Expat Audio Cavendish Build Guide

(April 2019)

Expat Audio Cavendish

All-discrete (API-style) signal path upgrade for the GSSL Compressor

Introduction

The Expat Audio Cavendish is an add on modification for the popular GSSL Audio Compressor. It takes place of the NE5534 differential input stage, and the NE5532 operational amplifiers used to drive the output, and drives the signals through discrete operational amplifiers (such as API2520, Jensen/John Hardy 990 or their clones) and onwards into output transformers.

Revision Control & Edits

Expat Audio PCB's are typically designed using a X.Y versioning system Please look on your PCB to see the version number. The silkscreen will either read "version X.Y" or PG X.Y

Cavendish is currently at PG1.1 and working well.

For reference the NE5534 contains a single operational opamp, whilst the NE5532 contains two. The Original GSSL schematic used one of the NE5532's opamp for Current/Voltage conversion, and the other for an inverted output to drive a balanced XLR output.

It appears that in many of the layouts of the GSSL mainboards, that the pins usage of the NE5532 are different from the schematic.
Owing to a discrepancies in the GSSL schematic versus the board layout, where the 5532 output stages are shown reversed on the schematic, Cavendish version PG1.0 requires that the 'Flywire / jumper' cables for the 5532 stages have three pairs of pins swapped:

Pin 1 must be swapped with pin 7
Pin 2 must be swapped with pin 6
Pin 3 must be swapped with pin 5

PG1.1 no longer needs this pin-swap. The layout of Cavendish was changed to compensate. However, those using newer GSSL layouts should be aware, in case this discrepancy in the board is now resolved and the swap is needed again.

A modification was made between pg1.0 and pg1.1, where pins 4 and 5 on the output connector are flipped to make sure both outputs are kept in phase.

This document was last updated April 2019

Theory of operation (Added in PG1.1 Documentation)

The schematic for the GSSL can be found at: http://www.gyraf.dk/gy_pd/ssl/ssl_sch.gif
Many thanks to Gyraf for the effort and support he's done over the years.

Below is part of it.

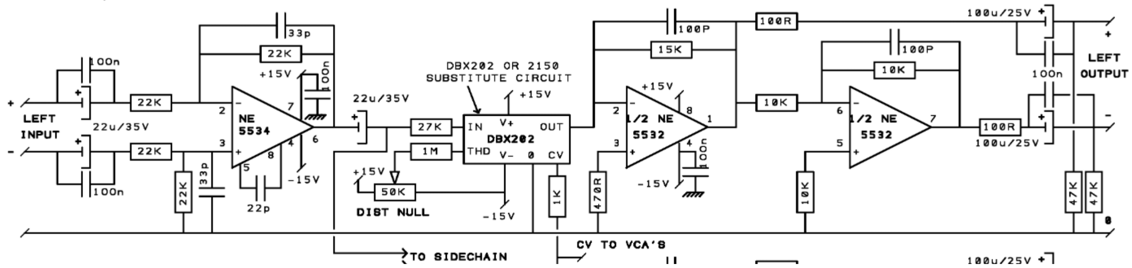


Figure 1: The Signal Chain of the GSSL (From Gyraf.dk)

The main audio signal chain for the GSSL can be simplified as:

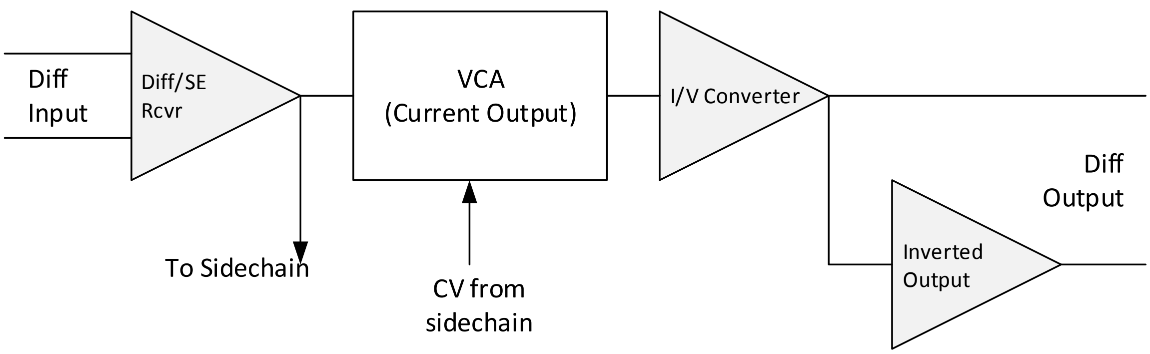


Figure 2: Simplified Audio Signal Path

Cavendish replaces two of the operational amplifiers in this diagram and does the inverter output (or actually drives a true balanced output) using the transformer. Most of the feedback resistors and caps remain on the GSSL motherboard.

