G.R.A.S.
SOUND & VIBRATION

Instruction Manual

G.R.A.S. Audiometer Calibration Systems 90AA/90AB

www.gras.dk

Revision History

Any feedback or questions about this document are welcome at **gras@gras.dk**.

Revision	Date	Description
1	19 December 2011	First publication
2	5 July 2017	42AG substituted for the obsolete 42AB

Contents

Introduction

This manual contains information about operating and calibrating the components of the 90AA and the 90AB. Due to their similarities, both products are described in this one manual.

Both systems include the Audiometer System Calibrator HW1001. This portable system makes acoustical measurements of frequency and levels of the test signal, as well as harmonic distortion. The result table includes values for frequency of the test tone, level of the test tone, LZeq, and harmonic distortion. These values are displayed together with the 1/3 octave band spectrum.

The 90AA and 90AB Audiometer Calibration Systems comply with the following international standards:

- IEC 60318 Electroacoustics – Simulators of human head and ear - Part 1: Ear simulator for the calibration of supra-aural earphones, 1998-07.

- ITU-T Recommendations P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears.

- ANSI S 3.7 – 1995 – American National Standard for Testing Earphones

The audiometers are calibrated with their supra-aural earphones, circumaural earphones, and insert earphones. This is done with the couplers provided with the 90AA and 90AB.

- The supra-aural earphones TDH 39 and TDH 49 are standardized earphones that require calibration with a 6cc coupler. These are also known as audiometric earphones, headphones, headsets.

- The circumaural earphones HDA-200 are a standardized earphone that must be calibrated with an ear simulator based on the IEC 60318 standard. HDA-200 is also known as a high-frequency earphones, headphones, or headsets.

- Insert earphones, also known as ear inserts, are 3A and 5A. These are de-facto standardized earphones, which can be calibrated with a 2cc coupler.

A typical calibration interval is once every other year. The calibration checks at each frequency for distortion and calibrates the level.

The high-frequency coupler setup (43AA) has a test jig and an ear simulator (RA0039) that is designed to follow the specifications of the IEC 60318-1 standard. The acoustic input impedance of the RA0039 ear simulator closely resembles that of the human ear. Therefore, it "hears", or loads a sound source, in the same way as the human ear. The adjustable spring-loaded arm of the test jig lets you carry out measurements under well-defined conditions.

The 6cc coupler setup (43AF) has a test jig and an ear simulator (RA0075) that is designed to follow the specifications of the IEC 60318-1 standard. The RA0075 is designed with a volume of 5.6 cm^3, which approximates the volume of 6 cm^3 when a human ear is wearing a supra-aural earphone. This is why this setup is ideal for measuring the earphones of audiometers. The adjustable spring-loaded arm of the test jig lets you carry out measurements under well-defined conditions.

Getting Started with the 90AA and 90AB

Before you begin using your G.R.A.S. Audiometer Calibration System, use these lists to check that you have the following components.

The 90AA packing list

Included Items	Part Number
Ear Simulator Kit according to IEC 60318-1 & -2	43AA *
1" 6cc Coupler Kit according to IEC 60318-3	43AF *
1 m LEMO-LEMO extension cable	
Audiometer calibration analyzer	HW1001
Multifunction Sound Calibrator	42AG
Force cauge	RA0184
Lightweight suitcase	
Manual	LI0039

* The artificial ears are delivered with the 26AB ¼" preamplifiers with LEMO connectors.

The 90AB packing list

Included Items	Part Number
Ear Simulator Kit according to IEC 60318-1 & -2	43AA *
6cc NBS 9A Coupler according to ANSI S3.7-1995	RA0075
Thread adapter for NBS 9-A coupler	RA0076
1" pressure microphone	40EN
1 m LEMO-LEMO extension cable	
Audiometer calibration analyzer	HW1001
Manual	LI0039

* The artificial ears are delivered with the 26AB ¼" preamplifiers with LEMO connectors.

Using this manual

The following conventions are used in this manual.

