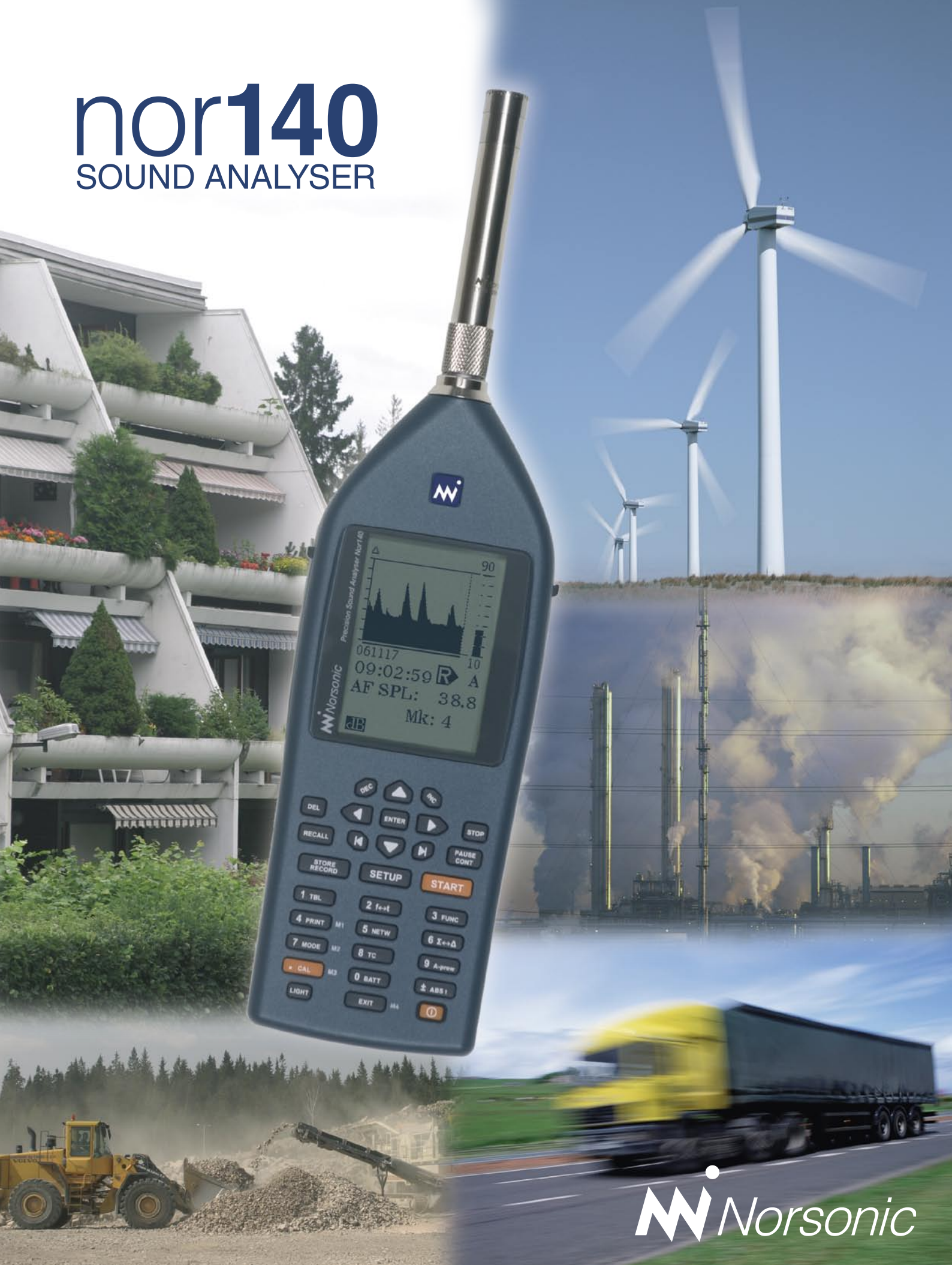
nor140
SOUND ANALYSER



Norsonic

Applications:

- Sound recording
- Environmental noise
- Building acoustics
- Noise source identification
- Industrial hygiene
- Product development
- Quality control
- Sound power
- Speech intelligibility - STIPA
- Vibration measurements

Features:

