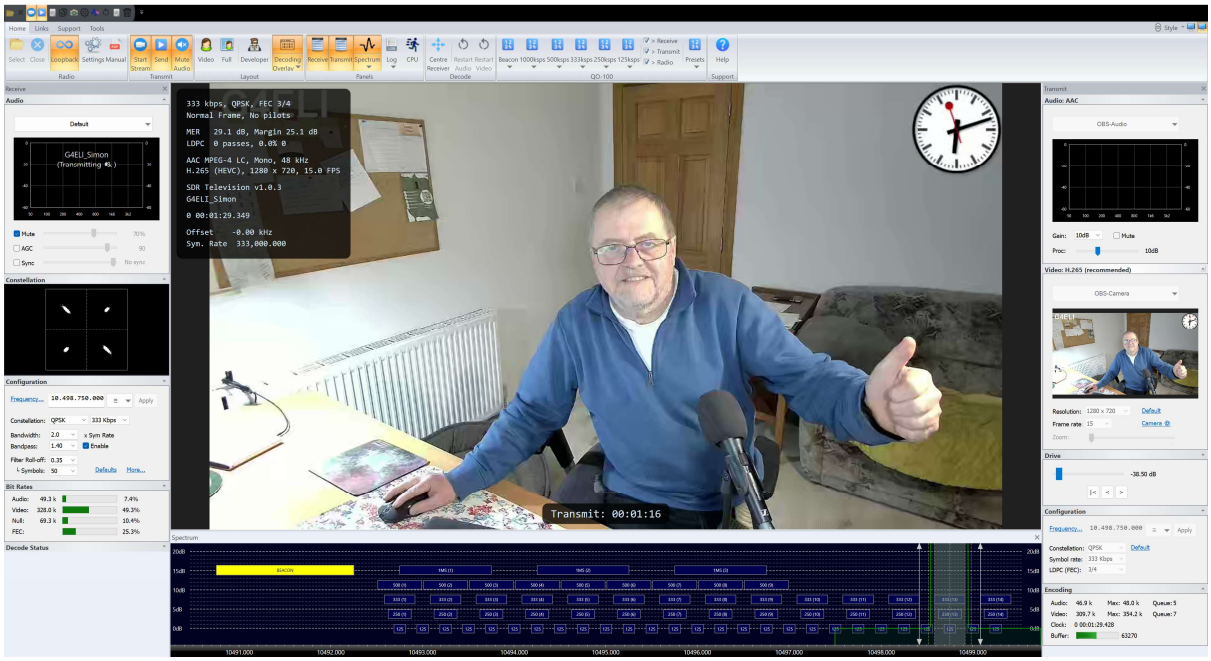
SDR Television

A Windows solution for DATV on QO-100

February 9, 2026



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Support: https://sdr-radio.groups.io/

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Chapter 1 Introduction

This program is a standalone Windows DVB-S2 solution for DATV, primarily for use on the Es'hail 2 (aka QO-100) satellite. Other than an SDR, no additional hardware is required.

Host Requirements

- Windows 11 is recommended. Windows 10 is also supported.
- 64-bit architecture.
- Ideally 8 cores or more but has been used at 333ksps with an i5-7200u.
- AVX2 (so no Core2Duo support).
- Use with emulators such as Prism and Parallels is discouraged.

Restrictions

- Support:
    - Constellations: QPSK is supported, 8PSK is planned for a future release.
    - Frame sizes: Normal is supported, short is planned for a future release.
    - Codecs:
        - Audio: AAC, MPEG
        - Video: H.264, H.265, chroma format 4:2:0 only. To decode other formats (4:2:2 and 4:4:4) use the IP Forwarding option and watch with VLC.
- Terrestrial operation using DVB-T(2) is not planned; DVB-T(2) is a very different standard to DVB-S2 and would therefore require a lot of additional programming.
- There are no plans for Linux, Mac or other non-Windows platforms.
- MPEG audio - only mono and stereo MPEG audio decoding is supported.

NVIDIA

If you have a NVIDIA GPU and want to use NVIDIA encoders, make sure the NVIDIA graphics card is enabled in your BIOS. Some systems, mainly laptops have the option to select between hybrid and discrete graphics. The GPU is a discrete device.

- Hybrid Graphics Mode (also called MS Hybrid or Optimus) uses both the integrated GPU (iGPU) and discrete GPU (dGPU) dynamically. The iGPU handles basic tasks like web browsing and video playback, while the dGPU activates for demanding applications like gaming or 3D rendering. This mode improves battery life by keeping the power-hungry dGPU inactive when not needed.
- Discrete Graphics Mode bypasses the iGPU entirely, connecting the display directly to the dGPU. This eliminates the performance overhead (~10-15%) caused by routing through the iGPU, providing higher frame rates, lower latency, and enabling features like G-Sync and higher refresh rates.

Implementation

- Uses Microsoft Media Foundation for all audio and video processing as this is the current state of the art for Windows.
- Support the Analog Devices Pluto and LibreSDR, other SDRs such as LimeSDR later.
- Code is highly optimised; minimum target hardware is the Intel Processor N100 at 333 ksps.
- Remove the need for extra hardware such as the MiniTioune, Ryde Receiver and software such as VLC Player.

- Full integration with OBS Studio (highly recommended). OBS Integration is explained in the appendices.
- An important goal of this project is low CPU load. Use the Windows task manager to confirm that CPU is acceptable. The CPU load for all key areas of the program is shown by selecting CPU from ribbon bar, Home, Panels.

Chapter 2 Release Schedule

Version 1

This is a proof of concept, the aim to support a full-duplex contact via QO-100 using a Pluto.

This version is now working and will be released by September 2025.

Version 1.0.6

This is an update to version 1; has improved decoding and a cleaner transmission.

Version 1.1

Will have an improved tuning interface and improved cross-band support for anyone using S2 terrestrially, for example 13/23 cms. Target release date April 2026.

Version 1.2

To be decided.

Chapter 3 Installation

This program uses many DLLs from SDR Console, so must be installed in the same folder as SDR Console.

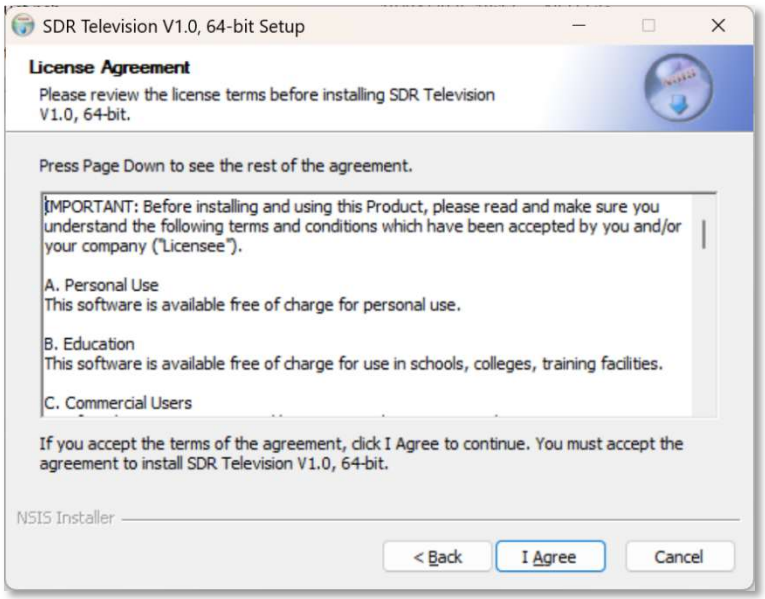
Start

The kit is a Windows executable, just run it. This is a code-signed kit; you will be shown the publisher is “SDR-Radio.com Ltd.”.

Each kit has a date stamp.

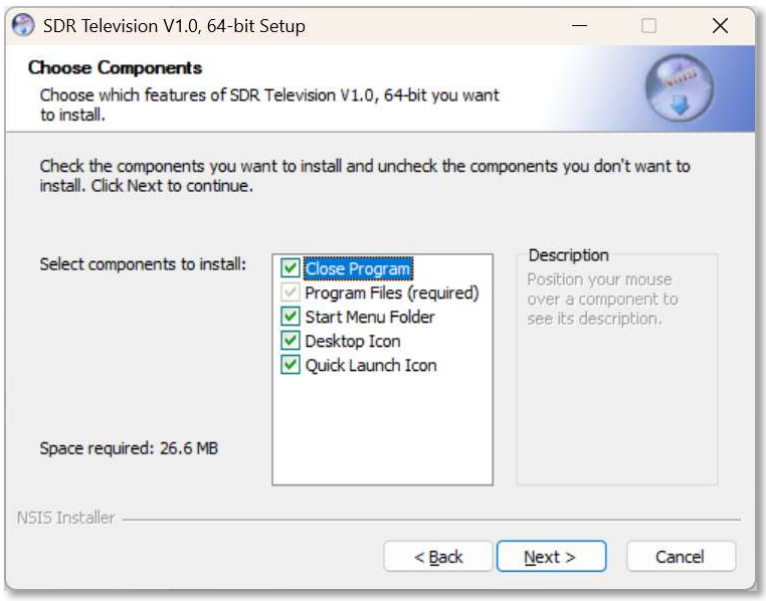
Licence

This is a very basic licence, essentially the software is free to use unless you are a commercial operation which is highly unlikely! It’s actually the same licence text used with SDR Console.



Choose Components

Select all options.

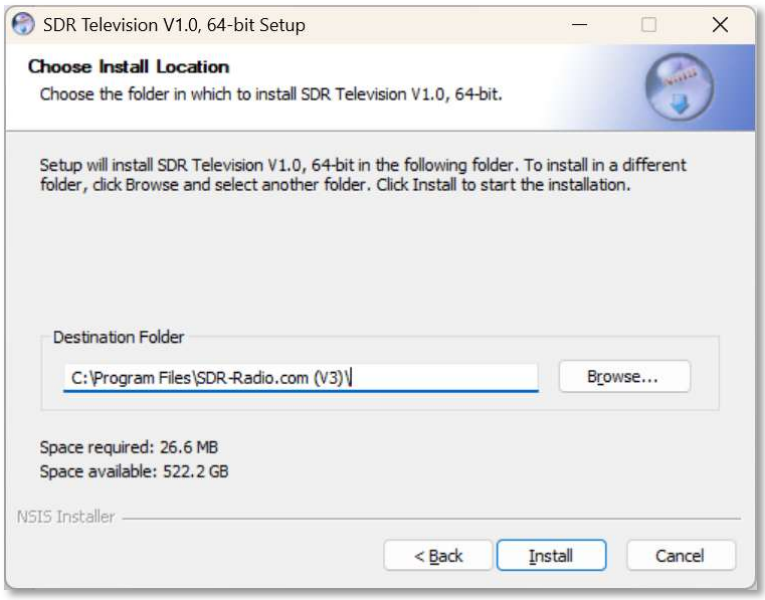


Choose Users

Normally you install for all users on your computer.

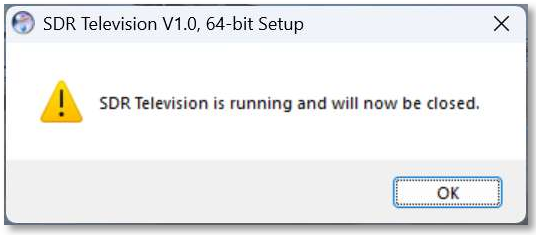
Choose Install Location

This is the important bit. The installer will check that SDR Console can be found in the selected folder. No check is made for the actual version of SDR Console, the check is made when SDR Television starts.

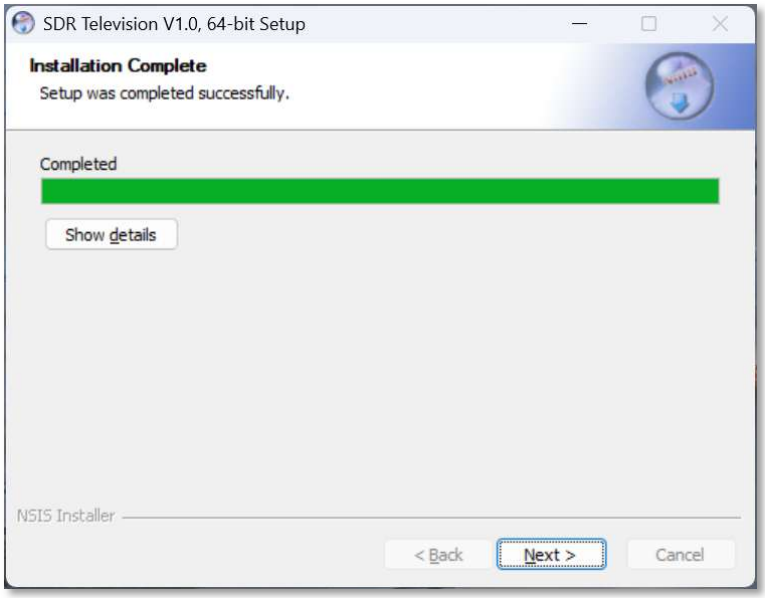


Installing

If SDR Television is already running you are prompted to confirm the program will be closed.



The program is now installed.



Completing

We're finished! You can now start the program.

SDR Television V1.0, 64-bit Setup
Completing SDR Television V1.0, 64-bit Setup
SDR Television V1.0, 64-bit has been installed on your computer.
Click Finish to close Setup.
Start the program now
< Back
Finish
Cancel

Chapter 4 Codecs

This program uses Media Foundation Transforms (MFTs) for encoding and decoding. MFTs are also referred to as codecs throughout this document.

The default settings are recommended, so you can skip this chapter as long as you have H.265 support.

Media Foundation transforms (MFTs) provide a generic model for processing media data. MFTs are used for decoders, encoders, and digital signal processors (DSPs). In short, anything that sits in the media pipeline between the media source and the media sink is an MFT.

As well as the MFTs provided with Windows, additional MFTs may be available from other sources such as NVIDIA if you have a suitable NVIDIA graphics card.

NVIDIA

If you select an NVIDIA encoder, make sure the NVIDIA graphics card is enabled in your BIOS. Some systems, mainly laptops have the option to select between hybrid and discrete graphics.

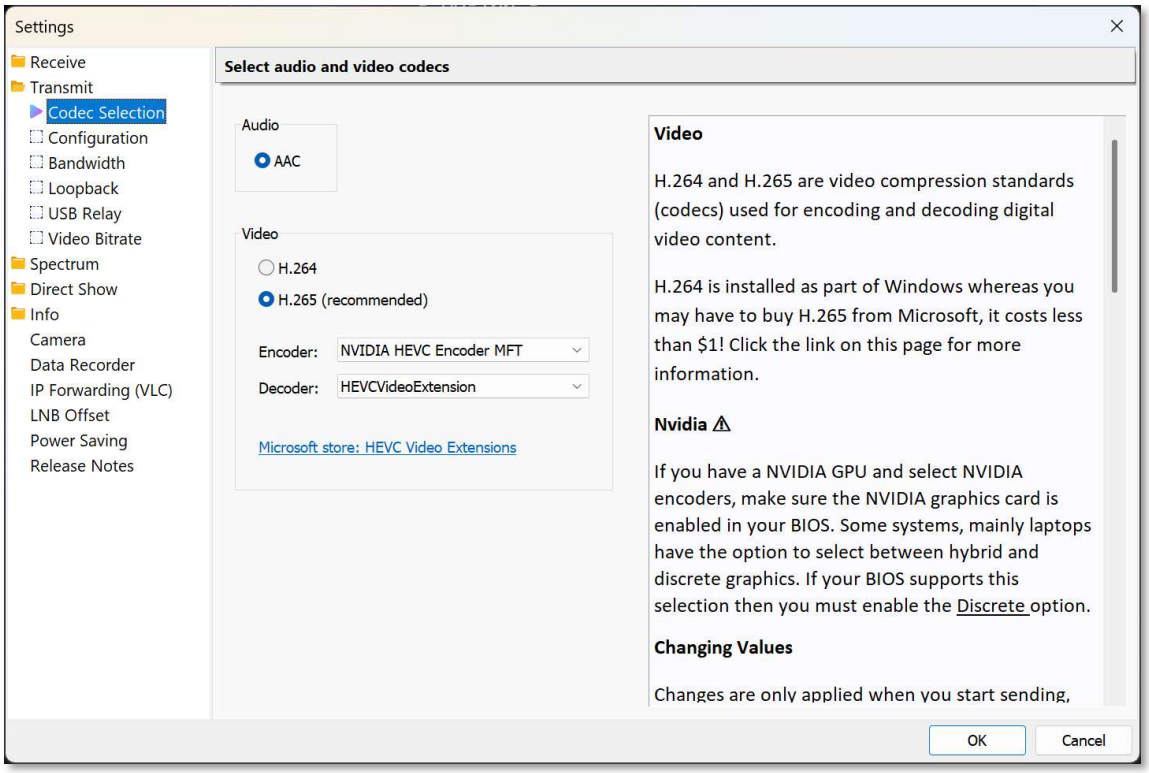
Receive

When receiving, the audio and video codec is selected automatically from the Program Mapping Table (PMT) which is sent at least twice per second with a DVB-S2 transmission, so no selection is required.

