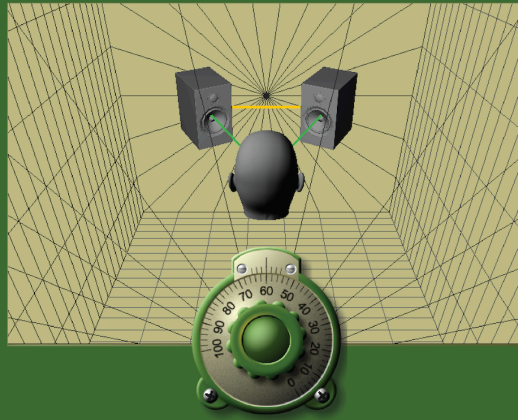




# BACCH-dSP



## BACCH-dSP RELEASE NOTES ARCHIVES

## **Version 14.0.3**

(Released on 2/18/2024)

Fixed a couple of issues related to parallelization and license management.

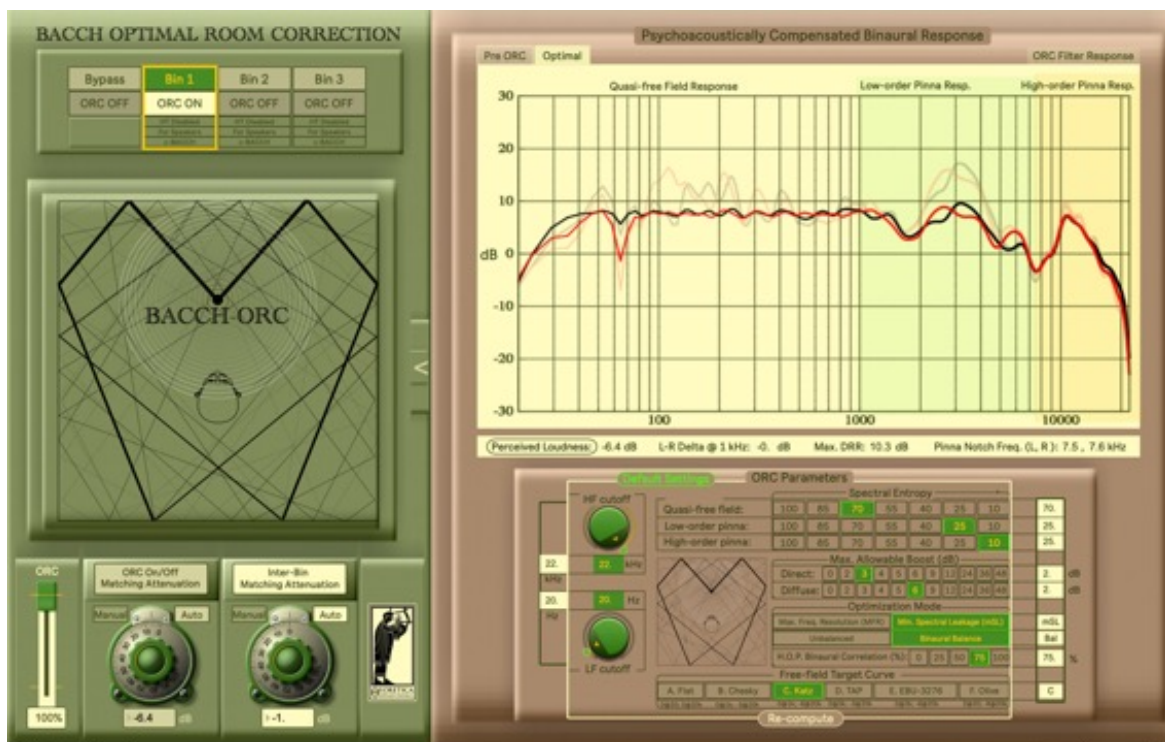
## **Version 14.0.2**

(Released on 2/16/2024)

Fixed a bug in BACCH-dSP 14.0.1 (Audiophile edition level and above) that can, intermittently, cause the sine sweeps played back during the measurement sequence, and the BACCH-dSP audio engine, to stop.

## **Version 14.0.1**

(Released on 2/16/2024)



Aside from a number of improvements to performance and robustness and to the graphical interface, V 14 Introduces Theoretica's new Optimal Room Correction technology (ORC), described on the [BACCH-ORC official webpage](#).

BACCH-ORC requires in-ear acoustic measurements and is therefore available only for the Audiophile Edition and above.

While the BACCH filter correction works in the time domain and vastly improves 3D imaging, the ORC filter correction works in the frequency domain and vastly improves tonal transparency. A matched pair of BACCH and ORC filters does both, and results in even better imaging than with the BACCH filter alone.

To make a matched pair of BACCH and ORC filters follow these steps:

**Step 1:** Click on the ORC button (or type cmd-R) to bring up the BACCH-ORC graphical user interface (GUI). Turn **on** both “**ORC On/Off Matching Attenuation**” and “**Inter-Bin Matching Attenuation**” by clicking on their buttons located under the BACCH-ORC logo panel. Leave them in the Auto mode. (This will ensure that the volume level is automatically compensated to remain the same when the ORC filter is turned on and off, or when you switch between bins with different ORC filters.)

You can click on the “>” symbol on the right edge of the panel to open the plot display and ORC parameter panel. For most cases of critical audiophile listening, optimal results are obtained when the ORC parameters at their default values (marked by bright green rectangles and circles).

**Step 2:** Click back on the main BACCH-dSP panel, with the Arm and Fire buttons, and get ready to make measurements by wearing the BACCH-BM microphones, taking extra care to align both mic capsules in your ears so that they are placed and pointed the same way. Make the usual level adjustments to your playback system for making BACCH filters.

**Step 3:** As usual when you make a BACCH filter, click on the “Arm” button once, and wait for the thin white LED under the chosen bin to start blinking, indicating that the system has been armed and is ready. Before you click on the “Fire” button as usual, **make sure you select “PASS I”** in the large new toggle switch that appears on top of the “Armed” and “Fire” buttons. (PASS I will produce new BACCH & ORC filters, and PASS II will produce a new BACCH filter that matches the ORC filter produced from PASS I)

**Step 4:** click “Fire” and follow the spoken directions as usual. At the end of the measurement sequence, when the progress bar reaches its end and disappears, there will be new BACCH and ORC filters loaded in the selected bin. **Do not remove the BACCH-BM microphone from your ears just yet.** You still need to take a new measurement with PASS II to produce a matched BACCH filter.

**Step 5:** Again, click on the “Arm” button once, and wait for the thin white LED under the chosen bin to start blinking, This time, before you click on the “Fire” button, **make sure you select “PASS II”** in the toggle switch, to produce the matching BACCH filter.

**Step 6:** As soon as you click on the Fire button, the white “ORC ON” button in the selected bin lights up, indicating that the new measurement will be done with the new ORC

filter engaged. After the measurement sequence is done and the plots have been updated, remove the BACCH-BM microphone from your ears and put it back in its flight case.

Note that there is now a white frame surrounding the selected bin, with the word “Matched” on top. This indicates that this bin now contains matching BACCH and ORC filters.

You can inspect the plots in the ORC GUI and use the toggle switch on top of the plots to switch between the various frequency response plots: the **Pre-ORC** response, the calculated **Optimal** target for your individual system, room and ears, and the **Measured** corrected response due to applying the ORC filter.

You can now audition the matched BACCH-ORC filters with music and audio that you are familiar with. You can toggle ORC on and off while you listen by clicking on the ORC ON/OFF button in the selected bin to instantaneously hear the difference between the corrected and uncorrected sound.

