INSTRUCTION MANUAL

INSTRUMENT SOFWARE 2.0

Norsonic has always been at the forefront introducing new technology to sound level meters. The Nor150 Sound and Vibration Analyser sets a new standard in user-friendliness. Featuring the largest colour touch screen in a handheld meter on the market today, the Nor150 provides the user-friendliness of a smart phone. Further features include built in web server, camera, GPS, sound recording, voice and text notes, sophisticated marker handling and event triggers in addition to high resolution time profile and multi-frequency spectra bringing the sophistications normally found in laboratory instrumentation out in the field. The instrument is designed to cover a variety of applications besides being a sophisticated sound level meter. This instruction manual is covering software version 2.0, which with its features address the noise assessment , building acoustics and sound intensity market.

nor150

SOUND & VIBRATION ANALYSER

Norsonic

Nor150 User Guide – February 2017 Edition
Im150_1Ed3R1En

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Finding the information you need

Thank you for choosing Norsonic!

The Nor150 has been designed to give you many years of safe, reliable operation.

Your approach to the Nor150 documentation depends on what you want to do and how much you already know.

This manual is divided into several sections plus an index. Each section provides useful and in depth information about the available features. Depending on your requirements and your familiarity with measurements as such, you may find that you use some parts of this manual quite often and others not at all.

A brief introduction of the user philosophy and use of the instrument is described in chapter 2. We recommend reading this chapter before use, and as a minimum, reading the safety instructions and precautions in chapter 1.

If you do not have this manual at hand, useful help is found in context sensitive help function in the instrument. In most pictures there is a red question mark "?" in the upper right corner of the display. Tap it to access the help function.

NOTE that the instruction manual describes a fully equipped instrument. Your version of the instrument may not have all the optional extensions available. Software extensions may, however, be installed as retrofit at any time, However, extensions like the dual channel option, camera and GPS cannot be installed as retrofit.

Denotes

Some denotes are used in the manual to ease the use and distinguish a keyboard key, a soft key or a menu.

VIEW denotes the View button found on the rubber keyboard.

Stop denotes a soft key mostly found in the lower line of the display.

Instrument denotes a menu point.

Contents

nor150

SOUND & VIBRATION ANALYSER

Important information

Please read all safety, precaution and storage information before use. These sections contain vital information to maintain safety and warranty.

Safety instructions

- Read these instructions.
- Follow all warnings and safety instructions.
- Do not use the instrument in rain or moisture.
- Keep the instrument out of corrosive atmosphere and do not use it in a hazardous area.
- Clean the instrument only with dry cloth, except for the display where special wipes are available.
- Do not place this instrument near any heat sources such as radiators, heat registers, stoves, or other apparatus that produce heat.
- Only use the original mains adapter supplied with the instrument.
- The internal battery is a Li-ion type. Make sure it is recycled properly if it is going to be replaced
- Make sure the instrument and any accessories are not damaged in any way use.
- Only use attachments/accessories allowed or specified by Norsonic AS.
- Be careful when using the instrument on a tripod or in combination with a rotating boom.
- Unplug this instrument during lightning storms or when unused for long periods of time.
- Refer all servicing to qualified service personnel. There are NO user-serviceable parts inside. Servicing is required when the instrument has been damaged in any way, such as power failure, battery failure or any plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the instrument has been exposed to rain or moisture, does not operate normally, or has been dropped.

Precautions

You probably already know it but…

… the microphone is a especially fragile device. It is easily broken, so take care.

…. always keep the microphone cartridge mounted on the preamplifier. This is the safest way to avoid damage and access of dirt on the contact pin between the preamplifier and microphone cartridge.

… keep the instrument in its carrying case, don't leave it everywhere.

… even the instrument is a field instrument, prevent it from direct contact with dust and moisture.

… Nor150 is a measurement instrument; protect it from impacts and strong vibration.

… never store the instrument with empty batteries. This may permanent damage the batteries

… fully recharge batteries every month if the instrument is not in use.

… always calibrate the microphone before and after a measurement.

… send the instrument for verification at an accredited laboratory minimum every 24 months.

Storage

- Fully recharge the batteries before storage. Never store the instrument with empty batteries. It may permanent damage the batteries.
- Fully recharge the batteries every month if not in use
- Store the instrument at room temperature. Storage above +35 °C / 95 °F, or below +5 °C / 41 °F is not recommended.

Taking a closer look at the instrument

Be sure to take utmost care when mounting a microphone cartridge onto a preamplifier. To avoid electrical shock from the 200 V polarization voltage always keep the preamplifier disconnected whenever you are mounting a cartridge onto a preamplifier and screw finger tight only!

The picture shows the Nor150 fitted with the standard preamplifier Nor1209 and the microphone Nor1225 mounted in sound channel one.

The instrument is powered from an internal rechargeable Li-ion battery pack. The battery is fully charged when leaving the factory, but due to self-discharge, you may experience the battery gauge shows a lower value than full. The batteries will be charged once the instrument is connected to mains via the supplied mains adapter Nor345A.

Always keep the microphone cartridge mounted on the preamplifier. This is the safest way to avoid damage and access of dirt on the contact pin between the preamplifier and microphone cartridge. The preamplifier input has extremely high input impedance (10 Giga ohms) in order not to load the microphone cartridge. Hence, dust, finger prints or other types of contamination may change the sensitivity of the microphone, especially at high humidity.

Switching ON/OFF

The instrument is toggled **ON/OFF** by pressing the lower right key ⏻. A short push is enough to start the instrument. The instrument is then going through an initial start-up procedure before showing a measurement display or the application selection menu.

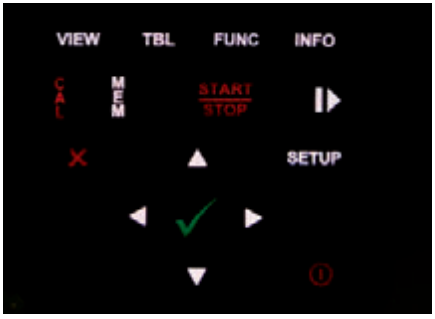
A new push on the button produces a question on the screen, where you confirm that the instrument shall be turned off or lock/unlock the keyboard and the touch-sensitive display.

You may force the instrument to turn off by pressing the **ON/OFF** key for more than 5 seconds.

Keyboard

The Nor150 is mainly operated via the touch screen. There is however a dedicated backlit rubber keyboard used for operation of the main important functions such as power **ON/OFF**, measurement **START/STOP, PAUSE** and **CALIBRATION**. The philosophy is that all important functions can be operated via the keyboard as well as the touch sensitive display.

The backlighted keyboard enables easy operation in dark environment. The backlight level is factory preset, but may be adjusted in the *Power Setting* menu. A time out function is added that will turn off the keyboard light. Touching the screen or push a button will turn the light on again. You may turn off the keyboard light or reduce the power consumption. This setting is done in **SETUP** > *Instrument* > *Power Setting*.



It is recommended to use the measurement control buttons in the touch sensitive screen if you are measuring low noise levels. The rubber keyboard may generate acoustical noise that might influence your measurements at levels below 40 dBA.

In this manual the following symbols are used to indicate the keyboard buttons:

VIEW — View button (**VIEW**): Switch between the four available view setups. Each view can have its own result types displayed, and the cursor movements can be linked.

TBL — Table button **(TBL**): Switch between graphical and numerical/table version of the results.

FUNC — Function button (**FUNC**): Rotating between selected measurement functions.

INFO — Information button (**INFO**): The info screen is available and shows important measurement settings even when the measurement is running and the menus therefore are not available.

CAL — Calibration button (**CAL**): Activates the calibration functions.

MEM — Memory button (**MEM**): Gives access to browse the memory system.

START STOP — Start/Stop button (**START/STOP**): Starts a measurement or Stops an ongoing measurement.

Pause/continue button (**I▶**): Temporarily prevents measured data to go into the global results. The pause is a toggle style function. It includes a graphical back-erase function.

SETUP — Setup button (**SETUP**): Gives access to the menu system. Display parameters are also available via pop-up menus which are context sensitive.

Cursor buttons (▶ ▲ ▼ ◀): Keys for moving the cursor in graphical and tabular displays. The cursor buttons may have different functionality in the different displays.

On/Off / Lock Keyboard button (**ON/OFF**): Turns the instrument On/Of or keyboard lock. A control question appears on the screen. Holding the button down for more than 5 seconds force the instrument to switch off. Pushing the button when the instrument is measuring will prompt you for keyboard lock only.

V button (✓ or **OK**): Exits the current menu and stores your current selections.

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

Touch sensitive screen

The large 4.3” capacitive touch display is optimised for use both in dark environment as well as in sunlight. The Nor150 uses the latest technology for touch sensitive displays. The capacitive touch technology eliminates the use of a stylus or calibrating the XY position of the screen.

Manoeuvring in the menus follows the same use as on any smart phone or pad. I.e. in all menus use your finger to tap on the selection fields or drag on the selection wheels or table up/down.

Placing the finger for a few seconds in a graphical display or numerical table or pushing the √ button gives access to a context sensitive menu with various selections available for the current display – easy and intuitive.

The backlight brightness is preset from the factory to work in various environments. It is however possible to adjust it in the power setting menu to optimise it for the current light condition. It may be needed to increase the brightness in heavy sunlight, while dark environments may call for a lower setting. Additionally there is a time out function that will turn off the backlight after a preset time. Touch the screen or push a button and the light will be turned on again.

Please note that the use of the backlight makes a significant impact on the power consumption.

Use the measurement control (Start/Stop, Pause/Continue) in the touch sensitive display when you measure low noise levels. The touch sensitive display is completely noiseless compare to a traditional keyboard.

The Main Status LED

The multi-colour LED above the display indicates several operating states. Red colour indicates some type of error condition (like overload) while green colour is for positive information.

State	Color	Behavior	PWM	Description
Startup/Booting	Red	Continuous		Startup before instrument is in Idle/ready mode.
Idle/ready	Blue	Continuous		Instrument is ready to start or measurement is finished.
Waiting for trigger	Blue	Blinking	Yes	Start is pressed, but instrument is waiting for trigger condition to be fulfilled.
Running	Green	Continuous		Instrument is measuring, no event.
Event trigger fulfilled(Audio, camera)	Green	Blinking	Yes	Any of the event triggers are fulfilled, recording or camera. The LED lights continuous as long as the recording/ video/picture is on
Overload	Red	Continuous		Instantaneous overload only, not latched.
Battery too low at start-up	Red	Blinking	No	Rapid flashing, before shutting down
Battery low when running	Yellow	Blinking	Yes	Instrument is running, the Green running state is turned into Orange.
After shutdown if battery low	Red	short ON long OFF		The LED will report some short red blink if you try to switch on the instrument after a battery shutdown to indicate that the battery has insufficient capacity to power on the instrument.
Charging	Yellow	Blinking	No	1 to 5 blink. 1 blink means 0-20 capacity. 5 blinks mean 80 to 100% capacity.

Input and output connectors

Input channel 1 is located at the top of the instrument. This is the “default” channel and is the channel used for most sound measurements.

Input channel 2 is mounted on the left-hand side of the instrument. This socket is wired identically to sound channel 1 on the top of the instrument.

Input channel 2 is optional and is not available as retrofit.

On the right-hand side of the instrument there are different communication sockets and the power socket. The mains adapter, Nor345A, is connected to the large circular socket. See chapter *“Technical specifications”* for further description.

Several sockets are located behind the rubber cover on the bottom side of the instrument.

LAN socket

Mini USB socket

Normal USB socket

Micro SD card socket

Headset. This socket is intended for connecting a headset with microphone. The signals directly from the input sound channels or from an audio recording can be available so the operator can listen to it. The microphone input can be used to add voice notes to the measurements.

The socket accept a 4 pole 3,5 mm jack plug, normally found on headset with microphone for smartphones or the Norsonic headphone Nor4584.

On the use of the internal battery vs. external DC

The Nor150 comes with an internal Li-ion battery pack (Nor150/Battery) using the latest available charging technology. The battery pack is a so called smart battery where a build in microprocessor holds all information about the power use and charging. The battery pack sends information to the instruments main processor about available capacity. Thus, the battery may be replaced with a fully charged one without any need for re-calibration of the battery gauge.

Battery lifetime is typically 6–9 hours (depends on measurement mode, use of backlight and interfaces etc). The battery pack is fitted with a fuel gauge. Push the switch below the row of LED's to verify the status of the battery.

A mains adapter type Nor345A is supplied with the instrument. This mains adapter will recharge the batteries (at least 80%) within 2 hours if the instrument is switched off. Longer time is needed if the mains adaptor shall power both the instrument and provide charging.

The instrument switches uninterrupted between mains adaptor and battery power. Hence, always keep the battery pack installed, even when continuously powering the instrument via the external power socket. This will increase the power redundancy.

An external DC voltage (10 – 28 V) can also be used to power the instrument. A cable for this purpose is available separately from Norsonic or our distributors. Please note that fast charging of the internal battery requires 13.2 V / 1.2 A.

Verify the real time clock if you change the batteries. It might be necessary to adjust it.

Charging the Internal Battery

We recommend that you use the mains adapter Nor345A for charging the battery pack. Connecting an external DC-source (10–28 V) to the instrument may do the same function if it can supply 1.2 A continuously. Icons in the upper line of the display indicate the battery condition and whether the instrument is connected to external power.

NOTE! Always fully recharge the battery before you store the instrument. Fully recharge every month if the instrument is not in use. The battery may be permanent damaged if this procedure is not followed.

If power fails

If the battery voltage drops below 9 V, the battery indicator turns red and after a short while the instrument will start to shut itself off. Any ongoing measurement will be terminated and stored. Memory contents are retained without the use of electrical power (flash memory). Upon inserting a fresh battery pack, or connecting to a proper DC voltage source, the instrument will start-up again, and ask the operator for the confirmation to store the previous measurement in the normal way.

Should the external power fail during a measurement, without any internal batteries installed (or the installed batteries have no power left), the instrument will be turned off immediately without storing the ongoing measurement. However, as the instrument automatically makes a backup storage every 2 minutes, the last file stored will include the correct results except for maximum the 2 last minutes prior to the power failure. Upon return of the external power, the instrument will automatically start to measure as if the **START/STOP** key had been pressed.

The Nor150 has a built in power saving feature that turns down the backlight and eventually switch itself off if left unattended in ready mode (I.e the instrument is not measuring or is in ended mode).

Optional extensions

The Nor150 comes with an extensive set of functions available in its basic version. Many other functions are available as optional extensions. The modular software design inside the Nor150 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 hardware related options such as option 1 and 2, which cannot be added as retrofit.

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

Software maintenance

Norsonic provide regular firmware updates with new features and bug fixes. By carefully listening to our customers we implement their wishes to improve the handling of the instrument and expand it with new features. New software versions can be uploaded from our website and are free of charge if the version is on the same main software version level. A software upgrade fee is charged if you want to upgrade to the next main version (i.e. from version 1.xx to 2.xx), unless you have signed a maintenance contract. Please contact your local Norsonic dealer to receive more information about our software maintenance program. A new main version consists of several new features. Such features can be adaption to new revisions of measurement standards, new measurement functions or new and easier use of the instrument. In addition to new software versions, new option extensions are developed to expand the use of the instrument.

Your first measurement

Make sure you have read the section *"Taking a closer look at the instrument" on page 3* earlier in this instruction manual.

Assemble the instrument if it is not already done.

Turn on the Nor150

and wait for the start-up sequence to terminate. If needed connect the mains adapter Nor345A. The upper line on the display shows a "fuel gauge" for the battery.

Select the transducer

When the instrument is delivered from the factory, data for the supplied microphone and preamplifier are entered as a selectable transducer in the input menu. Select **SETUP** > *Input* to see that it is selected.

Check the calibration

This is necessary to make sure you aquire results with correct level. Use a calibrator type Nor1251 or similar to produce the test signal. See *"Calibrating the instrument - field check" on page 38*.

Select a standard set up

The easy end repeatable way to perform a measurement is to select one of the stored set-ups from the memory. If none of these suits your needs, you can make your own and save them for later use. See *"Application Selection Menu - Predefined Setups" on page 65*".

Start and Stop of the measurement

So far only idle values have been displayed. By pushing the **START/STOP** button, the instrument will start to collect data, calculate averages, detect minimum and maximum values and so on. This activity will go on until the pre-set measurement time has expired or the operator pushes the **START/STOP** button again. All the values collected during the measurement will then be available for the user.

Starting a new measurement will delete all the previously measured data including indications of overload or under-range.

Saving the measurement to the memory

After the measurement is finished, all the results, markers and annotations can be saved together with the set up information to the memory. See section "*Storing a measurement – Memory organization Menu*" later in this manual.

Reducing the influence of the operator

If you experience that the presence of the operator (and the hand that holds the instrument) is influencing the sound field it is recommended idea to put the Nor150 on a tripod. It is a standard camera thread screw in mount hole at the rear side of the instrument.

Removing the influence of the instrument itself

Sometimes even the presence of the body of the Nor150 can influence the measurement more than desired, or the space may be narrow so only the microphone / preamplifier have space. A table of case reflections and uncertainties can be found in the specification section later in this manual. Then connect an extension cable between the preamplifier and the instrument. Using e.g. a 2 meter Nor1410A (with Lemo socket in both ends) will not influence the measurement quality. A microphone holder, Nor1261 or Nor1262, is available for the purpose.

Limiting the influence of wind and dust

The use of the windscreen Nor1451 will limit the influence of wind and dust on the microphone. These "foam-balls" are made of a special type of material, and they have a slight influence of the frequency response of the instrument. Therefore a windscreen correction has to be switched on. This is done in the *Input Menu* (available with the **SETUP** button).

When the wind screen is fitted and the correction is turned on the measurements performed will still be within the specifications of a type 1 sound level meter. The wind screen correction data and uncertainties are shown in a table in the specifications section later in this manual.

Similar, using one of the Norsonic outdoor microphones, needs corrections. These corrections are automatically "turned on" if selecting one of the outdoor microphones available. This is further discussed later in this manual.

The measurement functions available

What is a Function? In the Nor150 the term is used to denote the combination of RMS (or Peak) detection with certain time constants (when applicable) and certain spectral weighting functions involving measurement duration whenever relevant. Examples of such functions are A-weighted L_{eq}, the A-weighted SPL etc.

The functions are based on the following data types:

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_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

To form a function you combine a data type with a time constant; Fast, Slow or Impulse and a spectral weighting function A, C, Z, octave or third octave band frequency analysis.

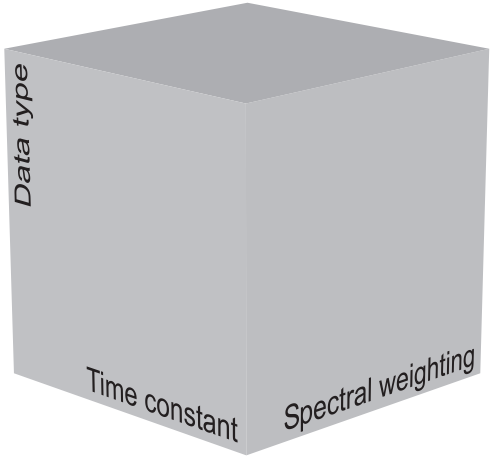


Figure 4.1 - A function can be described as a point in the three-dimensional space having data-type, time constant and spectral weighting as its three dimensions

The analyser does either full octave or third-octave analysis – it cannot do both simultaneously.

Special measurement function used in Building Acoustic, Sound Intensity mode, or other modes, are not discussed in this chapter.

Filling in the three dimensions with data types, time constant and spectral weighting, we arrive at the Function cube.

So far we have yet to mention statistics. In the Nor150 statistics are either based on SPL using a user defined time constant or Leq. The statistics can be presented in several ways – as statistical and cumulative distribution, but also as percentiles. There are 8 percentiles settings available. This must be set up in advance before a measurement.

The spectral weighting functions A, C and Z are measured simultaneously and in addition to the 1/3 or 1/1 octave filter bands (optional).

Statistics can be calculated for Global values and for the time profiles A and B, and for the Moving (sliding) L_{eq} function.

Ln cannot be selected simultaneously for Global and Profile B or Moving Profile, since they are based on different measurement functions. Profile A and Global uses SPL (either Fast or Slow – selectable) while Profile B and Moving Profile uses Leq as base for the calculation of Percentiles.

All three time constants (exponential averaging), Fast, Slow and Impulse are measured in parallel.

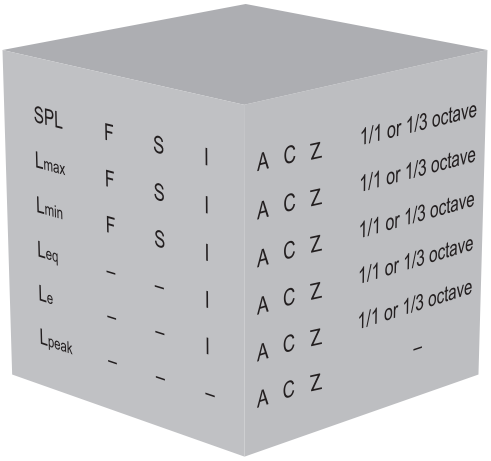


Figure 4.2 - The Function cube expresses a three-dimensional space with the data type (e.g. SPL), the time constant (e.g. F) and the spectral weighting (e.g. A-weighting) as the dimensions. A function will then be a point in this space. Note that not all the points in this space are defined. For example, the (normal) L_{eq} has no time constant and for the Nor150 the peak is not defined in octave and third octave bands.

The instrument measures all parameters both as global values and time profile values also in 1/1 octave band or 1/3 octave bands, if applicable. The user may configure which parameter to measure in order to limit the amount of data.

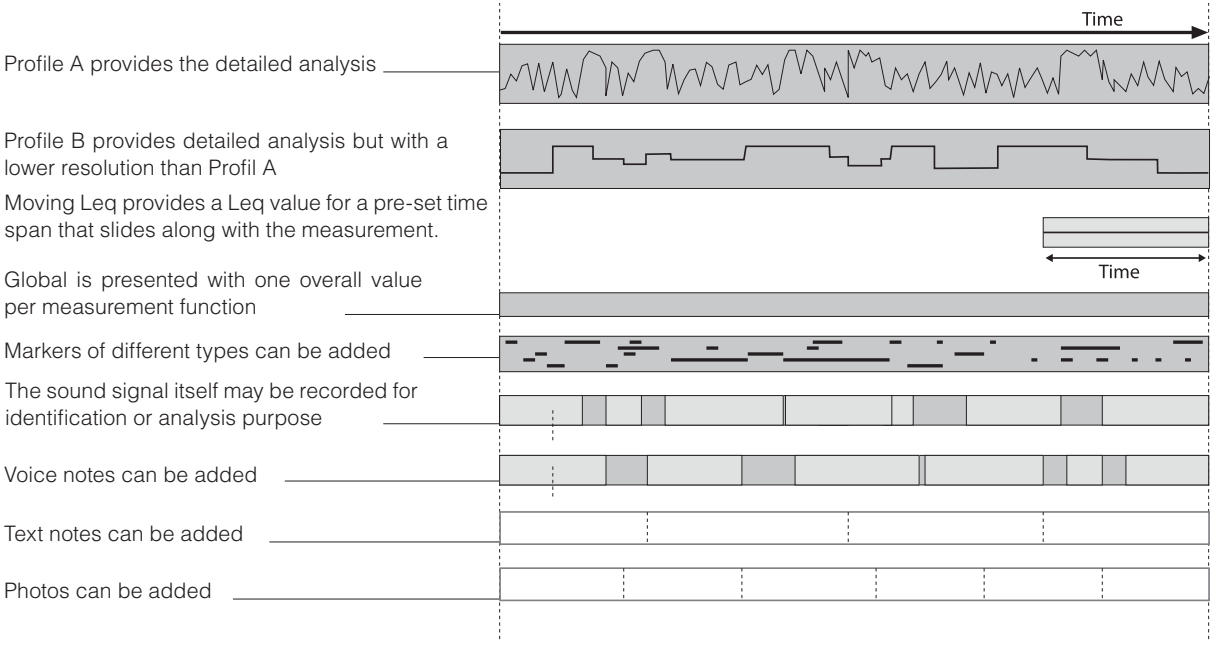
Global measurement values are a single set of measurement values describing the entire measurement. Such as L_{eq}, L_{max}, L_{min} etc. of the entire measurement as well as an octave or third octave spectrum. These are the same as the values you acquire with a traditional sound level meter

Level vs. time (L(t)), also known as **time profile** or electronic level recorder is a part of the basic functionality.

Three time profiles are available, Profile A, Profile B and Profile Moving. Profile A is the main profile from where the other two are extracted. Thus the **period length** must be set longer than profile A, but shorter than Global measurement for Profile B and Profile Moving. It can be specified in Hours, Minutes and Seconds and it must be a multiple of the Profile A period length.

Activating Profile B and/or Moving report will force Profile A period length to 1 second and it is not possible to continue a measurement if the measurement is elapsed or the stop is activated manually. The time profile logs the selected measurement values in time intervals defined by the user.

Figure 4.3 - The main features - an overview



The time profile resolution span is from 5 ms (10 ms in dual channel mode) to 24 hours. To avoid overloading the Digital Signal Processor – DSP some limitations are set dependent of the selected profile time and the number of selected measurement parameters;

Single channel and profile A selected:

<25 ms: One multispectrum function and No Audio recording

>=25 ms: If audio recording is enabled, only 3 multi-spectrum functions are allowed.

>=1 sec: No limitation

Dual channel and profile A selected:

10 ms is minimum profile time

<25 ms: One multispectrum function and no audio recording

>=25 ms: 3 multispectrum functions and no audio recording

>=100 ms: 3 multispectrum functions and dual channel audio recording with 12 kHz sampling rate or single channel audio recording with 48 kHz sampling rate.

>=1s: No limitation on multispectrum functions and dual channel audio recording with 12 kHz sampling rate or single channel audio recording with 48 kHz sampling rate.

Please Note: The dual channel audio recording is limited to a sampling rate of 12 Khz.

There is no limit to the of number weighting network functions (A, C and Z), only the multispectrum functions.

If time profile B or Profile Moving is selected:

- Resolution for time profile A is then set to 1 sec.
- Profile B must be a multiple of profile A.
- Profile B does not offer the multispectrum feature
- Profile B and Moving time resolution must be shorter than Global measurement time.

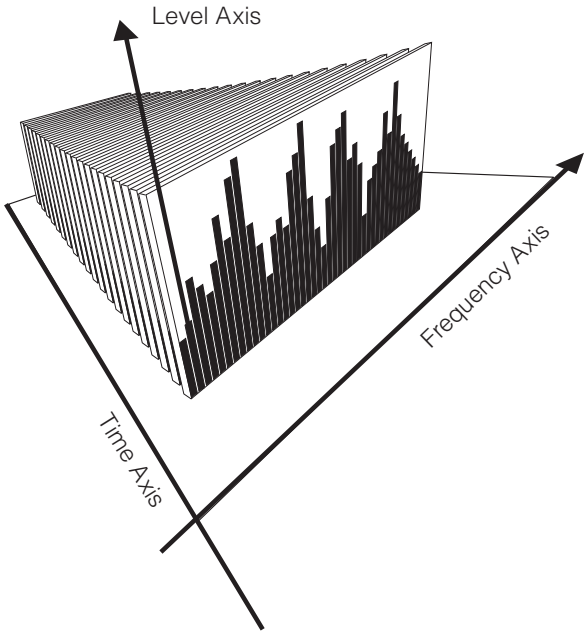


Figure 4.4 - Multi-spectra is a set of spectra captured at equidistant moments in time corresponds to setting up the analyser to measure the level vs. time involving frequency analysis in octaves or third-octaves.

It is not possible to continue a measurement if the measurement is elapsed or the stop is activated manually.

The term **Multispectrum** is octave or third octave values acquired in the time profile. One spectrum is measured per profile period. This requires a relatively high amount of calculation power due to the amount of data calculated. The highest work load however is triggered audio recording.

Statistics. There are eight percentiles available. The class width is 0.2 dB over the entire 130 dB range. Each of the eight percentiles can be set to any value between 0,1% to 99,9%.

The statistical distribution calculation applies to the spectral weighting networks (A, Z and C) as well as all the individual filter bands (if applicable). The statistics is also calculated for each period of the time profile, providing the time profile resolution is set to one minute or more in the profile A.

The graphical back-erase feature (Figure 4.5), which deletes the most recent seconds (0-20 sec back erase) of acquired global data prior to a pause upon resuming, updates the statistics buffers as well as maintain consistency.

For the statistical sampling the user can select either Fast or Slow time constant, irrespective of what time constant(s) the frequency analysis as such employs.

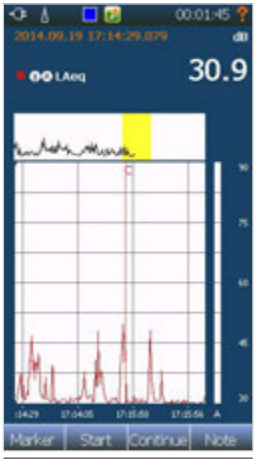


Figure 4.5

Setting up the analyser

The organisation of the display

After the Nor150 is turned on, the applications selection screen appears (Figure 5.1). If you just pass this screen or tap on the “last used” icon, the instrument will show the same types of displays as when you left it last time. If this is the first time you start your instrument, some predefined views will be there for you.

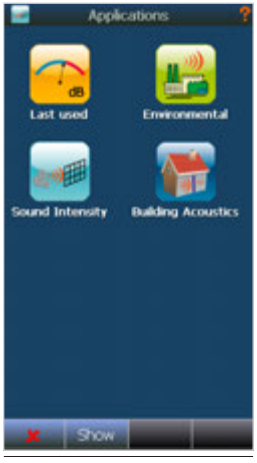


Figure 5.1

If a specific set up is selected in the applications selection screen, the associated functions and views will also be loaded.

The display (Figure 5.2) is divided in three main sections. On the top is a status bar holding information about the current state and at the bottom is a row with quick access keys. See *“The status bar”* and *“The soft key bar”* chapter on the next pages for detailed explanation. The middle part is either one full or two half displays that can be customized to your needs. By holding your finger on a graph (the white coloured area) for a couple of seconds, a context sensitive menu will be displayed, alternatively pushing the √ button located between the arrow keys on the keyboard.

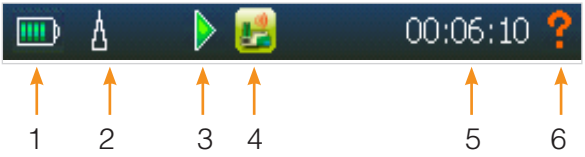
The display settings will be saved in the instrument so you can recall them back again next time you want to use the instrument.

Figure 5.2

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 Measurement status – Ready, waiting for trigger, running, pause, ended, stored, locked
4 Application mode
5 Real time clock in ready mode. In all other modes the measurement time is displayed
6 Help function

The status bar is not displayed in the menus.

Symbol # 1 Battery gauge / external power

Battery gauge. Exact capacity can be found in the Info menu. Press the **INFO** button to open this menu

External power connected.
Battery is not charging.

External power is connected.
Battery is charging.

Symbol # 2; Overload indication

No overload

Instantaneous overload. The symbol will turn to yellow after the overload disappear if a measurement is running. The LED on the front will also turn to red during an overload.

Latched overload. This indicates that there has been an overload during the measurement

Please note! A dual channel instrument will display two overload icons if both channels are activated, unless only one icon is displayed.

Symbol # 3, Measurement status

Ready mode

Waiting for global trigger to fulfil the set trigger condition

Measurement running

Measurement finish. Measurement is not saved

Measurement saved

Locked

Symbol # 4, Application mode

Environmental

Building acoustics

Sound Intensity

The soft key bar

In the bottom of the touch screen or on the left in landscape mode there are four soft keys. In some menus there are soft keys found elsewhere also. Some of the soft keys open up a “scroll down” menu with more functions. The following table shows the symbols that are used on the screen to indicate selectable functions.

Exits the current menu and stores your current selections (✓). Works in parallel with the ✓ button on the keyboard.

Exits a menu without doing your modifications (✘). Works in parallel with the ✘ button on the keyboard.

Opens the Marker selection menu in the measurement picture or jump between markers in ended mode.

Starts a measurement, works in parallel with the Start button found on the keyboard.

Stops a measurement, works in parallel with the Stop button found on the keyboard.

Pause an ongoing measurement and remove the paused values from the overall measurement. Time profile is continuing, but a pause marker is inserted in the time profile while paused. This button works in parallel with the ▮▶ (Pause/Continue) button found on the keyboard

Continue: Continues a paused measurement, works in parallel with the ▮▶ (Pause/Continue) button found on the keyboard.

Note: Opens up a menu where Recording, Camera, Voice and Text notes can be enabled.

Show/Hide: Hide - Used in the application menu. It toggles between Show and Hide. Push on the Show button to enable the application start up menu. Push on the Hide to disable the application start up menu.

Alpha/Numerical on-screen input keyboard. Switches between the parameter wheel(s) and a traditional numerical keyboard.

Add: Used in the menus to add a new item e.g. a new input device to the transducer selection.

Delete: Removes selected item.
Please note: usually there is no undo of a delete.

+ and -: Used for increasing or decreasing numerical values.

Calibrate: Starts an auto-calibration process in the calibration picture.

The softkey bar may have more function in other modes (Building Acoustic and Sound intensity application). These softkeys are described in the chapters describing these applications.

The measurement picture

The main part of the display is for the measurement results. The configuration of the measurement picture (named Views) is very flexible supporting a variety of different views dependent on the selected measurement application.

The measurement display can either be a single or dual type frame. The dual type frame is useful if you want to combine for instance Level vs Frequency, L/f and Level vs Time, L/t data in the same display, while the single type frame gives you a better resolution and workspace if that is preferred. All single type views, except from the Sound level meter, SLM, view, can be selected as landscape view. I.e. the display is turned 90 degrees to take advantage of a wider horizontal axis for time or frequency.

The following graphical displays are available:

- Sound level meter (SLM)
- Level vs time – available as portrait and landscape
- Level vs frequency – available as portrait and landscape
- Combined cumulative and statistical percentage – available as portrait and landscape

Special graphical displays are available in other applications.

Each graphical view has an associated numerical table available. Just push the **TBL** button to access it.

Up to four different views can be configured. Each view can either be a single or dual type. Use the **VIEW** button to switch between each of the four different views. For easy use you may turn off the views so that you at the extreme only have one view to deal with.

NOTE! You must configure which measurement functions you want to display in each of the views.

The instrument may measure more parameters than displayed on the screen. Each graphical view can display up to 3 measurement parameters simultaneously. You may however configure up to eight different parameters per view to display. Use the **FUNC** button to scroll through the selected parameters.

On-screen menus

Context sensitive menus (Figure 5.3) are available when needed. They give access to several of the parameters that decide the look and feel of the view you are looking at.

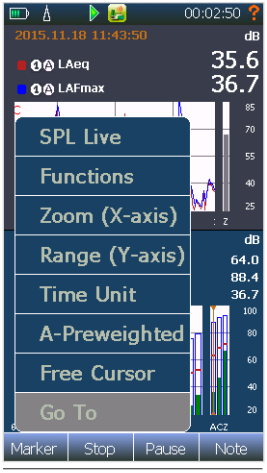


Figure 5.3

The context sensitive menu is accessed in two different ways.

1. Place your finger on one of the graphical (or numerical) displays and hold it there for a couple of seconds, and the menu will appear.
2. Push the √ button on the keyboard and the menu will appear instantly.

In dual view the context menu is assigned to the active view.

On-screen menus:

SPL Live	Selecting SPL Live will update the SPL values in the L(f) view also after the measurement is finished. SPL Live feature does not apply to retrieved measurements from memory or to other views than L(f)
Functions	Select display parameters, networks and functions, and how this shall be displayed
Zoom (X-axis)	X-axis zoom function.
Range (Y-axis)	Modifies the dB scale (Y-axis zoom).
Time unit	Changes from periods to absolute or relative time on the X-axis.
A-Preweighted	select A-preweighted. Selecting A-preweighting will add the A-weighting to the frequency spectra. Apply only to L(f) view.
Free cursor	Disconnects the cursor in the current view from following the other cursors. Enables the context sensitive menu again and select Link Cursor to set it back. When you Link Cursors again, the cursors in the other displays will jump to the cursor position in the view you are linking the cursors.
Go To	This opens up a submenu where you may key in the cursor position. Very useful when working with large L(t) files. Not applicable in running mode.

Different display types may show different contents.

Activate and deactivate the result displays

If the display is split in two halves you can tap on any of the display parts to set it active (Figure 5.4). The other half then turns inactive (greyish). An inactive display is still live updated.

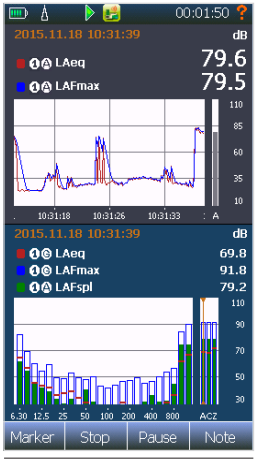


Figure 5.4

The purpose of the active/inactive setting is to determine which of the two displays the key buttons shall update.

Tapping an inactive display part will set it back to “normal” state.

While active you can also decide if the current view shall follow the general cursor selections. The function is called “Unlink”. It gives an easy way to look at the measurement at two different frequencies or in two places in time simultaneously.

The statistical distribution (Ln) view cannot be linked or connected in a similar way.

Cursor handling

As discussed in the previous chapter, the cursor will move in all display views if they are “linked”. This is useful if you want to move in the time domain and update the frequency domain accordingly. In the time domain (the level vs time view) you move in time with the horizontal arrow keys (or simply tap on the screen). In the level vs time view you may also move in the frequency domain with the vertical arrow keys. Similar you move in the frequency domain in the level vs frequency view with the horizontal arrow keys (or tap on the screen) and in the time domain with the vertical arrow keys.

The single level versus time view offers a compressed graph at the top of the graph. You may use this graph to rapidly move to a certain time. The yellow shaded area is the current displayed view in the large graph

The context sensitive menu offers a Go to function for the level vs time and level vs frequency view. This is especially useful for large time profile measurements with high resolution.

Another useful function is to jump between markers. This feature is found in the context sensitive menu.

NOTE! You cannot move cursor in the time domain while measuring.

The main menu system - an overview

The main menu appears when pushing the **SETUP** key on the front panel (Figure 5.5). Manoeuvring in the menus follows the same use as on any smart phone or pad. I.e. in all menus use your finger tapping on the selection fields or dragging on the selection wheels or drag a table up/down. The menu is organized so that you start on the top and manoeuvre downwards when setting up a measurement.

Use the ✓ or ✘ button to leave the main menu and return to the measurement pictures. While the sub-menus are on the screen you store and exit the currently shown selections using the ✓ button or leave without any changes using ✘. You may use either the display soft keys or the hard keys on the keyboard.

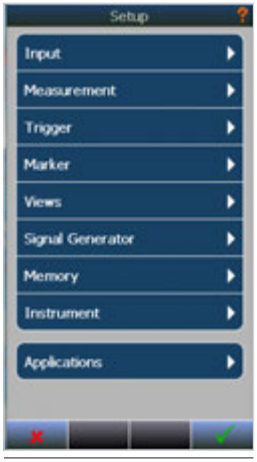


Figure 5.5

Input	Your transducers, microphones and preamplifiers are specified and connected to the analyser in the Input menu.
Measurement	All basic measurement parameters are set here, such as measurement parameters, time profile resolution, overall measurement time, Time constants, Filter frequency response and resolution etc.
Trigger	The trigger menu defines how to start a measurement and how to setup the event triggers.
Marker	Defines what the individual markers represent and how they are displayed in the graphical displays.
Views	Defines the graphical and numerical views consisting of four individual views that may contain almost any combination of display types and measured functions.
Signal Generator	The signal generator (optional) provides test signals that match your measurement needs.
Memory	Setup and configuration of the memory. Define file naming, path etc. Results can be organized in folders and projects.
Instrument	This menu contains instrument specific settings like date and time, language, number formats, power saving setting, interface setting etc.
Applications	Access the factory predefined applications and user defined settings.

On/Off/Available/Disabled indication

In most menus there are indications whether something is selected or not (Figure 5.6). The green tick means that the function is selected and the red X means that it is not.

A greyish menu indicates that this function is not available (Figure 5.7). Either due to the state the instrument is in, or that an option is not enabled.

A menu selection containing a submenu is indicated with an ▶ (Figure 5.8).

Figure 5.6

Figure 5.7

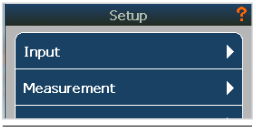


Figure 5.8

Selecting the different views and the parameters to display

Nor150 offer four different views that you can customize. You may rotate between the active views using the **VIEW** button. If wanted, some (but not all) of the views can be left unused.

Each view can either be a single or dual type frame except from L(t)(wide), L(f)(wide), Ln(wide) and Ln.

Available views are

SLM - Sound level meter display, only showing global values (Figure 6.1).

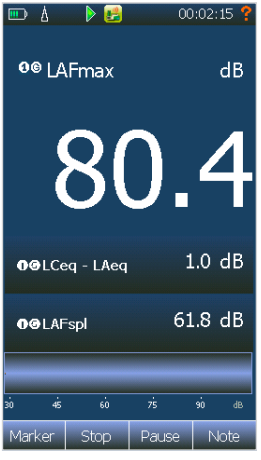


Figure 6.1

L(t) - Level vs time display is a Profile display showing the selected level function versus time, but no global values. – available as portrait in single and dual frame mode (Figure 6.2).

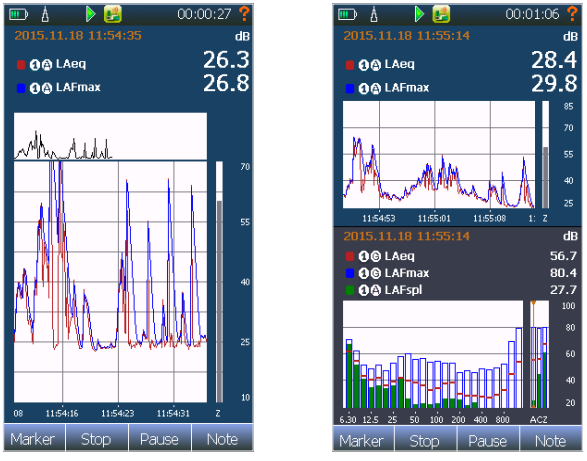
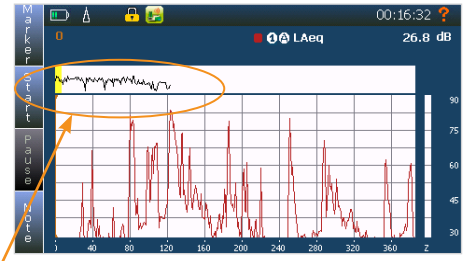


Figure 6.2

L(t) (Wide) (Figure 6.3) – same as Figure 6.2, but only available as landscape (wide) in single frame mode. I.e. The graphical display is turned 90 degrees.



Above the L/t graph is an additional graph that shows the entire L/t trace. The yellow marked area represents the part of the trace that is displayed in the main L/t view. You may tap on the compressed curve to move the main L/t curve to the same point. This function is not available in the dual view frame mode.

Figure 6.3

L(f) - Level vs frequency display (Figure 6.4) is a Spectrum display and can show spectra for both the on-going time profile and the global results at the same time. Available as portrait in single and dual frame mode.

L(f) (Wide) (Figure 6.5) – same Figure 6.4, but only available as landscape (wide) in single frame mode. I.e. The graphical display is turned 90 degrees.

Ln - Combined cumulative and statistical percentage display (Figure 6.6). Only available as single frame display.

Ln (wide) (Figure 6.7) - same as Figure 6.6, but displayed as landscape (wide). I.e. The graphical display is turned 90 degrees

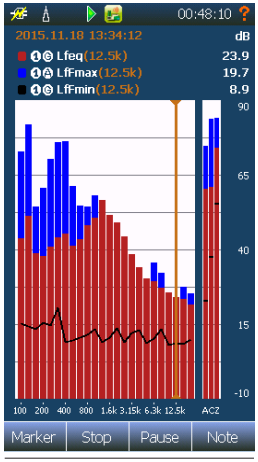


Figure 6.4

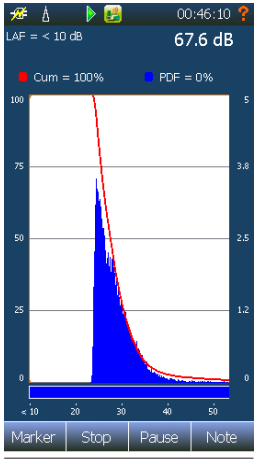


Figure 6.6

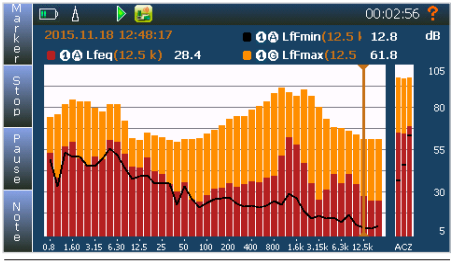


Figure 6.5

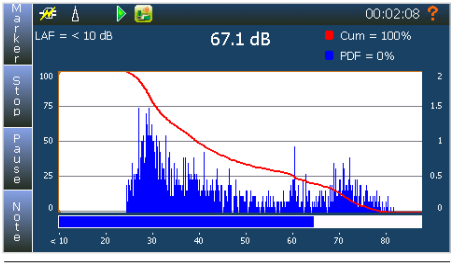


Figure 6.7

NOTE! Building Acoustic and Sound Intensity mode offers other views than described here.

