

FINAL SOLUTION – Optimized HAM Sample and Hold SDR (Software Defined Radio) Receivers, Modulator/Transmitter for DSB, SSB, CW, AM, FM, DRM.... HF (30 kHz to 70 MHz) in Connection With PC Sound Card Make it Simple as Possible with Outstanding Performances–Part 3

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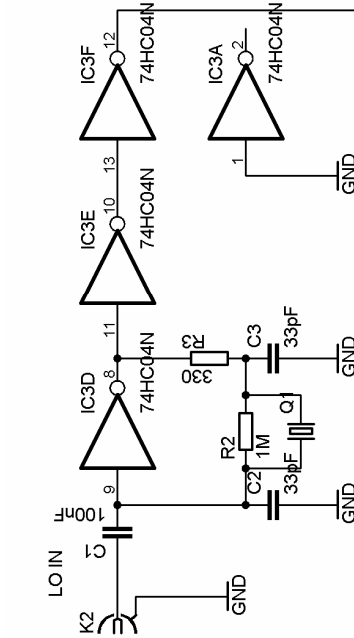
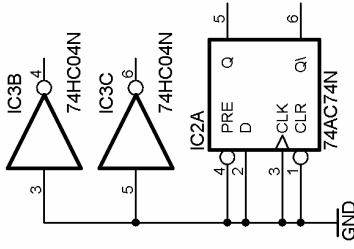
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In this article I shall describe final realization for both SDR radio receivers and transmitter. DR1A , DR2A and DT2A are with improved performances compared to the basic models with little more components. I started with some explanation in part 2. Switches have a finite resistance not 0 Ohms typical value for one 74HC4066 switch is 50 Ohms but this value depends from working frequency. This value for resistance is not problem in I/Q systems it is very important that we have a very good amplitude balance between branches. ON resistance in switches are not the same in all switches in one IC 74HC4066 and this parameter is frequency very depended also. This amplitude unbalances between switches lead to the very poor or not well predicted unwanted side band rejection. We need to have very similar audio AF branches which lead to the very well matched RC components through entire demodulated /modulated audio band. This demand is not like in classic I/Q DC (direct conversion) receivers but if we have a better match results will be better for the sure. Some unbalances are possible compensate in software but not in all programs. I started my SDR experiments with MIL 74HC4066-s on ceramic which have extremely good match between switches in one IC. All measured results are done with this IC-s 12 kHz from the carrier frequency. After that I ordered twice few new IC-s and results was not as good as previously. The results were not so good unwanted side band rejection fluctuated very much from one IC to another. I measured results between 15 dB to the 45 dB unwanted side band rejection. It depended from samples, frequency and receiver/transmitter type. Other RX/TX specifications aren't changing very much compared to the first realisation. For example IIP3 was still very good. I decided to improve SDR performances; one way was to use some newer one modern ICs FST.. PIV...CBT... which have very small switch Rds ON, few Ohms. Small ON resistance manufactory ICs achieved with new modern technology. Typically values for ON resistance are around 2-3 Ohms with adequate design switches unbalance have to be neglected. I choose hard way to keep on with IC -s 74HC4066. In article to the end I shall keep on with my FINAL solution for the SDR Radio both receivers /transmitters based on IC 74HC4066. Final solutions from my side are DR1A,DR2A and DT2A and my proposal for the builders. Results are similar to the measured previously (with extremely well match switches inside one IC) now with different ICs from different manufactories fluctuation is small. A benefit is 1-2 dB improvement in dynamic range this results is very sensitive to the measurements conditions and software program setup. I shall give also new PCB for DR2 which enable compensation amplitude unbalance between I/Q .

