INTRODUCCIÓN

AMSAT GITHUB

Alan github

BOM (Bill of Materials)

Drive nuestro con documentación (iremos actualizando el github):
https://drive.google.com/drive/folders/1DphjmLxVG4X5kF9EDcpYlZ8y54ql5W4_?usp=drive_link

In this document we will each note down all the progress we make, so we can carry out adequate follow-up.

FOXTELEM (PROGRAMM): Iniciar **como administrador** FoxTelem en el ordenador. Recibe telemetría cada 4-5 seg.

INFO:

Raspberry:
- user: **pi**
- password: **raspberry**
- dominio: **cubesatsim.local**
- Network: conectado por defecto a **StarLink@Tecnun**
- Conexión: por medio de ssh (guión explicativo en este drive)
- Coordenadas configuradas a la ubicación de Miramón (Latitud y Longitud): **43.290892672664384, -1.9834360865077036**
- Frecuencia de transmisión: TX: **434.9MHz** RX: **435MHZ**

¿Cómo leer los logs? En la consola de comando (CLI) del raspberry:
- Para ver todos los ajustes >**CubeSatSim/config**
- Para ver todos los posibles comandos >**CubeSatSim/config -h**
- Para ver el log actualizándose en tiempo real >**CubeSatSim/log**
- Para ver el transmisor >**CubeSatSim/log -r**
- You can see all the settings for your Pi Zero by typing CubeSatSim/config

Cambiar wifi de ssh: `sudo nano /etc/wpa_supplicant/wpa_supplicant.conf`

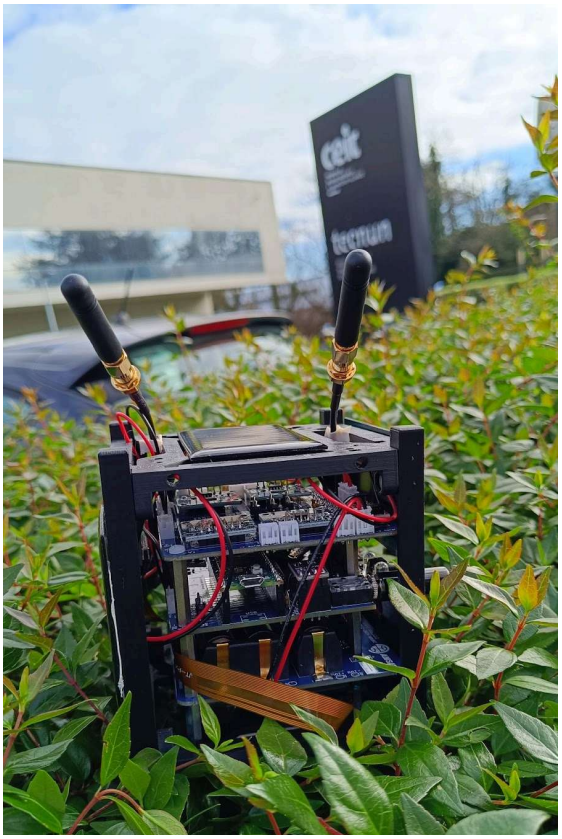
```
  GNU nano 5.4                                /etc/wpa_supplicant/wpa_supplicant.conf
country=ES
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1

network={
  ssid="StarLink@Tecnun"
  psk="GoForTelecom"
  key_mgmt=WPA-PSK
}
```

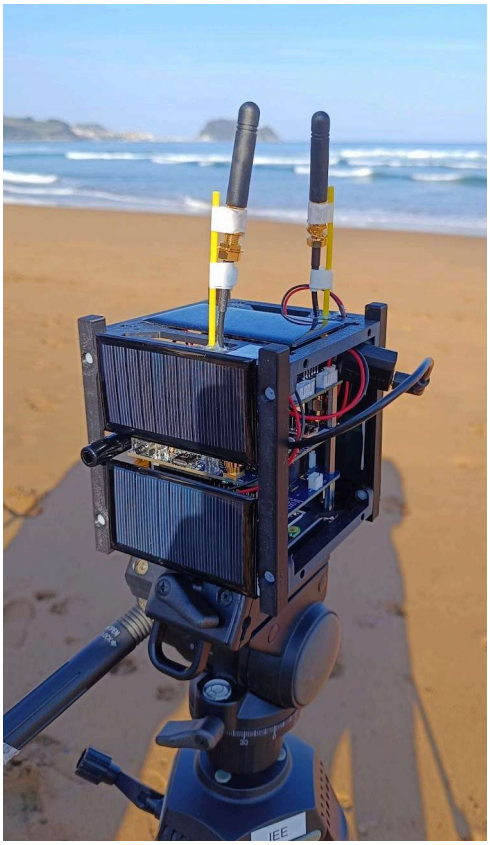
```
C:\Users\CUBESAT>ping -4 cubesatsim.local

Pinging cubesatsim.local [192.168.142.108] with 32 bytes of data:
Reply from 192.168.142.108: bytes=32 time=24ms TTL=64
Reply from 192.168.142.108: bytes=32 time=8ms TTL=64
Reply from 192.168.142.108: bytes=32 time=11ms TTL=64
Reply from 192.168.142.108: bytes=32 time=8ms TTL=64

Ping statistics for 192.168.142.108:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 24ms, Average = 12ms

C:\Users\CUBESAT>ssh pi@192.168.142.108
The authenticity of host '192.168.142.108 (192.168.142.108)' can't be established.
ED25519 key fingerprint is SHA256:cgU3Gxts/5EGpgyDes01IfMwWTbQfe76p8ylbeoIlOs.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.142.108' (ED25519) to the list of known hosts.
pi@192.168.142.108's password:
Linux cubesatsim 6.1.21+ #1642 Mon Apr  3 17:19:14 BST 2023 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Feb 14 13:30:31 2025 from 192.168.1.91

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@cubesatsim:~ $
```

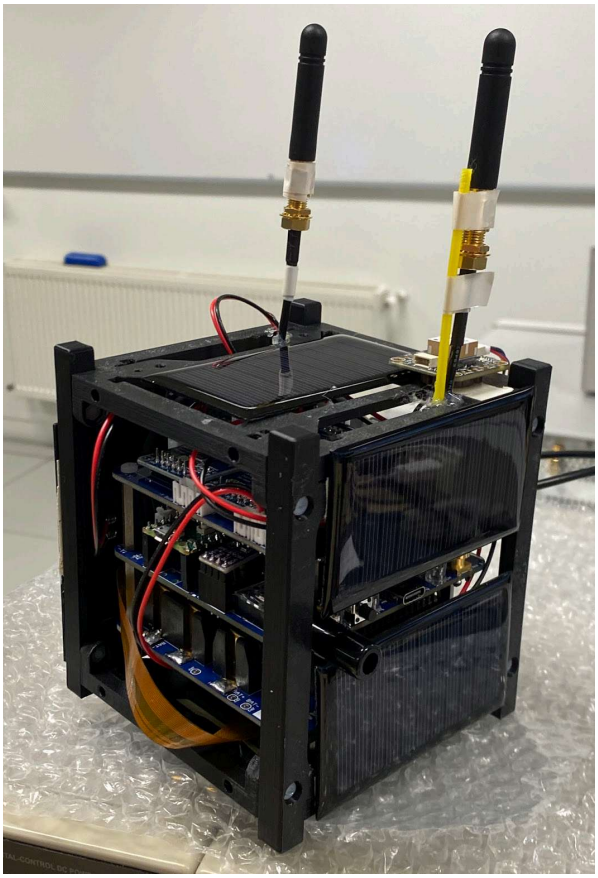
Ojo! La Ip puede haber cambiado. Si estás en la misma red que el ordenador ejecuta esto y verás la IP:

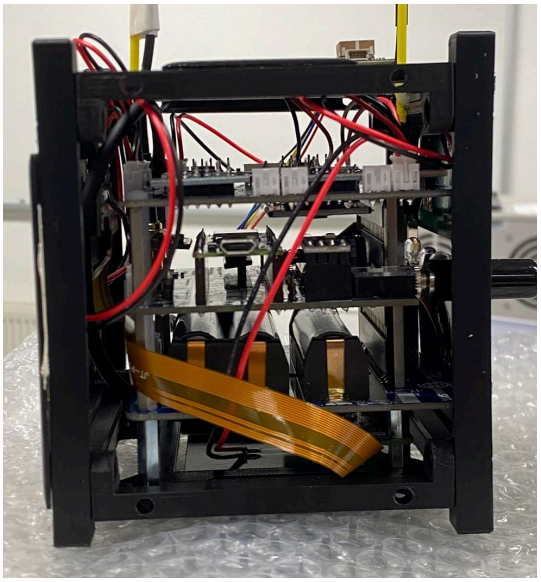
IMPORTANTE!!!!!!! NO APAGAR EL CUBO QUITÁNDOLO DE LA CORRIENTE DIRECTAMENTE. Primero conectarse por SSH (por terminal) y introducir el comando >**sudo shutdown now** una vez hecho, esperar 30 segundos y desconectarlo. Importante para que no corromper el código. Ha pasado y hay que volver a instalar todo de cero.

