

HF SDR (Software Defined Radio) S/H Sample and Hold Transceiver ADTRX1 from 30 KHz to 35 MHz, correction, new version ADTRX1V1 and control boards B1 and B2 - Make it Simple as Possible with Outstanding Performances Part 2

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When I succeeded to make operation with ADTRX1 board as I wrote in part 1 control and all other parts were on table or they were mainly “dead bug” construction with wires crossing all over the components and PCBs.. At that moment (April 2006) was problem software for transmission. I read a lot of articles and I made a lot of CAD simulations trying to find optimal solution in simplicity and a very good reproducibility with possibility to make CW/SSB and digital operation with built in hardware. In this moment November 2006 we have a quite different situation few software are ready for SDR transmission like Power SDR (KD5TFD version for Soft Rock KIT), Tom DL8SAQ’s and Duncan M0KGK’s see references down.

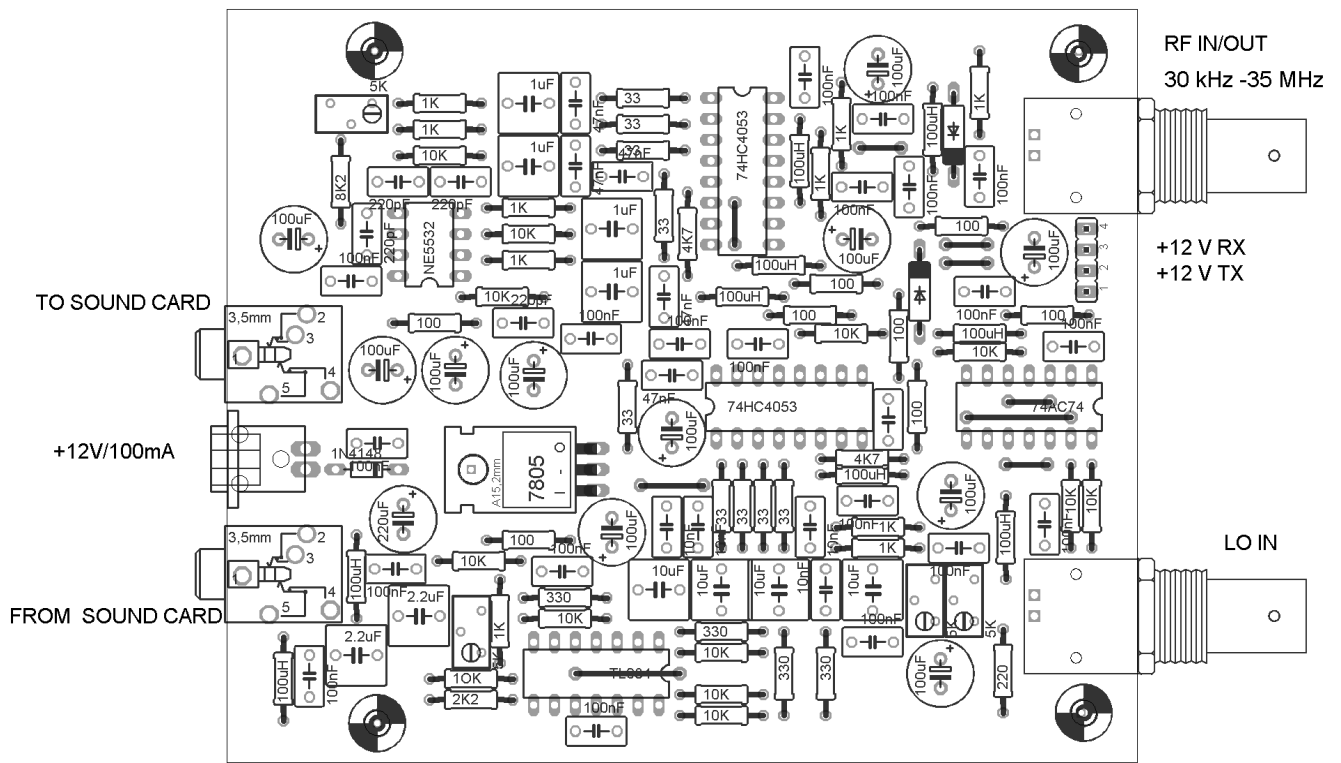
First let’s start with errors. I made one fatal error at ADTRX1 PCB. Operation was not possible as I published because I had mixed transmit/receive control between 74HC4053 ICs. I have thank you to OM Wolfgang DK2CQ who first noticed this error. PCB which I had been realized was 85%-90 % of PCB published in article. Also in PCB I marked wrong value for R46 as 1K instead 10K . I have asked all who build ADTRX1 transceiver for apology for inconveniences and try to find what is wrong. Here down is a corrected PCB.

I made a new one version of ADTRX1-V1 PCB, with 2 AF gain position like it is done in the SDR receivers DR2 and DR2A, also. Practical operation with ADTRX1 made this solution as imperative demand for the frequencies over the 10 - 15 MHz to increase receiver sensitivity to sufficient level... In the schematics, there is nothing new to describe and all is the same as in early mentioned and published receivers. Changing gain between 2 position 20-46 dB is possible realized simple with the help of double SPDT toggle switch or fixed gain with jumper to lower or higher value. This decision is determined with a signal levels coming from the antenna. The small antennas lead to the high gain position and big vice versa.

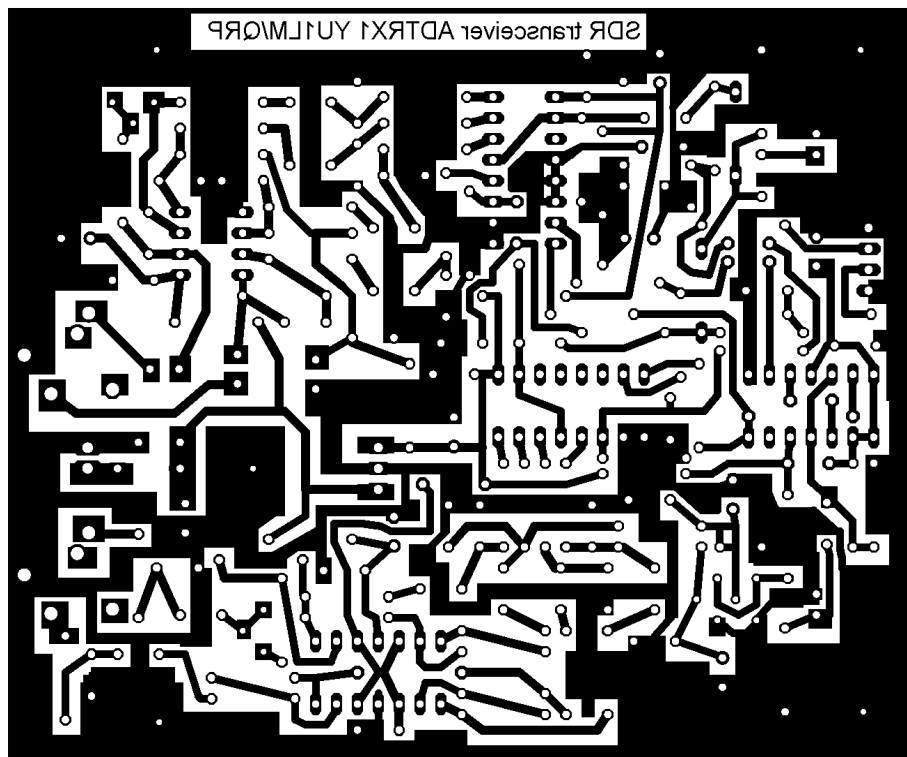
A receiving path in ADTRX1 is going always through the sound card (SB) and for transmission I describe here 3 ways how to perform them:

1. The first way is completely digitally with help of SB card or cards and PC only.
2. The second way is completely analog with built in hardware and it is classic direct phasing type transmitter with audio all pass phase shift network.
3. The third way is mixture, it is solution partly digital partly hardware with fixed audio IF.

In the moment when I started design and experimenting with control boards, there were not freeware software for transmission. Now we have new software and situation is a quite different. Readers can and have to individually decide what to do and how like to do transmission. All solutions have some positive and negative aspects and decision depend on what you like to realize, speed in CW operation or simplicity. Down is corrected PCB and part placement for ADTRX1.



