

ECHO AIO™ TEST INTERFACE



Product Manual

June 2017



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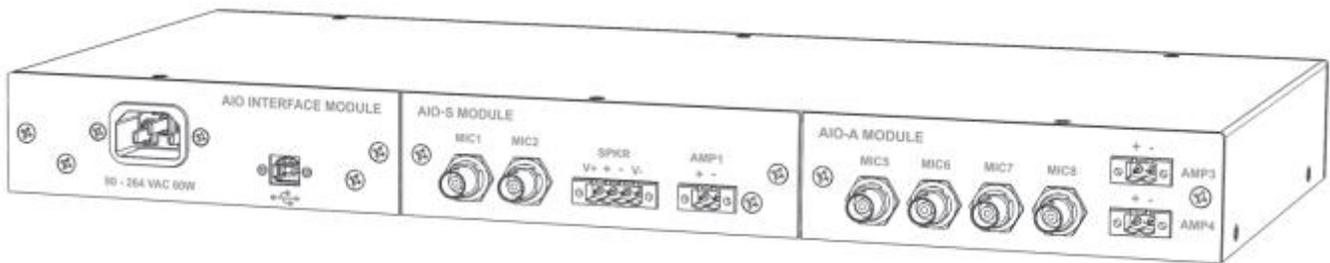
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Introduction

The AIO (All-In-One) Test Interface is a USB audio interface compatible with Macintosh and Windows computers. Along with a computer running test software, it provides a platform for acoustic testing of cell phones, tablets, computers and their components. The AIO combines the functionality of multiple pieces of test equipment into a single, integrated device for increased reliability at a reduced cost. It is ideally suited for a high-volume production environment where testing occurs on a continual basis.

The test computer and AIO communicate using a USB 2.0 Hi-Speed connection. The AIO contains data converters along with input and output amplifiers needed for connecting speakers, microphones, and other test equipment. Audio test tones are played out through the AIO and the responses of the unit under test are then recorded for analysis.

The AIO is a modular design consisting of a chassis, a USB Interface Module, and one or two audio I/O modules. The Interface Module is included with every AIO and provides the USB connection and power to the unit. To support different types of test stations there are several types of audio I/O modules available for the AIO. These differ in both the type and number of inputs and outputs available on the module. Module types may be mixed within a single chassis, allowing for many different AIO configurations. An AIO-S is shown below:



When a test station needs more inputs and outputs than a single AIO can provide, multiple AIOs can be used together as a group. The audio clocks may be synchronized, allowing them to act as if they were a single, integrated unit.

AIO Configurations

The AIO Test Interface is available in seven models depending on what module types are installed (AIO-A, AIO-S, AIO-L, AIO-T):

AIO Model	Inner Module	Outer Module	Mic/Line Inputs	10W Outputs	Line/HP Outputs	Imped/Haptic	Digital	Sample Rates
AIO-1	AIO-A	---	4	2	---	---	---	48, 96, 192 kHz
AIO-2	AIO-A	AIO-A	8	4	---	---	---	48, 96, 192 kHz
AIO-AT	AIO-A	AIO-T	4	2	---	---	TDM 10/10	48 kHz
AIO-L1	AIO-L	---	4	---	2	---	---	48, 96, 192 kHz
AIO-L2	AIO-L	AIO-L	8	---	4	---	---	48, 96, 192 kHz
AIO-LT	AIO-L	AIO-T	4	---	2	---	TDM 10/10	48 kHz
AIO-S	AIO-S	AIO-A	6	3	---	1	---	48, 96, 192 kHz

Table 1 – AIO Models



AIO-1 (AIO Test Interface with 1 AIO-A Module)



AIO-2 (AIO Test Interface with 2 AIO-A Modules)

AIO Configurations (cont.)



AIO-AT (AIO Test Interface with 1 AIO-A Module and 1 AIO-T Module)



AIO-L1 (AIO Test Interface with 1 AIO-L Module)



AIO-L2 (AIO Test Interface with 2 AIO-L Modules)



AIO-LT (AIO Test Interface with 1 AIO-L Module and 1 AIO-T Module)

AIO Configurations (cont.)



