HD 2110
INTEGRATING SOUND LEVEL METER - PORTABLE ANALYZER

The HD2110 is a precision integrating portable sound level meter, with data logging functions, performing both spectrum and statistical analysis. The instrument has been designed in order to offer high-performance analysis of acoustic phenomena, with particular regard to Italian legislation on environmental noise. Attention has been paid to the possibility of adjusting the instrument to regulatory modifications and to the necessity of meeting its users' needs of today and tomorrow. The HD2110 can be integrated with other options to extend its application scope at any time; the firmware can be updated directly by the user by means of the Noise Studio program supplied with the instrument.

Technical regulations:
- **Class 1 sound level meter according to IEC 61672-1, 2002 (Certificate of Compliance I.E.N. No. 37035-01C)**, IEC 60651 and IEC 60804.
- Class 0 octave and third octave filters according to IEC 61260
- Microphone in compliance with IEC 61094-4

Applications:
- Noise monitoring with sound event capture and analysis function,
- Real-time octave and third octave band spectrum analysis from 16 Hz to 20 kHz,
- Statistical analysis with calculation of all percentile levels from L_1 to L_{99},
- **Environmental noise measurement according to the decree of 16/03/1998,**
- **Identification of tonal components even at the standard third octave band crossing point,**
- **Estimate of the audibility of spectral components through comparison with equal loudness curves in real time**
- Measurement in workplaces,
- Selection of personal protective equipment (SNR, HML, and OBM methods),
- Sound insulation and reclamation,
- Production quality control,
- Measurement of machine noise,
- Optional architectural acoustics and building measurements.

Sound level meter kit

HD2110 kit 1: consists of HD2110 Sound Level Meter, HD2110P preamplifier, MK221 microphone for free field, windscreen, 5m extension cable and RS232 serial or USB connection cable. Noise Studio PC program.

HD2110 kit 1/E: Version for outdoor measurements. It consists of HD2110 Sound Level Meter, HD WME weatherproof microphone unit, heated preamplifier HD2110PW, MK223 microphone cartridge for free field, 5m extension cable and RS232 serial or USB connection cable. Noise Studio PC program.

HD2110 kit 1/IE: Version for indoor and outdoor measurements. It consists of HD2110 Sound Level Meter, HD WME weatherproof microphone unit, HD2110PW heated preamplifier, preamplifier HD2110P, MK223 microphone cartridge for free field, windscreen HD SAV, 5m extension cable CPA/5 and RS232 serial or USB connection cable. Noise Studio PC program.

Accessories

Option 4 "Reverberation Time": Measurement by sound source interruption or impulse response integration.

Option 6 "FFT": 1/32 s Short Leq profile, narrow band spectrum analysis (FFT).

Option 7 "SIT Calibration": SIT calibration replaces ISO 9001 reports. **For new instruments only.**

MK231: Class 1 microphone for diffuse field, type WS2D according to IEC 61094-4:1995.

MK223: Class 1 microphone for free field, type WS2F according to IEC 61094-4:1995. Protected membrane for outdoor use.

HD9101: Class 1 calibrator according to IEC90942:1988. Characteristics:
- Cavity for 1" and ½" microphones according to IEC61094,
- Frequency 1000Hz,
- Sound level 94dB/114dB.

The calibrator is supplied complete with calibration report according to ISO 9001.

HD2020: class 1 calibrator according to IEC60942:2003 with I.N.RI.M. certificate of conformity n.90-003-01. Characteristics:
- LCD display,
- Static pressure compensation from 65kPa to 108kPa,
- Cavity for 1" and ½" microphones according to IEC61094,
- 1000Hz frequency,

Sound level 94dB/114dB.
The calibrator is supplied complete with calibration report according to ISO 9001.

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

HD2110/USB: serial USB cable for PC connection.

