RTL-SDR Dongle

Software Defined Radio On the Cheap
By Rick Swenton, W1RHS 09-22-2021

What is a Software Defined Radio?

- Traditionally, receiver and transmitter components and features were implemented through hardware circuits. Things like oscillators, amplifiers and mixers were made using specific components that were tuned to desired frequencies or bands of frequencies.
- In a Software Defined Radio, these subsystems are implemented in software and run on a personal computer or embedded controller.

Examples of Software Defined Radios that use external personal computers

- TRANSCEIVERS
  Apache Labs ANAN Transceivers
  Flex Radio Transceivers such as the 6400

- RECEIVERS
  SDRPlay Receivers
  Air Spy Receivers
  RTL-SDR Dongle

Examples of Software Defined Radios that use embedded computers

- TRANSCEIVERS
  Icom Radios such as the IC-7300
  Yaesu Radios such as the FT-DX10
  Kenwood Radios such as the TS-990
  FlexRadio such as the 6600

- These radios support a connection to a personal computer for local or remote control but the PC is not required to use the radio from the front panel.

Examples of Software Defined Radios available with either internal or external computers

- TRANSCEIVERS
  Apache Labs made versions of the ANAN with either an external or internal personal computer.
- The internal PC is actually an Intel NUC (Next Unit of Computing) which is a complete PC with disk, memory and ports in a very small ~4” box.

Examples of Software Defined Radios available with either internal or external computers

- TRANSCEIVERS
  Of special note is that until recently, the versions of the ANAN with an embedded PC were not available with a front panel and controls on the radio. You need to connect a video display, keyboard and mouse directly to the radio. You would be using the same control software program that you would use on an external PC.

Examples of Software Defined Radios available with either internal or external computers

- TRANSCEIVERS
  Recently, Apache Labs announced the manufacture of the Andromeda. This is the ANAN with a full featured front panel with display and controls. Because of the virus impacting supply chains, availability is very limited.

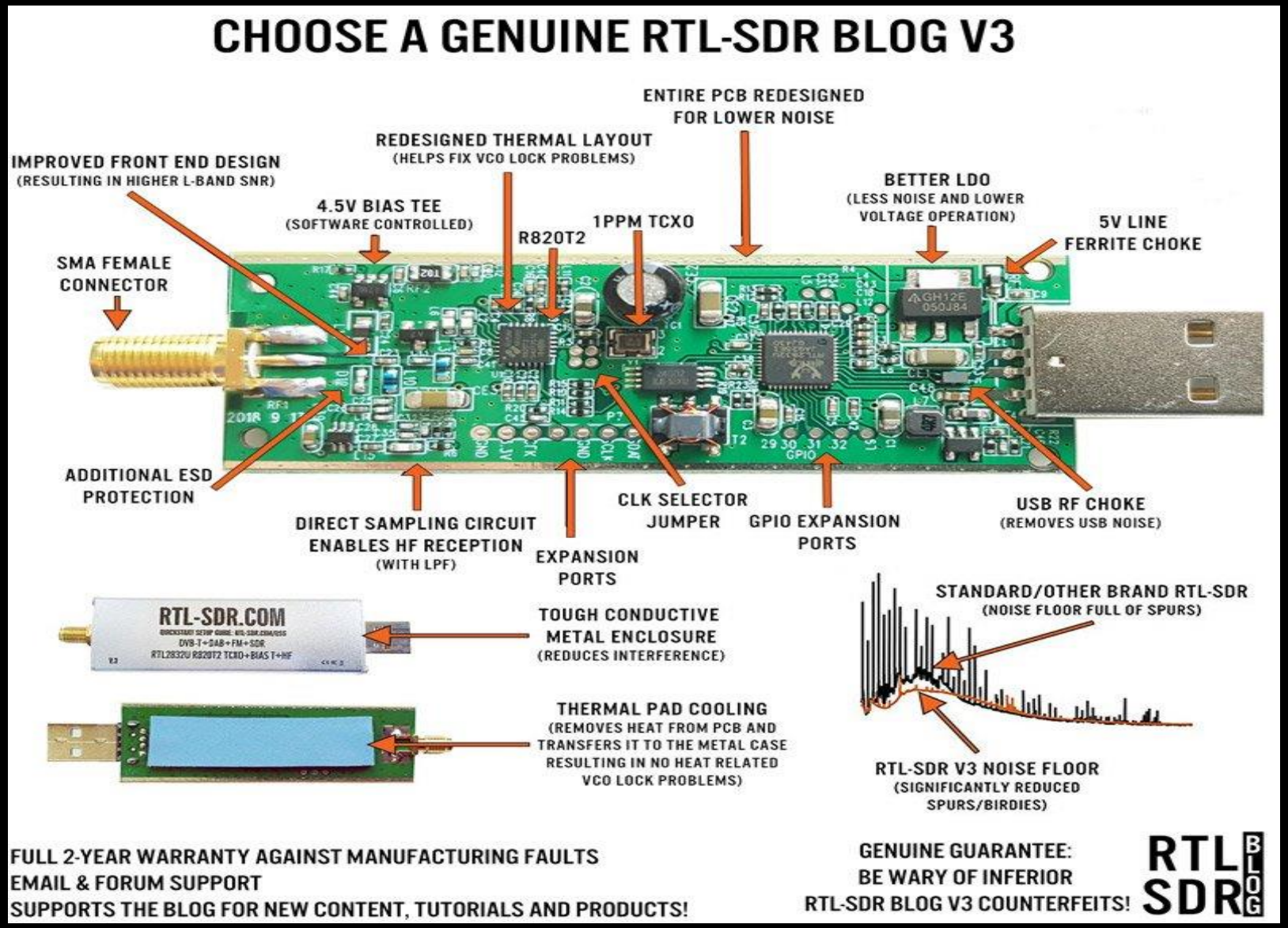
The RTL-SDR Dongle

- Typical applications are Radio listening, Ham Radio, SWL, Radio Astronomy, NDB-hunting and Spectrum analysis.
- Earlier SDR dongles only covered around 24 MHz to 1 GHz. The newer version allows the front end to be automatically switched out so that the A/D converter can directly sample the RF from around 100 KHz to 24 MHz.