Currently video decoding is restricted to chroma format 4:2:0. Support for 4:2:2 and 4:4:4 is planned for a future release. Use IP Forwarding to VLC to watch these formats.

Transmit

Select your preferred audio and video codecs.



Audio

Only Advanced Audio Coding - Wikipedia (AAC) is currently available, there are no configurable parameters. Although MPEG could also be offered, AAC is considered superior and should always supported by DATV receivers.

- Output rate = 6kB (6,000 bits),
- Encoding profile = AAC Profile L2 (see ISO/IEC 14496-3).

Video

Although encoders are available from NVIDIA and other sources, the Microsoft encoders may be the best option for real-time streaming. For example, the NVIDIA encoders may not honour the peak bitrate setting, so are not ideal. Tests made while developing this software could not discern any difference in encoding quality between Microsoft and NVIDIA with RTX 4060ti.

The Microsoft encoders use hardware acceleration when available; both AMD and Intel CPUs supported H.264 and H.265.

H.264 (AVC)

Windows has built-in support for H.264 (Advanced Video Coding), so no purchase needed. The encoder title is “H264 Encoder MFT”.

H.265/HEVC Codec

The High Efficiency Video Coding (HEVC) codec is the recommended choice as the output is of higher quality than H.264 when compared at the same sample rate. The encoder title is “HEVCVideoExtensionEncoder”.

In comparison to AVC, HEVC offers from 25% to 50% better data compression at the same level of video quality, or substantially improved video quality at the same bit rate. It supports resolutions up to 8192×4320, including 8K UHD, and unlike the primarily 8-bit AVC, HEVC's higher fidelity Main 10 profile has been incorporated into nearly all supporting hardware.

You may have to buy the H.265 (High Efficiency Video Coding) encoder from the Microsoft store if it is not already on your computer. This is not expensive – just 99 cents (US). Even if a 3rd-party MFT is available for encoding, the only known MFT for decoding is from Microsoft.

Sadly H.265 (HEVC) is covered by patents, for more information visit HEVC Advance - Access Advance.

Quality

Increasing the encoder quality uses considerably more CPU unless you are using a hardware-based encoder, for example from NVIDIA. The default quality (50%) is recommended, more than 80% results in minimal extra quality.

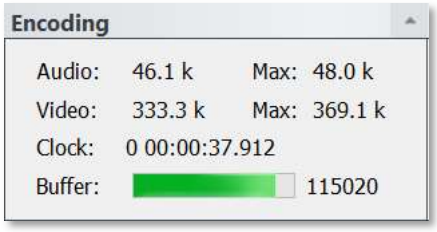
Testing

Testing the performance of the selected video encoder is strongly recommended. Use Loopback mode, described later in this manual.

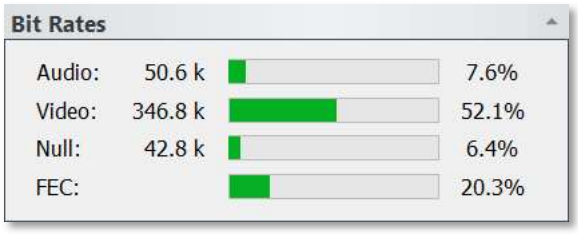
Before you start sending, the available bitrate for video is calculated from factors such as symbol rate, constellation, and FEC. The available bitrate is then reduced by 5 to 10% to provide overhead.

When everything is working well, you see:

1) Video bitrate less than the maximum (Transmit, Encoding),



2) Some Null data packets received (Receive, Bit Rates).

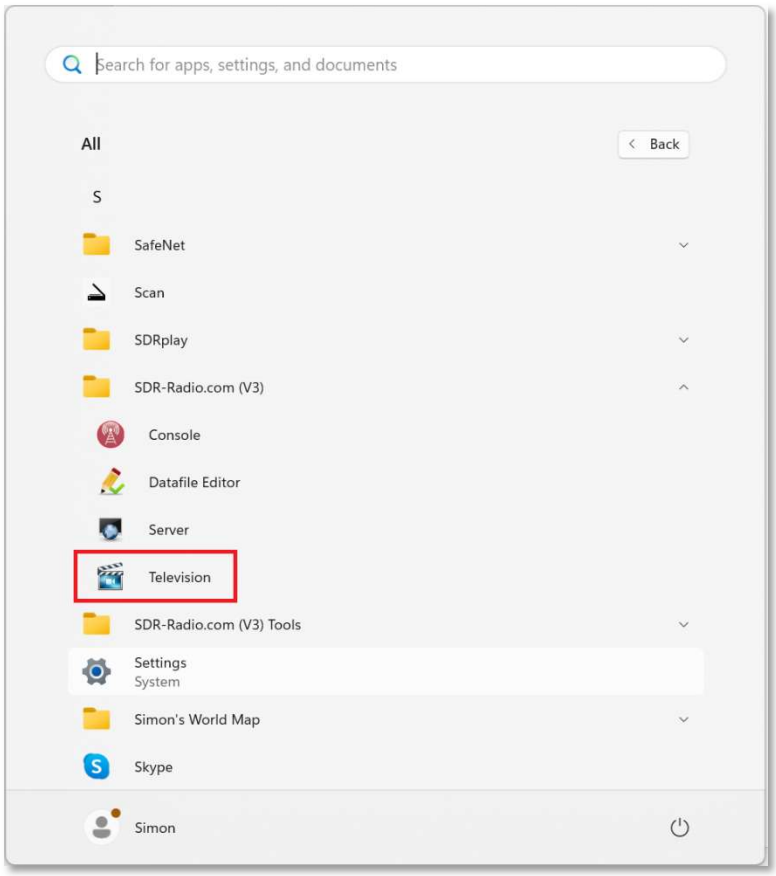


If you are using older CPUs the encoders may return more data than expected (the Null rate is 0). If this happens you must reduce the resolution and/or frame rate.

The recommended resolution of 1280 x 720 at 15 FPS works well on:

- Windows 10, Intel i7-4770MQ,
- Windows 11, Intel i5-6200U,
- Windows 11, Intel i5-14400F,
- Windows 11, Intel i5-13600KF.

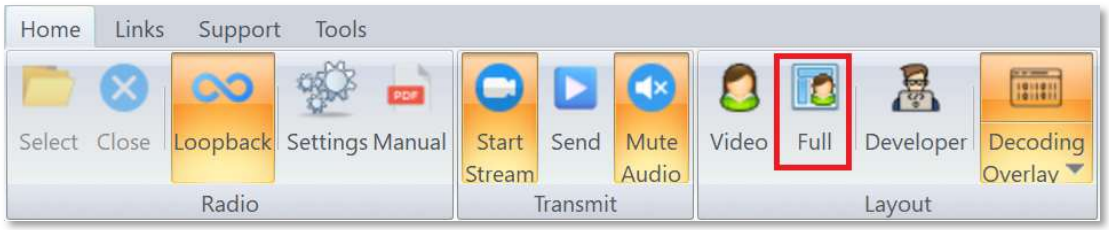
Chapter 5 Starting



When you install this program, a link is added to the Windows start menu under the SDR-Radio.com (V3) Folder.

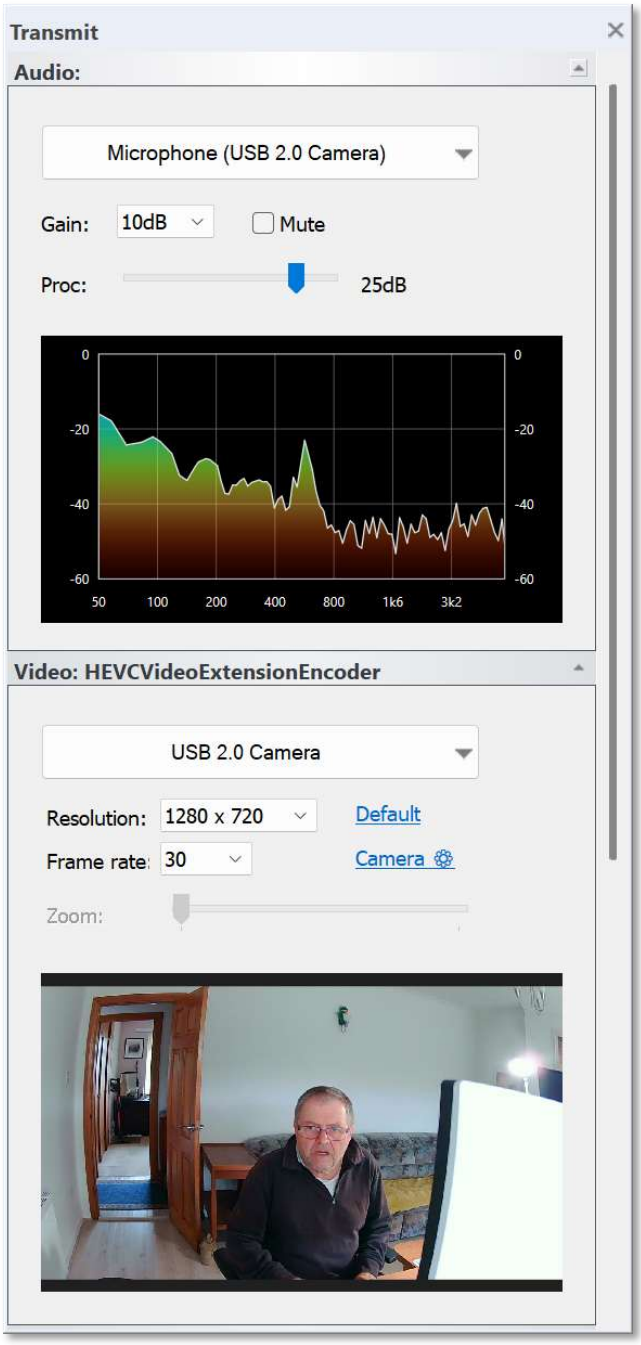
UI Layout

Select a predefined layout from the ribbon bar: Home, Layout. For the next steps the Full layout is required. You can change the layout at any time, even when transmitting.



Microphone & Camera

When you select the Full layout above, the Transmit panel is shown to the right of the main display.



Microphone

The audio window shows all available microphones. To interface with OBS Studio you must use a virtual audio cable (VAC).

Level

Adjust the audio level for good, full modulation.

Camera

The video window shows all available cameras including OBS Studio (not yet confirmed as working on Windows 10).

Resolution

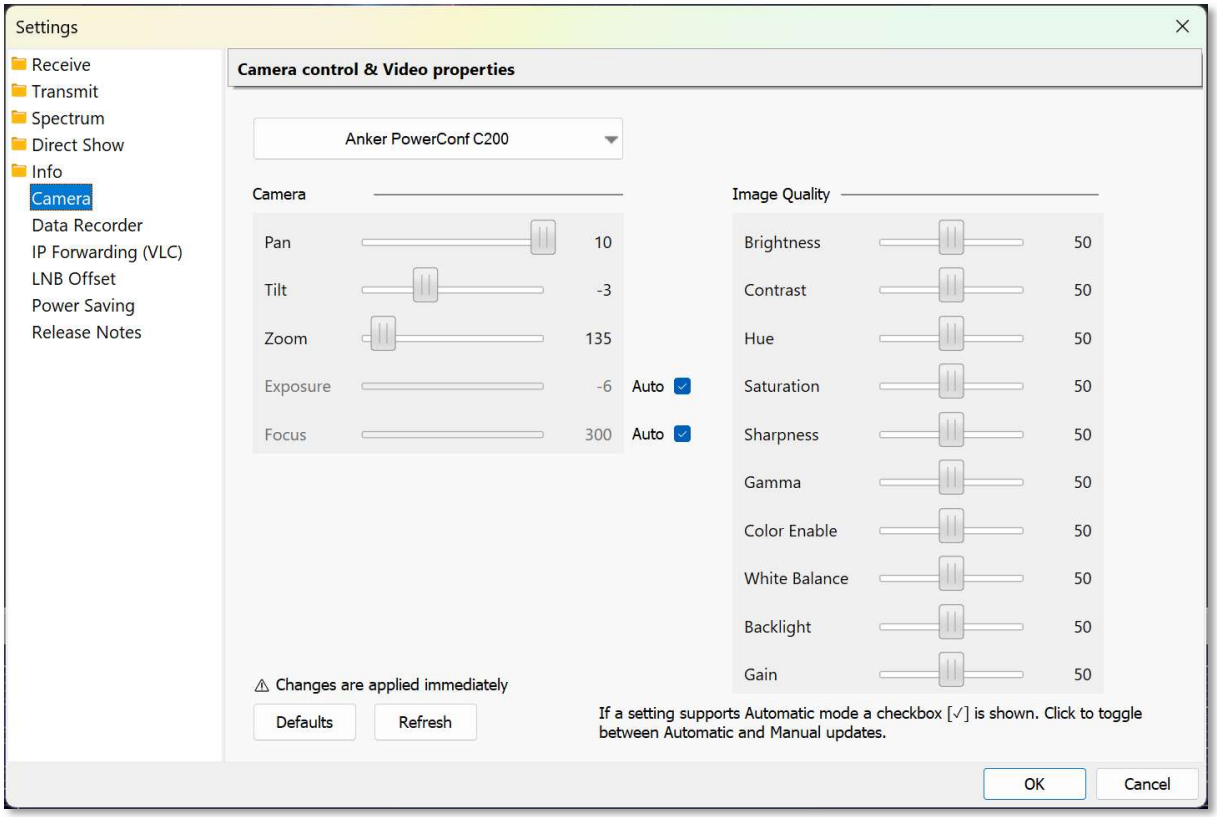
Increasing the resolution does not necessarily result in a better image, in fact increasing the resolution can degrade the encoding. The recommended resolution for 333 kbps and 500 kbps is 1280 x 720. The encoder requires more CPU to process a higher resolution than necessary.

Frame Rate

There's no need to use a high frame rate. The recommended rate is 15 fps, the standard for cinema is 24 fps. Depending on the subject, increasing the frame rate can degrade the encoding.

Camera Options

The camera options are displayed by selecting the Camera… link to the right of the frame rate. The options shown are camera-model specific, so be prepared for differences between cameras. In the window below, options are shown for the excellent Anker PowerConf C200.



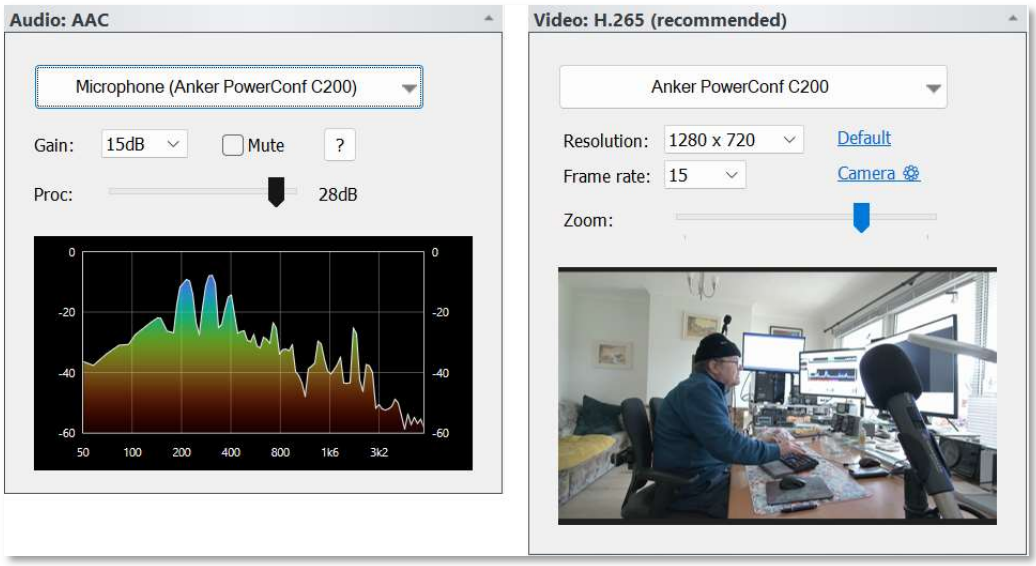
Adjust as required. Generally, the defaults are best.

Initialising

Some webcams such as the Anker PowerConf C200 don't honour the current settings, these must be applied after streaming has started. As a result, you will see a slight delay when streaming starts while the settings are applied.

Streaming

From the ribbon bar: Home, Transmit, Start Stream. The audio and video areas of the transmit panel should now indicate streaming activity as below.



Frequency, Symbol Rate

The frequency and symbol rate for both receive and transmit must be the same. The easiest way to ensure this is to select a QO-100 channel from the ribbon bar: Home, QO-100, 333ksps. In loopback mode all symbol rates are supported.

FEC

The forward error correction (FEC). DVB-S2 performs both BCH and LDPC coding. When you see values such as FEC 4/5 using DVB-S2 solutions, this refers to the LDPC selection which could arguably be written as LDPC 4/5.

