

Using the artificial head microphone from HEAD acoustics

The HEAD Shoulder Unit (HSU) from HEAD acoustics is an artificial head microphone for performing aurally accurate binaural recordings. Depending on the version, the HSU is either connected to the microphone inputs of a front end via LEMO plugs (HSU III and HSU III.3) or to inputs with ICP® power supply via BNC (HSU III.2). Furthermore, the HSU is available with microphones with different sensitivities, allowing very weak signals to be recorded, too.

This Application Note explains how to configure the correct equalization, how to calibrate the microphones, and other aspects to be taken care of when recording with the HEAD Shoulder Unit. Note that making recordings with an HSU connected to a BEQ II.1 unit is fundamentally different from using other front ends. There are also specific differences when the HSU is connected to a Squadriga II front end.

Making recordings with the HSU via a BEQ II.1	1
Making recordings with the HSU via other front ends	3
Creating an HSU sensor in the HEAD Sensor Explorer	3
Recording with the HEAD Recorder	4
Making recordings with a HSU via a Squadriga II in stand-alone mode	5

Making recordings with the HSU via a BEQ II.1

If an HSU is shipped with a binaural equalization unit BEQ II.1, the calibration values and the custom equalization filters of the HSU are already loaded on the BEQ II.1. The serial number of the corresponding HSU can be found on the BEQ II.1 housing. A matched combination of an HSU and a BEQ II.1 allows level-calibrated and equalized recordings to be made in an easy way. The desired equalization function¹, the required measurement range etc. can be selected in the HEAD Recorder software or via the HMS Remote Control software tool.

In the HEAD Recorder, the desired equalization function can be selected via **View -> Hardware Properties** in the line **Equalization** (see figure 1). In this dialog, you can also select the measurement configuration of the HSU in the **Configuration** field, e.g. **HSU without torso** or **HSU with windscreen**.²

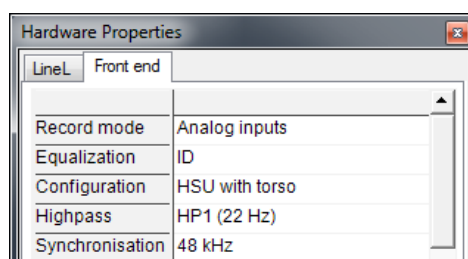


Figure 1: Hardware Properties of the BEQ II.1 in the HEAD Recorder

Once an HSU configuration has been selected, the HEAD Recorder automatically displays the HSU in the Channel List as an auto-sensor (see figure 2). Therefore, no new sensor needs to be created and defined. It is only important to select the correct input for the connected HSU (*Mic* or *Line*). In the Channel List, you can also select the measurement range. The selected range should be as low numerically (lower numbers, higher sensitivity) as possible in order to utilize the full dynamic range of

¹ Information as to why an equalization of binaural recordings is necessary and which equalization is suitable for which measurement can be found in the Application Note "Binaural measurement, analysis and playback".

² The **BHM** setting available besides the HSU configurations is required when the BEQ II.1 is connected to a Binaural Head Microphone (BHM). The **Sensor** setting is required when, for example, measurement microphones are connected to the BEQ II.1, for which no equalization filters need to be used.

the sensor: meters registering as high as possible without overloading, but also care must be taken to avoid clipping of the recorded signal.

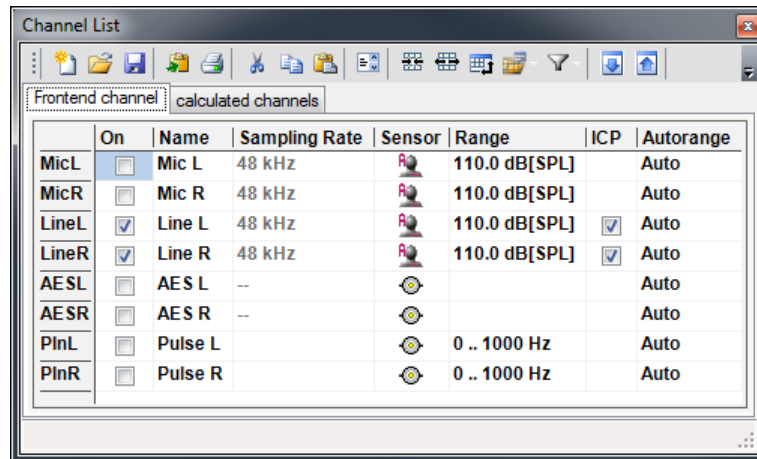


Figure 2: Channel List with auto-sensors in the HEAD Recorder (channels MicL and MicR: HSU with LEMO connector, channels LineL and LineR: HSU with ICP® powering and BNC connectors)