The RTL-SDR Dongle

- Are they any good? Yes.
- Are they as good as a $200 SDR Receiver? No.
- Why would I want one of these? For $30 it is a very economical way for you to get exposure to the broad array of features available in the same software used by the expensive products. You will be surprised.

The RTL-SDR Dongle



The RTL-SDR Dongle

- **RTL-SDR USB Dongle Purchase**
  https://www.amazon.com/RTL-SDR-Blog-RTL2832U-Software-Defined/dp/B0129EBDS2/

  Check for: Ships from Amazon and Sold by RTL-SDR Blog to ensure getting the genuine V3 product. Currently $30. Antenna jack is SMA.

The RTL-SDR Dongle

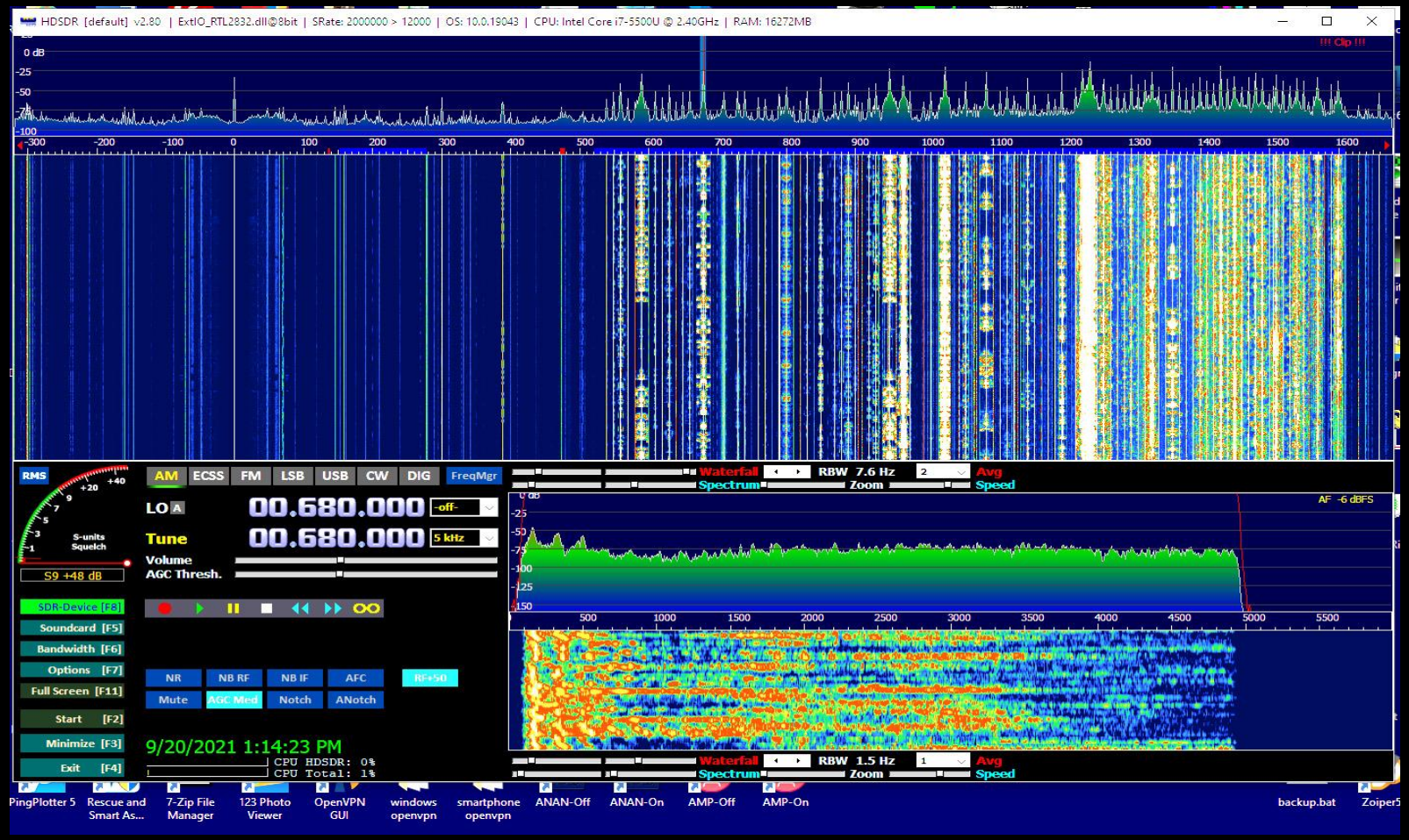
- Definitive Video: ***The Coolest Radio You've Probably Never Heard Of*** by Tom the Dilettante. This is a most excellent YouTube video that covers the RTL-SDR Dongle from top to bottom. https://www.youtube.com/watch?v=h4x7cGALaC8

RTL-SDR Supported Control Software

I can confirm that the following mainstream software programs work with the RTL-SDR dongle:

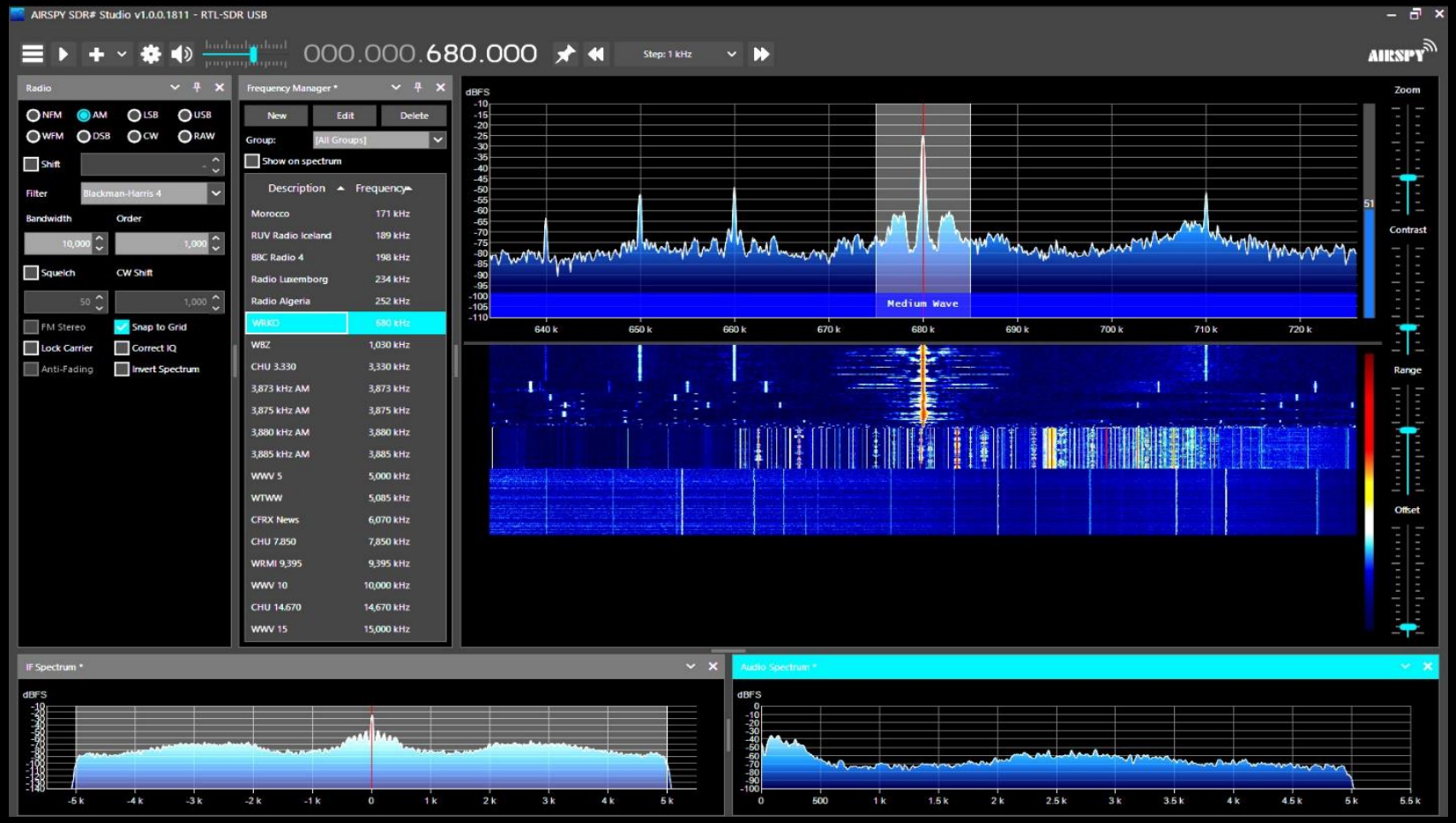
- HDSDR
- SDR# (SDR Sharp)
- SDR Console
- SDR Play
- SDRangel
- UniTrunker (Trunk Tracker)
- NRSC5 (decodes Ibiquity IBOC HD Radio)

RTL-SDR Supported Control Software



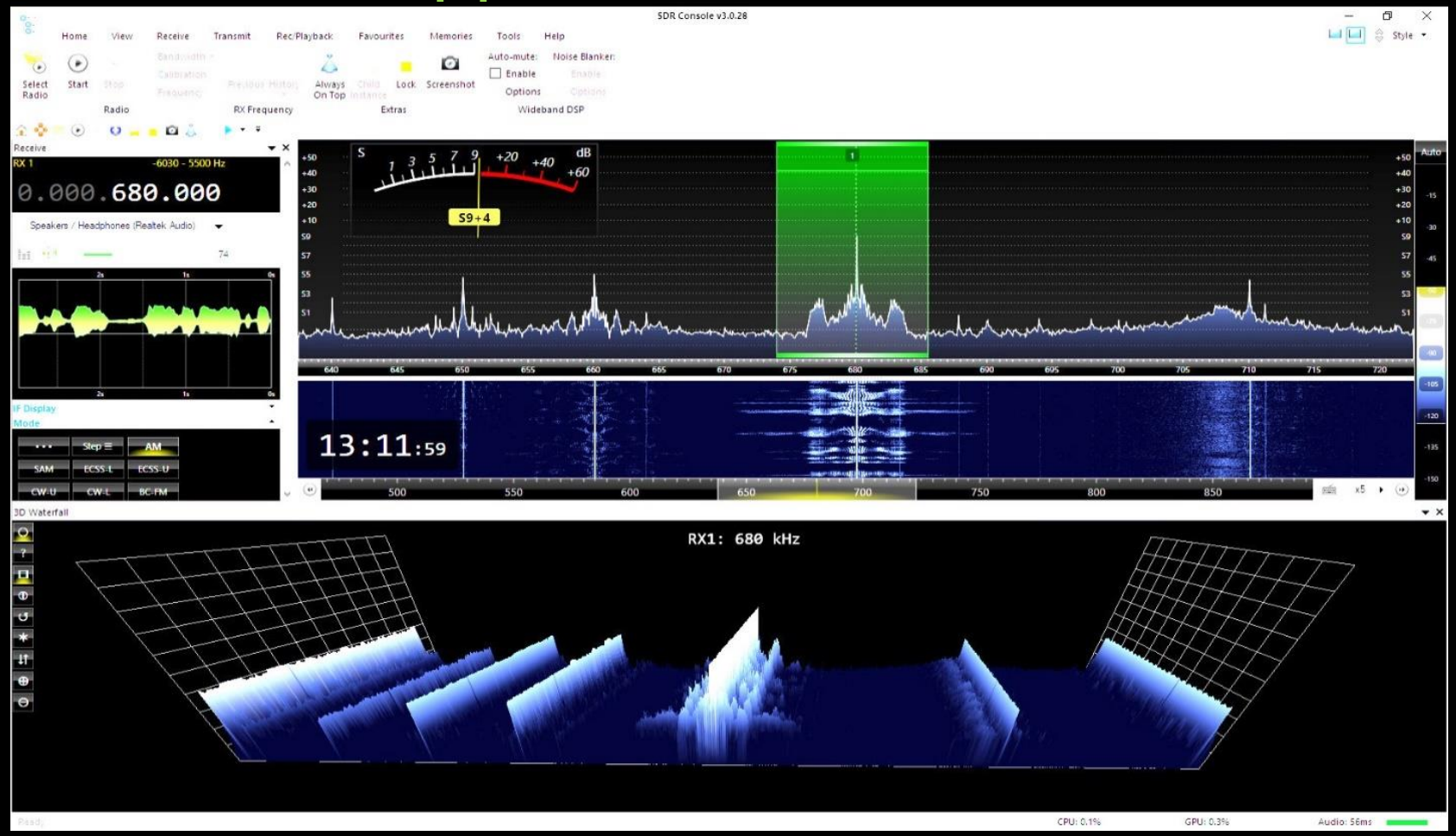
HDSDR is a freeware Software Defined Radio (SDR) program for Windows. The program originally came from WinRadio and has been around for a long time. It works with a wide range of radios. http://www.hdsdr.de/

