

Sound Analyser Nor140

 **SIAFA**[®]
Higiene Ocupacional y Medio Ambiente



Applications:

- Environmental noise
- Sound recording
- Building acoustics
- Reverberation time
- Noise source identification
- Industrial hygiene
- Low frequency measurements
- Remote noise monitoring
- Product development
- Quality control
- Sound power
- Speech intelligibility - STIPA
- Vibration measurements
- HVAC noise
- Low noise measurements

Features:

- Precision integrating sound level meter to IEC 61672 class 1
- Handheld real-time 1/1- or 1/3-octave frequency analyser (0,4Hz-20kHz)
- Measurement of A-weighted levels simultaneously with either C- or Z-weighted levels
- Parallel detection of SPL, L_{Eq} , L_{min} , L_{max} , L_E and L_{peak}
- 120 dB dynamic range giving a “one-range” instrument
- Measures L_{peak} levels up to 140 dB
- Parallel detection of F, S and I time constants
- USB 2.0 and High-speed RS-232 serial interface (115 kbaud)
- SD memory card and large high speed internal memory
- Sound recording in 8, 16 or 24 bit format with 12 or 48 kHz sampling
- Up to 90 sec high, contrast, graphical audio recording pretrigger
- High-resolution graphical backlit display
- Manual or automatic storage of results
- Automatically repeated measurements with clock synchronization
- Pause/Continue function with back erase feature
- Results displayed as dB or linear values
- Numerical printouts
- AC output signal
- Signal generator
- Windscreen correction
- Noise floor correction
- Support for IEPE sensors
- NC, NR and RC rating
- Multiple language selection
- Moving L_{eq}

Approved by:

- PTB Germany
- LNE France
- CEM Spain
- BEV Austria
-and others

The Nor140 – more than just a Sound Level Meter

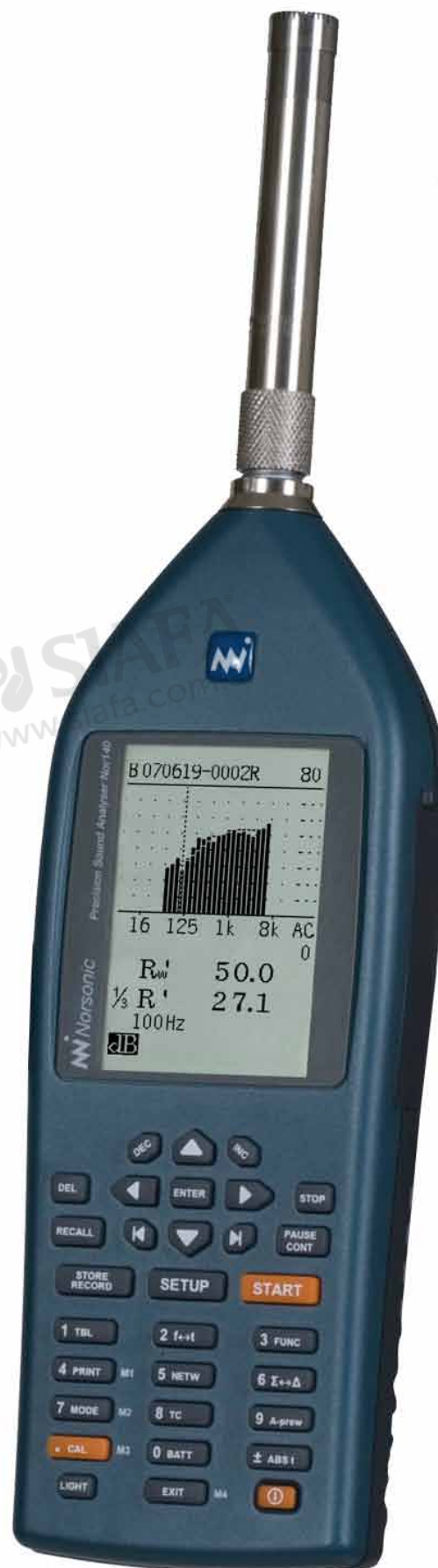
The precision handheld sound analyser Nor140, covers the widest range of applications, packed into the smallest real time analyser featuring sound recording present on the market today!

Norsonic's philosophy has always been to cover all possible applications within one modular instrument platform. We were the first company introducing software options. This enables functional expansion to take place when you need it and not necessarily at the time you purchase the instrument. The design is based on decades of experience making intuitive and easy to use field instrumentation. The Nor140 is Norsonic's second generation of handheld sound level meters featuring sound recording.

The Nor140 is more than a Sound Level Meter, it is a measurement platform used in Environmental Noise Monitoring Systems as well as a front end in Nor850 - our Multi-channel Building Acoustic and Sound Power Analyser.

Quality and durability - 3 years warranty

After the introduction the Nor140 immediately became a success. The user-friendliness, the broad range of applications covered by this single instrument and associated PC software makes the Nor140 to a market leader. It is covered by a 3 years warranty and is type approved by all the prestigious national approval laboratories worldwide, such as PTB in Germany and LNE in France. The Norsonic retrofit policy, allowing the users to add options later when needed, the frequent release of new software features combined with durability and Norsonic quality ensures that you do the right decision when purchasing a Nor140.



The instrument platform

By listening to key customers and our long experience in designing sound level meters, every effort has been made to design a rugged, small and light-weight, yet powerful instrument platform.

Clear display - user friendly

The large backlit display with a mirror effect is excellent to read in sunlight. The backlight is only needed in dark environments.

The instrument is designed to be operated by the same hand that holds the instrument. There is no need for a stylus. Real keys ensure tactile feedback to the user. The dust and splash proof rubber covers for the connectors and SD memory card together with the high friction coating on rear cover ensures an optimum grip and user comfort. A range of factory setup together with the possibility for the user to create his/her own setups minimise the risk of making mistakes when preparing the instrument prior to a measurement run. For simple use, the three orange buttons is what is needed to make a measurement; power on – calibrate – start measurement.

Memory – Storage handling

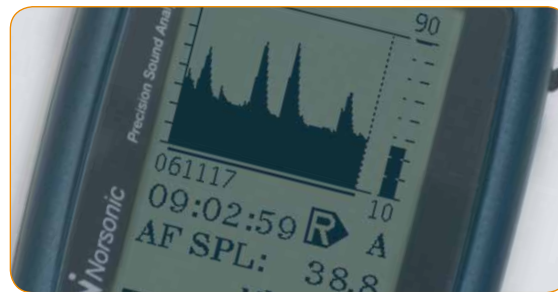
The instrument contains both an internal memory and an exchangeable SD memory card. The internal memory features the same structure as the SD card, but it is mainly intended for high-speed sampling applications. A backup copy of the current measurement is made every two minutes. This ensures that if a power interrupt occurs, a maximum of two minutes of data may be lost. The measurement is also automatically saved when a battery low warning is given. A special feature is making the instrument to auto restart and continue to measure after a power failure condition. This is especially useful for long term monitoring applications. To optimise the user friendliness four types of storage modes are supported:

Manual: The user manually stores the measurement.

Automatic: The instrument stores all results automatically when a measurement is completed or if stop is pressed.

Repeat: Same as automatic but it automatically restarts a measurement.

Synchronous: Same as repeat but the first measurement will be truncated to allow synchronisation to the next whole clock hour.



