GETTING STARTED USING RASPBERRY PI IN THE SHACK (PART 2)

Jack Weaver – AA5VZ

I love this hobby! Where else can you sit in a hotel room in Pittsburgh PA and enjoy a digital QSO on a laptop with a fellow Ham in France, using your transmitter & antenna in Texas via a Raspberry Pi computer connected to the internet? A strange thing to consider one's own signals passing overhead on their way to Europe and back!

December, 2017

INTRODUCTION

The Raspberry Pi Alternative for *WSJT-X*

Turn an inexpensive microcomputer into a digital communication machine.

Thomas Kocourek, N4FWD

In the "Eclectic Technology" column in the April 2017 issue of QST, *Chuck Kelly, W9MDO/VE1MDO, described a portable option for running* WSJT-X *digital mode software with a Raspberry Pi 3 microcomputer and a miniature LCD touchscreen. In this article, Thomas Kocourek, N4FWD, presents a similar solution, but with the emphasis on using the Pi as a dedicated home station computer for JT65, JT9, and WSPR — Ed.*

The author's station, with his Raspberry Pi 3 microcomputer at lower left, in its transparent case.

As we slide into the oncoming solar minimum, it's no surprise that we're seeing an uptick in popularity for digital modes, such as JT65 and JT9, as well as the WSPR digital beacon mode. JT65 and JT9 can support contacts on the HF bands under conditions that would render other modes unusable. And for those interested in HF propagation studies, WSPR is ideal.

All three modes are available in the free *WSJT-X* software package, created by Dr. Joe Taylor, K1JT. In addition to

around your ham shack. However, here is a list for those starting from scratch:

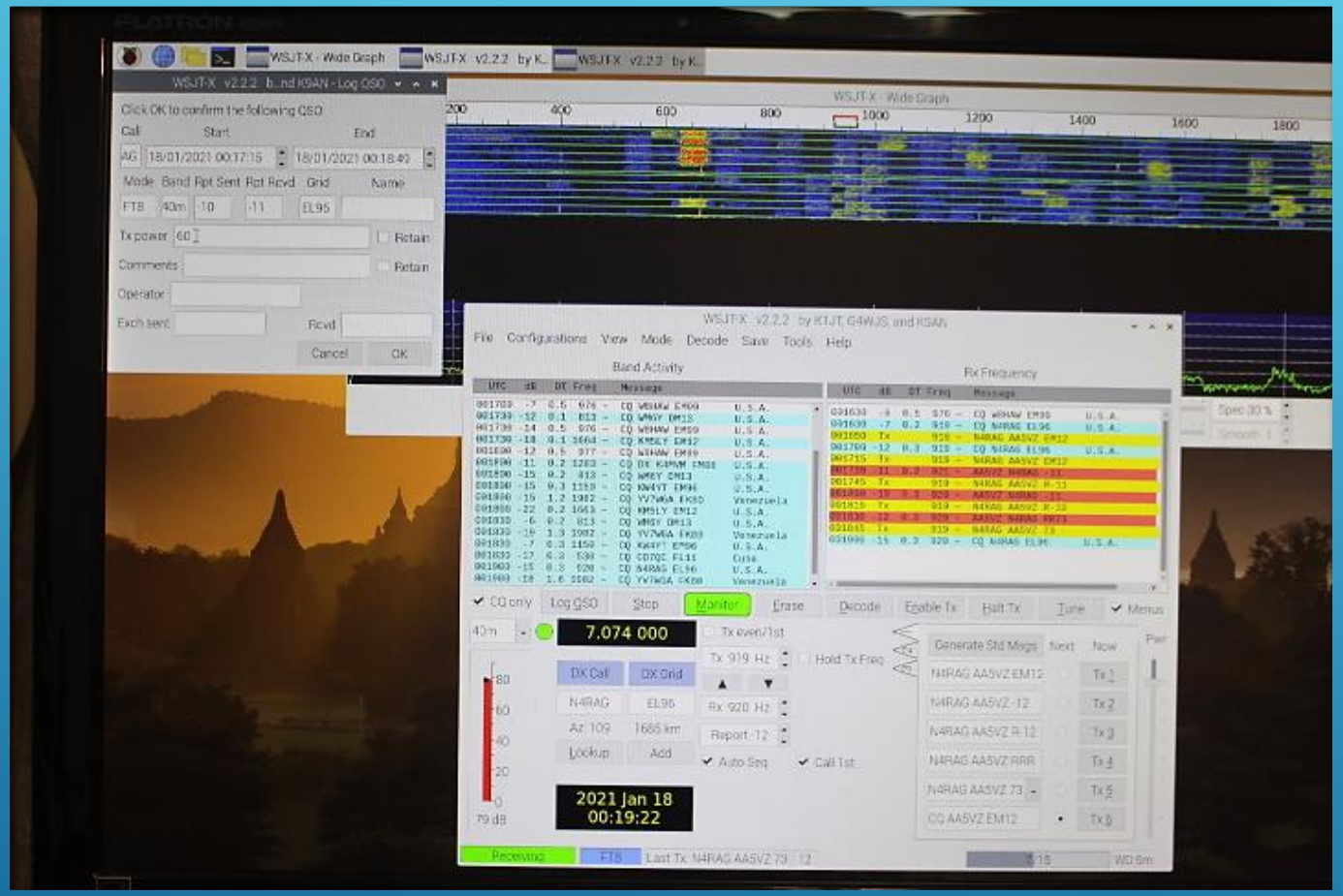
- **A Raspberry Pi 3 microcomputer**. For beginners, I strongly recommend a "kit," such as those offered by CanaKit (see Amazon and other sources), because these packages include almost everything you'll need, often including a case and power supply. Prices range

your monitor. Considering the small size of the Raspberry Pi, I'd recommend a lightweight cable to keep everything mechanically stable.

- **A USB "A-B" style cable**. This cable will link your Raspberry Pi to your interface or transceiver.
- **A keyboard and mouse**. To keep cabling to a minimum, I recommend a

WHERE IT ALL STARTED

QST Article, July 2017
Thomas Kocourek, N4FWD



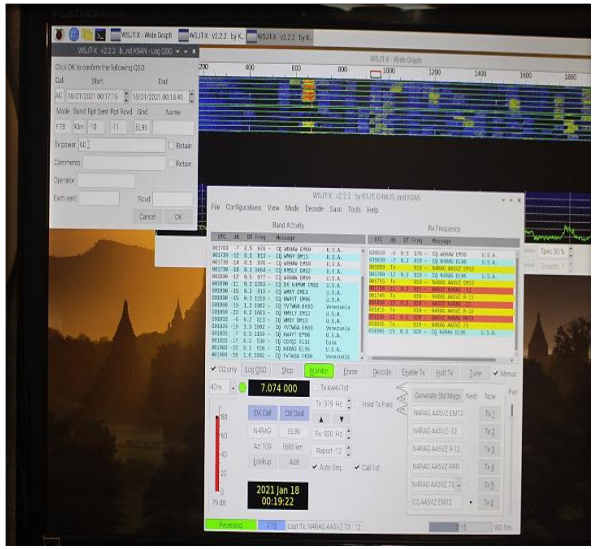
CURRENT ACTIVITY

- FT-8 Digital Mode
- Raspberry Pi-4
- Kenwood TS-590
- USB Direct Audio Interface
- Wireless Keyboard/Mouse

- >250 QSOs from Dec thru March

GETTING STARTED…

MOVING FORWARD



- **Assemble a Raspberry Pi-4 Workstation**
- **Load the base Operating System (O/S)**
- **Install and Configure Ham Radio Apps**
- **Interface the Pi with your Station**
- **Get on the Air!**

RECOMMENDED READING

- **WSJT-X User Guide – Available On-Line**
- **https://physics.princeton.edu/pulsar/k1jt/wsjtx-doc/wsjtx-main-2.3.1_en.html#NEW_FEATURES**

- **FL-Digi User Guide – Available On-Line**
- **http://www.w1hkj.com/FldigiHelp-3.21/html/index.html**

…OFF WE GO!

PART 1 (REVIEW)

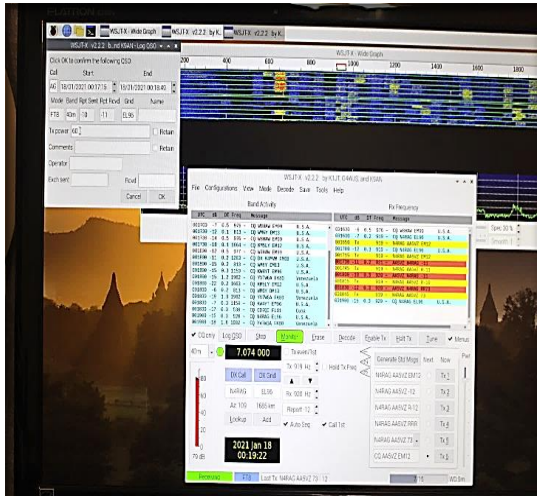
- **Procured a Pi-4 kit**
- **Assembled the components**
- **Assembled a Pi-4 work-station**
- **Installed NOOBS**
- **Installed/Updated the O/S**
- **Backed up our System SD Card(s)**
- **Allowed time for familiarization**

PART 1 (REVIEW)

- **Recommended add'l tools and free software to format and back up SD cards and System Files (see below)**

- **https://www.sdcard.org/**
- Download / Install "SD Memory Card Formatter for Windows"

- **https://sourceforge.net/projects/etcher.mirror/**
- Download / Install "Etcher"



PART 2 (TODAY)

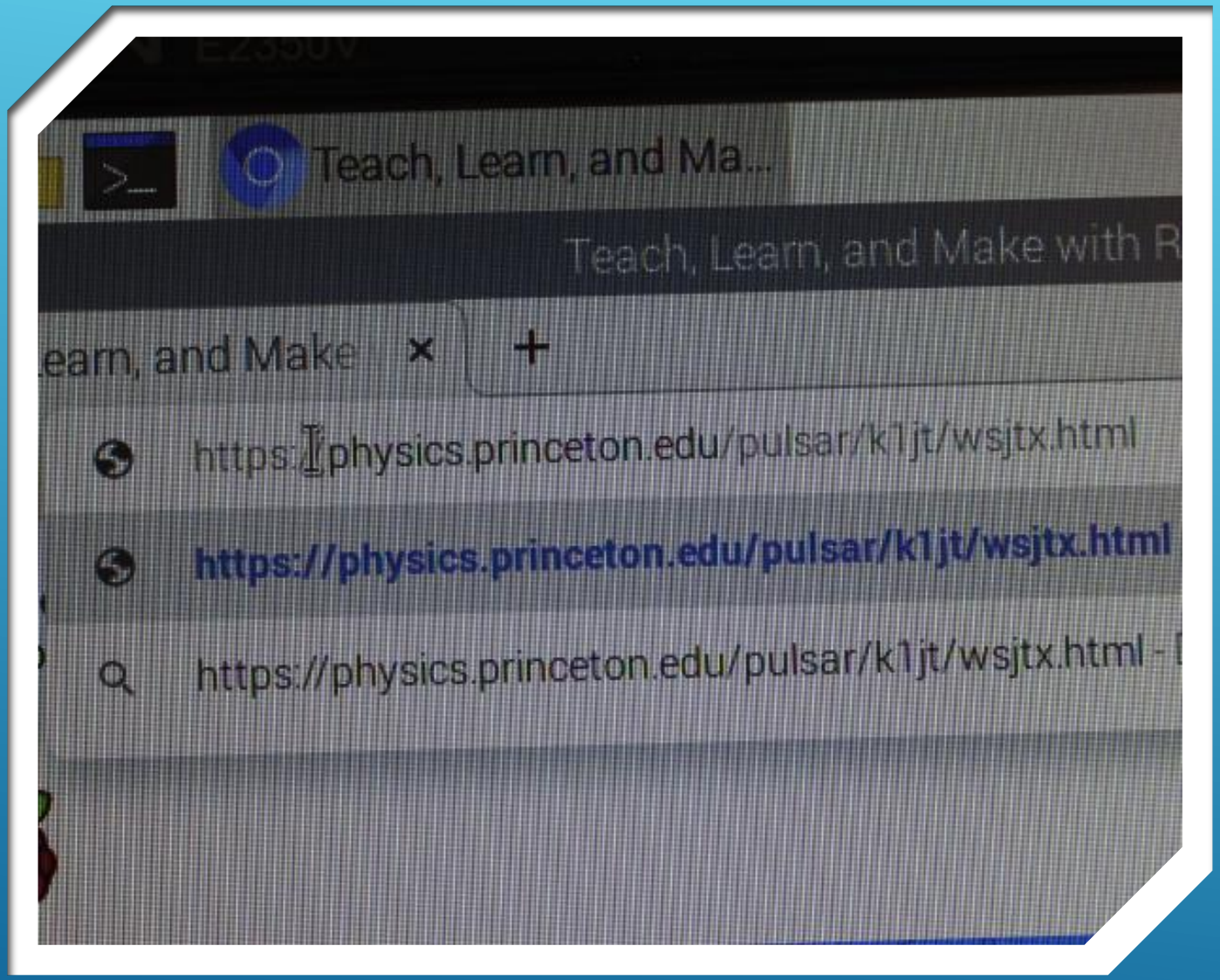
- Install WSJT-X (FT-8, JT-65, and others)
- Supplemental Addition - Install FL-Digi (PSK-31, etc) - TBD
- Interface the Pi-4 to your Radio
  - Audio Sound Card
  - Direct (USB)
- Configure the Interface
- Configure WSJT-X App
- Configure your Radio
- Get on the Air
- Have Fun!

INSTALL WSJT-X

- **Install WSJT-X (for FT-8, JT-65, and others)**

INSTALL WSJT-X

- **Open the Web Browser**

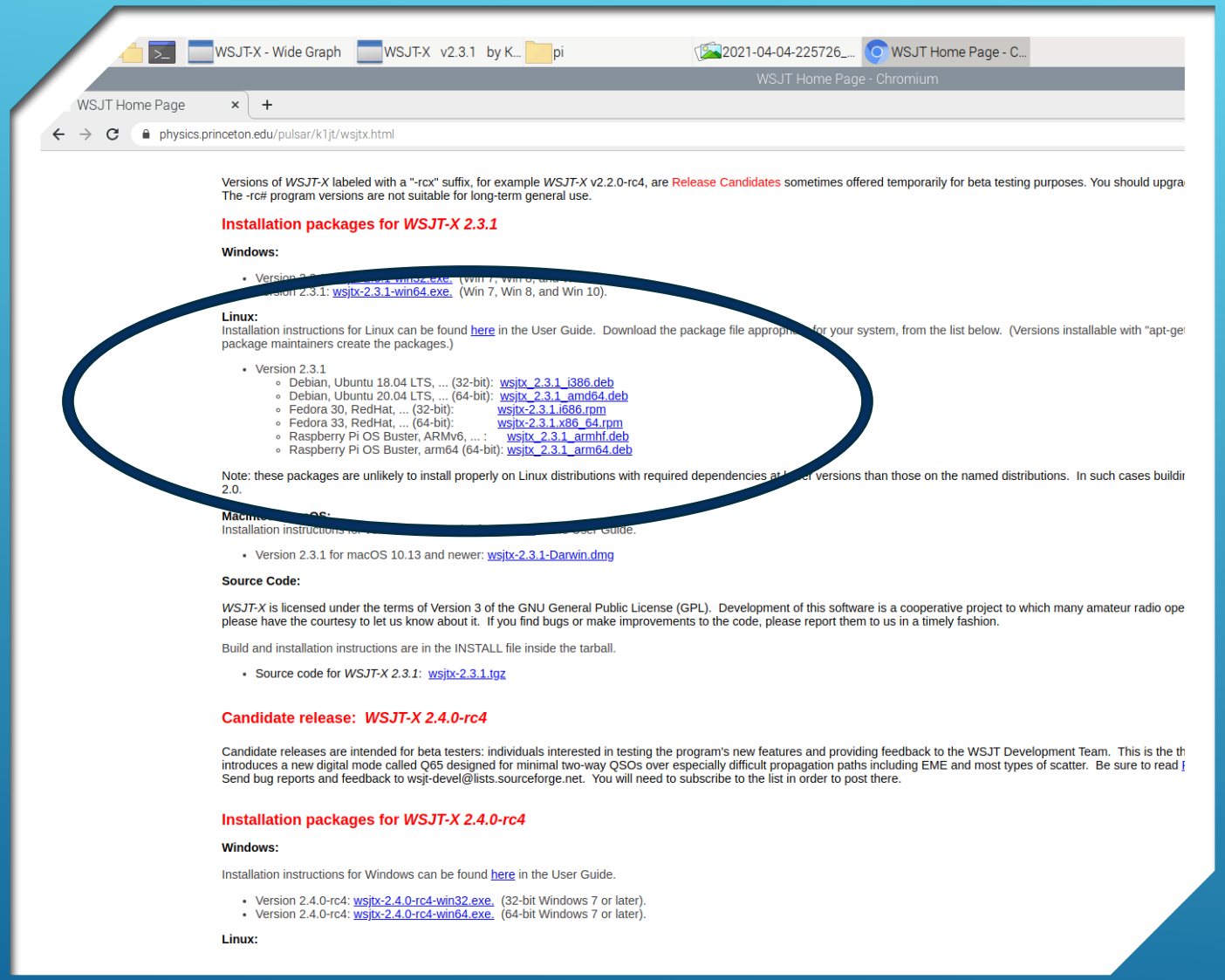


INSTALL WSJT-X

- **Type in the following:**
- **https://physics.princeton.edu/pulsar/k1jt/wsjtx.html**

