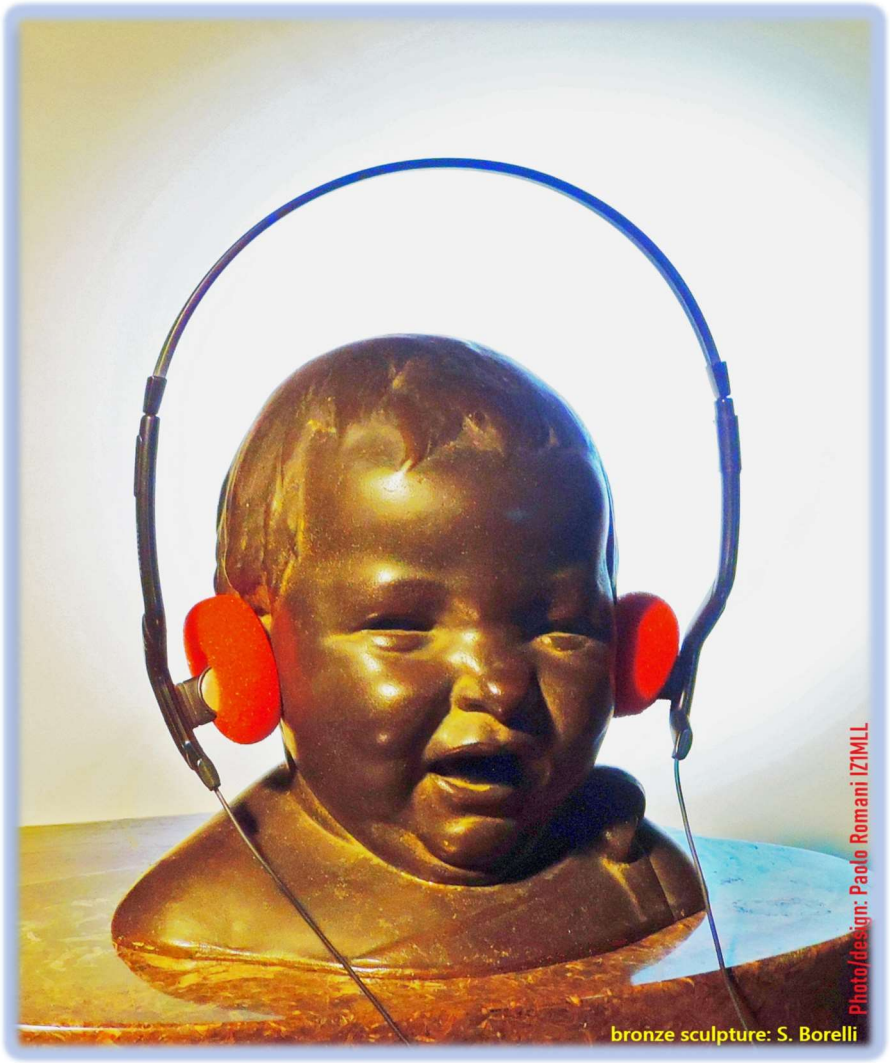
SDRsharp

The Guide

AIRSPY



SDRsharp, to make black and white listeners see colours...

Update to release 1.0.0.1804

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*.

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, performing, integrated, updated and customisable (with plugins for every need) freeware software 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/**

Contents

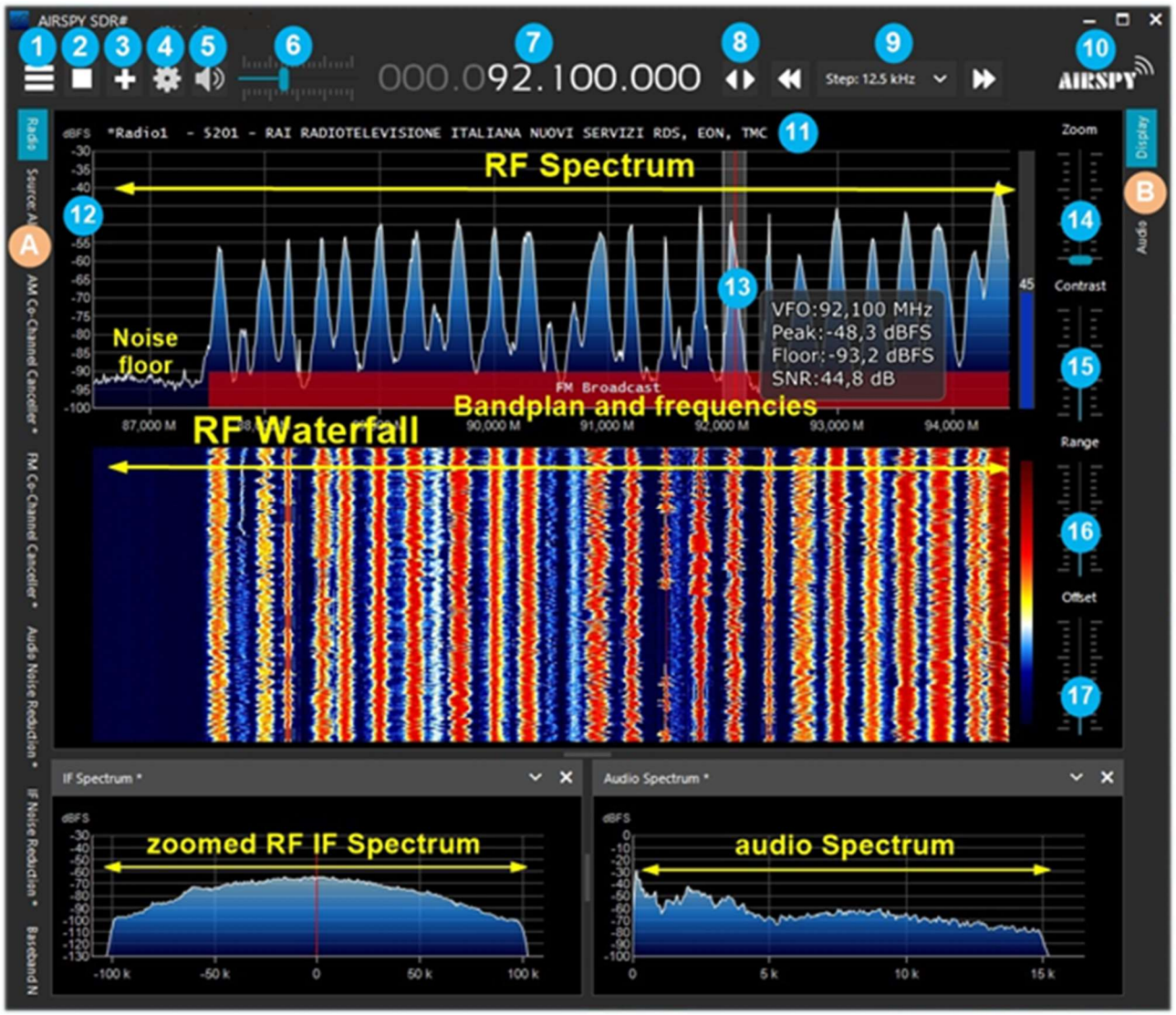
News: the release 1785, officially released on February 5, 2021 in a continuing and perpetual quest for improvement and refinement, has made a big leap to Microsoft's latest .NET 5. This multi-system, open source development platform is capable of supporting side-by-side execution without the need to 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).

Main screen



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

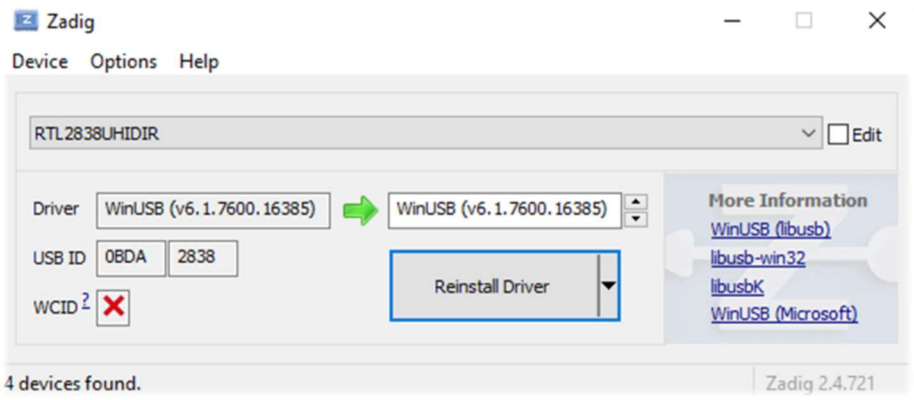
A. Left Menu (example: Radio, Source, various plugins) – since revision 1778
B. Right Menu (example: Display, AGC, Audio) – since revision 1778
1. Main Menu (in jargon as “hamburger menu”)
2. Start/close the program
3. Opening new session (slice) – since revison 1741 and new update
4. Device configuration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

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 obstruct the signals...

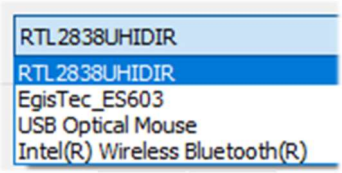
Dongle RTL-SDR’s configuration

The general rule of thumb for all of the following setups is that the default settings work and any changes require a good understanding of the underlying algorithms and own hardware.
Plug one of the many available dongles (with R820T/T2 or R860 chip, E4000, FC0012/13) into a USB port.

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



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



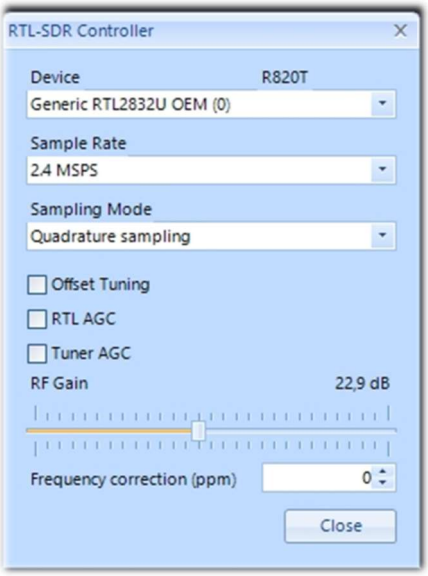
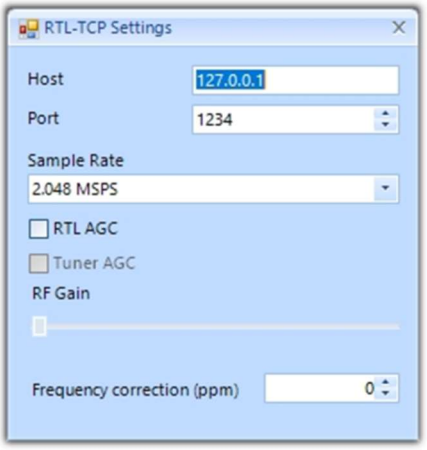
Proceed by clicking the INSTALL DRIVER or REINSTALL DRIVER button (if you have already done so). You can also try connecting your USB dongle after Zadig is running, as the list is automatically updated by the system.