Single side PCB size is 110 x 92 mm

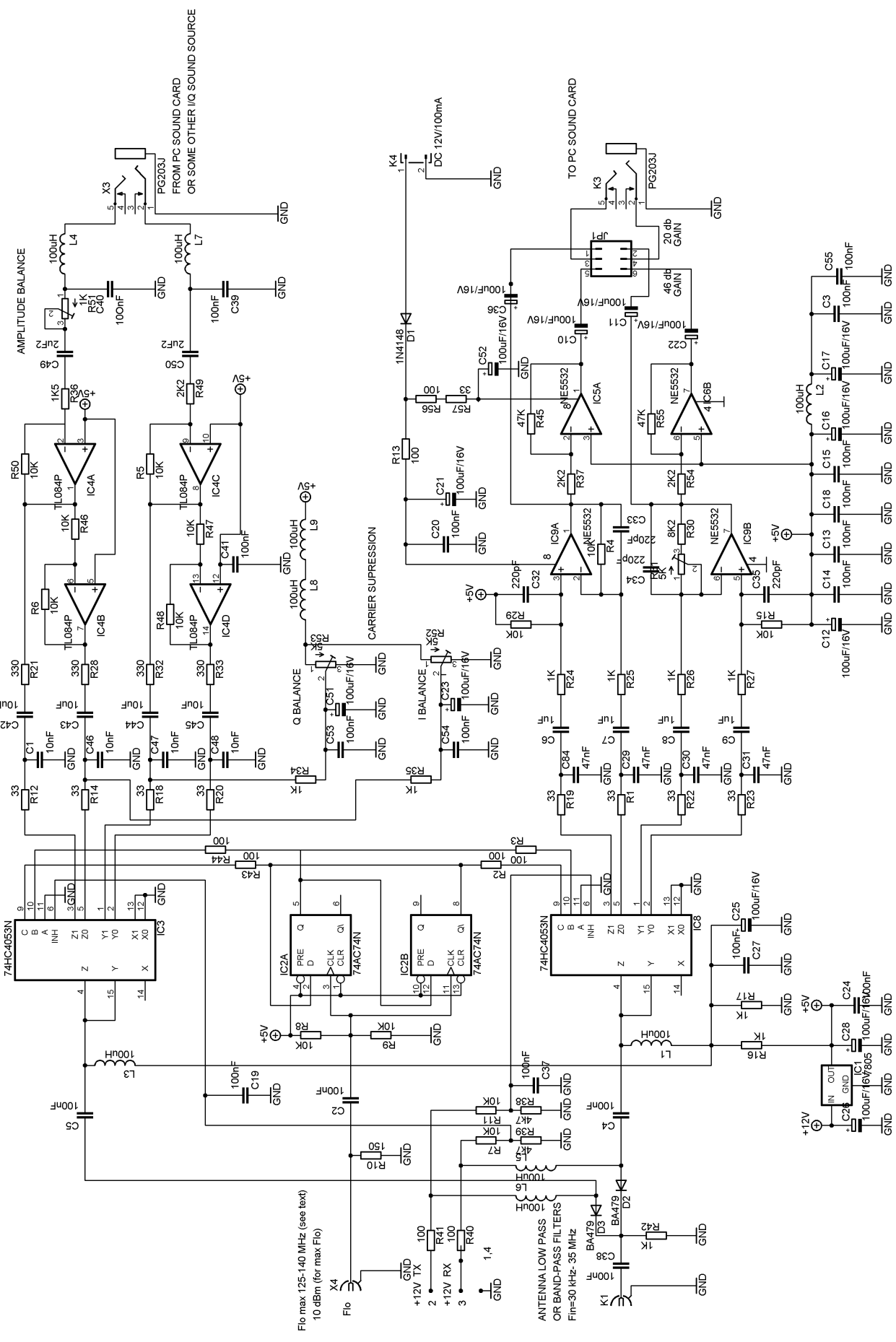


New version ADTRX1-V1 with 2 AF gain position

HF SDR Transceiver ADTRX1V1- YU1LM/QRP

30 kHz-33 MHz

C42,43,44,45 SHOULD BE ELCO 10uF/16V + TERMINAL ORIENTED TO THE 330 OHM



Flo max 125-140 MHz (see text)
10 dBm (for max Flo)

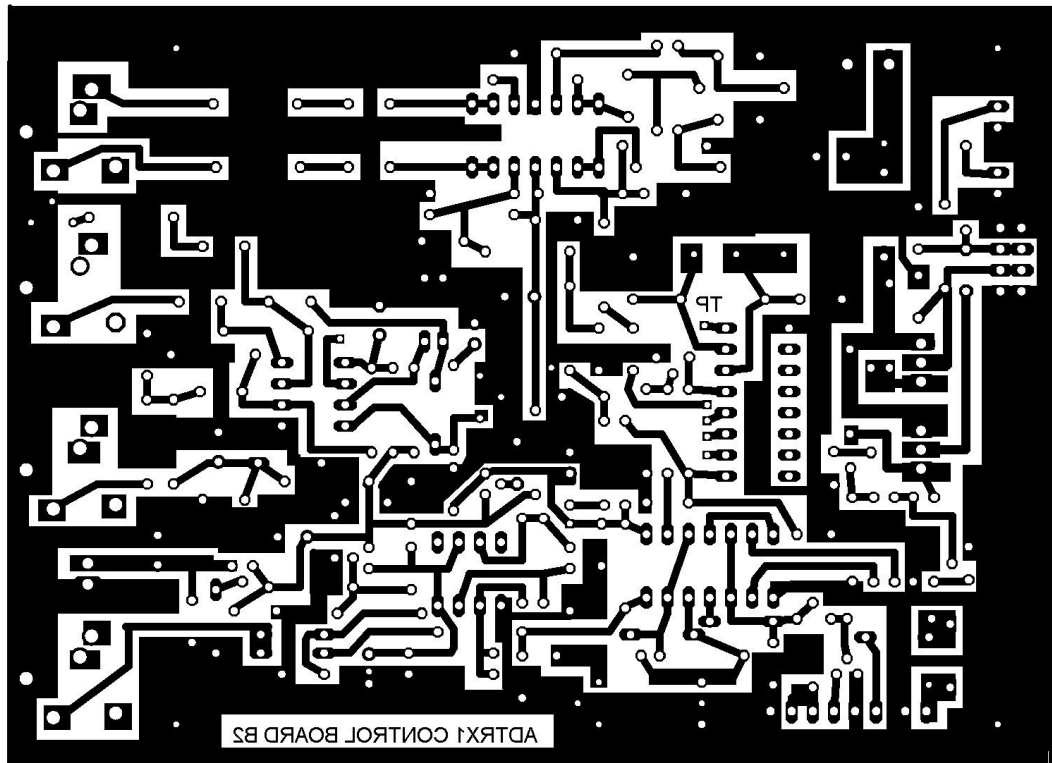
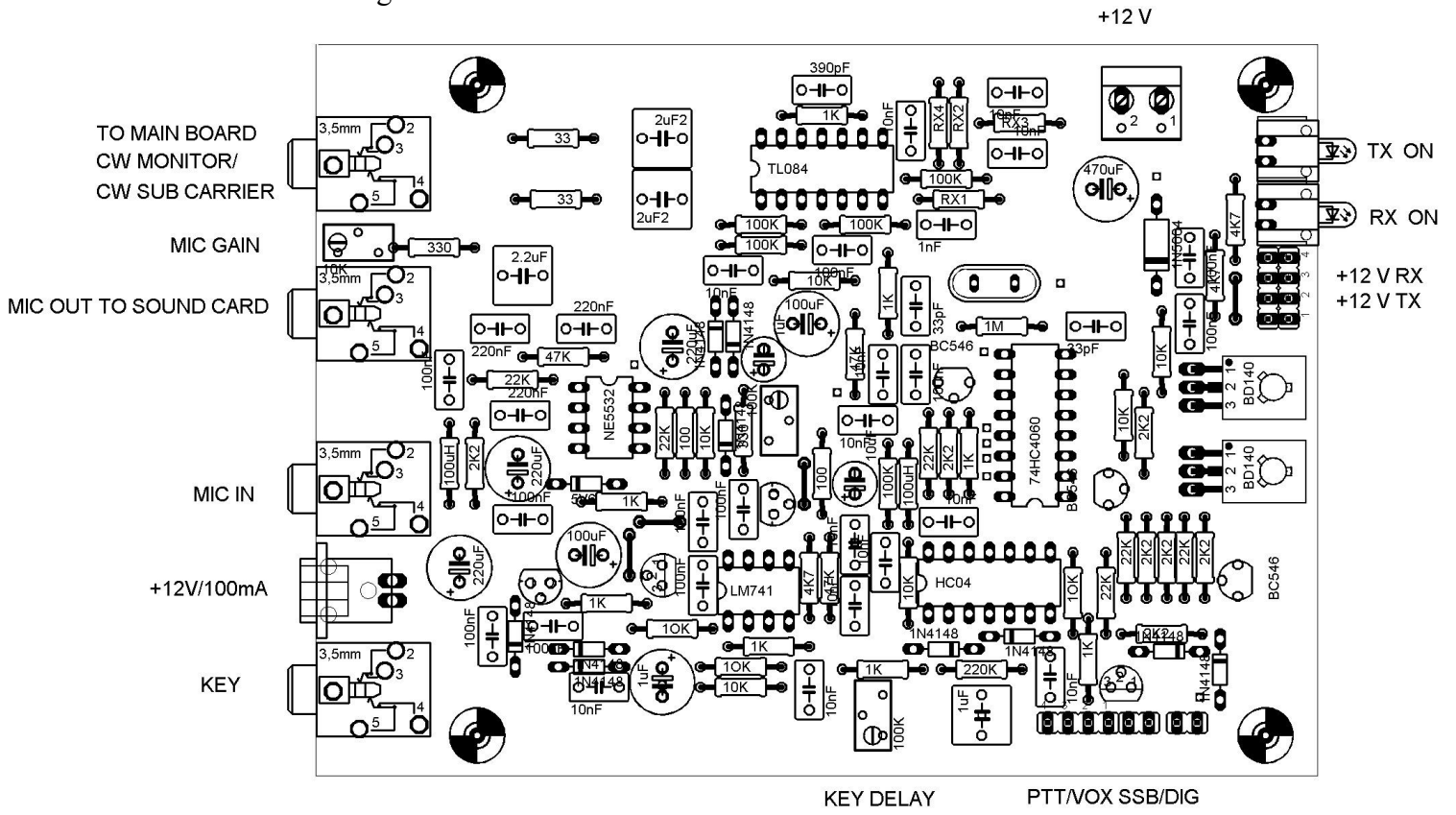
ANTENNA LOW PASS
OR BAND-PASS FILTERS
F_{in}=30 kHz-35 MHz

