



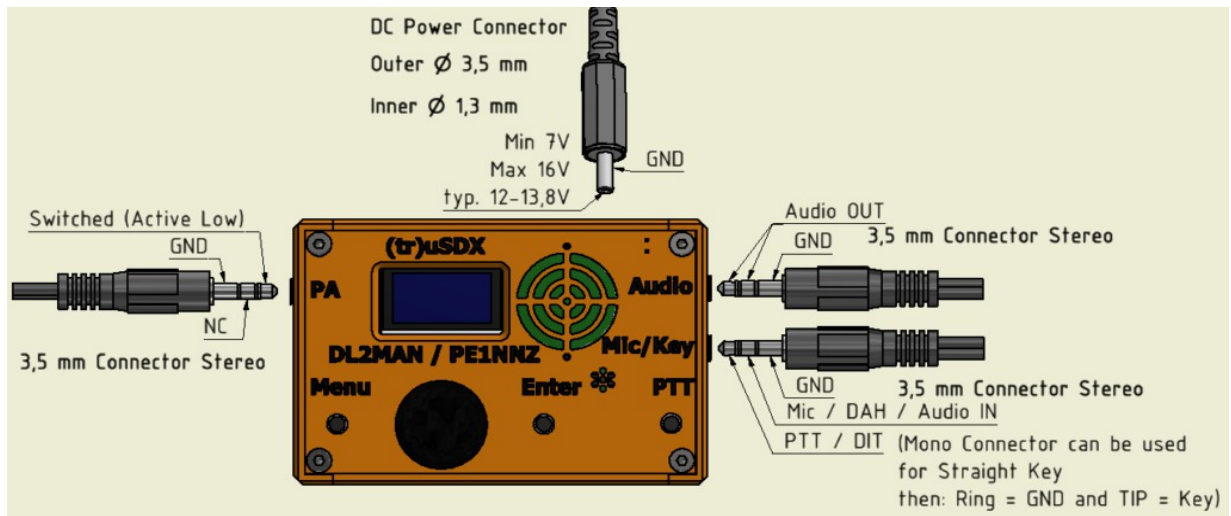
Overview

The (tr)uSDX is an interesting and very small radio, designed primarily by Manuel, DL2MAN and Guido, PE1NNZ. It's a variant of the uSDX project, which itself started out as a modification to the QCX, an Arduino-based CW only transceiver. I won't attempt to properly describe its design or working, as I would probably make a mistake – but briefly, it's a true SDR transceiver, with all modulation and demodulation done in code on an Arduino style microprocessor, rather pushing the utility of these tiny chips to the limits. All the further information you could want is online, albeit spread over a few sites.¹

As standard, it covers the 80, 60, 40, 30 and 20 meter bands at 4-5 watt output power, provides SSB and CW, built in power and SWR measurement, CAT control over USB, variable RX bandwidth... quite a lot considering it's tiny size and low cost. A microphone is built in, so it can be used handheld style - works quite well. Another interesting feature is the possibility of powering it via either a USB socket or a 7-14V input. 5V USB only gives around 0.5W TX power, but it's still possibly useful to have. Current draw is given as 80mA on RX, and 500mA on TX.

Going back to band coverage, the firmware has options to cover either the standard 'low band' set as above, 'high band' (20, 17,15,12,10m) or 'Classic' (80, 40, 20, 15, 10). Obviously, the filter values need changing to match – so you can't change on the fly. Again, the website has the full details. I might mention that not

only the FETs but also the capacitors are critical – one can't just use any old SMD parts.



I purchased my (tr)uSDX as a kit from the eBay seller in China recommended by the developers. Total cost, including the enclosure and postage, was just over \$200 AUD. You can also buy it pre-assembled, although I suspect the final alignment would still need doing.

Unpacking

Photo1

It arrived neatly packaged in a cardboard box so small that I wasn't sure if it was the radio! The small size is still surprising to me – each of the two circuit boards is only a little larger than a credit card.

I unpacked everything and laid it out for a photo.

Photo2

It's all there! I rather expected it to come with a DC power connector, as the supplied surface mount socket is a slightly unusual size. It didn't, but Jaycar came to the rescue.²

The antenna connector is an SMA, which is easily adapted to a SO239 or BNC depending on your preference.

It comes with very bare bones sheet of 'instructions' which are still useful when winding the coils.

