

Blackaddr Audio

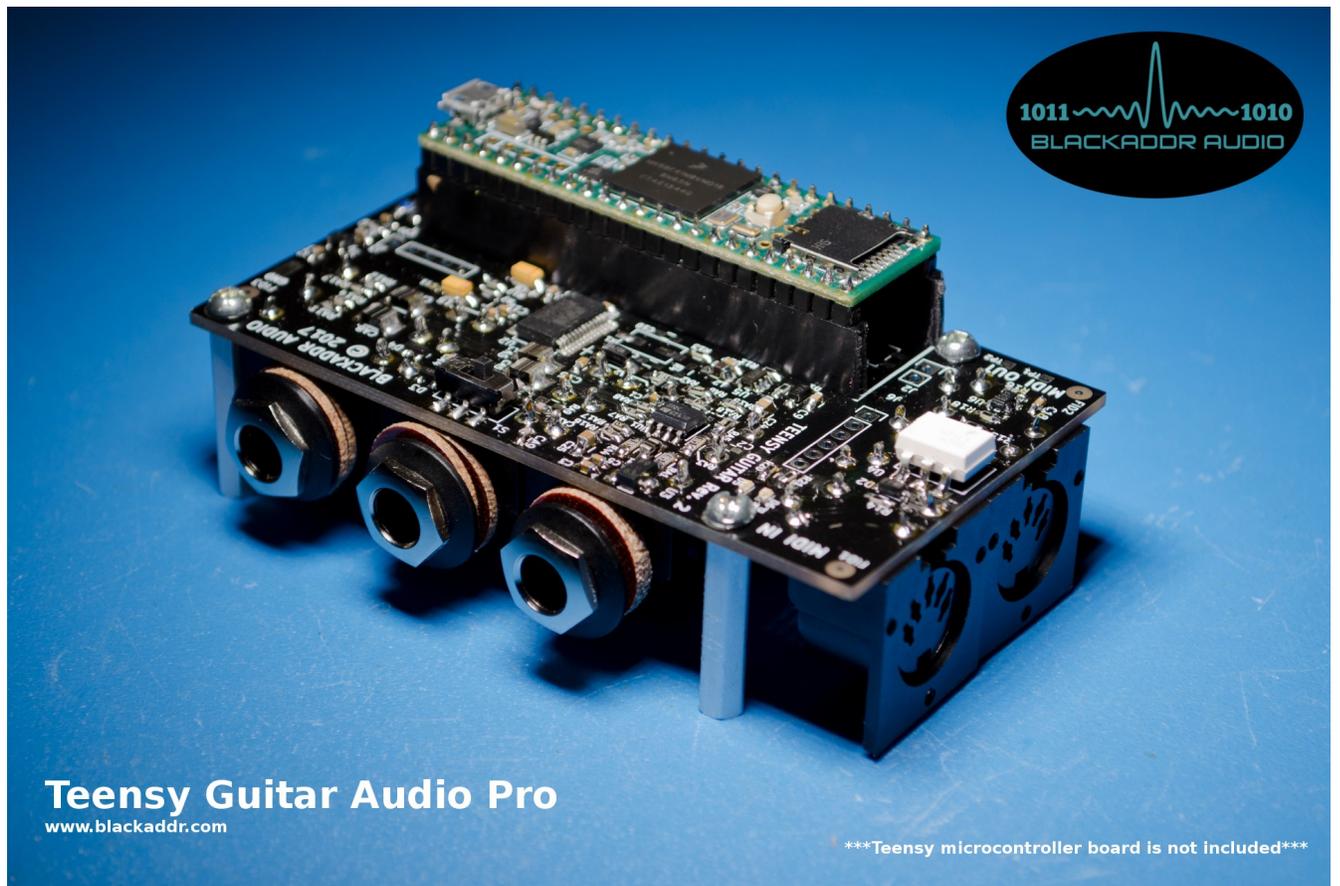
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Guitar Teensy Audio Series

GTA Pro

(PCB Rev 2/A)

User Guide v1.0



Teensy Guitar Audio Pro
www.blackaddr.com

Teensy microcontroller board is not included

Revision History

V0.9 - 9/17/2017 – Initial Release

v1.0 – 11/01/2017 – Added hints on avoiding ground loop noise

v1.1 – 02/04/2018 – Add complete technical details

TGA Pro Overview

The TGA Pro from **Blackaddr Audio** is a combined **Audio** and **MIDI** shield. This stereo-sound prototyping board is specifically designed for learning about and designing your own digital audio effects. Teensy-3 is a series of Arduino-software compatible microcontroller boards by [PJRC](#) that offer significantly improved processing power ideal for real-time audio applications (up to 180 MHz!)

