



SDRsharp

The Guide v3.3



aligned to revision 1.0.0.1822



Slow reading recommended (for specialists and non-specialists)

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Introduction

A guide like this does not come about by chance.

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 with SDR# on a daily basis, and there are so many, because it really is a common learning and growing experience for all of us.

The reference site is: <https://airspy.com/>

News: the release 1785, officially released on February 5, 2021 in a continuing and perpetual quest for improvement and refinement, has made a big leap to Microsoft's latest .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 package distribution and a large executable file. There are far fewer DLLs which shorten the start-up sequence of the program. The new SDR# can be used as before but with better performance by continuing to use the same configuration files, Band Plan, memories and plugins as before.

Previously, the graphical user interface developed in Visual Studio with fully customisable layouts was released on 13 November 2020.

SDRsharp download at: <https://airspy.com/?ddownload=3130>

and with prerequisite .NET 5 Runtime Desktop at:

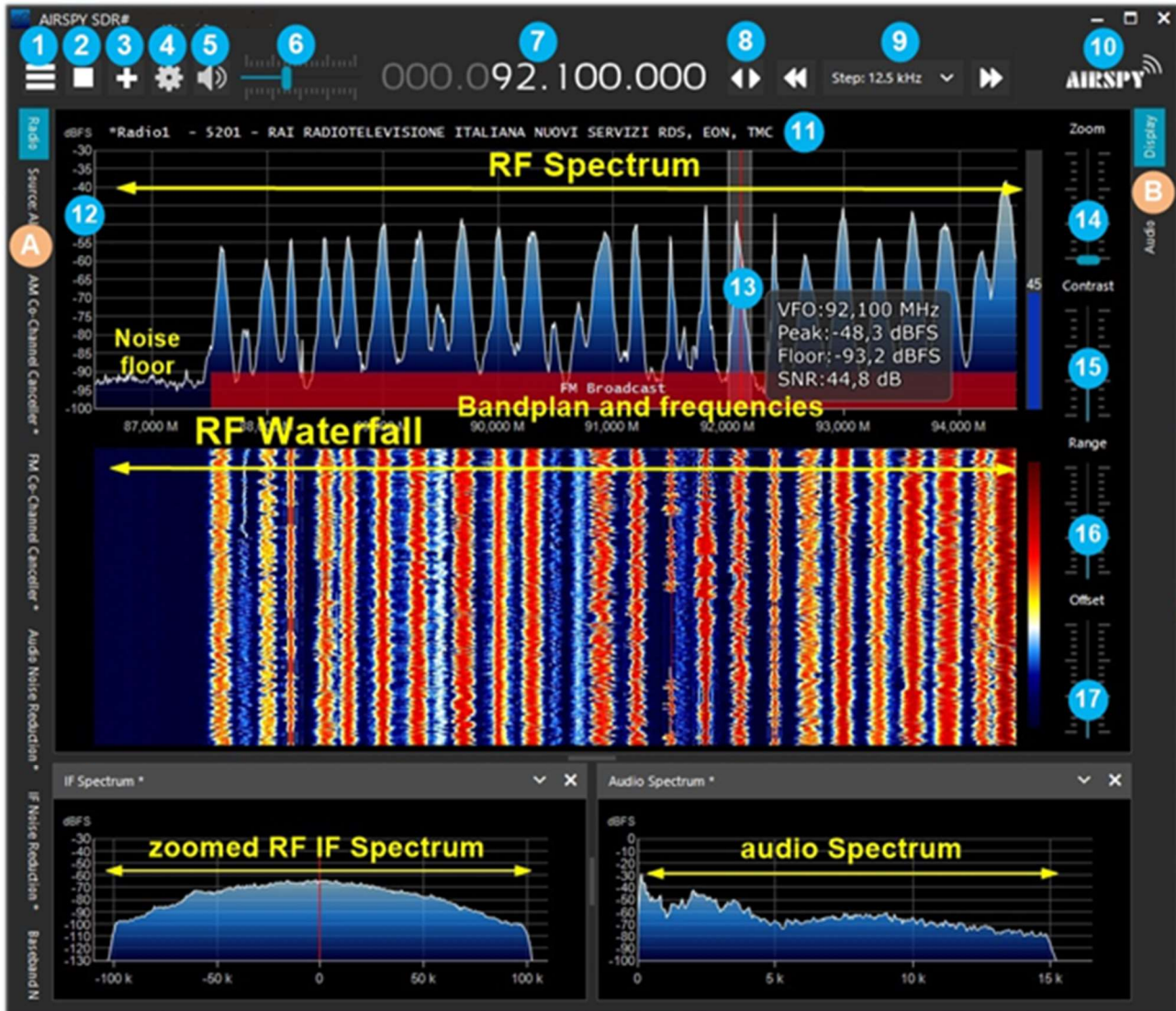
<https://dotnet.microsoft.com/download/dotnet/thank-you/runtime-desktop-5.0.2-windows-x86-installer>

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: vertical, wire, loop, 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 revision 1741 and new update
- 4. Device configuration
- 5. Audio On/Off (mute)
- 6. Volume control bar
- 7. VFO Input e Frequency
- 8. Tuning type
- 9. Step bar - since revision 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

SDRsharp 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 non-radical updates you only need to replace the SDRSharp.exe file.*

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. You can use Process Explorer tool to get an idea how different programs use your computer.

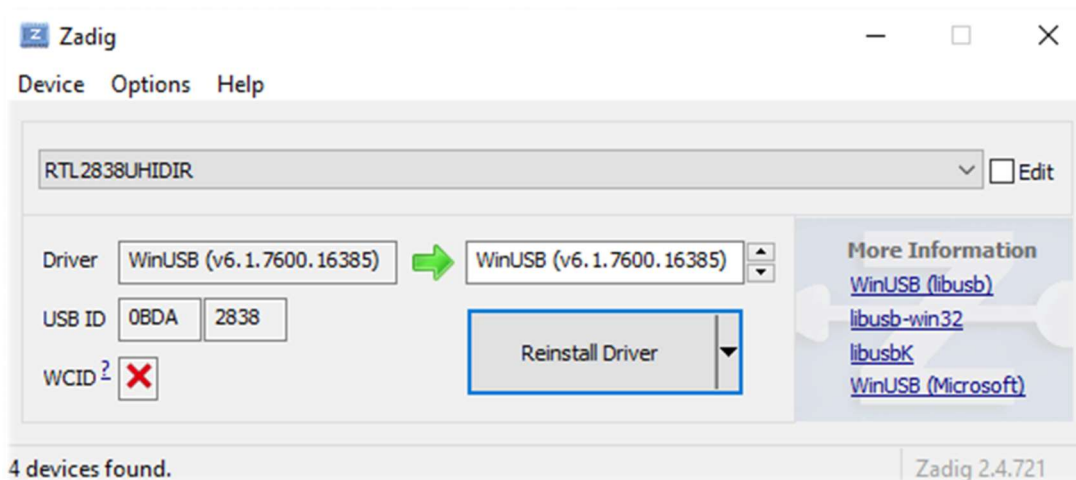
That's all.

Dongle RTL-SDR's configuration

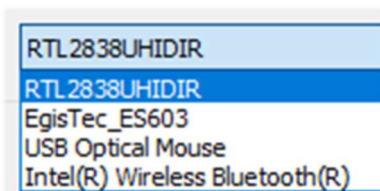
The general rule of thumb for all of the following setups is that the default settings work and any changes require a good understanding of the underlying algorithms and own hardware.

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.



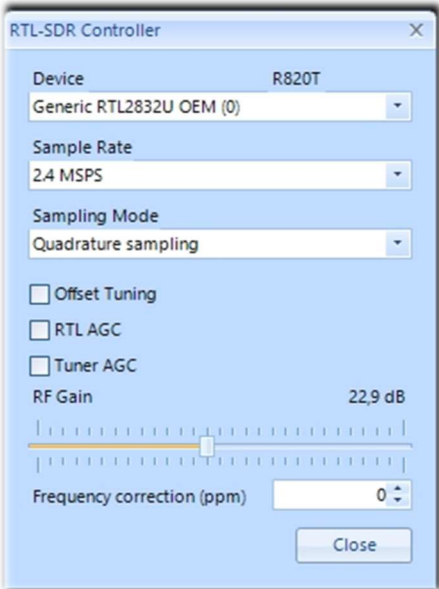
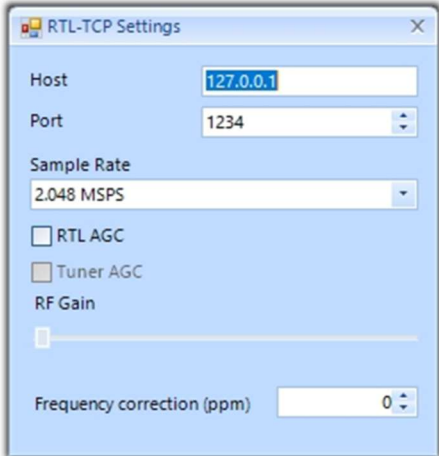
Proceed by clicking the INSTALL DRIVER or REINSTALL DRIVER button (if you have already done so). You can also try connecting your USB dongle after Zadig is running, as the list is automatically updated by the system.

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
<div data-bbox="165 280 606 866">  </div> <p data-bbox="252 913 523 947">TCP/IP configuration</p> <div data-bbox="165 952 606 1406">  </div>	<p data-bbox="635 280 1321 313">Click on the configuration button (4) (the cogwheel).</p> <p data-bbox="635 353 1439 526">Sample Rate – Allows you to choose the bandwidth to be displayed (0.25 to 3.2 MSPS ^(*)). <i>Generally, settings up to 2.4 MSPS work well on most PCs, but for slower machines we recommend reducing this value.</i></p> <p data-bbox="635 533 1439 712">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).</p> <p data-bbox="635 719 1439 824">Offset Tuning – For use on E4000/FC0012/13 tuner chips only. Selecting this option will eliminate the centre peak in the spectrum.</p> <p data-bbox="635 831 1375 864">RTL AGC – Enables AGC ^(*) for RTL2832U chips only.</p> <p data-bbox="635 871 1040 904">Tuner AGC - Enables AGC ^(*)</p> <p data-bbox="635 911 1439 969"><i>In many cases it is better not to flag it and manually setting the slider below.</i></p> <p data-bbox="635 976 1439 1111">RF Gain – Use this slider to manually set the RF ^(*) gain value. <i>Start from an average value in dB and gradually increase towards the maximum on the right according to the signals received.</i></p> <p data-bbox="635 1117 1439 1223">Frequency correction ppm ^(*) – Allows to set a correction value for those cheap dongles that do not have a TCXO ^(*). <i>Not needed for Airtspy users!</i></p> <p data-bbox="635 1229 1439 1408">If the dongle is not centred in frequency, tune in a strong and stable signal <i>(after ten minutes of powering up the dongle having reached the correct temperature and stability)</i>, changing the ppm value a little at a time so that it is centred at the tuning bar (point 13).</p>

AirSpy line

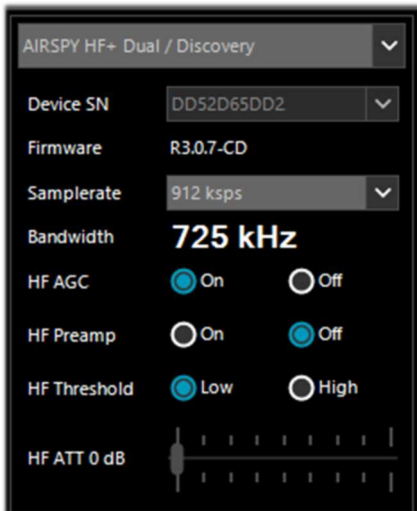
The AirSpy product family is now grown up, with receivers and options for every need:

- **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 in HF 1 kHz / 60 MHz
- **Antenna:** YouLoop for Airspy HF+ (usable up to 300 MHz)

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>

AirSpy HF+ Dual port / Discovery

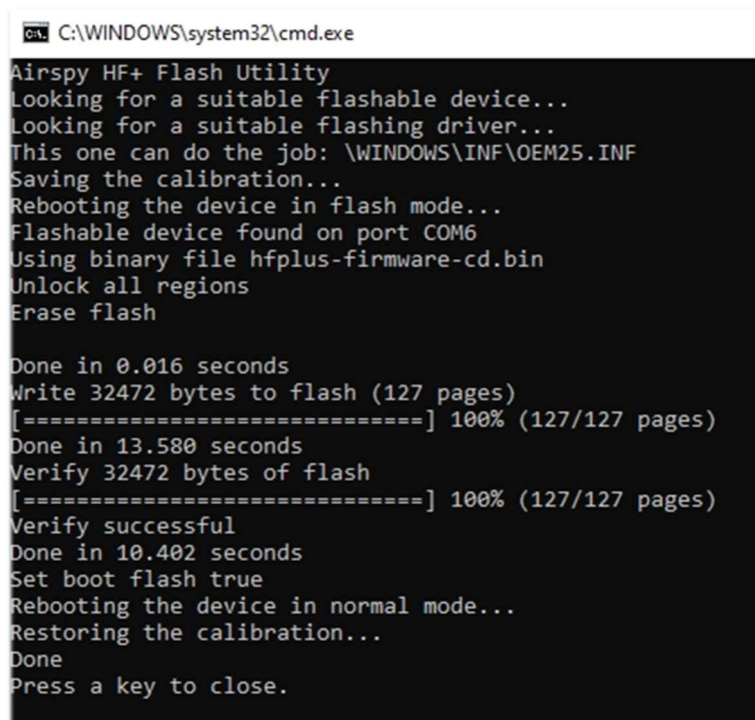
Panel	Feature
	<p>Device SN – Serial number of your device.</p> <p>Firmware – Indicates the firmware version installed on the device (see firmware upgrade procedure below).</p> <p>Samplerate – Allows you to choose the sampling rate: from a minimum of 14 ksps ^(*) to a maximum of 912 ksps ^(*).</p> <p>Bandwidth – 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.</p> <p>HF AGC – Automatic gain control. <i>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.</i></p> <p>HF Preamp – Activates or deactivates the preamplifier. <i>Set to ON for low signal reception, OFF for strong signals.</i></p> <p>HF Threshold – The "Low" threshold value introduces attenuation but gives the signal better linearity, unlike the "High" position which favours sensitivity. <i>You have to wait a few seconds to appreciate the differences when changing the threshold.</i></p> <p>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.</p>

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.

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.

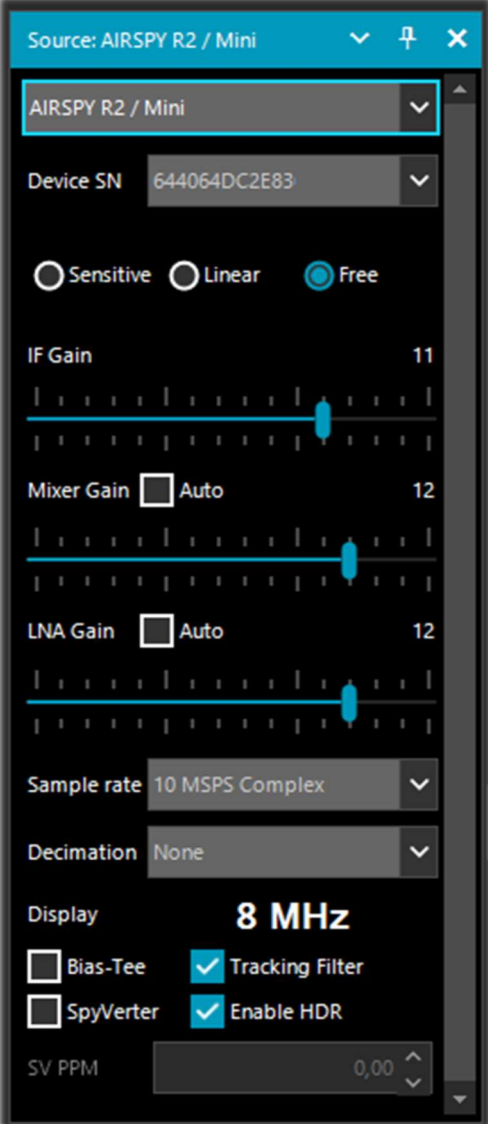


```
C:\WINDOWS\system32\cmd.exe
Airspy HF+ Flash Utility
Looking for a suitable flashable device...
Looking for a suitable flashing driver...
This one can do the job: \WINDOWS\INF\OEM25.INF
Saving the calibration...
Rebooting the device in flash mode...
Flashable device found on port COM6
Using binary file hfplus-firmware-cd.bin
Unlock all regions
Erase flash

Done in 0.016 seconds
Write 32472 bytes to flash (127 pages)
[=====] 100% (127/127 pages)
Done in 13.580 seconds
Verify 32472 bytes of flash
[=====] 100% (127/127 pages)
Verify successful
Done in 10.402 seconds
Set boot flash true
Rebooting the device in normal mode...
Restoring the calibration...
Done
Press a key to close.
```

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).

AirSpy R2 / Mini

Panel	Feature
	<p>Device SN – Serial number of your device.</p> <p>Gain: Sensitive/Linear/Free – Three different choices for the gain adjustment at IF (*), Mixer and LNA(*) level. <i>"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.</i></p> <p>Sample rate – Allows you to choose the sampling:</p> <ul style="list-style-type: none"> AirSpy R2: 10 or 2.5 MSPS (*) AirSpy Mini: 6 or 3 MSPS (*) <p>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. <i>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!</i></p> <p>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:</p> <ul style="list-style-type: none"> 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) <p>Bias-Tee – Allows the use of optional devices requiring an additional power supply: 4.5v at 50 mA(*).</p> <p>Tracking filter – Taking advantage of decimation and enabling this filter will result in better selectivity, <i>so more gain can be used!</i></p> <p>SpyVerter – Enables the optional "SpyVerter" device, which allows reception from longwave to 35 MHz and the initial portion of VHF. <i>In HF, the "Linear" mode, is recommended for the gain.</i></p> <p>Enable HDR (*) – When activated (with software off) applies a combination of analogue and digital filters to optimise the dynamic range for the visible spectrum. <i>A high decimation ratio can be activated and selected for better reception.</i></p> <p>SV PPM (*) – AirSpy devices are factory calibrated to approximately 0.05 ppm (*). This value can be adjusted for the SpyVerter. <i>Updating the firmware will not change this value which is stored in a different location.</i></p>

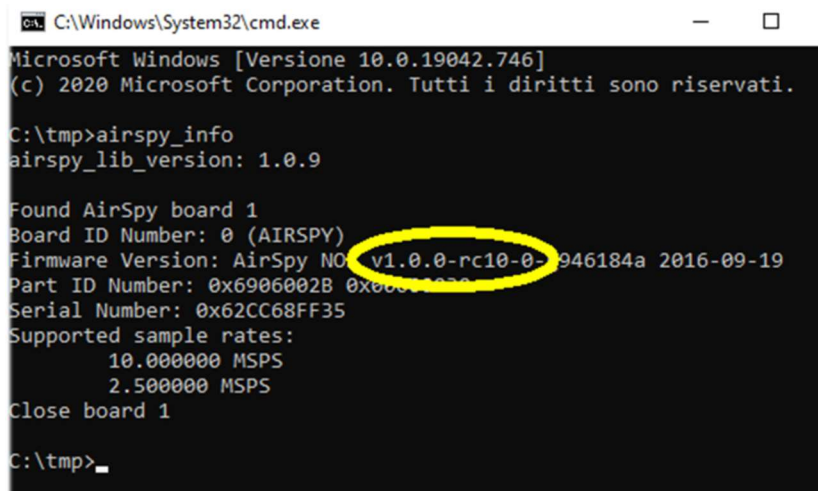
AirSpy R2 / Mini firmware update

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".



```
C:\Windows\System32\cmd.exe
Microsoft Windows [Versione 10.0.19042.746]
(c) 2020 Microsoft Corporation. Tutti i diritti sono riservati.

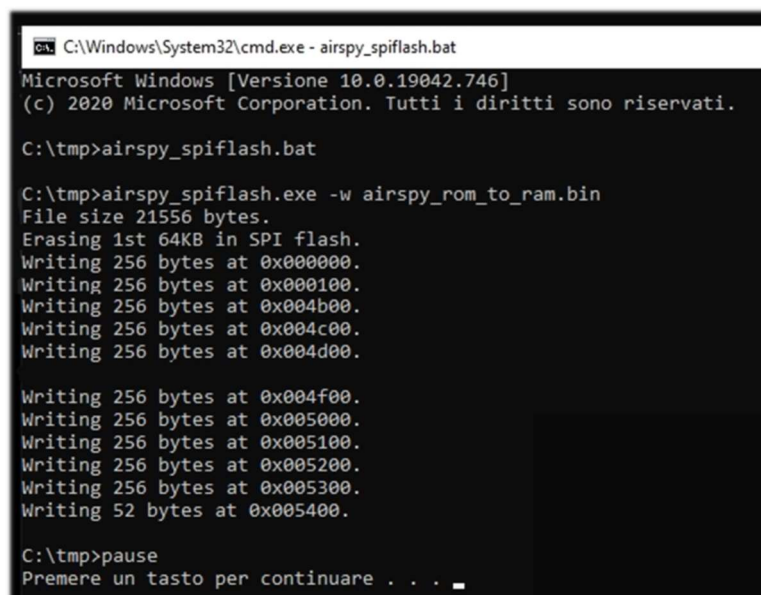
C:\tmp>airspy_info
airspy_lib_version: 1.0.9

Found AirSpy board 1
Board ID Number: 0 (AIRSPY)
Firmware Version: AirSpy NO v1.0.0-rc10-0-946184a 2016-09-19
Part ID Number: 0x6906002B 0x00000000
Serial Number: 0x62CC68FF35
Supported sample rates:
    10.000000 MSPS
    2.500000 MSPS
Close board 1

C:\tmp>
```

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.



```
C:\Windows\System32\cmd.exe - airspy_spiflash.bat
Microsoft Windows [Versione 10.0.19042.746]
(c) 2020 Microsoft Corporation. Tutti i diritti sono riservati.

C:\tmp>airspy_spiflash.bat

C:\tmp>airspy_spiflash.exe -w airspy_rom_to_ram.bin
File size 21556 bytes.
Erasing 1st 64KB in SPI flash.
Writing 256 bytes at 0x000000.
Writing 256 bytes at 0x000100.
Writing 256 bytes at 0x004b00.
Writing 256 bytes at 0x004c00.
Writing 256 bytes at 0x004d00.

Writing 256 bytes at 0x004f00.
Writing 256 bytes at 0x005000.
Writing 256 bytes at 0x005100.
Writing 256 bytes at 0x005200.
Writing 256 bytes at 0x005300.
Writing 52 bytes at 0x005400.

C:\tmp>pause
Premere un tasto per continuare . . .
```

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

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).*
- Set the correct "emission mode" according to the signals you intend to listen.

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.

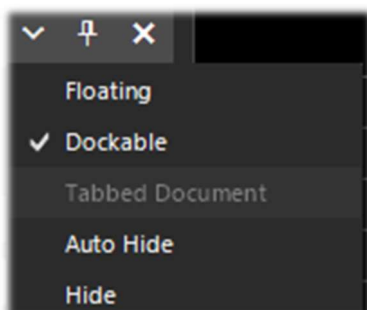
Now let's take some time to familiarize ourselves with the new side menus (A and B).

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.

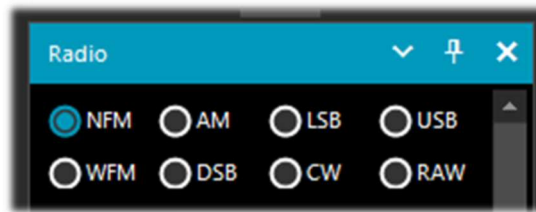
Dockable – The window is anchored to the main panel.

Auto Hide – The panel window is reduced to a minimum and is opened by positioning the mouse over it.

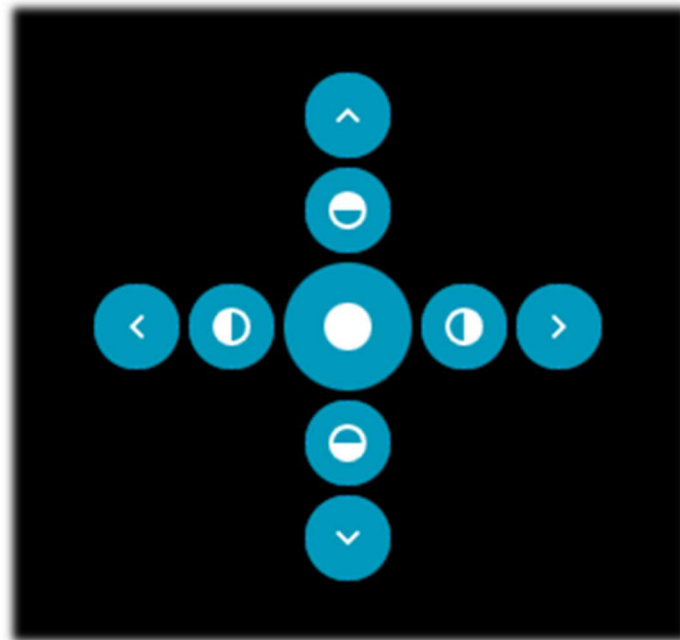
Hide – The panel window is hidden. To make it reappear, it must be enabled from step 1 (hamburger menu).

