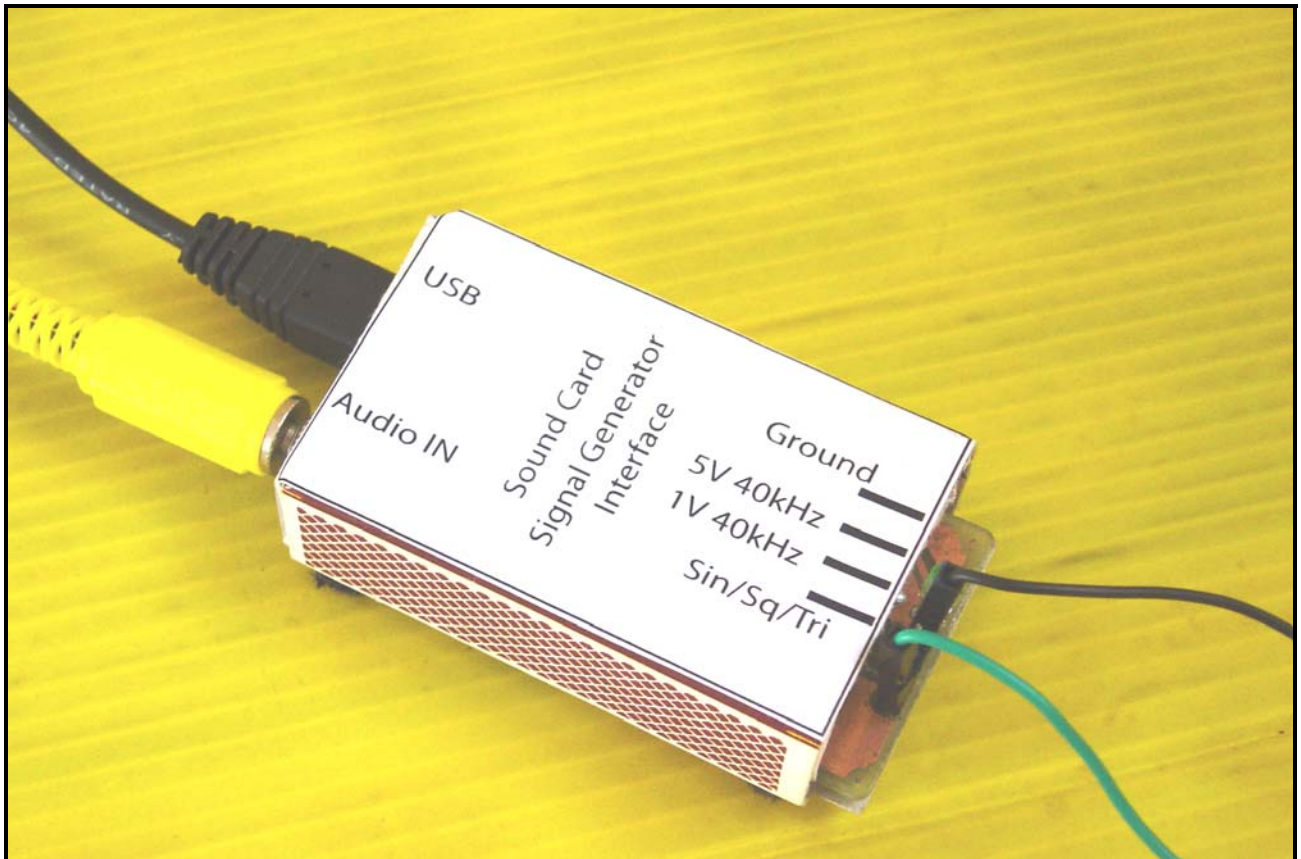


Aj_SoundCard

Sound Card Interface



Technical Manual

1. Introduction:

This is a brief manual containing relevant technical data required for understanding construction and use of the Aj_SoundGen_SigGen 'PC Sound card interface'.



Figure 1 Aj_SoundGen_SigGen PC Sound Card Interface

This unit is designed as a teaching aid for budding engineers, electronic enthusiasts and hobbyists.

The Aj_SoundGen_SigGen unit is connected to the PC audio output and draws power through an USB connector. This unit overcomes the basic limitations of AC coupling and $\pm 2V$ signal level limit of the audio output and implements a simple circuit providing a fixed gain and a variable offset of typically $\pm 5V$ at the signal generator output.

