The Big Book of SDRsharp and its whole universe v4.4

aligned to SDR# Studio revision 1.0.0.1858

Slow reading recommended (for specialists and non-specialists)

Introduction

This book was born out of a necessity: to spread the word about SDRsharp and, since a work like this did not exist, I decided to write a small guide at the beginning and a big book now... remembering that no book is for everyone, but for all SWL guys and experimenters there is this book just waiting to be read.

The following pages are the result of years of listening, dedication, passion and a great deal of personal commitment in the search for the best possible configurations and optimisations, as well as operational suggestions *that I have collected and typographically highlighted in blue italics* and, at the bottom, also a useful mini glossary with a reference on individual terms, indicated by (*), for check the definition.

Happy reading and good listening with "Software Defined Radio" to all those who believe in it, because when we switch on our new SDR we will be able to easily understand that this world really has many faces but only one heart. SDRSharp (or SDR#) is the most complete freeware software, performing, integrated, continuously updated and customisable (with plugins for every need) for all RTL-SDR dongles and of course for AIRSPY devices.

Many thanks to Youssef Touil and to all those who interact every day with SDR# and there are really many of them as I have been able to see over the years, because it is a common learning and growing experience: alone you can't get anywhere..

The reference site (restyling on 29 sept.2021) is only: **https://airspy.com/**

Note:

Due to evolutions in the development of SDR# and various third-party software, some illustrations, indications or comments, despite my constant updates, may differ from the current versions on the net.

SDR# download & installation

The main thing to know is that even the most inexperienced user can easily start with SDR# and successfully even with the most sophisticated plugins...
So let's see how to start using the software starting from the installation.

In fact, since there is NO real installation procedure, you only need to remember this:

- *Extract the zipped content into any directory (excluding only "Program Files...")*
- *All the necessary files are in the previous directory and nothing in the registry.*
- *Plugins must be inserted in the relative subdirectory and are automatically recognized.*
- *For "partial and not too deep updates" it is enough to replace the file **SDRSharp.exe** (and in the recent revision 18xx also the associated **Shark.dll**).*

Same for the uninstallation... to delete the software it is sufficient to delete the directory where it resides since no other dependency and/or registry key is used. Once started, SDR# resides in memory with a small active set and little to no swap will be required.

N.B. Since revision 1832, the START.BAT file has been included in the installation packages to temporarily configure the execution of some dotNET environment variables before the program run…

```
set DOTNET_TieredPGO=1
start sdrsharp.exe
```

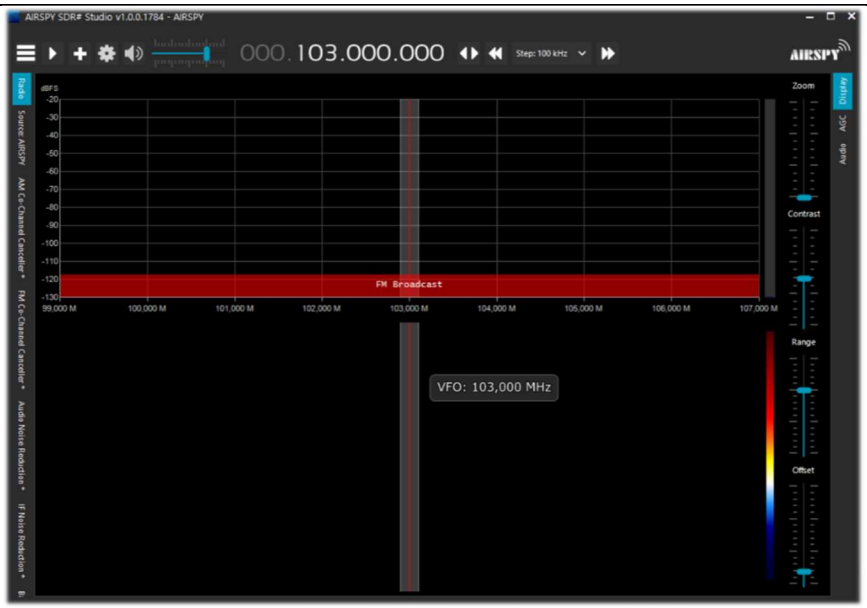
SDRsharp is a software in continuous and perpetual search for improvement and refinement. Many releases are completely different from the previous ones, even though they use the same configuration files, plugins, Band Plan and memory files, but always with better overall performance. ***For the chronology of the individual revisions, see the appropriate chapter "SDRsharp history".***

.NET 6 Microsoft *(current)*	Revision 1832 introduced Microsoft's brand new **.NET 6**, a platform that combines the .NET Framework and .NET Core, which is increasingly aimed at cross-platform software developers. In fact, the idea is to have a single .NET framework to be used on Windows, Linux, macOS, Android, etc. etc.
Download rev.18xx	https://airspy.com/?ddownload=3130

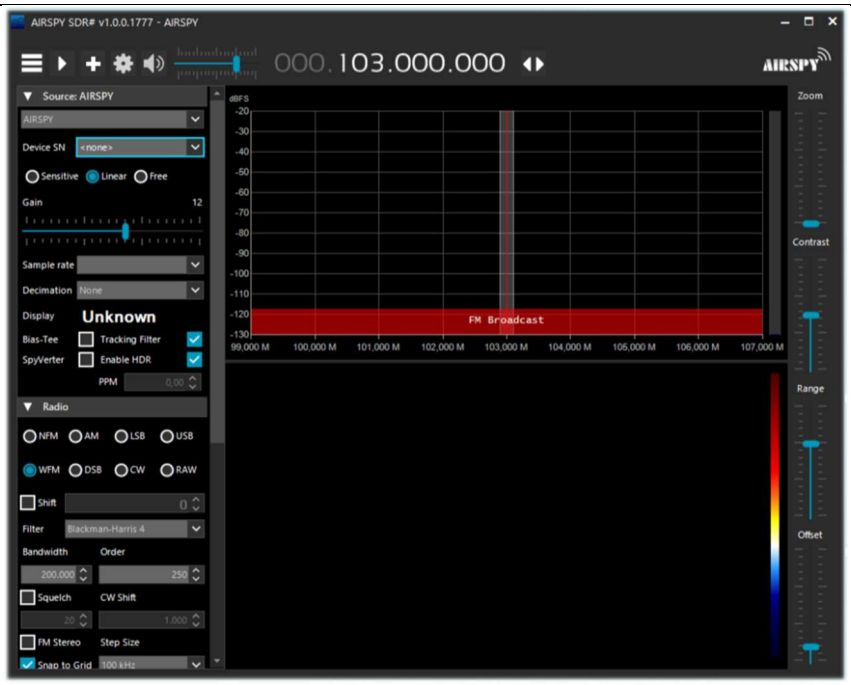
.NET 5 Microsoft *(previous)*	Revision 1785, officially released on 5 February 2021, has made a big leap towards Microsoft's **.NET 5**. This multi-system, open source development platform is capable of supporting side-by-side execution without the need to install the runtime. This is not a simple code recompilation effort but involves a lot of changes, some superficial and some fundamental! *Even externally you can see the difference with far fewer files in the distribution and a large executable file. There are far fewer DLLs that shorten the start-up sequence of the program.*
Download rev.1831	https://airspy.com/downloads/sdrsharp-x86-dotnet5.zip

.NET 5.xx Runtime Desktop	https://airspy.com/?ddownload=6293

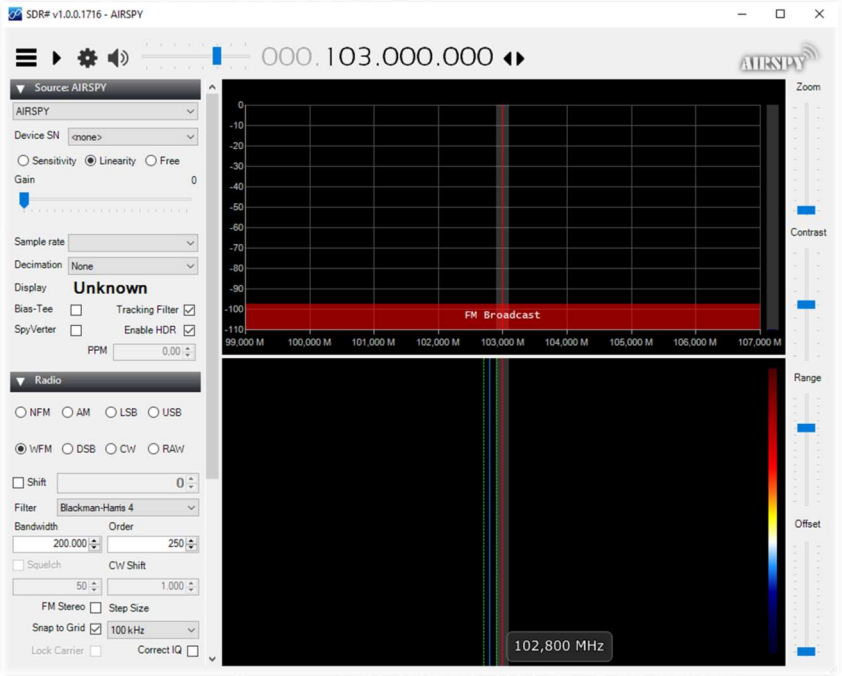
.NET 4.x Microsoft *(previous)*	Previously, the graphical user interface developed in Visual Studio with fully customisable layouts was released at the end of November 2020.
Download rev.1784	https://airspy.com/downloads/sdrsharp-x86-dotnet4.zip



rev.1777	Latest version with collapsible panels.
Download	https://airspy.com/downloads/sdrsharp-x86-collapsible-panels.zip



rev.1716	Latest version unskinned build.
Download	https://airspy.com/downloads/sdrsharp-x86-noskin.zip



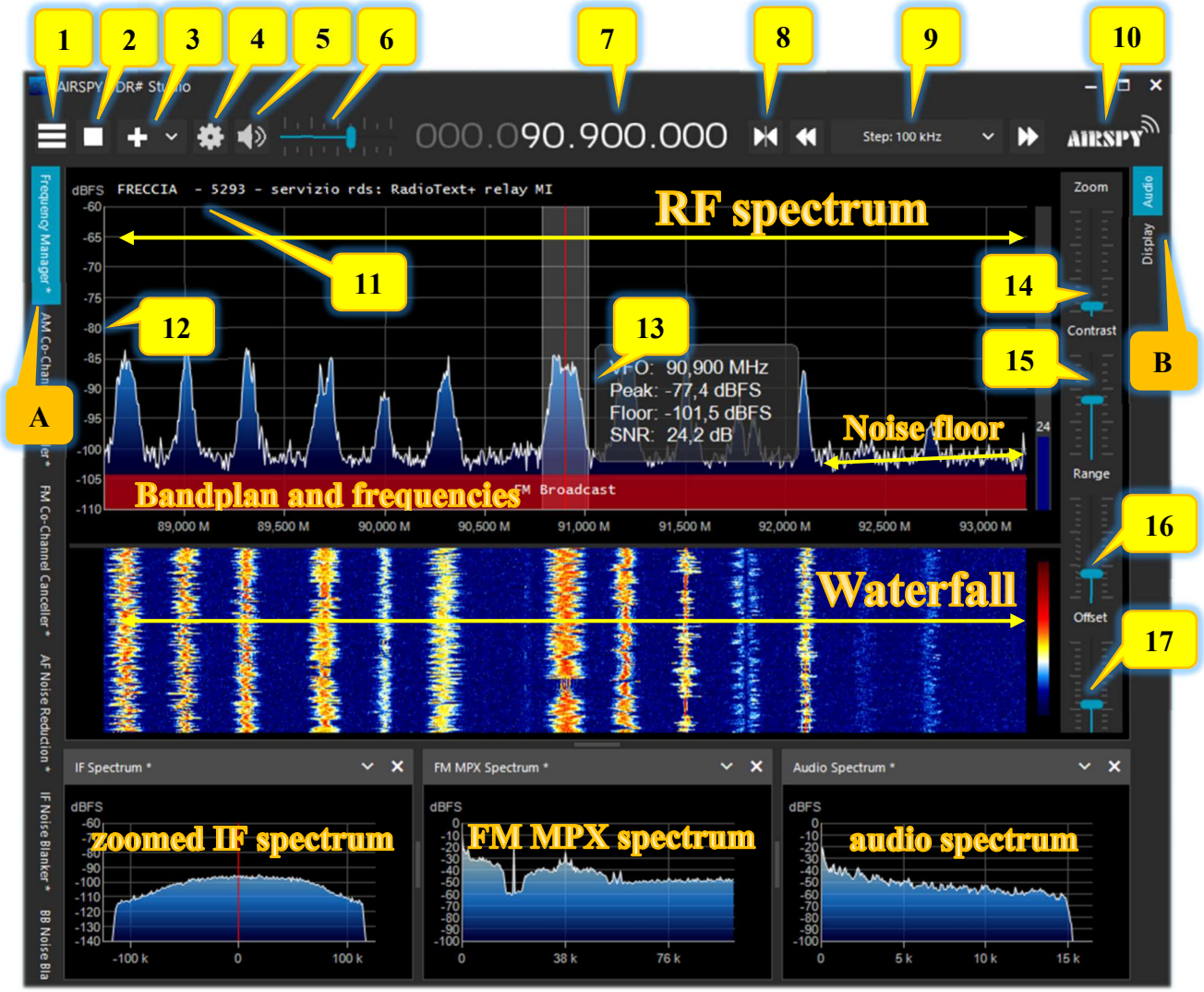
Normally AirSpy is a plug-and-play device that Windows (Vista to W10) automatically detects and recognises when plugged into a USB port. If this does not happen, you can download, unpack and install the following driver from the Windows device manager:

https://airspy.com/?ddownload=3120

The screens will present the dongles RTL-SDR and all the various devices AirSpy (but little change for the other devices if not the configuration menu and the bandwidths/decimations used). The graphic theme used in this guide (skin) is the dark one named "Fluent Dark" (selectable in the Display menu).

Obviously, since these are radio signals that can extend from long waves to the GHz of UHF, it is advisable to equip oneself with specific antennas (for HF: Youloop, vertical, wire, while for V-UHF: discone or collinear) to be installed outdoors and as far away as possible from other elements that can attenuate or interfere with the signals...

Main screen

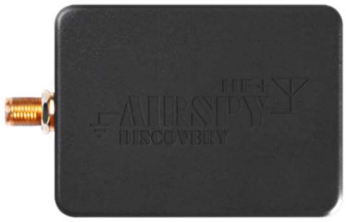


These are the main points in details, followed by many insights and *my tips*:

A. Left Menu (example: Radio, Source, various plugins) – since revision 1778
B. Right Menu (example: Display, AGC, Audio) – since revision 1778
1. Main Menu (in jargon as "hamburger menu")
2. Start/close the program
3. Opening new session (slice) – since revison 1741 and new update
4. Device configuration
5. Audio On/Off (mute)
6. Volume control bar
7. VFO Input / Frequency
8. Tuning type
9. Step bar - since revison 1782
10. Airspy logo (click above to visit the home page directly)
11. RDS decode (PS, PI, RT) for broadcaster stations in WFM (88-108 MHz)
12. Signal scale in dBFS (decibel Full Scale)
13. Vertical tuning bar (center red line, bandwidth and signal info)
14. Zoom bar for RF Spectrum and RF Waterfall
15. Contrast bar
16. Range bar
17. Offset bar

AirSpy line

The AirSpy product family is now grown up, with receivers and options for every need:



AIRSPY HF+ Discovery

HF 0.5 kHz / 31 MHz and VHF 60/260 MHz (single SMA input)

AIRSPY HF+ Dual port

HF 9 kHz / 31 MHz and VHF 60/260 MHz (double SMA input)

AIRSPY R2

10 or 2.5 MSPS IQ, continuous coverage 24/1700 MHz

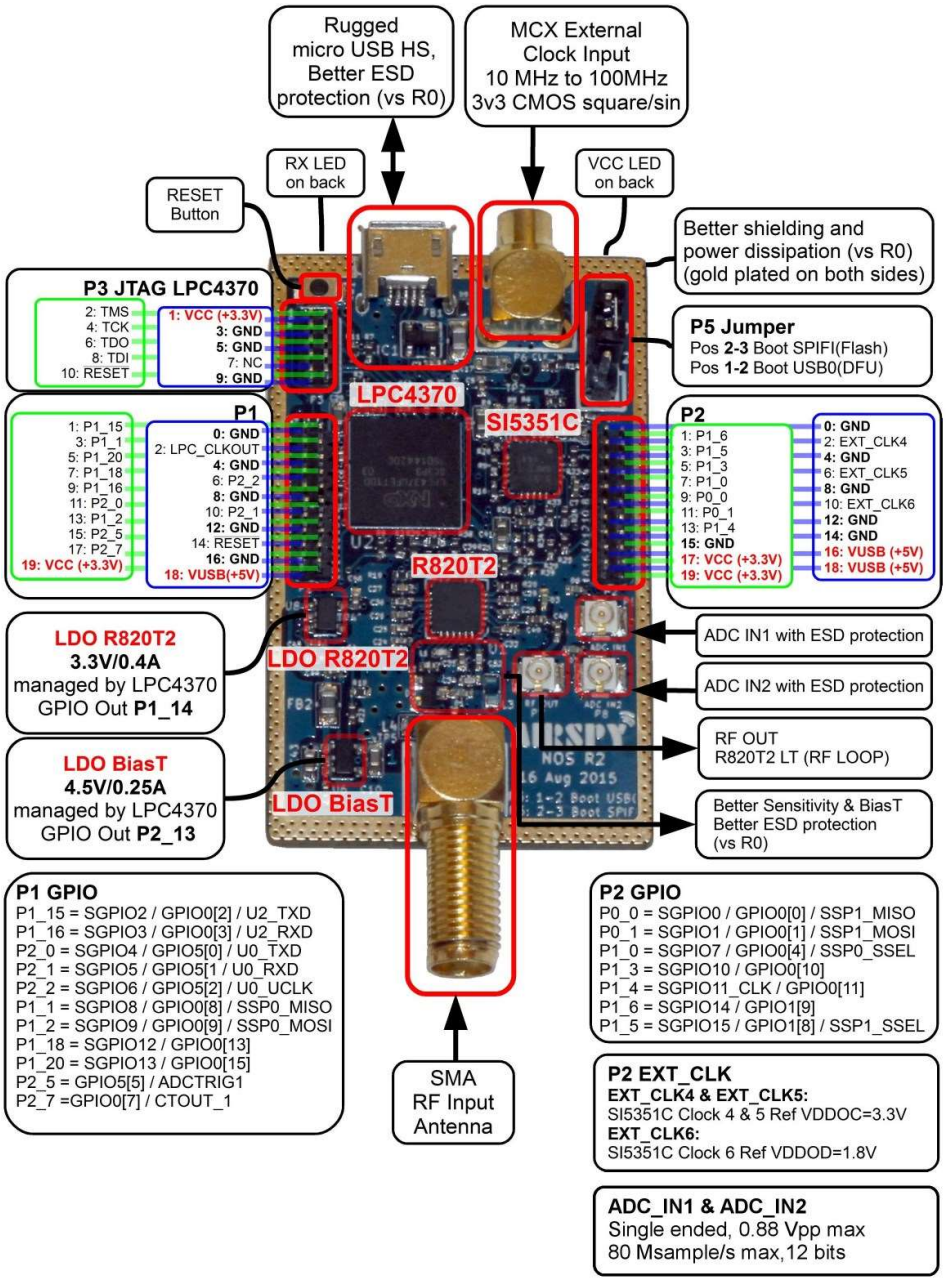
AIRSPY Mini

6 or 3 MSPS IQ, continuous coverage 24/1700 MHz

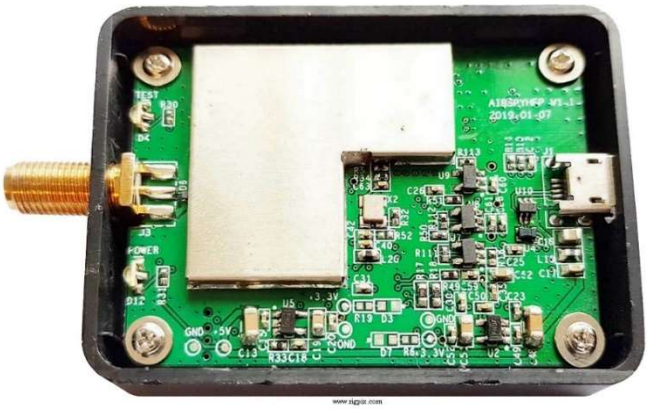
SpyVerter R2

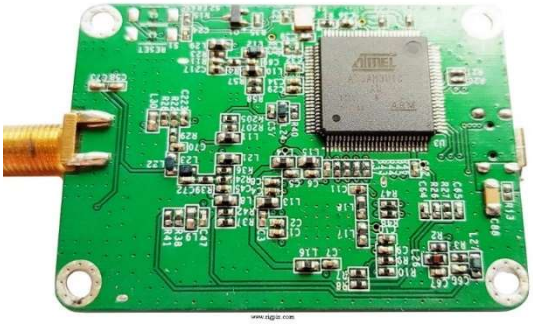
in combination with R2/Mini increases coverage 1 kHz/60 MHz

But what's inside? For the more curious we can also take a look inside an AirSpy R2 device…



While this is the inside of an HF+ Discovery thanks to the excellent images from the site: ***https://www.rigpix.com***





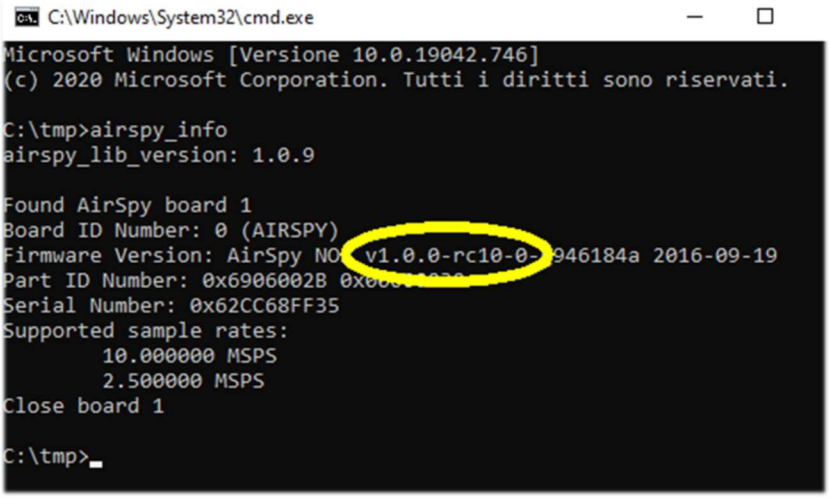
AirSpy R2 / Mini firmware update

Unlike the previous panel of the HF+ devices, here there is no indication of the firmware installed. To check the your firmware it is necessary to use the "AIRSPY HOST TOOL", downloadable here:

https://github.com/airspy/airspyone_host/releases

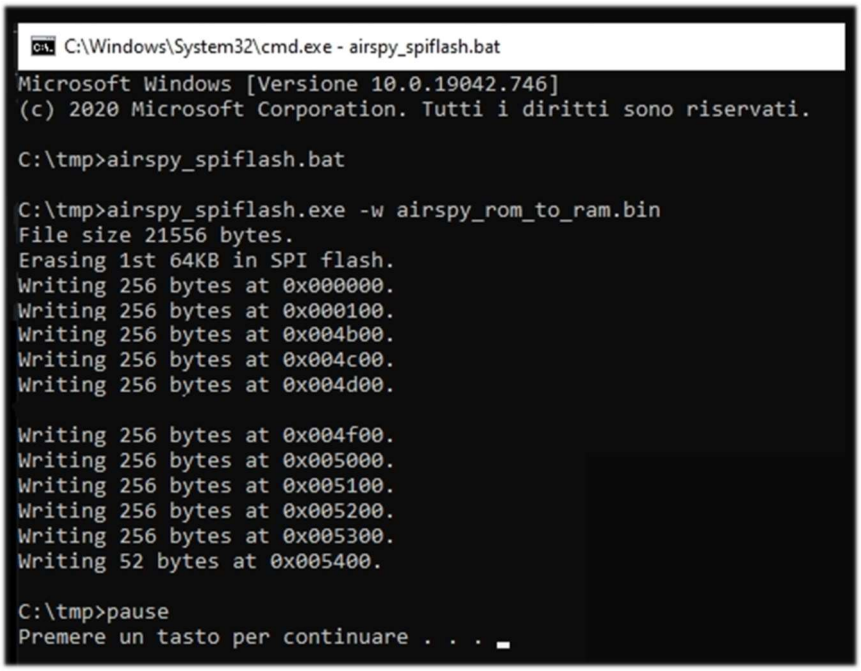
Start by extracting the content into a temporary directory (e.g. C:\TMP)

- In that folder, run the command line interpreter by typing CMD
- Type airspy_info.exe and press Enter
- Immediately, the screen below will appear and will read your "Firmware version".



The firmware update procedure should be carried out under Windows 7 or Windows 10. Make sure you do not have any other AirSpy devices connected to your computer and follow these steps:

- Download and unpack in a temporary directory (e.g. C:\TMP) the contents of this file:
  https://airspy.com/downloads/airspy_fw_v1.0.0-rc10-6-g4008185.zip
- Connect the device to be updated to a USB port on your computer
- From the command line, run the file "airspy_spiflash.bat", wait for the finish procedure (see screen)
- Disconnecting the AirSpy device from the computer
- Reconnect the AirSpy device to the computer and delete the temporary directory.

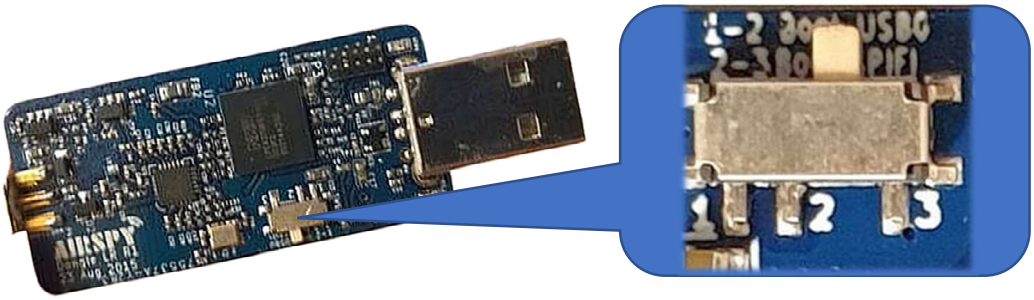


*The current and latest firmware release for the AirSpy R2/Mini is **v1.0.0-rc10-6** (08-05-2020)*

While reading in a forum, I happened upon a thread that may be helpful to some readers.

The topic was about the difficulty to update the firmware of an **AirSpy Mini** bought used...

Basically, it turned out that the upgrade was not successful because of the position of the internal microswitch on the side.



Position 2-3 is the correct one and allows Window to show the hardware in the device manager.

There are in fact two positions for the microswitch:

Position 2-3 Boot SPIFI (Flash) ← normal startup

Position 1-2 Boot USB0 (DFU) ← boot from ROM

The pos.1-2 should only be needed if there was some difficulty during the firmware update or if it was not flashed correctly.

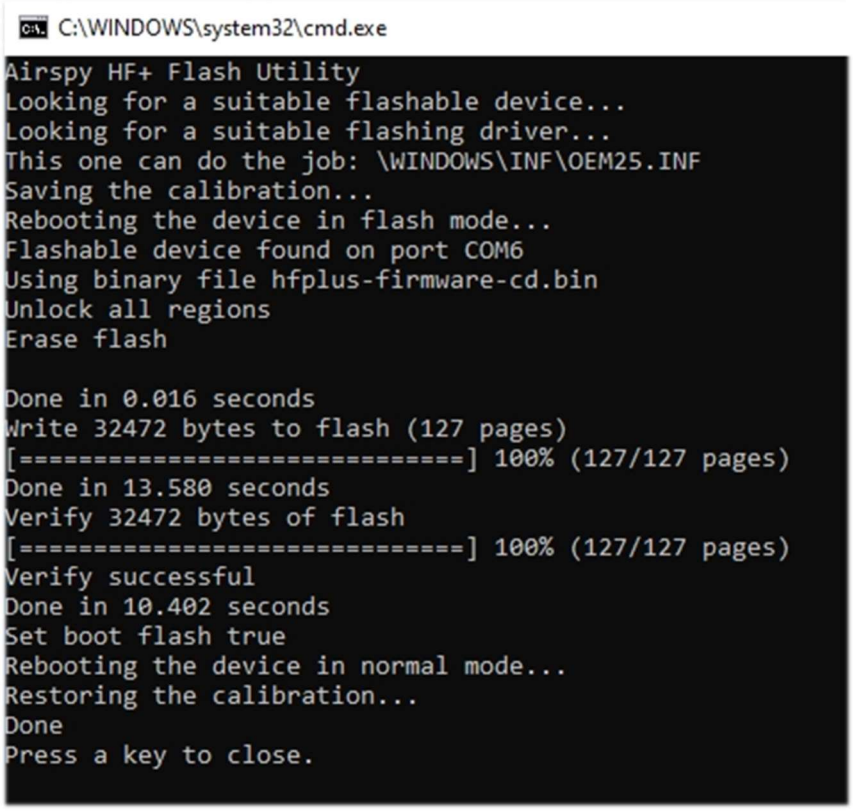
Please also read this disclosure carefully:

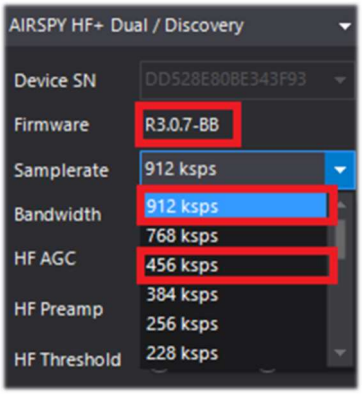
https://github.com/airspy/airspyone_firmware/wiki/Windows-how-to-flash-airspy-firmware

AirSpy HF+ Dual/Discovery firmware update

The firmware update procedure should be carried out under Windows 7 or Windows 10. Make sure you do not have any other AirSpy devices connected to your computer and follow these steps:

- Download and unzip the contents of this file into a temporary directory: ***https://airspy.com/downloads/airspy-hf-flash-20200604.zip***
- Connect the device to be updated to the computer's USB port
- From the command line run the "FLASH.bat" file and wait for the procedure to finish (see image)
- Disconnect the device from the computer
- Reconnect the device to the computer and delete the temporary directory.





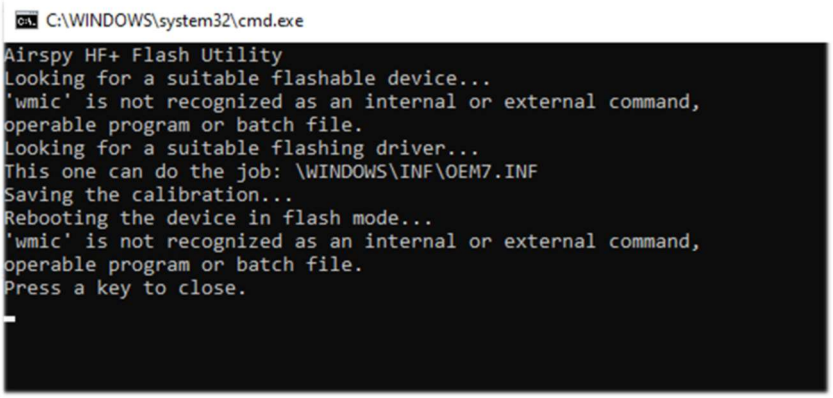
The current and latest firmware version R 3.0.7 (dated 4 June 2020) has improved USB streaming performance and two additional new samples at 456 and 912 ksps have been added.

It can be applied to device HF+ Dual port, HF+ Discovery (BB and CD).

Please refer to the following table for the latest HF+ firmware CHANGE LOG Revision 3.0.x

Revision	Date	Change log
R3.0.0	2019-07-19	Added processing gain compensation. Ready for Discovery.
R3.0.1	2019-07-30	Adjusted the Minimum AGC threshold to be 4 dB lower.
R3.0.2	2019-07-30	Set the AGC on by default.
R3.0.3	2019-08-16	Added support code for Pre-selector addon for the HF+ Dual Port.
R3.0.4	2019-08-19	Enabled the LNA control for AGC and Manual gain modes.
R3.0.5	2019-08-19	Adjusted the Low Gain theshold for the LNA.
R3.0.6	2019-08-20	Optimized the high AGC threshold.
R3.0.7	2020-06-04	Optimized the USB data streaming. Added 912 ksps and 456 ksps rates.

The full list can be downloaded here: **https://airspy.com/downloads/hfplus_changelog.txt**



Very rarely, during attemting to flash the device, was found a messages like this one...

Try the operation with a different computer.

Recovery procedure for firmware upgrade from initial R1.0.00

Due to a bug in the very first firmware, there is a specific procedure that should ONLY be used for this purpose when updating the R1.0.00 firmware. Subsequent updates should work with the standard procedure listed above.

- Open the HF+ case
- Connect the device to the PC
- Connect the "Erase points" for one second (see picture)
- Disconnect the device from the PC
- Connect again the device to the PC
- Double click on the FLASH.bat file
- Wait for it to be updated and verified
- Disconnect the device from the PC
- Connect the device to the PC again (the procedure is finished)

First SDRsharp start-up

The first time SDR# is started, check the following points:

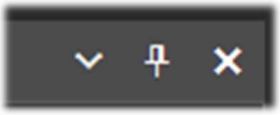
- Increase the RF gain level *(on the sliders from zero to the right for higher values, taking care that the waterfall window does not become over-saturated with strong orange/red signals, but adjust the gain to bring them towards the dark blue colour).*
- Reduce the "Range" slider (step 16) to about 30% from the bottom.
- Enable the "Correct IQ" field to remove the centre peak if using the R820-T/R820-T2 dongles or enable "Offset Tuning" in the configuration menu if using a dongle with an E4000/FC0012/13 chip.
- Disable the "Snap to grid" field in order to tune any signal independently of the specific step of the planned services or set it according to the preferred step (e.g. in FMN the step is 12.5 kHz). *If necessary, also disable the "Auto update radio settings" item in the "Band Plan" panel (read the specific function later).* ***For the demodulation of digital signals it is very important to tune the correct frequency: therefore if the transmission is at 160.512,5 kHz in DMR it is NOT good to tune for example at 160.515,788 kHz!!!***
- Set the correct "emission mode" according to the signals you intend to listen. ***Example WFM is not correct to demodulate FMN or digital signals!***

The following adjustment procedure ensures that you get the maximum SNR (*) on what you receive while preserving dynamic range:

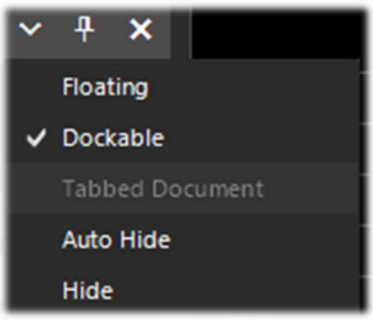
- Start with the RF gain set to the minimum level.
- Gradually increase the gain until the noise floor increases by about 5 dB.
- Check that increasing the gain does not also increase the SNR. Then increase the gain one notch higher and so on.
- Use the vertical blue bar of the "SNR meter" (to the right of the waterfall) to display the value.

Now let's take some time to familiarize ourselves with the new side menus (A and B).
The several menus and plugins (also from third parties, see the appropriate section below) may vary in number and relative position.

The A and B menus are all dynamic, you just need to position them on top to open them... For the various panels, in the upper right part, some options relating to the positioning of the windows: Windows State, Auto Hide, and Close Windows.

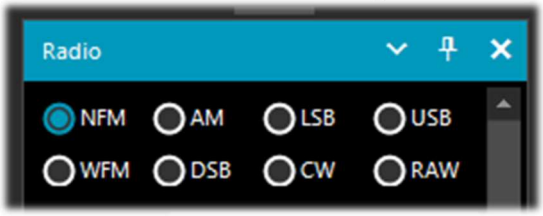


The "Window State" option can take the following values:

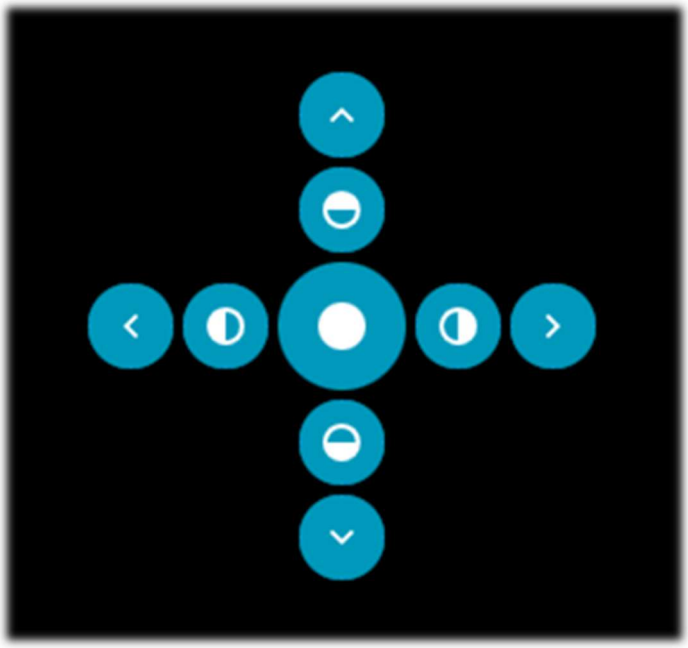


Floating – The panel window can be released from its current position and is free to be positioned anywhere, even outside the main program window.
Dockable – The window is anchored to the main panel.
Auto Hide – The panel window is reduced to a minimum and is opened by positioning the mouse over it.
Hide – The panel window is hidden. To make it reappear, it must be enabled from step 1 (hamburger menu).

But the new and perhaps more complex and less intuitive part, at least at the beginning, is the positioning of the individual panels with the wizard of the recently introduced GUI.
Keep the left mouse button clicked on the blue title of the panel, for example this:



let's start moving the mouse slightly (always keeping the left button clicked), these blue pointers will appear, we will have to position ourselves above the one of our area of interest, move towards the desired position and release the mouse button. This is the scheme of the possible areas (top, bottom, right, left).



icon for the outer left side positioning

icon for left half positioning

icon for central zone positioning

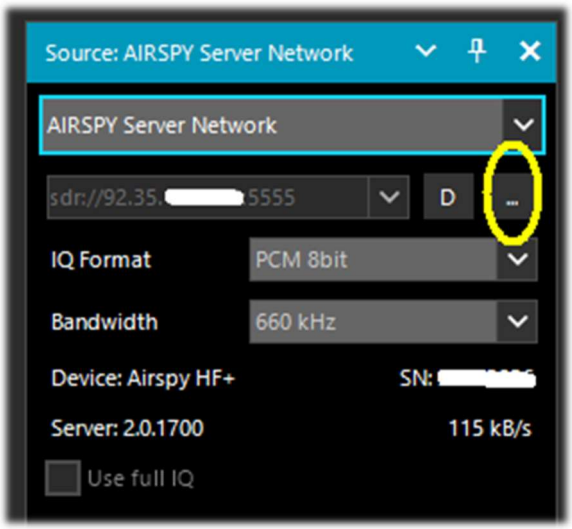
Below are some screens for how to bring the "RADIO panel" to the left side of the screen in **Dockable** mode, i.e. with the window docked to the main panel.

Since release 178x, the panels have an automatic scrolling function on the right, or for resizing, the little horizontal bar (highlighted in yellow) can be used with the mouse. At this point, if you like the composition, you can decide to save the layout with a name of your choice so that it can be loaded later using the items in the hamburger menu "Save Layout... and Load Layout...".

Personally, I have created some specific layouts: one for example for purely HF listening and others for V-UHF or FM 88-108 monitoring with my specific plugins of major use.

AirSpy Server Network

From revision 1553 it is possible to create or use a remote SDR server using the "SPY SERVER" tool. This allows you to connect via internet many "clients" to the same AirSpy or RTL-SDR device even in a Raspberry Pi, Odroid, or Linux environment.

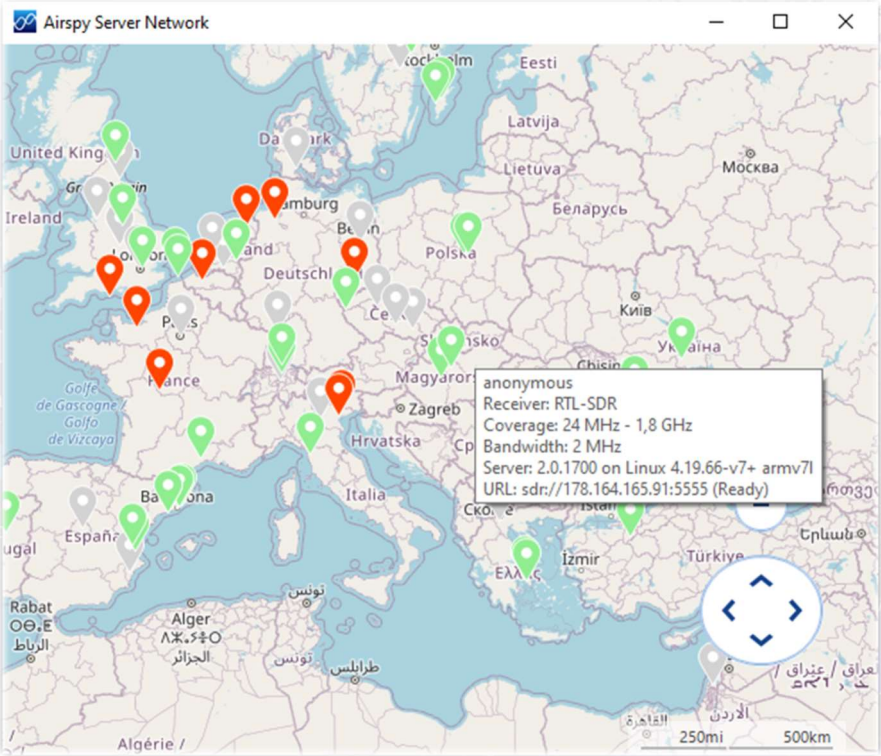


Or create a local network with your own SDRs remotely located in the attic and connected wirelessly to your computer throughout the house.

When only one user is connected, full control (frequency, RF gain) is allowed, while when several clients are connected, frequency and RF gain are blocked.

To use a Spy Server simply select the "AIRSPY Server Network" item in the Source panel. Click on the yellow highlighted button of the "Browse Spy Server Network", an internet page will open where you can see the various servers present: the active ones are highlighted with the green icon.

Since revision 1809 the webmap has been completely renewed with the latest Telerik RadMap.



Positioning the mouse over the various icons will open a box with all the technical characteristics highlighted: name, receiver type, coverage granted (in HF, V/UHF or full), bandwidth, server type and URL). To connect, click on the green icon.

Depending on the source device, adjustments can be made to gain, IQ format and bandwidth. The "Use full IQ" option allows streaming of the full spectrum provided *you have sufficient network bandwidth and a high-speed connection.*

To end the remote session press the "D" button (Disconnect). A similar map can also be found directly at: ***https://airspy.com/directory/***

To create your own Spy Server, you must edit the file 'spyserver.config' with your own data. The starting point is to know your static IP and to check that the ports are open and not blocked by firewalls/antiviruses.

For the port, configure your router or ask your Internet provider for information. You can also use the config file to indicate other additional information such as your name, QTH (*), device type, tunable frequencies, etc. etc.

Now run the file "spyserver.exe", launch SDR# and in "AIRSPY Server Network" enter our IP address and port. Press the "C" button (Connect) and if everything worked, you are in remote...

For the SpyServer Client: instead of using the Zoom on reduced spectrum data, ask a lower bandwidth to the server and it will send you a high resolution, lower bandwidth version of the FFT. The Zoom bar is left for convenience.

What does the SpyServer do in the first place?

It's basically a TCP server with the slicing capability. This means, you get X bandwidth from the hardware to the SpyServer, it cuts 0.1 * X and only sends that part after some good amount of number crunching. What you get in the end is not the whole spectrum, but rather a narrow band IQ representation of the signal you are listening to. For convenience, it also send a low resolution FFT for the general display, but that's not something you can use to create other slices.

The slicing always happens in the SpyServer. All the plugins that require the IF signal (IF NR, IF BB, IF Processor, Co-Channel Cancellers, Zoom FFT, etc...) still work with this model, giving you the false impression that the device is local, or the other "even falser" impression that the server is streaming all the IQ data - and that's not true.

It stream the minimum that is required to make things work properly, unless you ask the server to stream the "Full IQ" data and the server actually accepts.

There is a setting in the server to set the maximum data to send and a timer to prevent abusers from sucking your internet bandwidth. Now even when using the server in your local LAN at "Full IQ", you still can't create slices. This wasn't implemented for the simple reason that nothing is preventing you from using multiple SDR# instances to stream from the same server, be it in "Full IQ" or "Reduced IQ".

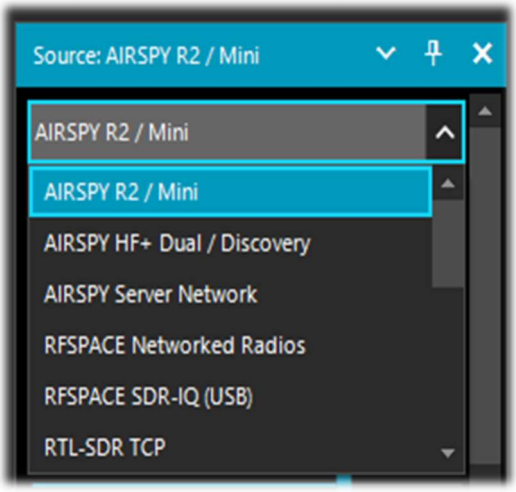
There are a couple of settings in the config file to set the "reduced" bandwidth limits when using the SpyServer.

Default panels

The following are the default panels that allow all the basic functions provided by the software as well as some specific and unique features of SDRsharp. All others defined as "plugin" can be inserted and used by the user (see later the appropriate section) or even developed independently for their needs by those who have the knowledge and appropriate technical skill.

Source

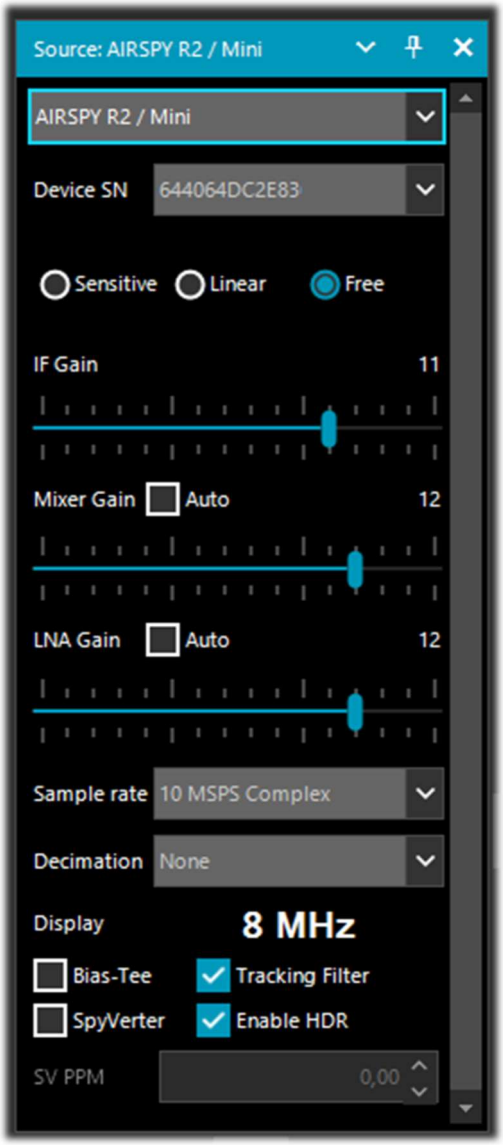
Choose your hardware from the drop-down list:



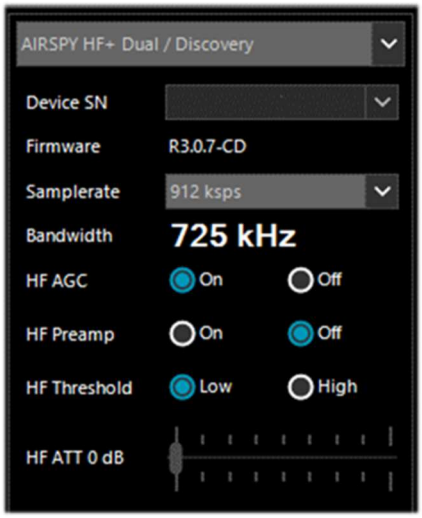
- AIRSPY R2 / Mini
- AIRSPY HF+ Dual / Discovery
- AIRSPY Server Network (see paragraph)
- RFSPACE
- RTL-SDR USB or TCP
- HackRF
- AFEDRI Networked Radios
- Funcube Pro / Pro +
- Softrock (Si570)
- UHD / USRP
- Baseband File (Vasili) / Baseband File (*.wav) / Baseband from Sound Card to load and play I/Q files. See below the "Recoding" panel.

For AIRSPY there are then to adjust: Gain controls (IF (*), Mixer, LNA (*) in a simplified or specific way Sensitive/Linear or Free), Sample rate, Decimation, Bias-Tee *(this option should be used carefully as it sends 5 volts via SMA (*) antenna connector to additional optional accessories),* SpyVerter which allows the hardware option to receive the HF (0 – 60 MHz), Tracking Filter and HDR (*).
The HDR feature gives a boost in dB in dynamic range.
This means that the gains can be turned up further without overloading occurring, and that weaker signals can come in much stronger without strong signals overloading and drowning them out.

AirSpy R2 / Mini

Panel	Feature
	**Device SN** – Serial number of your device. **Gain: Sensitive/Linear/Free** – Three different choices for the gain adjustment at IF (*), Mixer and LNA(*) level. *"Free" is the one that allows greater user intervention and customisation: there are no predefined settings and everyone will have to adjust it as best they can according to their own operating environment.* **Sample rate –** Allows you to choose the sampling: • AirSpy R2: 10 or 2.5 MSPS (*) • AirSpy Mini: 6 or 3 MSPS (*) **Decimation –** Allows a lower bandwidth to be used to the benefit of bit resolution and therefore lower quantisation noise. Values: none, 2, 4, 8, 16, 32 and 64. *To make the best use of it, recommend adjusting the Gain levels (shown above): the more you work in decimation, the more you can increase the gain!* **Display –** The value shown of the bandwidth displayed in the Waterfall and Spectrum windows is linked to the previous "Sample rate" and "Decimation" settings and changes for the different devices: • AirSpy R2 10 MSPS (*) (from 125 kHz to 8 MHz) • AirSpy R2 2.5 MSPS (*) (from 31.25 kHz to 2 MHz) • AirSpy Mini 6 MSPS (*) (from 75 kHz to 4.8 MHz) • AirSpy Mini 3 MSPS (*) (from 37.5 kHz to 2.4 MHz) **Bias-Tee** – Allows the use of optional devices requiring an additional power supply: 4.5v at 50 mA(*). **Tracking filter** – Taking advantage of decimation and enabling this filter will result in better selectivity, *so more gain can be used!* **SpyVerter** – Enables the optional "SpyVerter" device (see relevant chapter), which allows reception from longwave to 35 MHz and the initial portion of VHF. *In HF, the "Linear" mode,is recommended for the gain.* **Enable HDR** (*) – When activated (with software off) applies a combination of analogue and digital filters to optimise the dynamic range for the visible spectrum. *A high decimation ratio can be activated and selected for better reception.* **SV PPM** (*) – AirSpy devices are factory calibrated to approximately 0.05 ppm (*). This value can be adjusted for the SpyVerter. *Updating the firmware will not change this value which is stored in a different location.*

AirSpy HF+ Dual port / Discovery

Panel	Feature
	**Device SN** – Serial number of your device. **Firmware** – Indicates the firmware version installed on the device *(see firmware upgade procedure below)*. **Samplerate –** Allows you to choose the sampling rate: from a minimum of 14 ksps (*) to a maximum of 912 ksps (*). **Bandwidth** – The bandwidth displayed in the Waterfall and Spectrum windows is linked to the previous Samplerate value: from a minimum of 10 kHz to a maximum of 725 kHz. **HF AGC** – Automatic gain control. *It is recommended that you leave it ON (at the same time the Threshold to "Low" value) or disable to OFF and manually adjust the HF ATT cursor value.* **HF Preamp** – Activates or deactivates the preamplifier. *Set to ON for low signal reception, OFF for strong signals.* **HF Threshold** – The "Low" threshold value introduces attenuation but gives the signal better linearity, unlike the "High" position which favours sensitivity. *You have to wait a few seconds to appreciate the differences when changing the threshold.* **HF ATT** - With the HF AGC field set to OFF, it is possible to change the attenuation value slider from 0 dB to a maximum of 48 dB with 6 dB steps.

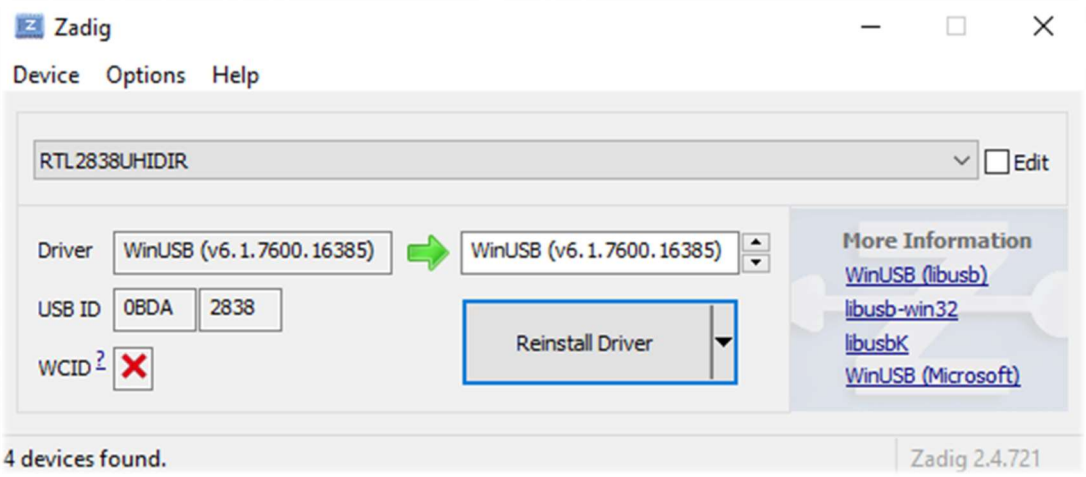
*An interesting note for all owners of the **"Griffin PowerMate"** wheel that may be lying unused in an old drawer: it works brilliantly with the AirSpy /SDRsharp in Windows 10 and tuning is much smoother and easier.*

Dongle RTL-SDR's configuration

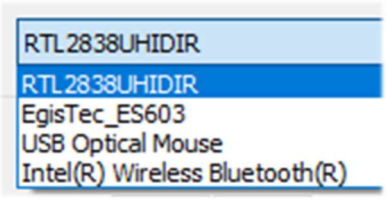
The general rule of thumb for all of the following setups is that the default settings work and any changes require a good understanding of the underlying algorithms and own hardware.

Plug one of the many available dongles (with R820T/T2 or R860 chip, E4000, FC0012/13) into a USB port.

Proceed to install the freeware software from the above link. SDRsharp is preconfigured for AIRSPY but is fully compatible for any RTL-SDR dongle by installing the drivers not present in the original package, running the internal batch file INSTALL-RTLSDR.BAT. An internet connection is required to find the missing and/or updated files. Then run the software ZADIG.EXE.



In the OPTIONS menu, select "LIST ALL DEVICES" (*if possible, without any other USB devices connected to the computer*), and your dongle ID should appear in the drop-down window, e.g. REALTEK, TERRATEC or in my case RTL2838UHIDR.

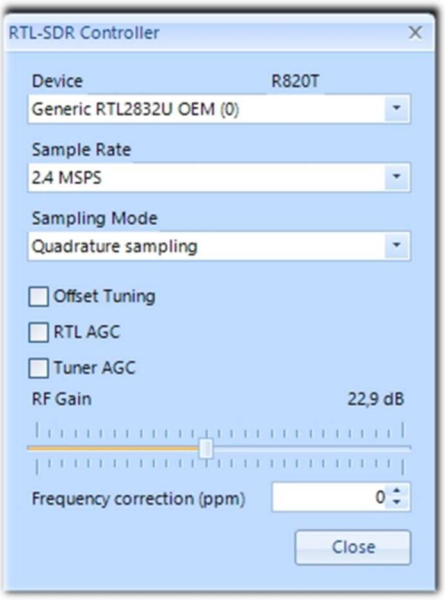
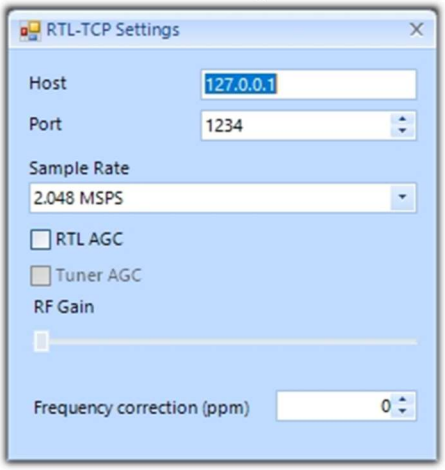


Proceed by clicking the INSTALL DRIVER or REINSTALL DRIVER button (if you have already done so). You can also try connecting your USB dongle after Zadig is running, as the list is automatically updated by the system.

Be very careful to select ONLY the identifier of your SDR dongle and not e.g. your Bluetooth mouse or keyboard, otherwise you will create serious problems with these devices!

After a few seconds everything is ready and you can start SDRsharp and select "RTL-SDR USB" in SOURCE panel.

Sometimes some dongles are not immediately recognised by the O.S., or rather a pair of devices that make up the dongle is shown but with other names, namely "Bulk-in, interface 0)" and "Bulk-in, interface 1)" which is for TV remote control functions. You then choose "Interface 0" with the target "WinUSB" and click INSTALL DRIVER.
If you still don't see your device you have to go to Control Panel / Windows Device Manager and remove those devices marked with a triangle and start again.

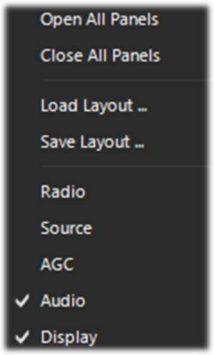
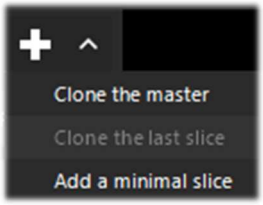
Panel	Feature
 TCP/IP configuration 	Click on the configuration button (4) (the cogwheel). **Sample Rate** – Allows you to choose the bandwidth to be displayed (0.25 to 3.2 MSPS (*)). *Generally, settings up to 2.4 MSPS work well on most PCs, but for slower machines we recommend reducing this value.* **Sampling Mode** – To tune above 30 MHz, leave set "Quadrature sampling". "Direct sampling" (I/Q branch) mode should be selected for lower frequencies for those dongles that are already set up for HF operation (otherwise a hardware change is required). **Offset Tuning** – For use on E4000/FC0012/13 tuner chips only. Selecting this option will eliminate the centre peak in the spectrum. **RTL AGC** – Enables AGC (*) for RTL2832U chips only. **Tuner AGC** - Enables AGC (*) *In many cases it is better not to flag it and manually setting the slider below.* **RF Gain** – Use this slider to manually set the RF (*) gain value. *Start from an average value in dB and gradually increase towards the maximum on the right according to the signals received.* **Frequency correction ppm** (*) **–** Allows to set a correction value for those cheap dongles that do not have a TCXO (*). *Not needed for Airspy users!* If the dongle is not centred in frequency, tune in a strong and stable signal *(after ten minutes of powering up the dongle having reached the correct temperature and stability),* changing the ppm value a little at a time so that it is centred at the tuning bar (point 13).

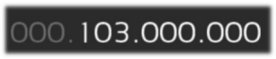
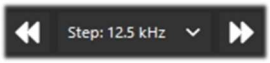
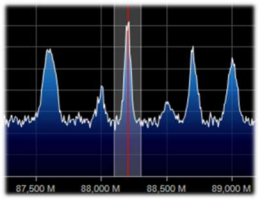
Please note:
If you notice that something is not working properly, especially with the cheap RTL-SDRs and their clones..., very often it is a driver conflict problem.
Uninstall everything and start over.

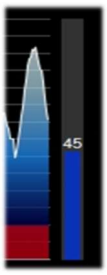
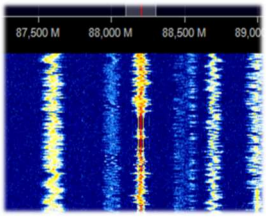
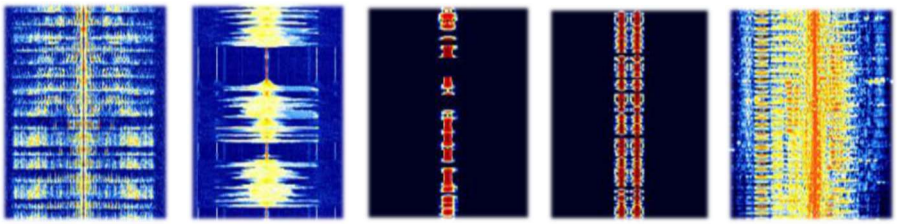
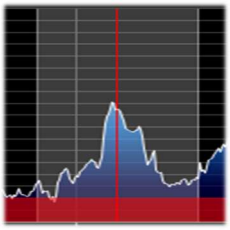
Main settings

As of revision 1825 (5 October 2021), SDR# shows some information about the user interface and plugins loading on the splash screen when starting...

The main settings and controls apply to all devices. The only differences, in some menus, may concern the side to which SDR# interfaces. All devices must be configured in the menu where you can find your RF gain controls, sample rate, AGC (*), PPM (*), etc...

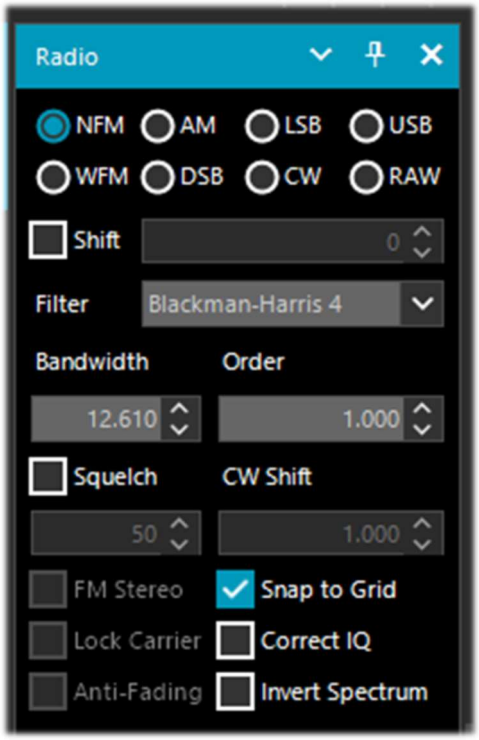
Key	Action
Menu panels  	With the button ("hamburger menu") you can access to the dedicated panels. *The check mark, preceding some items, is a "visual reminder" of the activation of some options inside (example "audio or service enabled").* **"Open All Panels"** and **"Close All Panels"** opens and closes all panels altogether. **"Save Layout..."** and **"Load Layout..."** to save/load your own layout, i.e. the arrangement and sizing of your active windows ***(but only this!).*** *Normally, when you close SDR#, many of the settings are automatically saved in the internal configuration files (e.g. Source device, VFO frequency, mode, volume level, audio output), but not everything, e.g. Zoom level is reset every time.*
Start **Stop**	With this button you start / turn off the SDR# software.
New slice (VFO)  	This button can be used to open one or more new SDR# sessions *(not just present in the "Spy Server Network")*. The "slice" is a separate session showing a portion of the spectrum of the "master" with full separate controls, but still in the sampled portion of the band! *For example, it is not possible to open a session in UHF (*) if the "master" receiver is tuned to VHF. Attention: with the introduction of this function from revision 1741 the previous Aux-VFO plugins (which used the same internal DSP algorithms) are no longer usable. To reduce CPU (*) usage, disable the slice you do not need and minimise its bandwidth*. You can choose to duplicate the "master" session completely or open a minimal session. See also for SpyServer in the dedicated chapter *New sessions will have different colours in the RF Spectrum bandwidth to identify them visually at a glance.*
Configuration menu 	Configuration menu of your hardware and settings: gain, sample rate, bandwidth, RF, PPM controls, etc.

