

# Environmental Noise Studio

NS-ENS

## INTRODUCTION

The quality and performance level of the Expert Line with the new XPT800 and XPT801 models for noise measurement is now supported by a completely renewed software line, which includes the highest levels of functionality and versatility.

The NS-ENS module dedicated to the in-depth analysis of environmental noise is designed by acousticians for the needs of acousticians, taking into consideration the potential of new technologies.

## USES

- Manage, download and archive noise measurement data
- View, post-process and export measurements
- Generate professional reports

## FEATURES

### Customizable Functions

Adapt the software to meet specific local country requirements effortlessly.

### Comprehensive Visualization

Implement plots of all relevant views to gain an in-depth understanding of acoustic phenomena and conduct thorough post-analysis.

### Advanced Processing Capabilities

Handle long time profiles and frequency spectra domains efficiently for detailed events identification and levels quantification.

### Noise Source Analysis

Extract and quantify noise sources with precision, utilizing advanced detection algorithms for tones and impulses.

### Detailed Statistical Insights

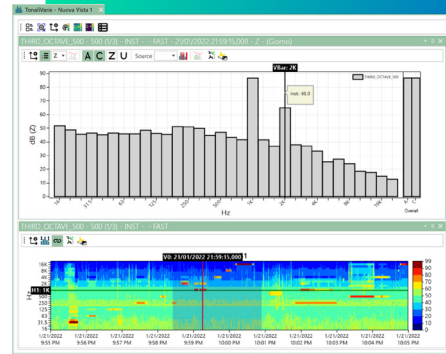
Generate statistics on broad band levels and spectra for comprehensive acoustic analysis.

### Regulation Compliance

Stay compliant with technical standards and regulations using powerful tools designed for acousticians.

### Effortless Reporting

Save time and generate professional documents with easy-to-use reporting features.



[www.senseca.com](http://www.senseca.com)



### CAPTURE THE ESSENCE OF SOUND PHENOMENA

Extract all the important details from your measurement and capture the essence of sound phenomena



### EFFORTLESS STORE AND ACCESS YOUR DATA

Data archive based on a free\* cloud storage platform NS Storage compatible with all models of Senseca sound level meters



### ACCORDING TO STANDARDS

Directive 2002/49/EC  
ISO 1996-2:2017  
DM 16 march 1998  
UNI111143-3

\* Limited free storage space

## FUNCTIONALITIES

New desktop software with advanced graphics and zoom capabilities, dockable windows and multiple monitor use. Project structure and management of sound and vibration (planned) measurements in a distributed architecture suitable both for single engineers as well as for big engineering companies.

### Free functionality\*

Measurement data storage on NS Storage web application (<https://noise-studio.senseca.com/>). Display, export, sharing of data. Account protected with users' management.

Full software functionalities on demo evaluation projects downloadable from NS Storage web application

### License-related functionality

Import, through NS Storage web application, of measurements data stored on new XPT80X series Expert Line of sound level meters or HD2110L, HD2010UC/A, HD2010UC models

Analysis of measurement data through a project structure including data and processing in the same container. Full project import and export functionality

**Views** Multiple measurements display on the same plot (from different instruments as well). Level vs time, level vs frequency, spectrogram, cumulative distribution, amplitude distribution, statistics vs time, spectral statistics, spectral statistics vs time, table views of all data. Powerful zoom and scroll functions for easy display of long-time histories. Plot between cursors.

**Cursors** Multiple vertical and horizontal cursor with level and time indication. Leq calculation between V cursors. Level difference between H cursors. Precise cursors positioning by date/time input or fine keyboard positioning. Cursors snap and centring on plots. Cursors sync: jump cursor to plot center or jump plot to cursor position.

GENERAL	<b>Language</b>	Multi language (English, Italian) - <i>additional languages planned</i>
	<b>Legislation definition</b>	Customizable daily periods (day, evening, night) and customizable acoustic areas with related noise limits by period and zoning area.
	<b>Instruments management</b>	Database of measurement chains (manufacturer, model, serial); periodic calibration date and time management with email notification on calibration expiry date. Possibility to insert on reports.
	<b>Plots customization</b>	Colours, transparency, lines style and thickness
	<b>Reporting</b>	Default templates path management
	<b>System environment</b>	Measurements database URL and NS Storage login settings

**Project settings** Customization of reference legislation, acoustic zoning areas and related noise limits. Measurements date/time shift.