RTL-SDR Supported Control Software



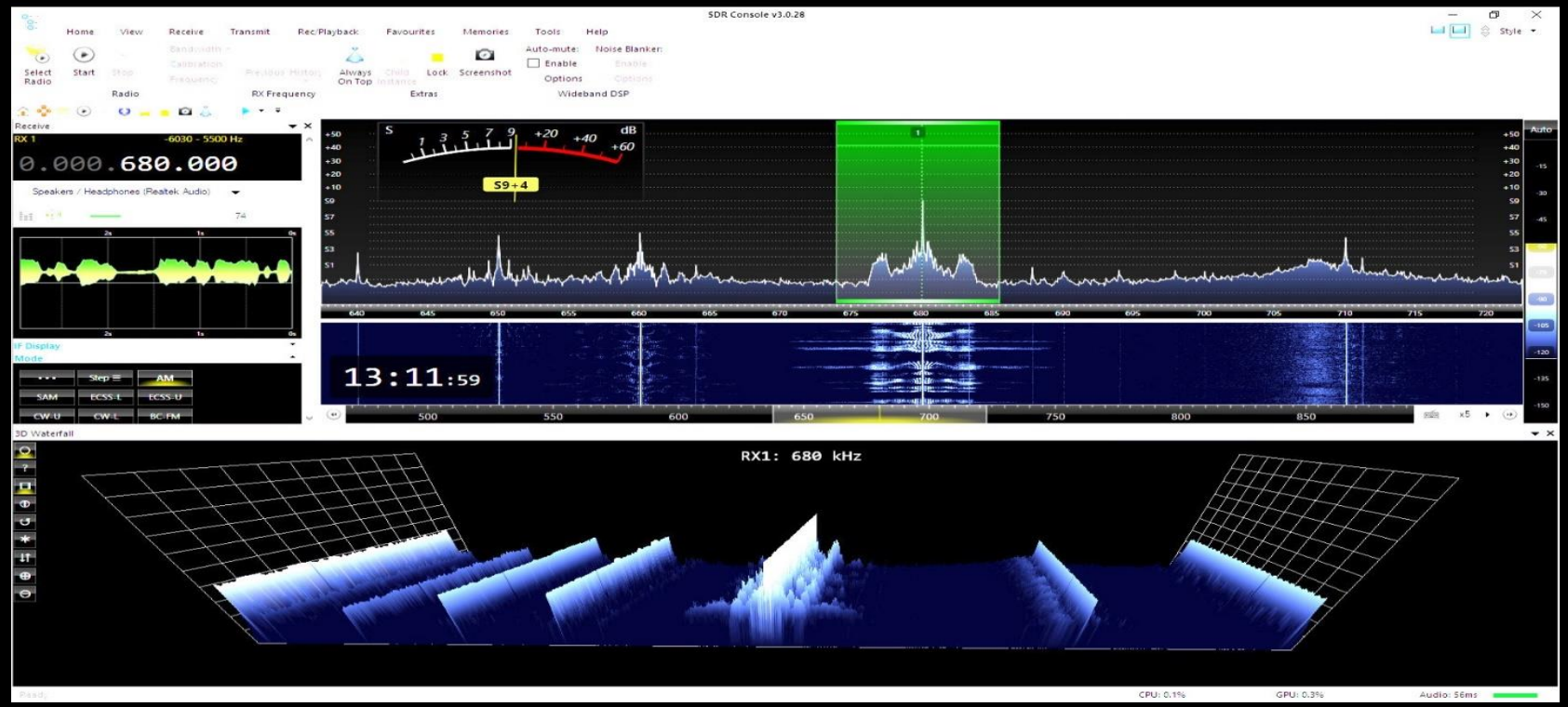
SDR# (SDR Sharp) is the flagship program for the AirSpy series of SDR Receivers. It is available as a free download for Windows. It is rich in features. https://airspy.com/download/

RTL-SDR Supported Control Software



SDR Console is a very powerful and full-featured SDR application for Windows. The image above shows the latest version of SDR Console with the 3D waterfall display. https://www.sdr-radio.com/download