- Handheld real-time 1/1- or 1/3-octave frequency analyser
- 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 or 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
- High-resolution graphical backlit display
- Manual or automatic storage of results
- Automatically repeated measurements with clock synchronization
- Pause/Continue function with backerase feature
- Precision integrating sound level meter to IEC 61672 class 1
- Results displayed as dB or Engineering Units
- Numerical printouts
- AC output signal
- Signal generator


Norsonic
Precision Sound Analyser Nor140
80
16 125 1k 8k AC
0
070419 APRW
10:47:51
AF SPL: 42.0
dB
INC
DEC
ENTER
STOP
PAUSE CONT
START
DEL
RECALL
SETUP
STORE RECORD
3 FUNC
2 f↔t
6 Σ↔Δ
1 TBL
5 NETW
9 A-prew
4 PRINT M1
8 TC
± ABS t
7 MODE M2
0 BATT
CAL M3
EXIT M4
LIGHT
1GB
50X

With the introduction of the precision handheld sound analyser Nor140, Norsonic set a new standard for sound level meters, covering the widest range of applications. The Nor140 is 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 years 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 covers a wide range of applications, making the instrument a natural choice for every professional user of sound level meters.



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 lightweight, yet powerful instrument platform.

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 ensures tactile feed-back to the user. The dust and splash proof rubber covers for the connectors and SD card together with the high friction coating on rear cover ensures an optimum grip and user comfort. A range of fac-tory setup together with the possibility for the user to create their own setups minimise the risk of making mistakes when preparing up the instrument prior to a measurement run.

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 2 minutes. This ensures that if a power interrupt occurs, you only loose a maximum of 2 minutes of your data. The measurement is also automatically saved when a battery low warning is given. A special feature can be enabled, making the instrument to auto restart and con-tinue to measure after a power failure condition. This is especially useful for long term monitoring applications.











Four types of storage modes are supported:

Manual
The user must manually store the measurement.

Automatic
The instrument stores all results automatically when a measurement is completed

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 measurment period (eg. the first full 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, the other for playback of recorded signals or AC output of the measured signal. A separate connector is available for RPM signals.

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 Nor140 we have added two useful features to this standard, improving its original functionality. Firstly ICP® power is added therby allowing the use of signal line powered sensors such as accelerometers and electret microphones with ICP® preamplifiers. This removes the need of expensive adaptors or cables when connecting them to the instrument. The second feature is the built-in calibration oscillator for verification of outdoor microphones that will be a great advantange 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 it is possible to buy anywhere. Hence, we designed it to use 4 pcs standard AA-cell batteries. However, the instrument also accepts rechargeable batteries. A battery monitortells 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 powers system with the highest possible security.

Preamplifier and microphone

The instrument is delivered in its standard version with a 1/2" microphone Nor1225 and peamplifier Nor1209. The well-known Nor1225 is a 200V polarised, 50mV/Pa free field microphone. The instrument has user selectable diffuse field and windshield correction networks. The preamplifier Nor1209 is an extremely 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 may be connected. The preamplifier Nor1209 has a built-in microphone check facility allowing remote verification of the microphone in environmental noise monitoring systems.

One measurement range

The instrument 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 extends 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 improves the overall self-noise by -3 dB.

The Measured functions

The functions available with the Nor140 include

SPL	Instantaneous Sound Pressure Level
L_{MAX}	Maximum Sound Pressure Level
L_{MIN}	Minimum Sound Pressure Level
L_{eq}	Integrated Time Averaged sound Pressure Level
L_{eqI}	Integrated Time Averaged Impulse Sound Level
L_E	Sound Exposure Level
L_{PEAK}	Maximum Peak Level
L_N	Statistically Calculated Level Exceedances (Eight values)

The spectral weighting functions A- and C- or Z-weighting are available for all functions including the L_{PEAK}. The SPL, Lmax and Lmin functions are measured for all the three time constants Fast, Slow and Impulse. 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 need to monitor the results from the instrument.

