

Digitally controlled 2.1 channel analog audio power amplifier

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Introduction

This article introduces high quality digitally controlled 2.1 channel analog audio power amplifier system. This project is mainly based on TDA7377 AF power amplifier and PIC18F452 8bit microcontroller. Basic technical features of this receiver are covered in table1.

This unit is specifically design to work with PC sound cards, radio receivers and CD/DVD/Blue-Ray players.

Construction

This system use commonly available electronic components and substitute components can also use.

Supply voltage and current	12V – 15V (5A)
Output power	2 × 6W + 20W on 4Ω load
Output drive	2 full range speakers and 1 bass woofer
Audio input	1 stereo audio input
Bass Cut/Boost	±14dB
Treble Cut/Boost	±14dB
Additional bass boost	up to +35dB, and configurable for both 2 speakers and for bass woofer.
Additional audio options	Loudness and bass mix

Table1: Technical features and specifications of 2.1 channel audio amplifier project.

For maximum quality we recommended to use components from same manufacturer. For example some actual capacitor values and resistor values are slightly varied from manufacture to manufacturer, and this cause some minor unbalances in output of amplifiers.

When soldering the PCB we suggested to soldering small components such as jumper wires, resistors first and moving to larger components at last.

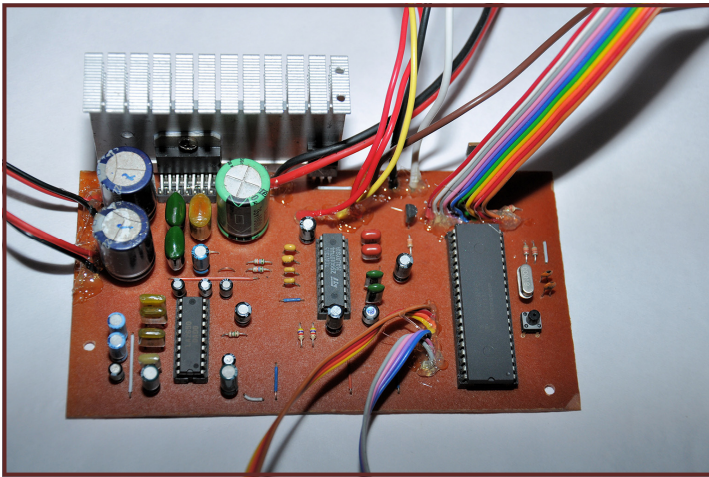


Fig.1: Prototype of 2.1 channel audio amplifier.

Also try to use IC sockets for all the DIP and TDA7377 ICs. In our prototype all the integrated circuits except 2 voltage regulators (IC5 - 7805 and IC6 - 7808) are connected to mainboard via IC sockets.

All the controls, I/O and power terminals and display modules are connected to mainboard through wires, and for control and display lines we recommended to use suitable ribbon cables.

For power and output wires 18-20 gauge multi-strand cables are recommended (these wires are commonly used for automotive wirings).

In given PCB design 4 wires need to be installed for I²C bus and MCU STAND-BY lines. For this, standard Teflon coated 32-30 gauge wires are sufficient.

Microcontroller firmware and source code

This project is an open hardware project and all the source codes of PIC18F452 MCU are available to download at project website.

The source code of PIC18F452 is written using *MikroC for PIC* compiler and free version of this compiler is available to download at *Mikroelektronika*^[1] home page.

Currently available firmware is design for 8MHz clock and other required MCU related settings are listed in table 2.

Compiled HEX file for PIC18F452 is also available to download at project website.

Configuration Address	Value
0x300001	0x0022
0x300002	0x000F
0x300003	0x000E
0x300005	0x0001
0x300006	0x0081
0x300008	0x000F
0x300009	0x00C0
0x30000A	0x000F
0x30000B	0x00E0

Table2: Required MCU configuration values

[1]: Mikroelektronika home page is <http://www.mikroe.com>. MikroC for PIC is available to download at <http://www.mikroe.com/mikroc/pic>

Testing the system

After assembling the system it is necessary to check all the power connections are working properly in this system. To check power lines follow the steps in below:

1. Connect both AGND and DGND together and from here onwards this connection is referred as GND.
2. Unplug TDA7377, TDA7315, LA2650, PIC18F452 and 1602 LCD module from the mainboard.
3. Disconnect any audio inputs and outputs.
4. Supply 12V – 14V DC input to GND and V+ lines.
5. Check the voltages between IC pins which are listed in table3.