Menu navigation

For the HW1001 Audiometer Calibration Analyzer, the menu navigation is described by each of the menus you must go through. For example,

SETUP > 1 (Instrum.) > 1 (Storing)

means press the SETUP button, then 1 on the number pad to choose the first item on the menu, and then 1 on the number pad to choose the first item on the new menu.

Field navigation

To navigate between editable parameter fields in the menu, use the cursor or arrow keys. A selected and editable field is shown in inverted colors, that is, white text on black background.

Key or button identification

References to keys on the HW1001 keypad are written in uppercase, for example, INC (increase) and DEC (decrease).
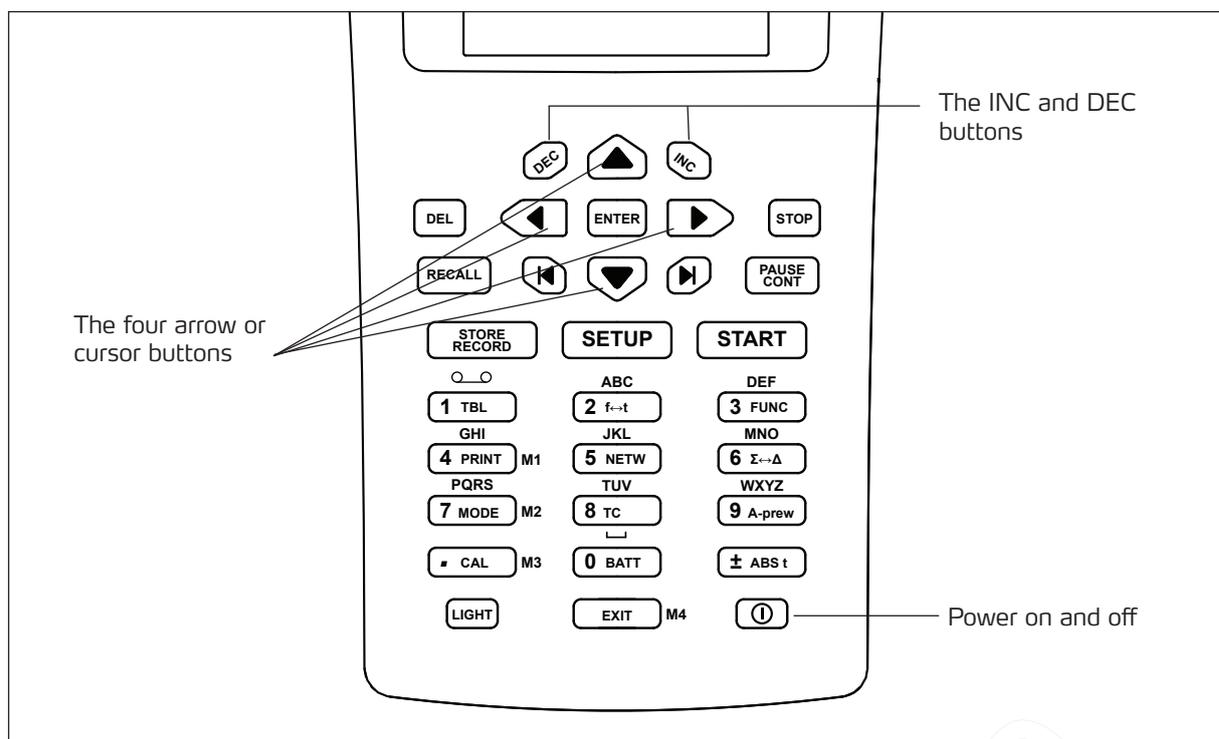
Fig. 1. The keypad on the HW1001 with several highlights.

General tips for using the HW1001

Use the INC and DEC keys to increase or decrease the current setting of the parameter. Alternatively use the keypad to type in the required value, whenever applicable.

When the # sign appears in the lower line of the display, you can type in data.

If you use the number keypad, press ENTER before moving to the next field. This is not necessary when using the INC and DEC keys. E is shown on lower line as a prompt.

To leave a menu and put your changes into effect, press ENTER.

There is no cancel function available, so you must complete your action. Reenter if you make a mistake.

Press STOP when you want to terminate an ongoing measurement.

Calibrating the HW1001 Audiometer Analyzer

Calibration is done through the menus and buttons on the HW1001. No special tools are required.