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

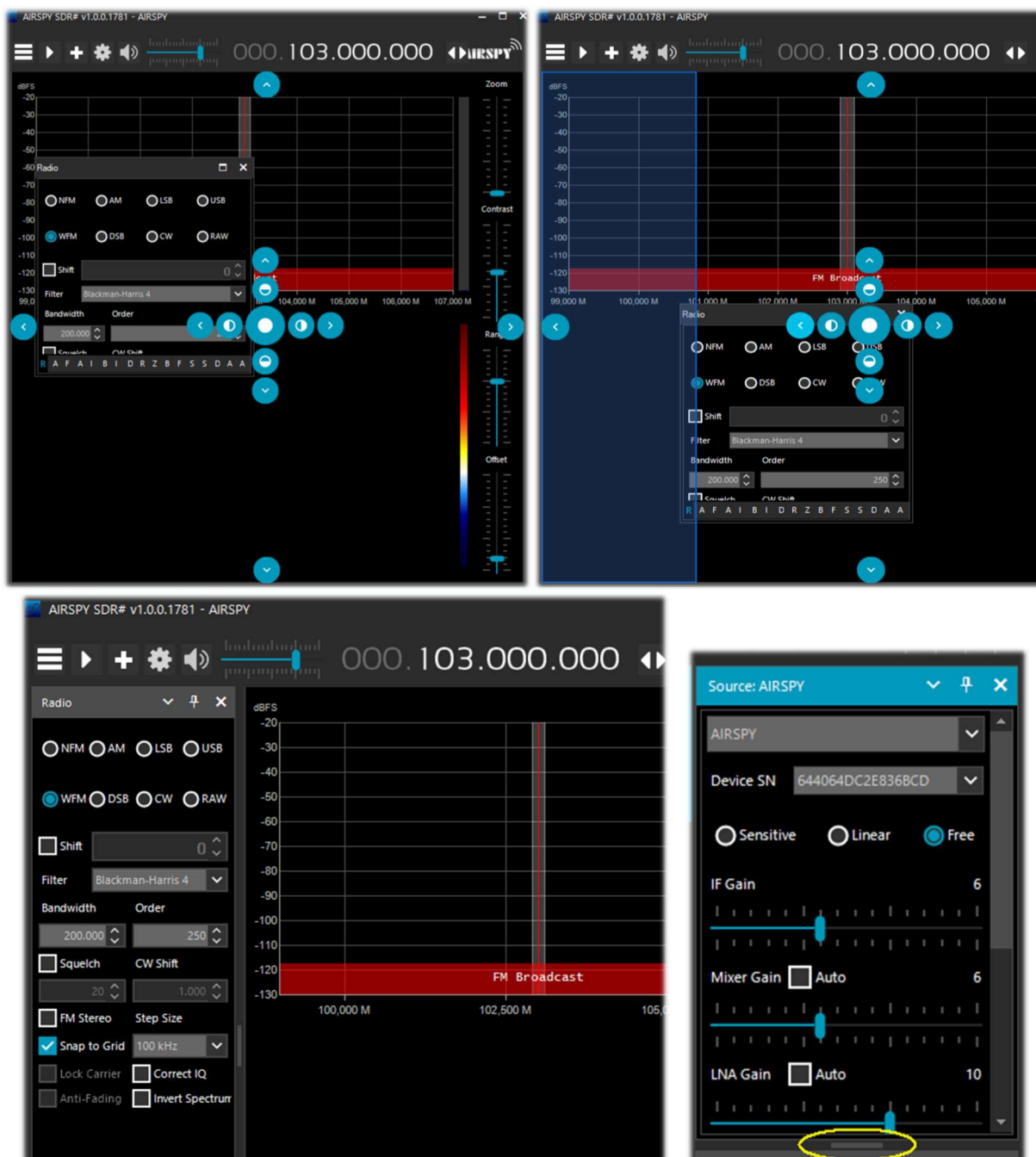


icon for left half positioning



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.

For those who are still faithful, for one reason or another, to previous releases, here are the download links for the main ones:

Revision v1716 (no skin)

<https://airspy.com/downloads/sdrsharp-x86-noskin.zip>

Revision v1777 (with collapsible panels)

<https://airspy.com/downloads/sdrsharp-x86-collapsible-panels.zip>

Revision v1784 (last build dotnet 4.x)

<https://airspy.com/downloads/sdrsharp-x86-dotnet4.zip>

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.

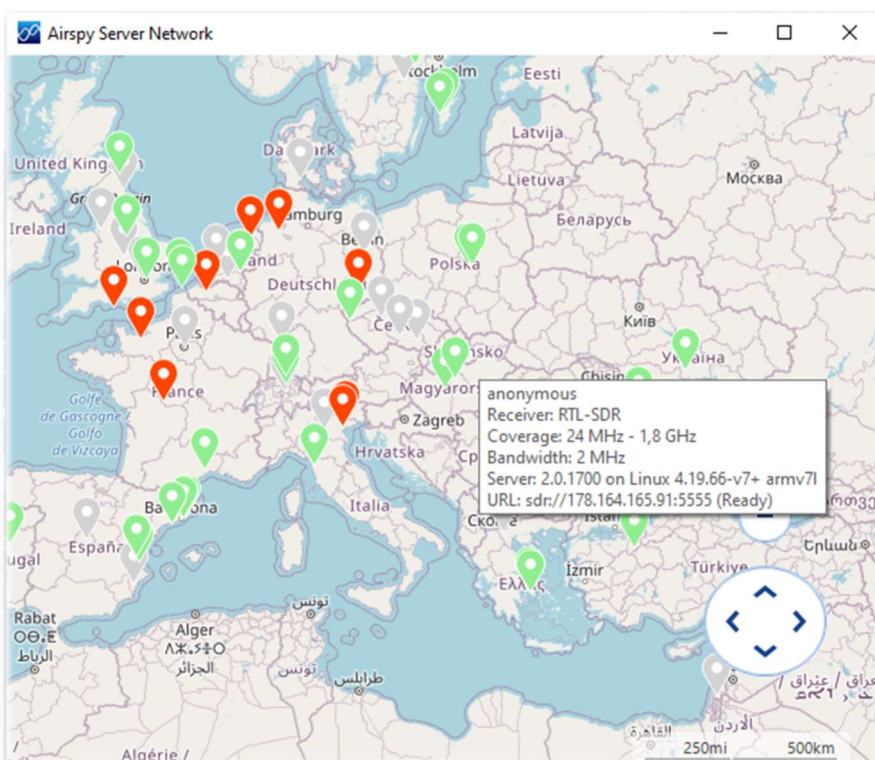
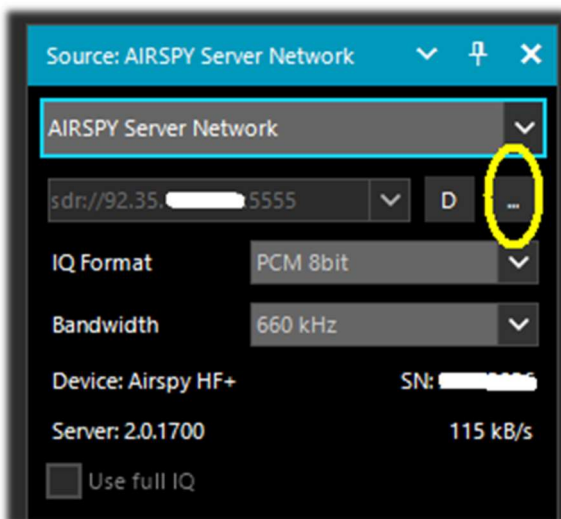
Depending on the source device, adjustments can be made to gain, IQ format and bandwidth. The "Use full IQ" option allows streaming of the full spectrum provided *you have sufficient network bandwidth and a high-speed connection*.

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.




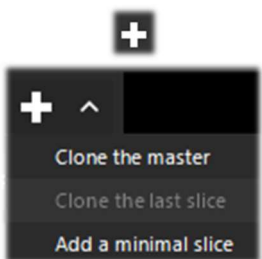

What does the SpyServer do in the first place?







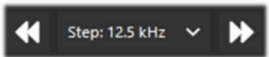
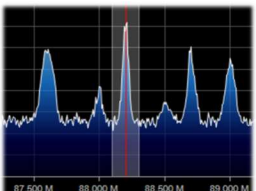
It's basically a TCP server with the slicing capability. This means, you get X bandwidth from the hardware to the SpyServer, it cuts $0.1 * X$ and only sends that part after some good amount of number crunching. What you get in the end is not the whole spectrum, but rather a narrow band IQ representation 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.

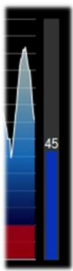
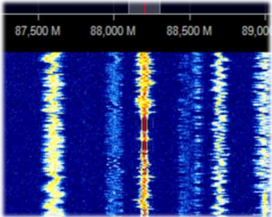
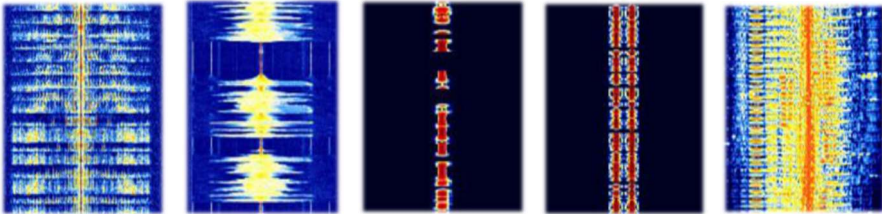
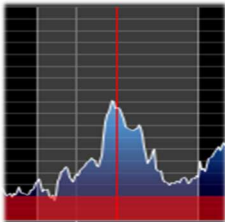
The slicing always happens in the SpyServer. All the plugins that require the IF signal (IF NR, IF BB, IF Processor, Co-Channel Cancellers, Zoom FFT, etc...) still work with this model, giving you the false impression that the device is local, or the other "even falser" impression that the server is 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.

Main settings

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

Key	Action
Menu panels 	With this button ("hamburger menu") you can access to the dedicated panels. <i>The check mark preceding some items is a "visual reminder" of the activation of some options inside (example "audio or service enabled").</i>
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 (<i>not just present in the "Spy Server Network"</i>). 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. <i>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.</i> You can choose to duplicate the "master" session completely or open a minimal session. <i>New sessions will have different colours in the RF Spectrum bandwidth to identify them visually at a glance.</i>
Configuration menu 	Configuration menu of your hardware and settings: gain, sample rate, bandwidth, RF, PPM controls, etc.

Volume 	<p>Activates / deactivates the volume, which you control (with the slider on the right) the desired output level to the speakers or external device (<i>example to a VAC Virtual Audio Cable</i>). <i>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).</i></p>
Input and VFO frequency 	<p>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</p> <ul style="list-style-type: none"> • <i>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</i>  <i>followed by Enter. Quick and easy.</i> • <i>Left click on the top of the digits (a small red rectangle will appear) to advance one unit</i> • <i>Left mouse click on the bottom of the digits (a small blue rectangle will appear) to decrease by one unit</i> • <i>or on the desired digit by turning the mouse wheel on it.</i> • <i>Right click the mouse to bring a digit to zero and reset all the ones to the right of it as well</i> • <i>UP / DOWN arrow keys change the digit</i> • <i>The Right/Left arrow keys move along the section in the input</i>
Tuning types	<div>  "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. </div> <div>  "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. </div> <div>  "Center tuning" - the tuned frequency will be always displayed in the center of the RF spectrum and waterfall. </div>
Step bar 	<p>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).</p>
RF Spectrum 	<p>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".</p> <p><i>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"</i></p>
SNR meter	<p>On the right side of the RF spectrum there is a vertical bargraph that shows the SNR value (in dB).</p> <p>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</p>

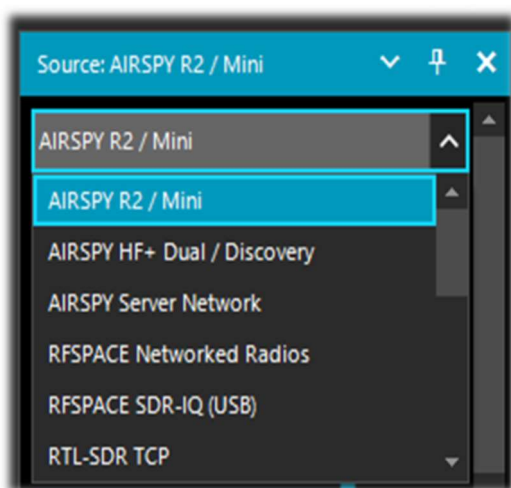
	<p>received signal, which is still receivable and understandable. In digital transmissions instead there is a minimum threshold of SNR below which the system no longer works for too many errors received.</p> <p><i>There is no S-meter to detect the signal strength, intended as an S-unit and mainly used in the radioamateur world.</i></p>
<p>Waterfall</p> 	<p>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.</p> <p><i>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:</i></p> <div style="text-align: center;">  <div style="display: flex; justify-content: space-around; margin-top: 5px;"> AM FM CW RTTY SSTV </div> </div> <p><i>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</i></p>
<p>Tuning bar</p> 	<p>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.</p> <p><i>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).</i></p>

..... 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:



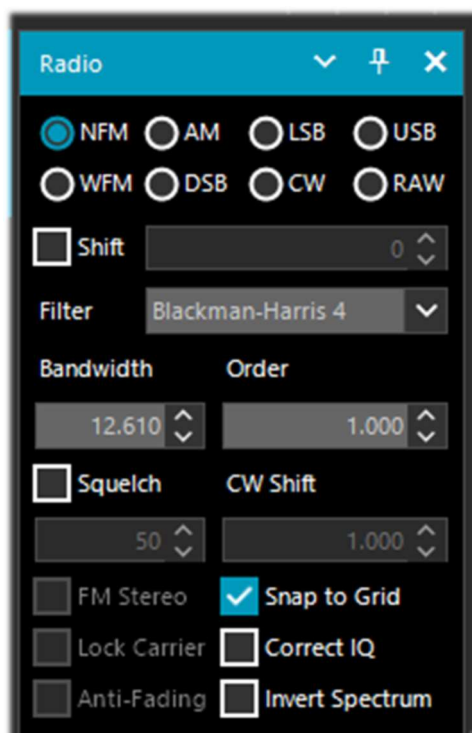
- AIRSPY R2 / Mini
- AIRSPY HF+ Dual / Discovery
- AIRSPY Server Network (see paragraph)
- RFSPACE
- RTL-SDR USB or TCP
- HackRF
- AFEDRI Networked Radios
- Funcube Pro / Pro +
- Softrock (Si570)
- UHD / USRP
- Baseband File (Vasili) / Baseband File (*.wav) / Baseband from Sound Card to load and play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

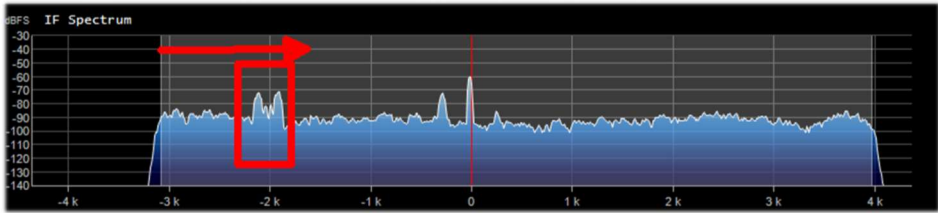
The HDR feature gives a boost in dB in dynamic range. This means that the gains can be turned up further without overloading occurring, and that weaker signals can come in much stronger without strong signals overloading and drowning them out.

Radio

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



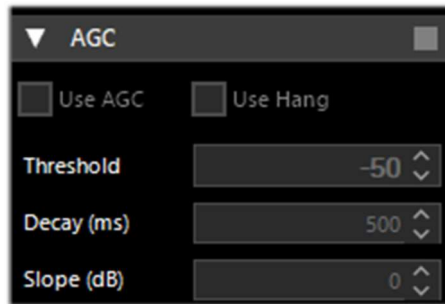
Mode	Features
NFM (*)	Transmission technique that uses the frequency variation of the carrier wave. Mode commonly used by civil and radioamateur services for both analog and digital modes in VHF/UHF but not under the 27 MHz.
WFM (*)	<p>This is the mode used by FM stations (88-108 MHz band).</p> <p><i>For 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:</i></p> <ul style="list-style-type: none"> ➤ <i>PI, Programme Identification. Unique four-character alphanumeric code that identifies the radio station.</i> ➤ <i>PS, Programme Service. They are eight characters used, usually, to send the name of the radio also in a dynamic way.</i> ➤ <i>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.</i>
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 (*)	<p>Use similar to AM but allows a higher modulation performance by suppressing the carrier and transmitting only the sidebands.</p> <p><i>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...</i></p> 	
SAM (*) <i>(even if it does not formally exist it is fully supported !)</i>	<p><i>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.</i> 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.</p>	
RAW (*)	<p>Used for playback or recording of RAW IQ streams or with external decoding program, for example DReaM (DRM) / DSD+. <i>DReaM works with RAW mode by setting the its input to IQ, or using USB mode in SDR#.</i></p>	
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 (<i>where each filter has a different response curve and characteristic</i>), 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. <i>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</i>

		<i>orders can cause a higher CPU load, so on slower PCs you should reduce this value.</i>
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. <i>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 DRealM software).</i>
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, <i>but may worsen the sound of weak and distant stations.</i> <i>If a stereo signal is detected, the RDS display (in item 11) will show the name of the broadcaster in a few round brackets.</i> <div style="background-color: black; color: white; text-align: center; padding: 2px;">(((Classica)))</div>
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. <i>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.</i>
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. <i>Try it in DSB mode, it makes all the difference for pleasant listening!</i>
Correct IQ	OFF	This setting removes the small, annoying center peak present with the dongles RTL-SDR R820T/R820T2. <i>Normally it should be activated.</i>
Anti-Fading	OFF	Use when "Lock Carrier" is activated. Leverages the symmetry of AM signals which helps in the presence of weak signals. <i>Activate it for better AM reception, but can increase CPU load.</i>
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. <i>The I/Q signals, (or I/Q data), are a fundamental element of RF communications systems, often represents signals in the time-domain.</i>

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. <i>It is especially useful to turn it on when listening to AM/SSB/CW mode because loud signals may be distorted.</i>
Use Hang		It allows you to change the default behavior of the AGC in its Threshold / Decay (ms) / Slope (dB) components, although in most cases the default values are fine. <i>Enabling it slightly changes the response over time and may be useful for some SSB or Morse signals.</i>
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.

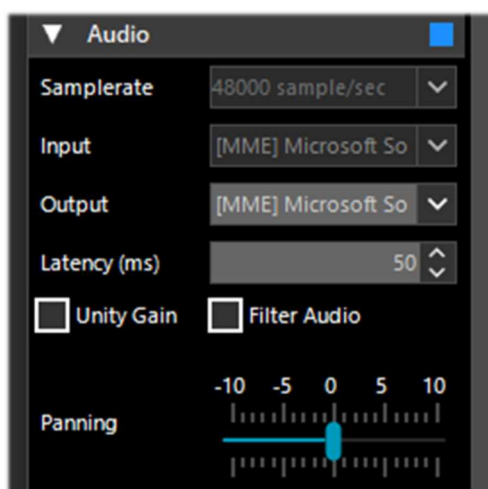
Important Notes:

- 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.

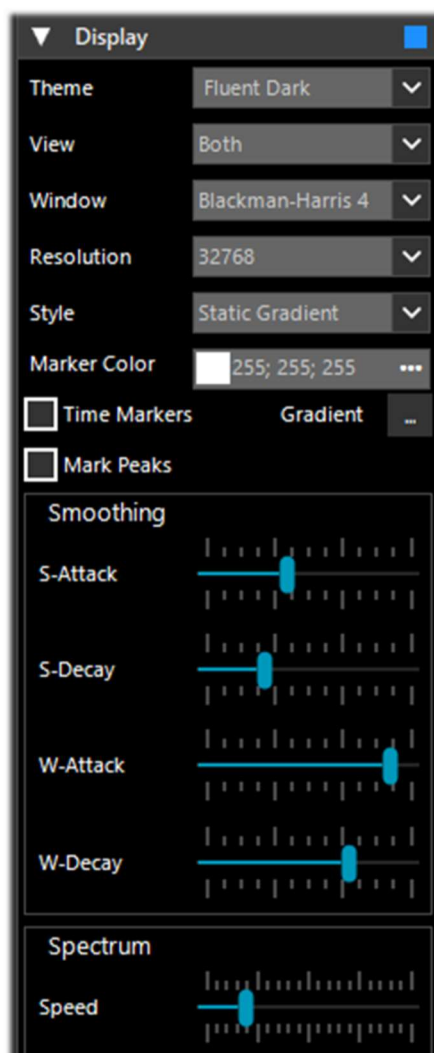


Key	Default	Features
Samplerate	48000	Sets the sampling rate of sound card. Some decoding software may require you to set a specific sample rate. Usually the default value at 48000 samples/second should be fine for general purposes.
Input	Sound card	The input sound card is highlighted in this field. <i>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.</i>
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...]. <i>Normally it defaults to the speaker line.</i>

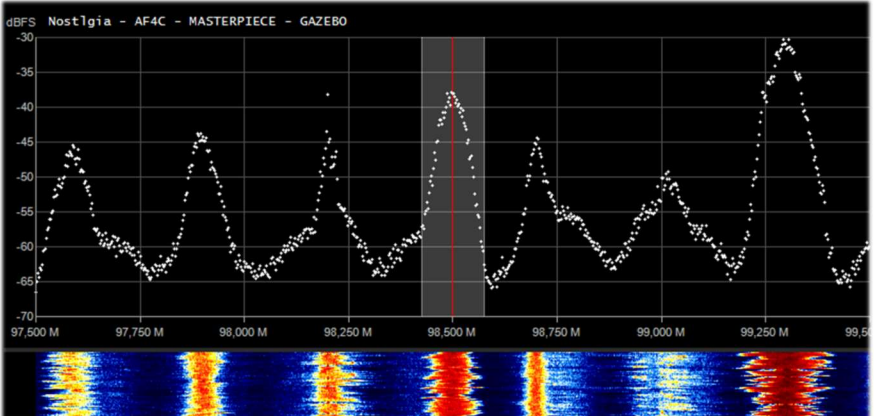
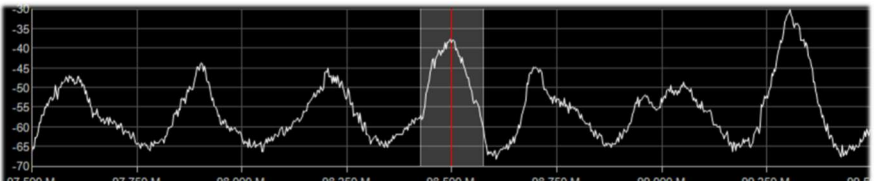
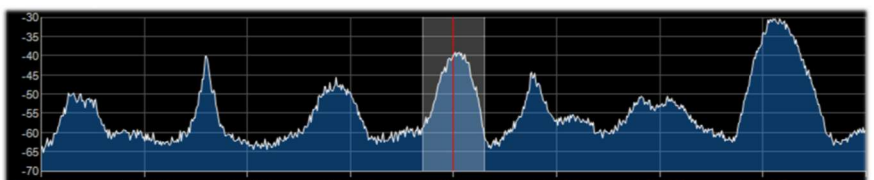

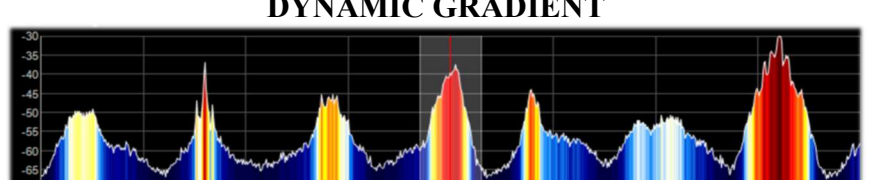

		<p>But what is ASIO? Audio Streaming Input Output is a low-latency communication protocol for digital audio signals developed by Steinberg. Thanks to it, a sound card can be able to record and play back audio without delays. Low-latency drivers, designed to obtain and manage incoming and outgoing audio streams with a small memory buffer (where stream exchange and digital/analog transformation takes place), allow for virtually zero delay!</p> <p>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!</p> <p>If they are not already present in your Windows 10, low latency drivers can be downloaded from the site:</p> <p style="text-align: center;">https://www.asio4all.org/</p> <p><i>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.</i></p>
Latency (ms)	<p>50 or lower with [Windows DirectSound] drivers</p> <p>1 with [ASIO...] drivers</p>	<p>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 reversion at the output.</p> <p><i>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.</i></p> <p><i>Since revision 1818 the latency has been drastically reduced again and now ASIO drivers work without problems with the value of 1 ms !</i></p>
Unity Gain	OFF	Normally it should be deselected as it sets the audio gain to the unit value of 0 dB.
Filter Audio	ON	<p>Audio filter. <i>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).</i></p> <p><i>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.</i></p>
Panning	0	Balances the audio between the left/right speakers.

