Using the RSP – Radio Spectrum Processor with your Transceiver as a Panadapter

Contents

- What is a Panadapter?

- Hardware Requirements

- Signal Routing / Antenna connections

- Software

- Example setup

- Troubleshooting

- Ham Radio Deluxe

- For more information

What is a Panadapter?

- Panadapter is short for Panoramic Adapter. The simple answer is that it allows us to see a panoramic display of the band our radio is tuned to. We can see every signal.

- Early implementations used a PC soundcard to achieve this function but were therefore limited to 192 kHz of bandwidth (only with a top end sound card).

- The advent of affordable SDR hardware such as the RSP has allowed implementations with much greater bandwidth, and hence much more usefulness.

- The RSP (Radio Spectrum Processor) from SDRplay is a Software Defined Radio which can turn a PC into a general coverage receiver or spectrum analyser spanning VLF (1/10kHz) through to Microwaves (2GHz).

- Combined with readily available, and capable, SDR software Panadapters are now an affordable and easy to implement reality!

- Some transceiver manufacturers now offer built-in Panadapter capabilities, or add-on hardware. However, an RSP still offers you the chance of a larger, more legible display, and is still the cheapest add-on option.

- Some transceivers now offer connections (IF out, RX out, RX Loop) that the RSP can use for easy, seamless panadapter integration.
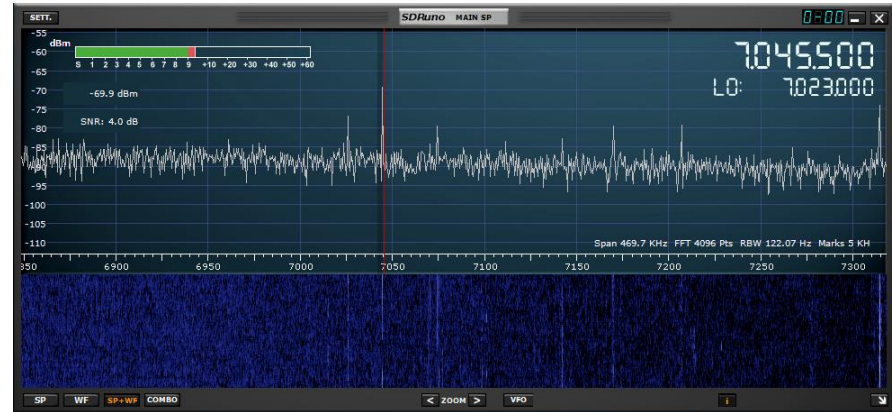
RSP Panadapter Advantages

1. Ability to monitor the entire band at once and identify newly active frequencies.

2. Monitor multiple bands at once – work one band and keep an eye on another!

3. Cheaper than the manufacturer's panadapter add-on.

4. Offers a larger display than built-in spectrum scopes.

5. User-customizable appearance and size.

6. Add panadapter capabilities to *any* rig, although full synchronization requires a CAT-equipped receiver.

Hardware Requirements

- ## An RSP – to acquire signals across the frequencies of interest.

- ## A Transceiver - preferably with either RF Out or IF Out capabilities, and CAT (Computer Aided Transceiver) capability to allow interaction with the SDR software.

- ## A PC – to run the SDR software and allow control signals to pass back and forth between the SDR software and the transceiver.

- ## Protection – for the RSP during transmit. This may be already built-in to the transceiver (if using RF- or IF-out) or by use of an external T/R switch

How do I implement a Panadpter?

- It's really not too difficult if you have a clear plan outlined up front:
  - How will I provide signals to the RSP?
  - How much integration do I want between SDR control and Rig control?

- First, we will consider the most important step, how do we route our signals around?

Signal Routing / Antenna Connections

Signal (RF) Routing

- The RSP can share the same antenna as your transceiver, or in some situations you may prefer to use an entirely separate antenna.

- If a separate antenna is used care must be taken with the physical layout to ensure that near-field effects do not overload the RSP when you are transmitting from the transceiver.

