Audial

USB interface board Mk3

INSTRUCTION MANUAL

Revision 0, July 2023

This manual comprises the introductory information on the use and performance of this device. For more information please refer to the Audial web site, or send your questions to info@audialonline.com.

IMPORTANT!

1. This manual is a guide only.

2. Device is claimed to work as such, however the customers are responsible for their applications.

3. Do not expose this device to rain or moisture, excessive heat, or mechanical force.

4. Use this device exclusively with specified voltages.

5. Unplug the device from the wall outlet during a lightning storm.

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THIS DEVICE

The Audial USB interface board is a USB audio decoding stage, which also generates a clock signal for D/A conversion, by operating as an asynchronous (master) USB Audio Class 2.0 device. It is intended for use as a module that decodes USB signal to raw PCM that can be sent to D/A converter stages.

The board is a factory programmed to output either Philips simultaneous data or I2S protocol. In Philips simultaneous data mode it supports sampling rates up to 384 kHz and up to four channels, while in the I2S mode it supports rates up to 192 kHz and up to eight channels. The mode can be changed by loading an appropriate file via the Windows control panel.

The board includes two low jitter clocks. A 22.5792 MHz works with 44.1/88.2/176.4/352.8 kHz, and 24.576 MHz works with 48/96/192/384 kHz sampling frequencies. This way the unit achieves a clean clocking scheme, and all the audio clock signals in the system are generated only by frequency dividing, and not by using PLL synthesizers.

It also facilitates the use of different alternative clock units, by offering additional DIP-14 clocks footprints, and U.FL connectors as clocks inputs.

The board also includes galvanic decoupling between its USB and PCM side, thus also separating the PC from audio clocks and other audio circuits.

OUTPUTS

For external wiring, the output signal is available at HDMI connector, and is compliant with Audial A-link specifications. For internal wiring, a set of U.FL PCB connectors is provided.

The A-link pinout is shown in the following table. The master clock output at pin 14 is normally disabled, for lower RF emission, and can be enabled by installing the optional resistor R232 at the bottom board side.

The same output signals are available on the set of PCB U.FL connectors. Nine U.FL connectors are factory installed.

Pin	I2S	Philips sim. data
1	**DATA (L/R CH)**	**DATA L (LEFT CH)**
2	**GND**	**GND**
3	**DATA 3 (5/6 CH)**	**DATA 3 (3 CH)**
4	**BCK**	**BCK**
5	**GND**	**GND**
6	N/C	N/C
7	**WS**	**LE**
8	**GND**	**GND**
9	N/C	N/C
10	**DATA 2 (3/4 CH)**	**DATA R (RIGHT CH)**
11	**GND**	**GND**
12	**DATA 4 (7/8 CH)**	**DATA 4 (4 CH)**
13	N/C	N/C
14	MCK (opt)	MCK (opt)
15	N/C	N/C
16	N/C	N/C
17	**GND**	**GND**
18	N/C	N/C
19	N/C	N/C
Shield	**GND**	**GND**

In addition, there are four unpopulated U.FL footprints (J203, J204, J207, J208), carrying the inverted ("negative" - hence the markings have the suffix "N") data signals, to facilitate the use of balanced DACs. When mounting these connectors, please check their orientation, so the signal pads are oriented towards the left side (i.e. towards the resistors R219-R231). Generally, when it comes to the U.FL connectors, there is no rule as to where the U.FL signal pad is located with respect to the notch at one of its corners. So, before mounting these connectors, please check their datasheet, and inspect them visually too.

The output voltage is 3 V nominal. A-link includes 82 Ohm, and U.FL outputs include 50 Ohm build-out resistors, and they both can drive several gates, but are not meant to drive terminated lines.

OUTPUT FORMATS

As said, depending on the firmware, this board may output Philips simultaneous data or I2S protocol.