Clicking on the Bypass bin will bypass both the ORC and BACCH filters if the ORC ON/OFF button in the Bypass bin is off. If it is on, you would hear the effects of the ORC filter without the BACCH filter, and you can toggle between the ORC filters stored in the three bins by using the small “1, 2 3” toggle bar that appears in the Bypass bin, without leaving the Bypass bin.

### **Head-tracked ORC**

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To make a matched BACCH-ORC filter pair with **head tracking**, make sure that the head tracking camera is on and properly zoomed and framed to track your head, then repeat the steps above, but click on the “**With Head Tracking**” option button before you click on the Fire button, for **both** PASS I and PASS II. Note that during the measurements of PASS II the yellow and red vertical lines that marked the locations of your head during PASS I will appear again so that you can position your head precisely where it was during PASS I, in order to ensure that the filters match well.

After the matched BACCH and ORC filters are produced, you can enable or disable ORC head tracking by clicking on the “ORC head tracking” toggle switch at the bottom of the BACCH-ORC logo in the ORC GUI.

The ORC GUI does not need to be open for ORC to work.

## **Version 13.5**

(Released on 9/11/2023)

1. New and improved upsampling algorithm (**All editions**)

2. Improved processing efficiency by 12%. **(All editions)**
3. Bad Measurement Alert. When a bad acoustic measurement is made (e.g. the user forgot to plug in the in-ear microphone before starting the measurement sequence,) the BACCH filter designer no longer hangs up. Instead, BACCH-dSP puts up an alert window to alert the user about the anomaly, and resets itself, after restoring the selected bin to its previous state. **(Audiophile Edition and above)**
4. The dB indicator under the Master Volume now lights up in red when the volume level is raised above 0 dB FS, to alert the user of the chance of clipping. **(All editions)**
5. The dB indicators under the Master Volume, and the level knobs for each of the bins (including the Bypass bin) can now be used to enter the level precisely by either typing the value, or clicking in the indicator's field and moving the mouse up and down. **(All editions)**
6. The speakers/headphones toggle button on top of the Bypass bin in dHP mode can now be toggled even if the Bypass bin is not selected. **(Audiophile+ Edition and above)**
7. Added a descriptive label on each plot. A number of minor enhancements, and a few minor bug fixes. **(All editions)**

### **Version 13.0.1**

(Released on 6/1/2023)

1. Head Tracking has been further improved with increased robustness in dim lighting conditions. **(Audiophile Edition and above)**
2. The use of the Intel RealSense depth camera for head tracking in darkness, introduced in v 12.0.3 of BACCH-dSP, is no longer possible under Mac OS Monterey (12.x) and Ventura (!3.x) due to Intel not releasing the required drivers. Consequently, BACCH-dSP 13 introduces a new IR webcam functionality for head tracking in darkness: simply plug this [low-cost infrared camera](#) (which you can purchase directly from Amazon.com, or other suppliers,) or a similar IR webcam, in your Mac instead of the regular webcam, and select "webcam" from the HT Sensor. **(Audiophile Edition and above)**
3. Webcam Resolution can now be selected from a toggle bar under sensor control sub-panel (upper right corner of the Advanced Settings panel). We recommend leaving this setting in the default "1280" position unless high resolutions are really needed. (Please note that changing the resolution will require remaking head-tracked BACCH filters with the new resolution setting.) **(Audiophile Edition and above)**
4. The low frequency resolution of the frequency response plot has been raised significantly. The plotted response below 80 Hz on that plot is now an accurate representation of the actual response. **(Audiophile Edition and above)**

5. Fixed a bug that caused the feedback detection system to be triggered when the Arm button is activated in systems where TotalMix was altered to allow phono stage input. **(Audiophile Edition and above)**

6. The “By Ear” mode for designing u-BACCH filters (most relevant in the Intro Edition of BACCH-dSP) has been significantly improved. When the “Left Image” or “Right Image” buttons (which appear when the “By Ear” mode is selected in the u-BACCH designer interface, after clicking the Arm button) are clicked, a new test signal is emitted for “By Ear” manual selection of the best u-BACCH filter. This new test signal is a specially designed pink noise signal, that is band-passed and HRTF-filtered in such a way that it allows a more precise spatial perception of the u-BACCH-rendered source in 3D space. The object of the u-BACCH design in this mode, is to simply vary the Speaker Span Half-Angle setting (using the large green vernier dial, or directly in the numerical value in the Speaker Span Half-Angle field) so that the pink noise source is perceived to be located as close to 9:00 o’clock, when the “Left Image” button is selected, or 3:00 o’clock, when the “Right Image” button is selected. **(Intro Edition and above)**

7. Added a “Free All Channels” button at the bottom of the Audio Settings sub-panel that allows freeing all input channels that they are all available in the 3DM mixer, including the channels that were assigned for mic input (typically channels 1 & 2) and loopback input. This setting is typically useful only when using the 3DM mixer (Pro Edition only) and carries the risk of causing feedback if there are live mics on the channels routed by the 3DM mixer to speakers in the same room as the mics (hence the alert window that comes up when this setting is selected, which warns of such a danger). **(All editions)**

8. Reduced CPU load by making many processes, including audio processing, more efficient. **(All editions)**

9. Various enhancements to the Graphical User Interface. **(All Editions)**

10. Various minor bug fixes and enhancements to functionality and stability. **(All Editions)**

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## **Version 12.1.5**

(Released on 1/19/2023)

1. Improved CPU efficiency **(All Editions)**
2. Fixed a bug in the application’s license management system. The correct licensed edition is now instantiated right after launch. **(All Editions)**
3. Fixed a bug that only affected the audio routing for the BACCH-XO module **(All Editions)**

## **Version 12.0.3**

(Released on 10/19/2022)

1. Significantly reduced CPU load by making many processes, including audio processing, more efficient. (All Editions)
2. Improved smoothness and robustness of head tracking. There is now an “HT Smoothness” toggle bar in the Misc. Command a& Settings sub-panel of the Advanced Settings panel that allows you to control the smoothness of head tracking (HT). A setting of 0 applies no smoothing to HT. A maximum setting of 4 significantly smoothest head tracking but at the price of some latency in adjusting for head movements. The recommended setting is 1 and is framed in a bright green frame. **(Audiophile Edition and above)**
3. Added a new capability of infrared head tracking (IR-HT) that allows head tracking in dim lighting down to pitch darkness. This new feature requires the use of the [Intel RealSense Depth Camera D415](#) and an IR illuminator such as [this one](#). **(Audiophile Edition and above)**

**Please note that this new IR-HT feature currently works on all Mac OS prior to 12.x, as Intel has yet to release the required drivers for the Mac OS 12.x. We intend to update BACCH-dSP and release a new version as soon as the new drivers are available.**

To use the Intel RealSense IR sensor,

- a. Make sure the sensor is plugged in a USB port of your Mac **before** you launch BACCH-dSP (unlike a webcam, the IR sensor is not “hot swappable”).
- b. Launch BACCH-dSP and wait for it to be ready.
- c. In the top right corner of the Advanced Settings panel there is a new button “RS IR” in the “Sensor” toggle bar, that represents the RealSense IR sensor. Click on that button to activate the sensor.
- d. Click on the “Display Off” button on top of the green video display rectangle to turn that display on. The button, now labeled “Display On”, will start blinking and you should see the IR sensor video in that display window.
- e. Turn on the [IR illuminator](#) and point it towards your head to illuminate it with IR light. Turn down the lights in your room to the level (including total darkness) that you wish to have when listening in the dark.
- f. Put the RealSense IR sensor on its tripod, place it securely on a surface so that the sensor is pointing towards your face.
- g. Use the Zoom slider on top of the video display window to Zoom on the desired head tracking area that includes your head.