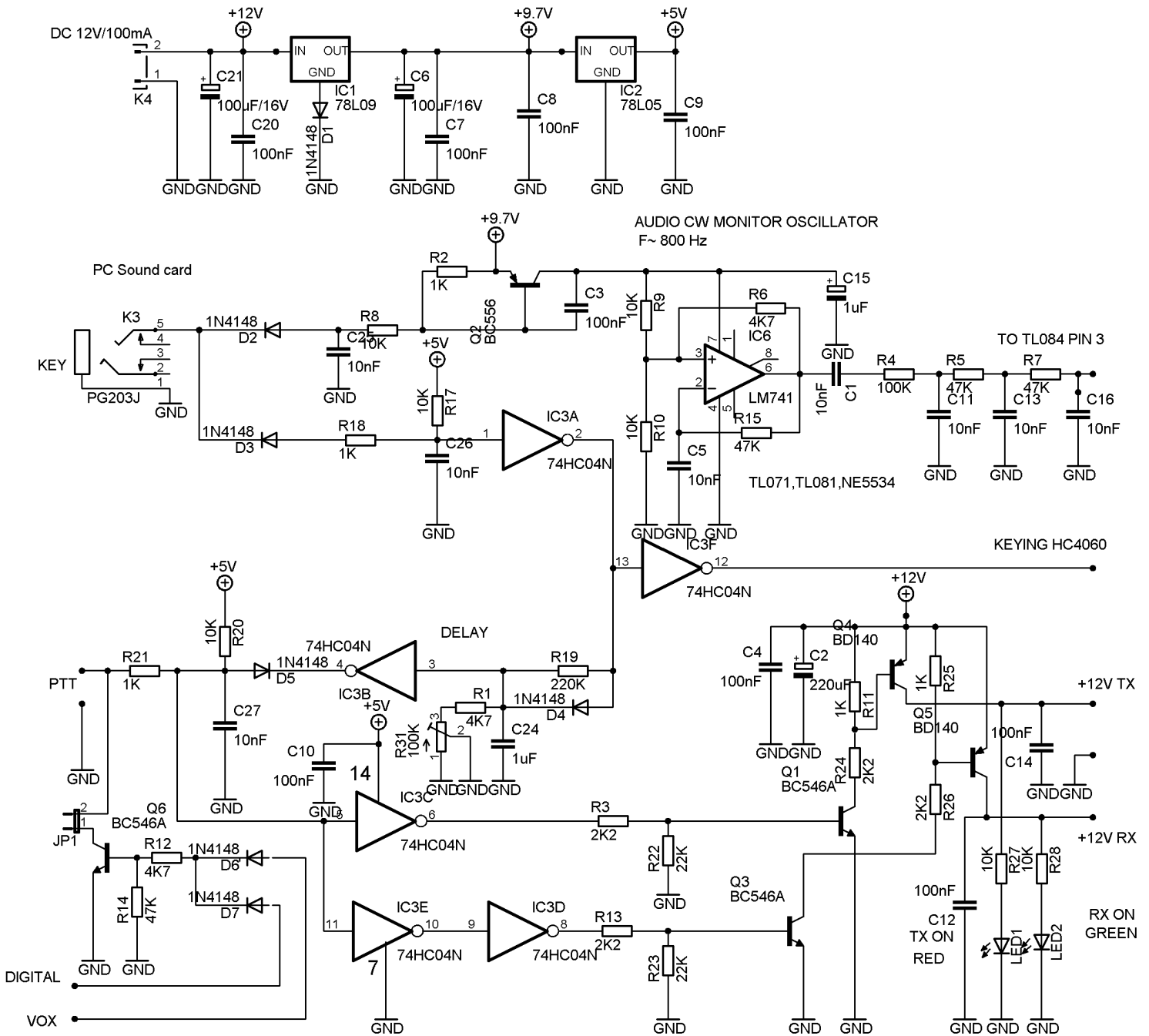
IN CASE RF_{in} < 0.3 MHz INCREASE INDUCTANCE 100uH ACCORDING FORMULA 31/(FMHz)²[uH]

MAIN BOARD ADTRX1-V1

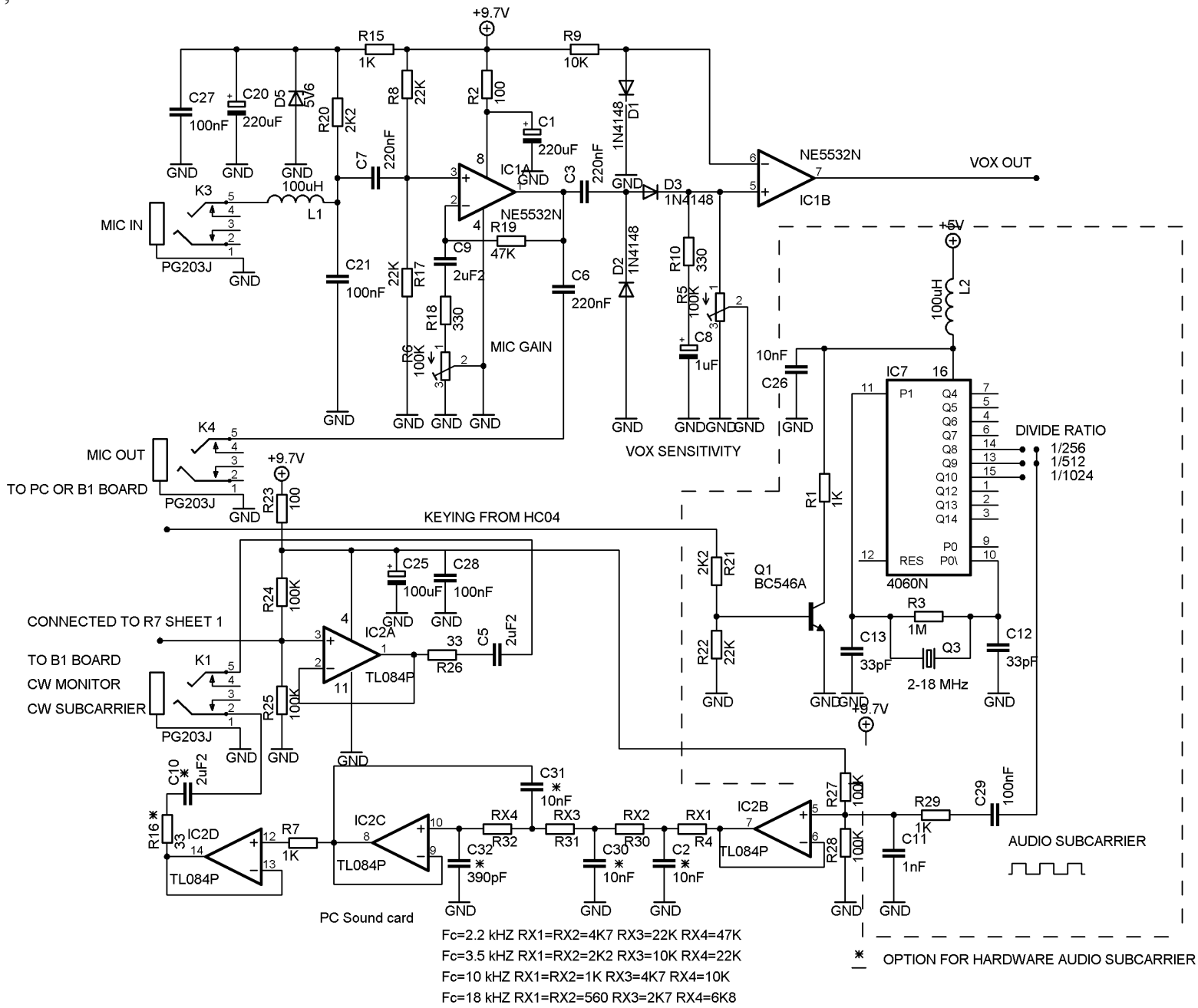
1. First way – ADTRX1 transmission is with a help of SB card and PC only. This way is optimum between simplicity and obtained performances. This is also the simple as possible way to make SDR transmission. For this way it is necessary PCBs with next order in sandwich: control board B1, ADTRX1-V1 board and B2 control board. B2 board is a combination published designs many times in different magazines and ARRL handbooks too. First we have variable MIC microphone gain amplifier for electrets microphone (you can chose cheap computer microphone) and VOX system for SSB or digital operation. B1 board system is in this moment without ANTI-VOX operation and it is not 100 % problem if we are using head phones. VOX system is realized at the same way as it is done in SDR1000 transceiver. With potentiometer is possible adjust VOX sensitivity. CW monitor is the same like it is in famous W7EL optimized QRP transceiver published in QST and many times reprinted in ARRL Handbooks. W7EL design was published first time more than 20 years ago. I used this solution few times in my designs and I like this simple solution very much. The output from the oscillator is square signal. To obtain much pleasant sound for my ear this signal is passing by through LP (low pass) realized with OP AMP TL084 CW shaping in keying is optimized with R-C combination to lower keying clicks. PTT/VOX and CW control and adjustable delay is realized with HC04 invertors. The control signals + 12V for receiving /transmission are obtaining with 2 PNP TO220 transistors BD140. VOX control is possible with PC DTR ...or some other controls signals and selection with jumper is possible also. At the same PCB we have place for montage option for 2 and 3 way of transmission it is digital oscillator with 4060 IC and binary divider inside IC. The XTAL frequency isn't critical. It is important that after dividing we are obtaining audio frequency between 3-20 kHz as IF frequency for transmission and same for receiving we are choosing in SDR software. It is choosing fixed audio SDR IF. Output signal after LP (low pass) with TL084 is a sinusoidal signal with the all harmonics content lower than 55-60 dBc.

