SunSDR2 pro review

By Andrew Barron ZL3DW

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Expert Electronics sites

www.sunsdr.com/ or eesdr.com/en/

Downloads and manuals

http://eesdr.com/en/products-en/transceivers-en/sunsdr2pro-en#documentation

http://eesdr.com/en/products-en/transceivers-en/sunsdr2pro-en#downloads

Dealer sites

sunsdr.eu/product/sunsdr2pro/

www.wimo.com/sunsdr2-pro-sdr-transceiver_e.html

www.cheapham.com/sunsdr2-pro-transceiver/

http://www.hamradio.co.uk/sdr-software-defined-radio-expert-electronics/expert-electronics/sunsdr2-pro-transceiver-pd-5828.php

Review Type: High level with a few basic tests

SDR Type: Compact DDC SDR QRP+ transceiver (HF and VHF)

Review Scope

The SunSDR2 Pro is a direct digital sampling QRP transceiver which is able to work on either the HF bands (90 kHz to 80 MHz) or on VHF (80 MHz to 160MHz) including the 2m amateur band.

Reviewer

Andrew Barron ZL3DW: licensed amateur since 1975, keen SDR operator and author of 'An introduction to HF software defined radio.' For more information please see http://www.qsl.net/zl3dw/ or email me via SDRzone.

First impressions

First impressions, the radio arrived very well packed. It was double boxed with the radio box inside a standard DHL box. There was ample foam packaging around the radio. The radio is quite small and fairly heavy. It looks to be very solid and well constructed. It measures about 167 x 180 x 50mm and it weighs 1.5 kg. I am impressed with the build quality. The finish is good and the labelling is good too. There is a serial number sticker on the bottom. The serial number consists of both a date code and a number. The original SunSDR2 had BNC antenna connectors but the pro model has mini UHF connectors which were new to me. They are gold plated and seem to be a quality connector. The other connectors on the back are gold plated SMAs, plus an RJ45 Ethernet port and a connector for the ALC.

Although Expert Electronics, the company that makes the SunSDR radio is based in Taganrog, Russia, the radio like a lot of consumer electronics is actually made in Taiwan. The review radio was shipped direct from Taiwan.

What's in the box?

Inside the box there was the radio, two 3.5mm to 2.5mm stereo phone adapters for the front panel microphone and headphone jacks, a 1.9m DC cable pre-terminated with the DC connector at one end, a 1.8m Ethernet cable, and a 340mm PL259 female to mini UHF male adapter cable. I thought that it was a nice detail that all connectors had protective caps on them, even the Ethernet and 'Mic2' RJ45 ports.

There was no documentation shipped with the radio. I expected at least a sheet referring me to the web site, or a quick start guide. Maybe it was just because the radio was sent to me specifically for this review.

Anyway it was no problem. I downloaded the software ExpertSDR2 v1.0.2 for SunSDR2 and the 15 page getting started guide. Although the documents are probably similar, you should make sure that you download the software and documentation from the SunSDR2 pro page http://eesdr.com/en/products-en/transceivers-en/sunsdr2pro-en#documentation, not from the earlier SunSDR2 page.

As well as the getting started guide there is a manual in the German language, a document on how to use the radio with CW Skimmer, a document on how to use the radio with a linear amplifier and a product brochure. It is well worth while downloading all of the English language documents as the brochure has information that is not included in the getting started guide.

The ExpertSDR2 software

This review is necessarily a review of both the SunSDR2 pro transceiver and the bundled ExpertSDR2 software which supports all of the SunSDR range. There is a version for the Colibri receiver as well.

As far as I know you cannot use any other SDR software with the SunSDR2 pro. Luckily ExpertSDR2 is very good indeed. This software is very well featured and has obviously been developed over quite a long time. It does have some differences to the software I am familiar with and I did have to ask a few questions. All of my emails were promptly answered.

