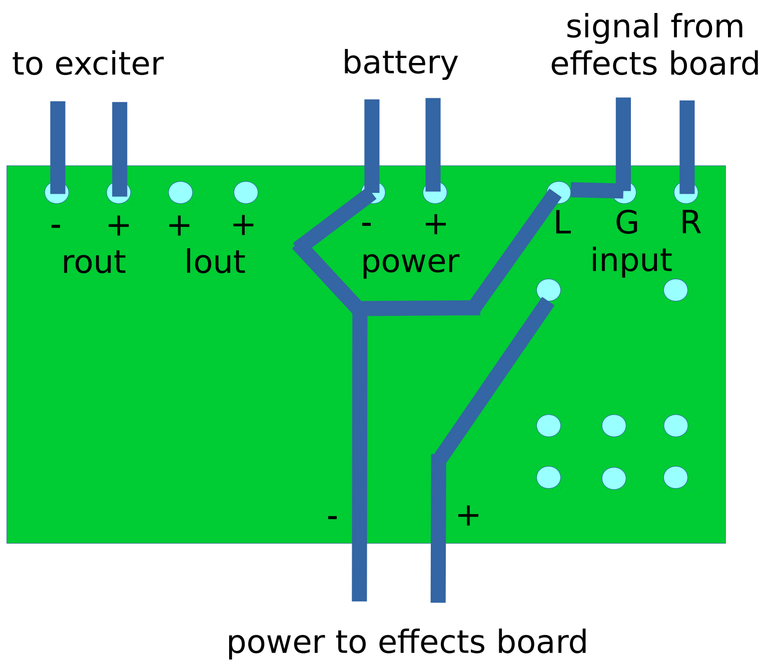
DIY Reverb Box for Acoustic Guitar
by DrAlx

Overview

There are two boards in this build. The main effects board (built on Veroboard) is shown in the schematic. A second small board contains a PAM8403 class-D amplifier to drive the audio exciter. This second board is extremely cheap, ready-assembled, and has an integrated power switch and volume control.

Wiring the PAM8403 board

The board is stereo but you only need one channel. I used the right channel, so I kept the left output pins open, and grounded the left input pin. The wiring should be self explanatory. Looking at the back of the board you have this.



The effects board takes its power from the back of the pot that acts as a switch and volume control, so this switch acts as the power switch for both boards.

The PAM8403 board has no output filter, and although it can drive the exciter directly it will radiate RF at about 230kHz. So you should shield the wires to the exciter with a grounded sleeve unless you want to broadcast yourself on the radio. Better still, add an output LC filter consisting of two

15uH inductors in series with the outputs of the PAM8403, and a 1uF ceramic capacitor shunting the exciter. Put the LC filter close to the board and you can have long wires from the filter to the exciter.

```
(rout +) ----- 15uH -----+---------------> Exciter
                         |
                      1uF (ceramic)
                         |
(rout -) ----- 15uH -----+--------------> Exciter
```

Warning: If you decide to use an output LC filter but for some reason have a broken connection between the filter and the Exciter, then you will most likely kill the PAM8403!!!

Fitting everything into a Hammond case (1591XXBSBK)

I spent more time trying to get everything into the enclosure than on anything else. I wanted to run everything off 4xAA NiMH batteries. My original plan was to put a battery holder in the enclosure, but the holder turned out to be too big for that, so I ended up breaking up the holder into pieces, sanding parts down to size, and then gluing them into the enclosure. It was a messy and time-consuming process which I will not document here. If I was going to advise someone on what to do, I would strongly suggest using 4xAAA NiMH batteries instead, as a battery holder for those cells should easily fit inside the enclosure. Either that or use a bigger enclosure.

The PAM8403 board is connected directly to the batteries. The board accepts 5.5V maximum, so using 4 regular alkaline cells will exceed this level and kill the chip. Therefore only run off 4 NiMH cells, or 3 regular alkaline cells.