When using the HMS Remote Control software, the desired equalization and measurement range can be specified in the **Equalization** and **Range fields** of the user interface. Furthermore, this interface also allows the measurement configuration to be selected via a select-box (see figure 3).

If you are using an artificial head microphone with LEMO connectors, the HMS Remote Control interface allows you to check and correct the existing calibration values via the **Check** button. For technical reasons, this function is not available for the ICP®-powered HSU III.2.

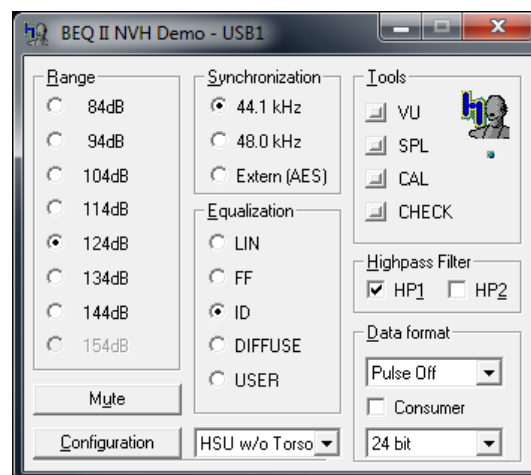


Figure 3: User interface of the HMS Remote Control software

If necessary, a calibration can be performed via the **CAL** button³. For this purpose, the ears must be removed as described in the manual. When remounting the ears afterwards, pay attention to the mark on the microphone capsules (described in the manual as well) to ensure that the capsules are positioned correctly after the calibration.

Please note that the HEAD Recorder and the HMS Remote Control both exchange data with the BEQ II.1. To avoid interference due to simultaneous access from both programs, it is recommended to open and use either only the HEAD Recorder, or only the HMS Remote Control for the configuration.

³ For calibrating an HSU in combination with a BEQ II.1, please always use the HMS Remote Control software and not the calibration function of the HEAD Recorder.

Making recordings with the HSU via other front ends

Creating an HSU sensor in the HEAD Sensor Explorer

In order to make a measurement with an HSU without a BEQ II.1, first a corresponding sensor must be created in the HEAD Sensor Explorer⁴. Use the **New Sensor** command to select the required HSU III, HSU III.2 or HSU III.3 sensor. A template appears, where the sensor properties can be specified. The template for an HSU III.2 sensor is shown in figure 4. Besides other parameters, you can specify the channel name, the sensitivity and the equalization.

The sensitivity of your HSU is stated on the included calibration certificate. Enter this value in the **Sensitivity** field, e.g. 53.4 mV/Pa as shown in figure 4.

	Sensor 1	Sensor 2
S.Name	HSU III.2 left	HSU III.2 right
Quantity	pressure	pressure
Input Unit	Pa	Pa
Output Unit	mV	mV
Calibration Mode	AC	AC
Sensitivity	53,400 mV/Pa	53,400 mV/Pa
Cal. Fact.	1	1
Cal. Date	12.01.2012 00:00:00	12.01.2012 00:00:00
Pol. Volt.	☐	☐
PreAmpl. Volt.	0	0
ICP	☒	☒
Coupling	AC	AC
Equalization	LIN	LIN
Filter File	ffs_cof[1].fft	ffs_cof[1].fft
Filter Ch.Idx	1	2

Figure 4: Sensor template for an HSU III.2 sensor in the HEAD Sensor Explorer

Double-clicking on one of the two empty fields in the **Filter File** line opens a file browser, where you can select an equalization filter file. The custom equalization filters for your HSU can be found on the included CD. Several filters can be chosen from:

- *dfs_cof* *dfw_cof*
- *ffs_cof* *ffw_cof* *fft_cof*
- *ids_cof* *idw_cof*

The first two characters in the names of the equalization filters stand for the equalization type:

- *df*: diffuse field
- *ff*: free field
- *id*: independent of direction

The next character stands for the measurement configuration:

⁴ As of ArtemiS SUITE 7.0 you can also create HSU sensors in a sensor library. Before you can use a Sensor Library created with ArtemiS SUITE in the Channel List of the HEAD Recorder (as of version 7.0) you have to import the library. One advantage of using Sensor Libraries is that the equalization curves needed for the correct recording are saved with the Sensor Library, thus after the sensor creation the EQU file is not needed anymore.