Use the **VIEW** button to switch between each of the four different views. For easy use you may turn off views so that you at the extreme only have one view to deal with.

Push the **SETUP** key and then the *Views* to gain access to the *View* setup menu (Figure 6.8). Each view has two menu points which can be turned on or off. Simply turn on one, two or none to set the current view to a single, dual or off. Access the setup of the menu by touching the menu point. This gives you access to the various choices listed above.

If only one selection in a view is active, as indicated in View 2, this view will use the whole available screen area. Otherwise, the two selected displays will use the upper and lower halves of the screen area respectively.

As can be seen, View 3 and 4 are not active in this example. The View button will therefore only switch between View 1 and 2 when it is pressed.

NOTE! *Wide* displays and the *Ln* display are only available as single frame pictures.

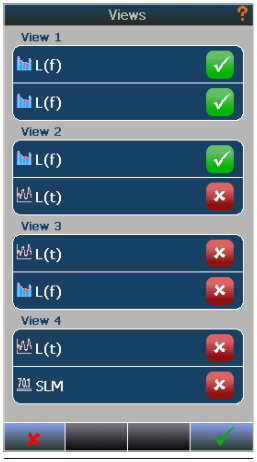


Figure 6.8

Function selection – selecting the measurement parameters

The different views can show different types of results (or the same result in different ways). But you can only show result for functions that are selected for measurement. I.e. the parameters you want to display in any of the views must be measured. Use **SETUP** > *Measurement* > *Functions* menu to select the measurement parameters necessary for your measurement. The parameters you select here will be available to select for configuration of the different views.

You may combine data from channel one and channel two in the same view.

Be careful when selecting the measurement parameters. Do not select more functions than what you really need. Too many functions may slow down the performance of the measurement system and make it complicated for you to select the interesting functions to display. In addition, having many functions selected take more space when storing and longer time to save or load.

Return to the measurement display and use the context sensitive submenu to customize or filter your display selection for each of the views. Hold your finger on the display for a couple of seconds, and the context sensitive menu appears. Select the Functions in the context sensitive menu. This gives access to a menu where you may select up to eight parameters per View. The View Function setup is a combination of channel information, data or result type information and finally information about how you want this information to be displayed.

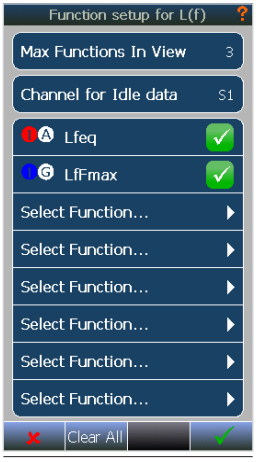


Figure 6.9

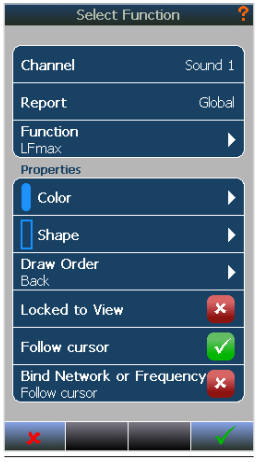


Figure 6.10

Function setup - Figure 6.9

Max Functions in View (Figure 6.9)	Selects how many parameters you like to display simultaneously. Up to three parameters may be displayed simultaneously. Select one if you need good readability, two or three if you want more parameters to be displayed simultaneously Back in the measurement display you use the **FUNC** button below the display to rotate between the selected functions if your selections of measurement parameter excess the number of functions to display in the view.
Channel for Idle data	Selects which channel the SPL value in idle mode should be acquired from. This is greyed out if channel 2 is turned off or option not fitted.
Select Function (Figure 6.10)	Selecting a Function access a submenu where you select measurement parameter type, colour, drawing order and shape. See separate description. Already selected parameters may be turned on/off or modified.

Select Function setup - Figure 6.10

Channel	Select which sound channel data shall be retrieved from. Only applicable if the instrument is fitted with the dual channel option and channel 2 is switched on. Else, this function is greyed out.
Report	Select whether the data shall be acquired from the global or one of the profile reports or the moving report. Due to the nature of the view, some views gives you only the option to select only global or profile data; **SLM** – Global only **L(t)** – Profile reports or moving **L(f)** – Profile A and Global **Ln** - Not applicable. This menu is fixed and not possible to configure.
Function	A list of available measurement functions will be present. Once a function is selected an additional field may be present above the list of available functions. The selection here is either time constant (Fast, Slow or Impulse) if an exponential average function is selected (SPL, Max or Min) or Normal or Impulse if a time averaged function is selected (Leq or LE). **Note!** Some of these choices may not be available since it is dependent on the settings done in the **SETUP** – *Measurement* menu.
Colour	Select which colour to use in the graphical view.
Shape	Select which shape to use. Applies only for the L(f) picture. Available shapes are; • Step Line • Rectangle • Framed rectangle • Line
Draw order	Apply to the L(f) picture only. Define the draw order, whether the bargraph shall be drawn back, middle or front.
Locked to View	If turned on, this parameter will always be displayed when the **FUNC** button is used to scroll through the selected measurement parameters.
Follow cursor	The selected data presented will follow the cursor position.
Bind Network or Frequency	Opposite to follow cursor, and locks the selected data to the selected frequency or network

SPL Live in ended mode

It is possible to select live SPL update of the L(f) – Level vs frequency display after a measurement is finished. This feature is only offered for the L(f) view. Use the context sensitive menu to turn SPL live on/off.

Numerical tables

Each graphical display has a numerical table as an alternative. Use the **TBL** button to switch between graphical and numeral display (Figure 6.11).

The **TBL** button is assigned to the active window. To produce a picture like the one shown below, first tap the lower display so it is active then use the **TBL** button to switch the lower display numerically.

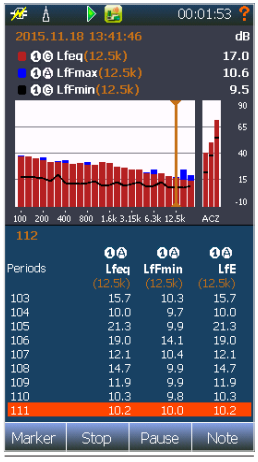


Figure 6.11

Input selection Menu

The *Input* selection menu is where you select which transducer to use for your measurement. You may also add new transducers or modify existing transducers or access the calibration menu. The Nor150 may be fitted with two sound channels (optional).

In the example in Figure 7.1, only *Sound Channel 1* is active. *Channel 2* is switched off. A transducer named "1209&1225" is connected to *Sound Channel 1* and BT2" is connected to *Sound Channel 2*, but switched off.

Selecting the menu *Sound Channel 1* or *Sound Channel 2* access a sub menu for selection of available sensors (Figure 7.2), a short cut to the *Calibration* menu and a list of available corrections like *Random Incident*, *Windscreen* and *High Level*. The corrections available are dependent on the selected transducer.

The Transducers button opens up a menu for adding, removing or modify transducers. See description in a separate section *"The Transducer menu" on page 34*.

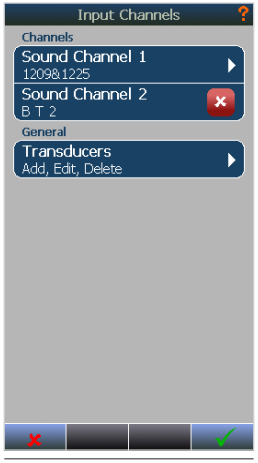


Figure 7.1

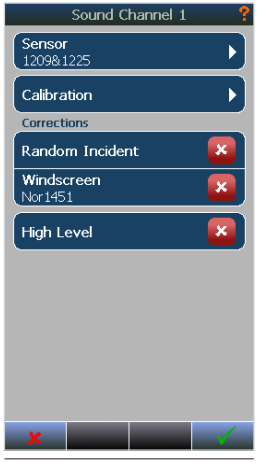


Figure 7.2

The Sound channel 1 or 2 menu

The Sensor button accesses a list of available sensors (Figure 7.3). Adding, removing or modifying a sensor cannot be done from the list offered here. This is discussed in a separate chapter below. You may find that a sensor is greyed out. This means that this sensor is already assigned to the other Sound channel and is not available.

The Calibration button access the *Calibration* menu. This is the same as pushing the **CAL** button. The *Calibration* menu is discussed in detail later.

Dependant on the selected sensor type there will be a set of corrections that may be added. These corrections are;

Figure 7.3

Line

No corrections available.

Microphones

Random incident. When turned on, a frequency correction is added so that the free field response is changed to a Random Incident type (only available if a free-field type microphone is selected.

Windscreen. Turn this correction on if the normal 60 mm windscreen Nor1451 is used. This adds a frequency compensation in order to compensate for the change in frequency response caused by the windscreen

High Level. Only available if an external polarized microphone is selected. For Nor1225 which is a microphone that require 200 V polarization voltage, the sensitivity can be reduced by approximately 10 dB by lowering this polarization voltage. The level range can therefore be extended without changing the microphone cartridge. This feature shall be used in combination with the Nor1225 cartridge only. It will not work with prepolarized microphones such as the Nor1227.

When this feature is selected, the polarization voltage is lowered from 200 V to 70 V. Reducing the polarization voltage alter the tension in the diaphragm. A correction network is therefore applied automatically to compensate for the change in frequency response of the microphone due to the lower polarization voltage.

NOTE that the needed correction will depend on the type of microphone, and shall only be applied when using microphone cartridge type Nor1225. Please note that you should calibrate with an acoustical calibrator if you change this setting.

Outdoor microphones

If any of the outdoor microphones Nor1214, Nor1216, Nor1217 or Nor1218 is selected, the corrections above will disappear and be replaced by the two following ones;

Orientation correction. This adds correction to the outdoor microphones listed above dependent on the sound incidence. Apply Horizontal for normal environmental noise such as traffic noise, construction site noise etc. Apply Vertical only when the noise incidence is consistently coming from above, such as under or close to an air flight path.

Windscreen Nor4576. Only available if Horizontal correction is selected. This correction should be enabled if the large 200 mm windscreen is added to any of the outdoor microphones listed above.

Selecting Nor1210 or a “non-standard” outdoor microphone offers no corrections.

The Transducer menu

The selections *Transducer* opens up a menu where you may edit add or delete existing sensors (Figure 7.4). You may also use this menu to acquire information about the sensors.

In the *Transducers* menu a list of the already added transducers is shown. As a minimum, one Microphone will be available. This is the transducer set from the factory and is normally denoted 1209&1225. The picture above shows a list of several microphones, one line sensor and several outdoor microphones.

If you tap on one of the fields in this case *1209&1225* a submenu with all the relevant parameters for this transducer will be available (Figure 7.5). Several are locked and cannot be edited.

The available fields differ from type of sensor, but the most common fields are discussed in table on next page.

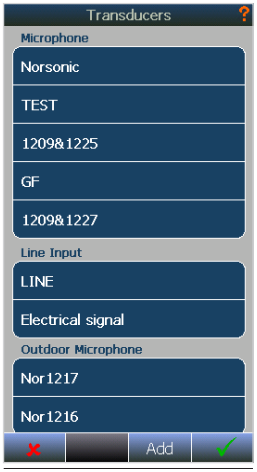


Figure 7.4

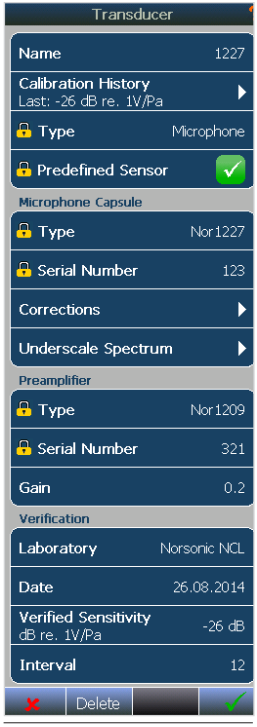


Figure 7.5

Name	The name of the sensor. Give each of your microphone / preamplifier combinations a name so they are easy to recognize. Name is not a locked field and may be edited.
Calibration history	Opens up a L(t) graph which holds historical data of the calibration. Move cursor to obtain information about previous calibrations. Please note that this is the values obtained each time you perform a calibration in the calibration menu. Must not be mixed with the data obtained at the annual verification normally performed by an external accredited laboratory.
Verification - Laboratory	The name of the calibration laboratory that performed the last verification of the transducer.
Verification -Date	The date of the last verification. The instrument will use this date and the Verification Interval to calculate a due date warning. A warning will appear on the screen when the due date for the verification is less than 30 days. Set the Interval to 0 if you want to avoid the verification due date warning.
Verification - Verified sensitivity	This is the sensitivity that was obtained when the last verification was performed. A typical sensitivity 50 mV/Pa microphone is -26 dB. This value is given in dB relative to 1V/Pascal. This value is used as a new “reference” line in the calibration history graph. As times goes by, the actual sensitivity may drift a little bit. If it drifts off, this is clearly seen in the calibration history view, and if it changes too much the system will refuse to calibrate correctly. See “Calibration chapter”.
Verification -Interval	This is the time interval, in months, between each verification.
Microphone capsule - Type	When adding a new microphone, you may choose from a list of predefined sensors or a non-predefined sensor. Choosing a predefined sensor will preset some of the fields below. This is a locked field and cannot be altered.
Microphone capsule - Serial number	The microphone cartridge serial number. This is a locked field and cannot be altered.
Microphone capsule - Polarization voltage	Set either to on or off. This is a locked field and cannot be altered.
Microphone capsule - Underscale Spectrum	Here you may add information about the self-noise values of your sensor. This is used to indicate under scale condition in the SLM view. Values displayed in the SLM view below the under scale spectrum value will be denoted with < in front of the measured value.

Preamplifier - Type	This is the type of preamplifier. When adding a new preamplifier, you may choose from a list of predefined sensors or a non-predefined sensor. Choosing a predefined sensor will preset some of the fields below. This is a locked field and cannot be altered once the information is stored.
Preamplifier - Serial Number	The preamplifier serial number. This is a locked field and cannot be altered.
Preamplifier - Gain	Here you add preamplifier gain. Normally the preamplifier attenuates the signal from the microphone due to its input capacitance. Hence you should enter a negative number. Negative gain=attenuation. For Norsonic preamplifiers this value is in the range of -0.2 to -0.5 dB. Set this to 0 dB if you don't know the gain. The result will be that you will measure a deviation between the open circuit sensitivity given on the microphone calibration certificate and the actual value you obtain when calibrating the instrument with an acoustic calibrator. You may use this difference and key that in to obtain a value closer to the open circuit sensitivity.
Preamplifier - IEPE	IEPE on or off. Off, means a traditional powered preamplifier. On means that the IEPE power is added to the signal line on the Lemo connector.

Adding a new sensor

With reference to the previous chapter, start by adding a name and then type. Current available selections are;

- Microphone
- Vibration Sensor
- Line Input
- Outdoor microphone

If a *Predefined sensor* is selected several fields are selected and locked.

Some microphone cartridges require a polarization voltage to work properly while other microphone types are pre-polarized. Pre-polarized microphones are normally marked with one or two thin ring(s) on the outside of the cartridge. By selecting the proper microphone type from the list, the polarization voltage will be set correctly.

Select the microphone type e.g. Nor1225.

Key in the serial number of this microphone.

Typical nominal microphone sensitivity values are:

mV/Pa	dB rel. 1V/Pa	Microphone types
50	-26	Nor 1220, 1225, 1227, 1228, 1230
40	-28	Nor 1229
12.5	-38	Nor 1236
4	-48	Nor 1245

Preamplifier selection

Select preamplifier type. Only types that will work with your microphone will be displayed. It is dependent on polarization voltage. If polarization voltage is required then a “traditional” preamplifier with a multi-pin (7 pin Lemo) socket is needed. Pre-polarized microphones can also be used on preamplifiers with IEPE type of connection.

IEPE (Integral Electronics Piezoelectric) is the generic name for transducers with built-in electronics powered by a constant current source. A number of other acronyms are in use, such as ICP®, DeltaTron®, ISOTRON®, PIEZOTRON®, CCLD® and CCP®.

Using other transducers

The Nor150 supports a variety of transducers. A typical use is the low noise microphone GRAS 40HL which may be directly connected to the Nor150. You need to specify this as a Non predefined sensor. This is an external polarized microphone, so the 200 V polarization voltage must be turned on. It has internal gain of 20 dB. Hence the sensitivity is typical -1,4 dB re 1 V/Pa instead of -26 dB re 1 V/Pa for a normal 50 mV/Pa microphone such as the Nor1225.

Adding or modifying an intensity probe is described in *“Sound intensity” on page 90.*

Calibrating the instrument - field check

Calibration (or field check) is the normal way to ensure that the sound level meter measures the level with sufficient accuracy. To check the level we need a sound calibrator. The use of sound calibrators dates back to the days when it was easier to design a stable sound calibrator than a stable sound level meter. Today, sound measuring instruments are, in general, as stable as sound calibrators. However, measuring microphones are very delicate devices designed to fulfil very rigid specifications. This makes them vulnerable and subject to damage if not taken well care of. Using a sound calibrator is just as much a verification of proper operation as it is a device of adjusting the sensitivity of sound measuring instruments.

The Nor150 is calibrated by clicking the **CAL** button or in the **SETUP** > *Input* > *Channels* > *Calibration* menu.

When to calibrate

Calibration of the Nor150 should preferably take place before a measurement session is commenced, or whenever required by applicable standards.

Carrying out the field check / calibration

You will need a sound calibrator of sufficient accuracy, I.e. a class 1 sound calibrator as defined by the IEC 60942 standard such as the Norsonic sound calibrator Nor1251.

The Nor1251 has a nominal sound pressure of 114.0 dB at 1 kHz. In order to compensate for effects due to diffraction around the microphone, we recommend adjusting the sound level meter to indicate 113.8 dB (diffuse field and wind screen corrections off), providing you are calibrating a ½" free field type microphone. Other correction may apply for different types of microphones.

Do as follows:

1 **Mount the calibrator onto the microphone**. Switch on the sound calibrator and wait until the level has stabilized. Information on how long time this will take should be available from the documentation accompanying your sound calibrator.

Note: Never calibrate the instrument before three minutes after switching the instrument on.

NOTE that frequency compensations, such as windscreen and or diffuse field, are disabled in the calibration menu in order to simplify the calibration. All you have to do is to compensate -0.2 dB for the difference bet ween the pressure and free field if you are calibrating a free field microphone using a 1000 Hz calibrator. The frequency corrections are enabled again when leaving the calibration mode. Hence, you may therefore obtain a different level when entering back to the measurement mode from what you obtained in the calibration mode if you have a correction switched on.

2 **Enter calibration mode**. Press the **CAL** key to gain access to the *Calibration* menu (Figure 8.1). Nor150 offers two different ways to perform an acoustical calibration, *Manual* or *Auto*. The third option *Mic. Check* is an electrical verification of outdoor microphones.

3 **Know the output level of your sound calibrator.** Some sound calibrators have an output level of 94 dB, while others (like the Nor1251 which is used in the example below) have an output level of 114 dB. Some have an output of 124 dB (like the Nor1253). Unless you know the output level of your sound calibrator you won't be able to know what level the measuring instrument is supposed to show. The output level is normally printed on the sound calibrator or stated in its accompanying user documentation.

4 **Free-field microphones require lower settings.** Be aware of the fact that instruments using free-field microphones shall be adjusted to a value slightly lower than the output level of the sound calibrator. For a half-inch cartridge this will typically amount to 0.2 dB lower for calibrators producing a 1000 Hz calibration signal (e.g. the sound level meter should then be set to 113.8 dB when using a 114 dB @ 1000 Hz sound calibrator). Other frequencies will require different correction values.

5 **Set the sensitivity.** Select either *Manual* or *Auto*.

Do not use *Mic. Check*. See separate chapter for description of this feature.

In Manual mode (Figure 8.2) you simply use the + and - to adjust the sensitivity until you read correct level. New values are set with the ✓. The old value is preserved with the ✘ button.

In Auto (Figure 8.3) you select the calibrator level and frequency and push the Calibrate soft key button. The instrument will automatically perform a calibration. The level is displayed in the L(t) trace in the calibration menu. New values are set with the ✓. The old value is preserved with the ✘ button.

Calibrating outdoor microphone Nor1214, Nor1216, Nor1217 or Nor1218! Please note that the frequency correction is turned off, when entering into the calibration menu. Perform calibration and calibrate the microphone as a normal free field microphone. I.e.-0.2 dB if using a 1000 Hz calibrator. When leaving the calibration menu, you will observe that the level measured with the calibrator on, is different from what obtained in the calibration mode. This is correct, and is due to the frequency correction added. If Horizontal position is selected the signal will be about 0.1 dB higher than the calibrated signal, in vertical position the signal will be 0.3 dB lower than the calibrated level.

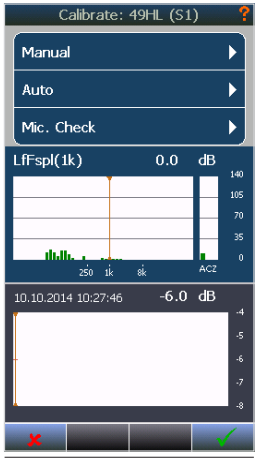


Figure 8.1

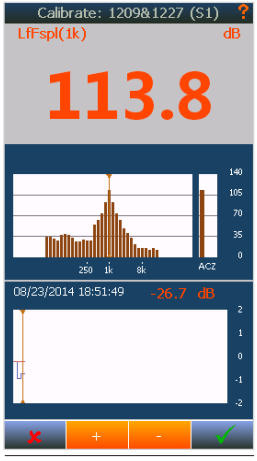


Figure 8.2

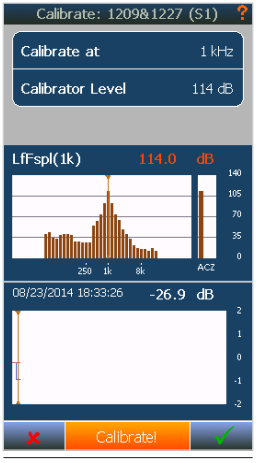


Figure 8.3

Microphone check

For long term monitoring purposes, it is often handy to be able to check the functionality of the measurement system along the signal line from microphone/ preamplifier until the display of the instrument without the use of an external calibrator. The Nor150 has a build-in Mic. Check feature that allows this (also called SysCheck).

Pin 1 on the microphone input socket is able to supply a known voltage signal to the Norsonic Preamplifier Nor1209. By enabling this constant voltage signal, the entire measurement chain including the microphone is tested, and the display will show the corresponding measured value in dB. Hence, if this value is constant from the previous check, it is highly likely that the overall functionality of the measurement chain is constant.

The procedure for using this Mic. Check feature is as follows:

1. Perform a normal calibration of the entire instrument by use of an external acoustical calibrator (see the previous pages in this chapter for details) before the first time you use the Mic. Check to establish a “reference level”
2. Press the **CAL** > *Mic. Check* to open the *Mic. Check* menu.

   Place the cursor on the 1 kHz bar and read the level. The level will be dependent of the actual previous sensitivity calibration as well as the individual preamplifier and microphone in use. Normally, using the Norsonic Preamplifier Nor1209 and Microphone Nor1225, the level will be approx. 90 dB with a 1-2 dB variation from instrument to instrument. The Nor1227 will normally return a value of about 94 dB. The exact level is not so important. What is

important is that the level you read the following times should not deviate much from your initial level. The Mic. Check level is mainly determined by the microphones cartridge capacitance. Hence, a ¼" microphone will return a much lower signal level than 90 dB. The Mic. Check feature works also with the Norsonic Dehumidifier Nor1284 and Nor1285 mounted.

3. It is recommended to not adjust the sensitivity level. Just leave the menu either by the cancel or OK button. If you leave by using the OK button, the date and sensitivity value will be updated.

If an external device should be controlled by the Mic. Check feature, go to the digital I/O menu. **SETUP** > *Instrument* > *Digital I/O* and select *Mic. Check* on the I/O line you have connected your device to. For the Nor1210 using a Nor512 unit, you shall use digital I/O line 3. This will then start the electrostatic actuator in the Nor1210.

NOTE/CAUTION: Always turn off the Mic. Check when calibrating the system with an acoustical calibrator. If not you will add the acoustical and the Mic. Check tone together resulting in a wrong calibration value, often observed as unstable calibration value.

Measurement Setup Menu

There are a large number of parameters that can be selected for a measurement. Use the **SETUP** key and then the *Measurement* selection to configure the various measurement parameters (Figure 9.1).

Global Time is the overall measurement time for the whole measurement sequence. In Repeat or Synchro mode the global measurement time is repeated until the stop button is pressed.

Profile A is the time period length, also known as the duration of each element (time slice) in profile A.

Profile B is the time period length, also known as the time duration of each element (time slice) in profile B. When Profile B is activated the period length in profile A is 1 sec. The period length for Profile B must be a multiple of Profile A, but shorter than the Global (overall) measurement time.

Profile Moving. This is the time length of the Moving Leq calculation. This is a sliding window updating a new Leq value for the entire mowing window every time Profile A calculates a new value. The period length must be a multiple of Profile A, but shorter than the Global (overall) measurement time.

Figure 9.1

Time Weightings. In this menu you set which time weighting functions you want to use. The instrument is capable of measure all three available time constants, Fast, Slow and Impulse in parallel. You may also define which time constant that shall be used in idle mode (ready mode).

Frequency Weightings. In this menu you set which time frequency weighting filters you want to use. The instrument is capable of measure all three available filters A, C and Z in parallel. You may also define which of the filters that shall be used in idle mode (ready mode).

Filter. In the Filter menu you select the bandwidth, 1/1 or 1/3 octave and the frequency range.

The Frequency Weightings networks are not affected by the frequency range setting of the 1/1 or 1/3 octave band filters since they are true weighting networks and not calculated from the 1/1 or 1/3 octave band filters.

Percentiles (%). The instrument can collect samples from one of the time weightings F or S for statistical calculations of the sound level. The statistical distribution function may be calculated for both Global and all the profile reports and all weighting networks and filter bands, providing that the time resolution is more than 1 minute. Up to eight percentiles values may be measured. Each percentile can be set with a resolution of 0.1 %. The complete statistical data can be shown both graphically and numerically in the View called Ln.

Ln cannot be selected simultaneously for Global/profile A and Profile B / profile Moving, since they are based on different measurement functions. In the Percentiles menu you can select “Calculation source” = LFSPL, LSSPL or Leq

If LFSPL or LSSPL is selected, Ln can only be selected/activated for Global report and Profile A report.

If Leq is selected, Ln can be selected/activated for Profile B and/or Moving report

Ln view will show data for Global statistics only

Functions. In the function list you select which measurement parameters you want to measure. The list is dynamic, based on the selections done in the Time Weightings, Frequency Weightings, Filter and Percentiles menu. The column denoted G is global values while the column PA, PB and PMov are profile values. Please note that the Global value will automatically be turned on if you select the profile value.

Audio Recording. Defines the fidelity of the audio recording, gain and pre-trigger. The resolution must be set to 16 bit if you want to replay the audio recording on the instrument itself. All formats are however supported in NorReview.

Camera. The Nor150 fitted with option 1 offers a support for various camera types. In this menu you configure the use of external camera(s). The camera configuration and use is described in a separate chapter.

Storage Mode. Here you set the storage mode. Nor150 offers four different storage modes.

- *Manual*, which requires that acquired data are stored manually by the operator before the next measurement is made. A dialogue box will appear to verify that you want to discard the measurement if forget to store it.
- *Automatic,* which causes the acquired data to be stored automatically upon measurement termination, regardless of the reason for termination – irrespective of whether termination took place because the duration expired or because you pressed **STOP**.
- *Synchronized.* In nature equal to repeat, but the instrument synchronizes itself with the next full hour of the time of day. To be active, synchronized requires a minimum measurement time (duration) of 5 minutes per individual measurement.

- *Repeat*, which causes the instrument to store the acquired data and then restart immediately and make another measurement using the same measurement setup and duration. Repeat applies to measurements terminated by themselves only. If you terminate a measurement by pressing stop, the instrument will not restart. There is no time gap between the measurements.

Synchronized – an example

Assume that you set up the instrument to measure in periods of one hour and that you start the measurement at 08:52:40. The first period will last 7 minutes and 20 seconds ending at 09:00:00. The next measurement will be started at 09:00:00, followed by a new measurement each full hour.

We recommend limiting the use of the synchronized-feature for measurement periods which are either a multiple of one hour or one hour divided by a whole number as the feature has been designed with this limitation in mind.

If you want to apply short measurement periods below a few minutes, we generally recommend using the level versus time feature instead (time profile), since this gives you a much more flexible way of displaying and work with the stored data.

Trigger Selection Menu

The *Trigger* menu (Figure 10.1) is used for two purposes; to start the overall measurement, the Global measurement and to specify the condition of the event triggers.

Global Trigger

The upper selection, Global Measurement, specifies how to start (trigger) the measurement, while the lower frame, Events, specify the settings of the event trigger. Global Measurement is the overall measurement. The Global measurement time (duration) is specified in the *Global Time* in the *Measurement* menu. For most application the Start button is used to start (trigger) a measurement. It is however, often required to start a measurement based on other criteria's than just push the start button. The Nor150 has a variety of choices found in the *Global Measurement* menu (Figure 10.2).

Independent on the selections made in the Global Trigger menu, the **START** button must be pressed to activate the setting. The measurement icon in the upper bar in the display will turn into "waiting" indicated by ⌛ icon to show that the instrument is ready to measure once the global trigger condition is fulfilled.

Figure 10.1

Figure 10.2

Manual Trigger	The measurement start is controlled by the Start/stop button on the keyboard and the soft buttons in the display. A delayed start of 0 - to 180 sec is available.
Clock Trigger	The measurement start is controlled by the real time clock.
On Next Full Hour	The measurement will start once the real time clock in the Nor150 passes the next full hour.
External Trigger	The measurement will start once the external trigger is activated. I.e. a digital signal on the I/O socket pin 1. The hand switch Nor263A or Nor263B is suitable for this use.
Threshold	Configuration of threshold trigger

The *Global Trigger Threshold* menu (Figure 10.3) configure *The trigger Level*, *Threshold type* and *Trigger function*

Figure 10.3

Level Below	The measurement will start once the level is below the set trigger level. In addition to the level, the measurement parameter can also be specified.
Level Above	The measurement will start once the level is above the set trigger level. In addition to the level, the measurement parameter can also be specified.
Level Exceeds	The measurement will start once the level exceeds the set trigger level. It derivate from the Level Above in which case it will trigger once the level is more than the set trigger level, the Level Exceeds must be below, and then exceed the set trigger to fulfil the trigger condition. In addition to the level, the measurement parameter can also be specified.
Level Drops	The measurement will start when the level drops below the set trigger level. It derivate from the Level Below in which case it will trigger once the level is less than the set trigger level, the Level Drops Below must be above, and then drop below the set trigger to fulfil the trigger condition. In addition to the level, the measurement parameter can also be specified.

In the trigger function menu you configure which function to trigger on. The functions can only be SPL functions (Figure 10.4). Only functions from channel 1 can be used.

Figure 10.4

The Event Trigger

An event is a significant change in the sound level for more than a minimum period of time. The amount of level change required is predefined by you by setting a threshold level. Hence, the purpose of the event triggers is to start an action based on the event. A typical action can be to start an audio recording if the noise exceeds a certain level. The event trigger criteria (and On/Off status) is controlled in the second frame in the Event Trigger menu (Figure 10.5). To picture an overview of the event trigger there is a certain terminology associated with events – see Figure 10.6.

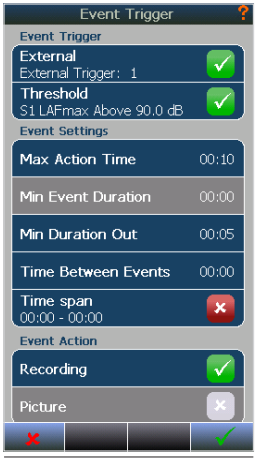


Figure 10.5

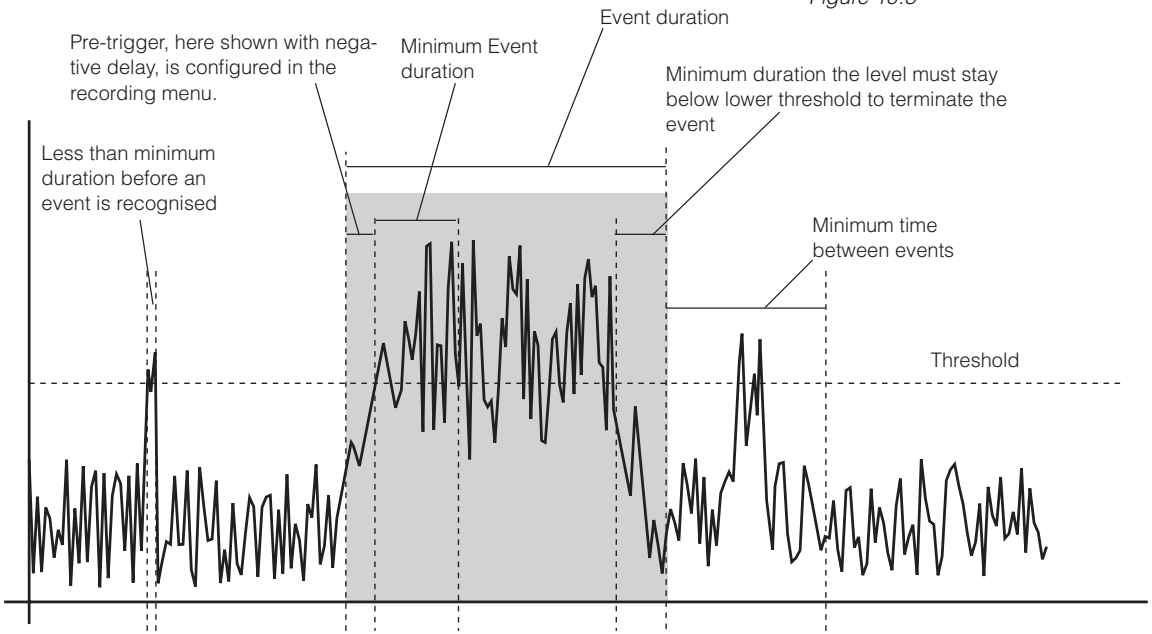


Figure 10.6 - Event related terminology

Each of the five event triggers can be configured independently. The main purpose of offering five instead of one trigger is to associate different trigger levels during a certain time period. Each of the five triggers is connected to the real time clock. This means that you may configure one trigger level for a certain period of the day, and another one for the evening and a third one for the night, or simply turn off the event trigger for a certain period of the day.

The upper selection frame “Event Trigger” is where you set the type of event trigger.

External; The event will be enabled if the hand switch type 263A or B is used, similar as pin number one on the digital I/O socket is enabled.

Threshold; The threshold trigger is a sophisticated trigger with several possibilities. Pushing the *Threshold* button opens up a submenu (Figure 10.7) where the threshold trigger is specified.

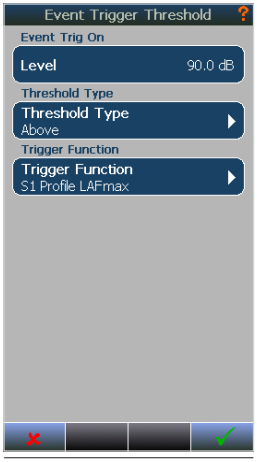


Figure 10.7

Both *External* and *Threshold* trigger may be activated simultaneously.

Start Level
This is the start trigger level.

Stop Level
This is the stop trigger level.

Threshold type

Above: Trigger once the level is above the set trigger level.
Below - Trigger once the level is below the set trigger level.

Trigger function
Here you set trigger measurement function, the report, and Frequency (if applicable). Channel selects from which sound channel your trigger source is.

In the reports you may choose any of the selected profiles; profile A, Profile B and Profile Moving.

Use Profile A if you want an instantaneous trigger.

Profile B is typically used if you want a “less nervous” trigger.

Profile Moving is typically used if you want a relative trigger. Say, you want a trigger level above the background noise. In this case you may trigger on a statistical value.

There is a difference in how the threshold trigger is calculated for the different profiles. In Profile B and Profile Moving, the trigger is fulfilled when the complete level for one profile period is above (or below) the set trigger level. That means that the trigger is checked after an entire period is calculated. This differs from trigging on profile A, where the trigger is fulfilled once the level reaches the set trigger level. That means that the trigger is checked during the profile period. Example; If you have one minute time resolution for profile A, a trigger level of 60 dB and trigger parameter is Leq. Once the Leq value within the current period is above 60 dB the trigger condition is fulfilled, even if the Leq level drops below 60 dB for the entire one minute period. Profile B however, will not trigger in this case, since the trigger level is checked after a time period is finished.

Max Action Time

This is the maximum time the event shall be active. The event action is terminated when the maximum Action Time is reached.

Min Event Duration

This is the minimum time the event must be fulfilled. Events shorter than the minimum time will be rejected. This function is not supported in firmware version 2.x.

Min Duration Out

This is the minimum duration the event trigger condition is not fulfilled.

Time Between events

This is the minimum time between events. An event will be rejected if it occurs before the minimum time is reached.

Time Span

Here you specify which time span of the day the event trigger settings shall be active.

The time span and thereby the new setting for trigger level etc. becomes only active each time a new global measurement is started. Hence, using the time span feature requires that you either use Repeat or Syncro storage mode with a global measurement resolution that matches the time span.

I.E. Say you want 70 dB trigger level between 0700 and 1600, then 60 dB from 1600 to 2200 and 40 dB from 2200 to 0700. Configure then 3 event triggers with the corresponding time span and trigger level. Select global time resolution to 1 hour and synchronised as storage mode in the measurement menu.

Event Action

In the lower frame you specify the Event action. Software version below 1.2 do not offer the Picture Event function, only Audio recording.

Setting the audio recording quality and pre-trigger is done in the **SETUP** > *Measurement* > *Audio Recording* menu. This setting is common for the audio recording regardless of which action that starts it; an event trigger, external hand switch, a marker etc.

The internal camera does not offer triggered picture. This function is only available on external cameras. See separate chapter for how to configure an external camera to work with the Nor150.

Working with Markers

Setting up Markers - the Marker Setup menu

Have you ever made a measurement where you later found out that you desperately need to identify the cause of the level? Recording the audio may be one answer, but for attended measurement it may be more convenient to add markers to the measurement.

Markers can be inserted into a running measurement. In the *Marker Setup* menu (Figure 11.1) there are up to 10 different markers available. Each marker can be set to sound incidents that are interesting to note in a measurement. Markers are connected to a specific period in the profile measurement.

There are two types of markers; single markers and toggle markers. A single marker is mainly used to indicate short duration sound events, while toggle markers typically are for noise events that last longer such as pass by noise of a train or similar types of noise.

In addition to selecting whether the marker is a single or toggle type, the real name and colour is also possible to configure in the sub menu associated with each marker. The marker will be added to the time profile with the selected colour. A single marker appears as a dotted vertical line, while the toggle marker appears as a horizontal line (Figure 11.2).

Figure 11.1

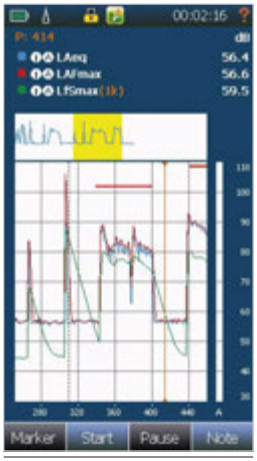


Figure 11.2

Each marker may also start an action. The following actions can be assigned to a marker.

Recording; The marker will start an audio recording. Setting of the audio recording such as pre-trigger, # of bits and sampling is set in the *Audio Recording* menu found in the *Measurement* menu.

Picture; A picture is taken when the marker is activated. This feature is only available on external cameras. See separate chapter describing the camera functions.

Digital Output; A digital output line will be set when the marker is activated. A digital output must be assigned to the marker. This is configured in the *Digital I/O* menu found in the *Instrument Setup* menu.

Reference tone; This will add tone signal to the time profile in the similar way as an audio recording. Mainly used for adding a "calibrated" sound level to the start of a measurement. The signal type, level and excitation time is set in the *Reference Tone Setup* found in the *Instrument Setup* Menu.

System specified markers

In addition to the user defined markers described above, other markers may be inserted by the instrument itself.

Pause marker; As discussed in *"Pausing and resuming a measurement" on page 61*, a yellow toggle marker including a blue shaded field indicates the duration of the pause. The values obtained in the pause area are removed from the global measurement, but remain in the profile. The single marker "P" is added to the periods to denote that these periods contain data acquired in pause mode.

Continue; A red single marker labelled "C" for continues is inserted in the time profile if you terminate an ongoing measurement prematurely by pressing the **STOP** key and later resume the measurement by pressing ⏯. The "C" marker will be added to the period within which the ⏯ key was pressed.

Recording; An orange recording marker is added to the profile during recording of the signal.

Signal Overload; A red marker is added to the profile if the input circuit is overloaded. I.E. the measured signal is higher than the measurement range.

DSP Work Overload; A black marker is added to the profile if some of the specified tasks have been omitted due to work overload for the signal processor.

Battery Marker: A marker is inserted when the instrument is powered from the internal batteries.

Event Marker: An event marker is inserted when the event trigger condition is fulfilled.

The Property button at the top of the menu gives you the option to turn on/off the battery marker and/or the Event marker. Please note that the battery and event markers will be available in NorReview regardless of the setting in this menu.

Adding a marker to an ongoing measurement

An on-screen selection with the available markers appears in the measurement picture when the Marker button is activated. This menu (Figure 11.3) then remains on the screen until it is closed with a new push on the marker selection field. Active markers remain active even when the menu is closed.

Several markers can be active simultaneously. The marker button turns orange when active.

The number of markers are counted up and presented as a number in front of the marker.

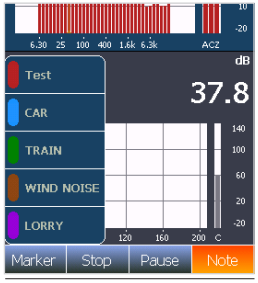


Figure 11.3

Working with markers - post processing

Once a measurement is elapsed, or recalled from memory, you may edit, delete, move or jump between markers. Unlike setting a marker which can be done in any view, regardless of type, you can only perform post processing in the L/t view.

The post processing marker management menu is a context sensitive menu. If you place the cursor on a user added marker and open the context sensitive menu you will find one menu point named marker. This submenu offers three choices; Move, Delete or Add.

Move: The marker you placed the cursor on is moved to where you place the cursor by tapping on the new position.

Delete: The cursor you placed the cursor on before you entered the menu is deleted.

Add: The available markers appear. Select the new marker and tap on the screen where you want the end position to be. Start position is where the cursor was placed before you entered the menu. A single marker will be added at the cursor position.

Jump between markers: Place the cursor on a marker. Tap on the *Marker* key and use the ◀▶ on the keyboard to jump to the next marker, left or right.

Recording the sound - Audio record and replay

The Nor150 allows storing the sound signal itself obtained by the microphone if the appropriate option 4 is installed. The most common application is for identification purposes (by listening to the sound signal). 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 flavours serving slightly different purposes. The main disadvantage for using an unnecessary high quality is large files which consumes a large part of the storing medium, increased calculation power and handling time due to the large amount of data.

The Audio setup (Figure 12.1) is found under **SETUP** > *Measurement* > *Audio Recording*.

Sampling Rate / Resolution. Three different Resolutions, 8 – 16 – 24 bit, and two sampling frequencies, 12 kHz and 48 kHz, give in total 6 different formats for the recorded sound. The sampling frequency of 48 kHz in combination with 24 bit resolution reflects closely to the basic accuracy of the instrument and should be used if further processing of the signal is requested. When the sampling frequency is set to 12 kHz, only frequencies up to 5 kHz can be reproduced.

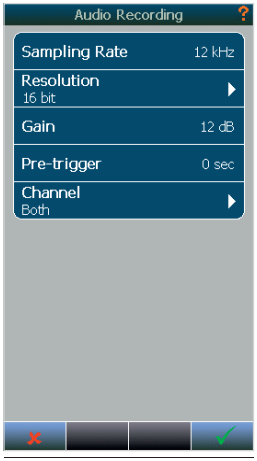


Figure 12.1

However, in most cases this is sufficient for noise source identification. Note that the best format consumes twelve times as much memory as the simplest for storing a recording with a certain duration.

Select 16 bit resolution if you want to replay the audio recording on the Nor150 itself. NorReview as well as most media players accept all formats.

