

# Logging Receiver Data with GPS Coordinates

**Ray WA1CYB**

**Stow**

**What is a Logging Receiver?** Receives SDR signals and GPS Information and stores it in a file

**Why would I use this?** To show signal coverage for your station *or* a repeater station *or* .....

**How is this implemented?** GPS program on laptop uses gpsd (I use Ubuntu 22.04.1). Receiver created with GNU radio and a custom python block

**What is the output file format?:** A Comma Separated Variable format. Read by many programs

**What SDR does it use:** I have 2 versions, one for the RTL-SDR Dongle and 1 for the Ettus B205mini  
From GNU Radio Companion it is easy to change the SDR type if desired.

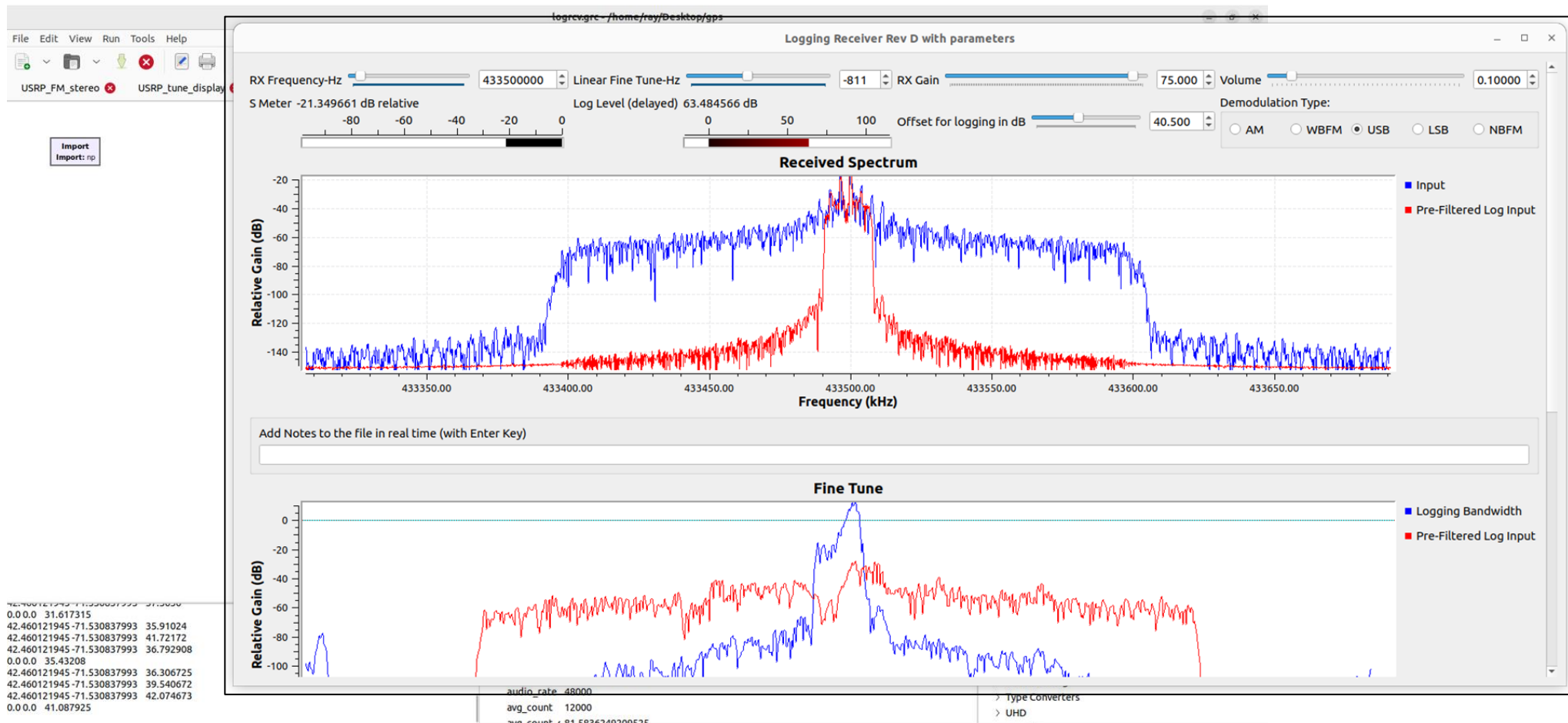
**Can the program be run from the command line?:** Yes. Display not needed IFF you are sure it's tuned in correctly and doesn't drift. Recommend setting up in GNU Radio Companion 1<sup>st</sup>.

**Any other features?:** Real time RF monitor of the frequency with choice of demodulation. S-meter. Offset averaging S-meter for logging. Logging Bandwidth is programmable. You can type on the keyboard while running and the note will show up in the CSV file in the 6<sup>th</sup> column