Interfaces and connectors

The instrument has one USB 2.0 high-speed data interface and one high speed RS232 interface. The multi I/O socket additionally contains several digital I/O ports for different control applications such as remote start/stop of the measurement process or audio recording and Go/NoGo signals for quality control applications. Two analogue outputs are available. One is dedicated to the signal generator output (optional), the other for AC output of the measured signal. A separate connector is available for Tacho meter (RPM) input.

The microphone input connector is a traditional 7 pin LEMO connector. This standard was invented by Norsonic in the early nineties, now widely adopted by most of the world's sound measuring equipment manufactures. In the Nor140 we have added two useful features to this standard, improving its original functionality. Firstly IEPE® power is added thereby allowing the use of signal line powered sensors such as accelerometers and electret microphones with IEPE® preamplifiers. This removes the need of expensive adaptors or cables for connection to the instrument. The second feature is the built-in calibration oscillator for verification of outdoor microphones; a great advantage on long term noise monitoring projects.

Power management

Our users told us that it is important to be able to change batteries in the field, and that the unit must use standard batteries that may be obtained anywhere. Hence, we designed it to use four standard AA-cell batteries. However, the instrument also accepts rechargeable batteries. A battery monitor tells the user the status of the batteries. The instrument may also be directly connected to any 12V source such as a car battery via the external DC input connector. An interrupt free inter-connection between internal batteries and external powers ensures a power system with the highest possible security.

Preamplifier and microphone

The Nor140 is delivered with a 1/2" microphone Nor1225 and preamplifier Nor1209. In some markets Nor1227, a prepolarised version of Nor1225 is delivered. Both types are a 50mV/Pa free field microphone. The instrument has user selectable diffuse field (random incident) and windscreen correction networks. The preamplifier Nor1209 is a low noise preamplifier that can drive long microphone cables

without any loss in performance. For special applications other types of microphones and preamplifiers, such as 1/4" types or 1/2 " low noise microphone systems like the GRAS 40HL may be connected. The preamplifier Nor1209 has a built-in microphone check facility (SysCheck) allowing remote verification of the Norsonic range of outdoor microphones.

One measurement range

The Nor140 has more than 120 dB dynamic span in a single measurement range. This makes the use of the instrument easy since there is no gain control to adjust; all measurements are covered by one range. The wide dynamic range covers all applicable functions such as the spectral weighting networks, real time 1/1- and 1/3-octave filters as well as the FFT option.

In order to extend the flexibility of the instrument a special high range mode can be selected. This shifts the upper measurement range by 10 dB to 150 dB with the standard Nor1225 microphone and up to 190 dB with special 1/4" microphones.

A self-noise compensation feature can also be selected to extend the lower measurement range of the A, C or Z network. This typically extends the measurement range downwards by 7 to 10 dB.

The Measured functions

The functions available with the Nor140 include

SPL	Time-weighted Sound Pressure Level (F, S, I)
L_{max}	Maximum Time-weighted Sound Pressure Level
L_{min}	Minimum Time-weighted Sound Pressure Level
L_{eq}	Time-Average Sound Pressure Level
L_{eqI}	Time-Average Impulse-weighted Sound Pressure Level
L_E	Sound Exposure Level
L_{EI}	I-Time weighted Sound Exposure Level under measured functions
L_{peak}	Maximum Peak Level
L_N	Statistically Calculated Exceedance Level
RT	Reverberation time, T20 and T30 (Optional)
NC	Noise Criteria value
NR	Noise Rating value
RC	Room Criteria value

STIPA Speech Transmission Index for Public Address system (Optional)

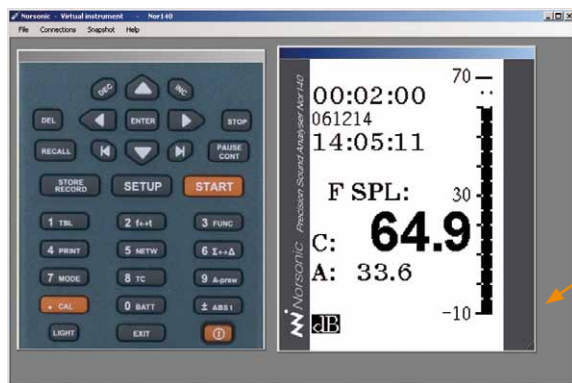
T_{max5} "Takt Maximalpegel" according to DIN45657 (Optional)

Moving L_{eq} with adjustable window length (Optional)

The spectral weighting functions A- and C- or Z-weighting are available for all functions including the L_{peak} . The SPL, L_{max} and L_{min} functions are measured for all the three time constants F, S and I. All the above functions are also measured in each band if 1/1 or 1/3 octave analyses extensions are added with the exception of L_{peak} .

NorVirtual instrument

Included in the Nor140 delivery is the Virtual Instrument software; a PC program that brings a virtual version of the instrument onto your PC screen. The user may remotely operate the keyboard, and view a picture of the instrument display on the PC screen. A useful tool for seminars, schools and similar applications where more than one person needs to view the operation of the instrument and the display.



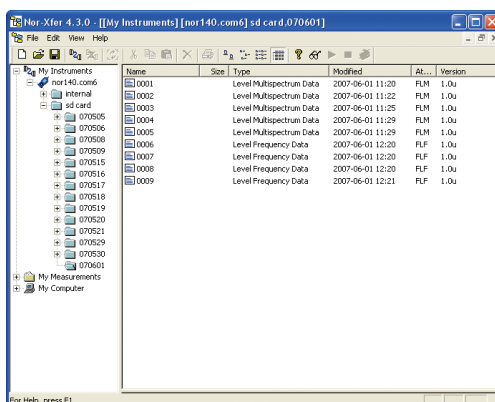
NorVirtual

NorXfer

Also supplied with the instrument is the PC data transfer software NorXfer. This program transfers and converts the measurement results from the internal memory or from the SD memory card to the PC. The data can then be seamlessly used by all other Norsonic post processing programs, such as NorReview, NorBuild or NorPower.

NorReport is an add-in module to the NorXfer. This reporting program enables the user to create Excel templates for calculation and reporting. A vast range of standard templates exist to cover for the local markets need. The measured data can also be directly converted into Excel or text files

Two optional extensions (not included in standard delivery) can be added to NorXfer. Option 1 is modem control, and option 2 is remote control of all Nor140 functions and setup parameters.



NorXfer

The Nor 140 as an Environmental noise monitoring analyser

The large memory and the time synchronising capabilities of the Nor140 makes it well suited to any environmental noise measurement and as a front-end in noise monitoring systems – perfect for community noise as well as indoors in workshops etc.

The high dynamic range makes the setup easy and ensures reliable measurements in all situations.

Source identification is possible thanks to the sound recording feature and eight markers, where four can be set for independent source coding.