When to calibrate

Calibration of the HW1001 should take place before a measurement session begins, or when required by the standards in use.

Note: This step does not replace calibration with a sound calibrator because the sensitivity adjustment procedure will be unable to reveal possible microphone, preamplifier, or extension cable malfunctions.

Adjusting the scale settings

The HW1001 has a 120 dB dynamic range (10–130 dB SPL), so the 80 dB bar graph range is only a display limitation. There is no need to set the full scale before going to the calibration menu. Also, because the HW1001 automatically enters C-weighted mode, you do not need to enter the calibrator frequency.

However, you may have to adjust the display top scale setting to see the top of the bar graph. Use the INC and DEC keys to make these adjustments before you go to the calibration menu.

Carrying out the calibration

Use the 42AG for calibration.

1. Mount the calibrator onto the HW1001. Switch on the sound calibrator and wait until the level has stabilized. For information about the time required for stabilization, see the 42AG instruction manual.

2. Press CAL to go to the Calibration menu.

Note: Never calibrate the instrument until at least three minutes after turning on the instrument.

3. The default output level of the 42AG is 114 dB. Knowing that value means you will know what level the measuring instrument is supposed to show. The output level is printed on the sound calibrator as well as in the documentation.

4. Free-field microphones require lower settings. Note that instruments using free-field microphones must be adjusted to a value slightly lower than the output level of the sound calibrator. For a half-inch cartridge, this typically amounts to 0.2 dB lower for calibrators producing a 1000 Hz calibration signal. This means the HW1001 should be set to 113.8 dB when using the 114 dB @ 1000 Hz 42AG sound calibrator.

Pressure microphones must be adjusted to a value equal to the output level of the sound level calibrator.

5. Set the sensitivity. To set the sensitivity correctly, use INC and DEC while watching the level read-out. Alternatively, you may enter the required sensitivity using the numerical keypad. Once the correct level reading is established, press enter to leave the menu. The sensitivity is listed on the calibration chart supplied with the microphones.

dB Value

The dB value corresponds to the sensitivity level of the microphone cartridge. dB is relative to 1 volt/pascal; for example, 50 mV/Pa corresponds to –26.0 dB.

Calibrating HDA-200 Circumaural Earphones

The HDA-200 circumaural earphones are standardized earphones used with audiometers. They are also known as high-frequency earphones, headphones, and headsets. They must be calibrated with an ear simulator that is designed according to the IEC 60318-1 standard.

Fig. 2. *A typical setup with circumaural earphones.*

Setting up a high-frequency coupler calibration

The steps for a high-frequency coupler calibration are

1. Calibrating the spring-load on the jig

2. Calibrating the sensitivity

3. Calibrating the microphone on the jig

4. Measuring the audiometer with circumaural earphones

Calibrating the spring load for 43AA

The spring-loaded clamp on the test jig must be calibrated. For test measurements, the earphone is placed on top of the coupler centered carefully over the coupler opening. The recommended total weight or pressure should be 4.5 N. The spring-loaded clamp provides this pressure or force on the device under test. Calibration is needed to document the force applied during each measurement, which also makes the tests reproducible.

To calibrate the spring-loaded clamp:

1. Adjust the screw on the side of the clamp.

2. Use the force gauge to hold the top bar of the clamp at precisely a 90° angle to the vertical bar. In that position, measure the force as you turn the finger screw and adjust the force to 4.5 N. You may need a slightly different force for your particular measurement. Be sure to record the force value for future tests.

Calibrating the sensitivity of 43AA

Sensitivity is registered on the calibration menu on the HW1001.

1. Press CAL to go to the Calibration menu.

2. Enter the sensitivity of the coupler. For circumaural earphone tests, use the measurement listed on the calibration chart under "6cc Coupler Sensitivity".

Calibrating the microphone on the jig

Before measuring with the audiometer, calibrate the microphone on the jig.

