

SoundEnhancer

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Chapter 1

SoundEnhancer

1.1 Sound Enhancer For Amiga

The Amiga Sound Enhancer Board Project
(c)1992 David Alan Caruana
Revision D., 8th November 1992

Introduction:

On this disk you have full instructions so as to make a PCB which will enhance your Amiga's sound greatly. The effect of the enhancement is most notable on headphones as the Amiga sounds MUCH nicer !! As an ulterior benefit, you also get a mixer with which you can combine the sound of (say) a synth with that of your Amiga. Any audio source may be input to the AUX input and it gets mixed with the Amiga's sound so you may amplify both simultaneously through one amplifier or record the mixed version onto tape. The other files on this disk are IFF pictures with schematics etc.

Theory of Operation of the Circuit:

The circuit is very simple and is based on the op-amp adder principle i.e. an operation amplifier (op-amp) may be used to add any number of input voltages (analog) with a specified gain. In the circuit, the opamp is capacitively coupled to both input and output circuits so that it may be operated off a single supply (+12V) instead of the split supply (-12V-0-+12V) normally needed by opamps. A reference voltage around 6V is generated by the circuit (using a voltage divider) so that internally, the 'ground' of the circuit is 6 volts above external grounds. This difference is blocked by the capacitors.

The circuit includes proportional input gains (set using potentiometers) and a master-volume control (which is set once using a preset).

Let's Start !!

OK then .. leave electronics theory for the electronics buffs ..
let us start off ..

Firstly:

Before anything, you will need some components. These may be

bought at any reputable electronics store. You will also need some hardware and some test-equipment in case the project doesn't work at once. So ,, here is a list of components :

- Copper clad board , approx 5inches * 5inches
- transfers for straight tracks and pads (these are the type you rub-on using a pencil)
- A good soldering iron , less than 25W power.
- Solder , 40-60 type is preferable.

Now comes the list of components:

POT1-6 Potentiometers , 220Kohms LOG , 6 off
 C1-6 Capacitors , 100nF ceramic , 6 off
 C7-10 Capacitors , 100uF electrolytic , 4 off
 C11,12 Capacitors , 10uF electrolytic , 2 off
 R1-6 Resistors , 220 KOhms , 6 off
 R7-10 Resistors , 8.2 KOhms , 4 off
 R11,12 Resistors , 470KOhms , 2 off
 PR1,2 Presets , horizontal , 5KOhms
 IC1,2 Semiconductors : CA3140E op-amps
 IC Sockets : 2 * 8-pin
 Connectors Female-phonon panel-mount sockets 6 off

Components for power-supply

TR1 Miniature transformer 240V -> 12V
 D1-4 Diodes, 1N4001, 4 off
 Capacitor, 1000uF 16V electrolytic
 Capacitors 100nF ceramic , 4 off
 IC3 Semiconductor : 7812 regulator
 SW1 Switch, SPST or SPDT

NOTE: uF means 'microfarads' throughout.

If you want to add a power-led (to show power on) also buy:

LED1 5mm LED , any color
 Res. 1 KOhm

NOTE: All resistors are 1/4 watt.

You will also need a few metres of single-strand wire to make connections from the board to outside components.

If you are going to case the project, buy a box min. 8 inches by 6 inches.

Lastly, you will need ferric chloride solution to etch the PCB. Ferric chloride may either be bought ready-mixed as a solution or in crystal form. In the latter case, mix into a solution as directed.

MAKING THE PCB:

Now the real work starts

The circuit to be built is that in Sheet 1. The circuit is not complete, as some other modifications are needed to make the full project. A layout for the PCB is shown in sheet 2. This is already in mirror-image (you have to this, otherwise the pinout

of the IC's comes out the wrong way round!!) so you may copy it directly onto PCB.

Using Transfers:

If you are using a 'standard' copperclad PCB and transfers work as follows:

Locate the approximate positions of the IC's and start by laying out transfers for them (remember, each IC has 8 pins)

Next start copying out the tracks away from the IC's. It is important to keep to the scale of the layout shown, otherwise the PCB might not fit in correctly. Remember to rub down transfers firmly with a blunt pencil.