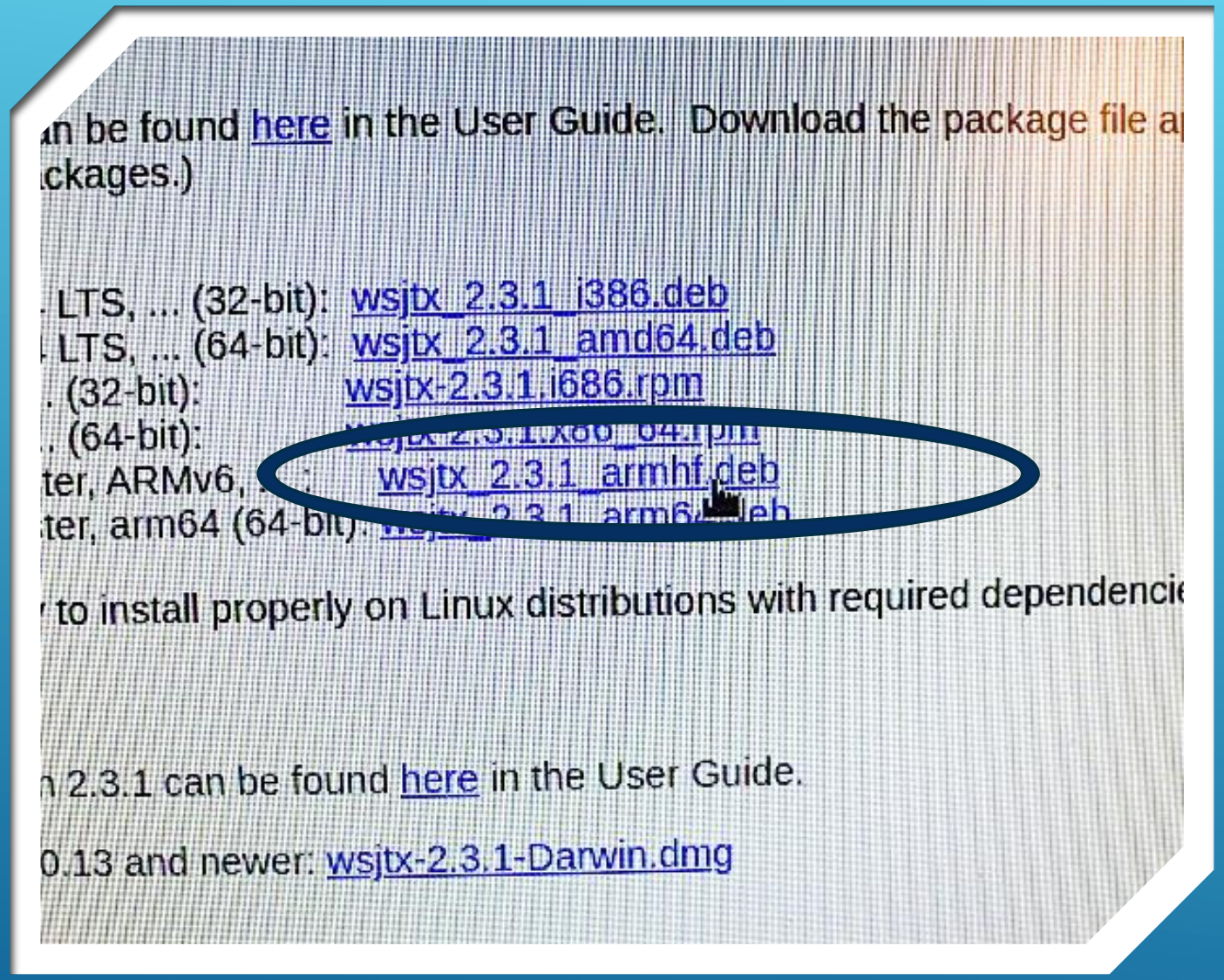
INSTALL WSJT-X

- **This takes you to the WSJT-X Web-Page**



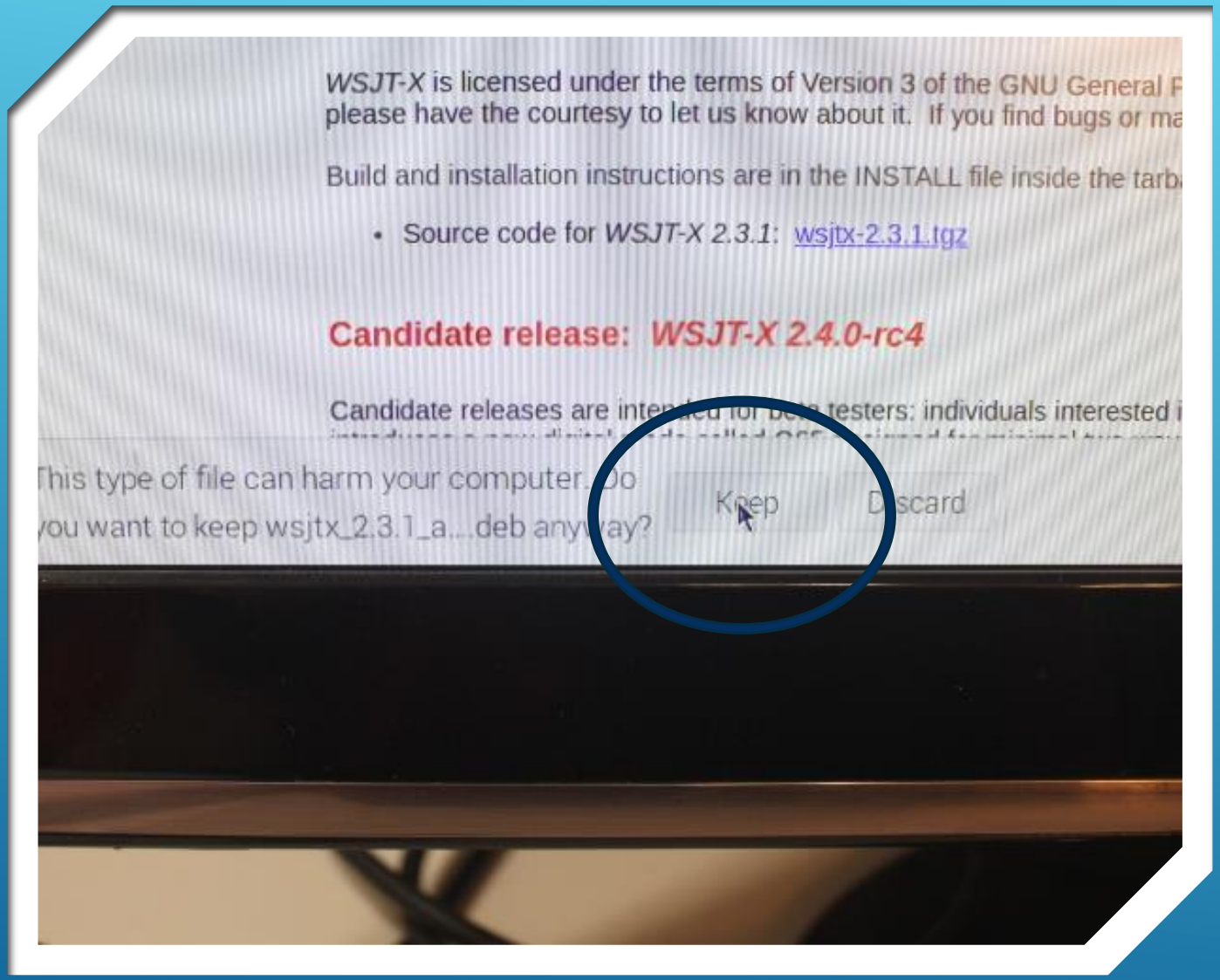
INSTALL WSJT-X

- **Scroll down the page and stop at the Linux package list for versions 2.3.1**



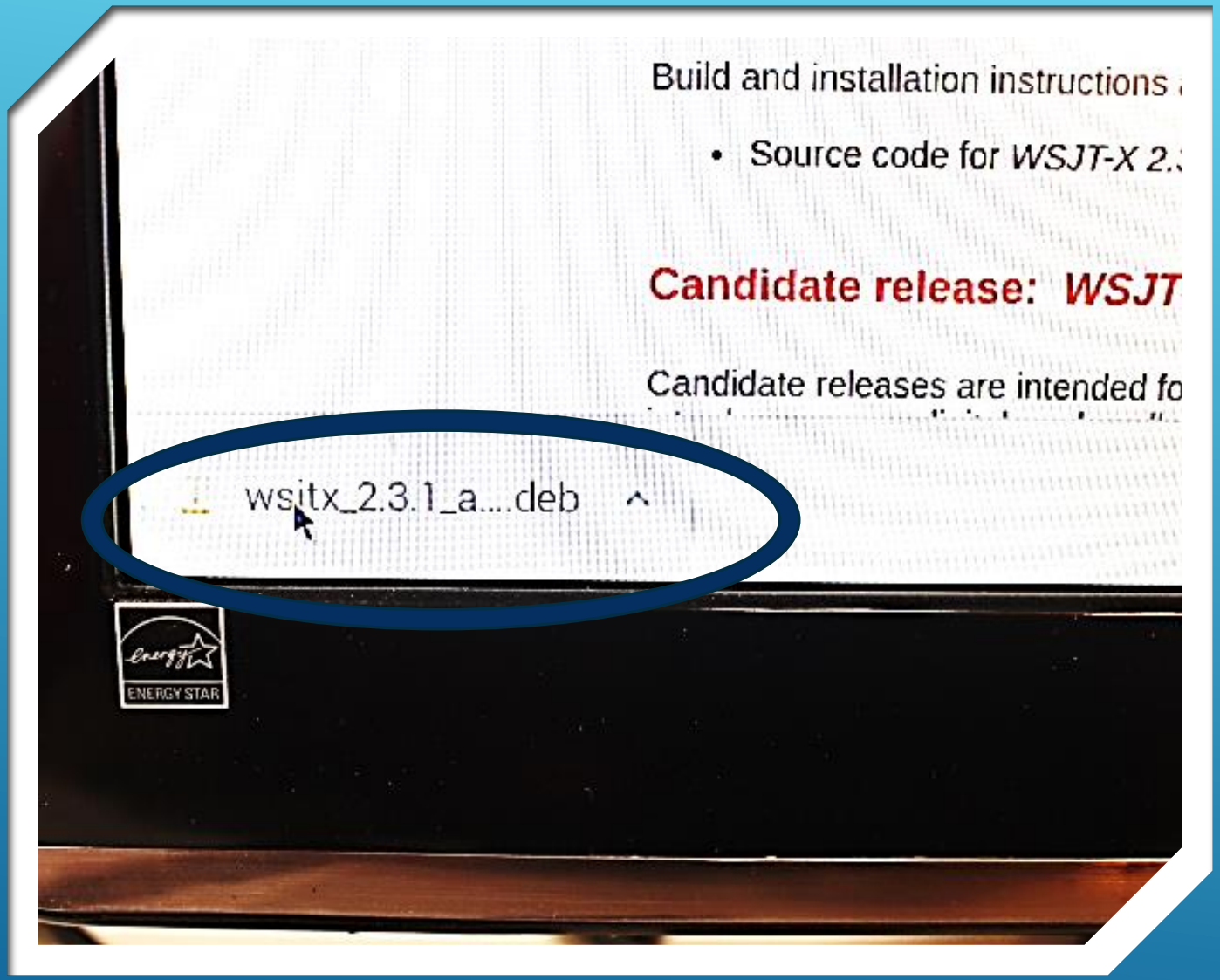
INSTALL WSJT-X

- From the 2.3.1 version list select:
- “wsjtx_2.3.1_armhf.deb”



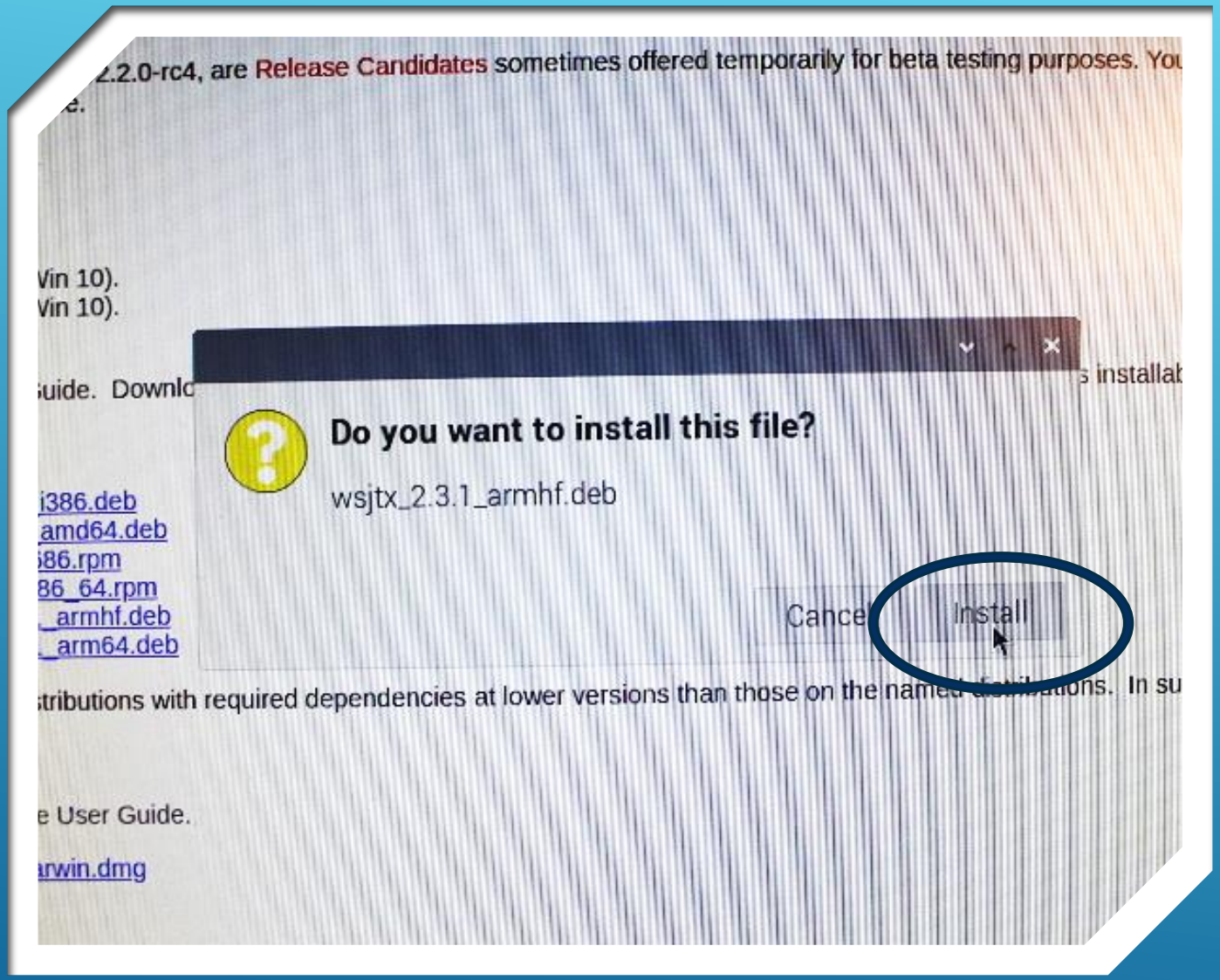
INSTALL WSJT-X

- **Observe message at bottom left corner of screen**
- **Select "KEEP"**



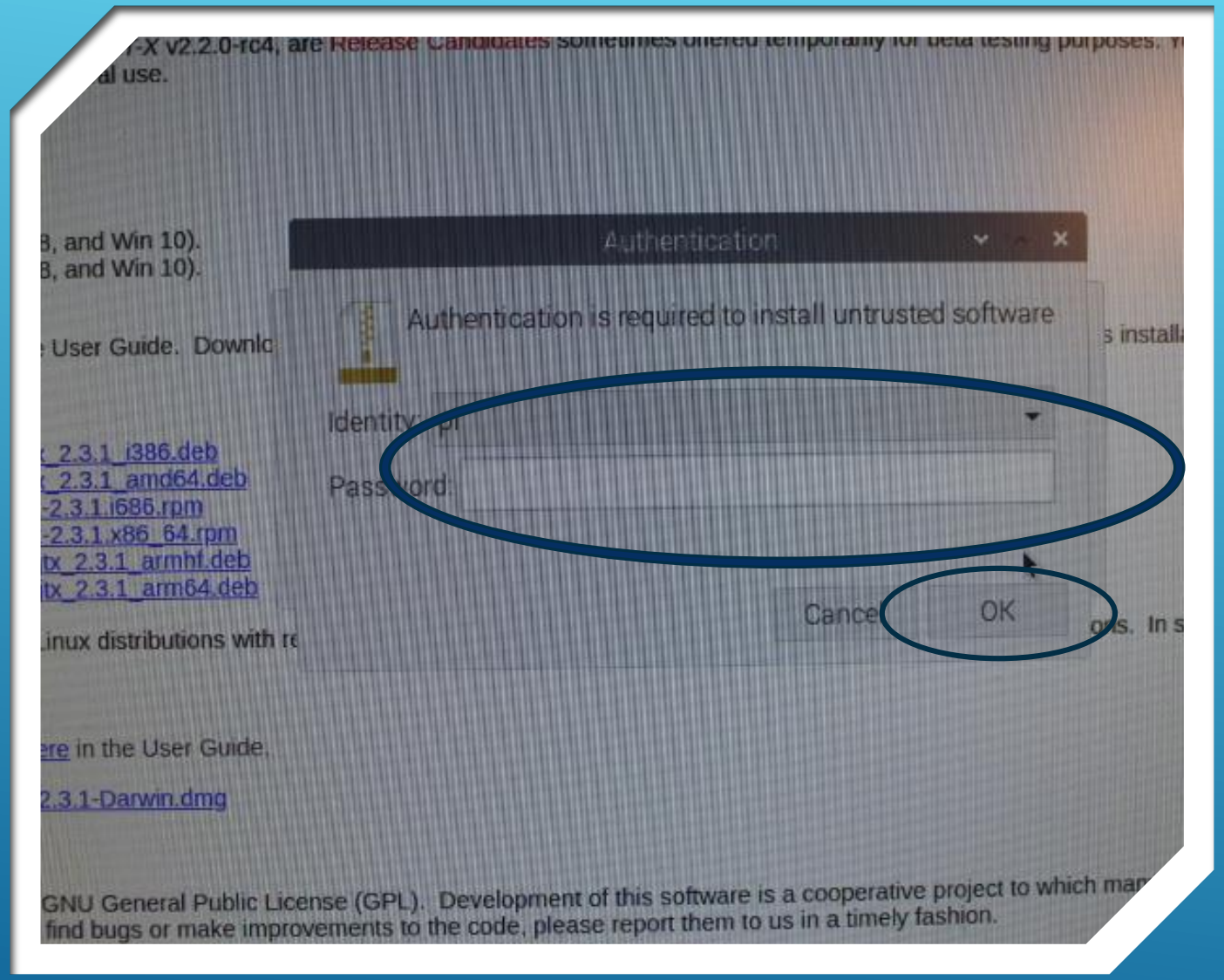
INSTALL WSJT-X

- To continue the installation, click on this item at bottom left corner of screen



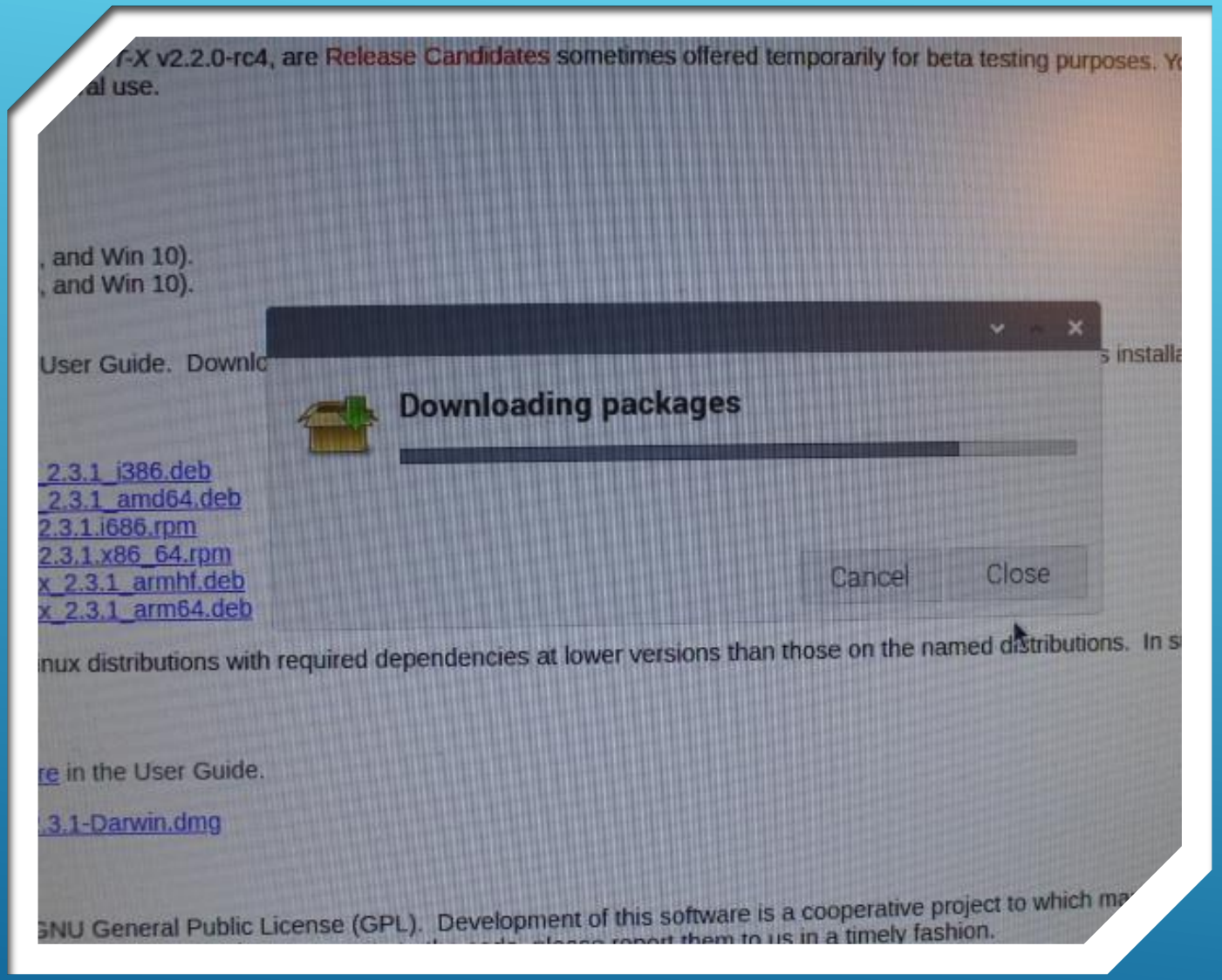
INSTALL WSJT-X

- The following message box will appear.
- Click the “Install” button.
- This will initiate the download of the selected file from the WSJT-X web-site to the “Downloads” directory of the Raspberry Pi.



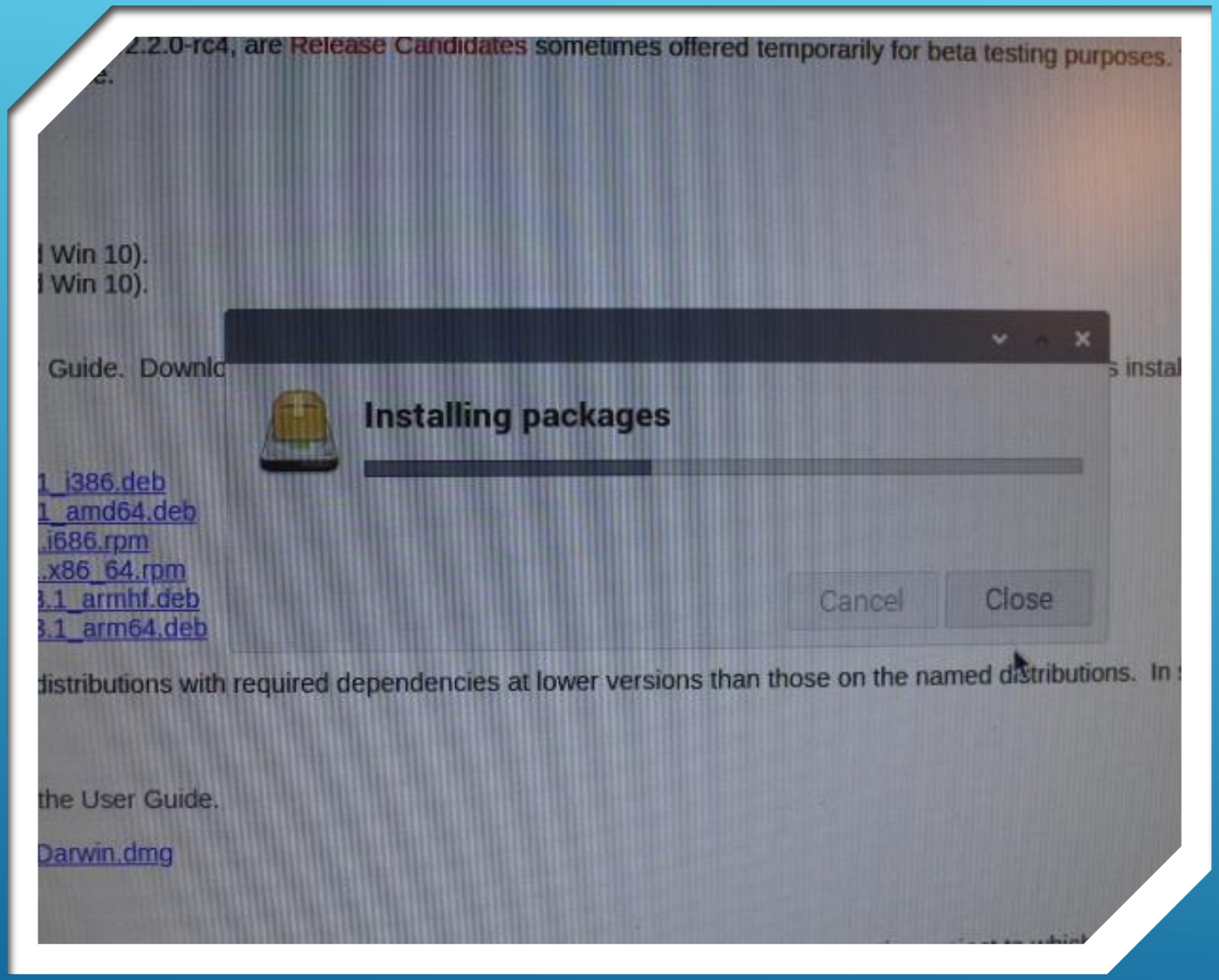
INSTALL WSJT-X

- **If you see this message box, it is asking you for your pi password.**
- **Type-in: raspberry**
- **Then click "OK"**
- **This should allow the file download to continue**