Gain. The instrument has a large dynamic range – exceeding 120 dB. This means that if you try to play back the recorded sound after having transferred the files to your PC, you will – in most cases – hear nothing! The reason why is that most soundcard/PC solutions simply can't handle the high dynamic range. To overcome this problem you may introduce a gain applied to the recorded sound only – the rest of the measurement is left unaffected. The drawback is that the dynamic range for the recording is reduced accordingly so a sound recording overload may occur with no overload being detected by the instrument. All other parts of the measurement are left unaffected by this gain setting.
The upper range for the recording will be the upper level for the instrument minus the selected recorder gain. The upper range for the instrument is dependent of the calibration, but is normally 130 dB (140 dB peak). The recording gain may be selected in steps of 6 dB (2x) from 0 dB to 60 dB.

Pre-trigger. The pre-trigger function allows the start of the sound recording to be recorded up to 120 sec before the recording was triggered.

The duration of a recording and how it shall be started is configured in the Trigger Menu. Please refer to ***Chapter "Trigger Selection Menu" on page 45*** for further details.

Channel. Instruments equipped with the dual channel option allow you to record from either of the two channels or both channels simultaneously.

Making a recording

The start of a recording may be done in many ways. Manually by pressing the Note soft key and then *Recording.*

Manually by connecting the audio recording action to a Marker.

Manually using the remote hand switch Nor263 connected to the I/O port.

Threshold triggered by connecting the Audio recording to one or several of the event triggers.

For a level triggered recording the recording will start during a measurement if the level in the selected network or filter band fulfils the trigger criterion. The length of the recording is selected as a part of the trigger setup discussed in ***Chapter "Trigger Selection Menu" on page 45***.

The recording file is automatically assigned to the current measurement. A marker is inserted in the L/t profile. See Figure 12.2. The figure also shows the Note menu open. The orange (as well as the orange Note button) indicates that there is an ongoing recording in addition to the orange marker.

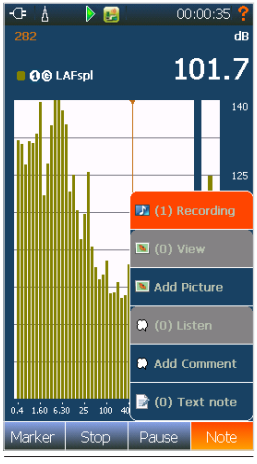


Figure 12.2

If you want to make an automatic recording lasting for the whole measurement, set a very low threshold (e.g.: 0,0 dB) and select the Max action time to 0 min and 0 sec.

The Time Span feature offered in the Event menu enables a different setting of the audio recording during a day. Each event may have its own Time Span. More details are found in *Chapter "Trigger Selection Menu" on page 45.*

Listening - replaying an audio recording

Once a measurement is elapsed, or recalled from memory, you may replay an audio recording if applicable. Place the cursor at the audio recording marker you want to listen to and enable the context sensitive menu and select play. The audio recording is now replayed via the headphone socket.

NOTE! 16 bit format is required to be able to replay audio recording on the instrument itself. NorReview supports all formats.

Be sure that you have configured the headphone socket to replay the audio recording and not set it to listen to the microphone signal itself. This is set in the **SETUP** > *Instrument* > *Analogue Output* > *Headset* menu. Select Playback. Here you also adjust the replay level.

Push the Marker softkey and then the left or right arrow key to move to the next audio recording. Please note that this function moves the cursor to the next marker regardless of type.

All recordings are made in a standardized WAV-format which allows most media-players to play the recorded file if they are transferred to a PC. We recommend using NorReview to work with the time profile data and listening to the audio recordings.

Software version V1.2 and above offers some additional functionality and user friendliness.

Audio recordings may be replayed via the note menu followed by the playback button. This gives you a list of all the captured audio recordings. However, this feature does not connect the recording to the applicable event marker. If this is needed, push the marker button and then jump to the right marker using the left/right arrow key, as described above. Open the context sensitive menu and select view or play button. The latter method assigns the correct recording to the marker. The recording may also be replayed in NorReview.

Insert a reference tone as a recording

When listening to a recording, it may be required to make the playback with the same actual sound level at the listener's ears as the original sound was at the spot of the actual measurement. In such cases a reference tone with a pre-defined level may be recorded during the measurement, and later replayed through the listener's loudspeaker system at the spot of the replay. The reference tone is configured in the **SETUP** > *Instrument* > *Reference Tone* menu. Here you select Level – 0 to -50 dB, Signal type- white, pink or sine, Excitation Time – 1 to 60 seconds, and Frequency if Sine is selected as signal Type.

The Reference Tone is activated by a marker. See ***Chapter "Working with Markers" on page 51.*** Only one of the markers can be assigned to activate the reference tone.

Camera

The Nor150 fitted with option 1 offers support for various camera types. External camera(s) is configured in the **SETUP** > *Measurement* > *Camera menu*. The internal camera is not affected by the setting in this menu. Basically the Nor150 supports three types of cameras, The internal camera, Device cameras and IP cameras.

Internal camera.

The internal camera may only be used before and after a measurement. The pictures taken with the internal camera is automatically assigned to the next measurement if taken before a measurement, and assigned to the elapsed measurement if taken after, provided that the instrument is in stored or ended state.

To take a picture press the Note soft button to access the Add Picture button. Ref Figure 13.1. Use the ✓ button to take a picture and the ✘ leave the camera mode

Device camera

A device camera is a camera found on pads and smart phones. Currently we support Android mobile phones and pads. The NorRemote app, available for units running Android OS, enables event triggered pictures among many other features offer by this mobile app.

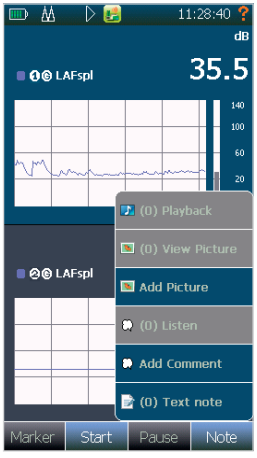


Figure 13.1

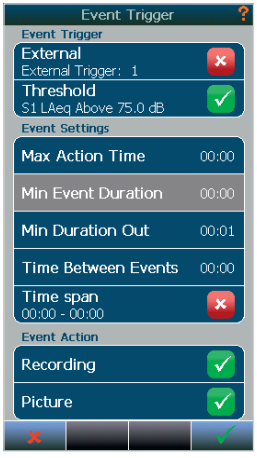


Figure 13.2

You must download and install this app from the Google Play store. A trigger threshold can be set up in the Nor150 trigger menu or via the NorRemote app from the device itself. Enable the use of the device camera in **SETUP** > *Measurement* > *Camera* > *Camera Selection*. Remember to enable Picture in the *Event Trigger menu* (Figure 13.2). You must also tick on the “device camera” in the NorRemote app in order to enable the use of the camera on the device running the NorRemote app. The device must be set up as an hot spot in the app configuration menu.

This hot spot will pop up in the WLAN connection menu. (**SETUP** > *Instrument* > *Communication* > *WLAN*).

IP camera.

IP cameras are fully supported directly from the Nor150 including event trigger control. This is the recommended solution for permanent or semi-permanent noise monitoring if you don't need the remote control features offered by the NorRemote app described in the previous section. We support the Axis F-series range of IP cameras, which are proven to be robust and reliable cameras.

IP camera communication follows a standard protocol, but to avoid possible conflicts we have decided for the time being to support the Axis F cameras only!

Configure and set up the camera as follow;

1. Connect to the camera or the network the camera is connected to in the **SETUP** > *Instrument* > *Communication* > *WLAN* menu if you are using a WLAN connection or in the *LAN* menu if you are using a cabled LAN connection.
2. In the **SETUP** > *Measurement* > *Camera* > *Allow Device camera(s)* menu you add a new connection to the IP camera.
3. Once the camera is configured it will be visible in the Camera Selection menu. The camera you added is by default turned off. Remember to turn it on. See Figure 13.3.
4. In the *Event Trigger menu,* set a proper trigger level for the camera and turn the camera on. See Figure 13.2.

Hint. You may use one trigger for audio recording, and another trigger (and trigger level) for the camera if needed.

5. The pictures are available in the Note on screen menu on the Nor150 after the measurement is finish. The pictures follow the measurement data and can be viewed in other Norsonic programs such as NorReview.

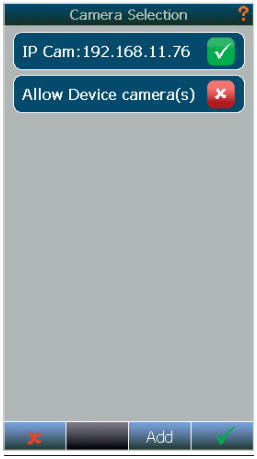


Figure 13.3

Voice and Text notes

You may add notes prior to, during and after a measurement. There are three types of notes, voice, text and picture. Each of these notes can be added as global note and profile note. A global note applies to the entire measurement, while the profile note will produce a marker and is meant to add additional description related to an event. You may add several profile notes, but only one global. For voice notes you need a proper headset with microphone connected to the headphone socket found on the rear input connector panel. In addition you need to select Playback in the **SETUP** > *Instrument* > *Analog Output* > *Headset* menu. The Norsonic headset Nor4584 is suitable for this use. Most other type of headset with microphone and a 3,5 mm jack plug is also suitable.

Adding text and voice notes

Push the Note soft button on the touch screen and select either *Text note, Add Picture* or *Add comment*. Notes added prior to a measurement assume you are in ready mode. I.e. no recalled measurement or ended measurement available on the screen. The note(s) will be added to the coming measurement. Notes added to an elapsed measurement will be assigned to the elapsed measurement. These notes are so called global notes.

Similar, notes may be added to an ongoing measurement. These notes are called time profile notes. The text note will produce a single marker, while the voice (comment) note will produce a toggle marker.

You may also add text to the global note while the measurement is running. To access the global note, press Text Note as usual and then the soft key Global found on the soft key bar in the bottom of the display. If you add a global text note prior to the measurement, and want to add more info after a measurement, you may add the information as additional text, or modify the existing text for the text note, while the voice note only offer the possibility to replace the one you made prior to the measurement.

Retrieving text and voice notes.

You may read the text notes by placing the cursor on the single marker and push the *Note* and then *Text* note button. To read the global note, just press the *Text* note button and then the Global soft key.

A voice note is replayed in the same way as an audio recording. Simply place the cursor within the marker field and open the context sensitive menu either by placing your finger for some seconds on the cursor/ marker or push the **OK** button on the keyboard.

Select *Play* to replay the voice comment. To replay a global voice note, push the *Voice* button. A dialogue box will appear and ask if you want play it, or replace it with a new one. If no voice note exists, a new voice note will be added.

You may push the *Marker* button to enable the jump to next marker function.

Pictures, Voice and Audio recordings may be viewed / replayed via the note menu followed by the corresponding note button (*Playback* or *Listen* button). This gives you a list of all the captured pictures, audio recordings or voice notes. However, this feature does not connect the notes to the applicable event marker. If this is needed, push the marker button and then jump to the right marker using the left/right arrow key. Open the context sensitive menu and select *view* or *play* button. The latter method assigns the correct note to the marker. The notes may also be viewed in NorReview version 6 and above.

HINT! To jump between markers, push the marker button and use the left right arrow key to jump to the next marker.

NOTE! The number in brackets added in front of the soft keys in the Note menu is the number of notes added. This feature is available in Software version 1.2 and above

HINT! Nor150 fitted with the enhanced environmental option (option 11) offers a neat solution for setting markers and adding comments to a measurement using a smartphone, pad or PC. These features are described in a separate manual.

Pausing and resuming a measurement

Extensive pause and continue functions are available. When paused, the instrument will produce and display the time profile for the last 20 seconds of the measurement. The time cursor can then be moved backwards in one seconds step to remove the unwanted noise and resumed. Data acquired to the right of the time cursor in the pause picture will be removed from the global measurement. This applies to the statistical values in global as well. If there was an overload in the selected time span, this will also be deleted from the overall measurement.

The data removed in the pause picture (Figure 15.1) is not removed from the time profile. Instead a pause marker is inserted in the time profile for easy identification of the paused area. The markers are also transferred to the post processing and reporting program NorReview

Figure 15.2. shows a paused area which is indicated by a greyish background followed by a yellow horizontal marker line. The yellow area in the summary graph is not indicating the paused area, but the current view in the summarized graph.

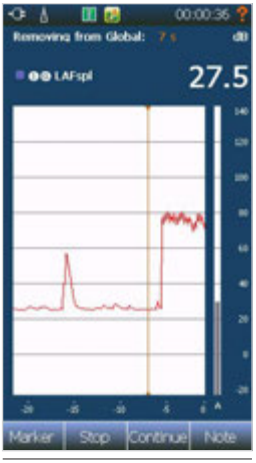


Figure 15.1

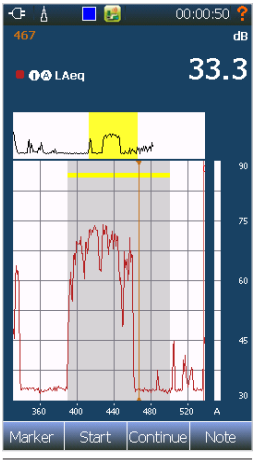


Figure 15.2

NOTE! Pause function is not available if Synchronized or Repeat storage mode is selected.

It is also possible to resume a measurement after Stop is pressed. Once you press Stop, the Continue function becomes available. Opposite to Pause/ Continue, the Stop/Continue sequence also removes data from the time profile in addition to Global. A red single marker labelled C is inserted in the time profile as shown in Figure 18.3. Notify the discontinuity in the time axis at the Continue marker.

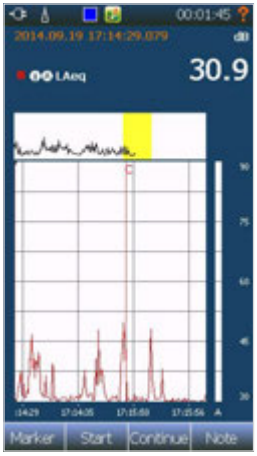


Figure 15.3

The difference between a “Pause” and a “Hold” function

In the sound level meter standard IEC 61672 Ed.2.0 there is a request for a “hold” function so that the operator has the possibility to manually read out more measured values (max and peak) while the measurement still runs. In the Nor150 this type of function is not needed since every level-display can have several parameters displayed simultaneously. It is up to the operator which results to display at any time. Hence no data will be lost due to the handling of the analyser while the measurement is running.

The Pause function is implemented in this analyser to facilitate removal of unwanted signal contributing to the overall measurement results.

Storing a measurement - Memory Organising Menu

The memory menu is found under **SETUP** > *Memory*. Here you configure the file name conventions, storage destination, move, rename and delete files or directories. This is also where you store and manage your setups.

Storage Folder: Here you select between Internal Memory and the SD Card, move around in the memory system and create new folders. Measurements containing audio recordings can only be stored on the SD card. Use the ↑ soft key to move up in the folder system. Push on the desired directory or storage media to select or move down in the memory system. NEW creates a new folder. You may copy your files from the internal memory or the SD card onto a USB memory stick. The memory stick is denoted Hard Disk. The memory stick cannot be used to directly store measurements, since the speed of this media is too slow. Hence it can only be used to move files from the SD card or the internal memory when the instrument is not measuring.

The instrument supports SDSC, SDHC and SDXC micro SD cards. The maximum size of the SD card is 128 Gbyte. The card must be class 10 or better.

It is important to know the different storage modes and what features they offer.

The configuration of the storage mode is set in the **SETUP** > *Measurement* > *Storage Mode.*

Cf. Chapter *Measurement Parameter Setup Menu*,

A short description of the storage mode is repeated below;

Manual - Results are not stored. If you want to keep the results then you have to save them manually by pressing the **MEM** button

Auto - Every measurement is automatically stored after it is finished. There are guidelines in the lover frame on how new file names are supposed to be generated.

Repeat - The results are saved and a new measurement similar to the first one is immediately started.

Synchronised - Similar as Repeat, but the next measurement is synchronised with the clock.

HINT! It is recommended to change the SD card frequently to avoid data loss. Back up or transfer data to another media. A memory card containing a higher number of files will slow down the performance of the storing process.

File name

The instrument offers a sophisticated file naming system with a variety of options.

You may either enter the file name manually when you store the file. This is only possible if you have selected manual as storage mode. Default suggestion is according to the settings in the *Memory* menu.

If *Auto*, *Synchronised* or *Repeat* is chosen as storage mode the default automatic file naming is chosen. This stores a file with the date and time at the time the measurement was stored. A more sophisticated naming is enabled if you turn on “Filename Base” and “Start Index”. The instrument will store the measurements automatically and increase the file index by 1. You may however choose which number to enumerate from (Start Index). In any case the time and date will be added to the filename.

Say you have a project consisting of several locations and several measurements on each location. You may then name your directory with the project name, say “Project Highway” and make subfolders under this directory, say “Route 66”

File Name Base. Here you specify the start name / default name of each location. Say “Sunny beach”

Start Index. The index is added to the File Name Base. If you start on one, the first file will be named “Sunny beach 1” plus the time and date.

Rename, Delete, Move

A file or directory may be renamed, deleted or moved. These features are offered in context sensitive menu in the *Memory* menu or pushing the **MEM** button. Touch the desired file or directory for a couple of seconds to gain access to the context sensitive menu (Figure 16.1). Open a file is also offered if you enter the menu from the **MEM** button.

Info displays vital information about the measurement, such as measurement time, measurement functions and so on.

The icon in front of the name indicates type of measurement. A small red C indicates that the measurement is a repeat or syncro type.

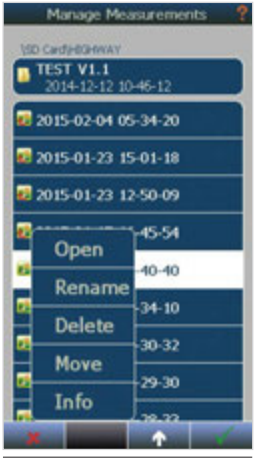


Figure 26.1

Application Selection Menu - Predefined Setups

The *Application menu* is normally the first menu that appears after the instrument is powered on and the boot sequence is finished. This is the menu where you may select your favourite setup or other setups dependent on your measurement application (Figure 17.1.)

The menu is organized with some large buttons labelled with different applications.

The Menu may also contain a set of smaller buttons with a user defined label.

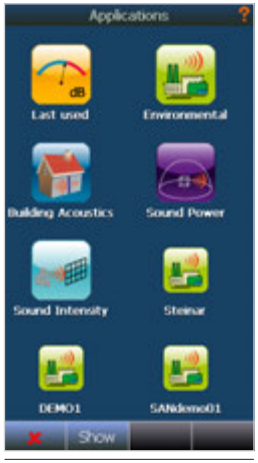


Figure 17.1

There are three different types of Setups; Instrument mode, Standard setup and User defined setups.

Instrument mode is where you select the main measurement task, such as environmental measurements, building acoustics, intensity etc.

These modes are indicated by large icons with a picture symbolizing the application. Tapping on a large icon gives access to a list of setups that are available for this application. These setups are grouped in three categories;

1. **Last used.** The last used is the same as tapping on the large icon “last used”
2. **Standard setups.** Standard setup is a set of pre-programmed setups, usually meant for a measurement task in accordance to a national or international standard. The instrument is preset for each country. Hence, only the country dependant standard for the country where the instrument is sold will be available. This prevents the user from scrolling through a long list of non-applicable standards.
3. **User defined setup** - setups created by the user itself.

Selecting a setup, except from “last used” will open up a “measurement info” picture (Figure 17.2) which holds the most important information about this setup. At the top of the information picture there is a menu point where you may decide if the setup shall be visible as an icon (shortcut) in the *Application* menu. It is recommended that you select the most popular setups to be visible as icons. These icons will have the same picture as the instrument mode it belongs to, but is slightly smaller. A standard setup is in addition indicated with an orange frame.

Storing a Setup

A user defined setup is stored via **SETUP** > *Memory* > *Save Setup as*. Here you select if the setup shall be visible as an icon in the *Application Selection* menu, or just in the list stored under the desired application icon. You may later change this. Please see previous chapter. You may also choose to set the setup as write protected. This means that it is not possible to change it later. Please note that a write protected setup is still possible to delete.

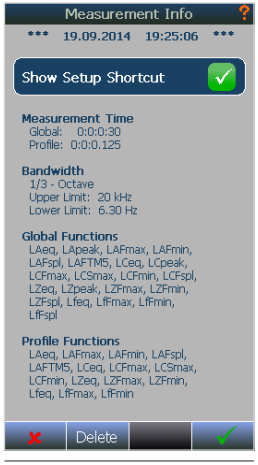


Figure 17.2

Building Acoustic

Introduction

When equipped with the required program option(s), Nor150 is well suited for measurement of building acoustics in the form of measuring reverberation time and sound insulation.

The Building Acoustics mode allows measurement of building acoustics parameters according to the ISO 16283 series of International Standards as well as National Standards like DIN, BS, SS, SIA, etc.

Measurements are made in one-third octave bands and the results are reported for each band as well as frequency-weighted values according to ISO 717-1 and ISO 717-2.

Full octave measurements are possible by selecting the ISO 10052 standard.

The mode is entered by pressing **SETUP** followed by *Applications* (Figure 18.1.). Select *Building Acoustics* from the available applications.

A list of predefined setups is ready to be picked (Figure 18.2).

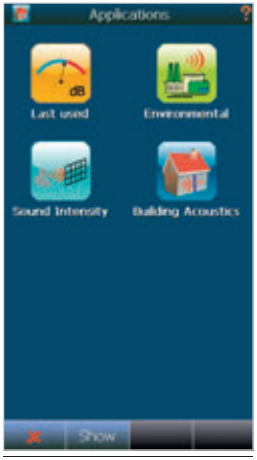


Figure 18.1

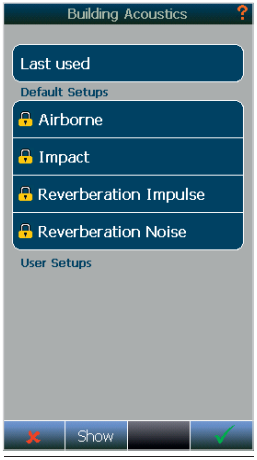


Figure 18.2

In this manual we often talk about

BA for Building Acoustics

Airborne for Airborne Sound Insulation calculations

Impact for Impact Sound Insulation calculations

Reverberation or *RT* for Reverberation Time calculations

BGN for Background noise

SPL Mode

The SPL mode appears after starting the instrument or changing into BA mode. This is the mode where measurements are taken, contrary to Data Mode where the accepted measurements and calculated results are presented. The soft key in the lower left corner lets you switch between these two display modes. The SPL mode may not be accessible and therefore the soft key is greyed out if an already stored BA measurement has been loaded and is currently open. Pushing the Cancel (✘) button will close the current measurement project and start a new one. If you want to reuse some or all of the current data click Yes when prompted and select the wanted data to be reused (see *“Start a new project” on page 89“Start*).

Display in SPL Mode

The SPL mode has a fixed set of display views. Compared to the Environmental Mode these views cannot be modified and therefore the setup menu item “Views” is not available.

While a single channel instrument will have two views, a dual channel instrument will offer four different views. The different views are toggled by pushing the **VIEW** button.

NOTE! The first time a view is activated the appearance is lagged due to the process of creating the graphs.

Single-Channel views

Figure 18.3 shows a split display with a L(f) on top of a L(t) graph. Figure 18.4 is a full screen L(f) graph.

There is a header line showing the selected standard, the measurement type (Level, BGN, RT) and the source position (#A...#D).

The function name is supplemented with the corresponding colour, channel number, and for Level measurements with the assigned room type (S = Source, R = Receiving) (Figure 18.5).

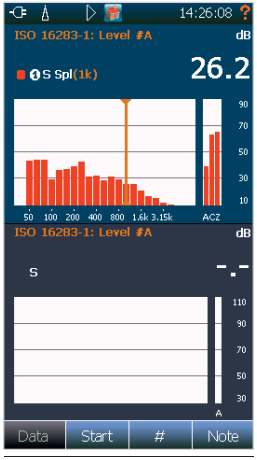


Figure 18.3

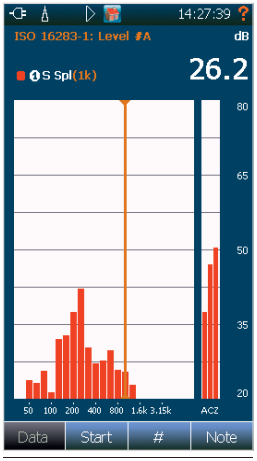


Figure 18.4

Figure 18.5

For single-channel instrument different colours are used to indicate the different measurement types. The colour assignment is fixed and cannot be changed by the user (Figure 18.6).

Level- Source room: **Red**
Level- Receiving room: **Blue**
Background noise: **Black**
Reverberation time: **Green**

Dual-Channel views

Figure 18.7 shows a split display with a L(f) on top of a L(t) graph with all activated channels in it. Figure 18.8 is a full screen L(f) graph of the Receiving room channel(s). Figure 18.9 is a full screen L(f) graph of the Source room channel(s). And Figure 18.10 is a dual L(f) graph of the source and the receiving room.

Figure 18.6

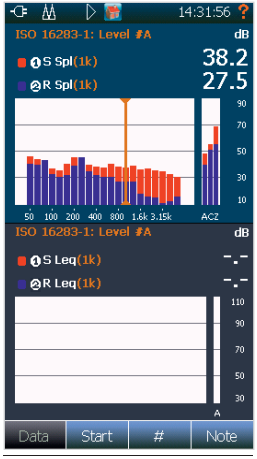


Figure 18.7

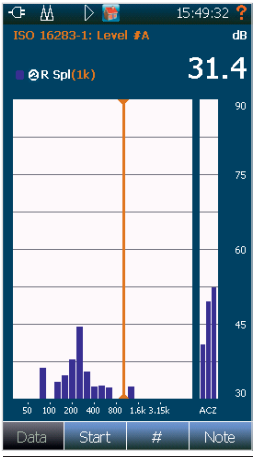


Figure 18.8

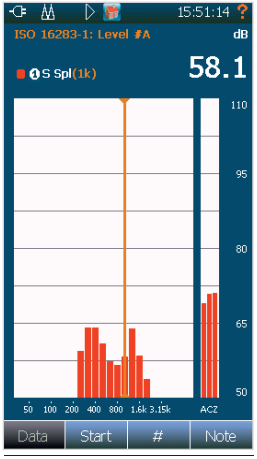


Figure 18.9

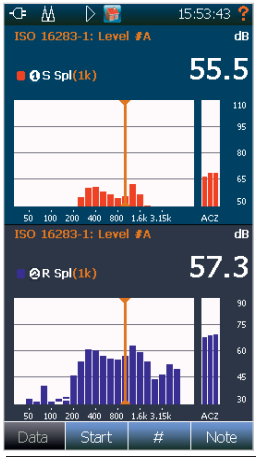


Figure 18.10

For dual channel instruments, different colours are used to indicate the different channels (Figure 18.11).

The colour assignment is fixed and cannot be changed by the user.

Channel 1: **Red**
Channel 2: **Blue**

There is a header line showing the selected standard, the measurement type (Level, BGN, RT) and the source position (#A...#D).

The function name is supplemented with the corresponding graph colour, channel number, and for Level measurements with the assigned room type (S = Source, R = Receiving).

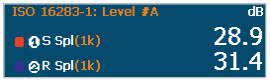


Figure 18.11

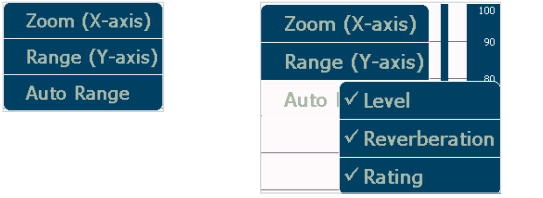


Figure 18.12

On-screen menus

Context sensitive menus (Figure 18.12) are available when needed. They give access to several of the parameters that decide the look and feel of the view you are looking at. See chapter *"Setting up the analyser" on page 18* for more information.

The automatic Y-axis range can be activated individually for Level, Reverberation and Rating graphs.

NOTE! Auto Range does not work while in idle or running state. The Auto Range will be triggered on Ended/Stopped or when displaying already accepted data.

Setup

There are different *Setup menus* available in order to adjust the Building Acoustics parameters (Figure 18.13). Push the **SETUP** button to get access to them. Some of the menus, sub-menus or parameters may be greyed out and cannot be changed as soon as the first measurement has been taken. Therefore make sure you have set-up the parameters correctly before starting a measurement. By pushing the ✘ button or the NEW soft key a new project will be initialized and full access to the measurement parameters will be gained.

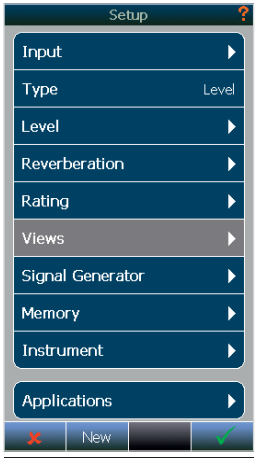


Figure 18.13

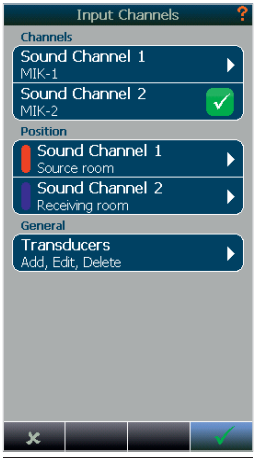


Figure 18.14

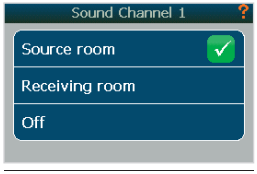


Figure 18.15

Figure 18.16

Input - Setup

The *Input selection* menu (Figure 18.14) is identical with the one explained in the chapter *"Selecting the different views and the parameters to display" on page 26*. Only the possibility to assign a channel to a room type is an additional feature.

Under Position click a channel to assign it to a room type (Figure 18.15).

Type - Setup

Toggle the measurement type by clicking the menu item. The measurement type selector (Figure 18.16) is used to select which kind of measurement to perform when hitting the **START** button. The selection is Level, Background noise or Reverberation Time.

TIP: When in SPL display mode, use the **FUNC** key to toggle the measurement type.

Level - Setup (Figure 18.17)

- *Level Duration* is used for pre-setting the measurement duration for the source and/or receiving room level measurements. Most Standards require 15 s for measurements down to 50 Hz and 6s for measurements down to 100 Hz.
- *Background noise Duration* is used for pre-setting the measurement duration for the background noise in the receiving room.
- *Filter* enables the user to switch between 1/3- and 1/1-octave measurements. Please note that for all but one currently supported building acoustics testing Standards in the Nor150 system, only the 1/3-octaves are selectable. If ISO 10052 is the selected standard, the bandwidth is automatically set to 1/1 octaves and set back to 1/3 octaves in all other cases.

  Lower frequency is used for selecting the lowest frequency band to be measured. In the BA mode, the minimum is 50 Hz for 1/3-octaves.

  Upper frequency is used for selecting the highest frequency band to be measured. In the BA mode, the maximum is 20 kHz for 1/3-octaves.
- *Source Position* is used for indicating the different loudspeaker or tapping machine positions. This may be a requirement by the standard. Instead of entering this setup menu to change the source position, use the # soft key in SPL mode display (Figure 18.18).

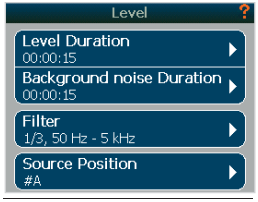


Figure 18.17

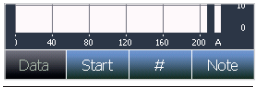


Figure 18.18

Reverberation - Setup (Figure 18.19)

- *Filter* enables the user to switch between 1/3- and 1/1-octave measurements. Please note that for all but one currently supported building acoustics testing Standards in the Nor150 system, only the 1/3-octaves are selectable. If ISO 10052 is the selected standard, the bandwidth is automatically set to 1/1 octaves and set back to 1/3 octaves in all other cases.
- *Excitation Type* is used for selecting the actual method for detecting the correct decay. Noise is used for operation with the internal noise generator, and Impulse is used for operation with an external impulsive noise.
- *Duration* is setting the time duration of the active noise excitation before the decays are measured.
- *Trigged at* is either setting the minimum threshold level or the time before the decay measurements are triggered.
- *Backward integration* can be activated in case of impulse excitation (Figure 18.20).
- *Max expected RT* is setting the maximum reverberation time to be measured. In reality, this setting controls the period length of each sample along the decay. The available settings of 4s, 8s, 16s and 32s are corresponding to sample periods of 5ms, 10ms, 20ms and 40ms respectively.
- *Min distance to noise floor* sets the minimum difference between the lower calculation range for the selected RT function and the background noise level. The background noise level for the RT calculation is handled individually for each frequency band, and is set identical to the horizontal part of the decay measurement after the decays have decreased below the RT calculation range.

Figure 18.19

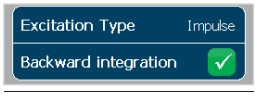


Figure 18.20

- *Primary RT function* is used for selecting between the reverberation time functions T20, T30, T15 or EDT/Tmax. The selected function will be used for the calculation in the rating part. All functions present the result as the time for the theoretical 60dB decay time, but the calculation ranges are individual for each function. EDT starts at 0 dB below the excitation level and end -10 dB below. All the other functions start at -5 dB below the excitation level, but ends at -20, -25 and -35 dB respectively.
- *Ensemble Averaging* When performing reverberation time measurements in multiple positions, a new feature for Ensemble averaging may be used to average the decay curves before calculation the reverberation time value.

Rating – Setup

This *Rating* menu (Figure 18.21) contains several subsections for setting the different properties of the upcoming sound insulation calculation, or, for pre-entering text descriptions for a final test report document.

Standard:

- *Category* is used for selection among the predefined Standard categories. *Field* is the only option at the moment.
- *Standard* (Figure 18.22) is used for selecting the different Standard group such as *ISO*, *DIN*, *ASTM* or other *national groups.*
- *Type* is the selection of *Airborne*, *Impact*, *Façade* or similar.
- *Number* is used for the selection of possible multiple Standard numbers within the set *Category*, *Standard* and *Type.*
- *Subtype* is used when required in cases such as selecting Staggered Rooms of the ISO 16283-1.

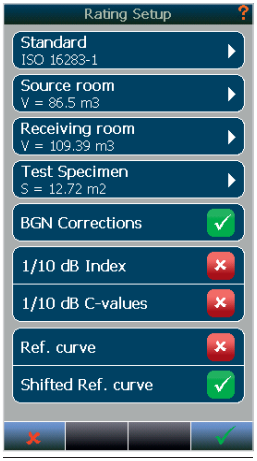


Figure 18.21

Figure 18.22

NOTE: Changing standard while there is already acquired measurement data will initiate a new project. You will be asked to save your current work and may be prompted to reuse the data. See *"Start a new project" on page 89* for more information.

Source (Figure 18.23)

- *Volume* is the actual volume of the source room given in m^3. For the source room, this value is calculated based on entered values for width, height and length of the actual room. If the room is non-square, and the final volume is known, the user may simply enter '1' for width and height and the actual volume as length to get the correct volume for the calculations.
- *Temperature* is the air temperature measured in ˚C.
- *Pressure* is the air pressure measured in kPa.
- *Humidity* is the humidity in the source room measured in %.
- *Condition* may be used for describing the condition of the source room.
- *Type* may be used for describing the actual type of source room.
- *Location* may be used for describing the location of the source room.

Receiving (Figure 18.24)

- *Volume* is the actual volume of the receiving room given in m^3. For the receiving room, this value is calculated based on entered values for width, height and length of the actual room. If the room is non-square, and the final volume is known, the user may simply enter '1' for width and height and the actual volume as length to get the correct volume for the calculations.

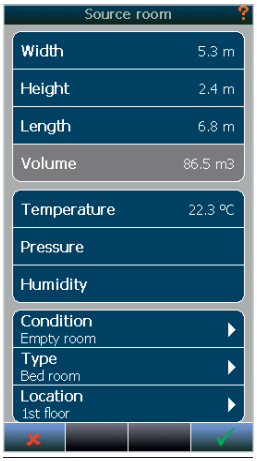


Figure 18.23

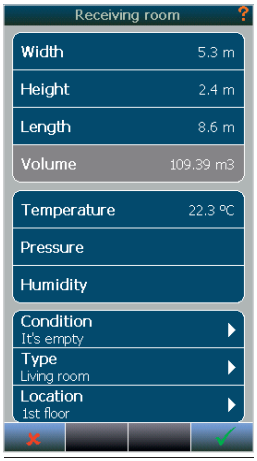


Figure 18.24

- *Temperature* is the air temperature measured in ˚C
- *Pressure* is the air pressure measured in kPa
- *Humidity* is the humidity in the receiving room measured in %
- *Condition* may be used for describing the condition of the receiving room
- *Type* may be used for describing the actual type of receiving room.
- *Location* may be used for describing the location of the receiving room.

Test Specimen

- *Area* (Figure 18.25) is the size of the common partition in square meters. This value is calculated based on entered values for width and height of the actual test specimen. For non-square objects, and the final size is known, the user may simply enter '1' for width and the actual size as height to get the correct area for the calculations.

Any special calculation rules for the area used in the calculations are indicated in the *Rating setup* overview. One example is the use of the maximum value of either entered Test Specimen area S or the entered Receiving Room volume divided by 7.5 (Figure 18.26).

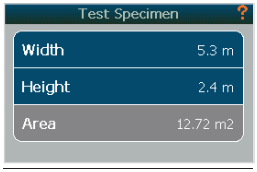


Figure 18.25

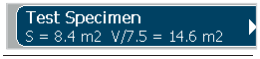


Figure 18.26

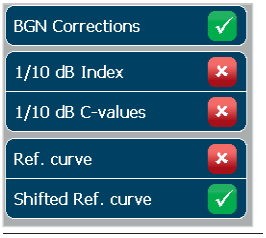


Figure 18.27

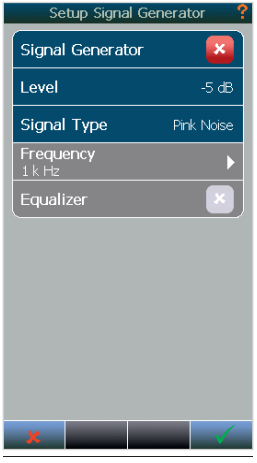


Figure 18.28

Various parameters (Figure 18.27)

- *BGN Corrections* is used for activating corrections to the measured values in the final calculations. By activating the tick-box, the receiving room average values will be corrected for the measured background noise level when measured. The selected Standard automatically gives the details for such corrections.
- *1/10 dB Accuracy* tick-box is used for making the final sound insulation index calculation in 1/10 dB step instead of the normal 1 dB step. This is handy when making small adjustment to the test object that cannot be measured with 1 dB final resolution.
- *Ref. curve* tick-boxes may be selected to have the reference curves being drawn either fixed, and/or Shifted. This allows the user to draw the red reference curve according to the preset fixed position in the selected Standard, and/ or, according to the calculated position for the final sound insulation index.

Signal Generator - Setup (Figure 18.28)

- Use the tick-box to activate the signal generator manually. Otherwise leave it to OFF, it will be turned ON automatically when starting a measurement.
- *Level* is used to set the output signal level in the range from 0 to -50 dB, where 0 dB corresponds to 1 Vrms.
- *Signal Type* is used to select between *Pink Noise* or *White Noise*.
- Use the cable Nor4514A to connect to the Noise generator signal to the power amplifier.

Memory – Setup (Figure 18.29)

- *Storage Folder* Specify a folder where you want to have your measurement projects stored. See chapter 13 for more information.
- *Auto Save On Accept* is used to automatically save your measurement project upon acceptance. You will be prompted for a file name at first use.
- *Save Measurement Setup as* is used to store your own setup. See *"Storing a Setup" on page 66* for detailed information.
- *Save Debug Log* will store the system internal log files to a removable media. You may be asked to pass these log files to Norsonic.

Figure 18.29

Making the Level measurements

As soon as all measurement parameters have been set, the instrument is ready for measuring. Set the measurement type to Level (Tip: use the **FUNC** key) and set the corresponding source position #A…#D by using the # soft key. Now, push either the large **START/STOP** key or the Start soft key to run the measurement. The Nor150 will now automatically activate the noise generator.

The display will then show the frequency spectrum of the source and/or receiving room and, depending on the selected view, combined with the A-weighted level vs time values. Each graphical view has an associated numerical table available. Just push the **TBL** button to access it.

Remember: A single channel instrument has two views (Figure 18.30 and 18.31), while a dual channel instrument will offer 4 different views (Figures 18.32, 18.33, 18.34 and 18.35). To toggle through the different views, push the **VIEW** button.

In the frequency spectrum, the SPL values are shown as filled bar graphs, the Leq values as a line, and the Lmax values as a step-line. The current duration of the measurement is displayed in the upper right corner. The function information is extended by the ongoing microphone position (#1, #2, etc).

Single-Channel views while measuring:

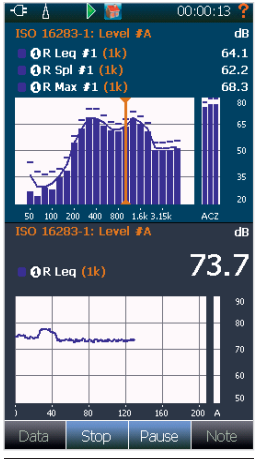


Figure 18.30

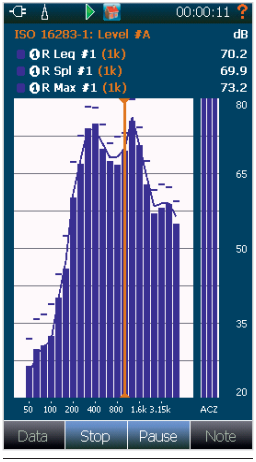


Figure 18.31

Dual-Channel Views 1 - 4 while measuring:

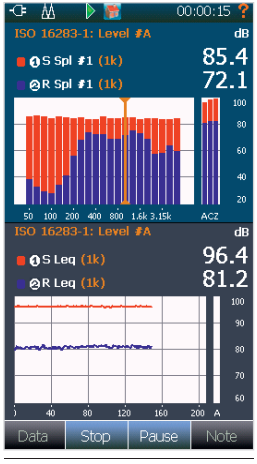


Figure 18.32

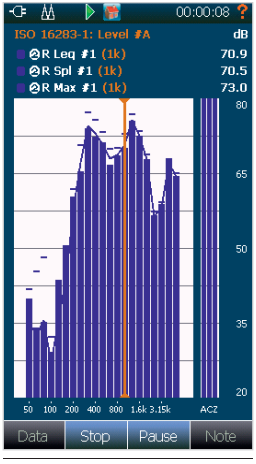


Figure 18.33

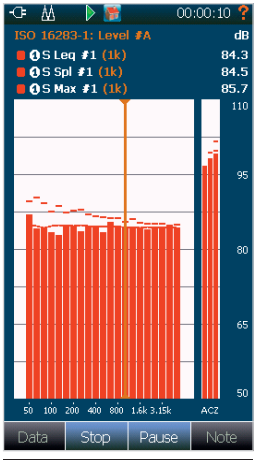


Figure 18.34

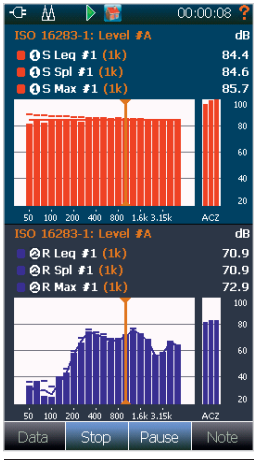


Figure 18.35

When the preset measurement duration is ended, or the Stop key is pushed the display changes its appearance. The frequency bar graph of the first view changes to a line graph. If measured beforehand, a black line will indicate the average level of the previously measured background noise. Figures 18.36 and 18.37.

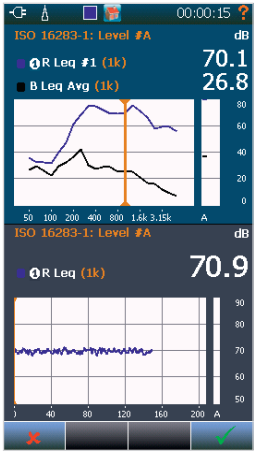


Figure 18.36 - Single channel view with Bgn.

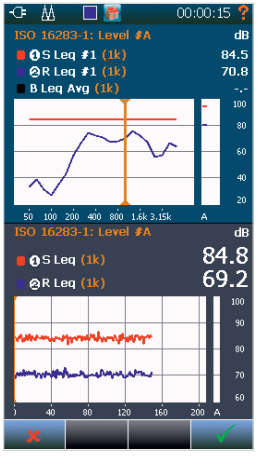


Figure 18.37 - Dual channel view with Bgn.

The bottom menu now presents ✓ and ✘ keys for the acceptance or cancellation of this performed measurement.