- *s*: standard configuration (with torso and without windscreen)
- *w*: configuration with windscreen (and with torso)
- *t*: configuration without torso (and without windscreen)

The configuration *t* (configuration without torso) is available only for free-field measurements, since only in this sound field, with sound coming in from the front direction, the influence of the missing torso box can be predicted reliably and taken into account in a generally applicable equalization filter.

The filters with *_con* in their names, which are available on the included CD as well, are not needed for the applications covered here.

Each of the files on the CD contains two filter curves, one for the left ear and one for the right ear of the HSU. The filter must be entered for both HSU channels, and the **Filter Ch. Idx** line specifies which channel of the file is to be used for filtering: **1** means left, **2** means right.

In order to avoid double equalization, the **Equalization** field is automatically set to **Lin** when custom filter files are used. In this case, the equalization is performed by the included equalization filters specifically matched to your HSU specimen, which you selected in the **Filter File** field.

Only one filter file can be assigned to each HSU sensor created in the HEAD Sensor Explorer. This means that if you want to use an HSU with free-field, diffuse field and ID equalization, you must create and save three sensors – one with FF equalization filters, one with DF filters and one with ID filters. In the HEAD Recorder, you must then select the sensor matching the actual sound field to obtain a correctly equalized recording.

In order to easily distinguish between the saved sensors later, it is recommended to include in the file name information about the respective equalization type (including the measurement configuration) and possibly also the serial number of the HSU.

Recording with the HEAD Recorder

After starting the HEAD Recorder software, the desired front end can be selected. In the following example, an HSU III.2 is connected to a HEAD/ab system. The procedure is almost identical when using other front ends.

After opening the HEAD Recorder and selecting the connected front end, the Channel List can be opened. Clicking on the sensor icon (BNC socket) of the respective channel with the right mouse button allows the HSU sensor (previously created in the HEAD Sensor Explorer) to be connected (see figure 5).