CALCULATIONS	<b>Lp levels</b>	Advanced analysis of sound pressure levels vs time and vs frequency.
	<b>Running Leq</b>	Calculations and plot of Leq between cursors and full measurement
	<b>Levels by period</b>	Day, evening, night or user defined); Ld, Le, Ln, Lden, Ldn
	<b>Sources</b>	Create, modify, delete, merge (union) multiple sound sources. Calculations of sources levels and sources levels by period. Detection by time interval, threshold exceedance levels (below threshold or above threshold) and duration.
	<b>Events</b>	identification manual, by time interval, by threshold exceedance level and duration; related individual levels calculation. List and number of occurrences of multiple events by period, with date, duration, levels (Leq, SEL..). Synchronization of single events plots with the selected event and interactive editing functionality. Events individual exclusion from calculation (masking)
	<b>Impulsive components</b>	Detection and analysis according to relevant standards. List of occurrences by customizable time window. Statistic plot of impulses distribution by time window and period. Leq correction factors (penalties) for impulsive components detected (according to DM 16/03/98)
	<b>Tonal components</b>	Identification and analysis according to relevant standards (DM 16/03/98 and ISO1996-2:2017). Prominence filters (adjacent band exceedance). Isophones contours (ISO226). List of tones occurrences by period with time of occurrence, level, Phon level, duration. Leq correction factors (penalties) for tones components detected by period.
	<b>Statistical analysis on broad band levels</b>	Calculation by source (single or multiple) of any Ln percentile levels, cumulative distribution of selected band, levels distribution of selected band over full measurement time of by time periods (customizable) with time evolution plot
	<b>Statistical analysis on frequency bands levels</b>	Calculation by source (single or multiple) of any Ln percentile levels, cumulative distribution of selected band, levels distribution of selected band over full measurement time of by time periods (customizable) with time evolution plot
	<b>Audio events</b>	play-back synchronized with time history plots (only for XPT80x).
<b>Max annoyance period</b>	calculation, within a measurement period, of sub-periods with maximum and minimum levels on a user defined sliding time window	

**Spectra** Broadband, A, C, Z, User, between 2 frequency bands. AVG Log, AVG, Min, Max between time cursors or by source. Spectrum post-weighting A, C, Z, USER. Multi-Spectra filtering by adjacent bands exceedance. Tone automatic identification, Equal-loudness level contours (ISO 226).  
Minima Sonogram: min multi-spectra on sliding time window (user customizable time period), on whole measurement or by source.

**Environmental Noise assessment** Calculations according to DM 16/03/98 (immission, emission, differential levels, CT, CB and CI detection, limits exceedance ev.)  
Calculations of environmental noise descriptors according to 2002/49/EC

**Reporting** Automatic reporting based on customizable Ms Word® templates with tags. Preview of report. Export in Ms Word®, PDF, HTML, Json. FastReport® preview. Management of customers, staff, instrumentation used, on site adjustment values (before and after measurement campaign), environmental conditions during measurement campaign.

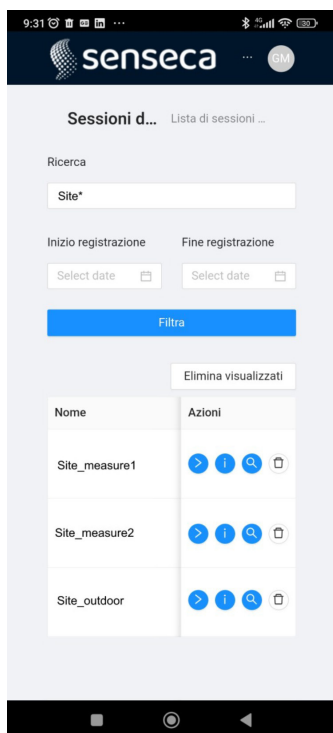
## Data management

Data stored in the new sound level meters XPT800 and XPT801 or in HD2110L, HD2010UC/A and HD2010UC (with datalogger) models, are manually archived\* or automatically synchronized (only with Push option for XPT80x via Wi-Fi, Lan or 4G device) in the cloud service through the NS Storage web application. Data stored and organized in workspaces protected by access credentials can be viewed by the workspace owner as graphs and tables through any device equipped with a web browser connected to the Internet and can be exported in text format.

Workspace owners can share their data with any user by assigning, for example to a collaborator, specific (revocable) permissions for the use of one or more workspaces.

The data in the workspaces are directly accessible through the NS-ENS software and can be downloaded and archived locally for analysis.

\*Limited free storage space.



