

Using SDRPlay2RSS

To gain full advantage of the software, you should familiarize yourself with some of the numerous settings in both SDRPlay2RSS and Radio-Sky Spectrograph (RSS). . If you haven't already installed the programs, first visit the SDRPlay/RSS Quick Start. In addition to this documentation, you may also access the Help menu in the SDRPlay2RSS program and refer to the Help pdf file that accompanies RSS.

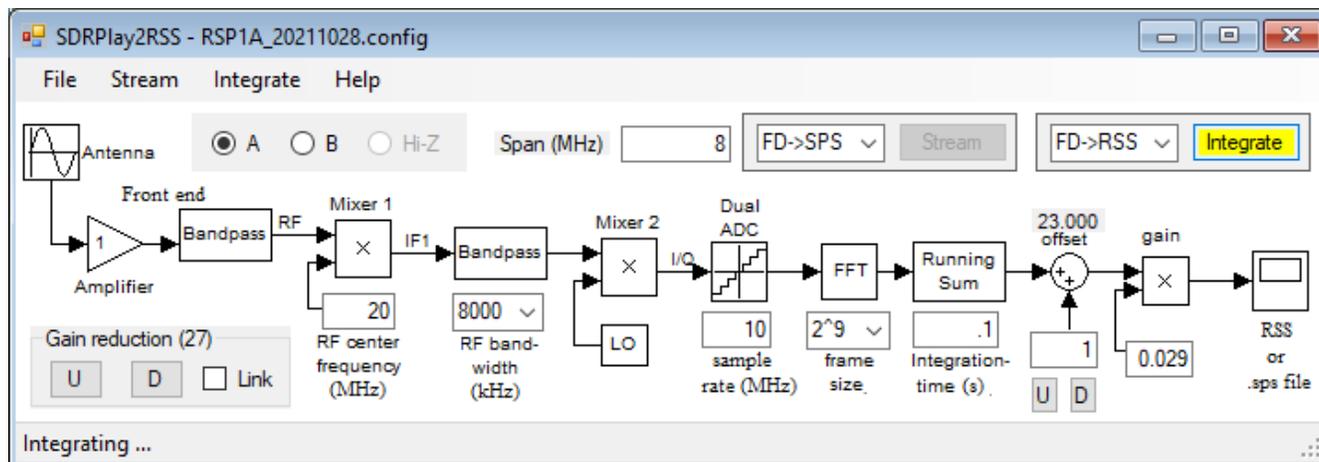


Illustration 1: SDRPlay2RSS window showing the signal path of the radio and software with adjustments along the path

Starting SDRPlay2RSS

SDRPlay2RSS is a separate program (executable file) from RSS. The SDRPlay2RSS exe file lives in the SDRPlay sub-directory of Radio-Sky Spectrograph. ("C:\Program Files(x86)\Spectrograph\SDRPlay"). When an SDRPlay receiver is selected in RSS and the **Start** button is pushed, RSS will check to see if SDRPlay2RSS is already running. If not, RSS will try to start SDRPlay2RSS. Once started, RSS will automatically press the **Integrate** button in SDRPlay2RSS to begin the data collection process. (If this process fails, see the troubleshooting section of the Quick Start Guide.)

Once SDRPlay2RSS is running, it will stay open until it is manually closed. The **Integrate** button should stay yellow (= on) until it is manually pressed or an error occurs that disables it.

You may also want to start SDRPlay2RSS manually at times. To do this, you can use the desktop shortcut that was installed with RSS. If you manually open SDRPlay2RSS.exe this way, you will have to press the **Integrate** button to start the data streaming from the SDRPlay receiver.

Configuration

As briefly described in the Quick Start guide, SDRPlay2RSS saves its settings in a configuration file. Default configuration files are provided for the SDRPlay1A and SDRPlay2 receivers. However, these settings may need modification for your particular location and antenna. Getting the correct settings may require some patience and numerous trials. It is helpful, (but not necessary), to have a multi-step

noise source calibrator to help you optimize your settings. That option will be discussed later, but for now we will focus on optimizing without the calibrator. The procedure is accomplished with a live data stream connection to RSS, which will act as your indicator device.

Color

Before adjusting your SDRPlay2RSS settings, you should set color controls in RSS. Set the **Color Offset** to zero, and set the **Color Gain** control to one. These controls in RSS affect how the colors are mapped to the signal strength data received from SDRPlay2RSS. The values saved in the RSS data files, are those received from SDRPlay2RSS and are not affected by the RSS Color Gain and Offset. It is best to make adjustments in SDRPlay2RSS to display the range of colors you expect to see. The colors you see depend on a *color file* which you load into RSS., Several color files are provided to choose from. The default color file is “AJ4CO Rainbow” and using it will be helpful when comparing results with, however, you may want to try other color files that may make features more visible in any given chart.

Later when making actual observations you will use the color controls in RSS to visually enhance features in the spectrogram. The Color Offset subtracts a given value from the incoming data, removing background environment and receiver noise. Color Gain multiplies the remaining signal by some value so that small signal enhancements are spread over a wider range of colors.



Illustration 2: Color mapping of the data occurs in RSS. The AJ4CO Rainbow color palette is shown on the right. 4096 colors are mapped to the 12 bit values coming from SDRPlay2RSS. Here you see where 1923 falls on the spectrum.

Receiver Dynamic Range

It is important to adjust the SDRPlay2RSS software controls so that the SDRPlay achieves a wide receiver dynamic range (**RDR**). By **receiver dynamic range**, we mean the difference in signal strength between the weakest and strongest received signals that can be received. For example, if the galactic background at the antenna feed point is 50kK (50 thousand degrees Kelvin) and a very strong solar burst is 50 Mk (50 million degrees Kelvin) we need a RDR of at least a thousand to one (30 dB). This represents the necessary dynamic range of the receiver (SDR) itself. If a signal exceeds the peak of the dynamic range the receiver will saturate – this means that as the input signal continues to increase in strength the output of the receiver will be maxed out and will not increase.

SDRPlay2RSS Controls affecting RDR include:

Gain Reduction – applies attenuation to signals entering the receiver. Increasing gain reduction lowers the amount of signal and allows you to receive stronger signals without overloading (saturating) the receiver. At the same time, adding Gain Reduction lowers the receiver's sensitivity to weak signals. To increase weak signal sensitivity you lower Gain Reduction. Use the U and D buttons in the Gain Reduction box.

Offset- adds or subtracts a fixed value from the processed data. Use the Offset adjustment to set the baseline level. You will likely adjust the Offset to counter or supplement the “brightness” affected by the Gain Reduction and Gain controls. Use U and D buttons below Offset icon. You can change the size of Offset steps in the associated text box.

Gain – is a signal strength multiplier. It is usually much less than one and is applied after the Offset is applied. Increasing the Gain value will increase the signal output, making weak signals relatively stronger, while at the same time decreasing the RDR at the top end. You may type a Gain value at any time in the text box below the Gain stage however, the setting will not register your change until you press Enter.

For the most part, these are the three adjustments that will be the focus of your tweaking activities. All of these adjustments may be made while test data is being collected. Other settings require stopping the observation by clicking the **Integrate** button.

Other Settings

Center Frequency – The center frequency you use will be determined by your research objective and by the bandpass characteristics of your antenna. The default in the Radio Jove configurations is 20 MHz.

RF Bandwidth – For radio Jove leave at 8000 kHz (8 MHz).

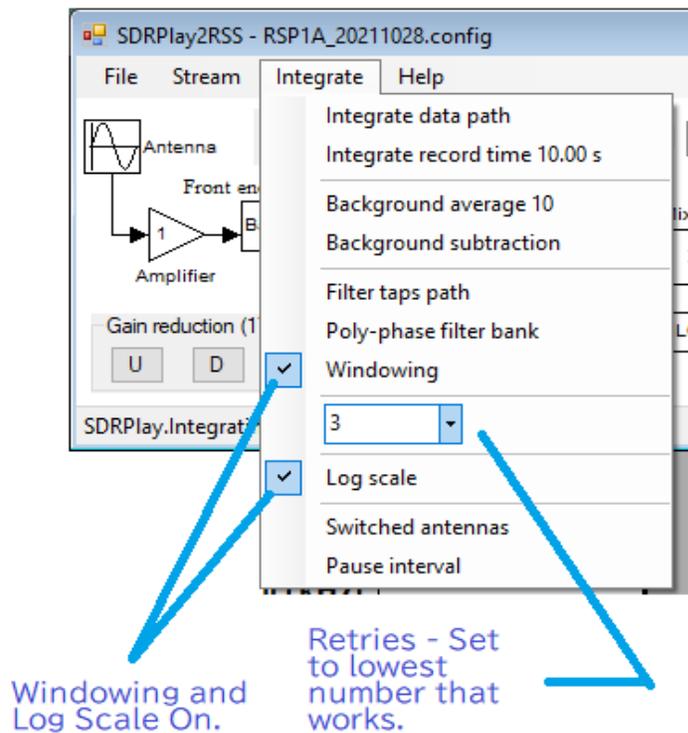
Sample Rate - Must be higher than the RF Bandwidth. For Radio Jove set to 10 MHz.

Frame size is the number of frequency channels generated in the spectrogram. The number of channels actually displayed in RSS is generally fewer than the number generated in the FFT. For reference, we normally use 300 channels with the FSX spectrograph, each with a bandwidth of 30 kHz. A frame size of 2^9 is suggested. If this setting causes the RSS display to exceed the vertical size of your monitor screen then reduce the frame size to 2^8 .

Frame size	Number of channels Generated	Number of channels Displayed	Channel width (kHz)
2^7	128	102	78.1
2^8	256	204	39.1
2^9	512	410	19.5
2^{10}	1024	819	9.8

Integration time controls the number of transforms that are averaged together. The longer the integration time the better the sensitivity. For normal Jupiter and Solar observations an integration time of 0.1 seconds is recommended. Fast events such as S-bursts may be resolved with shorter integration times (tens of milliseconds) and slowly varying features such as Cass A scintillations will benefit from longer integration times (tens of seconds).

Integration Menu – The following settings are standard for Radio Jove:



Windowing and Log Scale On.

Retries - Set to lowest number that works.

The unlabeled (in version 1.0.39) drop-down list of numbers is for **Retries**, and refers to the number of attempts made by SDRPlay2RSS to send data to RSS before giving up and terminating. On an average i5 level computer this problem can arise whenever the computer becomes busy. Setting the Retries to 3 seemed to fix the constant issues I was having on this computer.

Windowing and **Log Scale** should be turned on.

Your SDRPlay receiver has the ability to supply a DC bias voltage on the coax for remote amplifiers. You will find the **Bias T** option under **File** in SDRPlay2RSS.

*Once you have established your settings do a **File / Save As** and save your new configuration file with a new name.*

Calibration

You can observe without signal strength calibration. There are many interesting things to see in uncalibrated spectrograms. Ideally, however, we would like to know the strength of the signals we are seeing in our spectrograms. This is important for some scientific studies but it is also helpful in setting up your receiver to have optimum dynamic range. Calibration of radio frequency equipment has traditionally required expensive test equipment. We have found however, that it is possible to use the SDRPlay receivers themselves as reasonably accurate calibrators. Our typical goal in the Radio Jove project is to achieve 1 dBm accuracy and that level can at least be approached by using SDRPlay as a measuring device.

Unfortunately, SDRPlay2RSS does not directly provide us with calibrated data, this despite the fact the we are using a SDRPlay receiver. The best we can currently do is to produce a hardware calibrator and then use the SDRPlay receiver to calibrate the hardware calibrator. We then can use our hardware calibrator to calibrate our observations. For those who desire calibrated observations but do not own expensive test equipment, we have a created a design for a multi-step calibrator that you may use. It is composed primarily of off-the-shelf modules and is controlled by an inexpensive Arduino style microcontroller. To see the homebrew calibrator project go here. ([link to building your own calibrator document](#))