HF SDR Receiver DR1A

30 kHz-70 MHz

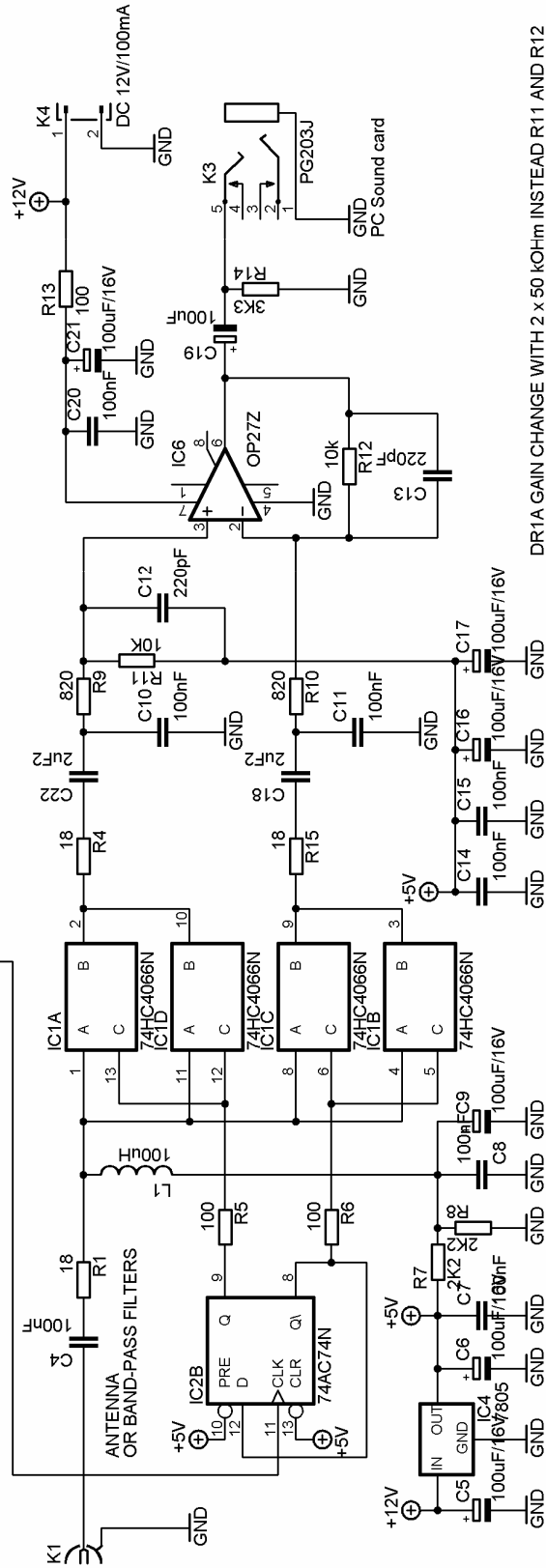
YU1LM/QRP



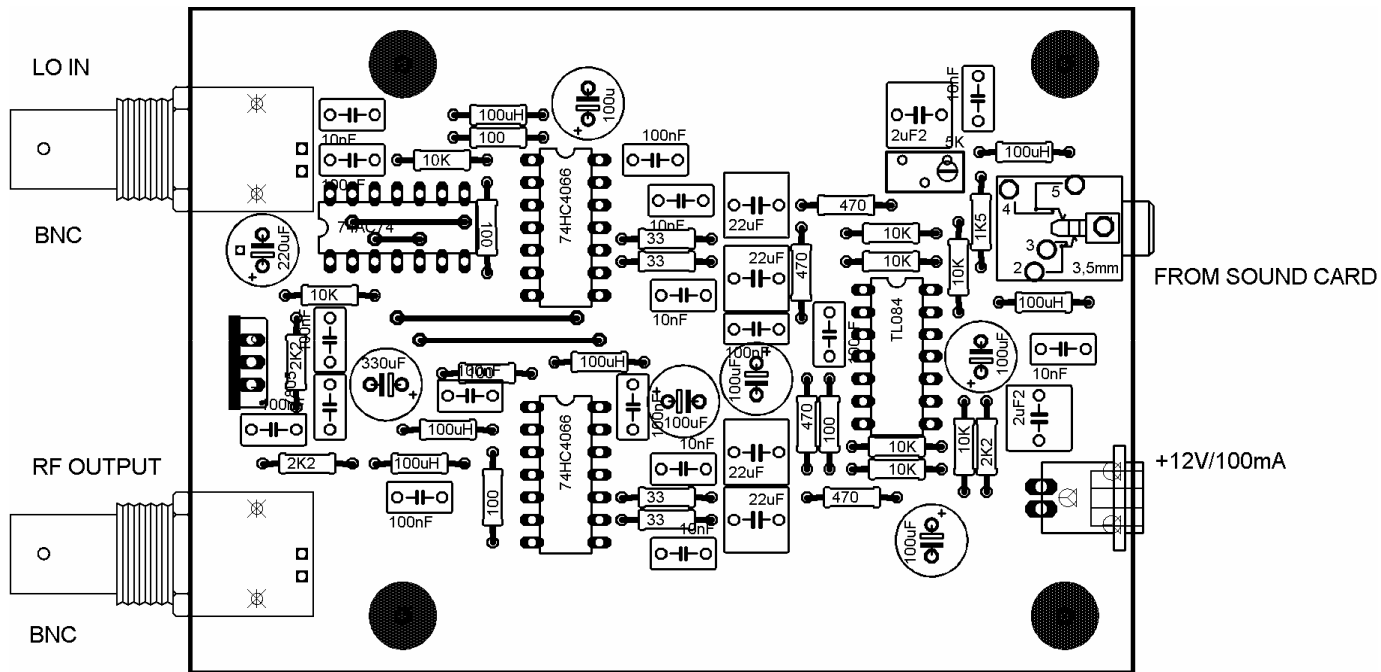
OPTION L1 REPLACE WITH R=220 OHM IN HF RECEIVER WITHOUT ANY COIL

IN CASE EXTERNAL LO MISS COMPONENT

