HD 2110L
INTEGRATING SOUND LEVEL METER - PORTABLE ANALYZER

The HD2110L is a precision integrating portable sound level meter, with multiparametric data logging capability, providing both spectral and statistical analysis. The instrument has been designed in order to offer high-performance analysis of acoustic phenomena, with particular regard to legislation on environmental noise. Attention has been paid to the possibility to update the instrument in order to comply with the technical standards evolution. The HD2110L can be integrated with additional options to extend its application range when required; the firmware can be updated directly by the user by means of the Noise Studio program provided with the instrument.

Technical regulations:
- **Class 1 sound level meter according to IEC 61672-1, 2002 (Type Approval Certificate I.E.N. No. 37035-01C)**, IEC 60651 and IEC 60804.
- Class 1 octave and third octave filters according to IEC 61260
- Microphone in compliance with IEC 61094-4

Features
- real time spectral analysis in **octave** bands from 16Hz up to 16KHz
- real time spectral analysis in **third octave** bands with a double bank of filters: from 16Hz up to 20KHz and alternatively from 14Hz up to 18KHz **(option HD2110.01)**
- narrow band **FFT** real time spectral analysis from 7Hz up to 22KHz with variable resolutions from 1.5Hz a 100Hz. Short Leq profile acquisition with 1/32s period **(option HD2110.06)**
- **statistical analysis** with probability distribution calculation in 0.5dB classes; calculation of all percentiles from L_1 to L_{99}.
- parallel storage of all **multi-parametric time profiles**, **reports** at programmable intervals and reports associated to specific **noise events** (automatically or manually identified).
- **reverberation time** measurement with *steady noise interruption* or with *back integration of impulse response* (**option HD2110.04**)

Applications:
- **Noise monitoring** with sound event capture and analysis function,
- **Environmental noise measurement,**
- Assessment of **noise tones** even if they are at a frequency located between two standard third octave band filters (with shifted bands filters),
- Assessment of **audibility of spectral components** through real time comparison with equal loudness curves (ISO226)
- Evaluation of **noise exposition** in workplaces, and selection of **personal protective equipment** (SNR, HML and OBM methods),
- **Sound insulation** and reclamation
- Production quality control,
- Measurement of machine noise, **sound power** measurements (sound pressure method)
- **Architectural acoustics** and **building acoustics** measurements.

Inputs and outputs
- LINE unweighted input/output (Ø 3.5 mm jack).
- DC output: A-weighed sound level with FAST time constant, updated 8 times per second
- TRIGGER input/output (Ø 3.5 mm jack).
- Standard RS232C serial port in compliance with EIA/TIA574. Baud Rate 300 to 115200 baud.
- USB 1.1 serial port.
- External power supply 9÷12Vdc (Ø 5.5 mm jack).

Functionality description
Acquisition
- Possibility to log time profiles of 6 simultaneous parameters freely selecting time or frequency weightings.
- Possibility to store the multi-parameter sound level analysis for more than 46 hours. Different time recordings can be recalled from internal memory and displayed and replayed using "Replay" function.
- In addition to sound level profiles, it's possible also to log at programmable intervals of 1s to 1h, report sequences with dedicated parameters, average spectra and full statistical analysis. A versatile trigger function allows to identify sound events and store results with 5 dedicated parameters, average spectra and statistical analysis.

HD WME

Dynamic capacity
- The measurement dynamic range exceeds 110 dB and it is limited in the lower range only by the instrument intrinsic noise. For example, by setting the full scale at 140 dB, it's possible, without modifying the gain setting, to carry out noise measurements in a quiet office with high accuracy and without overload indications at peak levels up to 143 dB.
- Thanks to its high dynamic range, long integrations can be carried out with a minimum possibility of under- or over-range indications.

Spectral Analysis
- Real time spectral analysis is carried out in parallel with the logging of 6 time profiles, both by octave and third octave bands (**Option HD2110.01**).
- The spectrum of sound signal is calculated twice a second and integrated linearly for up to 99 hours.
- It's possible to perform multi-spectrum CPB analyses, even maximum or minimum, both with linear or exponential time constants (Fast or Slow).
- Spectra are displayed together with an A, C or Z -weighted overall levels. Lin, A or C weightings are available for spectrum ponderation.
- The third octave band spectral analysis (**option HD2110.01**) can be carried out, in addition to standardized bands 16Hz - 20kHz, also with bands shifted downwards by $^1/_{6^{th}}$ octave, from 14Hz to 18kHz. This feature is useful to evaluate tones having a frequency close to filters crossing frequency (two third octave filters).
- While the third octave band spectrum (**option HD2110.01**) is displayed, it's possible to superimpose in real time the equal loudness curves (ISO226), for a fast estimation of spectral components audibility.