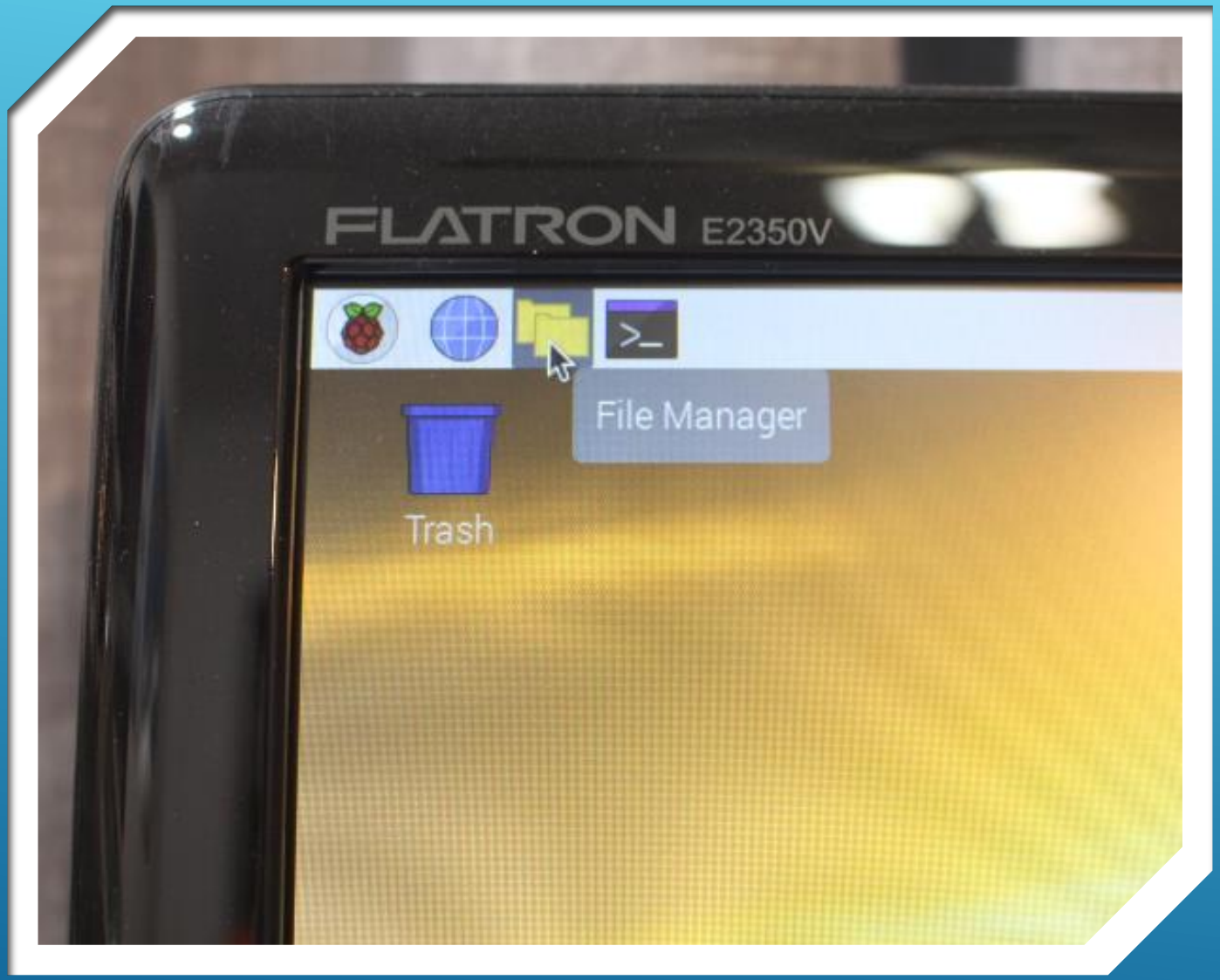
INSTALL WSJT-X

- **Success – the files are downloading…**



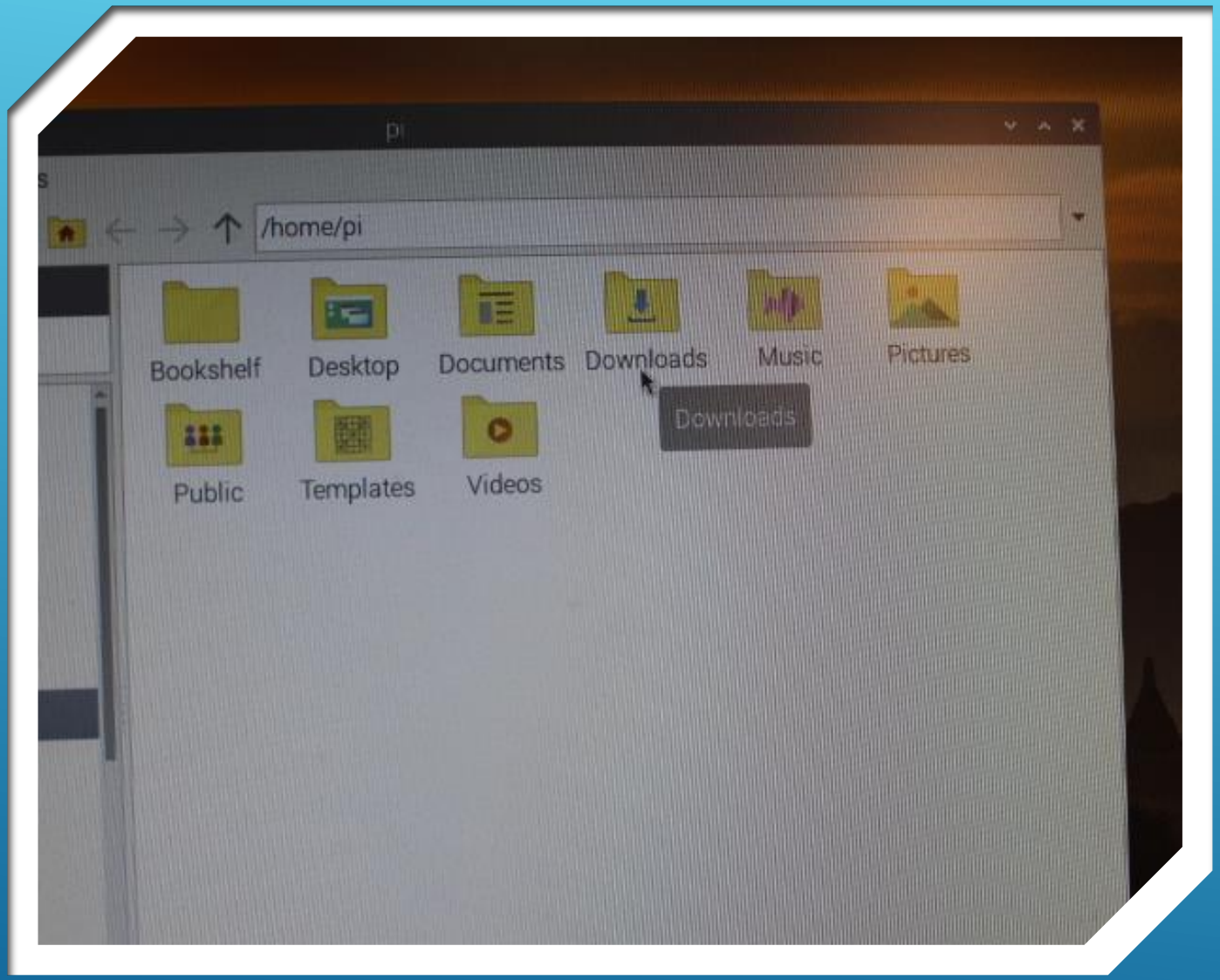
INSTALL WSJT-X

- **And being assembled into a package folder in the Downloads directory**



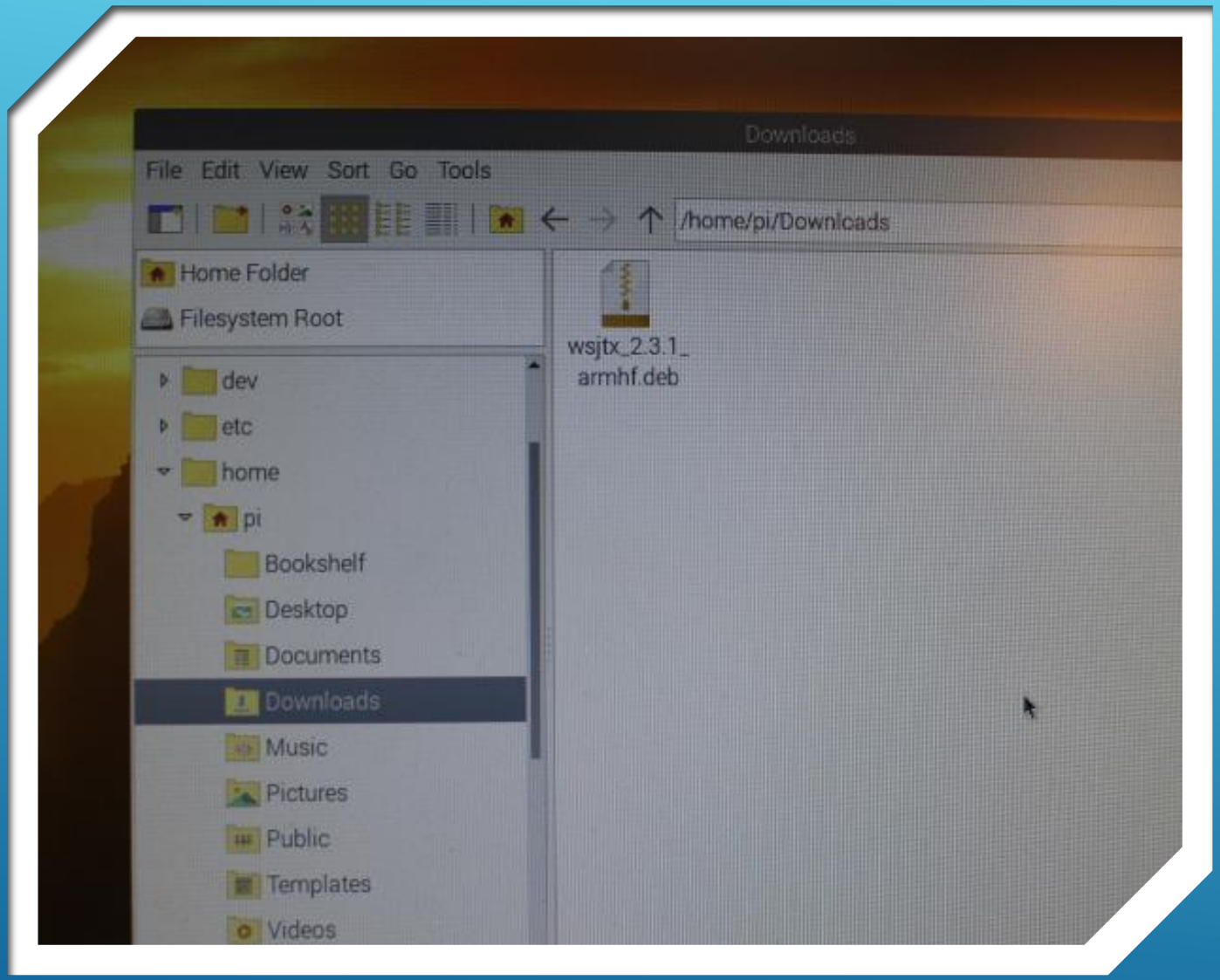
INSTALL WSJT-X

- **To verify the files downloaded successfully select File Manager on the Menu Bar.**



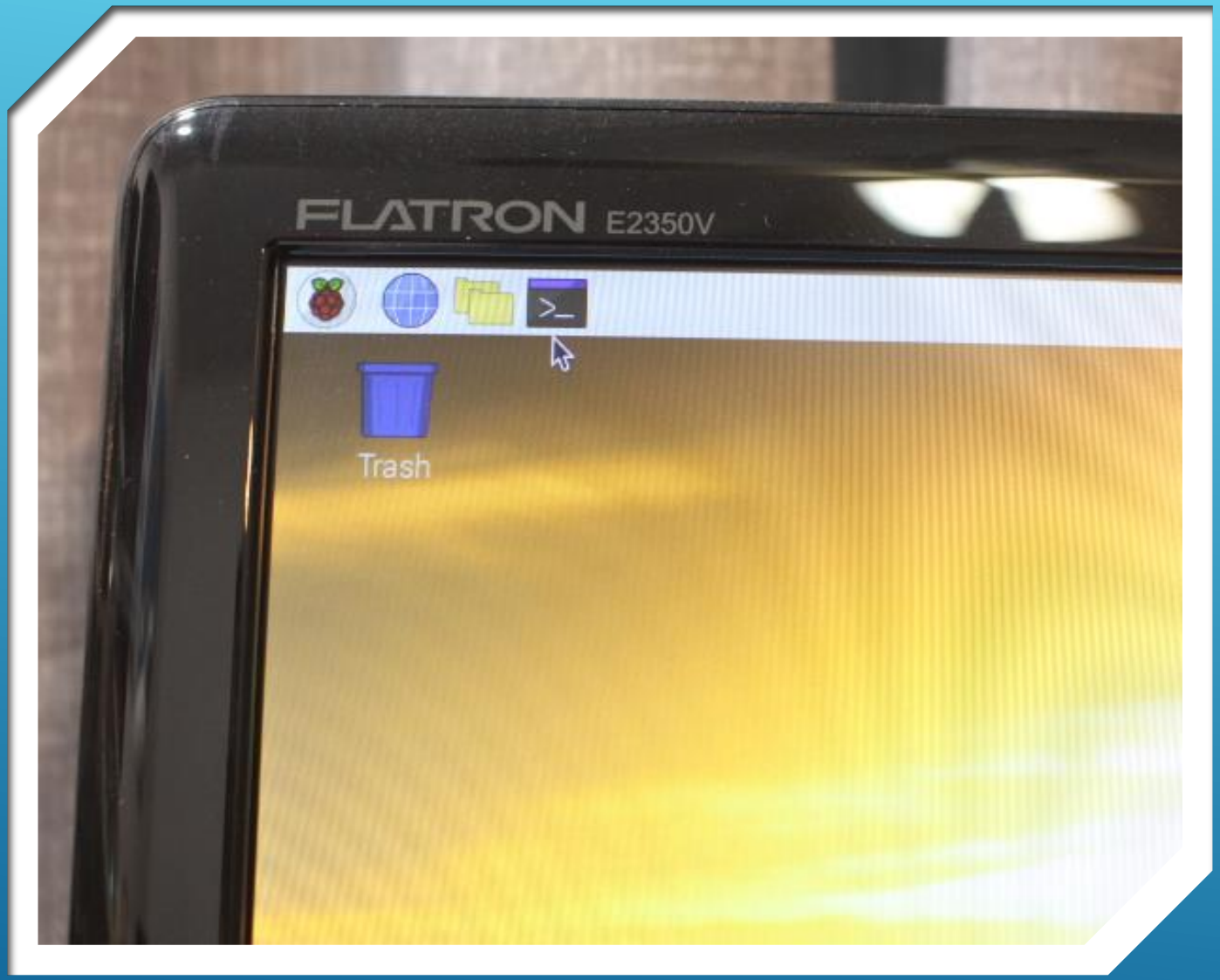
INSTALL WSJT-X

- **Open the “Downloads” Folder**



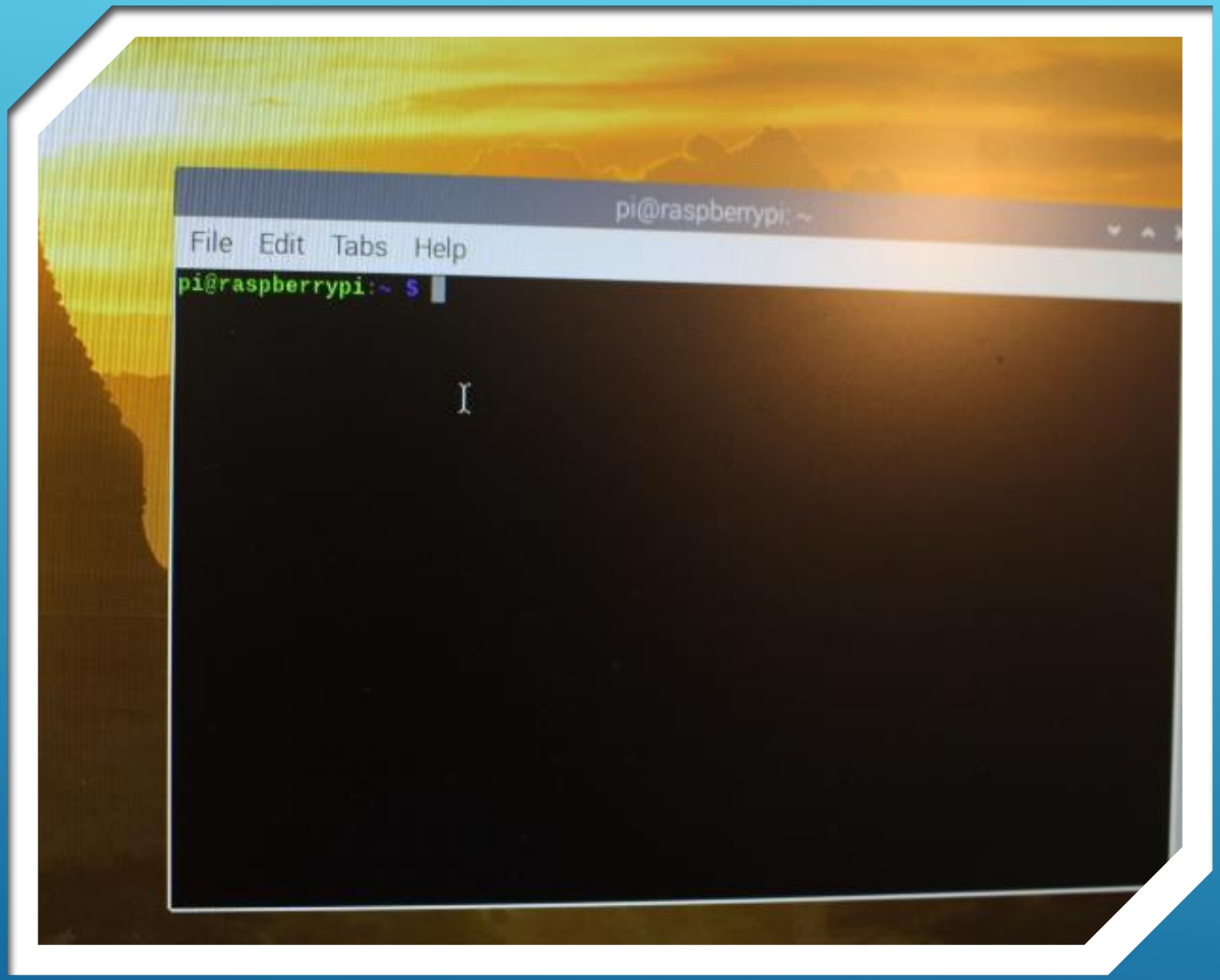
INSTALL WSJT-X

- If you see the wsjtx_2.3.1_armhf_deb zipped folder in the Downloads file, the package download was successful.
- At this point you are ready to load the wsjtx software onto your device.
- Close “X” out of this screen and…
- Read on…



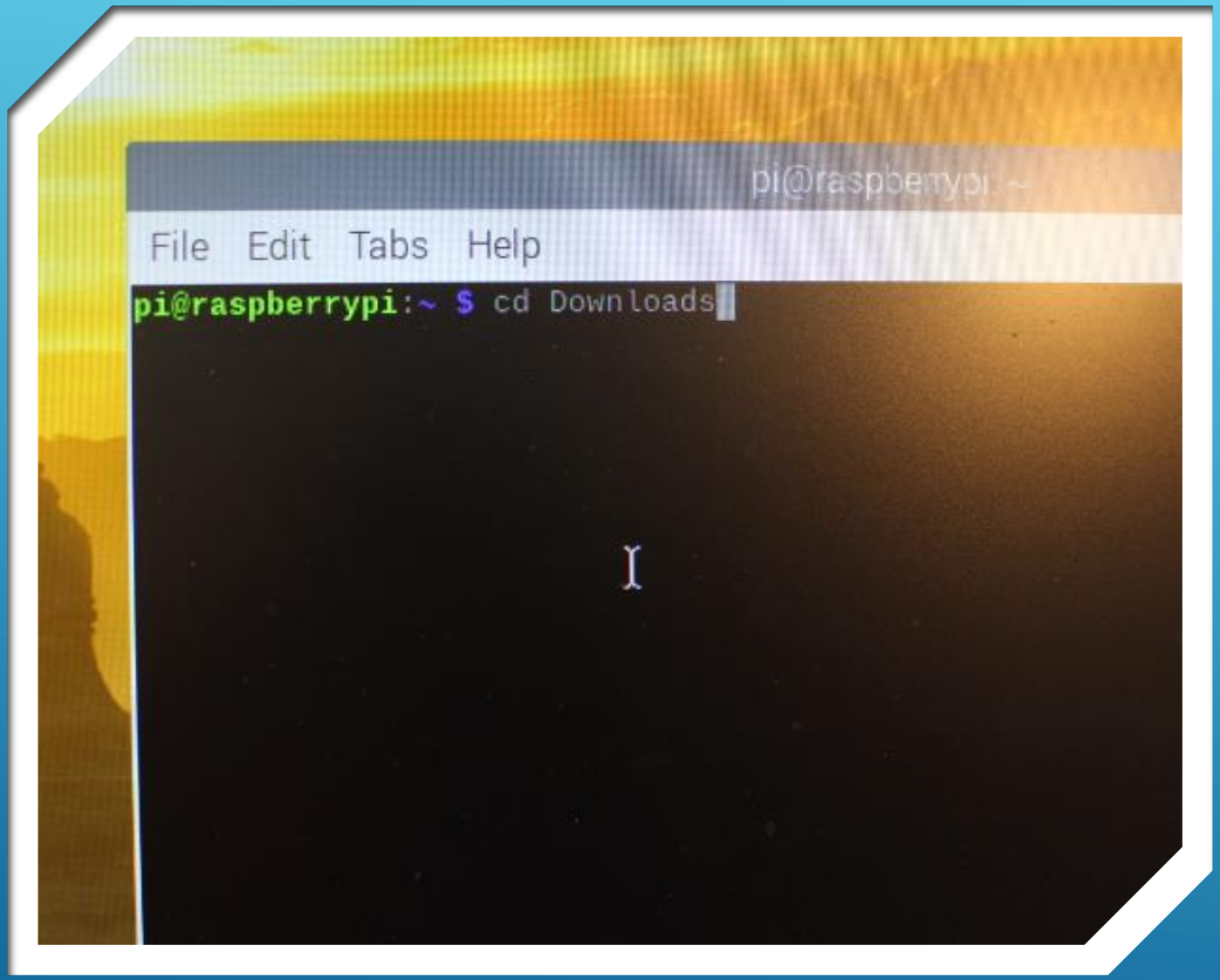
INSTALL WSJT-X

- Click this icon on the Menu Bar to enter desktop Terminal Mode.
- From the “Terminal” screen you will type in and enter specific commands to load the “wsjt-x” program onto your raspberry pi 4 device.



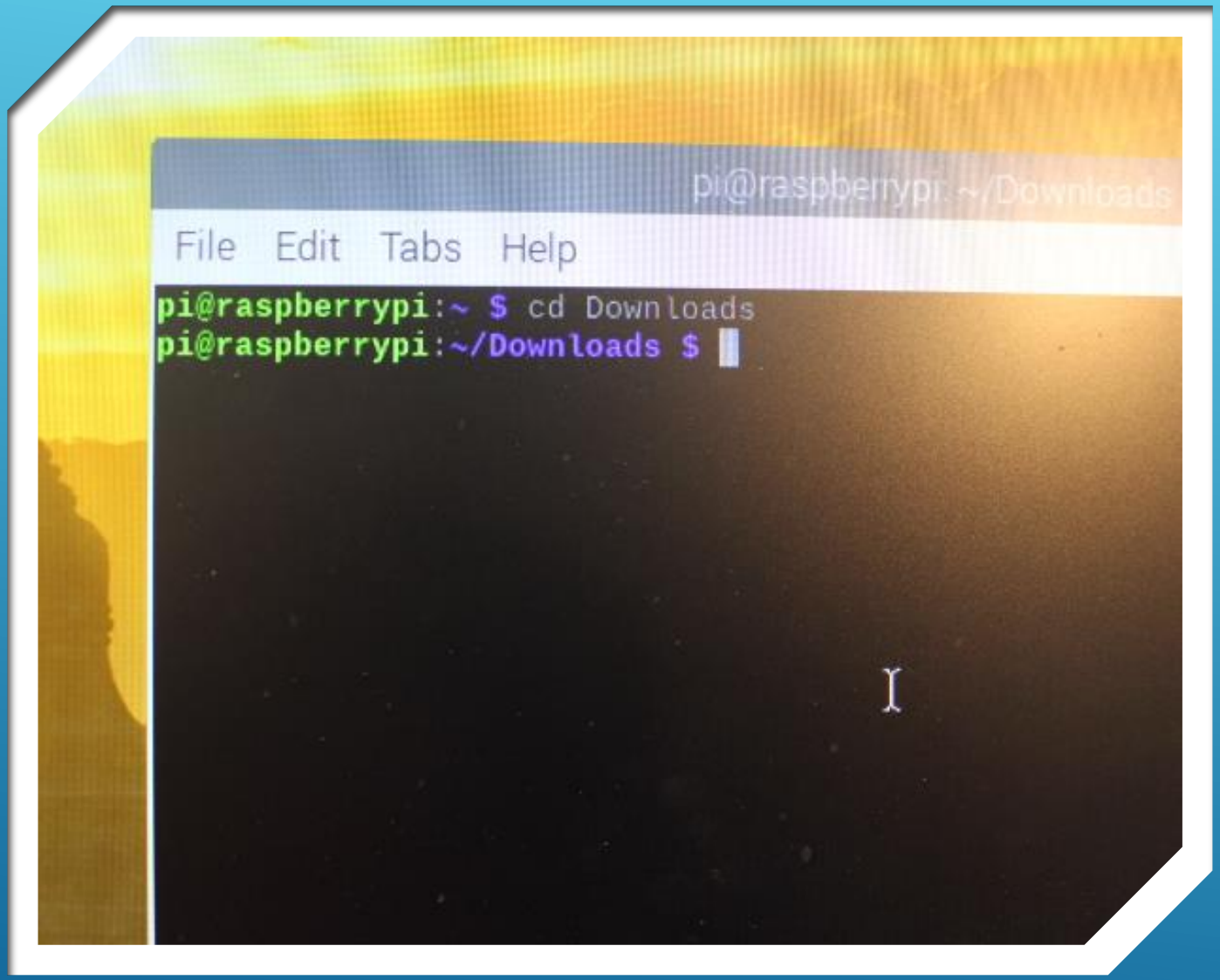
INSTALL WSJT-X

- The following prompt will be displayed on your screen.
- This indicates you are currently in the “raspberry pi”: root directory.
- The directory holding the wsjtx folder is named, “Downloads” (which you just saw in an earlier slide).
- The “CD” command will be used to “change directory” to the one specified next.



