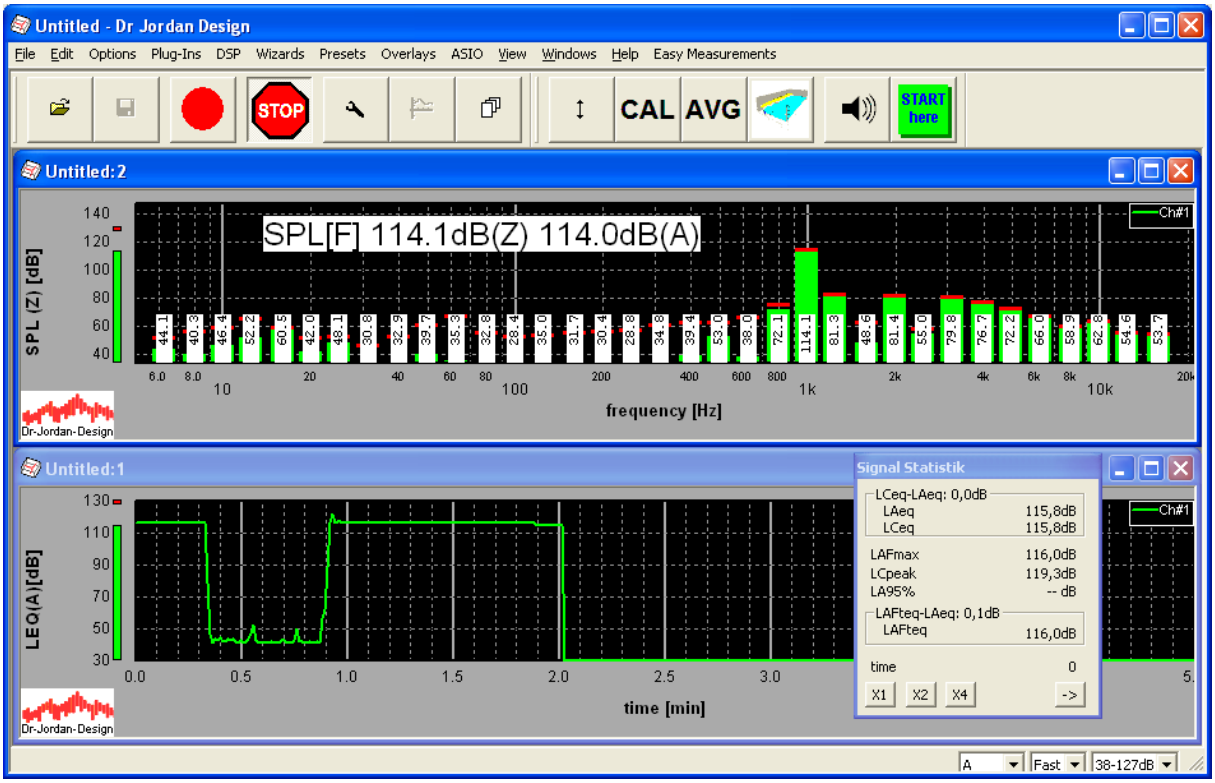
Press the button „CAL“ from the toolbar.

You can freely select the calibration level. Common are 94dB, 114dB and 124dB for pistonphones. Please ensure, that the level of the calibrator is within the measurement range.

If you select „save“, the system will save the calibration offset permanently.

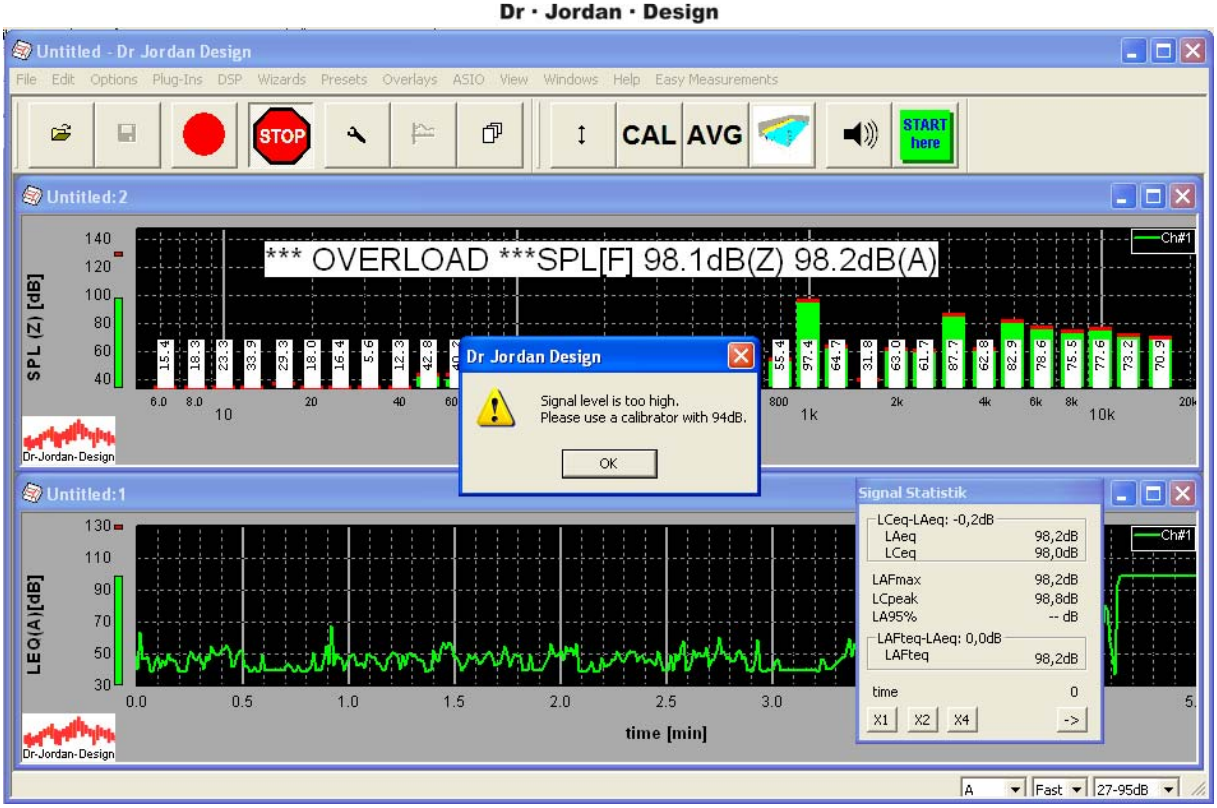
If you select “disable”, no calibration is used. The reference level 0dB will be full scale of the AD-converter. This feature is for advanced users.

Enter a level of 114dB and press ok. The system should now show the correct SPL of 114dB.



We recommend calibrating before each measurement. In addition, this simple step verifies the complete measurement chain.

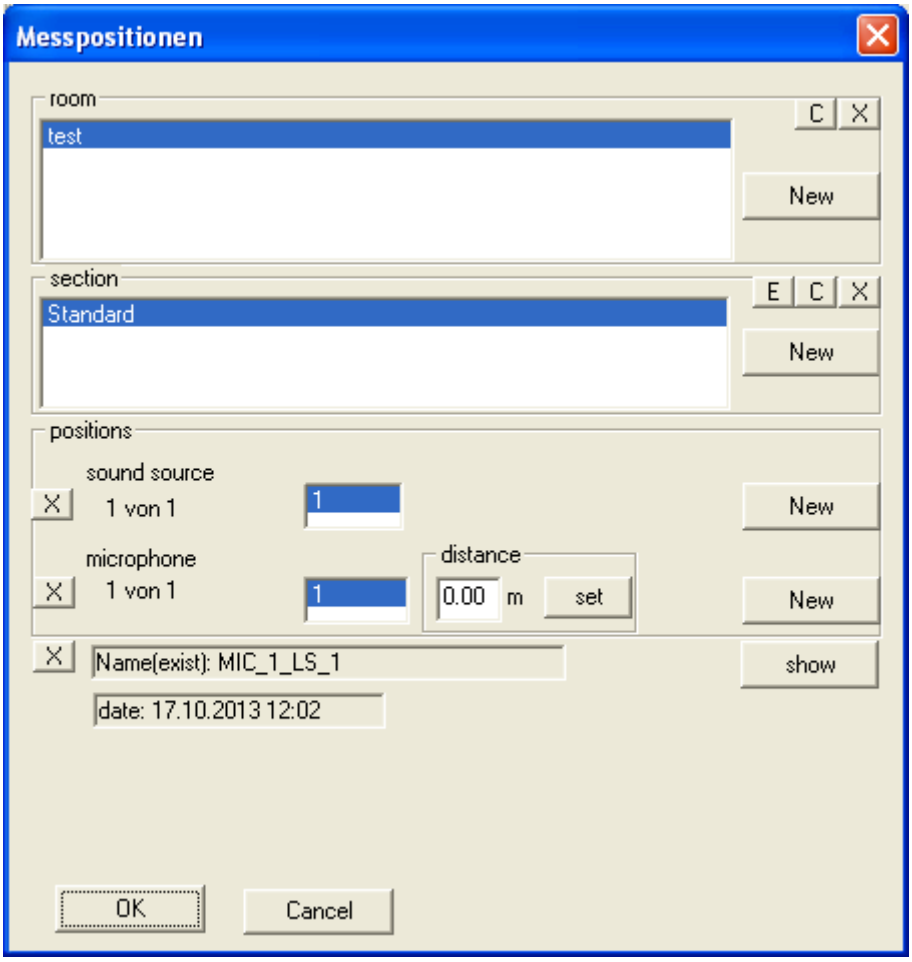
Please ensure that the level of the calibrator is within the range of the analyzer. The system has detection for overload and underload. In this case, use a different calibration level or measurement range.


Untitled - Dr Jordan Design
File Edit Options Plug-Ins DSP Wizards Presets Overlays ASIO View Windows Help Easy Measurements
STOP
CAL
AVG
START here
Untitled: 2
*** OVERLOAD ***SPL[F] 98.1dB(Z) 98.2dB(A)
SPL (Z) [dB]
Ch#1
Dr Jordan Design
Signal level is too high.
Please use a calibrator with 94dB.
OK
Untitled: 1
LEQ(A)[dB]
time [min]
Signal Statistik
LCeq-LAeq: -0,2dB
LAeq 98,2dB
LCeq 98,0dB
LAFmax 98,2dB
LCpeak 98,8dB
LA95% -- dB
LAFteq-LAeq: 0,0dB
LAFteq 98,2dB
time 0
X1 X2 X4 ->
Dr-Jordan-Design
A Fast 27-95dB

9 Organize your measurements

Akulap contains a manager to organize your measurements. With this manger you can easily keep the overview about thousands of measurement points. You can easily calculate averages about several measurement points.
This manager helps you to store all your results in a structured way.