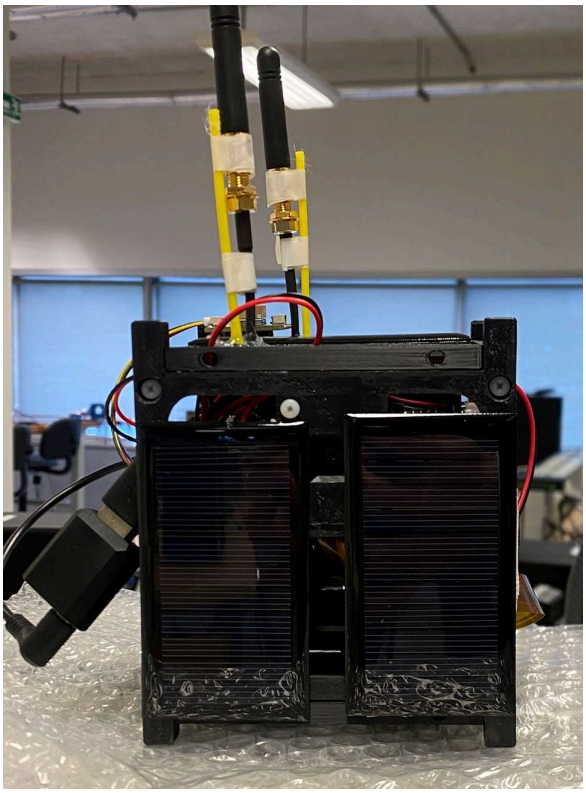
Imágenes del Cubo

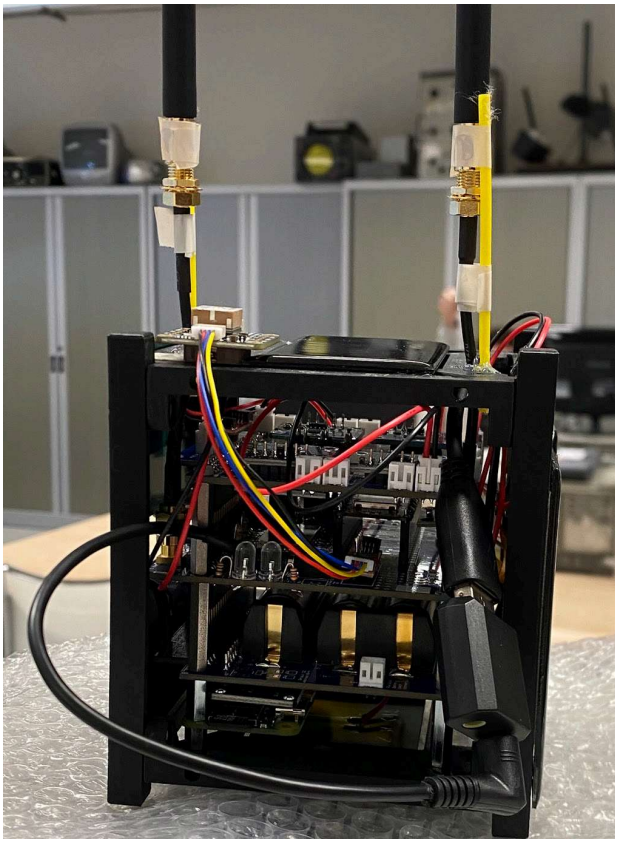


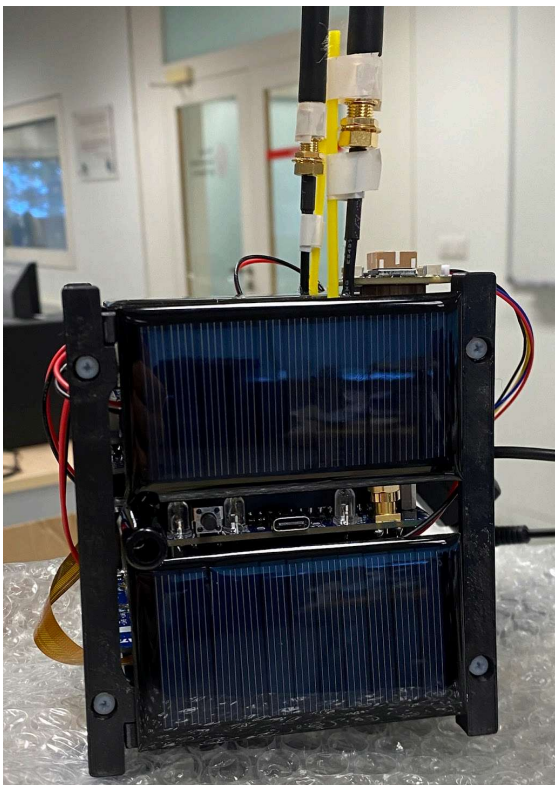






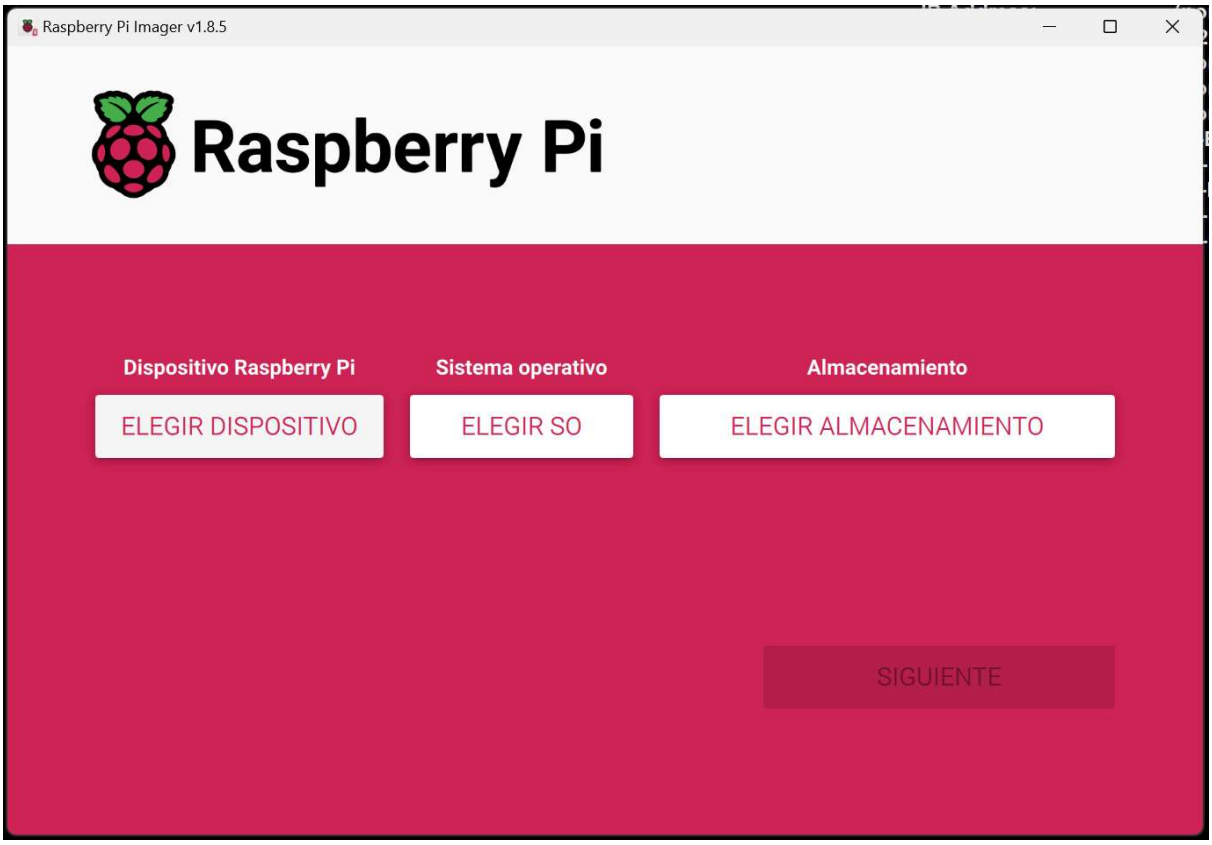


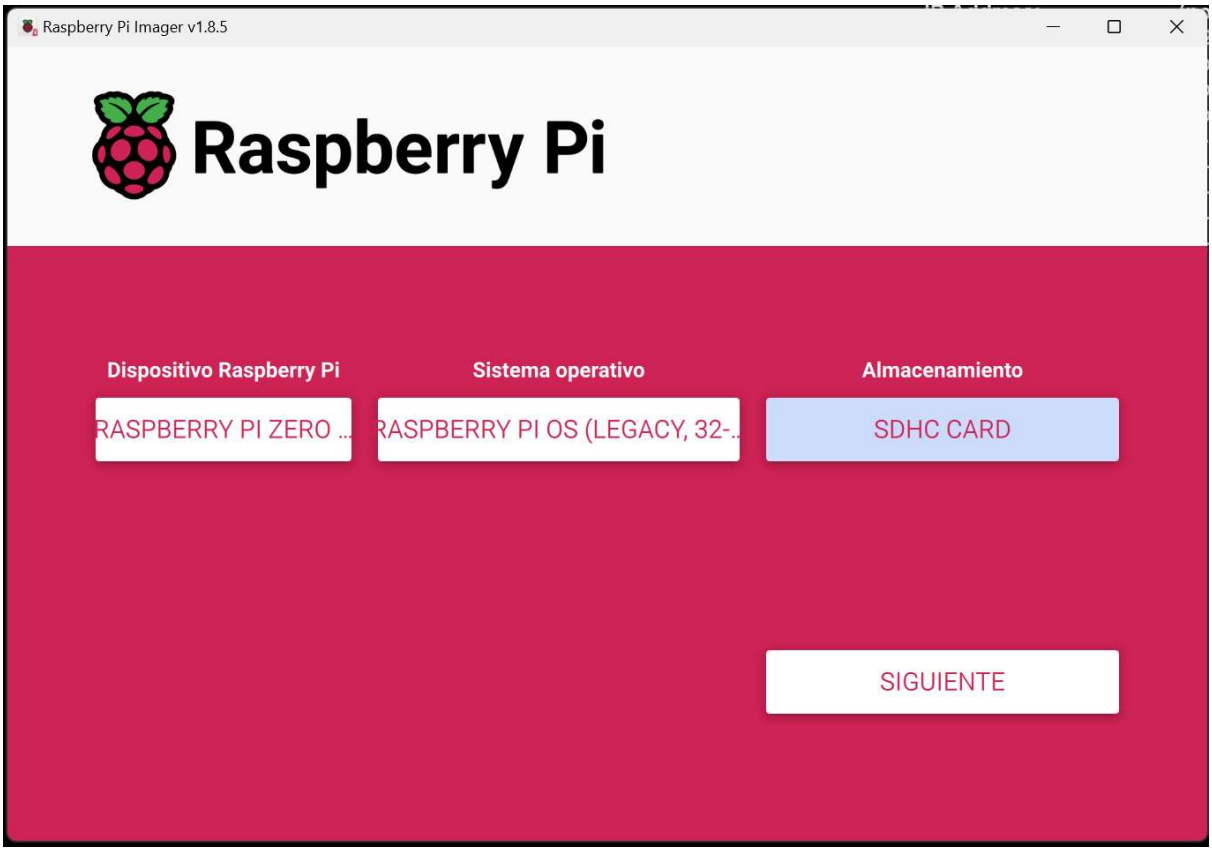




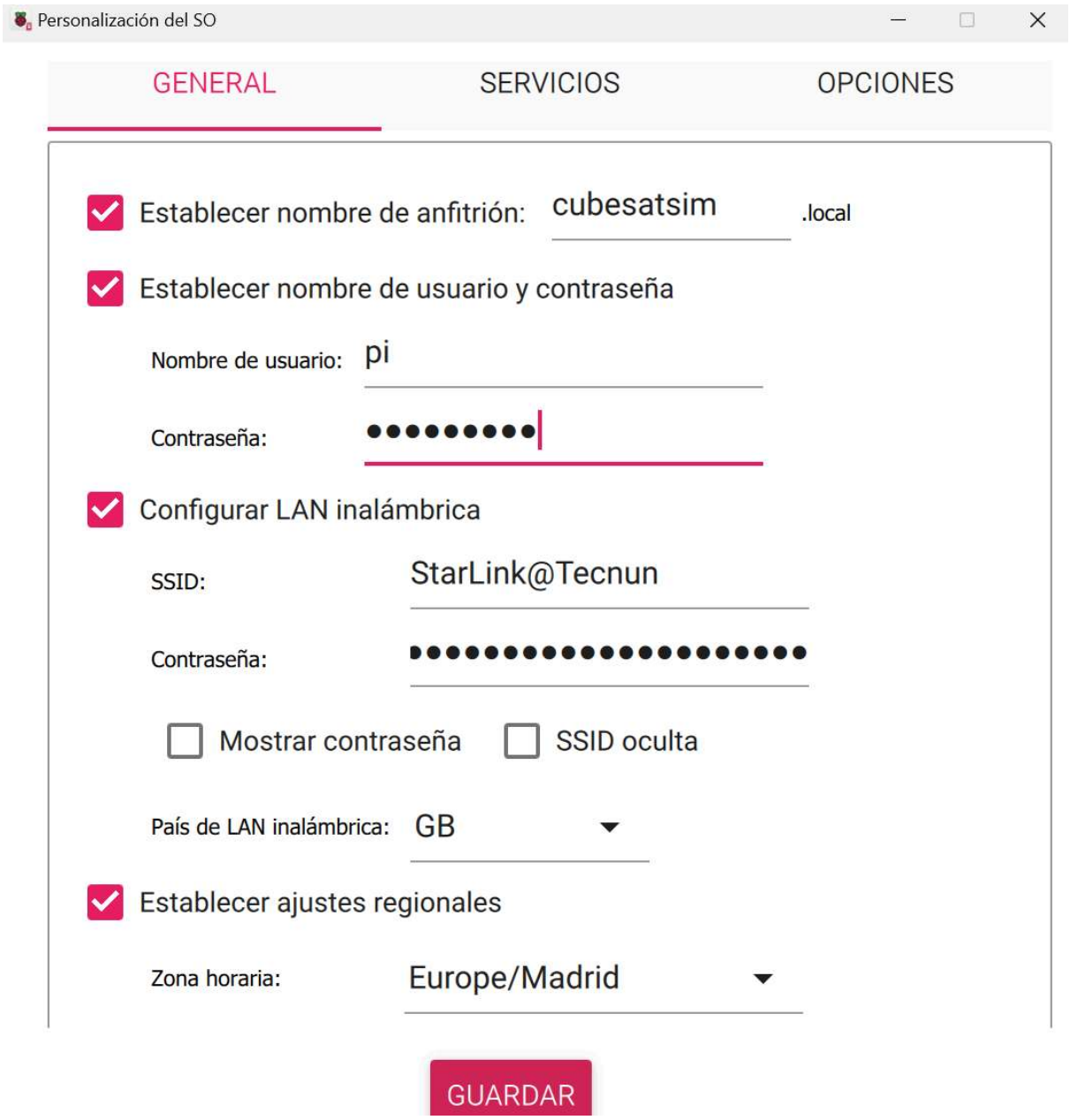
MONTAJE + INSTALACIÓN

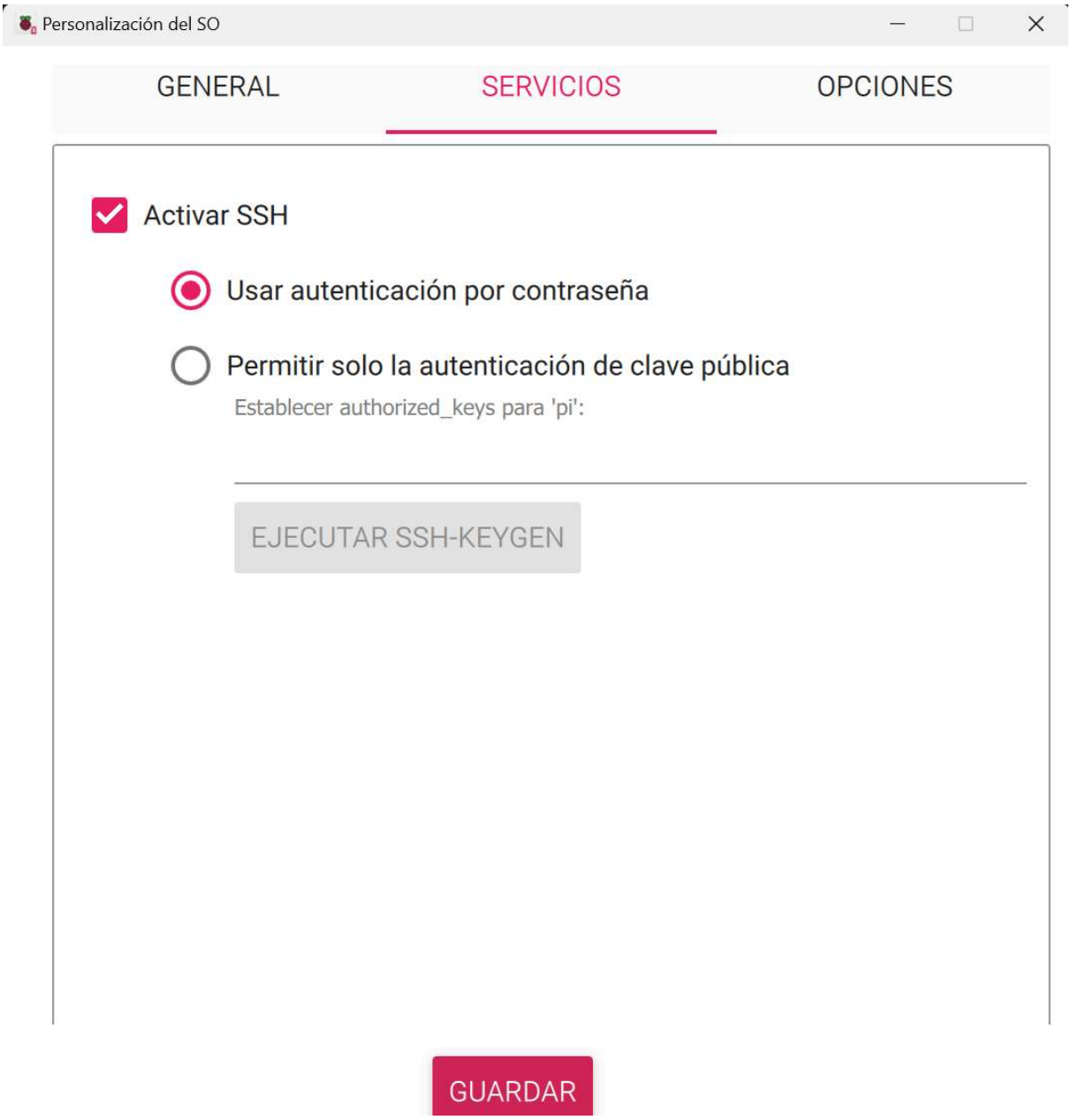
1. Ground Station configured
2. Main Board 1 completed
3. Raspberry Pi Zero W configured. La buena está en una caja blanca marcada, tiene la tarjeta SD introducida.




Raspberry Pi Imager v1.8.5
Raspberry Pi
Dispositivo Raspberry Pi
Sistema operativo
Almacenamiento
RASPBERRY PI ZERO ...
RASPBERRY PI OS (LEGACY, 32-...
SDHC CARD
SIGUIENTE

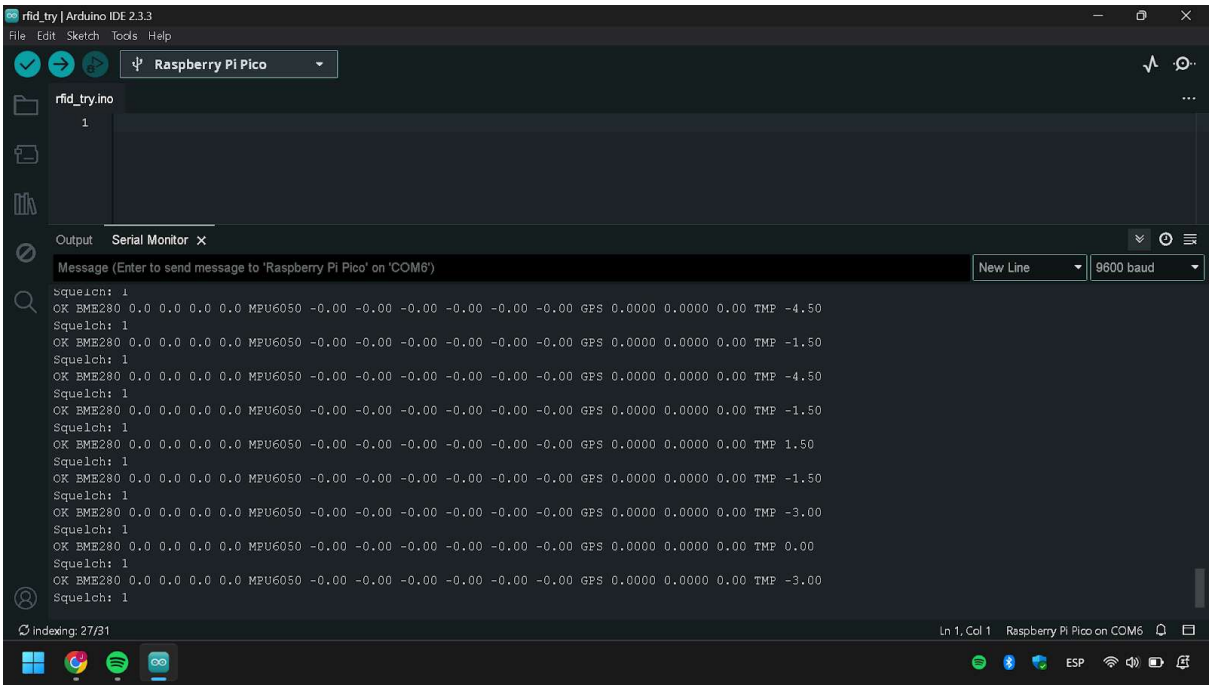

Raspberry Pi Imager v1.8.5
Raspberry Pi
¿Usar la personalización del SO?
X
¿Desea aplicar los ajustes de personalización del SO?
EDITAR AJUSTES
NO, BORRAR AJUSTES
SÍ
NO
SIGUIENTE


Personalización del SO
GENERAL
SERVICIOS
OPCIONES
Establecer nombre de anfitrión:
cubesatsim
.local
Establecer nombre de usuario y contraseña
Nombre de usuario:
pi
Contraseña:
Configurar LAN inalámbrica
SSID:
StarLink@Tecnun
Contraseña:
Mostrar contraseña
SSID oculta
País de LAN inalámbrica:
GB
Establecer ajustes regionales
Zona horaria:
Europe/Madrid
GUARDAR



4. Raspberry Pi Pico configured. El bueno es el que está en el lateral de la caja, el único que se puede sacar y está abierto. Ya tiene el archivo uf2 instalado. Ya está hecha la prueba y recibe.

SR105U (UHF:400M-480MHZ) is the transmission module. Módulo de transmisión de datos a larga distancia e intercomunicador de voz inalámbrico ultra compacto y de alto rendimiento. Tiene un chip transceptor de radiofrecuencia de alto rendimiento, un microcontrolador y un amplificador de potencia de radiofrecuencia. El controlador externo puede configurar los parámetros operativos del módulo y controlar todo el transceptor del módulo a través de una comunicación UART (nivel TTL) estándar. El módulo solo necesita una antena externa, un micrófono y un amplificador de audio para formar un intercomunicador o transceptor digital completo. Después de configurar los parámetros del módulo, se puede apagar y guardar. En aplicaciones simples, no se requiere un microordenador externo de un solo chip.



5. Software Installation completed. Prueba hecha y funciona hardware. Falta testear recibir la señal clara al ground station.

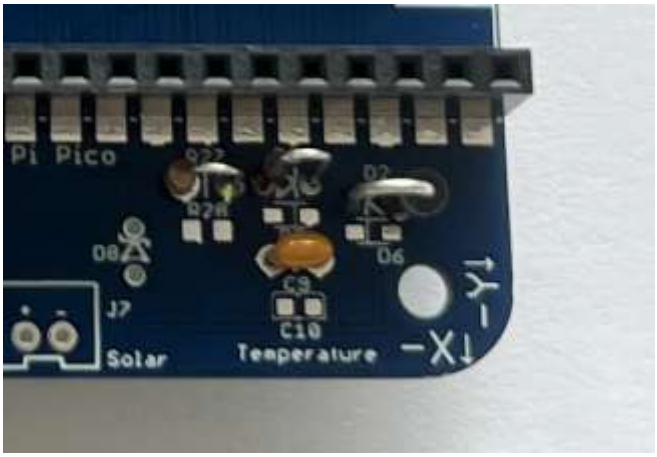
AMSAT MODES: When the push button is pressed and held, the green LED should blink rapidly in this sequence: 1 quick blink, 2 quick blinks, 3 quick blinks, 4 quick blinks, 3 slow blinks. Releasing the button after one of the quick blink sequences will put the CubeSatSim in that mode, and the green LED will stop blinking

1. APRS (Automatic Packet Reporting System)
   Digital comm protocol used to send real-time data, like GPS coordinates, weather info or telemetry using packets over radio.
2. FSK (Frequency Shift Keying)
   Digital modulation. Telemetry and data transmission. Simple and resistant to noise. Low-speed digital communication.
3. BPSK (Binary Phase Shift Keying)
   Phase modulation, data representation in 0º and 180º to convey binary info. More efficient than FSK for higher data rates. Common for advanced AMSAT satellites for telemetry and control. More bandwidth-efficient.
4. SSTV (Slow Scan Television)
   Analog transmission mode that sends images over radio frequencies. Sending images from space to ground stations. Transmits the video over narrow bandwidths. Arduino and Raspberry can decode SSTV signals received and display them as images.
5. CW (Continuous Wave)
   Simplest and oldest forms of communication, using Morse code. A continuous wave signal is either on or off. Highly efficient for long-distance communication with low power. Ideal for satellite beacons or emergency signals from AMSAT satellites.

NOTE: do not disconnect the BOARD before shutting down (no leds on nor blinking). Hold until all leds are off, unless red led if it is plugged in.

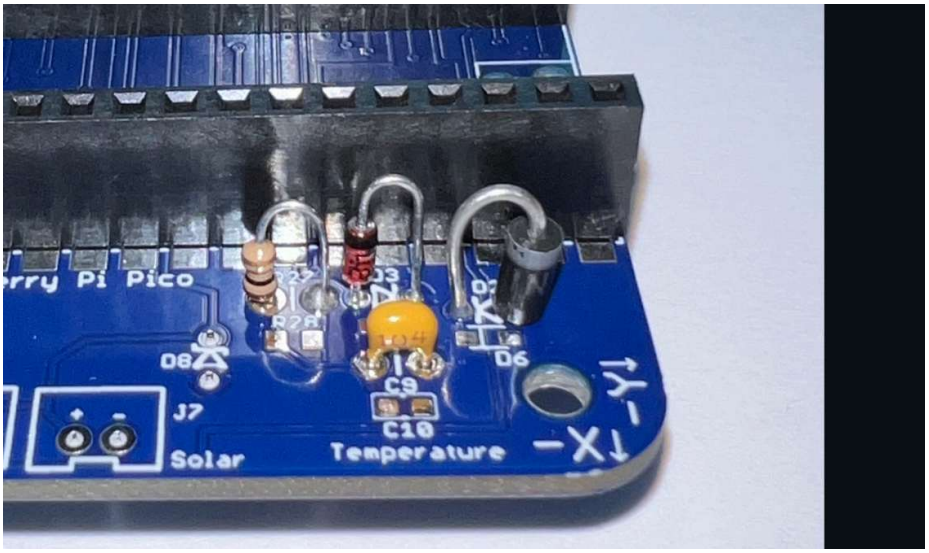
If you don't hear anything or see anything for the FM modes (APRS, SSTV, and CW), try listening on 450.000 MHz for the signal. If you hear the signal there, it means the FM Transceiver module hasn't had its frequency set to 434.9 MHz by the Pi Zero 2 software. Try powering down everything and then powering up again.

6. BME280 sensor (small purple board) and the MPU6050 Gyro and Accelerometer sensor (larger blue board) soldered.
7. He soldado esta parte de aquí, y el pin de 'solar' para conectar el conector de la placa solar



Pero falta soldar la resistencia de 10k (según github), no la encuentro en el material

8. LED2 y R30 resistor soldered



9. Test de transmisión hecho. El Ground Station recibe picos en 434.9 MHz cuando el LED azul se enciende (cuando transmite). Pero no logra decodificar y seguir la aeronave.

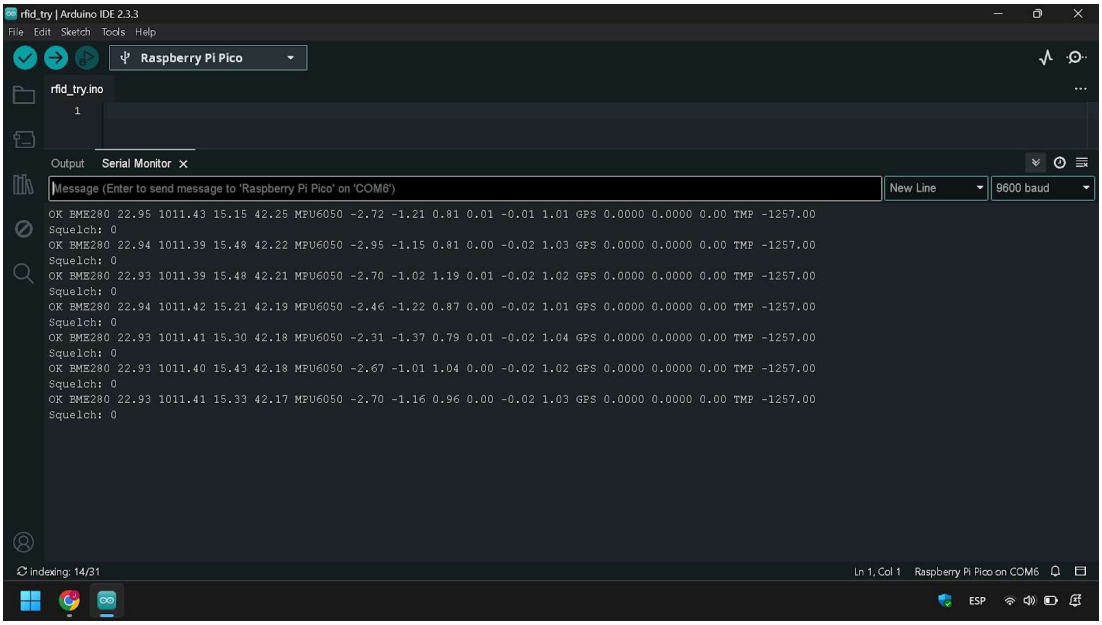
Todo hecho hasta el paso antes del paso 4.3 Antenna Install. Falta colocar la resistencia mencionada previamente y conectar el cable al jack de 2.5mm.

We need an usb-microusb adapter in order to connect a keyboard to the Raspberry Pi Zero W

La resistencia en la posición R27, ESTÁ MAL EL GITHUB. Pone que es una resistencia de 10k Ohmios pero son 100 Ohmios. Sólo en un caso. Resistencia R27 soldada.

Soldadas dos soportes para las antenas dipolos, conectadas ambos cables y los dipolos.

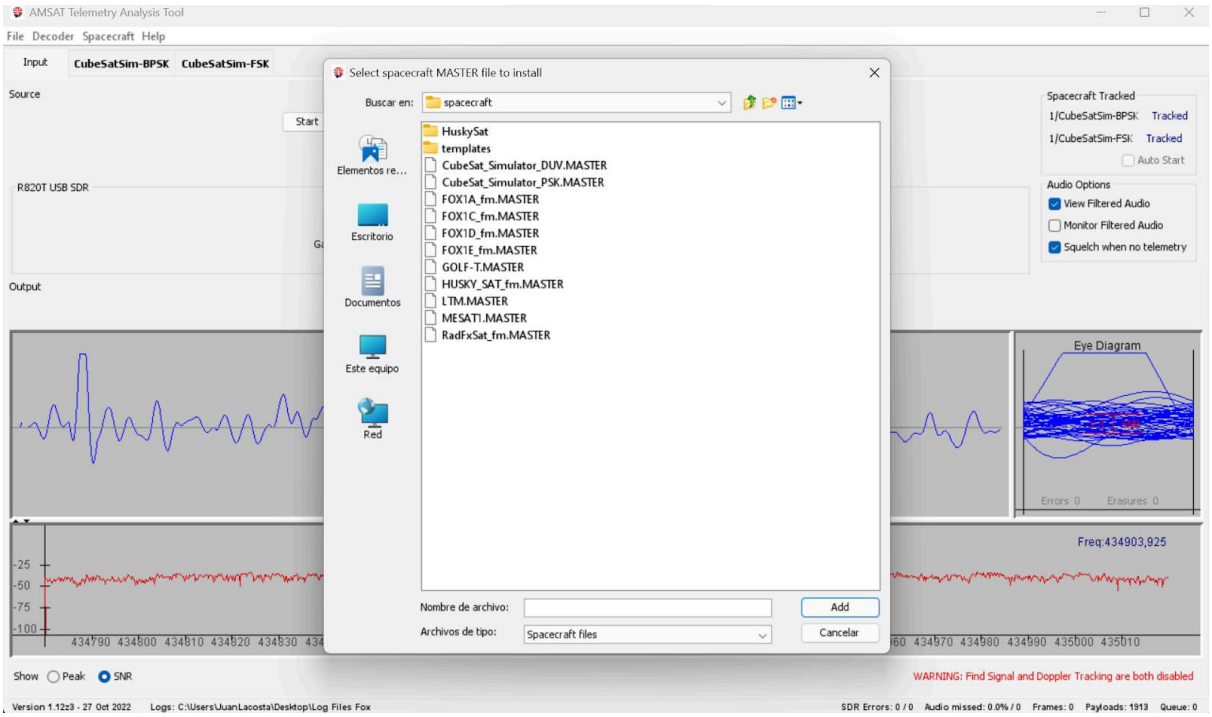
Test realizado. Conectando directamente el Pico por cable micro usb al ordenador, se reciben los datos.

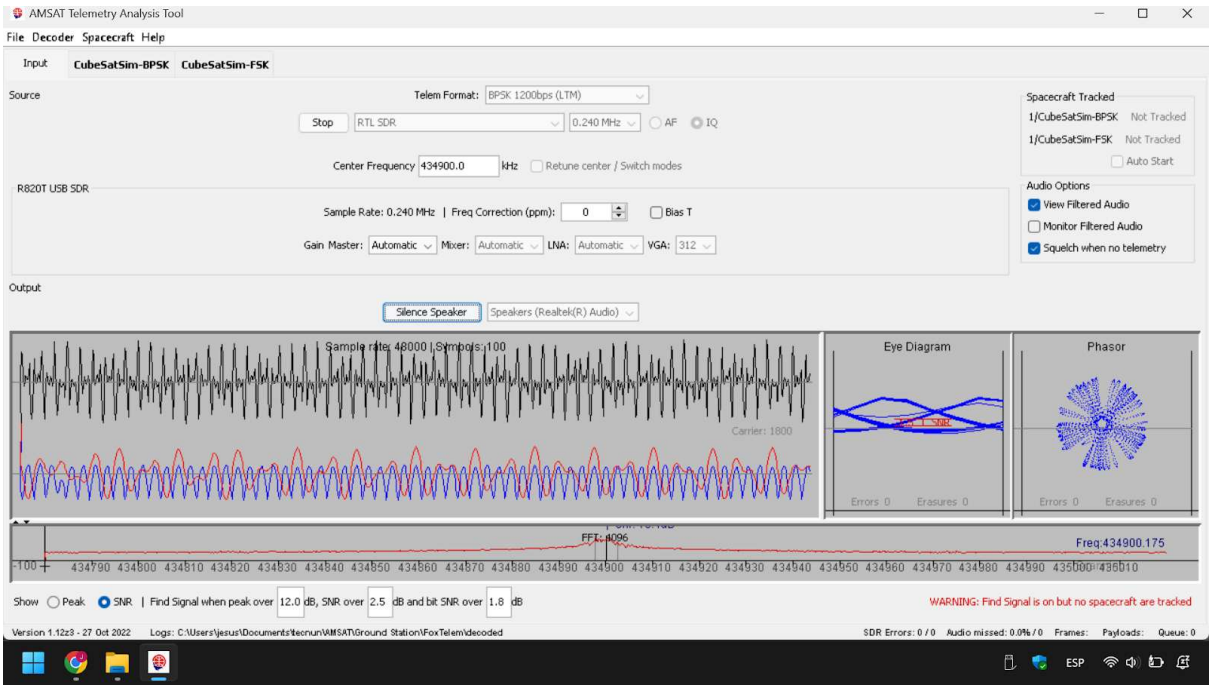


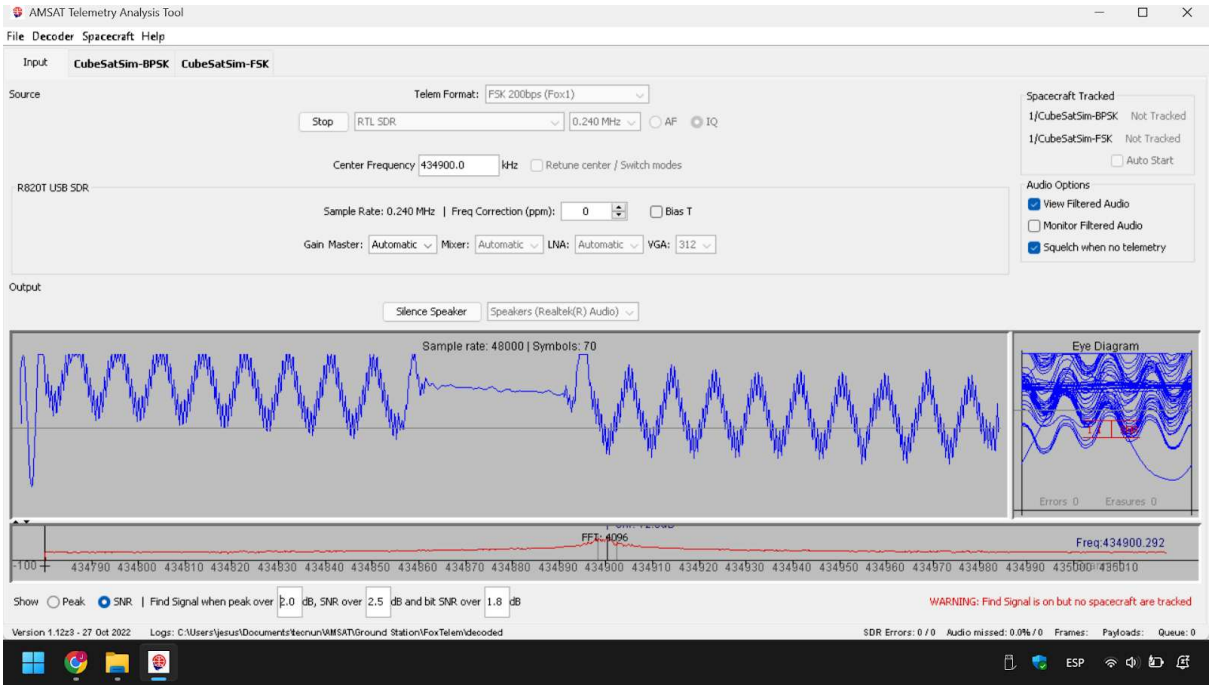
Giroscopio testeado y funcionando (Sensor MPU-6050). El sensor de temperatura marca una temperatura de -1200 grados. Va de locos #ironia. El sensor BME/BMP 280 (sensor morado) mide la presion, temperatura y humedad.