Some customers have said that the amplitude of the outputs through Cavendish have been lower than their existing system. In the majority of cases, this can be remedied by removing the 15KOhm resistor in the feedback path of the I/V opamp (one of the opamps in the NE5532) shown in figure 3

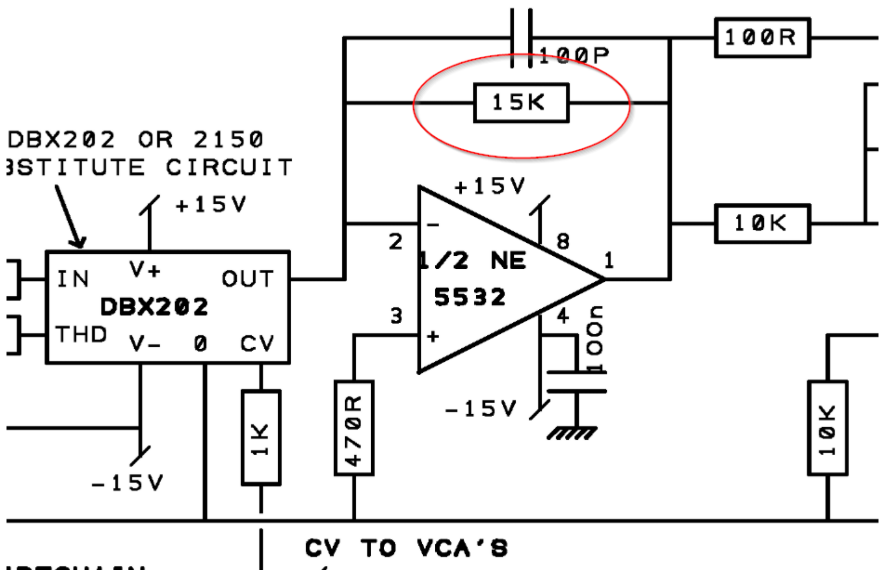


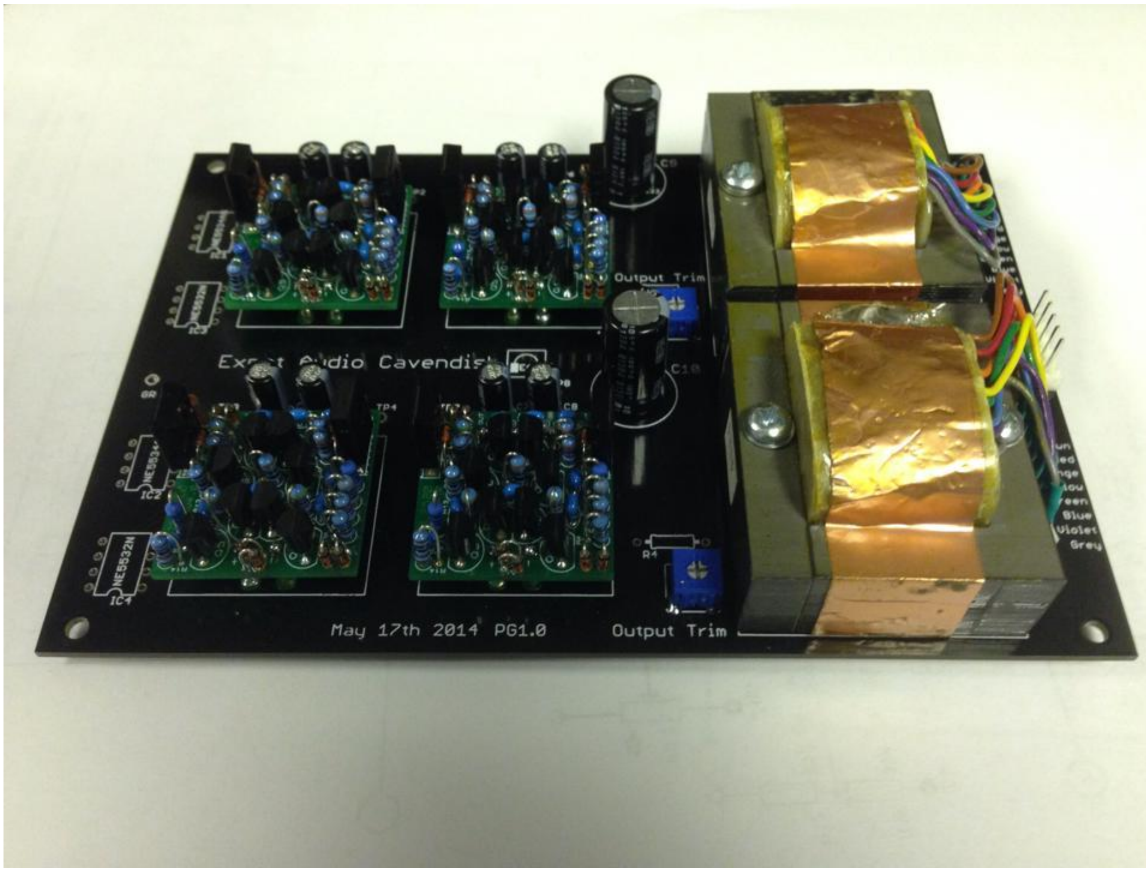
Figure 3 : The I/V Opamp stage and the I/V Gain setting resistor