AIO-S (AIO Test Interface with 1 AIO-S and 1 AIO-A Modules)

AIO Dimensions and Weight (all models):

AIO alone:

17.5" (44.4 cm) x 8.75" (22.2 cm) x 1.75" (4.4 cm), 7.2 lbs (3.3 kg)

AIO in box with cables:

21" (53 cm) x 10" (25.4 cm) x 5" (12.7 cm), 8.75 lbs (4 kg)

Shipping carton (6 AIOs):

22" (55.8 cm) x 22" (55.8 cm) x 17" (43.1 cm), 59.5 lbs (27 kg)

Safety Instructions

- 1. Read Instructions** – Be sure to read all of the safety and operating instructions before operating this product.
- 2. Keep Instructions** – The safety instructions and user's manual should be kept for future reference.
- 3. Warnings** – All warnings on your AIO and in the User's Manual should be followed.
- 4. Follow Instructions** – All operating and use instructions should be followed.
- 5. Moisture** – Water and moisture are detrimental to the proper operation of the AIO. Do not install or operate your AIO near sources of water or moisture such as sinks, damp basements, leaky roofs, etc.
- 6. Heat** – Your AIO should be situated away from sources of heat such as heaters or radiators.
- 7. Power Sources** – This unit should be operated only from a stable AC power source as indicated in this documentation or on the AIO. A surge protector is recommended in areas that are subject to lightning or noise from industrial equipment such as that found on a factory floor.
- 8. Grounding** – Precautions should be taken so that the grounding capabilities of the unit are not undermined. The AIO is provided with a cord with an equipment grounding conductor and grounding plug. This plug must be plugged into an outlet that is properly installed and grounded in accordance with all local rules and ordinances. Do not modify the plug provided with the equipment. If the plug will not fit into your outlet, have a proper outlet installed by a qualified electrician.
- 9. Power Cord Protection** – Power supply cords should be routed so that they are protected from damage. Pay particular attention to protecting the plugs, outlets, and the point at which the cord exits your AIO.
- 10. Servicing** – Do not attempt to service this unit yourself, as opening the case will expose you to hazardous voltage or other dangers. All servicing should be referred to qualified service personnel.

Installation

Power is supplied to the AIO with a three conductor AC power cable that plugs into a locking IEC C14 power inlet located on the Interface Module.

Power cables supplied with the AIO may have a locking connector to keep it from accidentally coming loose. However, a cable with a standard, non-locking plug may also be used.



The power cable has either a US or China style plug with three prongs, one of which is ground. For safety (see above) and performance reasons, **it is very important that the AIO is plugged into a properly grounded outlet.** It is also highly recommended that the AIO, test computer, and any other equipment connected to the AIO are all powered from the same AC power strip / source which includes surge protection.

To improve reliability and eliminate the possibility of broken switches, the AIO doesn't contain a power switch. Power needs to be turned on and off at the source. The blue LED on the front panel indicates when power is applied and the AIO is operating.

The AIO requires a USB 2.0 "HI-SPEED" cable to connect to the host computer. It plugs into a USB Type-B connector on the Interface Module.

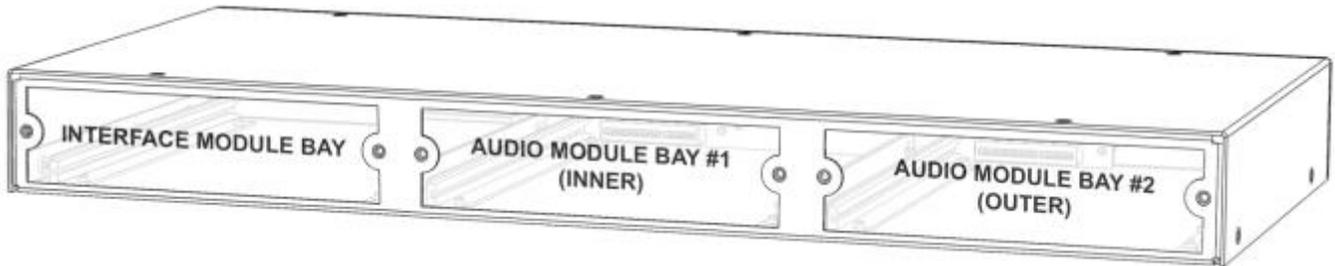
The supplied USB cable has a connector with two screws to securely connect it to the AIO and keep it from accidentally coming loose. However, a cable with a standard USB Type-B plug without mounting screws may also be used.