HD SAV2

SWD10: Stabilized mains power supply Vin=100÷230Vac / Vout=12Vdc/1000mA.
CPA/10: 10m extension cable.
VTRAP: Tripod, 1550 mm maximum height.
HD2110/SA: Support to fix the preamplifier to the tripod.
HD40.1: Portable serial printer with 57mm paper rolls and SWD10 power supply.
HD2010/MC: SD memory card interface complete with 1GB SD card

For Windows® /98/ME/2000/XP/Vista operating systems

Noise Studio: Software for Windows® 95/ME/2000/XP and Vista operating systems supplied in the sound level meter kit. Configuration of the instrument, downloading and graphical display of stored data. This programme supports some sound analysis application modules which can be enabled by licence with the hardware key. The program contains demo versions of the modules.

CH20: Hardware key for PC with Windows® operating systems. Inserted into a USB port enables PCs to use software modules of the program Noise Studio.

NS1: Activation of module "Worker protection" of the Noise Studio program. Analysis of noise in the workplace in accordance with Decree 81 of 2008 and the UNI 9432-2008.

NS2: Activation of module "Noise pollution" of the Noise Studio Program. Analysis of environmental noise according to the Law 447/1995 and Decree of 16/03/1998. Analysis of the noise climate and assessment of noise from road, rail and airport according to the law.

NS3: Activation of the module "Acoustic Insulation" of the Noise Studio program. Calculations of acoustic and architectural evaluation of passive acoustic requirements of buildings according to DPCM of 5/12/1997. **Requires option 4 "Reverberation time".**

NS4: Activation of the module "Monitor" of the Noise Studio program. Acquisition in real time on PC. Synchronized audio recording. Remote monitoring and data capture. Connection via Modem.

Noise Studio Suite: Noise Studio Program equipped with the following application modules:
- "Worker Protection"
- "Noise Pollution"
- "Acoustic Insulation"
- "Monitor".

Using the HD2110 sound level meter you can log the time profile of 6 simultaneous parameters choosing freely temporal or frequency weightings. The possibility of displaying, storing and even printing the multi-parameter sound level analysis allows the sound level meter to log sound level and store for more than 46 hours. For sound level monitoring, you can store 5 programmable parameters and the average spectrum at intervals of 1 second to 1 hour, both by octave and third octave bands. Thanks to its high dynamic range, long integrations can be carried out with a minimum possibility of under- or over-range indications. The measurement dynamic range exceeds 110 dB and it is limited downwards only by the instrument intrinsic noise. For example, if you set the measuring upper limit at 140 dB, you can carry out measurements at the typical sound levels of a quiet office, with high accuracy and without overload indications, peak levels up to 143 dB.
The sound level meter can also log report sequences with dedicated parameters, at programmable intervals of 1 second to 1 hour, average spectra and full statistical analysis, in addition to sound level profiles. Moreover, a versatile trigger function can identify sound events and record their analysis with 5 dedicated parameters, average spectrum and statistical analysis.

The spectrum analysis is carried out simultaneous with the logging of the 6 profiles in real time, both by octave and third octave bands. The spectrum of sound signal is calculated twice a second and integrated linearly for up to 99 hours. Alternatively, the instrument can perform multi-spectrum analyses, even maximum or minimum, both with linear and exponential weighting. Spectra are displayed together with an A, C or Z -weighted wideband level. The third octave band spectrum analysis can be carried out, in addition to standard bands from 16 Hz to 20 kHz, also with bands shifted downwards by $^1/_{6^{th}}$ octave, from 14 Hz to 18 kHz. This feature is useful for finding tonal components hidden at the standard band crossing point. While the third octave band spectrum is displayed, you can enable the calculation of equal loudness curves in real time, for quickly estimating the audibility of spectral components.

As a statistical analyzer, the HD2110 samples the sound signal 8 times per second with A-frequency weighting and FAST constant, and it analyses it in 0.5 dB classes. You can program 4 percentile levels from L_1 to L_{99} and choose to sample L_{Fp}, L_{eq} or L_{pk} with A, C and Z-weightings (only C and Z for L_{pk}).