The function of the 15KOhm resistor in the opamp is to set the conversion between the current output of the VCA (The DBX202 or THAT VCA) and the Voltage output.
On Cavendish, a 5K resistor and 5K pot is available between the input and output pins of the second opamp for this purpose. Should you populate the resistor and the pot, please remove the 15K resistors in the feedback loop of the IP on the main GSSL board.

The pot can then be used to trim/calibrate the gain value as needed.

Some customer have found that they can impact the gain value by changing the 27KOhm input resistor to the VCA. This changes the operating point of the VCA and is not recommended.

Assembling the board



Building and installing the Cavendish board is very simple. Two output transformers are needed for the output. EA2503 are what we used. They are available from CAPI.

4 discrete operational amplifiers are needed. Clones, (available at great places like CAPI or Whistle Rock Audio) can be used too.

Please follow users guides for those discrete operational amplifiers for details on how to build them. The transformers are really easy to install. Simply follow the color coding details on the PCB itself.

Should you want to install DOA (Discrete Op Amp) socket pins (such as the ones from CAPI), then you'll need to gently drill out the holes to be a little wider but also avoid ripping up the pads. The standard hole size is 0.078Inch, but those particular sockets require a hole size of 0.085Inch. Details on the pins can be found at: http://capi-gear.com/catalog/product_info.php?products_id=122
It's always easier to drill/ream out a hole than is it to fill one in. During development of Cavendish, we decided early on to give customers the option for the pins.

The large capacitors on board provide DC blocking protection for the transformers. Make these as large as possible, to reduce any high pass filtering effects, or if you're certain that you have near-zero DC offset, you could link these out. –Since the API designs we love use a DC-blocking capacitor we included the part, but the option is there for you.

The output trim pots allow the gain to be trimmed to match both outputs. This can be calibrated by setting the compressor to bypass and sending the same signal to LIN and RIN in the GSSL, then comparing the outputs. The GSSL uses 15KOhm resistors for this purpose. We recommend removing the 15K's on the main GSSL board and replacing with the 5K resistor and 5K trim pot on Cavendish.

Connecting them to the main PCB is done by replacing the output opamps on the GSSL mainboard with 8 pin ribbon cable, terminated with a DIP "IC" style header. This essentially "extends" the opamp from the original GSSL over to the Cavendish board. Also, Ground should be connected on a single wire from the Canvendish to a point as close to the GSSL Opamps as possible.

Newer GSSL boards may have resolved this discrepancy, so to know which opamp to "flywire" over from, look for the opamp that is using the 15K feedback resistor and connected to the VCA. These can be seen in figure 4.