What sets the **TGA Pro** apart from other boards is it's specifically designed for connecting a wide range of audio sources. Onboard high-impedance preamps with adjustable gain permit direct connection of guitars, guitar pedals, or line-level sources using full size 1/4" jacks. Guitar in particular have a wide range of signal levels ranging from tens of millivolts to several volts. A wide range of gain or attenuation is required in order to accommodate any instrument.

Key Features

- Compatible with Teensy 3.2, 3.5 or 3.6.
- Isolated, analog power supplies for CODEC and preamp are generated on board from Teensy.
- Overall +24dB to -34.5dB of user-controllable input gain/attenuation.
- 2-channel input, 2-channel output configuration allows you to process stereo guitar pedals (such as reverb, chorus, etc.) correctly, or create your own mono-to-stereo effects.
- Standard 5-pin MIDI input and output connections for use with the Arduino MIDI library
- Optional 1 Mbit / 2 Mbit SPI RAM for external data storage (ideal for longer delays!)
- Analog dry output jack splits passively the output of the analog preamp.
- GPIOs available on user-installable expansion headers.
- 1 user controllable LED.
- Overload protection circuit for CODEC analog input.

ADDITIONAL RAM: Please note the RAM chips provide extra storage via the Teensy SPI peripherals. They can be used for external storage of data, for example longer audio delays. They do not increase program memory. The first memory chip works with all Teensy 3.X models. Second memory chip requires pins only on the Teensy 3.5/3.6

Technical Specifications

Input Channels (unbalanced) : 2

Output Channels (unbalanced) : 2

Input Impedance: 1 Mohm

Maximum INPUT signal level: 9 Vpp

Maximum DRY output level: 9 Vpp

Maximum OUTPUT level: 1 Vrms

Maximum ADC level: 1 Vrms

Overall Input Gain: +24 dB to -34 dB via 2-stage preamp.

1st Stage Preamp Gain: switchable 0dB / +12 dB via mechanical onboard switch

2nd State Preamp gain: Onboard codec provides additional +12dB to -34.5 dB gain, software controllable.

Signal Levels

Most audio signals fall in to one of 4 general groups in order of descending signal level. Understanding them will help you ensure the preamp gain is set correctly for your application.

- Speaker/Headphone level
- Line level
- Instrument Level
- Microphone Level

The preamp circuit on the TGA pro is powered by +9V, just like a guitar pedal, thus it can safely take a voltage up to +9V peak-to-peak without damage. However, close to the maximum will cause the preamp to distort. The goal is to either raise or lower the signal level to around 1 V rms using the two preamp stages. This gives the ideal level for the CODEC's analog to digital converter.

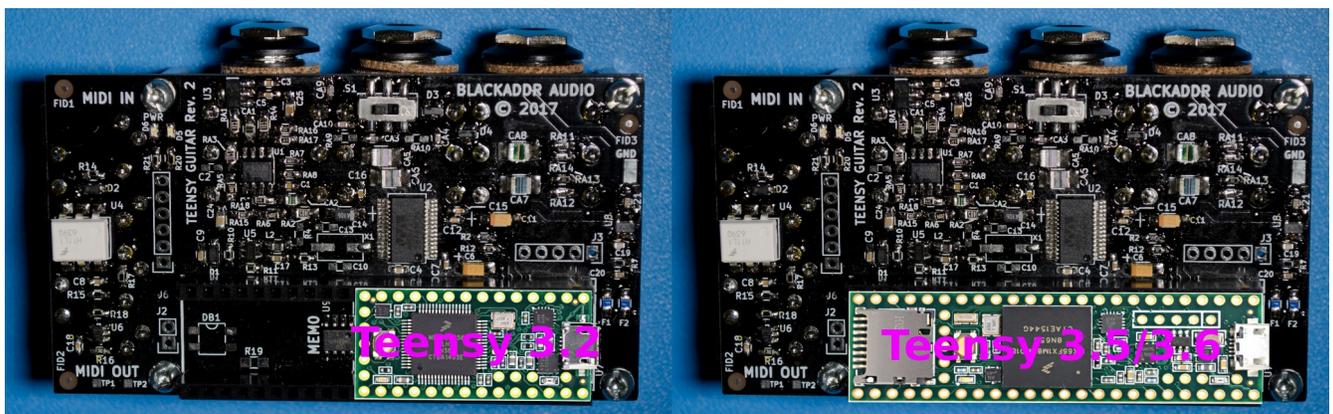
Speaker Level/Headphone level – generally these types of outputs are meant to drive actual speakers. However, headphone outputs from things like smart phones and music players work just fine as long as the volume isn't too loud. Start at zero and bring it up. Too loud a volume can damage the TGA Pro inputs.

