

Operating Instructions

DVB-T ATV Setup

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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.

TRANSMIT (see Figure 1)

Laptop: Acer Aspire 7740-5691, Windows 10 (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"

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>

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SureCom Pwr/SWR Meter
25W Dummy Load
HP ATX 12Vdc Power Supply (for RA30H4047M Amp)
ATX PC Power Adapter Board

Microphone, Eivotor YX-3

Software: Mini GPS Clock Configuration app
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 3 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)**:

Source = Video Capture Device

Settings --> Audio --> Global Audio Devices --> Mic/Auxiliary Audio = Microphone (2-High Definition Audio Device) --> OK

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

Settings --> Video

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Select: Output (Scaled) Resolution = 464 x 260
Common FPS Values = 10

Apply --> OK

Tools --> VirtualCam --> check "AutoStart" --> Start --> Exit

Settings --> Output

Select: Video Bitrate = 500 kbps
Audio Bitrate = 64

Check "Enable Advanced Encoder Settings"
Select: Encoder Preset = ultrafast

Apply --> OK

Minimize OBS

Mute speaker in Acer Aspire Taskbar.

3 Open **DATV-Easy**

Click "Easy." Select "421.25 Ch. 57". Click "Valid." "421.250" is shown under "Frequency MHz."

MPEG Transport Stream (most values are default values when "All Automatic" checkbox is checked):

DVB = DVB-T QPSK (see Note 1)

Codec = H264

Bandwidth = 125 kHz

Image size 16/9 = 426 x 240

FEC = 1/2

FPS = 12

Guard Factor = 1/32

Audio Codec = AAC+

Mode = 2K

Audio kb/s = 6 kb/s

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Configuration:

Settings/Equipment = Pluto F5OEO 0303 2402

Adalm Pluto SDR IP = 192 168 2 1 8282 1

Input/Entree = OBS + Virtual Cam

Encoder = SOFT Default FPS = 15

Audio sync \pm ms = 0 Audio SR = 48000

DVB Tables:

Default values

Click "Start +" button. The green LEDs light. "Transmission" reads about 94 kb/s.

4 Open **Microsoft Edge browser**

Click "ADALM Pluto DV . . ." tab on Windows Toolbar.

Brings up 192.168.2.1/pluto.php

Click "Controller" button at top.

"ADALM-PLUTO DATV Controller" page is displayed.

Click "Apply Settings" button.

Modulator Settings:

Power = -11.3 dB

PCR/PTS = 2000 ms PAT period = 800 ms

Freq-Manual = 421.25 Freq-Channel = Custom

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Mode = DVBT

Mod = QPSK

SR = 125 125 KS

FEC = 1/2

(Note: Modulator settings need to be checked because CCleaner may reset all Modulator settings to default values. PCR/PTS and PAT settings can be incremented or decremented in 1 ms steps by setting the cursor on the slider control and pressing the “up” or “down” arrow key while pressing the left mouse button)

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 --> Levels

Click “Analysis” button at top of browser “Controller” page. Note “Null Packets” on bargraph and data to right on the “Analysis” page. “Null

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packets among 94249 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 2 and 3)

Laptop: HP Elitebook, Windows 10:

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.”

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)

USB Sound Adapter (Manhattan 151429)

Amplified speakers

Software: GNURadio Companion v. 3.9.0.0

dvbt_rtl_rx_qpsk_v395002.grc (by HB9DUG and G4NZV)
dvbt_rtl_rx_qpsk_v395002_bandwidth_decim_factor.py

VLC Media Player

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- 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 = Speakers (USB PnP Sound Device)

Media --> Open Network Stream --> `udp://@230.0.0.10:10000` --> Play

- 3 Open **GNURadio Companion** (“run GRC shortcut” icon on desktop)

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_rtl_rx_qpsk_v395002**” 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 (press the “Enter” key after entering each value):

RF Gain (0 – 49) = 33.0 (default)

RX Frequency (MHz) --> click “0 Hz Enter Freq.” radio button

Frequency Correction (PPM) = 0 (default = 69.0)

RX Offset (MHz) Step (100 Hz) = 421.25 (default = 0)

RX DVB-T Bandwidth --> click “` 125 kHz” radio button

(QPSK, Guard 1/32) FEC --> click “1/2” radio button

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When receiving the other station, the “Constellation” display should show four distinct clusters (QPSK pattern).

