

Technical specifications

Unless stated otherwise, the specifications are for the complete sound level meter Nor140 equipped with microphone type Nor1225 and microphone preamplifier type Nor1209. Values are based on the sensitivity set to the nominal value for the microphone: -26.0 dB corresponding to 50 mV/Pa.

A microphone cable Nor1408 of length up to 20 m may be used between the microphone preamplifier and the instrument body without loss of performance. Longer cables may be used if maximum sound pressure level or frequency is reduced.

The definition of terms is based on IEC 61672-1 (2002-5): Electroacoustics - Sound level meters - Part 1: Specifications.

The options included in the basic instrument may vary. Please check with your local supplier for the latest information.

Type of instrument

Sound level meter IEC 61672-1, class 1, group X measuring exponential time-weighted levels, integrating-averaging 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 1.

Analogue inputs

Number of channels: 1

Input connector: 7 pin LEMO connector for Norsonic microphone systems. (LEMO ECG.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®:

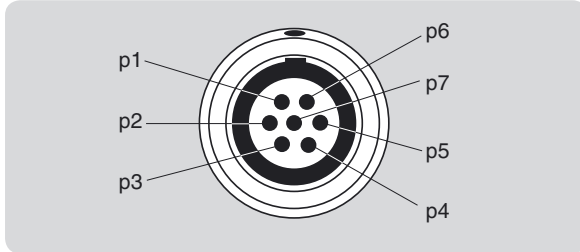
Supply current: 4 mA

Supply voltage: 24 V

Input impedance: More than 100 kohm, less than 650 pF

Measurement range: 0.3 μ V 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.



Microphone input socket

Pin Function

- 1 Microphone system check
- 2 GND – signal reference
- 3 Polarisation voltage – selectable: $0 \pm 1V$, $200 \pm 1V$ or adjustable 70 to 74V short-circuit current $< 1mA$, impedance: $2 M\Omega$
- 4 Signal input. Input impedance: min 0,6 M56, max 250 pF
- 5 $+15 \pm 1V$ preamplifier supply voltage, max 3 mA (Connected to pin 6)
- 6 Not connected
- 7 $-15 \pm 1V$, preamp. supply voltage, max 3 mA
Housing is GND instrument casing.

Highpass filter

The input section is equipped with an analogue high-pass 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 ($+>6,3Hz$).

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

Analogue to digital conversion

The analogue input signal is converted to a digital signal by a multirange 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.

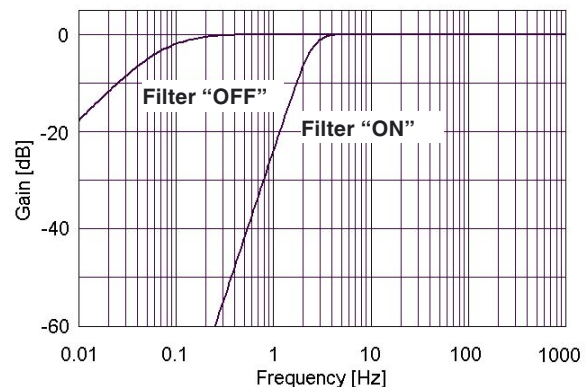
Frequency weightings

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.

Filters: 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).

Highpass filter frequency response



Level detector

Detector type: Digital true root-mean-square (RMS) detection and peak 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.

Time weightings and measured functions

Simultaneous measurement of the following functions:

- F-time-weighted sound pressure level, instantaneous
- Maximum F-time-weighted sound pressure level
- Minimum F-time-weighted sound pressure level
- S-time-weighted sound pressure level, instantaneous
- Maximum S-time-weighted sound pressure level
- Minimum S-time-weighted sound pressure level
- I-time-weighted sound pressure level, instantaneous
- Maximum I-time-weighted sound pressure level
- Minimum I-time-weighted sound pressure level
- Integrated-averaged sound pressure level
- Sound exposure level
- Peak sound level
- Exceeding level for F-time-weighted sound pressure level (cumulative distribution)

As an option, the sound level meter may also simultaneously measure:

- Integrated-averaged I-time-weighted sound pressure level
- I-time-weighted sound exposure level
- Taktmaximalpegel – DIN 45657, F time response, 5 seconds Takt.