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

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

Sometimes some dongles are not immediately recognised by the O.S., or rather a pair of devices that make up the dongle is shown but with other names, namely "Bulk-in, interface 0)" and "Bulk-in, interface 1)" which is for TV remote control functions. You then choose "Interface 0" with the target "WinUSB" and click INSTALL DRIVER.

If you still don't see your device you have to go to Control Panel / Windows Device Manager and remove those devices marked with a triangle and start again.

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

AirSpy

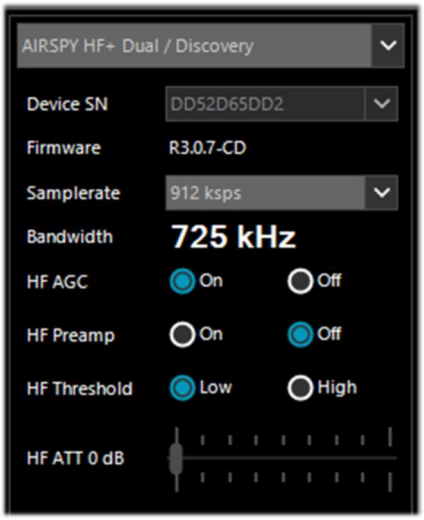
The AirSpy product family is now grown up, with receivers and options for every need:

- **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

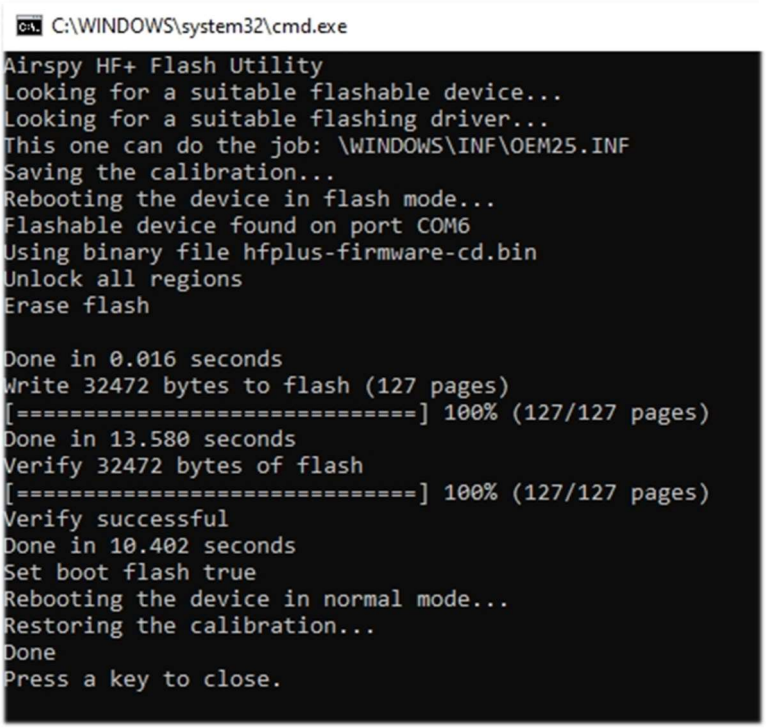
Panel	Feature
	**Device SN** – Serial number of your device. **Firmware** – Indicates the firmware version installed on the device (see firmware upgade procedure below). **Samplerate –** Allows you to choose the sampling rate: from a minimum of 14 ksps to a maximum of 912 ksps. **Bandwidth** – The bandwidth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

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

“AirSpy HF+ Dual / Discovery” firmware update

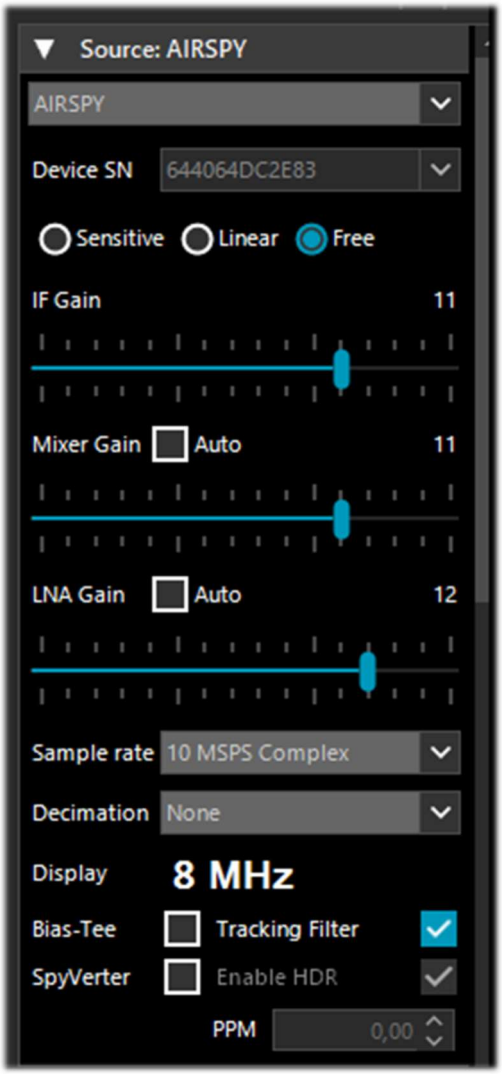
The firmware update procedure should be carried out under Windows 7 or Windows 10. Make sure you do not have any other AirSpy devices connected to your computer and follow these steps:

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



The current and latest firmware version R 3.0.7 (dated 4 June 2020) has improved USB streaming performance and two additional new samples at 456 and 912 ksps have been added. It can be applied to device HF+ Dual port, HF+ Discovery (BB and CD).

"AirSpy R2 / Mini" panel

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

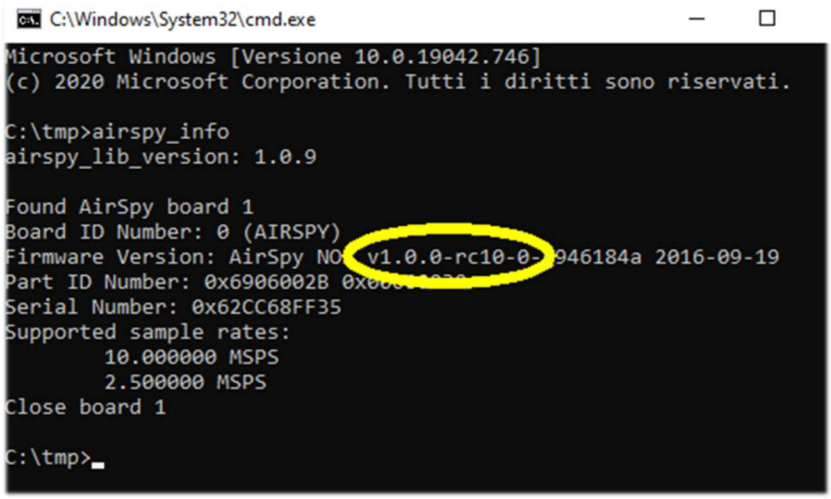
"AirSpy R2 / Mini" firmware update

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

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

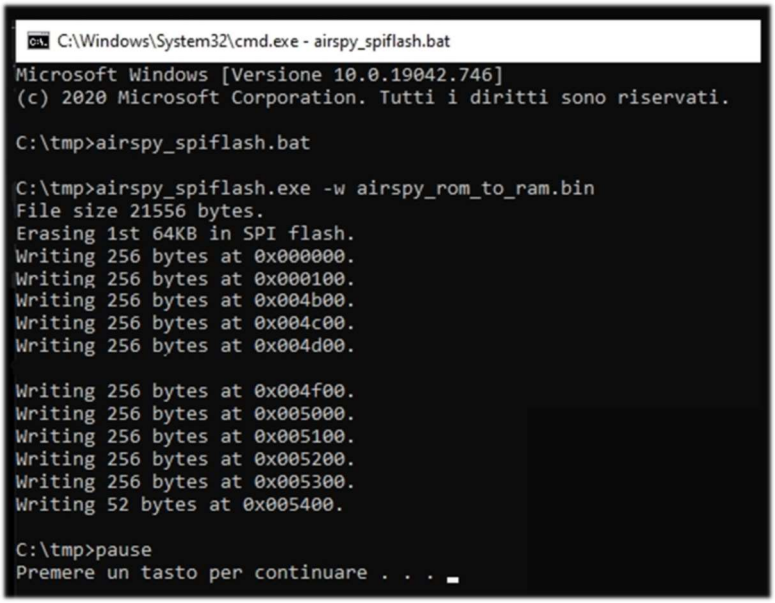
Start by extracting the content into a temporary directory (e.g. C:\TMP)

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



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

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



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

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.

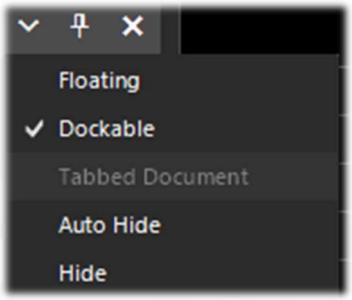
The following adjustment procedure ensures that you get the maximum SNR (Signal-to-Noise Ratio) on what you receive while preserving dynamic range:

- 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.

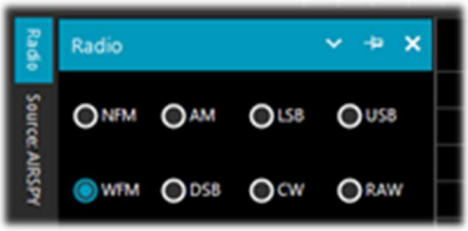
The A and B menus are all dynamic, you just need to position them on top to open them... For the various panels, in the upper right part, some options relating to the positioning of the windows: Windows State, Auto Hide, and Close Windows.