Construction

The website, dl2man.de is where all the schematics and so on are found, as well as links to Youtube videos showing the construction and tune-up being done. Very useful. I built it up step by step, watching each step in the video, then pausing and doing it myself. As you can see in the photos, all the SMD parts are pre-assembled, which doesn't leave that much to do. The most tedious part is winding all 11 inductors and 2 SWR circuit transformers. At first, I thought there was an error in the printed instructions, as it gave 1:7 turns for T1, and 3:21 for T2. Whereas in the video, both were 1:7. It turned out that the 3:21 ratio was a recommended modification³ to improve efficiency. I'll come back to these transformers a bit later... Another bit that needs doing is a modification to the OLED board – a little fiddly but quite easy.

Basically, assembly was straightforward. I think I spent about an hour on a Saturday morning, then another hour or two in the afternoon. At this point it was pretty much all in one piece. The supplied enclosure is 3D printed, and quite a nice design in my opinion. Easy to assemble and take apart again, but sturdy too. I'm not quite sure whether all the screws will grip properly though (mine is still not fully assembled) but that doesn't seem a problem in practice.

After checking it over for obvious mistakes I connected it to a USB charger and held my breath... and to my relief it came to life! I connected an antenna and a speaker (I didn't have the tiny internal speaker connected yet) and was able to tune across 40m. All seemed fine on receive, except being a bit off frequency. This is normal and easily corrected with the reference frequency in the menu. I just did it by ear listening to an on-frequency station, but obviously you can do it more scientifically.

First contact

This was the Lighthouse Weekend, so it wasn't long before I heard a lighthouse activator calling CQ... I decided there and then (probably unwisely) that the first TX test may as well be on air, instead of a dummy load! I put out my call – and he came straight back to me. Yippee! Remember, I was running on 5V still – so I really was using 'flea power'. But conditions were good, and I got a 4/3 report from Greg, VK3DX, at about 04:31 UTC. I was happy! I left it at this point to catch up on some other things.

Mistakes

When I came back later, I hooked it up to a dummy load and did some testing, recording the audio on my Icom and playing it back. I was a bit disappointed, as it sounded quite fuzzy and crackly. I wasn't expecting it to sound perfect, but it seemed a bit too bad. It has a couple of settings in the menu that affect the audio, 'TX drive' and 'noise gate' both of which do more or less what they say, on a software level. But I couldn't seem to improve it much. So I left the audio problem for the time being, and tried out the internal power and SWR measurement, and quickly found that it didn't work. To cut a long(er) story short, I discovered that I'd wound the SWR transformers out of phase. (Both of them...!) I also found out then about the modification I mentioned earlier. I actually ended up using 2:14 turns on T2 as I read that it should work fine too, and it's easier to wind. I found it rather difficult removing and replacing the transformer leads, as the board has plated-through holes. After removing it, I was left with solder-filled holes which made it hard to refit. It's just a matter of the right technique with a solder sucker – but it took me a while and one broken PCB pad before I got the hang of it. The metering worked though, after all this. Interestingly, it can also display transmitter efficiency, partly intended I think as an aid to tuning the output stage.

The next day I fitted the little on-board speaker (it actually works ok) and did some more testing.

For whatever reason, the TX audio seemed better at this point. Still distinctly lo-fi, but usable. I don't know what I changed – it wasn't the transformers, as I tried it after that. I did consider whether connecting the internal speaker may have somehow removed a path of RF feedback. Also, the patch lead I was using initially had a dodgy connector... annoyingly I can't be sure where the difference came from. Slightly worryingly, there are a couple of reports on the forums of worse-than-usual audio – so it's just possible that there is something in the design that's open to building "tolerances" or something. Or, more likely, it may just be plain user error!

It has only just sufficient audio power to drive a speaker. Possibly more suited to headphones or an amplified speaker. I discovered a little later that this is indeed the case – the internal speaker is more meant as an emergency backup when you've forgotten to bring headphones... it does work though!

Tuning the filters

I made a few more contacts (well, it needed testing!) before turning my attention to the tuning-up video. To do it properly, you need a nanoVNA (recommended) or something else to check the pi filter that notches out the second harmonic, before you can turn your attention to the 'serial resonance' filter, which is done by aiming for 4-5W output power and max efficiency, using the built-in metering. In both cases, tuning is done by spreading or compressing the turns of the relevant inductor (refer to schematic), or, if necessary, by adding or removing turns. I needed to remove a turn (more desoldering...) of the series inductor for 40m to get the power up to spec, and the same to the 80m pi filter inductor to get the 2nd harmonic notch in the right place. As I write this, I'm yet to tune 30 and 20m properly, although they do work ok. I do recommend watching the video, as it makes it quite easy to do. It seems quite easy to push the power to at least 7 watts, but apparently one shouldn't as it leaves the output mosfets vulnerable to high SWR and reduces efficiency.