B2 Control board single side PCB dimension 125 x 92 mm



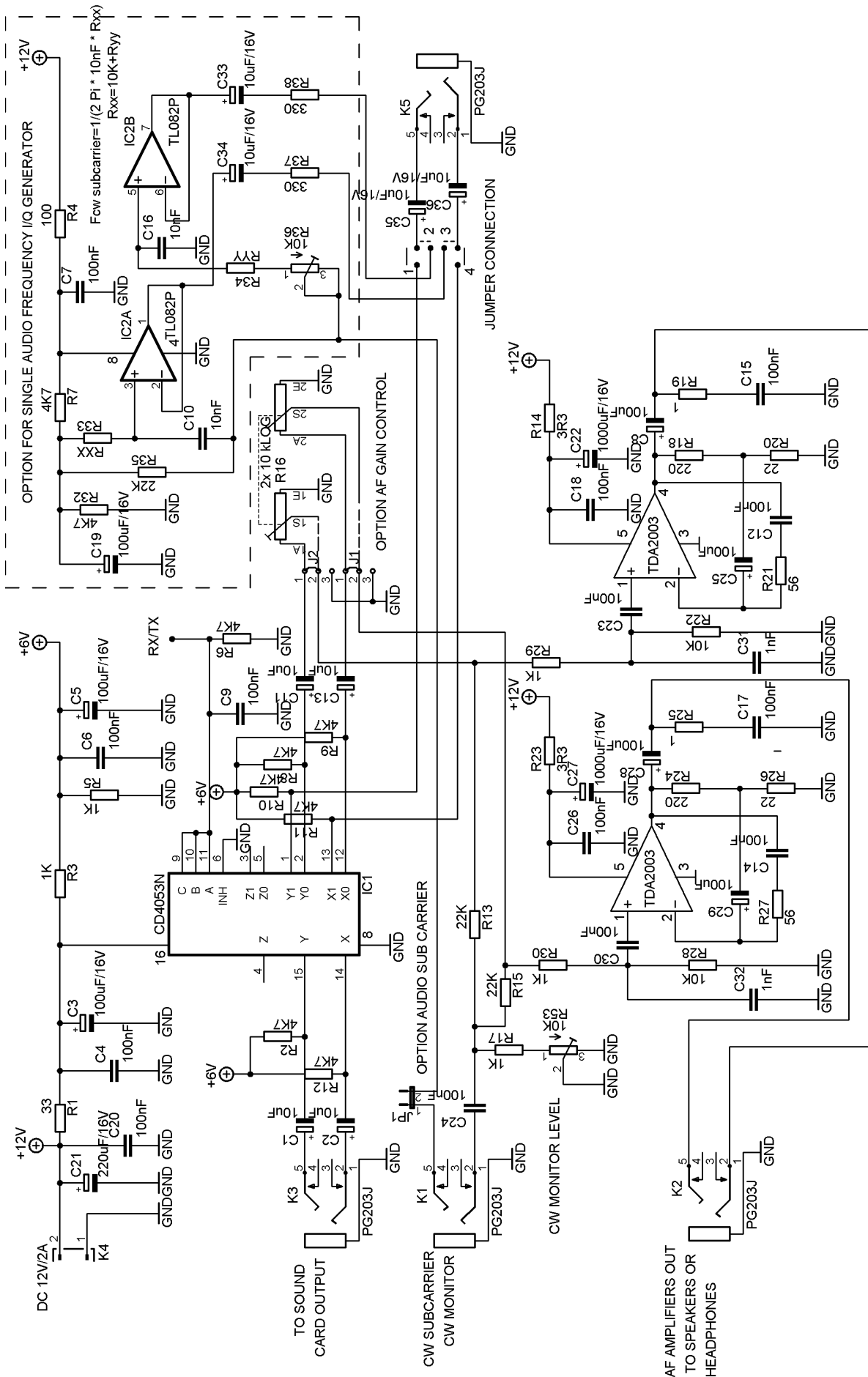


CONTROL BOARD B2 SHEET1



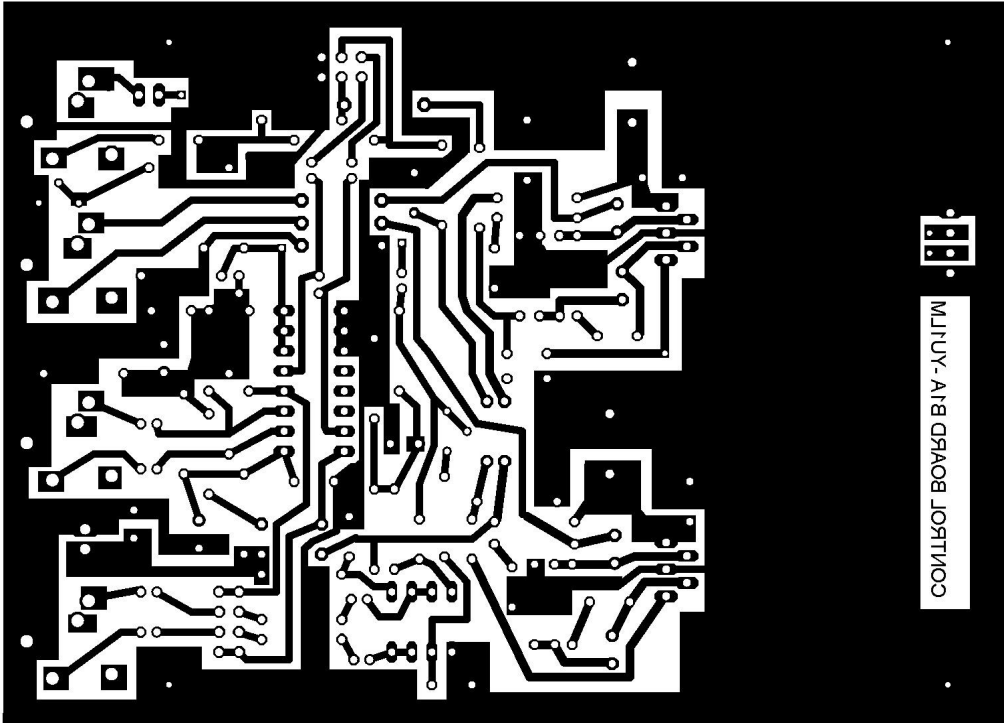
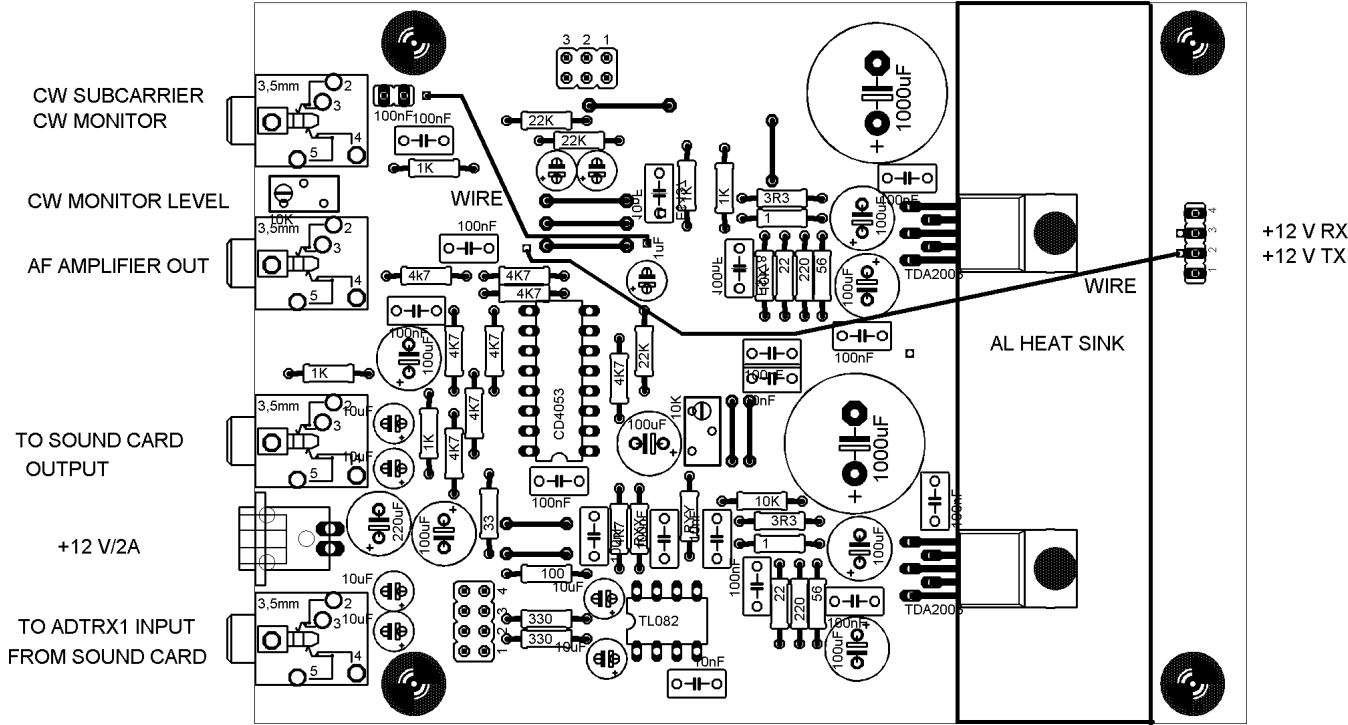
B2 BOARD SHEET 2

A control board B1 is commutating circuit during transmission/receiving change also on B1 PCB is 2 channel audio power amplifiers 2 x 2-3 W realized with TDA2003 ICs. This circuit and ICs are well known between radio designers as very good high performances solution for audio power output. In AF amplifiers we have possibility to reduce noise bandwidth with in serial 56 Ohms and 100nF connection it is important to notice that for the third way of SDR transmission we have a fixed audio IF. At the same PCB is CW audio level control and audio phase shift for fixed audio IF, for third way of transmission.



CONTROL BOARD B1A - YU1LM/QRP

I am using in commutating circuit for transmission/receiving path at +12V IC CD4053 or HEF4053 ICs. Most 74HC4053 will be destroyed with this VCC because it is over their voltage limits (typical limit values 7-10 V).