With 4xAAs in the enclosure there was only just enough room to fit the circuit into the lid of the enclosure, but I had to use low profile components for most electrolytic caps, and angle other tall parts like the foil caps. I was also fortunate in that the tall trimpot I used fit into the gap between two of the batteries. If I had used AAA batteries instead of AA, then I could have used taller components.

Soldering surface mount components.

The Spin FV-1 is a 28-pin SOIC package, so I bought an SOIC-to-DIP adapter board and a 32-pin header strip (broken into two strips of 14) to effectively convert the board into a DIP package. I had never soldered SOIC components before. If you have never done that before then here are some tips based on my (very limited) experience.

1) Watch videos on how to do it.

2) Use a temperature controlled soldering iron. I used a temperature of 350 centigrade.

3) Use nothing wider than 0.5mm multicore solder. Narrow width solder lets you feed the solder into each joint in a controlled way.

4) Use liquid flux on the board. (I actually didn’t have this, so instead I dissolved some rosin in a drop of methylated spirits, smeared that on the board and let it dry, leaving an invisible but slightly sticky coating of rosin over the pads on the board).

5) Buy desoldering braid. If you bridge pins together by mistake (as I did) just place the braid over the bridge, heat it to wick off the excess solder, and then lift off the braid immediately while it is still hot.

Writing an EEPROM for the FV-1

The FV-1 has some default programs but they are of limited use in this application because the reverb effects will not have the necessary tweaks needed to prevent feedback on an acoustic guitar using a piezo pickup. So it is necessary to supply the FV-1 with custom programs on an EEPROM.

Spin sell an FV-1 development board, but there is a much cheaper way to develop your own programs for the FV-1 and write them to EEPROM. You will need the following:

- The FV-1 development environment. This is free and can be downloaded from Spin.
- Microsoft Windows (since the FV-1 assembler does not run on Linux). I have Windows 7.
- An Arduino compatible board with USB cable.
- The Arduino IDE. This can be freely downloaded.
- A small Arduino program to write data to an EEPROM. This is supplied in the zip file containing this document.

Eight FV-1 programs can be placed into a project file in the Spin software, and the assembler can then build this to a single output *header file* containing all the ROM data.

The small Arduino program takes the data in the header file and writes it to the EEPROM. Note that you do not write the EEPROM while it is in the final product. Instead you make a separate board containing just an 8-pin DIP socket for the EEPROM, and 4 wires connecting the DIP socket to the Arduino. Make sure to read the comments in the code for the Arduino program. They explain how to wire the Arduino to the DIP socket.

If you do not want to learn how to write FV-1 assembler, you can use SpinCAD designer to create assembler code for you, though I have not yet tried this myself, and do not know if it has modules for notch filters and detune effect.

Note: If you just want to create an EEPROM with the program I used in the demo, then you don't even need the Spin software (or Windows). The small Arduino program I wrote already has the header file with the necessary ROM data. So you just need an Arduino compatible board, and the Arduino IDE for whatever platform you have available (e.g. Linux / Mac / Windows).