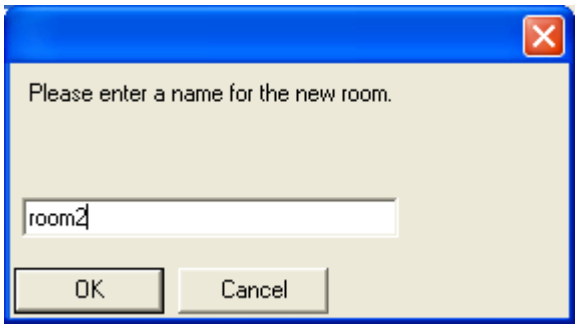
9.1 Use the Room-Manager



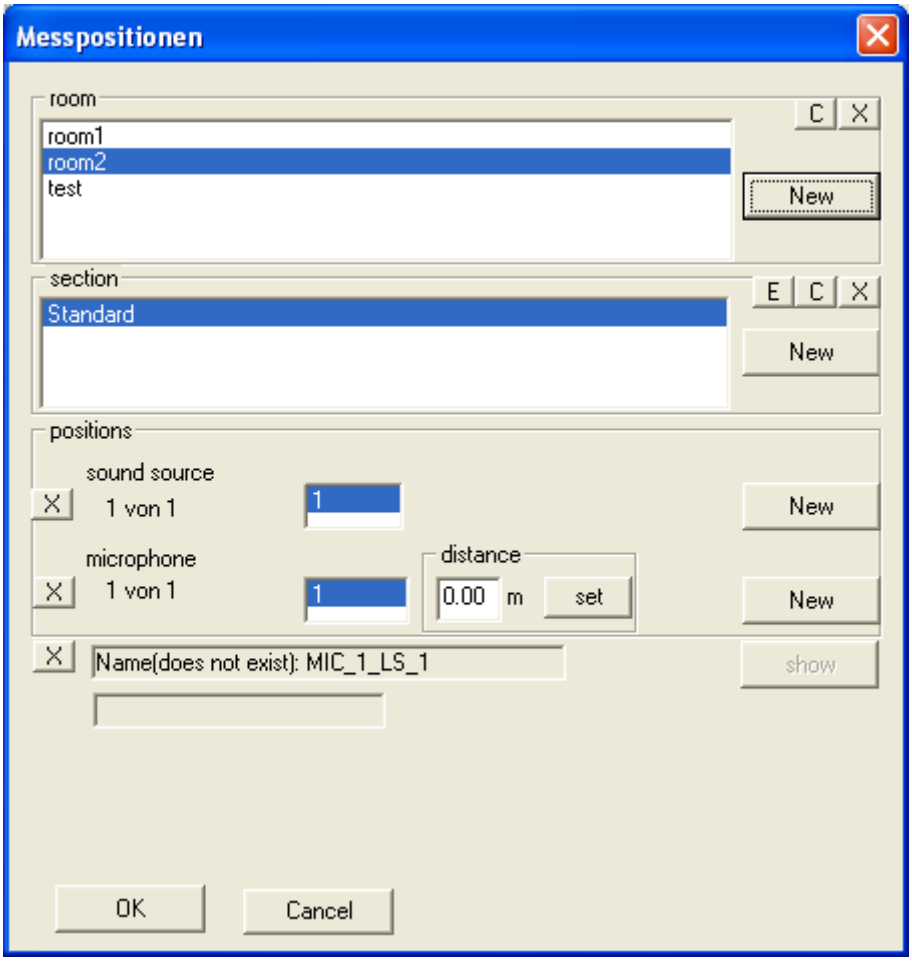
With the room manager you can organize your measurement positions.
You can separate large room into sections. For each section you can create an unlimited number of measurement points with different sound source and microphone positions. For documentation purposes, you can enter the distance between sound source and microphone.

With the room manager you can edit or delete rooms, sections or positions.

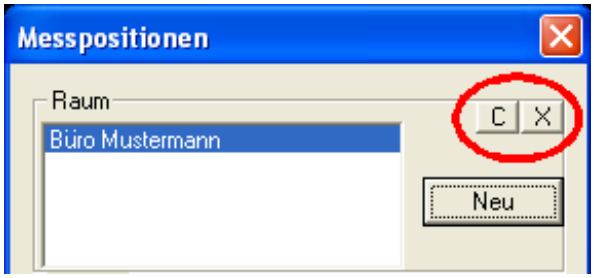
Create a new room with „New“



Enter the new name end press enter.



With “C” you can change the name later. With “X” you can delete a complete room.



In a similar way you can edit or delete sections of a room.

When you begin, a room contains a single section with the name “Standard” with one measurement position.

9.2 Directories

The room manager saves all files at
„My Documents\Measurements\Level__MANAGED__”

For each room a separate sub-directory is created. In each room you will find subdirectories with the different sections. In each section you will find the directories with the individual measurements.
The directory "MIC2_LS3" contains the measurement with the microphone position 2 and the sound source position 3
This directory structure is stored in a database. You should NOT rename, move or delete any directories by hand. Use the functions of the room manager to perform these tasks. If you change directories, the program recognizes this and you receive an error message. Therefore, use **always** the room manager to delete or rename rooms / sections etc.

9.3 Archive measurements

If you have a variety of rooms measured, the project can quickly get confusing. We therefore recommend archiving older measurements.

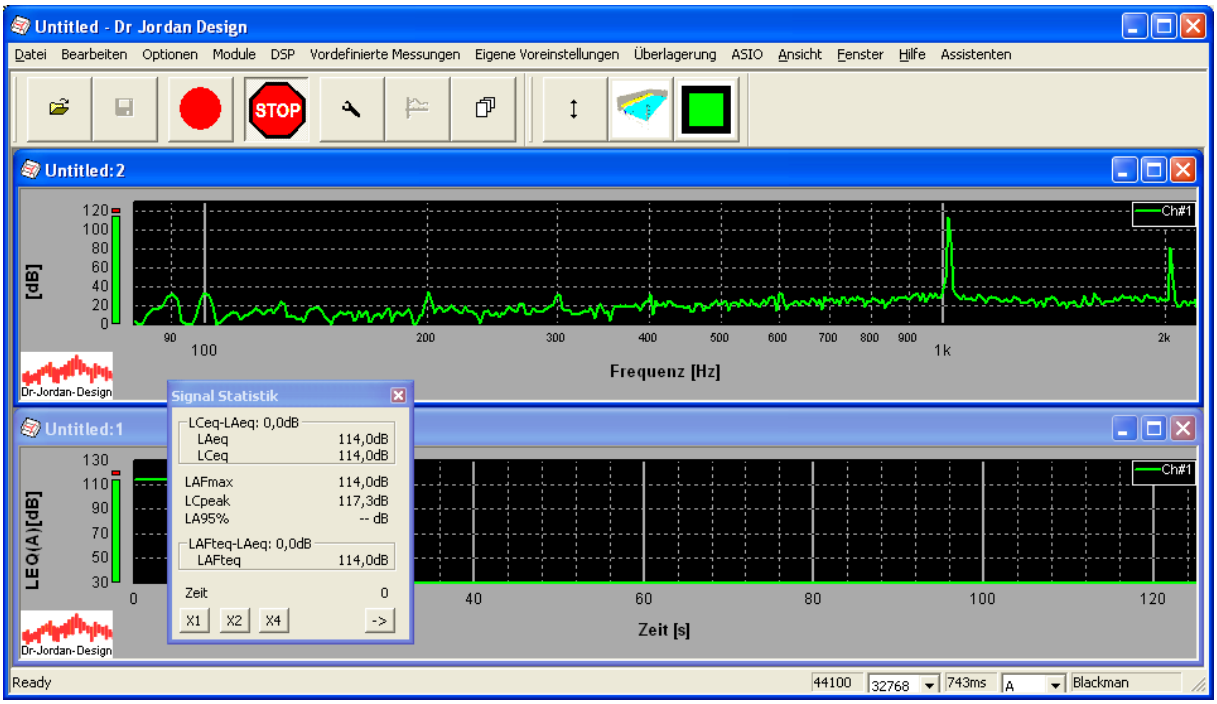
1. Close AkuLap
2. Move the individual rooms to any directory. This can be done as usual by means of the operating system, for example, File-Explorer
3. Start AkuLap and start the room manager

You receive a message that the room was not found and has been deleted from the database.

10 Narrow band analysis with FFT

If you need a narrow band analysis we recommend using the FFT. You can detect tonal components or measure e.g. the base frequency of a power generator.

Select the mode FFT.



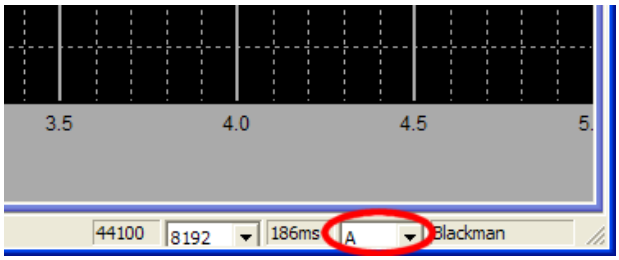
The default frequency resolution is 1.3Hz. You can increase the frequency resolution by adjusting the FFT size. However, the higher is the frequency resolution, the lower the time resolution. The system will "move slowly".

11 Weighting Filters

Akulap s the following weighting filters:

- Z without weighting
- A
- C

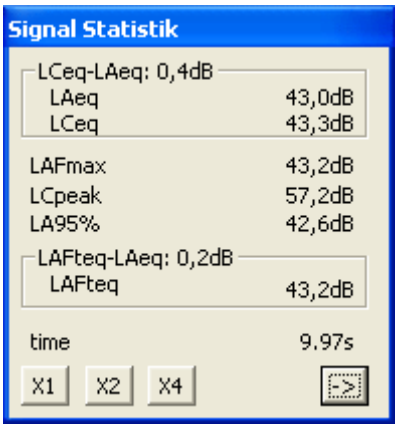
You can change the current weighting in the status bar in the lower right area.