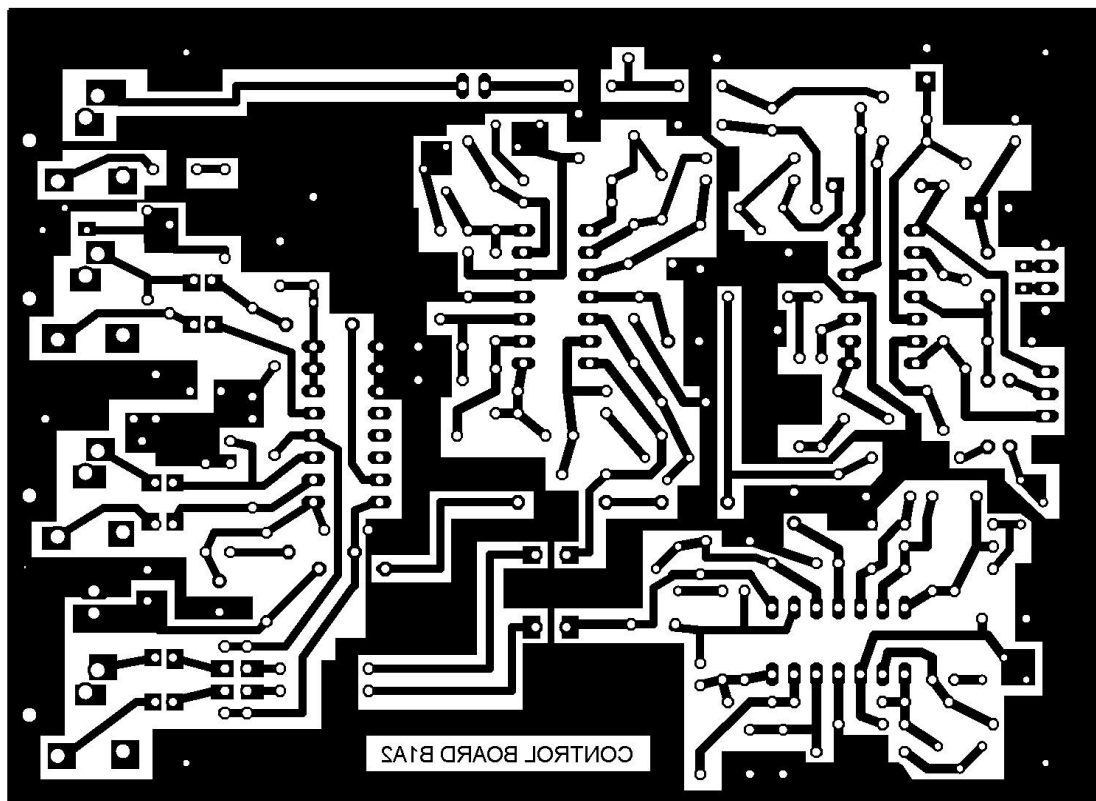


B1A control board single side PCB dimension 92 x 125 mm

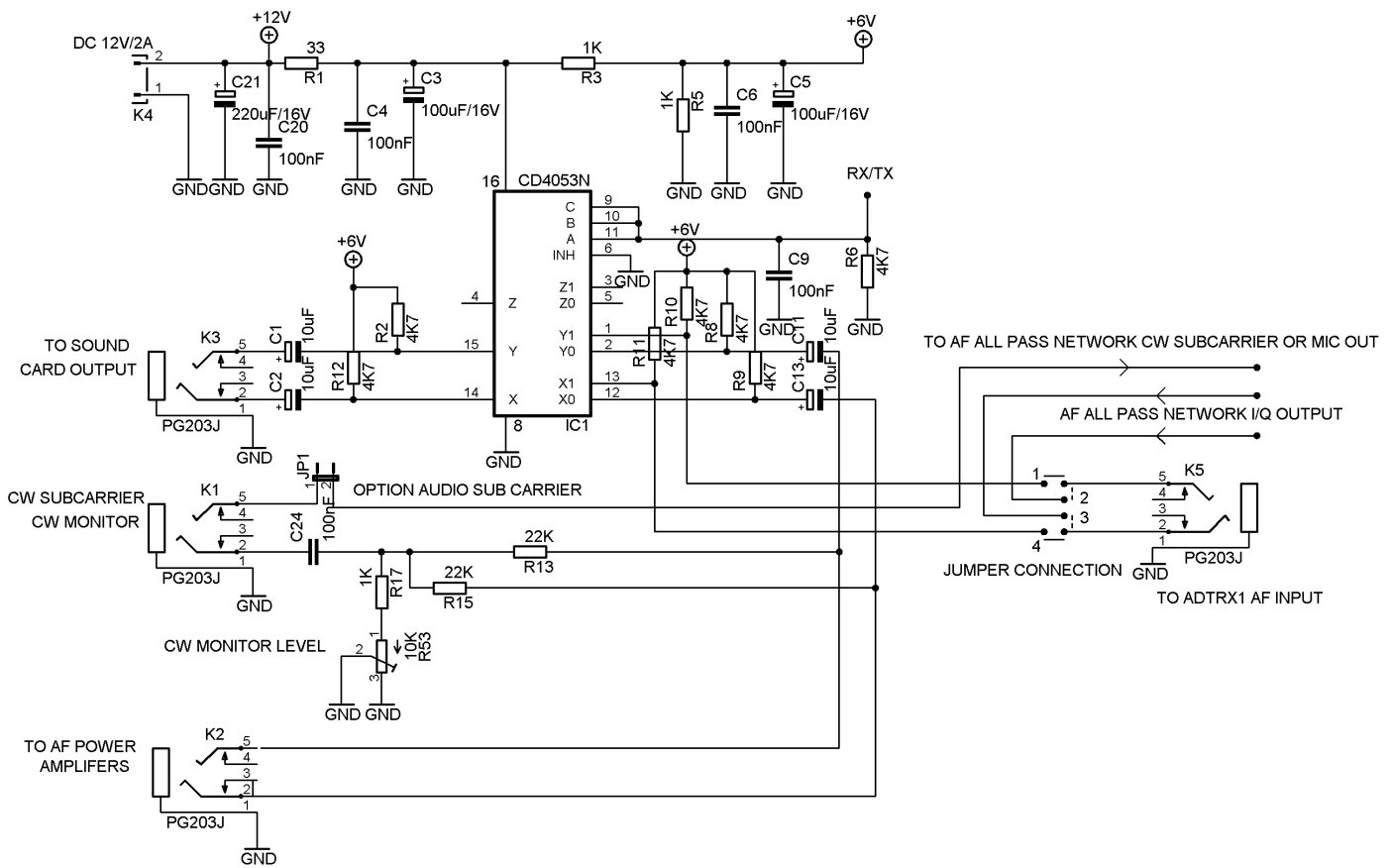
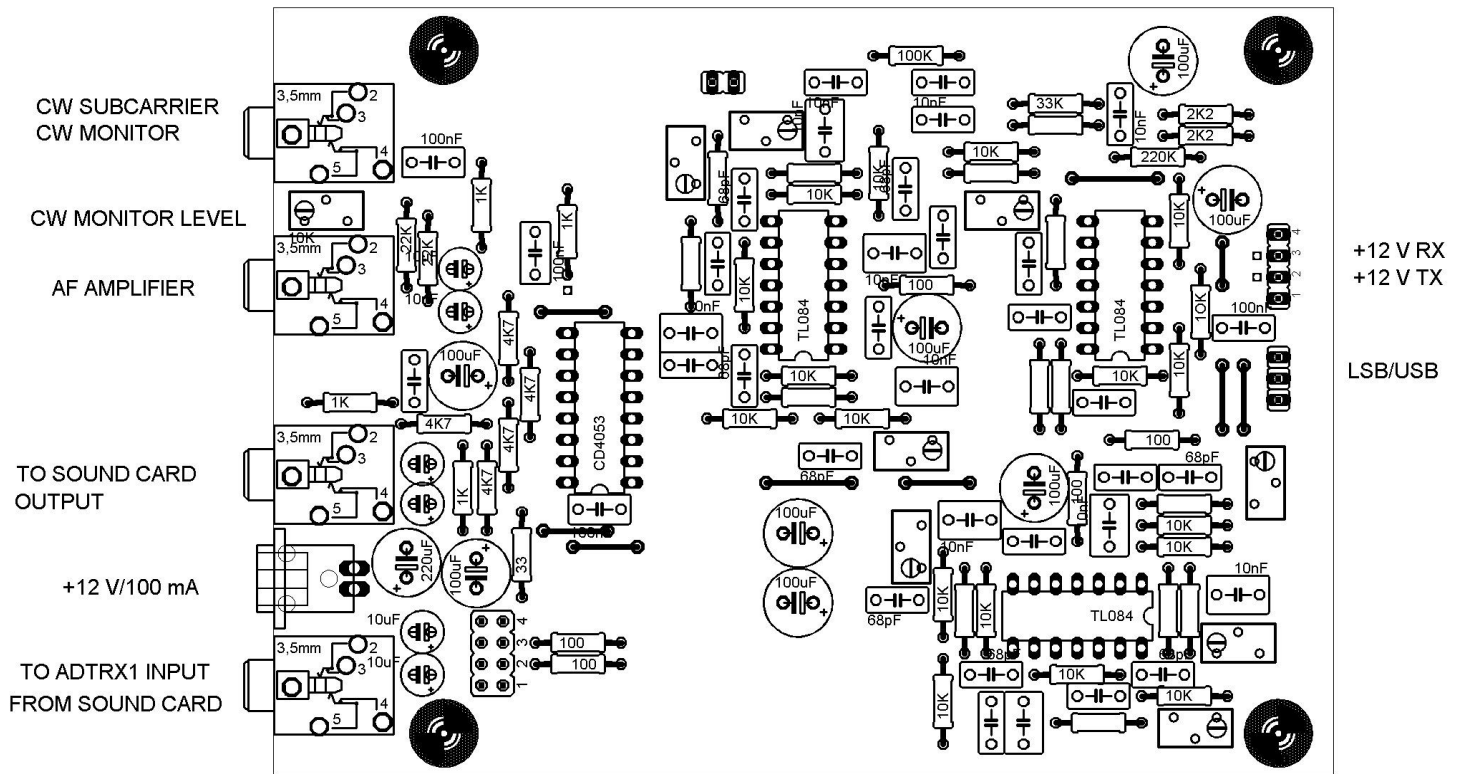
3. Third way – For the SDR transmission I am using the same hardware as for the first way only it is necessary to solder option components. The biggest difference is in CW transmission at fixed audio IF frequency. Changing transmitting frequency is possible only with changing LO frequency not as it is in first way where with the fixed LO frequency we can make transmission in of min range +/- 20 kHz or more around central frequency. This way is the way of CW operation with

maximum speed keying with min delay between receiving and transmitting as most operator learned.

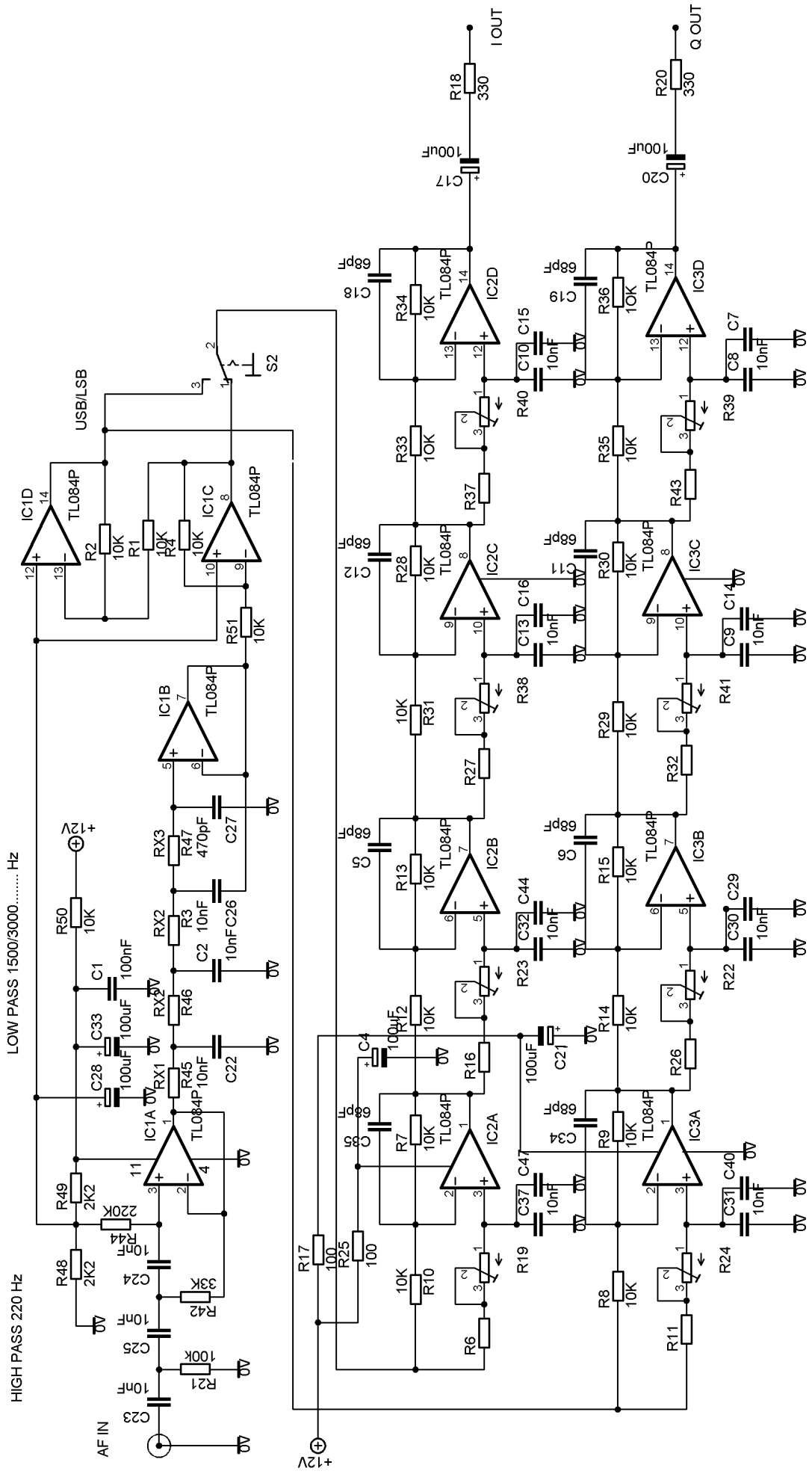
3. Second way- For SDR transmission I am using the new hardware 4 PCBs. The PCBs order is B2 PCB, ADTRX1-V1, B1A2 PCB and AF amplifier reduced B1A1 PCB. The third way is a classic phasing type SSB/CW transmitter. I made a great effort to find optimum way and simplest hardware solution and realization. Two options was in my focus from the very beginning classic phasing type transmitter and transmitter with Weaver type transmission. With both options I obtained similar results. I decided to publish in this moment classic phasing type transmitter. Reason is a quite simple Weaver type transmitter need more space than it is ADTRX1-V1 PCB. I didn't succeed made a PCB with this transmission options in desired dimensions 125 x 92 mm. I will try to publish this very interesting results as separate project in soon future because there are very small number articles related to this Weaver subject called third method of obtaining SSB... The phasing way of transmission with all pass AF phase shifter I am publishing as separate articles please read *AF all pass quadrature networks practical approach*. You need only to make choice what you want to do and than solder adequate components. B1A2 PCB is combination PCB from audio AF phase network and B1A1 PCB. For second way we need 4 PCBs ADTRX1, B2, B1A2 and audio power amplifier for B1A2.



