

# **iAudioInterface2 User Guide**



**STUDIO SIX DIGITAL LLC**

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# Quick Start

iAudioInterface2 (iAI2) is a combination audio line input, line output, digital optical output, headphone amp, and microphone input accessory for iPhone® 5, iPod touch® 5, and iPad®. It connects to the attached iOS device using a digital audio link for lowest noise and highest quality audio.

## ***Hardware Requirements***

iAudioInterface2 is designed to work with any iOS Lightning device, USB C device, or generic USB Audio host device.

## ***App Compatibility***

iAudioInterface2 is compatible with AudioTools, and many iOS Apps which play, record, or process audio. While we have tested iAI2 with many Apps and found that it works with many (including Apple's GarageBand), we do not guarantee compatibility with all Apple or 3rd party Apps. In particular, the phone App on iPhone does not use dock connector audio, and will not work with iAI2.

## ***Installation and Setup***

To install iAudioInterface2, plug it into the Lightning or USB C connector of any compatible device. Hold the plug parallel to the connector, since plugging in at an angle may cause the device to not recognize iAudioInterface2. Make sure that the DIN connector is fully seated into the socket on the iAudioInterface2 panel. It should press slightly into the panel.

Note that it takes approximately 3 seconds for iAudioInterface2 to be recognized by your iOS device. So, if you plug iAI2 in while AudioTools is running, wait for the confirmation box before trying to use it.

Note that it is possible for the iOS device to find the accessory, but iAudioInterface2 not be fully functional if the connector is not fully seated.

## ***Battery Charging and Power***

iAudioInterface2 always runs off its own battery, or the external power supply, if plugged into it. It draws no power from your iOS device. Run time is 3-5 hours, depending on usage.

Your iOS device always runs off its own internal battery, unless iAI2 is connected and an external power supply is plugged into iAI2. In that case, your iOS device will be powered from the external power supply, and the iOS device internal battery will be charging.

See the power / charging section of this manual for more information.

## ***App Installation***

If you do not have the AudioTools App installed, when you connect iAudioInterface2 to your device a prompt will appear, and you will be asked if you want to install AudioTools. This behavior is normal and is a feature of iOS. Although AudioTools is not required to use iAudioInterface2, it is recommended so that you can take advantage of all of its features.

## ***Calibration***

You can use iAudioInterface2 right out of the box, but for more accurate results see our calibration section below for information on how to calibrate your iAudioInterface2.

