SDRsharp - The Guide

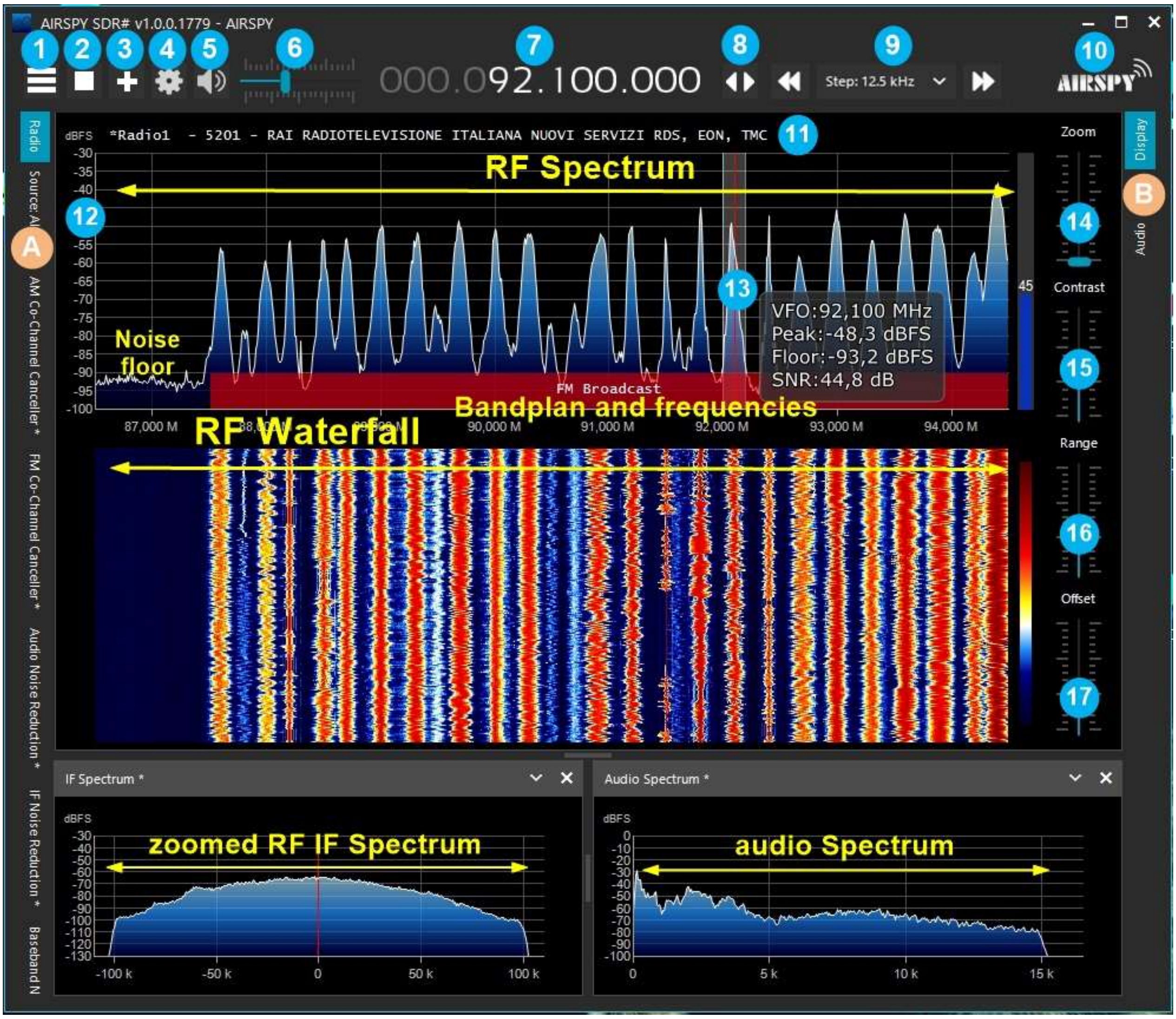
leans on the release v1.0.0.1784 - v1.4 Paolo Romani IZ1MLL

I started to collect, little by little, the various configurations and operating suggestions (*highlighted in blue italics*) initially only as a personal reminder and then for several of guys to whom I have long suggested SDRSharp (or SDR#) for OS Windows. It's the most complete, performing, lightweight, integrated, updated and customizable software (with plugins for every need) for the various RTL-SDR dongles and AIRSPY receivers (big thanks to Youssef and Prog !). *SDR# evolving permanently, the here after presented snapshots can be different from the ones of the last version that can be download for free here:*

https://airspy.com/download/

The date of November 13, 2020 saw the release of the new graphic interface developed in Visual Studio with fully customizable layouts. At the moment the screens will be mainly about AirSpy hardware (but little changes for the other types if not the configuration menu and the bandwidths/decimations used).

The graphic theme used (skin) in my basic version is the dark theme with the name "Fluent Dark" (selectable in the Display menu).