Upon accepting the measurement, these values are taken into account and put into the calculation of the average level. Cancellation of the measurement will discard the values and the average values remains unchanged.

It is a good idea to save your work frequently. We advise you to store your measurement project each time you have accepted a measurement. Activate the 'Auto Save On Accept' option in the Memory setup and the system will to take care of this task for you.

Making the Background noise measurements

Set the measurement type to Background noise (Tip: use the **FUNC** key). Push either the large **START/STOP** key or the Start soft key to run the measurement. The display will then show the frequency spectrum of the receiving room in the same way as for the level measurements (Figure 18.38). Each graphical view has an associated numerical table available. Just push the **TBL** button to access it.

The background noise measurements must be accepted or cancelled in the same way as the level measurements. Additional background noise measurement positions may now be measured by a new click on the Start key.

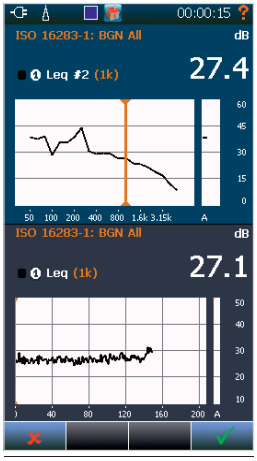


Figure 18.38

Making the Reverberation time measurements

Set the measurement type to Reverberation time (Tip: use the **FUNC** key). Push either the large **START/STOP** key or the Start soft key to run the measurement. If the excitation type is Noise, the Nor150 will now automatically activate the noise generator. In case of Impulse excitation, it's time for you to fire up the impulse signal.

The display (Figure 18.39) will then show the frequency spectrum of the receiving room and, depending on the selected view, combined with the level vs time values.

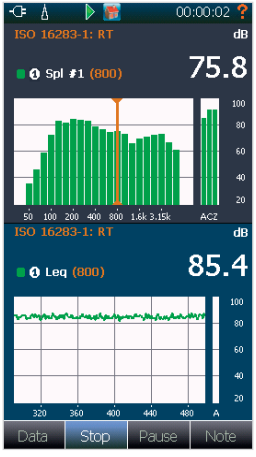


Figure 18.39

As soon as the reverberation time measurements is ended, the display will turn to show the calculated reverberation times as a function of frequency and, depending on the selected view, the decay with the calculated decay line and indicator lines for the T_{30}/ T_{20}/ T_{15}/EDT.

Each graphical view has an associated numerical table available. Just push the **TBL** button to access it (figure 18.40 / 18.41).

If the signal-to-noise ratio is insufficient for calculating the reverberation time, the sign "-.-" will be displayed instead of a value. If the reverberation time measured is too short compared to the values for minimum reverberation times, the '<' sign will be shown to the left of the value. Insufficient distance to noise floor will be marked with a 'B'.

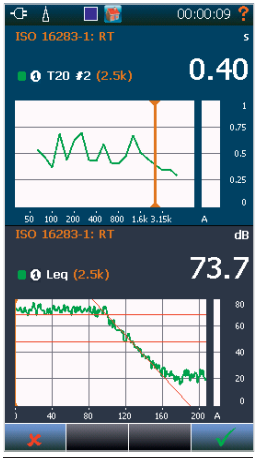


Figure 18.40

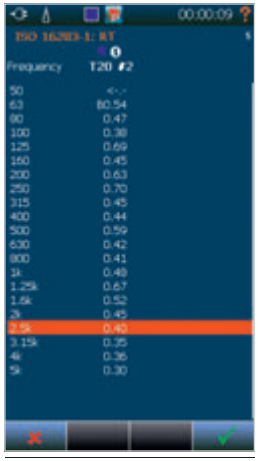


Figure 18.41

Use the **FUNC** key to show the values for the different RT functions (T_{20} – T_{30} – T_{15} – EDT/T_{max}).

IMPORTANT NOTE: This is just a display feature and has no impact of the function used for the rating calculation. The calculation will use the 'Primary RT function' as specified in the Reverberation Setup no matter what is on your display.

The bottom menu presents '√' and '✘' keys for the acceptance or cancellation of this performed measurement.

Upon accepting the measurement, these values are taken into account and put into the calculation of the averaged reverberation times. Cancellation of the measurement will discard the values and the average value remains unchanged.

It is a good idea to save your work frequently. We advise you to store your measurement project each time you have accepted a measurement. Activate the 'Auto Save On Accept' option in the Memory setup and the system will to take care for you of this task.

Data Mode

This is the mode where the accepted measurements and calculated results are presented. The Data mode comes up either by pressing the lower left soft button Data or when opening a saved project from the storage. In the latter case it's not possible to change into SPL mode. In this case you have to start a new project first (see '*Start a new project*' later in this chapter). The Data mode may not be accessible and therefore the soft key is greyed out if no accepted measurements are available. Pushing the ✘ will close the current measurement project and start a new one. If you want to reuse some or all of the current data click Yes when prompted and select the wanted data to be reused (see *"Start a new project" on page 89*).

Display in Data Mode

The Data mode has a fixed set of 4 display views. Compared to the Environmental Mode these views cannot be modified and therefore the setup menu item "Views" is greyed out. The **TBL** key behaves a little bit different, too. It doesn't only turn a graph into a table as expected, it also changes the dual type frame into a single type (and vice versa). The different views are displayed by pushing the **VIEW** button.

NOTE! The first time a view is activated the appearance is lagged due to the process of creating the graphs.

Within the Data mode there is a distinction between the views presenting the rating results (Rating) and the views presenting the accepted measurements (Reverberation, Receiving, Source and Background). Use the soft key Report to switch to the different data types. It starts with the Rating data and will rotate in the following order (Figure 18.42):

Figure 18.42

Rating views 1 - 4

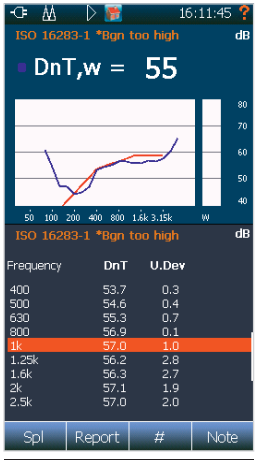


Figure 18.43

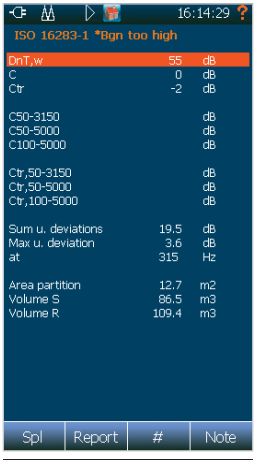


Figure 18.44

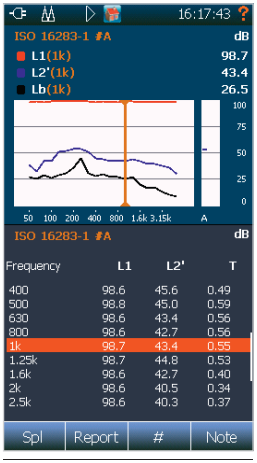


Figure 18.45

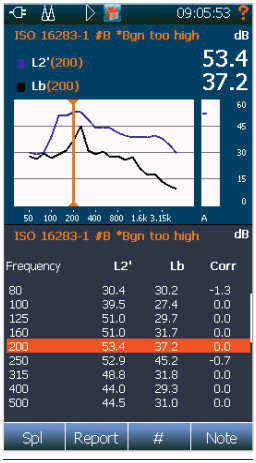


Figure 18.46

Rating View-1

Figure 18.43 presents the calculated sound insulation together with the single number index according to the selected standard in a dual frame. The upper frame shows the results graphically while the lower frame contains the numerical values. Use the **TBL** key to expand either of them to full screen. The header line contains the selected standard and may show background noise correction information (*Bgn too high). The calculated index may be viewed with or without background noise correction. Activate the function in the *Rating Setup*.

- Use the **FUNC** key to display other calculated functions (e.g. R'w) - Figure 18.47.
- Use the # soft key to have a specific source position (#A…#D) displayed - Figure 18.48.

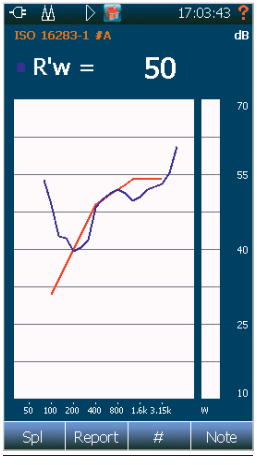


Figure 18.47

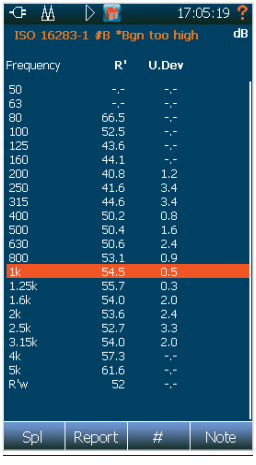


Figure 18.48

Rating View-2

Figure 18.44 is a plain numerical table to present the single number index along with the spectrum adaption terms. Furthermore it contains the sum of unfavourable deviations and the maximum unfavourable deviation from the single number index calculation. Information regarding the room and element dimensions can be found as well.

- Use the **FUNC** key to display other calculated functions (e.g. R'w)
- Use the # soft key to have a specific source position (#A…#D) displayed.

The **TAB** key has no function.

Rating View-3

This view (Figure 18.45) contains all numerical results of the analysis plus a level overview graph.

If the rating is based on the rating results of the individual source positions (e.g. ISO 16283) then no total average values are available, only the individual ones. Switch to a specific source position #A…#D by clicking the # soft key.

The screen shot shows the data for source position #A

- L1: average sound pressure level in the source room
- L2 or L2': average sound pressure level in the receiving room (L2' means it's corrected for background noise)
- Lb: average sound level pressure level of the background noise in the receiving room
- T: reverberation time in the receiving room

Screen shot with no total average values available (Figure 18.49).

Rating View-4

This view (Figure 18.46) contains information about the influence of the background noise to the receiving room levels. If the difference of the receiving room level and the background noise level is below a certain limit, corrections are applied according to the selected standard.

If the rating is based on the rating results of the individual source positions (e.g. ISO 16283) then no total average values are available, only the individual ones. Switch to a specific source position #A…#D by clicking the # soft key.

The screenshot shows the data for source position #B

- The header line may indicate that corrections are made so that the values are at the limit of the measurement (*Bgn too high).

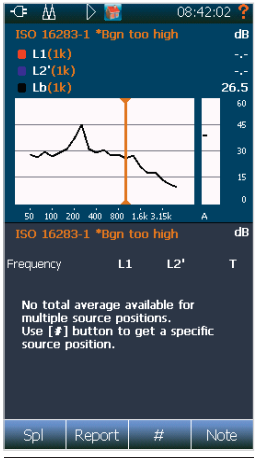


Figure 18.49

- L2 or L2': average sound pressure level in the receiving room (L2' means it's corrected for background noise)
- Lb: average sound level pressure level of the background noise in the receiving room
- Corr: applied correction values according to the standard

The background noise correction can be activated or de-activated in the *Rating Setup.*

Measurements views 1 – 4

Use the soft key Report to switch to the measurement data types. The measurement types follow after the Rating type in this order (Figure 18.50):

The different views are displayed by pushing the **VIEW** button.

NOTE! The first time a view is activated the appearance is lagged due to the process of creating the graphs.

The views for the reverberation time and the views for the sound pressure levels are in principle the same. It's only the unit and the scaling that is different.

For the reverberation time data use the **FUNC** key to show the different RT functions (T_{20} – T_{30} – T_{15} – EDT/T_{max}).

IMPORTANT! This is just a display feature and has no impact of the function used for the rating calculation. The calculation will use the 'Primary RT function' as specified in the *Reverberation Setup* no matter what is on your display.

Figure 18.50

View 1- 4 for reverberation time measurements:

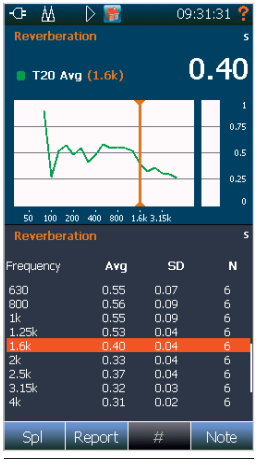


Figure 18.51

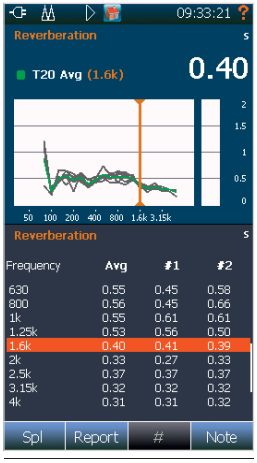


Figure 18.52

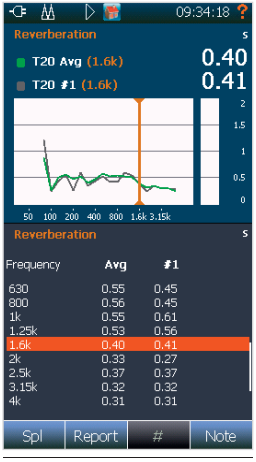


Figure 18.53

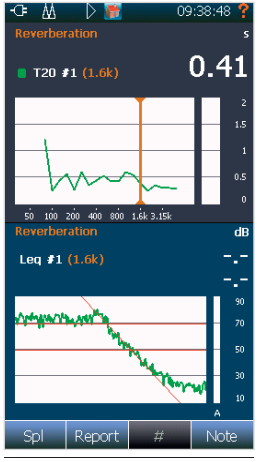


Figure 18.54

View 1 - 4 for receiving room measurements:

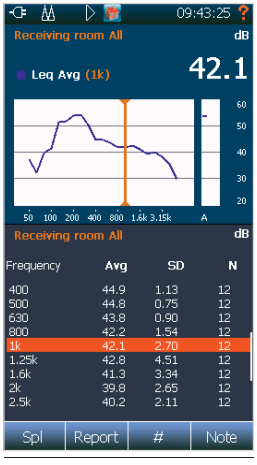


Figure 18.55

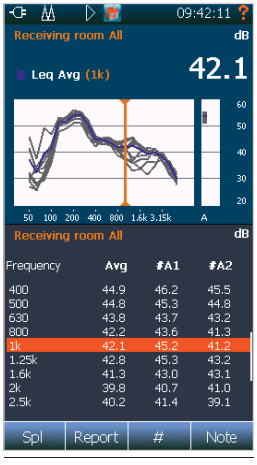


Figure 18.56

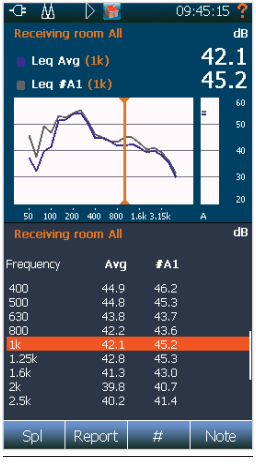


Figure 18.57

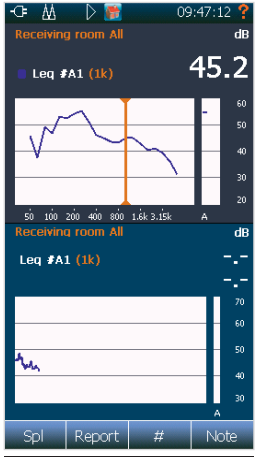


Figure 18.58

Measurement View-1

View-1 presents the average of accepted measurements in a graphical and numerical way. It covers all microphone and source positions. If available, use the # soft key to display the average of a specific source position #A…#D.

Screen shot of Receiving room total average (All) (Figure 18.59).

- Avg: Energetic (Level) or linear (Reverberation) average of accepted measurements.
- SD: Standard Deviation of the average
- N: Number of measurements included in the average

Screen shot of Receiving average limited to source position #A (Screenshot 18.60).

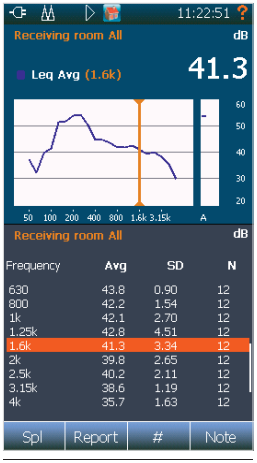


Figure 18.59

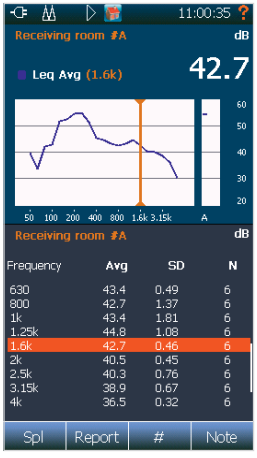
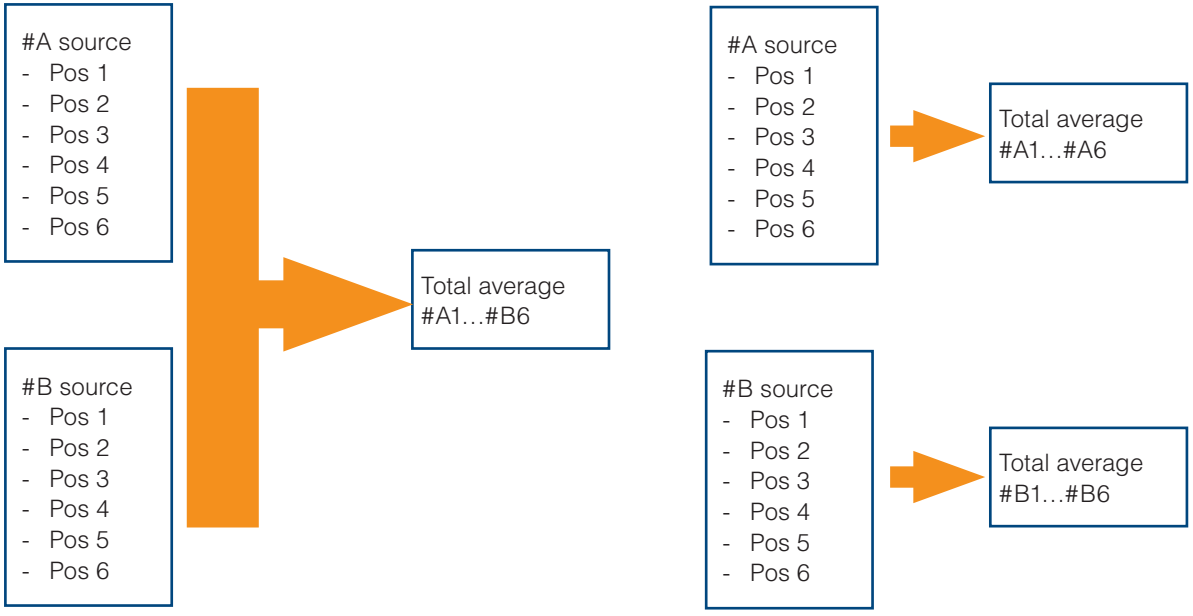


Figure 18.60

Measurement View-2

View-2 displays the average and its included measurements graphically and in a table. This is helpful to see how the different microphone positions vary. If available, use the # soft key to display the average of a specific source position #A…#D and the measurements belonging to it.



Screen shot (Figure 18.61) of Receiving room total (All) average and its measurements

- Avg: Energetic (Level) or linear (Reverberation) average of accepted measurements.
- #A1…#B6: The individual measurements (microphone positions). The measurements are labeled with the corresponding source position and the microphone position number (#A1, #A2…#B5, #B6)

On the upper frame use the ▲▼ keys on the keyboard to scroll the measurement positions. On the table frame use the ◀▶ keys.

Screen shot (Figure 18.62) of Receiving average on source position #B. The numerical table has been scrolled to position #3 and #4.

Measurement View-3

View-3 displays the average and just one of its measurements graphically and in a table. This is to compare one microphone position with the average value. If available, use the # soft key to display the average of a specific source position #A…#D and one measurement belonging to it.

Screen shot (Figure 18.63) of total average together with microphone position 3 at source position #B (#B3).

- Avg: Energetic (Level) or linear (Reverberation) average of accepted measurements.

On the upper frame use the ▲▼ arrow keys on the keyboard to scroll the measurement positions. On the table frame use the ◀▶ arrow keys.

Screen shot (Figure 18.64) of Receiving average on source position #A. The numerical table has been scrolled to position #6.

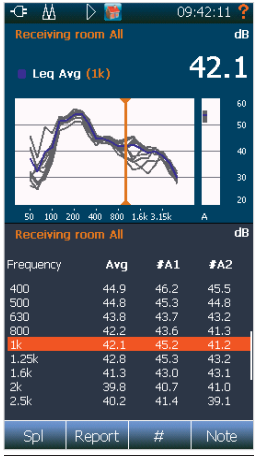


Figure 18.61

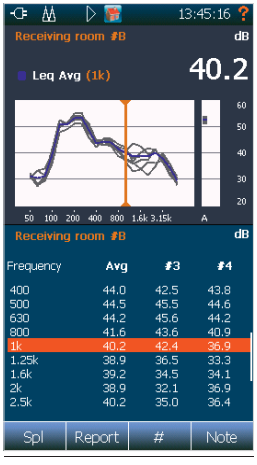


Figure 18.62

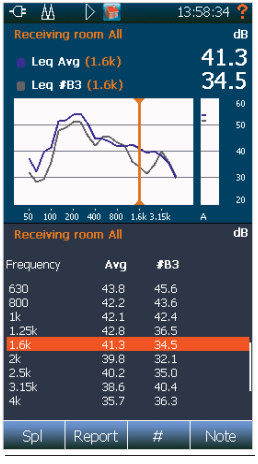


Figure 18.63

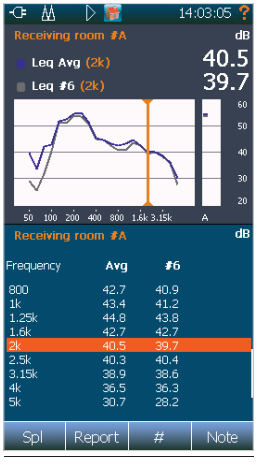


Figure 18.64

Measurement View-4

View-4 presents the selected microphone position (not the average!) from the previous view as a Level vs frequency L(f) and Level vs time (L(t) graph. Use the ▲ ▼ arrow keys on the keyboard to select a different microphone position. If available, use the # soft key to limit the measurements to a specific source position #A…#D.

It can be very helpful to see the reverberation time decay line for a specific microphone position or the signal steadiness in the receiving or source room for level measurements.

Screen shot (Figure 18.65) of Reverberation time data for microphone position #3

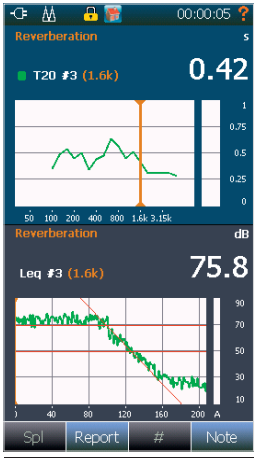


Figure 18.65

Use the **FUNC** key to select a different reverberation time function (T20, T30, T15, EDT/Tmax).

Screen shot (Figure 18.66) of position #5 and function T30.

Screen shot (Figure 18.67) of Receiving room data for microphone position #A1 Start a new project

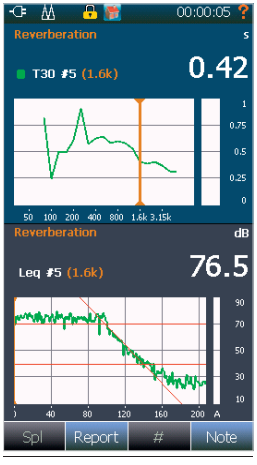


Figure 18.66

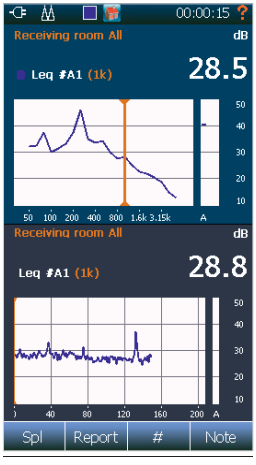


Figure 18.67

Start a new project

To start a new project pushing the ✘ button to close the current measurement project and start a new one. You may be asked to save the current data (Figure 18.68).

If you want to reuse some or all of the current data click *Yes* when prompted (Figure 18.69) and select the wanted folders to be reused (Figure 18.70).

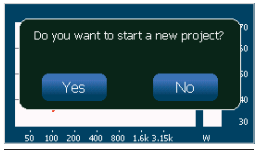


Figure 18.68

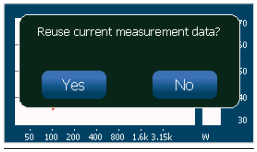


Figure 18.69

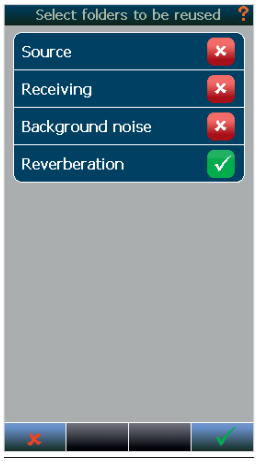


Figure 18.70

Sound intensity

The sound intensity option enables the Nor150 to measure sound intensity using a two-microphone intensity probe, complying to ISO 61043:1993. When entering the sound intensity mode, the user-configurable views in environmental mode will be replaced by graphics designed for intensity measurements and the currently selected measurement standard.

In intensity mode, the Nor150 measures sound intensity and sound pressure. These are the basic quantities, but they are available as time-equivalent values as well as instantaneous values with time-constants.

In addition, a range of measurement functions are deduced from the basic quantities. Some examples are L_W, sound power, and FpI. The range of available functions depends on the selected measurement standard.

The Nor150 will, in combination with the Nor1290 probe and the Nor1294 phase verification coupler, ensure that most intensity measurements may be performed with a single 12 mm spacer. This is due to the unique two-stage phase correction technique implemented in the Nor150.

The Nor1290 kit.

Setting up the instrument for intensity

The Nor150 may utilize a wide range of probes, both pre-polarized and 200 V polarized microphones in different configurations. However, the highest performance and ease of use is achieved using the Nor1290 probe kit. With the Nor1290, unique performance is achieved using a two-stage correction technique.

Assembling and handling the probe

The Nor150 delivered with the Nor1290 kit comes with a probe comprised of two phase-matched microphones, two accompanying CCP amplifiers and the probe hardware itself. In addition, the kit contains spacers, calibration charts, the Nor1294 phase correction coupler and an extension cable.

Note the serial number of each microphone cartridge, then mount each of the microphone cartridges on an angle adapter as illustrated in Figure 19.1. Please avoid touching the connectors. Mount the lowest serial number microphone/adapter on the lowest serial number preamplifier as shown in Figure 19.2 and vice versa. Make sure that the lowest serial number combination of microphone/preamp is inserted into the probe hardware port A.

Mount the spacer of choice on microphone A, and spacer sleeve on microphone B as illustrated in Figure 19.3. Make sure the spacer adjustment knob is loose, then push the microphones towards each other carefully such that the spacer enters the spacer sleeve. Ensure the microphones are positioned symmetrically around the probe centre, and tighten the spacer adjustment knob. Figure 19.4 shows the assembled probe along with the positive sound intensity direction.

Figure 19.1 - Mount the microphone on the angle adapter.

Figure 19.2 - Mount the microphone and adapter on to the preamplifier.

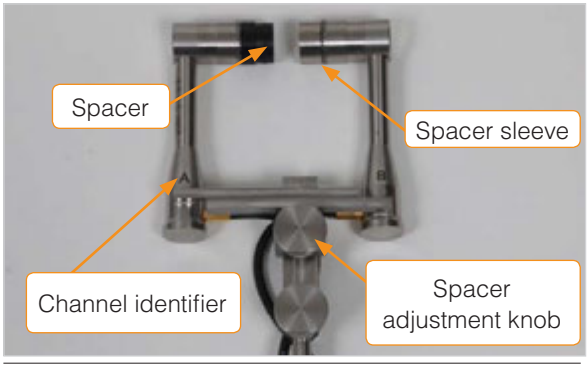


Figure 19.3 - The individual parts of the Nor1290.

NOTE! Norsonic recommends the 12 mm spacer for most measurements.

A single 7-pin Lemo-connector connects the probe to the instrument; any standard Norsonic microphone cable may be used as an extension. The Nor1290 kit comes with a light-weight rod with adjustable handle, with the option of mounting a smartphone directly on the handle. The rod has 7-pin Lemo-connectors, functioning as an ordinary microphone cable.

To use the probe handle, connect the probe at the top of the rod, then add an extension cable between the bottom end of the rod and the Nor150. The optional smartphone will provide the same view as the Nor150 itself, offering a one-hand operation of intensity measurements.

The probe may also be mounted directly on the Nor150, or on a microphone cable.

Figure 19.4 - The Nor1290 probe assembled with 12 mm spacer. Positive direction is from A to B.

Figure 19.5 - The Nor1290 with extension rod, smartphone handle and windscreen.

Probe dismantling

To do probe calibration and verification, it is necessary to dismantle the probe. Open the spacer adjustment knob (see Figure 19.3) and pull the microphones apart as shown in Figure 19.6. Please make sure to pull the microphones, such that friction between spacer and sleeve is minimized. Remove the spacer and sleeve by rotating them counter-clockwise off the microphone grid.

Figure 19.6 - Loosen the spacer adjustment knob and pull the microphones apart carefully.

Transducer setup

For customers buying the Nor150 with the Nor1290 probe kit, all settings are predefined from the factory. Setting up the probe is then easily done:

1. Enter intensity mode (**SETUP** > *Applications* > *Sound Intensity* > ✓)
2. Select the Nor1290 probe from the list in **SETUP** > *Input* > *Intensity Channel* > *Intensity Probe.*
3. Accept the changes using the ✓ button.
4. Configure spacer and environmental parameters
5. Tap into *Calibration*, and follow the instructions in section "*Calibration and phase correction*".

Figure 19.7 shows the *Channel* menu.

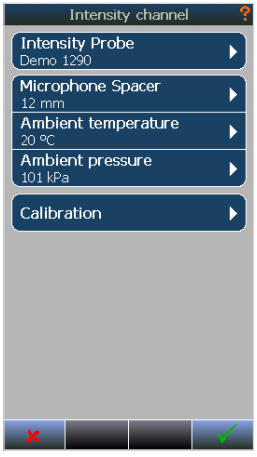


Figure 19.7 - The channel menu provides setup of the intensity probe.

If the kit is delivered separately, the parameters of the transducers and the probe must be set up before the probe may be used. We recommend to use the lower serial number for both the preamplifier and the microphone capsule at the A input on the Nor1290.

1. Enter intensity mode (**SETUP** > *Applications* > *Sound Intensity* > ✓)
2. Tap into **SETUP** > *Input* > *Transducers*, and press the Add soft key (see Figure 19.8).

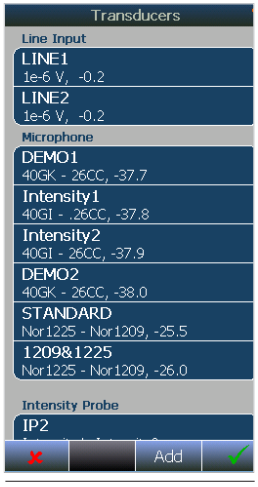


Figure 19.8 -
The transducer menu

3. Add the following properties:
   a. *Name:* "Intensity A" (or your preference)
   b. *Type:* Microphone
   c. *Predefined Sensor:* ✗ (No)
   d. *Microphone capsule*
      Measurand: "Pressure in air ref 20e-6 Pa"
      Type: as specified in the cal. chart
      Serial number: as specified in the cal. chart
   e. *Preamplifier*
      Type: as spec. in cal. chart
      Serial number: as spec. in cal. chart
      Gain: -0,9 dB
      IEPE: ✓ (Yes)
   f. *Laboratory* (as spec. in cal. chart)
   g. *Verified sensitivity:* as spec. in cal. chart
4. Accept with the ✓ soft key.
5. Repeat the procedure in in Step 3 for "Intensity B".
6. Add a new transducer, with the following properties:
   a. *Name:* "My Nor1290" (or your preference)
   b. *Type:* Intensity Probe
   c. *Predefined sensor:* ✓ (Yes)
   d. *Probe:* Nor1290
   e. *Serial number:* As spec. in verification chart
   f. *Channel 1 sensor:* Intensity A
   g. *Channel 2 sensor:* Intensity B
7. Accept with the ✓ soft key twice to return to the Input menu.
8. Tap into *Intensity channel*
9. Tap into *Intensity Probe* and select the probe you just configured.
10. Accept with the ✓ soft key
11. Set up the environmental parameters
12. Tap into *Calibration*, and follow the instructions in section "***Calibration and phase correction***".

For other probes, configuring the probe follows the same procedure as above. However, please pay attention to whether the probe uses a 200 V polarization microphone or is polarized, whether the preamplifier is of IEPE type or traditional. When configuring the probe, make sure to deselect *Predefined sensor*.

WARNING: If using other probes than the Nor1290, please contact your Norsonic distributor to verify that the probe may be used with the two-stage phase correction process. The calibration process may cause artificially high dynamic capability for other probes.

NOTE: If the probe is set up as a *Predefined* Nor1290, the instrument will route the Channel 2 input to pin 1 on the Channel 1 Lemo connector, and the Channel 2 Lemo connector will not be functional.

Connecting a smartphone

Any smartphone running Android version 4.1 or higher may download and use the NorRemote application found in the Google Play store. A SIM card is not necessary, but an internet connection over a regular WiFi is necessary to download the application.

1. Set up NorRemote on the smartphone
   a. Make sure the smartphone is connected to the internet, and open Google Play Store (Figure 19.9).
   b. Type in NorRemote in the search field and press search.
   c. Install NorRemote, and open the application (Figure 19.10).
   d. Tap the “more” icon in the upper right corner, then Settings (Figure 19.11). Note the default key. This is the encryption key you will need to type inn when connecting to the network.
   e. Make sure “Enable Hotspot” is on, and press back (Figure 19.12).
2. Connect the Nor150 to the smartphone
   a. Ensure the Nor150 is equipped with the WiFi-dongle Nor4614A (Figure 19.13).
   b. Go to **SETUP** > *Instrument* > *Communication* > *WLAN.*
   c. Tap “*NorRemoteAP*”. The network will typically have a device specific text at the end of the name (Figure 19.14).
   d. Tap Connect, and enter the security key as displayed in the smartphone settings: “Norsonic150”.
   e. Press the ✓ button until you have exited the menu system.
3. Press the refresh button in the NorRemote app (Figure 19.15). The name of the Nor150 will show up. Tap the name to connect (Figure 19.16).

Figure 19.9 - Open the Google Play Store.

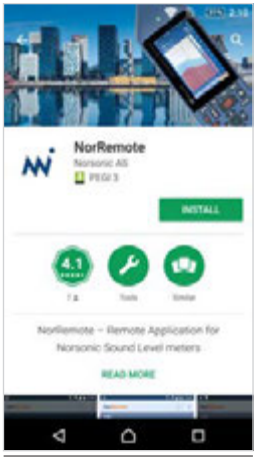


Figure 19.10 - Search for "NorRemote" and install the App.

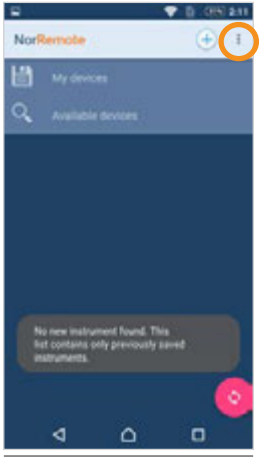


Figure 19.11 - The settings are located under the more icon in the top right corner.

Figure 19.12 - Switch on the Hotspot, note the encryption key and accept with the back button.

Figure 19.13 - The WiFi dongle.

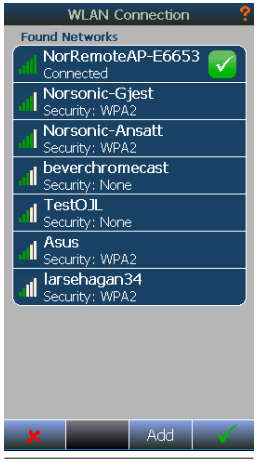


Figure 19.14 - The WLAN connection menu.

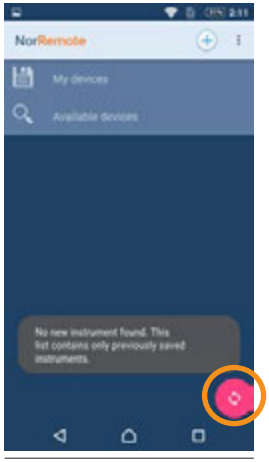


Figure 19.15 - Press the refresh button to update the device list.

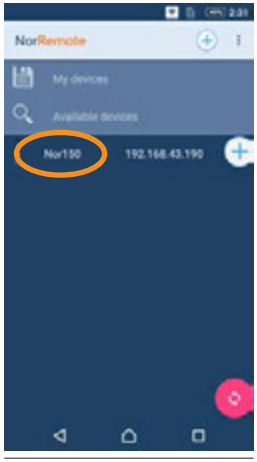


Figure 19.16 - Tap on the Nor150 name to connect.

Calibration and phase correction

To obtain correct results from the instrument, it is important to calibrate before a measurement. In general, Norsonic recommend to calibrate the probe each time the environment has changed significantly (ambient temperature and pressure especially), or every day of measurement. A verification should also be done at the end of the measurement day to ensure that the instrument has been reliable throughout the day. Most standards require that such a verification is done.

Calibrating an intensity probe involves two steps. The first step is a regular pressure calibration of each microphone. The second step is a phase correction procedure to minimize and verify the residual intensity when the probe is exposed to a completely reactive sound field. This is achieved with the Nor1294 Phase Verification Coupler. To start calibration, dismantle the probe as described in section "*Probe dismantling" on page ??*.

Pressure calibration

Insert probe microphone A into a sound calibrator such as a Nor1251. Open the calibration menu on the Nor150 by pressing **CAL**. The calibration menu is shown in Figure 19.17. Select *Pressure calibration* and then *Sound Channel 1*. Tap *Auto* and enter the correct calibration frequency and calibrator level. Press the Calibrate soft key to start the automatic calibration. The procedure will take a couple of seconds. Verify that the correct level is measured after the calibration procedure has finished, then accept with the ✓ softkey.

The pressure calibration menu is shown in Figure 19.18.

Repeat the procedure for probe microphone B/Sound channel 2.

HINT: More information about pressure calibration may be found in *Chapter "Calibrating the instrument - field check" on page 38*.

HINT: When calibration mode is active, the sound pressure of each individual microphone is considered separately. When returning to intensity mode, the sound pressure level will be 6 dB lower than the calibrator output when exposing only one mic to the calibrator. This is due to the very nature of intensity measurements, where the sound pressure measured as the mean of the two microphones.

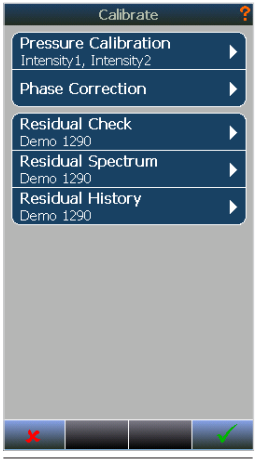


Figure 19.17 - The calibration menu.

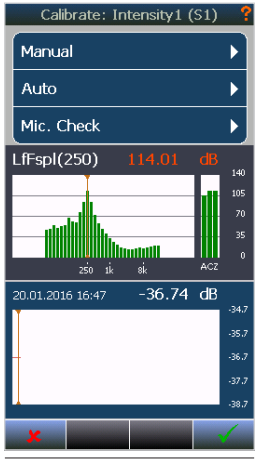


Figure 19.18 - Pressure calibration for a single channel.

Phase correction

After performing a pressure calibration, phase correction may be performed. Please note that the correction procedure relies on using a probe capable of such a correction – the Nor1290 is such a probe. For other probes, please contact your Norsonic distributor for more information about phase correction.

In the calibration menu, tap into *Phase correction*. Follow the instructions on the screen: Make sure the Nor1294 ventilation is in OPEN position, then insert both microphones into the Nor1294 as shown in Figure 19.19 and 19.20. Tighten the Nor1290 spacer adjustment knob, then put the Nor1294 into CLOSED position as shown in Figure 19.21. Connect the Nor1294 mini-jack into the headset output of the Nor150. Then press the **START** soft key to initiate the correction process. A progress bar will keep you updated, and the calibration is fully automatic. The Nor150 screen is shown in Figure 19.22.

When the correction process is done, the instrument will show the pressure-intensity residual spectrum measured with corrections applied. In addition, the minimum requirement defined in IEC 61043:1993 will be shown as step-lines. The screen is shown in Figure 19.23. If the obtained spectrum looks good, accept the correction with the √ soft button. The spectrum may be found for later reference by tapping into Residual Spectrum inside the calibration menu.

NOTE: Make sure the probe is not exposed to vibration during the correction process, as this may affect the calibration.

Figure 19.19 - Dismantle the probe, spacer and sleeve.

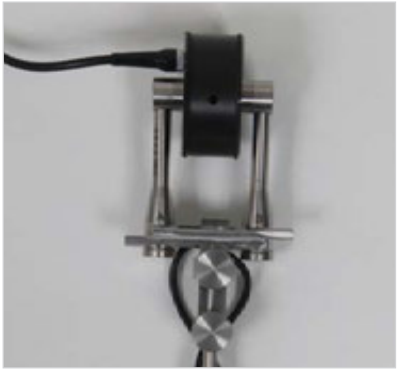


Figure 19.20 - Make sure Nor1294 is in open position and insert microphones carefully.

Figure 19.21 - Tighten the spacer and knob, and close the Nor1294.

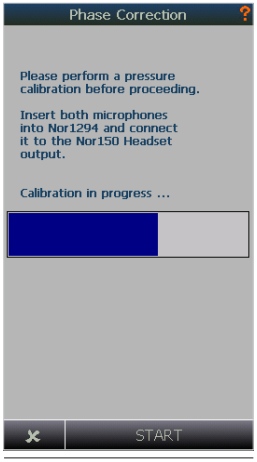


Figure 19.22 - Phase correction in progress. Allow about 30 seconds for the correction process.

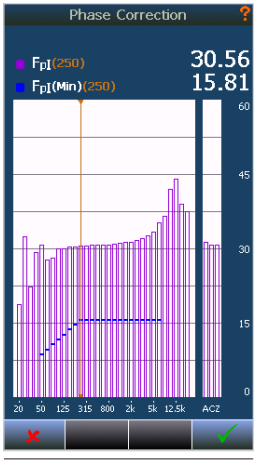


Figure 19.23 - Correction finished. Accept or discard the correction.

HINT: The instrument will warn you if it detects too low sound pressure during the calibration process. This will typically happen if the Nor1294 is left in OPEN position during calibration. Abort the calibration, close the Nor1294 and restart the process.

NOTE: If the correction process returns lower values than expected, the reason might be high pressures applied to the microphones before phase correction. This might happen if the microphones are inserted quickly into calibrators with small ventilation holes. Let the microphones rest for about 2 minutes and try again.

Verification procedure

After a measurement session, it is recommended (and mandatory according to most standards) to do a verification of instrument performance.

The *Calibration* menu offers a *Residual Check*. This procedure requires dismantling of the probe and use of the Nor1294 just as for a phase correction, but it will not generate a new phase correction. Instead, it will evaluate the pressure-intensity residual spectrum with the current correction applied.

When a residual check is accepted with the √ button, the resulting pressure-intensity residual spectrum is stored. The last saved spectrum is always easily available by tapping into *Residual Spectrum* in the *Calibration menu*, as shown in Figure 19.24.

Finally, the microphones should be verified separately using a pressure calibrator using the same procedure as specified for microphone calibration in section *"Calibration and phase correction" on page ??*.

The residual spectrum data is stored in the Nor150 along with time and date. Thus, it is possible to look at the previous calibration or verification, and track the history. Press **CAL** and tap *Residual History* to access this data.

Figure 19.17 shows the historical data. Tap on the lower half of the screen to make the cursor change time and date. The lower part shows the residual intensity as a function of time for the selected band.

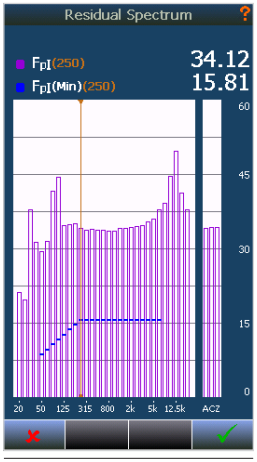


Figure 19.24 - The latest residual spectrum is always available.

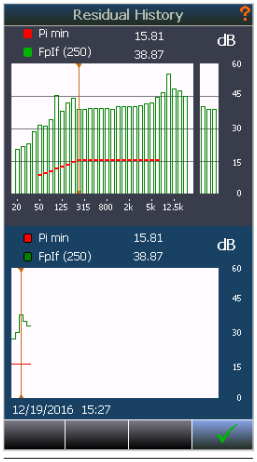


Figure 19.25 - A detailed history is available for the residual spectrum.