Volume	Activates / deactivates the volume, which you control (with the slider on the right) the desired output level to the speakers or external device *(example to a VAC Virtual Audio Cable)*: from "Muted" to 60 dB max. *It is useful to remember that if you use external software decoders for digital systems (e.g. DSD+), the volume control should be adjusted accordingly to have an optimal output signal level (and minimum errors).*
Input and VFO frequency 	The frequency input is represented in 4 sections (000.000.000.000). The first section from the left represents the values in GHz, the second the MHz, the third the kHz and the fourth the Hz. In the example to tune 103 MHz the input must appear as 000.103.000.000 while if you want to tune a frequency e.g. in MW (*) at 999 kHz, in addition to needing an up-converter (or the optional unit AirSpy Spyverter) you must enter 000.000.999.000 • *Move the mouse over the first digit that you want to impute (without clicking) and enter all the numbers that make up the frequency and confirm with the Enter key. This is the input I prefer! For example, you stand where the arrow points and type in the number 103* *followed by Enter. Quick and easy.* • *Left click on the top of the digits (a small red rectangle will appear) to advance one unit* • *Left mouse click on the bottom of the digits (a small blue rectangle will appear) to decrease by one unit* • *or on the desired digit by turning the mouse wheel on it.* • *Right click the mouse to bring a digit to zero and reset all the ones to the right of it as well* • *UP / DOWN arrow keys change the digit* • *The Right/Left arrow keys move along the section in the input*
Tuning types	**"Free tuning"** - free tuning throughout the range, by clicking anywhere in the RF spectrum or waterfall, the receiver will tune it, also changing the below frequency range indication. **"Sticky tuning"** - the frequency remains "connected" to the VFO and you can scroll the frequency bar left and right by "hooking" it with the left mouse button. **"Center tuning"** - the tuned frequency will be always displayed in the center of the RF spectrum and waterfall.
Step bar 	By selecting the appropriate step (expressed in kHz) in the center of the option, you can then easily scroll through the frequencies by simply clicking on the double arrows on the side. (See relevant section below).
RF Spectrum 	In this window the RF Spectrum is shown visually as a real-time graph. The active signals appear as peaks of greater or lesser intensity. The lower part represents the "noise floor. *A recently introduced feature is the "peak Color" which is activated by clicking with the right mouse button on the Spectrum window, where a yellow line of persistent memory relative to the received signals will appear. It is possible to modify the color by changing the following line: "SDRSharp.exe.config": "spectrumAnalyzer.peakColor" value="FFFF00"*
SNR meter	On the right side of the RF spectrum there is a vertical bargraph that shows the SNR value (in dB). The Signal-to-noise ratio is a numerical quantity that relates the power of the useful signal to the the noise in the system.

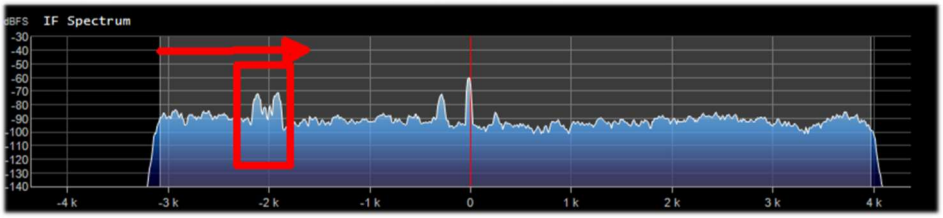
	In the case of analog transmissions, a decrease in SNR causes a gradual deterioration of the received signal, which is still receivable and understandable. In digital transmissions instead there is a minimum threshold of SNR below which the system no longer works for too many errors received. *There is no S-meter to detect the signal strength, intended as an S-unit and mainly used in the radioamateur world.*
Waterfall 	This window shows the graphic representation in real time of the intensity of the received signals as a function of frequency (on the horizontal axis) and time (vertical axis) with the new data represented in cascade starting from the top and going down: hence the name waterfall. *This representation is a great help to learn about the various types of signals visually. A trained eye detects and recognizes an interesting signal at first glance, even if it is weak and in the midst of disturbances, because each signal has its own "footprint", as well as electrical noises of all kinds !! Here are some examples of signals:*  AM FM CW RTTY SSTV *To more easily recognize the numerous types of signals and modulations I recommend the freeware software ARTERMIS 3 that collects and catalogs several hundred of them, also providing a sample audio playable:* ***https://aresvalley.com/Artemis***
Tuning bar 	The vertical red line in the center of the RF spectrum windows shows which frequency is currently tuned the receiver. The inside of the gray rectangle is the active bandwidth (or BW) that can be changed by simply dragging the left/right side of the rectangle. *The bandwidth must be set so that it covers the area of the tuned signal (not too wide or too narrow, especially when receiving digital signals).*

Radio

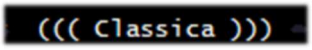
In this panel you select the various types of demodulation for the tuned frequency, Bandwidth, Squelch, Step Size, etc…



Mode	Features
NFM (*)	Transmission technique that uses the frequency variation of the carrier wave. Mode commonly used by civil and radioamateur services for both analog and digital modes in VHF/UHF but not under the 27 MHz.
WFM (*)	This is the mode used by FM stations (88-108 MHz band). *For stations with Radio Data System, in the upper part of the Spectrum RF, on the left (see item 11) there is the dynamic decoding of some codes RDS that carries a lot of informations:* ➢ *PI, Programme Identification. Unique four-character alphanumeric code that identifies the radio station.* ➢ *PS, Programme Service. They are eight characters used, usually, to send the name of the radio also in a dynamic way.* ➢ *RT, Radio Text. It allows to send free text from radios such as, for example, the author and the title of the song on air.*
AM (*)	Transmission technique that uses a radio frequency signal as a carrier signal. Used by worldwide long wave/medium/short wave broadcasting stations and by civil and military aeronautical communications in VHF/UHF.
LSB/USB (*)	Technique that foresees the modulation of a signal eliminating besides the carrier (as in DSB) also one of the two lateral bands. Used in the HF band (0-30 MHz) by utility and military services, by radioamateur radio in HF but also in VHF to transmit voice and data efficiently with small bandwidths.
CW (*)	Morse Code. System to transmit letters/numbers/symbols by means of a signal in pre-established code made of points and lines. Used from always from the radioamateurs and a lot of military stations still today in the age of the digital.

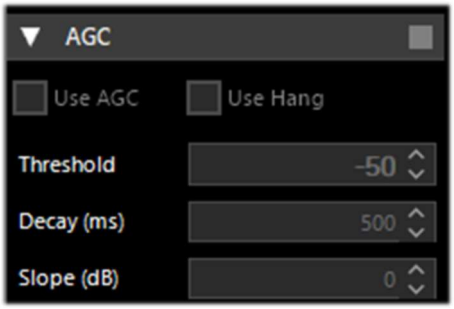
DSB (*)	Use similar to AM but allows a higher modulation performance by suppressing the carrier and transmitting only the sidebands. *It can be used to tune stations with interference (together with IF Spectrum window where you can best configure the signal window by removing the interfering signal) or with new AM Co-Channel canceller plugin...* 
SAM (*) *(even if it does not formally exist it is fully supported!)*	*To enable it, just set the DSB mode and check the option "Lock Carrier" on this panel. The IF filter helps choosing which part of the DSB signal to use: LSB, USB or both.* A very high-performance and adaptive PLL (*) is used, developed with the help from high-profile DXers that has no match in performance. It just locks everything even if the signal is barely visible in the RF spectrum. Even when the signal is completely gone, it finds its way to keep the lock until it reappears again. You don't get that nasty loss of lock in portable radios or other software. This can be combined with the "Anti-Fading" to improve SNR (*) when there is no co-channel interference.
RAW (*)	Used for playback or recording of RAW IQ streams or with external decoding program, for example DReaM (DRM) / DSD+. *DReaM works with RAW mode by setting the its input to IQ, or using USB mode in SDR#.*

Key	Default	Features
Shift	0 (if you dont use UpConverter)	This box is useful only if you use an UpConverter; it is used to rectify the frequency tuned to the value entered. For example, if you use an UpConverter (with a 100 MHz oscillator) you set the Shift to -100,000,000. Without the Shift, when using an UpConverter to tune a 7 MHz signal, you should tune 100+7 = 107 MHz. With the Shift set, you can tune normally to 7 MHz without artifice.
Filter	Blackman-Harris 4	Set the type of filter used in the Fourier transform. It is used to receive the signal highlighted in the RF window *(where each filter has a different response curve and characteristic)*, the default Blackman-Harris 4 filter is the best in most cases and should not be changed.
Bandwidth	AM: 10.000 WFM: 180.000	This is the bandwidth (BW) in the window of the gray rectangular area. You can set it manually in this field or by dragging the edges of the window with the mouse.
Order	500	This cell changes the steepness value of the filter sides. With low values (from 10 to 50), the transition between the pass band and the out-of-band zone takes place gradually. With high values (from 100 to 500), the transition is immediate. The effect of this adjustment is audible in the audio signal. *Very high values, however, can cause AGC instability or less clean listening. You may increase the order of the filter when there are strong signals near your tuned area. However, using*

		higher filter orders can cause a higher CPU load, so on slower PCs you should reduce this value.
Squelch	OFF	Squelch is used to mute the audio when the signal strength is below a specified threshold. A high value requires a stronger signal strength to activate the audio. *The Squelch is only implemented for AM (Amplitude Squelch) and FM (Noise Squelch). SSB needs yet another type of squelches that is not implemented yet. It is especially useful in NFM waiting to hear speech and not just listening to background noise,* ***but should be turned off when decoding digital signals (e.g. via DSD+ or DReaM software).*** ***Often I have collected opinions of difficulty, from friends and guys, in decoding digital signals with DSD+, perhaps it is better to use the original VAC rather than other similar software on the market!***
CW Shift	600	Mainly useful in receiving CW (Morse code) where you can set the offset between transmission and reception frequencies.
FM Stereo	OFF	It will enable stereo output for WFM signals (in the 88-108 MHz band) from FM broadcasting stations, *but may worsen the sound of weak and distant stations.* *If a stereo signal is detected, the RDS display (in item 11) will show the name of the broadcaster in a few round brackets.* 
Snap to Grid	ON	The activation of the "snap to grid" and relative "Step Size" drop-down menu helps a lot the fast and correct tuning of the signals centering the correct tuning for each type of emission. For example in civil air band the channels are now spaced with the step of 8.33 kHz and this field, enabled with this value, allows the correct tuning by clicking directly on the RF Spectrum or Waterfall. *To use it with a non-TCXO (*) dongle RTL-SDR, the PPM frequency offset correction must be set finely after at least 10 minutes after using the dongle, otherwise the frequencies may not be aligned on the grid with real frequencies.*
Lock Carrier	OFF	Active only in AM or DSB modes. Allow the Synchronous AM which can greatly improve reception and keep the signal perfectly locked, even if it is poor and unstable. *Try it in DSB mode, it makes all the difference for pleasant listening!*
Correct IQ	OFF	This setting removes the small, annoying center peak present with the dongles RTL-SDR R820T/R820T2. *Normally it should be activated.*
Anti-Fading	OFF	Use when "Lock Carrier" is activated. Leverages the symmetry of AM signals which helps in the presence of weak signals. *Activate it for better AM reception, but can increase CPU load.*
Invert Spectrum	OFF	If you use SDR# as a panadapter, some receivers may have the I/Q signals reversed and you must activate this option. *The I/Q signals, (or I/Q data), are a fundamental element of RF communications systems, often represents signals in the time-domain.*

AGC

The function of AGC (*) acts in real time on the amplification of the input signals by varying it in order to obtain an optimal level on the output on low signals and avoiding distortion on high signals.



In WFM mode the AGC is disabled because the FM signal is limited and its amplitude is constant. For NFM the AGC acts on the Audio output. This is useful with weak signals with low modulation index. For AM, SSB, CW and RAW, the AGC acts on the narrow band IF, as usual.

Key	Default	Features
Use AGC	ON	Activates the automatic gain control. The AGC will attempt to control the audio volume level so that loud sounds are not too loud and the same for low sounds. The default settings work well for voice signals. *It is especially useful to turn it on when listening to AM/SSB/CW mode because loud signals may be distorted.*
Use Hang		It allows you to change the default behavior of the AGC in its Threshold / Decay (ms) / Slop (dB) components, although in most cases the default values are fine. *Enabling it slightly changes the response over time and may be useful for some SSB or Morse signals.*
Threshold (dB)	-50	This is the threshold of intervention of the AGC. The signals below that level are not amplified, while those above are amplified at the level of the strongest ones.
Decay (ms)	500	Response time. High values delay intervention, too low values can cause an annoying sound effect.
Slope (dB)	0	Line slope for gain correction.

There are many AGCs at different levels:

Analog:

- RF AGC, which activates a 6dB stepped attenuator,
- IF AGC, which controls the IF gain just before the digitization.

Digital:

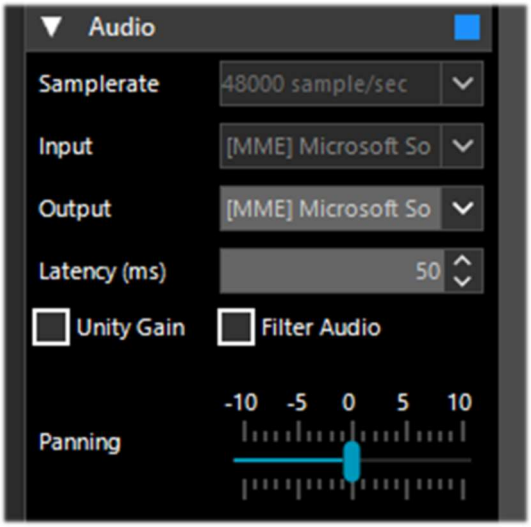
- IF AGC, to make sure the data is scaled properly (by digital amplification) before sending to the computer.
- Narrow band AGC, which is the AGC panel controlling the signal that passes through the VFO filter.

Important Notes:

- The role of the Analog AGCs is to adapt the sensitivity of the front-end to the signals at the input. When enabling the AGC in the Source panel, you are activating both Analog AGCs.
- The Digital IF AGC is always activated and only starts acting when the strongest signal(s) in the IF spectrum exceed -6 dBFS. This mechanism ensures your signals are always scaled properly for unattended operations.
- When turning the Analog AGCs off, you can control the stepped attenuator manually, but then, it's up to you to determine which attenuation level is adequate for your signal at input. In general, push the attenuation until the noise floor is around -100 dBFS. Higher levels do not necessarily improve your SNR but will definitely reduce your available dynamic range. If in doubt, turn the AGC on and let it do the job.
- When turning the Analog AGC on, you will notice that you also have a "Threshold" option available. It is used to instruct the AGC to tolerate an extra 3 dB of signal power before setting the next attenuation level. "Threshold Low" means the front-end is "less sensitive", and "Threshold High" means "more sensitive". This is really useful when chasing marginal signals in presence of very strong blockers (~ 100 dB of difference).

Audio

This panel adjusts the settings for audio processing.

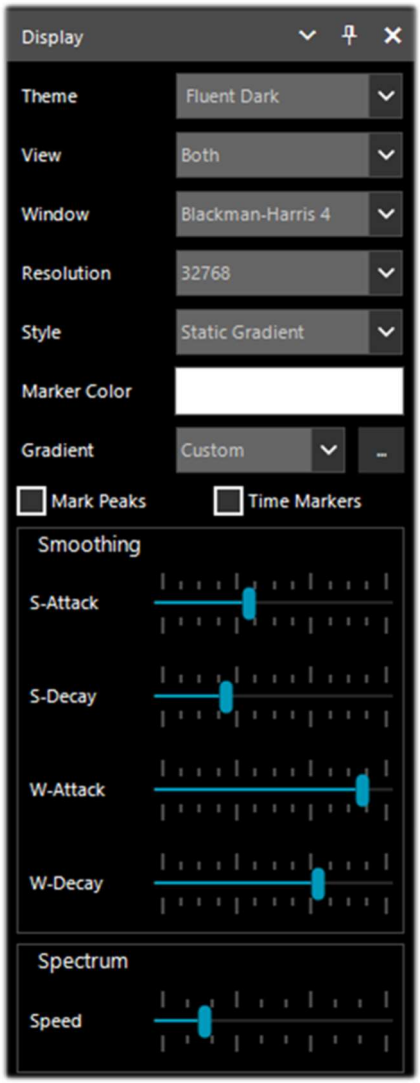


Key	Default	Features
Samplerate	48000	Sets the sampling rate of sound card. Some decoding software may require you to set a specific sample rate. Usually the default value at 48000 samples/second should be fine for general purposes.
Input	Sound card	The input sound card is highlighted in this field. *Normally it should not be changed, automatically detecting your card even if you are using SDR sound cards such as: SoftRock, Funcube dongle, Fifi SDR, etc.*
Output	Speakers	In this field you choose the output device from those available in your system: Speakers, Line 1, Digital Output and for the best audio

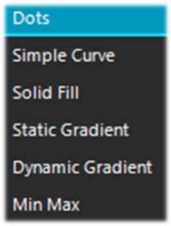
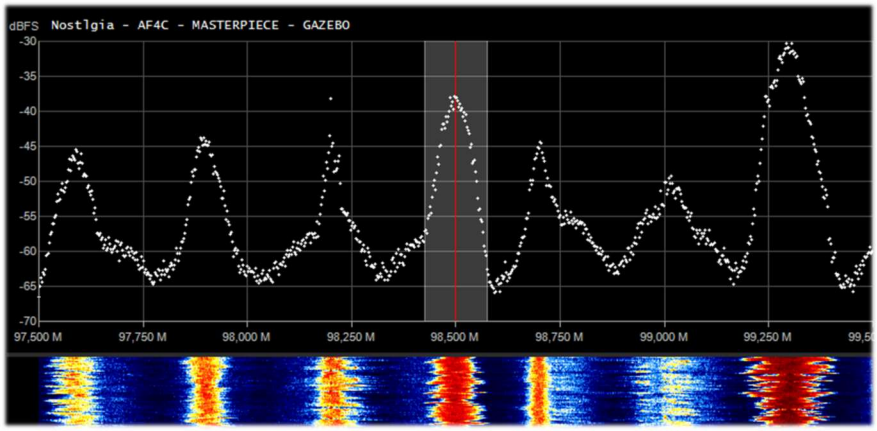
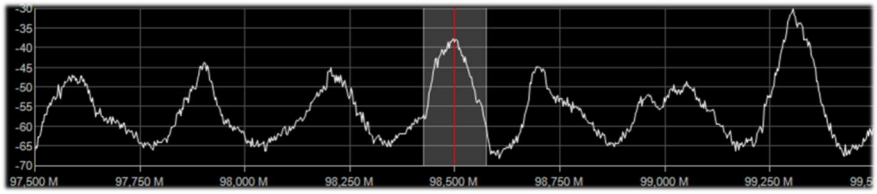
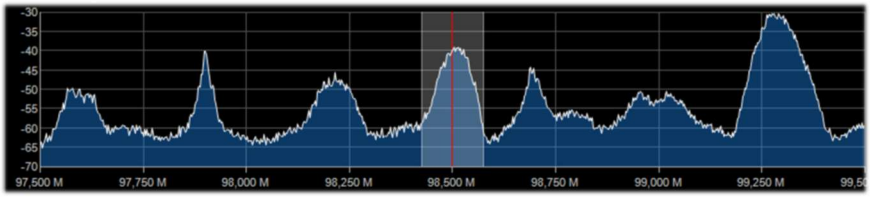
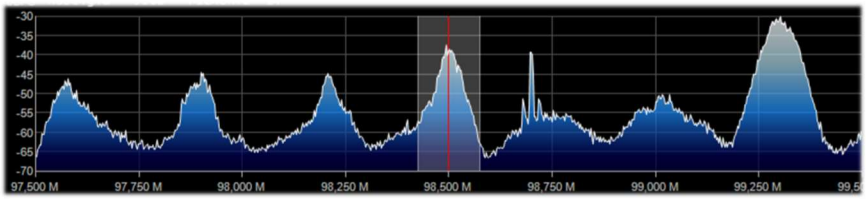
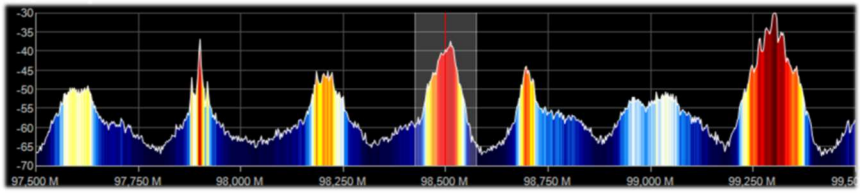
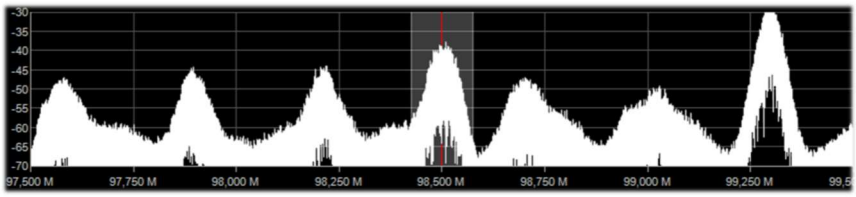
		quality: [Windows DirectSound...], [MME...] or the much better performing [ASIO...]. *Normally it defaults to the speaker line.* But what is ASIO? Audio Streaming Input Output is a low-latency communication protocol for digital audio signals developed by Steinberg. Thanks to it, a sound card can be able to record and play back audio without delays. Low-latency drivers, designed to obtain and manage incoming and outgoing audio streams with a small memory buffer (where stream exchange and digital/analog transformation takes place), allow for virtually zero delay! For audio devices that do not have native ASIO support, ASIO4ALL have been published universal and compatible ASIO drivers, however, not being native for many systems, this may result in slight reductions in performance but it is worth a try! If they are not already present in your Windows 10, low latency drivers can be downloaded from the site: ***https://www.asio4all.org/*** *You can then easily perform a test with these drivers enabled: tune in SDRsharp any broadcasting station and do the same with an external receiver… the audio coming out of both systems will be virtually in parallel and without any delay as is the case with normal drivers.*
Latency (ms)	**50** or lower with [Windows DirectSound] drivers **1** with [ASIO...] drivers	The latency value (expressed in milliseconds) is the time that elapses between the analog-to-digital conversion of the input signal, its processing and the digital-to-analog reconversion at the output. *It is advisable to keep this value as low as possible. The latest developments of SDR# (revision 1783) have almost halved the CPU/memory usage, while the latency is at the limit of what the hardware can do.* ***Since revision 1818 the latency has been drastically reduced again and now ASIO drivers work without problems with the value of 1 ms !***
Unity Gain	OFF	Normally it should be deselected as it sets the audio gain to the unit value of 0 dB.
Filter Audio	ON	Audio filter. *Improves the performance of speech signals by filtering the audio and eliminating hiss and DC noise. It should absolutely be deactivated when decoding digital signals (e.g. via DSD+ or DreaM).* ***The same applies to all other plugins (e.g. Audio Processors or Filters that act on the audio level), which must be absolutely deactivated when receiving digital signals (e.g. DMR, DSTAR, C4FM, satellites), otherwise they will result in incorrect decoding or dirty signals.***
Panning	0	Balances the audio between the left/right speakers.

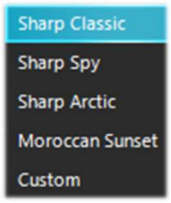
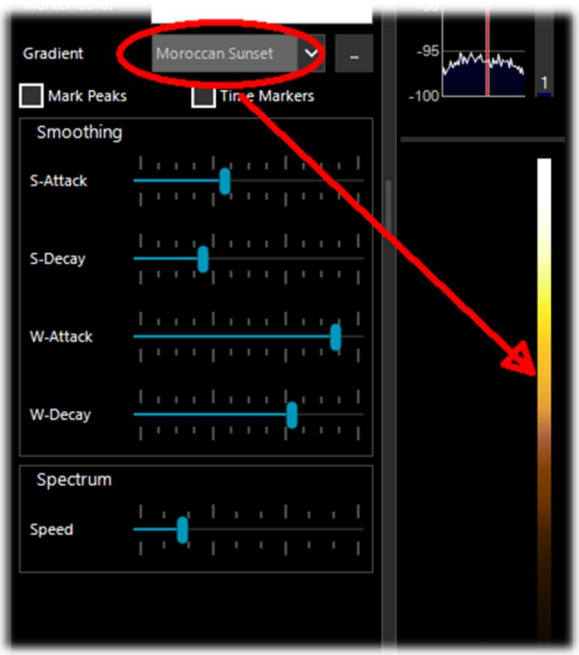
Display

Display settings adjust the Theme, RF spectrum and waterfall screen options and other settings.



Key	Default	Features
Theme		Recently introduced with the latest graphic interfaces, allows you to choose multiple design layouts, many even in dark theme.
View	Both	Allows to set the display of the RF spectrum screen, waterfall, or only one of them, or none at all. *On older PCs it may be useful not to display the waterfall to avoid overloading the processing.*
Window	Blackman-Harris 4	Set the type of filter, *where each filter has a different response curve and characteristic*: the default of Blackman-Harris 4, it has balanced performance and is the best in most cases and should not be changed.
Resolution	32768	Increased resolution will improve signal quality in the RF spectrum display and waterfall. Using a higher resolution can be useful when fine-tuning, as you can better see the peaks and structure of the signal.

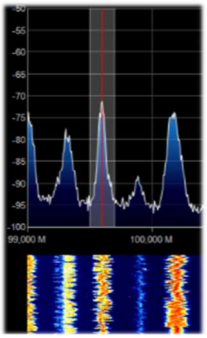
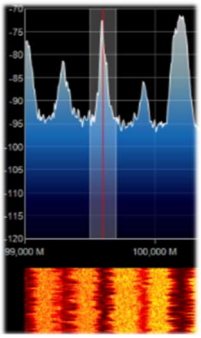
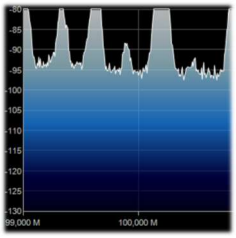
		Be aware, however, that high resolutions can slow down the PC and can cause problems especially with older machines. Normally, if your PC can handle it, you should use at least the value of 32768.
Style  		Allows you to choose different styles of waterfall signal representation: **DOTS**  **SIMPLE CURVE**  **SOLID FILL**  **STATIC GRADIENT**  **DYNAMIC GRADIENT**  **MIN MAX** 
Marker Color		It allows you to change the color of the marker on the waterfall by simply clicking on the Windows color palette.
		Allows customization of the color palette used in the waterfall.

Gradient  		*Youssef suggests for High Dynamic Range applications to modify the file "SDRSharp.config" with these values:* ***<add key="waterfall.gradient" value="FF0000,FF0000,FBB346,FFFF00,FFFFFF,7AFEA8,00A6FF,000091,000050,000000,000000" />***  Initially there was only one palette encoded within the configuration file, but starting with revision 1818 you can choose some pre-set gradients: Sharp Classic, Spy, Artic, Moroccan Sunset and Custom. *In order to immediately evaluate the most suitable one for us, once chosen from the menu, I suggest viewing the vertical bar on the right with the complete palette of colors represented.* The button activates the "Gradient Editor" to further customize the color palettes.
Mark Peaks	OFF	Allows to highlight a circular marker on each signal peak on the RF spectrum window.
Time Markers	OFF	Displays a time indicator on the left side of the waterfall screen to date the signals transmission. *By definition it is set to 5 seconds.*
S-Attack / S-Decay		Changes the uniformity and average of the received signals in the RF spectrum display. *Set them halfway.*
W-Attack / W-Decay		Changes the uniformity and average of the received signals in the waterfall display. *Set them halfway.*
Speed		Changes the refresh rate of the RF spectrum and waterfall. *Never keep it at maximum.*

Zoom Bar

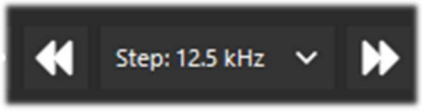
The four vertical sliders on the right (items 14/17), referred to as "Zoom Bar", adjust the following settings in the RF spectrum and Waterfall display.

Key	Default	Features
Zoom	down	Moving this slider up will magnify the RF spectrum and waterfall around the tuned frequency. However, the higher the magnification, the lower the

		resolution will appear. An alternative to zooming is to reduce the sample rate or use the decimation function in the Source panel.
Contrast	down	Adjusts the contrast of the waterfall. Moving the cursor upwards the signals will be distinguished from the background noise, *but do not exaggerate and avoid saturating by having an screen all yellow/orange or red...*
Range	down	Changes the level in dBFS (*) on the left axis of the RF spectrum window. *You should adjust it so that the noise floor threshold is very close to the bottom of the RF spectrum window.* This will make the RF spectrum and waterfall signals more readable, making weak signals easier to detect. *Correct*  *Wrong* 
Offset	down	Adds an offset to the dBFS (*) level range in the RF spectrum window. The offset is added to the upper value of the dB level range in the RF spectrum. *Normally you do not need to adjust it, unless you need additional contrast on weak signals in combination with the "range" adjustment. Adjust it so that the height of the signal peaks are not clipped at the top of the screen.*  *Wrong*

Step Bar

Since revision 1785, the "Step Size" field (next to the "Snap to Grid" item) is no longer present in the "Radio" panel, but the "Step Bar" has been created now on the right-hand side of the VFO (*).



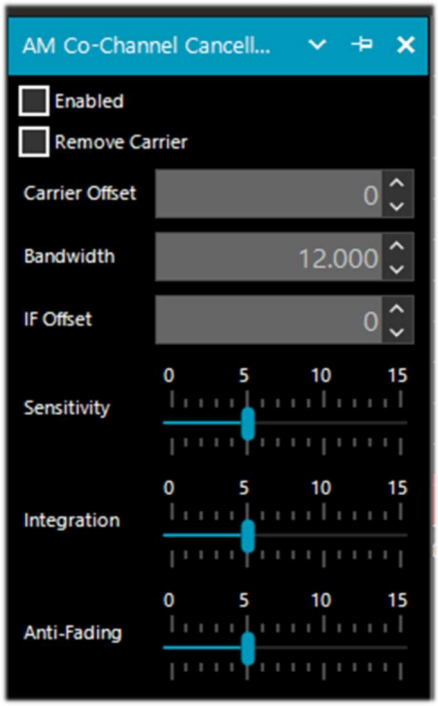
Clicking on the left double triangle will decrease the VFO frequency by the value indicated in the step, while clicking on the right double triangle will increase the frequency. *The possible choices concern steps between 1 Hz and 1 MHz or, with free tuning, not flagging the first item "snap". To use a new step not foreseen it is sufficient to edit the SDRsharp.config file at the key starting with* ***<add key="stepSizes" value="...*** *and insert in the right place for example the new value "3.125 kHz". Another very interesting and fast possibility is to use the mouse: just position yourself in the Waterfall or Spectrum window and with the central wheel of the mouse rotate it forward to advance with the frequencies of the pre-set Step or on the contrary, rotate it backwards to decrease the frequency.*

AM / FM Co-Channel Canceller

Following the user requests in order to enhancing Medium Waves and Short Waves AM DX reception in presence of Co-Channel interference, the AIRSPY team has developed the world's first working Co-Channel Canceller algorithm! There are two distinct plugins for AM and FM mode, this patent-pending algorithms not only recovers the interference plagued audio, but can also be combined with our other plugins to fight QRM, QRN, and anything that could compromise your signals.

This unique, free and constantly updated plugin (last revision with 1820) is not present in any other software!

This even works with Zero-Offset Co-Channel, you can remove the local station and listen to the DX stations on the same frequency. *A very strong local station with distorted phase can be completely cancelled to emphasize other very weak stations on the background!*



During a listening session it may happen to find the right conditions for using these plugins, obviously they are not a normal condition of use, but only in case of interfered stations from which to try to unravel a rare DX (*) signal devoting some time and attention because the procedure can be a bit laborious, at least the first few times…

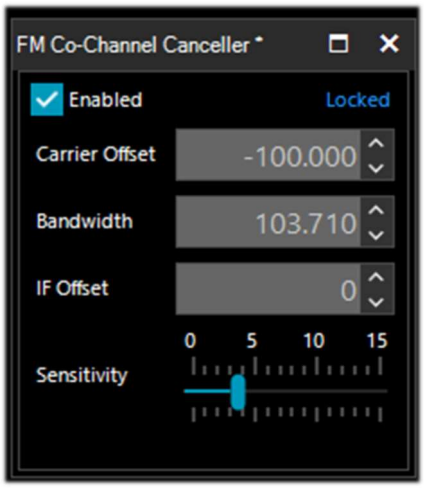
I will try to summarize the main steps, although they may vary slightly in your specific use:

A) MW local station with very strong signal at 819 kHz
B) DX station at 810 kHz buried and unreadable

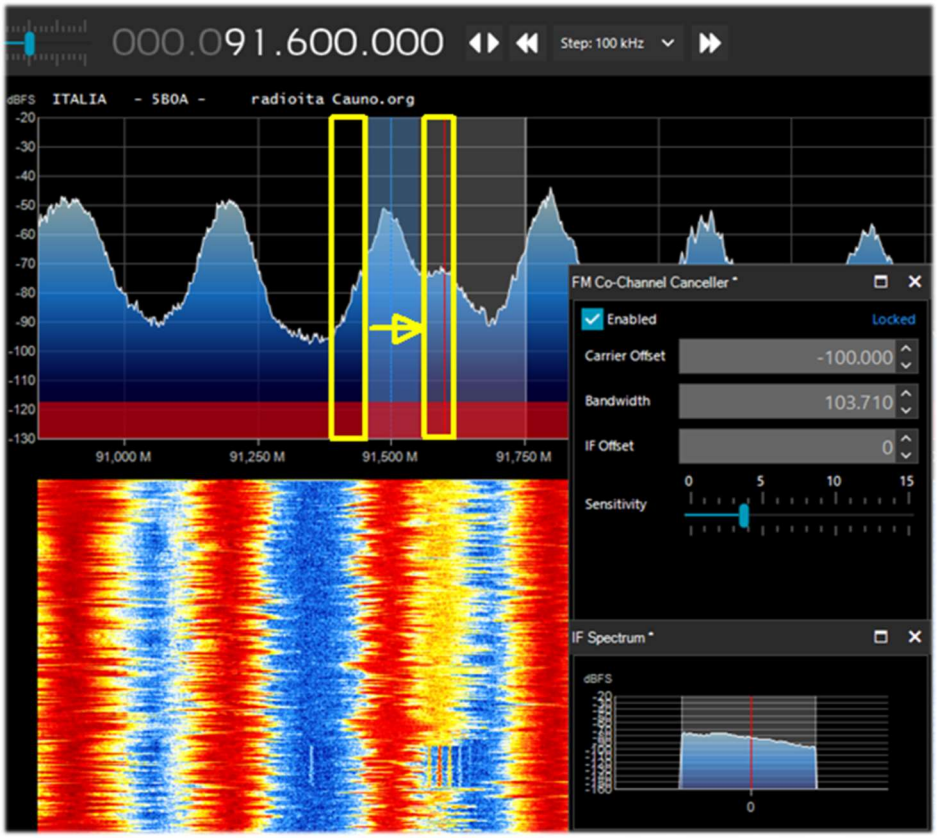
1) Tune the (B) station
2) Widen the filter from 810 to 820 kHz to include the right local signal carrier (A)
3) Enable the "AM Co-Channel Canceller" and the relative "Remove Carrier" with Carrier Offset value at 9.000 (designates interference is 9 kHz from the station). The plugin will hooked and show in blue "Locked" on the right hand side, and you see in Spectrum RF a vertical blue line over the carrier to be removed from (A)

4) Enable the plugin "Zoom FFT" and active the "Enable IF" + "Enable filter" always staying tuned on (B)
5) In the "Zoom FFT" windows narrow the BW to exclude the interfering carrier always on the tuned station (B): now listen and appreciates the new result!

In a similar way works the equivalent "FM Co-Channel Canceller"; *its initialization code and sensitivity have been further improved in revision 1819.* In this example we see how to set the panel to listen to a weak station overwhelmed by a very strong signal...



Example: strong WFM station at 91.500 MHz and weak station tuned to 91.600 MHz (red vertical center BW line at about 100k).
Enable the plugin, set the Carrier Offet to -100.000, to delete the signal at 91.500 MHz (blue vertical line on the left), adjust the left side of the filter in the IF Spectrum window and slightly change the position of the "Sensitivity" slider (range 0 / 15) until the desired effect is obtained… after a while, appears the name of the station with its PI code in RDS too.
Not only does it work "live" in realtime, it functions very well with previous recorded I/Q files too!

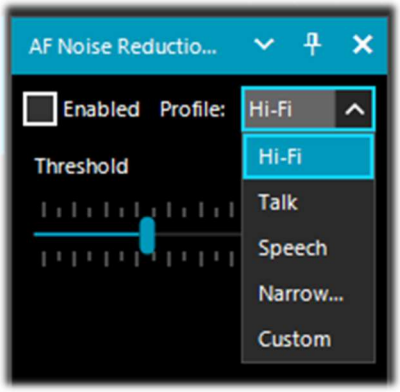


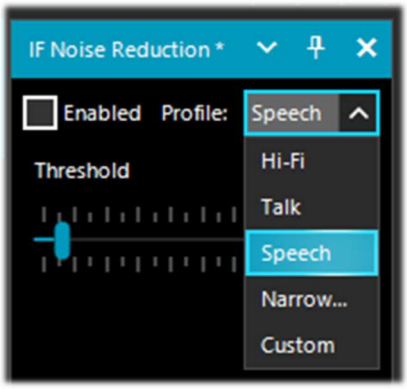
In the picture, make sure the cancelling filter covers the offending signal entirely. For example, if you leave the left side of the offender, you can't get rid of the right side which is on top of your signal.

AF / IF Noise Reduction

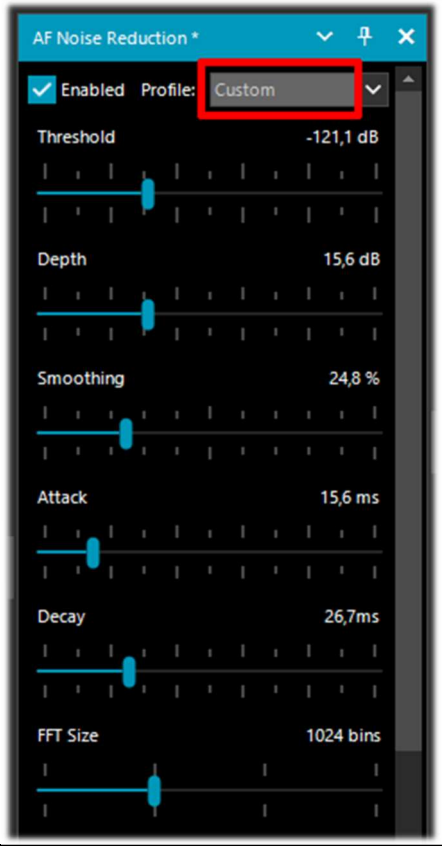
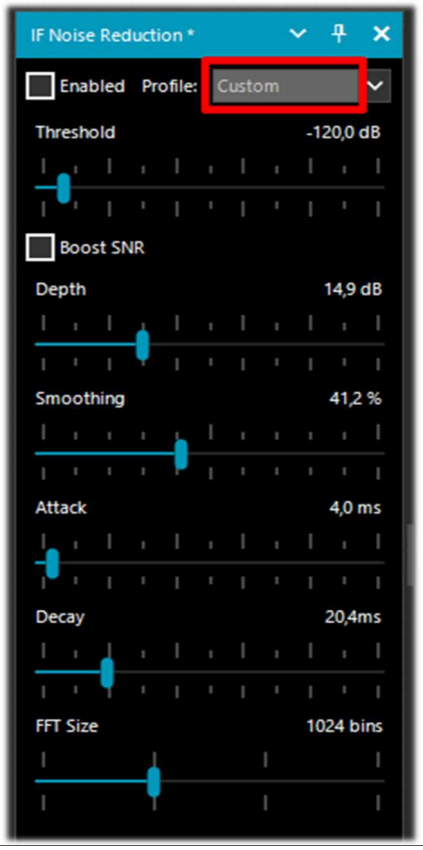
When listening to speech signals, which are often weak and noisy, it is very useful to activate digital noise reduction. In SDR# two Noise Reduction options are available: Audio AF and IF. The AF option uses the noise reduction algorithm on the audio output signal, the IF option on the IF signal.

Since **revision 1856**, the old noise reduction processor has been replaced with a brand new algorithm, **Natural Intelligence Noise Reduction (NINR)**. This results in better intelligibility with fewer artifacts, deeper noise cancellation, and lower CPU utilization.





Once the "Threshold" slider is enabled, the incisiveness of the applied algorithm is controlled, and some already optimized and predefined profiles can be used**: Hi-Fi, Talk, Speech, Narrow Band** and the **Custom.**
For the latter, individual components can be further customized:
Threshold (dB), Depth (dB), Smoothing (%), Attack (ms), Decay (ms), FFT Size (bins)

AF Noise Reduction	IF Noise Reduction
	

But when is it appropriate to use one or the other or together at the same time?

There is no general rule that fits everything and everyone, everyone will have to experiment personally according to their own needs and the specific levels of noise present. For AirSpy R2 owners, you can also try reducing the gain a bit...

To get started, you can use the predefined "Profiles" or try the "Custom" directly, which allows more flexibility and user control. One must take some time, however, to test all the parameters of this profile, which can give better results for specific types of signals and in various emission modes. Probably the best on the market today!!

With the help of some friends, I have collected and summarized the first impressions in the following tables.

Control	Range	Features
Threshold AF Threshold IF	-140 to -80 dB -130 to +30 dB	User-controlled threshold setting. It appears that the effect is appreciable from about -90 dB. At more aggressive settings, signals may have partially compromised quality.
Depth	0 to 50 dB	Depth of intervention: little change in quality was noted across the 0 to 50 dB range, with 50 dB applying the greatest effect.
Smoothing	0 to 100 %	At the moment I could not determine marked effects with this command, which consumes a bit more CPU at high rates.
Attack	1 to 101 ms	Most of the effect occurs between 0 and about 10-15 milliseconds; toward the end range it seemed to cut off the beginning and end of words.
Decay	1 to 101 ms	There is not much effect above about 30ms, but the audio comes closer to a natural sound at the higher settings.
FFT Size	512 to 4096 bins	Bins or spectrum samples by defining the frequency resolution of the window.

The only settings that can affect CPU consumption are "Smoothing" and "FFT size," the rest seem to have no appreciable effect on CPU utilization.

AM	The IF N.R. eliminates RF noise that can be anywhere in the signal. This has no effect in WFM or NFM with high modulation index because the signal is distributed over a large bandwidth, but with linear modulations such as AM and SSB, it can dramatically improve SNR by identifying the parts of the spectrum that do not contain signal and attenuating them. *Using the "Hi-Fi" profile on an AM broadcast, I forgot that the filter was on until I turned it off and all signals returned to the usual local noise...*
CW	The "Narrow Band" profile gives the best results with CW. It can also be used by selecting the "Custom" profile. *It really works very well and a weak morse signal becomes good.* One was able to pull out a couple of regional NDBs that otherwise would have been practically submerged in noise.
NFM	Joint use of both IF and AF Noise Reduction is necessary. The IF N.R. can still work for NFM signals, but it is mainly intended to be used with the other modes. I did some limited testing of AF Noise Reduction on NFM by tuning some stations in the 160/170 MHz range where the electrical noise is very high and annoying. *The AF N.R. audio is better for FM modes because it eliminates the hiss, which has mostly high frequency components in the audio spectrum.*
SSB	The new algorithm definitely helps the S/N on weak signals in SSB that are immersed in noise and thus become much more intelligible. *The IF N.R. eliminates RF noise that can*

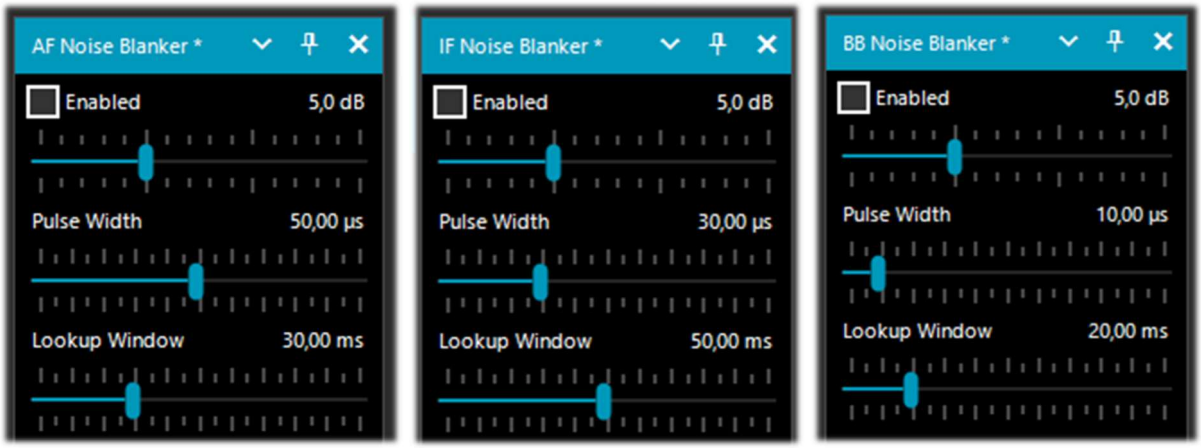
	be anywhere in the signal. This has no effect in WFM or NFM with high modulation index because the signal is distributed over a large bandwidth, but with linear modulations such as AM and SSB, it can drastically improve SNR by identifying the parts of the spectrum that contain no signal and attenuating them.
WFM	The Audio N.R. option is recommended for wideband FM. *AF N.R. audio is better for FM modes because it eliminates hiss, which has mostly high-frequency components in the audio spectrum.*

AF / IF / BB Noise Blanker

The Noise Blanker is a function that can be activated to try to reduce impulsive and pulsating noises such as that coming from sources such as some motors, power lines, power supplies of various kinds. This function can really make a difference, especially in the HF band, when receiving weak signals immersed in noise.
The algorithm tries to remove those tracks that have large pulses inside of them. In SDR# there are three different types:

- "AF Noise Blanker" operates within the tuned area
- "IF Noise Blanker" operates on the IF signal
- "BB (BaseBand) Noise Blanker" operates over the entire RF spectrum and removes pulses from the FFT and Waterfall.

The pulsing noise can appear in different forms at different stages. It's important to know that at the Baseband stage, you have more opportunity to eliminate very short pulses without affecting the rest of the processing. If the pulses are "fat", ie. have a long time window, you can eliminate them at the IF stage with better results, but it's less optimal than the BB NB with short pulses. Finally, at the Audio stage, the pulses will definitely take something from your signal, but that's the last resort when everything else fails. Consider there is more averaging effect happening between the Baseband, IF and AF stages, which will spread the pulses in time as the processing goes. The earlier you can cut the offending pulses, the better.



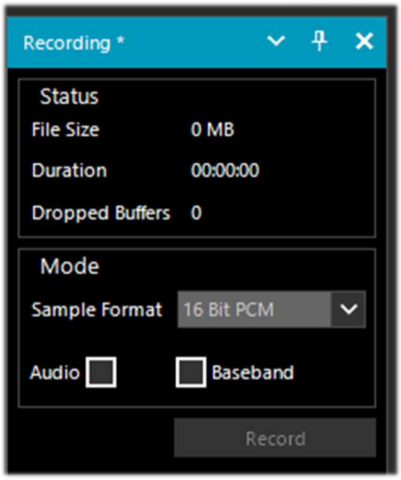
There are obviously no preset values or thresholds, *so you need to gradually move the various sliders until the pulsing noise disappears or reduces without distorting too much the received audio.*

Recording

This panel allows you to make Audio and I/Q recordings. The "Sample Format" allows to choose the quality level of the recording. *Since the various RTL-SDR dongles are 8-bit, we can select the 8-bit PCM option to save hard disk storage space.*

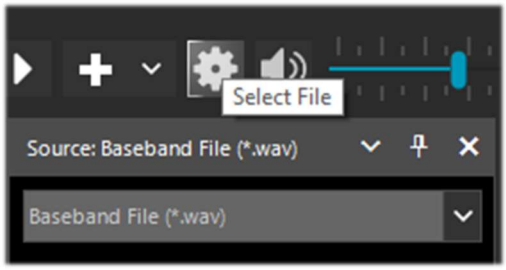
When saving the IQ data at a lower resolution, you must be sure the signals are strong enough to pass the quantization noise of the target resolution. For 8-bit, you will need a noise floor near -80 dBF. Increase the RF gain until you reach that level, then you can safely quantize the data.

The audio you hear can easily be recorded by checking the "Audio" box. A standard WAV audio file will be created in the SDR# directory that can be played with any player. An I/Q recording is a tuned full bandwidth recording that allows subsequent playback and analysis without the slightest loss of information. To make it, you need to check the "Baseband" box *but remember that recordings in this format take up a lot of disk space, so observe the two counters "File Size" (in MB) and time in "Durations"...*

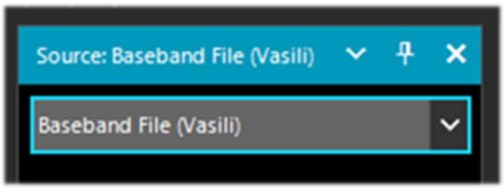


I/Q recordings can be played back in the Source panel by selecting "Baseband File (*.wav)".

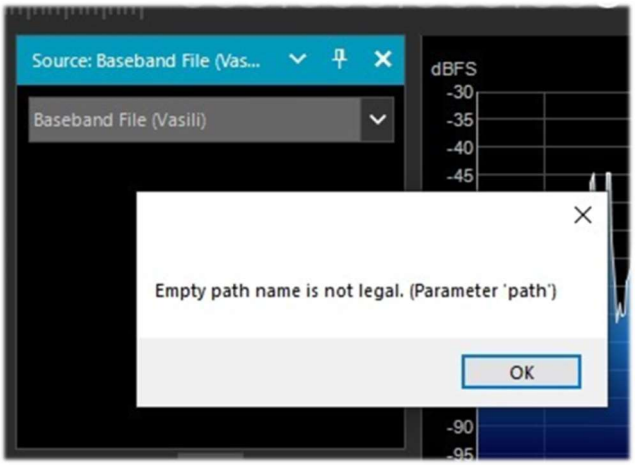
The first time you use it, a "Select File" pop-up is automatically opened where you can choose the IQ file to play. To load a new file later, simply click on the icon



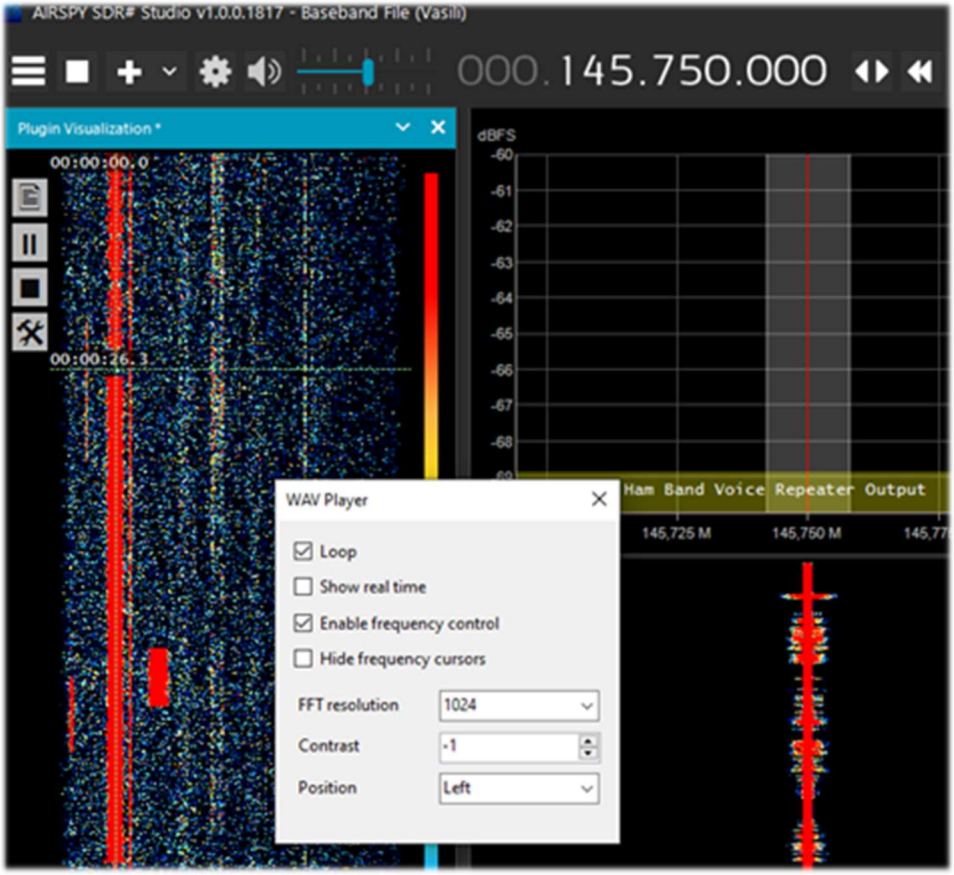
Another good choice to play the I/Q recordings is to select from Source the "Baseband File (Vasili)" by Vasili Beliakov that uses a different player with excellent features.



If the following warning window appears the first time it is used, it may be caused by the fact that in the SDRSharp.config file there is a FilePlayer line with an empty path or an incorrect path.

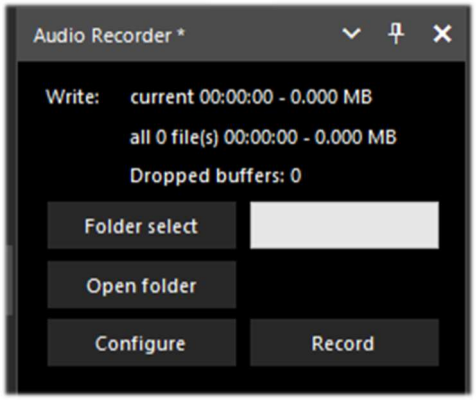


Just click on OK to close the window and then press the wheel of device configuration to load the IQ file and run it. At this point a new "Plugin Visualization" window will open, allowing you to move within the registered IQ file. By clicking on the icon the “WAV Player” panel will open with the possibility of further parameterizations.



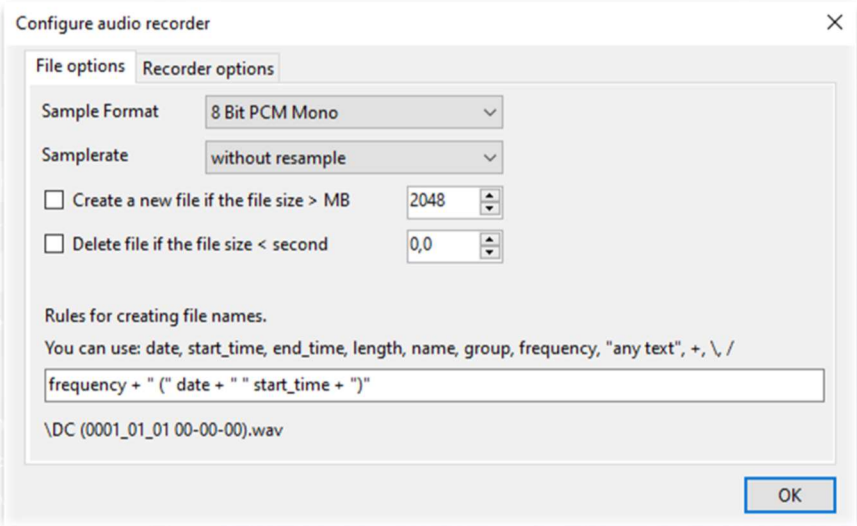
Audio Recorder

There is also this plugin worth mentioning that I personally use very often to make on-the-fly recordings in the normal audio format.

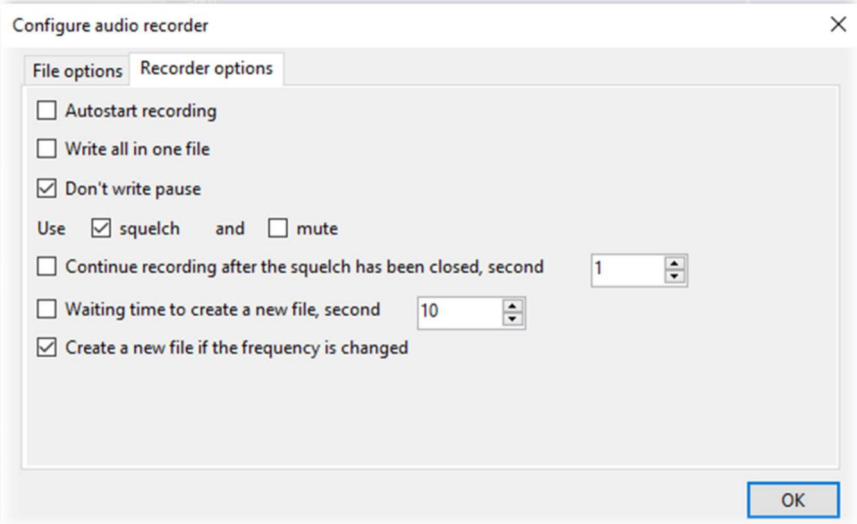


.

You establish where the files will be saved with the "Folder select" button while in the "Configure" button you can customize many things some really important... In "File options" for example you can decide for the quality of the WAV file and the automatic rules in the creation of the name !

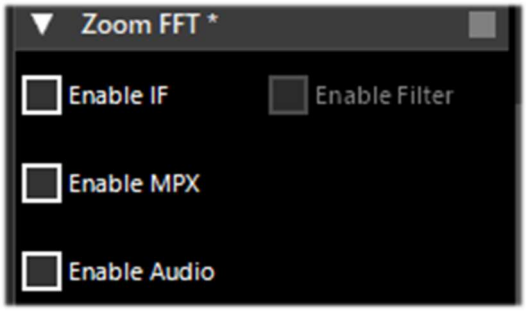


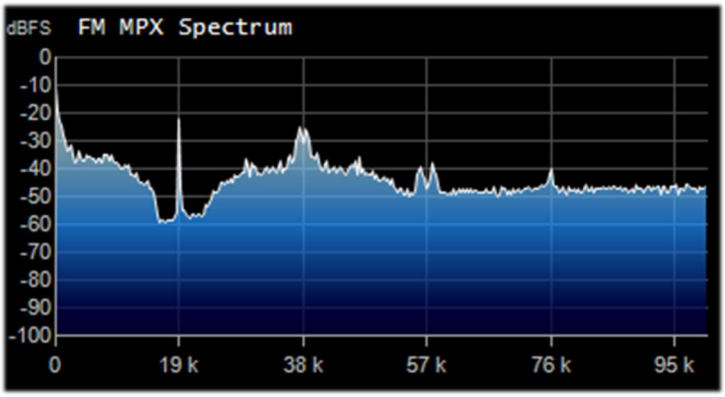
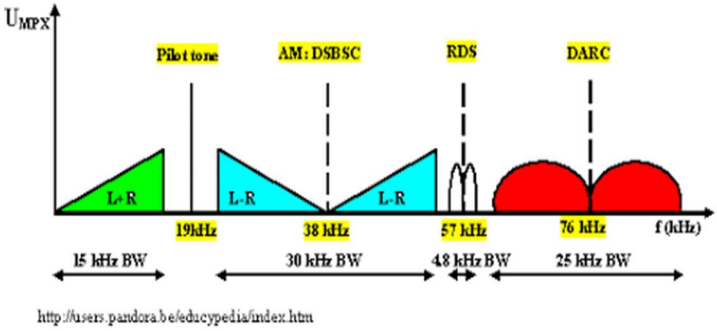
In "Recorder options" you can configure many other parameters. I consider very useful the "Write all in one file" otherwise the system creates many different files and especially the "Dont'write pause / Use squelch" very useful to make recordings only when the audio is activated...



Zoom FFT

Zoom FFT is a default plugin in SDR#. It creates a zoom, at the bottom of SDR#, of the spectrum display and other customizable windows.

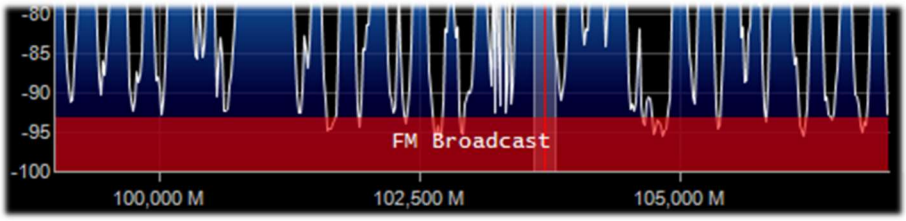


Key	Feature
Enable IF	Opens a new zoom window of the RF spectrum around the tuned IF bandwidth area. Allows you to view the signal structure with a better resolution.
Enable Filter	If the previous Enable IF option is selected, you can activate with this a special IF filter that can be adjusted as desired on both the left and right side of the tuned IF bandwidth.
Enable MPX	*Only active on WFM signals (band 88-108 MHz).* Allows you to see the MPX (*) spectrum (multiplexing), i.e. the baseband audio of an FM radio station. The spectrum contains, on the abscissae axis, from 0 kHz the monophonic audio section, then a pilot tone (at 19 kHz), the stereo section (centered at 38 kHz), then the RDS data sub-carrier (57 kHz) or other special services such as DARC all visible in this screen...  
Enable Audio	Allows to see the audio spectrum in the base band.

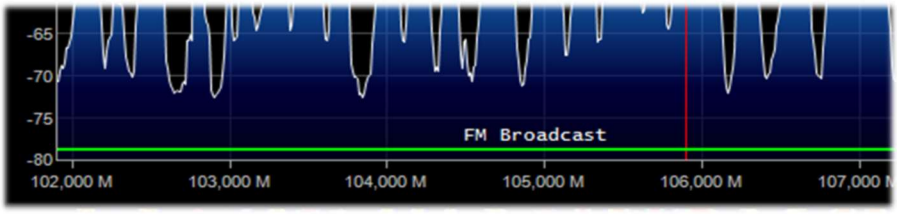
Band Plan

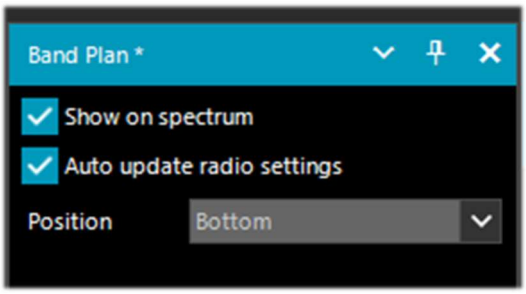
The Band Plan panel (or Frequency Plan) is very useful to view the many services that use radio frequencies across the spectrum in an organized way from different countries (in the following screen the "FM Broadcast").

Until revision 1834 it appeared like this (with a very thick coloured band). In the following example it is displayed in "Bottom" position)



Since revision 1835, the visualization has changed a bit, for the same information provided, it is now a very thin line and less intrusive to the UI, this is to make room for other plugins. XML files are now explicitly indented to facilitate offline editing and modification.