Line Level – these signals are usually around 1 volt RMS, ideal for the CODEC. Set the TGA Pro switch for 0dB of gain. There usually isn't a need to adjust the software controlled gain on the CODEC. These can be safely plugged into the high impedance INPUT jack on the TGA Pro.

Instrument Level – these signals typically are assumed to be guitar pickups. Passive pickups can be as low as 20 mV. Humbuckers are often 100 mV to 400 mV. Active pickups are often 500 mV to several volts. Guitar pedals can also be several volts. Depending on your configuration, you may need gain or attenuation applied using the 1st and 2nd stage on-board preamps.

Microphone Level – these signals are often very weak, required +20dB to +40dB of gain for passive microphones. For best results with the TGA Pro, use proper microphone preamp before connecting to the TGA Pro INPUT.

Compatibility



The TGA Pro is designed to work with the following boards from PJRC (www.pjrc.com)

- Teensy 3.2
- Teensy 3.5
- Teensy 3.6

Operating Instructions

WARNING:

The TGA Pro contains electro-static-discharge (ESD) sensitive components, as does the Teensy microcontroller board when installed. Avoid directly touching the electronic components on the board whenever possible. Always install and touch one of the metal standoffs while handling the board.

TIPS FOR OPTIMAL AUDIO QUALITY

The TGA Pro is designed to prevent digital signals generated on the board from coupling into the analog signals. However, it is not easy to prevent ground noise from other equipment from getting into the analog ground. This usually happens through ground loops caused by the common ground in household wiring.

The following tips can be used to reduce noise in audio equipment using unbalanced signals such as guitar pedals, amps and the TGA Pro.

- Plug all audio gear into the same outlet/power bar as the computer providing the USB connection to your Teensy. Using different wall outlets for the computer and your guitar gear can create large ground loops.
- When programming/debugging your Teensy programs, connect the Teensy to the PC or laptop host. Once programmed, power the Teensy with a micro-USB cellphone charger to avoid ground noise caused by the computer.
- If using a laptop with your Teensy, disconnect the laptop battery charger and run the laptop on it's own battery. This will also reduce ground loops within the household wiring.

Software

The BAGuitar Library used to control and configure the GTA Pro can be downloaded from:

<https://github.com/Blackaddr/BAGuitar>

Installing the Teensy PCB onto the GTA Pro

Get to know your GTA Pro before installing a Teensy board.

Install your Teensy microcontroller board into the socket. The Teensy board must have square shaped, 0.1" male pins to insert correctly. It is very important to make sure the Teensy PCB is aligned correctly.