  - See this article for a discussion of near-field effects: http://www.w8ji.com/antenna_coupling.htm

- If a shared antenna is used it may either be connected "behind" the transceiver, in which case internal circuitry in the transceiver will protect the RSP, or using a splitter "in front of" the transceiver. If a splitter is used it is essential that a switch is implemented that isolates the RSP1 from the antenna during transmit!

- **In any configuration the maximum input power to the RSP must not exceed 0dBm**

- On the following slides we will look at these configurations in more detail

DO NOT directly connect the 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 and invalidate your warranty.

How do I choose my connection scheme?

- This decision is in part determined by your rig's capabilities, in part by personal preference.

- If your rig offers IF Out or RF Out you can connect the RSP there and not have to worry about overloading the RSP during transmit.

- If you do not have the option of IF Out or RF Out you will have to provide external protection for the RSP.

- Let's consider the pros and cons of various configurations.....

Pros and Cons

1. Separate Antenna
   - Pros: Completely separate from existing rig setup, no impact on sensitivity or possible loss of receive function on rig.
   - Cons: Need to ensure no adverse near-field coupling between antennas, may need to add additional protection to RSP.

2. Shared antenna and splitter
   - Pros: Exactly same receive signals for rig and RSP.
   - Cons: Must protect the RSP during transmit. May lose Receive function on the rig.

3. IF Out from the rig
   - Pros: RSP protected by rig's internal circuitry
   - Cons: May be limited bandwidth capability, possible signal reduction (3dB)

4. RF Out from the rig
   - Pros: RSP protected by rig's internal circuitry
   - Cons: Possible signal reduction (3dB)

1. Separate antenna

- Care must be taken with the physical layout to ensure that near-field effects do not overload the RSP when you are transmitting from the transceiver.
    - See this article for a discussion of near-field effects: http://www.w8ji.com/antenna_coupling.htm
    - Some suitable products to protect your device are shown on next slide, "Protection Devices"
- Compatible with all rigs

Near-field coupling
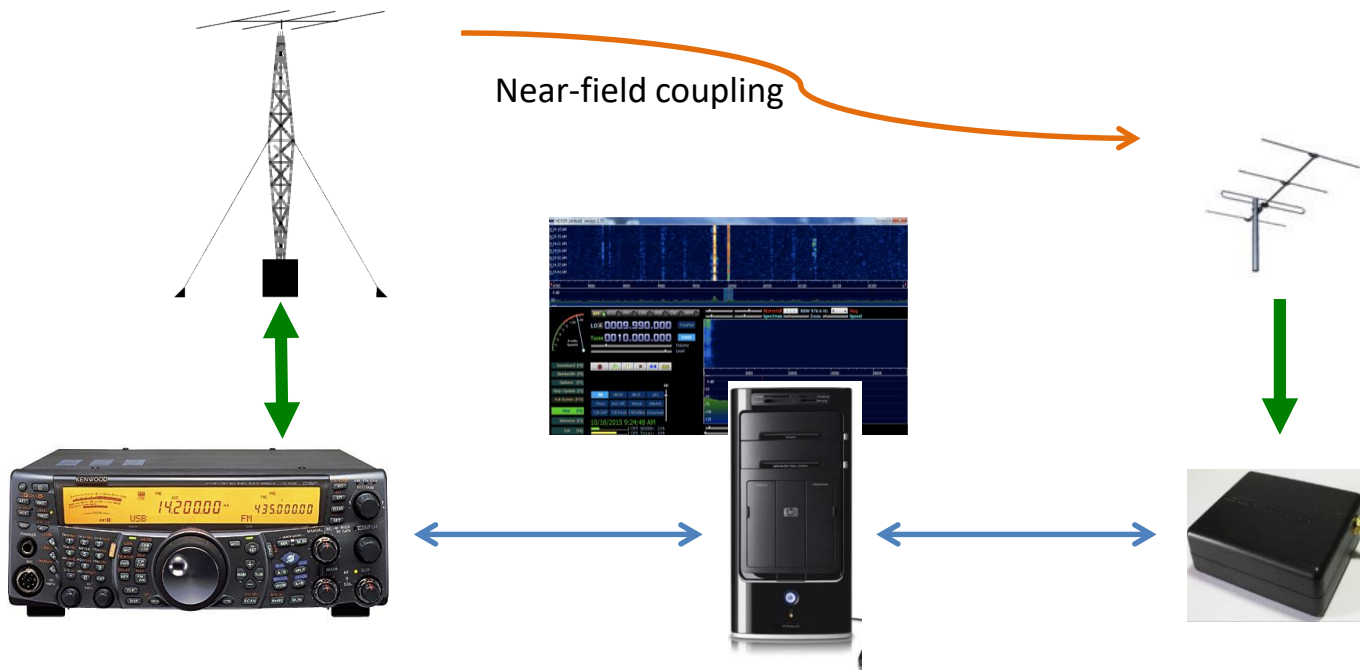
DO NOT directly connect the RSP to an antenna in the near field of a transmitting antenna, as this is likely to result in irreversible damage to your RSP and invalidate your warranty.