- Huge memory, both internal and on a removable SD card
- Sound recording
- 8 marker functions
- Precise internal clock for accurate timing between several Nor140 instruments
- Profile measurements with level vs. time resolution from 25ms to 199h
- Multi spectrum
- Statistical calculations, even in frequency bands
- 120dB dynamic range, also for the 1/1-octave and 1/3-octave real time filters
- Pure tone detection
- Microphone check
- Advanced post processing reports using NorReview software
- L_{den} calculation using NorReview software

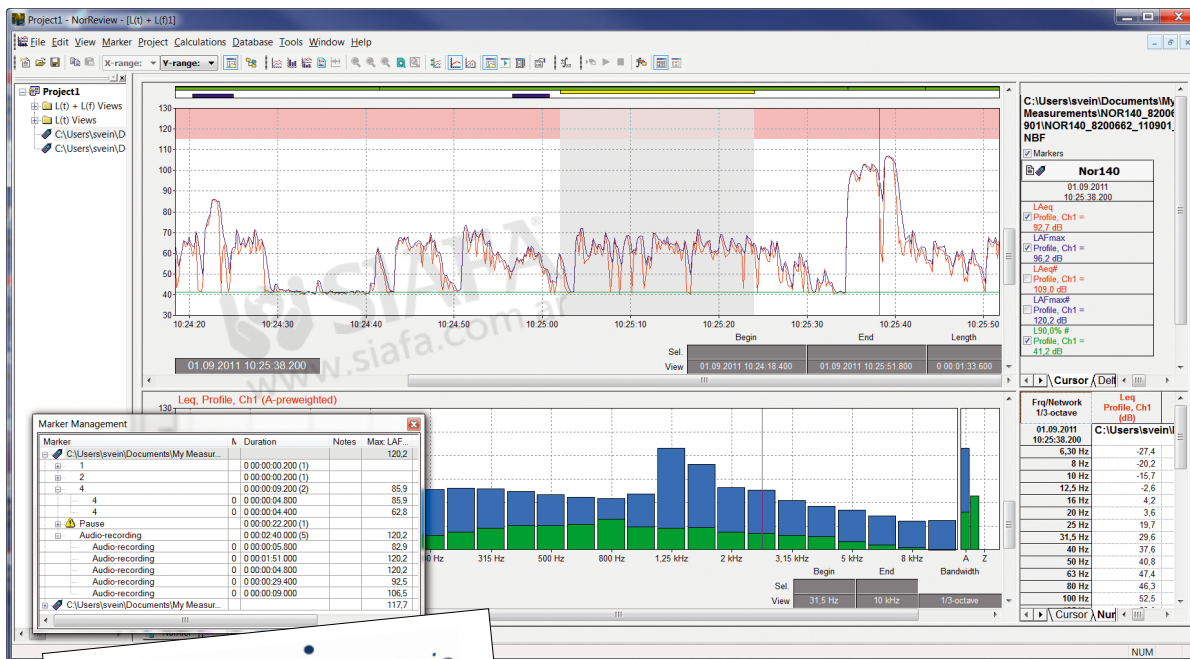
The Nor140 is designed to be left unattended for monitoring noise either as a measurement device in a larger sound monitoring system or semi-permanently for some days or weeks. The measurement results can be collected by swapping the SD memory card or downloaded via modem or LAN/WLAN/Bluetooth connections. In the latter case the remote control program NorMonit can automatically control this process. A manual remote option is possible using NorXfer with applicable software extensions.

An internal sine wave calibration oscillator feeds a calibration signal to the preamplifier/microphone combination (SysCheck) to perform a daily microphone check - no external device or power supply is needed.

NorReview is a powerful tool for analysing and reporting the captured data. NorReview is, as other Norsonic products, modular and provides in its basic version a view of L(t) data and will perform basic calculations and reporting. Fully configured the software can perform L_{den} calculations, automatic event reporting and calculation, replay of sound files with moving cursor along the L(t) graph, multi project handling including storage of pictures, text files etc. along with the measurement data.

*Nor1210 and Nor1216 outdoor microphones,
Nor1520 and Nor1530 environmental cabinets*





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Customer: _____

Project title: _____
Project description: _____

Notes: _____

Project file name: _____ Serial no: _____
Project responsible: _____ Serial no: _____

Instrument type: _____ Serial no: _____
Pre-amplifier type: _____ Serial no: _____

Microphone type: _____ Serial no: _____
Traceable periodic verification laboratory: _____ Serial no: _____
Date of last verification: _____

Calibration type: _____ Operation: _____
Traceable periodic verification laboratory: _____ Date: _____
Date of last verification: _____

Microphone position: _____
Measurement title: _____
Measurement duration: 0 00:00:06:000
Instrument sensitivity: 29.3 dB
Wind calibration level: _____

LAeq = 59.4 dB LAFmax = 87.2 dB

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Calibration type: _____ Operation: _____
Traceable periodic verification laboratory: _____ Date: _____
Date of last verification: _____

Microphone position: _____
Measurement title: _____
Measurement duration: 0 00:00:06:000
Instrument sensitivity: 29.3 dB
Wind calibration level: _____

LAeq = 89.4 dB LAFmax = 90.1 dB
LC peak = G_C_PE dB LAF95% = 89.0 dB

Nor1026 NorReview software

A special pure tone extension is available in order to perform tonal analysis.

NorReview may also be extended to display real time data on line in a noise monitoring system, in either single or multi-channel configurations.

Due to its flexibility and easy remote control programming, the Nor140 is widely used by many prestigious customers in their measurement applications. An example is Topsonic, a world leading company supplying advanced Airport Noise Monitoring systems. The Nor140 has been supplied to a numerous airports worldwide as a part of Topsonic's Airport Noise Monitoring systems.

Norsonic offers a complete line of products for use in environmental noise monitoring systems. We supply enclosures for permanent monitoring installations, environmental cases for semi-permanent installations, outdoor microphones for applications in tough environments, cables, modems, weather stations and post-processing software.

Noise nuisance recorder

The Nor140 is the third generation of noise nuisance recorders from Norsonic. This is a very cost effective method of investigating domestic noise complaints, particularly those occurring outside normal office hours.

A novel approach to this application is embodied in the Nor140 through its digital recording of the actual sound at the same time as the measurement.

All calibration and range settings automatically relate to both the measurement and recording part of the system greatly simplifying the set up; there is even a default “annoyance recorder mode” that can be accessed directly when switching on.

The instrument is housed within a tamper proof case and the only external components are the measurement microphone, mains connections and the plaintiffs hand switch. This hand switch has been specifically designed to make it suitable for use by subjects with limited manual dexterity and will activate the audio record for a predetermined period; the default setting is 60 seconds but may be set for any period between 1 second and 24 hours.

The default set up also provides up to 90 seconds of pre-trigger recording allowing the vital information occurring just before the switch was pressed to be recorded.

With the Video Noise Nuisance Recorder system Nor521A, Norsonic sets a new standard for this measurement application. The System is hosted in a small weatherproof case with a Nor140 and a small robust PC recording the video along with the noise

and audio data from the Nor140. Unlike CCTV, video recording is only collected/stored when a hand-switch is activated or set trigger levels are exceeded – which saves valuable officer time. The system offers a one minute video and audio pre-trigger.

Pure tone detection

Many environmental noise measurement criteria require compensation for the presence of pure tones. These standards are now moving away from the earlier purely subjective method of tone detection to a more scientifically quantified method. These methods require a detailed FFT analysis, and masking calculations, carried out to determine the prevalence of audible tones.

The optional FFT mode together with the NorReview software will enable you to analyse the noise in accordance with these new requirements. As a spin-off, any measurement task requiring the auto-spectrum of a full frequency range FFT with less than 3 Hz line separation is also supported.

The measured noise spectrum is shown as a normal FFT spectrum during the acquisition process.