Transmitter purity

I can't give many meaningful measurements here, but my observations agree with those I've read – basically that harmonic suppression is fine, but there is some distortion causing splatter outside the normal bandwidth. The redeeming point to me is that it is QRP – so in most situations I don't think it should be much of a problem. It does have provision for connecting it to a linear amplifier though – I'm not so sure about this! Having said that, in CW mode it's probably fine

Using it!

In my opinion, it's quite a user-friendly radio in operation. Not everyone thinks so, apparently. At first it seems like you have to enter the menu to adjust everything, even volume, but it has quite a few handy shortcuts, shown in table form on the website.

Here's a few:

Clicking (as in a short press) the tuning knob steps through the tuning steps. A double click of the same steps one by one through the bands.

Holding the tuning knob down while turning it changes the volume.

Clicking the 'ENTER' button steps through modes and double clicking it goes through the receive bandwidth settings.

A long press of the 'ENTER' button brings up the RIT, while two consecutive long presses toggles VFO A and B.

There's more but this covers most of it. Occasionally it seems to mistake a press of one button for another, but it's rare enough not to be much of a problem.

The receiver's audio is quite good into headphones or an active speaker. The receiver noise floor seems a bit high, but considering that it is a QRP radio, I found it was more than good enough to hear any stations that I could reply to. I think it's fairly sensitive with both attenuators off. There are two different attenuators in the menu. I haven't found out yet what the difference is, but the one with larger steps is useful with very strong stations as the AGC (which can be turned off) seems to get a bit overwhelmed. A well-known defect is that when using the internal speaker, turning up the volume beyond a certain point causes a sort of drone – there's an unintentional feedback loop somewhere. I haven't found out yet if this can be cured, but it isn't really a showstopper in most cases. It's not a problem with headphones, or an amplified speaker, as there's no need turn up the AF gain so much.

The 'TX drive' setting in the menu is effectively a combined mic gain and compression adjustment – I've read that setting it to 1 gives no compression, while maxing it to 8 gives what I think is described as 'constant envelope SSB' meaning it's compressed to the point where there is no amplitude variation at all! It sounds as you'd expect... not good. I found the sweet spot so far to be around 2-3, with the 'Noise gate' turned to minimum. But it would probably depend on what mic is used. I've been almost entirely using the built-in mic, which works just fine.

I haven't tried any FT8 or other digital modes yet. The rig has CAT control over USB, which I haven't really investigated yet. There are reports of it being unreliable, but also of it working perfectly, so I'm expecting it to work - after the usual possible issues getting serial comms set up! But I might not bother, as VOX is also available, so it should work well to just connect audio and set the frequencies manually.

My thoughts

I'm looking forward to getting out portable with it. I just need to come up with a suitably light and small antenna to go with it! I'm going to use a pack of 8 AA batteries to start with and see how long they last. The whole setup should be nearly pocketable or would more practically fit in a camera case or similar.

Here's quick list of pros and cons, from my point of view (at present).

Pros

- + Very small and light
- + Multiband including 80m and 40m, my favorites for general use
- + Sturdy and easy to use
- + Built in SWR meter
- + VOX should be useful for quick and easy setup for digital modes

Cons

- Transmitted audio not perfect
- Audio feedback at higher volume levels
- Doesn't cover higher bands (in the version I built)
- Reports of CAT control being unreliable.
- Can't use 60m in VK (this isn't really a serious con)

For me I think it'll work well for portable use, the pros comfortably outweighing the cons. Especially at the price. But it may not suit everyone.