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

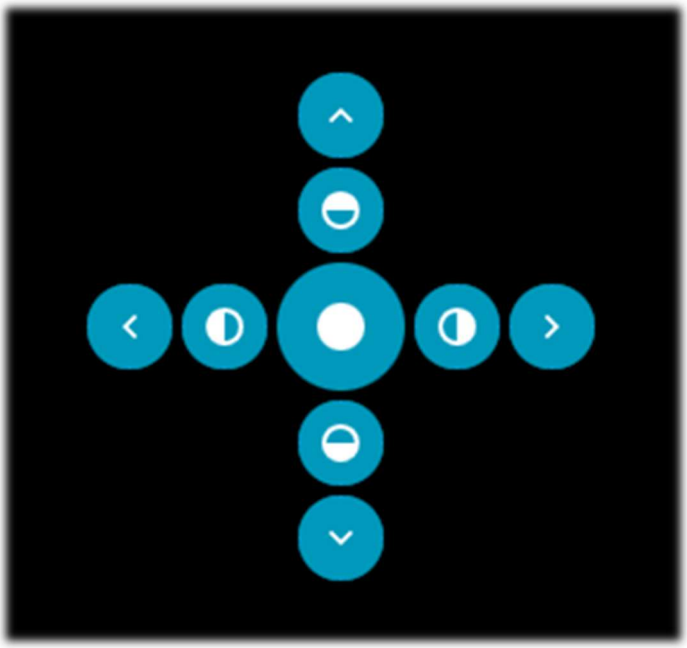


Floating – The panel window can be released from its current position and is free to be positioned anywhere, even outside the main program window.
Dockable – The window is anchored to the main panel.
Auto Hide – The panel window is reduced to a minimum and is opened by positioning the mouse over it.
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).

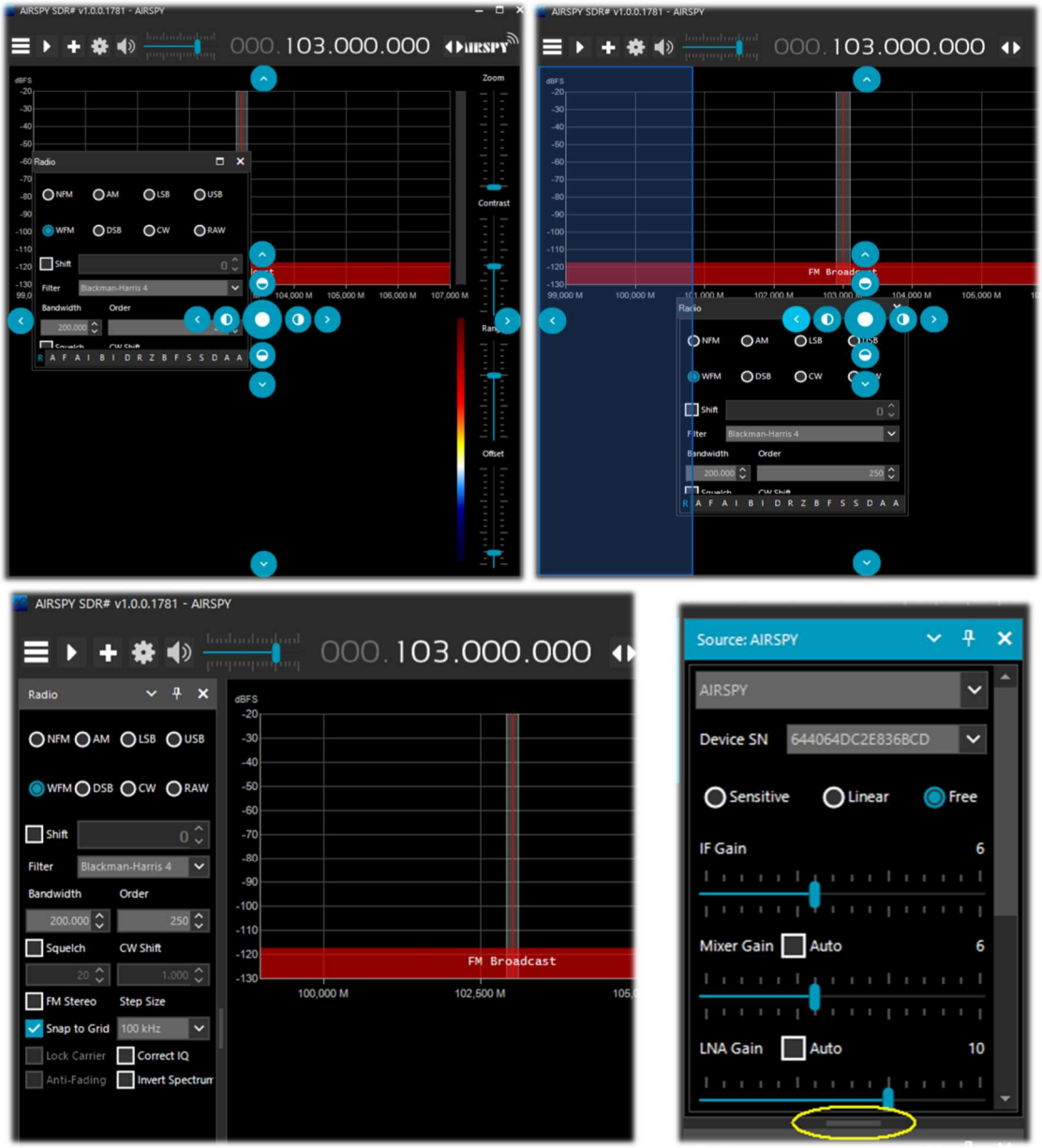


 icon for the outer left side positioning

 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

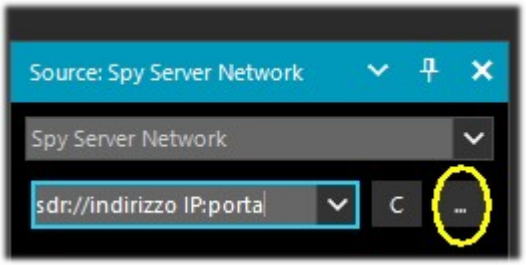
Revision v1777 (with collapsible panels)
https://airspy.com/downloads/sdrsharp-x86-collapsible-panels.zip

Revision v1784 (last build dotnet 4.x)
https://airspy.com/downloads/sdrsharp-x86-dotnet4.zip

Spy 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 you only need to select the "Spy Server Network" item in the Source panel. Click on the highlighted "Browse Spy Server Network" button, this will open an internet page where you can see the various active clients (those with green icons) in HF and V/UHF.



To connect, click on the IP address that appears on the left-hand side to launch it directly into SDR# and make the connection. To close the session, press the "D" button (Disconnect).

The 'full IQ' option allows streaming of the entire spectrum provided *you have sufficient network bandwidth and a high-speed connection.*

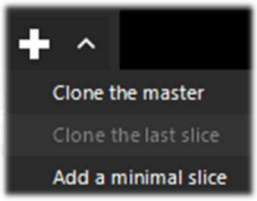
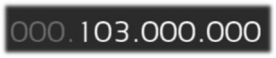
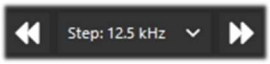
To create your own Spy Server, you must edit the file 'spyserver.config' with your own data. The starting point is to know your static IP and to check that the ports are open and not blocked by firewalls/antiviruses.
For the port, configure your router or ask your Internet provider for information. You 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 "Spy Server Network" enter our IP address and port. Press the "C" button (Connect) and if everything worked, you are in remote...

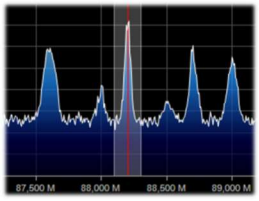
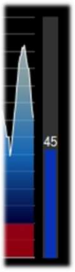
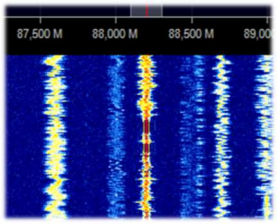
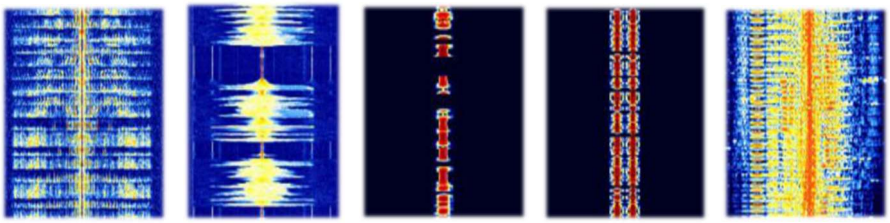
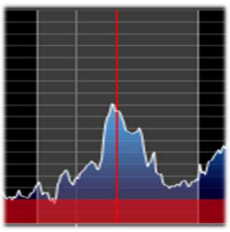
For the **SpyServer Client**: *Instead of using the Zoom on reduced spectrum data, ask a lower bandwidth to the server and it will send you a high resolution, lower bandwidth version of the FFT. The Zoom bar is left for convenience.*

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. *The check mark preceding some items is a "visual reminder" of the activation of some options inside (example "audio or service enabled").*
Start **Stop**	With this button you start / turn off the SDR# software.
New slice (VFO)	This button can be used to open one or more new SDR# sessions *(not just present in the "Spy Server Network")*. The "slice" is a separate session showing a portion of the spectrum of the "master" with full separate controls,

	but still in the sampled portion of the band. *For example, it is not possible to open a session in UHF if the "master" receiver is tuned to VHF. Attention: with the introduction of this function from revision 1741 the previous Aux-VFO plugins (which used the same internal DSP algorithms) are no longer usable. To reduce CPU usage, disable the slice you do not need and minimise its bandwidth*. You can choose to duplicate the "master" session completely or open a minimal session. *New sessions will have different colours in the RF Spectrum bandwidth to identify them visually at a glance.*
Configuration menu 	Configuration menu of your hardware and settings: gain, sample rate, bandwidth, RF, PPM controls, etc.
Volume 	Activates / deactivates the volume, which you control (with the slider on the right) the desired output level to the speakers or external device *(example to a VAC Virtual Audio Cable). It is useful to remember that if you use external software decoders for digital systems (e.g. DSD+), the volume control should be adjusted accordingly to have an optimal output signal level (and minimum errors).*
Input and VFO frequency 	The frequency input is represented in 4 sections (000.000.000.000). The first section from the left represents the values in GHz, the second the MHz, the third the kHz and the fourth the Hz. In the example to tune 103 MHz the input must appear as 000.103.000.000 while if you want to tune a frequency e.g. in MW at 999 kHz, in addition to needing an up-converter (or the optional unit AirSpy Spyverter) you must enter 000.000.999.000 • *Move the mouse over the first digit that you want to impute (without clicking) and enter all the numbers that make up the frequency and confirm with the Enter key. This is the input I prefer! For example, you stand where the arrow points and type in the number 103*  *followed by Enter. Quick and easy.* • *Left click on the top of the digits (a small red rectangle will appear) to advance one unit* • *Left mouse click on the bottom of the digits (a small blue rectangle will appear) to decrease by one unit* • *or on the desired digit by turning the mouse wheel on it.* • *Right click the mouse to bring a digit to zero and reset all the ones to the right of it as well* • *UP / DOWN arrow keys change the digit* • *The Right/Left arrow keys move along the section in the input*
Tuning types	 **"Free tuning"** - free tuning throughout the range, by clicking anywhere in the RF spectrum or waterfall, the receiver will tune it, also changing the below frequency range indication.  **"Sticky tuning"** - the frequency remains "connected" to the VFO and you can scroll the frequency bar left and right by "hooking" it with the left mouse button.  **"Center tuning"** - the tuned frequency will be always displayed in the center of the RF spectrum and waterfall.
Step bar 	By selecting the appropriate step (expressed in kHz) in the center of the option, you can then easily scroll through the frequencies by simply clicking on the double arrows on the side. (See relevant section below).

