How to Install the Grape Gen 1E OS Image and Use It

update by
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Ver 1.05

1 - Download the OS image file from the HAMSCI Google Drive:

https://drive.google.com/open?id=1YE5UjQknnhuRUq4Y86czhxbIwzUWbgbn&authuser=frissell%40vt.edu&usp=drive_fs

If you have high speed internet download, get the full uncompressed image

Grape1_OSGen1E.img (13.9GB)

or if not, the compressed image

Grape1_OSGen1E.zip (8.21GB)

The file Grape1_OSGen1E.cksums contains all the checksum info for these files.

2 - Verify the downloaded image using the SHA256 checksum
(under MintLinux 20.1 -> "gtkhash", MACOS -> "shasum -a 256 Grape1_OS_Gen1E.img")
and make sure the sha256 numbers match

If you downloaded the compressed image, verify the .zip image and when you unzip it you can also verify it just as before using the uncompressed sha256 checksum number.

3 - Get the program BalenaEtcher and install it on your computer:
https://balenaetcher.eu/

4 - Obtain at least a 32 or 64 GB uUSD flash drive and insert into appropriate USB adapter into your computer's USB port

For uSD flash cards, I recommend:

32G: Samsung PRO Endurance 32GB 100MB/s (U1)
https://www.amazon.com/gp/product/B07B98GXQT/ref=ppx_yo_dt_b_asin_title_o03_s00?ie=UTF8&psc=1

64G: Samsung PRO Endurance 64GB 100MB/s (U1)
https://www.amazon.com/gp/product/B07B9KTLJZ/ref=ppx_yo_dt_b_asin_title_o04_s00?ie=UTF8&psc=1

I have found the el-cheapo flash drives (like the Red/White & Gray/White SanDisk, etc) usually die in ~6 weeks with the constant writing to them. YOU HAVE BEEN WARNED!

5 - Start up Balena Etcher and point to the Grape1_OS_Gen1E.img file and then to the 32GB (or 64GB) uSD flash drive and start the write process.
It will completely write and verify the image to the drive.

6 - When done, remove the uSD card from the computer, then from the USB holder and insert it into the uSD socket on the RasPi4B that will become the Grape1 PSWS.

7 - Attach a HDMI monitor (that can do 1920 x 1080) to the uHDMI port right next to the power port on the RasPi (facing the side of the RasPi, it's the 2nd connector from the left side). Also attach a mouse/Keyboard to the RasPi USB connector(s). I recommend the wireless Logitech MK120 kybd/mouse combo (for ~$20).

8 - Turn on the monitor (make sure it has the HDMI port selected as input) and then turn on the Raspi.

9 - As soon as the screen comes up after it boots, EXIT FLDIGI IMMEDIATELY! Failure to do this may lock up FLDigi if it tries to access the Sound Card that's not plugged in yet. It should be noted that the new OS version now uses the PULSE Audio sound interface now to talk to the Sabrent USB sound card.

10 - <Left Mouse Button> or <LMB> Click on the terminal ICON in the lower left of task bar -it's the black box with a ">_" in it (hover the mouse pointer over it and it will say Terminal)

11 - Type **rpc** then **<enter>** Hint -- DO NOT use the GUI version of the RasPi config utility as it does not show the option I need.

12 - Arrow down to **6 Advanced Options** then press **<enter>**

13 - You will be on **A1 Expand Filesystem** now press **<enter>**

14 - It will expand the filesystem to the full size of the uSD card and then come back saying Root partition has been resized. **<OK>** will be highlighted press **<enter>**

15 - Press **<Tab>** twice so you highlight **<Finish>** now press **<enter>**

16 - It will ask you to reboot now and **<Yes>** will be highlighted. press **<enter>** The system will reboot

17 - Again, once the system reboots exit the FLDigi application immediately - we're not ready for it yet.

18 - The grape was designed to be run headless (i.e no keyboard/mouse or Display), so now you need to decide how it connects to the internet. Having a mouse/Kybd will mess up communications with the LB GPSDO (it moves the LB GPSDO system address), so scripts will have to be re-written to accommodate this. If you are planning to run the RasPi with mouse/kybd, we will cover it later in this document on how to fix it to do so. Running it with a display attached is not a problem either way. A headless unit is configured to run a screen resolution of 1920 x 1080.