BCH

There are no user-configurable options for the Bose Chaudhuri Hocquenghem (BCH) coding. BCH has a fixed size of 192 bits.

LDPC

Select a transmit low-density parity-check (LDPC) option in the Transmit, Configuration window.

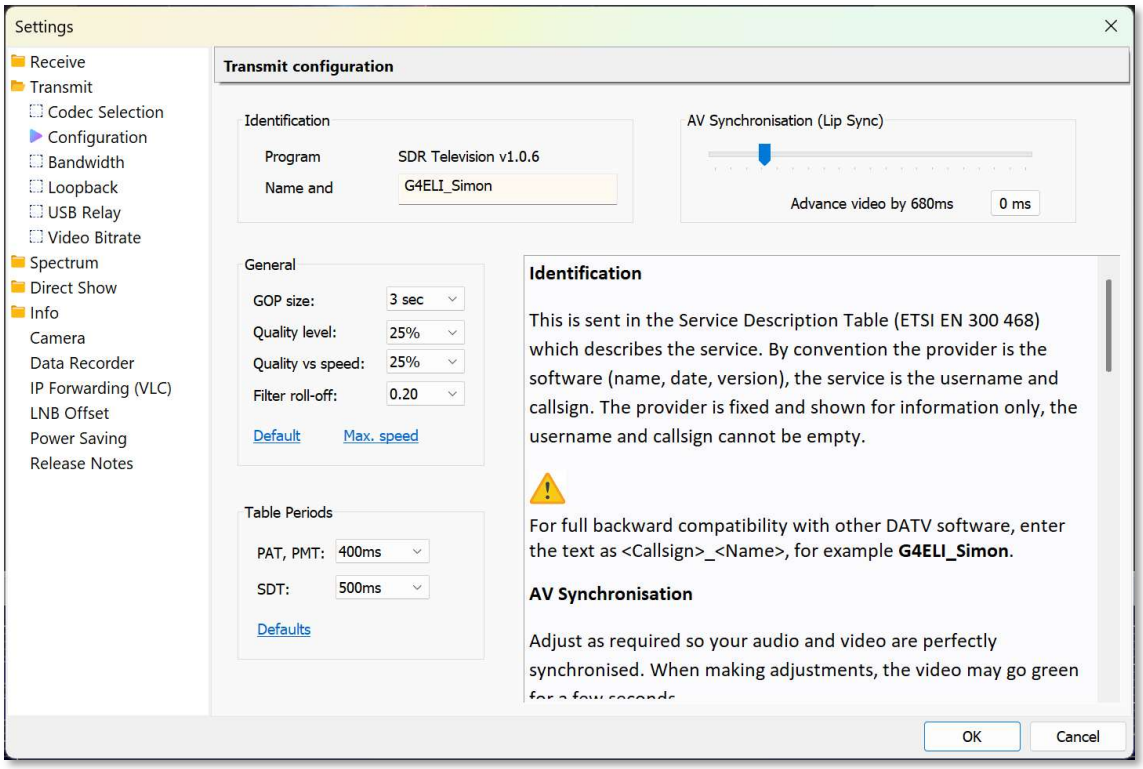
LDPC (FEC) values are shown as FEC X/Y, this is the ratio of message (X) to message and LDPC (Y), so for a higher value such as FEX 4/5 80% is the message being transmitted, 20% the LDPC data.

Lip Sync

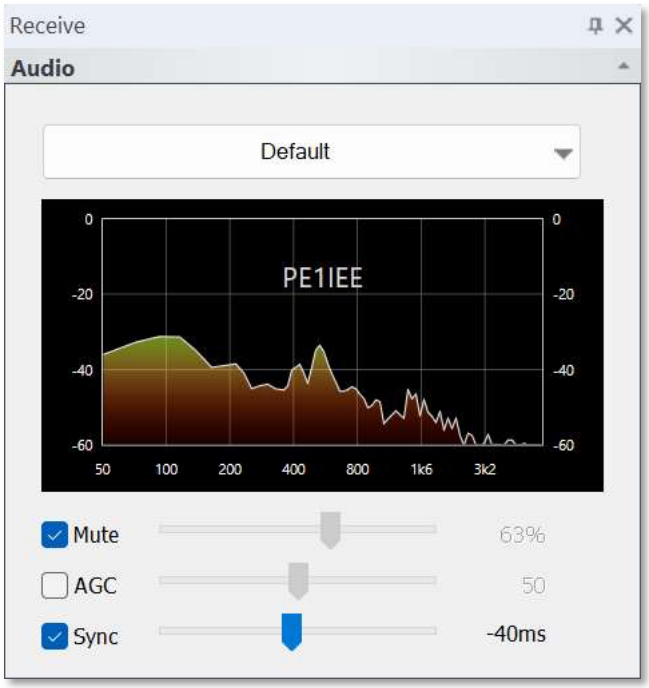
Synchronisation of audio and video is important.

The approach below ensures correct synchronisation when the transmission is received using VLC / Winterhill etc.

1. Enable IP Forwarding to VLC (described later in this document).
2. Select in Loopback mode.
3. Start streaming.
4. Open the Settings, select TX: Configuration.
5. Adjust AV Synchronisation for the best result.

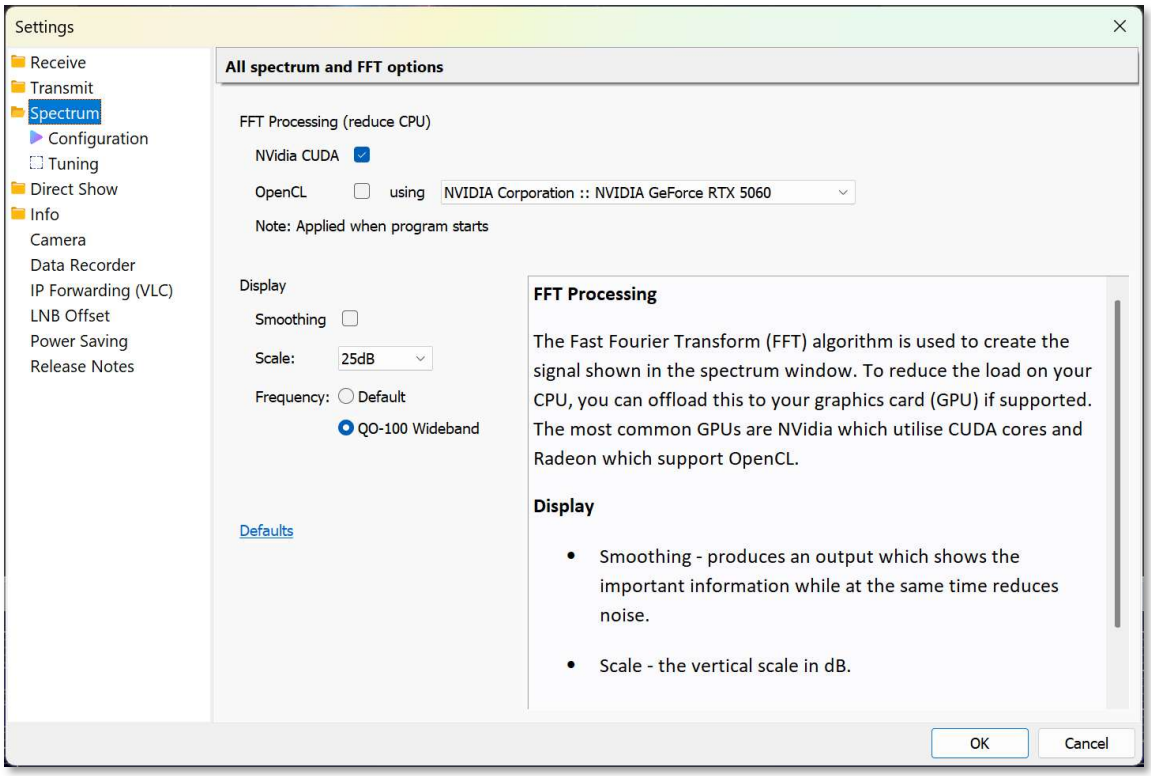


Now listen using SDR Television and adjust the Sync value in the Audio window.



All users should now be happy!

Spectrum



FFT Processing

The fast Fourier transform (FFT) algorithm is used to create the signal shown in the spectrum window. To reduce the load on your CPU, you can offload this to your graphics card (GPU) if supported. The most common GPUs are NVidia which utilise CUDA cores and Radeon which support OpenCL.

Display

- Smoothing - produces an output which shows the important information while at the same time reduces noise.
- Scale - the vertical scale in dB.
- Frequency - either the value returned from the SDR (Pluto) or the QO-100 wideband transponder.

In the image below, a 333 ksps signal is sampled at 666 kHz (2 x symbol rate) with a 1.4 x 333 kHz bandpass filter to remove the signal lower in frequency.

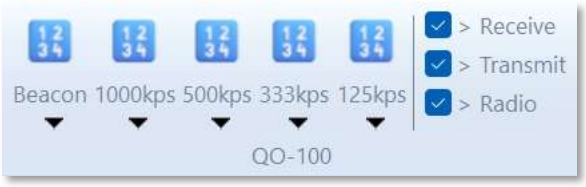
Chapter 6 Tuning

QO-100 Frequencies

Select the frequency from either the ribbon bar or the Spectrum display.

Ribbon Bar

Select from any of the dropdowns. You can't change frequency while transmitting.



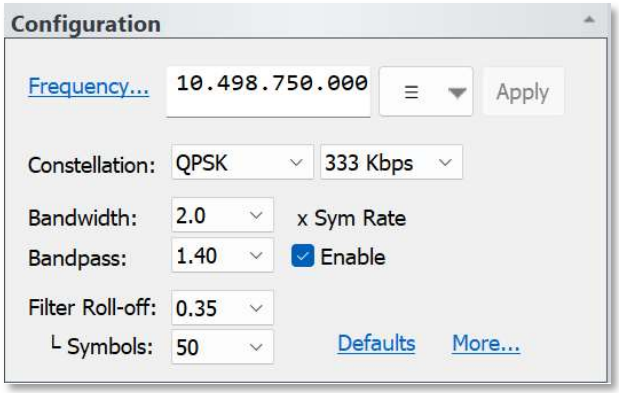
How the selected frequency is applied depends on the options:

- Receive,
- Transmit,
- Radio.

When Radio is checked the center frequency of the current radio is also set.

Configuration Window

In both the receive and transmit panels there is a Configuration window where you either manually enter a frequency or select from the 'hamburger' menu to the right of the frequency.

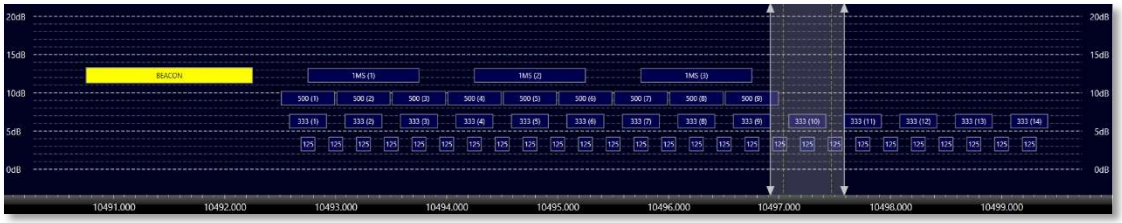


Spectrum Display

If you click in a rectangle the frequency is applied as above (receive, transmit, radio). If you click *and* press Shift then the radio center frequency is always applied.

If you click outside a rectangle then the frequency is taken from the scale at the bottom of the display.

Adjust the frequency with the mouse wheel, press *Shift* for accelerated tuning.



Streaming (Special Case)

If you are using IQ data streamed from SDR Console with a *Console Streamer* then the radio frequency option is disabled as the center frequency is set from SDR Console.

Using the *Console Streamer* is a great way to play IQ recordings until such a time as this program supports IQ recording and playback.

Chapter 7 Loopback Test

In loopback mode the transmit data (IQ format) is fed directly to the receiver and spectrum display. This was added during program development as a simple way to check transmit signal decoding without using a radio. It is also a good test of the computer infrastructure.

Assuming you have followed the checks described previously:

1. Start streaming audio and video,
2. Checked the frequency and symbol rate are the same for both receive and transmit,

from the ribbon bar select:

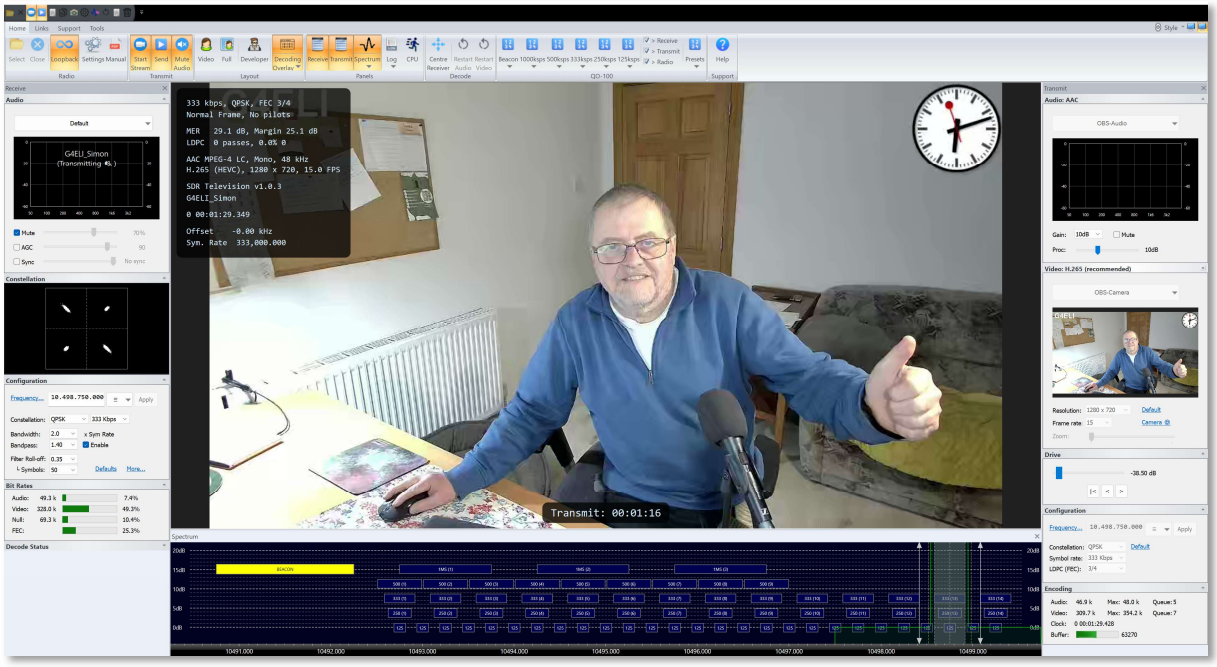
1. Home, Radio, Loopback.
2. Home, Transmit, Send.

After a few seconds you should see the video in the main window and audio in the Receive, Audio window.

Note:

1. To avoid feedback audio is muted while you are transmitting.
2. Modulation error ratio (MER) is much higher as the SNR is very high!
3. Don't worry about the Drive level – this only changes what you see in the Spectrum window. As we're using floating point data and there are no errors, you'll still get 100% decodes with -40 dB of drive.
4. As we're in loopback mode (i.e. not receiving 'on-air' transmissions) there will be no errors to correct, so a higher LDPC (FEC) selection is best as it requires less bandwidth reserved for forward error correction.

After testing at 333ksps, try a higher rate such as 500kbps or even 1,000kbps; you should see a noticeable improvement in image quality.



What to look for:

- Audio in the receive, Audio window (top left).
- A tightly packed constellation window (here we're sending QPSK),
- The transmitted (loopback) signal in the spectrum (bottom),
- An elegant picture in the main window (see above), this should be the same as that shown in the Transmit, Video window but delayed by a few seconds,
- Bit rates in the Receive, Bit rates window (bottom left). The Null field should be greater than 0%.

Also, in this image the Decoding Overlay is enabled (ribbon bar: Home, Layout), position is top left.

Chapter 8 Using A Radio

If you only want to receive DATV then use any SDR which receives at the required frequency. If using a LNB then you must take the LNB offset into account.

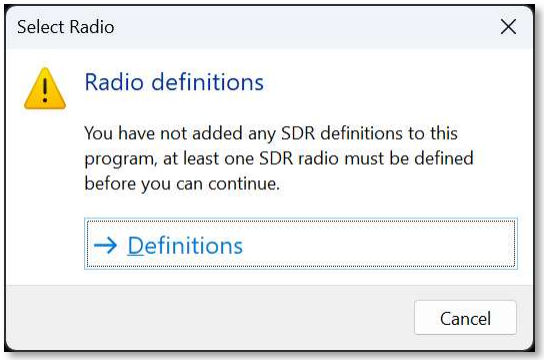
- RTL Dongle v4 – usually good for bandwidths up to 4MHz.
- Airspy R2 – maximum bandwidth 10 MHz, usable 8.5 MHz.
- SDRplay – maximum bandwidth 10 MHz, usable 8.5 MHz.
- LibreSDR – maximum bandwidth is 18MHz over ethernet, 8MHz using USB.
- …

For transmit, only the ADALM Pluto and LibreSDR are supported, LibreSDR is based on the Pluto design. Other SDRs such as Lime USB and Mini will be supported later.