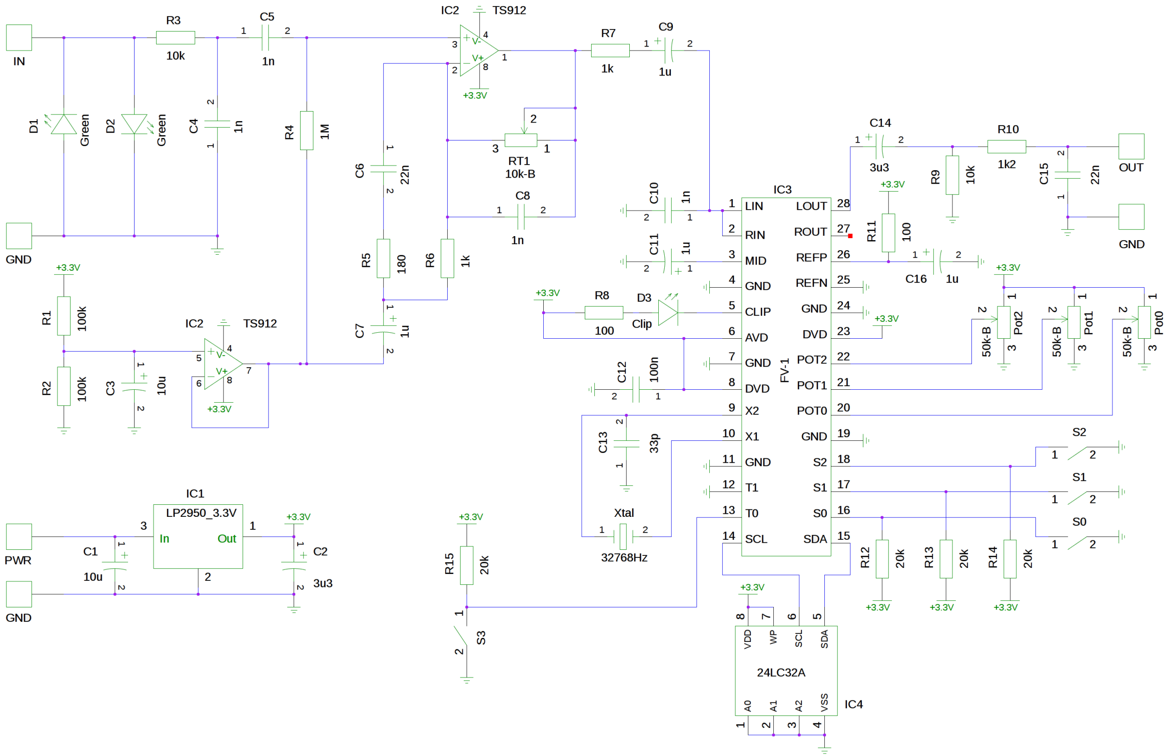
I put the following "*Reverb + Shimmer*" program into the ROM data.

POT0: The first 3/4 of a turn increases reverb time (RT60) from close to zero to about 10 seconds. The remaining 1/4 of a turn then keeps the reverb time at 10 seconds but brings in the shimmer effect.

POT1: This controls the amount of treble in the reverb loop. Suggest leaving this at minimum when using shimmer or else it can sound harsh, but try it out.

I put the same program into all 8 ROM slots so you can leave switches out of your build completely. You could even wire the POT1 to ground, and then have a two pot build (POT0 + the volume control on the class-D amp board).