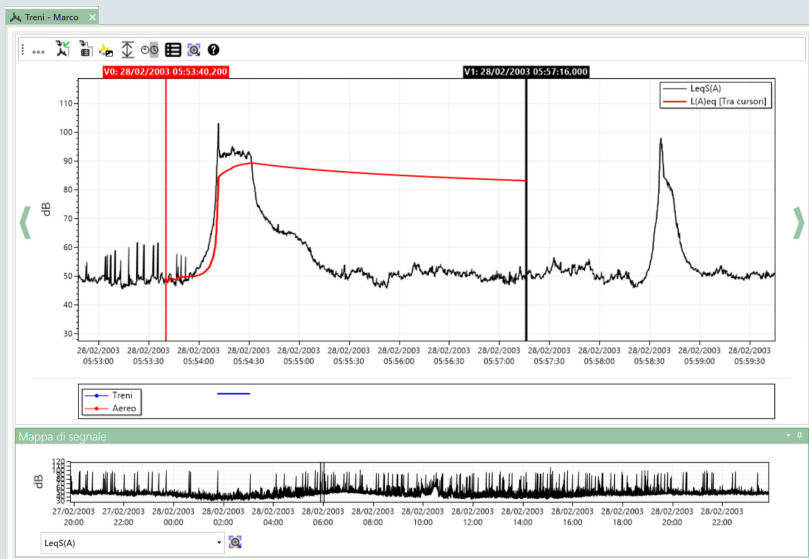
NS Storage for mobile



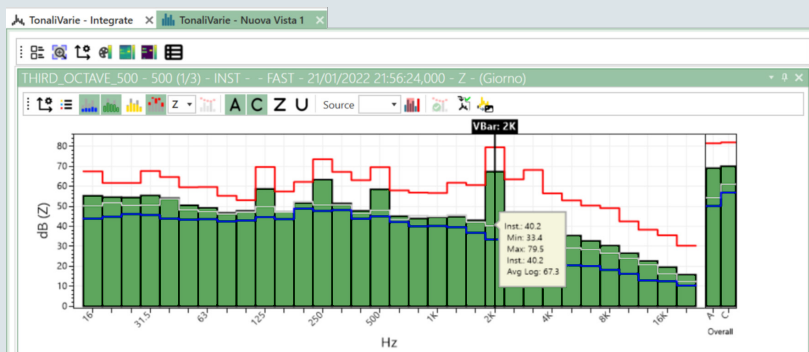
## IEWS

Parametro	Valore (dB)	Valore (Pa)	Ponderazione	Integrazione	Tipo	Classe	Formato	Inizio	Durata Misura
LLeq,T	95.2	1.1509	A	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LCEq,T	102.6	2.6979	C	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LZeq,T	102.7	2.7292	Z	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LALeq,T	99.4	1.8665	A	IMP	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LCLeq,T	106.9	4.4262	C	IMP	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LAE,T	104.5	3.3576	A	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LCE,T	111.9	7.871	C	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LZE,T	112.1	8.0543	Z	LIN	AVG	0	14/02/2024 08:50:41.000	00:00:08.600	
LZFp,mx,T	115.9	12.4747	Z	FAST	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	
LASp,mx,T	103.3	2.9244	A	SLOW	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	
LCSp,mx,T	110.8	6.9347	C	SLOW	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	
LALeq,mx,T	109.4	5.9024	A	LIN	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	
LCEq,mx,T	116.9	13.9968	C	LIN	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	
LZeq,mx,T	116.9	13.9968	Z	LIN	MAX	0	14/02/2024 08:50:41.000	00:00:08.600	

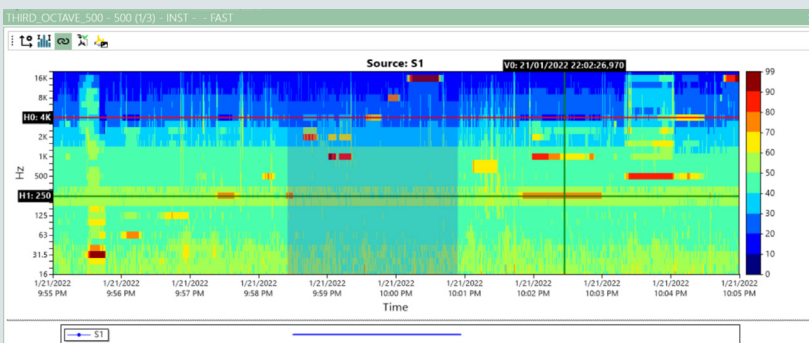
Overall levels list



Level vs time graph with running Leq between cursors calculation and plot (in red)



Third octave histogram: calculation of max, min, avg from multi-spectra



Spectrogram of third octave multi-spectra (frequency vs time)

## Overall levels

Broad band levels are displayed in tabular view with user friendly and advanced filtering functionalities.

All information are available and those not required for reporting, when necessary, can be hidden.

## Level vs Time

Sound pressure levels are plotted in an “amplitude vs. time”, multi-parameter graph with advanced scroll and zoom functionalities. Multiple vertical and horizontal cursors allow reading of values at specific times.

Useful interactive calculation functions can be activated between cursors and on plots to easily evaluate, numerically and graphically, specific events.

## Level vs Frequency

Amplitude versus frequency histograms with overlapping of different types of spectra. Calculation and display of average, min and max spectra, post-weightings, and calculations of overall levels between two selectable frequency bands.