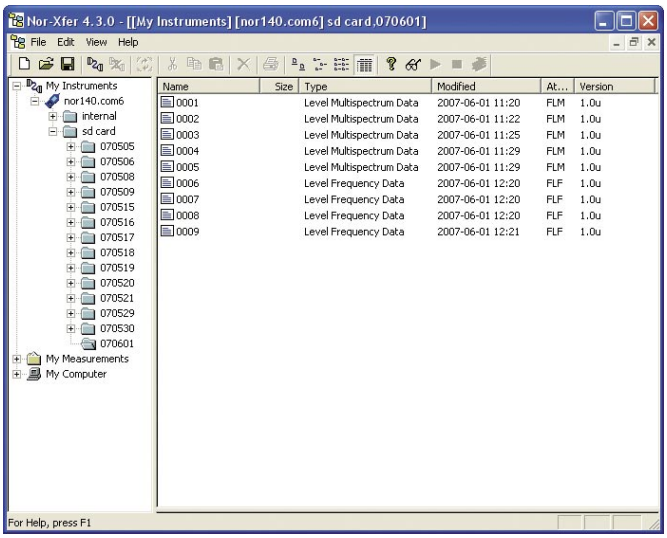


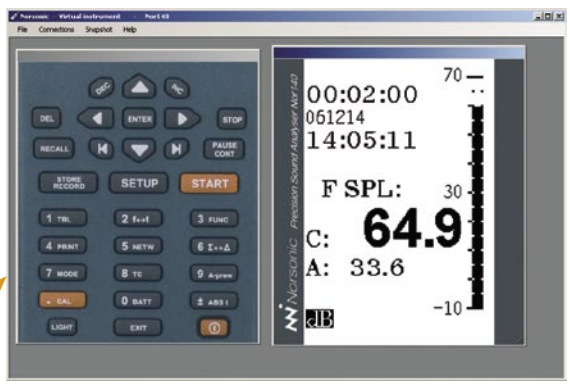
NorXfer

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.

The measured data can also be converted into Excel or text files for use in other software packages.

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.





Environmental noise monitoring

- Huge memory, both internal and on 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 50ms to 199h
- Multi spectrum
- Statistical calculations, even in frequency bands
- 120dB dynamic range, also for the real time filters
- Pure tone detection
- Microphone check
- Advanced post processing using NorReview
- Advanced L_{den} calculation using NorReview

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 – outdoors for community noise as well as indoors in workshops etc.

The high dynamic range (120 dB) makes the setup easy and ensures reliable measurements in all situations.

Source identification is possible thanks to the sound recording feature and 8 markers where as 4 can be set for independent source coding.



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 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 to perform a daily microphone check – no external device or power supply is needed.

The post processing software NorReview is a powerful tool for analysing and reporting the captured data. NorReview is, as other Norsonic products, modular and in its basic version provides 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. 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.

The Norsonic product range contains a wide range of equipment and accessories 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 Recorder from Norsonic. This is a very cost effective method of investigating domestic noise complaints, particularly those occurring outside normal office hours. To date systems have been



based on Digital Audio Tape recorders connected to a conventional sound level meter and as such often have complicated set up and calibration procedures. Any error in these procedures could easily result in the failure to collect the evidence of the alleged offence.

A novel approach to these systems is embodied in the Nor140 through its digital recording of the actual sound at the same time as the measurement; hence there is no longer a need for a separate DAT recorder; everything is within your analyser!

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 some seconds of pre-trigger recording allowing the vital information occurring just before the switch was pressed to be recorded.

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 is carried out and masking calculations carried out to determine the prevalence of audible tones.

The optional Pure Tone FFT mode 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.

Building acoustics

Sound insulation measurements

The Nor140 is a complete measurement tool for making both airborne and impact sound insulation measurements in accordance with the ISO-140 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.