2. Warning & Disclaimer:

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3. Specifications

Input		
No of Channels	Two	Audio Left/Right
Input impedance	10 kilo Ohm	
Input connection	3 mm Audio Jack	
Output		
Sin/Square/Triangle	Gain 5.5	
Offset	$\pm 5V$	
Aux out1	1V Sq 40kHz	
Aux out1	5V Sq 40kHz	
Sampling Rate	44 kbps	
PC Software	VB.Net 2.0	
Power Supply	USB +5V	20mA

4. Block Schematic and Function Description

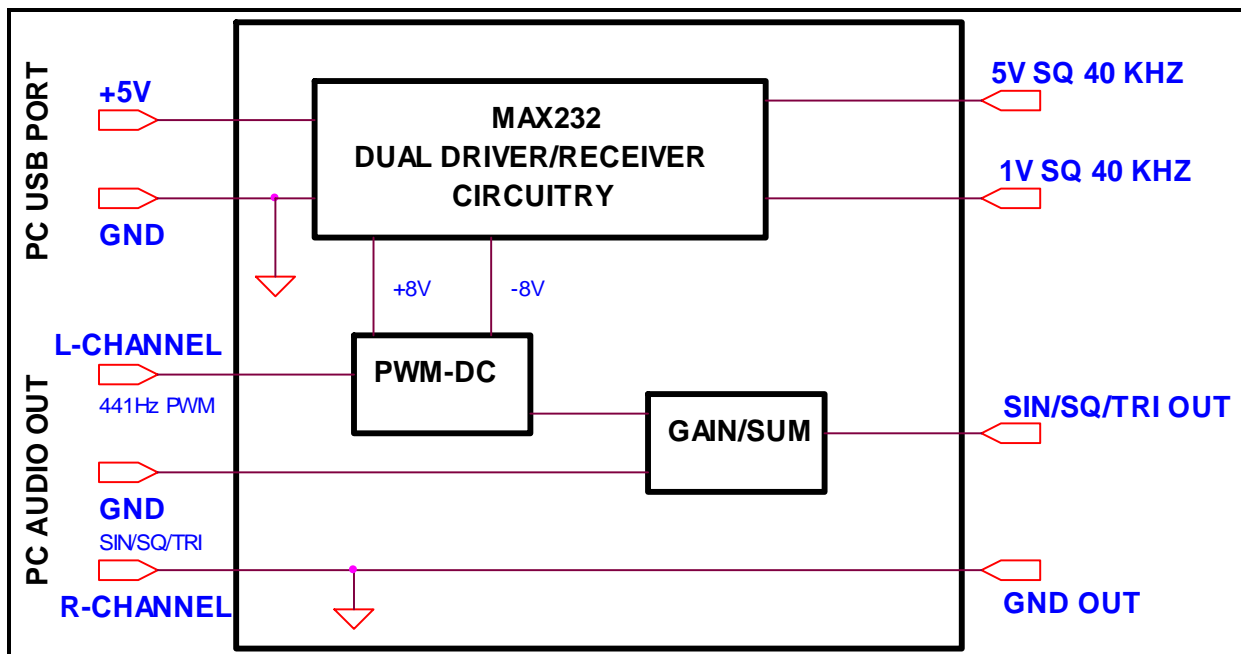


Figure 2, Aj_SoundGen_SigGen simplified block schematic

Figure 2 shows the simplified block schematic of the system. The USB +5V is fed to the MAX232 dual driver/receiver which carries out several functions:

- Generation of generates +8V and -8V supply for the op-amp circuitry
- Conversion of TTL level PWM to $\pm 8V$ level
- Generation of 40 kHz aux outputs

The Left-Channel outputs a 441 Hz PWM signal which when converted to TTL and fed to the Max 232 provides a $\pm 8V$ level PWM which is averaged to provide a DC offset signal.

The Right Channel provides the Sin/Square/Triangle signal from the PC which is amplified by 5.5 and summed with the DC offset signal to form the Aj_SoundGen_SigGen output.

5. Software on the PC Host:

Microsoft Windows based GUI software has been developed which interfaces with the internal sound-card of the PC and provides the audio-outputs to the Aj_SoundGen_SigGen via the speaker port.