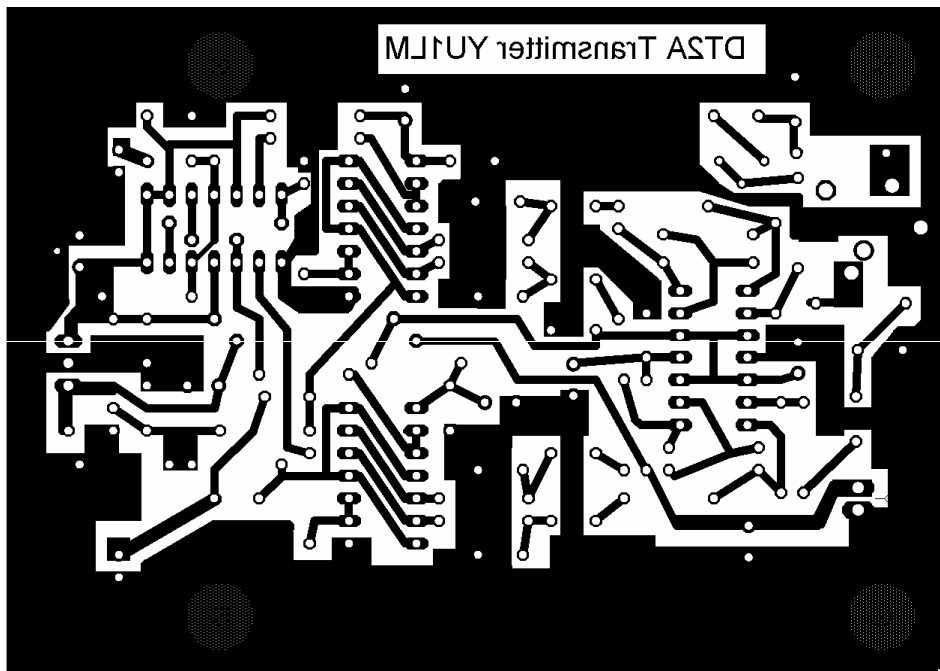
C2,3,Q1



DR1A GAIN CHANGE WITH 2 x 50 kOhm INSTEAD R11 AND R12



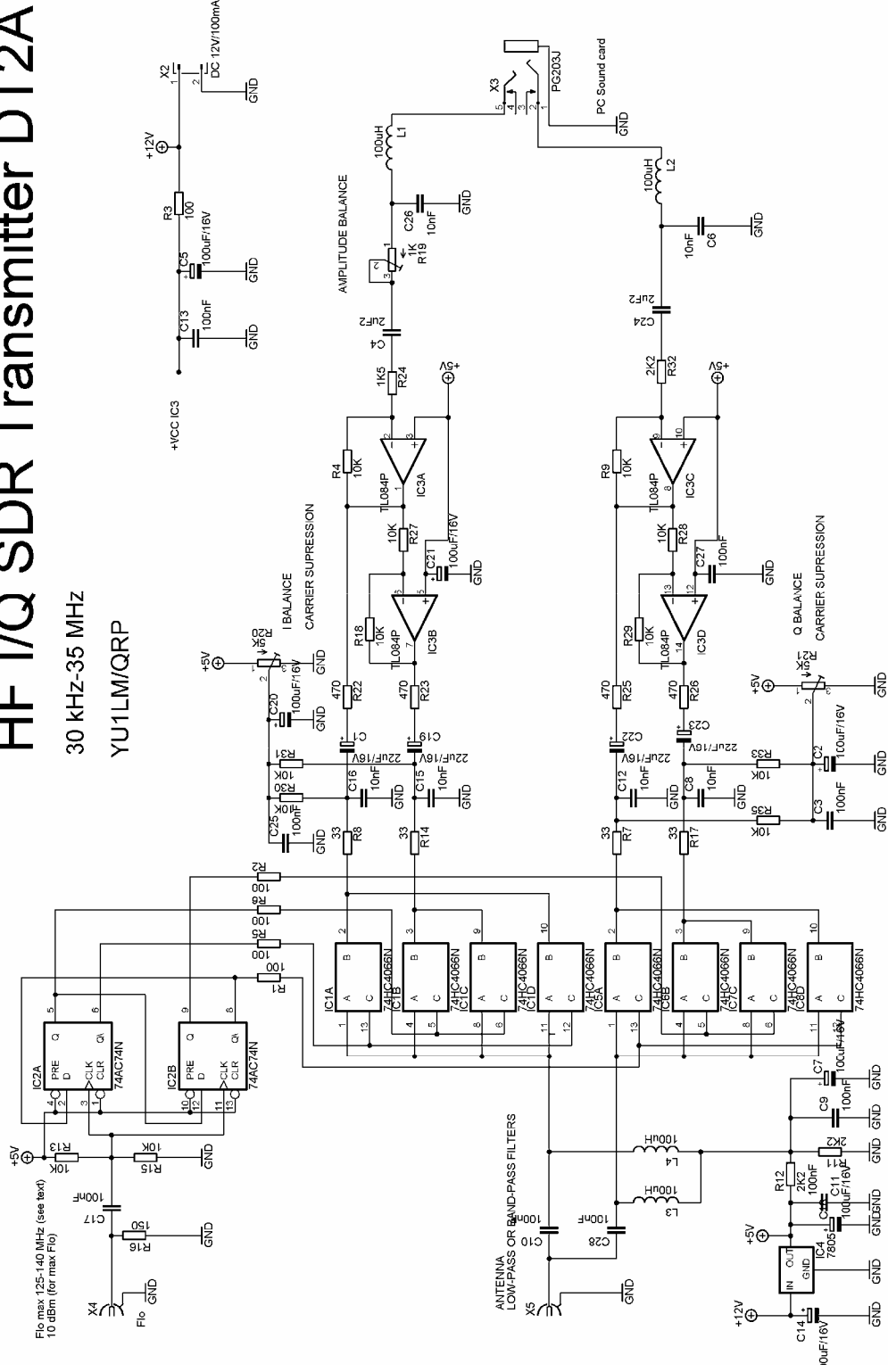
Low power HF transmitter DT2A, single side PCB dimensions are 107 x 75 mm