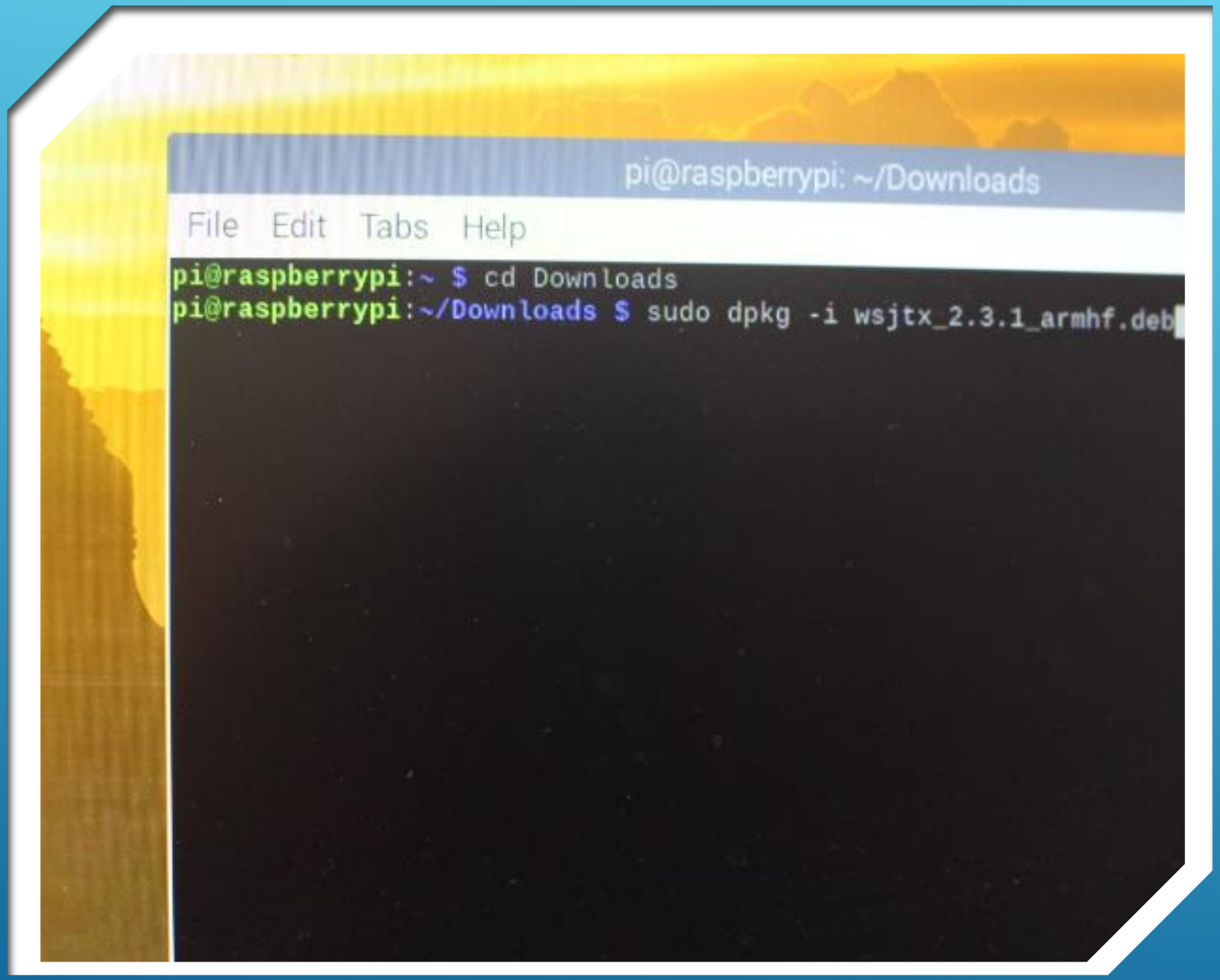
INSTALL WSJT-X

- **Type the following EXACTLY as shown and press Enter:**
- **cd Downloads**
- **Note: Be sure the word "Downloads" is capitalized as this is how the name of the directory is actually spelled. If you use all lower case, you will get an error message.**



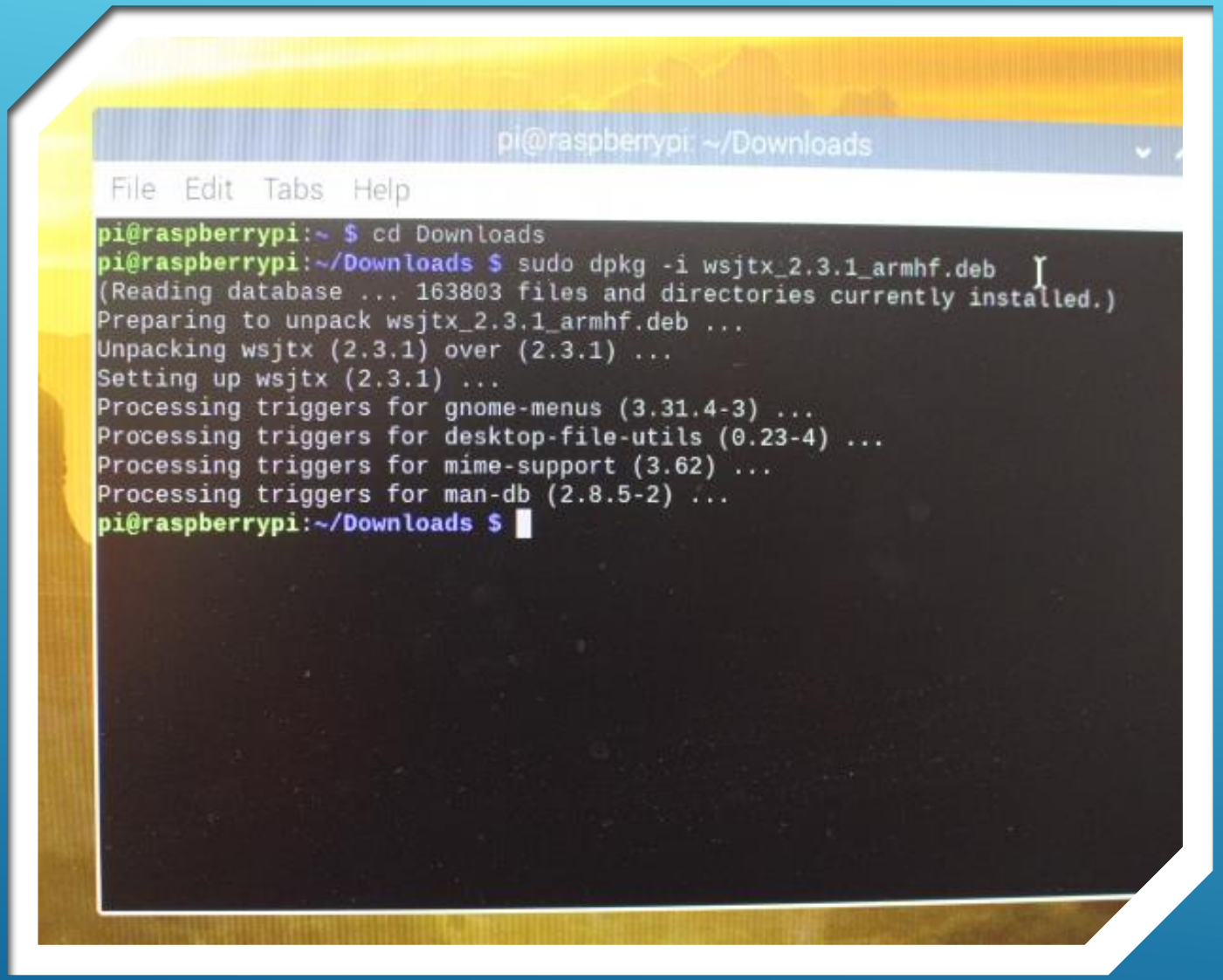
INSTALL WSJT-X

- **The screen prompt is now coming from the “Downloads” directory.**
- **Proceed to the next slide…**



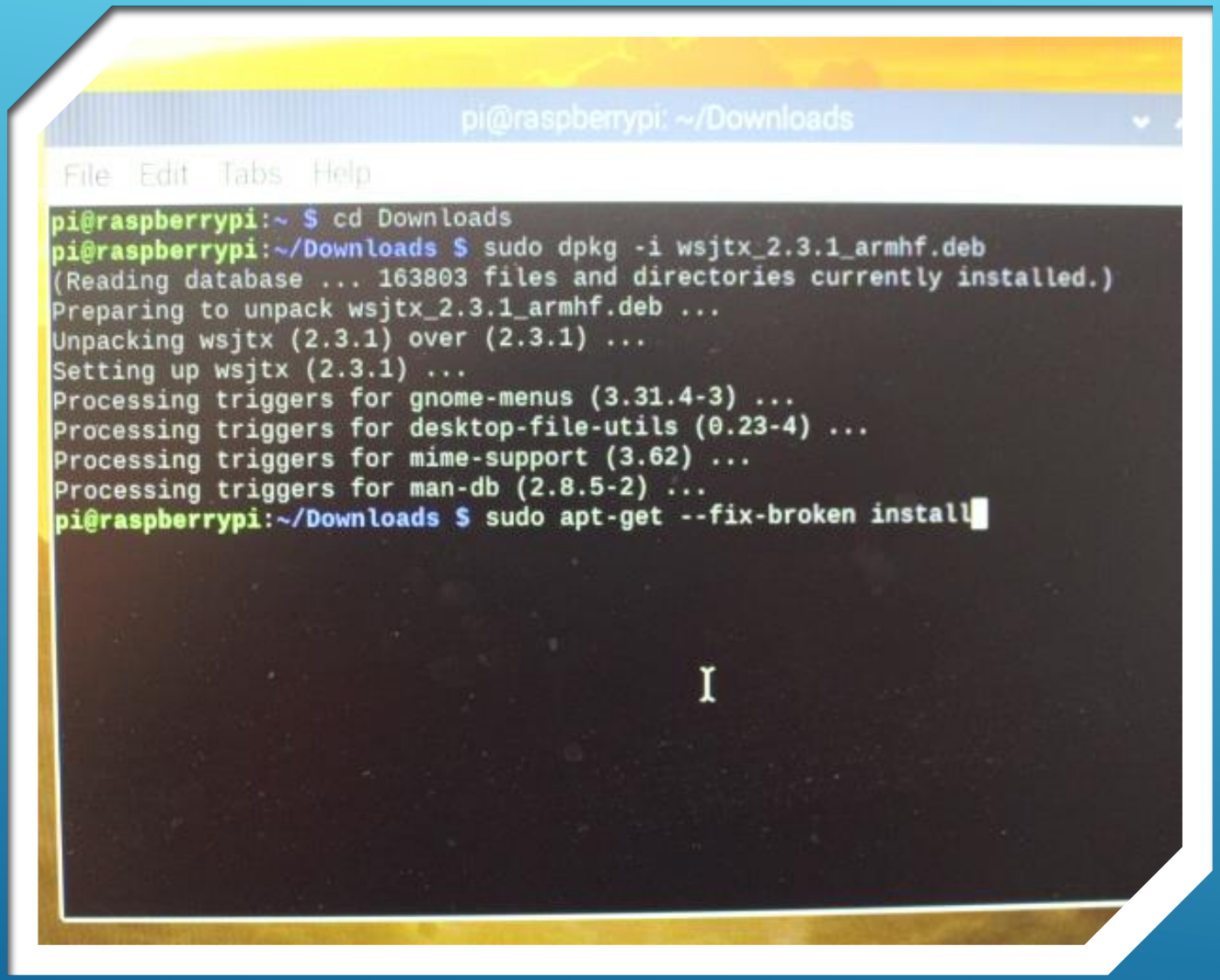
INSTALL WSJT-X

- **Type the following EXACTLY as shown and press Enter:**
- **sudo dpkg –i wsjtx_2.3.1_armhf.deb**



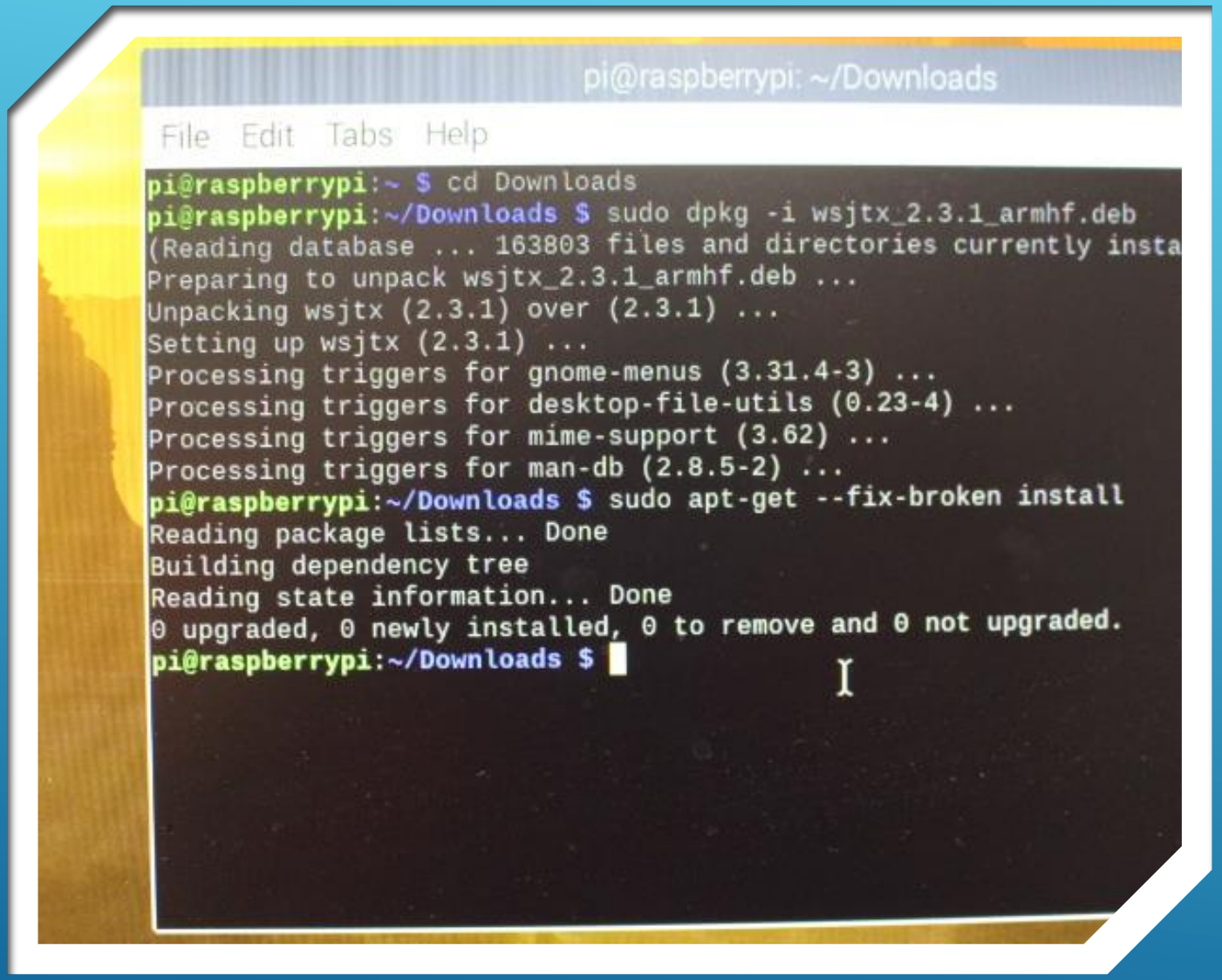
INSTALL WSJT-X

- The screen will display all the processes occurring as the command is executed. When the process has completed you will see a new command prompt as shown.
- Next slide…



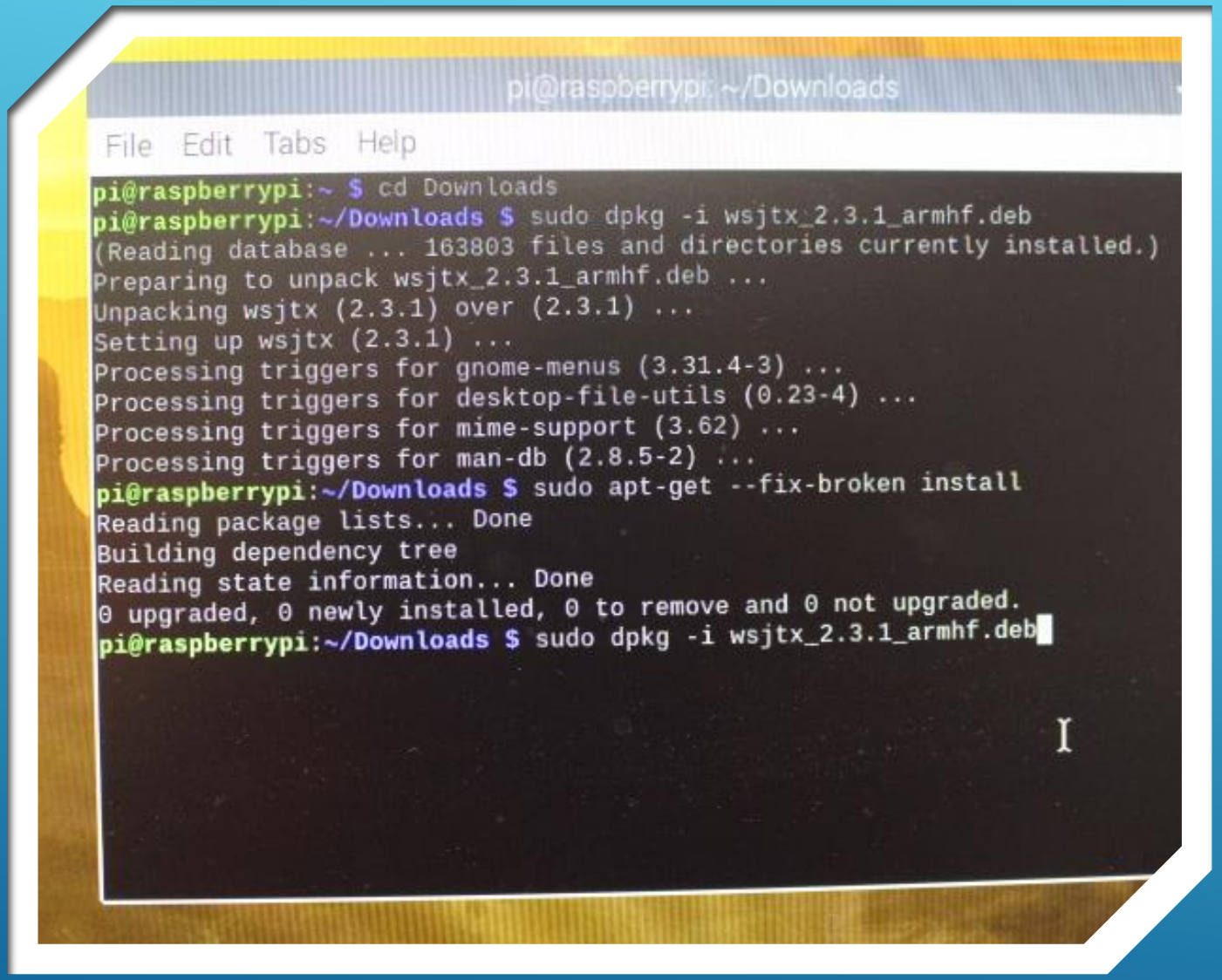
INSTALL WSJT-X

- After the command prompt type in the following EXACTLY as shown, then press ENTER.
- sudo apt-get --fix-broken install
- Next slide…



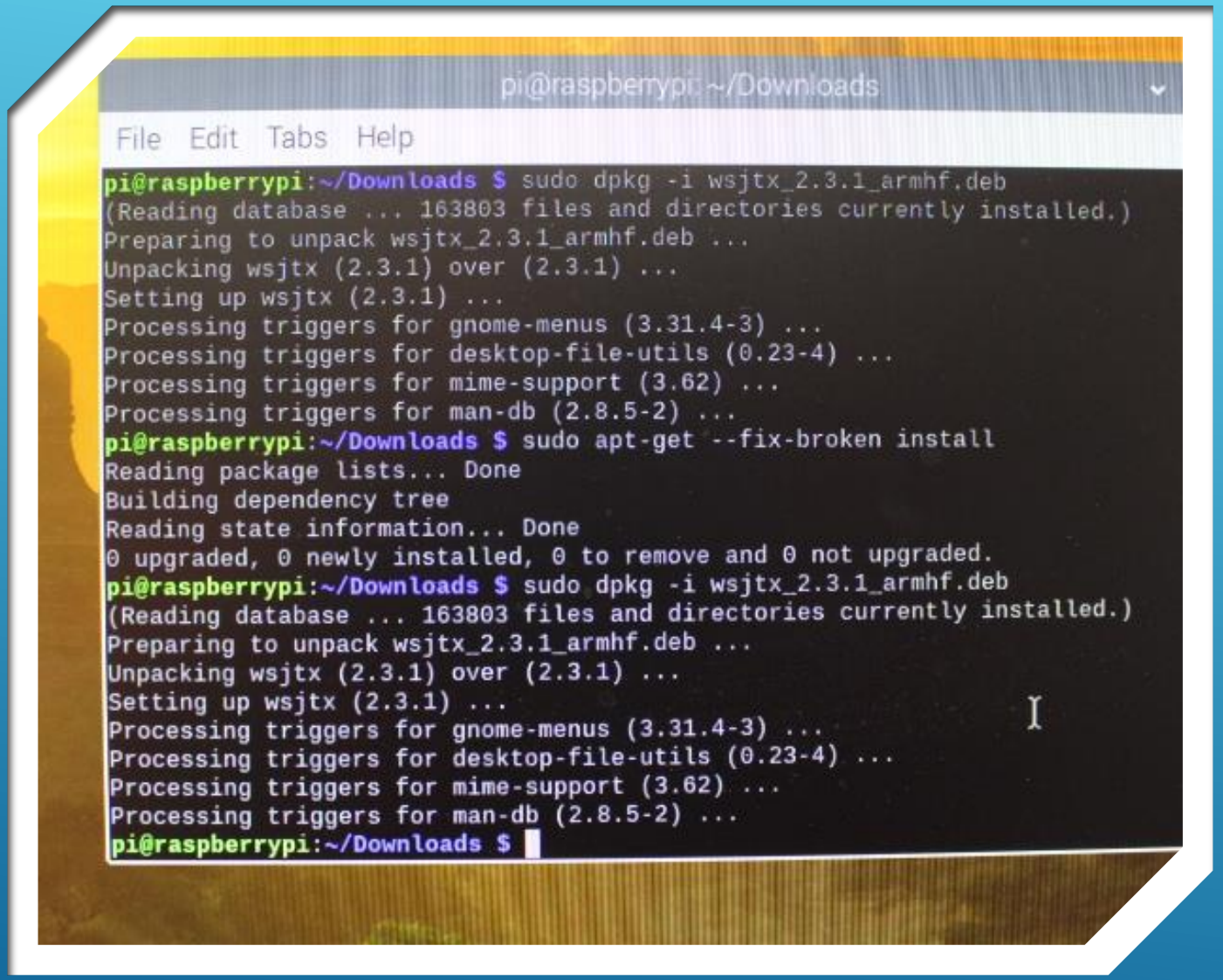
INSTALL WSJT-X

- Again, the screen will display the resulting processes as each one is executed by the command you entered.
- When the command has been fully executed a new command prompt will be presented.
- We're almost done.
- Next slide…



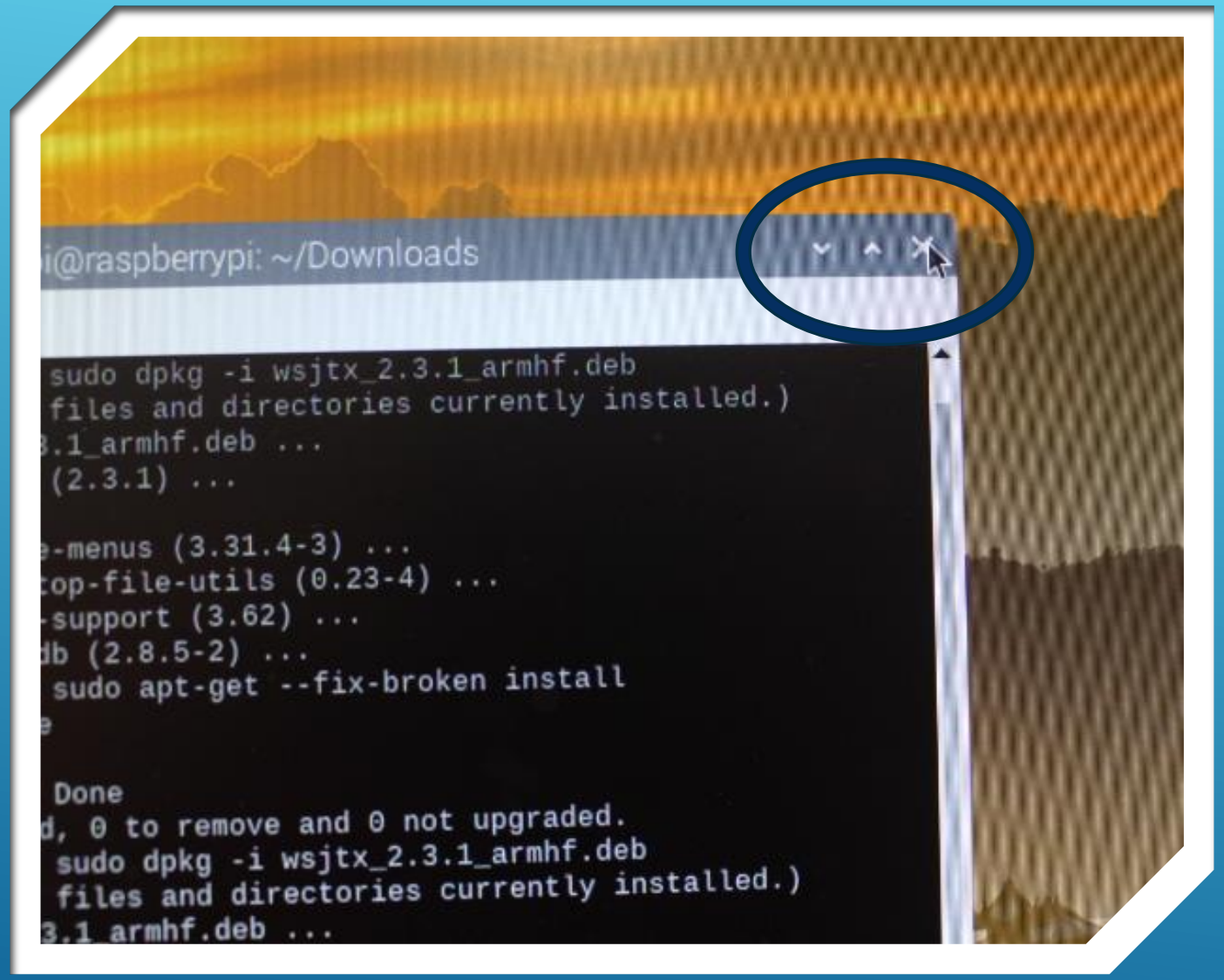
INSTALL WSJT-X

- **Lastly, type in the following command line EXACTLY as shown, and press ENTER:**
- **sudo dpkg –i wsjtx_2.3.1_armhf.deb**