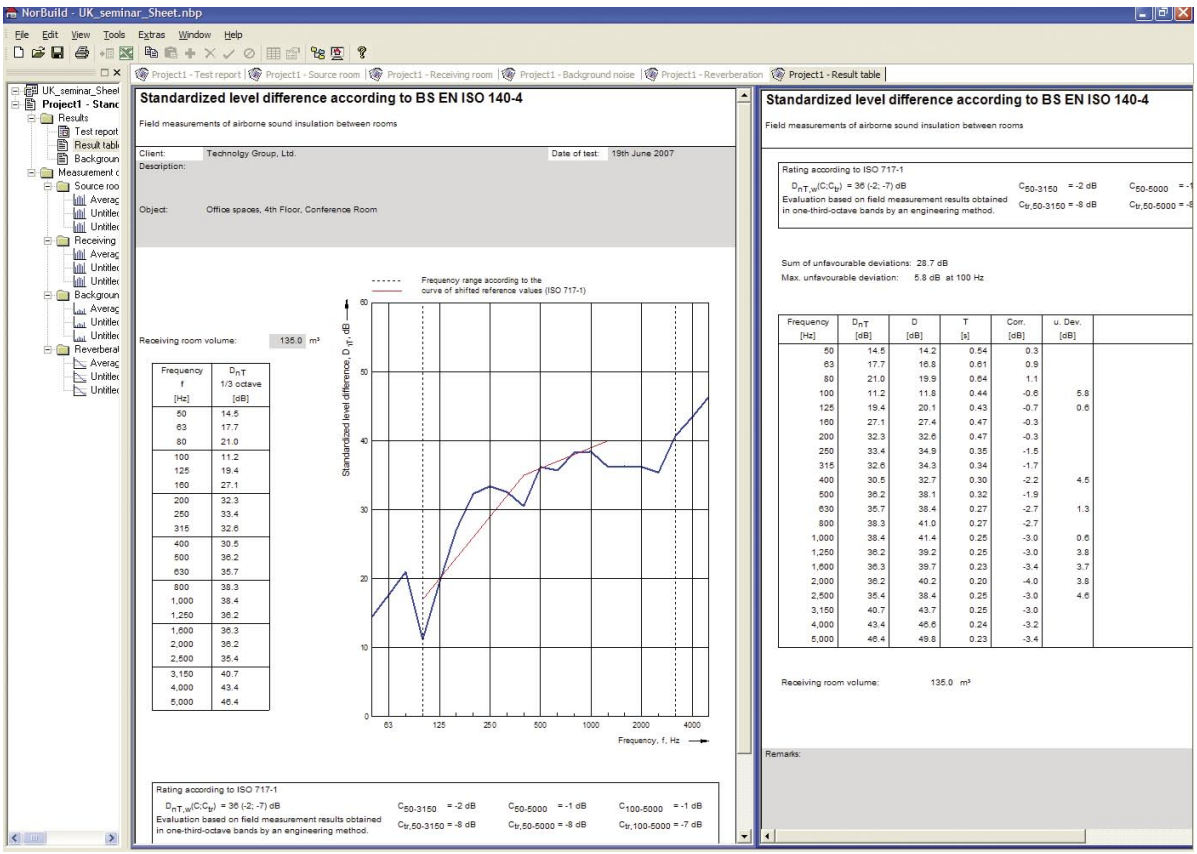
This feature includes level measurements and averaging of multiple microphone positions both in the source and the receiving rooms, measurement of the background noise level as well as the reverberation time measurements in multiple positions of the receiving room. An on-board calculator uses the actual room measures to calculate the room volume V and insulation area S. The correct sound reduction index (R'w, DnT,w, Dn,w, Ln,w or LnT,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. This Standard do not require the measurement of the reverberation time as it uses general correction terms based on room volume and actual physical design.

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 of course 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.

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 or other national variants.

Remote measurement control

For full PC control of the actual measurement process, the NorBuild software may be extended with the CtrlBuild module. By use of this module, the measurements may even be made by 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.

Alternatively, the CtrlBuild module will enable two individual Nor140 instruments to be synchronised to form a dedicated dual-channel measurement system for sound insulation tests.

Wireless measurement system

One Nor140 may be used as one wireless measuring channel in the Nor1516 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.

SweptSine measurement technique

The recent ISO-18233 Standard opens up for use of alternative measurement techniques for sound insulation testing. Hence, the Nor140 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.

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 is 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, may optionally be integrated in the Nor140 instrument. 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. The STIPA-method 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).

Each measurement lasts for about 13 seconds and the STI-value is displayed on the screen together with octave-band levels and the modulation indices. This allows the result to be corrected for additional background noise either by the instrument or later by post-processing the measured data.

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.