1. Move the spring-loaded clamp to its upright position or remove it completely.

2. Loosen and remove the ear simulator. This exposes the microphone.

3. Place the sound level calibrator over the microphone and turn it on.

4. Make sure that the calibration level shown in the display is 114.0 dB ± 0.1 dB.

5. Switch off the sound level calibrator and remove it from the microphone.

6. Put the ear simulator in place, and you are ready to make measurements.

Measuring the audiometer with earphones

You may have to detach the individual earphone from the headset before continuing with the measurement.

Place the earphone centrally on the mounting plate so that it transmits directly into the ear simulator. Use plate GR0337 for guiding the placement of the earphone.

Use the spring-loaded clamp to hold the earphone in place.

Start the Audiometer in Calibration Mode

For the "As found" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Calculate new correction factors

3. Enter the new corrections factors in the audiometer

4. Create an "As Found" certificate

For the "As left" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Create an "As Left" certificate

Calibrating TDH-39 Supra-Aural Earphones

The TDH-29 supra-aural earphones are standardized earphones used with audiometers, also knowns as audiometric earphones, headphones, or headsets. They must be calibrated with a 6cc coupler.

Fig. 3. A typical setup with supra-aural earphones.

Setting up a 6cc coupler calibration

The steps for a 6cc coupler calibration are

1. Calibrating the spring-load on the jig

2. Calibrating the sensitivity

3. Calibrating the microphone on the jig

4. Measuring the audiometer with supra-aural earphones

Calibrating the spring load for 43AF

The spring-loaded clamp on the test jig must be calibrated. For test measurements, the earphone is placed on top of the coupler centered carefully over the coupler opening. The recommended total weight or pressure should be 4.5 N. The spring-loaded clamp provides this pressure or force on the device under test. Calibration is needed to document the force applied during each measurement, which also makes the tests reproducible.

To calibrate the spring-loaded clamp:

1. Adjust the screw on the side of the clamp.

2. Use the force gauge to hold the top bar of the clamp at precisely a 90° angle to the vertical bar. In that position, measure the force as you turn the screw and adjust the force to 4.5 N. You may need a slightly different force for your particular measurement. Be sure to record the force value for future tests.

Calibrating the sensitivity of 43AF

Sensitivity is registered on the calibration menu on the HW1001.

1. Press CAL to go to the Calibration menu.

2. Enter the sensitivity of the coupler. For supra-aural earphone tests, use the measurement listed on the calibration chart under "6cc Coupler Sensitivity".

Calibrating the microphone on the jig

Before measuring with the audiometer, calibrate the microphone on the jig.

1. Move the spring-loaded clamp to its upright position or remove it completely.

2. Loosen and remove the NBS 9A coupler, but not the thread adapter. This exposes the microphone.

3. Place the sound level calibrator over the microphone.

4. Make sure that the calibration level is 114.0 dB ± 0.1 dB.

5. Switch off the sound level calibrator and remove it from the microphone.

6. Put the coupler in place, and you are ready to make measurements.

Measuring the audiometer

You may have to detach the individual earphone from the headset before continuing with the measurement.

Place the earphone centrally on the mounting plate so that it transmits directly into the coupler.

Use the spring-loaded clamp to hold the earphone in place.

Start the Audiometer in Calibration Mode

For the "As found" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Calculate new correction factors

3. Enter the new corrections factors in the audiometer

4. Create an "As Found" certificate

For the "As left" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Create an "As Left" certificate

Calibrating Insert Earphones

Insert earphones are another type of earphone used with audiometers.

Calibrating the EAR 3A ear-insert

Fig. 4. *A typical setup with insert earphones.*

The 3A and 5A are de-factor standardized earphones, also known as ear inserts.

They are calibrated with a 2cc coupler.

Mounting the RA0113 in 43AF

1. Loosen and remove the 6cc coupler to reveal the microphone.

2. Remove the microphone protection grid. Note: when the protection grid is removed, always handle the microphone with utmost care so you don't touch the diaphragm.

3. Mount the 2cc coupler RA0113 on the microphone.

Now the ear simulator is ready for use.

Calibrating the sensitivity of 43AF

Sensitivity is registered on the calibration menu on the HW1001.

1. Press CAL to go to the Calibration menu.

2. Enter the sensitivity of the coupler. For insert earphone tests, use the measurement listed on the calibration chart under "6cc Coupler Sensitivity".