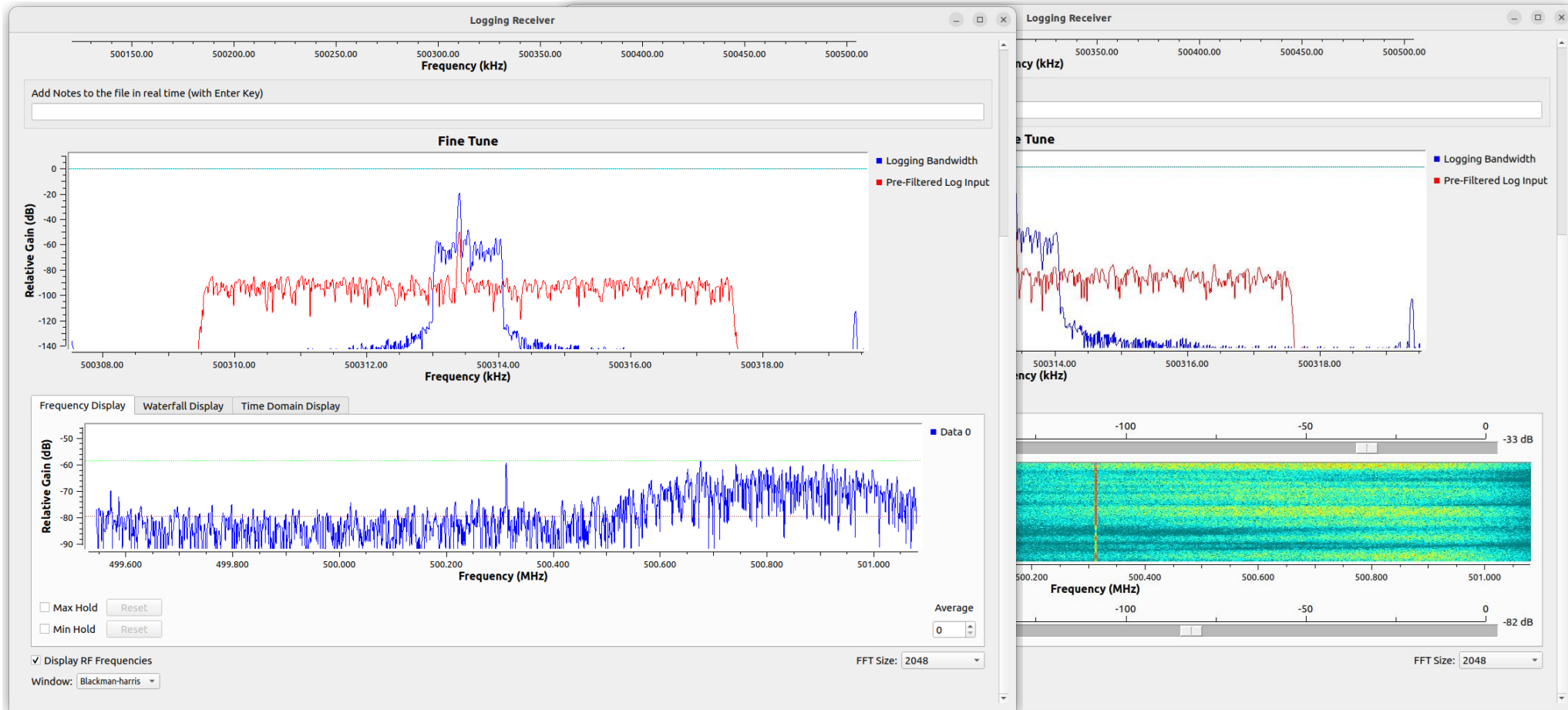
# Slides

- Screen Shots while running GNU Radio Companion
  - 2 Spectrum plots to tune in the signal for maximum strength
  - 1 Spectrum waterfall or Input Spectrum or time plot
- Screens while running from command line
  - 2 windows: 1 with the graphical plots, the other the current location and signal level
- Control Description, CSV File Description
- Example Output Plotted by other programs:
  - Excel my house to Bj's and back
  - Microsoft Excel: 3D Maps plugin plots data on the map directly, tile for signal value
  - Excel with 70cm coverage around my house when trees are wet (duty cycle controlled)
  - Converted a run with **RouteConverterLinux** and plotted on Google Earth
    - Modified the csv file so the Speed = Signal Level and new altitude = 100\*Signal Level
- Location of Files on Github: <https://github.com/WA1CYB/Receiver-logger>

# Typical Screen While Running GRC (GNU Radio Companion)



# Bottom Portion of Screen When Scrolled Down





# Running from command line – Typical Screen Output

The screenshot displays a Linux desktop environment. On the left, a terminal window titled 'rcv\_logger' shows the following output:

```
Warning: failed to XInitThreads()
Start Collection at: 18/09/2022 10:33:40
Warning: Ignoring XDG_SESSION_TYPE=wayland on Gnome. Use QT_QPA_PLATFORM=wayland to run on Wayland anyway.
Detached kernel driver
Found Rafael Micro R820T tuner
Reattached kernel driver
[INFO] Opening Generic RTL2832U OEM :: 00000001...
Detached kernel driver
Found Rafael Micro R820T tuner
[R2XX] PLL not locked!
len(audio taps) = 115
[INFO] Using format CF32.
Allocating 15 zero-copy buffers
0.0 0.0 0.0072250366
Latitude Longitude Signal Level (dB)
0.0 0.0 0.3408661
0.0 0.0 0.1466713
0.0 0.0 0.24054718
42.460006667 -71.530345 0.4123459
42.460006667 -71.530345 0.41199875
42.460006667 -71.530345 0.24908447
42.460006667 -71.530345 0.30929184
42.460006667 -71.530345 0.3736267
42.460006667 -71.530345 0.37905884
42.460006667 -71.530345 0.2574997
42.460006667 -71.530345 0.1727333
42.460006667 -71.530345 0.39470673
42.460006667 -71.530345 0.25492477
42.460006667 -71.530345 0.52708676
```

On the right, the 'Logging Receiver' application window is open. It features a 'Received Spectrum' plot showing relative gain (dB) versus frequency (kHz). The plot shows a signal centered around 10450 kHz. Below the spectrum plot is a 'Fine Tune' plot showing relative gain (dB) versus frequency (kHz), providing a more detailed view of the signal. The application also includes control panels for RX Frequency (Hz), RX Gain, and Volume.