## Level vs Time vs Frequency

Colour map plot with amplitude vs time vs frequency information.

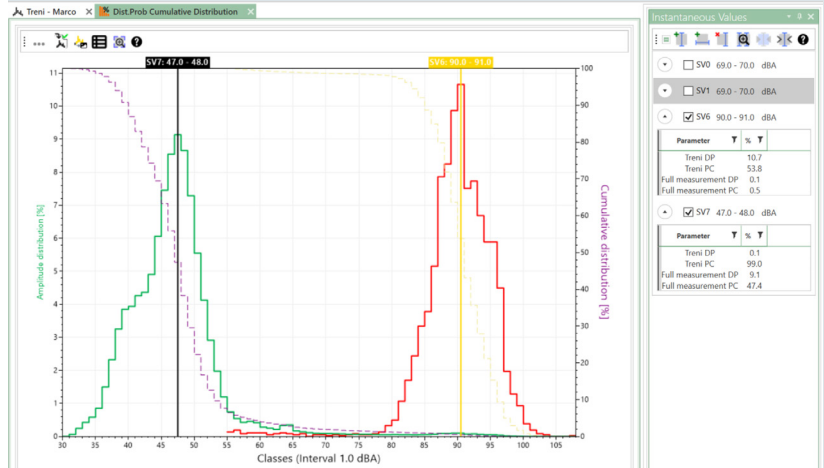
Time is represented on the horizontal axis, frequency on the vertical axis, while amplitude is represented in a configurable colour scale. Spectrogram representation is ideal for qualitative analysis of complex acoustic phenomena.

## VIEWS

### Cumulative and amplitude distribution

Statistical graphs allow evaluation of sound levels distribution.

Levels distribution and cumulative distribution are available also by sound source allowing to quantify contribution of all identified sources in a complex noise environment.



Levels statistical distribution by identified sound source

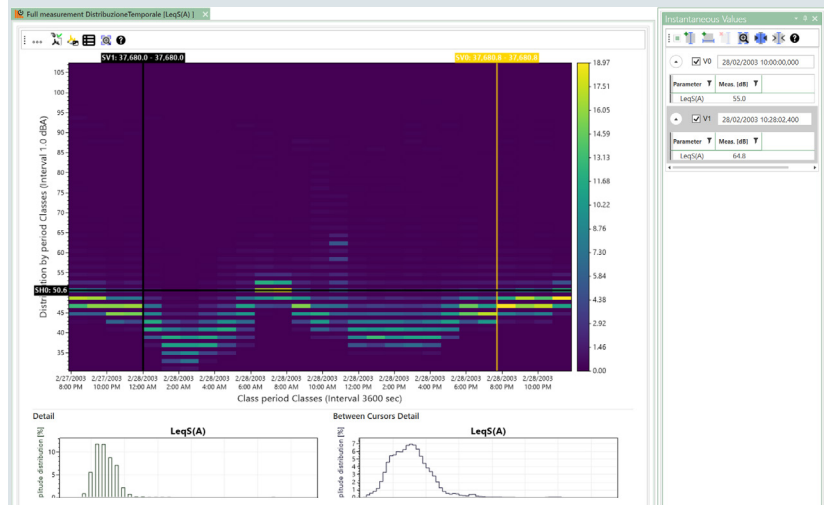
### Statistics vs Time

Distribution of sound levels is also available by user-customizable time periods.

This plot allows evaluation of statistical descriptors within specific user-defined time intervals of interest (ie hourly or daily).

The graph of an Ln percentile level by octave or third-octave bands, can also be calculated and displayed for time periods customizable by the user.

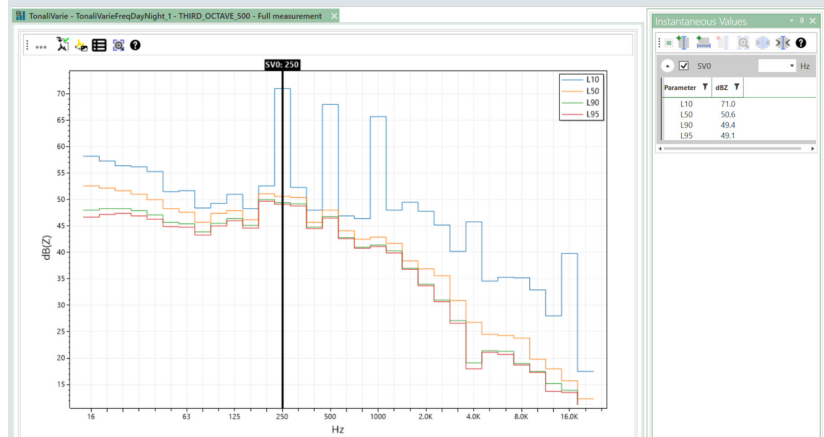
Frequency and time detail allow to evaluate specific time intervals or specific octave or third octave statistics evolution vs time.