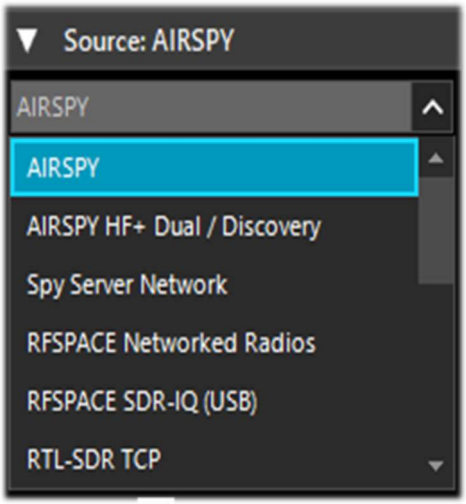
RF Spectrum 	In this window the RF Spectrum is shown visually as a real-time graph. The active signals appear as peaks of greater or lesser intensity. The lower part represents the "noise floor. *A recently introduced feature is the "peak Color" which is activated by clicking with the right mouse button on the Spectrum window, where a yellow line of persistent memory relative to the received signals will appear. It is possible to modify the color by changing the following line:* *"SDRSharp.exe.config": "spectrumAnalyzer.peakColor" value="FFFF00"*
SNR meter 	On the right side of the RF spectrum there is a vertical bargraph that shows the SNR value (in dB). The Signal-to-noise ratio is a numerical quantity that relates the power of the useful signal to the the noise in the system. In the case of analog transmissions, a decrease in SNR causes a gradual deterioration of the received signal, which is still receivable and understandable. In digital transmissions instead there is a minimum threshold of SNR below which the system no longer works for too many errors received. *There is no S-meter to detect the signal strength, intended as an S-unit and mainly used in the radioamateur world.*
Waterfall 	This window shows the graphic representation in real time of the intensity of the received signals as a function of frequency (on the horizontal axis) and time (vertical axis) with the new data represented in cascade starting from the top and going down: hence the name waterfall. *This representation is a great help to learn about the various types of signals visually. A trained eye detects and recognizes an interesting signal at first glance, even if it is weak and in the midst of disturbances, because each signal has its own "footprint", as well as electrical noises of all kinds !! Here are some examples of signals:*  AM FM CW RTTY SSTV *To more easily recognize the numerous types of signals and modulations I recommend the freeware software ARTERMIS 3 that collects and catalogs several hundred of them, also providing a sample audio playable:* ***https://aresvalley.com/Artemis***
Tuning bar 	The vertical red line in the center of the RF spectrum windows shows which frequency is currently tuned the receiver. The inside of the gray rectangle is the active bandwidth (or BW) that can be changed by simply dragging the left/right side of the rectangle. *The bandwidth must be set so that it covers the area of the tuned signal (not too wide or too narrow, especially when receiving digital signals).*

..... Default panels .....

The following are the default panels provided with the software installation. All other so-called "plugins" must be installed separately by the user (see the relevant section below).

"Source" panel

Choose your hardware from the drop-down list:

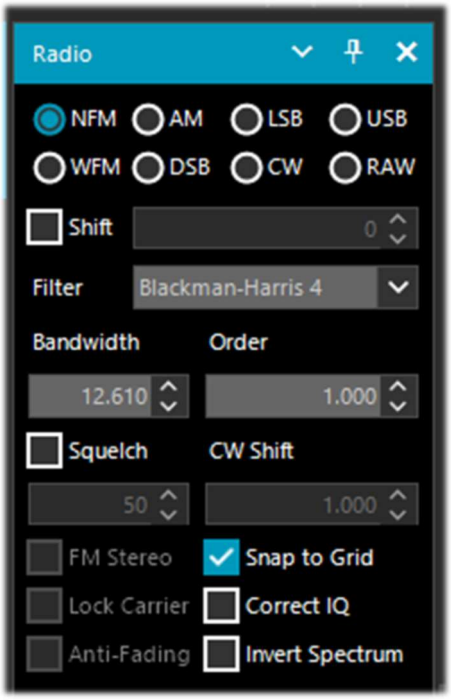


- AIRSPY for device: AirSpy-R2 e Mini
- AIRSPY HF+ Dual / Discovery
- Spy Server Network (see appropriate paragraph)
- RFSPACE
- RTL-SDR USB or TCP
- HackRF
- Afedri
- Funcube Pro/Pro +
- Softrock (Si570)
- UHD / USRP
- Baseband to load and play I/Q files. See below the "Recoding" panel.

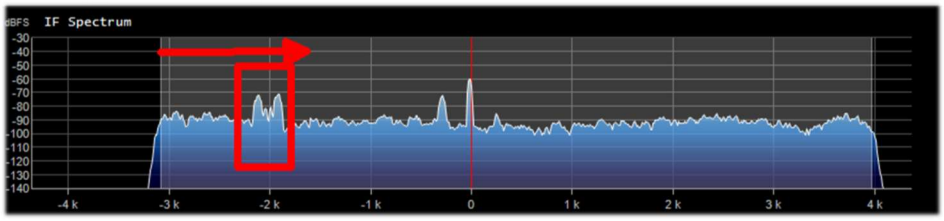
For AIRSPY there are then to adjust: Gain controls (IF, Mixer, LNA in a simplified or specific way Sensitive/Linear or Free), Sample rate, Decimation, Bias-Tee *(this option should be used carefully as it sends 5 volts via SMA antenna connector to additional optional accessories),* SpyVerter which allows 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" panel

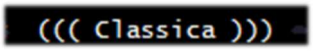
In this panel you select the various types of demodulation for the tuned frequency, Bandwidth, Squelch, Step Size, etc…



Mode	Features
NFM – Narrow Frequency Modulation	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 – Wide Frequency Modulation	This is the mode used by FM stations (88-108 MHz band). *For stations with Radio Data System, in the upper part of the Spectrum RF, on the left (see item 11) there is the dynamic decoding of some codes RDS that carries a lot of informations:* ➢ *PI, Programme Identification. Unique four-character alphanumeric code that identifies the radio station.* ➢ *PS, Programme Service. They are eight characters used, usually, to send the name of the radio also in a dynamic way.* ➢ *RT, Radio Text. It allows to send free text from radios such as, for example, the author and the title of the song on air.*
AM – Amplitude Modulation	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 – Lower Side Band / Upper Sideband	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 – Continuous Wave	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 – Double Side Band	Use similar to AM but allows a higher modulation performance by suppressing the carrier and transmitting only the sidebands. *It can be used to tune stations with interference (together with IF Spectrum window where you can best configure the signal window by*

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

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

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

"AGC" panel

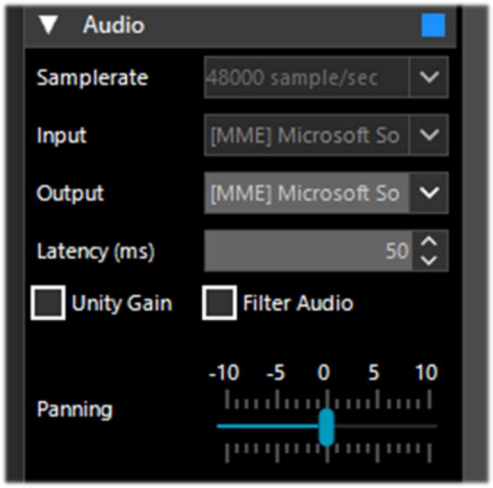
The function of AGC (Automatic Gain Control) acts in real time on the amplification of the input signals by varying it in order to obtain an optimal level on the output on low signals and avoiding distortion on high signals.

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

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

"Audio" panel

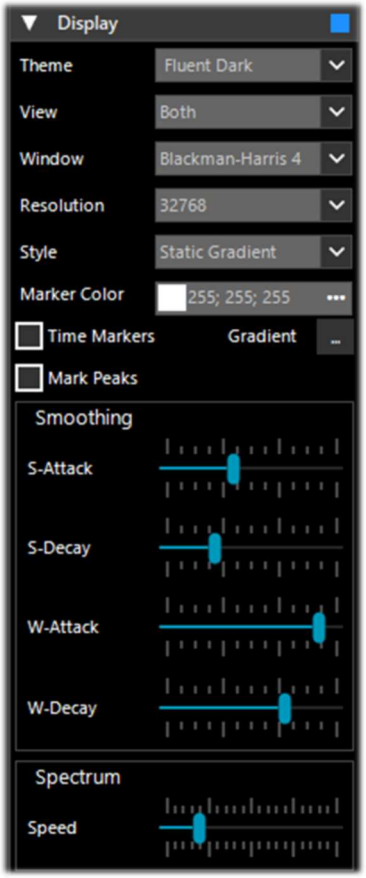
This panel adjusts the settings for audio processing.



