Audio Adapter+ Reference Manual

The Audio Adapter+ is a module that provides easy audio connectivity to the Analog Discovery 3. It is equipped with Mono and Stereo 3.5 mm audio connectors that provide signal paths to both the inputs of the oscilloscope and outputs of the arbitrary waveform generator. The Audio Adapter+ is equipped with a 2×15 MTE connector, which makes it compatible with the Analog Discovery 3, in addition to the Analog Discovery (Legacy), and Analog Discovery 2. An additional 2×15 MTE connector is loaded as a pass-through for digital signals, power supplies, and trigger pins so that these features are fully supported for your audio applications.

Feedback

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Audio Adapter +
PTC-M2V-0
94V-0
Output
Input
Mono/
Stereo
Mono
J1
J2
J3
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J5
FB2
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C7
NC NC
NC NC
V+ NC
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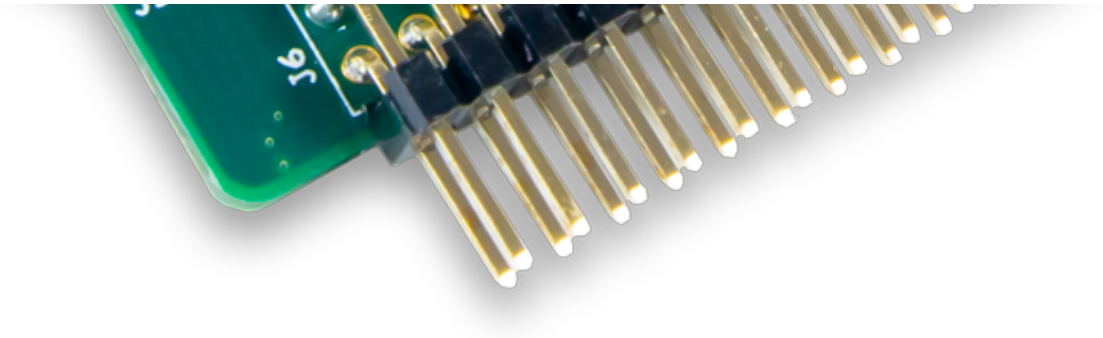