Protection Devices

- In addition to protection from near-field overload it is a wise precaution to provide external protection to your RSP to also guard against lightning strikes or static build-up.

- In a shared antenna setup, such protection may also help protect your rig.

- Regardless, when thunderstorms threaten, you should always disconnect any external antennas.

- Here are some devices that provide that protection:

    - DX Engineering: https://www.dxengineering.com/parts/dxe-rg-5000
    - Array Solutions: https://www.arraysolutions.com/surge-and-rf-protection/as-rxfep

    - ebay: http://www.ebay.com/itm/RF-Limiter-Receiver-Front-End-Protector-RF-Fuse-for-Hamradio-HF-QRO-use-/282234181986?hash=item41b677d962:g:ljYAAOSw3ydV5i9n

2. Shared antenna using splitter

- A switch (MFJ1708 or RTR-2) must be used to isolate the RSP during transmit!
- In Receive mode the switch may route the antenna to the RSP only, leaving the transceiver receive side inactive.

e.g. MFJ1708, DX Eng RTR-2

T/R switch

PTT
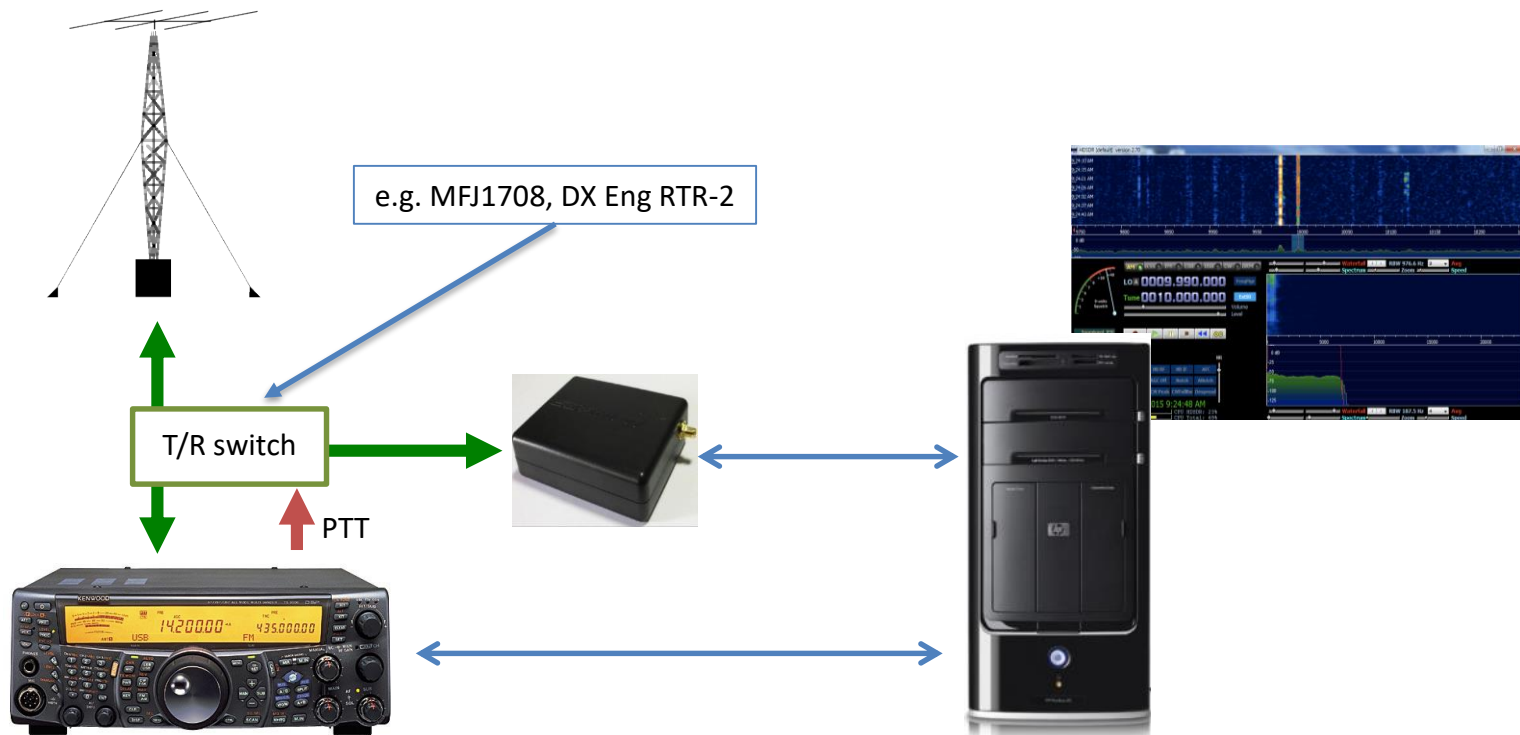
DO NOT directly connect the RSP to the same antenna as your transmitter as this is likely to result in irreversible damage to your RSP and invalidate your warranty.