Level distribution vs time period

### Spectral statistics

Ln percentile levels can also be calculated and displayed by octave or third octave bands.



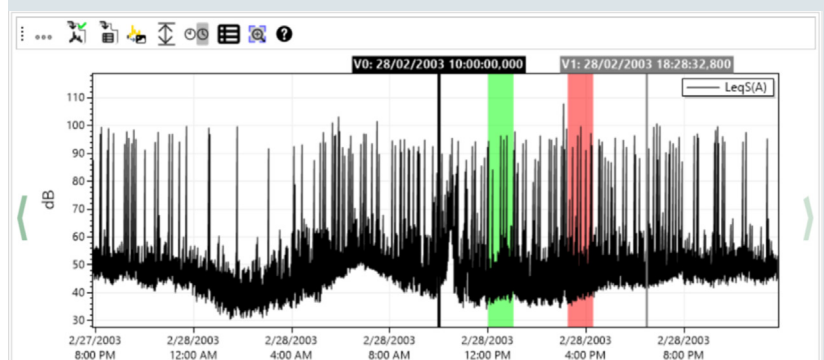
Ln percentile levels of third octave spectra

### Maximum and minimum annoyance periods

Identification of time periods when noise levels are the highest and the lowest.

The sliding window time duration and sliding step are customizable.

Max and min periods can also be calculated by day, night or any custom periods.



Maximum (red) and minimum (green) noisy periods in a long term noise monitoring

# PROCESSINGS

Events

Global levels per period

Parameters		Day: 07:00 - 19:00			Evening: 19:00 - 23:00			Night: 23:00 - 07:00			Day: 07:00 - 19:00			Evening: 19:00 - 23:00			Night: 23:00 - 07:00		
Source	Parameter	Occurrences	Leq	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	Occurrences	L <sub>Aeq</sub> TR	
Treno_Marco	Leq5(A)	76	92.4	0	0.0	10	72.0	4	63.2	36	70.4	12	70.0	14	67.3				
Treno_Paola	Leq5(A)	6	84.0	0	0.0	0	0	0	0	5	59.1	0	0	0	0.0				
Aggregati		82	88.0	0	0.0	10	72.0	4	63.2	41	66.5	12	70.0	14	67.3				

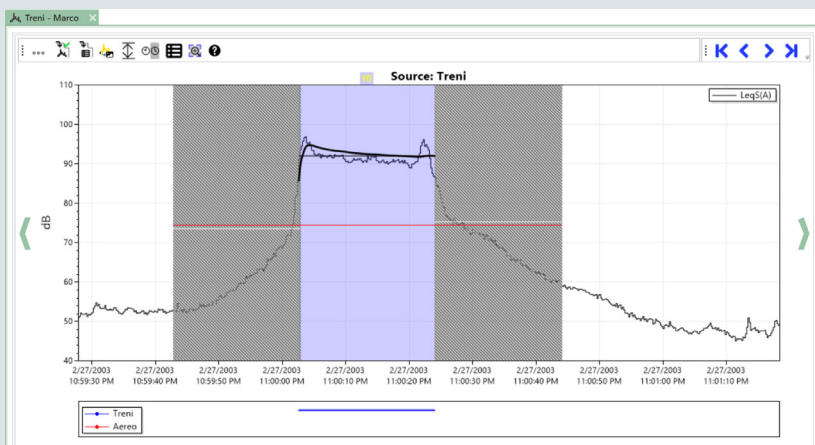
Events list

n°	T	Name	Origine	Start	End	Espace	Leq	Leq (db) before	Leq (db) after	SEL	Leq max	Range Leq max	
1		Treno		27/02/2003 20:14:33.200	27/02/2003 20:15:15.000	00:00:21.800	95.8	74.5	75.7	75.1	109.2	99.5	27/02/2003 20:15:11.400
10		Treno		27/02/2003 23:00:02.600	27/02/2003 23:00:24.000	00:00:21.400	92.1	71.6	75.3	74.5	105.4	96.9	27/02/2003 23:00:03.800
20		Treno		28/02/2003 05:17:22.000	28/02/2003 05:17:43.400	00:00:21.400	94.5	72.1	71.9	73.0	107.8	97.6	28/02/2003 05:17:41.000
27		Treno		28/02/2003 06:50:20.256	28/02/2003 06:50:40.202	00:00:19.946	82.9	54.1	54.4	54.2	95.9	93.4	28/02/2003 06:50:23.800

## Sound events

Sound events such as train transits or aircraft overflights are identified and marked, starting from both broadband or frequency band sound level profiles, thanks to an algorithm based on level and duration thresholds.

