Aj-Signal-Generator-and-Power-Supply

Technical Manual

www.ajoyraman.in

1. Introduction:

This is a brief manual containing relevant technical data required for understanding, construction and use of the Aj-SigGen-PS unit.

This unit is designed to compliment the Aj-Simple-Scope and serve as a teaching aid for budding engineers, electronic enthusiasts and hobbyists.

This USB connected unit implements a microcontroller based DDS Signal Generator providing Sin and Triangular waveforms with adjustable magnitude and offset up to 50 kHz. TTL and 1 V square waves are simultaneously provided. Additionally ± 12V and a variable +2 to 7V output with a total capacity of 1W are provided to power external circuits under test.

2. Warning & Disclaimer:

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3. Block Schematic and Function Description

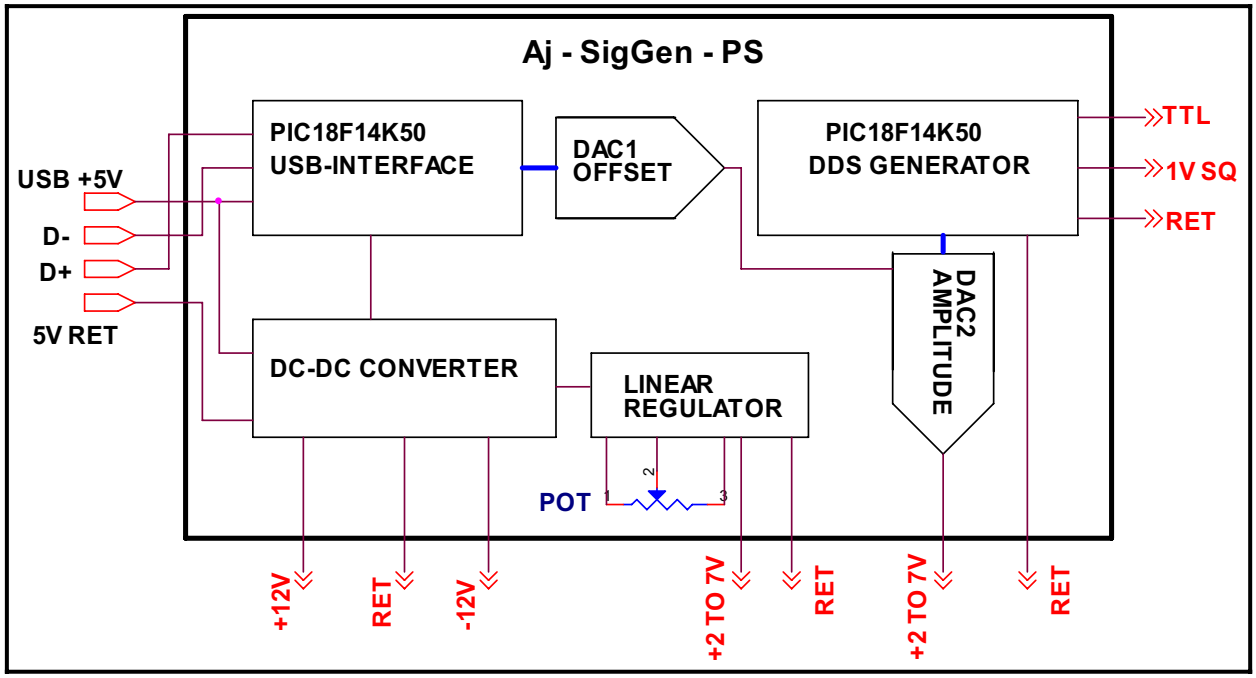


Figure 1, Aj-SigGen – PS simplified block schematic

Figure 1 shows the simplified block schematic of the system. For ease of portability the unit is powered and controlled from the USB port of a PC.

Two PIC18F14K50 microcontrollers are used to provide the functionality of the unit.

The first PIC microcontroller implements the following functions:

- Communicates with the host PC for enumeration as a USB to UART device
- Sets up the unit as a 500mA device
- Switches on power to the DC-DC converter
- Provides the complimentary square wave drive to the DC-DC converter
- Acts as a USB communication interface to the second PIC
- Provides the Amplitude reference for DAC2
- Provides the digital word for DAC1 giving the offset value.

The second PIC microcontroller implements the remaining DDS functions

- Direct Digital Synthesis (DDS) signal generation
- Sin/ triangle word output to DAC2
- TTL and 1 V square reference output

The DC-DC converter is a driven 1W, 5V to ± 12V operating at 100 kHz. The +12 V output is fed to a linear regulator to provide a variable +2 to 7 V output controlled by a variable potentiometer.

The DC-DC converter provides full protection to the host PC USB port as its outputs are short circuit and current limit protected.

The circuit under test can be rigged up on a standard breadboard and powered from the power sockets provided.