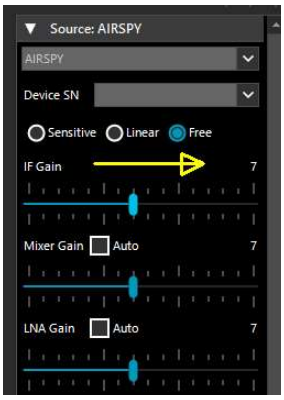


These are the main points in detail, followed by many insights and *personal suggestions*:

A. Left Menu (Radio, Source, various plugins) – from revision 1778
B. Right Menu (Display, AGC, Audio) - from revision 1778
1. Menu button
2. Start/close the program
3. Opening new window (slice) - from revison 1741
4. Configuration (vary depending on your hardware)
5. Audio On/Off (mute)
6. Volume control slider
7. VFO Input and Frequency
8. Tuning type
9. Step navigation bar - from revison 1782
10. Airspy logo (click above to visit the site 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. Cursor for adjusting the Zoom on windows RF Spectrum and RF Waterfall
15. Cursor for Contrast adjustment
16. Cursor for Range adjustment
17. Cursor for offset adjustment

The first time you start SDR# check the following points:

- Increase the RF gain level *(on the sliders from zero to higher values, taking care that the waterfall window is not too saturated with strong signals represented in orange/red color, but adjust the gain to bring them to dark blue color).*

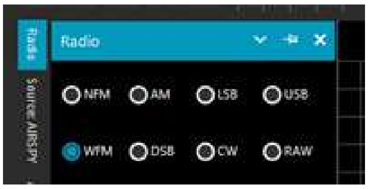


- Reduce the "Range" slider (at item 16) to about 30% starting from the bottom.
- Enable the field "Correct IQ" remove the center peak if using the dongle R820-T/R820-T2 or enable "Offset Tuning" in the configuration menu if using a dongle with E4000/FC0012/13 chips.
- Disable the field "Snap to grid" so that you can tune any signal, regardless of the specific step of the services provided, or set it to your preferred step (for example in FMN the step is 12.5 kHz).
- Tune a strong and stable signal, change the offset value PPM (frequency correction) little by little so that it is centered at the tuning bar (item 13). *The operation should be performed about 10 minutes after the activation, to allow better stability if your dongle does not have a TXCO. No need for Airspy users!*
- Set the correct "Emission mode" according to the signals you want to listen.

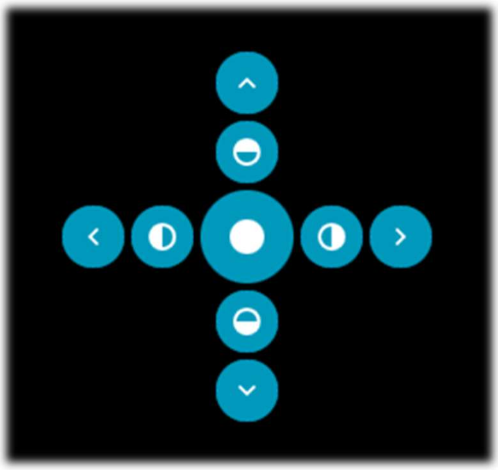
Now let's take some time to familiarize ourselves with the new side menus A and B.
The several menus and plugins (also from third parties, see the appropriate section below) may vary in number and relative position.

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.

But the new and maybe more complex appearance, at least at the beginning, is the one related to the positioning of the single panels with the recently introduced GUI wizard.
Keeping the left mouse button clicked on the title of the panel you are interested in, for example this one



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).

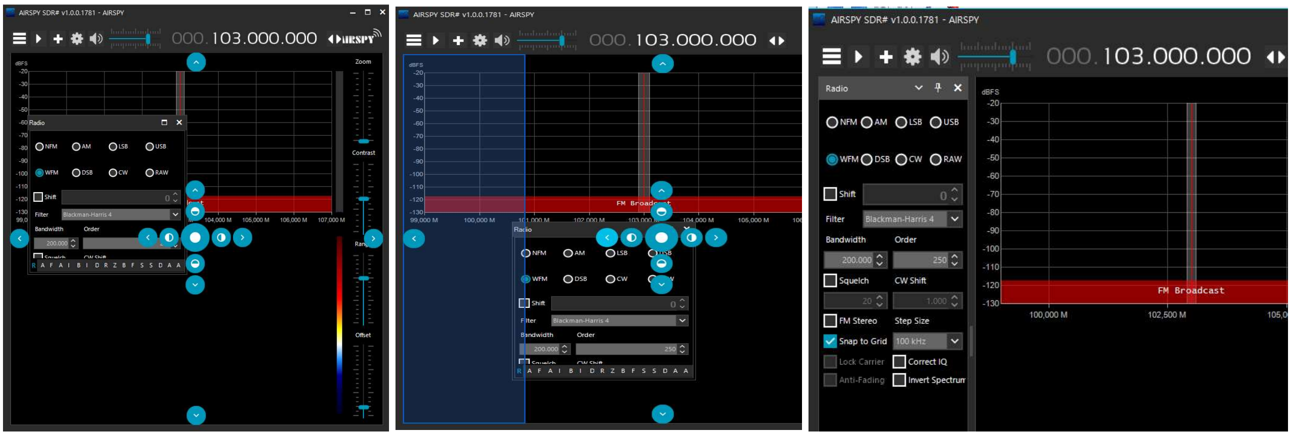


 icon for the outer left side positioning

 icon for left half positioning

 icon for central zone positioning

Here is how to take the RADIO panel on the left side of the screen as an example. At this point you can save the layout so that you can call it up successively from Menu (item 1) / Save Profile…

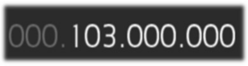


Main settings

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...

Control	Feature
Menu panels	With this button 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)	With this button you can open one or more new windows of the program, but always in the sampled band portion. *For example, you cannot open a window in UHF if the main receiver is tuned to VHF. Warning: with the introduction of this function since revision 1741 the previous Aux-VFO plugins (which used the same internal DSP algorithms!) are no longer available. To decrease CPU utilisation, please disable the unnecessary slice and minimize its bandwidth.*
Configuration menu	Configuration menu of your hardware and change the 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*
- *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.

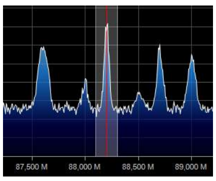
"Sticky tuning" - the frequency remains "connected" to the VFO and you can scroll the frequency bar left and right by "hooking" it with the left mouse button.