Key	Default	Features
Samplerate	48000	Sets the sampling rate of sound card. Some decoding software may require you to set a specific sample rate. Usually the default value at 48000 samples/second should be fine for general purposes.
Input	Sound card	The input sound card is highlighted in this field. *Normally it should not be changed. Automatically detecting your card even if you are using SDR sound cards such as: SoftRock, Funcube dongle, Fifi SDR, etc.*
Output	Speakers	In this field you can specify the audio output device. Preferably choose an output type [Windows DirectSound...], while [ASIO/MME...] may be better but sometimes it does not work.
Latency (ms)	50	The latency value (expressed in milliseconds) is the time between the analog-to-digital conversion of the input signal, its processing and the digital-to-analog conversion at the output. It is advisable to keep it as low as possible. *It is advisable to keep it as low as possible. The latest developments of SDR# (from revision 1783) have almost halved the CPU/memory load, while latency is at the edge of what the hardware can do: test with 2 ms and "Windows DirectSound" drivers… (not run with MME).*
Unity Gain	OFF	Normally it should be deselected as it sets the audio gain to the unit value of 0 dB.
Filter Audio	ON	Audio filter. *Improves the performance of speech signals by filtering the audio and eliminating hiss and DC noise. It should absolutely be deactivated when decoding digital signals (e.g. via DSD+ or DreaM).* ***The same applies to all other plugins (e.g. Audio Processors or Filters that act on the audio level), which must be absolutely deactivated when receiving digital signals (e.g. DMR, DSTAR, C4FM, satellites), otherwise they will result in incorrect decoding or dirty signals.***
Panning	0	Balances the audio between the left/right speakers.

"Display" panel

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

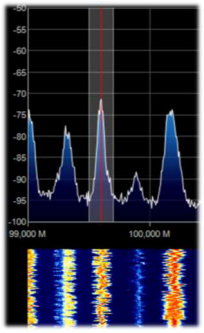
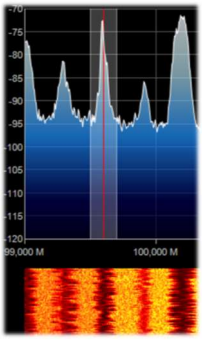
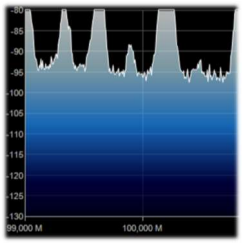


Key	Default	Features
Theme		Recently introduced with the latest graphic interfaces, allows you to choose multiple design layouts, many even in dark theme.
View	Both	Allows to set the display of the RF spectrum screen, waterfall, or only one of them, or none at all. *On older PCs it may be useful not to display the waterfall to avoid overloading the processing.*
Window	Blackman-Harris 4	Set the type of filter, *where each filter has a different response curve and characteristic*: the default of Blackman-Harris 4, it has balanced performance and is the best in most cases and should not be changed.
Resolution	32768	Increased resolution will improve signal quality in the RF spectrum display and waterfall. Using a higher resolution can be useful when fine-tuning, as you can better see the peaks and structure of the signal. *Be aware, however, that high resolutions can slow down the PC and can cause problems especially with older machines. Normally, if your PC can handle it, you should use at least the value of 32768.*
Time Markers	OFF	Displays a time indicator on the left side of the waterfall screen to date the signals transmission. *By definition it is set to 5 seconds.*
Gradient…		Allows to customize the colors used in the waterfall screen.
Mark Peaks	OFF	Allows to highlight a circular marker on each signal peak on the RF spectrum window.
S-Attack / S-Decay		Changes the uniformity and average of the received signals in the RF spectrum display. *Set them halfway.*

W-Attack / W-Decay		Changes the uniformity and average of the received signals in the waterfall display. *Set them halfway.*
Speed		Changes the refresh rate of the RF spectrum and waterfall. *Never keep it at maximum.*

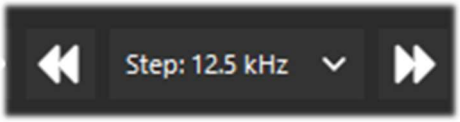
"Zoom Bar" panel

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

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

“Step Bar” panel

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. *You can choose from 29 steps between 1 Hz and 1 MHz or, the free tuning, by not flagging the first item "snap".*

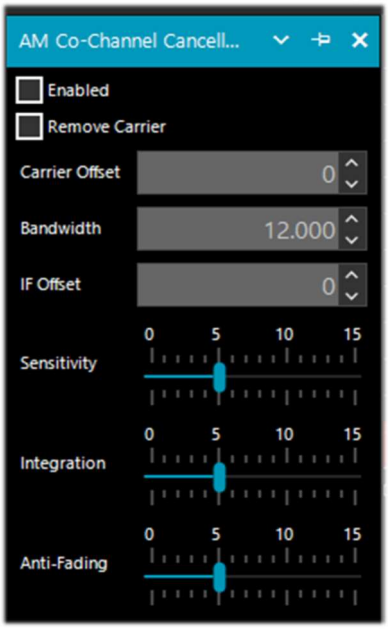
Another very interesting and fast possibility is to use the mouse: just position yourself in the Waterfall or Spectrum window and with the central wheel of the mouse rotate it forward to advance with the frequencies of the pre-set Step or on the contrary, rotate it backwards to decrease the frequency.

“AM / FM Co-Channel Canceller” panel

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 feature is unique and not present in other software and it’s a free addition to SDR#!

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…

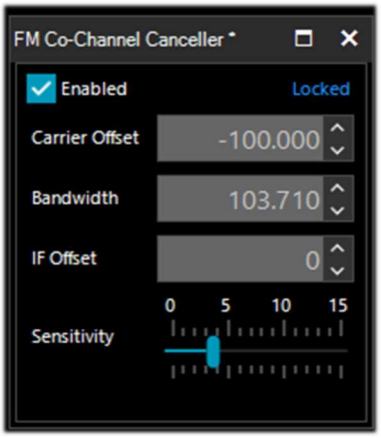
I will try to summarize the main steps, although they may vary slightly in your specific use:

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

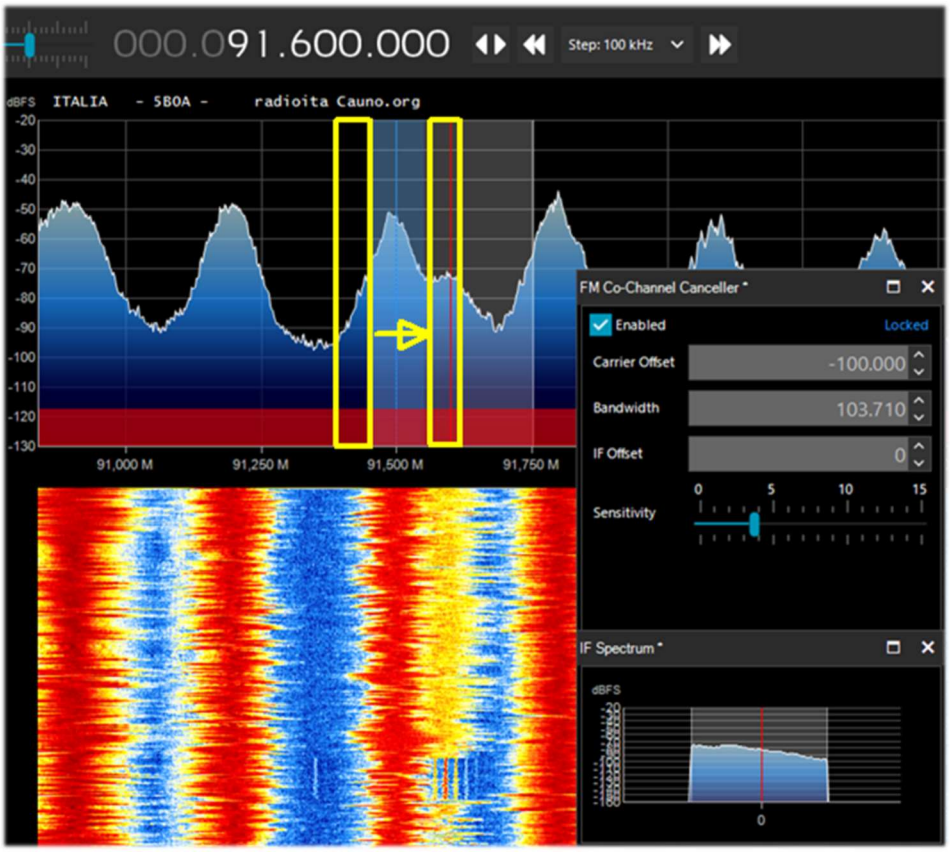
1) Tune the (B) station
2) Widen the filter from 810 to 820 kHz to include the right local signal carrier (A)
3) Enable the "AM Co-Channel Canceller" and the relative "Remove Carrier" with Carrier Offset value at 9.000 (designates interference is 9 kHz from the station). The plugin will hooked and show 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". In this example we see how to set the panel to listen to a weak station overwhelmed by a very strong signal...



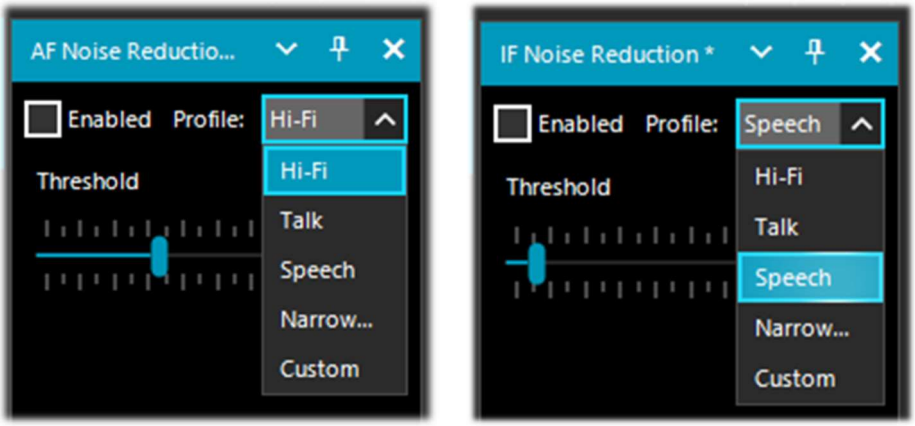
Example: strong WFM station at 91.500 MHz and weak station tuned to 91.600 MHz (red vertical center BW line at about 100k).
Enable the plugin, set the Carrier Offet to -100.000, to delete the signal at 91.500 MHz (blue vertical line on the left), slightly adjust the left side of the filter in the IF Spectrum window and that's it... 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 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" panels