During a measurement **all** weighting filters are stored simultaneously.

12 Signal statistic

With the signal statistic window you get a quick overview:



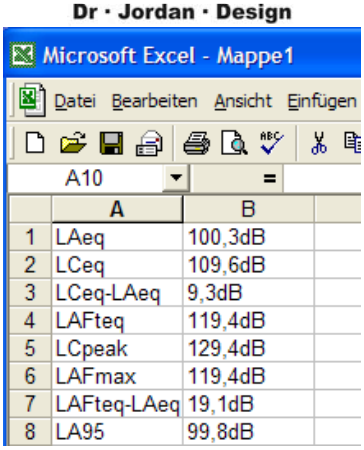
LAeq	Energy equivalent average weighting A
LCeq	Energy equivalent average weighting C
LAFmax	Maximum value from frequency weighting A und time weighting F
LCpeak	Peak value frequency weighting C
LA95%	95% Percentile
LAFteq	“Taktmaximalwert” 5s energy equivalent average

With the buttons X1,X2,X4 you can enlarge the statistic window to read it easily from a distance.

You can copy the current results to the clipboard with the button “->” and then export it easily to Excel.

```
LAeq           100,3dB
LCeq           109,6dB
LCeq-LAeq        9,3dB
LAFteq         119,4dB
LCpeak         129,4dB
LAFmax         119,4dB
LAFteq-LAeq     19,1dB
LA95            99,8dB
```

Dr · Jordan · Design



	A	B
1	LAeq	100,3dB
2	LCeq	109,6dB
3	LCeq-LAeq	9,3dB
4	LAFteq	119,4dB
5	LCpeak	129,4dB
6	LAFmax	119,4dB
7	LAFteq-LAeq	19,1dB
8	LA95	99,8dB

13 Starting a measurement

Once you started Akulap, all measurement results are displayed in real-time. This interactive mode is useful to analyze a device directly. Any measurement results are **NOT** stored.

Instead, you have to start a measurement manually to get all results over a period of time.

Press the start button from the tool bar. The measurement will stop automatically, when the measurement time has elapsed. In addition, you can stop a measurement manually with the stop button.

During a measurement the following parameters a stored.

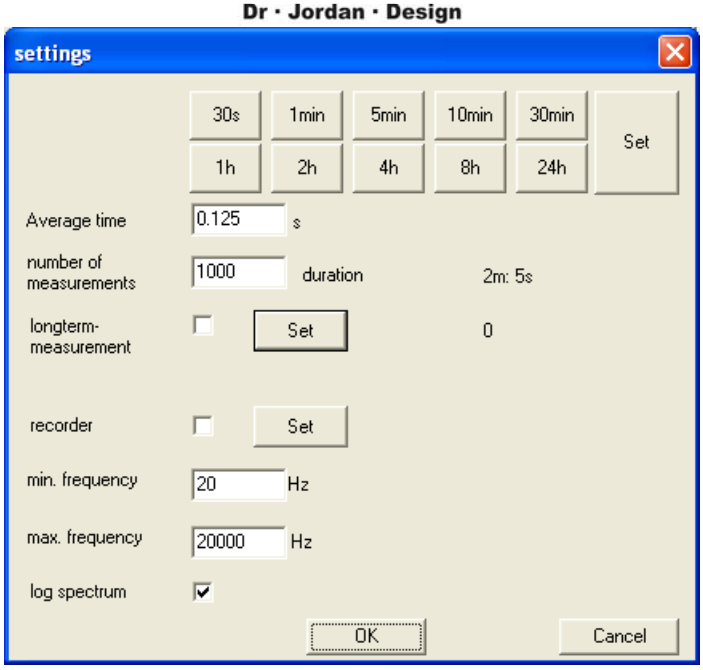
Wide band:

- SPL with time weighting (F,S,I)
- LEQ
- “Taktmaximalwert”
- Peak value

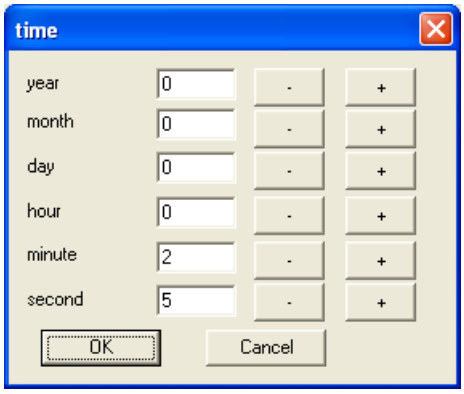
These values are stored for the frequency weighting Z,A,C simultaneously.

In addition, Akulap stores the 1/3 octave spectrum un-weighted (Z).

By default, all measurement results are stored with in interval of 125ms for a duration of 5min. You can easily modify these settings.



The most important parameters are Average time and the number of measurements. If you multiply the average time and number of measurements, you get the total duration of one measurement.
For typical measurement durations we have pre-defined buttons. Alternatively, you can set the time manually



13.1.1 Analysis of the measurement

Once you stopped y measurement, you can:

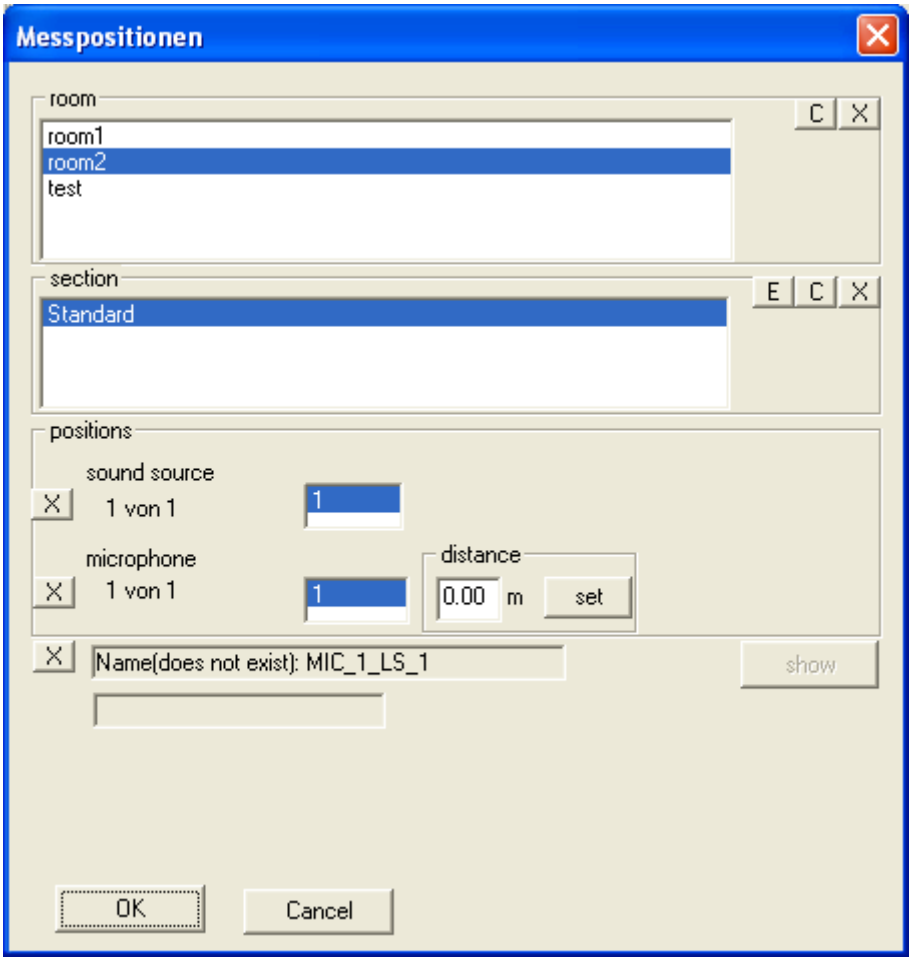
- Save
- Create a report
- Plot level vs. time curves

13.1.1.1 Save

You can save a measurement to disk with the save button from the toolbar.

Later you can load such file to create e.g. a report.

All measurement results are organized by the room manager. We discuss this room manager in a separate section of this user manual.



13.1.1.2 Report

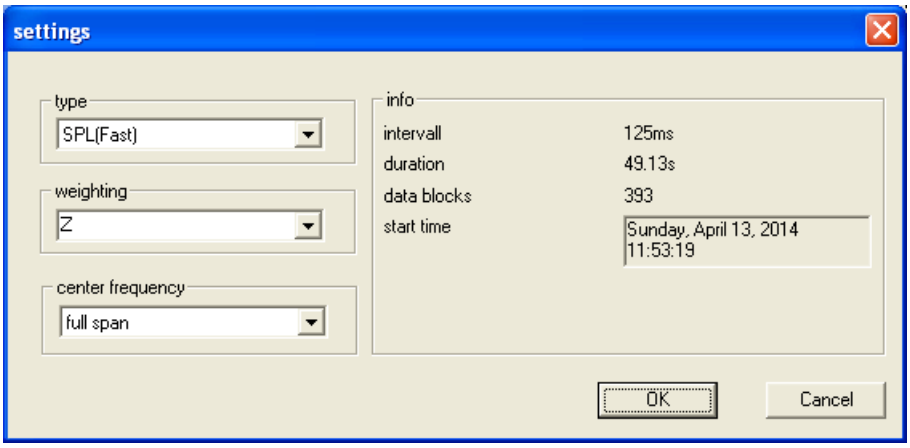
From the measured data you can create an automated report. This report contains a variety of statistics and can be archived easily, printed or exported to Word / Excel. The report is generated as an HTML file and automatically open your Internet browser.

You will first be asked for the location to save the date. This is done through the room manager. This is explained in a separate section. The data is stored at "My documents \ Measurements \ level" in an individual directory. A new subdirectory is created for each measurement.

After a short time, your internet browser will open with the report. Here you can print the report using the usual functions from your internet browser.

13.1.1.3 Plot level vs. time

Once you finished a measurement, you can plot various parameters. It is not required to save the data before.