At the bottom of the screen, a file manager window shows a list of files, including 'junk2.txt' and 'save\_junk3'. A notification at the bottom right indicates that 'rcv\_logger' is selected, containing 42 items.

Advantage is Bigger Font for Real Time Values in Window

# B205mini 'version'

The screenshot shows a GNU Radio flowgraph titled "logrcv\_b205.grc" in the "/home/ray/Desktop/gps" directory. The flowgraph includes several blocks and connections:

- UHD: USRP Source**: Receives data from the antenna. A large blue arrow points to this block.
- Low Pass Filter**: Decimation: 4, Gain: 1, Sample Rate: 1.536M, Cutoff Freq: 100k, Transition Width: 10k, Window: Hamming, Beta: 6.76. Labeled as "200 kHz BP Filter".
- AGC**: Rate: 1m, Reference: 300m, Gain: 1, Max Gain: 10G.
- Low Pass Filter**: Decimation: 16, Gain: 1, Sample Rate: 384k, Cutoff Freq: 8k, Transition Width: 200, Window: Hamming, Beta: 6.76. Labeled as "384 kHz BP Filter in 24 kHz out".
- Frequency Xlating FIR Filter**: Decimation: 1, Taps: 1, Center Frequency: -811, Sample Rate: 24k.
- Low Pass Filter**: Decimation: 16, Gain: 1, Sample Rate: 384k, Cutoff Freq: 8k, Transition Width: 200, Window: Hamming, Beta: 6.76. Labeled as "384 kHz BP Filter in 24 kHz out".
- QT GUI Frequency Sink**: Name: Received Spectrum, FFT Size: 2048, Center Frequency (Hz): ~.99M, Bandwidth (Hz): 384k.
- Virtual Sink**: Stream ID: rit\_agc, Stream ID: probe.
- Virtual Source**: Stream ID: rit\_agc, Stream ID: probe.

The interface also shows various options and variables:

- Options**: Title: Logging Receiver, Author: WA1CYB, Description: Loggi... B, LSB, Output Language: Python, Generate Options: QT GUI.
- Variables**: ID: samp\_rate (Value: 1.536M), ID: baseband\_rate (Value: 24k), ID: audio\_rate (Value: 48k).
- QT GUI Range**: ID: freq (Label: RX Frequency-Hz, Default Value: 104.5M, Start: 25M, Stop: 1.1G, Step: 100), ID: volume (Label: Volume, Default Value: 100m, Start: 0, Stop: 1, Step: 25m), ID: rit (Label: Linear Fine Tune-Hz, Default Value: -811, Start: -5k, Stop: 5k, Step: 1), ID: gain (Label: RX Gain, Default Value: 64.5, Start: 0, Stop: 76, Step: 500m).

At the bottom, there is a terminal window showing the following output:

```
42.460122981 -71.530807227 31.356403
0.0 0.0 30.583052
42.460122981 -71.530807227 31.613686
42.460122981 -71.530807227 26.982151
42.460122981 -71.530807227 27.985382
0.0 0.0 35.021465
42.460122981 -71.530807227 34.74688
42.460122981 -71.530807227 39.222572
42.460122981 -71.530807227 39.592857
```

Below the terminal, there is a code editor showing the following code:

```
ID Value
Imports
import_0 import numpy as np
Variables
amp <Open Properties>
audio_rate 48000
avg_count 12000
avg_count_0 81.5836249208525
```