- h. In the toggle bar under the video display window change the “Gain” setting “Low/High” and the “Exposure” (1-6) until you get good tracking, which is indicated when the small dot at the center of the Zoom frame turns from red to green.
    - i. Proceed with making head-tracked BACCH filters as you have done before using a webcam.
  - 4. There is a new toggle button at the bottom of the “Mono Component Correction” (MCC) sub-panel that allows toggling MCC on and off for the Bypass bin. **(All Editions)**
  - 5. There is a new toggle button that appears with the control for the output plugin (which is displayed on top of the Master Volume controller when “Output Plugin” is turned on) that allows toggling between applying or not applying the plugin to the audio in the Bypass bin. **(All Editions)**
  - 6. Restructured the head tracking and zoom control in the head tracking subpanel of the Advanced Settings panel and added a new HT monitoring feature that changes the color of the dot to bright green when a head is being tracked, and to red when HT loses the head. (Display On/Off toggle must be in the On position for the HT monitoring to work). **(Audiophile Edition and above)**
  - 7. We now recommend that BACCH-dSP Intro users using the BlackHole 2ch virtual audio device in the aggregate “BH4BACCH” to select the “BalckHole 2ch” device as the output device in Audio Midi Setup (AMS), instead of the BH4BACCH aggregate device. (This will avoid clock syncing and audio glitches problems with some DACs.) This is done either manually, by clicking on “BalckHole 2ch” in the list of available devices in AMS to select it, then control clicking in the blue area surrounding it to get the dropdown menu form which the speaker icon is selected, or automatically by running the “BH4BACCH” auto-configure script from the “ Auto-configure” dropdown menu in the “Audio Settings” sub-panel of the “Advanced Settings” panel of BACCH-dSP 12.x. **(All Editions)**
  - 8. Fixed a bug that sometimes caused the main head tracking display to be dark (when a non-HT filter is selected) instead of showing the BACCH-dSP logo. **(All Editions)**
  - 9. Fixed a bug that was introduced in v 10.5.2 and that caused the state (especially of the 3dm module) not to save all settings correctly. **(All Editions)**
  - 10. Various enhancements to the Graphical User Interface. **(All Editions)**
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## **Version 11.5**

(Released on 6/9/2022)

- 1 Improved head tracking robustness and stability (e.g. when tracking a listener wearing thick-framed glasses.). **(Audiophile Edition and above)**
2. Improved the ability of the BACCH Automatic Filter Designer Software (BFADS) to handle anomalous BACCH measurements. **(Audiophile Edition and above)**
3. Fixed one bug in BFADS that sometimes caused the Measurements with Existing Filters (MEF) function to give wrong measured XTC plots. Fixed another bug that affected BACCH-hp (headphones) filters. **(Audiophile Edition and above)**
4. Fixed a bug that sometimes caused the bins to be left in the wrong SP/HP/HT status when toggling between the dHp and non-dHP GUI modes. **(Audiophile Edition and above)**
5. Various improvements and minor bug fixes.

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## **Version 11.4.1**

(Released on 4/20/2022)

1. Fixes a bug in the BACCH Automatic Filter Designer Software (BFADS) that sometimes caused Measurements with Existing Filters (MEF) to give wrong XTC plots.

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## **Version 11.4**

(Released on 4/7/2022)

1. **HD Head tracking:** Takes full advantage of the 1280 x 720 resolution of webcams to deliver further improvement to head tracking.

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## **Version 11.1.1**

(Released on 3/3/2022)

1. Fixed memory leak issue that caused the application's memory allocation to grow, and over many hours (typically more than 20 hours) reach a point where an alert window comes up

stating that the application has been shut down due to unavailable memory. This issue seems to occur only for certain combination of Macs and MacOS (Catalina, Big Sur and Monterey), BACCH-dSP 10.0 or later, and mostly when head tracking is used. The fix should take of the problem but please let us know if encounter it. (You can always monitor the memory use of BACCH-dSP by launching the application “Activity Monitor” clicking on the Memory button on top of the main panel, and typing “BACCH-dSP in the search field. The use of BACCH-dSP should be stable and not exceed 5 GB.)

## 2. Ability to add VST/AU/VST3 plugins in BACCH-Xover.

The BACCH-Xover module (whose GUI is shown in the attached screenshot), which is built in all 4 editions of BACCH4Mac, allows applying a 64-bit 2-band or 3-band Linkwitz-Riley crossover network (and time delay to each band) inside BACCH-dSP. Starting with version 11.1.1 the BACCH-Xover module has now the capability of applying a VST, VST3 or AU plugin to each of the 3 bands in the crossover. This allows the user to instantiate, for instance, a convolution plugin for each band and apply a frequency/time room correction filter produced by a third-party room correction (RC) system (such as [Acourate](#)) as long as the filters are not in a proprietary format, and the convolution plugin can load filters of that format (there are many third party convolution plugins that can do that. One that we are familiar with and use is [Reverberate](#) by LiquidSonics). This way room correction (RC) can be implemented in BACCH-dSP and the BACCH+RC-processed multi-channel output sent to an outboard multi-input DAC system of the user.

The versatile and high-quality [Fireface UCX II](#) by RME (which Theoretica now offers as an option to the BabyFace Pro FS) has the 2-channel mic pre input required for making custom BACCH filters with the BACCH-BM in-ear binaural microphone, as well as the digital and analog outputs needed to apply BACCH-XO for implementing various crossover and room correction configurations. For instance, for the particular case of a 2-band system consisting of monitors having an AES/EBU digital input and a sub system with an analog input, you would simply select the 2-band option in BACCH-Xover, assign the LF band to the analog outputs of the UCX II, which drive your sub(s), and assign the HF outputs of the crossover to the AES/EBU output that feeds your powered monitors. You can then, if you wish, dial in delays for each band to time-align the speakers and apply any custom equalization or additional processing by instantiating a VST/AU/VST3 plugin at the output of each band in BACCH-Xover. Or you can instantiate a convolution plugin for each band to apply a room correction filter generated by a third-party room correction system as mentioned in the previous paragraph.



3. Fixed double convolution with u-BACCH when 3D Headphones processing is on.

## Version 11.0

(Released on 2/28/2022)

**1. Improved Head Tracking** (Audiophile Edition and above): Both translational head tracking (for speakers-based listening in Audiophile Edition and above) and rotational head tracking (for headphones-based listening in Audiophile Edition and above) have been significantly improved thanks to a new algorithm based on advanced face models. This allows for substantially more robust 6 degrees-of-freedom head tracking (6DOF HT) that works over longer distances, dimmer lighting, and stronger occlusion, and is more immune to the listener wearing eyeglasses, head covering and even face masks of various colors and patterns.

We have tested three USB webcams with the new HT system: The [Logitech C920](#), the [Logitech C270](#) (or the equivalent [Logitech C505](#)) and the [2 Megapixel 10X Optical Zoom, 5-50mm Varifocus](#).

The two Logitech webcams have the advantage of autofocus, while the Varifocus, needs to be focused manually but has the advantage of optical zoom (as opposed to the digital zoom of the Logitech webcams), which allows it to provide robust HT from much greater distances than the Logitech webcams.

For distances up to about 12 feet, the Logitech webcams work well with moderate lighting. The Logitech C270 has a lower resolution (1280x720) than the C920 (1920 x 1080) but at present BACCH-dSP's HT works at only 1280x720, therefore the higher resolution of the C920 is not an advantage. Moreover, due to its lower resolution the C270 has higher light sensitivity which makes it more suitable for HT in dim lighting. Based on our recent tests with the latest BACCH-dSP HT algorithm, we recommend the C270 over the C920, but both webcams will yield significantly better HT performance with BACCH-dSP 11.0 than with previous versions of BACCH-dSP.