Key	Default	Feature
Show on spectrum		Enabling this option will display a rectangular color bar with the bandplan in the RF Spectrum window at the position indicated by the "Position" option.
Auto update radio settings		Enabling this option will automatically detect the emission mode/step and set in the VFO (*). *So if in the bandplan, in certain portions of the HF band is provided the USB mode and 0,5 kHz step, it will be applied immediately only typing the frequency!*
Position	Bottom	It allows you to choose between three different positions for the display of the Bandplan: Top, Bottom, Full (over the whole RF Spectrum window).

The support "BandPlan.xml" file, present in the program directory, must be modified with the information of your national knowledge by inserting the appropriate lines of text and respecting the format syntax. This must be the format of each "RangeEntry" unique for each frequency group:

<RangeEntry minFrequency="87500000" maxFrequency="108000000" color="90FF0000" mode="WFM" step="12500">FM Broadcast</RangeEntry>

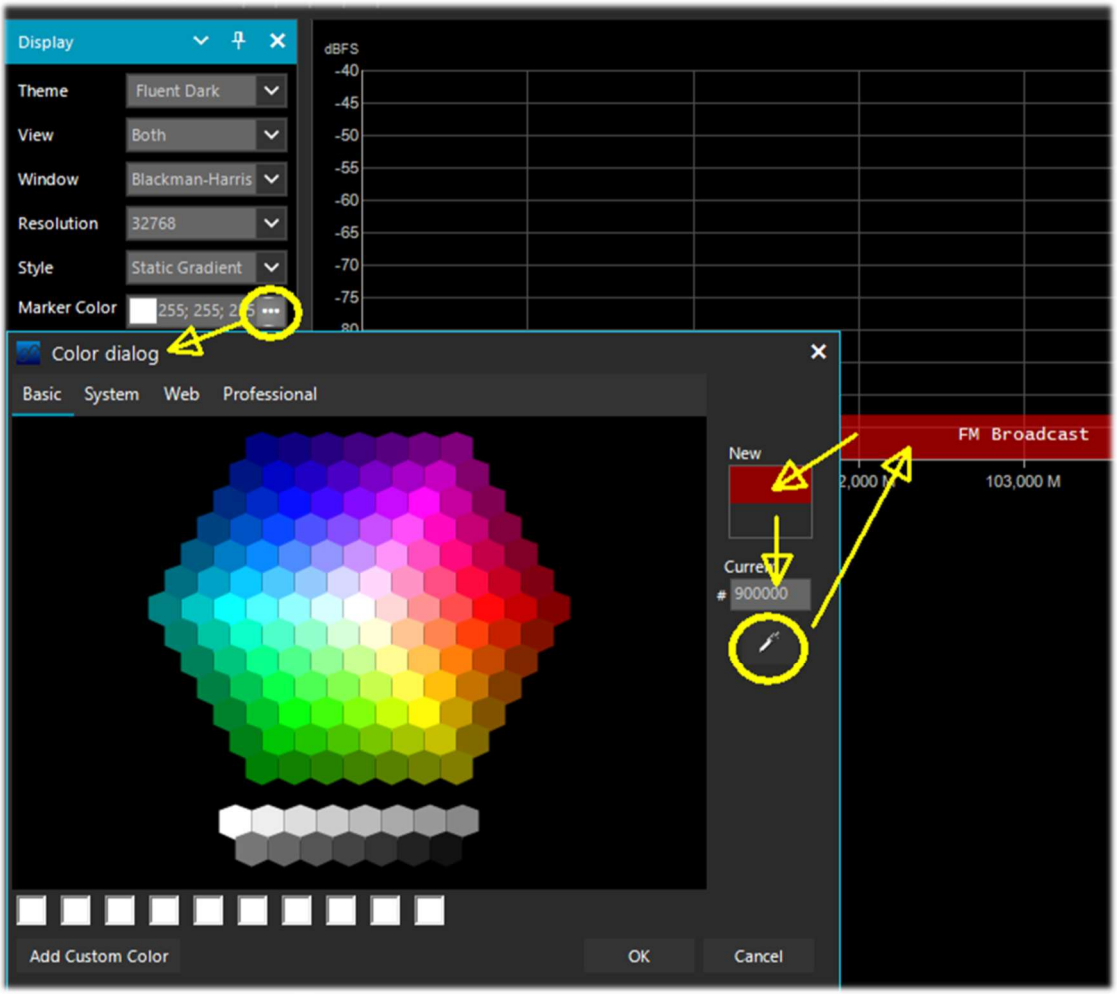
Each band can be divided into individual areas with different coloring, except for the overlapping of a subgroup (but not altogether).

Colors are defined as T-RGB, where T=Transparency (in values from 0 to 99 as a percentage, from almost completely transparent to full color) R=Red, G=Green, B=Blue in blocks of 2-digit hexadecimal values (indifferent to uppercase or lowercase letters).

To define the colors you can use the internal tool named "Color dialog" that you can reach from the panel "Display" → "Marker Color" →

In the BASIC menu, through this icon you can select a color on the screen to have immediately, in the "Current" window, the hexadecimal countervalue.

Or by entering a value you can immediately see the result in the field. In the example below, the red band of FM broadcast appears as "900000". Or you can use the "Professional" menu to have all possible color palettes available.



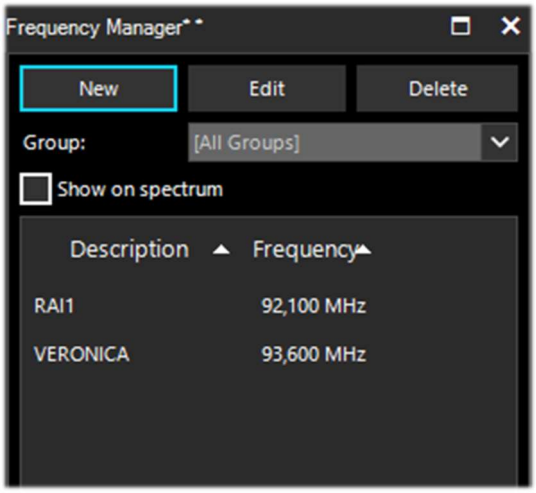
Or at these links among the many available on the net:
http://www.w3schools.com/colors/colors_names.asp
https://toolset.mrw.it/html/colori-del-web.html
http://www.colorihtml.it/
https://encycolorpedia.it/d0417e

The "mode" must be set between: WFM, NFM, AM, USB, LSB, CW. The "step" will automatically set the receiver VFO to the preset value for each band. The final field allows you to enter a text label that will appear as a name in the bandplan. *Be careful not to enter particular or special characters that could block the interpretation of the XML file, so it is recommended to use only alphanumeric characters.*
This plugin is very useful and allows you to divide the various bands of service assignment in automatic mode by simply clicking on the RF Spectrum*, but be careful because some bands with multiple assignment in emission modes make the correct mode pre-selection impractical (e.g. the articulated V-UHF bandplans of radioamateurs). In this case, deselect the "Auto update radio settings" option in the Band Plan panel.*
Any formatting errors in the file or the use of special characters will prevent the plugin from loading when the program starts!

Frequency Manager

The Frequency Manager panel allows you to catalogue a large database of all the frequencies of interest. A new frequency can be added directly by clicking on the "New" button. A small data-entry opens, where all you have to do is add the name of the Group (if any), the name of the station and confirm all the other data already automatically acquired.

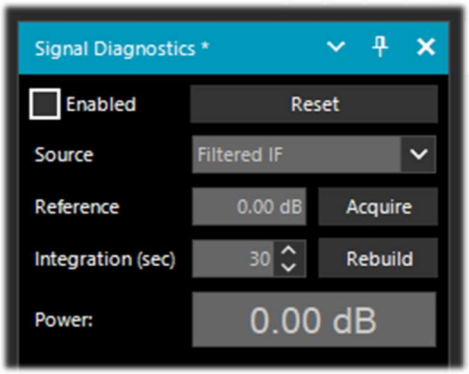
Then a double click on a record will tune SDR# to that frequency, automatically setting the emission mode and its bandwidth. *If the "Show on spectrum" box is checked, the frequency label will be displayed in the RF spectrum.*



.
See also the optional "Frequency Manager (FreqMan) & Frequency Scanner" plugin....

Signal Diagnostics

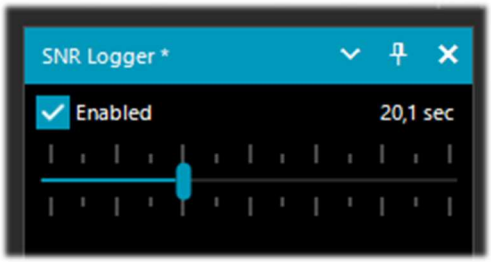
This diagnostic plugin is useful for determining the power levels (dB) of signals.



On YouTube, the radioamateur Leif Asbrink (SM5BSZ) has uploaded some very interesting and technical videos, where he shows how the AIRSpy HF+ can be used as an accurate power meter for RF signals. He points out that if the noise figure (NF) or minimum distinguishable signal (MDS) of a device is known, then it is possible to use this device as a power meter by calibrating it with a resistor (dummy load) at room temperature.

I suggest viewing at:
https://www.youtube.com/watch?v=ipwWayemCSQ&feature=youtu.be

SNR Logger



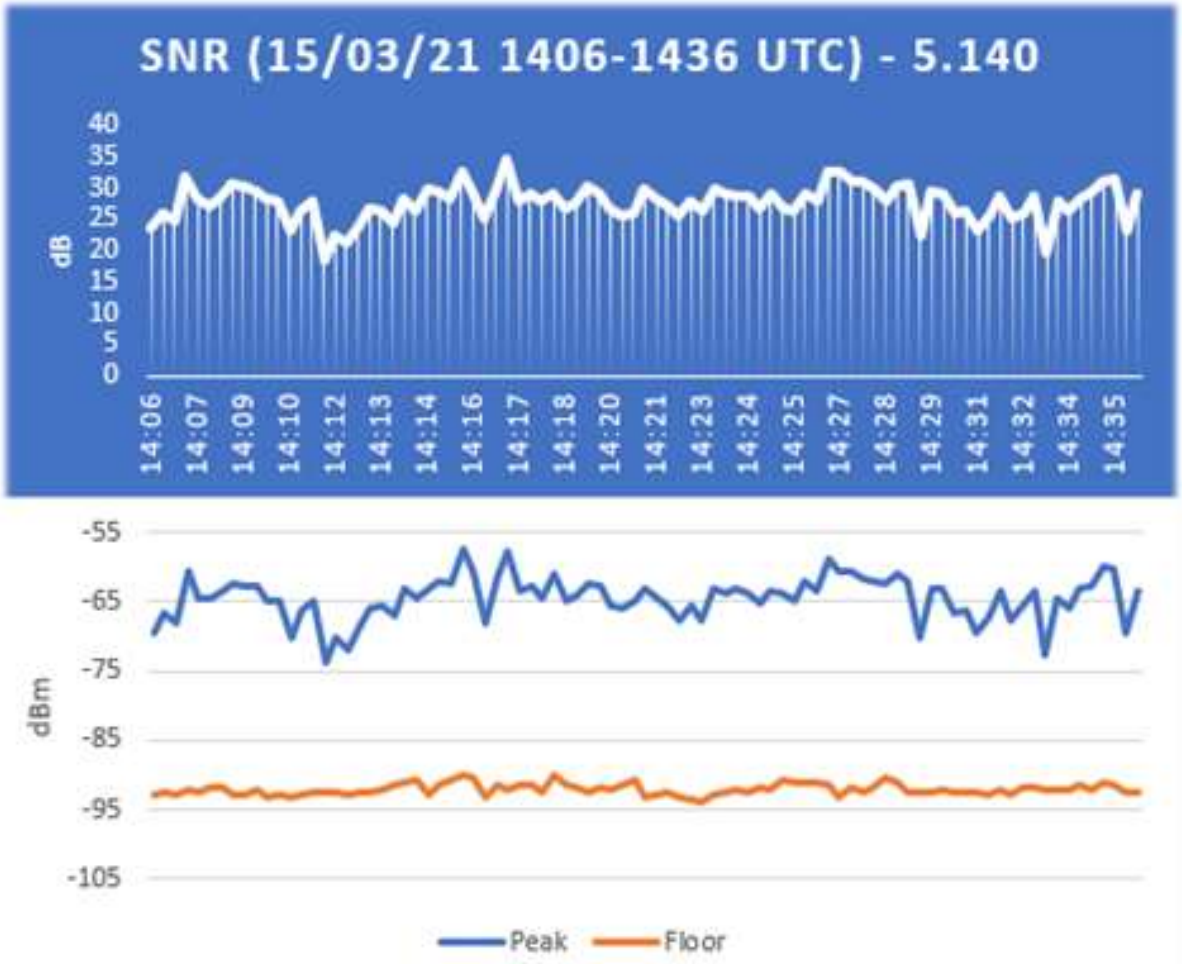
The SNR Logger has been implemented in the latest 18xx revision to include Peak and Floor in addition to SNR, making it truly unique in the SDR arena.

The signal strength is the height of the peak shown in the Waterfall while the noise level is simply the strength of the noise at frequencies where no signals are emitted. The absolute value of the difference between the two is called SNR and is expressed in dB.

1	Timestamp	Frequency	SNR	Peak	Floor
2	2021-03-15 14:06:31.866	5140000	23.44	-69.57	-93.01
3	2021-03-15 14:06:52.479	5140000	26.02	-66.63	-92.65
4	2021-03-15 14:07:13.089	5140000	24.84	-67.92	-92.76

Once the flag has been enabled in the panel and a time interval has been selected with the cursor (up to 60 seconds), a text file with a name similar to this one will be created in a directory of your choice: "SDRSharp_20210315_140603Z_SNR.csv" inside are written the values in dB for SNR, and dBm for Peak and Floor detected by the active frequency of the VFO (*).

The small CSV file can be imported into MS Excel for further analysis and, using a suitable graphical representation, it will be possible to report the Timestamp data (date/time) on the x-axis and the values of the received signals on the y-axis.
In the example the reception of R.Charleston at 5.140 kHz on 15 March 2021).


SNR (15/03/21 1406-1436 UTC) - 5.140
dB
40
35
30
25
20
15
10
5
0
14:06
14:07
14:09
14:10
14:12
14:13
14:14
14:16
14:17
14:18
14:20
14:21
14:23
14:24
14:25
14:27
14:28
14:29
14:31
14:32
14:34
14:35
dBm
-55
-65
-75
-85
-95
-105
Peak
Floor

Plugins

In this section I will describe, in alphabetical order, some "Plugins" that compared to the default "Panels" are options developed specifically for SDR# that expand or extend the original functionality. This is in fact another peculiarity of the software, unique in its genre, that allows to API developers to make it for all specific needs...

There are really a lot of them on the net, but recently SDR# software has been updated to the latest technical knowledge about internal DSP and graphical interface: therefore individual developers should review their plugins in this perspective, especially for readability with darker video themes. *In addition, from version 178x, non-default plugins will adopt the clear Windows theme*

C:\RADIO\SDR#
airspy.dll
airspyhf.dll
api-ms-win-core-winrt-l1-1-0.dll
BandPlan.xml
D3DCompiler_47_cor3.dll
...
C:\RADIO\SDR#\Plugins
dmr_full.dll
SDRSharp.AudioRecorder.dll
SDRSharp.AudioRecorder.dll
SDRSharp.FreqMan.dll
...

A lot has changed since revision 1801!
Now you just have to create a subdirectory "Plugins" and put the relevant DLLs in it. The upload will be automatic and the Plugins.xml file and its MagicLine are no longer needed!
You can also decide to use another custom directory by editing the instruction "core.pluginsDirectory" in the SDRSharp.config file.
To disable loading of a specific DLL (or directory) simply rename it so that it starts with the underscore "_" character.
If an error occurs when loading the plugin, it can be found in the log file "PluginError.log".

Previously, in order to manually insert a new plugin, downloaded from the network in compacted format, you had to close SDR#, extract the DLL (or more than one) in the software folder and insert the "MagicLine" in the Plugins.xml file, taking care not to change anything in its syntax, save the file and restart SDR#.

Some plugins are about innovative and purely ingenious things, others are specific radio or hardware management (e.g. for satellites), others are modified and extended versions e.g. for audio recording/reproduction, like all the original russian Vasili ones at: ***http:// http://rtl-sdr.ru/***

The plugins can be loaded manually and individually or via the flexible and always updated "Community Package" developed by Rodrigo Pérez, which can be reached here: https://sdrchile.cl/en/

Note to developers.
1) As a general recommendation, one's own plugin should load the first time with the 'disabled status' and leave it to the user how and when to activate it.
2) Youssef has recently included some sample plugins from the latest SDR# release candidate as a reference for other developments:

https://airspy.com/downloads/shrsharp-plugin-sdk-vs2019.zip

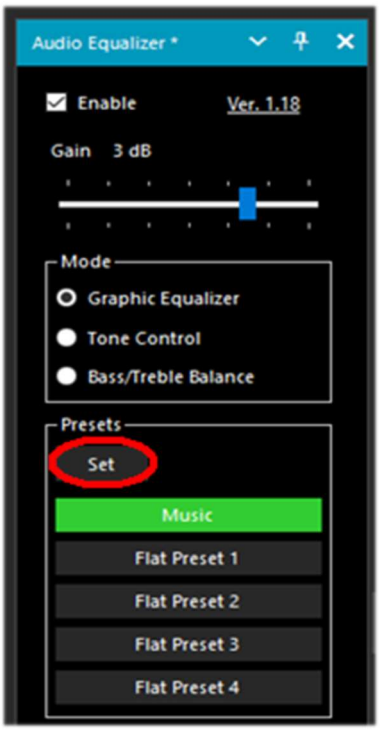
The solution provided allows you to edit, build and debug these plugins within Visual Studio 2019. This is probably the fastest way to develop plugins for SDR# now in dotnet 5, but the reference to the old programming still works.

WARNING! SOME OF THESE SYSTEMS IT COULD BE ILLEGAL IN YOUR COUNTRIES!

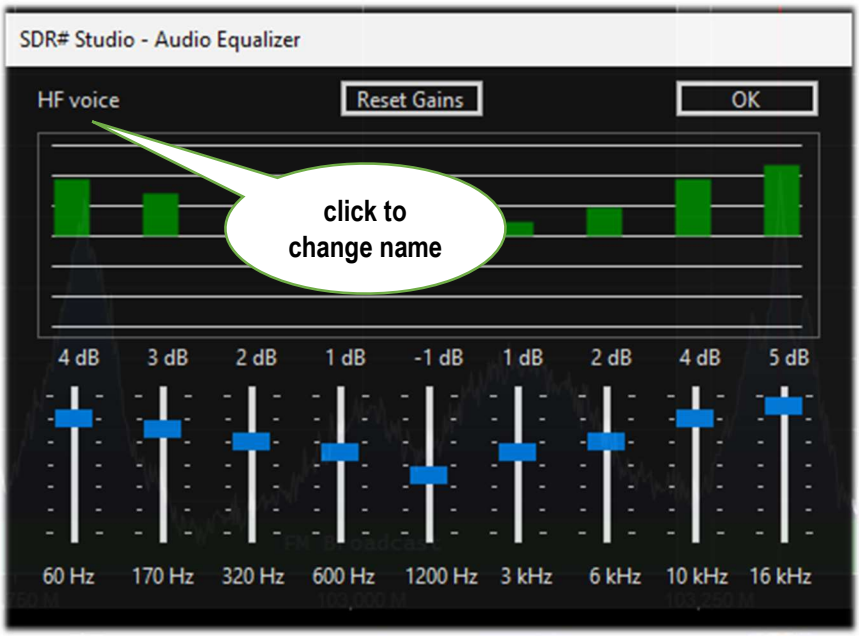
Check carefully and thoroughly the regulations in force in your country. Some of this radio system was specifically designed for use by government, emergency services, for public safety networks, etc etc. who all share spectrum allocated to a city, county, or other entity.

Audio Equalizer v1.18

Already author of the "Magic Eye" plugin (see below), BlackApple62 has made his latest work called "Audio Equalizer" available as freeware:
https://github.com/BlackApple62/SDRSharp-Audio-Equalizer-Plugin
The plugin provides a panoramic equalizer, tone and bass/treble balance control, now compatible with the latest SDR# Studio 32 bit updated to the .Net6.x (revision > 1831).



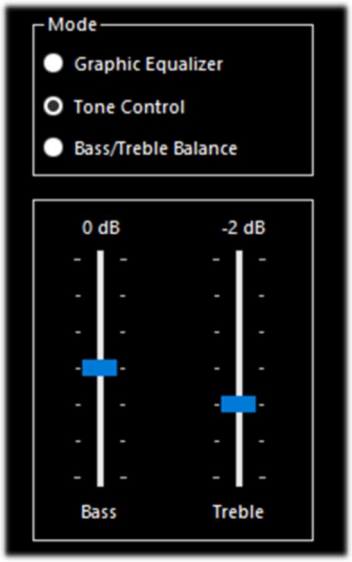
The "Enable" flag activates the plugin and with "Gain" slider sets the relative gain.
The "Set" button accesses the configuration of the five presets starting from the ability to assign a name (as shown below) at will and then set the nine bands (60 Hz to 16 kHz) in the range 6 dB / -6 dB.



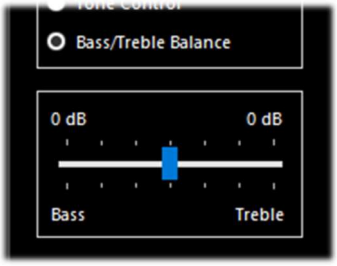
From this release the panoramic equalizer set window allows to control SDR# Studio while is active.

The "Reset Gains" button resets the gain of the nine bands to flat (0 dB value) within each preset.

The equalizer configuration data are automatically saved in the "SDRSharp.config" file.

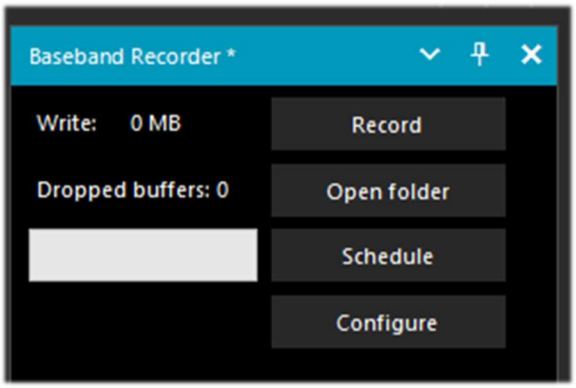


These are the two additional handy panels:
"Tone Control" and "Bass/Treble Balance"



Baseband Recorder

With this plugin, you can make baseband recordings in WAV format with some specific features that are useful to know before using it...



The "Configure" button allows you to choose the following file types:

- WAV SDR# compatible (size header 32 bit, for recording max 2,047 GB)
- WAV full (size header 32 bit, up to max 4,095 GB)
- WAV RF64 (size header 64 bit, for infinite files ... or almost!)

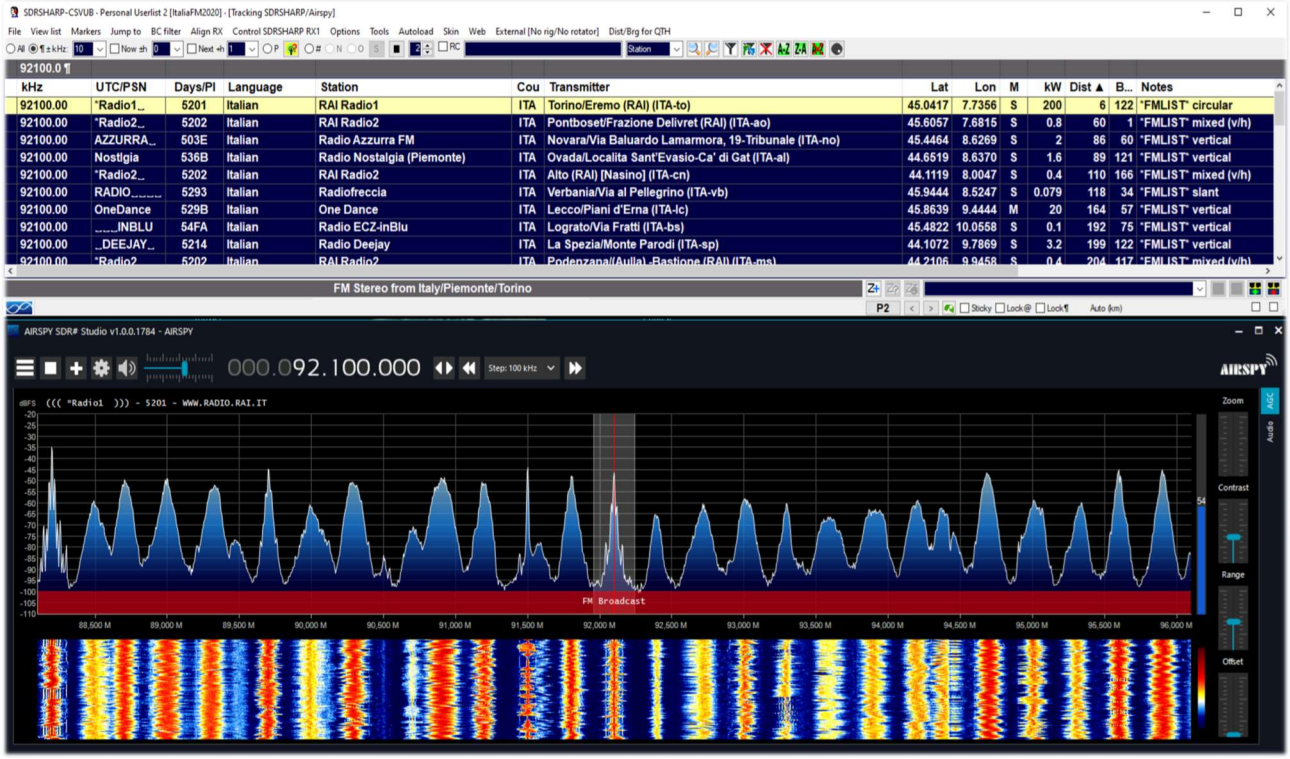
CSVUserlistBrowser v4.23

A software I've been using a lot since many years is the "CSVUserlistBrowser" (CSVUB) of radiomateur Henry (DF8RY). CSVUB is a Windows application that interfaces to SDR#, to manage numerous databases (or lists) of radio frequencies of long, medium, short and WFM broadcasting stations. It displays the lists in the following formats: AOKI, EIBI, HFCC, FMSCAN, numeric stations, "ITU monitoring", ClassAxe (for NDB), etc. etc. as well as Personal Userlists.

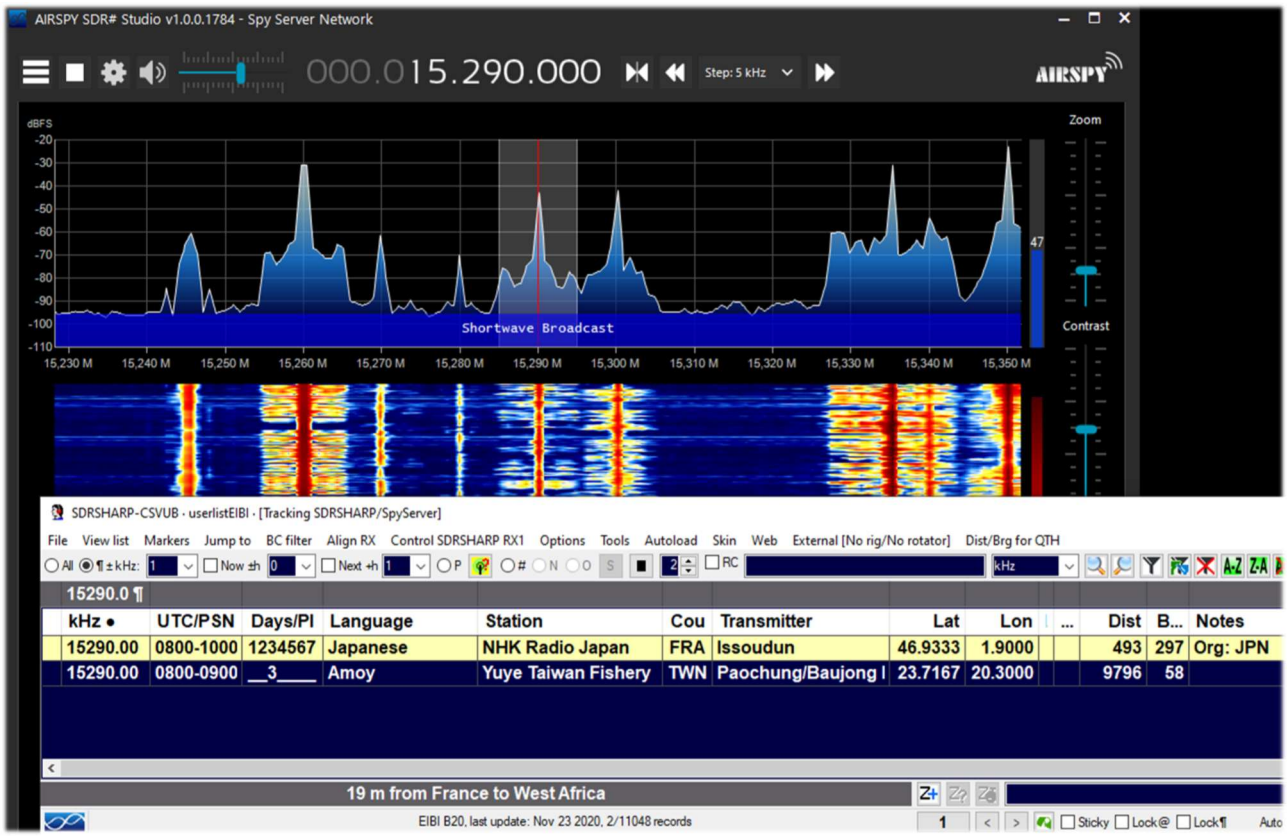
CSVUB tunes the receiver with a single mouse click in the proper emission mode, showing the station name, time, language, transmitter position, distance and bearing, as well as other information automatically updated by the respective servers! It also contains Hamlib and Omnirig control for external receivers, also analog receivers that can be connected via RS-232. The plugin allows you to interface SDR# in a fast and non-invasive way, unlike other much slower and uncomfortable to use. The CSVUB window is external, dimensionable and positionable at will.

kHz	UTC/PSN	Days/Pl	Language	Station	Cou	Transmitter	Lat	Lon	M	kW	Target	Dist ...	Brg	Notes
92100.00	*Radio1	5201	Italian	RAI Radio1	ITA	Torino/Eremo (RAI) (ITA-to)	45.0417	7.7356	S	200		6	122	*FMLIST* circular
92100.00	*Radio2	5202	Italian	RAI Radio2	ITA	Pontboset/Frazione Delivret (RAI) (ITA-ao)	45.6057	7.6815	S	0.8		60	1	*FMLIST* mixed (v/h)
92100.00	AZZURRA	503E	Italian	Radio Azzurra FM	ITA	Novara/Via Baluardo Lamarmora, 19-Tribu	45.4464	8.6269	S	2		86	60	*FMLIST* vertical
92100.00	Nostlgia	536B	Italian	Radio Nostalgia (Piemonte)	ITA	Ovada/Localita Sant'Evasio-Ca' di Gat (ITA	44.6519	8.6370	S	1.6		89	121	*FMLIST* vertical
92100.00	*Radio2	5202	Italian	RAI Radio2	ITA	Alto (RAI) [Nasino] (ITA-cn)	44.1119	8.0047	S	0.4		110	166	*FMLIST* mixed (v/h)
92100.00	RADIO FRECCIA	5293	Italian	Radiofreccia	ITA	Verbania/Via al Pellegrino (ITA-vb)	45.9444	8.5247	S	.079		118	34	*FMLIST* slant
92100.00	OneDance	529B	Italian	One Dance	ITA	Lecco/Piani d'Erna (ITA-lc)	45.8639	9.4444	M	20		164	57	*FMLIST* vertical
92100.00	INBLU	54FA	Italian	Radio ECZ-inBlu	ITA	Lograto/Via Fratti (ITA-bs)	45.4822	10.0558	S	0.1		192	75	*FMLIST* vertical
92100.00	DEEJAY	5214	Italian	Radio Deejay	ITA	La Spezia/Monte Parodi (ITA-sp)	44.1072	9.7869	S	3.2		199	122	*FMLIST* vertical
92100.00	*Radio2	5202	Italian	RAI Radio2	ITA	Podenzana/(Aulla) -Bastione (RAI) (ITA-ms)	44.2106	9.9458	S	0.4		204	117	*FMLIST* mixed (v/h)
92100.00	M DUE O	5233	Italian	m2o	ITA	Massa (ITA-ms)	44.0167	10.1500	S	0.79		229	120	*FMLIST* vertical
92100.00	*Number1	5238	Italian	Radio Number One	ITA	Villa di Tirano/Localita Piscedo (ITA-so)	46.2000	10.1333	S	6.3		229	56	*FMLIST* vertical
92100.00	*Radio1	5201	Italian	RAI Radio1	ITA	Viano/Querceto-Ca' del Vento (RAI) (ITA-re)	44.5760	10.5935	S	39.8		237	102	*FMLIST* horizontal
92100.00	CAPITAL	5219	Italian	Radio Capital	ITA	Livigno/Passo dell'Eira (ITA-so)	46.5413	10.1655	S	0.25		253	49	*FMLIST* vertical
92100.00	DEEJAY	5214	Italian	Radio Deejay	ITA	Riva del Garda/Monte Brione (ITA-tn)	45.8864	10.8744	S	0.63		266	69	*FMLIST* vertical

The CSVUB window is external, sizable and can be placed wherever you want. I prefer to keep it above SDR# to see all the frequencies and information immediately.

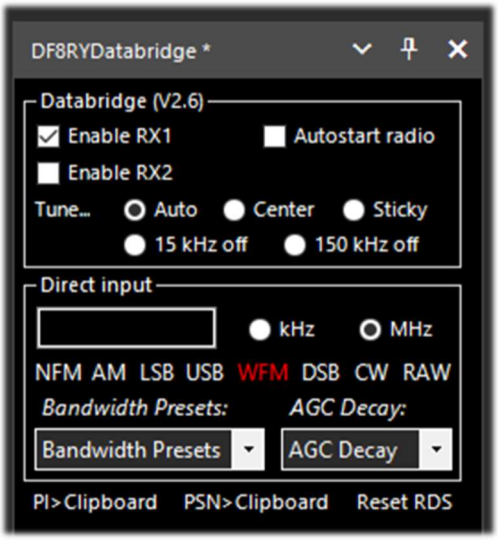


In the screen above, SDR# is tuned in full screen at 92,100 kHz WFM, the plugin sends the information to CSVUB, which displays it in tabular form, showing in the first line of different color the identified broadcaster. Everything is configurable in font and size, as well as having a customizable "skin" for the color scheme (in the example the skin used is the "SDRsharp"!). It can also work in reverse, you click on a frequency in the CSVUB table and the receiver will immediately tune in the correct emission mode and specific bandwidth preset.



In this screenshot, a Spy Server Network is used to verify a broadcaster on 19-meter. By enabling the "Track mode" option, the first line appears in CSVUB with its transmission highlighted. For very

busy slots, you could also use the "Now" option which immediately filters the transmission at the current time. Let's see in detail the possible plugin configurations through the “DF8RYDatabridge”.



Key	
Enable RX1 / RX2	Enable or disable SDR#-CSVUB control. There are two instances of connection to SDR#, for example one with an Airspy and the other with an RTL-SDR dongle.
Autostart radio	The plugin automatically starts the radio it finds connected. In case of problems when the radio is not connected, it is preferable to disable the option and start it manually. The receiver only starts automatically when RX1 is enabled. The autostart is blocked for a second instance of SDR# with RX2, otherwise it would start the same radio twice and cause confusion.
Tune… Auto	The frequency position, tunes in the RF spectrum, is controlled by SDR#.
Tune… Center	The tuned frequency always appears in the center of the SDR# RF spectrum *(see Tuning types).*
Tune… Sticky	Use SDR# Sticky tuning mode *(see Tuning types).*
Tune… 15 kHz off	The frequency is tuned to 15 kHz from the center. This avoids collisions with the typical peak I/Q that some RTL-SDR/sound cards produce in the center of the RF spectrum RF.
Tune… 150 kHz off	As in the previous point, but for reception in WFM. The frontend must have sufficient RF bandwidth (at least 300 kHz).
Direct input kHz or MHz	Here you can directly type a frequency in kHz or MHz and press Enter for tuning: *really very convenient and fast!* Or, when with the mouse, you have the "focus" on this field, the Pag Up/Down keys or Up/Down arrows tune the VFO gradually with the Step Size selected in SDR#.
NFM … RAW	Eight buttons for immediate setting of the various modes.
Bandwidth Presets and AGC Decay	These are some default snapshot settings for SDR# that may sometimes be useful. Not related to CSVUB.
PI / PSN > Clipboard	When a WFM station is received with the RDS decoded by SDR# it is possible to copy its PI and/or PSN code to the clipboard, to be used to compose its own Personal Userlist.

Reset RDS	The button activates a new RDS decoding in SDR# (it is basically a reset of the RDS).

For its many features and functions I invite you to consult here:
https://www.df8ry.de/htmlen/csvub/%F0%9F%91%93features.htm
and if you want, downloadable obviously freeware, to this the download link:
https://www.df8ry.de/htmlen/csvub/%F0%9F%93%BBsdrsharp.htm

It has so many options and features that it is impossible to treat them all here even minimally. I recommend that you download and consult the relevant manual.

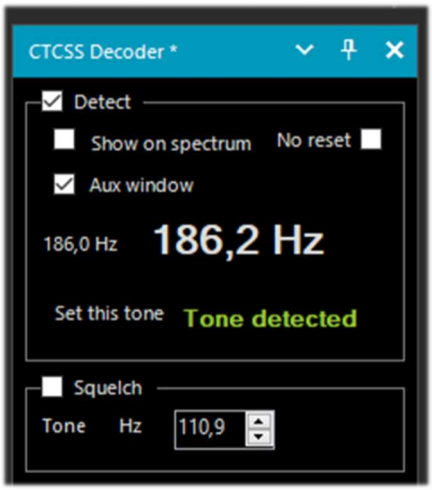
CTCSS & DCS v1.3.3.0

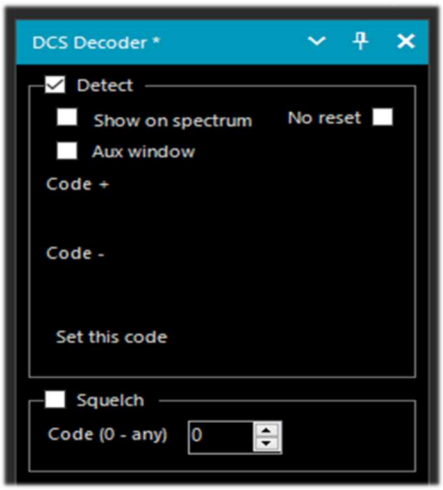
These two plugins, for analogue CTCSS (*) and digital DCS (*) detection *(for NFM mode only),* have recently been updated by the tireless work of "thewraith2008" (already the author of other plugins from the initial TSSDR Vasili work) to be functional again with the latest SDR# revisions 184x.

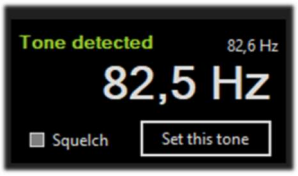
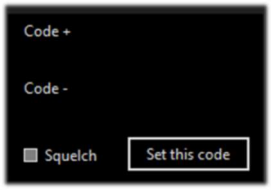
Important note: you cannot use CTCSS and DCS at the same time.

Versions 1.3.2.0 of both have recently introduced a new feature: the value of the detected CTCSS or DCS will be sent to the "Frequency Scanner" plugin for displaying/recording (obviously the latter must be updated to version v2.2.12.0 or later).

Before even with revisions 1818/1822, the size of the audio buffer having been greatly reduced, the previous plugins no longer worked, as they required the presence of some "zero crossings" in the audio buffer (i.e. points of zero crossing, just before the change of sign, in the alternation of the signal between positive and negative values) to detect the tones, and therefore have been updated again.
They can be downloaded, together with other plugins (Auto Start, FreqMan, Frequency Scanner, ScopeView and Short-wave info), from the site forum: ***https://www.radioreference.com***





Option	
Detect	"Detect" enables/disables plugins. The tones/codes detected and decoded by the audio buffer are made visible in the following ways: in the body of the plugin, in the spectrum window and/or in an auxiliary window. ***Read the three NOTES below...***
Show on spectum	 **CTCSS:** With this parameter enabled, you can display the detected tone directly on the bottom of the RF Spectrum, on the right side of the VFO mark, (or on the left side if the margin is at the edge of the screen). *Even if you have the Band Plan enabled, the tone shown will appear above his line.* **DCS:** The detected codes (positive or negative) will be displayed at the top of the RF Spectrum and next to the VFO marker.
No reset (on change of frequency)	Option recently added with release 1.3.0.0. Keeps the last detected CTCSS/DCS visible on the panel and on the external window but will delete the one on the RF Spectrum. *Can be useful during a scan to keep the last detected tone/code visible.*
Aux windows	  With this parameter enabled, it is also possible to display the measured data in auxiliary windows that can be positioned anywhere on the screen and always in the foreground with respect to all other open windows.
Squelch / Set this tone	Enables/disables Squelch to operate with the detected tone/code.

NOTE (1) - CTCSS: *The developer informs us that the plugin may have some difficulty in detecting subtones at a lower frequency in Hz and therefore recommends (SDR# v1810 and lower) to increase the Latency value to 60 (mS) in the "Audio" panel.*

NOTE (2) - DCS*: An option has been introduced to use only those DCSs that exist in the table, thus reducing the list of DCSs. The three options are:*
0 = Default - No need to vary anything.
1 = To use only the 83 standard DCS codes (those ETSI TS 103 236 v1.1.1-Table 2)
2 = As point "1" but in addition the 21 extended DCS codes.
To use the option, the following line must be added in the file "SDRSharp.exe.config" with the preference value, at the end of the block of the other entries starting with "DCS.xxxxx":
<add key="DCS.OnlyUseDcsCodesInTable" value="1" />

NOTE (3) - DCS*: Introduced an additional option to eventually switch the display of DCS codes between 'Normal' and 'Inverted'.*
To use this option, the following line must be added to the "'SDRSharp.exe.config" file:
<add key="DCS.SwapNormalInvertedDcsCodes" value="True" />

You can also try using the external KG-TONE software described below...

FMS-Frequency Manager Suite v2.2.1

Writing *"plugin"* can be very reductive, in fact that of Jeff Knapp is a freeware "suite" composed of several modules and plugins. The whole has been recently updated to make it fully compatible with the new versions of SDRsharp 18xx.

The reference link: ***http://www.freqmgrsuite.com/***

Here are some details but of course I refer to the online documentation and PDF that is very rich and comprehensive in every way:

Activity Logger

It records the scanner activity created by the "Frequency Manager+Scanner" plugin.

Data Tools Wizard

Is an external executable program (FMSuite.DataTools.exe) that I find really useful and very powerful. It is designed to download and import various frequency databases for use within the Frequency Manager+Scanner.
The databases available via the internet are: AOKI, CLASSAXE, EIBI, FMLIST, HFCC, MWLIST.
It also allows you to import the default SDR# Frequency Manager database, import a generic file and export an FMS database to a generic file.

Frequency Manager+Scanner

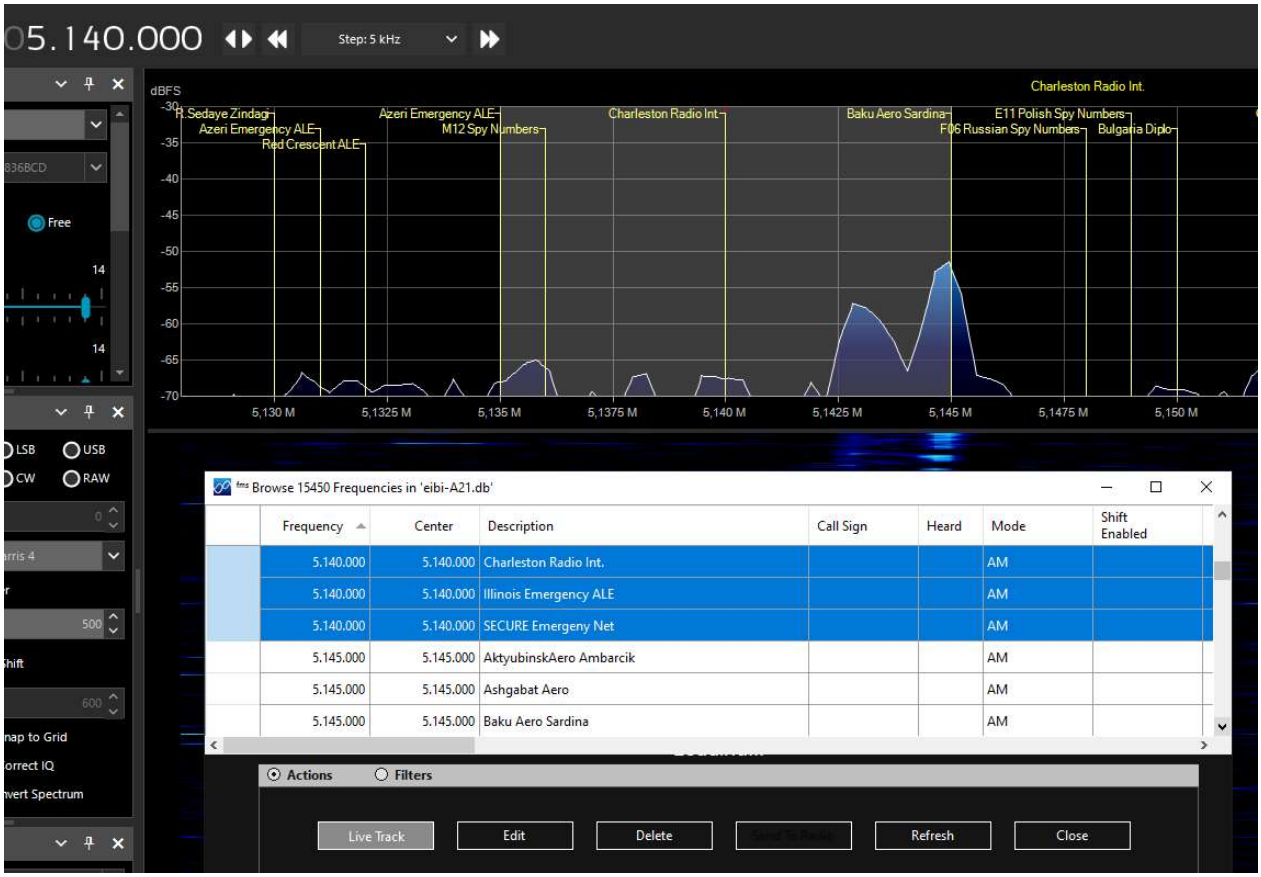
It is the real heart of this Suite (written in C#), perfectly integrated for the actual SDR#. It offers a management tool for any frequency and related emission modes and various information with data visualization on the waterfall. It easily allows to edit and browse frequencies and to scan previously defined frequency ranges or groups of frequencies.

Scanner Metrics

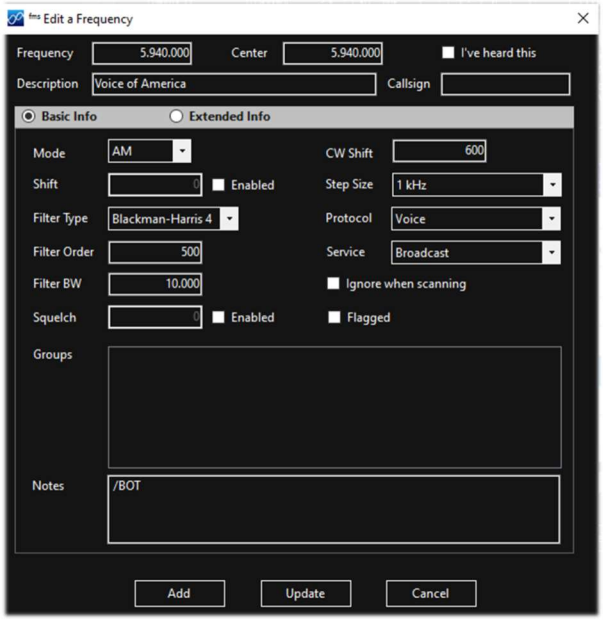
It is an accessory to the Frequency Manager+Scanner. It provides a means of recording scanner frequency activity to a database and later performing analysis on that information; the goal being to make it easier for you to determine which of the millions of frequencies you can receive actually are worth spending time on.

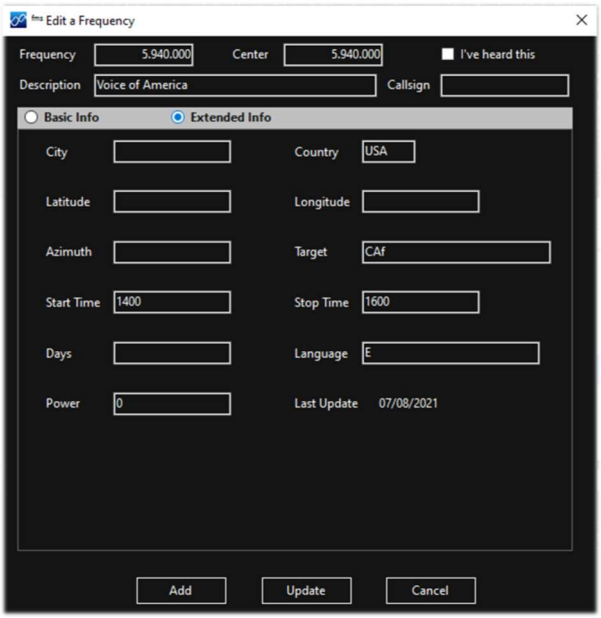
Scheduler

It provides a means of creating, using, and re-using schedules to manage frequency changes in SDR#. The plugin permits you to define multiple operating schedules. When a schedule is activated, the Scheduler will change the frequency on the dates and times you specify. You can use a schedule only on the dates and times defined in it, or you can ignore the dates and re-use the time portions of the schedule on any date. Schedule activity is logged to a file so that you can review the actions it took.
.



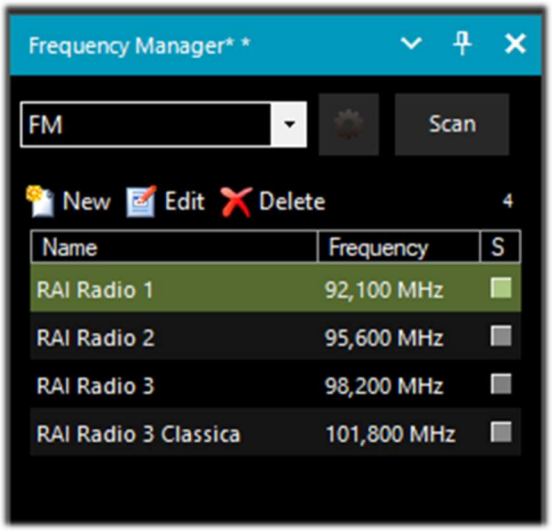
In the screenshot above you can see the FMS Frequency Manager+Scanner in combination with the newly imported EIBI A21 database.
Tuning for example in HF the frequency 5.140 kHz, the database, in "Live Track" mode, will be positioned at the corresponding frequency and the stations found isofrequency are highlighted in blue color.
A customizable label in font and color is also displayed in correspondence of the waterfall. It is possible to create personal archives for VHF and UHF frequencies, importing easily those that you have already inserted in your standard SDR# Frequency Manager.
These are the fields of the full-bodied SQLite database for Basic Info and Extended Info that you can enhance and make filters and searches.





FreqMan v1.1.7.1 & Scanner v2.2.13.0

These plugins, taken from TSSDR's (Vasili) initials, are now maintained and updated thanks to "thewraith2008". They are downloadable, with others (Auto Start, CTCSS/DCS, ScopeView and Short-wave info), from the site forum: **https://www.radioreference.com**

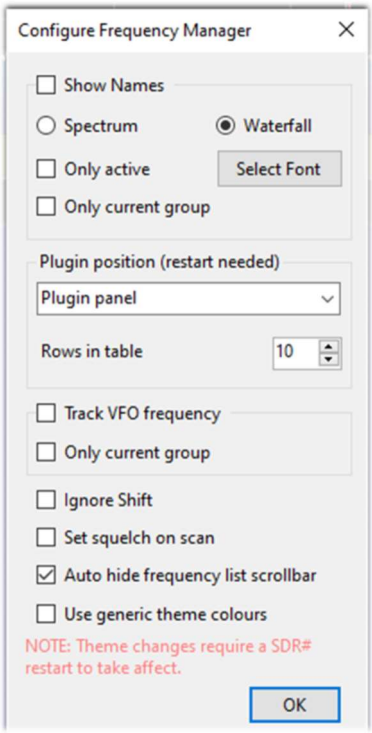


With the "**Frequency Manager**" (or **FreqMan** to distinguish it a bit from the previous one) you can create different groups to store any frequency by assigning a name.
Other parameters such as emission mode, BW filter, centre and shift are automatically detected by the current VFO of SDRsharp.

The very useful thing is that FreqMan uses the same archive as Frequency Manager (i.e. the file 'frequencies.xml' in the program directory). So both plugins will conveniently see the same groups and frequencies…

You can create many different groups according to your needs: HF, VHF/UHF or by genre, for example FM broadcasters, amateur radio, satellites, etc. ...

On the right, in this version of "FreqMan", there is a very useful checkboxes "S" that allows you to mark each record and then scan it by pressing the "Scan" button. Below the latter is a handy counter that indicates the memories currently saved in the group ("FM" in our example).

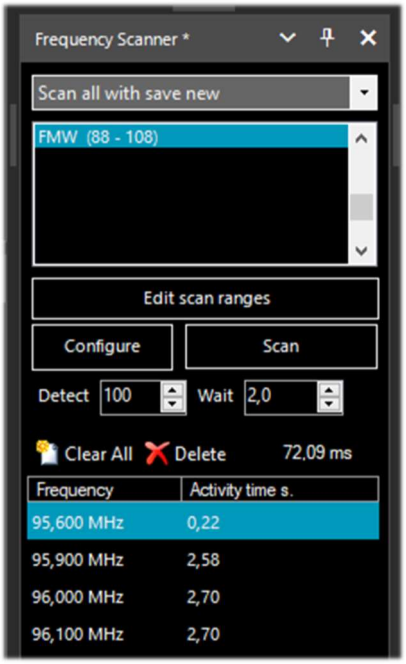


By pressing the wheel button instead you access the configuration panel where you can customise other options including the possibility of displaying a label on the Waterfall or Spectrum (with a font of your choice), of the only active frequency or of the current group, etc. etc...

With the "**Frequency Scanner**" it is possible to search in a wide range and with impressive scan speeds that cannot be achieved with any other scanner, even analogue!
There are two modes: the more immediate mode of searching in the current spectrum window using the "Screen" preset, or defining a scan range in priority by pressing the "Edit scan range" button for example with this data:

Edit Range

Name	Start (Hz)	End (Hz)	Detector	Bandwidth	Step size	Group
FMW (88 - 108)	88.000.000	108.000.000	WFM	130.000	100.000	fmw



You can take advantage of as many as 5 different scanning modes: **Scan all with save new, Scan all without save new, Scan only memorized exclude new, Scan only new exclude memorized, Scan only enabled in Manager.**

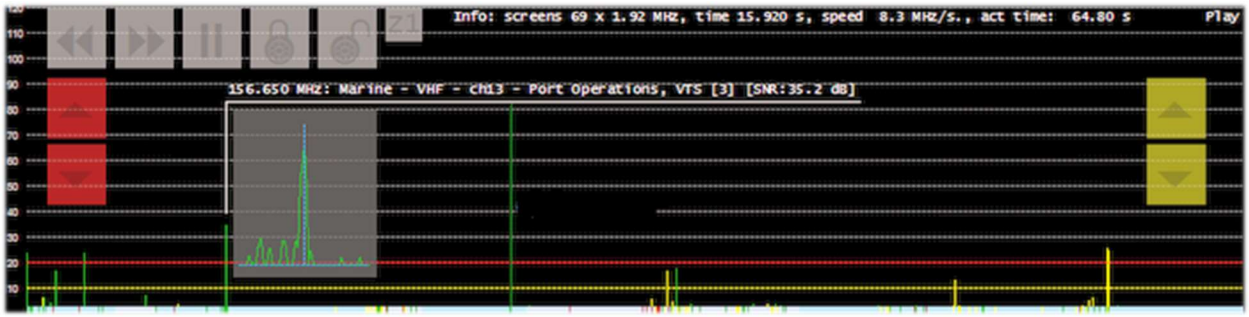
The "**Configure**" button allows you to set every possible parameter of the Scanner, Channel Analyzer and Logging to file in detail.

The "**Detect**" button allows you to vary the scanning speed allowing the best detection of an active signal. *The default value is 100.*

The "**Wait**" button allows you to vary (in seconds) the delay with which to resume scanning. *You can start testing with a value of 5 seconds.*

At this point you are ready to press the "**Scan**" button to see and appreciate the extreme speed of scanning (still improved in version 2.2.1x for CPU and scan speed!) and the wealth of supporting information.

In this author example, the nautical band is being scanned. The Channel Analyzer window will appear



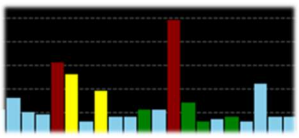
with a rich set of indications and operational buttons. Let's see how to use them:

- The buttons << >> control the scanning direction or to skip the current active frequency
- With | | to pause or resume scanning
- Use "locks" to lock/unlock one or more frequencies
- The Z1/Z2 buttons toggle the zoom type in the channel analyser window

While the following buttons control interrupting and resuming the scan:

- The red ones adjust the level of the "trigger" (red horizontal line). *When the signal goes above the red line the scan stops and you can listen.*
- The yellow ones adjust the "hysteresis" level (yellow horizontal line). *When a signal goes below the yellow line, the countdown (for waiting) starts. When the time is up, scanning resumes. If in the meantime the signal goes above the red line again, during the waiting period, the counter will be reset and the scanner will remain on the current frequency.*

The colours at the bottom of the Channel Analyser have these meanings:

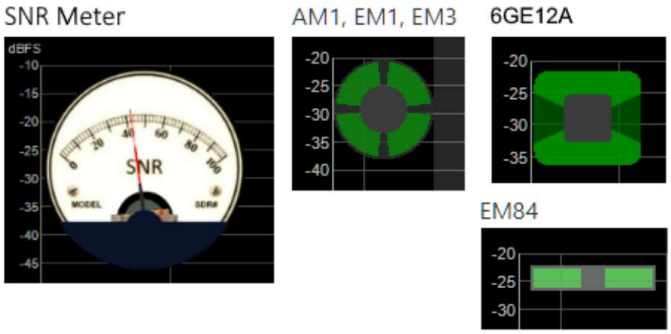


BLUE = The frequency is not present in the associated Frequency Manager database and is not locked.
DARK RED = The frequency is not present in the Frequency Manager database but is locked.
YELLOW = The frequency is present in the Frequency Manager database but is locked.
GREEN = The frequency is in the Frequency Manager database and is not locked.

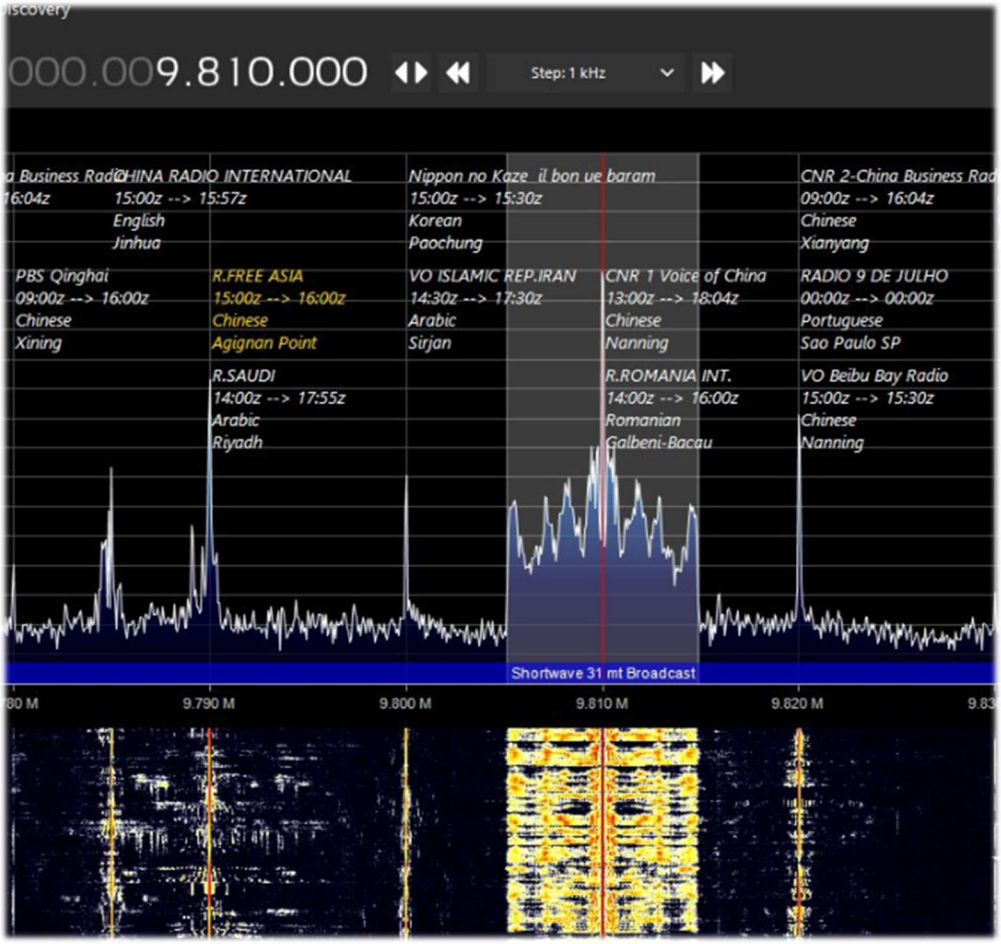
For a correct use of all the functionalities of this very useful and fundamental plugin, please read carefully its PDF manual of 27 pages.

Magic-Eye v1.70

On an “old-style” note, in this world of ultratechnological software, you might like to try the freeware plugin 'Magic eye', of old memory, by the author BlackApple62:
https://github.com/blackapple62/SDRSharp-Magic-Eye-Plugin
Once installed and activated, one of thirteen patterns will appear in the top left corner of the RF Spectrum window, customisable in size and transparency relative to the background.
An analogue SNR meter is also implemented.

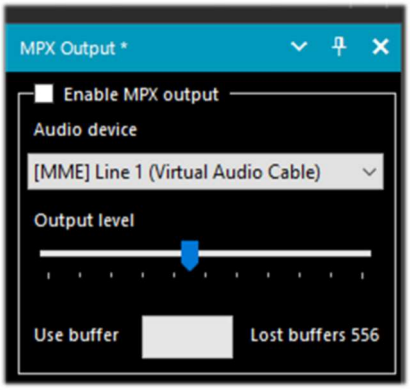


This is his Twitter: ***https://twitter.com/BlackApple62*** to keep in mind, because the author is also working on a brand new and unpublished plugin "ListenInfo" for all Shortwave Radio listening that will allow to display directly on the RF spectrum many details of the station!

