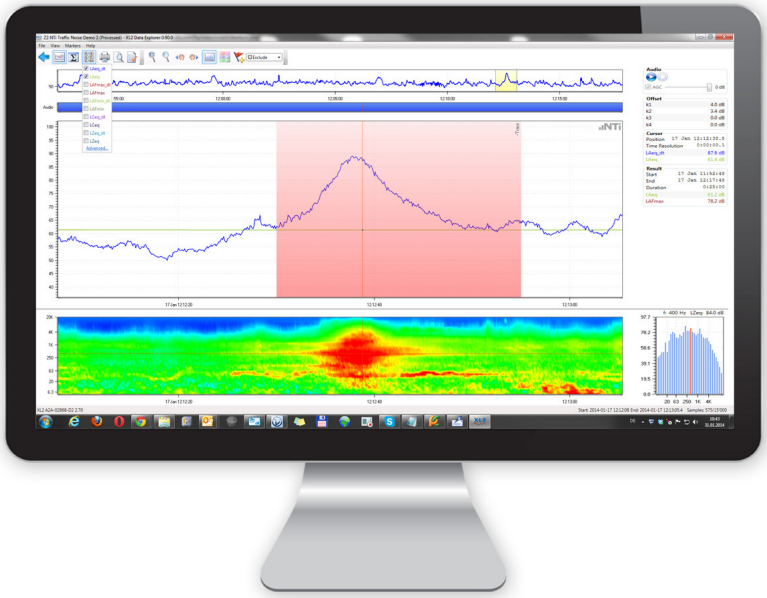
User Manual

NTi Data Explorer

PC-Software for the Analysis of Sound Level Data recorded with the XL2 or XL3 Acoustic Analyzer



Doc version	*2.1.0/1e*
Refers to SW	*v2.1.0 or higher*
and XL2 firmware	*v4.84 or higher*
and XL3 firmware	*v1.10 or higher*

Table of Contents

Part I Introduction 5

1 Installation ... 7
2 Specifications ... 8
3 Software structure ... 10
4 Tutorial ... 12
5 License agreement ... 20
6 Update history ... 22

Part II Project view 25

1 Data import ... 28
2 Preferences ... 32
3 Project info ... 38

Part III Chart view 39

1 Overview chart ... 44
2 Audio bar & player ... 45
3 Level selector ... 47
4 Audit Intervals ... 49
5 Main chart, Info section ... 52
6 Spectrogram, Spectrum ... 55
7 Cursor ... 58
8 Zoom & pan ... 60
9 Markers ... 61
10 Export subset to project ... 72

Part IV Result view 76

1 Markers (in Result view) ... 79
2 Audit Intervals (in Result view) ... 81

Part V Level Calculations 82

1 Statistics ... 83
- Level statistics ... 83
- Spectrum statistics ... 85
- Percentiles ... 86

2 Day Night Level ... 87
- LDEN examples ... 88

3 Rating Level ... 91
- Impulse analysis ... 92
- Tone analysis ... 94
  - Third Octave Tone analysis ... 94
  - FFT and Tone analysis ... 97
- Time of day ... 101
- Lr calculation ... 102
- National standards ... 106
  - BS 4142:2014 ... 106

DIN 45645-1/-2 109
DM 16 marzo 1998..... 111

Part VI Reporting **114**

1 Print preview **115**

2 Data Export..... **118**

Index **119**

Part

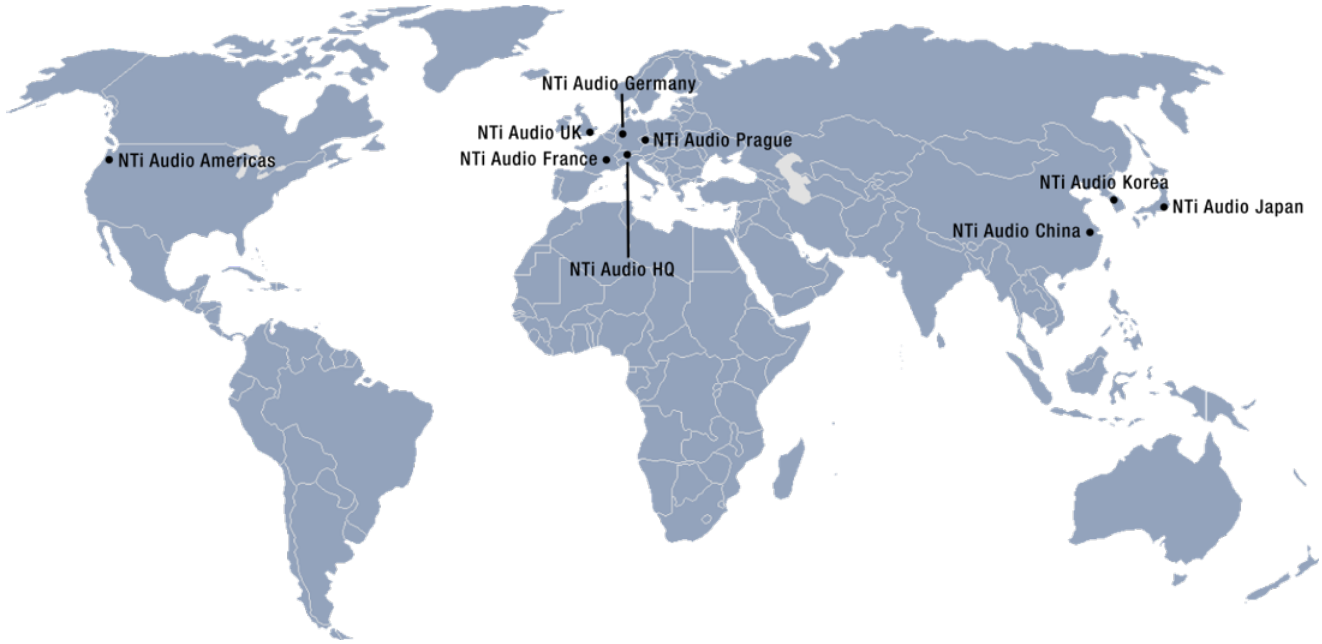
1 Introduction

The NTi Data Explorer is a PC-based software application with a powerful data processor for easy and fast analysis of sound level measurement data acquired by an XL2 or XL3 Sound Level Meter. Visualize, analyze and control millions of data points with this tool that is dedicated to acoustic consultants and noise measurement professionals. It provides a convenient way to view and manage your data and quickly create professional customized reports.

Features

- Data visualization
- Concatenation of projects
- Fast zoom and pan
- Audio playback synchronized to graph
- Markers with on-the-fly calculation
- Automated tonal and impulsive marker generation
- Percentile levels Ln calculation
- Rating level Lr calculation
- Export a data subset to a new project
- Customized reporting

For dedicated support, please contact your nearest NTi Audio partner.



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v2.10/1e, Dec.2022

1.1 Installation

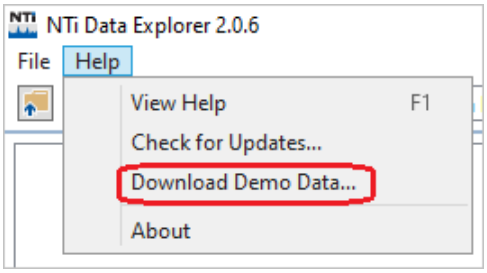
System requirements

- Supported operating systems:
  - Windows 7
  - Windows 8 Pro or 8.1 Pro
  - Windows 10
- Hardware requirements:
  - Recommended Minimum: Pentium 1 GHz or higher with 512 MB RAM or more
  - Video board with shader model 3.0 or higher (DirectX 9.0c)
- Minimum disk space: 2 GB

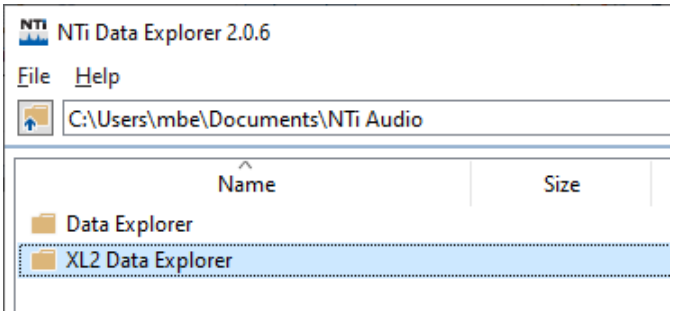
Hint ***Result data that is exported from the NTi Data Explorer to MS Excel is saved in "*.xlsx" format. Please check the compatibility of your MS Office installation with this file format, and install the Microsoft Compatibility Pack if necessary.***

Software installation procedure

1. Access your personal account in My NTi Audio
2. Download the NTi Data Explorer installation package
3. Double left-click on the installation file
4. Optional: After the installation procedure is completed, click on 'Help' and 'Download Demo Data ...' to install three sets of pre-recorded demo data.



Hint ***After updating the software to v2.10 or higher, your old XL2 Data Explorer folder is still accessible - just click on***  ***until you reach the directory "Documents\NTi Audio".***



XL2 Acoustic and Audio Analyzer

- Firmware V4.84 or higher (legacy data require minimum firmware V2.32 or higher)
- NTi Data Explorer option installed on the XL2 or XL3 device, or Data Explorer 365 license (if in doubt, contact your nearest NTi Audio partner).

1.2 Specifications

Supported data types

- XL2 or XL3 Sound Level Meter data
- Broadband, 1/1 and 1/3 octave band data
- Audio data playback aligned to graphs

Data handling

- Optimized for fast analysis of big data (millions of points)

Markers

- 11 different marker types available
- Exclude and event marker with on-the-fly calculations
- Overlapping markers of same type are merged automatically
- Notes

Percentiles

- Percentiles for wide band, 1/1 and 1/3 octave spectrum
- Simultaneous percentile calculation of full spectrum
- Flexible setting from 0.1% to 99.9%
- Class width = 0.1 dB

Calculated levels

- LAFT5eq_dt – LAeq
- LAleq – LAeq
- LCeq – LAeq
- LAFmax – LAeq
- LAImax – LAFmax
- LAImax – LASmax
- LAE
- Sum of frequency bands (e.g. 50 Hz to 250 Hz)

Audit intervals

- 1, 5, 10, 15, 30, 60 minutes

FFT and Tone Analysis

based on narrow-band method in accordance with the standards ISO 1996:2-2017, DIN 45681 Ber2:2006-08 and BS 4142:2014 with frequency steps of

- 2.93 Hz for linear audio (48 kHz, 24 bit)
- 1.46 Hz for compressed audio

Automated Marker Generation

- Level
- Pure Tone (based on Spectrum levels)
  - ISO 1996:2-2017, BS 4142:2014, DM 16 marzo 1998 (Italy)
  - Leq – Max or Leq – Mean (neighbors)
  - User-defined minimum tone duration
  - Distinguishing between small and prominent tones
- Impulsive Sound (based on broadband level)
  - LAleq – LAeq, LAFmax – LAeq, DM 16 marzo 1998 (Italy)
  - LAImax – LAFmax, LAImax – LASmax
- Time

Day-Night Levels

- Lden, Ldn, Lday, Levening, Lnight
- User-defined penalty

Rating Level

- BS4142:2014, DIN 45645-1/-2, DM 16 marzo 1998
- User-defined measurement periods and reference time interval
- Marker-based and reference time interval based correction
- Counter and duration of selectable marker

Reporting

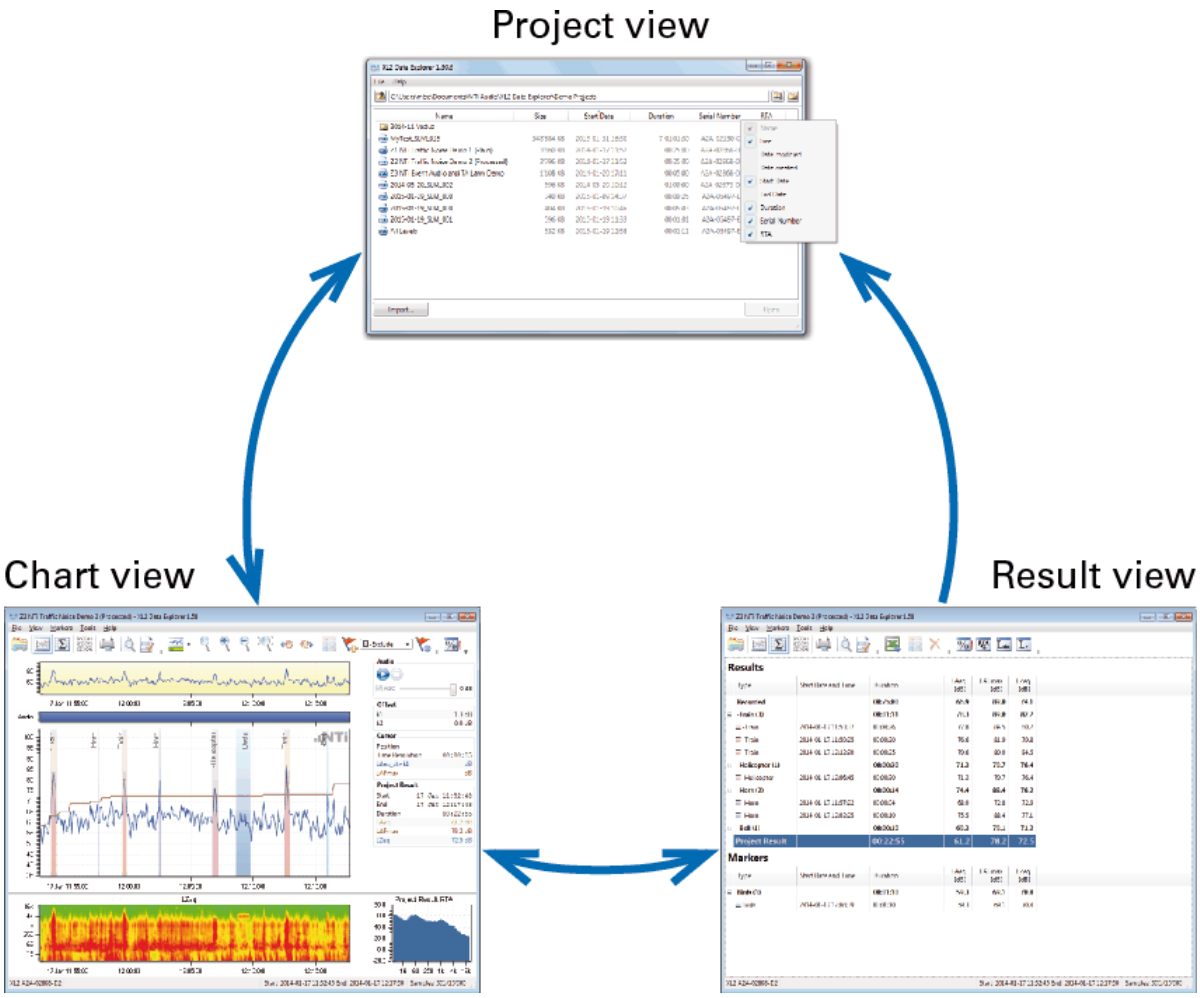
- Data export to MS Excel
- XPS report

1.3 Software structure

Views

The NTi Data Explorer offers three different views,

- Project: list of the imported projects
- Chart: detailed project data in graphical form + numerical readouts
- Result: numerical readout of the measurement results, and of marked sections



NTi Data Explorer views

Hint ***By switching from the Chart view or Result view to the Project view, all project data (i.e. including your amendments) will be automatically saved.***

Multiple instances

It is possible to run two or more instances of the NTi Data Explorer on one PC.

Multiple instances

This feature may be used, for example, for comparing

a) XL2 or XL3 Test files that were recorded in the same location, but at different dates,

b) XL2 or XL3 Test files that were record during the same event, but at different positions,

c) different sections of the same XL2 or XL3 Test file.

Hint ***A project file that is simultaneously open in two instances, can be edited only in the first instance.***

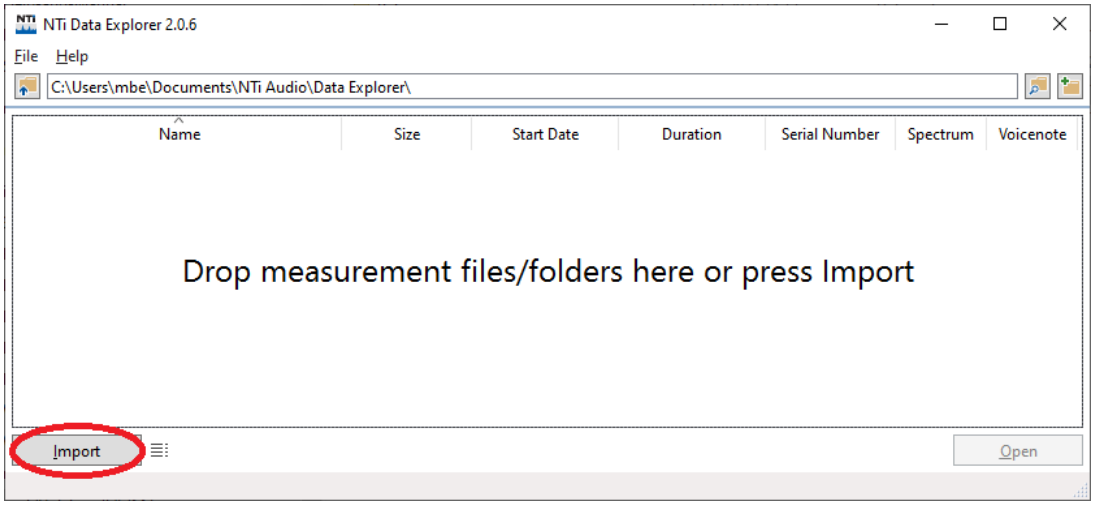
1.4 Tutorial

The following step-by-step guideline demonstrates a typical use of the NTi Data Explorer with the XL2 Acoustic Analyzer.

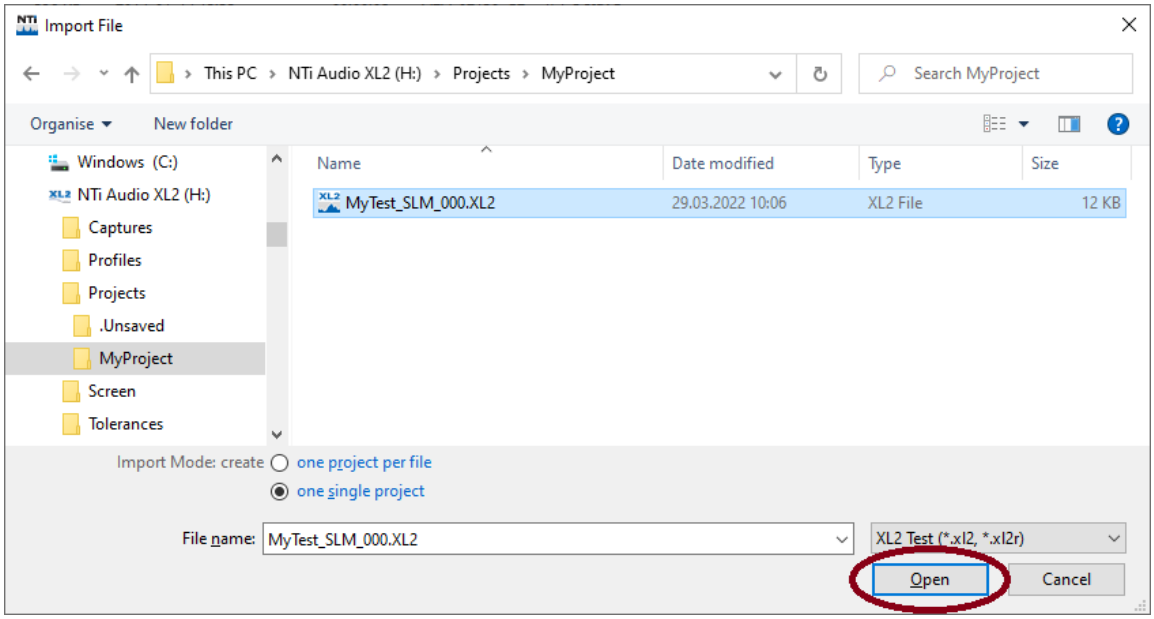
1. Activate the logging as well as the spectra and the audio file recording on the XL2 Acoustic Analyzer, then execute a sound level measurement and save the test.

2. Connect the XL2 directly to your PC via USB, or insert the SD-card into a card reader for faster data transfer.

3. Run the NTi Data Explorer, go to the Projects view and either
   - drag & drop the XL2 Test data, *or*
   - click on the 'Import' button.

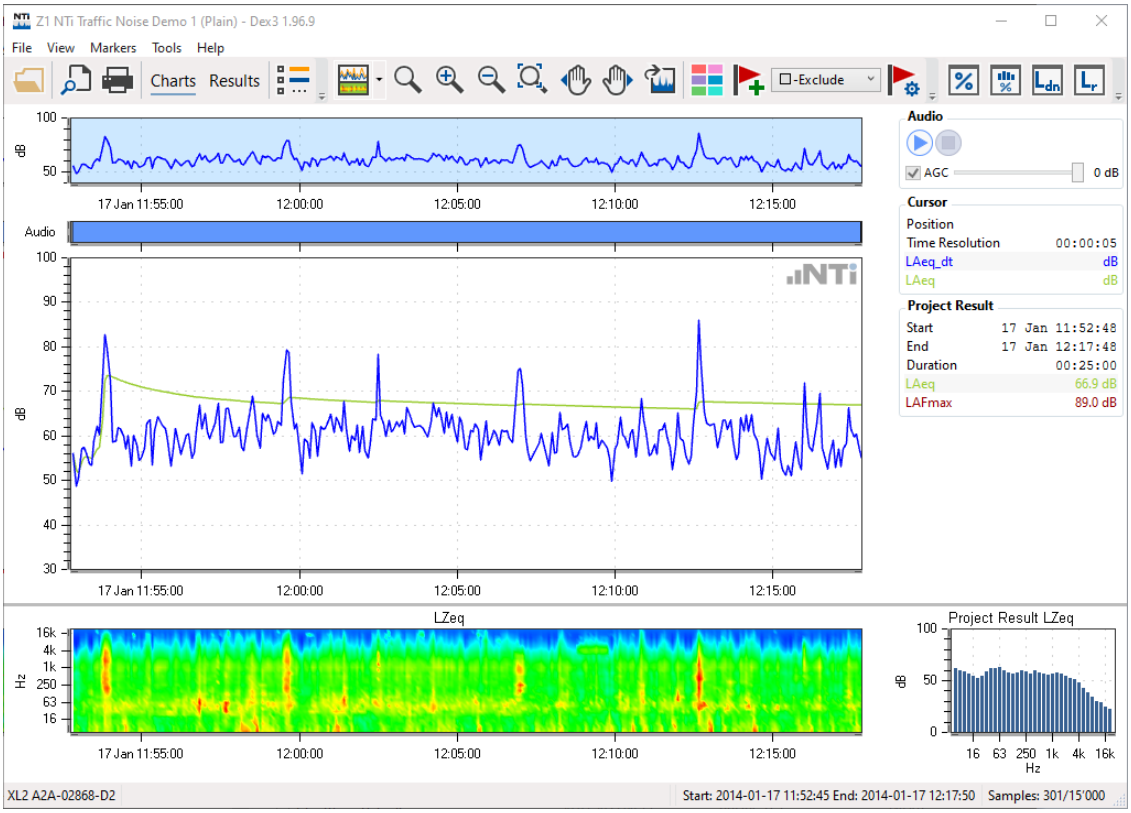


4. Select the XL2 Test file just recorded and click 'Open'. The NTi Data Explorer imports the logged data and audio file; this procedure can take a few seconds to some minutes, depending on the file sizes. During this process, all relevant files (including the WAV file associated with the selected project) are copied into the Data Explorer project folder.

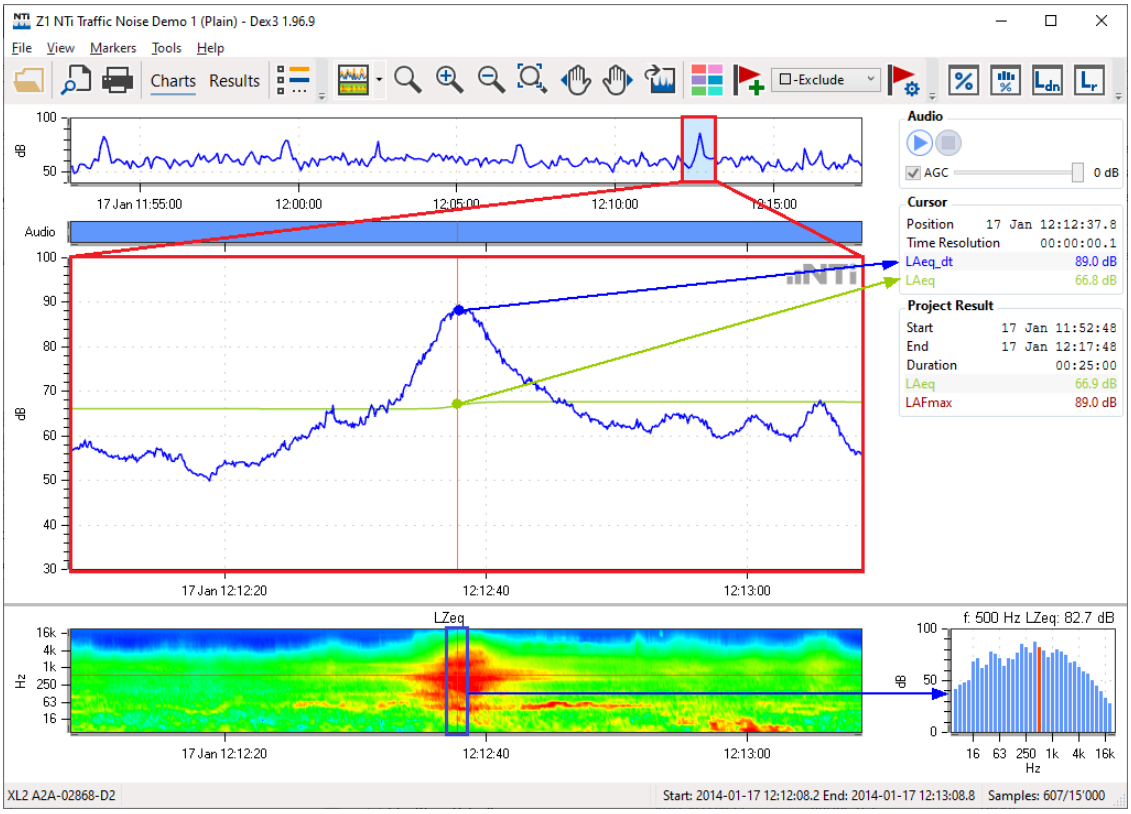


5. As soon as the import process is completed, select the imported project and click on the 'Open' button to open it in the Chart view.

6. You can now view the level curves and results.

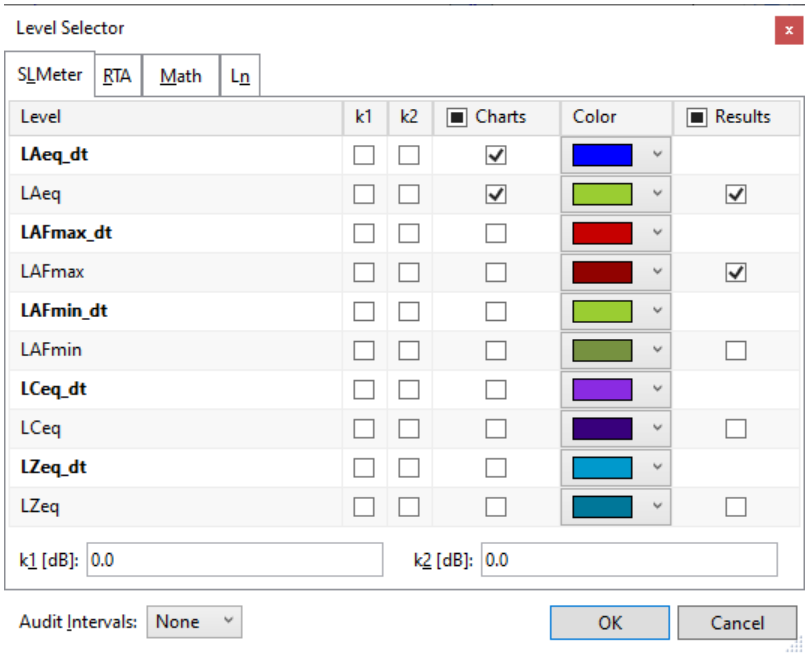


7. You may zoom into any area of the Main chart or Spectrogram: left-click+drag with the mouse over the area of interest. The zoom response is instantaneous. In addition, the Info section on the right-hand side of the Main chart shows the instantaneous levels at the current Cursor position, as well as the result of the whole project.

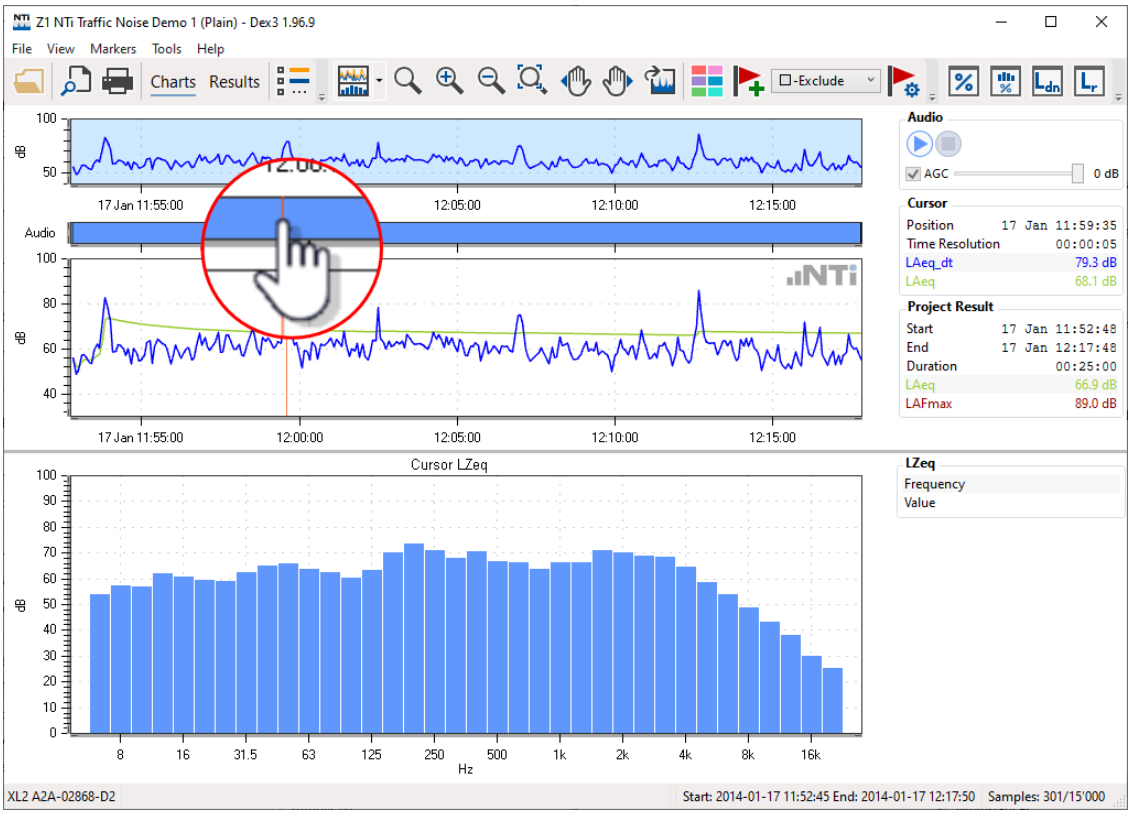


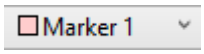
8. Click on the button  , and then on  to display the large spectrum.

9. Select the menu 'View -> Setup Levels...' to choose which levels are displayed in the Main chart, and select the appropriate colors. Here you may also enable or edit the values of the correction factors (k1, k2).

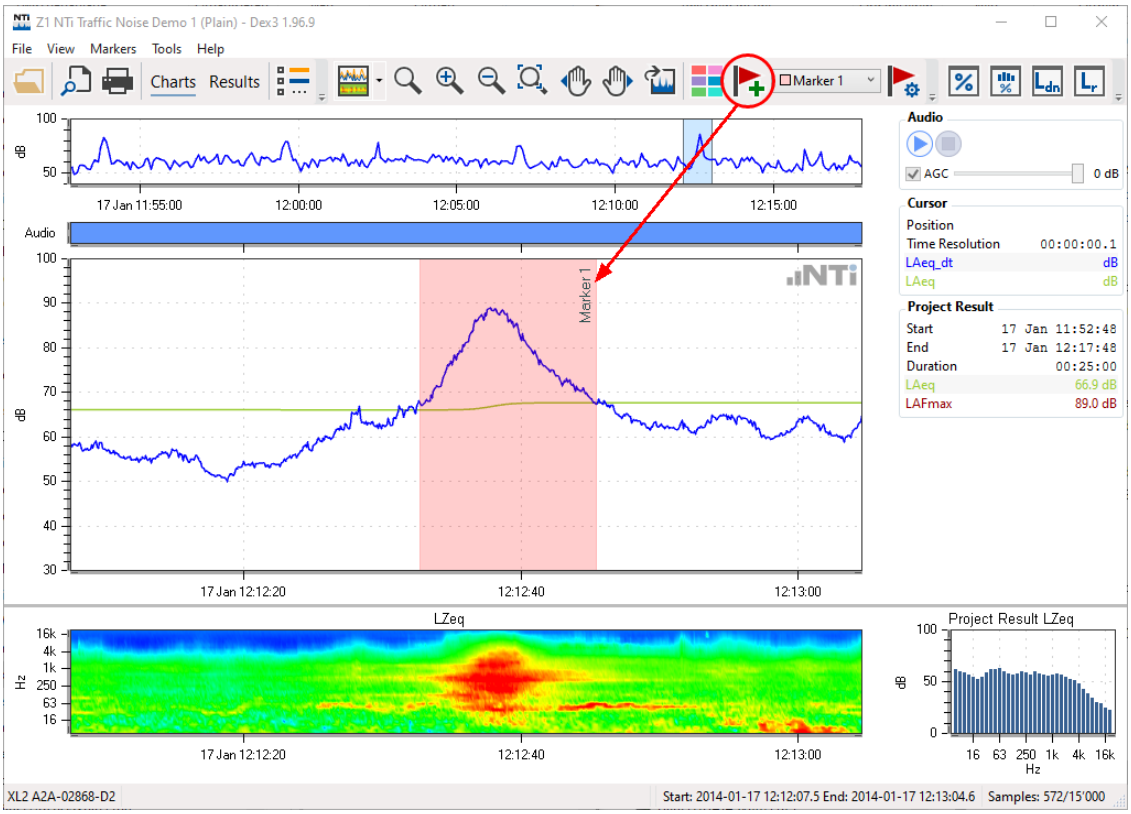


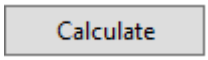
10. Listen to the sound recording to identify or further analyze an event; click on the corresponding point in the Audio bar to replay the sound.



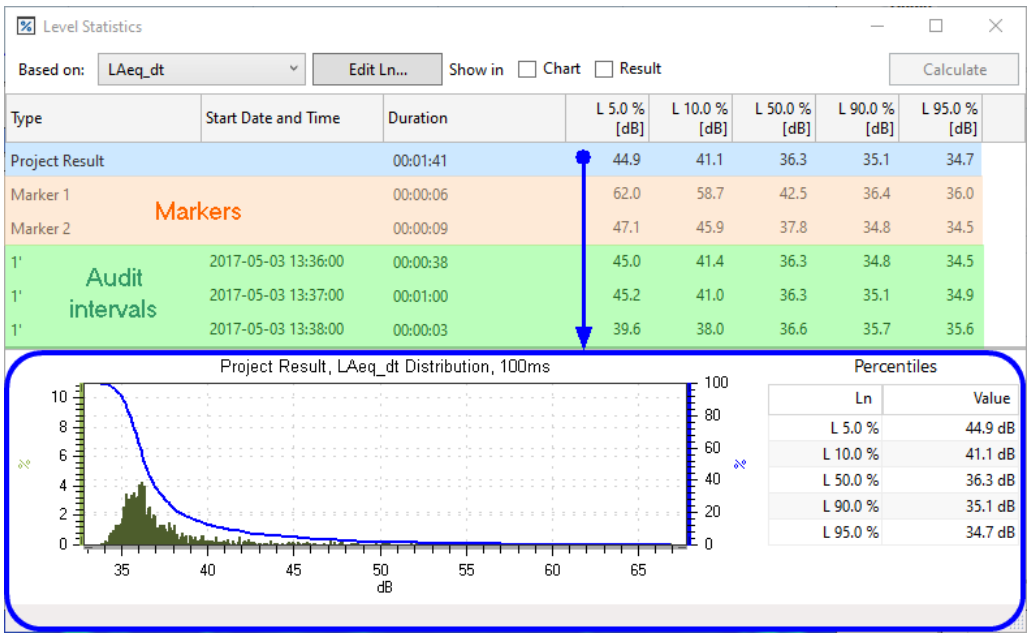
11. To highlight an area, or exclude it from the overall result calculation, add a Marker: first select the Marker type using the 

button, click on the  button, and then left-click+drag with the mouse over the Main chart to add the Marker.