The Digital Audio interface allows recording the sound sample on tape, for further analysis. Recording in digital format guarantees the best accuracy. Audio tracks recorded with other instruments can also be analyzed using the Line input. 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.

Recordings can be located in memory and viewed on the graphic display using the "Replay" function, which reproduces the time trend of the sound track. The high-speed USB interface, combined with the flexible RS232 interface, allows quick data transfers from the sound level meter to the PC mass memory, as well as controlling a modem or printer. For example, should the supplied memory not be enough, this is the case for lengthy recordings, you can activate the "Monitor" function. This function allows sending the displayed data to a PC via the serial interface and storing them directly on the PC mass memory.
The HD2110 can be completely controlled by a PC through the multi-standard serial interface (RS232 and USB) by using a special communication protocol. Through the RS232 interface, the sound level meter can also be connected to a PC via modem.

The calibration can be performed either by using the provided 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.
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 the damages occurred to the instrument, microphone included, can be promptly identified thanks to a complete analysis 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.

The HD2110 sound level meter can perform the measurements required to evaluate workers' noise exposure (Legislative Decree 81/2008). The personal protective equipment can be selected through octave band spectrum analysis (OBM method) and a comparison of the A and C-weighted equivalent levels that can be measured simultaneously (SNR method). If an undesired sound event produces an overload indication, or simply alters the result of integration, its contribution can be excluded using the versatile Back-Erase function.

The HD2110 sound level meter is suitable for sound level monitoring, acoustic mapping and the assessment of the acoustic climate with capture and analysis of sound events. When measuring traffic noise near airports, railways and roads, the sound level meter can be used as a multi-parameter sound recorder, combining statistical and spectrum analyzer features. Remote electrical calibrations and diagnostic tests can be executed using its remote control capabilities.

The HD2110 can also perform the measurements required to evaluate environmental noise (Decree of 16 March 1998, GU No.76 of 1 April 1998). Impulsive events can be easily identified thanks to the possibility of analysing the profile of the A-weighted level with FAST, SLOW, and IMPULSE constants. All measuring parameters can be stored for subsequent analysis. The identification of tonal components is also easy and certain as it allows displaying and recording the minimum spectrum with any wideband weightings (Z, C or A) both by third octave bands with standard nominal frequencies 16 Hz to 20 kHz, and with central frequencies shifted on the former crossing point 14Hz to 18 kHz. The audibility of the tonal component can be evaluated in the field thanks to the real-time calculation of equal loudness curves. The audibility of the tonal component, to be compared with that of the remaining spectrum, can also be evaluated using the Noise Studio program supplied with the instrument, thanks to the calculation of the equal loudness curves.

The HD2110 sound level meter with the "Reverberation Time" option can perform any measurement prescribed by the regulations on the room acoustics evaluation (D.P.C.M. of 5/12/1997). The sound level meter powerful DSP calculates 32 spectra/second, and it can measure reverberation times both using the sound source interruption method and the integration of impulse response technique. The analysis is carried out simultaneously by both octave and third octave bands.

Inputs and outputs

Digital audio input/output (IEC 60958:1999 type II) with RCA connector (S/PDIF).
LINE unweighted input/output (∅ 3.5 mm jack).
TRIGGER input/output (∅ 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 (∅ 5.5 mm jack).

Italian Laws

- Noise in workplaces: D. Lgs 81/2008, UNI 9432/2008 and European Directive 2003/10/CE.
- Noise pollution: Law 447 of 26/10/95, D.P.C.M. of 1/3/91, Decree of 16/03/98, Decree No. 194 of 19/08/2005 and European Directive 2002/49/CE.
- Airport noise: Decree of 31.10.97.
- Noise in dancing entertainment locals: D.P.C.M. 215 dated 16/4/99.
- Noise emission from machines D. Lgs 262 of 4/9/2002 and European Directive 2005/88/CE.
- Evaluation of passive requirements of buildings: D.P.C.M. of 05.12.97.