4. Software on the PC Host:

A Visual Basic .Net 2.0 based GUI program is used to control the functions of the Aj-SigGen – PS unit. An Aj_SigGen.exe along with associated USB driver files has been tested for compatibility with Windows XP and Windows 7 with .net 2.0.

5. GUI:

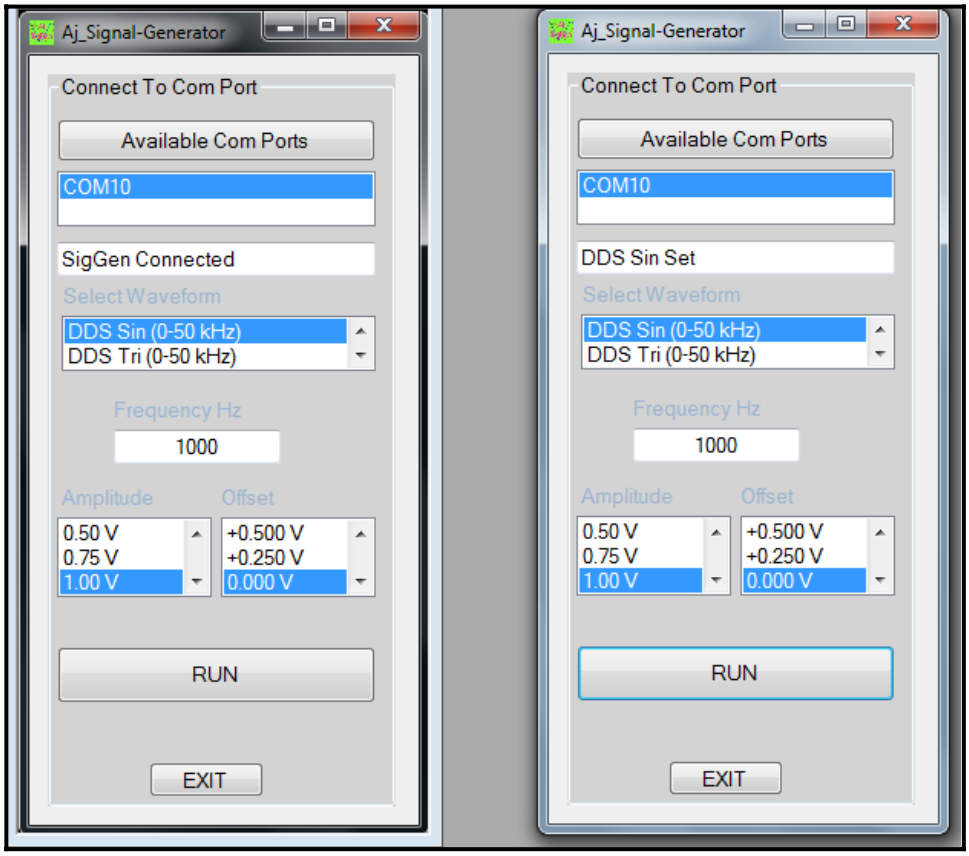


Figure 2, GUI

The GUI based Windows software on the Host PC permits checking for available COM ports and connecting to the port on which the hardware is connected.

Once connected the hardware unit responds with a ready signal.

Waveform type, frequency, amplitude and offset can be set using the simple controls.

The RUN button initiates the signal output and indicates the waveform set.

An EXIT button is provided to close the program and exit.