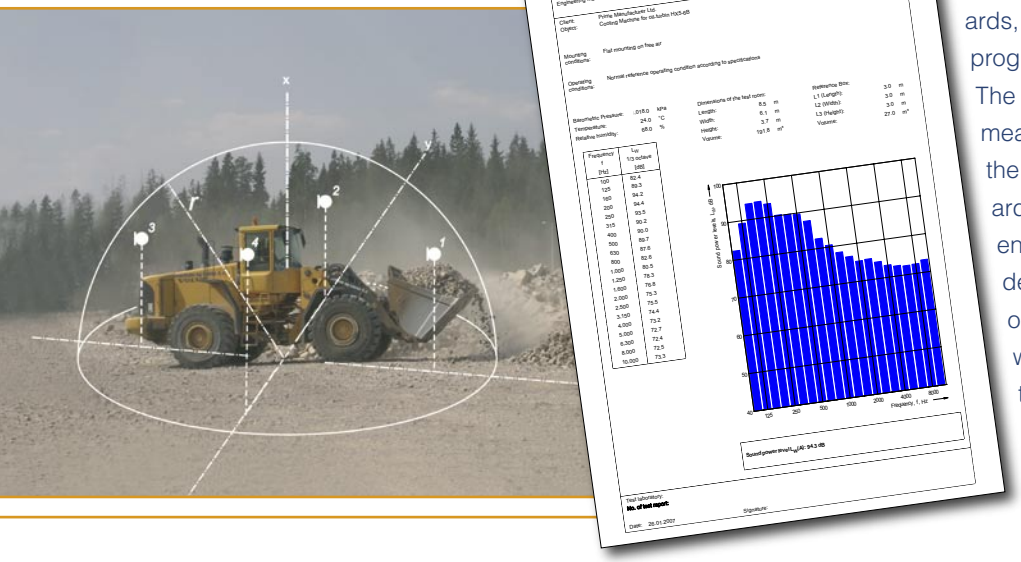
ICP® powered accelerometers can be directly connected to the instrument without use of any external power supply. Norsonic supplies a carefully selected range of accelerometers, all ICP® powered well suited for use with the Nor140.

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 measurements and calculations according to ISO-3746 on board. 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.

For measurement in accordance to other standards in the ISO-374x series or similar standards, the PC post processing program NorPower is a perfect tool. 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. A special software extension allows the user to remotely control the Nor140, the microphone boom Nor265 and the whole measurement process from the PC.



Sound power levels according to ISO/DIS 3743-1:2006

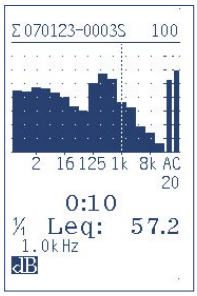
Optional extensions

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 extending the list of features with new options and improvements in existing options based on customers' requirements and new standards.
Please visit our web site www.norsonic.com for the latest details.

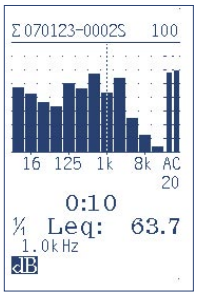
Option 1: 1/1-octave real-time filters

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

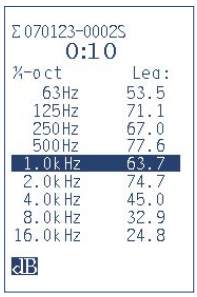
When fitted with option 1, the Nor140 can perform real time frequency analysis in octaves covering the frequency bands 0.5 Hz to 16 kHz in one range. A limited frequency range 8 Hz-16 kHz can be set in order to avoid low frequency noise. A 3 Hz 3rd order high pass filter is then enabled in the analogue 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.



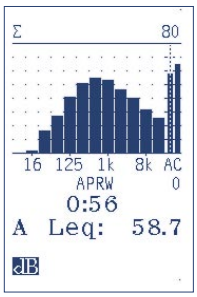
1/1-octave spectrum 0,5 Hz - 16 kHz



1/1-octave spectrum 8 Hz - 16 kHz



1/1-octave numeric table



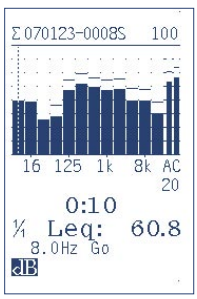
1/1-octave spectrum A-weighted

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

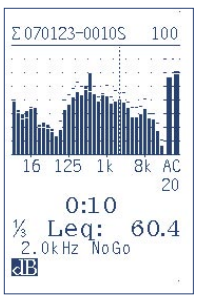
- Compare any measured frequency spectrum with a pre-selected reference spectrum
- Both upper and lower reference spectrum available
- "Go/NoGo" warning for quality control applications
- TTL output signal for automated systems

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. This is useful for many applications such as product control and spectrum comparison.

Option 2 requires that minimum option 1 be installed!