3. Using IF out from the rig

- Rig's Internal circuitry isolates the RSP
- Displayed bandwidth may be limited by the rig's IF filters
- Signal may be split (3dB loss) between the rig's receive circuitry and the RSP
- SDR software is tuned to the IF frequency

IF Out
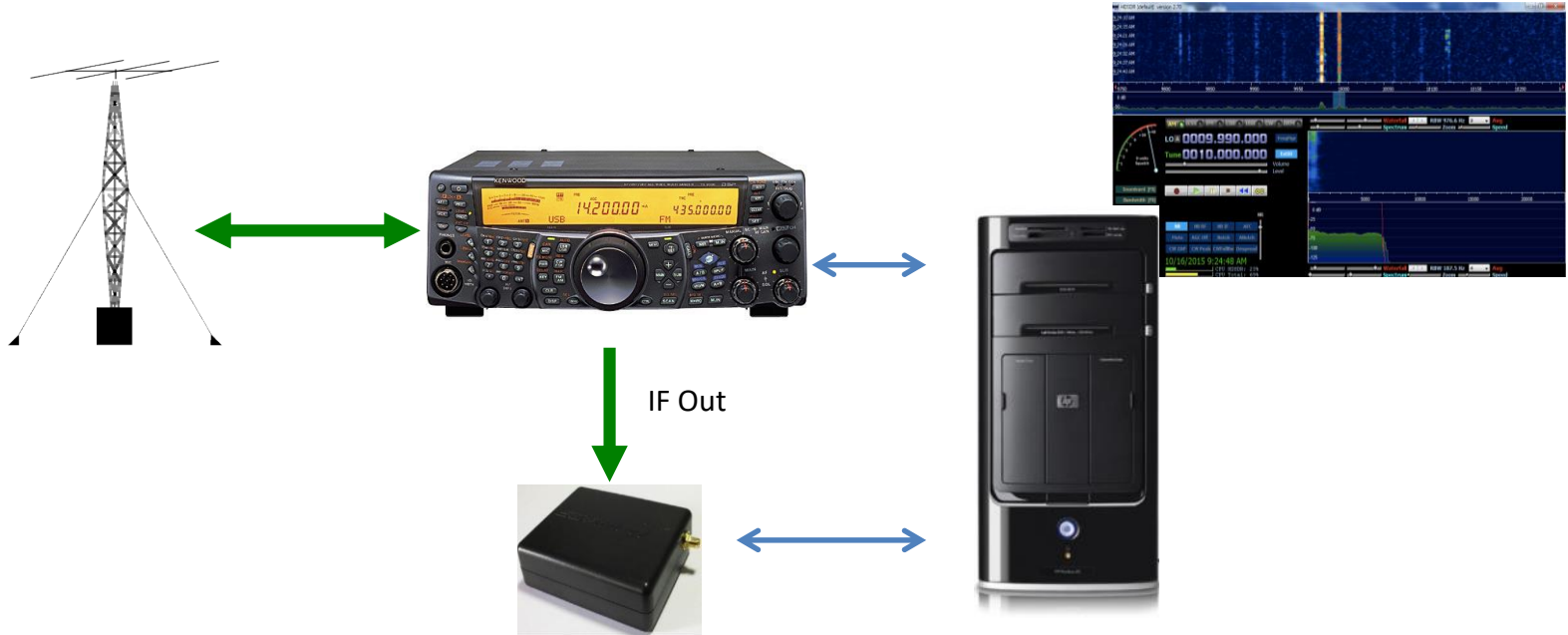
4. Using RF out from the rig

- Rig's internal circuitry isolates the RSP
- Signal may be split (3dB loss) between the rig's receive circuitry and the RSP
- Full bandwidth view available
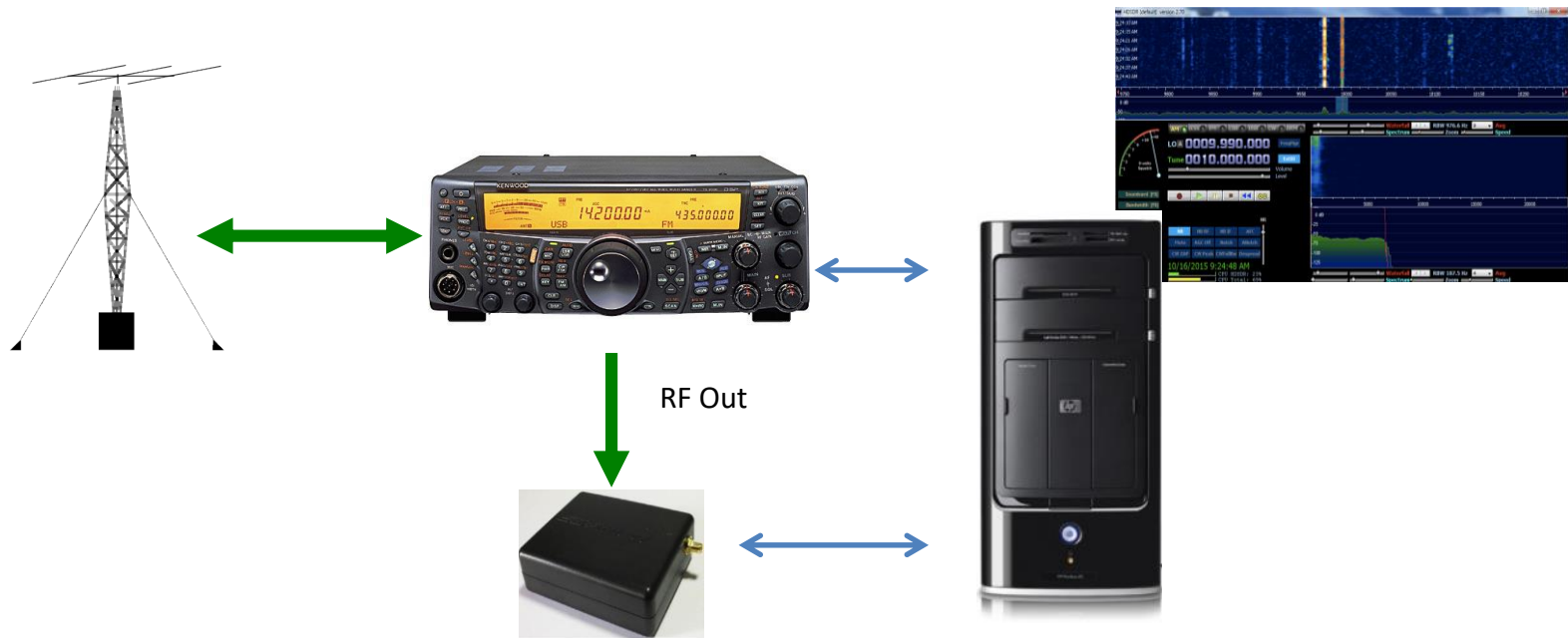
RF Out

