Black Cat sdrRewind 2.2.1b3 January 25, 2024

Black Cat sdrRewind lets you quickly go through terabytes of SDR I/Q recording files, looking for signals of interest.

Please report any bugs/crashes/etc. that you find, along with as much information about reproducing them as possible. Send an email to: support@blackcatsystems.com
Thanks!

Requirements:

Windows: Windows 8, 10, 11.

Macintosh: macOS 10.11 or later. 64 bit.

SDR I/Q recording files to analyze. Presently the following formats are supported:
• Elad
• Perseus
• RFSpace (Spectravue and SdrDx)
• SDR Radio -WARNING – THIS FILE FORMAT CHANGES OFTEN, MAY NOT WORK
• SDR# / Baseband Recorder
• Studio 1
• SDRuno (Studio1, format 2)

Please note: SDR I/Q recording file formats are not well documented. I've done my best to figure out the formats, but it involves a lot of guesswork. There's a good chance of some edge cases that cause problems. Or SDR app authors that routinely change the format, breaking things. I won't name any names ☺ If some files don't appear to work, contact me, and maybe we can figure things out. Likewise, if there's a format not presently supported, I can look into adding it. I'll need sample files of course, and ideally some scraps of information from the program author as to the format.

Installation:

Presumably you've gotten this far, and have downloaded and unzipped the .zip file.

If you are running on macOS, move the application anywhere you wish.

If you are running Windows, you can move the entire download directory/folder wherever you wish, but you must keep the Libs and Resources directories with the EXE file, or the app will not run.

First Things First:

Run the program by double clicking on the app's icon. You'll see the main window.

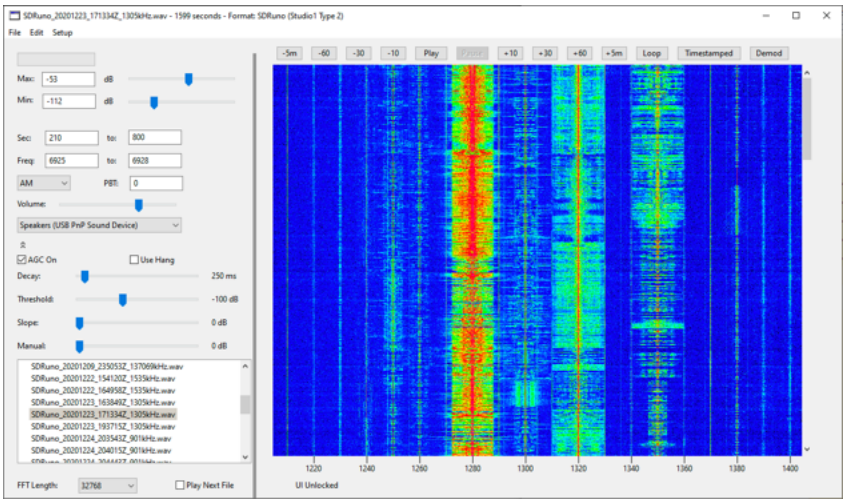
You need to set a few things up.

First, the directory where your SDR I/Q files are stored. Select Set Recording Directory from the File menu to do this.

Second, select the correct sound playback device. This is done via the popup menu on the left side of the window. Also set the volume as needed. Make sure the FFT length in the lower left corner is set, the longer the length the higher the frequency resolution in the waterfall. You can of course experiment with this value.

The Basics:

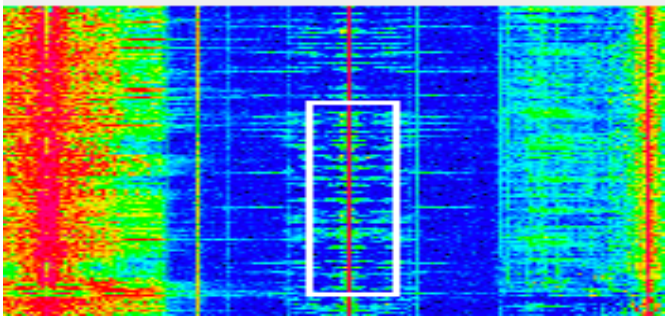
Select one of your I/Q files from the list on the left side of the window. A good way to start is to make a recording of a segment of the MW band, but not the entire band, as that is more difficult to work with. Around 200 kHz is fine.