6. Aj-SigGen-PS Unit, Front and Rear Panels:

Figure 4, Showing Aj-SigGen-PS Unit

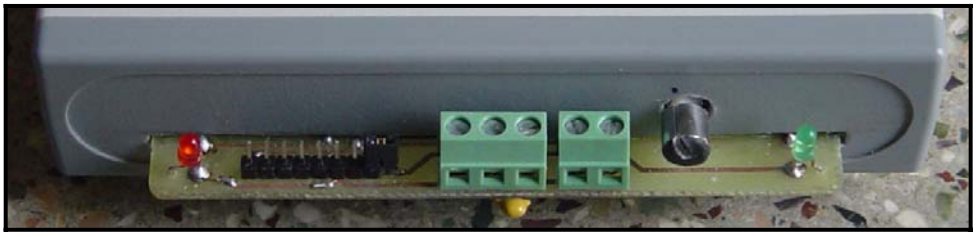


Figure 4, Front panel showing connectors, LED's and Potentiometer

Figure 5, Rear panel showing USB connector and Reset switch

7. Circuit Diagrams:

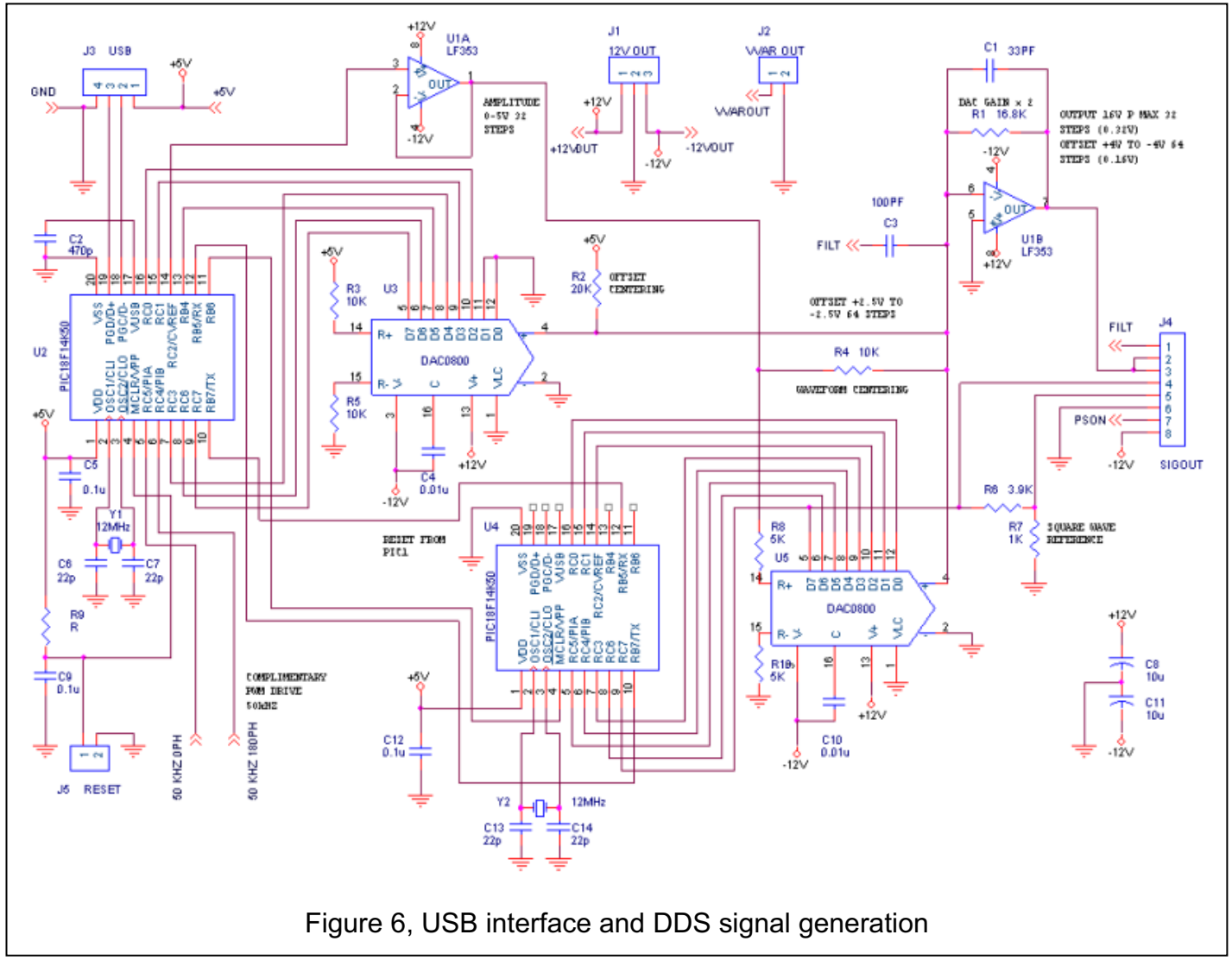


Figure 6, USB interface and DDS signal generation

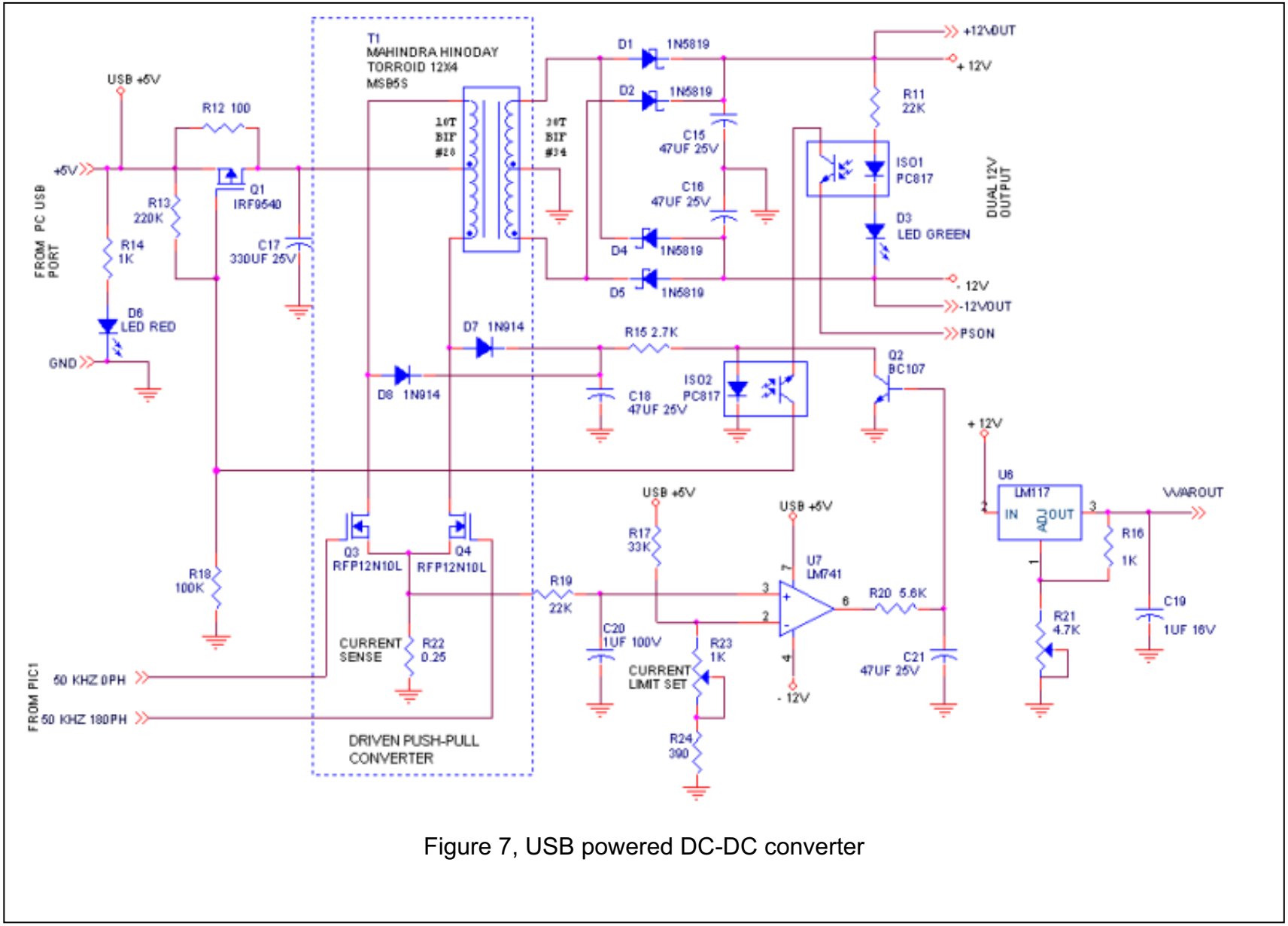


Figure 7, USB powered DC-DC converter

8. Bill of materials

Aj-SigGen-PS BILL OF MATERIALS COSTING

Item	Quantity	Reference	Part	Cost INR	Extended Cost
1	1	C1	33PF	0.50	0.50
2	1	C2	470p	0.50	0.50
3	1	C3	100PF	0.50	0.50
4	2	C4,C10	0.01u	0.50	1.00
5	3	C5,C9,C12	0.1u	0.50	1.50
6	4	C6,C7,C13,C14	22p	0.50	2.00
7	2	C11,C8	10u	1.50	3.00
8	4	C15,C16,C18,C2	47UF 25V	1.50	6.00
9	1	C17	330UF 25V	1.50	1.50
10	1	C19	1UF 16V	1.50	1.50
11	1	C20	1UF 100V	1.50	1.50
12	4	D1,D2,D4,D5	1N5819	1.00	4.00
13	1	D3	LED GREEN	1.00	1.00
14	1	D6	LED RED	1.00	1.00
15	2	D7,D8	1N914	0.50	1.00