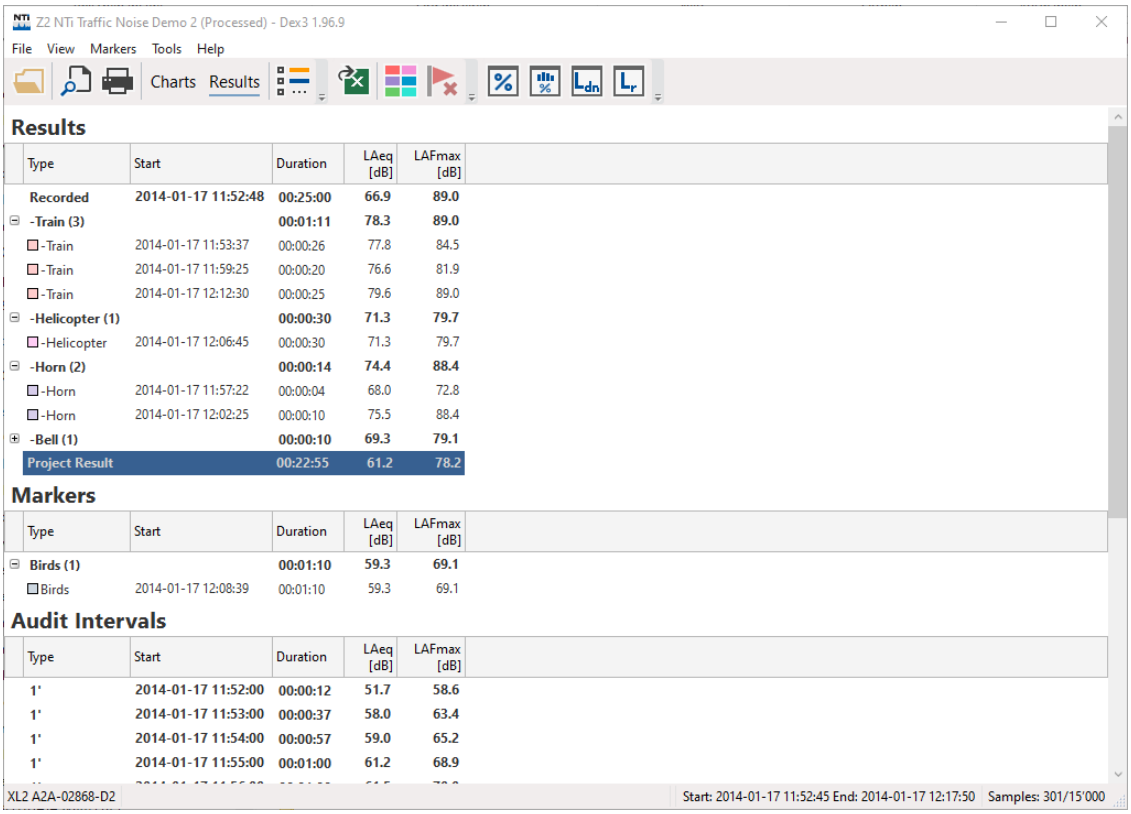


12. Click on  to open the Level statistics window, and then on 

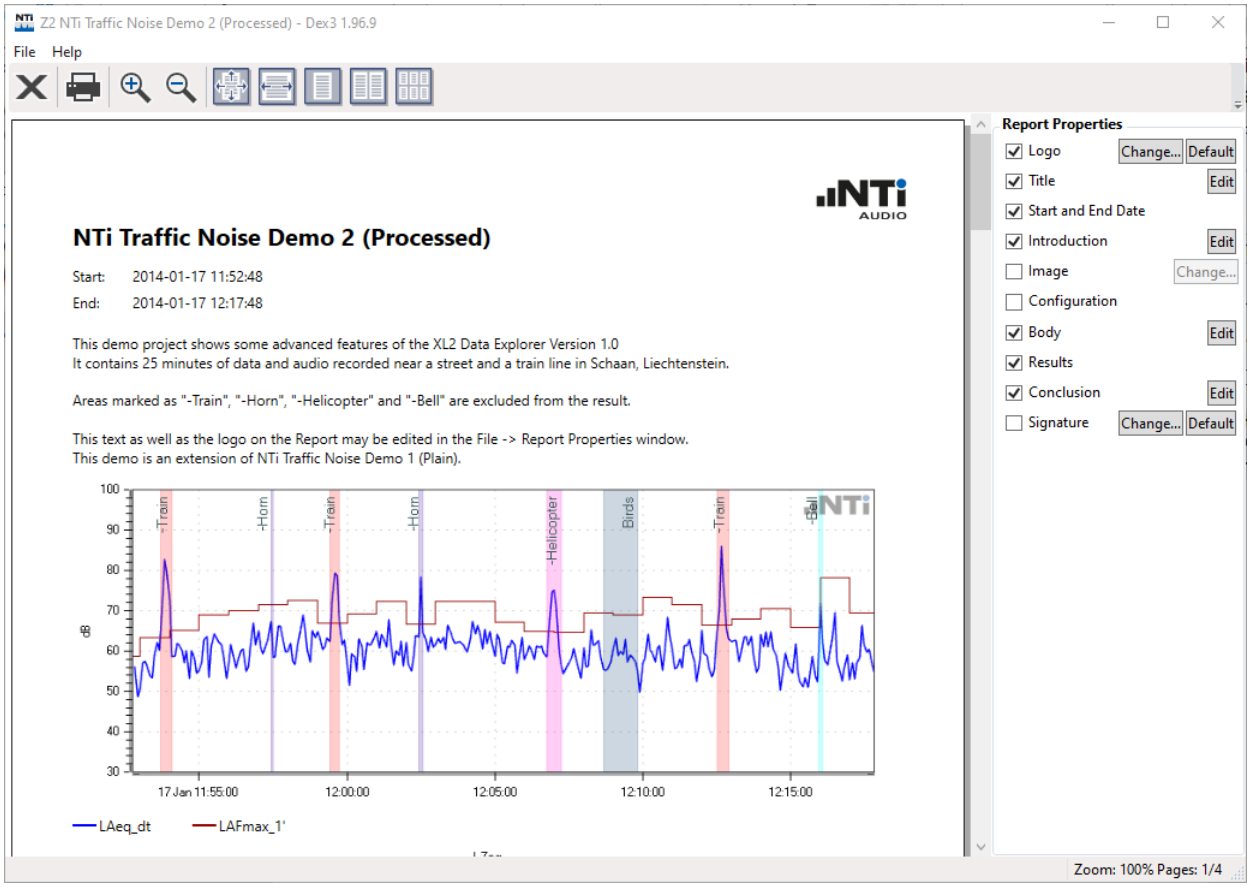
to show the statistical distribution of dt values in a graph, as well as the Percentile results in a table.



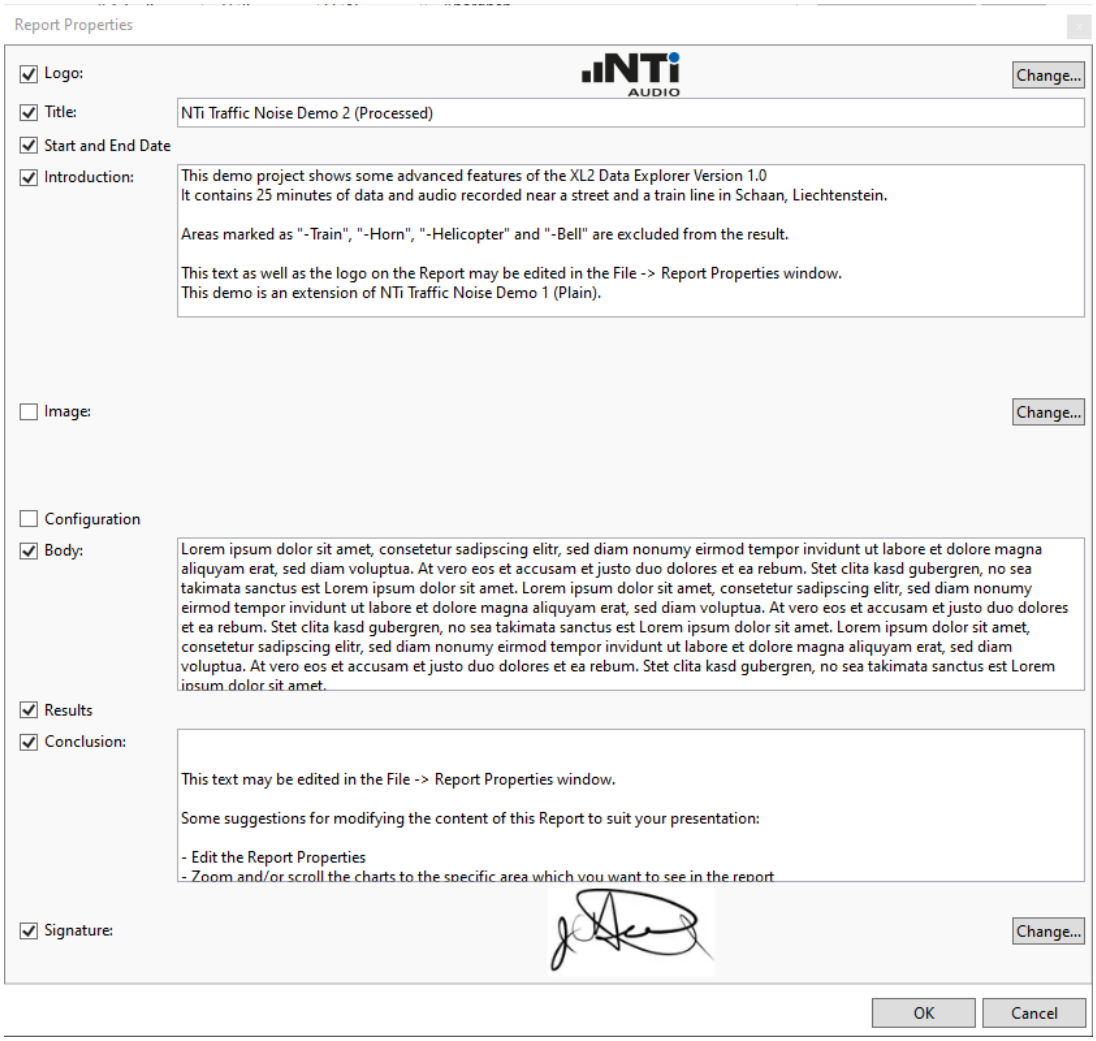
13. Click on Results to switch to the Result view, which provides an overview on the individual Marker data and the Project result (highlighted row). You may expand or collapse any of the Marker categories.



14. Click on  to show the Print preview; tick/clear or edit the checkboxes or modules of the report according to your demands.



15. Click on "File → Report Properties..." to edit the Report Properties: tick the checkboxes for the parts to be printed, edit the corresponding text and optionally add your own logo and signature.



16. Click on  to print the report.

17. Click on  to return to the Project view; this step automatically saves all project data, including your amendments.

1.5 License agreement

Scope

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1.6 Update history

V2.10

- XL3 Acoustic Analyzer: Import measurement and audio data
- Concatenation mode: support import of zip files
- Optimize marker visualization and calculation
- Audit interval 2 minutes in accordance with UK Noise Requirements of Approved Document O
- Support negative penalties at Rating Level Lr and Day-Night Level Lden calculation for railway noise
- Download demo data in Help menu

V2.00

- Spectrum: calculate 1/1 octave spectrum from 1/3 octave data
- Rating level: calculate LAeq and duration of markers
- Tonality assessment according to French standard Arrêté du 23_01_97
- Concatenated measurements: show results of each measurement in Results table
- Optimized scrolling of Results table
- Preferences: separate setting for spectrum Leq, Lmax, Lmin
- Improved calculation: sum of Lmax (xx Hz ... yy Hz)
- Taktmaximal-level synchronized with the full hour at import
- Show hearing threshold curve in spectrum according to ISO 226
- Adding image in report
- New look and feel for the toolbar
- Add Chinese and French language
- Replace “RTA” with “Spectrum”
- FFT Analysis based on RMS levels instead of Peak levels

V1.90

- Concatenate sequential measurements into a single project
- Noise measurement reports with flexible configurations
- Automated marker generation
  - on audit period noise levels
  - on impulsive noise in accordance with TA-Lärm (Germany)
  - on weather data
- Audio setting saved in project
- Preference settings extended with charts ratio and RTA layout
- Customizable date/time format in report
- Auto-scaling charts in 10 dB resolution
- Show units in charts

V1.85

- Calculating FFT Spectrum based on recorded audio file
- Narrow band tonality assessment in accordance with ISO 1996-2:2017, DIN 45681:2006 and BS 4142:2014 (Reference or Engineering method)
- Calculate Taktmaximal-level without earlier recording on XL2
- Import and replay of voice notes

V1.80

- Export a data subset to a new project
- Export & import of markers and marker types
- Import of zipped data files
- Extended reporting configuration

V1.70

- RTA Spectrum offers
  - Leq, Lmin and Lmax measurement data (requires XL2 firmware V3.31)
  - A, C and Z frequency weighting conversions
- German language user interface
- Extended reporting configuration

V1.60

- Impulsiveness penalty for rating level Lr in accordance with BS4142:2014 (UK), DIN 45645-1/2 (Germany) and NordTest ACOU 112
- Automatic marker generation of impulses in accordance with DM 16 marzo 1998
- Tones visualization in RTA Spectrum for ISO 1996-2:2007, BS 4142:2014, DM 16 marzo 1998
- Marker counter and duration calculation in the Rating Level tool
- Calculation of percentile levels for full RTA Spectrum in one step
- One minute Audit Interval
- Import of overload marker from recorded data

V1.50

- Calculate rating level Lr
- Automatic tonality and impulsiveness detection
- Automatic marker generation by level and time criteria
- Marker names and settings offered in preferences
- User comment per marker
- Marker counter
- Exclude markers supersede overlapping include markers
- Overlapping markers of same type are merged

V1.40

- Introduce audit interval calculations in Chart and Result View (5', 10', 15', 30', 60')
- Calculate percentiles Ln of audit intervals and show in Chart and Result View
- Simultaneous import of multiple XL2 files
- Adjustable color scaling of spectrogram and RTA Spectrum
- Extended usability of charting tools

V1.30

- Show individual frequency bands (e.g. 63 Hz) in main chart
- Calculate sum of individual frequency bands (e.g. 50 Hz - 100 Hz)
- Calculate differences of broadband values (e.g. LCeq – LAeq)
- Calculate and show Sound Exposure Level in report
- Offer setup of levels and day-night-periods in default preferences
- Display start date, duration, XL2 serial number and available spectral data in project view

V1.20

- Supports import of log data recorded in repeated timer mode (w/o cycle results)

V1.10

- Level Statistics
  - Calculate statistics for individual levels
  - LN table and level distribution
  - Copy data and bitmap
- RTA
  - RTA results of whole project, markers or cursor
  - Copy data and bitmap
- Improved result view table style
- Improved tutorial
- Minor bugfixes

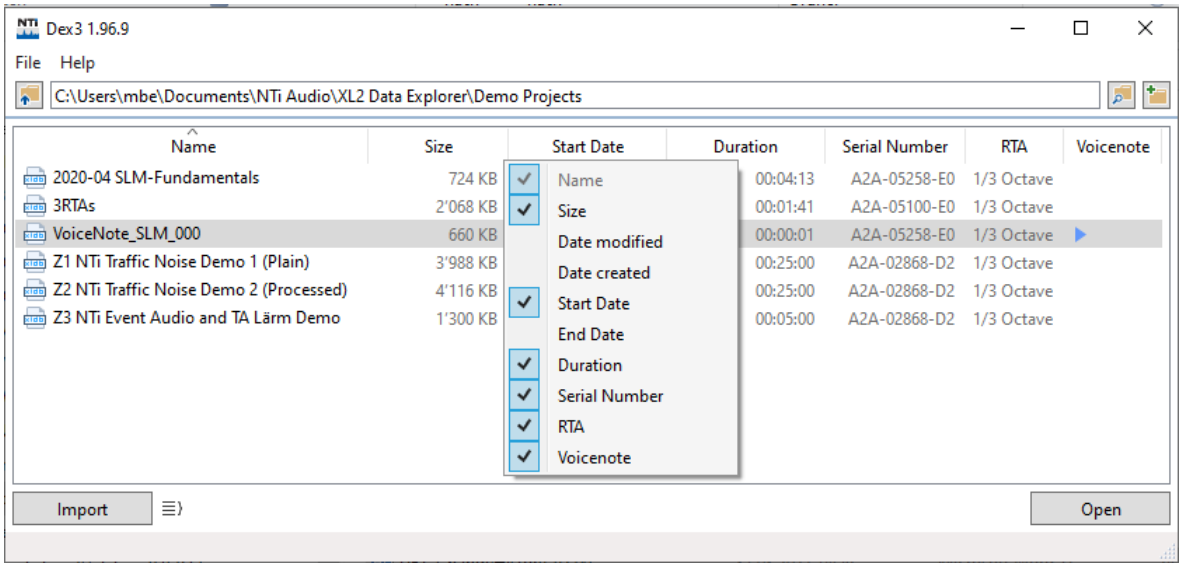
Part II

2 Project view

The Data Explorer always starts up in the Project view. The Project view is also accessible from the Chart or Result views by clicking the button.

- After the initial installation, the Project view shows the 'Demo Projects' folder.
- From then on, it always opens the same folder that had been selected the last time.

NOTE **The XL2 or XL3 unit, respectively, must have a Data Explorer Option installed to allow the direct import of XL2 or XL3 Test files to the Data Explorer software.**



Projects view with imported projects sorted by recording date, and right-click context menu

Hint ***Click on any column title to sort the projects in ascending or descending order. Right-click on any column title to amend the selection of displayed columns.***

Direct actions

- Import project(s): click on Import and select one or several XL2 or XL3 file(s) (*.xl2 or *.xl3)
- Replay voice note: click on ▶
- Open project:
  - double-click on project name
  - select a project and press Ctrl+O
  - select a project and click on Open
- Delete: select a project or folder and press Del (NOTE - All contents of the folder will be deleted!)
- Rename: select a project or folder and press F2
- Refresh the list of projects: press F5
- Organize the projects in ascending or descending order: click on the preferred column title
- Arrange the columns by moving them with the mouse to the preferred position
- Copy to: right-click on a project and select 'Copy To...'
- New folder: right-click in the Project view and select 'New Folder...'
- Up one folder level: click on

- Change working folder: click on 
- Create new folder: click on 

Save project

All amendments to an open project (e.g. Markers, layout of the Chart view or Result view) are automatically saved. Furthermore, upon returning to the Project view, the project file (*.xldb) is closed. Consequently, if you want to restore a previous project status, you may either

- manually undo every amendment,
- or restore an older version of the project file on your PC.

Copy project

You can copy & paste a Data Explorer project e.g. to another location, and open the copy if the PC has the NTi Data Explorer software installed.

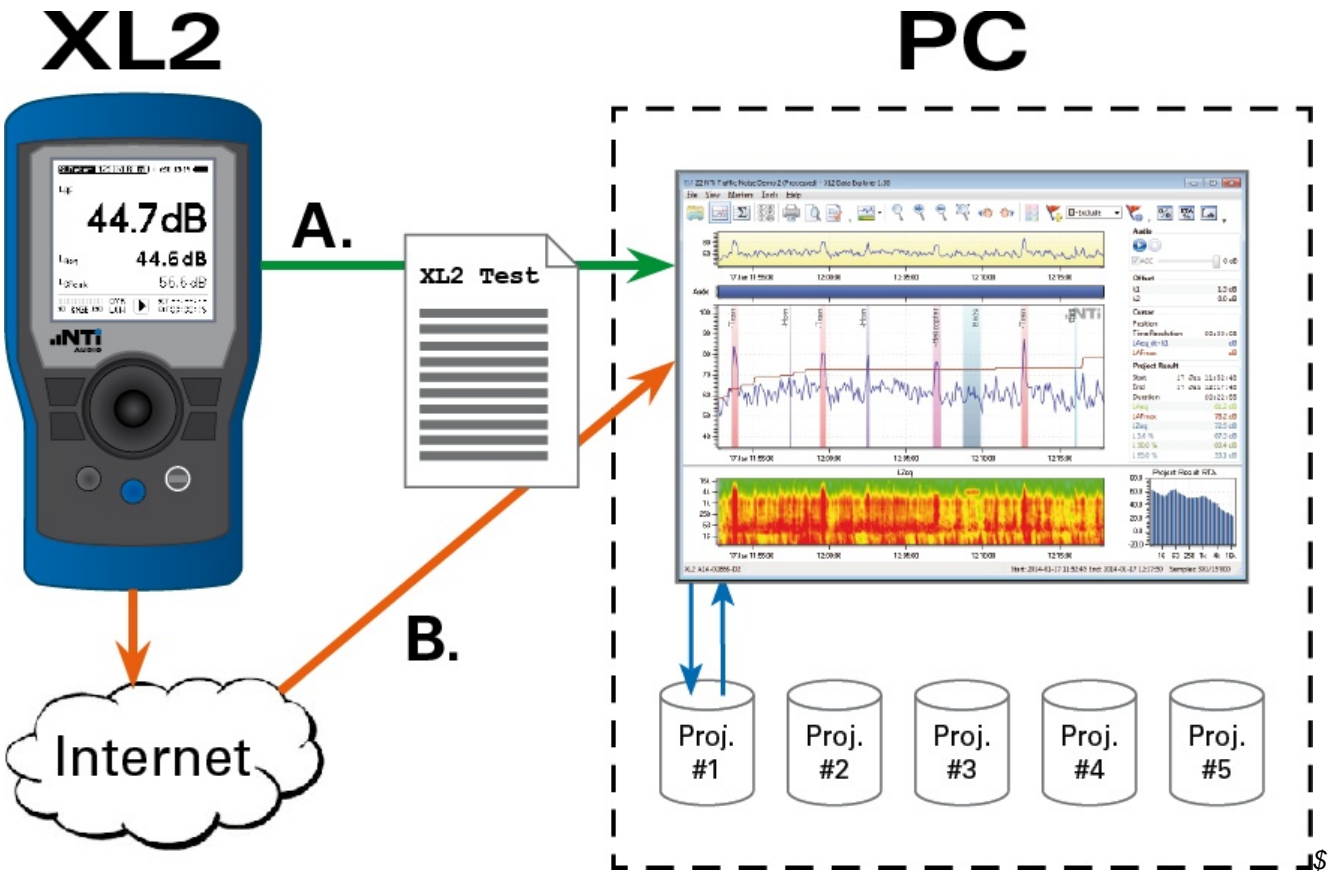
2.1 Data import

Data flow

There are basically two different ways to import logged data from an XL2 or XL3 to the Data Explorer software.

A. Test files that were recorded on an XL2 or XL3 with the Data Explorer Option installed on the XL2 or XL3 device at the time of recording the data, can be imported directly to the Data Explorer software.

B. Test files that were recorded on an XL2 or XL3 without the Data Explorer Option installed on the XL2 or XL3 device at the time of recording the data ("Legacy data"), require an internet connection in order to be imported to the Data Explorer software.



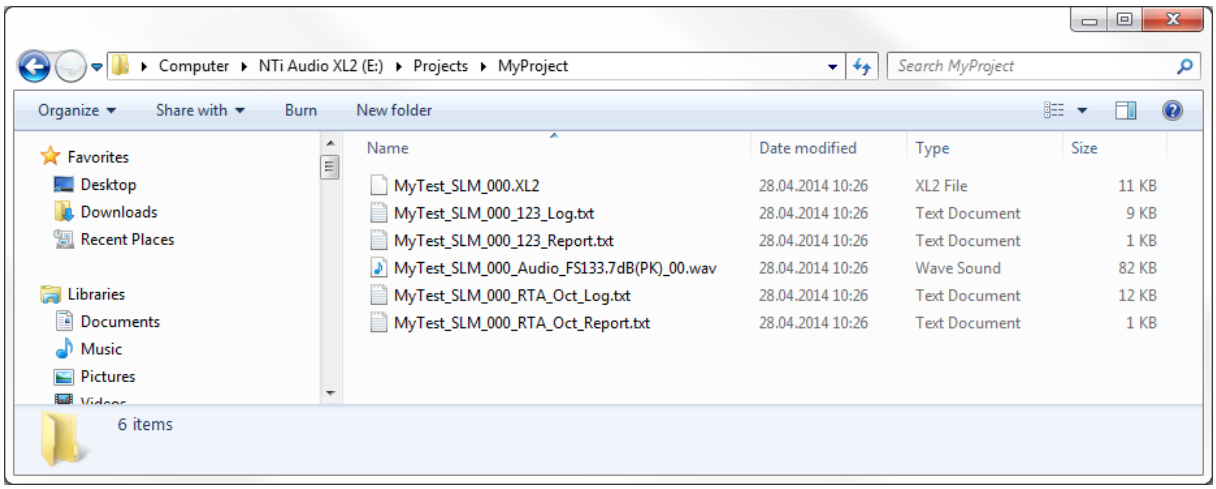
Data import procedures

NOTE **The NTi Data Explorer allows the import of XL2 or XL3 log files, regardless in which mode they have been recorded. This does not, however, include the "cycle results" that were acquired in the 'Repeated Timer' mode.**

Import procedure

1. Before importing new measurement data, you may activate the following options.
   a) Conversion of 1/3 Octave Spectrum data to 1/1 Octave Spectrum data,
   b) Y-axis definition and percentile preferences for imported files.

2. Connect the XL2 or XL3 to your PC with the Data Explorer software via the USB interface, or insert the SD-card into a card reader, and copy the required XL2 or XL3 test files to the hard disk.



Example of XL2 Test files with audio file

3. Select the import mode via the button in the bottom left corner of the Project view.

   a)  create one project for each of the selected XL2 or XL3 files.

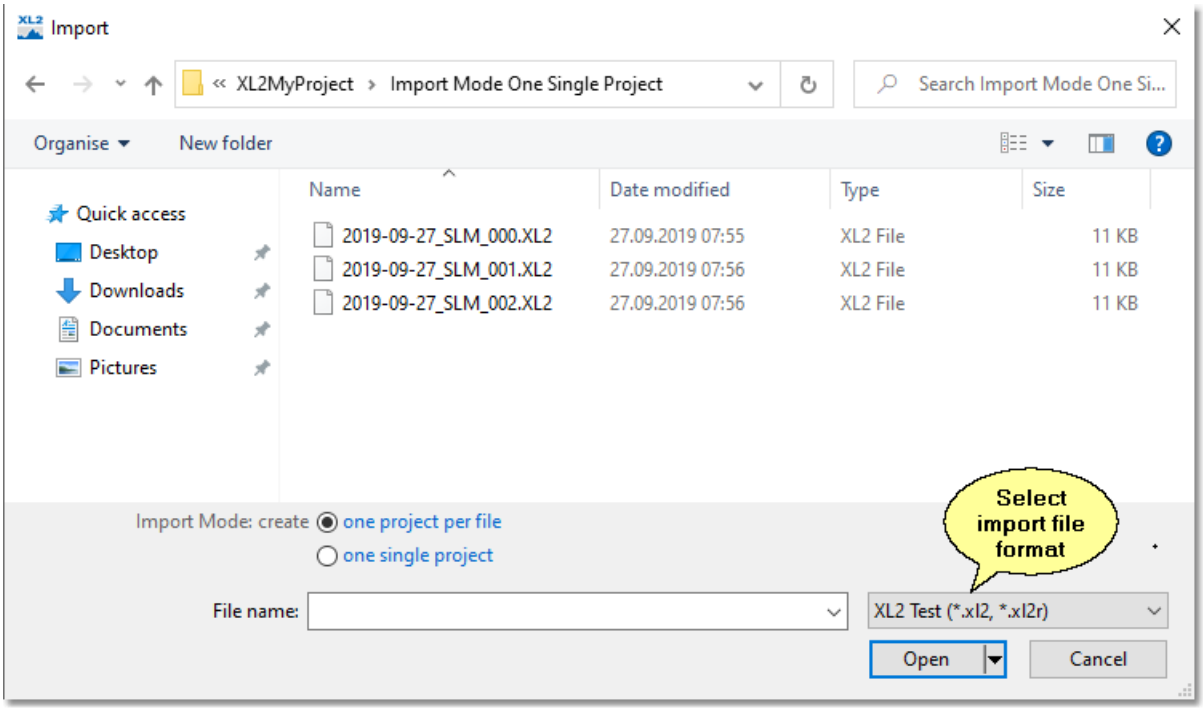
   b)  create one single project containing the concatenation of all the selected XL2 or XL3 files.

.

NOTES **If several projects shall be concatenated, they must have been recorded by the same XL2 or XL3 instrument with identical settings.**
The pauses between the recording periods of a concatenated project will be marked and filled with the last valid level.

4. Click on the 'Import' button and select the *.xl2, *.xl3 or *.zip file(s) to be imported.

Hint ***Only *.xl2 or *.xl3 files can be concatenated, but not *.zip files.***



Select XL2 Test file

Hint ***It is strongly recommended that you copy the XL2 or XL3 test files to the PC hard disk first, and then import them into the Data Explorer, and that you keep a backup of the imported XL2 or XL3 Test files or the converted NTi Data Explorer files in case of loss of data.***

Weather data import

There are two alternatives to import weather data to your Data Explorer project,

a) from a *NoiseScout location* that includes a weather station,

b) from an *autonomous* weather station.

Weather data import from NoiseScout location

If your NoiseScout location includes a weather station, you may import the corresponding data as follows.

1. Download the logged data from the NoiseScout location to your PC,
2. Drag & drop the downloaded *.zip file to the Project view.

The imported project contains the logged sound levels & weather data, which may be marked for further analysis.

Data import from autonomous weather station

If you may want to import the data of an autonmous weather station into your data Explorer project,

1. Click on the 

button in the Automatic Marker Generation panel,
2. Select the text file that contains the data from your weather station.

2.2 Preferences

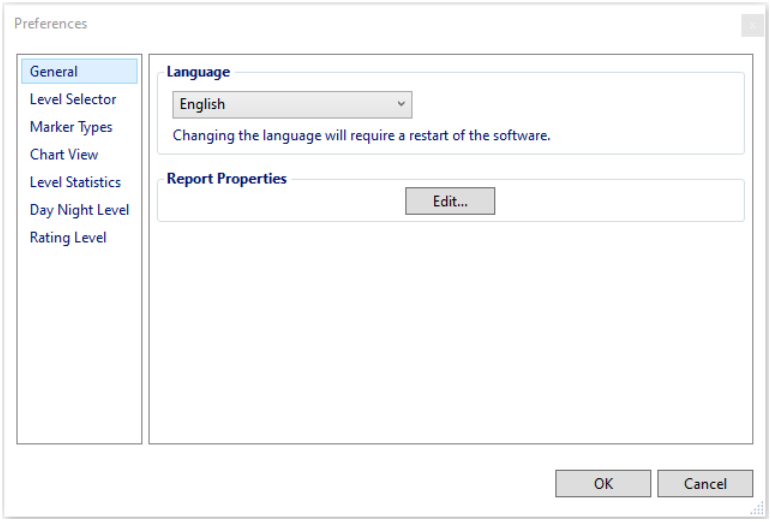
The 'Preferences' feature allows you to customize some default settings according to your requirements, e.g. the displayed level or spectrum curves, the Main chart Y-axis scale, the default percentiles or the Day Night Level periods.

The customized default settings

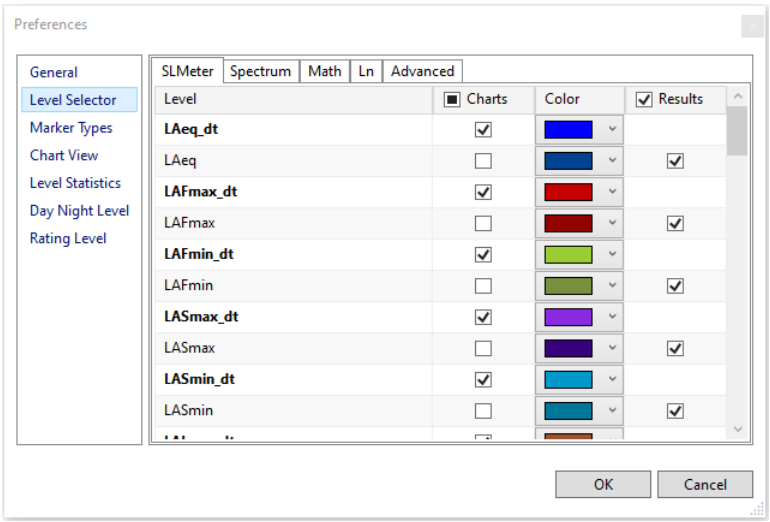
- are automatically applied on all XL2 or XL3 projects that are subsequently imported,
- may be applied individually by manual interaction on selected older XL2 or XL3 projects.

To define the default settings, select the menu 'File → Preferences...' in the Project view.

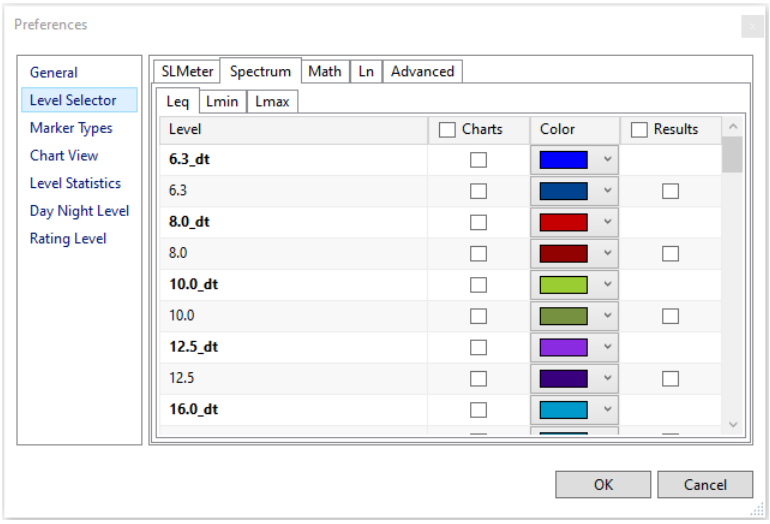
a) Select the preferred language and edit the default Report Properties.



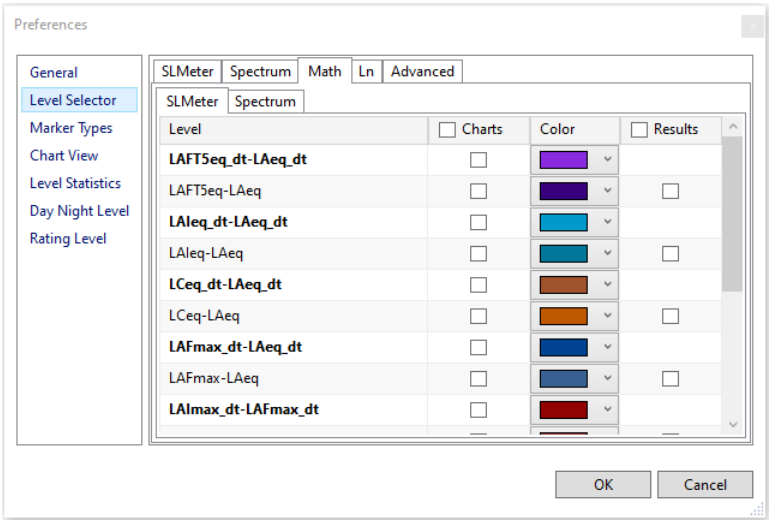
b) Select 'Level Selector' and 'SLMeter', and tick the level measurements that shall be displayed in the Chart view and in the Results view by default.

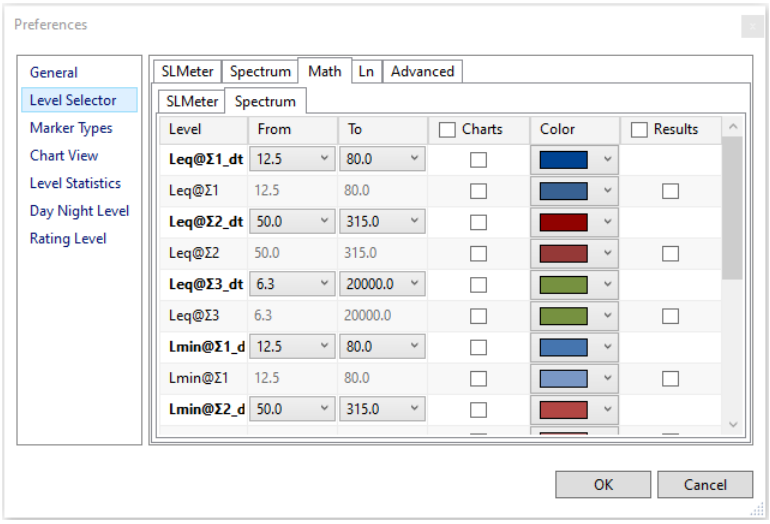


c) Select 'Spectrum' and either 'Leq', 'Lmin' or 'Lmax', and tick the Spectrum bands that shall be displayed in the Chart view and in the Results view by default.



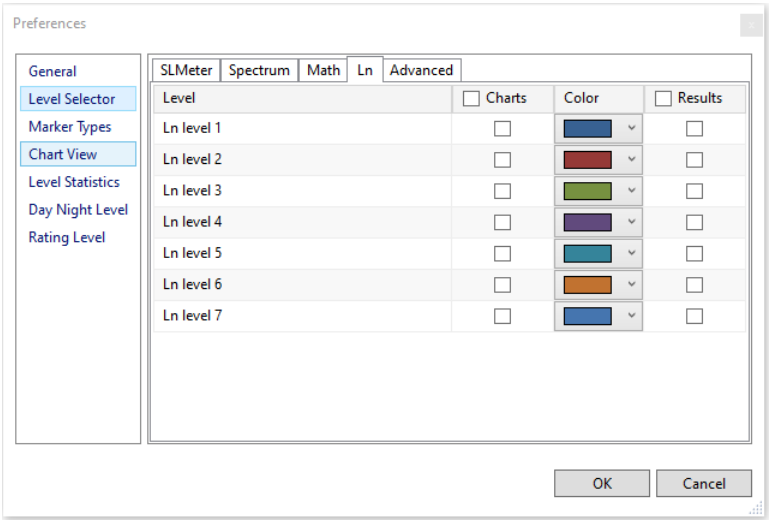
d) Select 'Math' and 'SLMeter' or 'Spectrum', and tick the calculation results that shall be displayed in the Chart view and in the Results view by default.





e) Select 'Level Selector' and 'Ln' and select the Level Statistics that shall be displayed in the Chart view and in the Results view by default.

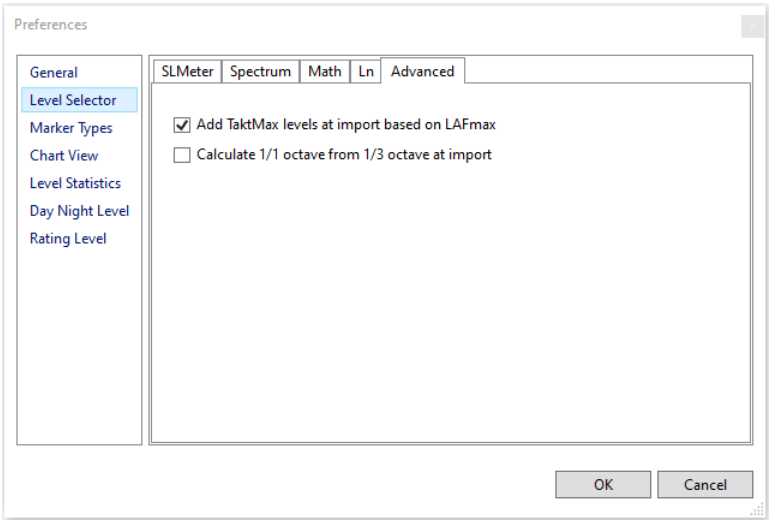
Hint ***The 'Preferences' settings are limited to seven percentiles.***



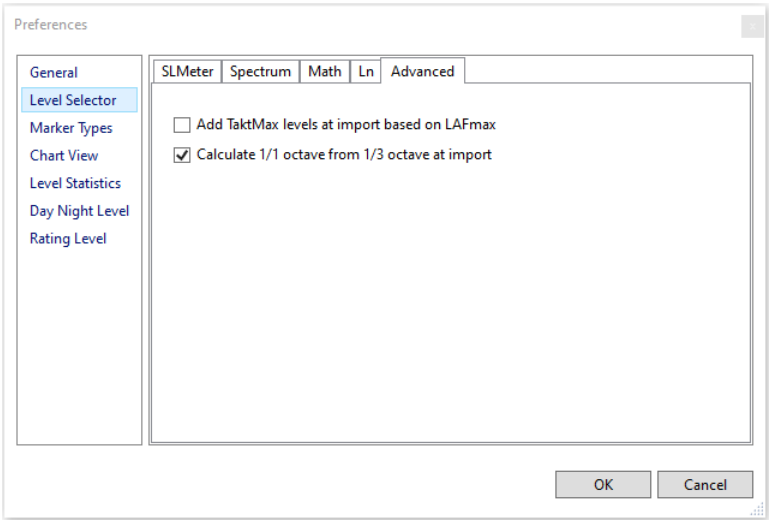
f) Select 'Level Selector' and 'Advanced' and tick the checkbox 'Add TaktMax levels at import based on LAF max' to let the Data Explorer software calculate the TaktMax levels, based on the imported LAFmax log data in case that no TaktMax level has been logged by the XL2 or XL3.