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Audio Adapter +
PTC-M2V-0
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Output
Mono/
Stereo
Mono
Mono
Mono
Input
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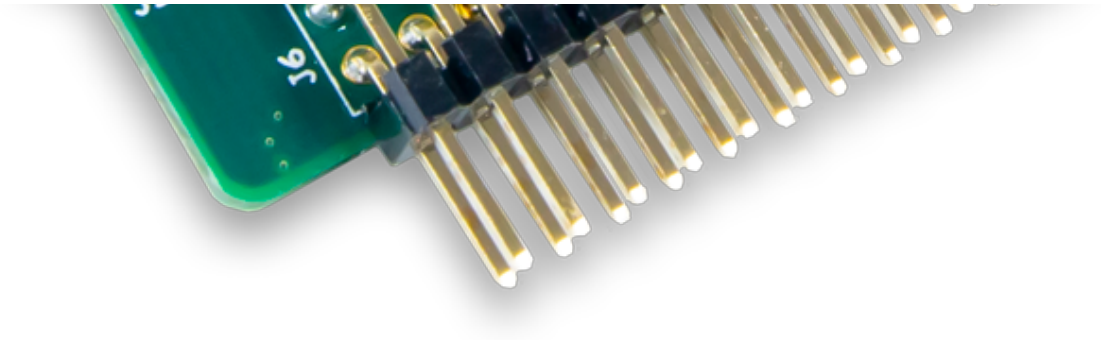
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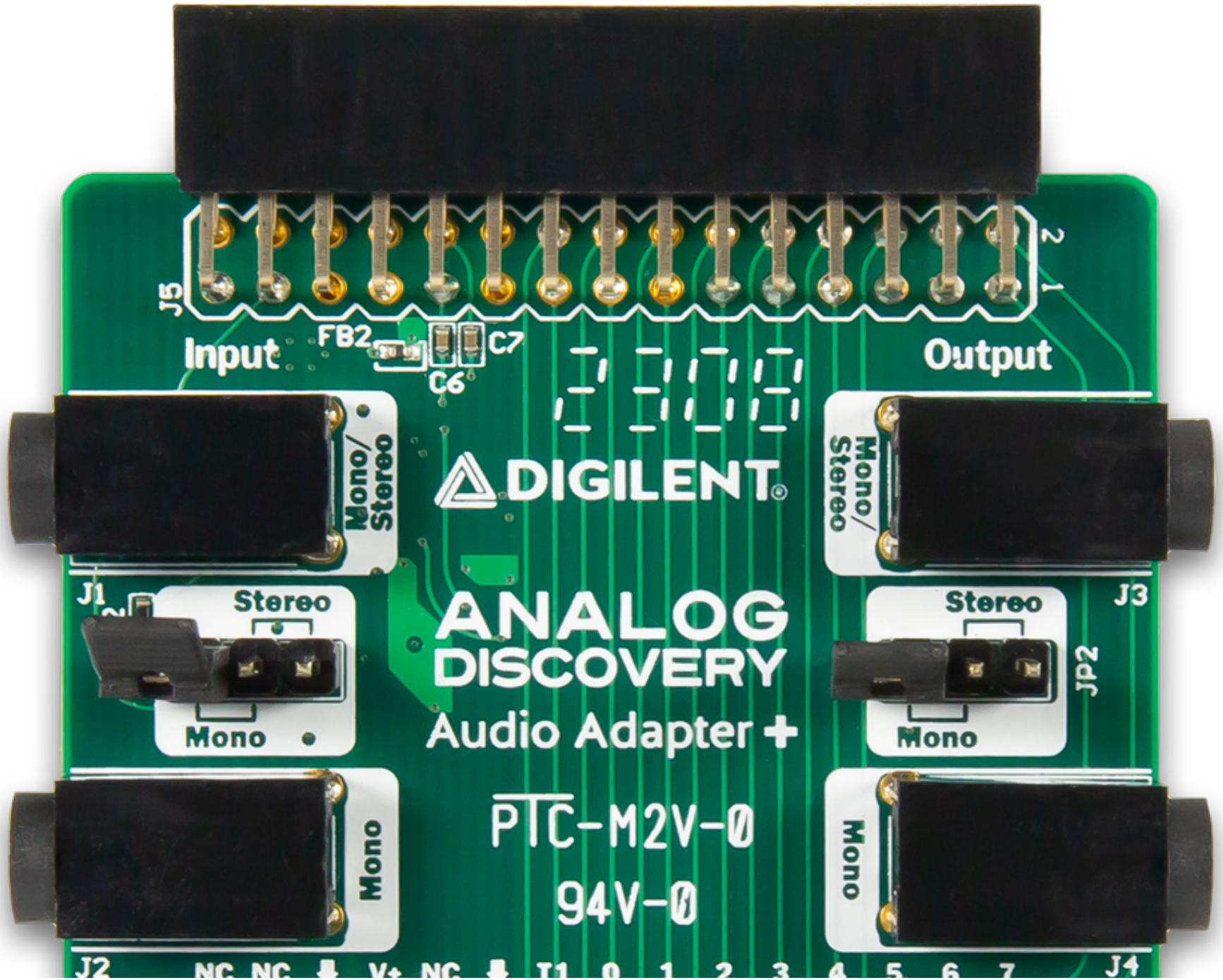
