



# SDRuno User Manual v1.23



## Overview

SDRuno is an advanced Software Defined Radio application platform which is optimized for use with SDRplay's range of Radio Spectrum Processing receivers. This means that the specific features of a particular SDRplay RSP receiver model are enabled automatically within SDRuno.

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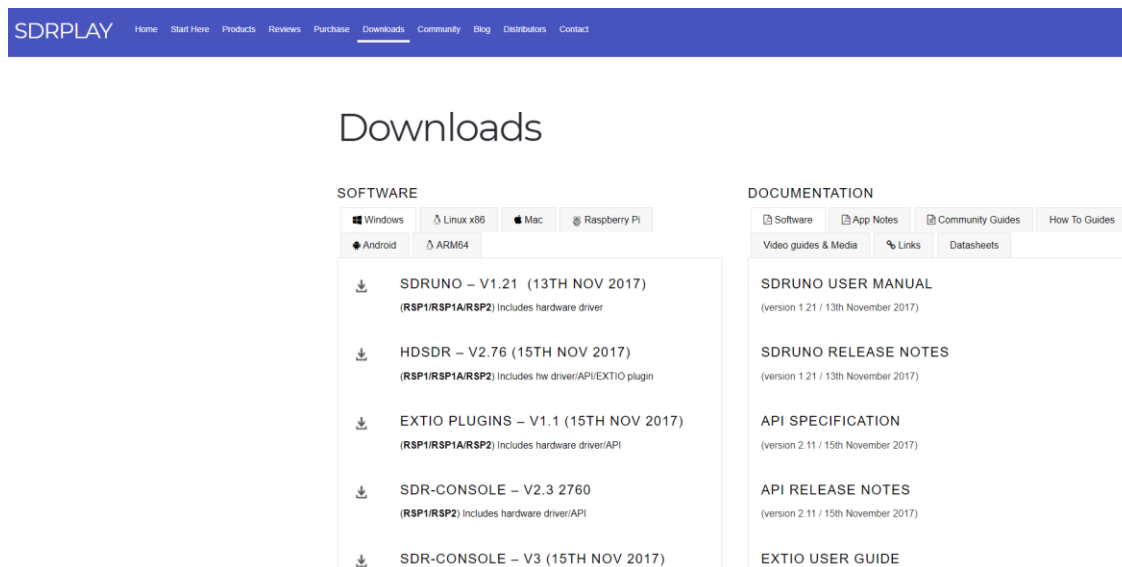
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It may be necessary to temporarily disable your Antivirus software to allow the installation to install uninterrupted. Remember to reenale your Antivirus after installation.

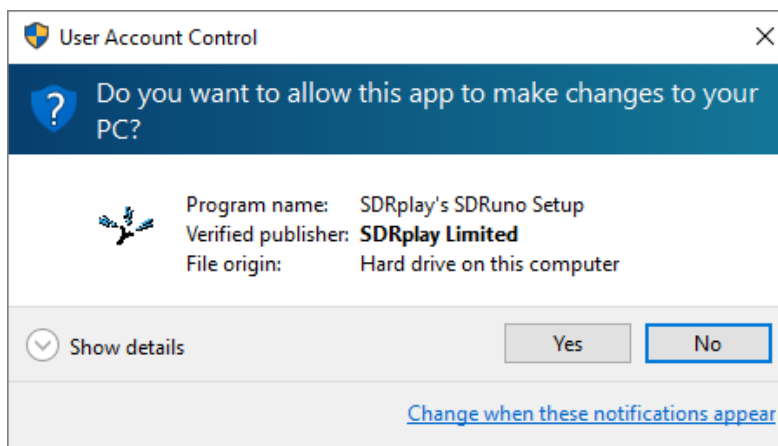
## 1. Installation

Download the SDRuno installer from the SDRplay website (<https://www.sdrplay.com/downloads>) which is shown below.

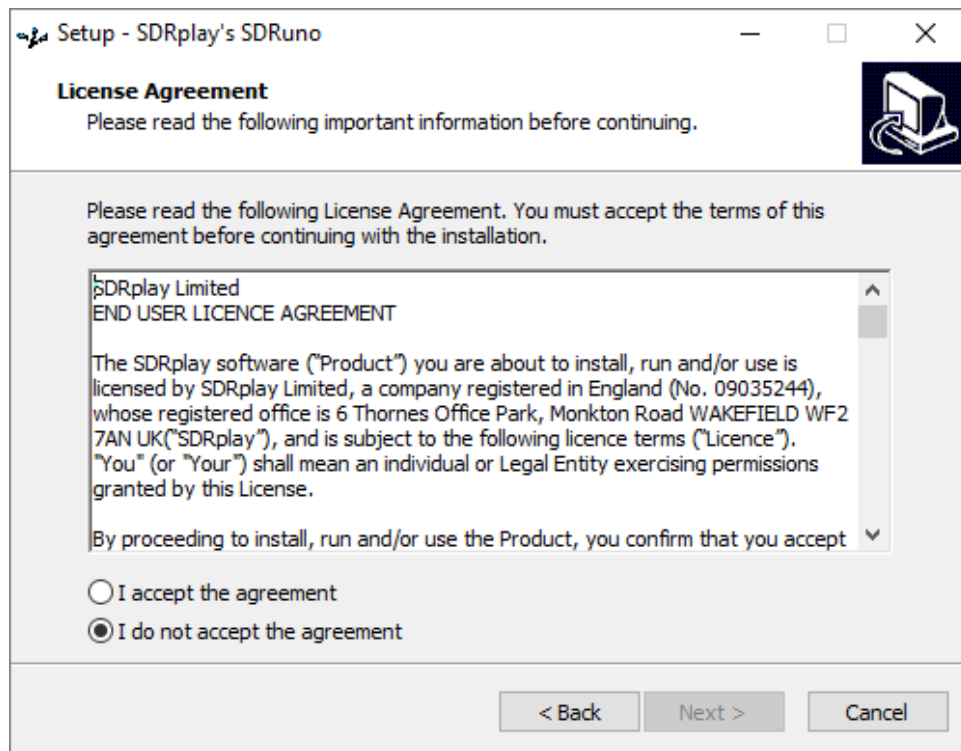


The screenshot shows the SDRplay website's Downloads page. The header is blue with the SDRPLAY logo and navigation links: Home, Start Here, Products, Reviews, Purchase, Downloads (active), Community, Blog, Distributors, and Contact. The main content area is titled 'Downloads' and is divided into two columns: SOFTWARE and DOCUMENTATION. The SOFTWARE column has tabs for Windows, Linux x86, Mac, Raspberry Pi, Android, and ARM64. Under the Windows tab, there are five download links with icons: SDRUNO – V1.21 (13TH NOV 2017) (RSP1/RSP1A/RSP2) Includes hardware driver, HDSDR – V2.76 (15TH NOV 2017) (RSP1/RSP1A/RSP2) Includes h/w driver/API/EXTIO plugin, EXTIO PLUGINS – V1.1 (15TH NOV 2017) (RSP1/RSP1A/RSP2) Includes hardware driver/API, SDR-CONSOLE – V2.3 2760 (RSP1/RSP2) Includes hardware driver/API, and SDR-CONSOLE – V3 (15TH NOV 2017). The DOCUMENTATION column has tabs for Software, App Notes, Community Guides, and How To Guides. Under the Software tab, there are four links: SDRUNO USER MANUAL (version 1.21 / 13th November 2017), SDRUNO RELEASE NOTES (version 1.21 / 13th November 2017), API SPECIFICATION (version 2.11 / 15th November 2017), and API RELEASE NOTES (version 2.11 / 15th November 2017). There is also a link to the EXTIO USER GUIDE.

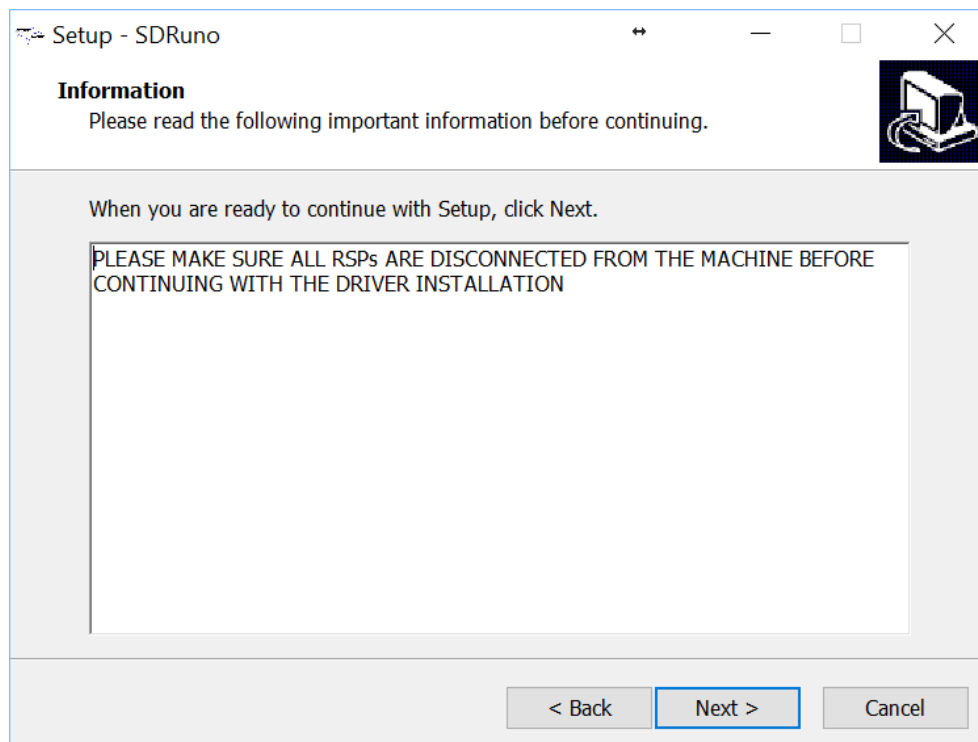
Run the downloaded installation file and you will see this, click Yes to continue.



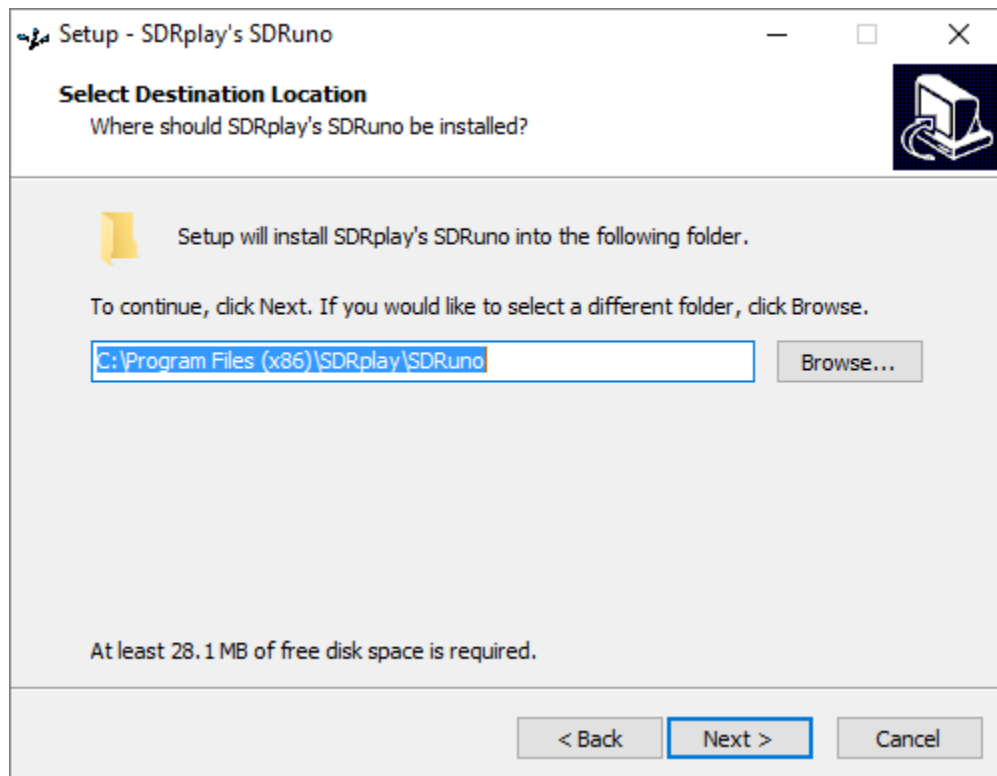
Please read and accept the license agreement.



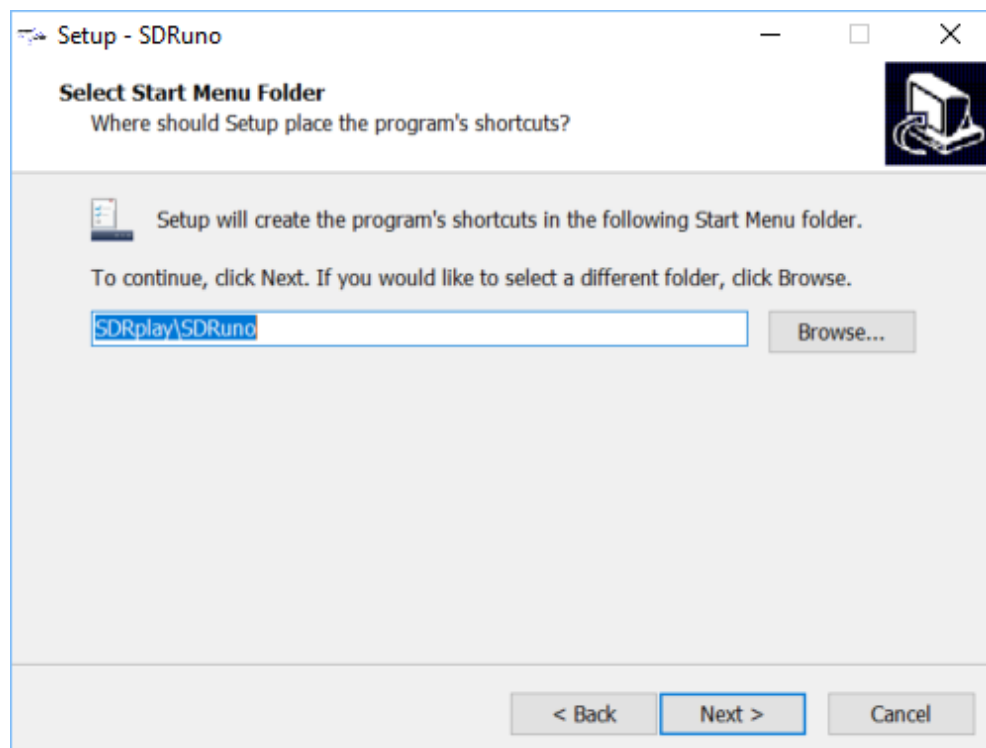
The next screen will display important information. Read and then click Next.



The next screen shows the installation directory. Check you have enough disk space and then click Next

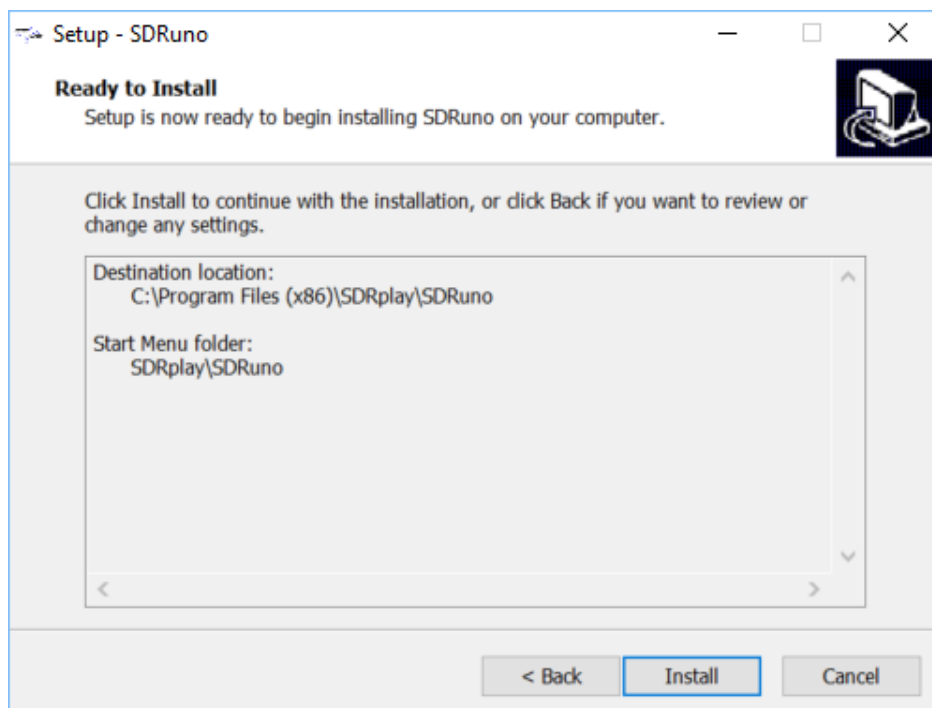


The next screen allows the Start Menu folder to be changed if needed.

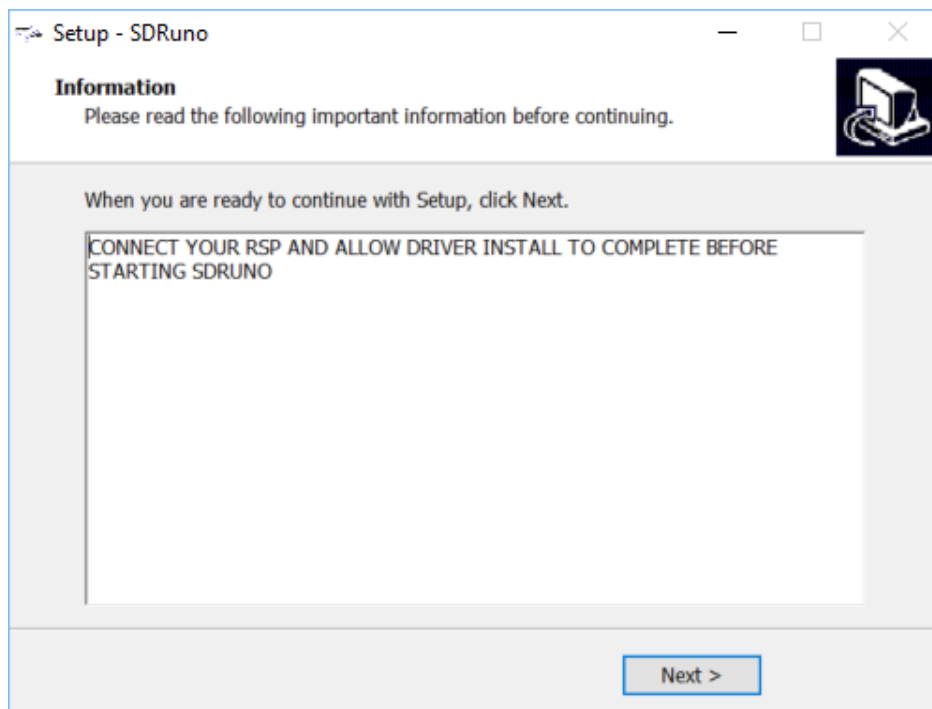




The next screen confirms where the software will be installed to. If correct, click Install.



Check the next window for important information about installing the hardware drivers.



This completes the installation; clicking Finish will close the installer and optionally start SDRuno. Be sure the RSPs is now connected before SDRuno is started

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*SDRuno Guides.*

[https://www.youtube.com/channel/UC4JDq3US2eb1N4dRCT45\\_Zw/videos](https://www.youtube.com/channel/UC4JDq3US2eb1N4dRCT45_Zw/videos)

*Guide for the RSP-1.*

<https://youtu.be/xBGHB0oMXHU>

*Guide for the RSP-2.*

[https://youtu.be/92ljh\\_NAEfc](https://youtu.be/92ljh_NAEfc)

*Guide for the RSP1A*

<https://youtu.be/qUZerxeHJvc>

*Guide for the RSPduo*

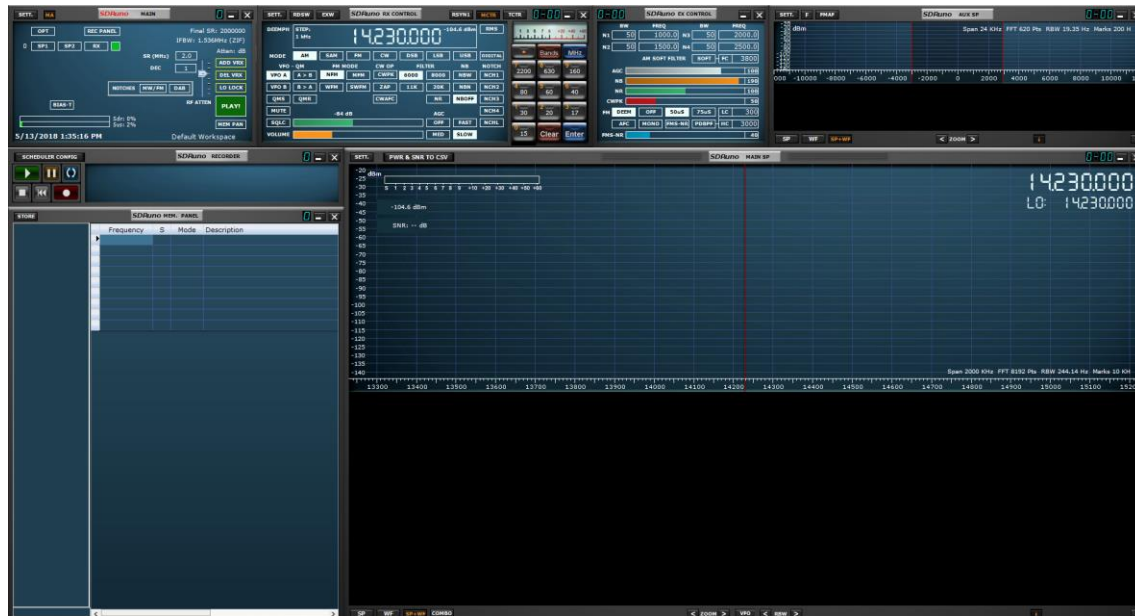
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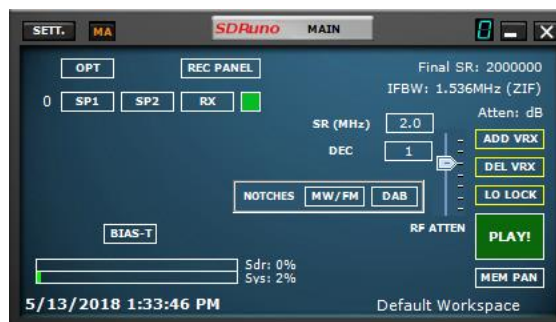


**DO NOT directly connect an RSP to the same antenna as your transmitter, or to an antenna in the near field of a transmitting antenna, as this is likely to result in irreversible damage to your RSP. Please note that simply unplugging the USB cable from the RSP does not protect it from possible damage.**

## SDRuno windows.



## MAIN



**SETT-** Shows the MAIN settings window.

**MA-** Enables the minimize & maximize feature of displayed windows.

**OPT-** Shows additional SDRUno functions.

**REC-** Displays the Recording window.

**SP1-** Displays the MAIN SP window.

**SP2-** Displays the AUX SP window.

**RX-** Displays the RX CONTROL window.

**ADD VRX-** Adds a VRX.

**DEL VRX-** Deletes the last added VRX.

**LO LOCK-** Locks the LO

**PLAY/STOP-** Starts and Stops the SDRUno stream.

**MEM PAN-** Displays the Memory window.

**WORKSPACES-** Displays available workspaces.

**ADC OVERLOAD-** The ADC overload warning is simply an indication that the gain is high enough to create a risk that the total signal may cause clipping at the ADC input. It is simply a warning provided to indicate that it may be necessary to reduce the RF or IF gain.

## RX CONTROL



**SETT** - Shows the RX CONTROL settings window.

**RDSW** - Shows the RDS data window.

**EXW** - Shows the EX CONTROL window.

**RSYN1** - Enables external application OMNIRIG for rig control.

**MCTR** - Enables memory tuning from the MEM. window.

**TCTR** - Enables T-Mate controller.

**0-00** - Current VRX number defined from the MAIN window.

**RMS** - Sets the S-Meter mode.

**AM** - Amplitude Modulation. Sub bandwidth filter sizes can be selected.

**SAM** - Synchronous AM. Sub bandwidth filter sizes can be selected.

**FM** - Frequency modulation. Sub bandwidth filter sizes can be selected.

**CW** - Continuous wave. Sub bandwidth filter sizes can be selected.

**DSB** - Double sideband. Sub bandwidth filter sizes can be selected.

**LSB** - Lower sideband. Sub bandwidth filter sizes can be selected.

**USB** - Upper sideband. Sub bandwidth filter sizes can be selected.

**DIGITAL** - Disables internal AF filtering. Used for decoding applications. Sub bandwidth filter sizes can be selected.

**FREQUENCY DISPLAY** - Shows the current tuned frequency, step size and dBm. Right clicking the display will allow you to change the tuning step size per mode.

**VFO A** - Selects VFO A.

**VFO B** - Selects VFO B.

**A>B** - Copies VFO A frequency to VFO B.

**B>A** - Copies VFO B frequency to VFO A.

**QMS** - Quick memory save.

**QMR** - Quick memory recall.

**MUTE** - Mutes the audio output.

**SCLC** - Enables the squelch. Adjustable via the green slider.

**Volume** - Adjusts the AF output via the orange slider.

**NFM** - Changes the FM sub mode to Narrow FM.

**MFM** - Changes the FM sub mode to Medium FM.

**WFM** - Changes the FM sub mode to Wide FM.

**SWFM** - Changes the FM sub mode to Stereo wide FM.

**CWPK** - Enables the CW PEAK filter. Adjustable via the EX CONTROL window.

**ZAP** - Selects the strongest signal in AUX SP filter bandwidth.

**CWAFC** - CW automatic frequency control.

**NR** - Enables noise reduction. Adjustable via the EX CONTROL window.

**NBW** - Noise blanker wide. Adjustable via the EX CONTROL window.

**NBN** - Noise blanker narrow. Adjustable via the EX CONTROL window.

**NBOFF** - Disables the noise blanker.

**AGC OFF** - Turns the automatic gain control to off.

**AGC MED** - Sets the audio automatic gain control to medium.

**AGC FAST** - Sets the audio automatic gain control to fast.

**AGC SLOW** - Sets the audio automatic gain control to slow.

**NCH1** - Enables notch filter 1. Adjustable via the EX CONTROL window.

**NCH2** - Enables notch filter 2. Adjustable via the EX CONTROL window.

**NCH3** - Enables notch filter 3. Adjustable via the EX CONTROL window.

**NCH4** - Enables notch filter 4. Adjustable via the EX CONTROL window.

**NCHL** - Locks the notch filters.

## EX CONTROL



**BW** - (mouse wheel adjustment): Set the bandwidth of notch filters 1-4. Use the mouse wheel to adjust these values  
**FREQ** - (mouse wheel adjustment): Set the center frequency of the notch filters 1-4 in Hz. Use the mouse wheel to adjust these values

**N1-N4** - This corresponds to each notch filter NCH1 - NCH4 (notch filters 1-4).

**AM SOFT FILTER** - (button): Clicking the "SOFT" button to activate the AM mode soft filter.

**FC** - (mouse wheel adjustment): Specify the cut-off frequency of AM soft filter. Use the mouse wheel to adjust this value.

**AGC** - (slider): Adjust the AGC threshold by sliding to the left and right.

**NB** - (slider): Adjust the threshold of the noise blanker by sliding to the left and right.

**NR** - (slider): Adjust the threshold of noise reduction by sliding to the left and right.

**CWPK** - (slider): Adjust the threshold of CWPK (the function that automatically tunes to the peak of CW) by sliding to the left and right.

**FM DEEM** - (button): Clicking the "DEEM" button to activate the de-emphasis function. Select 50 uS or 75 uS: (50 uS for non-US regions and 75 uS for US regions).

**AFC** - (button): Clicking the "AFC" button enables the automatic frequency tuning function.

**MONO** - (button): Clicking the "MONO" button switches to mono reception mode.

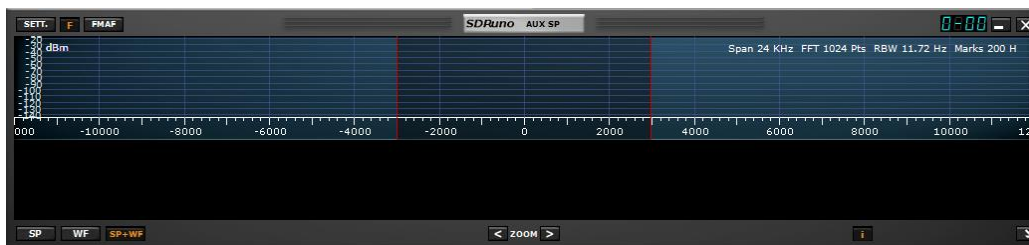
**FMS-NR** - (button): Clicking the "FMS-NR" button to activate Noise Reduction algorithm for FM stereo.

**FMS-NR** - (slider): Adjust the FMS-NR threshold by sliding to the left and right.

**PDBPF** - (button): Click to enable Pure Data Band Pass Filter.

**LC & HC** - (mouse wheel adjustment): You can adjust the low cut-off "LC" frequency value and the high cut-off "HC" frequency value. Use the mouse wheel to adjust these values.

## AUX SP



**SETT** - Shows the AUX SP settings window.

**F** - Toggles between filtered and nonfiltered display of the filter passband.

**FMAF** - Enabled FM DirectBand display.

**SP** - Shows only the spectral display.

**WF** - Shows only the waterfall display.

**SP+WF** - Shows the spectral and waterfall display with divider.

**< ZOOM** - Zooms out of the spectral display.

**> ZOOM** - Zooms into the spectral display.

**i** - Toggles the display of Span, FFT, RBW and Marks in the spectral display.

**->** - Resizes the AUX SP window.

## RECORDER



**Scheduler Config**- Sets the scheduled date and time of a IQ recording.

**Play**- Plays back the pre-recorded IQ stream.

**Pause**- Pauses the playback of the pre-recorded IQ stream.

**Loop**- Loops the playback of the pre-recorded IQ stream.

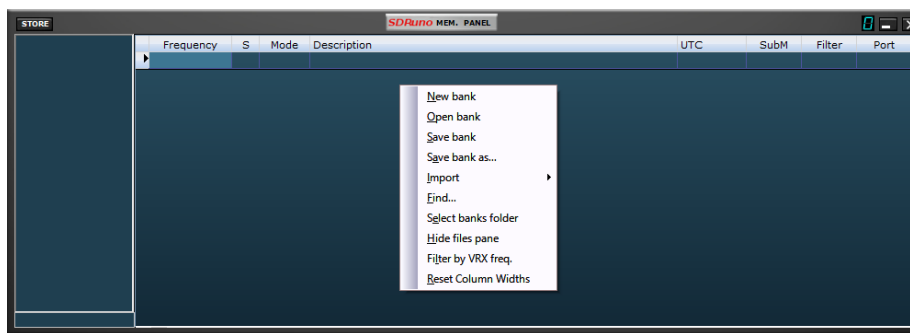
**Stop**- Stops the recording or the playback of the pre-recorded IQ stream.

**Back**- Plays the pre-recorded IQ stream from the beginning of the recording.

**Record**- Starts the recording of a IQ stream.

**Additional options are available from right clicking the mouse inside the Recorder window.**

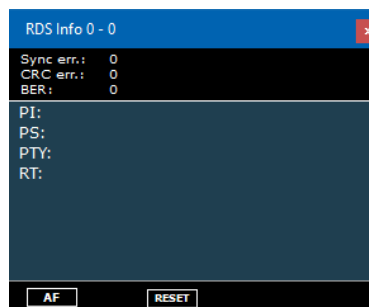
## MEM. window



**STORE**- Places the tuned frequency into the current bank selected.

**Additional options are available from right clicking the mouse inside the MEMORY window.**

## RDS INFO



**AF**- Shows additional frequencies if available from the RDS stream.

**RESET**- Resets the RDS decoder.

## MAIN SP



**SETT** - Shows the MAIN SP settings window.

**PWR & SNR to CSV** - Enables the recording of power and SNR signal measurement. Adjustable via the MAIN SP SETT. button.

**SP** - Shows only the spectral display.

**WF** - Shows only the waterfall display.

**SP+WF** - Shows the spectral and waterfall display with divider.

**COMBO** - Shows the spectral and waterfall display combined without separation.

**< ZOOM** - Zooms out of the spectral and waterfall tuned frequency.

**> ZOOM** - Zooms into the spectral and waterfall tuned frequency.

**VFO** - Centers the tuned frequency when zoomed into the spectral and waterfall display.

**< - RBW** Decreases the resolution bandwidth and FFT size shown on the spectral and waterfall display.

**> - RBW** Increases the resolution bandwidth and FFT size shown on spectral and waterfall display

**i** - Toggles the display of Span, FFT, RBW and Marks in the waterfall display.

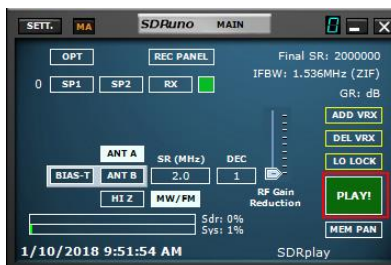
**->** - Right clicking selects pre-set resolutions that the MAIN SP can be displayed.

## 2. Changelog & Release Notes.

[https://www.sdrplay.com/docs/SDRplay\\_SDRuno\\_Release\\_Notes.pdf](https://www.sdrplay.com/docs/SDRplay_SDRuno_Release_Notes.pdf)

## 3. Getting Started

### 3.1 Starting the RSP stream

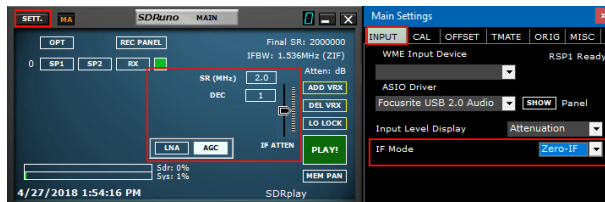


Starting the RSP in SDRuno is done by clicking on the green PLAY button within the MAIN window. The PLAY button will become red and relabelled STOP. Clicking on the STOP will stop the SDRuno stream.

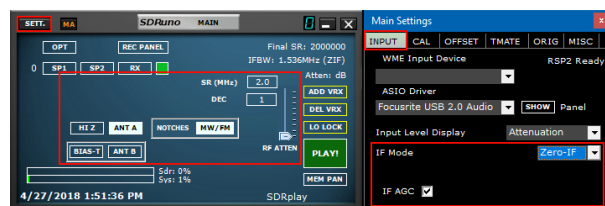


## 3.2 SDRplay RSP devices

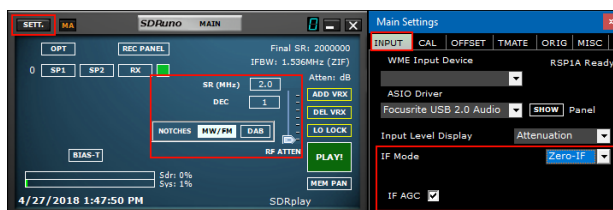
The RSP1, RSP2/2PRO & RSP1A all have specific features. These features can be selected via the MAIN window. Further controls for specific models are available by clicking on the SETT. Button within the MAIN window.



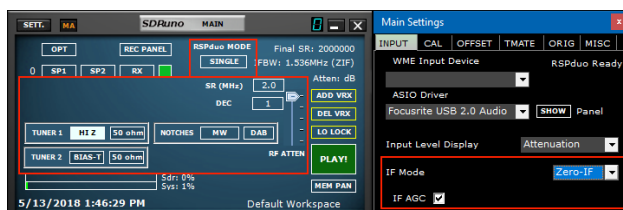
RSP1



RSP2/2PRO



RSP1A



RSPduo-Single tuner mode



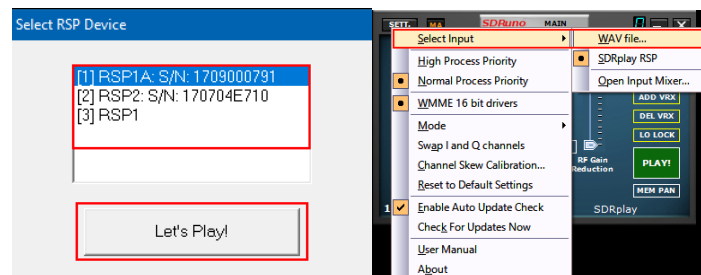
RSPduo-Dual tuner mode

### 3.3 Resetting SDRuno



SDRuno can be reset back to default state. From the MAIN window. Click the OPT button and select Reset to Default Settings from the drop-down menu. Resetting SDRuno can't be undone. All settings will be cleared and all instances of SDRuno will be shut down.




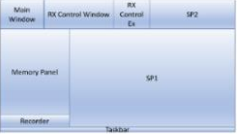
### 3.4 Application instance



SDRuno can run in multiple instances using multiplable RSP devices. The default device is always the RSP but the input device can also be a pre-recorded IQ file (Wave file). Each SDRuno instance stores and recalls its own setting known as a Workspace.

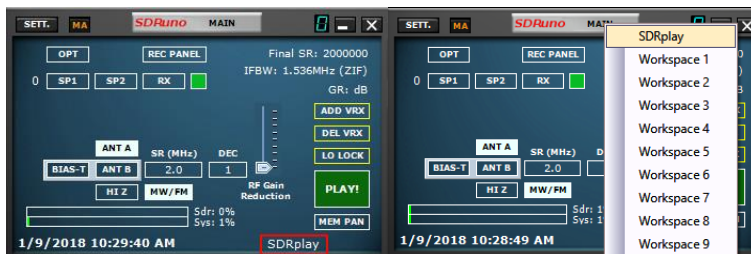
### 3.5 Workspace

Once you have started SDRuno you will have predetermined workspace based on the monitor resolution in use. You can still customize and build a custom workspace.

			
Default Workspace 1024x768	Default Workspace 1280x1024	Default Workspace 1366x768	Default Workspace 1920x1080

In SDRuno a workspace is a data set of visibility information (position, size and show/hide status) relative to all the VRX, Main and Recorder window used in an instance. The parameters of each VRX are also saved. Ten workspace memory positions are available in each instance (0 – 9). A workspace can be renamed. The first time you run SDRuno, you will have the workspace #0 recalled; its default name is "Default Workspace". The last used workspace in each instance is stored at program exit and recalled at the next start-up. Once you are satisfied with your work you can save the workspace.

## 3.6 Managing Workspaces



In order to manage workspaces, you have the following options:

**Save** the current windows set to a workplace memory position.

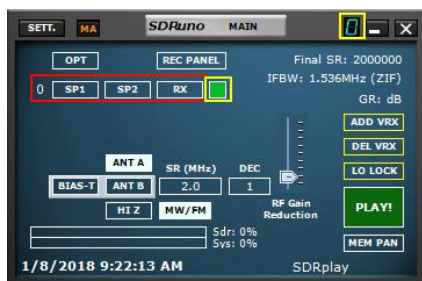
1. Press CTRL+W, the workspace selection window will open
2. Click on the Workspace location you want to use.
3. A workspace saved message will appear, click OK.
4. The workspace you just saved will have the same name as the workspace that was active when you set up the new window placements. To rename your new workspace right click on the workspace label name and input your new name. Press return.

**Recall** a workspace (making it the current workspace): click on the workspace name to popup the workspace list and click on the workspace you want to recall.

**Rename** the current workspace: Right-Click on the workspace name label in the Main window, enter the new name then press Enter to confirm or ESC to abort.

## 3.7 VRX

A VRX is a receiver implemented in software. Each VRX takes the signal from the defined sample rate processes it and will output the demodulated signal to an output device available of your choice (currently only WME devices are supported).

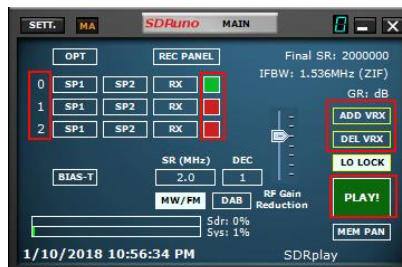


SDRUno can create and run multiple VRX inside the same application instance. When you run an instance of SDRUno, a single VRX is always created: it is the “master” VRX or VRX #0. VRX #0 has some peculiarities:

- can't be disabled or deleted
- it is the only VRX that can change the LO of the RSP
- it is (currently) the only working VRX when using the ASIO driver

## 3.8 Adding and Removing a VRX

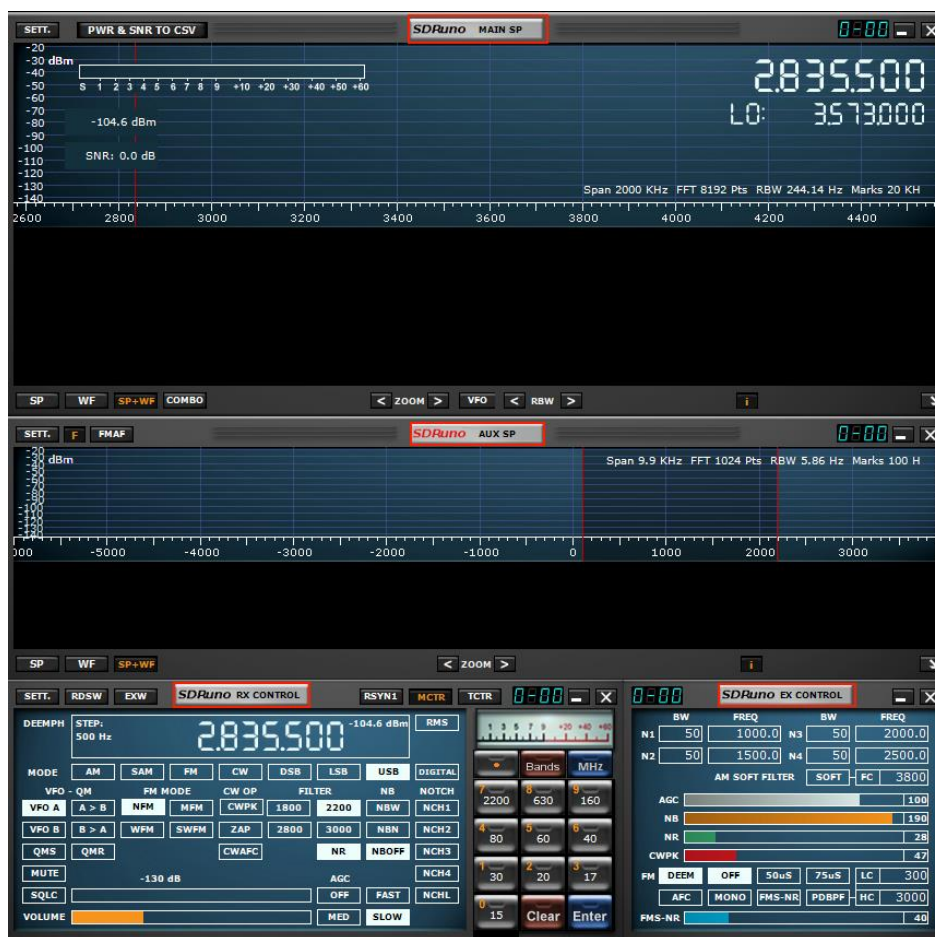
SDRuno must be stopped to add or remove a VRX.



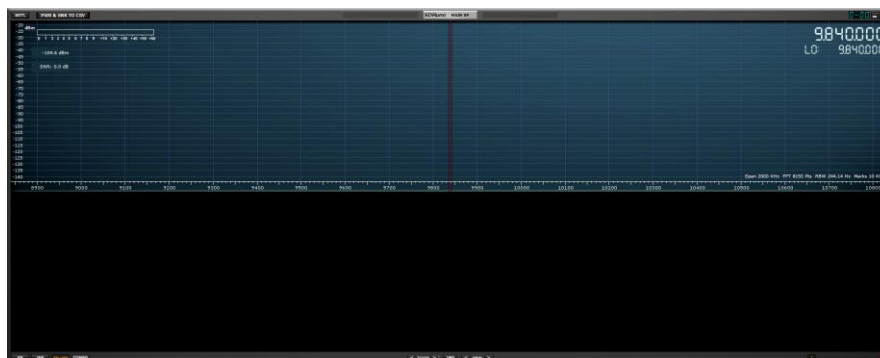
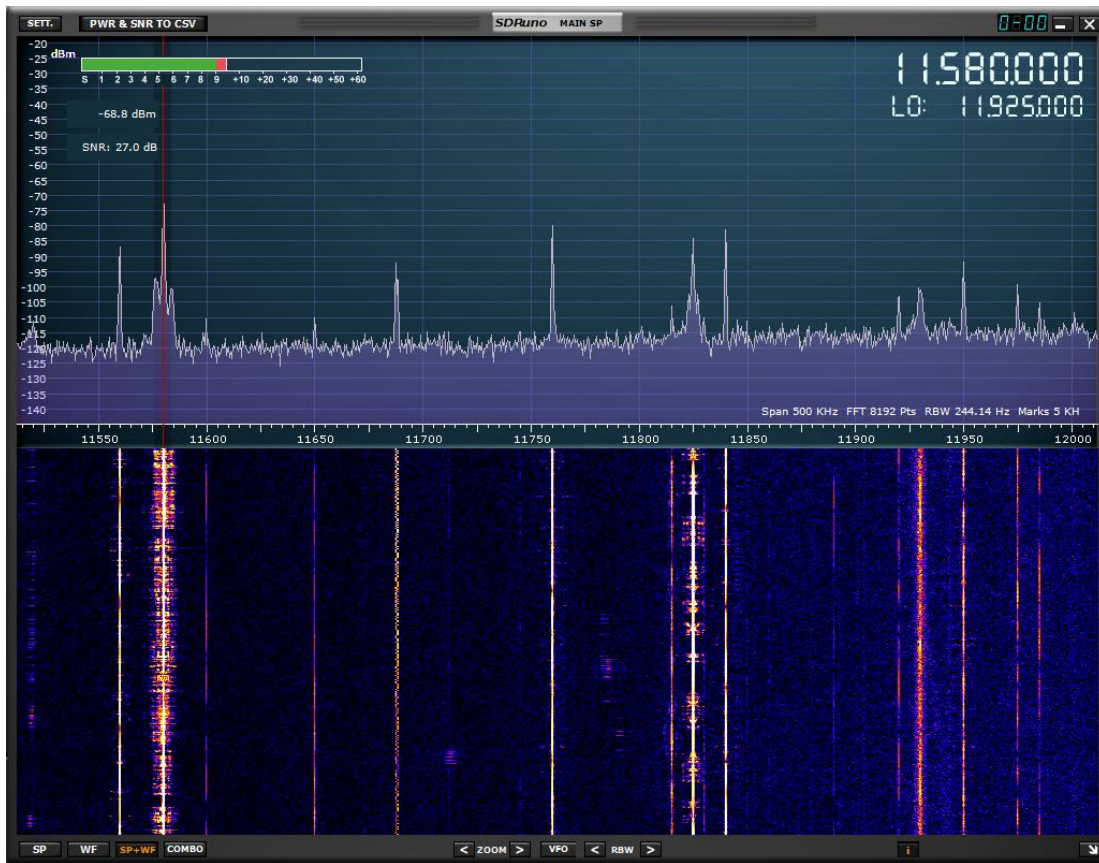
**ADD VRX** – This allows you to add an additional VRX, this can only be added if the RSP is stopped. The additional VRX must be in the selected bandwidth you have selected (SR MHZ).

**DEL VRX** – This allows you to delete the VRX last on the list.

Each VRX includes four default windows: **SP1**, **SP2**, **RX Control** & **RX EX Control** windows.



**SP1** or “Main spectrum” window: it shows the spectrum of the signal from the input device. This window is resizable and its settings are stored and recalled together with the relative VRX. Also, it can be closed or minimized to the task bar.

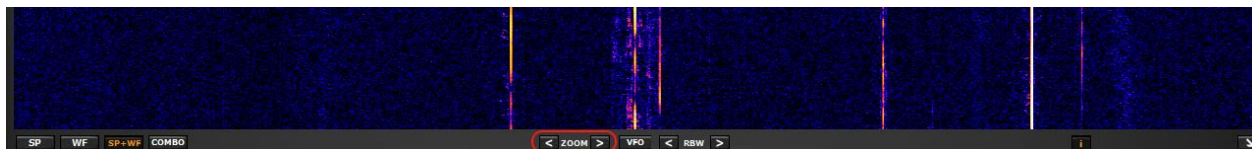


W = 528  
W = 1024  
W = 1280  
W = 1366  
W = 1920  
W = 2560  
W = 3840

The Main SP can be freely resized or a preset resolution width can be select by left clicking on the arrow on the lower right corner of the Main SP.

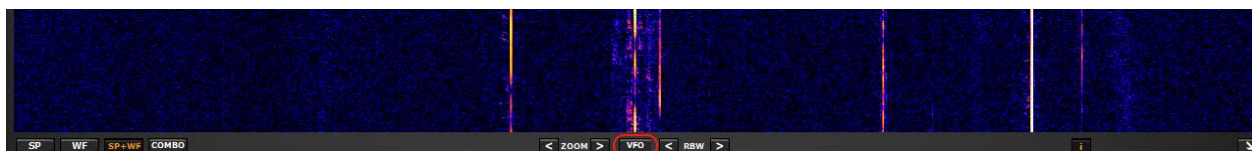


### 3.9 Zoom



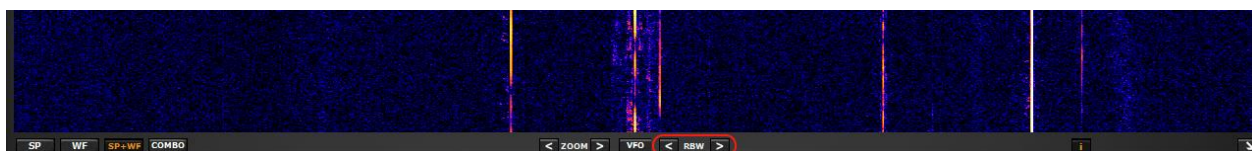
< Zoom > Zooming in and out on the MAIN SP is done by clicking on the < > icons. SDRuno has 5 zoom steps and will auto center on the tuned transmission

### 3.10 VFO



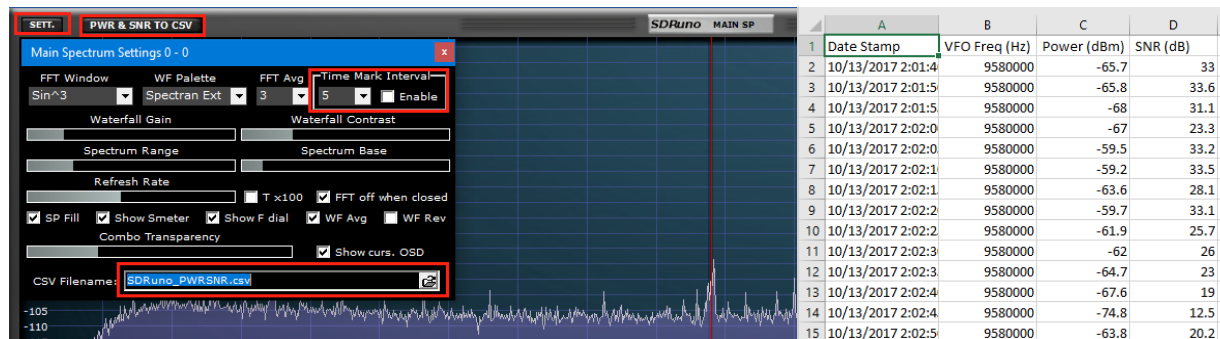
When zooming in and out of the MAIN SP you can have the VFO center within the MAIN SP by pressing the VFO button.

### 3.11 Resolution bandwidth



RBW is the detail of the spectrum display. It determines how much 'resolution' is displayed. Very fine frequency resolution can be achieved with smaller values. There is no optimum value. It depends on modulation and how much detail the user wishes to observe.

### 3.12 PWR & SNR TO CSV



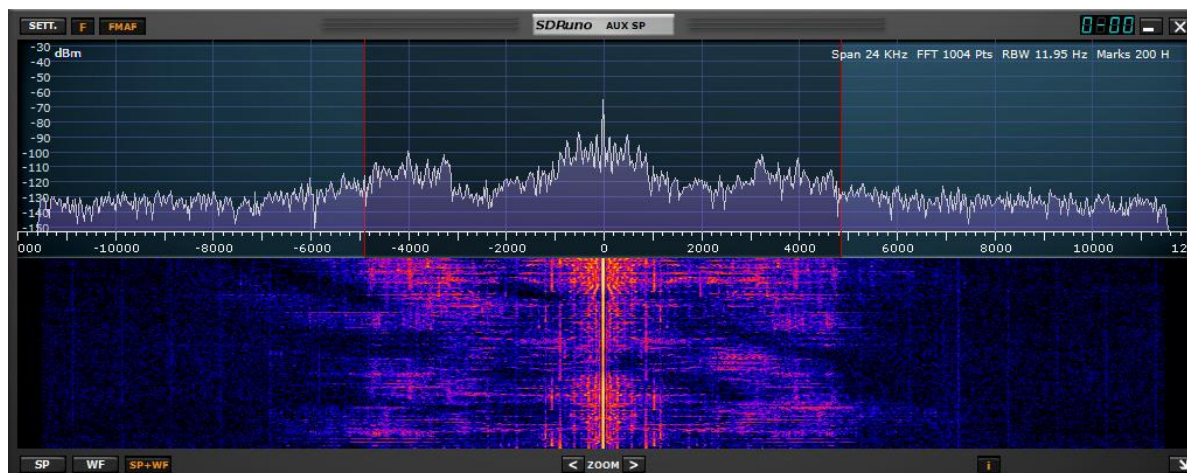
Power and signal to noise ratio measurements of a signal can be output to a standard CSV file for external processing by clicking on the PWR & SNR TO CSV button. The timing of each reading of that signal can be defined from the Time Mark Interval (in seconds). The location of the recording can be defined from the CSV filename box. Both variables can be changed from the MAIN SP settings button.

**SP2** or “Aux spectrum” window: it shows the spectrum in the down-converted bandwidth.

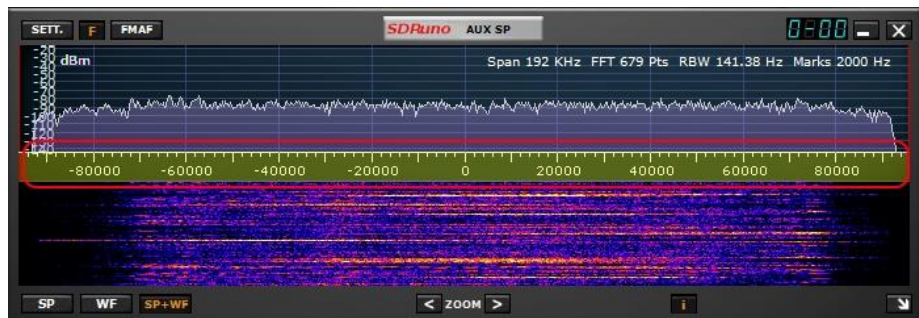
Here you can modify the selectivity filter, place notches etc.

This window is resizable, and its settings are stored and recalled together with the relative VRX.

Also, it can be closed or minimized to the task bar.



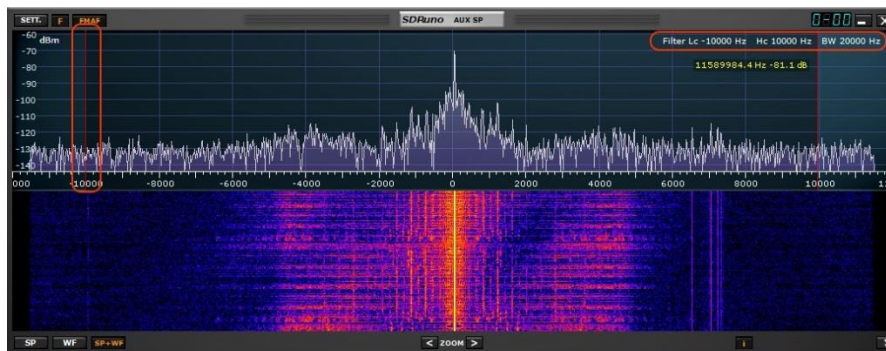
### 3.13 The spectrum “quick browser”



Sometimes in a spectrum window you need a high zoom factor and at the same time you need also to move quickly to another part of the spectrum; as the shown spectrum portion is small in comparison to the total it would take ages to reach the wanted position dragging the frequency scale. SDRuno has the “quick browser” function:

- Place the cursor inside the frequency scale.
- Press the SHIFT key, a yellow overlay will appear on a portion of the scale: here the size and position of this overlay indicates the currently shown portion of the spectrum relative to the total (the whole frequency scale).
- Click and drag the above overlay until the window shows the spectrum portion you wish.

### 3.14 SP2 filter adjustments



Besides the usual dragging of the selectivity filter edges (the red cursors) in the SP2 window there are other some useful features available.

#### 3.14.1 Asymmetrical adjustment

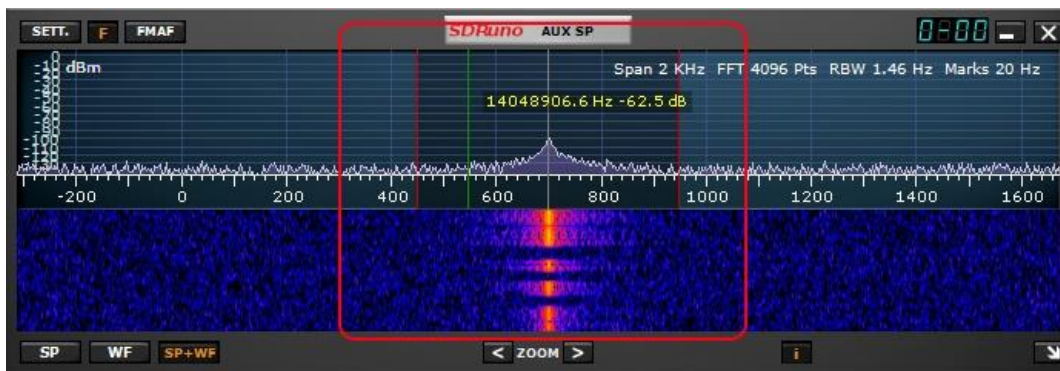
Usually in AM, SAM (DSB) and FM mode, dragging one edge has the effect of controlling simultaneously the other in order to create a symmetric filter (around 0). In SDRuno the selectivity filter high and low frequency parameters can be different. If you wish to set up an asymmetrical filter drag one edge while pressing the CTRL key.



### 3.14.2 Pass band Tuning

Put the cursor in between the filter red cursors. Right-click and drag: this will have the effect of moving both the filter edges (pass band tuning).

### 3.15 CW pitch (CW shift)



In CW receiving mode a VRX uses a frequency offset in order to obtain a CW note. This offset can be set as follows:

- Make sure you have the DSP engine running (so to have the spectrum window updated).
- Select CW receiving mode.
- Place the cursor in the spectrum part of the Aux Spectrum window (SP2); a green vertical line will be shown at cursor position.
- Choose your new CW pitch moving the above line to the corresponding mark on the frequency scale; a positive value will set a “lower than carrier” offset (USB-CW) while a negative value will set a “higher than carrier” offset (LSB-CW).
- Assign the new offset by Left-Click while pressing the CTRL key.

### 3.16 Adjusting the proportion of spectrum and waterfall displays



Inside SP1 and SP2 window, for the SP+WF display mode you can alter the proportion of the SP vs. WF by right-clicking the frequency scale and dragging it vertically to the desired position.

**RX Control** is the VRX control center. Here you can set the VRX output device, frequency, receiving mode, step size and many more parameters. Its settings are stored and recalled together with the relative VRX and it can be closed or minimized to the task bar.



### 3.17 Selecting an output device



As already seen previously, each VRX can have its WME output device. More VRX can share the same WME device. Output device can be selected in RX Control->Settings->Out Tab. If no device is selected (default) the VRX will use the system default (sound mapper). SDRplay must have a output device. When you change the output device the stream must be stopped and restarted via the MAIN window.

### 3.18 Setting the RX frequency



You have multiple choices for inputting a frequency value:

- Clicking on one of the band buttons (under the S-meter in the RX Control window).
- Moving the cursor to a specific digit in the frequency display (inside the RX Control window or inside SP1 if the dial is enabled) and turning the mouse wheel.
- Using the current tuning step turning the mouse wheel (when the cursor is outside any control and one of the VRX window is selected).
- Entering the frequency directly with the mouse and/or the keyboard.
- Clicking on the Main Spectrum window (spectrum or waterfall); the actual selected frequency is the nearest multiple of the current tuning step.
- Using the Memory Banks features.
- Using a dedicated hardware controller (Tmate – Tmate 2).
- Using CAT control and/or Omnirig.



Note that SDRplay displays the frequency in the format of GHz, MHz, kHz & Hz.

### 3.1 Step Size

If you wish to change the step size. Select the mode. Right click on the frequency readout. Select the new step size.



## 3.2 Entering frequency directly



If you wish to use the keyboard one of the VRX window must be selected. In order to enter a frequency directly with the keyboard and/or mouse:

- Press the SPACE bar or click on the RX Control frequency dial; this will start the input sequence. The dial will display 0 and the white frame around the dial will turn to yellow. In order to abort the input sequence, press the ESC key or click on the Clear button in the RX Control window.
- Enter the frequency in kHz using the numeric keys and/or clicking on the band buttons. If you wish to enter Hertz values, use the decimal separator of your system. For example, if you wish to enter 1455202 Hz type in 1455.202 (or 1455,202 depending on the system). Note: you can use whatever decimal separator you wish; the program will replace it automatically (if needed) with the correct one.
- Enter the frequency in MHz using the numeric keys and/or clicking on the band buttons. If you wish to enter Megahertz values, use the decimal separator shown in the RX Control. For example, if you wish to enter 146.520 MHz type in 146.520 & hit the MHz button.
- Press Enter or click the Enter button in the RX Control window. If the value has been accepted the dial will show the new frequency.
- Press Enter or click on the Enter button in the RX Control window. Type in the frequency in MHz and hit M on your keyboard



### 3.3 Automatic Ham band & Broadcast band Framing



When pressing one of the Ham band or Broadcast band framing buttons in the RX CONTROL the band button selected will light up orange enabling the following. Locking of the LO, auto adjustment of the sample rate and decimation value along with the proper mode picked for the band selected. The MAIN SP window will now “frame” the complete frequency range of the band chosen.

Unframing the Ham band or Broadcast band is done by simply click on the band framing button you selected. The orange band framing light will go off and the sample rate will be restored 2 MHz and decimation will be 1. Unframing a band also unlock the LO.

Decimation is not available when a band is framed. Framing wider than 10 MHz isn't possible in Zero IF mode (2 MHz in Low > IF mode), The LO LOCK is disengaged and the frequency is set to the centre of the band.



Left or Right clicking on the “Bands” button will bring up the additional band segment presets.



Ham Lower populates the preset band buttons with 2200m, 630m, 160m, 80m, 60m, 40m, 30m, 20m, 17m & 15m.

Ham Upper populates the preset band buttons with 12m, 10m, 6m, 4m, 2m, 1.25m, 70cm, 33cm, & 23cm.

Broadcast populates the preset band buttons with 75m, 60m, 41m, 31m, 25m, 22m, 19m, 16m, LW & MW

## 4. Synchronous AM



SDRuno implements a high-performance SAM mode. When you select SAM the last used sub-mode is also recalled (LSB, USB or DSB). Once SAM is engaged you can switch to the desired sub-mode by clicking the relative buttons:

- LSB: lower sideband SAM
- USB: higher sideband SAM
- DSB: double sideband SAM

LSB and USB SAM sub-modes share the same selectivity filter settings while DSB has its own settings. Some common filter settings are available as presets in the RX Control window. Of course, you can set the filter manually as indicated in 4.4.

Automatic volume compensation is performed while switching from LSB or USB to DSB. To leave SAM mode you can either click on the SAM button again (this will select the last used SSB mode) or select any other reception mode.

In SDRUno the SAM PLL has its own AGC and selectivity filter.

There are many advantages in using this configuration:

- The demodulation AGC timing can be optimized for listening while a much faster PLL AGC can cope with fast, deep fading
- The PLL selectivity filter can be made very narrow in order to allow only the wanted carrier passing thru; this way little noise reaches the PLL and the lock on noisy signal is much improved

The PLL step response can be set to two different modes:

- FAST: this is the default mode; in "fast" mode the PLL can track phase-modulated carriers that contain embedded data streams (for example BBC on 198 KHz), avoiding the demodulation of those noisy unwanted signals. Lock time is fast even if you are off-tune but the PLL is also more sensitive to noise given the wider loop bandwidth.
- SLOW: this is definitely the DX choice; lock time is slower and the PLL is much more immune to noise. This mode combined with a narrow PLL BW filter setting gives exceptional lock stability on very noisy signals.

Locking range is limited with this setting: if this is a problem, first select FAST mode then switch to SLOW if required.

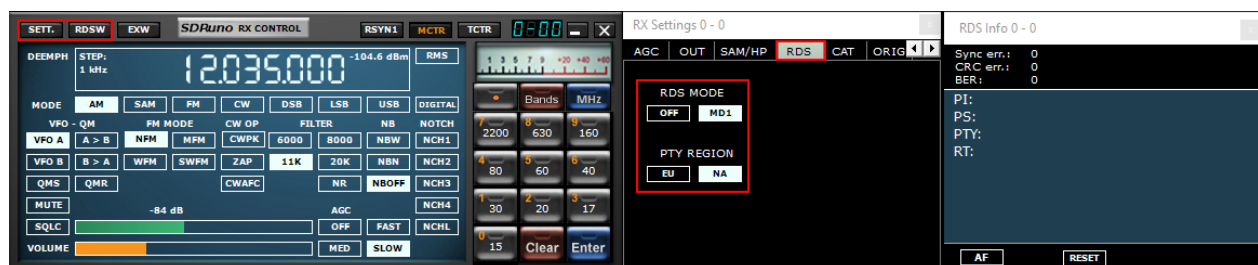
The pre-PLL pass-band filter can be adjusted from +/- 50 Hz to the full bandwidth available. Please note that this setting also limits the range in which the PLL can achieve lock: for example, if you are using a 500 Hz setting (default) and you tune outside the +/- 500 Hz from the carrier, the PLL will never lock as the carrier is filtered out.

All the PLL AGC parameters are pre-fixed for best results minus the release time. This parameter can be optimized for the specific reception condition; usually the default value works well.

All the SAM settings are available in RX Control->Settings->SAM/HP Tab.



## 5. RDS



There is a “DX mode” feature in the RDS decoder. The RDS processing offers “state of the art” performances, very close to the theoretical limits. Testing has shown that it is still possible to obtain a valid RDS PI from a signal with only a 10 dB S/N ratio. The settings window can be used to enable the RDS system and change the PTY region between North America (NA) and Europe (EU)

## 5.1 RDS “DX-mode”



RDS data is transmitted in pieces called “RDS groups” and each group is composed of four “RDS blocks”. To obtain valid data the RDS decoder must achieve “synchronization” first; this means that a correct sequence of blocks “A” to “D” must be validated by the embedded error correction system. In very poor S/N ratio (approximately below 11-12 dB) this is impossible. In normal use this is usually not a great concern but for DX enthusiast it is, as the main goal is the identification of the broadcaster by the RDS PI data. PI data is embedded at least in all “Block A” of any RDS groups so it is one of the more redundant pieces of information transmitted. In RDS “DX-mode” SDRplay tries to extract the PI by attempting a partial synchronization, then the relative PI data is shown in red. The level of confidence is very high (> 99.5%). The RDS decoder exits “DX-mode” once full synchronization is achieved, and the PI label returns to its normal state. In order to re-enter DX-mode you have to reset the decoder by the RESET button in the RDS Info window. For marginal signals DX-mode can be a very useful tool.

## 6. S-Meter function



When used with any RSP the S-Meter is accurate calibrated. In order to change the S-Meter function to FM tuning meter and vice versa, simply click on it.

**RX EX Control** groups additional controls for the VRX that are (generally) less frequently used. The purpose of this separation is to spare screen space when possible. Here you have access to all the parameters relative to notches, noise blanker, noise reduction, soft filter, SNR and more. These settings are stored and recalled together with the relative VRX and it can be closed or minimized to the task bar.

Note: Each VRX stores and recall its own settings.





## 7. Quick notch frequency setting and the notch-lock function



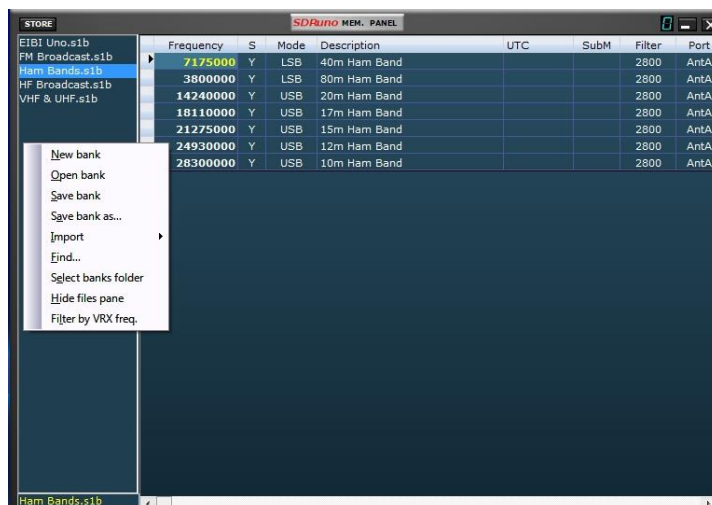
Each VRX offers four notch filters to suppress unwanted signals, placed before the AGC. Each notch filter can be enabled/disabled by the relative button in the RX Control window. The notch filters BW & Frequency settings are available in the RX EX Control window. For notch filters 1 & 2 the frequencies can be quickly set “on the fly” as follows:

- Place the cursor in the spectrum part of the Aux Spectrum window (SP2); press and hold the SHIFT key: a yellow vertical line will be shown at cursor position.
- Move the above line next to the signal you wish to suppress.
- Assign that frequency to Notch 1 by Left-Click or Notch 2 by Right-Click.
- Release the SHIFT key.
- For each enabled notch the relative frequency is marked in the spectrum by a dotted vertical line, light-blue for Notch 1 and light-pink for Notch 2.

The **NCHL** button in the RX Control window enable/disable the notch-lock feature. When notch-lock is active, the notch filters frequencies are updated when the receiving frequency is changed.

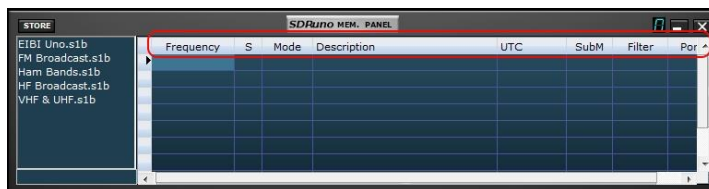
Let's see the purpose of the Notch Lock function in a typical usage scenario: you are following a SSB QSO where some operators are each other slightly off frequency, requiring retuning for good audio. At the same time you are using a notch filter to kill a heterodyne tone caused by a nearby emission. Without notch-lock you should re-adjust the notch filter(s) frequency every time you retune; notch-lock does this for you automatically.

## 8. Memory banks



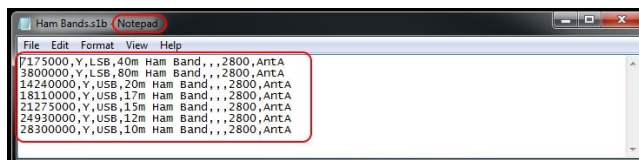
SDRuno supports its own memory banks. Considerable efforts have been put into the development of such an important feature, in order to provide a powerful yet easy to use and efficient implementation.

### 8.1 Basic concepts



In SDRuno each memory bank consists of a number of “memory locations”. Each memory location is composed of a number of data fields about a “reception channel” like frequency, description, RX mode and so on. Physically a bank is saved as a disk file and loaded in memory when needed.

### 8.2 The memory bank file format



SDRuno uses its own extension (.s1b) for memory bank files but the file format itself is not proprietary: it is a common CSV text file, a format that can be easily handled by many software tools.

## 8.3 GUI items added for memory banks management

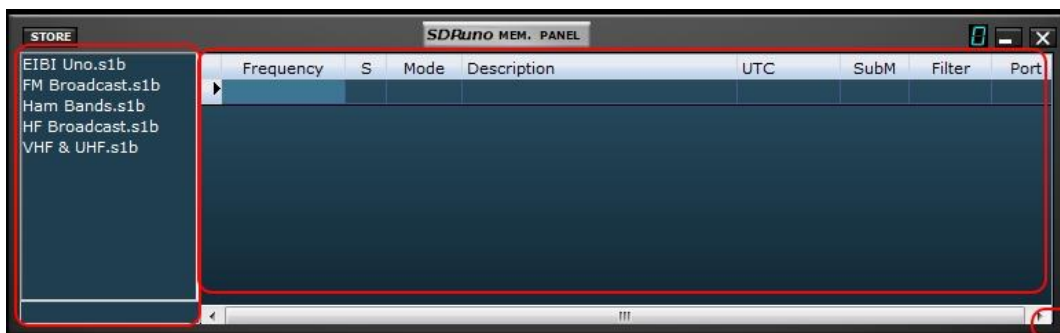


In order to implement memory banks, some GUI items have been added:

- A new window, the “Memory” window that is the control center of all memory related operations.
- A new button on the “Main” window labelled “MEM PAN”.
- A new button on the “RX Control” window labelled “MCTR”.
- Some new keyboard shortcuts.

These controls are described in the following chapters.

## 8.4 The “Memory” window



The **Memory Window** is an instance resource: you can have one for each instance of SDRuno (you actually need two of them in order to perform some advanced operations, more on this later); the window is resizable and its visibility parameters are stored in the workspace. To show the Memory window click on the **MEM PAN** button on the **Main** window or press the **B** key from any window of the program.

The Memory window is functionally split in two parts: the left part, also called the **files pane** and the right part also called the **data grid**. The files pane shows all the bank files in the current **banks folder**; you can quickly open one of the listed banks by double-clicking its name. On the bottom of the list a label shows the name of the currently loaded bank. The files pane can be hidden/shown with the **CTRL+F** keyboard shortcut or from the window context menu (mouse right-click); this setting is persistent (saved in the registry).

The **data grid** is the key control: here the current bank data are showed in **cells** organized in **rows** (the memory locations) and **columns** (the data fields), much like some spreadsheet programs you have probably used.

## 8.5 Memory data fields



Currently each memory location includes 5 data fields:

### Frequency

This is the most important field of course; frequency is expressed in Hertz up to 10 digits. If left blank the program will not change the tuning frequency of the relative VRX upon recalling.

### S (scan mode)

This single character field is a flag for the SDRuno scanning feature (not yet implemented); its purpose is to instruct the scanning system on what to do with that specific memory location. Allowed values are **blank**, **Y** and **N**.

### Mode

This field indicates the **RX mode** for that memory location. Allowed values are: **blank**, **AM**, **SAM**, **FM**, **CW**, **DSB**, **LSB**, **USB**, and **USER**. If left blank the program will not change the RX mode of the relative VRX upon recalling.

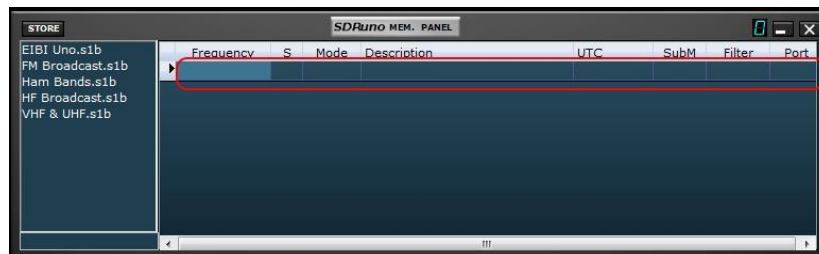
### Description

This field include an optional alphanumeric description of the memory location. The maximum length is undefined; however the grid editor for this field limits the input to a maximum of 255 characters.

### UTC

This field can optionally include a description of when the relative channel is on-air, a feature usually included in many frequency databases. The format is XXXX-YYYY where XXXX is the start time and YYYY the stop time (UTC time); for example 0000-2400 means that the station is on air 24 hours a day.

## 8.6 The data grid



The data grid has the main purpose of showing data but it also provides many ways for editing. Inside the grid you can:

- Scroll the bank data with the mouse wheel, scrolling bars or up-down arrow keys.
- Customize the columns order.
- Insert (add), delete, move and copy/paste rows.
- Manually edit single cells.
- Copy-paste single cells and cell selections.
- Perform row sorting (ascending/descending) with a single click.
- Search for specific data (incremental search).
- Filter data

Selected data fields are shown in yellow.

The current active cell is highlighted with a brighter background.

The current active row is shown by a small arrow marker shown in the row header.

## 8.7 Basic operations in the data grid

### 8.7.1 Customizing the columns order

By default the grid shows the columns in the same order as the relative data fields are stored in the bank file. However you might want to change the columns display order. To move a column to a new position click and drag the relative column header to the new position (a green arrow shows you the insertion point), then release the mouse button. Columns order is persistent (it is saved in the registry).

*You can't change the columns width.*

## 8.7.2 Manual editing of cells



In order to start manual editing of a cell you have two options:

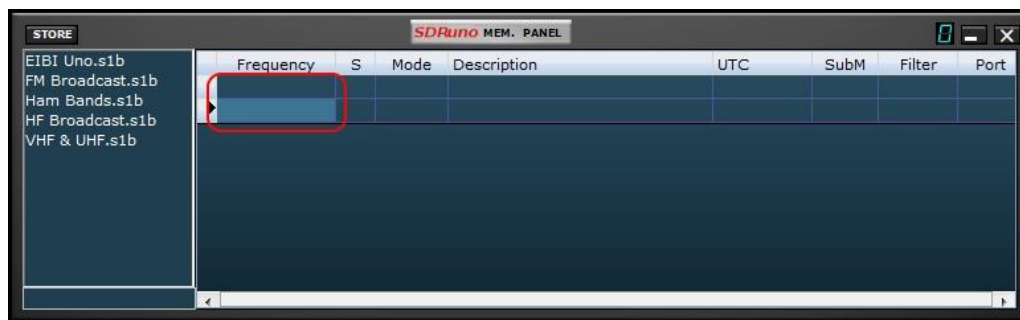
- **Click** on the relative cell then press **F2**.
- **Double-click** the cell.

The above operation starts the specific editor for that cell:

- The Frequency field editor allows up to 10 numeric characters.
- The Description field editor allows up to 255 alphanumeric characters.
- The Mode and S field editors are of the combo-list kind: upon pressing the combo button you are allowed to select one of the values in the drop down list.
- The UTC field editor allows up to 9 alphanumeric characters.

To close the editor, press the Enter key (combo-list editors close automatically upon selection). If the entry is invalid the cell shows the previous data.

## 8.7.3 Manually inserting a new row



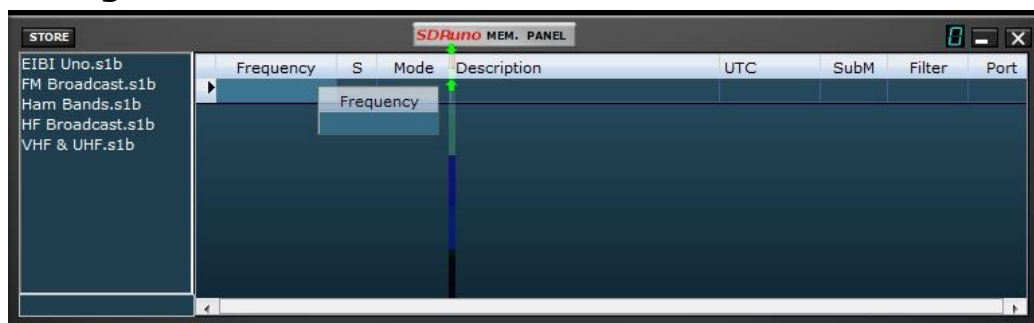
New rows are always inserted after the current one. To manually insert a new (blank) row press the **Ins** key.

## 8.7.4 Deleting a row



To delete the current row, press the **Del** key.

## 8.7.5 Moving a row



To move a row to a new location, click and drag its header to the new location (a green arrow shows you the insertion point); finally release the mouse button.

## 8.7.6 Copying a row

If you don't want to overwrite a previous row, first insert a new blank row to be used as the destination one.

- Select the source row by clicking its header.
- Copy to clipboard by **CTRL+C** shortcut.
- Now click the row header of the destination row.
- Paste from clipboard by **CTRL+V** shortcut.

## 8.7.7 Copying a single cell

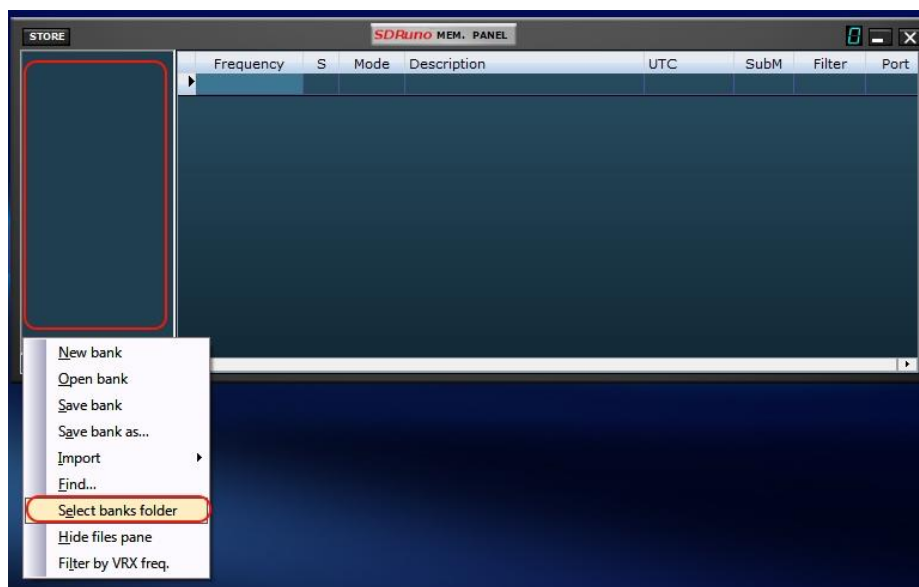


STORE	Frequency	S	Mode	Description	UTC	SubM	Filter	Port
EIBI Uno.s1b	7175000	Y	LSB	40m Ham Band			2800	AntA
FM Broadcast.s1b	3800000	Y	LSB	80m Ham Band			2800	AntA
Ham Bands.s1b	14240000	Y	USB	20m Ham Band			2800	AntA
HF Broadcast.s1b	18110000	Y	USB	17m Ham Band			2800	AntA
VHF & UHF.s1b	21275000	Y	USB	15m Ham Band			2800	AntA
	24930000	Y	USB	12m Ham Band			2800	AntA
	28300000	Y	USB	10m Ham Band			2800	AntA
	28300000							

- Click on the source cell; copy to clipboard by **CTRL+C**.
- Click on the destination cell; paste from clipboard by **CTRL+V**.

## 8.8 Bank file operations

### 8.8.1 Changing the current Banks Folder

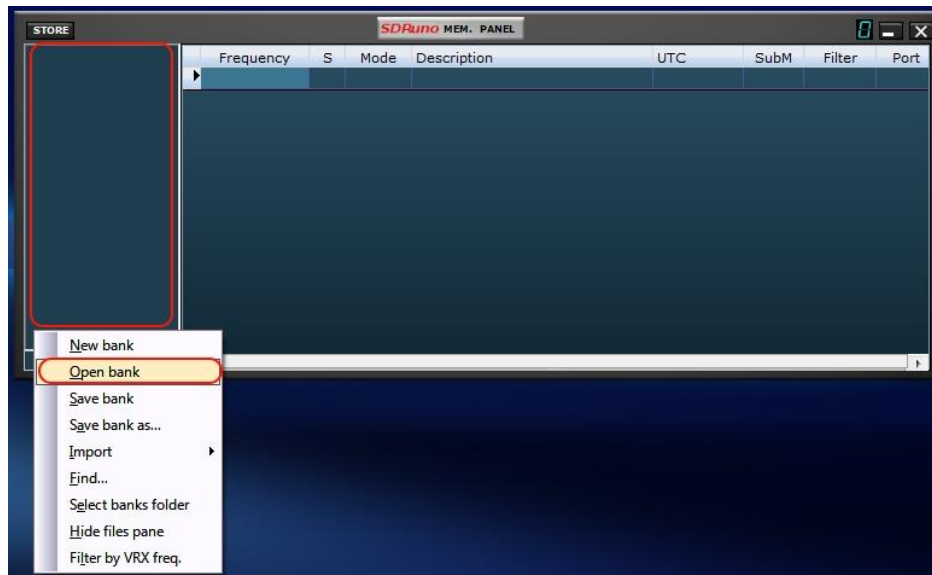


The default Banks Folder is My Documents\Mem\_banks.

To change the **Banks Folder**, pop up the context menu (right-click on the files pane or the grid) then choose **Select banks folder**; navigate to the new folder then click **OK**. The Banks Folder is persistent (it is saved in the registry).



## 8.8.2 Opening a bank file

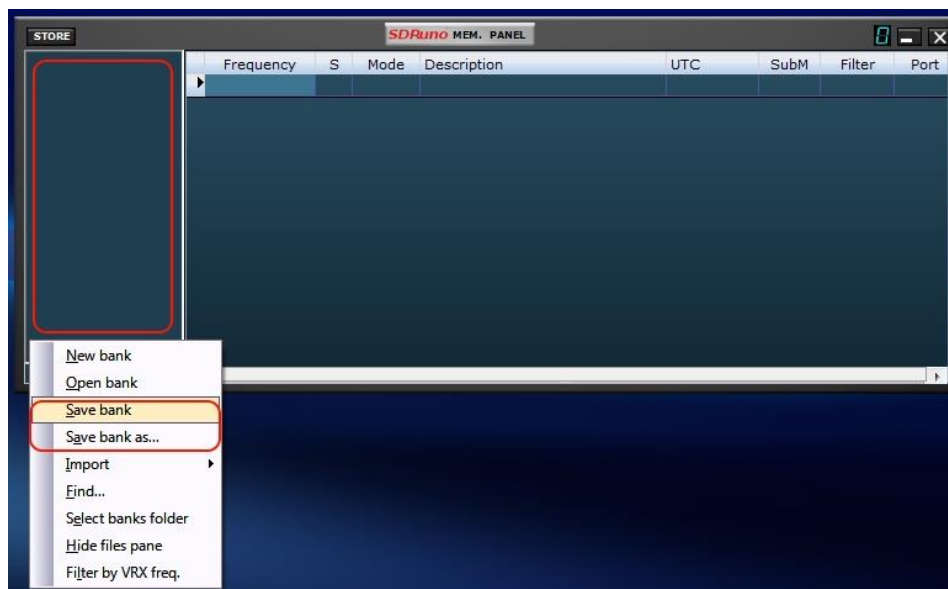


The quick way to open a bank file is by **double-clicking its name in the files pane**. Another option is by the context menu **Open bank** option.

**Caution:** To speed up operations, SDRuno will not bother you with pop-up window asking if you have saved your data. So if you made modifications to the current bank, make sure to save it before loading a new one.

The last used bank is automatically reloaded at the next program start-up.

## 8.8.3 Saving a bank

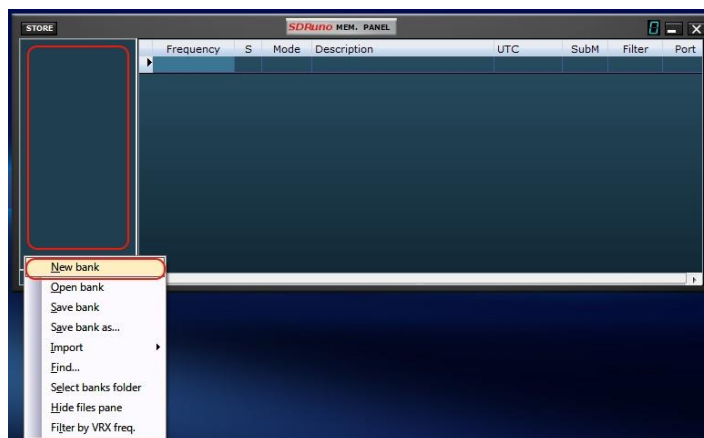


To save an already named bank choose **Save bank** from the context menu. If the bank is new (unnamed), Save bank starts a **Save bank as...** operation instead (see below).

## 8.8.4 Saving a bank with a specific name

This is the usual Save as operation: choose **Save bank as...** from the context menu. A save dialog window let you name the file; if the file already exists a warning window pops-up.

## 8.8.5 Creating a new blank bank



To create a new, blank bank choose **New bank** from the context menu.

**Caution:** as for the Open bank option in order to speed up operations, SDRuno will not bother you with pop-up window asking if you have saved your data. So if you made modifications to the current bank make sure to save it before creating a new one.

## 8.9 Recalling a memory location



In this context recalling a memory location means assigning its Frequency and Mode parameters to a SDRuno VRX. As an instance of SDRuno can have more than one VRX you need a way to tell the Memory Window which is your “target” VRX: this is the purpose of the **MCTR** button on the RX Control window. The MCTR button “connects” a specific VRX to the Memory Window for some operations. A mutual exclusion logic is implemented: only one VRX can be assigned at a given time (inside the same application instance). Once a VRX is “connected” recalling a memory location is straightforward: simply click on any cell of the wanted memory location (row).

## 8.10 Storing to a memory location



Storing to a memory location imply first inserting a new blank row after the current one, filling some fields automatically and finally making that row the current one in preparation for the next operation. The program fills the Frequency and Mode fields with data from a specific VRX. You have different options to perform the above operation:

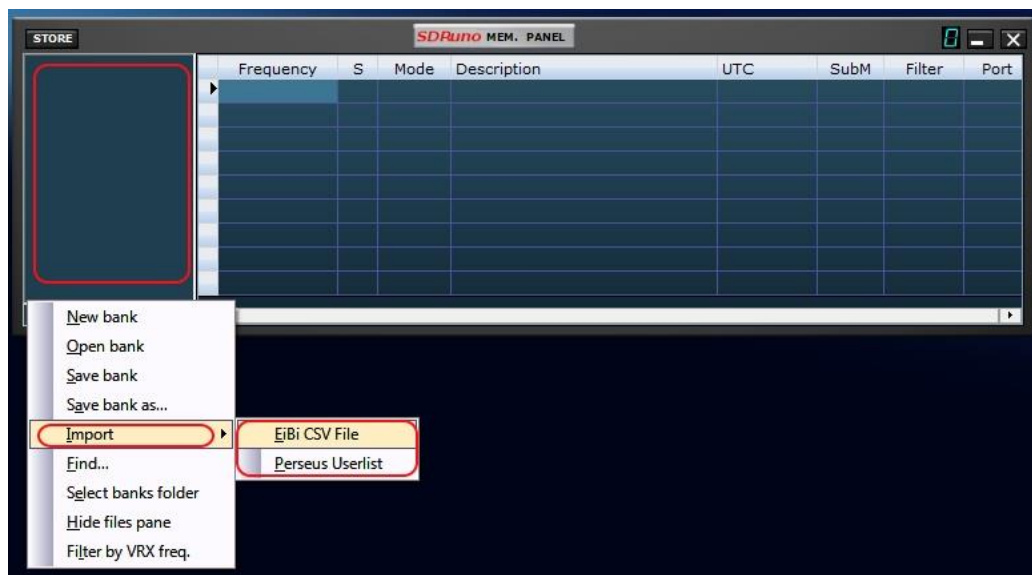
Storing from a VRX with the **MCTR** button active

- Click on the STORE button on the Memory Window.
- Alternative way: use its keyboard shortcut CTRL+S (the Memory Window must be selected).

Storing from a VRX that has been selected regardless of the MCTR button status

- Use **CTRL+S** (one of the VRX windows must be selected).

## 8.11 Importing from other database formats



In the future SDRUno will be capable of importing data from all the most used frequency databases. Currently the Import feature only works for **EiBi** database files (CSV format) and **Perseus "Userlist"** (\*.txt) files. In order to import from a database chose **Import** from the context menu, then select one of the import options. Locate the source file and click Open. The import process takes a couple of seconds (depending on the length of the database and your PC processing power).

The bank thus created can be saved as a SDRuno regular bank file.

## 8.12 Advanced editing operations



You can sort the loaded memory bank using any of the **data fields** as the main **sorting key**. To perform ascending sorting, click on the column header of the field you wish to use as the key. Click again to perform descending sorting. A further click undoes the sorting. An arrow indicator shows up in the column header used for sorting; it points upward to indicate an ascending sort and downward for a descending sort. A sorted bank can be saved in its state if needed.

### 8.12.1 Searching the memory bank



Sometimes you might have to search a large bank for a specific word occurrence. To activate the search function choose **Find...** from the context menu; a search footer appears. The search footer provides you with familiar functions to perform incremental search; as you type your text in the search edit box the search process refines. Use the **Next-Previous** buttons to navigate among multiple occurrences of the same word. Unless the Match case option is checked search is case-insensitive.

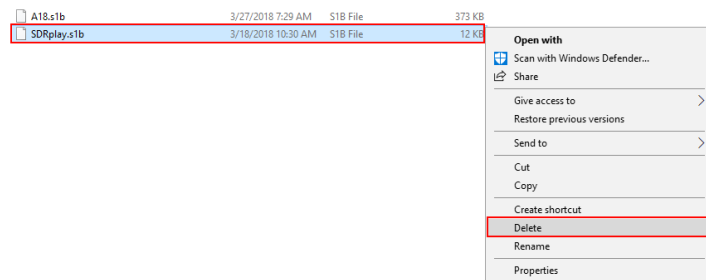
### 8.12.2 Selecting and copying multiple cells

It is possible to copy multiple cells at a time; to perform a multi-cell selection click on the upper left cell and drag to the right lower cell of the selection area (selected text turn to yellow). Then you can copy and paste the entire selection using the clipboard shortcuts already seen (**CTRL+C**, **CTRL+V**).

### 8.12.3 Creating a composite bank from several source banks

You can copy-paste from the Memory Window of a given SDRplay instance to the one of another instance; this capability allows complex editing operations like the composition of a bank including data from different "source" banks, without the need of a specialized tool. You only need another Memory Window from a second SDRplay instance. Simply apply all the editing operation already seen but this time using one Memory Window instance as the source and the other as the destination.

## 8.12.4 Deleting banks



Navigate to the directory assigned for saving SDRuno banks. Delete the bank that is no longer needed.

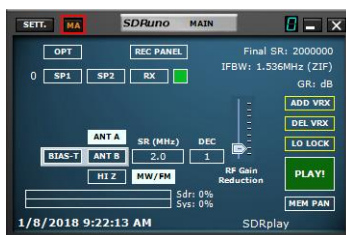
## 8.13 Filtering data



Filtering a data bank means showing only the rows that match filtering criteria. Currently you can only **filter by VRX frequency**. To enable this options choose Filter by VRX freq. from the context menu. The data grid is updated after every frequency change; since filtering a large data bank is a CPU intensive operation, the program waits until it detects that the tuning operation has ended, and then performs the filtering. If no VRX is assigned to the Memory Window, no filtering occurs. Filtering is disabled when choosing one of the following options:

- New bank
- Import

## 8.14 Minimize/Restore All option



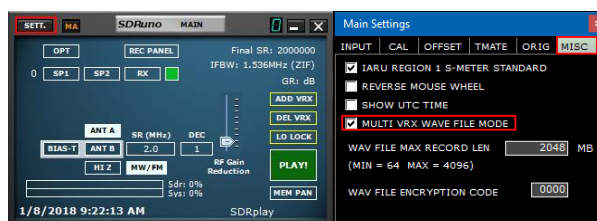
As the SDRuno GUI is made of many independent windows, an option to minimize or restore all the windows of an instance with a single action can be very handy sometime. The “minimize-restore all” option is controlled by the small “MA” button located in the upper left of the Main window. When enabled, minimizing or restoring the RX Control or the RX EX Control window will result in minimizing or restoring all the opened windows in the relative SDRuno instance.

## 8.15 VRX background

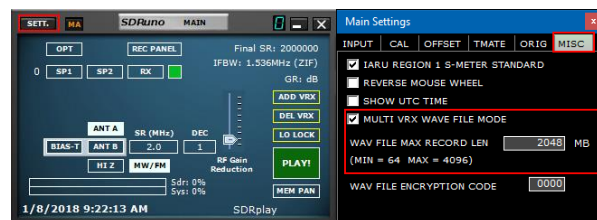


The VRX background colour can be customized by the user; the relevant control is located here: RX Control window->SETT.->MISC->VRX BACKGROUND COLOUR. Currently this parameter only affects the spectra (MAIN SP and AUX SP) background. In the future the functionality will be extended to all the VRX window.

## 8.16 Using multiple VRX while playing IQ files



SDRuno allows the use of multiple VRX while playing IQ files. Main window->SETT.->MISC->MULTI VRX WAVE FILE MODE. This option is enabled by default; if you wish to use only VRX#0 uncheck the option. IQ Wav files maximum length and custom encoding



The user has an option to define a custom file length up to 4 gigabytes (10243 bytes) which is the limit of the wav format itself. In fact, in the Wav file header size is stored as a 32 bit unsigned integer so the storable maximum size is  $2^{32}$  bytes. In the future SDRplay will offer the option to store IQ data in another format, without the above limitations. Please note that the advantage of keeping the wav format is compatibility: SDRplay files can be opened with any tools that support that file format. To change the default file size (2048 megabytes) go to Main->SETT.->MISC, double click on the "WAV FILE MAX RECORD LEN" and enter the new size, then press Enter to confirm.

The user has an option allowing a custom encryption code of the recorded IQ file. This code be used to secure the IQ file. This will prevent playback without the proper encryption code entered. The default is 0000 and allows playback without restriction.



## 9. Other functions in SDRuno

### 9.1 IQ Recording



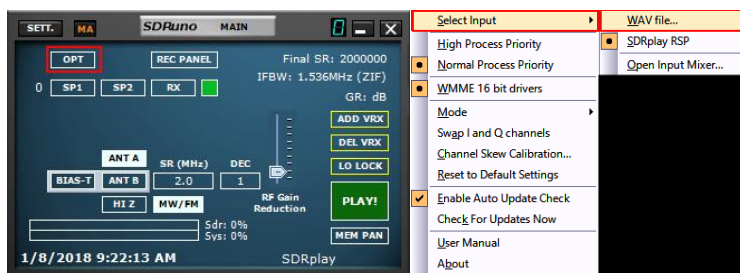
The Recorder window can be shown by clicking on the “REC” button inside the MAIN window.

### 9.2 Selecting the recording folder



Right-click on the recorder window in the Main window or on the Recorder window: this will pop up the folder selection window. The factory default is to use your “My Documents” folder.

### 9.3 Playback of IQ Recording



Launch SDRuno. Before clicking PLAY on the MAIN window. Click on the OPT button in the MAIN window. Select Input and select WAV file. Playback is controlled via the RECORDER window.

## 9.4 Scheduled IQ recorder



Unattended IQ recording can be configured via the Scheduler Config button within the RECORDER window.

The stream will be started/stopped by the scheduler if it isn't already running

## 9.5 Quick recording

SDRuno includes a feature to put a SDRuno instance in recording mode “on the fly”, without opening the Recorder window. When you wish to start recording simply press ‘\*’ on the keyboard (the relative SDRuno instance must be selected).

## 9.6 Using the custom controls

SDRuno implements some custom controls specifically created for it.

### 9.6.1 Sliders



Sliders are used for some parameters such audio level, squelch level etc.

You have several options to modify a slider value:

- For quick, large changes simply click in the new position of the slider
- For continuous variations click and drag.
- For fine, precise control put the cursor inside the slider and turn the mouse wheel



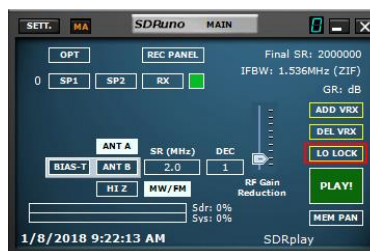
## 9.6.2 Wheel Edit Dials



These controls are easily recognizable as their background turn to purple as you place the cursor above them; some examples are the notch filters BW and Freq. controls in the “RX EX Control” window. In order to change the value of one of these controls, you must place the cursor inside it, then you have several options (here is an example for a notch Freq. control – actual steps depend upon the specific function):

- Turning the mouse wheel will change the value in +/- 1 Hz steps
- Turning the mouse wheel while pressing the SHIFT key will change the value in +/- 10 Hz steps
- Turning the mouse wheel while pressing the CTRL key will change the value in +/- 0.1 Hz steps
- Right-clicking will change the value in + 100 Hz steps
- Left-clicking will change the value in - 100 Hz steps
- Right-clicking while pressing the SHIFT key will change the value in + 1000 Hz steps
- Left-clicking while pressing the SHIFT key will change the value in - 1000 Hz steps
- Right-clicking while pressing the CTRL key will change nothing (not used in this case)
- Left-clicking while pressing the CTRL key will change nothing (not used in this case)

## 9.7 Temporary LO Lock



Changing the hardware LO has the effect of changing the tuning frequency of all the active VRX. This happens when you change the tuning frequency of VRX #0 (the master RX). If you wish to change the frequency of VRX #0 without changing the hardware LO you can use the LO LOCK button in the Main window. But if you need only a temporary lock simply press the SHIFT key while tuning.

## 10. Keyboard shortcuts

### RX control window

↑	Up frequency step
↓	Down frequency step
CTRL-S	Save frequency to memory bank
Space Bar	Start frequency edit
ESC	Aborts direct frequency input
A	AM
C	CW
D	DSB
E	DIGITAL
F	FM
L	LSB
M	Medium band FM
N	Narrow band FM
O	Stereo wideband FM
S	SAM
T	Toggle RX<->TX
U	USB
W	Wideband FM

### SP1 window

V	Center on VFO
+	Zoom in
-	Zoom out

### Main window

*	Start/Stop Recording
B	Open/Close Memory window
K	Toggle LO LOCK
CTRL-W	Save Workspace

### Memory window

F2	Edit current cell.
CTRL-F	Show/hide files pane
CTRL-S	Save frequency to memory bank
B	Open Memory window
Ins	Inserts a new row
Del	Deletes the current row

## 11. The I/O Sample Rate difference issue



Using different physical input and output devices means that there is no synchronization between the I/O sample rates; furthermore, a small deviation (in the order of less of ten to some hundreds of PPM) from the theoretical rates exists. SDR programs (including SDRuno) use memory buffers as “dampers” that absorb those differences; however, sooner or later the buffers will be all filled (overflow) or all empty (underflow), depending upon the sign of the combined input and output deviations. With typical hardware this can happen after several hours of continuous processing. At that point the program will re-establish the correct buffering, trashing some data and creating a small “gap” in the output stream. Of course, there is a way to prevent this, implementing a complex closed loop servo system that monitors the buffering and controls an output fractional resampler. SDRuno can do this and it works very well, ensuring that no data are lost at any time. However, when the above system is enabled a small frequency modulation of the output signal occurs (in the order of a fraction of Hz when the servo has settled down). In some sensitive applications (APT & other critical signal post-decoding), this small modulation can sometime cause problems; in SDRuno there is an option to disable the output resampler: RX Control ->SETT.->OUT->Lock Output Fractional Resampler. By default, the output fractional resampler is enabled.

## 12. Frequency calibration

In SDRuno the hardware frequency calibration can be done manually in Main Window->Settings->Cal or automatically in the VRX Control Window->Settings->Cal. For manual calibration, you can input a value in Parts Per Million; that value will be positive if the hardware oscillator is lower than its nominal frequency or negative otherwise. You can do the calculation of the compensation value at any frequency, but best accuracy is achieved using the upper tuning range of the hardware. You need a reference signal whose frequency is known and accurate (for example in HF could be WWV on 15000 KHz).

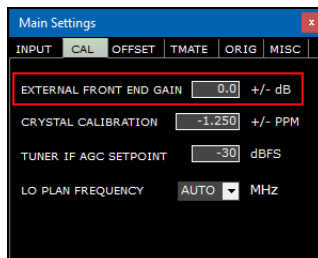
Let's see an example using CHU (14670 KHz) as reference:

- Using the Aux Spectrum window with a high zoom factor tune carefully the reference signal until you have the carrier at 0 Hz in the spectrum.
- Read the frequency indicated on the dial. In this example it is 14670082: this means that the reference oscillator in your hardware is lower than its nominal value.
- Compute the error as  $14670082 - 14670000 = 82$  Hz.
- Compute the PPM compensation value as  $82 * 1000000 / 14670000 = 5.590$
- Insert the above value in the HW LO Freq. Calib. edit box and press the Enter key.
- Retune the reference frequency and check that the calibration is effective.

For automatic calibration, follow the instructions within the VRX control window->Settings->Cal tab.

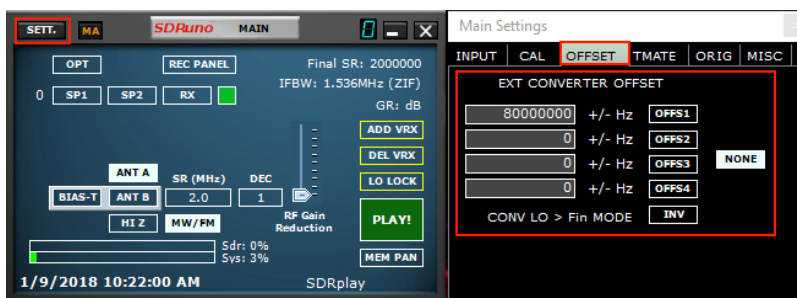


## 12.1 Adjusting S-meter to allow for external front end gain or loss



SDRuno automatically calibrates both the power measurement and the S-Meter for the RSP device. Additional external gain or loss can be set in Main window->Settings->CAL->EXTERNAL FRONT END GAIN.

## 13. External converter offset



Up to four converter offsets can be stored in each instance of SDRplay. Offset settings are available in Main window->Sett.->OFFSET.

### 13.1 Changing a converter frequency offset

Enter the new frequency in the edit box to the left of the relative button then press the ENTER key.

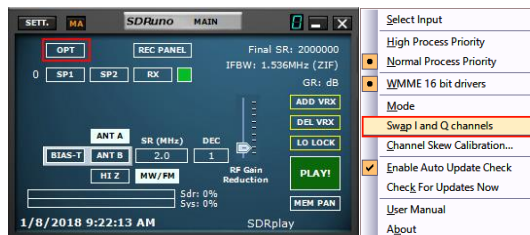
### 13.2 Enabling a converter offset

Click on the relative offset button.

### 13.3 Disable active offset

Click on the **NONE** button.

## 13.4 Inverted spectrum mode



Some converters are designed so that its LO frequency is greater than the input signal frequency; because of this the output spectrum is inverted. In such case the inverted spectrum mode must be activated, clicking the INV button. Also, the I and Q channels must be swapped (Main window->OPT->Swap I and Q Channels).

## 14. CAT



CAT control has been around for at least 25 years so it is a well-known technology: there is no need to review the basics here but a little refresh may be useful to understand how CAT has been implemented in SDRuno.

Whatever CAT protocol we choose, there is always a controlling device and a controlled one. In origin controlling devices were PCs and controlled devices were physical radios (receivers or transceivers) and accessories (rotors, switches, amplifiers etc.). Physical communication ports (serial ports for example) were used for the data exchange.

Per definition, in a CAT session only the controlling device can initiate a transaction. For example, the PC might send a “give me the VFO A frequency” while the radio might reply “the VFO A frequency is 3561230 Hz”. The logical roles can’t be exchanged.

Now that we have software radios (like SDRuno) a CAT session can be no more necessarily only between a program inside a PC and an external device but can be also between different programs inside the same PC (and even in different PCs).

In order to achieve this, we need a way to interconnect programs; one common solution is using special software tools to create “virtual com ports” pairs interconnected with “virtual null modem” cables. Then applications can see the virtual com ports as real ones, using them for communication. More on virtual ports later.

Another requirement we need is that the software radio must “impersonate” a controlled device and react the same.

## 14.1 How SDRuno implements CAT

CAT has been designed in SDRuno so that the application can act as a controlled device and a controlling one at the same time. More precisely, each VRX can be seen as a separate radio on a different com port while at the same time it can control a physical external device via Omnirig.

For CAT radio emulation we chose a sub-set of the extensive Kenwood command set. The following VRX parameters can be set and read:

- VFO A Frequency
- VFO B Frequency
- Active VFO (A – B)
- RX Mode
- AF level
- Squelch level
- S-meter (read only)

Several commands are implemented in a dummy way just to make some controlling programs happy (HRD for example).

## 14.2 VRX CAT parameters

VRX CAT parameters are accessible here: RX Control->SETT.->CAT.

### 14.2.1 COM DEVICE

This combo box allows you to select / enter the serial communication device. It is possible to choose among COM1 -> COM20 using the drop-down list. If the desired device has a name that it is not listed, enter it directly as follows:

- select the text inside the control (double click on the text)
- enter the device name by the keyboard
- press the Enter key on the keyboard

Default: COM10

### 14.2.2 BAUD RATE

This combo box allows you to select the speed for the serial device. This setting must match that of the controlling program, the higher the better. It is relevant only if the emulated virtual port has the "emulated baud rate" option enabled, otherwise it can be ignored.

### 14.2.3 RX MODE CTRL

This option let you to choose if the controlling program can set the VRX RX mode.

Default: enabled



#### **14.2.4      ENABLE & CONNECT**

This option enables CAT and starts the connection to the selected com device. Once enabled, the connection is effective until disabled or until the deletion of the relative VRX; also the connection is performed automatically every time the VRX is created. The status of the connection is indicated by the label placed on the bottom of the window (STATUS: CONNECTED – NOT CONNECTED). To save system resources, do not enable unused connections.

### ***14.3 Example: connecting to Ham Radio Deluxe***

Start creating a pair of virtual com ports named COM10 – COM11; do not select the “emulated baud rate” (you need to do this only once).

Launch SDRuno; assuming we wish to control VRX#0, open the CAT settings of that VRX. COM10 is selected per default; check “ENABLE & CONNECT”, the status should change to “CONNECTED”. Close the RX Settings window.

Launch HRD; click on “Connect”. The first time you need to create a new radio connection: select “Kenwood” as “Company” and TS-440S (for basic controls) or TS-480 (for additional AF gain, squelch level and S-meter controls) as radio type. Select COM11 as “COM Port” and click “Connect”.

Once the connection has started you can try to change frequency, mode etc.

In other programs select a generic Kenwood as radio or the above models.

### ***14.4 Applications***

- Log applications
- Frequencies databases
- Digital modes decoders
- Satellite tracking
- Special controllers
- Others

## 14.5 SDRuno as the controlling device – Omnirig



SDRuno can control other devices (via CAT) thru the Omnirig COM server, a brilliant utility developed by Alex Shovkoplyas, VE3NEA of Afreet Software, Inc. The main purpose (and advantage) of Omnirig is to provide a common “transparent” interface to applications; the controlling application doesn’t have to deal with a specific radio but instead sends and receives commands to Omnirig that in turn acts as a “bridge”. Omnirig can be “instructed” to work with a specific radio by “rig description” files that are relatively simple to create. There is already a huge list of supported devices and others can be added when needed, without the need to modify the code of neither Omnirig nor the application using it. In the past, Omnirig has become a standard and a huge list of applications relies on it: it is freeware, reliable and easy to install and set-up. For details please see the Omnirig web site <http://dxatlas.com>

## 14.6 Omnirig installation and set-up

You may already know about Omnirig and you may have already installed it on your system: if not please download Omnirig from <http://www.dxatlas.com/omnirig/>. Installation is straight-forward: just launch the installer and follow the instructions. Omnirig can control up to two devices at once (and so SDRuno, see below), RIG1 and RIG2; both must be configured in the Omnirig control window. If your rig is not listed among the available rig types, do a search on the web for a suitable rig description file, then add it to the “Rig” folder, located inside the Omnirig installation folder. Some setup tips: for best responsiveness use the higher baud rate your rig supports and set the polling interval to 100 mS. Please note that Omnirig can also see non-physical devices thru virtual COM ports (other applications for example).

## 14.7 How SDRuno handles Omnirig

As you know SDRuno is a multi-instance environment; for better control and efficiency SDRuno filters all the traffic from/to its VRX(s) to/from Omnirig thru an internal own “server”. The latter is created in the SDRuno instance #0. Omnirig can control up to two devices at once; at a given time only one VRX, of whatever SDRuno instance is allowed to connect to an Omnirig device (RIG1 or RIG2); a mutual exclusion logic prevents overlaps. In short, up to two VRX can connect to Omnirig at the same time, one per device.

## 14.8 Monitoring Omnirig status from SDRuno instance #0

A monitoring feature is available from SDRuno instance #0; go to Main->SETT->ORIG. Look at the bottom label first: this is the status of the connection to Omnirig; if Omnirig is correctly installed the label must show "Connected to OmniRig server". If there are problems "Can't connect to the OmniRig server" is shown instead: if this is the case recheck Omnirig installation. For each Omnirig device, additional information is shown (only RIG1 is described, the same applies for RIG2):

### **RIG1 Type:**

Shows the RIG1 device type currently configured in Omnirig.

### **RIG1 Status:**

Shows the RIG1 status reported by Omnirig; if there is an active working connection, the status is "On Line". Other statuses include "Rig is not responding" and "Rig is not configured".

### **RIG1 Used By:**

Shows which SDRuno VRX is currently connected to RIG1 (instance # and VRX #).

## 14.9 Which parameters are synchronized

The following parameters are sent/received from SDRuno to/from the controlled device:

Omnirig	SDRuno	Note
VFO A frequency	VFO A frequency	If the controlling device has only one VFO, VFO A is used
VFO B frequency	VFO B frequency	
VFO selection	VFO selection A - B	Optional
Modulation mode	Modulation mode	
RX-TX status	RX-TX status	

*Note: if the controlled device is a transceiver or transmitter, putting it in TX mode causes the VRX to enter a special mode: a yellow label "RF MUTE" shows up in the RX Control window, the MUTE button (AF muting) is activated and a 60 dB attenuation is applied to the signal after the SP1 display (so that real input levels are still shown) to facilitate AGC recovery. As the device exits TX mode the VRX returns to normal mode. you can use the key shortcut "T" to toggle the RX-TX modes of a synchronized transceiver/transmitter (provided that the "SYNC VRX -> RIG" option is enabled, see below); this feature can be useful also if there isn't a synchronized device as it also toggles the RF MUTE status in the relevant VRX.*

## 14.10 IF Output Mode



The IF output from a transceiver rig can be used as the signal source for the RSP. In this mode the LO frequency needs to be locked to the transceiver's IF frequency, whilst allowing the VFO to be tuned to within the transceiver's limits. Specify the IF output frequency in the settings window and press the ENABLE button to engage the system. A message is displayed in the SP1 window to remind the user that SDRUno is in this mode.

## 14.11 Omnirig related VRX options

Several options control the VRX/Omnirig connection; they are VRX parameters and must be set on a VRX basis. To access these parameters, go to RX Control->SETT->ORIG.

### 14.11.1 RIG SELECTION

These buttons select the target device, RIG1 or RIG2. This setting also changes the name of the RSYN button on the RX Control window to reflect the selection (RSYN1 or RSYN2). Default: RIG1.

### 14.11.2 SYNC VRX->RIG

If checked, the controlled device is synchronized to the VRX (the device reflect changes made on VRX). Default: checked.

### 14.11.3 SYNC RIG->VRX

If checked, the VRX is synchronized to the controlled device (the VRX reflect changes made on the controlled device). You must enable this option to use the muting on TX feature.

Default: unchecked.

### 14.11.4 SYNC CENTER FREQ. (LO)

If checked, the frequency information is relative to the VRX “centre frequency” (the SDR hardware local oscillator). You must enable this option if the controlled device is also the front-end of the receiving chain that includes SDRuno.

Default: unchecked.

### 14.11.5 SYNC RX MODE

If checked, the modulation mode is also synchronized.

Default: checked.

## 14.12 The RSYN button

The RSYN button on the RX Control window activates the synchronization of the relative VRX with the selected Omnirig device. A mutual exclusion logic avoids multiple VRX accessing the same device at the same time. The status of this button is persistent between sessions.

## 15. Tmate and Tmate 2



SDRuno natively supports the Tmate controllers. As the Tmate drivers are “single client” a way was developed to make full use of the controllers in the “multi instance” SDRuno environment: this has been achieved by implementing a “Tmate server” and using inter-process communication (IPC).

## 15.1 What do I need to use Tmate (and Tmate 2) with SDRuno?

First you need to connect the Tmate to a free USB port. For Tmate you need also to install its driver while for Tmate 2 this is not necessary (Tmate 2 is a HID device so it uses a system standard driver. The following files (supplied with SDRuno) must be included in your SDRuno folder(s):

- For Tmate: ELAD\_Encoder.dll.
- For Tmate 2: TMATE2\_DLL.dll.

If SDRuno doesn't find the needed dll it disables the server and reports the status in the Tmate settings window.

## 15.2 The Tmate server

The Tmate server implements bi-directional communication between the Tmate and whatever VRX you like, even across multiple application instances (more on this later). Think of the Tmate server as a “global resource”; it is created (if needed) by the SDRuno instance #0. The process is of course entirely transparent to the user.

## 15.3 Tmate server options

The Tmate server options are accessible only from the SDRuno instance #0 from here: Main window->SETT.->TMATE.

### 15.3.1 ENABLE SERVER

This checkbox enable/disable the Tmate server; the server status is reported on the window bottom: once enabled, if everything is ok you should read “Tmate server running.”. If the program reports an error, first check that no other application has allocated the Tmate (remember, Tmate is “single client”).  
Default: disabled

### 15.3.2 AUTO ASSIGN

This checkbox let you choose between two “assigning” options for the Tmate controller.

If AUTO ASSIGN is checked, the VRX controlled by the Tmate is the one that currently has one of its **SP1**, **SP2**, **RX Control** or **RX EX Control** panelss selected (the “SDRuno” label in the window plate is red). This is the simplest and fastest way to assign the Tmate controls to a VRX.

If AUTO ASSIGN is unchecked, you have to assign the Tmate to a specific VRX by the “TCTR” button located on the upper-right border of the relative RX Control window. To avoid confusion, a mutual exclusion logic is implemented: only one VRX can be assigned at a given time.  
Default: enabled



### **15.3.3 TMATE 2**

This checkbox let you choose between the two Tmate models. You can have both a Tmate and a Tmate 2 controllers connected to the system at the same time. In order to change this setting the Tmate server must be stopped (uncheck ENABLE SERVER).

Default: disabled (controller type is Tmate)

### **15.3.4 TMATE 2 USES VRX BACKG.**

The Tmate 2 controller features an LCD display with a RGB backlit. This checkbox let you choose between two backlighting modes:

If checked, the LCD backlighting colour follows the assigned VRX background colour.

If unchecked, the LCD backlighting is set to a fixed neutral colour.

Default: enabled

## **15.4 Tmate controls**

Currently the Tmate controls are implemented as follows:

### **15.4.1 TUNING KNOB**

Tmate employs a 128 steps/turn optical encoder. Each step corresponds to a given increment/decrement of the VRX tuning frequency and it is the same used for the mouse wheel (see 2.7 – 2.8). The current tuning step is shown in the RX Control window to the left of the frequency dial. When the spinning speed exceeds a certain threshold, a multiplying factor of 5X is applied to the current step; this feature is quite common in traditional (hardware) receivers and transceivers. The knob can be locked (see below).

### **15.4.2 F1 – DECREASE STEP**

This button decreases the tuning step to the next lower value (if available).

### **15.4.3 F2 – INCREASE STEP**

This button increases the tuning step to the next higher value (if available).

### **15.4.4 F3 – KNOB LOCK**

This button locks/unlocks the tuning knob; the locking status is indicated in the RX Control window, to the left of the frequency dial.

### **15.4.5 F4 – MUTE**

This button has the same effect of the MUTE button inside the RX Control window. Please note that the tuning step, lock and mute options are independent for each VRX.

## 15.5 Tmate 2 controls

Currently the Tmate controls are implemented as follows:  
Rotary encoders:

### 15.5.1 MAIN ENCODER (TUNING KNOB)

Tmate employs a 32 steps/turn encoder. Each step corresponds to a given increment/decrement of the VRX tuning frequency and it is the same used for the mouse wheel. The current tuning step is shown in the RX Control window to the left of the frequency dial and also in the Tmate 2 display. When the spinning speed exceeds a certain threshold, a multiplying factor of 5X is applied to the current step; this feature is quite common in traditional (hardware) receivers and transceivers. A further increment in speed triggers a 10X multiplying factor. The knob can be locked (see below). Pushing the tuning knob selects the current VFO (A – B).

### 15.5.2 E1 ENCODER

The function of this control can be selected by the user: pushing the knob selects the current function among the five available:

- VOL adjust the VRX audio level (AF level or volume).
- RFG adjust the AGC gain (if AGC is enabled) or the RF gain (if AGC is disabled).
- SQL adjust the squelch threshold.
- NR adjust the amount of Noise Reduction
- NB adjust the threshold of the Noise Blanker

### 15.5.3 E2 ENCODER

The function of this control can be selected by the user: pushing the knob selects the current function among the two available:

- HIGH adjust the selectivity filter high frequency limit.
- LOW adjust the selectivity filter low frequency limit.

Pushbuttons:

### 15.5.4 F1 – DECREASE STEP

This button decreases the tuning step to the next lower value (if available).

### 15.5.5 F2 – INCREASE STEP

This button increases the tuning step to the next higher value (if available).

## **15.5.6 F3 – KNOB LOCK**

This button locks/unlocks the tuning knob; the locking status is indicated in the RX Control window, to the left of the frequency dial and by the LOCK LED on the Tmate 2 window.

## **15.5.7 F4 – ASSIGNABLE BUTTON**

The function of this button depends upon the current parameter controlled by the E1 encoder:

- VOL MUTE on/off.
- RFG AGC on/off.
- SQL squelch on/off.
- NR Noise Reduction on/off.
- NB Noise Blanker on/off (NBW only).

## **15.5.8 F5 – RX MODE**

This button selects the current receiving mode.

## **15.5.9 F6 – VRX SELECTION**

This button assigns the Tmate to the next VRX of the same instance.

LEDs:

### **USB LED**

This LED is lit when there is connection with the Tmate server.

### **LOCK LED**

This LED is lit when the tuning knob is locked (see F3 button).

### **LCD DISPLAY**

The Tmate 2 display shows many VRX parameters; the tuning frequency field also doubles as parameter value indicator. When the frequency exceeds the 9 digits capability of the display, the entire field is shifted one digit to the right (10 Hz resolution).

## 16. ABBREVIATIONS ACRONYMS

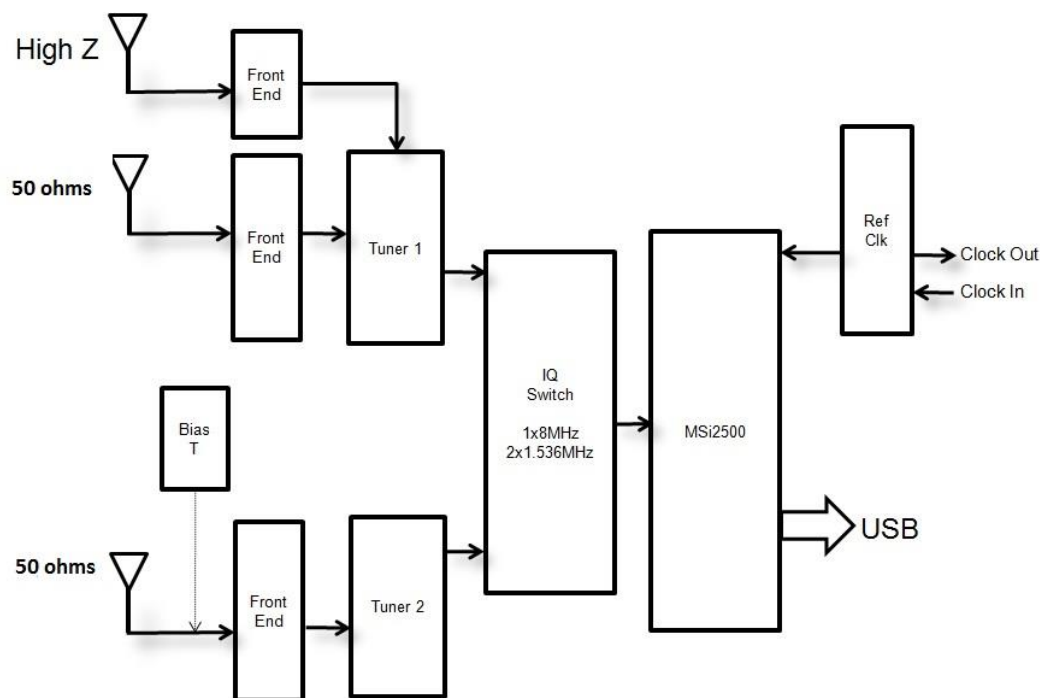
AGC	Automatic gain control
AM	Amplitude modulation
A/D	Analog to digital
ADC	Analog to digital converter or analog to digital conversion
AF	Audio frequency
ANF	Automatic notch filter
CAT	Computer aided transceiver
CPU	Central processing Unit
CW	Continuous wave
D/A	Digital to analog
DAC	Digital to analog converter or digital to analog conversion
dB	Decibel a way of representing numbers in a logarithmic scale.
dBFS	Signal level compared to the full-scale level, expressed in dB.
DLL	Dynamic link library
DSB	Double side band
DSP	Digital signal processing
FFT	Fast Fourier Transformation
FM	Frequency modulation
GUI	Graphical user interface
HF	High Frequency
Hz	Hertz
IF	Intermediate frequency
IQ	Refers to the I and Q data streams treated as a pair of signals
kHz	Kilohertz
LF	Low Frequency
LNA	Low noise amplifier
LO	Local Oscillator - the frequency that the SDR is tuned to.
LSB	Lower sideband transmission.
MHz	Megahertz
NFM	Narrowband Frequency Modulation
NR	Noise Reduction
Panadapter	A spectrum display of a section of spectrum
RDS	Radio data system
SAM	Synchronous amplitude modulation
SNR	Signal-to-Noise Ratio in dB.
USB	Universal serial bus
USB	Upper sideband transmission.
WFM	Wide Frequency Modulation

## 17. Appendix 1 Using the RSPduo with SDRuno (Release 1.23 only)

### RSPduo overview

The RSPduo is a radical new product from SDRplay. Architecturally, it is different from any previous RSP in that it features dual independent tuners, both piped through a single USB 2.0 interface. Superficially the RSPduo will look virtually identical to the RSP2pro and will be able to operate in a very similar way, but it also allows a completely new and unique set of usage scenarios.

The Basic block diagram of the RSPduo is:



The MSi2500 contains dual ADCs. This allows the sampling of I/Q analog baseband signals when the tuner is used in Zero IF mode. However, the tuner can also operate in a Low IF mode, where a single ADC is used to sample the output from the tuner. This opens up the possibility of having two independent tuners operating simultaneously, but this is **ONLY POSSIBLE IF BOTH TUNERS ARE OPERATING IN LOW IF MODE**. In Low IF mode, the maximum flat pass-band bandwidth of the IF filters in the tuner is 1.536 MHz, whereas in ZIF mode, it is possible to widen these filters to 8 MHz.

This is the approach used in the RSPduo. The receiver can either operate each tuner individually (one at a time) in zero IF mode with a displayed bandwidth up to 10 MHz or both tuners simultaneously with a maximum displayed bandwidth of 2 MHz.

The simultaneous use of two independent tuners (albeit with reduced bandwidth) makes certain key usage scenarios possible:

1. Simultaneous monitoring of two widely spaced bands – e.g. 40m and 2m
2. Mixing and matching applications simultaneously – e.g. ADS-B and ATC scanning
3. Phase and time coherent demodulation of two receivers

Scenario 3 is very difficult to achieve with two separate USB devices because of the uncertainty of USB latency. So whilst it is possible to phase lock the clocks of multiple RSP2s, the uncertainty of USB latency meant that the timing of the two units would not be aligned when it came to demodulation. The only way to overcome this was to apply timing correlation in software which requires a 'training sequence' to be simultaneously applied to both devices. The RSPduo overcomes this limitation because all traffic goes through a single USB interface.

## **Operating with two tuners simultaneously – The Master/Slave Concept**

Whilst the tuners can be controlled completely independently in terms of gain and frequency, there is one common factor that cannot (indeed should not) be separated and that is the ADC sample rate.

Because of this, whichever tuner is set up first will dictate the sample rate of the second receive path. To make it clear, we designate the first receiver to be set up as the 'Master' and the second one the 'Slave'.

## **A Windows Service based API for Device Management**

SDRuno release 1.23 features a new way of managing hardware. This is a requirement for handling the two tuners in the RSPduo.

Instead of the API either being embedded within the application (such as with SDRuno) or a separate DLL (as with HSDR and SDR Console), it is necessary to operate the API as a background 'service' within Windows. The service constantly monitors what is available in terms of receiver hardware and communicates this to the application at start-up. This way, it is possible to avoid the application attempting to configure a tuner on start-up into a mode that is simply not possible because another tuner is already designated as the 'Master' by a different application.



The matrix of available hardware options (for a single RSPduo) to the various applications will be as follows:

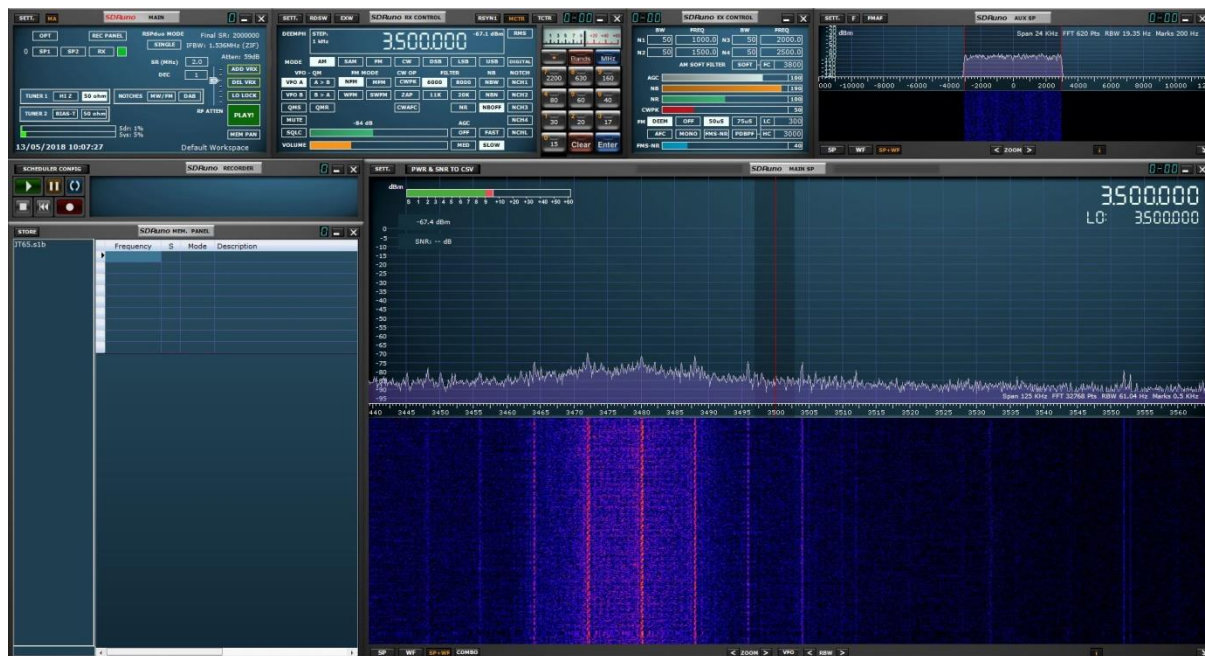
Operating mode	Tuner 1 Available RF ports	Tuner 2 Available RF ports	Master sample rate	Slave Sample rate	Tuner 1 IF Bandwidth	Tuner 2 IF Bandwidth	Tuner 1 frequency range	Tuner 2 frequency range
Single receiver (Tuner 1)	50 $\Omega$ /Hi-Z	Not available	2-10 MHz	N/A	200 kHz – 8 MHz	N/A	1 kHz – 2 GHz	N/A
Single receiver (Tuner 2)	Not available	50 $\Omega$ with Bias T	2-10 MHz	N/A	N/A	200 kHz – 8 MHz	N/A	1 kHz – 2 GHz
Dual tuner (tuner 1 master)	50 $\Omega$ /Hi-Z	50 $\Omega$ with Bias T	6/8 MHz*	Determined by Tuner 1	200 kHz – 1.536 MHz	200 kHz – 1.536 MHz	1 kHz – 2 GHz	1 kHz – 2 GHz
Dual tuner (tuner 2 master)	50 $\Omega$ /Hi-Z	50 $\Omega$ with Bias T	6/8 MHz*	Determined by Tuner 2	200 kHz – 1.536 MHz	200 kHz – 1.536 MHz	1 kHz – 2 GHz	1 kHz – 2 GHz

\*In low IF mode, there will only be two sample rates available:

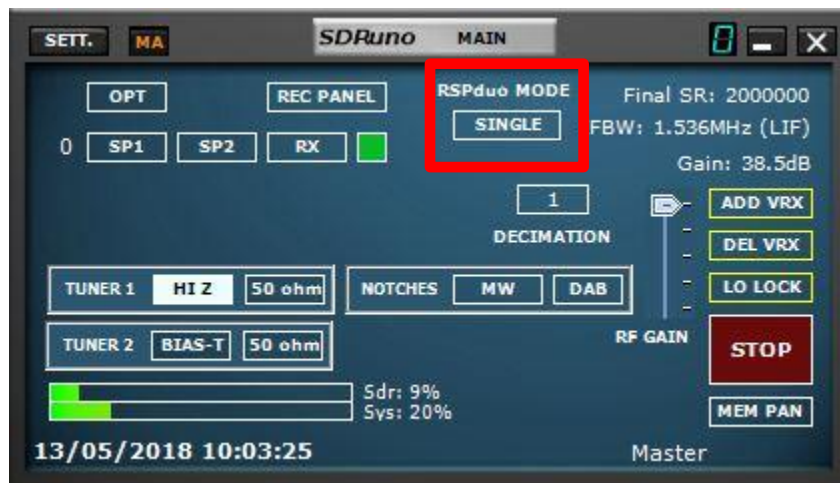
1. 6 MHz – This is designated “Normal Mode” when operating in dual tuner mode in SDRuno. In this mode, the ADC resolution is 14 bits.
2. 8 MHz – This is designated “ADS-B Compatible Mode” when operating in dual tuner mode in SDRuno. This mode is required for compatibility with dump1090 for ADS-B reception. In this mode, the ADC resolution is 12 bits.

## Operating the RSPduo with SDRuno (release 1.23 and onwards)

When first starting SDRuno when using the RSPduo application will auto configure the various panels to fill the screen in the most efficient manner possible.



## The Main Panel



When using the RSPduo, the Main Panel will indicate the operating mode of the device.

As long as no other application (e.g. ADS-B) is already using one of the tuners within the RSPduo, upon start-up, SDRUno will always initially configure the device in “Single” tuner mode. In Single Tuner Mode, either tuner can be operated individually but not both tuners simultaneously. In Single Tuner Mode, each tuner can be configured in Zero IF (ZIF) mode or in low IF (LIF) mode.

Selecting either the Hi-Z port or the 50 ohm port associated with Tuner 1 will automatically configure Tuner 1 for use. Selecting the 50 ohm port associated with Tuner 2 will automatically configure Tuner 2 for use. In Single Tuner Mode, the RSPduo will operate in a very similar way to the RSP2/RSP2pro.

## Dual Tuner operation (simultaneous operation of both tuners)

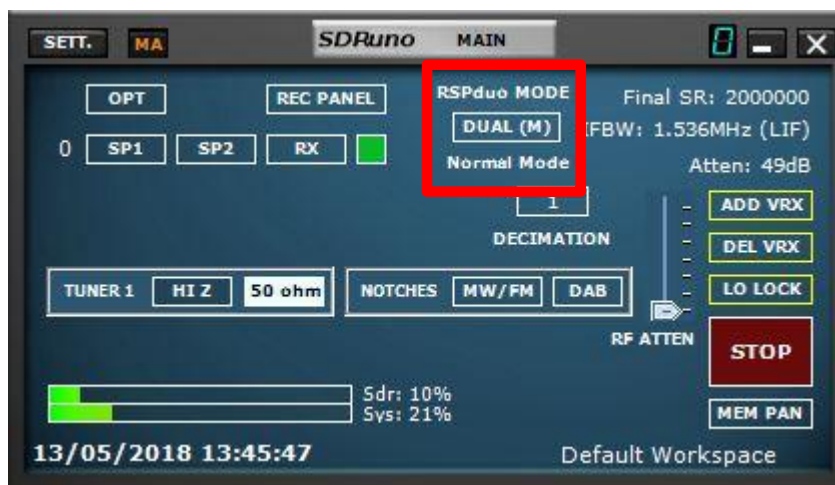
When switching to Dual Tuner, firstly determine which tuner you wish to be designated as the 'Master Tuner' and select one of the antenna ports for this tuner. Then select the RSPduo Mode button and two options will appear:



DUAL (NORMAL) - Select this mode unless you intend to run ADS-B using the Slave Tuner

DUAL (ADS-B) – This is ADS-B Compatibility Mode and is required if you intend to run ADS-B (dump1090) using the Slave Tuner. If you plan to use this mode, ensure that Tuner 1 has been selected BEFORE selecting this mode. This is because ADS-B (dump1090) uses Tuner 2 by default.

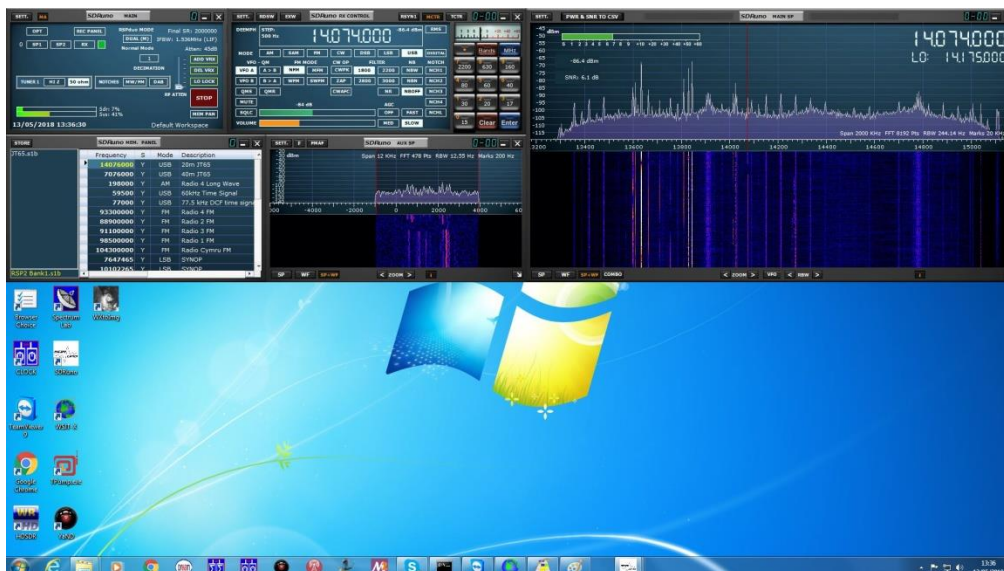
After selecting one of these two options the selected tuner will be the 'Master Tuner' and DUAL (M) will be the indicated RSPduo Mode:



If you intend to run both tuners with SDRUno using a single monitor, you can select the Auto Layout feature from the Options Panel:

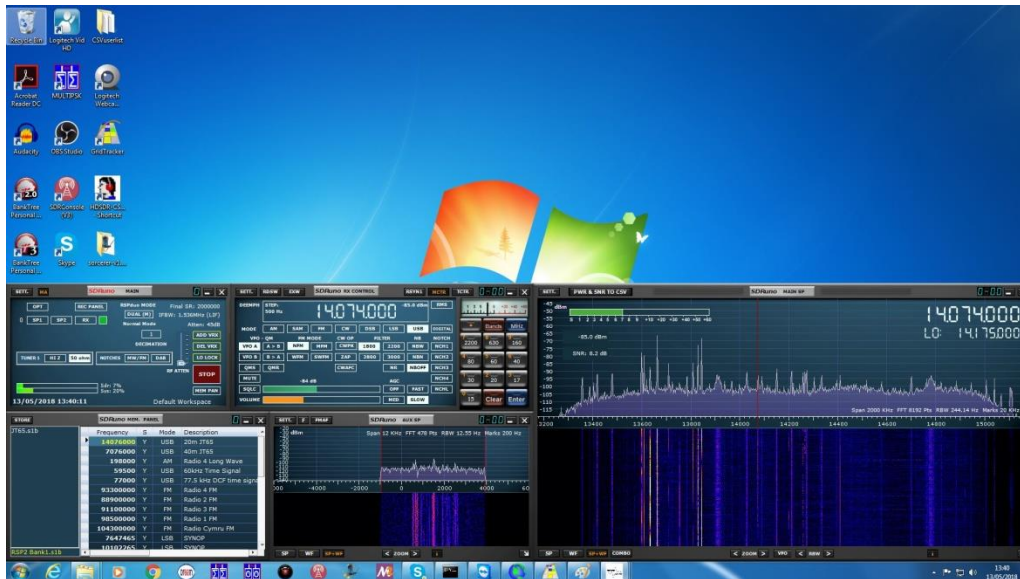


If you select the RSPduo Master option, the panels will be re-configured to fill the top half of the screen in an optimal way:



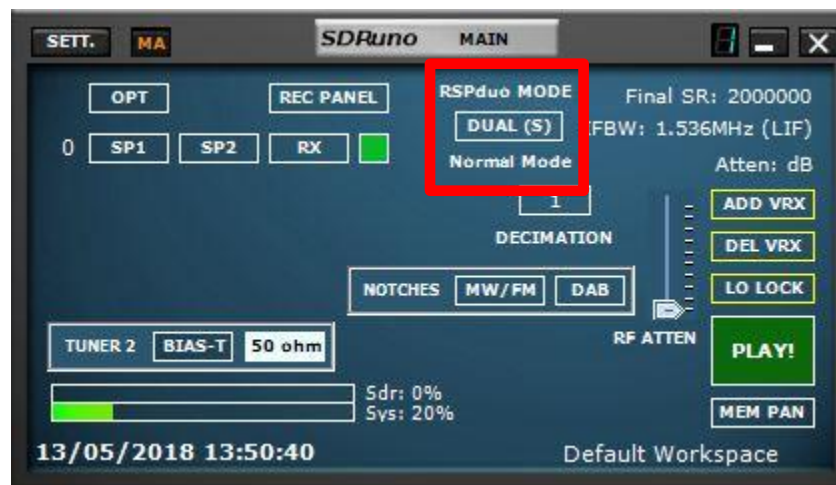


If you select the RSPduo Slave option, the panels will be re-configured to fill the lower half of the screen in an optimal way:

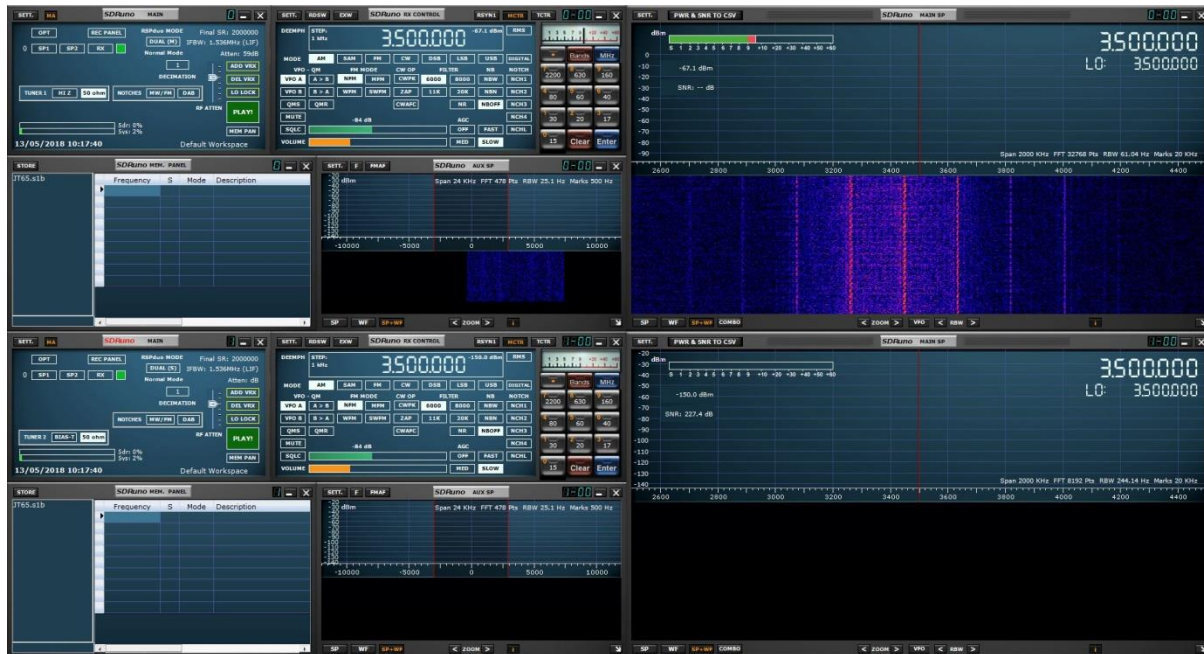


Either of these workspaces can then be saved so that they will open by default.

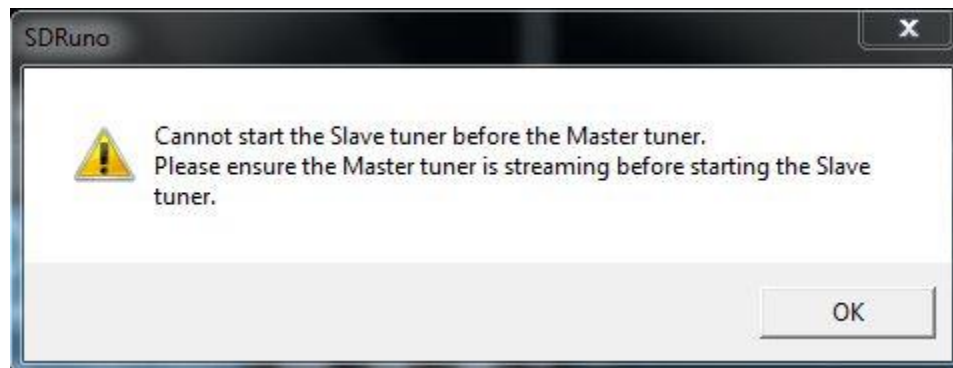
Having designated one of the tuners as the Master Tuner, to use the second tuner at the same time, it is now necessary to start a second instance of SDRuno. This second instance of SDRuno will automatically recognise that the second tuner is operating in 'Slave mode' and the Main Panel RSPduo Mode will indicate DUAL (S):



Using the Auto Layout Feature (OPT button), it is now possible to have both instances of SDRuno fill the screen in an optimum way:

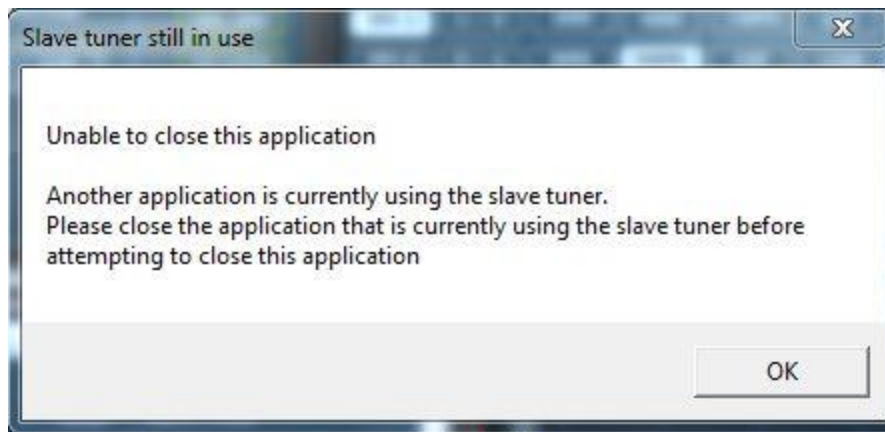


Before starting the stream for the Slave Tuner, it is first necessary to start the stream for the Master Tuner. If you attempt to start the Slave Tuner before first starting the Master Tuner, you will receive the following error message:





Having started the Slave Tuner via a second instance of SDRuno, if you attempt to close down the instance of SDRuno that is running the Master Tuner, you will see the following message:

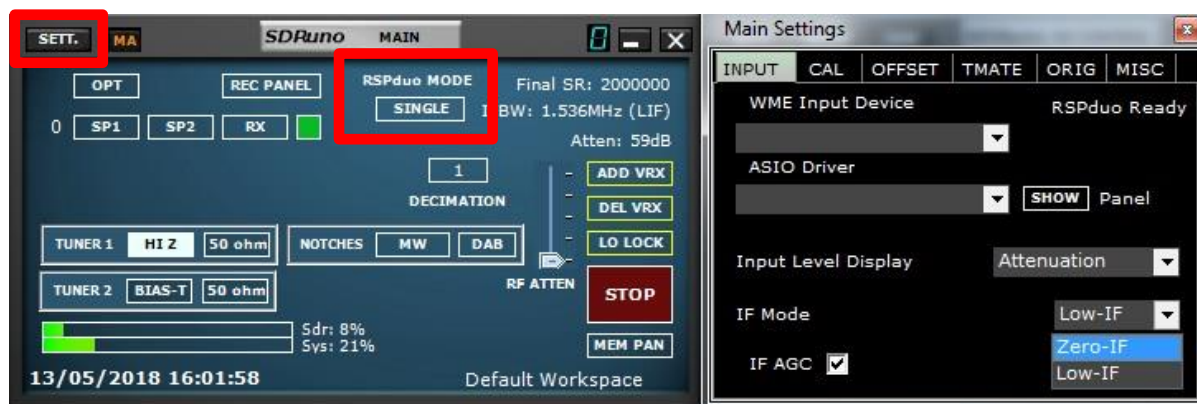


The Master can only be closed after the Slave has been closed.

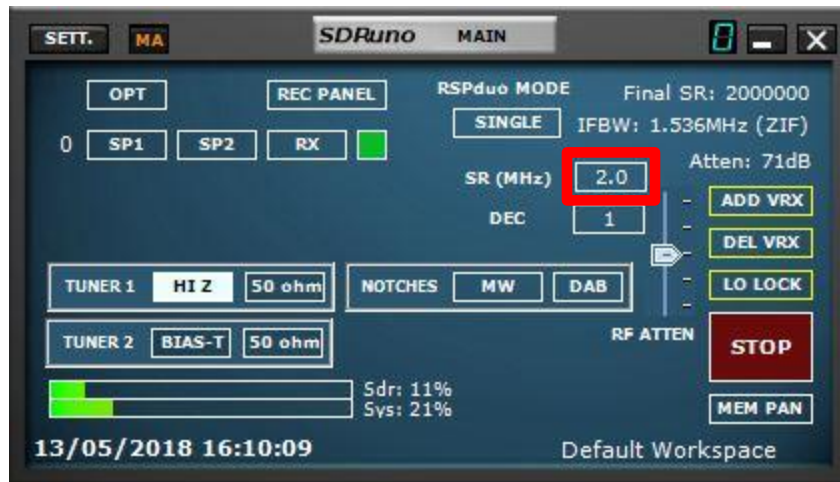
If a different application (e.g. ADS-B) is already using one tuner in Master Tuner mode, SDRuno will automatically open the remaining tuner as the Slave.

## Viewing more than 2 MHz of Spectrum (Single Tuner, ZIF mode only)

When the RSPduo is operating in Dual Tuner mode (Master or Slave), it will ONLY operate in Low IF mode with a maximum viewable bandwidth of 2 MHz. If you wish to have a viewable bandwidth of greater than 2 MHz, then it will be necessary to close the Slave Application and switch SDRuno back to Single Tuner Mode using the RSPduo Mode button on the Main Panel. After switching from Dual Tuner Mode back to Single Tuner mode, the device will still be in Low IF mode, so it will be now necessary to switch to Zero IF Mode via the Setting Panel:



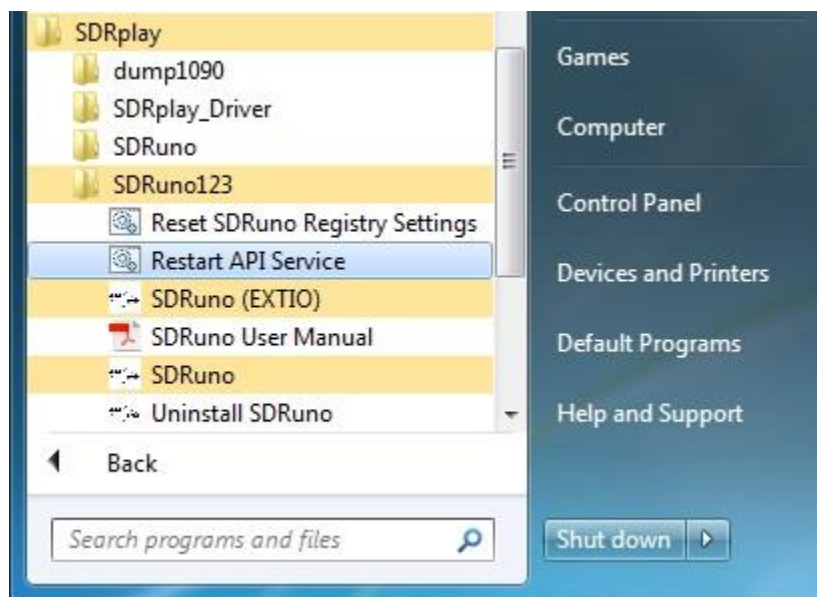
The Main Panel should now show that the device is operating in ZIF (Zero IF) mode and the amount of viewable spectrum can be changed by selecting a different sample rate:



## Troubleshooting

If an application using the RSPduo crashes, the Windows API Service may not be informed that the tuner has been released and is therefore available when the application is restarted. If the Windows service does not recognise that the device is present yet the device is present in the device manager, it may be necessary to restart the Windows API Service.

This can be done from the Windows Start Menu by navigating to the SDRuno 1.23 installation directory and selecting "Restart API Service"





## 18. Legal Information

For more information see

<https://www.sdrplay.com/>

For support see

<https://sdrplay.com/support/>

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