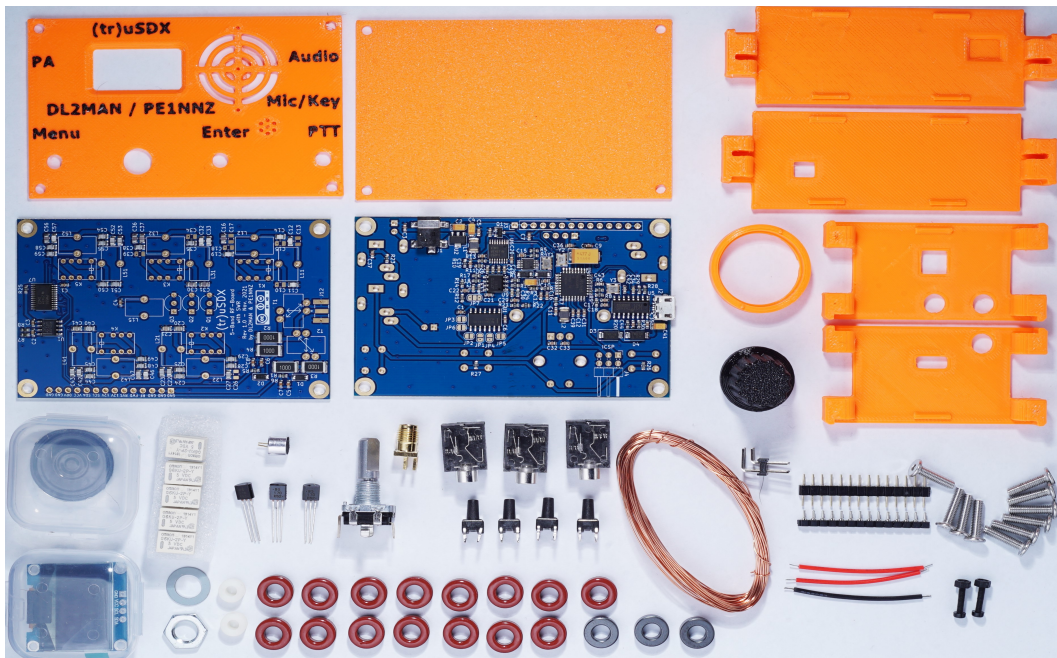
I wrote this article in the hope that it might be found interesting, but I may well have missed out something important... Feel free to email me at stevencallsign@gmail.com if you have any corrections or queries. (insert my call in place of the 'callsign' please!)

Thanks for reading!