The Varifocus camera is only necessary if the listening position is too far from the camera to give good HT with the Logitech webcams. With the Varifocus webcam you adjust the focus manually, and the 10x optical zoom allows you to zoom in on the listener's head far away and obtain robust HT over distance much greater than 10 feet.

**2. Automatic webcam resolution detection** (Audiophile Edition and above): BACCH-dSP now automatically selects the correct (1280x720) resolution format (out of all available formats) for any connected webcam when that webcam is selected.

**3. Accurate BACCH-BM mic gain calibration** (Audiophile Edition and above): BACCH-dSP 11.0 introduces a new mic gain calibration functionality that allows calibrating the gain of the BACCH-BM binaural microphone so that the level of the left and right mic capsules are perfectly matched. Well-matched mic capsules yield BACCH filters with improved crosstalk cancellation (XTC) level and L-R symmetry.

The individual equalization filter that comes with each BACCH-BM binaural microphone (and the is loaded manually in BACCH-dSP) insures that the free field frequency response of each of the two capsules is flat within a small fraction of 1 dB and that the gains of the two capsules are within a small fraction of 1 dB of each other.

Like all high-precision acoustic measurement microphones, with time and changing ambient conditions the frequency response does not change much but the gain (signal level) of the BACCH-BM mic capsules might drift, creating a difference in gain between the two capsules.

When that Left/Right gain difference exceeds 2 dB it can lead to XTC level asymmetries exceeding 5 dB at some frequencies, which can be audible as an asymmetry in 3D imaging.

BACCH-dSP 11.0 allows you (through a simple calibration procedure described below) to

quickly match the gain of the left and right capsules to within a small fraction of 1 dB through the following simple procedure:

Step 1. Hold the BACCH-BM mic capsules by their wires, as shown in the attached photograph, so that they are close to, or touching, each other, then hold them so that they are both facing the left loudspeaker of your audio system at a distance of about 1 m or more from that speaker. (The actual distance is not critical, as long as the signal at that location is not too low. Also, the exact orientation of the capsules is not important either as long as the capsules are roughly pointing in the same direction that is roughly in the direction of the left speaker.)



Step 2. Click on the “L. Spkr.” button under the “Mic Gain Calib” heading in the “Mic EQ & Gain Claib.” sub-panel of the Advanced Settings panel. In about 2 seconds, the system will go into mic gain calibration mode and emit a 1 kHz sine wave tone from the left loudspeaker.

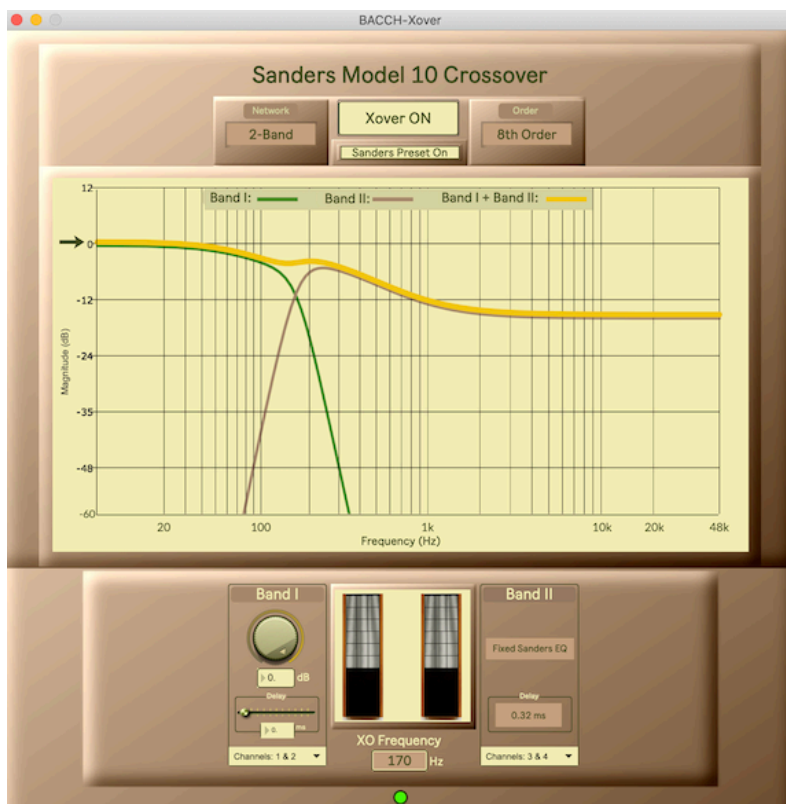
Step 3. Adjust the Master Volume in BACCH-dSP, or the volume on your playback system, or the distance between the capsules and the left speaker so that the Mic level meter (located in the lower right corner of the BACCH-dSP main panel) shows a level that is near or in the green region of the meter.

Step 4. Click the green-highlighted button labeled “Start Speaker-based Mic Caib.” that appeared in the “Mic EQ & Gain Claib.” sub-panel and wait for about 5 seconds until the measurement is done and the tone stops.

The result of this calibration procedure is displayed as two numbers in bright green (in that sub-panel) that represent the gain adjustments in dB that are now applied to each of the two capsules so that their levels are perfectly matched.

One of these two numbers (left or right) is always 0 while the other, a positive number, is the gain in dB applied to the capsule that has a lower level, to match the other capsule. That number is typically between 0 and 3 dB. No matter what that number is (even if it is higher than 3 dB) the capsules are now level-matched and you can proceed making BACCH filters with them. If that number is in excess of 6 dB, please let us know by sending an email message to [info@theoretica.us](mailto:info@theoretica.us) containing that number and the serial number of your mic.

**4. Crossover and Equalization module for Sanders 10 speakers** (All editions, including the Intro Edition): A growing number of BACCHers are using the [MODEL 10 Electrostatic Speakers](#) by Sanders Sound Systems, which among other properties, have a [high directivity](#) that renders them more immune to room reflections and thus capable of reaching high levels of crosstalk cancellation with BACCH. The Sanders 10 (and the older M11) speakers come with a DBX box that applies the necessary equalization and crossover needed to drive the Sanders 10 correctly. The new Sanders XO model, implements the specific equalization and crossover recipe provided to us by Roger Sanders, and allows forgoing the DBX box that comes with the Sanders speakers in favor of the more accurate (64 bit) crossover and equalization in BACCH-dSP, as well as avoiding the additional conversion (analog to digital) of the DBX box.



The Sanders XO module is accessed by clicking the “Xover” button located below the Master Volume slider on the main panel of BACCH-dSP and toggling the “Sanders Preset Off/On” button near the top of the Xover panel. When that button is in the On position (and the main Xover button on top of it is on), this new module applies all the equalization, crossover and delay parameters required for the Sanders 10.

To use this module instead of the DBX box, you would need a 4-channel DAC. The [Babyface](#)

[Pro FS](#) interface by RME (which ships with most BACCH4Mac Audiophile editions and above) provides 4 analog outputs and can be used as the 4-channel DAC instead of the DBX box. We have tested both the [Babyface Pro FS](#) and RME's [Fireface UCX II](#) (as well as the older UCX model) with the Sanders system and found that, while they both work nicely, the UCX II (and its older version the UCX) have more analog gain and thus provide a bigger pre-amplification headroom to drive the Sanders to higher sounds pressure level (SPL).

Our Tech Support team is happy to assist BACCH4Mac users who use the Sanders and help them properly configure the hardware and BACCH-dSP to benefit from this new functionality.