Vemos con el software FoxTelem, cuando se enciende la luz azul (transmite una señal), lo recibe y suena, se observa un pico.

Añadir spacecraft:


AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Start
R820T USB SDR
Output
Select spacecraft MASTER file to install
Buscar en:
spacecraft
Elementos re...
Escritorio
Documentos
Este equipo
Red
HuskySat
templates
CubeSat_Simulator_DUV.MASTER
CubeSat_Simulator_PSK.MASTER
FOX1A_fm.MASTER
FOX1C_fm.MASTER
FOX1D_fm.MASTER
FOX1E_fm.MASTER
GOLF-T.MASTER
HUSKY_SAT_fm.MASTER
LTM.MASTER
MESAT1.MASTER
RadFxSat_fm.MASTER
Nombre de archivo:
Add
Archivos de tipo:
Spacecraft files
Cancelar
Spacecraft Tracked
1/CubeSatSim-BPSK Tracked
1/CubeSatSim-FSK Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Eye Diagram
Errors 0 Erasures 0
Freq:434903,925
Show Peak SNR
WARNING: Find Signal and Doppler Tracking are both disabled
Version 1.12z3 - 27 Oct 2022
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 0 Payloads: 1913 Queue: 0


AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Telem Format:
BPSK 1200bps (LTM)
Stop
RTL SDR
0.240 MHz
AF
IQ
Center Frequency
434900.0
kHz
Retune center / Switch modes
R820T USB SDR
Sample Rate: 0.240 MHz | Freq Correction (ppm):
0
Bias T
Gain Master:
Automatic
Mixer:
Automatic
LNA:
Automatic
VGA:
312
Spacecraft Tracked
1/CubeSatSim-BPSK Not Tracked
1/CubeSatSim-FSK Not Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Output
Silence Speaker
Speakers (Realtek(R) Audio)
Sample rate: 48000 | Symbols: 100
Carrier: 1800
Eye Diagram
Phasor
Errors 0 Erasures 0
FFT: 4096
Freq:434900.175
Show Peak SNR | Find Signal when peak over 12.0 dB, SNR over 2.5 dB and bit SNR over 1.8 dB
WARNING: Find Signal is on but no spacecraft are tracked
Version 1.12z3 - 27 Oct 2022
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: Payloads: Queue: 0
ESP



Batteries tested.

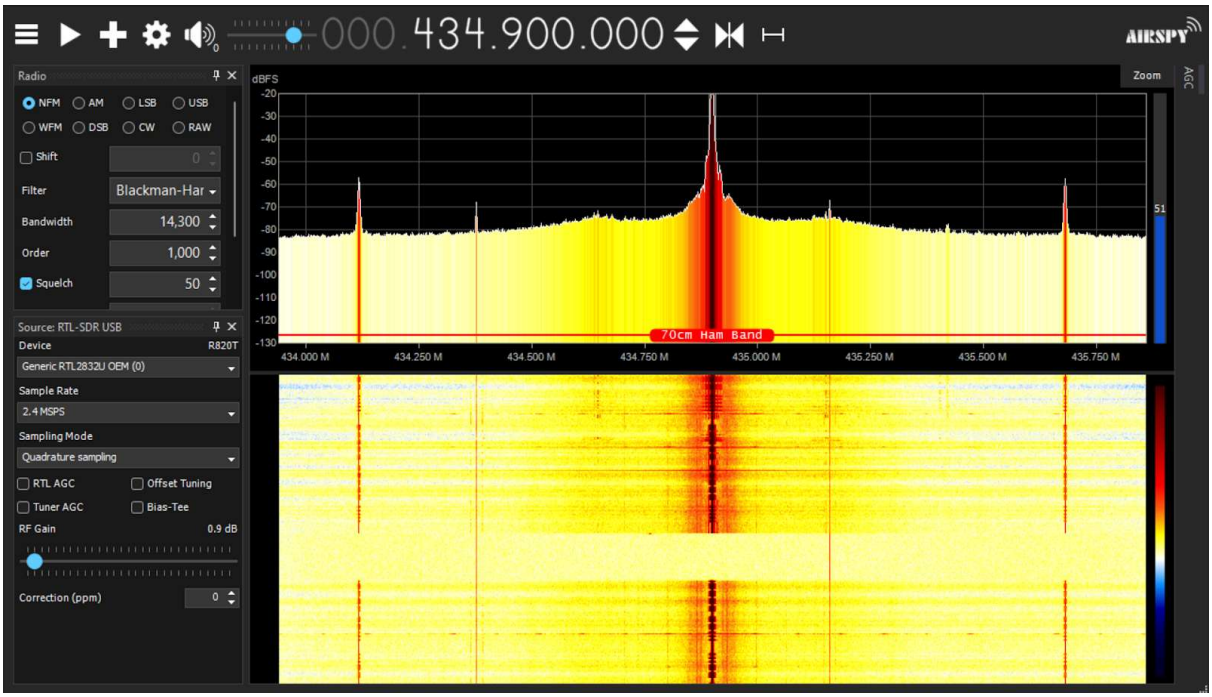
Solar Panels, all tested and working.

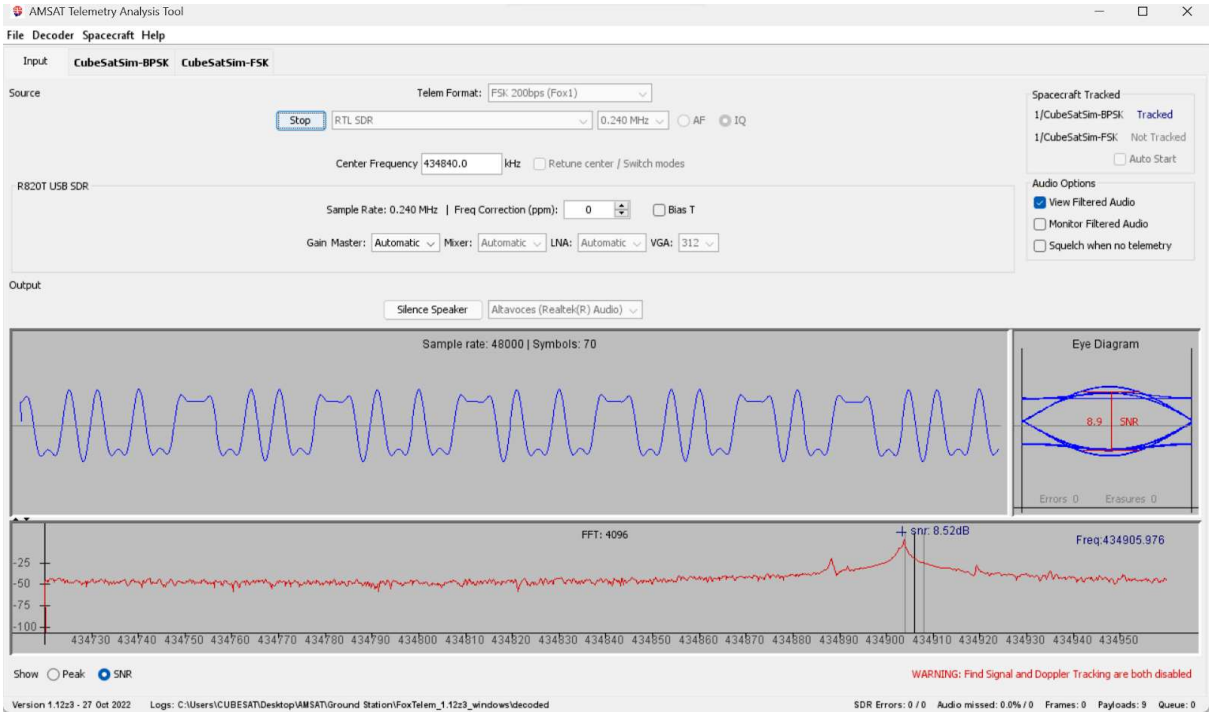
Materiales que necesitamos:

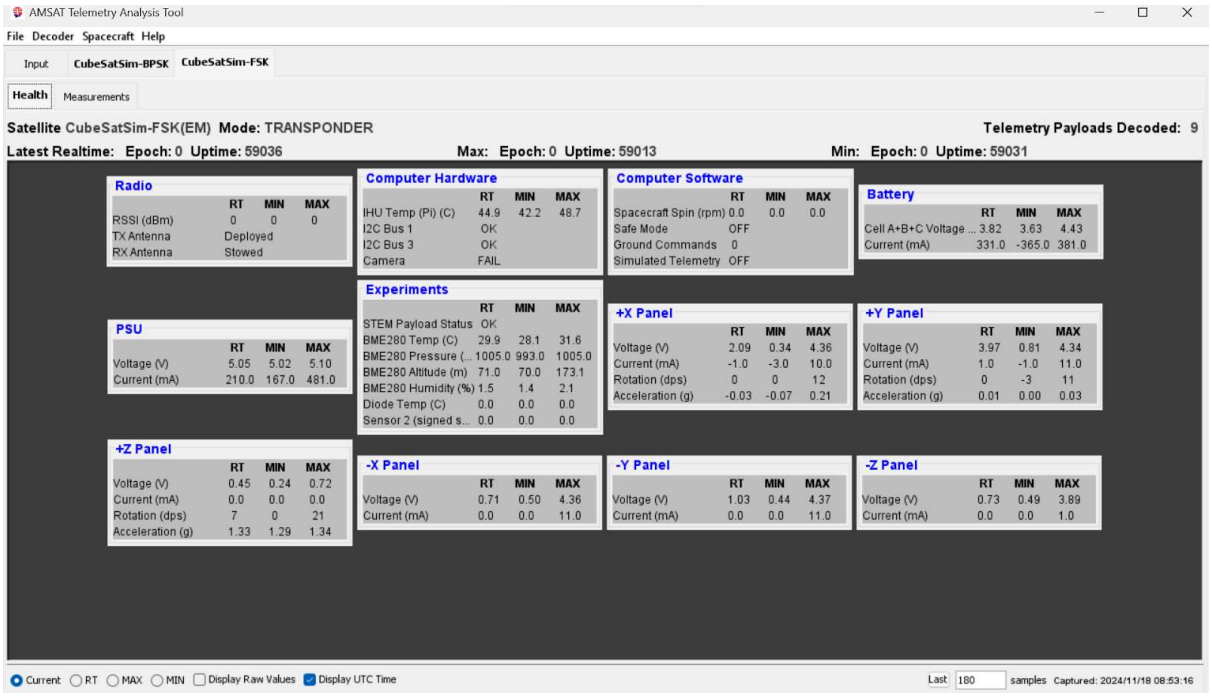
1. Bridas (finas), Zip ties en inglés, en verdad con un par bastan, pero pillar mas por si acaso.
2. El cable que se conecta al jack de 2.5mm que no se para que sirve. Es un cable con rizos en plan inductancia negro (en las fotos del github)

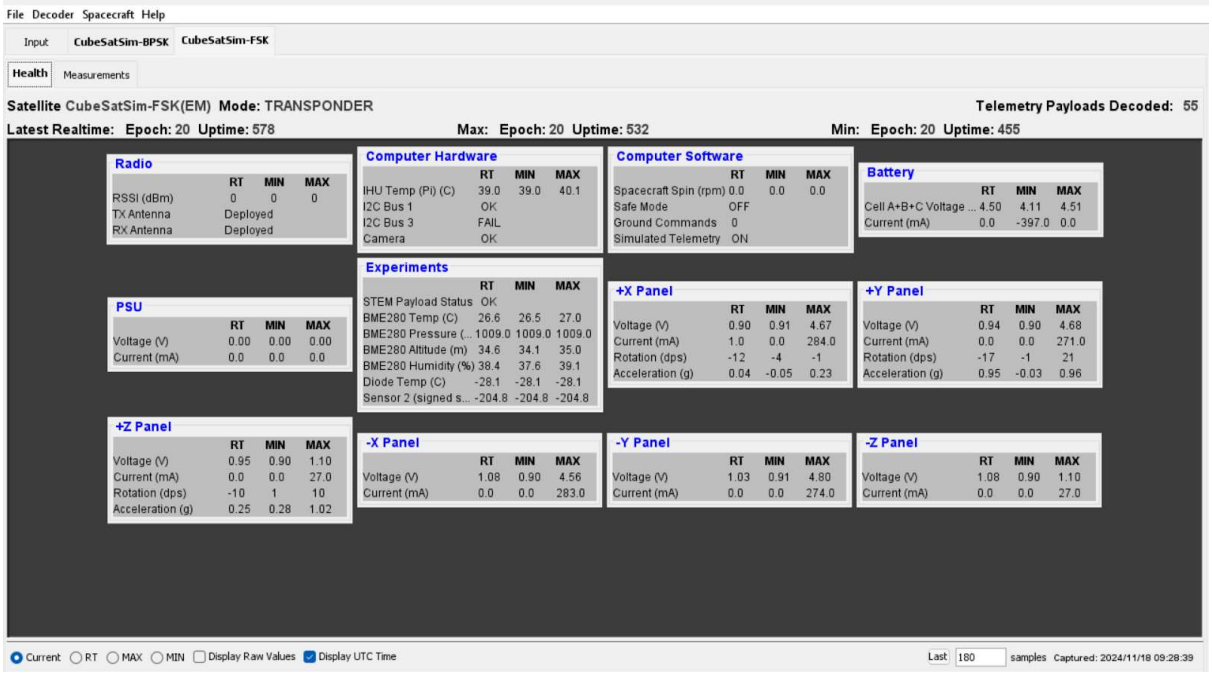
He hecho la prueba de conectar el Battery Board al Main Board. Funciona.

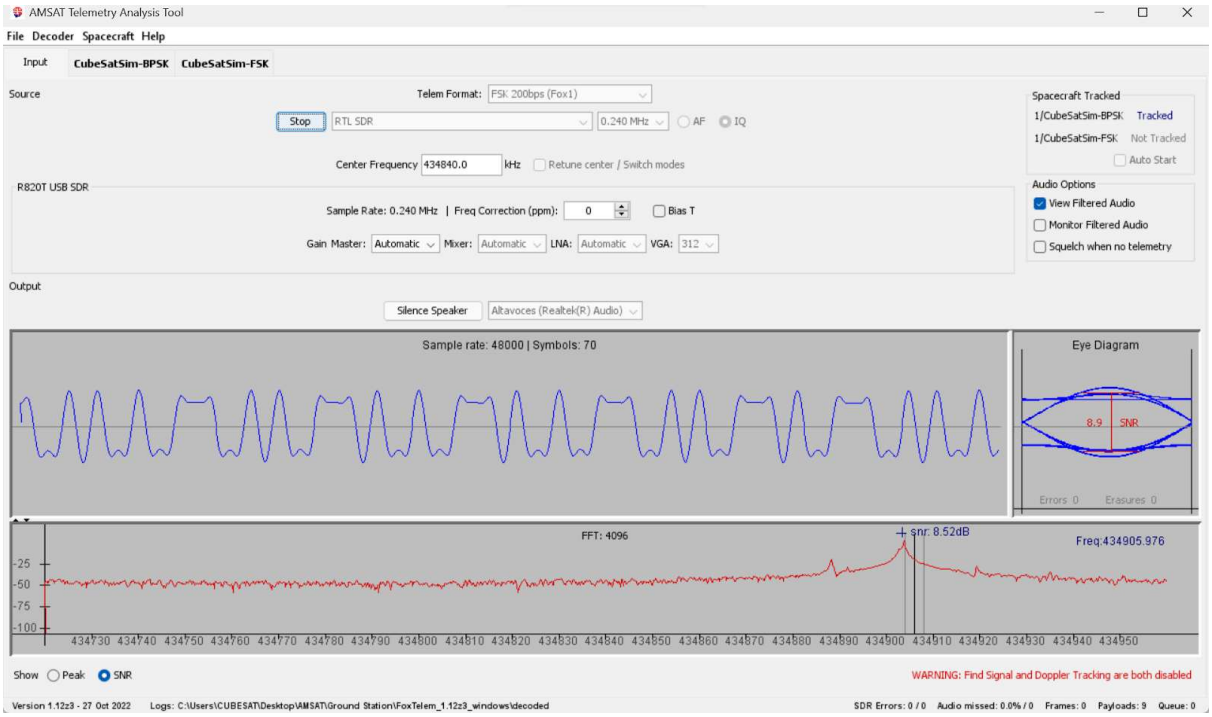
Hemos hecho pruebas con FoxTelem y SDR y hemos obtenido estos resultados:

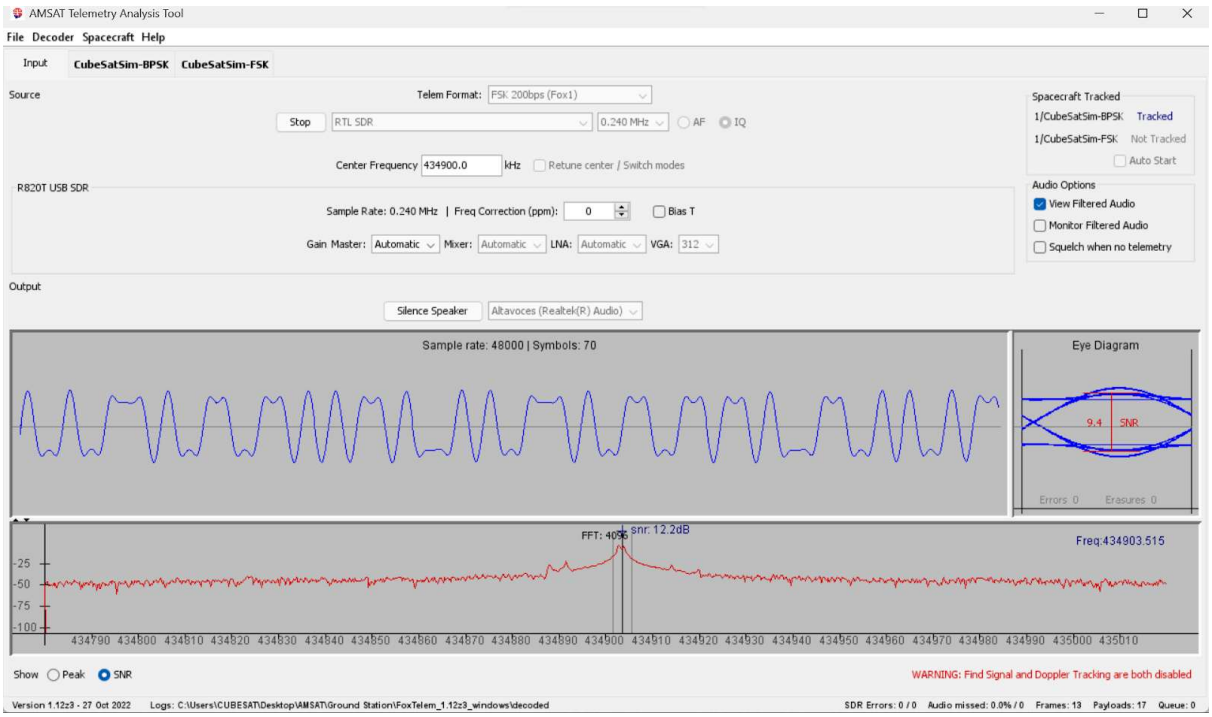




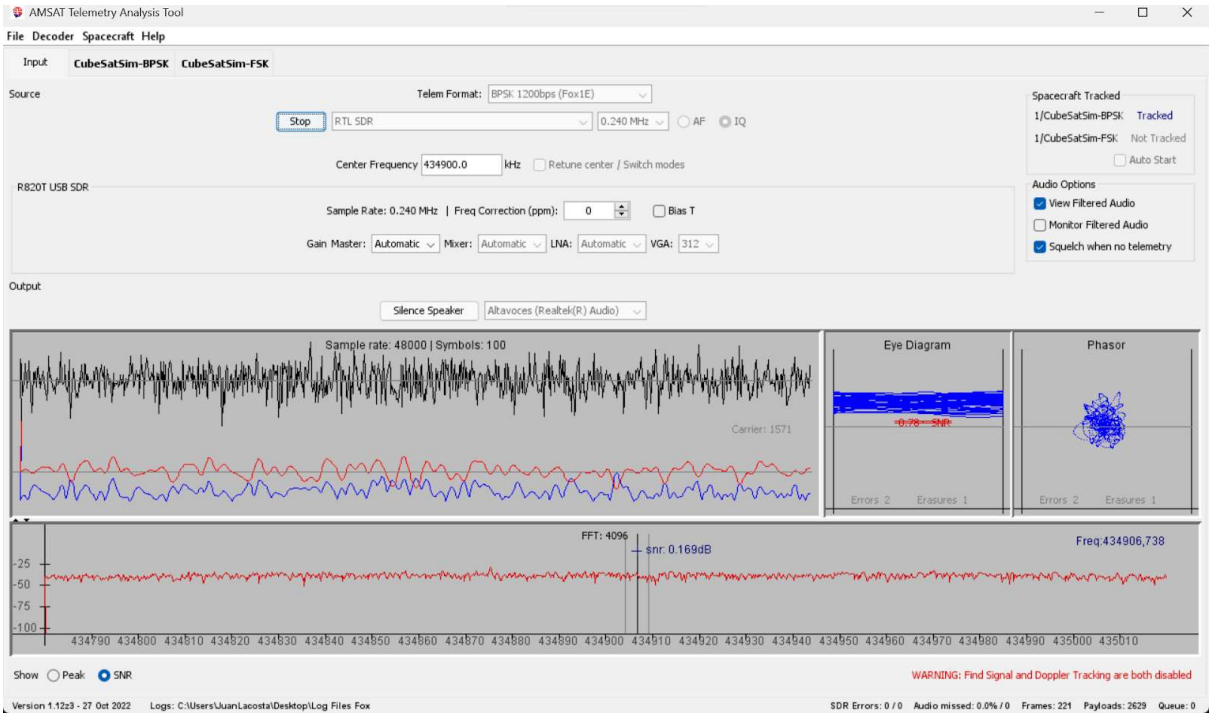

AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input CubeSatSim-BPSK CubeSatSim-FSK
Health Measurements
Satellite CubeSatSim-FSK(EM) Mode: TRANSPONDER
Telemetry Payloads Decoded: 9
Latest Realtime: Epoch: 0 Uptime: 59036
Max: Epoch: 0 Uptime: 59013
Min: Epoch: 0 Uptime: 59031
Radio
RT MIN MAX
RSSI (dBm) 0 0 0
TX Antenna Deployed
RX Antenna Stowed
Computer Hardware
RT MIN MAX
IHU Temp (PI) (C) 44.9 42.2 48.7
I2C Bus 1 OK
I2C Bus 3 OK
Camera FAIL
Computer Software
RT MIN MAX
Spacecraft Spin (rpm) 0.0 0.0 0.0
Safe Mode OFF
Ground Commands 0
Simulated Telemetry OFF
Battery
RT MIN MAX
Cell A+B+C Voltage ... 3.82 3.63 4.43
Current (mA) 331.0 -365.0 381.0
Experiments
RT MIN MAX
STEM Payload Status OK
BME280 Temp (C) 29.9 28.1 31.6
BME280 Pressure (... 1005.0 993.0 1005.0
BME280 Altitude (m) 71.0 70.0 173.1
BME280 Humidity (%) 1.5 1.4 2.1
Diode Temp (C) 0.0 0.0 0.0
Sensor 2 (signed s... 0.0 0.0 0.0
+X Panel
RT MIN MAX
Voltage (V) 2.09 0.34 4.36
Current (mA) -1.0 -3.0 10.0
Rotation (dps) 0 0 12
Acceleration (g) -0.03 -0.07 0.21
+Y Panel
RT MIN MAX
Voltage (V) 3.97 0.81 4.34
Current (mA) 1.0 -1.0 11.0
Rotation (dps) 0 -3 11
Acceleration (g) 0.01 0.00 0.03
PSU
RT MIN MAX
Voltage (V) 5.05 5.02 5.10
Current (mA) 210.0 167.0 481.0
+Z Panel
RT MIN MAX
Voltage (V) 0.45 0.24 0.72
Current (mA) 0.0 0.0 0.0
Rotation (dps) 7 0 21
Acceleration (g) 1.33 1.29 1.34
-X Panel
RT MIN MAX
Voltage (V) 0.71 0.50 4.36
Current (mA) 0.0 0.0 11.0
-Y Panel
RT MIN MAX
Voltage (V) 1.03 0.44 4.37
Current (mA) 0.0 0.0 11.0
-Z Panel
RT MIN MAX
Voltage (V) 0.73 0.49 3.89
Current (mA) 0.0 0.0 1.0
Current RT MAX MIN Display Raw Values Display UTC Time
Last 180 samples Captured: 2024/11/18 08:53:16

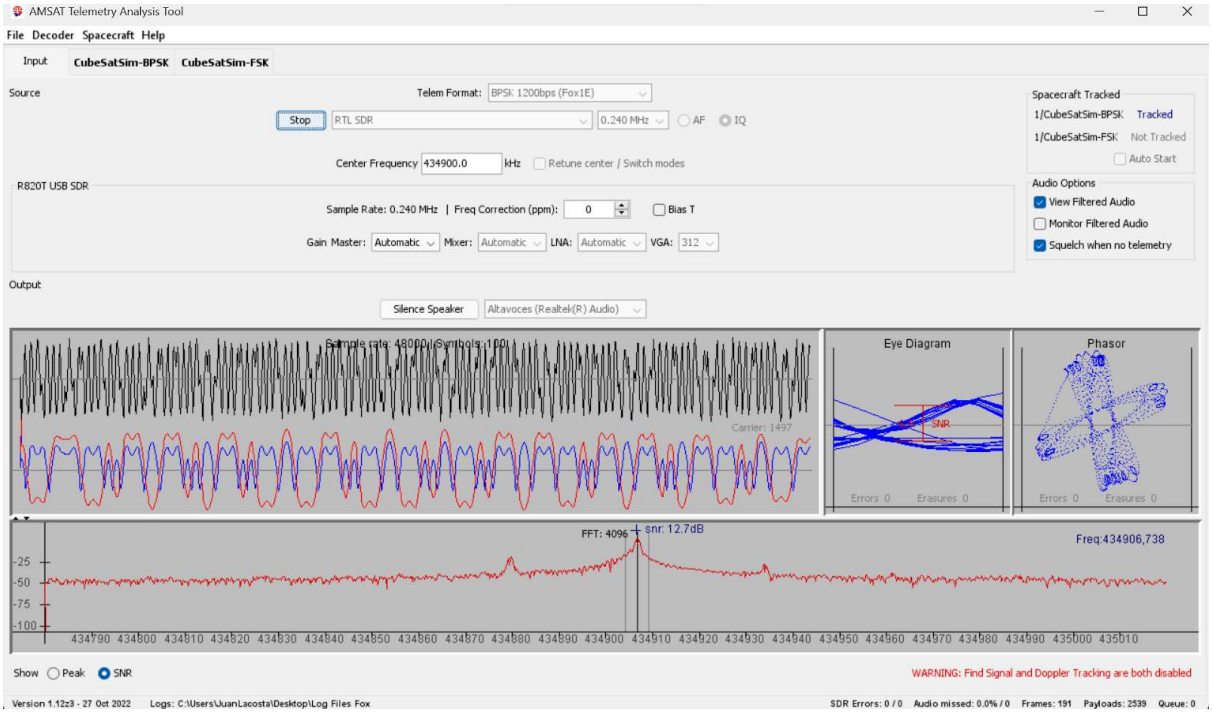

File Decoder Spacecraft Help
Input CubeSatSim-BPSK CubeSatSim-FSK
Health Measurements
Satellite CubeSatSim-FSK(EM) Mode: TRANSPONDER
Telemetry Payloads Decoded: 55
Latest Realtime: Epoch: 20 Uptime: 578
Max: Epoch: 20 Uptime: 532
Min: Epoch: 20 Uptime: 455
Radio
RT MIN MAX
RSSI (dBm) 0 0 0
TX Antenna Deployed
RX Antenna Deployed
Computer Hardware
RT MIN MAX
IHU Temp (PI) (C) 39.0 39.0 40.1
I2C Bus 1 OK
I2C Bus 3 FAIL
Camera OK
Computer Software
RT MIN MAX
Spacecraft Spin (rpm) 0.0 0.0 0.0
Safe Mode OFF
Ground Commands 0
Simulated Telemetry ON
Battery
RT MIN MAX
Cell A+B+C Voltage ... 4.50 4.11 4.51
Current (mA) 0.0 -397.0 0.0
Experiments
RT MIN MAX
STEM Payload Status OK
BME280 Temp (C) 26.6 26.5 27.0
BME280 Pressure (... 1009.0 1009.0 1009.0
BME280 Altitude (m) 34.6 34.1 35.0
BME280 Humidity (%) 38.4 37.6 39.1
Diode Temp (C) -28.1 -28.1 -28.1
Sensor 2 (signed s... -204.8 -204.8 -204.8
+X Panel
RT MIN MAX
Voltage (V) 0.90 0.91 4.67
Current (mA) 1.0 0.0 284.0
Rotation (dps) -12 -4 -1
Acceleration (g) 0.04 -0.05 0.23
+Y Panel
RT MIN MAX
Voltage (V) 0.94 0.90 4.68
Current (mA) 0.0 0.0 271.0
Rotation (dps) -17 -1 21
Acceleration (g) 0.95 -0.03 0.96
PSU
RT MIN MAX
Voltage (V) 0.00 0.00 0.00
Current (mA) 0.0 0.0 0.0
+Z Panel
RT MIN MAX
Voltage (V) 0.95 0.90 1.10
Current (mA) 0.0 0.0 27.0
Rotation (dps) -10 1 10
Acceleration (g) 0.25 0.28 1.02
-X Panel
RT MIN MAX
Voltage (V) 1.08 0.90 4.56
Current (mA) 0.0 0.0 283.0
-Y Panel
RT MIN MAX
Voltage (V) 1.03 0.91 4.80
Current (mA) 0.0 0.0 274.0
-Z Panel
RT MIN MAX
Voltage (V) 1.08 0.90 1.10
Current (mA) 0.0 0.0 27.0
Current RT MAX MIN Display Raw Values Display UTC Time
Last 180 samples Captured: 2024/11/18 09:28:39


AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Telem Format: FSK 200bps (Fox1)
Stop
RTL SDR
0.240 MHz
AF
IQ
Center Frequency 434840.0 kHz
Retune center / Switch modes
R820T USB SDR
Sample Rate: 0.240 MHz | Freq Correction (ppm): 0
Bias T
Gain Master: Automatic Mixer: Automatic LNA: Automatic VGA: 312
Spacecraft Tracked
1/CubeSatSim-BPSK Tracked
1/CubeSatSim-FSK Not Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Output
Silence Speaker
Altavoces (Realtek(R) Audio)
Sample rate: 48000 | Symbols: 70
Eye Diagram
8.9 SNR
Errors 0 Erasures 0
FFT: 4096
snr: 8.52dB
Freq:434905.976
-25
-50
-75
-100
434730 434740 434750 434760 434770 434780 434790 434800 434810 434820 434830 434840 434850 434860 434870 434880 434890 434900 434910 434920 434930 434940 434950
Show Peak SNR
WARNING: Find Signal and Doppler Tracking are both disabled
Version 1.12z3 - 27 Oct 2022
Logs: C:\Users\CUBESAT\Desktop\AMSAT\Ground Station\FoxTelem_1.12z3_windows\decoded
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 0 Payloads: 9 Queue: 0

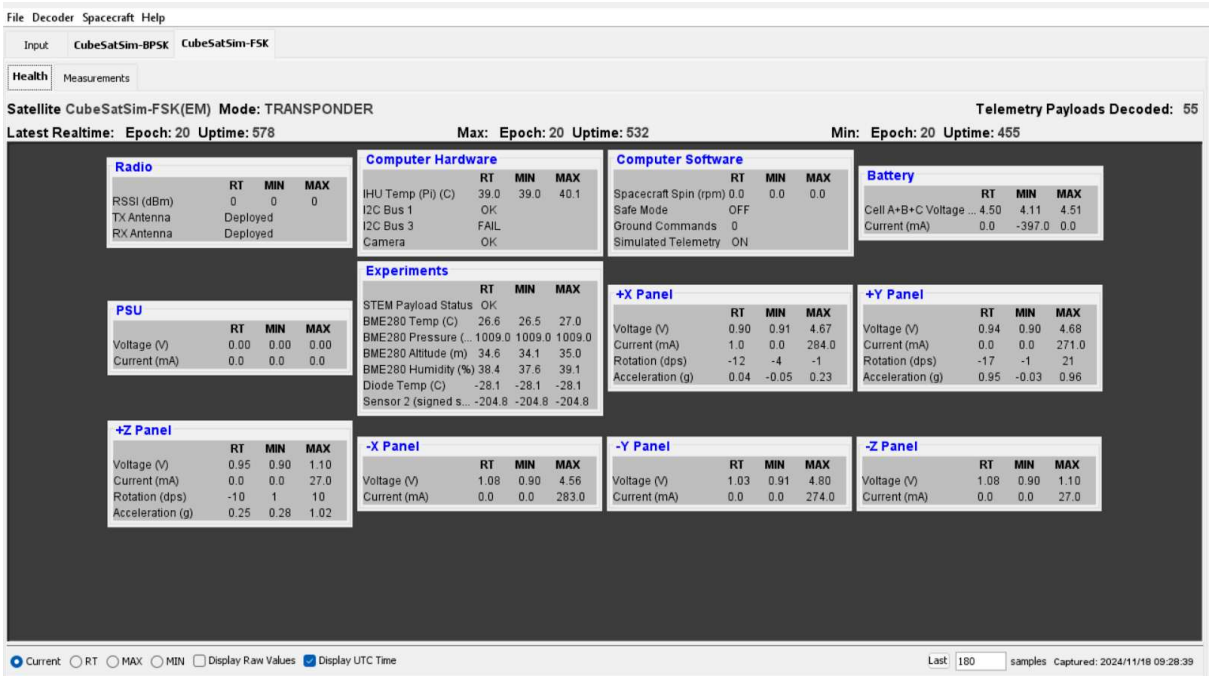

AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Telem Format: FSK 200bps (Fox1)
Stop
RTL SDR
0.240 MHz
AF
IQ
Center Frequency 434900.0 kHz
Retune center / Switch modes
R820T USB SDR
Sample Rate: 0.240 MHz | Freq Correction (ppm): 0
Bias T
Gain Master: Automatic Mixer: Automatic LNA: Automatic VGA: 312
Spacecraft Tracked
1/CubeSatSim-BPSK Tracked
1/CubeSatSim-FSK Not Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Output
Silence Speaker
Altavoces (Realtek(R) Audio)
Sample rate: 48000 | Symbols: 70
Eye Diagram
9.4 SNR
Errors 0 Erasures 0
FFT: 4096
snr: 12.2dB
Freq:434903.515
-25
-50
-75
-100
434790 434800 434810 434820 434830 434840 434850 434860 434870 434880 434890 434900 434910 434920 434930 434940 434950 434960 434970 434980 434990 435000 435010
Show Peak SNR
WARNING: Find Signal and Doppler Tracking are both disabled
Version 1.12z3 - 27 Oct 2022
Logs: C:\Users\CUBESAT\Desktop\AMSAT\Ground Station\FoxTelem_1.12z3_windows\decoded
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 13 Payloads: 17 Queue: 0

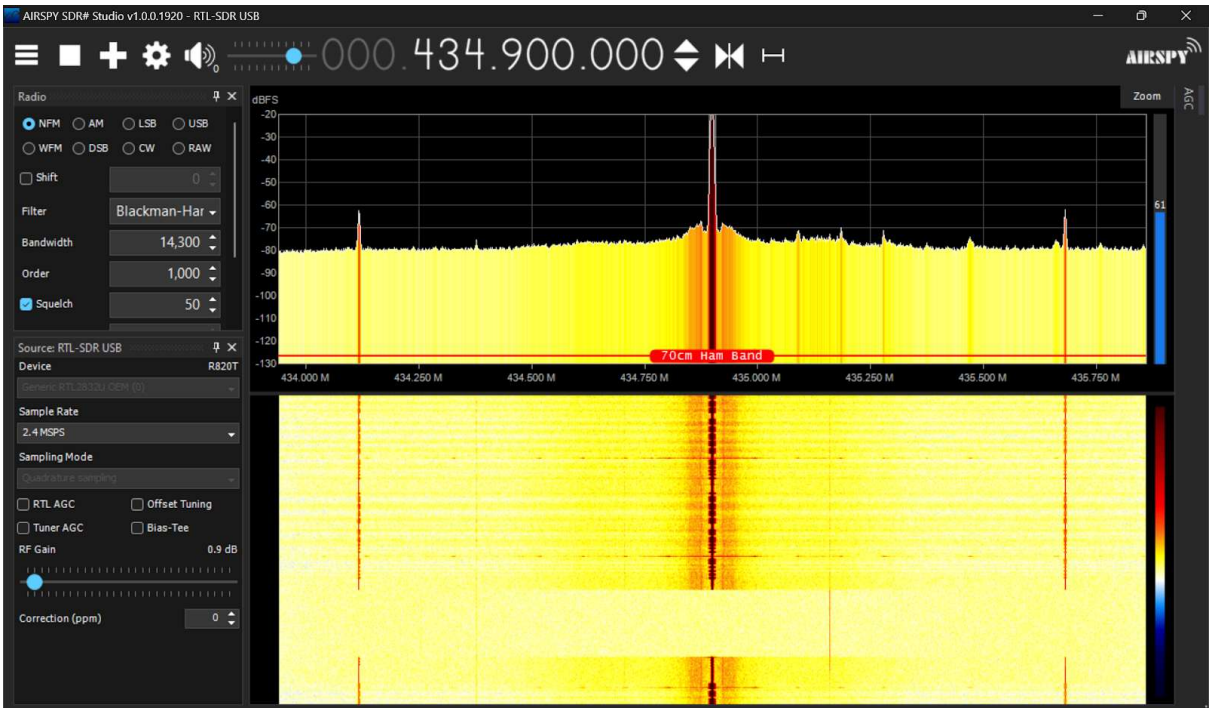
MODO 3 (FSK)


AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Telem Format: BPSK 1200bps (Fox1E)
Stop
RTL SDR
0.240 MHz
AF
IQ
Center Frequency 434900.0 kHz
Retune center / Switch modes
R820T USB SDR
Sample Rate: 0.240 MHz | Freq Correction (ppm): 0
Bias T
Gain Master: Automatic Mixer: Automatic LNA: Automatic VGA: 312
Spacecraft Tracked
1/CubeSatSim-BPSK Tracked
1/CubeSatSim-FSK Not Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Output
Silence Speaker
Altavoces (Realtek(R) Audio)
Sample rate: 48000 | Symbols: 100
Carrier: 1571
Eye Diagram
-0.78 SNR
Errors 2 Erasures 1
Phasor
Errors 2 Erasures 1
FFT: 4096
snr: 0.169dB
Freq:434906,738
-25
-50
-75
-100
434790 434800 434810 434820 434830 434840 434850 434860 434870 434880 434890 434900 434910 434920 434930 434940 434950 434960 434970 434980 434990 435000 435010
Show Peak SNR
WARNING: Find Signal and Doppler Tracking are both disabled
Version 1.12z3 - 27 Oct 2022
Logs: C:\Users\JuanLacosta\Desktop\Log Files Fox
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 221 Payloads: 2629 Queue: 0

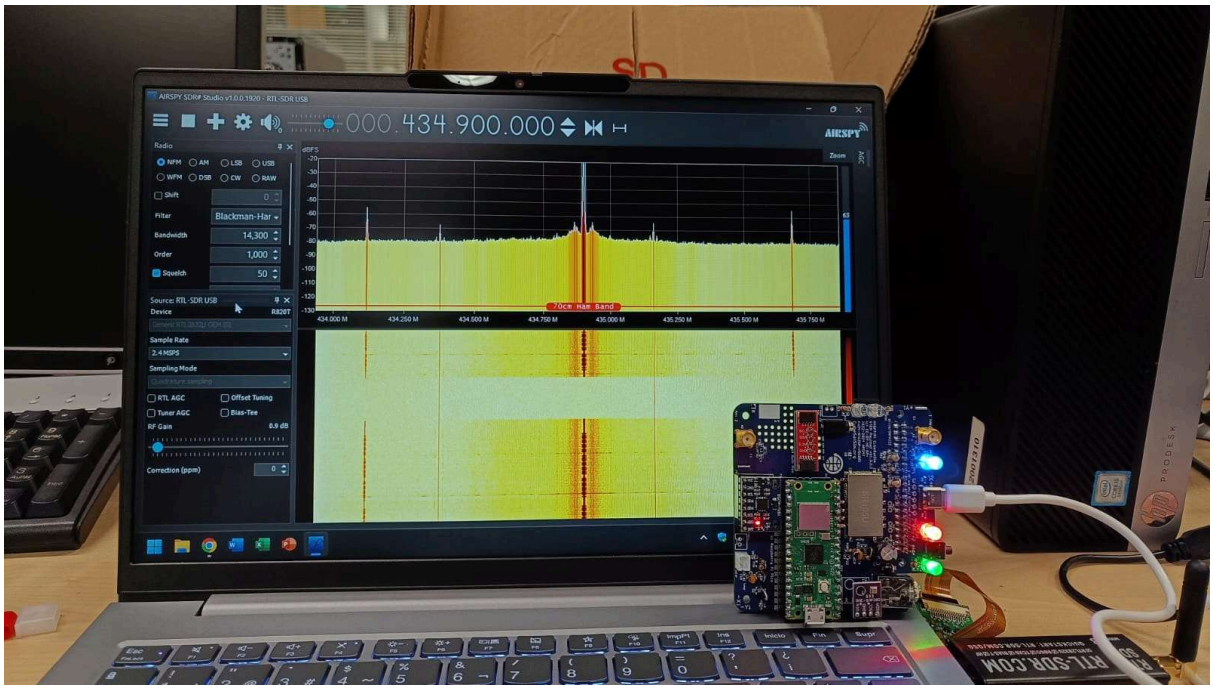

AMSAT Telemetry Analysis Tool
File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Source
Telem Format: BPSK 1200bps (Fox1E)
Stop
RTL SDR
0.240 MHz
AF
IQ
Center Frequency 434900.0 kHz
Retune center / Switch modes
R820T USB SDR
Sample Rate: 0.240 MHz | Freq Correction (ppm): 0
Bias T
Gain Master: Automatic Mixer: Automatic LNA: Automatic VGA: 312
Spacecraft Tracked
1/CubeSatSim-BPSK Tracked
1/CubeSatSim-FSK Not Tracked
Auto Start
Audio Options
View Filtered Audio
Monitor Filtered Audio
Squelch when no telemetry
Output
Silence Speaker
Altavoces (Realtek(R) Audio)
Sample rate: 48000 | Symbols: 100
Carrier: 1497
Eye Diagram
SNR
Errors 0 Erasures 0
Phasor
Errors 0 Erasures 0
FFT: 4096
snr: 12.7dB
Freq:434906,738
-25
-50
-75
-100
434790 434800 434810 434820 434830 434840 434850 434860 434870 434880 434890 434900 434910 434920 434930 434940 434950 434960 434970 434980 434990 435000 435010
Show Peak SNR
WARNING: Find Signal and Doppler Tracking are both disabled
Version 1.12z3 - 27 Oct 2022
Logs: C:\Users\JuanLacosta\Desktop\Log Files Fox
SDR Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: 191 Payloads: 2539 Queue: 0