Visual Basic .Net Microsoft Windows Application Code



Figure 3, Aj_SoundGen_SigGen icon MS Windows

GUI VB.Net 2.0:

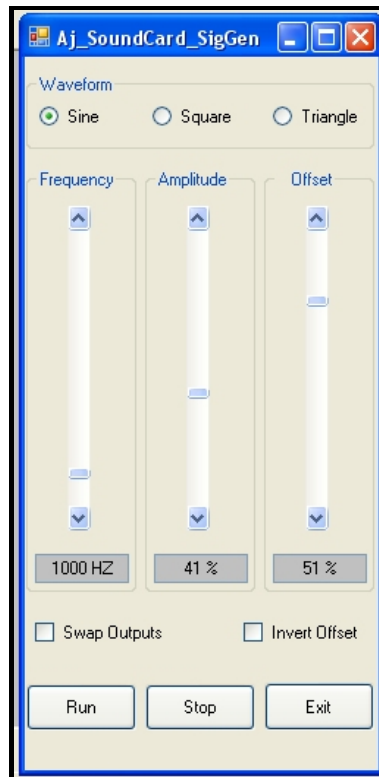


Figure 4, Aj_SoundGen_SigGen GUI

A simple GUI is used to control the PC sound-card outputs and indirectly the Aj_SoundCard_SigGen.

Once the Aj_SoundCard_SigGen USB and Audio connector are connected and the PC sound card enabled with maximum volume:

- Three Radio-Buttons select the type of waveform
- The first slider sets the signal generator frequency
- The second slider sets the amplitude of the chosen waveform
- The third slider controls the duty-cycle of the 441 Hz PWM which controls the DC offset.
- The RUN ,STOP and EXIT buttons are self explanatory

To ensure compatibility with different sound-cards:

- The swap-output check-box swaps the L/R channels if required
- And the Invert-Offset check-box inverts the polarity of the 441 Hz PWM.

6. Aj_SoundCard_SigGen Unit:

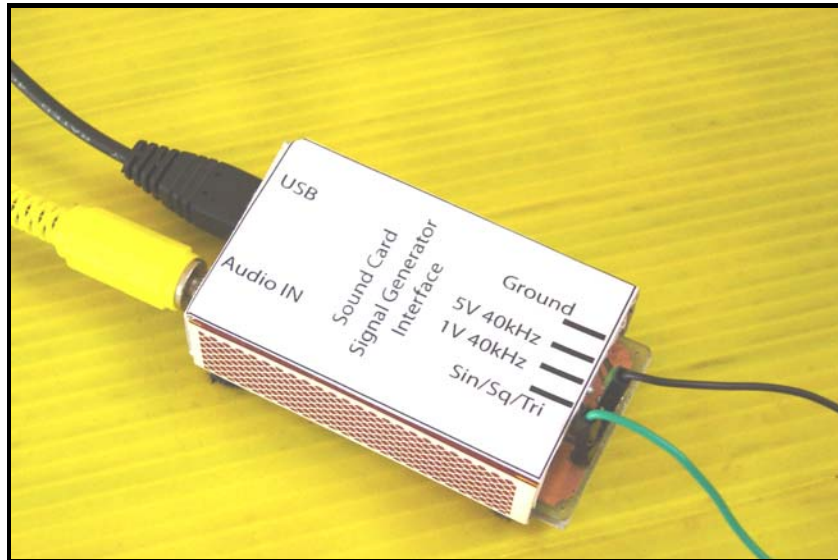


Figure 5, Aj_SoundGen_SigGen UNIT

In order to economize on the cost of an enclosure the circuitry has been designed to fit within a small matchbox.

The USB connection to the PC is on one end along with the Audio-Jack for the audio-signal input. The outputs are provided on the other side along with a power-ON LED.

7. Functional Description:

PC sound cards form a readily available Signal Generator for testing electronic circuits. The utility of these signal generators is limited because the outputs are AC coupled and limited to $\pm 2V$.

Taking advantage of the two channels provided by the sound card the circuit uses one channel to output the Sin/Square/Triangle waveform with a fixed gain, while setting up a 441 Hz PWM square wave on the second channel. This PWM waveform is converted to $\pm 8V$ averaged and summed with the first channel to provide a DC offset controllable by the duty-cycle setting.

The circuit in **Figure 6** provides a variable offset of typically $\pm 5V$ at the signal generator output.