If it will be wired ENET, connect it to the ethernet cable now.
If wireless, <LMB> on the icon just to the right of the Bluetooth icon and turn on WiFi. Choose the wireless network and provide the password and once it logs it you will see the signal strength in the 3 upward going semi-circles.
Hovering over the wireless icon will also show you your assigned IP address.

19 - Once connected, the NTP daemon will set the system time and lock into an external NTP server. You can check this status in the terminal window by typing **ntps <enter>**

20 - In a terminal window, type **ns <enter>** this gives network status
There are 2 numbers we're after
1 - Gateway Address (always ends in .1 or .254 [4th number])
2 - Inet address (first 3 numbers are same as gateway address)

21 - In order to keep the lease on the IP address alive with the router we have to show activity within the timeout window on the router. This can be anything from 6000 sec and up (depends on the router). So I have a crontab job ping the router once an hour to keep the IP address lease active. To do this, we need to put the gateway (router) address into the crontab job correctly.

In the terminal window remember the Gateway Address.
now type **sudo crontab -u root -e** then press **<enter>**

22 - Arrow down to the last line (MOUSE DOES NOT WORK IN THIS EDITOR!) and then arrow over to the beginning of the 170.85.170.254 number

23 - Using the <DEL> key delete the first 170.85.170 numbers and then type in your gateway numbers so you have 4 numbers separated by 3 "." like 192.168.100.254

24 - Now hold down the <ctrl> key and press the letter s key (denoted as **<ctrl-s>**) That just saved the file

25 - Now do a **<ctrl-x>** to exit the editor (hold down the <ctrl> key and press the letter x). This should bring you back to the command prompt in the terminal window

26 - Now from the ns info screen, we need to get the RasPi4's Inet address (either from the eth0: info block for wired or the from the wlan0: block for wireless). Note that the first 3 numbers of this address will be the same as in the Gateway address. The 4th number will be between 2 and 253 inclusive.

27 - With this address handy, type the following in the terminal window:
sudo nano /etc/hosts then press **<enter>**

28 - Arrow down to the last line (again the mouse does not work in this editor) and replace the 170.85.170.106 number (in front of PSWSGrape1) that you just got from step 26 (something like 192.168.100.123)

29 - Once the 4 numbers separated by "."'s is completed, do the **<ctrl-s>** (or do a **<ctrl-o>** and then **<enter>)** to save the file, then do **<ctrl-x>** This will exit the editor and return you to the command prompt.

30 - Download and install the VNC viewer on your computer (for headless operation) from https://www.realvnc.com/en/connect/download/viewer/

31 – Install and then run the program. Close the info screen, then in the center of the running VNC window **<RMB>** and in the appearing menu select **NEW CONNECTION**

32 - Enter the INET address (from step 26) into the VNC SERVER IP address window. For the **Name** enter **PSWSGrape1** Then **<LMB>** the **<OK>** button

33 - **Double <LMB>** click the new icon that you just created and a window will pop up asking to continue with the identity check (as it's a new connection it doesn't know about). **<LMB>** click on **continue.**

34 - Enter username as **pi** password as **pi** **<LMB>** click the box to remember the password and then **<LMB>** click **<ok>**

35 - A window will now pop up that is the full display screen to the PSWSGrape1 Station! Congrats! You should notice that the VNC logo On the RasPi has a dark gray background indication that a VNC session is active (it is white when not active).

36 - We are now ready to start setting up the final station configuration, so in the VNC session at the top center of the window there will be a white line that when you put the mouse pointer there will cause a drop down menue to appear. Do this and click on the **X** at the right end of the box. Answer **YES** to exit the VNC session. Sometimes the Graphics doesn't show the drop-down box the first time, so just use the normal **x** (close window) in the OS frame of the VNC viewer.

37 - Now on the keyboard that is tied to the PSWSGrape1, in the terminal window type **sd** then press **<enter>** This will shut down the system.