HF I/Q SDR Transmitter DT2A

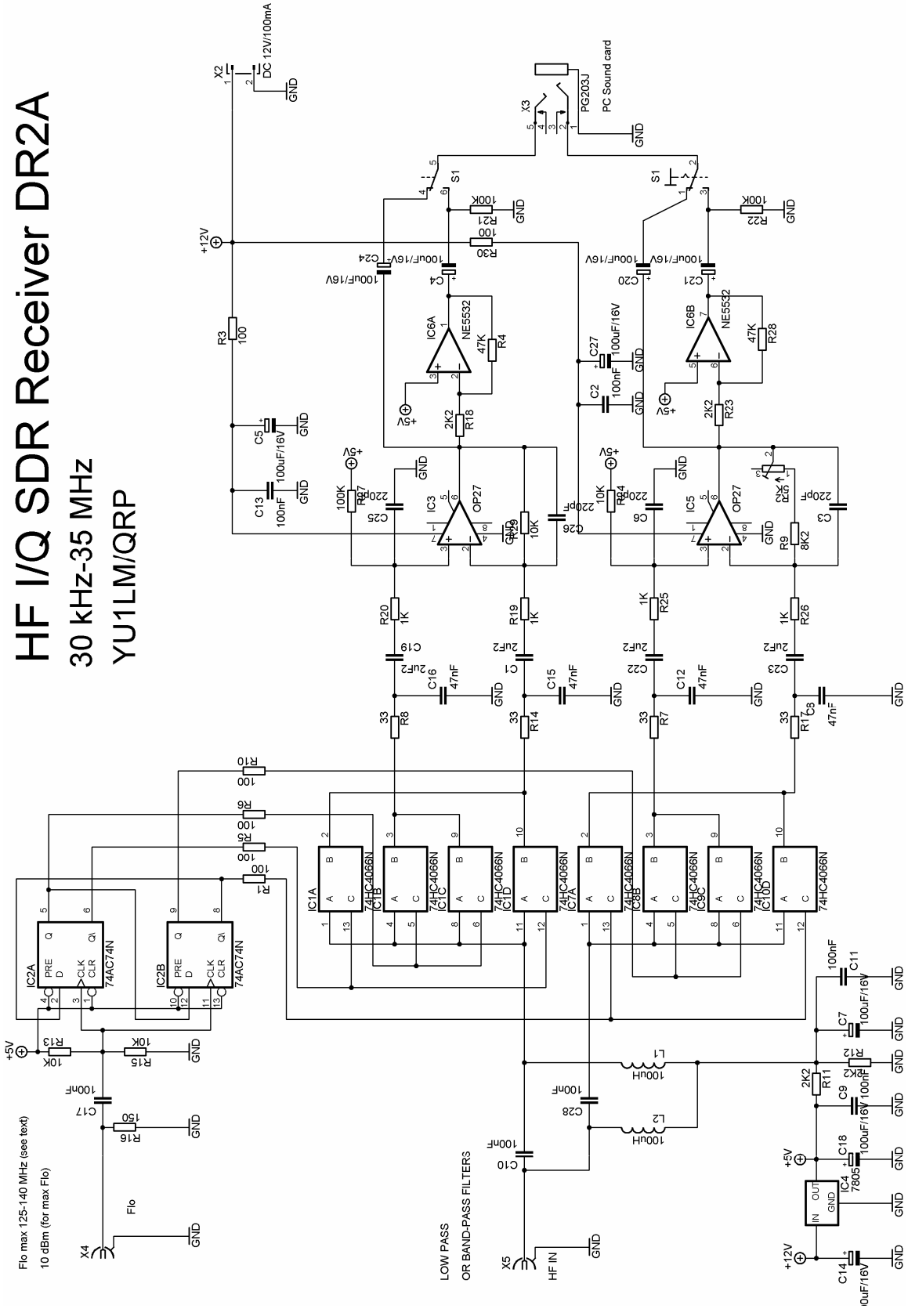
30 KHZ-35 MHZ

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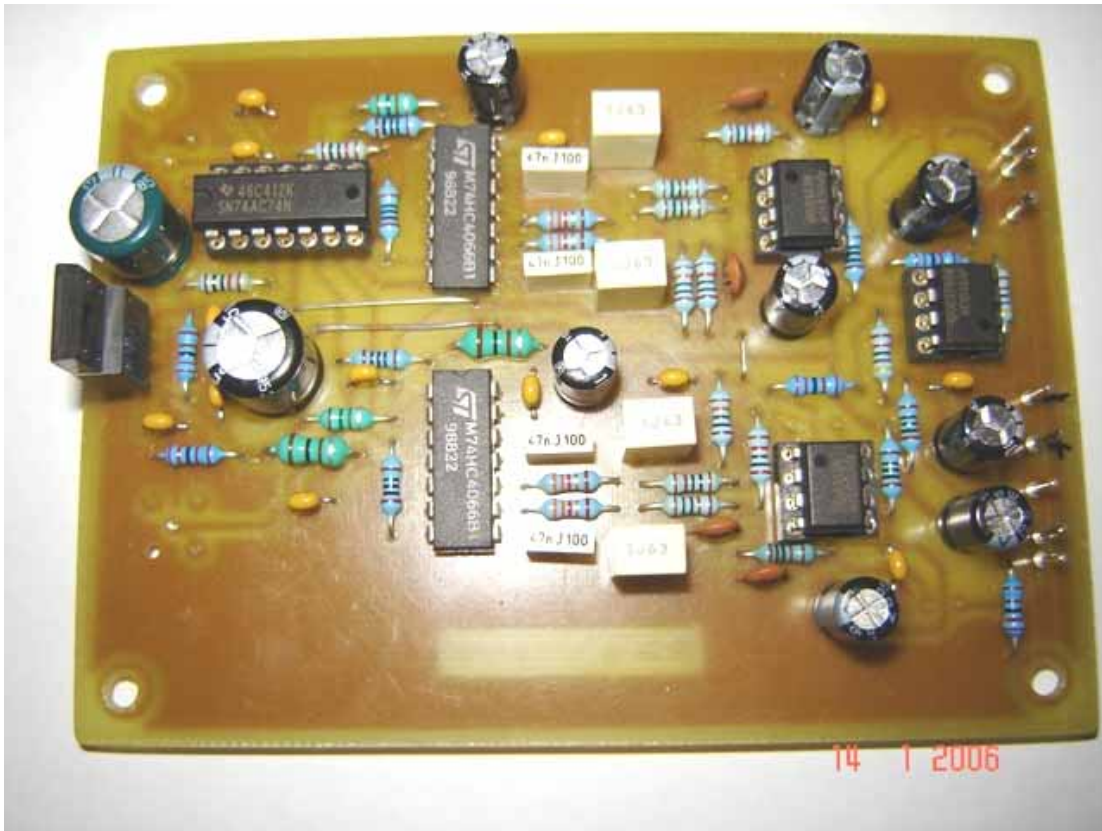