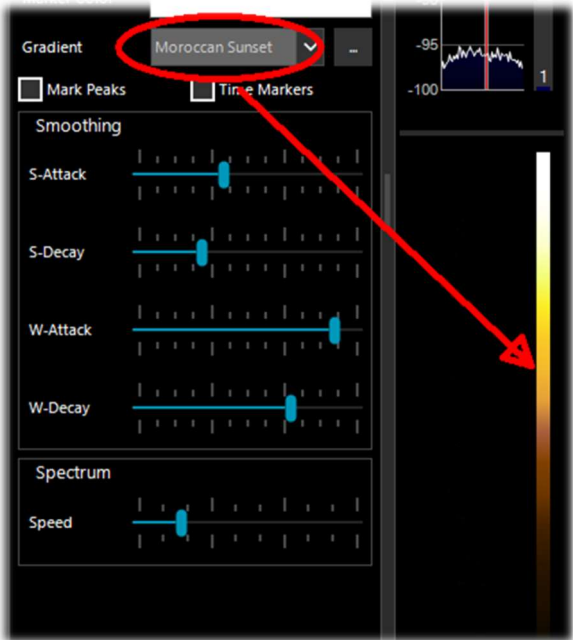

Display

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. <i>On older PCs it may be useful not to display the waterfall to avoid overloading the processing.</i>
Window	Blackman-Harris 4	Set the type of filter, <i>where each filter has a different response curve and characteristic</i> : 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. <i>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.</i>

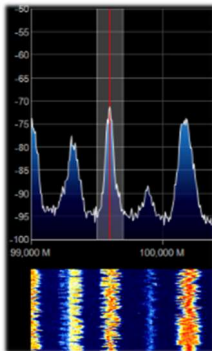
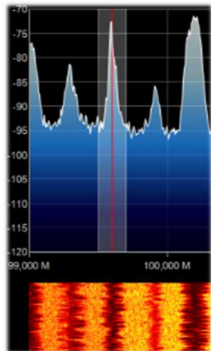
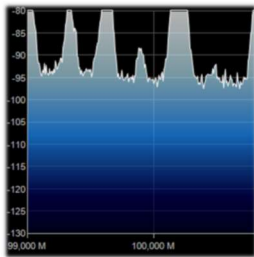
<p>Style</p> <div data-bbox="167 257 327 470"> <p>Dots</p> <p>Simple Curve</p> <p>Solid Fill</p> <p>Static Gradient</p> <p>Dynamic Gradient</p> <p>Min Max</p> </div>	<p>Allows you to choose different styles of waterfall signal representation:</p> <p>DOTS</p>  <p>SIMPLE CURVE</p>  <p>SOLID FILL</p>  <p>STATIC GRADIENT</p>  <p>DYNAMIC GRADIENT</p>  <p>MIN MAX</p> 
<p>Marker Color</p>	<p>It allows you to change the color of the marker on the waterfall by simply clicking on the Windows color palette.</p>
<p>Gradient</p>	<p>Allows customization of the color palette used in the waterfall.</p> <p><i>Youssef suggests for High Dynamic Range applications to modify the file "SDRSharp.config" with these values:</i></p> <pre><add key="waterfall.gradient" value="FF0000,FF0000,FBB346,FFFF00,FFFFFF,7AFEA8,00A6FF,000091,000050,000000,000000" /></pre>

<div data-bbox="165 185 328 376"> <p>Sharp Classic</p> <p>Sharp Spy</p> <p>Sharp Arctic</p> <p>Moroccan Sunset</p> <p>Custom</p> </div>		<div data-bbox="507 163 1082 801">  </div> <p>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.</p> <p><i>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.</i></p> <div data-bbox="667 831 735 898">  </div> <p>The button activates the "Gradient Editor" to further customize the color palettes.</p>
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. <i>By definition it is set to 5 seconds.</i>
S-Attack / S-Decay		Changes the uniformity and average of the received signals in the RF spectrum display. <i>Set them halfway.</i>
W-Attack / W-Decay		Changes the uniformity and average of the received signals in the waterfall display. <i>Set them halfway.</i>
Speed		Changes the refresh rate of the RF spectrum and waterfall. <i>Never keep it at maximum.</i>

Zoom Bar

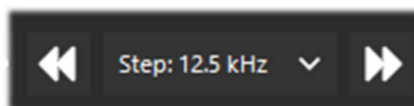
The four vertical sliders on the right (items 14/17), referred to as "Zoom Bar", adjust the following settings in the RF spectrum and Waterfall display.

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, <i>but do not exaggerate and avoid saturating by having an screen all yellow/orange or red...</i>
Range	down	<p>Changes the level in dBFS (*) on the left axis of the RF spectrum window. <i>You should adjust it so that the noise floor threshold is very close to the bottom of the RF spectrum window.</i> This will make the RF spectrum and waterfall signals more readable, making weak signals easier to detect.</p> <p><i>Correct</i></p>  <p><i>Wrong</i></p> 
Offset	down	<p>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. <i>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.</i></p>  <p><i>Wrong</i></p>

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 (*).



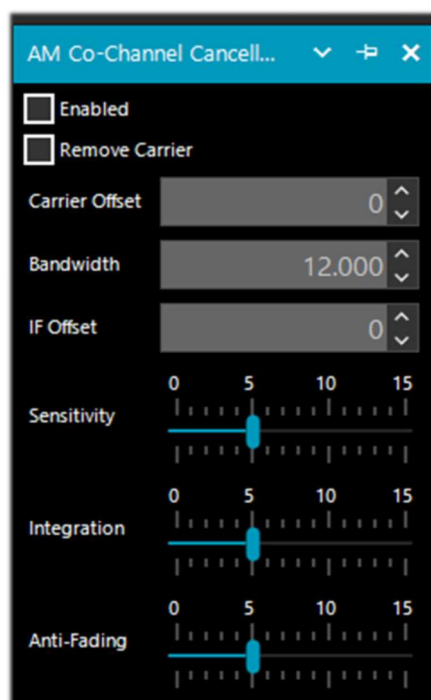
Clicking on the left double triangle will decrease the VFO frequency by the value indicated in the step, while clicking on the right double triangle will increase the frequency. *The possible choices concern steps between 1 Hz and 1 MHz or, with free tuning, not flagging the first item "snap". To use 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)

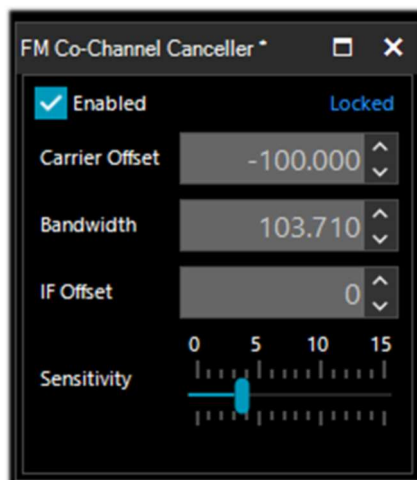
3) Enable the "AM Co-Channel Canceller" and the relative "Remove Carrier" with Carrier Offset value at 9.000 (designates interference is 9 kHz from the station). The plugin will hooked and show in blue "Locked" on the right hand side, and you see in Spectrum RF a vertical blue line over the carrier to 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!



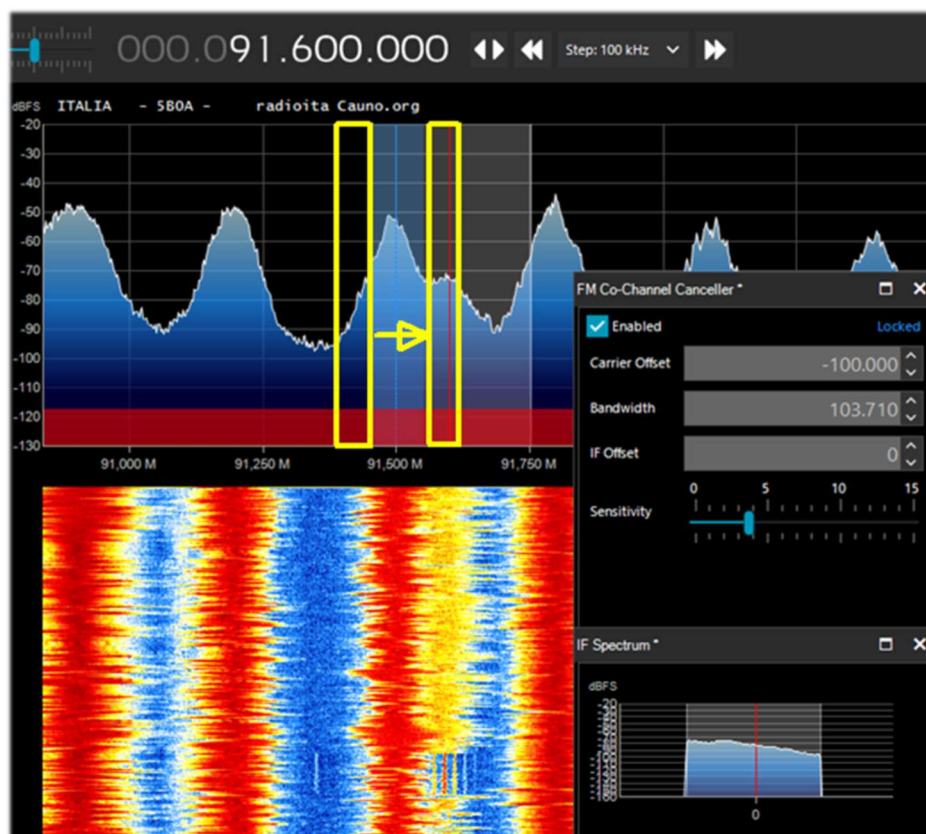
In a similar way works the equivalent "FM Co-Channel Canceller"; *its initialization code and sensitivity have been further improved in revision 1819*. In this example we see how to set the panel to listen to a weak station overwhelmed by a very strong signal...



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 Offset 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.

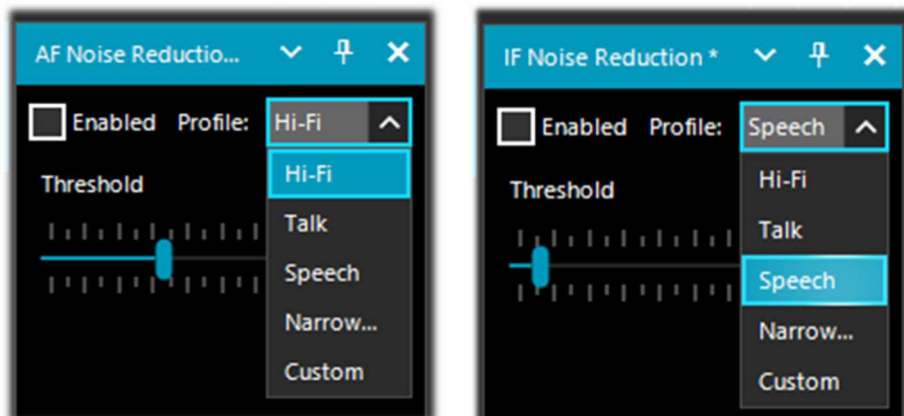
Not only does it work "live" in realtime, it functions very well with previous recorded I/Q files too!



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. 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.



Audio AF NR is better for FM modes because it eliminates the hiss, which has mostly high frequency components in the audio spectrum. The IF NR eliminates the RF noise which can be located anywhere within the signal. This has no effect in WFM or NFM with high modulation index because the signal is spread over a large bandwidth, but with linear modulations like AM and SSB, it can improve the SNR dramatically by detecting the parts of the spectrum that do not contain any signals and attenuating them. The combination of AF and IF NR can give some excellent results when using “Custom” profiles tuned for the signal in question. Probably the best in the market today.

The sliders control the strength of the applied algorithm, and you can use some predefined and optimised profiles: **Hi-Fi, Talk, Speech, Narrow Band and Custom.**

For **Custom** profile, it is possible to customise all the individual components down to the smallest detail: Boost SNR, Depth (in dB), Slope (in dB), Attack (in ms), Decay (in ms) and FFT Size (in bins or spectrum samples by defining the frequency resolution of the window).

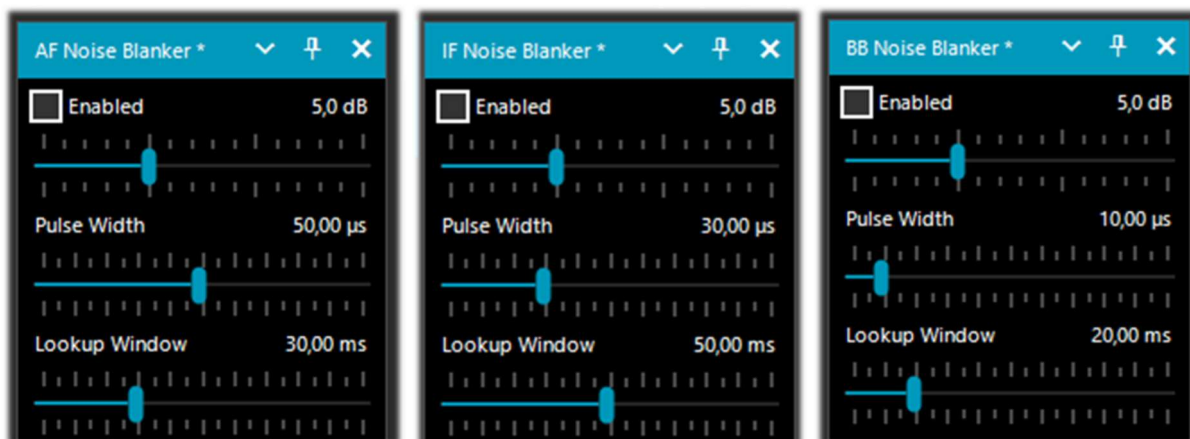
AF / IF / BB Noise Blanker

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.

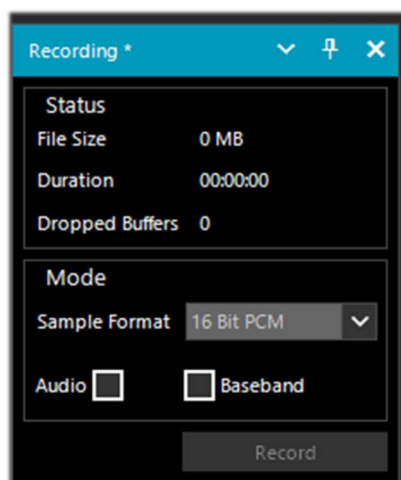


There are obviously no preset values or thresholds, *so you need to gradually move the various sliders until the pulsing noise disappears or reduces without distorting too much the received audio.*

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.*

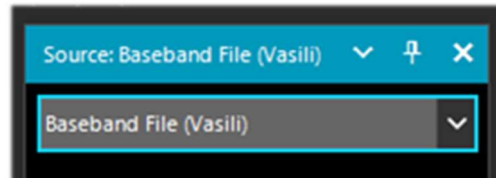
The audio you hear can easily be recorded by checking the "Audio" box. A standard WAV audio file will be created in the SDR# directory that can be played with any player. An I/Q recording is a tuned full bandwidth recording that allows subsequent playback and analysis without the slightest loss of information. 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"...*



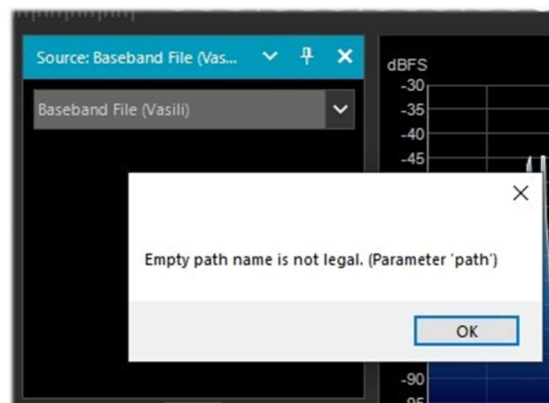
I/Q recordings can be played back in the Source panel by selecting "Baseband File (*.wav)".





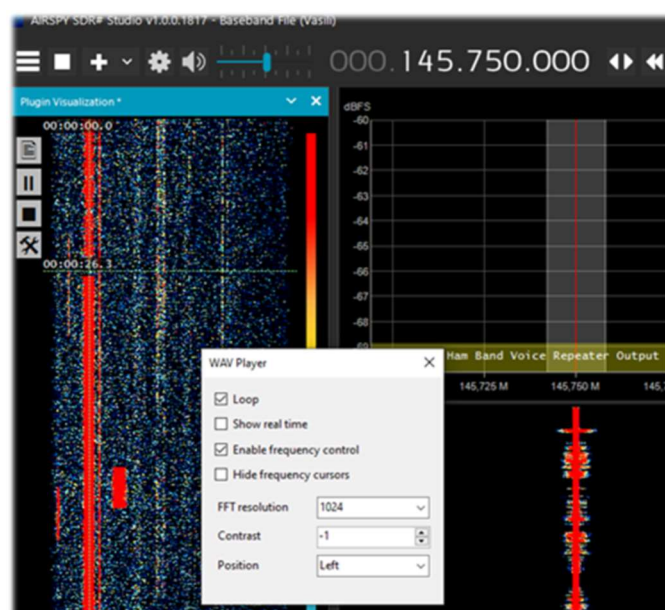
Another choice to play the I/Q recordings is to select from Source the "Baseband File (Vasili)" by Vasili Beliaikov that uses a different player with excellent features.



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.

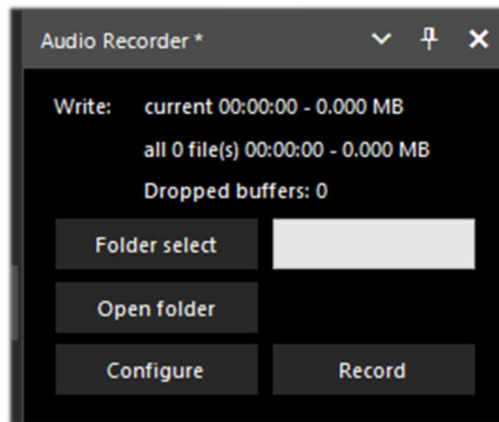


Just click on OK to close the window and then press the wheel  of device configuration to load the IQ file and run it. At this point a new "Plugin Visualization" window will open, allowing you to move within the registered IQ file. By clicking on the icon  the "WAV Player" panel will open with the possibility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

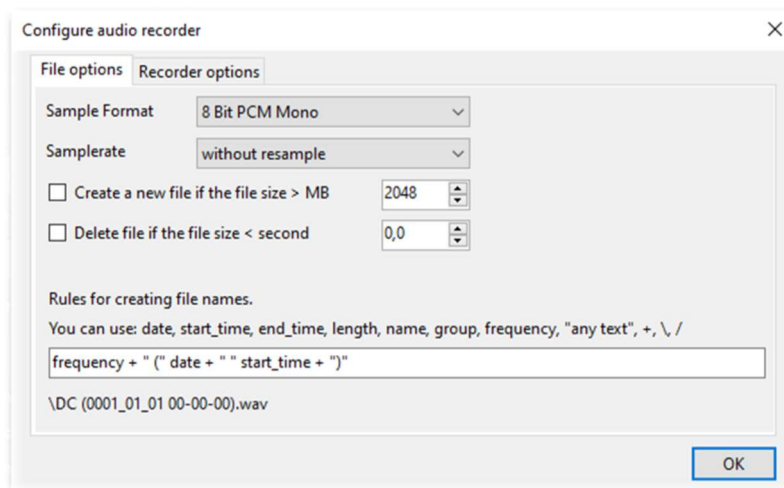


Audio Recorder

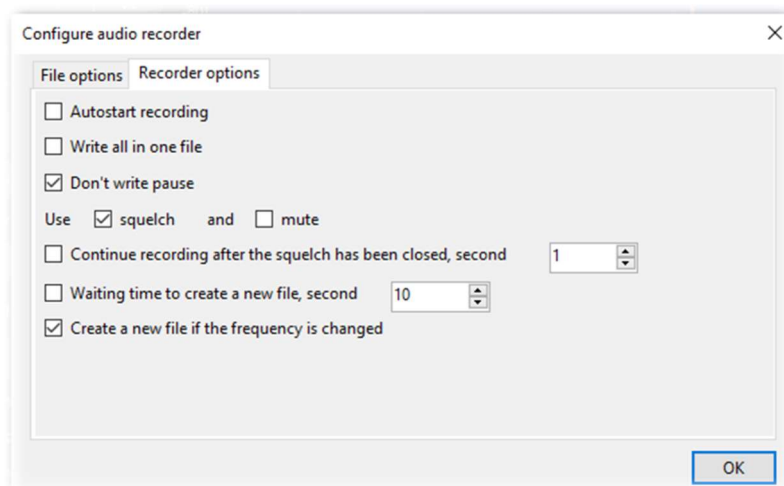
There is also this plugin worth mentioning that I personally use very often to make on-the-fly recordings in the normal audio format.



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 !

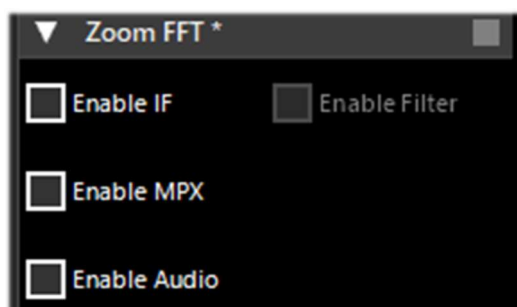


In "Recorder options" you can configure many other parameters. I consider very useful the "Write all in one file" otherwise the system creates many different files and especially the "Don't write pause / Use squelch" very useful to make recordings only when the audio is activated...



Zoom FFT

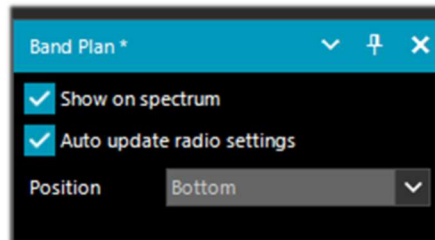
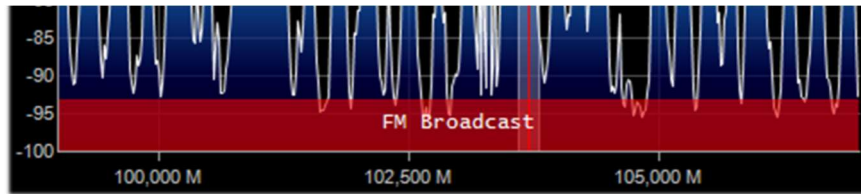
Zoom FFT is a default plugin in SDR#. It creates a zoom, at the bottom of SDR#, of the spectrum display and other customizable windows.



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	<p><i>Only active on WFM signals (band 88-108 MHz).</i> 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...</p> <p><small>http://users.pandora.be/educypedia/index.htm</small></p>
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").

