# Precision Sound Analyser
## Nor145


### Applications

- Environmental noise
- Building acoustics
- Noise monitoring
- Product noise testing
- Noise at work
- Infrasound
- Noise nuisance recorder
- Front end for Nor850
- General noise and vibration measurements

# General features

- Precision sound level meter and frequency analyser according to class 1
- Easy connectivity via built in WLAN and 3G/4G LTE modem
- Large colour touch-screen (4.3")
- Real push keys for quick operation in challenging environments
- Intuitive user interface with graphical icons for selection of measurement mode and custom-made user setups
- Built-in webserver
- Voice, text notes and built-in GPS for documentation of the measurements
- Wide frequency range (0,4 Hz – 20 kHz in 1/3 octave band)
- Parallel 1/3 octaves and FFT analysis
- 120 dB measurement range
- Extensive trigger system for reports, audio recording and camera
- Seamless integration with Nor850 software
- Multi language support
- Extensive on-board help system

The Nor145 Sound Analyser is a precision single channel sound level meter designed to cover all measurement tasks for the most demanding acousticians. It shares the same user and design philosophy as the Nor150, but hosted in a smaller and lighter enclosure. The Nor150 is mainly designed for dual channel applications while the Nor145 is a single channel unit optimized for easy connectivity to NorCloud, NorRemote or Nor850, through the built-in WLAN and 3G/4G LTE modem.

Nor145 sets new standards in user-friendliness and sophistication not yet found in any other Sound Level Meter on the market. The robust design combined with a vast range of measurement applications covered in one unit, makes it the natural choice for every professional acoustician.

Featuring a large 4.3" true colour touchscreen, the Nor145 provides the user-friendliness of a smartphone. Further features include; built-in web server, WLAN, 3G/4G modem, GPS and advanced voice and text notes bringing the sophistication normally found in laboratory instrumentation out in the field. Connect your smartphone, pad or PC and take full control of the instrument. Add photos, video and voice notes obtained on your smartphone seamless integrated with markers to your noise data.

Nor145 is seamless integrated with NorCloud and the Norsonic range of post processing and reporting programs, as the Nor850 multi-channel measurement platform and NorReview. It has never been easier to export data to third party tools like Excel® or further process the data in Matlab®.

## Startup application menu

The Nor145 covers a wide range of measurement applications.

The configuration and use of the instrument however are easy and intuitive. At the startup, an application setup menu with icons appears where you select what application you want to work with.

You may also create your own favourite setups and choose to display them in the same menu. These are listed as smaller icons. A set of preset setups are also available, indicated with an orange frame around the icon. The preset icons are country dependent. Thus, you don't need to scroll through setups for national standards not applicable for your country.

# Innovative design for simplified measurements

Status LED provides useful information by changing colour for measurement running, overload, battery low, audio recording etc.

4,3” colour touch screen

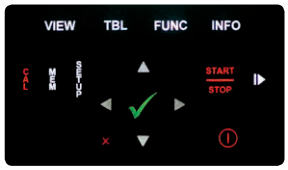
Connector for headset and comment microphone.

Audio recordings and comments may be replayed on the instrument


Optional built in GPS, WLAN and 3G/4G modem with internal antennas.

For operation in areas with low signal strength external antennas for the 3G/4G modem may be connected. It supports two antennas for diversity giving a better coverage. The external antenna has additional support for 2G/Edge. For normal applications the internal 3G/4G antenna is sufficient.


Backlit keyboard and display. To extend battery time, both brightness and time-out is adjustable in the power setting menu.




LAN, USB, Micro SD card, 15 pin Norsonic multi I/O plug and power connector.

# User interface

The Nor145 features a graphical touch interface similar to a smart phone. In addition, we included a real push keys for demanding field application in which a touch interface may be challenging to operate.

The touch display is used to set up the analyser and working with post processed data. For measurement control and during a measurement you may choose to use the real push buttons.

The Nor145 can be configured with different types of display views. A selection of graphical displays, such as Level versus Frequency (L/f), Level versus Time (L/t) and Sound Level Meter view are available.

You may configure up to four different views, and toggle through the views with the **VIEW** button. A view can be single or dual view.

The dual view, or split screen, gives you the option to combine such as a L/f display with a L/t display This combination is especially useful when you do multi-spectral analysis and want to manoeuvre both in the time and frequency domain. You may even choose to display 1/3 octave and FFT- all analysed in parallel!

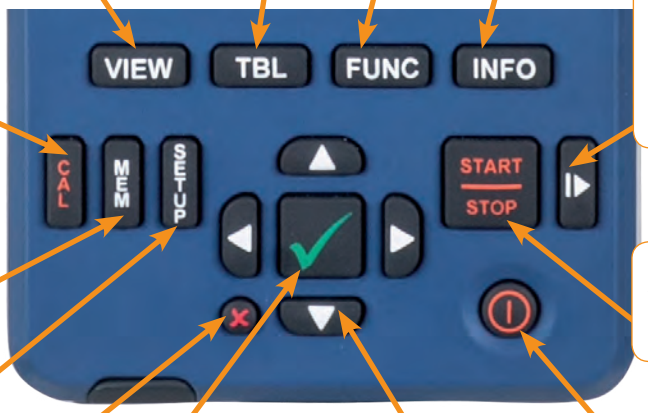
Different display views are available, dependent on what measurement mode you are working with such as Environmental or Building Acoustics.

**TBL** button. Switch between graphical and numerical/table display. Each graphical display has an associated numerical display.

A graphical display can display up to 3 different measurement functions in one graph. If you have selected more than 3 functions to be measured, you can use the **FUNC** button to scroll through the measured functions.

Information button (**INFO**). The info screen shows important measurement settings or shows useful hints about error messages and field indicators.

Pause/continue (⏯). Temporarily stop measured data to go into the global results. The pause is a toggle style function. It includes a graphical back-erase function.




Calibration button (**CAL**) activates the calibration functions.

Memory button (**MEM**) access the memory system.

Setup button (**SETUP**) access the menu system.

X button (✘) exits a menu without doing your modifications.

V button (✓ or **OK**) exits the current menu and store/accept your current selections.

**START** a measurement or **STOP** an ongoing measurement.

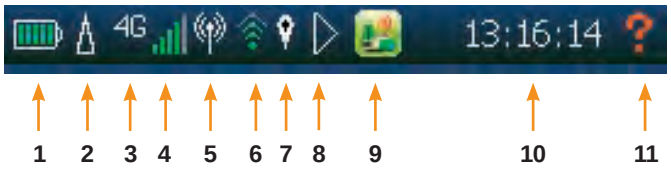
On / Off / Lock Keyboard button.

Cursor buttons (▶▲▼◀). Keys for moving the cursor in graphical and tabular displays.

# The status bar

The status bar at the top of the display provides useful information about the instrument and the on-going measurement.

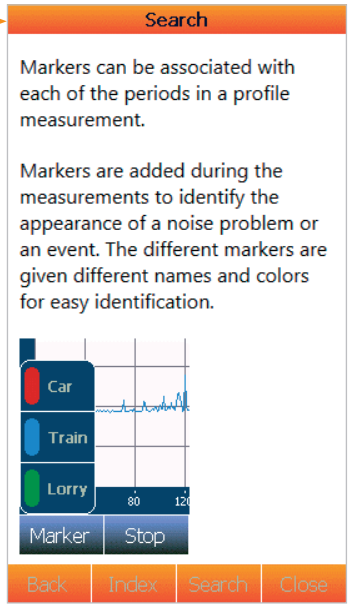
*The status bar*




**1** Battery gauge
**2** Overload indication.
**3** 3G or 4G LTE mode
**4** Mobile signal strength indicator
**5** HotSpot Signal strength
**6** WLAN Signal Strength indicator
**7** GPS
**8** Measurement status – Ready, waiting for trigger, running, pause, ended, stored, locked
**9** Application mode
**10** Real time clock in ready mode. In all other modes, the measurement time is displayed
**11** Help function

The status bar is not displayed in the menus.