RTL-SDR Supported Control Software

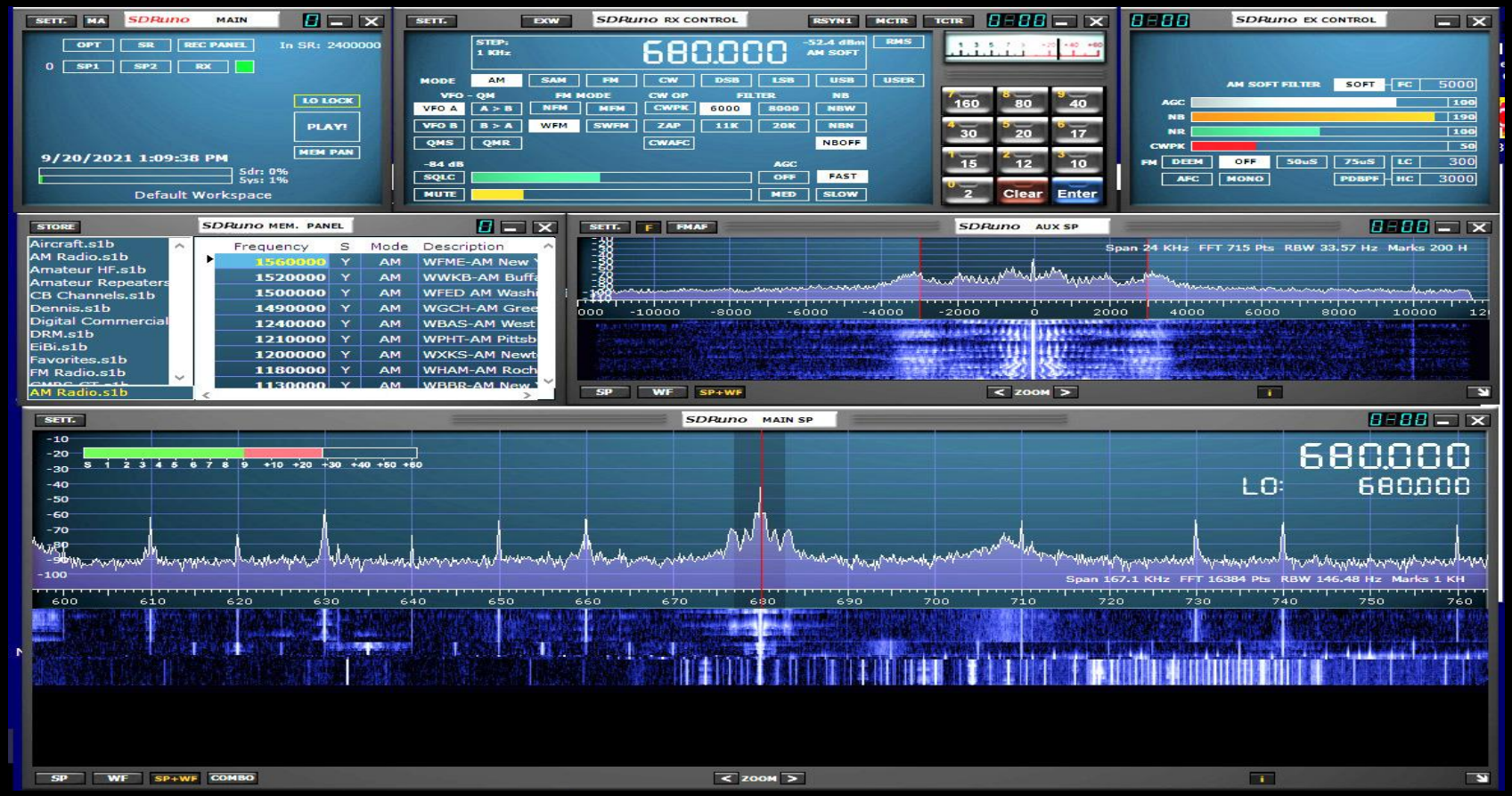


ExtIO Driver for SDR Console

SDR Console comes with native support for the RTL-SDR. This ExtIO and driver now has an option to enable the direct sampling mode, which is allows the HF mode on the V3 dongles to be activated. The ExtIO module can be downloaded from this Google drive link. Copy files into the SDR Radio.com Program Files folder.

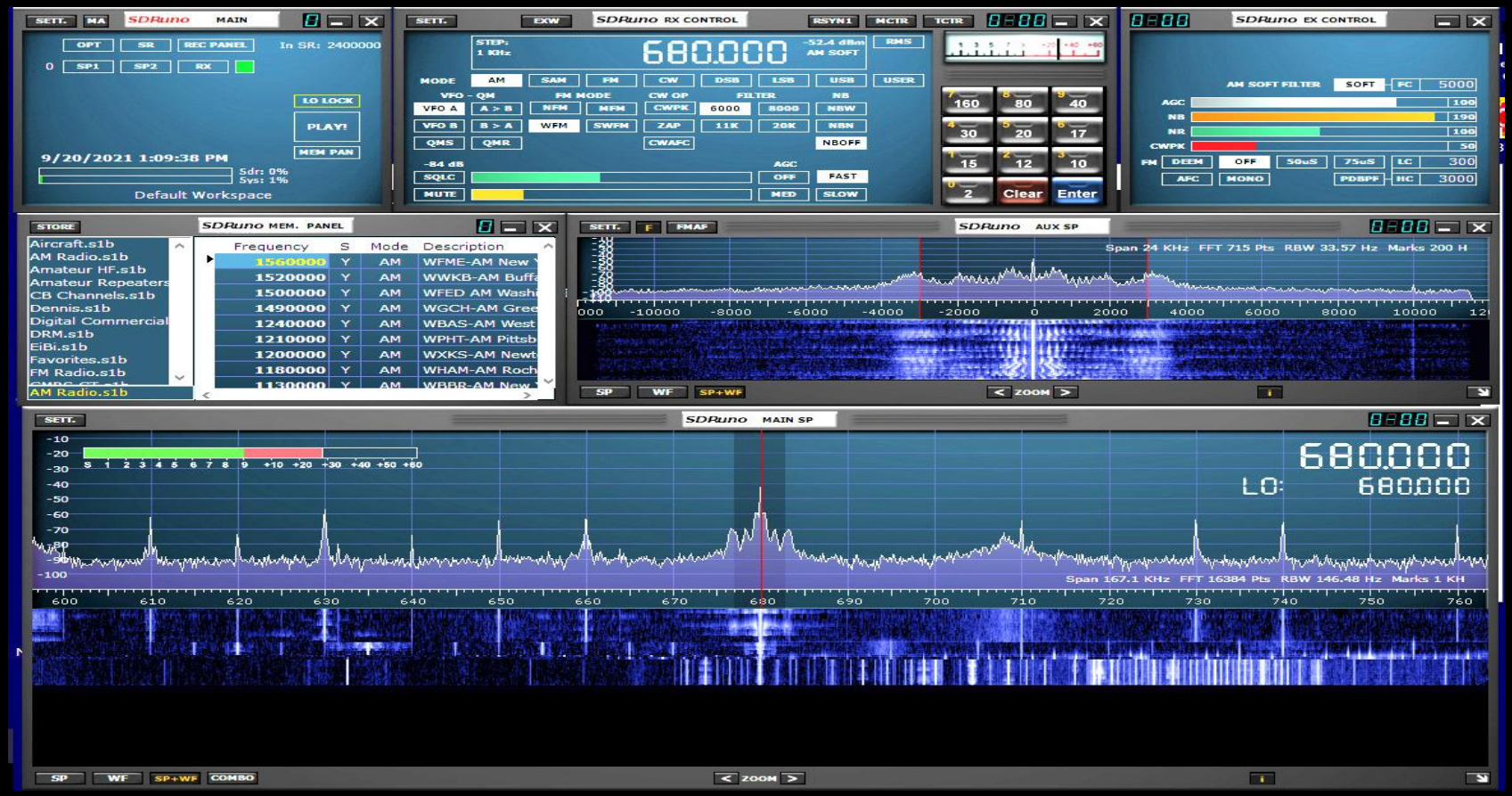
https://drive.google.com/file/d/1ZNhi1YwZtejVcHzzcglm8g_fnfUbP-cZ/view?usp=sharing