HF I/Q SDR Receiver DR2A

30 KHz-35 MHz
YU1LM/QRP



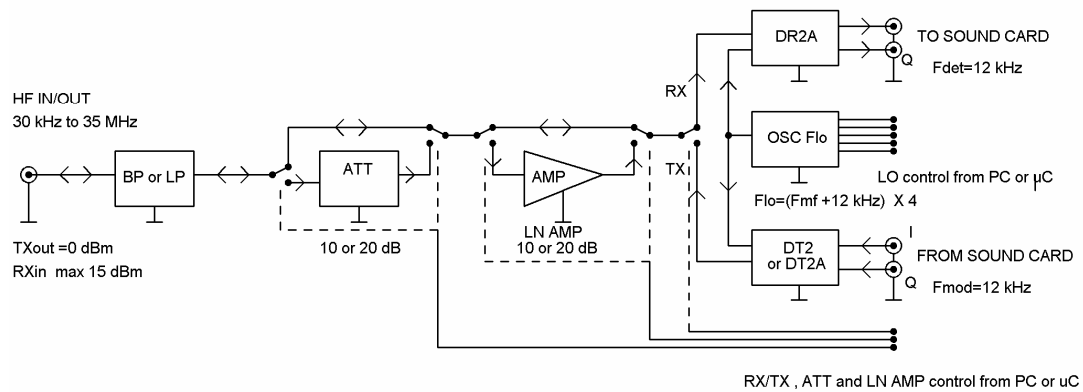
Flo max 125-140 MHz (see text)
10 dBm (for max Flo)