Configuring an intensity measurement

Intensity measurements are organised a bit different compared to normal level measurements. As intensity measurements involves the concept of measurement surfaces, intensity measurements are stored as projects. Each project may be comprised of several surfaces or segments.

All configuration of an intensity measurement is done inside the measurement menu (**SETUP** > *Measurement*), except for the measurement surface setup and the environmental parameters/spacer. Starting a new measurement project is done by tapping the New softkey available in the **SETUP** menu (Figure 19.26).

The Nor150 intensity mode offers different setups when pressing the **SETUP** key, followed by a tap on *Applications* and then *Sound Intensity*. The menu is shown in Figure 19.27. The setups have preconfigured settings to suit the application and standard. Setups may also be stored by the user if changes has been made to a setup. Press **SETUP** followed by a tap on *Memory* to find the *Save Measurement Setup as* option, as shown in Figure 19.28.

The following setups are provided from the factory:

- ISO 9614-2 (Sound power by scanning)

Tapping into a setup will show a summary of the setup as shown in Figure 19.29. Tap the ✓ to load the setup.

Select *Show Setup Shortcut* to show the setup in the *Applications* menu.

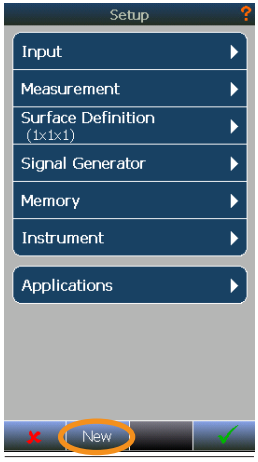


Figure 19.26 - Press the "New" button to start a new project.

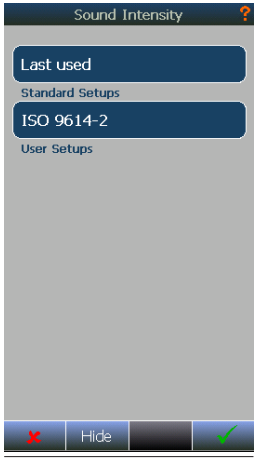


Figure 19.27 - The sound intensity setups.

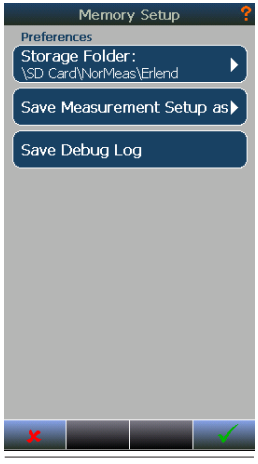


Figure 19.28 - The memory menu offers storing the current measurement setup.

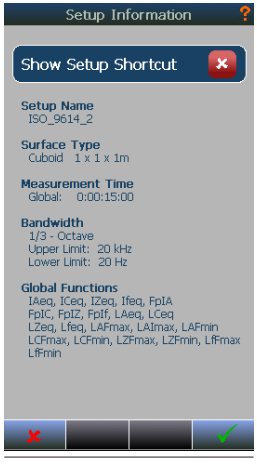


Figure 19.29 - A measurement setup summary.

Probe and environment parameters

Before a measurement is started, the probe must be configured. For the Nor150 in combination with the Nor1290 kit, the 12 mm spacer is the correct choice for most measurement applications.

Go to the channel menu by **SETUP** > *Input* > *Intensity Channel* to access the menu in Figure 19.30. Select the correct value for microphone spacer by tapping into *Microphone Spacer*, then selecting the correct spacer using the wheel. Accept with the √ softkey.

Along with the spacer distance, ambient temperature and pressure is needed for the instrument to correctly measure sound intensity.

Accept all changes with the √ softkey.

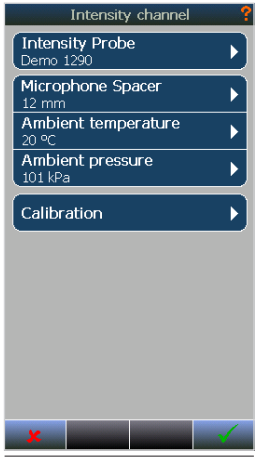


Figure 19.30 - Use the channel menu to set up environmental parameters.

Defining a measurement surface

In intensity mode, the Nor150 organises measurements in projects. Normally, the user will define a measurement surface enclosing the sound source to isolate it from the surrounding environment. The concept of source isolation is illustrated in Figure 19.28.

Different baseline surface types may be selected. In the example in Figure 19.31, the baseline surface type is a cuboid. Considering such a measurement surface definition, the cuboid will be divided into surfaces left, right, front, back, and top. Each surface contains a set of segments. The concept is illustrated in Figure 19.32.

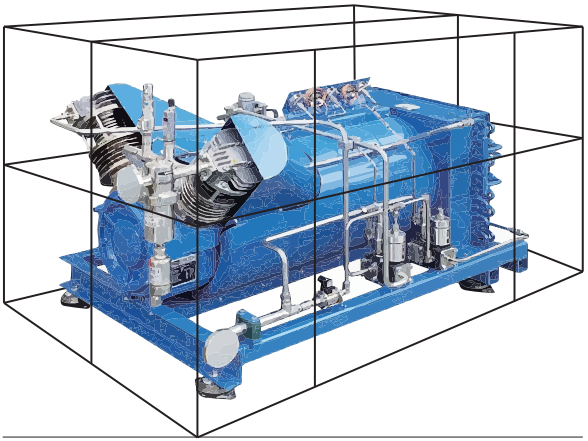


Figure 19.31 - A typical measurement surface enclosing the noise source.

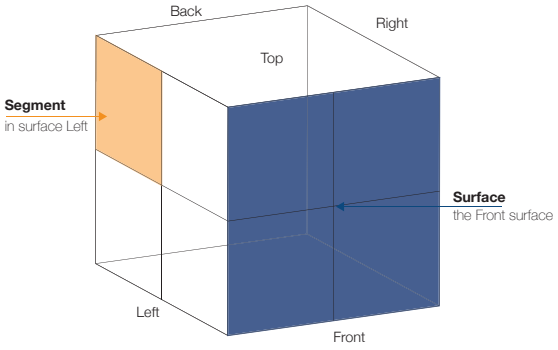


Figure 19.32 - The cuboid is divided into surfaces, and each surface is built up of one or more segments.

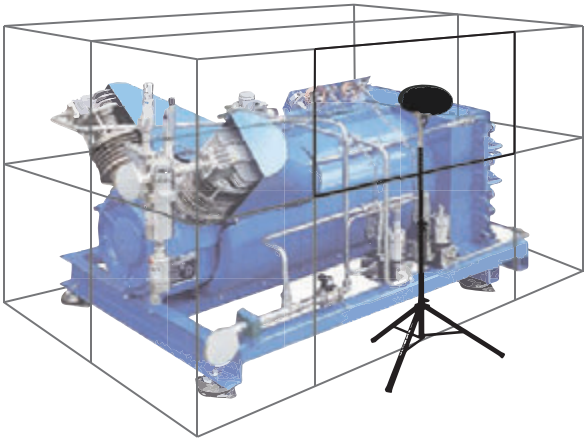


Figure 19.33 - Intensity measurement with fixed probe positions.

The segments contain the actual measurement, whether it be a scan or a fixed-point measurement. Each segment may consist of either one or two measurements. The resulting levels will be either the single measurement directly, or an average of the two measurements. When using two measurements per segment, the arithmetic difference between the two measurements will also be calculated.

The ability to measure twice on a single measurement surface is especially useful when measuring intensity by scanning, where standards require the evaluation of repeatability between two orthogonal scans.

Each segment is defined by its physical dimensions, resulting in an area. The area is used for calculation of sound power. Figure 19.33 and 20.34 illustrates two common ways of measuring intensity on a surface.

To define the measurement surface, push **SETUP** and tap into *Surface definition* menu as illustrated in Figure 19.35.

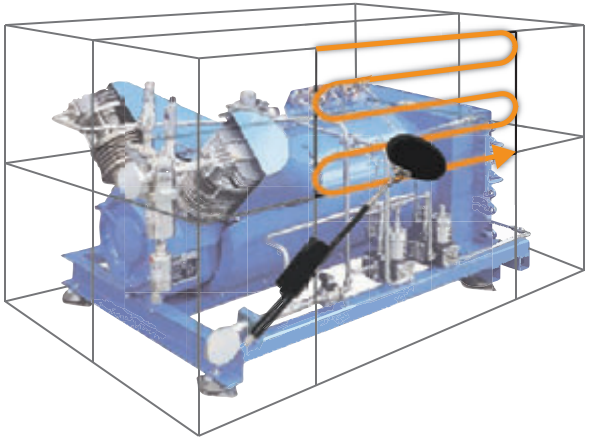


Figure 19.34 - Intensity measurement using the scanning method.

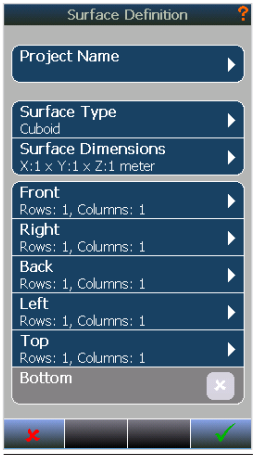


Figure 19.35 - The surface definition menu.

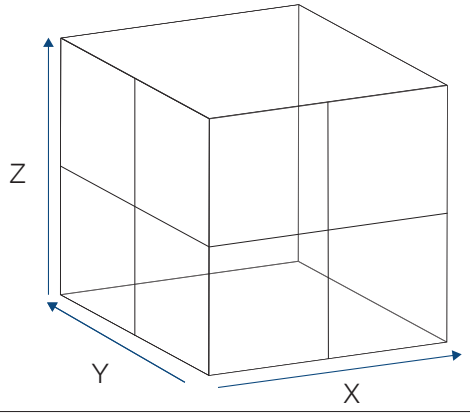


Figure 19.36 - The coordinates defining the cuboid surface.

Start with the ***Surface type*** to select a baseline geometry. After selecting the surface type, the overall dimensions are defined in the ***Surface dimensions*** menu. These dimensions will be used to generate the surfaces and segments making up the total surface, as illustrated in Figure 19.36.

When entering the surface dimensions, the Nor150 will divide the surfaces (e.g. left) into several segments, such that no segments will have an area of more than 1 m^2. However, the number of segments are changeable to the users choice.

The generated surfaces will depend on the total measurement surface type. These surfaces will be available in the ***Surface definition*** menu. In Figure 19.35, the Cuboid surfaces are listed below the ***Surface Dimensions*** item. Tapping into either of these surfaces will show the parameters defining the surface, and allow adjustment of the number of segments inside the surface.

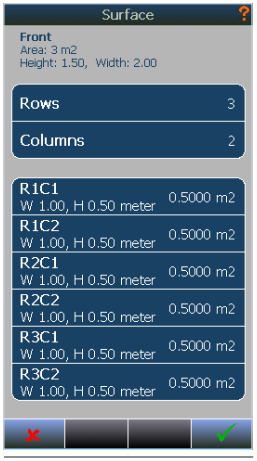


Figure 19.37 - Properties and segments belonging to surface front. Changing either rows or columns will cause loss of data.

Figure 19.38 - Properties for a single segment. Changing parameters on a segment will not cause loss of data.

Figure 19.37 shows the settings found inside a surface created when a cuboid surface type is selected. The menu contains settings for number of rows and columns. Changing either of these will make the instrument recalculate the segment dimensions based on the surface dimensions. This must be done before the segments are measured, as the segment data will be lost when generating new segments.

Tapping into a segment enables editing the parameters defining each segment. This is possible even after a measurement has been performed, causing a recalculation of sound power if this part of the measurement. Figure 19.38 shows the options available for a cuboid segment.

Measurement settings

The fundamental settings are available from the *Measurement* menu (**SETUP** -> *Measurement*). Figure 19.39 shows the menu.

Global time is the time a measurement will run before it is automatically stopped. When using scanning procedures, the global time is not relevant and should be set to the longest expected measurement time plus some margin. For fixed-point measurements, the global time is a useful feature.

Profile A is the profile measurement time. Enable Profile A if time analysis of the measurements is needed by tapping the enable/disable box. The time data is generated with the resolution defined by tapping into the Profile A menu.

Filter defines the properties of the filtering process. Sound intensity measurements are possible in 1/3 octave bands with center frequencies ranging from 20 Hz to 20 kHz. This setting may not be changes after a measurement commenced in an intensity project.

NOTE: In intensity mode, the A, C and Z networks are calculated from the 1/3 octave bands. The frequency range for networks may be changed at any time, independent of the filter settings, as long as the respective bands has been measured. Norsonic recommends to always set the Filter range to span from 20 Hz to 20 kHz.

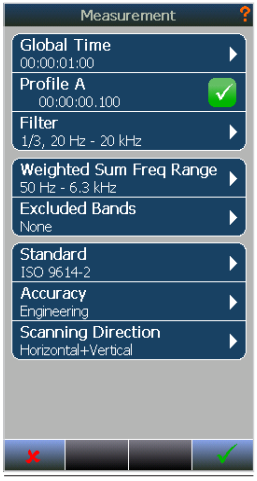


Figure 19.39 -
The measurement menu.

Calculation settings

Weighted sum frequency range specifies the range from which the weighting networks A, C and Z is calculated. Frequency bands within this range is included in the calculation.

Excluded bands is a list of frequency bands removed from the weighted sum frequency range. This is useful both for analysis of weighted intensity and sound power without problematic bands, and in certain measurements standards where bands with repeatability errors may be neglected due to insignificant levels in the respective bands.

NOTE: If a band is excluded, the exclusion applies to the complete measurement project.

HINT: The calculation settings may be changed at any time during or after measurement.

Selecting a standard

The sound intensity mode in the Nor150 will provide different measurement functions based on the selected measurement standard. Warnings, functions and views will be configured accordingly.

Standard - the Nor150 provides the following standards:

- Sound power by scanning, ISO 9614-2

The setup and features of each measurement standard is discussed in separate sections.

Accuracy provides a list of available accuracy grades. The list depends on the selected measurement standard.

Scanning direction provides selection of the scanning direction if a scanning standard is selected. When using a scanning standard, the result of each measured surface segment will be the mean of two scans.

The Nor150 operates with scanning direction *Horizontal*, *Vertical* and *Both*. Some standards and accuracy grades require two orthogonal scans. The user may choose to measure all segments with vertical scans first, and later add horizontal, or measure both scans for each segment immediately.

The concept of horizontal and vertical scanning directions is illustrated in Figure 19.40. The notations “horizontal” and “vertical” is just a way of conveniently remembering scanning directions. The user may of course use any preference in orientation while scanning.

Selecting either *Horisontal* or *Vertical* will make the instrument progress to the next segment after the measurement is accepted, while *Both* will make the instrument assume two consequent scans before progressing to the next segment.

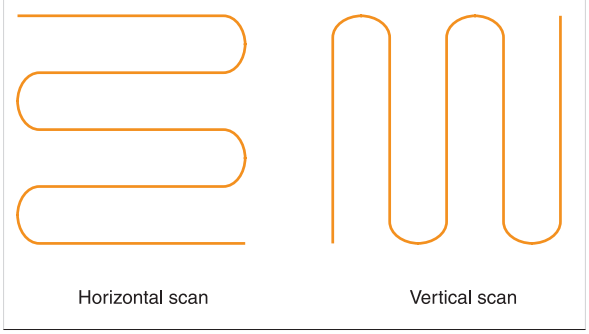


Figure 19.40 - The definition of the scanning directions. Note that the scanning directions are orthogonal.

Navigating the Sound Intensity mode

In Sound Intensity Mode, some of the measured quantities are levels with a direction. The Nor150 indicates this property by a ***Mirror graph***. The mirror graph has the lower range limit in the center, with positive direction upward on the screen and negative direction downward. Negative direction for numerical values are indicated with a negative sign in a parenthesis in front of the value. Note that sound pressure has no direction, and will always be displayed both upwards and downwards for easy comparison with intensity values.

Figure 19.41 - An overview of the simple view in Sound Intensity mode.

Introducing the surface scopes

As discussed in *"Defining a measurement surface" on page 102* the Nor150 operates with the concept of a total measurement surface divided into several surfaces and segments. To enable easy navigation in the measurement surfaces, the instrument presents the measurements using three different scopes:

Total scope shows the total levels based on the sum and average of all segments, and values for the different surfaces.

Surface scope provides levels for all segments inside a surface, along with the total levels for the surface.

Segment scope shows the results of an individual segment.

To navigate, double-tap a surface or segment to enter the underlying scope. Tapping the Back softkey will navigate upwards in the scope hierarchy. Figure 19.42 shows the navigation steps.

Inside each scope, pressing **VIEW** will toggle between Scope view (graphical representation of the surfaces), Simple view and Advanced view. Simple view and advanced view presents graphs of the results in the current scope.

The views

The instrument provides different views to represent data. The content inside the views will depend on the selected measurement standard. To change graph level limits, simply tap and drag on the graphs as illustrated in Figure 19.42. To change the range of the graphs, tap and hold the on the graph as shown in Figure 19.43. Select range from the context menu.

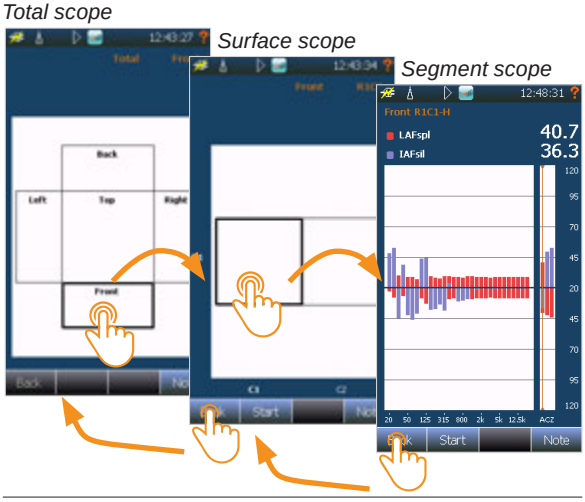


Figure 19.42 - Double-tap a surface or segment to open the corresponding scope. Back *will bring you up in the scope hierarchy.*

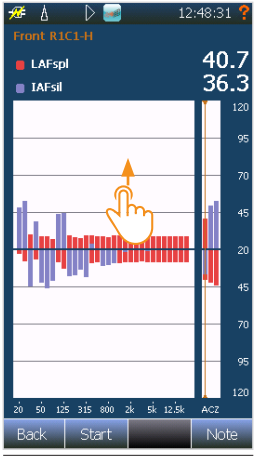


Figure 19.43 - Tap and drag up or down to change the level limits.

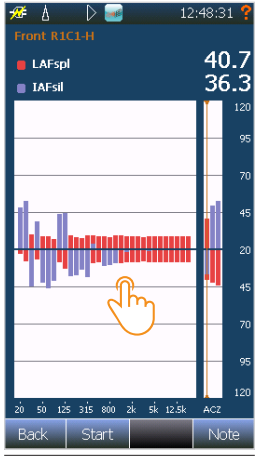


Figure 19.44 - Tap and hold somewhere on the graph to bring up the context menu, then tap range.

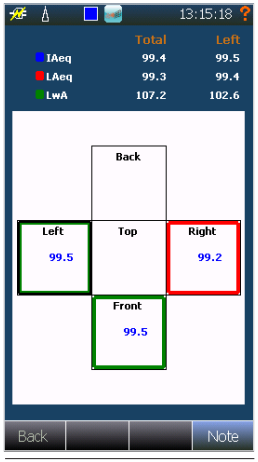


Figure 19.45 - Scope view for the total scope.

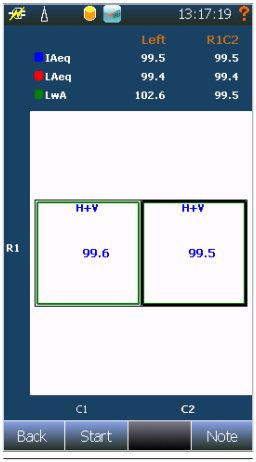


Figure 19.46 - Scope view for the surface scope.

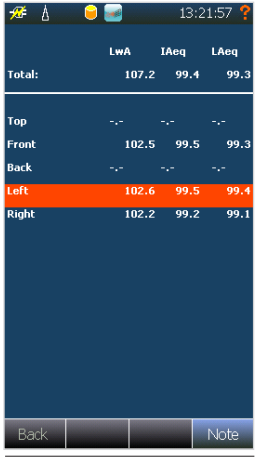


Figure 19.47 - Table display in the scope view.

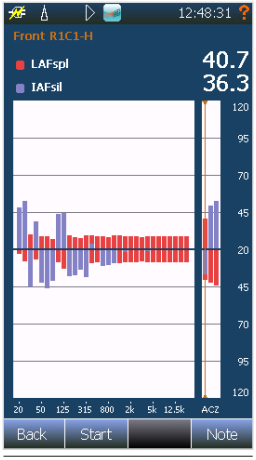


Figure 19.48 - Idle view.

Scope view

The scope view provides a graphical representation of the measurement surface for the Total scope and the Surface scope, as discussed in the previous section.

When viewing the total scope, scope view presents the A-weighted values for the whole measurement surface along with the currently selected surface. For a surface, the scope view will show the A-weighted values for the surface, and the currently selected segment. The scope view for the total scope is shown in Figure 19.45. In Figure 19.46, the scope view for surface Left is shown, accessed by double-tapping the Left segment in Figure 19.45.

Selecting a surface or segment may be done either by the cursor keys or by tapping the desired surface or segment. Press **FUNC** to change which functions that are presented on the surface or segment, or use **TBL** to switch to a tabular format, as shown in Figure 19.47.

The colour frames around surfaces and segments indicate the current status of a surface or segment. Depending on the standard, different conditions apply. No colour (black) indicates that the surface/segment or underlying segments are not measured at all. Red indicates that not all segments are completely measured. Green indicates that all segments are completely measured. The bold black frame indicates which segment or surface is currently selected.

For segments, an “H”, “V” or “H+V” are indicated for scanning standards. These are used to indicate whether the segments has been measured by horizontal, vertical or both scanning directions.

Idle view

Idle view is only available for the segment scope, providing live data for sound pressure and sound intensity using the fast time constant. The view is shown in Figure 19.48.

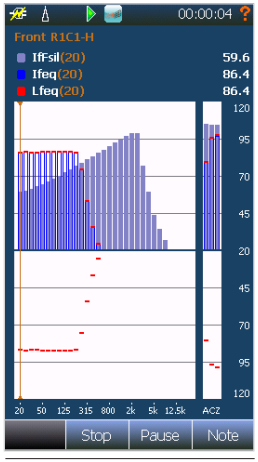


Figure 19.49 - Running view shows the equivalent sound intensity, equivalent sound pressure and instantaneous intensity.

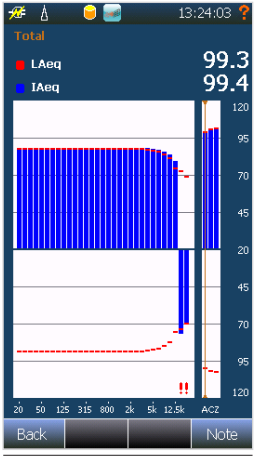


Figure 19.50 - Simple view for the total scope.

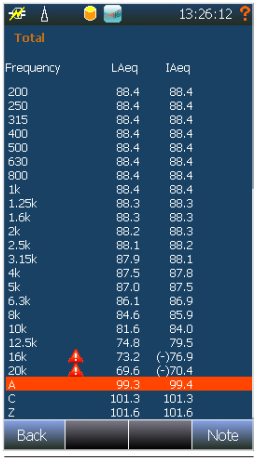


Figure 19.51 - Table in simple view.

Running view

This is the view which appears when a measurement is running. Leq, Ieq and IfSPL (time constant fast) is displayed. Figure 19.49 shows how the running view typically looks.

Simple view

If inside a scope view, pressing the **VIEW** button will bring you the simple view representation for the current scope. For the surface scope, this is the sum and average of all segments inside the corresponding surface, and for the total scope, simple view presents the sum and average of all segments in the project.

In simple view, the presented results are the intensity and sound pressure levels. Using **FUNC**, the user may choose to replace the intensity levels with sound power level. Simple view is shown in Figure 19.50.

All data may also be presented in tabular format using the **TBL** key, as shown in Figure 19.51. Scroll by tap-and-drag, or use the cursor keys.

HINT: Tap and hold on a graph to find A-network pre-weighting. For measurements aiming to determine an A-weighted value, showing the pre-weighted spectrum may provide useful information.

Advanced view

If pressing **VIEW** inside simple view, advanced view will show up. The content and information presented in advanced view will depend on the selected measurement standard. Please see the individual instructions for each measurement standard. Different presentations of data are available, switching between these are easily done by pressing the **FUNC** key.

Errors and warnings

The Nor150 calculates field indicators and evaluates criterions belonging to different standards in the background after each measurement. Deviations from a perfect measurement is indicated by warning triangles. These warnings may belong to a frequency band, a segment, surface or the total measurement. The different meanings are:

Standard is compromised

Attention required

The purpose of the yellow triangle is to help the user avoid problems later in the measurement process, thus avoiding to start the measurement process all over again.

In addition, a blue triangle indicates that a band is excluded:

Excluded band

In the frequency spectrum view, the warnings are indicated with exclamation marks below the bar. Figure 19.52 illustrates the warning indication.

The warnings for bands inside the weighted sum frequency range, along with general warnings for the segments, will be indicated for cursor positions A, C and Z. The warnings are also indicated at the top right side of the screen.

When stepping up one scope using the Back softkey, the warnings are also indicated for the surface and total, as shown in Figure 19.53 and 20.54.

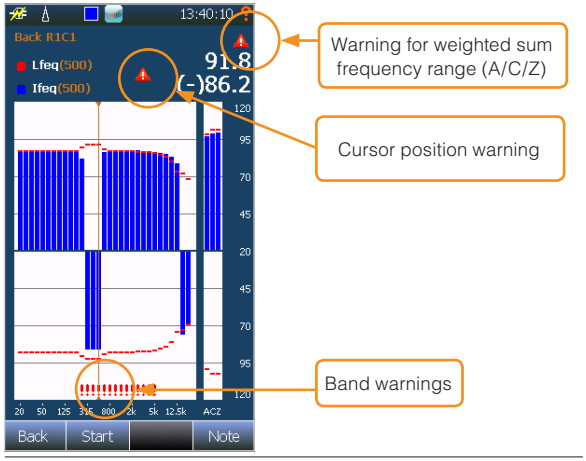


Figure 19.52 - Warning indicators in simple and advanced view.

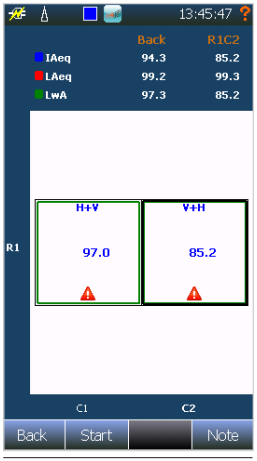


Figure 19.53 - Warnings for A/C/Z bands for the segment is presented in the scope view.

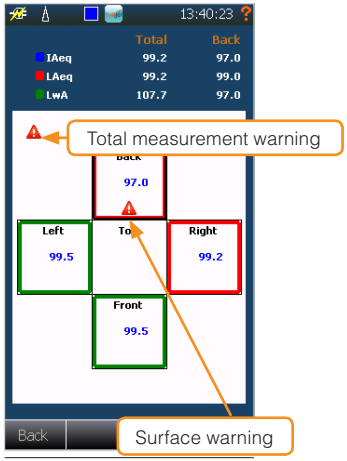


Figure 19.54 - Surface warning are displayed in total scope, along with warnings for the entire project.

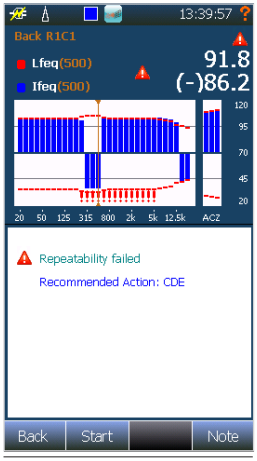


Figure 19.55 - Warning panel shows warnings for the cursor position. Press the action text to show an explanation text.

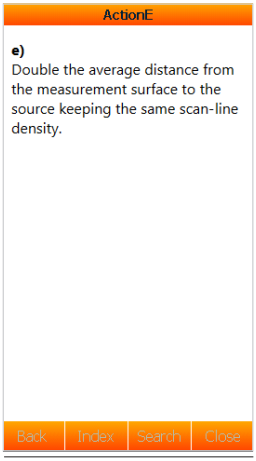


Figure 19.56 - Recommended action for a frequency band.

Warning panel

When showing either simple view or advanced view, the warnings may easily be investigated in detail. Simply press **INFO** to toggle the warning panel. The warnings are written out in clear text. An example from the ISO 9614-2 standard is shown in Figure 19.55.

For standards providing information about possible actions to counter the problem, the instrument also suggests such actions. The full text proposals are easily accessed by tapping on the action text. Figure 19.56 shows a typical action code text.

HINT: Most warnings have an analysis display available in the advanced view. More information is available in the sections for specific standards.

Saving and loading intensity projects

The Nor150 in intensity mode automatically saves a project using the current date and time when a measurement is started. However, to assign a name to the project, press the **MEM** button.

Loading a measurement is also done simply by pressing **MEM**. Select measurements from the list. For details about folders, SD card storage etc, please refer to*"Storing a measurement - Memory Organising Menu" on page 63*.

Exporting projects is done in the same way for intensity projects as for normal measurements, using the NorConnect software. Please see *chapter "Norsonic software" on page 124*.

Helpful features

The note functions available in environmental view is also available in intensity view. The details of the functions are discussed on *"Voice and Text notes" on page 59*.

In general, notes, voice recordings and pictures belong to the scope level. If inside the surface scope, the applied notes will belong to this scope. Thus, it is possible to find notes corresponding the complete measurement, a surface or a segment later, either on the instrument or in post-processing software.

Using the smartphone

The smartphone provides the same features as the instrument for scope view, simple view and advanced view. Surface setup and measurement settings must be done from the instrument itself, but during the measurement, the smartphone provides all necessary information, including the warning panel and action codes.

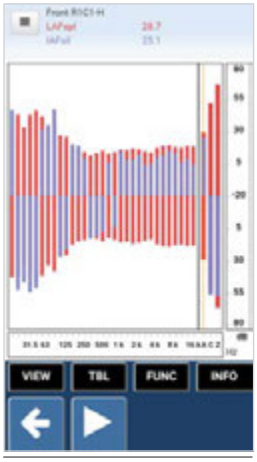


Figure 19.57 - Idle view on the smartphone.

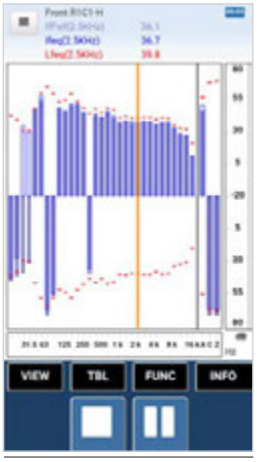


Figure 19.58 - Running view on the smartphone.

The measurement pictures are always synced while using the smartphone. Pressing a key on either the Nor150 or the smartphone will cause both devices to do the change. Thus, no additional configuration is necessary.

The smartphone displays the **VIEW, TBL**, **FUNC** and **INFO** keys in addition to the softkeys on-screen. Figure 19.57, 19.58 and 19.59 shows the smartphone interface.

To access options for A-preweighting and taking pictures, use the menu icon at the top left corner on the smartphone's screen.

HINT: The smartphone may be used to take pictures of the measurement surfaces. These will show up as a background on the smartphone surface view, and in the post-processing software Nor850.

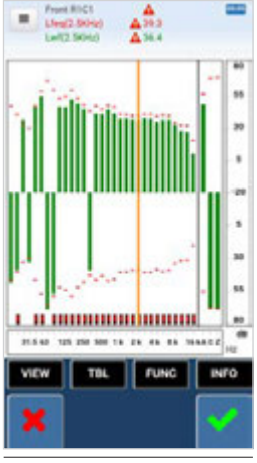


Figure 19.59 - Simple view on the smartphone.

Sound power using ISO 9614-2

The ISO 9614-2 is a standard for determining sound power based on sound intensity. The method relies on the scanning method, and is available for both engineering and survey grade accuracy.

The following sections will discuss the setup, measurement and review of sound power measurements according to ISO 9614-2.

Measurement configuration

To set up a measurement, go to **SETUP** > *Applications* > *Sound Intensity* and select the default setup *ISO 9614-2.*

The measurement setup will be loaded with the following parameters:

Global time: 15 minutes. Profile A: off

Filter range: 1/3 octave bands, 20 Hz to 20 kHz.

Weighted sum frequency range: 50 Hz to 6.3 kHz

Standard: ISO 9614-2

Accuracy: Engineering

Scanning direction: Horizontal and Vertical

The standard specifies that the frequency range must be set to 50 Hz to 6.3 kHz. A warning will be given if the weighted sum frequency range is changed.

Engineering grade accuracy requires two orthogonal scans for each segment. These are denoted *Horizontal* and *Vertical* on the Nor150. If survey grade is desired, change the *Accuracy* setting to *Survey*. You may still use two orthogonal scans by leaving the *Scanning Direction* to *Both*, but the instrument will no longer provide warnings for repeatability and extraneous intensity. If only a single scan per segment is desired, please change the *Scanning Direction* to for instance *Horizontal*.

HINT: There is no difference between Horizontal and Vertical scanning direction except for the name, which could rather be Scan 1 and Scan 2. Horizontal and Vertical is used as annotation for convenience. An H and V will appear on the segments when either of these scanning directions has been used.

Define a measurement surface as described in *"Defining a measurement surface" on page 102*. The standard specifies a minimum of four segments. Thus, only one segment within each surface element is sufficient for a cuboid surface. However, the standard also specifies that the total surface should be divided into segments such that individual components are separated. Parts of the surface where negative intensity is expected should be separated from the rest. Please consult the standard for more details.

The ISO 9614-2:1996 recommends to use singularly curved surfaces such as the cuboid, and using an average distance to the source under test of minimum 200 mm. Small and compact sources may use 100 mm.

NOTE: The measurement surface represents the surface of which the probe should have its acoustical centre.

Before the measurement is started, the environmental parameters must be set up and the probe calibrated as described in *"Probe and environment parameters" on page 102* and *"Calibration and phase correction" on page 97*.

NOTE: The dynamic capability check in the instrument relies on the measured dynamic capability during a correction or verification. Always calibrate if the instrument has been transported or the environmental conditions has been changed since last verification, or if the last verification was more than 24 hours ago.

Measuring

Please make sure that the measurement is configured and set up as described in the previous section, including the calibration routine.

The measurement surface should be marked to guide the orientation of the probe during a scan. Tape, or a thin rigid grid may be helpful. A single-plane laser device may also be useful to keep the probe on the measurement plane, as shown in Figure 19.60.

Decide where to begin the scanning, and tap into the correct surface. Pressing **START/STOP** will automatically start at the lower-left segment of the selected surface. Scan the segment, and press **START/STOP** to stop the measurement when the scan is completed.

HINT: If an obstacle is encountered during a scan, press the ▮▶ key. The measurement will be paused. If desired, some seconds of the measurement may also be removed by using the cursors on the displayed time graph, before pressing the key once more to resume the measurement.

When the measurement is stopped, the Simple View will be displayed, and the instrument will allow either to accept the measurement using the ✓ key, or discard the measurement using the ✘ key. The measurement may be reviewed as normal while waiting for accept. The next section will describe how to review the results in detail.

If Scanning Direction is set to Both, the next press on the **START/STOP** key will start the second measurement on the same segment. Otherwise, the next segment will be scanned. The instrument will progress through the segments one row at the time, from top to bottom, always starting with the leftmost segment in each row. Figure 19.61 shows the segment order progress.

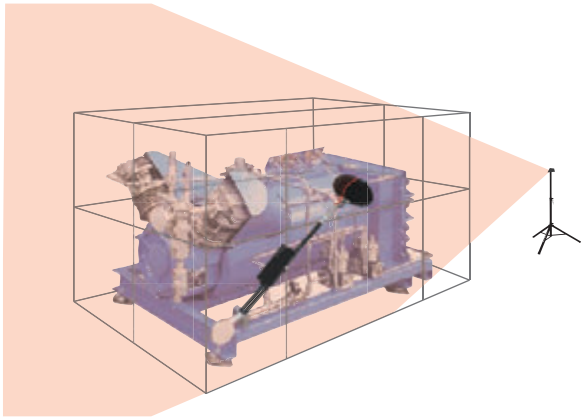


Figure 19.60 - A single plane laser may help keeping a consistent distance.

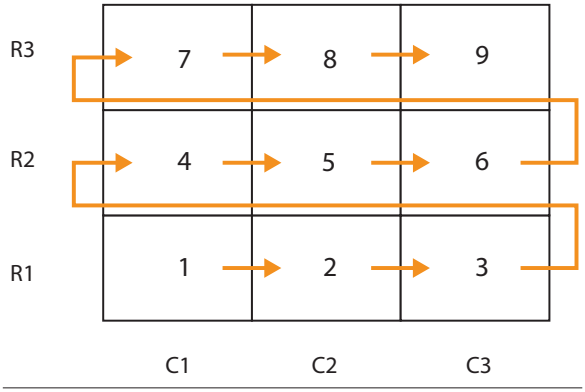


Figure 19.61 - Segment order.

Reviewing the measurements

Measurements using the ISO 9614-2 requires evaluation of field indicators in addition to the sound power and sound intensity. The indicators are presented in separate views in the Nor150. Below is an overview of the data presented in the different scopes.

HINT: The concept of scopes is discussed in section *"Introducing the surface scopes" on page 108*.

Segment scope

The segment scope presents data for a single segment. Thus, no graphical surface (scope view) is available in this scope, and simple view is selected when tapping into a segment.

Simple view

A graph is presented for sound pressure and either sound intensity or sound power. Warnings are indicated for each frequency band and the segment total. Toggle between sound power and sound intensity using the **FUNC** key. Press **INFO** to bring up the warning window. Figure 19.62 and 19.63 shows the simple view for a segment, with and without the warning panel.

Advanced view

Three different graphs are presented by toggling the **FUNC** key. The warning window is available for all graphs by pressing the **INFO** button.

The first graph shows sound power, sound intensity and sound pressure at the same time, as illustrated in Figure 19.64.

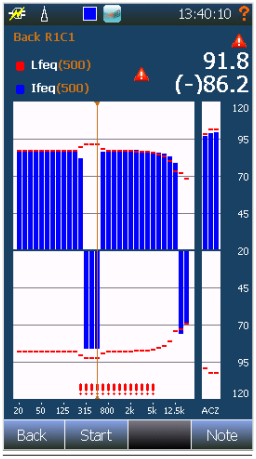


Figure 19.62 - Simple view for a segment.

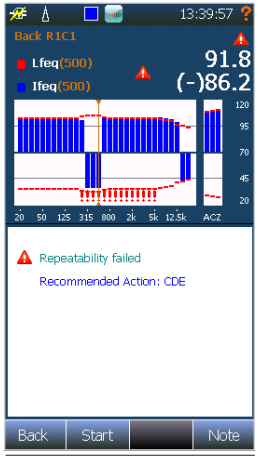


Figure 19.63 - Simple view plus warning panel for a segment.

The second graph displays dynamic capability along with the field indicator FpI, as illustrated in Figure 19.65.

If two scans have been made on the segment, a third graph is available. This graph shows the difference (Δ) functions generated based on the two scans as illustrated in Figure 19.66.

Surface scope

The surface scope presents data from all segments inside a surface scope. Thus, it functions as an intermediate total, simply to gain overview of the different surfaces and provide easier analysis of the source under test.

Scope view

Presents a graphical view of the measurement surface. The A-weighted value for the surface is displayed, along with A-weighted data for each individual segment. Select the displayed function using the **FUNC** key. Scope view is illustrated in Figure 19.67.

A red frame will be present around a segment in scope view if engineering mode is selected, and only a single scan is performed. In survey grade, only a single scan is required. A green frame indicates that the required number of scans has been performed for the segment.

Simple view

A graph is presented for sound pressure along with either sound intensity or sound power. Warnings are indicated for each frequency band, and the complete surface. Toggle between sound power and sound intensity using the **FUNC** key. Press **INFO** to bring up the warning window. In surface scope, the warnings are summed and they display how many warnings there are for all segments inside the surface. The display is equal to simple view for a segment.

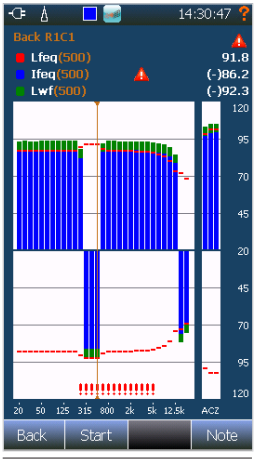


Figure 19.64 - Advanced view 1 for a segment.

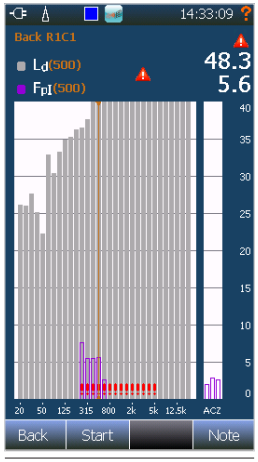


Figure 19.65 - Advanced view 2: Dynamic capability.

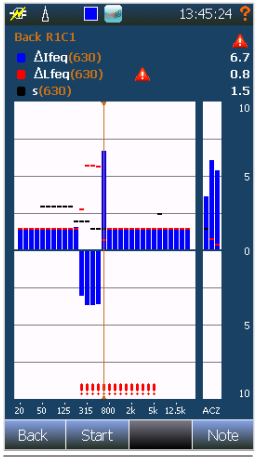


Figure 19.66 - Advanced view 3: Delta view (segment only).

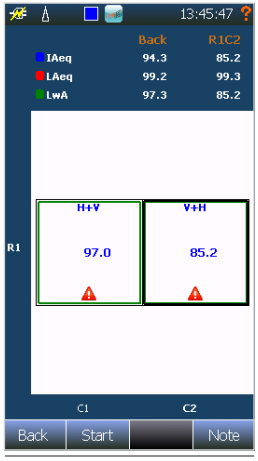


Figure 19.67 - Scope view for surface.

Advanced view
Two different graphs are presented by toggling the **FUNC** key. The warning window is available for all graphs by pressing the **INFO** button.

The first graph shows sound power, sound intensity and sound pressure at the same time, the same way as for a segment.

The second graph displays dynamic capability along with the field indicator FpI, the same way as for a segment.

Total scope
The total scope presents the total data generated from the sum and average of individual segments.

NOTE: The sound power levels are calculated based on the area defined for each of the measured segments. The area resulting from the specified Surface Dimensions is strictly a guidance for defining the surfaces and segments.

Scope view
Presents a graphical view of the total measurement surface. The total A-weighted data is shown, and A-weighted data is indicated for each measurement surface. Select the displayed function using the **FUNC** key.

A red frame will be drawn around incomplete surfaces. For engineering grade accuracy, this implies two scans per segment, while survey grade accuracy only requires a single scan per segment. The surface will have a green frame when all segments are measured.

Simple view
A spectrum is presented for sound pressure along with either sound intensity or sound power. Warnings are indicated for each frequency band, and the complete surface. Toggle between sound power and sound intensity using the **FUNC** key. Press **INFO** to bring up the warning window. In total scope, the warnings are summed and they display how many warnings there are for all segments. The display is equal to simple view for a segment.

Advanced view
Three different spectrums are presented by toggling the **FUNC** key. The warning window is available for all spectrums by pressing the **INFO** button.

The first graph shows sound power, sound intensity and sound pressure at the same time.

The second graph displays dynamic capability along with the field indicator FpI.

The third graph shows the field indicator F+/-. The display is illustrated in Figure 19.68.

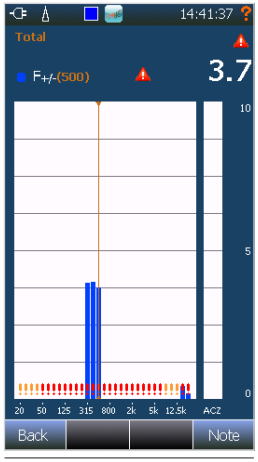


Figure 19.68 - Advanced view 3: The extraneous intensity view.

Measurement functions and indicators

Sound power measurement according to ISO 9614-2 uses the intensity values to generate sound power levels for each individual segment, and summing these for both surfaces and the total measurement surface.

The physical quantities measured are

Ieq – time-equivalent sound intensity level, referenced to 1 pW/m^2.

Leq – time-equivalent sound pressure level, referenced to 20 µPa.

Deduced measurement functions

Lw – sound power, calculated for all scopes, referenced 1 pW.

FpI – pressure-intensity indicator (Leq – Ieq), calculated for all scopes.