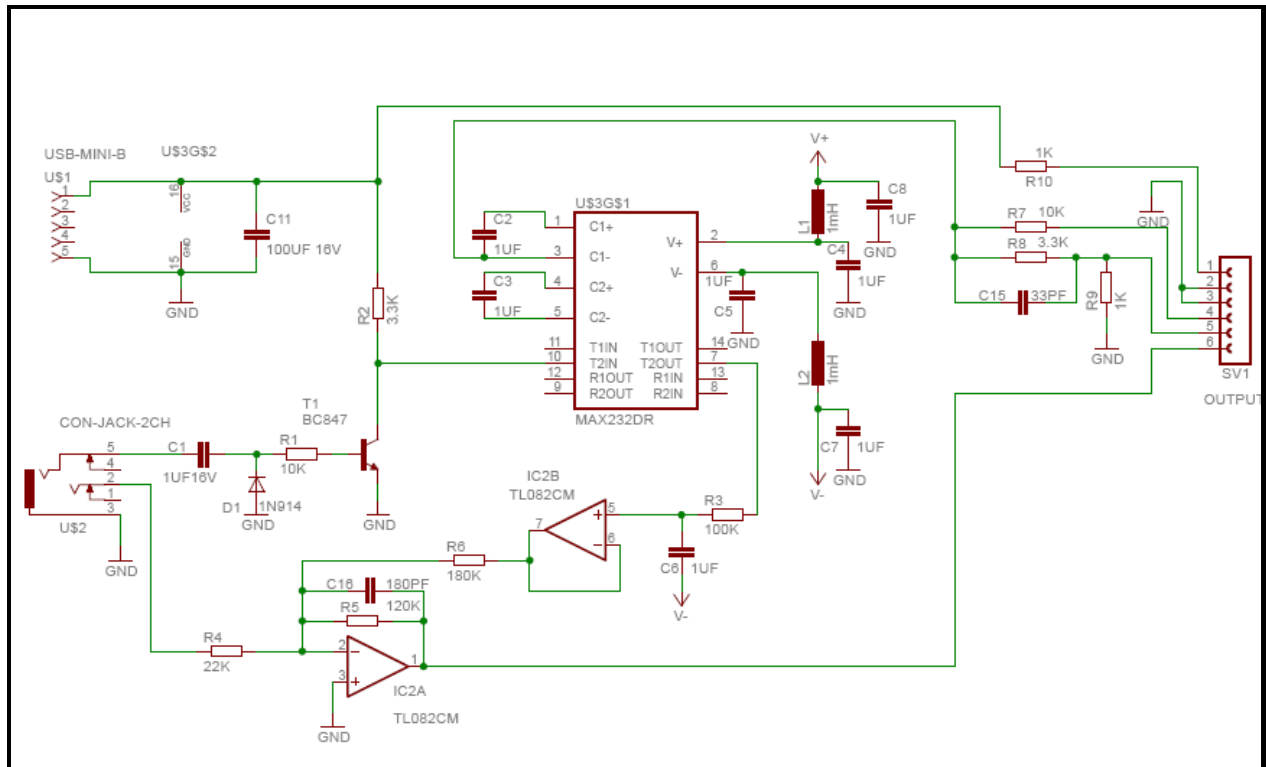


Figure 6, Aj_SoundGen_SigGen Schematic

The circuit is powered from the PC USB +5V supply which is converted by the capacitive voltage generator within the MAX232 dual driver/receiver IC, U1 to typically $\pm 8V$ to power the TL082 low power op-amp, U2. L1/C8 and L2/C7 filter out the ripple on the V+ and V- outputs of U1. The 441Hz PWM waveform output on the sound-card left-channel is clamped by C1/D1 and fed through R1 to the base of T1. This produces a TTL compatible square wave at the collector of T1 which is fed to the T2IN of U1. T2OUT is a $\pm 8V$ PWM waveform which is averaged by R3/C6 and buffered by U2B to generate a DC voltage depending on the PWM duty-cycle. This voltage is summed along with the Sin/Square/Triangle waveform output on the sound-card right-channel by U2A and forms the signal generator output. C16/R5 forms a low-pass filter to smoothen the quantized signal generated by the sound-card. With the values of the components shown the right-channel is amplified by a fixed gain of 5.5 and the DC offset variation is typically $\pm 5V$.

Figure 7 illustrates the circuit operation. The 75% duty-cycle PWM input signal is converted to typically $\pm 8V$ at T2OUT and when averaged produces $\sim 4V$ DC at Pin7 of U2B. The 0.5V sin-wave is amplified and offset by the inverting summing amplifier U2A to form the signal generator output.