16	2	ISO2,ISO1	PC817	4.00	8.00
17	1	J1	12V OUT	6.00	6.00
18	1	J2	VVAR OUT	4.00	4.00
19	1	J3	USB	8.00	8.00
20	1	J4	SIGOUT	8.00	8.00
21	1	J5	RESET	4.00	4.00
22	1	Q1	IRF9540	27.00	27.00
23	1	Q2	BC107	7.00	7.00
24	2	Q4,Q3	RFP12N10L	51.00	102.00
25	1	R1	16.8K	0.20	0.20
26	1	R2	20K	0.20	0.20
27	3	R3,R4,R5	10K	0.20	0.60
28	1	R6	3.9K	0.20	0.20
29	4	R7,R14,R16,R23	1K	0.20	0.80
30	2	R8,R10	5K	0.20	0.40
31	1	R9	10K	0.20	0.20
32	2	R19,R11	22K	0.20	0.40
33	1	R12	100	0.20	0.20
34	1	R13	220K	0.20	0.20
35	1	R15	2.7K	0.20	0.20
36	1	R17	33K	0.20	0.20
37	1	R18	100K	0.20	0.20
38	1	R20	5.6K	0.20	0.20
39	1	R21	4.7K	0.20	0.20
40	1	R22	0.25	0.20	0.20
41	1	R24	390	0.20	0.20
42	1	T1	TRANSFORMER	20.00	20.00
43	1	U1	LF353	5.00	5.00
44	2	U4,U2	PIC18F14K50	230.00	460.00
45	2	U3,U5	DAC0800	35.00	70.00
46	1	U6	LM117	68.00	68.00
47	1	U7	LM741	5.00	5.00
48	2	Y2,Y1	12MHz	5.00	10.00
49	1	PCB	Aj_SigGen_PS	100.00	100.00
50	1	ENCLOSURE	GIANTA 1814	184.00	184.00
				TOTAL COST INR	**1,127.30**
				TOTAL COST $	**20.50**

