

My QO100 station

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Not finished yet!!

The pictures for this are on the same website.

History

In the summer of 2020 I started building devices for QO100 operation.

My antenna options on my 2nd QTH were severely limited, so I initially used a long yagi then a helix antenna (40 turns) for the uplink and a tablet antenna for the downlink.

I had an old Funcube SDR with the SDR Console as the receiver and an old 20W PA for the transmitter.

Unfortunately, the PA broke after the first tests and I bought the Kuhne upconverter with 20W. As a transceiver I have an IC9700 with GPS reference.

The whole thing worked tolerably: the Longyagi rather not. The sending side was a bit off the frequency but stable and I was able to determine the frequency offset with the WebSDR.

The receiver side was worse: the tablet antenna and the funcube were quite unstable and to determine the receiving frequency of a station I used the WebSDR as well.

The reception field strength of the flat antenna also was at the limit and the transmission signal with the helix was sufficient.

At least with good weather. When it was very cloudy, I couldn't hear anything and when it rained I had to unmount the antennas anyway; as well as at night and most of the time.

So overall it wasn't fun, but it worked.

In spring 2022 we moved into the neighbouring house. There is an opportunity to put a satellite dish there and there is a chance to do DATV as well.

Analogue voice qsos are ok, DSSTV has many errors and for digital voice I found no other station yet.

I still have an old DATV transmitter from SR Systems (from early 80s?) with an even older Graetz Colorscope camera (who still knows Plumbicons? Unfortunately not working any more) I got the Minitourner in 2021.

The video transmission over a few meters worked after a bit of testing and reading the transmitter's documentation.

Then I tested the Windows DATV express transmitter and the portdown (raspberry) solution with the pluto; not via QO100, because I had no PA. This worked after solving some problems.

Meanwhile the portdown solution works via QO100 with 128kS.

The block diagrams of DATV express, portdown solution and the video system are found in [1].

The control is done via browser. It uses the MYC protocol. For details see [2].

Since 2023 I additionally have a DX Patrol groundstation. For details see below.

NB technics

For NB receive I now use the Pluto1 with SDRConsole. The frequency isn't accurate either (8kHz too high), but it's sufficiently stable because I don't use the pluto transmitter.

If you want to use the transmitter, you should take additional modifications (cooling, TCXO)
At start the SDR console did not work. The program stopped after short time. I did not find the reason. Meanwhile it is working, but sometimes not with the first start.
The (very old) Funcube dongle works as well, but the waterfall bandwidth is 50kHz only.
I have not changed the transmitting side compared to my solution from 2020: IC9700 and Kuhne upconverter.

Pluto tips:

I use 2 pluto version C

Both pluto use FIRM2101RC_v0.31-5-g9ceb-dirty.

To use the Pluto with windows you need the drivers [4] [5] and [6]

Som additional hints can be found in [16]

Tips for SDRConsole

The program is quite complex, so some training work may be necessary.

A good (german) description, how to synchronize the frequency to a beacon is in[5]

This synchronisation gives a defined frequency offset, but is not an automatic regulation of the receiving frequency due to frequency variation of the LO of the LNB or the pluto.

If the program hangs, try the ResetConsole batch program (in the program directory).

Nevertheless I had the problem, that the program was running but there was no waterfall and no audio. Reinstallation and deleting the Console registry entry entry did not help. There is additional data in <user> Appdata/Local/Temp. To delete this may help. Reinstalling the computer will help but should be the last chance. It may help to reduce the bandwidth if the processor load is too high.

Tips for the Kuhne Upconverter:

As per datasheet it needs 2 -5 W for an output power of 20W. The rear side has a potentiometer for adjustment of the input power.

With my 1m dish I need 5W about for a good signal. Setting the potentiometer to middle 2% of the output power of the IC9700 (circa 1.5W) are sufficient.

The new firmware require 19k2 instead of 115k for the serial interface!

WB / DATV technics

Minitiouner tips:

The assembly of the DARC Minitiouner was problem-free.

In order to load the software from VIVADATV, you have to register. A confirmation never came, but eventually I was able to download the software

The drivers were missing in the latest software version. For this you should load the version Minitioune V0_9_9_1_package. There you will find the needed usrc-ax driver.

Furthermore, VLC (not Pro but the 32 bit version!!) should be installed.

The FTDI virtual comport driver is also required [4].

The LAV filters (including H264) are necessary as well [8].

In Minitioune V0-9_9_1_package you will find a testprogram and some other programs.

In order to see the video image in the program, you have to click VLC.dll (on the right side)

If you select QO100 for the frequency setting you should pay attention to the correct offset.