**5. Reinit Mac Video** (All editions, including the Intro Edition): There is now a new button “Reinit Mac Video” located in the “Misc. Commands & Settings” sub-panel of the Advanced Settings panel, to be used in the rare instances where the Mac video system does not allow BACCH-dSP to access the HT camera (this can happen when another application using the camera does not release it properly due to a crash or a bug). Clicking on that button will launch the Mac’s Terminal application where you are asked to enter your Mac user password before a command is quickly executed to initialize your Mac’s system. BACCH-dSP should then have access to all the available webcams.

**6. Installer no longer requires to restart the Mac** (All editions, including the Intro Edition): Starting with version 11.0 the BACCH-dSP installer no longer requires that the Mac is restarted. Simply click on the “Close” button that appears at the end of the installation to quit the installer. You can then launch BACCH-dSP.

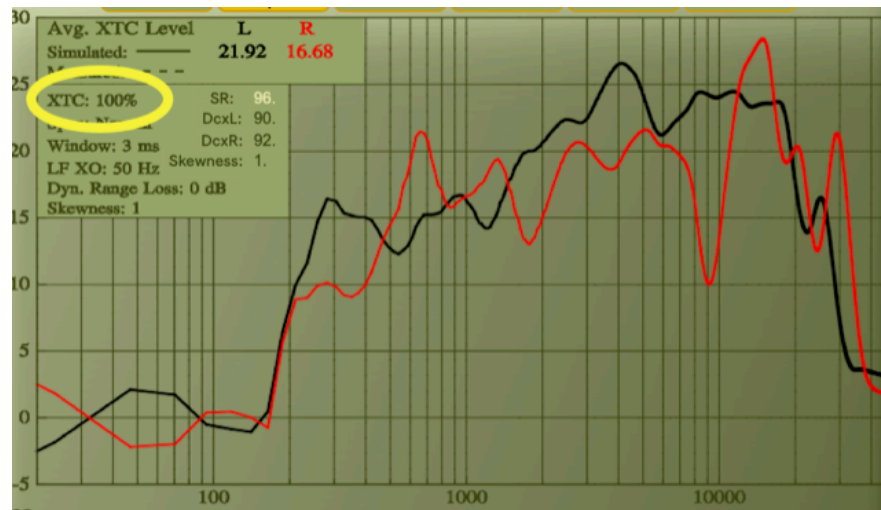
**7. BACCH-dSP is ready to use immediately after the main panel brightens up after launch** (All editions, including the Intro Edition): In previous versions, after launching BACCH-dSP and waiting for the progress bar to reach its end and the main panel to brighten up, the application remains unresponsive and sluggish for up to 20 seconds, with the rainbow spinning wheel (the common Mac wait cursor) appearing sporadically during that period. This no longer happens with BACH-dSP 11. As soon as the progress bar reaches its end and the main panel brightens up at the end of the launch procedure, BACCH-dSP is ready and fully responsive.

**8. Wrong webcam resolution format warning.** (Audiophile Edition and above.) BACCH-dSP requires that a webcam resolution format of 1280 x 720, and as per the Automatic webcam resolution detection described in item 2 of the release notes above, BACCH-dSP automatically selects this required format from the many formats typically available for a webcam. If the user manually selects another format from the dropdown menu at the bottom of the HT sensor sub-panel, that resolution is highlighted in bright red to warn the user that that selection is wrong.

### 9. Fix to a bug that caused BACCH filters to be produced with the 0% XTC option applied.

(Audiophile Edition and above.) We discovered a bug that appeared in recent versions that caused BACCH filters to be produced with the 0% XTC option applied, which leads to severe XTC degradation. (This option is controlled by the XTC % slider in the sub-panel labeled “BACCH Filter Designer Settings” and should be left at 100% for all cases of audiophile listening.) This bug only appears after importing an exported workspace using the Import/Export workspace functionality. (The bug was due to a failure to internally reset the value of XTC percent to that

diald by the XTC % slider). With BACCH-dSP 11.0 this bug has been completely eliminated.



If you have imported an old workspace that was imported with a BACCH-dSP version prior to v 11.0, make sure that XTC % value displayed on the XTC plot of that filter (see the highlighted region of the attached XTC plot) is 100%. If it is 0 % or any

value other than 100, make a new BACCH filter in that bin to override the old one.)

### 10. Numerous minor fixes, performance and robustness enhancements (All editions, including the Intro Edition).

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## Version 10.0.1

(Released on 1/31/2022)

Fixed a bug that occurs with some computers (e.g. Mac mini M1) in the audiophile edition (and above) of BACCH-dSP and that causes the Fire button not to work the first time you attempt to



make a BACCH filter after you launch the application. The update is highly recommended for all BACCH-dSP users.

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## **Version 10.0**

(Released on 12/29/2021)

1. Introduces bac10, a new generation of BACCH filters. While BACCH filters of the previous generation ("bac9") provided tonally transparent processing of audio, they had a perfect ruler-flat frequency response for central and side images, and a largely flat one for other imaging angles. The new bac10 filters provide perfectly flat frequency response for all imaging angles, and extend such flatness to the Nyquist frequency (the highest frequency for the playback sampling rate). Furthermore, the impulse response of bac10 filters is made even more compact, improving the reproduction of transients. **(All editions).**
2. bac10 filters solve the issue of the center image moving slightly (with respect to the side images) with head movements during head tracking: bac10 maintains the integrity (relative source imaging) of the spatial image during tracked head movements. **(Audiophile edition and above).**
3. Runs natively under M1 Macs. **(All editions).**
4. Compatible with Monterey (Mac OS 12.x), the most recent version of the Mac OS, as well as all Mac OS down to Yosemite (10.10). **(All editions).**
4. Ability to abort measurement process, at any point during the process, by clicking on the new "Abort" button that appears after the measurement system is armed. **(Audiophile edition and above).**
5. Improved GUI and new skin. Graphs are shaper, controls are clearer and better defined. **(All editions).**
6. New voice for guidance during measurements. **(Audiophile edition and above).**
7. Further improved bass correction algorithm leading to better 3D imaging at low frequencies. **(All editions.)**
8. The "Clear Hung Process" button now allows to clear most anomalously hung states of BACCH-dSP operation. **(All editions.)**

9. Added option to route "Existing Filter Measurement" to the Bypass bin in order to allow measuring the XTC of speakers with no BACCH filtering for research and development purposes. **(Audiophile edition and above).**

10. Improved HOA decoding algorithms in BACCH-hoa module **(Pro edition).**

11. A number of improvements to stability and functionality, and many minor bug fixes. **(All editions.)**

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### **Version 9.8.8**

(Released on 7/26/2021)

1. Improved mono correction algorithm leading to more flattened off-center response. **(All editions.)**

2. Improved bass correction algorithm leading to better 3D imaging at low frequencies. **(All editions.)**

3. A number of improvements to stability and functionality, and a few minor bug fixes. **(All editions.)**

4. Adjusted processing headroom to accommodate highly compressed source audio. **(All editions.)**

5. Resolved issue of 3D head and loudspeaker objects not appearing in u-BACCH and 3dm modules. **(Pro edition)**

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### **Version 9.7**

(Released on 1/31/2021)

1. Upon launch the sampling rate dropdown menu, the head tracking sensor selector switch, and the webcam selection dropdown menu are now all restored correctly to the settings they had when BACCH-dSP was last quit. (All editions.)
  2. The auto-configure scripts for the various physical and virtual devices now insure that all I/O mappings are reset and automatically configured correctly if they were manually set incorrectly. (All editions.)
  3. The 3D trajectories in the 3dm Mixer are no longer obscured by the room's walls the first time the 3dm window is opened. (Pro edition.)
  4. A number of minor improvements and UI enhancements. (All editions.)
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### **Version 9.6.3**

(Released on 12/23/2020)

