

A Communications Receiver to Build - Part 1 of 3:

Part 1 - The Concept and the Modules I Needed to Build a Communications Receiver...

As everyone that has been a radio enthusiast knows, the ultimate acquisition for a SW listener or Ham Radio operator is to own a high end communications receiver. Being able to span the bands and listen to most anything from DC to nano waves is the ultimate goal in any radio nuts mind. I have owned many receivers over the years, but never one that is as sophisticated as a high end communications receiver. I have drooled over the catalogs with those amazing appliances, but quite simply have never been able to afford one. The unfortunate part of acquiring one is that they cost an arm



and a leg and perhaps a spleen and a kidney or two. I have built a few over the years but they never performed quite as well as those amazing Icom receivers did and certainly didn't have the range that high end receivers did. Then someone invented the Software

Defined Receiver (SDR)...

Most manufacturers have adopted the direct sampling SDR as their basic building block for engineering great performing receivers today. Icom, Yaesu, Flex etc. have all adopted them and there are more to come. Instead of relying on the superheterodyne receiver design that has been the mainstay of good receiver design for decades, they went with the SDR with its inherent lower noise figure and ability to be everything on a chip thus reducing the overall cost dramatically and complexity with feature rich devices being the result.



I bought my first SDR a few years ago. It was a RTL-SDR that cost about \$35 and worked well but was prone to birdies and overload. I reduced much of that problem by putting a dedicated HF up converter from Nooelec ahead of it. It worked well and I used

it as a band scope receiver on my computer with the antenna input attached to my Kenwood RX input circuitry for awhile. After awhile I bought a RSP1 from SDRPlay and installed it in place of the RTL-SDR. The Kenwood 590S is controlled by Ham Radio Deluxe which is shown as the bottom of the display. It gives me complete control of everything important on the radio



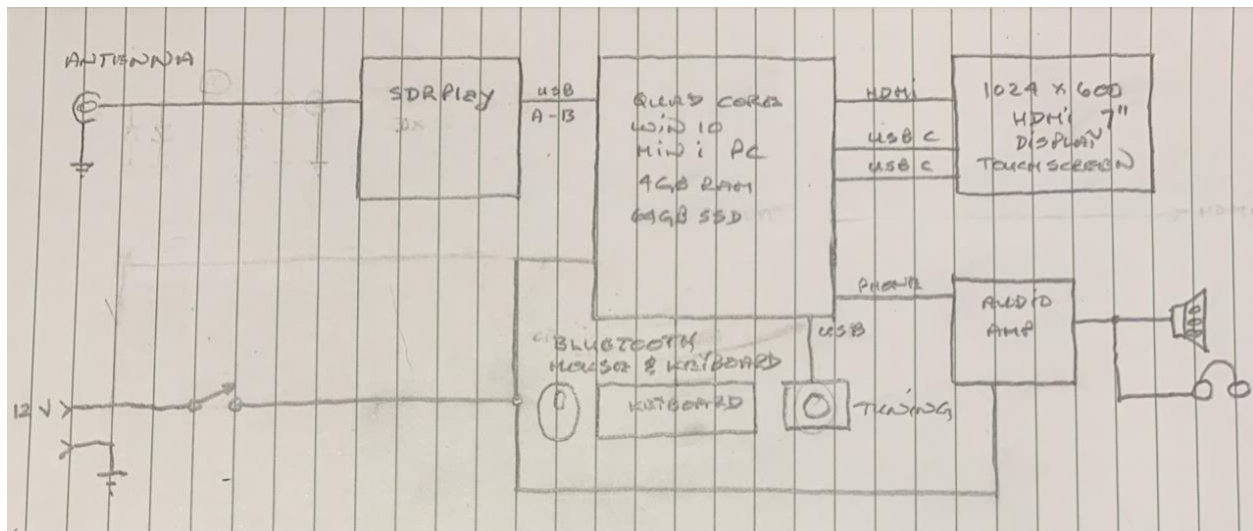
from software. Above the 14.228.00 shown on the display is a shot of HDSDR which is integrated with the Ham Radio Deluxe and anything I change on it is reflected on the bottom display and thus the Kenwood radio. I put this all together about five years ago and it works flawlessly. It not only gives you control of the radio but also provides another, high end receiver with its superb weak signal capabilities through the computer's headphone jack. Here's what it looks like on my computer:

But the nagging desire crept up into my mind that I really didn't own a real, stand-alone communications receiver. So, I put together a want list and here it is:

1. Receiver must cover 50 KHz to 2 GHz continuously
2. All mode, AM, USB, LSB, FM
3. Digital touchscreen display - HDMI minimum 1024x600
4. Must have a tuning knob and not just rely on the touchscreen for tuning
5. Powered by 12 volts
6. Must have both speakers and a headphone jack
7. Must be controllable with a Bluetooth mouse
8. I must be able to input frequencies with a Bluetooth keyboard
9. Must be able to run various versions of software (HDSDR, SDRuno etc.)
10. Must run on a MS Windows 10 operating system
11. The computer must be physically small and have lots of I/O to work with such as video, audio and USB
12. The entire unit must fit into its own case and have an attractive front panel display

So that is the wish list that I have put together for my communications receiver. I designed it around the SDRPlay RSP1A and it does the job nicely. Fortunately, all the parts and pieces to put one together are available either from a hardware store, Amazon and GPS Central, Radio World or other amateur radio stores including SDRPlay themselves out of the UK.

So, here's the block diagram I developed before I built this receiver:



The next trick was to source the pieces to make this thing and I was successful in finding them all in a few days. Here's the list:

1. Mini PC with HDMI output, audio output, Bluetooth, USB ports and Windows 10 installed and that worked on 12 volts. Beelink T4 mini with Wifi - Amazon \$198.45
2. Portable monitor with Acrylic Case 7 inch screen -IPS Capacitive Display 1024x600 and compatible with Windows 10 - Amazon \$87.13
3. SDRPlay RSP1a - GPS Central or Radio World - \$159.99
4. Speakers - Gikfun 2" 4 Ohm 3W Full Range Audio Speaker Stereo Woofer Loudspeaker with 3.5mm Audio Cable Extension with Volume Control DIY Kit EK1755 - Amazon \$15.98
5. Encoder - Gikfun rotary encoder with switch with knobs - Amazon \$12.98
6. A 7 port USB 2.0 Hub for connecting everything together without using all the USB ports on the computer - found it in my junk pile - Try Amazon or flea-market or thrift stores
7. A package of short USB A to USB B cables. 1 foot long - Amazon \$47.82 (Ouch expensive)
8. An old USB MS mouse. Pull it apart and remove the scroll wheel and replace it with a rotary encoder - Try your junk box or thrift stores for old mice
9. The enclosure - This will be a separate subject on how to fabricate this in our 3 part series.
10. A tuning knob. I had one in my junk box but they are available at flea markets or perhaps a volume knob off your stereo receiver would work too. Just don't tell the XYL where it went

There are lots of other parts involved but we will leave that for another part. Here is what the whole device looks like right now and I might say I am delighted with the results:



As you can see I am running HDSDR on the computer and if you look at the inside of the case, everything fit in nicely with lots of room for expansion. The SDR is on the left and the computer is on the right mounted on the walls of the case. The 7 port USB Hub is in the middle and the speakers are on the left. The speakers come with a small in-line amplifier so that takes care of having to source a USB powered amplifier. It provides room filling audio that is clear and easy to listen to. The radio is sensitive and works perfectly and

exactly as I wanted it to. I now have a 50 KHz to 2 GHz all mode communications receiver that didn't break the bank and works as well or better than the expensive ones. If you are not happy with the performance, just upgrade it to different software.

Part 2 of this project will be dedicated to fabricating the aluminum case that it all fits into.

I wanted to mention that I am creating a new front panel for the radio by learning how to cast in plastic. It will be another part of this fascinating receiver project that I can show you how to do to finish your electronic projects off and give them professional looking results. My friend on the coast suggested I put the whole thing into a wooden cabinet and that might be a nice touch too. We will see.