Level distribution

As an optional extension, the instrument may be fitted to calculate the exceeding level (cumulative level distribution) for the F time weighted level. The calculation is done for frequency weightings A and C or Z and for 1/1 octave or 1/3 octave filters (if present and used in a measurement).

Class width: 0.2 dB

Number of classes: 652 for levels between 10 dB above full scale (140 dB) and 120 dB below full scale (10 dB). The classes for the highest and lowest levels are extended to also include levels above and below, respectively.

Sampling frequency for level: 10 samples per second.

Display resolution: 0.1 dB based on interpolation.

Indication range

The calibration of the instrument allows microphones with sensitivity in the range -84 dB to +15.9 dB relative to 1 volt/pascal to be applied. The corresponding display range for the indicated sound level is -50 dB to +180 dB.

Self-noise levels

The self-noise is measured with the calibration set to -26.0 dB corresponding to a microphone sensitivity of 50 mV/Pa. For voltage input, the level 0 dB then corresponds to 1 μ V. Typical values for the self-noise are 5 dB lower than the values stated. The noise levels are measured without light in the display.

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

Spectral weighting functions: A-weighted: 13 dB, C-weighted: 15 dB, Z-weighted: 25 dB

Filter bands: 1/3 oct: 6.3 Hz to 250 Hz: 10 dB (option)
1/3 oct: 315 Hz to 20 kHz: 5 dB (option)

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

Spectral weighting functions: A-weighted: 18 dB, C-weighted: 22 dB, Z-weighted: 30 dB

Filter bands: 1/3 oct: 6.3 Hz to 250 Hz: 15 dB (option), **1/3 oct: 315 Hz to 20 kHz:** 10 dB (option)

Noise measured with the input terminal on the sound level meter short-circuited to ground, averaged over 30 s of measurement time:

Spectral weighting functions: A-weighted: 10 dB, C-weighted: 10 dB, Z-weighted: 15 dB

Filter bands: 1/3 oct: 6.3 Hz to 250 Hz: 0 dB (option)

1/3 oct: 315 Hz to 20 kHz: 7 dB (option)

Field calibration

The recommended sound calibrator for verification of the sensitivity of the sound level meter is Norsonic Nor1251 with a nominal sound pressure 114.0 dB at 1 kHz. In order to compensate for effects due to diffraction around the microphone, we recommend adjusting the sound level meter to indicate 113.8 dB (diffuse correction off).

If other types of calibrators or electrostatic actuators are used for the calibration, we recommend ad-

justing the sound level meter to indicate the following levels referred to the sound pressure acting on the diaphragm of the microphone (diffuse correction off):

Freq	125 Hz	250 Hz	1 kHz	4 kHz	8 kHz
Level	0.0 dB	0.0 dB	-0.2 dB	-0.8 dB	-2.8 dB

Measurement duration and resolution

The total time period for a measurement (global period, designated Σ) may be set from 1 second up to 200 hours less 1 second with 1 second resolution. The global period may be subdivided in shorter periods, designated time resolution (Δ) from 1 second up to the global period. As an option the time resolution may be set in an additional range: from 50 millisecond and upwards to 1 second in steps of 25 millisecond.

Total range for measurement of A-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	98 dB	137 dB	138 dB	136 dB	133 dB
Lower level	24 dB	24 dB	24 dB	24 dB	24 dB
Ref level test	94 dB	114 dB	114 dB	114 dB	114 dB

The primary indicator range for compliance with IEC 60651 type 1 is 24 dB to 117 dB. For compliance with IEC 60804 type 1, the linearity range is 24 to 137 dB, and the pulse range 24 dB to 140 dB, respectively

Total range for measurement of C-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	134 dB	137 dB	136 dB	134 dB	131 dB
Lower level	30 dB	30 dB	30 dB	30 dB	30 dB
Ref level test	114 dB	114 dB	114 dB	114 dB	114 dB

Total range for measurement of Z-weighted levels

The linear operating range is identical to the total range.

