DVB-T Setup for Higher Symbol Rates

Using SV1BDS Python Receiver 2K5B Software

by Rick Peterson, WA6NUT

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by Rick Peterson, WA6NUT

INTRODUCTION

This document provides the procedure for setting up the DVB-T station at WA6NUT. Settings for OBS Studio, DATV-Easy, F5OEO firmware, DVB-T receiver, and VLC Media Player are given. Other details are specific to the WA6NUT setup, and may not apply to your station.

This document describes the best ATV setup I've found for higher symbol rates. It uses receiving software from SV1BDS and transmitting software from F1EJP and F5OEO. And all on one $179 HP laptop! (2024 Cyber Monday price – at this writing the price is now back to $599! – I paid $299 on Cyber Monday in 2023).

This document shows the setup running a symbol rate of 1 M symbols/sec (2 M symbols/sec is available with the SV1BDS receiver). Of course, satisfactory operation is obtained at lower symbol rates. The 1 M symbol rate is compatible with the WA8RMC Versa Tune Express receiver, and also the HiDes HV-122 receiver.

You'll find many links to other documents and websites in this document. If you're reading this PDF document from a computer screen, each link is a hyperlink: to access a link, just position the cursor over the link and click the mouse once.

Download the most recent version of this document, along with the app, from:

https://www.qsl.net/wa6nut/DVB_T_RX_2K5B.zip

LAPTOP PC

HP 17z-cp200, Windows 11 (with camera), AMD Athlon processor with Radeon GPU

Control Panel --> Hardware and Sound --> Power Options --> Create a Power Plan:

Click on “Performance” radio button
“Turn off the display” = Never
“Put the computer to sleep” = Never

Click on “Create”

TRANSMIT (see Figures 1-4)

Hardware:

Camera (Logitech C920)

Mic (Eivotor YX-3)

USB Sound Card (Manhattan 151429)

USB Hub (GigaWare 26-424)

USB Wall Charger (available from many sources)

USB-C to USB-A Adapter Cable (Amazon Basics)

Transmitter hardware:

ADALM Pluto Rev. C with F5OEO 0303 firmware

Leo Bodnar Mini Precision GPS Reference Clock

SBB5089/SZA2044 Amplifier: See KH6HTV review p. 6
https://kh6htv.files.wordpress.com/2023/02/tv-rptrs-rptr-122.pdf

(the above items are housed in the DVB-T Transmitter)

13.5/30Vdc 1A AC Adapter (for DVB-T Transmitter)
(set to 13.5Vdc)
Radio Shack 273-1668

RA30H4047M Amplifier See W6ORG website:
https://hamtv.com/pdffiles/PA5RA30H4047M.pdf

SureCom Pwr/SWR Meter
25W Dummy Load

HP ATX 12Vdc Power Supply (for RA30H4047M Amp)

ATX PC Power Adapter Board (diymore from Amazon)

Software: Mini GPS Clock Configuration app
Logitech Capture (Driver for C920)
OBS Studio v. 27.2.4 (64-bit)
DATV-Easy v. 2.16 (by F1EJP)
Microsoft Edge browser: Pluto Controller and Analysis pages

Ensure that the SMA connector on the DVB-T Transmitter front panel is connected to the amplifier input, and that the DVB-T Transmitter power receptacle is connected to the 13.5 VDC power supply (the front panel green LED should be illuminated). The amplifier output should be connected to the SureCom Pwr/SWR meter input, and the meter output should be connected to the 25W dummy load. Ensure that the SMA connector on the DVB-T Transmitter rear panel is connected to the GPS antenna, and that the 2 USB ports are connected to the PC.

1 Open **Mini GPS Clock Configuration** app. Check that the PLL Lock text box indicates “PLL Lock OK.” If it is not locked:

Advanced –-> Update

2 Open **OBS Studio (with OBS VirtualCam 2.0.5 plugin installed)**:

See F1EJP DATV-Easy 2.16 PDF instructions p. 2

Source = Video Capture Device
HD Pro Webcam C920

Settings --> Audio --> Global Audio Devices --> Mic/Auxiliary Audio = Microphone (3-C-Media USB Headphone Set) --> OK

Tools --> VirtualCam --> uncheck “AutoStart” --> Stop --> Exit

Settings --> Video

Select: Base (Canvas) Resolution = 1920 x 1080
Output (Scaled) Resolution = 1920 x 1080
Common FPS Values = 25 PAL

Apply --> OK

Tools --> VirtualCam --> check “AutoStart” --> Start --> Exit

Settings --> Output

Select: Streaming Bitrate = 2500 kbps
Audio Bitrate = 150

Apply --> OK

Minimize OBS

3 Open **DATV-Easy**

Click “Easy.” Select “437.00 DX”. Click “Valid.” “437.000” is shown under “Frequency MHz” (may not be necessary: 437.000 is the default value).

DVB/MPEG-TS tab (see F1EJP DATV-Easy 2.16 PDF instructions p. 8)

DVB = DVB-T QPSK (see Note 1) Codec = H262

Bandwidth = 1000 kHz Image size 16/9 = 640 x 360

FEC = 2/3 FPS = 15

Guard Factor = 1/32 Audio Codec = AAC+

Mode = 2K Audio kb/s = 12 kb/s

Configuration tab (see F1EJP DATV-Easy 2.16 PDF instructions p. 3)

Settings/Equipment = Pluto F5OEO 0303 2402 60 100

Adalm Pluto SDR IP = 192 168 2 1 8282 1 (my IP, yours may vary)

Input/Entree = OBS + Virtual Cam

Encoder = AMD Default FPS = 15

Audio sync ±ms = 0 Audio SR = 44100

DVB Tables tab (see F1EJP DATV-Easy 2.16 PDF instructions p. 6)

Default values

4 Open **Microsoft Edge browser** (See Note 3)

Click “ADALM Pluto DV . . .” tab on Windows Toolbar.

Brings up 192.168.2.1/pluto.php (my IP, yours may vary)

Click “Controller” button at top.