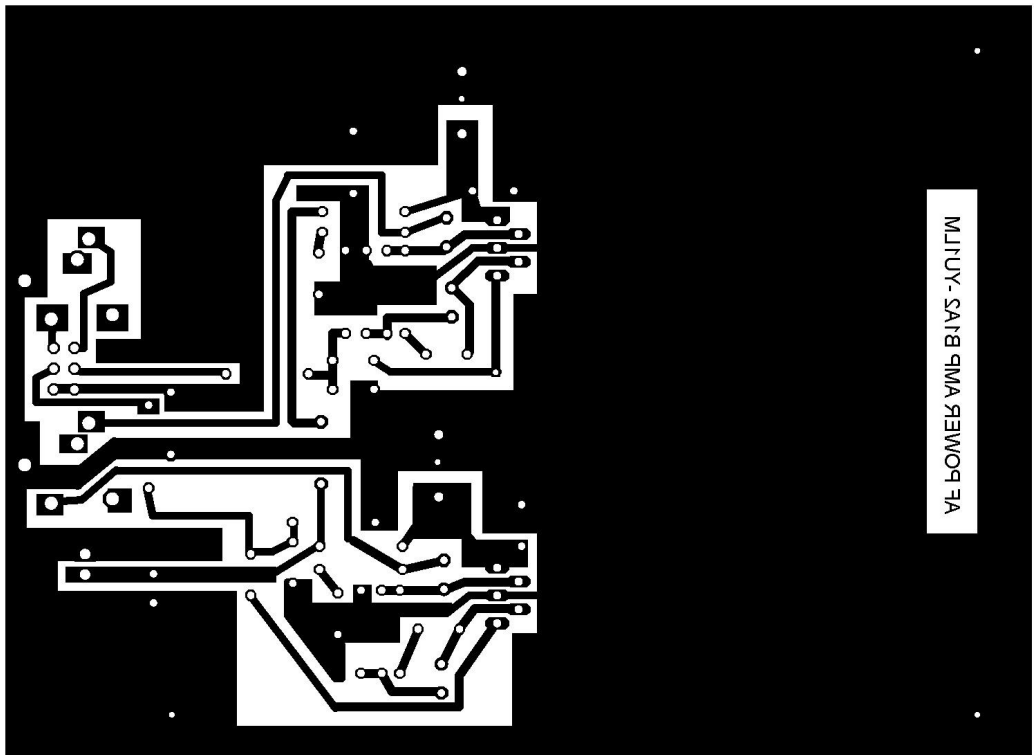
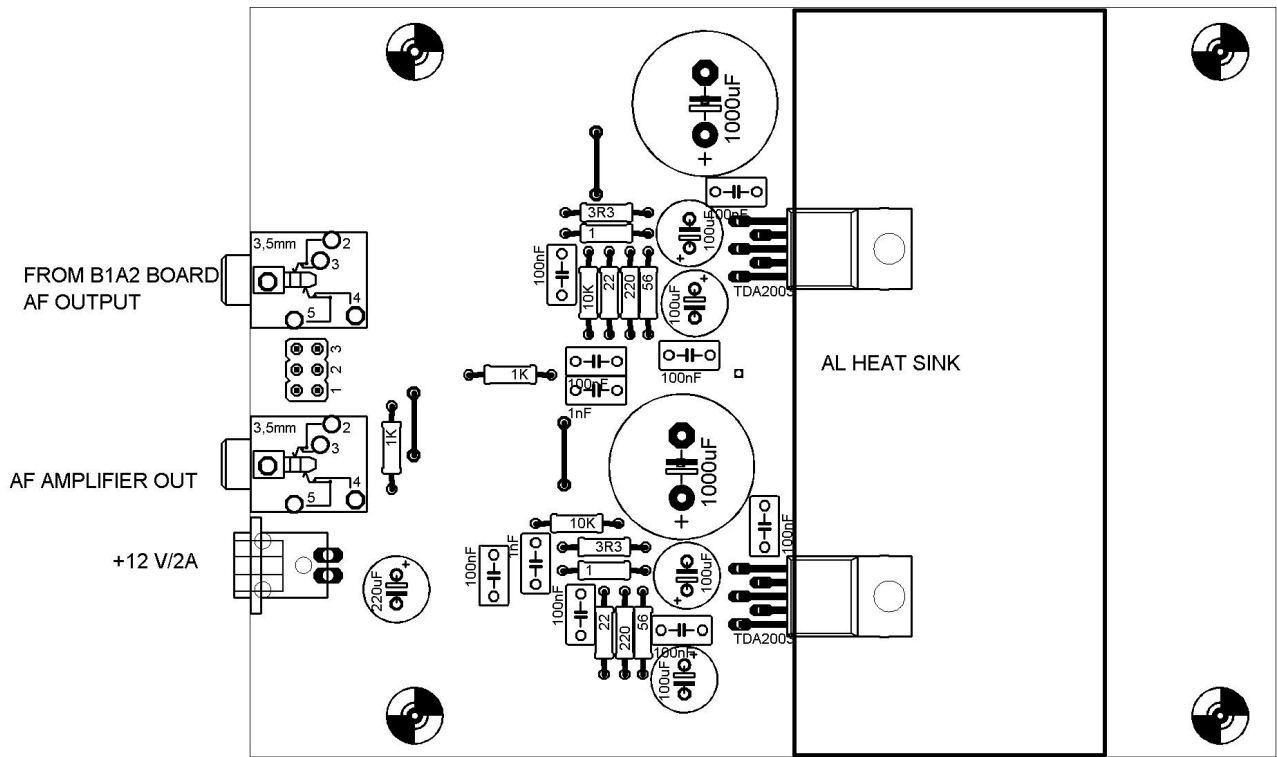
B1A2 Single side PCB dimension 92 x125 mm