Loading and starting a new version of ExpertSDR2 may result in an associated automatic firmware upgrade. When I upgraded to the Beta version of the v1.1.0 version this happened seamlessly with no problems. It also works fine if you decide to return to using the v1.0.2 version.
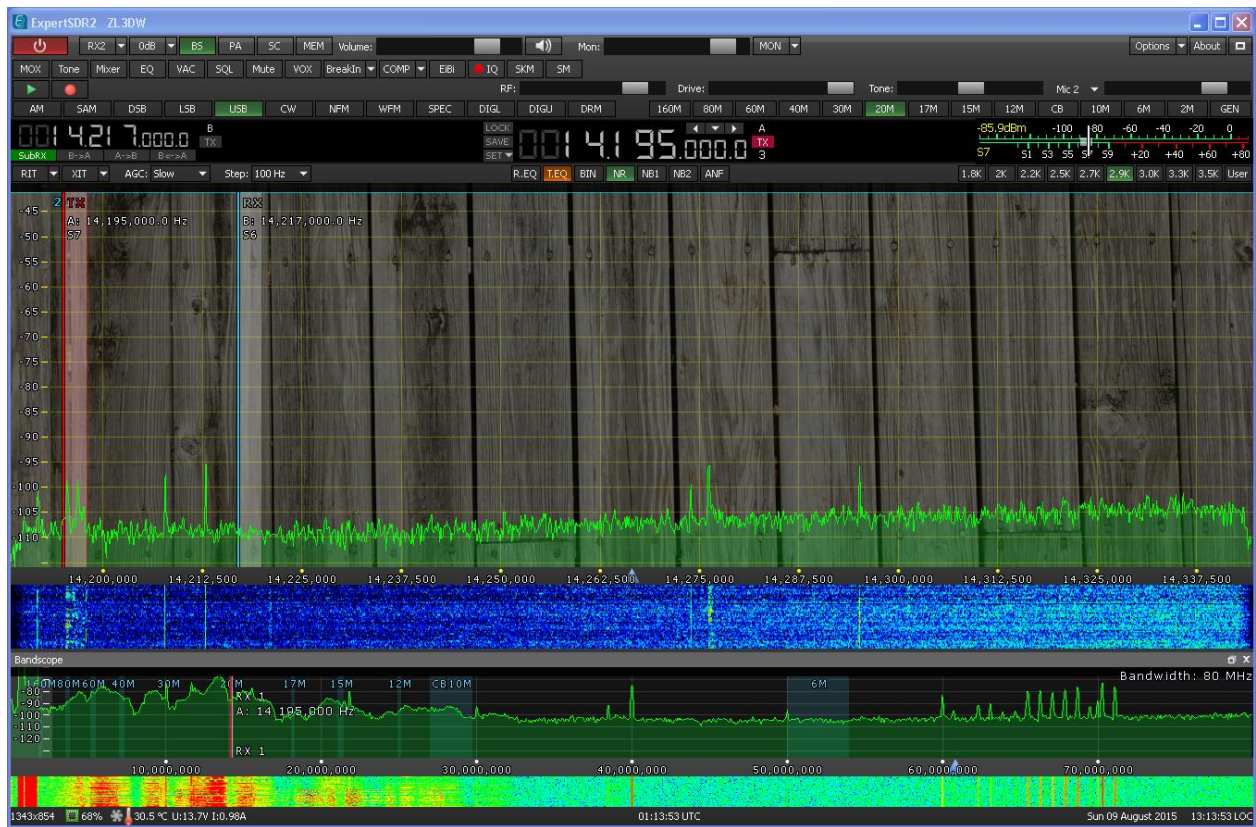
As you can see from the photo you are able to change the background image to any photo that you like. It is best if you choose a dark photo so that the spectrum shows clearly on top. You are able to change the colours and transparency of the spectrum, waterfall and background grid as well.