“ADALM-PLUTO DATV Controller” page is displayed.

DVB-T Setup for Higher Symbol Rates

On browser “Controller” page, the following settings are required:

Modulator Settings:

Power = -11.3 dB

PCR/PTS = 2000 ms PAT period = 1000 ms

Freq-Manual = 437000000 Freq-Channel = Custom

Mode = DVBT Mod = QPSK

SR = 1000 1000 KS FEC = 2/3

On browser “System” --> “Setup” page, the following settings are required:

Main mode selection = DATV
DATV operating mode = UDP

Pluto Configuration

USB on Ethernet

Host name = pluto
IP Address = 192.168.2.1
Host IP address (computer) =192.168.2.10
Network mask = 255.255.255.0

Ethernet

IP Address = 192.168.1.40 (my IP, yours may vary)
Network mask = 255.255.255.0
Gateway IP Address = 192.168.1.1

Click “Start +” button. The green LEDs light. “Transmission” reads about 1005 kb/s on DATV-Easy app.

On browser “Controller” page note red “ON AIR” text and red border around Modulator settings. When DATV-Easy “Start +” button is clicked, “Buffer” on the “Controller” page should change from “Underflow” to “Nominal.”

Initialize the DVB-T transmitter by reducing the F5OEO “Controller” page power setting by 1-2 dB, then increasing it by 1-2 dB to the original setting (don't ask why, it just works!).

Click PTT “Stop” button on DATV-Easy GUI.

To transmit, press RA30H4047M Amplifier PTT button, then click DATV-Easy PTT “Start+” button. The SureCom Pwr/SWR meter should read 3-4 watts output power. To end transmission, click DATV-Easy “Stop” button, then press RA30H4047M Amplifier PTT button.

Allow for a 12-15 sec delay between clicking the DATV-Easy PTT “Start+” button and VLC displaying your video at the receiving station. Typical latency in the received video is about 7-9 sec.

Adjust Mic gain from Windows Sound (Recording) as needed:

> Sound --> Sound Settings --> Sound Control Panel --> Recording --> Microphone (3-C-Media USB Headphone Set) --> Levels

The OBS Mic/Aux level slider control should be left at mid-scale to avoid feedback problems.

Click “Analysis” button at top of browser “Controller” page. Note “Null Packets” on bargraph and data to right on the “Analysis” page. “Null packets among 1005 345 kbits/s” should be < 20%. Note “Video buffer analysis” graph at bottom of page. This graph shows the health of the transport stream being applied to the Pluto transmitter. Note how the graph is disturbed when the camera detects rapid motion.

Return to “Controller” page by clicking browser “back” <-- button.

RECEIVE (see Figures 1-4)

Receiver Hardware: GE 42178 Antenna Amplifier: See AH2AR/N8ZM video:
https://www.youtube.com/watch?v=Gekwf6SgM8k&ab_channel=W8BIATVRepeater

SDR Receiver (RTL-SDR V3)

Amplified speakers

Software: GNURadio Companion v. 3.8.2.0

DVB_T_RX_2K5B.zip (by SV1BDS)

(after unzipping, the DVB_T_RX_2K5B.py file should be placed in the C:\ folder)

VLC Media Player 2.2.5.1

1 Apply power to the GE Antenna Amplifier.

Turn laptop ON and let it boot up to opening screen.

2 Open **GNURadio-3.8** (“run_gr” shortcut” icon on desktop)

Command line black screen opens.

At c:\Program Files\GNURadio-3.8\bin prompt,
type cd c:\Program Files\GNURadio-3.8
Press Enter key.
At c:\Program Files\GNURadio-3.8 prompt,
type python c:\DVB_T_RX_2K5B.py -s 1 -r 1
Press Enter key.

The SV1BDS receiver (GUI) will be displayed.

See the Appendix for a simplified method for opening the SV1BDS 2K5B receiver app.

Receiver settings:

Bandwidth = 1M (set via menu: “-s 1 -r 1”: default = 500K)

FEC = 2/3 (default: cannot be changed)

RF Gain (dB) = 15.0 (my setting, yours may vary: default = 10.0))

RIT = -7500 (my setting, yours may vary: default = 0)

Frequency = 437000000 (default: can be changed from the GUI)

When receiving the other station, tune the receiver RIT control so that the upper “Constellation” display shows four distinct clusters (QPSK pattern). The clusters should not be too tight (avoiding receiver overload) nor too loose (ensuring VLC lock). See Note 5.

Adjust the RF Gain control for the highest MER reading (should be greater than 10 dB for a strong signal).

The VLC timer/counter (located below the lower left corner of the displayed image) doesn't increment. So the VLC Current Media/Stream Statistics window is used to monitor audio and video stream activity. Access in VLC by:
Tools --> Codec Information --> Statistics (see Figure 4).
If the Video Decoded Block count stalls, restart VLC by:
Media --> Open Network Stream --> Play

Settings can be changed from default values using the menu options, entered following“python c:\DVB_T_RX_2K5B.py.” So “python c:\DVB_T_RX_2K5B.py -s 1 -r 1” designates a 1000K symbol rate, with all other parameters set at default values. Here are the settings and options available from the menu:

-s Numerator of fraction multiplying 1M for symbol rate.

-r Denominator of fraction multiplying 1M for symbol rate.

Examples: “-s 2 -r 1” gives symbol rate = 2/1 x 1M = 2M/sec
“-s 2 -r 2” or “-s 1 -r 1” gives symbol rate = 2/2 x 1M or 1/1 x 1M = 1M/sec
“-s 1 -r 2” gives symbol rate = 1/2 x 1M = 500K/sec (default)

-i IP address (default is 127.0.0.1)

-p Port (default is 5555)

Example: -i 127.0.0.10 -p 10000 gives address with port = 127.0.0.10:10000

3 Open **VLC Media Player** (“traffic cone” icon on desktop).

Audio --> Audio Device = Default: Headphone (Realtek (R) Audio)

Media --> Open Network Stream --> udp://@127.0.0.1:5555 --> Play

4 VLC lock to the input stream from the receiver is indicated when the orange search activity bar (just below displayed image) stops scanning and disappears.