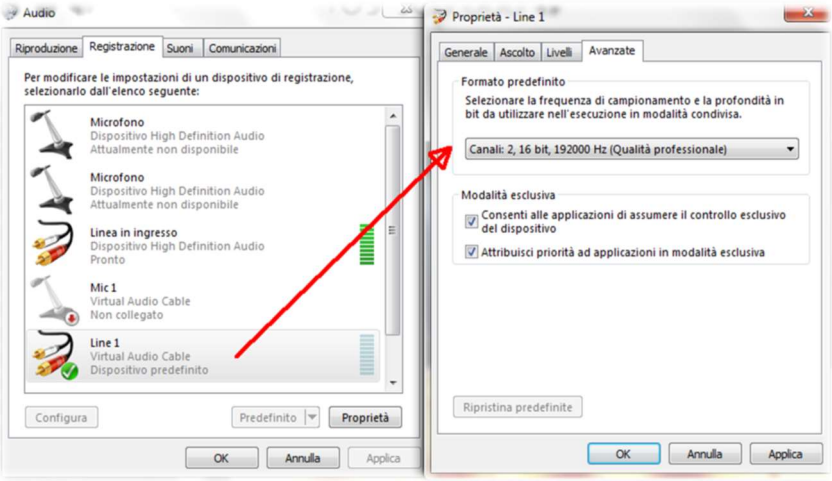


MPX Output v0.2.1 and RDS-Spy

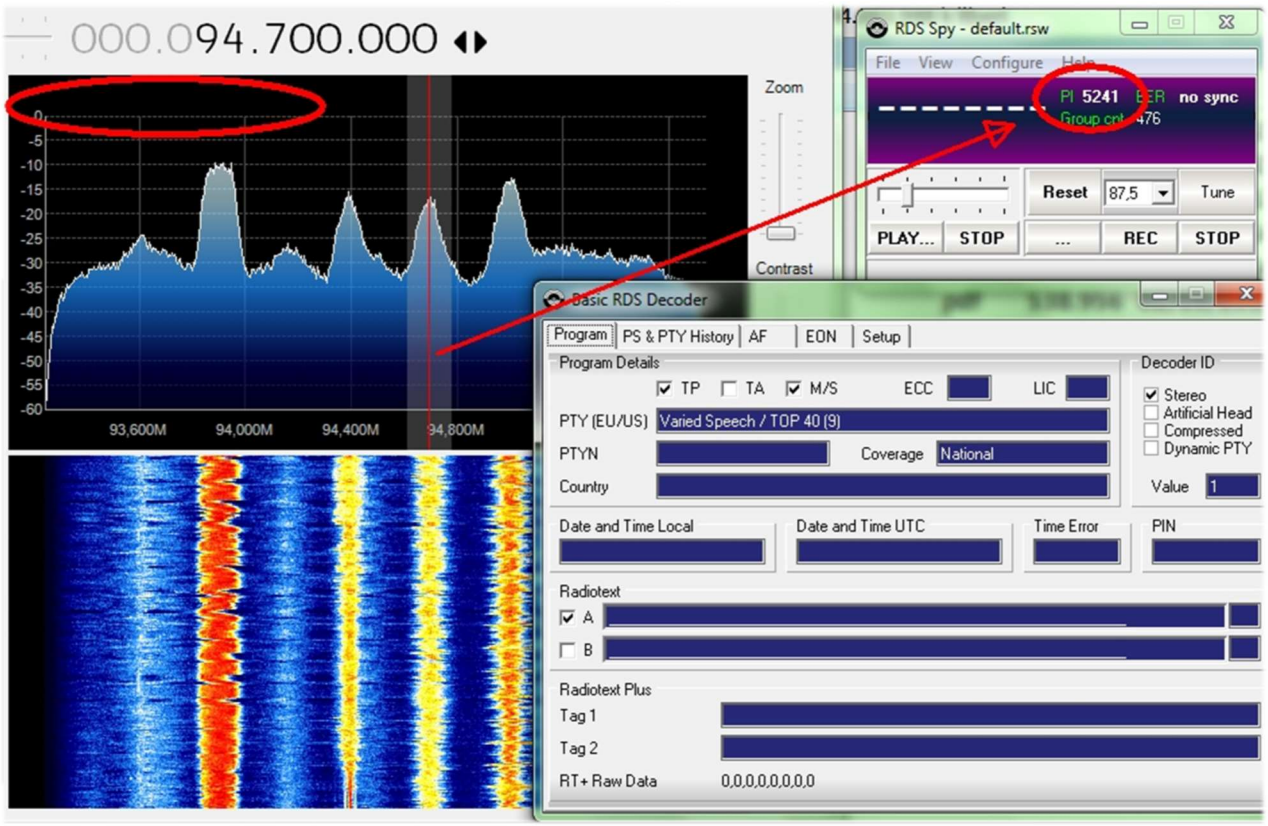
For a friend who is interested in FM-DX (*) I tried the new plugin "MPX Output" in combination with the professional decoder "RDS-Spy" which allows you to discover and highlight all, but really all, the "secrets" hidden inside the RDS (*): **https://rdsspy.com/downloads/**



The system is really performant and very sensitive, often it hooks the PI codes (*) even before they are detected by the SDR# integrated RDS decoder (see below the picture with the immediate PI detection). *For this, however, it is necessary that your sound card supports 192 kHz sampling in recording and that this is enabled in the audio panel (as shown below), only then you can have the decoding of the RDS.*

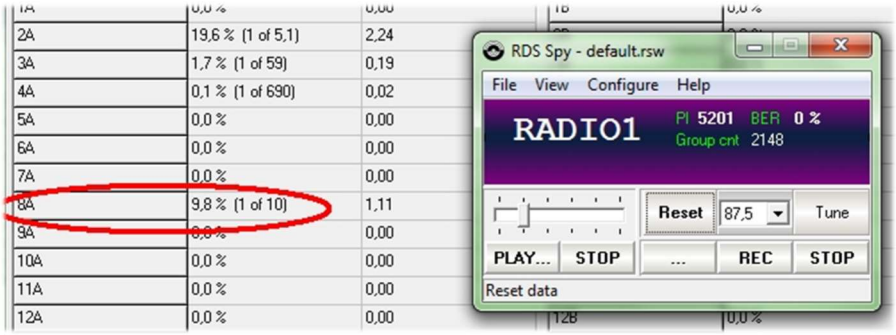


By enabling the checkbox "Enable MPX output" the multiplexed audio stream will be routed to the indicated device and from this to the RDS-Spy decoder which will be configured in the panel "Configure / Select RDS Source / Sound Card / Input Mode "Direct RDS/MPX (192 kHz)" with the same device selected in the MPX plugin.

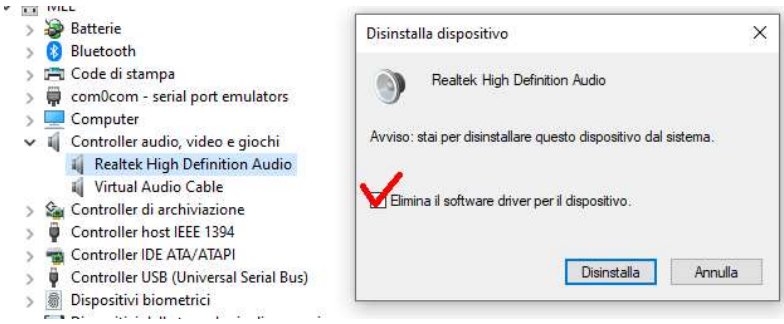


At this point the decoder panel will animate with all the RDS information and in "View / Basic RDS services" you can appreciate the multiple indications "Program Details, PS & PTY, AF, EON". In the "Group Analyzer" all the active groups will be checked with their percentage of diffusion in time...

In the following example I found for the RADIO1 broadcaster the presence of the TMC service - Traffic Message Channel on block 8A

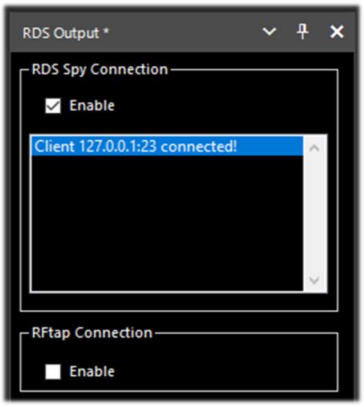


In the my tests I found some difficulties to set the 192 kHz sampling that was not present in my W10 operating system despite the drivers were updated, then reading a thread on the net, someone suggested to uninstall the drivers of device also marking the highlighted field.



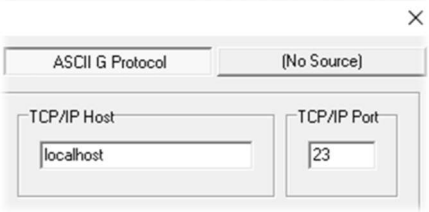
Upon restarting Windows the system was correct…

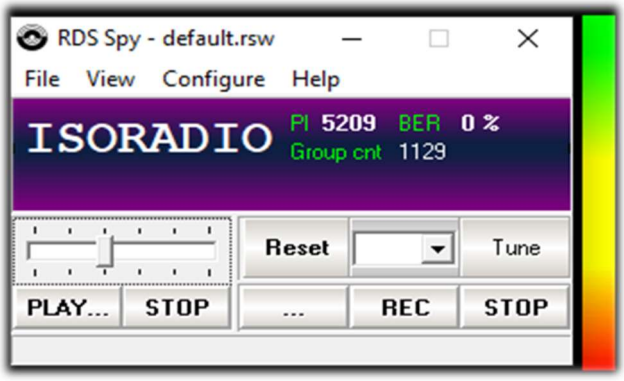
Only on a laptop I didn't succeed and so, on a friend's suggestion, I tried another way with the plugin "SDRsharp RDSOutput" that allows to use RDS-Spy but without MPX, Virtual Audio Cable and the whole issue of sampling and configuration for 192 kHz.



The "trick" is done by using the TCP/IP protocol and taking SDR#'s internal RDS decoding. The RadarFolf plugin is available here: ***https://github.com/RadarFolf/RDSOutput***

After unpacking the DLL, in the usual SDR# directory, configure RDS-Spy in the "Source / ASCII G Protocol" menu with these settings: localhost, port 23. Then click in RDS-Spy on File / Play Stream...





Simple APCO / DMR / dPMR

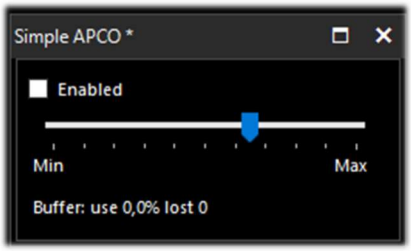
Digital fans and radioamateurs will find these simple plugins, which are fully integrated with SDRsharp, very practical and immediate.

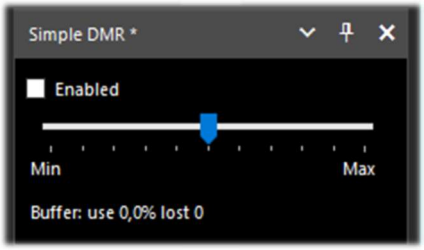
Freeware downloadable: ***http://rtl-sdr.ru/***

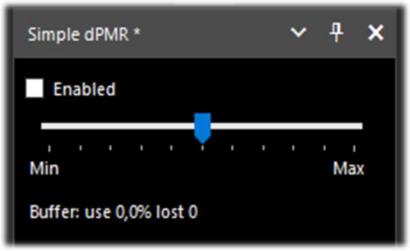
As the title says, they are 'simple', perhaps even too simple, with no indication of the various information that the DMR (*) can carry, such as Colour Code, talkgroup, network type, etc., etc., but for this very reason they are fast and ultra-practical!

Extract the DLLs in the Plugins directory and launch SDRsharp.

All that remains is to enable the plugin in the checkbox at the top left and, if necessary, adjust the volume slider: as soon as one of these digital transmissions will pass, you will hear the audio directly through SDRsharp.





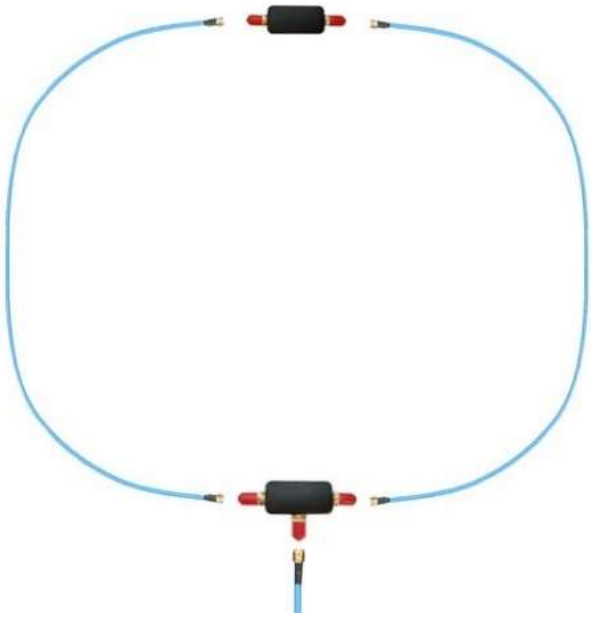


..... Accessories .....

Antenna YouLoop

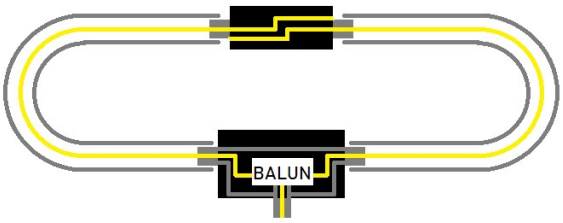
A new magnetic loop concept

The success of the Airspy HF+ series brought a lot of feedback from users noting that many problems were related to receiver antennas that were ineffective, too sensitive to surrounding noise, had excessive gain, and lacked the necessary linearity. This led to the idea of designing a new 'Noise-Cancelling Passive Loop' (NCPL) to solve the noise problem and take advantage of the low noise performance of AirSpy receivers. The new loop antenna was named 'YouLoop' from its designer Youssef.



Architecture

YouLoop is a generalisation of the Möbius loop in which a two-turn balanced coaxial cable is used as the centre of a multi-turn loop. This construction is electrically balanced for large wavelengths, i.e. when Lambda is very large compared to the size of the antenna. This helps to cancel the electrical noise at the lower bands, exactly where most of the electrical noise energy is concentrated. To preserve this electrical balance from being disturbed by the transmission line, a miniature low-loss BALUN (*) is used underneath the loop.



Performance in VHF too

Another interesting aspect of this two-wire coaxial construction is its response in the VHF range. The same HF magnetic loop can therefore be used in the FMW, aviation and 2m amateur radio bands with a slight change in its basic principle: it is now a folded dipole. In fact, the feed point of the folded dipole is at the top and the arms of the dipole form the ground of the coaxial. At the feed point, the signal is routed from the two sections of coaxial cable to the wideband, low-loss BALUN.

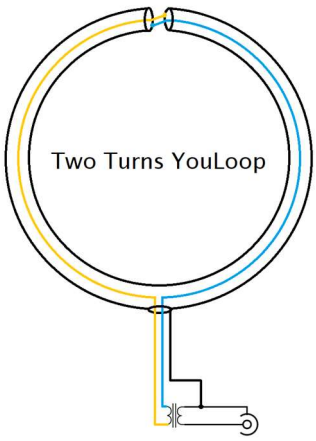
Equipment list

Once the best quality components have been chosen (beware of clones and imitations!!) and the PCB has been pre-assembled with the BALUN, the only thing to do on receipt of the loop is to connect the blue cables marked SMA (*) in just a few seconds *and maybe attach the antenna itself to a rigid Hula-Hoop, like the ones used in children's games, to make it more manageable and steerable on some temporary structure (e.g. a photo tripod).*

For semi-permanent outdoor installations, it is recommended that the "Balun-T" and "Phase Inverter" elements be sealed very well with sealing tape.

For optimum performance it is recommended to use coaxial cables suitable for the purpose.
Any phase or amplitude mismatch will result in sub-optimal performance. Those proposed meet the criteria for optimum performance:

- 2 arms (1m) in RG402 18 GHz coax cable, with male SMA connectors
- 1 transmission line (2m) in RG402 18 GHz cable, with male SMA connectors
- Phase inverter (upper part of the loop)
- Wideband low-loss T-shaped BALUN (bottom of loop)

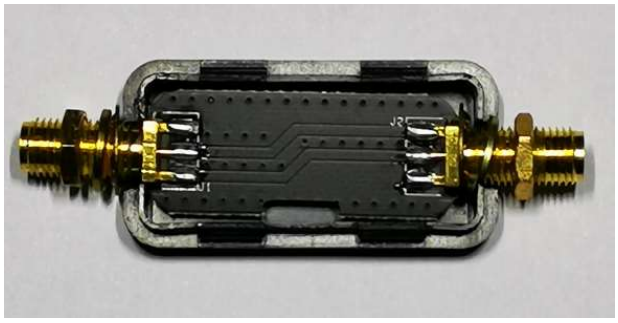


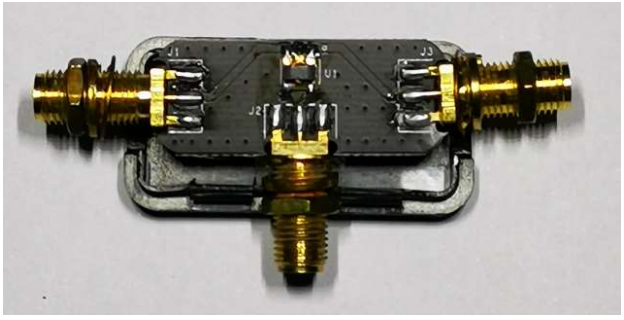
Technical specifications:
HF: from 10 kHz to 30 MHz
VHF: up to 300 MHz
Maximum Power: 250 mW
Passive design and no tuning/synchronisation required
Low-loss, wide-band BALUN (0.28 dB loss)

Compatibility:
Airspy HF+ Discovery (Recommended)
Airspy HF+ Dual Port ((with R3 short-circuited)
Other SDR with MDS (*) <= -140 dBm

It is very likely that your own third party receiver is not sensitive enough to work properly with the YouLoop... Not using an Airspy HF+ Discovery, some people have even tried, without much success, to make preamplifiers to compensate for the lack of sensitivity and/or dynamic range required by substandard receivers.

But what's inside? A friend got me these images....





SpyVerter R2

Before the advent of Airspy HF+ Discovery/Dual Port you could extend your coverage below 30 MHz with the **SpyVerter Upconverter** in combination with your devices...

It is a low-loss, high-dynamic-range up-converter based on a switched-mode design, the same type that is used in high-end HF rx which, due to its frequency stability and sensitivity, can compete with analogue designs at a very affordable cost.

SpyVerter R2 is based on the successful SpyVerter architecture and enhances the key points of high performance HF reception.

The architecture is based on a dual balanced switched-mode mixer that transposes the entire HF spectrum in the VHF band between 120 MHz and 180 MHz.

An embedded microcontroller provides both PLL programming (Si5351C) and VCTCXO voltage control via its built-in DAC.

The substantial difference between SpyVerter R0 and R2 is the high-speed PLL instead of the TCXO.

Technical specifications:

RF Input 1kHz to 60 MHz
IF Frequency 120 MHz – Positive Image
Technology: Switched Double Balanced Mixer
Total Conversion Loss + Filtering: 8 dB typ.
35 dBm IIP3
LO leakage: -42dBm typ. (12 dB lower than the original SpyVerter)
Phase noise at 10kHz separation: -122 dBc/Hz
RF Filtering: Low Pass Filter with corner at 65 MHz – 75dB ultimate rejection
IF Filtering: Band Pass Filter with corners at 120 MHz and 180 MHz – 75dB ultimate rejection
Max RF power: +10 dBm
Return Loss: -10 dB
Bias-tee voltage: 4.2v to 5.5v
Internal 10 MHz Reference Clock input
Current consumption: < 100 mA

Compatibility:

Airspy R2
Airspy Mini
HackRF One
RTL-SDR

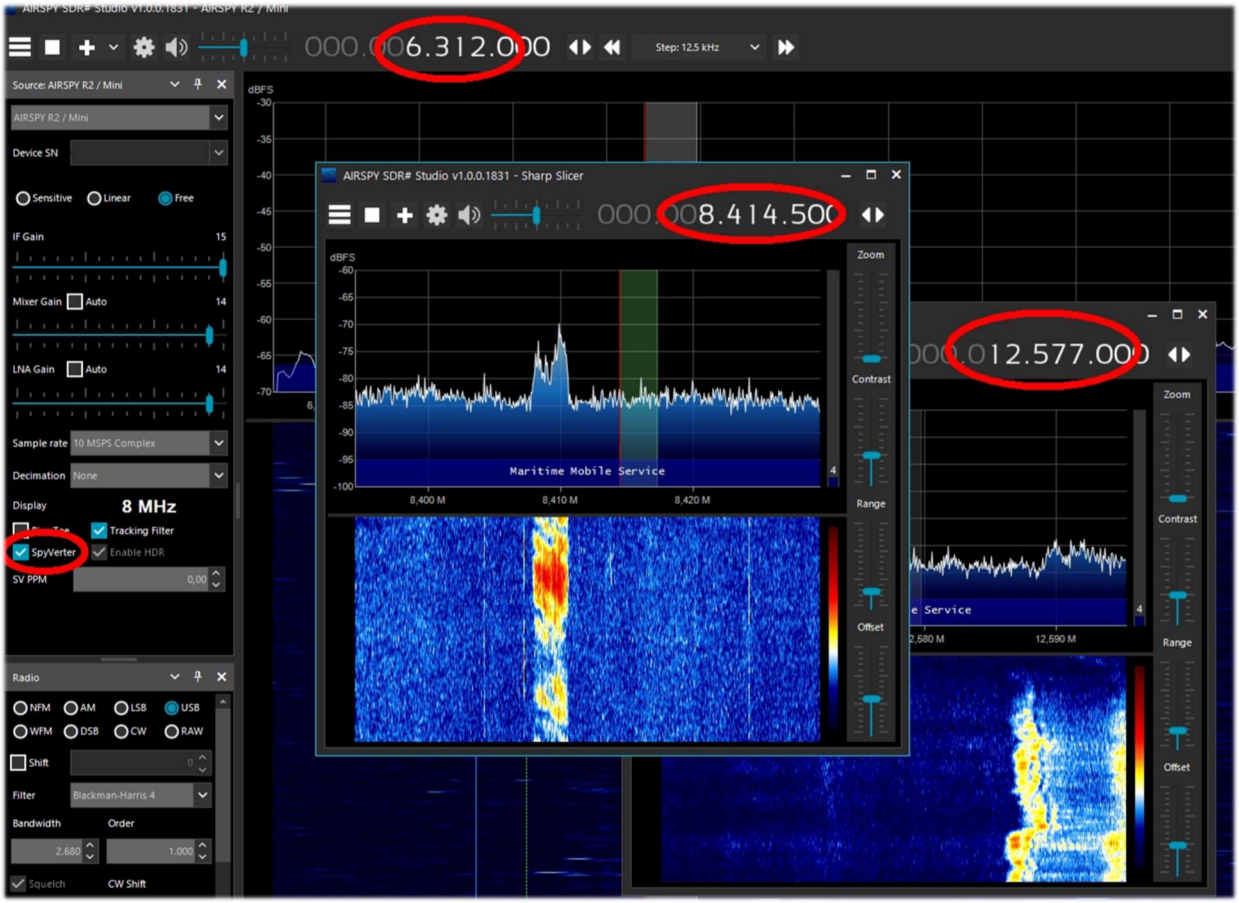
The SpyVerter offers HF coverage starting near DC and up to 35 MHz where it overlaps with Airspy's VHF-L.

The default software settings allow the Airspy to power the SpyVerter unit via the "bias-tee" feature, so no extra power is needed. Simply connect the SpyVerter's IF output to the Airspy's RF input via the supplied barrel adapter.

It is recommended to use the "Linear gain" mode in HF.

An idea I had recently was to use the SpyVerter in combination with an AirSpy R2 for simultaneous HF decoding of ALE and GMDSS signals thanks to the brand new multi-channel decoders by Chris Smolinki's Black Cat (W3HFU)...
Let's see some steps together.

I'll give more information on Black Cat's ALE and GMDSS decoders in the "Listening Recipes" chapter later, but this is the general principle. Exploiting the SpyVerter and the combined use of the Slice *(see "New Slice" in the chapter "Main settings and controls")* is like having several independent receivers (but always within the default bandwidth) to which you can feed several signals to monitor and decode!
For example, for HF world nets in ALE or in the GMDSS system there are many frequencies to keep an eye on and not all of them are active at the same time or can only be received at certain times of the day...
If you could have a decoder active on each frequency you could optimise simultaneous reception and automatically catalogue a large number of logs.
All this is possible by using some new multi-channel decoders designed specifically for this purpose in combination with multiple virtual audio channels, with the only limitation of having a sufficiently powerful computer / CPU ...
Obviously you can start with two/three frequencies and its VAC properly configured on Line 1/2/3.
In this screenshot on an AirSpy R2 tuned to 6.312 kHz of the GMDSS world system I opened two new Slice at 8.414,5 and 12.577 kHz



Keep in mind, however, that the SpyVerter is designed to be a broadband HF receiver. This may be useful for some scenarios, but it may lack the dynamic range for high performance use when receiving weak signals or with strong blocks in the vicinity. The limitation does not come from the SpyVerter as the weight is delegated to the VHF receiver output. Slice is the way to have stand-alone receivers with full functionality from the same front-end.

If the SpyVerter is used remotely, the following parameters must be used in the **spyserver.config** file

```
# Initial Center Frequency
#
initial_frequency = 7100000
# Minimum Tunable Frequency
# Comment if using the device default
#
minimum_frequency = 0
# Maximum Tunable Frequency
# Comment if using the device default
#
maximum_frequency = 35000000
# Converter Offset
# Set to -120000000 to enable the SpyVerter offset
converter_offset = -120000000
# Bias-Tee
# For AirspyOne only – Useful for LNA's and SpyVerter
enable_bias_tee = 1
```

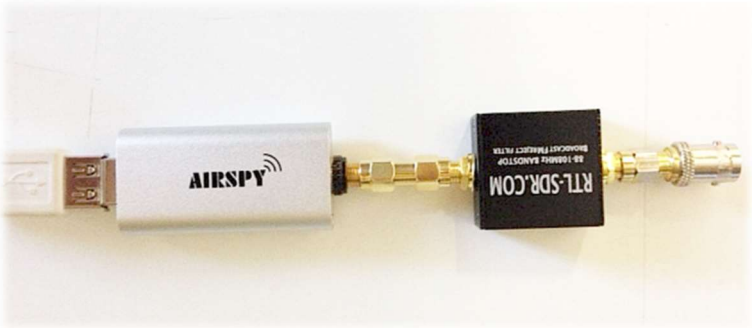
Notch filter 88-108

Those who live in cities or in the vicinity of strong/very strong signals from WFM broadcast stations will need to make or buy a good notch filter to attenuate the presence of these signals, which can also desensitise other portions of the spectrum not included in the operating range in question (e.g. the adjacent aeronautical band).

There are different forms and performances (with attenuation, expressed in dB, also very high). In the best ones, the insertion loss outside the operating band and up to 500 MHz is practically absent, while it is very low for higher frequencies.

In our case, it is preferable to choose the newer ones with an SMA connection so as not to put too much mechanical strain on the older, heavier ones still with BNC or PL connectors.

This is a typical usage configuration...



If you start using them afterwards, you won't be able to do without them....

..... Various topics .....

NEW

ADS-B SPY v2.2-RC26

This valuable tool allows the real-time reception of aircraft transponders transmitted on the nominal frequency of 1.090 MHz, i.e. for the acquisition of ADSB (*) by Airspy R0/R2/MINI devices and subsequent visualization on cartography in graphical and tabular format by other software (e.g. Virtual Radar Server, Flightaware, etc...).

Need a dedicated antenna and possibly little and good coaxial cable, but you can initially try with a discone or a bibanda VHF / UHF but better would be to realize the project of a small dedicated collinear copper or brass alloy that offers good gain and reception in the range of a few hundred kilometers ... Please refer to the link: **http://www.radioamatoripeligni.it/i6ibe/ads-b/ads-b.htm**

On the AirSpy website there are brand new updated versions of the ADSB-SPY (for Windows, Linux, Raspberry, Odroid). The Airspy R0/R2 and Mini can be used as high performance ADSB receivers capable of 12, 20 and 24 MHz MLAT. The brand new and original algorithms compare favorably with high-end ADSB receivers turning your Airspy into a self-contained ADSB station with low power requirements.

I will cover the one for Windows here.

airspy_adsb	exe	196.608
flightaware	bat	74
virtualradar	bat	52
libusb-1.0	dll	135.680
pthreadVCE2	dll	61.952
msvcr100	dll	773.968

Once I downloaded the file **airspy_adsb_win32.zip** I proceeded to unpack the six files in the SDR# directory.

I start in my case by running the Virtualradar.bat file which contains the following line of parameters:

```
start airspy_adsb -v -e 20 -w 5 -m 20 -l 47806:asavr
```

The meaning of the various commands can be better understood thanks to the help

```
A High Performance ADSB/Mode-S decoder for Airspy
Options:
 -s <serial_number>         Device serial number
 -t <timeout>               Aircraft timeout in seconds (default: 60)
 -g <rf_gain>               RF gain: 0..21 or auto (default: auto)
 -f <bits>                  Forward Error Correction (FEC) bits (default: 1)
 -e <preamble_filter>       Preamble filter : 1..60 (default: 4)
 -C <target>                CPU processing time target (percentage): 5..95 (default: disabled) (adjusts preamble filter while running)
 -E <max_preamble_filter>   Maximum preamble filter when using CPU target 1..60 (default: 60)
 -P <non_crc_preamble_filter> non-CRC Preamble filter: 1..preamble_filter (default: disabled)
 -w <whitelist_threshold>   Whitelist threshold: 1..20 (default: 5)
 -c <host>:<port>[:format]  Add a Push Client
 -l <port>[:format]         Add a Listener
 -m <mlat_freq>             MLAT frequency in MHz: 12, 20 or 24 (Airspy R2 only)
 -n                         Enable Verbatim mode
 -x                         Enable DX mode
 -r                         Reduce the IF bandwidth to 4 MHz
 -R <rssi_mode>             RSSI mode: snr (ref = 42 dB), rms (default: rms)
 -D <comma separated list or "none">  ignore these DF types (default: 24,25,26,27,28,29,30,31)
 -b                         Enable Bias-Tee
 -p                         Enable Bit Packing
 -v                         Verbose mode
 -h                         Display this help screen
Available output formats:
 * AVR        - Raw AVR format
 * AVR-STRICT - Raw AVR format with only CRC valid frames
 * ASAVR      - Raw Airspy AVR format
 * Beast      - Raw Beast Binary format
```

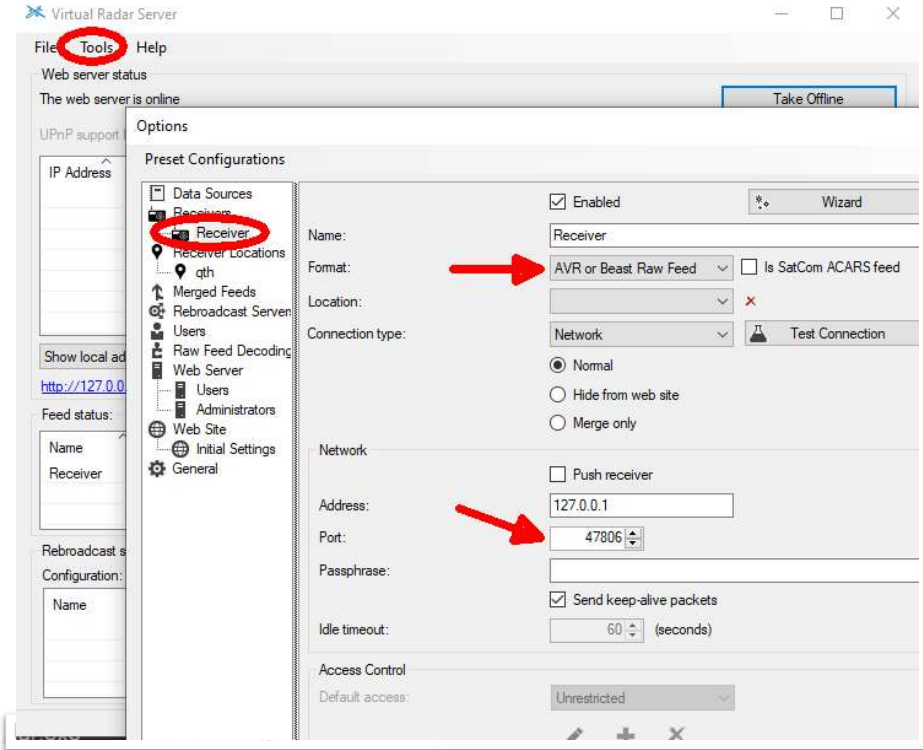
It will then open a window like this, while in the meantime we're going to install and configure the free Virtual Radar Server software:

```
airspy_adsb v2.2-RC26
Listening for asavr clients on port 47806
Acquired Airspy device with serial 644064DC2E836BCD
Decoding started at 20 MSPS (Gain: auto; Preamble Filter: 20.0)
```

https://www.virtualradarserver.co.uk/Download.aspx

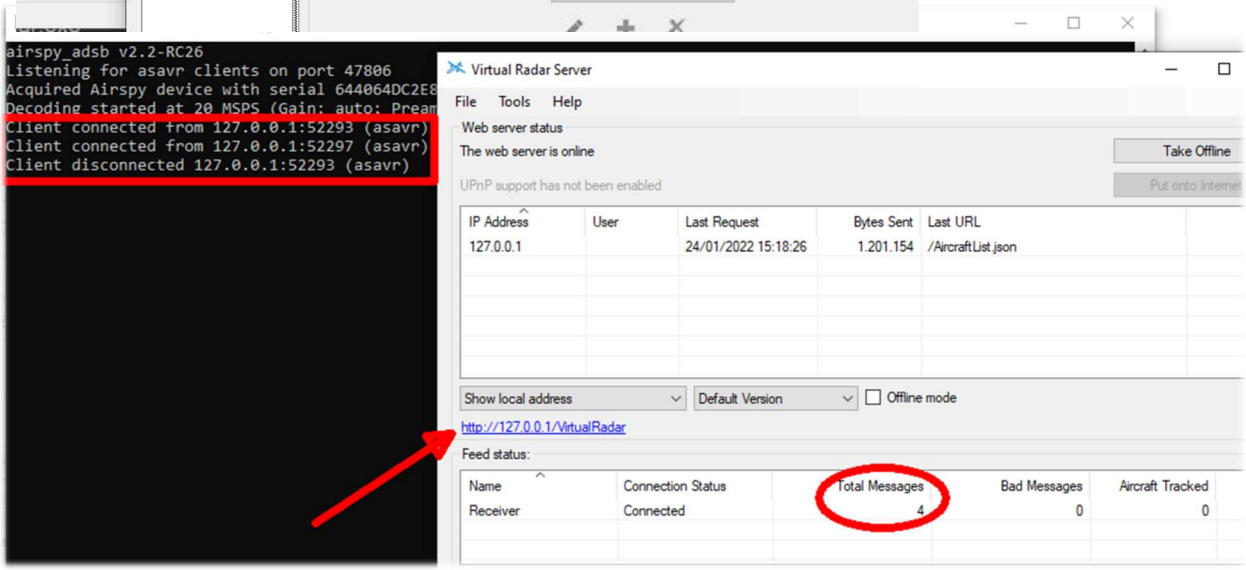
```
*5D896408971F97;011A9470;06;0736;
*20001490D60A4F;011CA3E3;06;076E;
*28000017562C3A;011E55E9;06;07CE;
*5D896408971F97;011E798F;06;06BE;
*20001490D60A4F;0122B27E;06;069A;
*5D896408971F96;01263E06;06;0772;
*5D896408971F97;012A1BF7;06;0747;
*A0001490CC300030A401803BAE8E;0140AF49;06;05F8;
*A8000017A29A5733615C2330159B;0141EC1D;06;0605;
*5D896408971F8A;015E3157;06;0686;
*A000149020154133E58820385DE3;0162D911;06;0659;
*5D896408971F8A;0163146C;06;06E7;
*A8000017A29A5933614423B2C94F;016434F8;06;06AB;
*A8000017CC300030A40180021A67;01644F67;06;05D7;
*28000017562C3A;01668291;06;069C;
```

As mentioned at the beginning, ADS-S SPY receives the data in "raw form" like these on the left... which are then sent to port **47806** of the program that will display them at their best!

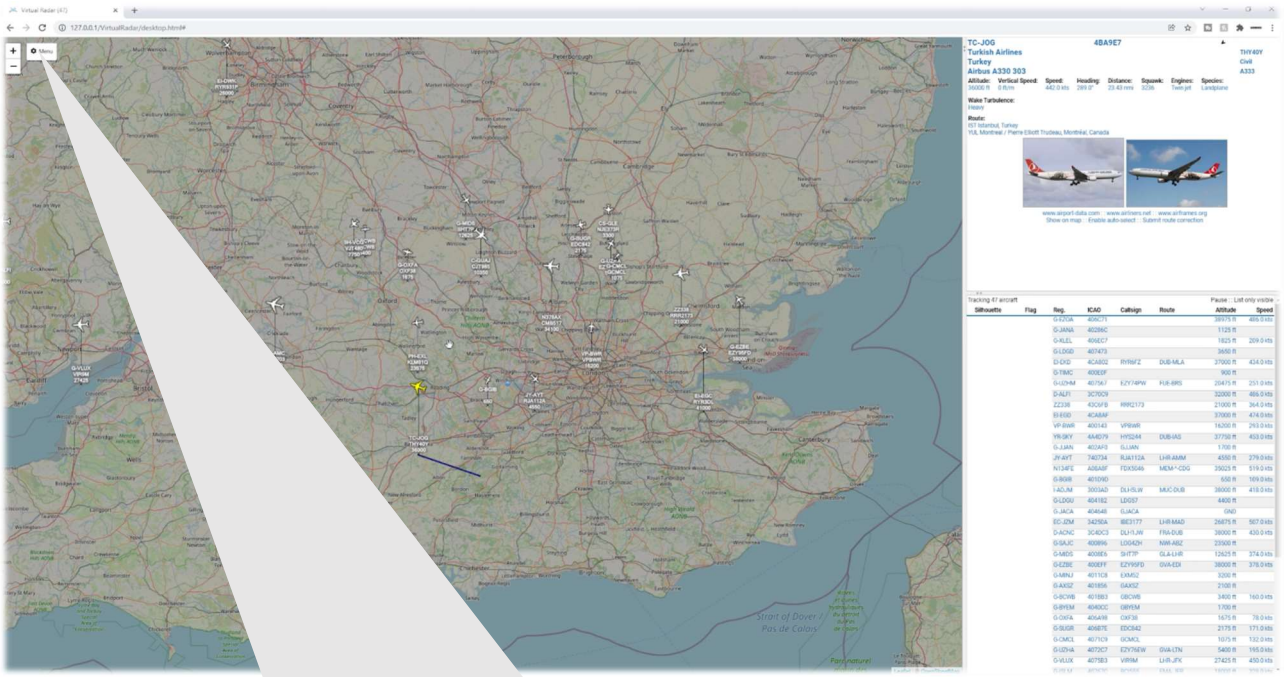


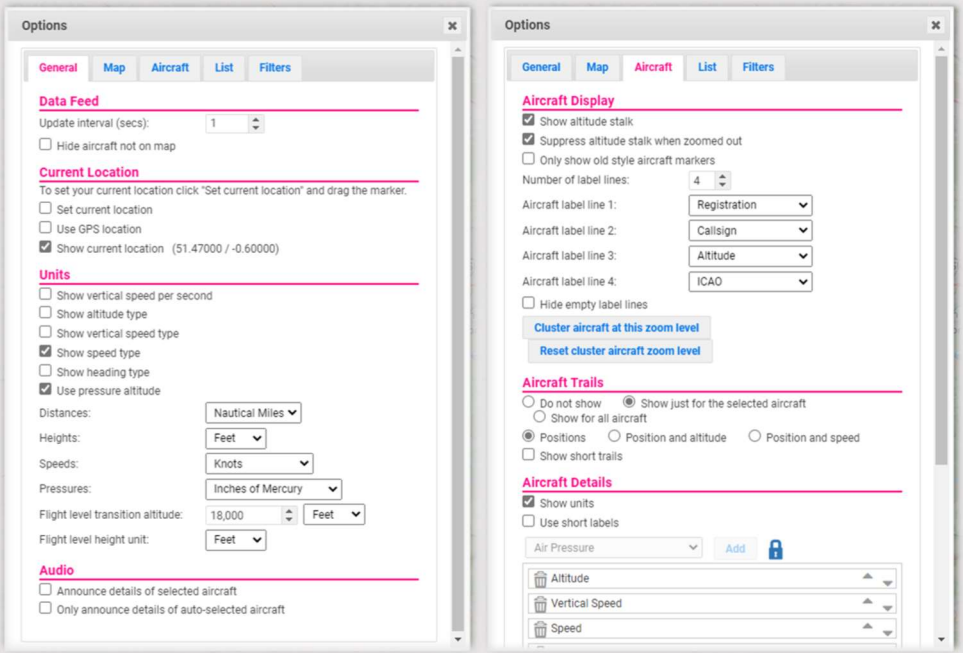
In TOOLS / OPTIONS / RECEIVER we are going to configure the highlighted points...

while in TOOLS / OPTIONS / RECEIVER LOCATIONS I inserted a line with my coordinates.



At this point the windows of the software will begin to populate with data and messages received in real time. Just click on the link highlighted in blue, to open your browser and visualize on a map all the movement in our skies.





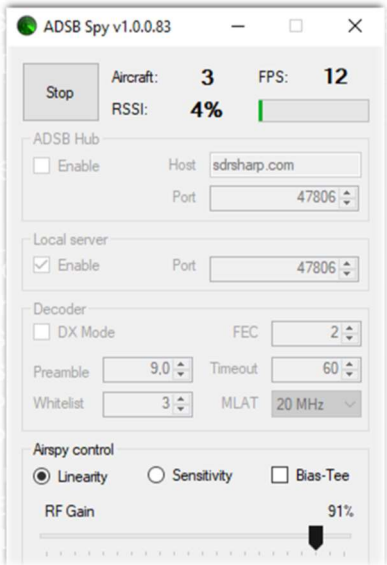
Some windows with multiple Virtual Radar Server settings and customizations.

An excellent Youtube video can be viewed here: ***https://youtu.be/coqNi2lM3gw***

ADSB, Astro and Spectrum Spy

Until revision 1784 (which can still be downloaded from the link on page 3), the distribution included some standalone utilities **for use with Airspy devices**, which many of you will remember and which can still be used today.

ADSB Spy v1.0.0.83



Once started, after a few moments, the "Aircraft" and "FPS" counters will appear, indicating the data packets received, providing a real-time view of correct reception, as well as the received signal strength indicator (RSSI).

The default port address is 47806 and is used to communicate with the decoding programs (see below).

The "ADSB Hub" and "Local server" boxes are used to send data to a specific host, IP address and port.

Previous versions of ADSB Spy also allowed the use of normal RTL-SDR sticks with good results.

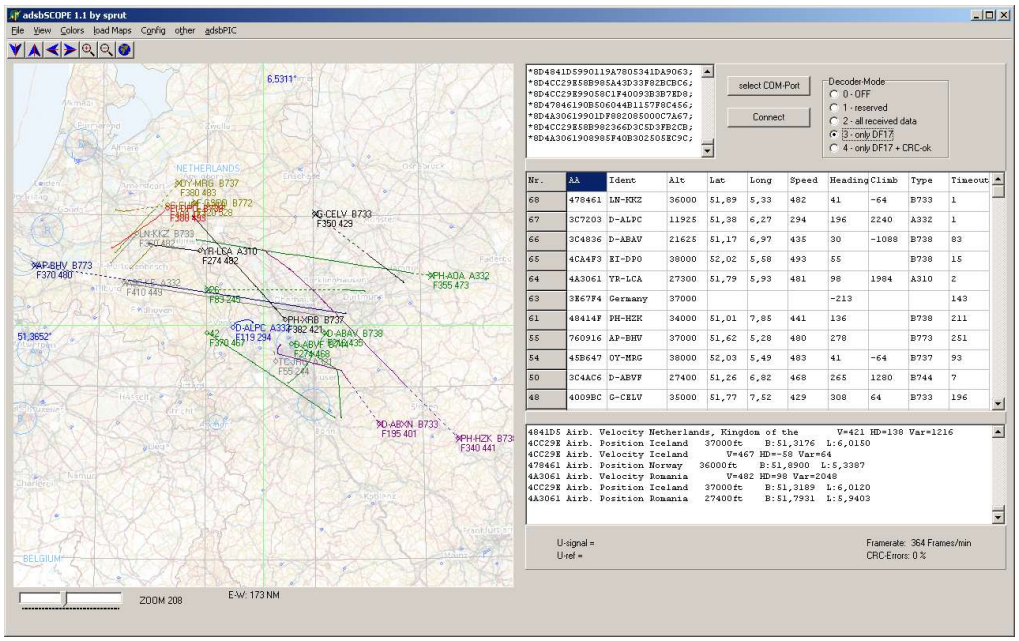
The most popular radar software, in alphabetical order, are:

adsbSCOPE (see screen): ***http://www.sprut.de/electronic/pic/projekte/adsb/adsb_en.html***

Planeplotter: ***https://www.coaa.co.uk/planeplotter.htm***

Virtual Radar Server: ***http://www.virtualradarserver.co.uk/Default.aspx***

Each one needs its own specific configuration and settings and this is not the place for a detailed individual sheet. Please refer to the links and various enthusiast sites on the net.



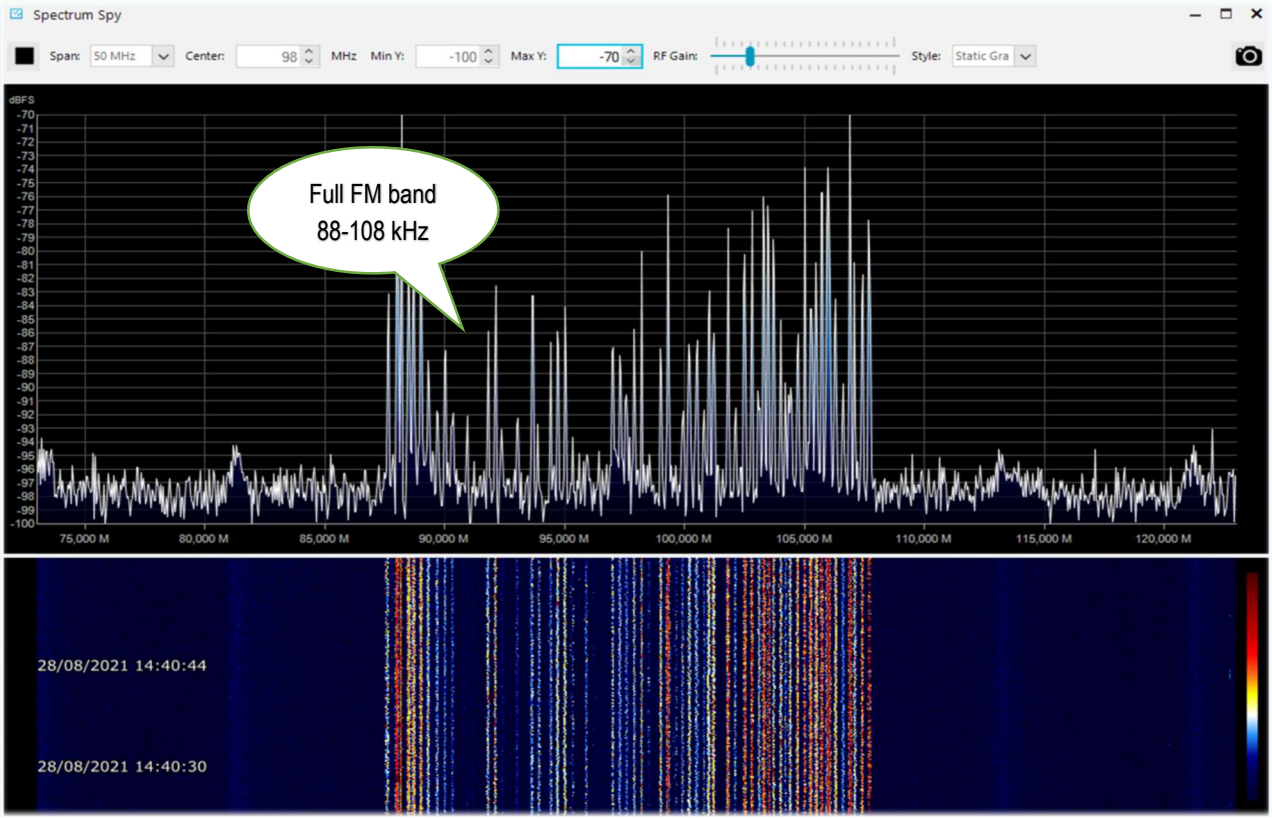
Astro Spy

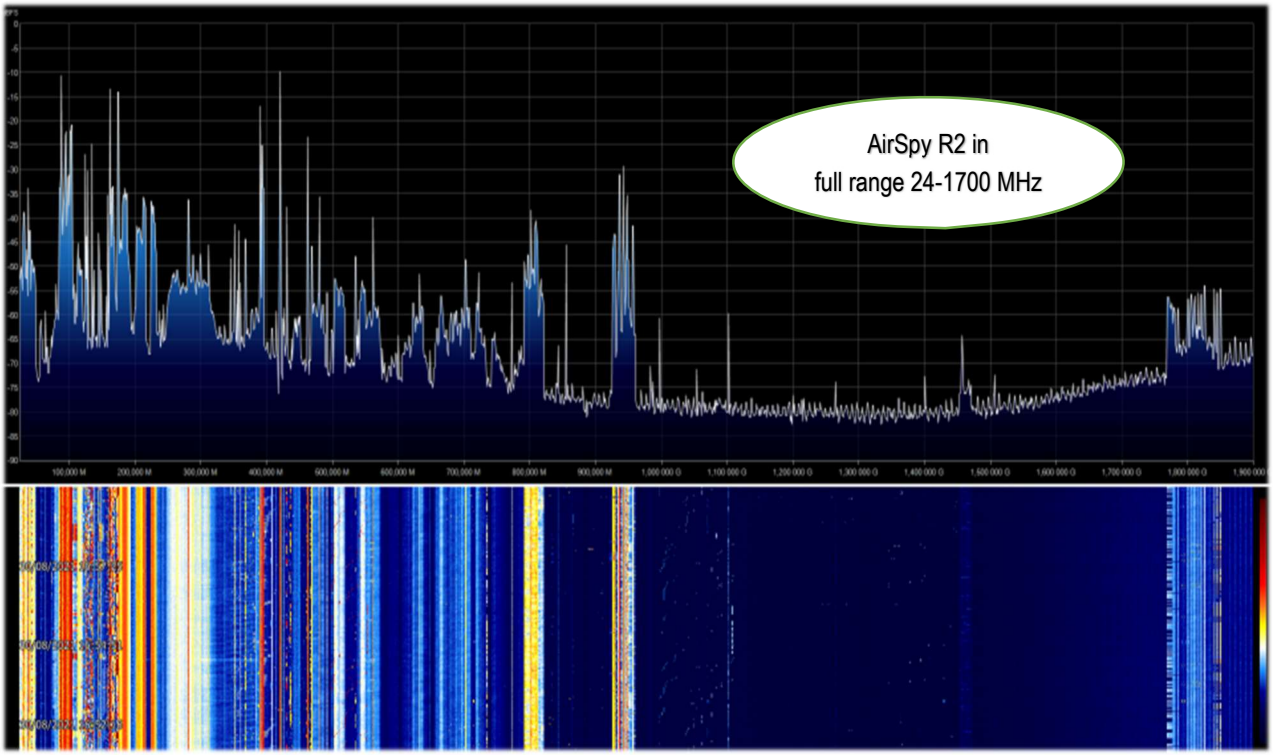
Developed for radio astronomy to observe a specific L-band frequency over time. I have not been able to test it, it should detect the hydrogen line 21 cm at 1420 MHz perhaps with a horn antenna pointed at the Milky Way.

Spectrum Spy

The Spectrum Analyser allows the display (no sound) of wide frequency ranges (or the whole range in 'Full' mode) by exploiting the scanning speed which is comparable to 'real' spectrum analysers (...and maybe even more!). *I've loved it since the first time I used it and resort to it whenever I need to analyse small or large portions of the spectrum or to see the source of some new signal (often unwanted like a local noise) or if a slot has opened up in the 88-108 MHz range to try FM-DX(*)...*

Key	Features
▶ ■	Starting / closing the programme
Span	Allows you to choose a specific portion of the range for analysis (10, 20, 50, 100, 200, 500 MHz, 1 GHz, Full)
Center	Allows the desired frequency to be centred on the screen. *The combination of Span / Center allows the best analysis of the signal in the desired range.*
Min Y	To choose the minimum values for the ordinate axis (-80 / -120 dBFS(*))
Max Y	To choose the maximum values for the ordinate axis (-70 / 0 dBFS(*))
RF Gain	To increase or decrease gain
Style	Allows you to choose the style of signal representation in the Spectrum (Simple curve, Static gradient, Dynamic gradient, Old school)
📷	Allows a screenshot of the Spectrum/WF to be saved at any time.


Spectrum Spy
Span: 50 MHz
Center: 98 MHz
Min Y: -100
Max Y: -70
RF Gain:
Style: Static Gra
dBFS
Full FM band
88-108 kHz
75,000 M
80,000 M
85,000 M
90,000 M
95,000 M
100,000 M
105,000 M
110,000 M
115,000 M
120,000 M
28/08/2021 14:40:44
28/08/2021 14:40:30


AirSpy R2 in
full range 24-1700 MHz

Signal decoding and analysis

As mentioned elsewhere in this guide, a very interesting possibility is the study of digital signals and their decoding, using special software and a "virtual audio cable".
This is necessary in order to redirect the audio of SDRSharp (or other SDR programs) towards external decoders for many signals that we can find in HF (examples: MultiPSK, Fldigi, WSJT-X, Morse, Wefax, DReaM [(1)] etc.,) or in V-UHF (examples: DSD+ [(2)], APRS, satellites and weather satellites, etc.).

1. *DReaM for the Digital Radio Mondiale (DRM), which is the only worldwide digital broadcasting system planned for long, medium and shortwaves that can use the same frequencies currently allocated to the amplitude modulation (AM) broadcasting service in the spectrum up to 30 MHz. The system is currently active but with only a few stations.*
2. *DSD+ (Digital Speech Decoder) è un programma open source per la decodifica di segnali di parlato digitale multistandard come il DMR, Dstar, Fusion, P25, ecc...*

In general for decoding there are some aspects to consider in order to improve the chances of success, these are the main indications:

- Except in special cases, check whether your "Virtual Audio" program is configured for 48 ksps sampling rate on both input and output ports.
- Check that the SDR software is set to an appropriate volume level (not too low and not too high). All decoding programs have a level indicator that allows you to see the incoming signal and fine-tune it. You can start with a volume of 60/70% if the decoders don't report any errors... Remember that when the audio is redirected, for example to a Line1 or similar, it is no longer heard through the loudspeaker, but often the software comes with a suitable "audiorepeater" in case you still want to listen to the digital signal being processed.
- Disable Squelch and all those plugins (e.g. Audio Processor or Filters) that act on the audio level, which must be absolutely deactivated when receiving digital signals, otherwise they will result in incorrect or incomplete decoding or dirty signals.
- Check that the SDR software is set to the correct reception mode for the decoder. For example, on HF [(*)] the USB (upper sideband) prevails, while on VHF-UHF [(*)] the FMN [(*)] is used. For narrower digital modes such as CW [(*)], DGPS [(*)], RTTY [(*)], you can go gradually with a narrow filter of 400 or 600 Hz and increase to 1500/3000 Hz for FT8 [(*)] or wefax [(*)]. You can also do it the other way around: start with a wide filter and then narrow it down to reduce noise and get proper decoding.

We should now be able to start searching the radio waves for signals other than speech, and make use of the many websites (with frequencies and lists of utility stations), to better understand what we will find in our listening sessions...
I would recommend the UDXF (Utility DXers Forum) for the exchange of news and information related to utility stations and signals below 30 MHz: **http://www.udxf.nl**

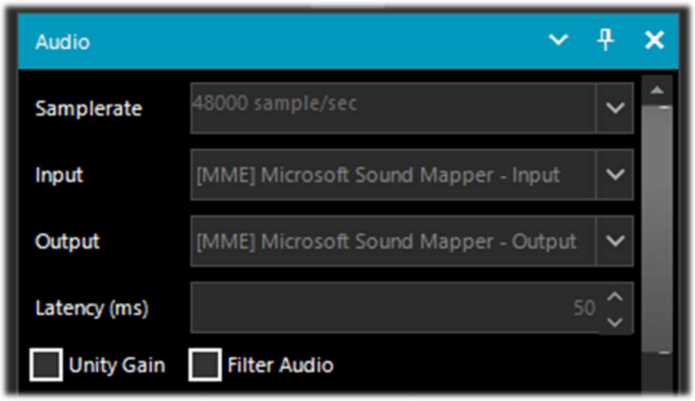
Much more complex and fascinating topics are the analysis of signals and transmission modes and related protocols.

It would take a book just to minimally introduce the subject (there are a few on the net) so I will just give a flash, citing the most professional I know and the only one of its kind, the blog by Antonio Anselmi: **http://i56578-swl.blogspot.com** and also his Twitter : **https://twitter.com/i56578_swl**

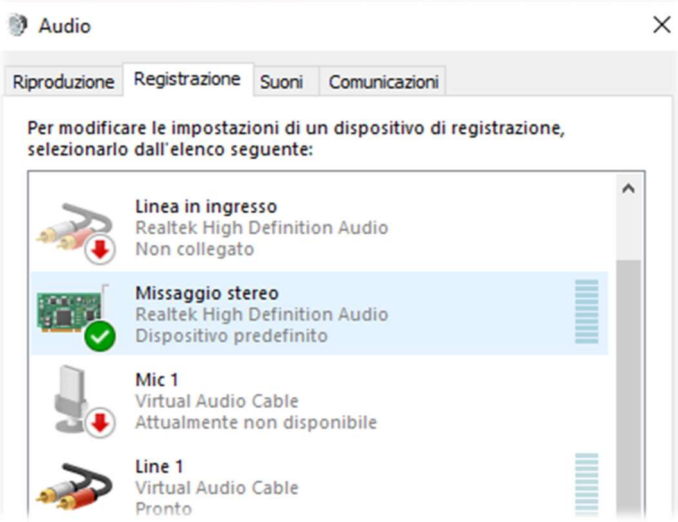
WARNING! SOME OF THESE SYSTEMS IT COULD BE ILLEGAL IN YOUR COUNTRIES! Check carefully and thoroughly the regulations in force in your country. Some of this radio system was specifically designed for use by government, emergency services, for public safety networks, etc etc. who all share spectrum allocated.

Another possibility is to use the sound card to share the signal without any particular need for decoding, but to read in your own language what a broadcasting station is transmitting at that moment...
In fact, you can direct the audio to the Google translator to have it translated in real time into your native language (try it to believe it!). This is really very nice and funny, let's see what you need to do...

The prerequisite is to use the Google Chrome browser, which allows you to convert speech audio directly live via your sound card on your computer.



"Audio panel" SDRsharp with Input/Output for your sound card. You can also use "Stereo Mix" by enabling it in the "Recording" tab in the Windows Audio setting.



If the entry does not appear, you need to click on the other input devices and temporarily choose "Disable".

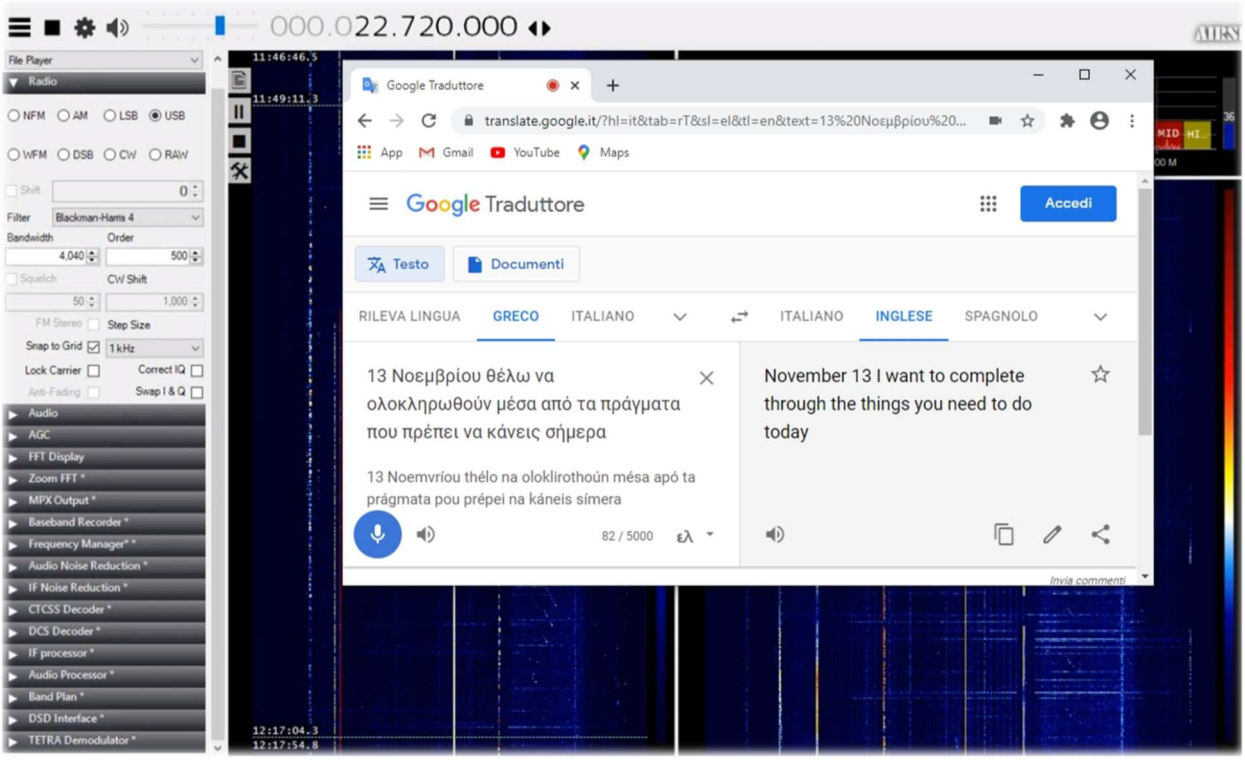
It should now be enabled and set as "Default device" with a green tip icon.

Access Chrome's settings by clicking on "Settings", then "Privacy and security", then "Site settings" by scrolling until you find "Authorisation - Microphone". From the drop-down menu, select "Stereo Mix".

You start up Google Chrome, select the source language (automatic detection is not yet working...) and the target language:

and finally click on the blue icon of the microphone symbol and this is the result, when I captured China Radio International on 7435 kHz frequency during a language lesson in Chinese, promptly translated into my own language.

here is another example…



Listening recipes

How to combine a great SDR and some excellent software to set up a useful receiving capability.

As in the best cookbooks are written the recipes, ingredients and operations necessary to deal with culinary dishes of all kinds, in this new chapter I will collect some screenshots, just with a title and a few brief comments, leaving the images the right weight and trying to arouse personal interest for subsequent insights that will be made by following the instructions of the developer of the individual software indicated.