Hint ***Requirements for***

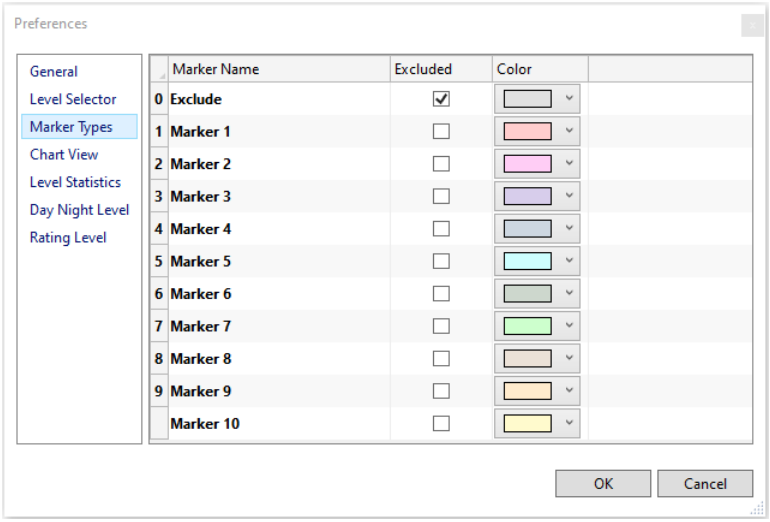
- ***post-calculation of LAFT3eq and LAFT3eq_dt: LAFmax logged with 100 ms, 1 sec or 3 sec interval***
- ***post-calculation of LAFT5eq and LAFT5eq_dt: LAFmax logged with 100 ms, 1 sec or 5 sec interval***



Tick the checkbox 'Calculate 1/1 octave from 1/3 octave at import' to let the software calculate the 1/1 octave Spectrum, based on the measured 1/3 octave data, and save the calculated results in the project.

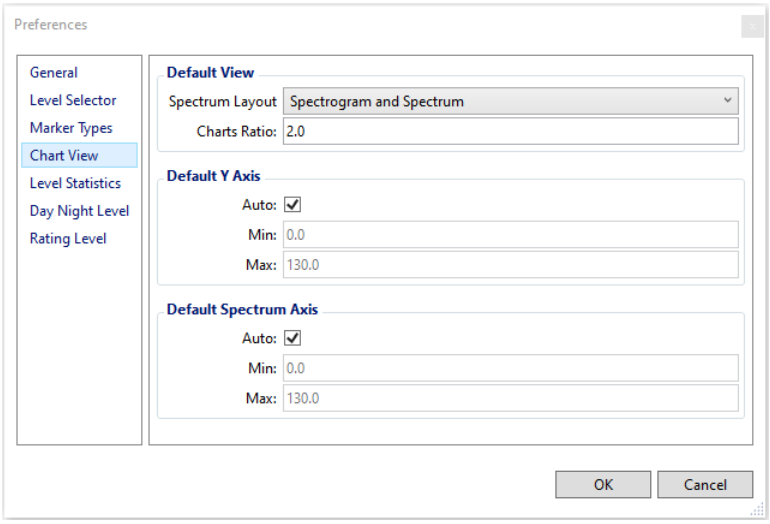


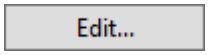
g) Select 'Marker Types' to edit the default names, define Exclude markers or default colors



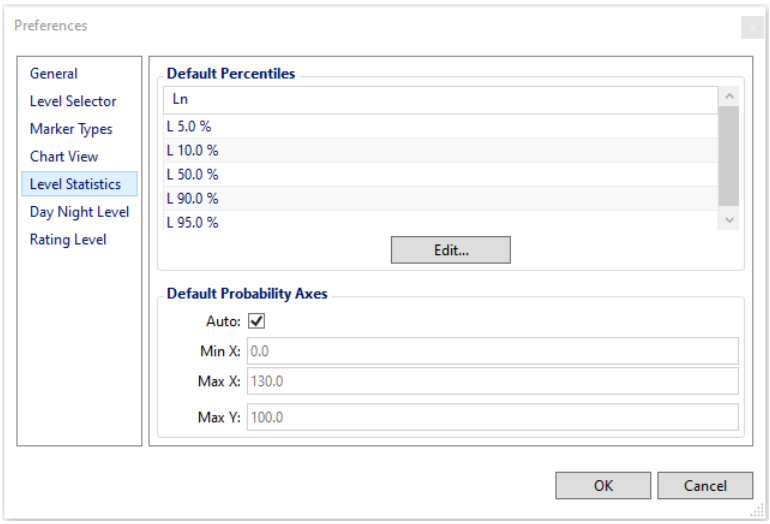
h) Select 'Chart View' to

- define the default layout of the Chart view
- activate and amend the default Minimum and Maximum dB values for the lower and upper ends of the Y-axis of the Main chart or the Spectrogram and the Spectrum.

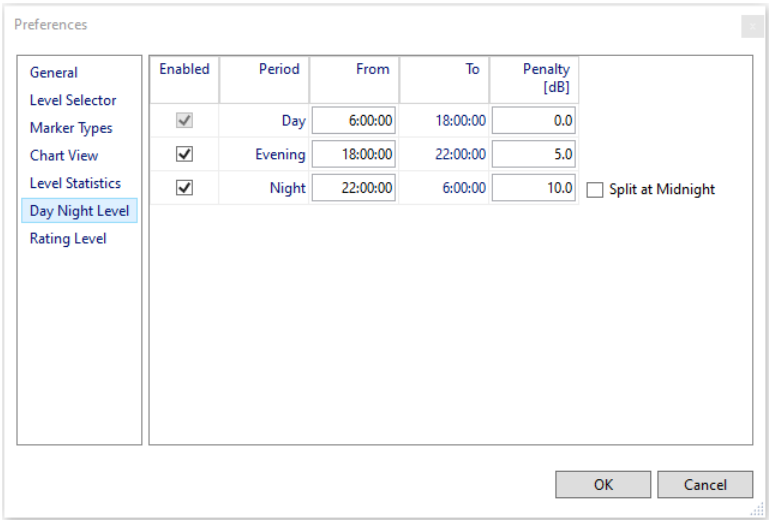


i) Select 'Level Statistics' and press 

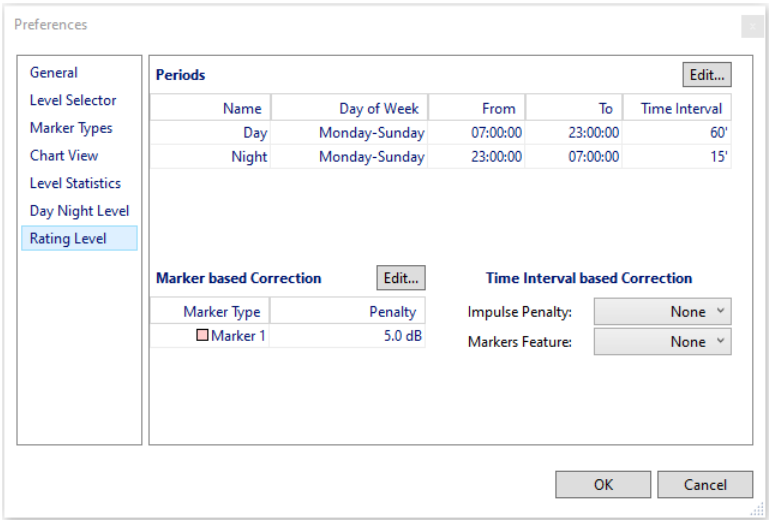
to edit the percentiles that shall be calculated and displayed by default, and/or edit the scaling of the graph axes.



k) Select 'Day Night Level' and the edit the time scheme or penalties according to your requirements.



l) Select 'Rating Level' to edit the default penalties or time periods.



Hint ***Changes of the preference settings are applied on all XL2 or XL3 log files that are subsequently imported.***
The preferences of older projects may be updated individually via the Setup Levels panel, the Zoom panel, the Edit percentiles panel or the Day Night Level panel.

2.3 Project info

As soon as an XL2 or XL3 test file has been imported to the Data Explorer, it becomes a Data Explorer Project with the following content:

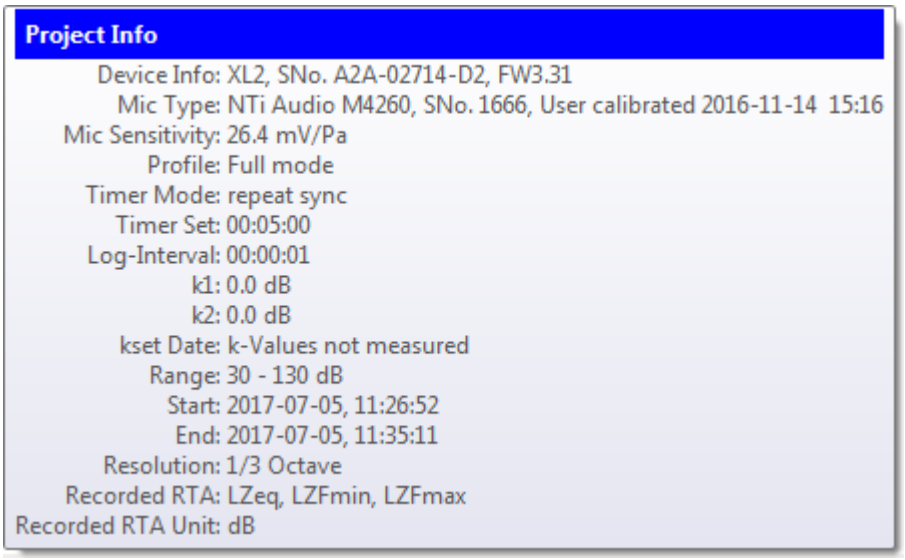
- Logged level data
- Recorded audio file (if applicable)
- Project info (see below)
- Events (Markers) created by the XL2 or XL3 or by the user from within the Data Explorer
- Print preview
- List of level measurements
- Expansion level / layout of Result view (also after exit & re-enter)

Hint ***To re-establish the original status of a Data Explorer Project after you have amended the data, simply re-import the *.xl2 or *.xl3 Test file***

Project Info pop-up

To open the Project Info pop-up, hover the cursor over the left bottom corner in the Chart or Result view.

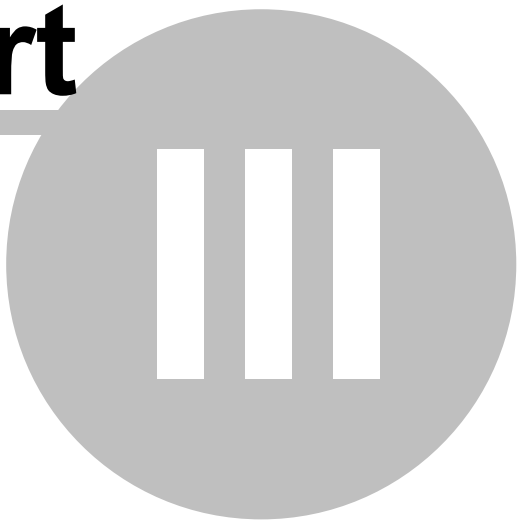
The Project Info pop-up contains the following list of **non-editable** information.



Project info pop-up (example)

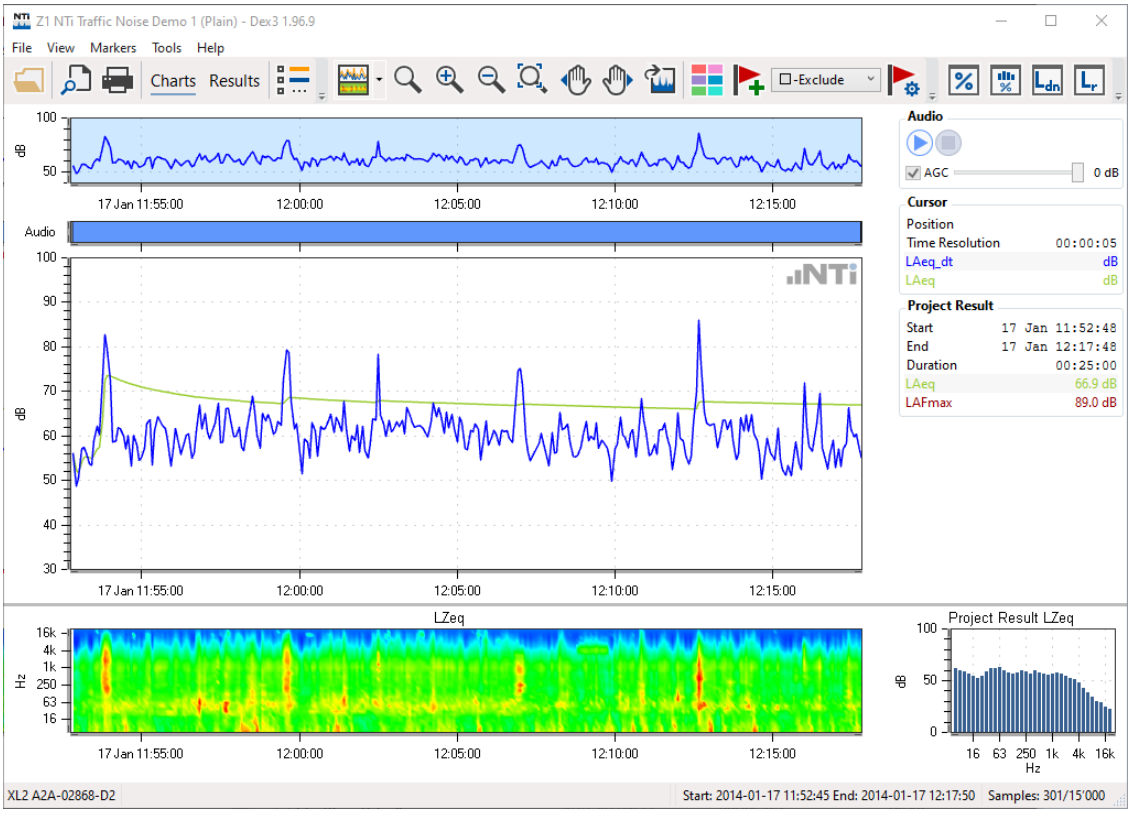
Hint ***Please refer also to chapter Print preview***

Part



3 Chart view

The Chart view contains the Overview chart, Audio bar & player, Main chart & info section, Spectrogram with Spectrum and the Project info.



Default Chart view

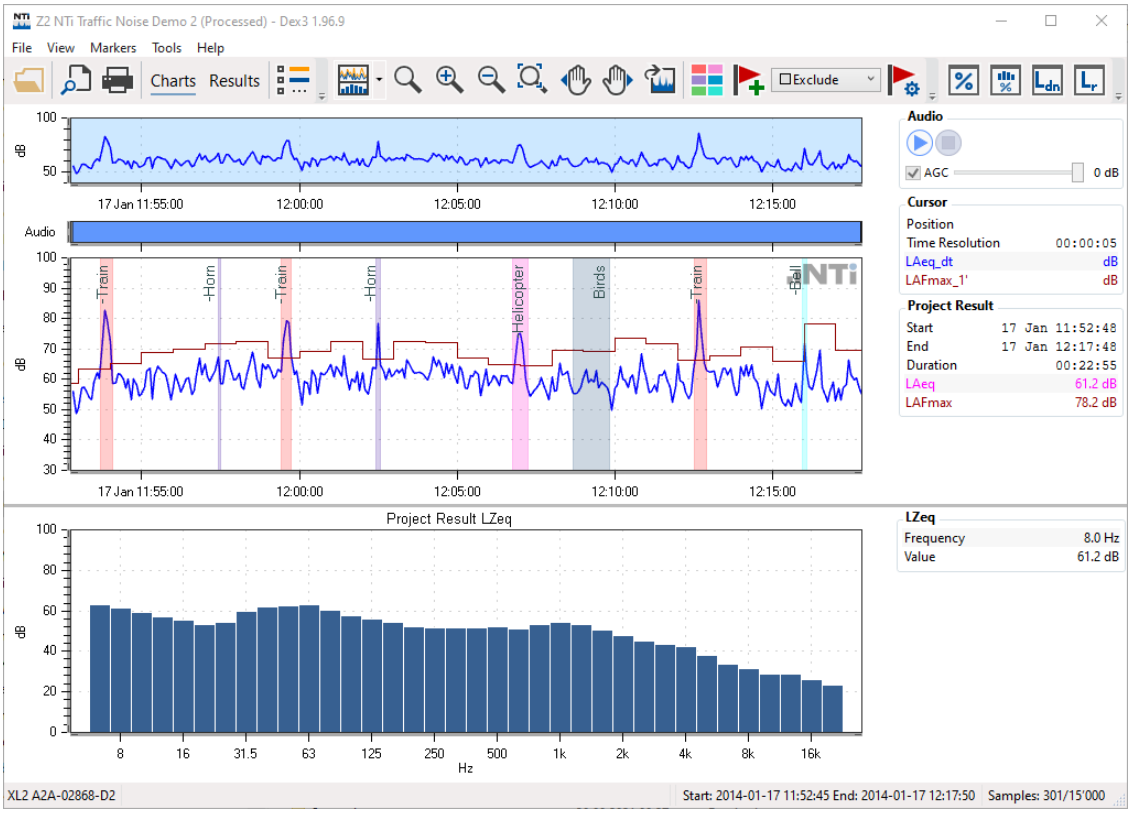


Chart view with large Spectrum

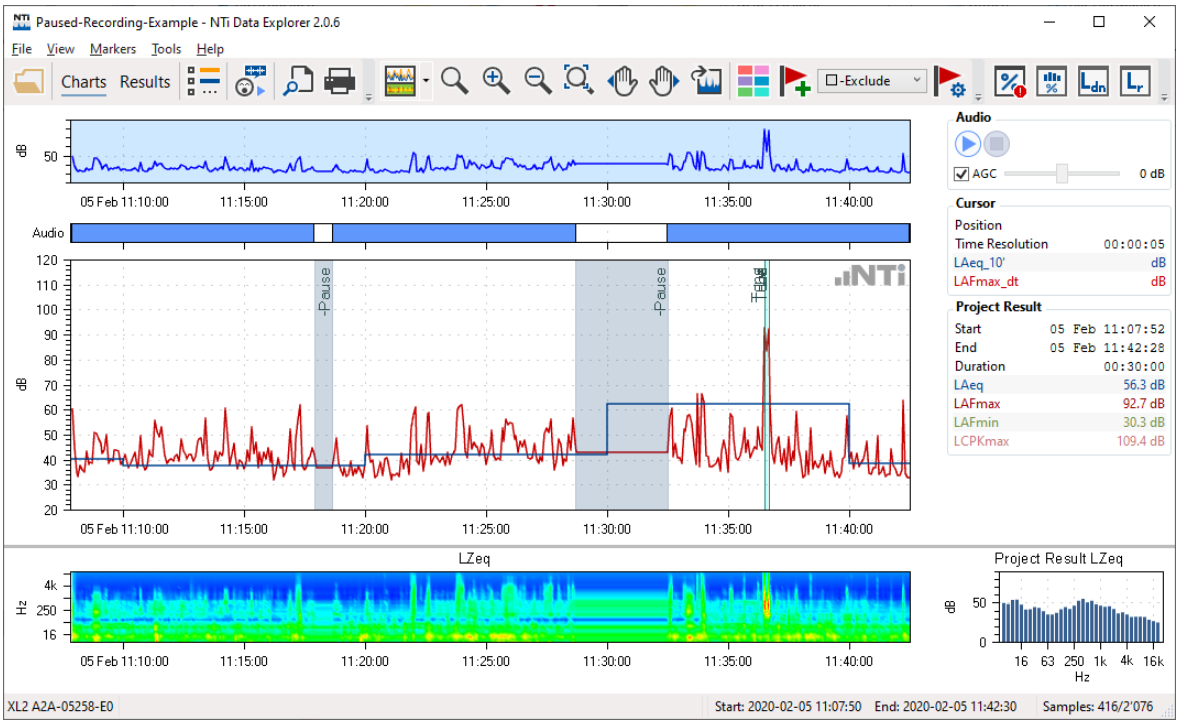
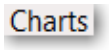
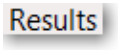
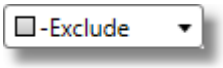


Chart view of concatenated project

Buttons

Icon	Description
	Open Another Project
	Switch to Chart view
	Switch to Result view
	Select the levels to be displayed
	Print the project report
	Preview the project report
	Replay the Voice note (*icon only visible if project includes Voice note*)
	Change the layout of the chart view: Main chart only / with Spectrogram / with large Spectrum
	Zoom by Date Time
	Zoom in / out
	Zoom All out
	Pan left / right
	Export a data subset to a new project
	Edit the name, function or color of the Markers
	Add a Marker
	Select the type of a new Marker
	Open the Automatic Marker Generation window
	Open the Level statistics window. The red warning indicates that the level statistics have to be re-calculated.
	Open the Spectrum statistics window
	Open the Day Night Level window
	Open the Rating Level window

Time axes

The time axes always show the absolute date & time as recorded by the XL2 or XL3 at the time when the level data was acquired.

- The time axis of the Overview chart always shows the full recorded period.
- The time axis of the Audio bar, Main chart and Spectrogram automatically adapts to the current zoom range.

Separator

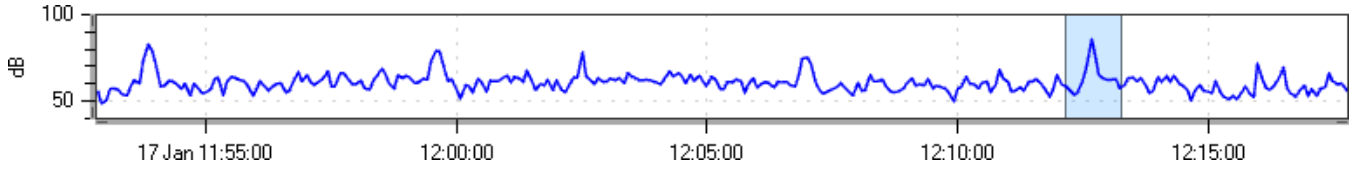
The separator line between the Main chart and the Spectrogram can be shifted vertically, adjusting the height of the graphs.

Project info

A pop-up with the Project info opens as soon as the cursor is moved over the XL2 or XL3 serial number / firmware version in the left bottom corner of the Chart view.

3.1 Overview chart

The Overview chart provides a permanent view of the full recorded period.



Overview chart with highlighted zoom range

The level curve that is displayed by default is, if available, the LAeq. Otherwise, it's the first level measurement data recorded in the log of the XL2 or XL3 Test file.

The yellow background of the Overview chart indicates the area that is currently displayed in the Audio bar, Main chart and Spectrogram. If you zoom in to an area in the Main chart, the area will be highlighted in yellow in the Overview chart.

- The time axis of the Overview chart always shows the full recording period.
- The time axis of the Audio bar, Main chart and Spectrogram cover the currently displayed (i.e. zoomed) recording period only.

Example of Overview chart, Audio bar and Main chart

3.2 Audio bar & player

NOTE The Audio bar is only shown if the audio recording was switched ON in the XL2 or XL3.

Example of a continuous Audio bar

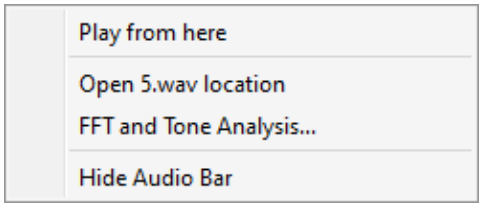
Example of a segmented Audio bar

The Audio bar is normally continuous, but can also be segmented. For example, if the XL2 'Log Audio' mode was switched to 'Events Only'. Furthermore, longer audio recordings will be concatenated, as the maximum file size for an audio log is restricted to approx. 500 MB (= 1 hour full audio, or 12 hours compressed audio).

The area displayed in the Audio bar always corresponds to the content of the Main chart (i.e. the zoomed area). The vertical lines below the Audio bar consequently refer to the time scale of the Main chart, too.

There are three ways to listen to the recorded audio file.

a. To replay the audio file, you may
   - click on the desired position in the audio bar, or
   - right-click on the Audio bar, the Main chart or the Spectrogram and select 'Play from here', or
   - click on the button of the Audio player.



Right-click context menu

b. To pause the audio file replay,
   - press the 'Space' bar, or
   - right-click on the Audio bar, the Main chart or the Spectrogram and select 'Pause', or
   - click on the button of the Audio player.

c. To stop the audio file replay,
   - press the 'Esc' button, or
   - right-click on the Audio bar, the Main chart or the Spectrogram and select 'Stop', or
   - click on the button of the Audio player.

Audio player

You may switch off the AGC (Automated Gain Control), and manually adjust the gain. However, please note that in this mode the Audio player may still reduce the gain to avoid clipping.

Hint ***The AGC cannot be switched off if the XL2 or XL3 audio file was recorded in the mode 'Compressed+AGC'.***

You may access the WAV file(s) behind the Audio bar (segments). To do so, right-click on the appropriate segment and select 'Browse to ...'.

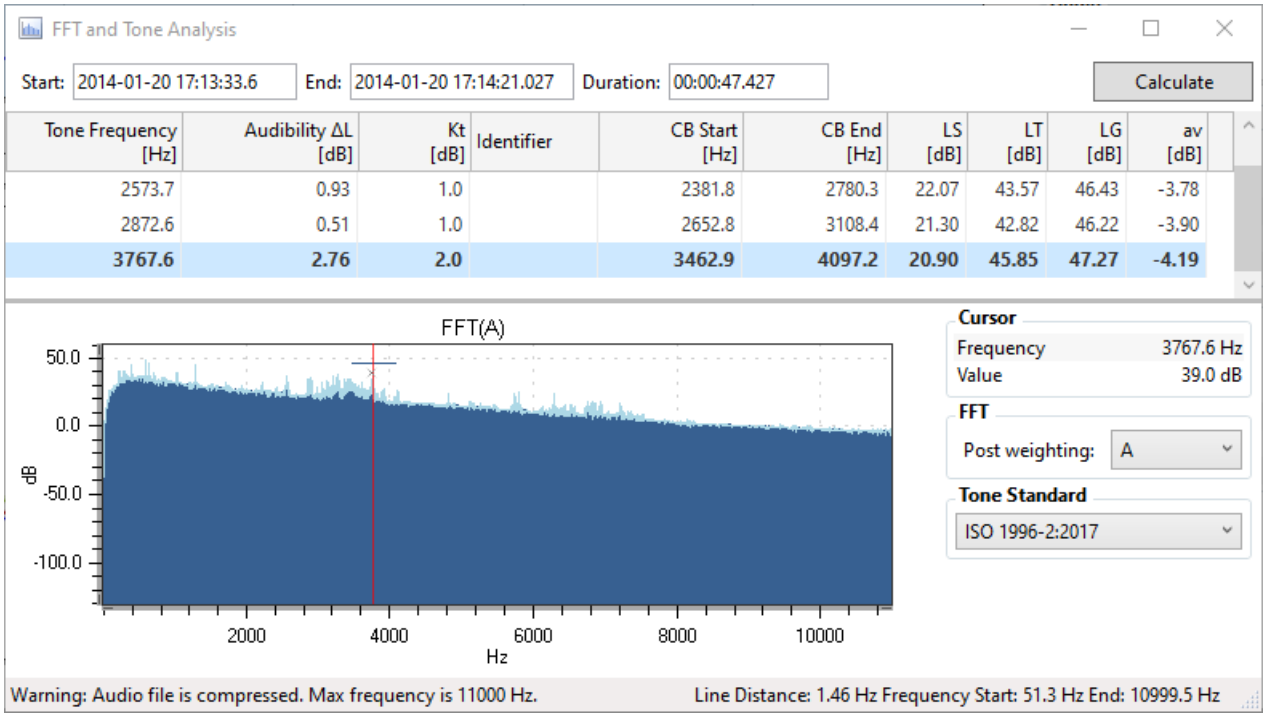
Alternatively, you may hover over the time indicator in the Audio player to read the file path of the related WAV file.

Replay voice note

If the imported XL2 or XL3 log file includes a voice note, you may replay the latter by clicking on the button.

FFT and Tone analysis

Right-click on the Audio bar to open the FFT and Tone analysis panel.

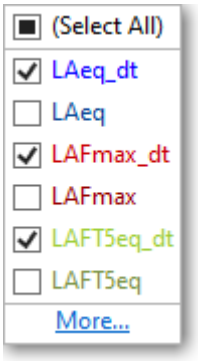


Example of FFT and Tone Analysis

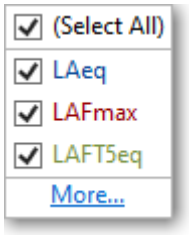
3.3 Level selector

Click on the  button or press Ctrl + L to select the sound levels, math results and level statistics to be displayed in the Chart view and Result view respectively.

Hint ***The displayed levels are selected independently for the Chart and the Result view.***



Example of available levels in Chart view

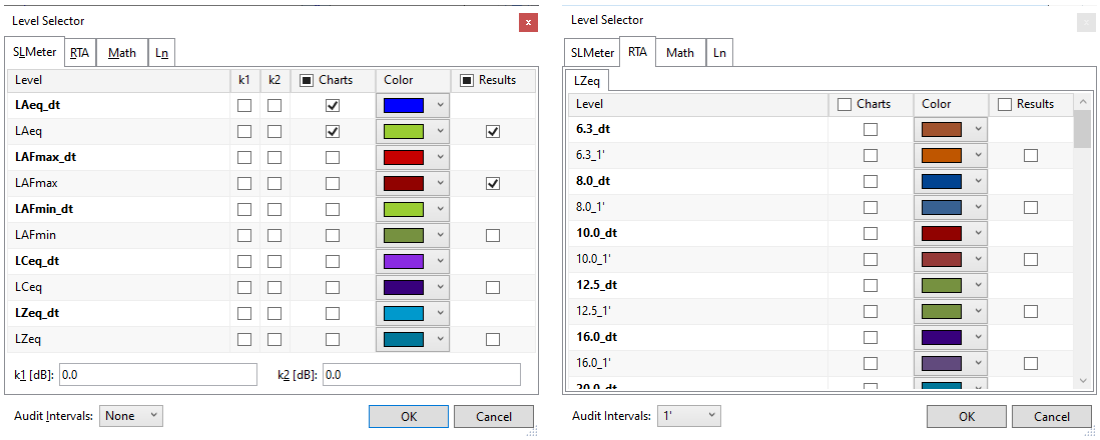


Example of available levels in Result view

Click on 'More...', to open the 'Level Selector' panel, which provides access to more settings.

a) Sound levels

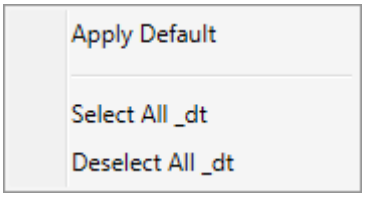
- Tick the ■ checkbox to select ☑ (i.e. display) or deselect ☐ all level or Spectrum curves and results in the corresponding view.
- Tick the particular checkboxes of the levels, spectra or correction factors k1, k2 that shall be displayed.
- Edit the values of the correction factors k1, k2.



Level Selector panel, tabs 'SLMeter' and 'Spectrum'

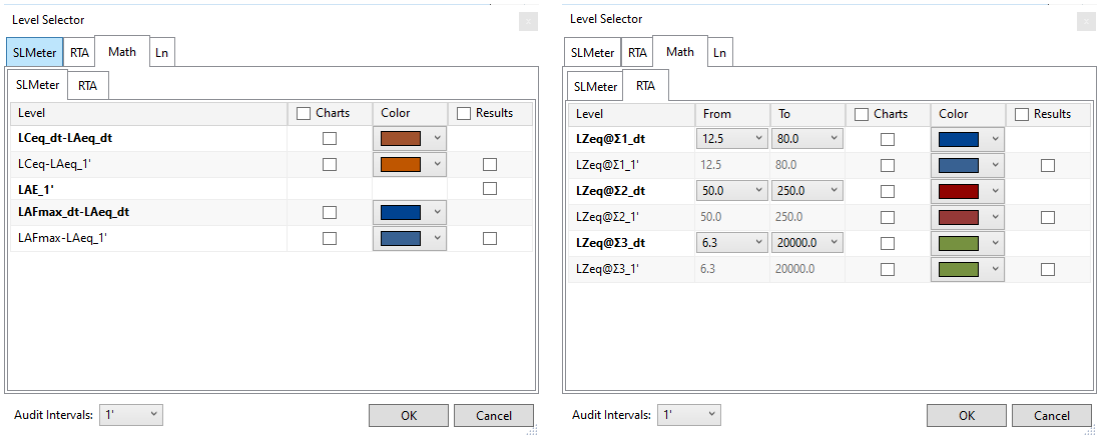
Hint ***Activate an Audit Interval if required (optional)***

Hint ***By right-clicking on the 'SLMeter' or 'Spectrum' Setup Levels panel you may***
a) apply the current default settings (→ preferences),
b) select all _dt values in the list,
c) deselect all _dt values in the list.



b) Math results

- Tick the ■ checkbox to select ☑ (i.e. display) or deselect ☐ all math results in the corresponding view.
- Tick the particular checkboxes of the math results that shall be displayed.

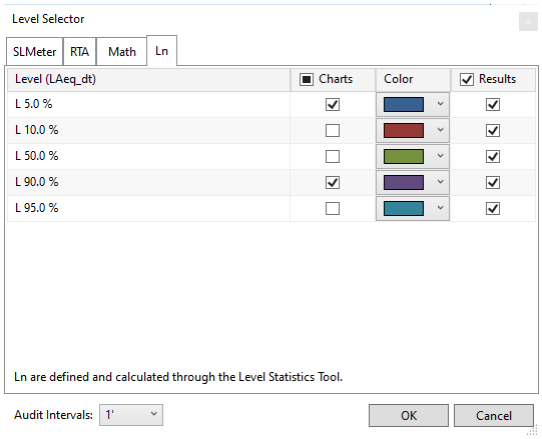


Level Selector panel, tabs 'Math / SLMeter' and 'Math / Spectrum'

NOTE **'Math' values are only available if the corresponding raw data have been logged in the XL2 or XL3 project.**

c) Level statistics

- Tick the ■ checkbox to select ☑ (i.e. display) or deselect ☐ all level statistics in the corresponding view.
- Tick the particular checkboxes of the level statistics that shall be displayed.



Level Selector panel, 'Ln' (level statistics)

3.4 Audit Intervals

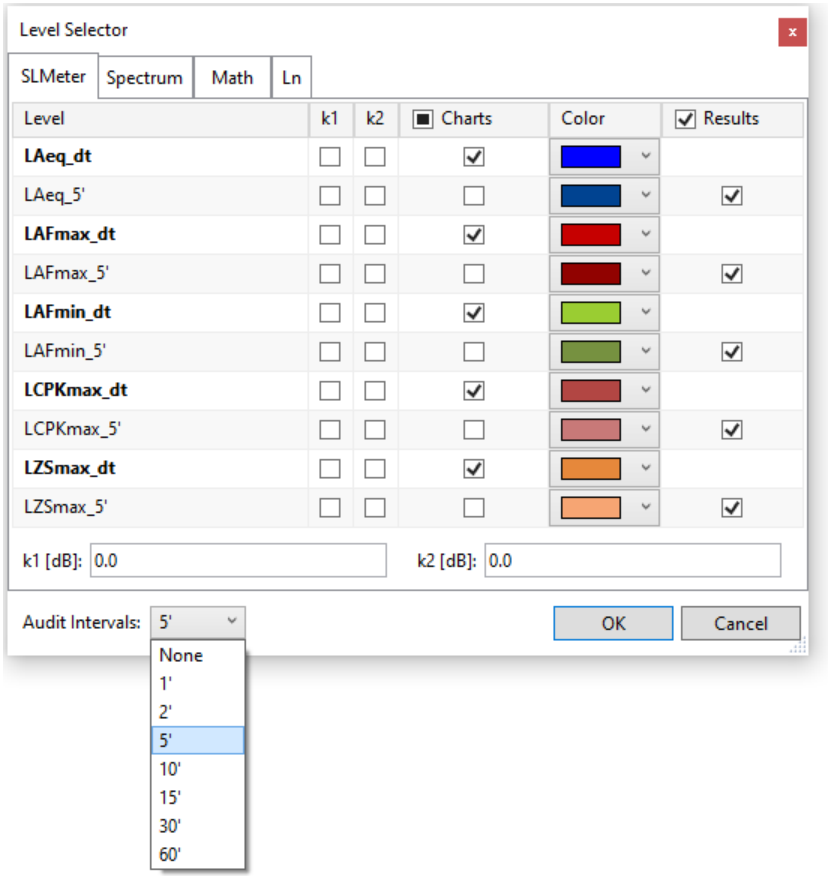
The 'Audit Intervals' feature allows the log data to be divided into measurement intervals (segments) of selectable length. These intervals are always synchronized with the full hour.

For instance, the 15' (15 minutes) audit interval would divide a recording from 08:12 to 09:05, for example, into following intervals: 08:12 → 08:15 → 08:30 → 08:45 → 09:00 → 09:05.

The selected measurement results are then displayed for each interval in the Main chart and in the Result view.

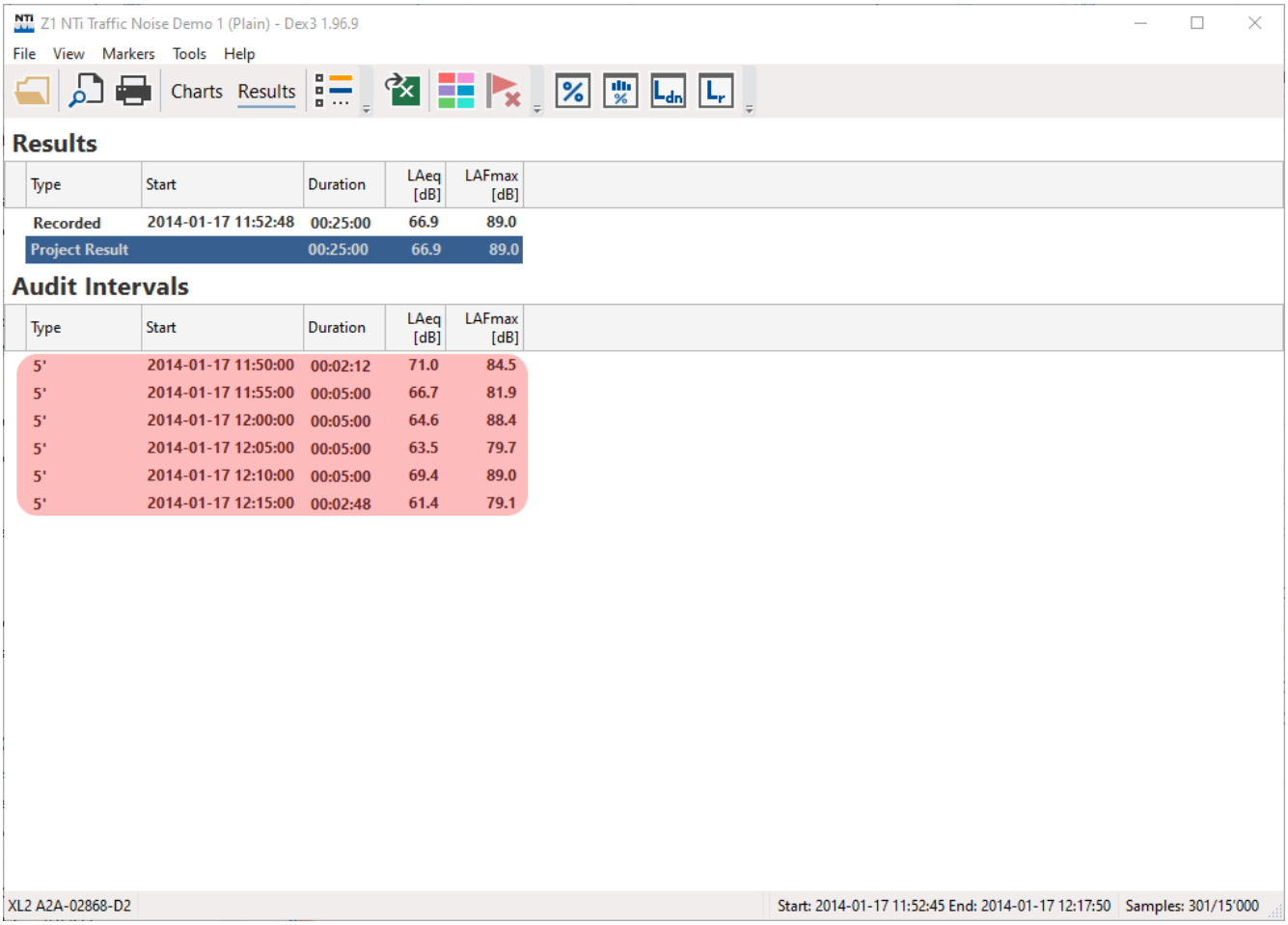
NOTE The 'Audit Intervals' feature is only available if the XL2 or XL3 log interval is 20 sec. or shorter (recommended: 1 sec.)