Video noise nuisance recorder system Nor521A

Building acoustics

Sound insulation measurements

The Nor140 with the Building Acoustics option is a complete measurement tool for making both airborne and structureborne (impact) sound insulation measurements in accordance with the ISO 140, ASTM, and other national standards. A step-by-step menu takes the operator through all required 1/3-octave real-time measurements until the final sound reduction index is presented graphically on the screen in accordance with the ISO 717 Standards. Other national indices may be calculated in combination with the optional NorBuild software.

This feature includes analysing sound level measurements and averaging of multiple microphone positions, both in the source- and the receiving-rooms, measurement of the background noise level as well as measurements of the reverberation time in multiple locations in the receiving room. An on-board calculator uses the actual room dimensions to calculate the room volume V and insulation area S . The correct sound reduction index (R_{w} , $D_{nT,w}$, $D_{n,w}$, $L_{n,w}$ or $L_{nT,w}$) is then presented graphically on the instrument screen.

Alternatively, the Nor140 may be used to measure the survey grade sound insulation based on 1/1-octave real-time frequency spectra in accordance with the ISO 10052 Standard.

Reverberation time measurements

The Nor140 measures the reverberation decay based on either impulse or noise excitation. All frequency bands are measured either in 1/1- or 1/3-octave real-time spectra, and presented on the screen one-by-one.

Two reverberation time values are calculated for each decay in each frequency band. The T_{30} is calculated from 5 dB below the excitation signal down to 35 dB, but the Nor140 will additionally calculate the T_{20} value. All values are normalised to the required 60 dB decay time.

On-board noise generator

The Nor140 is equipped with an on-board noise generator supplying both white and pink noise. During the level and reverberation time measurements, the generator is turned on and off in synchronization with the actual measurements.

The generator contains a unique spectrum shaper feature allowing the adjustment of source room noise in accordance with the requirements in ISO 140 part 3 and 4. This requirement set a maximum value of 6 dB between all neighbour frequency bands. Simply run a short test measurement and the source room spectrum will be modified as close as possible to this requirement.





Complete reports

The Nor140 building acoustics measurements are seamlessly transferred to a PC for further post-processing. The full sound insulation report is generated by use of the NorBuild software package, and the final report sheets are calculated in accordance with ISO 140/717, ASTM or other national standards.

Wireless measurement system

By connecting the Nor520 Bluetooth transceiver, one Nor140 may be used as one wireless measuring channel in the Nor1516B wireless sound insulation system. By using two separate Nor140 instruments in such a system, the operator gets a unique wireless measurement system that performs complete sound insulation measurements in the field without all the hassle and problems of long microphone extension cables.

Swept-Sine measurement technique

The recent ISO 18233 Standard opens up for use of alternative measurement techniques for sound insulation testing. Hence, the Nor140 together with the CtrlBuild control software is optionally available with the new SweptSine measurement method. This new technique is useful when measurements have to be performed in background noise conditions where traditional technique will not enable any measurements to be made at all.

SweptSine technique may also be used for the measurement of extremely short reverberation times.

Remote measurement control, single dual or multichannel

Norsonic offers two solutions for full PC control of the actual Building Acoustic measurement process. The reporting program NorBuild software may be extended with the CtrlBuild module. By use of this module, the user may perform dual channel sound insulation measurement controlling two Nor140, either using cables or wireless using the Nor520 long range Bluetooth system. The software allows the user to retake measurements by serial scanning through the frequency range using 1/3-octave band filtered noise. This feature is handy when background noise is high compared to the measured receiving room levels. Norsonic also offers the state of the art building acoustic analyser system, Nor850, where the Nor140 may be used as a front end. The Nor850 takes the user interface to another level of user friendliness and its sophistications supports all needed functionality both for field and laboratory use. Both systems support the SweptSine measurement technique offered by the Nor140.

Other applications

Speech intelligibility – STIPA

The speech transmission index, STI, has shown to be a valuable tool for objective assessment of the speech intelligibility. The basis for the STI-index is that speech intelligibility is to a large extent based on the slow amplitude modulation of octave band sound levels due to the acoustic environment in the test area.

A simplified version of the STI-metric, known as STIPA, is an option in the Nor140 instrument. Adding the STIPA option to Nor140 turns the analyser into a powerful tool for analysing the Speech Transmission quality in public areas. The method can be used to compare the speech transmission quality at various positions and under various conditions within the same listening space. STIPA replaces the former used RASTI method as a more accurate method compared to RASTI.

A measurement in one listening position takes about 13 sec. Unlike many other STIPA measurement systems, the Nor140 can also correct the results for the background noise. In addition all calculated indexes are displayed, not only the single STIPA value. This feature is valuable for engineers optimising the room acoustics in public spaces or other areas where the speech quality is important.

The method is made according to the requirements in IEC 60268-16 (2003-05): Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index.

The option includes an audio-CD with the required excitation signal. The STIPA-method is suitable for assessing speech intelligibility in rooms or auditoria as well as for public address systems. It may in general be used as a replacement for RASTI which normally should be applied only for room acoustic measurements. The result is presented as a STI-value and a CIS-value. The latter is normally used for assessing the quality of sound systems for emergency purposes (IEC 60849).

Vibration measurements

Thanks to its broad frequency response the Nor140 is suitable for both sound and vibration applications. The low frequency response extends down to 0,4 Hz in 1/3 octave band mode and FFT mode. The results can be displayed in dB or in Engineering Units.

IEPE® powered accelerometers can be directly connected to the instrument without use of any external power supply. Norsonic supplies a carefully selected range of accelerometers, all IEPE® powered, well suited for use with the Nor140.





Sound power

Sound power level may be calculated from sound pressure level measurements using almost any type of sound level meter. However, the methods described in the different standards involve quite a lot of calculation before the final sound power figure can be reported.

The Nor140 supports on board measurements and calculations according to ISO 3746. You simply specify measurement surface, its dimensions, the location of your measurement object (on the floor, against a hard reflecting wall or in a corner), apply the correction factors and start your measurement. The sound power will then be calculated and displayed in a tabular form.

Norsonic offers two solutions for full PC control of measurement and calculation of Sound Power according to various standards, such as ISO 374x. The simple solution is NorPower. The program guides you through the measurement process and reports the data as described in the standard. NorPower is a valuable tool for engineers working with product development, product control or certification. The program allows you to use single channel measurements using Nor140 as a frontend.

For multichannel Sound Power measurements, Norsonic offer a state of the art solution with the Nor850 analyser, where the Nor140 may be used as a front end. The Nor850 takes the user interface to another level of user friendliness and its sophistications supports all needed functionality both for field and laboratory use.

Audiometer calibration

Audiometry is the testing of hearing ability. Audiometric tests determine a subject's hearing levels with the help of an audiometer. For reliable test results, it is essential that audiometers are regularly calibrated in accordance with the relevant standards.

Nor140 can be equipped with the option for audiometer calibration which provides the ability for acoustical measurement of frequency and level of the test signal as well as harmonic distortion.

Measurement take only 2 seconds and is performed in an intuitive way presenting the 1/3 octave band spectrum together with a result table containing values for frequency of the test tone, level of the test tone, $L_{z,eq}$ and harmonic distortion.

Optional extensions

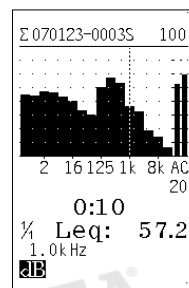
The Nor140 may be extended with a large selection of optional features, thereby allowing you to tailor the instrument to your specific requirements. Optional features may be ordered and installed at any time by just adding a new set of option codes.