The second receiver, wideband spectrum and waterfall, equaliser, alternate S meter, and mixer can all be used while docked to the main window or in a floating window of their own. You can place these windows on a second monitor if you are using one. That could be useful if you were using the radio for a SO2R (single operator two radio) contest. I think that it is the first time that I have seen a waterfall on the wideband display as well as on the panadapters. There is a second larger S meter which can be placed in a separate window. It is designed to look like a traditional meter rather than the flat bar scale meter at the top right of the console. The standard panel meter displays S points and the signal strength in dBm while receiving. It displays transmit power, reflected power and SWR while you are transmitting.

You can set the program to use either Russian or English for the menu settings although most of the buttons don't change, resulting in a mix of Russian and English text on the Russian setting. It is all English on the English setting.

The program can automatically launch other applications when it starts. This could be your favourite digital mode program, rotator controller, propagation, or logging program. Or all of them! You can start up to 10 other applications.

Making it go

The SunSDR2 pro uses static network addressing which did present an initial challenge. Unlike radios that can accept an address allocated by DHCP from a router, this radio needs to be specifically allocated a network address. There are instructions on how to do this in the user's guide. The address setting only has to be done once and after that the radio will work with no problem. The radio ships with an address of 192.168.16.200. If your computer uses a different sub-net, the ExpertSDR2 software will be able to locate the radio but it will not be able to receive or send any data. There are a couple of ways to resolve the problem. You can connect the radio directly to the Ethernet port on the computer and then set the address of the radio so that it is in the correct sub-net, or you can take the approach that I did. I left the radio connected to my Ethernet switch, the same as the ANAN. Then I set up a static route in my Internet router to 192.168.16.200. It is actually easy to do. That let the radio communicate with the PC over the network. I could have left it that way, but instead I used the ExpertSDR2 software to change the address of the radio to 192.168.1.20 which is in my subnet. After that I could disable the static route and the radio continues to work fine.

The quick start user's guide does not include the pin-outs for the microphone connectors, although the German language manual does. By the time you read this the new English language manual should be available online. I have seen a preview copy.

I thought that this might be a problem, but my Yaesu microphone just plugged in and worked using a standard Ethernet patch cable as a cord. I had to use the Ethernet cable because my microphone has an 8 pin Yaesu connector on the supplied curly cord.

I had no problem at all downloading and installing the ExpertSDR2 program. The first time you start the program it may automatically update the radio firmware. It only takes a few seconds.

Using the radio

The SunSDR2 Pro supports sample rates of 39.0625, 78.125, 156.250 and 312.500 ksps resulting in maximum panadapter spans of around 39, 78, 156 and 312 kHz respectively.

The radio can work on either the HF bands from 90 kHz to 80 MHz, or on VHF from 80 – 160 MHz. This gives it coverage of the 2m amateur band in addition to all of the HF bands and 6m. It should be noted that since there is only one ADC you cannot use the radio on VHF and HF at the same time. When you tune to any frequency above 80 MHz the radio automatically switches to VHF mode and to antenna port A1. There are two antenna ports for HF, so it is possible to use one antenna port for receiving and the other for transmitting. This would be very useful for those who use a separate receive antenna such as a Beverage for 160m or a receiving loop antenna. Unlike the earlier SunSDR2 model the three antenna connectors are mini UHF types not BNC connectors. These were new to me but they are gold plated and they seem to be of good quality.

Like the ANAN radios, the radio supports the Kenwood TS-480 CAT commands. This will make it compatible with most digital mode programs.

The radio runs HOT!!! The heatsink gets up to about 41.5 degrees Centigrade during normal operation. Interestingly it gets much hotter when the radio is actually running rather than just being left turned on with the software in standby mode. I don't know if that is because of heat dissipation from the audio

amplifier, or from the FPGA, or the ADC. Anyway it does get hot. I thought that this would be a problem when extra heat was being generated by the power amp while transmitting, but it does not seem to get significantly hotter on transmit. However I think that it would be wise to down rate the transmitter for high duty cycle modes like RTTY and PSK. In fact the radio puts out more power than you need. If you are serious about operating QRP then 20W is probably a bit high and if you are driving a 100W or similar linear amplifier you probably won't need 20W to drive it. By the way 20W will drive my Elecraft KPA-500 to nearly full power output. There are control outputs which can be used to connect an external fan.