*The soft key bar in the bottom of the display holds different functions dependent on which menu or display you are in.*




*Even though the instrument is easy and intuitive to use an extensive on-line help is available. Just push the ? to access the help for the current display you are in.*
*In addition, you may search for a keyword or look it up in the index.*

# The measured functions

The Nor145 basic configuration is fitted with parallel detection of Fast, Slow and Impulse time constants and the A, C and Z spectral weighting functions. The basic measurement parameters are;

| | |
|---|---|
| SPL | The instantaneous Sound Pressure Level |
| $L_{max}$ | The Maximum Sound Pressure Level time weighted |
| $L_{min}$ | The Minimum Sound Pressure Level time weighted |
| $L_{eq}$ | The Integrated Averaged SPL |
| $L_{Eq}I$ | Impulse weighted Time Average SPL |
| $L_E$ | The Sound Exposure Level |
| $L_{PEAK}$ | The Maximum Peak Level |
| $L_n$ | Statistical functions |
| $T_{MAX5}$ | "Takt Maximal" – a special parameter measured mainly in Germany |
| $T_X$ | Reverberation time $T_{15}$, $T_{20}$, $T_{30}$ |
| EDT | Early decay time |

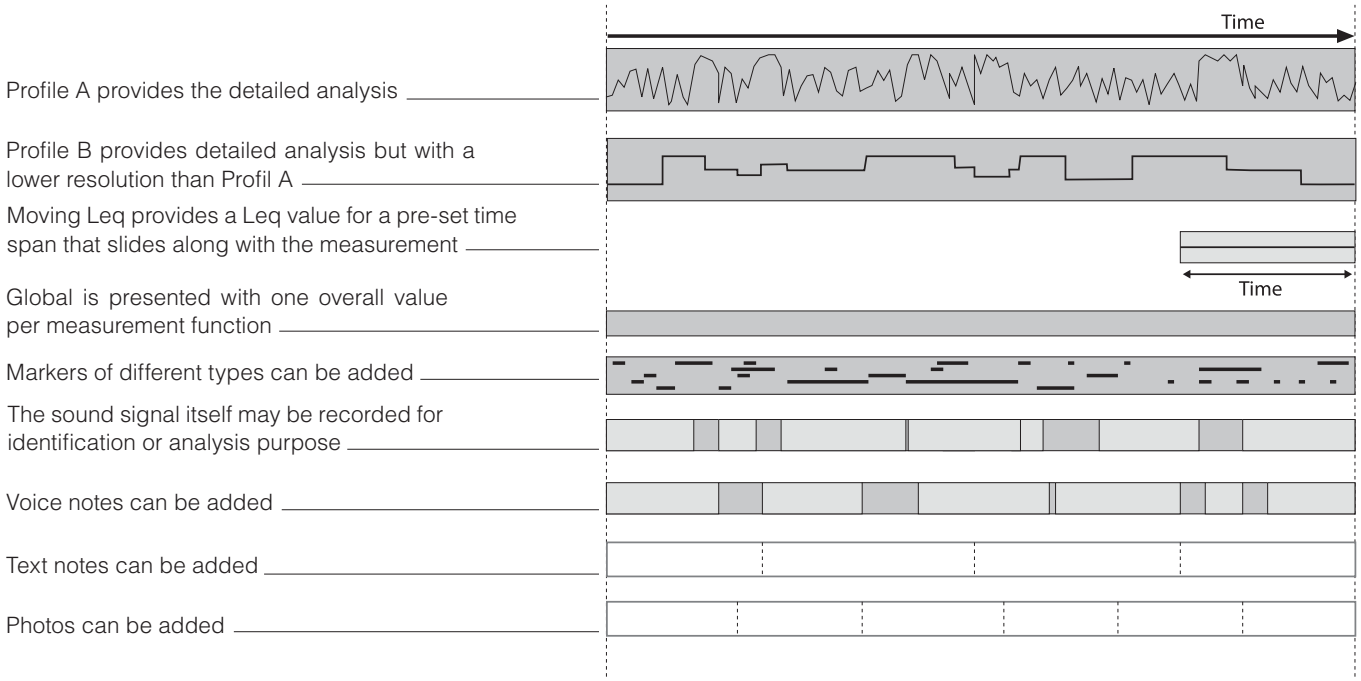
## Time Profile

The time profile concept, named level versus time profile (L/t), also known as electronic level recorder is a part of the basic functionality. Three time profiles are available, Profile A, B and Moving. Profile A is the main profile from where the two others are extracted. The resolution of time profile A can be set to any value between 5 ms to 24 hours. Profile B has a resolution starting from 1 sec. Profile A is set to 1 sec if Profile B or Moving is activated.

The advantage by having more than one time profile is to measure some values with high resolution (Profile A) and let the Profile B measure values with a longer time interval.

Eg. Leq values every second and L95 every 15 minutes. In addition Global (overall) values are measured for the entire measurement. You may choose to measure one or a selection of the available measurement parameters for the time profiles and global.

*The main features - an overview*

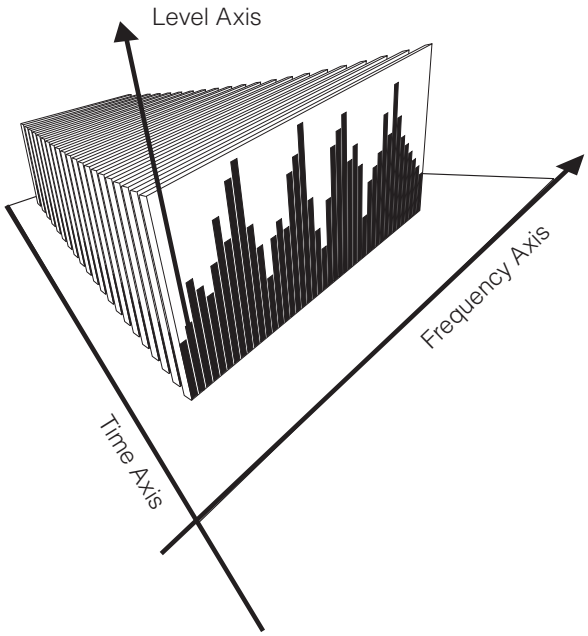


## Frequency analysis - Multispectra function

With 1/1 and 1/3 octave real time filters ranging from 0,4 Hz to 20 KHz installed you can do detailed analysis of the frequency content of a noise spectra. A basic analysis is just to analyse the frequency spectra of a stationary signal. However, it is often needed to capture a multi spectrum to analyse how the frequency content in the time domain of a non-stationary signal.

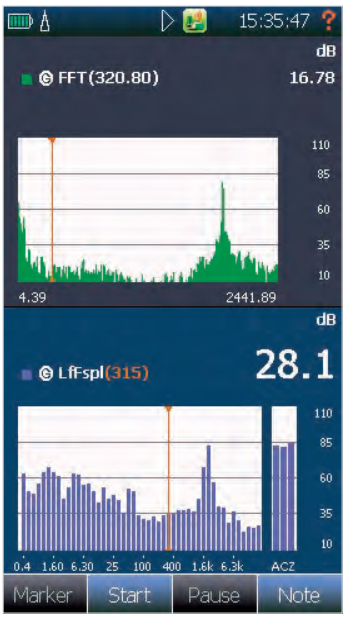
The Nor145 measures 1/3 octave multispectra from 0,4 Hz to 20 kHz with a resolution of 25 ms with full dynamic range (>120 dB) simultaneously with all spectral weighting networks and audio recording enabled! From 5 ms if audio recording is disabled.

*Multi-spectra is a set of spectra captured at equidistant moments in time corresponds to setting up the analyser to measure the level vs. time involving frequency analysis in octaves or third-octaves.*




## FFT

The powerful measurement engine in the Nor145 enables parallel analysis of FFT, 1/3 octave and weighting networks. The frequency range is up to 20 kHz. Two frequency resolutions are supported, 1,46 Hz/14000 lines and 2,94 Hz/7000 lines.