## ***Default Configuration***

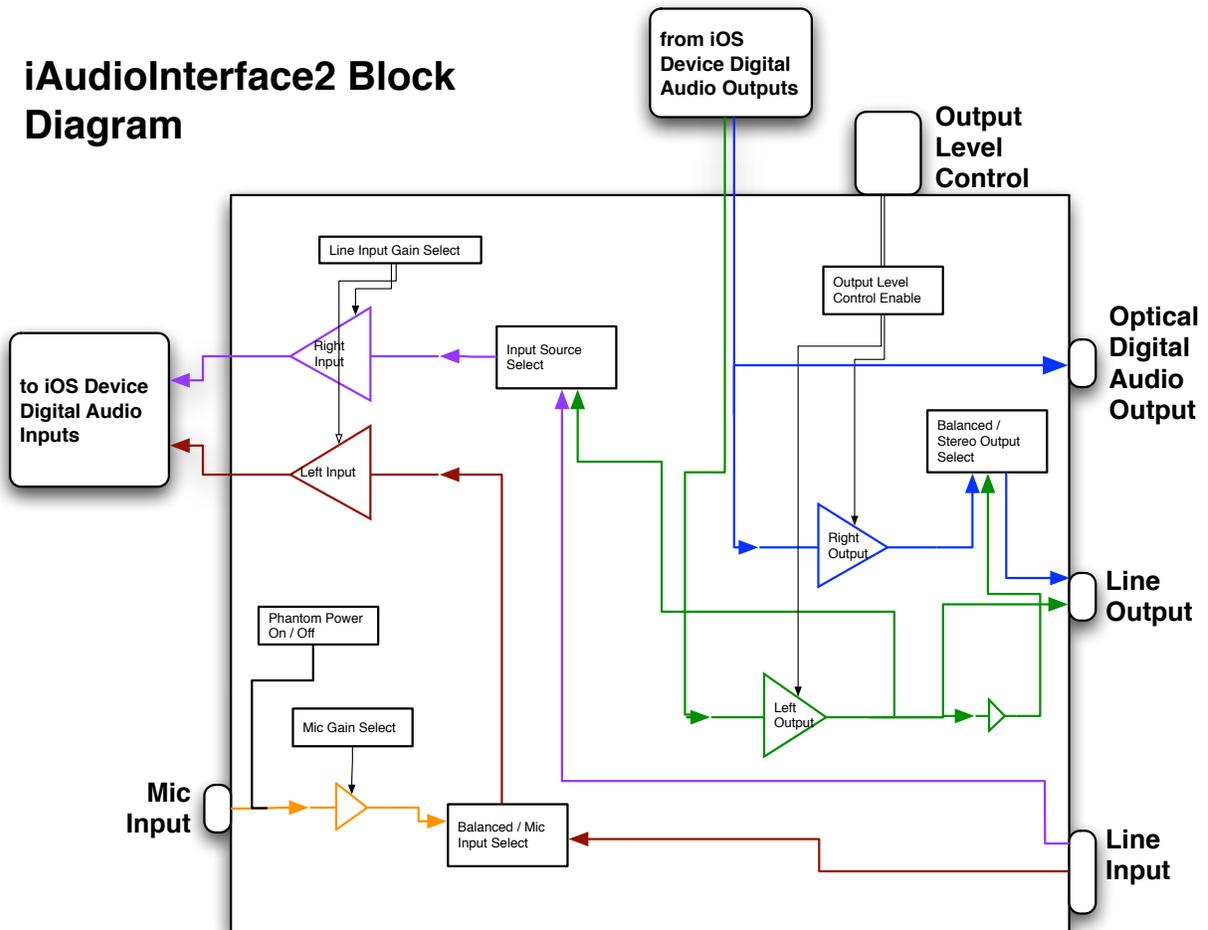
As shipped, iAudioInterface2 is in the following configuration, which is used in Apps other than AudioTools:

- Mono Line Input, microphone input enabled, phantom power off, 0 dB gain
- Line input gain range -70dBu to +8dBu
- Stereo (headphone) output
- Output level control enabled

These settings can be changed in the AudioTools App, see below for more information.

# Block Diagram

## iAudioInterface2 Block Diagram



### Legend

- Right Output Signal →
- Left Output Signal →
- Right Input Signal →
- Left Input Signal →
- Microphone Signal →
- Control Signals →

# Connections

## Configurations

iAudioInterface2 may be setup in a number of ways depending on your needs. The input and output can be mono or stereo, the output level control can be enabled or disabled, and there are several available gain ranges for the inputs. It is also possible to internally connect the line output to the right input, in order to monitor the output level directly (AudioTools only).

While you are running AudioTools, all of these settings are controlled to set up iAudioInterface2 appropriately for the function or test that AudioTools is currently running.

When you are using iAudioInterface2 with another App, you can still control its configuration.

To select the settings that you want to be in effect when you are using iAudioInterface2 with another App, start AudioTools and go to the Settings->Configuration screen, and select the settings that you want. When you exit AudioTools, these settings will be in effect, and as they are stored in non-volatile memory in iAudioInterface2, even if you unplug it or power down your iOS device, the Configuration settings will be available when you next use iAudioInterface2.

Note that the every time you exit AudioTools, iAudioInterface2 will be set to the configuration stored on the General->Configuration screen.



### **Line Input**

The line input connector is a ¼" TRS connector, which may be set up as a stereo unbalanced line input, or a mono balanced line input capable of handling -90dBu to +40dBu in three ranges.

**Make sure that you first select the correct input range before connecting a high-level input to this connector.**

This input is configured as a mono balanced line input by default, and used in this mode in almost

all functions in AudioTools. In stereo mode, the microphone input is disabled, and the connector is configured as a stereo input jack. To set this mode for other 3rd-party Apps, go to the Settings->Configuration page, and enable stereo input.

The line input supports three ranges, -90 dBu to -10dBu, -70dBu to +8 dBu, and -35 dBu to +40 dBu. These input ranges are available whether you are in stereo or mono mode.