Norsonic is continuously improving the features in the No140. New firmware adding new features to the instrument is frequently released. This ensures the user that a Norsonic instrument is kept up to date years after the initial purchase. We therefore reserve the rights to amend any of the information given in this leaflet in order to take advantage of new development.

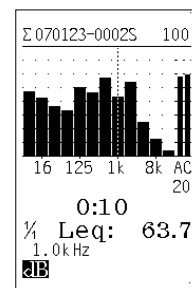
Option 1: 1/1-octave real-time filters

- Parallel 1/1-octave real-time filters covering the 0.5 Hz - 16 kHz frequency with full dynamic range.
- All filters fulfil the IEC 61260 class 1 digital IIR base 10 requirements and ANSI S1.11-2004 Class 1.
- 120 dB "one-range" even in the filter band.
- Results are displayed both graphically and numerically.
- A-weighting (pre-weighting) feature available on displayed results.

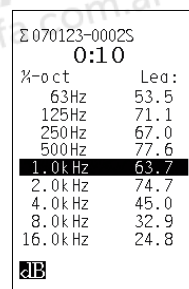
When fitted with option 1, the Nor140 can perform real time frequency analysis in octaves covering the frequency bands 0.5 Hz to 16 kHz in one range. A limited frequency range 8 Hz - 16 kHz can be set in order to avoid low frequency noise. A 3 Hz 3rd order high pass filter is then enabled in the analogue input stage to prevent overload due to low frequency noise. The wide frequency range with full dynamic range of more than 120 dB makes the instrument well suited for both vibration and noise measurements.



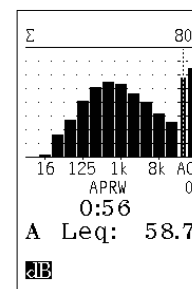
1/1-octave spectrum
0.5 Hz - 16 kHz



1/1-octave spectrum
8 Hz - 16 kHz



1/1-octave
numeric table



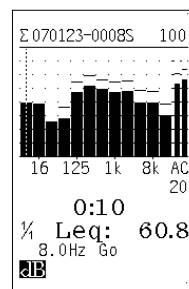
1/1-octave spectrum
A-weighted

Option 2: Reference spectrum with "Go/NoGo" comparison

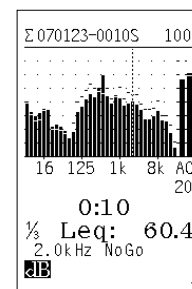
- Compare any measured frequency spectrum with a pre-selected reference spectrum.
- Both upper and lower reference spectrum available.
- "Go/NoGo" warning for quality control applications.
- TTL output signal for automated systems.

The reference spectra feature is used for comparison of any measured frequency spectrum with a pre-selected user defined spectrum. It functions for 1/1-octave, 1/3 octave and the spectral weighting networks. The measured spectrum may be compared to an upper limit, a lower limit or both. If the measured signal exceeds the boundaries, a "NoGo" warning is given on the screen, and a digital signal is set on the I/O port. The "NoGo" flag is also stored as a part of the measurement. The "Go/NoGo" comparison is selectable between instantaneous during a running measurement or after a measurement is elapsed. The duration of digital output signal may be set between 0 and 99 sec. Option 2 requires that minimum option 1 be installed!

An alarm lamp kit, Nor268 with opt.1, is available as accessories.



1/1-octave
reference spectrum



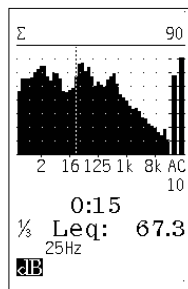
1/3-octave
reference spectrum

Option 3: 1/3-octave real-time filters

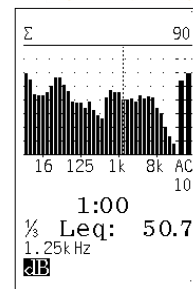
- Parallel 1/3-octave real-time filters covering the 0.4 Hz - 20 kHz frequency range in one span.
- All filters fulfil the IEC 61260 class 1 digital IIR base 10 and ANSI S1.11-2004 Class 1 requirements 120 dB "one-range" even in the filter bands.
- Results are displayed both graphically and numerically.
- A-weighting (pre-weighting) feature available on displayed results.

When fitted with option 3, the Nor140 can perform real time frequency analysis in 1/3 octave covering the frequency bands 0.4 Hz to 20 kHz in one range. A limited frequency range covering 6.3 Hz - 20 kHz can be set to avoid low frequency noise. A 3 Hz 3rd order high pass filter is then enabled in the analogue input stage to prevent overload due to low frequency noise. The wide frequency range with full dynamic range of more than 120 dB makes the instrument well suited for both vibration and noise measurements.

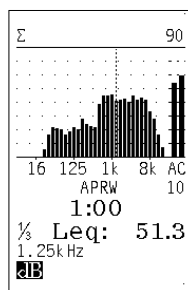
Option 3 requires that minimum option 1 be installed



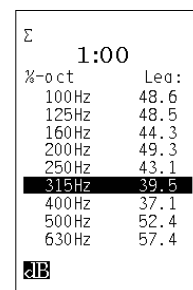
1/3-octave spectrum
0,4 Hz - 20 kHz



1/3-octave spectrum
6,3 Hz - 20 kHz



1/3-octave spectrum
A-weighted



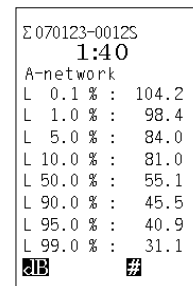
Σ 90
1:00
%oct Leq:
100Hz 48.6
125Hz 48.5
160Hz 44.3
200Hz 49.3
250Hz 43.1
315Hz 39.5
400Hz 37.1
500Hz 52.4
630Hz 57.4
dB

1/3-octave
numeric table

Option 4: Statistical calculation of L_N values

- Calculate 7 fixed LN values ($L_{1\%}$, $L_{5\%}$, $L_{10\%}$, $L_{50\%}$, $L_{90\%}$, $L_{95\%}$ and $L_{99\%}$).
- Parallel calculation of 1 editable LN value selectable within the range 0.1 – 99.9 %.
- Statistical calculations based on 0.2 dB class widths covering a total range 130 dB.
- Parallel statistical calculation on both A- and C-/Z-weighted networks.
- If real-time filters are installed (option 1 or 3), statistical calculations are available for the individual filter bands as well.

The back-erase feature, which deletes up to the ten most recent seconds of acquired global data prior to a pause upon resuming, updates the statistics buffers as well to maintain consistency.



Σ 070123-0012S
1:40
A-network
L 0.1 % : 104.2
L 1.0 % : 98.4
L 5.0 % : 84.0
L 10.0 % : 81.0
L 50.0 % : 55.1
L 90.0 % : 45.5
L 95.0 % : 40.9
L 99.0 % : 31.1
dB

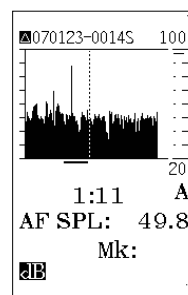
Static L_N table

Option 5: Parallel F, S and I time weightings

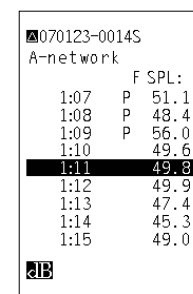
- Simultaneous measurement of F, S and I time weightings.
- Parallel measurement of three different SPL, L_{\min} and L_{\max} functions based on F, S and I time weightings.
- Parallel calculation of L_{eq} , $L_{eq,I}$, L_E and $L_{E,I}$ functions using no time constant and I time weighting simultaneously.
- The parallel measurement using three time weightings is available on both A- and C-/Z-weighted networks and the real time 1/1 and 1/3 octave filter.