*Split view with FFT and 1/3 octave. The link cursor feature connects the cursor in FFT and 1/3 octave displays, making it easy to manoeuvre in the frequency domain*

## Vibration

Vibration measurements are made easy with the Nor145. Just enable IEPE power and connect your accelerometer direct to the 7 pin preamplifier socket via a suitable cable.

You may choose to analyse in dB or real units, such as mm/s$^2$. Further, you may choose to analyse in 1/3 octave bands from 0,4Hz, FFT or both in parallel.

The following measurands are supported:

- m/s$^2$ (acceleration)
- m/s velocity)
- m (displacement)

# Large display – intuitive use

The Nor145 offers you several ways of composing a set of display views that provides maximum information for your measurement application.

Up to 4 different display views may be configured and scrolled through with the **VIEW** button, before, during and after a measurement sequence. You easily compose a view from a selection of available graphs, such as level versus time display, level versus frequency display, sound level meter display or cumulative and probability distribution display.

A display view may be a single view or dual view. Each graphical display is accomplished by a numerical display. Just push the **TBL** button to toggle between numerical and graphical view.

If more than 3 parameters are measured you can toggle through the different parameters using the **FUNC** button. One measurement parameter may be locked to the view so that it always is displayed while scrolling through the other available parameters.

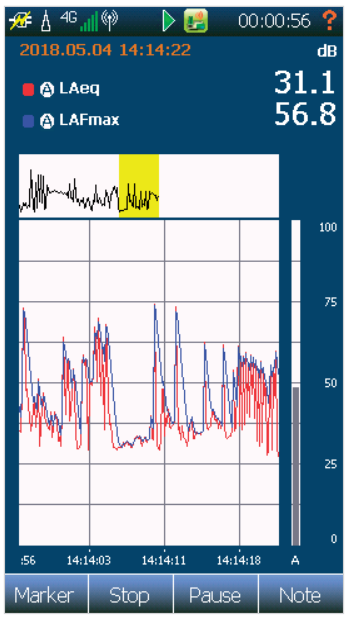
Your graphical view configuration is stored together with the measurement and may also be stored as a user-defined setup.

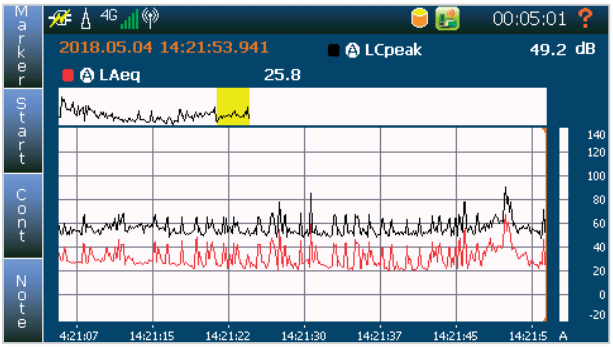
## Level vs time

The single view of the level vs time display consists of a main window displaying up to three values simultaneously. Markers are indicated by bold horizontal lines. Markers can indicate an audio recording or a manual inserted marker. A dotted horizontal line indicates a single marker, such as a triggered picture or a manual inserted single marker.

The upper graph is a compressed graph covering the entire measurement to give you a complete overview. The yellow field is the current view in the main graph.

The X-axis can be set to period #, relative or absolute time. You can rapidly move along the x-axis by tapping on the upper graph or use the zoom function. In addition, you can jump between markers or replay audio recordings, view pictures and comments.

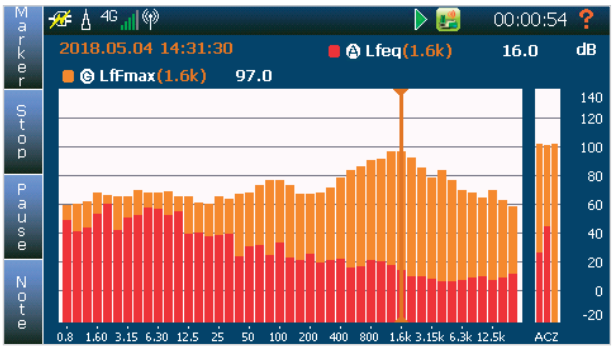


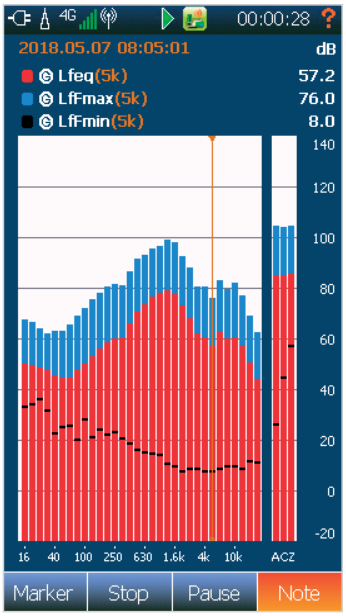




*Level vs time display single view. The level vs time picture is available as portrait or landscape view.*

## Level vs frequency display

The single view of the level vs frequency display is available as portrait or landscape view. Several types of drawing shapes are supported; filled or open bar graph, line or step line. In addition to colour selection of each graph, you may also configure the drawing order of the graph; back, middle or front.



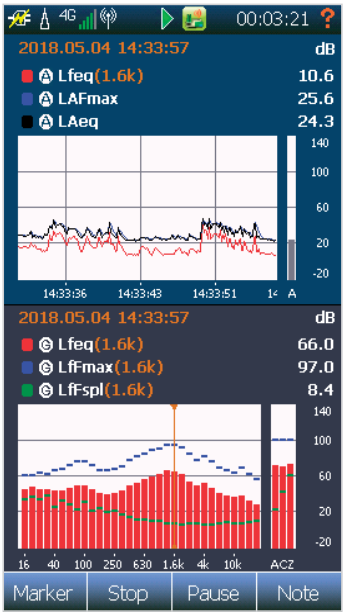

*Level vs frequency display single view - available as portrait or landscape view.*

## Dual view with L/t and L/f

You may compose any mix of the available graphs in a split view configuration. The split view is only available as portrait displays.

A special useful view is the combination of L/f and L/t. By selecting the link cursor feature you move the cursor in both the time and frequency domain simultaneously.

Another useful combination is to combine a graphical and numerical view.



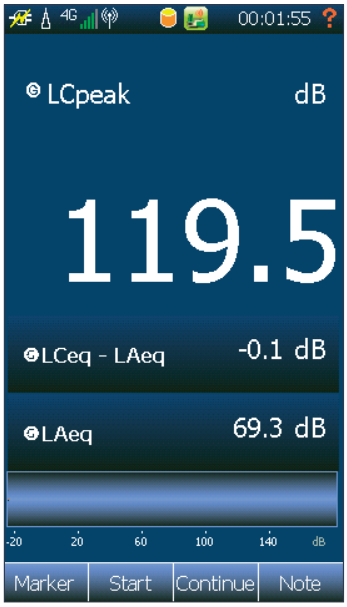

*Dual view with L/t and L/f*

## Sound level meter display

The sound level meter display is especially designed for users who requires large numbers and little information.

As with the other displays you may configure three measurement parameters to display simultaneously. The bar graph shows the instantaneous value.

This view is only available as portrait.