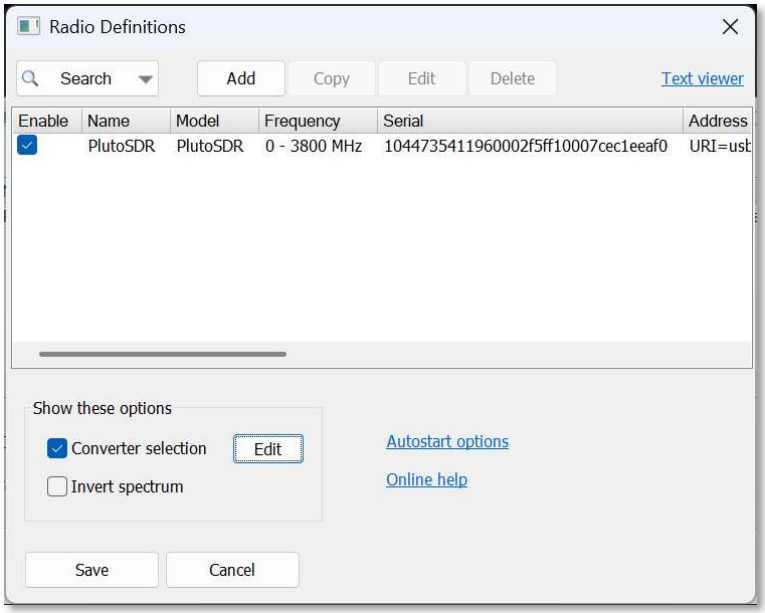
Definitions

The procedure here is the same as used with SDR Console.

When you select a radio for the first time you are prompted to add a definition. As well as the radio, you must also define and select a converter definition when using QO-100.



Select *Definitions*.



In the Radio Definitions window select an entry from the *Search* dropdown list, in this example PlutoSDR.

After adding your radio, select *Converter selection*, then select *Edit* to open the Converter Definitions window.

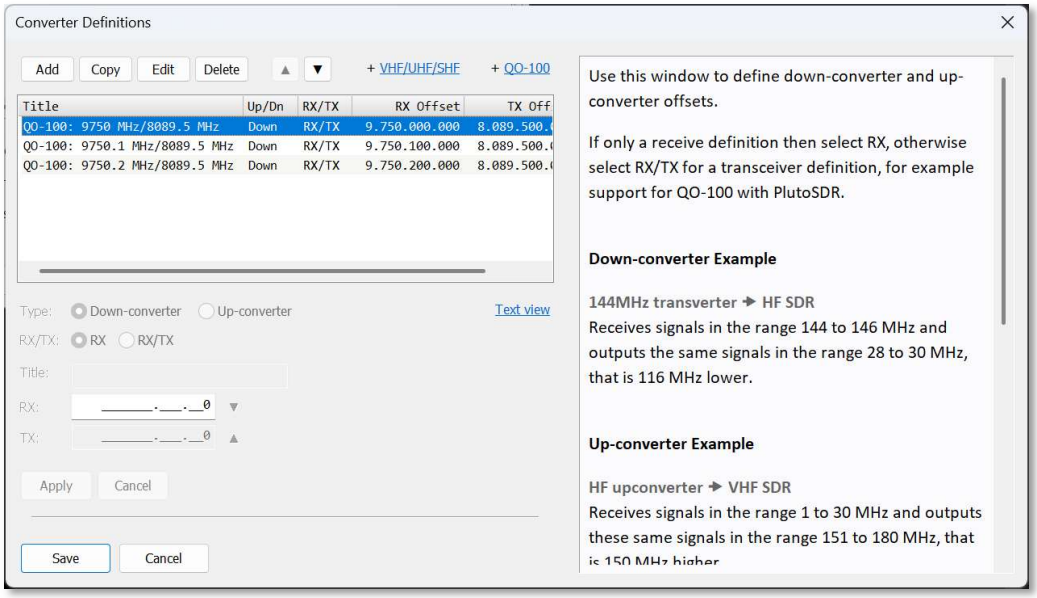
Es'Hail 2 (QO-100)

If using an LNB and SDR such as Pluto or Lime select QO-100 at the top of the window below to add downconverter definitions designed for QO-100.

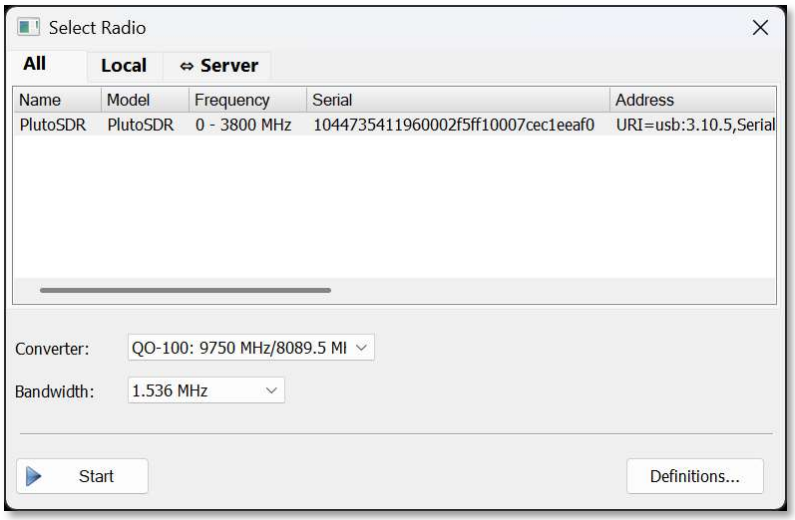
Downconverter example:

- Down-converter
- RX/TX
- RX: 9750.000.000 ▼ (Subtract 9750.0 MHz from the QO-100 frequency)
- TX: 8089.500.000 ▲ (Add 8089.5 MHz to the transmit frequency)

Note: you may have to change the RX offset - this depends on the accuracy/stability of your LNB. The range is usually 9750.000 MHz to 9750.200 MHz, so a list of definitions is added for you.



Now select *Save*.



Select a radio definition and a converter definition, then select *Start*.

Bandwidth

To receive a transmission, the recommended bandwidth when starting the radio is *at least twice* the bandwidth of the transmission. For example, if receiving 333ksps on QO-100 use a bandwidth of at least 666kHz.

With the PlutoSDR 1.536 MHz is a recommended selection for 333 and 500 kbps, this supports TX. For the beacon (1,500 kbps) 4 MHz or higher is recommended.

ADALM Pluto

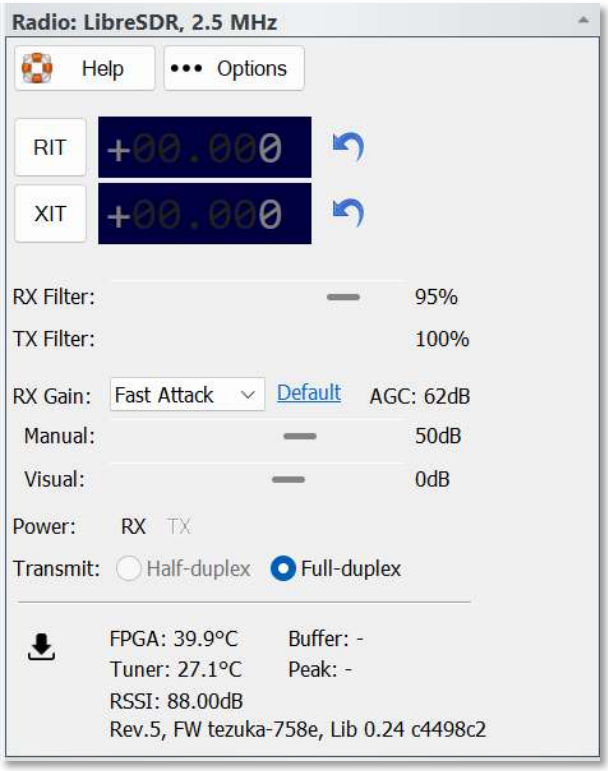
You do not need special firmware when using a Pluto, the latest firmware from Analog Devices is recommended. At the time of writing this is version .39 which has better internal DSP than earlier versions, resulting in better DATV decoding as indicated by an increase in MER.

Below is the radio panel showing recommended Pluto settings.

Recommended settings for best MER:

- RX Filter: 100%
- RX Gain: Fast Attack
- Visual: 0dB

Note: Half-duplex is currently disabled, if required in the future then it will be enabled.


Radio: LibreSDR, 2.5 MHz
Help
Options
RIT
+00.000
XIT
+00.000
RX Filter:
95%
TX Filter:
100%
RX Gain:
Fast Attack
Default
AGC: 62dB
Manual:
50dB
Visual:
0dB
Power:
RX
TX
Transmit:
Half-duplex
Full-duplex
FPGA: 39.9°C
Buffer: -
Tuner: 27.1°C
Peak: -
RSSI: 88.00dB
Rev.5, FW tezuka-758e, Lib 0.24 c4498c2

Chapter 9 Receiving

LNB

The LNB / feed adjustment is critical for DATV as every 1/10th of a dB really matters, unlike SSB on the narrow band transponder where signals are much stronger.

Voltage

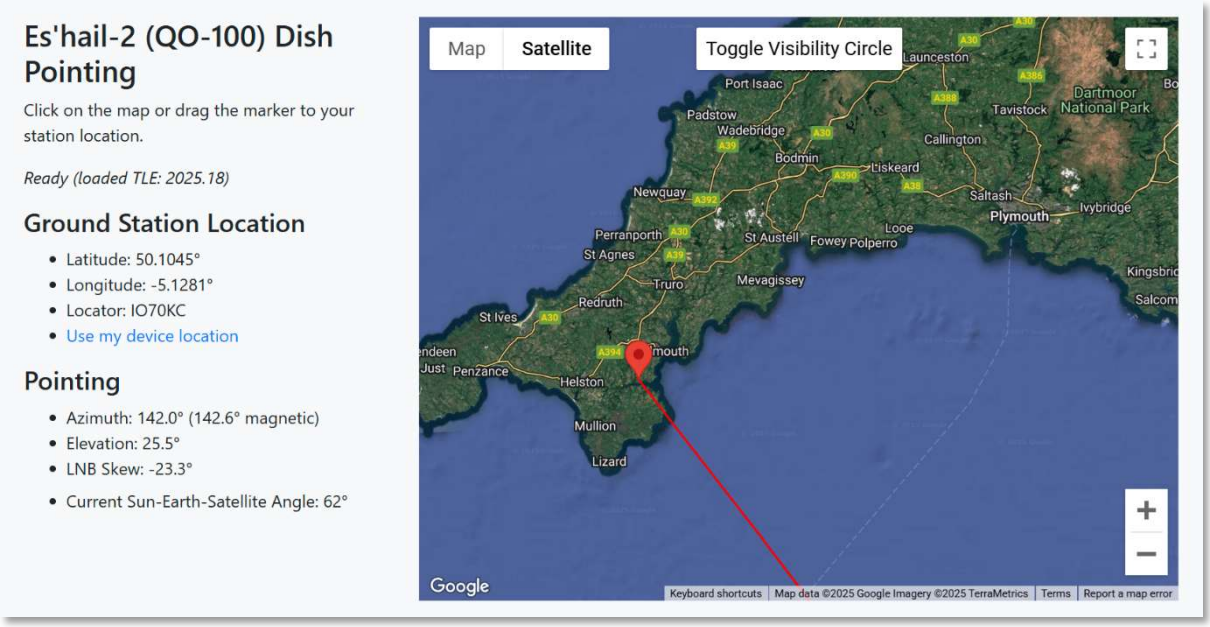
Don't forget – for the wide-band transponder you must select the correct voltage for your LNB to receive horizontal polarisation.

Polarisation switching is controlled by DC voltage supplied by the receiver. Typically, 12.5v to 14.5v gives vertical and 15.5 to 18v gives horizontal polarisation. A higher voltage than that can damage the LNB. A voltage that is too low will prevent the LNB from working correctly.

Skew Angle

Skew refers to the angle of the LNB relative to the rest of the dish. As you are maximising the gain of the LNB, this could be the difference between a good watchable picture or poor reception.

Here's a great BATC site where you can find your skew angle. Here's the results from my location in south-west Cornwall (IO70kc) where the skew angle is -23.3°.

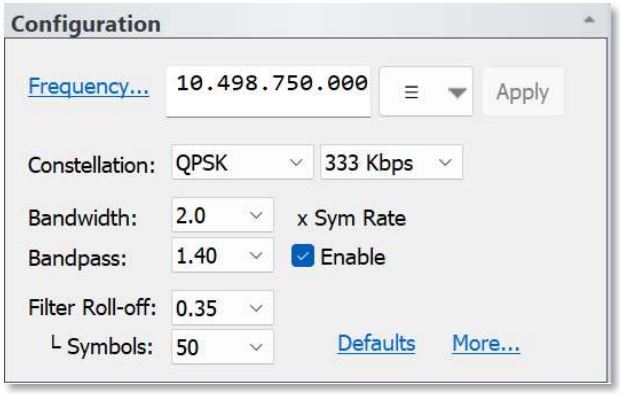


A recommended way to adjust the skew angle is to watch the narrow band transponder beacon signal and adjust for minimum signal level, minimum narrow band signal level corresponds to maximum wide-band signals.

Dish Focus

As well as the skew angle, you should position your LNB at the dish's focal point. An easy way to determine the best position is to switch the LNB voltage and monitor the narrow band beacon while adjusting the LNB position for maximum signal to noise.

Configuration



Frequency

The receive frequency, don't forget to select an optional Converter when starting a SDR radio (if required).

Constellation

The default is QPSK. In later releases 8PSK will be supported. If there is demand (and a good reason) then 16APSK and 32APSK will also be supported.

Symbol Rate

This cannot be determined automatically; you must select the symbol rate used by the transmission you are receiving.

Sample Rate

This is the IQ data rate (bandwidth) processed to return the symbols. It must be less than the radio bandwidth and greater than the symbol rate.

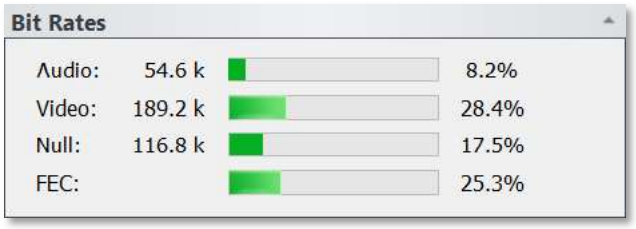
Bandpass Filter

The BPF is used when there are other transmissions close to that you are receiving.

Matched Filter

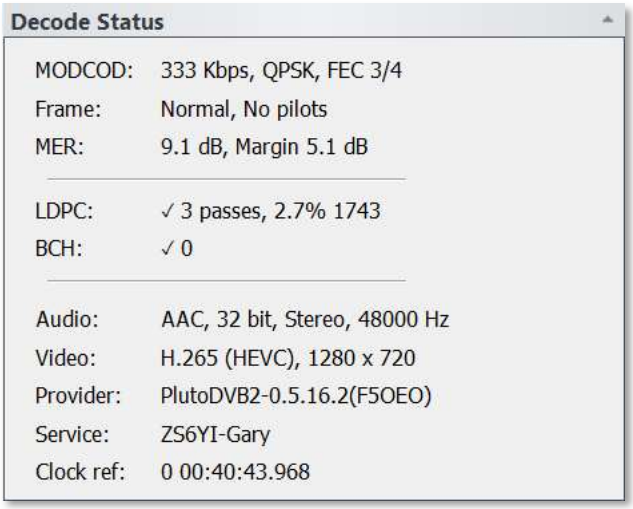
The DVB-S2 signal is square root raised cosine filtered, so for receive a matching filter must be used.

Bit Rates



This display-only window shows the available bit rate used for audio and video data. When there is nothing to send, the transmission sends null packets. Seeing some null packets in this display is normal, typically 10% of the video rate but this depends on the transmitting station's configuration.

Decode Status



This display-only window shows key receive metrics. A Decoding Overlay with receive metrics is also available; select this from the ribbon bar, layout panel.

MODCOD – sample rate, constellation, FEC.

Frame – either Normal or Short, currently only normal frames are supported.

MER – modulation error ratio, *higher is better*. The theoretical minimum value depends on the FEC, the margin is the difference between measured MER and minimum required for decoding in an ideal scenario. For more information see Chapter 6, ETSI EN 302 307.

LDPC – Low Density Parity Check is the inner FEC encoding. Here you see the errors corrected as both a percentage and count. As the MER and signal quality increases the LDPC value should decrease. You'll only achieve a value of 0% when sending a signal in your laboratory, in a real-world situation there will be errors, that's why we use FEC.