Statistical analysis
- As a statistical analyzer, the HD2110L samples the sound signal 8 times per second and analyses it in 0.5 dB classes.
- 4 percentiles values can be directly displayed on the screen. Additional percentiles can be calculated as reports.
- Calculation and direct display of probability distribution and cumulative distribution from L_1 to L_{99}
- You can program to sample L_{Fp}, L_{eq} or L_{pk} with A, C and Z-weightings (only C and Z for L_{pk}).

Analog Input/Output
- For further analysis, the LINE unweighted output allows recording the sound sample either on tape or directly on a PC equipped with a data acquisition card.
- Audio tracks recorded with other instruments can also be analyzed using the Line input.
- DC output: LAFp 1/8s

Calibration
- The calibration can be performed either by using an acoustic calibrator (type 1 according to IEC 60942) or the built-in reference generator.
- The electric calibration uses a special preamplifier and checks the sensitivity of the measuring channel, microphone included.
- A protected area in the non-volatile memory, reserved to factory calibrations, is used as a reference for the user's calibrations, so to allow keeping instrument drifts under control and to prevent the instrument from losing of calibrations.

Diagnostics
- The control of the complete sound level meter functionality can be made directly by the user, on site, thanks to a diagnostic programme.
- Most of possible damages occurred to the instrument, microphone included, can be promptly identified thanks to a complete diagnostic program that includes the frequency response measurement of the whole measuring chain: microphone, preamplifier and sound level meter.
- The regular execution of diagnostic programs allows making reliable sound measurements, avoiding any repetition due to a malfunction later discovered.

PC connection
- The RS232 and USB interfaces, allow quick data transfers from the sound level meter to the PC memory. For example, should the internal memory not be enough, in case of long term recordings, it's possible to activate the "Monitor" function that allows sending the displayed data to a PC via the serial interface and storing them directly on the PC mass memory.
- The HD2110L can be completely controlled by a PC through the multi-standard serial interface (RS232 and USB) by using a dedicated communication protocol. Through the RS232 interface, the sound level meter can also be connected to a PC via modem.
- Remote electrical calibrations and diagnostic tests can be executed using its remote control capabilities.

Reverberation time
- The HD2110L sound level meter with the "Reverberation Time" (**option HD2110.04**) can measure the T60 both using the sound source interruption method or the *impulse response integration* technique.
- The sound level meter's powerful DSP calculates 32 spectra/second allowing T60 calculations from 0.375s (according to ISO 3382), and it carries out simultaneously both octave and optional (**option HD2110.01**) third octave bands analysis.

Applications

Environmental noise
- It's possible to perform sound level monitoring, acoustic mapping and the assessment of the acoustic climate with capture and analysis of sound events.
- When measuring airports, railways and roads noise, the sound level meter can work as a multi-parameter sound level recorder, combining statistical and spectrum analyzer features.
- Impulsive events can be easily identified thanks to the ability to analyse the A-weighted profiles with FAST, SLOW, and IMPULSE time constants. All measurement parameters can be stored for later analysis.
- The identification of tonal noises is also easy as it is possible to display and record the minimum spectrum with any wideband weightings (Z, C or A) both by third octave bands (**option HD2110.01**) with standard nominal frequencies (16Hz - 20kHz), and with shifted by $1/6^{th}$ oct. central frequencies (14Hz to 18kHz).
- The tonal component audibility can be evaluated in the field thanks to the real-time calculation of equal loudness curves (ISO 226) directly on the SLM's display or using the Noise Studio software supplied.