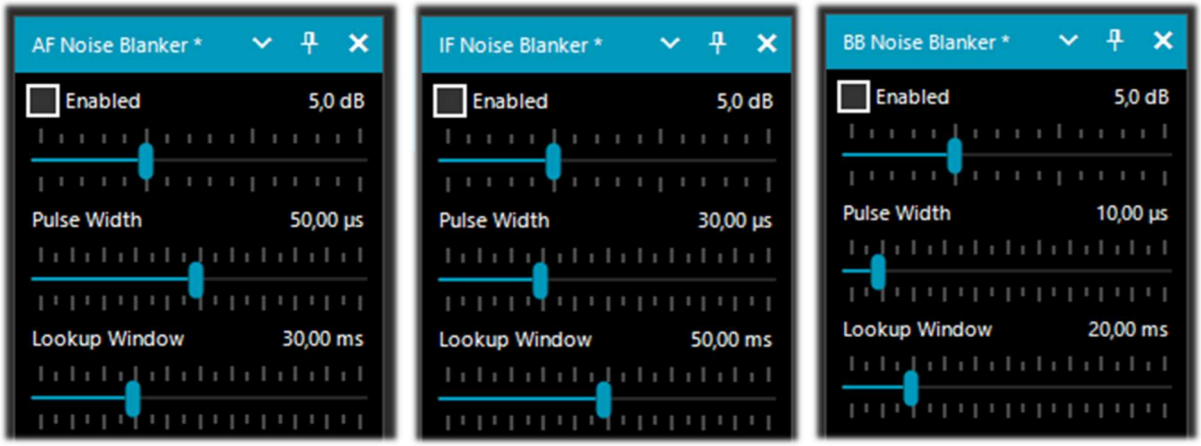
When listening to speech signals, which are often weak and noisy, it is very useful to activate digital noise reduction. Two Noise Reduction options are available: Audio AF and IF. The AF option uses the noise reduction algorithm on the audio output signal, the IF option on the IF signal.
Audio AF NR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

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: the "AF Noise Blanker" operates within the tuned area, the "IF Noise Blanker" operates on the IF signal and the "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.



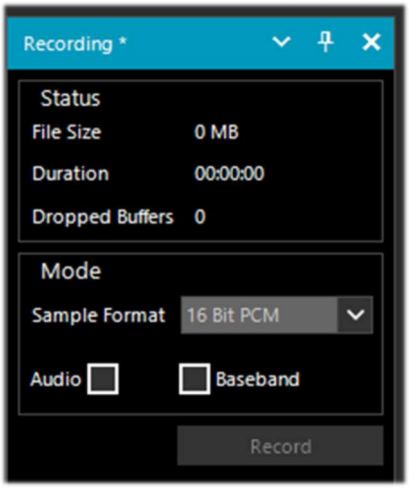
There are obviously no preset values or thresholds, *so you need to gradually move the various sliders until the pulsing noise disappears or reduces without distorting too much the received audio.*

“Recording” panel

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.

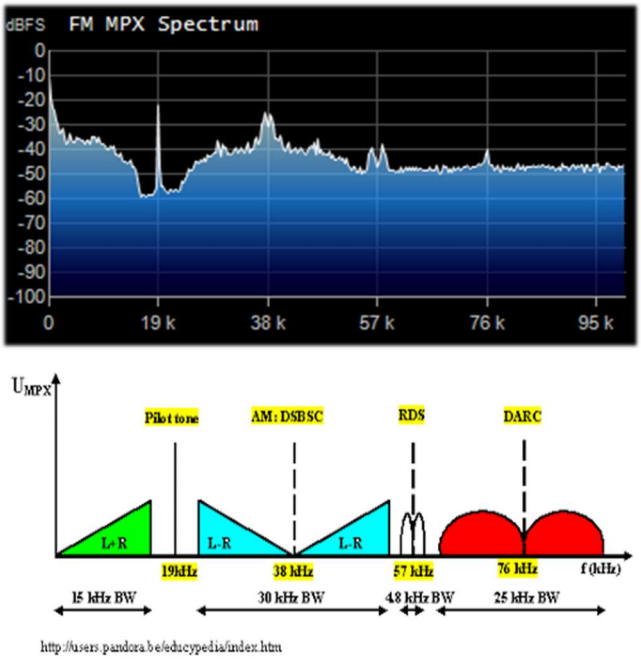
An I/Q recording is a tuned full bandwidth recording that allows subsequent playback and analysis without the slightest loss of information. To make it, you need to check the "Baseband" box *but remember that recordings in this format take up a lot of disk space, so observe the two counters “File Size” (in MB) and time in “Durations”...*



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

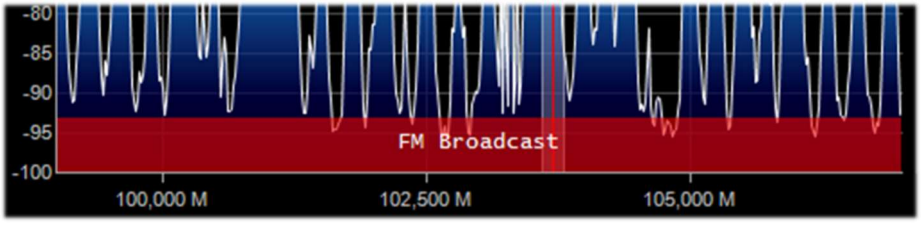
“Zoom FFT” panel

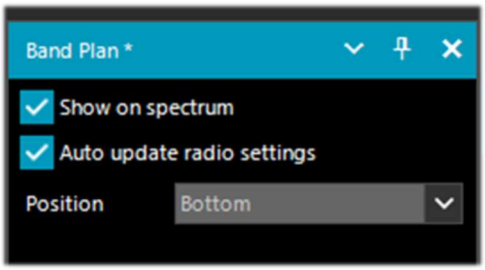
Zoom FFT is a default plugin in SDR#. It creates a zoom, at the bottom of SDR#, of the spectrum display and other customizable windows.

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

"Band Plan" panel

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").



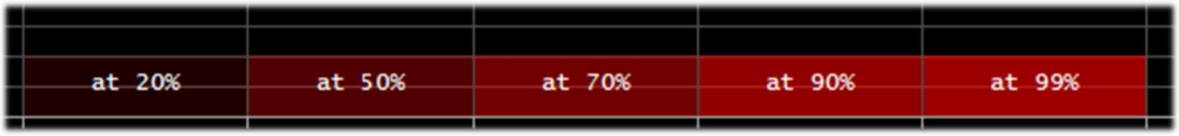


Key	Default	Feature
Show on spectrum		Enabling this option will display a rectangular color bar with the bandplan in the RF Spectrum window at the position indicated by the "Position" option.
Auto update radio settings		Enabling this option will automatically detect the emission mode/step and set in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

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

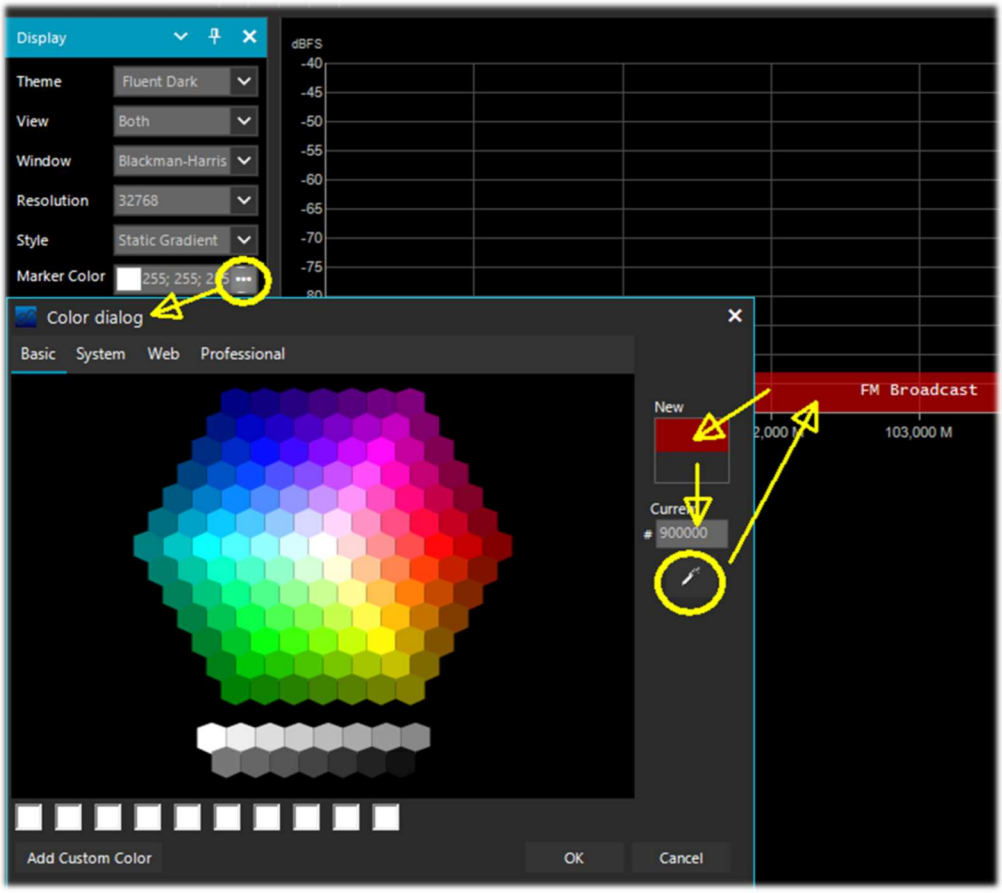
<RangeEntry minFrequency="87500000" maxFrequency="108000000" color="90FF0000" mode="WFM" step="12500">FM Broadcast</RangeEntry>

Each band can be divided into individual areas with different coloring, except for the overlapping of a subgroup (but not altogether). Colors are defined as T-RGB, where T=Transparency (in values from 0 to 99 as a percentage, from almost completely transparent to full color) R=Red, G=Green, B=Blue in blocks of 2-digit hexadecimal values (indifferent to uppercase or lowercase letters).



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

In the BASIC menu, through this icon  you can select a color on the screen to have immediately, in the "Current" window, the hexadecimal countervalue. Or by entering a value you can immediately see the result in the field. In the example below, the red band of FM broadcast appears as "900000". Or you can use the "Professional" menu to have all possible color palettes available.