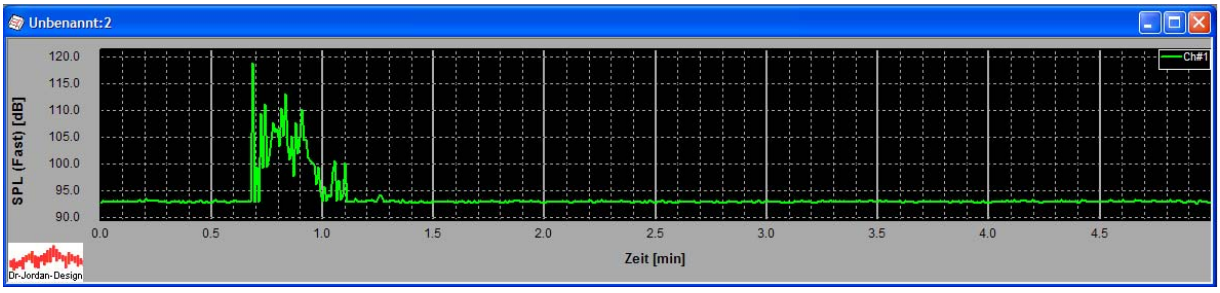


In the right part you see some detailed info about your measurement. On the left side you can select different parameters

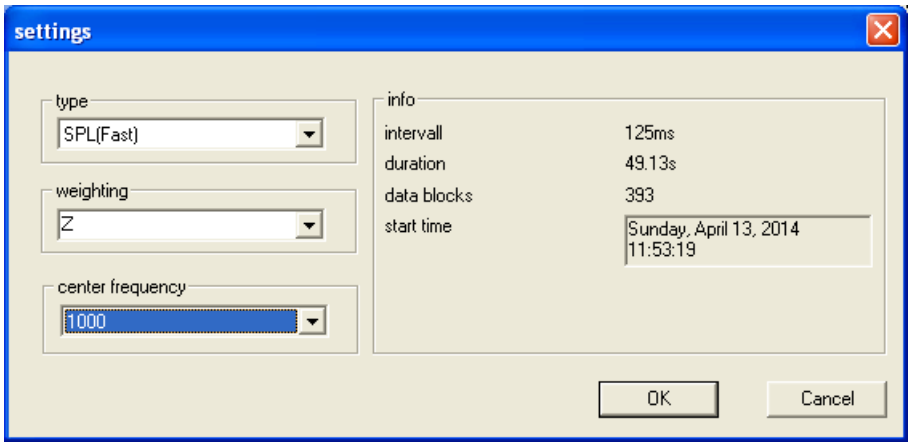
- SPL with different time weighting (F,S,I)
- LEQ
- Taktmaximal
- Peak value

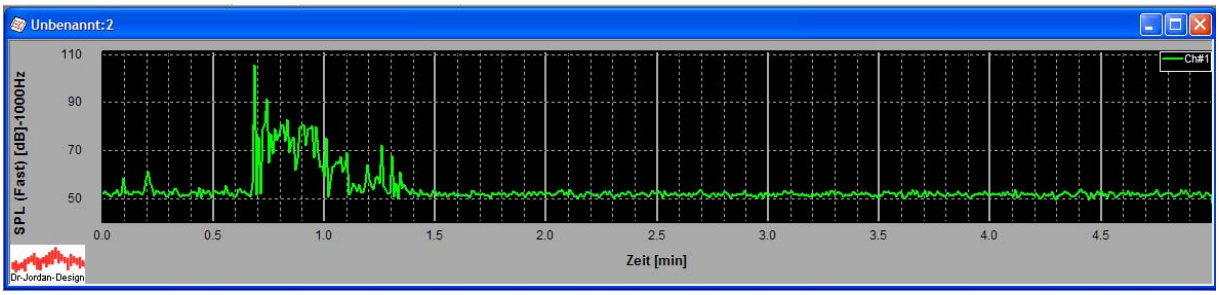
All parameters are available wide band or for a single band using the 1/1 or 1/3 filter bank
For all wide parameters you can enter the frequency weighting.
All narrow band data uses no frequency weighting (Z)

The following curve shows SPL(F) with no frequency weighting



With the following section you can plot the narrow band SPL with a center frequency of 1000Hz.


settings
type
SPL(Fast)
weighting
Z
center frequency
1000
info
intervall
125ms
duration
49.13s
data blocks
393
start time
Sunday, April 13, 2014
11:53:19
OK
Cancel

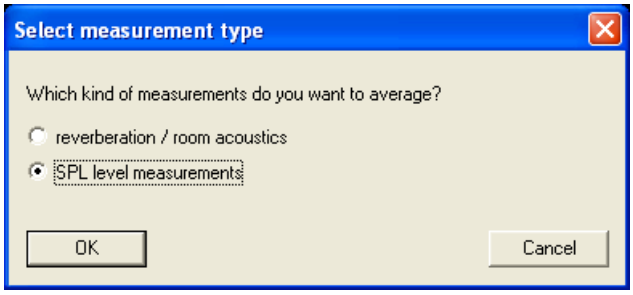

Unbenannt:2
SPL (Fast) [dB]-1000Hz
110
90
70
50
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Zeit [min]
Ch#1
Dr-Jordan-Design

14 Average level measurements

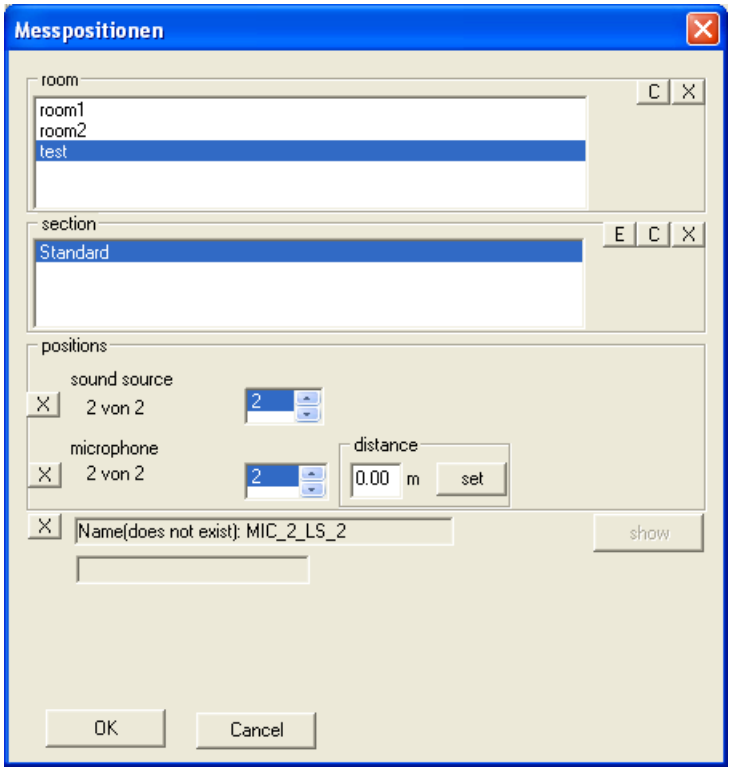
By using the room manager, you can easily calculate the average of several measurements within one section.

Press the „AVG“ button from the tool bar.