If you fix a transfer in the wrong place, this may be lifted off using a sharp craft knife or a scalpel. If the transfer overlaps other correctly-placed transfers then cut around the good transfers and then scratch away from them.

When you have placed all the transfers, you may proceed to etch the PCB. While the PCB is under the ferric chloride, agitate the solution every now and then. Etching takes between 30 minutes and 1 hour depending on the strength of the solution and how long it has been used.

Using Optical-PCB:

If you are lucky enough to have a UV source for PCB exposure, you may print out the layout and then photocopy-it onto transparency. It should then be 'burnt' into optical board using the UV source, fixed and etched.

Drilling the Board:

Using the component layout sheet (sheet 3) as a guide drill 1mm holes for all the components. For the presets drill 1.5mm as the 1mm holes are not wide enough. If you are going to mount the potentiometers on the PCB (to save boxing the project!!) drill 1.5 mm holes for them too. Note that the potentiometers must be PCB-mounting in this case. Always drill from the solder side (where the tracks are) toward the component side (the other side!!).

Soldering Components:

Use sheet 3 (component layout) as a guide while soldering components. Keep components as close to the board as possible so as to avoid noise. Capacitors should be of the vertical type as these fit snugly on the close pads as in PCB. Resistors may be soldered in a horizontal position. If you are making a box to house the circuit, don't solder in the variable resistors yet. Solder in the IC sockets with the notch pointing in the correct direction ('up' in my diagrams) and then insert the IC's. Remember to insert them correctly otherwise they will be fried as soon as you switch on the power. Be very careful to solder the electrolytic capacitor with correct polarity. In sheet 1, the capacitors with both plates black are non-electrolytic and may be soldered in any direction. The electrolytic caps have the negative plate black and the positive white. The 100 microfarads

on the potential divider (near pin 3 on the IC) is of VITAL importance so do not leave it out on any account !!
Lastly a note about jumpers J1-4. These are simply wire-links. It is best to use cut-off component leads to do the job. Any pair of them may be substituted by a DPDT switch which gives the option of switching the sound enhancement off and using the circuit as a two-channel stereo mixer.

External Components:

When all the components have been soldered in proceed to solder leads for the external components. The connection diagram in Sheet 4 should help you in doing this. It is important that the potentiometers 'open' in a clockwise direction, otherwise operation of the mixer will be very unlogical.

Note that the six potentiometers have the following functions:

Pot1 : Amiga LEFT channel strength
Pot2 : Amiga right channel thrown onto left output (enhancer)
Pot3 : Auxiliary input LEFT channel strength
Pot4 : Amiga RIGHT channel strength
Pot5 : Amiga left channel thrown onto right output (enhancer)
Pot6 : Auxiliary input RIGHT channel strength
PR1 : Master LEFT volume
PR2 : Master RIGHT volume

Remember to connect together the ground tags of all the inputs together with the ground of the circuit board. The ground connections of the potentiometers are taken care of by the PCB.

Putting it all together:

All that is left now is to drill holes in the casing so that you may stick in the potentiometers and input/output jacks. Put the potentiometers on the front panel and the sockets at the back. Also make a hole for an SPST switch which will be the power-switch. If you are using the option to use enhance on/off (see the 'soldering components' section) make a hole also for the enhance switch. If you are building a mains power-supply (very much recommended) leave place within the box where to stick the transformer and add a mains socket on the back-panel. The regulator PCB should be very small and is not a problem in itself.

Making the PowerSupply:

A good, cheap and easy-to-build regulator circuit is shown on sheet 5. Making a PCB for it should be very easy and it is easier still to use a piece of veroboard. Note the connections of the IC!

Operating the Powersupply:

Plug the transformer to the mains via a 400mA fuse. You should get an accurate 12V output at the output of the regulator and using a multimeter you can measure about 15V AC at the terminals of the transformer. Install the power-switch on the low-voltage side of the system. When the power is 'off' the transformer will still be connected to the mains but the amount of power it takes is very minimal. Be careful to disconnect the circuit from the mains when you are working on it .. remember .. mains can KILL!!