9. Printed Circuit Boards :

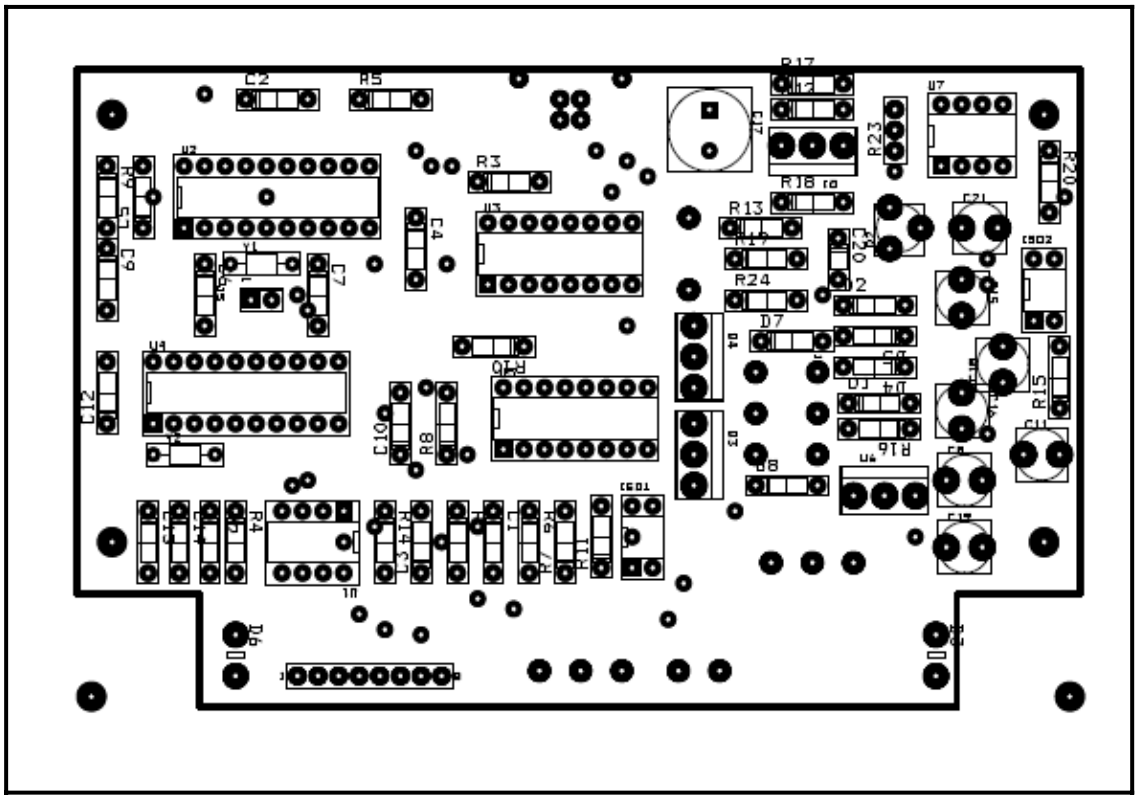


Figure 8, Component Layout

Figure 9, Wired PCB top view

10. Appendices