Option 6: Level versus time measurements

- Measures the time "Profile" (level vs. time) of the noise signal with preset time resolution simultaneously with the overall "Global" measurement.
- Selection of preset intervals within the 1 second to 199 hours interval range.
- Automatic level versus time storage of L_{Aeq} , L_{Amax} and L_{Cpeak} (or L_{Zpeak}).
- Automatic multispectrum storage of L_{eq} and L_{max} if option 1 is installed
- Level versus time measurement continues during a paused Global measurement.
- Automatic markers identify any pause, stop or continue of the measurement as well as recording and overload.
- Real-time graphical and numerical display of the level versus time results.



Level versus Time



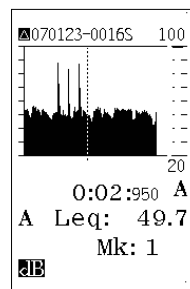
070123-0014S
A-network F SPL:
1:07 P 51.1
1:08 P 48.4
1:09 P 56.0
1:10 49.6
1:11 49.8
1:12 49.9
1:13 47.4
1:14 45.3
1:15 49.0
dB

L(t) numeric table

Option 7: Advanced Level versus time measurements

- Selection of preset intervals within the 25 msec to 199 hours interval range.
- Free selection of any A- and C-/Z-weighted functions to be stored at each pre-set interval.
- Possible operator marker settings during the measurement.
- Selection of 3 different single markers and 1 toggle marker.

The enhanced time profile mode allows logging of L_{eq} , L_{max} , L_{min} , L_{peak} , L_e and SPL for all weighting networks and frequency bands for time constant F, S and I in parallel if option 5 parallel time constant is enabled. The user may select from one to all available parameters to log. The time resolution is from 25 ms logging to memory. If the frequency analysis option is installed, these values may be measured too, both as time profile multi spectrum values and as global values.



L(t) with markers

Δ070123-0016S	
A-network	
	Leq:
0:02:750	53.7
0:02:800	52.9
0:02:850	52.4
0:02:900	50.9
0:02:950	49.7
0:03:000	49.9
0:03:050	50.3
0:03:100	47.6
0:03:150	45.6

Table with markers

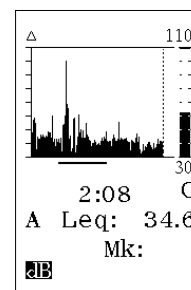
User controlled source coding

With option 7, the instrument gets eight marker functions, where as four are user defined. Three of these are single markers and one is a toggle marker.

Option 7 requires that minimum option 6 be installed.

Option 8: Sound recording

- Storage of the sound signal itself synchronised with the acquired noise data onto the SD-card or the internal memory.
- Triggered by an external hand-switch, by a level trigger or by a manual key push.
- 8, 16 or 24 bit accuracy.
- 12 or 48 kHz sampling.
- 0 - 96 dB digital gain.
- Reference calibration tone can be added at the beginning of the first recording in a measurement.



Lt with recording marker

This option is especially useful for source identification. The sound recording can be triggered by an external hand switch, by a level trigger (requires option 16) or by a manual key push. An adjustable pretrigger records events up to 99sec before the trigger point.

Several recording formats are supported, ranging from 8, 16 or 24 bit and with sampling rates of 12 or 48 kHz. Using 48 kHz sampling and the stored sound signal may be used for further processing. The Nor140 has a large dynamic range – exceeding 120 dB. This means that if you try to play back the signal on your PC you will – in most cases - hear nothing! To overcome this problem a special digital gain, 0 – 96 dB can be added to the sound recorded signal without affecting the calibration or measured values.

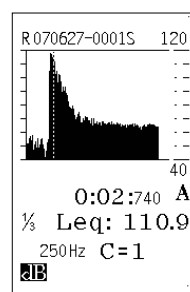
Another useful feature is that you may play a 10 sec reference tone - sine wave, pink or white noise in the beginning of a measurement to set a reference level when later replaying recorded data.

Option 8 requires that minimum option 6 be installed.

Option 9: Reverberation time measurement

- Reverberation time based on impulse or noise (option 10) excitation.
- Calculates both T20 and T30; backward integrated decay for impulse.
- Displays the graphical reverberation decay for each frequency band.
- Covers the 63 – 8000 Hz frequency bands for the 1/1-octave filters.
- Covers the 50 – 10000 Hz frequency bands for the 1/3-octave filter.
- Possible to store the reverberation time measurement as a wave-file.

Option 9 requires that minimum option 1 be installed.



Reverberation decay

R 070627-0001S	
%-oct	T20
100Hz	0.26?
125Hz	0.31
160Hz	0.24
200Hz	0.38
250Hz	0.29
315Hz	0.28
400Hz	0.34
500Hz	0.27
630Hz	0.26

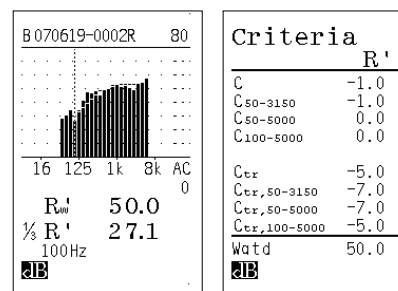
Numerical RT table

Option 10: Noise Generator

- Produces white or pink noise excitation signals with adjustable output level.
- Synchronization of noise signal with measurement start and stop.
- Allows noise excitation of reverberation time measurements if used with option 9 Reverberation time.
- Automated spectrum shaper feature to reduce neighbour frequency band differences as required in ISO 140 part 3 and 4.
- Impulse and continuous noise.

Option 11: Building Acoustic measurement

- Extends the Nor140 instrument into a complete single channel building acoustic analyser.
- Synchronises excitation in the source room with the measurement operation.
- Makes room averaging of multiple microphone positions for sound level and reverberation time measurements for ISO 140/717 users.
- Calculates the survey and engineering grade airborne sound insulation ratings $R_{w'}$, $D_{n,w'}$, and $D_{nT,w'}$.
- Calculates the survey and engineering grade impact sound insulation ratings $L_{n,w'}$ and $L_{nT,w'}$.
- Calculates the correction terms C, Ctr and Ci including the extended frequency versions.
- In conjunction with NorBuild, can easily calculate rating per ASTM and other National Standards.
- Allows remote use in combination with the Nor1028/3 CtrlBuild software package.
- Can be used for cable-free measurements using the Nor520 Bluetooth transceiver.
- Fulfills the requirements of the survey grade ISO 10052 Standard.



Results

Corrections

Option 11 turns your Nor140 into a powerful single channel building acoustic analyser. All the required parameters for performing both airborne and impact sound insulation are calculated. Using the Nor140 for measuring building acoustic, both airborne and impact noise has never been easier. With the Nor1028 NorBuild or Nor850 sound insulation reporting program, Norsonic offers a powerful and user-friendly building acoustic solution.