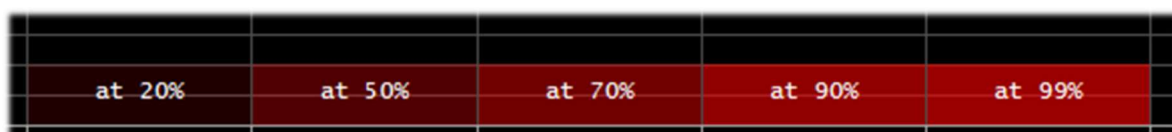


Key	Default	Feature
Show on spectrum		Enabling this option will display a rectangular color bar with the bandplan in the RF Spectrum window at the position indicated by the "Position" option.
Auto update radio settings		Enabling this option will automatically detect the emission mode/step and set in the VFO (*). <i>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 !</i>
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>
```

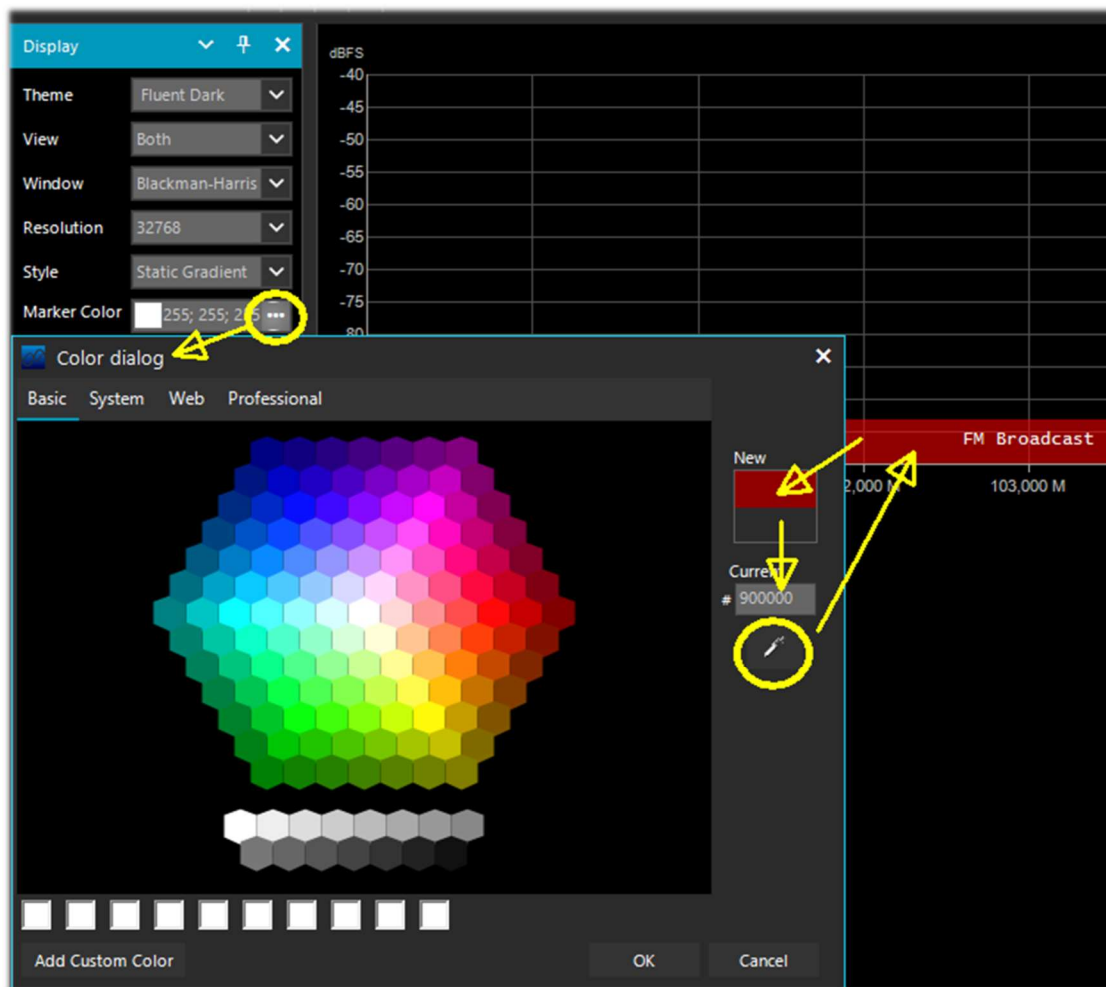
Each band can be divided into individual areas with different coloring, except for the overlapping of a subgroup (but not altogether). Colors are defined as T-RGB, where T=Transparency (in values from 0 to 99 as a percentage, from almost completely transparent to full color) R=Red, G=Green, B=Blue in 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>

<https://www.sitiwebgallery.it/blog/tabella-colori/>

<http://www.colorhtml.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.*

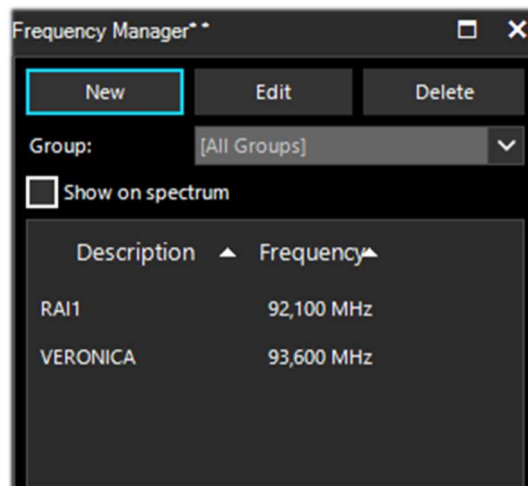
This plugin is very useful and allows you to divide the various bands of service assignment in automatic mode by simply clicking on the RF Spectrum, *but be careful because some bands with multiple assignment in emission modes make the correct mode pre-selection impractical (e.g. the articulated V-UHF 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.

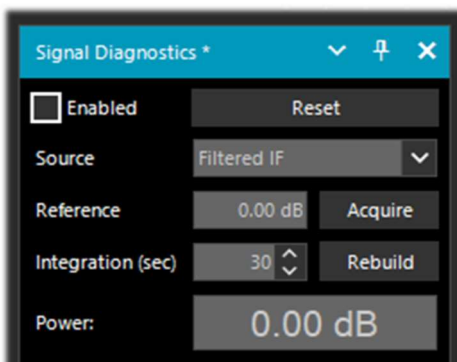
Then a double click on a record will tune SDR# to that frequency, automatically setting the emission mode and its bandwidth. *If the "Show on spectrum" box is checked, the frequency label will be displayed in the RF spectrum*



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.

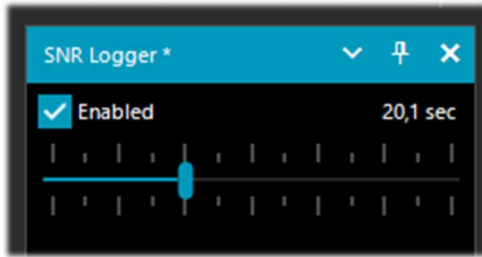


On YouTube, the radioamateur Leif Asbrink (SM5BSZ) has uploaded some very interesting and technical videos, where he shows how the AIRSpy HF+ can be used as an accurate power meter for RF signals. He points out that if the noise figure (NF) or minimum distinguishable signal (MDS) of a device is known, 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.

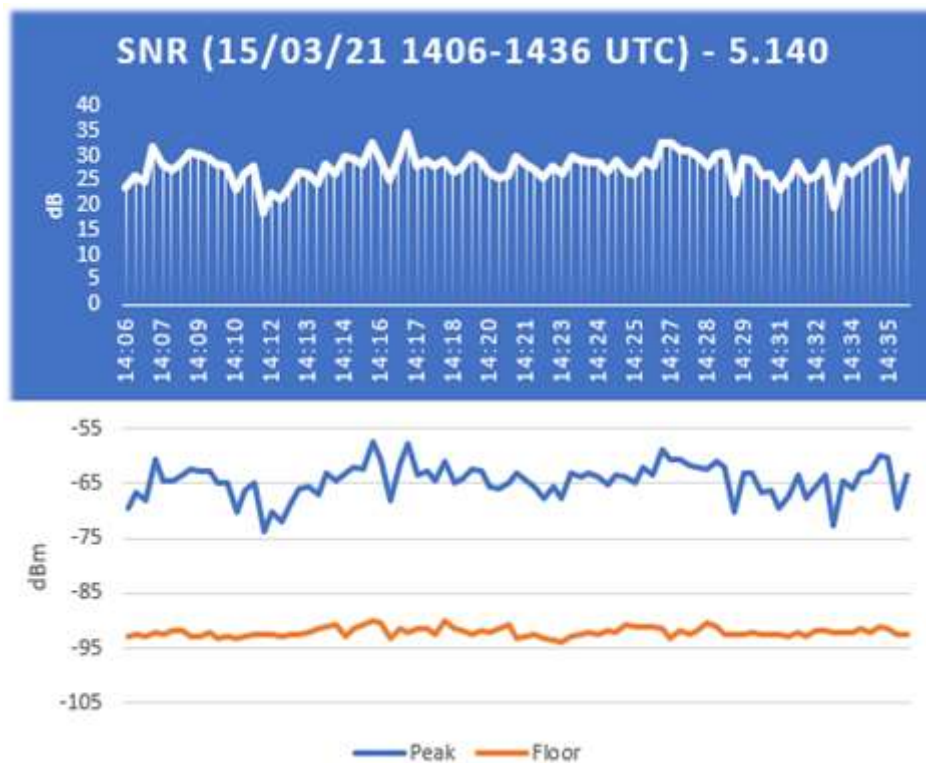
The signal strength is the height of the peak shown in the Waterfall while the noise level is simply the strength of the noise at frequencies where no signals are emitted. The absolute value of the difference between the two is called

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).



..... Plugins

In this section I will describe 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*

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/](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>

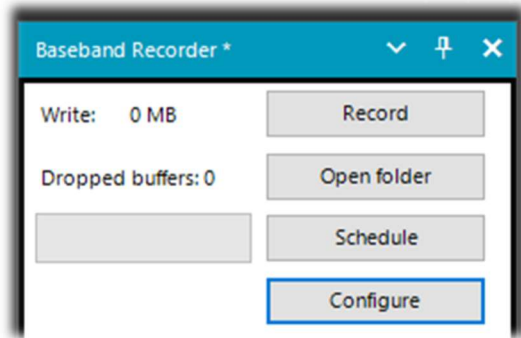
The solution provided allows you to edit, build and debug these plugins within Visual Studio 2019. This is probably the fastest way to develop plugins for SDR# now in dotnet 5, but the reference to the old programming still works.

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.

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!)

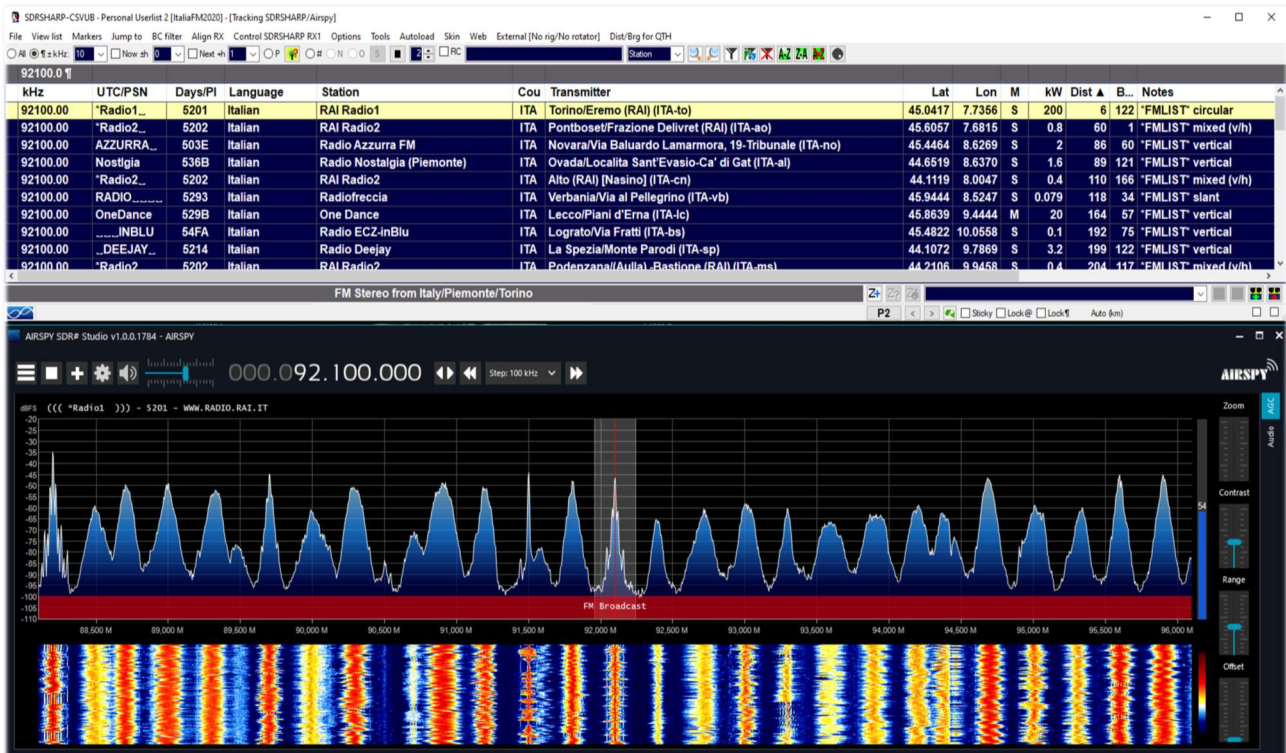
CSVUserlistBrowser v4.20

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.

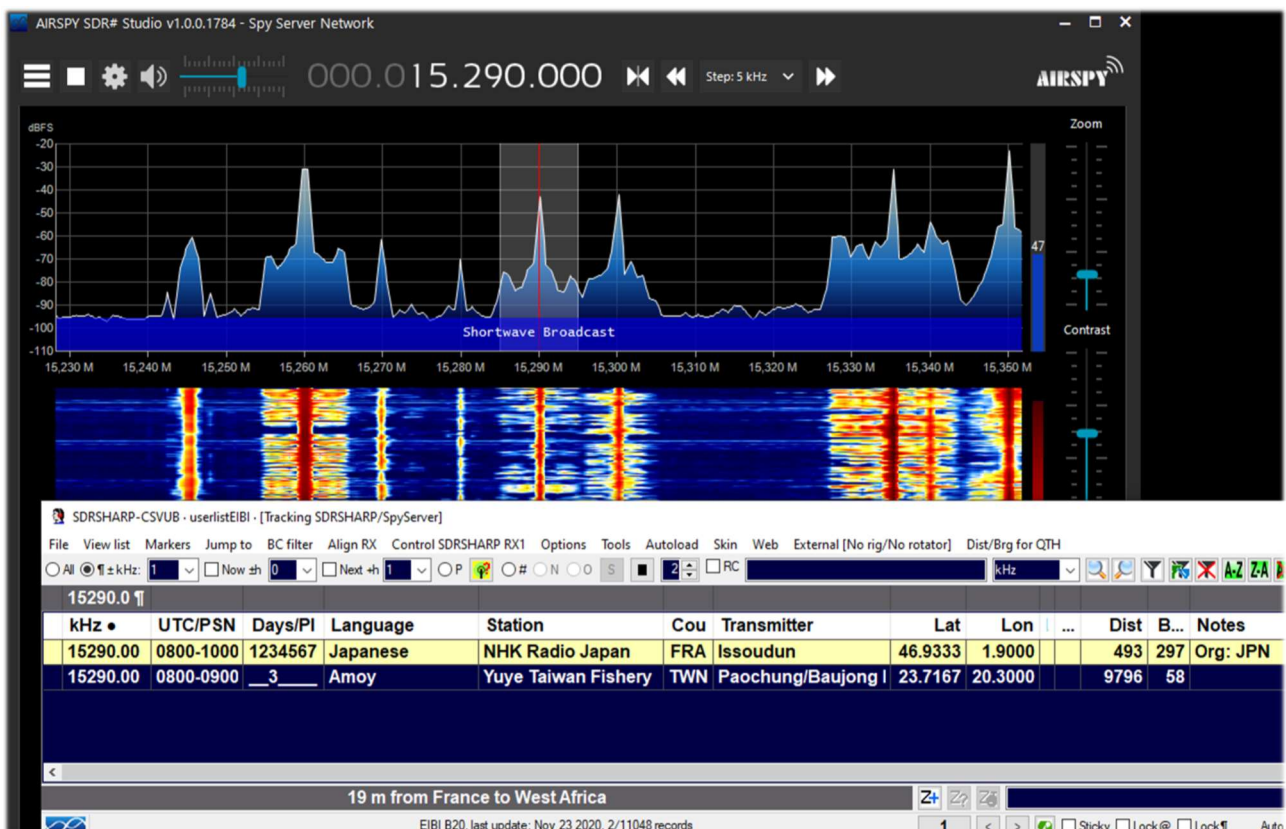
CSVUB tunes the receiver with a single mouse click in the proper emission mode, showing the station name, time, language, transmitter position, distance and bearing, as well as other information automatically updated by the respective servers! It also contains Hamlib and Omnirig control for external 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	Nostigia	536B	Italian	Radio Nostigia (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-ic)	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.



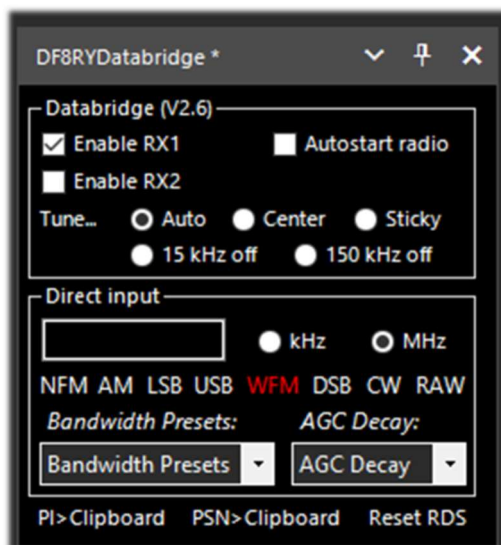
In the screen above, SDR# is tuned in full screen at 92,100 kHz WFM, the plugin sends the information to CSVUB, which displays it in tabular form, showing in the first line of different color the identified broadcaster. Everything is configurable in font and size, as well as having a customizable "skin" 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

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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 Airtspy 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: <i>really very convenient and fast!</i> 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.

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.fregmgrsuite.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.

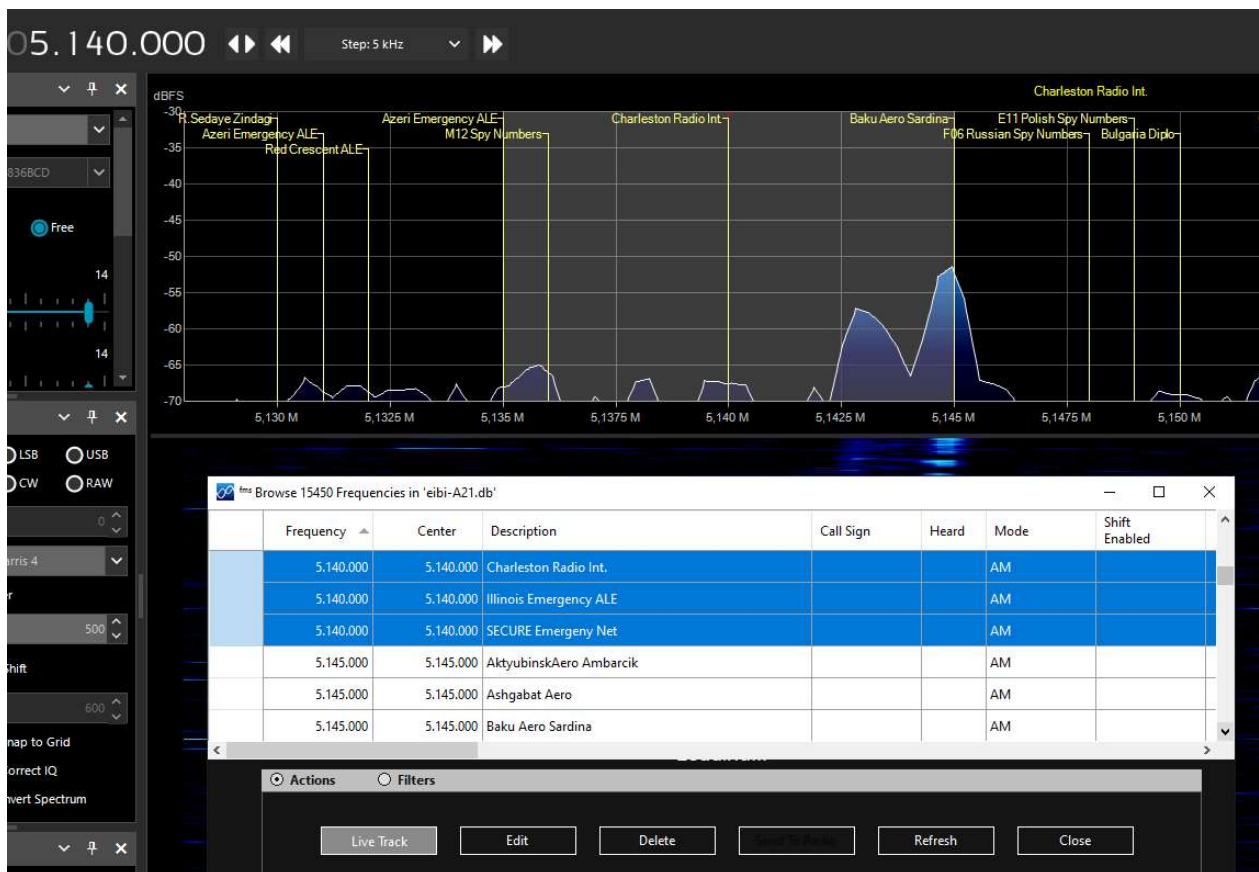
Data Tools Wizard - Is an external executable program (FMSuite.DataTools.exe) that I find really useful and very powerful. It is designed to download and import various frequency databases for use within the Frequency Manager+Scanner.

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, 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 – 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.

Frequency: 5.940.000 Center: 5.940.000 I've heard this: ☐

Description: Voice of America Callsign:

Mode: AM CW Shift: 600

Shift: Enabled: ☐ Step Size: 1 kHz

Filter Type: Blackman-Harris 4 Protocol: Voice

Filter Order: 500 Service: Broadcast

Filter BW: 10.000 Ignore when scanning: ☐ Flagged: ☐

Squelch: Enabled: ☐

Groups:

Notes: /BOT

Add Update Cancel

Frequency: 5.940.000 Center: 5.940.000 I've heard this: ☐

Description: Voice of America Callsign:

City: Country: USA

Latitude: Longitude:

Azimuth: Target: CAI

Start Time: 1400 Stop Time: 1600

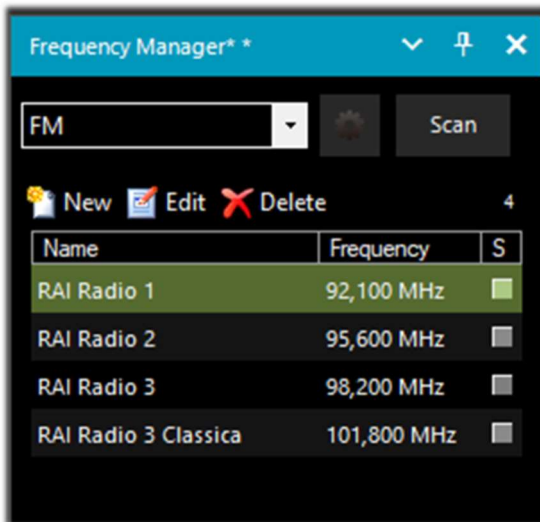
Days: Language: E

