ColibriDDC Receiver Review

By Andrew Barron ZL3DW

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Expert Electronics sites

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

ColibriDDC, downloads and manuals

http://eesdr.com/en/products-en/receivers-en/colibriddc-en

http://eesdr.com/en/products-en/receivers-en/colibriddc-en#downloads

http://eesdr.com/en/products-en/receivers-en/colibriddc-en#documentation

Review Type: High level with a few basic tests

SDR Type: DDC SDR receiver (HF and 6m)

Review Scope

The ColibriDDC is a direct down conversion, software defined radio receiver which covers the HF bands and the 6m 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 well packed. There was ample foam packaging around the box containing the radio. The radio is quite small but is larger than the USB stick style. It is in an alloy case and looks to be well constructed. It measures about 64 x 24 x 115 mm and it weighs around 1/2kg. I am impressed with the build quality. The finish is good and the labelling is good too. The radio was shipped direct from the manufacturer in Russia.

On one end of the case there are the Ethernet port, 5V DC input, headphone (amplified speaker) jack and the power switch. A green LED flashes when the radio is looking for a network connection then stays on to indicate that the radio is on.

On the other end of the case there is an 'external control' accessory connector and gold plated SMA connectors for the antenna and reference clock inputs. A SMA to PL259 'UHF' adapter cable is provided.

What's in the box?

Inside the box there was the radio, a 5V DC plug pack, an Ethernet cable, and a PL259 female to SMA adapter cable. I thought that it was a nice detail that all connectors had protective caps on them.

There was also a CD containing the Expert2 SDR software and documentation. If you want to look at the manuals and software before buying the radio, you can download the manuals and the latest software release from the website above. CW skimmer server and an ExtIO.dll file are

available for free download as well. Extio.dll allows the radio to be used with other SDR software such as SDR#, WinRad, HDSDR, or Studio1.

The ExpertSDR2 software

This review is necessarily a review of both the ColibriDDC receiver and the bundled ExpertSDR2 software which supports the whole SunSDR range. The version for the ColibriDDC receiver is similar to the version used by the SunSDR2 pro transceiver.

I like the ExpertSDR2 software, it looks good and it works well. It has most of the features that you would want from an HF SDR receiver package such as; two panadapters, each with two VFOs, wideband scope, zoomable panadapters, noise filters and blankers, an auto notch filter etc. The S meter shows the level of the received signal in both S points and dBm.

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. 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 panel meter

rather than the flat bar scale meter at the top right of the console. The meter displays both S points and the signal strength in dBm.