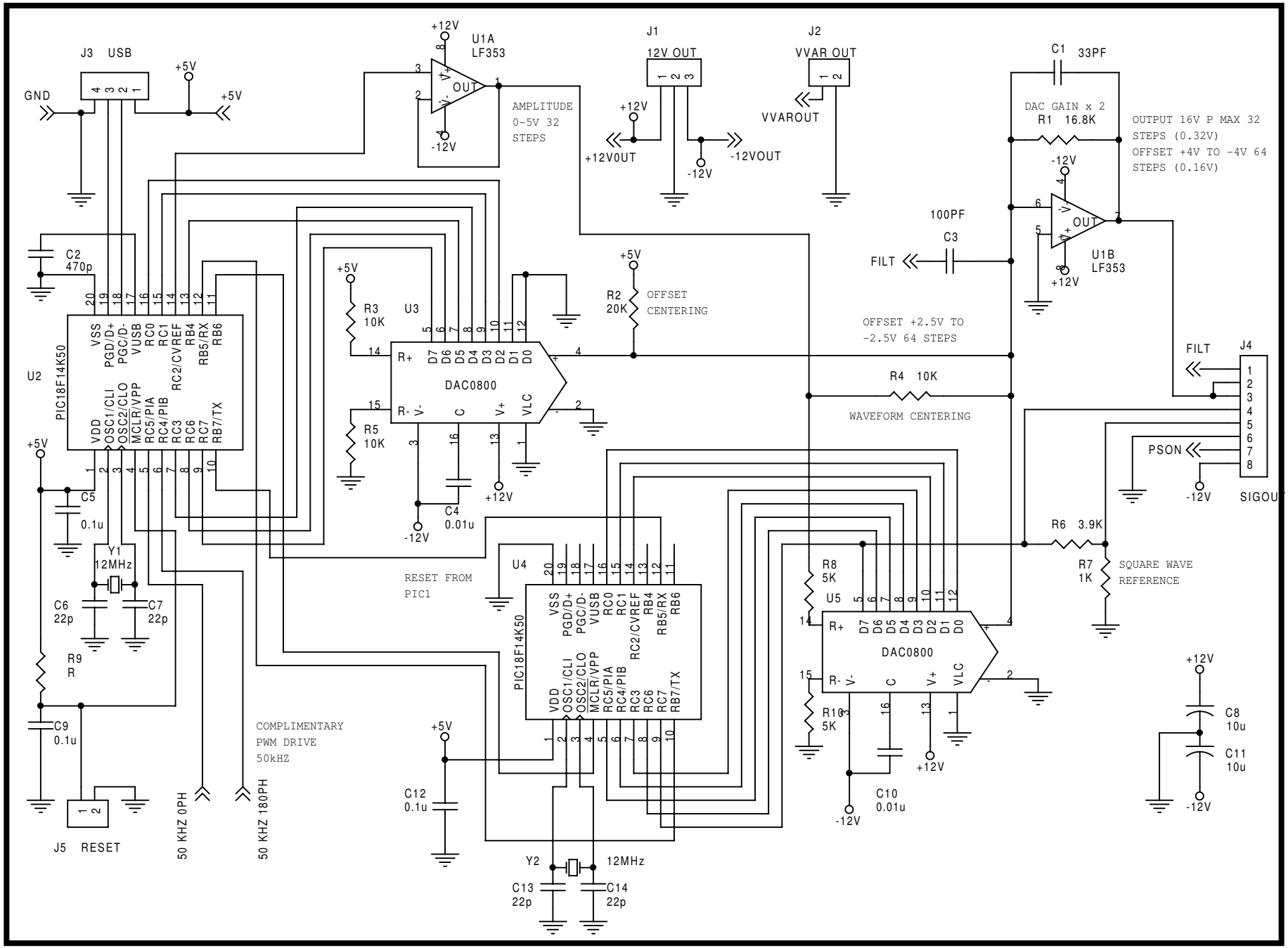
- DDS Signal Generator Circuit
- DC-DC Converter Circuit
- Component layout
- PCB 1:1 A4 Top mirrored
- PCB 1:1 A4 Bottom