LOW PASS
OR BAND-PASS FILTERS

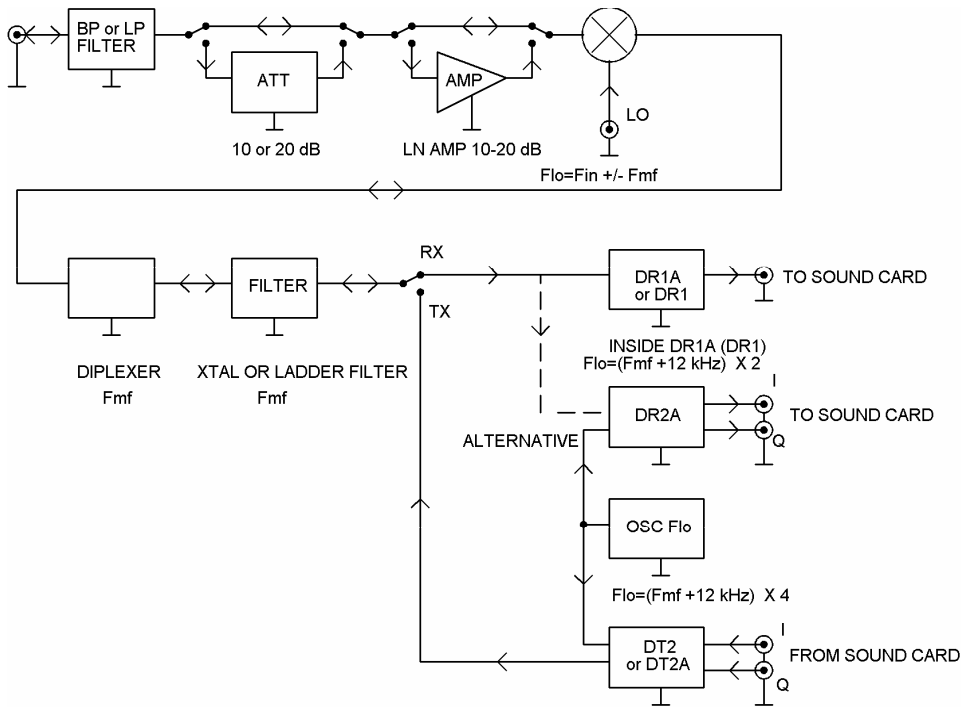


HF SDR receiver DR2A built by Batke YU1OL

Practical use SDR receivers and transmitters



USE SDR RECEIVERS AND TRANSMITTERS BY YU1LM INSIDE THE HF TRANSCEIVERS



USE SDR RECEIVERS AND TRANSMITTERS BY YU1LM INSIDE THE HF SUPER HET. TRANSCEIVERS

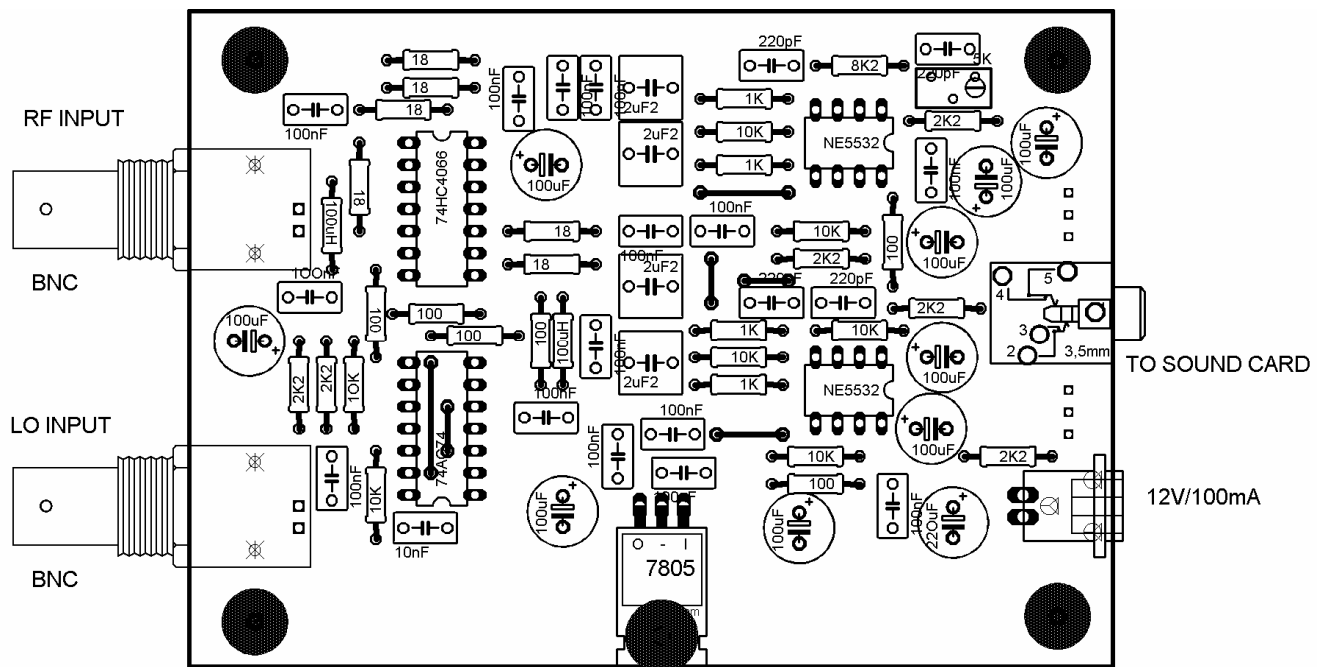
How to use SDR receivers and transmitters inside HF transceivers is question for the homebrew builders see my proposal figs up. One way is to make transceiver like Gerald AC5OG SDR1000 was do. I am waiting with big expectation new SDR software which will Aberto I2PHD release in the soon future for transmission. SDR receiver software done by Alberto I2PHD is my favorite software for SDR radio receiving and all measurements which I made ware done by this software. This realization is complicated dictated by LO realization and control interfaces. Simplest way is to use it as had been proposed by similar designs done by HAM OMs Oleg UR3IQO in T03DSP, Peter G3XJP in Picastar and W7PUA.in DSP10. In this moment I tried only second version. Results are very good but I have to do some improvement to make competent transceiver for my main task good contest transceiver. Now in this moment I can transmit only CW. I shall publish some new modules which I tested and I think that it will be interesting for homebrew builders.