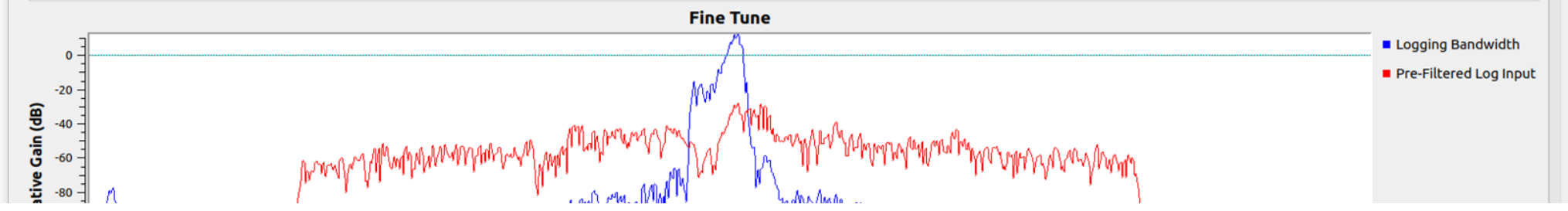
# Controls

frequency

Monitor Audio Offset

SDR Gain

Audio Monitor Volume



# Comma Separated File Output `log_my_rcvr_gps.csv`

\* Parameters that were run: Freq, gain, offset, date&time

\*Latitude, Longitude, Signal Level, Elevation, GPS\_Time and Notes

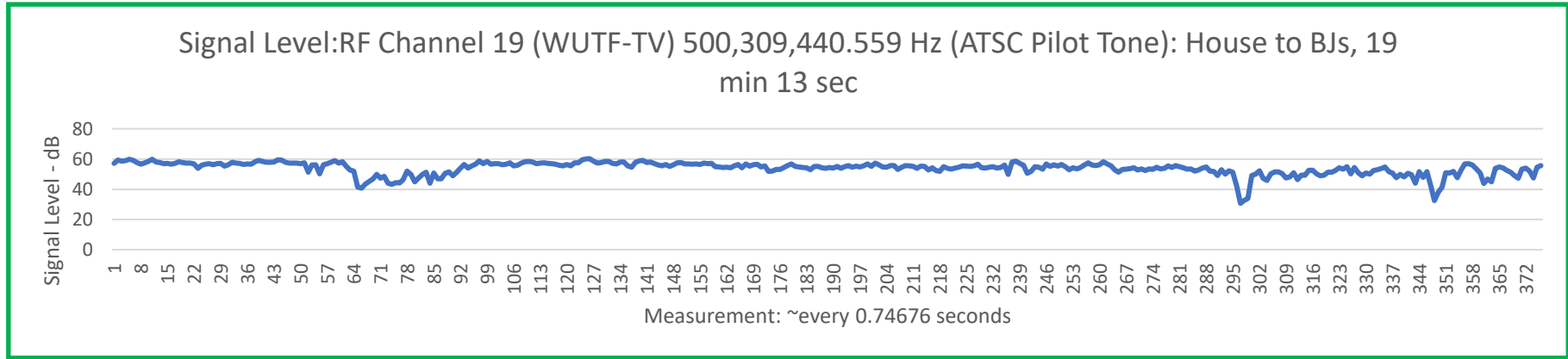
Notes manually typed in while running

	A	B	C	D	E	F	G	H	I	J	K	L
1						logFREQ:433500000.0 Gain:77.0 Offset:44 start time:02/10/2022 16:16:24						
2	Latitude	Longitude	Signal Level (dB)	Elevation	gps Time	notes						
3	0	0	56.212105	nan								
4						Latitude	Longitude	Signal Level (dB)				
5	0	0	54.802338	nan								
6	0	0	54.54431	nan								
7	0	0	55.803623	nan	2022-10-02T20:16:40.460Z							
8	42.45983724	-71.53065748	56.35217	114.8786	2022-10-02T20:16:40.460Z							
9	42.45984108	-71.5306421	55.69851	114.4126	2022-10-02T20:16:41.150Z							
10	42.45984108	-71.5306421	55.405666	114.4126	2022-10-02T20:16:42.000Z							
11	0	0	55.38034	nan	2022-10-02T20:16:43.000Z							
12	42.45984021	-71.53063824	55.49604	113.0378	2022-10-02T20:16:43.000Z							
13	42.45984789	-71.53064592	56.128246	112.1043	2022-10-02T20:16:44.000Z							
14	42.45984702	-71.53064207	-0.5215416	110.7295	2022-10-02T20:16:45.000Z							
15	0	0	-0.26473618	nan	2022-10-02T20:16:46.000Z							
16	42.45984614	-71.53063822	-0.38463974	109.3547	2022-10-02T20:16:46.000Z							
17	42.4598519	-71.53063437	-0.42312622	108.6549	2022-10-02T20:16:47.000Z							
18	42.45984719	-71.5306459	48.71967	107.7461	2022-10-02T20:16:48.000Z							
19	0	0	50.535152	nan	2022-10-02T20:16:49.000Z							
20	42.45985295	-71.53064205	52.455	107.0464	2022-10-02T20:16:49.000Z							
21	42.45985295	-71.53064205	63.748	107.0464	2022-10-02T20:16:50.000Z							
22	42.45985872	-71.5306382	73.03367	106.3466	2022-10-02T20:16:51.000Z							
23	0	0	72.65481	nan	2022-10-02T20:16:52.000Z							
24	42.45985207	-71.5306382	72.5972	105.6715	2022-10-02T20:16:52.000Z							
25	42.45985784	-71.53063435	72.57312	104.9718	2022-10-02T20:16:53.000Z							
26	42.45985784	-71.53063435	72.34866	104.9718	2022-10-02T20:16:54.000Z							
27	0	0	72.45337	nan	2022-10-02T20:16:55.000Z							
28	42.45985976	-71.53064588	59.629234	104.7381	2022-10-02T20:16:55.000Z							

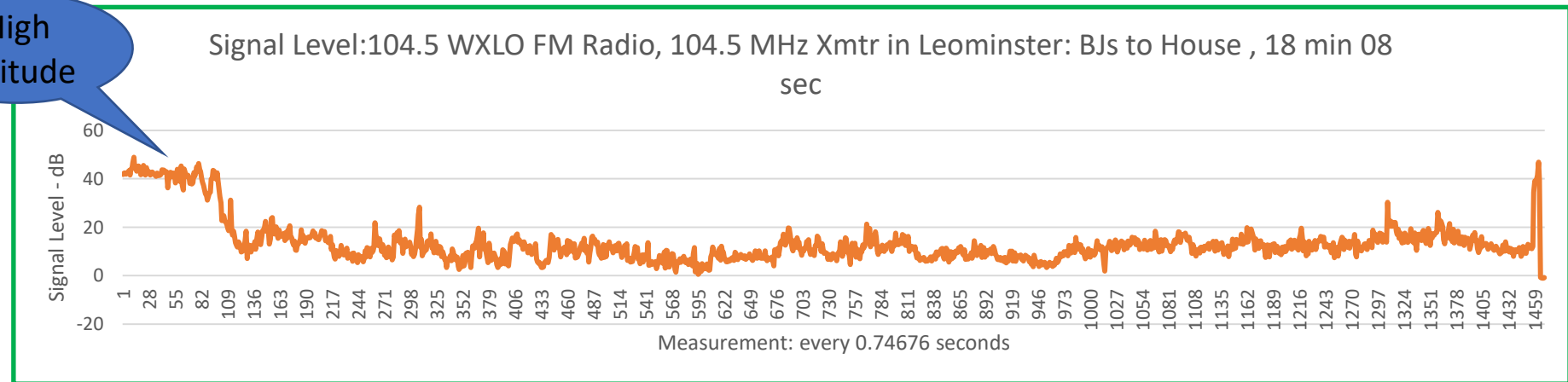
Notes Show up in this column

# If you look at the data in Microsoft Excel or LibreOffice:

## Examples



High Altitude



# If you look at the data in Microsoft Excel: 3D Maps

The screenshot displays the Microsoft Excel 3D Maps application interface. The main window shows a map of the Camp Virginia area with a red path overlaid. A data popup is visible over the path, displaying the following information:

Latitude	42.435367194
Longitude	-71.57116941
Signal Level (dB)	45.20882

The interface includes a ribbon with tabs for FILE and HOME, and various toolbars for navigation and data manipulation. A right-hand panel titled 'Add Layer' is open, showing options for location, size, category, time, filters, and layer options. The Windows taskbar at the bottom shows the system tray with the time 3:50 PM and date 9/16/2022.

# Cursor Can Show Signal Level (From Data Card)

The screenshot shows a 3D Maps application interface. The main map displays a red dotted path overlaid on a street map. A data card is visible over the path, showing the following information:

- Latitude: 42.393523389
- Longitude: -71.60720877
- Signal Level (dB): 44.05563

The application's toolbar includes various tools such as Play Tour, Create Video, Capture Screen, New Scene, Themes, Scene Options, Refresh Data, Shapes, Map Labels, Flat Map, Find Location, Custom Regions, 2D Chart, Text Box, Legend, Time Line, Date & Time, Tour Editor, Layer Pane, and Field List. The right-hand panel shows layer configuration options, including Location (Longitude, Latitude), Size, Category, Time, Filters, Layer Options (Size, Opacity, Color), Show Values (Zeroes, Negatives, Nulls), and Data Card (Customize).

# Shows Route Back With FM Radio

The screenshot displays the ArcGIS Pro software interface. At the top, the title bar shows the file name "log\_my\_rcvr\_gpsbjts to house wbifm.xlsx - 3D Maps" and standard window controls. Below the title bar is a ribbon with tabs for FILE and HOME. The HOME tab is active, showing various toolbars for Tour, Scene, Layer, Map, and View. The main map area shows a 3D map with a purple route and a green route. A data popup is visible on the map, displaying the following information:

Latitude	42.39207054
Longitude	-71.59595141
Signal Level (dB)	39.153244

On the right side, there is a "Field List" dialog box with the following content:

Field List  
Drag fields to the Layer Pane.

- Range
- Latitude
- Longitude
- Signal Level (dB)

Below the Field List is a "Layer Properties" dialog box for the "FM Radio" layer. It includes sections for Location, Height, Category, Time, Filters, Layer Options, and Show Values. The "Show Values" section has checkboxes for "Zeros" (checked), "Negatives" (checked), and "Nulls" (unchecked). The "Data Card" section has a "Customize" button.

At the bottom of the screen, the Windows taskbar is visible, showing the system tray with the time "4:04 PM" and date "9/16/2022".

# Cursor can show signal level (from data card)

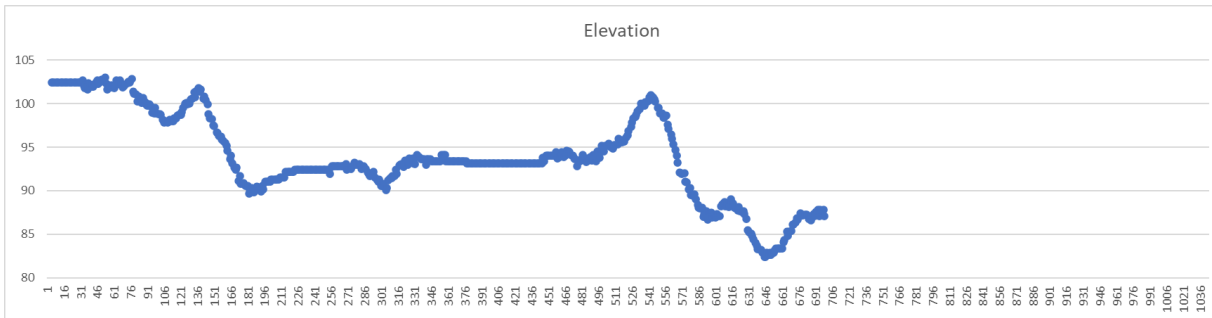
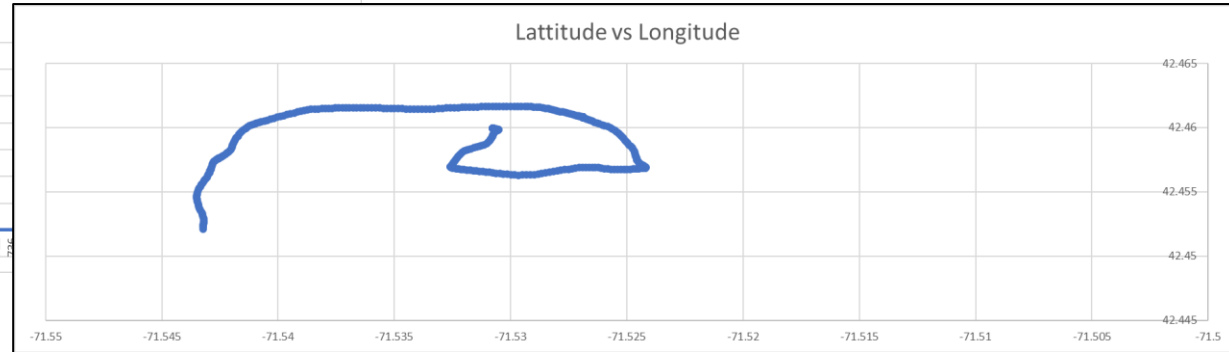
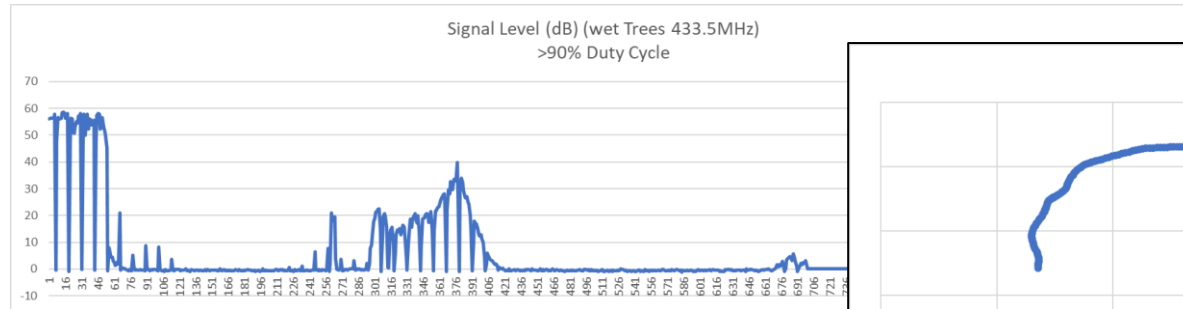
The screenshot displays a 3D mapping application interface. The main map area shows a green path of data points along a road. A data card is open over one of these points, displaying the following information:

- Latitude: 42.437972993
- Longitude: -71.52574983
- Signal Level (dB): 11.3013

The interface includes a top menu bar with options like FILE and HOME, and a toolbar with various tools such as Play Tour, Create Video, Capture Screen, New Scene, Themes, Scene Options, Refresh Data, Shapes, Map Labels, Flat Map, Find Location, Custom Regions, 2D Chart, Text Box, Legend, Time Line, Date & Time, Tour Editor, Layer Pane, and Field List. On the right side, there is a 'Layer' panel with settings for Location, Size, Category, Time, Filters, Layer Options (Size, Opacity, Color), Show Values, and Data Card. The bottom of the screen shows the Windows taskbar with the search bar and system tray.

# 433.5 MHz Test From My Ground Plane To A Rubber Duckie On my Car

- Needed to modulate Transmitter with a duty cycle to prevent shutdown
- I used 66% to 90% on/off for most tests
- PTT “Modulation” circuit on github (Raspberry PI pico, transistor, relay)

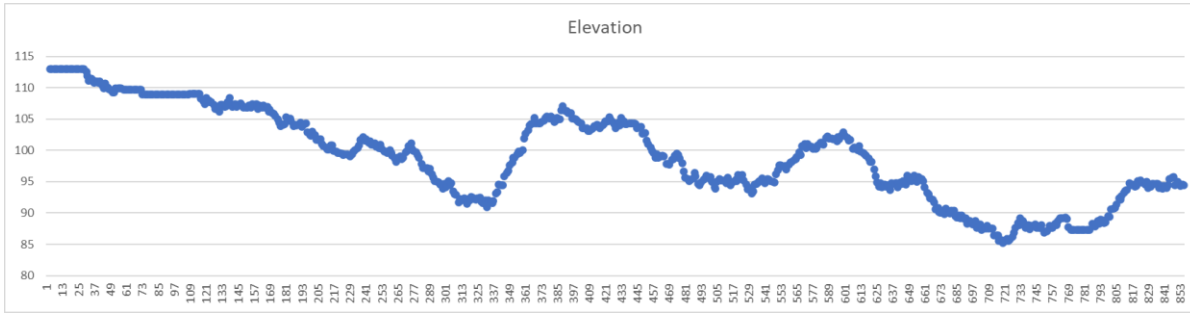




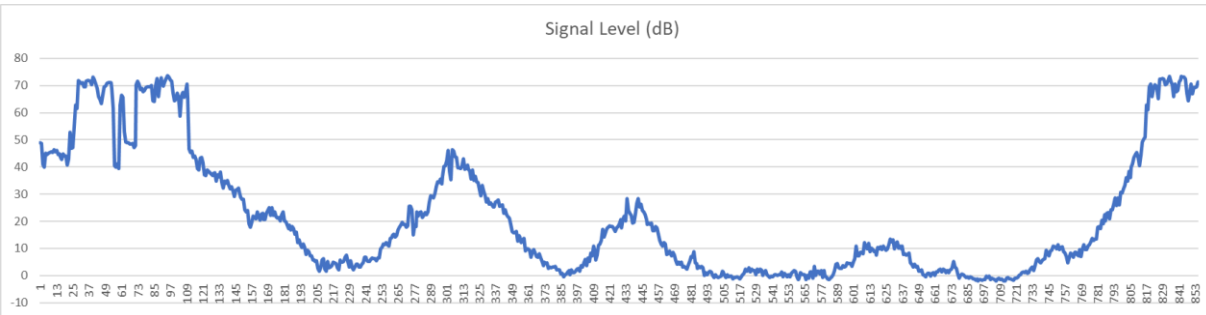
# 433.5 MHz Test From My Ground Plane To A Rubber Duckie On my Car