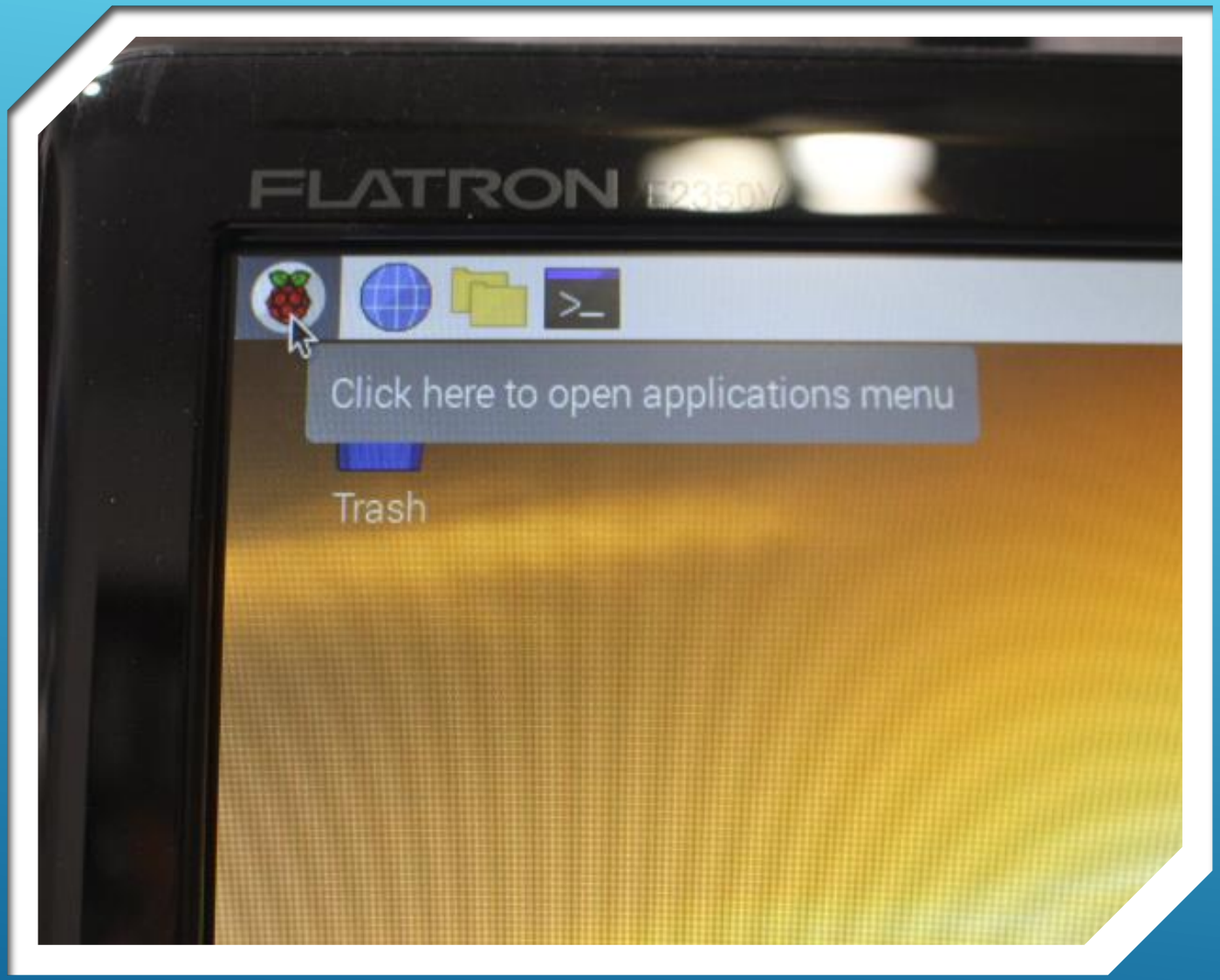
INSTALL WSJT-X

- When all command processes have been executed the screen (once again) will display a new command prompt.
- At this point, you are done inputting terminal commands.
- Next slide…



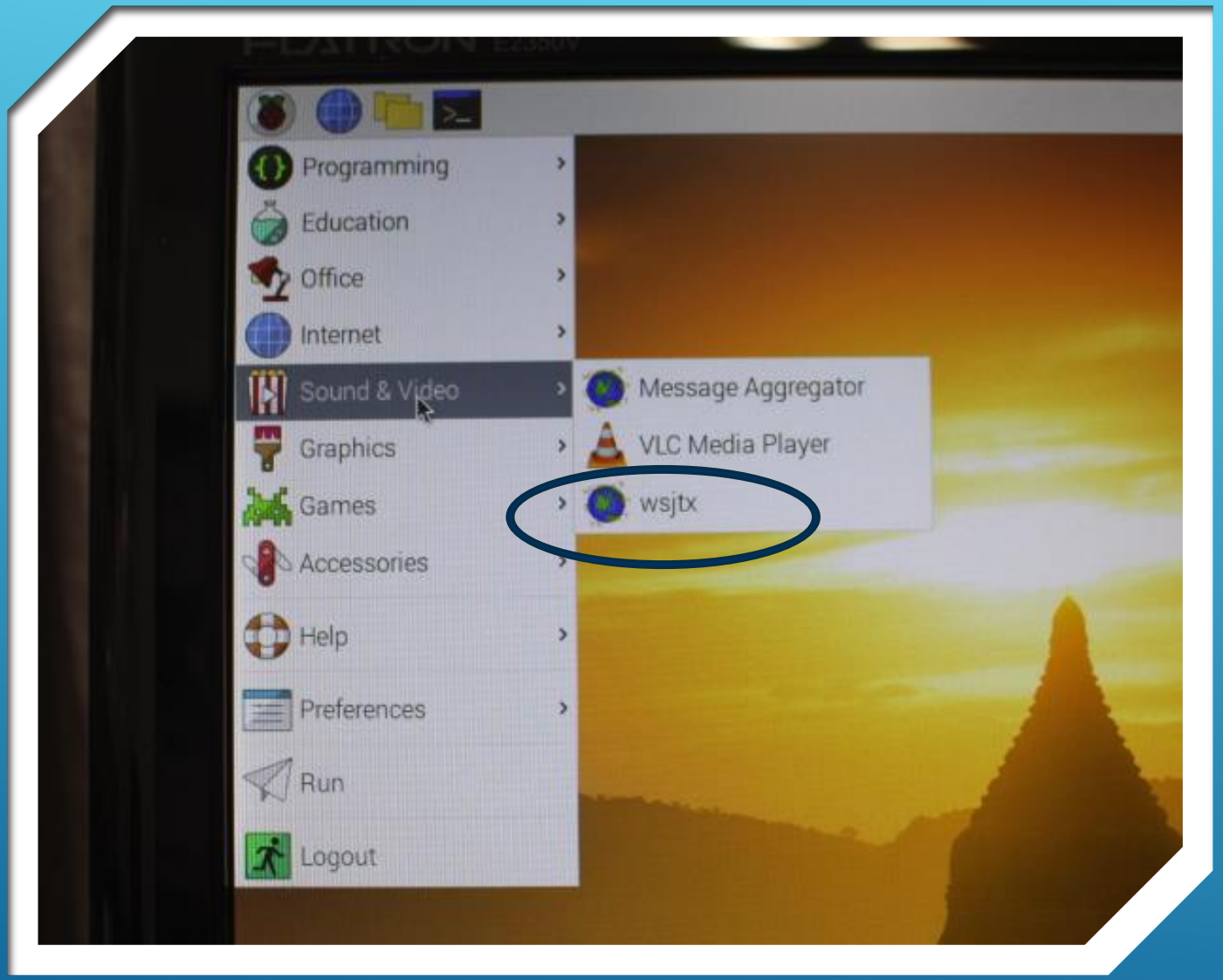
INSTALL WSJT-X

- You can now "X" or close out of Terminal Mode.
- WSJT-X should now be available on your device, ready to choose from the menu screen.
- Let's verify…
- Next slide…



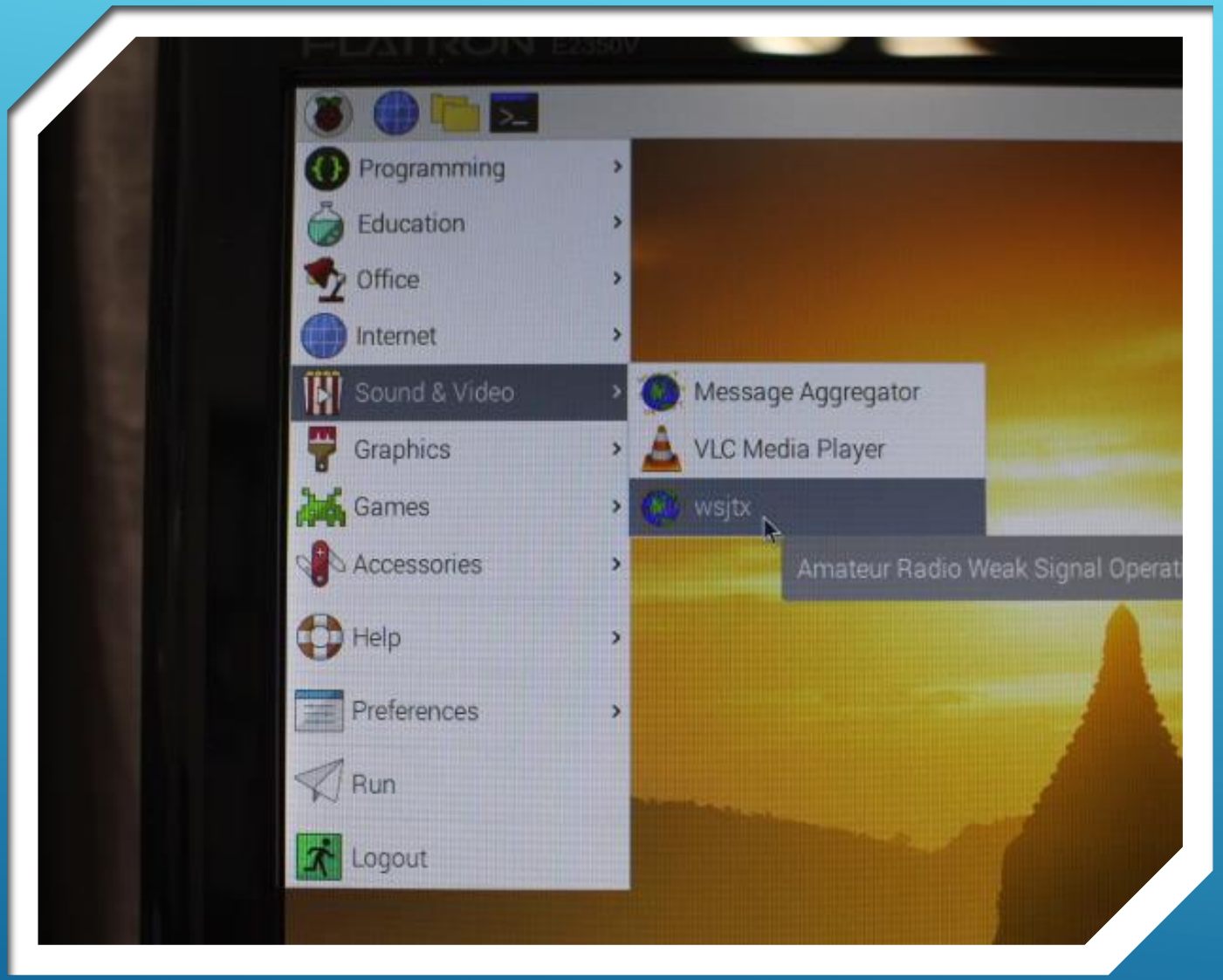
INSTALL WSJT-X

- **Open the Applications Menu**



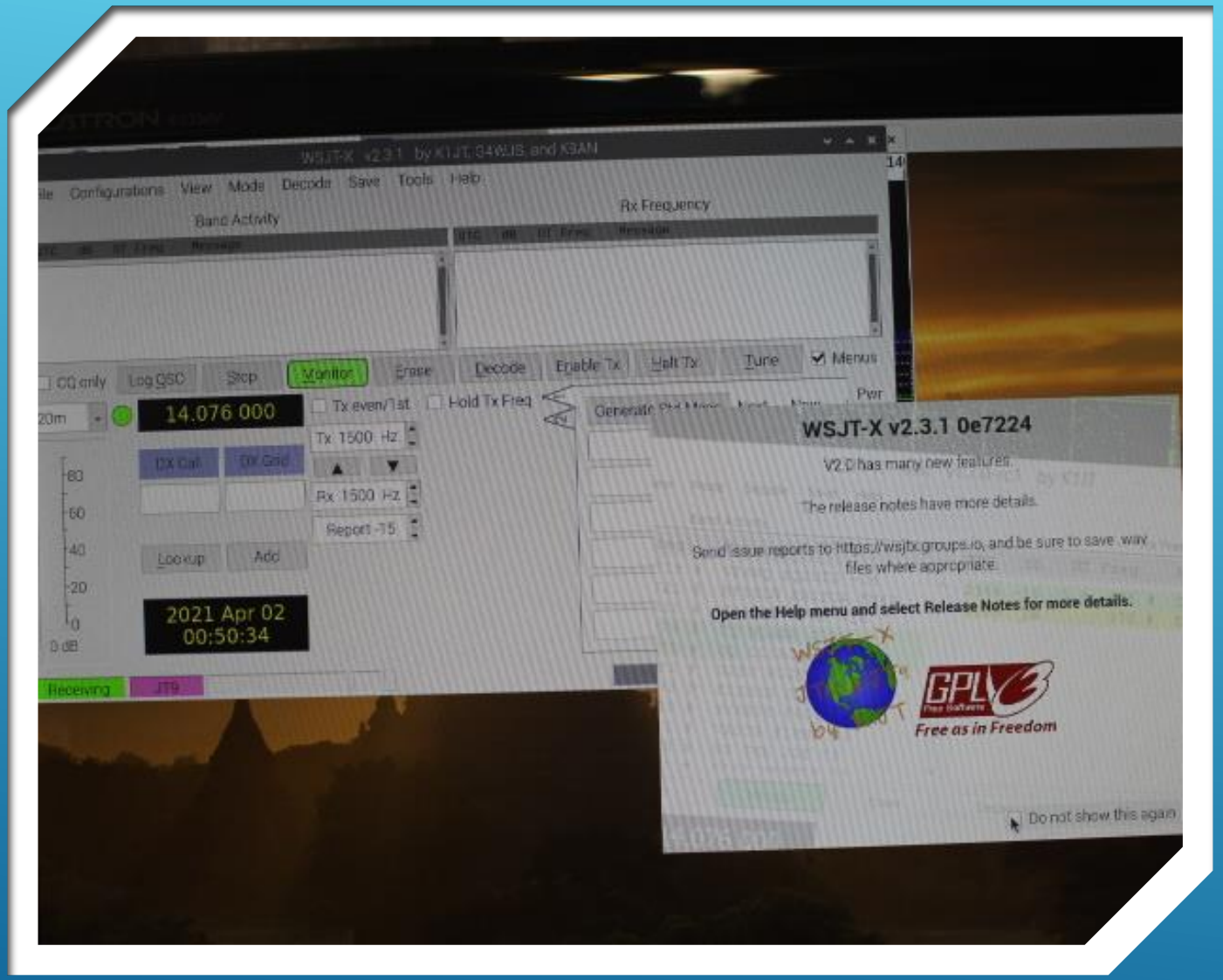
INSTALL WSJT-X

- **Select the “Sounds & Video” bar**
- **You should now to see the “wsjtx” menu option.**
- **This is where you will start up the program to use FT8 and other digital modes with your radio**



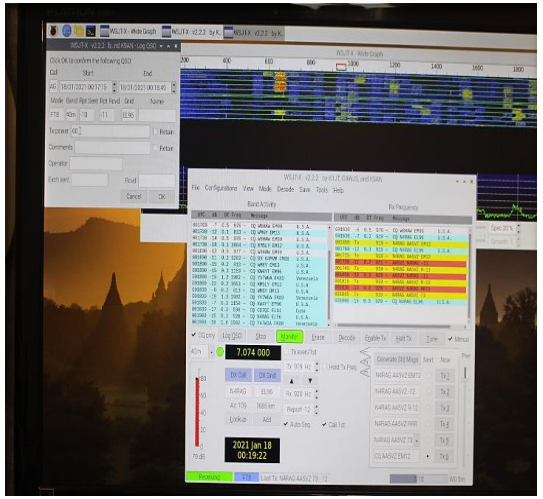
INSTALL WSJT-X

- **Click on the “wsjtx” icon.**



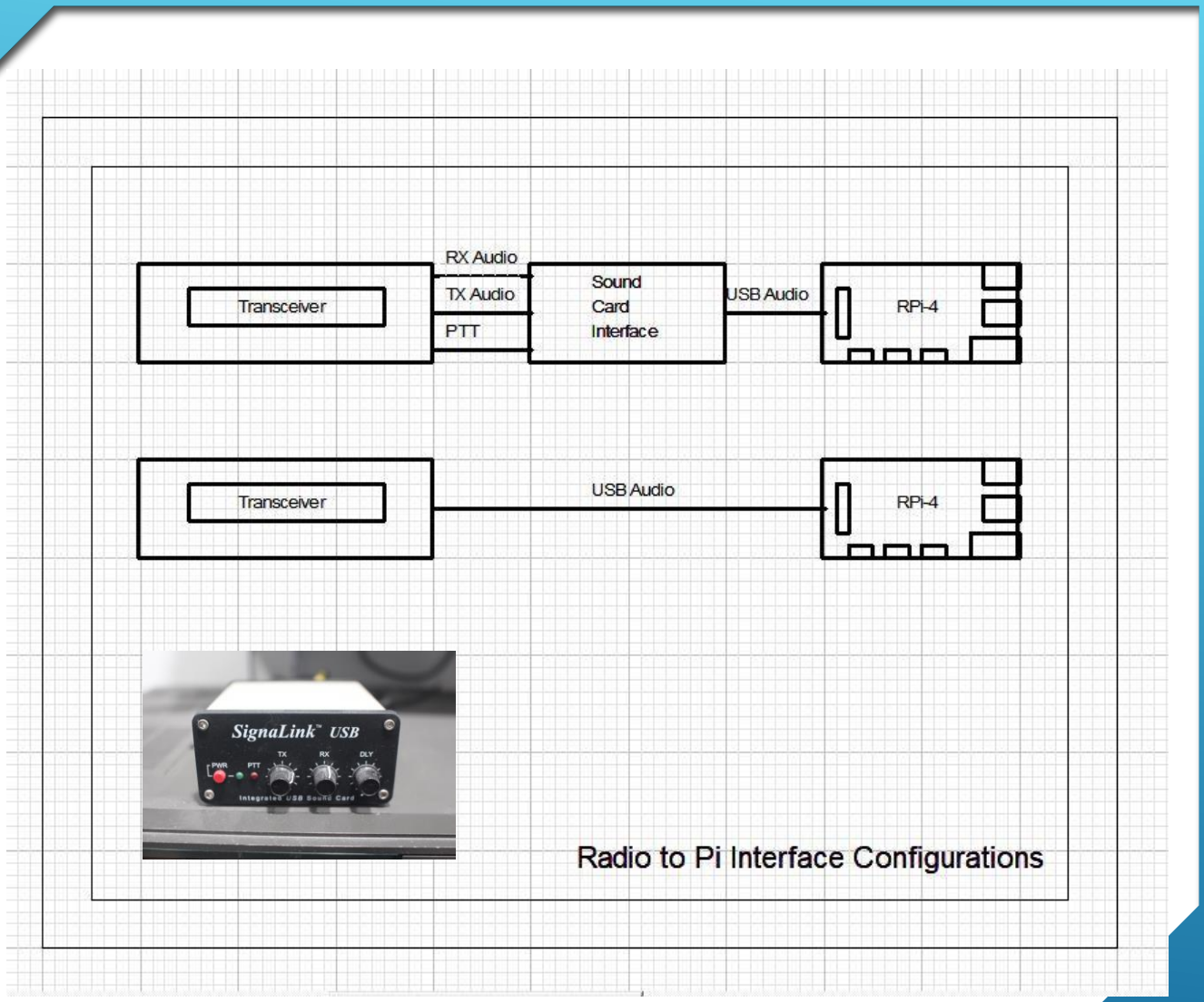
INSTALL WSJT-X

- The WSJT-X program should open.
- If it does, CONGRATULATIONS!
- This would be a great time to log-off, shut down and back up your SD Card.
- Take a break…You deserve it!
- We'll return later…



THE INTERFACE

- Install WSJT-X (FT-8, JT-65, and others)
- **Interface the Pi-4 to your Radio**
  - **Audio Sound Card**
  - **Direct (USB)**
- Configure the Apps
- Configure your radio
- Get on the Air
- Have Fun!



THE INTERFACE

- Top diagram
- Very common with older radios
- Uses a USB Sound Card Interface
  - Tx/Rx Audio + PTT connections to radio
  - USB Audio Connection to Rpi-4
- Example: Kenwood TS-940
- **********
- Bottom diagram
- Newer radios provide this type of connectivity
  - No Sound Card Interface Device
  - USB Direct Connection / Pi to Radio
- Example: Kenwood TS-590

THE INTERFACE

- Numerous products available by various manufacturers.
  - Tigertronics SignaLink
  - West Mountain Radio
  - Rig Expert
  - MFJ
  - others
- I currently use Tigertronics SignaLink USB which will be used for descriptive purposes here.

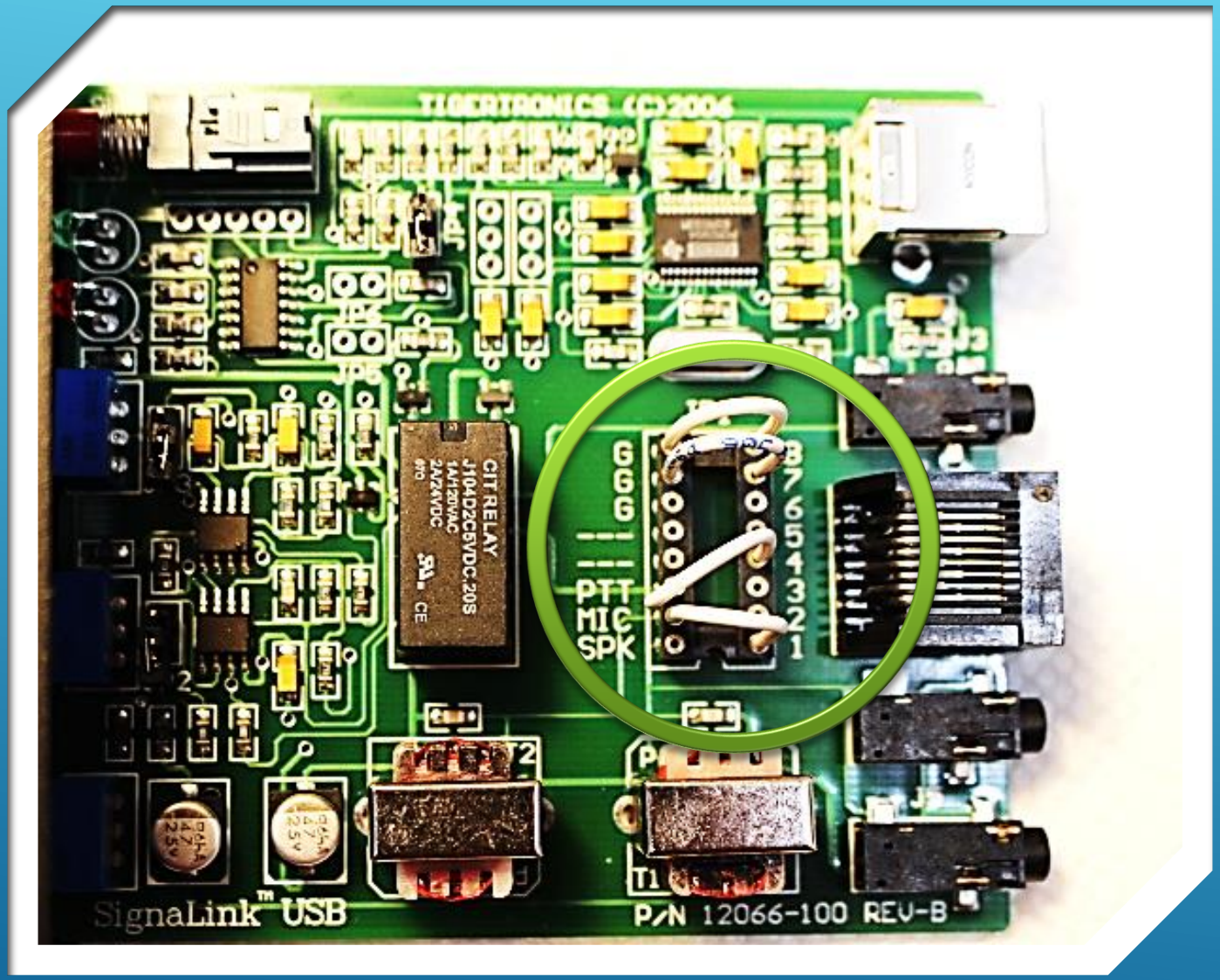
THE INTERFACE

- **Refer to device User Manual**
- **https://www.tigertronics.com/slusbmain.htm**

- **USB:**
- **Connects to USB on R-Pi**

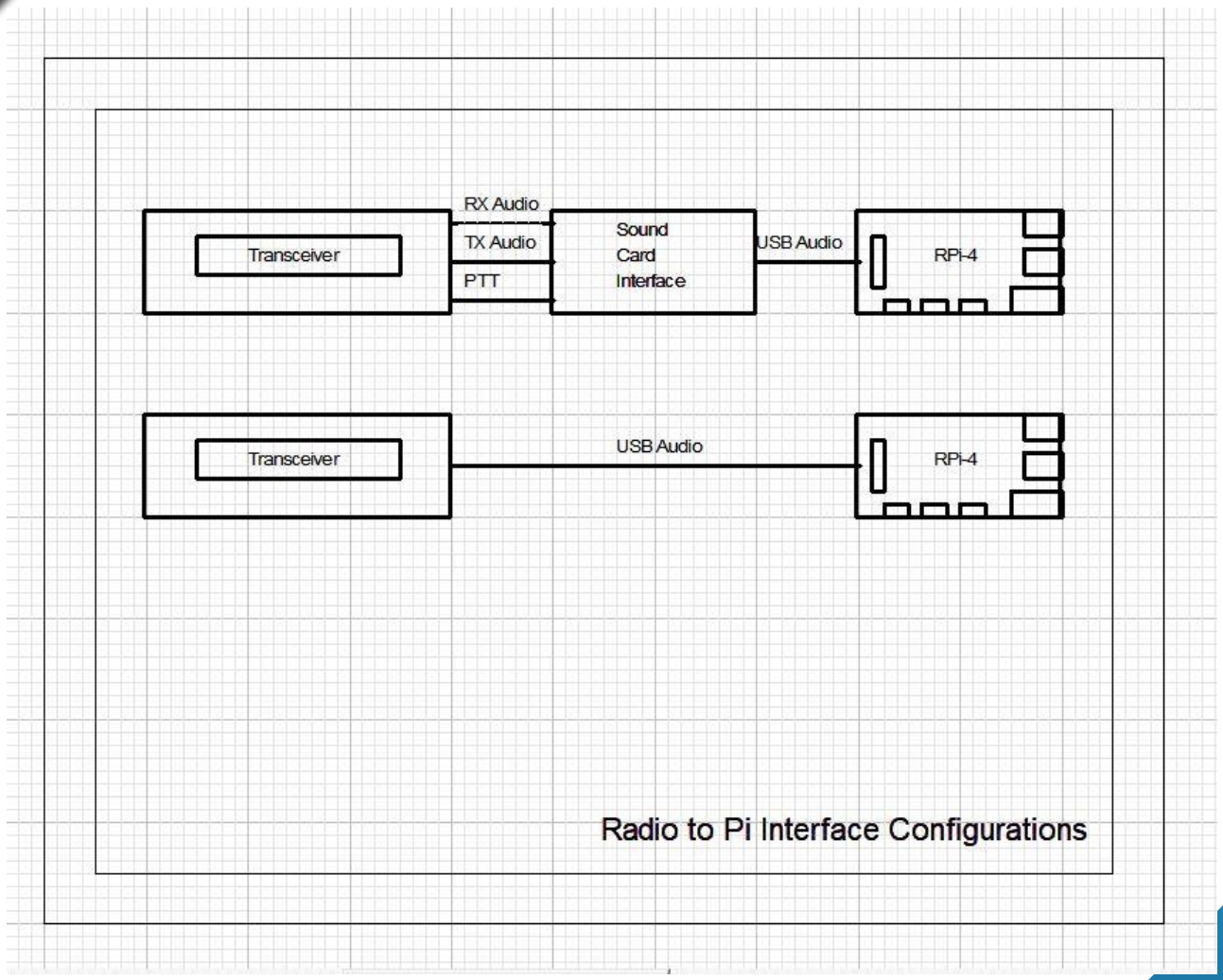
- **RADIO:**
- **Connects to Mic or ACC plug on radio**

- **SPKR:**
- **Connects to Ext. Spkr. or Audio Out on Radio**



THE INTERFACE

- **Refer to device User Manual**
- **https://www.tigertronics.com/slusbmain.htm**
- **Depending on the type of interface used it may be necessary to configure internal jumpers or add a jumper plug that conforms to the type of cable and radio you are using.**
- **This is the configuration I use for my Kenwood TS-940 radio.**



CONFIGURE THE RADIO FOR WSJT-X

- Decide on an interface method
- Top diagram:
- Very common with older radios
- Uses a USB Sound Card Interface
  - Tx/Rx Audio + PTT connections to radio
    - Uses Mic and Spkr. Connectors
    - or ACC connector
  - USB Audio Connection to Rpi-4
- Ex: Kenwood TS-940
- Bottom diagram:
- Newer radios provide this type of connectivity
  - No Sound Card Interface Device
  - USB Direct Connection / Pi to Radio
- Ex: Kenwood TS-590 / Icom IC-7300

- Refer to Instruction Manual for the Radio You are Using
- Connect USB Sound Card "Radio" Cable to Radio's MIC Input
- Connect USB Sound Card SPKR Cable to Radio's EXT SPKR
- Alt. Method – Connect USB Sound Card to your Radio's ACC connector using appropriate cable
- On Radio, ensure VOX is enabled
- Use TX and RX Controls on USB Sound Card in conjunction with microphone and speaker settings on your radio to establish "optimum" audio levels. This is a bit of a balancing act.

CONFIGURE A RADIO FOR FT8 USING SOUND CARD INTERFACE

- Typical settings for modern radios follow…
- Refer to Instruction Manual for the Radio You are Using
- Connect USB Cable from Rpi-4 to Radio USB Port
- Go to MENU settings
- Set Audio Input Line Selection to “USB”

CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION

- Refer to Instruction Manual for the Radio You are Using
- Set a USB INPUT LEVEL value for Data Communications

CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION

- Refer to Instruction Manual for the Radio You are Using
- Set a USB OUTPUT LEVEL value for Data Communications

CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION

- Refer to Instruction Manual for the Radio You are Using
- Set a USB VOX level for Data Communications use

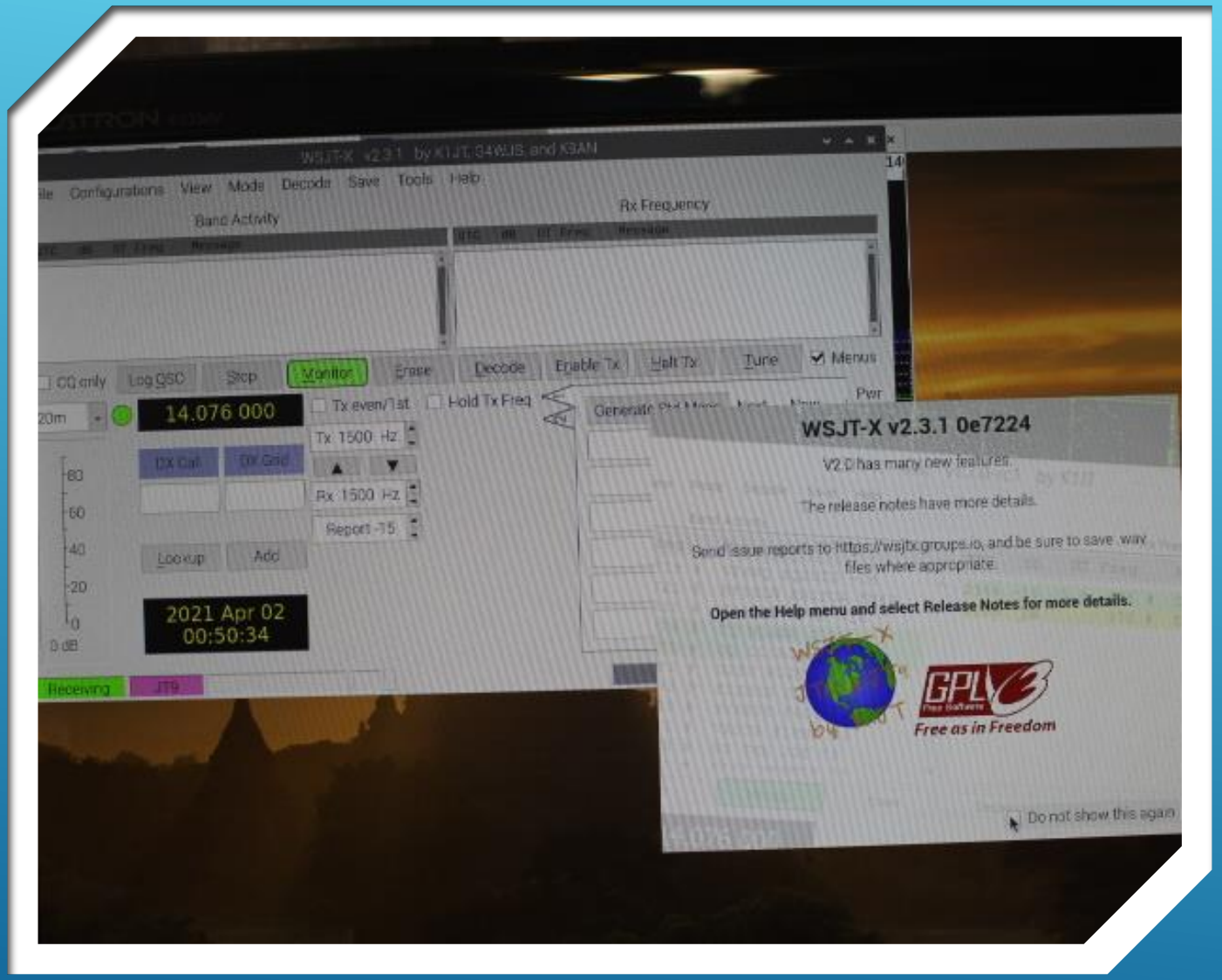
CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION

- Refer to Instruction Manual for the Radio You are Using
- Set the correct BAUD RATE for the radio USB Port

CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION

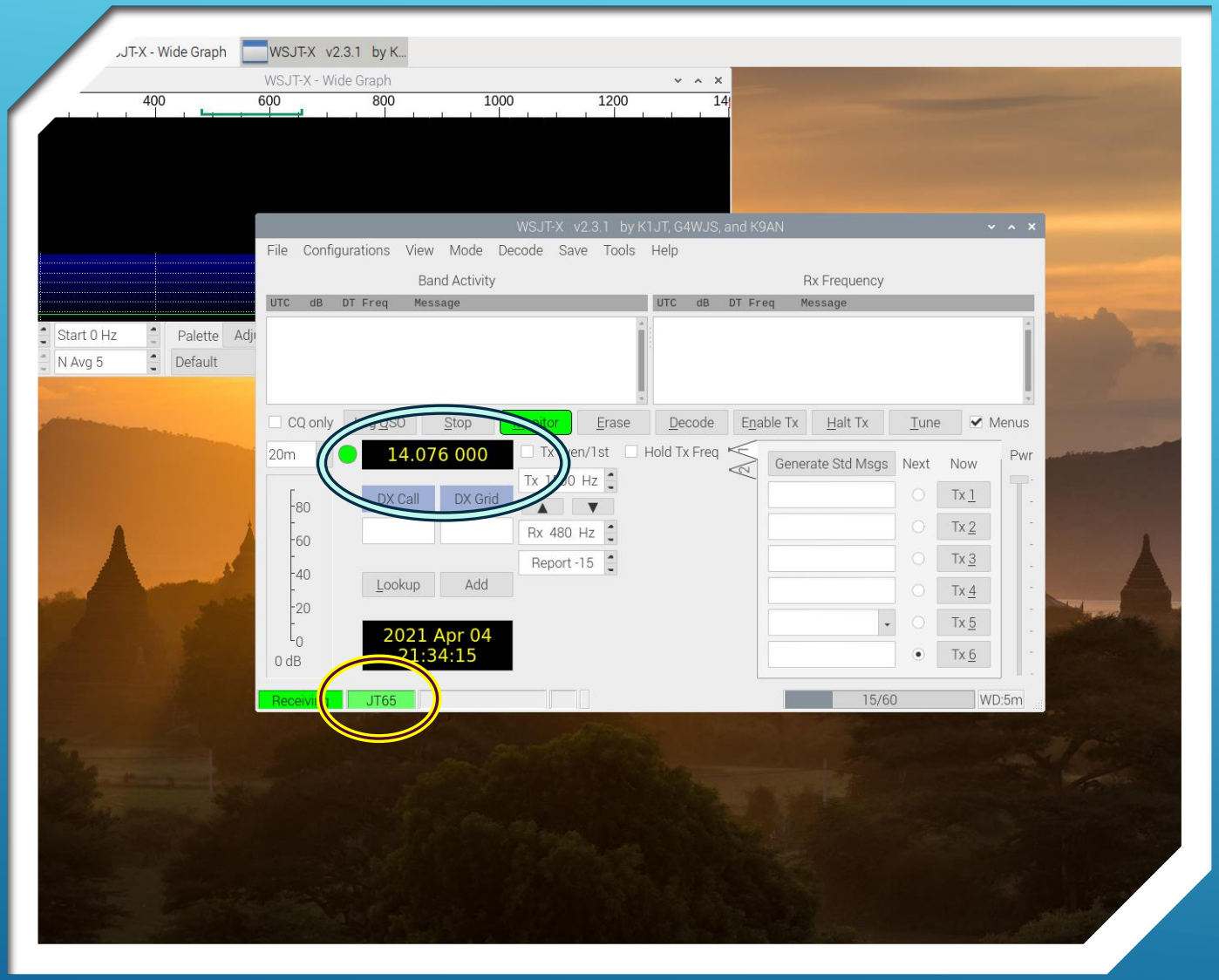
- Refer to Instruction Manual for the radio you are using.
- Be sure selected frequency for FT8 on radio and on the R-Pi WSJT-X control panel correspond.

CONFIGURE A RADIO FOR FT8 USING A DIRECT USB CONNECTION



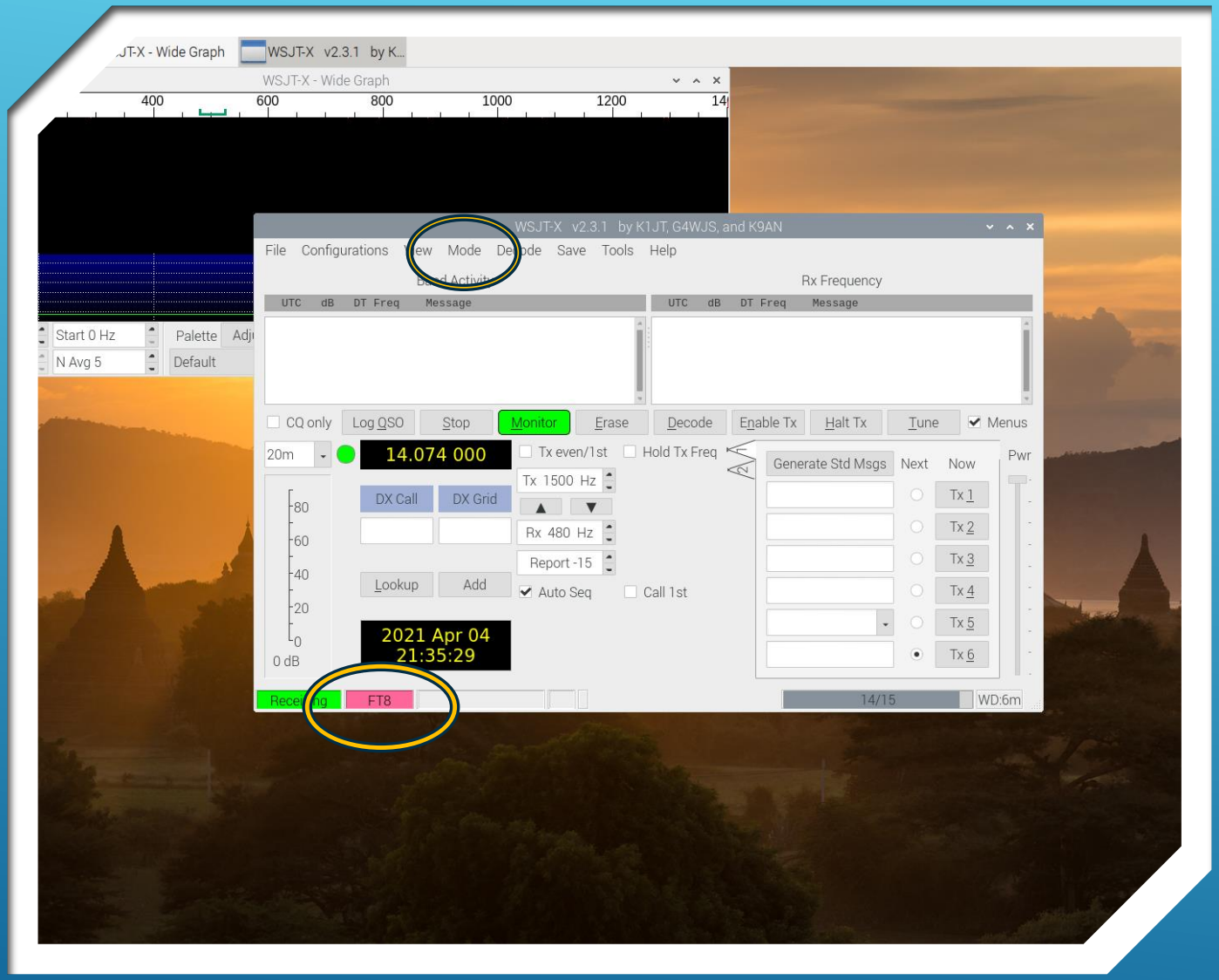
CONFIGURE WSJT-X FOR FT-8 OPERATION

- Connect Radio to R-Pi using appropriate Interface
- Use Dummy Load during initial configuration and testing
- Turn on Radio
- Start Up the Raspberry Pi
- Power Up the Sound Card Interface (if used)
- Open WSJT-X program
- Waterfall and Control Screens overlap.



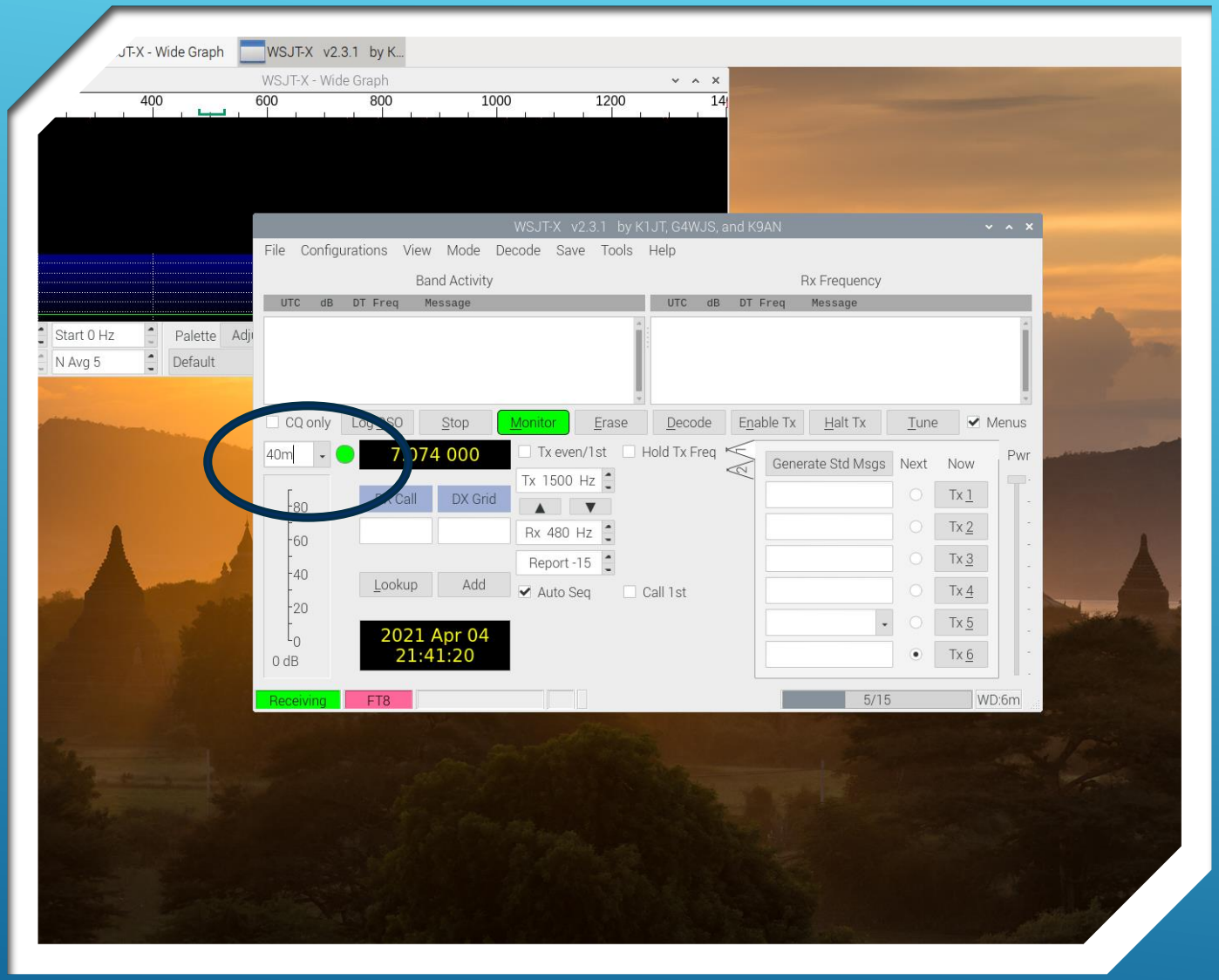
CONFIGURE WSJT-X FOR FT-8 OPERATION

- **Position windows accordingly for now.**
- **Program initially starts in JT65 mode, 14.076Mhz displayed.**