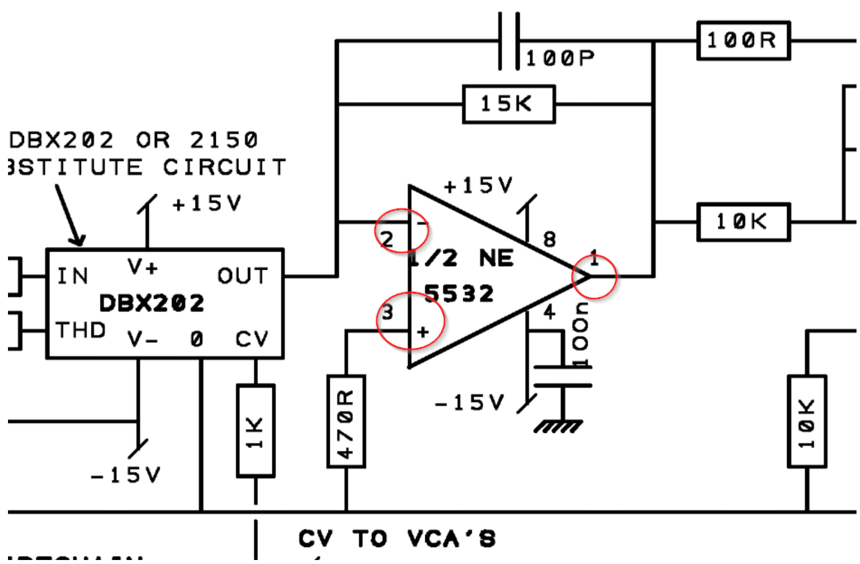
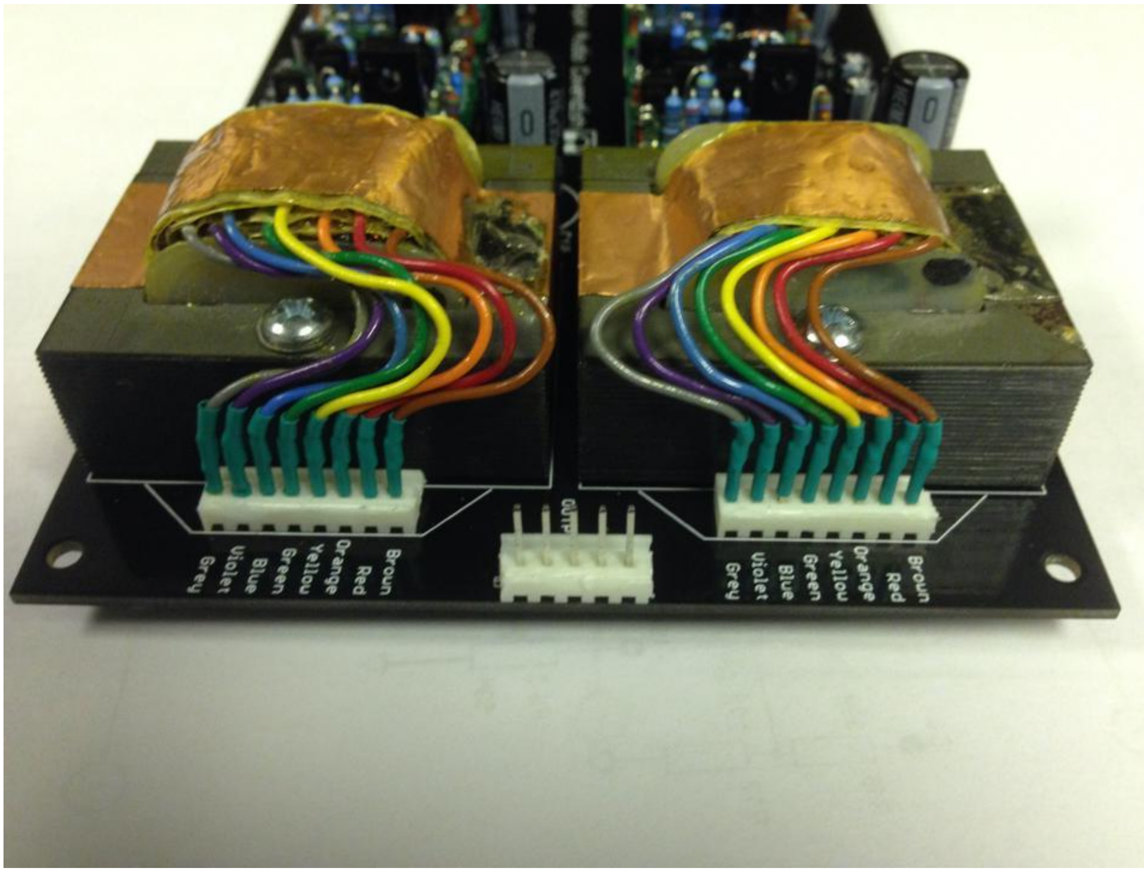
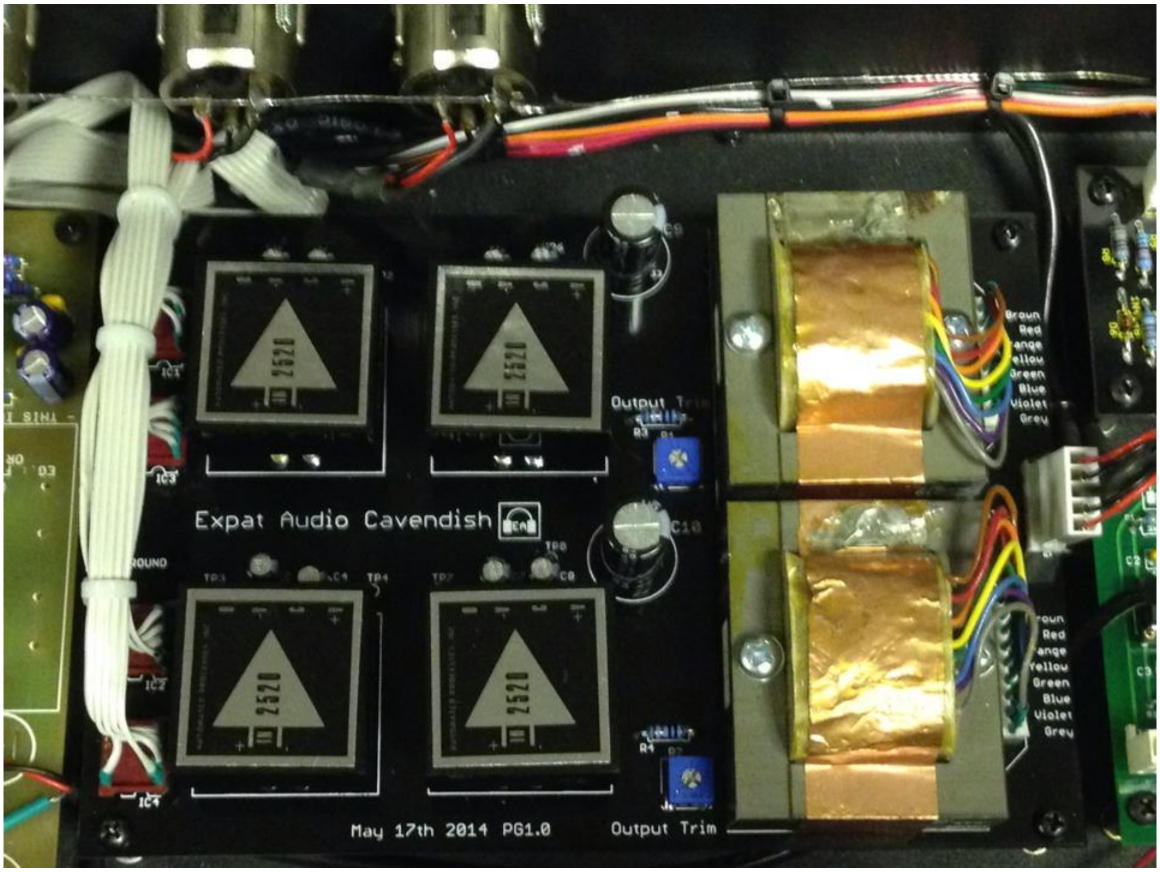


