

Diida

A web-based audiometer

By Audiology Technology Solutions, LLC

User Manual

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<https://audiologysimulator.com/>

Diida User Manual

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General information:

Diida was created by Audiology Technology Solutions, LLC. While designing Theta, we realized the powerful tools available via the webAudio interface in Google Chrome and other web browsers and decided to see if it could create a calibrated stimulus acceptable for performing audiometry. Using the Theta 3 virtual audiometry module, and tools built for audiometry education, you can now use Diida to perform actual hearing tests, right from your device.

Contact: <https://audiologysimulator.com/contact>

How Diida should be used

Diida is currently intended to be used as a practice audiometer. Hearing tests obtained with Diida should not be considered diagnostically accurate at this time. We are in the process of collecting preliminary data on the use of Diida as a fully operational, calibratable audiometer for diagnostic hearing assessment in the near future. We hope you will enjoy practicing audiometry using Diida until that time. If you are interested in participating in research comparing thresholds obtained with Diida to traditional audiometers, please contact us!

Safety first

Since Diida is intended to be used to perform audiometric tests, it has the capability of generating extremely loud sounds. We urge all users to exercise the utmost caution when calibrating and using Diida and to regularly check your sound levels to ensure they are within acceptable tolerances and at levels that will not be detrimental to the listener's hearing.

We'll especially note that the webAudio interface sound level is set to maximum whenever the Diida Calibration checkmark is checked in the Settings tab. Please use caution when calibrating Diida, as doing so will play extremely loud sounds.

Recommended equipment

We recommend using transducers and equipment that are easily accessible and which have normative data already established. Specifically, we recommend using the following:

Transducer: Sennheiser HD280 Pro Circum-aural Earphones

These headphones are relatively inexpensive and were investigated by Smull and Colleagues (2019) to derive Reference Equivalent Threshold Sound Pressure Levels necessary for calibration of Diida. Thus, we can confidently utilize these headphones in lieu of much more expensive models and still obtain accurate measures of a listener's hearing.

Smull, C. C., Madsen, B., & Margolis, R. H. (2019). Evaluation of two circumaural earphones for audiometry. *Ear and Hearing, 40*(1), 177-183.

In addition to the transducers, you will need a device with an audio connection and a stable, high-speed internet connection.

Preferred system requirements:

Diida is currently only fully compatible with the [Google Chrome web browser](#).*

Other browsers (Firefox, Safari, Edge, Opera) may also be supported as we expand coverage.

Minimum system requirements: 8GB RAM, Intel i5 (8th generation or later) or equivalent processor, display, stable high-speed internet access, web browser installed and up-to-date (as mentioned above). Most modern flagship smartphones and tablets (i.e., 2018 or later) will also be able to easily handle the processing requirements for Diida.

Note: Most current forms of tablets and phones opt to not have an audio output (i.e., a headphone jack) and so it may be necessary to purchase a 3.5mm audio-to-lightning conversion cable or other similar cable to connect the transducer to your device.

Create a user account

First-time users should create a user account (<https://audiologysimulator.com/signup>) to access their Dashboard. Diida is one service available via subscription from the Dashboard. Please check your dashboard or the pricing page for current pricing. The following YouTube video should help with the account creation process:

Create a user account: <https://youtu.be/lvYbZqiXKMI>

How to log into your account: <https://youtu.be/EjHy3xCsJSM>

When creating your user account (if you don't already have one), choose "Theta Academy" as your affiliation. If you already have a user account, you can use your current affiliation and still subscribe to Diida.

Subscribe to the Diida service

Once you have a user account, you'll need to pay for the subscription to Diida. Once you log into your account, you'll be taken to your User Dashboard and you can follow the steps in this video to subscribe. The process is the same – you can use an access code (if you have one) or go to a secure checkout page hosted by our 3rd party credit card processor (Stripe).

How to start a subscription: <https://youtu.be/tgXW2HSgOvs>

Enroll and Enter Diida

Once your subscription is active, you'll be able to see and enroll in the Diida course card in the "Available Courses" section of the Dashboard. Follow the steps in these videos to enroll in the Diida course and Enter the Diida Course to get started!

Enroll in a course: <https://youtu.be/-zTtkZGECOI>

Enter the course: <https://youtu.be/lkBXpfS-xzs>

Diida virtual audiometer control panel

Now that you're enrolled and inside Diida – you're all set! If you're familiar with Theta, then the user interface should feel very familiar to you. If you're not, here's some information on the user control panel that should be helpful for you.

Pro tip: Each button has an associated keyboard shortcut or "hot key". If you ever forget a shortcut, you can hover over any button to see what it does and its shortcut. A list of all shortcuts is also found in the Theta User Manual Appendix 1 (<https://audiologysimulator.com/manual>)

The buttons on the audiometer group into different categories (Figure 1). There are buttons that:

1. Change the stimulus
2. Change the ear routing
3. Change the transducer
4. Change the frequency and level
5. Turn the stimulus on and off
6. Save the value for the current task



Figure 1. Virtual audiometer buttons colored by group. Red – sound selection, Orange – ear selection, Yellow – transducer selection, Green – sound properties, Blue – sound presentation, and Purple – save.