"Center tuning" - the tuned frequency will be always displayed in the center of the RF spectrum and waterfall.

Steps 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.

RF Spectrum

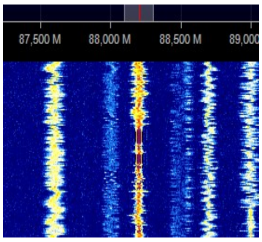


In this window the RF Spectrum is shown visually as a real-time graph. The active signals appear as peaks of greater or lesser intensity. The lower part represents the "noise floor. *A recently introduced feature is the "peak Color" which is activated by clicking with the right mouse button on the Spectrum 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"
Searching for the color of liking for example here:
http://www.domynex.com/strumenti/tabella-colori-esadecimali.php

SNR meter

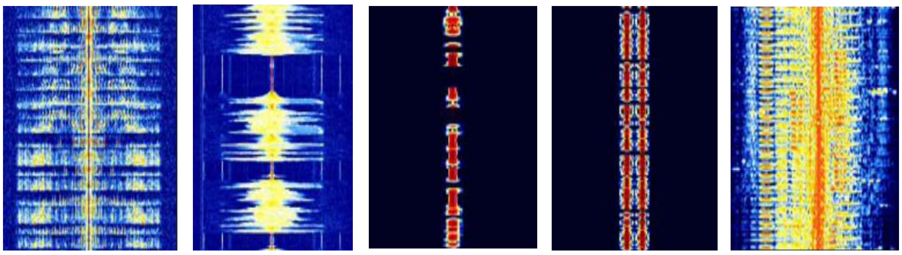
On the right side of the RF spectrum there is a vertical bargraph that shows the SNR value (in dB). The Signal-to-noise ratio is a numerical quantity that relates the power of the useful signal to the the noise in the system. In the case of analog transmissions, a decrease in SNR causes a gradual deterioration 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.

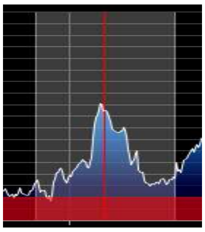
This representation is a great help to learn about the various types of signals visually. A trained eye detects and recognizes an interesting signal at first glance, even if it is weak and in the midst of disturbances, because each signal has its own "footprint", as well as electrical noises of all kinds !! 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 listenable: ***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).

“Source” panel

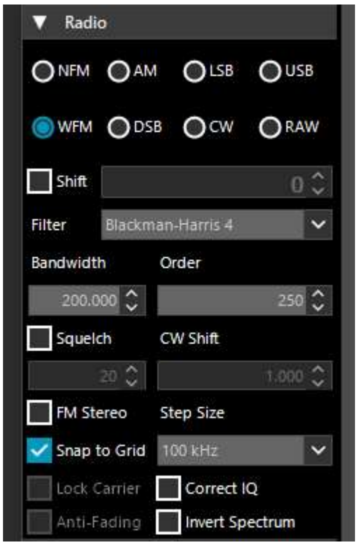
Choose your hardware from the drop-down list:

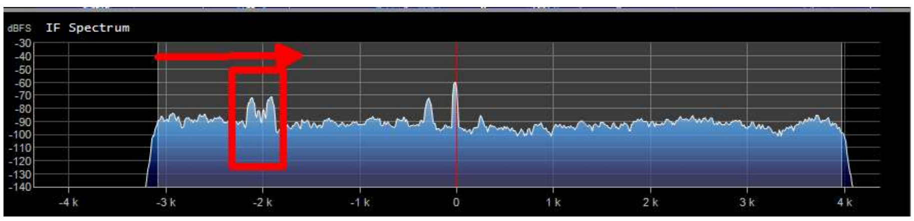
- AIRSPY for AirSpy-R(x) or AirSpy-Mini
- AIRSPY HF+ Dual / Discovery
- RFSpace
- RTL-SDR/USB for dongle RTL-SDR,
- HackRF
- Funcube Pro/+
- Softrock
- UHD/USRP
- If you intend using a Remote Server of the AirSpy family select "Spy Server Network" and search for the one you are interested in among the active on the world map (green icon).
- For an RTL-SDR dongle via TCP select "RTL-SDR/TCP".
- The last list option concerns the 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 - 30 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…



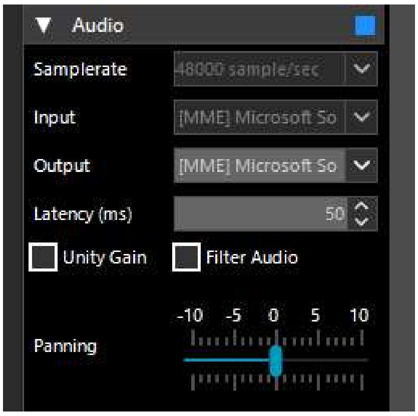
Mode	Feature
NFM - Narrow Frequency Modulation	Transmission technique that uses the frequency variation of the carrier wave. Mode commonly used by civil and radioamateur services for both analog and digital modes in VHF/UHF but not under the 27 MHz.
WFM - Wide Frequency Modulation	This is the mode used 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 Sideband / 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...* 
RAW - Raw IQ signal	Used for playback or recording of RAW IQ streams.

Option	Default	Feature
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	OFF or step	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 mode. Allows the synchronous AM which can greatly improve reception and automatically center the signal. *Activate it for better AM reception, but can increase CPU load.*
Correct IQ	ON	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.*

"Audio" panel

This panel adjusts the settings for audio processing.