Figure 4, sources for the output stage wiring.

Simple ☺



The output header can be connected directly to the XLR’s.


Expat Audio Cavendish
May 17th 2014 PG1.0
Output Trim
Output Trim
Brown
Red
Yellow
Green
Blue
Violet
Grey
2520
2520
2520
2520
C9
C10
R3
R4
IC1
IC2
IC3
IC4

Bill of Materials

Qty	Value	Device	Parts	Supplier	Supplier PN
1	Cavendish PCB			Expat Audio	
4	DOA Socket Set		DOA-Socket-Set	CAPI	DOA-Socket-Set
8	>22uF @ 20V+	CPOL-EUE2.5-6	C1, C2, C3, C4, C5, C6, C7, C8	Mouser	
2	>47uF @ 20V+	CPOL-EUE5-13	C9, C10	Mouser	
1	5pin 0.1" header	FE05-1	OUTPUT	Mouser	
2	**5KOhm**	R-EU_0207/10	R3, R4	Mouser	
2	**5KOhm**	TRIM_EU-CA6V	R1, R2	Mouser	
4	2520	2520	DOA1, DOA2, DOA3, DOA4	CAPI	GAR2520 Bundle
2	EA2503	EA2503	U$1, U$2	CAPI	EA2503
8		Jumper pin Header	8-Pin header	Mouser	571-5746613-1
length	8-way ribbon cable				