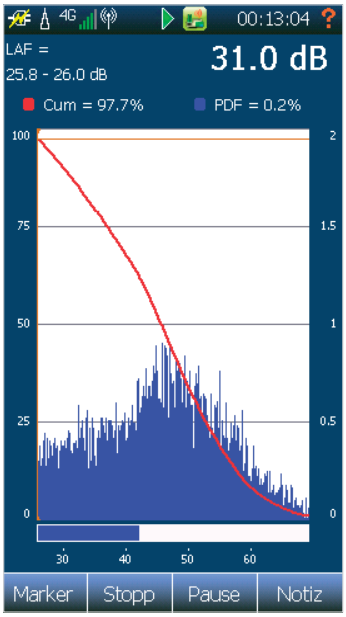


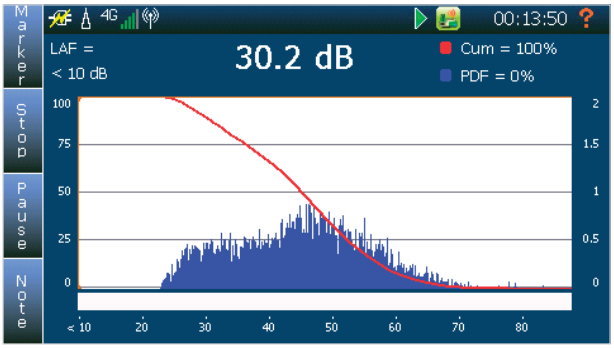

*Sound level meter display*

## Cumulative and Probability Distribution Function (PDF)

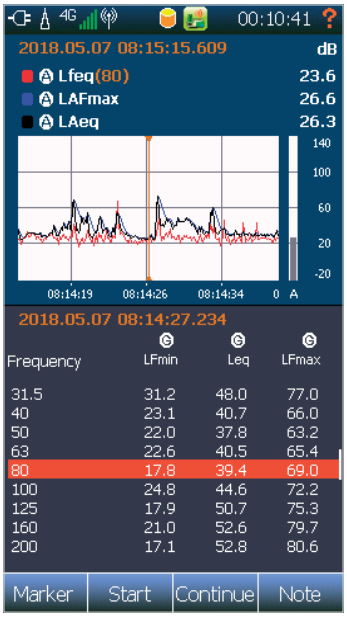
- combined in one display with a horizontal instantaneous sound pressure level graph. Both the value of the PDF and the Cumulative value at the cursor position are displayed simultaneously.

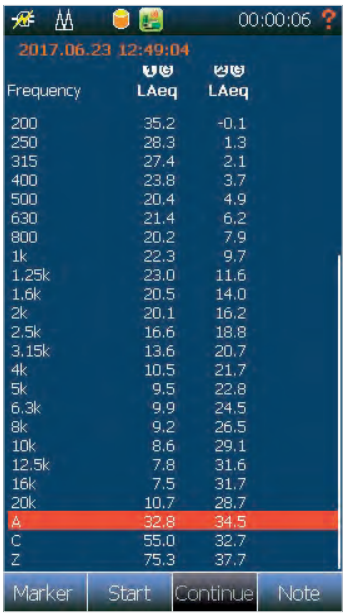
Up to 8 freely selectable percentile values may be measured. Any value from 0,1% to 99,9% can be selected. All frequency bands and weighting networks are calculated, both for the entire measurement global, and for every period in the time profile, provided that the profile resolution is set larger than 2 minutes.




*Cumulative and Probability Distribution Function (PDF) - both as portrait and landscape.*
*The statistical class width is 0,2 dB over the entire 130 dB range including the 1/1 and 1/3 octave bands.*



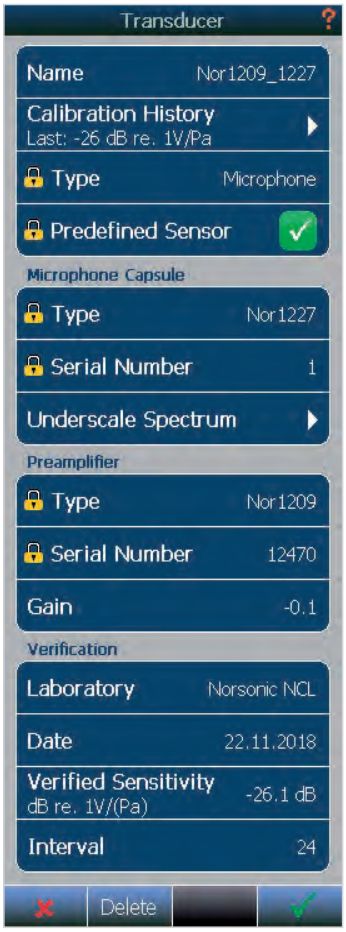




*A numerical table is associated with all the graphical views. Just press the* **TAB** *button to toggle between graphical and numerical view. Works both with single and split screen.*

## Sensor administration menu

A built-in sensor database is holding information of a set of standard transducers. This avoid you from making improper settings. In addition, you may add other sensors to the database. All data regarding calibration etc are stored and can be recalled at a later stage.

Define a verification interval for a sensor and the instrument will notify you if a sensor is due for periodic verification.


*The Transducers menu*
*The calibration history gives you full traceability of the microphone sensitivity.*

## Calibration

The calibration menu offers three calibration methods; **manual**, **auto** and **mic. check**.

**Manual** is the traditional way, where you manually adjust the sensitivity until you read the desired level.

**Auto** is an easier way. Just select calibration level and press “go”. The level will be automatically adjusted to the right value.

**Mic.Check** is a manual test of an outdoor microphone having the SysCheck feature added.

The 1/3 octave spectrum available in the calibration menu helps you to verify that the ambient noise level is well below the calibration signal level.

The lower L/t graph holds the historical information about earlier calibration levels made for the selected transducer. In this way, you may see how a transducer maintain its calibration level. Changes more than ±1.5 dB relative to the verification level set for the transducer will result in an error message. The verification level is indicated by the orange horizontal line.

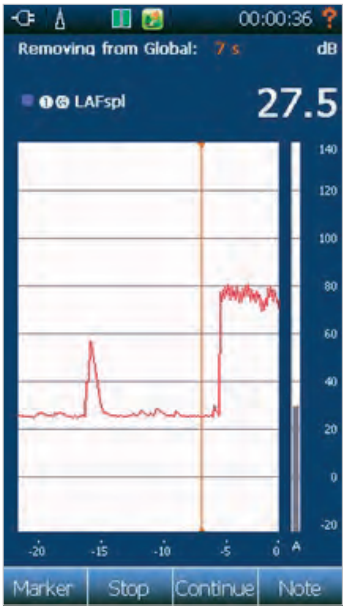

*The Calibration menu - Manual and automatic mode*

## Graphical pause back-erase

The 0 to 20 sec graphical pause back erase feature allows you to pause an ongoing measurement and remove an unwanted noise event.

Just tap on the graph where you want to continue from. The unwanted noise event is removed from the overall calculation. In the level versus time profile, the event is kept but pause marker is inserted.

In NorReview post processing and reporting program you can choose to include or exclude the paused noise event from your reporting.




*Graphical pause back-erase feature*

# Optional extensions and future proof

The Nor145 comes with an extensive set of functions available in its basic version. The modular software design enables functional expansion to take place when you need it and not at the time you purchase the instrument. This applies to all options except for the hardware related options 1 and 16, which cannot be added as retrofit.

All installed options remain in the instrument and there is no need for further loading of the options when used.

Norsonic provide regular firmware updates with new features and optional extensions. We implement new features to improve the handling of the instrument. Implementing new standards or revisions of existing standards are a part of our software maintenance scheme. Our retrofit policy is to keep your Norsonic instrument up to date the whole lifecycle of the instrument.


The options listed below are the current features available. There are more to come to expand the use of the Nor145 further. The priority and what features that should be, is decided by carefully listening to our customers. Your voice is determining the future development of the Nor145, helping us to stay in the forefront creating an even more complete unit for noise and vibration measurement applications.

**Nor145 basic** unit includes A, C and Z weighting networks with measurement of $L_{eq}$, $L_{eql}$, $L_E$ – sound exposure level, SPL, $L_{max}$, $L_{min}$ with parallel detection of Fast, Slow and Impulse time constants, statistical calculation of $L_n$, and $T_{MAX5}$. The measurement data is analysed as global values in addition to two parallel time profiles with an adjustable resolution ranging from 5 ms to 24 h. Voice and text annotation included.

**Option 1.** Built in GPS.

**Option 3.** 1/1 and 1/3 octave filters (0,4-20kHz in 1/3 octave band) including multi-specter functionality in time profile A.

**Option 4.** Audio recording, marker management and event trigger.

**Option 7.** Signal generator with sine, white, pink, band pass filtered noise, sine and swept sine (swept sine only with Nor850 software).