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	137 dB	137 dB	137 dB	137 dB	137 dB
Lower level	40 dB	40 dB	40 dB	40 dB	40 dB
Ref level test	114 dB	114 dB	114 dB	114 dB	114 dB

Measurement range for C-weighted peak levels

Frequency	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper level	137 dB	140 dB	139 dB	137 dB	134 dB
Lower level	45 dB	45 dB	45 dB	45 dB	45 dB
Ref level test	114 dB	114 dB	114 dB	114 dB	114 dB

Power supply

Battery: 4 cells, IEC LR6, AA-sized, Alkaline batteries are recommended (e.g. Duracell Ultra M3). AA-sized NiCd or NiMH rechargeable batteries may be used, but must be charged outside the instrument. Battery voltage and time on battery since last change of batteries are indicated.

Typical battery life time (Duracell Ultra M3): 8 hours.

External dc: 11 – 16 volt. Power consumption approximately 1.2 watt dependent on selected modes of operation. External DC source should have source-impedance less than 1 ohm and be able to supply at least

300 mA. The mains adaptor 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 has switched off due to loss of power or insufficient supply voltage, the instrument will automatically switch on and resume normal operation after reapplying the external DC supply.

Socket for external dc: 1.3 mm plug, negative voltage on centre-terminal.

The instrument will automatically switch off if the battery or external voltage is too low for operation within the stated specifications. The maximum battery voltage for conformance testing is $4 \times 1.6 \text{ V} = 6.4 \text{ V}$.

The instrument has a calendar clock powered from the batteries or external DC-supply. The clock is supplied from a charged capacitor during change of batteries. Contact your Norsonic service department for change of this component. After replacement the instrument need factory calibration and to re-install the options.

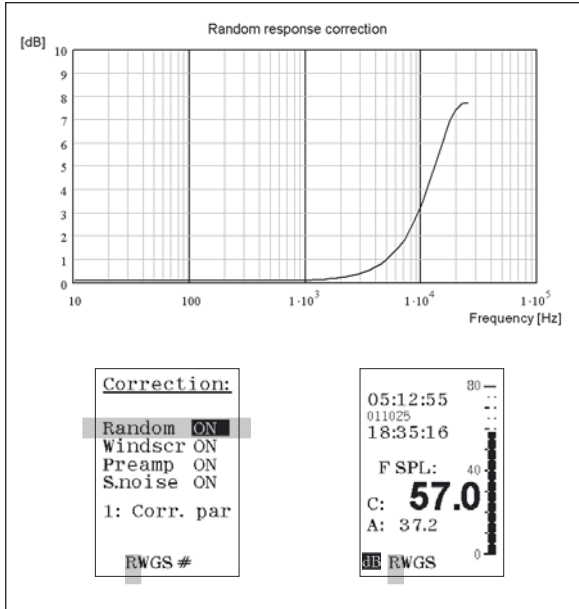
Display

The display is a monochrome, transreflective LCD graphical display with 160x240 pixels (WxH) with automatic temperature compensation for contrast and viewing angle. Pressing the light key illuminates the display. The light switches off automatically 2 minutes after the last operation of any key.

The bar graph display covers 80 dB, which may be scrolled in 10 dB steps to cover the total range.

Keyboard

The keyboard is of silicon-rubber type.



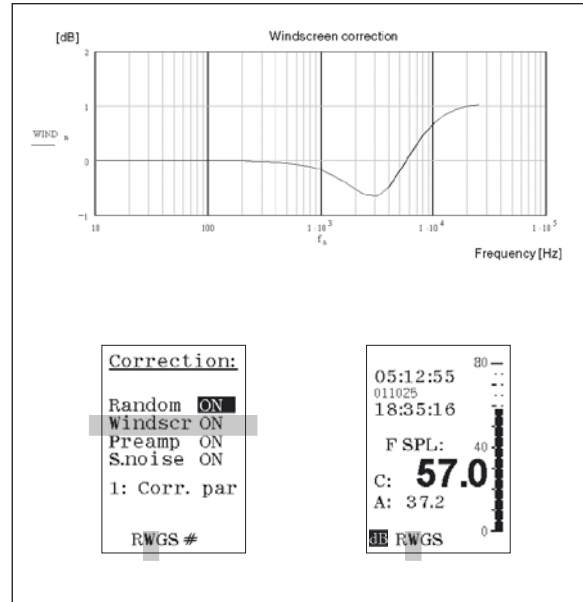
Adjustment of indicated levels

Random response. The instrument is equipped with a microphone with flat free-field response and satisfies the class 1 requirements in IEC 61672-1 to free-field response. By selecting the random response correction network included, the instrument will satisfy the class 1 requirements in IEC 61672-1 to random response as well as ANSI S1.4-1997 type 1. The nominal correction to obtain flat random response is shown in the figure above.