Panadapters

On the 39 ksps sample rate the panadapter can be zoomed from 39 kHz down to a span of 1.2 KHz. On the 312 ksps sample rate the span ranges from 312 kHz to 10 kHz. I quite like how you change frequencies on the panadapter. If you right click and hold, you can drag the frequency up and down but the receiver stays in the same place on the screen. Alternatively if you right click the shaded receiver part of the panadapter you can drag the receiver and the panadapter frequency at the same time. This is useful if you want to stay listening to the same frequency but look further up or down the band. Of course you can also change the numbers on the frequency display and the mouse wheel fine tunes the frequency in pre-set steps.

You can have two panadapters operating on the same or on different bands. This includes having two panadapters on VHF, but you can't concurrently use one on HF and the other on VHF. Each panadapter can have two VFOs (receivers), so you can work using 'split' operation. You can hear the audio from both VFOs and you can use the mixer panel to move one onto the left audio channel and the other to the right. I find this very useful for listening to a DX station and the pileup at the same time.

It is OK to leave the balance controls set that way because when you switch off the sub receiver (2nd VFO) the audio returns to mono on both audio channels. You can listen to the two VFOs on the second panadapter as well. This means that it is possible to listen to four signals at the same time. On each panadapter, both VFOs must be within the current panadapter bandwidth, i.e. a 312 kHz slice of the spectrum if the radio is set for that sampling speed. If you set the sub receiver to a frequency outside of the panadapter bandwidth it will be muted. There is a squelch control so you could possibly monitor 4 repeater outputs at the same time.

The 'RX Wideband Filter' checkbox disables the band pass filters leaving only the wideband anti alias filter. There is an auto function which will select the narrow band-pass filter when one panadapter is in use, or when both panadapters are on the same band. On auto mode, it will select the wideband mode when the two panadapters are open on different bands or when you display the wideband spectrum display.

The wideband scope displays from about 26 kHz up to 80 MHz with the ham bands and the HF CB band highlighted. The wideband filter needs to be enabled or on the auto setting to get the full wideband display otherwise a low pass filter is in circuit. Unusually the wideband scope has its own waterfall display. Another unique feature is that the wideband scope can be zoomed to show the band or bands of interest. I thought that this was a good feature. You could restrict the wideband scope to only show the activity on 10-15-20, or just 40 and 80. The wideband scope runs docked or in a separate window which can be moved away from the SDR console and even onto another monitor if you have an expanded desktop. On VHF, the wideband scope covers from 80 MHz to 160 MHz.

There are large spurs at every 10 MHz with the largest being at 10 MHz at -62.2 dBm and 40 MHz at -62.8 dBm. These are a minor annoyance since for most users they fall outside of the bands of interest. These spurs are also evident on the VHF band but they are much lower. The worst one is -81.7 dBm at 120 MHz. The spurs are extremely sharp which probably indicates very low phase noise on the main clock. In fact you can zero beat the spur and receive WWV on 10 MHz AM with no problem.

Memories and other displayed items

The 'quick memory' automatically remembers the last 16 frequencies. There is a memory bank as well which you can tag with a description for each frequency entered. The main console shows the temperature of the radio, DC voltage applied, current draw, cpu loading, day and date, local and UTC time. On transmit the S meter shows both transmit power and reflected power along with a numeric indication of the SWR. On receive it shows the received signal strength within the receiver passband, in S points and dBm.

Performance

The radio is extremely sensitive with performance similar to my ANAN-100. With the 10 dB preamp turned on you can expect MDS figures better than -131 dBm and up to -136 dBm on some bands. With the 10dB pre-amp off the MDS ranged from -120 on 15m to -130 on 80m. In all cases you can hear any signal that is showing above the panadapter noise floor. At most locations the local noise will be above -120 dBm so that will become the limiting factor. The radio sensitivity is even better with the front end filters turned off. I suppose there is a little insertion loss. Most bands improved to an MDS of   -136 dBm with the pre-amp on and the 'use RX wide filter' check box selected. On the 160m, 20m and 15m bands, I noticed a slight increase in the noise floor when the narrow filters were engaged.