1/1-octave reference spectrum



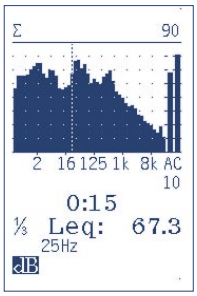
1/3-octave reference spectrum

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

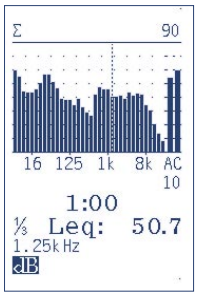
- Parallel 1/3-octave real-time filters covering the 0.4 Hz - 20 kHz frequency range in one span
- All filters fulfil the IEC-61260 class 1 digital IIR base 10 requirements 120 dB “one-range” even in the filter bands
- Results are displayed both graphically and numerically
- A pre-weighting feature available 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 can be set to avoid low frequency noise covering 6.3 Hz - 20 kHz. 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.

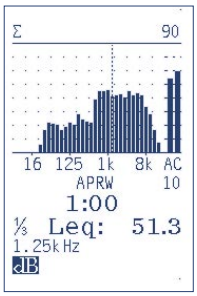
Option 3 requires that minimum option 1 be installed



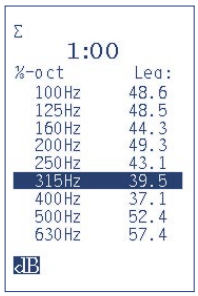
1/3-octave spectrum 0,4 Hz - 20 kHz



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



1/3-octave spectrum A-weighted



1/3-octave numeric table

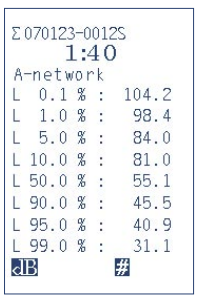
Option 4: Statistical calculation of LN values

- Calculate 7 fixed L_N values ($L_{1\%}$, $L_{5\%}$, $L_{10\%}$, $L_{50\%}$, $L_{90\%}$, $L_{95\%}$ and $L_{99\%}$)
- Parallel calculation of 1 editable L_N value selectable within the range 0.1 – 99.9 %
- Statistical calculations based on 0.2 dB class widths covering the entire 120 dB range
- 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 optional extension 4 adds statistical distribution to the Nor140 functionality. There are eight percentiles shown, out of which one is user selectable. The class width is 0.2 dB over the entire 120 dB range.

The statistical distribution calculations employs the F time constant and applies to the spectral weighting networks (A and C or Z) as well as all the individual 1/1- and 1/3-octave filter bands (if applicable).

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



Statical L_N table

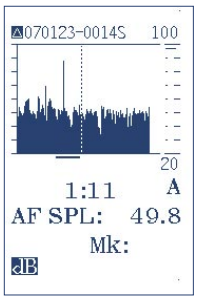
Option 5: Parallel F, S and I time constants

- Simultaneous measurement of F, S and I time constants
- Parallel measurement of three different SPL, L_{MIN} and L_{MAX} functions based on F, S and I time constants
- Parallel calculation of L_{eq}, $L_{eq,I}$, L_E and L_{EI} functions using no time constant and I time constant simultaneously
- The parallel measurement using three time weightings is available on both A- and C-/Z-weighted networks

Option 5 enables parallel measurement of all time constants simultaneously. If real time filters are installed, the parallel time weighting functions are available for the individual filter band as well.

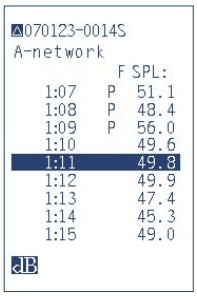
Option 6: Level versus time measurements

- Measure a time "Profile" of the noise signal with preset time resolution simultaneously with the overall "Global" measurement (i.e. all measured data described for the basic instrument including any of the options 1-5 described above) and Profile results based on a level versus time values at preset intervals
- Selection of preset intervals within the 1 second to 99 hours interval range
- Automatic level versus time storage of L_{Aeq}, L_{Amax} and L_{Cpeak} (or L_{Zpeak})
- Automatic multispectrum storage of L_{Feq} and L_{Fmax} if option 1 is installed
- Level versus time measurement continues during a paused Global measurement
- Markers identify any pause, stop or continue of the measurement
- Real-time graphical and numerical display of the level versus time results



Level versus Time

Automatic markers:
A pause marker is inserted into the time profile in pause mode. A recorder marker is inserted when the instrument is doing a sound recording, and an overload marker is inserted if overload occurs. If external voltage disappears or drops below 10.5V, the instrument switches to internal batteries, and a battery marker is inserted.