Without offset you can test the quality of your own signal, The mimitiouner receives 2.4GHz. Do not forget to use a sufficient damping element!!

As a transmitter I will use either the express transmitter software for windows or the portsdown software for raspberry pi.

I had a Raspberry4, the LimeSDR was no longer available at the beginning of 2022; so I bought a Pluto. There are also various other applications and programs for the Pluto. I tried a spectrum analyzer satsagen. It is not as good as my Siglent SSA 3032X Plus, but it only costs 10% of that.

Express transmitter with windows:

Originally I wanted to use this software for transmit. But the program did not found the pluto. After many tests without success I tried later on another Win11 laptop, where SDRConsole was installed meanwhile. Using the detailed installation description [9] I had success. The description for the Lime can be used. I tested on 2408MHz with Minitiouner and the C920 Webcam. [10] Unfortunately after running the express transmitter the SDRConsole program may not work (no audio, no waterfall). You may overcome this problem by setting the SR to 4000000 before switching off express transmitter. Another solution may be to switch the pluto off and on again. To avoid this problem I use a 2nd pluto.

As video input I can use the laptop camera, external camera or OBS studio. OBS can be active on the same computer or via VGA- grabber on a second laptop. This has the advantage, that you see the video always.

The CS920 camera resolution is 640 470, 30 MJPG

I have problems with the express transmitter sometimes. New installation may help.

Portsdown with raspberry4

Unfortunately, it has the limitation that you need a touchscreen (I don't know if anything other than the original Raspberry will work)

Another limitation is that only some Logitech webcams work: I use the C920.

The video grabber from EasyCap) works, I ordered a EasyCap grabber but got another brand. The webcam must be unplugged and to see the video select the CS920 webcam. Two ancient grabbers from my craft box didn't work.

After creating the SD card and setting up, the Pluto does not provide an output signal. Help came from the BATC forum: Portsdown only works with an old firmware [17]

The output power is highest at position 0 and lowest at -71!

Band/ Tvtr must be set to "Direct" and then shows "13cm".

The frequency is set with "IF".

With a few other obvious settings it worked.

The transmit delay may be long.

The portsdown solution requires a second USB (long) USB cable and a second pluto.

With Kuhne upconverter

There is the question whether the upconverter can be used for DATV.

The frequency response is sufficiently good: from 144 to 155MHz the output signal raise by 4dB.

The small signal amplification (input: 6mW) can be changed by the potentiometer from -5 – +24 dB (150MHz in, 1206MHz out).

You need another coaxrelais. I have not tested this solution.

Video generation

For windows I use OBS studio: very comprehensive and working together with the express transmitter. The usage require some learning effort.

For portsdwn a program, that send the data to the grabber us necessary. My old laptop has a VGS output, and a converter produces the required S-video signal.

DATV PA:

First tests:

The pluto delivers 60uW with the express transmitter software. The CN0417 has 20dB, the Kuhne KU231XL 7dB and the 30W PA 16dB.

Then I replaced the CN0417 and KU231XL by an amplifier from DK6JL(25dB).

This results in 4W. The level in the BATC waterfall was at 4dB with 333kS (the beacon has 9dB). That is not enough.

The portsdwn solution has 290uW. With driver and PA I had 12W. The PA is linear for 333kS; I could get a picture, sending it directly to the minitiouner. But not enough for QO100.

128kS gave a level of 8dB an QO100 transmission was working!

Next steps:

I have a 150W PA (MT2.3Z with 22dB gain. Not tested.

Originally I used 2 CN017 in series. This do not work: the second is destroyed due to too much input power.

In case of problems with overall gain the usage of thin flexible cable is not a good idea: the loss is higher than semirigid cables eg.

Antenna:

As an antenna I use a 1m dish with LNB from WIMO with bias-T with 10MHz reference input.

The LNB requires this BiasT and works with an attached 10MHz reference only (default).

It can use the internal TCXO by switching an internal jumper.

The LNB has a maximum DC voltage of 21V (as per OK2ZAW). 18V for H polarisation is more safe than 15V.

The dish is attached to the wall of the house right next to the window with heavy-duty dowels. So I can access it at any time (was necessary meanwhile) and the cables are short.

[12] [13] and [14] are pictures of the spectrum for vertical and horizontal polarisation.

The alignment of the dish is very sensitive!

Tips for the IceCone

The original IceCone doesn't quite fit on the LNB: the hole of the front part for the LNB is too small.

Therefore the clamping only works on a width of 2mm. Time will tell if that's enough.