Calibrating the microphone on the jig

Before measuring with the audiometer, calibrate the microphone on the jig.

1. Loosen and remove the ear simulator. This exposes the microphone.

2. Place the sound level calibrator over the microphone.

3. Make sure that the calibration level is 114.0 dB ± 0.1 dB.

Now you can begin the measurement process.

Measuring the audiometer

Start the Audiometer in Calibration Mode

For the "As found" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Calculate new correction factors

3. Enter the new corrections factors in the audiometer

4. Create an "As Found" certificate

For the "As left" measurement:

1. Measure the Level, Frequency and Distortion at each test frequency at the preset level.

2. Create an "As Left" certificate

Memory handling

The instrument has a large built-in, non-volatile memory which can hold large amounts of measured data and measurement setups.

Data can also be stored on an SD card with up to 2 GB storage.

Memory structure

The memory structure of the HW1001 is quite similar to that of a PC using both folders and files.

The HW1001's naming process is simplified: the folder available for storage has the name of today's date and the files are numbered consecutively in ascending order as they are stored, starting at 0001.

Internal memory size

The size of internal memory for storing measured data is approximately 25 MB.

SD-card memory

An SD memory card may be used for storing setups, measurement data, and sound recordings. The card is located on the left side of the instrument behind the rubber protection. We recommend using a card with a memory size of 2 GB or less as operation on such card will be faster.

Note: Do not use a miniSD without a proper adapter.

Important: Never remove the card from the instrument during reading or writing operations!

Formatting the SD card

Always format the SD card in the instrument before using it the first time.

Formatting a card is also the fastest way for deleting all data on the card. We recommend that you format your card on a regular basis. After a period of time with normal use where files are stored and deleted, the file structure becomes fragmented, which lowers the speed for transfer of data.

To format the SD card:

1. Mount the card in the card slot on the left side of the HW1001.

2. Press DEL.

3. The upper line in the display should read "Clear: SDC". If not, press INC or DEC.

4. Press the left cursor, then ENTER.

5. Scroll down to FORMAT and press ENTER.

6. Confirm the FORMAT selection and press ENTER.

7. Wait until the format operation has been completed before performing other actions on the HW1001.

Select the device for storing

Select either the internal memory or the optional SD card as the location for storing data. You have one selection for measurement setups and one for the result of the measurements. The selection is done in the instrument menu.

1. Press SETUP > 1 (Instrum.) > 1 (Storing)

2. Use the cursor key to move to the field for setup.

3. Use INC or DEC to select the desired place for storing the setup.

4. Use the cursor key to move to the field for Result.

5. Use INC or DEC to select the desired place for storing the measurement results.

6. Press ENTER until you return to the main menu.

Storing a measurement setup

Measurement setups can be stored for future use. This is handy and practical when the instrument is used by several people or for many different tasks.

Working with global parameters

The setup parameters are stored separately for each mode of operation. Due to this feature, you don't have to readjust the filter bandwidth to 1/3-octave due to a previous measurement of STIPA, which requires a full octave bandwidth.

The mode related setup covers most measurement parameters as selection of network, measurement time, time resolution, frequency resolution, etc. However, some parameters are global and adjustment in one mode will define these parameters when the instrument is operated in a different mode.

The following parameters are global where adjustment in one mode of operation will also be valid in other modes of operation:

- Instrument sensitivity (calibration)

- Preamplifier/polarization voltage

- Calendar/clock settings

- Serial interface on/off and baud rate or USB-selection

- Second weighting-network (C-weighting or Z-weighting)

- Level range (Normal/High)

- Units (dB or engineering units)

- Correction on/off

- Printer

- Language (for print)

- Instrument identification (Option 11)

Mode dependent parameters

The parameters that are not global can be adjusted in one mode of operation for the instrument without affecting the value of the same parameters in another mode of operation. If you close a mode and return to it later, the value last used for the parameters will be automatically loaded.

Storing a measurement setup

Set up the instrument as required and press STORE without making a measurement. Setups are stored in a separate folder called SETUP.