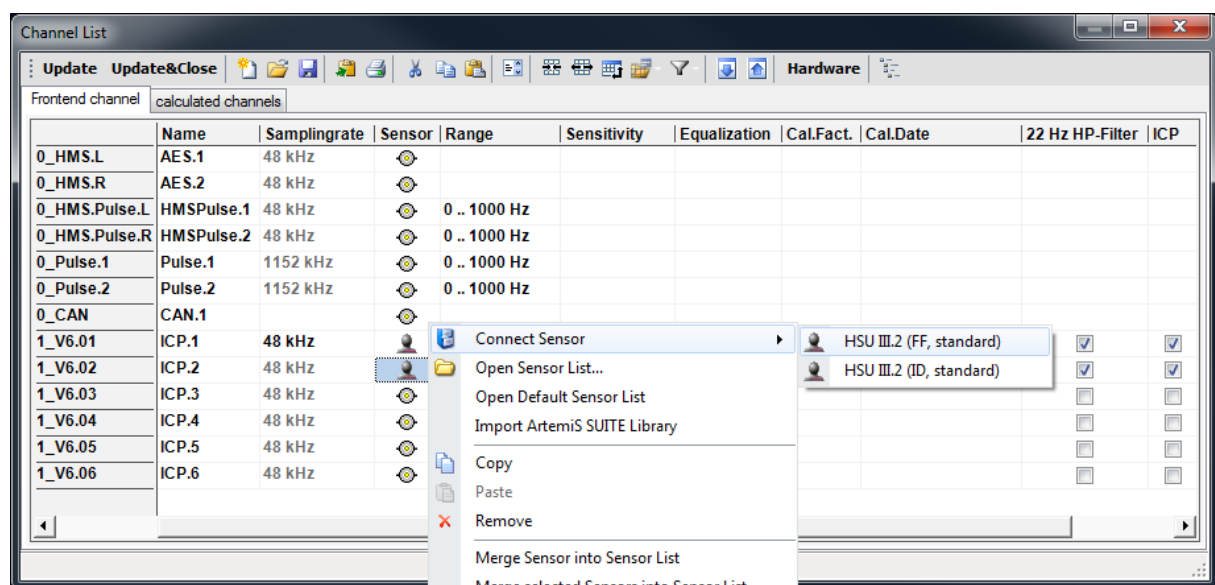


Figure 5: Channel List in the HEAD Recorder

Furthermore, in the Channel List you can also select the desired measurement range and – if not already done automatically due to being set in the sensor definition – turn on the ICP® power supply for the HSU III.2. As discussed earlier, the selected range should be as small numerically as possible in order to utilize the full dynamic range of the sensor, but taking care to avoid clipping of the recorded signal.

When you connect your HSU sensor (created in the HEAD Sensor Explorer) in the Channel List of the HEAD Recorder, the **Equalization**⁵ column will automatically show the grayed-out setting *Lin*. This is correct, since you integrated the equalization filter already when creating the sensor in the HEAD Sensor Explorer, and the equalization must not be applied twice.

In order to ensure a correct playback via the *labP2* or *labO2-V1*, the HEAD Recorder checks the name of the filter used when creating the sensor and writes the corresponding equalization type (FF, DF or ID) to the header of the HDF file.⁶ When playing the recording via *labP2* / *labO2-V1* operated in **Auto** mode, this information is read and the correct playback filters are applied automatically.

For a calibration of the artificial head microphones, the ears must be removed using the included tool. The procedure is described in detail in the HSU manual. When remounting the ears after the calibration, it is important to pay attention to the mark on the microphone capsules to ensure that the capsules are positioned correctly.

After removing the microphones, the calibration dialog in the **Tools** menu of the HEAD Recorder can be started. The calibration procedure is also described in the manual.

Making recordings with a HSU via a SQuadriga II in stand-alone mode

When using a SQuadriga II unit in stand-alone mode, it is possible to apply equalization filters to the HSU recordings if the filters have been uploaded to the SQuadriga II before. To upload the equalization filters, the SQuadriga II must be connected to a computer. For equalization in stand-alone mode, the same filters are used as described above on page 3. The filters are transferred using the SQuadriga Tools software, instructions can be found in the document “SQuadriga II - Configuration and utilization”. Once the equalization filters are uploaded, they are available for selection in the sensor definition under **BHM/HSU** (see figure 6).

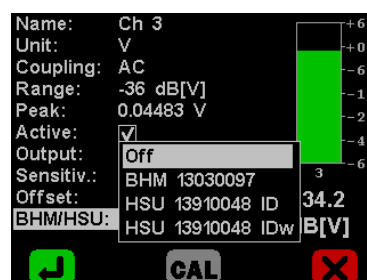


Figure 6: Sensor definition on the SQuadriga II display

Besides the correct equalization, it is also important to take care of the calibration. When creating a HSU sensor on the SQuadriga II, the sensor sensitivity specified in the calibration certificate must be entered. It is also possible to perform a calibration using the **CAL** button (see figure 7). The calibration values determined are then automatically stored by the SQuadriga II for the corresponding sensor and are used for subsequent recordings.

This ensures a properly equalized and calibrated signal. When using the correct equalization filters during the recording in stand-alone mode, the HSU signals saved to the SD card of the SQuadriga II are already equalized and need not be filtered after reading from the memory card. Like the HEAD Recorder, SQuadriga II analyzes the name of the selected filter and writes the corresponding

⁵ Note that this column may be hidden. In this case, you can make it visible with the  button.

⁶ To ensure that the correct information about the equalization type used is stored in the header of the file, make sure that the name of the filter is not changed.

equalization type to the header of the HDF file, so that this information is read and the correct playback filters are applied automatically when playing the recording.

When using the SQuadriga II in front-end mode (i.e. connected to a computer via USB), please proceed as described in the previous chapter, using the equalization filters of the HEAD Recorder software. Any filters activated in the sensor definition in SQuadriga II are automatically disabled in frontend mode in order to avoid double equalization.

Do you have any questions or remarks? Please write to:

imke.hauswirth@head-acoustics.de

We look forward to receiving your response!