If voltage readings are correct, plug all the ICs and LCD module and hold down the SYSTEM-RESET button and apply power to the system. While holding the SYSTEM-RESET button press

POWER ON/OFF button and turn on the system.

Once you got the LCD on, release the SYSTEM-RESET button and adjust the controls and check the audio outputs.

After firmware update or at initial run, pressing the SYSTEM-RESET button is essential to avoid any damages to speakers due to high volume levels.

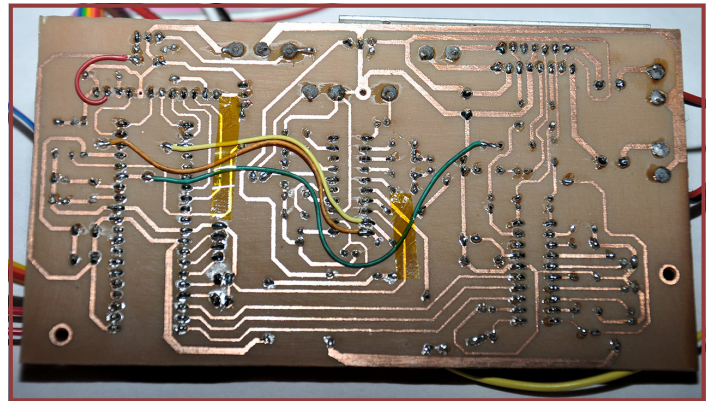
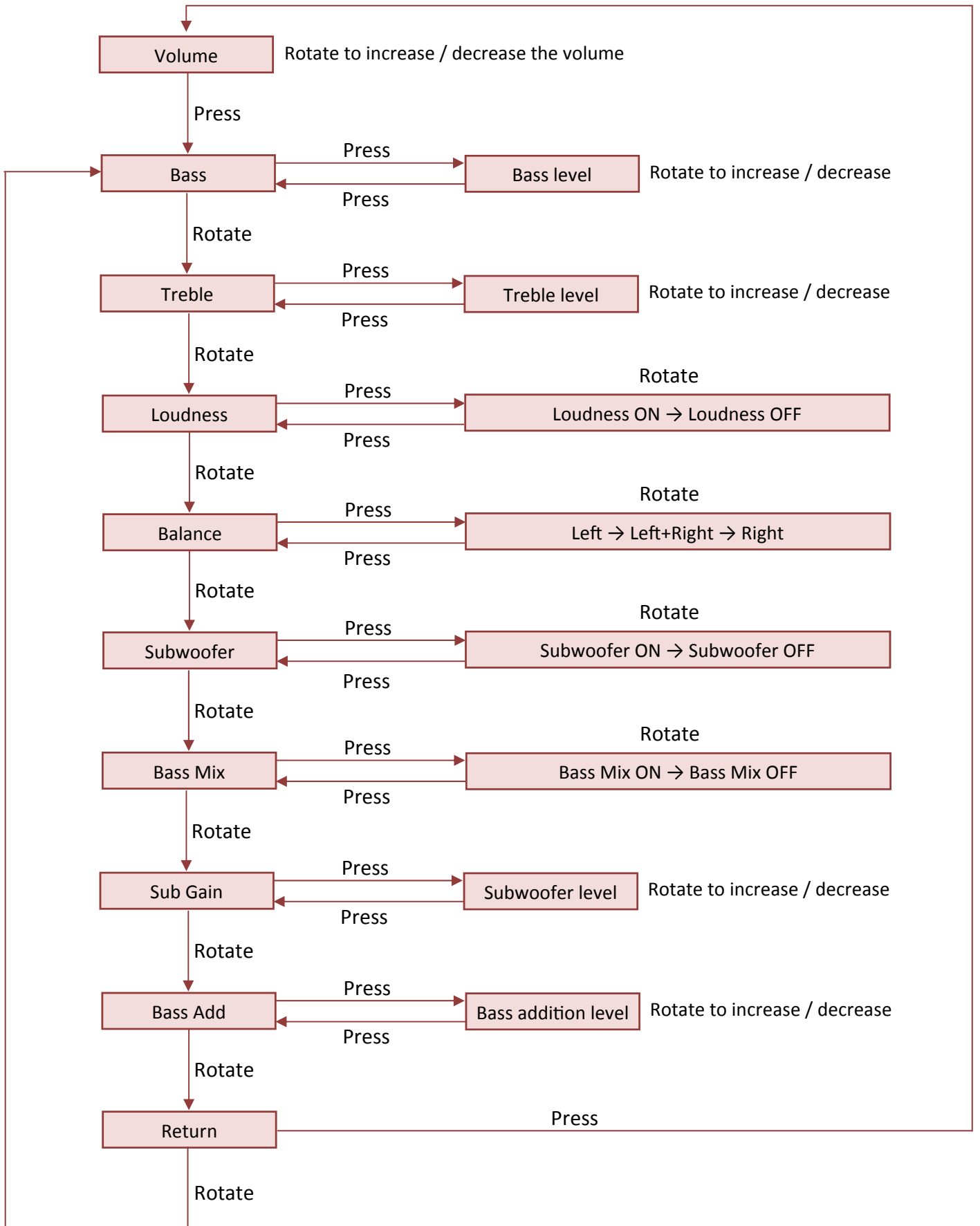