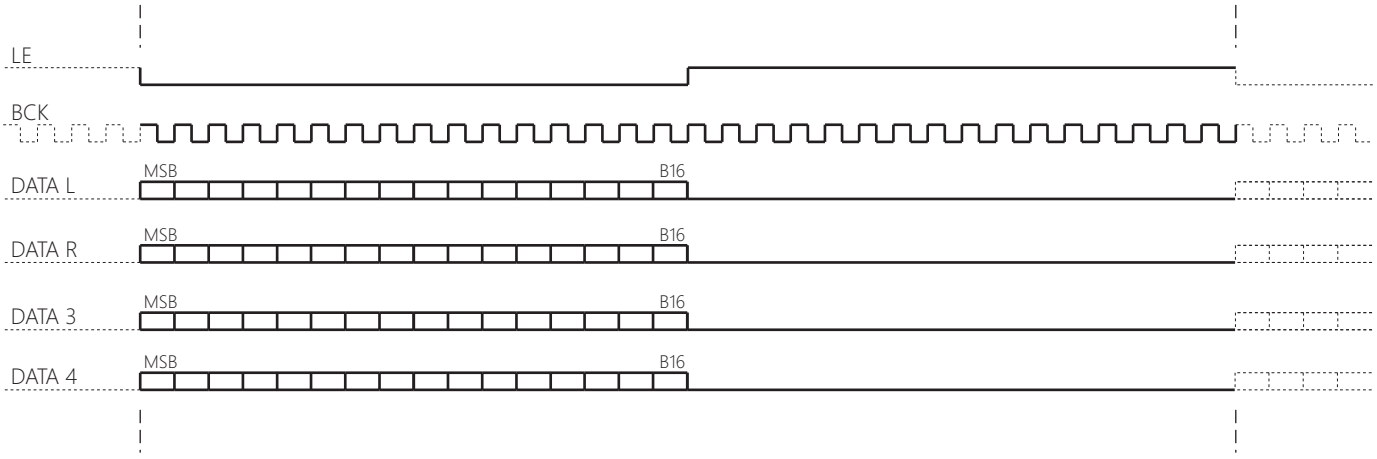
Philips simultaneous data protocol is intended for use exclusively with TDA1541(A). The output has 16-bit right justified data line for each channel. Data is in offset binary format, and is clocked on the falling edge of BCK.

I2S is as specified, so two data channels are time multiplexed in one data line, and the binary word starts one BCK cycle after the WS transition. Data is in two's complement format, and is clocked on the rising edge of BCK.

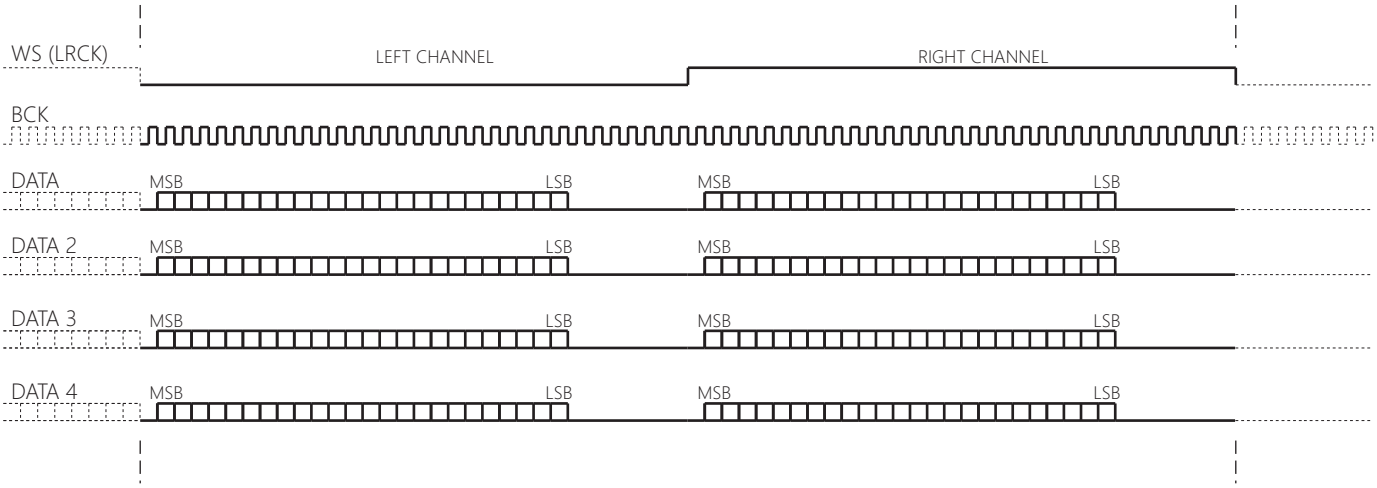
UP TO 384 KHZ COMPATIBILITY

The board version with Philips simultaneous data output supports up to 384 kHz operation. Please note that the Windows audio is limited to 192 kHz, however the operation at 352.8 kHz and 384 kHz is possible using ASIO or WASAPI (exclusive mode) interface.