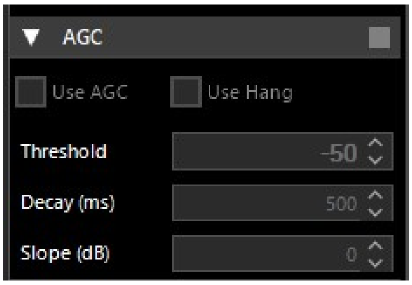


Option	Default	Feature
Samplerate	48000	Sets the sampling rate of sound card. Some decoding software may require you to set a specific sample rate. Usually the default value at 48000 samples/second should be fine for general purposes.
Input		The input sound card is highlighted in this field. *Normally it should not be changed.*

Output		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. It is normally default on speakers. *If you intend to use an external decoding program, e.g. DSD+ or DReaM, you should install and set to "virtual audio cable" software (VAC) to redirect the audio, or stereo mixing to share audio without special decoding needs. For example, you can redirect the audio of a good broadcasting station to the Google Translator of the Chrome browser, to see the content of the broadcast transalted in real time in your language!* ➢ *DSD+ (Digital Speech Decoder) is an open source program for decoding signals containing digital speech such as DMR, Dstar, Fusion, P25, etc…* ➢ *DRM (Digital Radio Mondiale) is the only non-proprietary digital transmission system in the world intended for short, medium and long waves and able to use the same frequencies currently assigned to the amplitude modulation (AM) broadcasting service in the spectrum up to 30 MHz.*
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 speech signals by filtering audio and eliminating hiss and DC noise, but must be turned off when decoding digital signals (e.g. via DSD+ or DReaM software)!!*
Panning	0	Balances the audio between the left/right speakers.

"AGC" panel

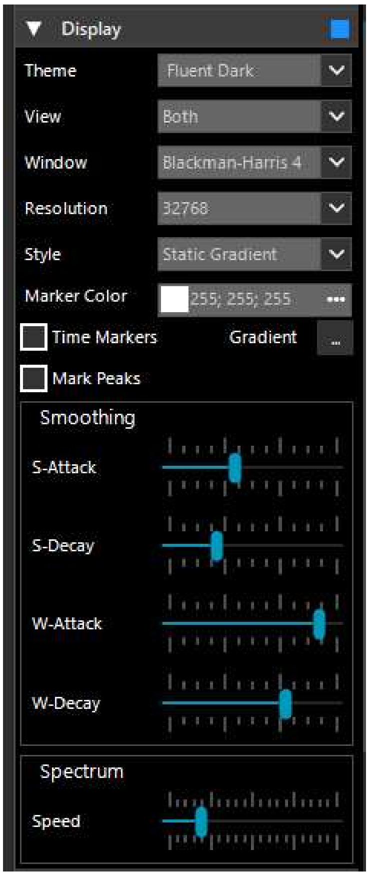
The function of AGC (Automatic Gain Control) acts in real time on the amplification of the input signals by varying it in order to obtain an optimal level on the output on low signals and avoiding distortion on high signals.



Option	Default	Feature
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 / USB / LSB 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 (ms)	0	Line slope for gain correction.

"Display" panel

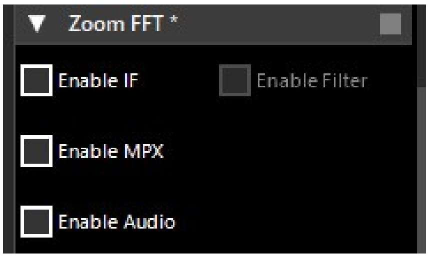
Display settings adjust the RF spectrum and waterfall screen options.



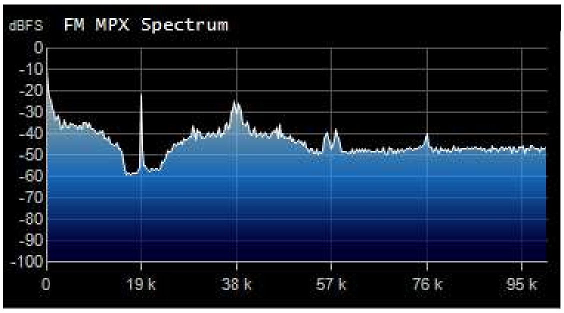
Option	Default	Feature
Theme		Recently introduced with the latest graphic interfaces allows you to choose multiple design layouts, many even in dark theme.
View	Both	Allows to set the display of the RF spectrum screen, waterfall, or only one of them, or none at all. *On older PCs it may be useful not 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.*

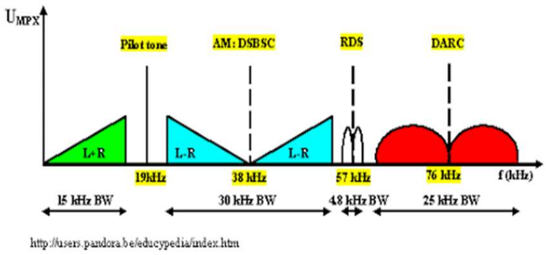
“Zoom FFT” panel

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.



Opzione	Funzionalità
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...

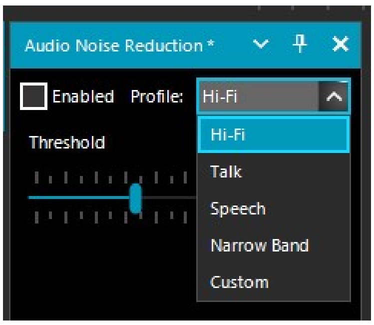


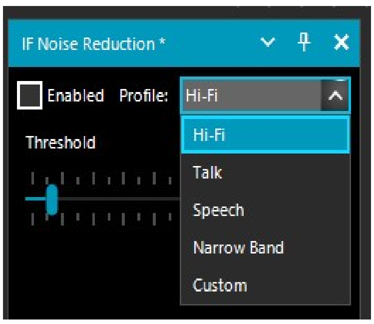


Enable Audio	Allows to see the audio spectrum in the base band.