F+/- negative partial power indicator, calculated for total scope

ΔIeq – arithmetic sound intensity difference, calculated for segment scope with two measurements

ΔLeq – arithmetic sound pressure difference, calculated for segment scope with two measurements

Ld – dynamic capability, available for all scopes, calculated based on probe verification and grade of accuracy

Warning indicators

Dynamic capability too low – Trigged if the FpI exceeds the dynamic capability for a frequency band.

High FpI – trigged if FpI is greater than 10 dB for a frequency band-

Repeatability – trigged if Engineering accuracy is selected and ΔIeq exceeds the threshold *s* defined by the standard.

Extraneous intensity – trigged if the Engineering accuracy is selected and F+/- exceeds 3 dB

Frequency range not compliant – trigged if Weighted sum freq. range is not set to exactly 50 Hz to 6.3 kHz

Too short averaging time – trigged if the averaging time is less than 20 seconds for a segment.

Instrument Specific Setup

This menu (figure 20.1) holds all the setup related to the peripherals, power saving settings, language etc.

Instrument Name This is the name that is used as identification tag for transferred measurements, remote control etc

Digital I/O. Here you configure the 4 digital output lines found on the 15 pin I/O socket on the left hand side of the instrument. Each line may be set to the following functions:

Running – The line goes active when the instrument is measuring.
Recording S1 – The line goes high when sound recording is performed.
Overload S1 – The line goes high when sound channel 1 is overloaded.
Calibrating – The line goes high when you enter the calibration menu.
Mic. Check – The line goes high when the Mic. Check feature is enabled. Mainly used to start the electrostatic actuator calibration feature in the outdoor microphone 1210A or C. See *"Microphone check" on page 40*.

Remote controlled – The line goes high when the Nor150 is controlled from another device.
High – The line stays permanently high.
Low – The line stays permanently low.
Events/Markers – The line goes high if an event or marker is enabled.
Remote Output – This line may be controlled from remote via a PC.

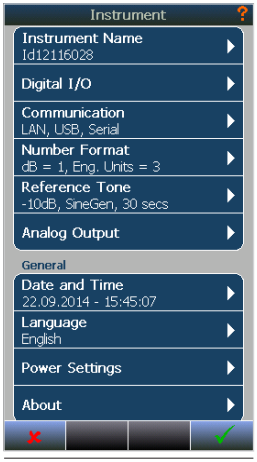


Figure 20.1

Communication. In this menu you specify different settings related to the LAN interface, the USB interface and the RS232 interface

LAN. Defines how to communicate via the LAN interface. You may choose between automatic or static IP address. If Static, specify the IP address, Subnet Mask and Default gateway.

USB. Select between Normal, where you use the USB as a IP interface, or Remote Display.

I/O socket. RS232 is found on the 15 pin I/O socket on the left hand side of the instrument. Use cable Nor1441B to connect the unit to a PC via the RS232 interface.

Number Format. Here you specify the number of decimals you want to use.

Reference Tone. Please see *"Recording the sound - Audio record and replay" on page 54* for more details

Analog Output. Here you manage the setting of the headphone socket and the analog output found on the 15 pin I/O socket. For the headphone socket you may either listen to a sound channel or to an audio recording. Similar on the I/O socket you may either connect it to a sound channel or set it to off.

Date and Time. Here you set the date and time. You may also choose the time to be synchronized with the GPS clock. This provides that this option is installed and that the GPS is activated in the power menu and that the GPS receives satellite signals.

Language. Select the language to be used in the menus and help texts if applicable. Some languages may only be supported with English help file text.

Power Settings. Here you may select different time out and brightness levels. Please note that the factory settings are a good compromise between power use and keyboard brightness and keyboard backlight intensity. You may also "power off" the GPS here.

About. Here you find information about the software versions and installed options. This is also where you install new options and software.

Installing new software. Norsonic will frequently issue software updates with new features and bug fix. The software is found on www.norsonic.com/release. When entering the download site you are prompted to leave your Name, e-mail, product type and serial number of the Nor150 to access the download site. The only reason for asking for your contact data is to enable us to inform you in case of vital bugs are found in the software you have downloaded. Your contact data will not be distributed or used by Norsonic for other purpose than described above.

Follow the instruction given on the download site. The instructions on download site supersede the information given below.

Copy the software onto a USB memory stick.

Unzip the files if the update contains a new service pack and place the unzipped files together with the other files belonging to the new software version. The term service pack is the name for all files belonging to the update of the operating system. Connect it to the Nor150 USB port while the instrument is turned off. Turn on the instrument. The Instrument will find that a new software version is available and ask you to confirm to update the software. The software update takes a few minutes. If the automatic search for a new software update fails, you may start the software installation from the **SETUP** > *Instrument* > *About* > I*nstall Software* menu. If your memory stick contains more than one version, select the version to update. Use also this menu if you want to downgrade to an earlier version.

The software license system

Nor150 may be fitted with software option extension at any time. The capabilities and setup options of your Nor150 will depend on which of the available extensions it has been equipped with.

Extensions are modules – made as software, in the instrument. Instrument extensions are always optional and hence often referred to as options. In this way you do not have to pay for features you're not going to use.

However, you may find that your tasks are expanding into new areas of acoustics as time goes by. Therefore a typical Norsonic extension will be available for installation as retrofit. The optional extensions may enhance the operation of the instrument considerably. Normally these types of options are called modes of operation. Such extensions may be Sound Intensity or Building Acoustic for the measurement of sound insulation including measurement of the reverberation time. Please note that some hardware options cannot be installed as retrofit.

A license code may also be time limited. This means that you may hire a special software option for a time limited period.

Installing new options

Installing new options requires a new licenses code. The licenses code should be copied onto a memory stick. Usually the license code is set in a text file named License.txt. Connect the memory stick to the USB port on the Nor150. Install the new license code in **SETUP** > *Instrument* > *About* > *License* > enter license.

NOTE! Only the license code string shall be copied to the memory stick. Not the associated text that normally follows the license. Use Notepad or similar simple text editors to copy the license string and create the license.txt file

NOTE! If you enter a time limited license code the instrument will revert to the license code menu after the license has expired. The old license code must be available on a memory stick and installed as described above.

Activate evaluation license

The Nor150 offers a 60 days trial period where all options is enabled. Activate the trial period in the **SETUP** > *Instrument* > *About* > *License* > *Switch to Evaluation License*. The menu button becomes inactive after the trial period expires.

NOTE that in several countries the software update may be blocked. The reason is that your instrument is type approved with a certain version. Hence, updating to a non-approved version is not legal. In this case contact your local Norsonic sales office.

Remote Properties.

Public Host: If the device (Nor150) has a another IP address than default local address, this should be named here. Typically this is a public IP address given f ex by SIM card supplier for connecting Nor150 through f ex a Sierra modem. The sirerra modem will be the local address, but the Sim card will give the public address. In these cases the public host should have this address. Otherwise, keep this field empty!

Remote Password : Password for Administrator. If this is given you need to log in with correct password to start/stop/configure measurement.

Guest Password : The guest user may see the live data, but will not be able to adjust/configure the setup. If the Guest password is given, the user must login to see any live data.

Timeout: If no access from user in the limit of minutes given, the client will be disconnected.

Set Factory Default. If you need to go back to initial settings, use this menu. This will set back most of the settings, except from calibration values etc.

Save Internal Info. In case you are asked to send vital data like setups and error logs to Norsonic you use this menu. Insert a memory or a SD-card for this purpose and send it (or its contents) to Norsonic. Data stored is called zippedsummeries.

Service Menu. Is protected by a password and is only for authorized personnel. Wrong settings here may change vital calibration settings in the analog and digital measurement chain.

Signal Generator (Optional)

A signal generator is added in the Nor150. This facilitates the use of the instrument for various applications.

White, pink, sine and band-pass filtered noise types are available. The noise excitation can also be synchronized with the measurement sequence. Band-pass filtered noise is not available in software version 1.2.

The frequency of sine and band-pass filtered noise can be set in 1/3 octave bands from 6,3 Hz to 20 kHz.

The signal output from the signal generator is on pin 15. Signal ground is found on pin 14 and the connector housing. Suitable cables provided are Nor4513B; Cable for simultaneous connection to RS-232 interface and signal generator output and Cable 4514A.

The built in signal attenuator is adjustable in 1 dB steps from 0 dB to 50 dB attenuation

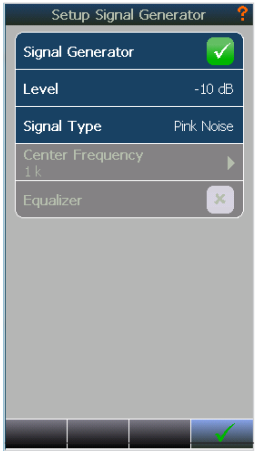


Figure 20.2

Norsonic software

There are several software programs associated with the Nor150:

NorConnect Nor1051 as covered in this chapter is a browser program for downloading data from the instrument (freeware included in the delivery). One may say it is for the Nor150 what the NorXfer is for the other Nor13x and Nor140 instruments. Additionally it has a viewer function that displays the L(t) and L(f) data and seamless integration to NorReview, Nor850, NorReport and MS Excel.

Nor1049 (also called NorConnectWeb) for connecting and downloading to Nor150 when the instrument is used in a remote monitoring system

NorRemote Nor1050 lets you control the Nor150 remotely from any PC via a web based user interface. It offers an online graph- and frequency view allowing marker setting during the measurement.

NorReview Nor1026 is a sophisticated analyzing tool for calculations, report generation and for replaying of audio recordings and marker management. The use of this program is not covered by this manual.

Nor850 is a program for control-, analysis- and reporting for building acoustics-, sound power- and sound intensity applications

NorReport is a is a module in several Norsonic programs (NorXfer, NorReview, Nor850) for making your own reports based on Excel templates.

NOTE! NorXfer does not support the Nor150.

NorConnect Nor1051

Installation

NorConnect is a freeware and can be downloaded from:

www.norsonic.com/release.

When entering the download site you are prompted to leave your Name, e-mail, product type and serial number of the Nor150 to access to the download site. The only reason for asking for your contact data is to enable us to inform you in case of vital bugs are found in the software you have downloaded. Your contact data will not be distributed or used by Norsonic for other purpose than described above.

Follow the instruction and install the program on your PC.

We have chosen to use USB port on the Nor150 instrument for download of measurements. Connect the Nor150 to the PC using the delivered USB cable. This is recommended before you start the installation because this will also install the needed Nor150 SW driver. Answer yes to create shortcut and to view the read-me file.

Please refer to the Nor150 section in this manual on how to setup the USB.

Description

The manual is sectioned as a quick reference guide first, using an example measurement transfer, followed by a detailed tour through the different functions in the program.

The Figure 21.1 shows the main working environment picture. A brief overview is shown and more details are given in the following chapters

The right-hand side of the screen shows the content of the instrument memory while the left part of the screen shows the content of the designated measurement file folder on the PC. We can call the latter the “file work space” since this is where you will work with the downloaded measurement files.

Files are easily transferred (drag & drop) from the meter. Connect the Nor150 to the PC using the delivered USB cable. After some seconds the connection is established and the content of the memory for the connected instrument is shown. Simply select from the list in the right-hand (device) frame and drag & drop it over to the left-hand (computer) frame. Just highlight the measurement(s), and click on one of the reports icons (Excel or a specific post-processing program to produce the desired report.

The files of different types (General, Building Acoustics, Intensity) are automatically put in separate categories, so they are easily located. Sorting- and searching criteria can be applied to enhance the “housekeeping” further.

A graph tool is available to view the Profile part of a General Analyser measurement and listen to audio recordings.

Synchro- and Repeat files can be concatenated directly “at the click on a button”

NOTE that you can only connect one instrument at the same time. However, it is possible to connect an instrument and simultaneously connect to a microSD card from another instrument, given that this card is inserted in a card reader connected to the PC.

Tool tips are found for many functions. Hover the mouse over a menu or button to learn.

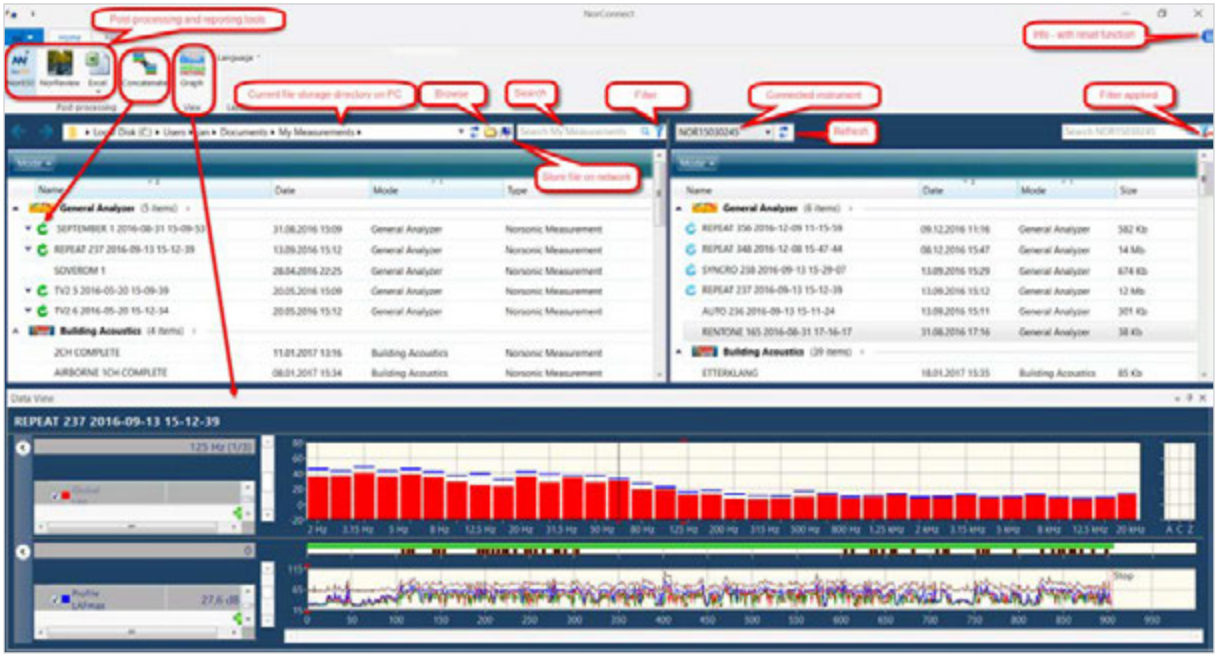

Post processing and reporting tools
Info - with reset function
Current file storage directory on PC
Browse
Search
Filter
Connected instrument
Filter applied
Refresh
Store file on network
REPEAT 237 2016-09-13 15-12-39

Figure 21.1

Quick Reference Guide

Connecting the instrument

Connect the Nor150 to the PC via USB (at IP address 10.150.150.1) as explained

Connected instrument “Nor150” is shown in Figure 21.2.

NOTE: The name “Nor150” is read from the instrument. You may set/change this. Description is found in the Nor150.

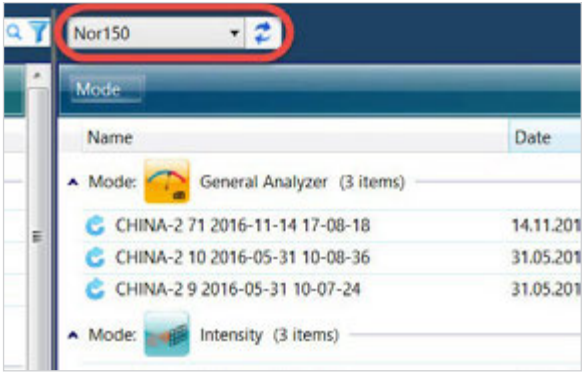


Figure 21.2

Transfer

To transfer the measurement simply select and drag & drop to the PC directory you are working in (Figure 21.3). You may also use Copy & Paste or Ctrl-C & Ctrl-V

The default view groups the measurements according to mode, ie. general, building acoustics etc., then within each “mode” they are sorted at “Date” when you are browsing the instrument memory, while we have chosen “Name” when you look at the transferred files in the PC directory

NB! This means that the default view always shows the last measured file within each mode on top when you browse the memory of the Nor150 connected!

Please note that you must close the measurement before attempting to transfer it. Failing to do so may result in an error message from the program

Where are my measurements and reports stored

The default storage folder on the PC is shown in Figure 21.3.

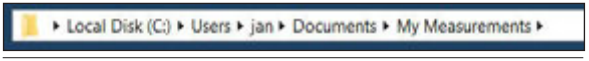


Figure 21.3

Reports are by default stored under “My measurements” ie. at the level above the measurement to which it belongs as shown in Figure 21.5. They are shown in the group “Other files”.

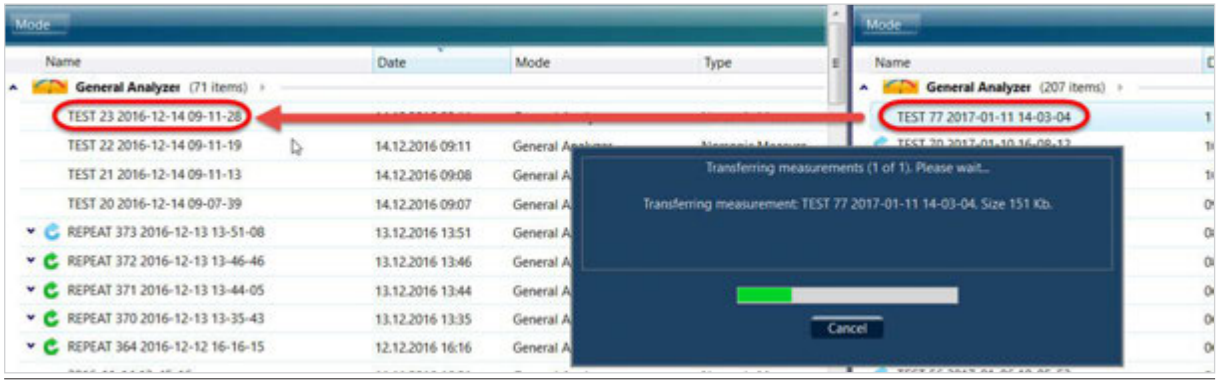


Figure 21.4

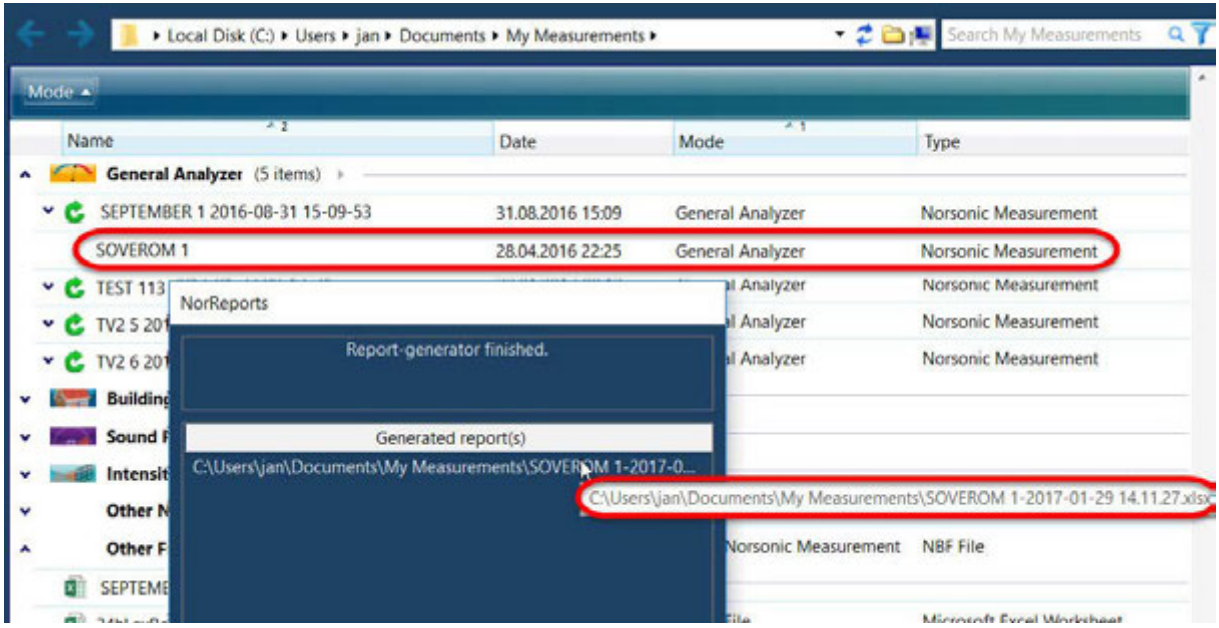


Figure 21.5

Making reports

There are basic reports in Excel format easily at hand

To simply report just the data measured, choose Overview, click the arrow just below the Excel button on the menu line, then “Overview” (Figure 21.6).

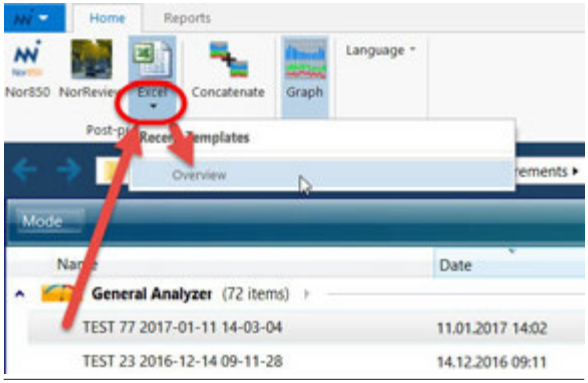


Figure 21.6

The measurement example chosen is of the type “General analyzer”. The functionality is the same for other file types also, with a corresponding Excel report

There are also more sophisticated templates and direct access to Nor850 and NorReview functions (if installed). More on this later.

The measurement results are found in tabs as Global- and profile values for each report S1 and S2 (and Moving if measured) as shown in Figure 21.7.

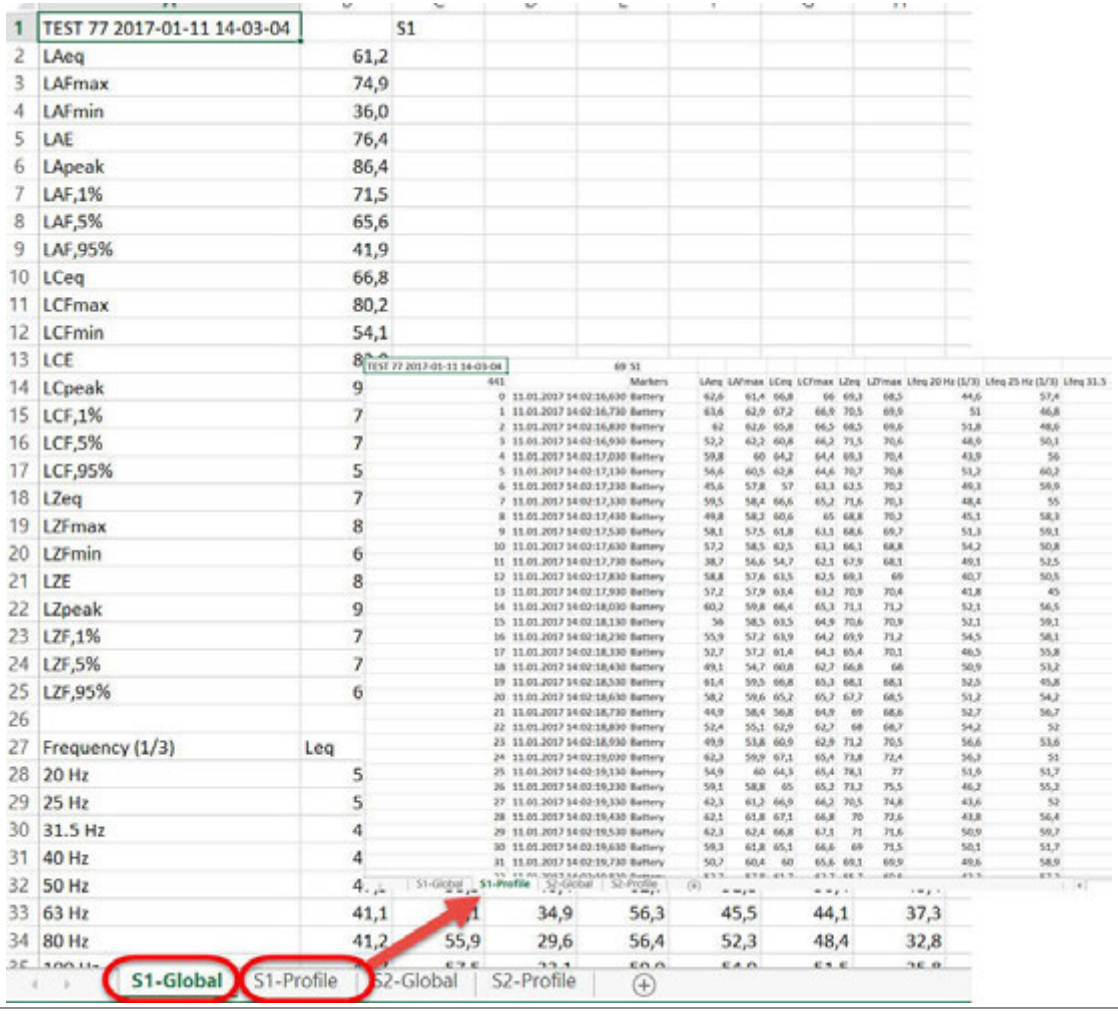


Figure 21.7

Building Acoustic- and Sound Intensity measurements reports

There are also similar Excel reports for building acoustics and intensity measurement files.

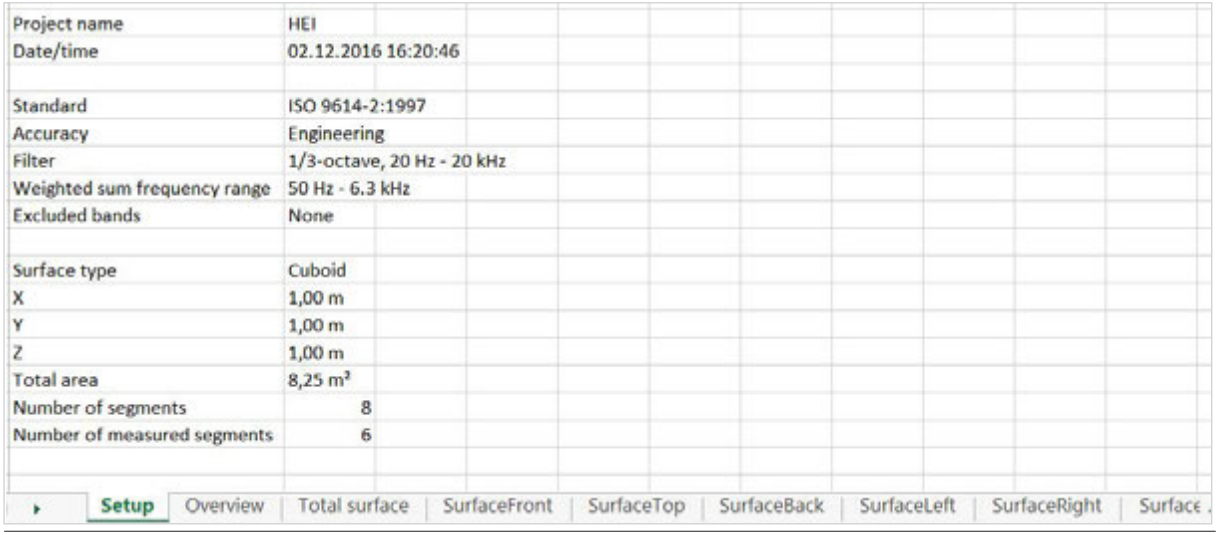
These reports contains all the measured data, as shown in Figure 21.8 and Figure 21.9.

For the intensity report, here are individual tabs for each segment, as well as for the Total Surface (Figure 21.10 and an Overview (Figure 21.11).

2CH COMPLETE (DIN 4109-4 HallRoom)																													
Band/Network (1/3)	**Source**	**Source - (Pos #A)**	**Receiving**	**Receiving - (Pos #A)**	**Receiving - (Pos #B)**	**Receiving - (Pos #C)**	**Receiving - (Pos #D)**	**Background noise**	**Reverberation**	**Rating D**	**Rating D - (Pos #A)**	**Rating R'**	**Rating R' - (Pos #A)**	**Source - (Pos #A, #1 13:13:46)**	**Source - (Pos #A, #2 13:13:46)**	**Receiving - (Pos #A, #1 13:15:53)**	**Receiving - (Pos #A, #2 13:15:53)**	**Receiving - (Pos #B, #1 13:16:07)**	**Receiving - (Pos #B, #2 13:16:07)**	**Receiving - (Pos #C, #1 13:16:30)**	**Receiving - (Pos #C, #2 13:16:30)**	**Receiving - (Pos #D, #1 13:16:38)**	**Receiving - (Pos #D, #2 13:16:38)**	**Background noise - (#1 13:15:24)**	**Background noise - (#2 13:15:24)**	**Reverberation - (#1 T30+ 13:14:56)**	**Reverberation - (#2 T30+ 13:14:56)**
A	93,7	93,7	28,6	28,6	28,7	28,6	28,7	37,9						87,6	96,2	27,7	29,3	27,8	29,4	27,8	29,4	27,9	29,4	36,9	38,7		
50 Hz	45,9	45,9	11,1	11,3	11,1	10,9	11,2	45,1		35,9	35,9			45,4	46,3	8,1	13,1	8,1	12,9	7,8	12,7	7,7	13,1	45,7	44,5		
63 Hz	51,1	51,1	-2,2	-2,3	-2,1	-2,4	-1,8	41,2		54,7	54,7			44,4	53,6	-3,1	-1,7	-2,9	-1,4	-2,7	-2,2	-2,5	-1,2	40,6	41,8		
80 Hz	66,0	66,0	-2,4	-2,0	-2,5	-2,5	-2,4	40,3	0,69	69,3	69,3	69,6	69,6	59,3	68,5	-2,2	-1,9	-3,0	-2,1	-3,0	-2,1	-2,3	-2,6	39,8	40,8	0,90	0,47
100 Hz	78,3	78,3	-1,6	-1,6	-1,3	-1,4	-2,0	47,0	0,83	81,2	81,2	82,3	82,3	70,4	80,9	-2,1	-1,1	-2,0	-0,7	-2,0	-0,9	-2,3	-1,7	47,0	46,9	1,35	0,31

2.5 kHz	83,5	83,5	19,3	19,3	19,4	19,3	19,3	24,7	0,16	65,5	65,5	59,5	59,5	77,2	86,0	18,5	19,9	18,6	20,1	18,4	20,0	18,5	20,0	19,8	27,0	0,15	0,16
3.15 kHz	81,4	81,4	20,7	20,5	20,7	20,7	20,7	22,3	0,19	62,2	62,2	56,9	56,9	75,9	83,7	19,6	21,3	19,8	21,5	19,8	21,5	19,9	21,4	16,4	24,7	0,19	0,19
4 kHz	79,0	79,0	21,0	21,0	21,0	21,1	21,0	17,5	0,16	59,3	59,3	53,3	53,3	72,5	81,5	20,1	21,8	20,1	21,8	20,2	21,8	20,2	21,7	13,7	19,5	0,22	0,10
5 kHz	78,2	78,2	21,9	21,9	22,0	21,8	22,0	12,9	0,19	56,9	56,9	51,6	51,6	70,4	80,8	21,0	22,6	21,1	22,7	21,0	22,5	21,1	22,7	11,3	14,1	0,16	0,22
Weighted										69	69	64	64														
C										-1	-1	-2	-2														
Ctr										2	2	2	2														
C50-3150										-2	-2																
C50-5000										-6	-6																
C100-5000										-6	-6																
Ctr50-3150										-9	-9																
Ctr50-5000										-9	-9																
Ctr100-5000										-1	-1																

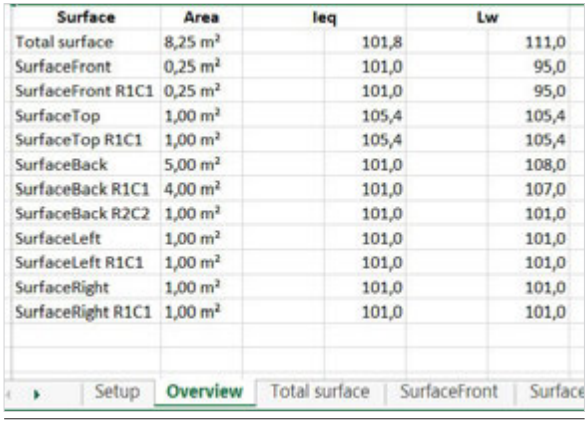
Figure 21.8 - Building Acoustics measurement report



Project name	HEI
Date/time	02.12.2016 16:20:46
Standard	ISO 9614-2:1997
Accuracy	Engineering
Filter	1/3-octave, 20 Hz - 20 kHz
Weighted sum frequency range	50 Hz - 6.3 kHz
Excluded bands	None
Surface type	Cuboid
X	1,00 m
Y	1,00 m
Z	1,00 m
Total area	8,25 m²
Number of segments	8
Number of measured segments	6

Setup | Overview | Total surface | SurfaceFront | SurfaceTop | SurfaceBack | SurfaceLeft | SurfaceRight | Surface

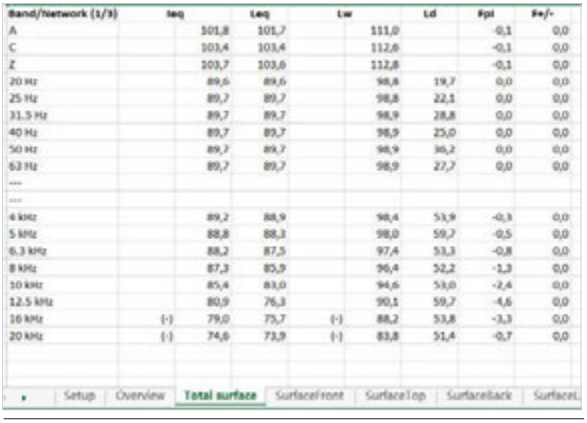
Figure 21.9 - Intensity measurement report



Surface	Area	leq	Lw
Total surface	8,25 m²	101,8	111,0
SurfaceFront	0,25 m²	101,0	95,0
SurfaceFront R1C1	0,25 m²	101,0	95,0
SurfaceTop	1,00 m²	105,4	105,4
SurfaceTop R1C1	1,00 m²	105,4	105,4
SurfaceBack	5,00 m²	101,0	108,0
SurfaceBack R1C1	4,00 m²	101,0	107,0
SurfaceBack R2C2	1,00 m²	101,0	101,0
SurfaceLeft	1,00 m²	101,0	101,0
SurfaceLeft R1C1	1,00 m²	101,0	101,0
SurfaceRight	1,00 m²	101,0	101,0
SurfaceRight R1C1	1,00 m²	101,0	101,0

Setup | Overview | Total surface | SurfaceFront | Surface

Figure 21.10 - Intensity report - Overview



Band/Network (1/3)	leq		Leq	Lw		Ld	Fpl	F+/-
A		101,8	101,7		111,0		-0,1	0,0
C		103,4	103,4		112,6		-0,1	0,0
Z		103,7	103,6		112,8		-0,1	0,0
20 Hz		89,6	89,6		98,8	19,7	0,0	0,0
25 Hz		89,7	89,7		98,8	22,1	0,0	0,0
31.5 Hz		89,7	89,7		98,9	28,8	0,0	0,0
40 Hz		89,7	89,7		98,9	25,0	0,0	0,0
50 Hz		89,7	89,7		98,9	36,2	0,0	0,0
63 Hz		89,7	89,7		98,9	27,7	0,0	0,0

---								
4 kHz		89,2	88,9		98,4	53,9	-0,3	0,0
5 kHz		88,8	88,3		98,0	59,7	-0,5	0,0
6.3 kHz		88,2	87,5		97,4	53,3	-0,8	0,0
8 kHz		87,3	85,9		96,4	52,2	-1,3	0,0
10 kHz		85,4	83,0		94,6	53,0	-2,4	0,0
12.5 kHz		80,9	76,3		90,1	59,7	-4,6	0,0
16 kHz	(-)	79,0	73,7	(-)	88,2	53,8	-3,3	0,0
20 kHz	(-)	74,6	73,9	(-)	83,8	51,4	-0,7	0,0

Setup | Overview | Total surface | SurfaceFront | SurfaceTop | SurfaceBack | Surfaceł

Figure 21.11 - Intensity report - Total surface

Details

File browser

A file browser shows the content of the instrument in the right hand frame.

In the default view, the files are conveniently grouped (Figure 21.12) by the mode in which they are made: General Analyser, Building Acoustics, Intensity, Sound Power and so on…

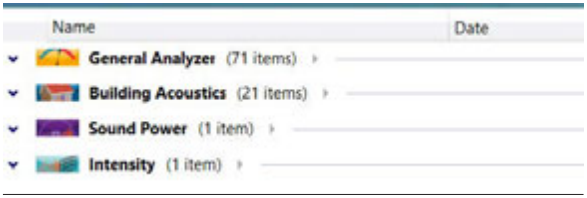


Figure 21.12

Within each Mode the default sorting used is “Date” when you are browsing the instrument memory, while we have chosen “Name” when you look at the transferred files in the PC directory.

This means that the default view always shows the last measured file on top when you browse the memory of the Nor150 connected!

PS! You may change the way the measurements are grouped and sorted.

We strongly recommend to use NorConnect for measurement transfer, NOT WinExplorer. One reason for this is that you may open a directory not meant to be accessed. If changes are made to such a directory, the instrument may fail to work properly and/or you may lose data!

In Figure 21.13 an “opened” ”General Analyzer” folder is shown, sorted with the latest measurement on top, ie. by “Date”. This is indicated by the arrow pointing downwards in the column header “Date” as shown in Figure 21.13.

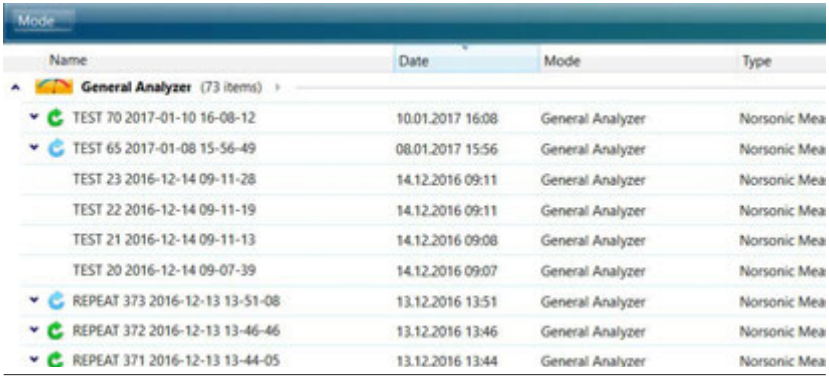


Figure 21.13

This makes it easy to locate the last file taken in each category.

You may choose a network location for your files instead of storing to a PC directory (Figure 21.14).

We have also included “Back” and “Forward” (Figure 21.15) as well as “Refresh buttons (Figure 21.16).

Figure 21.14

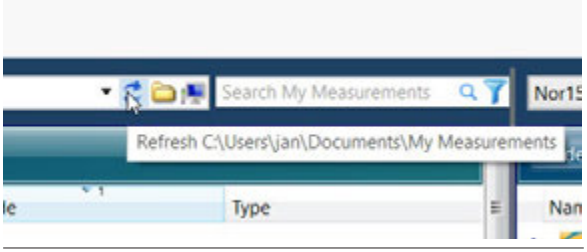


Figure 21.15

Figure 21.16

SD card connection

Alternatively, to connecting the meter via the USB cable, you may remove the micro SD card from the meter and insert it in the PC. Doing this will also produce a pop-up window, either opening an Explorer window like Figure 21.17 (win10) or prompting you to take an action. Disregard this.

Usually the internal readers are SD card size, so you may need an adapter from the micro SD card size and up. Or use an external card reader connected to the PC.

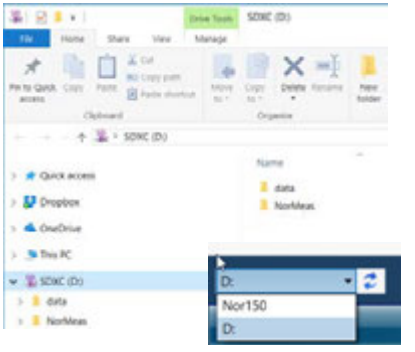


Figure 21.17

Graph view

For “General Analyser” measurements you may use the “Graph view” function to show the content of the Profile part of a measurement. Just double-click on the file to open this, alternatively click on the chosen file, the toolbar will activate, then click on “Graph view” (Figure 21.18).

The measurement data is presented as a level vs. time- and frequency view.

NOTE that the Frequency display shows the Global values, while the level vs. time display shows the Profile data

You may also use Zoom in/out functions as found under “graph tools” (Figure 21.19) and listen to audio recordings using the standard Windows Media Player (click on the green markers) as well as setting the time unite (relative, Absolute or Periods) (Figure 21.20).

Figure 21.19

Figure 21.20

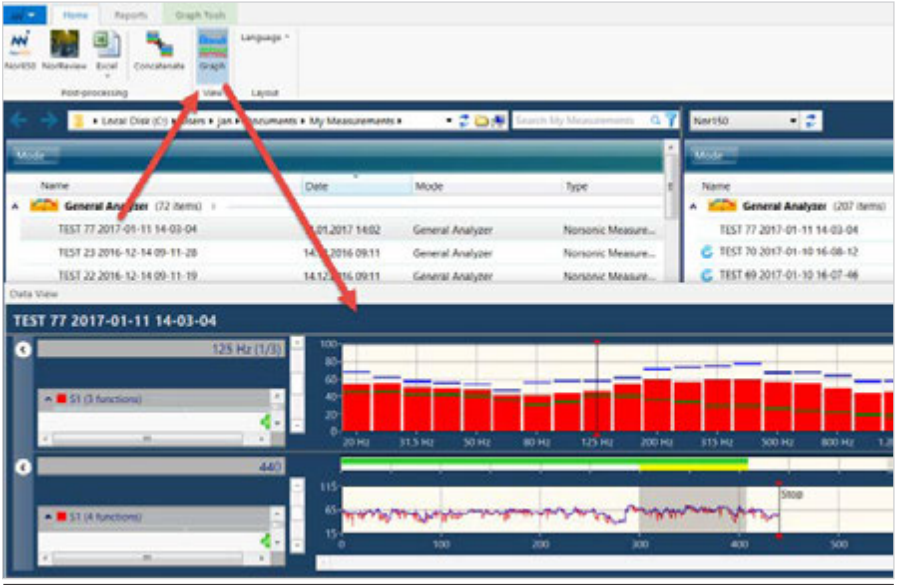


Figure 21.18

Choose/add function

Other functions may be added. Just click the green + sign (Figure 21.21). Select among available functions

HINT! You can “dock” this window conveniently to a specific location

Right-click function to change colour and style (Figure 21.22).

To remove a function, just click the function name and press Delete.

Figure 21.21

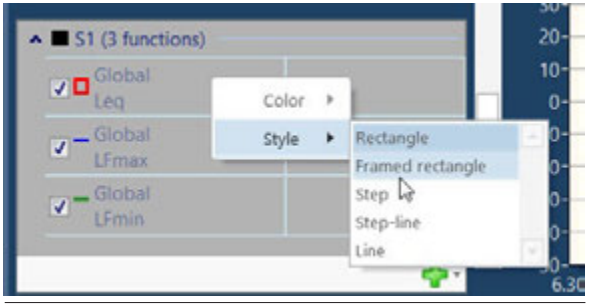


Figure 21.22

Concatenate measurements

When you are doing Repeat- or Synchro measurements with the Nor150, all individual files will be put into the same folder. NorConnect offers a function called “Concatenate” (Figure 21.23) to get a summary of these files.

After transfer to the PC, the Blue symbol indicates that this is a Repeat- or Synchro measurement that has yet to be concatenated. Select the file, hit “Concatenate”. When the process is finished you will get a confirmation and the symbol changes to Green.