Workers protection
- The HD2110L sound level meter can perform the measurements required to evaluate workers' noise exposure (European Directive 2003/10/CE). PPE can be selected through octave band spectral analysis (OBM method) or comparing the A and C-weighted equivalent levels measured simultaneously (SNR method).
- If an undesired sound event causes an overload indication, or simply alters the integration result, its contribution can be excluded using the Back-Erase function.
- Sources impulsivity can be evaluated using the IMPULSE time constant (L_{Aleq} descriptor compared to L_{Aeq})

Software for Windows® operating systems:

CH20: Hardware key for PC with Windows® operating systems. Plugged into a USB port enables PCs to use Noise Studio's software modules.

Noise Studio

The Noise Studio programme, supplied in the sound level meter kit, allows interfacing HD2110L to PC in a simple and intuitive way. It supports the *application modules* to be enabled with licence on the protection dongle. The software includes demo versions of the application modules. Main functions are:
- Transfer of stored data from the sound level meter to PC memory.
- Display of data in graphic and tabular format.
- Export to Excel and PDF format.
- Printing of graphs and data tables.
- Comparison of third octave bands spectra with ISO 226 noise contours.
- PC based data logging.
- Sound level meter user setup management.
- Sound level meter firmware update.

It results easier creating reports from sound level meter's measurements, thanks to the copy and paste function which allows to copy graphs or tables to external applications and to create PDF files.

Noise Studio NS1: 'Workers protection' module (to be activated by license)
This application module analyses noise and vibrations in the workplace according to the European directives 2003/10/EC, 2002/44/EC, UNI 9432/2011 and ISO 9612/2011. Sound level measurements and vibration measurements in workplaces are organized in a project where they can be handled and analysed according to standards requirements. The company information, the list of workers and the noise or vibration sources are organized in a database. In addition to calculating the noise exposure of workers the program allows to evaluate the effectiveness of personal protective equipment's (PPE) using the SNR, HML and OBM methods (the method applied depends on the presence or not of octave band spectrum on the sound level meter performances). According to UNI 9432/2011, the program also calculates the impulsiveness index of a noise source. The software creates complete reports both for individual worker and synthetic including the company exposition summary. Reports can be exported or printed directly.

Noise Studio: NS1 "Workers Protection" module; PPE effectiveness analysis.

Noise Studio NS2A: 'Acoustic Pollution' module (to be activated by license)
This application module analyzes sound level profiles for the assessment of the noise climate, airports noise, road traffic noise and railway noise according to 2002/49/CE Directive.
The noise climate analysis is made on a daily, weekly and annual basis with resolutions up to 1 minute.
Noise profiles detected outdoor, are analyzed in order to search for annoying sources characterized by a sequence of events such as railways and airports. The analysis is performed on a daily basis with a resolution equal to 1/8 of a second and with automated detection and analysis of sound events.

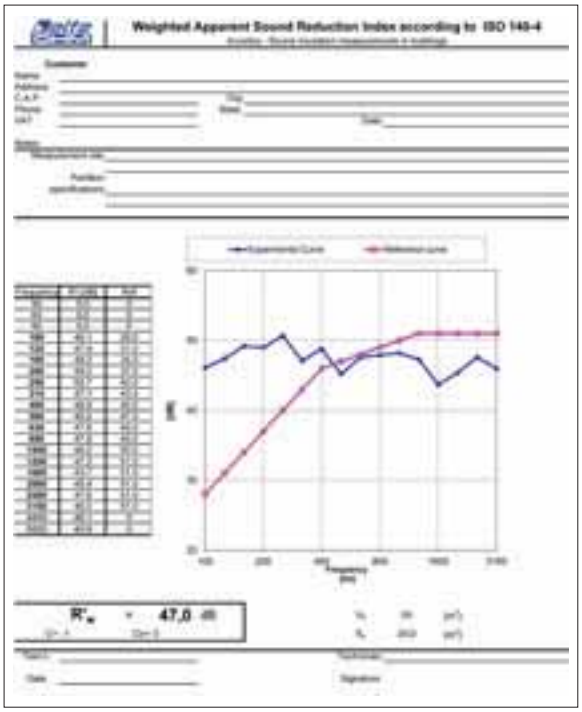
Noise Studio: NS2A "Acoustic Pollution" module; railway traffic noise, 24h analysis with automatic identification of train transits.