Activating random response correction:

- Press **SETUP > 1 (Instr.) > 6 (Correct.)** to gain access to the Corrections menu. Navigate in the menu as usual and activate the correction parameter Random

by means of the **INC** and **DEC** keys. Do the same to deactivate. Random response correction activated is indicated by an **"R"** in the lower line of the display.



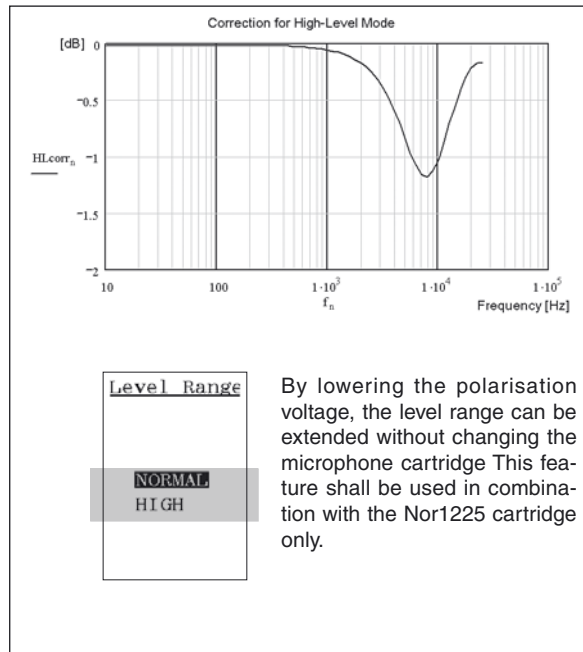
Windscreen

The instrument may be used with windscreen Nor1451. The windscreen correction has to be switched on to obtain the stated specifications when the windscreen is mounted. The nominal correction for the windscreen correction network is shown in the figure above.

Activating windscreen correction

- Press **SETUP > 1 (Instr.) > 6 (Correct.)** to gain access to the Corrections menu. Navigate in the menu as usual and activate the correction parameter Windscr

by means of the **INC** and **DEC** keys. Do the same to deactivate. Windscreen correction activated is indicated by a **“W”** in the lower line of the display.



High levels

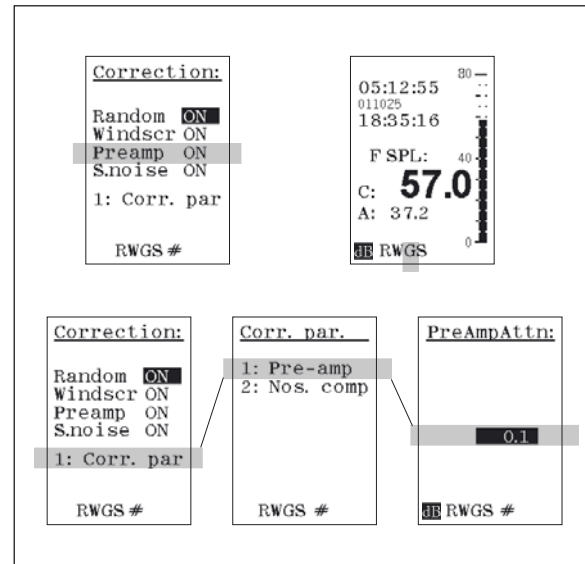
As an option, the instrument may measure levels 10 dB higher than stated as the standard range. The extended measurement range is obtained by reducing the sensitivity of the microphone through the application of a lower polarisation voltage. When this option is selected, the polarisation voltage is lowered from 200V to about 70 V. A correction network is applied automatically to compensate for the change in frequency response of the microphone due to the lower polarisation voltage. The nominal response for the “high level

correction network” is shown in the figure.

Note that the needed correction will depend on the type of microphone, and shall only be applied when using microphone cartridge type Nor1225.

Activating the high level range:

- Press **SETUP > 5 (Lvl.range)** to gain access to the level range setting menu. Navigate in the menu as usual.