1. First version that is fully compatible with both Big Sur and the new M1 Macs. It is backward compatible with all Macs running Mac OS down to, and including, 10.10 (Yosemite). **(All editions)**
- 2 Added a radio button labeled "Auto Assign Dev." to the Audio Settings sub-panel in the Advanced Settings panel. Leaving that switch on (recommended) will cause BACCH-dSP to send commands to Audio Midi Setup to switch the input and output assignments to the input and output device(s) selected in BACCH-dSP (as was done in the previous version of BACCH-dSP). Turning that switch Off will disable that update feature, which may be needed in order not to disturb some special audio routing scenarios in Audio Midi Setup. There is a green frame on the On side of that button to remind the user that this is the standard setting. **(All editions)**
3. Ported the 64-bid 31-band Graphic EQ functionality (previously available in the Audiophile Edition and above) to the Intro Edition. To use that capability, click on the EQ graph button to bring up the Graphic EQ interface, dial the desired EQ curve by moving the slider (avoid going above 0 to avoid clipping of the signal), then click on the small circle next next to the "Eq On/

Off” button under the desire bin. The EQ curve will then be applied to that bin (and only to that bin). Clicking on the Eq On/Off will toggle the EQ on and off for that bin. **(All editions)**

3. Added Capability of loading VST3 plugin. **(All editions)**

4. Ported the VST/AU/VST3 plugin functionality to all editions. Clicking on the “Show Output Plug” button at the bottom of the Advanced Settings panel will add a plugin control on top of the Master Volume slider.

Here is an example of using the Output Plugin to apply a Room Correction filter at the output stage of BACCH-dSP.

4.1. Install a VST, AU or VST3 convolution plugin that allows convolving a finite impulse response (FIR) filter. (We recommend the [SIR3 Plugin](#) by SIR Audio Tools or the [Reverberate 3](#) plugin by LiquidSonics, but any such convolution plugin should do.)

4.2. Launch BACCH-dSP and click on the “Output Plug: On” button at the bottom of the Advanced Settings panel. This will add a plugin control on top of the Master Volume slider.

4.3. Click on the VST, AU or VST3 dropdown menu and select the plugin. This will instantiate the plugin at the output stage of BACCH-dSP and bring up the plugin’s window. Load the FIR filter (e.g. a room correction filter produced by a Room Correction measurement system) in the .wav format and dial the appropriate settings (including Dry = 0; Wet = 100%,)

The audio in BACCH-dSP will now go through the plugin before it is sent to to the output. The plugin is that last stage before the output.

To Bypass the plugin click on its name this will grey the name field and bypass the plugin. To eject the plugin click on the Eject button in the lower right corner of the plugin control sub-panel.

Please note that applying a Room Correction (RC) filter that causes changes to the relative phase of the left and right channels may decrease the XTC performance of a u-BACCH filter. c-BACCH (i.e. regular BACCH) filters do not have this issue as they are based on measurement. The measurements for making (regular) c-BACCH filters should be made while that RC filter is applied so that the sweep goes through the RC filter, so that the resulting BACCH filter can account for the phase and amplitude changes that the RC filter imposes.

5. Fixed a bug that was causing some third-party plugins not to load or to crash BACCH-dSP. **(All editions)**

## 6. Minor bug fixes and GUI enhancement. (All editions)

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### **Version 9.5**

(Released on 11/7/2020)

#### **1. Enhanced CPU efficiency** (Intro Edition and above):

Significant improvement to CPU efficiency, which allows BACCH-dSP to run with no audio glitches on older/less powerful Macs, and more efficiently on recent Macs.

#### **2. Soundstage Balance Control** (Intro Edition and above):

There is now a horizontal slider that appears under the Master Volume fader when any bin other than the Bypass bin is selected. This slider, we call **Soundstage Balance Control (SSBC)**, is very effective at fixing issues of soundstage asymmetry that may arise in the following cases (to be distinguished from the intended/natural spatial distribution of sound level at the recording/production stage):

##### 2.a Asymmetric Rooms: Highly

asymmetric (Left-Right) sound pressure distribution in the listening room.

##### 2.b Content with inherent or degraded

Left-Right balance: Some stereo recordings, most notably on old tapes and vinyl, may have a left-right unbalance due to production non-idealities and/or media degradation.

##### 2.c Content with large inter-aural time

difference (ITD) values: Recent (and yet unpublished) research at Princeton University's [3D3A Lab](https://www.3d3a.com/) has shown that while level (ILD) panning is robust and left-right symmetric for human listeners who have no differential (left-right unbalance) hearing issues, many (at least 20%) of the same listeners perceive ITD panning to be asymmetric, i.e. audibly biased to the right or left. There seems to be an anti-correlation between the side of the asymmetry and whether the listener is left-eye or right-eye dominant, with right-eye dominant listeners perceiving the soundstage louder on the left side than the right side (and the opposite for left-eye dominant listeners). (Here is a simple test to find out if you are left or right-eye dominant: <https://www.allaboutvision.com/resources/dominant-eye-test.htm>).

Some recordings (especially acoustic recordings made with ITD-based stereo microphone techniques, such as the “spaced omni” or “Decca tree” techniques), may contain high enough ITD values to make such an asymmetry audible.

The three types of asymmetries listed above are often more noticeable with BACCH than without it, since without BACCH the soundstage is firmly (and unnaturally) anchored in the speakers thus making the perceived soundstage asymmetry less pronounced.

The new SSBC control can significantly compensate for the perceived soundstage asymmetry resulting from any of the above listed three causes, without compromising the accurate localization of the sources within the soundstage, or the sound quality. It represents a new technology that we first introduced recently in our flagship BACCH-SP processor.

To fix a perceived soundstage asymmetry simply slide the SSBC slider to the left or right enhance the side (left or right) of the soundstage that is perceived fainter than the other. Often a compensation of 2 to 3 dB is enough to fix the asymmetry. With mono-heavy programs (like pop music with a strong central image such as a lead singer) avoid going over 5 dB as that may result in shifting the center image a bit away from the center.

(The SSBC control does not affect BACCH filters or the measurements needed to make BACCH filters, it is applied upstream of all BACCH filtering.)

### **3. Infrared head-tracking with TrackIR (Audiophile Edition and above):**

BACCH-dSP 9.5 allows two options for the choice of the head tracking (HT) sensor: a. webcam (which as before includes built-in webcams and USB-connected cameras and webcams) and Infrared HT with [TrackIR](#), which is a [third-party](#) HT sensor that consists of an infrared emitter (placed somewhere in front of the listener) and a lightweight passive reflector worn on the head of the listener. The advantage of TrackIR over webcam-based HT is that the former extends six degrees of freedom (6 DOF) HT to pitch darkness conditions. Another advantage of TrackIR over webcam HT is that it provides more precise head rotation tracking (relevant only for the BACCH-hp and HT-Nav modules in the Audiophile+ and Pro Editions respectively).

On the other hand, the advantage of webcam-based HT is that it does not require the listener to wear anything on the head.

Theoretica, in its continuous efforts to evolve and adapt BACCH-dSP, continues to evaluate the latest advances in head tracking technology and intends to add in the future the option of depth-sensor infrared HT that does not require the listener to wear anything.

To use TrackIR the user needs to purchase the [TrackIR 5](#) hardware from the third-party developer (which consists of an IR emitter and TrackClip passive reflector), plug the IR sensor in the Mac via USB and position it at some distance ahead, then attach the TrackClip to the brim of

a hat or visor that is worn on the head. Simply selecting “TrackIR” in the radio button bar labeled “Head Tracking” located in the uppermost right corner of the Advanced panel of BACCH-dSP will turn on the TrackIR emitter and starts head tracking. (All the software components required for TrackIR to work were automatically installed on your computer by the BACCH-dSP 9.5 installer.)