A waterfall will be generated from the I/Q file as shown above. Depending on the size of the file and speed of your computer and hard drive, this could take 30 seconds to a minute or so. You will need to adjust the minimum and maximum dB sliders to get a good looking waterfall with good contrast. Select Auto Set dB Sliders from the Edit menu to get close, then tweak the settings manually. The exact settings will depend on the signal strengths in your I/Q file.

Now we'll listen to one of these stations. First make sure the mode popup menu is set to AM mode, and the Pass Band Tuning (PBT) is zero.

Next, use your mouse to drag select one of the signals, you want to create a white rectangle centered on the transmission, as shown below:



After you have done this, the Time (time range for playback) and frequency range (IF bandwidth) text fields will be set based on the rectangle you drew. Your values will depend on your file and settings of course:

You can also directly type into these fields, and change the demodulation rectangle. This is handy for touching up values.

Now click on the Play button, and playback of the recording will begin. While the file is playing, the signal strength will be displayed both as text and in the indicator in the upper left corner. Also, the current playback date and time will be displayed, as well as the measured carrier frequency. The carrier frequency is computed from the strongest observed signal in the passband, so it can jump around a little, and the accuracy will of course depend on the accuracy/stability of the ADC clock in your SDR.

Use the 5m, 60, 30 and 10 buttons to skip ahead 5 minutes, 60 seconds, 30 seconds or 10 seconds. Likewise use the -5m, -60, -30 and -10 buttons to jump back that amount of time.

Clicking the Loop button turns on looping – when the audio clip has finished playing, it will start playing again. This is handy when you want to listen to the same clip over and over, like when trying to pull a weak ID out of the noise. The looping is not seamless, but adequate for the task.

You can also demodulate SSB. For example, if you wanted to demodulate a signal on 14230 kHz in USB mode with an IF bandwidth of 2.5 kHz, you would drag around the signal so that the lower frequency value was 14230 kHz, and higher frequency was

14230+2.5=14232.5 kHz. You could directly enter these in, or you could drag with the mouse and then use the option in the Edit menu to zero the frequency to the nearest kHz. You could edit the frequency value by hand as well, of course.

If you wanted to demodulate an LSB signal, you set the higher frequency to the station frequency, and then set the lower frequency to that minus the bandwidth. For example, to demodulate a signal on 7150 kHz LSB mode with a 2.5 kHz bandwidth, set the higher frequency to 7150 kHz, and the lower to 7150-2.5=7147.5 kHz.

Likewise, there are also menu items to zero the beginning time, and set the end time to the length of the recording file, which are handy when you wish to listen to a transmission over the entire length of the recording.

Clicking on the Demod button will demodulate the selected time period to a WAVE file, which will be named Demod.wav and stored in the directory you chose to save such files. (Specify this directory by selecting Set Demod File Directory… from the File menu).

Clicking Timestamped does the same thing, except the name of the file is the frequency demodulated plus a timestamp of the start time.

Right clicking either of these two buttons will append to an existing file, rather than overwrite the existing Demod.wave file or creating a new timestamped file. The most recent timestamped file is written to.

AGC – Automatic Gain Control:

The AGC On checkbox toggles whether AGC is enabled or disabled. If disabled, the Manual gain slider is used to set the RF gain.

When enabled, Threshold specifies the dB value where AGC becomes active (the knee). Slope factor specifies the reduction in gain starting at the knee, relative to maximum gain.

Normally the AGC value fallows an exponential decay mode, with a time constant set by the Decay slider. Checking Use Hang enables hang mode, which causes the AGC value to be held constant for a period of time, then rapidly increased.

PBT – Pass Band Tuning:

PBT can be used to shift the IF filter. For example, say you want to listen to a fairly narrow transmission (CW, FSK, etc) on 7038 kHz. You could use USB mode, with the frequency range text fields set to 7037 and 7038.5 kHz, this sets the IF filter to pass

7037-7038.5 kHz. But this passes more of the spectrum than you need, potentially increasing noise/interference.