**Option 8.** Reverberation Time decay and calculation of T20 and T30 based on impulse or noise excitation. Requires option 3. Requires also option 7 if RT shall be based on noise excitation.

**Option 9.** Complete Building Acoustic mode with microphone position room averaging in accordance with ISO 16283 as well as sound insulation indices calculated in accordance with ISO 717/1 and /2. (Req. opt. 3, 7, 8).

**Option 11.** Enhanced noise assessment package with internal web server including NorRemote for remote control via smartphones, pads and PC and additional four triggers for independent setting of different trigger levels during a day. Requires option 4.

**Option 12.** NorCloud connectivity. This option gain access to NorCloud, the Norsonic cloud based measurement and data storage service.

**Option 13.** FFT. Works in parallel with the 1/1 or 1/3 octave analysis.

**Option 16.** Built in WLAN and LTE modem (Edge – 4G).

# Environmental Analyser

- Twin time profiles with resolution from 5 ms and additional Moving report with trigger possibility
- Extensive trigger system for reports, audio recording, camera and digital output lines
- Voice, text and picture notes
- 5 independent event triggers (LDEN support)
- Advanced marker management
- Full remote control support via NorRemote app for smartphone, PC or pads
- Seamless connection to NorCloud for unattended monitoring and reporting
- 0-20 sec graphical back erase / pause function
- 0-120 sec Audio pre-trigger
- Seamless integration to post-processing programs and Excel

Nor145 is ideal for all types of environmental noise measurements, permanent, semi-permanent, attended or unattended. Measurements with markers, audio recordings and event triggered pictures are easily made. The large 4.3" display gives you all the necessary information. Up to 60 measurement parameters may be logged simultaneously.

The sophisticated trigger system enables different trigger levels for Day, Evening or Night with event triggers to collect markers, audio recordings and pictures. The data can be displayed remotely on any PC, notepad or smartphone. From the same device, you may change settings or simply check the status of the Nor145.

## The Audio recording and Picture feature

The Nor145 records the sound signal itself if option 4 is installed. The most common application is for source identification purposes.

Dependent on the selected quality of the recording format, the signal may also be used for further analysis. The recording quality is available in several formats to suits different applications, 8, 16 and 24 bit resolution with a sampling rate of 12 or 48 kHz. A pre-trigger may be set to start capturing a recording up to 120 sec before the event took place. The audio recording may be started manually using the keyboard or a remote hand switch. It is also possible to start a recording if a marker is activated. Continuous recording is only limited by the size of the SD memory card. The recording may be replayed on the Nor145 by connecting a standard head-set. You may easily scan through the captured recordings in a measurement sequence without transferring the data to a PC. Detailed analysis however is more convenient using the NorReview postprocessing and reporting program.

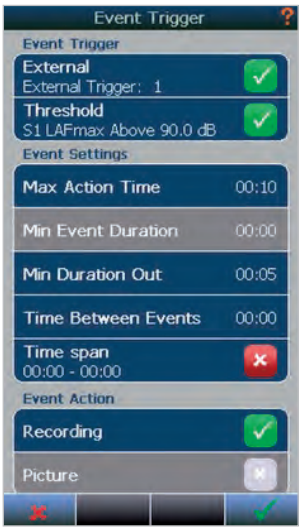
## Advanced marker management

The Nor145 features a sophisticated, but yet easy to use marker management. Up to ten markers may be selected. The user can name the marker, select between single and toggle marker, colour and associate an action to the marker. The action can be; enable a reference tone, start a recording, take a picture or set one of the digital outputs on the Norsonic 15 pin digital I/O socket. It is easy to add markers to an on-going measurement. The marker menu can be hidden from the full overview of the L/t display. Notes may be added to an ongoing measurement in the same way as markers.


*Advanced marker management*

## Sophisticated event trigger

Up to five independent event triggers may be configured. Each trigger can be activated by an external switch/digital signal and/or by a preset sound level threshold. In the event setting menu you configure which of the measurement parameters to trig on, the maximum event action time, the minimum duration after an event and the time between events to limit repetitive events caused by a barking dog etc. In addition, you may configure the time span an event shall be active. With the five trigger you can combine up to five different thresholds for LDEN or similar applications. An event action inserts a marker in the level vs time profile to enable further investigations in the NorReview postprocessing and reporting program. Additionally, you may record the sound and capture a picture. The picture can be taken with an IP camera or a device camera found on a smart phone, pad or PC. The pictures are automatically transferred and bundled with the measurement data. You may view the picture or replay the audio recording on the Nor145 itself or in the NorReview postprocessing and reporting software.




*Event trigger menu*

# Easy connectivity to NorCloud

Whenever and wherever you need to monitor and collect noise data on a permanent or a shorter time span as in:

- Construction noise monitoring
- Transport noise monitoring
- City noise monitoring
- Industrial estate noise monitoring
- Airport noise monitoring
- Harbour noise monitoring
- Race track and Shooting range monitoring
- Outdoor concerts and venues

Nor145 is made for these tasks. Turn on the instrument, enable NorCloud connection. In NorCloud, register the id number of the Nor145 in your NorCloud project, and you are up and running collecting data from one or many Nor145s. You may control settings, receive event alarms and create automatically reports. Once registered you can easily move the instrument between your projects when needed.

A powerful report generator integrated in NorCloud offers you to design your own report templates, or you can use one of our standard templates. You can set NorCloud to distribute via e-mail as many measurement reports that you need, as often you want. Or just select a time window in the graph and generate a NorCloud report on demand based on the selected time span.

NorCloud is seamless integrated with NorReview, when further analysis of measurement data is needed. Just select the period window of interest, download the measurement and open it in NorReview. The NorReview PC software package is a powerful tool for post processing and presentation of environmental noise data.

Nor1545 is an all-weather proof cabinet supplied as a ready to go unit supplied in various configurations;

Standard version is fitted with a Nor145 and Nor1217 outdoor microphone including one year basic NorCloud subscription. It can be upgraded with internal battery, external 12V input from solar panel and/or external batteries and power supply for weather station.

For permanent noise monitoring an upgrade to the microphone heated outdoor microphone system Nor1216 is recommended.

NorCloud

# Generating reports

Measuring sound is often more than just reporting a dBA value. Most measurements are made in accordance to a standardized method requiring a report generated on a standard format, but sometimes you may need a customized report or calculations made in Excel. Whatever need you have, we offer a broad range of programs that helps you to evaluate the data and generate proper measurement reports.

## NorConnect for Nor145

NorConnect is a measurement suite and data management program for measurement files downloaded from Nor145 and Nor150. Nor145s meta tag features makes it easy to sort and search across projects to find measurements with equality. The program also offers a graphical and numerical viewer function of your measurements.

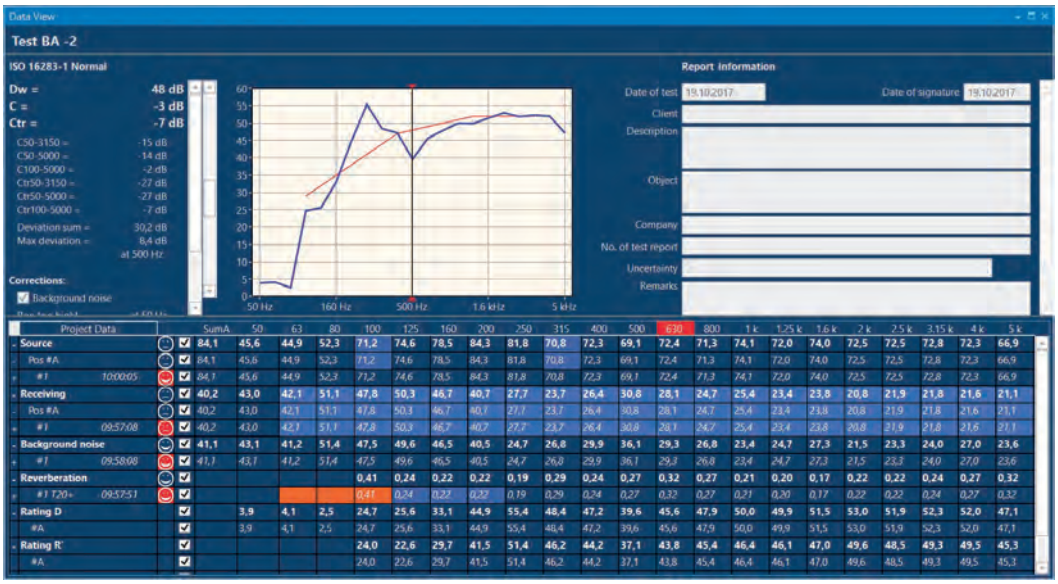
Dependent of your measurement, optimized graphical tools are offered for building acoustic, sound power and environmental/ general measurements.