#### **4. Head-steered sound spotlight (BACCH-hs^3) (Pro Edition):**

BACCH-dSP 9.5 adds a new sub-module, called BACCH-hs^3 (head-steered sound spotlight), to the BACCH-hoa main module. The BACCH-hs^3 sub-module features a new ground-breaking technology that relies a higher-order ambisonics (HOA) microphone (use as the [Eigenmike](#)) to create a "high-order beam" that can be steered anywhere in 3D space (using the BACCH-HT-Nav module) by simply looking in that direction, to significantly isolate sound sources in the beam from the background.

The BACCH-hs^3 sub-module has the following main features:

- Selectable HOA beam pattern, up to 4-th order hypercardioid, that allows up to 16 dB isolation from the background.
- Accurate 3D head-tracked steering through the BACCH-HT-Nav module using virtually any regular webcam or infrared Track IR headtracking hardware.
- Low-latency binaural rendering through 3D through headphones or earphones (ideally, capable of noise cancellation ) or BACCH-filtered 2-loudspeakers.

#### **5. BACCH-sme (stereo mic emulation) (Pro Edition):**

BACCH-dSP 9.5 adds another new sub-module, called BACCH-sme (stereo mic emulation) , to the BACCH-hoa main module. The BACCH-sme sub-module allows the accurate emulation of a variable-pattern pair of stereo mics for recording (or low-latency live monitoring) using a single HOA mic.

The BACCH-sme sub-module has the following main features:

- 14 selectable beam patterns (omni, and 1st, 2nd, 3rd and 4th-order cardioid, supercardioid, and hypercardioid), for each mic in the stereo pair.
- Beam steering in 3D, manually or through the BACCH-HT-Nav module using virtually any regular webcam or infrared Track IR headtracking hardware.
- Presets for emulation of "XY", Blumlein, and "MS" stereo pair of microphones.

**6. A number of improvements to the User interface (UI)**, including a new and improved Master Volume fader and high-resolution versions of the vernier dial in u-BACCH and BACCH-Xover modules.

**7. Numerous more minor improvements and bug fixes.**

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### **Version 9.0.4**

(Released on 6/4/2020)

1. Fixed a bug that appeared on rare combinations of Mac models and Mac OS (e.g. Mac mini 2014 under High Sierra). The bug causes the BACCH filters bins (for the Audiophile Edition and above) to remain in u-BACCH mode.

2. There is a new radio button at the bottom of the camera display sub-panel (located in the top right corner of the Advanced Settings panel) that allows you to verify that your camera is computable with BACCH-dSP. By default this format information is hidden but it can be seen by clicking on the Show button. BACCH-dSP requires a format of 1280 x 720 from the camera in order to properly frame the camera view field in the display window and allows the zoom and camera pointing functions to work properly. A typical webcam can stream in various formats and BACCH-dSP automatically queries the active camera (which is selected from the drop-down menu in the top right corner of the Advanced Settings panel) for a list of available formats and automatically selects a 1280 x 720 format. Most webcams, including the Logitech C270 and C920, C920e, C920S and C920 HD offer a 1280 x 720 format among other higher and lower resolution formats but at least one webcam, the Logitech C930e, does not. If the drop-down menu in the "Format" field does not show an option that has "1280 x 720" in its name, the camera is not compatible with BACCH-dSP and its field of view will not be correctly framed in the camera display window.

For the additional extensive version notes related to BACCH-dSP 9.0, please see the message with the subject "BACCH-dSP 9 (Catalina compatible)" that we sent you on May 31, 2020.



## **Version 9.0**

(Released on 5/31/2020)

1. (All Editions) BACCH-dSP 9 is the first version of BACCH-dSP to be fully code-signed by Theoretica and notarized by Apple, thus meeting all of Apple's conditions to install and run safely on your Mac.

2. (All Editions) Handling of the audio engine sample rate (SR) syncing has been simplified, and SR syncing optimized to happen faster. Whenever a new audio device is selected from the "Device for mic input" or "Device for audio out" drop-down menus BACCH-dSP will go into off-sync mode in order to make further settings easier to do. When BACCH-dSP is in off-sync mode a large red button labeled "SYNC Device" appears on top of the SR dropdown menu, and the small bright green LED (which appears on both the main and Advanced panels) blinks at a rate of about 1 blink per second. You can either configure the settings in the Audio Settings sub-panel manually or select an appropriate "Auto configure" script to have it done automatically.

2.a Manual Configuration: In off-sync mode BACCH-dSP remains responsive in order to allow you to easily select your input and output devices (which should be running on the same clock, as set in Audio MIDI set up). After you select your devices click on the "SYNC Device" button. It should then take only a few seconds for BACCH-dSP to sync to the clock of the selected device. You can change the sample rate selection from the SR dropdown menu at any time after the device is synced and it will take only a few seconds to re-sync to the new SR value. When the SR is synced the selected SR value will be bright green and small bright green LED will be on steadily.

2.b Auto Configure. There are new auto configure scripts in the "Auto Configure" drop-down menu (in the "Audio Settings" sub-panel). As before, these auto configure scripts will select and configure appropriate audio devices and their corresponding BACCH-dSP settings in "Audio Settings", automatically.

(Please note that the SF4BACCH script, which relies on the Soundflower extension to loopback audio from sources on the Mac into BACCH-dSP, no longer works under Catalina as Soundflower does not work with that Mac OS. Instead of Soundflower, we recommend the BlackHole system extension (<https://existential.audio/blackhole/>), which is free and compatible with Mac OS 10.15. In that case, you can use the new BH4BACCH auto configure script (after you create an aggregate device with that name in Audio MIDI Settings — we would be happy to help you set this up. If you have an RME device, like the Babyface Pro, you do not need such additional system extensions to do the loopback as the RME software driver does it nicely for you.)

If, like most BACCH4Mac users, you are using RME's Babyface Pro you can simply run the "Babyface Pro Analog Out" or "Babyface Pro Digital Out" auto configure scripts. Most computer audiophiles using the Audiophile, Audiophile+ or Pro edition of BACCH4Mac use an outboard DAC for output and the Babyface pro for mic input, through an aggregate device, called

BFP&DAC, created in the Audio Midi Setup utility application. Such users can simply run the “BFP&DAC” script from the “Auto Configure” drop-down menu to automatically auto configure the audio settings in BACCH-dSP.

3. (All Editions) Setting and syncing to the sampling rate (SR) of the previous session is now done automatically and quickly after launching BACCH-dSP. In previous versions of BACCH-dSP automatically reinstating the SR of the previous session after launch proved difficult for some combinations of audio devices and Mac OS. This has been made much more robust with BACCH-dSP 9.

4. (All Editions) There is a new radio button labeled “Output Protection” at the bottom of the "Audio Settings" sub-panel. When Output Protection is on, the BACCH-dSP constantly monitors the level of internal audio signal and quickly shuts down the digital path to the output device if that level exceeds what is expected of a normal audio signal. This provides protection to your audio equipment (and ears!) in the unlikely event that an anomalous process or computer malfunction causes the audio signal to be corrupted, which may cause a loud signal to be sent to your audio system. When Output Protection is tripped by such an anomaly BACCH-dSP shuts down its output, displays an alert window and displays a flashing red toggle button under the Master Volume control. Instructions on how to handle such an anomalous and rare occurrence are given in that alert window.

While you can defeat Output Protection by clicking the red-framed “Off” button of the "Output Protection" radio button (located on the lower border of the Audio Settings sub-panel), we recommend that you leave it on at all times.