RF Out: DRV output on some Kenwoods

RX out on some Yaesus (Note: RX Out may need to be split and one leg returned to RX In to maintain received audio, resulting in 3dB signal loss).

Software

Software Requirements

- Any of the SDR Software programs that support the RSP can be used to provide a basic spectrum display.

- SDRuno, HDSDR, SDR-Console and CubicSDR all have built-in capabilities for rig control.

- OmniRig is recommended for ease of use when controlling a rig via CAT.

- Software manufacturer links:

SDRplay:	www.sdrplay.com
HDSDR:	www.hdsdr.de
SDR-Console:	www.sdr-radio.com
CubicSDR:	cubicsdr.com
OmniRig:	www.dxatlas.com/omnirig/

Note: Most popular SDR software packages can be downloaded from sdrplay.com. These packages come with an installer which includes all necessary API, Driver and/or EXTIO files for one step installation.

Software capabilites

- Regardless of which SDR software you choose, you have the ability to control how much interaction there is with the rig:
  - SDR software tunes the rig (click on a frequency of interest in the spectrum display and the rig will automatically tune to that frequency)
  - Rig tunes the SDR (tune the rig to a particular frequency and the SDR will track that frequency)
  - Mute the SDR during transmit (prevents the display from overloading and mutes audio out during transmit)

- Rig without CAT?
  - Even if you do not have the ability to automatically sync your SDR with the rig it is often beneficial to implement a panadapter to see all signals within the band. Using the spectrum display you can click on a frequency of interest and read out the frequency, which is then manually tuned into the rig

Set up example - SDRuno

- We will now look at an example of how to set up a panadapter. For this example we will use SDRuno and the Kenwood TS-590SG.

- There is a video available of the procedure on our YouTube channel: https://www.youtube.com/watch?v=n96ZgDQa77Y&list=PLOlniSsm 2f1PX3BHHZ4jS8q-qkgUiHE0V&index=23
   (there are also videos covering other radios on the channel)

- Although there is some redundancy in the following setup sequence at the beginning, we believe in taking small steps rather than trying to throw the whole thing together at once and hope it all works!

- As we go through the steps we'll highlight any differences for other setups.

Hardware setup (1)

1. Verify your rig is working normally. With your usual antenna connections verify that everything works as expected on your bands of interest.

2. Verify the RSP and SDRUno is working. Power down the rig and transfer the antenna connection to your RSP. Start up SDRuno and make sure the RSP is also receiving as expected on all bands of interest. Familiarize yourself with using SDRuno, in particular how to change bands and tune frequencies.

3. Setup your panadapter antenna configuration. Close SDRuno and configure your antenna connections as you want them for the panadapter. We elected to use Configuration 4 – RF out from the rig – so we connected a cable from DRV out on the Kenwood to the RSP antenna input. This also entailed going into the Kenwood's menu system and configuring the DRV output to be RF Out. Set up your cabling as appropriate.

Hardware setup (2)

4. Turn on the rig and verify you still have reception.

   (If using the MFJ1708 antenna switch this may not be possible, reception is via the SDR, proceed to next step)

5. Start SDRuno and verify you are still receiving signals.

   (If you are using IF Out you will need to tune to the IF frequency of your rig to see signals)

6. Now, we can make the CAT connections to your rig. Close SDRuno and power down the rig. Connect a cable from the CAT connector on the rig to a USB port on your PC. Depending on model, this may be a straight USB cable or a special RS-232 (DB-9) to USB adapter. Install any manufacturer provided drivers, or in some cases allow Windows to install the drivers for you.