To activate the 'Audit Intervals' feature, open the 'Level Selector' panel, click on "More...",select the required interval duration and press 'OK'.



Selection of audit interval

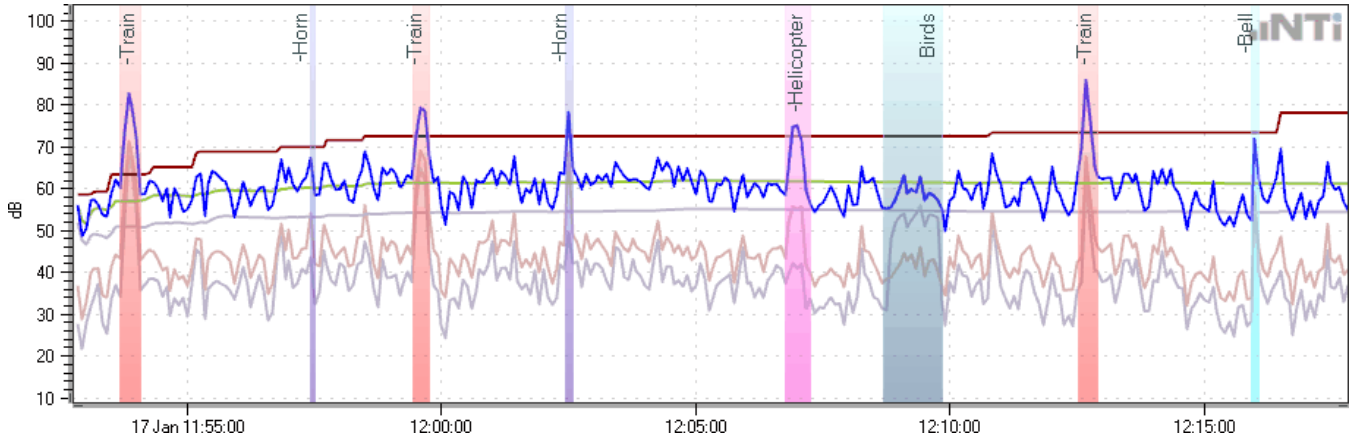
Example of Chart view with 5' audit interval



Example of Result view with 5' audit interval

3.5 Main chart, Info section

Main chart

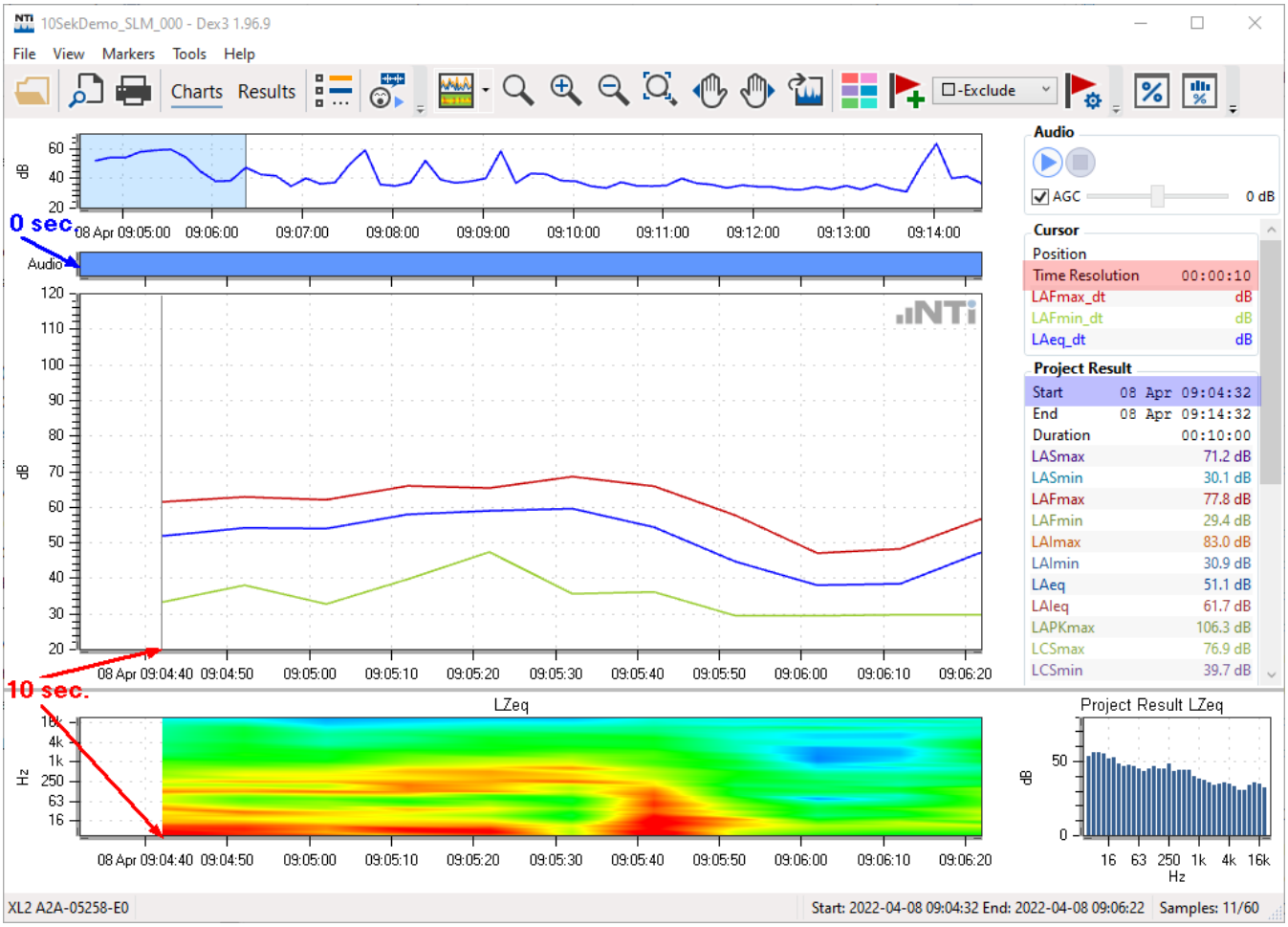


Example of Main chart with Level curves

The Main chart shows the curves of the selected levels and Spectrum data over time.

- Zoom in to or out of a specific area.
- Move the cursor to a specific position in the Main chart to read the instantaneous value(s) of the displayed level(s) in the Info section.

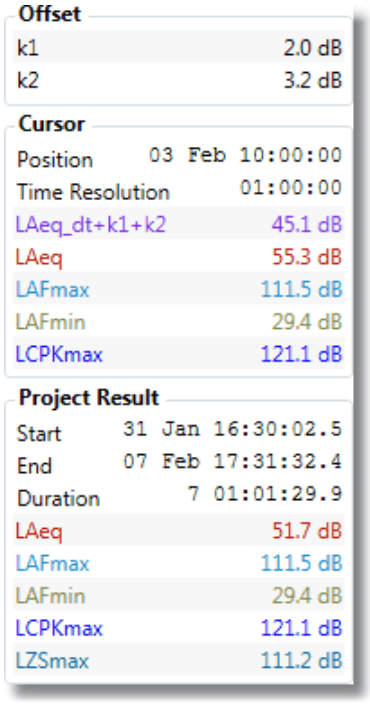
Hint ***There is a gap between the start point of the recording, and the first sample(s) of the result curve(s). This gap corresponds to the XL2 or XL3 log "Interval dt". The first results are only available at the end of the first log interval, whereas the audio file recording starts at the very beginning.***



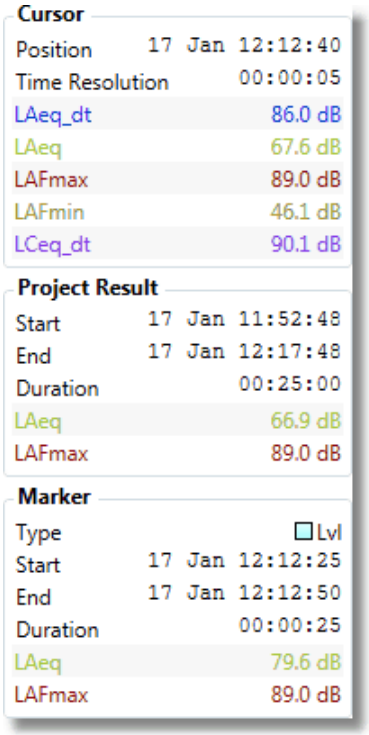
The audio file recording starts at the very beginning (0 s), while the first samples are only available after the first logging interval dt has elapsed (10 s)

Info section

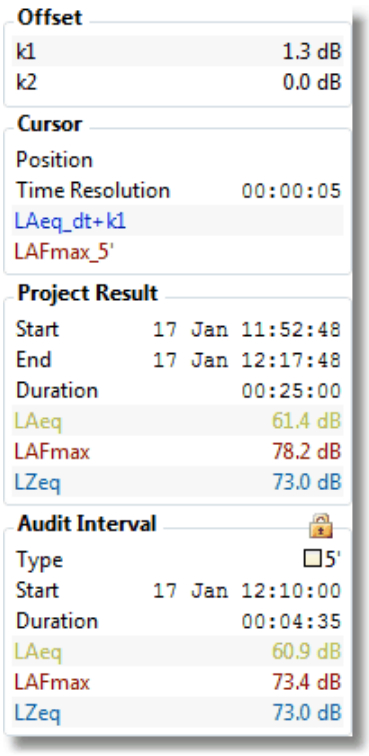
The Info section provides contextual information related to the displayed levels and the current cursor position.



Example #1 of Info section



Example #2 of Info section



Example #3 of Info section

Hint ***The "Marker" extension appears as soon as the mouse is placed on a Marker band.***

- **Offset**: values of the correction-factors k1, k2 (only visible if at least one correction-factor ≠ 0)
- **Cursor**: instantaneous values of the cursor
  - Position: date & time of the current cursor position
  - Time resolution of the currently-displayed Main chart (depends on the actual zoom range)
  - The instantaneous value(s) and color of the displayed level(s) at the current cursor position
- **Result**: absolute result data
  - Start, End and duration of the whole recording
  - The Results (i.e. all recorded values minus the excluded Markers)
- **Marker**: properties of the selected Marker
  - Type of the Marker
  - Start, End and duration of the Marker
  - Level data values of the Marker
- **Audit Interval**: properties of the selected Audit Interval
  - Type of Audit Interval
  - Start, End and Duration of the Audit Interval
  - Level data values during the Audit Interval

3.6 Spectrogram, Spectrum

The chart view allows to show the Spectrogram or the Spectrum via the display modes  and  .

Right-click on the Spectrogram or the Spectrum to select

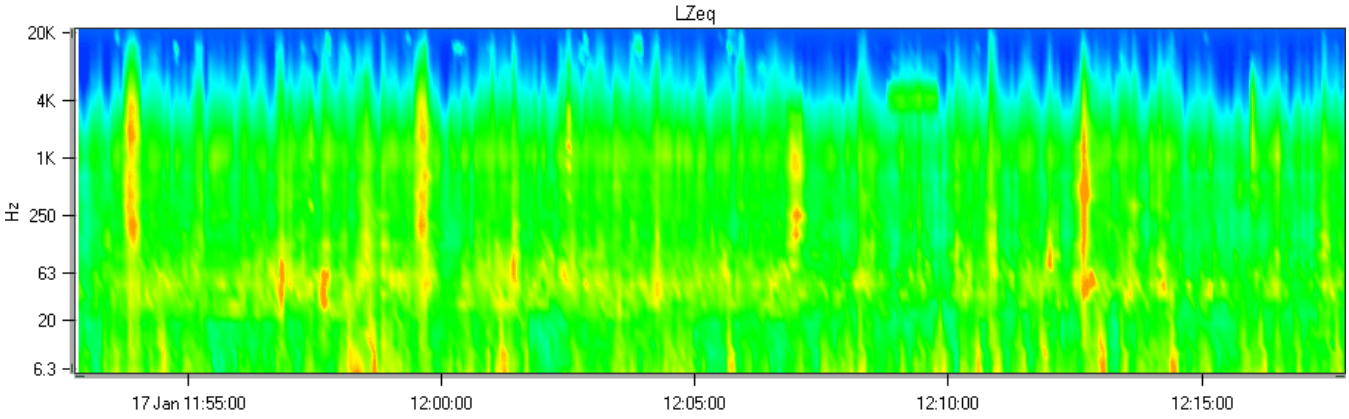
- Spectrum Weighting: A, C or Z
- Spectrum based on Leq, Lmax or Lmin

NOTE **The Spectrogram and the Spectrum are only available if "Add Spectra" was set to "Leq" or to "Leq, Lmax, Lmin" in the XL2 or XL3 during the data logging.**

Spectrogram

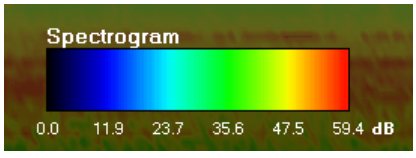
The Spectrogram displays the logged spectra of the XL2 or XL3 test (i.e. sound level at each frequency over time).

- X-axis: time
- Y-axis: frequency
- Colors: red represents the highest levels, through orange, yellow, green, cyan and blue, to black representing the lowest levels



Example of Spectrogram

Hint ***Right-click in the Spectrogram and select 'Show Legend' to show the color assignments.***



Legend

Hint ***You may edit the Spectrum-axis via the Zoom panel and thus define an absolute level ↔ color scheme. This may facilitate the comparison of the spectra from different projects, for example.***

Spectrum

The Spectrum displays the selected level vs. frequency of the cursor position; it may be enlarged via the 'Change Layout' button.

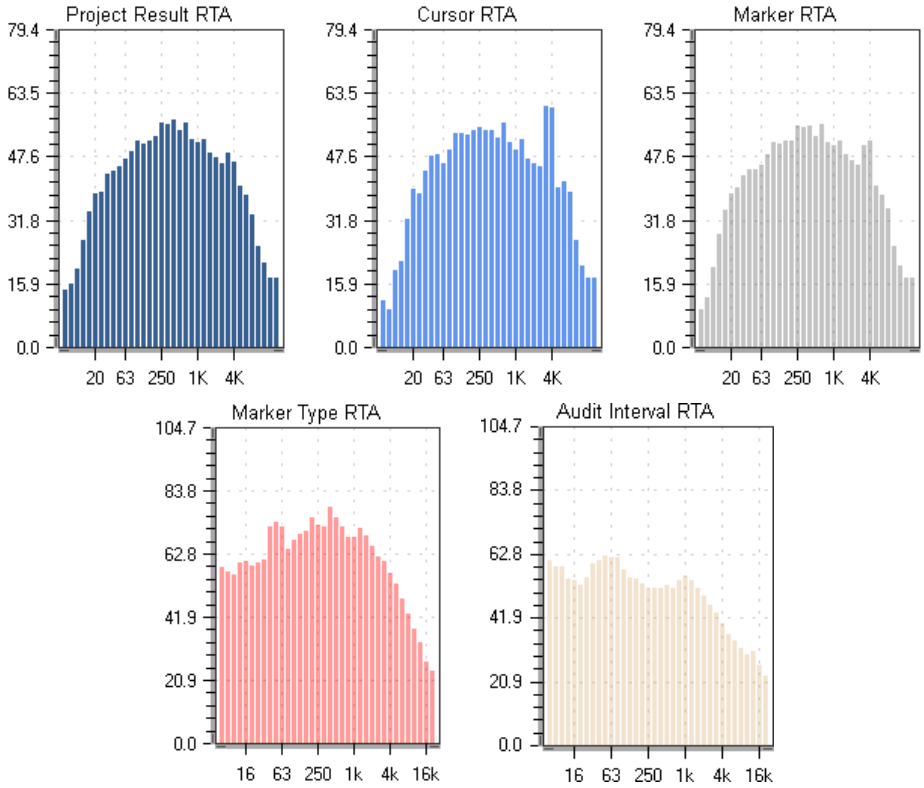
i. Cursor outside Main chart / Spectrogram → overall project spectrum is displayed

ii. Cursor over Main chart or Spectrogram → spectrum for the current cursor time position is displayed

iii. Cursor over a Marker label → spectrum of the marked area is displayed (*Hint: Marker color is applied to the Spectrum*)

iv. Cursor locked to all markers of the same type → spectrum of all markers of the same type is displayed

v. Cursor locked to Audit Interval → spectrum of the selected area is displayed

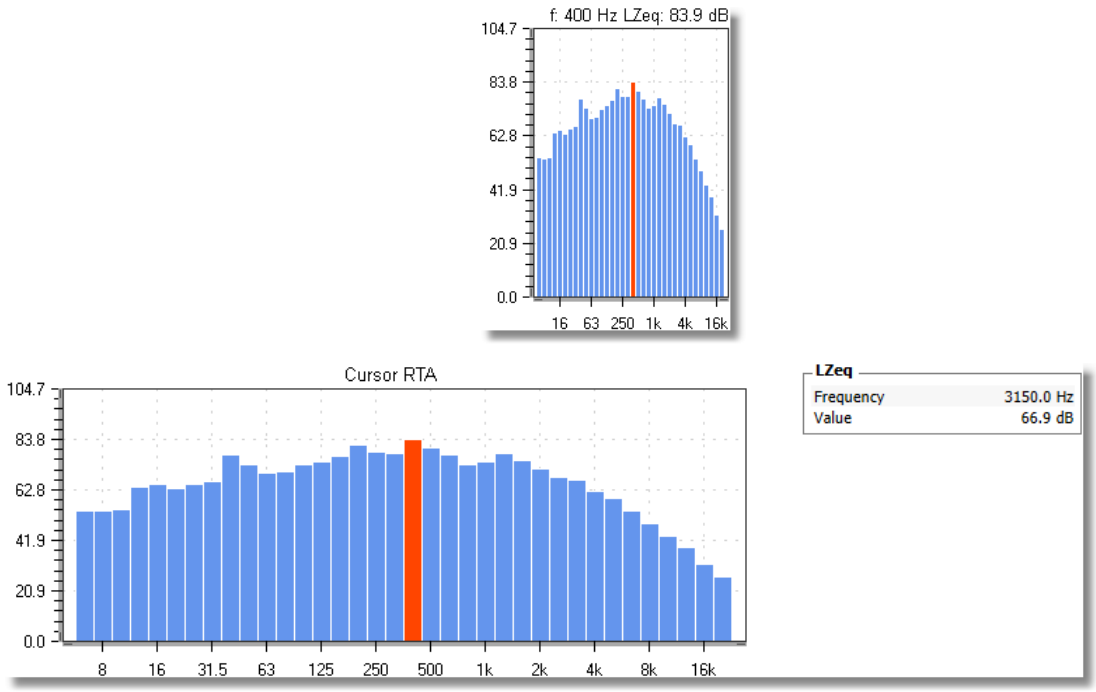


Different Spectra displayed (default size) depending on the cursor position (i, ii, iii, iv, v)

In addition, the Spectrum provides individual level/frequency information both numerically (on top of the graph), and graphically with a red bar.

a) Move the cursor over the Spectrum or Spectrogram

b) Lock the cursor in the Main chart or on a Marker label, then move it over the Spectrum.

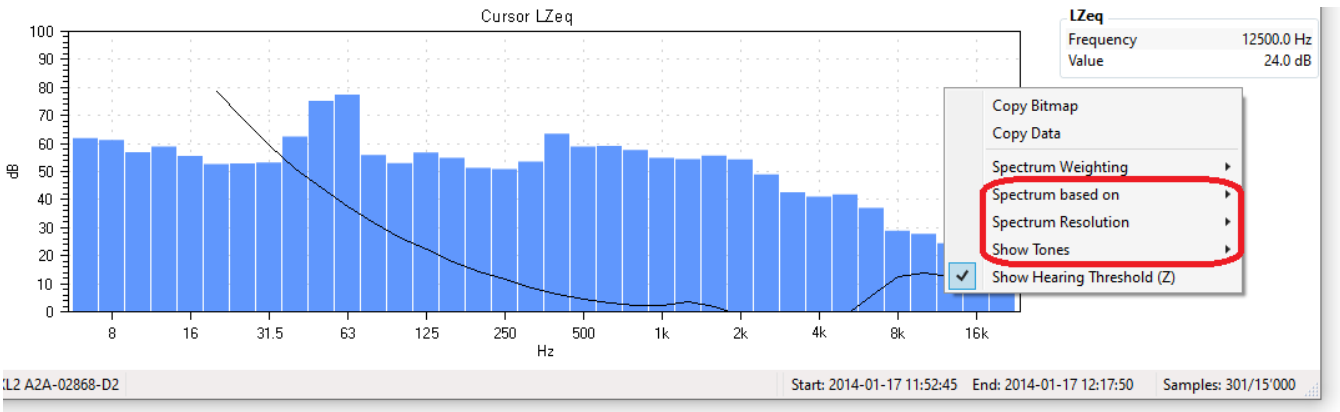


Spectrum with readout: default size (above) / large size (below)

Tones

Right-click on the Spectrum and select

- "Spectrum based on" → the applicable level, i.e. Leq or Lmax or Lmin
- "Spectrum Resolution" → the displayed resolution (1/1 or 1/3 Octave) of the Spectrum and Spectrogram
- "Show Tones" → the appropriate standard to show the tones, which are used for the Rating Level calculation.



Select applicable level & standard for the Rating Level analysis

Hearing threshold

To show the human hearing threshold, right-click on the Spectrum and select "Show Hearing Threshold (Z)".

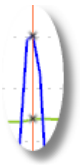
3.7 Cursor

The cursor (mouse pointer) can be used to perform several actions:

- Readout the instantaneous level results (-> info section) or level & frequency (-> Spectrum)
- Zoom & pan
- Start audio file replay: right-click on the required start point in the Main chart or Spectrogram, then select 'Play from here'

Readout

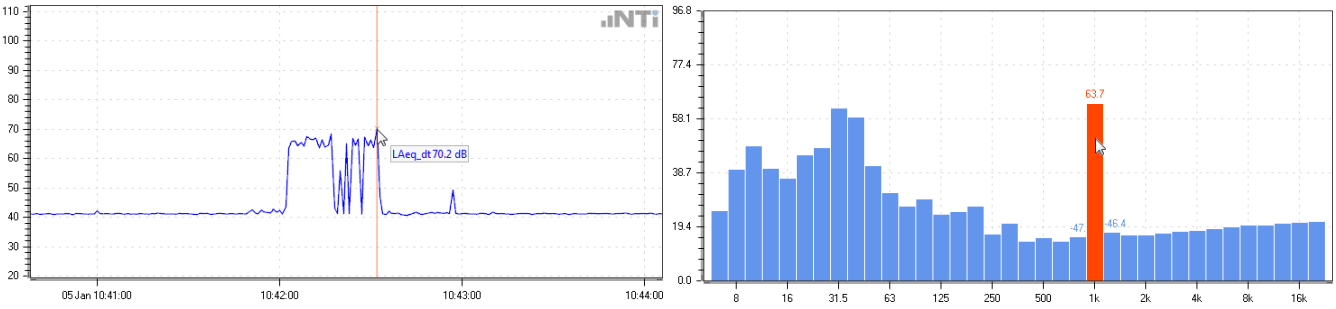
The info section shows the instantaneous level or spectrum of the cursor position in the Main chart or Spectrogram.



- If the cursor is located in the Main chart, the info section shows the corresponding level values. In addition, the intersection(s) of the cursor and the displayed curve(s) are highlighted by a small "x".
- If the cursor is located in the Spectrogram, the frequency and the level value that corresponds to the actual cursor position is also shown in the Info section.

If you press the Shift key while the cursor is over the Main chart or over a bar in the Spectrum, an additional readout will appear

- Main chart → sound level
- Spectrum → band level, and differences to adjacent bands



Cursor color

The default cursor color is **red**. While the audio file is playing, the cursor is **blue**.

Zoom-in/-out, pan

- Zoom-in:
  - select the zoom area with left-click+drag over the target area of the Main chart or Spectrogram, or
  - use the scroll wheel of your mouse.
- Zoom-out:
  - double left-click on the Main chart or Spectrogram, or
  - use the scroll wheel of your mouse.
- Pan:
  - Overview chart, place the cursor on the zoom range (yellow area) then left-click+drag
  - Main chart or Spectrogram, press Ctrl+left-click+drag

Lock cursor

The cursor position can be locked by right-clicking in the Main chart or Spectrogram, or over a Marker label, or in an Audit Interval. The Spectrum consequently shows the spectrum at the corresponding cursor position, or of the marked area.

Lock cursor ... → Spectrum

a) ... in the Main chart → of the specific cursor position

b) ... to a single Marker → of the marked area

c) ... to all Markers of a specific type → of the combined Marker areas

d) ... in the Spectrogram → of the specific cursor position

e) ... to an Audit Interval → of the marked area

Hint ***A locked cursor is indicated by a 🔒 in the Info section.***
When printing a report, the values of the locked cursor appear in the printout below the charts.

To unlock the cursor,

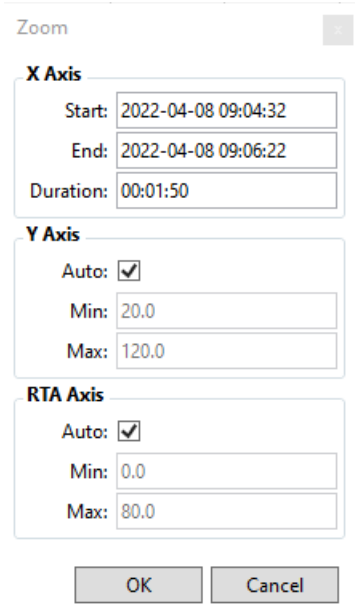
- press Esc
- click on 🔒 in the Info section
- right-click and select "Lock cursor" again
- lock the cursor at a new position

3.8 Zoom & pan

Zoom

There are several ways to zoom:

- Click on the  ,  buttons to zoom in/out,
- Place the cursor in the Main chart or Spectrogram, then
  - left-click+drag to the end position of the required zoom range,
  - use the scroll wheel of your mouse to zoom in/out.
- Click on the  button (or right-click on a graph) to open the Zoom panel, and manually edit the X-axis zoom range, Y-axis scale and the Spectrum-axis color scheme:



Zoom panel

Hint ***The Y-axis scaling may be adjusted to a predefined default via the preferences. To adjust the Y-axis of an XL2 or XL3 Test file that has been previously imported, right-click on the Y-axis section of the Zoom panel and select 'Default'.***

- Return to the overall view:
  - click on  ,
  - double click on the Main chart,
  - right-click on the Main chart or Spectrogram and select 'Zoom All Out'.

Pan

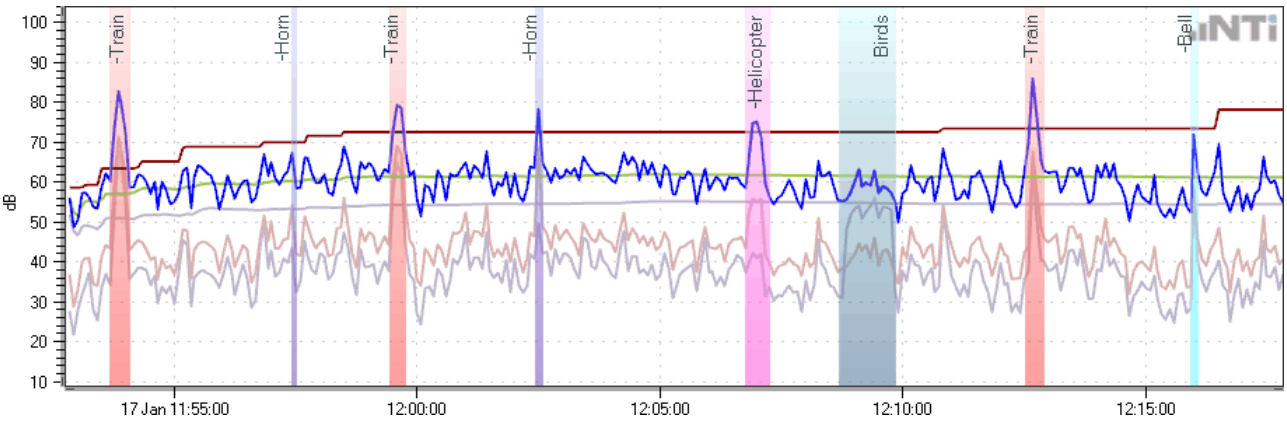
When you are zoomed in, there are several ways to pan:

- Click on the  or  button.
- Press the left / right arrow on the PC keyboard.
- Click on the zoom range in the Overview chart and move it with the mouse.
- Press Ctrl+left-click in the Main chart or Spectrogram and move the zoom range with the mouse

3.9 Markers

Markers are a very helpful way to

- exclude user-defined areas of the recording from the overall result calculation, and
- highlight specific events that occurred during the recording.



Example of main chart with five different marker types

Markers are either logged by the XL2 during the recording, or manually added by the user within the Data Explorer. Every Marker is displayed as a colored band in the Main chart.

Irrespective of how it was created, any Marker may be edited or deleted by the user.

Hint ***From Data Explorer v1.50 onwards, the Simplified Marker Calculations apply.***

A) Marker types

The NTi Data Explorer supports eleven different Marker types, which are by default labeled "Exclude" and "Marker 1...10". The name & color of each Marker type may be edited. Also, you can choose which Marker type(s) should be excluded from the result calculation. These settings may be edited in two different ways,

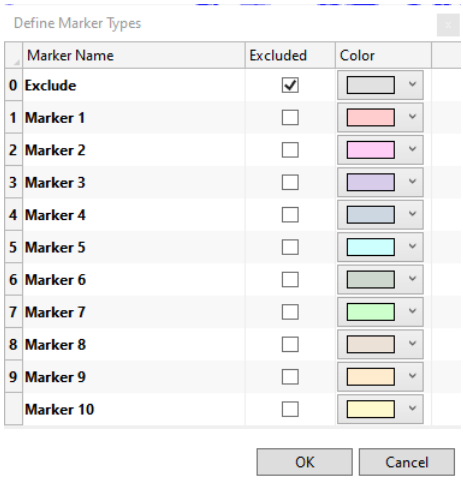
i. globally via the Preferences → amends the default settings,

ii. individually for each project → amendments apply only for the selected project.

Click on  to open the 'Define Marker Types' panel. The panel shows the 11 Marker types.

- Double left-click on any entry in the first column to edit the corresponding Marker Name (consequently the name of all Markers of this type in the Main chart or Result view will be amended).
- Tick the checkbox in the second column to exclude all Markers of this type from the level result calculation.
- Amend the color of any Marker type via the corresponding dropdown menu.

Hints ***The level data of an excluded Marker is <u>not</u> considered for the overall level result calculation.***
In the Main chart, every excluded Marker is identified by a "–" (minus) sign in front of its name.
If an excluded Marker overlaps with a standard (included) Marker, the overlapping part will be ignored (i.e. excluded).



Example of edited Marker types

B) Create a Marker

Markers can be created in three different ways,

i. Automatically by the XL2

ii. Manually via the Data Explorer

iii. Automatically via the Data Explorer

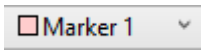
NOTE Proper creation of Markers is an essential prerequisite for the Rating Level calculations

i. Automatic XL2 Markers

If Markers were set by the XL2 unit during the recording, they are assigned and labeled as follows:

- Marker 4 → Pause: the XL2 recording had paused for a while
- Marker 5 → Lvl: the XL2 input level exceeded the user-defined threshold
- Marker 6..9 → Key 1...4: the operator pressed the XL2 Input Keypad during the recording
- Marker 10 → Error: a technical problem (e.g. SD-card overflow) occurred during the recording

ii. Manual Data Explorer Markers

1. Select the Marker type using the 

combo box, then click on the  button
   - or -
   press the corresponding number key 0...9 on the PC keyboard.

2. Create the Marker by selecting an area in the Main chart with left-click+drag.

Hints ***Overlapping Markers of different types are supported.***
Overlapping Markers of the same types are merged.

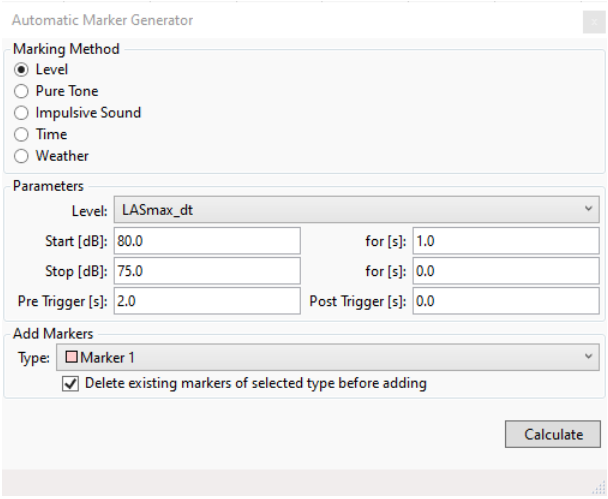
iii Automatic Data Explorer Markers

1. Click on the  button, or select the menu 'Markers → Automatic Marker Generator ...' to open the Automatic Marker Generator panel

2. Select the method, how the Marker(s) shall be generated,
   a) Level → if the sound level exceeds a user-defined threshold
   b) Pure Tone → identification of tones (a frequency band sticks out of the third Octave spectrum)
   c) Impulsive Sound → detection of short impulses
   d) Time → user-defined time periods

a) Level

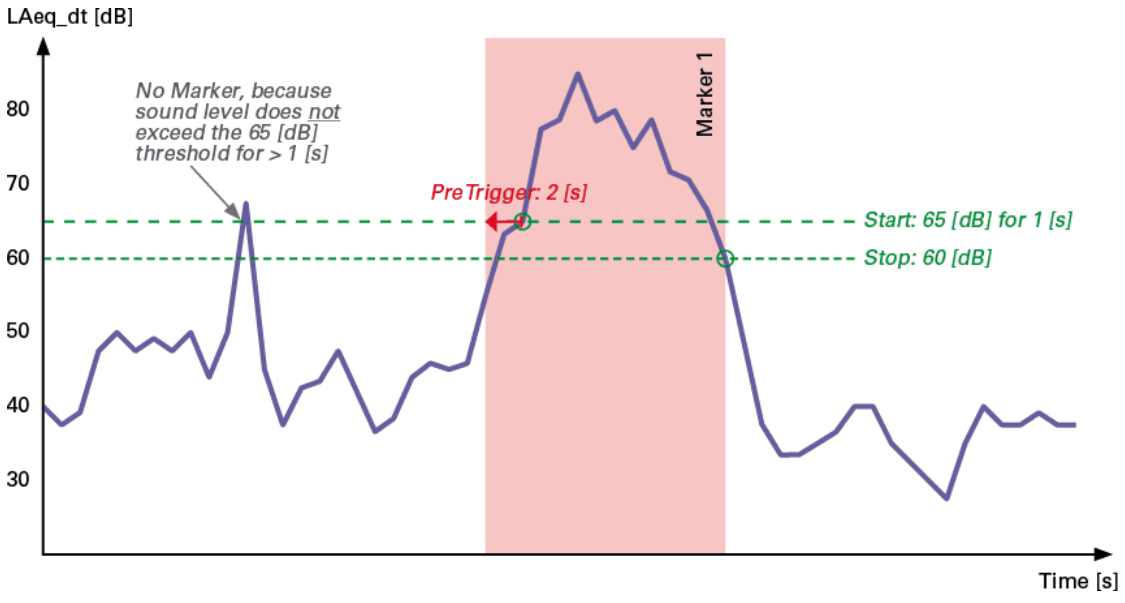
The Data Explorer automatically marks every section of the recorded sound level that exceeds the user-defined threshold.



Parameters

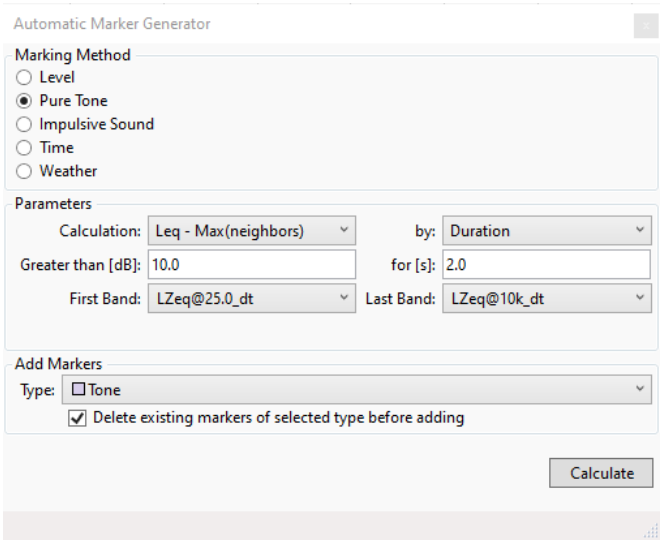
- Level → select the sound level, above which the automatic Level Markers shall be generated.
- Start [dB] / for [s] → threshold level that must be exceeded for at least the specified duration to generate a Marker at this point
- Stop [dB] / for [s] → the generated Marker ends as soon as the sound level falls below this threshold for at least the specified duration
- Pre Trigger [s] → the generated Marker starts the specified time earlier than the point where the 'Start' threshold specified above is exceeded
- Post Trigger [s] → the generated Marker ends the specified time later than the point where the sound level falls below the 'Stop' threshold specified above
- Add Markers Type → select the Marker type that shall be generated
- ☑ → tick this checkbox if you want that all previously-created Markers of the selected type be automatically deleted

Example



b) Pure Tone

The Data Explorer automatically marks every section of the recorded sound level, where the level in a band of the 1/1 or 1/3rd Octave spectrum (i.e. a tone) exceeds the level of the two neighboring bands by a user-defined minimum difference (⇒ identification of discrete-frequency spectral components).