Digital noise or audio from other station will be heard on speakers (adjust speaker volume from Taskbar as required). The received image is displayed on the VLC screen. Maximize the VLC display for a full-screen image. Adjust the receiver RF Gain control for maximum height of the displayed spectrum above the spectrum “shoulders.”

Display VLC Current Media Information to check the health of the UDP stream from the DVB-T receiver:

Tools --> Codec Information --> Statistics

If reception of the DVB-T signal becomes intermittent, VLC may need to be stopped and restarted:

Playback --> Stop
Media --> Open Network Stream --> Play

5 To EXIT:

Receiver:

Close SV1BDS receiver app.

Close GNURadio-3.8 by typing “exit”, then pressing Enter key.

VLC Media Player:

Media --> Quit

Turn GE Antenna Amplifier OFF.

URLs for Downloading Software/Firmware

Transmit

F5OEO 0303 Firmware for ADALM Pluto (See Note 2 below)

https://www.f5uii.net/en/patch-plutodvb/

mini GPS clock configuration: Leo Bodnar Mini Precision GPS Reference Clock

http://www.leobodnar.com/shop/index.php?main_page=index&cPath=107

http://www.leobodnar.com/shop/index.php?main_page=product_info&cPath=107&products_id=301

OBS Studio v. 27.2.4 (OBS-Studio-27.2.4-Full-Installer-x64.exe & obs-virtualcam-2.0.5-Windows-Installer)

https://github.com/obsproject/obs-studio/releases
https://github.com/Fenrirthviti/obs-virtual-cam/releases

Note: Newer versions of OBS are not compatible with VirtualCam (see DATV-Easy 2.16 .pdf instructions, p. 2).

DATV-Easy v. 2.16 (by F1EJP) Be sure to download both the software (.zip file) and the instructions (.pdf file).

http://www.vivadatv.org//viewtopic.php?f=84&t=982

Also see DATV-Easy presentation by PA3FBX at:
https://www.youtube.com/watch?v=mp05-faLtHU&ab_channel=BATCOnline

Also install the following (included in the SetupF1EJP-DATV-Easy-V2.16 folder):

PlutoSDR-M2k-USB-Drivers.exe
libiio-0.24.gc4498c2-Windows-setup.exe

Logitech Camera Driver (Logitech Capture)

https://www.logitech.com/en-us/software/capture.html

Receive

GNURadio Companion v. 3.8.2.0 (see Note 4 below)

https://web.archive.org/web/20220316012358/gcndevelopment.com/gnuradio

VLC Media Player 2.2.5.1

https://download.videolan.org/pub/videolan/vlc/

Note: the DVB_T_RX_2K5B.py app may not be compatible with newer versions of VLC (doesn't work with VLC version 3.0.20).

***** If VLC doesn't run with older software, try an older version of VLC *****

DVB_T_RX_2K5B DVB-T Receiver by SV1BDS

https://www.qsl.net/wa6nut/DVB_T_RX_2K5B.zip

Note that the receiver software can be downloaded from the AMSAT-DL site:

https://forum.amsat-dl.org/index.php?thread/2745-my-qo100-setup/&pageNo=30

but it will be necessary to process the file with the TwotoThree.py utility included with GNURadio-3.9 (not needed for the DVB_T_RX_2K5B.py file included in the .zip folder, it has already been processed). See Note 6.

You'll find useful information regarding the DVB_T_RX_2K5.py app at the AMSAT-DL website referenced above.

Notes:

1 If there is no “DVB-T QPSK” option in the “MPEG Transport Stream” “DVB” text box, try typing “DVB-T QPSK” into the text box. You may find that the text will complete itself before you finish typing!

2 Install F5OEO 0303 firmware using the instructions at the ZR6TG website (here's the link):

https://www.zr6tg.co.za/2022/06/28/adalm-pluto-rev-c-d-configuration-for-datv/

You'll need the PuTTY utility to do this. Download PuTTY from:

https://www.putty.org/

The ZR6TG website also gives instructions for configuring the Pluto for an

external 40 MHz clock (the Leo Bodnar Mini Precision GPS Reference Clock). The external clock replaces the Pluto's clock oscillator (with ±25 ppm stability). An accurate, stable transmitted signal is especially important when when the other station's receiver lacks AFC.

3 Open the Microsoft Edge browser and enter 192.168.2.1/pluto.php (my IP, yours may vary) in the search window. Press the Enter key, and the F5OEO Pluto screen should appear. Set this address as a favorite in the Edge browser, so that it can be opened in the future by simply clicking on a tab.

4 Version 3.8.2.0 downloads as a .zip file from the archive.org website. After unzipping, go to GNURadio-3.8 --> bin --> run_gr.bat (it's a batch file).

Right-click on run_gr and select "Create Shortcut." Then drag the shortcut to the desktop. Now you can open GNURadio by double-clicking on the "run_gr- Shortcut" icon on the desktop.

After downloading and unzipping the DVB_T_RX_2K5B.zip file, the DVB_T_RX_2K5B.py file should be placed in the c:\ folder.

5 **Tuning DVB-T with SV1BDS 2K5B App:** Make sure the 2K5B "Frequency" is set to the transmitting station's frequency.

COARSE TUNE: Using the "RIT" and "RF Gain" controls, find settings that produce a QPSK pattern in the upper Constellation window with minimum scatter in the each of the four QPSK clusters. The MER value should be maximized (MER > 10 dB for strong signals).

FINE TUNE: Using the "RIT" control, find the setting for steady incrementing of the "Video Displayed" frame count in the VLC "Current Media Information Statistics" window. The frame count should increment in 15-16 frame steps.

Note that the count may stall but should recover within a second or two. If the count doesn't recover for any "RIT" setting, restart VLC:
Media --> Open Network Stream --> Play

NOTES: The count may stall with rapid motion in the image, but should recover within a second or two.