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Audio Adapter +
Stereo
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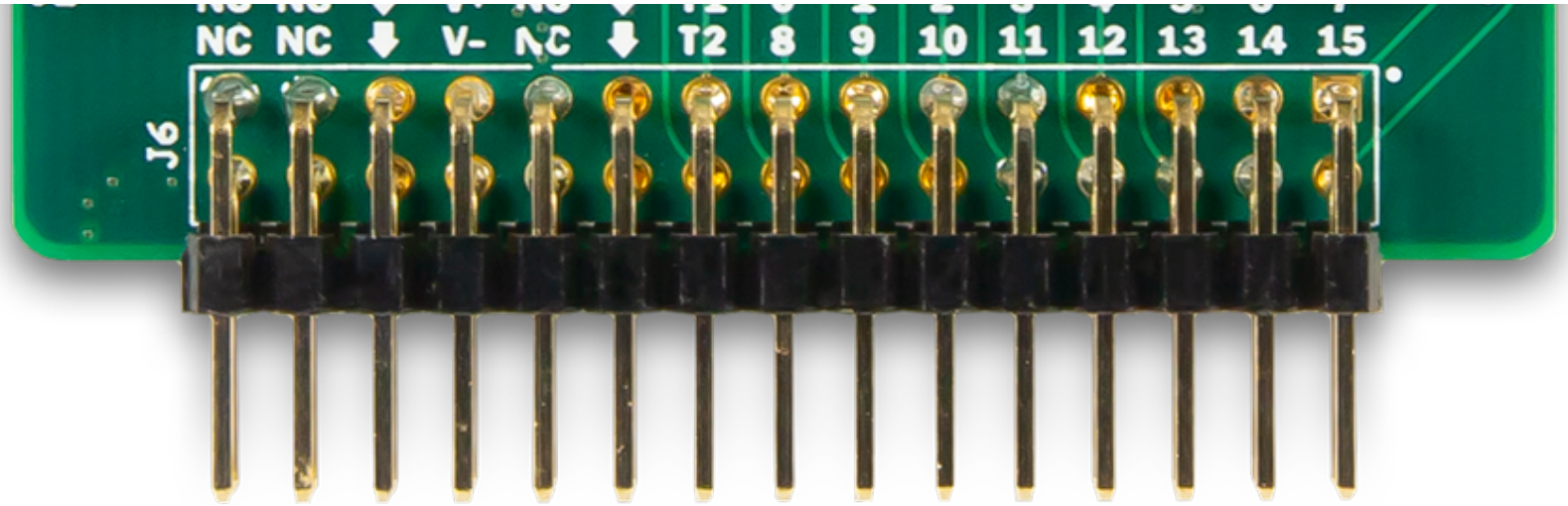
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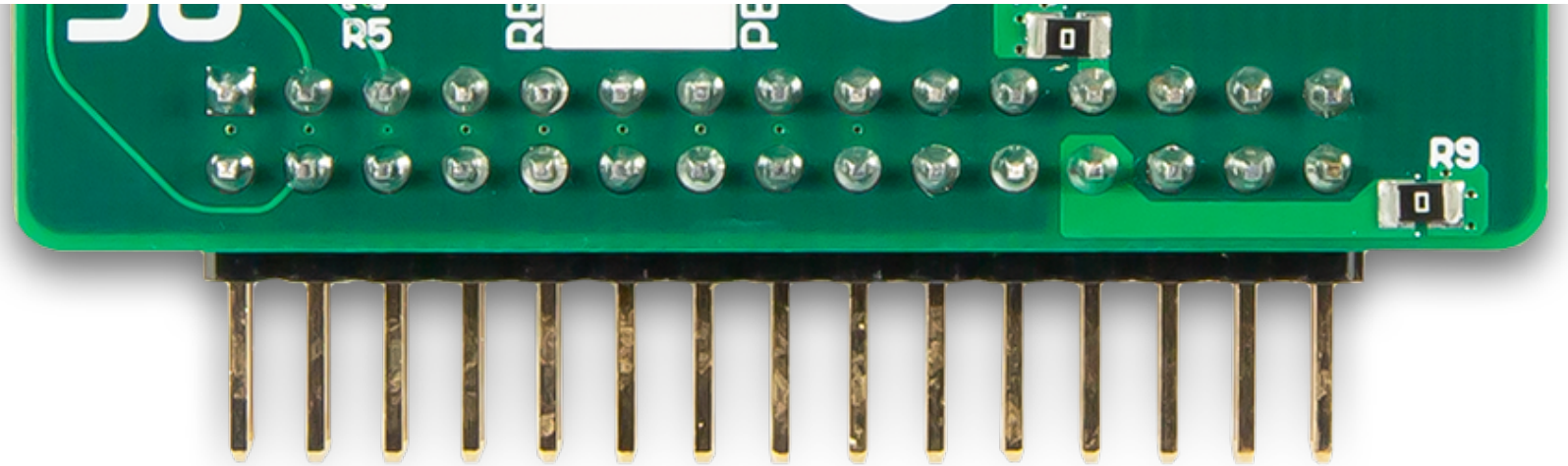
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DISCOVERY
Audio Adapter+
PTC-M2V-Ø
94V-Ø
Mono/
Stereo
Mono
J1
J2
J3
J4
J6
JP1
JP2
NC
V+
V-