Options and accessories:

HD2110MC reader

It allows interfacing SD and MMC memory cards with the sound level meter.
This device is connected to the sound level meter through the serial interface that also gives the required power supply. In addition to its remarkable storing capacity, the interface allows quickly downloading the data stored in the sound level meter internal memory. Cards with a maximum capacity of 2 GB can be connected. Includes a 1GB SD card.

Option 4 "Reverberation Time"

The measure of reverberation time is performed by using the sound source interruption and the impulsive source method.
The measure of reverberation time is performed simultaneously by wideband, octave band from 125 Hz to 8 kHz, and third octave band from 100 Hz to 10 kHz. Sampling interval 1/32 s.
Automatic calculation of reverberation times EDT, T10, T20 and T30 by all bands, and decay profile analysis with the possibility of calculating the reverberation time over a chosen interval.

Option 5 "Advanced Analyzer"

(included in new sound level meters only)

This option combines the sound level analyzer functions with the following:

- Statistical analysis available graphically, both as probability distribution and cumulative distribution.
- Trigger for noise event capture with level threshold and duration filter.
- Recording of measurement reports at intervals of 1s to 1 hour, with a dedicated set of parameters that includes average spectra and full statistical analysis.
- Recording of event parameters with the possibility of setting the maximum time resolution for event recording and a lower resolution for background noise recording.
- Possibility of storing markers.
- Timer for a delayed start of the capture.

Option 6 "FFT"

(only for HD2110 sound level meters with "Advanced Analyzer" option)

This option adds:

- Leq profile at 1/32 s intervals.
- Narrow band spectrum analysis (FFT) over the whole audio range with variable resolutions according to the frequency from 1.5Hz to 100Hz.

Software:

Noise Studio

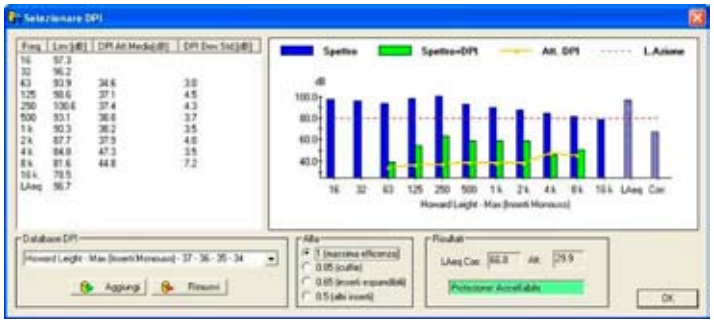
The Noise Studio programme allows interfacing HD2110 to the PC in a simple and intuitive way. Main functions are:

Transfer of stored data from the sound level meter to the PC memory.
Display of captured data under graphic and tabular form.
Export to Excel and PDF format.
Printing of graphs and data tables.
Comparison of spectra for third octave bands with noise contours.
Logging control by a PC.
Sound level meter setup management.
Sound level meter firmware update.

It results easier drafting documents regarding the sound level meter's relief due to the handy function which allows to copy graphs or visualized tables from other applications and to create PDF files.
Moreover Noise Studio is a post processing programme able to perform different kind of analyses, studied for specific applications assembled in software modules to be enabled with licence. Demo versions of the software modules are provided.