Let's say you wanted a 500 Hz (0.5 kHz) wide IF centered on 7038 kHz. Set the frequency range to 7037.0 and 7037.5 kHz. This passes 7037.0-7037.5 kHz. Now set the PBT value to 0.75 kHz. This shifts the IF up 750 Hz, so it runs from 7037.75-7038.25 kHz. Likewise, you could use negative PBT values to shift the IF in the opposite direction.

Another option, especially for CW, is to use CWU and CWL modes. Drag select around the signal, and select either mode. CWU demodulates CW using USB mode, CWL using LSB mode. The IF filter and PBT values will be adjusted according to center the filter around the signal, so leave PBT at zero. You can select your designed CW tone frequency from the Settings.

If the Play Next File checkbox is checked, then when playback of the recording ends, the next I/Q file will be loaded, and playback will resume at the beginning of the file. This is useful for listening to a station that spans several files. To take advantage of this, the I/Q files must appear sequentially in the list of files (they usually do as the filename is typically timestamp based), and be the same format/bandwidth/center frequency/etc. Make sure the selected playback time period extends to the very end of the recording before starting playback in this mode, so the entire period is played before the next recording is loaded and played.

Next File under the File menu can be used to load the next I/Q file in the list of files.

More on selecting the portion of the recording to demodulate:

There are quite a few ways to select the demodulation parameters – the time period and frequency range, as well as "fine tune" these parameters. These are discussed below:

First, you can drag select around the signal, as described earlier.

Second, you can click with the mouse to set the starting time and frequency, and then contextually (right click) with the mouse to set the ending time and frequency.

Holding down the shift key while clicking sets the start time, leaving other parameters the same.

Holding down the control key while clicking sets the end time, leaving other parameters the same.

Holding down shift and control when clicking sets the end time to the maximum for the recording file.

Holding down shift and alt (option on macOS) sets the start time to zero seconds.

Holding down control and alt (option on macOS) when clicking will set the start (lower) frequency, depending on the cursor location.

Holding down shift, control and alt (option on macOS) when clicking will set the end (upper) frequency, depending on the cursor location.

Alt (option on macOS) clicking will set the lower demodulation frequency to the cursor location, rounded based on the setting of the “nearest” popup menu. In addition, upper demodulation frequency will be set based on the “bw” (bandwidth) value and the demodulation time will be set based on the “Sec” (seconds) value, centered on the cursor location. Both of these values must be non-zero, of course. This is handy when you want to demodulate a short burst style transmission, such as ALE.

If you double click on a transmission, sdrRewind will attempt to set the demodulation start and stop times so they enclose the transmission. Of course, this works best with strong signals well above the noise, and worst with weak signals.

There are six buttons that adjust the demodulation frequency by +/- 0.1, 0.5 or 1 kHz steps:

There are also four buttons that adjust the starting (first two buttons) and ending (second two buttons) times. Right click instead to increase by steps of 10:

There are also menu items (and shortcuts) to perform some of these functions:

Z undo
X cut
C copy
V paste
A all
shift Z zero demodulation frequency to nearest kHz
shift B zero beginning time
shift E max end time

Chaining files:

This lets you combine a series of I/Q files into one waterfall. All of the files must be sequentially recorded with the same settings (center frequency, bandwidth, etc).

Select Chain Files… from the File menu.

Then press the Select IQ Files button, and select your files.

Then press the Waterfall button.

Quickly Demodulating From Multiple I/Q Files to WAVE Files

You may have need to demodulate one or more frequencies on multiple I/Q recording files to WAVE files, for later processing (decoding digital signals) or listening.

Select Demodulate Multiple Files from the Edit menu and a new window appears.

On the left hand side is a list of your recording files, as in the main window. Select a file and basic information about that file will be displayed: the center frequency, sample rate, bandwidth, starting date and time, and length in seconds.

Demodulation settings are displayed immediately to the right of this, again as in the main window. Configure this for the frequency of interest, then select one or more I/Q files and click the Start button. Each I/Q file will be demodulated and written to a separate timestamped WAVE audio file. The entire I/Q file will be demodulated, from start to finish.