If there is vertical jitter in the Spectrum display, start CCleaner, proceeding through all scans and cleaning steps. This can be done with DVB-T TX and RX software running. The Microsoft Edge browser will close, but the F5OEO 0303 TX software will continue running. Download CCleaner from:

https://www.ccleaner.com

6 **TwotoThree.py:** A problem arises when apps written in Python 2 (such as DVB_T_RX_2K5.py) are to be used with other software written in Python 3 (such as GNURadio-3.8). Fortunately, there is software, written in Python, to process an app written in Python 2 to be compatible with Python 3. The software, TwotoThree.py, is a part of the GNURadio-3.9 distribution (unfortunately not available with GNURadio-3.8). Here's the procedure, assuming that GNURadio-3.9 has been installed in the c:\Program Files folder:

Relocate the Python app to be processed (for example, DVB_T_RX_2K5.py) to the c:\Program Files\GNURadio-3.9\tools\python3\Scripts folder

Open the Command Line screen in Windows: Task Manager --> File --> Run new task: Enter “cmd” and press “OK” key.

At the c:\WINDOWS\system32 prompt,
type cd c:\Program Files\GNURadio-3.9\tools\python3\Scripts

At the c:\Program Files\GNURadio-3.9\tools\python3\Scripts prompt,
type python TwotoThree.py -w DVB_T_RX_2K5.py
(using DVB_T_RX_2K5.py as an example).

When processing of the app is complete, you'll see the c:\Program Files\GNURadio-3.9\tools\python3\Scripts prompt. You can then exit out of the Command Line screen and relocate the processed app to another location (the c:\ folder is handy).

Note that this procedure is not required with the SV1BDS app supplied in the DVB_T_RX_2K5B.zip distribution. This app has already been processed with TwotoThree.py (or its predecessor 2to3.py).

For more information, see:

https://pythonprogramming.net/converting-python2-to-python3-2to3/

GNURadio-3.9 is available from the archive.org site referenced above.

7 Figure 5 shows the %CPU utilization for simultaneous transmit and receive at 1 M symbol rate. The 82% utilization shows adequate margin. When testing other receivers the %CPU utilization was 100%, and operation was intermittent. Testing the %CPU utilization is important to insure reliable operation, especially at higher symbol rates.

8 For troubleshooting the transport stream from DATV-Easy (to Pluto) or from the DVB-T receiver (to VLC), you can use TSReader Lite.

Download TSReader Lite from:

https://www.tsreader.com/purchase/purchase/downloadlite.html

When last checked, this was a dead link. However, the Lite version of TSReader is available from several other websites.

9 For troubleshooting the ADALM-Pluto, you can use the IIO Oscilloscope from Analog Devices. Download the IIO Oscilloscope from:

https://github.com/analogdevicesinc/iio-oscilloscope/releases

For more information, go to:

https://wiki.analog.com/resources/tools-software/linux-software/iio_oscilloscope

10 For more information on GNURadio, check out the “Field Expedient SDR” books by Paul Clark and David Clark. You'll find the first three volumes useful, especially if you want to customize a GNURadio flow graph.

For more information, go to:

http://www.factorialabs.com/fieldxp/

Or search in Amazon for “field expedient sdr.”

The books recommend implementing GNURadio Companion in Linux (rather than in Windows), probably because the Windows version worked poorly back in 2015. But today, in 2025, you'll find the Windows version much simpler to implement and use.

Last revised: 9/7/25

Appendix

Simplified Receiver Setup with a Shortcut

Opening the receiver app involves opening GNURadio-3.8 (with a shortcut), then typing in cd c:\Program Files\GNURadio-3.8, then typing python c:\DVB_T_RX_2K5B.py -s 1 -r 1. That's a lot of keystrokes, with a high probability of a mistake (especially when operating portable).

But there's an easier way, involving only double-clicking a desktop shortcut and typing one four-letter word (“exit”).

The SV1BDS 2K5B .zip folder includes a batch file, SV1BDS 1M.bat. We'll install the .bat file in the c:\ folder and use it to create a shortcut, SV1BDS 1M -Shortcut, on your PC's desktop. And it's easy to edit the .bat file for your preferred symbol rate ,(the default is 1M), frequency (the default is 437.000 MHz), and other parameters available for the 2K5B receiver.

Procedure

Note: If you don't want to edit the .bat file, skip the edit step and proceed to copy and paste the file with default parameters to a convenient folder as described below, and follow the steps to create a shortcut.

After unzipping the SV1BDS 2K5B.zip folder, open the SV1BDS 1M.bat file in Notepad. If you want to change the receiver parameters from the 1M symbol rate and the other default values to your parameters, just edit the line that starts with “python c:\ . . . “ For example,

“python c:\DVB_T_RX_2K5B.py -s 1 -r 8”

And you might want to rename the file's title on the first line:

“title SV1BDS 125K”, for example

Next, we'll save the file as a .bat file to a convenient folder (I use a subfolder DVB-T in the Documents folder). Under “File”, select “Save as” and type “SV1BDS 125K.bat” as the File name (don't forget the .bat suffix).

And, for “Save as type” select “All files.” Navigate to the Documents/DVB-T folder, highlight it, then click the “Save” button.

Next, we'll copy and paste the .bat file to the c:\ folder. You'll get a message “You'll need to provide administrator permission to copy to this folder.” Just click on the “Continue” button, and the .bat file will be copied to the c:\ folder.

Right-click on the .bat file, and you'll see several options, including “Create shortcut.” Select “Create shortcut” with a left-click, and you'll see the message “Windows can't create a shortcut here. Do you want the shortcut to be placed on the desktop instead?” Click the “Yes” button, and you'll find your “SV1BDS 125K -Shortcut on your desktop!

Double-click the shortcut on your desktop, and you'll see the Command Line black screen with a c:\> prompt. Type “exit”, then press the Enter key, and the SV1BDS 2K5B receiver will open. Note the “BW: 125.0” label on the receiver GUI.