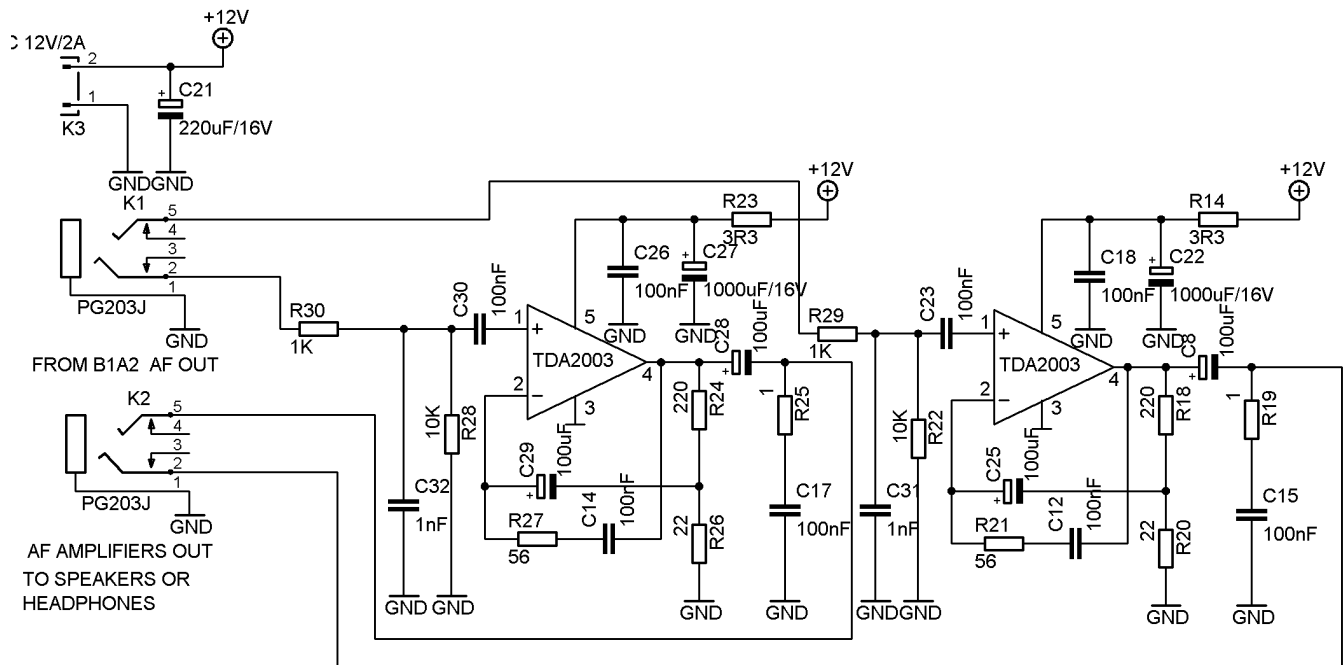
CONTROL BOARD B1A2 - SHEET1



AUDIO ALL PASS PHASE SHIFTER
YU1LM/QRP



Audio 2 x 3 W power amplifier, single side PCB dimensions 125 x 92 mm

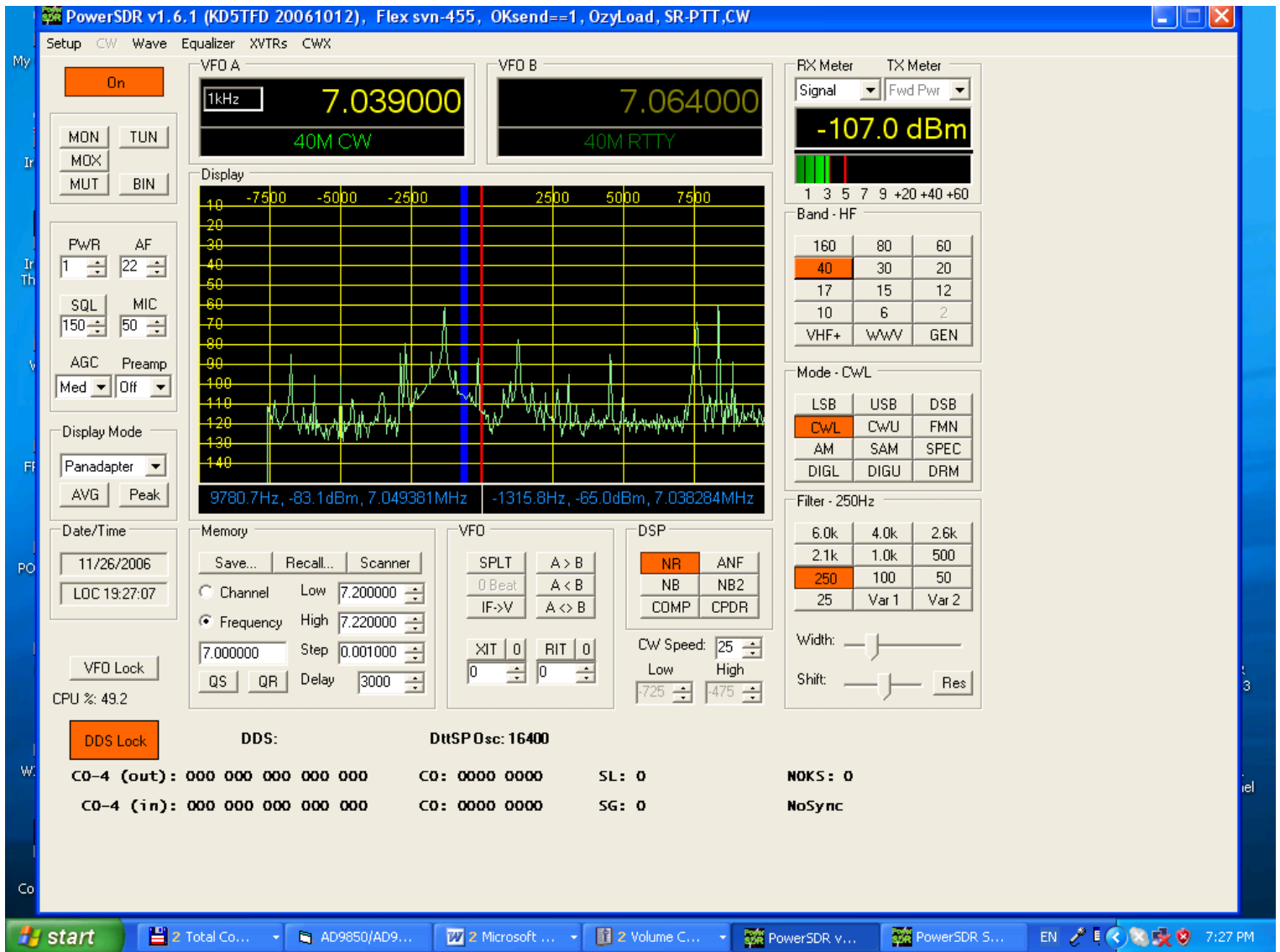


AUDIO AMPLIFIER FOR B1A2 BOARD - YU1LM/QRP

In practice:

I made successful CW, SSB and Digital operation but only several QSOs were in the “air”. My biggest problem is a lack of free time and my family little misunderstanding for wires all over the tables in apartment. From other side I am lazy to finish designs in BOX for me all is never ending story and I always see some alternative way or new possibility in any design. This homebrew designs are my hobby in which I enjoy very much. If I have to “cut” some things in professional life to finish at time for my hobby this isn’t necessary thing.

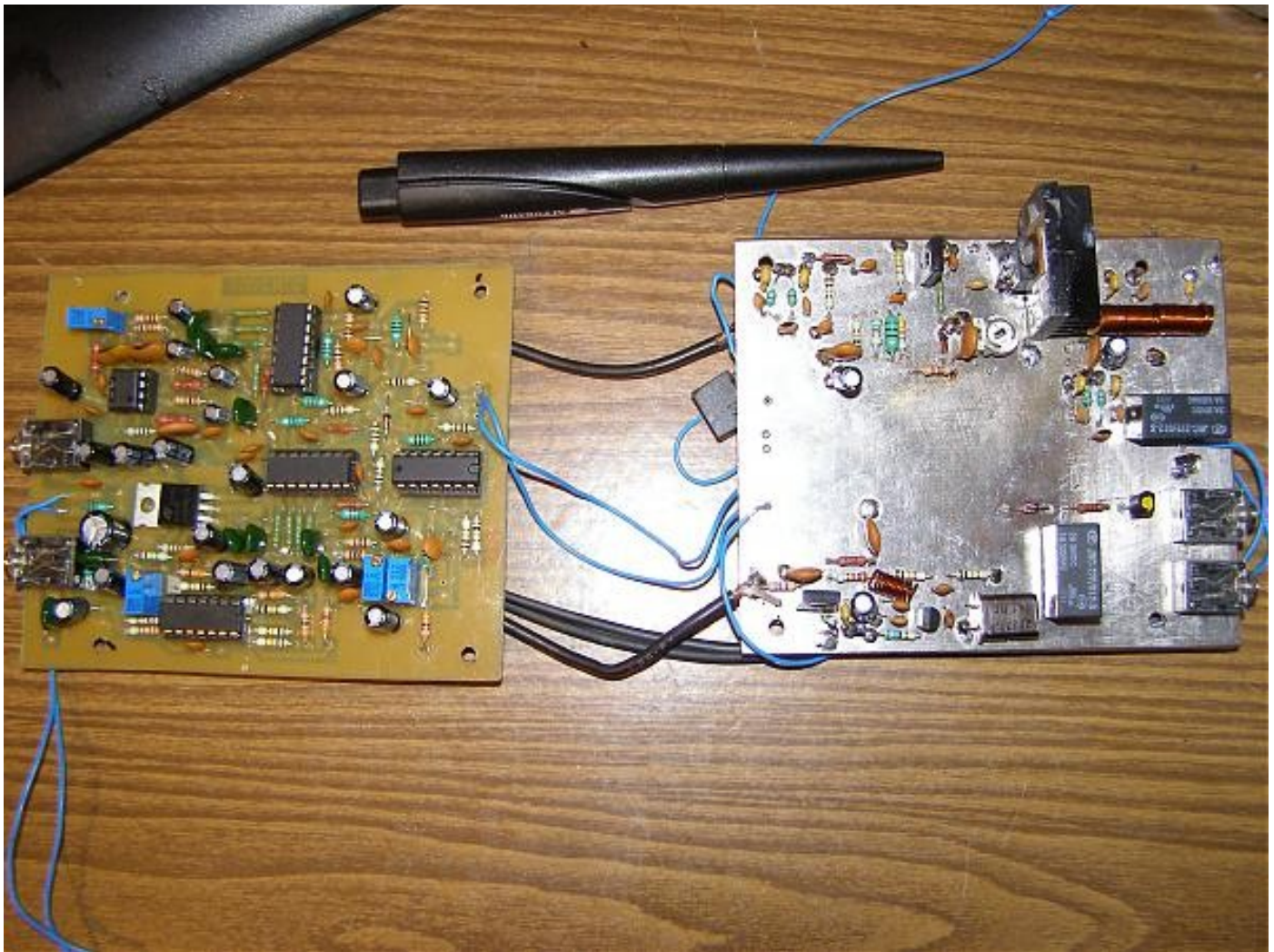
Digital operation is possible now with only one SB card with help virtual cable software VAC 4.03 (see FLEX Radio site for installation and download) or how this does Patrick F6CTE with his freeware famous software MULTIPSK. MULTIPSK I can say that have all digital modes in practical use today. Alternative way for digital transmission is use 2 SB cards, one for SDR receiving and second for digital receiving and transmitting. I made digital operation at that way first and I have admit that this way consume a lot of PC CPU power and for slower PC is practically impossible. Last version PowerSDR from FLEX Radio have big improvements in possibilities and speed and now it is relative easy to do CW/SSB and digital operation see screen shot from PowerSDR (KD5TFD version for Softrock transceiver) in last WW CW 2006 contest on 7 MHz.



Picture up screen shot from ADTRX1 SDR transceiver RX screen – I was receiving clear and loud without problems, band 7 MHz, VK6LW signal close to the noise level. VK6LW signals was 100% readable in present of the close very strong signals 50 dB stronger 1 kHz down, 200 Hz down 20 dB stronger and 25 dB stronger 350 Hz up!!!

It was really great pleasure listening low HAM bands and see how SDR receiver is superior in performances to the most very good classic transceivers. Only little deficiency is still not too much comfortable operation during transmission /receiving with many software at the same times (SDR program, DDS control, contest log...). My hardware is not 100 % compatible with SDR1000. I have separate program for DDS but when I am changing PowerSDR setup it unpredictably change frequency from time to time because I am using same LPT port for DDS programming. I have to be "Speedy Gonzales" to make delay in operation little noticeable HI!!!! I have to do investigation how to make operation optimal for the sure. I didn't test Duncan M0KGGK transceiver software yet to see how it is comfortable for practical operation.