Adding a Power LED:

Take a lead just after the power-switch and connect the LED in series with a 1kohm resistor to ground. Make a 5mm hole in the front panel and stick the LED in with some adhesive.

Testing the Mixer:

Connect the Amiga to the amiga inputs of the mixer.

Set the output presets to full.

Connect the output to a hifi amplifier

Switch on the system.

With the Amiga showing the 'Insert Workbench' prompt, the amplifier should be silent with at most a slight hum if you crank up the volume to maximum.

Turn up the channel 1 (Amiga) gain controls slowly and no change should happen to output. The same applies for channel 2. If channel 3 is not connected it may produce a hum when turned up. This will vanish as soon as an input is connected. For the moment leave channel 1 on max. gain , channels 2 and 3 off.

Load a program on the Amiga with music.

The signal coming from the mixer should be clear (similar to the normal Amiga sound) but stronger. Adjust the presets until both the left and right outputs are at the normal Amiga output levels. Now turn up the channel 2 gain controls to Maximum. The Amiga should now be heard as MONO. (hear it on a headphones and the full sound should be heard on both left and right speaker). Using a VU-Meter display or a headphones and your hearing, adjust the stereo centering using the output preset potentiometers. Now turn the channel 2 potentiometers to mid-track. The signal you are hearing now is stereo but not as separated as the original Amiga signal so it sounds much better on headphones.

Try connecting an input to channel 3 and turn up the gain controls. Both the now input and the Amiga should now be heard simultaneously.

At this point , all should be working 100%

If it doesn't work:

Switch off the mains supply and short the regulator output to discharge its capacitors. Now pull the IC's out of their sockets and check the following connections:

Pin 3 - Ground = 8.2K

Pin 3 - Supply = 8.2K

Pin 4 - Ground = Short Circuit

Pin 4 - Supply = Open Circuit

Pin 7 - Supply = Short Circuit

Pin 7 - Ground = Open Circuit

Pin 2 - Pin 6 = 470K

Connect the powersupply and measure the following voltages relative to ground ...

Pin 3 - 6 Volts (or very near)

Pin 4 - 0 Volts

Pin 7 - 12 Volts

All other pins : 0 Volts

If these are not OK recheck the circuit thoroughly,

If there ARE OK then you have either a burnt component or a cut track on the PCB .. Some patience is in order here !! Check each track with a multimeter and then compare values in the tow circuits (left and right). Check that power is coming. Try calculating resistance values off the circuit diagram and measuring them in practice until you locate the fault.

Contact Me:

I would like contacts interested in the Amiga, Electronics, Engineering, Programming, KCS Power PC Board and Music.

I am a second-year engineering student at University.

Addresses:

Snail Mail-

"Blossom",
Acacia Str,
San Gwann SGN03
M A L T A

EMail (internet)

dac%panther@carla.dist.unige.it

Licence

You may use this circuit freely provided :

- if you build it and you like it PLEASE send me a note. I am not asking for any money so a few pence spent on a stamp should be enough.

- If you would like to send me something, PD software will do fine!!

----- THE --- END -----

This doc. typed on 9-11-1992 , time now is 0037 hrs.

I am using Wordworth 1.0 on the following system :

- Amiga A500 with v2.04 ROM
- 1 Meg chip + 2 Megs fast
- 105 Meg Quantum harddisk with Commodore controller
- KCS Power PC-Board
- Star LC10 Color printer
- Ext. floppy drive
- Trilogic Midi Interface
- Yamaha PSS795 MIDI synthesizer

Also connected to the system are

- An Atari 520STFM
 - Sansui A1000 40W * 2 hifi amplifier
 - Pair of home-built speakers with Eunex 7" woofers and Motorola 3.5" piezo tweeters.
 - Fisher AD-9020 CD-Player
-

- TEC 2377PP 3-in-1 hifi system with TEC speakers and 2*50W PMPO output.
- Hitachi B/W television (13")
- a pair of Philips headphones ...

that should be about all of my system ..

If you write, state yours !!

My Amiga is now 3 years old and the Atari ST is 7 years old (!!)

OK then .. bye and goodnight from David Alan Caruana ...

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