By the way you have to be careful when you switch between the narrow and wide filters, because the pre-amp / attenuator settings are remembered for each filter setting. That means when you switch to the wideband filter you may also be changing the overall gain. If you see a large change in the panadapter noise floor when you change from the wide to the narrow filter, this is likely to be the reason.

On the 2m band, with the VHF LNA (low noise amplifier) turned on as well as the usual preamp, I could hear a signal at -140 dBm which is exceptional. This would make the radio a real contender for weak signal work on the 2m band. You would normally leave the LNA turned on unless you were listening to big signals such as an FM broadcast station. There is a wideband FM mode, but I don't think there is a stereo decoder.

Frequency stability and offset

According to my rather old IFR radio test set the radio was very slightly high in frequency. 10Hz on 30m HF and about 130 Hz high at 145.2 MHz. This is a very creditable 0.9 ppm so nothing to worry about and the error might be inside my test setup. However you can adjust the frequency in the setup screen and I was able to get zero Hz error on both VHF and HF by setting a frequency coefficient adjustment of minus 0.000100. The specification sheet says that the master clock has a stability of 0.5 ppm and I am sure that the test radio is well within that. I did not notice any frequency drift as the radio comes up to temperature. The frequency was stable and the same every time I checked it. Once I changed the offset it stayed rock solid.

Transmitting

Generally the displayed transmit power readings are accurate with 19 – 20W out on all of the HF bands except 15W on 160m and 13W on 6m. The specification says 15W – 20W output on the HF bands with reduced power on 6m, so the output power is pretty spot on. You can control the maximum power output by altering settings in the setup, but you can't make it higher. On the 2m band the internal ExpertSDR2 power meter shows 9.8W but the radio is only putting out 6W. The specification states 7W max on VHF so the meter reading is a bit optimistic. I only checked one VHF frequency using a DC voltage of 14.4V so it is likely that the 7W power can be achieved if you are running the full 15V DC supply voltage.

I conducted some test QSOs on 2m and on 10m with my good friend Rod ZL3NW. He reported good audio on both FM and SSB on HF and on VHF. You do have to be a bit carful about the microphone level on FM. I believe that you can deviate the signal too wide if you set the microphone level too high. I

recommend selecting the Mic AGC option to make sure that you don't overdrive anything. The panadapter switches to showing your transmit signal on transmit. Unfortunately the display changes bandwidth on transmit making your transmit signal look very wide, particularly on FM.

CW

The radio generates CW modulation inside the FPGA so it should have fast switching for QSK operation and negligible latency. I'm not a CW guy so I was unable to fully test the radio on CW transmit. The ExpertSDR2 software has built in CW Skimmer support. Both panadapters can output IQ signals for Skimmer to work in its wideband mode. There is also the facility to make a Telnet connection to the CW Skimmer server.

I tried out the CW keyer using a stereo 3.5mm phone plug and shorting the contacts, but I was not able to make any timing measurements. The switching sounds fast. There was no noticeable latency on the side tone. The internal keyer works up to 60 wpm. The ExpertSDR2 program does not have the CWX text macros that PowerSDR has, but you could easily interface a CW keying program.

DRM

The DRM mode sets a 10 kHz filter for receiving digital shortwave broadcasts. A third party program like 'Dream' is required in order to decode DRM transmissions. I tried this, but with my antenna, I can't get enough signal strength to decode the DRM transmission.

RTTY and PSK

I compared the radio receiving both PSK31 and RTTY against my ANAN-100. It is very subjective but the SunSDR2 pro seemed maybe a tiny bit better than the ANAN. Using MixW the digital signals looked a little cleaner and possibly decoded a little better. Really any differences were "too close to call" but the SDR2 pro was certainly at least as good and it was a good test of the VAC operation.