Parameters

- Calculation → select the condition for the tone detection
    - Leq – Max (neighbors) → a tone is marked if its Leq exceeds the maximum levels of the two neighboring bands
    - Leq – Mean (neighbors) → a tone is marked if its Leq exceeds the mean levels of the two neighboring bands
    - ISO 1996-2:2017 (international), DIN 45645-1/-2 (Germany), BS 4142:2014 (Great Britain) or DM 16 marzo 1998 (Italy) → a tone is marked, if it meets the conditions proposed by the standard

  a) Duration → a tone is marked if it exceeds the minimum difference and lasts at least for the user-defined time period
    - Difference [dB] → minimum level difference between the tone level and the levels of the two neighboring bands
    - for [s] → minimum time period, for which the 'Difference' condition must be met

  b) Level Range → a tone is marked if its level difference to the neighbor bands is within the user-defined range
    - Difference [dB] → minimum level difference between the tone level and the levels of the two neighboring bands
    - to [dB] → maximum level difference between the tone level and the levels of the two neighboring bands
- First / Last Band → optional user-defined limitation of the frequency band, in which tones shall be marked
- Add Markers Type → select the Marker type that shall be generated
- ☑ → tick this checkbox if you want that all previously-created Markers of the selected type be automatically deleted

Hint ***The detected tones are listed in the Info section under 'Marker → Notes'***

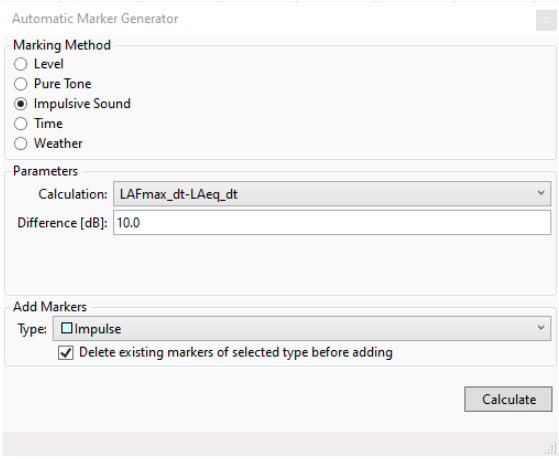
Examples

a) Level difference ≥ 10 dB, Duration ≥ 2 s

b) Level Range 20 to 40 dB

c) Impulsive Sound

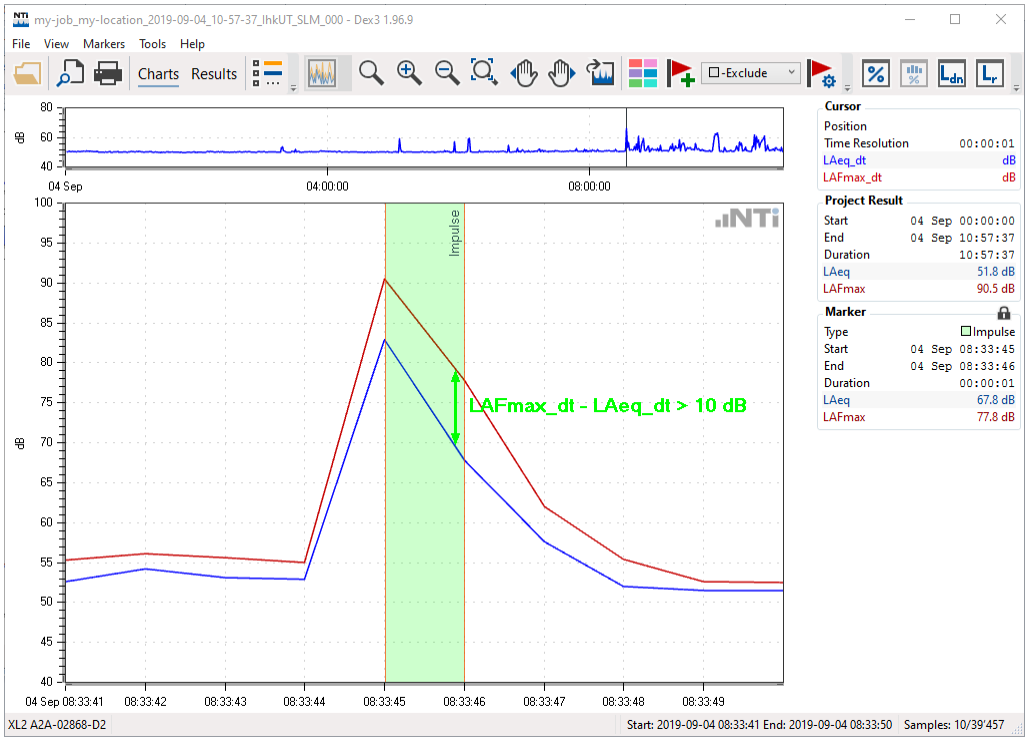
The Data Explorer automatically identifies & marks short impulsive sounds (⇒ identification of brief bursts of sound pressure, usually < 1 s).



Parameters

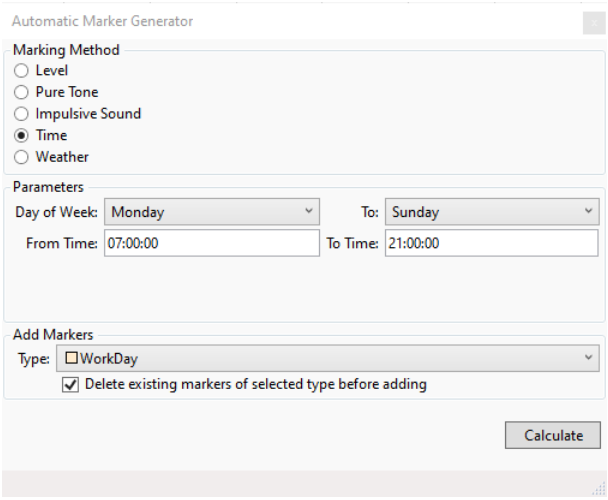
- Calculation → select the sound level, for which the automatic Impulsive Sound Markers shall be generated
  - LAFmax_dt-LAeq_dt
  - LAImax_dt-LAFmax_dt
  - LAImax_dt-LASmax_dt
  - DM 16 marzo 1998
- Difference [dB] → threshold level that must be exceeded to generate a Marker at this point
- Add Markers Type → select the Marker type that shall be generated
- ☑ → tick this checkbox if all previously-created Markers of the selected type be shall be automatically deleted

Example



d) Time

The Data Explorer marks user-defined time slots.

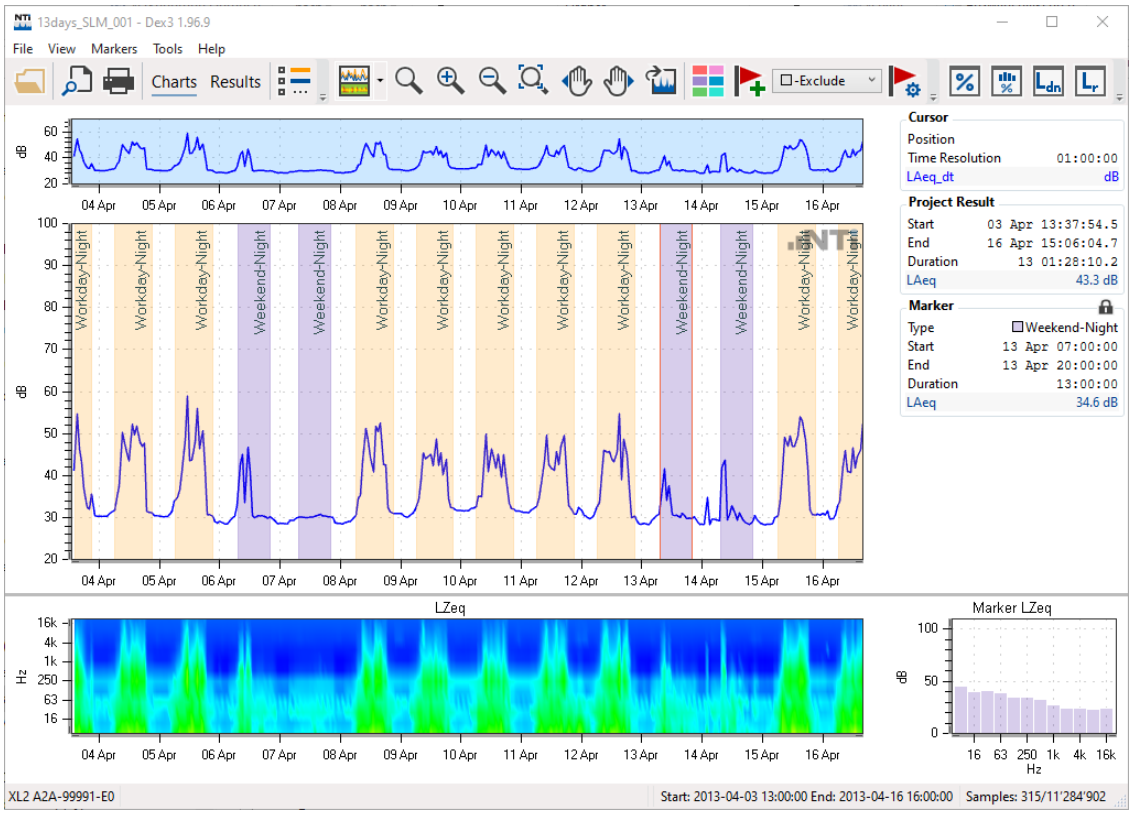


Parameters

- Day of Week / To → select the day(s), when the Marker(s) shall be generated
- From Time / To Time → the start & stop times of the Marker per day (*e.g. Monday 07:00 to 21:00, Tuesday 07:00 to 21:00, …*)
- Add Markers Type → select the Marker type that shall be generated
- ☑ → tick this checkbox if you want that all previously-created Markers of the selected type be automatically deleted

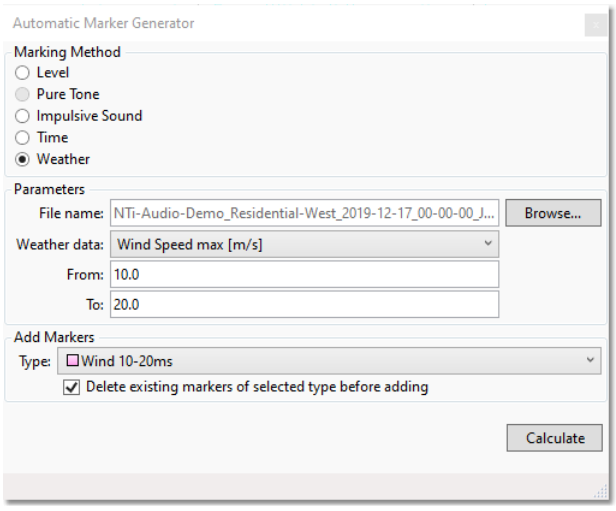
Hint ***If you want to mark separate time slots per day, you have to generate these Markers one by one.***

Example



e) Weather

If the project contains weather data, you may create automatic Markers.



Parameters

- File name / Browse → enter the file path & name of the weather data file, or click on Browse... to select the requested file

NOTE The weather data file must be formatted appropriately.

- Weather data → select any of the recorded weather data (*e.g. Wind Speed, Wind Direction, Air temperature, Relative Humidity, Air pressure, Rain intensity, …*)
- From / To → the weather data range, wherein a Marker shall be generated (*e.g. Wind Speed average 10 to 20 m/s, Rain intensity 3 to 5 mm/h, …*)
- Add Markers Type → select the Marker type that shall be generated
- ☑ → tick this checkbox if you want that all previously-created Markers of the selected type be automatically deleted

C) Edit a Marker

The type, the start/end points or the duration of any Marker can be edited, regardless whether it has been imported from an XL2 test, or created in the Data Explorer software.

Right-click on the Marker (or Marker name) in the Main chart and select 'Edit', then

- amend the Marker Type, Start, End or Duration in the Info section, or
- click on the left or right edge of the Marker band and manually adjust it with the ↔ cursor, or
- click on the Marker band and pan it with the ⟺ cursor, or
- edit a note (i.e. comment) to the Marker via the Info section

Click on 'OK' in the Info section to confirm or on 'Cancel' to abandon your changes.

Hint ***If two or more Markers of the same type are overlapping, they will be merged***

D) Export / Import of Markers

You can export the Markers from a project and import them into another project. This feature allows you to compare, for example, the marked incidents between two measurements that have been recorded at the same time.

- Select the menu "Markers → Export Markers..." or "Markers → Import Markers... ", respectively.
- Select the memory location of the *.XML file and confirm.

Hints ***The exported *.XML file contains the Markers of the project, their individual time stamps and Marker types.***
During import, only the Markers that fit into the recording period are considered.

It is also possible to export the Marker *Types* from a project, and import this set to another project. This allows you to share the Marker names among different PCs.

- Click on the  button to open the 'Define Marker Types' panel.
- Right-click on the panel, select the menu "Export Marker Types..." or "Import Marker Types...", respectively, and confirm.

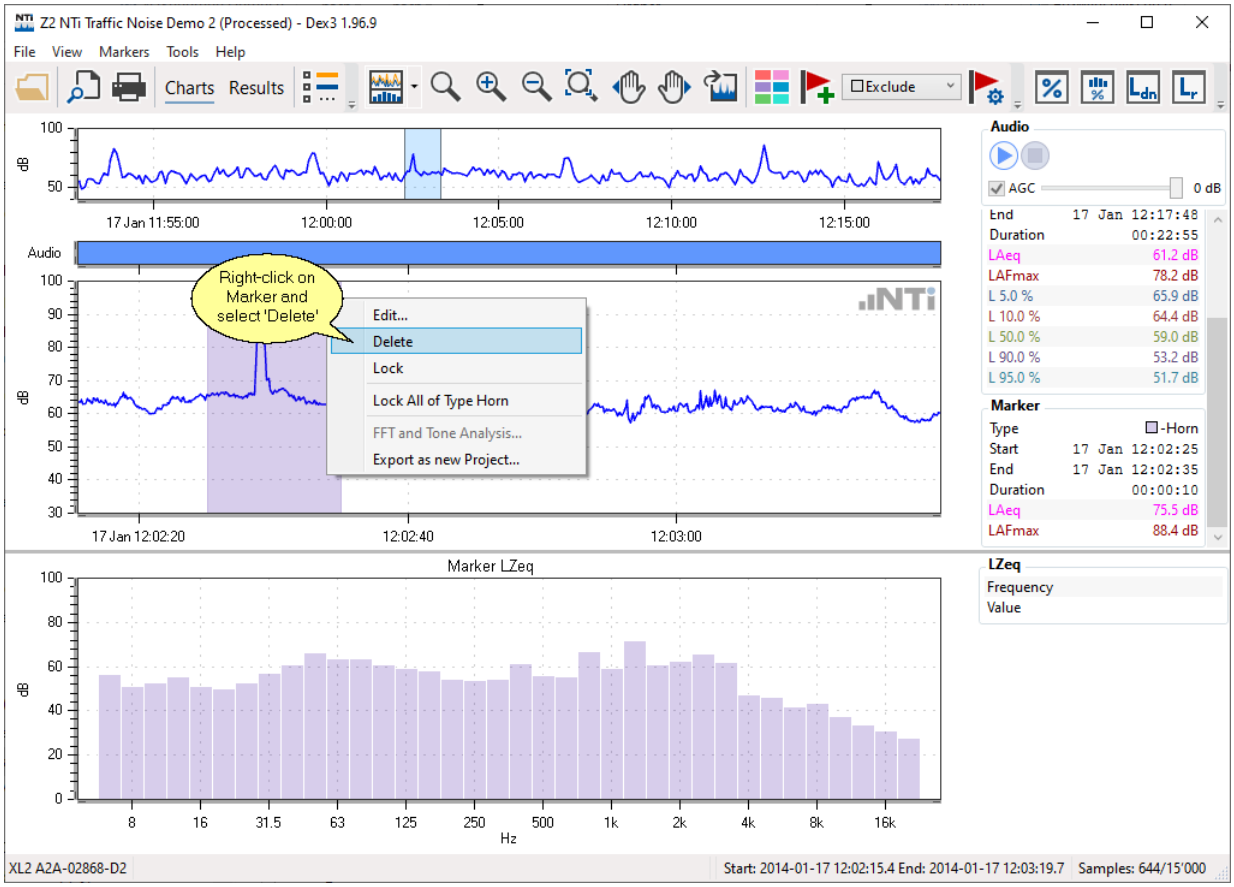
E) Delete a Marker

There are two ways to remove Markers.

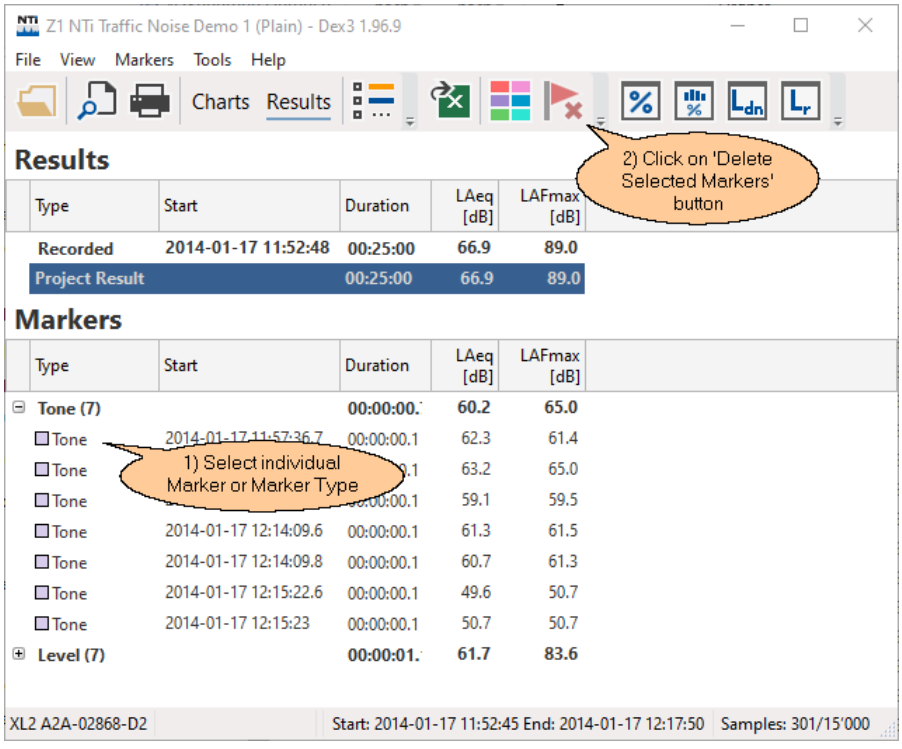
i. In the Main chart
   - Right-click on a Marker and select 'Marker → Delete', or
   - Right-click on the Marker name and select 'Delete', or

ii. In the Result view
   - Left-click on a single or several Markers and click on  or
   - Select several Markers using Shift + left-click or Ctrl + left-click and click on  or
   - Select a Marker type (⇒ all Markers of that type) and click on 

Examples



Delete Marker in Main chart



Delete Marker in Result view

F) Marker Spectrum

You may either display the Spectrum of a specific Marker, or of all Markers of the same type.

a) Spectrum of a specific Marker
   i. Right-click on the Marker name and select 'Lock'
   ii. Right-click on the Marker area and select 'Marker → Lock'

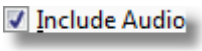
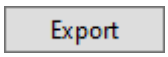
b) Spectrum of all Markers of the same type
   i. Right-click on the Marker name and select 'Lock All of Type [*MarkerName*]'
   ii. Right-click on the Marker area and select 'Marker → Lock All of Type [*MarkerName*]'

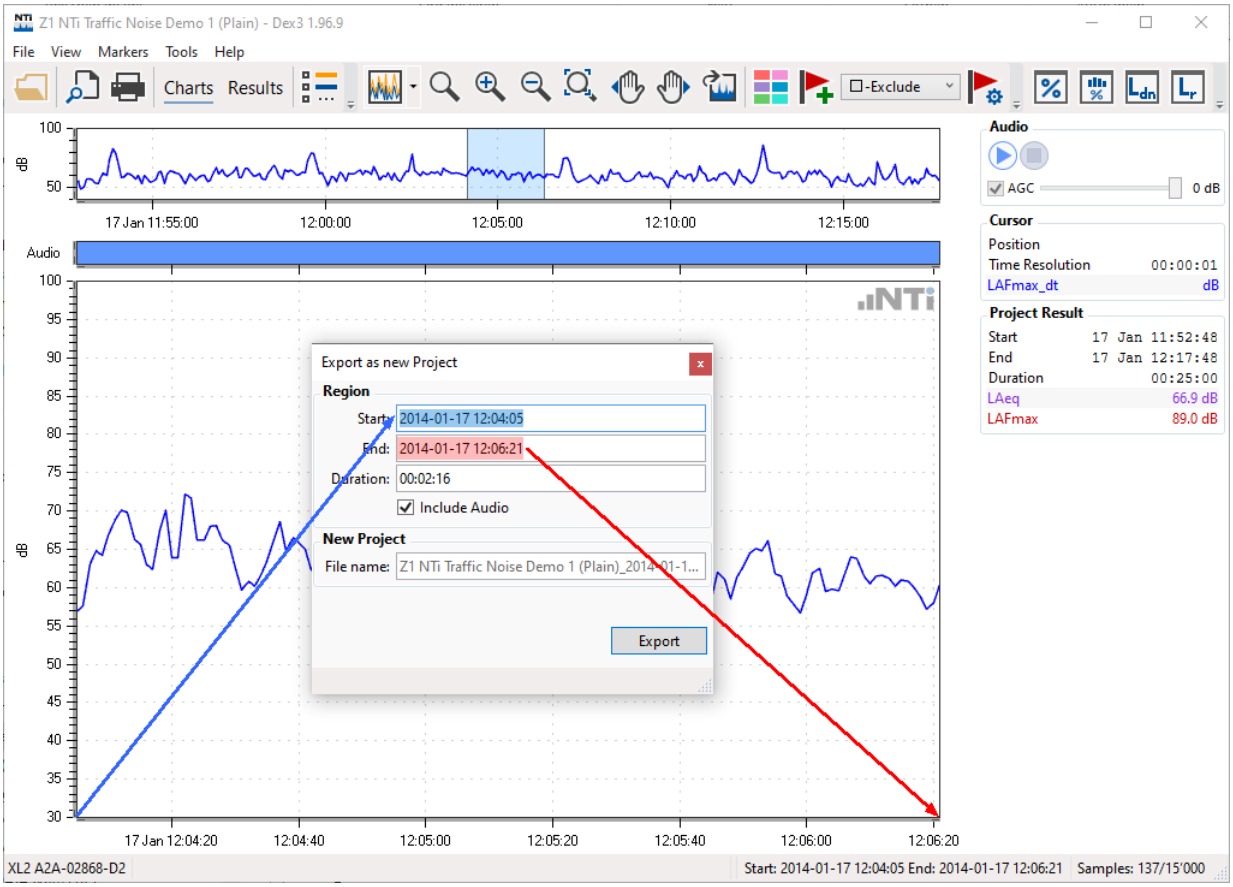
3.10 Export subset to project

The NTi Data Explorer allows you to export a subset of the recorded data (i.e. level results, Markers and audio recording) to a new project.

Thus you may, for example, take the sound file of a specific event, or the relevant part of a longer recording, and make it available to your customer.

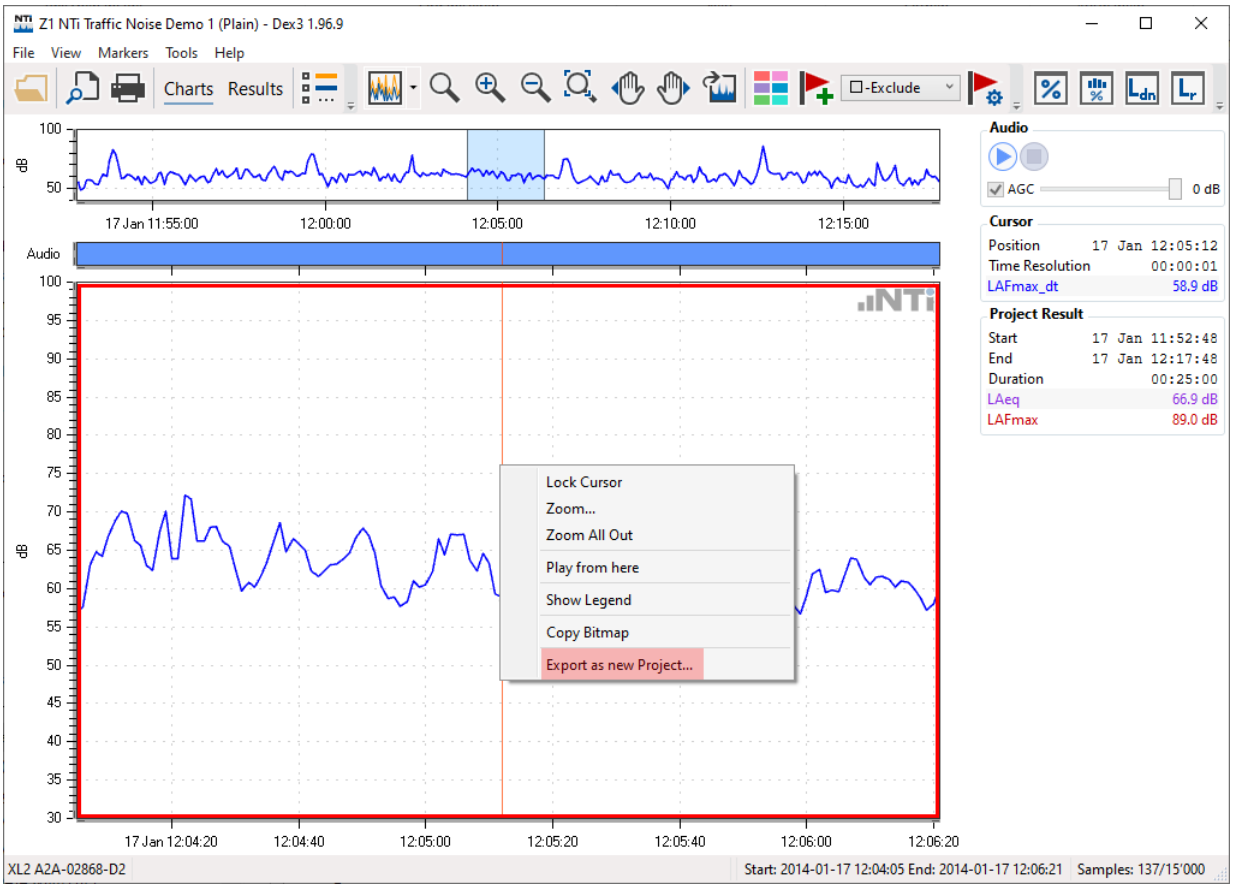
A) Zoom in & Export

1. Zoom in to the interval that you want to export.
2. Click on the  button to open the 'Export as new Project' window; you may now optionally
   - amend the Start or End time, or the duration,
   - tick or clear the checkbox  to include or exclude the audio recording,
   - edit the File name of the new project.
4. Click on  to complete the project export.



Export user-defined time interval to new project

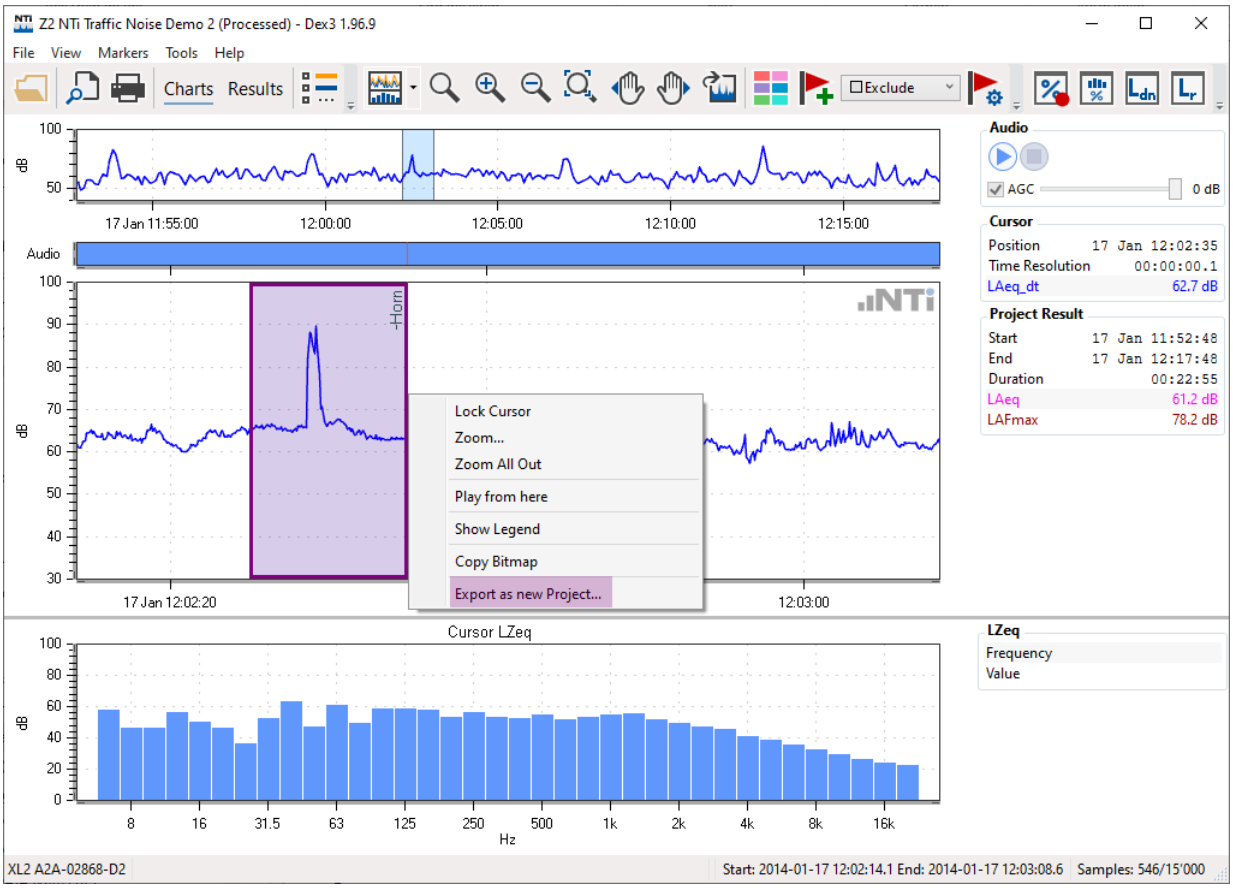
Hint ***Alternatively you can right-click on the Main chart and select the menu "Export as new Project...".***



Export zoom interval to new project

B) Export a Marker

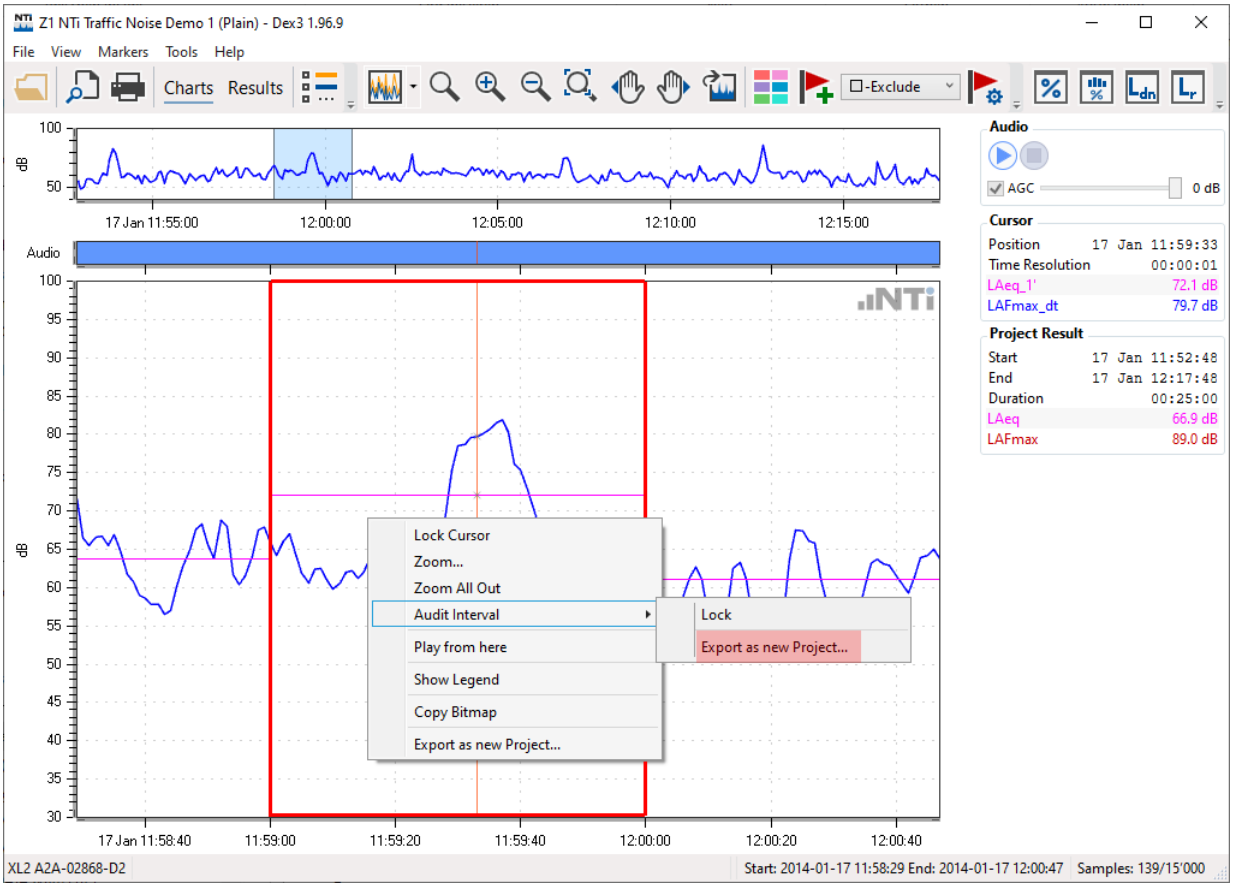
Right-click on a Marker and select the menu "Export as new Project...".



Export Marker to new project

C) Export an Audit Interval

Right-click on an audit interval and select the menu "Audit Interval → Export as new Project...".



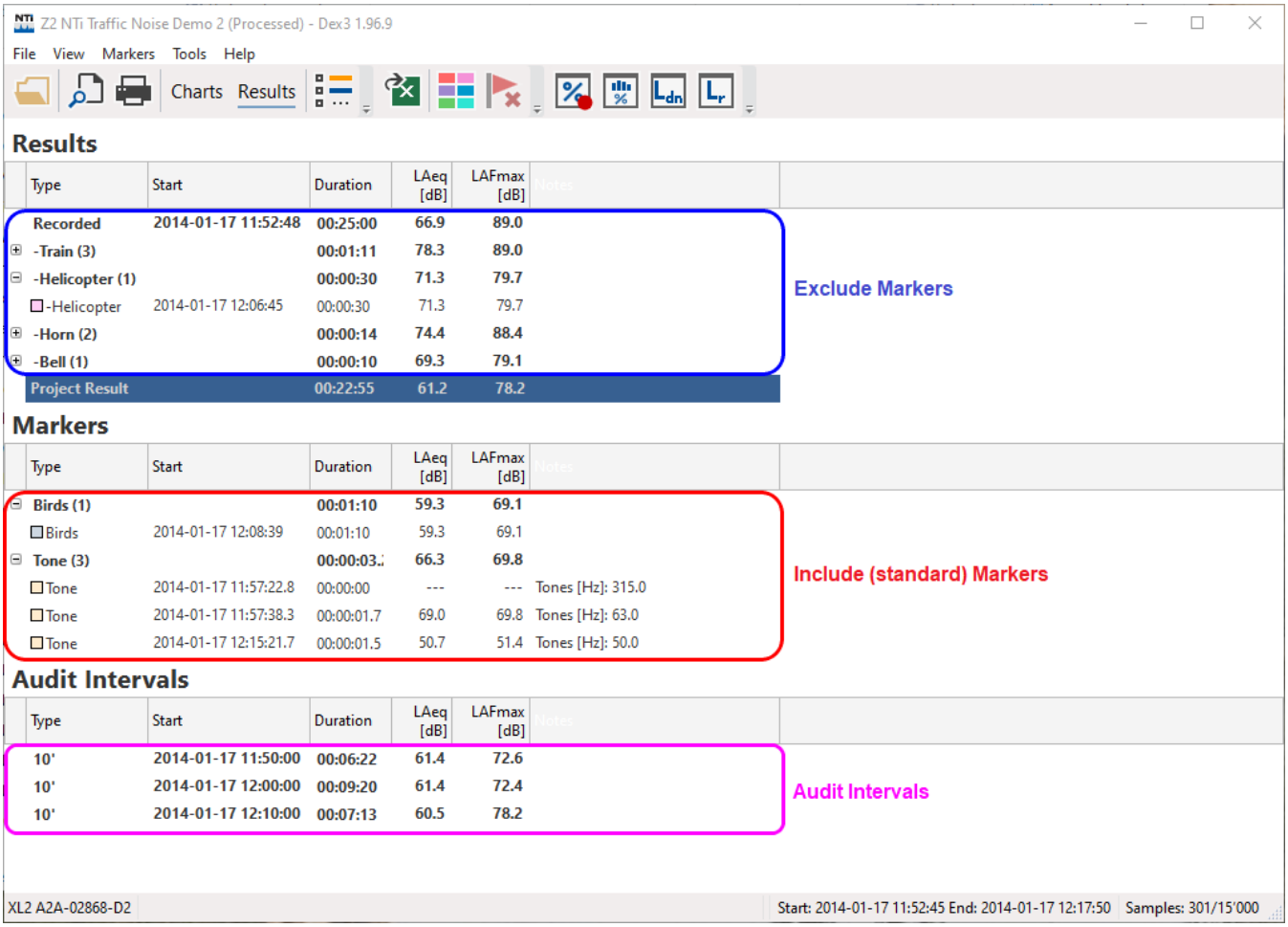
Export audit interval to new project

Part IV

4 Result view

The Result view summarizes the numerical results of the selected levels in a table.

Hint ***Click on***  ***to select the level results that are displayed in the columns. Notice that the Result view does not display dt values.***



Example of Result view

Structure

The Result view is vertically divided in two sections, Project Results and Markers.

a) Project Results

1. **Recorded**: the overall level results including the data of all Markers.
2. Every Marker with a "–" sign in front of its name is excluded from the Result and shown separately
3. **Result** (highlighted row): the overall level results without considering the data of the excluded Markers.

b) Markers

The individual results of all remaining Markers (i.e. no excluded Markers)

c) Audit Intervals

The individual results of all Audit Intervals

Features

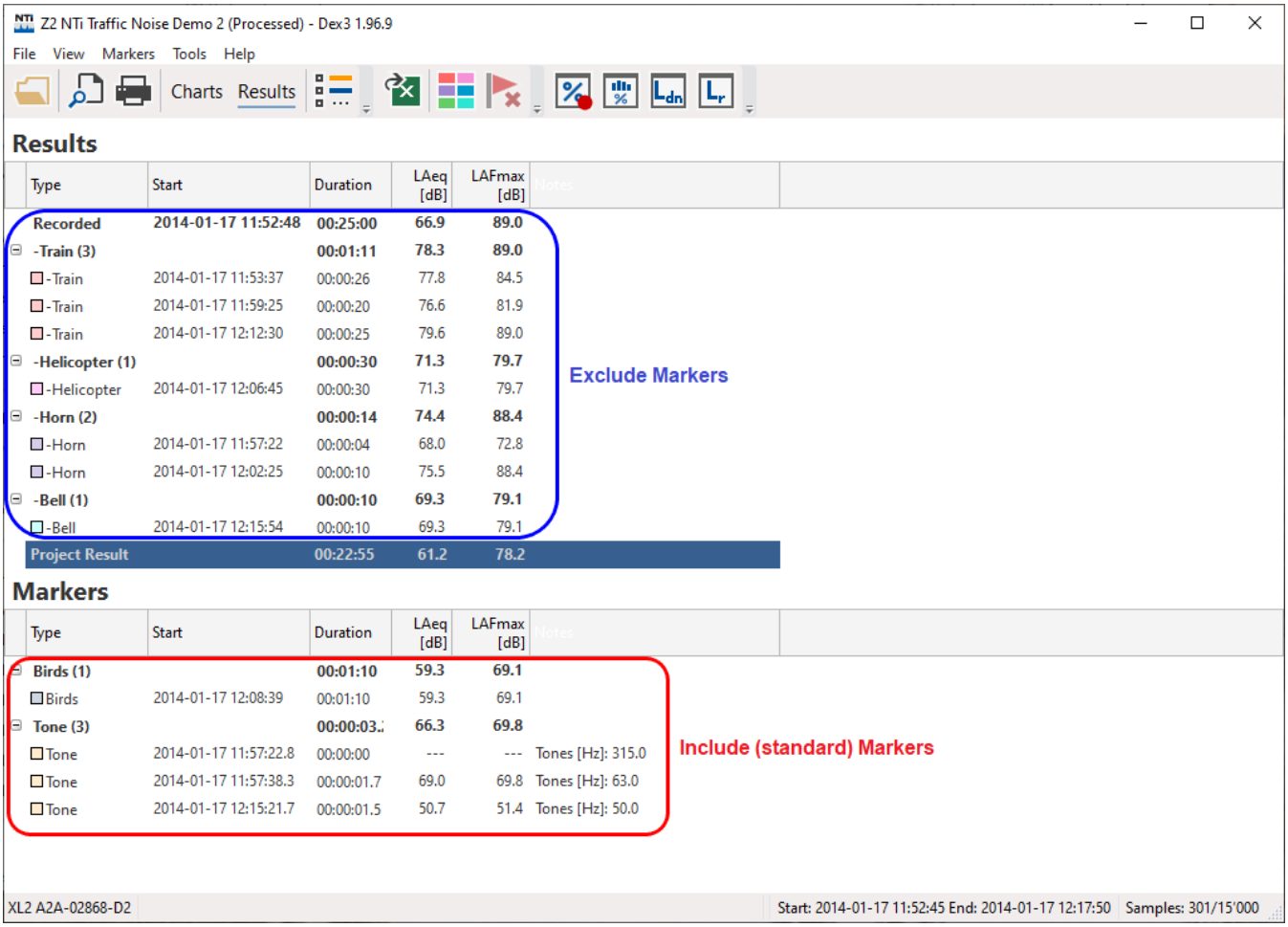
The following operations are supported in the Result view.