## ***Line Output***

Outside of AudioTools, the output connector is configured as a stereo headphone jack by default. For example, if you play music from your device, you will hear the music in stereo.

When the AudioTools App is running, in most situations, the output connector is configured as a true balanced line output. Exceptions to this are cases where stereo audio is being played back, for example in the Recorder module. The maximum output level is approximately +12 dBu in balanced mode, and +6dBu in stereo mode.

## ***Output Level Control***

The level control may be used to set the output level, the input level, or may be disabled.

The output level control is enabled by default, but AudioTools will enable it during use for most functions. Some functions, such as the Impedance Meter, will disable it to get repeatable readings.

You can control whether or not the level control is enabled once you leave AudioTools by setting a preference on the Settings Menu->Configuration page.

## ***Clip Indicators***

AudioTools will normally indicate when iAudioInterface2 is clipping (level greater than the input is capable of measuring correctly) by showing a red “clipping” indicator on the screen. In some cases, where the input level is much greater than the current level range, the clipping indicator may not be seen. If you are using auto-ranging, iAudioInterface2 will attempt to select the best range for the running measurement. However, if you know the level of the input signal, it is recommended to set the gain range manually.

The method for selecting the gain range varies, but usually it can be selected from the Setup page for the function that you are running, either from the Input Select button, or from a control on the Setup screen itself.

## ***Microphone Input***

The microphone input supports phantom powered microphones, or unpowered (dynamic) microphones.

The microphone input has six fixed gain steps, from 0 dB to +50 dB. AudioTools allows you to set different hardware gain settings for each of two gain ranges: High and Low. This lets you set one gain range that is optimized for measuring low noise situations, and the another for high-SPL environments. Also, you can select auto-range, or either High or Low range.

If you know that the input levels that you are measuring will be in one of the gain ranges, it is recommended that you select that range manually. The mic gain range may be set from the Setup screen for the function that you are running, by tapping the Input Source button.

To set up the microphone input, go to the AudioTools Settings->Microphone Setup page, and then select iAI Mic. From this screen, you are able to select a hardware gain range, turn phantom power on or off, and enter a calibration constant for your microphone. These settings will be stored by AudioTools and will be in effect whenever you start the App. See the Calibration section for more information about hardware gain settings, and entering settings for more than one microphone.

## ***Digital Audio Output (Optical)***

The digital audio output provides an optical Toslink digital audio output which comes directly from the iOS device digital audio. The bit rate and sample rate of this signal are set by the iOS device. Currently, this is always stereo, 16 bit, and may be 32000, 44100, or 48000 Hz. No sample rate conversion is ever done by iAudioInterface; the audio is passed through unaltered.

This output is off by default. It may be enabled or disabled from the AudioTools Settings->Line Output Setup screen. If enabled, you will see a red glow if you look into the connector. This setting controls the output while running AudioTools. To change whether or not it is enabled when you exit AudioTools, see the Settings->Configuration screen. Keeping it off saves a small amount of power.

Use a standard Toslink cable to connect this output to any device which accepts standard optical digital audio as an input.

## ***Power***

The power inlet connector will accept a 5.5mm plug with 2.1mm pin. It requires 5VDC at 3.0A, pin positive. When the power adapter is plugged in, it will charge the internal battery, and any iOS device that is also connected.

## ***Charge Status Indicator***

The charge status indicator will be on while charging the internal battery, and will turn off when the battery is completely charged. It may flash if the battery is faulty, overheated, or defective.

## ***Dock connector cable***

The dock connector cable is used to attach iAudioInterface2 to your device. Connect it only to an iPhone 4, iPod touch 4, or iPad. The cable should be connected to the device before starting AudioTools. Never use any dock-extender cable, as these are not approved for usage.

# Power Options

iAI2 has an internal li-ion battery, so it never draws power from your iOS device. And, when an external power source is plugged into iAI2, it charges its own battery, and the battery in any iOS device that is attached to it.

## ***External Power Source***

iAI2 will run off of any power source that can deliver 5 VDC at 3.5A. The connector is 5.5mm with a 2.1mm pin, the polarity is pin +.

## ***Battery Charging***

Anytime an external power source is plugged into iAI2, the internal battery will be charging. When the internal battery charging, the red charge indicator LED will be lit solidly. When the battery is fully charged, the LED will go out.