7. Hardware setup is now complete.

Software setup - OmniRig

1. Download and install OmniRig (www.dxatlas.com/omnirig/)
2. In Device manager identify the COM port in use to communicate with your rig
3. Start OmniRig and select the matching COM port. Select your rig from the dropdown
4. For now leave the other settings at their defaults. Go into the menu on your rig and make sure the baud rate and other settings match what you see in OmniRig

Driver successfully installed as COM3
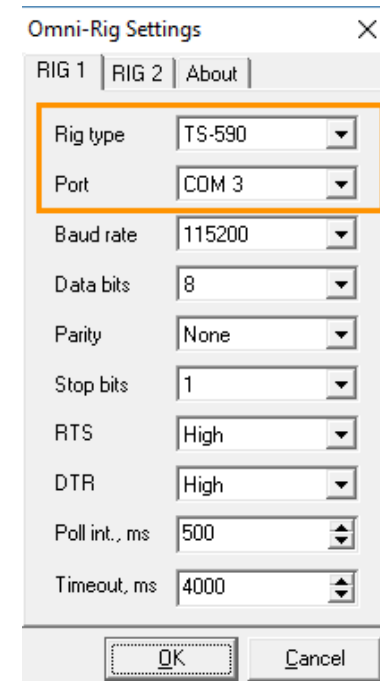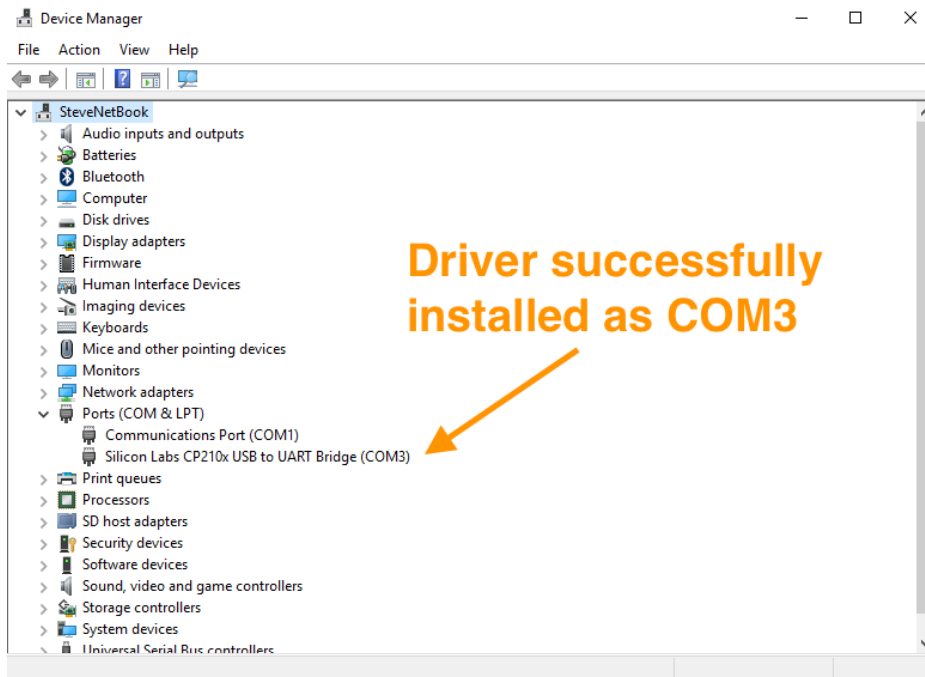
Software setup - SDRuno

1. Start SDRuno and click on the SETTings button in the main window.

2. Click on the ORIG tab. Your rig should appear next to "Rig1 Type", status should be "online", and the message "Connected to OmniRig server" should appear at the bottom.