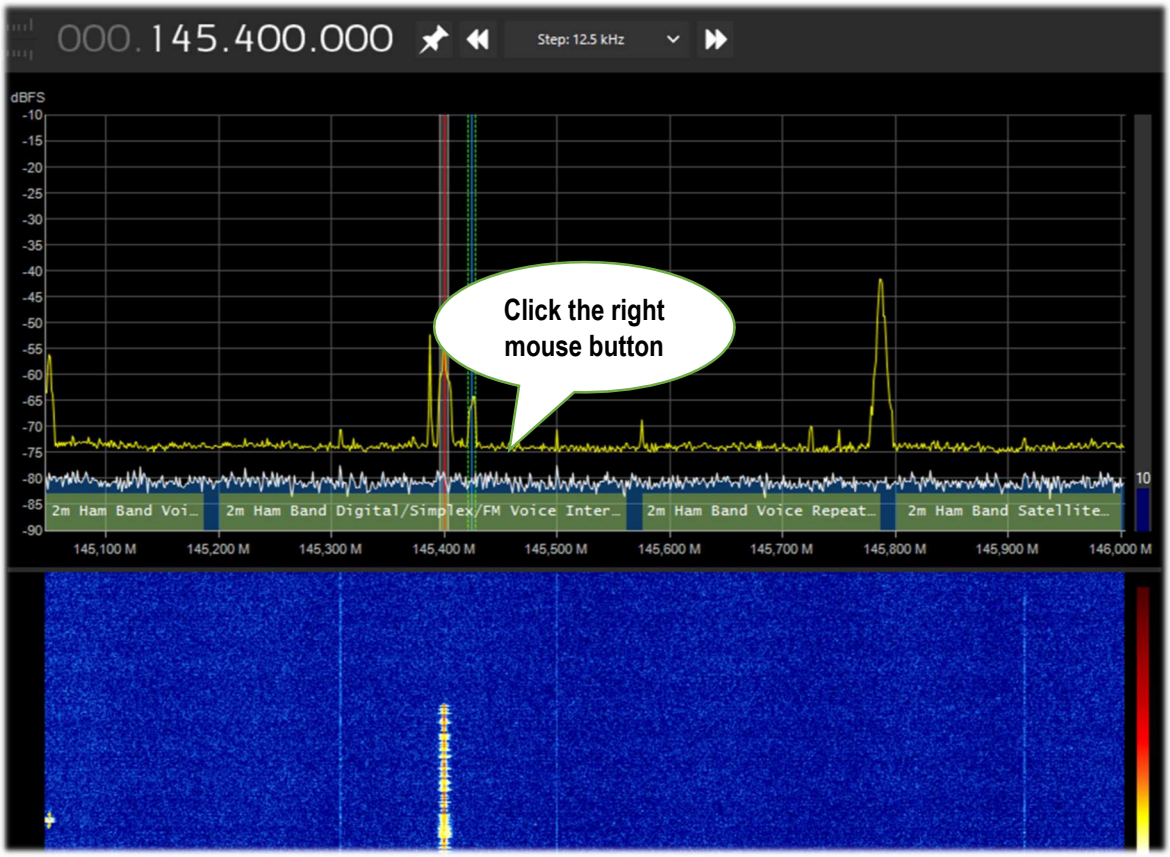
I would like to point out that ALL third party applications are made by different individuals/companies who have no connection to SDR# and AirSpy. Third-party applications are stand-alone programmes that add or complement functionality.

WARNING! SOME OF THESE SYSTEMS IT COULD BE ILLEGAL IN YOUR COUNTRIES! Check carefully and thoroughly the regulations in force in your country. Some of this radio system was specifically designed for use by government, emergency services, for public safety networks, etc etc. who all share spectrum allocated to a city, county, or other entity.

The legendary yellow 'peak colour' line (see RF Spectrum feature) SDR#: RF Spectrum + right mouse button

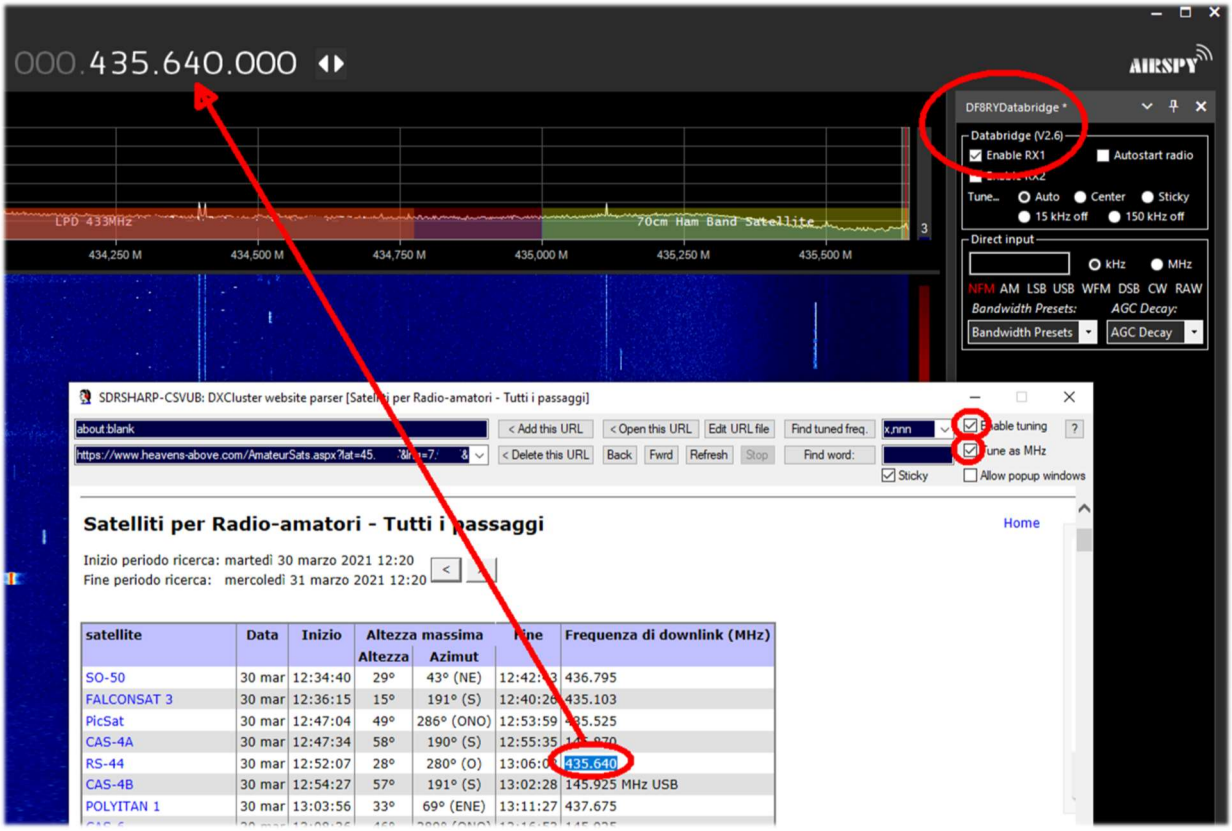
I find this option very interesting, a kind of chronological memory of the RF Spectrum. In the example, in the amateur radio band 2 meters, already after a few minutes you can see the peaks of the stations that have been activated and, positioning the mouse over them, you can read the frequency and intensity of the signal received.

An idea could be to use it in some portions of the spectrum not well known and after a few hours to see what has occurred ... a bit like going fishing with our SDR 😉

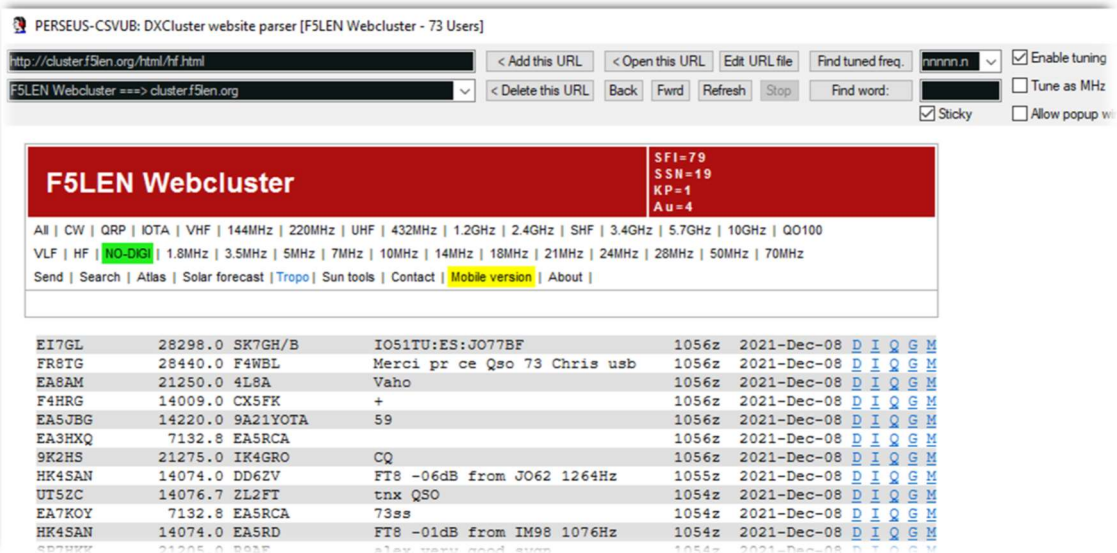


Tune a frequency with a simple move
SDR# + CSVUB plugin in “frequency parser” mode

With CSVUB plugin, previously mentioned, it is possible to tune the VFO of SDR# only highlighting the frequency taken from a site like DXcluster or, as in the following example, from a site of calculation of radioamateur satellite transits.
Enable the DF8RYDatabridge plugin (top right) with the flag on "Enable RX1" will access from the menu WEB / DX CLUSTER WEBSITE PARSER (or with Ctrl+Shift+D keys) where you will choose the URL to which we want to connect…
Really convenient and very fast!!

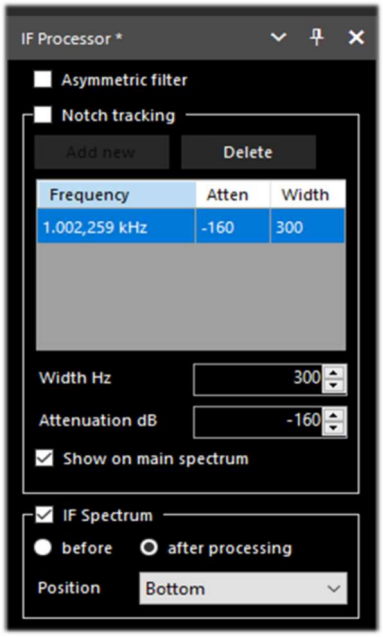


The same thing is possible in HF with one of the many radioamateur Webclusters even more interesting...

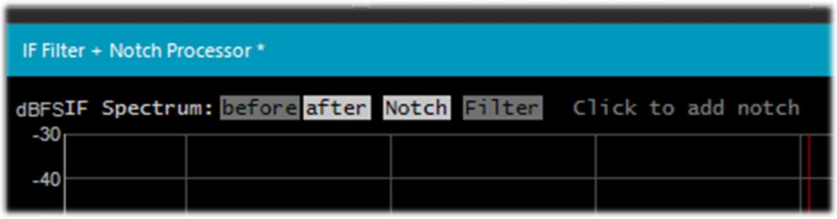


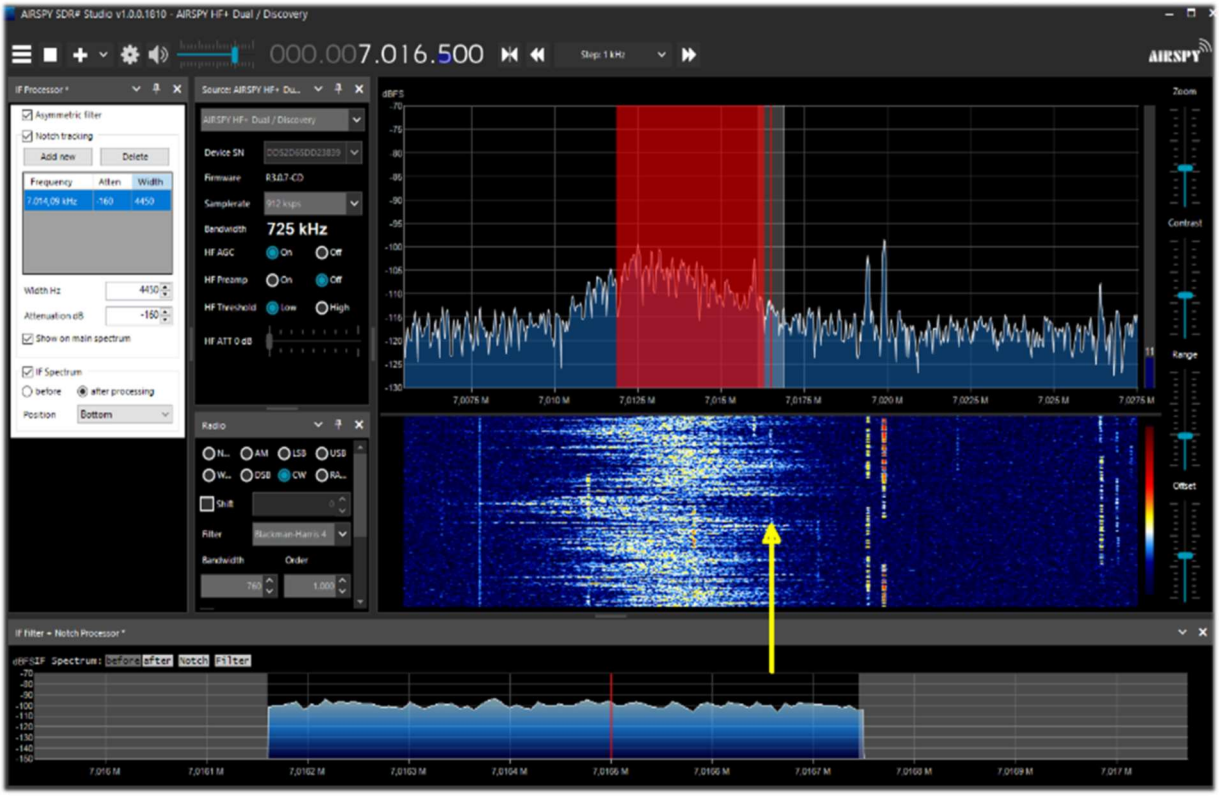
How to eliminate unwanted signals
SDR#: IF Processor, Notch and IF Spectrum

Inserting the DLL "SDRSharp.DigitalIfProcessor.dll" in the plugins directory makes the **IF Processor** available.



The power of its "Asymmetric filter", the multiple "Notch tracking" and "IF Spectrum" with multiple functions allow to eliminate entire portions of frequencies that in some circumstances can create serious interferences...



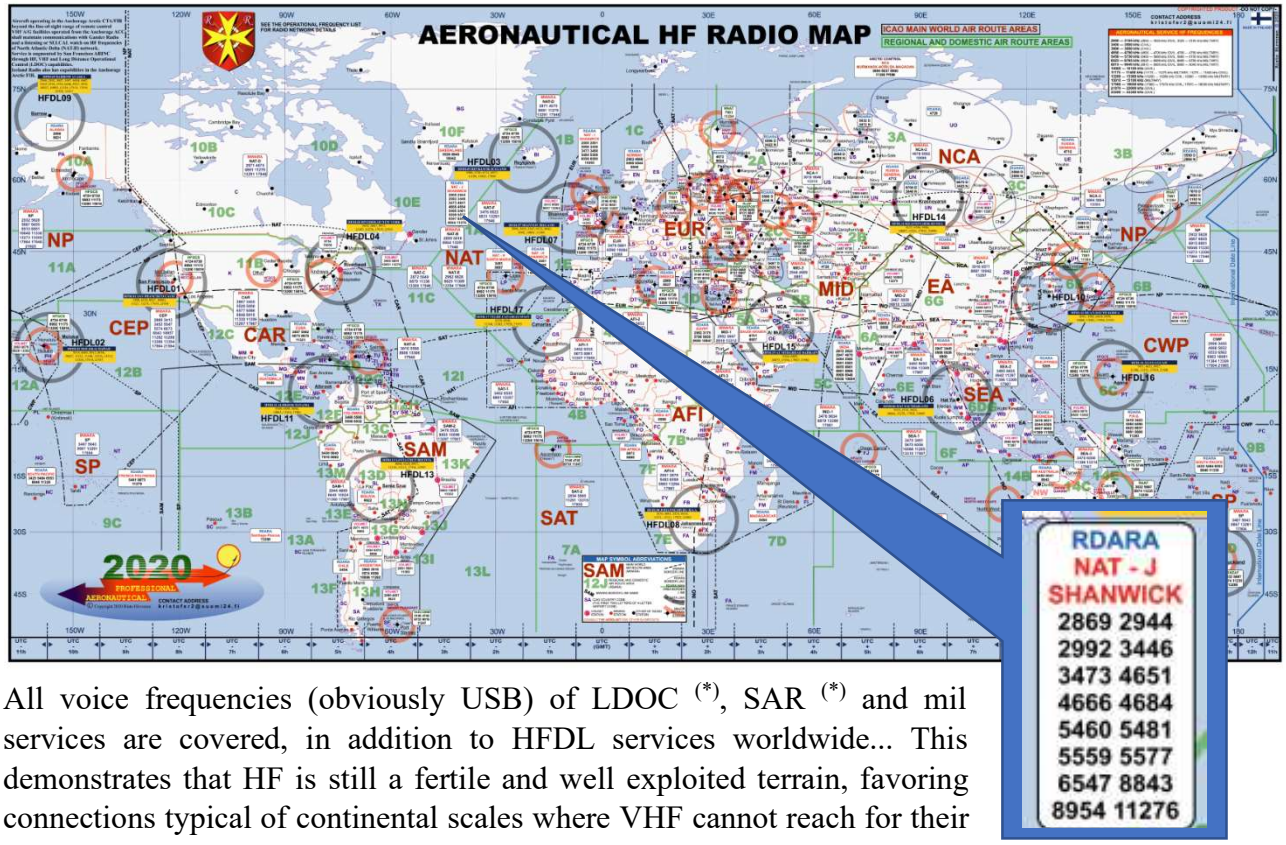


In the screen the red portion a few kHz wide with extreme variable noise that made it difficult to receive the very weak CW signal at 7016.5 kHz (indicated with the yellow arrow)...

Aerolist ...the entire aeronautical world!
AirSpy HF+ Discovery

NEW

An excellent list is Risto's Aerolist (OH2BVB), known by most of us, which reports all HF frequencies used by aircrafts in flight, towers and company operators. The package he distributes for a modest fee includes an Excel file with three thousand records, MWARA (*), Volmet (*), RDARA (*) tables and a large list of high resolution PDF maps and charts as well as many audio samples...



All voice frequencies (obviously USB) of LDOC (*), SAR (*) and mil services are covered, in addition to HFDL services worldwide... This demonstrates that HF is still a fertile and well exploited terrain, favoring connections typical of continental scales where VHF cannot reach for their limited coverage.

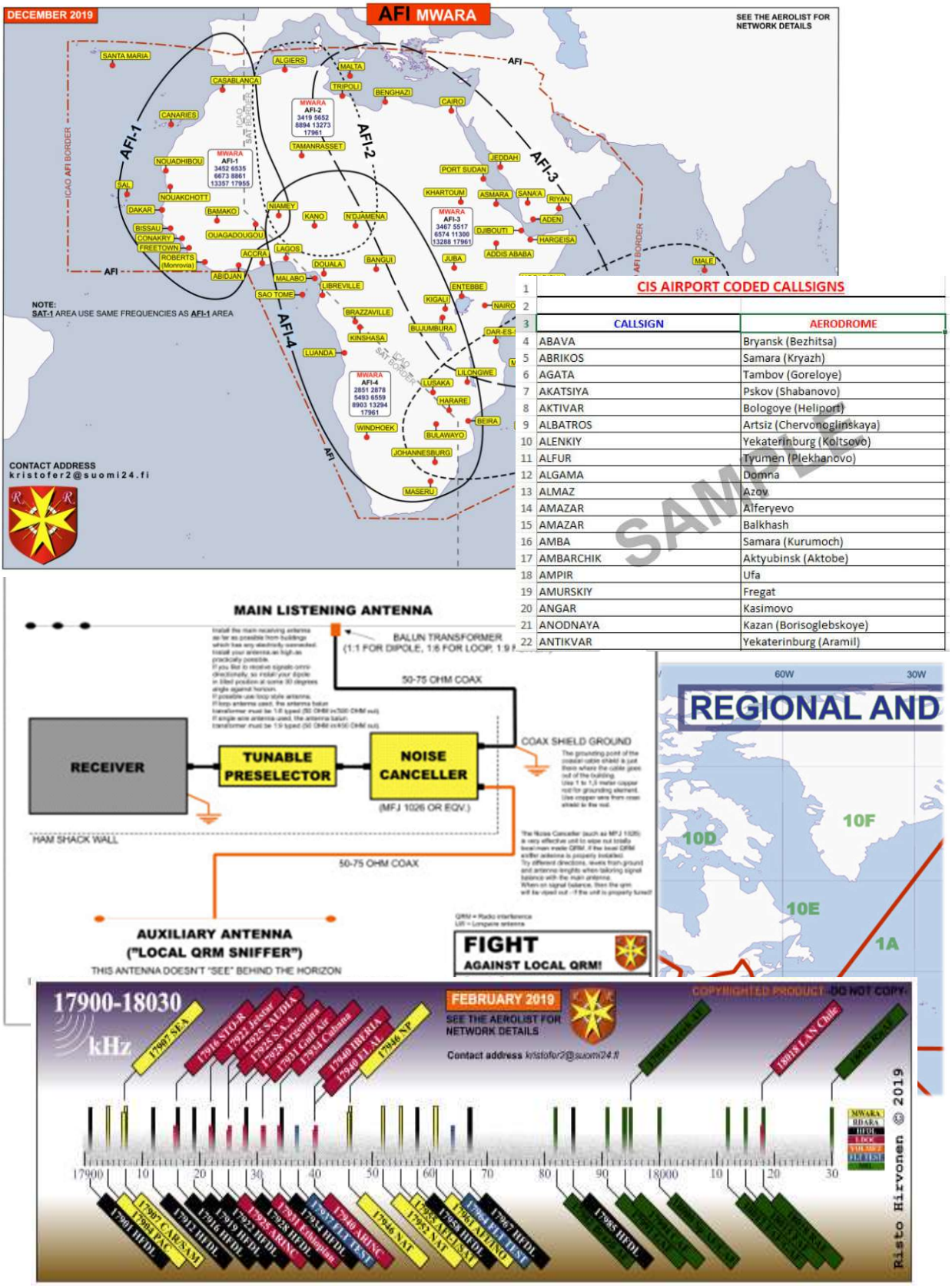
All aircraft crossing continents and oceans must still be able to rely on shortwave to contact air traffic controllers, assisted of course by satellite communications and new technology (though not all of it always available in certain transpolar routes or where satellite coverage is poor or critical).

5643		DEC19	MWARA SP	Auckland OAC (SP-6), San Francisco OAC (SP-7), Nadi ACC (Fiji) (SP-6/7), Tahiti (Papeete) ACC (SP-7), Brisbane OAC (SP-6), Nauru Is. ACC, Pascua ACC (Easter Is.)
5646			ITU ALLOCATION	MWARA NCA
5646			ITU ALLOCATION	RDARA 12G
5646		JUL13	LDOC	SAUDIA, Jeddah (Domestic flights)
5646	1		MWARA NCA-1	Khanty Mansiysk, Syktyvkar, Yekaterinburg, Vologda
5649			ITU ALLOCATION	MWARA NAT SEA
5649		SEP20	MWARA NAT-C	Gander OAC, Shanwick OAC, Iceland (Reykjavik) OAC; (Central and Northern routes with aircrafts registered east of 30W)
5649	1		MWARA SEA-2	Sanya ACC, Singapore ACC, Manila ACC, Bangkok ACC, Phnom Penh ACC, Hong Kong ACC, Vientiane ACC, Hanoi ACC, Ho Chi Minh ACC, Kota Kinabalu ACC
5650		JUL20	VOLMET/R	Khanty-Mansiysk meteo. The WX information of areas Noyabrsk, Khanty-Mansiysk, Salekhard, Tomsk. Transmission 15 minutes by russian language and 15 minutes by english. Then again by russian language 15 minutes, then by english, endlessly. Taped information. Automated female voice. Federal Air Transport Agency/Aeronautical Information Service.
5652			ITU ALLOCATION	MWARA AFI CWP
5652		FEB10	MWARA AFI-2	Algiers ACC (Maghreb Control), Niamey ACC (East sector), Tripoli ACC, Maiduguri ACC, N'Djamena ACC, Tamanrasset ACC, Ghardaia (Noumerate ACC)
5652		FEB17	MWARA CWP	Tokyo OAC, San Francisco OAC
5652		JAN17	HFDL	Riverhead (New York USA) [4]
5653	A	OCT08	UNID	Greek/YLOM/110CT02/0418UTC // 01OCT08/0632UTC/Calling [...TIRO TREA...]
5654	A	NOV13	UNID	RR/2OM/13NOV2013/1558UTC/Station c/s LODA-40 and KARLOTA-57/Suspected russian MIL AERO
5655			ITU ALLOCATION	MWARA EA SEA
5655		APR20	MWARA EA-2/SEA-2	Singapore ACC, Manila OAC, Hong Kong ACC, Kuala Lumpur ACC [LUMPUR], Ho Chi Minh ACC, Vientiane ACC, Sanya ACC, Hanoi ACC, Bangkok, Phnom Penh, Guangzhou, Irkutsk, Pyongyang, Ulaanbaatar
5655		SEP20	HFDL	Hat Yai (THAILAND) [6]

AERADIOS 2020 | MWARA FREQ | RDARA | HFDL | VOLMET | DELETED INFO | ABBREVIATIONS & COLOR STATUS

SAMPLE

A recent email exchange with the author confirms to me that he has made a major update for the operating frequency list which is now updated for the year 2022. A minor update has also been made to the HF world radio map.



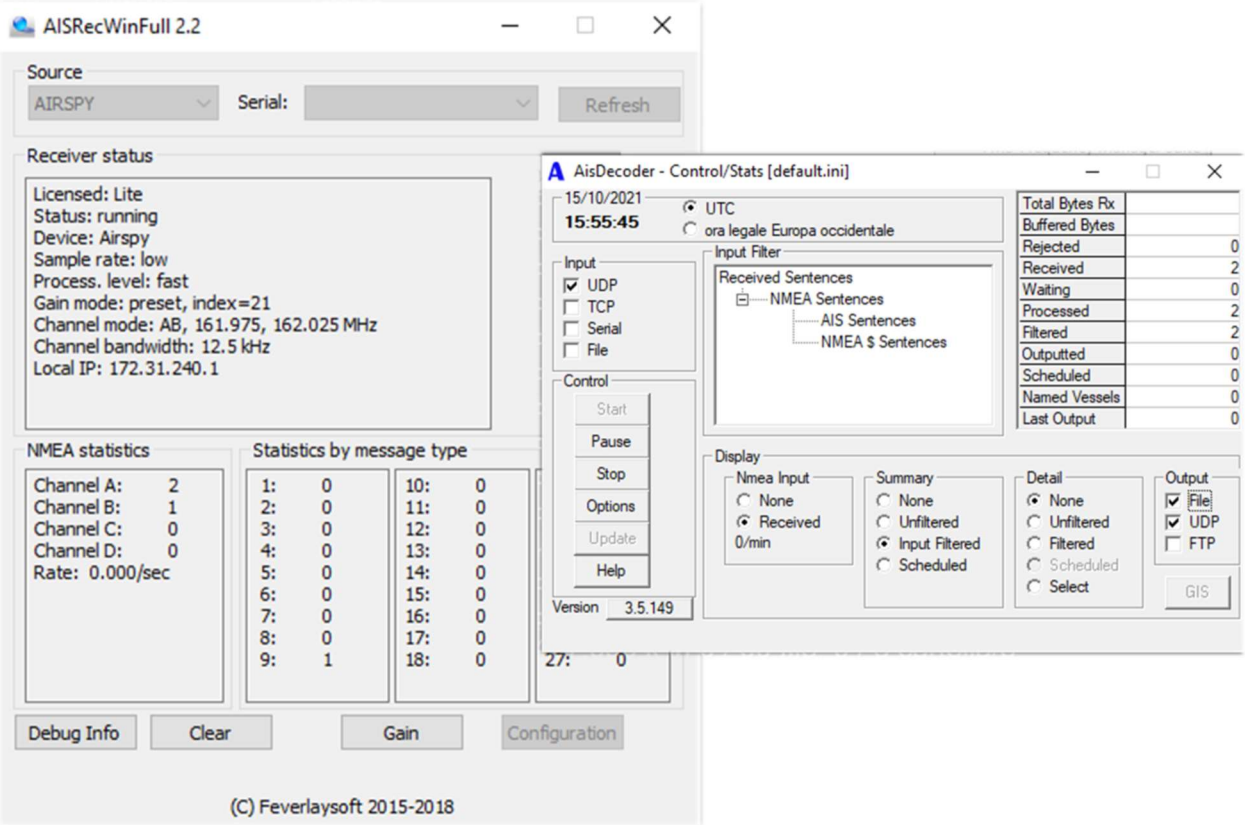
	CIS AIRPORT CODED CALLSIGNS	
1		
2		
3	CALLSIGN	AERODROME
4	ABAVA	Bryansk (Bezhitsa)
5	ABRIKOS	Samara (Kryazh)
6	AGATA	Tambov (Goreloye)
7	AKATSIYA	Pskov (Shabanovo)
8	AKTIVAR	Bologoye (Heliport)
9	ALBATROS	Artsiz (Chervonoglinskaya)
10	ALENKIY	Yekaterinburg (Koltsovo)
11	ALFUR	Tyumen (Plekhanovo)
12	ALGAMA	Domna
13	ALMAZ	Azov
14	AMAZAR	Alferyevo
15	AMAZAR	Balkhash
16	AMBA	Samara (Kurumoch)
17	AMBARCHIK	Aktyubinsk (Aktobe)
18	AMPIR	Ufa
19	AMURSKIY	Fregat
20	ANGAR	Kasimovo
21	ANODNAYA	Kazan (Borisoglebskoye)
22	ANTIKVAR	Yekaterinburg (Aramil)

SAMPLE

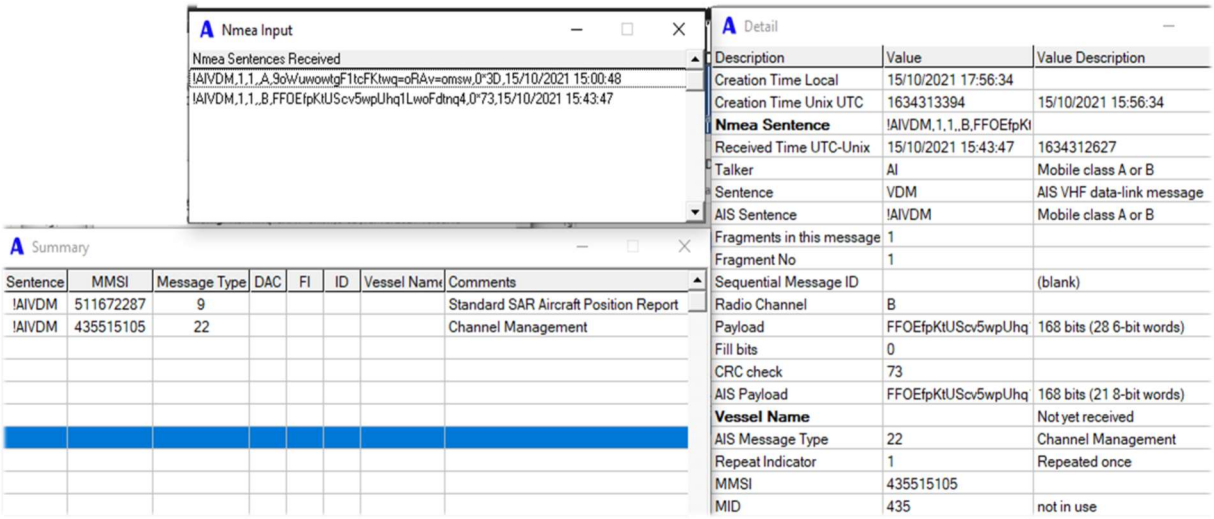
For many more examples and informations this the reference site: ***http://www.elisanet.fi/bvb1438/***

AIS …to navigate a bit virtually!
AirSpy R2 with software AISRec + AIS Decoder

In the vicinity of the coast it is easy to come across two VHF frequencies in the nautical band that H24 transmit AIS spots (*): 161.975 and 162.025 MHz.
The AISRec software for Windows allows you to simultaneously receive the two signals in IQ format and extract the NMEA sequences to send them via UDP to another software (AIS Decoder) for decoding all 27 types of AIS messages provided...



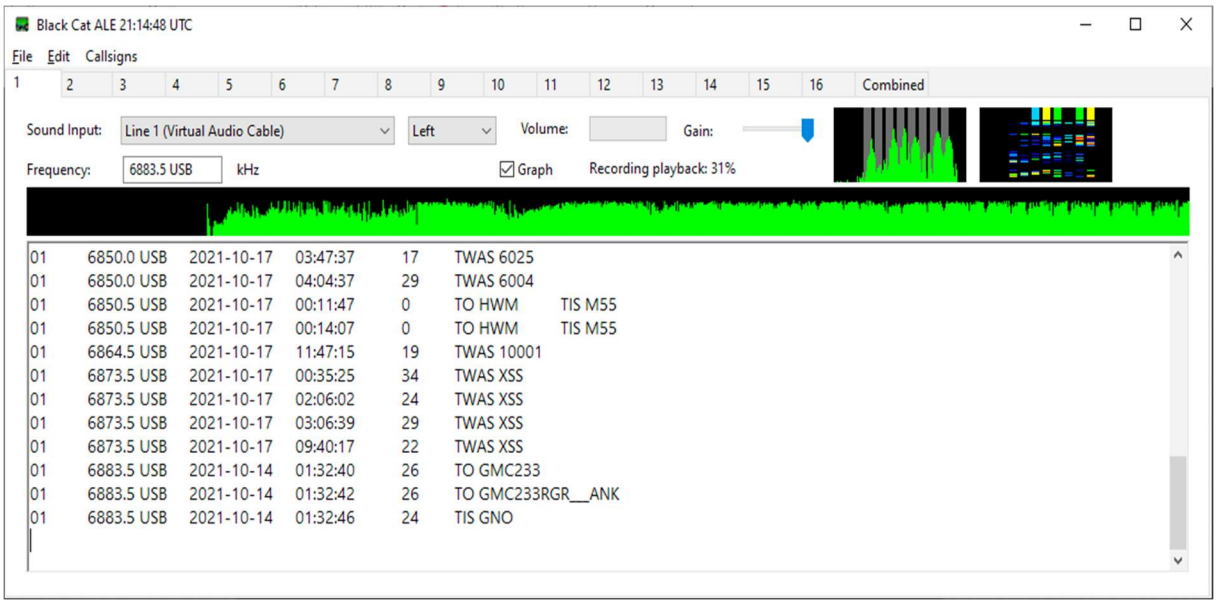
To complete the thing
, it is also possible to combine a map (e.g. with the OpenCPN freeware) which, thanks to the geographical coordinates received, makes it possible to display the position of vessels and various fixed stations received by our receiving system...



ALE …a new decoder, indeed a multi-channel decoder! AirSpy HF+ Discovery and software Black Cat ALE

HF is always fertile ground for developers with new ideas and strong technical knowledge...

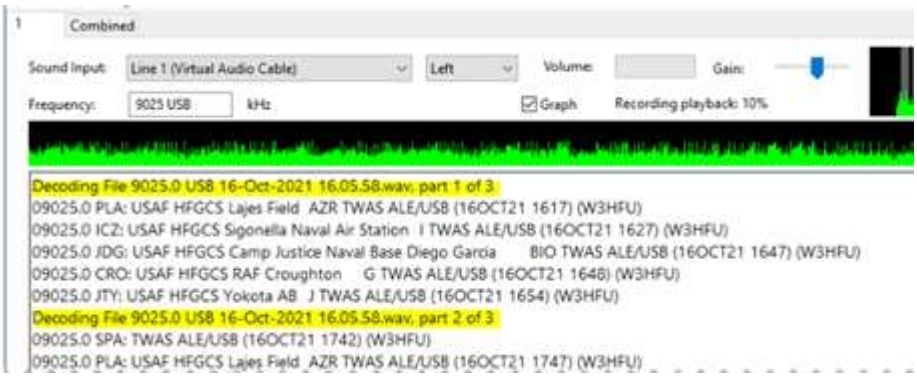
It is still in beta but you can download the demo that allows you to try for 30 days a software with extreme sensitivity compared to other software used by fans for a long time and with the ability to use up to 24 decoders simultaneously (SDR and computer permitting!).



With the "regular license" you can use up to 3 decoders simultaneously, while you can get up to 24 with the "High performance" mode.
It is possible to monitor in a totally automatic and independent way different frequencies or single net of interest, each one combined to a specific audio channel (example VAC on Line1/2/3/x).
Each decoder/tab will display the text (in different formats provided in the software) in a special screen 1/2/3/x, while in the "Combined" one there will be the result of all individual channels.

Other innovative features are:

- Use previously recorded audio files or WAV samples present on the network (even more than one at the same time) with an impressive decoding speed (even 10 times the real one)!



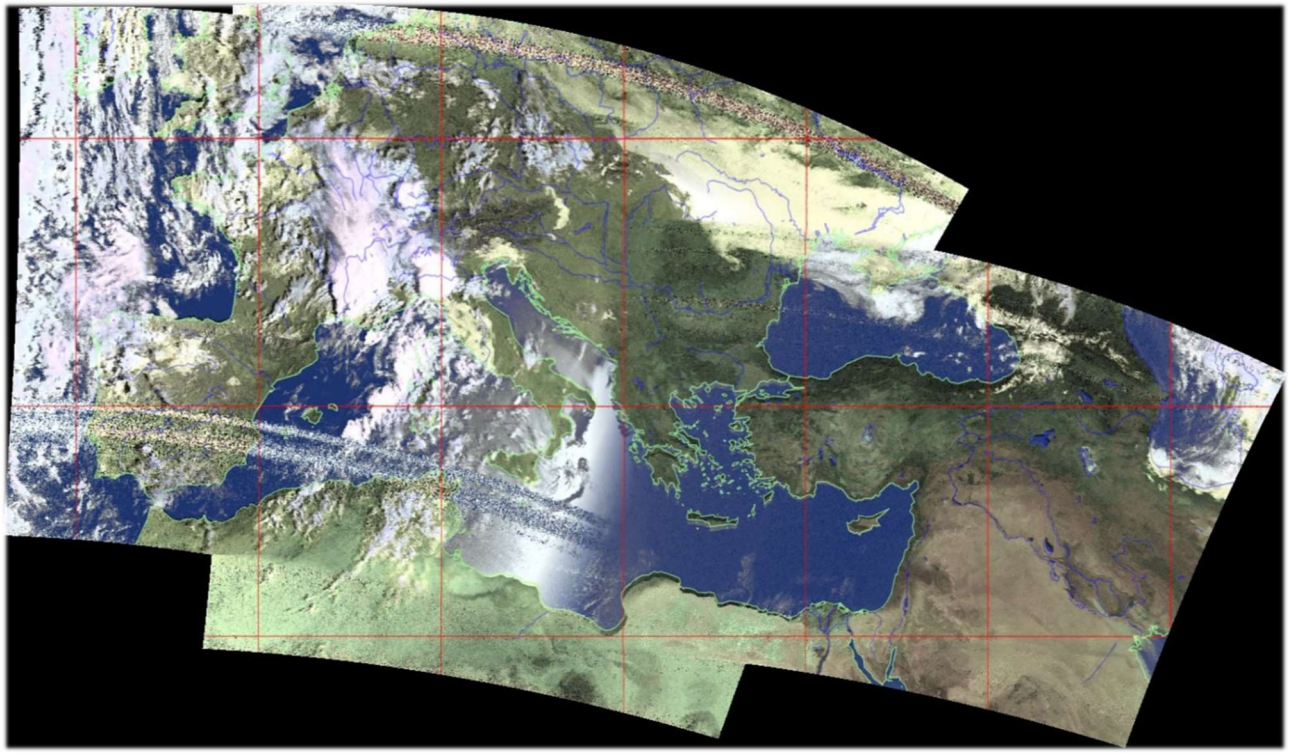
- Creation of Logs with different custom formats, also for the UDXF Bulletin Board
- Other features still under development to work on specific Callsigns / Net / ...

I have write a PDF guide that can be downloaded here:
https://blackcatsystems.com/download/BlackCatALEGuide.pdf

APT NOAA images mosaic…
AirSpy R2 with software WXtoImg

WXtoImg is one of the best software for fully automated decoding of APT and WEFAX (WXsat) weather satellite signals.
The software allows recording, decoding, editing and viewing in Windows, Linux and Mac OS X.

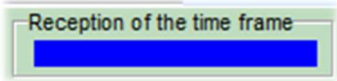
It supports real-time decoding, map overlays, advanced color enhancements, 3-D imagery, animations, multi-pass imagery, projection transforms (e.g. Mercator), text overlays, computer control for many satellite weather receivers, and much more...

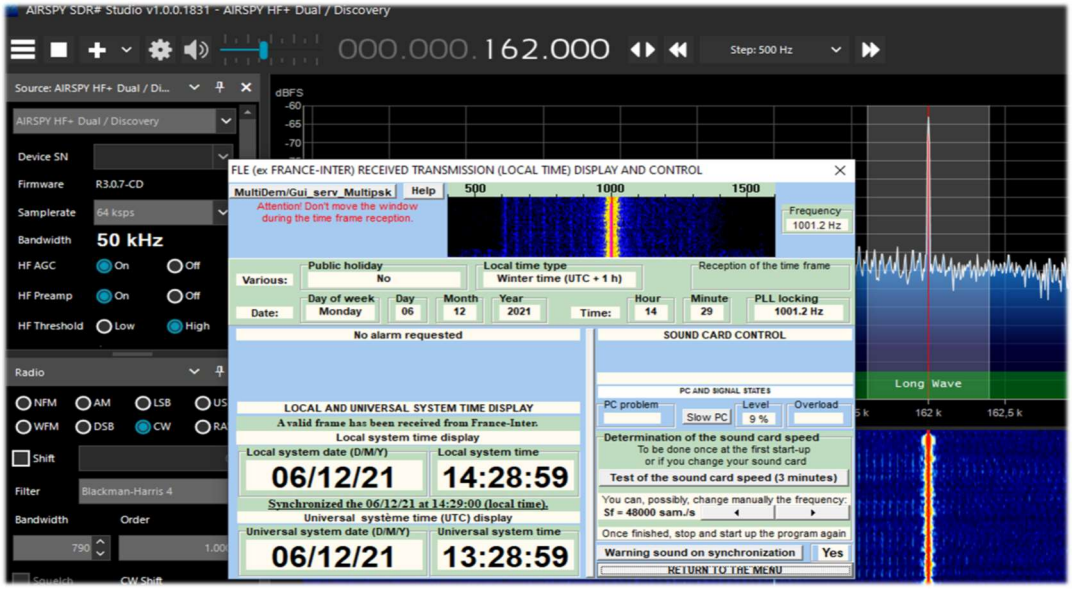


This a mosaic of images captured in September 2021 by friend Rob (IZ0CDM) assembling the output of signals received from the following satellites at later times:
NOAA15 06:52 UTC,
NOAA19 07:18 UTC,
NOAA18 07:59 UTC...

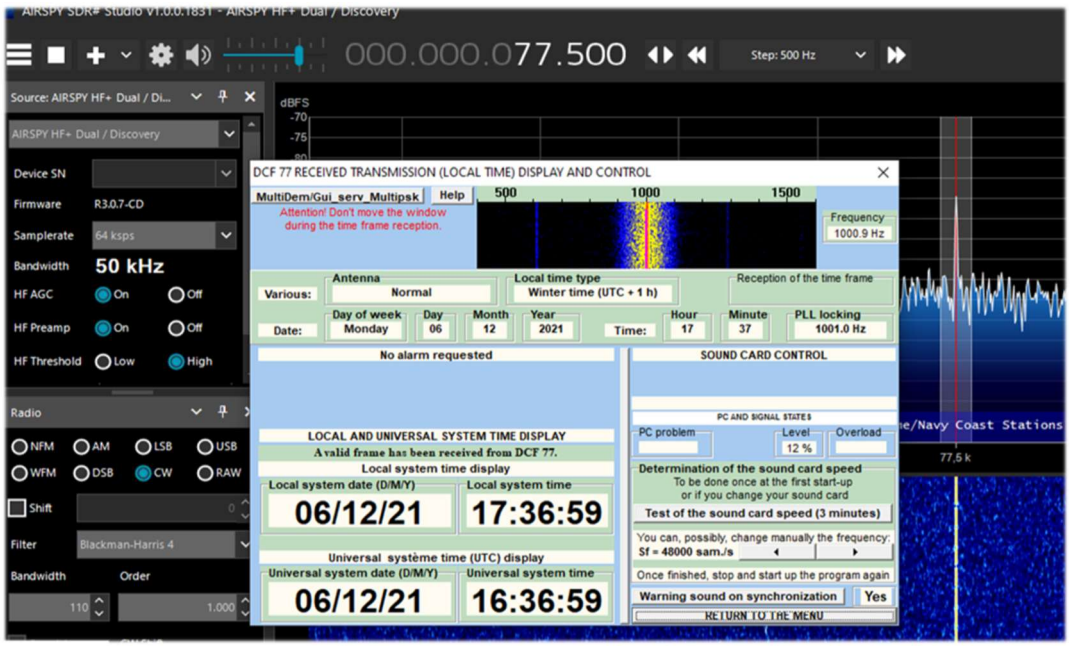
CLOCK, to synchronize via radio the time of your computer AirSpy HF+ Discovery

"Clock", included in "MultiPSK" Windows software by Patrick Lindecker (F6CTE), provides date and time by decoding time frames received via radio from FLE (ex France-Inter), DCF77, HBG, MSF, BBC, WWVB, WWV, WWVH, CHU, RAI, JJY, or via GPS or the Internet.
In addition, you can synchronize the local (current) and universal time (UTC) of your computer with the time received by radio! After synchronization (confirmed with a loud beep) the computer clock will be accurate to within 1 second with the real time.
In the following screen, received on 162 kHz frequency of FLE (ex Radio France-Inter), once the signal is locked and confirmed by PLL Locking (in my case demodulated in CW), the field "Reception of the time frame" will be initially colored blue and after a while the decoding of the data of "Public holiday", "Local time type", "Minute", "Hour" and at the end of each minute of the remaining information: "Day of week, Day, Month, Year".





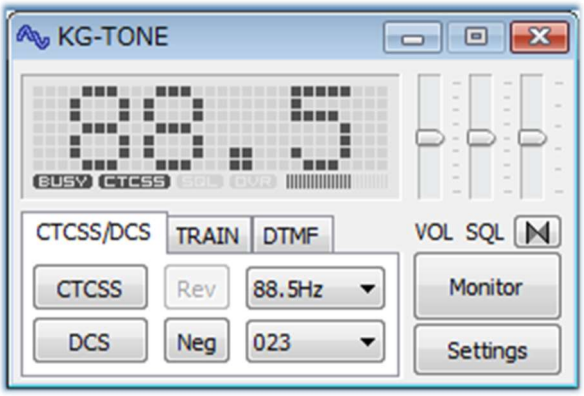
While the following, similarly, is a time frame of DCF77 (Mainflingen, Hesse, Germany) received by tuning at 77.5 kHz frequency.



Decoding CTCSS / DCS / DTMF /…
Software KG-TONE

A very good external software to help identify unknown radio link signals using subaudio tones (or CTCSS) and/or DCS digital codes.

It's called KG-TONE and it's free. The latest release for Windows XP/Vista/7 is 1.0.1 (Dec'2011) at: ***http://www2.plala.or.jp/hikokibiyori/soft/kgtone/kgtone.zip***



In KG-TONE, the following sources were provided as input signals in menu "Settings / Wave input device" *(useful to know as SDR receivers were not contemplated at the time):*

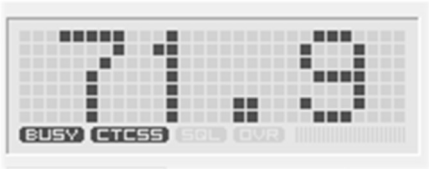
FM voice - obtained from the headphone socket or the loudspeaker socket, is not always good, as the audio path may be filtered in later stages (e.g. the elimination of audio subtones!).
FM detect – i.e. the signal taken before filtering by subsequent stages of the receiver: for decoding purposes it is better than the previous one.
12 kHz I/Q – the I and Q components are samples of the same signal detected orthogonally in phase and therefore contain different informations. With their separation it is possible to measure the relative phase of the signal components, which is useful not only for FM demodulation. This is the best mode, ideal for signal analysis and can be processed directly by the software without any loss. The manual at the time stated to check if your receiver was equipped with a 12 kHz I/Q output socket and referred only to the AOR-5001D and ALINCO DJ-X11 receivers.

Translated directly from Japanese (in the hope of interpreting it correctly from the brief instructions included with the software), I provide a comprehensive table of all the decoding possibilities in the various modes:

Source signal type	NQSL	CTCSS	DCS	TRAIN	MSK	DTMF
FM voice (audio)	**C**	**A**	**C**	*	*	*
FM detection	**A**	**A**	**B**	*	*	*
12 kHz I/Q	*	*	*	*	*	*

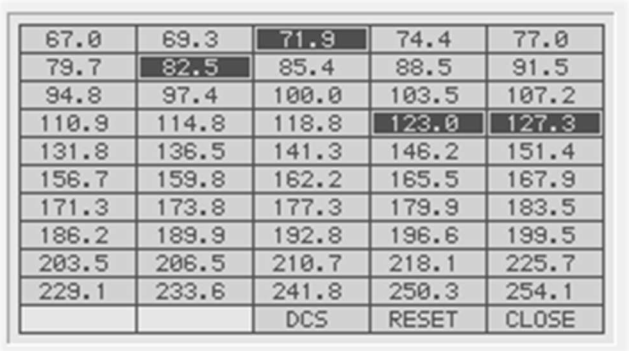
(*) = Possible in many cases
(A) = Possible, but depends on the model
(B) = Impossible, but it depends on the model
(C) = Almost impossible
NSQL = Noise Squelch operation (noise silencing)

Operationally, using with our SDRs, I noticed no difference with the settings set to "Audio" or "Discriminator".



Turn on the audio from e.g. the VAC *(also running the audiorepeater.exe file to keep hearing the audio!)*, choose the audio input in KG-TONE and press the 'OK' button.
The software analyses the signals and displays the detected data in its small, graphically appealing panel. If the audio paths are correct, and the noise squelch is open, the "BUSY" icon and thus the detected tones will be highlighted on the left in bold.

It also has a "COMBO" mode with which you can have a larger underlying panel displaying all CTCSS or DCS and with a useful "memory effect" of all those activated over time appearing on a dark background. *Truly an excellent piece of professional software!*



67.0	69.3	71.9	74.4	77.0
79.7	82.5	85.4	88.5	91.5
94.8	97.4	100.0	103.5	107.2
110.9	114.8	118.8	123.0	127.3
131.8	136.5	141.3	146.2	151.4
156.7	159.8	162.2	165.5	167.9
171.3	173.8	177.3	179.9	183.5
186.2	189.9	192.8	196.6	199.5
203.5	206.5	210.7	218.1	225.7
229.1	233.6	241.8	250.3	254.1
		DCS	RESET	CLOSE

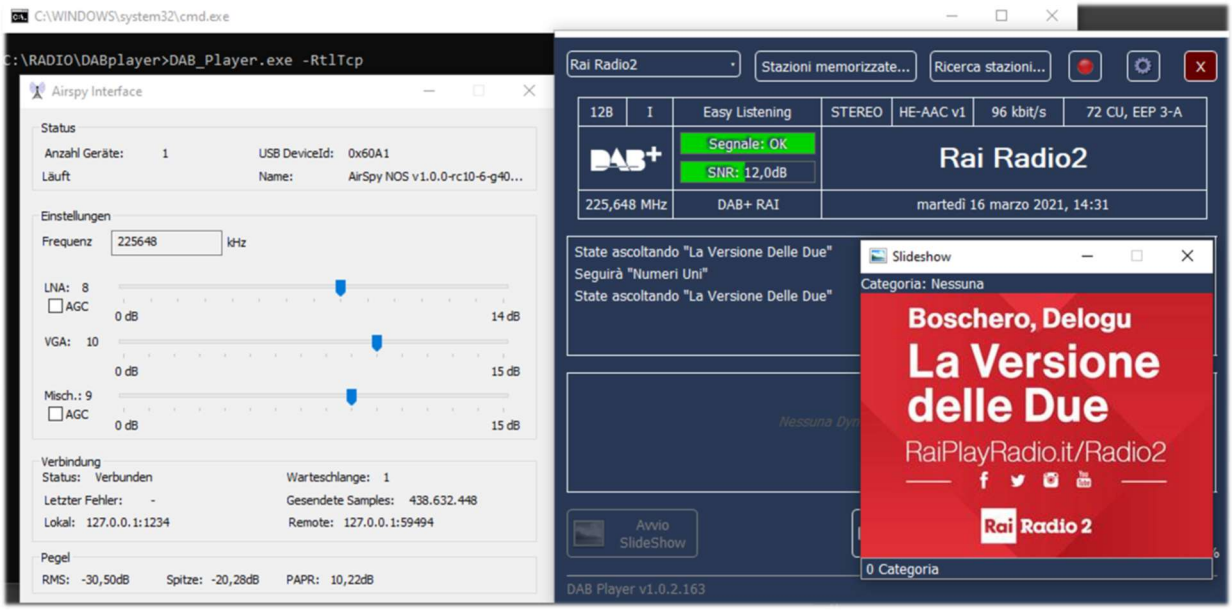
It can also detect DTMF (*) but I was not able to test it for TRAIN / MSK modes, which are not active in my country.

Unless specifically required, the sliders can be held initially in the following positions:

Perhaps few people are aware that by pressing the button *it is also possible to activate an "audio inversion band" decoder and adjust its tone (pitch) by slightly moving the vertical slider above...*

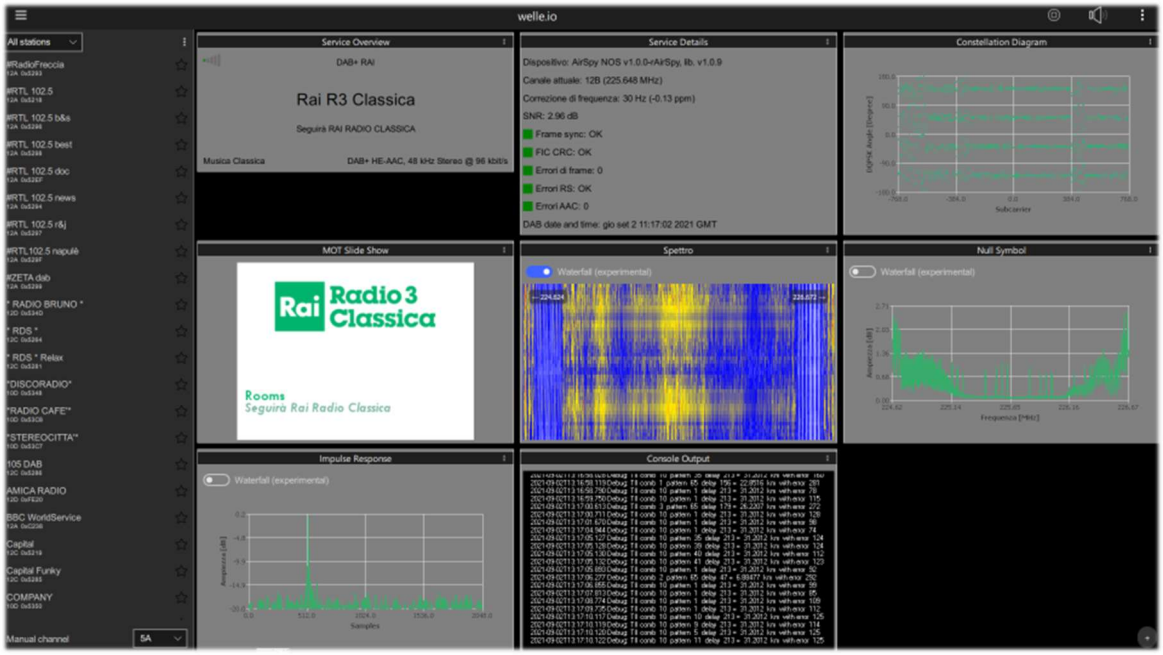
DAB / DAB+ (part 1)
AIRSpy Interface + DABPlayer

Simple but ingenious interface to connect via TCP (*) your AIRspy devices to Andreas Gsinn's DABplayer and enjoy the full DAB (*) content with slideshows, quality recordings and lots of informations on Ensemble, FIC (*), MSC (*) and audio...



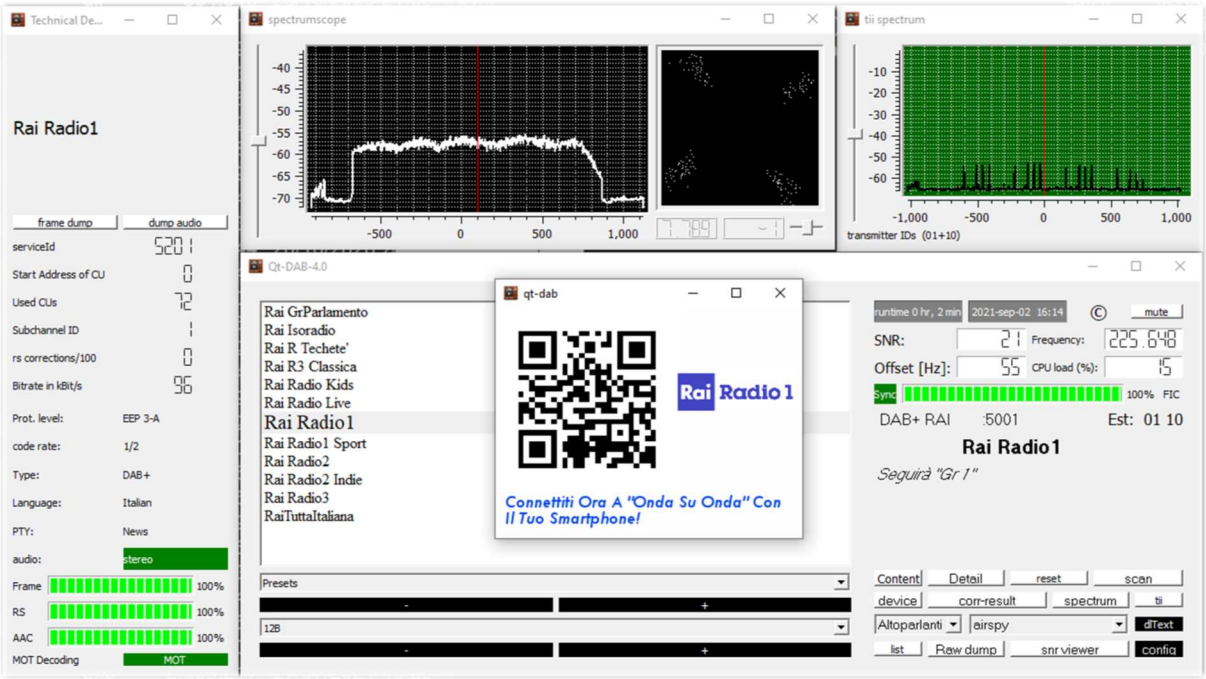
DAB / DAB+ (part 2)
software WELLE.IO

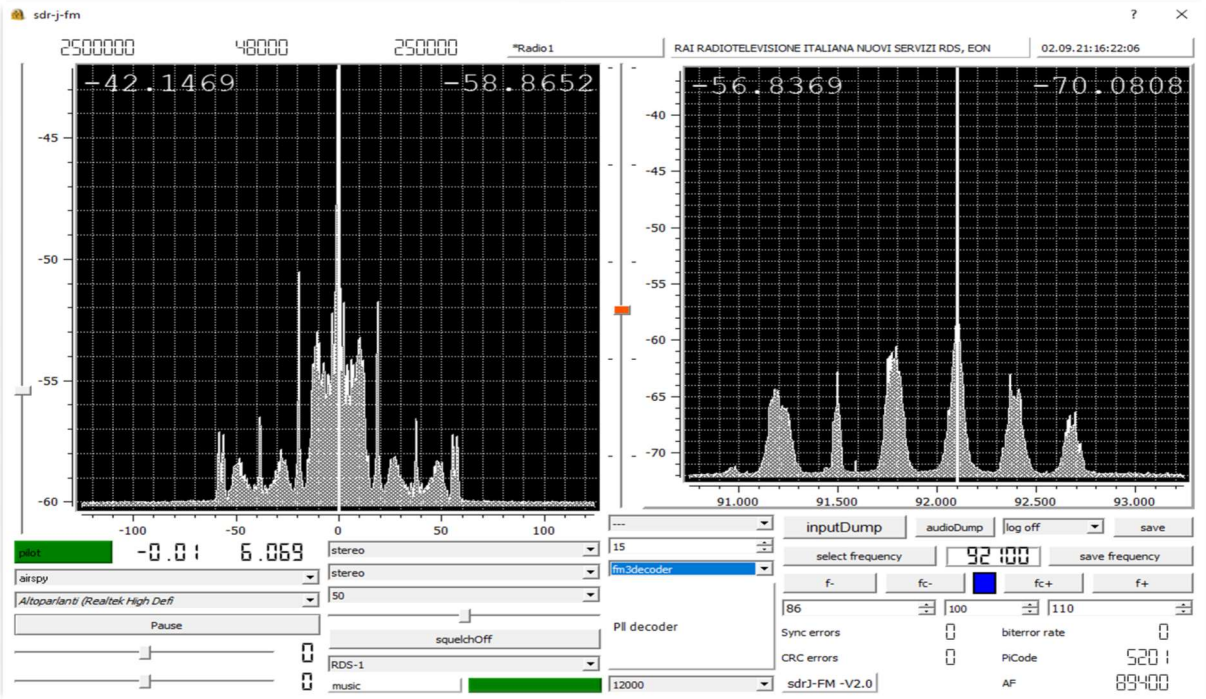
It is an open source SDR (for Windows10, Linux, macOS, Android), with support for Airspy (R2/Mini), RTL-SDR, SoapySDR. It supports high DPI resolutions (*) including touch screen displays and also works on cheap mini computers like the Raspberry Pi 2/3 and various tablets / smartphones.



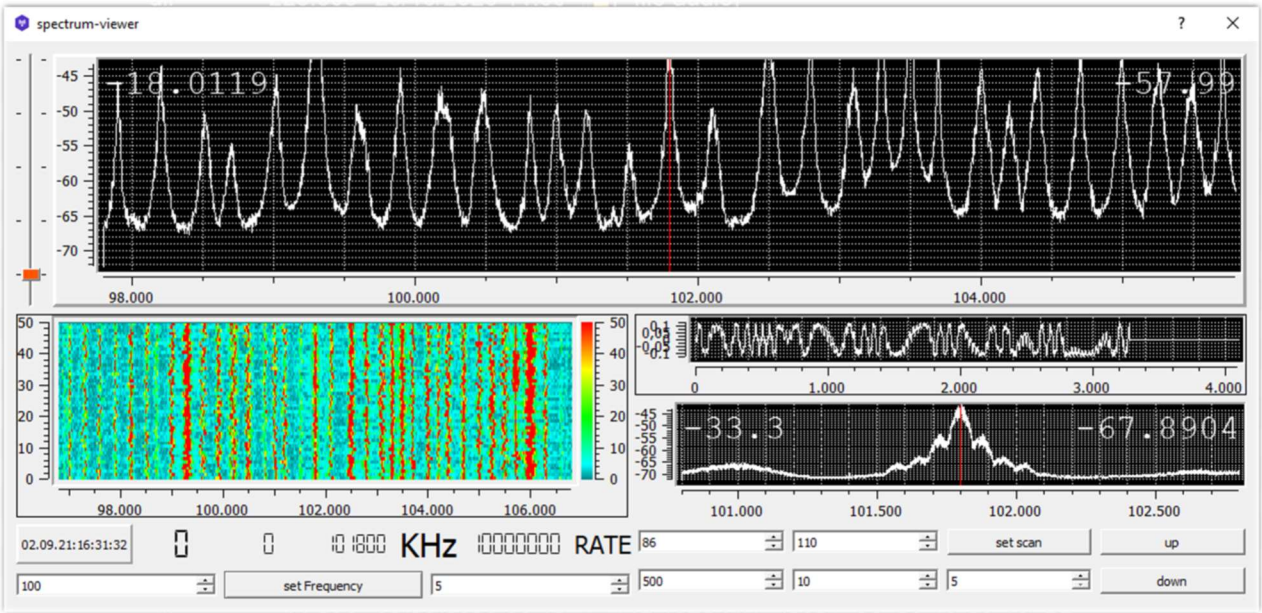
Suite DAB / FM (and spectrum displays) software SDR-J

This is a rich suite of different open source SDR programmes (for Windows and Linux OS) for receiving FM, DAB/DAB+, etc.
Support is for Airspy, HackRF, Lime, Pluto, RTL-SDR and SDRplay. The first screenshot is of DAB+ and the second is of FM reception.

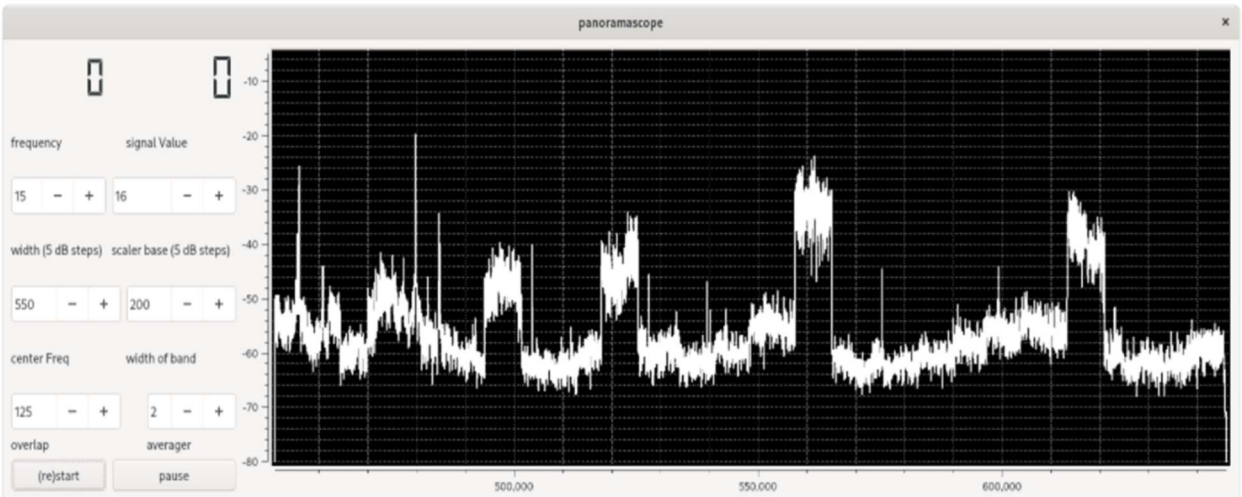




A **Spectrum-viewer** also completes the equipment

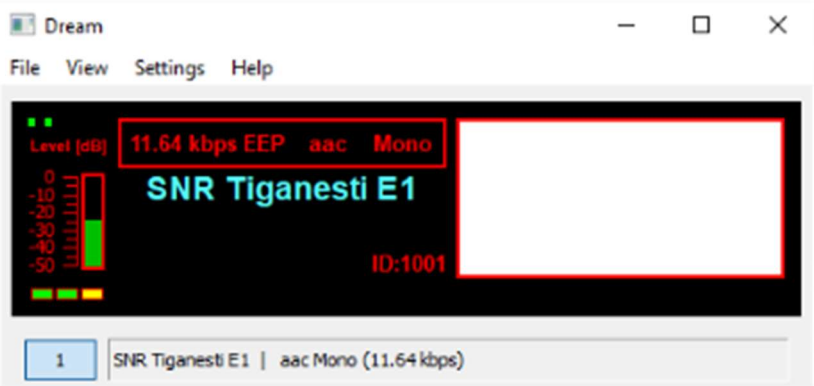


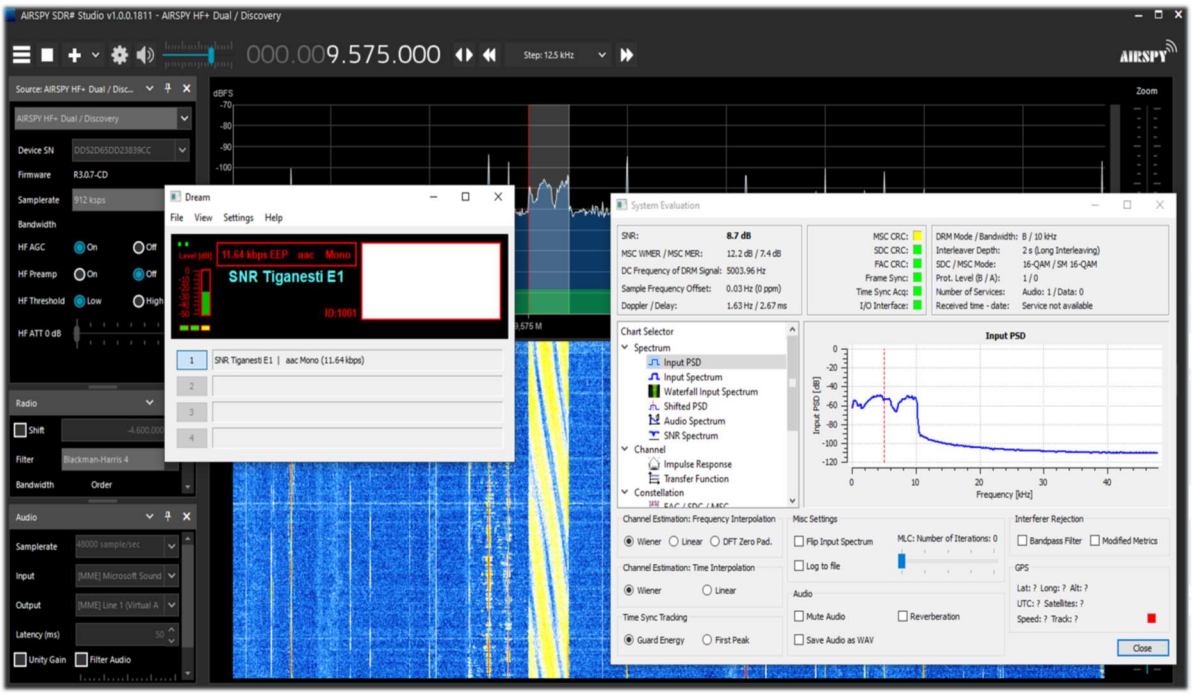
and the **Panoramascope**



DRM in HF
SDR# + DReaM software

Using an AirSpy HF+ Discovery, tuned in USB mode in HF during a DRM (*) transmission it is possible to listen to the programming (also multi-channel) in high quality thanks to the free software DReaM that you can find free here: ***https://sourceforge.net/projects/drm/***





Read DTMF ...without a decoder!
Software Audacity

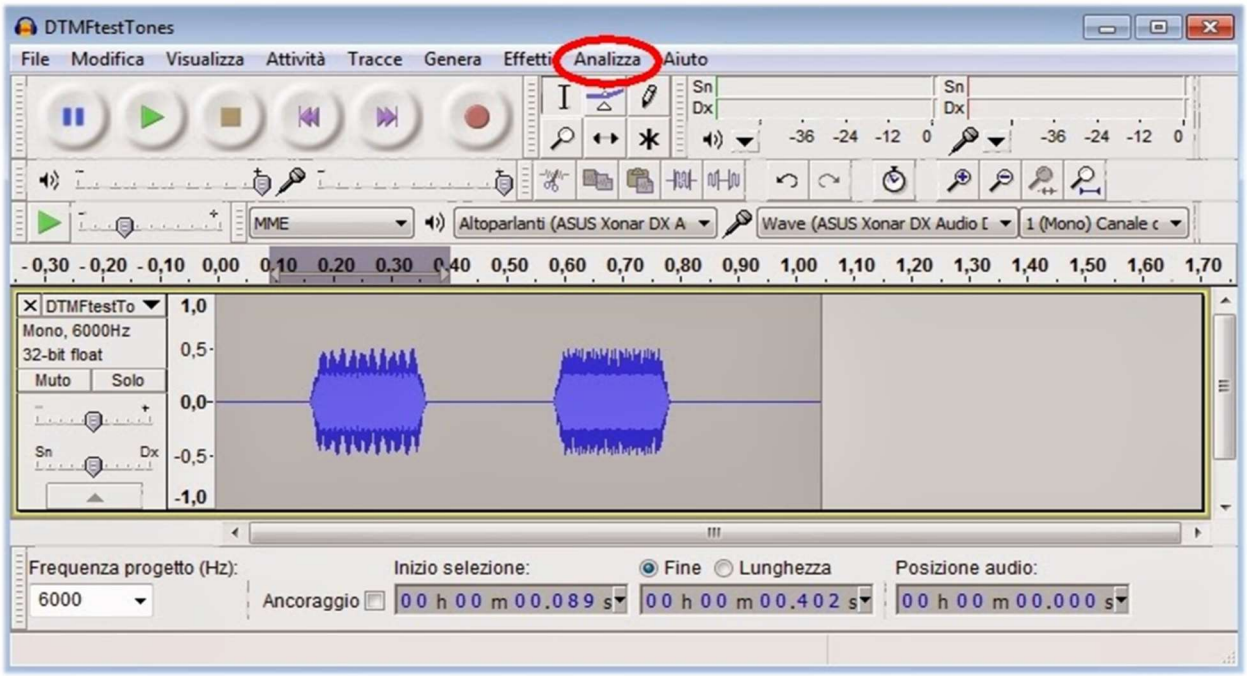
We do not always have a decoder to detect DTMF (*) tones such as the one shown above. So let's see how to easily identify DTMF frequencies (in hertz), which is a coding system created for telephony, at Bell laboratories, to encode numerical codes in the form of sound signals in the audio band.

1	2	3	A	697 Hz
4	5	6	B	770 Hz
7	8	9	C	852 Hz
*	0	#	D	941 Hz
1209 Hz	1336 Hz	1477 Hz	1633 Hz	

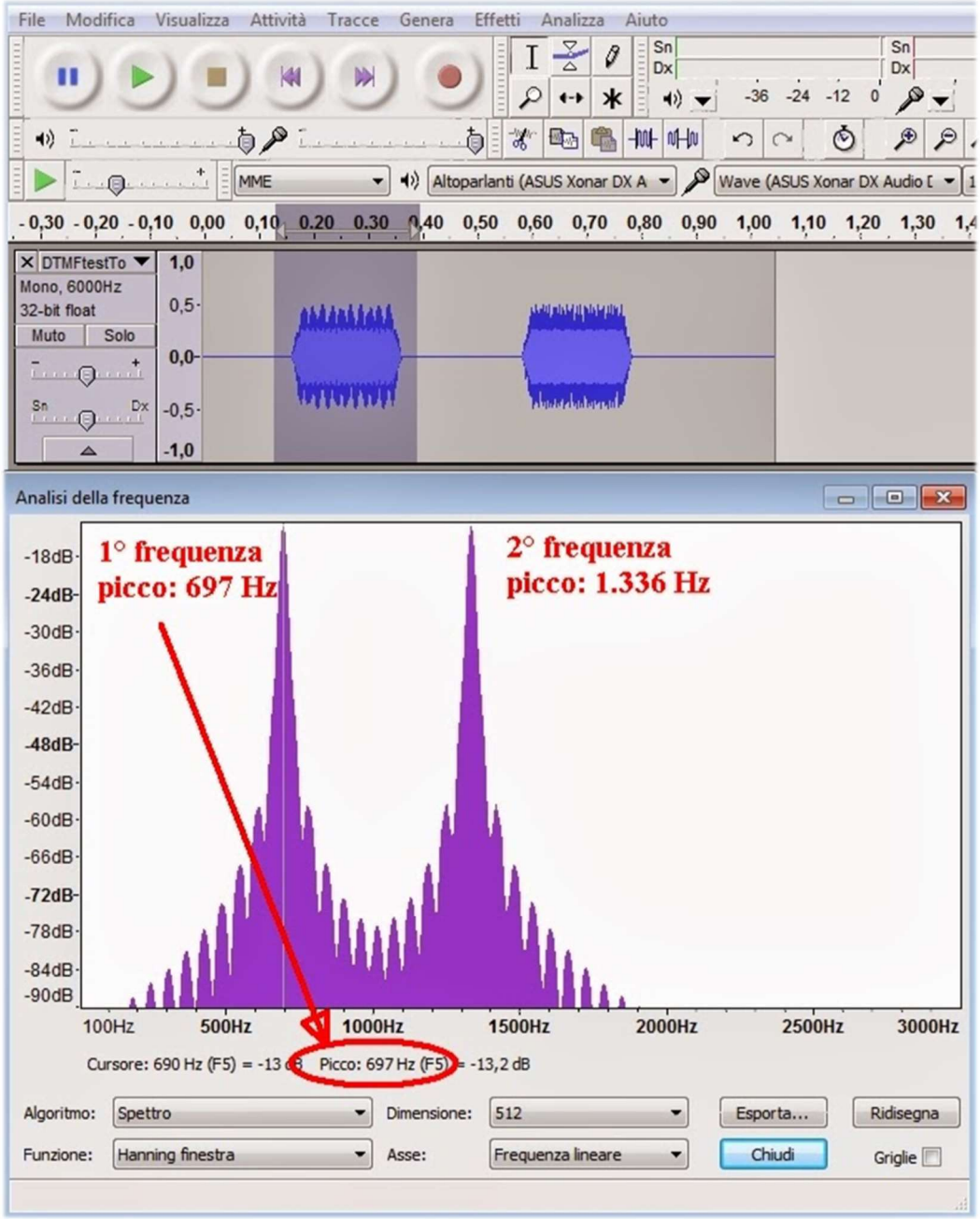
The DTMF keyboard consists of a 4×4 = 16-position matrix, where the row represents a low frequency and the column represents a high frequency. For example, pressing the 2 key generates two sine waves at frequencies of 697 Hz and 1336 Hz.

Rather than using 16 different frequencies for the 16 numbers/letters on the keyboard, 8 different frequencies have been used, with 2 being associated to each key. The term multi-frequency is therefore derived from the simultaneous use of two audio tones.

The frequencies have been allocated appropriately and with good intrinsic safety.
So to start it is necessary to save a WAV file from our SDR and analyse it for example with the freeware software Audacity.



Load the wave file, select the first portion of the DTMF signal, go to the menu "Analyze" and then "Show spectrum" where the program will perform the analysis of the frequencies.



In this window we will position ourselves on the two peak frequencies, reading down the two frequencies at 697 Hz and at 1336 Hz, which from the previous table correspond in fact to the number "2".

Then move to the second audio portion and repeat the analysis.

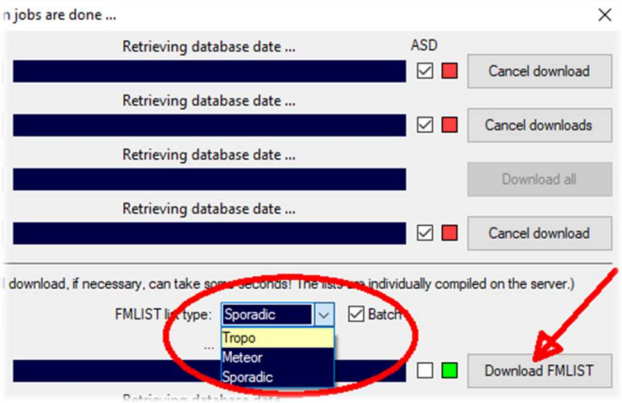
FM e FM-DX
AirSpy R2/HF+ Discovery and CSVUB

I have already written CSVUB extensively in the previous Plugins section, but this time I want to illustrate another of its excellent features in managing FMLIST databases:

https://fmscan.org/index.php

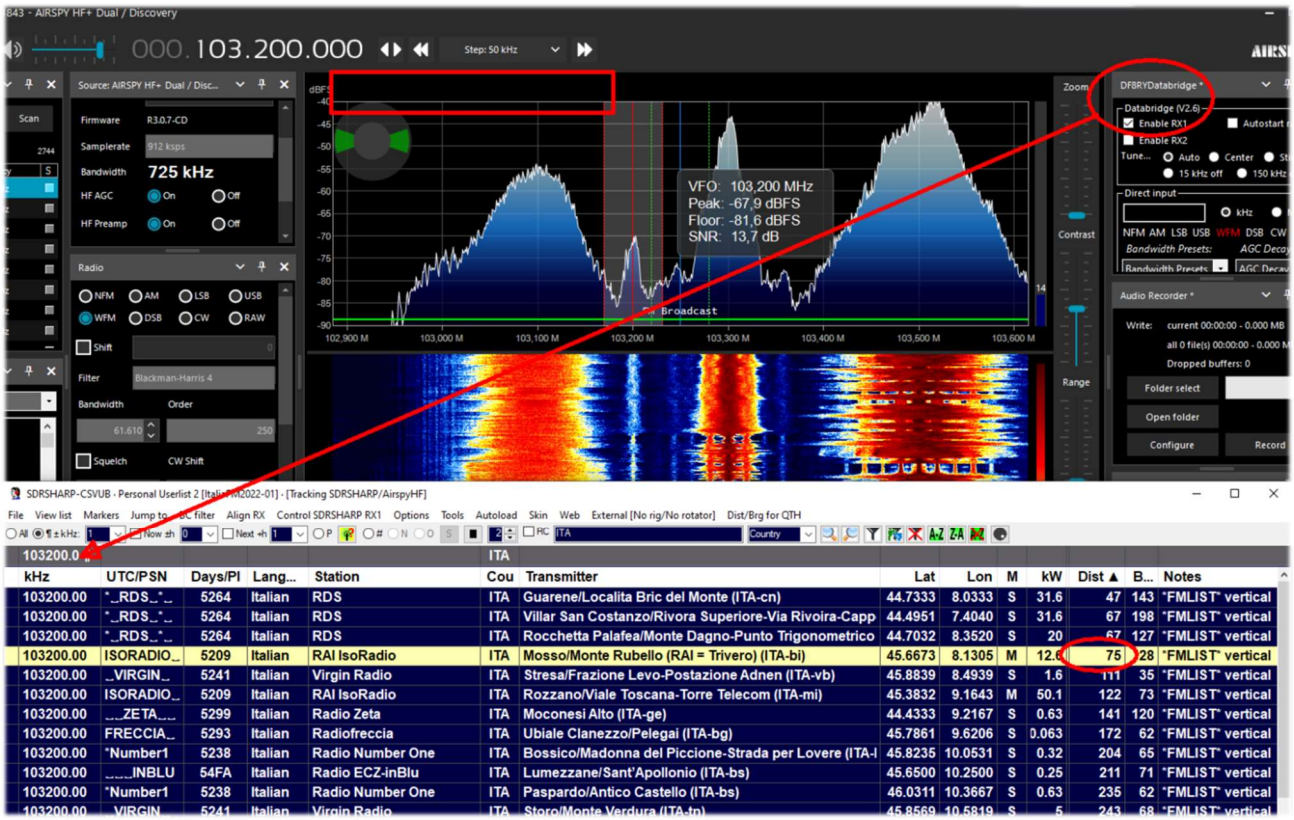
Certainly of interest to all FM and FM-DX (*) enthusiasts, let's look at a few things...

Starting the program we go to TOOL / QTH MANAGER to enter our geographical coordinates, then to WEB / DOWNLOADER-CONVERTER to download one of the three lists or all together by flagging "Batch".



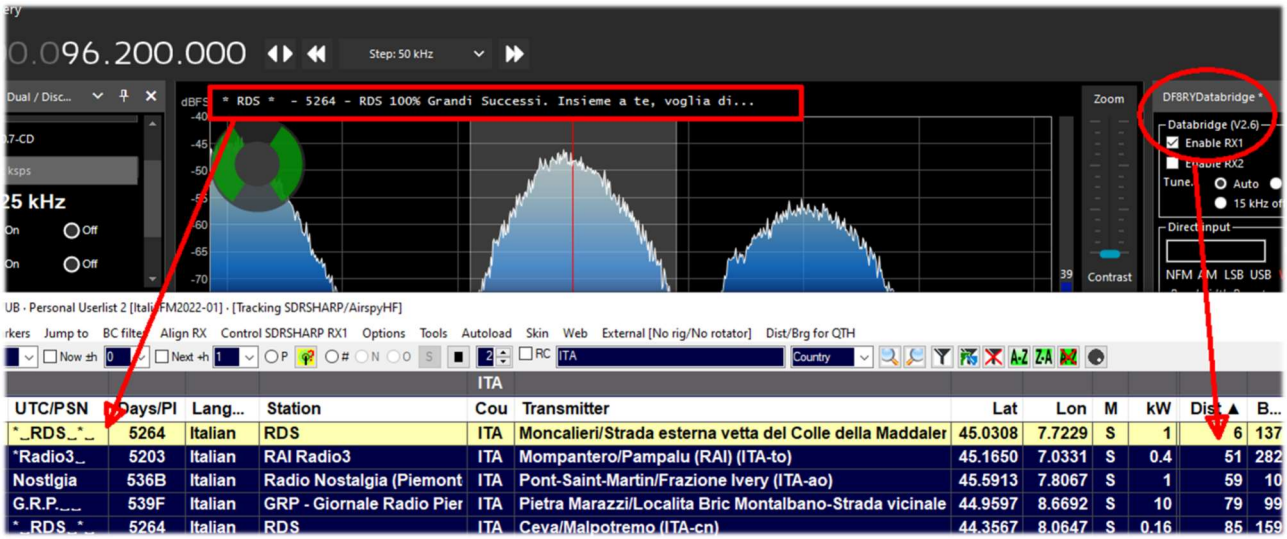
Now that we have the updated archives we can load them and use them to make searches and filters in conjunction with SDR# using the "DF8RYDataBridge" plugin mentioned above.

The tool can be useful for example to identify some distant and interfered signal that does not have the possibility to carry RDS (as in the example below at 103.200 MHz, where RDS (*) is completely absent and the small signal appears between two powerful big-powers). In CSVUB, automatically hooked the frequency of the VFO, I sorted the database on the column "DIST" (distance in kilometers from my QTH) by clicking on it while holding down the CTRL key, will appear a little black triangle like this **Dist ▲**

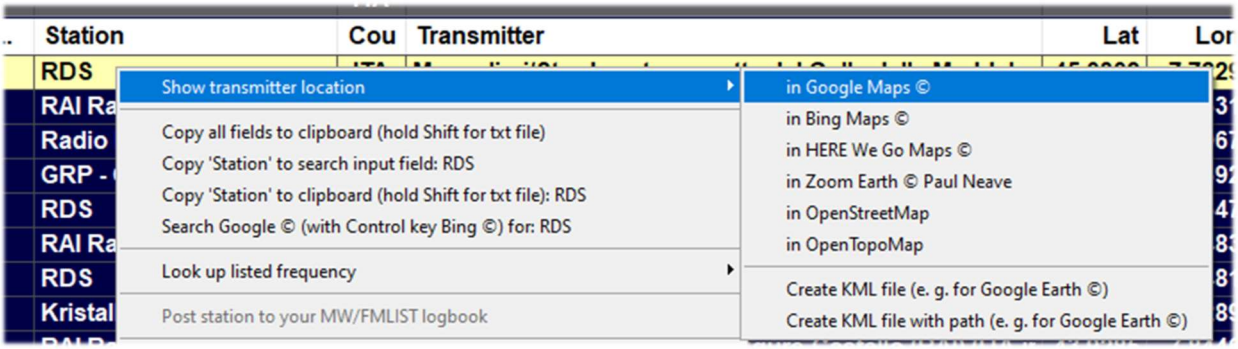


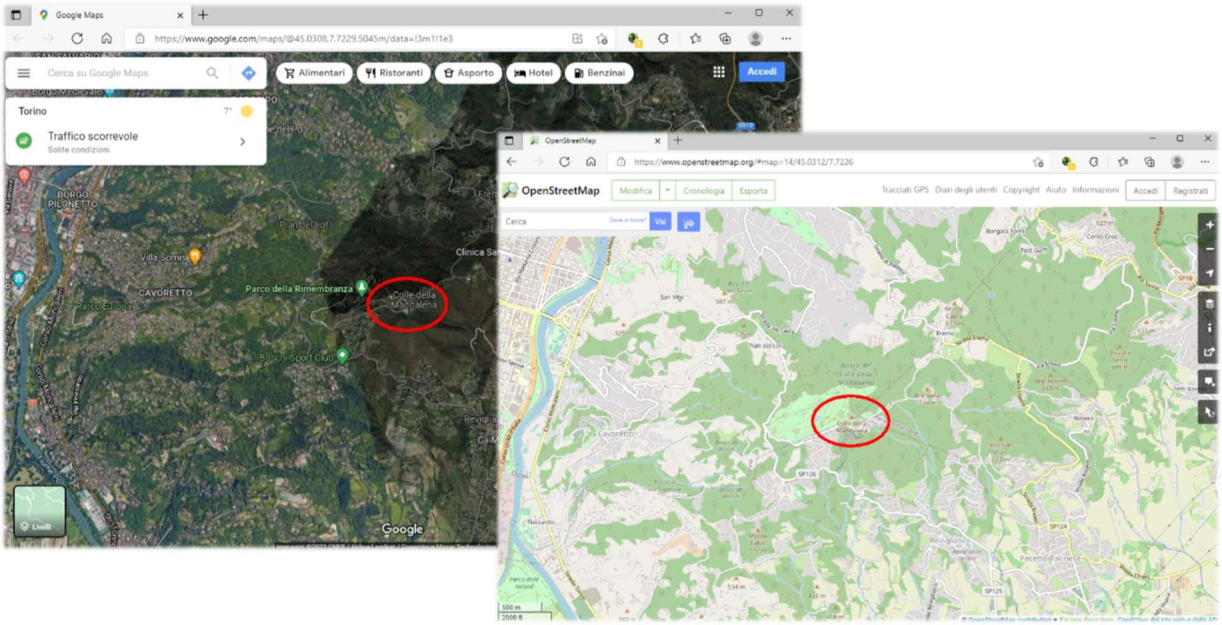
Hearing by ear that it was the transmission "RAI ISORADIO", the first line highlighted by the database CSVUB reports in fact that the station received could be that distant 75 km with 12 kW of power...

Much easier is the case that the RDS code is detected and with the immediate feedback of the PI (*) code we have a certain and precise identification on the database of the stations present in CSVUB!



In the example above we can see for the station tuned to 96.200 MHz, in CSVUB: name of the station "RDS-Radio Dimensione Suono", its PI code "5264", transmitter site information, power in kW, geographical coordinates, distance from my QTH and the bearing in degrees if you have an antenna rotor connected to your system.
Clicking then on the highlighted record, with the right mouse button, opens a specific menu that allows you to view the site of the transmitter with various graphics and details.





Think about the possibility of easily identifying during FM-DX sessions, distant stations that reach us only thanks to propagation or summer phenomena of E-sporadic…

black cat systems

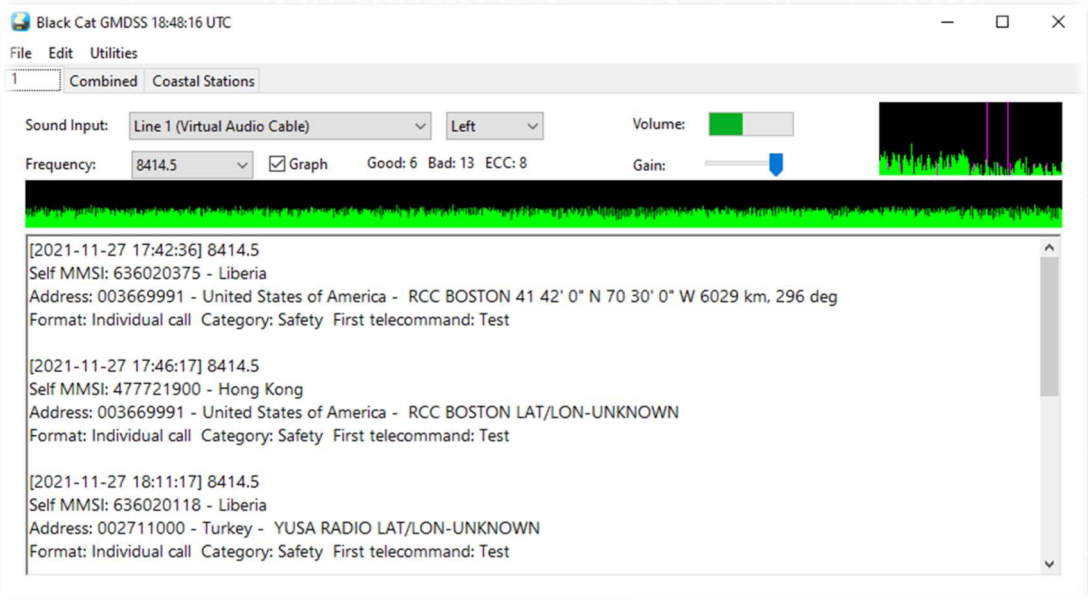
GMDSS, a multi-channel decoder
AirSpy HF+ Discovery and Black Cat GMDSS decoder

Black Cat GMDSS is a first multi-channel GMDSS HF decoder with new concept compared to previous radioamateur decoders that will surely make people talk!

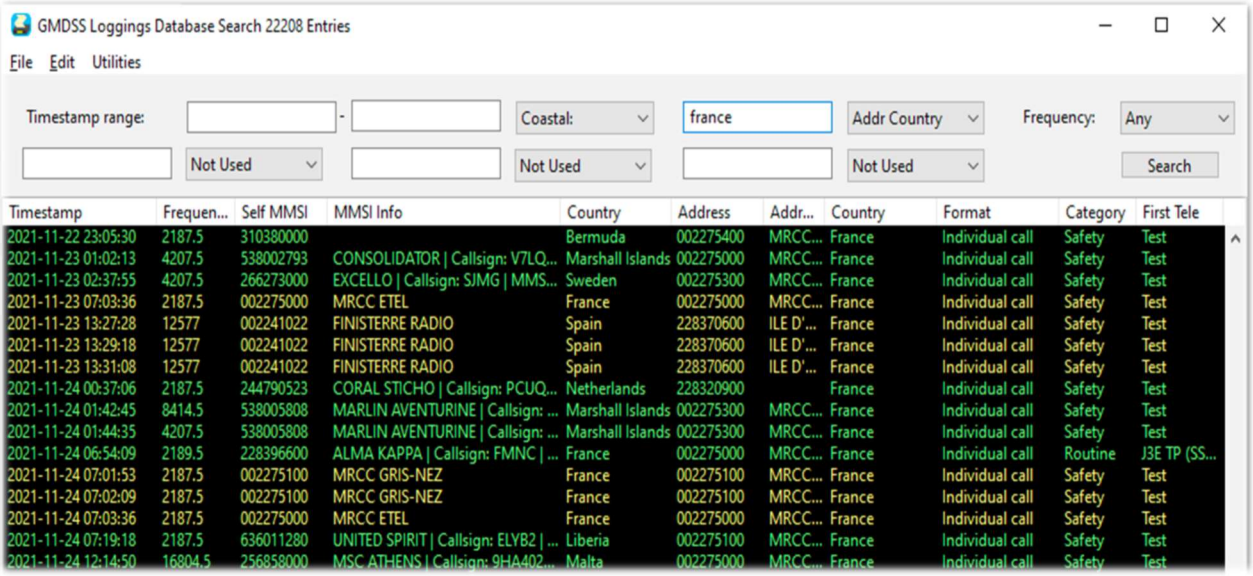
https://blackcatsystems.com/software/black_cat_gmdss_decoder.html

Up to 8 decoders can run at the same time for all GMDSS channels provided by the worldwide system at 2187.5, 4207.5, 6312, 8414.5, 12577, 16804.5 kHz.

Each decoder can be connected to its own audio input source (a virtual audio device or physical sound input device).

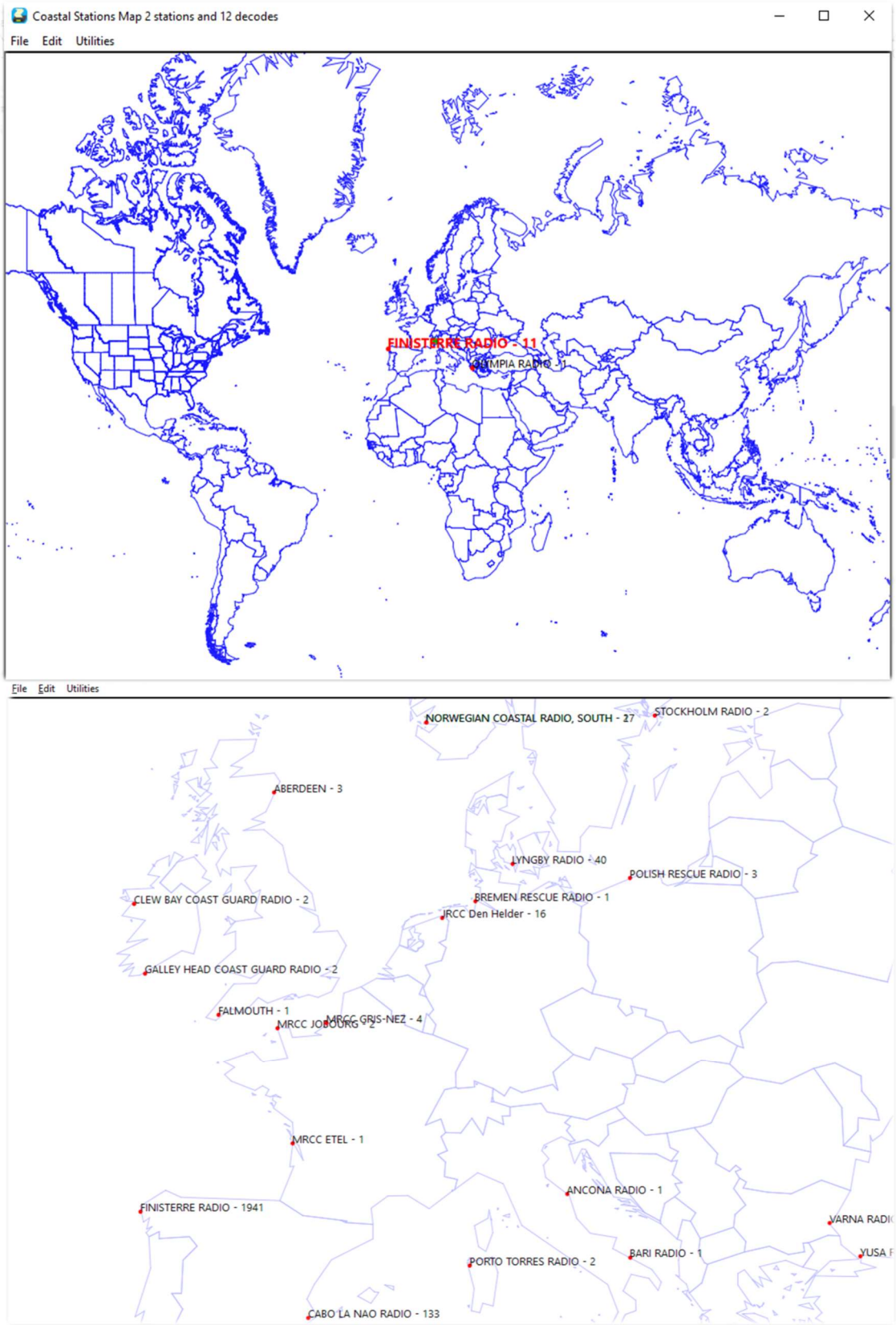


One of the distinctive features of the decoder is that it can decode directly from a WAV audio file. Multiple files can be selected, they will decode one after another.
Decoding of WAV files is much faster than real time decoding, limited by the speed of your computer, often 10x real time processing.
There are also a number of useful tools for map visualization and online search on the MMSI database.



Timestamp	Frequen...	Self MMSI	MMSI Info	Country	Address	Addr...	Country	Format	Category	First Tele
2021-11-22 23:05:30	2187.5	310380000		Bermuda	002275400	MRCC...	France	Individual call	Safety	Test
2021-11-23 01:02:13	4207.5	538002793	CONSOLIDATOR | Callsign: V7LQ...	Marshall Islands	002275000	MRCC...	France	Individual call	Safety	Test
2021-11-23 02:37:55	4207.5	266273000	EXCELLO | Callsign: SJMG | MMS...	Sweden	002275300	MRCC...	France	Individual call	Safety	Test
2021-11-23 07:03:36	2187.5	002275000	MRCC ETEL	France	002275000	MRCC...	France	Individual call	Safety	Test
2021-11-23 13:27:28	12577	002241022	FINISTERRE RADIO	Spain	228370600	ILE D'...	France	Individual call	Safety	Test
2021-11-23 13:29:18	12577	002241022	FINISTERRE RADIO	Spain	228370600	ILE D'...	France	Individual call	Safety	Test
2021-11-23 13:31:08	12577	002241022	FINISTERRE RADIO	Spain	228370600	ILE D'...	France	Individual call	Safety	Test
2021-11-24 00:37:06	2187.5	244790523	CORAL STICHO | Callsign: PCUQ...	Netherlands	228320900		France	Individual call	Safety	Test
2021-11-24 01:42:45	8414.5	538005808	MARLIN AVENTURINE | Callsign: ...	Marshall Islands	002275300	MRCC...	France	Individual call	Safety	Test
2021-11-24 01:44:35	4207.5	538005808	MARLIN AVENTURINE | Callsign: ...	Marshall Islands	002275300	MRCC...	France	Individual call	Safety	Test
2021-11-24 06:54:09	2189.5	228396600	ALMA KAPPA | Callsign: FMNC | ...	France	002275000	MRCC...	France	Individual call	Routine	J3E TP (SS...
2021-11-24 07:01:53	2187.5	002275100	MRCC GRIS-NEZ	France	002275100	MRCC...	France	Individual call	Safety	Test
2021-11-24 07:02:09	2187.5	002275100	MRCC GRIS-NEZ	France	002275100	MRCC...	France	Individual call	Safety	Test
2021-11-24 07:03:36	2187.5	002275000	MRCC ETEL	France	002275000	MRCC...	France	Individual call	Safety	Test
2021-11-24 07:19:18	2187.5	636011280	UNITED SPIRIT | Callsign: ELYB2 | ...	Liberia	002275100	MRCC...	France	Individual call	Safety	Test
2021-11-24 12:14:50	16804.5	256858000	MSC ATHENS | Callsign: 9HA402...	Malta	002275000	MRCC...	France	Individual call	Safety	Test

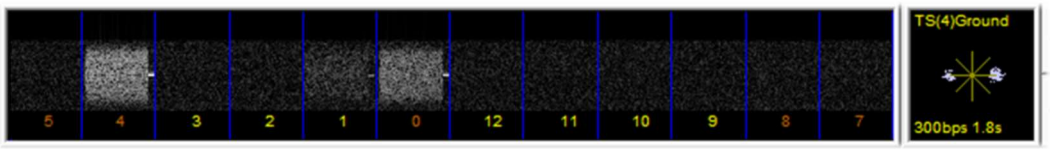
Those who have had the opportunity to try and test it in comparison with other GMDSS decoders says the best accuracy in decoding, with fewer errors than all competitors. In addition, not least, is the extreme lightness in terms of CPU usage (in some cases even 5 times less than others!)



I have write a PDF guide that can be downloaded here:
https://blackcatsystems.com/download/BlackCatGMDSSGuide.pdf

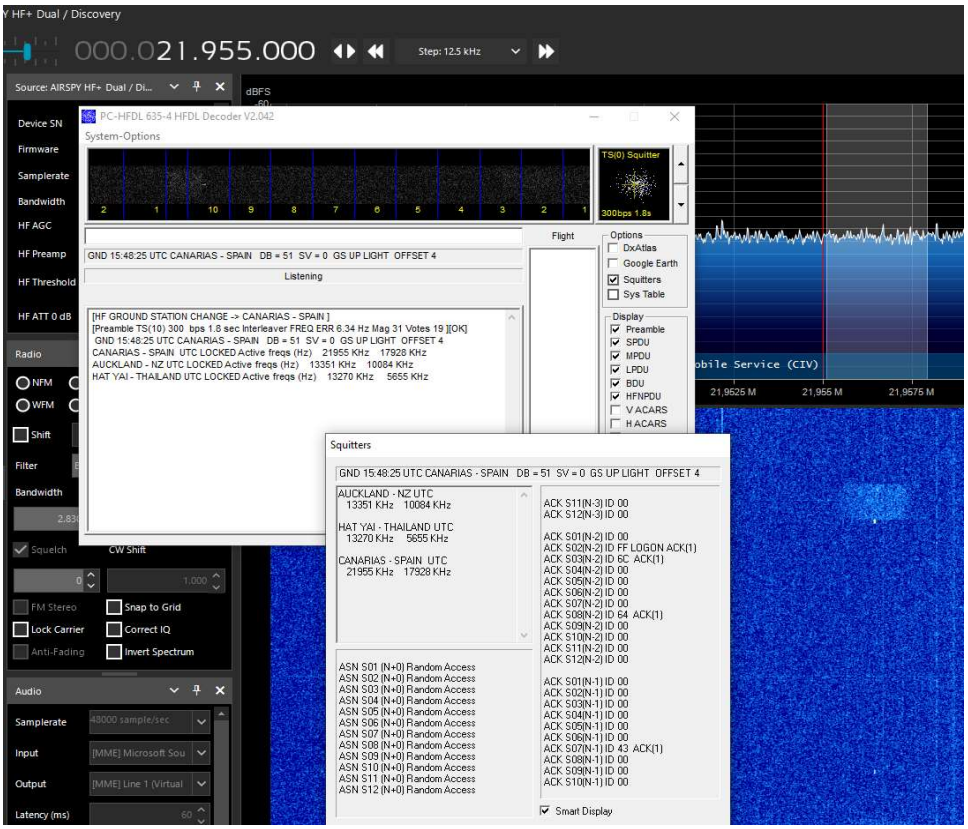
HFDL at 300 bps
AirSpy HF+ Discovery e decoder PC-HFDL

PC-HFDL is a windows based decoder for the ARINC 635-3 HF data-link protocol. Is based on a number of interconnected ground stations. Each ground station transmits a frame called a Squitter every 32 seconds (see screenshot). The Squitter frame informs aircraft of the system status, provides a timing reference and provides protocol control.



Each ground station has a time offset for its Squitters this allows planes to jump between ground stations when trying to log on to the best one. When passing traffic Time division Multiplexing is used (TDMA) this prevents two aircraft transmitting at the same time causing collisions.
The program uses the system table (now version 51) to determine the frequencies being used are. This information is transmitted by the HFDL groundstations.

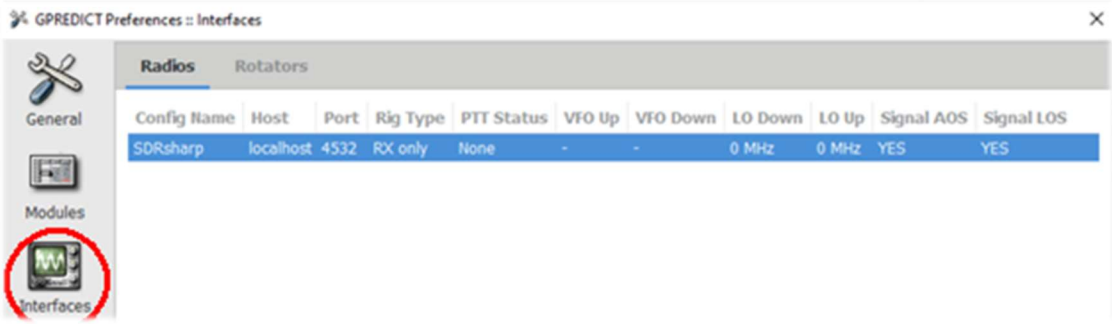
Net of current worldwide stations: AGANA – GUAM, AL MUHARRAQ – BAHRAIN, ALBROOK – PANAMA, AUCKLAND – NEW ZEALAND, BARROW – ALASKA, CANARIAS – SPAIN, HAT YAI – THAILAND, JOHANNESBURG - SOUTH AFRICA, KRASNOYARSK – RUSSIA, MOLOKAI – HAWAII, MUAN - SOUTH KOREA, REYKJAVIK – ICELAND, RIVERHEAD - NEW YORK, SAN FRANCISCO – CALIFORNIA, SANTA CRUZ – BOLIVIA, SHANNON - IRELAND



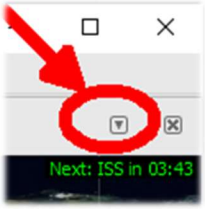
The "Squitters" display write information in a separate dialog box. "Smart display" shows next timeslot allocations.
This software has been designed as a decoder and does not carry out extensive logging or analysis of received information.

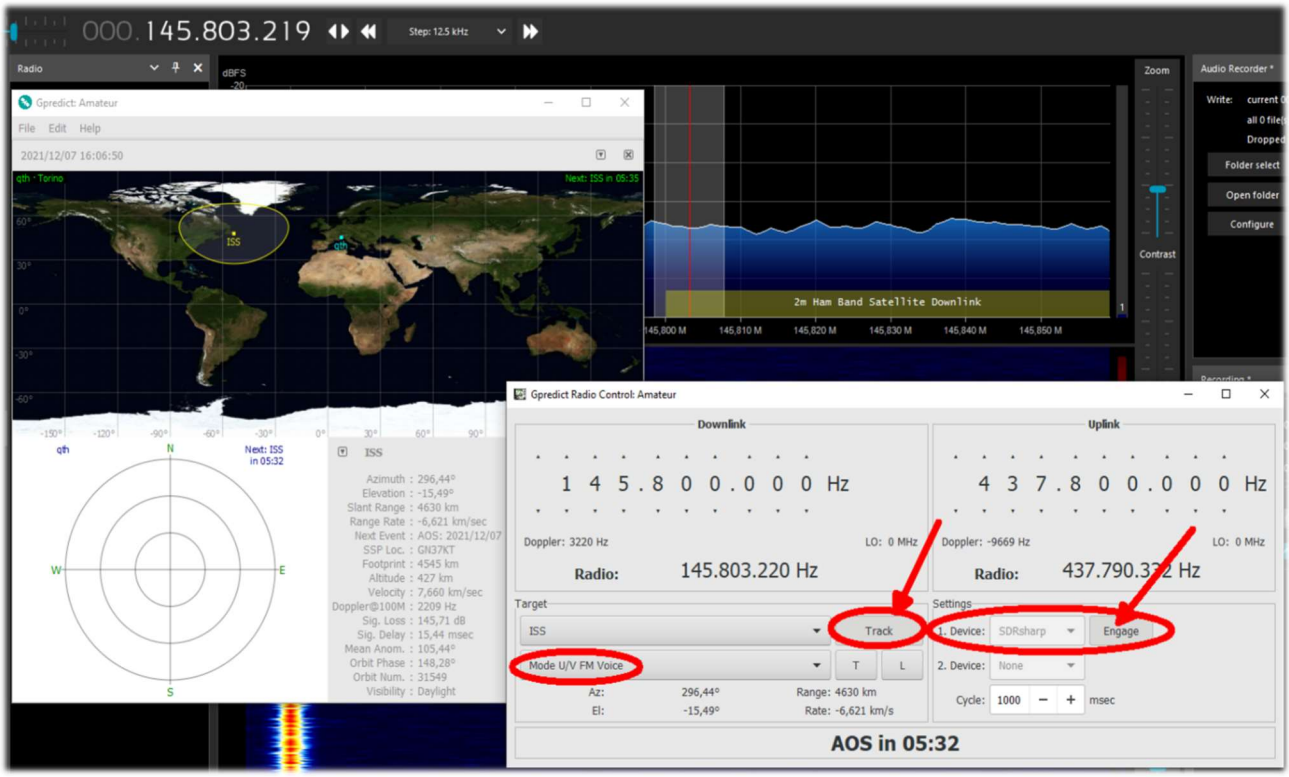
ISS reception and satellite tracking
AirSpy R2 + Gpredict & plugin Gpredict Connector

The ISS and other amateur radio satellites are not difficult to receive and it is sufficient even only a discone antenna or a vertical antenna for the 2 meters band... the most important thing is to use a good software for the calculation of satellite passages and their automatic tracking to compensate for the frequency shift due to the doppler effect in many cases very marked.
It will be necessary to look for and download the GPREDICT software (for example the release "gpredict-win32-2.3.37.zip") and install it...
For the first configuration: set your coordinates in EDIT / PREFERENCES / GENERAL / GROUND STATIONS while in INTERFACES / RADIOS you will have to create a line like the following for our SDRsharp with Localhost and port 4532:



For subsequent use: always update the TLE data in the EDIT / UPDATE TLE DATA FROM NETWORK menu or provide an automatic update in ED in EDIT / PREFERENCES / GENERAL / TLE UPDATE
To configure tracking: in Gpredict, click on the "Module options/ Shorcuts" icon (highlighted here at the side), select a satellite (in our case the ISS) from the CONFIGURE menu and then access the RADIO CONTROL panel to set some fields to confirm the type of traffic to be monitored (e.g. "Mode U/V FM VOICE") and then click on the "TRACK" and "ENGAGE" buttons...

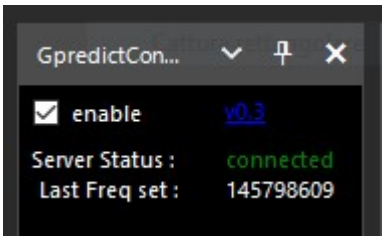




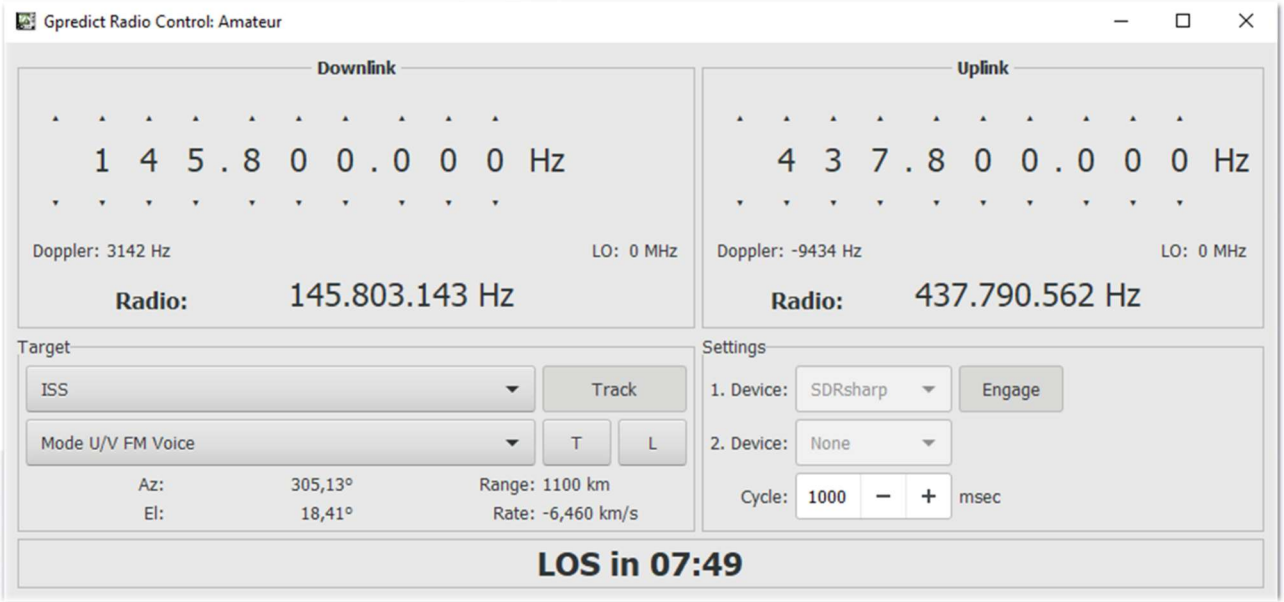
Let us now see on the SDR# side what needs to be done.

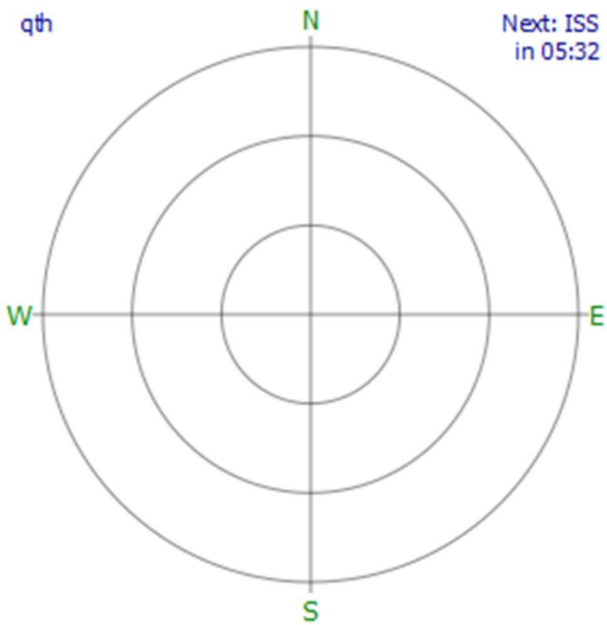
We will use the free plugin "GpredictConnector", which can be downloaded here: https://github.com/alexwahl/SDRSharp.GpredictConnector

By extracting the DLL in the usual directory, it enables automatic dialogue with Gpredict as soon as the “enable” flag is enabled.



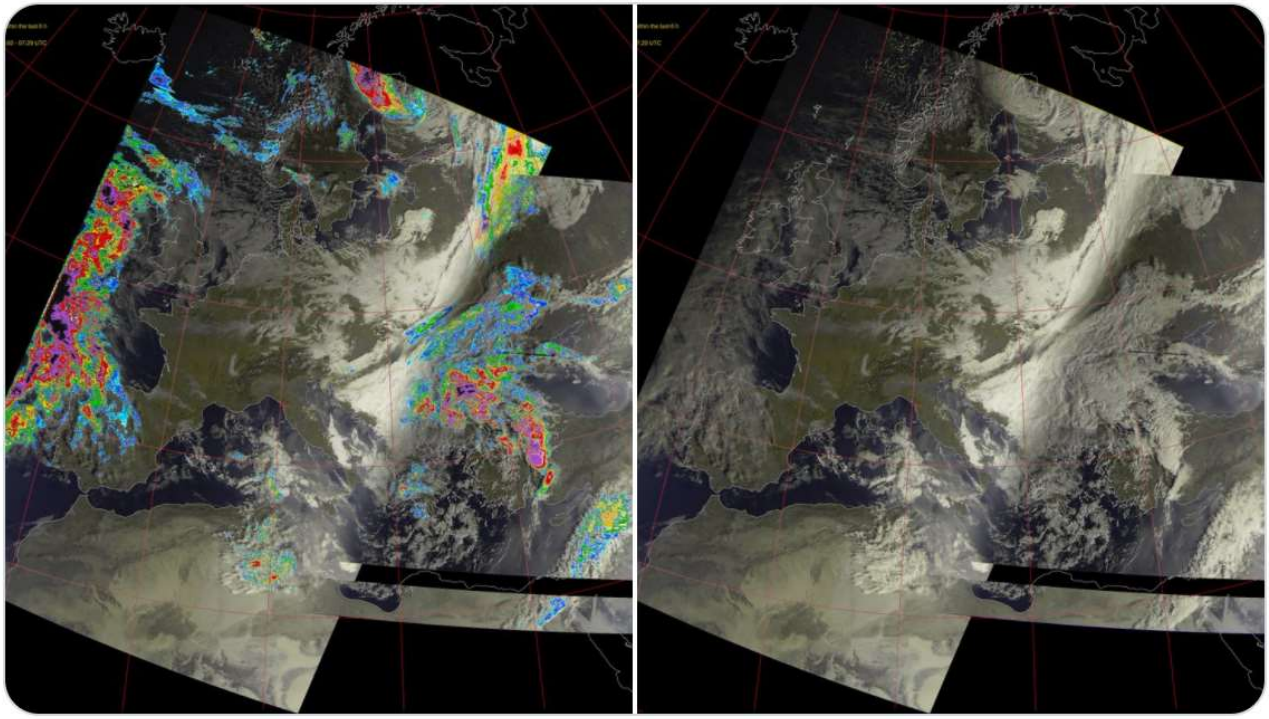
If everything is working properly the plugin will connect to port 4532 and "Server Status" will not only display "connected" in green colour, but SDR# will and autonomously follow the downlink frequency of the satellite with appropriate VFO changes to compensate for the doppler effect, as well as providing multiple tracking information and AOS (*) and LOS (*) times.



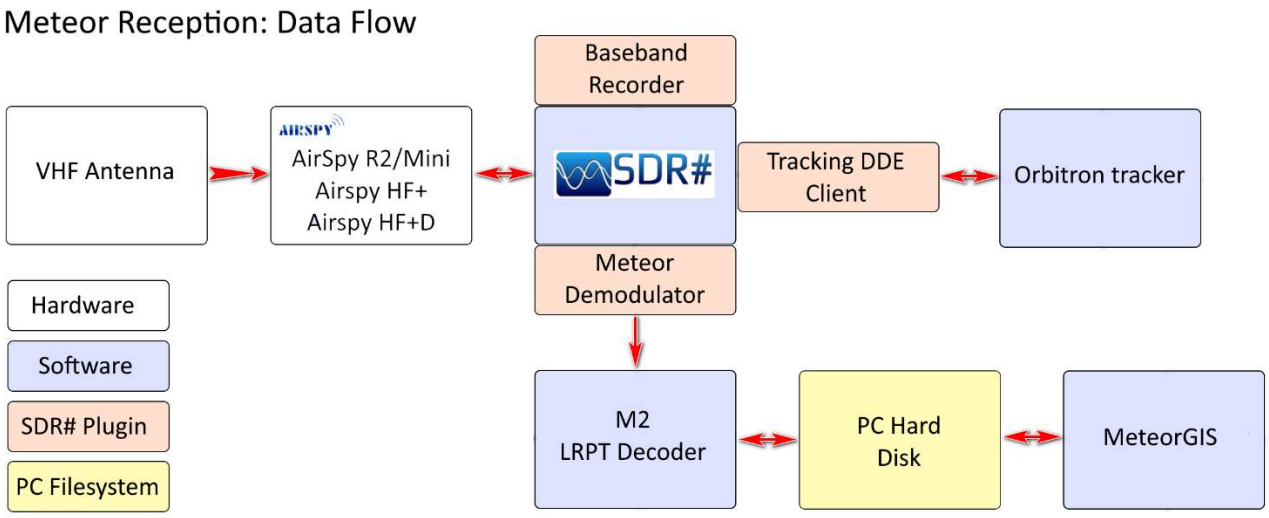


METEOR-M N2 Reception of quality images
AirSpy HF+ Discovery and many software

It is not easy to condense the whole process in a few lines, but the final result of BlackApple62 in receiving images from the METEOR-M N2 satellite is definitely of very high quality...



LRPT images received at 137.1 MHz in RGB+Rainfalls/RGB mode with Turnstile antenna and SPF5189 RF Low Noise Amplifier. These are the software used: Tracking DDE v1.2 + Meteor Demodulator v2.3 + LRPT decoder v2019.9.14.0056 + Postprocessor MeteorGIS v2.24.



The "data flow" kindly granted to me, represents in a very simplified way how data pass from radio reception to decoded images on disk. A more detailed description of the events in each software module would be needed, starting from the AOS phase of the satellite, up to the LOS and finally to the writing of the processed images, but it would take a dedicated guide, so for those interested this is an introduction: http://happysat.nl/Setup_Meteor/Setup.html

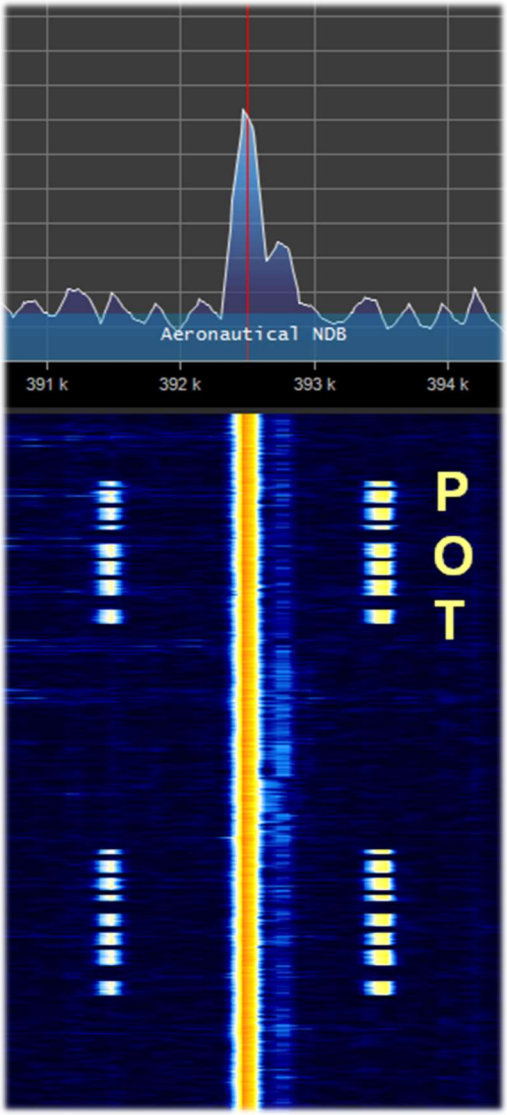
NDB's, dinosaurs in extinction...
AirSpy HF+ Discovery

Non-Directional Beacons, better known as NDBs, are beacons used for many years for instrument air navigation or maritime radionavigation.

In the course of 2021, the Italian Air Navigation Authority has planned to phase out NDB, L and VOR type radio beacons at italian airports.

The NDB works in medium waves (between 200 and 1750 kHz), transmitting a continuous wave in vertical polarisation, on which an amplitude modulation of an audio signal is superimposed, through which the instrument communicates its identification in Morse code.

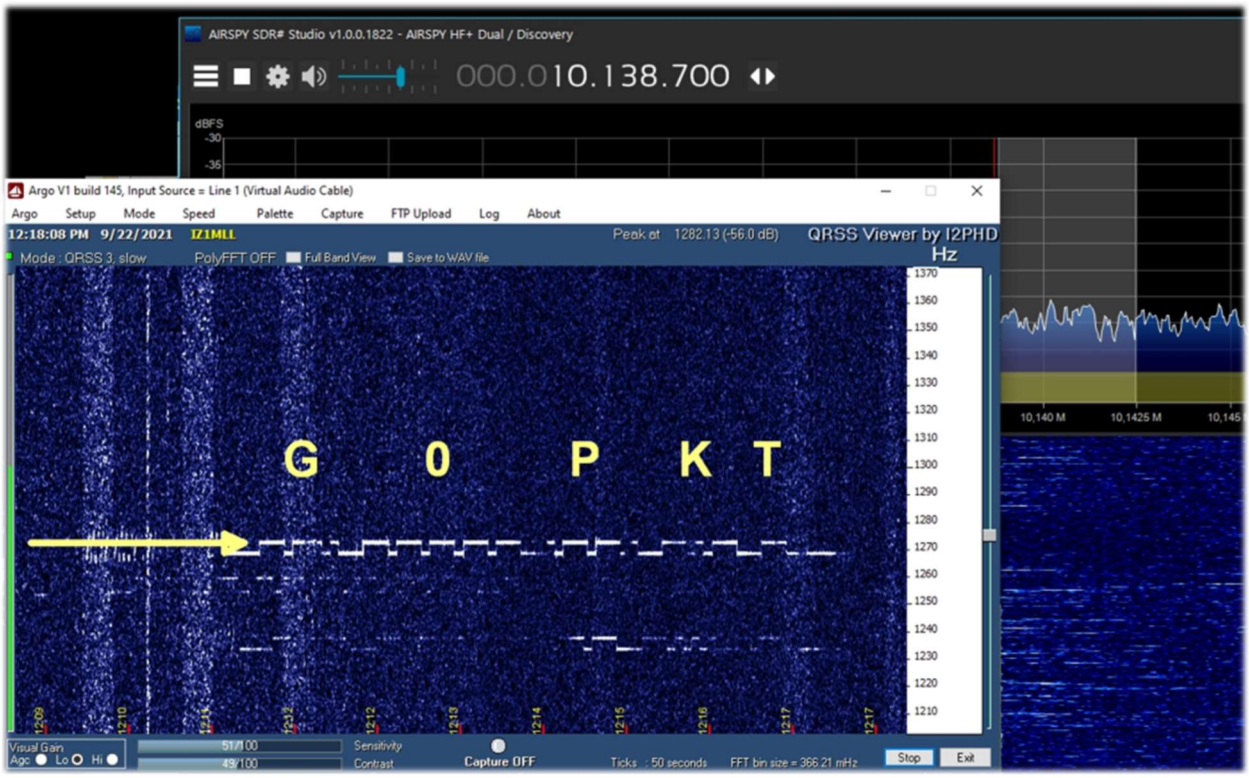
Here is an example of one of the last NDBs still receivable at the moment: 392.5 kHz and with “TOP” Morse code identification (Poirino/Torino - Italy) remembering that decoding starts at the bottom...