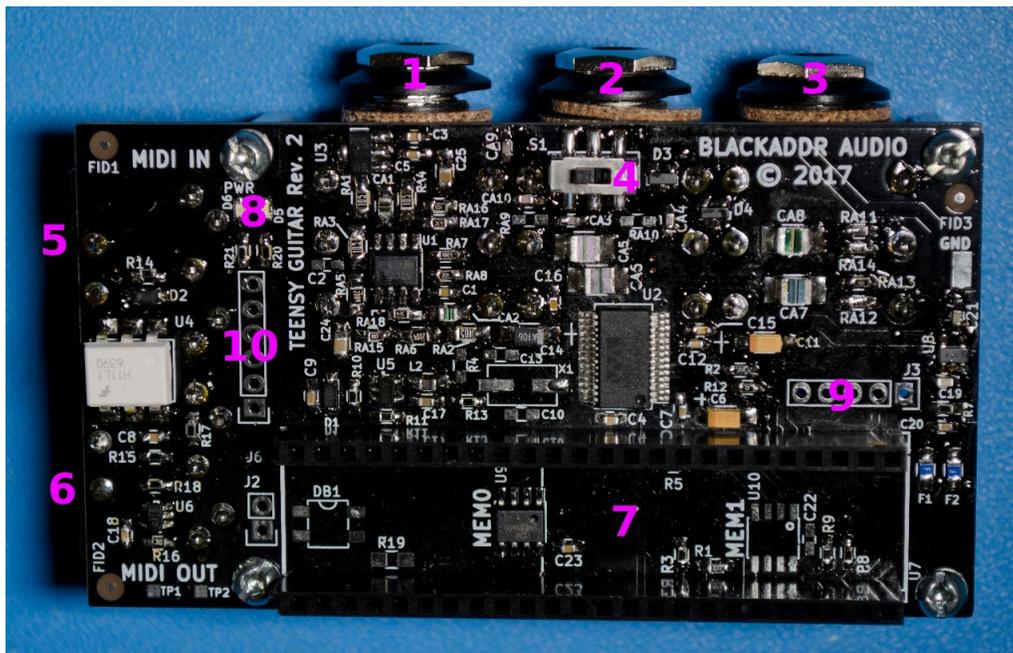
Failure to align the pins correctly (accidentally shifted to the right or the left) can cause

permanent damage to both the Teensy PCB and the TGA Pro. The Teensy should be installed by aligning the rightmost pins on the Teensy board with the right most socket pins when the USB connector is on the side shown below.

GTA Pro Legend

Get to know your GTA Pro!

- | | |
|-----------------------|--------------------|
| 1. Audio Input | 6. MIDI Output |
| 2. Dry Output | 7. Teensy Socket |
| 3. Audio Output | 8. LEDs |
| 4. Preamp Gain Switch | 9. J3 GPIO Header |
| 5. MIDI Input | 10. J6 GPIO Header |



1. Audio Input

Stereo TRS, unbalanced input. Plug your guitar in to this jack. Also will work with line-level sources. When no plug is inserted, both channel inputs are grounded automatically.

Input impedance: ~ 1M

Voltage Max: 9V peak-to-peak

2. Dry Output - Instrument

Stereo TRS, unbalanced output. This is the output of the analog preamp before going to the CODEC, but after the first-stage anti-aliasing filter. The preamp is powered by +9V, just like a guitar pedal, and is capable of achieving approximately 6 Vpp output. *This output is safe to drive guitar pedals and guitar amps, but caution should be used when connecting the DRY output to the input on another line-level device a non-line level source is connected to the TGA Pro INPUT jack.*

Output impedance: ~ 1K

Voltage Range: ~6V peak-to-peak maximum

3. Audio Output

Stereo TRS, unbalanced output. This is the analog output of the stereo codec's digital-to-analog converter (DAC). It is suitable to drive line-level, guitar pedal, or guitar amp inputs.

Output impedance: ~ 100Ohm

Voltage Range: 1.0V RMS

4. Preamp Gain Switch

This switch selects the gain of the high-impedance preamp. Preamp gain is either 0dB (unity) or +12dB gain.

5. MIDI Input

This jack is a MIDI compliant 5-pin jack. The on-board MIDI phy converts MIDI signals to the correctly levels to be received by the Teensy UART. The Teensy software library has built in MIDI support through this port. See the BAGuitar Library demos for more details.

6. MIDI Output

This jack is operated at 3.3V, and is designed to be compliant with MIDI outputs using the voltage level. It is safe to connect to any MIDI input, regardless of whether that circuit operates at 3.3V (modern) or 5V (vintage). The MIDI output phy is driven by the Teensy UART. The Teensy software library has built in MIDI support through this port. See the BAGuitar Library demos for more details.