BCH – Bose-Chaudhuri-Hocquenghem (BCH) is the outer FEC encoding, a value of 0 or higher is expected.

Audio, video – the codecs used by the transmission.

Provider, service – sent by the transmission, usually provider refers to the transmitter firmware or software and service is a username and callsign.

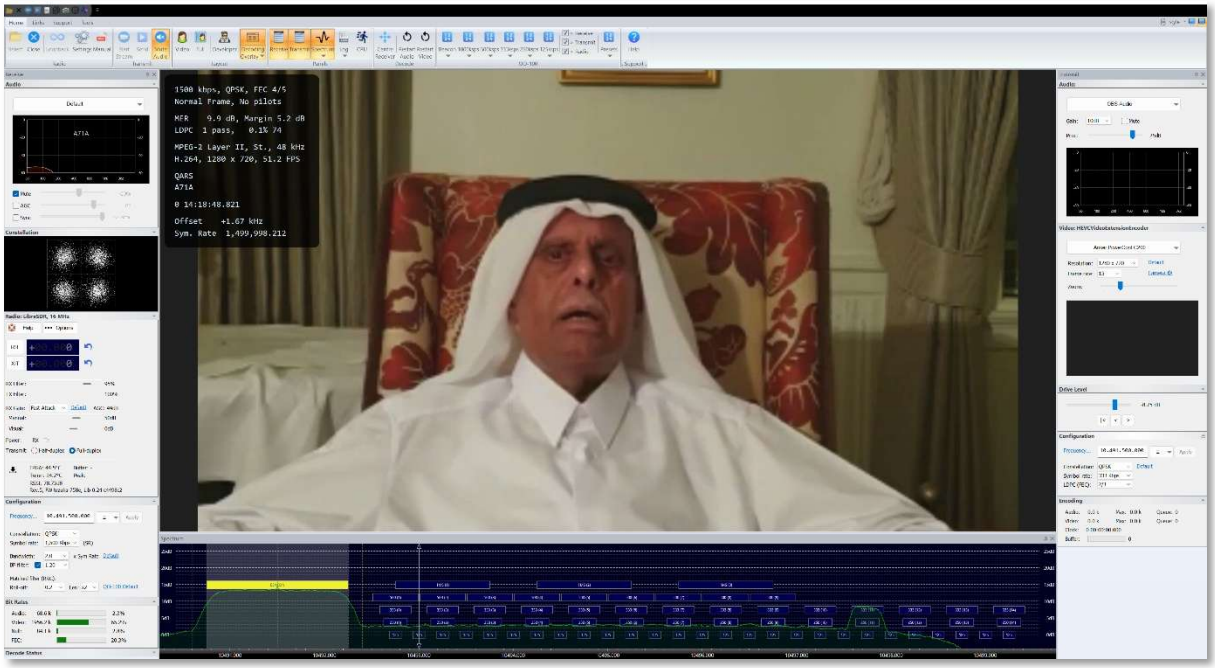
Clock reference - Program Clock References (PCRs) provide the means for the receiver to lock to the encoded transmission.

QO-100

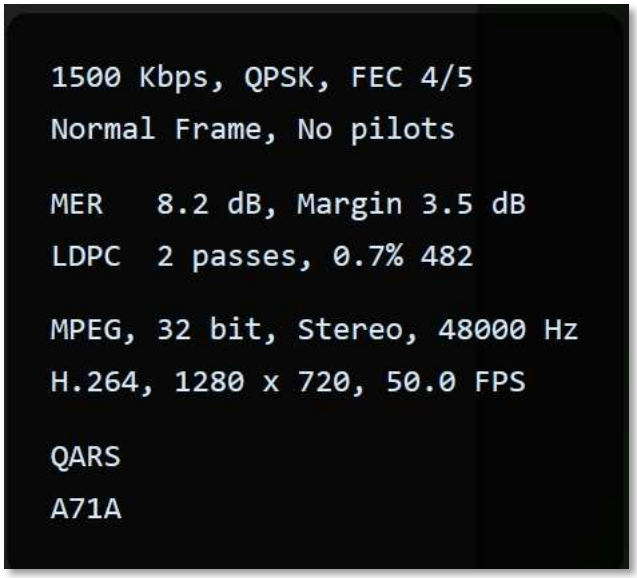
Beacon

The Beacon is the easiest signal to receive but sometimes the beacon signal is corrupted – it is actually transmitted from earth, possibly using a Raspberry Pi. I've seen it rebooting!

- The beacon sample rate is 1.5 MHz, start your radio with a bandwidth of 3 MHz (or more),
- A very strong signal,
- Requires H.264 and MPEG decoders which are already part of Windows.



Here's the decoding information, you should see the same with the exception of MER and LDPC which will obviously be signal dependent.



Weekly Nets

Two nets which run for an hour or more are:

1. British Amateur Television Club (BATC), Thursday at 20:00, 10499.25 MHz, 333 ksps.
2. Worldwide net hosted by Gary ZS6YI, Sunday at 14:00 UTC, 10499.25 MHz, 333 ksps.

As with all nets, the quality depends on the participants.

FEC

The FEC system in DVB-S2 is based on LDPC (Low-Density Parity Check) codes concatenated with BCH (Bose–Chaudhuri–Hocquenghem) codes, allowing Quasi-Error-Free operation at about 0,7 dB to 1 dB from the Shannon limit.

FEC doesn't come for free – it can consume a lot of resources unless implemented professionally.

LDPC

First the LDPC runs in a series of passes, attempting to correct all detectable errors. LDPC uses the most CPU resources, so it is essential that it is coded as efficiently as possible. Fortunately, Ahmet Inan has written a masterful LDPC decoder which is available on Github under the BSD Zero Clause License. This is a very fast, intelligent design which is well worth looking at should you be crazy enough to write your own DVB-S2 decoder.

Status

The result of the LDPC is either success with all errors corrected, or failure. The results shown in this program are of the format:

```
A passes, b.c% dddd
```

Where **A** as is the number of passes required to correct the errors, **b.c** the percent of bits determined to be in error and **dddd** the actual number of bits determined to be in error. Remember that a normal frame is 64,800 bits and a short frame 16,200.

BCH

The BCH is a cyclic error-correcting code which can correct a few errors, the main use is to confirm the integrity of the LDPC output. Although the LDPC may believe it has corrected all errors, this is not always the case.

The BCH code in the program has been written from the ground up using AVX2 instructions where possible, this greatly reduces CPU.

Status

The status of the BCH is the number of bits corrected; this is almost always zero. In the very rare occasion that a bit is corrected then an entry is added to the logfile.

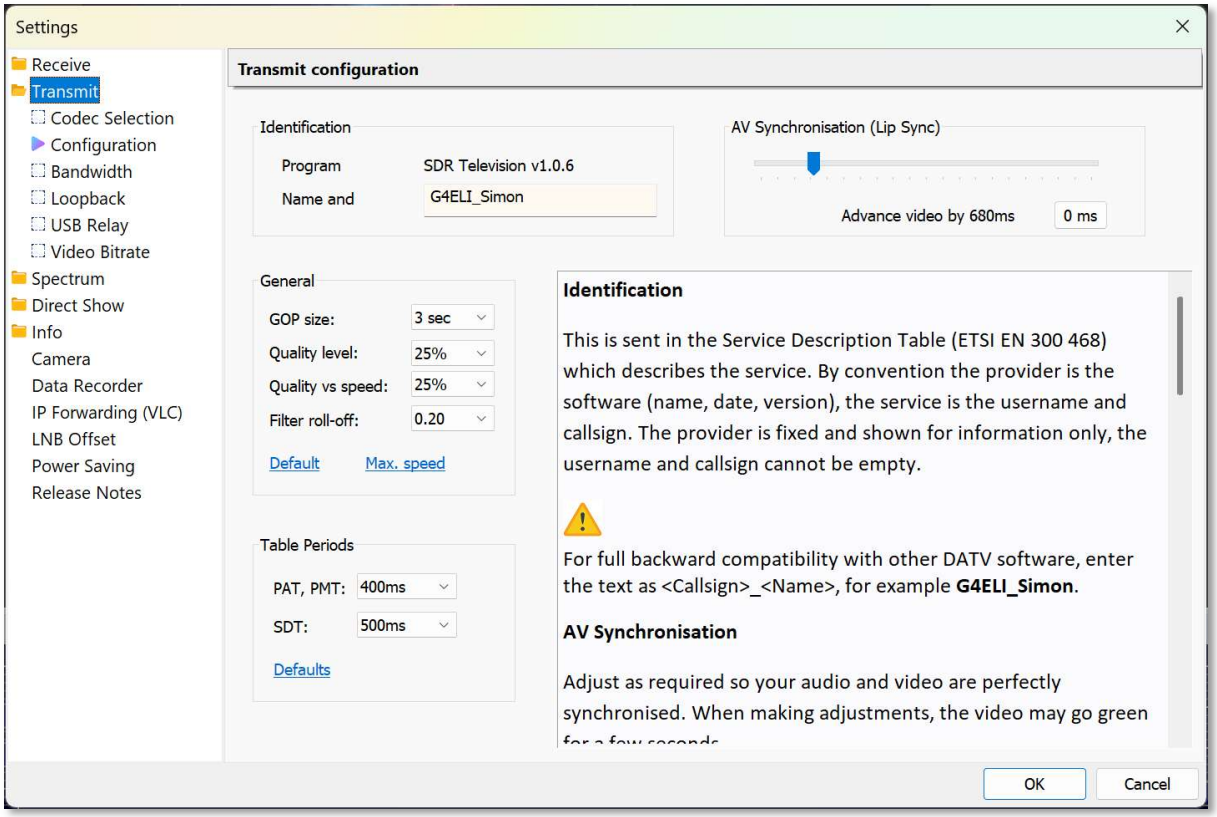
Chapter 10 Transmitting

"Try not to bore the socks off everyone; short overs are best."

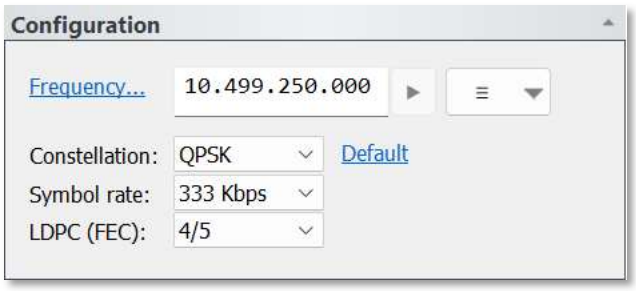
Unknown DATV programmer, 2025.

Configuration

All transmit options are shown in the window below.



The main settings are also accessible in the Transmit panel.



Identification

This is sent in the Service Description Table (ETSI EN 300 468) which describes the service. By convention the provider is the software (name, date, version), the service is the username and callsign. The provider is fixed and shown for information only, the username and callsign cannot be

empty.

Note: currently only Latin alphabet chars are allowed.

Constellation

The most commonly used constellation is QPSK (aka 4PSK), later versions of this software will support 8PSK, possibly 16APSK and 32APSK (ETSI EN 302 307-1). Increasing the constellation increases the available bit rate (bits per symbol) but requires more transmit power.

- More information will be added when additional constellations are supported.

Symbol Rate

The most commonly used rate on QO-100 is 333 Kbps.

FEC

DVB-S2 offers a powerful forward error correction (FEC) based on LDPC codes concatenated with Bose Chaudhuri Hocquenghem (BCH) codes. This mechanism allows quasi error-free operation at about 0.7 dB to 1 dB from the Shannon limit. (https://uk.mathworks.com/)

Forward Error Correction is defined in (ETSI EN 302 307-1), the default in this program is FEC 4/5, so roughly 20% of the data sent is LDPC (low-density parity-check) code. By contrast for FEC 2/3 roughly 33% of the data is LDPC.

Roll-Off

The shaping filter roll-off factor shall be α = 0,35, 0,25 and 0,20, depending on the service requirements.

- DVB-S: 0.35,
- DVB-S2: 0.25, 0.20,
- DVB-S2X 0.15 (for future use).

For QO-100 use a roll-off factor of 0.25 or 0.20. here's the formula:

$$H(f) = 1 \qquad \text{for } |f| < f_N(1-\alpha)$$

$$H(f) = \left\{\frac{1}{2} + \frac{1}{2}\sin\frac{\pi}{2f_N}\left[\frac{f_N - |f|}{\alpha}\right]\right\}^{1/2} \qquad \text{for } f_N(1-\alpha)$$

$$H(f) = 0 \qquad \text{for } |f| > f_N(1+\alpha)$$

Table Periods

Three tables PAT (Program Association Table), PMT (Program Mapping Table) and SDT (Service Description Table) are send at regular intervals. These tables contain key information required to decode the transmission.

Packet Identifiers

This is shown for information only.

Radio Bandwidth

To transmit, the radio must support transmit and the bandwidth must be the same as or greater than the sample rate (typically twice the symbol rate).

The sample rate is calculated with the formula:

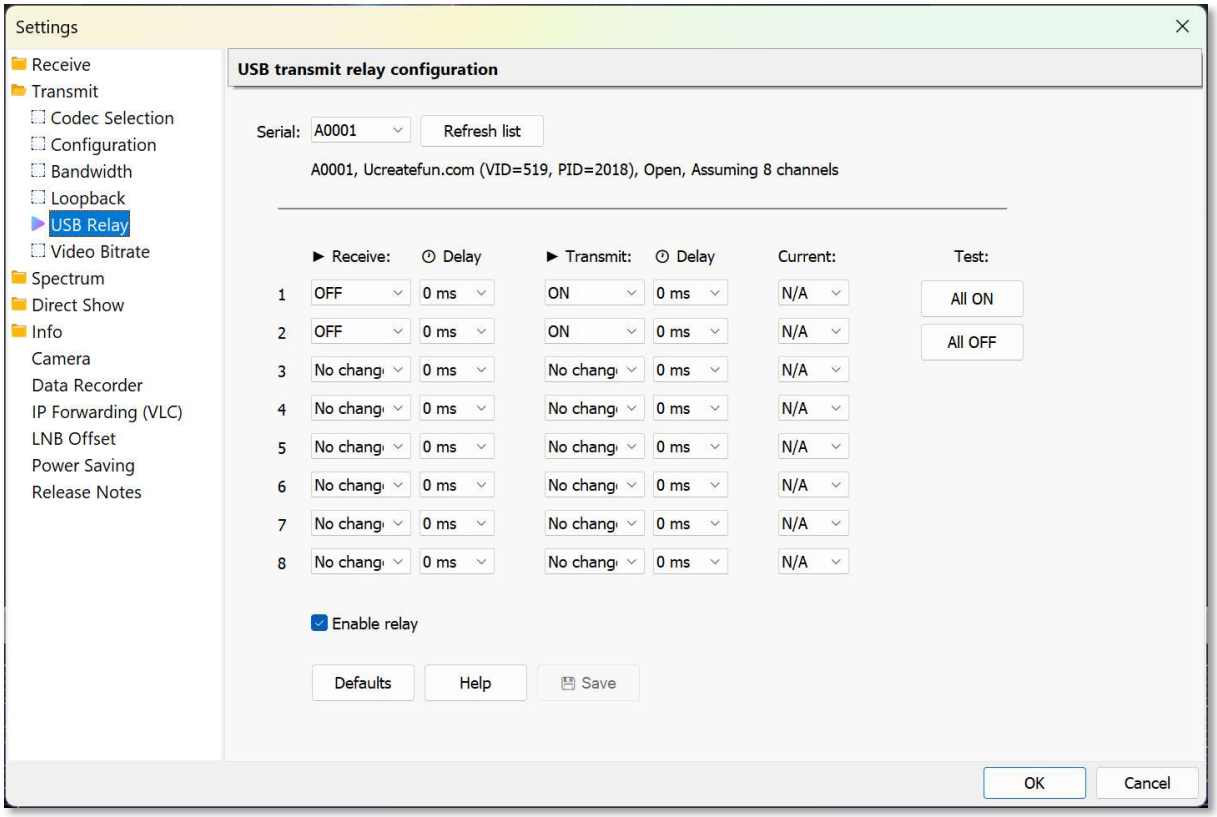
- Sample Rate = Symbol Rate * Constellation (Bits).

The Constellation value is the number of bits per symbol, so for QPSK use a factor of two.

For example, if the symbol rate is 333 kbps and the constellation is QPSK then the sample rate is 2.0 * symbol rate, that is 666 kHz.

The above rule is applied when sending - an error message is displayed if the radio bandwidth is insufficient.

USB Relay



Full support for USB relays, used for switching amplifier stages. In this example relay 1 of 8 is enabled.

Drive Level

Adjust the drive level in the range -40.00 dB to 0.00 dB in steps of 0.25dB. A MER margin of 4dB or more is very good.