Option 11 requires that minimum option 1, 3, 9 and 10 be installed.

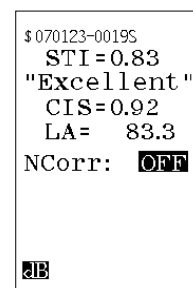
Option 12 Swept-Sine measurements

- Used in combination with the CtrlBuild remote control feature of the NorBuild or the Nor850, the Nor140 may perform advanced sound insulation measurement using the innovative Swept-Sine technique.
- Building acoustics measurements using impulse response measurement technique as described in ISO 18233 enables the measurement of sound insulation and reverberation time under severe background conditions.
- Performs tests of dividing walls with extreme sound insulation indices.
- Measures extreme short reverberation times.

Option 13: STIPA (Speech Transmission Index) measurement

- Calculates the STIPA speech transmission index.
- Fulfills the requirements of the IEC 60268-16 Standard for STIPA.
- Includes signal excitation CD (Nor1034) for use through separate public address, loudspeaker system or portable CD-player.
- Background noise correction.

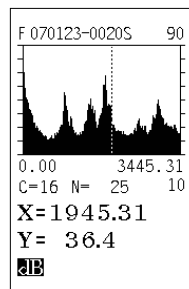
Option 13 requires that minimum option 1 be installed.



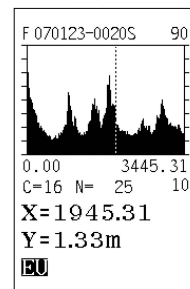
STIPA results

Option 14: FFT measurement

- 8000 line FFT analysis with 1.46Hz line resolution.
- Covers the 1.46 – 9.6 kHz frequency range.
- Both engineering units and dB.
- Pre-selection of 1 - 1028571 averages.
- Useful when searching on problems with rotating machinery.
- Fulfil the requirements for FFT analysis when searching for tonality according to the ISO/DIS 1996-2 Annex C (2005) standard.
- Display compression in binary sequence 1 – 64.



FFT spectrum with dB



FFT spectrum with Engineering Units

Option 15: Survey Sound Power measurement

- Calculates the survey grade LWA sound power level based on multiple measurement positions on a theoretical hemisphere above a noise source placed on a reflective floor.
- Automatic correction of background noise level.
- Fulfils the requirements of the ISO 3746 Standard.

This option allows the user to perform survey grade LWA sound power level measurements in the field without any other external device. A perfect tool for verifying the sound power level of equipment after installation. A graphical wizard guides the user through the measurement – easy and intuitive to use!

RESULTS	
Surface:	Hc
S:	3.53m ²
LeqA:	71.6
BGN:	44.9
K1:	0.0
K2:	2.0
Imp:	Yes
PeakC:	115.5
LWA:	75.1
	dB W

Sound Power results

Option 16: Measurement trigger

- Trigger the start of a measurement based on the internal clock, level threshold or external TTL signal such as hand switch Nor263A.
- Level threshold trigger used in combination with Repeat storage makes an automatic event measurement device.
- The audio recording is triggered based on the clock, level threshold or external TTL signal such as hand switch Nor263A.

The measurement and audio recording trigger can be set independently of each other. A special pre-trigger feature on the audio recording can be set up to capture up to 99 seconds of the audio signal prior to the trigger point.

Meas.trig:	
Manual	
Clock	
External	
Lvl.above	
1: Trig.par.	
BRWGS	#

Measurement Trigger

Option 17 Audiometer calibration

- Calculates frequency of the pure tone, Level of the pure tone, $L_{z,eq}$ and Harmonic distortion based on the 1/3 octave frequency spectrum
- Frequency range: 20 Hz – 17766 Hz
- Frequency accuracy: 0.3%
- Frequency resolution: 0.1 Hz
- Harmonic distortion resolution: 0,1%

Option 17 requires that minimum option 3 is installed

Option 18: Extended measurement range

- Microphone self-noise compensation at the lower-levels
- Compensate all measured function of the A- and C-/Z-weighting networks
- Adjustable microphone self-noise levels for use of other microphones
- Improves the lower measurement range by typically 7 - 10 dB
- Shifts the measurement range 10 dB upwards (i.e. 25 - 147 dBA)
- Possible to detect L_{peak} levels up to 150 dB without changing microphone

Accessories and software

Below is a list of carefully selected accessories for the Nor140. This is just a view of the most popular accessories. Please contact your local Norsonic sales office or the factory if you need other accessories than listed.

Nor340	Mains Adaptor, 90-230 Vac input with standard EU mains plug, 12 Vdc output.
Nor342/SLM	Portable battery pack with fuse protection, 7Ah, 12V, including charger and cable for connecting battery to Nor140.
Nor263A	Remote hand switch with 5m cable for external triggering of start or audio recording (if applicable) on Nor140 (require option 16).
Nor1251	Precision Microphone Calibrator with 114dB pressure level. Supplied with accredited calibration certificate.
Nor1216	Outdoor microphone for community and aircraft noise for both permanent and temporary applications. With SysCheck facility. Fulfils IEC60651, IEC61672 type 1 and ANSI S1.4 type 1. Protection class IP55 against dust and water. Complete with microphone type Nor1227 or Nor1225, preamplifier Nor1209A with heater to minimize condensation problems.
Nor1217	Outdoor microphone for community and aircraft noise for temporary applications. Uses the preamplifier and microphones supplied with the Nor140. Fulfills IEC60651, IEC61672 type 1 and ANSI S1.4 type 1. Protection class IP55 against dust and water.
Nor268	Relay interface unit for connection to digital output on Nor140. Requires 24 - 240 Vac.
Nor268/01	Rotating signal alarm lamp for connection to Nor268, relay interface unit. 220V connection.
Nor520A	Wireless Bluetooth module for Nor140. More than 100 meter transmission in free field if used together with Nor520A/PC, PC Bluetooth adapter.
Nor518A	Rugged case with space for 2 x Nor140, PC and cables. For dual channel building acoustic applications.
Nor1506B	Portable environmental "Pelican" case with sun screen, room for measuring instrument Nor140, Outdoor Microphone, Nor4610 Moxa 3G-modem, Nor1251 Calibrator, and two batteries Nor344. One battery supplies the Nor140 and the other the Nor4610 allowing more than one week of operation.
Cables:	<p>Nor1408A Microphone cable. Specify length</p> <p>Nor4525 USB Data cable for interfacing Nor140 and Nor13x instruments to PC via USB port. (included in delivery)</p> <p>Nor4549 Trigger cable (2m) for nested triggering of Nor140</p> <p>Nor1441B RS232 Cable (2m) for connection of to PC with 9-pin connector.</p> <p>Nor4513B Cable for simultaneous connection to RS-232 interface and AC(Flat) output.</p> <p>Nor4514A Cable (2m) for AC output (BNC)</p>

A large range of various application software for evaluation controlling and reporting is available. The most used packages are listed below:

Nor850	A new measurement concept, mainly designed for multichannel use (2 or more channels) This product offer unique user friendliness and support Nor140 as a standalone measurement channel. Support Building acoustics, sound power and general analyser applications.
Nor1028	NorBuild 3.0. PC-software for calculating and presenting graphically the Sound Insulation Indices according to the field measurement Standards ISO-140/4, /5 and /7 as well as ISO 717/1 and /2. Results are based on measurement files from Nor140 which are stored on the PC itself. Alternatively results are imported by using the instrument remote control module Nor1028/3 CtrlBuild feature.
Nor1026	NorReview 5.x. Postprocessing software for graphically and numerically review of the Level vs. time profile and frequency spectrum. Advanced calculation module, event and recording handling. Generates Word-reports of basic measurement functions/graphs for further editing by operator. Perform Quick-Calc analysis as well as insert markers at selected time intervals. Runs user defined Excel macro functions and enables the user to prepare user-defined reports with the NorReport feature. Audio recordings may be replayed on PC installed media-player or Norsonic player with "running cursor".
Nor1035	NorPower. PC-software for calculating and presenting graphically the Sound Power indices according to the measurement Standards in the ISO374x series. Results are based on measurement files which are stored on the PC itself. Alternatively results are imported by using the instrument remote control module Nor1035/3 CtrlPower feature.