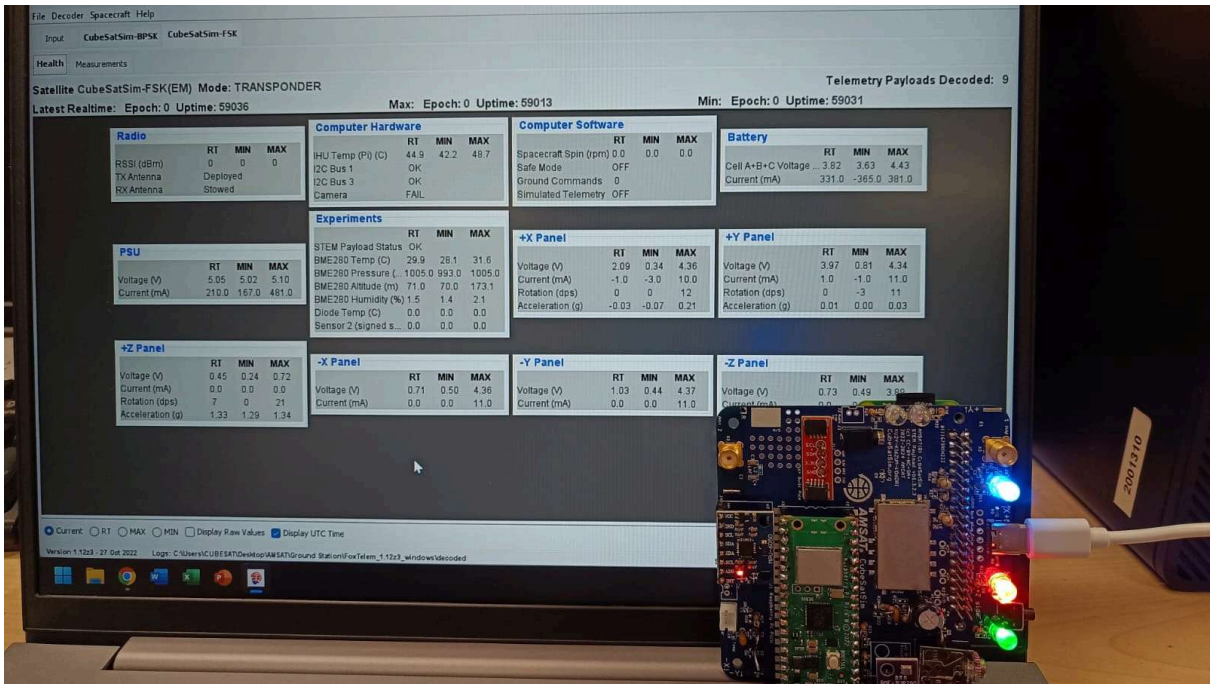
(BPSK)

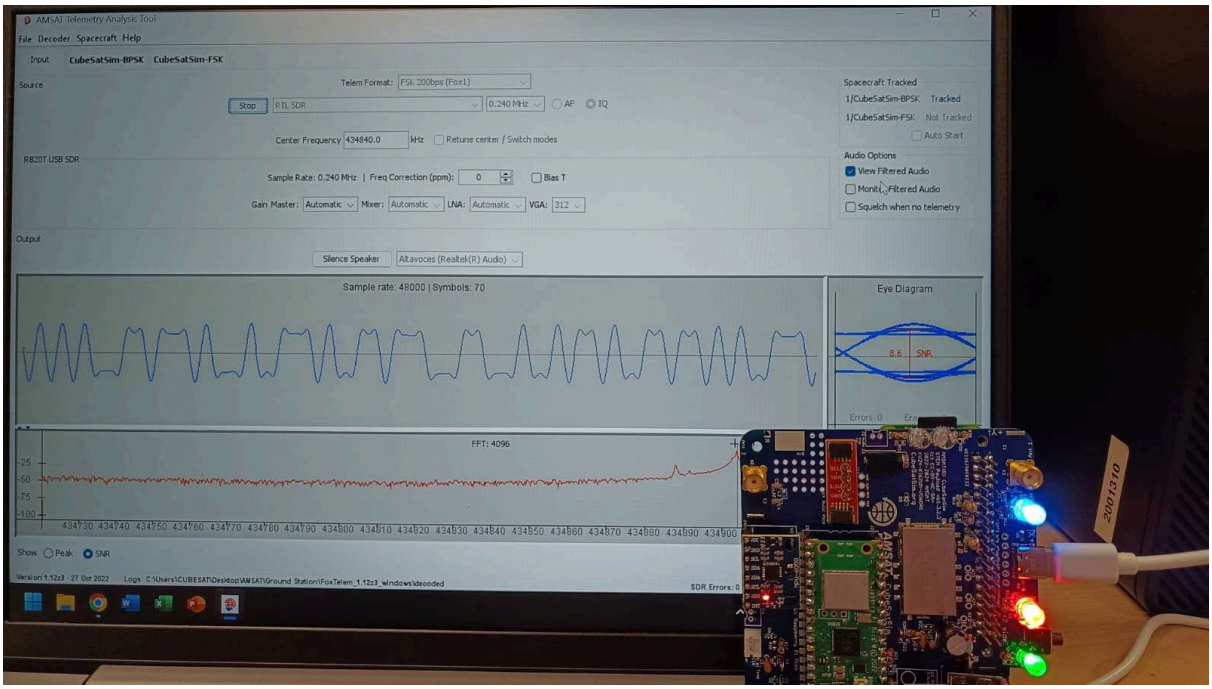

File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Health
Measurements
Satellite CubeSatSim-FSK(EM) Mode: TRANSPONDER
Telemetry Payloads Decoded: 55
Latest Realtime: Epoch: 20 Uptime: 578
Max: Epoch: 20 Uptime: 532
Min: Epoch: 20 Uptime: 455
Radio
RT MIN MAX
RSSI (dBm) 0 0 0
TX Antenna Deployed
RX Antenna Deployed
Computer Hardware
RT MIN MAX
IHU Temp (PI) (C) 39.0 39.0 40.1
I2C Bus 1 OK
I2C Bus 3 FAIL
Camera OK
Computer Software
RT MIN MAX
Spacecraft Spin (rpm) 0.0 0.0 0.0
Safe Mode OFF
Ground Commands 0
Simulated Telemetry ON
Battery
RT MIN MAX
Cell A+B+C Voltage ... 4.50 4.11 4.51
Current (mA) 0.0 -397.0 0.0
Experiments
RT MIN MAX
STEM Payload Status OK
BME280 Temp (C) 26.6 26.5 27.0
BME280 Pressure (... 1009.0 1009.0 1009.0
BME280 Altitude (m) 34.6 34.1 35.0
BME280 Humidity (%) 38.4 37.6 39.1
Diode Temp (C) -28.1 -28.1 -28.1
Sensor 2 (signed s... -204.8 -204.8 -204.8
PSU
RT MIN MAX
Voltage (V) 0.00 0.00 0.00
Current (mA) 0.0 0.0 0.0
+X Panel
RT MIN MAX
Voltage (V) 0.90 0.91 4.67
Current (mA) 1.0 0.0 284.0
Rotation (dps) -12 -4 -1
Acceleration (g) 0.04 -0.05 0.23
+Y Panel
RT MIN MAX
Voltage (V) 0.94 0.90 4.68
Current (mA) 0.0 0.0 271.0
Rotation (dps) -17 -1 21
Acceleration (g) 0.95 -0.03 0.96
+Z Panel
RT MIN MAX
Voltage (V) 0.95 0.90 1.10
Current (mA) 0.0 0.0 27.0
Rotation (dps) -10 1 10
Acceleration (g) 0.25 0.28 1.02
-X Panel
RT MIN MAX
Voltage (V) 1.08 0.90 4.56
Current (mA) 0.0 0.0 283.0
-Y Panel
RT MIN MAX
Voltage (V) 1.03 0.91 4.80
Current (mA) 0.0 0.0 274.0
-Z Panel
RT MIN MAX
Voltage (V) 1.08 0.90 1.10
Current (mA) 0.0 0.0 27.0
Current RT MAX MIN Display Raw Values Display UTC Time
Last 180 samples Captured: 2024/11/18 09:28:39

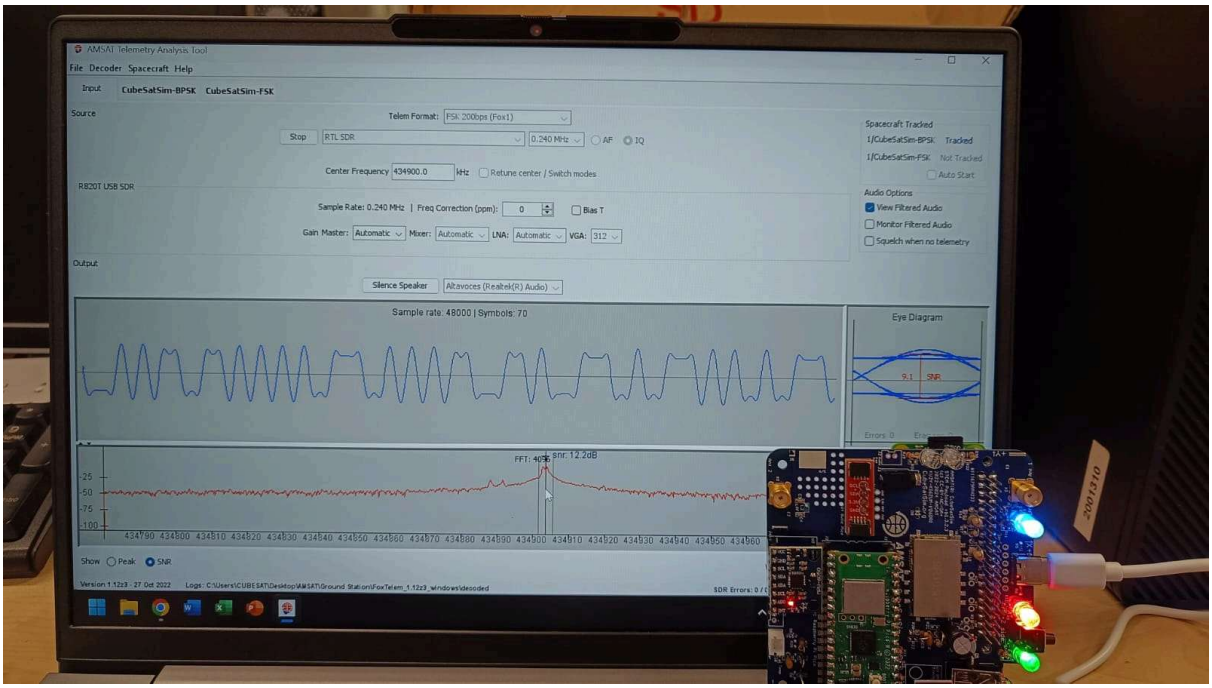

AIRSPY SDR# Studio v1.0.0.1920 - RTL-SDR USB
000.434.900.000
AIRSPY
Radio
NFM AM LSB USB
WFM DSB CW RAW
Shift
Filter Blackman-Har
Bandwidth 14,300
Order 1,000
Squelch 50
Source: RTL-SDR USB
Device R820T
Sample Rate
2.4 MSPS
Sampling Mode
RTL AGC
Offset Tuning
Tuner AGC
Bias-Tee
RF Gain 0.9 dB
Correction (ppm) 0
dBFS
Zoom
AGC
70cm Ham Band
434.000 M
434.250 M
434.500 M
434.750 M
435.000 M
435.250 M
435.500 M
435.750 M

MODO 5 (MORSE)


AIRSPY SDR# Studio v1.0.0.1920 - RTL-SDR USB
434.900.000
AIRSPY
Radio
NFM AM LSB USB
WFM DSB CW RAW
Shift
Filter
Blackman-Har
Bandwidth
14,300
Order
1,000
Squelch
50
Source: RTL-SDR USB
Device
R820T
Sample Rate
2.4 MSPS
Sampling Mode
RTL AGC
Offset Tuning
Tuner AGC
Bias-Tee
RF Gain
8.6 dB
Correction (ppm)
70cm Ham Band
RTL-SDR.COM


File Decoder Spacecraft Help
Input
CubeSatSim-BPSK
CubeSatSim-FSK
Health
Measurements
Satellite CubeSatSim-FSK(EM) Mode: TRANSPONDER
Latest Realtime: Epoch: 0 Uptime: 59036
Max: Epoch: 0 Uptime: 59013
Min: Epoch: 0 Uptime: 59031
Telemetry Payloads Decoded: 9
Radio
RT MIN MAX
RSSI (dBm) 0 0 0
TX Antenna Deployed
RX Antenna Stowed
Computer Hardware
RT MIN MAX
IHU Temp (PI) (C) 44.9 42.2 48.7
I2C Bus 1 OK
I2C Bus 3 OK
Camera FAIL
Computer Software
RT MIN MAX
Spacecraft Spin (rpm) 0.0 0.0 0.0
Safe Mode OFF
Ground Commands 0
Simulated Telemetry OFF
Battery
RT MIN MAX
Cell A+B+C Voltage ... 3.82 3.63 4.43
Current (mA) 331.0 -365.0 381.0
Experiments
RT MIN MAX
STEM Payload Status OK
BME280 Temp (C) 29.9 28.1 31.6
BME280 Pressure (... 1005.0 993.0 1005.0
BME280 Altitude (m) 71.0 70.0 173.1
BME280 Humidity (%) 1.5 1.4 2.1
Diode Temp (C) 0.0 0.0 0.0
Sensor 2 (signed s... 0.0 0.0 0.0
+X Panel
RT MIN MAX
Voltage (V) 2.09 0.34 4.36
Current (mA) -1.0 -3.0 10.0
Rotation (dps) 0 0 12
Acceleration (g) -0.03 -0.07 0.21
+Y Panel
RT MIN MAX
Voltage (V) 3.97 0.81 4.34
Current (mA) 1.0 -1.0 11.0
Rotation (dps) 0 -3 11
Acceleration (g) 0.01 0.00 0.03
PSU
RT MIN MAX
Voltage (V) 5.05 5.02 5.10
Current (mA) 210.0 167.0 481.0
+Z Panel
RT MIN MAX
Voltage (V) 0.45 0.24 0.72
Current (mA) 0.0 0.0 0.0
Rotation (dps) 7 0 21
Acceleration (g) 1.33 1.29 1.34
-X Panel
RT MIN MAX
Voltage (V) 0.71 0.50 4.36
Current (mA) 0.0 0.0 11.0
-Y Panel
RT MIN MAX
Voltage (V) 1.03 0.44 4.37
Current (mA) 0.0 0.0 11.0
-Z Panel
RT MIN MAX
Voltage (V) 0.73 0.49 3.99
Current (mA)
Current RT MAX MIN Display Raw Values Display UTC Time
Version 1.12z3 - 27 Oct 2022
Logs: C:\Users\CUBESAT\Desktop\AMSAT\Ground Station\FoxTelem_1.12z3_windows\decoded
AMSAT
20013310





Módulo GPS

Guía del módulo que vamos a implementar:
https://cdn-learn.adafruit.com/downloads/pdf/adafruit-mini-gps-pa1010d-module.pdf

Nombre: adafruit mini gps **PA1010D GPS**

Se puede conectar con el protocolo I2C ó UART. Tenemos que barajar cuál es mejor. Finalmente el I2C puesto que es el que hemos utilizado para los demás sensores y para poder conectarlo mediante Qwiic connectors.

Este GPS soporta GPS, GLONASS, GALILEO y más redes de satélites. Lo mejor es utilizar una combinación de **GPS + GLONASS** puesto que GPS es una amplia red de satélites y GLONASS está diseñado específicamente para la Unión Europea, zonas urbanas y altas. Será el más preciso.
De no poder configurar dicha combinación, utilizaremos únicamente **GLONASS**.

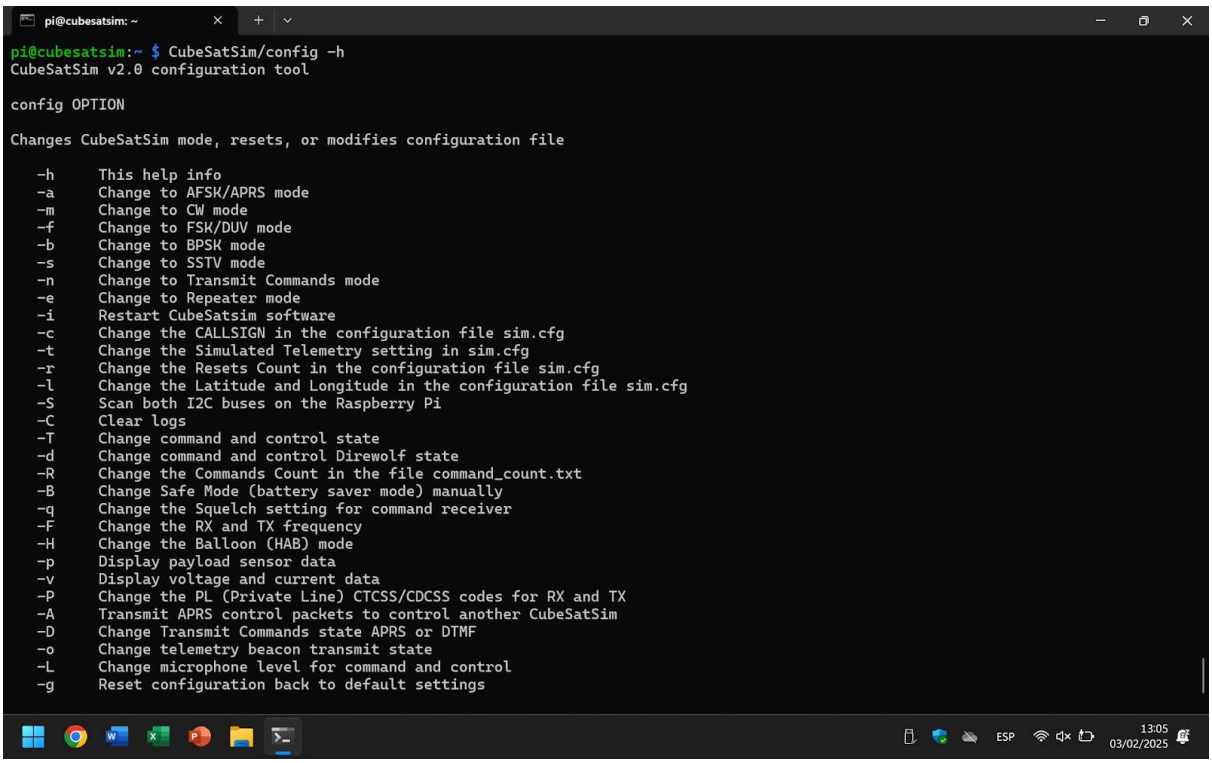
NOTA: este sensor tiene una antena integrada. Es muy sensible y puede necesitar una visión al cielo que no esté obstruida por otras partes del cubo. Si da problemas, probar a mover el módulo GPS a un sitio más claro con la antena apuntando al cielo.

Hemos comprobado que situando el módulo GPS en la posición de la foto recibe posición GPS. Si se enciende el LED PPS es que ha adquirido posición GPS. (el LED rojo de la foto es el LED PPS).

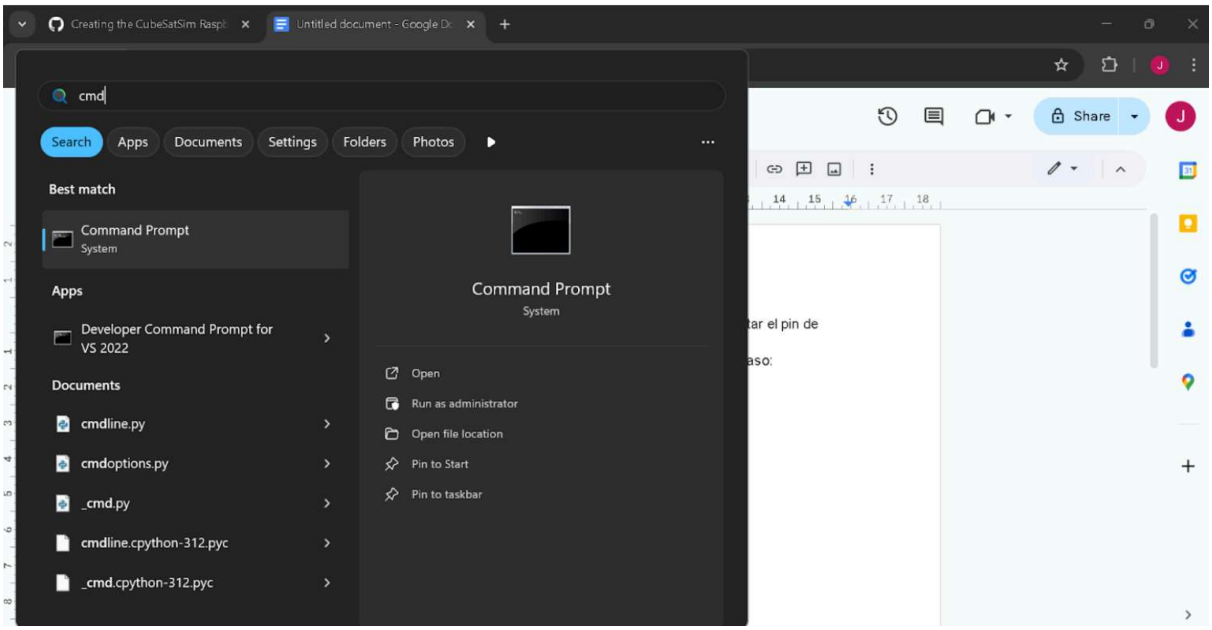
TELEMETRÍA Y SOFTWARE

SSH:

El archivo config (el menú del ssh) se puede abrir y editar para incluir cosas:
sudo nano config



1. Conectar a la corriente toda la placa (por medio del cable usb c). Quitar el pin de seguridad para encender todo.
2. Conectarse con el portátil a la misma wifi que el raspberry. En este caso:
   BSSID: StarLink@Tecnun
   Password: GoForTelecom
3. Abrir la terminal de windows. Pulsar tecla Windows, buscar ‘cmd’ y ejecutarlo.



4. Insertar el comando: **ssh pi@192.168.1.58**

```
C:\Users\CUBESAT>ssh pi@192.168.142.108
pi@192.168.142.108's password:
Linux cubesatsim 6.1.21+ #1642 Mon Apr  3 17:19:14 BST 2023 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Feb 14 13:43:37 2025 from fe80::d6be:4e73:c613:57d5%wlan0

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@cubesatsim:~ $
```

Cuando aparezca, darle a ‘yes’ (sólo aparece la primera vez). Cuando pida el usuario introducir **pi** y cuando pida la contraseña introducir **raspberry**
Ahora ya deberíamos estar dentro del raspberry como se muestra en la foto.
Nota: en vez de introducir la propia IP del raspberry, se puede introducir el dominio; es decir, se puede conectar con el comando **ssh pi@cubesatsim.local**

```
C:\Users\CUBESAT>ssh pi@cubesatsim.local
pi@cubesatsim.local's password:
Linux cubesatsim 6.1.21+ #1642 Mon Apr  3 17:19:14 BST 2023 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Feb 14 13:43:01 2025 from fe80::d6be:4e73:c613:57d5%wlan0

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@cubesatsim:~ $
```

Nota: en vez de conectarse por terminal, también se puede realizar utilizando el software Putty: https://www.putty.org/ Aquí deja guardar directamente el perfil del raspberry (guarda su IP) para no tener que introducirlo siempre que nos queramos conectar.