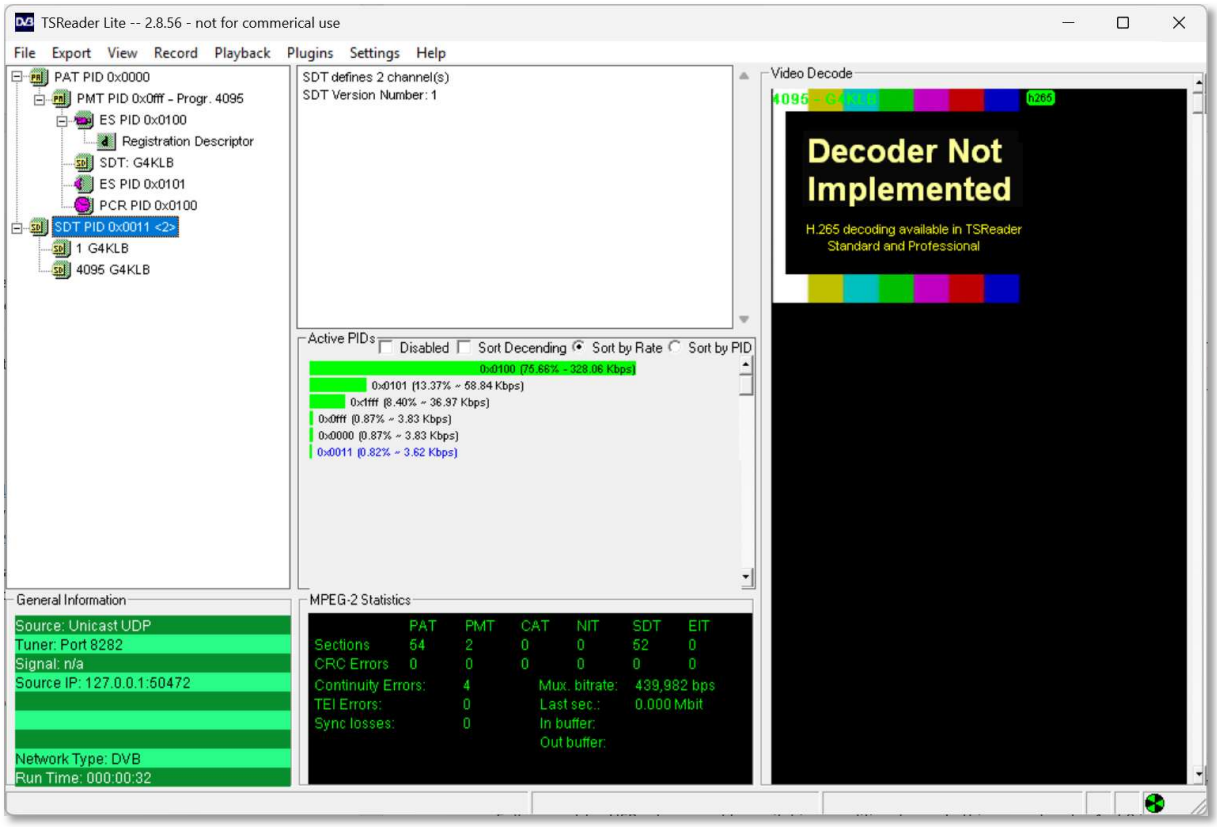
Chapter 11 IP Forwarding

You can forward the receive and/or transmit streams to programs such as TS Reader and VLC media player via UDP.

TS Reader

TSReader is a very popular MPEG-2 transport stream analyzer. Used by thousands of people around the world, it allows inspection and recording of data carried in these television streams used for satellite, cable, off-air and IPTV streaming such as UDP, RTP, HLS and MPEG-DASH.

Download TS Reader from https://www.tsreader.com/ . This is an excellent program for use when diagnosing issues with DATV software. The screenshot below is from the Lite version, purchase the Standard or Professional version for more options.



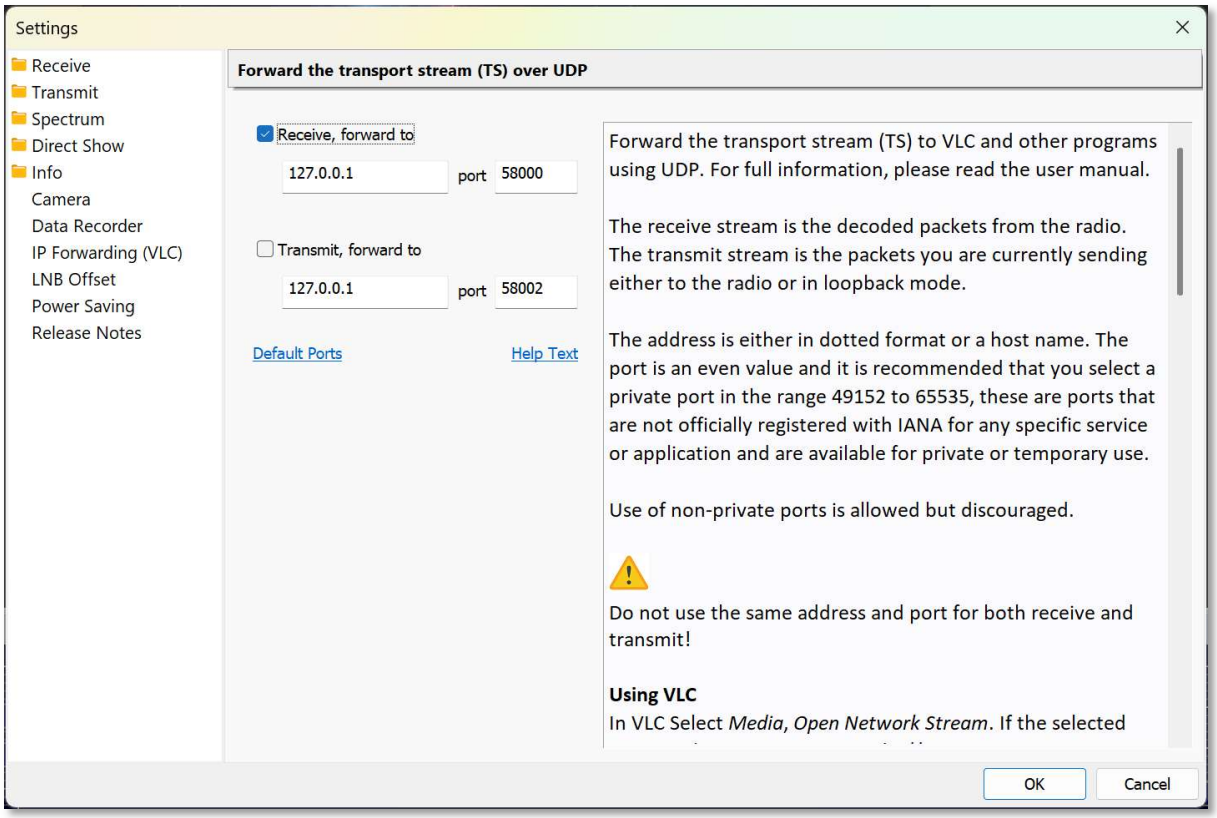
VLC Media Player

VLC is a free and open source cross-platform multimedia player and framework that plays most multimedia files as well as DVDs, Audio CDs, VCDs, and various streaming protocols.

Download VLC from https://www.videolan.org/vlc/.

Configuring

In the program settings, select *IP Forwarding*.



Select the address and port for each stream. The address is either in dotted format or a host name. The port is an even value and it is recommended that you select a private port in the range 49152 to 65535, these are ports that are not officially registered with IANA for any specific service or application and are available for private or temporary use.

Use of non-private ports is allowed but discouraged.

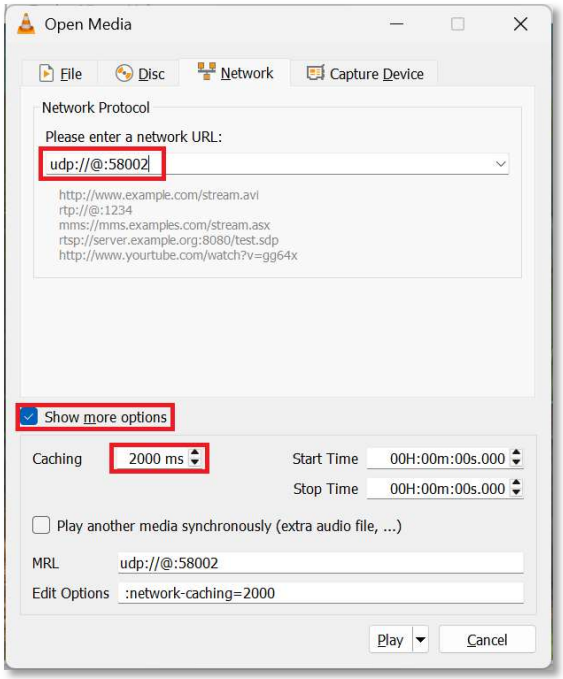
The default for the receive stream is 58000, for the transmit stream 58002. Normally you just enable the receive stream.

Network Protocol

In VLC Select *Media*, *Open Network Stream*.

- If the selected port number is 58000, enter udp://@:58000.
- If the selected port number is 58002, enter udp://@:58002.
- Check [X] Show more options, then set Caching to 2000 ms to avoid dropouts.

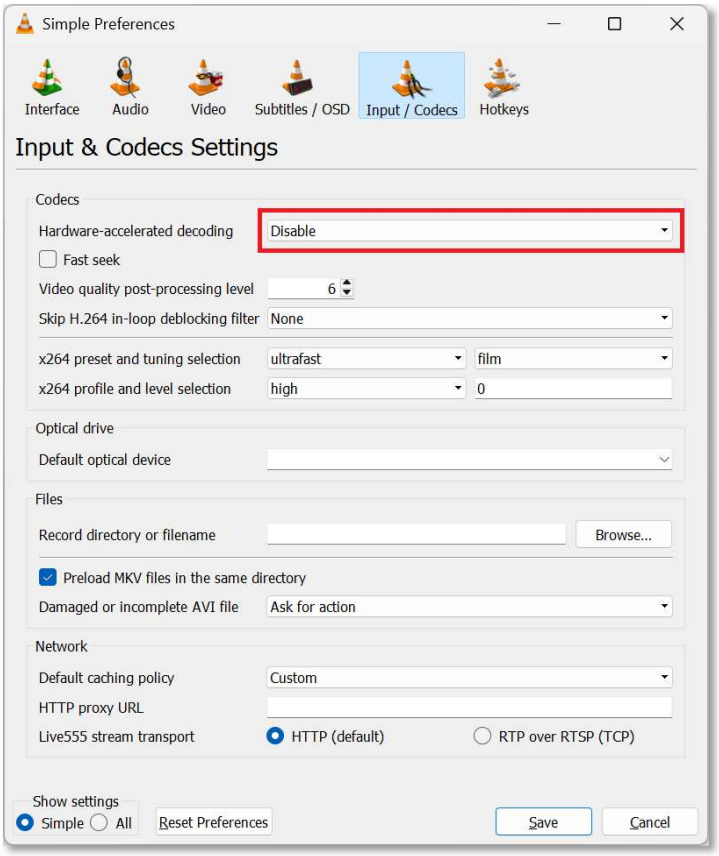
Now press *Play*.



Display Problems

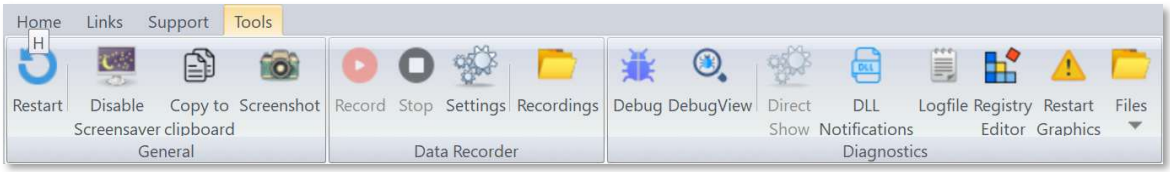
VLC may not display the video properly, sometimes just a single image. If this happens try disabling hardware acceleration:

- From the VLC menu select *Tools*, *Preferences*.
- Select *Input / Codecs*.
- Set *Hardware accelerated decoding* to *Disable*.
- Press *Save*.



Chapter 12 Tools

Various options in the Tools panel of the ribbon bar.



General

Restart – restarts the program.

Disable Screensaver – stops screensavers and monitors will not be switched off due to user inactivity.

Copy to clipboard – similar to Screenshot below, but saves the image to the clipboard.

Screenshot – take a screenshot of the whole display, to browse the screenshot folder select Diagnostics, Files, Screenshots.

Diagnostics

Debug – all log entries are also written to the Windows debugger.

DebugView – an excellent program from Sysinternals (part of Microsoft), used to display the Debug output.

Logfile – displays the contents of the Log window as a text file, opened for you in your default text file viewer.

- Files – browse key folders used by the program:
- Installation – where the program is installed,
- Screenshots – where screenshots are saved,

User Files – where program options are stored, usually as XML.

Links

Useful links, may change in future releases.

Data Recorder

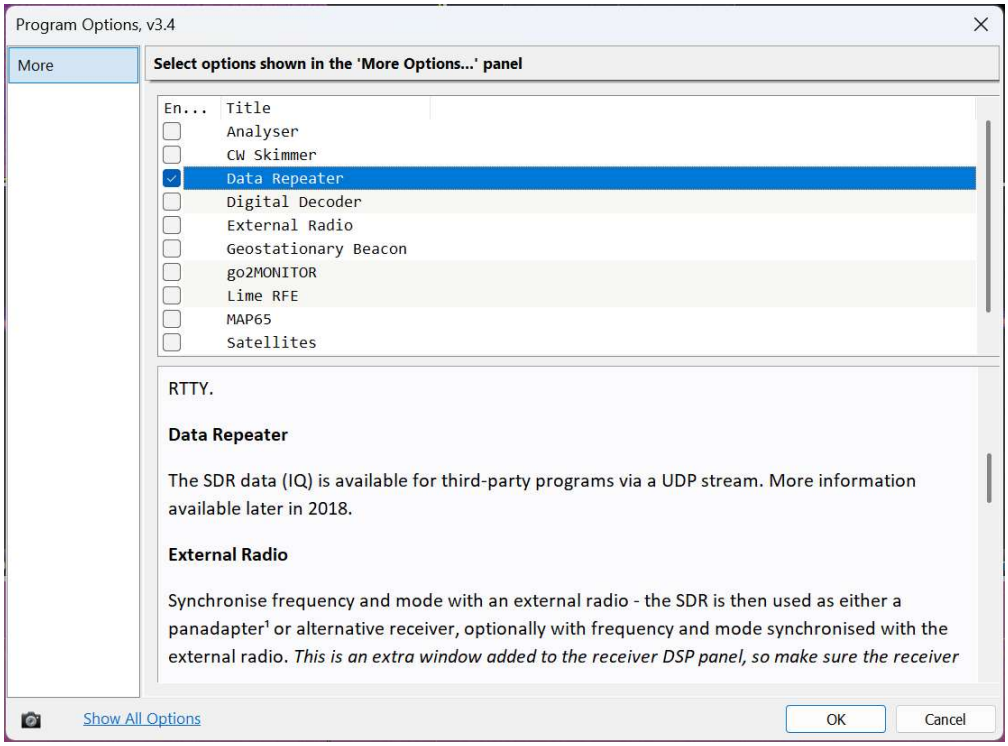
The data recorder saves the data (IQ) from your SDR as a .WAV file in a folder you select on this page. Recordings help to diagnose decoding issues; transmissions can be replayed through SDR Console and streamed to SDR Television.

The file format is:

- 16-bit (unsigned short) complex (IQ) samples.
- RF64 format (unrestricted file size) https://en.wikipedia.org/wiki/RF64 .

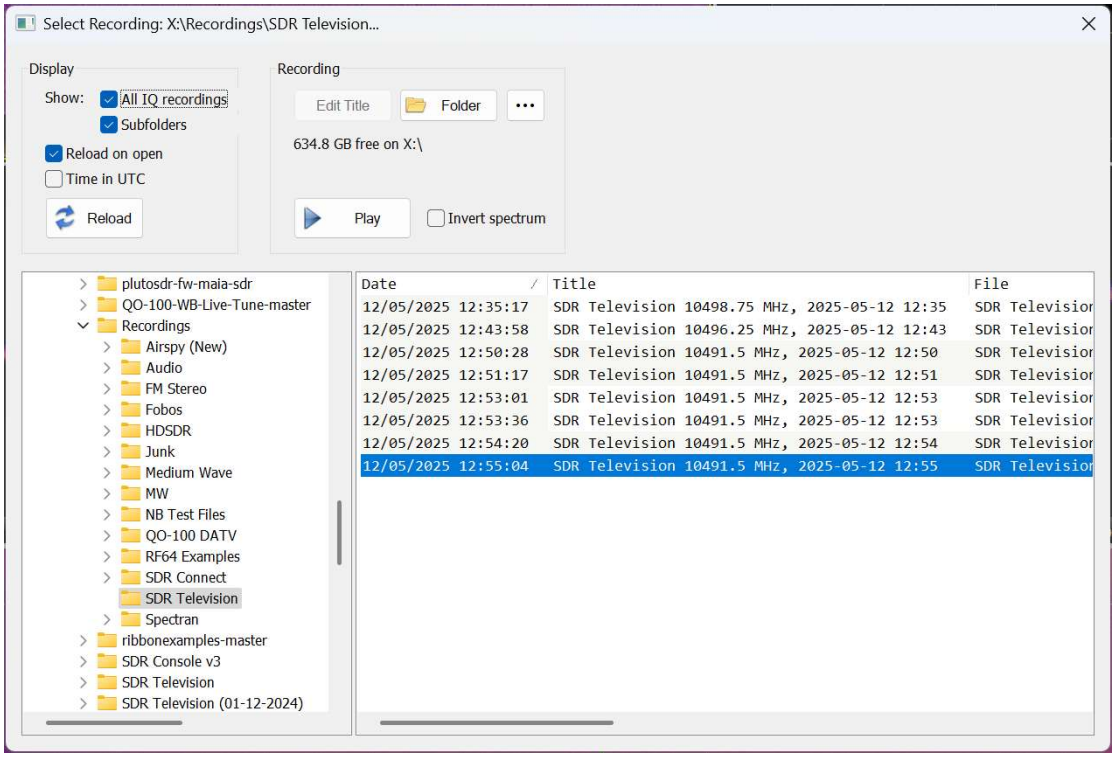
Playback with SDR Console

1.Enable the Data Repeater: Ribbon Bar, View, More Options..., Select, Data Repeater.