Noise Studio: 'Worker protection' module (to be activated by license)

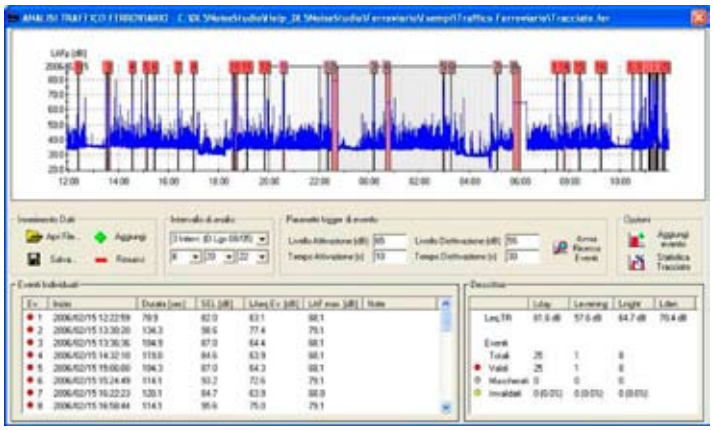
This application module analyzes noise in the workplace according to the DL 81/2008, the European directive 2003/10/EC and the UNI 9432:2008. Data sound level measurement in work environment is organized in a project where they can be handled according to regulatory requirements. In addition to calculating the noise exposure of workers the program allows to evaluate the effectiveness of protective equipment by the methods SNR and OBM. According to UNI 9432 of 2008, the program also calculates the index of impulsiveness of a machine.



Noise studio: "workers' protection" module: analysis of the effectiveness of ipd

Noise Studio: 'Acoustic Pollution' module (to be activated by license)

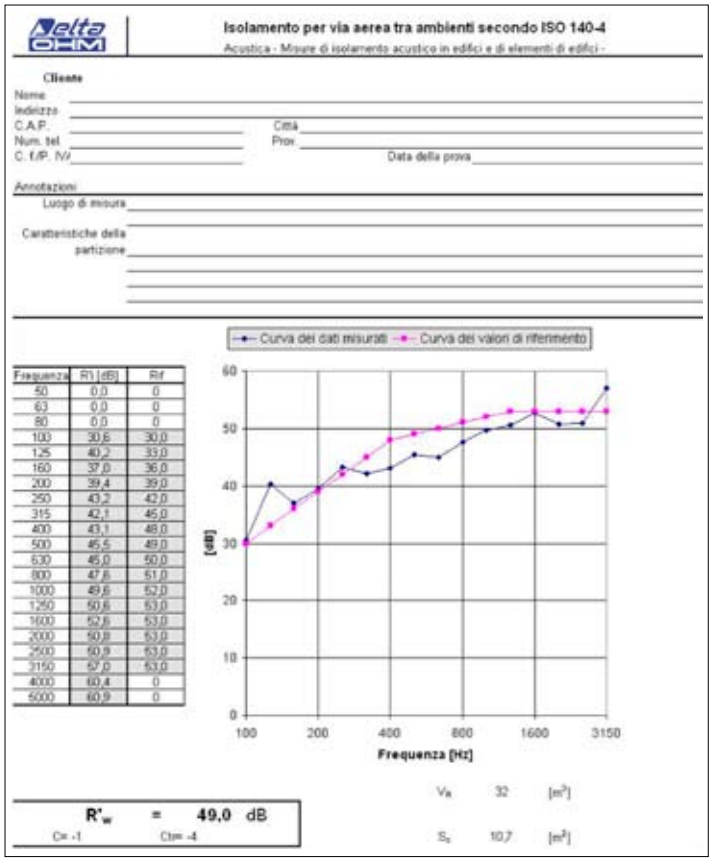
This application module analyzes sound level profiles detected in indoor and outdoor environment for the assessment of the noise climate, the noise of industrial sites, ports, airports and transport infrastructure, and noise generally understood as a disturbance of human activity. The analysis of the noise climate is made on a daily, weekly and annual basis with resolutions up to 1 minute, according to DL 194, 19/08/2005. The profiles of noise detected in the external environment are analyzed to search for disturbing 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 automatic search and analysis of sound events, according to the Ministerial Decree D.L. 194, 19/08/2005 of 16/03/1998. For the evaluation of the disturbance caused to the population from any source of noise even domestic, according to DM of 16/03/1998, the measured noise profiles are analyzed in search of impulsive or tonal components.