"Noise Reduction" panels

When listening speech signals, often weak and noisy speech, it is very useful to activate the digital noise reduction. Two Noise Reduction options are available: Audio and IF. The first uses the noise reduction algorithm on the audio output signal, the second on the IF signal. Normally the one on the IF works better, but you could also try a combination of both. The sliders control the sharpness of the applied algorithm and you can use some already optimized profiles like this: Wi-Fi, Talk, Speech, Narrow Band and Custom.

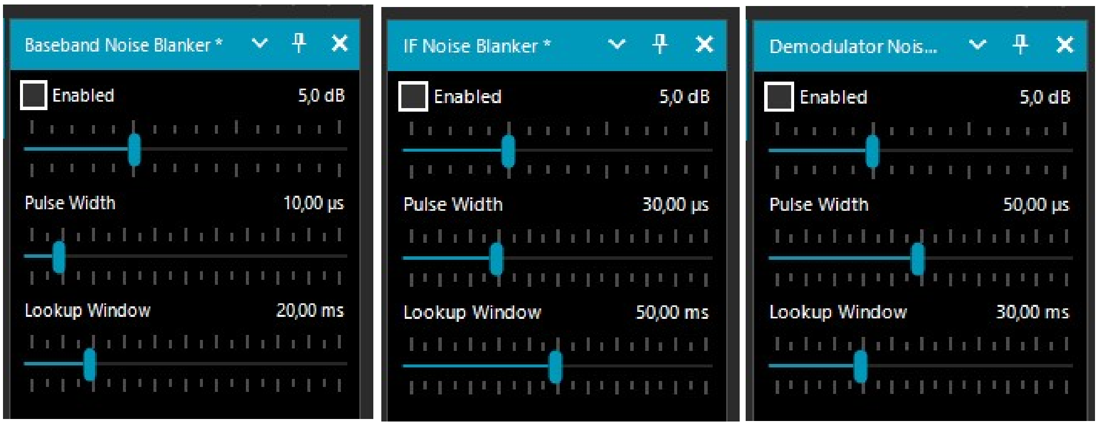




“Noise Blanker” panels

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 “Baseband Noise Blanker” works across the entire RF spectrum and removes pulses from FFT and Waterfall. The “IF Noise Blanker” works on the IF signal while the “Demodulator Noise Blanker” works only within the tuned area. 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.*

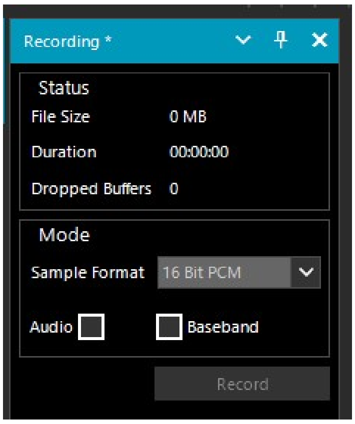


“Recording” panel

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 be easily recorded by checking the "Audio" box. A standard WAV audio file will be created in the SDR# directory.

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”...*

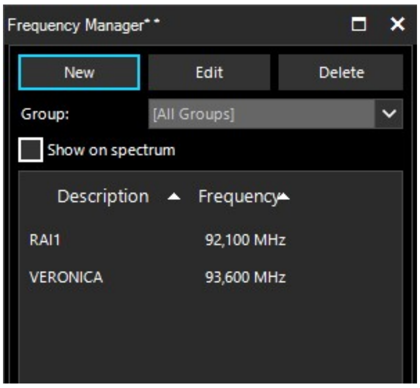


I/Q recordings can be played back in the Source panel by selecting "Baseband File (*.wav)".

"Frequency Manager" panel

The "Frequency Manager" panel allows to save a large database of all frequencies of interest. A new frequency can be added directly by clicking the "New button". A small data-entry opens where you just need to add the name of the possible Group (for a better subdivision and cataloguing), the name of the station and confirming all the other data already acquired automatically.

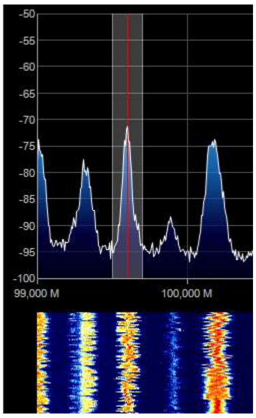
Then a double click on a record will tune SDR# to that frequency, automatically setting the emission mode and bandwidth. The "Edit" and "Delete" buttons allow the variation of a memory already inserted or its deletion. *If you check the "Show on spectrum" box, the frequency label will be displayed in the RF spectrum.*



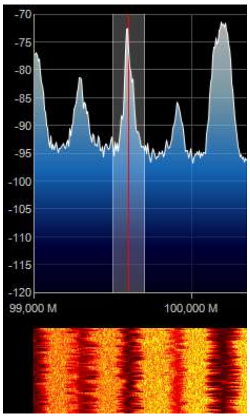
Vertical side sliders on the right

The sliders located vertically to the right (items 14/17) adjust the following RF spectrum and waterfall display settings.

Option	Default	Feature
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.