My idea was from the beginning not to made big theoretical discussion about SDR radio, this is excellent done in references below, but to intrigued potential homebrew to try new technique and to see how easy is to open some new frontiers in HF radios and homebrew. I apologize for mistakes which I made also I apologize for my English it is not my native language. If you have some comments positive or negative don't hesitate write to me I wish you successful building my SDR modules.

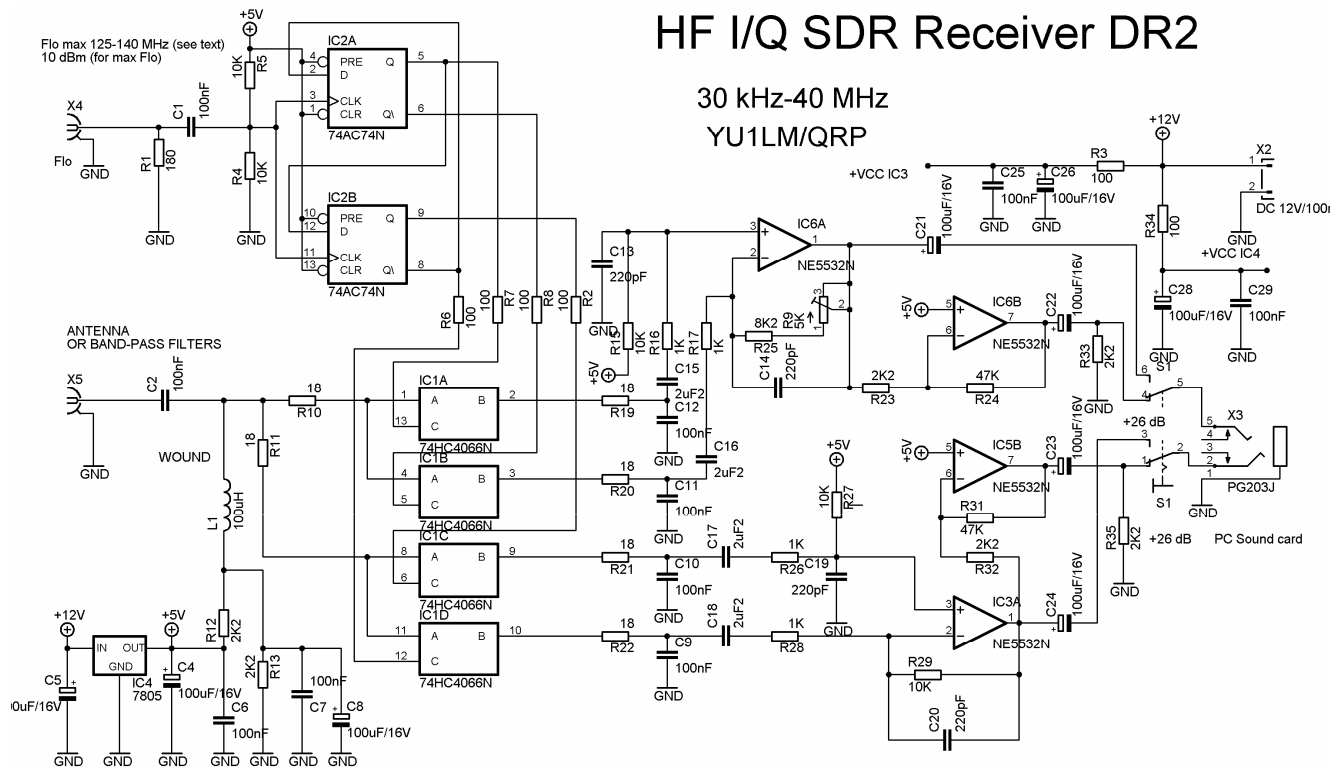
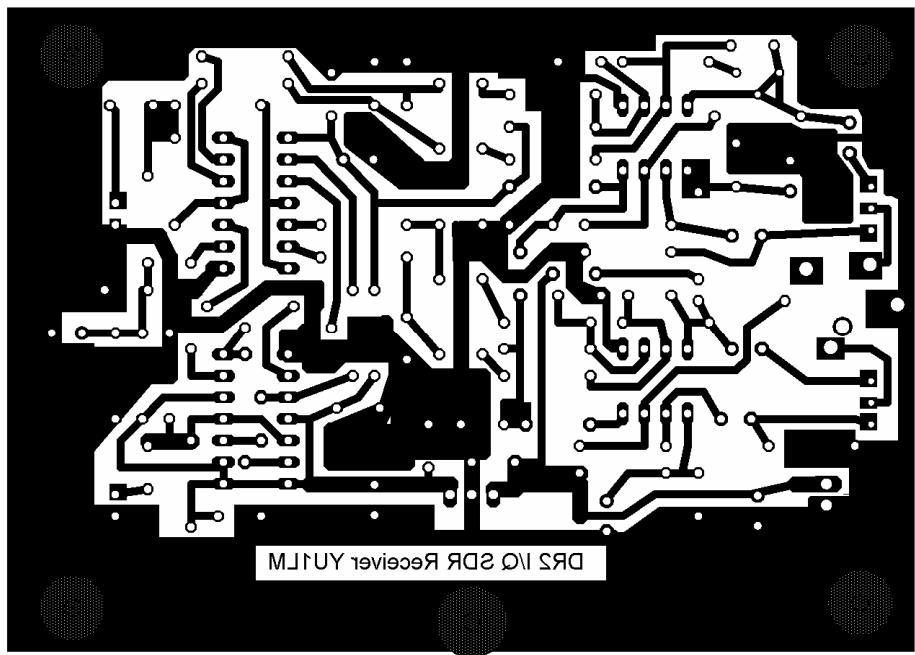
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PRACTICE