Noise studio: "railway traffic" module: analysis of 24 hours with automatic search of transit

Noise Studio: 'Acoustic Insulation' module (to be activated by license)

according to the DPCM of 5/12/1997.
The measures necessary for the analysis of a building are grouped in a project to simplify their storage and research. You can also add to the measures themselves, a technical report, comments, graphics, photos, etc... which remain part of the work and, if necessary, can be found easily.
An updateable database, divided by walls and floors, contains the principal characteristics of sound-insulating structures. The data contained in the database can be compared graphically with measures in place.
With this program you can calculate:
Average reverberation time (ISO 3382)
Area of equivalent absorption coefficient of sound absorption (ISO 354)
Isolation by air: indices R, R 'and D_{nT} (ISO 140/III and IV)
Insulation of facades and facade elements: indices $D_{2m,nT}$ and Rθ (ISO 140 / V)
Isolation of noise impact: indices L_n, DL, The N and L'_{nT} (ISO 140/VI, VII and VIII)
Global Indices (ISO 717-1 and 717-2)
For the calculation of some indices, option 4 'Reverberation time' is required.



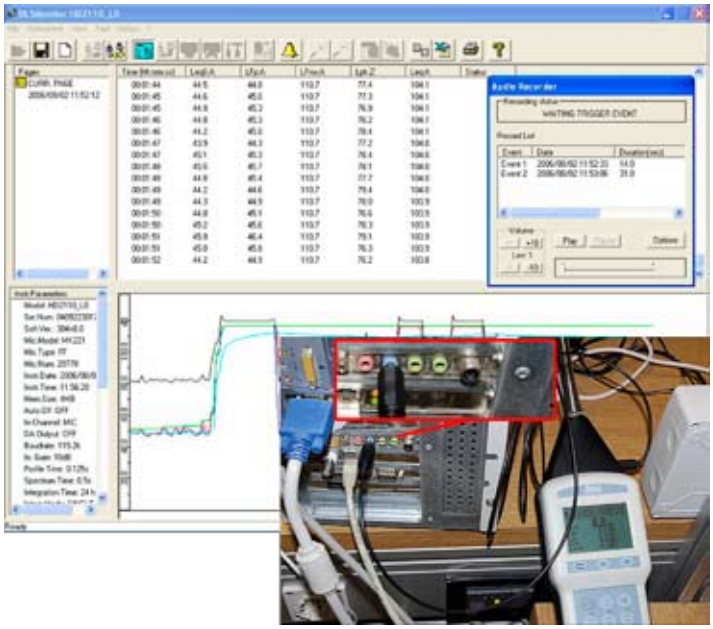
Noise studio "acoustic insulation" module: filling iso report.

Noise Studio: '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:

Real time display of acquired data, in graphical and tabular form.
Possibility of connection via modem with the sound level meter.
Acquisition of data sound level data directly into the mass memory of the PC (monitor function).
Management of calibration and diagnostic functions.
Automatic acquisition and monitoring program.

Possibility of synchronized audio recording with the sound level measures, using a versatile trigger function.



Noise studio: "monitor" module: acquisition om pc with synchronized audio recording

Kit and accessories purchasing codes

HD2110 kit 1: consists of HD2110 Sound Level Meter, carrying case, HD2110P preamplifier, MK221 microphone, 5m extension cable CPA/5, HD SAV windscreen, Noise Studio software and RS232 serial (HD2110RS) or USB connection (HD2110/USB) cable.

HD2110 kit1/E: Version for outdoor measurements. It consists of HD2110 Sound Level Meter, carrying case, HD WME weather equipped with bird spike protection, wind screen and rain shield, HD2110PW heated preamplifier with 5m extension cable (other lengths available upon request) and MK223 microphone. The kit includes also Noise Studio software and serial cable for connection to a PC (HD2110/RS) or USB (HD2101/USB interface).