RTL-SDR Supported Control Software



SDR Uno – ExtIO Version is the flagship program for the SDRPlay RSP series of radios. It's a little more challenging to set up than the others. You need to use the ExtIO version of SDR Play for the RTL-SDR dongle to work.
https://www.sdrplay.com/you-can-use-sdruno-with-an-rtl-sdr-dongle-new-video-guide/

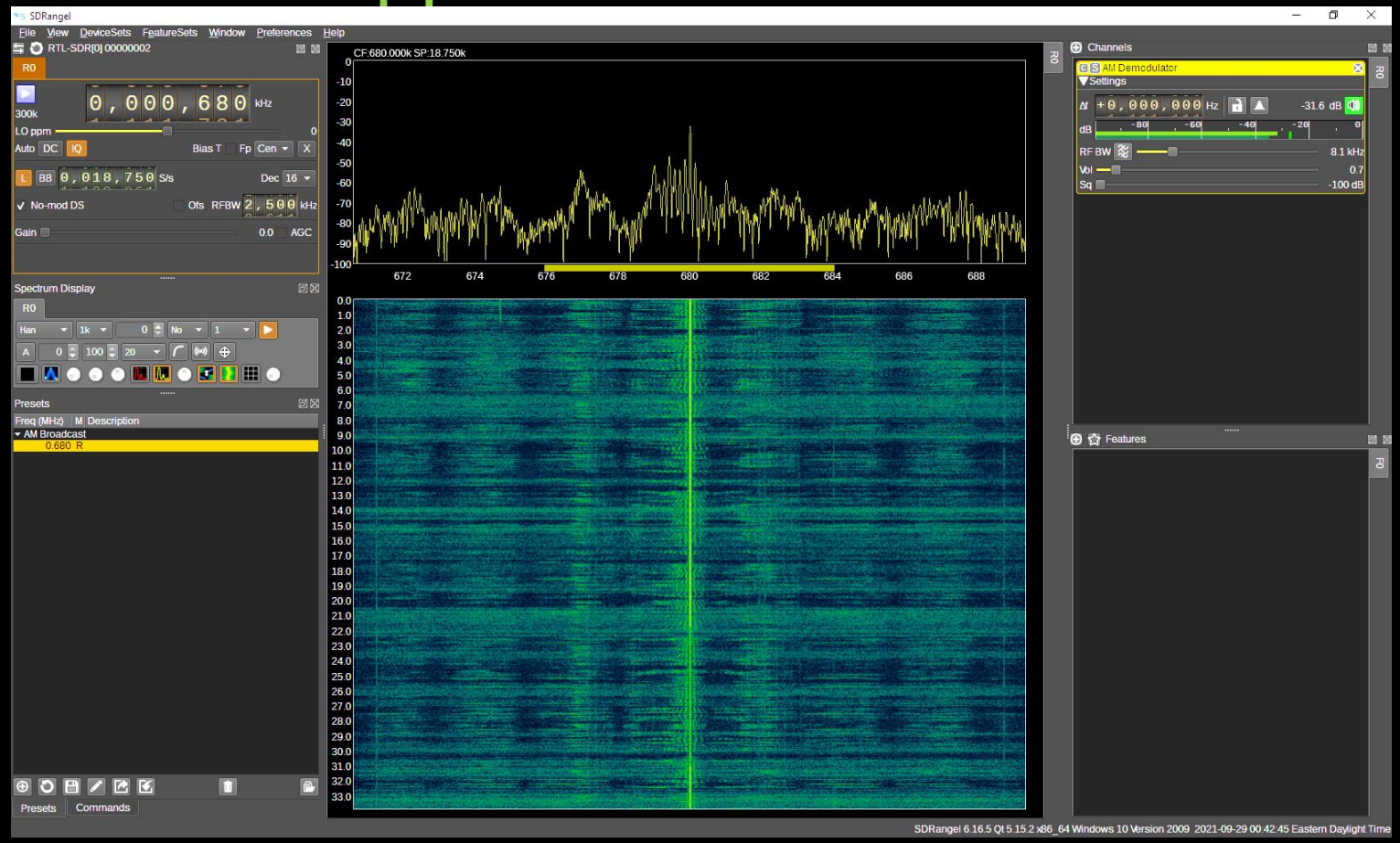
RTL-SDR Supported Control Software



ExtIO_RTLSDR_u8.dll version 1.1.1.7 for SDR Play https://www.rtl-sdr.com/forum/download/file.php?id=1026