Overview

Features

- Provides audio connectivity via 3.5 mm jacks for both Scope inputs and Wavegen outputs
- Inputs and outputs can independently use 2 mono jacks or 1 stereo jack, selected via jumpers
- Active circuitry powered by the Analog Discovery 3 power supplies
- Pass-through Connector for all other Analog Discovery 3 signals, including Digital I/O, Triggers, and Power Supplies
- Compatible with the Analog Discovery 3, Analog Discovery 2, and Analog Discovery (Legacy)

Compatible Products

The Audio Adapter+ is compatible with the following:

- Analog Discovery 3 (https://digilent.com/shop/analog-discovery-3/)
- Analog Discovery 2 (https://digilent.com/shop/analog-discovery-2-100ms-s-usb-oscilloscope-logic-analyzer-and-variable-power-supply/)
- Analog Discovery (Legacy)

About this Document

This reference manual applies to Revision C of the Audio Adapter+.

Functional Description

Connectors and Jumpers

Table 1: Connectors and Jumpers

Label	Name	Description
J1	Input Mono/Stereo jack connector	Used to connect a mono or a stereo audio source to the inputs of the Scope
J2	Input Mono jack connector	Used to connect a mono audio source to the inputs of the Scope
JP1	Input Mono/Stereo select jumper	Used to select mono or stereo for Scope inputs
J3	Output Mono/Stereo jack connector	Used to connect a mono or a stereo audio sink to the outputs of the AWG
J4	Output Mono jack connector	Used to connect a mono audio source to the outputs of the AWG
JP2	Output Mono/Stereo select jumper	Used to select mono or stereo for AWG outputs
J5	2×15 MTE connector	Connects the Audio Adapter+ to the Analog Discovery
J6	2×15 MTE connector	Pass-through for non-Scope and -AWG signals

Table 2: JP1 Behavior

Jumper Position	Behavior
Mono	Scope channel 1+ is connected to J1, Scope channel 2+ is connected to J2
Stereo	Scope channels 1+ and 2+ are connected to J1 left and right channels, respectively, and J2 is grounded

Table 3: JP2 Behavior

Jumper Position	Behavior
Mono	AWG Channel 1 (W1) is connected to J1, AWG Channel 2 (W2) is connected to J2
Stereo	AWG Channels 1 and 2 are connected to J3 left and right channels, respectively, and the J4 input is left floating

Warning: *Please be careful when connecting a stereo audio source to mono connectors as it will short the second channel to ground. This may lead to damaging your audio equipment if it's not protected.*

Audio Inputs

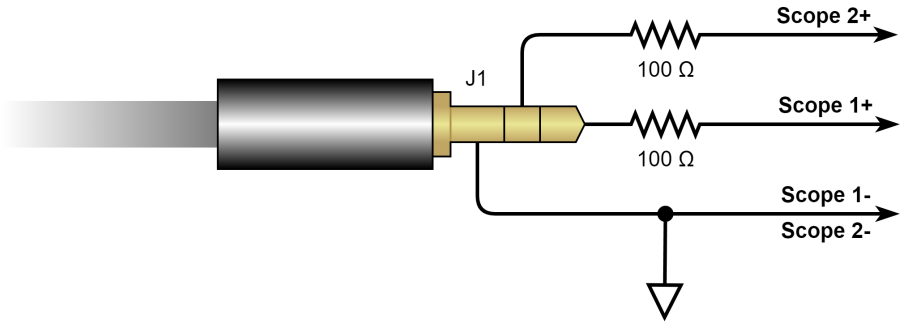
The Audio Adapter+ can be used to acquire audio signals generated by other devices. The audio inputs make use of Scope input channels, and can make use of any WaveForms instruments that leverage these hardware resources, like the Oscilloscope, Spectrum Analyzer, and Network Analyzer instruments. Scope inputs can be used simultaneously alongside AWG outputs and other I/O.

The adapter can process either stereo or mono audio signals passed in through the 3.5 mm audio input jacks, J1 and J2. The Mono/Stereo input connector (J1) can be used with either mono or stereo inputs. The Mono-only input connector (J2) can only be used with mono inputs and is only active when the adapter is being used in mono mode. In order to select the input type, JP1 should be placed in the desired position.

The equivalent circuits for the Mono and Stereo audio input modes are summarized in the circuit diagrams, below:

Stereo Mode

By selecting Stereo mode on JP1, the signals from the Mono/Stereo input connector (J1) are routed to Scope channels 1+ and 2+. The negative Scope channels, 1- and 2-, are connected to ground. In this mode, each stereo audio channel corresponds to a scope channel.