Audio connections will vary according to the type of module and the equipment being connected. These are described in the sections for each module type elsewhere in the manual.

AIO Chassis

The AIO chassis is a steel case that measures 17.5" x 8.0" x 1.8" (44.5 cm x 20.3 cm x 4.6 cm). It has a blue LED within the front panel to indicate when power is applied. Three bays are available on the rear for inserting the Interface Module and two audio I/O modules:

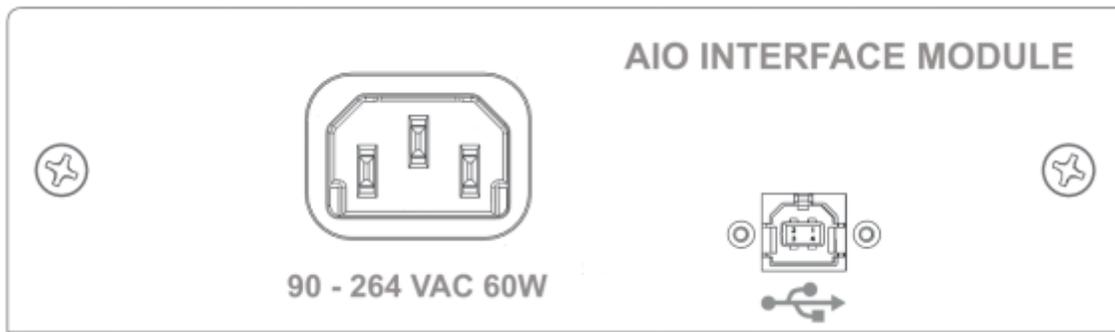


A backplane runs along the front of the chassis with card edge connectors for each module. Modules have tabs with gold fingers that are inserted into the backplane connectors when installed. Signal traces on the backplane connect the Interface Module to the analog I/O modules, allowing data and commands to pass between them.

Each bay has guides on either side to align the module with the connector as it is inserted. Two screws secure the module mounting plate on the rear of the module to the chassis. Removing these screws allows modules to easily be pulled out for repair or replacement as needed.

CAUTION: Always disconnect the power cable from the AIO before removing or inserting modules!

AIO Interface Module



The Interface Module is the heart of the AIO. It provides DC power to the modules from its integrated AC/DC power supply. An embedded processor on the module communicates with the host computer via USB. This processor:

1. Automatically configures itself according to the types of audio modules that are installed, then reports the AIO model type, channel counts, and other pertinent information to the host computer.
2. Routes audio between the computer and the appropriate audio modules.
3. Controls the audio modules according to commands sent from the computer or passes the commands on to any processors on the modules themselves.
4. Downloads software from the host computer onto any modules that require it.
5. Stores calibration data for modules that need it in flash memory, retrieving and using it whenever the AIO is powered on.

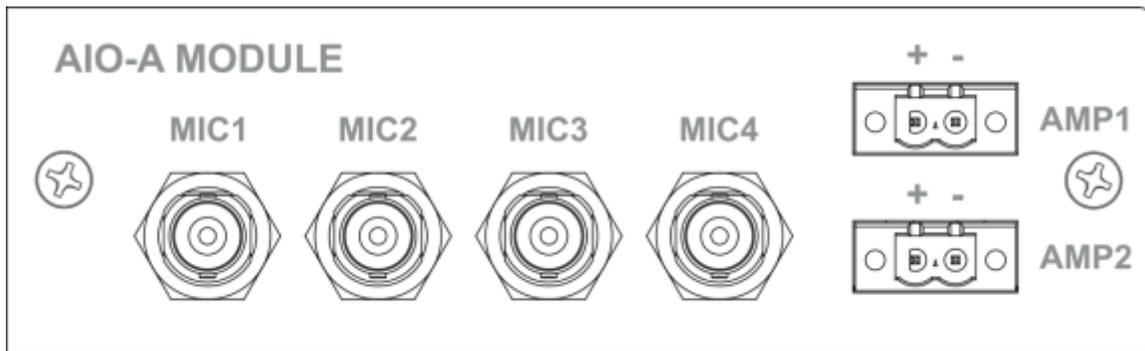
The AIO is a USB Audio 2.0 Class compliant device.

Power Supply

The Interface Module has a 60W AC/DC power supply that converts the incoming AC voltage to 15VDC. This voltage is converted to several other needed DC voltages by voltage regulators on the interface and audio modules. AC input voltage may range from 90 – 264 VAC and be either 50 or 60 Hz.

CAUTION: The power supply has exposed high voltages present that pose a shock hazard. Never remove the Interface Module or take off the AIO cover with the AC power cable attached!

AIO-A Module



Microphone/Line Inputs

Four inputs with BNC connectors are available for connecting microphones or other inputs. Input gain, IEPE constant current supply, and TEDS interfacing are software controlled.

Full-Scale Input Voltage and Dynamic Range:

Gain Setting	Full-Scale Input Voltage	Dynamic Range (A-weighted)
x1	$\pm 8.75\text{V}$	$> 110\text{dB}$
x10	$\pm 875\text{mV}$	$> 105\text{dB}$
x100	$\pm 87.5\text{mV}$	$> 95\text{dB}$

THDN (A-weighted): $< -95\text{dB}$ 20Hz – 20kHz

Frequency Response: $\pm 0.5\text{dB}$ 20Hz – 20kHz

Maximum Input Voltage: $\pm 15\text{V}$ (do not exceed)

Input Impedance: $1\text{M}\Omega$

Constant Current Supply: 4mA / 21V excitation voltage

TEDS: IEEE 1451.4 Class 1

AIO-A Module (cont.)

Class-D Amplified Outputs

Two amplified outputs with Euroblock connectors are provided for connecting speakers or other devices. The outputs are differential with (+) and (-) connections and the speaker should be connected directly across them. Both the (+) and (-) outputs are biased at $\sim 7.5V$.

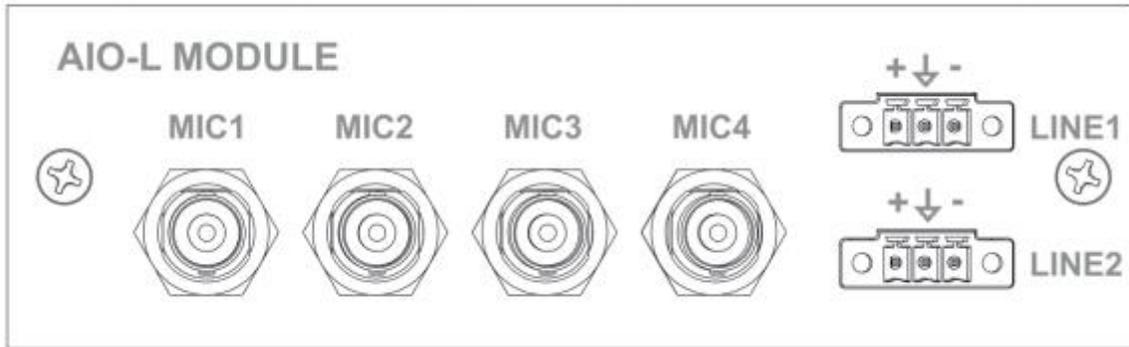
Note: Connecting a speaker or other low impedance path from one of the outputs to ground will cause the amplifier to shut down. If this happens, the AIO needs to be power cycled for the amplifier to resume normal operation.

Output Power (THDN $<.1\%$): 10W continuous at 1kHz

Maximum Output Voltage: $\pm 13.5V$

Frequency Response: $\pm 0.5dB$ 20Hz – 20kHz

AIO-L Module



Microphone/Line Inputs

Four inputs with BNC connectors are available for connecting microphones or other inputs. Input gain, IEPE constant current supply, and TEDS interfacing are software controlled.

Full-Scale Input Voltage and Dynamic Range:

Gain Setting	Full-Scale Input Voltage	Dynamic Range (A-weighted)
x1	$\pm 8.75\text{V}$	> 110dB
x10	$\pm 875\text{mV}$	> 105dB
x100	$\pm 87.5\text{mV}$	> 95dB

THDN (A-weighted): <-95dB 20Hz – 20kHz

Frequency Response: $\pm 0.5\text{dB}$ 20Hz – 20kHz

Maximum Input Voltage: $\pm 15\text{V}$ (do not exceed)

Input Impedance: $1\text{M}\Omega$

Constant Current Supply: 4mA / 21V excitation voltage

TEDS: IEEE 1451.4 Class 1

AIO-L Module (cont.)

Line Level / Headphone Outputs

Two amplified outputs with Euroblock connectors are provided for connecting headphones or line level devices. The outputs are differential with (+), (-), and ground connections. For headphones or other low power speakers the ground connection may be ignored. Both the (+) and (-) outputs are biased at ground.

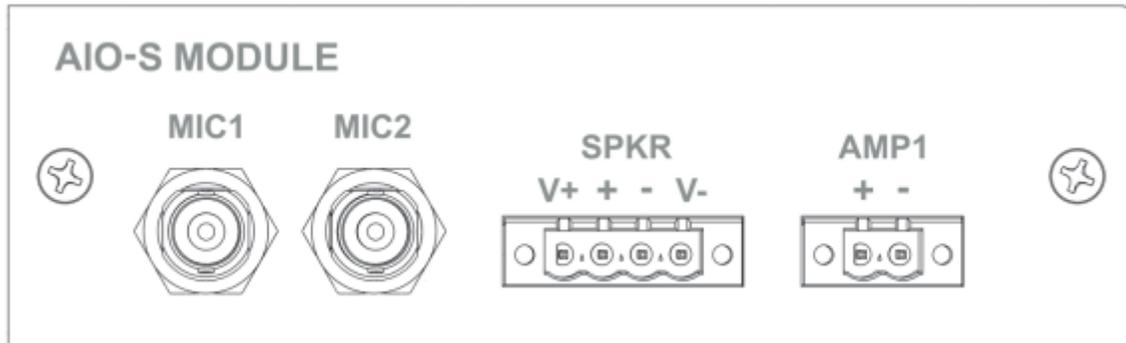
Note: Driving loads smaller than 32Ω will cause the amplifier to clip and/or oscillate at higher output levels.

Output Power (THDN $<.1\%$): 32mW continuous at 1kHz

Maximum Output Voltage: $\pm 2.65V$

Frequency Response: $\pm 0.5dB$ 20Hz – 20kHz

AIO-S Module



Microphone/Line Inputs

Two inputs with BNC connectors are available for connecting microphones or other inputs. Input gain, IEPE constant current supply, and TEDS interfacing are software controlled.

Full-Scale Input Voltage and Dynamic Range:

Gain Setting	Full-Scale Input Voltage	Dynamic Range (A-weighted)
x1	$\pm 8.75V$	$> 110dB$
x10	$\pm 875mV$	$> 105dB$
x100	$\pm 87.5mV$	$> 95dB$

THDN (A-weighted): $< -95dB$ 20Hz – 20kHz

Frequency Response: $\pm 0.5dB$ 20Hz – 20kHz

Maximum Input Voltage: $\pm 15V$ (do not exceed)

Input Impedance: $1M\Omega$

Constant Current Supply: 4mA / 21V excitation voltage

TEDS: IEEE 1451.4 Class 1

AIO-S Module (Cont.)

SPKR – Voltage/Current Monitoring Inputs

The third and fourth inputs on the AIO-S module measure the voltage and current supplied to a speaker (or haptic device) connected to the (+) and (-) outputs of the SPKR connector to calculate impedance, resonance, or other value.

Voltage is monitored using separate wires connected to the (V+) and (V-) terminals of the connector. This measures the voltage at the speaker without the influence of the wires delivering the test signal. There is a precision current sense resistor within the AIO-S module that is in series with the output. The voltage across this resistor is measured using the fourth input of the module, yielding a current measurement.