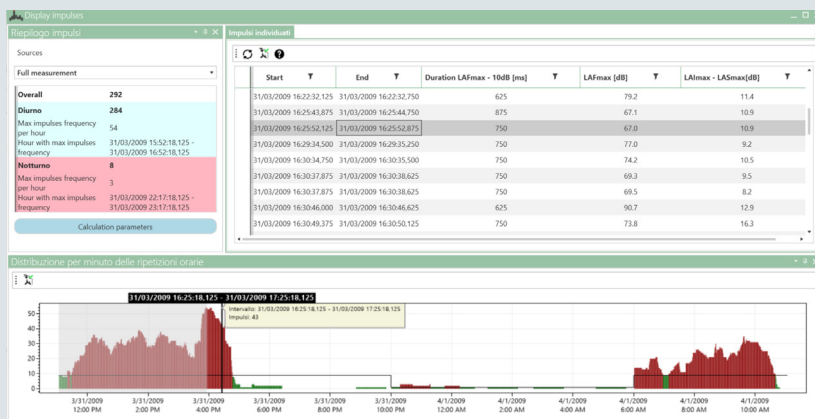
For each identified event, individually listed and graphically plotted, it is possible to interactively modify extremes of the time interval, calculate sound levels (Leq, SEL, Lmax.), times of occurrence, duration, and other descriptors or compare calculated levels with the background noise level. Detected sound events can subsequently be evaluated and attributed to any different sound source also with the aid of audio playback. Overall levels of identified events during specified day time periods and number of occurrences are calculated and a comprehensive list is given with all relevant information for reporting.



Identification of events: train transit with indication of study zone and list of all events levels

## Sound sources

Manual or automatic sound sources creation. Automatic detection by threshold level exceedance (on broadband levels or on specific frequency bands), duration and time period. Sources merging, exclusion from calculation (masking). Sources individual levels calculation for the whole period or by occurrence. Sources levels by period of law (ie. day, evening, night or user defined). Sources levels by specific user defined periods (ie. minute, hour, day).



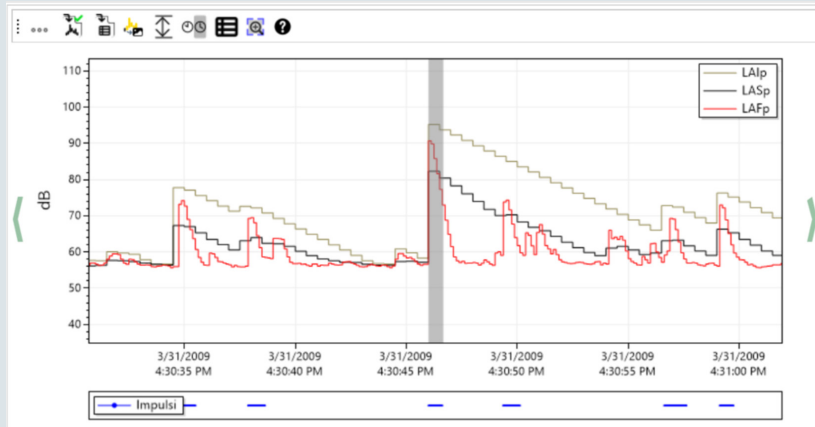
## Impulses identification

A specific configurable algorithm allows automatic identification of impulsiveness of noise. All detected occurrences, related to impulsive noises, are individually listed and detailed analysis of each impulse can be done through an interactive interface.

Number of occurrences by day period (day, night or user defined) as well as related levels are given. Statistical analysis including distribution of occurrences during configurable sliding time window is available, allowing an in-depth evaluation of impulsive noise events during day, night or any time periods.

An interactive graphic representation of occurrences by time period, sliding time window and exceedance limits is available for easier analysis and reporting.

A +3dB penalty can be applied to environmental noise level at receiver.



Impulses identification: list, statistical distribution and individual event plot

## PROCESSINGS

### Tones identification

Tone identification is based on the following alternative methods:

#### D.M. 16/03/1998

Automatic identification of tonality according to Italian law Decree (DM16/03/98).

The automatic identification of sound sources with tonal characteristics, is obtained, starting from LFP multi-spectra in 1/3 octave bands, through an algorithm capable of filtering the frequency components exceeding those immediately adjacent. The algorithm offers the possibility of adapting detection parameters such as the temporal resolution, the amplitude of the temporal window and the amount of the exceedance from adjacent bands. The result is a map of possible tonal components. The "candidate" components thus identified, can be selected by technician and compared with isophones contours (ISO 226) to determine whether they are more audible and annoying compared to other frequency components on the same spectrum. According to named technical rule, a penalty of +3 dB can be applied to environmental noise immission level at the receiver and an additional +3dB when tonality is detected below 200Hz.

#### ISO1996-2:2017

Tonality tests for the presence of tones by comparing the time-averaged sound pressure level (SPL) in a given 1/3 octave band with the time-averaged SPLs in the adjacent two 1/3 octave bands.