Option packages:

- Standard package** containing the basic Nor140 with the options 1, 3, 4 and 5.
- Environmental package** containing the basic Nor140 with the options 4, 5, 6, 7, 8 and 16.
- Building Acoustic package** containing the basic Nor140 with the options 1, 3, 9, 10 and 11.
- Consultant package** containing the basic Nor140 with the options 1, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 16.

Technical specifications

ANALOGUE INPUTS

Number of channels: 1

Input connector:

7 pin LEMO connector for Norsonic microphone systems.

Microphone: Nor1225, 1/2", free-field, 50 mV/Pa.

Preamplifier: Nor1209 (Normal) or IEPE-type by menu selection.

Preamplifier supply voltage:

±15 volt, max 3 mA

Polarisation voltage:

0 V and 200 V, selectable.

Maximum input signal: ±11 V peak

Preamplifier IEPE@:

Supply current: 4mA

Supply voltage: 24V

Input impedance:

>100 kΩ, <650 pF

Measurement range: 0,3 μV - 7Vrms (10 Vpeak) in one range corresponding to -10 dB to 137 dB (140 dB peak) with a microphone sensitivity of 50mV/Pa. Option 18 shifts the measurement range to 147 dB (150 dB peak) by reducing the microphone sensitivity.

Highpass filter

The input section is equipped with an analogue highpass filter to reduce noise from wind or other sources with frequencies below the frequency range for measurements. The filter is switched on if the limited frequency range is selected (>6,3 Hz).

Filter type: 3rd order HP filter (-3 dB at 3,4 Hz, Butterworth response).

Analogue to digital conversion

The analogue input signal is converted to a digital signal by a multi-range sigma-delta converter with an effective sampling frequency of 48 kHz. The anti-aliasing filter is a combination of an analogue and a digital filter.

Frequency weightings

Simultaneous measurement of A- and C-weighting or A- and Z-weighting. 1/1 octave band or 1/3 octave band levels may be measured simultaneously if options providing these weightings are installed.

1/1 octave filters: 0,5 - 16000 Hz, class 1, digital IIR filters, base 10 system (IEC 61260) and ANSI S1.11-2004 Class 1.

1/3 octave filters: 0,4 - 20000 Hz, class 1, digital IIR filters, base 10 system (IEC 61260) and ANSI S1.11-2004 Class 1.

Level detector

Detector type: Digital true root-mean-square (RMS) detection, resolution 0.1 dB which may optionally be increased to 0.01 dB for indicated levels in the range -9.99 to 99.99 dB.

Crest factor capability: The crest factor is only limited by the peak-value of the signal.

Simultaneous measurement of the following functions: SPL, L_{max} , L_{min} , L_{eq} , L_{E} , L_{peak} , L_N , L_{eq} , L_{E1} , L_{TMax5} .

Indication range

The calibration of the instrument allows microphones with sensitivity in the range -84 dB to +15.9 dB relative to 1V/Pa 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 50mV/Pa. For voltage input, the level 0 dB then corresponds to 1μV. Typical values for the self-noise are 5 dB lower than the values stated.

Noise measured with 18 pF microphone dummy and microphone preamplifier Nor1209, averaged over 30 s of measurement time:

A-weighted: 13 dB

C-weighted: 15 dB

Z-weighted: 25 dB

1/3 oct: 6.3 Hz to 250 Hz: 10 dB

1/3 oct: 315 Hz to 20 kHz: 5 dB

Noise measured with Nor1225 microphone and preamplifier Nor1209, averaged over 30 s of measurement time:

A-weighted: 18 dB

C-weighted: 22 dB

Z-weighted: 30 dB

1/3 oct: 6.3 Hz to 250 Hz: 15 dB

1/3 oct: 315 Hz to 20 kHz: 10 dB

Power supply

Batteries: 4 cells, IEC LR6, AA-sized

Typical battery life time: up to 14 hours

Overall Performance

The Nor140 fulfil the following standards set for sound level meters, 1/1-octave and 1/3 octave filters: IEC61672-1:2002 class 1, IEC60651 class 1, IEC60804 class 1, IEC61260 class 1, ANSI S1.4-1983 (R2001) with amendment S1.4A-1985 class 1, ANSI S1.43-1997 (R2002) class 1, ANSI S1.11-2004 class 1.

External DC: 11 - 16V. Power consumption approximately 1.2W depending on selected modes of operation. The mains adapter Nor340 is recommended for use with the instrument. If the external supply falls below 9V, the instrument will use the internal batteries if available. If the instrument switched itself off due to loss of power, it will automatically switch on and resume normal operation after reapplying the external DC supply.

Display

The display is a monochrome, trans-reflective LCD graphical display with 160×240 pixels (W×H) with automatic temperature compensation for contrast and viewing angle. Pressing the light key illuminates the display. The light switches off automatically two minutes after the last operation of any key. The bargraph display covers 80 dB which may be scrolled in 10 dB steps to cover the total range.

Signal generator output

Max output voltage: ±10V

Output impedance: <100Ωohm. 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: ±0.5 dB for 20 Hz < f < 20 kHz

AC-out: 3,5 mm stereo jack. 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. Full scale on the display bargraph corresponds to 100 mV.

Output impedance: Less than 10 ohm, AC-coupled 100 μF.

Gain accuracy 1 kHz: ±0,2 dB

Frequency response re. 1 kHz: ±0,5 dB for 20 Hz < f < 20 kHz.

USB interface: USB type 2.0

USB socket: B411

Serial I/O port:

RS232 port, 9600 - 115200 baud.

Digital inputs: 3

Digital outputs: 4

SD Memory Card

The instrument may use SD memory card for storing of setup information, sound recordings and measurement results. SD memory card included in the delivery.

Data storage

Measured data is stored in the internal memory of the sound level meter or on the SD memory card. The internal memory is of the "flash" type retaining the information without battery supply. Approximately 25 Mbyte is available for the data storage.

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.

Dimensions:

Depth: 30 mm **Width:** 75 mm

Weight incl. batteries: 410 g

Length, excl. microphone/ preamplifier: 210 mm

Length, incl. microphone/ preamplifier: 292 mm

Some of the features listed in this leaflet may be optional in certain markets. Contact your local representative or the factory for details.

Norsonic is continuously improving the features in the No140. New firmware adding new features to the instrument is frequently released. This ensures the user that a Norsonic instrument is kept up to date years after the initial purchase. We therefore reserve the rights to amend any of the information given in this leaflet in order to take advantage of new development.

Distributor: