DVB-T
with
Pluto (TX)
and
AirSpy Mini (RX)

by Rick Peterson, WA6NUT

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Table of Contents

Figures

Appendix

Operating Instructions

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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. It uses receiving software from HB9DUG 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 is a rewrite of the earlier “All-in-One DVB-T Setup” document, with the AirSpy Mini SDR receiver substituted for the RTL-SDR previously used. The 6 M samples/sec rating of the AirSpy Mini (vs. only 2.4 M samples/sec for the RTL-SDR) permits receiving DVB-T signals at higher bandwidths (if not limited by computer speed and/or software availability).

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.

For the latest revision of this document, go to:

https://www.qsl.net/wa6nut/Pluto%20AirSpy%20Mini%20DVB-T.pdf

LAPTOP PC

HP 17z-cp200, Windows 11 (with camera)

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 “436.00 DX”. Click “Valid.” “436.000” is shown under “Frequency MHz.”

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

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

Bandwidth = 250 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.

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 = 436000000.000 Freq-Channel = Custom

Mode = DVBT Mod = QPSK

SR = 250 250 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 250 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.” The DATV-Easy “Stop” button is not clicked until the end of the ATV session.

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 “Switch OFF” button on browser “Controller” page.

To transmit, press RA30H4047M Amplifier PTT button, then click F5OEO PTT “Switch ON” button. The SureCom Pwr/SWR meter should read 3-4 watts output power. To end transmission, click F5OEO PTT “Switch OFF” button, then press RA30H4047M Amplifier PTT button.

Allow for a 12-15 sec delay between clicking the F5OEO PTT “Switch ON” 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

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 251 332 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 (AirSpy Mini)
https://v3.airspy.us/product/a-airspy-mini/

Amplified speakers

Software: Radioconda 2021.07.27

dvbt-airspy-rx-qpsk-fec-filter-v6 (by HB9DUG)

VLC Media Player

1 Apply power to the GE Antenna Amplifier.

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

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

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

Media --> Open Network Stream --> tcp://:127.0.0.1:10000 --> Play

3 Scroll to **GNU Radio** folder.

Open **GNU Radio Companion (radioconda)**

Command line black screen opens, GNURadio sets up GR Companion (this will take a while)

When setup is complete, a flow graph is displayed.

Click on “**dvbt-airspy-rx-qpsk-fec-filter-v6**” tab.

Click “Execute the flow graph” button (“play” triangle on button).

GR Companion will convert the flow graph to a receiver control/display screen (GUI). Watch progress in text displayed at lower left.

Receiver controls and displays (GUI) appears.

Receiver settings:

Bandwidth = 250K

FEC = 2/3

Tuned Frequency (Hz) = 435993950 (after Fine Adjust)

Frequency Fine Adjust (Hz) = -6050 (my setting, yours may vary)

RX Frequency (Hz) = 436000000

RF Gain (dB) = 30.0 (my setting, yours may vary)

When receiving the other station, the “Constellation” display should show four distinct clusters (QPSK pattern). The clusters should not be too tight (avoiding receiver overload) nor too loose (ensuring VLC lock).
The counter at the left below the VLC display should be incrementing.

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 slider 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 --> Media Information --> Statistics

If reception of the DVB-T signal becomes intermittent, try stopping ("pause" square on button) and restarting ("play" triangle on button) the DVB-T receiver flow graph (after minimizing the receiver control/display screen). Or VLC may need to be stopped and restarted:

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

5 To EXIT:

Receiver:

Minimize receiver controls/display screen to return to flow graph.

Click the "Kill the flow graph" button ("pause" square on button).

File --> Quit. Command line black screen will be briefly displayed.

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

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

Radioconda 2021.07.27 (see Note 4)

https://github.com/ryanvolz/radioconda/releases?page=2

dvbt-airspy-rx-qpsk-fec-filter-v6 DVB-T Receiver by HB9DUG (see Note 5)

https://www.radioamateur.ch/category/software/
(Translate with Google Translate)

VLC Media Player

https://www.videolan.org/vlc/download-windows.html

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 Radioconda 2021.07.27 downloads as a Windows-x86_64.exe file from the github website. Follow the steps in the CondaInstall document:

https://wiki.gnuradio.org/index.php/CondaInstall

During the installation, choose the options for gnuradio 3.8.2 and python 3.8. Use the CTRL-C key to bypass compatibility tests. Retain the Conda option (no Mamba). After installing, the “GNU Radio” folder will be accessible from the Windows Start menu. You'll find “GNU Radio Companion (radioconda)” in the folder

5 After downloading the dvbt-airspy-rx-qpsk-fec-filter-v6 file, the file should be placed in a folder (in the author's setup, the c:\users\arand\Documents\DVB-T folder). Open GNU Radio Companion (radioconda), navigate from File to Open, highlight dvbt-airspy-rx-qpsk-fec-filter-v6 then click on Open at the bottom of the page. GNU Radio Companion will set up the HB9DUG DVB-T receiver flow graph, with a “dvbt-airspy-rx-qpsk-fec-filter-v6” tab above the flow graph. In the future, the tab will be available to select the HB9DUG receiver after GNU Radio Companion (radioconda) is opened.

6 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

7 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

8 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: 3/24/25

For the latest revision of this document, go to:

https://www.qsl.net/wa6nut/Pluto%20AirSpy%20Mini%20DVB-T.pdf

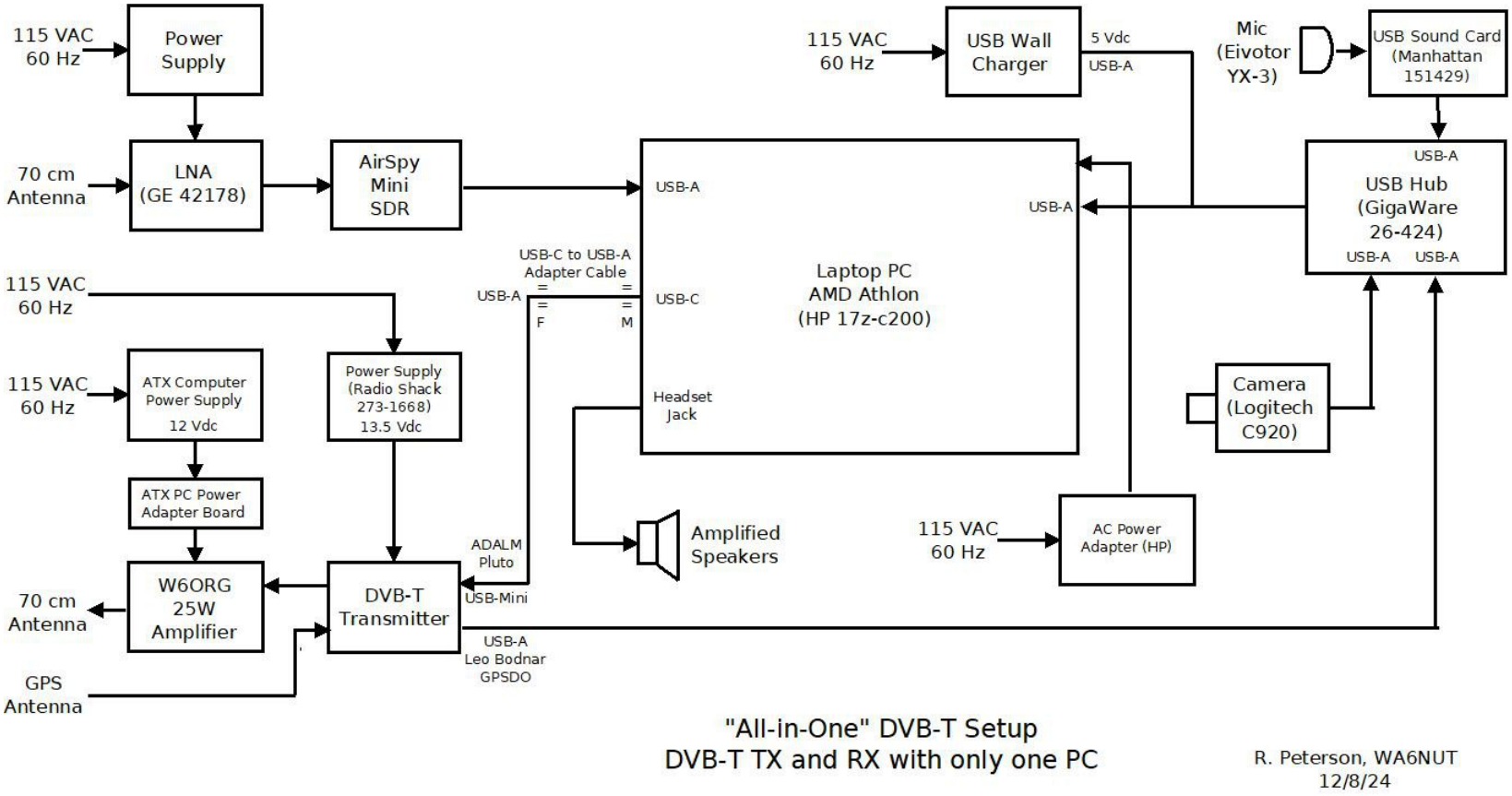

Figure 1: Block Diagram: All-in-One DVB-T Setup

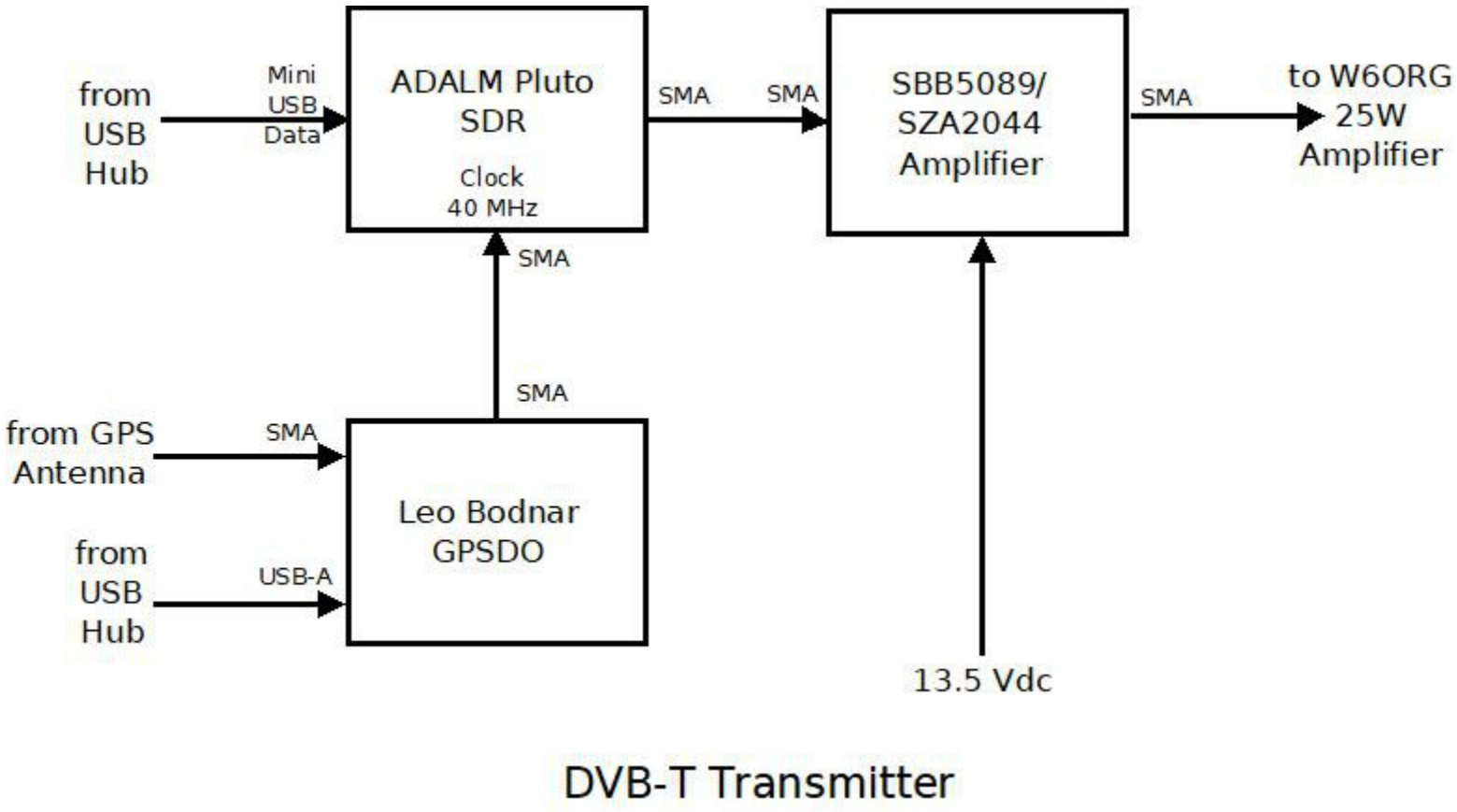

Figure 2: DVB-T Transmitter

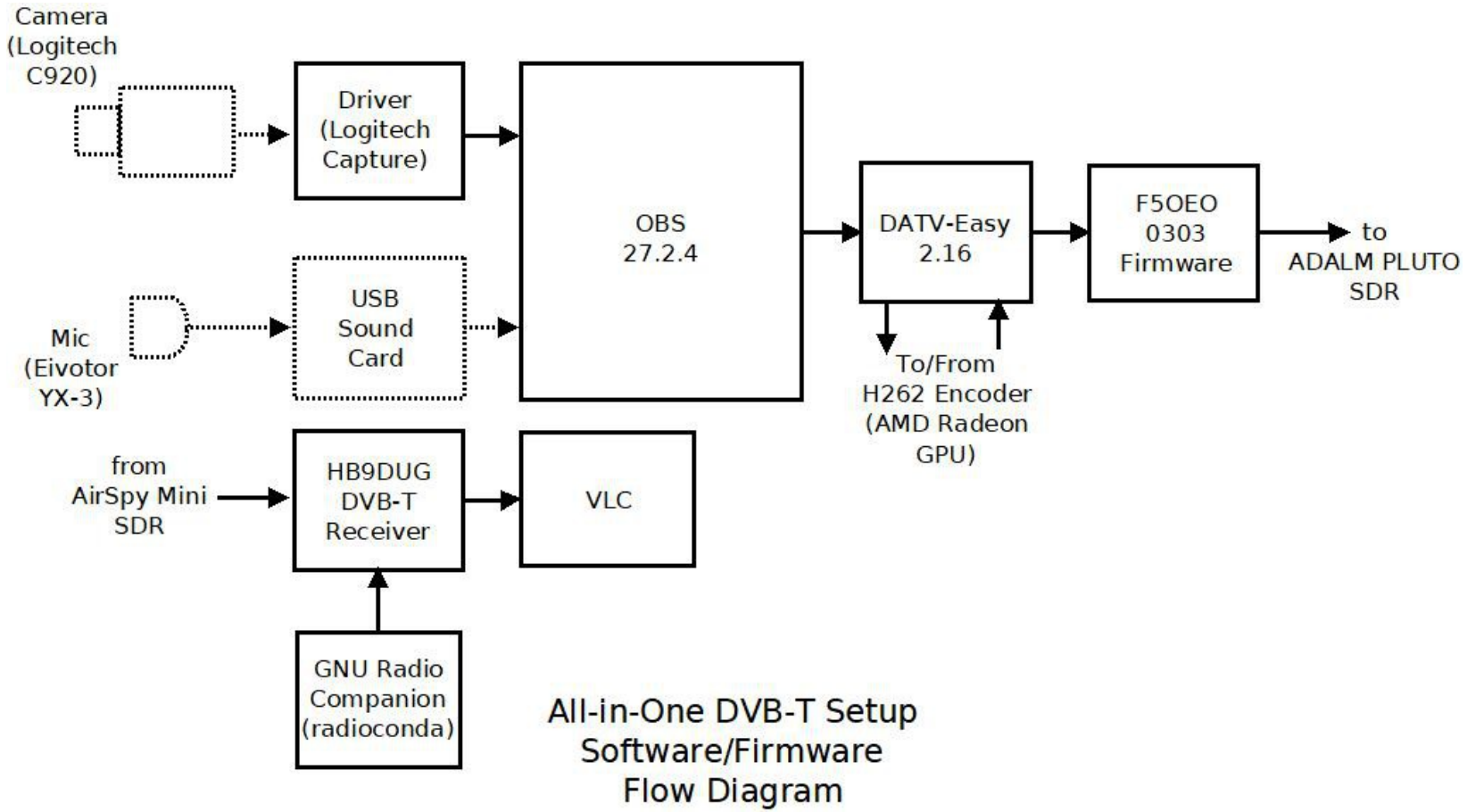

Figure 3: All-in-One DVB-T Setup Software/Firmware Flow Diagram

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

DVB-T with Pluto (TX) and AirSpy Mini (RX)

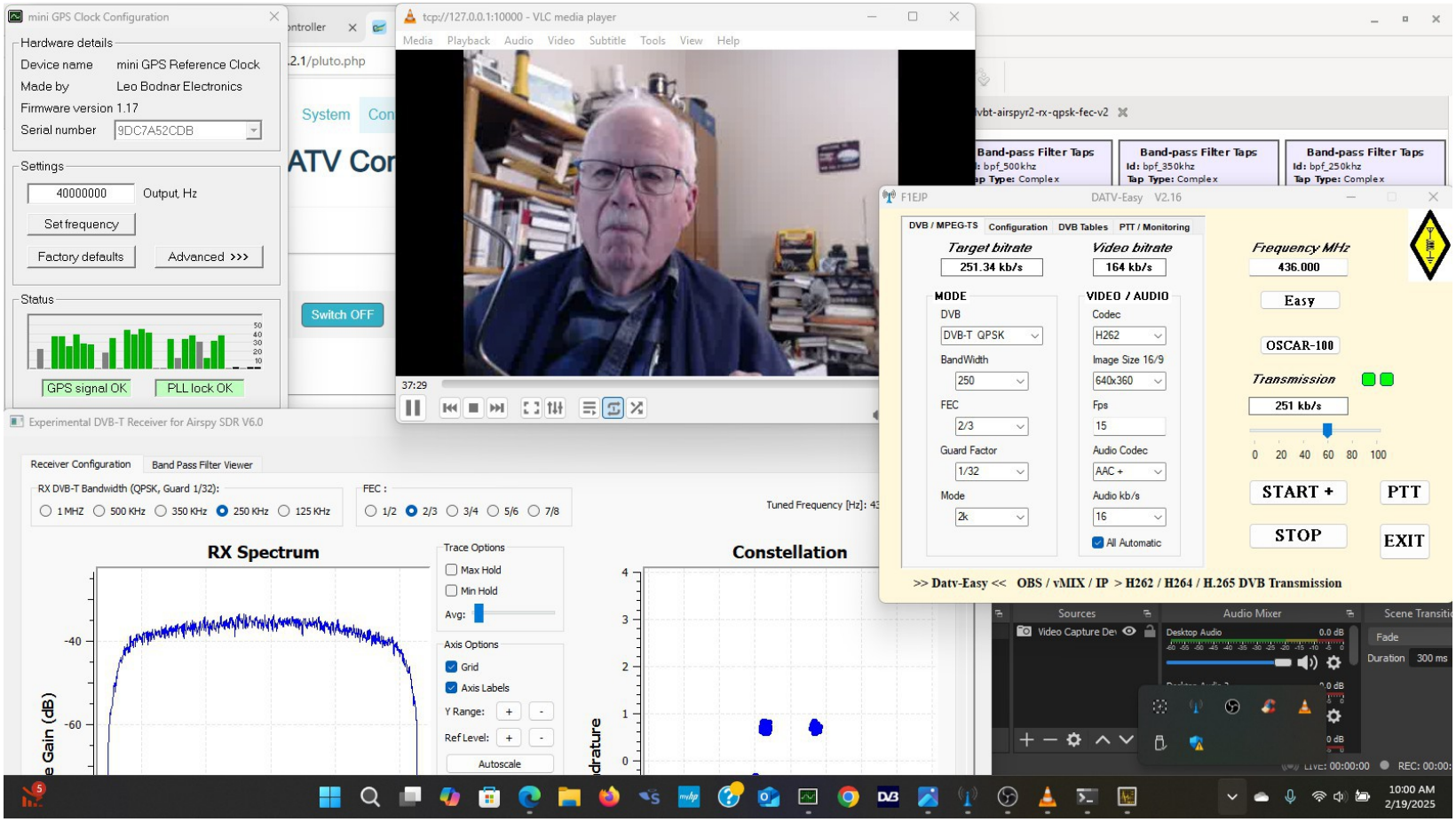

Figure 4: Screenshot: Pluto/Airspy Mini Setup: Clockwise, from top center: VLC (showing received video), GNU Radio Companion (showing portion of flowgraph), DATV-Easy 2.16, OBS (showing TX audio levels), HB9DUG receiver, Leo Bodnar GPSDO software, F5OEO ADALM-PLUTO DATV Controller (note TX Switch ON/OFF).

Appendix

Extending DVB-T Bandwidth to 1 MHz

INTRODUCTION

The preceding provides instructions applicable for DVB-T bandwidths up to 250 kHz. But at higher bandwidths operation becomes intermittent, with the constellation stuttering or even stalling.

Operation with 1 MHz bandwidth may provide compatibility with certain HiDes DVB-T transmitters (HV-210, HV-320) and receivers (HV-122). See the review of the HV-122 receiver in the KH6HTV Video Application Note AN-57c at: https://kh6htv.com/application-notes/ Also see: https://www.hides.com.tw/product_HV120DCA_eng.html

The author discovered that operation up to 1 MHz is possible if, prior to an operating session, a system cleaner utility (CCleaner) is used to scan and clean the PC operating environment. See https://www.ccleaner.com/

Setup to operate at bandwidths greater than 250 kHz is the same as described previously, except that once set up, you'll need to scan and clean the PC using CClean. Application of CClean closes the ADALM-PLUTO tab on the Edge browser, requiring the use of DATV-Easy controls to set transmit power (“Power” slider) and for PTT (the “Start+” and “Stop” buttons).

PROCEDURE

Setup (SureCom Pwr/SWR meter connected to 25W dummy load)

1 Set up CCleaner icon in PC toolbar by opening the CCleaner app, then minimizing it.

2 Set up apps on screen per previous instructions, except F5OEO ADAM-PLUTO page, DATV-Easy, and HB9DUG RX Bandwidth settings are increased from 250 kb/s to 1000 kb/s.

3 Click the RA30H4047M amplifier PTT pushbutton to transmit mode. Click DATV-Easy “Start +” button. The green LEDs light. “Transmission” reads about 1000 kb/s on DATV-Easy app**.** Click the “Start” button on the F5OEO ADALM-PLUTO page. Constellation will display four QPSK clusters, with stuttering and even stalling (see Figure A-1).

4 Open CCleaner by clicking on the toolbar icon (see Figure A-2). Follow the prompts to enable CCleaner cleaning processes. Note that 1.) the F5OEO ADALM-PLUTO page is closed and 2.) the constellation clusters become steady as cleaning progresses.

5 Note the power output level on the SureCom Pwr/SWR meter when CCleaner cleaning is finished. Using the DATV-Easy Power slider control, back the power level off to about 3-4W output power indication (see Figure A-3).

6 Click PTT “Stop” button on DATV-Easy GUI, then click RA30H4047M amplifier PTT pushbutton to receive mode.

Operation during DATV QSO (SureCom Pwr/SWR meter connected to antenna)

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

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.

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

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

CHECK % CPU UTILIZATION

To avoid marginal operation, it's a good idea to check the % CPU Utilization (Windows Task Manager, under the Performance tab: Open Task Manager by right-clicking on a blank space on the Task Bar at the bottom of the screen).

First, check % CPU Utilization with both TX and RX software running on the same PC (HP Athlon laptop). See Figure A-4. Note that operation is marginal, with % CPU Utilization close to 100%. Bandwidth is 1 MHz. The HB9DUG v6 software is being used for receiving with the AirSpy Mini SDR receiver.

Next, we again run both the TX and RX software on the PC, but with the HB9DUG v6 RX software replaced by the DDØCW “Knucker” RX software, and the AirSpy Mini receiver replaced by an RTL-SDR (see Figure A-5). Now the % CPU Utilization is running at a comfortable 67%. It seems that the bandpass filtering used in the HB9DUG RX software is responsible for extra loading of the CPU.

Conclusions: For my setup, more reliable operation will be obtained at 1 MHz bandwidth if a simpler receiver (with lower CPU loading) is used. And transmitting at 2 MHz bandwidth seems to be beyond the capability of the HP Athlon laptop PC, even without RX software running.* However, YMMV (your mileage may vary).

* Note that the HP Athlon laptop PC will not provide sustained operation transmitting at 2 MHz bandwidth, even with no RX software running. Output from the Pluto will be intermittent, and the laptop will eventually crash (sometimes with an “Unknown Hard Error” message).

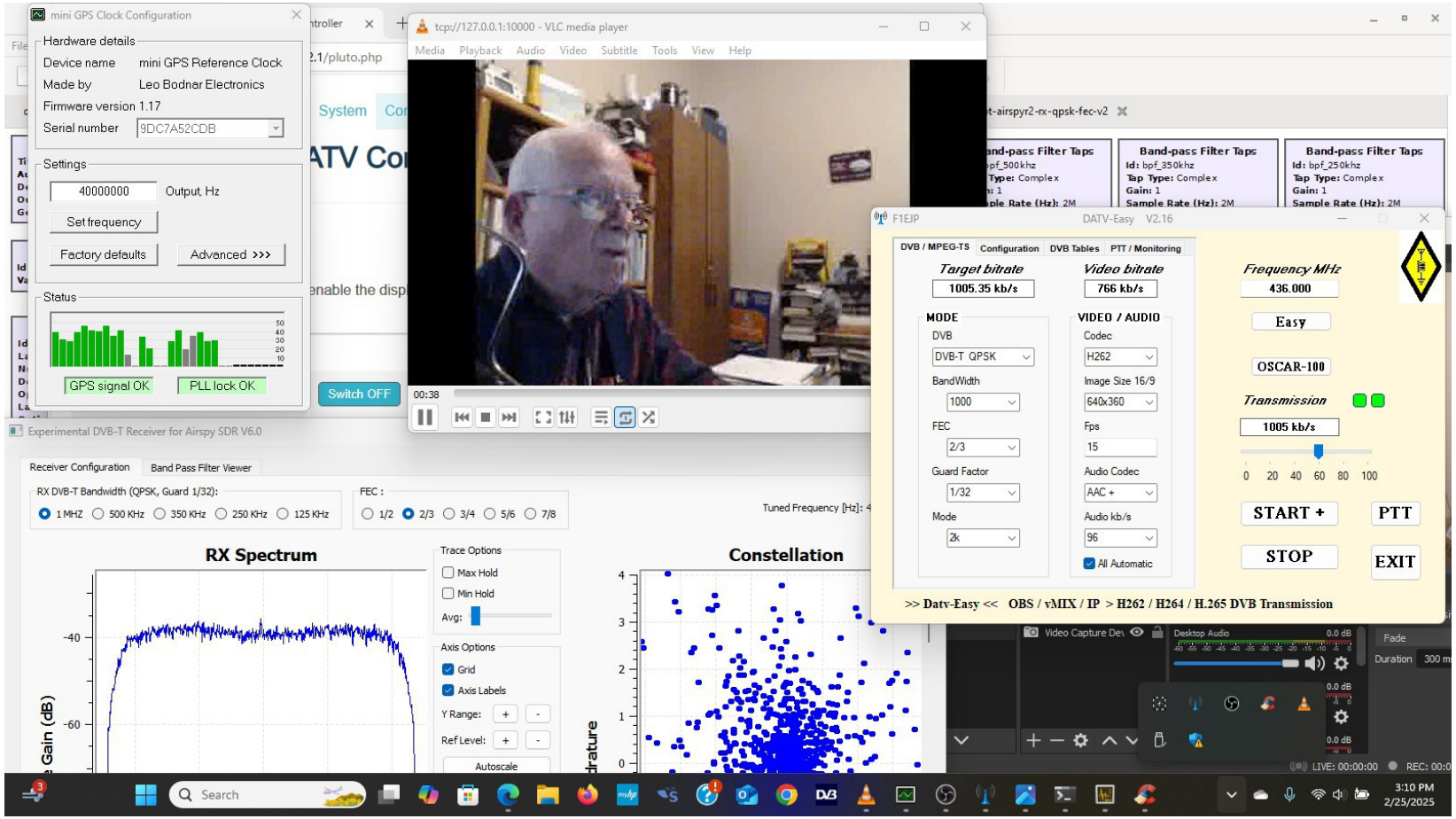

Figure A-1: Screenshot prior to applying CCleaner: Note that constellation clusters are stuttering and even stalling. Note the blue F5OEO PTT button (obtained with the ADALM-PLUTO tab in the Edge browser). And note the CCleaner icon at the right in the Windows toolbar at the bottom of the screen.

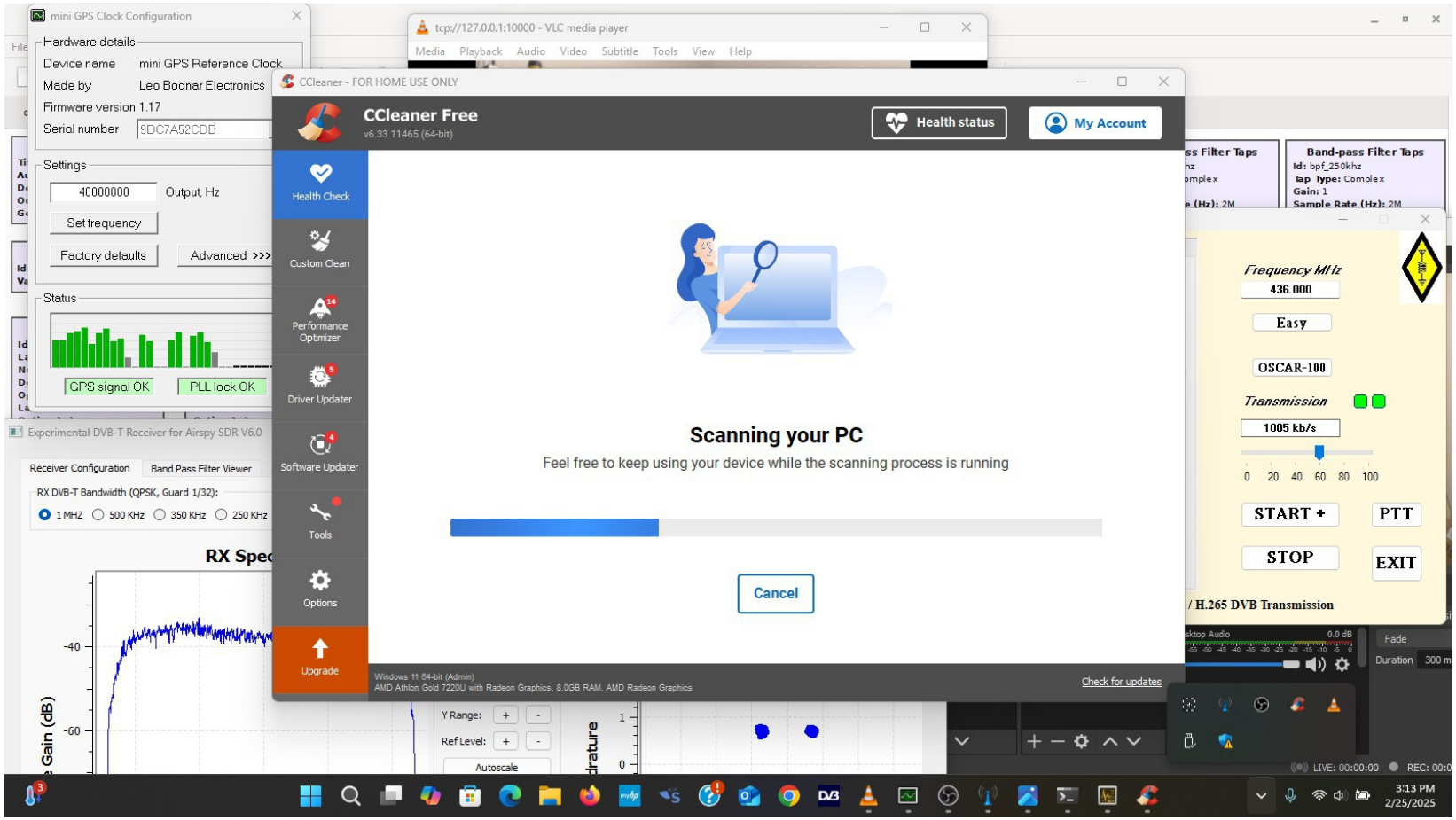

Figure A-2: Screenshot of CCleaner in scan mode. Operator has clicked on the CCleaner icon located in the PC toolbar. Cleaning steps to follow (operator will follow CCleaner prompts).

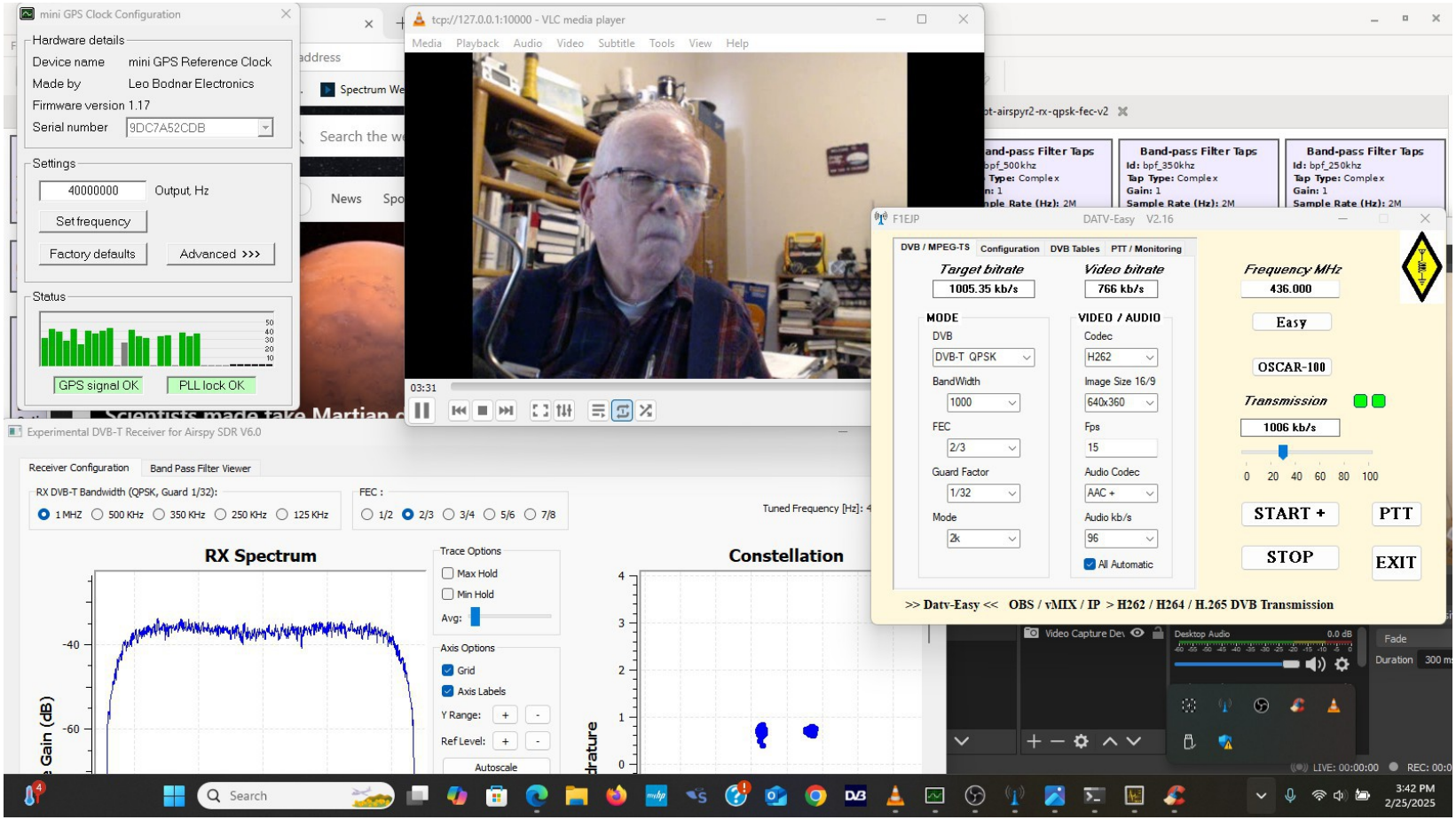

Figure A-3: Screenshot of operation at 1 MHz DVB-T bandwidth after application of CCleaner. Note that the ADALM-PLUTO tab is gone, with the main page of the Edge browser exposed. Constellation clusters are steady, and VLC counter is incrementing.