- Select the levels that are displayed.
- Click on ⊞ or ⊟ to expand or collapse Markers.
- Right-click to the Result view and select
  - 'Expand All' or 'Collapse All' (applies to all Marker categories),
  - 'Date and Time Format' to adjust the format of the 'Start' column to your demands.
- Double click on a Marker or an Audit Interval to open the Chart view, with the zoom range at the selected Marker position / Audit Interval, respectively.
- Delete a selected Marker if necessary.
- Click on  to export the formatted table to an MS Excel file.
- Open the Level statistics calculation
- Open the Day Night Level calculation.

Hint ***All settings are saved in the Project, i.e. the Result view layout will re-open in its last state when the project is opened again.***

4.1 Markers (in Result view)

The Result view shows the Marker Types, number of Markers per type, Start Date & Time, Duration, the measured level(s) within the corresponding Marker and Notes (optional).



Example of Markers in the Result view

Hint ***The impact of including/excluding a Marker in/from the result calculation can be directly visualized via the 'Define Marker Types' panel.***

Please notice that

- Markers can only be edited in the Main chart
- you may nevertheless delete the Marker(s) in the Result view by using the  button
- if you double-click on a Marker line, the software automatically toggles to the Chart view and displays the corresponding section

Hint ***Right-clicking in the Result view opens a context menu to***
- ***expand or collapse all Markers,***
- ***show or hide the notes***
- ***copy the selected row to the clipboard.***

Hint ***The individual Spectrum Math Level per Marker is calculated by summing up the related band levels (refer to blue example below).***
The overall minimum Spectrum Math Level is calculated by summing up the minimum levels per band (refer to red example below).

Markers

Type	Start Date and Time	Duration	LZFmin@6.3 [dB]		LZFmin@8.0 [dB]		LZFmin@10.0 [dB]		LZFmin@Σ6.3..10.0 [dB]
Marker 1 (4)		**00:00:11**	**37.9**	+	**35.3**	+	**33.8**	=	**40.8**
Marker 1	2018-07-26 16:51:20	00:00:03	39.3		36.6		33.8		41.9
Marker 1	2018-07-26 16:51:24	00:00:03	42.0	+	37.2	+	45.9	=	47.8
Marker 1	2018-07-26 16:51:28	00:00:02	43.6		40.3		38.2		46.0
Marker 1	2018-07-26 16:51:31	00:00:03	37.9		35.3		41.3		43.6
Marker 3 (1)		**00:00:03**	**39.3**		**36.6**		**33.8**		**41.9**

Example of sum level calculation

4.2 Audit Intervals (in Result view)

The Result view shows the Type, Start Date, Duration and the measured level(s) within the corresponding Audit Interval.

Audit Intervals

Type	Start Date	Duration	LAeq [dB]	LAFmax [dB]	LZeq [dB]
5'	2014-01-17 11:50:00	00:01:46	58.2	65.2	69.6
5'	2014-01-17 11:55:00	00:04:36	62.2	72.6	75.3
5'	2014-01-17 12:00:00	00:04:50	62.5	72.4	72.2
5'	2014-01-17 12:05:00	00:00:00	---	---	---
5'	2014-01-17 12:10:00	00:04:35	60.9	73.4	73.0
5'	2014-01-17 12:15:00	00:02:38	59.7	78.2	69.4

Example of Audit Intervals in the Result view

Hint ***If an Audit Interval is completely covered by an 'Exclude' Marker, it shows no results.***

Please note that

- the duration of the Audit Intervals must be selected via the Setup Levels
- if you double-click on an Audit Interval line, the software automatically toggles to the Chart view, displays the corresponding section and locks the cursor to it.

Part V

5 Level Calculations

The NTi Data Explorer offers three tools for customized level calculations,

i. the Level statistics, Spectrum statistics or percentiles are accessible via the  and  buttons,

ii. the Day Night level window is opened by clicking on the  button.

iii. click on the  button to definite the Penalties or calculate the Rating Levels.

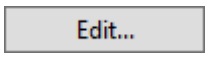
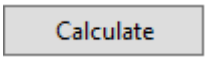
5.1 Statistics

The Data Explorer supports the calculation of

- Level statistics
- Spectrum statistics

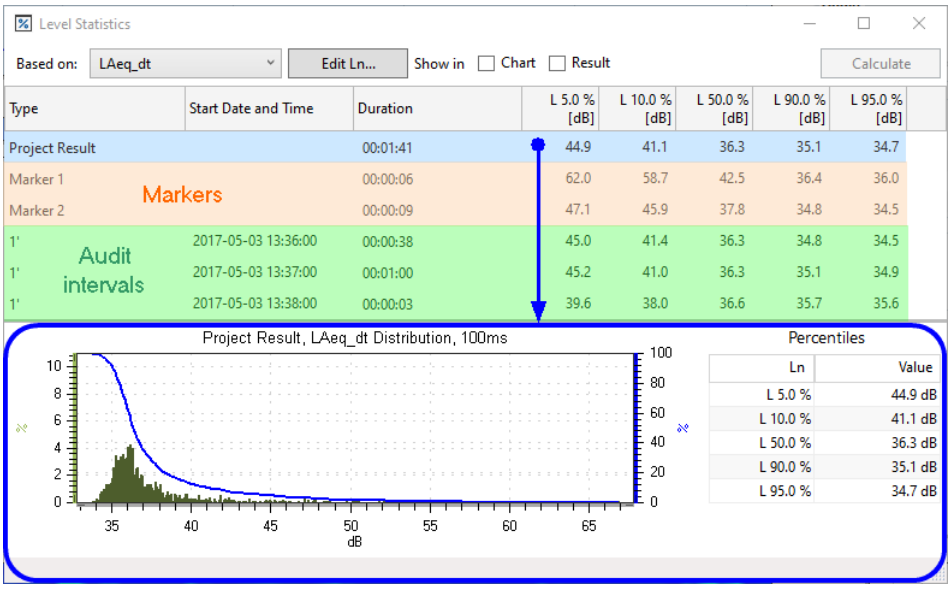
5.1.1 Level statistics

Clicking on  opens the 'Level Statistics' window. Therein, you may calculate the statistical distribution of single levels and display them in a numerical table and graphically.

1. Select the Level of interest (e.g. ).
2. Optionally click on  to open the 'Edit percentiles' panel.
3. Optionally tick one or both checkboxes  (→ *refer to explanation below*).
4. Click on  to initiate the statistical calculation.

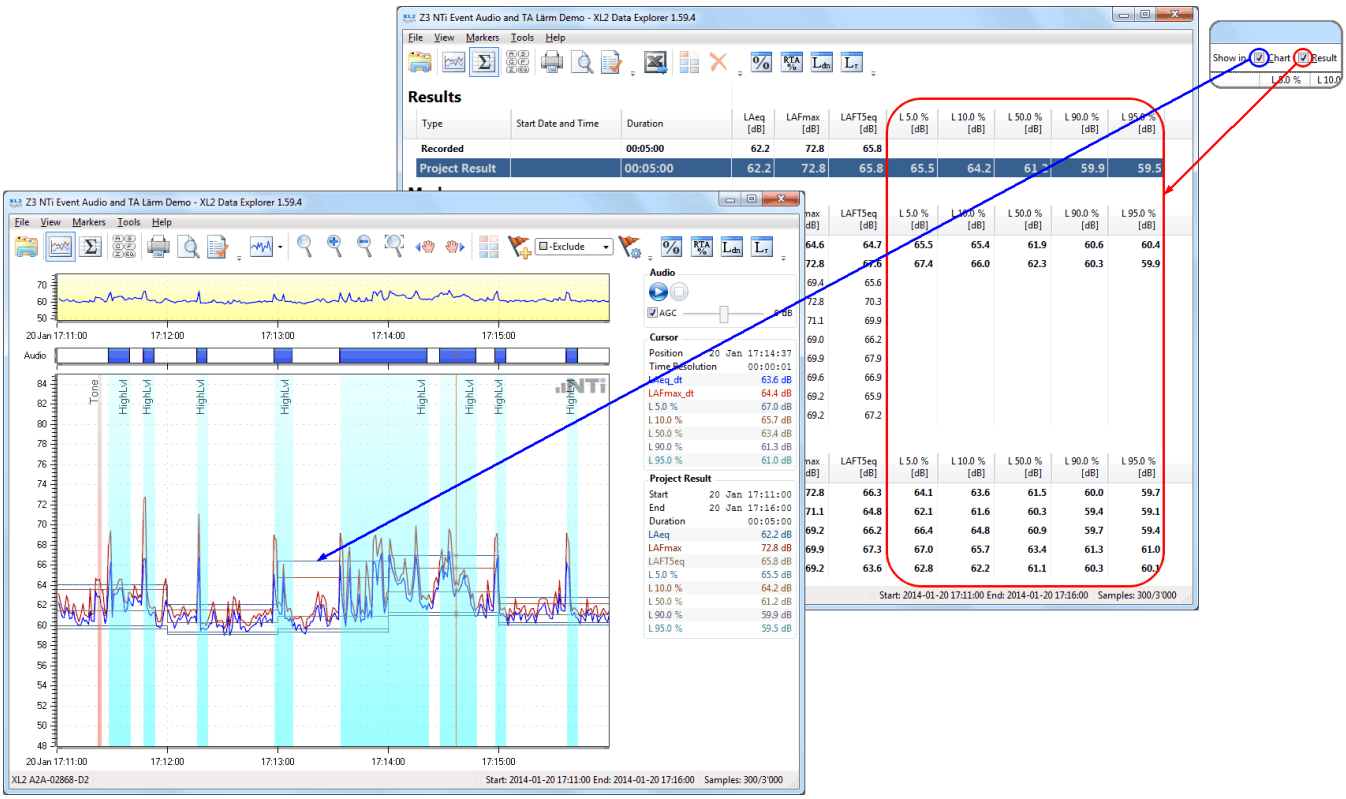
The Level Statistics window consequently shows the selected percentiles in a numerical table and a graph.

- Project Result (i.e. selected level)
- Markers (if applicable)
- Audit intervals (if applicable).



Level Statistics window

- The graph shows the individual and the cumulative probability for the selected row (i.e. of the Project Result, of a Marker or of an Audit interval); hover over the graph to read out the individual results.
- Tick the 'Chart' / 'Result' checkbox and close the Level Statistics window ⇒ the percentiles will be shown in the Chart / Result view (*Hint: the 'Chart' checkbox is only available if an Audit Interval has been activated*).



Tick checkboxes to view the percentile results in the Chart, Result view

Hint ***If the 'Level Statistics' button shows a red warning***  ***the level statistics have to be re-calculated. This happens e.g. if a marker is added or edited, or if the audit interval is changed. Thus, the calculated statistics will get invalid and disappear in the Result view, until they are re-calculated.***

- To copy and export the percentile data, right click on the numerical table or the graph and select between
  - "Copy All Rows" → copies the percentile data (Project Result, Markers and Audit intervals) to the clipboard
  - "Export to Excel..." → opens a new MS Excel file with all percentile data
  - "Copy Bitmap" → copies the graph as bitmap to the clipboard
  - "Copy Data" → copies the numerical probability data to the clipboard
- To zoom the graph,
  - click & drag to select an area of the graph that shall be enlarged
  - right click on the graph, select 'Zoom...' and manually enter the preferred Min.X, Max.X, Max.Y values
  - right click on the graph and select 'Zoom All Out' to return to the full view

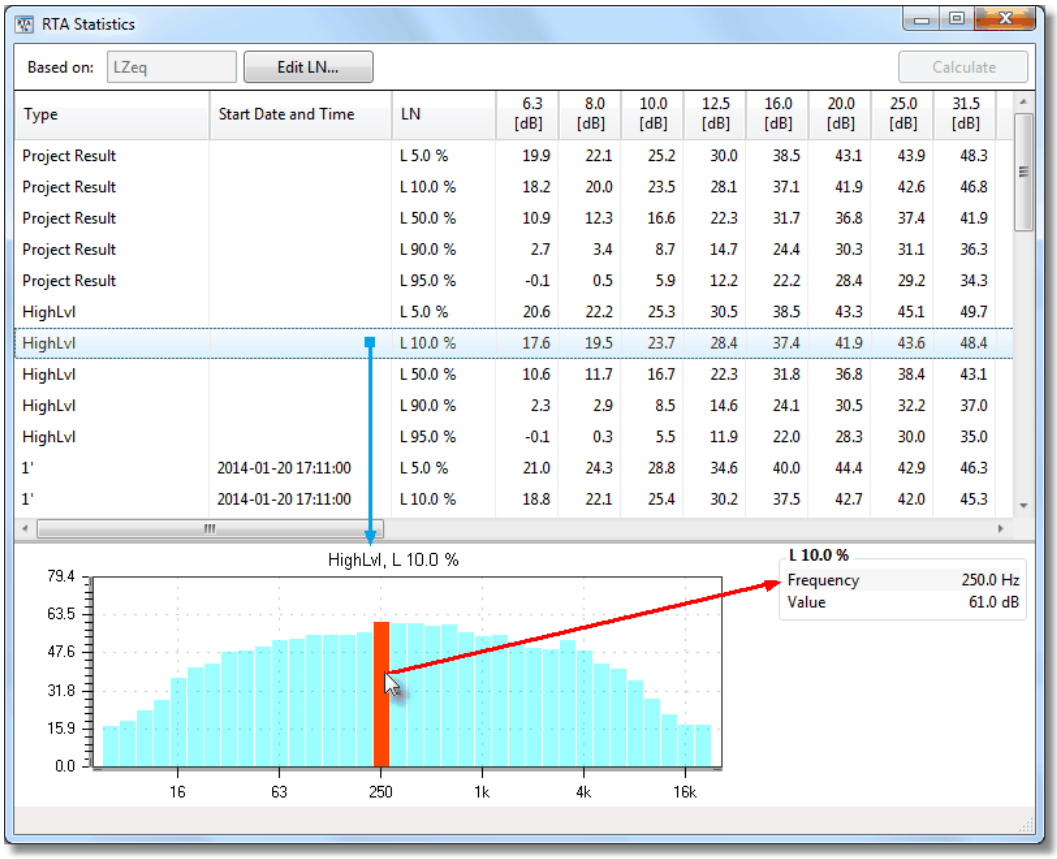
5.1.2 Spectrum statistics

Clicking on  opens the 'Spectrum Statistics' window. Therein, you may calculate the statistical distribution of all the Spectrum levels and display them in a numerical table and graphically.

1. Optionally click on Edit... to open the 'Edit percentiles' panel.
2. Click on Calculate to initiate the statistical calculation.

The Spectrum Statistics window consequently shows the selected percentiles in a numerical table and a graph.

- Project Result (i.e. selected level)
- Markers (if applicable)
- Audit intervals (if applicable).



Spectrum Statistics window

To copy and export the percentile data, right click on the numerical table or the graph and select between

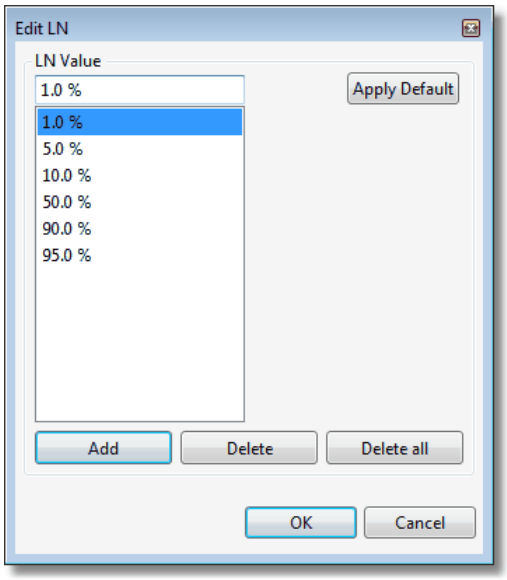
- "Copy All Rows" → copies the percentile data (Project Result, Markers and Audit intervals) to the clipboard
- "Export to Excel..." → opens a new MS Excel file with all percentile data
- "Copy Bitmap" → copies the graph as bitmap to the clipboard
- "Copy Data" → copies the actual percentiles per band to the clipboard

Hint ***After exporting / pasting the result data to MS Excel, you may sort the table e.g. by the 'Type' or 'LN' according to your demands.***

5.1.3 Percentiles

The list of LN values for the percentiles calculation can be edited as follows.

- Enter a numerical LN value in the top input box and click on 'Add'.
- Select an LN value from the list and click on 'Delete', or 'Delete All'.
- Click on 'Apply Default' to apply the default values (→ preferences).

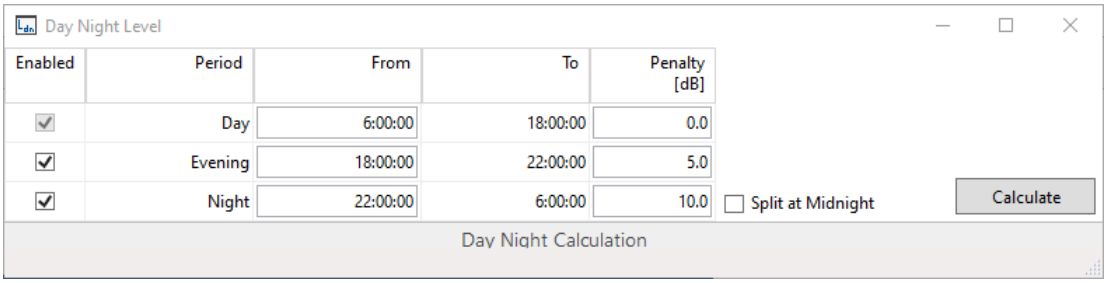


Edit percentiles panel

Hint ***The default list of LN values may be defined via the preferences. XL2 or XL3 Test files that have been previously imported, may be adjusted by clicking on the 'Apply Default' button.***

5.2 Day Night Level

The 'Day Night Level' window calculates the L_{Day}, $L_{Evening}$, L_{Night}, L_{DN}, L_{DEN} levels with individual weightings (penalties).



Example of Day-Evening-Night time scheme with penalties

Time scheme and penalties

The top section of the window comprises of the parameter settings for the time scheme and penalties.

- Enabled, Period: each 24 hour period can be divided into between 1 and 3 periods,
  1) Day → always enabled
  2) Night → tick checkbox to enable a separate result calculation or penalty for the night period
  3) Evening → tick checkbox to enable a separate result calculation or penalty for the evening period (only accessible if 'Night' is enabled)
- From, To: assign individual start times to the enabled periods
  - Adjust the times for when the individual enabled periods begin.
  - The end time of a period is automatically the start time of the next period.
  - Enter the times in the format **hh:mm:ss**
- Penalty: positive or negative offset that should be added to or withdrawn from the measurement results to reflect the annoyance level during that period.
  - Enter the penalties, expressed in dB, for the Day, Evening and Night periods separately.
- Split at Midnight: the Night level is calculated separately for each calendar day (*see example*), i.e. split by
  1) 00:00:00 hrs to start of Day +
  2) end of Day/Evening to 24:00:00 hrs

Hint ***The default list of Day Night Levels may be defined via the preferences. XL2 or XL3 Test files that have been previously imported, may be adjusted by right-clicking on the top section of the window and selecting 'Apply Default'.***

Click on Calculate to let the system evaluate & display the level results that correspond to the current settings.

NOTE **If no valid measurement could be executed, the message "n. def." (not defined) is shown as result.**

5.2.1 LDEN examples

Example #1

Day Night Level

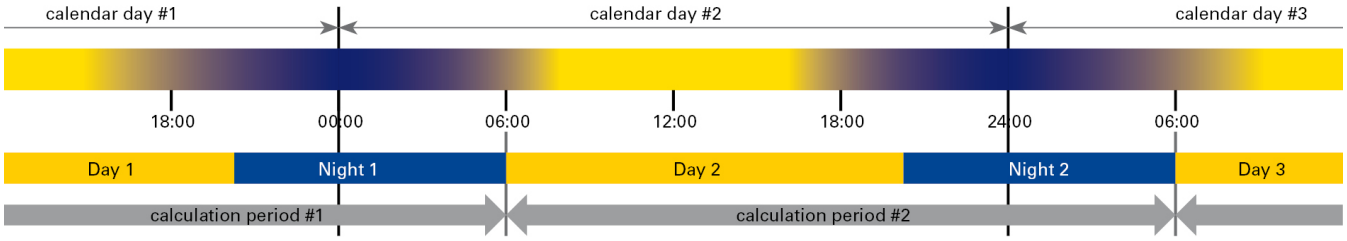
Enabled	Period	From	To	Penalty [dB]
☑	Day	6:00:00	22:00:00	0.0
☐	Evening	18:00:00	22:00:00	5.0
☑	Night	22:00:00	6:00:00	10.0

☐ Split at Midnight Calculate

Day Night Calculation

Period	Start Date	Measurement Duration	Weighting Duration	LAeq [dB]	Penalty [dB]	Result [dB]
Day	03 Apr	08:22:05.5	16:00:00	46.5	0.0	46.5
Night	03 Apr	08:00:00.0	08:00:00	30.7	10.0	40.7
Ldn	**03 Apr**					**45.3**
Day	04 Apr	16:00:00.0	16:00:00	47.1	0.0	47.1
Night	04 Apr	08:00:00.0	08:00:00	31.1	10.0	41.1
Ldn	**04 Apr**					**45.8**
Day	05 Apr	16:00:00.0	16:00:00	49.8	0.0	49.8
Night	05 Apr	08:00:00.0	08:00:00	29.2	10.0	39.2
Ldn	**05 Apr**					**48.3**

Example #1: Day-Night time settings, penalties and calculated results



Example #1: Day-Night time scheme

Example #2

Day Night Level

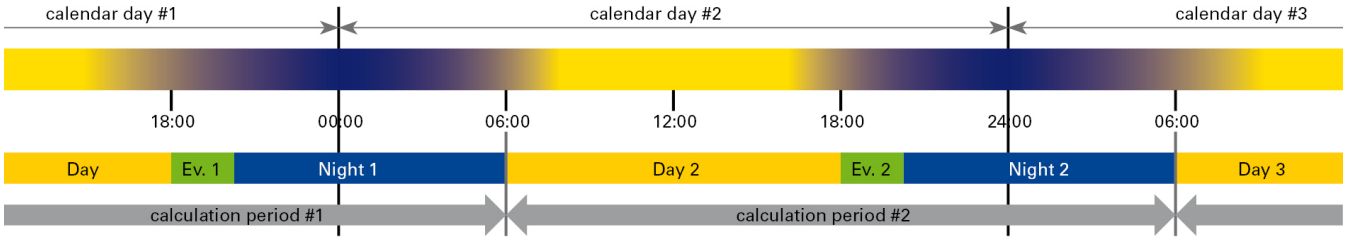
Enabled	Period	From	To	Penalty [dB]
☑	Day	6:00:00	18:00:00	0.0
☑	Evening	18:00:00	20:00:00	5.0
☑	Night	20:00:00	6:00:00	10.0

☐ Split at Midnight Calculate

Day Night Calculation

Period	Start Date	Measurement Duration	Weighting Duration	LAeq [dB]	Penalty [dB]	Result [dB]
Day	03 Apr	04:22:05.5	12:00:00	49.2	0.0	49.2
Evening	03 Apr	02:00:00.0	02:00:00	32.2	5.0	37.2
Night	03 Apr	10:00:00.0	10:00:00	31.5	10.0	41.5
Lden	**03 Apr**					**46.8**
Day	04 Apr	12:00:00.0	12:00:00	48.3	0.0	48.3
Evening	04 Apr	02:00:00.0	02:00:00	31.3	5.0	36.3
Night	04 Apr	10:00:00.0	10:00:00	31.1	10.0	41.1
Lden	**04 Apr**					**45.9**
Day	05 Apr	12:00:00.0	12:00:00	51.1	0.0	51.1
Evening	05 Apr	02:00:00.0	02:00:00	30.7	5.0	35.7
Night	05 Apr	10:00:00.0	10:00:00	29.3	10.0	39.3
Lden	**05 Apr**					**48.3**

Example #2: Day-Evening-Night time settings, penalties and calculated results



Example #2: Day-Evening-Night time scheme

Example #3

Day Night Level

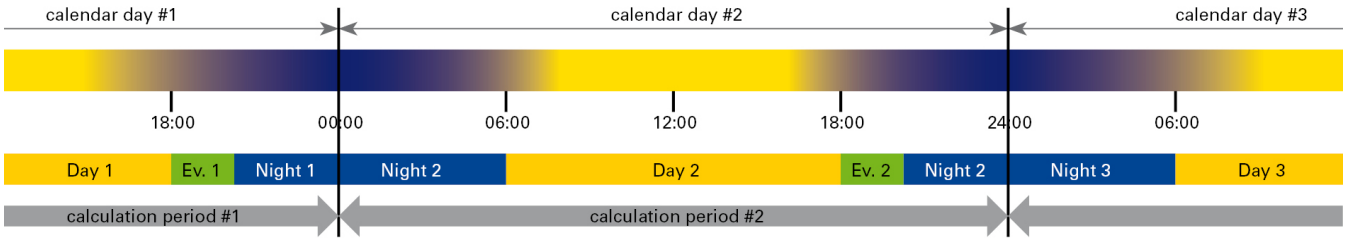
Enabled	Period	From	To	Penalty [dB]
☑	Night	0:00:00	6:00:00	10.0
☑	Day	6:00:00	18:00:00	0.0
☑	Evening	18:00:00	20:00:00	5.0
☑	Night	20:00:00	0:00:00	10.0

☑ Split at Midnight Calculate

Day Night Calculation

Period	Start Date	Measurement Duration	Weighting Duration	LAeq [dB]	Penalty [dB]	Result [dB]
Day	03 Apr	04:22:05.5	12:00:00	49.2	0.0	49.2
Evening	03 Apr	02:00:00.0	02:00:00	32.2	5.0	37.2
Night	03 Apr	04:00:00.0	10:00:00	32.3	10.0	42.3
Lden	**03 Apr**					**46.9**
Day	04 Apr	12:00:00.0	12:00:00	48.3	0.0	48.3
Evening	04 Apr	02:00:00.0	02:00:00	31.3	5.0	36.3
Night	04 Apr	10:00:00.0	10:00:00	30.7	10.0	40.7
Lden	**04 Apr**					**45.9**
Day	05 Apr	12:00:00.0	12:00:00	51.1	0.0	51.1
Evening	05 Apr	02:00:00.0	02:00:00	30.7	5.0	35.7
Night	05 Apr	10:00:00.0	10:00:00	30.6	10.0	40.6
Lden	**05 Apr**					**48.4**

Example #3: Day-Evening-Night time settings, split at midnight, penalties and calculated results



Example #3: Day-Evening-Night time scheme, split at midnight

5.3 Rating Level

The rating level Lr is calculated according to the formula

Lr = LAeq + Ki + Kt + Kr + Ks

whereby

- LAeq: measured sound level
- Ki: adjustment for impulsiveness (→ *refer to Impulse analysis*)
- Kt: adjustment for tones / information content (→ *refer to Third Octave Tone analysis and FFT and Tone analysis*)
- Kr: adjustment for the time of the day (→ *refer to Time of day*)
- Ks: adjustment for special situations and noise sources (→ *based on subjective assessment*)

In other words, the rating level is calculated by adding 'penalties' (i.e. user-defined offsets) to the LAeq. Penalties such as these can be applied, for example, due to impulsive noise or annoying sound incidents (tones) during a period of rest.

Evaluation procedure

In order to calculate the Lr, you have to execute the following steps.

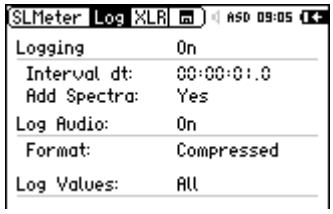
1. Identify & mark impulses
2. Identify & mark tones
3. Identify & mark the time of day (e.g. daytime / nighttime / weekend)
4. Optionally identify & mark special events
5. Assign individual penalties to the aforementioned Markers and calculate the Lr

5.3.1 Impulse analysis

Hint ***The following guideline describes an approach how to calculate the penalties for impulses. Please refer also to chapters British, German and Italian standard for more specific information.***

Step 1 - Log the appropriate level data

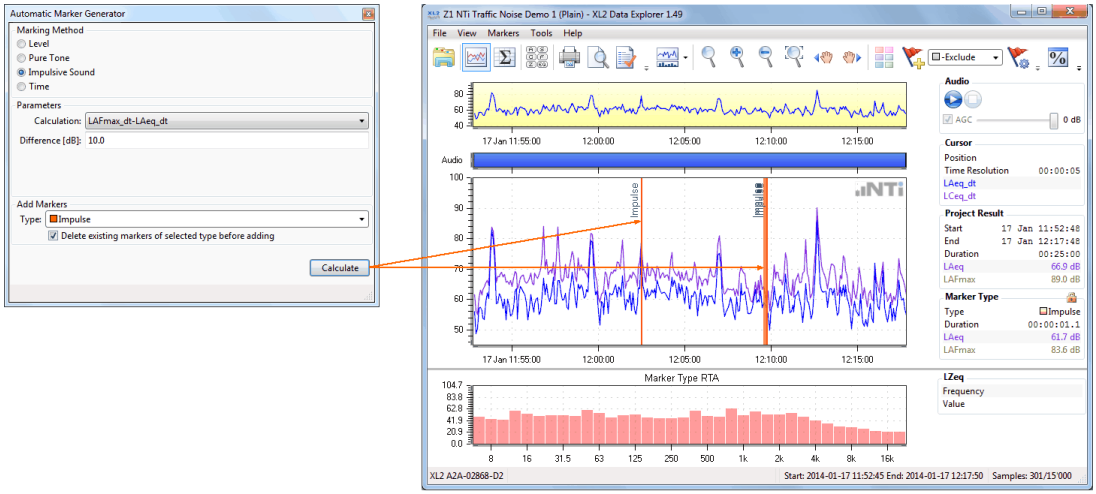
- Adjust the XL2 or XL3 logging parameters according to your demands, or to the applicable national standard.
- Run the measurement.
- Import the logged data to the Data Explorer.



Example of XL2 logging setup

Step 2 - Create Markers automatically 

a. Open the Automatic Marker Generation panel.
b. Select the Marking Method 'Impulsive Sound'.
c. Select the applicable calculation method, i.e.
   - LAIeq_dt – LAeq_dt
   - LAFmax_dt – LAeq_dt
   - LAImax_dt – LAFmax_dt
   - LAImax_dt – LASmax_dt
   - DM 16 marzo 1998 → Italy
d. Adjust the Difference [dB] as applicable.
e. Select the Marker type.
f. Tick or clear the checkbox "Delete existing markers of selected type before adding".
g. Click on "Calculate" to start the automatic Marker generation (*you may optionally abort this process by pressing the Esc key and re-adjust the calculation parameters*).



Automatic 'Impulsive Sound' Marker generation

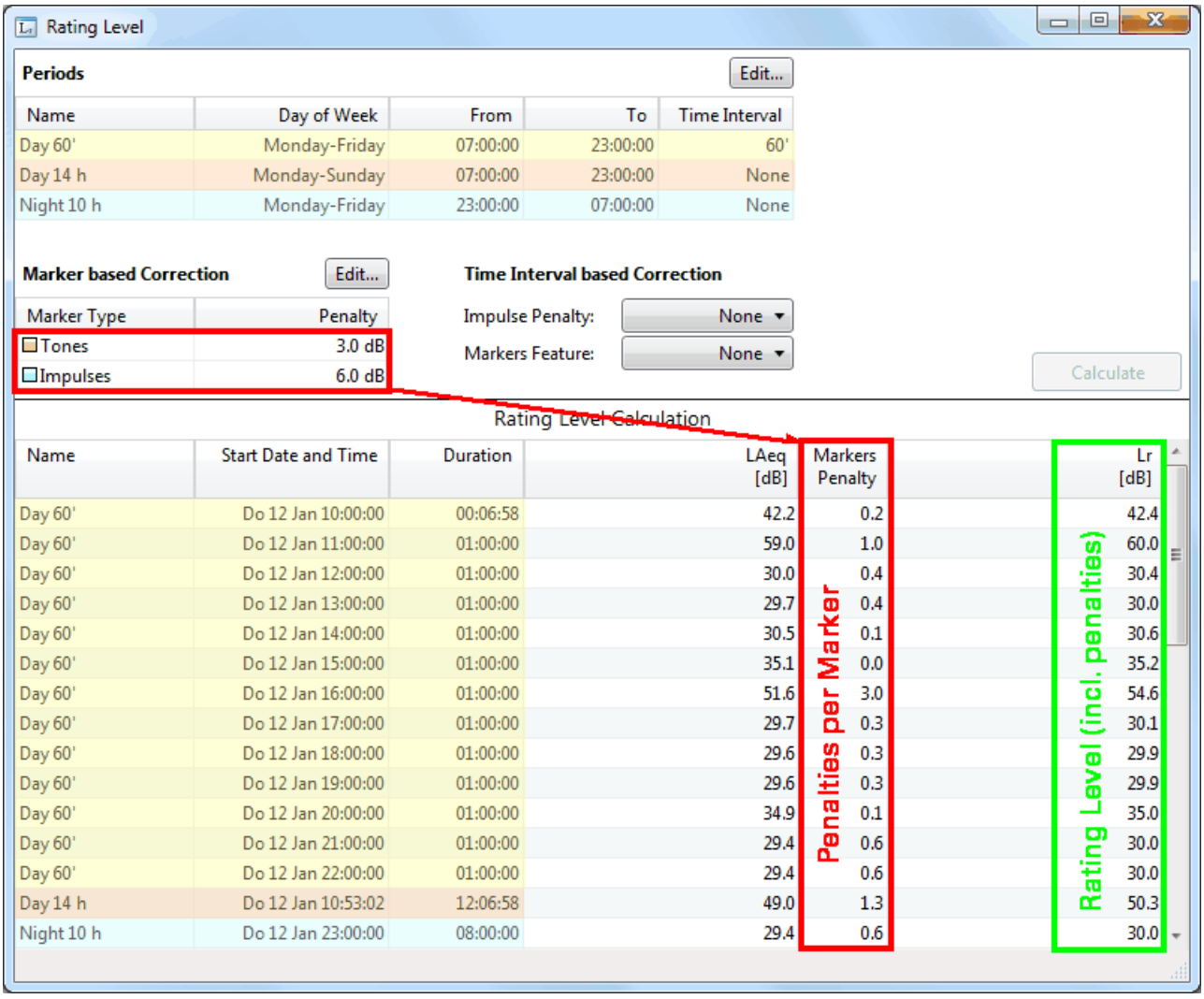
Hint ***The impulses acc. to BS 4142:2014 are automatically detected by the XL2 or XL3 Sound Level Meter The applicable penalty is listed in the log file (i.e. no automated Marker generation required).***
The impulse penalty acc. to DIN 45645 is calculated by using the TaktMax level (i.e. no Marker generation required).

Step 3 - Review the Markers

a. Review the automatically generated Markers and amend or delete them if necessary.
b. Optionally add Markers manually.

Step 4 - Edit the rating level parameters

a. Open the Rating Level panel
b. Define and adjust the Periods (e.g. a day/night scheme)
c. Edit the individual penalties (positive or negative) for selected Markers
d. Click on 'Calculate' to get the results.



Example of rating level calculation

5.3.2 Tone analysis

Basically, there are two approaches to determine penalties to represent the annoyance of tones,

i. the "Survey method" (acc. ISO 1996-2:2017), also called "Third Octave method" (acc. BS 4142:2014)

ii. the "Engineering method" (acc. ISO 1996-2:2017), also called "Reference method" (acc. BS 4142:2014)

Hint ***The decision, which of the aforementioned methods shall be applied may be specified by local regulations.***

5.3.2.1 Third Octave Tone analysis

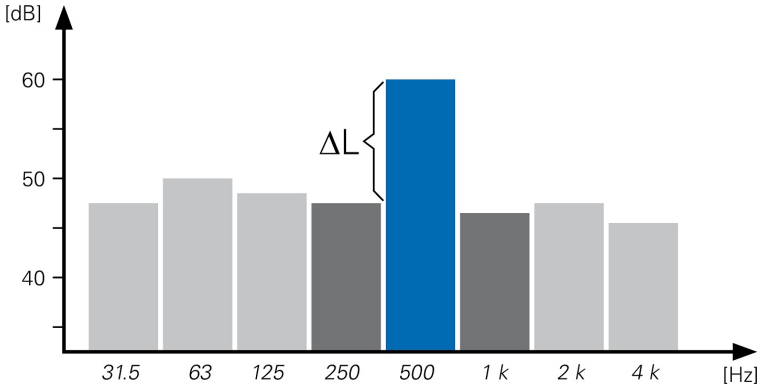
The "Survey" or "Third Octave" method identifies tones according to the following rule.

The difference ΔL between the LZeq in the ⅓rd Octave band of interest and the LZeq of both adjacent ⅓rd Octave bands must be

≥ 15 dB @ 25 Hz … 125 Hz

≥ 8 dB @ 160 Hz … 400 Hz

≥ 5 dB @ 500 Hz … 10 kHz



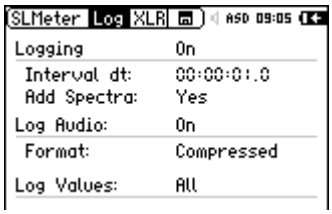
Tone detection according to "Survey" / "Third Octave" method

Tutorial

Hint ***The following guideline describes an approach how to calculate the penalties for tones, based on the "Survey" or "Third Octave" method.***
Please refer also to chapters British, German and Italian standard for more specific information.

Step 1 - Log the appropriate level data

- Adjust the XL2 or XL3 logging parameters according to your demands, or to the applicable national standard.
- Run the measurement.
- Import the logged data to the Data Explorer.