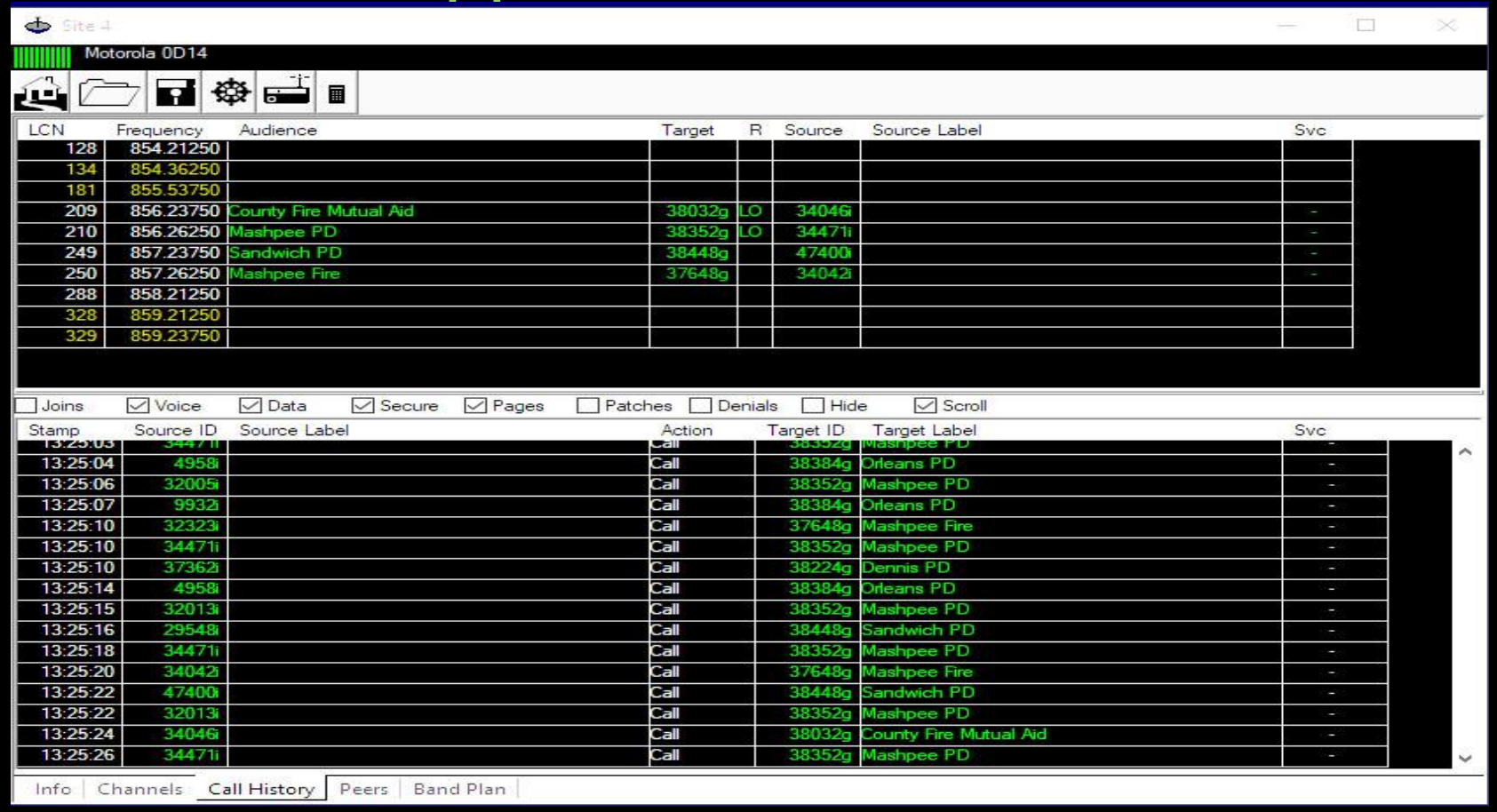
1. This ExtIO file needs to be in your Windows Documents folder. C:\Users\(username)\Documents
2. Not all settings are remembered after shutdown. Go back into the Main Panel, Opt => Select Input => EXTIO_RTLSDR and check RTL AGC to improve LW and HF sensitivity.

RTL-SDR Supported Control Software



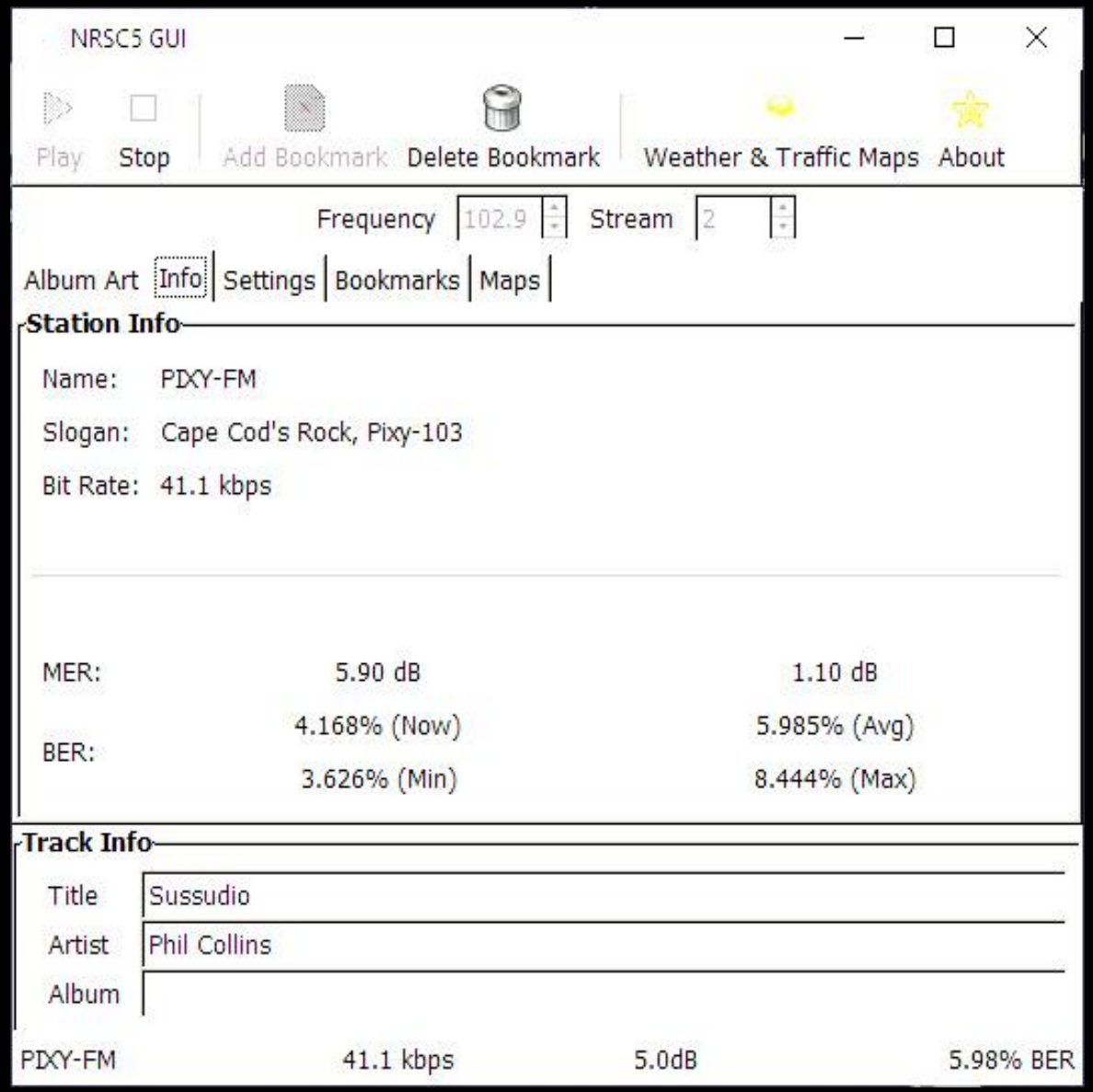
SDRangel https://rgetz.github.io/sdrangel/ is intended for the power user. It is expected that you to already have some experience with SDR applications and digital signal processing in general. SDRangel might be a bit overwhelming. There's a discussion group: https://groups.io/g/sdrangel and a Wiki Page: https://github.com/f4exb/sdrangel/wiki