All settings are stored, but when a setup is called up, not all the settings affecting the hardware are read back into the instrument. Hardware settings such as baud rate, preamplifier gain, and the calibration sensitivity are examples of settings that are not read back.

However, all the function and parameter settings used in the measurements are read back.

Note: If you have made a measurement and the result is displayed on the HW1001, pressing the STORE key stores only the result and not the setup. You can clear the values and return to the Ready mode by pressing EXIT.

Storing a measurement

When a measurement is made, it can be stored in either the internal memory or the SD card.

To store the data after a measurement, press STORE/RECORD.

The data will now be stored in a folder with the name of today's date. If this folder does not exist, it will be created by the HW1001. The first file is given the number 0001, the next file is given the number 0002, and so on. If you choose to delete one of the files already stored, you will leave a gap in the file list. This gap will not be filled with a file that is stored later, but will be left open. Otherwise, you will easily lose track of which file contains what.

Retrieving stored setups and data

Stored measurements are easily retrieved.

To retrieve a stored setup or stored data:

1. Press RECALL.

2. Use INC or DEC to select the storage device - internal (INT) or SD card (SD)

3. To scroll in the folder list, press the left arrow key once. Then you can use the vertical cursor keys to navigate to the desired folder.

4. To display the contents of the folder, press the right arrow key. This displays the files in the folder.

5. Use the vertical cursor keys to navigate to the desiger file.

6. Press ENTER to recall or retrieve the file/setup.

7. If you do not want to recall any file or setup, press EXIT to leave this menu.

If you retrieved a stored setup, it is now available for use.

If you retrieved a stored measurement, it is now available for inspection.

The text line at the top of the display identifies retrieved files by showing an R for a recalled file and S for a stored file.

Deleting files and folders in the memory

To delete files and folders in the directory, press CLEAR, and the CLEAR menu is displayed.

To find the file or folder to delete, use the same procedure in "Retrieving stored setups and data" on page 23.

You cannot delete a file that you are displaying. Exit it before beginning the deletion or CLEAR process.

Deleting a single file

1. When you have found the file or folder to delete, make sure that it is selected, that is highlighted as white text on black background.

2. Press DEL.

3. Press ENTER.

4. You will be prompted to confirm your action. The cursor is positioned by default on CANCEL to avoid deletion of the wrong file.

5. Use the arrow keys to move to CUR.FILE.

6. Press ENTER again. The file is now deleted.

Deleting folders or the entire memory

1. When you have found the file or folder to delete, make sure that it is selected, that is highlighted as white text on black background.

2. Press DEL.

3. Now you have several choices:
   —CUR.DIR. (clear the current folder or directory)
   —ALL DATA (clear all data in the entire memory)
   —RESET (to reset the entire memory)
   —CANCEL (included to avoid accidental deletions – use EXIT to leave the menu if you want to cancel)

Note that RESET is replaced by FORMAT if you have selected the SD card. Formatting is the fastest – and recommended – method to clear all data on the SD card.

Technical Specifications

Unless stated otherwise, the specifications are for the complete audiometer analyzer 90AA equipped with the 40AG ½" pressure microphone and the 26AB preamplifier. 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 of up to 20 m may be used between the microphone preamplifier and the HW1001 body without loss of performance. Longer cables may be used if maximum sound pressure level or frequency is reduced.

Standards

The components of the 90AA/90AB comply with the following international standards.

Standard	Applies to
IEC 60318 Electroacoustics – Simulators of human head and ear –Part 1: Ear simulator for the calibration of supra-aural earphones, 1998-07	43AA, RA0039
ITU-T Recommendations P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparaturs: Artificial ears.	43AA, RA0039
ANSI S3.7 – 1995 – American National Standard for Testing Earphones	43AF, RA0075
IEC 61672-1 (2002-5): Electroacoustics – Sound level meters – Part 1: Specifications	HW1001

Analog inputs

Number of channels	1
Input connector	7 pin LEMO connector (LEMO ECG.1B.307.CLL)
Preamplifier	26AB
Preamplifier supply voltage	±15 volt, max 3 mA
Polarization voltage	0 V and 200 V, selectable
Maximum input signal	±11 V peak
Input impedance	More than 100 kΩ, 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.