For a tone to be identified as present, the time-average SPL in the band of interest must exceed the time-averaged SPLs of both adjacent 1/3 octave bands by some constant level difference. The assessment is carried out in accordance with Annex K of ISO-1996-2:2017. The before mentioned constant level differences given in Annex K, described as „possible choices“ are: 15 dB in low-frequency bands (25Hz-250Hz) 8 dB in mid-frequency bands (160Hz-400Hz) 5 dB in high-frequency bands (500Hz-10KHz)

### Statistical analysis

Recalculation of statistical **broadband levels**: user-defined Ln percentiles by source or on full measurement period.

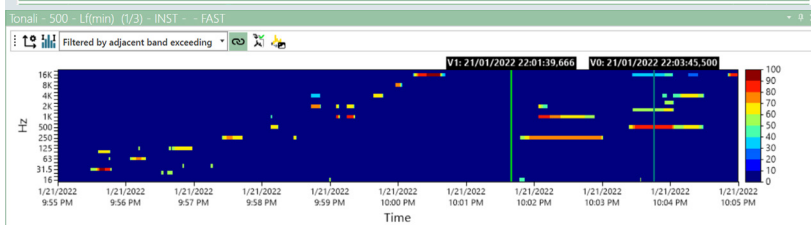
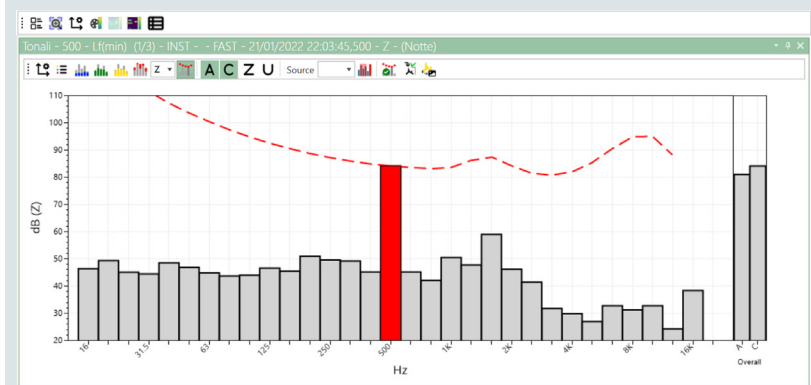
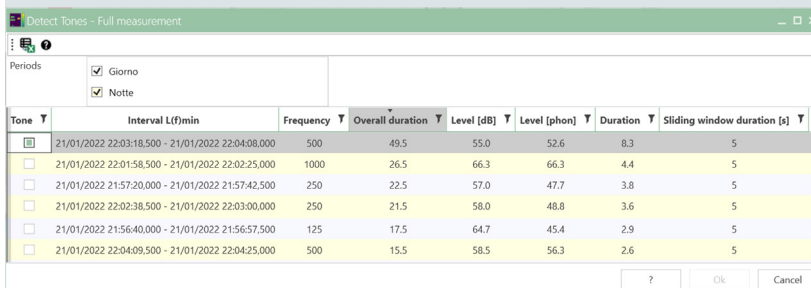
Calculation of percentile levels graph by source or on full measurement period with customizable level class.

Calculation of cumulative distribution graph by source or on full measurement period and levels distribution graph with customizable level class.

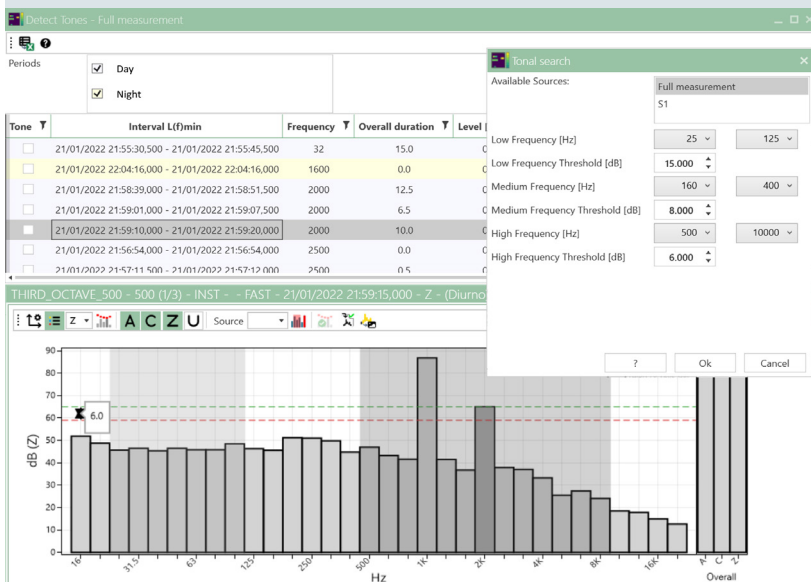
Recalculation of **spectral** (1/1 or 1/3 oct) statistical levels: user defined Ln percentiles on full measurement period or by source.