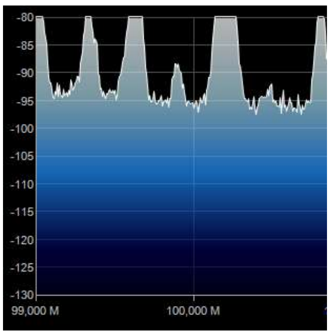


Correct



Wrong

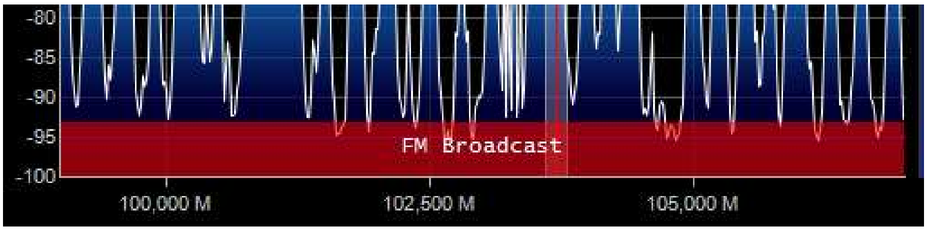
Offset	down	Adds an offset to the dBFS level range in the RF spectrum window. The offset is added to the upper value of the dB level range in the RF spectrum. *Normally you do not need to adjust it, unless you need additional contrast on weak signals in combination with the "range" adjustment. Adjust it so that the height of the signal peaks are not clipped at the top of the screen.*

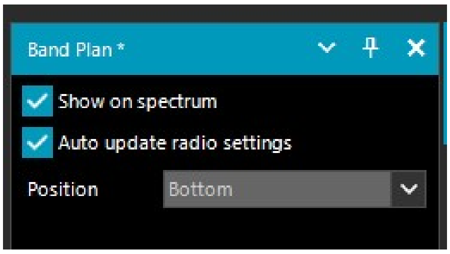


Wrong

“Bandplan” panel

The Bandplan 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").





Option	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…		Enabling this option will automatically detect the emission mode / step and set it in the VFO. *So if in the bandplan, in certain portions of the HF band is provided the USB mode and 0,5 kHz step, it will be applied immediately only typing the frequency.*
Position	Bottom	It allows you to choose between three different positions for the display of the Bandplan: Top, Bottom, Full (over the whole RF Spectrum window).

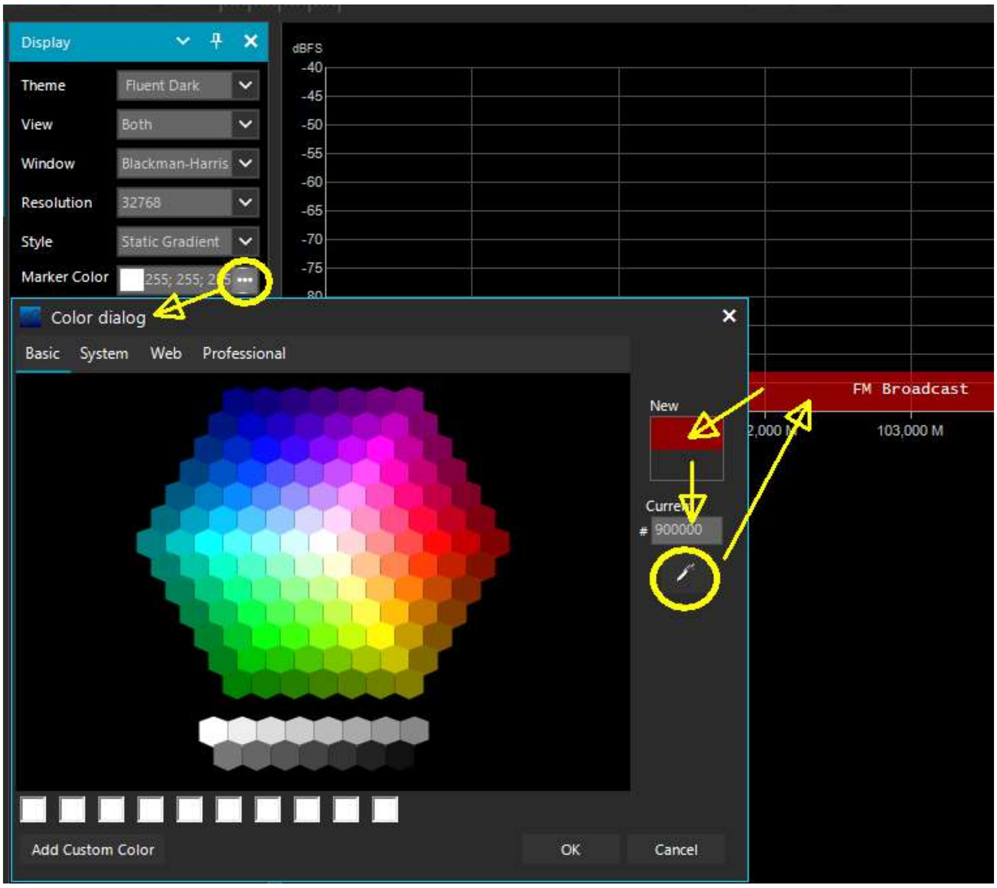
The support "BandPlan.xml" file, present in the program directory, must be modified with the information of your national knowledge by inserting the appropriate lines of text and respecting the format syntax. This must be the format of each "RangeEntry" unique for each frequency group:

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

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

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

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



Or these links:
http://www.w3schools.com/colors/colors_names.asp
http://www.domynex.com/strumenti/tabella-colori-esadecimali.php

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.*

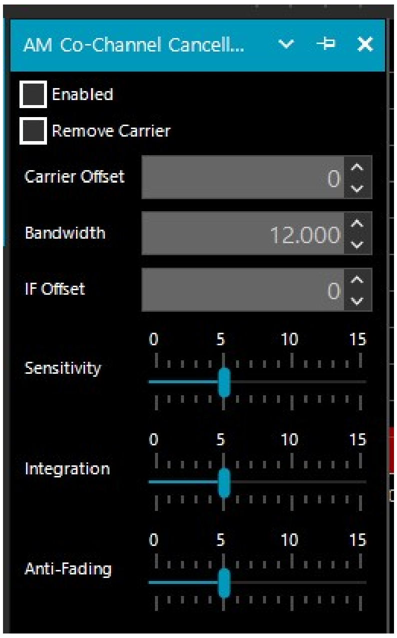
Any formatting errors in the file or the use of special characters will prevent the plugin from loading when the program starts!