L(t) numeric table

Option 7: Advanced Level versus time measurements

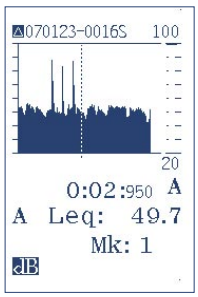
- Selection of preset intervals within the 50 msec to 99 hours interval range
- 25 msec interval resolution below 1 second, and 1 second resolution above
- Free selection of any A- and C-/Z-weighted functions to be stored at each preset interval
- Possible operator marker settings during the measurement
- 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 Fast, Slow and Impulse 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 50 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.

User controlled source coding

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

Option 7 requires that minimum option 6 be installed



L(t) with markers

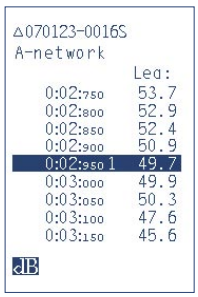


Table with markers

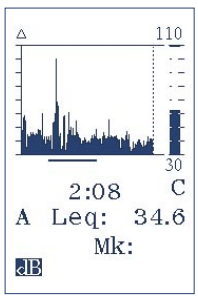
Option 8: Sound recording

- Storage of the sound signal itself 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

Option 8 allows storing the sound signal itself onto the SD card or the internal memory. This option is especially useful for source identification. An external hand switch can trigger the sound recording, by a level trigger (requires option 16) or by a manual key push.

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.



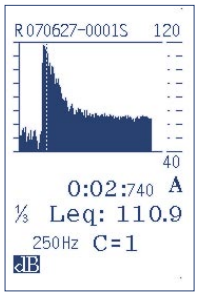
Lt with recording marker

Option 9: Reverberation time measurement mode

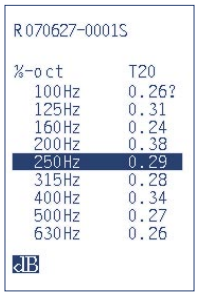
- Reverberation time based on impulse or noise (option 10) excitation
- Calculates both T_{20} and T_{30} based on backward integrated decay
- Displays the graphical reverberation decay for each frequency band
- Covers the 63 – 8000 Hz frequency bands for the 1/1-octave filters
- If option 3 is installed, covers the 50 – 10000 Hz frequency bands for the 1/3-octave filters

The reverberation time (RT) calculation calculates both T_{20} and T_{30} based on backward integrated decay. The decay curve can be displayed for each individual frequency band. The calculation supports both impulse and noise excitation.

Option 9 requires that minimum option 1 be installed



Reverberation decay



Numerical RT table

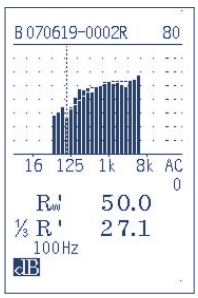
Option 10: Noise Generator

- 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

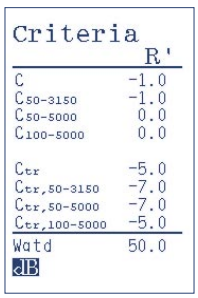
The signal generator option generates both white and pink noise. Both impulse excitation and continuous noise excitation are supported, making the noise generator useful for both reverberation time measurements as well as sound insulation measurements.

Option 11: Building Acoustic measurement mode

- Extends the Nor140 instrument to a single channel building acoustic analyser according to ISO-140/717
- Perform room averaging of multiple microphone positions for level and reverberation time measurements
- 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
- Allows remote use in combination with the Nor1028/3 CtrlBuild software package
- Extends the Nor140 instrument to a measurement module in the Nor1516 Wireless Building Acoustic System
- Fulfils the requirements of the survey grade ISO-10052 Standard
- Noise excitation in the source room synchronized with the measurement operation (option 10)



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.

The Nor140 combined with Nor1028 NorBuild sound insulation reporting program, Norsonic offers a powerful and user-friendly building acoustic solution.