You may access the individual files by clicking the file header, then select one of the “Sub-measurements

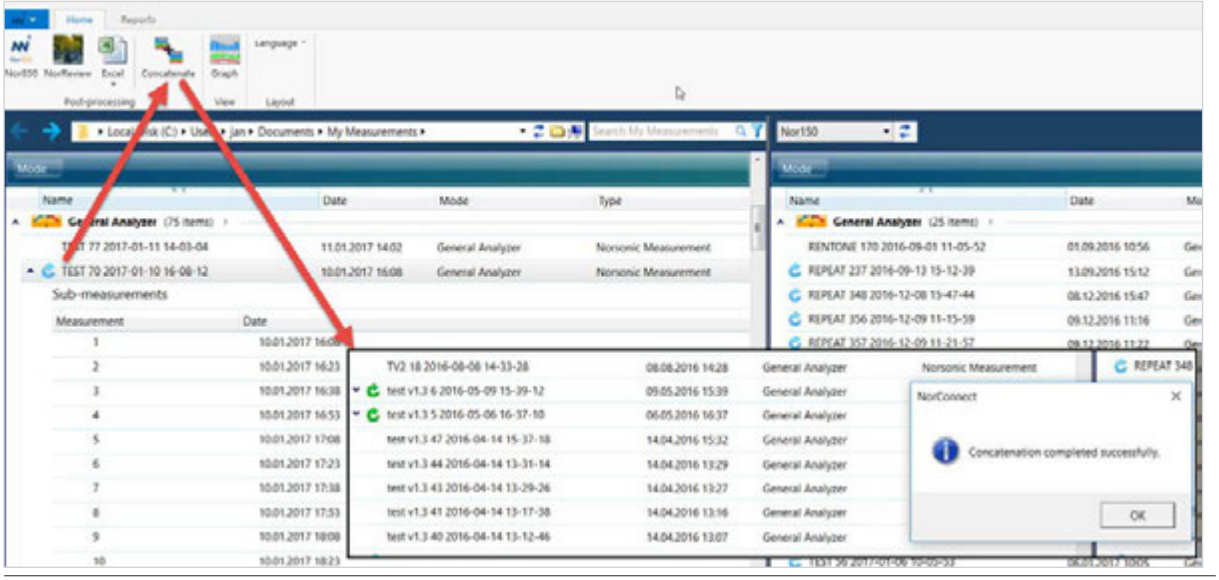


Figure 21.23

Sort criteria

Default sorting applied when browsing the Nor150 memory is by “Mode” then “Date”. This is marked with a small number 1 and 2 in the header of the columns as shown in Figure 21.24.

In the PC, the default sorting is “Mode” then “Name”

You may change and set your own sorting preference by SHIFT + click on the column header

In the example in Figure 21.25 “Date” is selected as the 3rd sort criteria, following “Name” (2nd) and “Mode” (1st)

You may also change the default grouping for the browser (Figure 21.26).

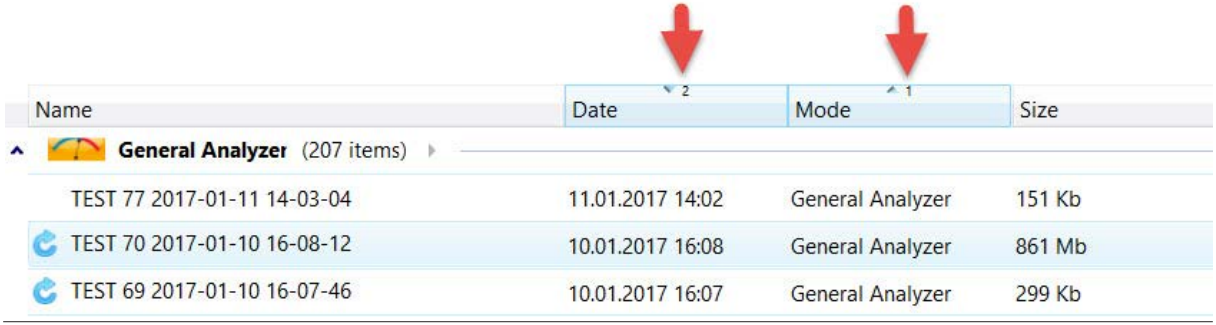


Figure 21.24

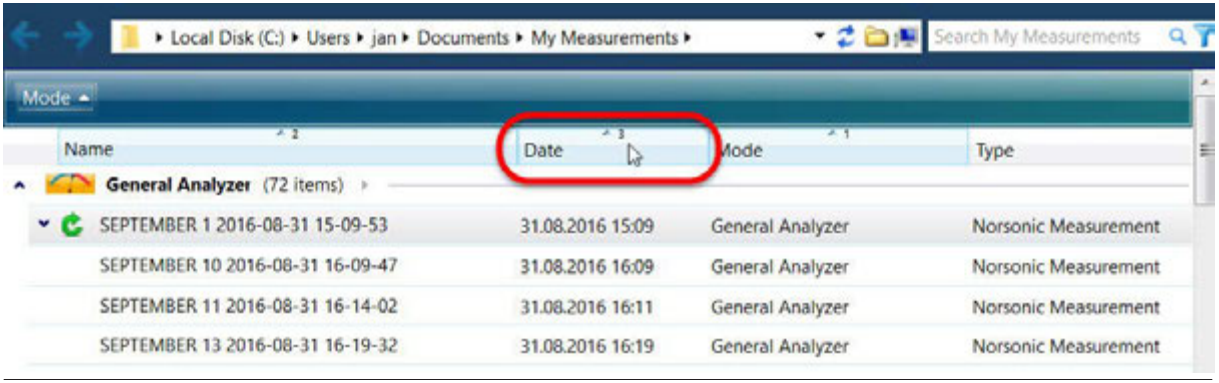


Figure 21.25

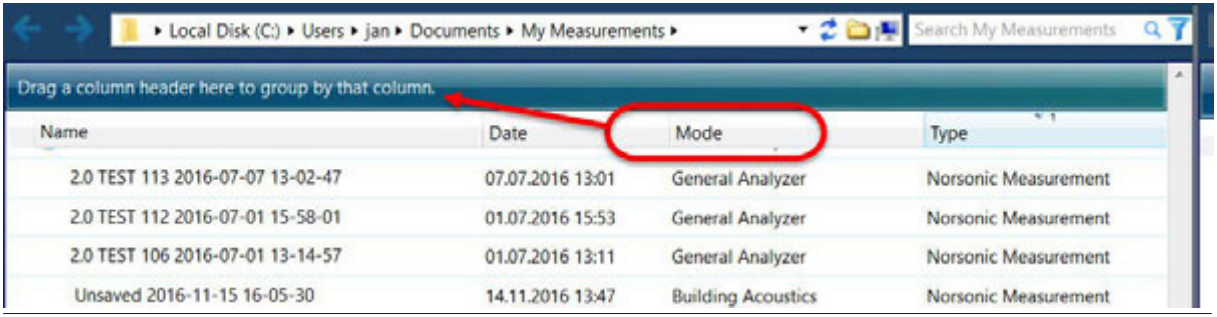

Local Disk (C:) ▸ Users ▸ jan ▸ Documents ▸ My Measurements ▸
Search My Measurements
Drag a column header here to group by that column.
Name
Date
Mode
Type
2.0 TEST 113 2016-07-07 13-02-47
07.07.2016 13:01
General Analyzer
Norsonic Measurement
2.0 TEST 112 2016-07-01 15-58-01
01.07.2016 15:53
General Analyzer
Norsonic Measurement
2.0 TEST 106 2016-07-01 13-14-57
01.07.2016 13:11
General Analyzer
Norsonic Measurement
Unsaved 2016-11-15 16-05-30
14.11.2016 13:47
Building Acoustics
Norsonic Measurement

Figure 21.26

Excel reports

There are several possible reports

1. Gen. Mode: advanced possibilities with either self-made or customized templates, latter as included in installation

   Click the Excel icon and choose among the reports available.

2. All modes: Overview report. These are “hardcoded”, ie. not from a template.

Please note that for “general analyser” measurements you have to click the “down-arrow” below the Excel icon to start this function (Figure 21.27).

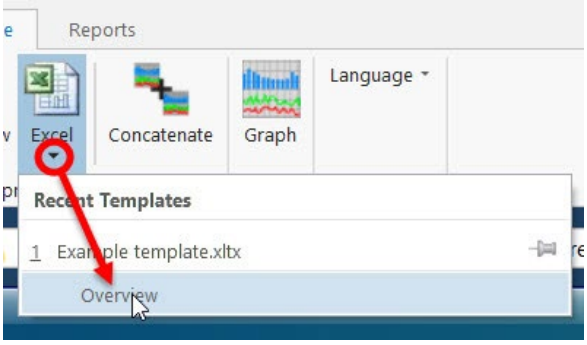


Figure 21.27

There are also different naming conventions for reports

1. Overview: filename + report date
2. Using a report template there are 2 different versions:

   Multiple-file where the template name is followed by the report date and Single-file templates having various naming conventions

If you use “intersected functions” (Figure 21.28) across a selection of multiple measurements, you will get a report containing the values for parameters found in only files with similar functions.

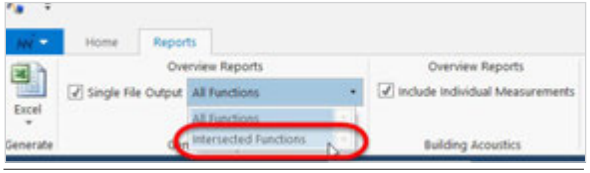


Figure 21.28

You can also make your own customized reports based on Excel templates with NorReport.

Enhanced reports with Nor850 and NorReview

If you have installed the programs Nor850 and/or NorReview you may also use these directly from the menu line to post-process the measurements. Nor850 program can be used for building acoustics-, sound power- and intensity measurements, while NorReview is used for the category “General Analyzer” measurements - Figure 21.29.

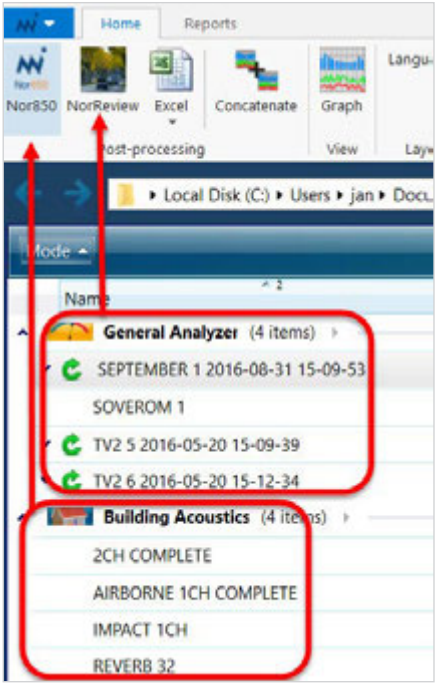


Figure 21.29

Where are my Measurements stored?

The default directory is

You may however select any directory for your measurements. Use the browser to select/make/change directory. See Figure 21.30.

NOTE that when you exit the program the current (last) directory is shown when you start up again

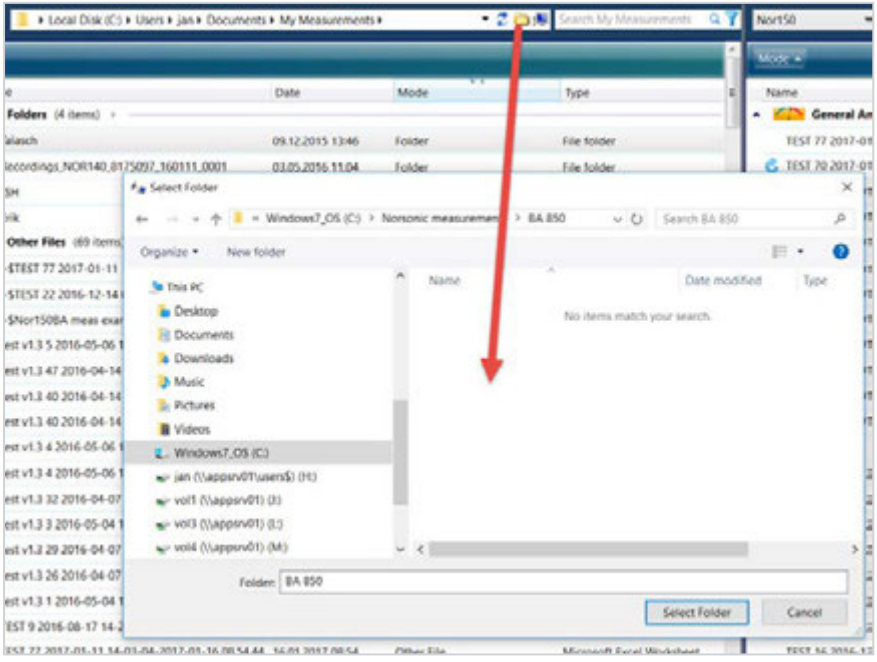


Figure 21.30

Search

It is possible to search for files on the PC or a measurement. Just key in a search phrase, eg part of the file/ measurement name

You may also narrow your search by applying different filter criteria (Mode, Date) on the connected instrument/ SD card as shown in Figure 21.31.

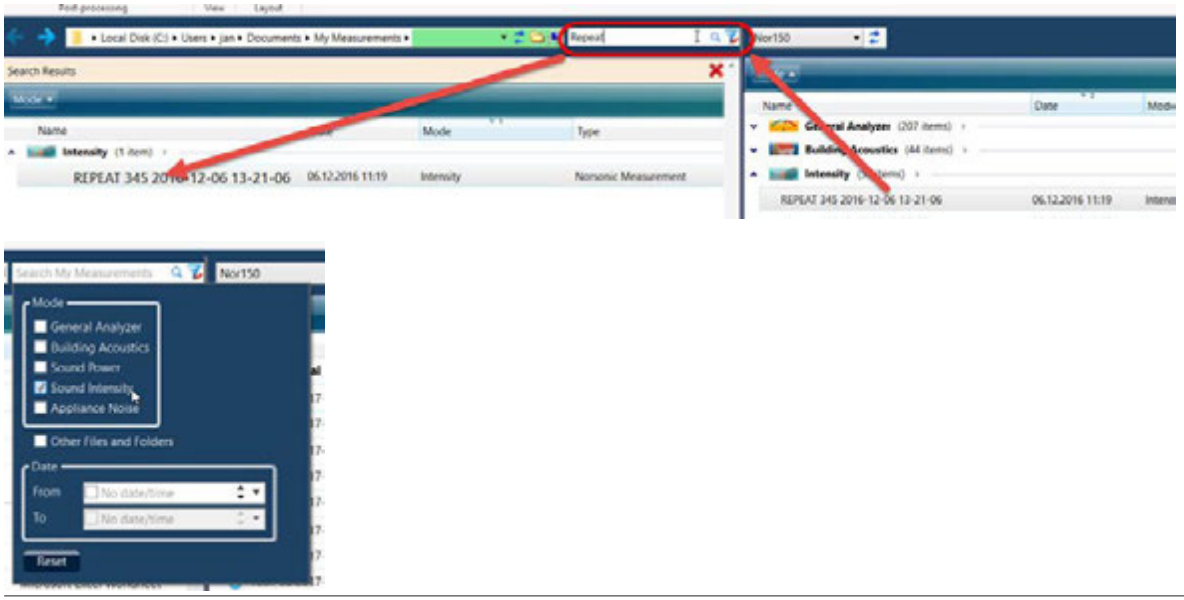


Figure 21.31

Initialize Nor150 USB

If you installed NorConnect without a connected Nor150, you can choose to do so later.

Connect the Nor150 to the PC with the USB cable Nor4525.

The USB in the meter must be set to “Normal” with the Static IP address at 10.150.150.1.

Click the “Information” button in the upper right corner of the screen and select “Initialize” (Figure 21.32).

This will install the driver and allow you to work with the Nor150 on USB.

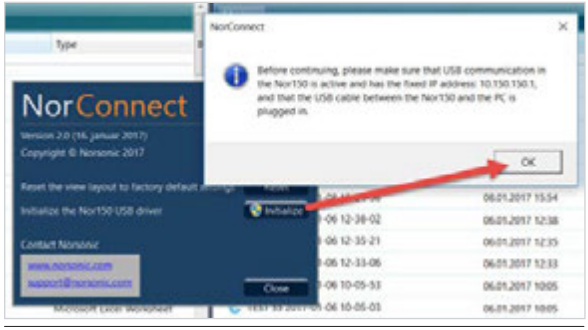


Figure 21.32

Language selection

Select your preferred language. This is applied when the program is restarted (Figure 21.33)

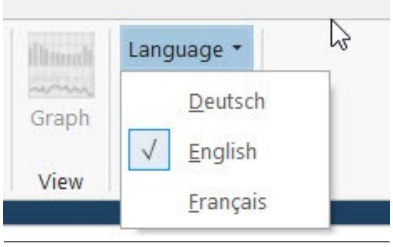


Figure 21.33

Info

The reset button (Figure 21.34) is a useful tool to apply to reset to the default view properties, eg. when a special sorting criteria shall be reset.

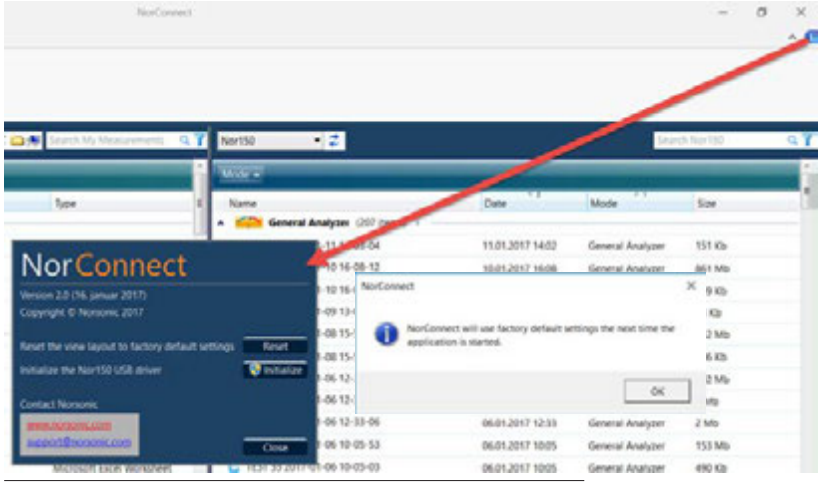


Figure 21.34

Technical Specifications

Unless otherwise stated, the specifications are given for a complete sound level meter Nor150 equipped with microphone type Nor1225 and microphone preamplifier type Nor1209. Values are based on the sensitivity set to the nominal value for the microphone: –26.0 dB, corresponding to 50 mV/Pa.

A windscreen type Nor1451 and preamplifier extension cables of type Nor1408 and Nor1410 may also be used.

The definition of terms is based on:
IEC61672-1 Ed.2.0 (2013): Electroacoustics - Sound level meters - Part 1: Specifications.
IEC 62585 Methods to determine corrections to obtain the free field response of a sound level meter

Firmware version

The specifications in this manual are valid for a Nor150 with software version 1.2 and above. The version number can be found using the **SETUP >** *Instrument* > *About* key sequence.

The Nor150 may also be supplied with the prepolarized version of the Nor1225, the Nor1227. The specifications listed in this chapter are the same for both microphone types except that the Nor1227 does not support the high level option.

Type of instrument

Sound level meter IEC61672-1, class 1, group X measuring exponential time-weighted levels, integrating- averaging levels and sound exposure levels. It complies with IEC 61672-1 Ed.2.0 (2013).

The optional 1/1 octave-band and 1/3 octave-band filters complies with IEC 61260 (2014) class 1.

The instrument also conforms to a number of national standards such as: DIN 45657 (2013-02-06).

Analog inputs

Number of channels: Two Sound channels. The physical and electrical specifications are identical for both channels.

Channel 1 is located on the top of the instrument and Channel 2, under the flip at the left hand side of the instrument.

Input connector

7 pin LEMO connector for Norsonic microphone systems. (LEMO ECG.1B.307.CLL)

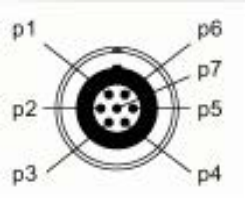
Input impedance direct connection to input socket: More than 100kohm, less than 650pF

Maximum input signal: ±10 V peak

Normal measurement range: 0.3 µV to 7 V (RMS) in one range corresponding to –10 dB to 137 dB with a microphone sensitivity of 50 mV/Pa.

Extended range: With the optional extension permitting high measurement range, peak values up to 150 dB may be measured.

Microphone input socket (outside view)



Pin	Function
1	Microphone system check / signal input Channel 2 in Sound Intensity mode when Nor1290 and some other probes is seleced
2	GND - signal reference
3	Polarization voltage – selectable: 0±1V, 200±1V or adjustable 70 to 74 V short-circuit current <1mA, impedance: 2 MOhm
4	Signal input. Channel 1 Input impedance: min 0,6 MΩ, max. 250 pF. When IEPE is selected in the setup, a constant current of 3 mA is supplied (25 volt source)
5	TEDS interface pin for Lemo style preamplifiers
6	+15±1 V preamplifier supply voltage, max 18 mA
7	-15±1 V preamplifier supply voltage, max 18 mA

High-pass input filter

The microphone input section is equipped with an analog high-pass filter to reduce noise from wind or other sources with frequencies in the lower end of the frequency range.

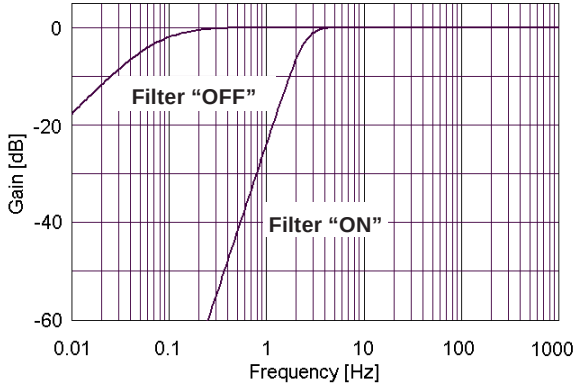
The filter response is -0.5 dB at 4 Hz (or -3 dB at 3 Hz). It should be switched on if the lower frequency of interest is in the normal audio range.

When this filter is “Off” the lower frequency response is -3 dB at 0.08 Hz (or -0.5 dB at 0.25 Hz). The setting of this filter has a great influence especially on the Z network.

Filter type: 3rd order HP filter (-3 dB at 3 Hz, Butterworth response)

The filter is turned on when the 1/1- or 1/3-otave filter is set equal to or higher than 6,3 Hz.

Highpass filter frequency response



Microphone

Nor1225 data

Microphone type: Free field microphone
Frequency range (±2 dB): 3.5 Hz to 20 kHz
Dynamic range lower limit: 17 dB(A)
Dynamic range upper limit: 141 dB
Open circuit sensitivity @ 250 Hz (±2 dB):
-26 dB rel 1 V/Pa (50 mV/Pa)
IEC 61094 Compliance: WS2F
Typical cartridge capacity: 18 pF
Microphone venting: Rear
Resonance frequency: 14 kHz
Temperature range, operation: -40 to 85 °C
Temperature coefficient @250 Hz: -0.01 dB/°C
Static pressure coefficient @250 Hz: -0.011 dB/kPa
Humidity range non condensing: 0 to 100 % RH
Humidity coefficient @250 Hz: -0.001 dB/% RH
Influence of axial vibration @1 m/s²:
62 dB re 20 µPa
Weight: 6.5 g

Preamplifier

The standard preamplifier for Nor150 is Nor1209. But different types of preamplifiers can be used. The instrument has the ability to correct for the attenuation in the preamplifier. Typical value of the attenuation is -0.2 dB.

Nor1209 data

The microphone preamplifier Nor1209 has been designed for general use with most ½" condenser microphone of type WS2 or LS2 according to IEC 61094-4: Measurement microphones - Part 4: Specifications for working standard microphones. The microphones may be pre-polarized or use externally supplied polarization voltage up to 200 V. By the use of adaptors, the preamplifier may be used for other microphone sizes. The frequency response covers the range from below 1 Hz to above 200 kHz.

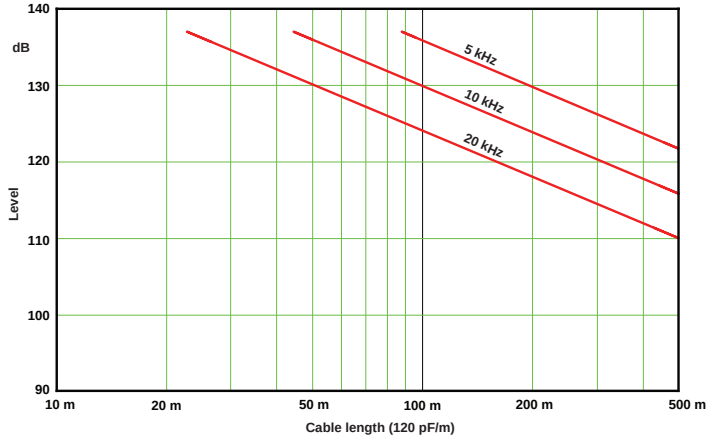
The Nor1209 preamplifier may be mounted directly on the sound level meter, or connected via a suitable cable.

The preamplifier is equipped with a system check facility. By enabling the SysCheck signal in the calibration menu, the capacitance of the microphone as well as the complete signal chain from the microphone cartridge to the sound level meter may be checked.

The voltage gain of the preamplifier is very close to one or correspondingly 0 dB. As the input impedance is 10 GΩ, the attenuation due to loading of the source will mainly be determined by the low input capacitance

Cables and cable length

The Nor1209 preamplifier has excellent driving capability for long cables. The signal output from the microphone preamplifier will be loaded by the capacitance of the cable between the microphone system and the instrument. The capacitance will increase proportionally with the length of the cable. A typical value for microphone cables from Norsonic is 120 pF per metre. Hence, a cable with length 100 m, will load the output with a capacitance of 12 nF. For lower frequencies there are seldom problems with long cables. However, when the signal contains the combination of high amplitude and high frequency, the capacitive loading will lead to high output current. A limited current capacity will set limits for the maximum slew-rate for the signal. The figure below shows the maximum level as function of cable length and frequency. 20 kHz corresponds to the bandwidth of the microphone system with the normal microphone Nor1227.



Nor1209 Technical Specifications

Frequency response (18 pF/small signal):
20 Hz ¬– 20 kHz: ±0,1 dB
Gain: Typically -0,1 dB (-0,2 with 20 pF)
Input impedance: 10 GΩ, 1,4 pF
Output impedance: 50 ohm typical
Noise (20 pF dummy microphone):
A-weighted < 2,2µV (typically 1,8µV)
Noise (20 pF dummy microphone):
Lin (20 Hz – 20 kHz) <6 µV (typ 3,8 µV)
The preamplifier accepts the following voltage i fused via external power supply.
Power supply: ±14 V(1 mA) to ± 60 V (2,8 mA). The Nor150 supply ± 15 V to the preamplifier.
Alternative Power supply:
Single: 28 V (1mA) to 120 V (2,8 mA)
Operating temperature range: -25°C to +70°C
Relative humidity: 0 – 90 %RH
Length: 83 mm
Diameter: 12,7 mm (Ring: 18 mm)
Weight: 36 g

Acoustical data

Acoustical data for Nor1225 and Nor1209 mounted on Nor150

Reference direction:

The microphone reference direction is from the microphone and along the axis of rotational symmetry for the microphone and preamplifier.

Microphone Reference Point

The microphone reference point is the geometric centre of the diaphragm of the microphone.

The following tables gives free field frequency response and uncertainty information for the complete sound level meter.

The data are valid in under the following environmental conditions:
Atmospheric pressure: 80 – 105 kPa
Temperature: 20 – 26 °C
Humidity: 25 – 70 % RH

Summary of correction values for verification tests

Nominal frequency	Exact frequency	P → FF corrections	Uncertainty P → FF	Case corrections	Uncertainty Case	WS corrections	Uncertainty WS
Hz	Hz	dB	dB	dB	dB	dB	dB
63	63,1	0,0	0,1	0,0	0,1	0,0	0,0
125	125,9	0,0	0,1	0,0	0,1	0,0	0,0
250	251,2	0,0	0,1	0,0	0,1	0,0	0,0
500	501,2	0,0	0,1	-0,1	0,1	0,0	0,0
1 k	1000,0	0,1	0,1	0,1	0,1	0,1	0,0
2 k	1995,3	0,3	0,1	-0,3	0,1	0,1	0,0
4 k	3981,1	1,1	0,2	-0,1	0,1	-0,2	0,1
8 k	7943,3	3,4	0,2	0,1	0,2	-0,3	0,1
12,5 k	12589,3	6,8	0,4	-0,1	0,2	-0,4	0,1
16 k	15848,9	8,4	0,3	0,2	0,2	-0,5	0,2

WS = Wind Screen. These data assume that the wind screen correction in the instrument is activated

Detailed table for level corrections according to IEC 62585

Nominal frequency	Exact frequency	Typical free-field response	Pressure to free-field correction	Expanded uncertainty Pressure-FF	Case correction	Expanded uncertainty case corr.	Windscreen correction	Expanded uncertainty windscreen
Hz	Hz	dB	dB	dB	dB	dB	dB	dB
63	63,1	0,00	0,00	0,05	0,00	0,05	0,03	0,03
80	79,4	0,00	0,00	0,05	0,00	0,05	0,03	0,03
100	100,0	0,00	0,00	0,05	0,00	0,05	0,03	0,03
125	125,9	0,00	0,00	0,05	0,00	0,05	0,03	0,03
160	158,5	0,00	0,00	0,05	0,00	0,05	0,03	0,03
200	199,5	0,00	0,00	0,05	-0,01	0,05	0,03	0,03
250	251,2	0,00	0,00	0,05	-0,03	0,05	0,03	0,03
315	316,2	0,01	0,00	0,06	-0,06	0,10	0,03	0,03
400	398,1	0,03	0,01	0,06	-0,10	0,10	0,03	0,03
500	501,2	0,03	0,01	0,07	-0,12	0,10	0,04	0,03
630	631,0	0,02	0,04	0,07	-0,04	0,10	0,05	0,03
800	794,3	-0,01	0,05	0,07	0,08	0,10	0,08	0,04
1 k	1000,0	-0,01	0,07	0,08	0,14	0,10	0,09	0,03
	1059,3	-0,01	0,09	0,09	0,23	0,10	0,09	0,03
	1122,0	-0,01	0,11	0,09	0,35	0,10	0,10	0,04
	1188,5	-0,02	0,13	0,09	0,44	0,10	0,12	0,05
1,25 k	1258,9	-0,03	0,16	0,09	0,41	0,10	0,12	0,06
	1333,5	-0,04	0,16	0,10	0,21	0,10	0,12	0,05
	1412,5	-0,04	0,17	0,10	-0,02	0,10	0,12	0,03
	1496,2	-0,03	0,17	0,10	-0,12	0,10	0,12	0,03
1,6 k	1584,9	-0,03	0,18	0,10	-0,10	0,10	0,12	0,03
	1678,8	-0,03	0,21	0,11	-0,14	0,10	0,12	0,03
	1778,3	-0,04	0,24	0,11	-0,33	0,10	0,13	0,03
	1883,6	-0,05	0,28	0,13	-0,45	0,10	0,13	0,03
2 k	1995,3	-0,06	0,32	0,13	-0,31	0,10	0,12	0,03

Nominal frequency	Exact frequency	Typical free-field response	Pressure to free-field correction	Expanded uncertainty Pressure-FF	Case correction	Expanded uncertainty case corr.	Windscreen correction	Expanded uncertainty windscreen
	2113,5	-0,07	0,34	0,13	-0,01	0,10	0,12	0,03
	2238,7	-0,08	0,36	0,13	0,13	0,10	0,10	0,03
	2371,4	-0,09	0,42	0,14	0,11	0,10	0,08	0,04
2,5 k	2511,9	-0,10	0,48	0,14	0,30	0,10	0,06	0,04
	2660,7	-0,10	0,54	0,15	0,53	0,10	0,02	0,04
	2818,4	-0,12	0,60	0,15	0,15	0,10	-0,02	0,04
	2985,4	-0,12	0,64	0,16	-0,14	0,10	-0,05	0,05
3,15 k	3162,3	-0,13	0,68	0,16	0,00	0,10	-0,10	0,05
	3349,7	-0,14	0,77	0,16	-0,19	0,10	-0,13	0,06
	3548,1	-0,15	0,87	0,16	-0,06	0,10	-0,16	0,07
	3758,4	-0,18	0,96	0,16	0,17	0,10	-0,19	0,08
4 k	3981,1	-0,18	1,05	0,16	-0,11	0,10	-0,22	0,09
	4217,0	-0,18	1,15	0,17	0,15	0,10	-0,23	0,10
	4466,8	-0,17	1,25	0,17	0,02	0,10	-0,23	0,12
	4731,5	-0,17	1,39	0,17	0,34	0,10	-0,21	0,13
5 k	5011,9	-0,17	1,53	0,16	-0,06	0,15	-0,18	0,14
	5308,8	-0,16	1,69	0,17	-0,09	0,15	-0,13	0,14
	5623,4	-0,14	1,85	0,17	-0,15	0,15	-0,07	0,14
	5956,6	-0,12	2,08	0,18	0,10	0,15	-0,01	0,13
6,3 k	6309,6	-0,10	2,31	0,18	0,31	0,15	0,02	0,11
	6683,4	-0,04	2,57	0,22	-0,03	0,15	-0,03	0,14
	7079,5	-0,03	2,84	0,22	-0,16	0,15	-0,04	0,17
	7498,9	0,03	3,11	0,22	0,05	0,15	-0,16	0,16
8 k	7943,3	0,12	3,39	0,22	0,13	0,15	-0,33	0,13
	8414,0	0,21	3,78	0,30	0,08	0,15	-0,46	0,11
	8912,5	0,25	4,17	0,30	-0,07	0,15	-0,62	0,10
	9440,6	0,38	4,59	0,30	-0,13	0,15	-0,69	0,10

Nominal frequency	Exact frequency	Typical free-field response	Pressure to free-field correction	Expanded uncertainty Pressure-FF	Case correction	Expanded uncertainty case corr.	Windscreen correction	Expanded uncertainty windscreen
10 k	10000,0	0,48	5,01	0,30	0,25	0,20	-0,68	0,11
	10592,5	0,54	5,50	0,38	-0,22	0,20	-0,55	0,12
	11220,2	0,55	5,99	0,38	0,06	0,20	-0,41	0,14
	11885,0	0,58	6,38	0,38	-0,01	0,20	-0,32	0,15
12,5 k	12589,3	0,58	6,78	0,38	-0,06	0,20	-0,39	0,15
	13335,2	0,61	7,13	0,38	0,01	0,20	-0,51	0,13
	14125,4	0,78	7,48	0,38	-0,18	0,20	-0,66	0,10
	14962,4	0,87	7,93	0,38	0,03	0,20	-0,65	0,12
16 k	15848,9	0,90	8,39	0,29	0,16	0,20	-0,46	0,20
	16788,0	0,79	8,78	0,34	0,25	0,20	-0,25	0,23
	17782,8	0,58	9,17	0,34	0,07	0,20	-0,21	0,12
	18836,5	0,14	9,59	0,34	0,15	0,20	-0,27	0,16
20 k	19952,6	-0,40	10,01	0,29	-0,10	0,20	-0,18	0,21

Typical free-field response: Typical free-field response of the microphone and preamplifier connected to the sound level meter through a microphone extension cable without windscreen.

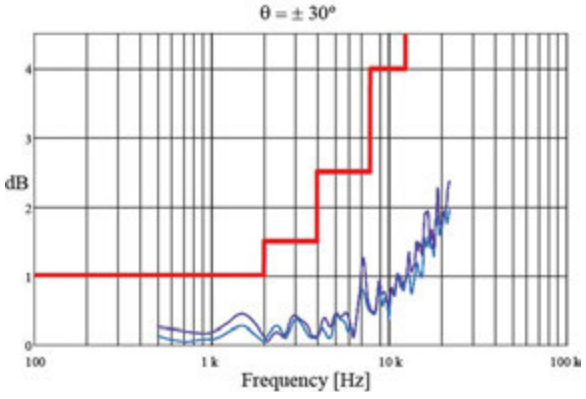
Pressure to free-field correction: Correction to be added to the measured pressure response (electrostatic actuator response) to obtain the free-field response for the microphone system. The corresponding expanded uncertainty (95%) includes the typical variations between different microphones of the same model.

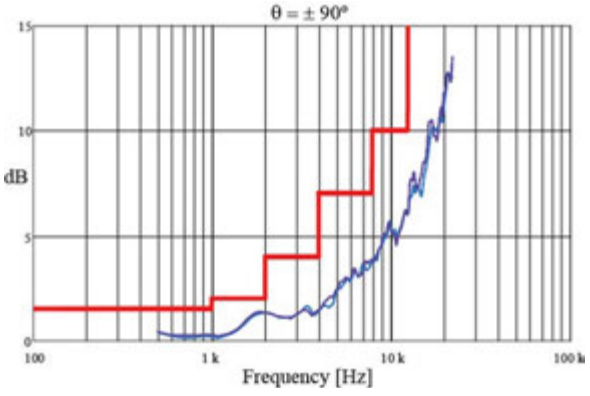
Case correction: Correction to be added to the displayed values for obtaining the free-field sound pressure level when the microphone system is mounted in the front of the instrument (Sound channel 1). The corresponding expanded uncertainty (95%) includes the typical variations between different instruments of the same model measured at reference conditions.

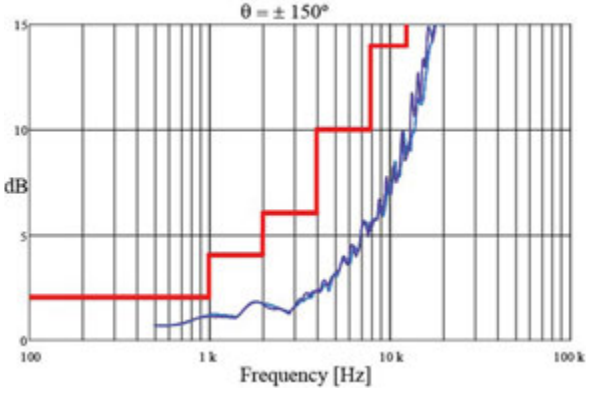
Windscreen correction: Correction to be added to the displayed values for obtaining the free-field sound pressure level when the microphone system is equipped with windscreen type Nor1451 and the windscreen correction in the instrument is switched on. The corresponding expanded uncertainty (95%) includes the typical variations between different windscreens of the same model measured at reference conditions.

Directional response – Horizontal

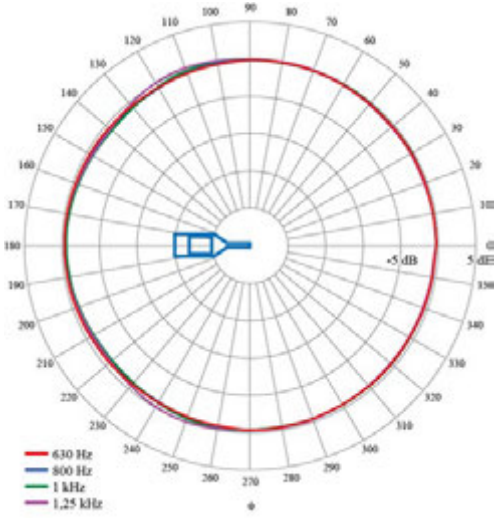
Maximum absolute value of the difference between displayed sound levels at any two sound-incidence angles within ±ϴ degrees from reference direction.

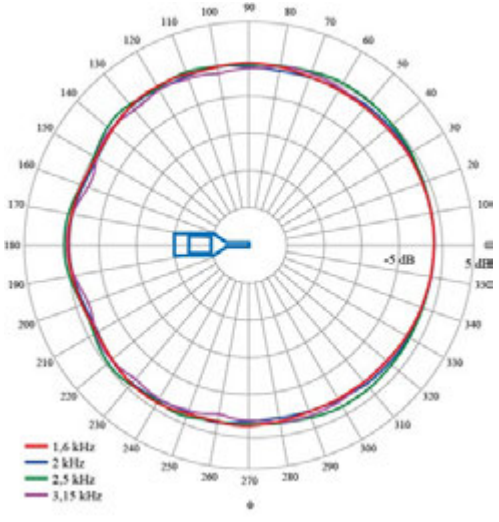


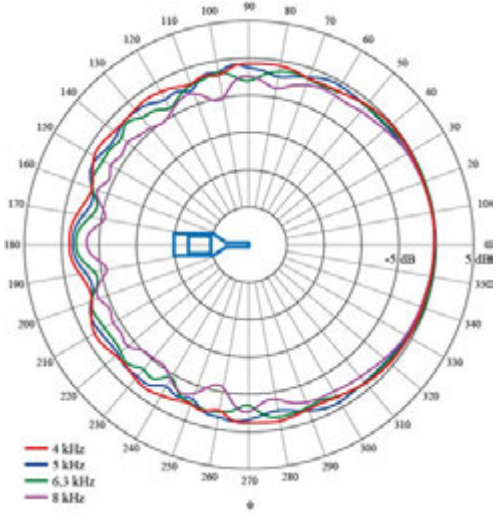


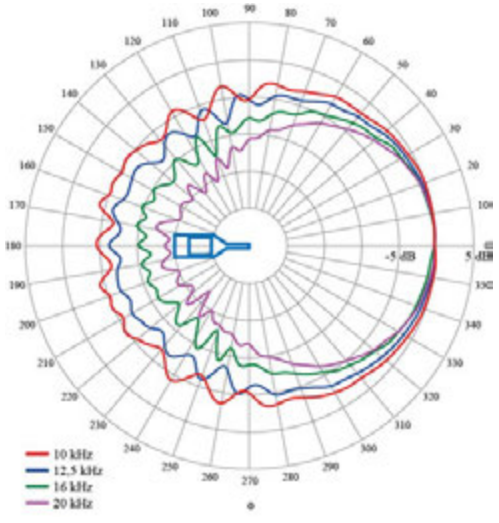


Directional response



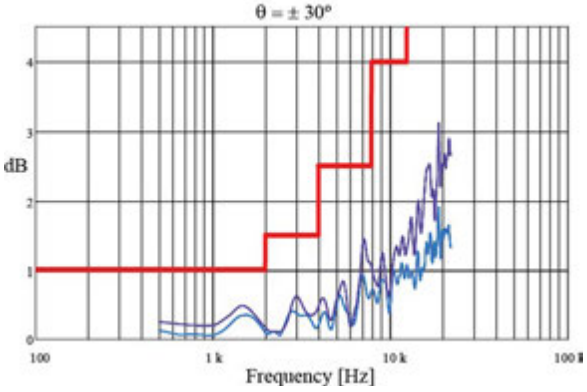


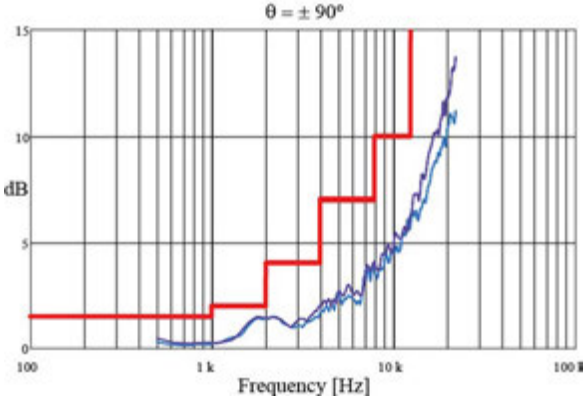


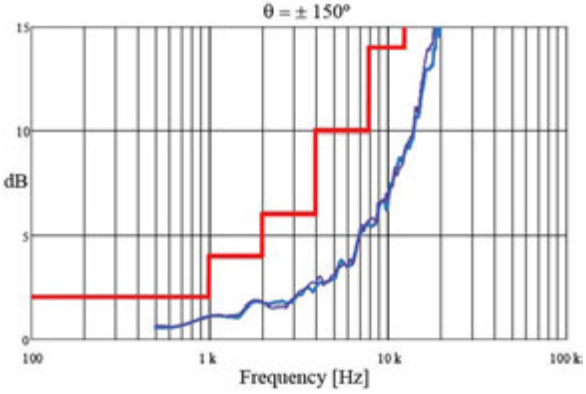


Directional response - Vertical

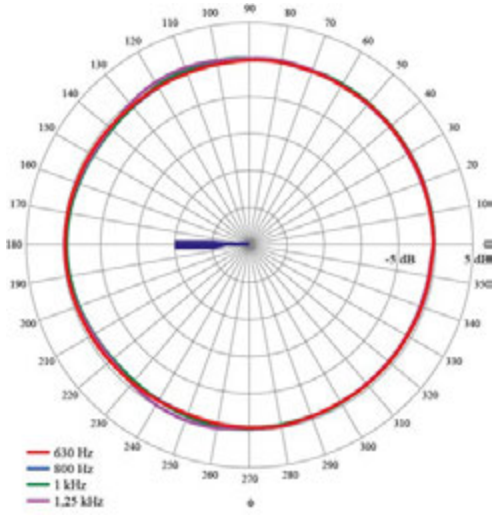
The directional response of the complete instrument is measured in the horizontal direction (sideways, with the display facing upwards). Zero degrees are in the direction of the microphone.