5. (Audiophile Edition and above) Webcams are now hot swappable. This means you can disconnect a webcam or add one, without having to relaunch the application, and BACCH-dSP will automatically detect the disconnected or added webcam and refresh the drop-down list of connected webcams.

(In rare cases, such as that of the 2017 iMac Pro, which is one of the rare Macs with a built-in 1080p FaceTime camera, you may see after launching BACCH-dSP that only a part of the field of view is showing in the camera display panel. In that case, simply re-select the camera from the camera drop-down menu and the camera will be reset correctly.)

6. (Audiophile Edition and above) Head tracking (HT) now works with virtually all webcams (including the Mac’s internal FaceTime webcam) and USB cameras. For users sitting far from the camera (more than 4 meters) or in dim lighting we recommend a camera with optical (as opposed to digital) zoom. We have tested the ELP 2 MP Webcamera with 5-50 mm Varifocal Lens (currently available from Amazon for \$84.99: [https://www.amazon.com/dp/B07M7JN595/ref=cm\\_sw\\_em\\_r\\_mt\\_dp\\_U\\_e9YEbT7QC0FV](https://www.amazon.com/dp/B07M7JN595/ref=cm_sw_em_r_mt_dp_U_e9YEbT7QC0FV)) and found it to be very effective for head tracking for listening distances of more than 10 meters (although, unlike the Logitech webcams which have autofocus, this camera requires focusing manually on the listener’s head). We do not

recommend higher resolution cameras than 2 MP as 1) BACCH-dSP's head tracking image resolution is currently limited to 720p and cannot benefit from higher resolution; and 2) higher resolution cameras typically have lower light sensitivity, which will make HT less robust in dim lighting.

7. (Audiophile Edition and above) The "Display On/Off" toggle on top of the camera display in the Zoom sub-panel (in the top right corner of the Advanced Settings panel) now flashes when that display is turned on, to remind you not to leave it on after you are done pointing and zooming the camera as it would consume CPU needlessly.

8. (Pro Edition) The voices (sources) in the BACCH-3dm mixer are now perfectly (sample-accurate) synchronized. In previous versions turning off and on a voice (source) may sometimes cause the sources in the mix to go out of sync. This no longer happens.

9. (Pro Edition) The BACCH-3dm mixer has a new toggle button (next to the "Reflections" and "Reverb" buttons) labeled "Doppler". Turning this button on will add the Doppler effect, which changes the pitch of moving voices as they get closer or further from the head.

10. (Pro Edition) The graphical user interface (GUI) of the BACCH-3dm mixer module has a much higher graphics refresh rate than in previous versions, and allows moving and animating all 20 sources with no visual glitches.

11. Numerous other performance and stability enhancements, as well as fixes to all discovered and reported bugs (including a couple of typos in the interface).

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## **Version 8.2**

(Released on 12/18/2019)

1. The new BACCH-Xover module allows applying a network of crossover Linkwitz-Riley filters to the signal at the output stage of BACCH-dSP in order to split it into 2 or 3 bands, which can be sent to different physical outputs of the audio device for bi-amping or tri-amping applications. Each band can be attenuated separately and has its own time delay control which can be used for transducer alignment. The filters can be either 2nd order (12 dB/octave) or 4th order (24 dB/

octave). The graphical display shows the network's frequency response in real time. (We recommend lowering the playback volume on the speakers while changing the crossover frequency below 100 Hz as this may cause clicking or thumping sounds due to abrupt changes in the filter's coefficients when the crossover frequency is being changed). This new module is available in all editions of BACCH-dSP (Intro, Audiophile, Audiophile+, and Pro).

2. New HT-Nav module allows head-tracked navigation of the soundfield in the BACCH-3dm mixer. To launch the module's control GUI click on the "HT-Nav" button in the "Soundfield Navigation" sub-panel under the display in the BACCH-3dm module. When head tracking is activated from that module head movements of the tracked listener's head are instantaneously reproduced by the 3D dummy head object in BACCH-3dm allowing the listener 6 degrees of freedom (DOF) navigation of the soundfield. Each DOF can be activated or deactivated separately and its coordinates amplified or attenuated to allow amplified or compacted motion in 3D space. These controls could be used to allow navigating a large soundfield with small movements of the user's head.

This new module is particularly effective with the BACCH-hoa module, as it can be used to allow the user to navigate in 6 DOF a real acoustic soundfield captured by the HOA microphone.

The HT-Nav module is available only in the Pro edition of BACCH-dSP.

3. The BACCH-hoa module (available only in the Pro Edition) now supports the new MADI-based driver for the em32 eigenmic

4. Setting and syncing to the sampling rate (SR) of the previous session is now done automatically after launching BACCH-dSP. In previous versions of BACCH-dSP automatically reinstating the SR of the previous session after launch proved difficult for some combinations of audio devices and Mac OS. This has been resolved for all the combinations we could test.

5. Handling of the audio engine syncing, SR changes, and re-syncing has been significantly improved and made more robust. The small bright green LED (which appears on both the main and Advanced pages) now gives meaningful feedback on the status of the audio engine:

Multiple blinks indicate that the audio engine is syncing to the clock. This occurs after launch of the application, when the sampling rate (SR) is changed, or when the audio engine has stopped and restarted for whatever reason. When such multiple blinks are occurring the user interface will be a bit sluggish and the user should wait until the blinking stops (the green LED is lit steadily) before using the application and processing audio. Typically, the blinking stops after about 20 seconds at most. Continuous blinking for more than 20 seconds is often an indication that the list of the SR in the SR dropdown menu does not correspond to the actual list of SR supported by the audio device. In such cases, clicking on the small button labeled "Get dev SR

list” will query the device for its SR list, update the SR dropdown menu, and and allows the user to sync the audio engine by selecting the desired SR value or clicking on the red “Resync” button that appears next to the SR dropdown menu.

1 or 2 blinks indicate that the audio engine is executing normal housekeeping tasks, e.g. clearing the audio buffers. Such quick tasks are automatically triggered before some processes (such as arming the audio sweep system, turning on the BACCH-BM microphone, or arming a recorder). This is normal operation and the green LED will return to its steady lit state after one or two blinks.

6. On top of the “Camera on/off” toggle button near the top right corner of the Advanced panel, there is a new button labeled “Reset webcam”. In the rare cases when the webcam stops working and turning it on gives an error message that the webcam is tied up with another application, tapping on this new button will launch Apple’s Terminal application which will ask you for your password. Upon entry of your password the webcam will be reset and will become available to BACCH-dSP.

7. Numerous other performance and stability enhancements, as well as fixes to all discovered and reported bugs.

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## **Version 8.1.4**

(Released on 8/6/2019)

1. Fixed a bug that caused Source 1 in BACCH-3dm to lose audio if it initially has a negative azimuth coordinate. (Pro version only).
2. Fixed a bug that caused the room-controlled reverb in BACCH-3dm not to work reliably. (Pro version only).
3. Updated the convolution engine (that internally applies BACCH filters to the audio) to the latest version, which is more robust and efficient. (All versions).

## **Version 8.1**

(Released on 6/14/2019)

1. Fixed a bug that was introduced in v 8.0.5 and that caused the 3D soundstage to collapse when "Bass Correction" is turned on in the Advanced Settings panel.
  2. Left and Right level meters in Master Volume were swapped in u-BACCH mode. Bug fixed.
  3. Replaced small unlabeled "repopulate SR button" next to the SR dropdown menu with a bigger button labeled "Get dev SR list". Clicking on that button will query the selected audio device for its list of available sampling rates, and refreshes that SR dropdown menu with that list.
  4. Fixed bug that caused the file recorder in the "Multi-track File Player and Recorder" module not to display the Record button when the Arm button is clicked.
  5. Other minor enhancements.
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