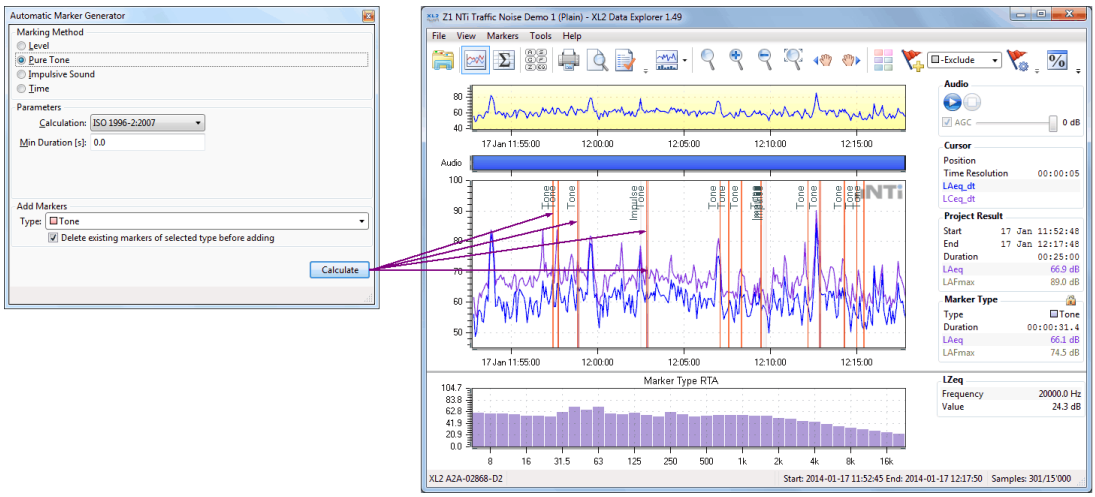


Example of XL2 logging setup

Step 2 - Create Markers automatically 

a. Open the Automatic Marker Generation panel.
b. Select the Marking Method 'Pure Tone'.
c. Select the applicable calculation method, i.e.
   - Leq - Max(neighbors) → DIN 45645-1/-2
   - ISO 1996-2:2017
   - BS 4142:2014 → Great Britain
   - DM 16 marzo 1998 → Italy
d. Adjust the calculation parameters.
e. Select the Marker type.
f. Tick or clear the checkbox "Delete existing markers of selected type before adding".

g. Click on "Calculate" to start the automatic Marker generation (*you may optionally abort this process by pressing the Esc key*); optionally re-adjust the calculation parameters (e.g. minimum duration) and restart the automatic Marker generation until you get a relevant result.



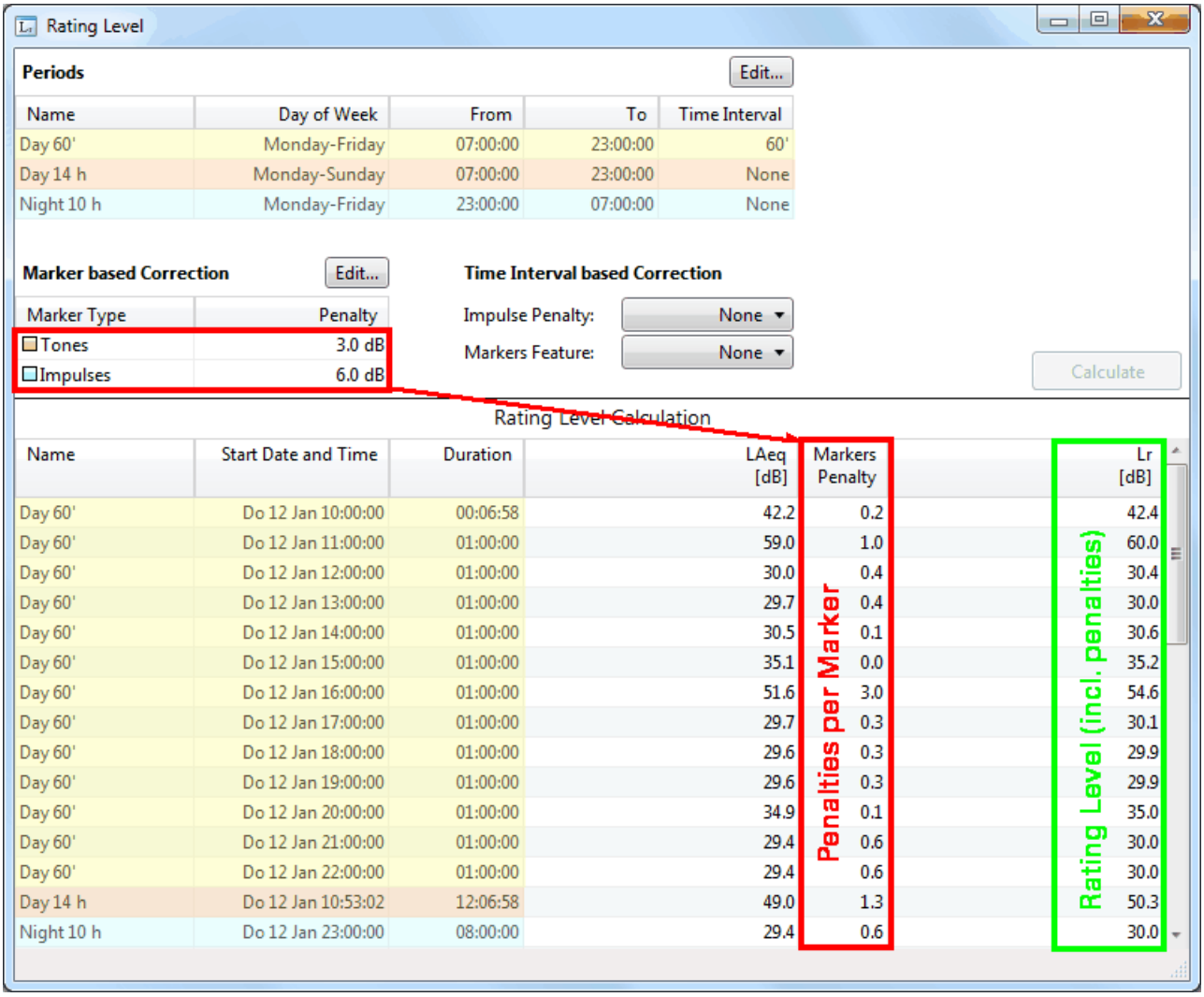
Automatic 'Pure Tone' Marker generation

Step 3 - Review the Markers

a. Review the automatically generated Markers and amend or delete them if necessary.
b. Optionally add Markers manually.

Step 4 - Edit the rating level parameters

a. Open the Rating Level panel
b. Define and adjust the Periods (e.g. a day/night scheme)
c. Edit the individual penalties (positive or negative) for selected Markers
d. Click on 'Calculate' to get the results.

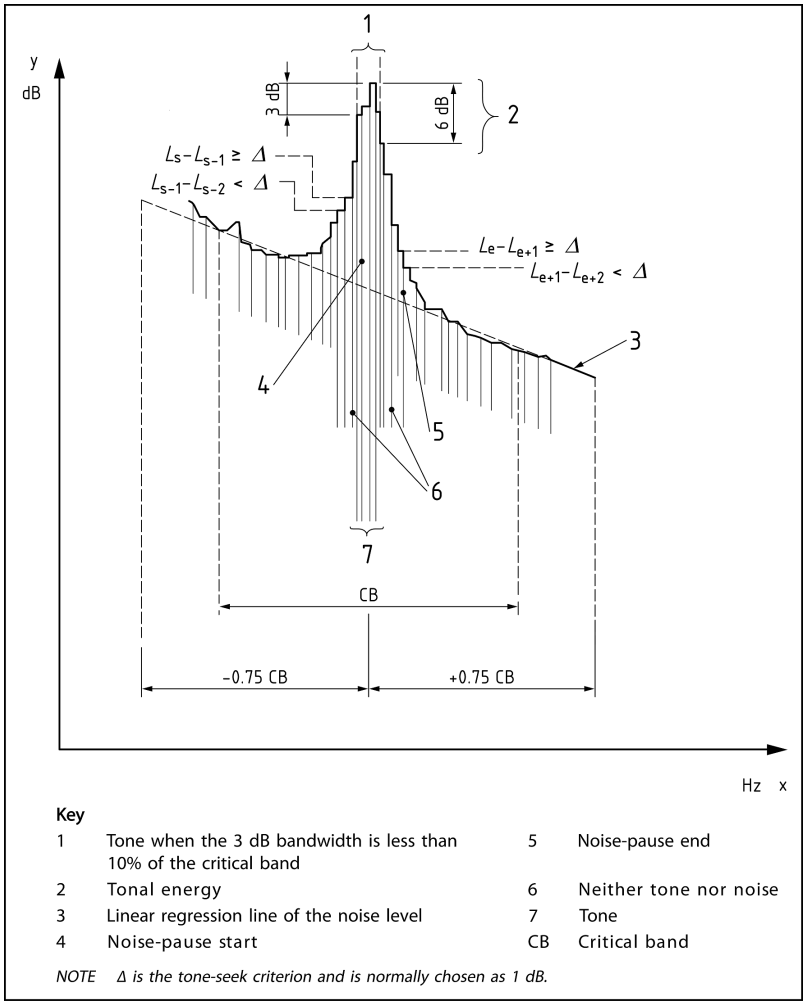


Example of rating level calculation

5.3.2.2 FFT and Tone analysis

The "Engineering" or "Reference" method identifies tones based on the FFT spectrum of the level recording.

Depending on the applicable standard, it calculates the difference ΔL between the level of a prominent tone, and the level of the masking noise in a critical band around the tone frequency.



Key

1	Tone when the 3 dB bandwidth is less than 10% of the critical band	5	Noise-pause end
2	Tonal energy	6	Neither tone nor noise
3	Linear regression line of the noise level	7	Tone
4	Noise-pause start	CB	Critical band

NOTE Δ is the tone-seek criterion and is normally chosen as 1 dB.

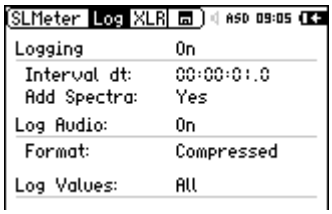
Tone detection according to "Reference" method

Tutorial

Hint ***The following guideline describes a general approach how to calculate the penalty for tones, based on the "Engineering" or "Reference" method.***
Please refer also to chapters British, German and Italian standard for more specific information.

Step 1 - Data logging

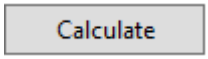
Adjust the XL2 or XL3 logging parameters according to your demands, or to the applicable national standard.



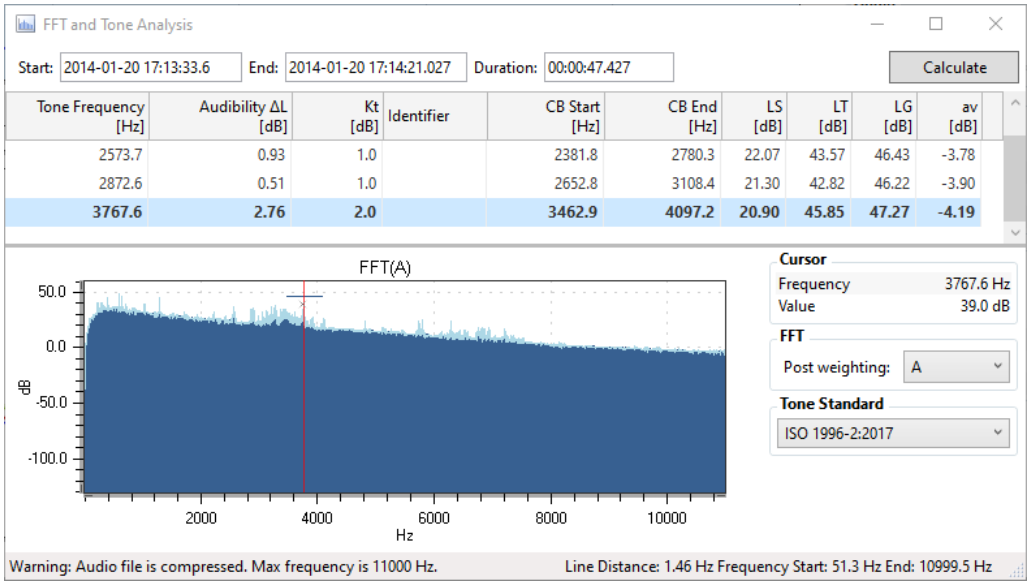
Example of XL2 logging setup

NOTE **The FFT and Tone Analysis feature is only available if the XL2 or XL3 logging setup included the Audio file recording in format 24-/32-Bit @ 48/96 kHz (recommended) or "Compressed".**

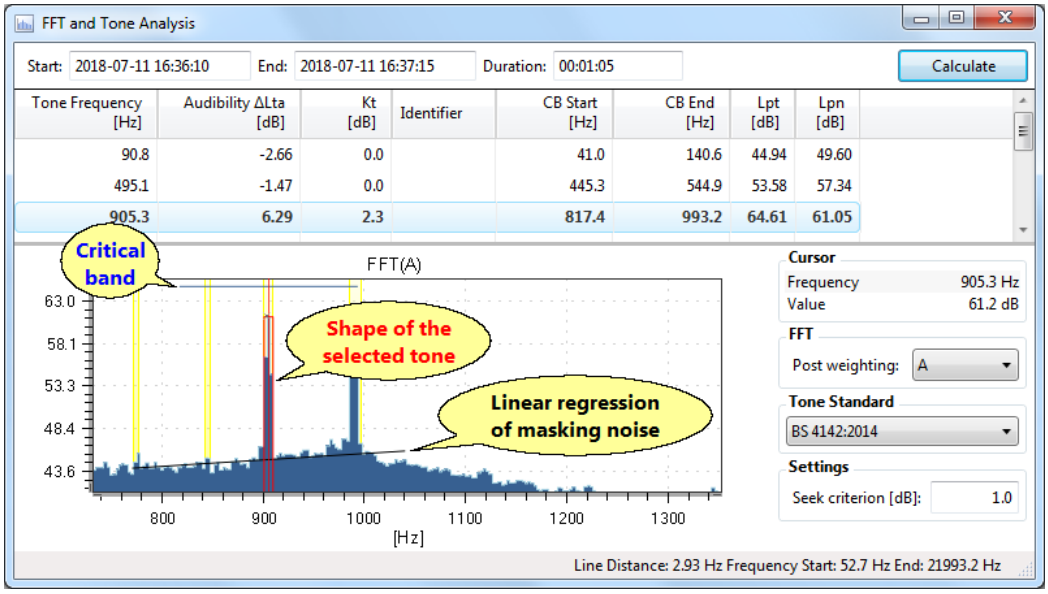
Step 2 - FFT and Tone Analysis

1. Right click on the Audio bar, or on a Marker name and select "FFT and Tone Analysis"
2. Optionally edit the Start / End time of the analysis
3. Select the FFT Post weighting (A for Tone Analysis / Z only for FFT)
4. Select the applicable Tone Standard; optionally edit the Seek criterion (applies only for BS 4142:2014)
5. Click on 

6. Optionally zoom in by placing the cursor in the FFT graph, and then
   - left-click+drag to the end position of the required zoom range,
   - use the scroll wheel of your mouse to zoom in/out.



FFT and Tone Analysis panel (ISO 1996-2:2017)



FFT and Tone Analysis panel (BS 4142:2014)

Hint ***If you zoom out the FFT graph, the light blue is the max value for all the bars in that pixel, while the dark blue is the min value for all the bars in that pixel.***

The table in the FFT and Tone Analysis panel provides the following information.

- **Tone Frequency f_T** [Hz]: frequency of the spectral line, to the level of which the tone contributes most strongly
- **Audibility ΔL** or **Tonal Audibility ΔLta** [dB]: calculated difference between the tone level L_T, and the masking or audibility threshold
- **Kt** [dB]: correction factor that reflects the annoyance of tonal sounds; Kt has to be added to the value of LAeq for a time interval, to get the tone-corrected rating level for that interval
- **Identifier**: lists the frequency group (FG) when a number of tones are present in the range of a critical band; the critical band is positioned symmetrically around the most significant tones. The tones level LT is the energy sum of these tones; the level LT is the assigned to the frequency of the participating tone that has the maximum value of audibility ΔL
- **CB Start** [Hz], **CB End** [Hz] ('critical band'): frequency band, within which the auditory system integrates the sound intensity in the formation of loudness, and within which it integrates the sound intensity in the formation of the masking threshold
- **LS** [dB] ('mean narrow-band level of the critical band'): energy mean value of all narrow-band levels in a critical band that (as a rule) does not exceed this mean value by more than 6 dB
- **LT** [dB] ('tone level'): energy summation of the narrow-band level with the tone frequency, and the lateral lines about, assignable to this tone
- **LG** [dB] ('critical band level'): level of noise that is assigned to the critical band that describes the masking characteristic of the noise for one or more tones of the noise in this critical band
- **av** [dB] ('masking index'): difference between the masking threshold, and the critical band level LG, of the masking noise
- **Lpt** [dB] ('sound pressure level of tones')
- **Lpn** [dB] ('sound pressure level of the masking sound within a critical band')

The graph shows the calculated FFT spectrum.

- The row with the **bold** numbers represents the most prominent tone in the spectrum
- You may read out individual frequencies and their related level by using the cursor.
- Right-click on the graph to zoom out, or to copy the bitmap or numerical data to the clipboard

Furthermore, if the BS 4142:2014 has been selected, the graph may also show yellow bands = **Noise Pause** (i.e. local maximum in the FFT spectrum with a probability of containing a tone)

Hint ***Seek criterion [dB] (only available for BS 4142:2014) = level for the tone detection in the FFT spectrum. For normal and smooth spectra, a tone Seek criterion of 1 dB works without problems; for irregular spectra values up to 3 dB or 4dB can give better results.***

Step 3 - Note the penalty

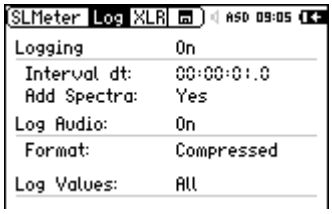
- Manually note the highest penalty Kt [dB] shown in the table and add it to the rating level, *or*
- Right-click on the table to copy the rows to the clipboard, or to export the numerical data to an MS Excel spreadsheet.

5.3.3 Time of day

Hint ***The following guideline describes an approach how to define the penalties for the time of day. Please refer also to chapters British, German and Italian standard for more specific information.***

Step 1 - Log the appropriate level data

- Adjust the XL2 or XL3 logging parameters according to your demands, or to the applicable national standard.
- Run the measurement.
- Import the logged data to the Data Explorer.

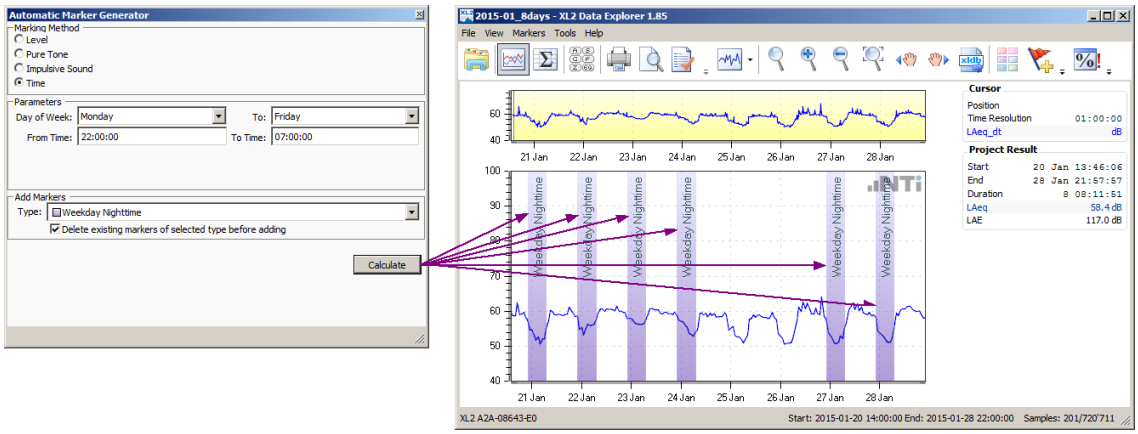


Example of XL2 logging setup

Step 2 - Create Markers automatically

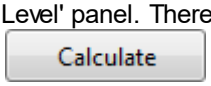
a. Open the Automatic Marker Generation panel.
b. Select the Marking Method 'Time'.
c. Select or adjust the applicable parameters, i.e.
   - Day of Week
   - From / To Time

d. e. Select the Marker type.
f. Tick or clear the checkbox "Delete existing markers of selected type before adding".
g. Click on "Calculate" to start the automatic Marker generation (*you may optionally abort this process by pressing the Esc key*).



Automatic 'Time' Marker generation

5.3.4 Lr calculation

Click on  to open the 'Rating Level' panel. Therein you may define the penalties, day-/night-time periods and time intervals, before you click on  to let the software calculate the rating level.

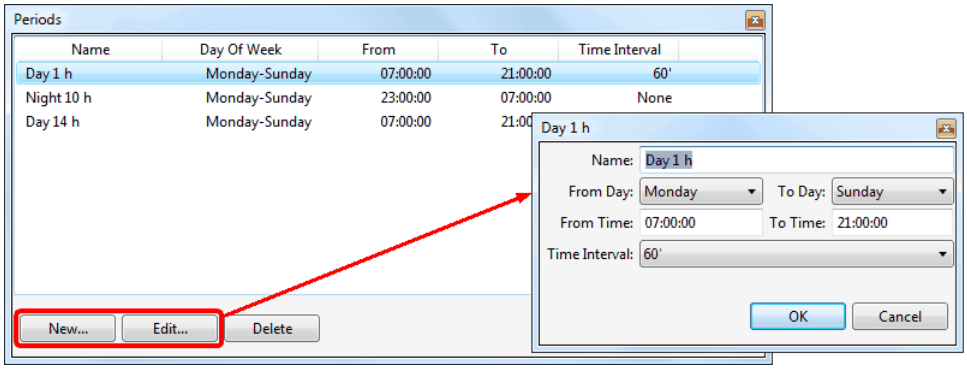
Rating Level window

Hint ***Right click on any section of the Rating Panel window to apply the default settings.***

Periods

The periods define the (reference) time intervals, in which the rating levels are calculated.

Click on  to open the 'Periods' panel.



Definition of a time period

i. Create a new period:
   - click on 'New',
   - enter the name of the new period,
   - select the day(s) for which the new period shall apply,
   - enter the 'From Time / To Time', i.e. the duration of the new period per day,

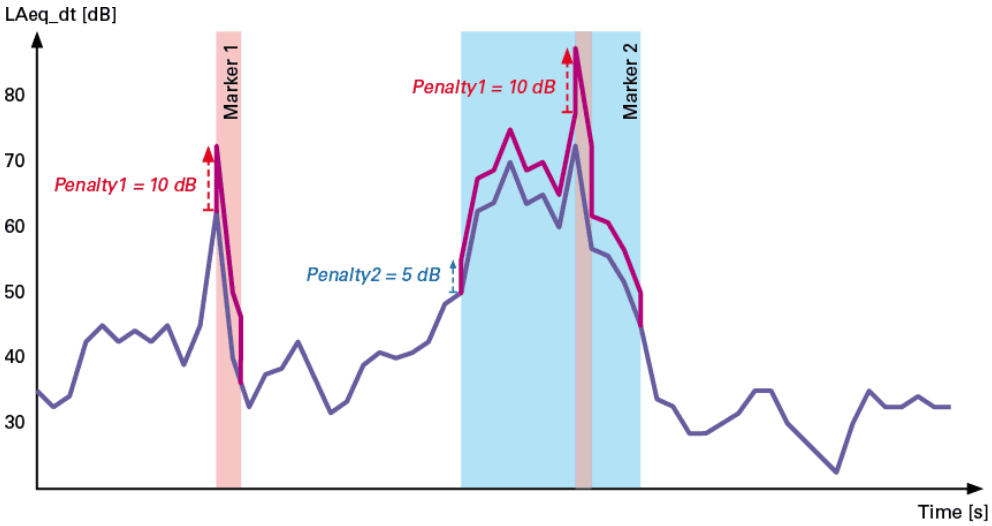
Hint ***The duration applies individually on each of the selected days, e.g. Monday 07:00 to 21:00, Tuesday 07:00 to 21:00, ... Sunday 07:00 to 21:00 (i.e. not Monday 07:00 to Sunday 21:00)***

   - select the 'Time Interval' that shall be applied (*Example: Time Period = 60' ⇒ the 'From Time / To Time' is sliced into sub-periods of 1 hour duration*)
   - click on 'OK' to confirm

ii. Amend an existing period
- select the period and click on 'Edit',
- amend the settings as required,
- click on 'OK' to confirm

iii. Delete a period: select the period and click on 'Delete'.

Hint ***If two or more Markers are overlapping within a time period, their penalties are added together.***

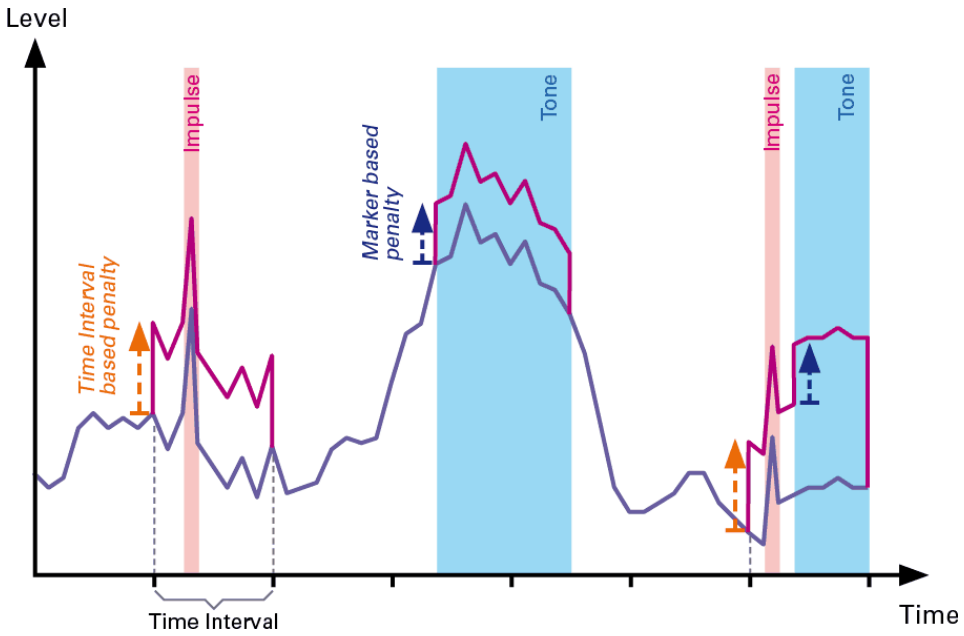


Example of time period with overlapping penalties

Marker vs. Time Interval based Correction

The Rating Level features supports two different correction types,

1. Marker based Correction → the penalty is applied only on each sample of the marked section.
2. Time Interval based Correction → the penalty is calculated and applied on the entire time interval.

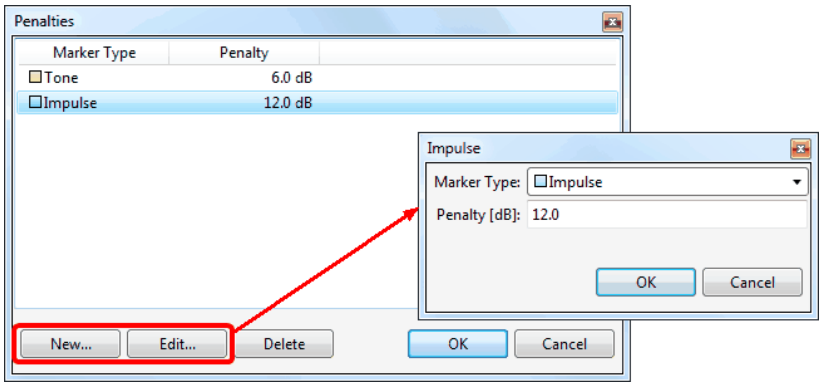


Marker / Time Interval based Correction

Marker based Correction

The 'Marker Penalty' is applied per Marker. The Marker may identify a tone, impulse, rest time or other period. Different Marker types may have individual penalties.

Click on Edit... to open the 'Penalties' panel.



i. Create a new penalty:
   - click on 'New',
   - select the Marker type,
   - enter the required penalty,
   - click on 'OK' to confirm.

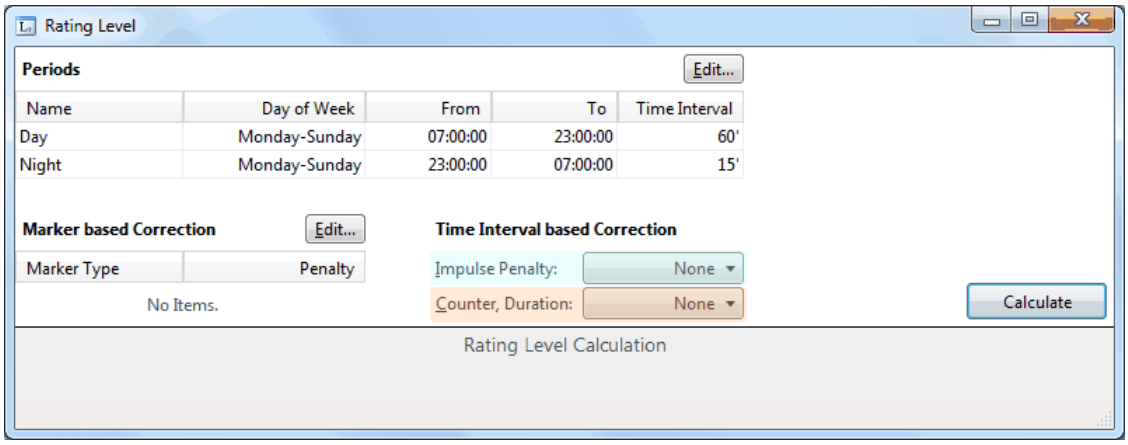
ii. Amend an existing penalty:
   - select the Marker type and click on 'Edit',
   - amend the Marker type or the penalty,
   - click on 'OK' to confirm.

i. Delete a penalty:
   - select the Marker type and click on 'Delete',
   - click on 'OK' to confirm.

Time Interval based Correction

- The 'Impulse Penalty' is applied per time interval, in which e.g. an impulse has occurred. The amount of the penalty depends on the selected standard.
- Alternatively, the selection "Markers Feature" counts the number of Markers and their combined duration per time interval. Based on the acquired results a user-defined penalty may be applicable.

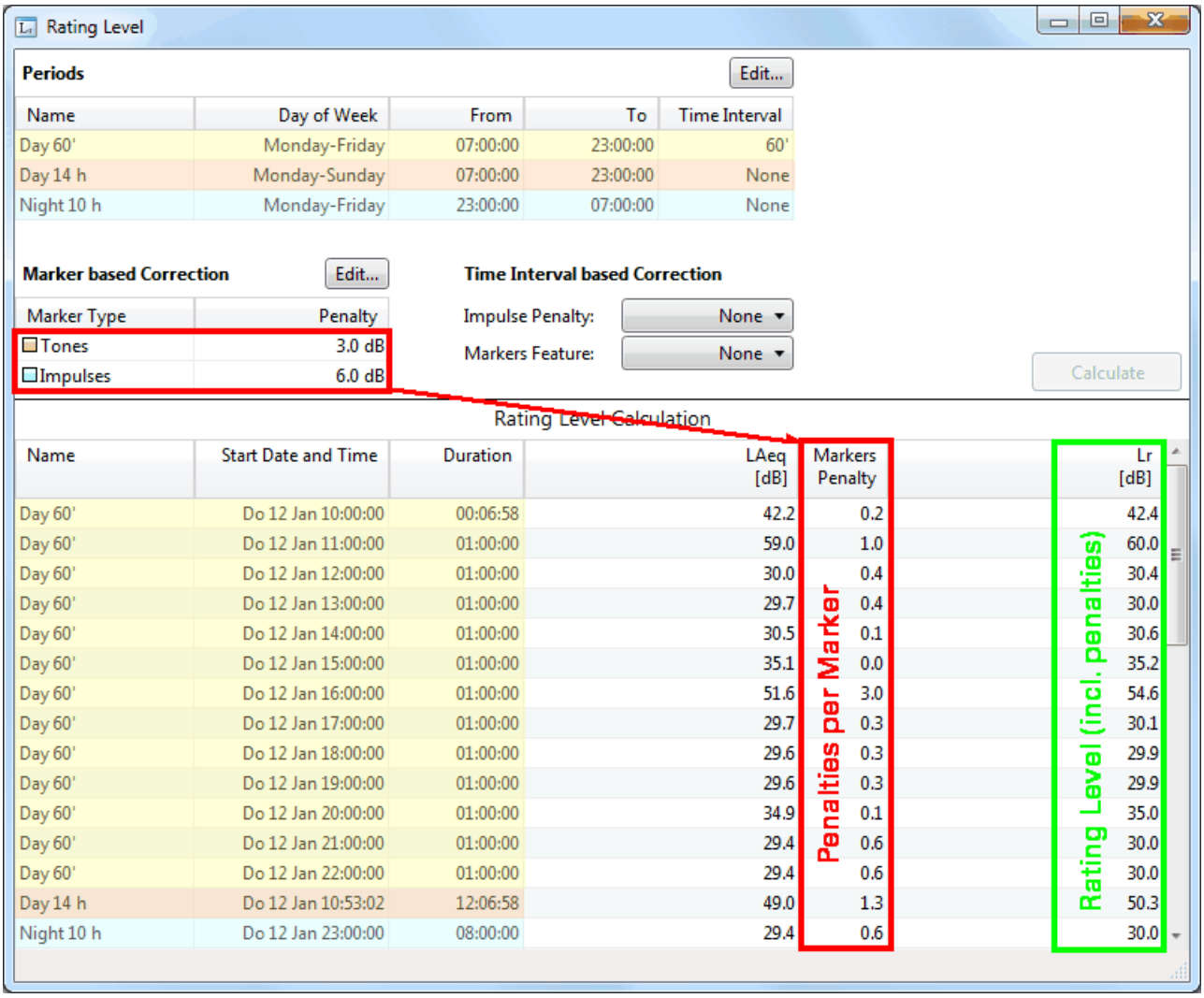
Click on the corresponding button to select the Impulse Penalty calculation method, or the Marker type to be counted.



Rating level panel

Calculate Lr

Click on Calculate to start the Lr calculation.



Example of rating level calculation

5.3.5 National standards

The NTi Data Explorer software supports the following national standards.

- BS 4142:2014 → Great Britain
- DIN 45645-1/-2 → Germany
- DM 16 marzo 1998 → Italy

5.3.5.1 BS 4142:2014

In Great Britain, the rating level is calculated by applying penalties acc. to BS 4142:2014 on the tones and impulses that happened during the recording period.

XL2 logging setup

- Logging: ON
  - Interval dt: 1 s
  - Add Spectra: YES (i.e. LZeq 1/3rd octave spectrum)
- Log Audio: ON (e.g. Compressed)
- Log Values*: ALL

**: requires XL2 firmware v3.24 or higher*

XL2 logging setup for BS4142:2014

Identification of impulses

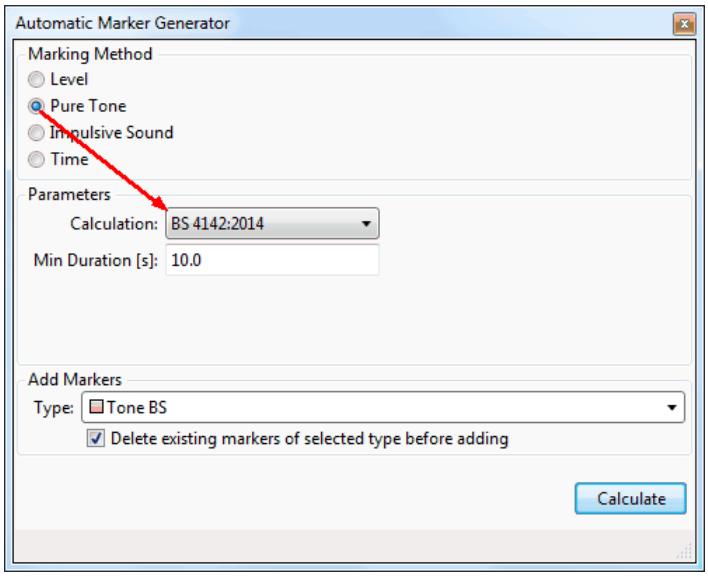
Impulses are detected and marked automatically by the XL2 during the logging process.

NOTE The Extended Acoustic pack must be installed on the XL2 to detect impulses acc. to BS 4142.

Identification of tones

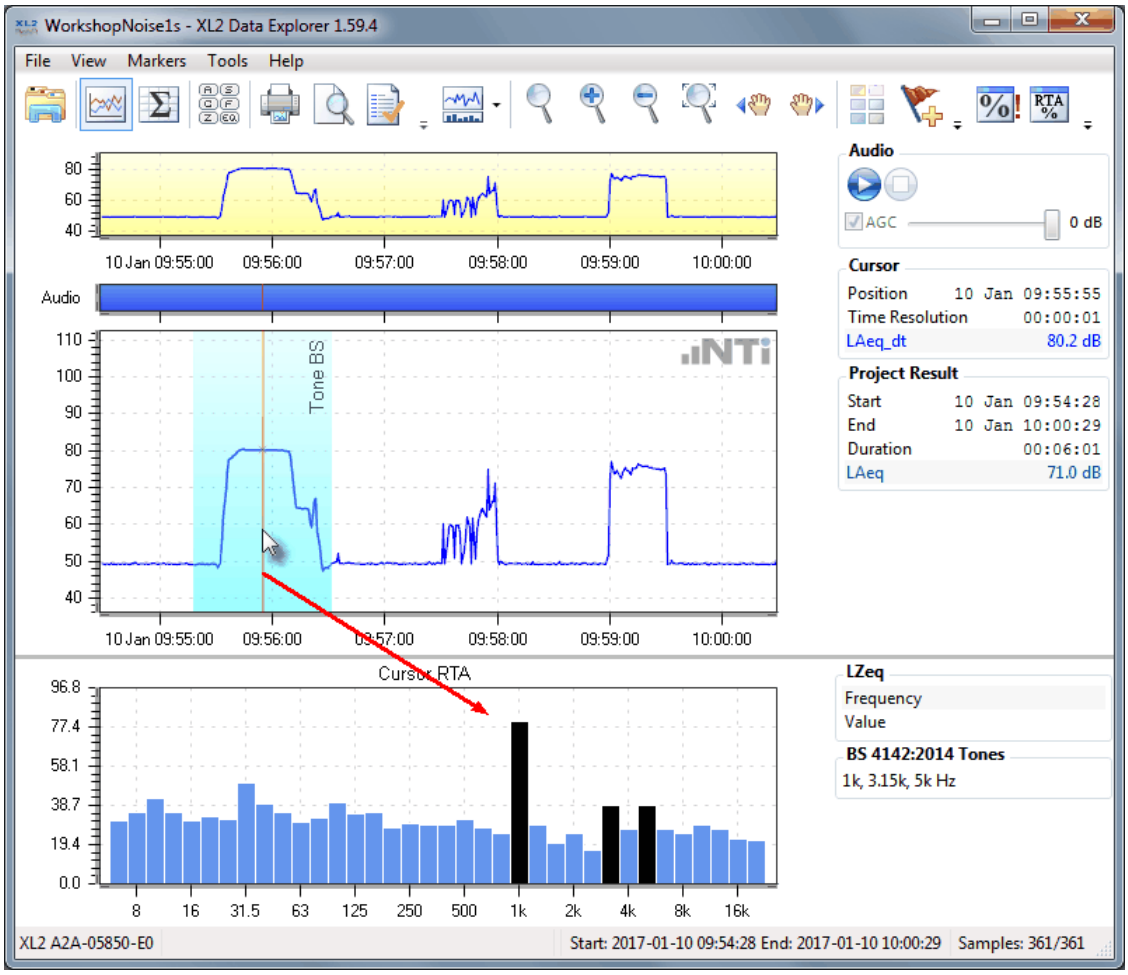
Use the Automatic Marker Generation to identify tones according to BS 4142:2014.

Hint Optionally adapt the Min. Duration to streamline the generated tone markers.