Schematic

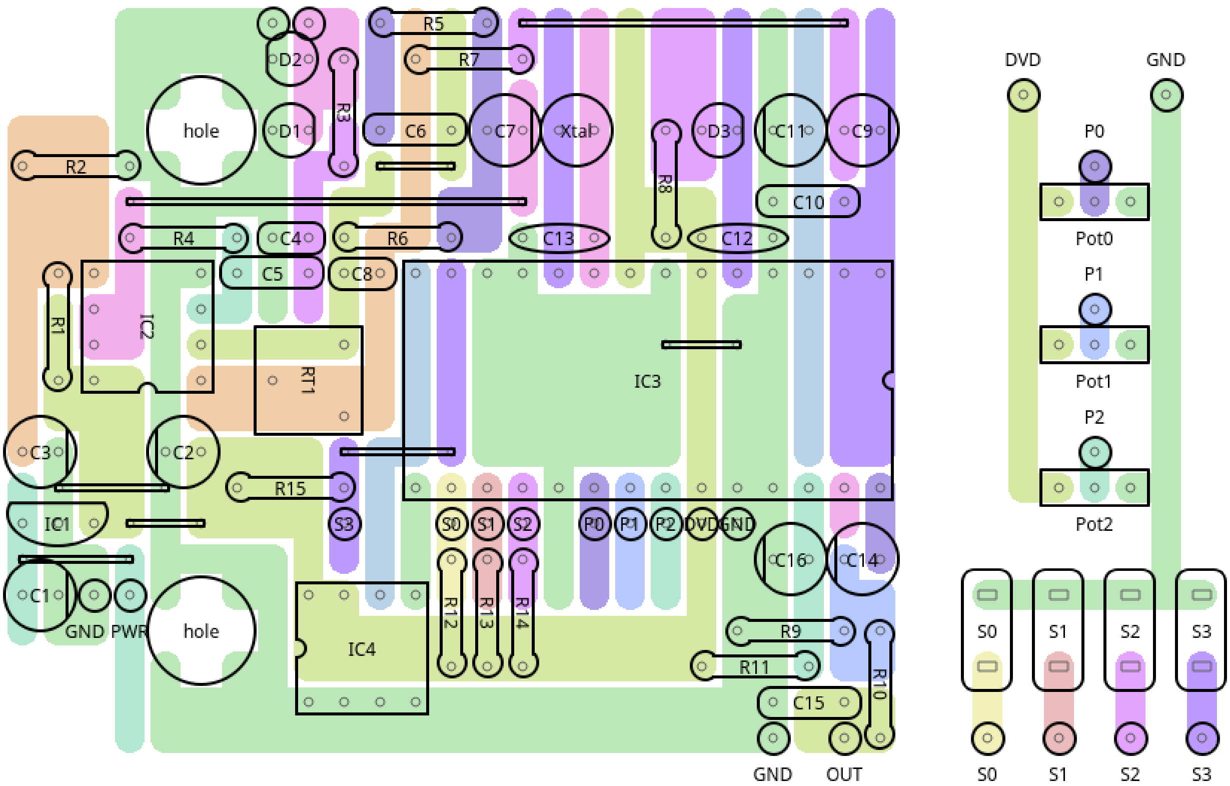


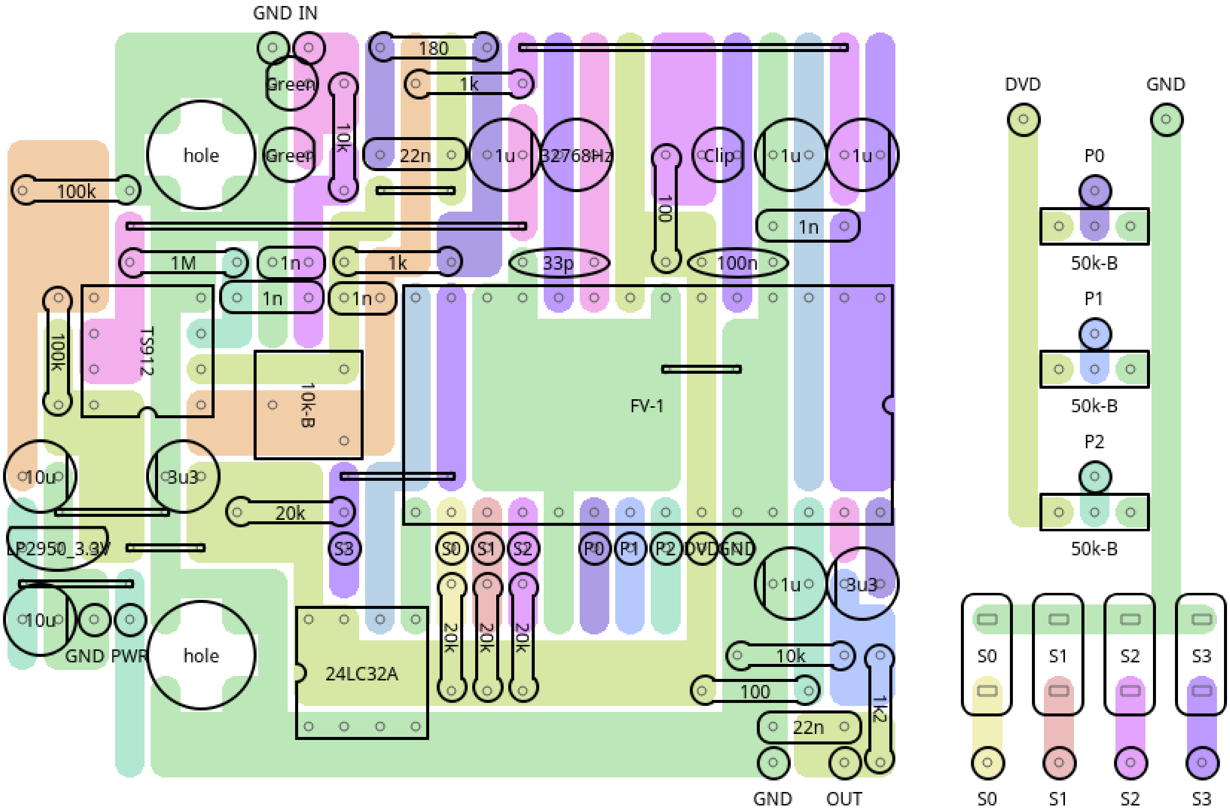
- This is the basic FV-1 circuit from the datasheet with a few modifications. To reduce noise, the opamp circuit applies pre-emphasis at the input of the FV-1 to cancel out the de-emphasis provided by R10 and C15 at the output.
- RT1 sets the input gain to the FV-1. It should be as large as possible without causing the clip diode to light up or the sound to distort. On my build, I found that the correct setting of RT1 for my piezo pickup was about 5k. I also tried a passive single coil Fishman pickup as the input and that needed a larger RT1 setting, more like 10k.
- I had a piezo with no buffer connected directly to the input. Piezos can generate large voltages if knocked, so the two LEDs at the input act as protection diodes for the opamp.
- TS912 is a low-voltage rail-to-rail opamp. Any other opamp capable of running at 3.3V supply will do.
- Any 3.3V regulator with a low drop-out voltage will work for IC1.