QRSS signals not listenable and nor visible in RF spectrum! AirSpy HF+ Discovery and software ARGO

Hams like to experiment and a lot, especially in the study of propagation...

The QRSS (*) is a very special morse signal, transmitted so slowly that you cannot hear it by ear (a "dot" takes six seconds to be sent while a "line" takes eighteen seconds) and with very low power using frequency shift coding.
With this system you do not make conversation (in Q code called "QSO") but you can analyze the propagation, test antennas or specific software. In my case I used the software "ARGO" but I suggest also "FSKview" for the visualization of the spectrograms of FSK (*) signals.

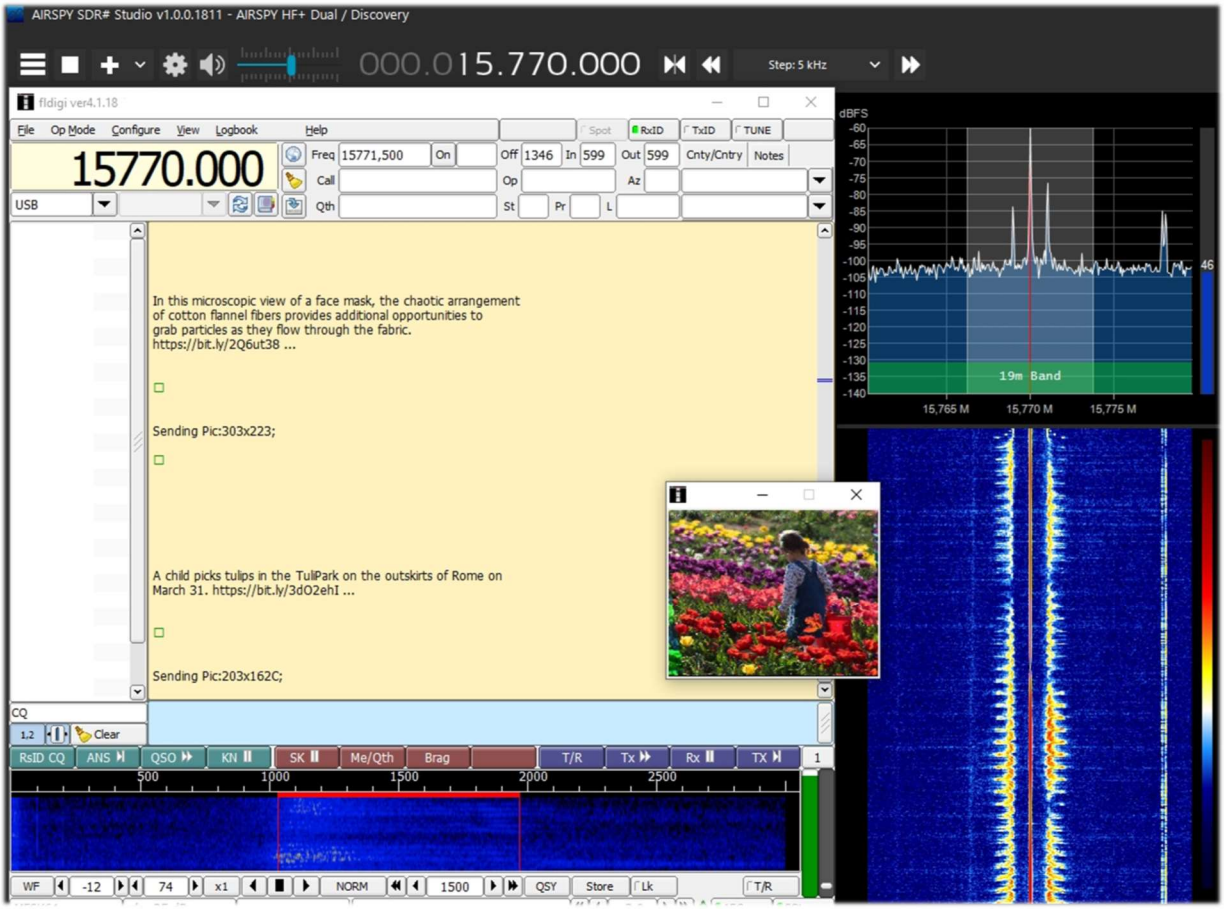


My SDR was tuned to 10138.7 kHz in USB and after several minutes I received and decoded the english beacon G0PKT as highlighted in the first line. Note that in the waterfall and in the RF Spectrum on the right no signal is visible...
From the net says that the beacon is active on 30 meters with the power of about 250 mW.

Try it on the other bands in WSPR and QRSS mode as well!

Radiograms (bulletins and images)
SDR# + FLdigi software

Using an AirSpy HF+ Discovery, tuned in my example to the 15770 kHz frequency on certain days and at certain times, it is possible with the FLdigi software to receive curious transmissions, RadioGrams, i.e. digital text and images (MFSK-32/64 mode) via the analogue radio transmission...



https://wiki.radioreference.com/index.php/Shortwave_Radiogram_Gateway

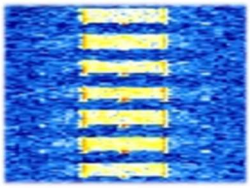
https://swradiogram.net/

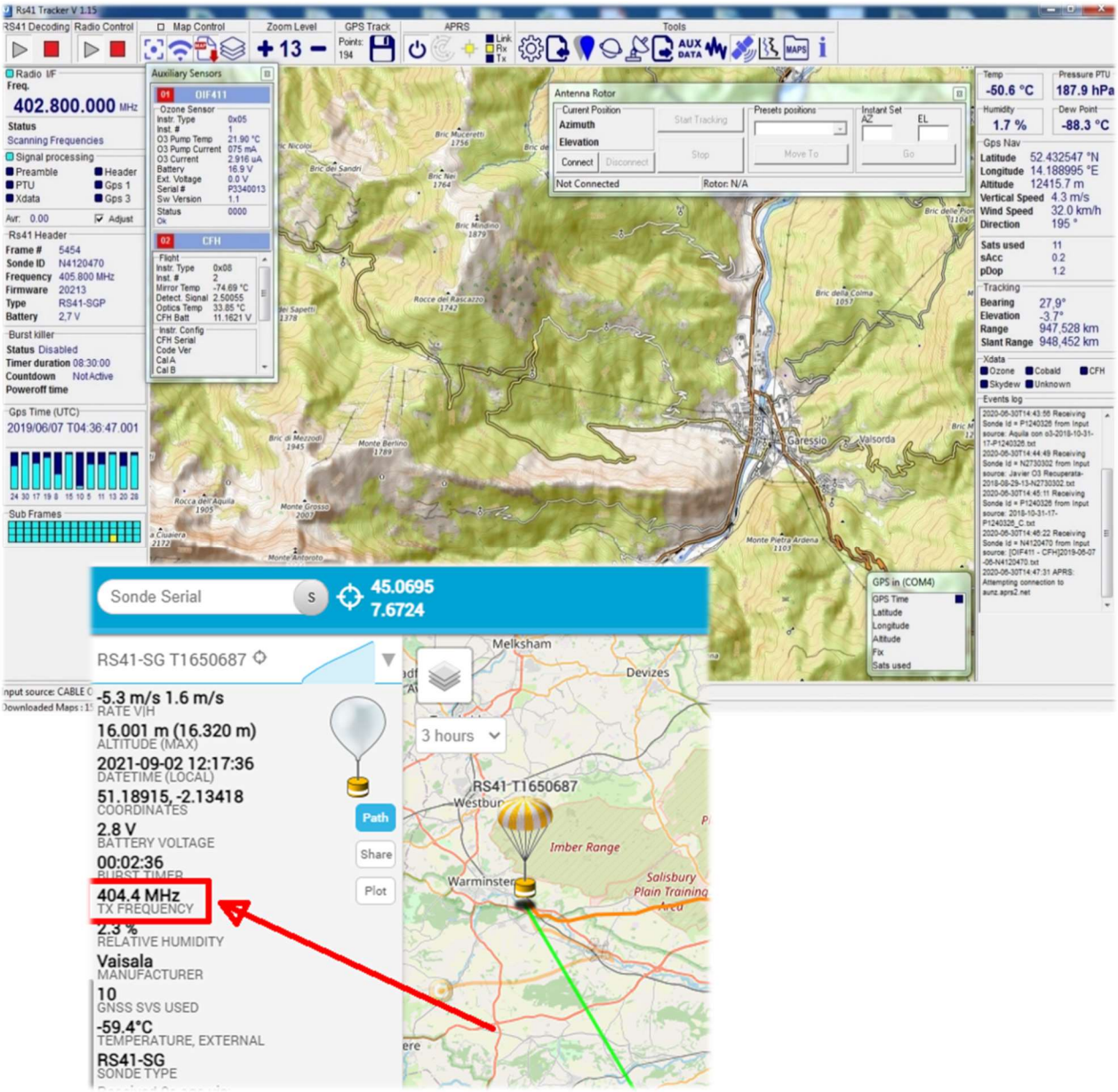
Radiosondes12 in UHF
AirSpy R2 + software RS41 Trakers

RS41 Tracker is an external software, developed by Diego (IW1GIS), capable of decoding real-time telemetry from Vaisala RS41 radiosondes. Used in conjunction with an SDR it allows you to display the positions of the radiosondes on a map and control parameters such as height, temperature, wind speed/direction and burst killer information, etc.

Link: ***http://escursioni.altervista.org/Radiosonde/***

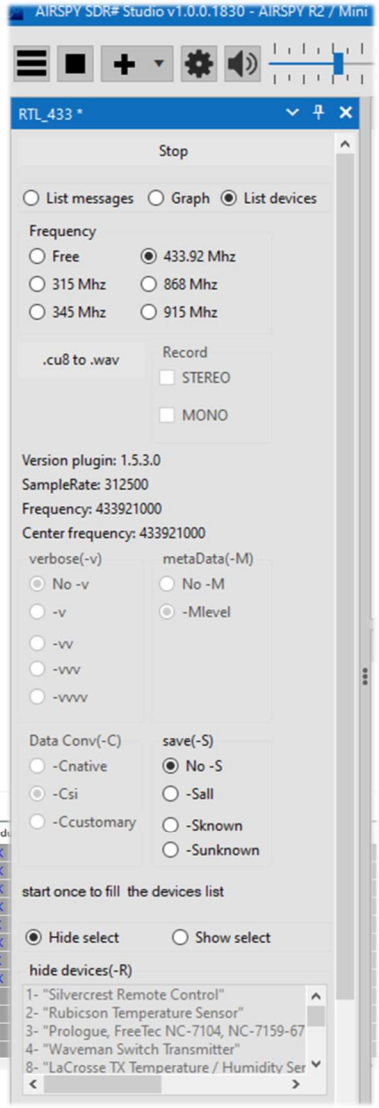
By tuning into UHF (here at the beginning of the 400 MHz band) at set times and with a bit of luck it is possible to receive directly signals like this and using a virtual audio cable send them to the decoder.





By referring to this informative link, you can also find the UHF frequency for transits in your area: ***https://tracker.sondehub.org***

RTL_433 for reading tyre pressure, weather sensors, etc. etc. AirSpy R2 and RTL_433 plugin



With this nice plugin it is possible to detect and decode particular data signals transmitted on specific bands dedicated worldwide to these services.
It is therefore possible to decode hundreds of sensors that detect temperature/humidity, weather data, energy consumption, tank level, etc... etc... and why not the TPMP ones, i.e. the tyre pressure and temperature monitoring system of some car models!

The plugin, with all the necessary instructions, can be downloaded free of charge, here:
here:https://marco40github.wixsite.com/website/plugin-sdrsharp-pour-rtl-433?lang=en

You can start by trying in RAW mode and with a bandwidth of at least 200k, disabling squelch and any other audio filters...

It can be configured to receive the overall message **list of all received devices**, with the possibility of exporting the data to files.

Devices received : 8/1000 Column:30 / 100

Device	Time	Protocol	Brand	Model	House Code:	Channel	Battery	Celsius	Modu
Protocol:12 Model: Oregon-THR228N Channel:1	2021-10-08 17:46:53	12	OS	Oregon-THR228N	236	1	1	25.90 C	ASK
Protocol:25 Model: GT-WT02 Channel:1	2021-10-08 17:46:46	25		GT-WT02		1	0		ASK
Protocol:19 Model: Nexus-T Channel:1	2021-10-08 17:47:11	19		Nexus-T	26	1	0		ASK
Protocol:19 Model: Nexus-TH Channel:1	2021-10-08 17:46:30	19		Nexus-TH	54	1	1		ASK
Protocol:88 Model: Toyota	2021-10-08 17:46:45	88		Toyota					FSK
Protocol:19 Model: Nexus-TH Channel:2	2021-10-08 17:47:08	19		Nexus-TH	168	2	1		ASK
Protocol:90 Model: Renault	2021-10-08 17:45:54	90		Renault					FSK
Protocol:91 Model: inFactory-TH Channel:1	2021-10-08 17:47:11	91		inFactory-TH		1			ASK

Or **single lists** such as the following with a Toyota TPMS and of an outdoor temperature sensor (model GT-WT02) or a **graphic window** of a termosensor (Oregon THR228N).

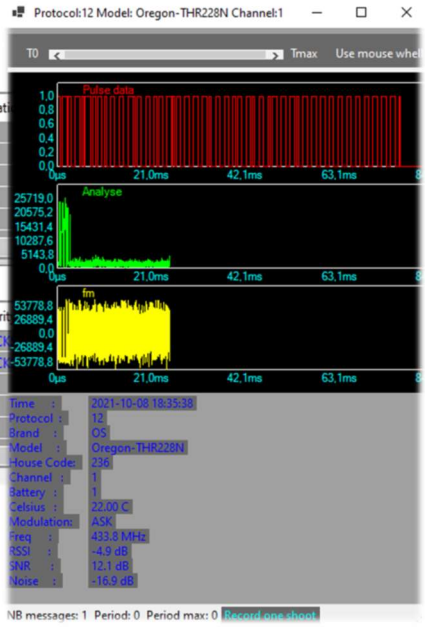
Protocol:88 Model: Toyota (Messages received : 2/1000)

N° Mes.	Time	Protocol	Model	Type	Id	Status	Pressure_kPa:	Temperature_C:	Mic	Modulati
2	2021-10-08 17:49:57	88	Toyota	TPMS	f10ce151	128	218.909	21.000	CRC	FSK
1	2021-10-08 17:49:23	88	Toyota	TPMS	f10ce133	128	217.185	20.000	CRC	FSK

Protocol:25 Model: GT-WT02 Channel:1 (Messages received : 2/1000)

N° Mes.	Time	Protocol	Model	ID Code	Channel	Battery	Temperature:	Humidity	Button	Integrit
2	2021-10-08 17:50:57	25	GT-WT02	172	1	0	21.2 C	0 %	0	CHECK
1	2021-10-08 17:50:06	25	GT-WT02	172	1	0	21.1 C	0 %	0	CHECK

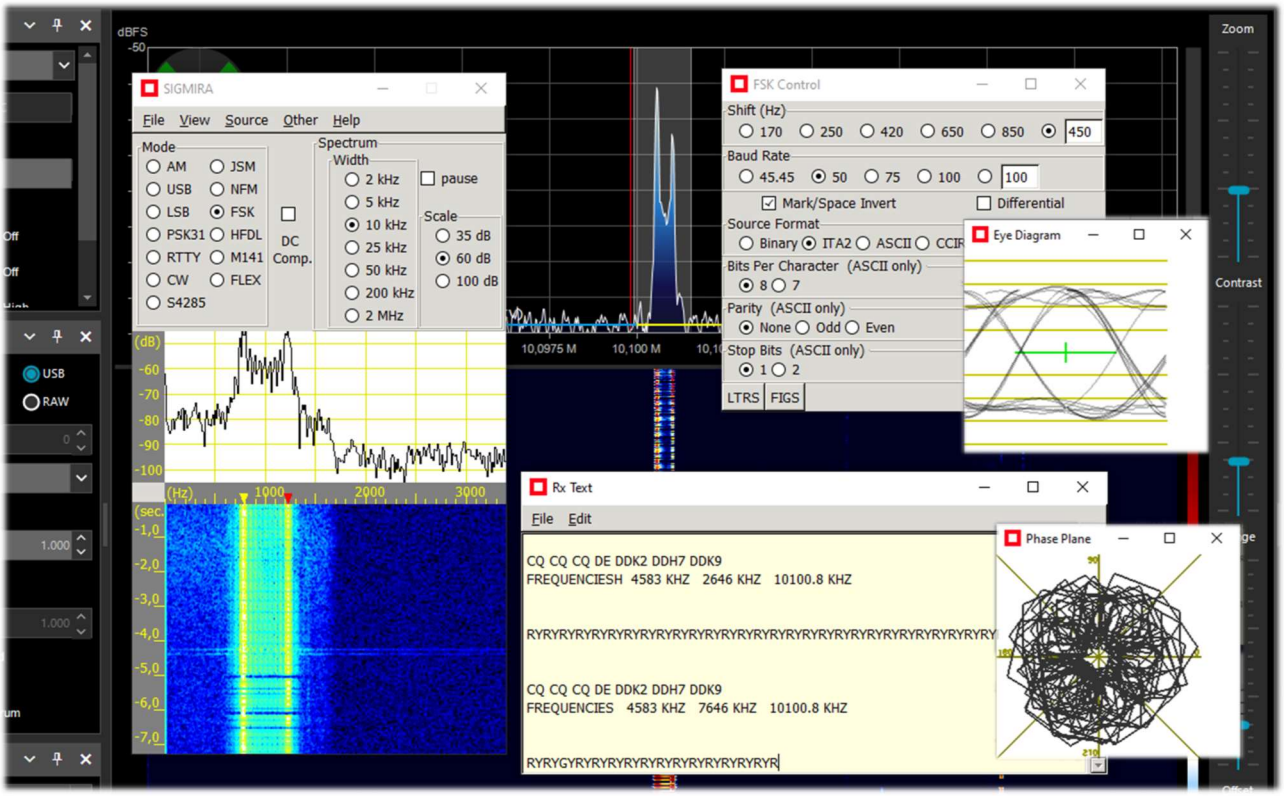
Export data (WARNING replace the file if it exists)



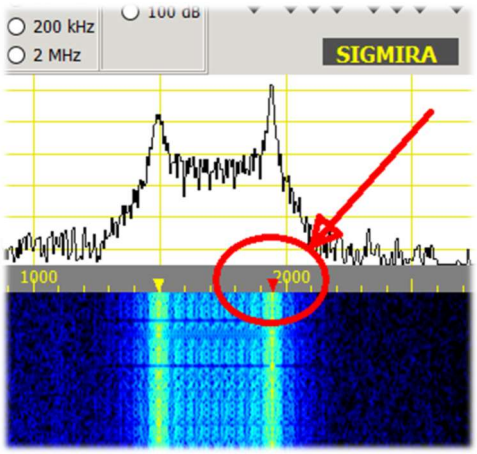
SIGMIRA: multidecoder with database Airspy HF+ Discovery

NEW

In the panorama of free decoders there is an interesting software for Windows.
It is called SIGMIRA, it allows demodulation of the following modes: ALE, CW, FLEX, FSK, HFDL, PSK31, RTTY, SITOR-B, JSM-SLOT MACHINE, STANAG-4285 and the display of the spectrum in real time, waterfall and phase (Phase plane).
It accepts signal input via sound card (for conventional receivers) and via VAC as well as direct connection with some SDR devices.

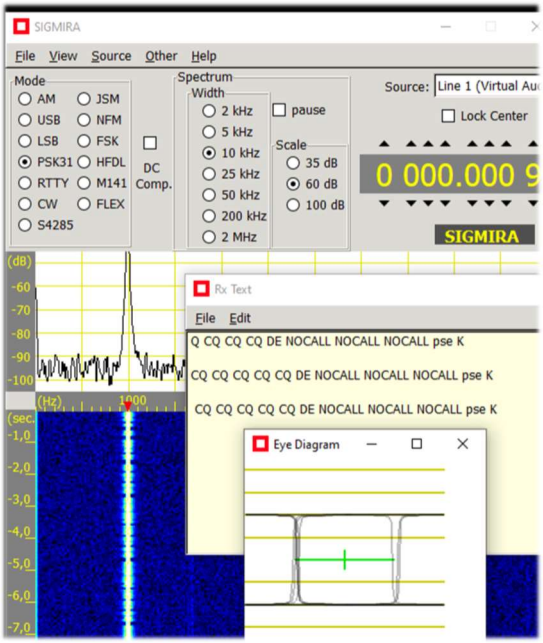


Here we see SIGMIRA with many of its windows open (selectable from the VIEW menu), struggling with an RTTY signal (50 baud reverse, shift 450 Hz) tuned through the HF+ Discovery (in USB mode) and its decoding of messages in the window "Rx text".



In the decoder, I chose the mode and parameters of FSK, then to click on the waterfall at the right signal marked with red triangle.

The yellow one will automatically adjust according to the preset shift: yellow and red correspond to the Mark/Space of the FSK signal.



You can also use as signal source: WAV files or external inputs like VAC.
In the example on the right I have used an old demo WAV file of the ham radio mode PSK31.

In this case the only red triangle should be placed with the mouse on the signal column to have immediately the decoding in the "Rx Text" window and display its shape in "Eye Diagram".

Another unique feature of SIGMIRA is its internal database with over 2000 frequencies in all modes of emission and different categories of users ("Cat1" column).

Signal Database

File

New | Delete | Scan | Freq Lookup

Frequency	Mode	Description	Cat1	Scan Cat.	Parameters
7,449570	hfdl	hfdl?, psk? much prior to 0812	fixed		
7,455000	fsk	150222_0711 utc 2311 lcl	fixed		850,50
7,456000	fsk	fsk, wide ?	fixed		
7,465000	am	broadcast, religious, s9+10 081225_2232	broadcast		
7,470000	am	ch faint 081228_0750	broadcast	ch	
7,480000	am	faint 081230_0105 utc 1705 lcl	broadcast		
7,505000	am	religious childrens' story, s9+30 070218_0115	broadcast		
7,520000	am	fr?, faint 081225_2233	broadcast		
7,527000	m141	PtReyes and coast guard 110324_0108 utc 1808 lcl	maritime	ale	
7,530000	am	asian 051231_0806	broadcast		
7,532000	usb	looks like 40kHz wide psk, 200824_0507 utc 2207 lcl	curious		
7,540000	am	asian 051231_0806	broadcast		
7,545400	usb	two way sp, 081226_0843	fixed		
7,555000	am	asian faint 051231_0806, sp s9+5 081225_2234	broadcast		
7,570000	am	faint 081230_0104 utc 1704 lcl	broadcast		
7,593000	fsk	fsk, wide, pauses 051126_0021 cratt2, 850s/75b, s9+10 061125_113 5, 081225_1740	fixed		850,75
7,597000	fsk	s9 091126_2043 utc 1243 lcl	fixed		850,75
7,620000	am	faint 051231_0806	broadcast		
7,630000	usb	SAC?, eng. 7 groups of 5 letters and numbers,"Trilake 22, out." 1505 16_1355 utc 0655 lcl, Washington Cap 4602			
7,643000	usb	signal or noise?, 15khz wide, sinusoid sweep, 150224_0247 utc 1847 lcl	curious		
7,668276	ofdm	ofdm, 12 carriers, 75 baud approx 110307_0600 utc 2200 lcl	curious		
7,681000	am	numbers reported 061111_2359	numbers		
7,683000	usb	40 khz wide psk, 200727_0525 utc 2225 lcl	curious		
7,688000	usb	numbers, chinese, USB with carrier, 121013_1318 utc 0618 lcl	numbers		
7,730000	usb	broadcast, deu, religious, s9, 081222_2126	broadcast	deu	

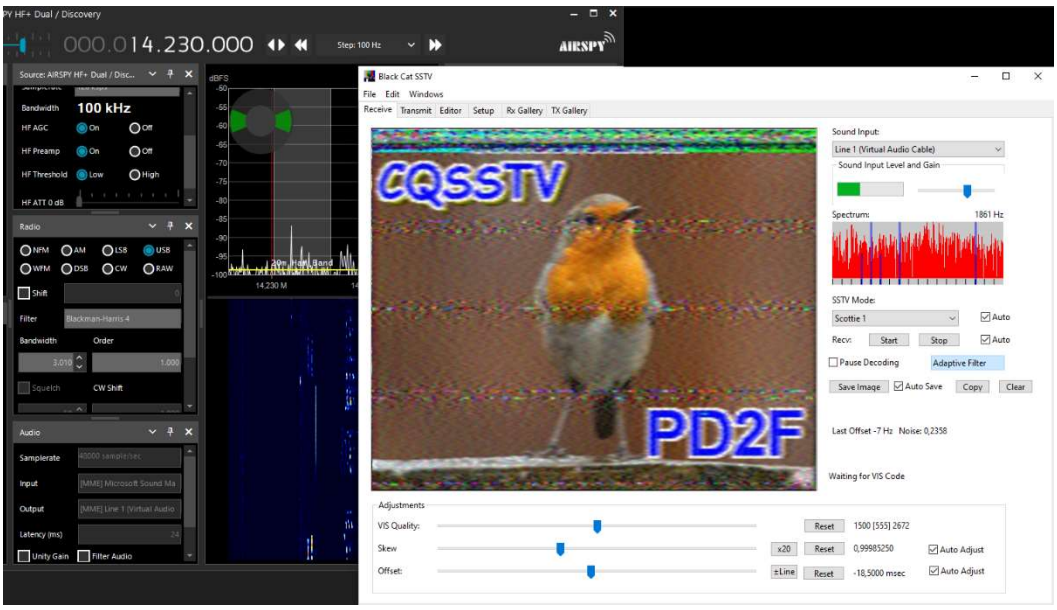
Link: ***http://www.saharlow.com/technology/sigmira/***

black cat systems

SSTV …the charm of Slow Scan TV
AirSpy HF+ Discovery and Black Cat SSTV decoder

NEW

The SSTV (*) transmitted in HF by radio amateurs around the world has a very special charm and always arouses in me astonishment both as OM and SWL. Very often the signals are very bad and interference does not allow to receive good images, but sometimes with a little luck and good propagation there is plenty of time to be able to receive and decode a good image. Obviously we need a very sensitive decoder with advanced features such as Black Cat SSTV (for Windows and macOS): ***https://www.blackcatsystems.com/software/sstv.html***



The developer has built many SSTV software in twenty years with a focus on decoding weak and difficult signals. It's easy to write an SSTV decoder that works with a strong signal, but he decided to write a new SSTV application from scratch, with an emphasis on performance under weak signals.

The decoder has an extremely sensitive VIS (*) detector, with an adjustable threshold depending on personal tolerance for false triggering. The images are automatically adjusted, after reception, also for Skew and Offset using all transmitted information, for an almost perfect lock even with extremely weak signals. Images can be automatically saved to a directory of your choice and there is a built-in gallery to view received images.

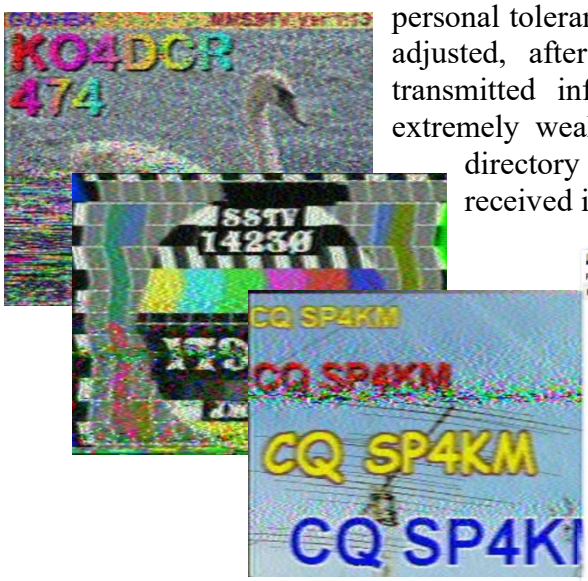
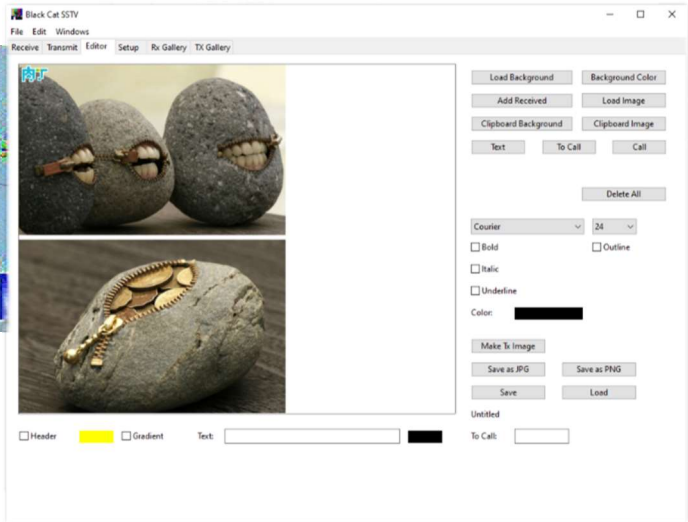


Image transmission is also supported and there is a basic editor (see side screen) to prepare images for transmission.



Things to know for don't lose the head...

It can sometimes happened that after particular changes or risky actions the program will fail due to internal (or often external) code problems. Many things have changed since the 177x revision (including scheduled Windows updates…), sometimes if something crashes, it is for external problems at SDR# code. All errors are automatically detected and recorded in the "crash.txt" file in the program directory...

Maybe the only thing to do, if the program is very "customized", is to copy again the file "SDRSharp.exe.config" from the original distribution package. You will lose some customizations (example of the "audio recorder" panels) but this way it will start again for sure. So I suggest to save this file in a moment that everything works so that you can reuse it when you need it. Or even to diversify SDR# installations on your HD and keep a "test directory" to test and verify the new plugins or own customizations.

In other cases and situations it has been verified that some problems came from too many devices plugged into the same powered HUB (*). *Therefore it is preferable to connect the devices directly to the native USB socket!*

Another suggestion is to avoid the simultaneous use of 4 or more RTL-SDR devices (4.8 MSPS) on a single USB2 bus. Preferable then is a USB3 card...

The Microsoft .NET Runtime can also sometimes cause problems when starting SDR#, especially if you have previous versions installed on your PC (perhaps a mix of x86 and x64). It is recommended to use a good uninstaller to do a complete clean up and reinstall the software from the following AirSpy link: https://airspy.com/?ddownload=6293

After some specific Windows 10 updates it happened that you could no longer send audio to external decoding programs (e.g. Fldigi, HFDL, WSJT, etc.). *I suggest checking this:*

- Select **Start** > **Settings** > **Privacy** > **Microphone** . In **Allow access to the microphone on this device,** select **Change** and make sure **Microphone access for this device** is turned on.
- Then, allow apps access to your microphone. In **Microphone settings**, go to **Allow apps to access your microphone** and make sure it's turned on.

Check your computer's performance

A number of utilities (command-line) have been developed to help detect and resolve some performance issues often related to USB controllers/drivers.

WINDOWS

Download the latest version of the software: ***https://github.com/airspy/airspyone_host/releases***

- Open a console (cmd.exe) and run: `airspy_rx -r NUL -t 0`
- Let it run for 30 seconds, then close it with `Ctrl + C`
- If the average throughput is below than 10.0 MSPS then either the USB controller has problems or the CPU can't process the data.

Possible solutions:

- Try another USB port (avoid HUBs and port repeaters)

- Update the USB drivers (prefer OEM drivers to generic ones). For more details see also: ***https://github.com/libusb/libusb/wiki/Windows***
- Check antivirus or any other software at the same time with heavy loads on the CPU
- Use a PCIe USB 2.0/3.0 controller

LINUX (Debian/Ubuntu) Ubuntu possibly with the distro 14.04 LTS.

- **Building airspy, gr-osmosdr and gqrx:**

Download the airspy-git repository, compile it, install it

Download the gr-osmosdr repository, compile it, install it

Download the gqrx repository, compile it, install it

Get pulseaudio using standard Arch way

Configure pulseaudio (add user and group…)

Thanks to SEGFAULT post ***http://airspy.com/?topic=linux-airspy-gqrx/#post-658***

- **Performance problems:**

- Build the host tools following "How to build the host software on Linux": ***https://github.com/airspy/host***
- Open a shell and run `airspy_rx -r /dev/null -t 0`
- Leave it running for 30 seconds, then `Ctrl+C`
- If the average throughput is below 10.0 MSPS then either your USB controller has problems or your CPU can't process the data.

Possible solutions:

- Use another USB port
- Update your kernel
- Use a PCIe USB 2.0/3.0 controller

For further technical details:

https://github.com/airspy/airspyone_host/wiki/Troubleshooting

SDRSHARP.CONFIG

For the more curious it may be interesting to know the "behind the scenes" of a very important support file, in which all the configurations and settings of SDR# are saved, that is SDRsharp.config, but always pay attention to what you modify taking care to save the file previously...

Let's take a look at some strings already covered in previous specific chapters:

<add key="stepSizes" value="1 Hz,10 Hz,100 Hz,500 Hz,1 kHz,2.5 kHz,3 kHz,5 kHz,6.25 kHz,7.5 kHz,8.3333 kHz,9 kHz,10 kHz,12.5 kHz,15 kHz,20 kHz,25 kHz,30 kHz,50 kHz,100 kHz,150 kHz,200 kHz,250 kHz,300 kHz,350 kHz,400 kHz,450 kHz,500 kHz,1 MHz" />
Listed here are the possible choices of VFO steps between 1 Hz and 1 MHz. If you need to use an unexpected step, simply edit it and enter the new value, e.g. "3.125 kHz".

<add key="waterfall.gradient" value="FF0000,FF0000,FBB346,FFFF00,FFFFFF,7AFEA8, 00A6FF,000091,000050,000000,000000" />
Modification initially suggested by Youssef for High Dynamic Range applications.

<add key="core.pluginsDirectory" value="Plugins" />
Directory where all Plugins are saved.

<add key="DCS.OnlyUseDcsCodesInTable" value="1" />
DCS: an option has been introduced to use only the DCSs that exist in the table, thus reducing their list (see previous plugin "CTCSS & DCS").

<add key="DCS.SwapNormalInvertedDcsCodes" value="True" />
DCS: Introduced additional option to eventually switch the display of DCS codes between "Normal" and "Inverted" (see previous plugin "CTCSS & DCS").

… <add key="plugin.AudioEqualizer.ParametricGainValues" value="0,-2,-3,-4,-5,-4,-3,-2,0:0,0,0,0,0,0,0,0,0,0:0,0,0,0,0,0,0,0,0,0:0,0,0,0,0,0,0,0,0,0:0,0,0,0,0,0,0,0,0,0:0,0,0,0,0,0,0,0,0,0" /> <add key="plugin.AudioEqualizer.ParametricPresetNames" value="Music:Flat Preset 1:Flat Preset 2:Flat Preset 3:Flat Preset 4" /> …
Also all configuration data of "Audio Equalizer" plugin by BlackApple62 are saved here automatically in "plugin.AudioEqualizer.ParametricGainValues..." section, here are some lines highlighted.

… <add key="FilePlayerLastFileName" value="C:\SDR#\092,100 MHz (2021_12_15 1030).wav" /> <add key="FilePlayerLoopEnabled" value="False" /> <add key="FilePlayerShowRealTime" value="False" /> …
Vasili Beliakov's FilePlayer adds in the <add key="FilePlayer..." section several lines of configuration, here are a few highlighted.

Wiring of the devices and their positioning

The advent of 3D printers provides the ability to create very custom accessories and storage boxes. However, the general consensus seems to be not to use any form of support/mounting that would limit heat dissipation, perhaps inside small plastic enclosures even for weather protection when used outdoors or in an attic.

At the limit just a small piece of double-sided Velcro to stop it on the receivers shelf, but for my part I prefer to leave them free on the table of the radios, maybe in the vicinity of a small fan properly turned on just in the hottest summer months to help the cooling of the outer shell.

Another issue concerns the "micro USB" cable and connectors that must be arranged for minimum tension, pressure and torsion so that they do not create mechanical stress on the connector itself and the underlying PCB to which they are soldered.

Rigid cables are not a solution because they tend to lift the connectors from the boards and the soldering and tracks on the PCB are insufficient to maintain contact for long periods of stress.

Also not recommended the continuous connection/disconnection of the cable from the device "micro USB" socket (surely preferable to do it from the side of the normal USB socket of the computer).

Also the antenna connection would be preferable to make it through short SMA connector cables (male/female) of excellent and thin flexible cable to connect in line your more robust and rigid coaxial antenna cable maybe even equipped with heavy and bulky adapters. All this will help to remove physical stress and allow long life to our small devices...

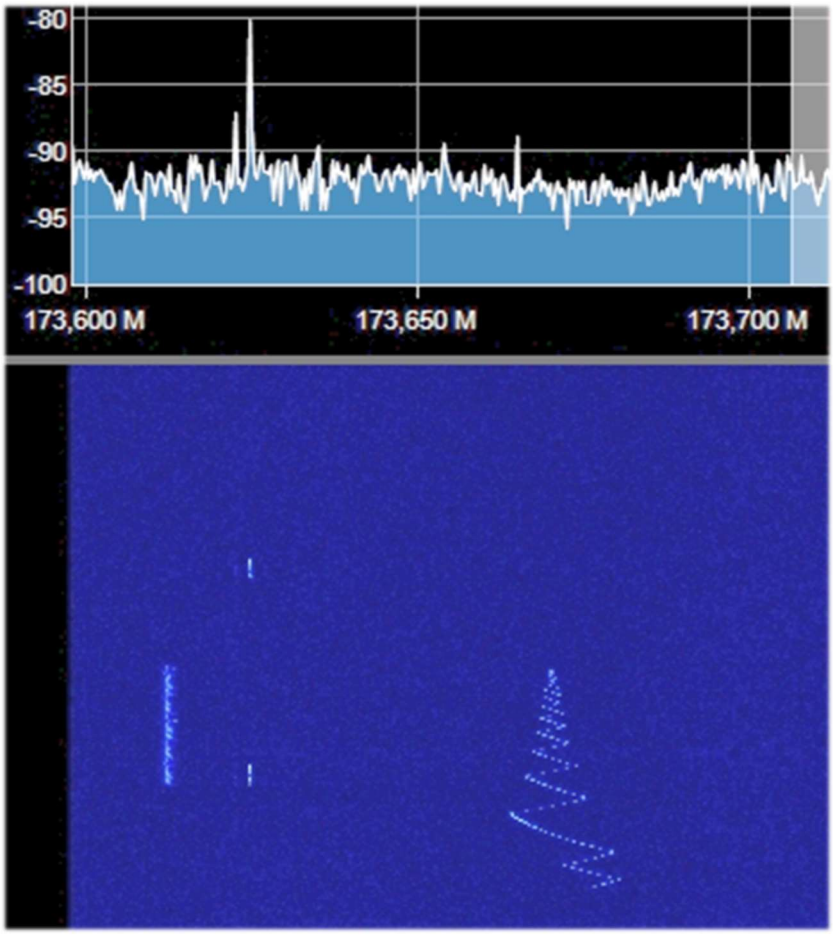
Things I didn't understand...

Over the years I have received many signals like the previous one and very few are easily identifiable at first glance. It must be said that not all signals emitted in HF/VHF/UHF are on purpose because many of them are caused by the most disparate radio interference and disturbances: noise generated by the internal circuits of the receiver itself or by the USB or power supply of your computer, industrial equipment or the many poorly designed or poorly shielded domestic equipment, but also occasional natural phenomena of various entities (solar storms, ionospheric propagation, etc.).

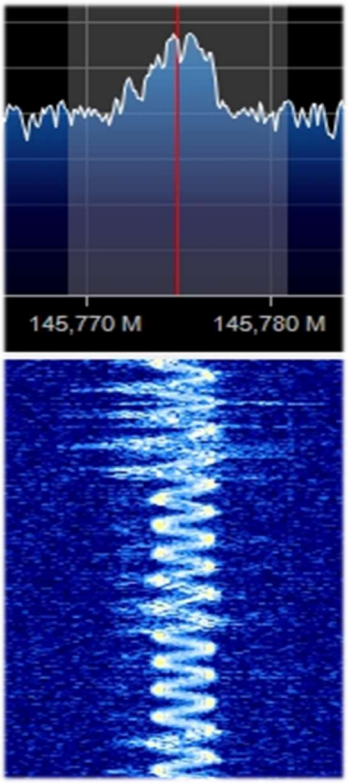
Today, thanks to the use of SDRs, it is possible to have a clear graphical representation of these phenomena and with the use of waterfall, it is possible to visualize and analyze in real time all the received signals including interferences. But being able to make a cataloging is quite difficult if not impossible. Sometimes even a simple switching power supply of low cost radiates signals difficult to identify if not turning off one at a time the various utilities (but what if it were our neighbor?)

On the net sometimes you come across similar screenshots received from guys maybe from the other side of the world, but no one has yet assigned a unique name, there are those who call them **Squiggles** or **Doodles** or **Ladders** but in the end they are the same things... *What do you think can be a new form of radio listening or why not of what I define "**Waterfall Art**"? Will you give me a hand to collect and try to catalog the most curious and strange?*

Oddities in VHF, a unknown signal drawing a Christmas tree in the middle of August!!

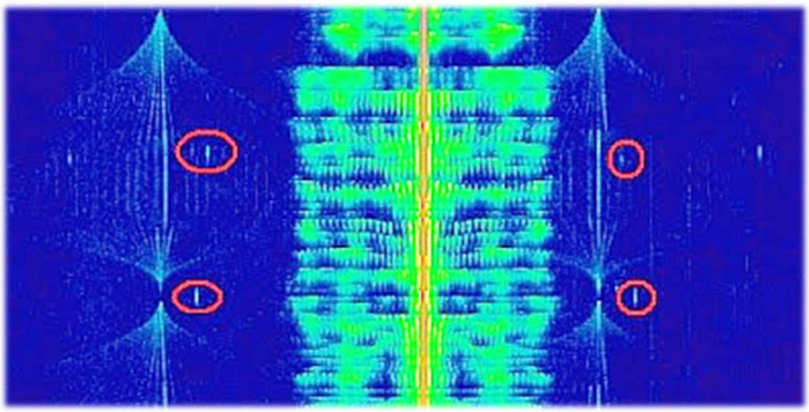


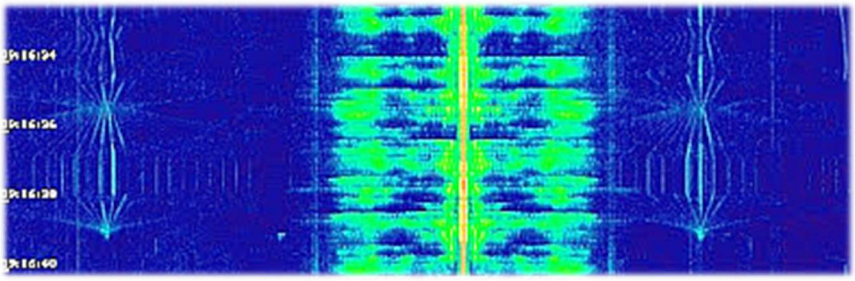
Very unstable speech transmission on 145 MHz



MW signals from the ...Umbrella Corporation?

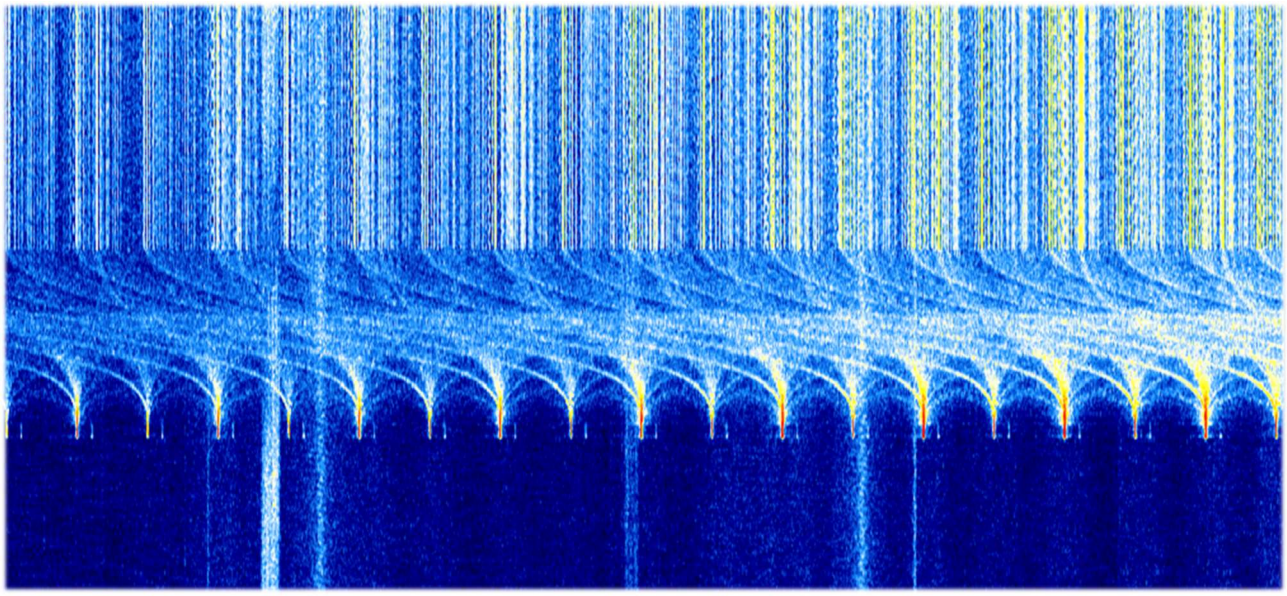
While listening to my local medium wave station I came across some unknown specular signals in the 999 kHz vicinity. Demodulated in USB by ear it sounded like a low audio note that gradually extended its frequencies to open up like a digital umbrella. I had to increase the contrast of the following images a lot as it didn't appear too sharp on screen. After a few seconds the cycle changed and the umbrella closed, leaving a further trace: a very short, higher-pitched audio note that I have circled in red. In about 100 kHz bandwidth the signal was visible 7 times every 16 kHz exactly... Curious indeed, and the definition of the "Umbrella Corporation" - the fictional biotechnology company featured in the Resident Evil video game series - came to my mind.



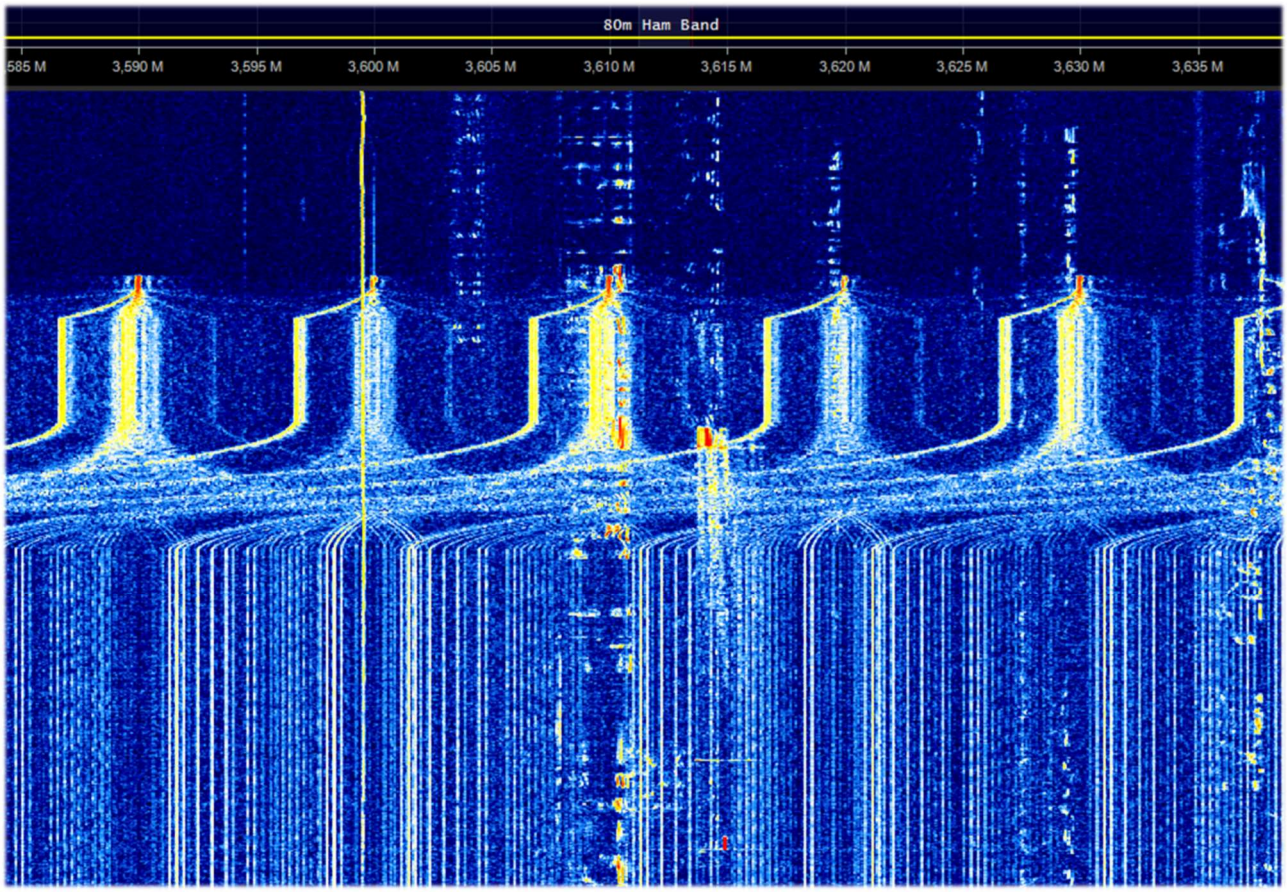


Also this noise has been raging for years in all my HF: it is a cycle of several seconds that opens and closes with the following signals matrix...

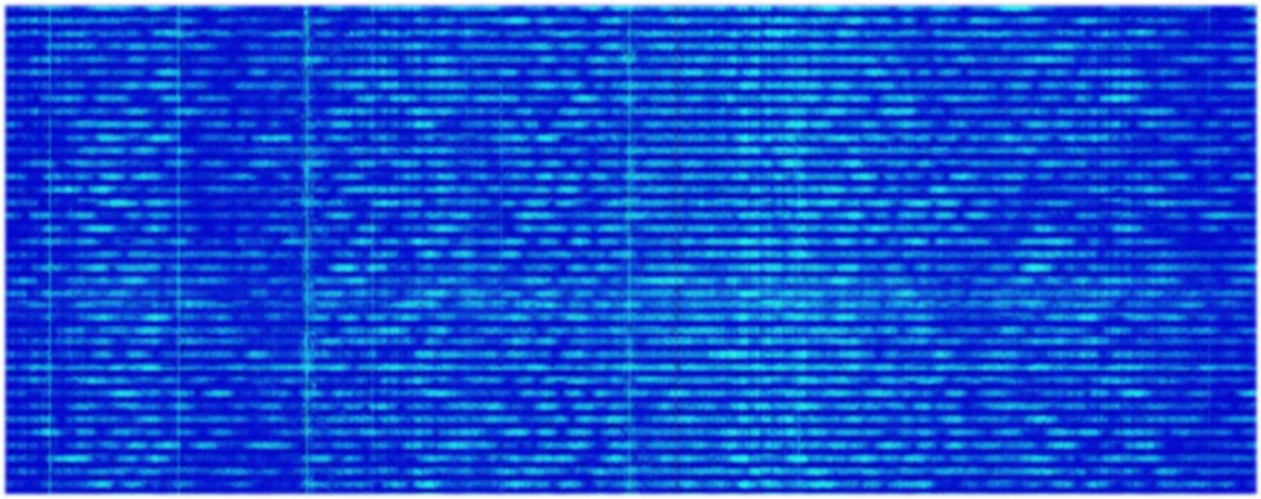
OPENING



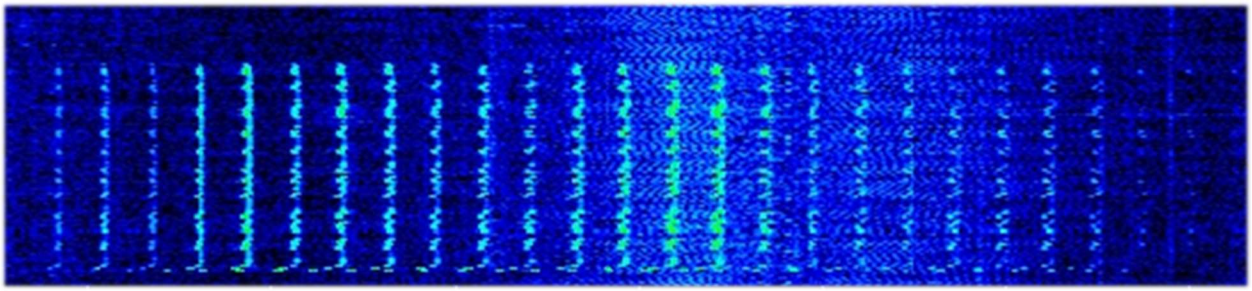
CLOSING



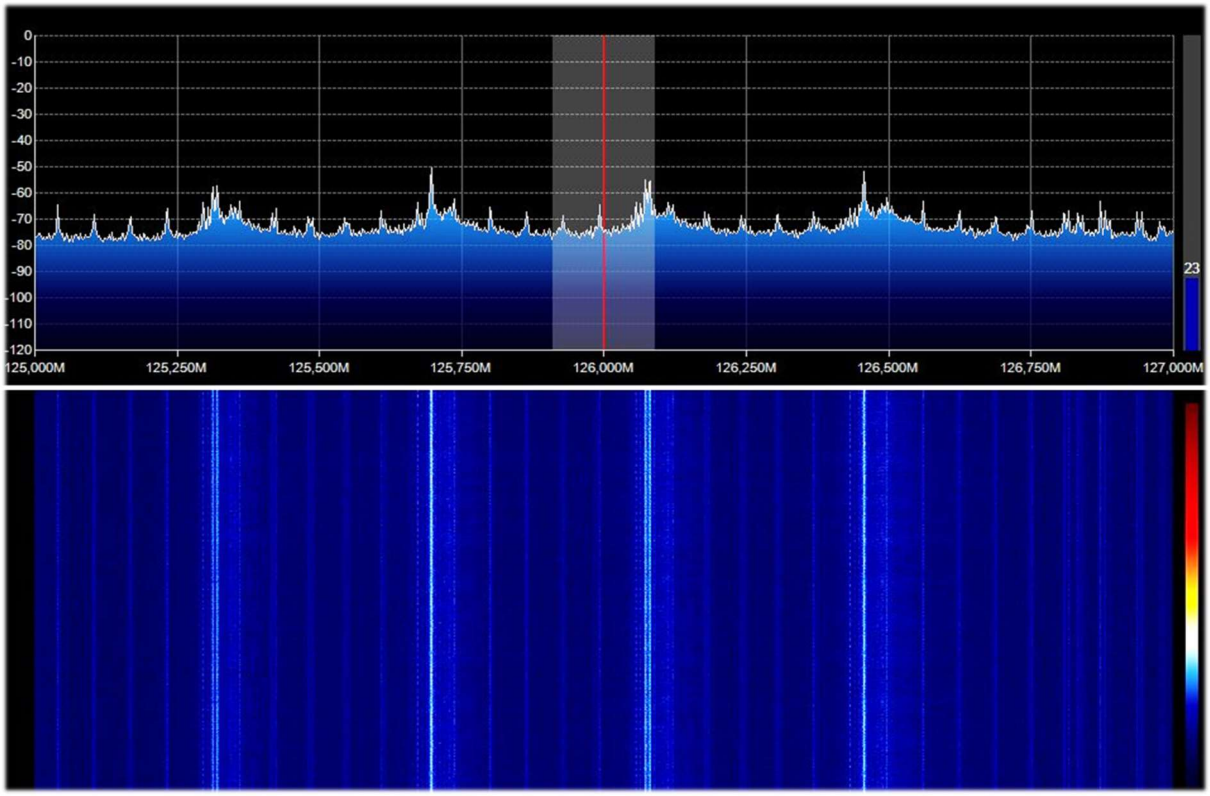
A strange and dense array of signals appeared on HF for a few days between 11 and 13 MHz, perhaps one of the many OTH - Over the Horizon radars?



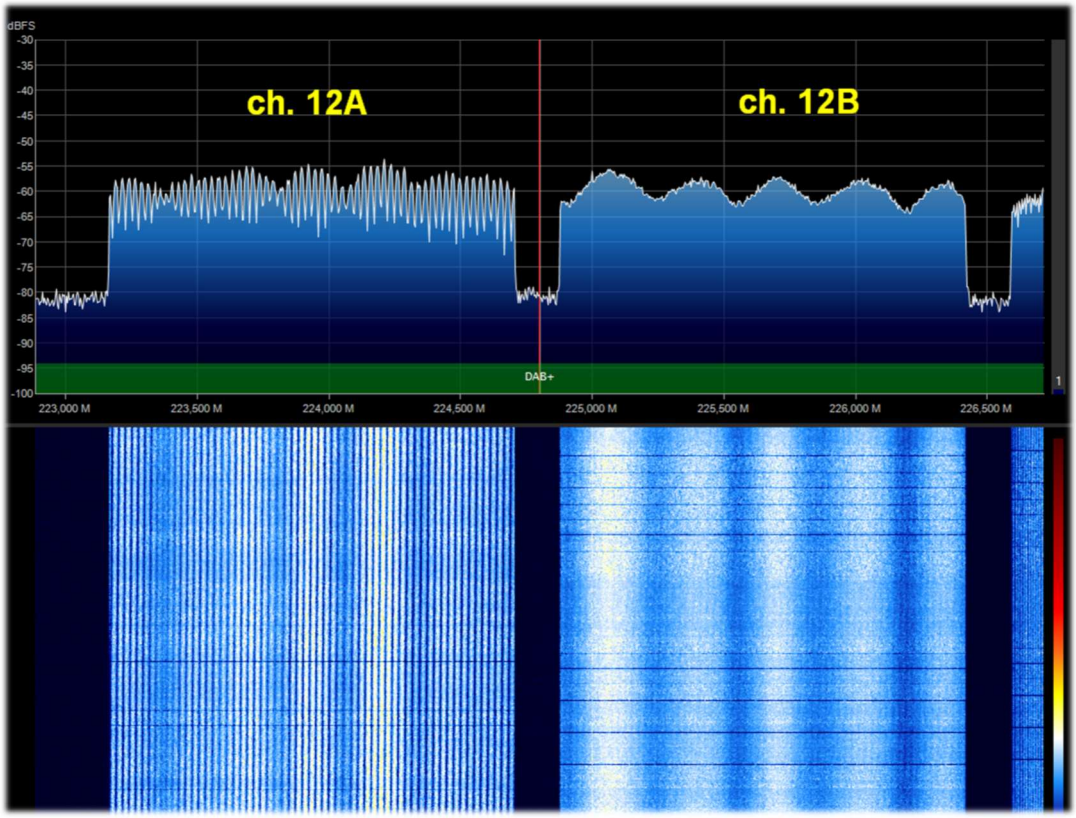
Continuous HF noise from 1.0 to 5.0 MHz from my Atlantis desktop PC power supply.



What about these? All noises coming from the USB or the laptop's internal power supply?

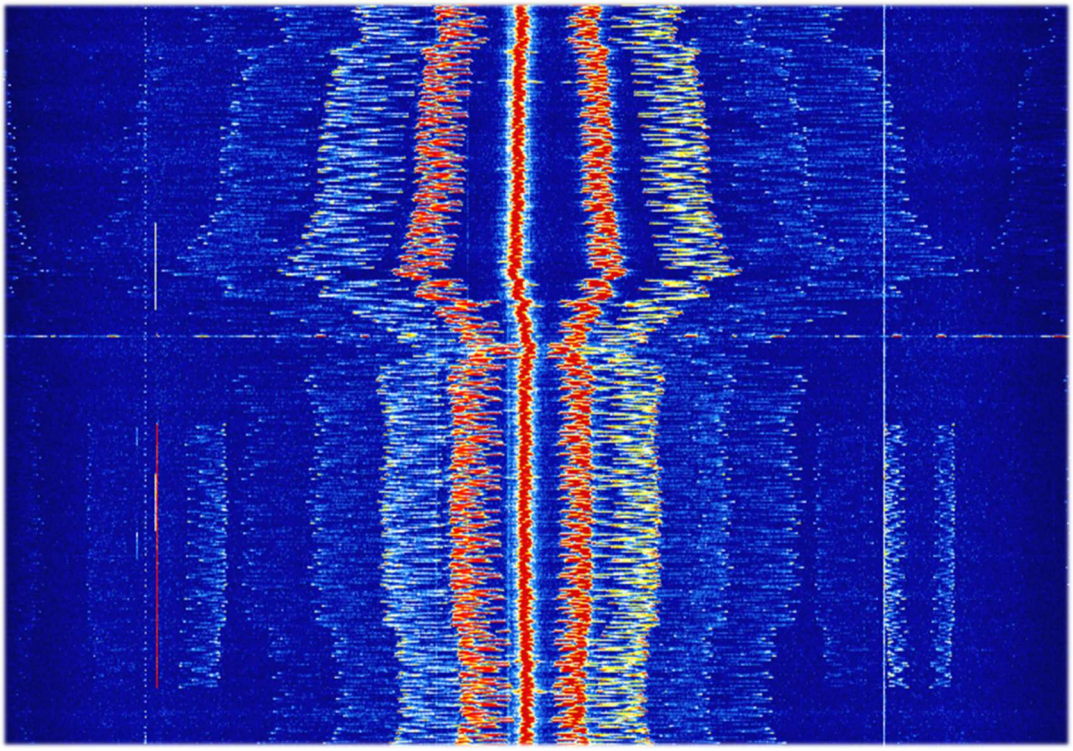


Here everything is ok: …DAB+ signals, but who knows why with such a different multiplexing?