Fig.2: Bottom side wiring and layout of prototype amplifier PCB.

Component	Positive lead	Negative lead	Voltage readings
TDA7377 socket	13	9	need to be same as supply voltage (= 12V – 14V)
TDA7377 socket	3	8	need to be same as supply voltage (= 12V – 14V)
TDA7315 socket	2	3	between 7.8V to 8.2V
LA2650 socket	14	6	between 7.8V to 8.2V
PIC18F452 socket	32	31	between 4.8V to 5.1V
PIC18F452 socket	11	12	between 4.8V to 5.1V
1602 LCD connector	2	1	between 4.8V to 5.1V

Table3: Voltage readings for audio ICs and microcontroller.

Menu system defined in current version of firmware



Parts list

C1, C2	15pF	Q1	8.00MHz HC49U Crystal
C12, C13	0.0027 μ F/50V	T1	2SC945
C14, C15, C16, C17	0.039 μ F/50V	IC1	PIC18F452
C6, C7, C8, C9, C10, C11, C34	0.1 μ F/50V	IC2	TDA7315
C25, C26	0.22 μ F/50V	IC3	LA2650
C27	0.47 μ F/50V	IC4	TDA7377
C19, C23, C24, C31, C32, C33	1 μ F/16V	IC5	L7805
C3, C4	2.2 μ F/16V	IC6	L7808
C18, C20, C21	4.7 μ F/16V	S1	4Pin OMRON tactile switch
C5	22 μ F/16V	S2, S3	2Pin push ON switch
C22, C35	47 μ F/16V	ROT1	360° Rotary Encoder with push button
C30	47 μ F/25V	LCD1	1602 - 16 \times 2 LCD with HD44780 base controller
C36	1000 μ F/25V		
C28, C29	2200 μ F/25V		
R2	330 Ω		
R1	2.2K Ω		
R8, R9	4.7K Ω		
R6, R7	5.6K Ω		
R3, R4, R5, R11	22K Ω		
R10	1M Ω		

All the resistors are 1/4W carbon film type.