"AM / FM Co-Channel Canceller" panels

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:

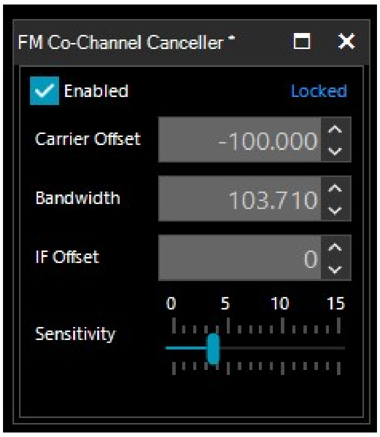
A) MW local station with very strong signal at 819 kHz
B) DX station at 810 kHz buried and unreadable

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

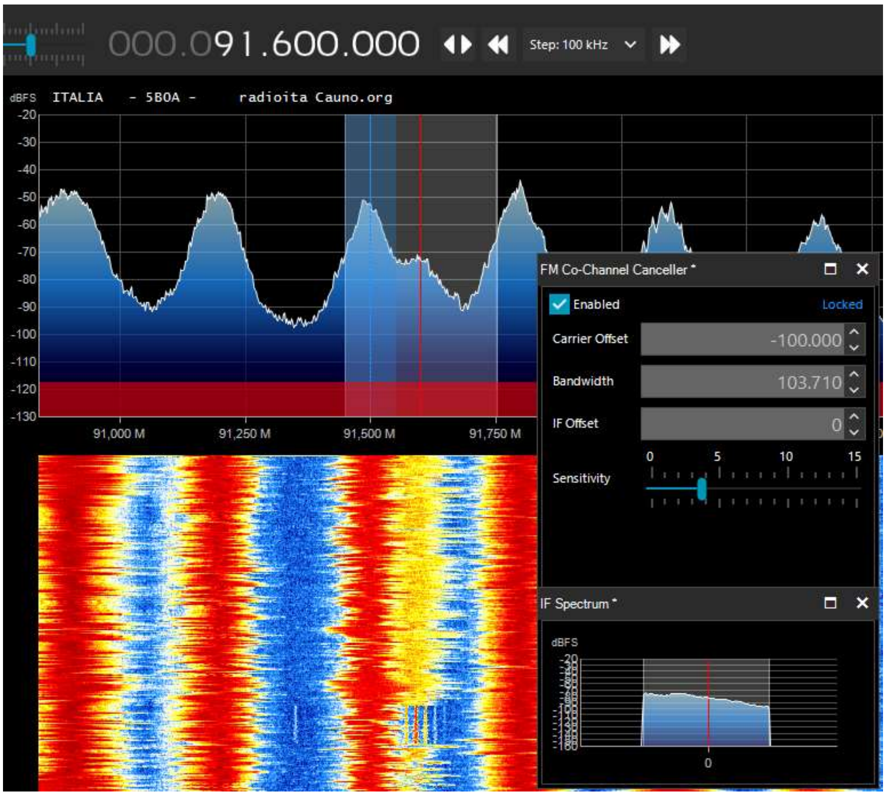
the station). The plugin will hooked and show in blue "Locked" on the right hand side, and you see in Spectrum RF a vertical blue line over the carrier to be removed from (A)

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...



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!



- 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.

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 the original russian Vasily ones.

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

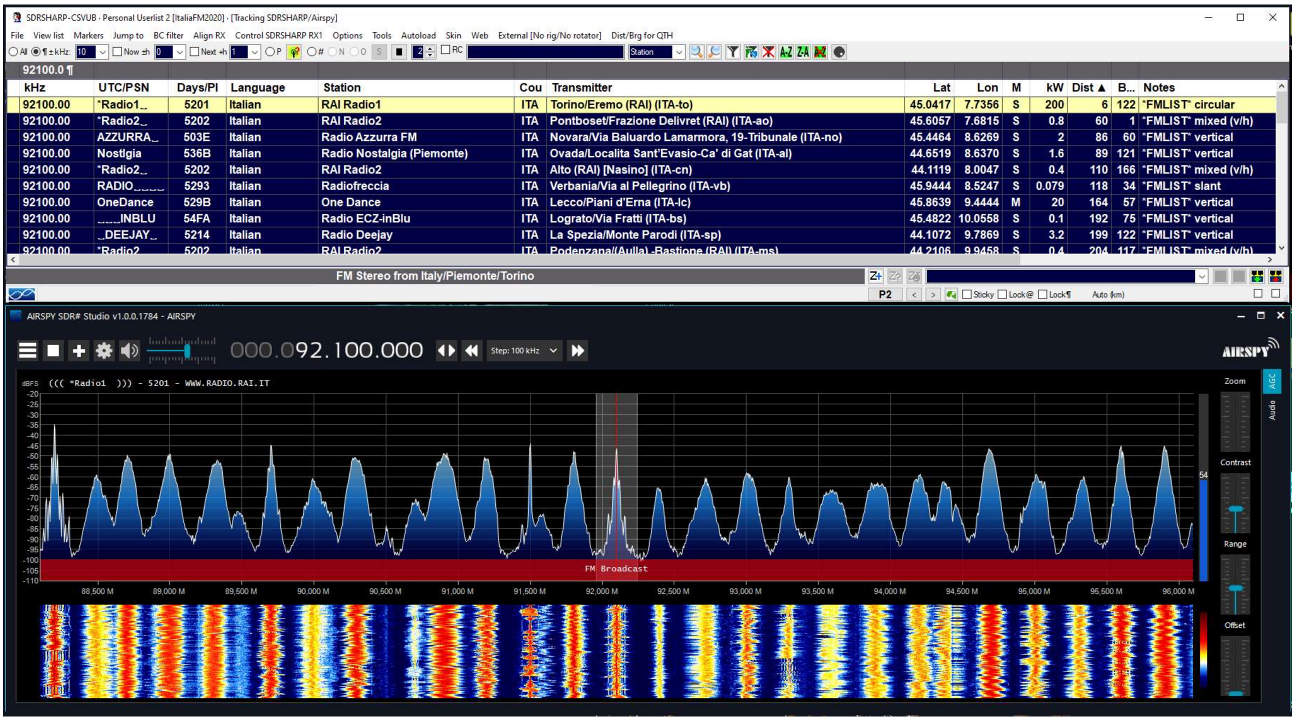
To insert a new one, downloaded from the net in compact format, you must close SDR#, extract the DLL (or more than one) in the program folder and insert the "MagicLine" (the start line) in the Plugins.xml file taking care not to change anything in its syntax, save the file and restart SDR#.