SSB

I compared the radio against my ANAN-100 on the 20m band. As far as I can tell the two radios had identical performance on a typical ham band.

CAT Control

Another excellent feature of the ExpertSDR2 software is that the two panadapters each have their own separate CAT control. Each can be set to a different COM port. You could use one panadapter with a CW program at the same time as using the other with a digital mode program.

Final impressions

The radio is well made and it works pretty much as advertised. It is a bonus that you get the VHF band including transmit on the 2m band. The software is pretty good, I was impressed. It seems to be well thought out and to perform well. I found that the company responded well to emails and were able to answer my questions. Taganrog Russia is 9 hours behind New Zealand time but I always got a reply the next day. The online reviews confirm good communication from the company.

Overall the radio is very good. It is available from a range of dealers in the USA, Europe and the UK, so there is local support in most regions.

Interesting and unusual features

The SunSDR2 pro has some features which are rare or unique in this type of transceiver.

- The radio covers HF up to 80 MHz and VHF up to 160 MHz.

- You can listen to 4 VFOs at the same time, on two different bands.

- There is an ALC output to control a linear amplifier.

- There is a proposed option for built in WiFi networking. The case already has a position for the Wifi antenna.

- It has a low noise amplifier for the VHF band.

- There is direct access to the ADC input and the DAC output, which you could use to create a UHF or SHF radio. In other words you can use this radio as the SDR portion of a radio that uses completely different front end hardware.

- There is a connector for the connection of a 10 MHz reference oscillator. Although the built in oscillator is very stable and has very low phase noise.

- There is a receiver output for connection to another receiver.

- You can configure the HF antenna ports so that one is used for transmit and the other is used for receiving. This would let you use a separate receive antenna such as a loop or a Beverage.

- The radio has two microphone connectors, one for a PC Electret type microphone and the other for a standard dynamic microphone (Yaesu pin out).

- There are programmable pins for band switching and other control (like the ones on an ANAN radio).

- There is an internal thermometer. This can be used to drive outputs which can switch on and off an external fan at preset temperatures. You also get a display of the temperature on the main console.

- The software displays the; day and date, local and UTC time, computer cpu loading, the power supply current and voltage and the window size.

- Recommended power supply is 15 Volts. The radio will run fine, with a slight reduction in maximum RF power on transmit, off a standard 13.5 V supply.

- Separate CAT control for each panadapter.

Specifications – from the Expert Electronics product brochure

Features

- DUC/DDC Architecture
- Quick hardware formed CW
- Two independent receiver channels
- I/Q stream up to 312 kHz
- Reception from 9 kHz
- Bandpass filters in receiver front end
- LAN interface for connection to PC
- Optional WLAN interface
- External devices control
- CAT and VAC interfaces for connections to third-party software like loggers and digital modes software
- Reception of Broadcasting FM stations
- Contest special functions

Receiver

General coverage receiver in HF   0.09 - 65 MHz
Frequency coverage in HF in TX mode   All amateur frequencies HF +6m
General coverage receiver in VHF   95-148 MHz
Frequency coverage in VHF in TX mode   144-148 MHz (depends on region)
Sensitivity   0,07 uV (same as I measured)
Blocking dynamic range in HF mode (BDR)   129dB
Blocking dynamic range in VHF mode (BDR) 114dB
RF ADC clock frequency   160 MHz
RF ADC resolution   16 bits

Transmitter

Nominal transmitter's output power HF   15W   (I measured 19W)
Nominal transmitter's output power VHF   7W   (I measured 6W on 145 MHz)
RF DAC clock frequency   640 MHz
RF DAC resolution   14 bits
ALC input voltage range   0-4 V

General

Recommended power supply   15 V
Supply voltage range   12 – 16 V
Local oscillator's stability   +/- 0.5 ppm
Maximum consumption current   5 A
Built-in audio codec resolution   24 bits
Operating temperature   0 - +75 ºC
Dimensions   165x165x35 mm
Weight   1.5 kg