If the LED ever blinks slowly, it is indicating a faulty battery.

The battery will fully charge in 2-3 hours. It does not hurt the battery to leave the charger plugged in, either with an iOS device attached or without.

## ***Run Time***

iAudioInterface2 will run for 3-5 hours on a full charge. Run time depends on what features are in use. Phantom power uses the most power, and its load depends on how much current your microphone draws. Next is the output, driving headphones can use power. Also, the digital audio output (TOSLink) uses some power.

## ***iOS Device Power and Battery Charging***

Your iOS device will always run from its own internal battery, unless the iAI2 is plugged into it with an external power source attached. In this case, your iOS device will be powered from the iAI2 power source, and the iOS device battery will charge.

iAI2 will charge any compatible iOS device, including iPhone, iPod touch, and iPad. Charge times vary by device.

# AudioTools App

iAudioInterface2 is designed to work with the Studio Six Digital App “AudioTools”, which is available for download on the App Store. When used with AudioTools, all of the features of iAudioInterface2, such as multiple gain ranges and output configuration, are available. When used with any other App, iAudioInterface2 operates in the configuration specified on the Settings->Configuration Settings screen of AudioTools.

This manual will not cover the AudioTools App in detail, but it will discuss some of the ways in which AudioTools interacts with iAudioInterface2.

## ***iAudioInterface2 Modules***

When iAudioInterface2 is connected to an iPod touch running AudioTools, additional modules may become available. Some of these modules are available as optional in-app purchases.

## ***Acoustic Analysis and SPL Functions***

These functions use the input source selected and gain range settings on the Settings menu, Microphone Setup module. The currently active input source is always shown on the screen. You may see labels like “iAI Mic Low Range” or “iAI Line Mid Range”.

## ***Line Level Functions***

These functions are available from the Line Level menu.

### **Level Meter**

Level meter can measure the level on the mono balanced line input connector, or the level that is present on the balanced line output connector. The switch in the upper right corner selects the source of the measurement.

You can select the input gain range, or allow iAudioInterface2 to auto-range. You can also select the units that you would like to see the results in.

Level Meter also includes an accurate frequency counter, and will display the frequency of a symmetric periodic waveform, if it is within the normal audio bandwidth.

The bottom part of the screen controls the output. You can turn on the generator, select the desired waveform, and for sine and square waves, the frequency. If you need more specialized signals, see the Generator function on the Utility menu.

## Phase Meter

Phase Meter is used to measure the phase angle between two sine waves.

## THD+n

You can measure Total Harmonic Distortion + noise (THD+n) with iAudioInterface2. To do this, the App will generate one of several octave-band sine waves, which are routed to the device under test (DUT). The output of the DUT is then routed back to line input of iAudioInterface2.

To measure the lowest possible distortion, the output level must be set close to the upper range of the middle line input range, 8 dBu. Make sure that you keep the input level to iAudioInterface2 is as close as possible to this level when you route the signal through an external device.

If you are generating a signal yourself, make sure that it is exactly the frequency that THD+n is set to, and that the level is as close as possible to +8dBu, as shown on the AudioTools input level meter.

The App then subtracts the fundamental sine wave, and the resulting signal is compared to the full input signal. The result is the THD+n.

For best results, and to measure the lowest possible THD+n, use the middle line input range if possible. You may select the other ranges, but the minimum distortion that you can measure will be greater than can be read using the middle level.

## Impedance Meter and Impedance Sweep

To measure impedance, you need a special cable. This cable is a ¼" TRS cable with the tip and ring brought out to test leads, and the ground not connected (open). **You must use only this cable configuration with the impedance test functions.** This cable is plugged into the line output connector. The test leads are then connected across the load, and the generator is turned on. The App then computes the impedance of the load and displays the equivalent wattage for the selected voltage source.

The output of iAudioInterface2 is fixed in impedance testing. Before you set up for impedance testing you must calibrate the impedance test. To do this, go to the impedance setup function, which you can reach from either impedance test by tapping the wrench icon or pressing Setup.

Next, turn on the generator, disconnect the clip leads (maximum resistance), wait 10 seconds for the reading to stabilize, and tap the Maximum button.