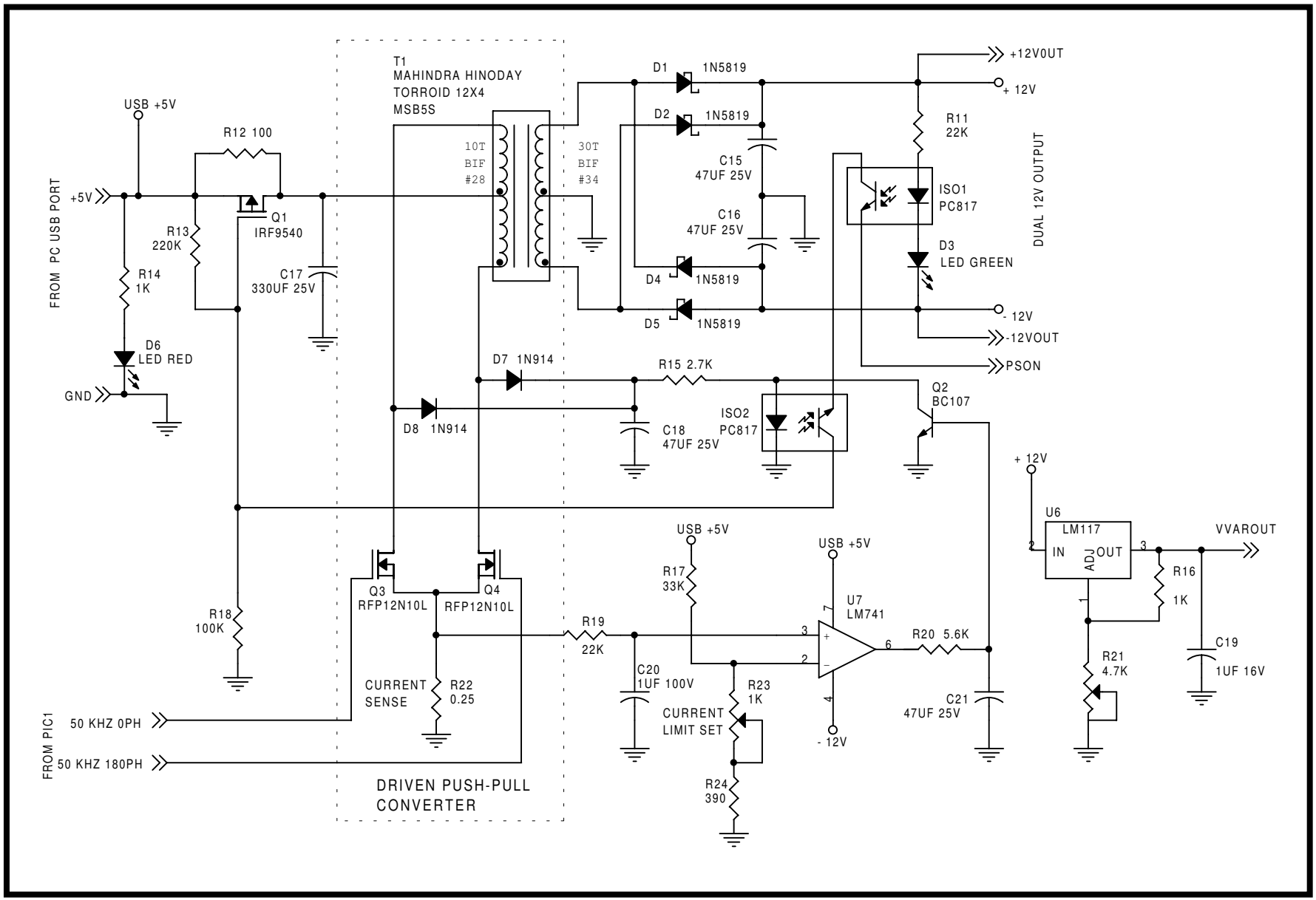
11. Summary

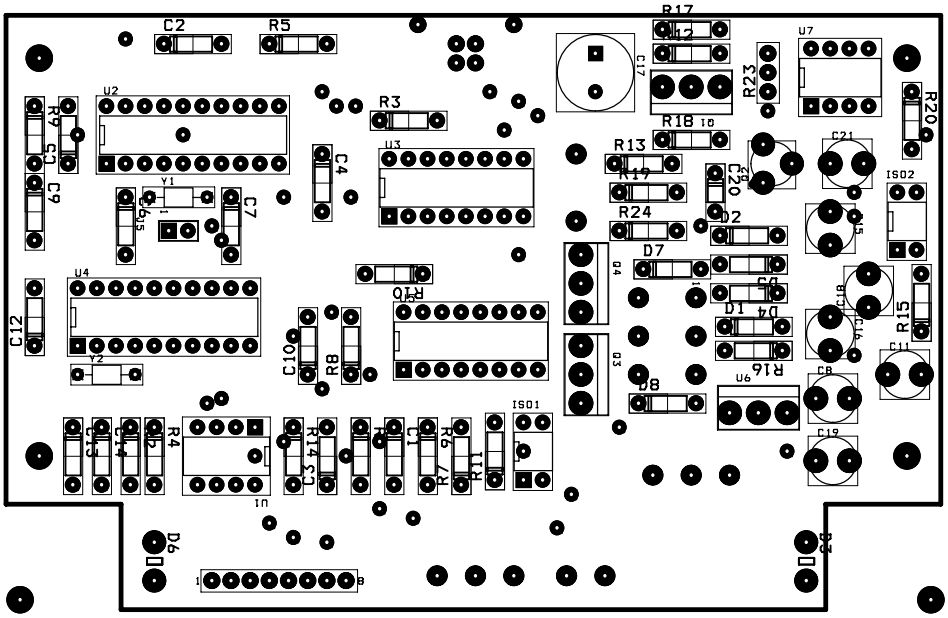
This document provides essential information for fabrication and operation of the Aj-SigGen-PS unit.