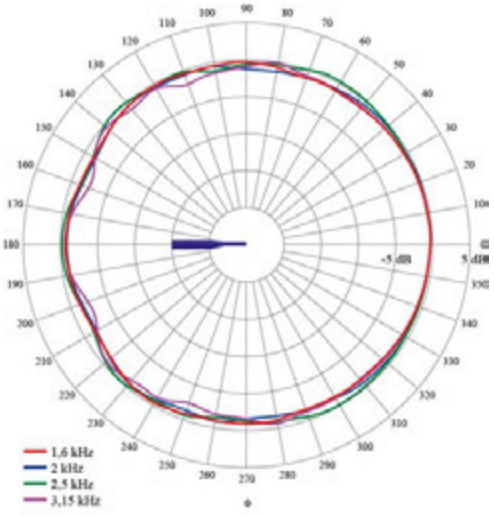


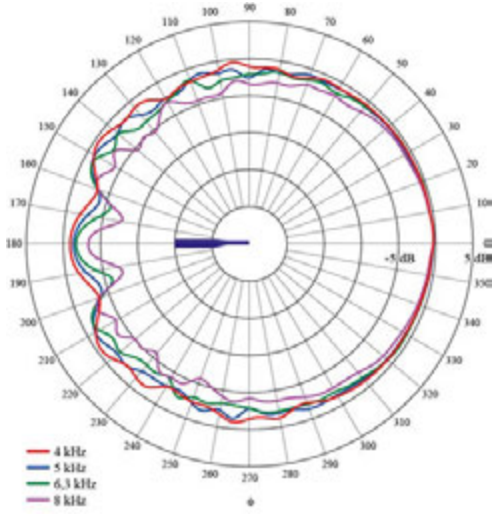


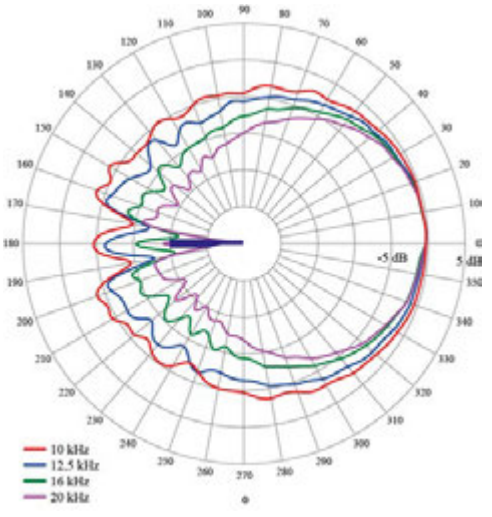


Directional response



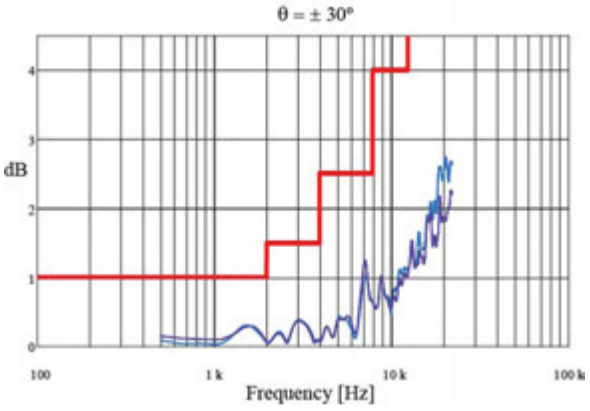


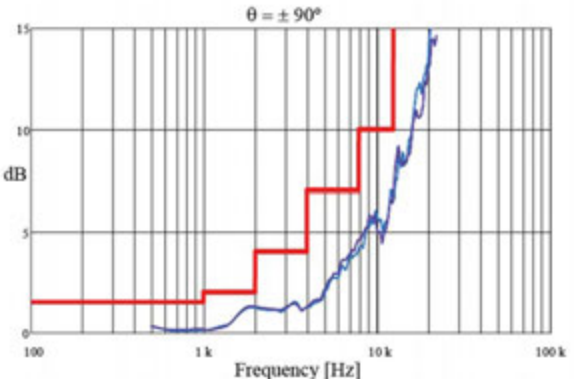


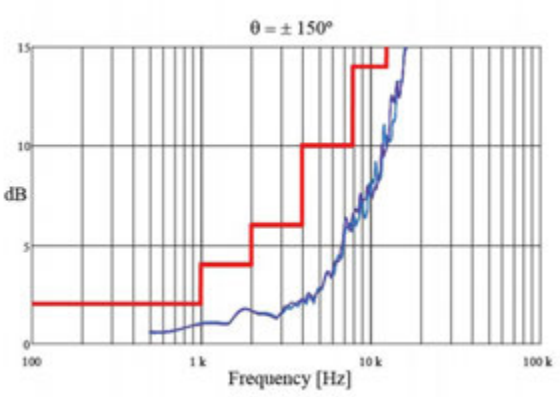


Directional response – Horizontal with Wind Screen

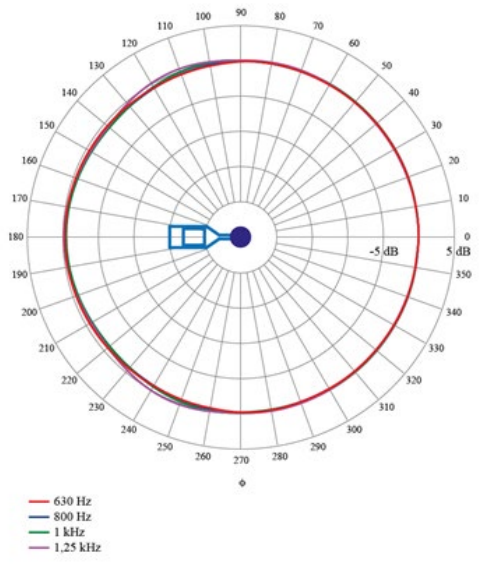
The graphs and plots below show the directional response for the complete sound level meter Nor150 with preamplifier Nor1209, microphone Nor1225 and windscreen Nor1451.

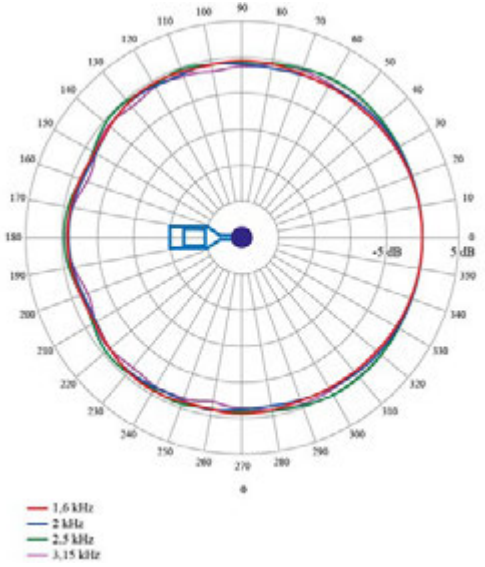


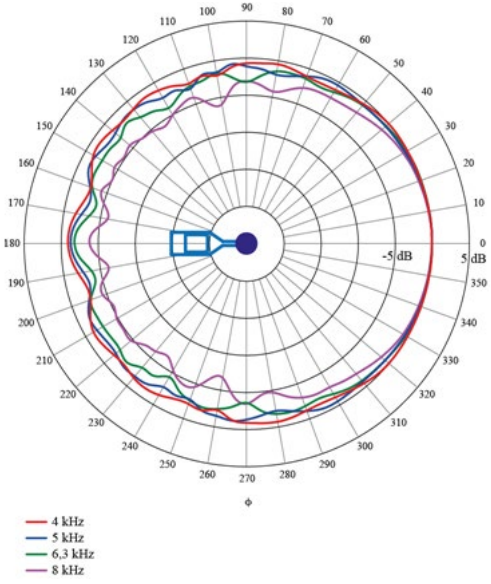


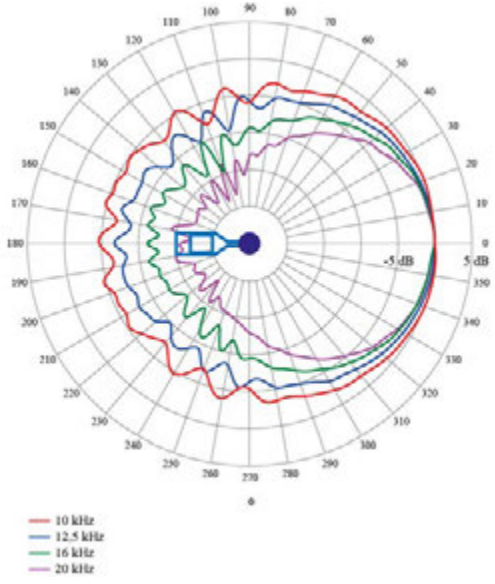


Directional response



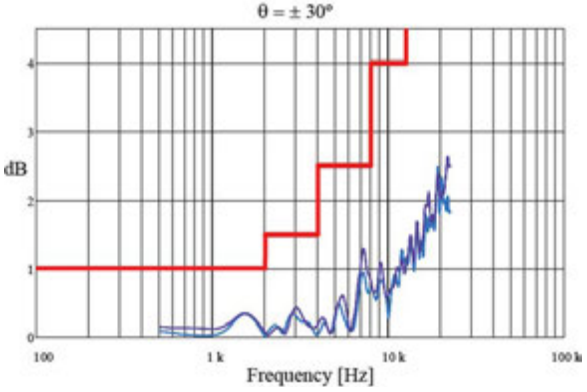


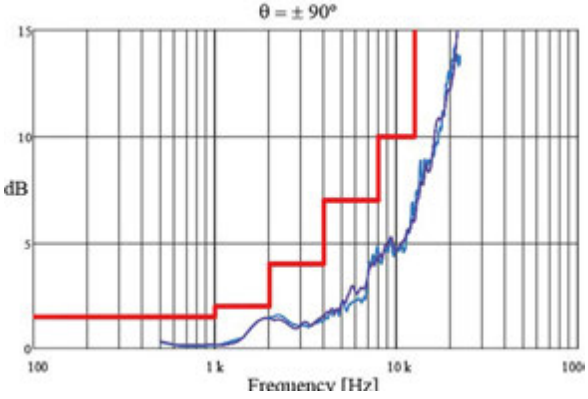


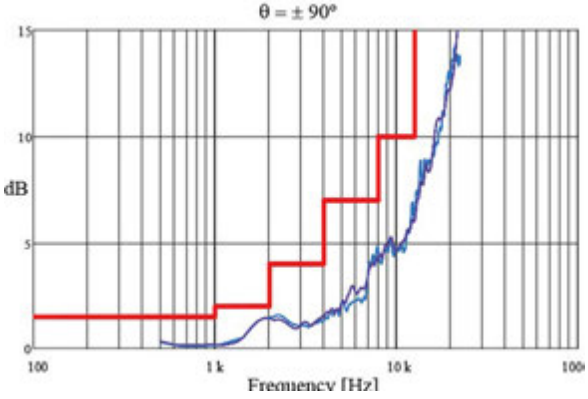


Directional response – Vertical with Wind Screen

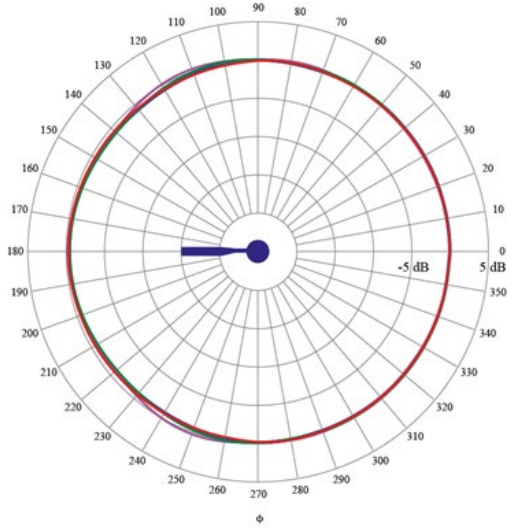
The graphs and plots below show the directional response for the complete sound level meter Nor150 with preamplifier Nor1209, microphone Nor1225 and windscreen Nor1451.



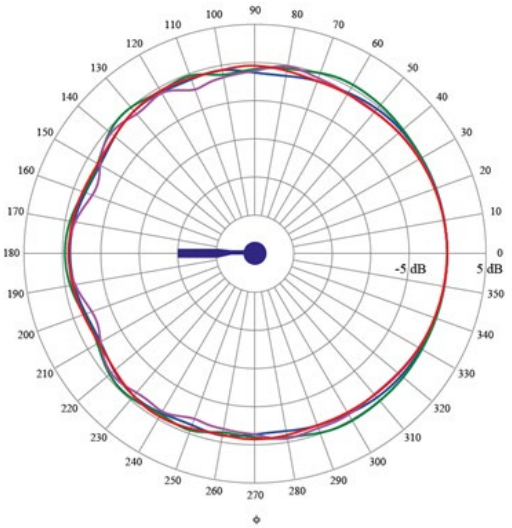




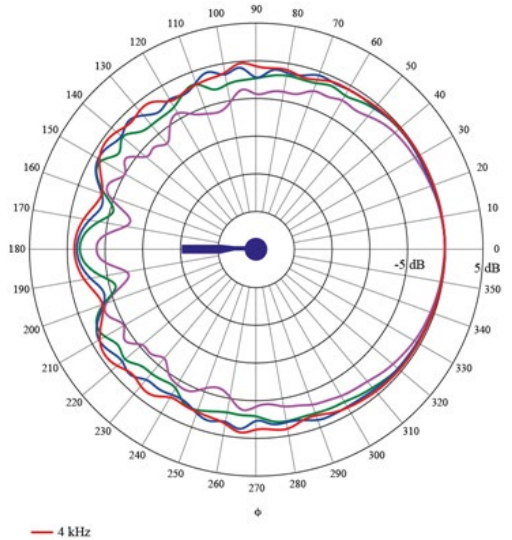
Directional response



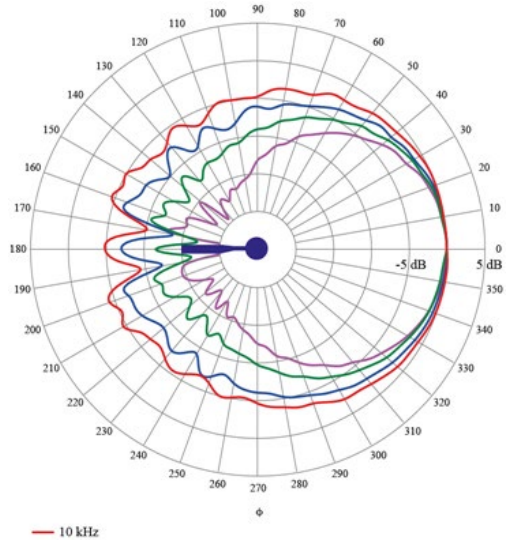
630 Hz
800 Hz
1 kHz
1,25 kHz



1,6 kHz
2 kHz
2,5 kHz
3,15 kHz



4 kHz
5 kHz
6,3 kHz
8 kHz



10 kHz
12,5 kHz
16 kHz
20 kHz

Verification of the free field response

There are several ways to verify the acoustical performance of the Nor150. For periodic verification according to IEC 61672-3 Ed.2.0 it is recommended to use a multi frequency calibrator.

The table below shows data for the B&K 4226. The calibrator is set to position “a” and “Pressure”. Any of the three selectable levels (94, 104 and 114 dB) can be used, but we recommend the use of 114 dB.

Free field correction table

Frequency (db)	Correction (Hz)	Uncertainty (Hz)
31,5 to 500	0	0,1
1 k	0,1	0,2
2 k	0,2	0,2
4 k	0,8	0,2
8 k	2,8	0,2
12,5 k	5,8	0,2
16 k	6,9	0,2

For periodic verification only the values for 125 Hz, 1 kHz and 8 kHz are in use.

Analog to digital converters

The analog input signals are converted to digital signals by a multi-range sigma-delta converter with an effective sampling frequency of 48 kHz. The anti-aliasing filter is a combination of an analog and a digital filter.

Frequency weightings

Weighting networks:

The Nor150 simultaneously measure the three weighting networks A, C and Z. These networks are designed as described in the IEC 61672-1.
The lower frequency limit of the Z-weighting is only restricted by the high pass filter in the input section, which means that when this filter is off the frequency range is flat down below 0.5 Hz.

Filters

The 1/1 octave band or 1/3 octave band levels may be measured simultaneously with the weighting networks if appropriate options are installed.

1/1 octave filters: 0,5 Hz – 16 kHz
1/3 octave filters: 0,4 Hz – 20 kHz

Filter type

Class 1, digital IIR filters, base 10 system. According to IEC 61260 (2014). The use of filters requires that appropriate options are installed in the instrument.

Level detector

The instrument has only one measurement range.
Reference level (unless otherwise noted) is 114 dB sound pressure level.
Reference range is the same as the only available measurement range.

Detector type

Digital true root-mean-square (RMS) detection and peak detection, displayed resolution 0.1, 0.01 and 0.001 dB selectable in the instrument set up menu. There is only one measurement range.

Crest factor capability

The crest factor is only limited by the capability to measure the peak-value of the signal. The sound input can measure more than 10 V peak.

Overload indication

An Overload condition is indicated in two different ways. Both with a red light in the Status LED above the display and with an overload sign in the status bar in the display. Overload occurs if the input signal is above 10 V peak (either polarity relative to ground).

Under-range indication

Each individual microphone transducer connected to the Nor150 can have its own low level information. In the transducer set up menu the operator can key in the lowest acceptable level information for each 1/3rd octave filter band and the three weighting networks.
Low level indication is only available in the SLM picture and its corresponding numerical table. When a level is detected that is lower than the set threshold, the numerical value will be indicated with a “<” sign in front of it.

Selectable range for Low Level Indication:

The selectable range of low level values goes from -30 dB to + 40 dB in full dB steps.

A separate menu in Transducer set up gives access to the values. The values can be altered after the transducer is selected.

This indication is stored as a part of the measurement data. When a new measurement is started, the under-range indication is cleared.

Time weightings and measured functions

The time weighting functions F and S have time constants of 125 ms and 1000 mS respectively, and are designed as described in IEC 61672.

The time weighting I has a 35 mS on-time with a peak hold function and a 2.9 dB/S decay rate as described in DIN 45657 (2013).

Simultaneous measurement of the following functions:

- F–time-weighted sound pressure level, instantaneous
- Maximum F–time-weighted sound pressure level
- Minimum F–time-weighted sound pressure level
- S–time-weighted sound pressure level, instantaneous
- Maximum S–time-weighted sound pressure level
- Minimum S–time-weighted sound pressure level
- I–time-weighted sound pressure level, instantaneous
- Maximum I–time-weighted sound pressure level
- Minimum I–time-weighted sound pressure level
- Integrated-averaged sound pressure level
- Sound exposure level
- Peak sound level
- Exceeding level for F–time-weighted sound pressure level (cumulative distribution)
- Integrated-averaged I–time-weighted sound pressure level

- I–time-weighted sound exposure level
- Taktmaximalpegel – DIN45657, F and I time response, 5 seconds “Takt”.

Level distribution

As an optional extension, the instrument may be fitted to calculate the exceeding level (cumulative level distribution) for the F time weighted level. The calculation is done for frequency weightings A, C and Z and for 1/1 octave or 1/3 octave filters.

Minimum integration time for the global measurement (and for the period length of a profile measurement): 100 seconds.
Sampling frequency: 10 samples per second
Display resolution: 0.1 dB based on interpolation
Class width: 0.2 dB
Number of classes: 652
Covered levels: The levels between 10 dB above full scale (140 dB) and 120 dB below full scale (10 dB). The classes for the highest and lowest levels are extended to also include levels above and below, respectively.

Statistics

The Nor150 can be equipped with a statistical level distribution function. Up to eight percentiles can be shown numerically in a table. All of them are freely selectable. The class width is 0.2 dB over the entire 130 dB range. The statistical distribution calculation applies to all the spectral weighting networks (A, C and Z) as well as all the individual filter bands, octaves or third octaves, if they are measured. The selectable Ln values can be set to anything from 0.1% to 99.9%, both extremes included.

The cumulative and probability distribution functions can be shown graphically, and the values read out using the cursor buttons.

The back-erase feature, which deletes up to 20 (selectable 0 - 20) of the most recent seconds of acquired global data prior to a pause upon resuming, updates the statistics buffers as well as to maintain consistency.

For the statistical sampling the instrument makes use of any of the time constants F, S or I. Even Leq based statistics are selectable.

Note that you don’t have to define the percentile prior to the measurement. You may redefine the percentile as many times as you like – even after the measurement.

However, once you start another measurement or switch off the instrument, only the selected percentiles will be stored to keep the amount of stored data lower unless you specifically have selected to save the complete probability density function.

Indication on the screen of the Nor150

These indications are in use both on the graphical displays and on the numerical tables.

Time weighted sound levels are indicated on screen as follows based on Time Constant (F, S or I) and Weighting Networks (A, C and Z)

	A-Weighted	C-weighted	Z-weighted
F	LAF	LCS	LZS
S	LAS	LCS	LZS
I	LAI	LCI	LZI
F Max	LAFmax	LCFmax	LZFmax
S Max	LASmax	LCSmax	LZSmax
I Max	LAImax	LCImax	LZImax
F Min	LAFmin	LCFmin	LZFmin
S Min	LASmin	LCSmin	LZSmin
I Min	LAImin	LCImin	LZImin

Time averaged sound levels are indicated on screen as follows based on averaging type

	A-weighted	C-weighted	Z-weighted
Equivalent level	LAeq	LCeq	LZeq
Exposure level	LAE	LCE	LZE

"Takt Maximal" Averaged Levels. Only 5 second "takts" are calculated based on F and I time constant.

	A-Weighted	C-weighted	Z-weighted
F	LAFTM5	LCFTM5	LZFTM5
I	LAITM5	LCITM5	LZITM5

Indication range

The calibration of the instrument allows microphones with sensitivity in the range –84 dB to +15.9 dB relative to 1 volt/Pascal to be applied. The corresponding display range for the indicated sound level is –50 dB to +180 dB.

Self-noise levels

The self-noise is measured with the calibration set to –26.0 dB corresponding to a microphone sensitivity of 50 mV/Pa. For voltage input, the level 0 dB then corresponds to 1µV.

Z-network considerations. The Z-wide network requires several minutes to stabilize at a low level. The preamplifier between the microphone and the sound level meter is a very high impendence device and due to their construction they all have a noise spectrum with increased levels at lover frequencies. There may be relatively large variations in this noise level between the different samples of preamplifiers. It is recommended to have the high pass filter switched on when using the Z-network.

Electric self-noise

Noise measured with 18 pF microphone dummy and microphone preamplifier Nor1209, averaged over 30 s of measurement time and the high pass filter switched on.

Spectral weighting functions:
A-weighted: 14 dB
C-weighted: 18 dB
Z-weighted: 28 dB

Third octave filter bands:
0,4 Hz to 2,0 Hz: 48 dB
2,5 Hz to 6,3 Hz: 18 dB (High pass filter Off)
6.3 Hz to 20 kHz: 10 dB (High pass filter Off)
1/3 oct: 6,3 Hz to 20 kHz: 5 dB (High pass filter On)

Acoustic self-noise

The acoustic self-noise is measured with Nor1225 microphone and preamplifier Nor1209 connected.

The high-pass filter (in the Setup Input menu) shall be turned ON except otherwise noted.

The noise levels are given as equivalent levels averaged over 30 s of measurement time.

Spectral weighting functions:
A-weighted: 19 dB
C-weighted: 22 dB
Z-weighted: 32 dB
Z-weighted: 45 dB (High-pass filter OFF)

Filter bands:
1/3 oct: 0,4 Hz to 5,0 Hz: 45 dB (High-pass filter OFF)
1/3 oct: 6.3 Hz to 250 Hz: 15 dB
1/3 oct: 315 Hz to 20 kHz: 10 dB

Considerations for low noise measurements

If the measured level is within 5 dB of the acoustical self-noise given for the actual transducer, special care shall be taken not to underestimate the influence of the self-noise of the equipment. The measured value may be overestimated. If you know the correct low level limits for the transducer in use, it is possible to energetically subtract these numbers from your measurement results.

Measurement duration and resolution

Global (Overall) measurement: The total time for a measurement may be set from 1 second up to 7 days 200 hours less 1 second with 1 second resolution.

Timing accuracy: The measurement duration and resolution is locked to the extremely accurate internal clock. Within the temperature range 0°C to +40°C the maximum drift is ±3 ppm corresponding to an accuracy of better than 10 seconds per month. Aging for 10 years may increase the figure with additional 13 seconds per month.

Profile / level recorder measurements: The global period may be subdivided in shorter periods, designated profile time resolution from a few milli seconds up to 24 hours.

Starting and Stopping a measurement: If the software selectable start delay is set to zero seconds, the measurement will start (or Stop) within a short time (usually less than a second). But using the Start/Stop button involves a lot of communication inside the instrument. To have an immediate start of a measurement, within 10 ms, use an electric signal (or hand-switch) on the dedicated digital input line. In this way it is also possible to start measurements in several instruments simultaneously.

The stop function is always almost immediate. Never the less, a waiting symbol may be seen after the stop of the measurement. This is either due to that the measurement is stored, and that takes time dependent on the measurement itself and where in memory it shall be stored, or that the instrument is preparing for another measurement.

In synchro and repeat mode the stop of one measurement and the start of the next is handled without time gap. Then all the storing and memory organization is handled separated from the measurements.

Measurement ranges

These ranges are dependent of that the analog high pass filter at the input is turned on.

The “Lower Level” and “Upper Level” given in the tables below are given for the Nor1225/1209 transducer combination. The levels are independent of running on battery/mains adapter, connection to a PC/LAN or use of microphone cables providing the length of the microphone cable is less or equal to what specified in the preamplifier specification.

Total range for measurement of A-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	98	137	138	136	133
Lower level	24	24	24	24	24
Reference level	94	114	114	114	114

The “Reference level” shall be used as the start level when measuring the level linearity. Levels above the “Upper level” will normally indicate Overload. Self-noise of the system will typically be more than 5 dB below the “Lower levels”. These levels will normally indicate Under-scale.

The primary indicator range for compliance with IEC 60651 type 1 is 24 dB to 117 dB.

For compliance with IEC60804 type 1, the linearity range is 24 to 137 dB, and the pulse range 24 dB to 140 dB, respectively.

Total range for measurement of C-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	134	137	136	134	131
Lower level	30	30	30	30	30
Reference level	114	114	114	114	114

Levels above the “Upper level” will normally indicate Overload. Self-noise of the system will typically be more than 5 dB below the “Lower level”. These levels will normally indicate Under-scale. If C-weighted levels are used for linearity testing, then the “Reference level” shall be used as the start level of the test.

Total range for measurement of Z-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	137	137	137	137	137
Lower level	40	40	40	40	40
Reference level	114	114	114	114	114

Levels above the “Upper level” will normally indicate Overload. Self-noise of the system will typically be more than 5 dB below the “Lower level ”. These levels

will normally indicate Under-scale. If Z-weighted levels are used for linearity testing, then the "Reference level" shall be used as the start level of the test.

Measurement range for C-weighted peak levels

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	137	140	139	137	134
Lower level	45	45	45	45	45
Reference level	114	114	114	114	114

Levels above the "Upper level" will normally indicate Overload.

The Nor150 used for electrical measurements

By replacing the microphone with an input adapter (Nor1447) the instrument is well suited for electrical measurements. Alternatively the complete transducer can be removed and replaced with the BNC to Lemo cable type Nor1438.

Please note that when the Nor1438 cable is used it is needed to specify a new transducer with a new name in the sensor set up menu system. Then the instrument can also be configured to feed an IEPE device.

Electrical verification measurements

Electrical signals resembling the microphone signal is used to assess conformance to the specifications and the sound level meter standard. The input adapter Nor1447 with an internal capacity of 18 pF (± 20%) is then used for feeding the signal into the instrument.

The reference level is 114 dB SPL (10 Pa) and the nominal microphone sensitivity for Nor1225 is 50 mV/Pa, so the reference level shall be indicated with an input voltage level of 500 mV ± 3 dB.

Maximum allowed input signal for this purpose is 10 V rms that is equivalent to 140 dB SPL.

Power supply

After the instrument is turned on, it takes some time to boot up correctly. In addition to this all electronic parts (especially the 200 V polarization voltage) need some time to stabilize properly. It takes two minutes from the power is turned on until the instrument is ready for use.

Internal battery

Battery type: Li-Ion package (simply called Nor150/Battery) with power capacity control circuit. Each battery pack has a "fuel gauge" and its own serial number. The battery and the instrument are designed so the full battery capacity will last for a normal 8 hour work day.

Voltage: 7.4 V

Capacity: 3760 mAh

Charging time using Nor345A mains adapter:
4 hours (80% in 2 hours)

No other battery type than Nor150/Battery from Norsonic can be used in the instrument. Replacement or extra batteries are available from all Norsonic representatives.

The battery must be treated with care. Never store in a hot place or in direct sunlight. Keep free from moisture and dust.

Recycling: These types of batteries are poisonous.

Never waste the battery without knowing that it will be handled as required. If you are in doubt, return it to the Norsonic representative.

Power consumption

Typically 3.6 Watt dependent on selected modes of operation. External DC source should have source impedance less than 1 ohm and be able to supply at least 1.2A. The mains adaptor Nor345A is recommended for use with the instrument. If the external supply falls below 10V, the instrument will use the internal batteries if available. If the instrument has switched off due to loss of power or insufficient supply voltage, the instrument will automatically switch on and resume normal operation after reapplying the external DC supply.

External DC / Charging input

Socket for external DC: Lemo FFA 0.8 plug, Positive voltage on centre terminal.

The instrument will automatically switch off if the battery or external voltage is too low for operation within the stated specifications. The Nor150 can be used on external voltage without the battery installed.

- Nominal input voltage: 13.2 V
- Low / cutoff voltage: 10 V
- High input voltage: 28 V

The maximum power consumption is below 15 W.

Mains adapter Nor345A

The Nor150 is delivered with a mains adapter. This adapter can be fitted with connector for different mains systems.

- Input voltage range: 100 – 240 V AC, 50 – 60 Hz
- Output voltage: 13.2 V
- Max output current: 1.2 A

Display

Display type: Capacitive touch, trans-reflective colour display.

Display resolution: 272 x 480 pixels (W x H)

Backlight: Adjustable in the Setup Instrument menu

Update frequencies: The contents of the display are updated 2 times per second for numerical values, and graphical values are updated 10 times per second.

Keyboard

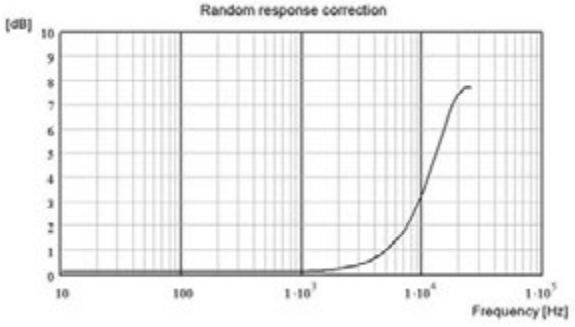
Keyboard type: Silicon-rubber type

Backlight: Adjustable in the Setup Instrument menu

Adjustment of indicated levels

Random response

The instrument is equipped with a microphone with flat free-field response and satisfies the class 1 requirements in IEC 61672-1 to free-field response. By selecting the random response correction network included, the instrument will satisfy the class 1 requirements in IEC 61672-1 to random response as well as ANSI S1.4-1997 type 1. The nominal correction to obtain flat random response is shown in the figure.

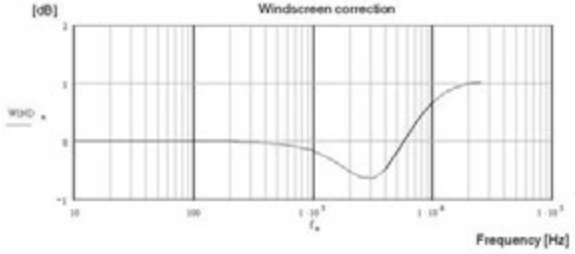


Windscreen

The instrument may be used with windscreen Nor1451. The windscreen correction has to be switched on to obtain the stated specifications when the windscreen is mounted.

When the wind screen is fitted and the correction is turned on the measurements performed will still be within the specifications of a type 1 sound level meter.

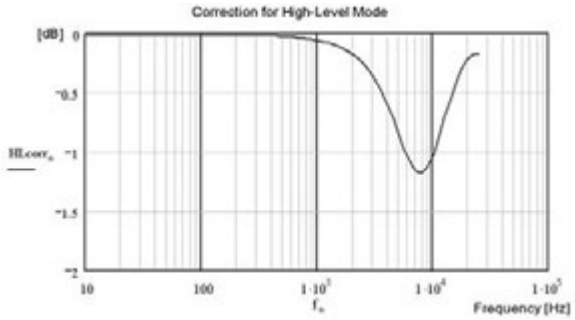
The wind screen correction data and uncertainties are shown in the table in pages 84 - 87.



High Levels

For Nor1225 which is a microphone that require 200V polarization voltage, the sensitivity can be reduced by approximately 10 dB by lowering this polarization voltage. The level range can therefore be extended without changing the microphone cartridge. This feature shall be used in combination with the Nor1225 cartridge only.

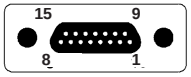
When this feature is selected, the polarization voltage is lowered from 200 V to 70 V. Lowering the polarization voltage after the tension in the diaphragm. A correction network is therefore applied automatically to compensate for the change in frequency response of the microphone due to the lower polarization voltage. Note that the needed correction will depend on the type of microphone, and shall only be applied when using microphone cartridge type Nor1225.



Diffraction around the instrument casing

The instrument casing and the microphone is designed to have low effects on the sound field in which it is measuring. Nevertheless there is some influence and it is also dependant on the environmental conditions. See the table in pages 84 - 87 for details.

The general I/O socket



Pin no.	Signal name	Direction	Remarks
1	DO-1	Out	General digital output control line
2	DO-2	Out	General digital output control line
3	DO-3	Out	General digital output control line
4	RTS	Out	RS232 Request To Send
5	TXD	Out	RS232 Transmit data
6	PWR	Out	3.3V. Max 100 mA
7	RES	In	Instrument reset (0 = Reset)
8	DI-1	In	External trigger input
9	DI-2	In	General digital input control line
10	DI-3	In	General digital input control line
11	AC-out(DO-4)	Out	AC signal output or digital output number 4 dependant on activated menu settings.
12	CTS	In	RS232 Clear To Send
13	RD	In	RS232 Read Data
14	GND		Reference for analog signals
15	SG-out		Noise / signal generator output
Housing	GND		Instrument housing

Signal output – Noise generator

An analog output from the internal signal (noise) generator.
Max output voltage: ±3 volt. Output impedance: < 100 ohm. The output is short circuit proof to GND and output current is in excess of 3 mA
Gain accuracy at 1 kHz: ±0.2 dB.
Frequency response re. 1 kHz: ±0,5dB for 20 Hz < f < 16 kHz.

Signal output – Microphone signal

The signal from one of the AD converters for channel 1 or 2 can be converted back to an analog signal and fed to this output. (Only channel 1 in this version.) The signal can be digitally amplified, but this will reduce the available dynamic range. It will also influence the self-noise level. A possibility for overload will increase.

Serial I/O port

RS232 port, 9600 – 115200 baud. The port may be switched off to reduce power consumption, which should be considered if an unused cable is attached to the socket.

Digital inputs

The digital input signals are 3.3V CMOS signals. The voltage levels must be within 0V to +5V to avoid harming the instrument. Voltages in the range 0 to 0.6 V will be accepted as Logical “0” and voltages above 2.5V will be Logical 1.

Input impedance: 10 kΩ connected to the positive supply 3.3 volt. Any open input will therefore be in the high state.

Digital outputs signals are 3.3V CMOS signals. Maximum output impedance: 100 Ω. During power-up the output lines will be low or in a high impedance state (100 kΩ to ground).

Digital output control lines

The Nor150 instrument has 4 general digital output lines which all can be used to alarm and control external devices or functions based on the internal status of the instrument. The digital output lines are named DO-1 to DO-4 (see the pin configuration of the general I/O sockets for connection details). The function of each digital output line is controlled / selected by the user through the Digital I/O menu or by remote control of the instrument.

NOTE! DO4 is special. It can be used both as a digital output line and as an analog AC signal output line controlled from the Analog output signal menu. If the DO4 is in use as an analog output, it cannot be used for other purposes, so the analog output function has priority.

The following functions are available for each of the output lines:

Running – The line goes active when the instrument is measuring
Recording S1 – The line goes high when sound recording is performed
Overload S1 – the line goes high when sound channel 1 is overloaded

Calibrating – The line goes high when you enter the calibration menu
Mic. Check. – The line goes high when the Mic check feature is enabled. Mainly used to start the electrostatic actuator calibration feature in the outdoor microphone 1210A or C
Remote controlled – The line goes high when the Nor150 is controlled from another device
High – The line stays permanently high
Low – The line stays permanently low
Events/Markers – The line goes high if an event or marker is enabled
Remote Output – This line may be controlled from remote via a PC.

The low signal level is 0 V while the high levels are 3.3 V.

The “In” and “Out” connectors located above the general 15 pin I/O connector will be supported in later SW versions.

Headset input and output socket

Both channels have identical signals driven by two separate amplifiers. Load impedance shall be 16 ohm or more. Output voltage is generated by the 48 kHz DAC based on data from DSP. Normally a replica of the normalized microphone signal. Full scale on the display bargraph corresponds to 100 mV. Output impedance: Less than 10 ohm, AC-coupled 100 mF. Gain accuracy 1 kHz: ±0,2 dB Frequency response re. 1 kHz: ±0,5 dB for 20 Hz to16 kHz.

LAN interface

This is the preferred way of communication with the instrument. The IP address is found in the **SETUP** > *Instrument* > *Communication* menu and the port number is set to 8501. The easy way is to set the Nor150 to automatically receive its IP address from the network.

USB interface

USB type 2.0 USB socket: B411

Data / Result storage

SD-card

The instrument may use SD-card for storing of setup information, sound recordings and measurement result. Memory size: Up to 64GB cards can be used. Please note that no file in the system may exceed the 4 GB limit given by the operating system. This file size is only possible to achieve with audio recordings, and it corresponds to a recording of approximately 8 hours using 48 kHz sampling 24 bit resolution or 92 hours of 12 kHz 8 bit resolution.

Internal memory

Set up and measured data can also be stored in the internal memory of the sound level meter or on the SD-card. The internal memory is of the “flash” type retaining the information without battery supply. Approximately 375 Mbyte is available for the data storage.

Environmental conditions

Reference conditions. The reference conditions for the instrument are as specified by IEC 61672-1 Temperature: 23°C Humidity: 50% RH Atmospheric pressure: 101.325 kPa

Environmental condition for operation Temperature: –10°C to +50°C Humidity: 5% to 90% RH, dewpoint less than 40°C Atmospheric pressure: 85 kPa to 108 kPa

Environmental condition for storage Temperature: –30°C to +60°C Humidity: 5% to 90% RH, dewpoint less than 40°C Atmospheric pressure: 50 kPa to 108 kPa

Warm-up time

The warm-up time for the main instrument without preamplifier/microphone is very short and the instrument obtains the final accuracy as soon as the self-test is made. Used with a preamplifier and microphone, this time is prolonged due to the charging of the microphone with the polarisation voltage. Normal sensitivity is reached within two minutes. Before a recalibration is attempted, at least three minutes for warm-up is recommended.

Changes in the environmental conditions

Normally the environmental conditions do not change that rapidly in a room or during a measurement that this causes any problem for the sound level analyser. But when the Nor150 is brought from one room to another or from outdoor to indoor the changes in the temperature and humidity can be so large that special precautions should be taken.

Condensation in the microphone may destroy it permanently.

Excessive condensation may cause permanent damage to the whole instrument.

Typically the stabilization time after a large change in the environmental conditions is 15 minutes.

Sensitivity to static pressure

The sensitivity for change in the atmospheric pressure is low for Nor150 sound level meter: Typically -0.01 dB/kPa for frequencies at and below 1 kHz. At such frequencies, for a static pressure of 85 kPa the sensitivity will increase typically 0,2 dB and for 65 kPa typically 0,4 dB. For higher frequencies the pressure sensitivity is even lower up to about 7 KHz where the pressure coefficient changes from negative to positive.

A sound calibrator with known pressure sensitivity may be applied to set the correct sensitivity at the prevailing atmospheric pressure; alternatively a correction based on typical values may be applied.

Sensitivity for vibration

If the instrument is used under strong vibrating conditions, it is recommended to use an extension cable between the preamplifier and the instrument body. The vibration will mainly affect the microphone.

A mechanical vibration with an acceleration of 1 m/s2 with a direction parallel to the microphone membrane for any of the frequencies 31,5 Hz, 63 Hz, 125 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz, or 1,0 kHz, will increase the lower boundary of the measurement range to 53 dB(A).

A mechanical vibration with an acceleration of 1 m/s2 with a direction nominal to the microphone membrane for any of the frequencies 31,5 Hz, 63 Hz, 125 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz, or 1,0 kHz, will increase the lower boundary of the measurement range to 76 dB(A).

Sensitivity for magnetic fields

The maximum indication for exposure to magnetic field (50 or 60 Hz) of 80 A/m and any orientation is typically less than 15 dB except for the 50 Hz 1/3rd octave band filter (or 63 Hz octave band) where the influence may be up to 25 dB.

Sensitivity for radio frequencies

The Nor150 conforms to the requirements in the IEC 61672. The deviation of the measured sound level due to the standardized test radio frequency field is less than 1.3dB.

The most sensitive setup is when the Nor150 is connected via an extension cable (Nor1208/50) to the preamplifier Nor1209 and microphone Nor1225.

In addition a mains power (Nor345A) and a 3 meter LAN cable shall also be connected. The instrument and cables are lying on a table with the display facing the source. The microphone cable is rolled up and the mains adapter and LAN cable are stretched out.

The operating mode during this test (which is supposed to give the highest influence of the radio field) is when a measurement is running with the profile mode activated, and the profile length is set to less than 100ms.

Emission of radio frequencies

The Nor150 conforms to the requirements in the IEC 61672. The actual setup for the verification is when the Nor150 is connected to the preamplifier Nor1209 and microphone Nor1225.

In addition a mains power, Nor345A, and a 3 meter LAN cable shall also be connected.

The instrument and connected cables are lying on a table with the microphone facing the testing antenna.

The operating mode during this test (which is supposed to give the highest influence of the radio field) is when a measurement is running with the profile mode activated and the profile length is set to less than 100ms.

Sensitivity for AC power frequency

The sensitivity for a mains power frequency field is small. The instrument performs according to the requirements in the sound level meter standard when the microphone / preamplifier is connected to the instrument's input socket . The worst situation that can occur is when a microphone extension cable and an AC power line are positioned very close and parallel to each other – which should be avoided.

Recovery after electrostatic discharge

The Nor150 is constructed to have high immunity towards electrostatic discharge as required in the sound level meter standard. It will operate normally when exposed to a contact discharge of ± 4 kV or an air discharge of ± 8 kV. If an even more powerful electrostatic pulse reaches the instrument, it might restart. After this, the instrument (if not destroyed) will go through a normal start up sequence and continue operation. If this happens, a qualified service technician shall inspect the instrument, and specially the microphone, to verify the performance of the device.

Size and weight

Depth: 30 mm
Width: 75 mm
Length, excl. microphone/preamplifier: 210 mm
Length, incl. microphone/preamplifier: 292 mm
Weight (incl. Preamplifier and microphone): 700g

Index

Symbols

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W

Norsonic

Declaration of Conformity

We, Norsonic AS, Gunnersbråtan 2, N-3408 Tranby, Norway, declare under our sole responsibility that the product:

Precision Sound & Vibration Analyser Nor150

to which this declaration relates, is in conformity with the following standards or other normative documents:

Performance complying with:

IEC61672-1 Class 1	ANSI S 1.4 1983 type 1
IEC 60651 Type 1	ANSI S 1.43 1997 class 1
IEC 60804 Type 1	ANSI S 1.11-2004 class 1
IEC 61260 class 1	EN 61010-1
IEC 61043 class 1	

This product has been manufactured in compliance with the provisions of the relevant internal Norsonic production standards.

All our products are tested individually before they leave the factory. Calibrated equipment—traceable to national and international standards—has been used to carry out these tests.

During the RF emission test the following was connected: LAN cable (3m), mains adapter Nor345A, microphone preamplifier Nor1209 and microphone Nor1225. Setup: Measurement duration 1h, Frequency mode parallel; 1/1 octave, all weighting networks on.
During the RF immunity test the following was connected: LAN cable (3m), microphone preamplifier, Nor1209 and microphone Nor1225. Setup: Frequency mode parallel; 1/1 octave, all weighting networks on. Orientation: Laying face up on the table and the microphone was pointing towards the antenna.
During the AC power frequency field test the following was connected: microphone preamplifier Nor1209 and microphone Nor1225. Setup: Frequency mode parallel; 1/1 octave, all weighting networks on.
The orientation of the instrument in the magnetic field had no influence. During the ESD test the SPL value may show some fluctuations from the ESD pulse. Power supply: Battery voltage 7.2V. External DC voltage 13.2V.

This Declaration of Conformity does not affect our warranty obligations.

Tranby, February 2017

Dagfinn Jahr
Quality Manager

The declaration of conformity is given according to EN 45014 and ISO/IEC Guide 22.

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Norsonic AS supplies a complete range of instrumentation for acoustics – from sound calibrators, microphones and preamplifiers; via small handheld sound level meters to advanced, yet portable, real time analysers, but also spectrum shapers, building acoustics analysers and complete community, industry and airport noise monitoring systems. Contact your local representative or the factory for information on our complete range of instrumentation.