The diameter at the rear end is also a bit too big, so I had to remove a part of the LNB carrier.

10MHz reference:

10MHz reference is a GPS frequency standard from ID-Electronics (DK2DB). It should be noted that the output level is quite high. With my GPS reference the frequency is 245kHz too low at start (at 10GHz) and it take up to 10 Minutes before the frequency is locked. May be better not to switch off the reference.

Control:

I added a control-circuit to the power distribution board[2]

Control is via USB using the MYC protocol.

The wire for the PTT is not used any more and the wire to switch NB / WB is optional.

At power on NB is selected.

Putting all together:

QO100 hf parts and shack are about 15m/20m (cable length) apart. I use RG58 cable to connect the IC9700 to the upconverter. The HF components are 2-3m away from the antenna. The connection to the laptop / Raspberry is made via two USB cables and USB hub.

[12] shows block diagram for the portdown solution; [13] for the express transmitter.

There is a 28V and a 12V power supply and DC-DC converters for 18V and 5V on the control board. Everything was mounted on a board, [2]. So all component can be easily connected together.

I use the two laptops for QO100 only. Laptop1 is quite old (>10 years) laptop2 is new with win11.

Laptop programs:

Laptop1 (videogrneration):

OBS studio

Laptop2

Driver for Pluto

Driver for Minitiouner

VAC

Minitioune

SDR Console

others (DSSTV, DV, CW...)

Express transmitter

Apache server

Browser

python

(OBS Studio)

Raspberry4

Portdown Software

NB operation:

The output power of the 9700 is reduced to 3 – 3% (input regulator of the upconverter set to „mid position”).

After switching to NB, the upconverter is switched on; For transmit the PTT must be switched on
Transmission is started with the IC9700 PTT.

The frequency of the transmission signal is very stable because GPS is synchronized but is 200Hz below the signal of the WebSDR of BATC. Reason is unknown.

The Pluto as a receiver is quite stable but the frequency is about 8KHz too high. There is a good (german) help from OE5VLL to synchronize the frequency with a beacon [7]

The noise level is at -90dBm (S9) with SDR console and at -87dBm (S9+) with the BATC WebSDR. The level of the md beacon is 30dB higher for my equipment and BATC.

Programs for DV, (D)SSTV CW... will run on the NB Laptop. The connection to the IC9700 is via USB for transmit and via audio bridge form SDRConsole the other program. I have an old VAC license from 2007. It was no problem to update it.
I tried DSSTV with easypal, but this was not very successful: SNR too bad. KDSTV and MixW was ok.

DATV operation

After some problems with the LNB and an exact alignment of the dish receiving was ok. The receiving signal must not be more 2 - 3dB lower than the beacon. Here the loss of 2dB (may be a little bit more) due to the Icecone come into effect.

For generating the video to transmit there are 2 solutions

Express transmitter with OBS studio

Express transmitter find VMIX /OBS as input (both programs on the same laptop).
Using a grabber I can use OBS studio on the second laptop.

Portsdown:

The (old) laptop1 has a VGA output. A converter converts this to Svideo. This is the input for the Easycap grabber for portsdown. The screen resolution mus be switched to a lower resolution. The camera are connected to the laptop, any other programs are possible, if the result can be shown on the laptop screen.

DxPatrol Groundstation (TM)

The transverter is small and easy to handle. I was portable qrv in EA8 since november 2023. For blockdiagram see [3].

The station is outside of the apartment connected via 10m coax cabel and 12V supply. For control I use the IC705 with 3 - 4W on 144MHz with Hf VOX. I have a 1m offset dish and the DXPatrol helix for transmit.

I had some problems:

The LNB voltage is 10.9V only. With long (or bad) 75Ohm cable the LNB may not work. Therefore my groundstation is not in the shack.

A high SWR is shown often; mostly near 3 sometimes more than 4 or infinite Because I measured the helix (it was ok) I guess this is a measuring error is due to the hf vox.

My signal strength is 4 - 5dB below the mid beacon. With the 1m dish I expected more. This may be due to the helix.

The groundstation requires a sufficient GPS signal. If this fails, a new synchronisierung starts. That happened two times during a qso. A solution as used by the IC9700 would be better: The equipment know the configuration of the vfo and do correction only if required.

The most worst: After 5 weeks (100 – 200 hours) I had a total failure After a transmit the display was dark. Most probably a power supply failure.

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Reference

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- [2] <https://dk1ri.de/dhw/QO100control.pdf> oder <https://dk1ri.de/dhw/QO100control.txt>
- [3] https://dk1ri.de/block_schaltbild_portabel.pdf
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