Noise Studio: NS3 'Acoustic Insulation' module (to be activated by license)
This module performs building acoustics calculations for the assessment of acoustic performances of buildings, according to ISO standard. The measurements necessary for the analysis of a building are grouped in a project to simplify their storage and search. Also, technical reports, comments, graphics, photos, etc. which remain part of the work can be added to the same measures and, if necessary, may be found easily.
An upgradable database, divided by walls and floors, contains the main characteristics of sound-insulating structures. The data contained in the database can be graphically and numerically compared with on-site measures.
It's possible to calculate:

- Average reverberation time (ISO 3382)
- Reverberation time decays editing
- Acoustic classification according to UNI 11367/2010
- Service equipments noise: continuous and discontinuous systems
- Area of equivalent absorption, coefficient of sound absorption (ISO 354)
- Airborne sound insulation: indices R, R' and D_{nT} (ISO 140/3, 4. 14 and ISO717-1)
- Insulation of facades and facade elements: indices $D_{2m,nT}$ and R_{θ} (ISO 140/5 and ISO717-1)
- Impact noise insulation: indices L_n, DL, L'_n and L'_{nT} (ISO 140/6, 7 and 8 and ISO717-2)

Most of the calculation require "third octave" and "reverberation time" options installed on the sound level meter.

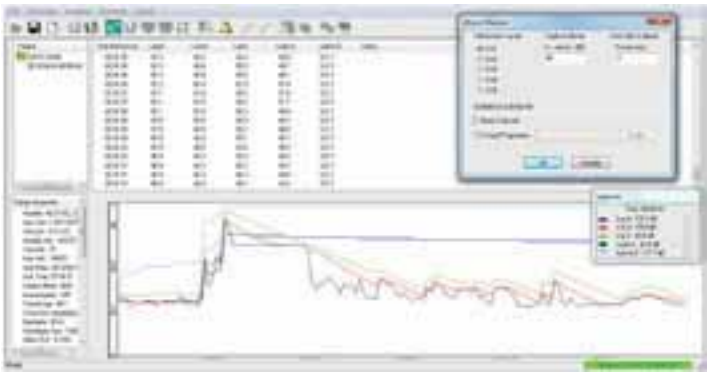
Noise Studio: NS3 "Acoustic Insulation" module; calculation of *airborne sound insulation* and *impact noise* descriptors.



Noise Studio: NS3 "Acoustic Insulation" module; ISO717 report.

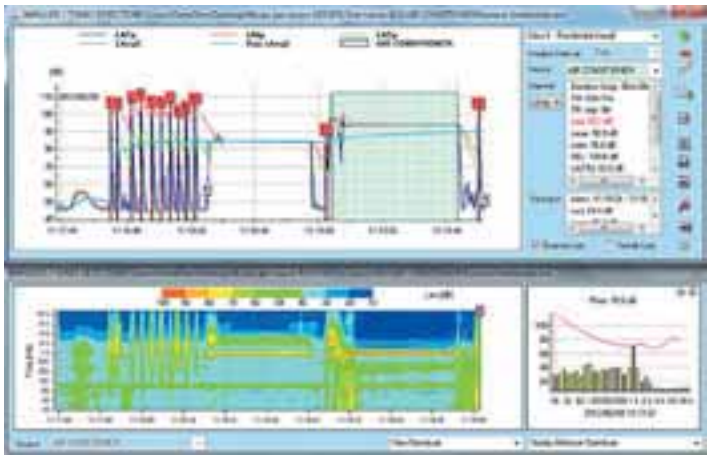
Noise Studio: NS4 'Monitor' module (to be activated by license)
This software module allows to control the sound level meter with PC in remote location. The main functions are:

- PC based real time display of acquired data, in graphical and tabular form.
- Possibility of connection via modem with the sound level meter.
- Acquisition of sound level data directly into the mass memory of the PC (monitor function).
- Management of diagnostic and calibration functions.
- Automatic acquisition and monitoring programme.
- Possibility to log synchronized audio records along with the sound level measurements, using a trigger function.



Noise Studio: NS4 "Monitor" module; PC based noise acquisition with synchronized audio recording (for later playback).

Noise Studio: NS5 "Environmental noise" module (to be activated by license)
Detailed analysis of acoustic pollution and environmental noise sources. The software performs statistical and spectral analyses; manually and automatically identifies, by means of the trigger function, single and combined sources. Partial sources levels can be calculated and compared to background noise. Masking and automatic search for pulse and tonal components. Automatic report and comparison with the limits, both absolute and differential.
Some of the functions require option HD2110.01 "Third octaves".