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 mV. Typical values for the self-noise are 5 dB lower than the values stated. The noise levels are measured without light in the display.

The values in the following table are all averaged over 30 s of measurement time.

Noise mea-sured with…	Spectral Weighting Functions			Filter Bands	
	A	C	Z	1/3 oct: 6.3 Hz – 250 Hz	1/3 oct: 315 Hz – 20 kHz
18 pF dummy microphone & 26AB	13 dB	15 dB	25 dB	10 dB (option)	5 dB (option)
40AG micro-phone & 26AB	18 dB	22 dB	30 dB	15 dB (option)	10 dB (option)
With HW1001's input terminal short-circuited to ground	10 dB	10 dB	15 dB	0 dB (option)	7 dB (option)

Level detector

Detector type: Digital true root-mean-square (RMS) detection and peak detection, displayed 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 capability to measure 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
  Minimum

- S–time-weighted sound pressure level
  Instantaneous
  Maximum
  Minimum

- I–time-weighted sound pressure level
  Instantaneous
  Maximum
  Minimum

- Integrated-averaged sound pressure level

- Sound exposure level

- Peak sound level

- Exceeding level for F–time-weighted sound pressure level (cumulative distribution)

Level distribution

As an optional extension, the HW1001 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 HW1001 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.

Measurement range

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

Frequency Measurements

- **Frequency range:** 20 Hz – 20 kHz

- **Accuracy:** 0.3%

- **Resolution:** 0.1%

Distortions Measurements

- **Frequency range:** 20 Hz – 20 kHz

- **Measurement range:** 0.4 – 50%

- **Accuracy:** 0.3% (1/10 of indication)

- **Resolution:** 0.1%

Power supply

The lower, right-hand button on the front of the HW1001 is the power button. Press quickly to turn the device on, but press and hold for more than one second to turn the device off.

Battery: The four batteries (IEC LR6 AA size alkaline) are inserted on the back of the HW1001.

Battery voltage and time on battery since last change of batteries are indicated.

Battery lifetime is typically 8 to 12 hours depending on HW1001 and battery brand. If you use lithium batteries, the lifetime is typically 15 to 20 hours. The use of alkaline or lithium batteries is strongly recommended to avoid leakage.

AA-sized NiCd or NiMH rechargeable batteries may also be used, but they will have a reduced operating time. They must also be charged outside the HW1001.

The internal calendar/clock runs on the internal batteries even when the instrument is turned off. A charged capacitor supplies the needed current when the batteries need changing.

Data is stored in a non-volatile memory that needs no power to retain information.

External DC: Connecting an external DC source (11 - 16 V) is an alternate way to power the HW1001. Connecting the HW1001 to an external power source while there are rechargeable batteries in the device does not recharge the batteries.

Power consumption is approximately 1.2 watt depending on selected modes of operation. The external DC source should have source-impedance less than 1 Ω and be able to supply at least 300 mA.

If the external supply falls below 9 V, the HW1001 will use the internal batteries, if available. If the HW1001 has switched off due to loss of power or insufficient supply voltage, the HW1001 will automatically switch on and resume normal operation after reapplying the external DC supply.

When the combined battery voltage drops below 3.9 V, a "battery low" indicator appears in the display and the instrument will start to shut itself off. Any ongoing measurement will be terminated and stored in a directory called BATLOW. Memory contents are retained without the use of electrical power (flash memory). When fresh batteries are installed, the instrument will at start up ask for confirmation to store the previous measurement in the normal measurement directory.

If the HW1001 is connected to an external DC source, the external source voltage will be displayed (EV). If the external power fails during a measurement without any internal batteries installed (or the installed batteries have no power left), the HW1001 will be turned off immediately without storing the ongoing measurement. However, as the instrument automatically makes a backup storage every 2 minutes, the last file stored will include the correct results except for maximum the 2 last minutes prior to the power failure. When external power returns, the HW1001 will automatically start to measure as if the START key had been pressed.

If powered from internal batteries and left unattended and unoperated, the HW1001 will switch itself off after ten minutes. However, this does not apply if the HW1001 is measuring (including being paused during a measurement) nor when powered from an external source.