The preceding procedure can be used to create shortcuts for each receiver configuration you want to use. The screenshot in Figure 6 shows the author's desktop with shortcuts for 125K, 500K, and 1M symbol rates.

In the unlikely event that the receiver stalls (VLC Video Displayed frame counter not incrementing regardless of RIT setting), it may be necessary to restart the receiver.* Simply close the receiver app, then use the desktop shortcut to restart the receiver. Shortcuts can be located on the desktop for easy access, as shown in Figure 4.

* Or VLC might need restarting: Media --> Open Network Stream --> Play

The link below explains the procedure used to create the shortcuts for the SV1BDS 2K5B receiver:

https://www.makeuseof.com/tag/launch-multiple-programs-single-shortcut-using-batch-file/

Several useful links relating to batch files are at this link:

https://www.makeuseof.com/tag/batch-file/

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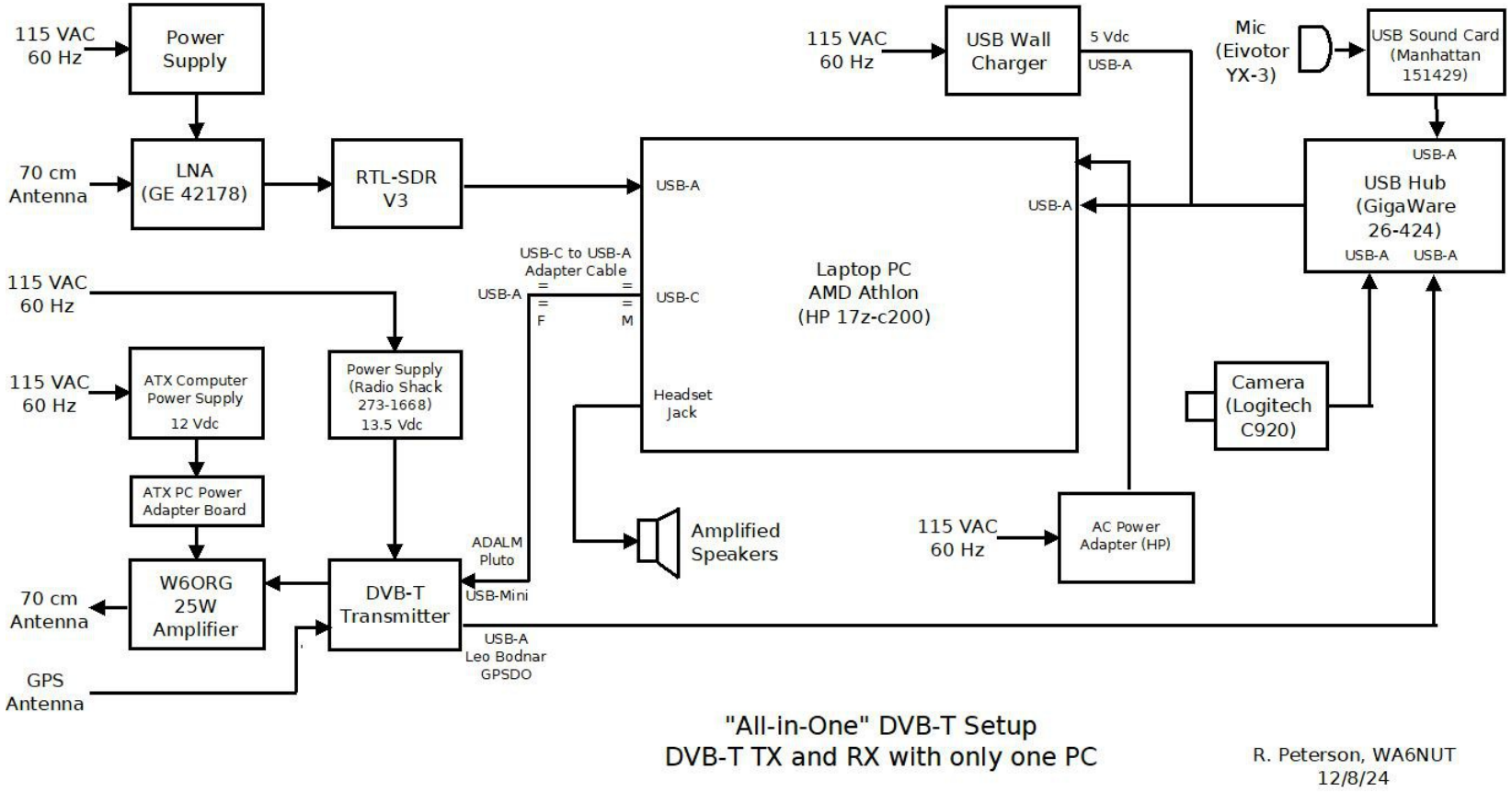