1. Stimuli

Symbol	Stimulus	Information
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–	Constant pure tone	25 ms linear ramps on and off
--	Pulsed pure tone	200 ms stimulus with a 200 ms inter-stimulus interval. 25 ms linear ramps on and off
FM	Frequency-modulated (warble)	8 Hz frequency modulation on the carrier center frequency. 25 ms linear ramps on and off
SP	Speech (Synthesis)	webAudio Speech Synthesis of the selected word.
NBN	Narroband-noise	1/3 octave around the target center frequency.

2. Ear routing

- L Left ear
- R Right ear
- L/R Both ears

3. Transducers

Changing the transducer in Diida will change the calibrated settings based on your current calibration profile (more on calibrating later)

- TDH *Supra-aural headphones (e.g., TDH-49/50)*
- ER3A *Insert earphones (e.g., ER-3A)*
- HDA *Circum-aural headphones (e.g., Sennheiser HDA200)*
- B71 *Bone oscillators (e.g., B71/81)*

4. Change the sound properties



Increase the sound level



Decrease the sound level

Change the frequency (for non-speech sounds)

5. Turn the sound on and off

On/Off Changes the sound to be always on or always off

Present The “interrupt”

6. Save the value for the current task

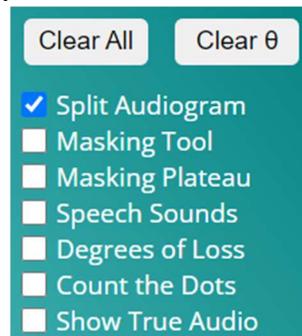
Save	Saves the threshold or value obtained and plots the symbol.
NR	Save as a No Response.
VT	Save as a Vibrotactile response.
MD	Save as a Masking Dilemma.

Display

The display defaults to a split-screen audiogram, with the Right ear audiogram on the left of the screen (visually in line with the listener's right ear) and the Left ear audiogram on the right side of the screen (visually in line with the listener's left ear).

There is a small black cross cursor on the audiogram that shows you the device's current position on the audiogram in terms of ear routing for Channel 1, the level, and the frequency being tested. When Channel 2 (masking) is turned on, you will see a gray circle indicating that same information for Channel 2.

There are a number of display overlays that can be seen on the right column:



Split Audiogram (checked): When checked, the audiograms will split. Unchecking this will give you a combined audiogram with both the left and right ears on a single plot.

Masking Tool: Visual aide to help conceptualize your masking

Masking Plateau: Plot the masking plateau as you do the testing

Speech sounds: Plots the speech sounds by frequency and amplitude

Degrees of loss: Overlays the degrees of loss as a background to the audiogram.

Count the dots: Adds the updated count-the-dots AI estimation method to the audiogram.

Show True Audio: No functionality in Diida, but quite useful for simulation in Theta.

Clear all: Clears the whole audiogram

Clear threshold: Clears the current threshold

Left and right arrows: No current functionality in Diida; Used in Theta for element navigation.

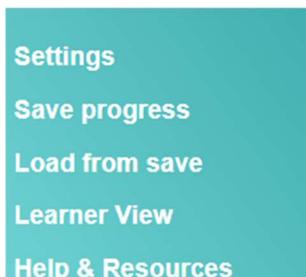
Calibration and use

VERY IMPORTANT: Before using Diida, turn your device volume up to its maximum level and disable system sound settings (to prevent sound notifications chiming while completing testing). This will ensure you have the full dynamic range available to you for testing.

Diida defaults will allow you to perform a hearing test with any headphones you have available. However, it can be calibrated to be extremely precise – and since the user (i.e., you) have full control of the calibration parameters, you can maintain your own audiometer yourself without the need to pay a 3rd party vendor to calibrate your own machine. Pretty neat, huh?

To calibrate, you'll need a sound level meter with an acoustic coupler appropriate for your chosen transducer. If you don't have access to one, contact us and we'll see if we can do your calibration with a 3rd party who does.

Once you have the equipment you need, click the Settings button in the bottom left of the Diida page



Click "Diida" to expand the settings.

Here you'll see a bunch of settings that make Diida run. You'll change these values as you perform your calibration, and doing so will give you a device profile that you can save so you don't have to calibrate every time you load up Diida.