"CSVUserlistBrowser" plugin

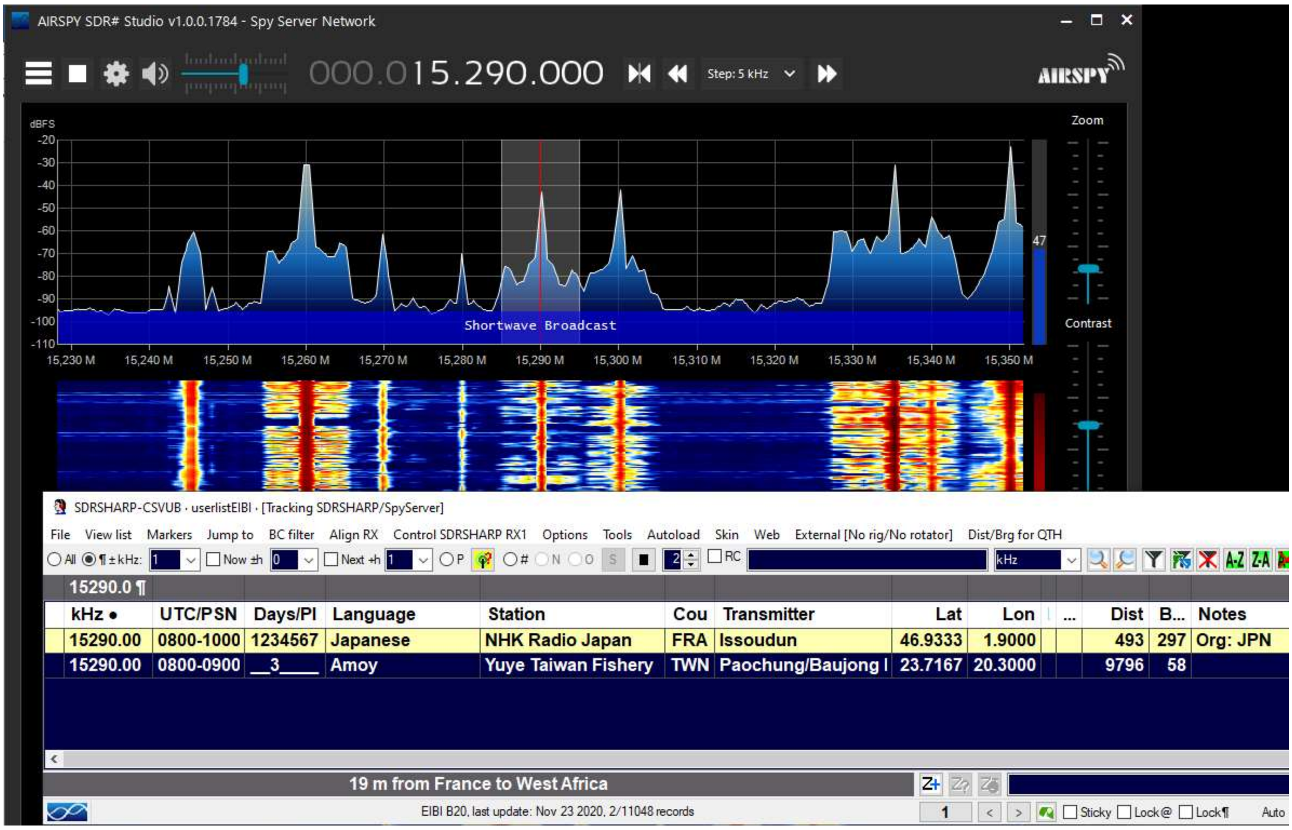
The first one I have been using since many years is the "CSVUserlistBrowser" (CSVUB) of Henry DF8RY. CSVUB is a Windows application, to manage numerous databases (or lists) of radio frequencies of long, medium, short and WFM broadcasting stations. It displays the lists in the following formats: AOKI,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

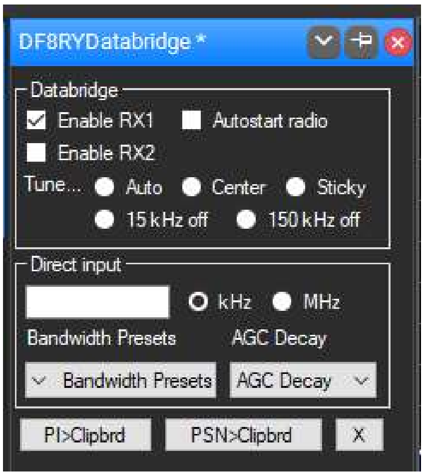
I prefer to keep it above SDR# to immediately see all the frequencies it can bring back.



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 configurations through the databridge.



Option	Feature
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#.
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.

Critical points and errors

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 file. 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.