You may scan through your measurements and listen to audio recordings and generate reports using predefined or your customized report templates. The program is seamless integrated to Nor850 and NorReview if a more detailed analysis is required. It also offers easy integration to Excel.

The program supports all communication environments offered by Nor145 and enables you to connect to the instrument remotely via modem, WLAN or LAN.

NorConnect is freeware and is a part of the Nor145 delivery.


*L/t view with audio recording*




*Building Acoustic view*

## NorVirtual

NorVirtual emulates the Nor145 on a PC. Whatever view (graphs, menus, tables etc.) the same view is mirrored on the PC screen. The mouse can be used to operate the virtual keyboard.

The program supports all communication channels on the Nor145. Hence, you may use this program in combination with NorConnect to connect and control the Nor145 remote from virtually any place in the world. NorVirtual is a perfect tool for seminars, schools, universities etc.

NorVirtual is freeware and is part of the Nor145 delivery.


## NorRemote Nor1050

The Nor145's built in web server opens up new possibilities of remote communication and acquisition of data from a Sound level meter. Simply connect to your instrument via LAN, GPRS or WiFi using a web browser to control, download or view the measurement in real time.

The program covers all applications from downloading files to full control of your analyser, add markers, start a recording or just check the battery status.

Connect your smartphone, pad or PC to the Nor145. Photos and voice notes obtained on your smartphone or pad are seamless integrated with markers into your noise data with markers in the time profile.

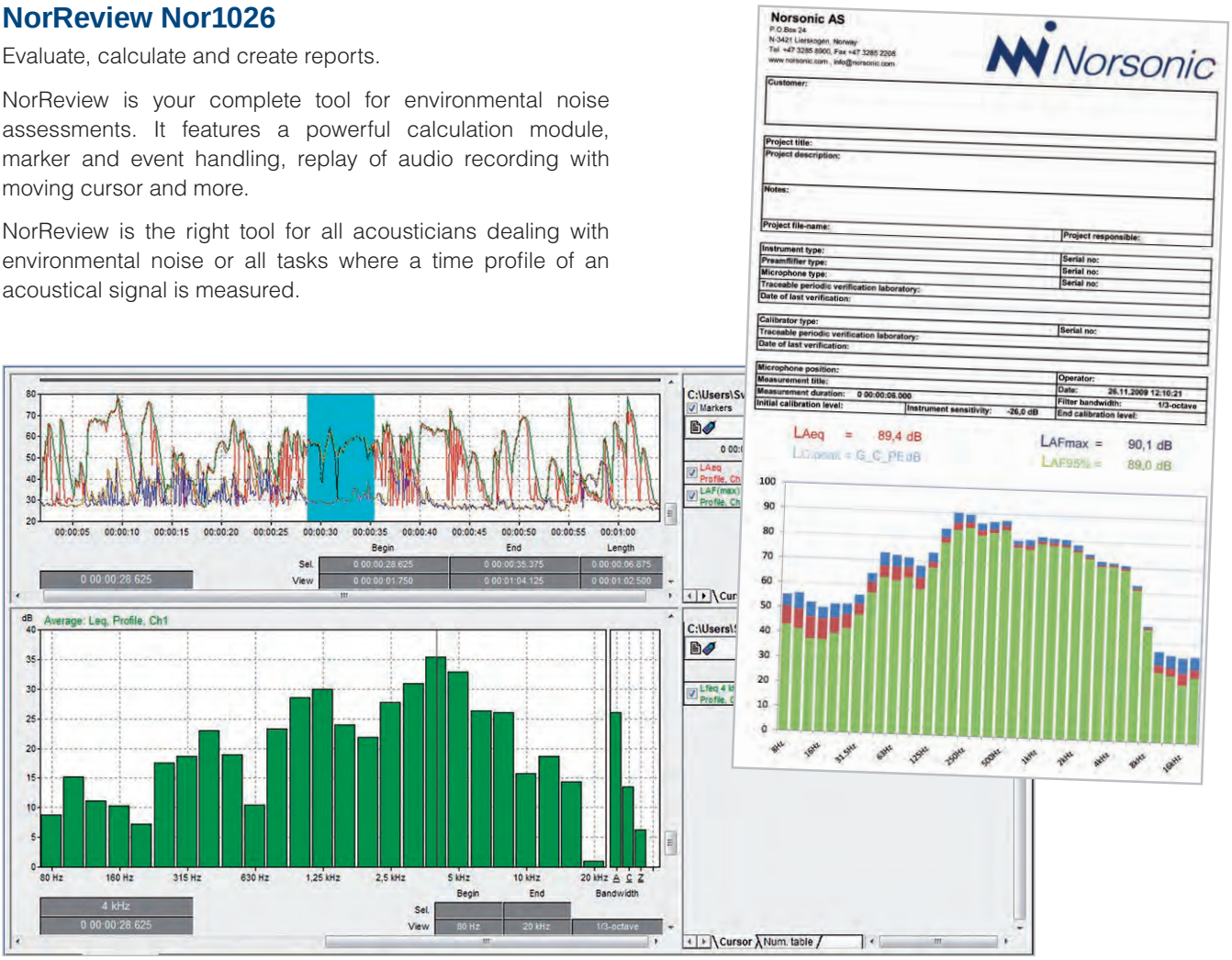
NorRemote is part of option 11.