Also, while non -A version of the TDA1541 chip will normally work up to 384 kHz, a TDA1541A will need a small tweak. Please contact us for detailed information.



TDA1541(A) simultaneous data protocol: split channels, 16 bit; data is offset binary



I2S protocol: two channels are time-multiplexed in one line; data is two's complement

TRANSFORMER

This board requires a transformer with two secondary windings. Nominally required voltages are 9 VAC (AC1) for USB front end, and 8 VAC (AC2) for clocking and output side.

Regarding the tolerances, an AC1 source can be anything between 8.5 and 11 VAC, but if it is above 10 VAC, a transistor Q111 (BD139, TO-126 package) should have some heatsink. For the record, with 11 VAC feeding the AC1 input, there will be about 11.5 VDC at C2 i.e. at the Q111 collector. Since the Q111 is a 5 V (pre)regulator series pass transistor, without a heatsink it will develop about 80 °C.

The AC2 source can be anything between 7 and 11 VAC.

The transformer should be capable to supply 500 mA - 1 A, for both AC1 and AC2. The current actually needed by AC1 is 110 mA typically (120 mA max). The current needed by AC2 is normally 30 mA, but may be higher if different clocks are used, or more gates are driven downstream.

Generally, if the dedicated separate transformer is used for this board, a 20 VA rated unit is plenty, under any circumstances.

MASTER CLOCKS

This board includes two low jitter audio master clocks, 22.5792 MHz and 24.576 MHz, made by Crystek. The USB stage processor selects the appropriate one for a given sampling frequency, and sets the multiplexer to output the appropriate frequency, which is then forwarded both back to the processor, and forth to the reclocker.

Other than pre-installed clocks, this board provides additional footprints, so the other clocks can be used instead. In this case, the pre-installed clocks must be removed.

To use DIP-14 clocks, local bypass capacitors C205 and C206 must be removed too, and their bottom PCB side equivalent footprints, C205B and C206B, can be used instead.

Clocks' supply voltage is 2.9 VDC, typically. This voltage is supplied to clocks by the transistor Q203, via local RC networks, which, other than said bypass capacitors, include resistors R207 and R208 (4R7). These supplies are normally connected to the clocks' pins 4, and if clocks are powered externally, these supplies can be disabled by removing these resistors.

Fully external clock sources can be also used, and this board provides U.FL connectors footprints, which can be used as inputs. Please note that the signal pads for these connectors are those closest to the on-board clocks, i.e. their pins 4.

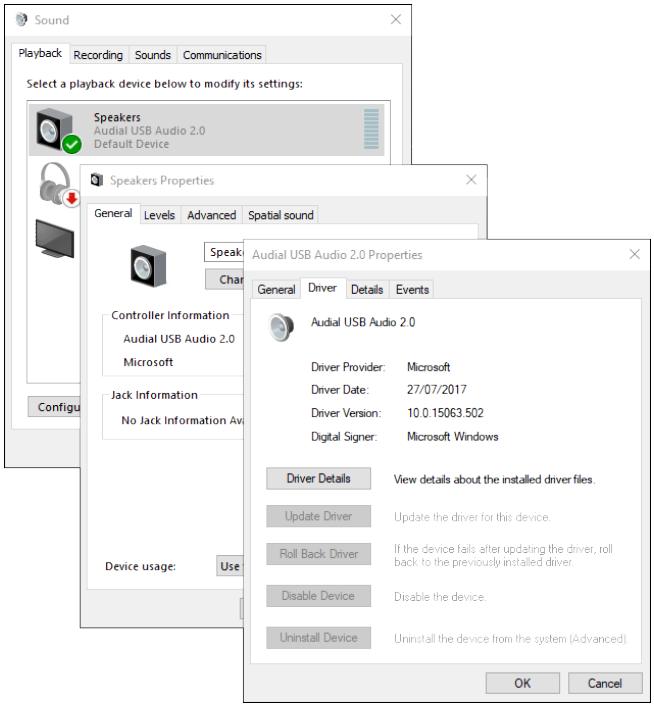
The board normally uses 22.5792 MHz and 24.576 MHz master clock frequencies. To use different frequencies, appropriate firmware changes must be also applied.