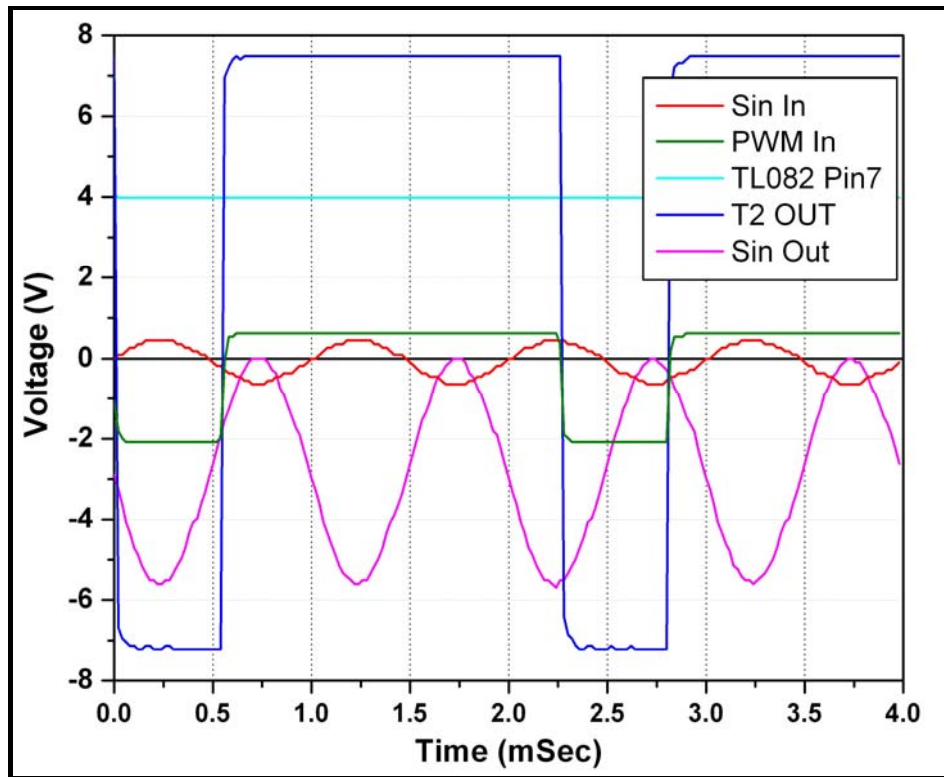


Figure 7, Aj_SoundGen_SigGen Waveforms

This circuit while removing the limitations of AC coupling and $\pm 2V$ signal level limit provides a bonus output by potential dividing the C1- output of U1 using R1/R2 to provide a 1V, 40 kHz square wave which can be used for step response testing of analog circuits.

8. Bill of materials:

SI.No.	Qty	Value	Package	Parts
1.	2	1K	R0805	R9, R10
2.	1	1N914	DIODE-SOD323-W	D1
3.	7	1UF	C1210	C2, C3, C4, C5, C6, C
4.	1	1UF16V	C1210	C1
5.	2	1mH 35mA	C1812	L1, L2
6.	2	3.3K	R0805	R2, R8
7.	2	10K	R0805	R1, R7
8.	1	22K	R0805	R4
9.	1	33PF	C0805	C15
10.	1	100K	R0805	R3
11.	1	100UF 16V	C1812	C11
12.	1	120K	R0805	R5
13.	1	180K	R0805	R6
14.	1	180PF	C0805	C16
15.	1	BC847	SOT23	T1
16.	1	CON-JACK-2CH	CON-JACK-2CH	U\$2
17.	1	TL082CM	SO08	IC2
18.	1	MAX232DR	SO16	U\$3
19.	1	OUTPUT	FE06-1	SV1