Comandos:

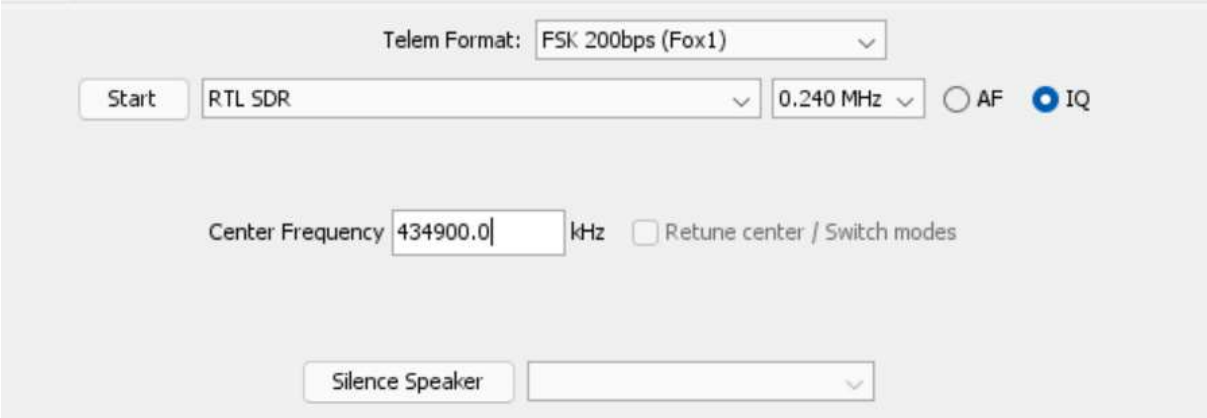
- Menú de operación: CubeSatSim/config -h
- Ver la pestaña de comandos (ejecutable): CubeSatSim/log

Primera vez saldrá esto de fingerprint:

```
C:\Users\CUBESAT>ssh pi@cubesatsim.local
The authenticity of host 'cubesatsim.local (fe80::27c:fba6:1a23:af0c%10)' can't be established.
ED25519 key fingerprint is SHA256:cgU3Gxts/5EGpgyDes01IfMwWTbQfe76p8ylbeoIlOs.
This host key is known by the following other names/addresses:
    C:\Users\CUBESAT/.ssh/known_hosts:1: 192.168.142.108
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'cubesatsim.local' (ED25519) to the list of known hosts.
pi@cubesatsim.local's password:
Linux cubesatsim 6.1.21+ #1642 Mon Apr  3 17:19:14 BST 2023 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Feb 14 13:38:04 2025 from 192.168.142.48

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@cubesatsim:~ $ cd CubeSatSim/
```

Comprobación telemetría fox telem:

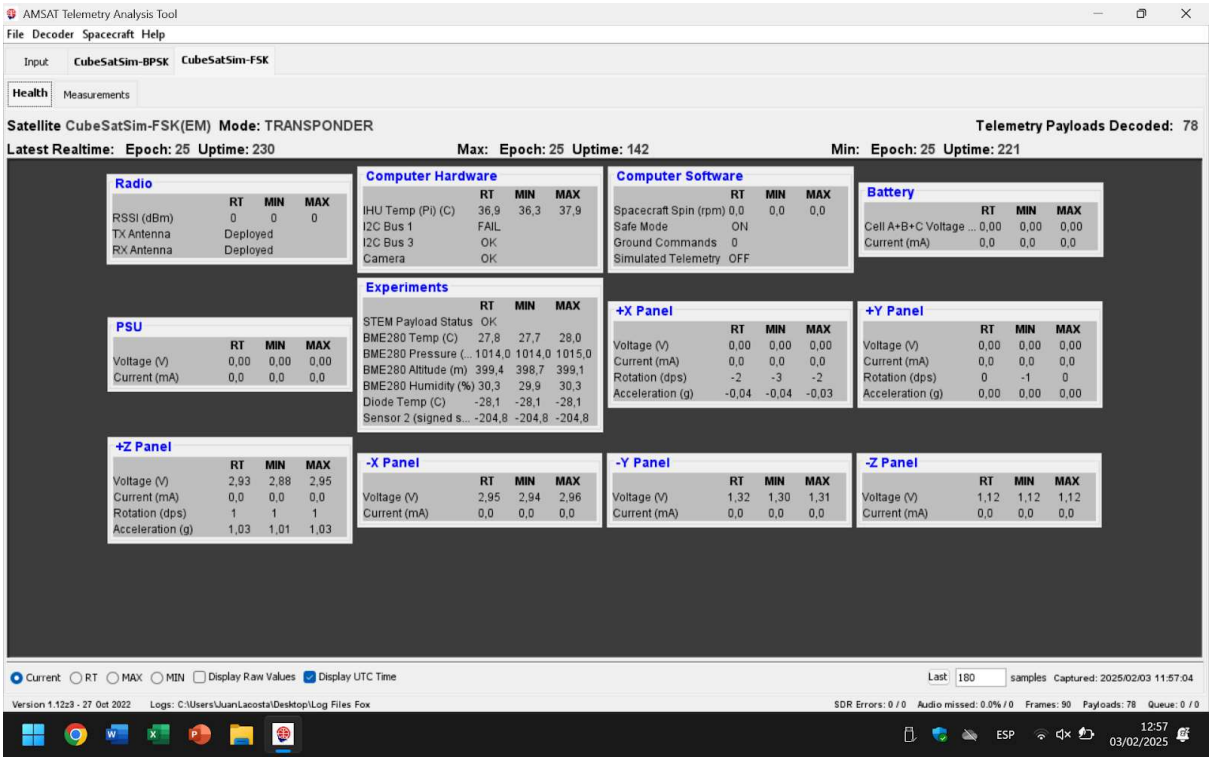
Iniciar **como administrador** FoxTelem en el ordenador. Recibe telemetría cada 4-5 seg. Poner (en caso de FSK) esta configuración:



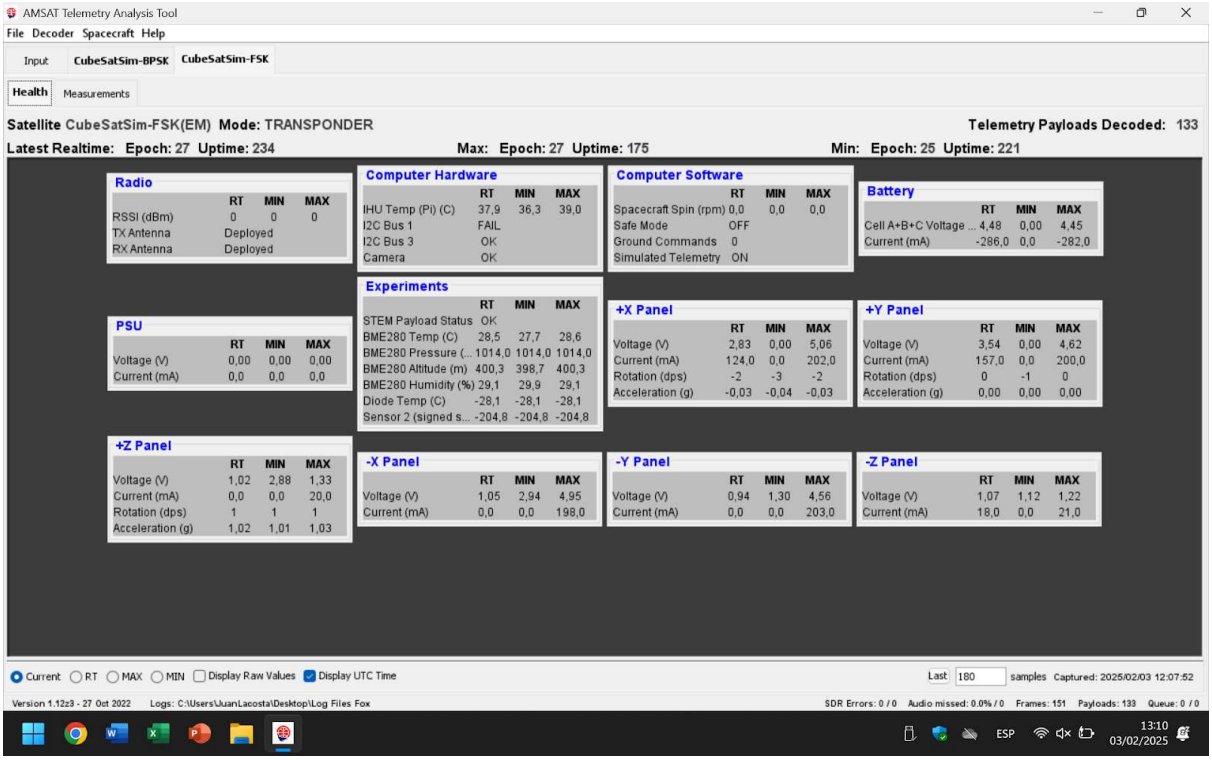
Start y empezará a recibir paquetes (paciencia).

- Voltajes de baterías:

```
pi@cubesatsim:~ $ CubeSatSim/config -v
CubeSatSim v2.0 configuration tool

Real-time output from the INA219 voltage and current sensors:

CubeSatSim v2.0 INA219 Voltage and Current Telemetry
ERROR: 1 bus has a problem
  Check software to see if enabled
/usr/local/lib/python3.9/dist-packages/adafruit_blinka/microcontroller/generic_linux/i2c.py:30: RuntimeWarning: I2C freq
uency is not settable in python, ignoring!
  warnings.warn(

+X   |  0.00 V     0 mA
+Y   |  0.00 V     0 mA
+Z   |  2.94 V     0 mA
-X   |  2.95 V     0 mA
-Y   |  1.32 V     0 mA
-Z   |  1.12 V     1 mA
Bat  |  0.00 V     0 mA
Bat2 |  0.00 V     0 mA
```

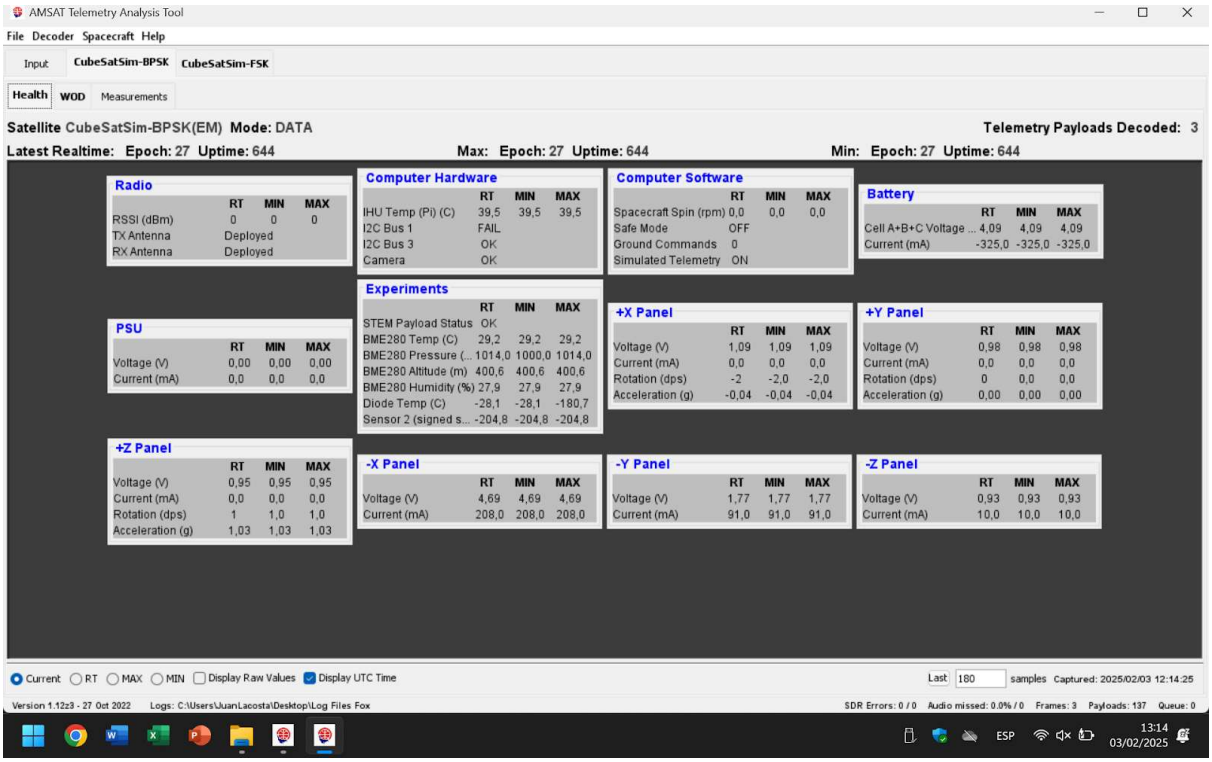


- Safe mode battery OK
- Simulated telemetry:

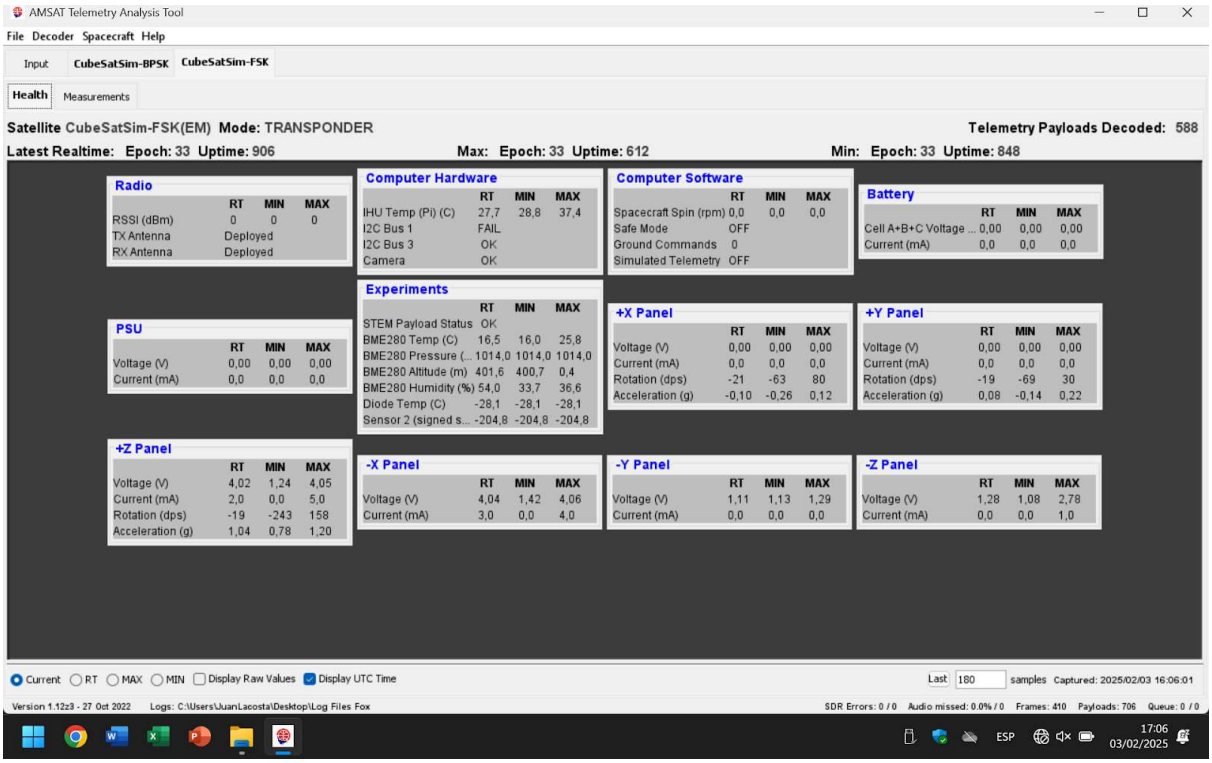


OK

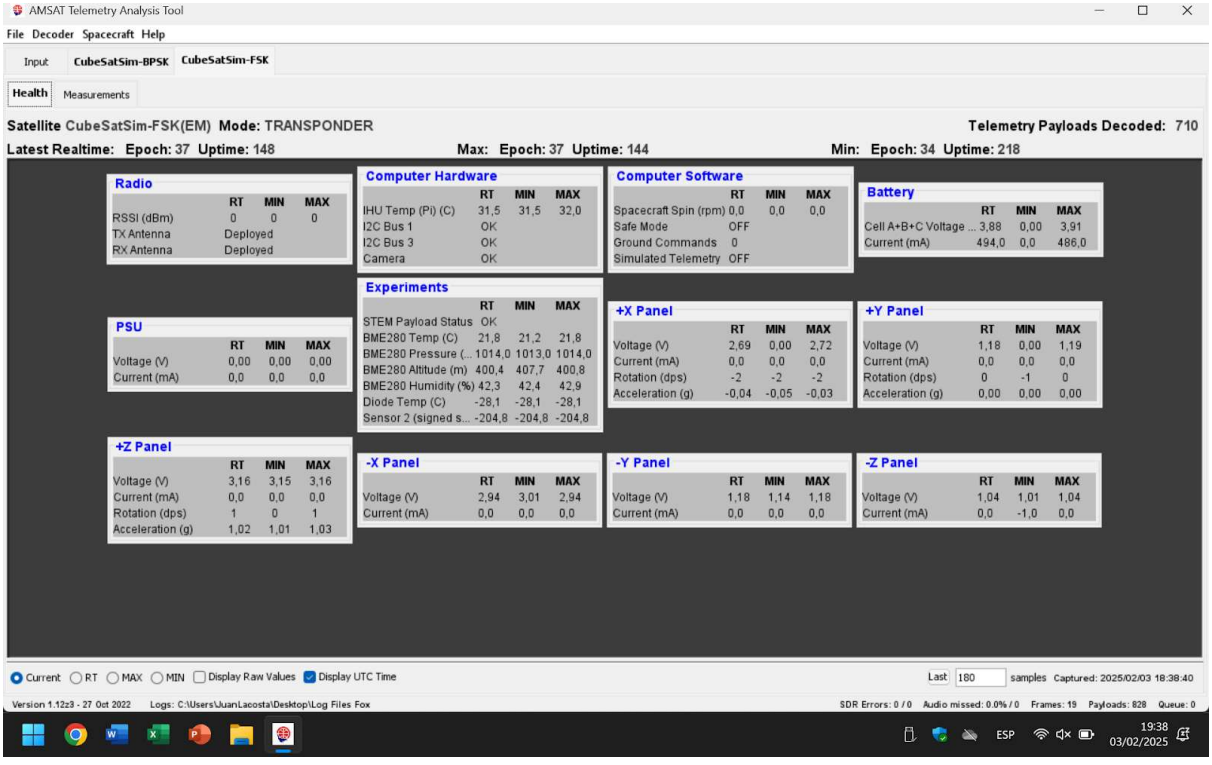
- **BPSK data transmission:**



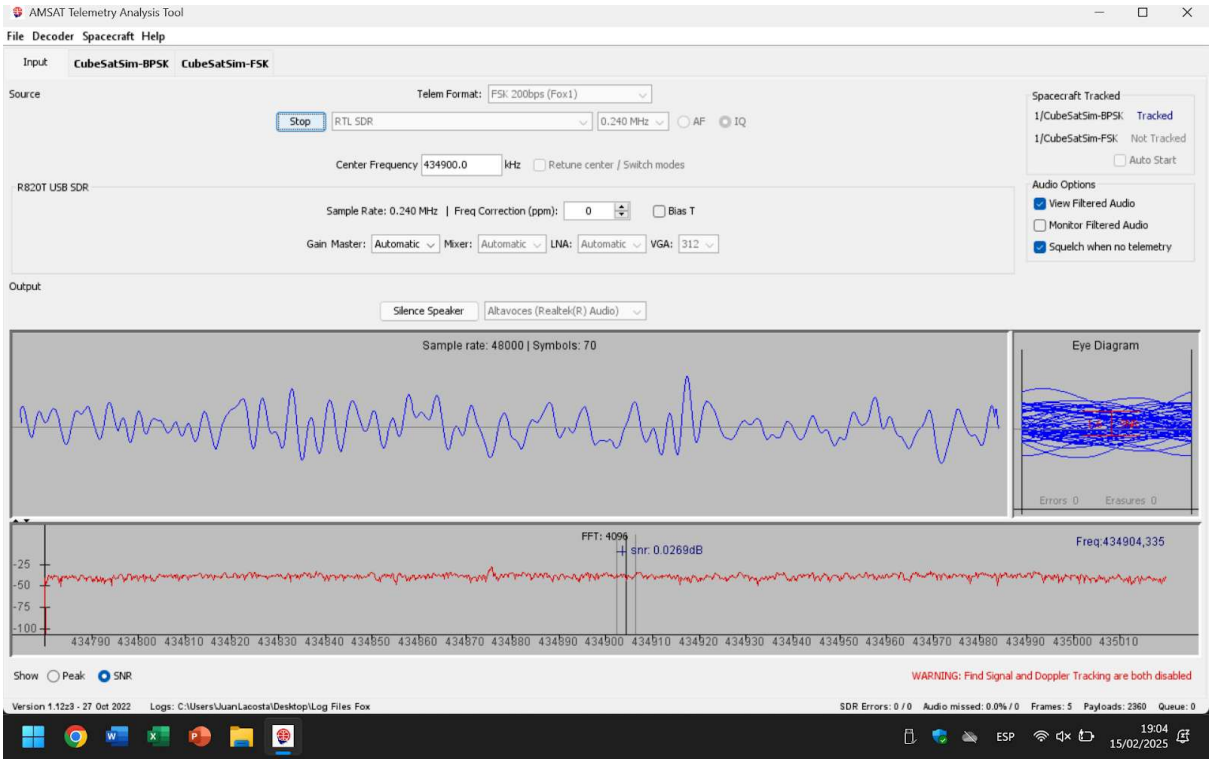
- **Exterior (sensores frío, humedad, altitud)**:



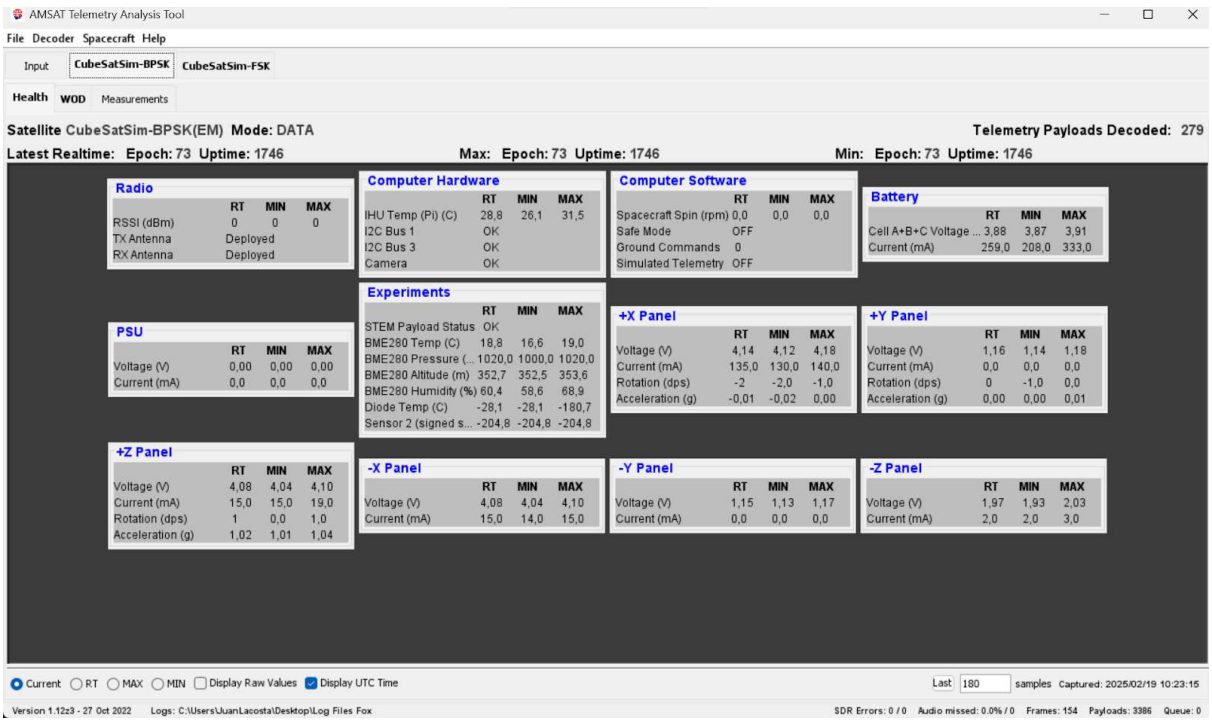
- Battery:

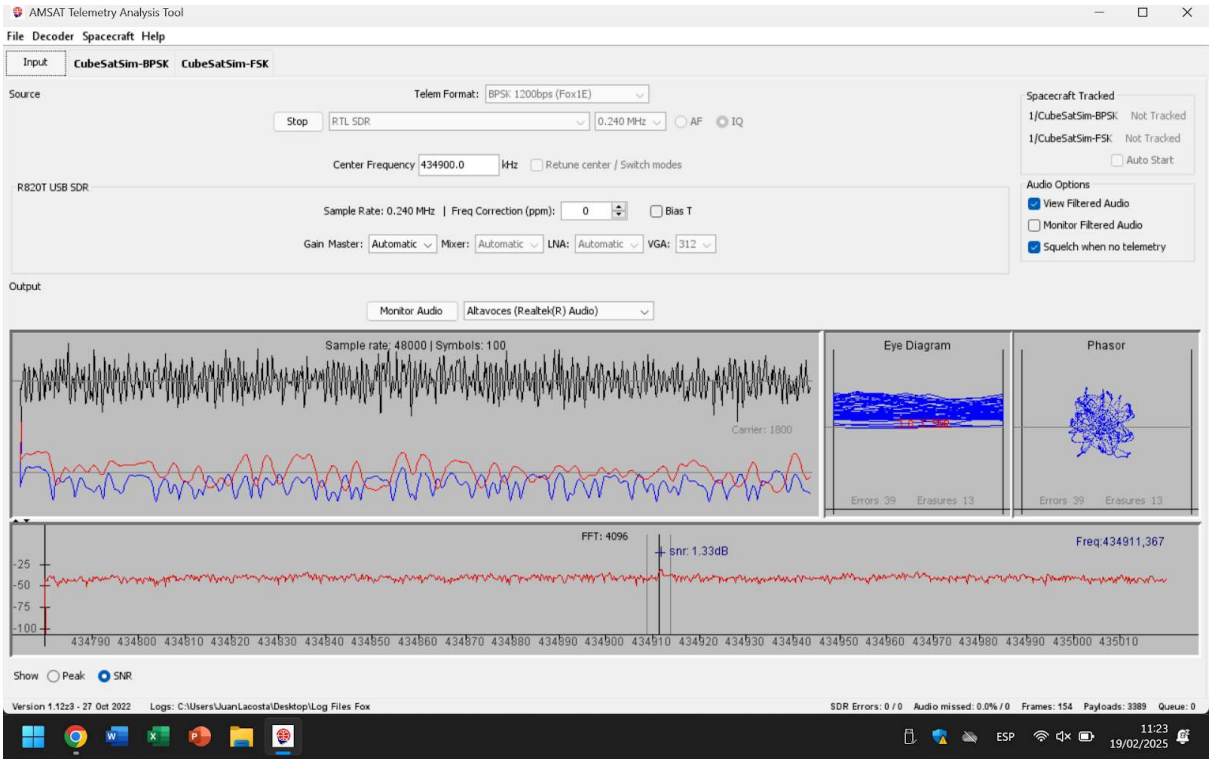


- Sin enviar datos:

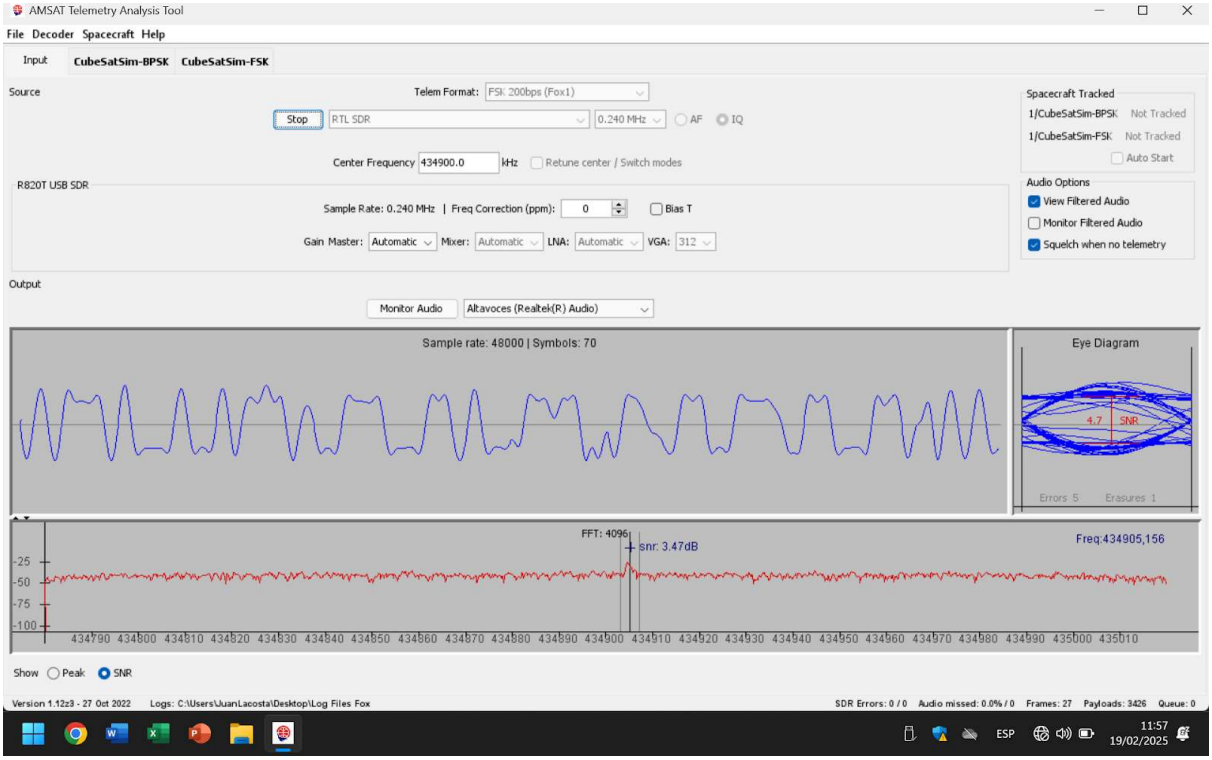


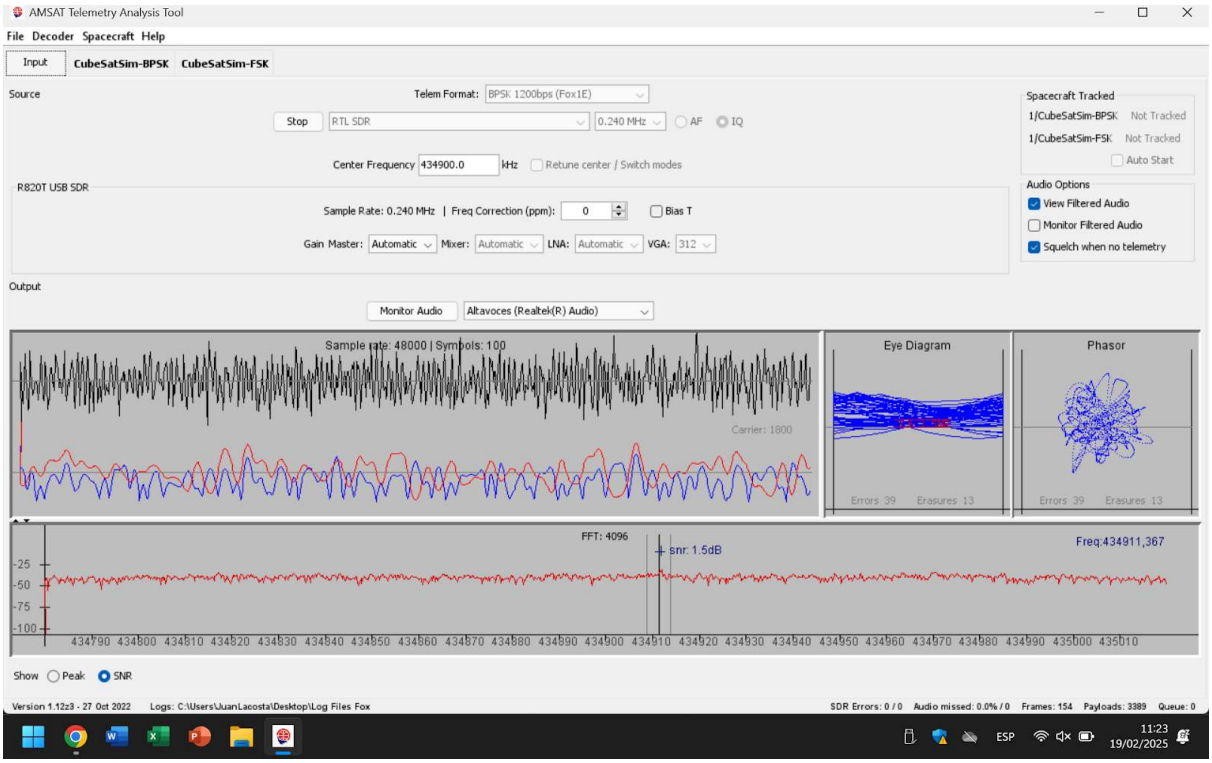
BPSK transmission (max): 275 pasos

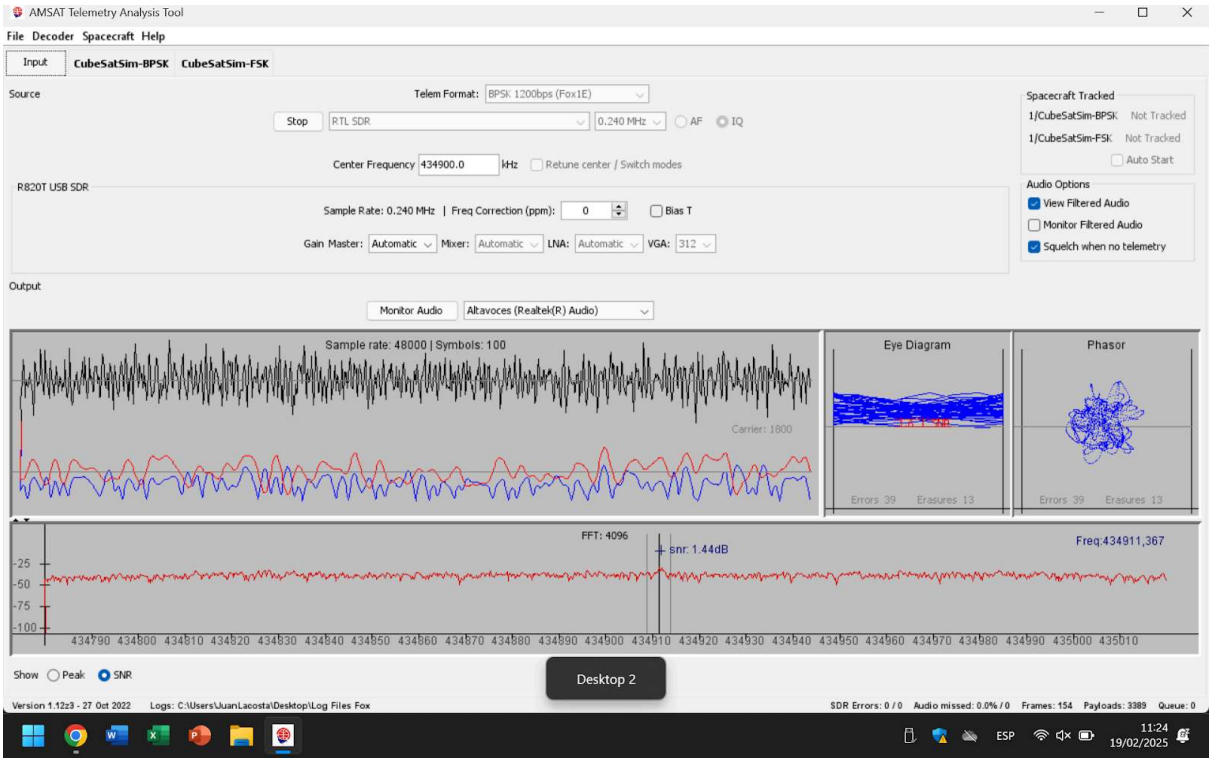




FSK transmision (max) (300 pasos) - 200m

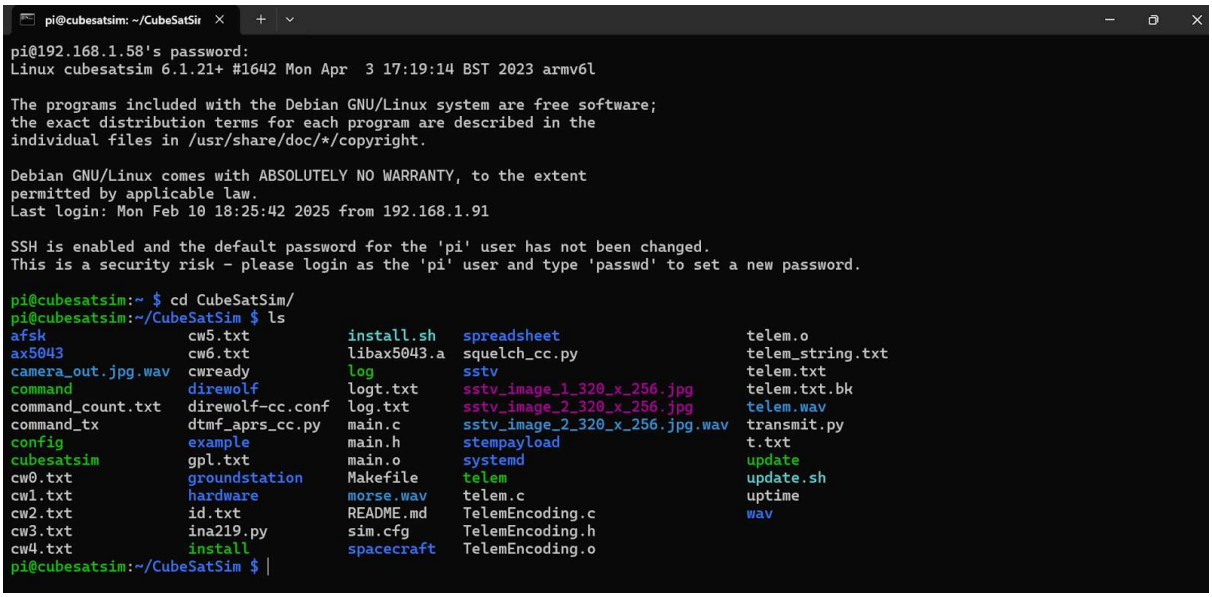


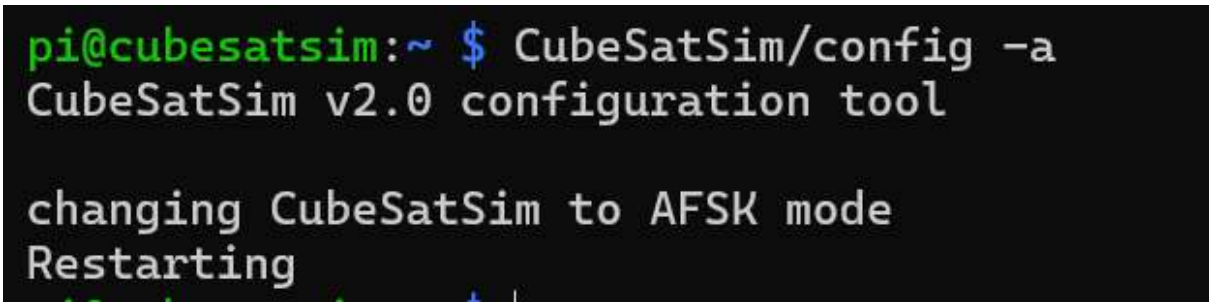


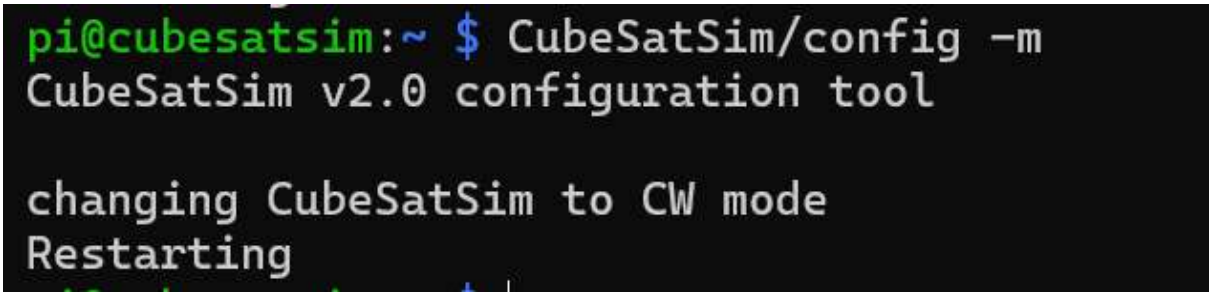


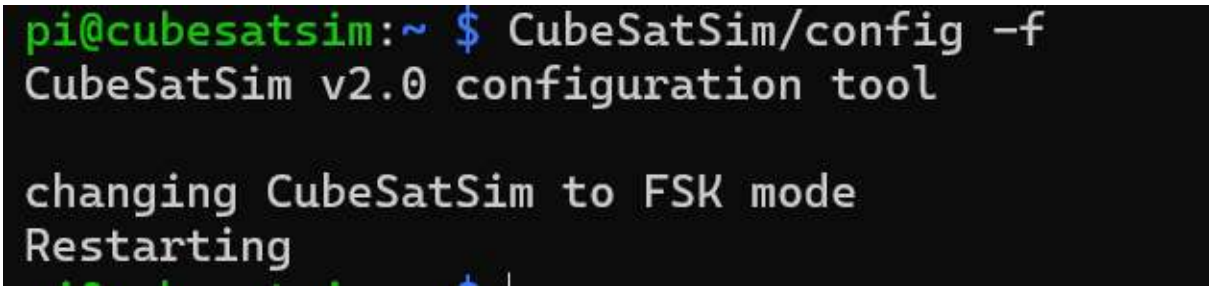
Fotos extra:

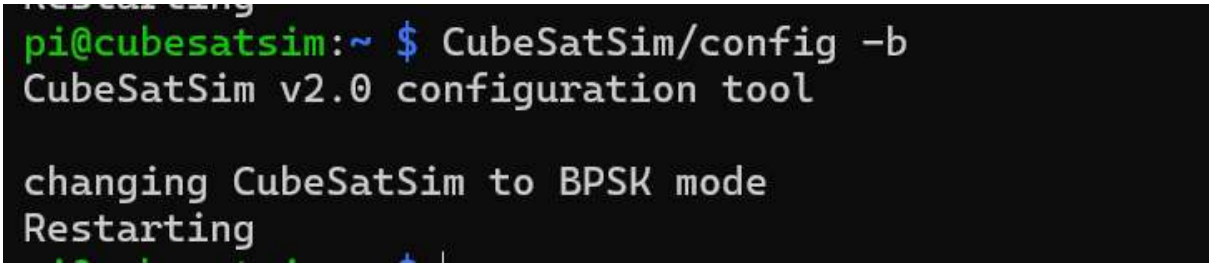
SSH:


pi@cubesatsim: ~/CubeSatSir
pi@192.168.1.58's password:
Linux cubesatsim 6.1.21+ #1642 Mon Apr 3 17:19:14 BST 2023 armv6l
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Feb 10 18:25:42 2025 from 192.168.1.91
SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.
pi@cubesatsim:~ $ cd CubeSatSim/
pi@cubesatsim:~/CubeSatSim $ ls
afsk cw5.txt install.sh spreadsheet telem.o
ax5043 cw6.txt libax5043.a squelch_cc.py telem_string.txt
camera_out.jpg.wav cwready log sstv telem.txt
command direwolf logt.txt sstv_image_1_320_x_256.jpg telem.txt.bk
command_count.txt direwolf-cc.conf log.txt sstv_image_2_320_x_256.jpg telem.wav
command_tx dtmf_aprs_cc.py main.c sstv_image_2_320_x_256.jpg.wav transmit.py
config example main.h stempayload t.txt
cubesatsim gpl.txt main.o systemd update
cw0.txt groundstation Makefile telem update.sh
cw1.txt hardware morse.wav telem.c uptime
cw2.txt id.txt README.md TelemEncoding.c wav
cw3.txt ina219.py sim.cfg TelemEncoding.h
cw4.txt install spacecraft TelemEncoding.o
pi@cubesatsim:~/CubeSatSim $


pi@cubesatsim:~ $ CubeSatSim/config -a
CubeSatSim v2.0 configuration tool
changing CubeSatSim to AFSK mode
Restarting


pi@cubesatsim:~ $ CubeSatSim/config -m
CubeSatSim v2.0 configuration tool
changing CubeSatSim to CW mode
Restarting


pi@cubesatsim:~ $ CubeSatSim/config -f
CubeSatSim v2.0 configuration tool
changing CubeSatSim to FSK mode
Restarting


pi@cubesatsim:~ $ CubeSatSim/config -b
CubeSatSim v2.0 configuration tool
changing CubeSatSim to BPSK mode
Restarting

```
pi@cubesatsim:~ $ CubeSatSim/config -s
CubeSatSim v2.0 configuration tool

changing CubeSatSim to SSTV mode
Restarting
```

```
pi@cubesatsim:~ $ CubeSatSim/config -n
CubeSatSim v2.0 configuration tool

changing CubeSatSim to Transmit Commands mode
Turning Transmit Command and Control mode ON
Restarting
```

```
pi@cubesatsim:~ $ CubeSatSim/config -t
CubeSatSim v2.0 configuration tool


Editing the Simulated Telemetry setting in
the configuration file for CubeSatSim

Simualted Telemetry is OFF

Do you want Simulated Telemetry ON (y/n)
```

```
pi@cubesatsim:~ $ CubeSatSim/config -S
CubeSatSim v2.0 configuration tool


Scan both I2C buses on the Raspberry Pi

I2C Bus 1

     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:                         -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: 40 41 -- -- 44 -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --

I2C Bus 3

     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:                         -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: 40 41 -- -- 44 45 -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --
```