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.
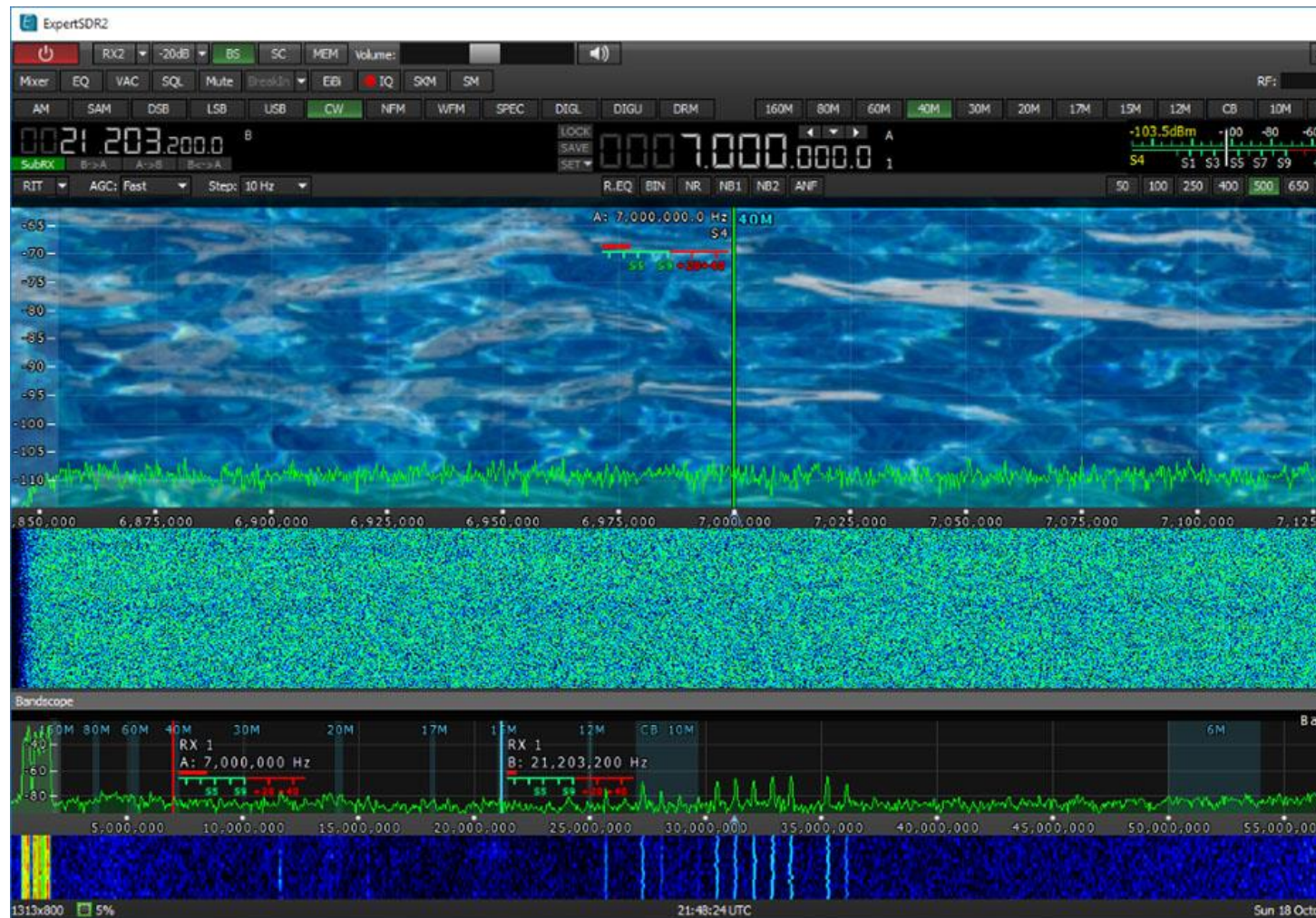
Making it go

Unlike the SunSDR2 pro transceiver, the ColibriDDC receiver does use DHCP addressing. The software found the radio on the network with no problems and the radio worked immediately. Rather than use the software on the CD, I downloaded it from the manufacturer's web site. But it turned out that the version on the CD was the latest release anyway. 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 ColibriDDC 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 specifications say that the radio can work from 10 kHz to 55 MHz so it covers shortwave and the amateur radio HF and 6m bands. However I found that the radio actually works well up to around 62.4 MHz. This is consistent with its 125 MHz ADC sampling frequency.

Using the two VFOs and two panadapters (receivers) you can listen to two frequencies on two different bands at the same time, four VFOs in all. The VFOA audio from each receiver can be moved using the mixer controls to one side of the stereo audio output while the VFOB audio is shifted to the other audio channel. You are unlikely to want to listen to four frequencies at the same time, but the feature is handy if you want to listen to a DX station and the pileup of calling stations at the same time, or to listen out for a station on one band while listening to a station on another. You can monitor CW on two bands using Skimmer or look at digital modes using the virtual audio cable capability. Each receiver has its own CAT control and separate VAC settings.

If you do want to use the under sampling mode to receive VHF or UHF channels you are able to switch off the 55 MHz anti-alias low pass filter and replace it with an external band pass filter. The radio has an input for an external 10 MHz reference signal which could be useful at higher frequencies.

The ExpertSDR2 software supports the Kenwood TS-480 CAT commands which makes it compatible with most digital mode programs.

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. Each panadapter can have two VFOs (receivers) and you can hear the audio from both VFOs at the same time.

The ColibriDDC does not include any band specific filters, but it does have a 55 MHz anti alias low pass filter (LPF). Unlike the ANAN transceiver, you can switch the LPF out of circuit which allows the receiver to deliberately receive signals above the 62.5 MHz Nyquist bandwidth. It is recommended that you provide your own bandpass filter in front of the antenna port if you are intending to use the receiver in this way. I was easily able to tune and listen to FM broadcast stations with the filter switched out of circuit. Unfortunately the filter performance is not good enough to completely eliminate these aliased signals of the FM stations when the filter is in circuit, but more about that later. With suitable external bandpass filters you can use the radio as high as 900 MHz.

The wideband scope displays from about 26 kHz up to 62 MHz with the ham bands and the HF CB band highlighted. 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.