- 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

If both VLC and the DVB-T receiver need to be restarted (and this is often the case), the preferred sequence is:

First stop VLC and the DVB-T receiver, then restart VLC, and
Then restart the DVB-T receiver

- 5 To EXIT:

Receiver:

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

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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.f5uui.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)

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

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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

Receive

GNURadio Companion v. 3.9.0.0 (see Note 3 below)

<https://web.archive.org/web/20220316012358/gcndevlopment.com/gnuradio>

dvbt_rtl_rx_qpsk_v395002.grc (by HB9DUG and G4NZV) (see Note 4 below)
dvbt_rtl_rx_qpsk_v395002_bandwidth_decim_factor.py

<https://forum.batc.org.uk/viewtopic.php?f=76&t=7285&hilit=g4nztv+hb9dug&start=10>

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/>

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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 the other station's receiver lacks AFC.

- 3 Version 3.9.0.0 downloads as a .zip file from the archive.org website. After unzipping, go to GNURadio-3.9 --> bin --> run_GRC. Right-click on run_GRC and select "Create Shortcut." Then drag the shortcut to the desktop. Now you can open GNURadio Companion by double-clicking on the "run_grc Shortcut" icon on the desktop.
- 4 Modify the dvbt_rtl_rx_qpsk_v395002 DVB-T receiver flowgraph as follows:

Replace the soapy_rtlsdr_source block with an RTL-SDR Source block. Enter the following parameters:

Device Arguments: "rtl=0"
Sample Rate (sps): samp_rate
Ch0: Frequency (Hz): $(rx_freq_coarse * 1e6 + rx_freq_offset * 1e6) * (1 - freq_correction * 1e-6)$
Ch0: Frequency Correction (ppm): 0
Ch0: RF Gain (dB): rf_gain
Ch0: IF Gain (dB): 20
Ch0: BB Gain (dB): 20
Ch0: Bandwidth (Hz): 0

- 5 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>

- 6 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>

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For more information, go to:

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

- 7 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 2023, you'll find the Windows version much simpler to implement and use.

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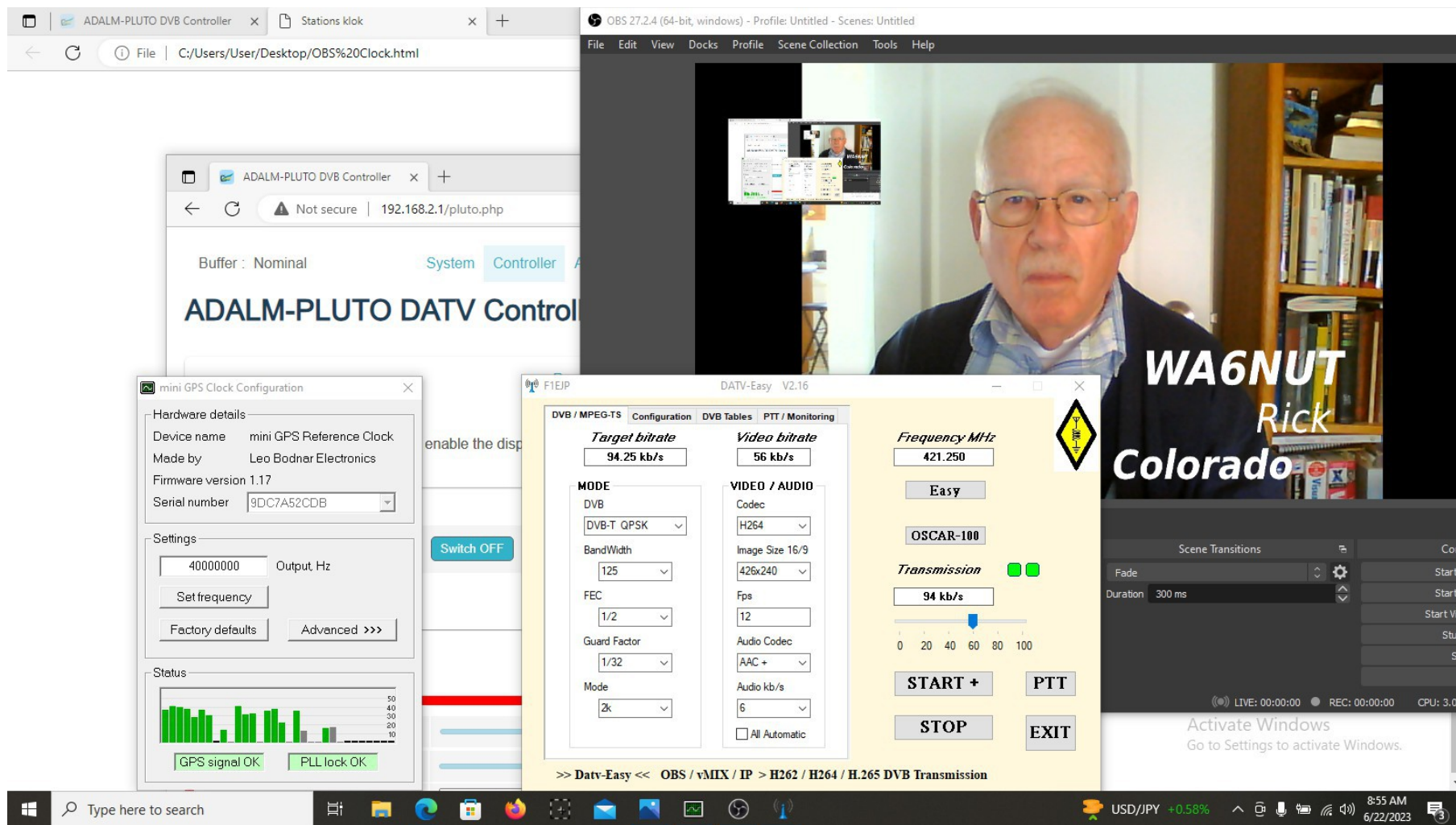