Noise Studio: NS5 "Environmental Noise" module; sound sources analysis with tonality and impulsiveness evaluation.

Options:
Option HD2110.01 "Third Octave": Third octave band spectrum analyzer according to class 1, IEC 61260 from 16Hz to 20KHz. Additional $^1/_3$ octave filters with shifted central frequencies from 14Hz to 18KHz.
The audibility of the different spectrum components can be evaluated thanks to the equal loudness curves (ISO 226:2003) displayed on the SLM's screen. Spectral analysis can be performed in multi-spectrum as well.

Option HD2110.04 "Reverberation Time": reverberation time **measurement both with steady** source interruption and with impulsive **noise back integration** method **(Shroeder's) according to ISO 3382.**
Reverberation time measurement performed in octave bands from 125 Hz to 8 kHz, and third octave bands (**option HD2110.01**) from 100 Hz to 10 kHz with sampling interval $^1/_{32}$ s.
Automatic calculation of reverberation times EDT, T10, T20 and T30 on all bands, and decay profile analysis with the possibility to calculate the reverberation time over a chosen interval.

Option HD2110.06 "FFT": constant bandwidth FFT analysis**.**
This option adds:

- Leq profile at $^1/_{32}$ s intervals.
- Narrow band spectrum analysis (FFT) from 7Hz up to 22KHz with spectral resolution from 1.5Hz to 100Hz.

HD2110.0P "Polarized microphone": replacement of the standard MC21E pre-polarized microphone and HD2110PEL preamplifier with the MC21P or MC22P microphone polarized at 200V and HD2110PL preamplifier.

HD2110.0R "Heated preamplifier": replacement of the standard preamplifier HD2110PEL with the heated version HD2110PEWL. The heated preamplifier is combinable with the microphone outdoor protection HDWME and is equipped with CTC device for electrical calibration and 5m integrated extension cable (other lengths 10, 20, 50 mt on request). **This option is available only in conjunction with MC21E or standard pre-polarized microphones. It's not compatible with option HD2110.0P**

Ordering codes and accessories
HD2110L.kit 1: includes, HD2110L sound level meter, MC21E pre-polarized ½" condenser microphone (alternatively MC21P or MC22P microphone polarized at 200 V) and HDSAV windscreen, HD2110PEL preamplifier (HD2110PL in combination with the microphone polarized at 200 V MC21P or MC22P), HD2110USB cable (alternatively, on request, HD2110RS serial cable for RS232 connection), Noise Studio software and carrying case, individual ACCREDIA calibration certificate, according to IEC 61672, of the chain consisting of sound level meter, preamplifier and microphone. ACCREDIA calibration certificate, according to IEC 61260, of the octave filters bank.
HD2110.01 "**Third octave**": spectral analysis with double bank of third octave from 16 Hz to 20 kHz and from 14 Hz to 18 kHz according to IEC61260. Evaluation of audibility of the spectral components by real-time comparison with the isophonic curves ISO 226:2003. ACCREDIA Calibration certificate according to IEC61260 of the bank from 20 Hz to 20 KHz included.
HD2110.04 "**Reverberation time**": reverberation time measurement by source interruption and integration of impulse response method.
HD2110.06 "**FFT**": $^1/_{32}$ s Short Leq profile and FFT spectral analysis over the entire audio range with variable resolution from 1.5 Hz to 100 Hz.
HD2110.0P "**Polarized microphone**": replacement of the standard MC21E pre-polarized microphone and HD2110PEL preamplifier with the MC21P or MC22P microphone polarized at 200V and HD2110PL preamplifier.
HD2110.0R "**Heated preamplifier**": replacement of the standard preamplifier HD2110PEL with the heated version HD2110PEWL. The heated preamplifier is combinable with the microphone outdoor protection HDWME and is equipped with CTC device for electrical calibration and 5m integrated extension cable (other lengths on request). **This option is available only in conjunction with MC21E or standard pre-polarized microphones. It's not compatible with option HD2110.0P.**

HD2020 Sound level calibrator class 1 IEC 60942:2003 with LCD display. Frequency 1000 Hz, levels 94 dB and 114 dB. **ACCREDIA individual calibration certificate included.**

HD9101: Sound level calibrator class 1 IEC 942:1988. Frequency 1000 Hz, levels 94 dB and 114 dB. **ACCREDIA individual calibration certificate included**

HD2010MC Module for data logging and data download to MMC or SD type memory cards, 2 GB SD card included.