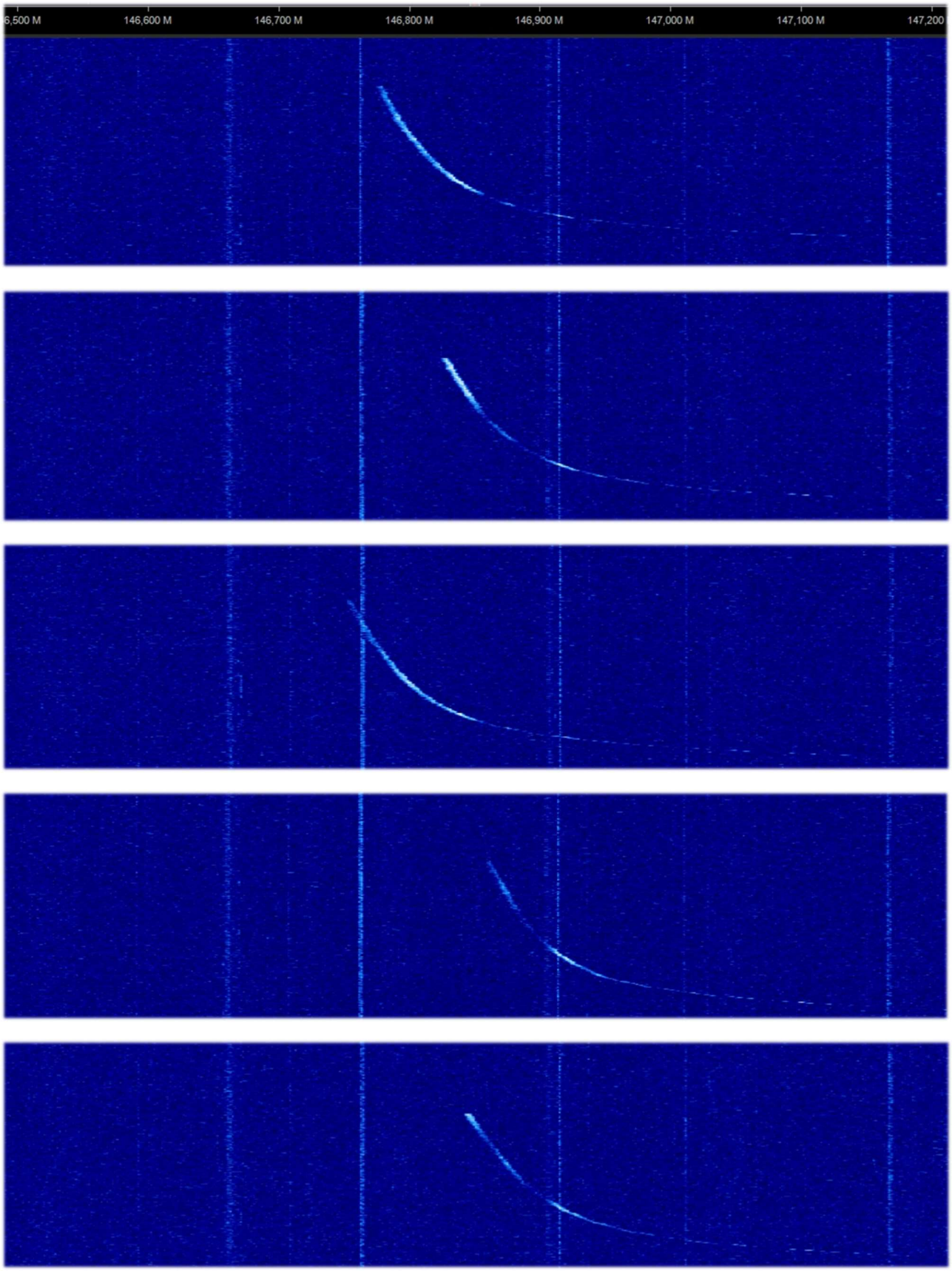


The friend Claudio, a technical expert in the field, explained to me that you cannot see differences in the multipath in the spectrum because there is a scrambling signal that makes them all visually equal. However the difference in the shaping of the signal amplitude depends either on the multipath or on the composition of two or more signals at the same frequency that are periodically summed with a longer or shorter period depending on the difference in path or phase.

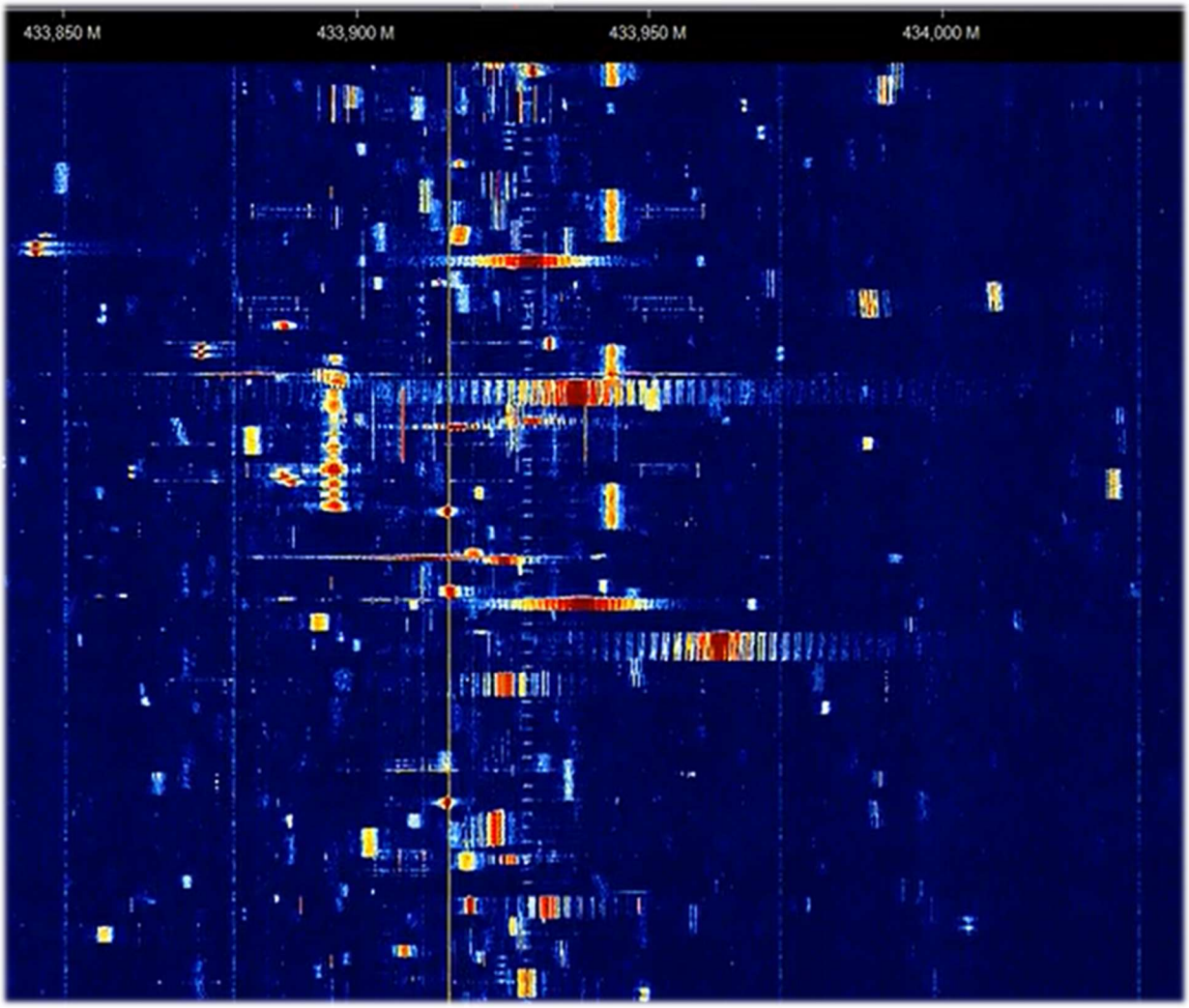
Here the problems in UHF return... with these unknown 'sculptures' of pure noise!



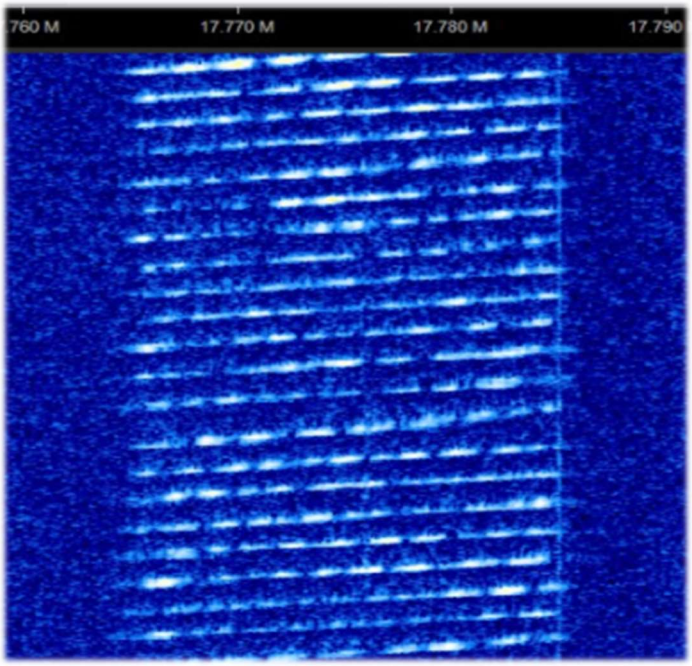
And who generated these curious VHF "whiskers" with signal ranging from 147.1 to 146.8 MHz captured in the time frame of only five minutes? (October 1, 2021 at 13:30 UTC)



A varied palette of digital bursts on 433 MHz, but how many are there…?!

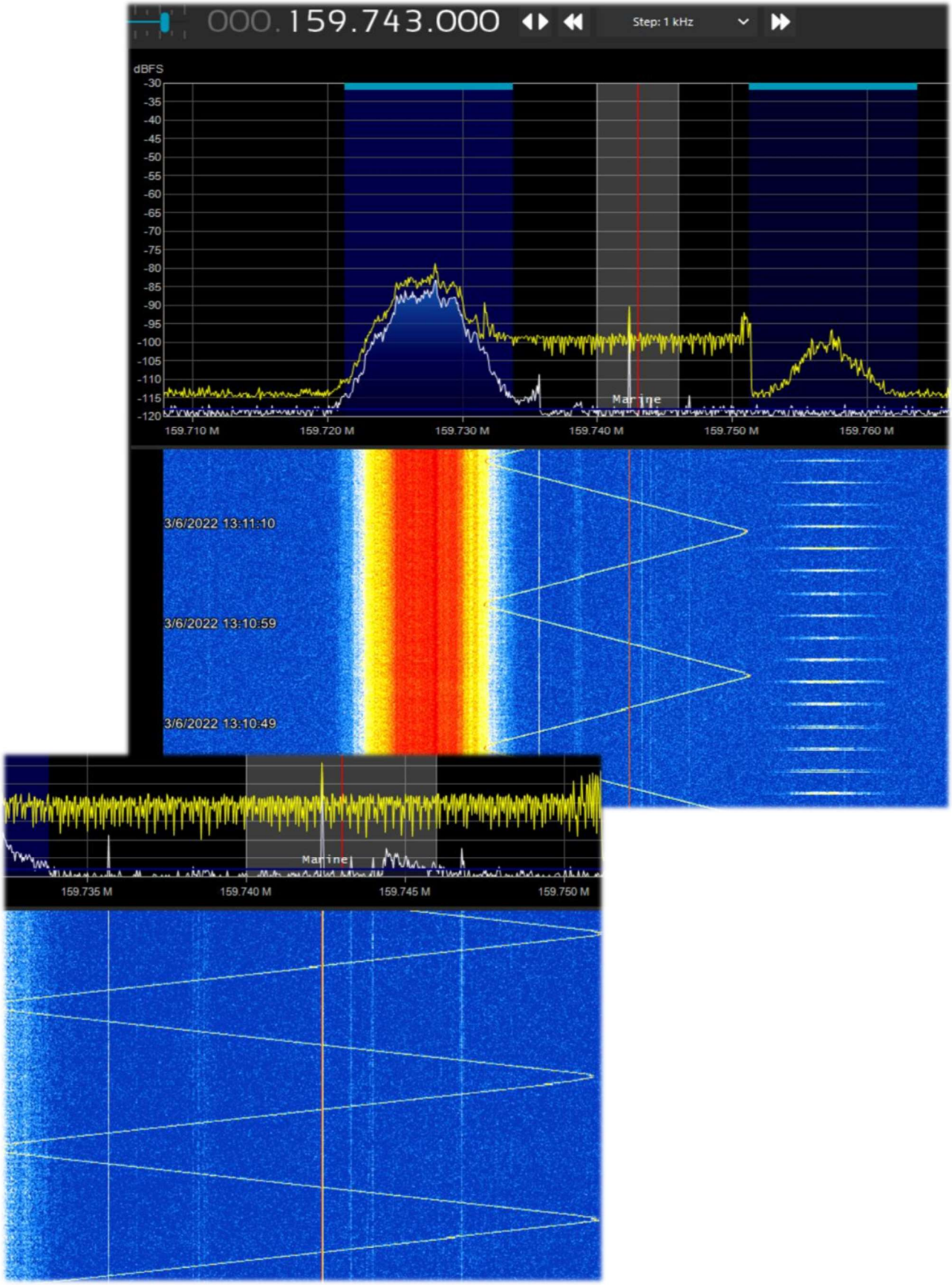


Certainly another of the many OTHRs on HF (here on 17 MHz, 16 meter broadcast band)



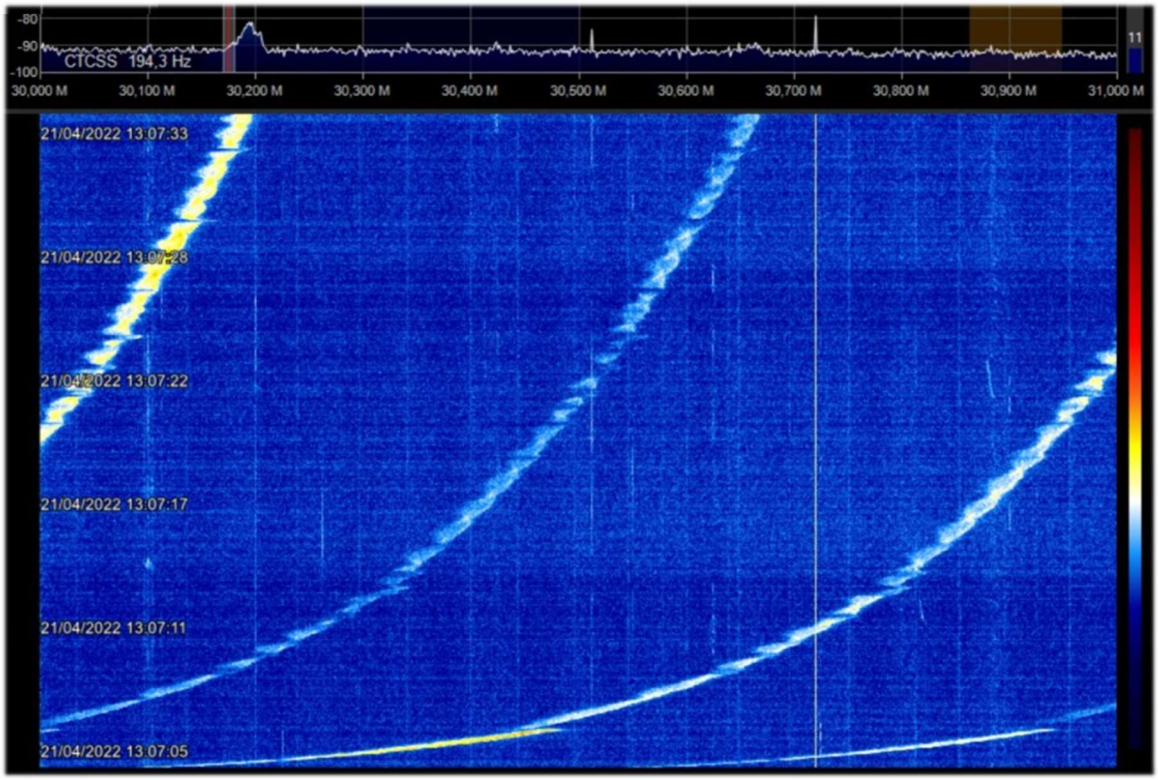
NEW

Lee (Maine, border with Canada) sent me these two screenshots of a very strange signal detected on 159 MHz. It lasted about half an hour, not visible anywhere else in the spectrum. You can see that the audio signal moved rapidly in frequency in a cyclic fashion and then reversed in the narrow range of the 20 kHz BW, creating that curious jagged appearance.



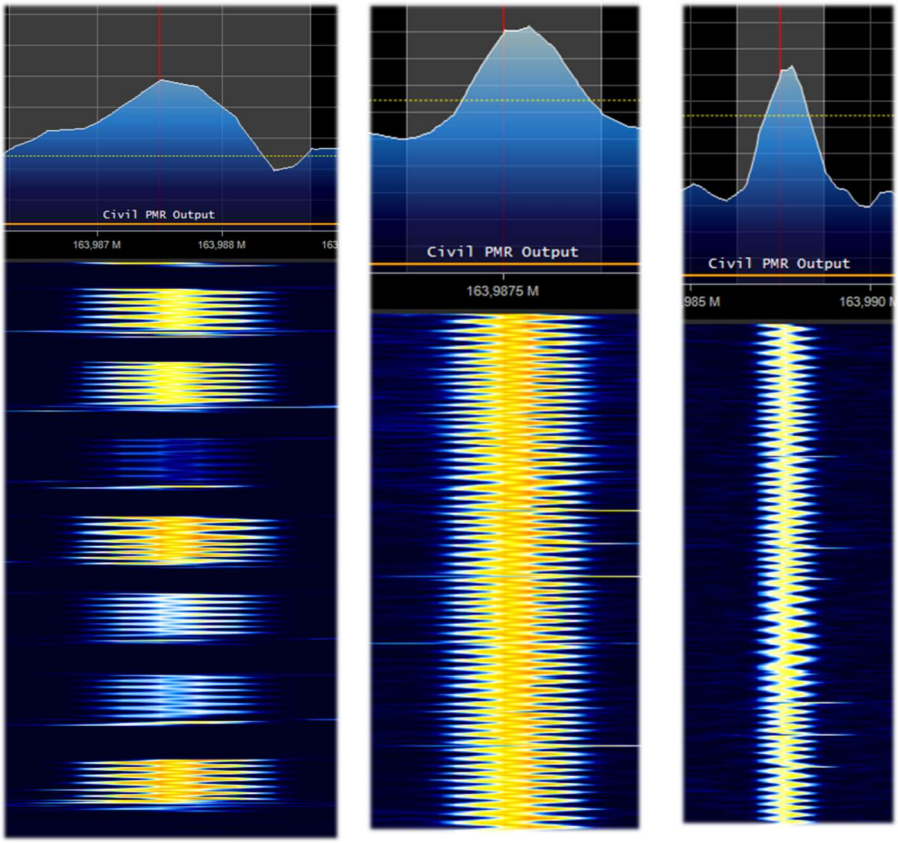
NEW

Roberto (Italy), a dearest friend and fellow radioamateur, sent me the following screenshot (April 21, 2022) detecting curious increasing signals in the 21/50 MHz range (but after a while the frequency stabilizes) also indicating that usually induction welders are retrograde. These instead go forward...



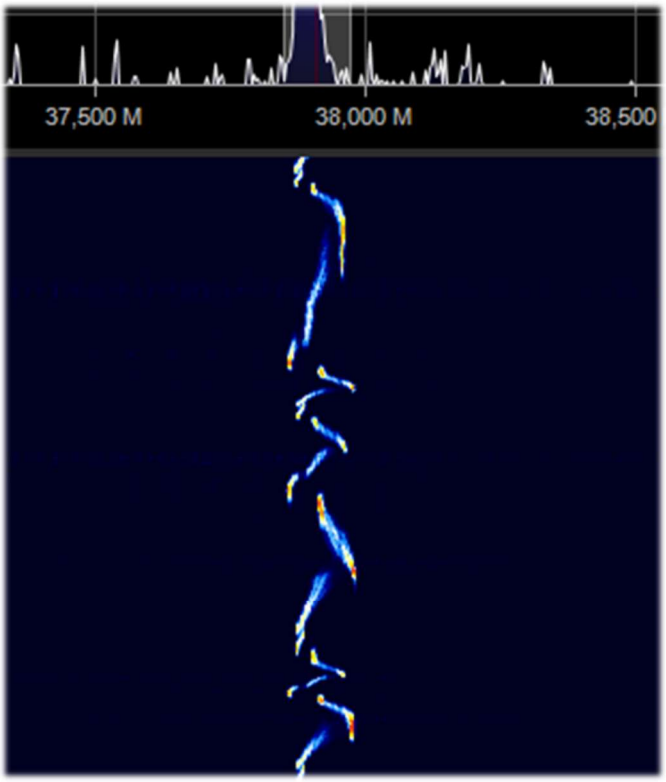
NEW

(Italy). A net of local vhf links with a curious problem of hooking/unhooking to the system and with only carriers with hiccupping audio and with continuous triggers that went on for half a day...



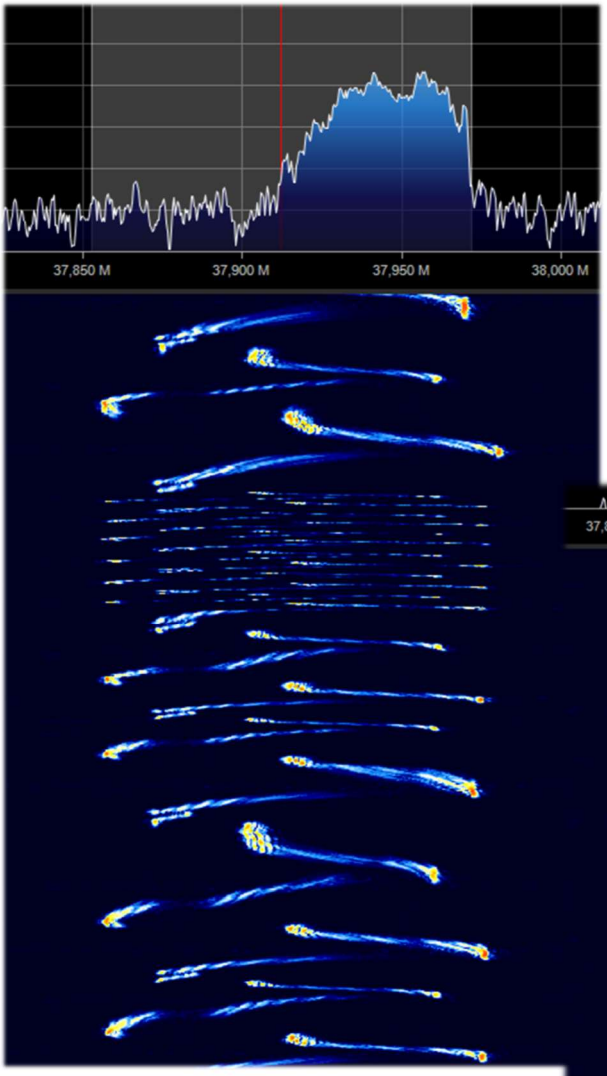
NEW

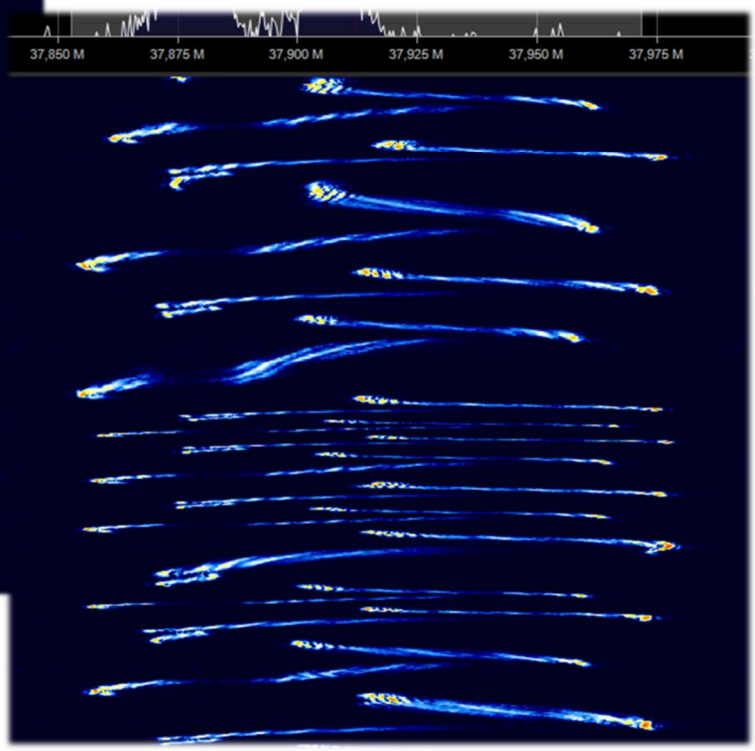
(Italy). Another of my virtual sculptures collected from the ether, perhaps thanks in part to being in a chaotic inner city!!!



The signal is present fairly strongly at the beginning of 38 MHz with a bandwidth around 120 kHz. Perhaps some switching power supplies in full operation?

Here are some zooms of greater detail...





Raspberry Pi 3/4

Sometimes it can be useful not to depend on a personal computer running 24 hours a day (CPU/HD/monitor consumption, fan noise) or to have the need to remotely locate your receiving station (perhaps in an attic near the antenna cable) and so the use of a Mini-computer can open the way to many projects and applications even in the amateur radio field. The Raspberry Pi (or "single-board computer"), which costs very little and consumes very little power, is ideal both for its high-end technical features and for its extensive software/radio equipment, which also includes all our AirSpy devices!

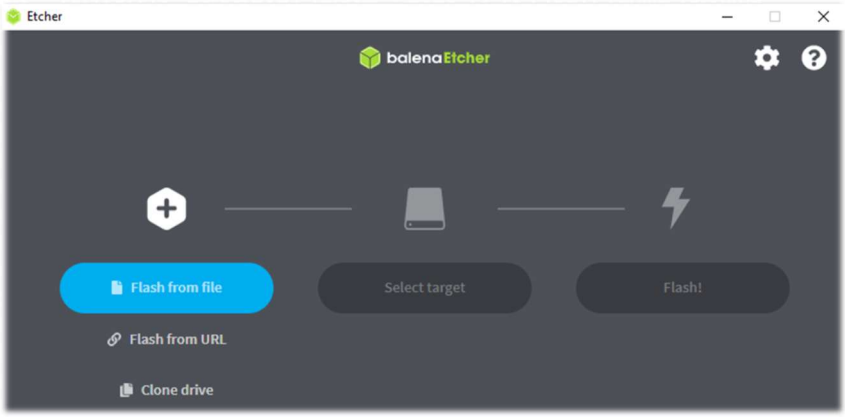
There are certainly other ways, and I will describe one of them in detail, which has led to excellent results, even though it will be the most challenging chapter, and with some possible criticalities. Those who know Linux well can try it differently by following the indications given here: ***https://photobyte.org/raspberry-pi-running-spy-server-as-a-service/***

Prerequisites:

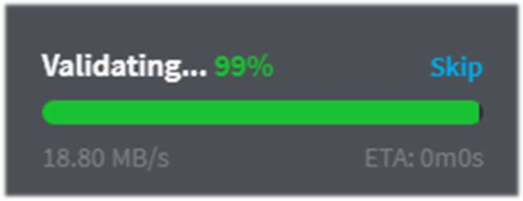
- **Raspberry Pi (with power supply, monitor and keyboard)**
- **a microSD card (of at least 8 GB)**
- **software PiDSR (image file): *https://github.com/luigifcruz/pisdr-image/releases/tag/v5.0.0***
- **portable BalenaEtcher (for flashing the microSD): *https://www.balena.io/etcher/***

This is not the session to describe in detail the various types of Raspberry, there are dedicated sites for every need as well as describing the different distributions and customisations available created specifically for the ARM (*) architecture which is very different from the PC architecture.

In my test, I reused a Raspberry Pi 3 model B that had been lying in a drawer for a long time, in combination with a good external power supply (since it is well known that the Pi3 model is very sensitive to power supply variations). So let's see the bare minimum to get up and running in no time, starting with the software that we are going to download from the links indicated in a directory on our Windows computer (e.g. C:\Temp).



Connect the microSD to the PC and run the opensource and portable software BalenaEtcher. Choose "Flash from file" where in my case I indicated the image file (a "Raspbian" modified with SDR software compatible with each Pi model) named "**2020-11-13-PiSDR-vanilla v5.0.img.xz**", taken from the site of the developer: the radioamateur Luigi Cruz (PU2SPY). Then in "Select target" choose the drive that contains the microSD and finally the third button "Flash!" to start the process. It will take about 15 minutes between writing and verification, do not interrupt it and at the end you will see the following screen:



Make sure that no errors are reported when writing/verifying the image, otherwise reformat the SDcard or use another one. The image has now been created (it is obviously not accessible or viewable via a Windows browser), so it can be extracted from the PC and installed in the Raspberry's slot.

PiSDR's pre-installed software for radio use is very rich indeed, but I have only tried a fraction of it at the moment... The supported SDRs are the following: RTL-SDR, LimeSDR, LimeNET, PlutoSDR, all Airspy (R2, Mini, HF Discovery and HF+), HackRF One, USRP.

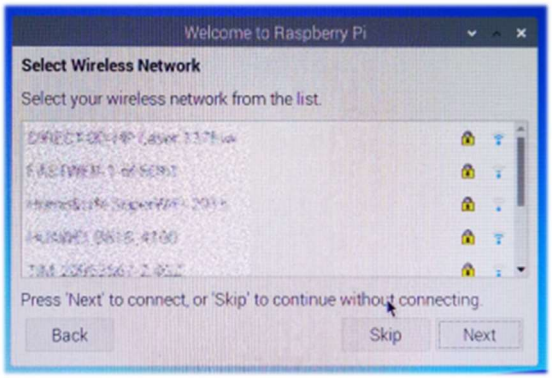
In my case, I connected the Pi to my home WiFi router with a good Ethernet cable (i*f the distance is long, consider a class 7 cable, which is also shielded)* then a video/keyboard and of course an Airspy!

Let's take a look in sequence at the various screenshots that appear on first start-up for configuration:

1) Welcome

2) Choose country and language

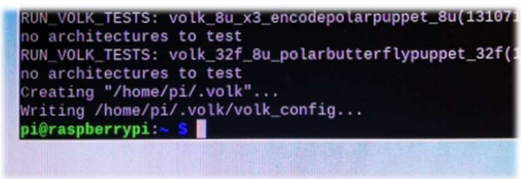
3) Change password



4) Select wireless network

While I left out the window with the request to update the software (which I did not do)...

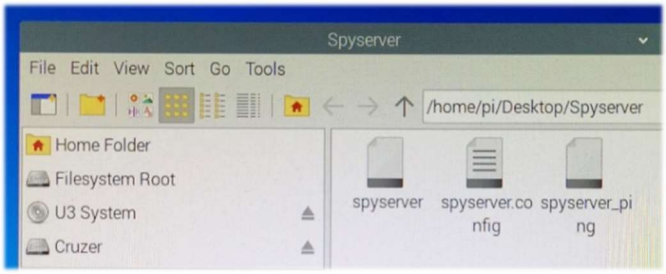
On the developer's website, it is recommended to run the following command from the "Terminal": **volk_profile** which will optimise the system. The Terminal icon is this (the fourth in the top left corner)



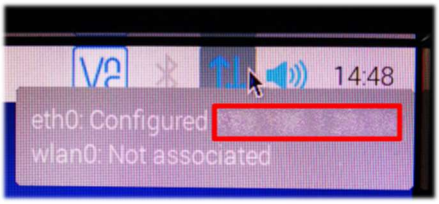
Allow time for the update to take place (several minutes) and then close the Terminal only when you see the usual terminal prompt...

At this point, our new operating system is almost ready. All that remains is to connect to the Airspy website using the "Web Browser" (second icon on the top left), and download to the desktop the file **"SPY SDR Server for 32-bit ARM boards"** from the following link: ***https://airspy.com/?ddownload=4247***

Once the file **"Spyserver_arm32.tgz"** has been downloaded, I created a folder called Spyserver on my desktop and extracted the three files from it...

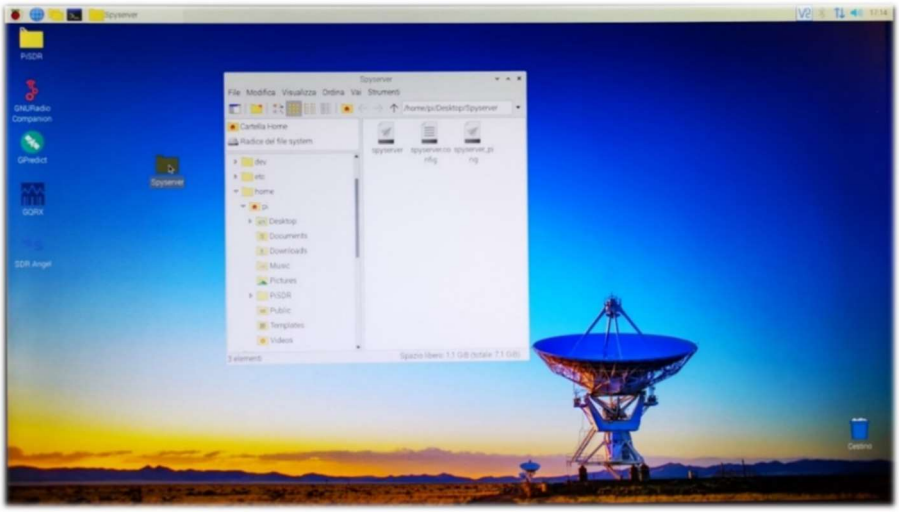


For these operations and to move between the system's folders, I used the third icon in the menu at the top left..



I disabled the Bluetooth icon in the menu at the top right... Instead, I wrote down the number of the IP address assigned by the system that appears by hovering the mouse over the blue Wireless icon at the top right "eth0: Configured xxx.xxx.xxx.xxx". *We will need it shortly afterwards...*

Now we need to edit the file "**spyserver.config**" for our needs. You can either click on it or stand on it and with the right mouse button choose the "Text Editor". We need to edit some values, remove a # (which means to make that line of the script active) and finally save the file, being careful not to change any other parameters for this time.



We will have time later to go back and analyse and better understand all the lines of the "SPY Server Configuration File". These are the lines to be considered for modification and use with an AIRSPY R2 *(read below for other devices):*

bind_port = 5557
list_in_directory = 0 — **Value 1 makes the server public !**
device_type = AirspyOne
device_sample_rate = 2500000
initial_frequency = 101800000 *(optional, it concerns the frequency that will appear at start-up in the VFO of the SDR#: in my case I can see if everything works on the first shot: if in my attic the active antenna and the multicoupler are on and working, if the remote switch is correctly positioned, etc.).*
initial_gain = 10 *(for device: R0, R2, Mini)*

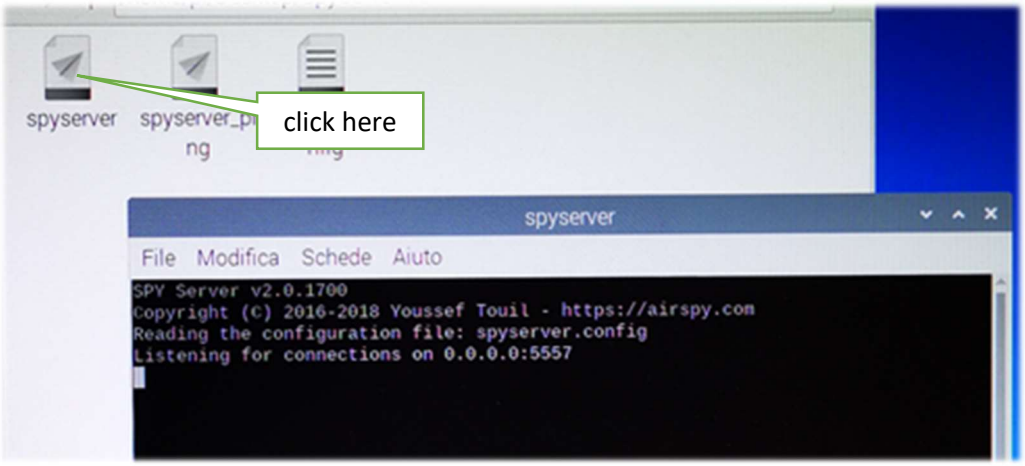
The **"Device Type"** group has these choices (so indicate your own instead of xxx)

```
# Device Type
# Possible Values:
#   AirspyOne  (for device: R0, R2, Mini)
#   AirspyHF+
#   RTL-SDR
#
device_type = xxx
```

The **"Device Sample Rate"** group has these choices (indicate value instead of xxx)

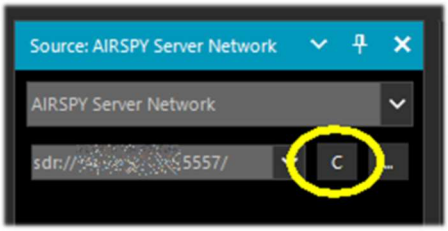
```
# Device Sample Rate
# Possible Values:
#   Airspy R0, R2 : 10000000 or 2500000
#   Airspy Mini   :  6000000 or 3000000
#   Airspy HF+    :   768000
#   RTL-SDR       :   500000 to 3200000
#
device_sample_rate = xxx
```

Now that the file has been properly configured, all that remains is to run it by double-clicking on the "Spyserver" icon and then "Run in Terminal" which will open with a few lines highlighting that it is "listening" while waiting for the client to connect...

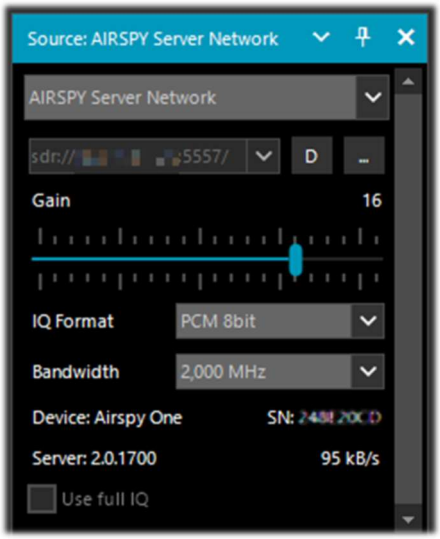


We are finally almost at the end... thanks for your patience!

Now from the laptop that I have decided to use as SDR# Client (wirelessly connected to my home network) it will be necessary to activate the Source field "AIRSPY Server Network" by typing under my ***IP address (previously marked) : port number***, and then press the "C" button.



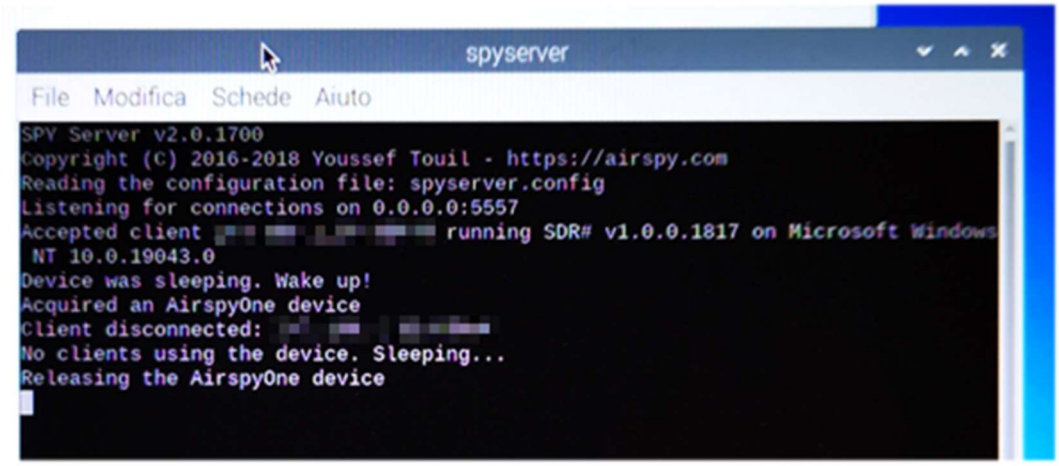
If everything is working properly, the client/server connection is established and the panel populates with more informations. The only thing needed is to adjust the Gain to the right, set the proposed frequency and use it normally: audio, decoding and functionality will be practically the same. For the other options already discussed please refer to the AIRSPY Server Network chapter.



Subsequently, to correctly close the connection it will be necessary to press the "D" button while on the server side, on the Pi, the Terminal will be closed and then the Raspberry from the "Close Session / Stop" menu from the first icon at the top left...

Wait a few moments and then the power can also be switched off...

Looking back at our Raspberry Server we can see that in the meantime the Terminal panel had been populated with more information during our connection.



For those who would like to know more, here are some commands to execute in the Terminal that may be very useful:

dmesg	Allows you to read (in the USB lines) the details of your connected SDR
free -h	to see how much RAM in your Raspberry
htop	to monitor system processes in details. To close: CTRL + C
hostname -I	to get the IP address of the our Raspberry

Here a complete list: ***https://www.tomshw.it/hardware/comandi-linux-raspberry-pi/***

Owners of a Raspberry Pi4 (with AARCH64 ARM architecture) can instead download and use the "**SPY SDR Server for 64-bit ARM boards**" from the following link: ***https://airspy.com/?ddownload=5795***

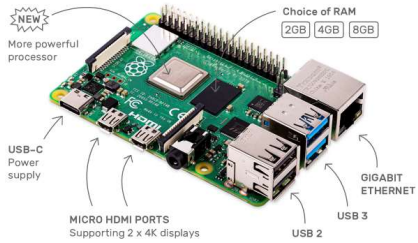
I have to admit that all this was not immediate, unfortunately you can find very few indications on the net and they are often misleading for your needs, hardware/software available on your computer as well as firewall and antivirus configuration.

Then an important thing was to check which IP address was to be pursued and configured so that everything could talk at its best and without bottlenecks. For example, your own router can reserve some unpleasant surprises, in my case with the R2 and the 10M sample rate, the transferred audio is hiccuping and ripped (unusable) and I could not understand if it depends on the RAM of my Pi or on other configuration parameters of the Spyserver.config file (for example I tried to change the parameter "Force-8bit = 1")…

But all this is part of that amateur radio spirit that leads to experimenting with patience and renewed enthusiasm even the most complex and unfamiliar things. Limited knowledge of Linux and its various distributions held me back a little at first, but I managed to reach my goal in the end.

Tests carried out on a Pi3 have shown that it is possible to run two RTL-SDRs at the same time, provided that the performance is not too exaggerated... In fact, it is possible to obtain reasonable results by using, for example, AIS and ADS-B decoders in parallel, which do not require the entire stream to be transferred, but only the processed stream...

Who knows what you could do with a Pi4? Let's start by looking at the main features and differences between the two models....

	Raspberry Pi 3 B+	Raspberry Pi 4
		
RAM	1 GB (LPDDR2 SDRAM)	2/4/8 GB (LPDDR4 - 2400 SDRAM)
Processor	Broadcom BCM2837B0 Quad core Cortex-A53 @ 1.4 GHz	Broadcom BCM2711 Quad core Cortex-A72 @ 1.5 GHz
GPU	VideoCore IV @ 250-400 MHz	VideoCore VI @ 500 MHz
Power connector	MicroUSB	USB-C
USB 3.0	-	2
USB 2.0	4	2
Display connector	1x HDMI	2x microHDMI
WLAN / Wi-Fi	802.11n	802.11ac
Ethernet	300 Mbps	Gigabit / 1000 Mbps
Bluetooth	4.1	5.0
Dimension	86 x 56 x 21 mm	

I got to try out a Pi4 with 8GB of RAM which definitely offers more modern equipment, better technology, and even more usage options due to the larger and faster RAM.

These are basically the main differences with the Pros and Cons.

	Raspberry Pi 3 B+	**Raspberry Pi 4**
Pros	Single full-size HDMI port; Lower power consumption and board overheating	Better CPU and memory; Dual 4k monitor support; USB 3.0
Cons	Less brilliant specifications; USB 2.0	Higher power consumption and board overheating; Absence of full-size HDMI ports; New case; Higher cost

In our area of interest, with the same software installed and hardware connected (wireless router and AirSpy R2 device) the Pi4 proved to be really strong and finally I was able to manage the SpyServer at its maximum potential at 10 MSPS IQ *(with the previous Pi3 B+ beyond 2.5 MSPS IQ the audio reached the client all fragmented and hiccupping)*.

Thank you for following me in the hope that all the notes collected will help you too!

Conclusions and quotes

If this book has helped you to better appreciate SDRsharp I consider it an excellent result. I have personally tested everything in the guide, now it's your turn !

It is always a difficult thing when switch to the SDR world from your good old analogue receiver. There are plenty of SDR's on the market, but to get similar performance to a top class analogue receiver, people spent a lot of money because the underlying technology was (and still is) very expensive when aiming for a high level of performance.
Those who initially venture into SDR often confuse performance with displayed bandwidth, when in fact it is quite the opposite. The more you are "open" to other signals that you don't need, the worse it is. Also, some hobbyists unfortunately often confuse their strong local interference with their radio's ability to cope with the dynamics in the various bands.

I conclude our journey together with this collection of famous quotes that I find well matched to our topics....

The quotation attempts to reproduce in writing a passion for reading, to rediscover the instantaneous electrocution of the stimulus, because it is precisely reading, stimulating and exciting, that produces the quotation - A. Compagnon

Without bases there are no heights - Anonymous
When faced with an obstacle, the shortest line between two points can be a curved line – B.Brecht
Words are chosen by the writer. The meaning is chosen by the reader - Ginevra Cardinaletti
There are some things you learn best in calm, and some in storm – W. Cather
Reading is one of the greatest pleasures and tools in our lives - Roal Dahl
You were not made to live like brutes but to follow virtue and knowledge - Dante
A smattering of everything, and a knowledge of nothing - – C. Dickens
Auxilio Divino - Sic parvis magna – F.Drake
You do not possess what you do not understand – J.W. Goethe
Whoever tries to penetrate the Philosophers' Rose Garden without a key, resembles a man who wants to walk without feet - M. Maier
Perfection has one grave defect; it is apt to be dull – W.S. Maugham
The things that escape us are more important than the things we possess - W.S. Maugham
Either say something better of silence, or keep quiet - Menander
If I have seen further, it is because I standing on the shoulders of giants – I. Newton
Blessed be the man who expects nothing, for he shall never be disappointed - A.Pope
Often a small gift produces big effects - Seneca
Geniuses are those who say long before what will be said long afterwards - R.G.Serna
Virtute siderum tenus (with valor toward the stars).

If SDRsharp did not exist, it would have to be invented – d'après Voltarie / P.Romani
SDRsharp, to make black and white listeners see colours - d'après Maneskin / P.Romani
SDRsharp makes your life better! – P.Romani
Switch off the smartphone and switch on the SDR – P.Romani

(*) Abbreviations

ADS-B - Automatic Dependent Surveillance - Broadcast
AF – Alternate Frequencies (RDS)
AGC – Automatic Gain Control
AIS – Automatic Identification System
ALE - Automatic Link Establishment / HF standard for initiating/supporting digital comms
AM – Amplitude Modulation
AOS - Acquisition of Signal (or Satellite)
BALUN - BALanced-UNbalanced, device for adapting an unbalanced/balanced line
BW – BandWidth
CPU – Central Processing Unit
CTCSS - Continuous Tone-Coded Squelch System (analogic)
CW – Continuous Wave
DAB/DAB+ - Digital Audio Broadcasting
dB - decibel
dBFS - Decibels Full Scale
DCS - Digital Coded Squelch (digital)
DGPS – Differential Global Positioning System
DMR – Digital Mobile Radio, is one of the main open standards for radio communications
DPI - Dots Per Inch, graphic screen resolution
dPMR – digital Private Mobile radio, other open radio communication standard
DRM – Digital Radio Mondiale – digital radio in HF
DSB – Double Side Band
DSP – Digital Signal Processing
DTMF - Dual-tone multi-frequency
DX – Long-distance radio connection
EON – Enchanced Other Networks (RDS)
FFT – Fast Fourier Transform
FIC - Fast Information Channel (DAB)
FM - Frequency Modulation
FM-DX - search for distant FM radio stations under particular propagation conditions
FSK – Frequency shift keying
FT8 - Franke-Taylor design, 8-FSK modulation
GNSS - Global Navigation Satellite System, geo-radiolocation system
GPS - Global Positioning System, USA satellite positioning and navigation system
HDR – High Dynamic Range
HF – High Frequency (3-30 MHz, decametric 100-10 m)
HUB - hardware connecting various devices to the computer
IF – Intermediate Frequency
KSPS – kilosample per second (10^3 * sps)
LDOC - Long Distance Operational Control
LF – Low Frequency (30 / 300 kHz, kilometric 10-1 km)
LNA – Low Noise Amplifier
LOS - Loss of Signal (or Satellite)
LSB – Lower Side Band
mA – milliAmpere (submultiple Ampere)
MDS - MultiDimensional Scaling
MF – Medium Frequency (300 kHz / 3 MHz, ettometric 1 km-100m)
MPX – Multiplexing
MSC - Main Service Channel (DAB)
MSPS - Megasample per second (10^6 * sps)

MUX - short for "Multiplex", technique for transmitting digital radio/TV signals
MW – Medium wave
MWARA - Major World Air Route Areas
NDB - Non-Directional beacons
NFM o **FMN**– Narrow Frequency Modulation
PI – Programme Identification (RDS)
PLL – Phase-Locked Loop
PPM – Parts per Million
PS or **PSN** – Programme Service Name (RDS)
PTY – Program Type (RDS)
QRSS - Very slow speed Morse code
QTH – amateur radio Q code indicating own geographical position
RAW – unprocessed data
RDARA - Regional and Domestic Air Route Area
RDS – Radio Data System
RF – Radio Frequency
RT – Radio Text (RDS)
RTTY – Radioteletype
SAM – Synchronous AM
SAR – Search And Rescue
SMA – SubMiniature type A (coaxial connector)
SSTV – Slow Scan TV
TA – Travel Announcements (RDS)
TCP - Transmission Control Protocol
TCXO – Temperature Compensated Crystal Oscillator
TII - Transmitter Ident Information (DAB)
TMC – Traffic Message Channel (RDS)
TP – Traffic Programme (RDS)
UHF – Ultra High Frequency (300 MHz / 3 GHz, decimetric 1m-100mm)
USB – Upper Side Band
UTC – Universal Time Coordinated
VFO – Variable Frequency Oscillator
VHF –Very High Frequency (30 / 300 MHz, metric 10-1 m)
VIS - Vertical Interval Signaling (SSTV)
VLF – Very Low Frequency (3 / 30 kHz, miriametric 100-10 km)
VOLMET - vol météo (Weather Information for Aircraft in Flight)
WEFAX – Weatherfax
WFM o **FMW** – Wide Frequency Modulation

SDRsharp history

Just to keep chronological memory of the "latest" software revisions....

revision	date	Change log
...		
1716	15sep19	**Last revision with No Skin**
...		
1761	04oct20	Added real sampling capability for single ADC radios. This brings significant CPU savings compared to the full bandwidth IQ conversion. To enable this feature for the R2/Mini the config key "airspy.useRealSampling" must be set to "1". The baseband recording is not yet available for real sampling, but the IF should be still available for third party plugins.
1763	06oct20	Added full support for recording and playing Real spectrum files. Plugin authors are invited to contact me for more details.
1764	07oct20	Added Vasili's File Player and RTL R820T enhanced plugin.
1765	09oct20	Fixed the audio recording in the Wave plugin; Added more acceleration to the DSP.
1766	18oct20	Added AM DX Co-Channel Canceller plugin. Use in combination with the Zoom FFT filter.
1767	19oct20	Enabled the Boost SNR feature for all IF signals in the DNR plugin; Added marker colors for the Dark and Clear themes in the Co-Channel plugin; Many DSP code enhancements.
1768	19oct20	Improved the rejection in the Co-Channel Canceller; Added more controls: - Channel Bandwidth for the co-channel, IF Offset to shift the IF and filter out the interference.
1769	20oct20	Improved the the Co-Channel Canceller algorithm: Better tracking, Better phase noise, Better rejection
1770	24oct20	Many enhancements for the AM Co-Channel Canceller: Added more controls: Integration and Sensitivity, Better phase and amplitude tracking, Added some visual feedback in the spectrum Window to ease the tuning.
1771	28oct20	Added a new Co-Channel Canceller for FM. Same usage as the AM version; Allow wider bandwidth selection with dynamic decimation; Many DSP code enhancements.
1772	30oct20	Added a "Sensitivity" setting to the FM Co-Channel Canceller. This allows better fine tuning of the co-channel rejection. Many enhancements for the AM Co-Channel plugin. Added a new noise threshold algorithm that works with the dynamic decimation. The Wide FM mode is also supported.
1773	05nov20	Added Anti-Fading processing for the AM Co-Channel Canceller. Use this with Zero Offset. Changed the stepped increments to continuous for the different settings when applicable (NR, NB, CCC, Zoom, etc.)
1774	06nov20	Initialize the maximum VFO bandwidth for the SpyServer client from the config.
1775	06nov20	Polish: Enable the keyboard control of the Telerik sliders.
1776	07nov20	Added a status marker for the different DSP and plugin sections.
1777	10nov20	**With collassable panels**. Added a new high performance resampler for digital outputs.
1778	13nov20	New Visual Studio Interface with support to all the existing plugins.
1779	14nov20	Fixed the device initialization synchronization when the control panel is not active.
1780	14nov20	Added support for saving/loading the UI layout; The profiles can be saved/loaded live.
1781	16nov20	Smoother and faster handling of Airspy devices; Faster startup; The spectrum is now kept in shape when resizing; Same for the peak hold.
1782	17nov20	Added a stepped navigation bar.
1783	22nov20	Many audio and FFT latency optimizations; The sizes of the dock windows are now saved.
1784	23nov20	Smoother FFT streaming and lower memory usage.
1785	05feb21	**Now in Dotnet 5 Microsoft.**

1786	06feb21	Added new IMustLoadGui interface for forcing the plugin loader to bypass the lazy loading if needed. This is useful for plugins that need to be activated on startup. Examples updated in the Plugin SDK.
1787	06feb21	Added support for lazy GUI loading with active background processing.
1788	07feb21	Added a menu command to open all the setting panels available.
1789	10feb21	Faster loading of the "full plugin config", Better layout, Faster rendering, Fixed the auto-scroll theming.
1790	11feb21	Faster master loading; Faster slice loading; More slicing options; Many UI enhancements (rendering and performance). More layout enhancements; Added fall-back docking for older plugins. More layout and UI improvements.
1792	12feb21	Removed the panel borders for the plugins.
1793	13feb21	New adaptive FFT slicing/overlapping/skipping algorithm for the display; Improved refresh rate.
1795	15feb21	Optimized the adaptive FFT sequencing. Added sequence control and dynamic frame skip for the FFT display. Now the FFT display supports high sample rates at speed-and-resolution-constant resource usage.
1796	16feb21	Set the Garbage Collection to low latency mode; Added dynamic buffering depending on the data usage; A few minor UI enhancements.
1797	17feb21	Fixed many numerical rounding issues due to the way LLVM handles int64 and doubles; Code cleanup.
1798	17feb21	Set the step bar to fixed size. That was really annoying; Added new properties in the control interface: LockCarrier, AntiFading, VisualPeak, VisualFloor, ThemeName, Added extended logging to SNR Logger plugin, Clode cleanup. Getting ready for rev 1800.
1799	18feb21	More resampler optimizations. Significant gains in CPU usage.
1800	18feb21	Added two more properties in the control interface: ThemeForeColor, ThemeBackColor
1801	19feb21	Added automatic Plugin discovery and loading. Now you can just place the extra plugins in the "Plugins" directory and they will be loaded automatically. It is also use separate directories or some custom file tree. To disable the loading of a specific directory or a dll, rename it so it starts with an underscore "_". The plugin directory can be set in the config file so you can share it between multiple installations. You can use the config key "core.pluginsDirectory". Added automatic IF shift adjustment for the slices when using IF shifted sources. Many minor UI refinements.
1802	20feb21	Added more APIs: ThemePanelColor Property, RegisterKeyboardShortcut.
1803	20feb21	Added fail-save boundaries for range APIs.
1804	23feb21	Added more support code for RTL-SDR with the Community Package.
1805	24feb21	Updated Telerik library to version R1 2021 SP2; More consistent behavior of the PanelBackColor property.
1806	24feb21	Enhanced the initial control panel resizing mechanism for the plugins; Updated the build system for easier Telerik upgrades; Updated Microsoft.Windows.Compatibility" to version 5.0.2.
1807	26feb21	More loading speed optimizations; Fixed the initial position of the spectrum splitter with the main window maximized.
1808	02mar21	Removed the old .net Framework compatibility assemblies from linked executable. No impact on the API; More UI polishing: Main window size, startup location and startup size; More UI polishing: Plugin panels.
1809	04mar21	Replaced the web map with Telerik RadMap in the SpyServer source; Added full support for mouse wheel scrolling in the TrackBars (sliders); A few other UI enhancements. Initialize the bandwidth display for the HF+ source; Added binding redirects for better support of different .net assembly versions; Minor UI enhancements.
1810	06mar21	Added the necessary dependencies for Calico and many other plugins in the main package. These are not necessary for SDR# to run, but will ease the deployment of the plugins. Re-added the Windows Compatibility Package for the older plugins.

1811	29mar21	More DSP optimizations; Many fixes for RTL dongles (mainly workraounds for old libs); Revert to libusb 1.0.20.11004 for backward compatibility; Revert to portaudio 2016 for backward compatibility; Code cleanup. The ThemeForeColor property now reflects the color of a label within a plugin panel; Many performance optimizations for the Sharp Kernels library (shark.dll).
1812	03aug21	Added a new API for enumerating the loaded plugin instances. Added Linrad spectrum dot mode. Updated Telerik toolkit to version 2021.2.614.50; Added Gray and Dark Office 2019 Themes; Rewrote the spectrum rendering code to take advantage of more poweful CPUs and give smoother experience; Allow Airspy front-end controller to tune using sub-harmonic mixing (up to 4.29 GHz); Optimized the layout of the trackbars; More GC tweaks.
1813	16aug21	Switched to Server Garbage Collection for faster Telerik loading; Reordered RTL sources in the menu.
1814	17aug21	Updated the Table Layout controls and UI animations; Replaced the RadColorBox control with the OS default; Improved the layout loading.
1815	17aug21	Rearranged the loading of the plugins.
1816	18aug21	Fixed a regression in the dock visibility.
1817	18aug21	Improved the default waterfall gradient for better handling of HDR signals; Improved the resizing of the zoom/offset/range sliders.
1818	19aug21	Added low-latency "best effort" mode for audio playback; Added a gradient selector and a few built-in styles; Added more Airspy specific buffering; Many UI improvements. optimizations; Configured the audio latency dynamically; Improved the loading of docked plugins.
1819	20aug21	Improved the sensitivity of the FM Co-Channel Canceller; Improved the Co-Channel initialization code.
1820	21aug21	Added more sanity checks in the AM Co-Channel Canceller; Added theming fallback.
1822	21aug21	A few layout optimizations; More IQ buffering for slow sources; New theme loading mechanism with automatic theming for legacy plugins.
1823	01oct21	Upgraded to Telerik UI for WinForms R3 2021 (version 2021.3.914); Improved the UI loading.
1824	04oct21	Many GUI optimizations; Added progressive loading.
1825	05oct21	Many UI and GC optimizations; Added a status message in the splash screen.
1826	05oct21	Much faster UI loading.
1827	05oct21	Fix the Zoom FFT plugin initialization. Updated the quantization of the spyserver and moved its Windows tool chain to clang.
1828	06oct21	Fixed the initialization of the Airspy Network Browser.
1829	08oct21	Rounded corners around the status text in the Splash Screen - Windows 11 Style.
1830	08oct21	Moved more C# functions to the Sharp Kernels (shark) library.
1831	26nov21	Upgraded Telerik UI for WinForms R3 2021.
1832	24dec21	Improved the spectrum responsiveness when streaming the FFT data from a SpyServer; Improved the resolution of the frequency display for frequencies below 2 MHz. **Upgraded to dotnet 6 with single file build and R2R.**
1833	31dec21	Multi-threaded GFX for smoother display; Many other optimizations for lower resource usage in the lower hardware configurations.
1834	01jan22	The Band Plan plugin now supports the multi-threaded UI; Fixed the text update of the main window; The Frequency Manager plugin now supports the multi-threaded UI; Better property UI updating code.
1835	04jan22	**New display for the Band Plan** and the built-in Frequency Manager to avoid over-crowding the spectrum view. The xml databases are not loaded from the current directory of the process, which eases the use of profile-specific entries; Many FFT optimizations; Smoother rendering and more responsive UI even with limited resources; The produced XML files are now indented; More FFT polishing.
1836	05jan22	More robust code for the waterfall update.

1837	05jan22	More graphics optimizations; Smoother frame timing; More graphics optimizations; Smoother frame timing; Fixed a sequential resizing crash that needed to be atomic.
1838	06jan22	Fixed the frequency manager loading; Sharper edges for the bookmarks.
1839	07jan22	Offloaded the main thread from all the real-time UI processing.
1840	08jan22	Rendering API cleanup; Fixed the SpyServer FFT updating.
1841	08jan22	Fixed the FFT display configuration.
1842	08jan22	Added a new hardware accelerated API for the plugin rendering. This can be used like the standard .net Graphics API.
1843	13jan22	Better FFT scheduling to save CPU time while still getting optimal rendering; More drawing APIs; Using the system's threadpool for handling the FFT; Better FFT timing for smoother rendering; Compensate for CPU clock irregulatities in the FFT stream; Added config settings to bypass automatic database update in the Band Plan plugin.
1844	18jan22	Added a new FFT engine with better performance; Added a new FFT API for plugin developers; Lower CPU usage overall; Lower memory usage; Faster and more accurate rendering.
1845	18jan22	Fixed the MPX visualization; Adjusted the latency of the display pipeline; Moved more function to the native kernel library (shark.dll); Added native memory allocation; More performance optimizations to use the new infrastructure.
1846	18jan22	Added more gfx caching for faster rendering.
1847/9	18jan22	One more rendering optimization to accomodate for slow plugins; Added more steps in the rendering pipline of the spectrum analyzer. This allows instant responsiveness while the data is being rendered.
1850	19jan22	Added dynamic latency adjustment to minimize the lag between the visual and the audio paths.
1851	20jan22	More polishing: Lower CPU usage for the same processing quality.
1852	20jan22	Update the visual feedback for the filter band.
1853	20jan22	New Telerik release 2022 R1. **Starting from SDR# release 1853, the DSP will be using a reworked version of the PFFFT (yes, that's not a joke) FFT library.** This surprisingly fast library was modified to fit within the object model of the DSP and will allow faster FFT speeds in the spectrum displays and some filters. Some frequency domain plugins like the Noise Reduction, IF Filter, etc. can also benefit from this improvement. The legacy FFT routines are still available for the old plugins, but the new ones are encapsulated in a simple to use C# class called DFT. Another area of improvement is the deterministic memory management for the buffers. This comes as a side effect of the global rework of the DSP, and will allow a more accurate on-demand adjustment of the used memory. The changes are transparent for the plugins, unless something stupid is being done. The other side effect is the lower memory usage on average. The display components have also been revamped to use a pipelined approach. This includes the sequencing the IQ (or Real) data, planning the FFTs, executing them, timing the display and compensating for the CPU fluctuations. A lot of operations are now hardware accelerated, but will not show as a direct GPU usage. Instead, the dwm.exe (Desktop Window Manager) process will show some extra GPU usage, but it's not that big. The overall electric power usage is lower with these changes, which may be a most welcome improvement for portables. And of course, a lot of polishing has been done and still ongoing.
1854	26jan22	Added support to clear native memory in the UnsafeBuffer class; More FFT polish; Better stream synchronization code.
1855	26mar22	Added assembly resolving for the plugins compiled using a newer version of the .NET SDK.Scaled down the FFT display for the SpyServer client; Many improvements in the FFT display components; Added more dependencies for the plugins: System.Data.DataSetExtensions; Better FFT sequencing and timing; Increased the Zoom FFT resolution; Better stop/tear-down sequence for font-ends; Upgraded Telerik

		to version 2022 R1 SP1; Added forward compatibility for plugins written in more recent versions of the .NET SDK.
1856	28apr22	Replaced the old Noise Reduction processor with a new algorithm**: Natural Intelligence Noise Reduction (NINR).** This results in less artifacts, deeper noise cancelling, and lower CPU usage.
1858	28apr22	Adjusted the NINR spectra smoothing.

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AIRSPY
Spyverter
AIRSPY
AIRSPY
Design: Paolo Romani IZ1MLL