7. Teensy Socket

Install your Teensy microcontroller board in this socket. The board must have square shaped, 0.1” male pins to insert correctly. It is very important to make sure the Teensy PCB is aligned correctly. Failure to align the pins correctly (accidentally shifted to the right or the left) can cause permanent damage to both the Teensy PCB and the TGA Pro. Use the images below as a guidelines.

8. LEDs

Two LEDs are installed on the TGA Pro. One is BLUE, and will illuminate whenever 3.3V power is received from the Teensy board. The other is GREEN, and is user controllabe by software running the Teensy. See the GTA Pro schematic, and BAGuitar Library for more details.

9. J3 GPIO Header

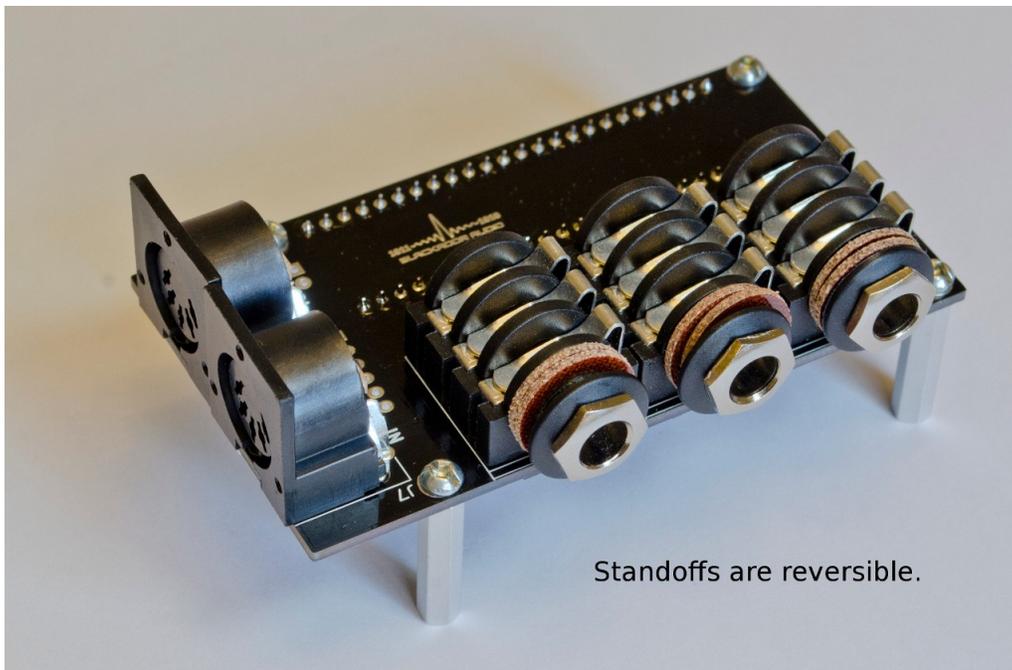
Contains 4-user controllable pins from the Teensy. See the GTA Pro Schematic for details. This pins operate at 3.3V.

10. J6 GPIO Header.

Contains 4-user controllable pins from the Teensy. See the GTA Pro Schematic for details. This pins operate at 3.3V.

Using your GTA Pro

It is recommended to install the standoffs such that the ESD sensitive components are hidden underneath. This makes handling easier when inserting and removing plugs.



*** If you wish to have full control over the TGA Pro, install the BAGuitar Library by downloading it from the Github link at installing it into your Arudino IDE as an 'additional Library' by importing a ZIP file.

<https://www.arduino.cc/en/Guide/Libraries>

1. Insert the Teensy PCB as shown previously in this User Guide.
2. Plug a USB cable into the Teensy PCB.
3. Plug the other end of the USB into your computer.
4. Launch the Arduino IDE and program. If you installed the BA Guitar Library you can access the provided examples from with the IDE. Additional Libraries will be found at the very bottom of the list.

Help & Troubleshooting

Help with the Arduino IDE and Teensy PCB programming can be obtained from the PJRC Forums.