HD2110PEL: Microphone preamplifier for MC21E pre-polarized microphones, equipped with CTC device for electrical calibration and driver for cable up to 100 m.

HD2110PL: Microphone preamplifier for MC21P and MC22P microphones polarized at 200V, equipped with CTC device for electrical calibration and driver for cable up to 100 m.

HD2110PEWL: Heated preamplifier for pre-polarized MC21E microphones, with 5m integrated extension cable (10, 20, 50 mt lengths on request). The preamplifier is combinable with the microphone outdoor protection HDWME and is equipped with CTC device for electrical calibration and driver for cable up to 100 m.

MC21E: ½" high stability pre-polarized condenser microphone, suitable for free field measurements. Compliant with IEC61094-4 WS2F type. Combinable with HD2110PEL and HD2110PEWL preamplifiers.

MC21P: ½" high stability condenser microphone polarized at 200 V, suitable for free field measurements. Compliant with IEC61094-4 WS2F type. Combinable only with HD2110PL preamplifier.

MC22E: ½" high stability pre-polarized condenser microphone, suitable for diffuse field measurements. Compliant with IEC61094-4 WS2D type. Combinable with HD2110PEL preamplifiers.

MC22P: ½" high stability condenser microphone polarized at 200 V, suitable for diffuse field measurements. Compliant with IEC61094-4 WS2D type. Combinable only with HD2110PL preamplifier.

HDWME: Outdoor protection with windscreen, rain shield and birds spike. **Combinable with the HD2110PEWL preamplifier**. Includes: windscreen HDSAV3, birds spike HDWME1, rain shield HDWME2, stainless steel support HDWME3

HDSAV: Windscreen for ½" microphone.

HDSAV3: Windscreen for HDWME microphone unit.

HDWME1: Bird spike for HDWME microphone unit.

HDWME2: Rain shield for HDWME microphone unit.

HDWME3: Stainless steel housing for the preamplifier of the outdoor microphone unit HDWME.

CPA/5: 5m extension cable.

CPA/10: 10m extension cable.

CPA/20: 20m extension cable.

CPA/50: 50m extension cable.

HD2110 RS: RS232 serial cable for PC connection or connection to HD40.1 printer.

HD2110 USB: serial USB cable for PC connection.

SWD10: Stabilized mains power supply Vin=100÷230Vac / Vout=12Vdc/1000mA.

VTRAP: Tripod, 1550 mm maximum height.

VTRAP.H4: Tripod with 4 m maximum height. Max. load 10 kg.

HD2110/SA: Support to fix the preamplifier to the tripod.

HD40.1: Portable serial printer with 57mm paper rolls and SWD10 power supply.

CH20: Hardware key for PC working with Windows® operating system. When plugged into the USB port, according to licence purchased, it enables the following Noise Studio software modules:

NS1: Noise Studio **"Workers' Protection"** module activation . Noise and vibration analysis in the workplaces according to UNI 9432/2011, ISO 9612/2011; 2003/10/CE and 2002/44/CE European directives.

NS2A: Noise Studio "**Acoustic Pollution**" module activation. Acoustic climate analysis and evaluation of road, railway and airport traffic noise (according to 2002/49/CE Directive). Some of the functions require HD2110.01 "Third Octaves" option.

NS3: Noise Studio "**Acoustic Insulation**" module activation. Architectural and building acoustic according to ISO354, ISO140 and ISO717 series standards and UNI11367/10. For some calculations sound level meter options HD2110.01 "Third Octaves" and HD2110.04 "Reverberation Time" are required.

NS4: Noise Studio "**Monitor**" module activation. Real time PC data acquisition. Synchronized audio recording. Monitor and remote control programming. Connection by modem.