1. Some OMs wrote me and other told me that OP AMP series LM741 .LM358 and LM324 not working good inside SDR receivers and transmitters .They have very big distortions for higher output levels. I didn't found reason why these happenings I still think that is working condition correct .When I tried this ICs problem exist. At the beginning I didn't try this OP AMP because they are very noisy. Reason why this irregular work happening is still mystery for me? OP AMP which I tested and they are working correct (they are giving 8 Vp-p at the output before they are starting clipping $V_{cc}=5V$) are OP07,OP27,OP275 ,TL071,TL072 ,TL084,LF356,CA4140,NE5532 and NE5534.
2. In DR2 I permutated pins which isn't problem for work but it isn't good correspondence between schematics and PCB, thank you Mike N2EAB. Also I read wrong value for some resistors (6 colors) incorrect values degrade CMRR of OP AMP. Because of that and some new test which reduces noise I changed PCB, thank you Batke YU1OL. I made new PCB and corrected schematics see below!!



HF SDR receiver DR2, single side PCB dimensions are 75 x 107 mm



3. IC 74HC4066 is not possible substitute with other 4066 IC s in text I explain problem is frequency and IL limitation (much higher ON resistance with frequency) HEF4066 useful to 7 MHz. 74AC74, 74AC02 and 74AC04 is possible change with 74HC74,

74HC02 and 74HC04 to LO input frequency 50 MHz. CD4066 is possible use to 1.5-2 MHz. LS IC is not compatible with CMOS IC levels and behavior is un predictable.

References:

1. Skidan@mail.ints.net T03DSP UR3IQO <http://users.ints.net/skidan/T03DSP>
2. <http://www.nitehawk.com/sm5bsz> Leif LINARD
3. <http://www.flex-radio.com> SDR1000 Gerald AC5OG
4. <http://www.njgrp.org/mbrproj/9850dds.html>
www.analog.com/en/prod/0,,770_843_AD9850,00.html
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<http://www.qsl.net/om3cph/dds/rx.html>
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<http://koti.netplaza.fi/~jonverro/ad9854.htm>
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<http://hem.passagen.se/communication/dds.html>
5. *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. <http://digilander.libero.it/i2phd/> SDRadio software ver 0.95
www.qsl.net/i2phd Alberto I2PHD <http://gpsdo.i2phd.com/>
2. ik2czl@weaksignals.com <ik2czl@weaksignals.com>ik2czl@weaksignals.com
<ik2czl@weaksignals.com>Vittorio
3. www.ciaoradio.com
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