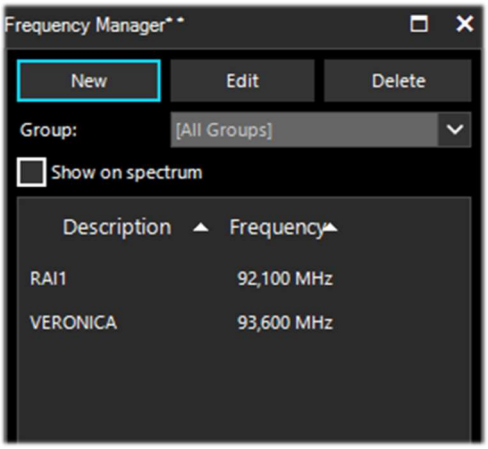
Oppure a questi link tra i molti disponibili in rete:
http://www.w3schools.com/colors/colors_names.asp
https://toolset.mrw.it/html/colori-del-web.html
https://www.sitiwebgallery.it/blog/tabella-colori/
http://www.colorihtml.it/
https://encycolorpedia.it/d0417e

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

"Frequency Manager" panel

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

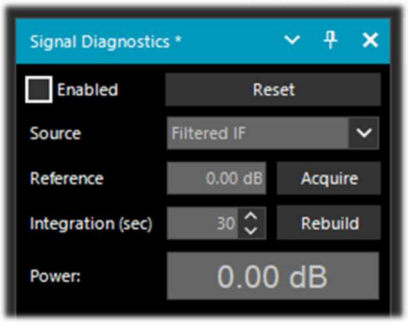
opens, where all you have to do is add the name of the Group (if any), the name of the station and confirm all the other data already automatically acquired.



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.*

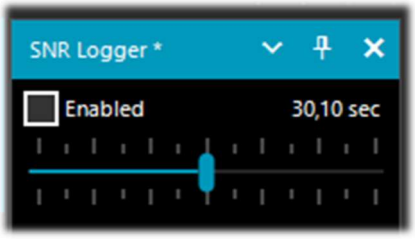
"Signal Diagnostics" panel

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" panel



Once the flag has been enabled 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 the program directory: "SDRSharp_20210205_153455Z_SNR.csv" in which the SNR values (in dB) detected by the active frequency in the VFO will be recorded. *The file can be imported into Excel for further analysis.*

1	Timestamp	Frequency	SNR
2	05/02/2021 15:35:25	103300000	29.72
3	05/02/2021 15:35:55	103300000	30.17

..... 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/***

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

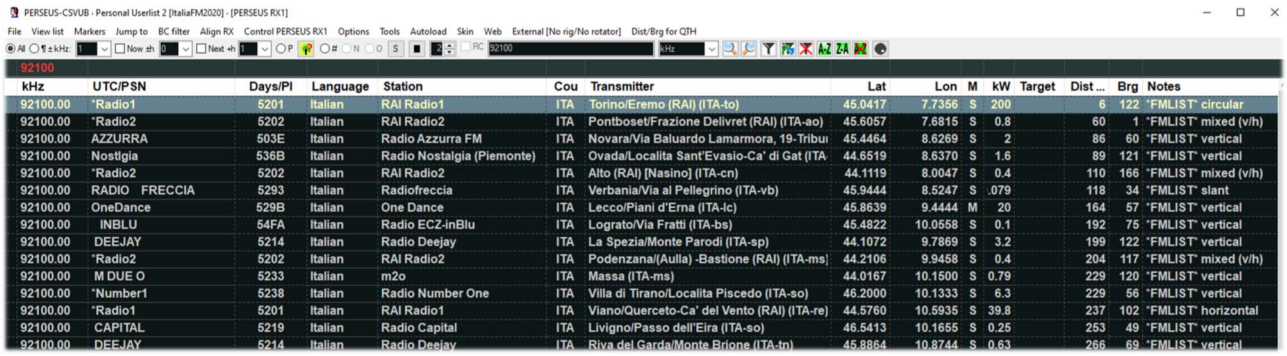
The solution provided allows you to edit, build and debug these plugins within Visual Studio 2019. This is probably the fastest way to develop plugins for SDR# now in dotnet 5, but the reference to the old programming still works.

"CSVUserlistBrowser" plugin

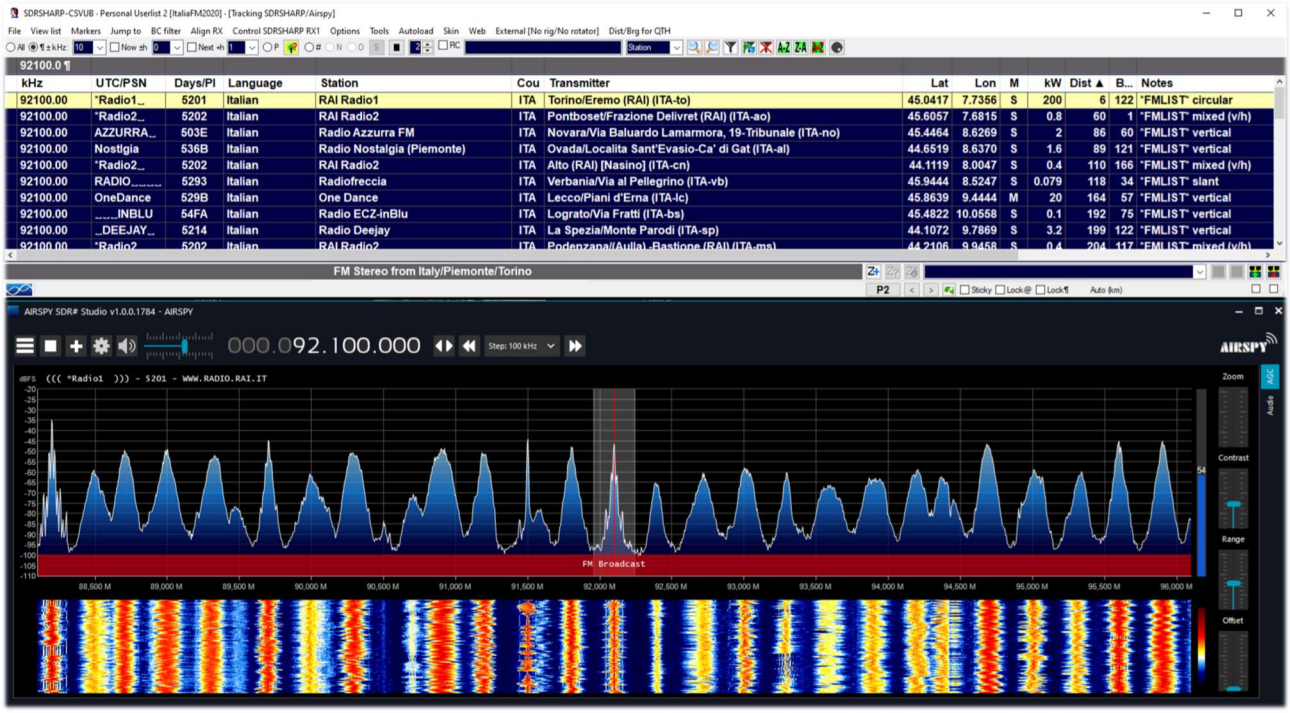
The first one I have been using since many years is the "CSVUserlistBrowser" (CSVUB) of Henry DF8RY. CSVUB is a Windows application, to manage numerous databases (or lists) of radio frequencies of long, medium, short and WFM broadcasting stations. It displays the lists in the

following formats: AOKI, EIBI, HFCC, FMSCAN, numeric stations, "ITU monitoring", ClassAxe (for NDB), etc. etc. as well as Personal Userlists.

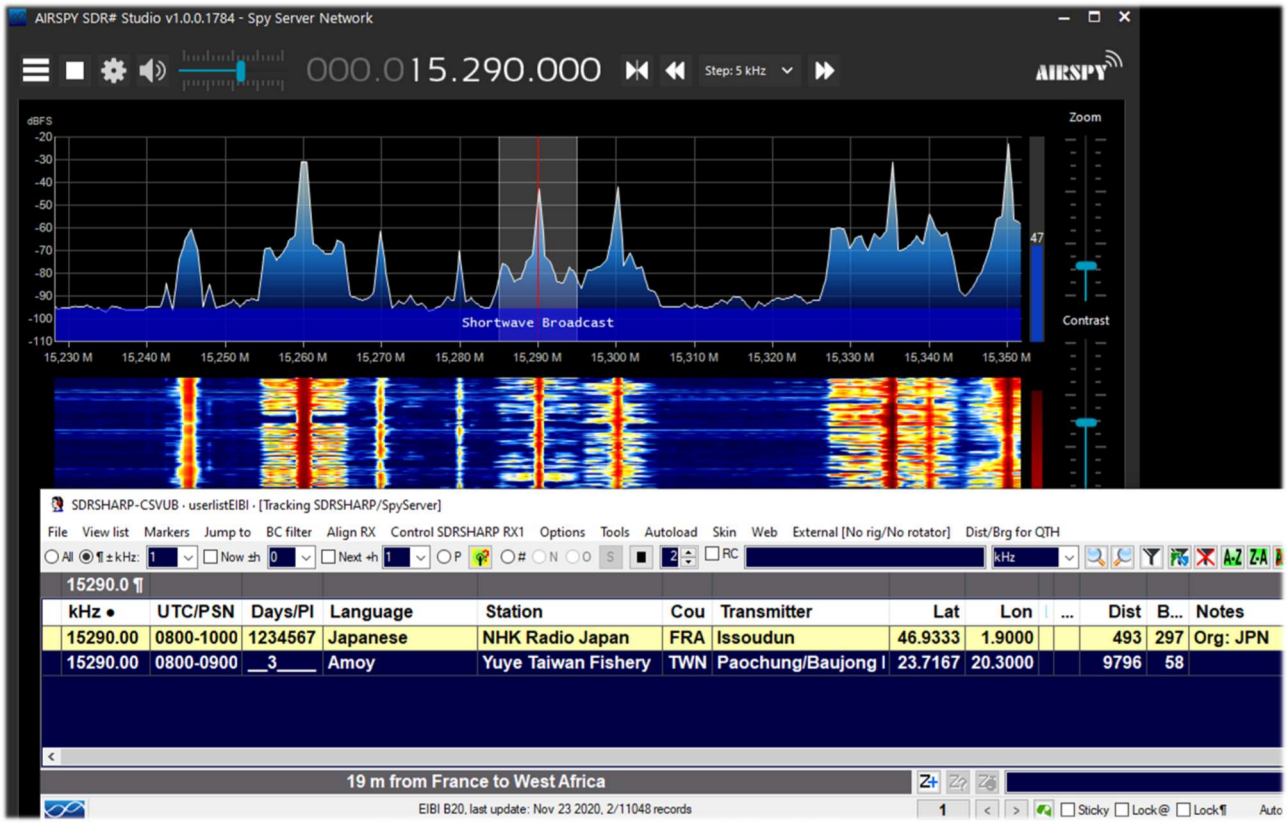
CSVUB tunes the receiver with a single mouse click in the proper emission mode, showing the station name, time, language, transmitter position, distance and bearing, as well as other information automatically updated by the respective servers! It also contains Hamlib and Omnirig control for external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



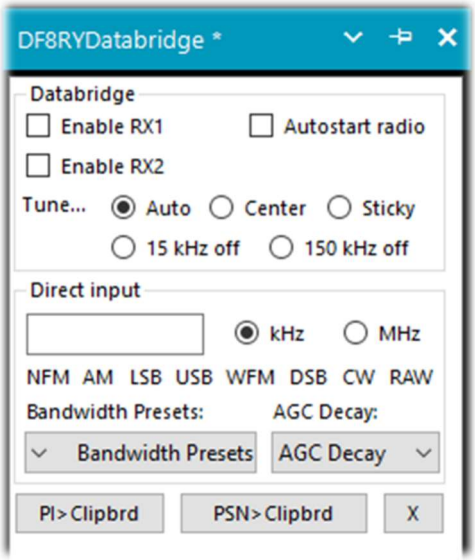
The CSVUB window is external, sizable and can be placed wherever you want. I prefer to keep it above SDR# to see all the frequencies and information immediately.