Figure 1: Block Diagram: Higher SR DVB-T Setup

DVB-T Setup for Higher Symbol Rates

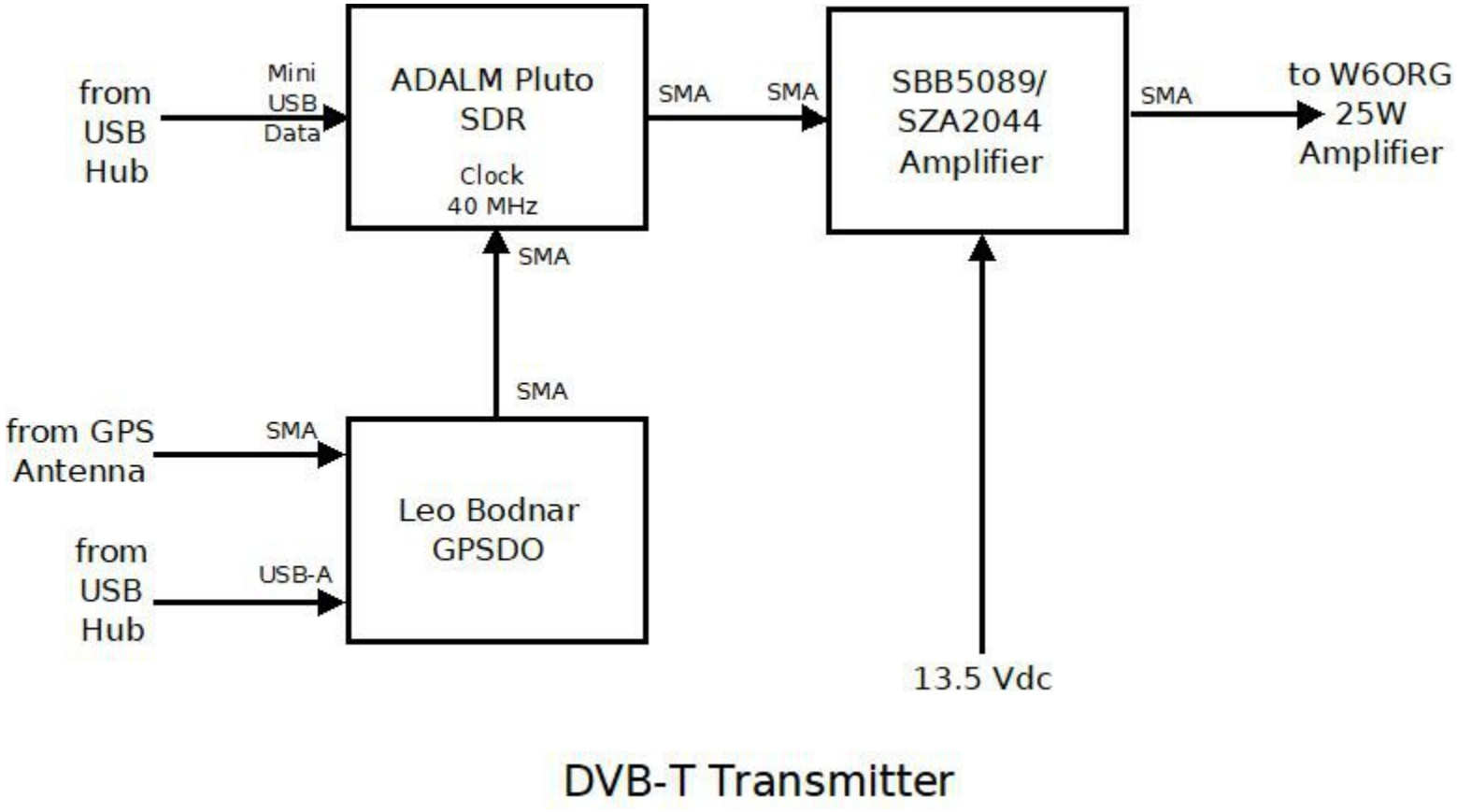

Figure 2: DVB-T Transmitter

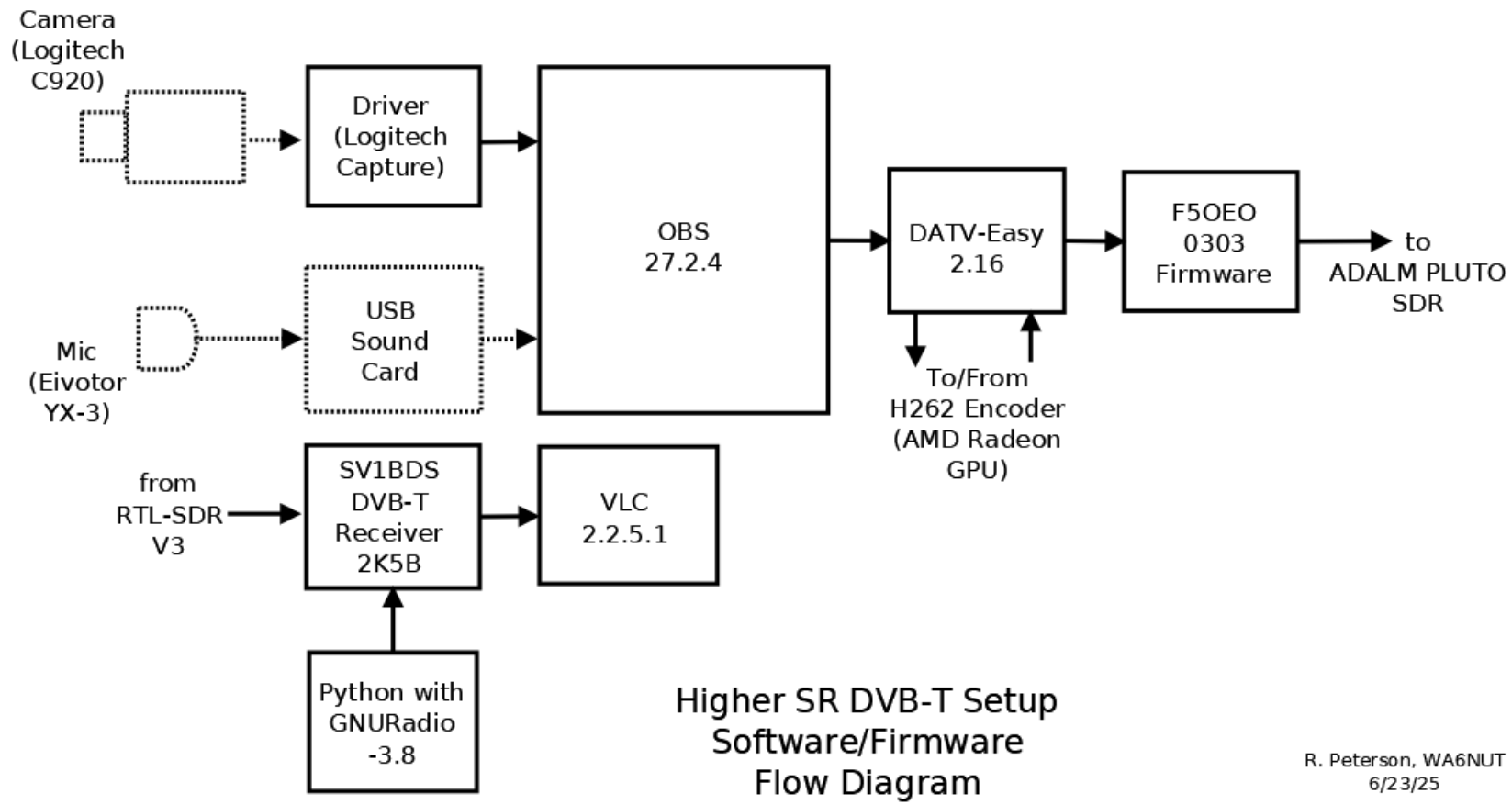

Figure 3: Higher SR DVB-T Setup Software/Firmware Flow Diagram

See DATV-Easy presentation by PA3FBX at: https://www.youtube.com/watch?v=mp05-faLtHU&ab_channel=BATCOnline