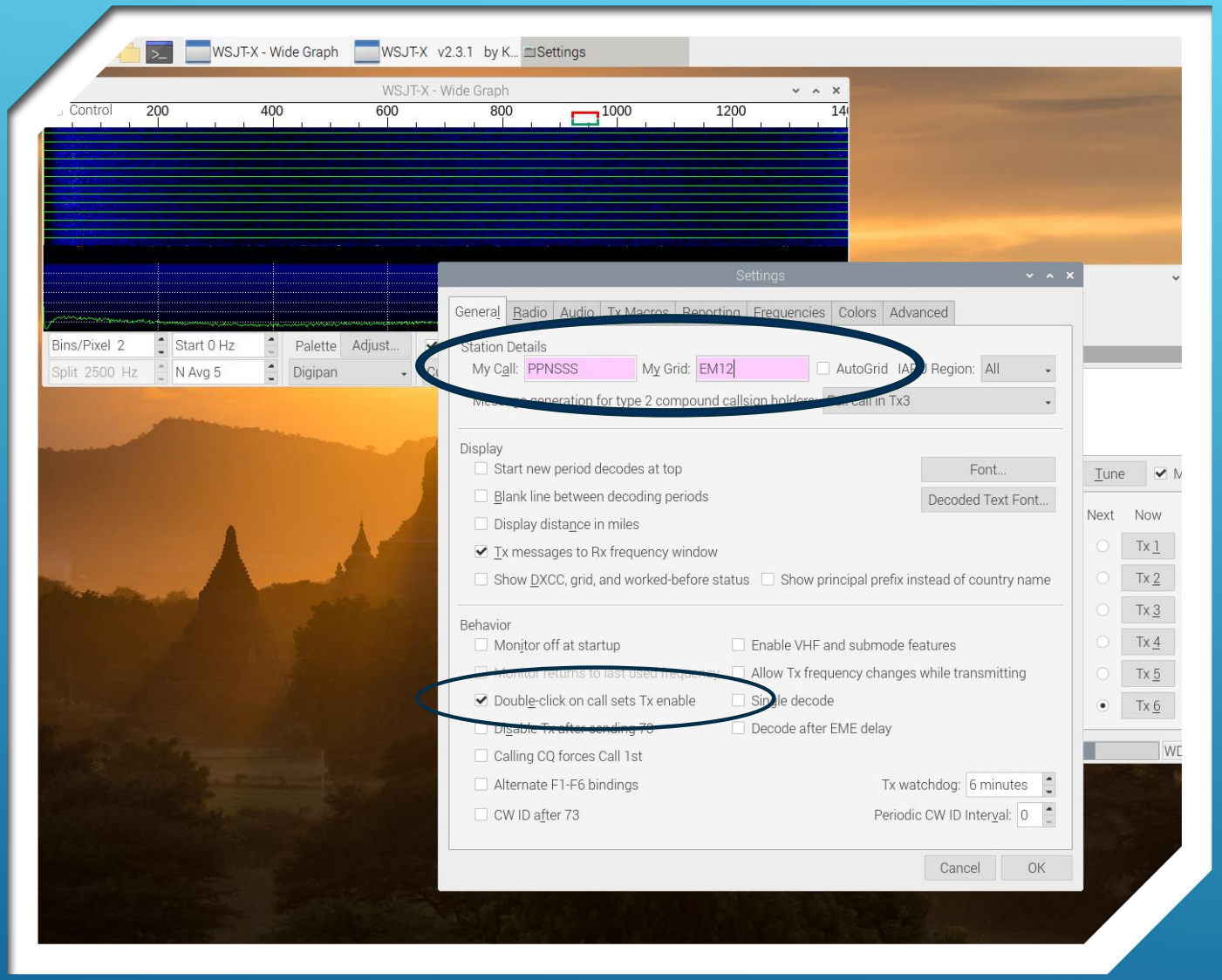
CONFIGURE WSJT-X FOR FT-8 OPERATION

- **Change operating mode by clicking “Mode” on menu tab, then select “FT8” from the drop-down list.**
- **Control screen is now set to FT-8 mode with corresponding frequency (14.074 MHz) for the band indicated (20m).**
- **Once set, program will always re-open to the mode and band used last.**



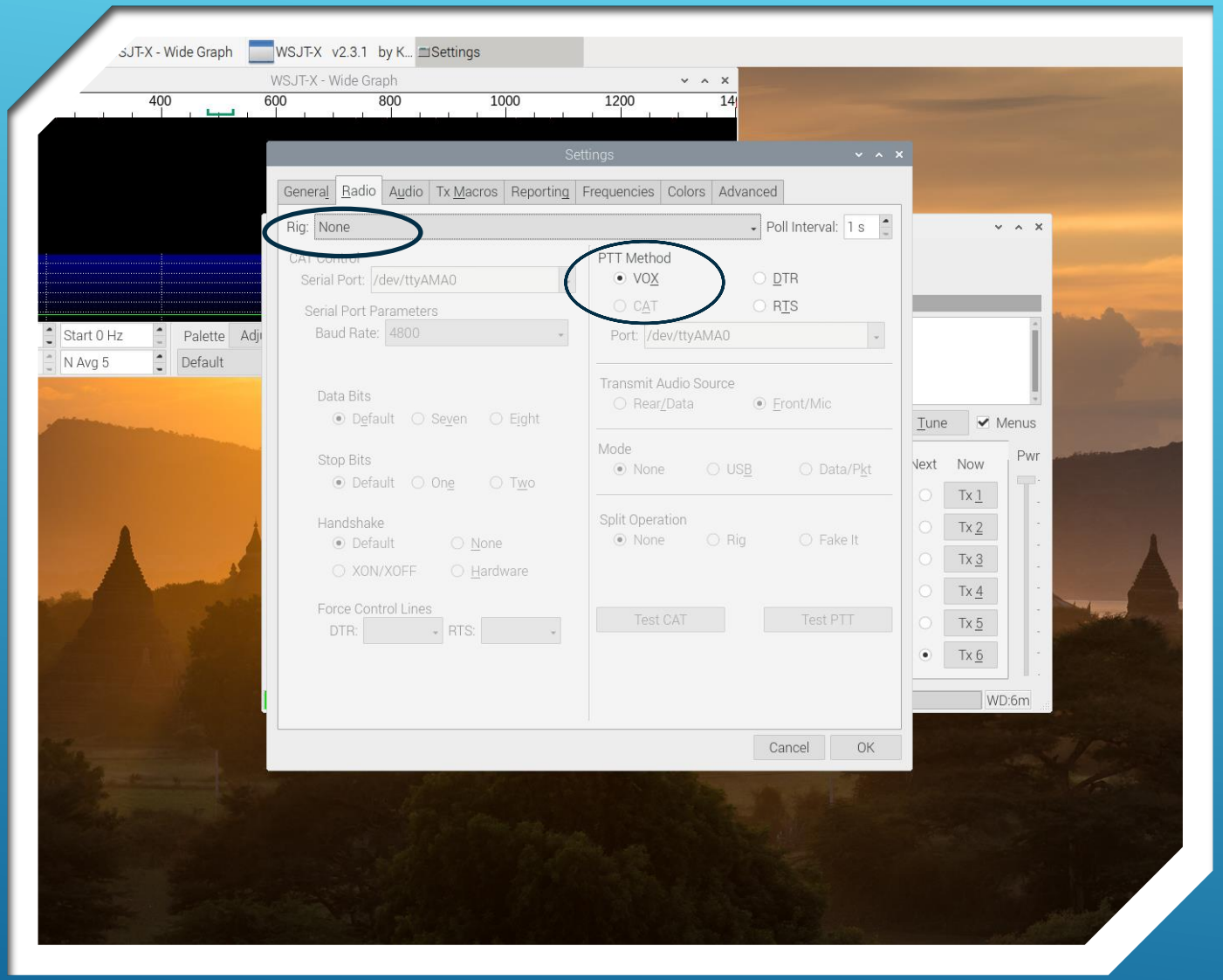
CONFIGURE WSJT-X FOR FT-8 OPERATION

- To change the WSJT operating band, click on the band selection arrow and select the desired operating frequency from the list.
- The new operating band and corresponding operational frequency will be indicated.
- NOTE: You must separately adjust the controls on your radio to transmit and receive on the band and mode operating frequency you plan to use. The configuration settings discussed here are the "matching" modes and frequencies the WSJT program uses to operate and log your FT-8 contacts.
- Advanced rig control features are available within WSJT but will not be attempted here.



CONFIGURE WSJT-X FOR FT8

- **Download and Consult the WSJT-X program manual for detailed instructions.**
- **Open the WSJT-X program.**
- **Under the File Menu go to Settings**
- **Note: Click OK in each tab window to save settings for the selected tab.**
- **Under the General Tab enter your Call Sign and Grid location (EM12 in DFW area).**
- **In the "Behavior" section click the box, "Double-click on call sets Tx enable".**
- **Under the Radio Tab select None for Rig and VOX for PTT method.**
- **Under the Audio Tab select an applicable audio source for Input and Output.**
  - **For straight USB connection or SignaLink USB Sound Card I use sysdefault:CARD =CODEC for both.**
- **Under Colors Tab select colors you want to use to display various information.**
- **Under Advanced Tab select Two-pass Decoding**



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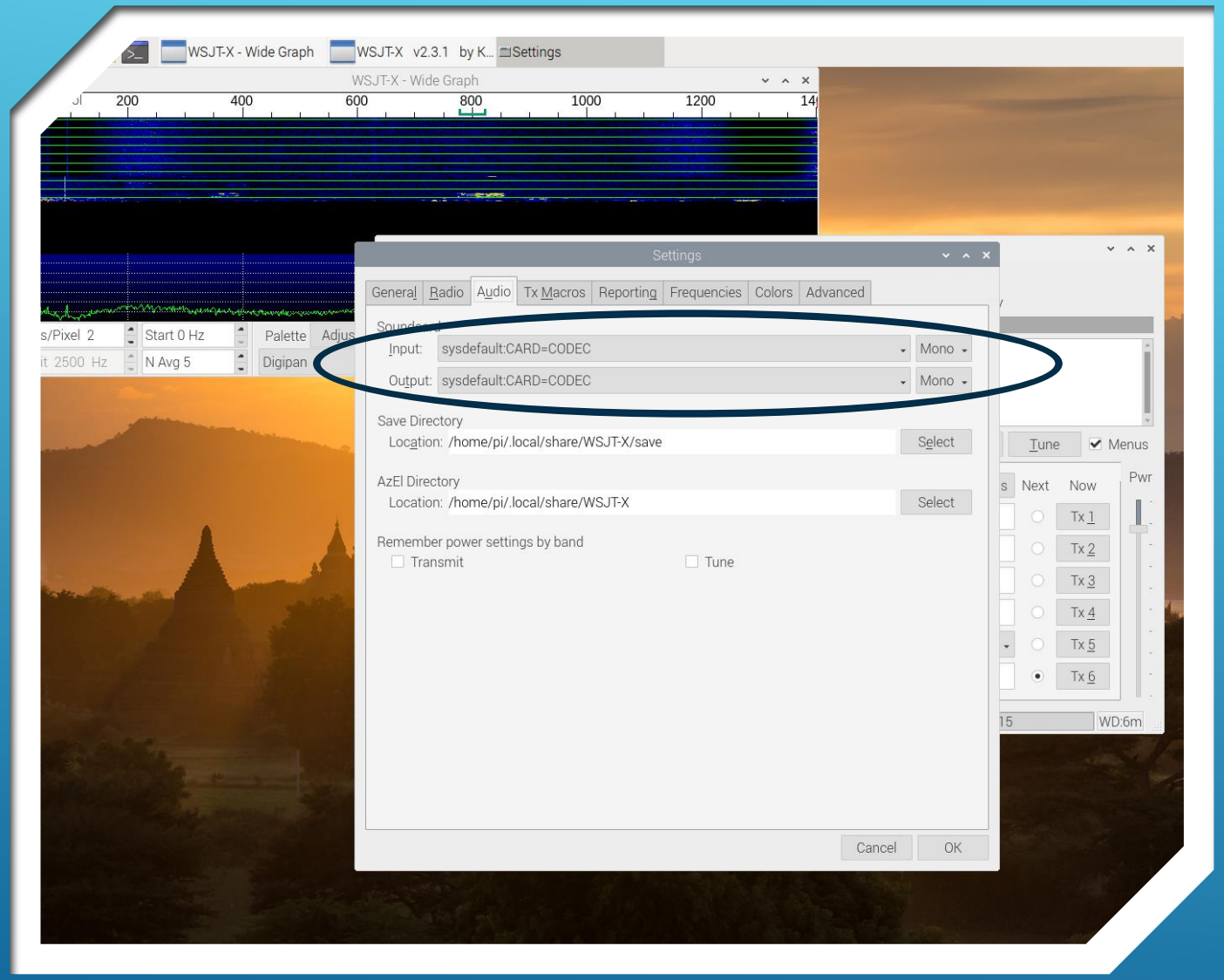

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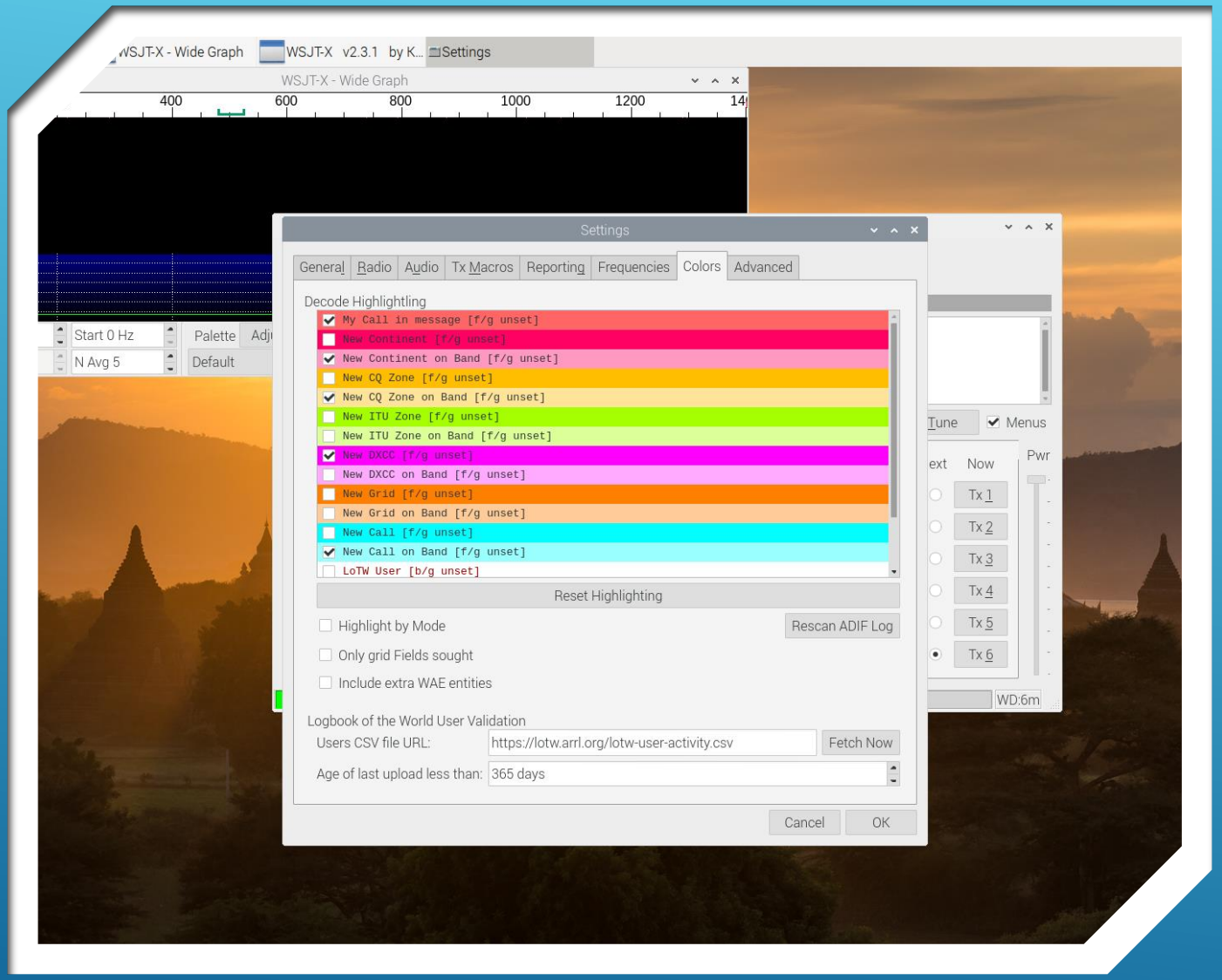

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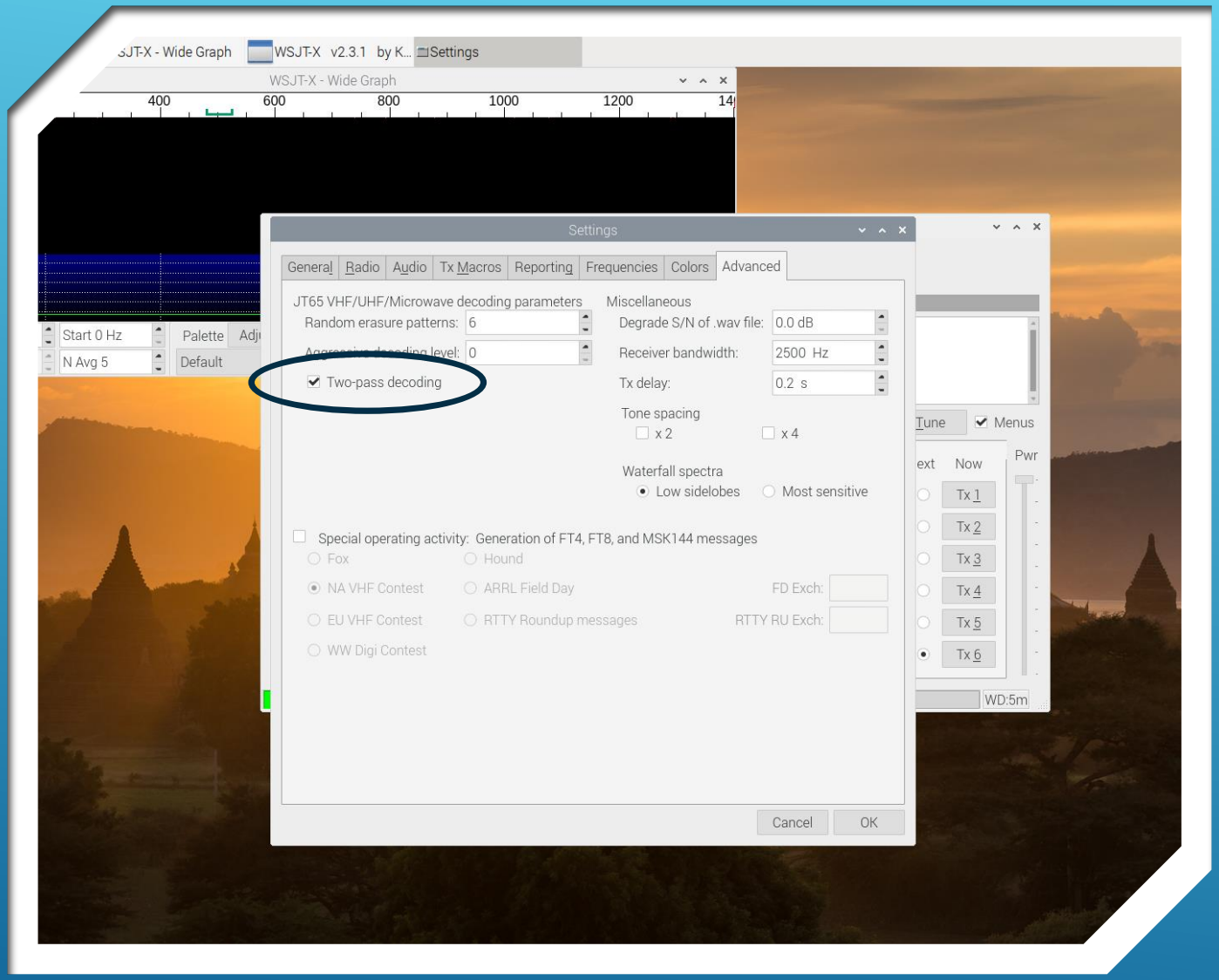

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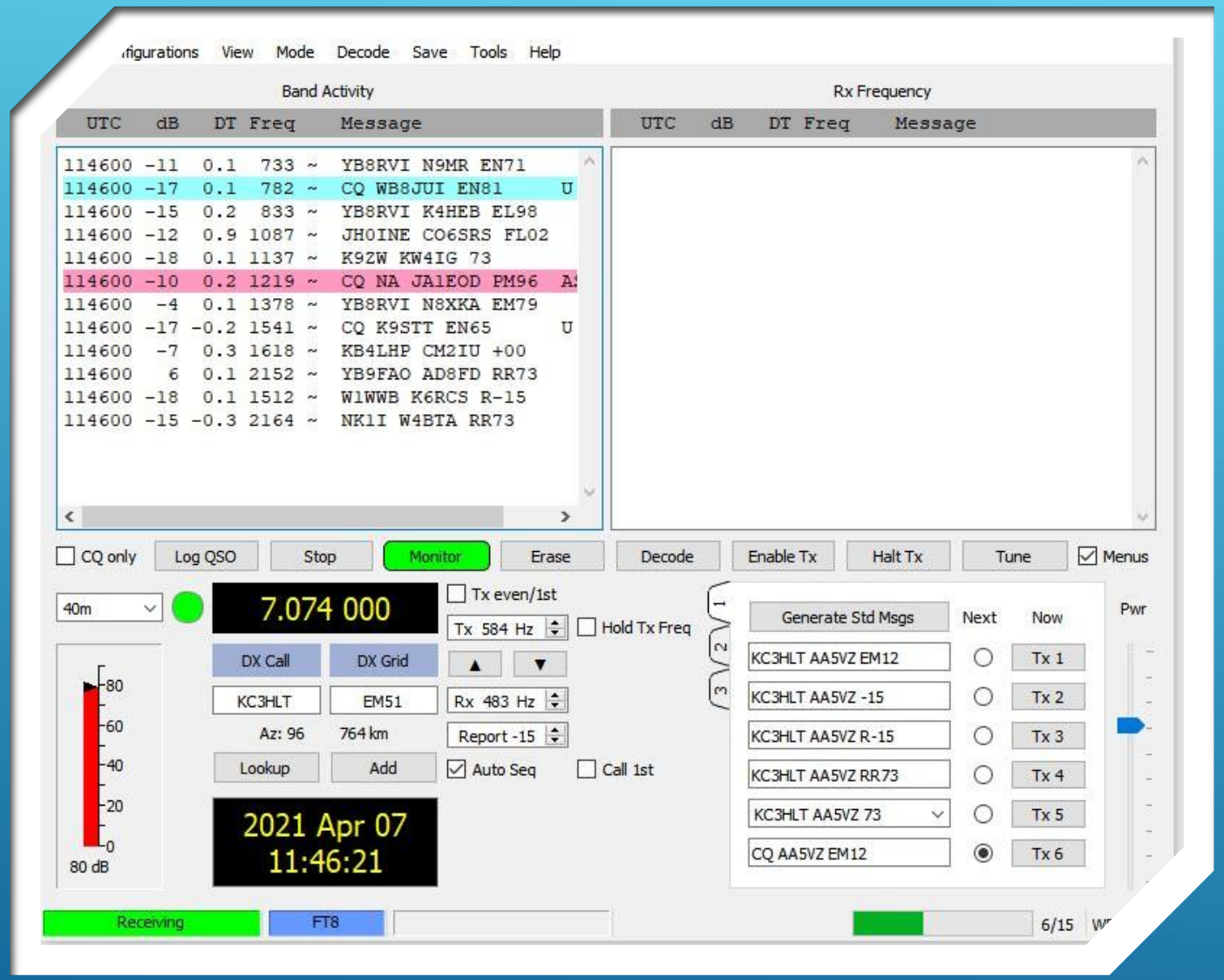
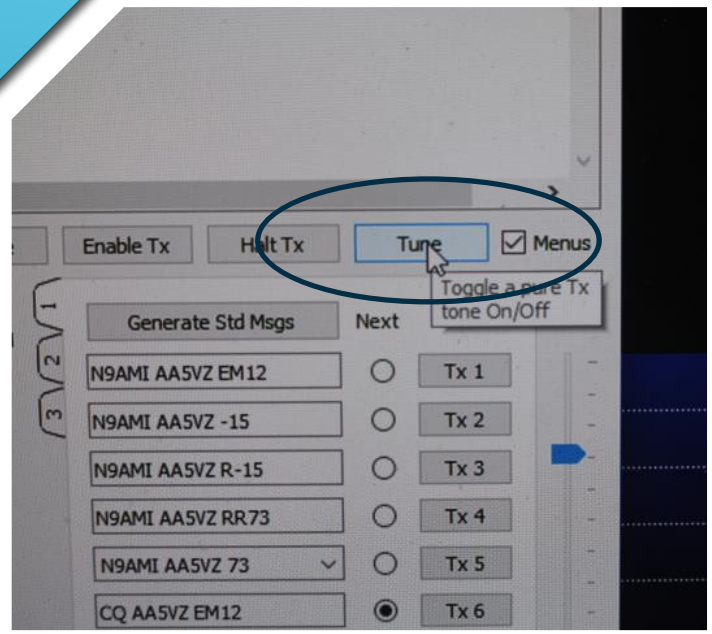


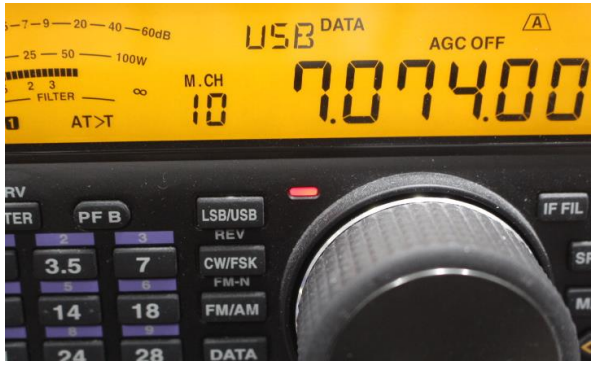
CONFIGURE WSJT-X FOR FT8

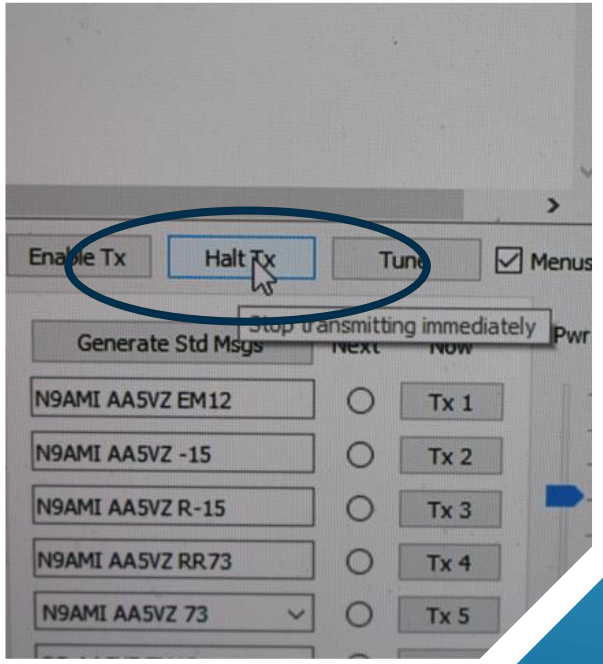
- Download and Consult the WSJT-X program manual for detailed instructions.
- Connect Radio to an Antenna
- Ensure Radio, Raspberry Pi and Interface (if used) are all powered “ON”.
- Open the WSJT-X program.
- Ensure Radio is tuned to the FT8 base frequency for the band you will be using, and that the WSJT-X band frequency and mode selection indications match. In this case we are using 40m (7.074.000 Mhz).
- If everything is connected and configured correctly, you should be able to see activity in the “Band Activity” window.
- If activity is indicated on the screen, proceed to test the transmit functions. (Next slide).