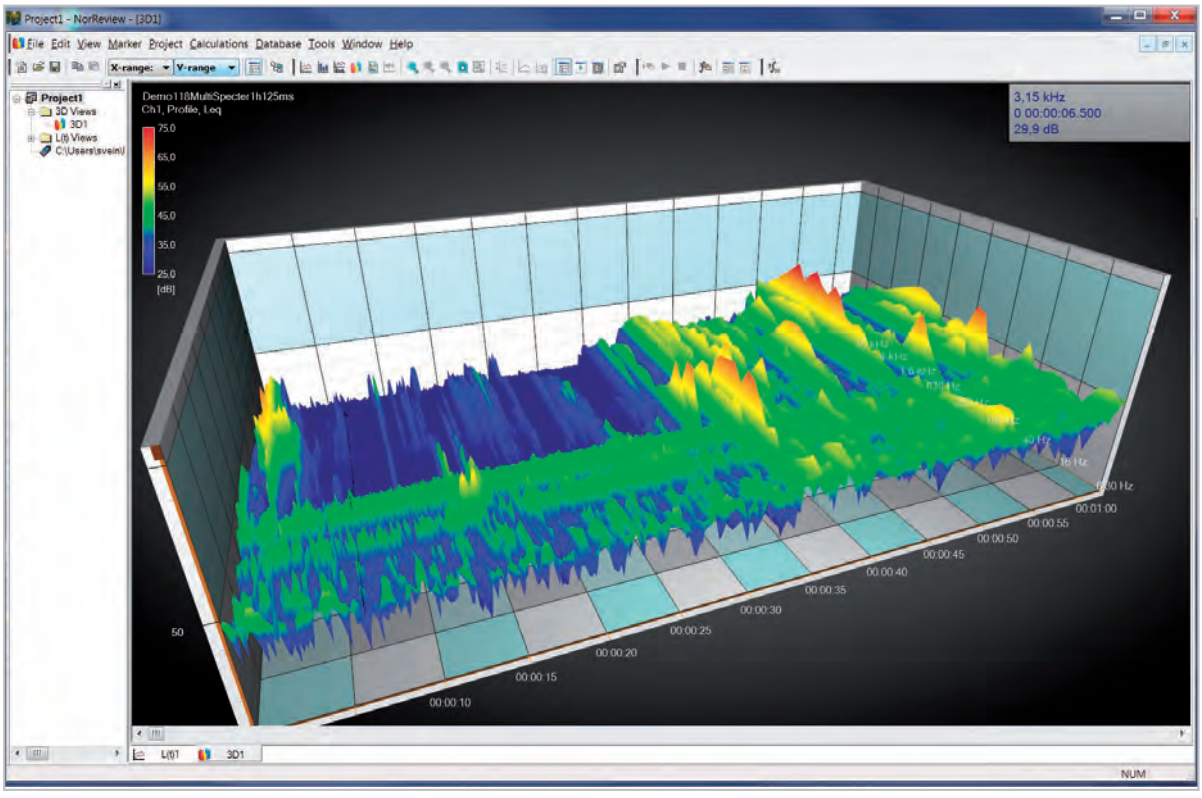
## NorReview Nor1026

Evaluate, calculate and create reports.

NorReview is your complete tool for environmental noise assessments. It features a powerful calculation module, marker and event handling, replay of audio recording with moving cursor and more.

NorReview is the right tool for all acousticians dealing with environmental noise or all tasks where a time profile of an acoustical signal is measured.



# Building Acoustic Analyser

- Complete calculation of airborne, façade and impact sound insulation indices in accordance with international and national Standards
- Wireless single or dual channel measurements using one or two Nor145 controlled from Nor850
- Reverberation time measurements with parallel calculation of T15, T20, T30, Tmax and EDT
- Ensemble averaging of reverberation decays
- Backward integration of reverberation decays based on impulse excitation
- User adjustment of individual RT decay lines
- Signal generator with white, pink or bandpass filtered noise
- Supports multiple microphone and loudspeaker positions with corresponding on-board energetic or arithmetic averaging
- Project overview with information about all individual measurement details and project progress
- Seamless integration with Nor850 reporting software

The Building Acoustics mode is designed to cover any in-situ sound insulation measurement tasks. You may choose to measure airborne, façade or impact sound insulation. The Nor145 will offer you a wide range of user-friendly features that helps make your desired measurement task more efficient than ever.

## Supported Standards

Nor145 is supporting the international series of ISO 16283 Standards for field measurement of sound isolation in buildings and building elements. ISO 16283-1 for airborne sound insulation contains calculations for both normal and staggered rooms, even with the additional corner measurements. ISO 16283-2 is used for impact sound insulation. ISO 16283-3 for facade sound insulation contains calculations based on both traffic and loudspeaker excitation as well as for façade elements.

The following international and national Standards for in-situ sound insulation are currently supported:

- ISO 16283-1, -2 and -3
- ISO 140-4, -5 and -7
- ISO 717-1 and -2
- ISO 10052
- ASTM E336 and E413
- ASTM E1007 and E989
- DIN 4109-4 and -11
- BS-ISO 140-4 and -7
- SS-EN-ISO 25267
- SIA 181

## Measuring sound insulation

Nor145 supports all the intricate calculation details given in the various Standards in an intuitive and user-friendly interface.

Measuring the sound insulation implies measurement of the sound level in the receiving room with noise or impact excitation as well as the background noise level without excitation. In addition, the reverberation time in the receiving room must be measured using either noise or impulse excitation. The reverberation time is used for correcting the received level for room absorption.

Additionally, the sound level in the source position must be measured for airborne and façade insulation. Room averaging using multiple microphone positions is also required. Some standards require multiple loudspeaker positions which are easily made with the user-friendly Nor145 Building Acoustics mode.


*Setup menu for selecting standards. You may recalculate for additional standards based on already measured data.*

## Level measurements

For airborne insulation, the loudspeaker is placed in the source room and the various microphone positions are measured. For impact insulation, the tapping machine is placed in the source room, but no positions are measured. In the receiving room, however, the various microphone positions are measured in both cases with the loudspeaker or tapping machine activated in the source room. In addition, the background level is measured in the receiving room without any active source in the other room.

To avoid the use of measurement data that is interfered with impulsive background noise, the Nor145 has two active features built-in.

Firstly, by measuring the $L_{eq}$ and the $L_{max}$ values simultaneously, you may easily obtain, before acceptance, that something is wrong if these values differ more than 3-4 dB.

Secondly, as the graphical profile view for each measurement is displayed, a similar situation may easily be detected. Both features are stored with the measurement data, and may be evaluated in the post processing Nor850 software later.


*Split screen display (left) with Receiving and Background levels in the upper level versus frequency (L/f) graph. The lower graph is a level versus time presentation of the Receiving room based on the cursor position from the L/f graph. Alternatively, all microphone positions and the average values are displayed together (right).*

## Wireless dual channel measurements

The on board Building Acoustics mode supports single channel measurement. However, the Nor850 software enables you to connect to two or more Nor145 to perform multi-channels measurements.

Using the built in WLAN and 3G/4G modem you can perform wireless building acoustic measurement for faster and more accurate measurement results without any hassle with cables.


*Graphical Reverberation Decay (left). Move with the cursor along the frequency axis to display the corresponding graphical reverberation curve. Press the Num button to get the corresponding numerical values. Alternatively, all reverberation time measurements and the average values are displayed together (right).*

## Reverberation time measurements

The measured sound level must be corrected for the absorption in the receiving room. Hence, measuring the reverberation time is required before the final calculation of the sound insulation index. The Nor145 offer reverberation time measurements based on either noise or impulse excitation, and calculates the $T_{15}$, $T_{20}$, and $T_{30}$ in parallel in addition to Tmax for noise excitation and EDT for impulse excitation.

All decay curves may be viewed graphically before acceptance of each measurement. If you find the calculated decay line not to be acceptable, the instrument offer a manual adjustment feature to improve those decay lines and the corresponding reverberation time.

## Sound insulation rating index

After performing minimum one microphone position for all required measurements of the selected Standard, the calculation of the rating index will automatically follow to give an initial indication about the rating index. You may then perform the missing microphone positions, and the final rating index is displayed in a graphical view including the reference curve.

## Project View

ISO 16283-1 requires measurement of five microphone positions for each of two the loudspeaker positions, in both the source and receiving room. In addition, background noise and multiple reverberation time measurements in the receiving room must be measured. In various national Standards, this requirement may differ, but in all cases, there are a long list of individual measurements. The Nor145 Building Acoustic mode offers an easy method to keep track of all these measurements; the Project View.

With a simple push on the Project softkey, a table containing all measurements appear - sorted after room and measurement type. For each group the number of measurements as well as a possible warning sign are displayed. Additionally, the table may be expanded to show all individual measurements. Should there be a warning or error for any of these, you may step directly to this measurement for further details or adjustments. Individual measurements may be temporarily excluded from the final rating index calculation.