- Switch S3 enables you to use the default programs on the FV-1 when the switch is closed. I did not use this switch on my build, but have left R15 on the board in case some people want to wire it to a switch.

Effects Board Layout

Off-board pots and switches are shown to the right. The board has two holes drilled in it so that it can fit into the lid of the enclosure which has stand-offs in those locations. The board does not sit on the stand-offs. The stand-offs pass though it.




GND IN
Green
180
1k
10k
hole
Green
22n
1u
32768Hz
Clip
1u
1u
100k
100
1n
1M
1n
1k
33p
100n
1n
1n
100k
TS912
10k-B
FV-1
10u
3u3
20k
LP2950_3.3V
S3
S0
S1
S2
P0
P1
P2
DVD
GND
1u
3u3
10u
GND PWR
hole
24LC32A
20k
20k
20k
10k
100
22n
1k2
GND
OUT
DVD
GND
P0
50k-B
P1
50k-B
P2
50k-B
S0
S1
S2
S3
S0
S1
S2
S3

The following is a diagram of the back of the veroboard (i.e. a mirror of the previous two images) showing where to make breaks in strips and where to bridge adjacent strips together. To make a break in a strip, I use a sharp blade to make two parallel cuts and then scratch out the copper between the cuts. I make all the breaks before I put any parts in the board. I join adjacent strips together using bare wire on the back of the board.