Software can be downloaded from my website http://www.ajoyraman.in

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


J3 USB
GND
+5V
+5V
U1A
LF353
+12V
-12V
OUT
AMPLITUDE
0-5V 32
STEPS
J1
12V OUT
+12V
+12VOUT
-12V
-12VOUT
J2
VVAR OUT
VVAROUT
C1 33PF
DAC GAIN x 2
R1 16.8K
OUTPUT 16V P MAX 32
STEPS (0.32V)
OFFSET +4V TO -4V 64
STEPS (0.16V)
-12V
U1B
LF353
+12V
100PF
C3
FILT
C2
470p
U2
PIC18F14K50
VSS
PGD/D+
PGC/D-
VUSB
RC0
RC1
RC2/CVREF
RB4
RB5/RX
RB6
VDD
OSC1/CLI
OSC2/CLO
MCLR/VPP
RC5/PIA
RC4/PIB
RC3
RC6
RC7
RB7/TX
+5V
R3
10K
U3
DAC0800
R+
R-
V-
C
V+
VLC
D7
D6
D5
D4
D3
D2
D1
D0
R5
10K
C4
0.01u
-12V
+12V
+5V
R2
20K
OFFSET
CENTERING
OFFSET +2.5V TO
-2.5V 64 STEPS
R4 10K
WAVEFORM CENTERING
FILT
J4
PSON
-12V
SIGOUT
C5
0.1u
Y1
12MHz
C6
22p
C7
22p
R9
R
C9
0.1u
J5 RESET
50 KHZ 0PH
50 KHZ 180PH
COMPLIMENTARY
PWM DRIVE
50kHZ
RESET FROM
PIC1
U4
R6 3.9K
R7
1K
SQUARE WAVE
REFERENCE
R8
5K
U5
R10
5K
C10
0.01u
+12V
-12V
C8
10u
C11
10u
+12V
-12V
C12
0.1u
Y2
12MHz
C13
22p
C14
22p


T1
MAHINDRA HINODAY
TORROID 12X4
MSB5S
10T
BIF
#28
30T
BIF
#34
USB +5V
R12 100
FROM PC USB PORT
+5V
R13
220K
Q1
IRF9540
C17
330UF 25V
R14
1K
D6
LED RED
GND
D1 1N5819
D2 1N5819
D4 1N5819
D5 1N5819
C15
47UF 25V
C16
47UF 25V
+12V0OUT
+ 12V
R11
22K
ISO1
PC817
D3
LED GREEN
DUAL 12V OUTPUT
- 12V
-12VOUT
PSON
D7 1N914
D8 1N914
R15 2.7K
ISO2
PC817
C18
47UF 25V
Q2
BC107
+ 12V
U6
LM117
IN
ADJ
OUT
VVAROUT
R16
1K
C19
1UF 16V
R21
4.7K
R18
100K
Q3
RFP12N10L
Q4
RFP12N10L
USB +5V
R17
33K
R19
22K
U7
LM741
R20 5.6K
C20
1UF 100V
R23
1K
CURRENT
LIMIT SET
C21
47UF 25V
- 12V
CURRENT
SENSE
R22
0.25
FROM PIC1
50 KHZ 0PH
50 KHZ 180PH
R24
390
DRIVEN PUSH-PULL
CONVERTER



DRILL CHART				
SYM	DIAM	TOL	QTY	NOTE
×	0.711 mm		45	
+	0.864 mm		98	
◇	0.940 mm		2	
⊠	0.965 mm		80	
⊜	1.422 mm		6	
⊕	1.448 mm		8	
○	1.651 mm		3	
⊠	2.032 mm		16	
△	2.540 mm		33	
⊜	2.794 mm		6	
TOTAL			297	

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SYM	DIAM	TOL	QTY	NOTE
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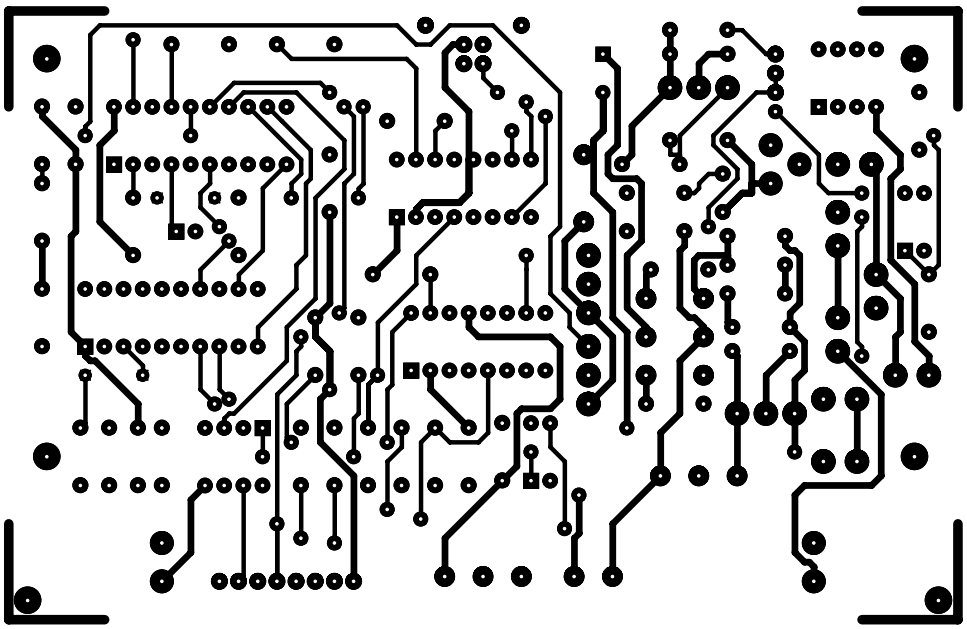

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