Figure 1: Transmitting PC screenshot: Showing DATV-Easy, OBS Studio, and the Leo Bodnar GPSDO app, with the F5OEO “Controller” page in the background (note the blue “Switch OFF” PTT button).

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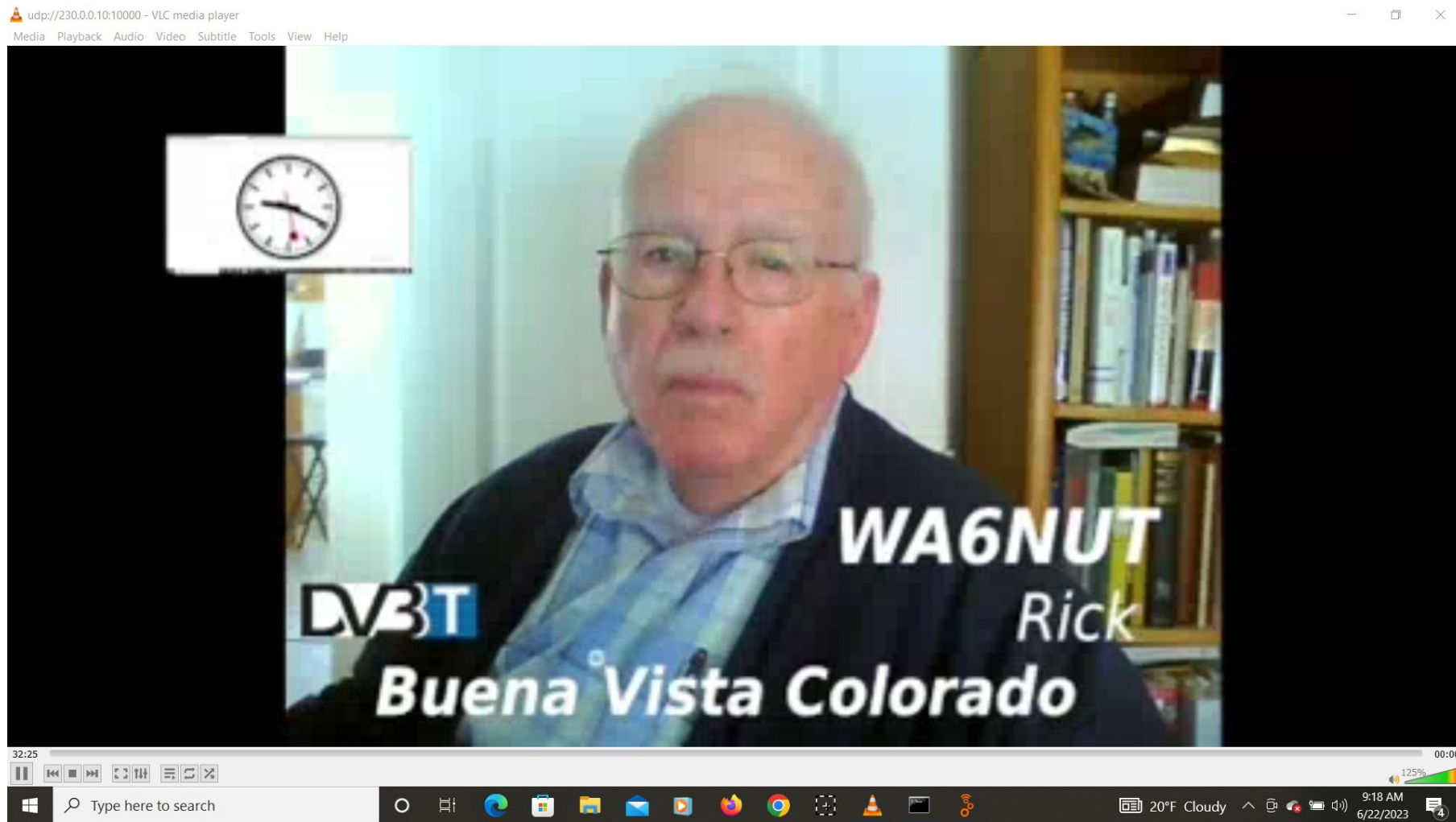


Figure 2: Receiving PC screenshot: Showing the received image on VLC Media Player. The HB9DUG/G4NZV GNURadio DVB-T receiver is shown in Figure 3.