38 - When the green LED stops blinking and goes out (Next to the RED PWR LED on the RasPi4B – always on with power applied), then shut the power off to the RasPi4B

39 - Remove the Monitor, Keyboard and Mouse from the RasPi4B [if you plan to run it headless]

40 - Install the USB Sound adapter (in the upper right USB3 [blue] slot), and the LB GPSDO control cable in the lower left USB2 slot. If you're leaving the mouse / kybd on it will be a tight fit with the USB sound adapter. I use a wireless combo and it fits very nicely… **From this point on I'm assuming headless operation**

41 – Turn power on to the RasPi4b. It will take about ~30 seconds to completely boot (when the green light stops flashing a lot it should be ok to log in remotely). You will also see the red light on the LB GPSDO start blinking. This indicates it's looking for a satellite lock (make sure the antenna is attached). When it finally locks on the satellites, it will stay on solid. For a first time boot this may take several minutes.

42 – On your local computer, start a VNC session to the PSWSGrape1 system after its booted. It should show the booted screen with FLDigi running.

43 - Leave FLDigi running this time - we now have to set up the GPSDO for the beacon frequency you want to monitor.

44 – We now need to find where the LB GPSDO ended up in the dev mapping. Currently the scripts have it at /dev/hidraw1. Having a kybd / mouse will move this. This operation will correct for having the mouse / kybd present automatically.
At the command prompt, type **lbs** then press **<enter>** If you get

```
Leo Bodnar GPS Clock Status
Opening device /dev/hidraw1
Device Info:
      vendor: 0x1dd2
      product: 0x2211
Device Name: Leo Bodnar Electronics mini GPS Reference Clock
...
Loss of Signal Count: 1
Sat Status: Locked
PLL Status: Locked
```

You're good to go and you should now jump to step 49. If not...

45 – We now need to find where the LB GPSDO ended up in the dev mapping. Currently the scripts have it at /dev/hidraw1. At the command prompt, type **ll /dev/hidraw*** then press **<enter>**

46 – If the only listing that shows up is /dev/hidraw0 then move on to step 47. If multiple entries show up we have to figure out which one is the LB GPSDO. To do this, type **alias lbs <enter>**. This will show what the alias is for the string I named **lbs** (Leo Bodnar Status). Once it's typed out, place the mouse cursor between the first quote and the s in sudo and then **<LMB>** and hold it down – now move the mouse to the end of the string between the w and the 1 in hidraw1 and then release the **<LMB>**. You have now copied this into the mouse paste buffer. If you center mouse button **<CMB>** click this will paste it onto the current command line. Do this and then you can now type in the numbers one by one and then press **<enter>** after

each one to determine which one yields the following output:

```
Leo Bodnar GPS Clock Status
Opening device /dev/hidraw0
Device Info:
       vendor: 0x1dd2
       product: 0x2211
Device Name: Leo Bodnar Electronics mini GPS Reference Clock
...
Loss of Signal Count: 1
Sat Status: Locked
PLL Status: Locked
```

This one came from /dev/hidraw0. You need to use whatever number you found associated with the one that gave the correct response.

We need to update the .bashrc file to reflect this so the scripts that control the programming of the LB GPSDO will work.

47 – On the command line type **mousepad .bashrc <enter>**
(NOTE: GUI version of EDIT won't find the .bashrc hidden file)

48 – When the editor window pops up, from the pull-down menus do
Search → Find and Replace

for the **Search for:** entry type **raw1**
for the Replace with: entry type **raw#**: (in my case raw0)

where # is the number that maps to the LB GPSDO in this system. There are 5 entries that need to be changed, so keep hitting **replace** until all entries have been updated.

Now do: **File → Save** Now exit the editor **File → Close Window**

49 – Close the Terminal window by typing **x** then **<enter>**

50 – Open another terminal window (this re-reads the updated .bashrc file we just edited) Type **lbs <enter>** and verify you get the correct response

51 – We now need to set the correct output drive of the LB GPSDO.
In the terminal window, type **lbd8 <enter>** You should see the drivestrength be changed to 8ma.

52 – We now need to enter your station information.
To do this, type **PSWSsetup <enter>**

NOTE: All station information **should not** include white space characters (<space or <tab>] or commas where indicated.

It will first go thru and create / verify the full directory structure for the PSWS. Once finished, it will ask you if you want to change the Node Number from N0000000. Just press **<enter>** to keep this value

53 - Next enter your callsign if you have one and then press **<enter>** if not, just press **<enter>**

54 - Next enter your Latitude in decimal format to at least 4 decimal places (6 preferred). press **<enter>** when done.