Now leaving the generator running, and clip the impedance test lead together (0 ohms). Wait 10 seconds for the reading to stabilize, and tap the Minimum button. Calibration is now complete and you may use the function.

# Calibration

Since the calibration values are stored in your iOS device, you must calibrate iAudioInterface2 to any iOS device to which it is attached. Although you can use iAudioInterface2 without calibrating it, you will get the most accurate results if you calibrate it.

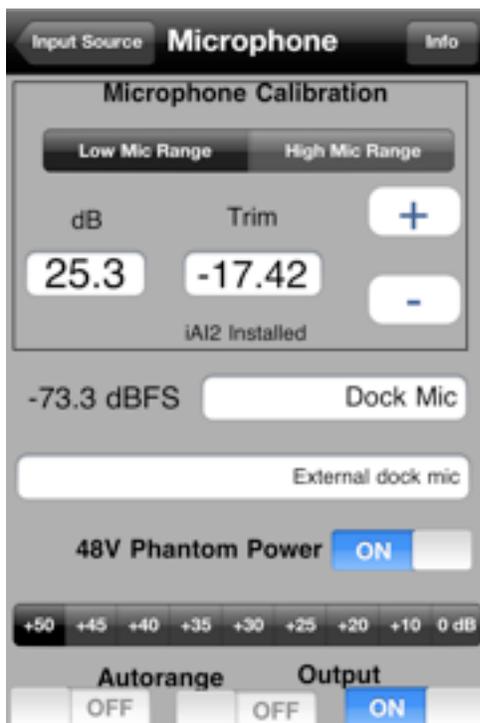
We also provide factory calibration service of your complete setup. This service does not require that you send us your iOS device along with iAudioInterface2, since the connection to the iOS device is via digital audio. You will receive a calibration certificate from us along with a copy of the calibration values for your device. See our website for the cost for this service and for more details.

## ***Microphone Calibration with a Calibrator***

Before beginning calibration, connect your microphone to iAI2, and connect iAI2 to your iOS device. You can connect your mic with a cable, or, if the microphone body is designed to plug into a standard XLR jack, you can plug it directly into iAI2.

Now start the AudioTools App and go to the Settings menu, Microphone Setup function. The Input Sources screen appears.

Select the first option, by tapping the blue disclosure triangle for the first entry on the top of the screen. If you have more than one microphone that you wish to store calibration values for, you can store additional calibration values (described below).



To begin calibration, select Low Range (darker). Select gain range +10 as a starting point (see picture below). Turn on Phantom Power, if required by your microphone. Now attach and turn on your calibrator. Leave the calibrator running for the remainder of this procedure.

Before setting the calibration value, you need to select an appropriate microphone gain range. This gain is added before the A/D converter, so for the low range you typically want the highest dBFS value possible, without clipping. Note that for a sine wave 0.0 dBFS is the highest value that can be reached without clipping, so you want a number that is lower than 0.0 dBFS by several dB.

Note: AudioTools uses the AES standard for dBFS, which is that for a sine wave just reaching clipping, the reading will be 0.00. A square would by this formula show +3.00 dBFS.

Slowly increase the gain range setting until the dBFS value nears, but does not exceed, 0.0. This is your input gain range setting for the low range. Now enter the calibrator output setting (typically 94) in the dB field by tapping on the field, clearing the value in the field, and entering your calibrator's fixed value. Tap Done. The trim value will be set automatically by this process, so do not alter it.

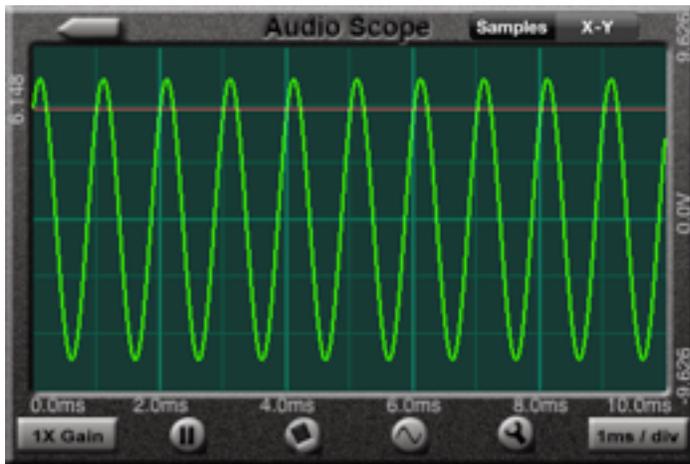
The low range setting is now complete.