<https://forum.pjrc.com/>

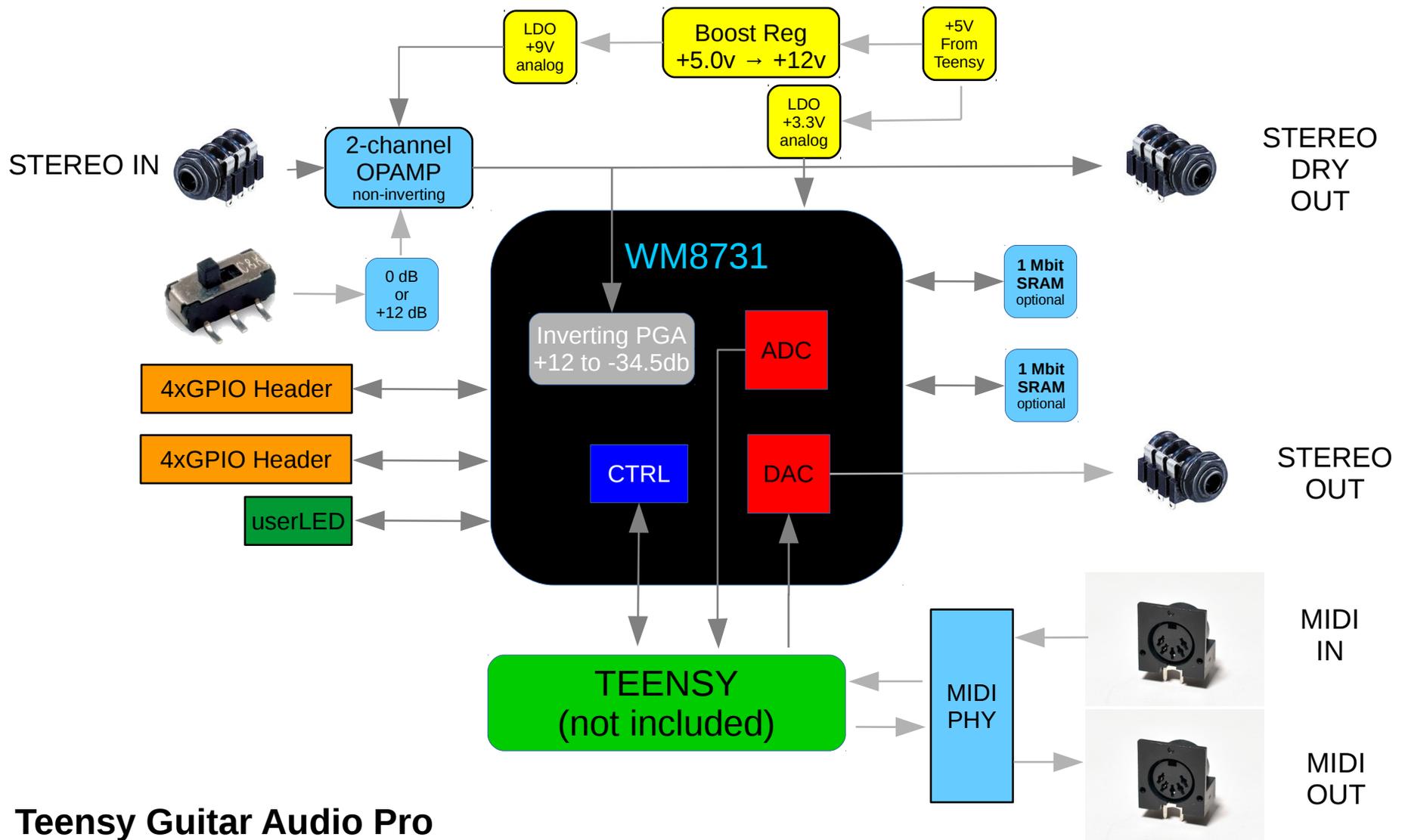
Eratta

On Rev. A boards, the silkscreen label for the 0dB/+12dB switch is reversed.