Select level measurement



The room manager will start



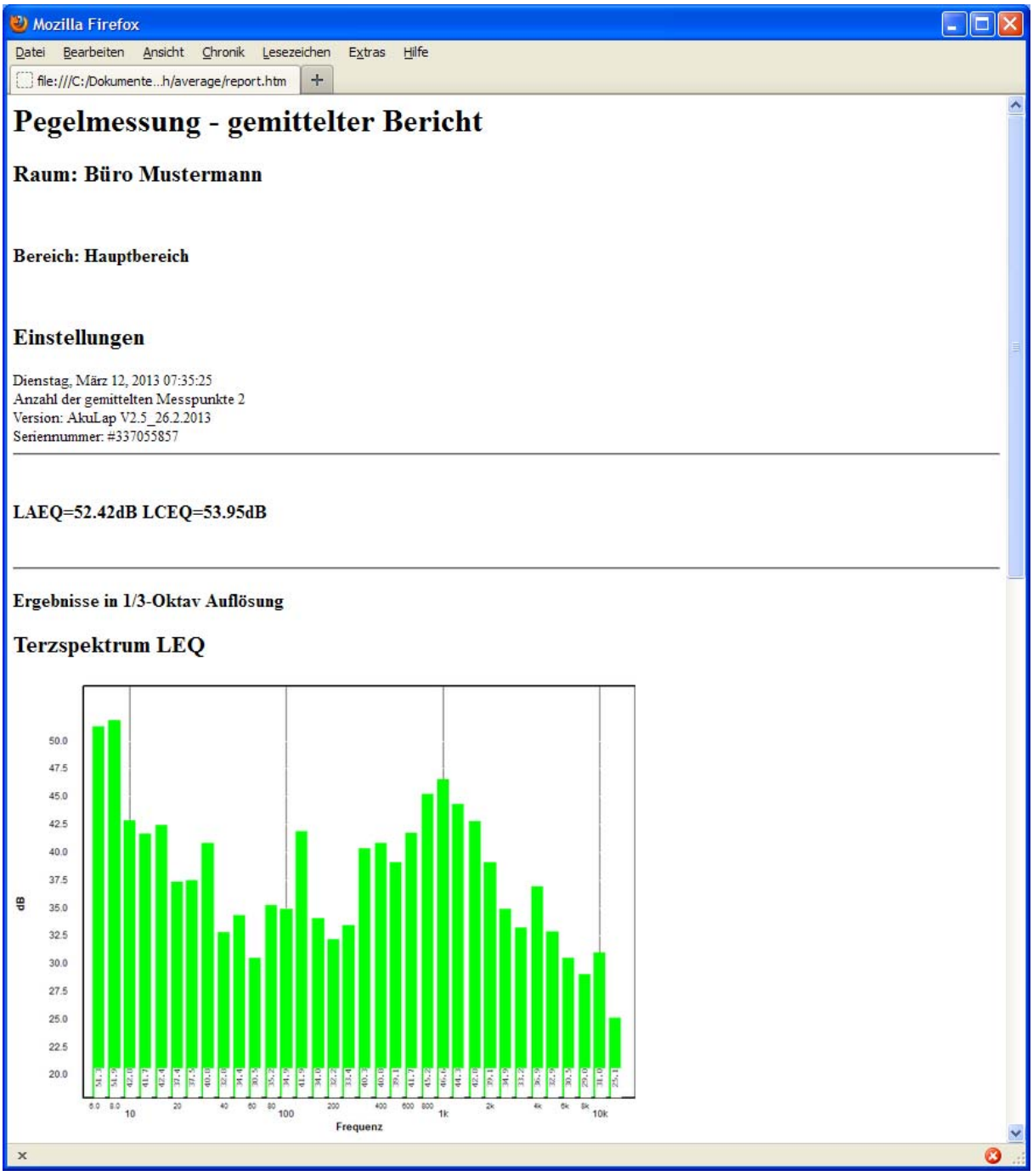
Select a section and press ok

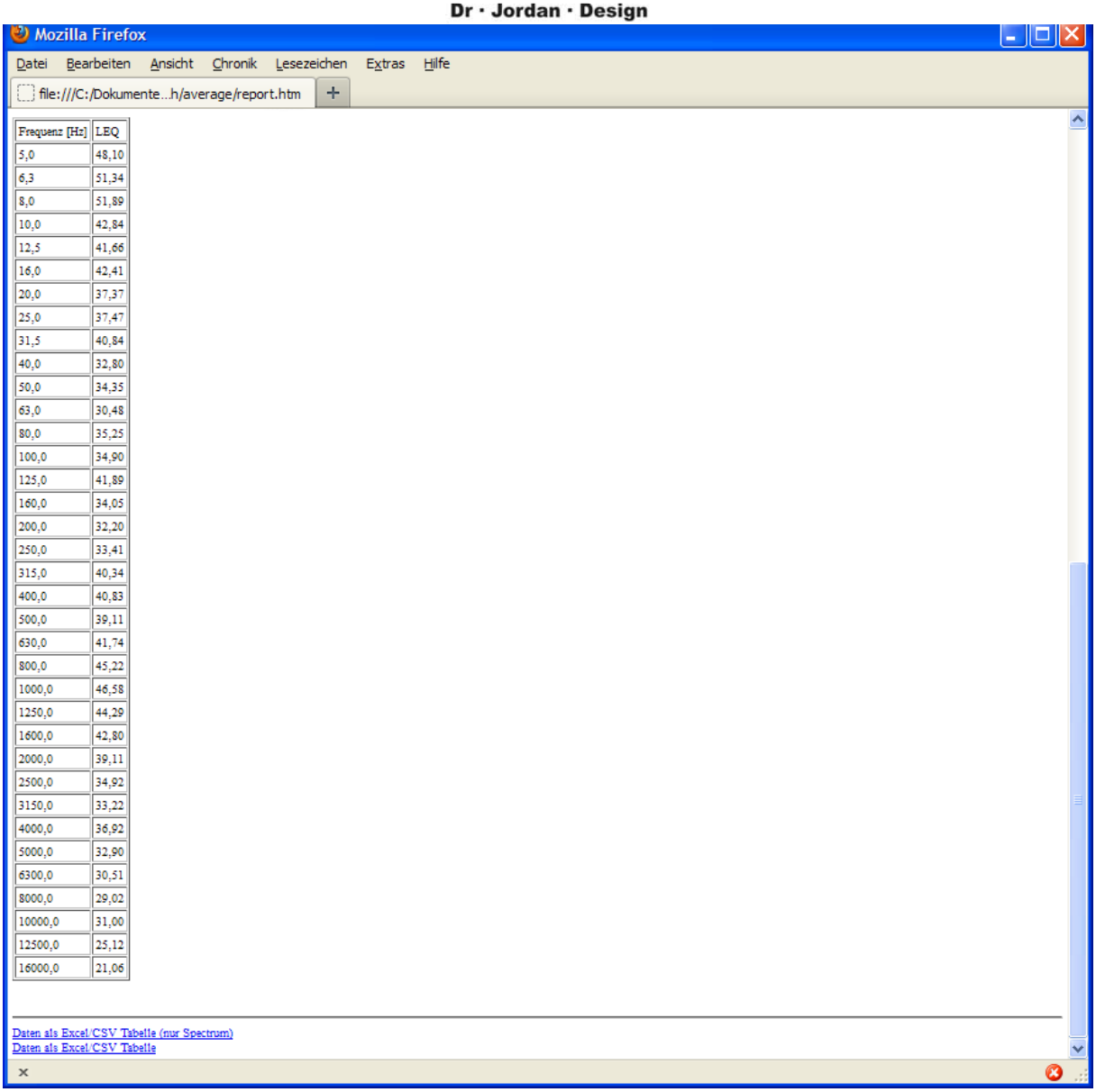
Akulap creates a report and opens it. This report contains the following averages:

- LAEQ
- LCEQ
- Spectrum (Z-weighted) as table and graphic

In addition, several CSV files are created for easy import to excel.

Next, we show some screenshots of such a report.





Frequenz [Hz]	LEQ
5,0	48,10
6,3	51,34
8,0	51,89
10,0	42,84
12,5	41,66
16,0	42,41
20,0	37,37
25,0	37,47
31,5	40,84
40,0	32,80
50,0	34,35
63,0	30,48
80,0	35,25
100,0	34,90
125,0	41,89
160,0	34,05
200,0	32,20
250,0	33,41
315,0	40,34
400,0	40,83
500,0	39,11
630,0	41,74
800,0	45,22
1000,0	46,58
1250,0	44,29
1600,0	42,80
2000,0	39,11
2500,0	34,92
3150,0	33,22
4000,0	36,92
5000,0	32,90
6300,0	30,51
8000,0	29,02
10000,0	31,00
12500,0	25,12
16000,0	21,06

Daten als Excel/CSV Tabelle (nur Spectrum)
Daten als Excel/CSV Tabelle

15 Marker

15.1 Overview

Once you finished a measurement, in many cases you will need some post-processing. Let's assume you measured the noise 5min in a quiet office, but suddenly someone opens the door. Of course, you can simply repeat the measurement. However, there are cases where this is not possible. In this case you can remove the short noise from the calculation.
In addition, marker helps you to analyze noise of e.g. a machine with different working phases.

Akulap supports the following type of markers:

1. **Exclude** of a section. Certain parts of the measurement are excluded from statistics calculation
2. **Include** of a section. Akulap calculates all signal statistics from the marked sections.
3. **Level**. You change the level of marked sections.

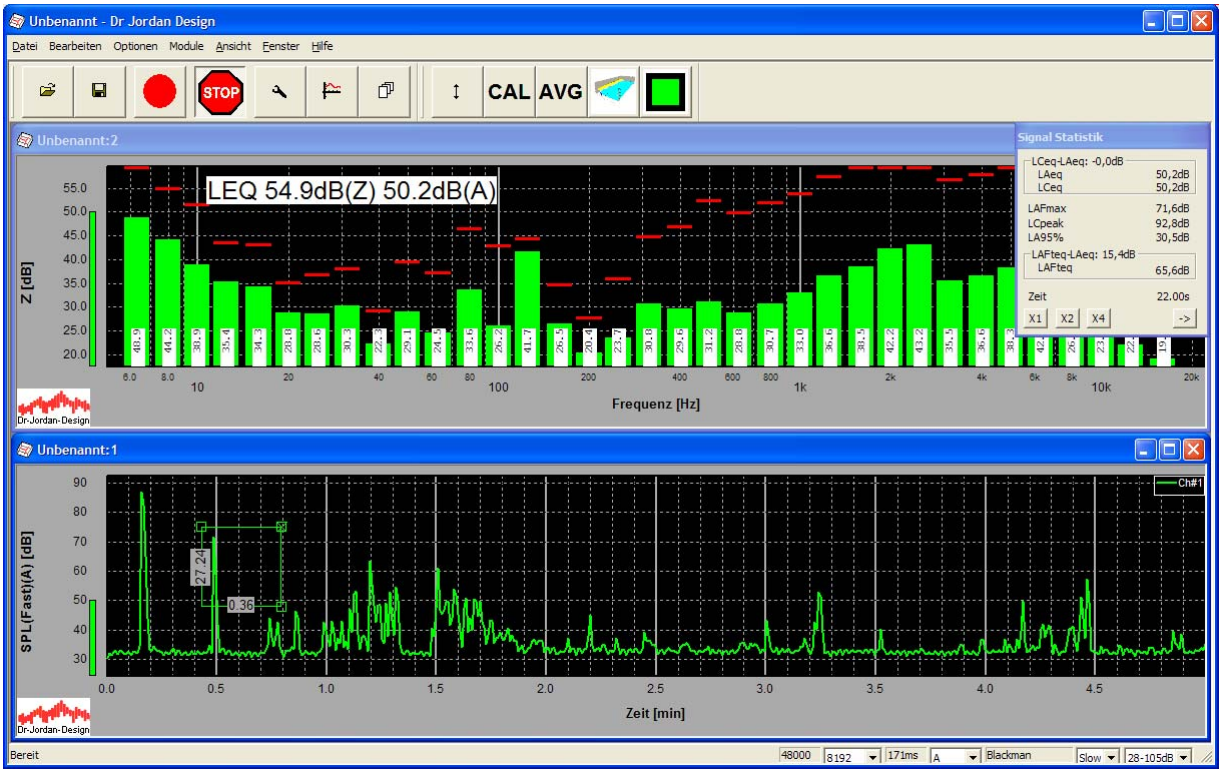
Simply mark the sections with the mouse in the level plot. In addition, you can enter precise times.
It is very useful to enter a name for a marker. The name is plotted in all graphics. Akulap creates a table with all signal statistics for the markers.

When you change the length of a marker interactively with the mouse, all statistics are updated in real-time. This feature is useful to analyze the effect of a marker.

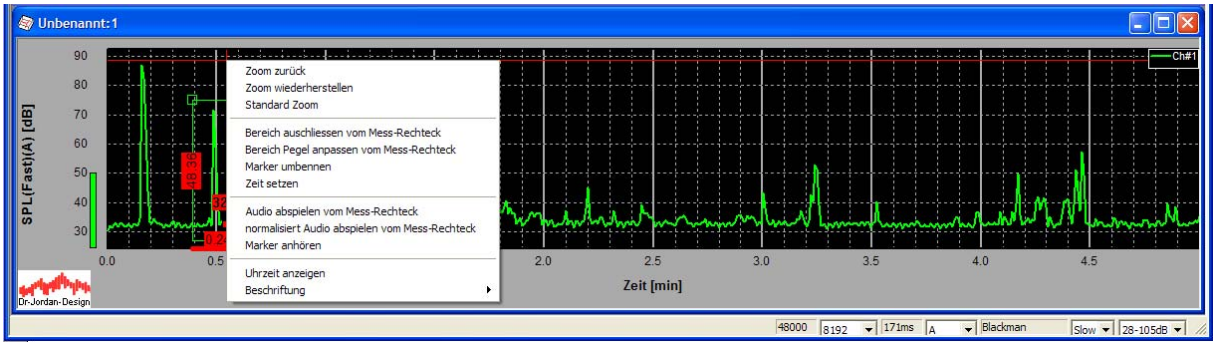
If the measurement included a wav recording, you can listen to the recorded sound of the marked section.

15.2 How to use markers

You set and edit markers, once you save a measurement and loaded it again.
Double click with the left mouse button in the lower SPL vs. time view. A measurement rectangle opens. You can move or resize this rectangle with the mouse.

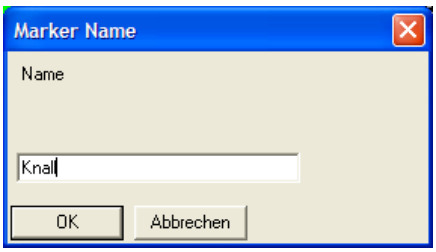


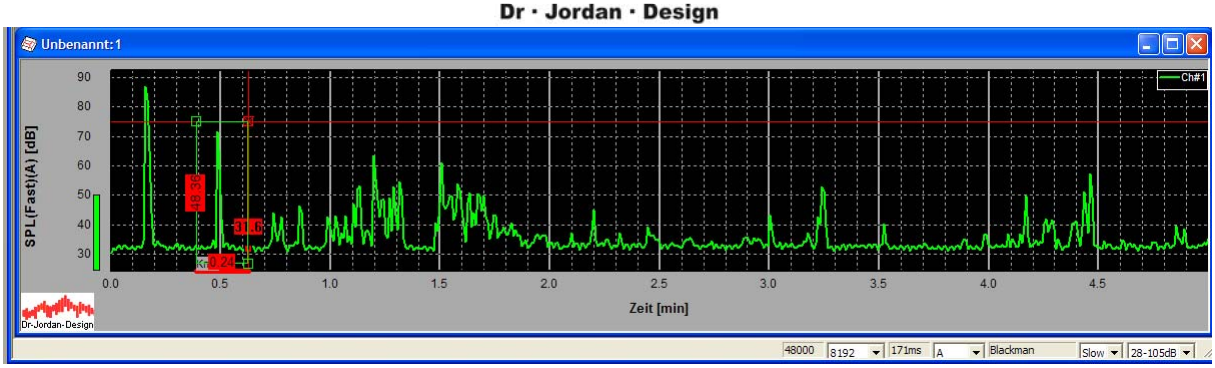
Press the right mouse button and a context menu opens.



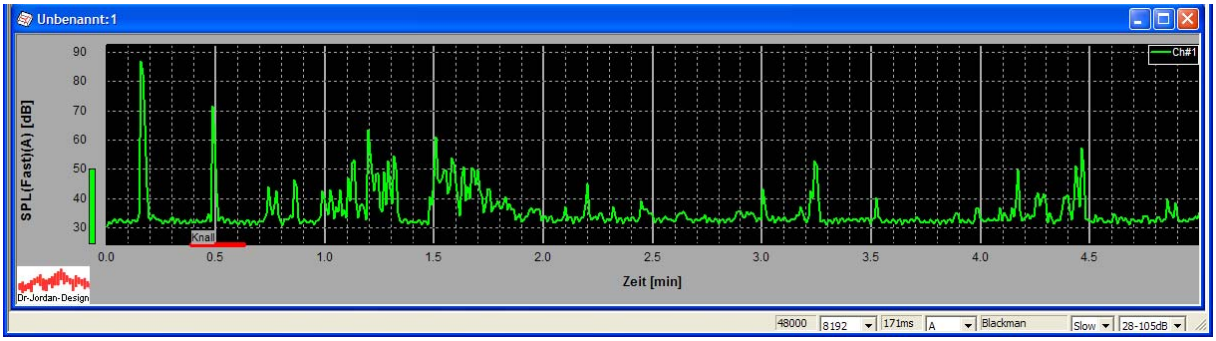
Select Marker exclude from measurement rectangle.

Enter a name for the marker.

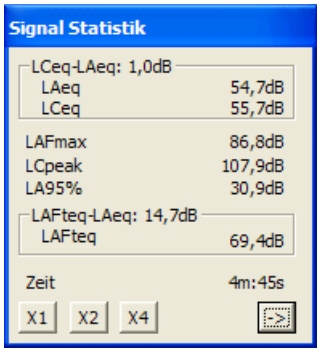




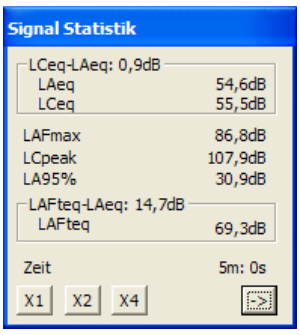
Close the measurement rectangle by clicking on the red ‚x' in the upper right corner.



The red marked section will now be ignored for any statistic calculation.

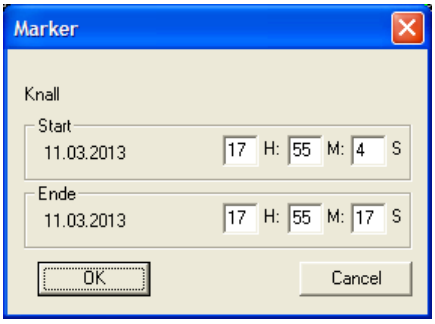


Double click on the marker to deactivate it. In this case the marker is displayed, but ignored for calculation. In this case the section is not ignored anymore.



In this case the difference for total LEQ is 0.1dB.

In addition, you can enter the exact marker position with the keypad. Select a marker and use “time set” from the context menu.



Delete

Select a marker and press the”Del” key.

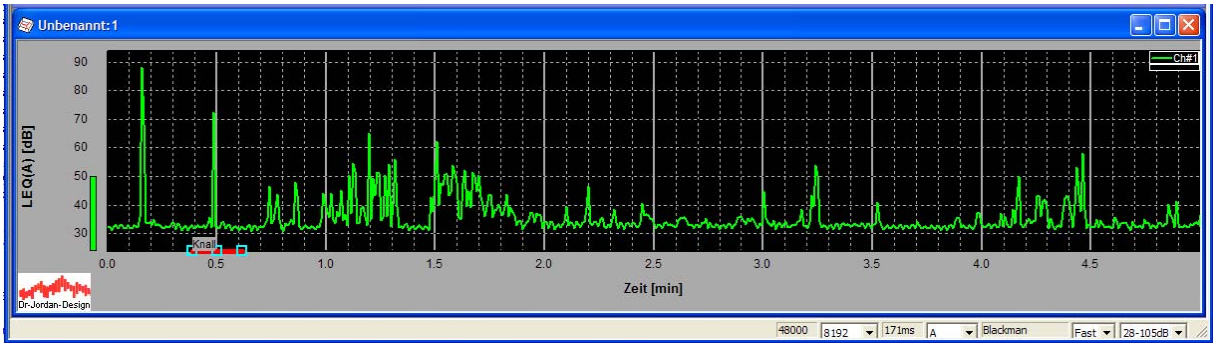
Rename

Select a marker and use “marker rename” from the context menu.

Listen

Select a marker and use “listen to marker” from the context menu.

Move

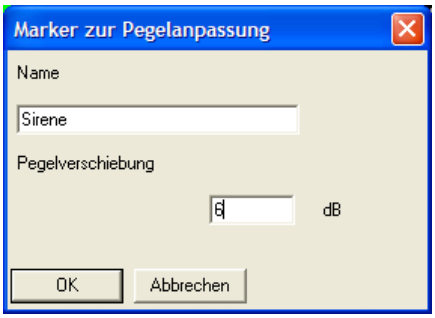


Each marker contains three active elements. With the middle box, you can move the marker. With the left or right box you change its size.

15.2.1 Marker type level

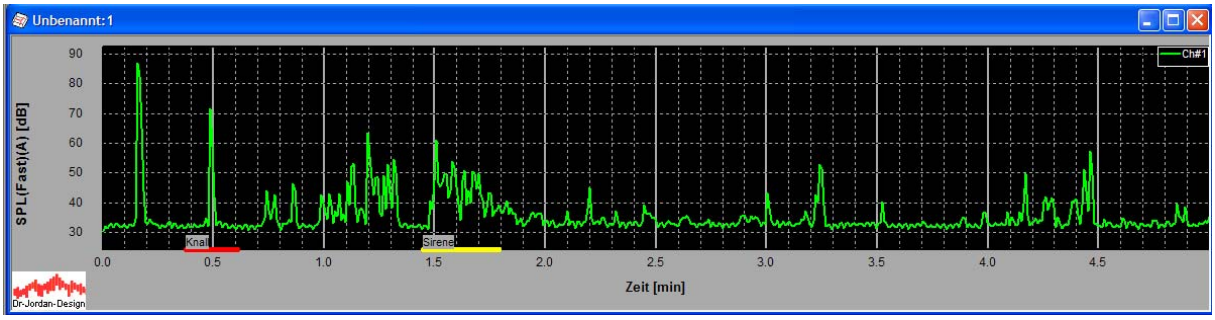
With this type of marker you can reduce or increase the level within the section. Typically this is used for certain periods of time e.g. during night. If the noise contains tonal components, such markers are useful for adding a penalty level.

You can use this type of marker in a similar way. Select a measurement rectangle, choose marker level, and enter the name and the level offset.



The level offset can be positive or negative.

The marker does not modify the SPL curve itself. Akulap considers this marker during calculation of the statistics, only.



Hint

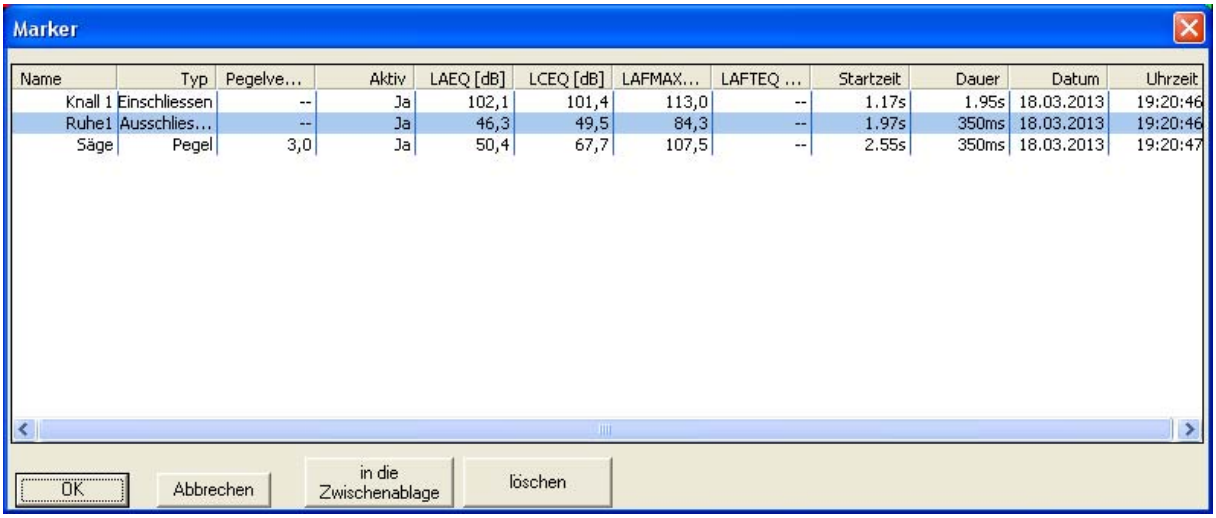
This type of marker is very useful for just marking sections without any influence to the signal statistic. All reports will contain this marker and its statistic information. Simply enter a level offset of 0dB.

15.2.2 Marker overview

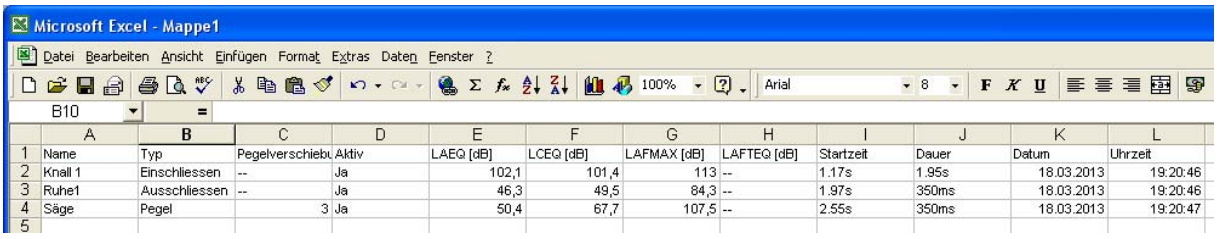
Akulap can report all markers in a clear way. From the context menu select marker overview.

For each marker you will get the following statistical information

- LAEQ
- LCEQ
- LAFMAX
- LAFTEQ



Use the button „clipboard“ to copy the content to e.g. Excel.



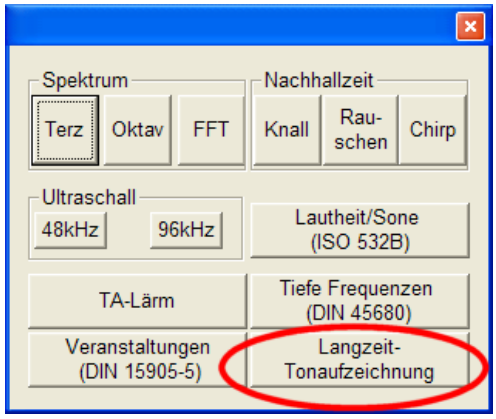
15.2.3 Report

In a report, Akulap will summarize all markers in a clear table.

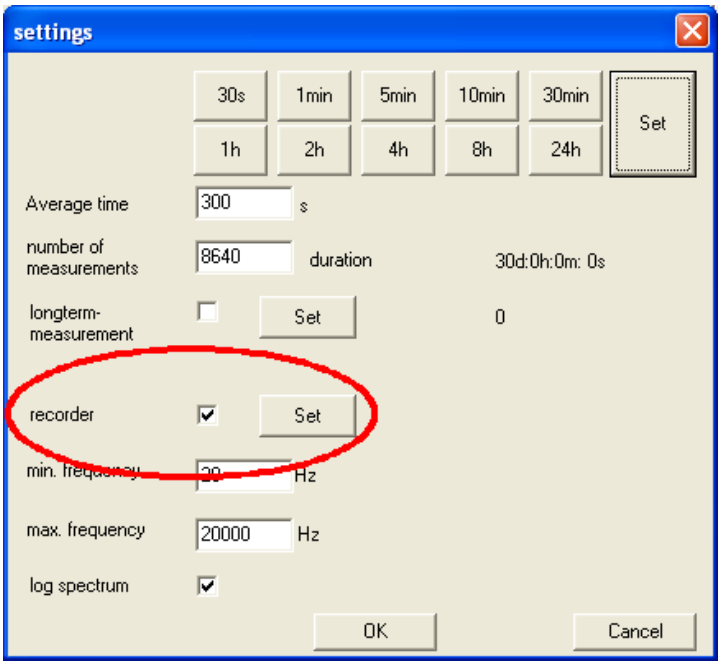
Name	Type	Offset [dB]	LAEQ [dB]	LCEQ [dB]	LAFMAX [dB]	LAFTEQ [dB]	Start	Duration	Ti me
Knall	Exclude	--	52,1	51,7	71,6	68,6	22.44s	13.95s	Montag, März 11, 2013 17:55:04
Sirene	Level offset	6	44,7	50,4	61,1	56,2	1m:27s	20.25s	Montag, März 11, 2013 17:56:09

16 Audio recordings

With Akulap, you can perform long-term sound recordings. The duration ranges up to months and is limited by the capacity of the hard disk, only.
The recording will be automatically divided into blocks, so that the file sizes remain manageable. The block size is adjustable with a typical length of 15min.
Using the predefined measurements is the easiest way to start an audio recording. By default, the recording time is 30 days. However, you can stop the measurement at any time.

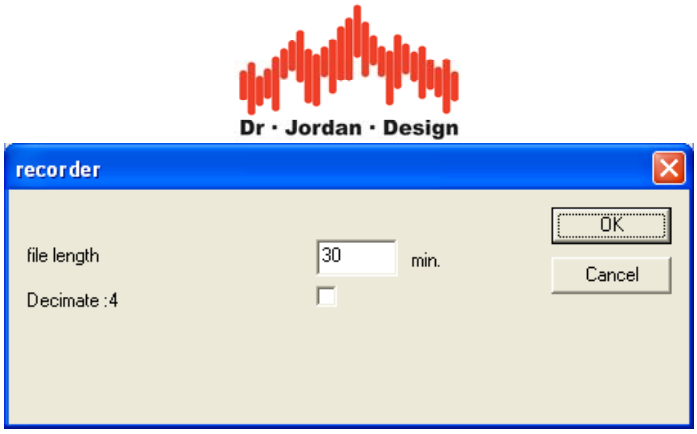


You can configure your settings individually.



Please ensure that the recorder is active. For long measurements, we recommend using long average intervals to save memory. In this example we use 5min.

In some cases you will need more advanced settings. Press the set button.



You can adjust the maximum file length. Small files are easier to handle. In this example we use 30min. If you record 24h, you will get 48files. The files are named automatically with a timestamp.

You can reduce your disk space when recording audio. Activate “decimate :4” to reduce the sample rate by a factor of 4. Of course, this reduces the bandwidths. But in many cases a bandwidth of 8kHz (Samplerate 16kHz) is sufficient.

All recordings are saved in the directory
„My documents \ Measurements \ Waves“

17 Directory structure

„My documents \ Measurements“

Level: This directory contains all level measurements. The room manager uses the directory “__MANAGED__”. Do not modify these files by hand.

Waves: All audio recordings are saved to this directory.

18 Expert mode

The program has two modes of operation. This quick guide covers only a fraction of the features. In order to simplify the operation, the program starts with clear and simple user interface. This interface is tailored to the typical measurement tasks menus. You can switch Akulap via Options-> Expert Mode . The program then restarts and displays the advanced options. This setting is permanent. You can switch back to simplified mode at any time. A description of the advanced options can be found in the extensive (about 400pages) user manual. In addition, you will find there a lot of background information. Of course, this manual cannot replace thorough acoustic knowledge. We provide individual consultations on a fee basis. Please note that we offer free support only for the service / technical support. Unfortunately, we cannot answer basic acoustic questions free of charge. For this purpose, we offer training courses on different topics together with the company “Stratenschulte-Messtechnik”.

19 Sample report

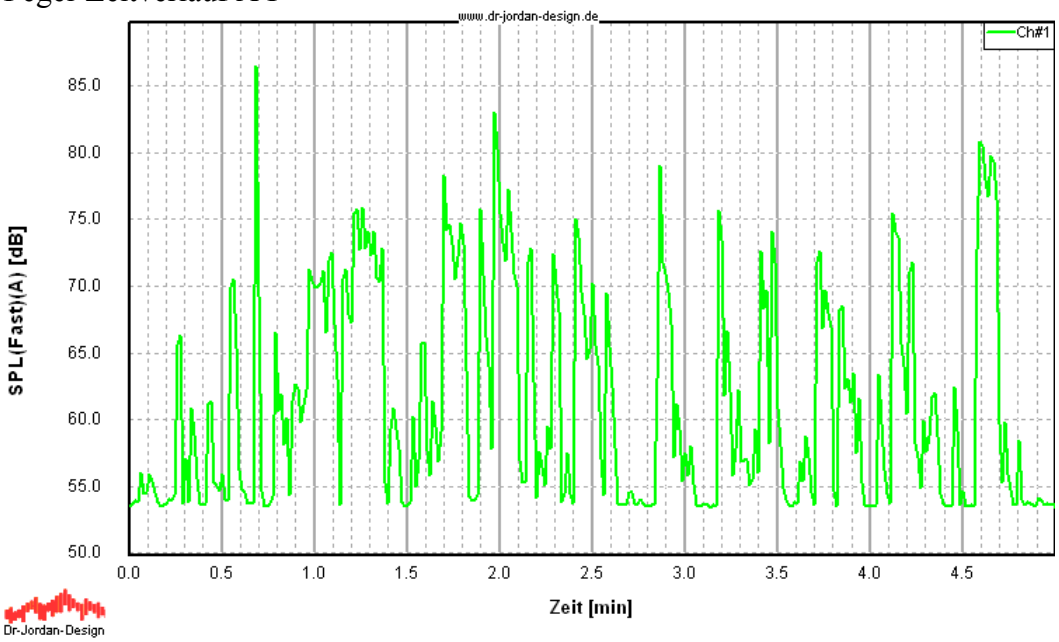
Akulap creates an automatic report with the following plots