HD2110 kit1/IE: Version for indoor and outdoor measurements. It consists of HD2110 Sound Level Meter, carrying case, HD WME weather equipped with bird spike protection, wind screen and rain shield, HD2110PW heated preamplifier with 5m extension cable (other lengths available upon request), HD2110P preamplifier, 5m extension cable CPA/5, HD SAV wind screen and MK223 microphone. The kit includes also Noise Studio software and serial cable for connection to a PC (HD2110/RS) or USB (HD2101/USB interface).

Option 4 "Reverberation Time": Reverberation time measurement by source interruption and the impulsive source method.

Option 6 "FFT": Short Leq profiles at 1/32 s, narrow band spectrum analysis (FFT). **It requires the "Advanced Analyzer" option**.

Option 7 "SIT Calibration": SIT calibration replaces ISO 9001 reports. **For new instruments only.**

HD9101: Class 1 calibrator according to IEC90942:1988. Characteristics:
- Cavity for 1" and ½" microphones according to IEC61094,
- Frequency 1000Hz,
- Sound level 94dB/114dB.

The calibrator is supplied complete with calibration report according to ISO 9001.

HD2020: class 1 calibrator according to IEC60942:2003 with I.N.RI.M. certificate of conformity n.90-003-01. Characteristics:
- LCD display,
- Static pressure compensation from 65kPa to 108kPa,
- Cavity for 1" and ½" microphones according to IEC61094,
- 1000Hz frequency,

Sound level 94dB/114dB.
The calibrator is supplied complete with calibration report according to ISO 9001 (replaced by a SIT certificate when combined to Option 7 "SIT Calibration").

MK231: Class 1 microphone for diffuse field, type WS2D according to IEC 61094-4:1995.

MK223: Class 1 microphone for free field, type WS2F according to IEC 61094-4:1995. Protected membrane for outdoor use.

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.

CPA/10: 10m extension cable for HD2110P preamplifier.

CPA/20: 20m extension cable for HD2110P preamplifier.

CPA/50: 50m extension cable for HD2110P preamplifier.

VTRAP: Tripod, 1550 mm maximum height.

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

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

BAT40: Spare battery pack for HD40.1

RCT: rolls of thermal paper, 57 width and 32mm diameter.

HD2010/MC: SD memory card interface including 1GB SD card

Codes of spare parts and other accessories

Option 5 "Advanced Analyzer": Profile+report+event data logging, capture and analysis of events, full statistical analysis. **This option is included in new instruments.**

HD WME/PMK: HD WME weather protection complete with bird spike, windscreen and rain shield, HD2010PW heated preamplifier with CPA/5 5m extension cable, HDSAV windscreen, MK223free field microphone unit.

HD WME/P: HD WME weather protection complete with bird spike, windscreen and rain shield, HD2010PW heated preamplifier with CPA/5 5m extension cable (other lengths upon request).

HD WME: Weather protection, equipped with:
- Stainless steel housing for the preamplifier WME3 HD with holder for rain protection HD WME2,
- WME1 HD bird spike,
- HD SAV3 wind-screen,
- HD WME2 rain-shield.

HD SAV: Windscreen for 1/2" microphone.

HD SAV2: Windscreen with bird spike for HD WME950 microphone unit.

HD SAVP: Rain shield for HD WME950 microphone unit.

HD SAV3: Windscreen for HD WME microphone unit.

HD WME1: Bird spike for HD WME microphone unit.

HD WME2: Rain shield for HD WME microphone unit.

HD WME3: Stainless steel housing for the preamplifier of the outdoor microphone unit HD WME with holder for rain protection HD WME2.

HD2010P: Microphone preamplifier for ½" microphones. Provided with CTC device for electrical calibration. The HD2010P is also equipped with a driver for extension cable up to 100m length.