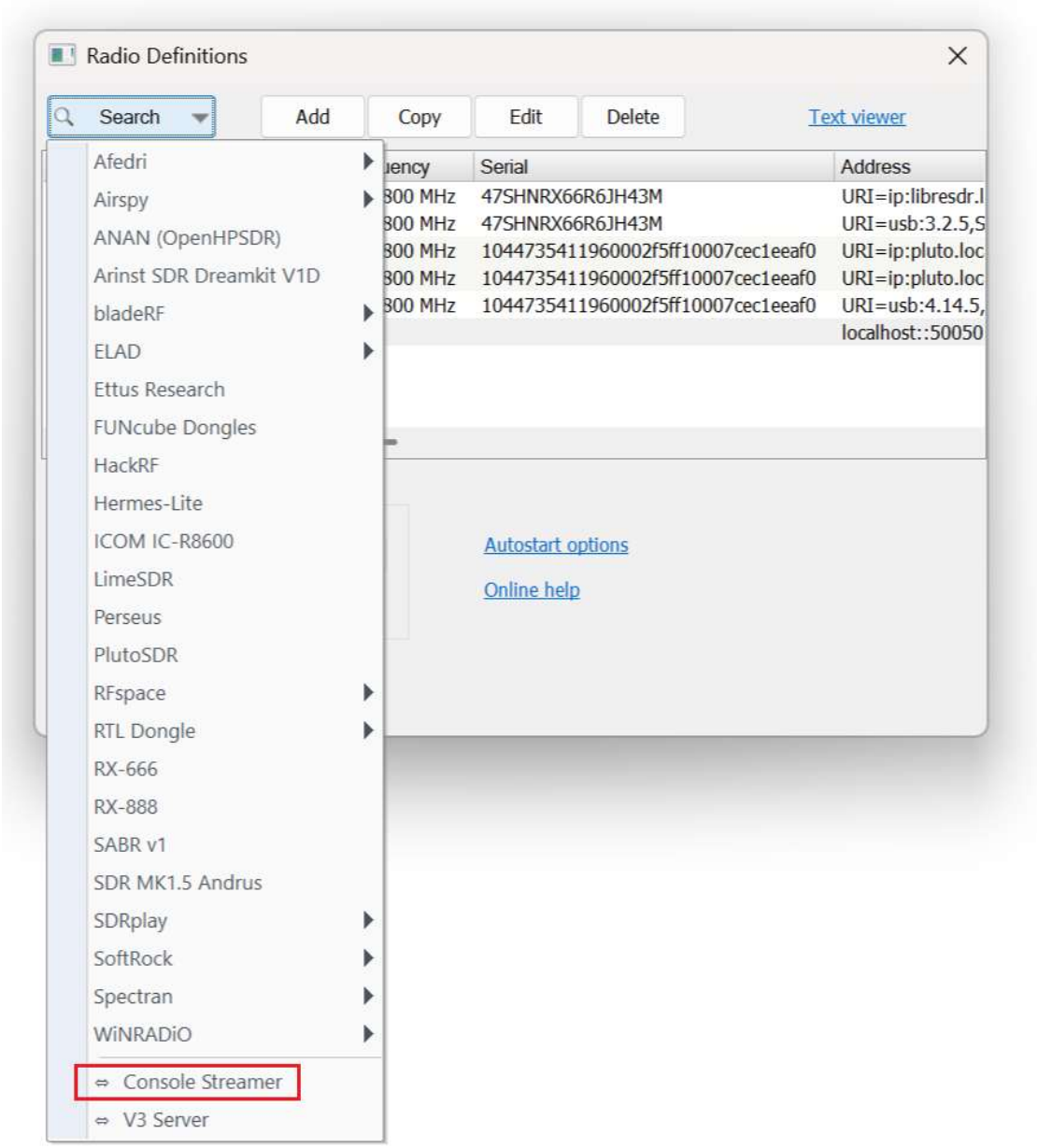
2.Open the recording: Ribbon bar, Rec/Playback, Data :: Playback, Open.

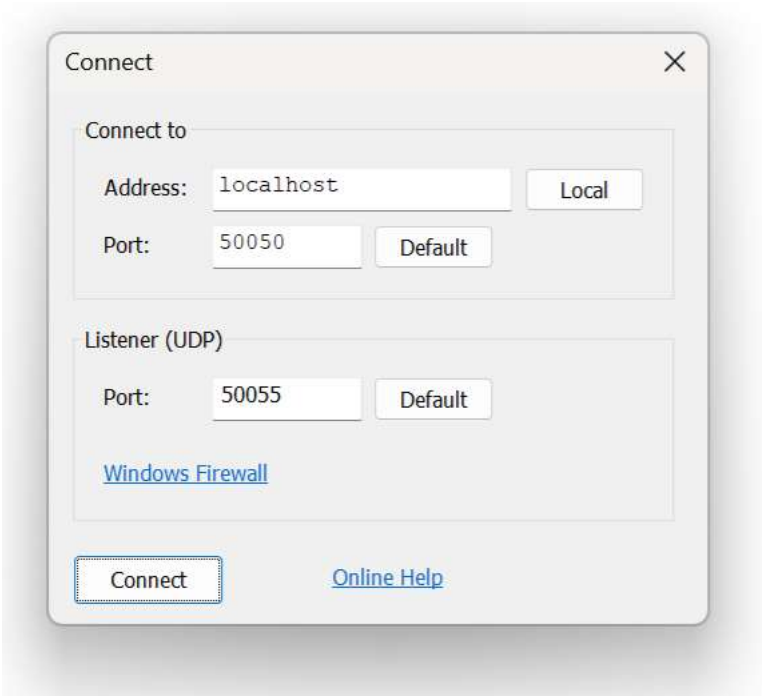
3.Select the recording.



In SDR Television

1.Add a *Console Streamer* radio definition.




Connect
Connect to
Address:
localhost
Local
Port:
50050
Default
Listener (UDP)
Port:
50055
Default
Windows Firewall
Connect
Online Help

Appendix A Encoder Configuration

The log window contains copious information used in the development and support of this program. This information is provided for reference.

AAC

Note:

1. According to the documentation, the supported byte rates are 12000, 16000, 20000, 24000 but 6000 is also supported with Windows 11. This determined by trial and error.
2. The encoder creates one output sample for every 1024 input bytes.
3. Payload level value 41 (x29) is the recommended default used with the AAC encoder.

```
Creating AAC Encoder
  Bits per sample ...: 16
  Samples per sec ...: 48000
  Num channels ......: 1
  Avg bytes per sec .: 6000
  Payload type ......: 1
  Payload level ind .: 41
-
```

H.265

First the encoder is created, then all attributes are shown: Transform (aka Encoder), Input and output streams. The attribute diagnostics show everything known about the encoder.

Note:

1. Max bit rate is the maximum bit rate available for encoded H.265 data, computed from various factors such as symbol rate, constellation and FEC.
2. NVIDIA transforms are generally asynchronous, Microsoft synchronous.

```
Create H.265
Creating MFVideoFormat_HEVC Encoder
  Media category ....: MFMediaType_Video
  Media subtype .....: MFVideoFormat_HEVC
  Encoder name ......: NVIDIA HEVC Encoder MFT
  Input format ......: MFVideoFormat_NV12
  Asynchronous ......: Yes
  Frame size ........: 1920 x 1080
  Frame rate ........: 15 / 1
  Interlace mode ....: Progressive
  Quality vs speed ..: 80 %
  MPEG2 level .......: 4.1
  MPEG2 profile .....: 420:8 (H.265)
  Colour range ......: Wide
  Rate control mode .: Peak Constrained VBR
  Peak bitrate ......: 1261867 bps
-
Codec Properties:
  Quality vs Speed ....: 80
  Rate control mode ...: 1
```

```
  Max bit rate ........: 1261867
-
NVIDIA HEVC Encoder MFT:
  Transform: CODECAPI_AVLowLatencyMode ............: 1
  Transform: MF_MT_MAJOR_TYPE .....................: MFMediaType_Video
  Transform: MF_MT_SUBTYPE ........................: WMMEDIASUBTYPE_Base
  Transform: MF_SA_D3D11_AWARE ....................: 1
  Transform: MF_TRANSFORM_ASYNC ...................: 1
  Transform: MF_TRANSFORM_ASYNC_UNLOCK ............: 1
  Transform: MF_VIDEO_MAX_MB_PER_SEC ..............: 8985376
  Transform: MFT_CODEC_MERIT_Attribute ............: 8
  Transform: MFT_ENCODER_SUPPORTS_CONFIG_EVENT .....: 1
  Transform: MFT_ENUM_HARDWARE_URL_Attribute .......: NVIDIA HEVC Encoder MFT
  Transform: MFT_ENUM_HARDWARE_VENDOR_ID_Attribute .: VEN_10DE
  Transform: MFT_FRIENDLY_NAME_Attribute ...........: NVIDIA HEVC Encoder MFT
  Transform: MFT_GFX_DRIVER_VERSION_ID_Attribute ...: 8725724279018537
  Transform: MFT_SUPPORT_DYNAMIC_FORMAT_CHANGE .....: 1
  -
  Input stream:  MF_MT_ALL_SAMPLES_INDEPENDENT .: 1
  Input stream:  MF_MT_AVG_BITRATE ............: 0
  Input stream:  MF_MT_FIXED_SIZE_SAMPLES ......: 0
  Input stream:  MF_MT_FRAME_RATE ..............: 15 x 1
  Input stream:  MF_MT_FRAME_SIZE ..............: 1920 x 1080
  Input stream:  MF_MT_INTERLACE_MODE ..........: 2
  Input stream:  MF_MT_MAJOR_TYPE ..............: MFMediaType_Video
  Input stream:  MF_MT_SUBTYPE .................: MFVideoFormat_NV12
  Input stream:  MF_MT_VIDEO_NOMINAL_RANGE .....: 2
  -
  Output stream: MF_MT_ALL_SAMPLES_INDEPENDENT .: 1
  Output stream: MF_MT_AVG_BITRATE ............: 1191763
  Output stream: MF_MT_FRAME_RATE ..............: 15 x 1
  Output stream: MF_MT_FRAME_SIZE ..............: 1920 x 1080
  Output stream: MF_MT_INTERLACE_MODE ..........: 2
  Output stream: MF_MT_MAJOR_TYPE ..............: MFMediaType_Video
  Output stream: MF_MT_MPEG2_LEVEL .............: 123
  Output stream: MF_MT_MPEG2_PROFILE ...........: 1
  Output stream: MF_MT_SUBTYPE .................: MFVideoFormat_HEVC
  Output stream: MF_MT_VIDEO_NOMINAL_RANGE .....: 2
  -
-
```

Appendix B OBS Studio

You don't have to use OBS Studio but it is a highly recommended free solution for video and audio playback.

This chapter shows the steps required to set the recommended resolution (1280x720) and frame rate (15 FPS).

Using a higher resolution and/or higher frame rate will not make your image any better; in fact, quite the opposite. Also, the encoder requires considerably more CPU to process a high resolution.

This is not a OBS Studio tutorial as there are many elsewhere on the internet, for example Quick Start Guide | OBS.

OBS Studio is only supported on Windows 11 and higher. *This program uses the Windows Media Foundation Virtual Camera which is not supported on Windows 10, actually requires Windows 11 21H2 or higher.*

Installation

Download and install OBS Studio from https://obsproject.com/download. At the time of writing, version 31.0.1 works well.

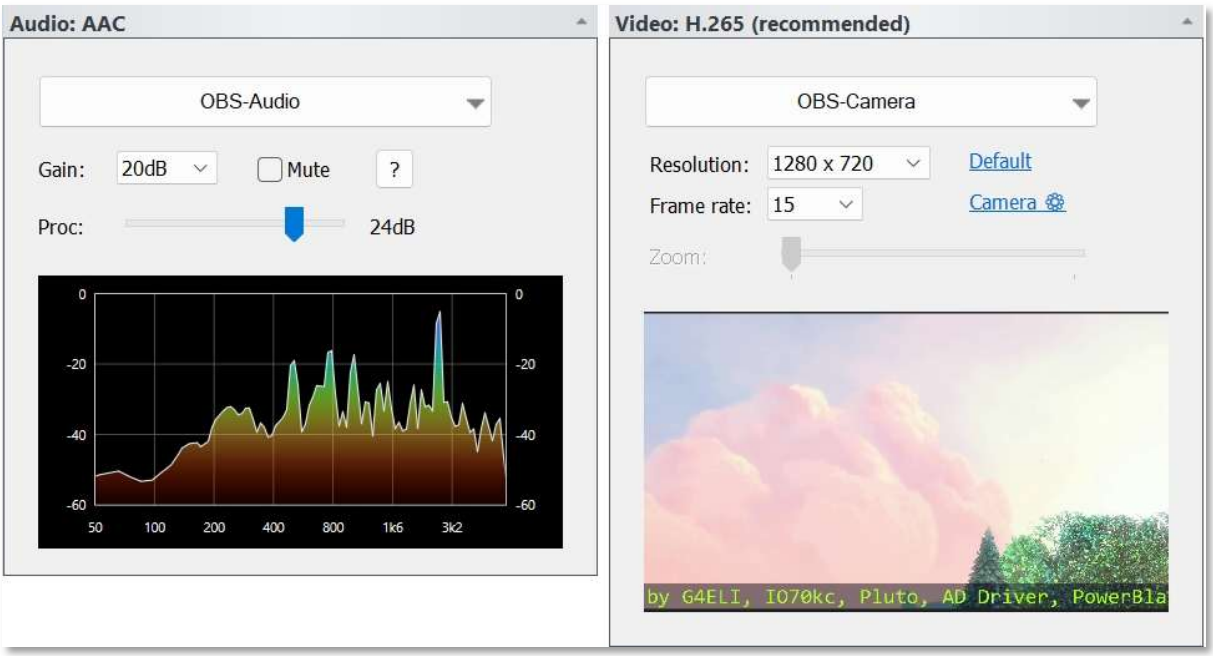
OBS-VirtualCam

obs-virtualcam is a plugin for OBS Studio , transforming the output video to a virtual DirectShow device. Note: This is not the same as OBS Virtual Camera, a different plugin!

Download from miaulightouch/obs-virtual-cam . Recommended version is 2.1.2.

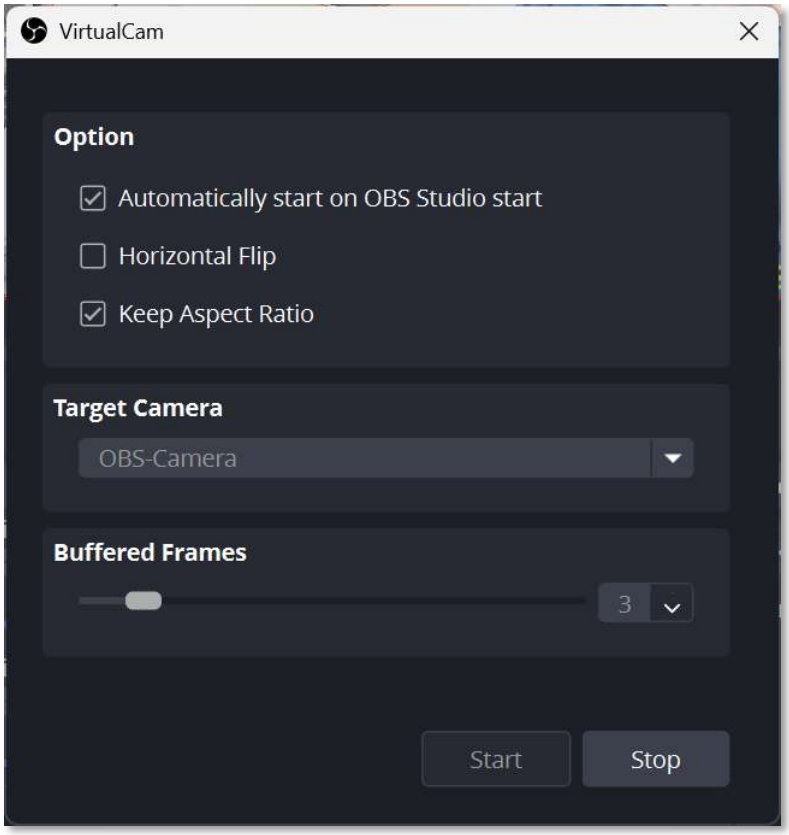
- Supported Platforms : Windows 10, Windows 11
- Supported OBS Studio version : 30.0.0+

This creates two new devices, OBS-Audio and OBS-Camera.