Power: 0 Last Update: 07/08/2021

Add Update Cancel

FreqMan v1.1.5.0 & Scanner v2.2.9.0

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.

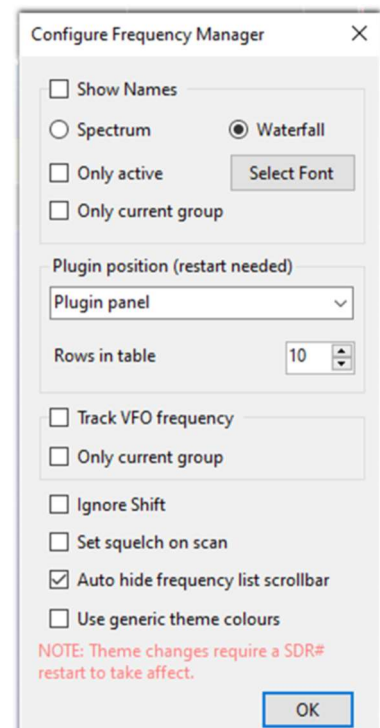
The very useful thing is that FreqMan uses the same archive as Frequency Manager (i.e. the file 'frequencies.xml' in the program directory). So both plugins will conveniently see the same groups and frequencies...

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...

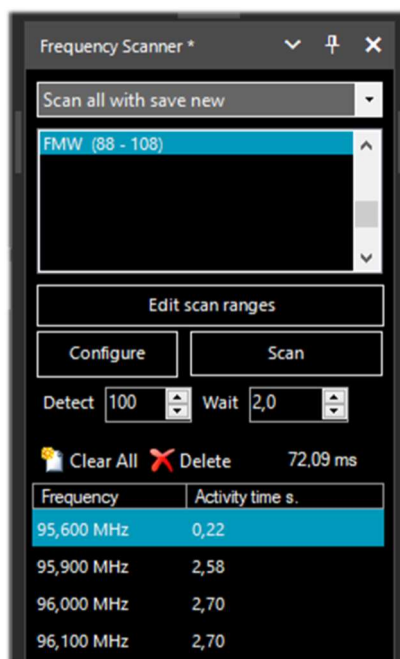


With the "Frequency Scanner" it is possible to search in a wide range and with impressive scan speeds that cannot be achieved with any other scanner, even analogue!

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 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.*

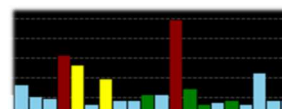
The colours at the bottom of the Channel Analyser have these meanings:

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.

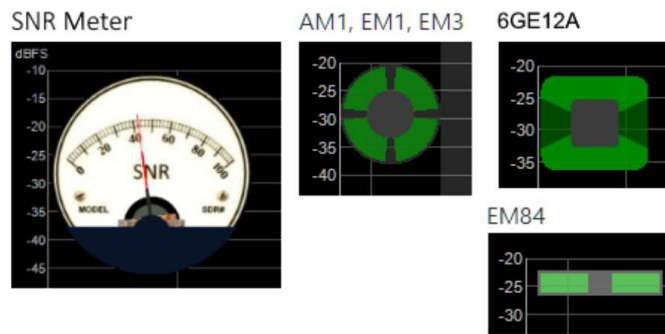
Magic-Eye v1.70

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>

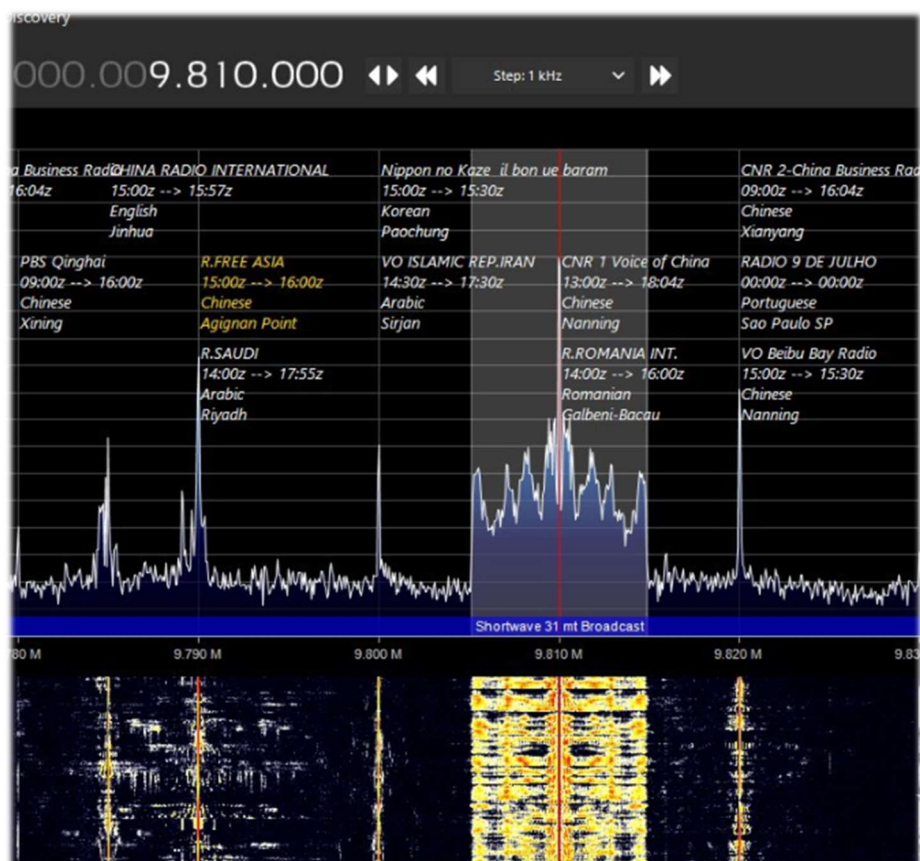
Once installed and activated, one of thirteen patterns will appear in the top left corner of the RF Spectrum window, customisable in size and transparency relative to the background.

An analogue SNR meter is also implemented.



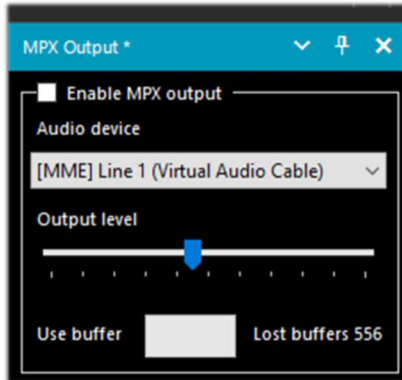
The latest update, available at the time of this writing, is version 1.70

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

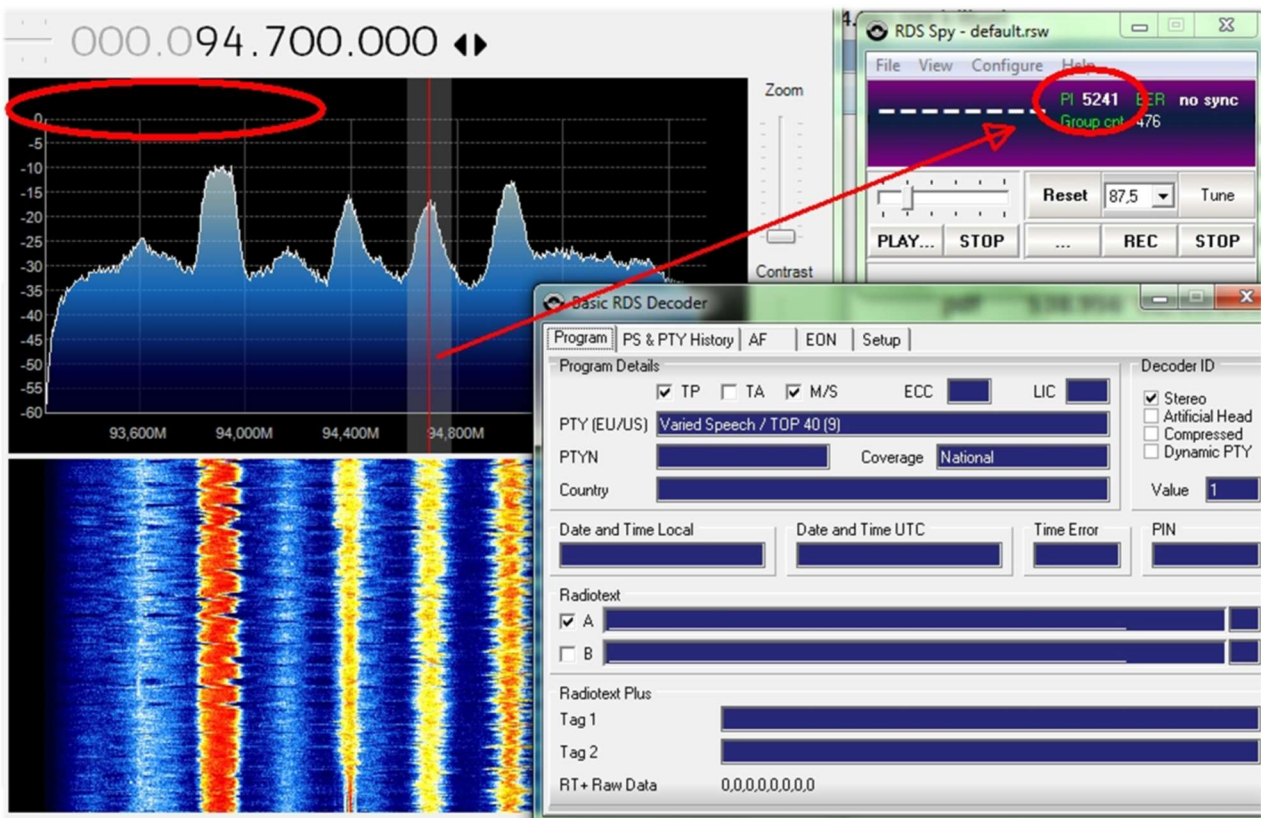
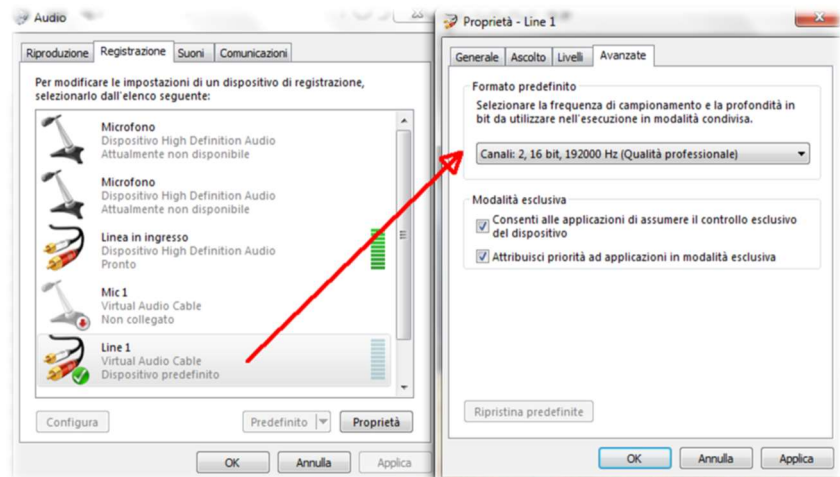
For a friend who is interested in FM-dx I tried the new plugin "MPX Output" in combination with the professional decoder "RDS-Spy" which allows you to discover and highlight all, but really all, the "secrets" hidden inside the RDS (*): <https://rdsspy.com/downloads/>



enabled in the audio panel (as shown below), only then you can have the decoding of the RDS.

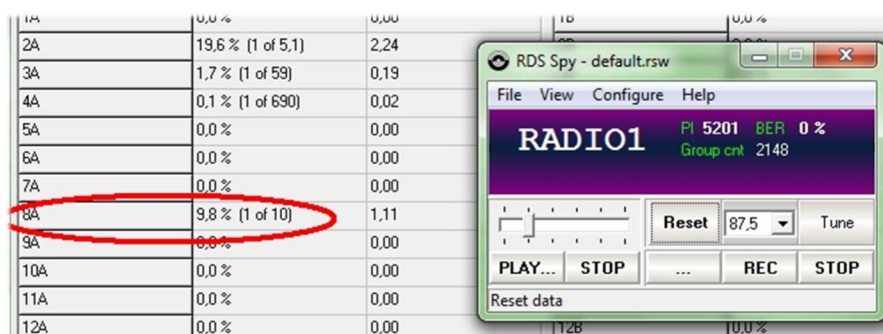
By enabling the checkbox "Enable MPX output" the multiplexed audio stream will be routed to the indicated device and from this to the RDS-Spy decoder which will be configured in the panel "Configure / Select RDS Source / Sound Card / Input Mode "Direct RDS/MPX (192 kHz)" with the same device selected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

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*

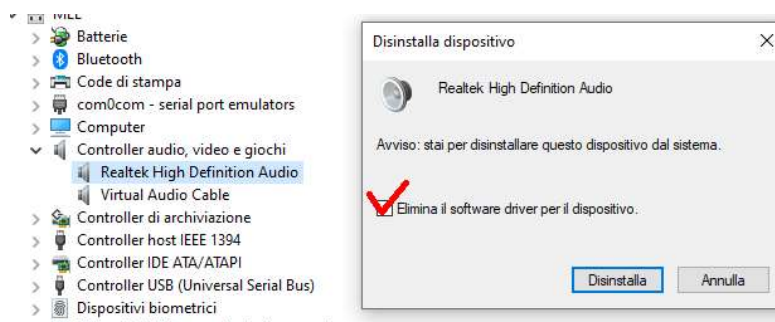


At this point the decoder panel will animate with all the RDS information and in "View / Basic RDS services" you can appreciate the multiple indications "Program Details, PS & PTY, AF, EON". In the "Group Analyzer" all the active groups will be checked and their percentage of diffusion in time...

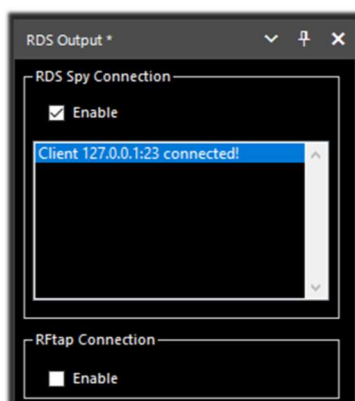
In the following example I found for the local broadcaster the presence of the TMC service - Traffic Message Channel on block 8A



In the my tests I found some difficulties to set the 192 kHz sampling that was not present in my 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...

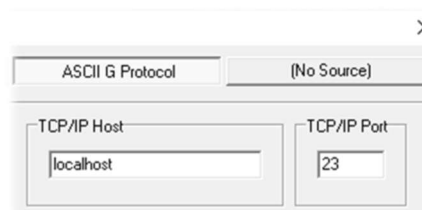


Only on a laptop I didn't succeed and so, on a friend's suggestion, I tried another method with the plugin "SDRsharp RDSOutput" that allows to use RDS-Spy but without MPX, Virtual Audio Cable and the whole issue of sampling and configuration for 192 kHz.



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...

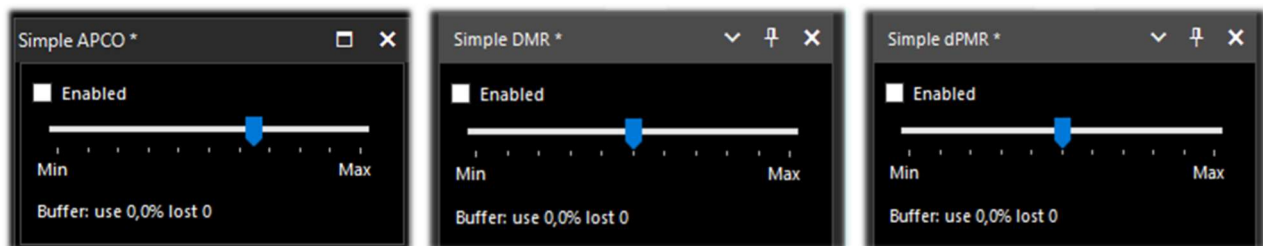


Simple APCO / DMR / dPMR

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.



..... Various topics

Faults

It can sometimes happen 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 USB socket!

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 kbps 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>

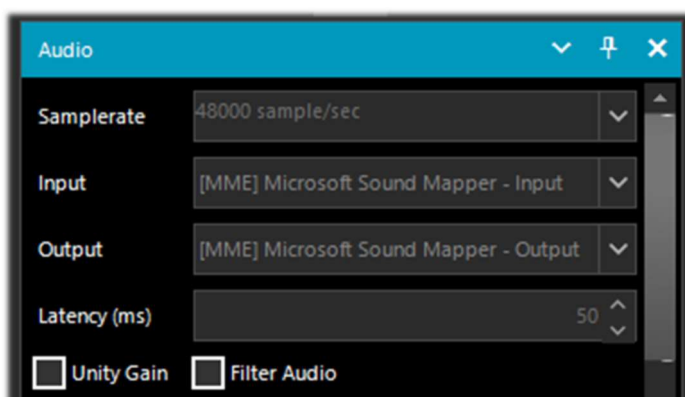
Much more complex and fascinating topics are the analysis of signals and transmission modes and related protocols. I

t 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

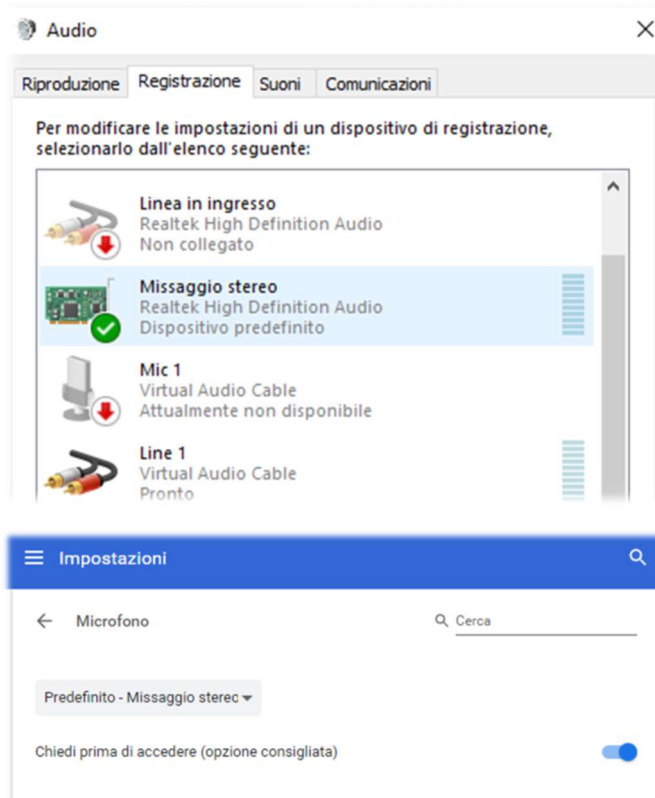
WARNING! SOME OF THESE SYSTEMS IT COULD BE ILLEGAL IN YOUR COUNTRIES! Check carefully and thoroughly the regulations in force in your country. Some of this radio system was specifically designed for use by government, emergency services, for public safety networks, etc etc. who all share spectrum allocated.

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.

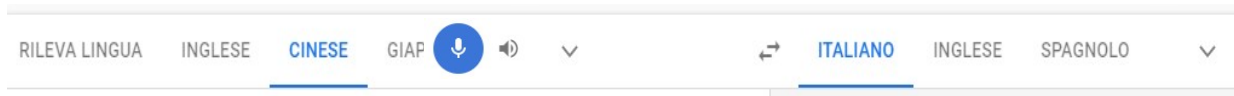


If the entry does not appear, you need to click on the other input devices and temporarily choose "Disable".

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.



Modi Operandi

In this chapter I will collect some screenshots, just with a title and some very short comments, giving the images the right weight and trying to arouse personal interest for the subsequent in-depth analysis that will be carried out only on the site of the developer of the single software indicated.

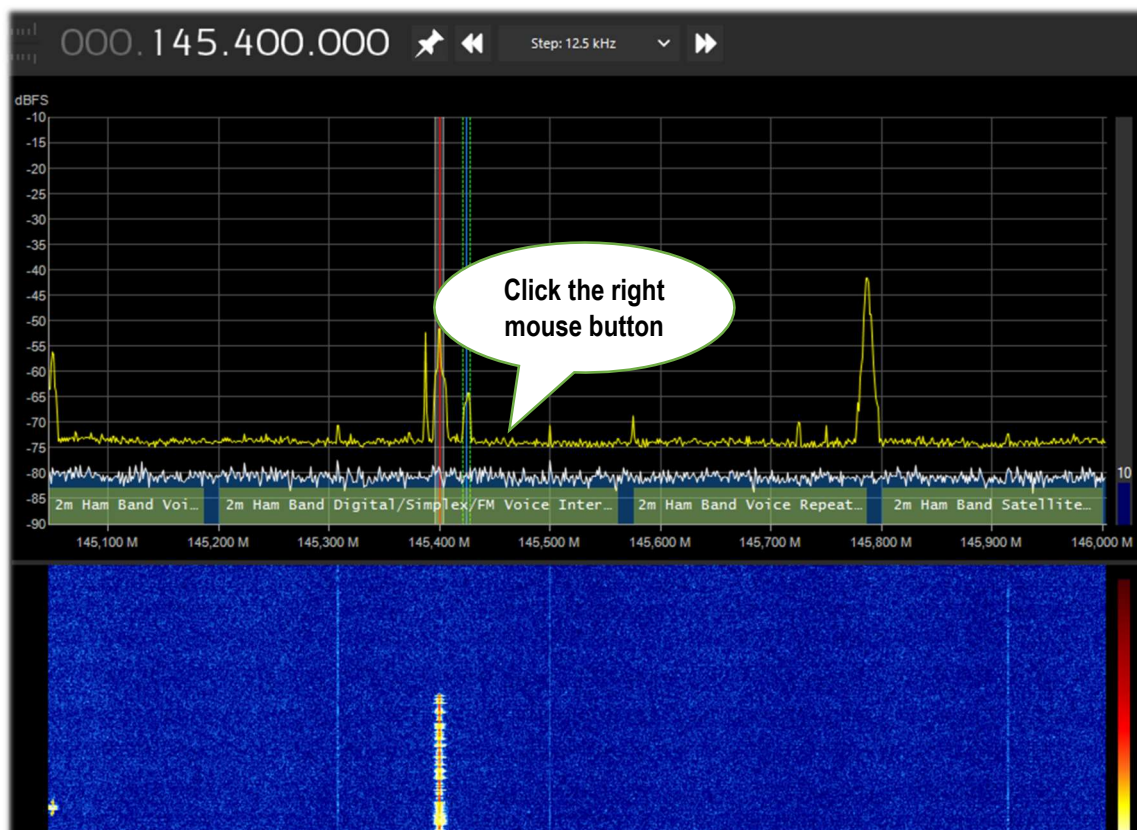
I would like to point out that ALL third party applications are made by different individuals/companies who have no connection to SDR# and AirSpy. Third-party applications are stand-alone programmes that add or complement functionality.

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

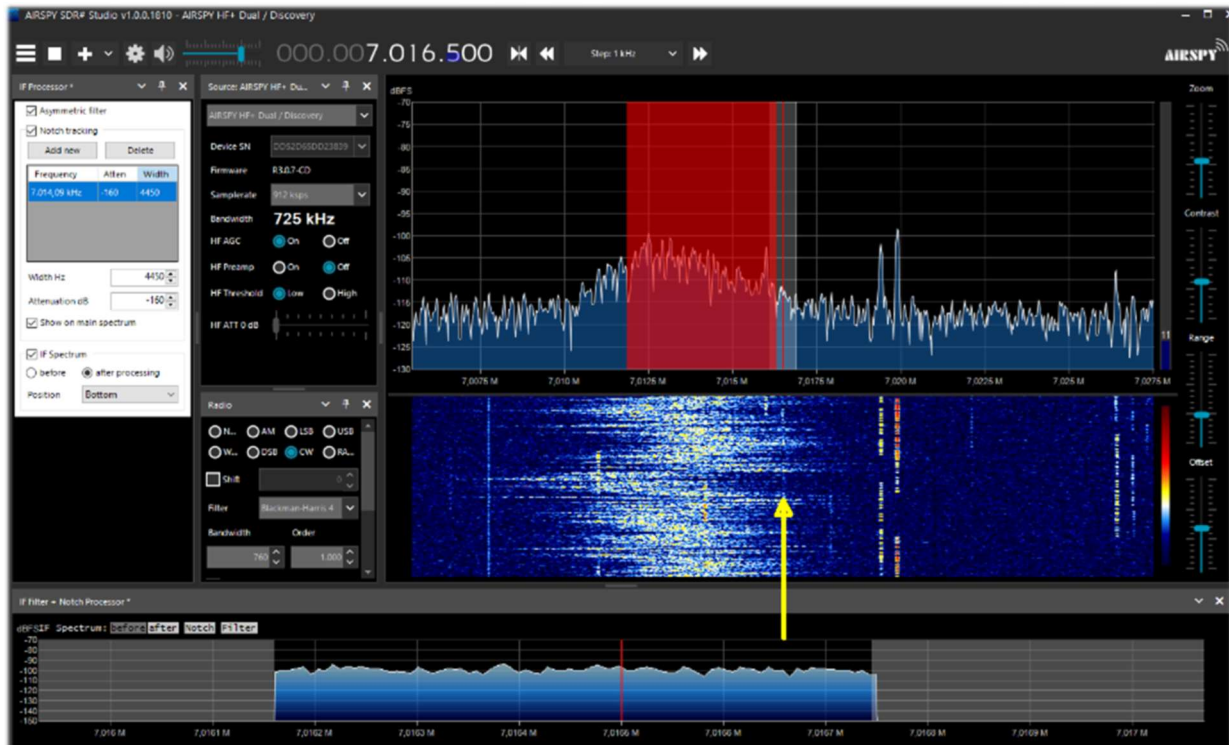
I find this option very interesting, a kind of chronological memory of the RF Spectrum. In the example, in the amateur radio band 2 meters, already after a few minutes you can see the peaks of the stations that have been activated and, positioning the mouse over them, you can read the frequency and intensity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