*Project View display an overview of the entire measurement project in a concentrated form (left) and with all details in the expanded form (right)*


*The rating picture for impact insulation. Split screen with graphical and numerical values. If more than one loudspeaker or tapping machine position have been measured, you may use the softkey '#' to scroll through the individual calculated results for each position named A, B, C, ….. The total result is called 'Total'.*

## Re-use of measurement data

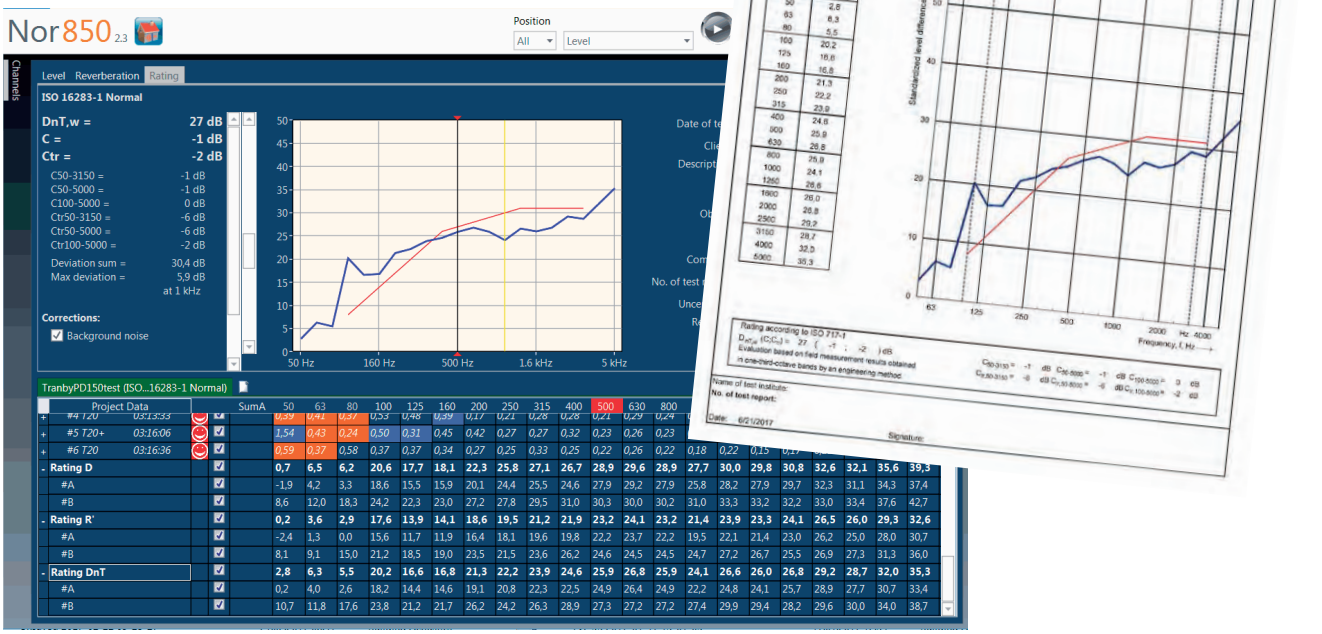
When a sound insulation project with all required measurements are finished, the operator may re-use these data for additional projects. This comes handy if the background noise level and the reverberation times in the receiving room shall be re-used for an impact test in the same room.

Re-calculation of the sound insulation index based on another Standard is also possible. This is simply done by changing the Standard selection after storing the initial project. Hence, no need to re-take all the measurements for making additional national sound insulation indices - the Rw, DnT,w and ASTC a.o. indices are all calculated based on the same measurements!

## Final reports

The Nor145 is seamless integrated with Nor850 Building Acoustic postprocessing and reporting software for professional and easy generation of measurement reports in accordance to national and international standards.

Alternatively, you may transfer the data to your PC via NorConnect and automatically convert it to Excel for report generation based on your favourite templates.



# Specifications

The Nor145 Precision Sound and Vibration Analyser is supplied with ½" preamplifier Nor1209 and the ½" measurement microphone Nor1227. It conforms to the latest revision of the following National and International standard including amendments, all type 1 / class 1; IEC 61672, IEC 61260, DIN 45657, ANSI S1.4, ANSIS1.11, and ANSI S1.43. It also conforms to the obslote sound level meter standards IEC 60651 and IEC 60804.

## Measured Parameters

Simultaneous measurement of SPL, $L_{eq}$, $L_{eql}$, $L_{Max}$, $L_{Min}$, $L_E$, $L_{EI}$, $L_{Peak}$, $L_n$ and $T_{max5}$.

Time weighting functions: Fast, Slow and Impulse

Spectral weighting functions: A, C and Z - weighting

Frequency analysis: 1/1 and 1/3 octave real time filters from 0,4 Hz to 20 kHz.

Statistical calculations: 8 individual adjustable percentiles from L0,1% to L99,9%, The statistical calculations are performed in real time within each frequency band and for each profile period if period length is set longer than 2 minutes. Class width is 0,2dB. Dynamic range is 130dB.

## Measurement control

Overall measurement duration: 1 sec – 7 days. (If set to Repeat or Synchro mode a new measurement will be started automatically, with no time gap between each measurement).

Time profile A resolution 5 ms – 24 hours including full frequency spectra. From 1 sec if profile B or Moving is enabled.

Time profile B and Moving resolution 1s – 24 hours. A, C and Z - no frequency spectra.

0-20 sec free selectable graphical back erase.

## Audio recording

12 and 48 kHz sampling rate / 8, 16 and 24 bits / 0-120 sec pre-trigger.

## Measurement range

One range covering 120 dB without any range adjustments.

Self-noise measured with 1/2" microphone with a nominal sensitivity of 50 mv/Pa: 17 dBA.

Maximum RMS level 137 dBA, Maximum Peak level 140dB PeakC.

The high SPL mode enables measurements up to 194 dB using a suitable 1/4" microphone.

## Noise Generator

Built in noise generator with Sine, White, Pink, 1/1 and 1/3 octave band passed filtered noise and Impulse noise.

## Reverberation Time

Parallel calculation of T15, T20 and T30 in addition to Tmax for Noise excitation and EDT for impulse excitation.

## FFT

Sampling rate: 48 kHz

Frequency resolution: 1.46 Hz or 2.92 Hz (FFT size 8192 or 16384 lines).

Upper frequency: 22kHz.

Functions: Auto spectrum, linear averaging.

Acquisition rate: 700 ms – no overlap.

Zoom: Dynamic display zoom – to 64 in binary steps.

## Display

4,3" colour display with capacitive touch. Protected by an anti-smudge coated and scratch-proof glass.

## GPS / Camera

Built in GPS.

Support for external IP camera. With an external IP camera, you can make event triggered pictures. Pictures captures during a measurement is marked as events in the L/t graph and can be viewed on the Nor145, in NorCloud or in NorReview.

## Datastorage / Datatransfer

Storage modes: Manual, Auto, Repeat and Synchro. Synchro synchronise the start of the next measurement to the next full hour.

Internal memory: 350 MB - not used for measurement storage.

Micro SD card: Supports XC and HC standard. No limitation in max. SD card size.

Data transfer via LAN and USB.
Optionally built in GPRS - 3G/UMTS - 4G/LTE and Wifi infrastructure and hotspot.

Internal antenna supports 3G/4G. External antennas with diversity may be connected. External antenna supports also GPRS connection.

## Inputs

Microphone input: One microphone input. Supports standard 7 pin Lemo preamplifiers including SysCheck, Microphone heating, TEDS and IEPE.

Polarization voltage: 0.

Preamplifier voltage is ± 15V.

Comment microphone: Via 3,5 pin mini jack.

## Analogue outputs

AC out, 100mV full scale on 15 pin I/O socket.

3 pin mini jack headphone socket for replay of voice notes, listen to microphone AC signal or replay of audio recordings. Comment microphone for voice notes is connected to same plug.

Signal generator on 15 pin I/O socket with Pink, White, Bandpass filtered, sine and impulse noise.

## Power

Rechargeable 7 Ah Li-Ion batteries with built in fuel gauge
External power: 9 - 15Vdc 3-5Watt.

Typical battery lifetime: 8 hours.

Dimensions (ex. preamplifier and microphone LxWxH):
235 x 82 x 29mm.

Weight (including preamplifier and microphone): 535g.

## Accessories included (Standard package)

Nor145, Precision Sound Analyser with A, C and Z weighting networks, Parallel time constants, Statistical calculation and time profile A, Parallel calculation of T15, T20 and T30 in addition to Tmax for Noise excitation and EDT for impulse excitation.

Supplied with rechargeable battery pack, mains adaptor Nor345B, carrying case Nor1346, 32GB micro SD card, USB cable, Microphone Nor1227, Preamplifier Nor1209, Windscreen Nor1451, Instruction manual, 3 years warranty and calibration certificate, Nor1051 NorConnect software for file transfer & measurement view and NorVirtual - sound level meter emulation program.

*Specifications may change witouth further notice*

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