- Level vs. time A F
- Taktmaximalpegel 5s A F
- Level vs. time LEQ A and C in one plot
- Average spectrum Z LEQ

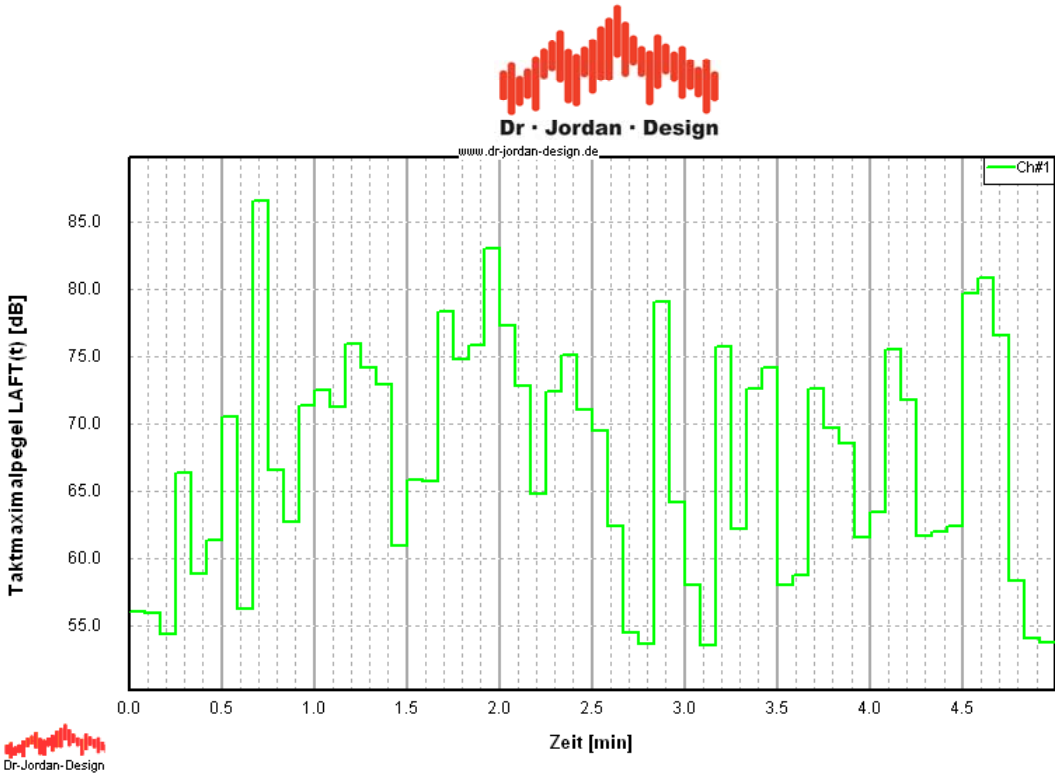
The average spectrum and the level vs time data are saved as a table

Einstellungen
Beginn der Messung: Thursday, April 07, 2011 12:26:57
Anzahl der Datenpunkte: 2400
Meßintervall: 125ms
Meßdauer: 5m: 0s
Kalibrieroffset: 133.6dB

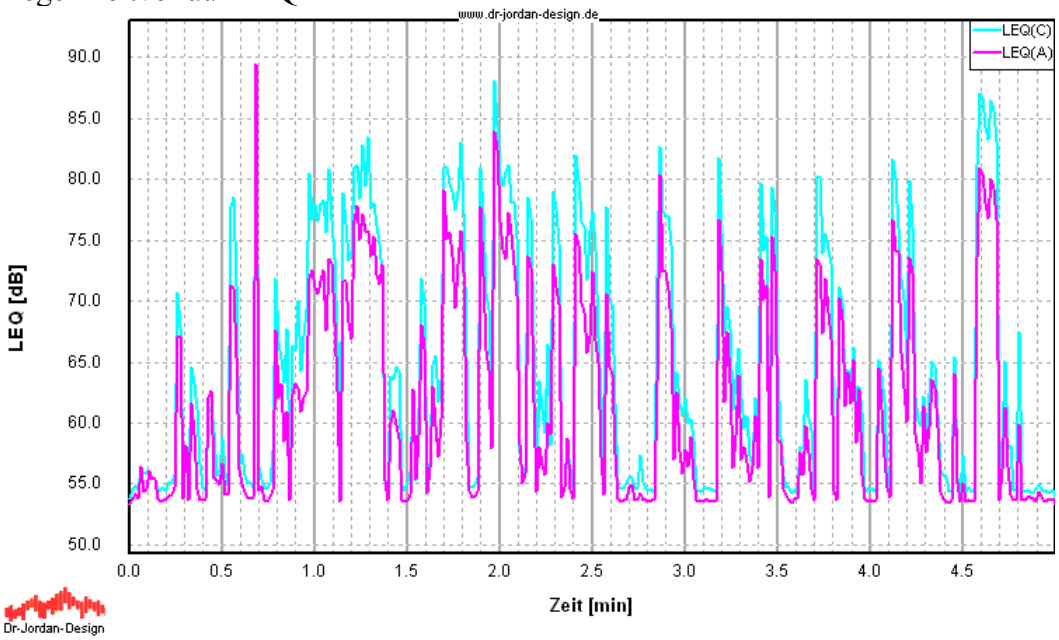
Pegel-Zeitverlauf A F



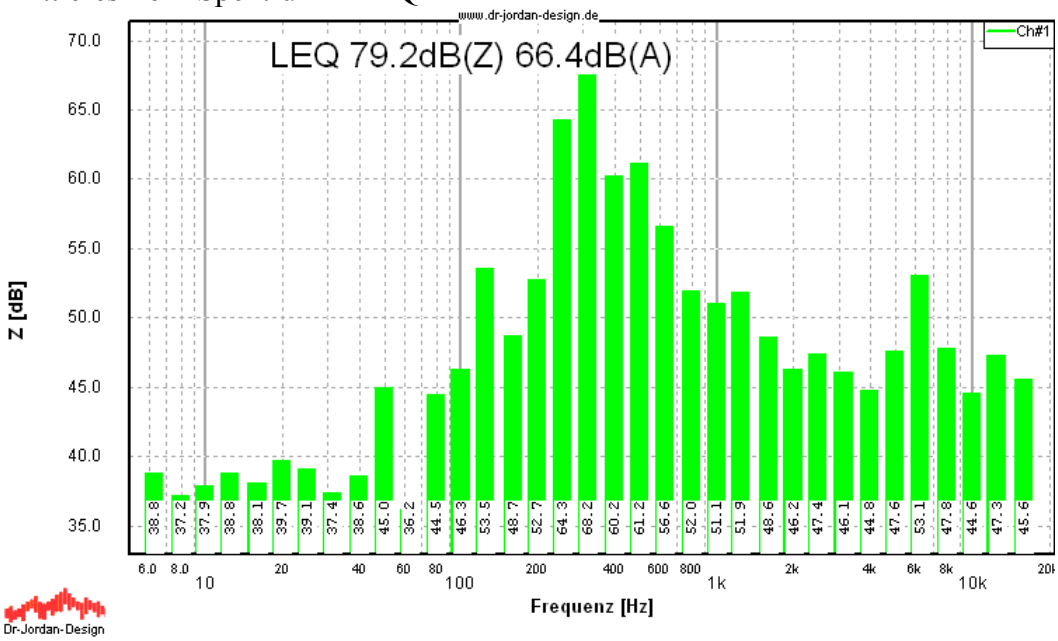
Taktmaximalpegel 5s A F



Pegel-Zeitverlauf LEQ



Mittleres Terz-Spektrum Z LEQ



TA_Lärm Parameter

TA Lärm	dB
LAeq	66,4
LCeq	71,5
LCeq-LAeq	5,1
LAFteq	74,3
LCpeak	111,8
LAFmax	86,5
LAFteq-LAeq	7,9
LA95	53,4

Perzentile A F

Perzentile	dB
LAF95	53,4
LAF5	72,6
LAF1	78,5
LAF0.1	82,2

Statistiken breitbandig
Bewertung:Z
LEQ: 79.2dB
SPL (Fast): min: 75.3dB max: 87.6dB
SPL (Slow): min: 76.1dB max: 85.8dB
Spitzenwert (ohne Zeitbewertung): 113.1dB

Bewertung:A
LEQ: 66.4dB
SPL (Fast): min: 53.2dB max: 86.5dB
SPL (Slow): min: 53.4dB max: 80.1dB
Spitzenwert (ohne Zeitbewertung): 114.4dB

Bewertung:C
LEQ: 71.5dB
SPL (Fast): min: 53.5dB max: 87.0dB
SPL (Slow): min: 54.0dB max: 84.9dB
Spitzenwert (ohne Zeitbewertung): 111.8dB

Statistiken 1/3 Oktav Bewertung:Z

Frequenz [Hz]	LEQ(Z)[dB]	LEQ(A)[dB]	LEQ(C)[dB]
5	39,2	-54,0	14,1
6	38,8	-46,6	17,5
8	37,2	-40,3	19,6
10	37,9	-32,6	23,5
13	38,8	-24,8	27,5
16	38,1	-18,3	29,7
20	39,7	-10,7	33,5
25	39,1	-5,7	34,7
32	37,4	-2,1	34,4
40	38,6	4,1	36,7
50	45,0	14,7	43,7
63	36,2	10,0	35,4
80	44,5	22,1	44,0
100	46,3	27,2	46,0
125	53,5	37,3	53,4
160	48,7	35,5	48,6
200	52,7	41,9	52,7
250	64,3	55,7	64,3
315	68,2	61,6	68,2
400	60,2	55,5	60,3

500	61,2	57,9	61,2
630	56,6	54,7	56,7
800	52,0	51,2	52,0
1000	51,1	51,1	51,1
1250	51,9	52,4	51,8
1600	48,6	49,6	48,5
2000	46,2	47,4	46,1
2500	47,4	48,7	47,1
3150	46,1	47,3	45,6
4000	44,8	45,8	44,0
5000	47,6	48,1	46,3
6300	53,1	53,0	51,1
8000	47,8	46,7	44,8
10000	44,6	42,1	40,2
12500	47,3	43,1	41,2
16000	45,6	38,9	37,0