RTL-SDR Supported Control Software



<u>Unitrunker</u> provides Trunk Tracking for many LMR Trunking Systems. The image above shows Unitrunker receiving the Cape Cod Public Safety System (800 mHz Motorola Type-II) just using a small 4” antenna in the basement. Keep in mind this program only does Trunk Tracking and does not perform reception of encrypted transmissions. Only one dongle is needed because the control and data channels are within the SDR passband. http://www.unitrunker.com/download/

RTL-SDR Supported Control Software



NRSC5 (HD Radio IBOC) provides reception of IBOC HD Radio. The image above shows reception of 102.9 MHz FM WPXY HD2 with a basement 4" whip antenna. I have not tried this program on the AM band because of a lack of available stations here. Incidentally, HD Radio does not mean "High Definition." It means "Hybrid Digital"

Software comes in two parts

NRSC5 Command Line Utility – you have to compile this yourself.

https://github.com/theori-io/nrsc5

NRSC5 GUI that provides a functional GUI screen derived from the command line utility.

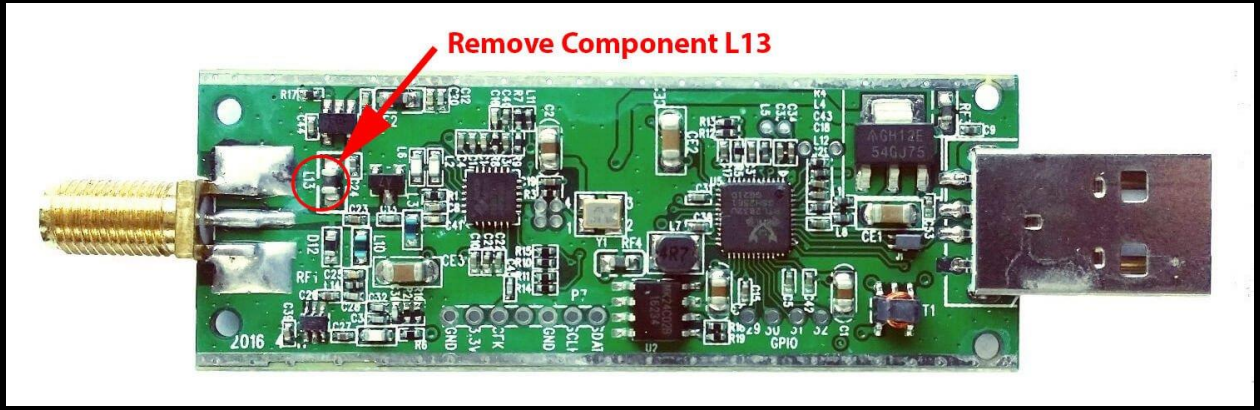
https://github.com/zefie/nrsc5-gui/releases/tag/v1.2.2

RTL-SDR Supported Control Software

Other Software

If the program supports output redirection, (such as SDR Play, you can use a Virtual Audio Cable program to “pipe” the audio from SDR Play to other programs that decode signals like RTTY, Fax, PSK, Slow Scan TV and even DRM – Digital Radio Mondiale, the high definition radio format used on shortwave. You would need to receive a very strong DRM signal to decode on a dongle.

RTL-SDR Modification



LF/MF Improvement / Bias Tee Disable Mod

If you want to improve the performance at LF/MF (below 500 kHz) and do not require the bias tee, then you can remove the bias tee inductor at L13. Of course remember that if you are interested in VLF/LF, it might be a better idea to use an upconverter which can be powered by the bias tee on the dongle.

Bias-Tee is when the SDR sends a voltage through the coax to power a pre-amp or upconverter located remotely from the SDR.

The RTL-SDR Dongle

- **RTL-SDR Quick Setup Guide** https://www.rtl-sdr.com/qsg

- Get the RTL-SDR running with SDR# first by following the Setup Guide

- Pay particular attention to the step that runs a program called ZADIAG or Windows won't recognize the dongle.

The RTL-SDR Dongle

- **RTL-SDR Quick Setup Guide**
  https://www.rtl-sdr.com/qsg

- SDR-Console supports the RTL-SDR dongle out of the box.
- SDR-Uno is a little more challenging to get running. You need the special ExtIO version and the DLL file.
- All require slight tweaking to optimize the signal reception.

Keep those cards and letters coming!

Over the years, many Hams have found Rick's presentations to be a valuable resource.

Just kidding! I hope I have helped in a small way to spark an interest in SDR devices and accompanying software. -Rick, W1RHS