Contact

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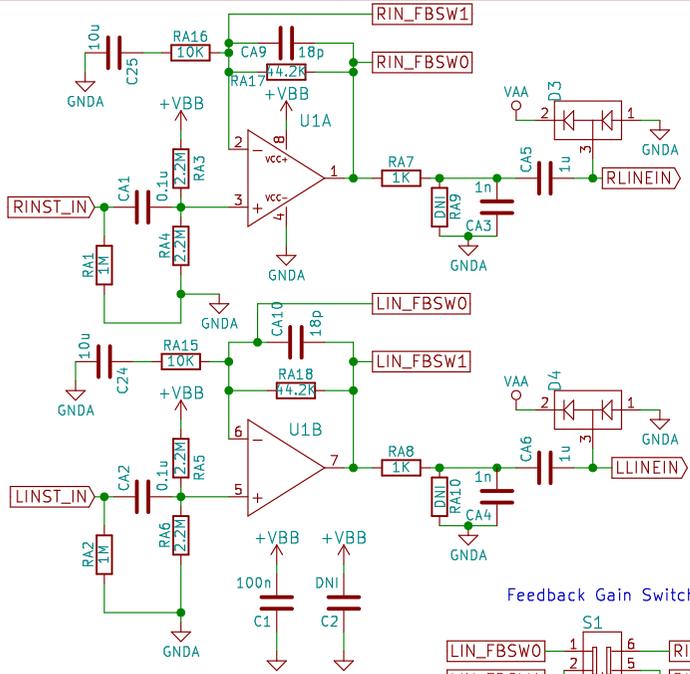
Teensy Guitar Audio Pro

- can run entirely off Teensy USB power (preamp runs off clean 9V LDO)
- Neutrik 1/4" jacks
- 2 channel input, 2 channel output
- 2 channel buffered analog (dry) out

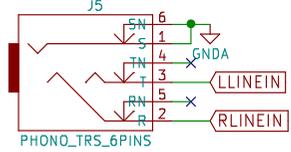
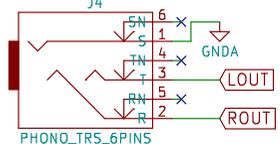
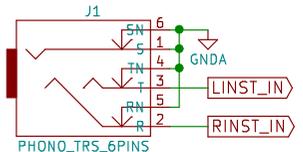
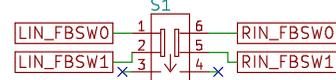
- 8 GPIOs via headers
- 1 user controllabled LED
- Preamp (opamp) with dual gain (0dB or +12dB)
- Overall analog gain +24dB to -34.5dB
- External MIDI via DIN jacks

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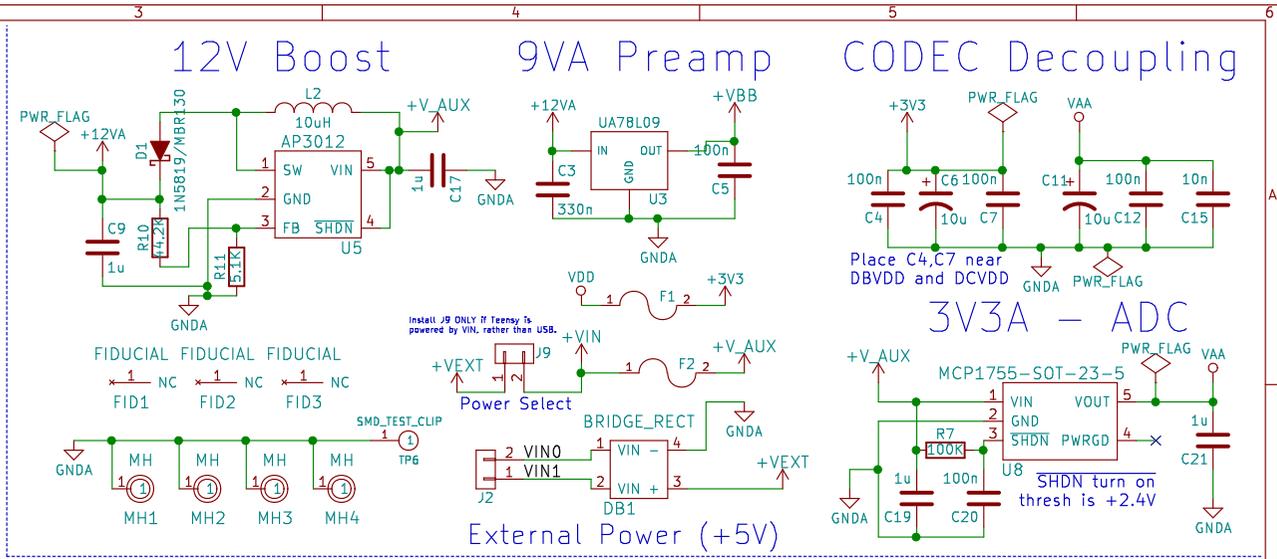