9. Printed Circuit Boards:

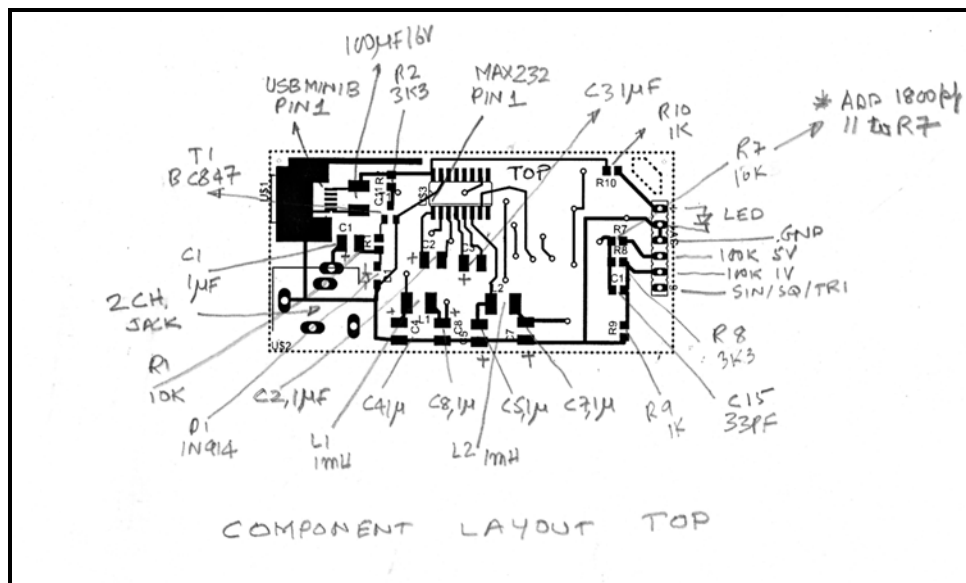


Figure 8, Component layout Top

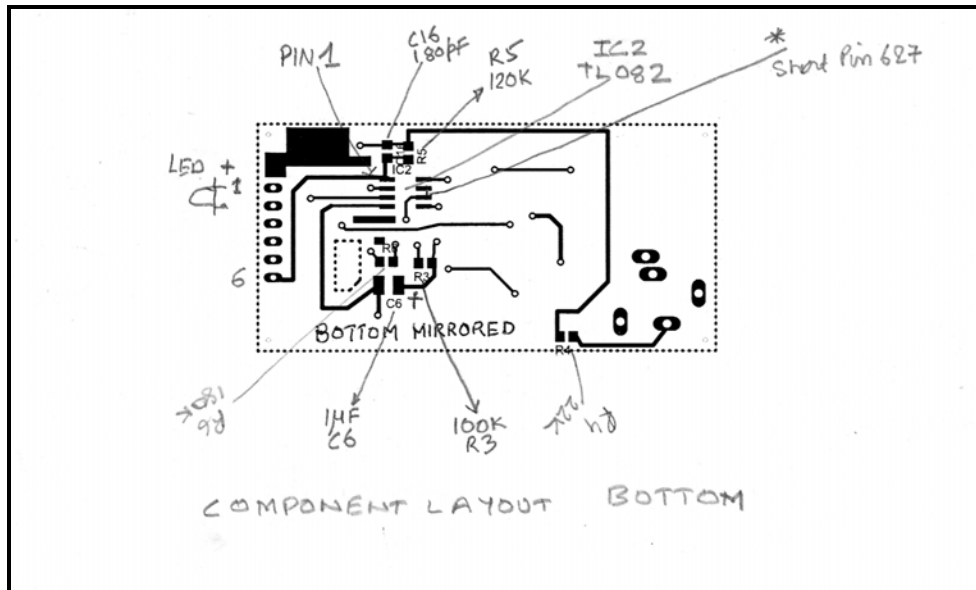


Figure 9, Component layout Bottom

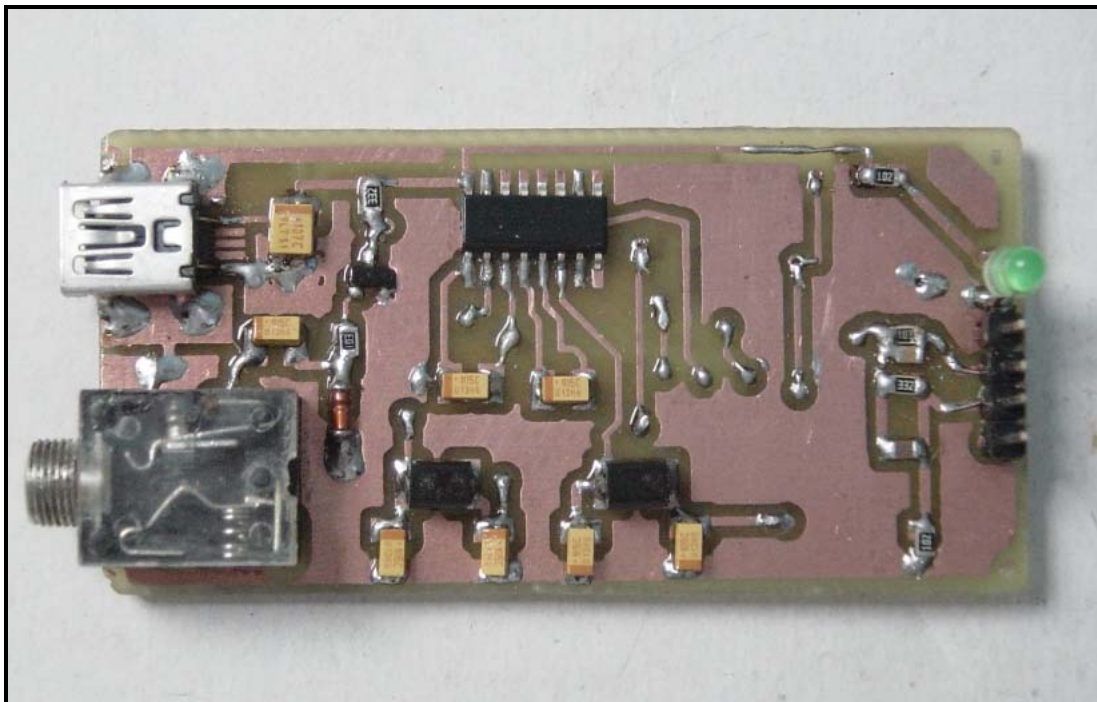


Figure 10, Wired PCB Top

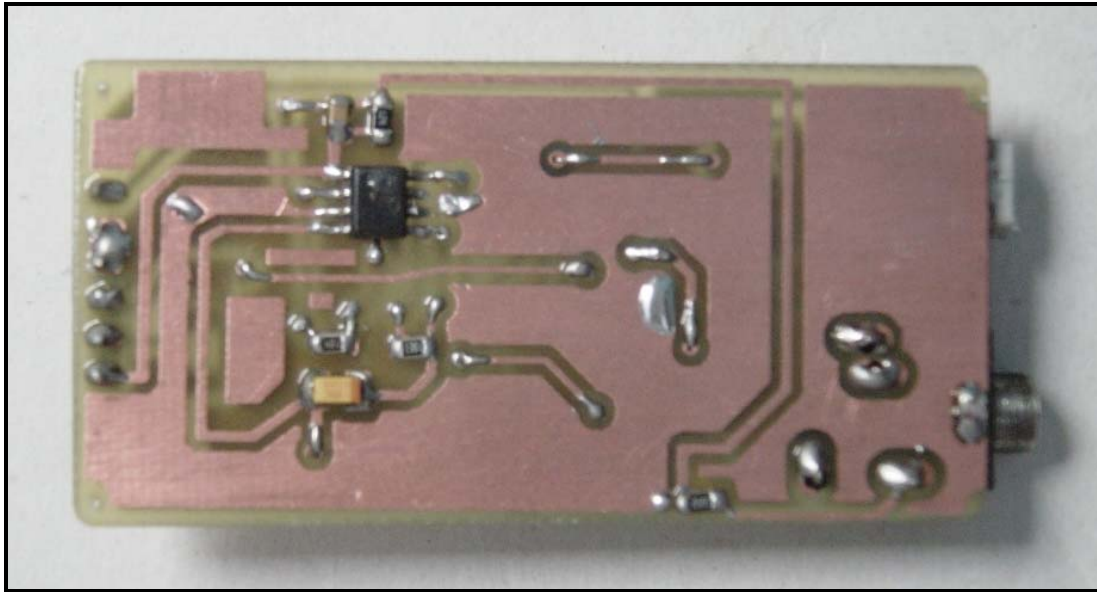


Figure 11, Wired PCB Bottom

10. Appendices

- Schematic Colour
- Schematic B&W
- PCB 1:1 A4 Top mirrored
- PCB 1:1 A4 Bottom

11. Summary

This document provides essential information for fabrication and operation of the Aj_SoundCard_SigGen unit.

Software and Gerber Files can be downloaded from my website

<http://www.ajoyraman.in>

Address any doubts and clarifications to me at ajoyraman@gmail.com