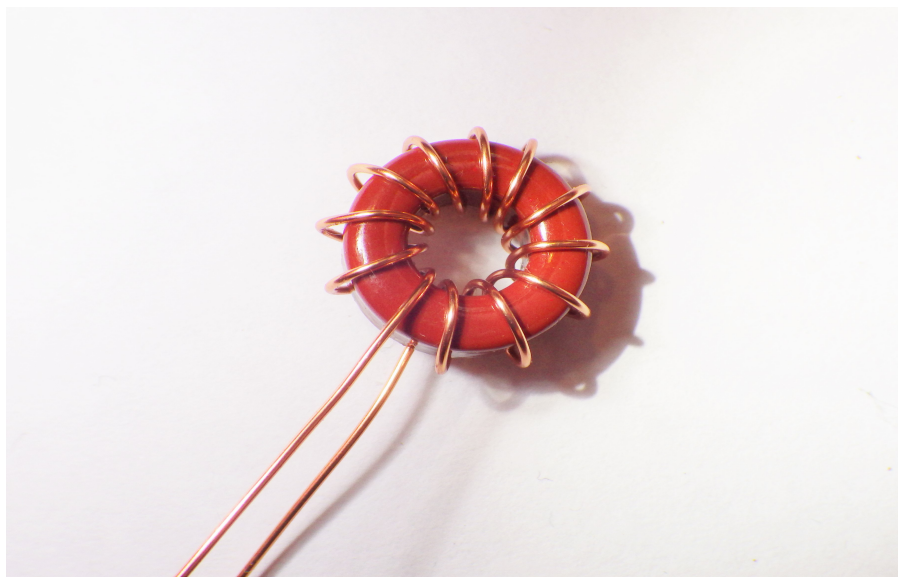
73 from Steven VK2STG

References

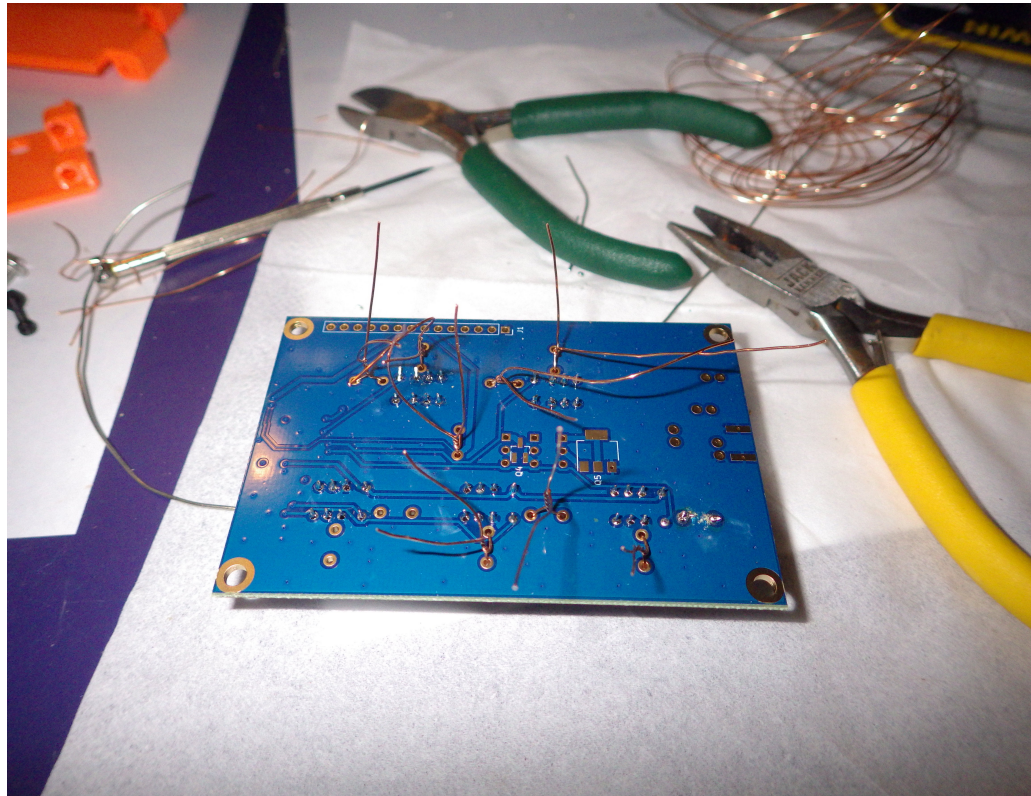
1. www.dl2man.de and <https://forum.dl2man.de/> (these two are more or less 'official') and also the uSDX group, as this is where things started, <https://groups.io/g/ucx>
2. Jaycar part no. [PP0506](#) seems a good fit.
3. <https://forum.dl2man.de/viewtopic.php?p=3160&hilit>



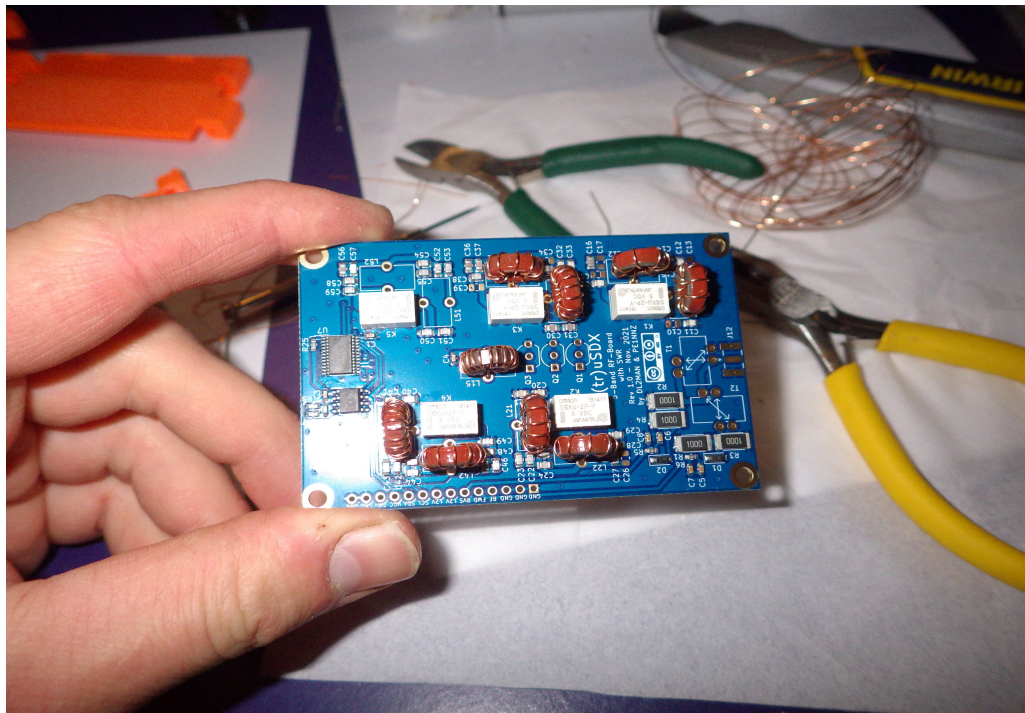
Basic Kit Layout



An inductor



Mounting the inductors



Board construction in progress



Screen