Calculation of percentile levels graph by source or on full measurement period with customizable level class.

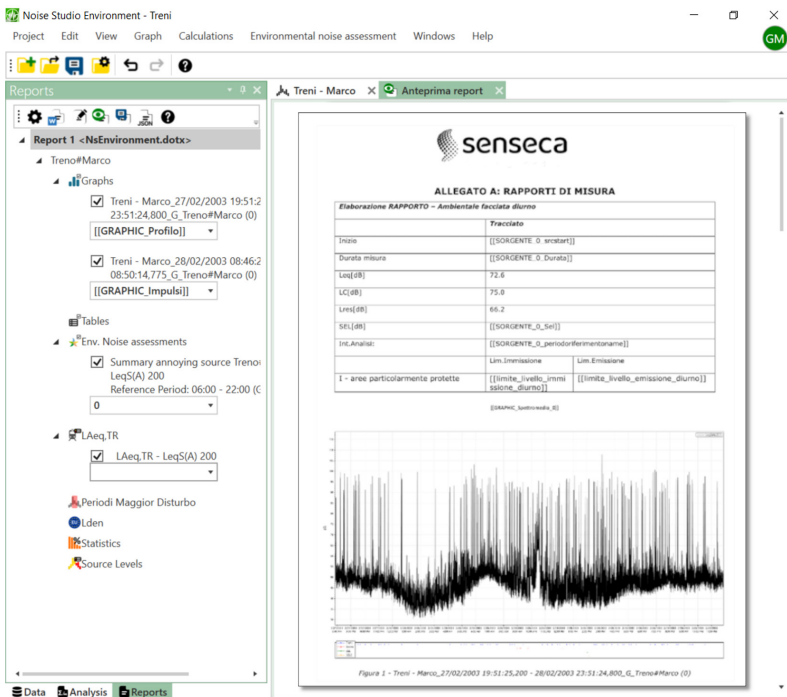
Calculation of Ln percentiles by source on user defined measurement periods.



Tonality: tones list and plot. Filtered tones by exceedance



Tonality: tones list and plot according to ISO 1996-2



Reporting manager tree and document preview

## Reporting

The application allows to create a Microsoft Word® docx document with the contents obtained during the analysis process.

The report that is generated is based on loading a .dotx template (an example is provided with the application itself).

By inserting references in the template, it is possible to place the graphic, tabular and scalar elements anywhere in the report and automatically. By default, each project always contains a standard report, but you can add an unlimited number of different reports.

In the application general settings and in each project's settings section, the user can save information like measurement chain used, certificate of calibration with expiry date, areas of use and related exceedance limits, applied legislations; such information's can be included automatically in the report on user's request.

## General characteristics

- Language** English, Italian (others TBA)
- Help** Online contest-sensitive help English and Italian  
Keyboard shortcut commands
- Licence** Single-user license: license allows to use Noise Studio from one machine at a time, not necessarily the same one, and you do not need to be online except for the first login from a machine. Operation of the program is guaranteed offline on the last registered machine without time limits.  
  
Multi-user licenses: license allows to use Noise Studio from N machines simultaneously where N is the size of the purchased license. Each machine can work offline for a limited time (e.g. 4 - 8 hours), after which the program turns off. To reactivate it you will need to go back online. During online/offline operation the program consumes one of the N licenses associated with the user.
- Hardware** Operating System:  
Windows® 10 (32-bit / 64-bit) or higher.  
.net Framework 4.7.2  
Recommended PC:  
Intel® Core™ i7  
16 GB of memory  
Sound card  
At least one available USB port  
Display resolution: 1920x1080 px minimum

## Ordering codes

- NS-ENS** Environmental Noise Studio: desktop software module for advanced environmental noise analysis. Compatible with Windows OS (min. Windows10)

## Standards

- EU** Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise
- ISO** ISO 1996-2:2017 Acoustics – description, measurement, and assessment of environmental noise – Part 2: Determination of sound pressure levels (Tones assessment)
- UNI** UNI 11143-3 Metodo per la stima dell'impatto e del clima acustico per tipologia di sorgenti. Parte 3: rumore ferroviario
- Italy** DM 16 marzo 1998 - Tecniche di rilevamento e di misurazione dell'inquinamento acustico  
DPCM 14 novembre 1997. - determinazione dei valori limite delle sorgenti sonore  
DPR 18 novembre 1998, n. 459. Regolamento recante norme di esecuzione dell'articolo 11 della legge 26 ottobre 1995, n. 447, in materia di inquinamento acustico derivante da traffico ferroviario