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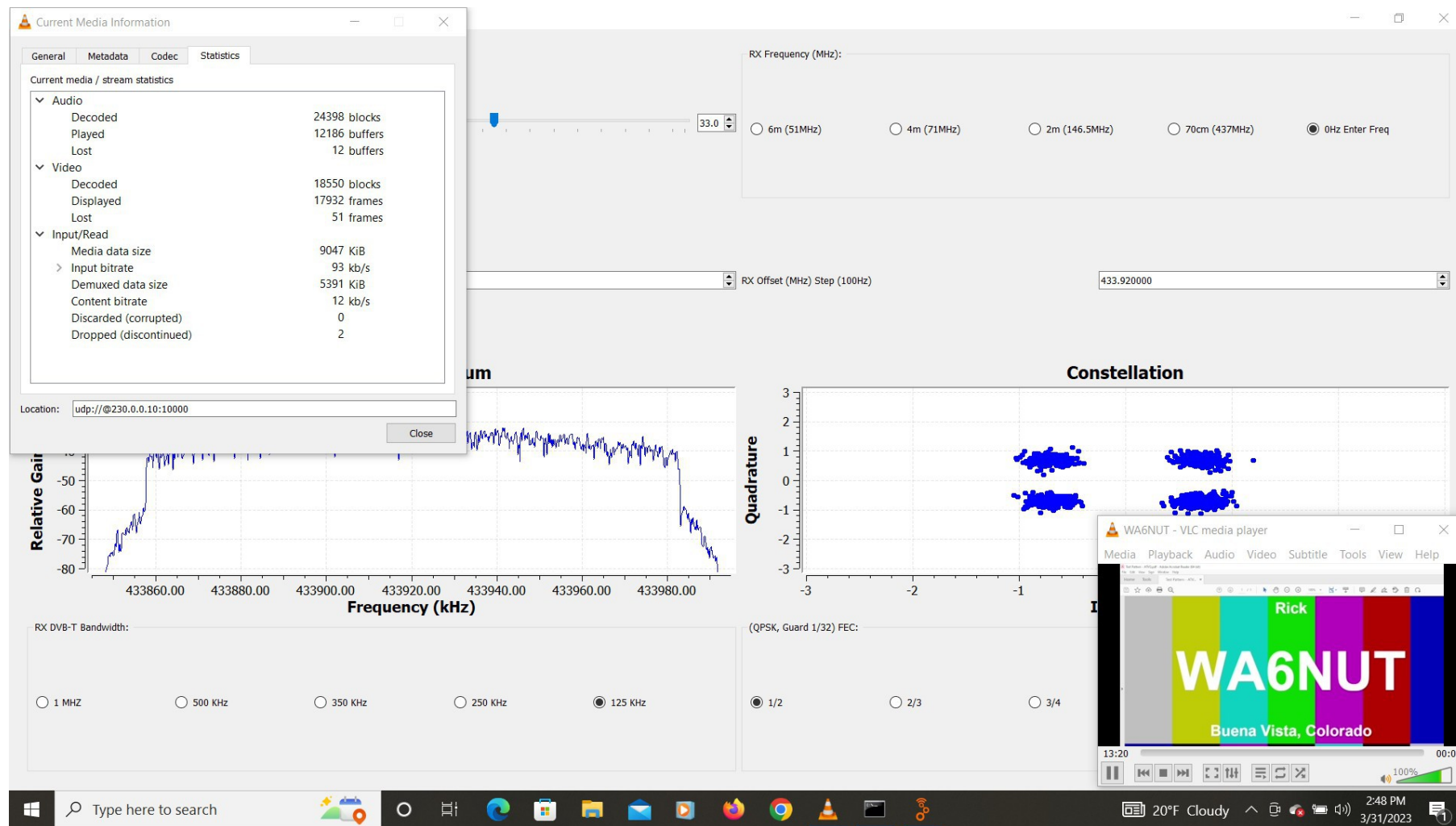


Figure 3: Receiving PC screenshot: Showing the HB9DUG/G4NZV GNURadio DVB-T receiver: VLC is shown in the lower right corner; the VLC Current Media Information is shown in the upper left corner.