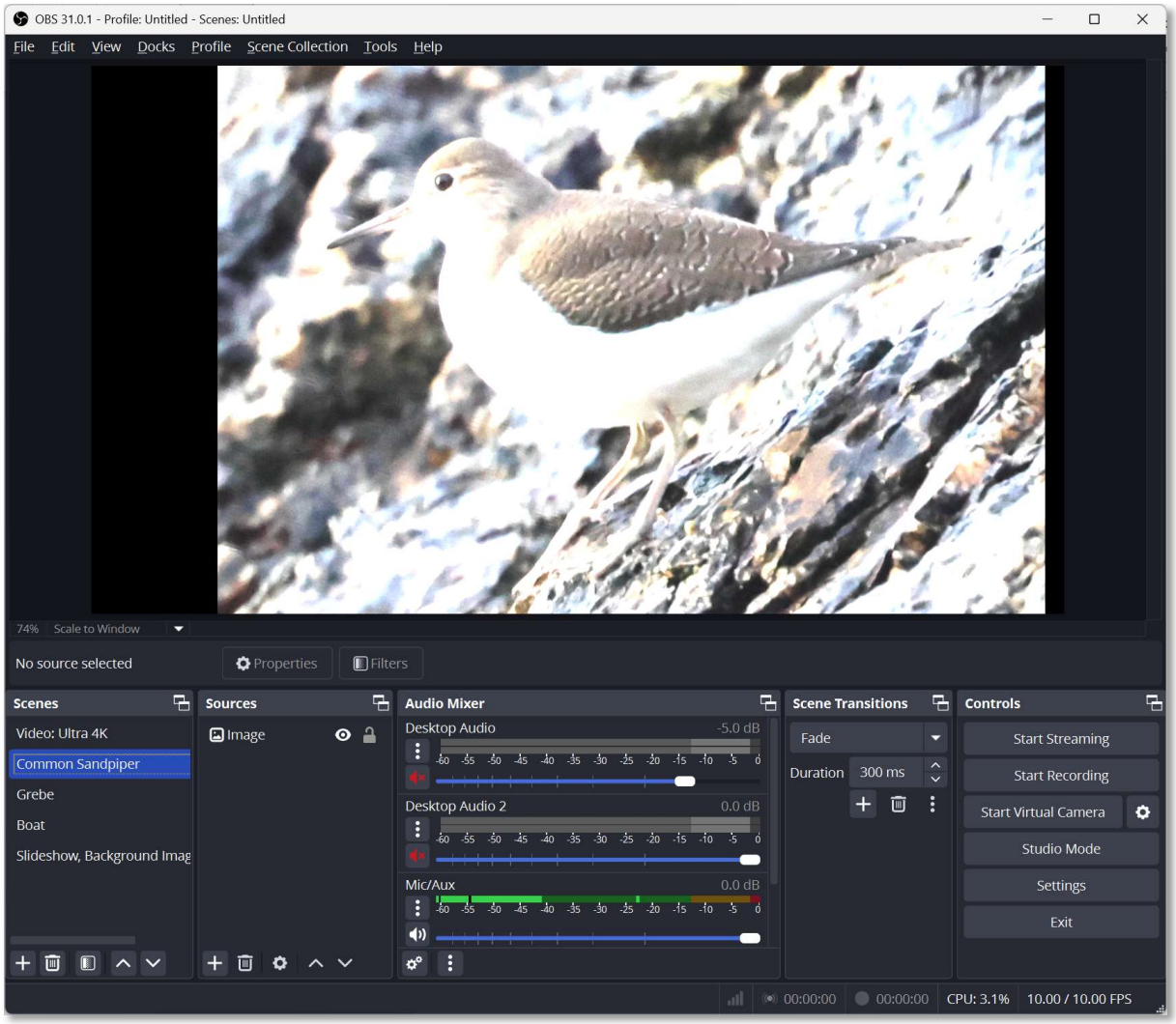


Starting

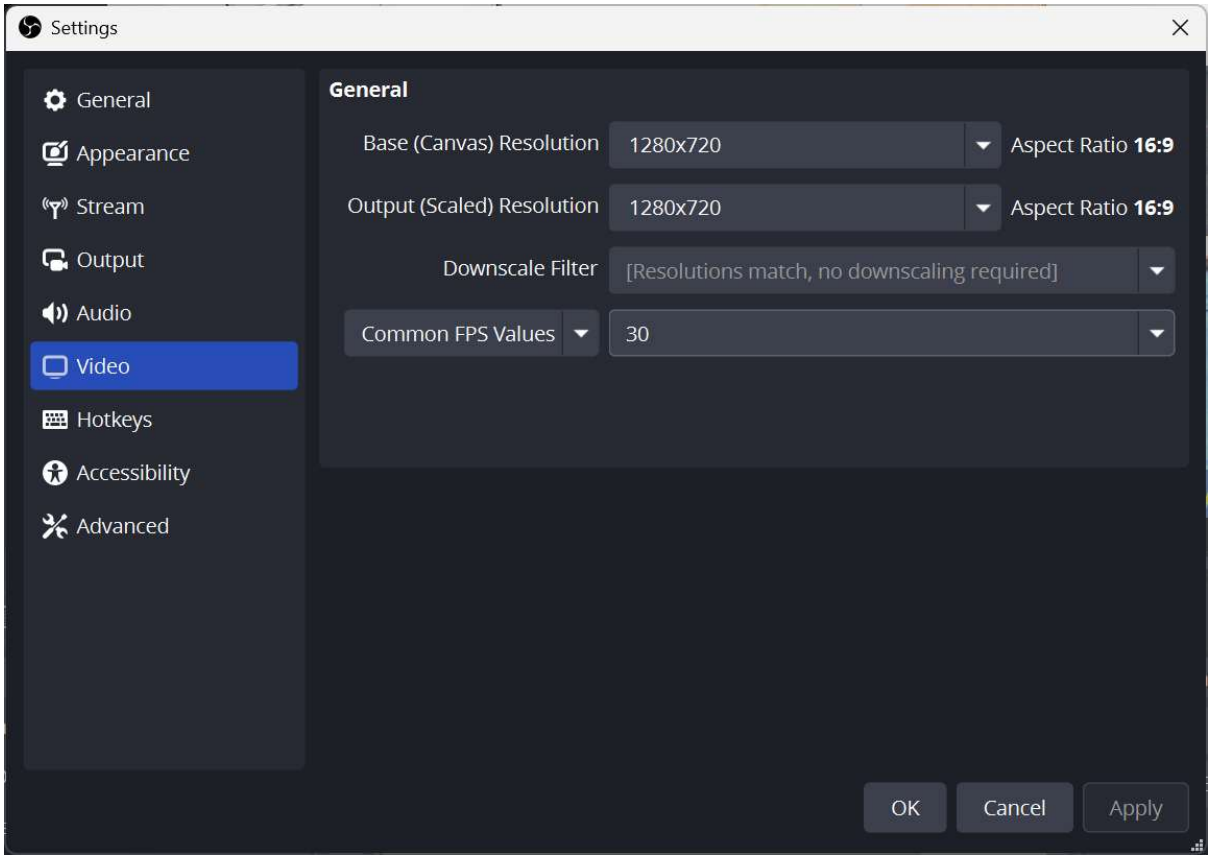
From the menu bar select Tools, VirtualCam. Select options as below.



Configuration



In the Controls panel, select *Settings*. Here we will set the resolution to 1280 x 720.

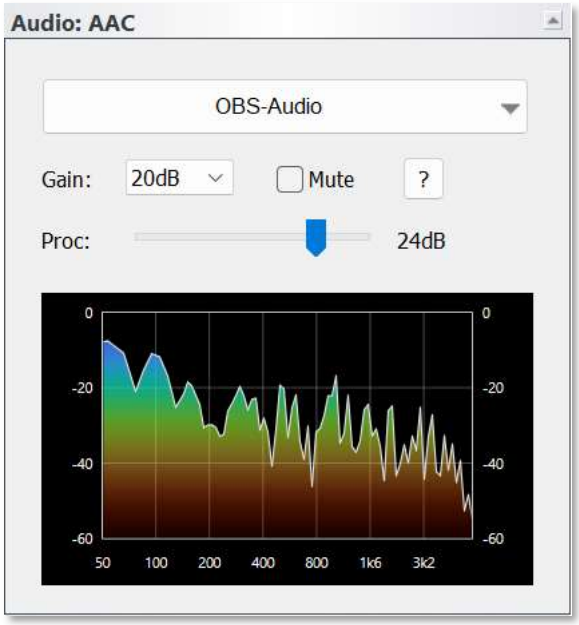


Set the Output (Scaled) Resolution to 1280x720 and frames per second (FPS) to 30. To set FPS to 30 you must first select *Common FPS Value*.

Now select *Apply* followed by *OK*.

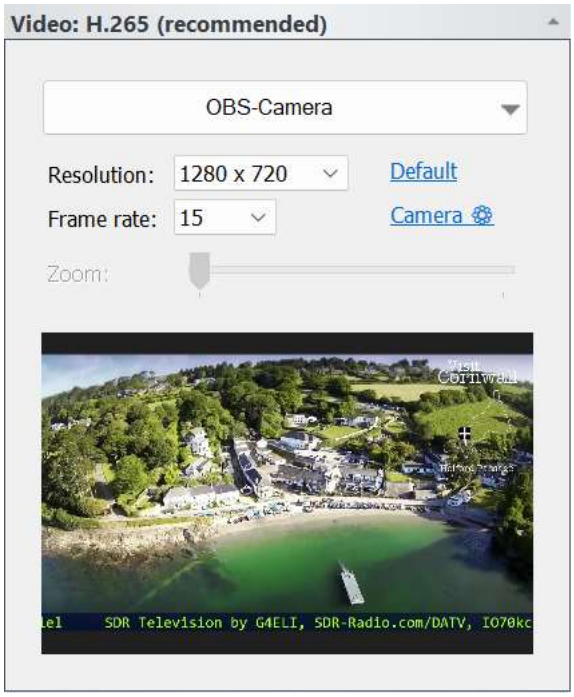
From the menu bar select Tools, VirtualCam and start the camera.

Selecting



Audio

In SDR Television make sure the Transmit panel is visible. In the in the Audio window select *OBS-Audio*.



Video

In SDR Television make sure the Transmit panel is visible. In the Video window select *OBS-Camera*.

The recommended frame rate to 15 – the actual frame rate is that defined in OBS Studio.

Resolution

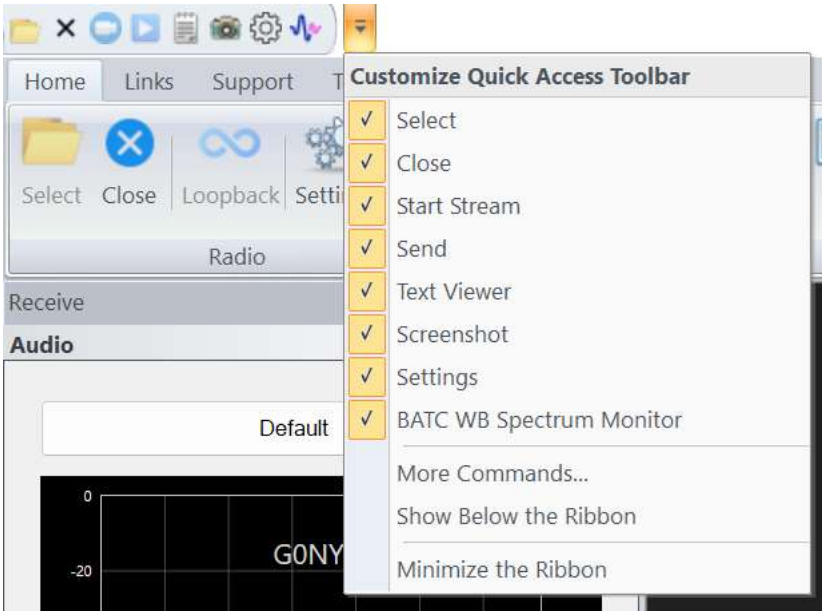
OBS Studio's camera plugin offers resolutions which aren't actually supported! The only resolution you can select is the resolution defined in OBS Studio.

At some stage this plugin must be corrected, maybe by myself.

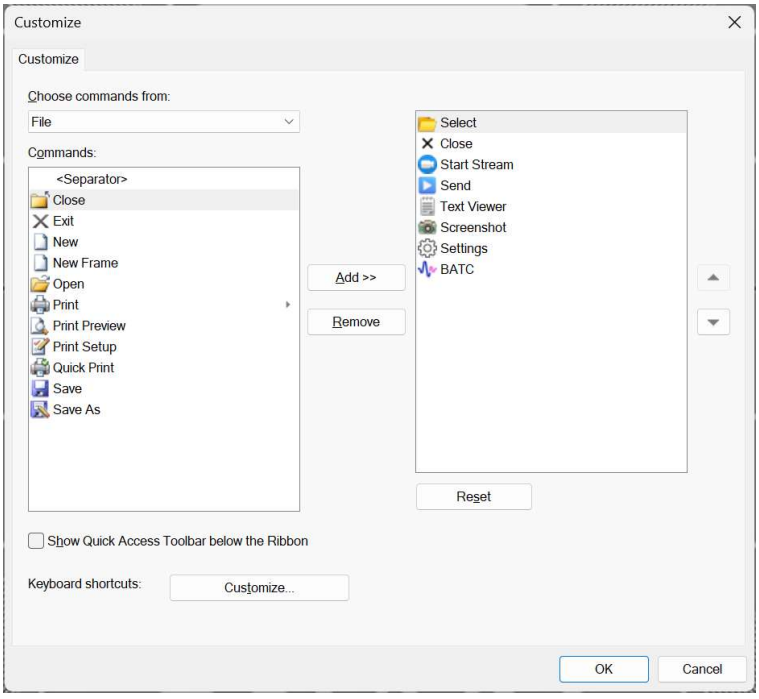
Appendix C Customising The Ribbon Bar

Follow these steps:

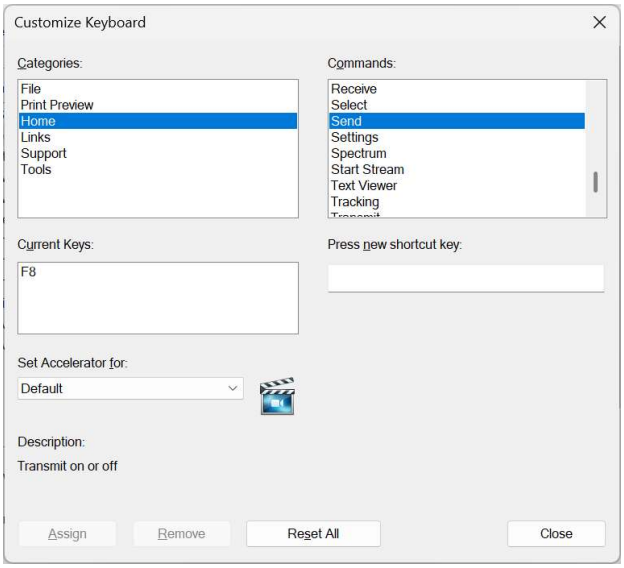
1) Click the down-arrow on the right of the Quick Access Toolbar, select *More Commands…*



2) Add or remove entries in the Quick Access Toobar.



3) Select *Keyboard shortcuts, Customize*.



Select *Reset All* to restore the defaults shortcuts. When you have finished making changes, select *Close*.

Appendix D User Settings

Unlike SDR Console which stores many settings in the registry, this program stores user settings in a series of XML-formatted files in the user folder.

To view the contents of this folder, from the ribbon bar select *Tools*, *Diagnostics*, *Files*, *User Files*.

Do not edit these files!

Appendix E Standards

This program is implemented in accordance with international standards (below). Wikipedia is a great place to start if you want more information about the DVB standards.

- EN 302 307-1
  Digital Video Broadcasting (DVB);
  Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2
- EN 300 421
  Digital Video Broadcasting (DVB);
  Framing structure, channel coding and modulation for 11/12 GHz satellite services.
- EN 300 468
  Digital Video Broadcasting (DVB);
  Specification for Service Information (SI) in DVB systems