USB AUDIO CLASS 2.0

This board employs the USB Audio Class 2.0 definitions.

Mac OS X and Linux are natively USB Audio Class 2.0 compliant for more than 10 years, and this device hence does not require a special driver when used with Mac OS X or Linux.

Since September 2017, Windows 10 (1703) also supports USB Audio Class 2.0 definitions, so this board is plug-and-play with Windows 10 too. Once it is connected to the Windows 10 machine, a small window will pop up in the bottom right corner of the screen, reporting about the initial connection routine, and once this process is finished, the device can be found as a playback audio device, available in the system.

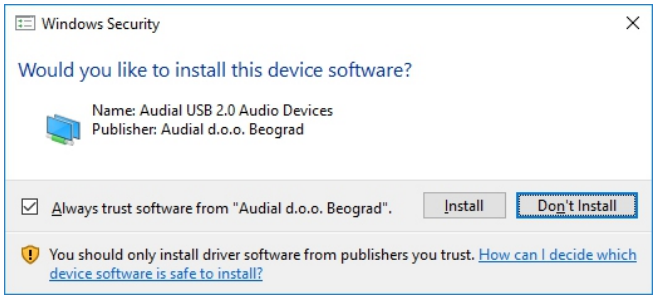


DEDICATED WINDOWS USB DRIVER

In addition, Audial provides a dedicated Windows USB driver for this device, which is still necessary with earlier Windows versions. This driver also provides additional functionality such as firmware update, ASIO interface, and buffer length control, and it can be generally preferred soundwise.

Users can download this driver from the Audial website. Driver version 1.26 can be installed on Windows XP, Vista, 7, 8, 8.1, and 10. Later driver version 2.10 however improves on compatibility with later PC systems, and can be installed on Windows 7, 8, 8.1, and 10. All driver versions are compatible with both 32 and 64-bit Windows. Please however note that the driver version 2.10 does not support multi-channel functionality.

To install the driver, please unzip the provided file, and run setup.exe. The installation window will pop up, and at one stage you will be asked to connect the device. Also, during this process, depending on your Windows version and security settings, you might be asked a couple of times to allow the installation, so please do so. These windows will look like this.



Once the installation is complete, you can configure your settings by using the control panel, available in Windows Start Menu -> Audial.

LED INDICATORS

LED D101 indicates the USB cable connection (it is connected to USB Vbus), while D102 indicates the audio stream i.e. playback (flag comes from the decoding processor).

LED D0, along with the resistor R0, can be installed to indicate externally the board's power on/off state. The R0 value should be chosen for the given LED, taking into account the supply voltage, which is typically 9-10 VDC (tapped from C4, fed by AC2),

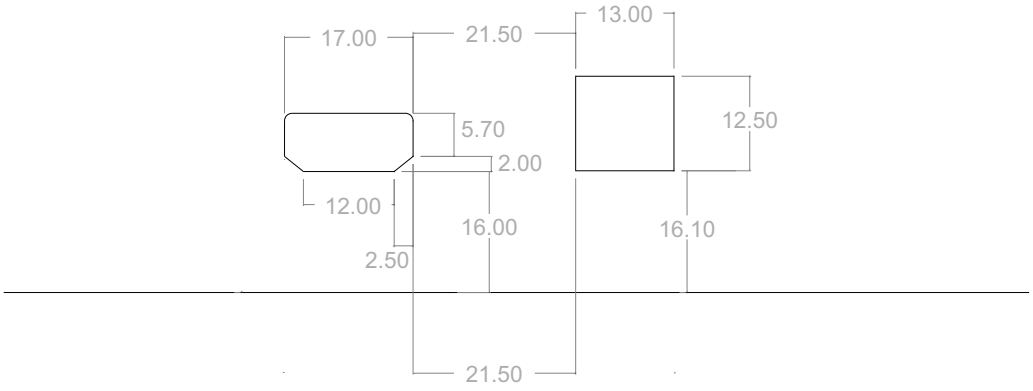
BOARD SIZE AND MOUNTING

The board size is 100 mm (width) x 135 mm (depth). There are five mounting holes, each 4 mm in diameter.