Do not make any changes to any controls in this window will files are being processed.

If you wish to demodulate several frequencies from each file, instead use the list to the right:

Right click in it and select Add Entry. A new row will be added. Set the low and high frequency limits of the IF passband, as well as (optionally) the pass band tuning (PBT). Change the mode by right clicking on it, and select a different mode from the popup menu. The same AGC settings will be used for all entries.

When you are finished, click the Start All button. Each I/Q file will again be processed, this time for each of the frequencies in the list. Click abort to stop processing additional files, however the file currently being processed will need to finish.

The Clear button can be used to quickly remove all entries from the list.

Making A Long Waterfall From Multiple I/Q Files

Experimental

Overview

Select “Make Waterfall From Multiple Files…” from the File menu, and a new window appears.

Click the Add Files… button to add I/Q files to the window. Note that it is extremely important that all of the files you add are recorded from the same SDR program with the same settings (sample rate, bandwidth, etc.). These files should be sequential with no gaps in the recording time.

To remove files from the list, click the Clear Files button and they will all be removed.

Set the FFT Length from the popup menu. 64K or 128K often gives good results, as with all the settings you should experiment to see what works best for each application.

Set the minimum and maximum dB values, which sets the color scale mapping for the waterfall.

Set the width of the resulting waterfall image. This is used to control the vertical dimension of the resulting waterfall.

Set the number of seconds between each line (pixels in the Y dimension) on the resulting waterfall image. This is used to control the vertical dimension of the resulting waterfall.

Take care to keep the size of the image (horizontal and vertical dimensions) somewhat reasonable, as large dimensions will result in large file sizes. Perhaps so large as to cause unstable software behavior.

Click the Process button. The I/Q files will be processed and the waterfall generated. This could take several minutes. The title of the window will update with status information.

The waterfall will be written to a file named Waterfall.png located in the same directory as demodulated audio files, or the documents directory for your user account if you did not set a directory. If you cannot find the file, use the file search tools built into Windows or macOS to locate it.

A tour of the menu bar:

File menu:

Set Demod Directory: specified where demodulated WAVE files are stored.

Select Demod File Directory: Quickly select a directory from the list specified in Settings.

Set Recording Directory: specifies where your I/Q files are loaded from.

Refresh File List: Updates list of files, handy if the program has been running while your SDR program has been generating new I/Q files.

Scroll To End of Recording Files: Goes to the end of the list of files.

Next File: Automatically loads the next I/Q file.

Chain Files… Combines several I/Q files into one waterfall.

Edit menu:

Zero Frequency: Rounds the frequency text field(s) to the nearest kHz value(s).

Zero Beginning Time: Sets the playback begin time to zero, start of file.

Maximum End Time: Sets the playback end time to the length of the file.

Auto Set dB Sliders: Auto adjusts the dB sliders based on the signals on the waterfall, you may need to tweak values.

Setup menu:

Enter Registration Code: Enter your registration information.

Help: This file.

Color Waterfall: When checked, the waterfall is color, otherwise it is greyscale.

Unlock UI: When files are being loaded, the UI is locked out until the load finishes. If for some reason the UO is not unlocked, you can do this manually.

Settings: Opens the settings window.

Settings / Preferences:

General Tab:

Update Waterfall while loading: When checked, the waterfall is drawn as it is loaded. This slows down the loading a little, so if you want to speed it up, you can tell the program to only draw it when it has been completely loaded.

CW Tone: Sets the tone frequency for CWL and CWU modes.

Data Offsets Tab:

SDR I/Q files are not well documented. If you find that files are not being correctly loaded, or I/Q are swapped, you can enter numbers in this field to shift the data. For 16 bit I/Q files the valid numbers are 0, 1, 2 or 3. For 24 bit, 0-5, for 32 bit, 0-7. *You* would need to experiment to find the correct values, assuming zero does not work.

Demod Directories:

You can enter one or more directories here, and quickly select one of them from the File menu. Right click on the list to add a blank entry. Then right click on that new entry to set the directory/folder. Right click on any entry and select Delete Entry to remove it.

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