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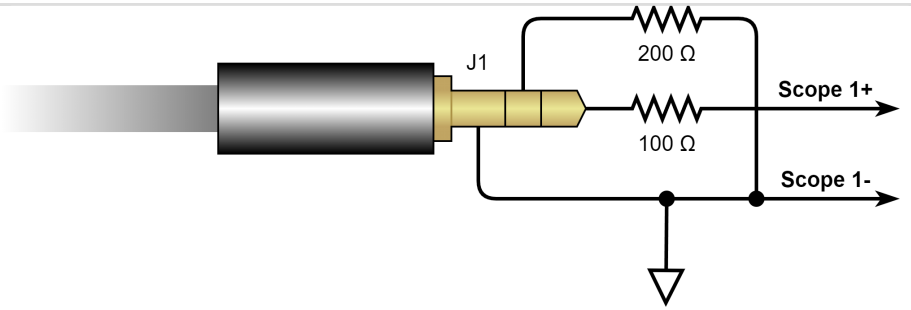
Mono Mode

By selecting Mono mode on JP1, one audio channel from the Mono/Stereo input connector is routed to Scope channel 1+. As the connector itself is stereo, the second signal contact is then connected to ground. The negative channel, 1-, is also grounded.



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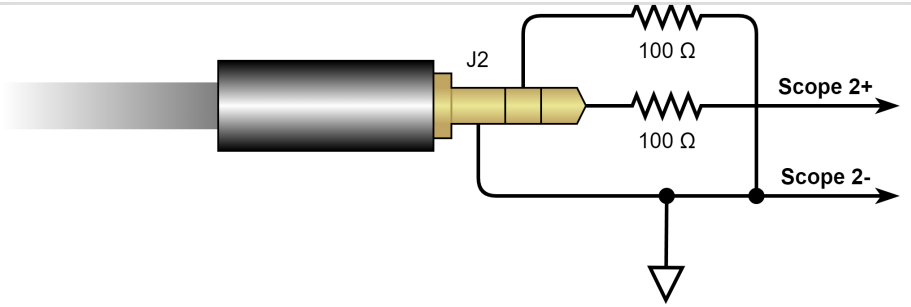
When Mono mode is used, the Mono input connector (J2) can be used for a second mono input. The single audio channel is routed to Scope channel 2+, while 2- is grounded.



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Audio Outputs

The Audio Adapter+ can be used to generate audio signals. The audio outputs make use of AWG output channels and can make use of any WaveForms instrument that can leverage these hardware resources, like the Wavegen, Network Analyzer, and Impedance Analyzer instruments. AWG outputs can be used simultaneously alongside Scope inputs and other I/O.

The adapter can generate signals for both stereo and mono audio cables and devices, via the 3.5 mm audio output jacks, J3 and J4. The Mono/Stereo output connector (J3) can be used with either mono or stereo outputs. The Mono-only output connector (J4) can only be used with mono outputs and is only active when the adapter is being used in mono mode. In order to select the input type, JP2 should be placed in the desired position.

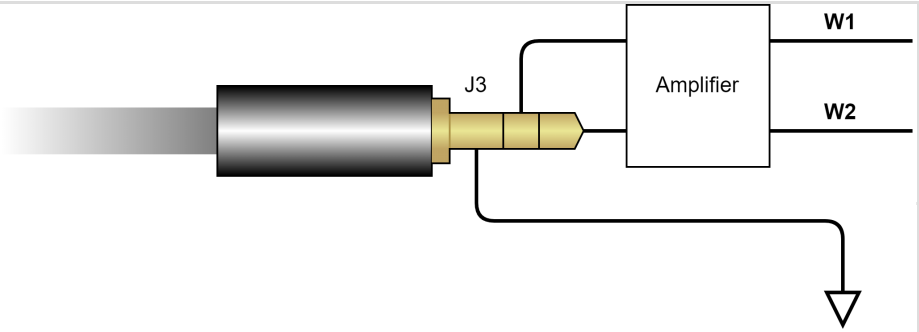
An active amplifier circuit is used to condition AWG output signals prior to sending them out over audio output jacks. This means that voltage levels displayed in the Wavegen instrument in WaveForms are not necessarily representative of the amplitude of a signal on an actual audio cable. For more information, check out the "Amplifier" section, below.