CONFIGURE WSJT-X FOR FT8

- The buttons shown will be used to test the Transmit feature of the Raspberry Pi, Interface and Radio connections.
- Proceed to next slide…



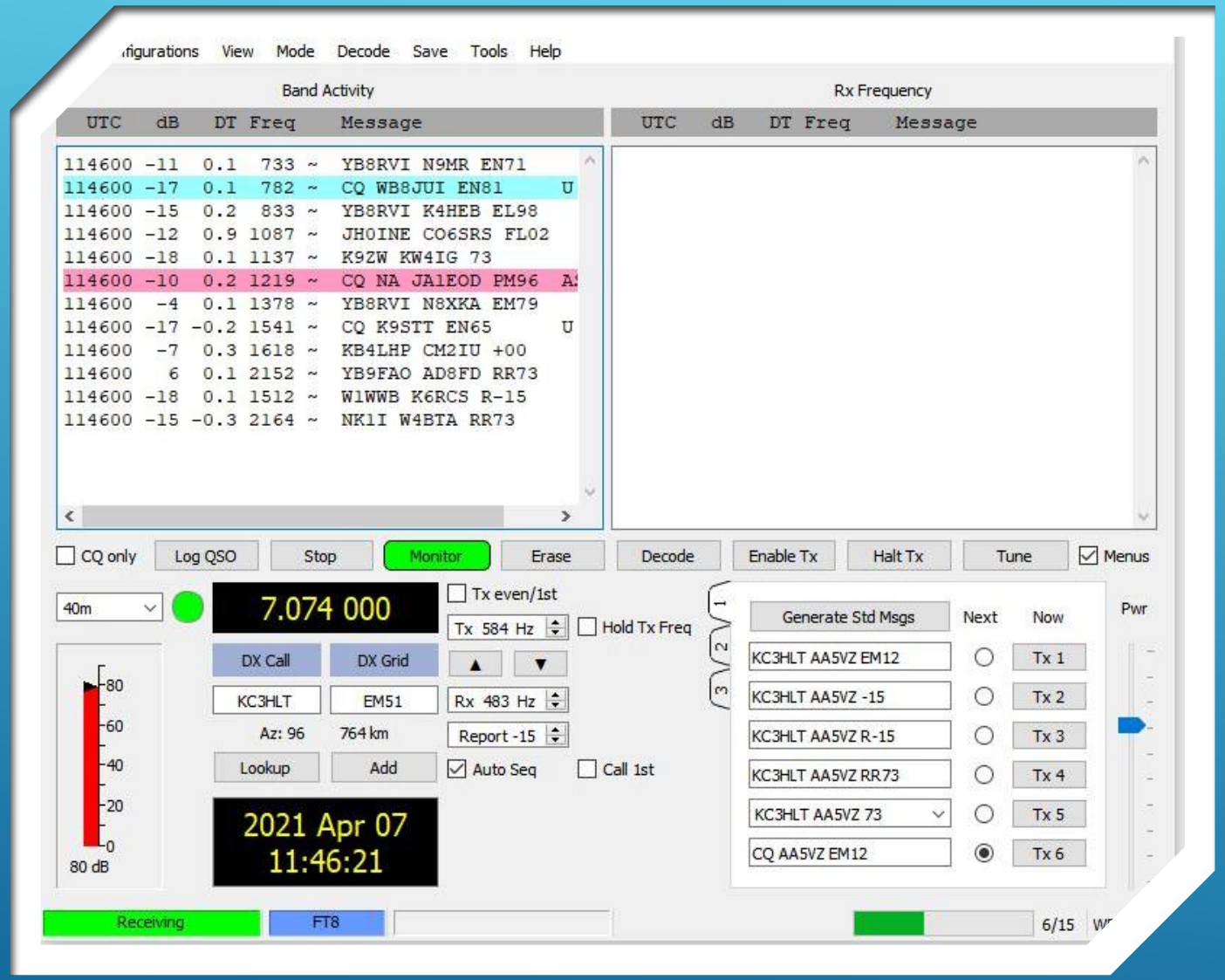




"ON-AIR" TEST

- **IMPORTANT: Use a Dummy Load when performing this test so as to NOT interfere with ongoing Amateur Radio communications.**

- Test "Transmit" mode:
- Click the "Tune" Button
- Radio should enter "TRANSMIT" mode.
- Click "Tune" Button again (or Halt Tx)
- Radio returns to "RECEIVE" mode

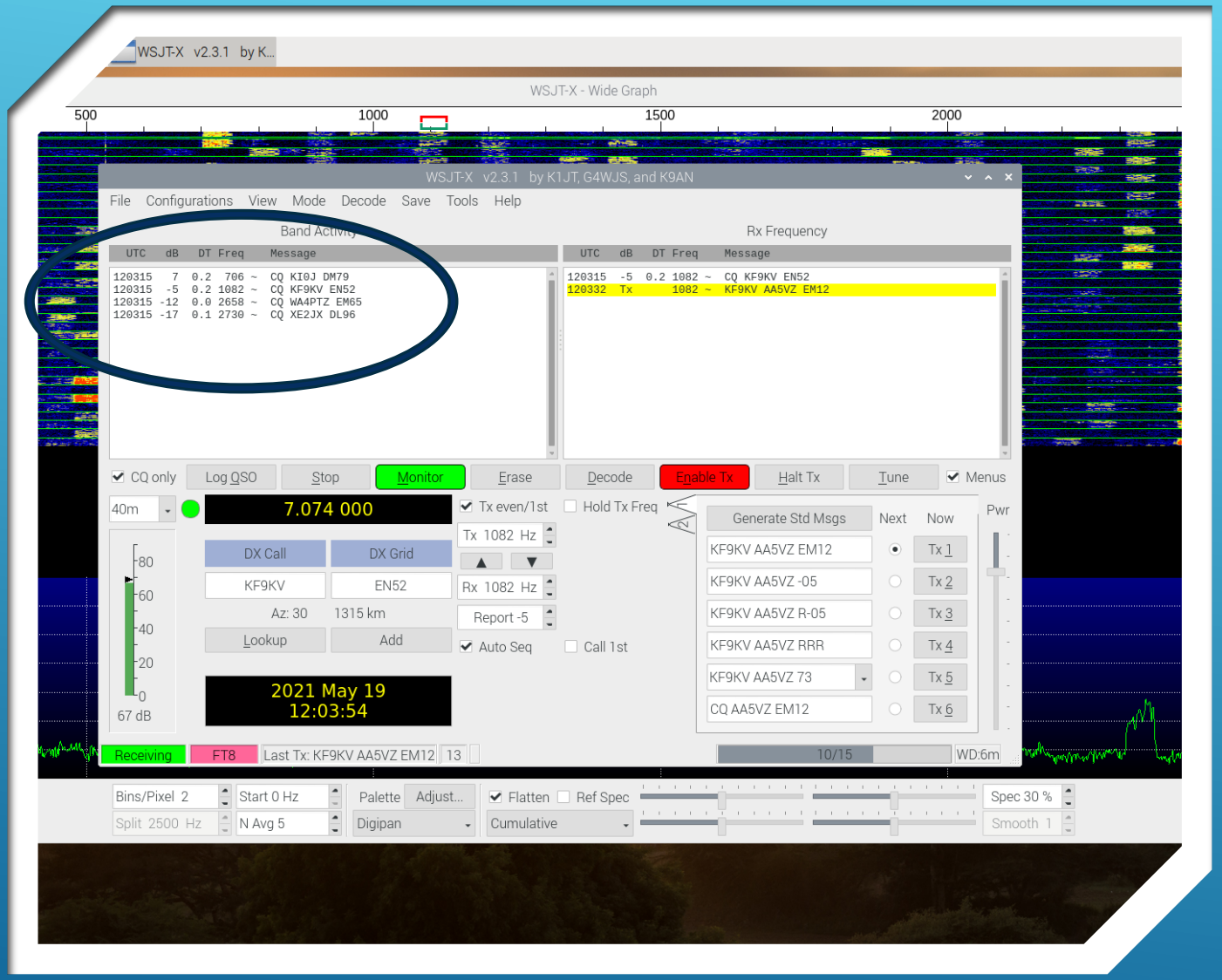


CONFIGURE WSJT-X FOR FT8

- Download and Consult the WSJT-X program manual for detailed instructions.
- Connect Radio to an Antenna
- Ensure Radio, Raspberry Pi and Interface (if used) are all powered “ON”.
- Open the WSJT-X program.
- Ensure Radio is tuned to the FT8 base frequency for the band you will be using, and that the WSJT-X band frequency and mode selection indications match. In this case we are using 40m (7.074.000 Mhz).
- If everything is connected and configured correctly, you should be able to see activity in the “Band Activity” window.

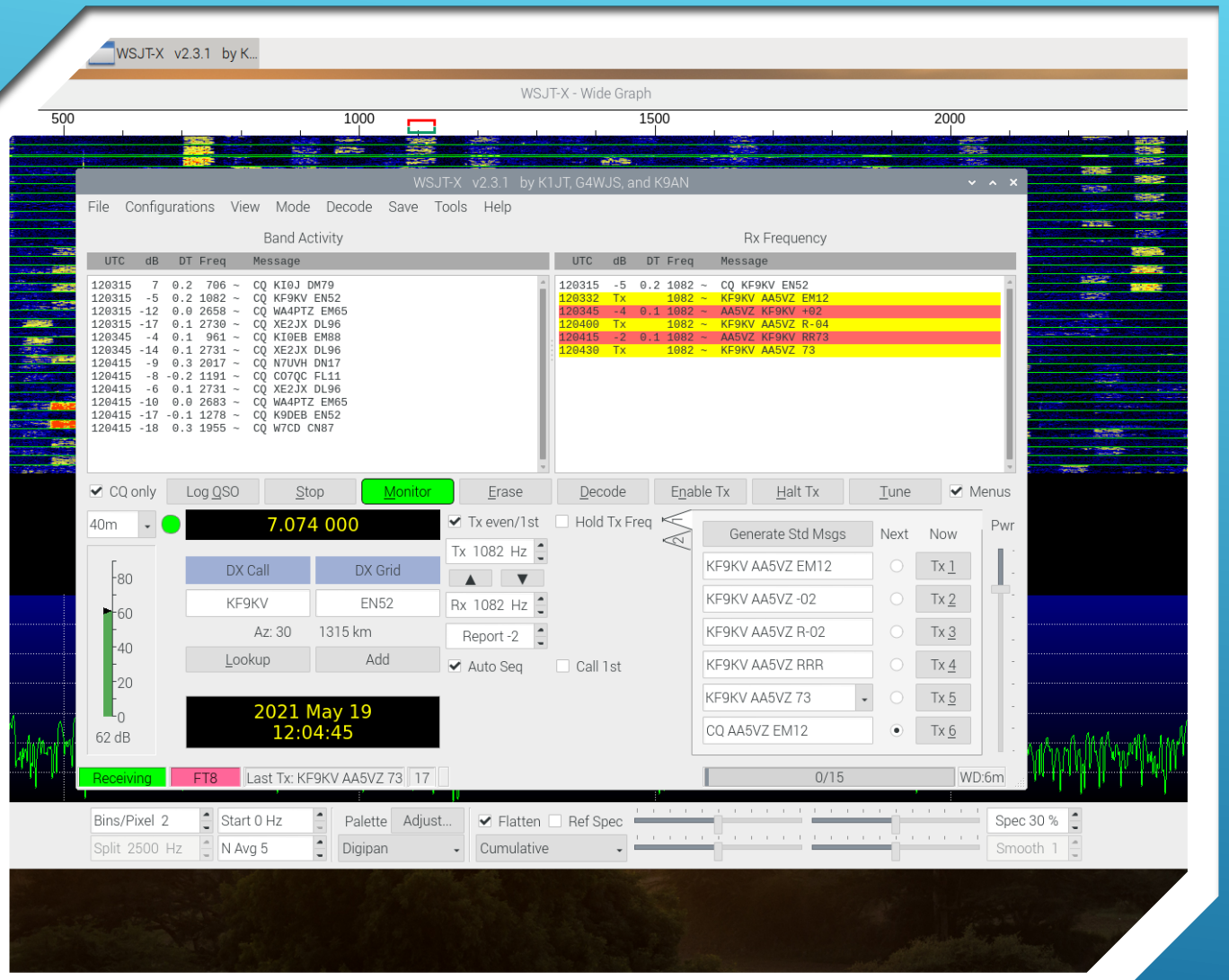
GET ON THE AIR

- Consult the WSJT-X program manual for detailed instructions.
- On the WSJT-X Dashboard, “check” the box “CQ only”.



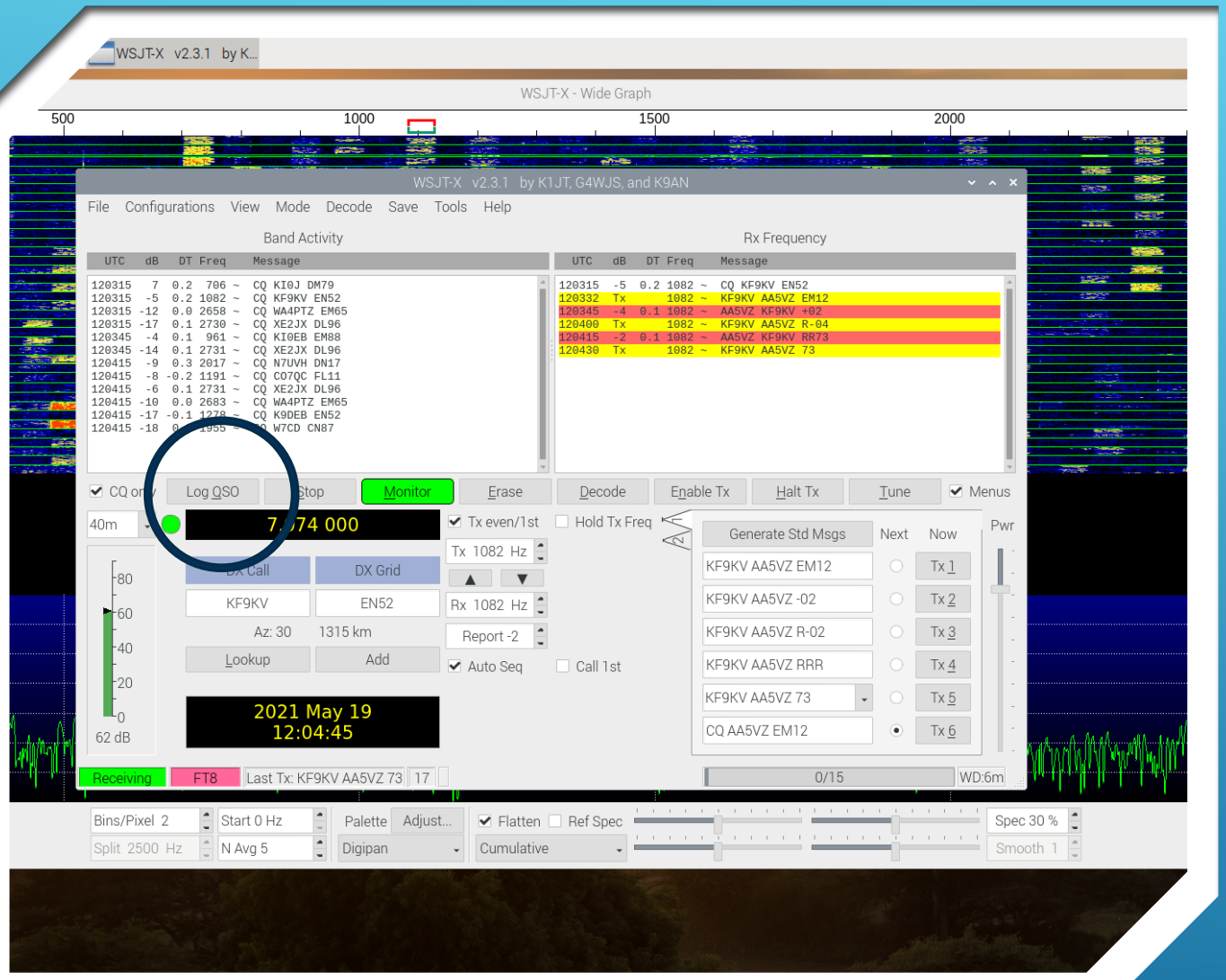
GET ON THE AIR…

- **Only stations calling “CQ” will be displayed in the “Band Activity” window.**
- **“Double-click” on the callsign you wish to call.**
- **The “Yellow” line indicates the message you are transmitting to the station you selected.**



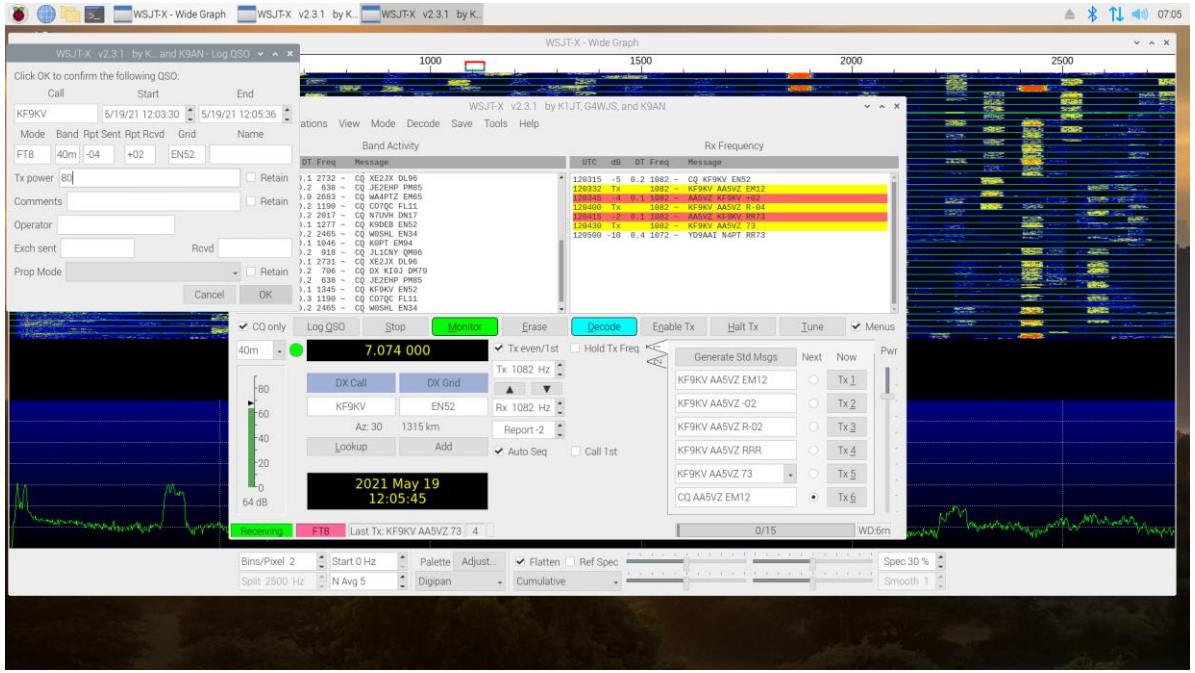
GET ON THE AIR… HAVE FUN!

- Consult the WSJT-X program manual for detailed instructions.
- The “Yellow” line indicates the message you are transmitting to the station you selected.
- The subsequent “Red” line indicates station called heard you and is calling you back.
- The remaining messages cycle automatically until the QSO is completed (when both stations have sent “73” in their message.
- At this point you can log the QSO and work another station.
- YOU DID IT! CONGRATULATIONS!



LOGGING THE QSO

- **Consult the WSJT-X program manual for detailed instructions.**
- **Click on the "LOG QSO" Button**

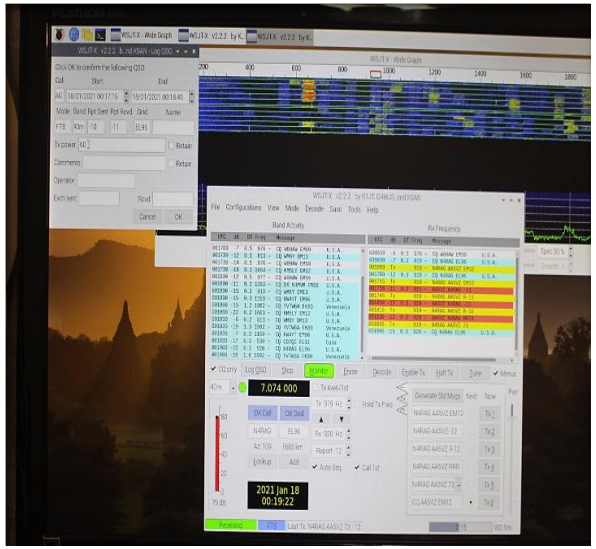


LOGGING THE QSO

- Consult the WSJT-X program manual for detailed instructions.
- Basic Information about the QSO is already pre-populated on the form.
- Enter additional information you want to record such as station power or any other comments
- Click the “OK” Button
- That’s all there is to it.
- Congratulations!

GETTING STARTED…

MOVING FORWARD



- **Assemble a Raspberry Pi-4 Workstation**
- **Load the base Operating System (O/S)**
- **Install and Configure Ham Radio Apps**
- **Interface the Pi with your Station**
- **Get on the Air!**

REFERENCES

1. Link to configure WSJT-X for operation with Icom IC-7300
https://www.k0pir.us/icom-7300-wsjt-x-ft8-easy-way/

2. WSJT-X Home Page

3. https://www.tigertronics.com/slusbmain.htm

4. www.google.com

5. www.youtube.com

QUESTIONS OR TESTIMONIALS?

GETTING STARTED USING RASPBERRY PI IN THE SHACK (PART 2)

Jack Weaver – AA5VZ