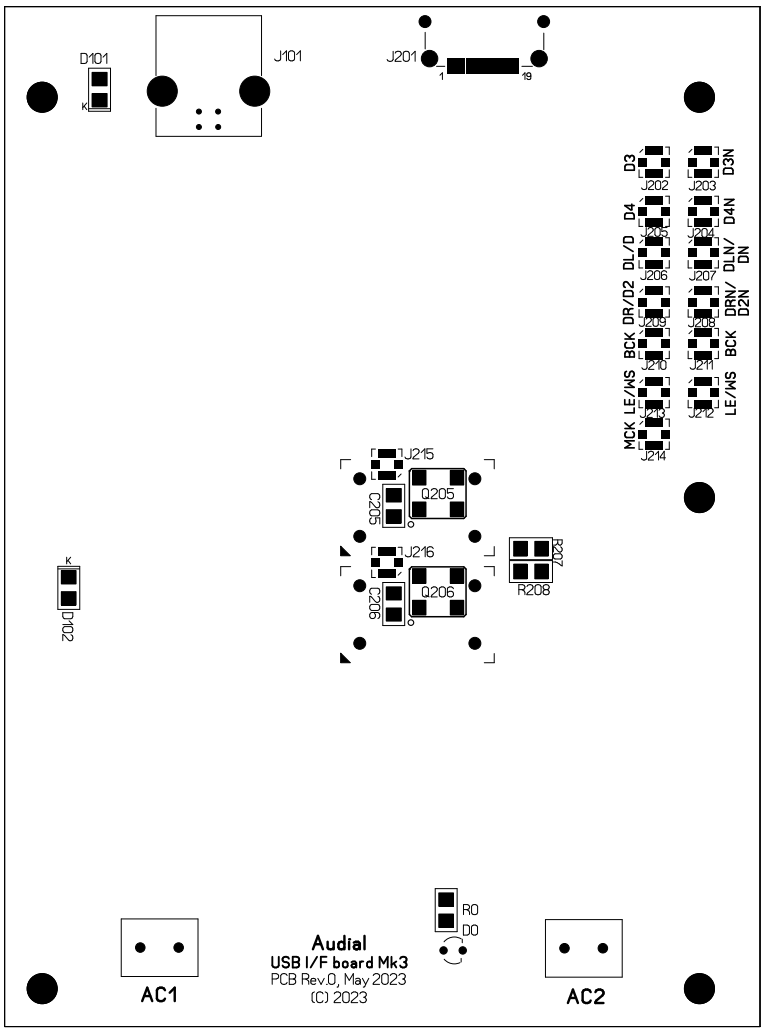
Four holes make a rectangle, and are located 10 mm from the board's back, 5 mm from the front and left, and 8 mm from the board's right edge. The fifth hole is located 70 mm from the front, and 8 mm from the right edge.

The center of the USB connector is 27 mm from the left edge of the board, and the center of the A-link output connector is 63.5 mm from the left edge of the board.

To determine the heights of the holes at the back plate required for these connectors, please consider not only PCB stand-offs, but also PCB itself, which is 1.6 mm thick. The drawing below shows recommended A-link and USB connectors panel cut-out (rear view), taking into account 15 mm stand-offs at that.



Recommended rear panel cut-out, rear view (all measures in mm)



Top side of the board

USB input connector (J101), A-link output connector (J201),
U.FL output connectors (J202 - J214),
master clocks (Q205, Q206) with associated local RC decoupling networks parts,
U.FL input connecotrs for external clocks (J215, J216),
transformer connection pads (AC1, AC2),
power on/off LED diode connection pads with associated current setting resistor (D0, R0),
USB LED indicators (D101, D102),
and mounting holes