Socket for external DC: 1.3 mm plug, negative voltage on center-terminal.

The HW1001 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 4×1.6 V = 6.4 V.

Keyboard and Display

The keyboard is silicone rubber.

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 2 minutes after the last operation of any key.

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

AC-out

- 3.5 mm stereo jack.

- Both channels have identical signals driven by two separate amplifiers.

- Load impedance must be 16 Ω or more.

- Output voltage is generated by the 48 kHz DAC based on data from DSP. Normally a replica of the normalized microphone signal. Full scale on the display bar graph corresponds to 100 mV.

- **Output impedance:** Less than 10 Ω, 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.

USB interface

- **USB type:** 2.0

- **USB socket:** B411

SD-Card and Data Storage

You can use the SD card to store setup information, sound recordings, and measurement results. The memory size can be up to 2 GB.

Measured data is stored in the internal memory of the HW1001 or on the SD-card. The internal memory is a flash memory that retains data without the battery. It has approximately 25 MB of data storage.

Environmental conditions

The reference conditions for HW1001 are as specified by IEC 61672-1.

Environmental conditions	Reference	Operation	Storage
Temperature	23 °C	–10 °C to +50 °C	–30 °C to +60 °C
Humidity	50% RH	5% to 90% RH, dewpoint less than 40 °C	5% to 90% RH, dewpoint less than 40 °C
Atmospheric pressure	101.325 kPa	85 kPa to 108 kPa	50 kPa to 108 kPa

Warm-up time

The warm-up time for HW1001 without preamplifier/microphone is very short and the HW1001 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, we recommend at least three minutes for warm-up.

Ordering Information

Two pre-configured G.R.A.S. Audiometer Calibration Systems are available for ordering.

Included Items	Part Number
Audiometer Calibration System consisting of ear simulator kit, 1" 6cc coupler kit, 1 m LEMO-LEMO extension cable, analyzer, sound calibrator, force gauge, suitcase, manual.	90AA
Audiometer Calibration System consisting of ear simulator kit, 6cc NBS 9-A coupler, 1" pressure microphone, 1 m LEMO-LEMO extension cable, analyzer, manual.	90AB

Options and Accessories

The following items can be ordered separately.

Item	Part Number
Ear-insert option —RA0113 IEC 60318-5 Artificial Ear	OP0001
Free-field option —½" Free-field Microphone incl. Preamplifier 46AF —AA0009 Microphone extension cable, 10 meter —Tripod AL0004 —Microphone Holder AL0012	OP0002
Verification Option —42AG Multifunction Sound Calibrator —RA0184 Force Gauge	OP0003 *
Audiometer Calibration System Suitcase	KM0076 *

* Applies only to the 90AB because this option is already included in 90AA.

Calibration

Before leaving the factory, all G.R.A.S. products are calibrated in a controlled laboratory environment using traceable calibration equipment.

We recommend a yearly recalibration at minimum, depending on the use, measurement environment, and internal quality control programs.

We recommend calibration prior to each use to ensure the accuracy of your measurements.

Warranty

All G.R.A.S. products are made of high-quality materials that will ensure life-long stability and robustness. The 90AA/90AB is delivered with a 5-year warranty.

Damaged diaphragms in microphones can be replaced.

The warranty does not cover products that are damaged due to negligent use, an incorrect power supply, or an incorrect connection to the equipment.

Service and Repairs

All repairs are made at G.R.A.S. International Support Center located in Denmark. Our Support Center is equipped with the newest test equipment and staffed with dedicated and highly skilled engineers. Upon request, we make cost estimates based on fixed repair categories. If a product covered by warranty is sent for service, it is repaired free of charge, unless the damage is the result of negligent use or other violations of the warranty. All repairs are delivered with a service report, as well as an updated calibration chart.

Manufactured to conform with:

CE marking directive:
93/68/EEC

WEEE directive:
2002/96/EC

RoHS directive:
2002/95/EC

G.R.A.S. Sound & Vibration continually strives to improve the quality of our products for our customers; therefore, the specifications and accessories are subject to change.