The equivalent circuits for the Mono and Stereo audio output modes are summarized in the circuit diagrams, below:

Stereo Mode

By selecting Stereo mode on JP2, the signals from the two AWG outputs, W1 and W2, are routed to the two channels of the stereo audio output jack, J3. In this mode, each stereo audio channel, left and right, corresponds to an AWG channel.

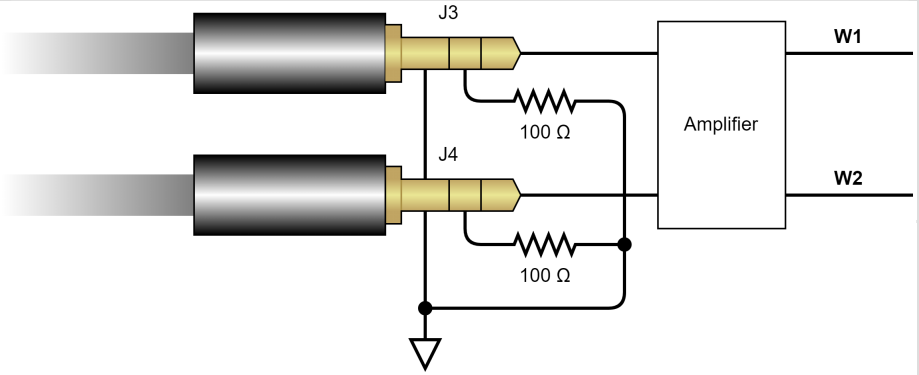
The Mono-only output (J4) is grounded when Stereo mode is selected.



(https://digilent.com/reference/_detail/add-ons/audio-adapter-plus/audio-connector-j3-stereo.png?id=add-ons%3Aaudio-adapter-plus%3Areference-manual)

Mono Mode

By selecting Mono mode on JP2, the signals from the two AWG outputs, W1 and W2, are routed to each of the mono audio output connectors. W1 is connected to J3 and W2 is connected to J4. The unused ring contacts are grounded.



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Amplifier

The audio outputs go through a voltage divider and an amplifier, which are used to scale down the output range from -5 to 5 V to between -1 and 1 V, in order to protect external audio equipment from inadvertent damage. The gain between the AWG output and the audio connector is roughly 1/5.

The amplifier requires power from the Analog Discovery's power supplies in order to function. While the Audio Adapter+ is in use, see the **Power** section, below.

The gain from each AWG output to the Audio jack is roughly:

$$V_{Audio} = \frac{V_{AWG}}{5} \tag{1}$$

As such, the audio signal range is:

$$-909mV < V_{Audio} < 909mV\ (High\ Range)$$

$$-227mV < V_{Audio} < 227mV\ (Low\ Range) \tag{2}$$

The analog output signals are AC coupled. The common mode voltage of the amplifier is set to 0 V, which means that any DC offset applied to the AWG output is effectively removed when it reaches the audio connector.

For a detailed circuit diagram of the analog output amplifier circuitry, refer to the Audio Adapter+ Schematics (https://digilent.com/reference/lib/exe/fetch.php?tok=c86f37&media=https%3A%2F%2Ffiles.digilent.com%2Fresources%2Fadd-ons%2Faudio-adapter-plus%2Faudio-adapter-plus-sch.pdf)

Power

In order to function properly, the Audio Adapter+ must be provided with power from the Analog Discovery 3 power supplies. Active circuitry is used in the output amplifier and should be provided power through the use of the Power Supplies instrument in WaveForms. The Power Supplies should provide 1.5 V or greater through the positive supply rail, with tracking enabled to provide -1.5 V or the equivalent through the negative rail.

Software Support

The Analog Discovery Audio Adapter is controlled with the Analog Discovery 3 through the use of WaveForms.

Additional Information

- For more information on the Audio Adapter+ and Analog Discovery 3, check out their resource centers: Audio Adapter+ (https://digilent.com/reference/add-ons/audio-adapter-plus/start), Analog Discovery 3 (https://digilent.com/reference/test-and-measurement/analog-discovery-3/start)
- WaveForms can be downloaded from the WaveForms Resource Center (https://digilent.com/reference/software/waveforms/waveforms-3/start).
- Audio Adapter Schematics (https://digilent.com/reference/lib/exe/fetch.php?tok=c86f37&media=https%3A%2F%2Ffiles.digilent.com%2Fresources%2Fadd-ons%2Faudio-adapter-plus%2Faudio-adapter-plus-sch.pdf)

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