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



In this screenshot, a Spy Server Network is used to verify a broadcaster on 19-meter. By enabling the "Track mode" option, the first line appears in CSVUB with its transmission highlighted. For very busy slots, you could also use the "Now" option which immediately filters the transmission at the current time. Let's see in detail the possible plugin configurations through the “databridge”.



Key	
Enable RX1 / RX2	Enable or disable SDR#-CSVUB control. There are two instances of connection to SDR#, for example one with an Airspy and the other with an RTL-SDR dongle.
Autostart radio	The plugin automatically starts the radio it finds connected. In case of problems when the radio is not connected, it is preferable to disable the option and start it manually. The receiver only starts automatically when RX1 is enabled. The autostart is blocked for a second instance of SDR# with RX2, otherwise it would start the same radio twice and cause confusion.

Tune… Auto	The frequency position, tunes in the RF spectrum, is controlled by SDR#.
Tune… Center	The tuned frequency always appears in the center of the SDR# RF spectrum *(see Tuning types).*
Tune… Sticky	Use SDR# Sticky tuning mode *(see Tuning types).*
Tune… 15 kHz off	The frequency is tuned to 15 kHz from the center. This avoids collisions with the typical peak I/Q that some RTL-SDR/sound cards produce in the center of the RF spectrum RF.
Tune… 150 kHz off	As in the previous point, but for reception in WFM. The frontend must have sufficient RF bandwidth (at least 300 kHz).
Direct input	Here you can directly type a frequency in kHz or MHz and press Enter for tuning: *really very convenient and fast!* Or, when with the mouse, you have the "focus" on this field, the Pag Up/Down keys or Up/Down arrows tune the VFO gradually with the Step Size selected in SDR#.
NFM … RAW	Eight buttons for immediate setting of the various modes.
Bandwidth Presets e AGC Decay	These are some default snapshot settings for SDR# that may sometimes be useful. Not related to CSVUB.
Copy PI/PSN > Clipbrd	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.
X	The button activates a new RDS decoding in SDR# (it is basically a reset of the RDS).

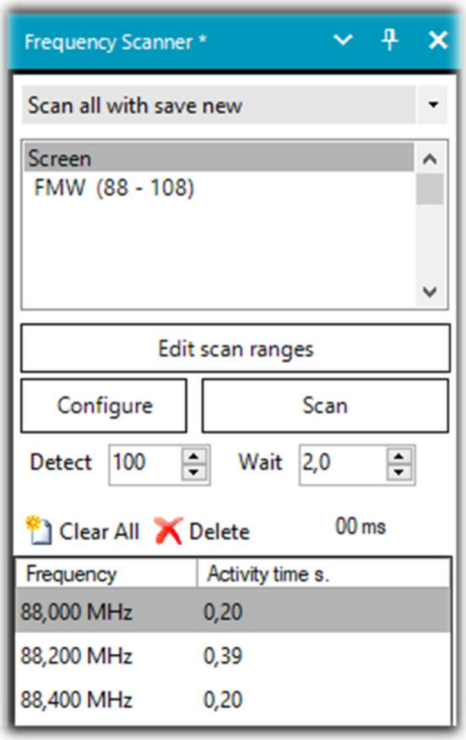
For its many features and functions I invite you to consult here:
https://www.df8ry.de/htmlen/csvub/%F0%9F%91%93features.htm
and if you want, downloadable obviously freeware, to this the download link:
https://www.df8ry.de/htmlen/csvub/%F0%9F%93%BBsdrsharp.htm

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.

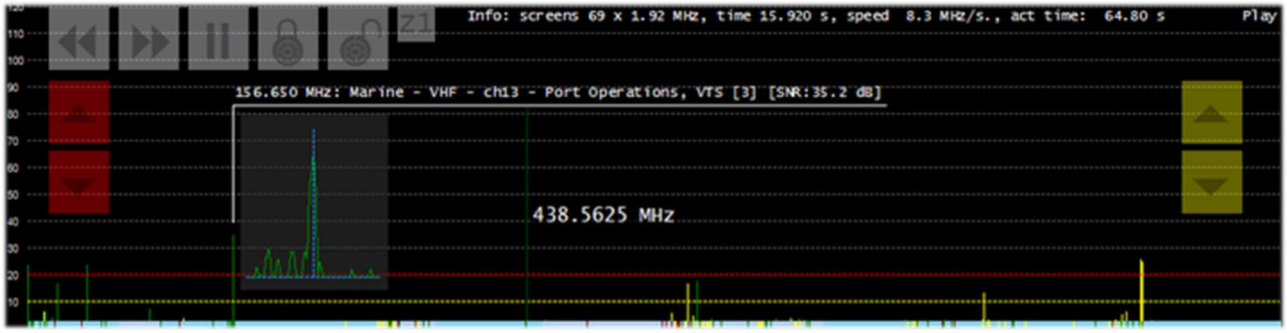
The latest update, available at the time of this writing, is version 4.20

"Frequency Scanner" plugin

The second I present, taken from the original TSSDR (Vasili) but now maintained and updated by "thewraith2008", is the "Frequency Scanner" downloadable, along with other valuable plugins, on the forum of the site: ***https://www.radioreference.com***



If with the “Frequency Manager” you can instantly save and recall any memory, with the “Frequency Scanner” you can carry out wide-ranging station searches with impressive scanning speeds!
There are two modes: the more straightforward one of searching the current spectrum window using the "Screen" preset, or defining a scan range, e.g. the FMW 88-108 band (or the 145 MHz radioamateur band), with your own emission mode and scan step using the "Edit scan ranges" button and taking advantage of no less than 5 different scan modes.
The "Configure" button allows you to set every possible parameter in detail of the Scanner, Channel Analyser and Logging to file.
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 the delay time (in seconds) with which to resume scanning. *You can start testing with a value of 5 seconds.*
You are now ready to press the "Scan" button. The Channel Analyser window will appear at the bottom of the screen with a wealth of prompts and operational buttons.

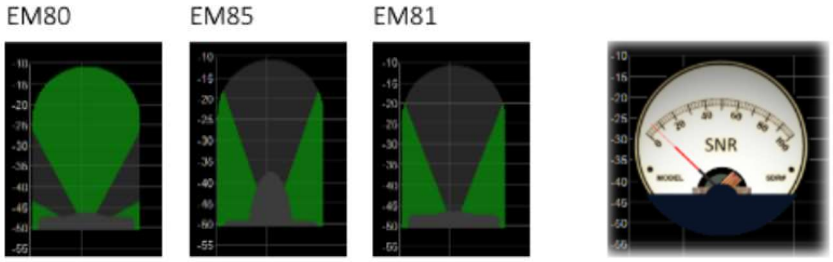


For the correct use of all the functions of this very useful and essential plugin, please refer to its comprehensive 26-page PDF manual.

The latest update, available at the time of this writing, is version 2.2.7.0

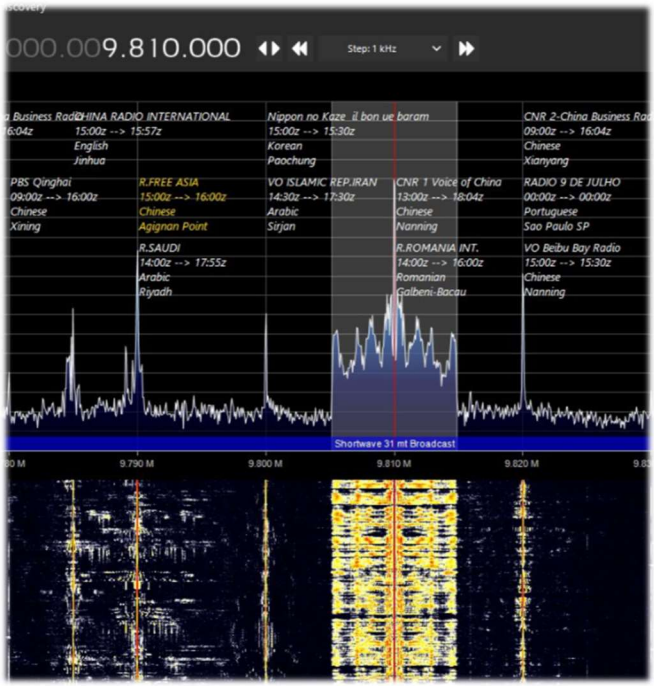
“Magic-Eye” plugin

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 1.60

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 !



Faults

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

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

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

Another alternative is to take advantage of the "Stereo Mix" offered by your soundcard to share audio without any special decoding requirements. *You can, for example, route the audio of a good broadcasting station to the Google Translator of the Chrome browser, to see the content of the broadcast translated in real time into your native language (try it to believe it!).*

However, there are some aspects to be considered in order to improve the chances of success...

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

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

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

Good listening and good DX !

Quotes

If this guide has helped you to better appreciate SDRsharp and get this far, I consider it a good result and conclude with this collection of famous quotes...

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
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
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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