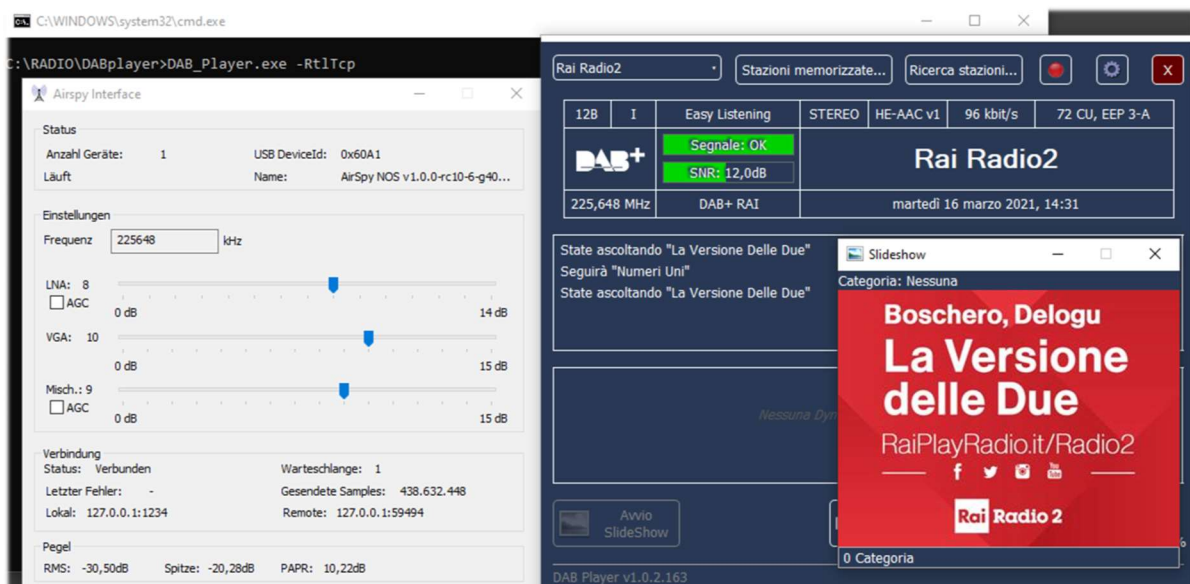
How to eliminate unwanted signals SDR#: IF Processor, Notch and IF Spectrum

Inserting the DLL "SDRSharp.DigitalIfProcessor.dll" in the plugins directory makes the IF Processor available with the power of its "Asymmetric filter", "Notch tracking" and "IF Spectrum" that allow you to eliminate entire portions of frequency that in some circumstances can cause interferences... (in the screen the red portion a few kHz wide with extreme variable noise that made it difficult to receive the weak CW signal at 7016.5 indicated with the yellow arrow)...



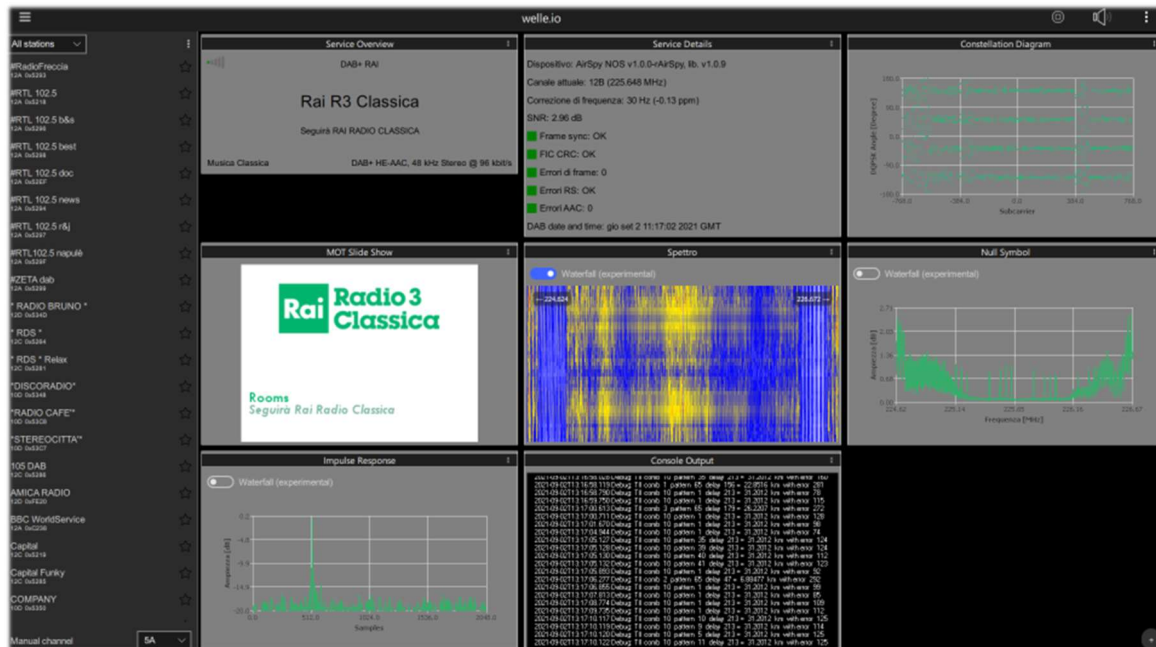
DAB/DAB+ reception (part 1) AIRSpy Interface + DABPlayer

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...



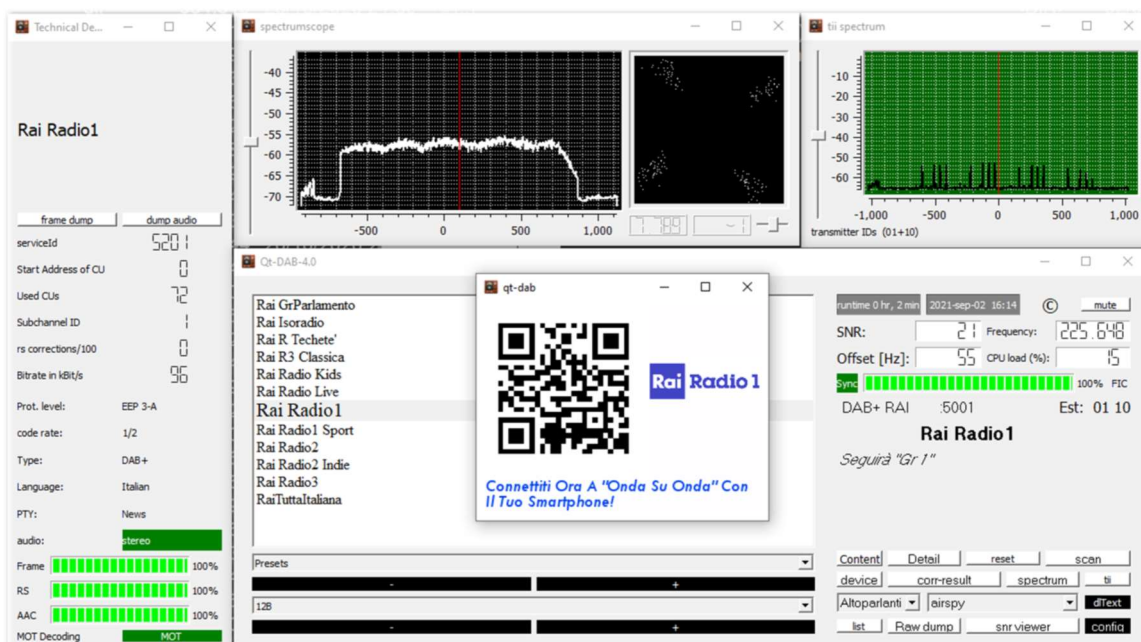
DAB/DAB+ reception (part 2) software WELLE.IO

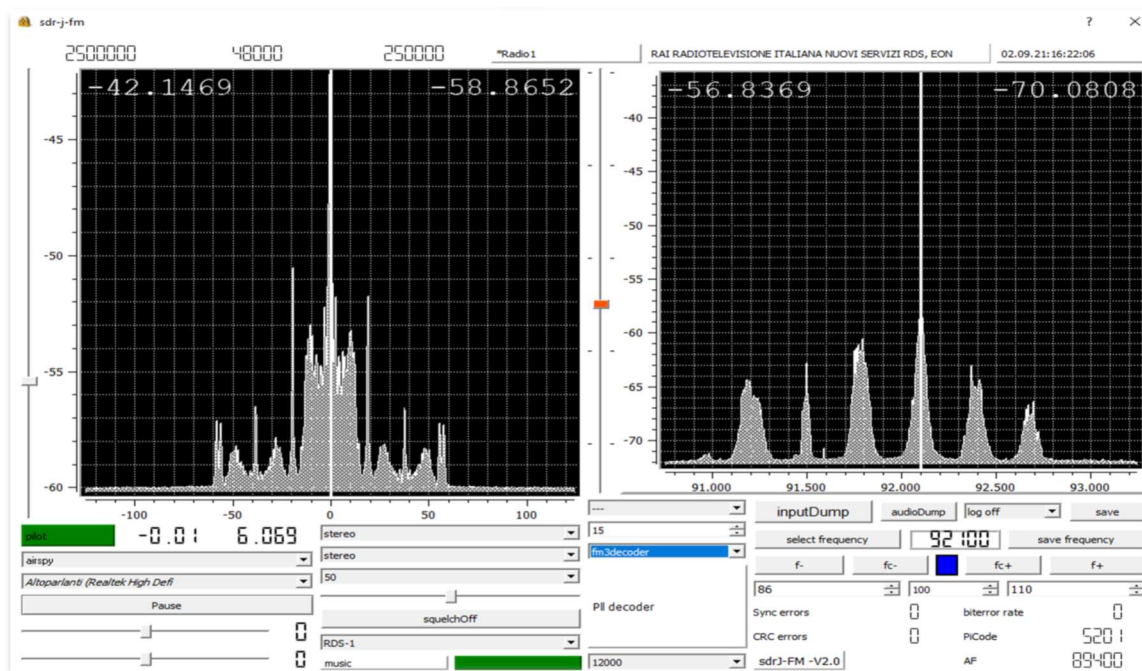
It is an open source SDR (for Windows10, Linux, macOS, Android), with support for Airspy (R2/Mini), RTL-SDR, SoapySDR. It supports high DPI resolutions (*) including touch screen displays (!) and also works on cheap mini computers like the Raspberry Pi 2/3 and various tablets / smartphones.



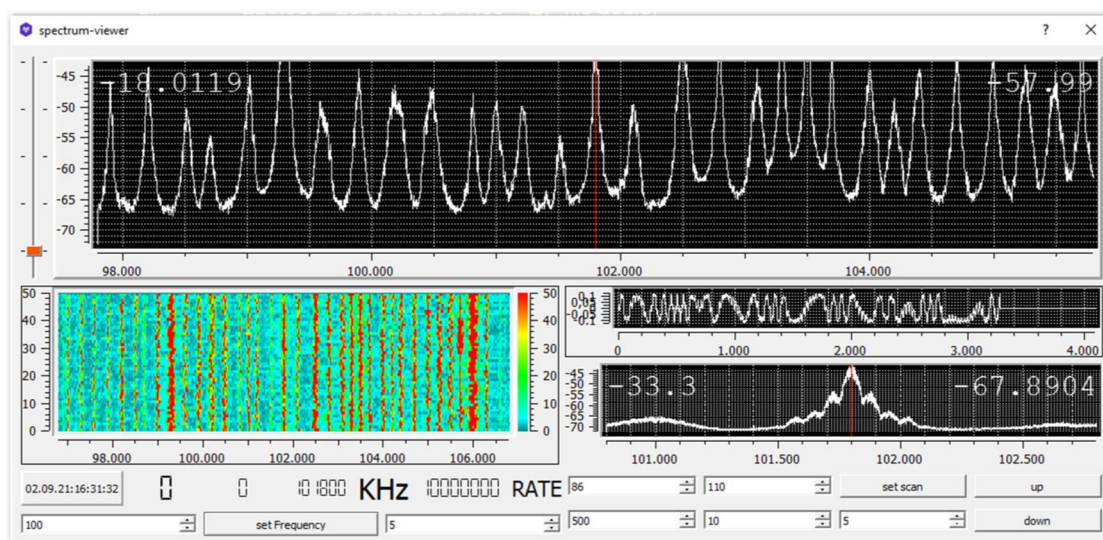
Suite DAB / FM (and spectrum displays) software SDR-J

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.

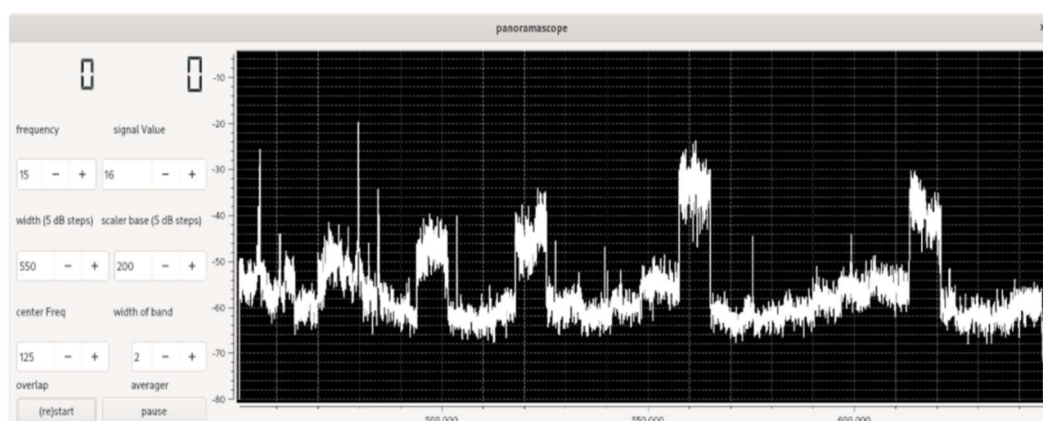




A **Spectrum-viewer** also completes the equipment



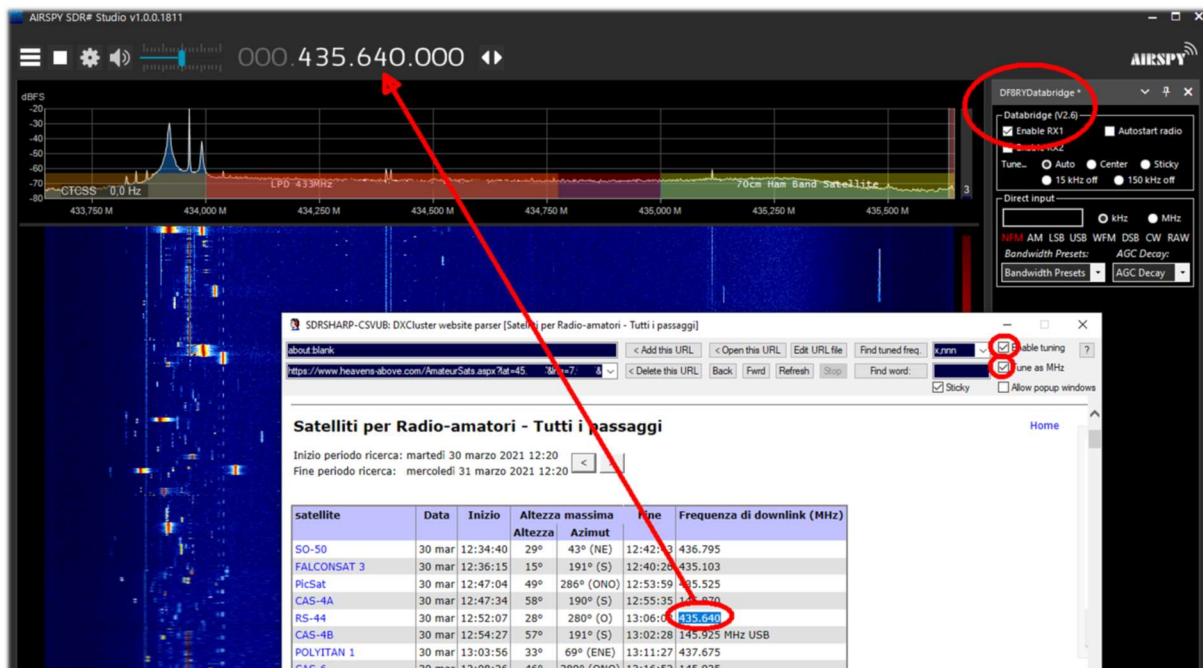
and the **Panoramascope**



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

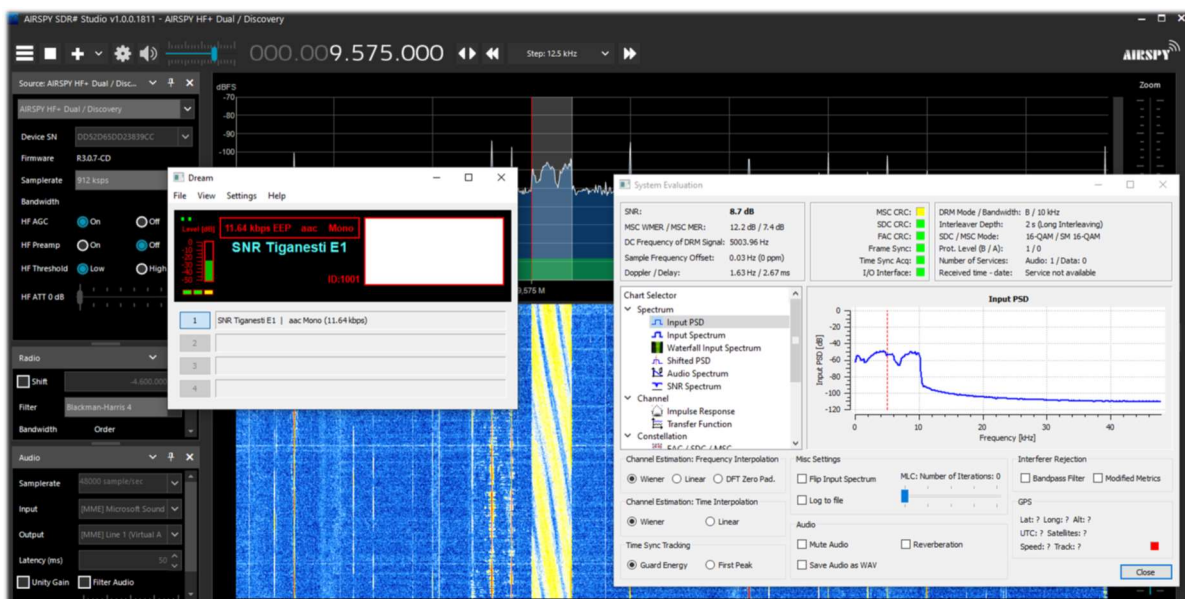
With CSVUB plugin, previously commented, it is possible to tune the VFO of SDR# only highlighting the frequency taken from a site like DXcluster or, as in this example, from a site of calculation of amateur radio satellite transits.

Enabled the DF8RYDatabridge plugin (top right) and written the URL to which we want to connect, just highlight with the mouse (!!) the frequency that interests us from the menu "DX Cluster website parser" (or Ctrl+Shift+D keys) to have immediately tuned our VFO. Really convenient and very fast!!



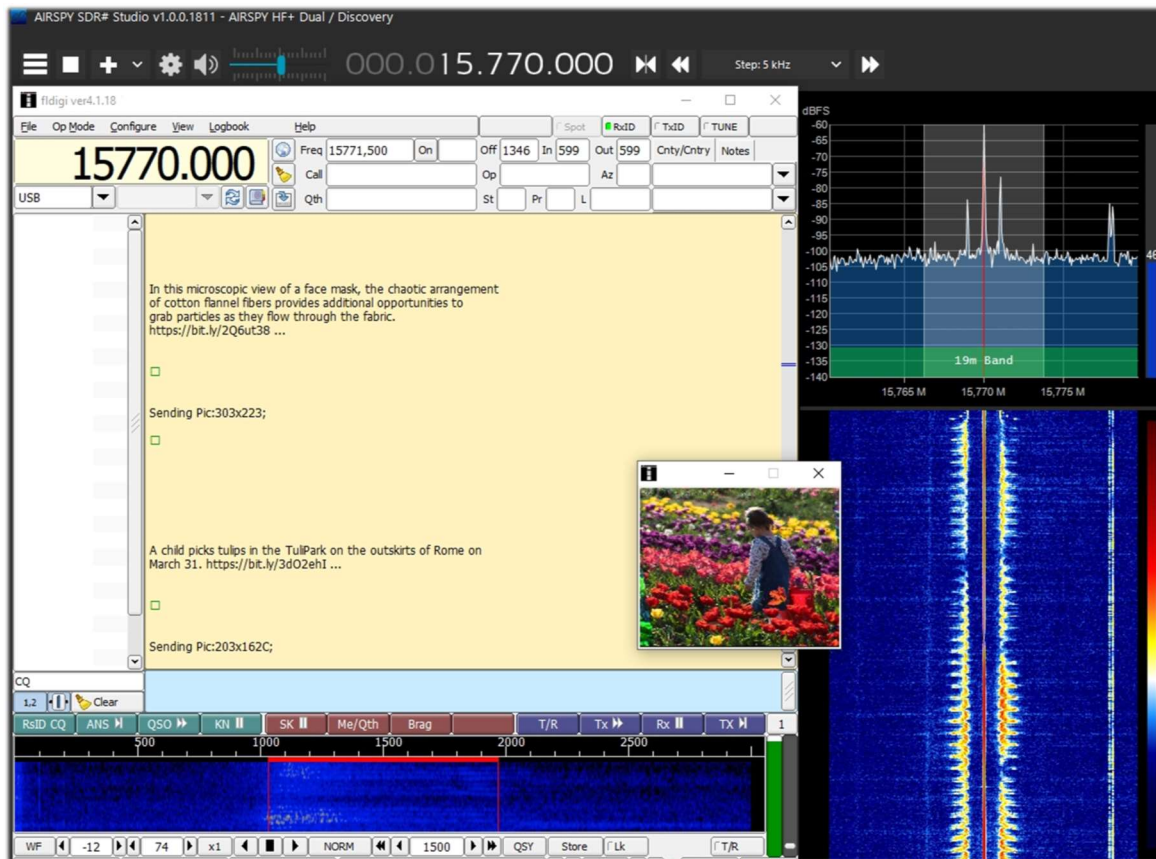
DRM reception in HF SDR# + DReaM software

Using an AirSpy HF+ Discovery, tuned in USB mode to an international frequency during a DRM^(*) broadcast and the free DReaM software, you can listen audio in high quality digital mode.



Radiograms (bulletins and images) SDR# + FLdigi software

With the AirSpy HF+ Discovery, tuned to frequency 15.770 kHz on certain days and times, it is possible to receive with FLdigi curious transmissions in MFSK-32/64 mode.

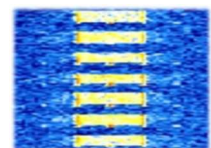


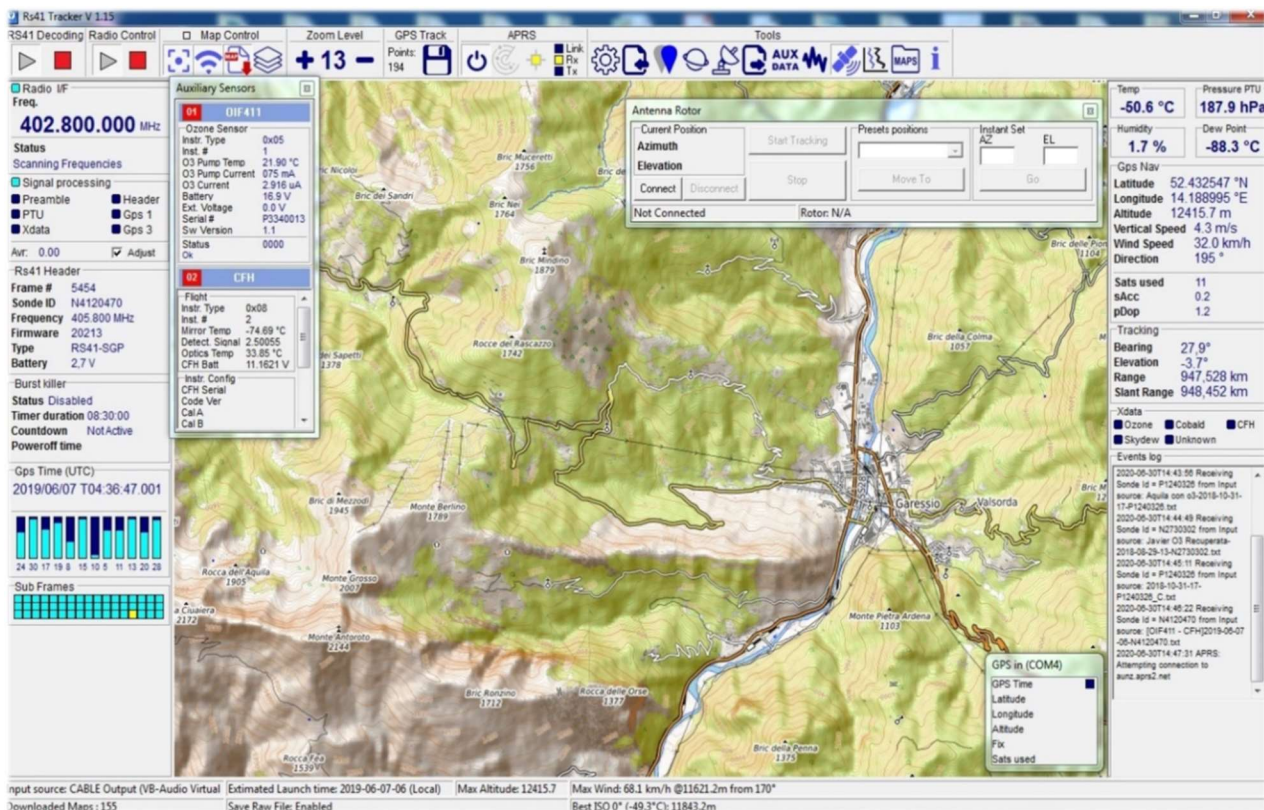
Radiosonde reception software RS41 Trakers

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.

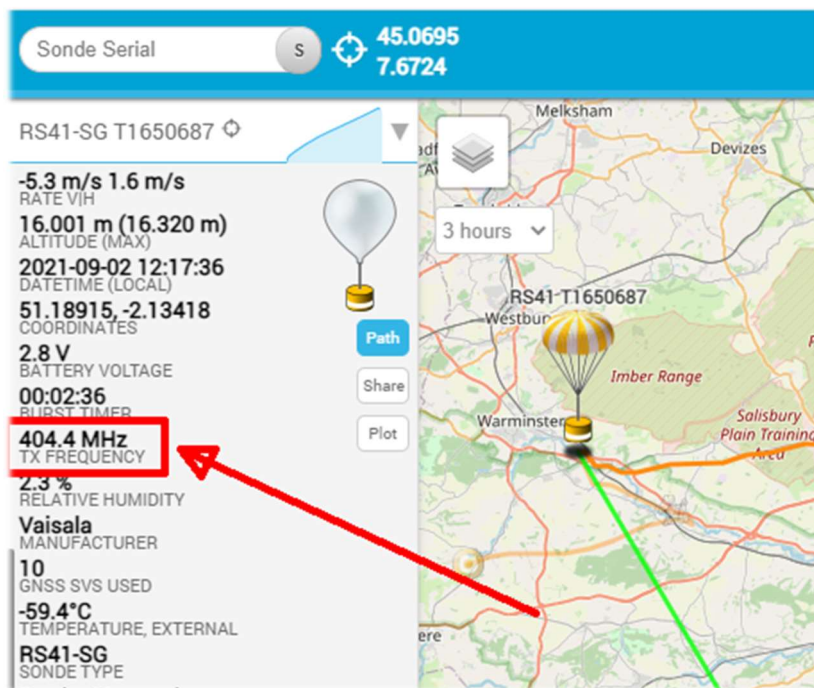
Link: <http://escursioni.altervista.org/Radiosonde/>

By tuning into UHF 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.





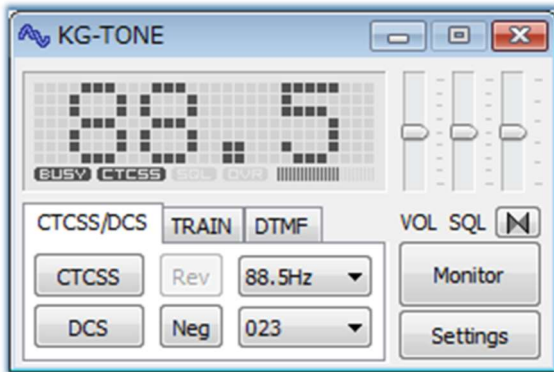
By referring to this informative link, you can also find the UHF frequency for transits in your area:
<https://tracker.sondehub.org>



Decoding CTCSS / DCS / DTMF /...

Software KG-TONE

Since a recent revision 1818 of SDR# the old CTCSS (*) and DCS (*) plugins no longer work. These plugins required some “zero crossings” in the audio buffer (points, just before the change of sign, in the signal alternating between positive and negative values) to detect tones, but since the size of the audio buffer has been reduced a lot this is not possible anymore.



While waiting for the developers to find a solution I suggest a very good external software to help identify unknown radio link signals using subaudio (or CTCSS) and/or DCS tones. It's called KG-TONE and it's free. The latest release for Windows XP/Vista/7 is 1.0.1 (Dec'2011).

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

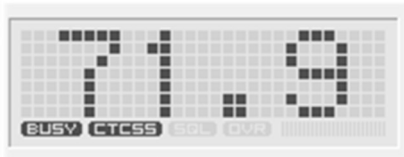
(A) = Possible, but depends on the model

(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

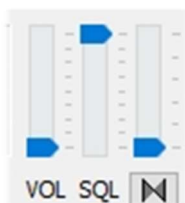
correct, and the noise squelch is open, the "BUSY" icon and thus the detected tones will be highlighted on the left in bold.


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!*

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:

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



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...

Free download at: <http://www2.plala.or.jp/hikokibiyori/soft/kgtone/kgtone.zip>

Read DTMF ...without a decoder! Software Audacity

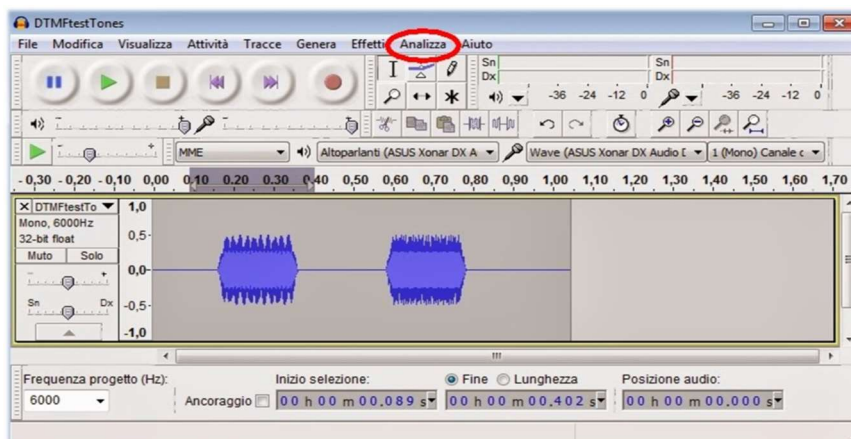
We do not always have a decoder to detect DTMF (*) tones such as the one shown above. So let's see

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	

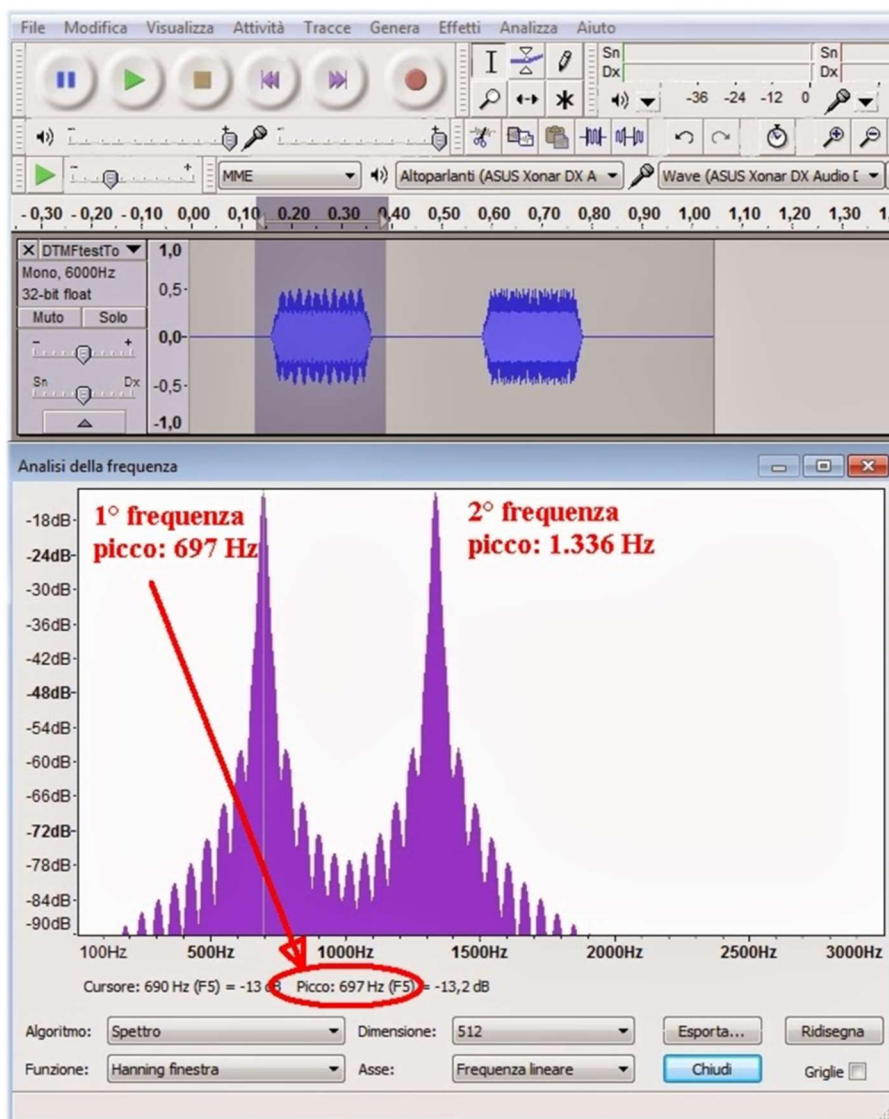
how to easily identify DTMF frequencies (in hertz), which is a coding system created for telephony, at Bell laboratories, to encode numerical codes in the form of sound signals in the audio band. The DTMF keyboard consists of a 4×4 = 16-position matrix, where the row represents a low frequency and the 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.



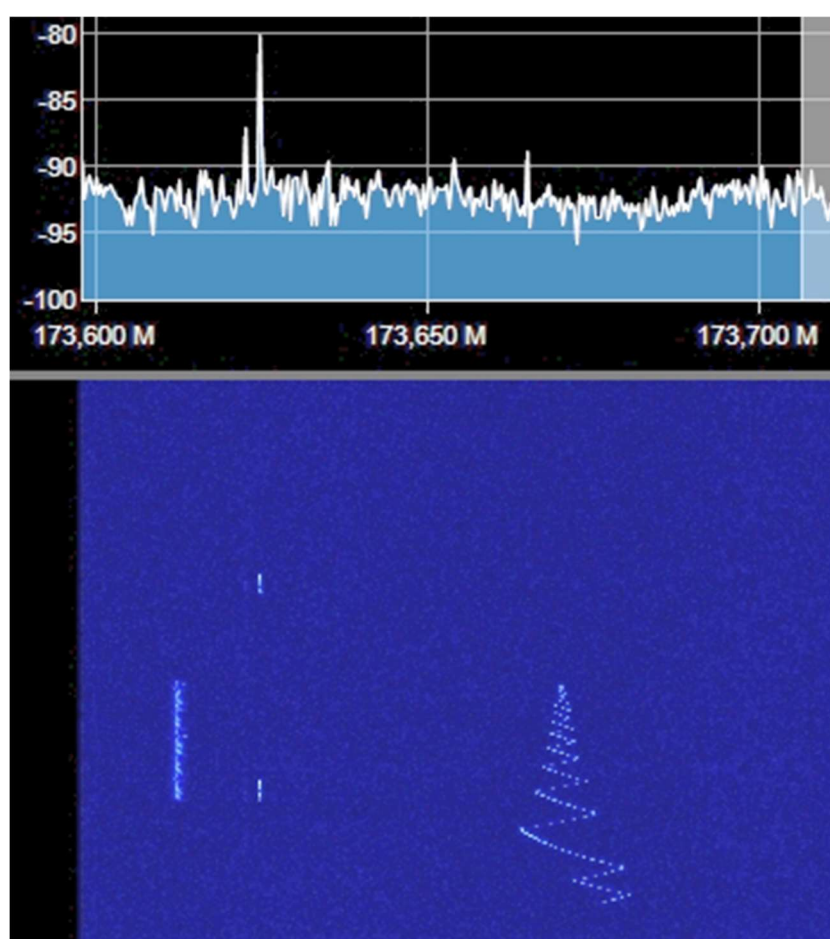
Noise and unknown signals

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.).

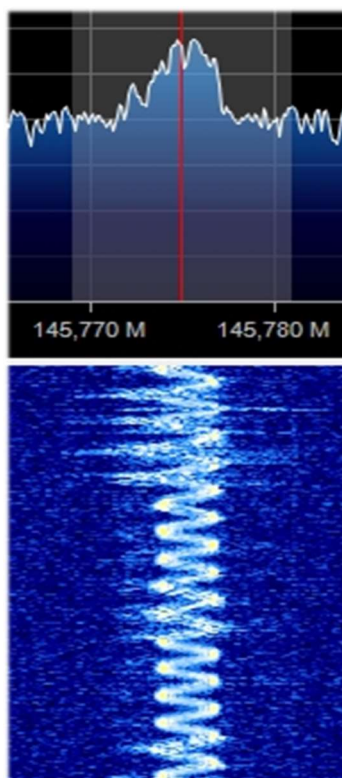