Preamplifier attenuation

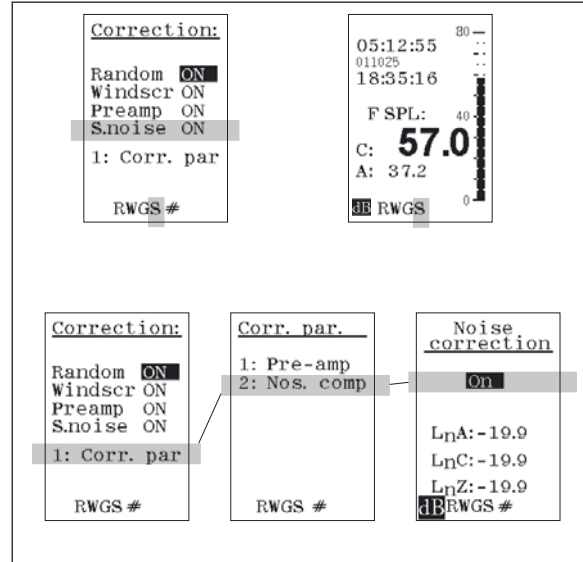
The instrument has the ability to correct for the attenuation in the preamplifier. Typical values of the attenuation is 0.2 dB. The correction can be set in the range 0.0 to 9.9 dB. The correction can be switched on/off to facilitate applications of other transducers without preamplifier. The correction is automatically switched off if ICP-type of preamplifier is selected.

Activating the preamplifier attenuation:

- To activate the preamplifier attenuation press **SETUP** > **1** (Instr.) > **6** (Correct.) to gain access to the Corrections menu. Navigate in the menu as usual and activate the correction parameter Preamp by means of the inc and dec keys. Do the same to deactivate. Preamplifier attenuation activated is indicated by a **G** (for Gain) in the lower line of the display

Setting the amount of attenuation:

- In the Correction menu, press **1** (Corr.par) to gain access to the correction parameter setup menu. Press **2** to gain access to the attenuation setting itself. Never change this setting unless you know what you're doing! Use the numerical keypad to set the attenuation value. Press **ENTER** twice to leave the menu. See Fig. on the previous page for menu details

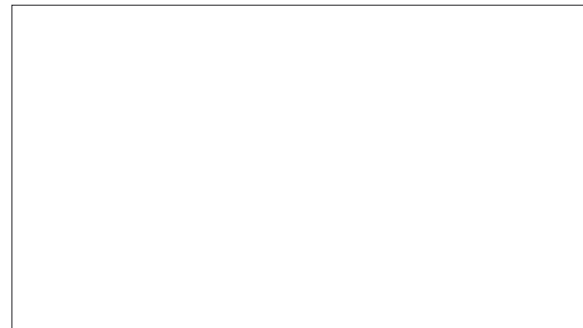


Self-noise compensation

The displayed values for A-, C- and Z-weighted levels may, as an option (extension 18), be corrected automatically for the self-noise of the microphone. The noise levels for each of the spectral weightings must be specified. The correction is applied by unlinear level subtraction. The option allows levels close to the self-noise to be displayed with reduced level linearity error. When the level is equal to the self-noise level, the correction is -3 dB. (See chapter "Self-noise.....").

Diffraction around the instrument casing

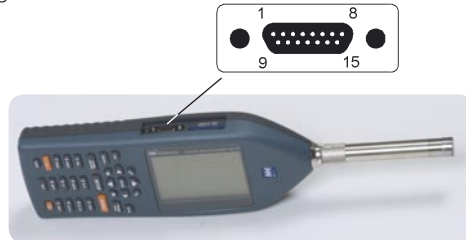
The instrument casing is designed to have low effects on the sound measured at the microphone. The figure below shows the measured effect of the instrument casing at reference environmental conditions.



General I/O socket

A 15 pin socket for general I/O is placed on the left-hand side of the instrument. Socket type: ITT Cannon MDSM-15PE 250-8550-021.

The general i/o socket



Pin	Signal	Dir.	Remarks
1	DO-1	Out	Digital output
2	DO-2	Out	Digital output
3	DO-3	Out	Digital output
			Reserved for calibration. (high = calibration ON)
4	RTS	Out	RS232
5	TXD	Out	RS232
6	PWR	Out	3.3V, max 10mA
7	RES	In	Reset
8	DI-1	In	Digital input - Reserved for ext.trig.
9	DI-2	In	Digital input
10	DI-3	In	Digital input
11	DO-4	In	Digital output
12	DSR	In	RS232
13	RD	In	RS232
14	GND		ref. analogue signal
15	AC-out	Out	Noise output
Housing	GND		Instrument casing

Signal output

An analogue output from the internal signal (noise) generator.