Some other SDR fans made ADTRX1 transceiver and made successful operation. I am presenting here practical experience from Andrey (Андрей Мисюрко) US5EQQ which made 7 MHz single band SDR transceiver. Andrey is using very cheep computer surplus quartz 28.322 MHz. See his ADTRX1 transceiver and PC setup and results he accomplished down.



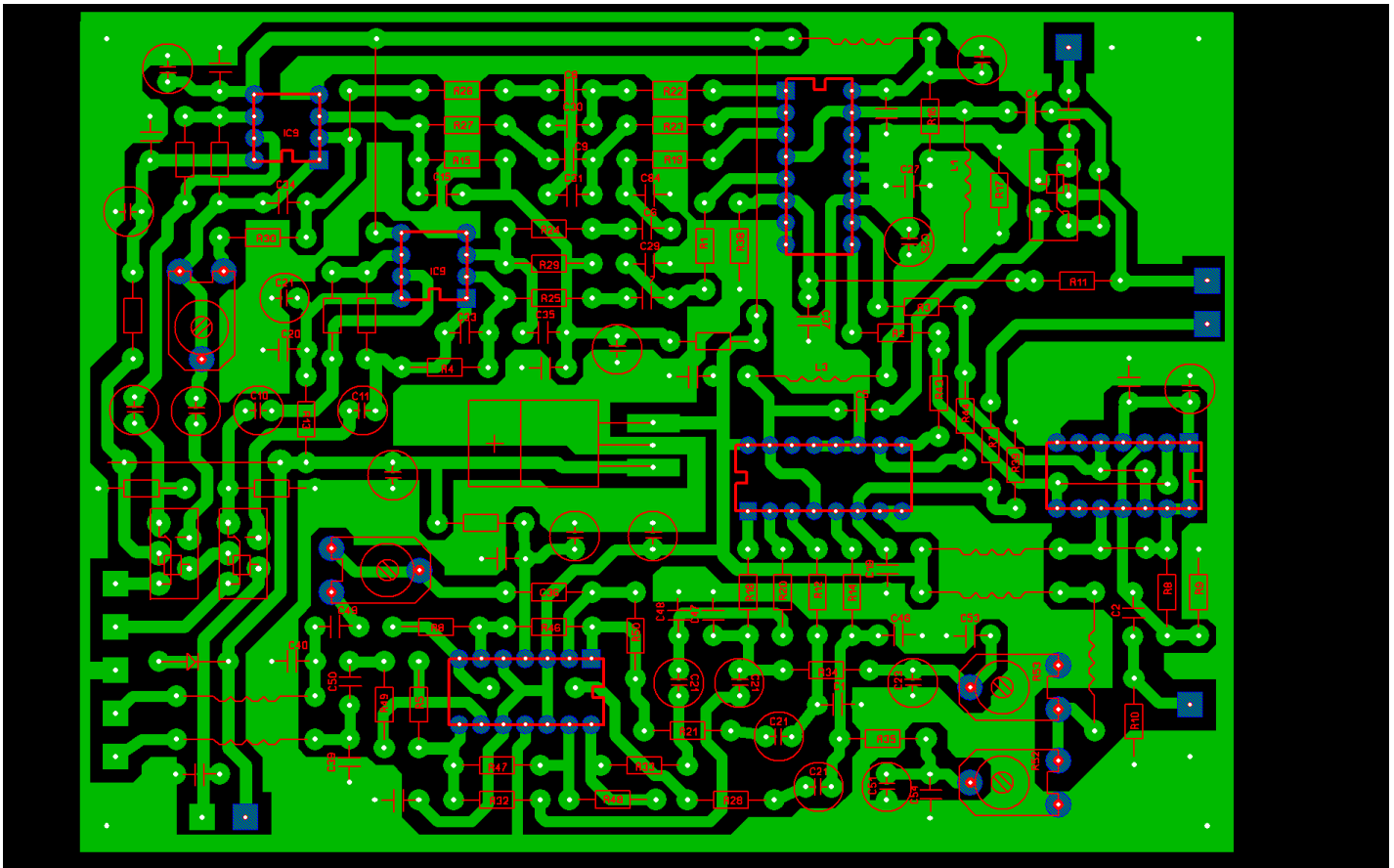
PC AMD 3100 MHz , RAM 512MB , Audio card CREATIVE AUDIGY 4

1. Sensitivity for 10 dB S/N better than 1 uV
2. Carrier suppression 60 db
3. Opposite band suppression 40-60 dB in receive and transmit mode
4. Output power 1 W realized with 2SC2078 transistor
5. Software PowerSDR version KD5TFD

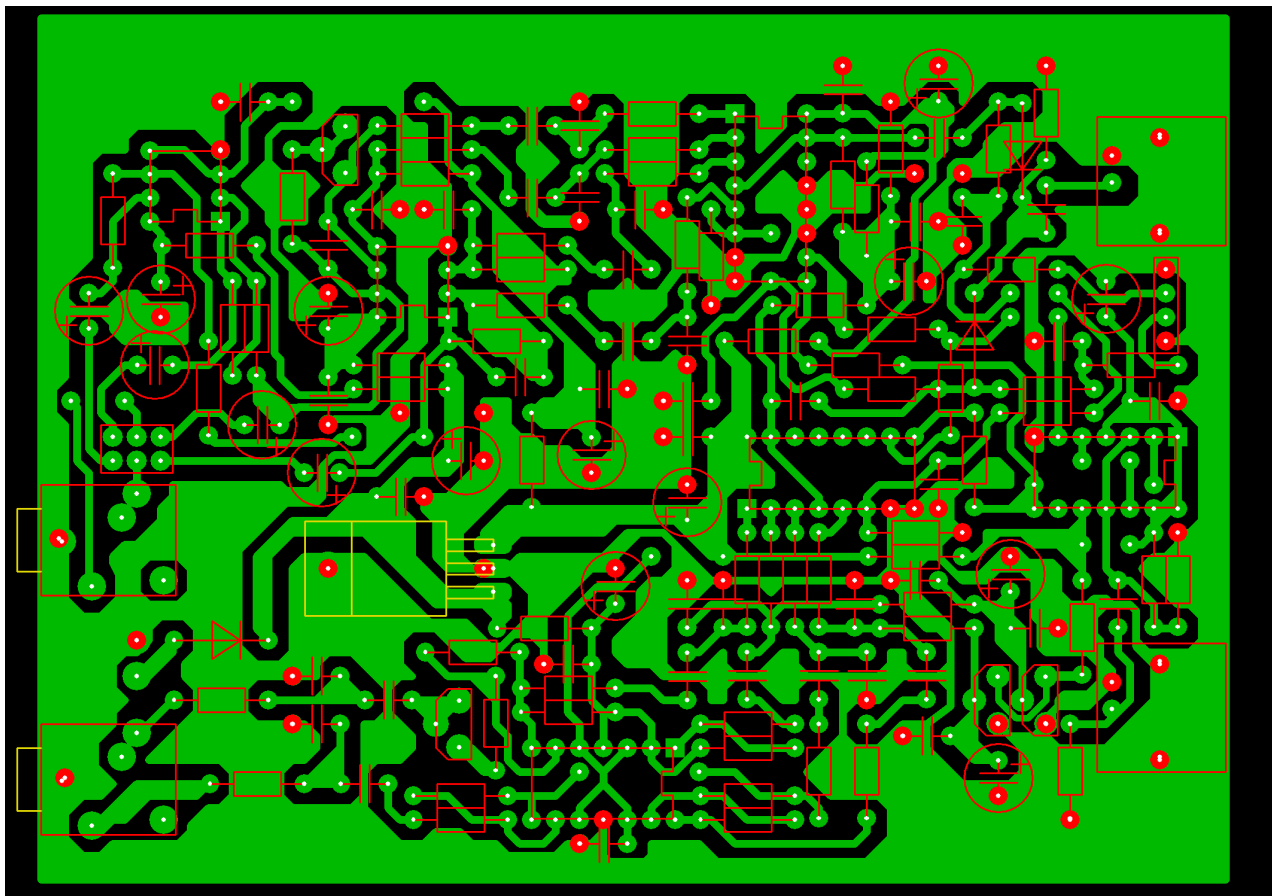
I wish you successful AFTRX1 realization and I apologize for the some possible mistakes. I made great effort to make SDR projects and share them with all who are interesting for. Send me your comments positive or negative anyway, results or photos of your realization please. In part 3 I shall publish simple QRP power amplifier and quartz XTAL oscillators for the few band operation 2 or 3? Transmitting HAM band are harmonically related (for example 14, 7 and 3.5 MHz)

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Some guys like Gennady UA6XW/9 made similar PCB for ADTRX1-V1 with little different placement and with relay switching. See his realization down first picture.



Here down is also PCB for ADTRX1-V1 made by UR3VCD



References:

1. www.qsl.net/yu1lm/homebrew
2. www.yu1lm.qrpradio.com
3. <http://forum.cqham.ru/viewforum.php?f=28>
4. Skidan@mail.ints.net T03DSP UR3IQO <http://users.ints.net/skidan/T03DSP>
5. <http://www.nitehawk.com/sm5bsz> Leif LINARD
6. <http://www.flex-radio.com> SDR1000 Gerald AC5OG
7. <http://www.njqrp.org/mbrproj/9850dds.html>

www.analog.com/en/prod/0,,770_843_AD9850,00.html

<http://www.qsl.net/pa3ckr/signalgenerator/>

http://www.k6ese.com/DDS_Project.htm

http://ham.kiev.ua/pic/dds_ham2.html

<http://www.qsl.net/om3cph/dds/rx.html>

<http://www.seboldt.net/k0jd/othervfo.html>

<http://perso.wanadoo.fr/f6itv/p2063001.htm>

<http://koti.netplaza.fi/~jonverro/ad9854.htm>

<http://www.labyrinth.net.au/~steve/freq/>

<http://members.aol.com/DI4JAL/DDS.html>

<http://hem.passagen.se/communication/dds.html>

8. *Recent Advances in Shortwave Receiver Design* Dr. Ulrich Rohde *QST* Nov 1992 page 53
6. *RF Design* 6/1995

Software LINK for SDR radio receiving and transmitting

1. www.weaksignals.com WINRAD,SDR0.99
2. www.ciaoradio.com
3. www.m0kgk.co.uk/sdr
4. www.g8jcf.dyndns.org Peter G8JCF
5. <http://www.nitehawk.com/sm5bsz> Leif LINARD
6. <http://www.flex-radio.com> SDR1000 Gerald AC5OG
7. dl6iak.ba-karlsruhe.de