Parts List

Name	**Type**	**Value**	**Quantity**
R8, R11	Resistor (0.25W)	100	2
R5	Resistor (0.25W)	180	1
R6, R7	Resistor (0.25W)	1k	2
R10	Resistor (0.25W)	1k2	1
R3, R9	Resistor (0.25W)	10k	2
R12, R13, R14, R15	Resistor (0.25W)	20k	4
R1, R2	Resistor (0.25W)	100k	2
R4	Resistor (0.25W)	1M	1
RT1	Trim-pot	10k-B	1
Pot0, Pot1, Pot2	Potentiometer	50k-B	3
D1, D2	LED	Green	2
D3	LED	Red	1
C13	Ceramic	33p	1
C4, C5, C8, C10	Film	1n	4
C6, C15	Film	22n	2
C12	Ceramic	100n	1
C2, C14	Electrolytic (at least 6V)	3u3	2
C7, C9, C11, C16	Electrolytic (at least 6V)	1u	4
C1, C3	Electrolytic (at least 6V)	10u	2
IC1	3.3V LDO Regulator	LP2950_3.3V	1
IC2	Low voltage op-amp	TS912	1
IC3	Reverb IC	Spin FV-1	1
IC5	Serial EEPROM	24LC32A	1

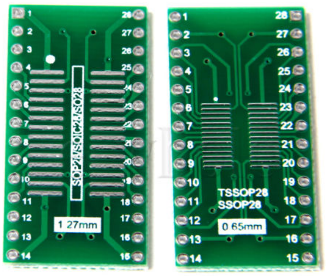
Xtal	Quartz watch crystal	32768Hz	1
S0,S1,S2,(S3)	Single pole switches	SPST/SPDT(on-on)	3 (4)
	28-pin SOIC to DIP adapter board		1
	14-pin header pin strip		2
	Dayton Audio Exciter (4W/4ohm)	DAEX19SL-4	1
	Class-D amplifier board with volume control and switch	PAM8403	1
	Hammond ABS enclosure	1591XXBSBK	1
	Battery holder	4xAAA	1
	6.35mm jack socket		1

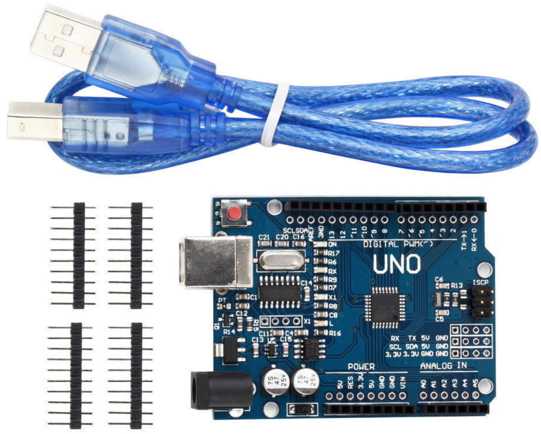
Sourcing parts

I am in the UK but sourced most of my parts from Banzai music in Germany, except for the following eBay purchases. It was cheaper to buy some parts in lots of multiple pieces rather than as single items.

- **Dayton Audio DAEX19SL-4 Slimline Coin Type 19mm Exciter 4W 4 Ohm**
- **2PCS PAM8403 5V 2 Channel USB Power Audio Amplifier Board 3Wx2W Volume CF**
- **2950-3.3 Reg Ldo 3.3V 0.1A TO-92 rs**
- **5pcs SO28 SOP28 SSOP28 TSSOP28 SOIC28 to DIP28 Adapter Converter PCB Board WT**
- **Arduino Uno R3 Rev3 ATMEGA328P Compatible Board FREE USB CABLE & Pins** (Note: An Arduino Nano could have been a cheaper option).
- **MICROCHIP - 24LC32A/P - IC, EEPROM SERIAL 32K, 24LC32, DIP8**
- **1591XXBSBK Black Genuine Hammond ABS Enclosure Project Box (113 x 63 x 28mm)**
- **SODIAL(R) Plastic On/Off Switch 4 x 1.5V AA Battery Case Holder w Cap Black A6J1**
- **5PCS B50K Audio Amplifier Sealed Potentiometer 15mm Shaft 6 Pins with Nuts**


DAYTONAUDIO
daytonaudio.com
DAEX19SL-4 / 4ohm / 4W
BST
billionsound technology


TSSOP28
SSOP28
1.27mm
0.65mm


UNO