Now select High Range (darker). Select a gain range that is lower by as many dB as you wish to have as headroom above the calibrator value. For example, if your calibrator value is 94 dB, and your low gain range was +35, and you wish to be able to measure 120 dB SPL, set the gain range value to 0 dB, which would actually allow  $94 + 35 = 130$  dB SPL. After selecting the desired gain range setting, once again enter the calibrator value in the dB field.

You can if you wish rename the microphone, and change the description to something that describes your microphone. This name will appear on the screen of any function that is using the microphone.

Since these settings will be lost if you delete the app or move to another iOS device, we recommend writing them down somewhere that you can recall them. Also, the settings are transferrable to another device. Simply open the Microphone Calibration screen and enter the values.

After setting the ranges, it's a good idea to double check your headroom using Audio Scope. To do this, exit this screen, and go to the Line Input menu, Audio Scope screen. Go to settings (tap the wrench icon), and select Line Input Mode Mono, Input Source Mic. Now go back to the scope screen and check that the sine wave is not clipped. It should look something like this picture:



Now that your gain ranges and calibrator settings are complete, you can select either the low or high gain range, or use Autorange to let AudioTools pick the gain range for you.

## Microphone Calibration by Matching

If you do not have access to a microphone calibrator, but you do have access to a calibrated SPL meter, you can do basic calibration by matching iAI2 to the SPL meter. To do this, follow the instructions above, with these changes:

- \* Use an acoustic noise source such as pink noise, or white noise. White noise will have less low frequency, and may be a better choice, since it is best to calibrate with mid-band energy. Do not use a sine wave signal, because you may get cancellation or reinforcement effects that can throw off the readings.
- \* Use C Weighting, if possible, with the calibrated meter.
- \* Enter the value read from the calibrated SPL meter into the dB field in AudioTools.

## Line Input Calibration

AudioTools will use default values for line input calibration. These defaults will typically be within +/-1.5dB, even without calibration, independent of the iOS device that is attached. You can improve this performance by following this procedure.

Connect iAudioInterface2 to your device, and start the AudioTools App. Now go to the Settings menu, Line Input Setup function.

Select Low Range (darker). Enter the “**Line Input Low Range Trim Value**” into the Trim field, by tapping the field. Tap Done when complete.

Select Mid Range (darker). Enter the “**Line Input Mid Range Trim Value**” from the Calibration Card into the Trim field, by tapping the field. Tap Done when complete.

Select High Range (darker). Enter the “**Line Input High Range Trim Value**” from the Calibration Card into the Trim field, by tapping the field. Tap Done when complete.

## **Line Output Calibration**

Connect iAudioInterface2 to your device, and start the AudioTools App. Now go to the Settings menu, Line Output Setup function.

Enter the “**Line Output Trim Value**” from the Calibration Card into the Trim field, by tapping the field. Tap Done when complete.

If you wish, you can also define a reference level. For example, if you wish to define 0.0 dBu as your reference level, turn on the Generator Output, and turn on Set Reference Level. Now, adjust the slider until your reference level appears in the Output Level dBu field. This level is now stored, and can be activated on the Line Input menu, Level function, by turning on the Output Reference Level switch.

# Specifications

All specifications are subject to change.

## ***Microphone Input***

+0 to +50 dB gain available in 9 ranges.  
Equivalent Input Noise (EIN) -112 dBu A-weighted  
48V phantom power, +1.0, -3.0V at 13ma.

## ***Line Input***

Noise floor to clipping, -85 dBu to +45 dBu.  
Frequency response 20-20kHz +0.0 -0.50.  
Distortion (lowest THD+n that can be read) 0.010%.

## ***Line Output***

Maximum +10 dBu balanced.  
0.009% THD+n at +8.00 dBu output level.

## ***Headphone Amplifier***

Suitable for driving 150 ohm headphones.

## ***Battery and Power***

Input power supply, +5VDC, 3.0A, pin positive.

Charge current available, 2.1A @5VDC. Current limited to 2.5A, self resetting after over current.

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