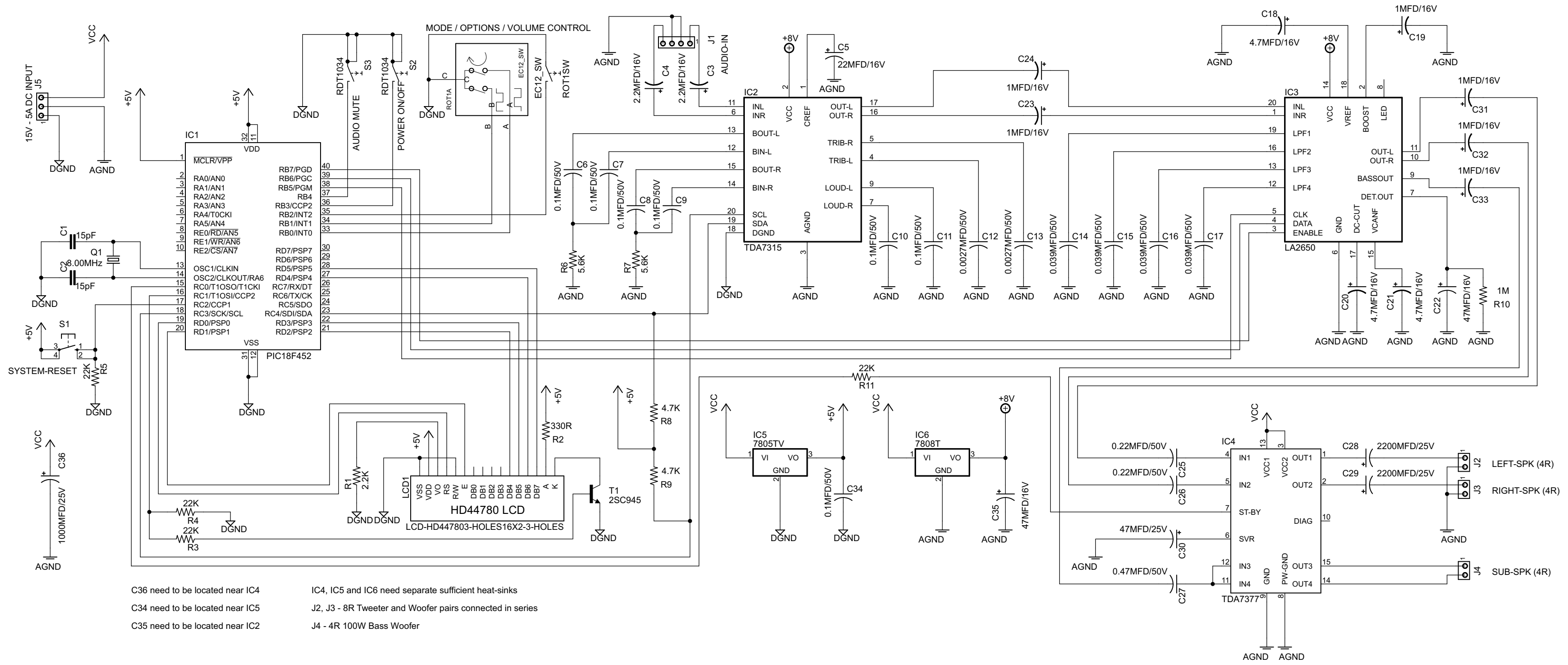
All capacitors which range between 0.0027 μ F to 0.47 μ F are Mylar capacitors.

Troubleshooting

The most common problem can occur in this amplifier system is no audio from the power amplifier IC. The most possible reasons are excess supply voltage (which is above 18V) or short circuits in output terminals of amplifier. TDA7377 is equipped with several protection features and state of the protection system can be monitored through Pin 10 of TDA7377 IC.

Second most common issue is LCD with 16 \times 2 boxes. This occurs due to initialization problems of HD44780 controller. A common reason for this issue is wrong wiring or faulty PORTD outputs.

If LCD output is too light (or dimmed), change the value of R1 (2.2K Ω) resistor. We set this value for commonly available Blue/White 1602 LCD module.



- C36 need to be located near IC4
- C34 need to be located near IC5
- C35 need to be located near IC2
- IC4, IC5 and IC6 need separate sufficient heat-sinks
- J2, J3 - 8R Tweeter and Woofer pairs connected in series
- J4 - 4R 100W Bass Woofer