NS5: Noise Studio "**Environmental Noise**" module. Analysis of acoustic pollution and environmental noise sources. The software performs statistical and spectral analyses; automatically identifies noisy events, impulsive and tonal components of the noise sources. Some of the functions require HD2110.01 "Third Octaves" option

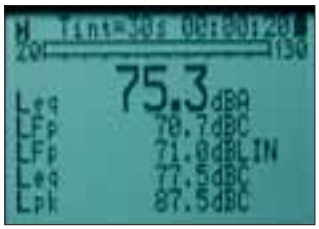
Noise Studio combined packages:

NSA "**Environment**" modules package including: NS2A "Acoustic Pollution", NS5 "Environmental Noise"

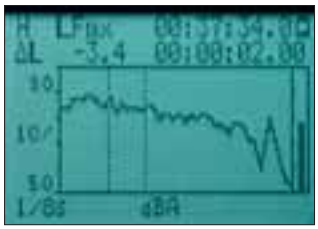
NSLA "**Work & Environment**" modules package including: NS1 "Workers Protection", NS2A "Acoustic Pollution", NS5 "Environmental Noise"

NSAE "**Environment & Building**" modules package including: NS2A "Acoustic Pollution", NS3 "Acoustic Insulation", NS5 "Environmental Noise"

NSS Noise Studio software **Complete Package** including: NS1 "Workers Protection", NS2A "Acoustic Pollution", NS3 "Acoustic Insulation", NS4 "Monitor", NS5 "Environmental Noise"

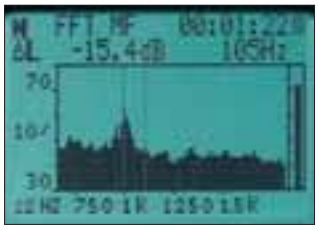


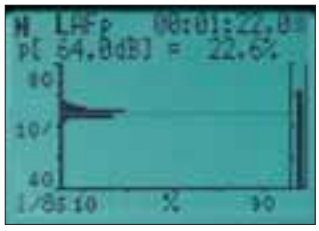
SLM screen

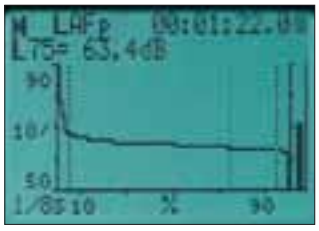

Profile screen


Octave bands spectrum


Third octave bands spectrum (option HD2110.01)


FFT narrow band spectrum (option HD2110.06)