Today, thanks to the use of SDRs, it is possible to have a clear graphical representation of these phenomena and with the use of waterfall, it is possible to visualize and analyze in real time all the received signals including interferences. But being able to make a cataloging is quite difficult if 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!!

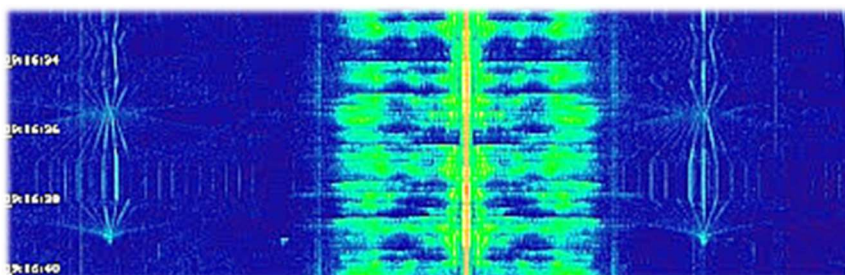
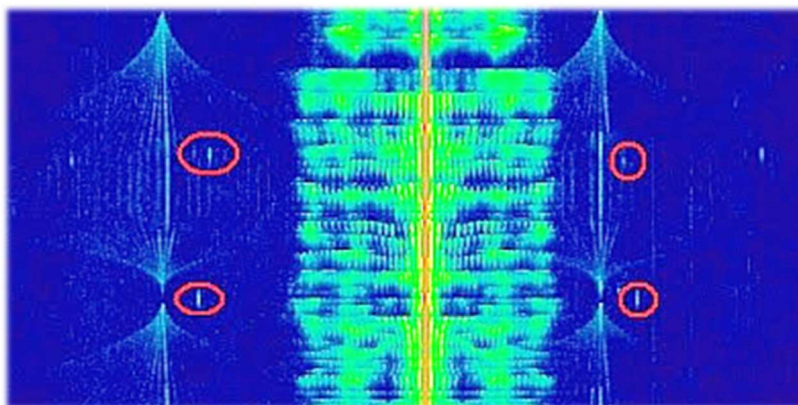


Very unstable speech transmission on 145 MHz

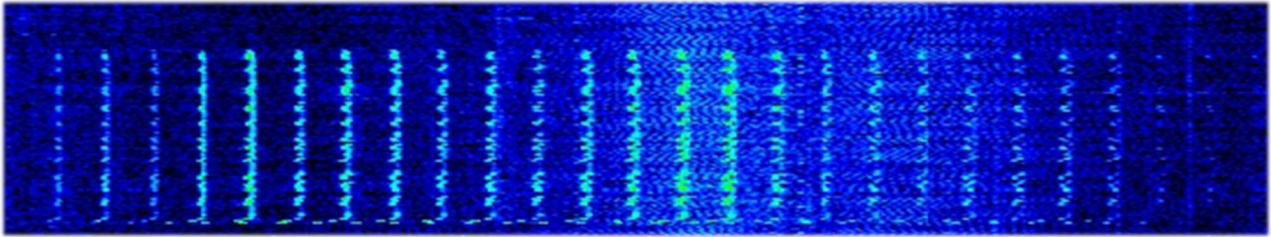


MW signals from the ...Umbrella Corporation?

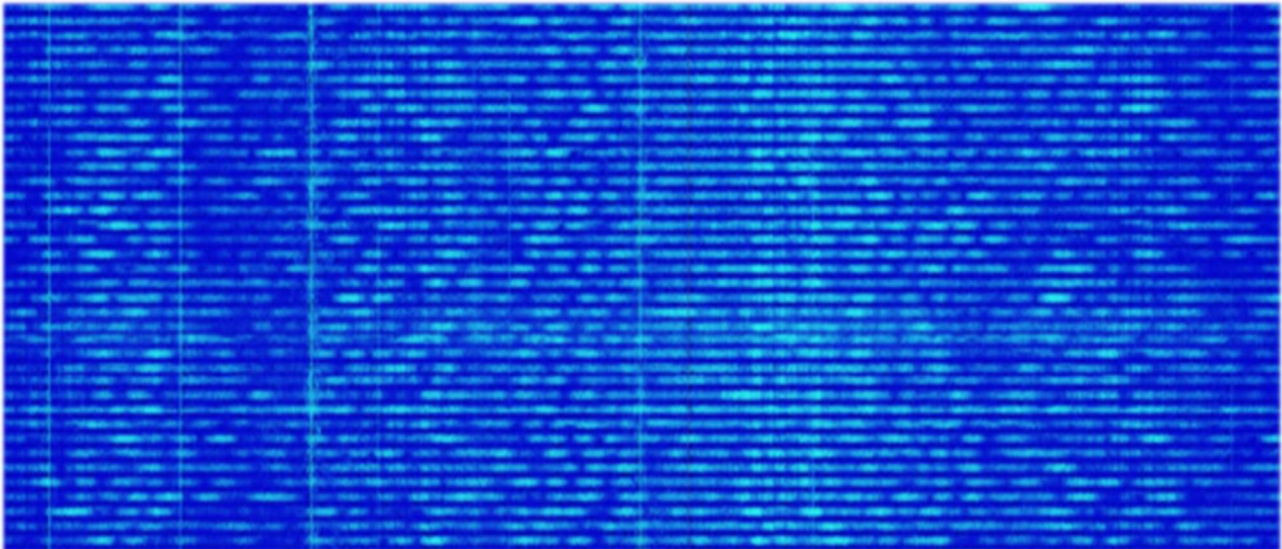
While listening to my local medium wave station I came across some unknown specular signals in the 999 kHz vicinity. Demodulated in USB by ear it sounded like a low audio note that gradually extended its frequencies to open up like a digital umbrella. I had to increase the contrast of the following images 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.



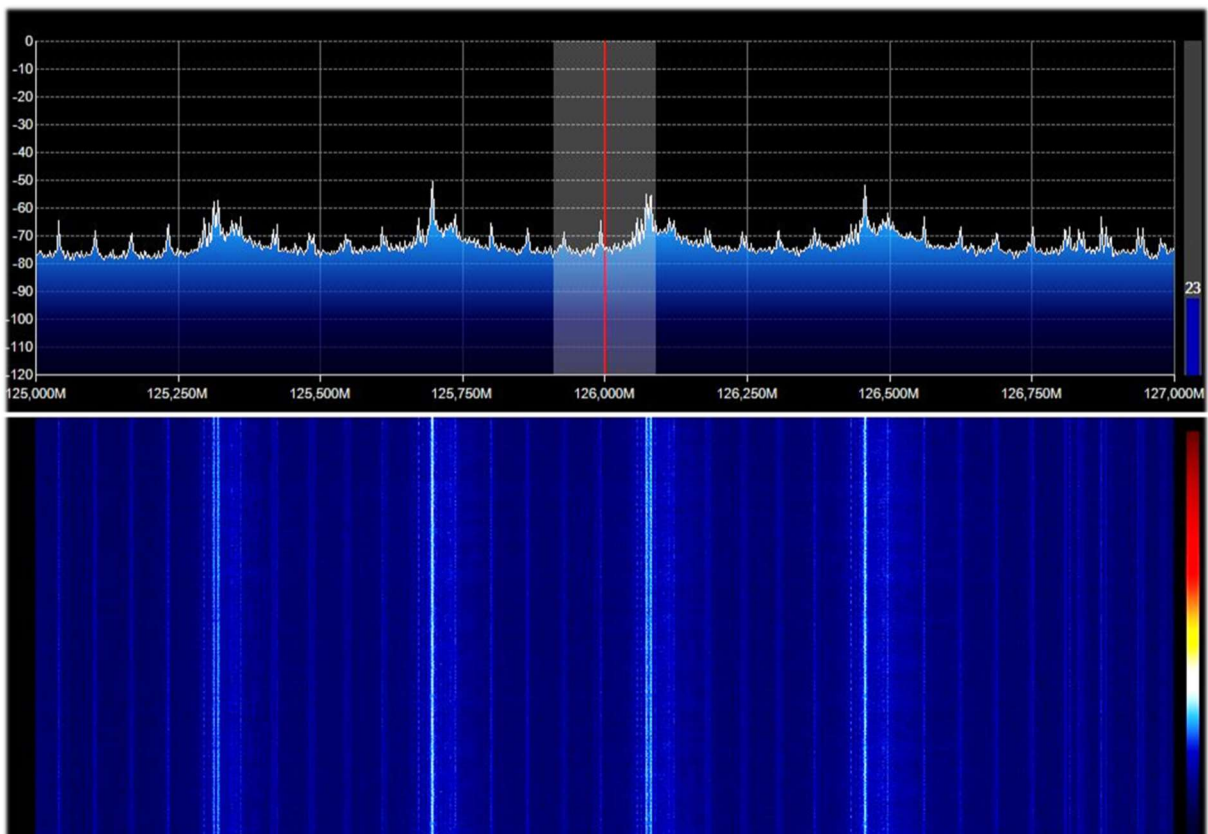
Continuous HF noise from 1.0 to 5.0 MHz from my Atlantis desktop PC power supply.



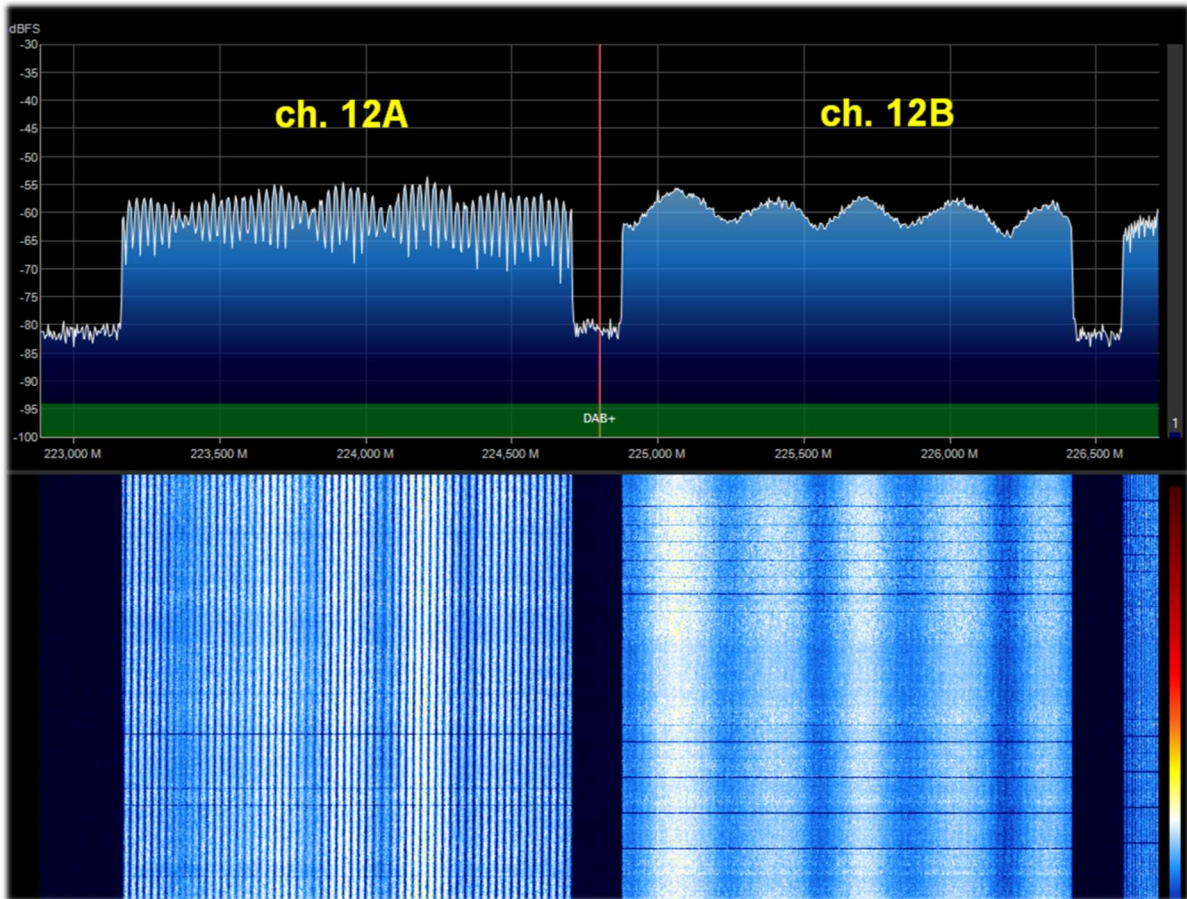
A strange and dense array of signals appeared on HF for a few days between 11 and 13 MHz, perhaps one of the many OTH - Over the Horizon radars?



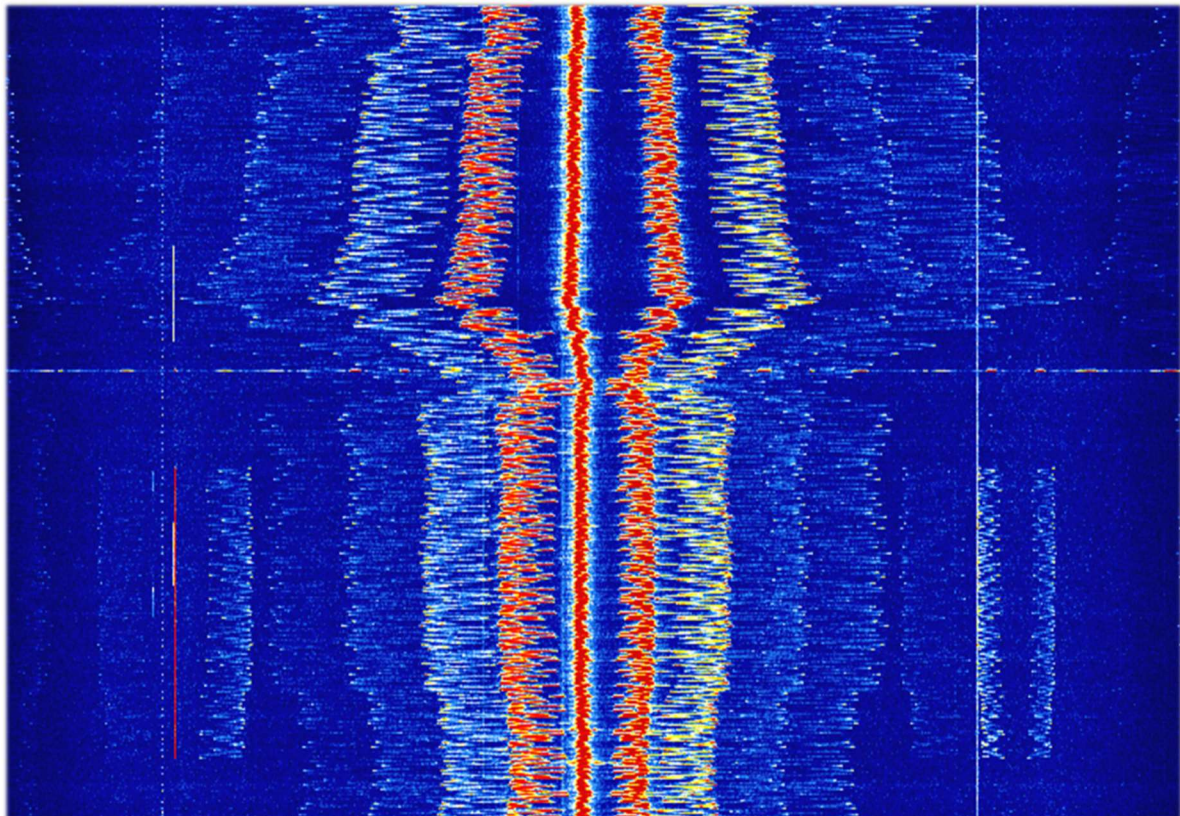
What about these? All noises coming from the USB or the laptop's internal power supply?



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



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

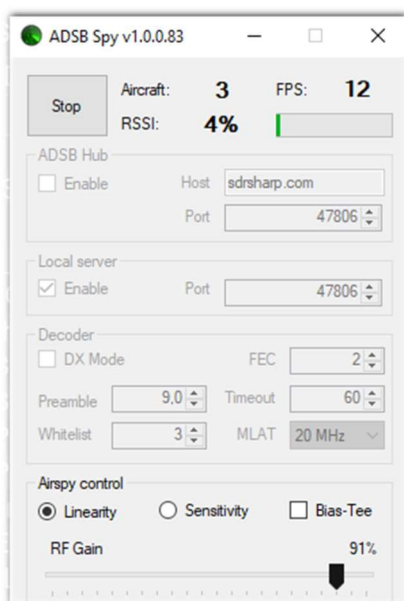


ADSB, Astro and Spectrum Spy

Until revision 1784 (which can still be downloaded from the link on page 13), the distribution included some standalone utilities **for use with Airspy devices**, which many of you will remember and which can still be used today. For a bit of amarcord, let's take a brief look at them.

ADSB Spy v1.0.0.83

This valuable tool is used for real-time reception of aircraft transponders on the nominal frequency of 1,090 MHz. It would require a dedicated antenna and possibly little and good coaxial cable, but you can initially try with a discone or a VHF/UHF bibanda but better would be to design a small dedicated collinear copper or brass alloy that offers good gain and reception in the range of a few hundred kilometres ... Please refer to the link: <http://www.radioamatoripeligni.it/i6ibe/ads-b/ads-b.htm>



The ADSBSpy interprets the ADSB data received from the device and redirects them to the decoder software for appropriate display on maps (in graphic and table format).

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:

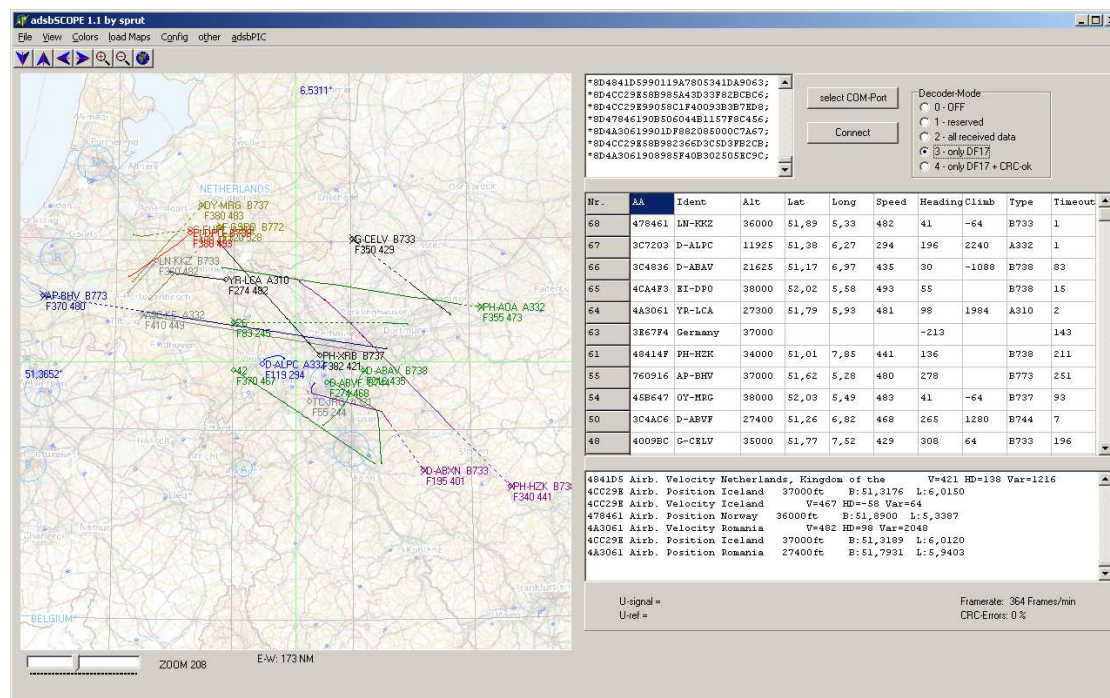
adsbSCOPE (see screen): http://www.sprut.de/electronic/pic/projekte/adsb/adsb_en.html

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.

At the time of writing, developers Youssef and Wiedehopf are working on a new version of ADSB for Airspy, which seems to give the best performance of all ADSB receivers.





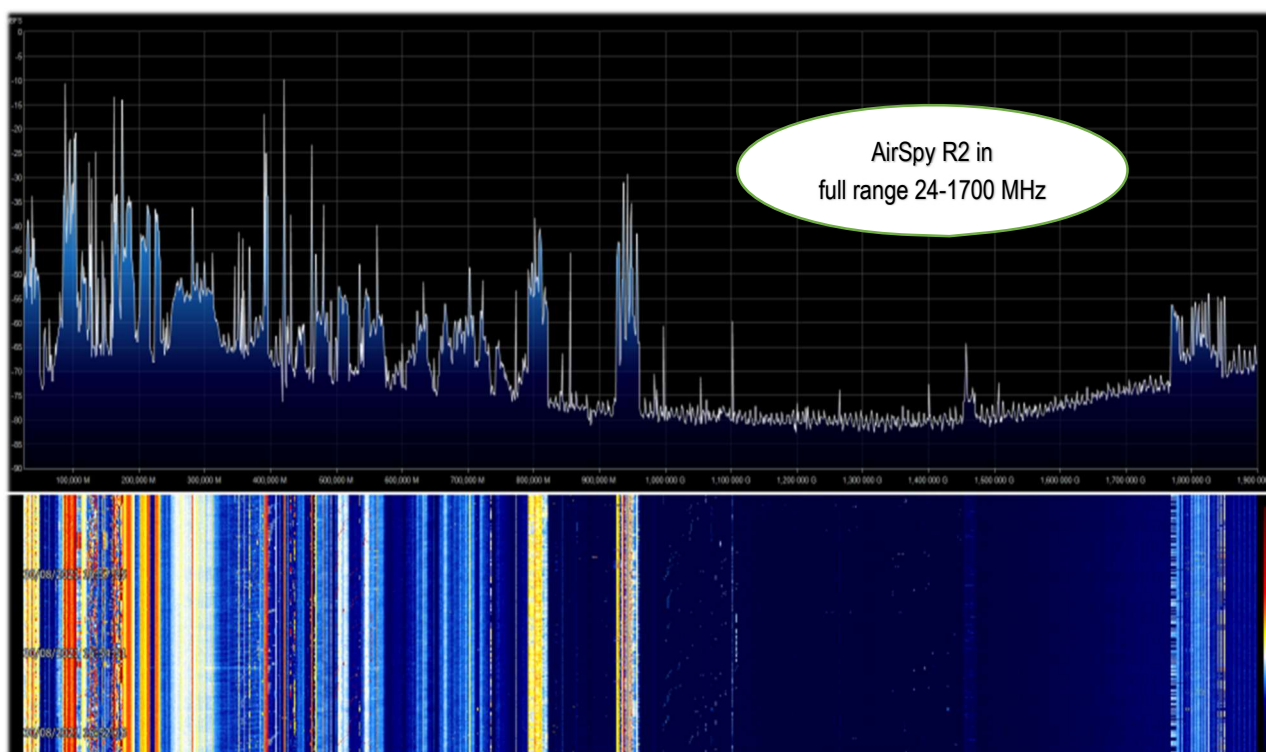
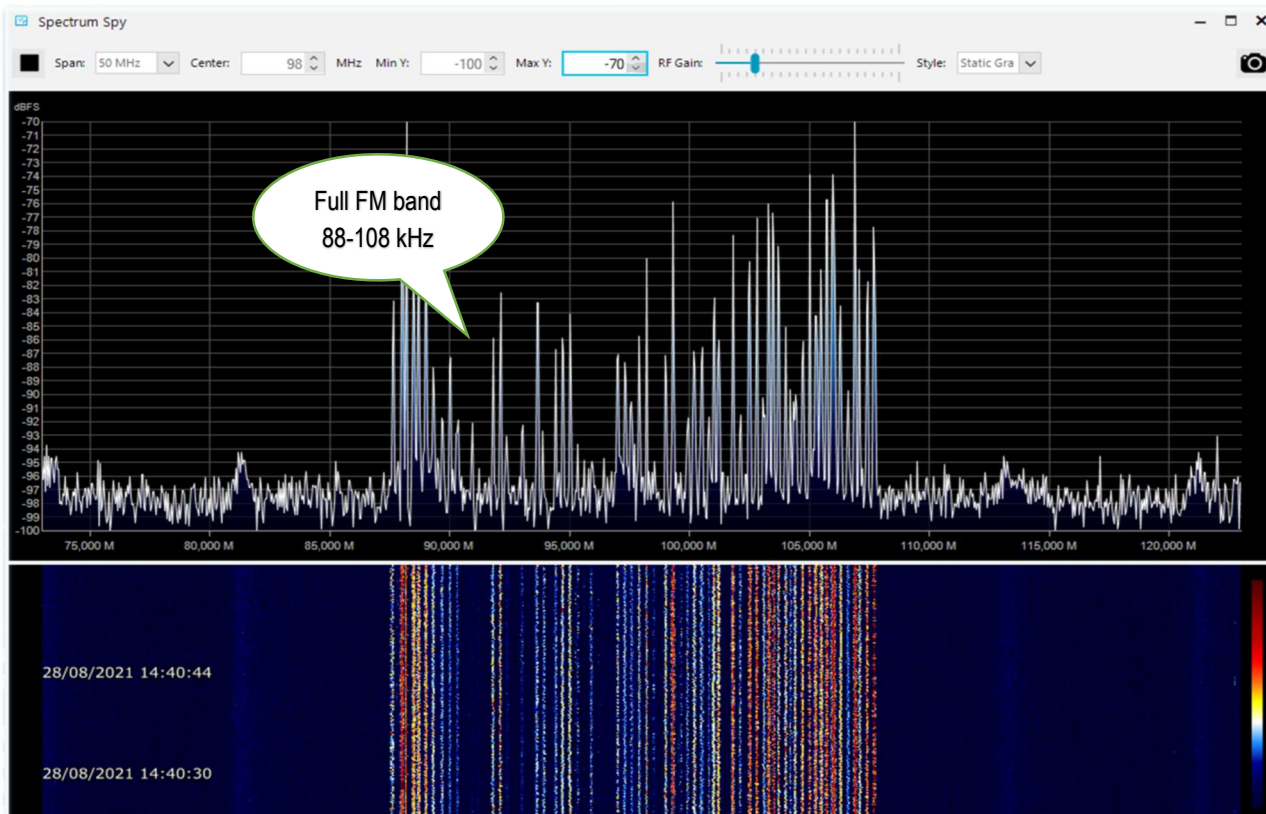
Astro Spy

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.

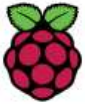
Spectrum Spy

The Spectrum Analyser allows the display 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. <i>The combination of Span / Center allows the best analysis of the signal in the desired range.</i>
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.



Raspberry Pi



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!

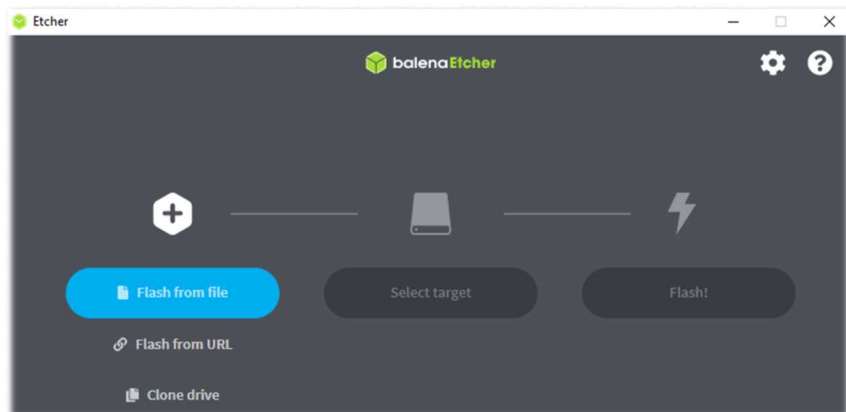
There are certainly other ways, and I will describe one of them in detail, which has led to excellent results, even though it will be the most challenging chapter, and with some possible criticalities. Those who know Linux well can try it differently by following the indications given here: <https://photobyte.org/raspberry-pi-running-spy-server-as-a-service/>

Prerequisites:

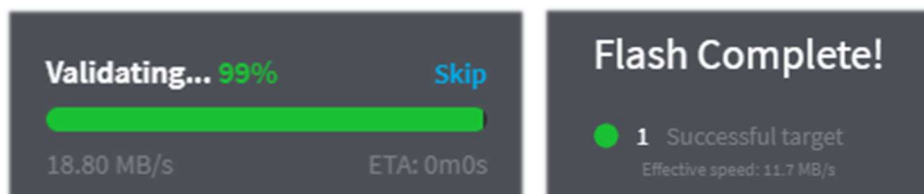
- **Raspberry Pi (with power supply, monitor and keyboard)**
- **a microSD card (of at least 8 GB)**
- **software PiDSR (image file):** <https://github.com/luigifcruz/pisdr-image/releases/tag/v5.0.0>
- **portable BalenaEtcher (for flashing the microSD):** <https://www.balena.io/etcher/>

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:



The image has now been created and verified (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 (*if 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:



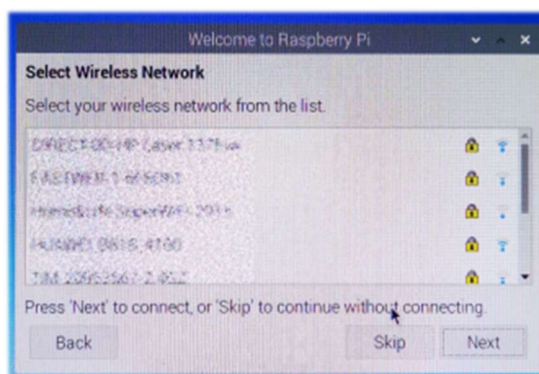
1) Welcome



2) Choose country and language

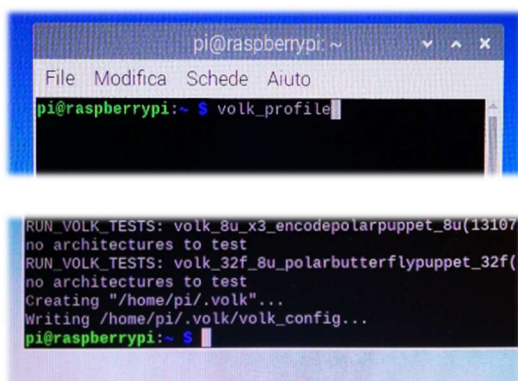


3) Change password



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...

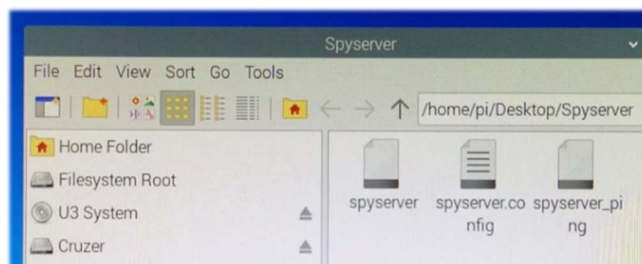
At this point, our new operating system is almost ready. All that remains is to connect to the Airspy website using the "Web Browser" (second icon on the top left), and download



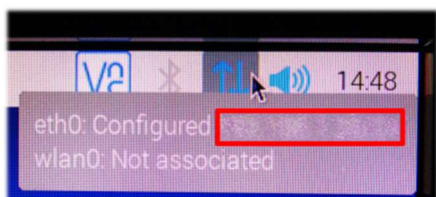
to the desktop the file “**SPY SDR Server for 32-bit ARM boards**” from the following link:
<https://airspy.com/?ddownload=4247>

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..

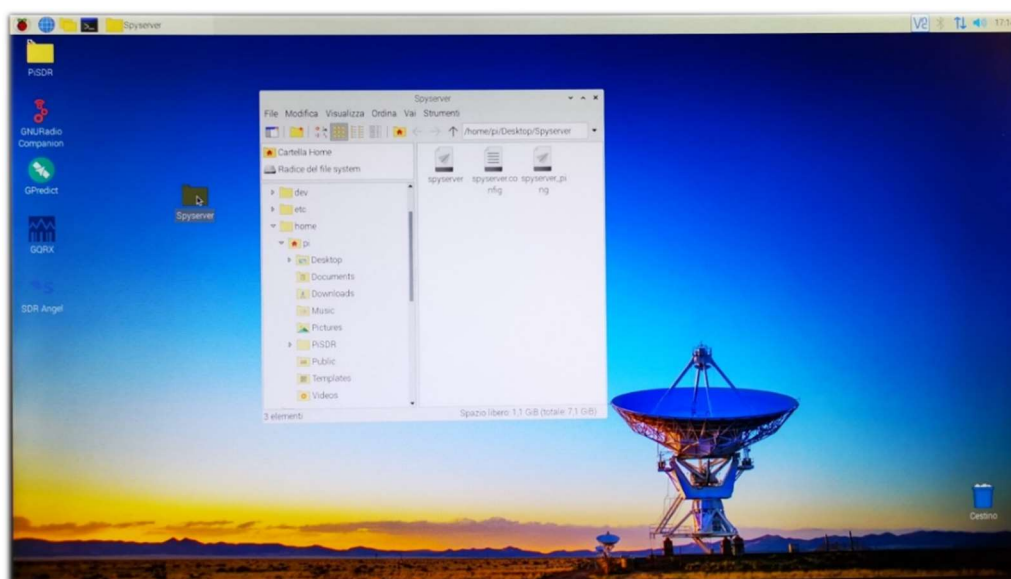


For the moment, I disabled Bluetooth and Wireless from their respective blue icons in the menu at the top right... Instead, I wrote down the number of the IP address assigned by the system that appears by hovering the mouse over the Wireless icon at the top right "eth0: Configured xxx.xxx.xxx.xxx".



We will need it shortly afterwards...

Now we need to edit the file "**spyserver.conf**" 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
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 the 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)
```