HD2010PW: Heated microphone preamplifier for HDWME950 and HD WME. It is heated and provided with CTC device for electrical calibration. Ending with 5m connection cable (other lengths upon request). The HD2010PW is also equipped

with a driver for extension cable up to 100m length.

HD2110PW: Heated microphone preamplifier to be housed in outdoor protection WME950 HD and HD WME. The preamplifier for ½"microphones is heated and provide with CTC device for electrical calibration; it ends with a 5m connection cable (other lengths on request). The HD2110PW is also equipped with a driver for extension cable up to 100m length.

CPA/5: 5m extension cable for HD2010PN and HD2110P preamplifiers.

HD2101/USB: USB serial cable for PC connection. **For sound level meters with serial Mini-Din connector**.

HD2110CSNM: RS232 serial cable for PC connection. **For sound level meters with serial Mini-Din connector**.

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 0 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	✓MK221 condenser microphone, polarized (200V), for free field, high stability, type WS2F according to IEC 61094-4 ✓MK223 condenser microphone with coated membrane, polarized (200V), for free field, high stability, type WS2F according to IEC 61094-4 (combined with the HDWME950 weatherproof microphone unit) ✓MK231 condenser microphone, polarized (200V), for diffuse field, high stability, type WS2D according to IEC 61094-4
Dynamic range	23 dBA ÷ 143 dB Peak
Linear range	110 dB
Acoustic Parameters	Spl, L_{eq}, 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 filters in real time complying with IEC61260 class 0 specifications. ✓Octave bands from 16 Hz to 16 kHz ✓Third octave bands from 16 Hz to 20 kHz ✓Third octave bands from 14 Hz to 18 kHz ✓Optional FFT from 7 Hz to 22 kHz with variable resolutions from 1.5 Hz to 100 Hz Average spectrum (AVR) mode, multi-spectrum analysis (MLT), maximum spectrum (MAX), and minimum spectrum (MIN)
Audibility	Real-time comparison of third octave band spectrum with equal loudness curves according to ISO 266:2003
Statistical Analysis	Probability distribution and percentile level calculation from L_1 to L_{99} ✓Parameter: 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 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 (opt.)	Reverberation time measurement by sound source interruption and impulse response integrated
Profile Data Logging	1 profile with programmable sampling from 1/8 s to 1 hour and 5 profiles with 2 samples/second
Spectrum Data Logging	Programmable sampling from 0.5s to 1 hour (MLT, MAX, or MIN modes)
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 ✓Graph of sound level probability distribution ✓Graph of percentile levels from L_1 to L_{99} ✓Optional narrow band spectrum analysis (FFT) from 7Hz to 22 kHz
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 HD2110MC memory card interface, using MMC or SD cards up to 2 GB
Input/Output	✓ RS232 serial and USB interfaces ✓ AC input and output (LINE) ✓ S/PDIF digital audio input and output ✓ External event identification trigger
PC Programs	✓ Noise Studio (supplied with the instrument): PC interface for data download, set up and instrument management. Licensed software modules to be enabled by hardware key. ✓ "**Worker protection**" module. Analysis of noise in the workplace in accordance with Decree 81 of 2008 and the UNI 9432-2008. ✓ "**Acoustic pollution**" module. Analysis of environmental noise according to the Law 447/1995 and Decree of 16/03/1998. Analysis of the noise climate and assessment of noise from road, rail and airport according to the law. Some program functions require option 1 "Third octaves". ✓ "**Acoustic Insulation**" module. Calculations of acoustic and architectural evaluation of passive acoustic requirements of buildings according to DPCM of 5/12/1997. Requires option 4 "Reverberation time". ✓ "**Monitor**" module. Acquisition in real time on PC. Synchronized audio recording. Remote monitoring and data capture. Connection via Modem. The program allows programming of measurements and calibrations with timer and audio recording with programmable event triggers.
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 (with batteries)