Statistical analysis: probability distribution graph


Statistical analysis: percentile levels graph

TECHNICAL SPECIFICATIONS

Standards	Class 1 group X according to IEC 61672:2002 and class 1 according to IEC 60651:2001 and IEC 60804:2000 Class 1 according to IEC 61260:1995 Type 1 according to ANSI S1.4-1983 and S1.43-1997 Class 1-D, order 3, Extended range according to ANSI S1.11-1986
½ inch Microphones	✓ MC21E: ½" pre-polarized (0V) free field condenser microphone. Frequency range 3.15Hz-20KHz. Compliant with IEC61094-4 WS2F type. Compatible with HD2110PEL and HD2110PEWL preamplifiers. ✓ MC21P: ½", polarized (200V) free field condenser microphone. Frequency range 3.5Hz-20KHz. Compliant with IEC61094-4 WS2F type. Compatible only with HD2110PL preamplifier. ✓ MC22E: ½" pre-polarized (0V) diffuse field condenser microphone. Frequency range 3.15Hz-12.5KHz. Compliant with IEC61094-4 WS2D type. Compatible with HD2110PEL preamplifiers. ✓ MC22P: ½", polarized (200V) diffuse field condenser microphone. Frequency range 3.5Hz-12.5KHz. Compliant with IEC61094-4 WS2D type. Compatible only with HD2110PL preamplifier.
Dynamic range	23 dBA ÷ 143 dB Peak
Linearity range	110 dB
Acoustic Parameters	Spl, L_{eq}, L_{leq} SEL, $L_{EP,d}$, L_{max}, L_{min}, L_{pk}, Dose, L_n
Frequency Weighting	Simultaneous A, C, Z (only C and Z for L_{pk})
Temporal Weighting	Simultaneous FAST, SLOW, IMPULSE
Integration	From 1s to 99 hours with Back-Erase function
Spectrum Analysis	Parallel real time filters complying with IEC61260 class 1 specifications. ✓ 1/1 octave bands from 16 Hz to 16 kHz ✓ 1/3 octave bands double digital filters (**option HD2110.01**) from 16 Hz to 20 kHz and from 14 Hz to 18 KHz (shifted center frequency) ✓ FFT from 7 Hz to 22 kHz with variable resolutions from 1.5 Hz to 100 Hz (**option HD2110.06**) Modes: average spectrum (AVR), multi-spectrum (MLT), maximum (MAX), and minimum (MIN). Time averaging: Linear, Exponential (Fast or Slow) Spectral analysis can be A or C weighted or unweighted (LIN)
Audibility	Real-time comparison of 1/3 octave spectrum (option HD2110.01) with equal loudness curves (ISO 226:2003)
Statistical Analysis	Probability distribution and percentile level calculation from L_1 to L_{99} ✓ Parameters: L_{Fp}, L_{eq}, L_{pk}, A, C or Z weighted (only C or Z for L_{pk}) ✓ Sampling frequency: 8 samples/second ✓ Classification: 0.5 dB classes
Event Analysis	✓ Calculation of 5 freely programmable event parameters ✓ Calculation of octave and third octave (option HD2110.01) band average spectra ✓ Calculation of statistical levels from L_1 to L_{99} ✓ Event identification trigger with programmable threshold and duration filter ✓ External and manual trigger
Reverberation Time	Reverberation time measurement (option HD2110.04) using sound source interruption or back integration of impulse response
Profile Data Logging	1 user defined parameter profile with programmable sampling from 1/8 s to 1 hour, 5 profiles at 2 samples/sec, 5 additional user defined parameters from 1s to 1h (Report mode).
Spectrum Data Logging	Programmable sampling from 0.5s to 1 hour (MLT, MAX, or MIN modes) and parallel additional multi-spectrum sampling from 1s to 1h (Report mode)
Display	Backlit graphic display 128x64 ✓ 5 numerical parameters ✓ Profile of a selectable parameter with sampling time from 1/8 s to 1 hour ✓ Octave band spectrum from 16 Hz to 16 kHz ✓ Third octave band spectrum from 16 Hz to 20 kHz or 14 Hz to 18 kHz (option HD2110.01) ✓ Graph of probability distribution in 0.5dB, 1dB or 2dB classes ✓ Graph of percentile levels from L_1 to L_{99} ✓ Narrow band spectrum analysis (FFT) from 7Hz to 22 kHz (option HD2110.06)
Memory	Internal, equal to 8 MB (1 profile for 72 hours or over 46 recording days of 5 parameters + spectra per minute) External, via the HD2010MC memory card interface, using MMC or SD cards up to 2 GB
Input/Output	✓ RS232 serial and USB interfaces ✓ AC input and output (LINE) ✓ External event identification trigger ✓ DC output (Fast time constant)
PC Programs	Noise Studio (supplied with the instrument): PC interface for data download, setup and instrument management. Licensed software modules to be enabled by hardware key. ✓ NS1"Workers protection" module. Analysis of noise and vibrations in the workplaces according to ISO 9612/2011, UNI 9432/2011 and European Directives 2003/10/CE and 2002/44/CE. ✓ NS2A"Acoustic pollution" module. Analysis of environmental noise. Analysis of the noise climate and assessment of noise from road, rail and airport according to the law. Some of the functions need option "Third octaves". ✓ NS3"Acoustic Insulation" module. Evaluation of airborne sound insulation, impact noise and sound absorption; buildings insulation classification (UNI 11367). Some of the calculation require option "Third octaves" and option "Reverberation time" installed in the sound level meter. Calculation according to ISO140, ISO717 and ISO354. ✓ NS5"Environmental Noise" module: environmental noise analysis. Noise sources identification with threshold conditions. Tonality and impulsiveness evaluation. Some of the calculations require option "third octaves". ✓ NS4 "Monitor" module. Acquisition in real time on PC. Synchronized audio recording. Remote monitoring and data capture. Connection via Modem.
Operating conditions	Working temperature -10÷50°C, 25÷90%RH (without condensation), 65÷108kPa. Protection degree: IP64
Power supply	4 alkaline or rechargeable NiMH type AA batteries or external 9÷12Vdc 300mA
Dimensions and weight	445x100x50 mm equipped with preamplifier, 740 g (including batteries)