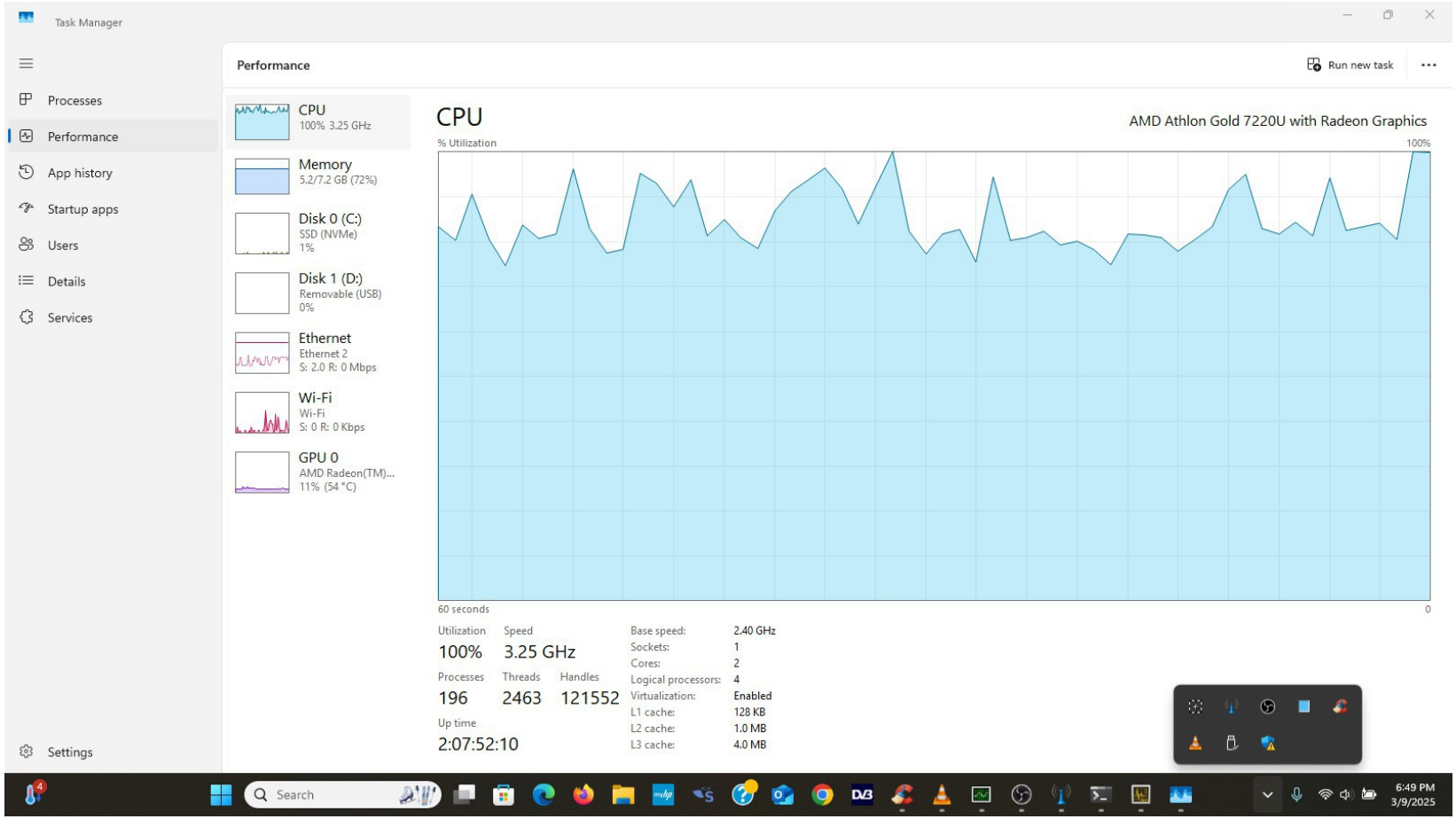

Figure A-4: % CPU Utilization for HP Athlon PC running both TX software and HB9DUG RX software (1 MHz BW). Using an AirSpy Mini receiver.

DVB-T with Pluto (TX) and AirSpy Mini (RX)

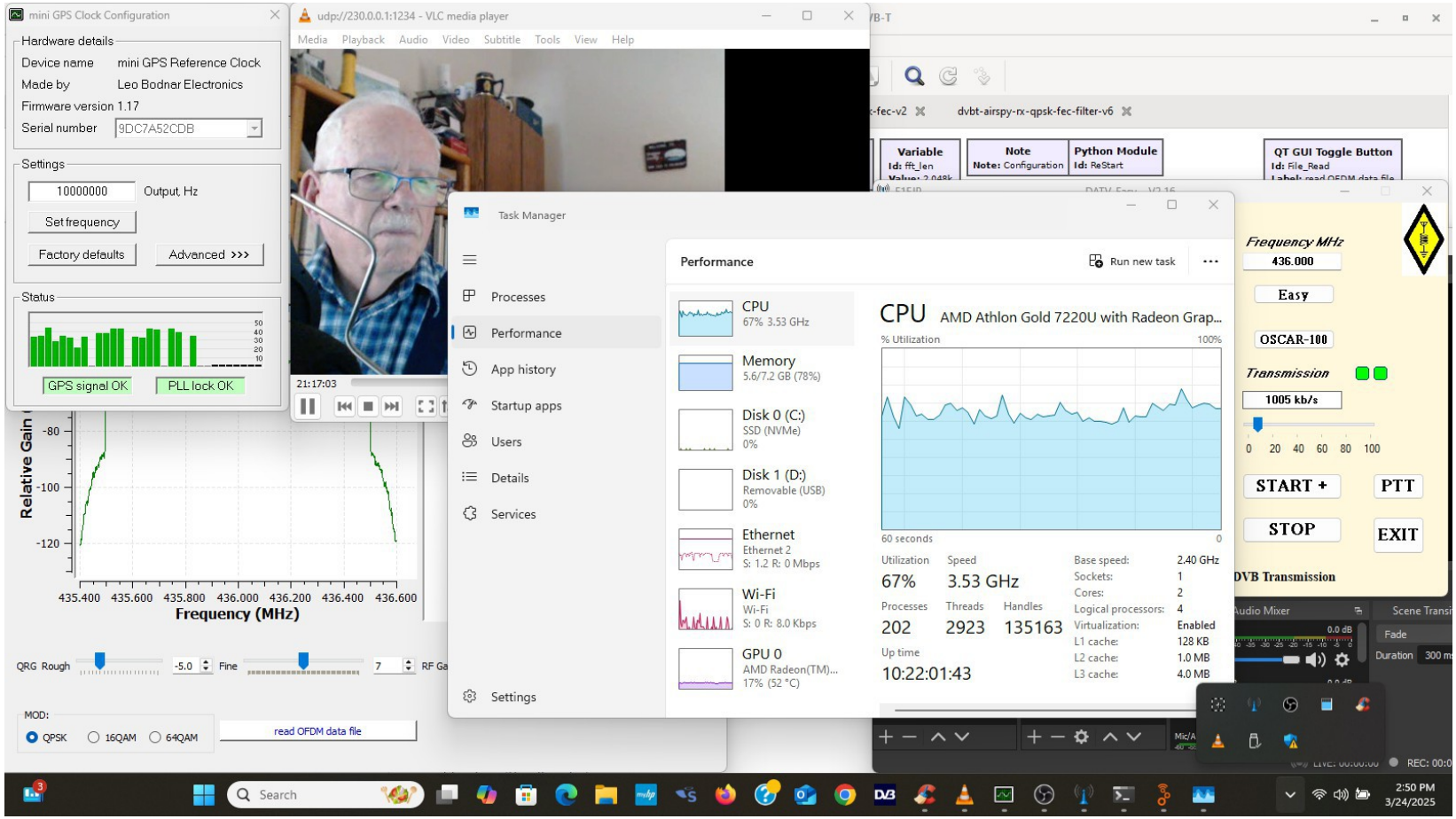

Figure A-5: % CPU Utilization for HP Athlon PC running both TX software and DDØCW “Knucker” RX software (1 MHz BW). Using an RTL-SDR receiver.