Automatic generation of tone Markers acc. to BS 4142:2014

To verify the generated Markers, place the cursor over the Spectrum spectrum, right click and select "Show tones → BS 4142:2014". You may now hover the cursor over the Chart view, while watching the Spectrum ⇒ as soon as the cursor 'hits' a tone, it will be displayed in the spectrum.

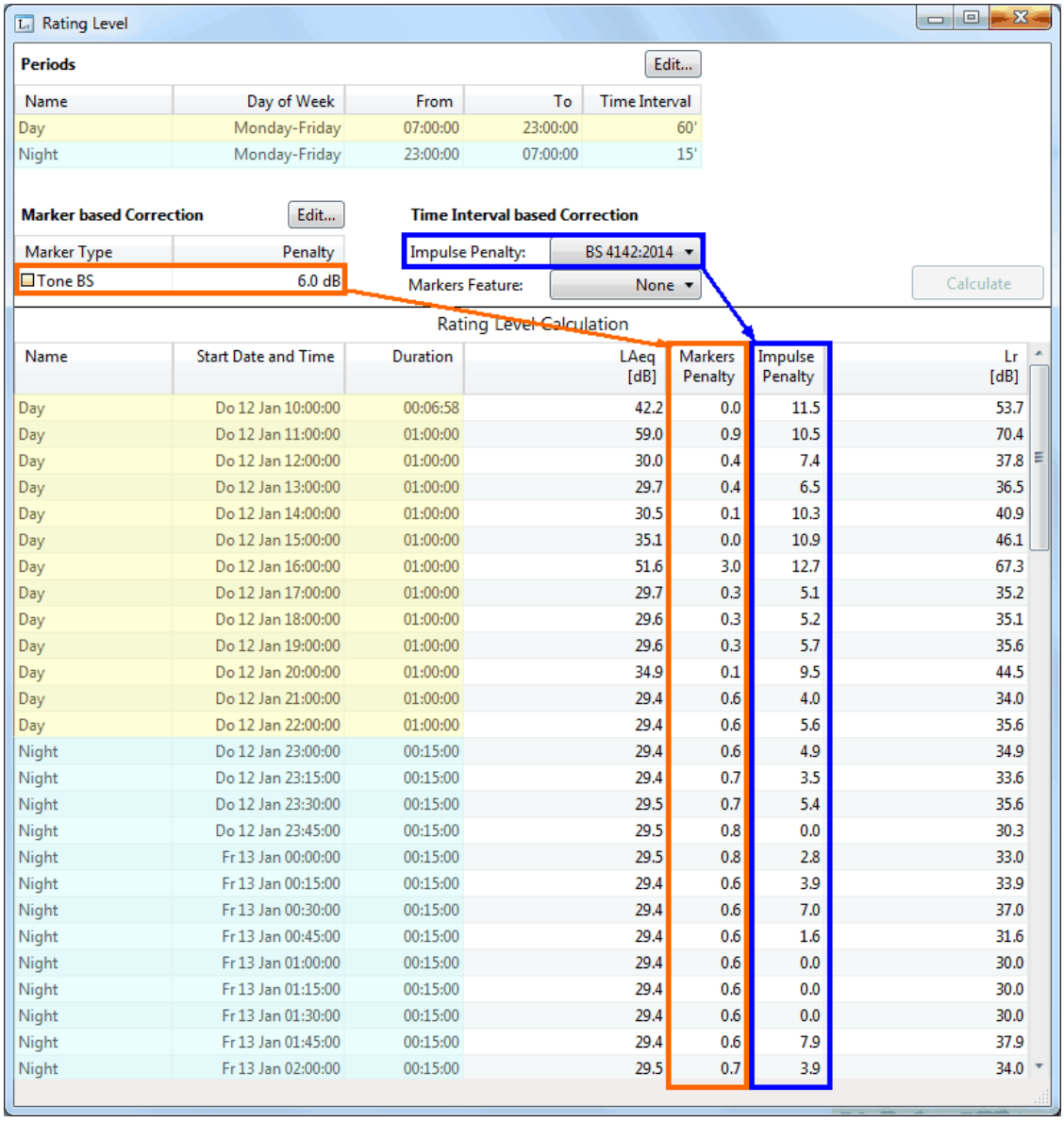


Hover cursor over the chart view to verify the generated Markers and tones

Rating Level calculation

Open the Rating Level panel and

a. Define the periods (day/night scheme)
b. Apply a penalty on the tone Markers
c. Select the Impulse Penalty BS 4142:2014
d. Click on Calculate to get the results.



Example of Rating Level calculation results acc. to BS 4142:2014

5.3.5.2 DIN 45645-1/-2

In Germany, the rating level is calculated by applying penalties acc. to DIN 45645-1/-2 on the tones and impulses that happened during the recording period.

XL2 logging setup

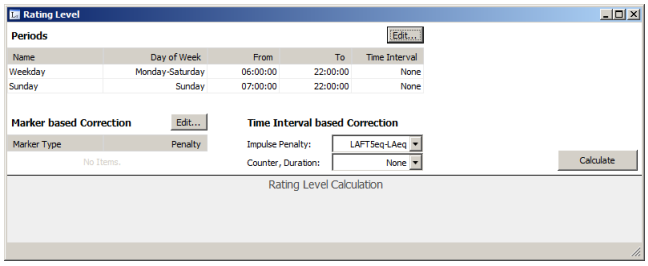
- Logging: ON
  - Interval dt: 1 s
  - Add Spectra: YES (i.e. LZeq 1/3rd octave spectrum)
- Log Audio: ON (e.g. Compressed)
- Log Values*: ALL

**: Extended Acoustic Pack option for the XL2 required*

XL2 logging setup for DIN 45645-1/-2

Identification of impulses

The impulse penalty Ki is calculated with the formula LAFT3eq–LAeq, or LAFT5eq–LAeq. Consequently, no Markers have to be established.

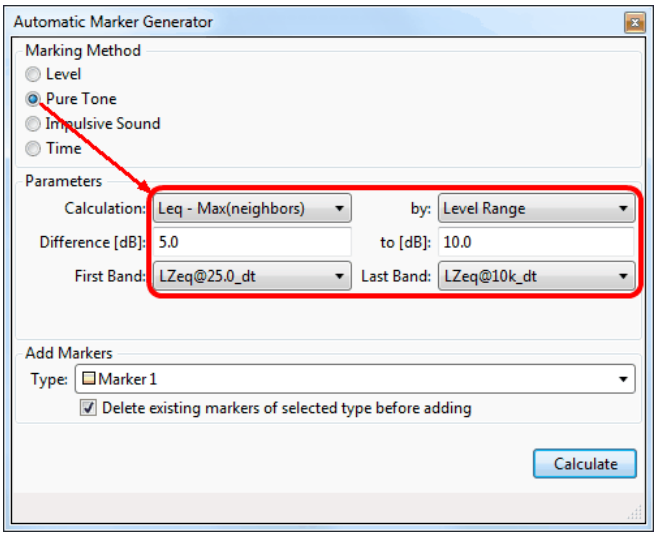


Impulse penalty calculation by using the TaktMax level

Identification of tones

Use the Automatic Marker Generation to identify the tones.

Hint ***Optionally adapt the Min. Duration to streamline the generated tone markers.***

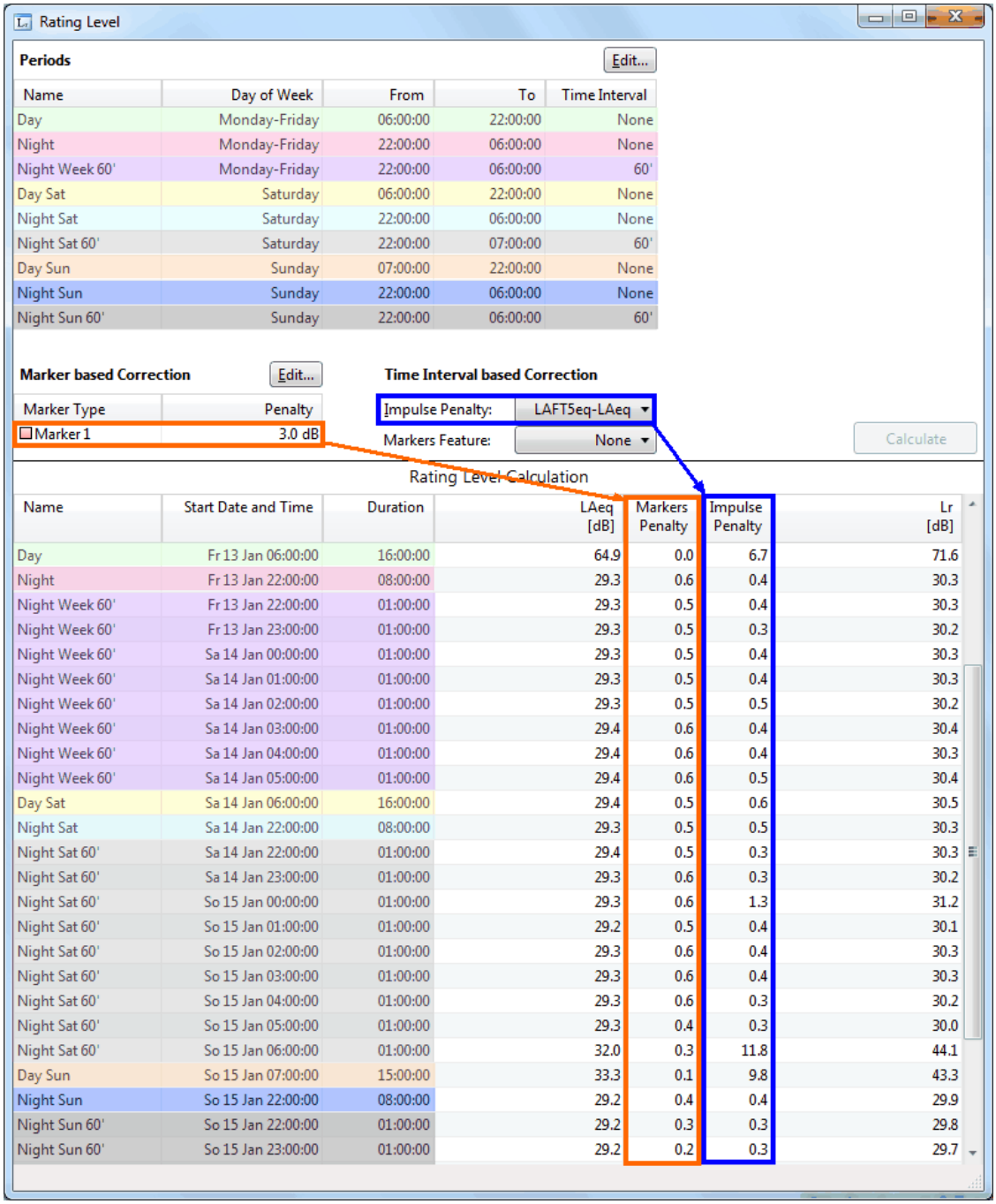


Automatic generation of tone Markers acc. to DIN 45645-1

Rating Level calculation

Open the Rating Level panel and

a. Define the periods (day/night scheme)
b. Apply a 3 or 6 dB penalty on the tone Markers
c. Select the Impulse Penalty → LAFT5eq-LAeq (DIN 45645-1) or LAIeq-LAeq (DIN 45645-2)
d. Click on Calculate to get the results.



Example of Rating Level calculation results acc. to DIN 45645-1/-2

5.3.5.3 DM 16 marzo 1998

In the Italian standard DM 16 marzo 1998, the Rating Level is evaluated by analyzing the *number of impulses* and *tones* that happened during the recording period.

XL2 logging setup

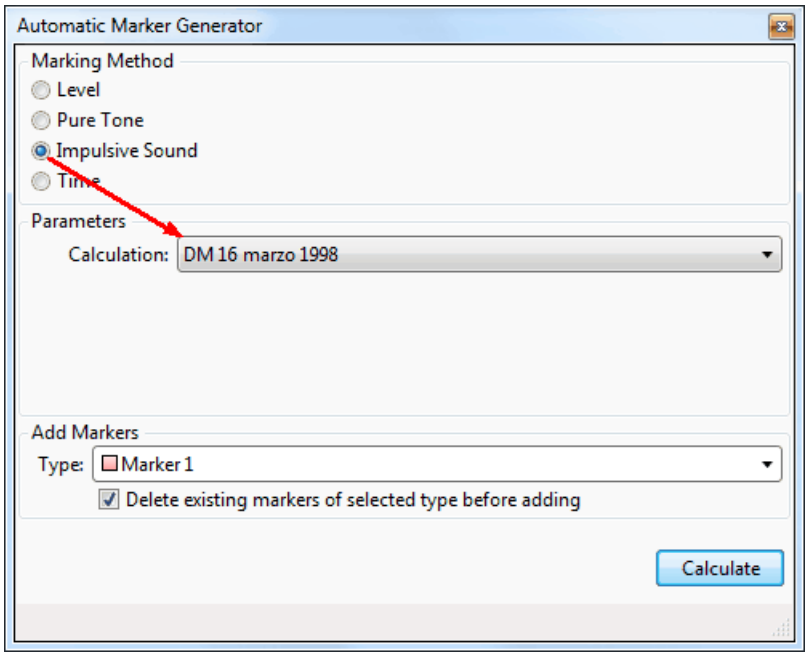
- Logging: ON
  - Interval dt: 0.1 s
  - Add Spectra: Leq, Lmax, Lmin *
- Log Audio: ON (e.g. Compressed)
- Log Values: LAeq, LAFmax, LASmax, LAImax

**: requires XL2 firmware v3.32 or higher, as well as 'Extended Acoustic Pack' option and special file in XL2 root directory ⇒ please contact NTi Audio*

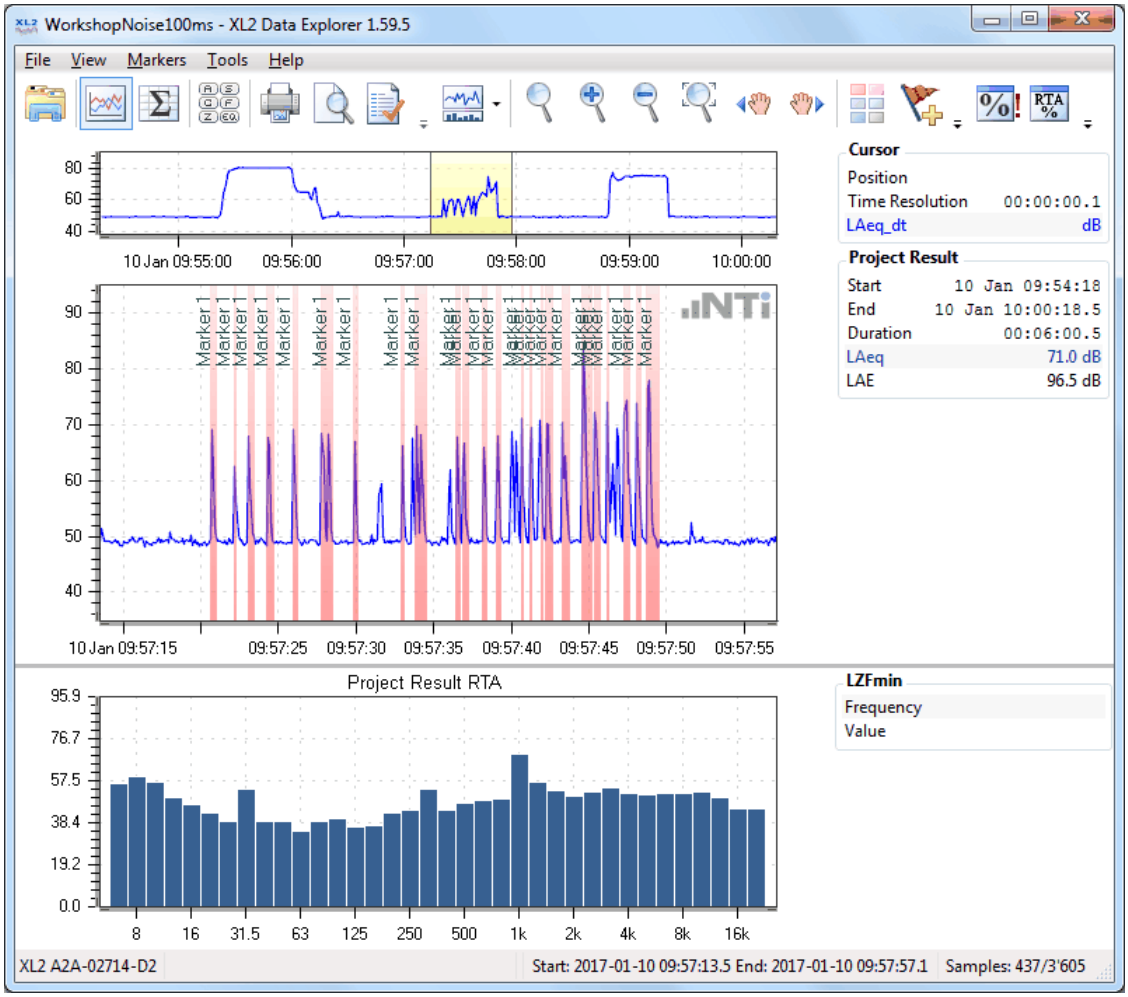
XL2 logging setup for DM 16 marzo 1998

Identification of impulses

Use the Automatic Marker Generation to identify impulses according to DM 16 marzo 1998.



Automatic generation of impulse Markers acc. to DM 16 marzo 1998



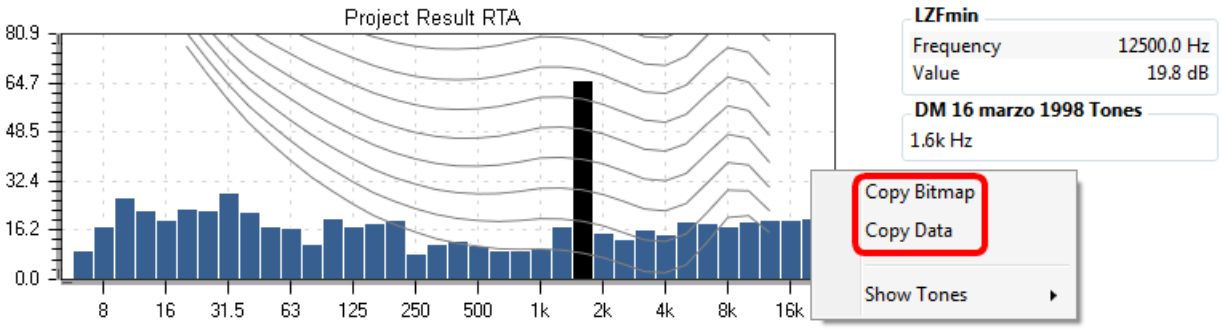
Automatically generated impulse Markers acc. to DM 16 marzo 1998

Tone analysis

Place the cursor over the Spectrum, right click and select "Show tones → DM 16 marzo 1998"; the spectrum will consequently show the dominant tone of the recording.

NOTE DM 16 marzo 1998 is only available if the XL2 has recorded the Lmin spectra

Right click on the spectrum and copy the bitmap or numerical data to export it to a spreadsheet application (e.g. MS Excel) for further analysis and reporting.

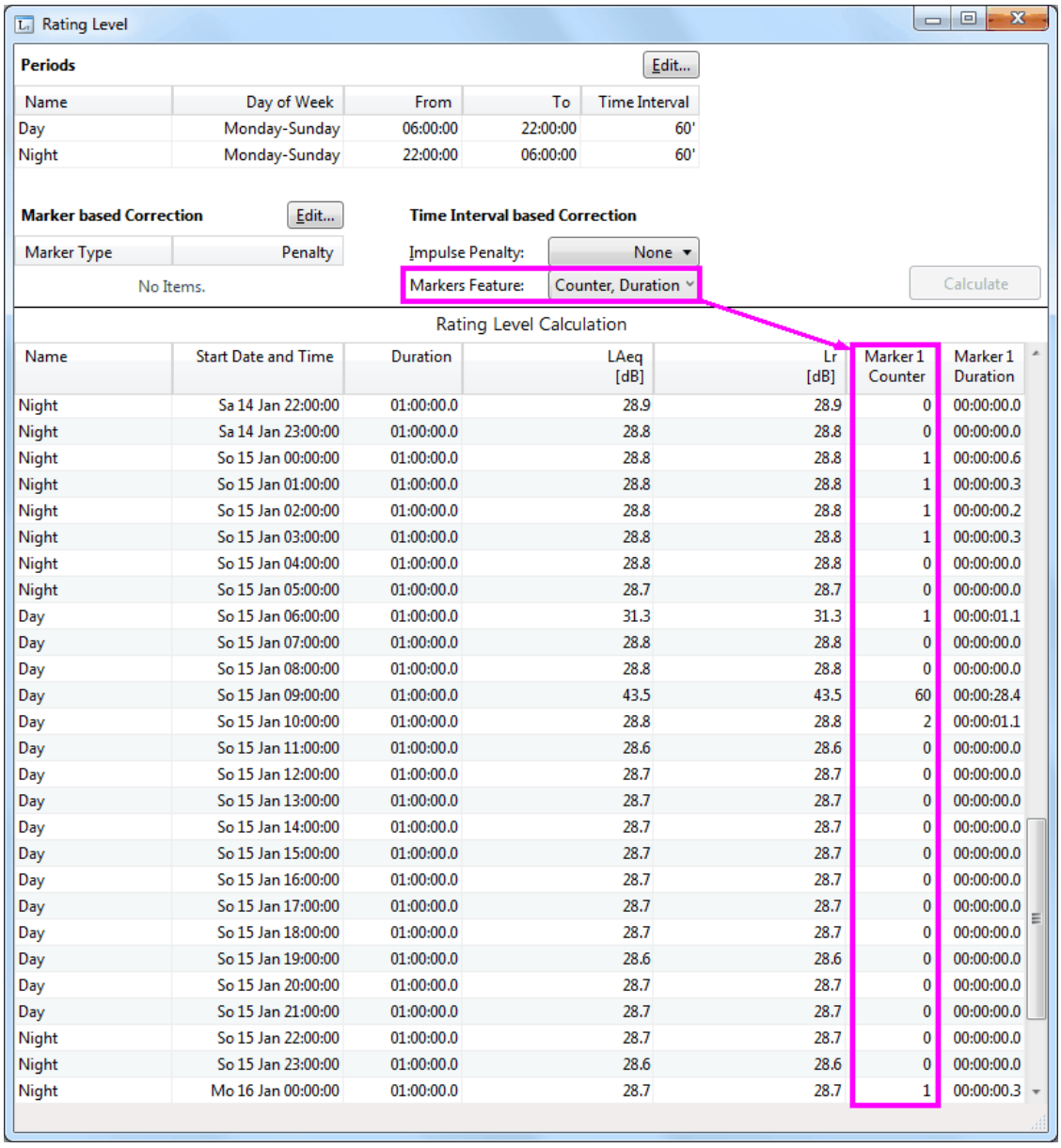


Right click on spectrum to export bitmap or numerical data

Rating Level calculation

Open the Rating Level panel and

a. Define the periods (day/night scheme)
b. Select 'Counter, Duration' in the Markers Feature
c. Click on Calculate to get the results.
d. Right click on the calculation results and copy the numerical data to export it to a spreadsheet application (e.g. MS Excel) for further analysis and reporting.



Example of impulse evaluation acc. to the standard DM 16 marzo 1998

Part VI

6 Reporting

The NTi Data Explorer provides several features for creating a report from the project data.

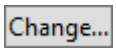
- Editable Report properties and Print preview 
- Data export to MS Excel 
- Copy graph to clipboard (bitmap format)
- Copy numerical data to clipboard

6.1 Print preview

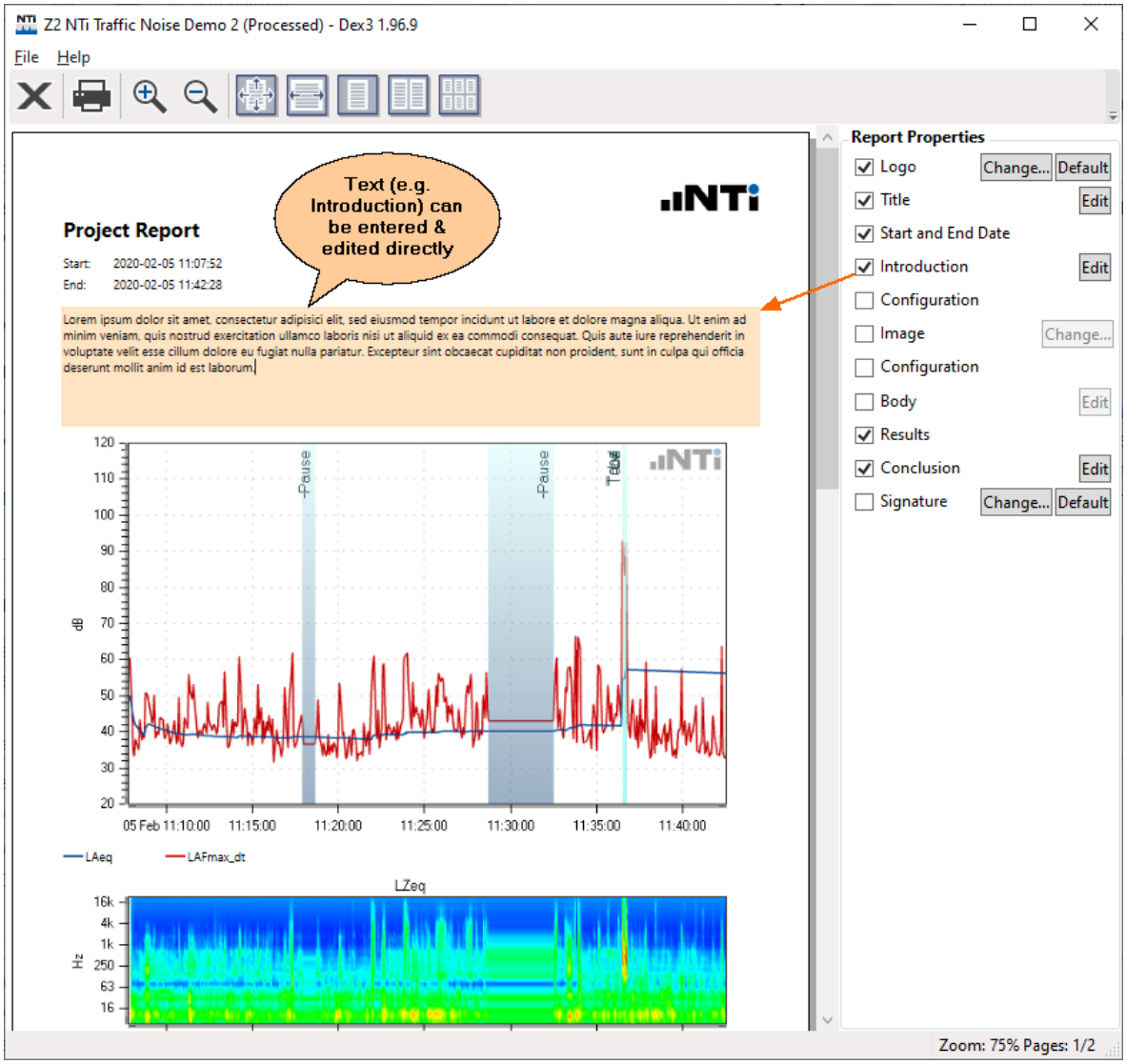
Print preview

You may open the Print preview via the menu 'File → Print Preview', or by clicking on  in the Chart or Result view.

Consequently, a window opens wherein you may enable/disable and edit the following Report properties:

- Logo: default (NTi Audio), or your own logo (up to 350 x 70 pixels)
- Title: headline of the project report
- Start and End Date
- Introduction: user comment that precedes the charts in the project report
- Image: tick the checkbox, click on 

and select a picture (e.g. a photo or a sketch) that shall be included to the report
- Configuration: status of the test instrument used
- Body: graph subtitle
- Results: measurement results in table form
- Conclusion: user comments
- Signature: empty line or picture (e.g. scanned signature with up to 350 x 70 pixels)



Report properties control panel

Printouts

To print out the report, click on  or select the menu 'File → Print...'

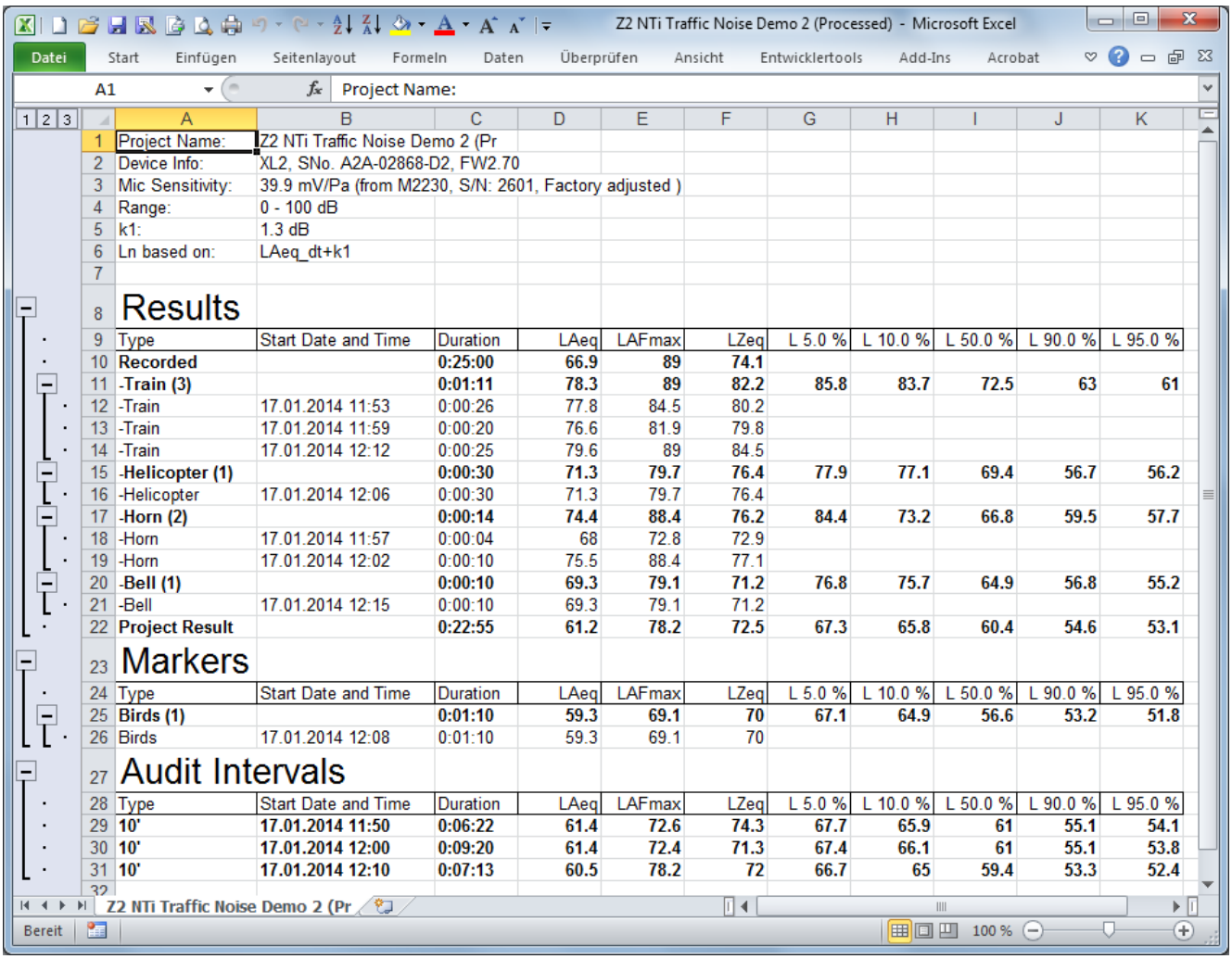
Example of print preview

Hints ***If you lock the cursor within the Main chart or Spectrogram, the corresponding data are added to the printout.***
The report printout includes neither the default size Spectrum, nor the Level statistics.

6.2 Data Export

Export to MS Excel

Click on the  button to export the numerical data of the Result view to an MS Excel spreadsheet.



Z2 NTi Traffic Noise Demo 2 (Processed) - Microsoft Excel

Project Name: Z2 NTi Traffic Noise Demo 2 (Pr
Device Info: XL2, SNo. A2A-02868-D2, FW2.70
Mic Sensitivity: 39.9 mV/Pa (from M2230, S/N: 2601, Factory adjusted)
Range: 0 - 100 dB
k1: 1.3 dB
Ln based on: LAeq_dt+k1

Results

Type	Start Date and Time	Duration	LAeq	LAFmax	LZeq	L 5.0 %	L 10.0 %	L 50.0 %	L 90.0 %	L 95.0 %
Recorded		**0:25:00**	**66.9**	**89**	**74.1**					
-Train (3)		**0:01:11**	**78.3**	**89**	**82.2**	**85.8**	**83.7**	**72.5**	**63**	**61**
-Train	17.01.2014 11:53	0:00:26	77.8	84.5	80.2					
-Train	17.01.2014 11:59	0:00:20	76.6	81.9	79.8					
-Train	17.01.2014 12:12	0:00:25	79.6	89	84.5					
-Helicopter (1)		**0:00:30**	**71.3**	**79.7**	**76.4**	**77.9**	**77.1**	**69.4**	**56.7**	**56.2**
-Helicopter	17.01.2014 12:06	0:00:30	71.3	79.7	76.4					
-Horn (2)		**0:00:14**	**74.4**	**88.4**	**76.2**	**84.4**	**73.2**	**66.8**	**59.5**	**57.7**
-Horn	17.01.2014 11:57	0:00:04	68	72.8	72.9					
-Horn	17.01.2014 12:02	0:00:10	75.5	88.4	77.1					
-Bell (1)		**0:00:10**	**69.3**	**79.1**	**71.2**	**76.8**	**75.7**	**64.9**	**56.8**	**55.2**
-Bell	17.01.2014 12:15	0:00:10	69.3	79.1	71.2					
Project Result		**0:22:55**	**61.2**	**78.2**	**72.5**	**67.3**	**65.8**	**60.4**	**54.6**	**53.1**

Markers

Type	Start Date and Time	Duration	LAeq	LAFmax	LZeq	L 5.0 %	L 10.0 %	L 50.0 %	L 90.0 %	L 95.0 %
Birds (1)		**0:01:10**	**59.3**	**69.1**	**70**	**67.1**	**64.9**	**56.6**	**53.2**	**51.8**
Birds	17.01.2014 12:08	0:01:10	59.3	69.1	70					

Audit Intervals

Type	Start Date and Time	Duration	LAeq	LAFmax	LZeq	L 5.0 %	L 10.0 %	L 50.0 %	L 90.0 %	L 95.0 %
10'	**17.01.2014 11:50**	**0:06:22**	**61.4**	**72.6**	**74.3**	**67.7**	**65.9**	**61**	**55.1**	**54.1**
10'	**17.01.2014 12:00**	**0:09:20**	**61.4**	**72.4**	**71.3**	**67.4**	**66.1**	**61**	**55.1**	**53.8**
10'	**17.01.2014 12:10**	**0:07:13**	**60.5**	**78.2**	**72**	**66.7**	**65**	**59.4**	**53.3**	**52.4**

Z2 NTi Traffic Noise Demo 2 (Pr
Bereit
100 %

Example of a Data Explorer result table after export to MS Excel

Copy bitmap to clipboard

Right-click on a graph and select 'Copy Bitmap'; the graph is now in your clipboard and may be pasted to a document, etc.

Copy data to clipboard

Right-click on a graph and select 'Copy Data' or 'Copy Selected Rows'; the relevant data is now in your clipboard and may be pasted to a table, document, etc.

Index

- A -

adjustments 91
AGC 45
audio
  bar 40, 45
  player 40, 45
audit interval
  export 72
audit intervals 49
  activate 47
  level statistics 83
  percentiles 83
automated gain control 45
automatic marker 61

- B -

bitmap 118
BS 4142:2014 106

- C -

calculation 83
chart
  main 52
  overview 44
  spectrogram 55
  spectrum 55
  view 40
clipboard 118
clipping 45
comment 61
company logo 115
concatenated project 28, 40
copy project 26
copy to clipboard 118
correction factor 47
cursor 58

- D -

data 28
  export 77, 115, 118
  flow 28
  import 12, 26, 28, 32
Data Explorer
  option 26, 28
  structure 10
day 87
  example 88
daytime 101
default settings 32, 47, 86, 87
demo data 7
DIN 45645-1/-2 109
DM 16 marzo 1998 111

- E -

edit
  marker 61
engineering method 97
error marker 61
evening 87
  example 88
exclude 61
export 72
  data 118
  project 26
export data 77

- F -

folder 26

- G -

gain control 45
Germany rating level 109
Great Britain rating level 106

- H -

hardware 7
hearing threshold 55
highlights 6

- I -

image 115
import
  multiple projects 28
  NoiseScout *.zip 28
  preferences 32
  repeat mode data 28
  weather data 28
  XL2 file 28
impulse analysis
  survey method 92
  third octave method 92
impulses 91
impulsive sound marker 61
info section 40, 52
installation 7
instance 10
internet 28
interval 102

interval 102
export 72
introduction 6
Italy rating level 111

- K -

k1, k2 47
key marker 61

- L -

LDEN 87
example 88
legacy data 28
legend 55
level
display 52
marker 61
overview 44
results 77
setup 47
setup default 32
spectrum 55
statistics 83
level marker 61
license 28
license agreement 20
lock cursor 58
logo 115

- M -

main chart 40, 52
marker
automatic 61
data 77
export 72
result view 79
spectrum 61
measurement results 52
midnight 87
MS Excel 118
multiple instances 10

- N -

night 87
example 88
nighttime 101
NoiseScout 28
notes 61
NTi Audio 6, 20
NTi Data Explorer
option 26, 28
structure 10

- O -

option 26, 28
overview chart 40, 44

- P -

pan 60
pause 61
penalties 91
penalty 87
impulse 92
tone 94, 97
percentiles 83, 85, 86
default 32
period 102
photo 115
post trigger 61
pre trigger 61
print 115
probability 83
project 26
concatenate 28, 40
content 38
copy 26
export 72
import 28
info 38, 40
restore 26
save 26
pure tone 61
pure tone marker 61

- R -

rating level
calculation 102
definition 91
Germany 109
Great Britain 106
Italy 111
read-only mode 10
readout 58
reference method 97
repeat mode
data import 28
replay
sound file 45
voice note 26, 45
replay sound file 58
Replay Voice Note 46

report 115
preview 115
restore project 26
result view 77
RTA
levels default 32
RTA spectrum 55

- S -

save project 10, 26
separator 40
setup levels 47
default 32
share project 26, 28
shift zoom range 60
signature 115
software
installation 7
structure 10
sound file 45
special events 91
spectrogram 40, 55
spectrum 40, 55, 61
standard
Great Britain 106
Italy 111
statistics
level 83
RTA 85
step-by-step 12
structure 10
support 6
survey method 92, 94

- T -

table export 118
TaktMax 32
third octave method 91, 92, 94
threshold 61
time
marker 61
of marker 61
time axis 40
time of day 91, 101
tonality 61
tone analysis 94
engineering method 97
FFT 97
reference method 97
survey method 94
third octave method 94
tone marker 61
tones 91
trial mode 28
trigger 61
tutorial
basics 12

- U -

undo amendments 26

- V -

view 10
chart 40
project 26
result 77
voice note 26, 45

- W -

weather data
import 28
marker 61
weekday 101

- X -

X-axis zoom 60
XL2
marker 61
XL2 Data Explorer
old projects 7
XL2 setup 12

- Y -

Y-axis scale 60
default 32

- Z -

zoom 58, 60

Notes