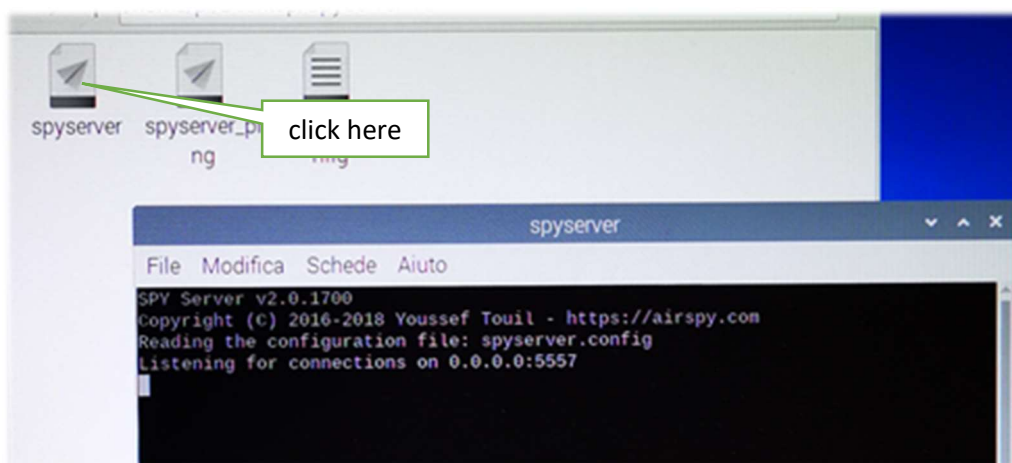

The "Device Type" group has these choices (so indicate your own instead of xxx)

```
# 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)

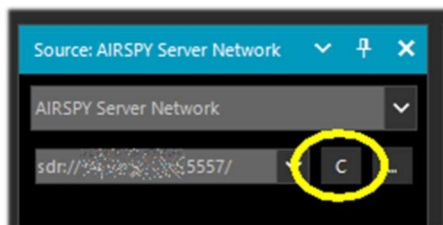
```
# Device Sample Rate
# Possible Values:
# Airspy R0, R2 : 10000000 or 2500000
# Airspy Mini   : 6000000 or 3000000
# Airspy HF+    : 768000
# RTL-SDR       : 500000 to 3200000
#
device_sample_rate = xxx
```

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!

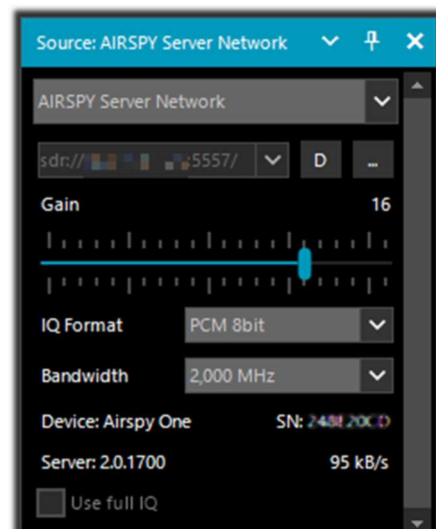
Now from the laptop that I have decided to use as SDR# Client (wirelessly connected to my home network) it will be necessary to activate the Source field "AIRSPY Server Network" by typing under my **IP address (previously marked) : port number**, and then press the "C" button.



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

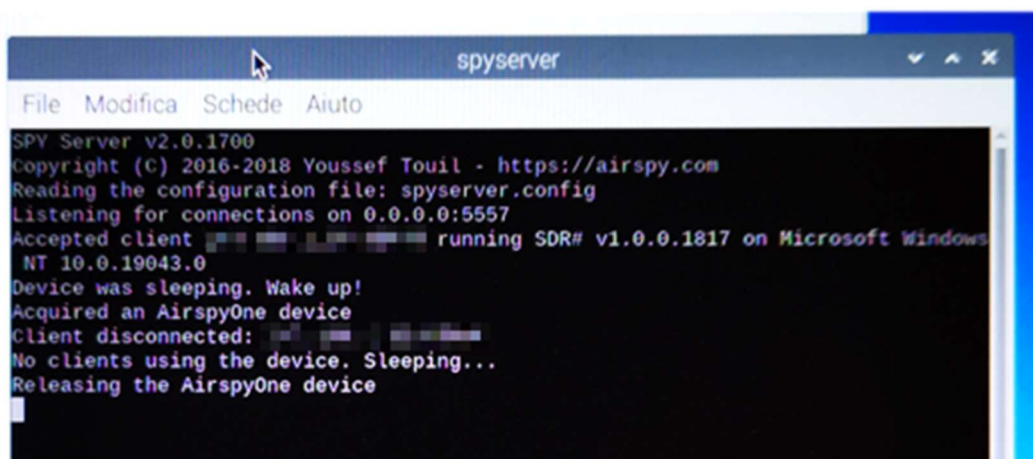
normally: audio, decoding and functionality will be practically the same. For the other options already discussed please refer to the AIRSPY Server Network chapter.

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.



If you want to find out about how much RAM your Raspberry, you can run the command from the Terminal: **free -h**

Or even the much more comprehensive HTOP utility by running it from Terminal: **sudo htop**
To close it, press together: **CTRL + C**

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.

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

(*) Mini glossary

ADS-B - Automatic Dependent Surveillance - Broadcast
AF – Alternate Frequencies (RDS)
AGC – Automatic Gain Control
AM – Amplitude Modulation
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 – Enhanced 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 ($10^3 * \text{sps}$)
LF – Low Frequency (30 / 300 kHz, kilometric 10-1 km)
LNA – Low Noise Amplifier
LSB – Lower Side Band
mA – milliAmpere (submultiple Ampere-ora)
MF – Medium Frequency (300 kHz / 3 MHz, ettometric 1 km-100m)
MPX – Multiplexing
MSC - Main Service Channel (DAB)
MSPS - Megasample per second ($10^6 * \text{sps}$)
MUX - short for "Multiplex", technique for transmitting digital radio/TV signals
MW – Medium wave
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)
QTH – amateur radio Q code indicating own geographical position
RAW – unprocessed data
RDS – Radio Data System
RF – Radio Frequency
RT – Radio Text (RDS)
RTTY – Radioteletype
SAM – Synchronous AM
SMA – SubMiniature type A (coaxial connector)
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)
VLf – Very Low Frequency (3 / 30 kHz, miriametric 100-10 km)
WEFAX – Weatherfax
WFM o **FMW** – Wide Frequency Modulation

Conclusions and quotes

If this guide 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

When faced with an obstacle, the shortest line between two points can be a curved line – B.Brecht

There are some things you learn best in calm, and some in storm – W. Cather

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

You do not possess what you do not understand – J.W. Goethe

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

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

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