Full-Scale Voltage, Current, and Dynamic Range:

Gain Setting	Full-Scale SPKR Voltage	Full-Scale SPKR Current	Dynamic Range (A-weighted)
x1	± 8.75V	± 4.375A	> 110dB
x10	± 875mV	± 437.5mA	> 105dB
x100	± 87.5mV	± 43.75mA	> 95dB

THDN (A-weighted): <-95dB 20Hz – 20kHz

Frequency Response: ± 0.5dB 20Hz – 20kHz

Calibrated Accuracy: 0.25%

Class-D Amplified Outputs

Two amplified outputs are provided for connecting speakers or other devices. The first output is part of the SPKR connector while the second uses the AMP1 connector. The outputs are differential with (+) and (-) connections and the speaker should be connected directly across them. Both the (+) and (-) outputs are biased at ~7.5V.

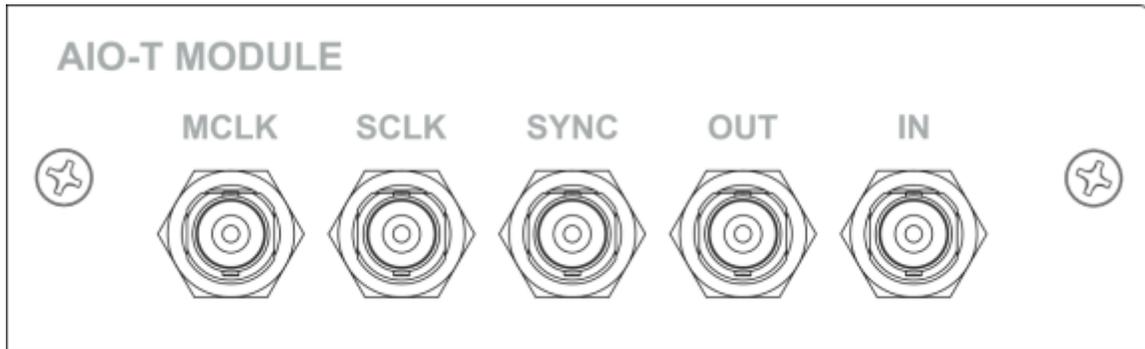
Note: Connecting a speaker or other low impedance path from one of the outputs to ground will cause the amplifier to shut down. If this happens, the AIO needs to be power cycled for the amplifier to resume normal operation.

Output Power (THDN <.1%): 10W continuous at 1kHz

Maximum Output Voltage: ± 13.5V

Frequency Response: ± 0.5dB 20Hz – 20kHz

AIO-T Module



TDM Audio Interface

The AIO-T module provides a digital TDM (Time-Division Multiplexed) interface for connection directly to audio converters or other ICs. Four outputs (MCLK, SCLK, SYNC, and OUT) and one input (IN) are provided on BNC connectors. The module functions as a TDM master, sourcing the clocks and synchronization signals. Logic voltage levels are hardware selectable between 1.8V and 3.3V using a jumper on the PCB.

1.8V 3.3V
TDM VOLTAGE

The TDM interface may be programmed for number of channels, bits/sample, bits/frame, sync type (width, polarity, and placement), and clock polarity. The module always presents 10 channels of input and output to the host computer, regardless of the number of TDM channels. Unused channels are ignored.

USB Audio

The AIO is a USB Audio 2.0 Class compliant device and operates according to the USB specification.

macOS (CoreAudio)

Support for USB audio is part of macOS and its audio component, CoreAudio. The AIO is automatically detected whenever it is powered on and connected to a Mac USB port. Programs send audio to and from the AIO the same as any other audio device, such as the internal speaker and microphone.

Windows (ASIO)

Windows has no built-in support for USB Audio 2.0 and requires a driver to be installed to support the AIO. Echo supplies a driver that supports the ASIO (Audio Stream Input/Output) protocol as well as other audio APIs. Most professional audio and test applications support ASIO, which Echo recommends for use with the AIO.

Multi-AIO Synchronization

Every AIO has its own internal crystal for generating the audio clocks with a tolerance of ± 50 ppm. When set for a nominal sample rate of 48,000 sample/sec, the actual sample rates can vary up to 4.8 samples/sec between two AIOs. This causes problems if multiple AIOs need to be used together for more channels than a single AIO can provide. Output audio and recordings will drift between them and be out of sync.

To overcome this, the AIO may be programmed to slave its audio clock to the 8kHz USB Start-of-Frame signal instead of using its internal clock. Multiple AIOs connected to the same computer and running off of the USB clock will have their audio clocks synchronized, running at precisely the same sample rate.