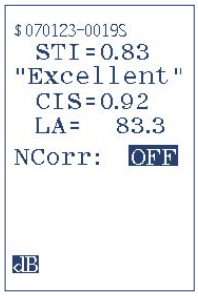
Option 11 requires that minimum option 1 be installed!

Option 13: STIPA (Speech Transmission Index) measurement mode

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

Adding 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.

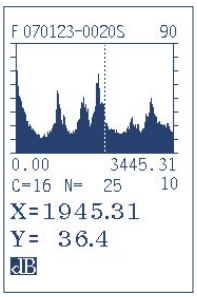


STIPA results

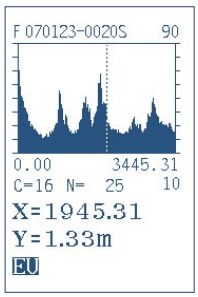
Option 13 requires that minimum option 1 be installed!

Option 14: FFT measurement mode

- 8000 line FFT analysis with 1.46Hz line resolution
- Covers the 1.46 – 9.6 kHz frequency range
- Pre-selection of 1 - 9999 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 – 32



FFT spectrum with dB

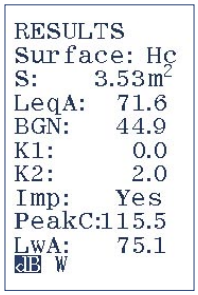


FFT spectrum with Engineering Units

Option 15: Survey Sound Power measurement mode

- Calculates the survey grade L_{WA} 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 L_{WA} 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!



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-rigger feature on the audio recording can be set up to capture the latest seconds of the audio signal prior to the trigger point.



Measurement Trigger

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 – 3 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

Option 19: Noise Monitoring

- Continuous read-out of pre-selected measurement samples via RS-232 and USB interface
- Automatic re-start of measurements after power down

Technical Specifications

ANALOGUE INPUTS
Number of channels: 1
Input connector:
7 pin LEMO connector for Norsonic microphone systems.
(LEMO ESG.1B.307.CLL)
Preamplifier: Nor1209 (Normal) or ICP®-type by menu selection.
Preamplifier Nor1209:
Preamplifier supply voltage:
±15 volt, max 3 mA
Polarisation voltage:
0 V and 200 V, selectable.
Maximum input signal: ±11 V peak
Input impedance: More than 100 kohm, less than 650 pF
Preamplifier ICP®:
Supply current: 4mA
Supply voltage: 24V
Input impedance: More than 100 kohm, less than 650 pF

Measurement range: 0.3 mV to 7 V (RMS) in one range corresponding to – 10 dB to 137 dB with a microphone sensitivity of 50 mV/Pa. The maximum peak value ±10 V corresponds to 140 dB. With the optional extension permitting extended measurement range, peak values up to 150 dB may be measured.

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).
1/3 octave filters: 0,4 - 20000 Hz, class 1, digital IIR filters, base 10 system (IEC-61260).

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_{eql}; L_{EI}; 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 50 mV/Pa. For voltage input, the level 0 dB then corresponds to 1mV. 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

Sound level meter to IEC-61672-1, class 1, group X requirements measuring exponential time-weighted levels, integrating-averaged levels and sound exposure levels. If 1/1 octave-band or 1/3 octave-band filters are installed, the instrument complies with IEC-61260 class 1. The instrument also complies with the previous standards IEC-60651 type 1 and IEC-60804 type.

Dimensions:
Depth: 30 mm, **Width:** 75 mm, **Weight incl. batteries:** 410 g
Length, excl./incl. microphone/preamplifier: 210 mm / 292 mm

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 (requires option 19).

Display
The display is a monochrome, transreflective 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 output
Max output voltage: ±10V
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: ±0.5 dB for 20 Hz < f< 16 kHz
USB interface: USB type 2.0
USB socket: B411
Serial I/O port:
RS232 port, 9600–115200 baud.

Digital inputs: 3 pc
Digital outputs: 4 pc

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 < 16 kHz.

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.

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

Norsonic reserve the right to amend any of the information given in this leaflet in order to take advantage of new developments.

Distributor:

Norsonic
P.O.Box 24, N-3421 Lierskogen, Norway
Tel: +47 32 85 89 00 Fax: +47 32 85 22 08
info@norsonic.com www.norsonic.com

07.2007
Copyright © Norsonic AS 2007 - All rights reserved