55 - Next enter your Longitude in decimal format to at least 4 decimal places (6

preferred). Remember in the USA it's a negative number. press **<enter>** when done.

56 - Next enter your Elevation in meters (rounded to the nearest meter). press **<enter>** when done.

57 - Next enter your City and State, Use the 2 Letter abbreviation for your state and NO COMMA between the two – in this case just a space. press **<enter>** when done.

58 - Next enter to know your frequency standard – the Grape Gen1 uses the LB GPSDO so just press **<enter>**

59 - Next enter the radio you are using, so Grape Gen 1 Rcvr 1 is correct, press **<enter>**

60 - Next enter the ID code for the Grape Receiver 1 – G1, so just press **<enter>**

61 - Next enter your antenna – enter it here (like 40M OCF dipole, Gap Titan, etc.) press **<enter>** when done

62 - Finally it wants the system info – just press **<enter>**

63 – Now it will print out the metadata that will be inserted at the beginning of each day's data file. Make sure the info is correct (ignore the beacon being decoded – I forgot to delete that file before I made the distro…). If an error is found, just re-rerun the PSWSsetup program again using <enter> to keep correct values.

64 – To get this summary saved in a text file, type **PSWSinfo <enter>.** File location will be displayed on the screen.

65 -**To get an assigned node number**, send this file along with your mailing address, and phone contact number to John Gibbons – email: jcg66@case.edu

66 – FLDigi wakes up in NULL mode now on a boot of the system – we need to change that so that if there is a power failure, it will start back up taking data.
On the command line type **cd .fldigi <enter>**

67 – Now type the command **cp fldigi.prefs.analy fldigi.prefs <enter>**
This changes the initialization file for FLDigi to start in ANALYSIS mode instead of NULL mode. Now type **cd <enter>** to get back to the home directory

68 – In FLDigi, you can now fill out the station information under the drop-down menu **Configure → Config Dialog** It should be under the tab **Operator – Station**
Note that the Station Locator is your Grid Square calculated for you in the metadata of the PSWS. Be sure to do a **Save Configuration** to save your changes.

69 – Now we need to choose a beacon frequency that you want to monitor:
WWV 2.5MHz, 5.0 MHz 10.0MHz FLDigi is currently set to monitor WWV 5.0 MHz (the freq display should be showing 4999.000 MHz.

Let's choose 10MHz to walk you thru the process.

70 – Set FLDigi to NULL opmode by **OP MODE → NULL** (is still there but good practice)

71 – Using the scroll wheel on the mouse, hover over the freq digits and rotate the wheel to change that digit. Enter the freq of 9999.000

72 – To make this be recalled at boot time do a **Save Configuration** again.

73 – Unfortunately this erases the start-up mode back to null in the **fldigi.prefs** and we need to fix that. This is accomplished by going to where this file is located and editing it. Type cd ~/.fldigi to get to the system storage directory for FLDIGI. Now type **sudo nano fldigi.prefs <enter>.** Using the arrow keys a move down to the entry (9th line down) that says
mode_name:NULL

change it to say
mode_name:ANALYSIS

Also, if you want to change the default startup frequency at startup arrow down to the entry (23rd line down)that says
noCATfreq:9999000

and change it to what your Leo Bodnar GPSDO frequencyn is set to.

Now press **<ctrl-s>** to save the file and **<ctrl-x>** to exit the nano editor.
The system will now start itself in frequency analysis mode at the frequency you entered.
74 – Now in the terminal window, type the command **sf9999 <enter>** You should see what the previous frequency was and that is was set as the following:

```
New Settings:
    GPS Frequency = 199980
    N31           = 1
    N2_HS         = 11
    N2_LS         = 2900
    N1_HS         = 11
    NC1_LS        = 58
     NC2_LS        = 58

    VCO           = 6379362000.000000 Hz

    Clock Out 1   = 9999000.000000 Hz
    Clock Out 2   = 9999000.000000 Hz
    Bandwidth     = 15
    Drivestrength = 8
Frequency Set
```

75 – Change the jumper on the Grape Receiver (input filter select) to the 10MHz position.

76 – Attach the antenna to the Grape receiver. You should see a change in the waterfall and depending on propagation (time of day) see the waterfall for the 1KHz carrier of WWV (10 and 15 MHz is during the day, 2.5 and 5.0 are at night).