Feedback Gain Switch



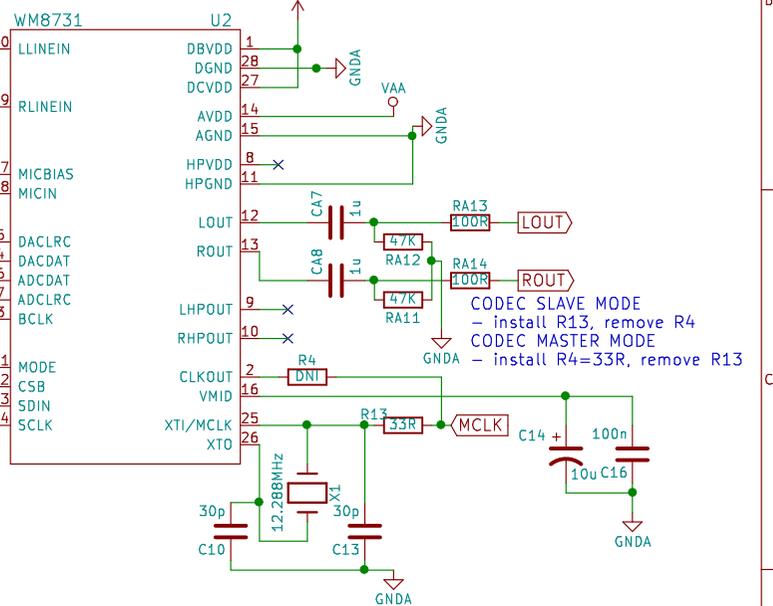
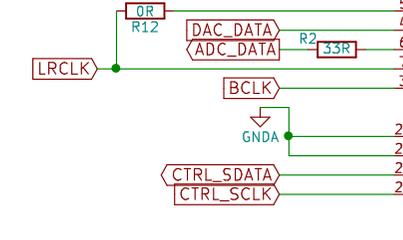
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TEENSY & MEMORY
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Sheet: MIDI
MIDI
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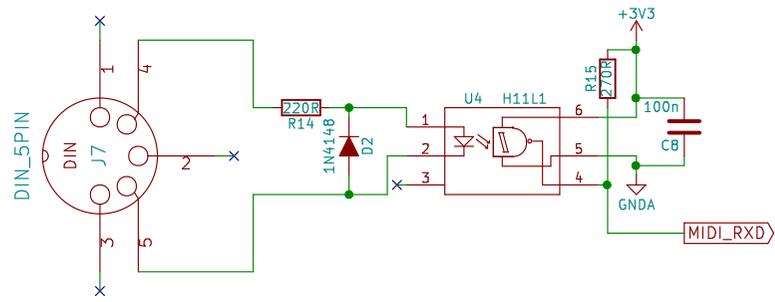


WM8731 inputs have internal gain stage of +12db to -34.5db before ADC.

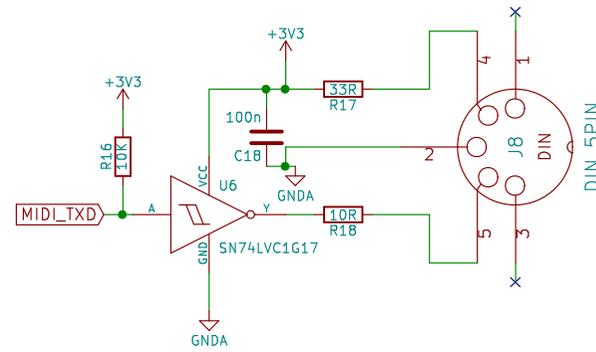
Short R12 when LRCLK is shared



MIDI_IN



MIDI_OUT



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Sheet: /MIDI/

File: MIDI.sch

Title: Teensy Guitar Audio

Size: A4 Date: 2017-03-15

KiCad E.D.A. kicad 4.0.4-1.fc25-product

Rev: 1

Id: 2/3