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 window size in pixels, cpu loading, day and date, local and UTC time. The S meter shows the received signal strength within the receiver passband, in S points and in dBm.

The Panadapter shows the ham and CB bands and you can optionally display an S meter as well. This means that each VFO can have an independent S meter. The wideband scope also indicates the each VFO frequencies and they can all have their own S meter as well. There are optional 'EiBi' markers to show the spot frequencies of many shortwave broadcast stations.

Performance

The received spectrum is very flat with the displayed panadapter noise floor around -130 dBm. With the 20 dB attenuator switched into circuit the noise floor is around -110 dBm. I did notice a spur at 30 MHz and another at 31.250 MHz. Neither is in a band segment of much interest so they shouldn't cause any problems. These two spurs are quite weak, in most cases less than – 90 dBm. The worst case was -87.7 dBm (31.250 MHz spur at the 39 kHz sample rate with -20 dB attenuation). The level of the spurs is affected by the 20 dB attenuator and also a little by the selected sample rate. When you turn off the attenuator the noise floor improves by 20 dB and the spur level drops by 20 dB as well. Overall the receiver is very clean. In normal use I would recommend leaving the 20 dB attenuator in circuit unless extreme sensitivity is required. The attenuator limits some of the image signals and provides overload protection. I found that the radio experienced ADC gain compression problems when the 0 dB setting was used.

Sensitivity

The radio has excellent sensitivity. Not quite as good as the SunSDR2 pro, but that is to be expected as the ColibriDDC uses a 14 bit ADC. The S meter is a little optimistic, but no worse than many other radios.

Measurement	500 kHz	7.1 MHz	14.2 MHz	50.03 MHz
S meter accuracy Reading for -70 dBm input	-67.8 dBm	-64.6 dBm	-67.6 dBm	-67.5 dBm
Signal input for S9	-76 dBm	-78 dBm	-76 dBm	-74 dBm
MDS (-20 dB att)	-106 dBm	-106 dBm	-106 dBm	-106 dBm
MDS (no att)	-118 dBm	-118 dBm	-120 dBm	-122 dBm

The MDS sensitivity was measured on CW mode in a 500 Hz bandwidth. S meter accuracy and the input level for an S9 indication was also measured on CW mode in a 500 Hz bandwidth.

When connected to my main station antenna I found that the radio suffers from severe ADC gain compression when set to the 0 dB mode. The problem is worse below 14MHz. The panadapter noise floor jumps around 20 dB or so. It is so annoying that you really have to use the 20 dB attenuator. However the receiver sensitivity is still perfectly acceptable with the 20 dB attenuator in use. The interference causing this ADC gain compression is from local AM broadcast stations which

are showing at almost -20 dBm on the wideband scope. An external or internal high pass filter at 2 MHz would certainly help to eliminate this issue. Or you could use a bandpass filter designed to reduce the level of signals on the AM broadcast band.

Under sampling mode

Just for interest I did some measurements using the under sampling mode (with the LPF switched out and no external band pass filters). The receiver was able to cover the 2m amateur band 144 – 148 MHz with just 1.1 dB of signal attenuation. Over the 70cm band the attenuation rises to between 3 and 4 dB but this still represents excellent sensitivity. The MDS is still better than -120 dBm at 435 MHz. The radio is perfectly usable at 921 MHz where there is a 14.5 dB loss. At that frequency you would probably be using a masthead amplifier anyway.

Aliased image signals

Do not turn off the low pass filter unless you specifically want to receive signals from Nyquist zones above 62.5 MHz. Turning off the LPF results in a large number of aliased signals from the FM broadcast band. Note that these are image signals due to the way that the ADC works and not image signals due to inadequate IQ signal cancellation, which is not a problem with direct sampling radios like the ColibriDDC.

I made some measurements of the aliased signals at different frequencies. All of the comparison tests in the table below were done with the -20 dB attenuator in circuit. While there is reasonable rejection of frequencies above 100 MHz the rejection of signals closer to 62.5 MHz is not very good.

Even with the LPF in circuit, it is possible to demodulate the wideband FM signals on and above the 10m band. This was a problem with the SunSDR2 pro transceiver as well. I believe that the radio would really benefit from a better anti-alias low pass filter.

Effectively the amount of alias rejection is a reflection below 62.5 MHz of the filter shape of the low pass filter at frequencies above 62.5 MHz. The faster the roll off, the better the alias rejection.