77 – On the bottom of the FLDigi waterfall display just there is a frequency display of where the red line is positioned on the waterfall. Be sure this is set to exactly 1000. Use the left and right arrows to adjust it to 1000 if it's not already there.

78 – Now on FLDIGI, change the op mode as follows:
OP MODE → Freq ANALYSIS

This starts the data collection and you should see on the the bottom line of FLDigi

ANALYSIS, the time [in UTC / Zulu], Frequency Decoded and file currently being saved

CONGRATS! You are now collecting PSWS data!

Every day at 00:00:00 UTC it will start a new file with the new days data.

79 – If you want the plot of the previous days data to auto display at 00:00:00 UTC in the terminal window type **apon <enter>** to stop this type **apoff <enter>** You will want to close the window every day as it consumes system memory and after 4 or 5 days you will be restricting the system memory resources. I normally leave this shut off as it's easy to forget about closing them and after enough time crashing the system due to insufficient memory.

80 – To set your node's file xfer time, edit the crontab job [for the user pi] as follows:

On the command line type:
crontab -u pi -e

This will put you into the crontab editor (which defaults to nano):
You will see a bunch of entries that start with the character '#' - these are considered comments and are ignored. You should then see an entry starting with
00 00 * * * python3 ...
This is the crontab job that processes the data files at 00:00:00 UTC – do not change this entry.

The second entry will start with 42 00 * * * /home/pi/PSWS/ …

This is the entry that performs the transfer or your data to the repo. We need to change it for your node number such that all the nodes don't hit the repo all at the same time. We will accomplish this by using your node number as a minute offset from 00:00:00 UTC to perform the transfer. Since node numbers are now above 60 we will subtract 60 from your node number and add 1 to the hours digit to account for it. The line entry format into the crontab job (as the last commented line shows) is: m h dom mon dow command

So if you are node N0000073 the minute(m) and hour(h) entry would be 13 and 01 as follows:

13 01 * * * /home/pi/PSWS/Scode/…

Edit this entry by using the arrow keys / <DEL> key and change the time according to your assigned node number. Save the changes with a <ctrl-s> and exit the editor with a <ctrl-x>.

81 – To enable the auto transfer of your node data to the repo (send the daily created files), type the cmd **xferon <enter>** This will place the day's files into the xfer directory for daily uploads. **xferoff <enter>** shuts this function off.

82 – To view the status of the last repo xfer look in the Status directory for the logged entries found here:

/home/pi/PSWS/Sstat/

The file xferstat will contain the status of the last file xfer and will list the files transferred by the full path name.

For example on my N0000001 system the xferstat contents looks like the following:

```
pi@N8OBJWWV5:/home/pi/PSWS/Sstat$ cat xferstat
Files to send to Repo:
/home/pi/PSWS/Sxfer/2023-09-24T000000Z_N0000001_G1_EN91fh_FRQ_WWV5.csv
/home/pi/PSWS/Sxfer/2023-09-24T000000Z_N0000001_G1_EN91fh_WWV5_graph.png
Attempting xfer to repo...
Files transferred ok - removing them from ~/Sxfer/
```

Some useful aliases I've defined:

cl – clear – clears the terminal window
osv – operating system version – show current verion of OS
osb – operating system bits - shows number of bits the OS is using
cpuv – Displays the Processor version being used on the System
ns – network status – shows network connection info
ntps – ntp status – shows how the link to the ntp server is doing
lbs – Leo Bodnar Status - shows the status of the LB GPSDO
lbsf – Leo Bodnar Set Freq – shows /sets the freq the LB GPSDO is set to presently
ut – up time - shows users and how long the system has been running since last boot
rb – reboot - reboots the system
sd – shutdown – shuts down the system (do this before shutting off power!)
x – exit – exits / closes the terminal window

If you want to see what an alias is defined as (such as osv), type
alias osv <enter>

alias - will show ALL aliases I've defined. CAREFUL! - you can get into trouble if you don't know what they do! Especially the sf* commands – you'll reprogram the freq on the LB GPSDO and mess up your monitoring function.

Also – DO NOT update the OS. You may break things and you will be on your own to fix it. Most likely reload the original image and start over.. You've been warned!