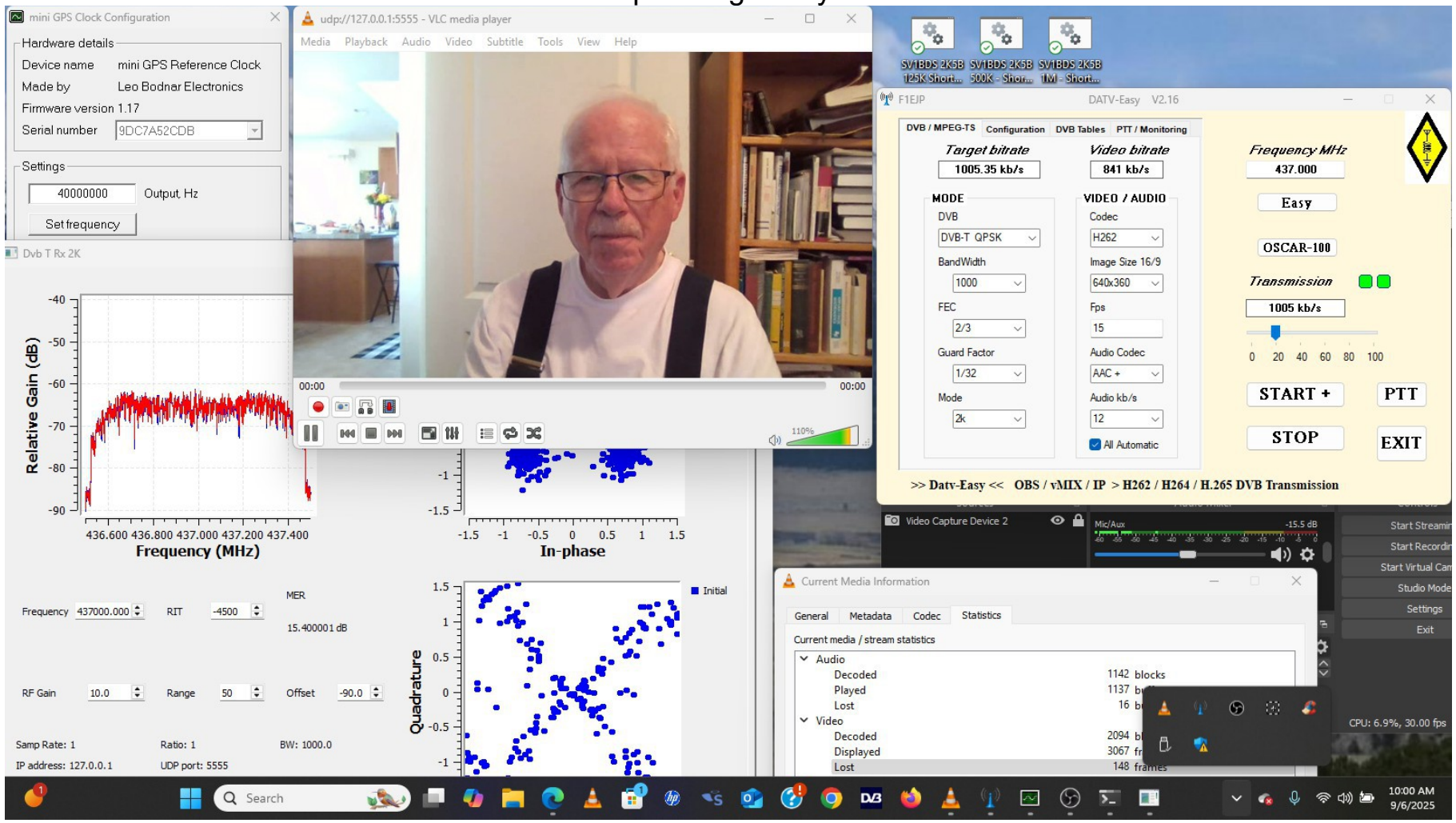

Figure 4: Screenshot: Higher SR DVB-T Setup: Clockwise, from upper right: Receiver desktop shortcuts, DATV-Easy 2.16, OBS 27.2.4 (showing TX audio levels), VLC Current Media/Stream Statistics, SV1BDS Python Receiver 2K5B, Leo Bodnar GPSDO app, VLC 2.2.5.1 (displaying received video).