~10 watts ERP

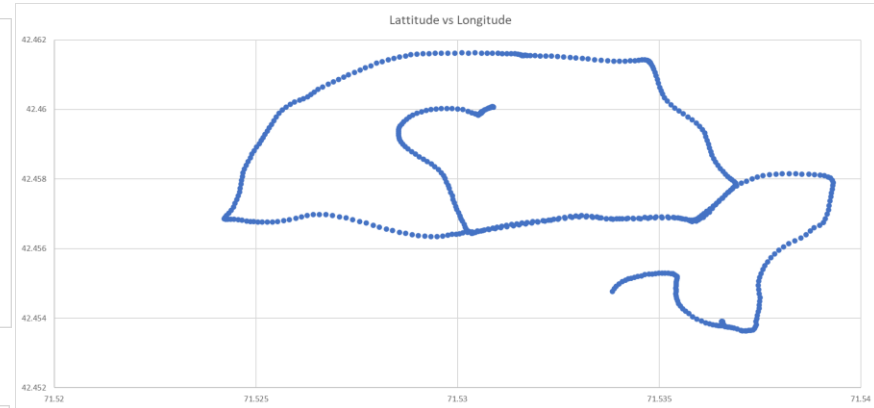
Elevation



Signal Level (dB)



Latitude vs Longitude

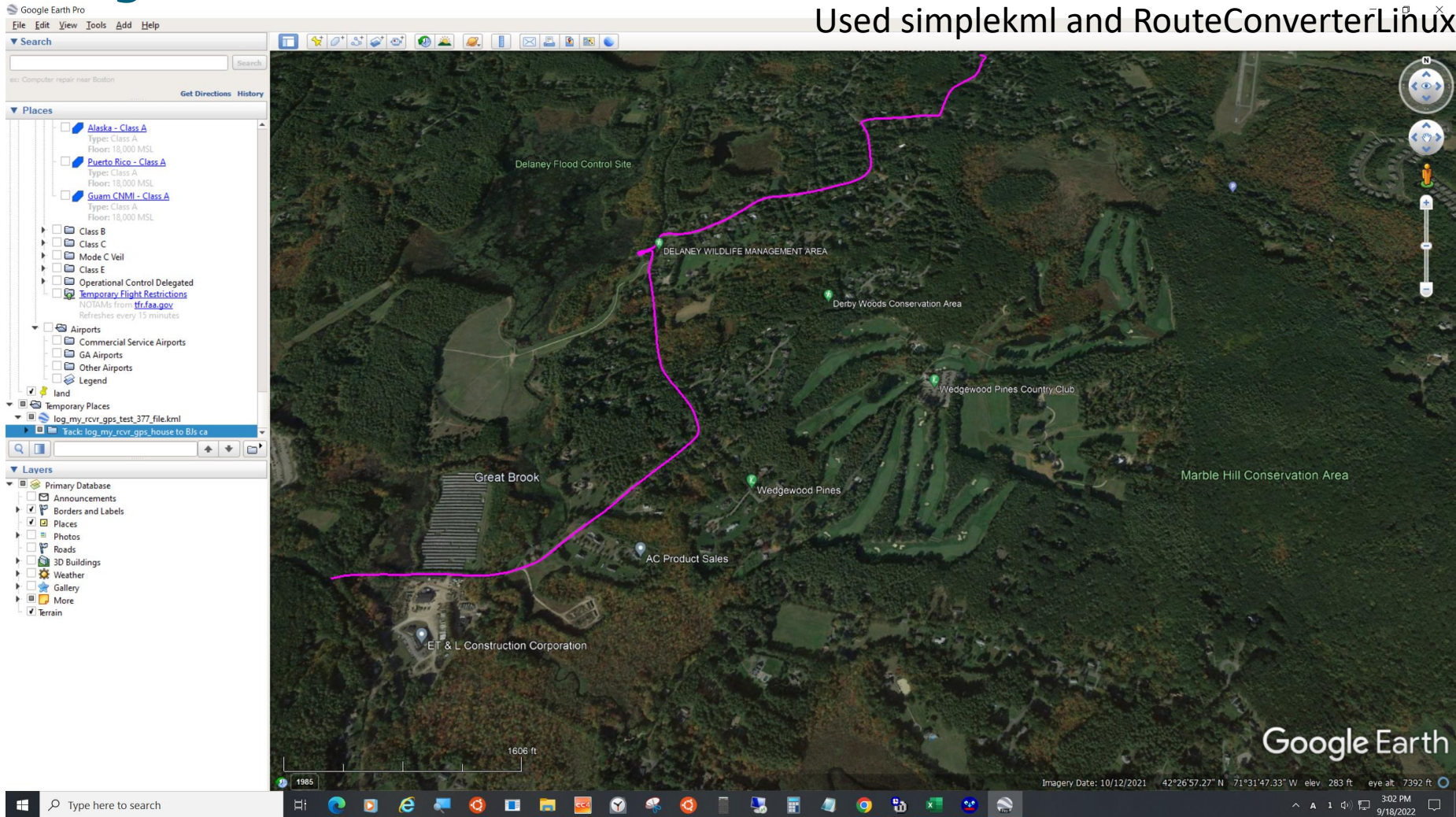


Latitude vs Longitude



# Google Earth Pro – Shows Path

Used simplekml and RouteConverterLinux.jar



# Google Earth Pro – Shows Speed = Signal Level: Alt = 100\*Signal Level versus Excel (reversed)

The screenshot displays the Google Earth Pro interface with a terrain map of a rural area. A signal level profile is overlaid on the map, showing a jagged line with a color gradient from blue (low) to red (high). The profile is divided into segments, with labels for 1 Km, 2 Km, and 3 Km. A legend on the left lists segments with speed ranges:

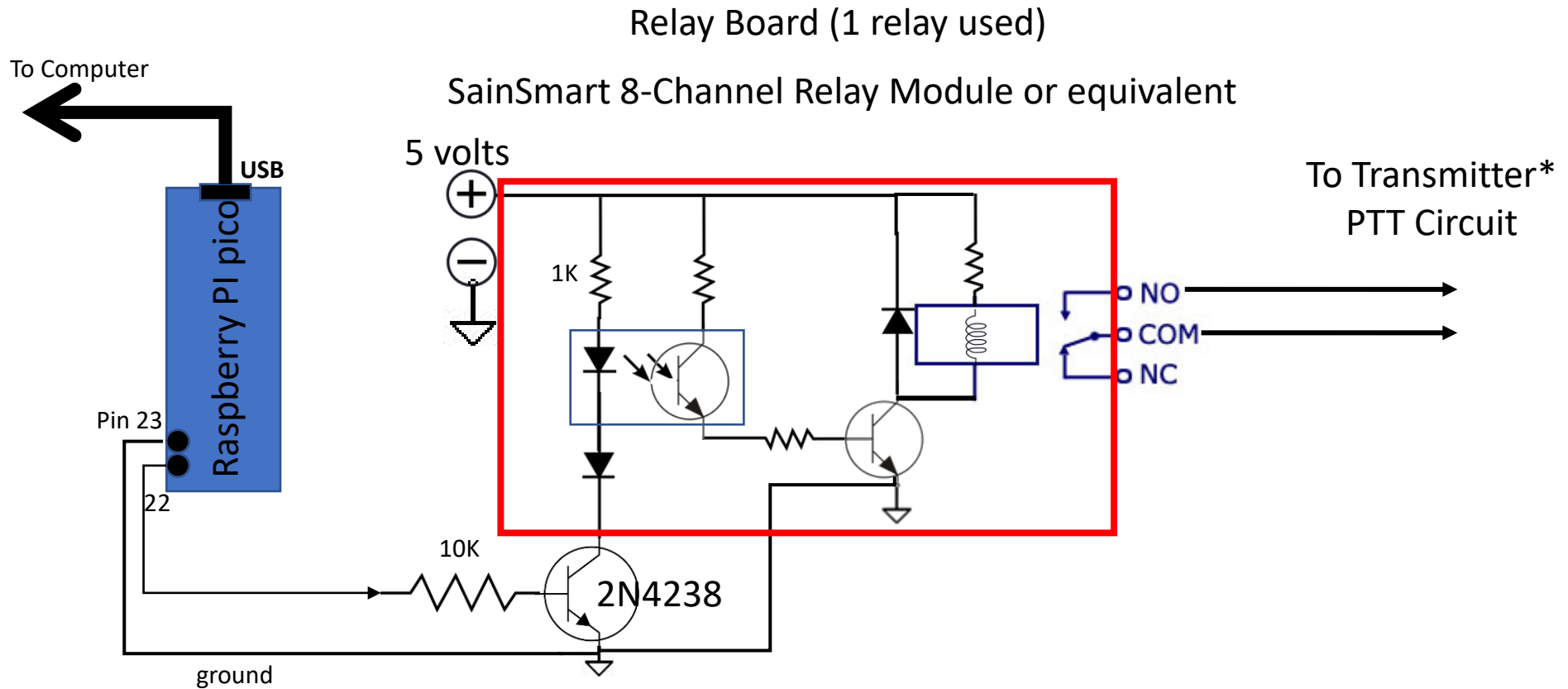
- Segment 22: 30 - 40 Km/h
- Segment 23: 20 - 30 Km/h
- Segment 24: 30 - 40 Km/h
- Segment 25: 20 - 30 Km/h
- Segment 26: 30 - 40 Km/h
- Segment 27: 20 - 30 Km/h
- Segment 28: 30 - 40 Km/h
- Segment 29: 20 - 30 Km/h
- Segment 30: 30 - 40 Km/h
- Segment 31: 30 - 40 Km/h

An inset graph in the bottom center shows the signal level data in a purple line format, with the title "level length = 'baseq2'". The graph shows a jagged line with a color gradient from blue to red, matching the profile on the map. The y-axis ranges from 0 to 200, and the x-axis ranges from 0 to 100. The Google Earth interface includes a search bar, a menu bar (File, Edit, View, Tools, Add, Help), and a toolbar. The bottom status bar shows the date and time: 4:04 PM 9/18/2022.

## **Software Location for Download:**

**<https://github.com/WA1CYB/Receiver-logger>**

# PTT Controller To Control The Duty Cycle Of The Transmitter



\* PTT Circuit for a UV25X4 are pins 4 and 5

# PTT Controller To Control The Duty Cycle Of The Transmitter

**\*\*\* Software is a simple modification of the LED Blink Program \*\*\***

```
from machine import Pin, Timer
from time import sleep
from machine import Pin

tim = Timer()

led = Pin(25, Pin.OUT)
bfradio = Pin(17, Pin.OUT)
# PINS are GPIO Numbers not PIN Numbers
# REAL Pin(22) = GPIO(17)
# Ground = Pin(23)

myled = led

def tick(timer):
    global led, bfradio
    myled.on()
    bfradio.off()
    sleep(5.000)
    myled.off()
    bfradio.on()
    sleep(10.000)
# polling time must be <2 seconds. Set to 0.2 sec (5 Hz)
tim.init(freq=5.0, mode=Timer.PERIODIC, callback=tick)
```