3. *If you are using "configuration 3 – IF Out from the rig" input your IF frequency (in Hz) in the box and click the "ENABLE" button. This will instruct SDRuno to calculate and display the tuned frequency correctly, even though it will always be tuned to the IF frequency.*
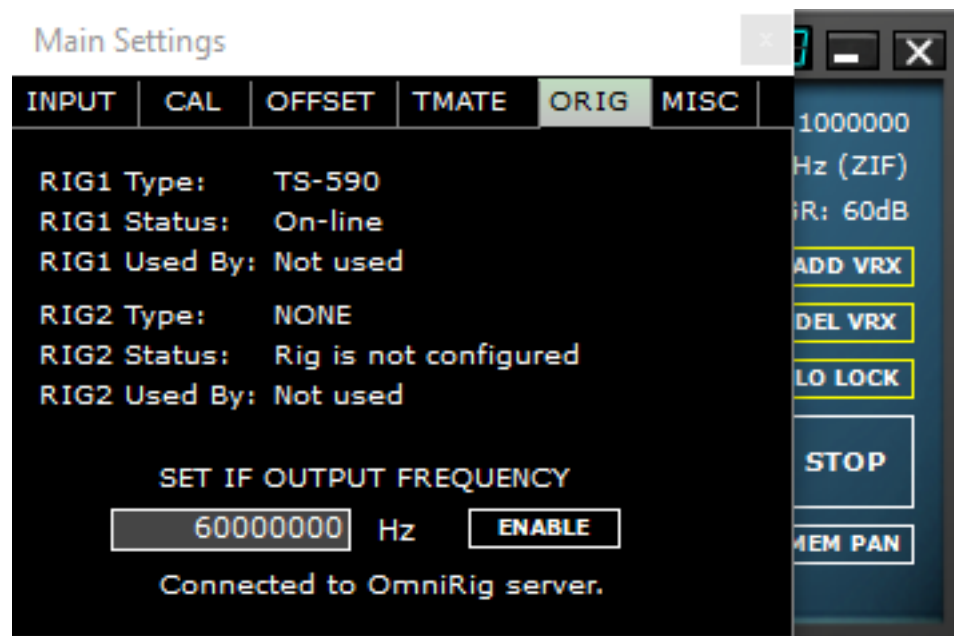
Software setup - SDRuno

4. If you have not already done so, open up a VRX (RX Control) window. Click on its SETTings button.

5. Click on the ORIG tab. Place checkmarks in the boxes for your sync preferences, (sync RX mode mutes SDRuno during transmit). The settings as shown are preferred by most people.

   DO NOT ENABLE ANYTHING ON THE CAT TAB!

6. Click RSYN1 in the RX Control window, the Main settings window should reflect this by showing "RIG1 used by: VRX0"

7. This completes the software setup. Click on "PLAY" in the SDRuno main window and have fun!

Troubleshooting

- Most times, if you follow these instructions carefully, everything should work.

- Some people report issues with the rig slow to respond or other spurious actions from the rig.

- The solution is to experiment with some of the OmniRig settings. Many of the config (.ini) files have been submitted by users and may not work in all cases.

- It is often beneficial to experiment with the baud rate settings and the polling and timeout intervals. Just be sure that you reflect any changes in the rig's control menus, and also check the COM port settings in Windows to ensure they also match.

- If you still have no luck you can download additional software from the OmniRig site entitled "OmniRig Client" It enables you to experiment and verify operation of the various commands that are used with your rig.

Ham Radio Deluxe

- Some users use HRD for various logging and/or digital decoding functions. Since this often involves HRD trying to control the rig this can cause conflicts with SDRuno also trying to control the rig.

- The solution to this is to reconfigure HRD so it does not control the rig directly, instead HRD is set up to control the VRX in SDRuno.

- In the VRX Settings window go the CAT tab. Create a virtual serial port that will be used to control SDRuno from HRD. Then, in HRD set it up to provide "rig control" to that same virtual COM port rather than the rig's actual COM port (which is being used by SDRuno).

- Further information on setting up CAT control can be found in the SDRuno Users Manual - http://www.sdrplay.com/downloads/

For more information:

- Company website: www.sdrplay.com

- Community Forums: www.sdrplay.com/community/

- Email: support@sdrplay.com
  - US customers: support-us@sdrplay.com

- Facebook: https://www.facebook.com/groups/sdrplay/
  - Independent group run by enthusiastic users!

- YouTube: https://www.youtube.com/c/SDRplayRSP
  - Many instructional videos here on all aspects of the RSP