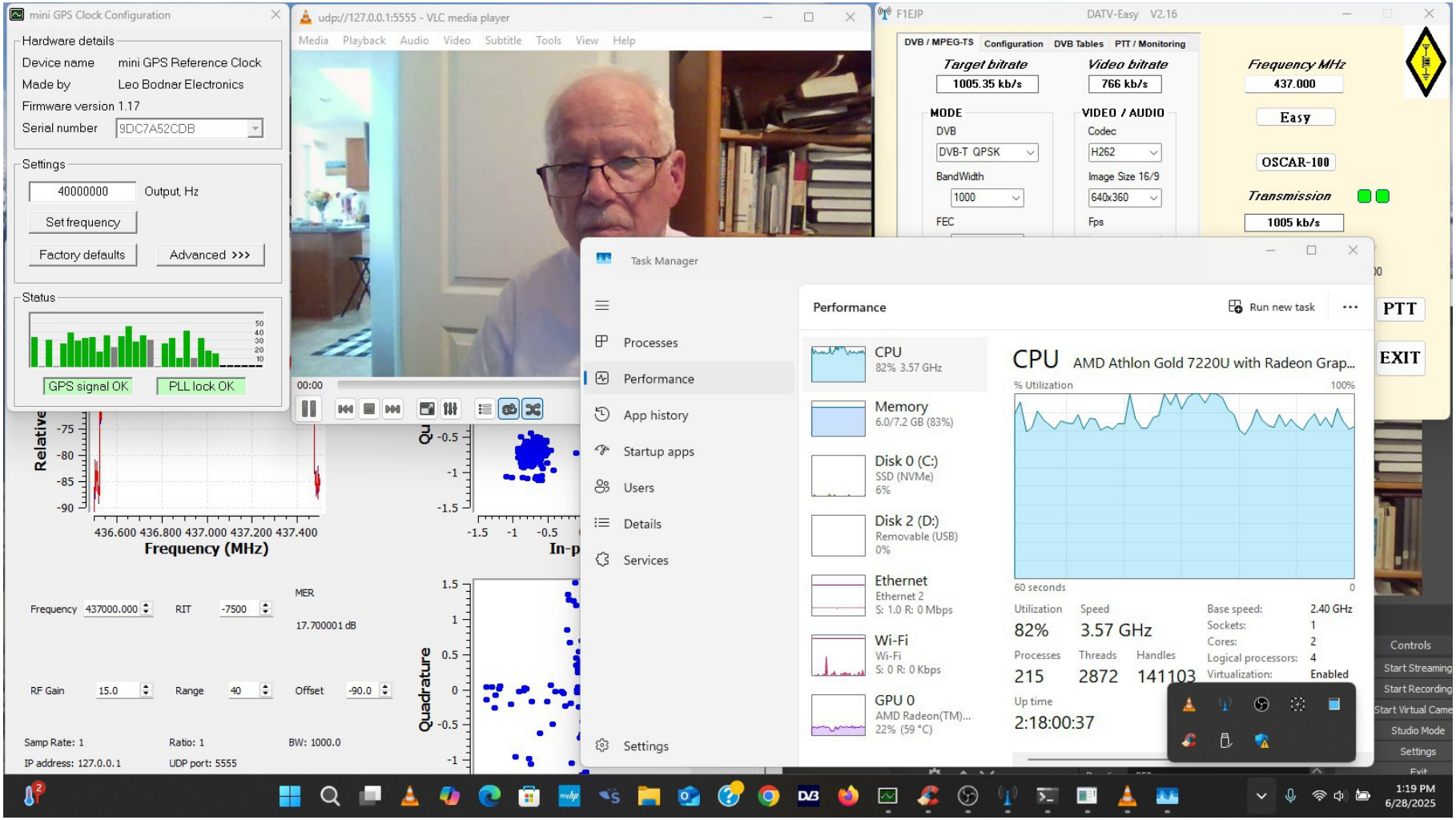

Figure 5: Screenshot of %CPU Utilization (Windows Task Manager) with simultaneous transmit and receive at 1 M symbol rate on HP Athlon laptop, running SV1BDS Python 2K5B receiver software.

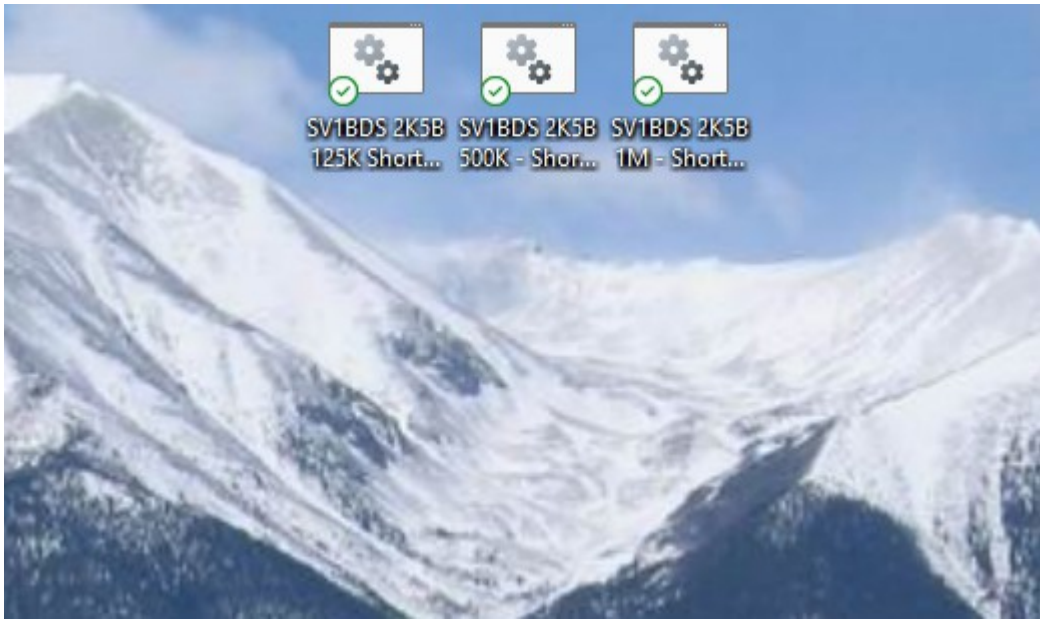

Figure 6: Screenshot showing 3 shortcuts on the PC desktop opening the SV1BDS 2K5B receiver with symbol rates of 125K, 500K, or 1M. Each shortcut passes parameters such as symbol rate, frequency, IP address, and port to the receiver. See the Appendix for details on setting up the shortcuts.