RF input	Received at	Level LPF off	Level LPF on	LPF Rejection
64 MHz	61 MHz	-70 dBm	-71.5 dB	1.5 dB
70 MHz	55 MHz	-70 dBm	-73 dB	3 dB
80 MHz	45 MHz	-70 dBm	-85.2 dB	15.2 dB
91.3 MHz	33.7 MHz	-70 dBm	-96 dB	26 dB
96.9 MHz	28.1 MHz	-70 dBm	-99.5 dB	29.5 dB
101 MHz	24 MHz	-70 dBm	-101.5 dB	31.5 dB
110 MHz	15 MHz	-70 dBm	-113.8 dB	43.8 dB

The 91.3 and 96.9 MHz frequencies were chosen because they are local FM station frequencies.

With my 10m – 15m – 20m triband Yagi antenna connected, the interference from the 96.9 MHz FM broadcast station which appears at 28.1 MHz on the 10m ham band was at – 60 dBm with the LPF off and -95 dBm with it on. That is with the -20 dB attenuator in circuit. With the attenuator switched off the radio went into overload and the low part of the 10m band was unusable.

An interfering signal of -95 dBm is not too bad, but it is 10 dB above the local noise floor and it could mask weak 10m ham radio stations. I guess it is handy if you want to use the radio to listen to the local FM stations in wideband FM mode. Overall the problem is not too bad and it probably won't be

a problem below about 25 MHz. You could add an external low pass filter, for extra image rejection, if the image signals really bother you.

Turning the LPF off and adding an external 125 MHz to 187 MHz band pass filter would allow reception of the VHF marine band, the 2m ham band and the top part of the VHF aircraft band. As this range is in the 3ʳᵈ Nyquist zone, SSB signals on the 2m band would not be inverted.

Taking the different ADC sampling rate into account, I tried to find images from the same two FM broadcast frequencies on my Apache Labs ANAN radio. I was not able to see any image signals on the ANAN radio, either using the signal generator or with the antenna connected. The Hermes board used in the ANAN-100 radio uses a mini circuits LPF-50B low pass filter which attenuates the alias image signals by up to 70 dB.

CAT Control

An 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. The software is pretty good, I like it. It seems to be well thought out and to perform well. Overall the radio is very good although a better anti-alias filter and perhaps some way of rejecting the AM broadcast band would make it even better. The ColibriDDC receiver is available from a range of dealers in the USA, Europe and the UK, so there is local support in most regions.

Prices vary according to the dealer and exchange rates but the receiver is nominally $650 USD. The price compares well with similar direct sampling SDR receivers like the Microtelecom Perseus receiver at $999 or the RFSpace NetSDR at $1449, neither of which cover the 6m band. Another rival is the Software Radio Laboratory QS1R receiver at $899. The QS1R has fairly similar specifications but a 16 bit ADC and wider maximum panadapter bandwidth. Being a direct digital conversion receiver, the ColibriDDC has significantly better performance than the multitude of RTL dongle type receivers with HF down converters and most QSD based receivers.

Specifications – from the Expert Electronics product brochure

Receiver	Quoted data	Review notes
Modes	AM/SAM/NFM/WFM/LSB/USB/DSB/CW	VAC output for digital modes or DRM
Frequency range	10 kHz to 55 MHz	useable up to 61 MHz
Under sampling	10 kHz to 800 MHz	62 MHz - 920 MHz in 61.5 MHz blocks
10 MHz reference input	present	not tested
LAN 100 Mbps protocols	UDP, DHCP Client / Server	DHCP works well, static IP can be set

Audio DAC	24 bits	stereo
IQ Sample rates	39, 78, 156, 312 kHz	times two panadapters
Independent receivers	2	2 panadapters with 2 VFOs on each
Wideband scope	Up to 60 MHz	26 kHz to 62 MHz, can be zoomed and includes a waterfall display
ADC	14 bits sampling at 125 Msps	
IQ image rejection	>110 dB	No IQ images detected
Internal oscillator	TXCO 20 MHz +-0.5 ppm	
Attenuator	0 dB or -20 dB switchable	
Input filters	55 MHz LPF	Anti-alias filter, can be switched out
External control	7 programmable outputs	
Power supply	+5V at 0.7A	Plug pack PSU supplied but not tested
Dimensions	64 x 24 x 115mm	
Weight	0.5 kg	
Software	ExpertSDR2 supplied	Others with ExtIO.dll (not tested)