Max output voltage: ± 10 volt.

Output impedance: < 100 ohm. The output is short-circuit proof to GND and output current is in excess of 3 mA

Gain accuracy at 1 kHz: ± 0.2 dB.

Frequency response re. 1 kHz:
 ± 0.5 dB for $20 \text{ Hz} < f < 16 \text{ kHz}$.

Serial I/O port

RS232 port, 9600 – 115200 baud. The port may be switched off to reduce power consumption, which should be considered if a cable is attached to the socket.

Digital inputs

The digital input signals are 3.3V CMOS signals. The voltage levels must be within -0.25V to $+5.25\text{V}$ to avoid harming the instrument.

Input impedance: 10 kohm connected to the positive supply 3.3 volt. Any open input will therefore be in the high state.

Digital outputs

The digital output signals are 3.3V CMOS signals.

Maximum output impedance: 100 ohm. During power-up the output lines will be low or in a high-impedance state (100 kohm to ground).

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. Normally a replica of the normalised microphone signal. Full scale on the display bargraph corresponds to 100 mV.

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

Gain accuracy 1 kHz: $\pm 0,2$ dB

Frequency response re. 1 kHz: $\pm 0,5$ dB for $20 \text{ Hz} \leq f \leq 16 \text{ kHz}$.

USB interface

USB type 1.1

USB socket: B411

SD-card

The instrument may use SD-card for storing of setup information, sound recordings and measurement result.

Memory size: Up to 2GB

Data storage

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

Environmental conditions

Reference conditions. The reference conditions for the instrument are as specified by IEC 61672-1

Temperature: 23°C

Humidity: 50% RH

Atmospheric pressure: 101.325 kPa

Environmental condition for operation

Temperature: -10°C to $+50^{\circ}\text{C}$

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 $+60^{\circ}\text{C}$

Humidity: 5% to 90% RH, dewpoint less than 40°C

Atmospheric pressure: 50 kPa to 108 kPa

Warm-up time

The warm-up time for the main instrument without preamplifier/microphone is very short and the instrument obtains the final accuracy as soon as the self-test is made. Used with a preamplifier and microphone, this time is prolonged due to the charging of the microphone with the polarisation voltage. Normal sensitivity is reached within one minute. Before a recalibration is attempted, at least three minutes for warm-up is recommended.

Sensitivity for vibration

If the instrument is used under strong vibrational conditions, it is recommended to use an extension cable between the preamplifier and the instrument body.

The vibration will mainly affect the microphone, which is most sensitive if the vibration is applied perpendicular to the diaphragm. Typical values are 55 dB to 65 dB for acceleration values of 1 ms^{-2} perpendicular to the diaphragm.

Sensitivity for magnetic fields

The maximum indication for exposure to magnetic field of 80 A/m and any orientation is typically less than 20 dB.

Size and weight

Depth: 30 mm

Width: 75 mm

Length, excl. microphone/preamplifier: 210 mm

Length, incl. microphone/preamplifier: 292 mm

Weight incl. batteries: 410 g

Information for conformance testing

Reference Sound Pressure Level: 114.0 dB re 20 μPa . The reference frequency is 1000 Hz.

Reference Level Range: The instrument has one level range only.

Microphone Reference Point and Direction: The microphone reference point is the geometric centre of the diaphragm of the microphone. The microphone reference direction is from the microphone and along the axis of rotational symmetry for the microphone and preamplifier.

Battery voltage: The instrument will automatically switch off if the battery or external voltage is too low for operation within the stated specifications. The max. battery voltage for conformance testing is $4 \times 1.6 \text{ V} = 6.4 \text{ V}$.

Electromagnetic Compatibility: When the instrument is tested for conformance to electromagnetic compatibility requirements, the instrument should be in the measurement mode, as this normally will generate the highest levels of emissions. The highest susceptibility is normally observed when the display faces the principal direction of propagation for the electromagnetic field.

For further information related to type approval periodic verification, consult the factory.