Diida
 Diida calibration tone

Device Presets Custom device setup and calibration

New Device Calibration
 Device Type Other Device Type
 Device Make/Model custom
 Device Year 2022

Transducer HD 280 Pro

RETSPL AC	13.5,6.8,1.8,1.4,3.7,1.9,-3.9,2.2,13.9,22.8
RETFL BC	0,0,0,0,0,0,0,0,0
RETSPL Masker	13.5,6.8,1.8,1.4,3.7,1.9,-3.9,2.2,13.9,22.8
Max SPL AC	100,100,100,100,100,100,100,100,100,100
Max FL BC	0,0,0,0,0,0,0,0,0
Max SPL Masker	100,100,100,100,100,100,100,100,100,100
Correction Factors AC	0,0,0,0,0,0,0,0,0
Correction Factors BC	0,0,0,0,0,0,0,0,0
Correction Factors Masker	0,0,0,0,0,0,0,0,0

Diida (checked): This must remain checked

Diida Calibration (unchecked): When checked, Diida will play its max volume. Use caution!

Device Presets: This is where your saved device calibrations will be listed

New device calibration: This is information that other users will be able to see to try using your calibration as a starting point if they happen to be utilizing the same type of device.

Device Type: This is the general type of device you're using to help with sorting

Device Make/Model: This is the specific device

Device Year: If you know which year your device was released, this can help!

E.g., **Microsoft Surface Laptop 4 (2022)**

E.g., **Apple iPad Pro 11" (2018)**

The more specific you can be with the make/model input – the more other users will be able to identify their device from a list of options. If your device doesn't have a calibration, you can be the one to add it!

Transducer: The type of transducer you used for your calibration

The following variables contain ten numbers, one for each testable frequency, that you will need to know in order for Diida to work right. If RETSPLs aren't established for your transducer, then your calibration will be slightly off.

Testable frequencies: 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000, 8000 Hz

RETSPL: Reference Equivalent Threshold Sound Pressure Levels – offsets that convert dB SPL to dB HL for given transducers. Provided for AC, BC, and NBN – each of which will need its own calibration – These are pre-filled based on the transducer you select according to normative data obtained for the listed transducers.

Calibration SPL: The output level from the computer at the specified calibration level. Adjust the calibration level parameter if you need to calibrate at a higher or lower level. These values are measured with webAudio playing at the calibration level and your computer speakers at full volume. These values are found by the following procedure:

1. Check the “calibration tone” checkbox
2. Set the calibration level (the default is a good starting place; -44 dB re: soundcard max.
3. Return to the audiometer (click “Audiometer” in the left navigation panel)
4. Turn your computer volume up as high as it can go
5. Connect your transducer to the sound level meter via the appropriate coupler
6. Either present the tone using the “Present” button, or click the “on/off” button
7. Record the Calibration SPL level in the settings as the level displayed on the sound level meter
8. Repeat for all test frequencies

Correction Factors: You can use this input to add microphone corrections or other adjustments needed to bring Diida into perfect calibration. Since you're in control of the calibration, you can fine-tune your audiometer to be at the exact level it should be. After entering your RETSPLs and Max SPLs, you should check your calibration using the following procedure:

1. Make sure the “calibration tone” checkbox is **unchecked**
2. Return to the audiometer (click “Audiometer” in the left navigation panel)
3. Adjust the level to 80 dB HL
4. Ensure your computer volume is as high as it can go and that the headphone is still connected to the sound level meter
5. Present the tone and check the measurement. Your measurement should be equal to 80 dB SPL + the RETSPL for that frequency.

6. Record the difference between your expected value and your measured value in the “correction factor” settings and re-measure. Your measurement should be exactly correct now.

E.g., if you expected 85.4 dB SPL (80 dB HL + 5.4 dB RETSPL) and measured 85.6 dB SPL, you would enter -.2 for the correction factor for that frequency

Once you’ve performed the calibration and entered your device information, you press the “Save new device calibration” to add the device to the list of presets. The next time you want to use Diida on that device, you can just load the settings from the “Device Presets” dropdown.

Reporting

Once you complete a hearing test with Diida, you can click “submit” in the bottom right corner of the audiometer page to generate a PDF report.

Diida will store copies of any hearing test you submit for 6 months. After that time, it’s your responsibility to download and save a copy of the hearing test. Diida also does not store any personal health information on the evaluation report.

One really neat thing about Diida is that it runs on the Theta 3 simulation learning platform, which means it tracks how you do the hearing test and can give you immediate feedback in the report about whether or not you administered the test correctly. This could be particularly useful if a trainee or employee with less experience is using Diida for practice – you can have them complete a real audiogram on a real listener and get real feedback for whether or not they are performing the test correctly! Diida currently flags things like not following the modified Hughson-Westlake procedure, presenting a stimulus for too long or too short, not re-checking 1000 Hz, and more. More flags will become available as they are completed.

That’s it!

We are very excited about Diida, but nothing is ever done perfectly the first time. We welcome feedback from you with suggestions and ideas for how it could be improved! Thanks for subscribing to Diida, and we hope you enjoy practicing your hearing tests!