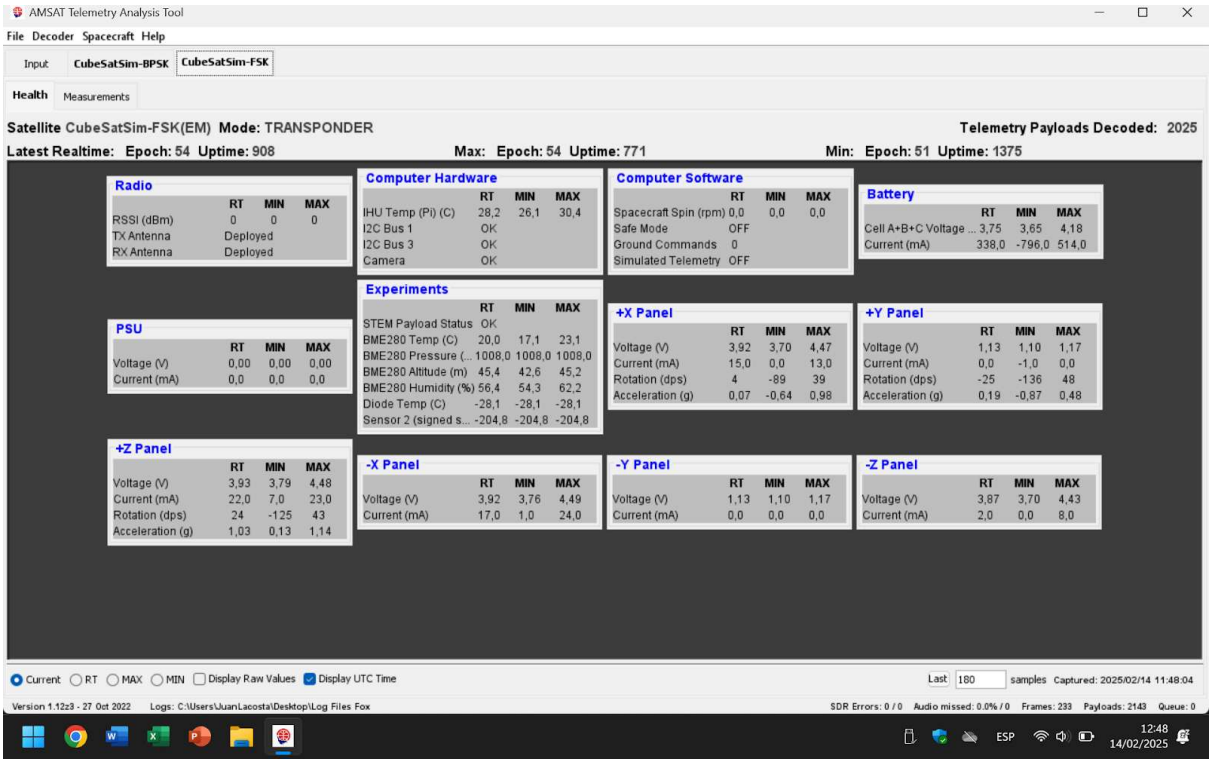
```
pi@cubesatsim:~ $ CubeSatSim/config -B
CubeSatSim v2.0 configuration tool


Manually setting Safe Mode (battery saver mode)

Safe Mode is OFF.
Battery saver mode is OFF.

Do you want Safe Mode (battery saver mode) ON (y/n)
```

```
pi@cubesatsim:~ $ CubeSatSim/config -H
CubeSatSim v2.0 configuration tool

Editing the Balloon mode setting in
the configuration file for CubeSatSim

Balloon mode is OFF

Do you want Balloon mode ON (y/n)
y

Balloon mode is ON

CubeSatSim configuration sim.cfg file updated to:

AMSAT 56 43.2909 -1.9834 no 3 434.9000 435.0000 yes 0 0


Broadcast message from pi@cubesatsim (pts/0) (Fri Feb 14 13:13:36 2025):

Reboot due to config change!
```

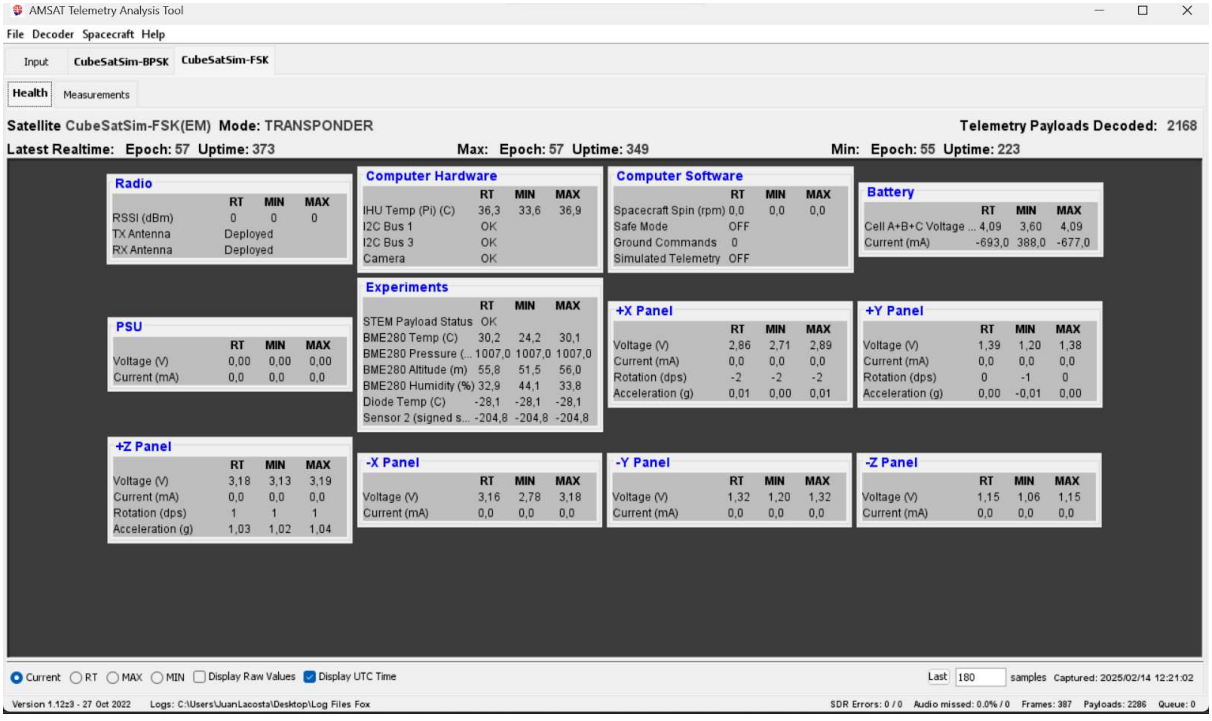
```
pi@cubesatsim:~ $ CubeSatSim/config -p
CubeSatSim v2.0 configuration tool

Real-time output from the serial port from the Pico:

_START_FLAG_OK BME280 29.94 1006.56 55.86 33.28 MPU6050 -3.15 -0.99 1.08 0.01 -0.00 1.03 GPS 0.0000 0.0000 0.00 TMP -1257.00_END_FLAG
_
_START_FLAG_OK BME280 29.95 1006.53 56.13 33.27 MPU6050 -3.53 -1.25 1.19 0.01 -0.01 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00_END_FLAG
_
_START_FLAG_OK BME280 29.96 1006.56 55.85 33.27 MPU6050 -3.39 -0.96 1.21 0.01 -0.00 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00_END_FLAG
_
```

```
pi@cubesatsim:~ $ CubeSatSim/config -v
CubeSatSim v2.0 configuration tool

Real-time output from the INA219 voltage and current sensors:

CubeSatSim v2.0 INA219 Voltage and Current Telemetry
/usr/local/lib/python3.9/dist-packages/adafruit_blinka/microcontroller/generic_linux/i2c.py:30: RuntimeWarning: I2C frequency is not
settable in python, ignoring!
  warnings.warn(

+X   |  2.87 V     0 mA
+Y   |  1.39 V     0 mA
+Z   |  3.18 V     0 mA
-X   |  3.17 V     0 mA
-Y   |  1.33 V     0 mA
-Z   |  1.15 V     1 mA
Bat  |  4.09 V  -671 mA
Bat2 |  0.00 V     0 mA
```

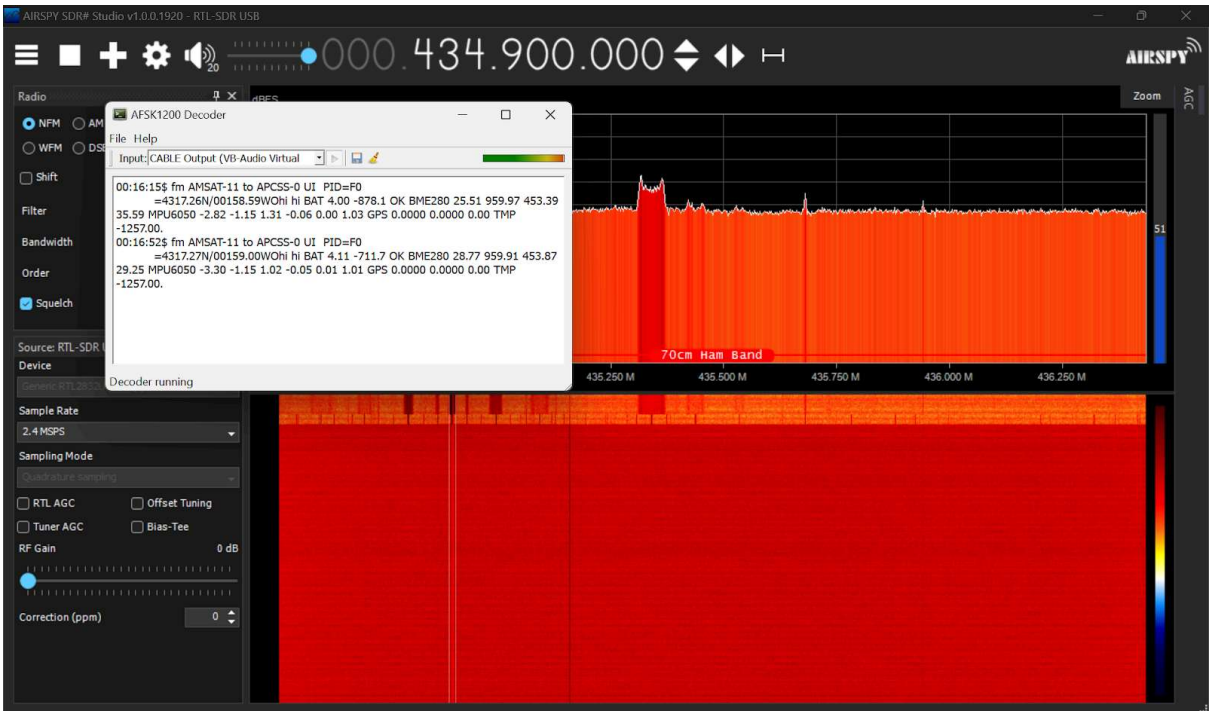
FoxTelem:

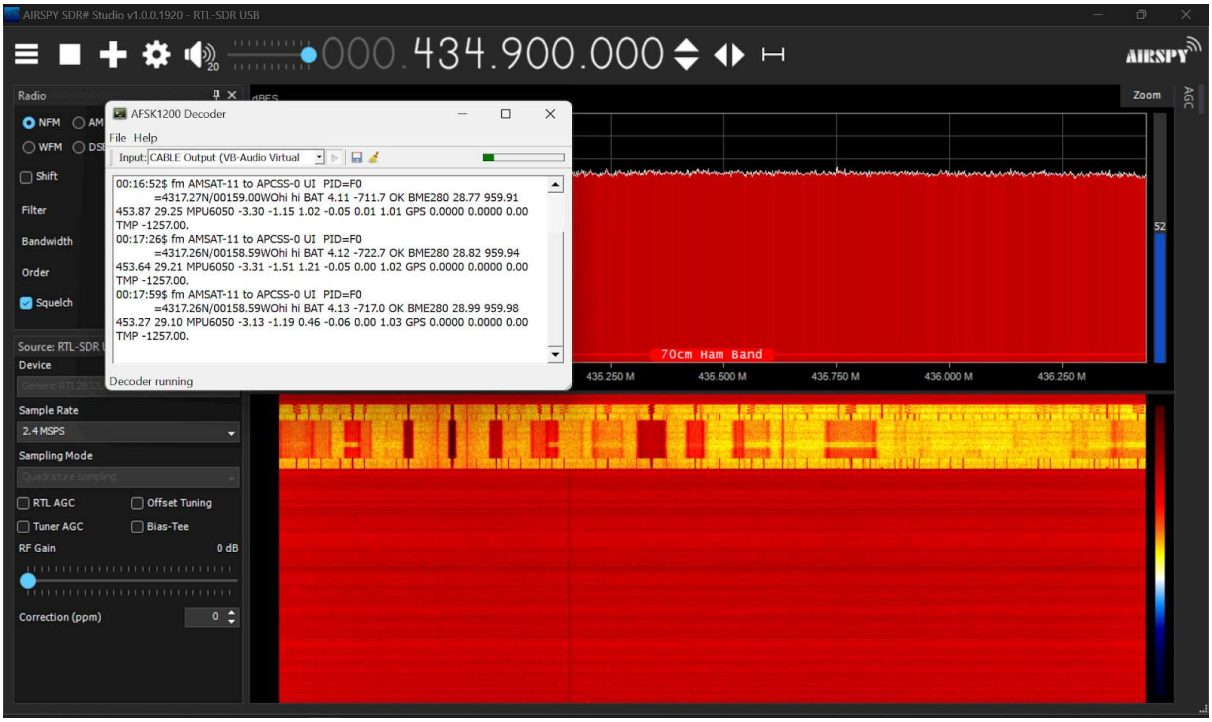


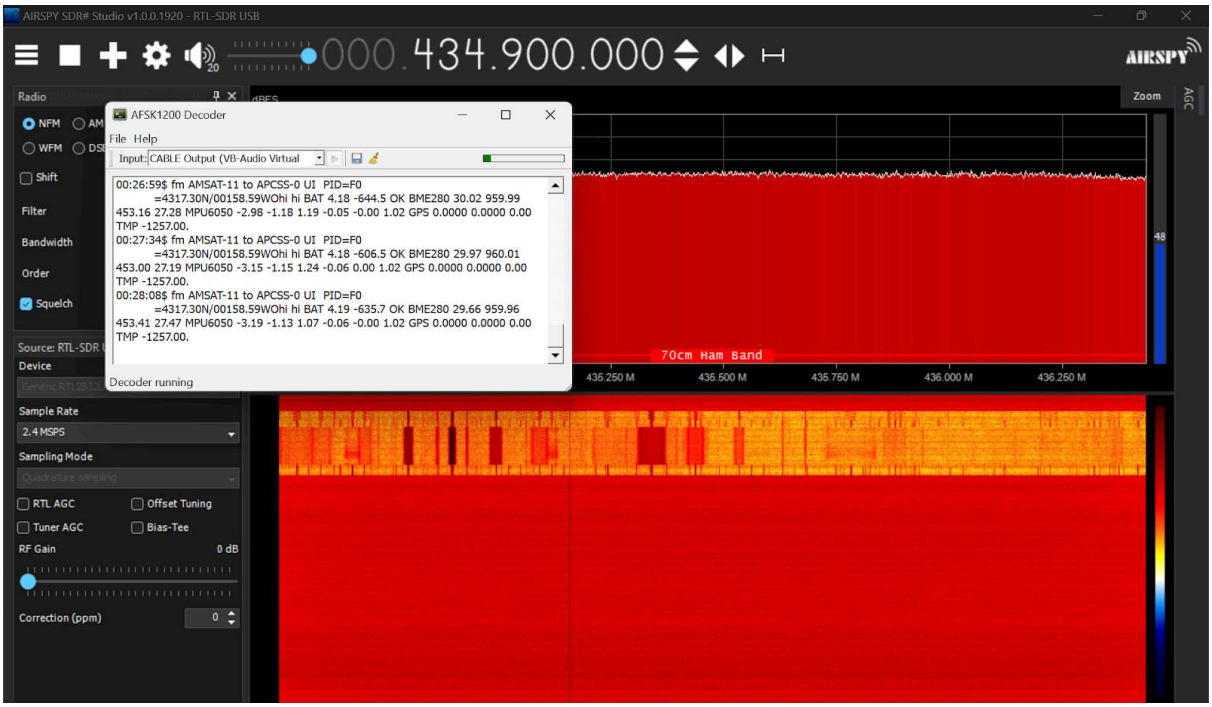
HAB Mode on (todo lo demás off y con FSK)



Recepción paquetes APRS AFSK Telemetry SDR#:


AIRSPY SDR# Studio v1.0.0.1920 - RTL-SDR USB
000.434.900.000
AIRSPY
Radio
NFM
WFM
Shift
Filter
Bandwidth
Order
Squelch
Source: RTL-SDR
Device
Sample Rate
2.4 MSPS
Sampling Mode
RTL AGC
Offset Tuning
Tuner AGC
Bias-Tee
RF Gain
0 dB
Correction (ppm)
Zoom
AGC
AFSK1200 Decoder
File Help
Input: CABLE Output (VB-Audio Virtual
00:16:15$ fm AMSAT-11 to APCSS-0 UI PID=F0
=4317.26N/00158.59WOhi hi BAT 4.00 -878.1 OK BME280 25.51 959.97 453.39
35.59 MPU6050 -2.82 -1.15 1.31 -0.06 0.00 1.03 GPS 0.0000 0.0000 0.00 TMP
-1257.00.
00:16:52$ fm AMSAT-11 to APCSS-0 UI PID=F0
=4317.27N/00159.00WOhi hi BAT 4.11 -711.7 OK BME280 28.77 959.91 453.87
29.25 MPU6050 -3.30 -1.15 1.02 -0.05 0.01 1.01 GPS 0.0000 0.0000 0.00 TMP
-1257.00.
Decoder running
70cm Ham Band
435.250 M
435.500 M
435.750 M
436.000 M
436.250 M
51


AIRSPY SDR# Studio v1.0.0.1920 - RTL-SDR USB
000.434.900.000
AIRSPY
Radio
NFM
WFM
Shift
Filter
Bandwidth
Order
Squelch
Source: RTL-SDR
Device
Sample Rate
2.4 MSPS
Sampling Mode
RTL AGC
Offset Tuning
Tuner AGC
Bias-Tee
RF Gain
0 dB
Correction (ppm)
Zoom
AGC
AFSK1200 Decoder
File Help
Input: CABLE Output (VB-Audio Virtual
00:16:52$ fm AMSAT-11 to APCSS-0 UI PID=F0
=4317.27N/00159.00WOhi hi BAT 4.11 -711.7 OK BME280 28.77 959.91
453.87 29.25 MPU6050 -3.30 -1.15 1.02 -0.05 0.01 1.01 GPS 0.0000 0.0000 0.00
TMP -1257.00.
00:17:26$ fm AMSAT-11 to APCSS-0 UI PID=F0
=4317.26N/00158.59WOhi hi BAT 4.12 -722.7 OK BME280 28.82 959.94
453.64 29.21 MPU6050 -3.31 -1.51 1.21 -0.05 0.00 1.02 GPS 0.0000 0.0000 0.00
TMP -1257.00.
00:17:59$ fm AMSAT-11 to APCSS-0 UI PID=F0
=4317.26N/00158.59WOhi hi BAT 4.13 -717.0 OK BME280 28.99 959.98
453.27 29.10 MPU6050 -3.13 -1.19 0.46 -0.06 0.00 1.03 GPS 0.0000 0.0000 0.00
TMP -1257.00.
Decoder running
70cm Ham Band
435.250 M
435.500 M
435.750 M
436.000 M
436.250 M
52

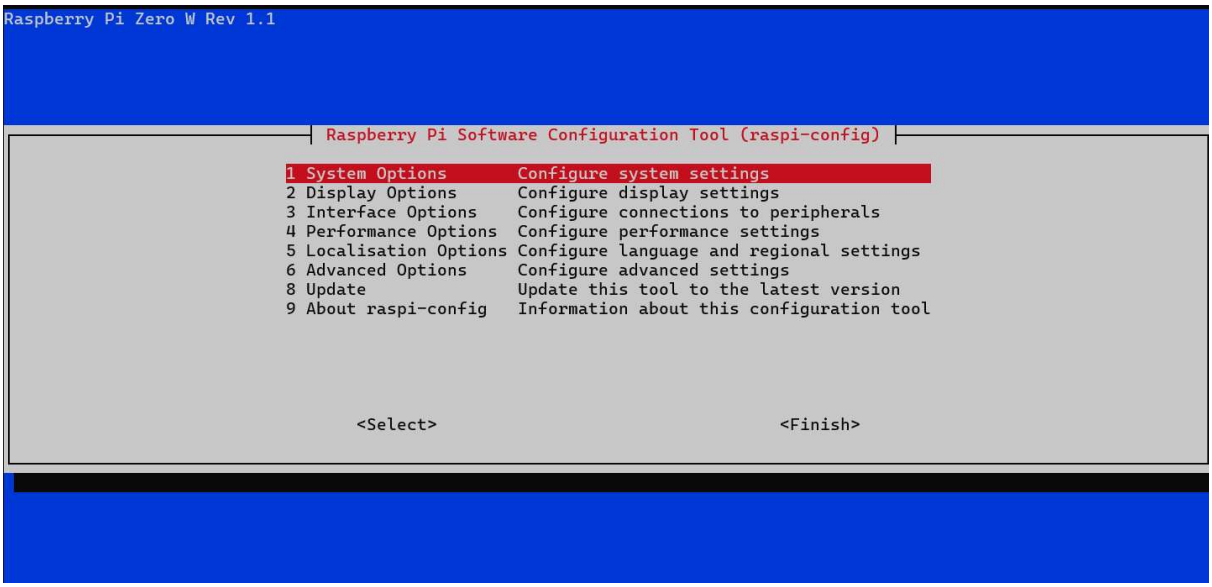


Decodificación y recepción paquetes APRS AFSK Windows cmd:

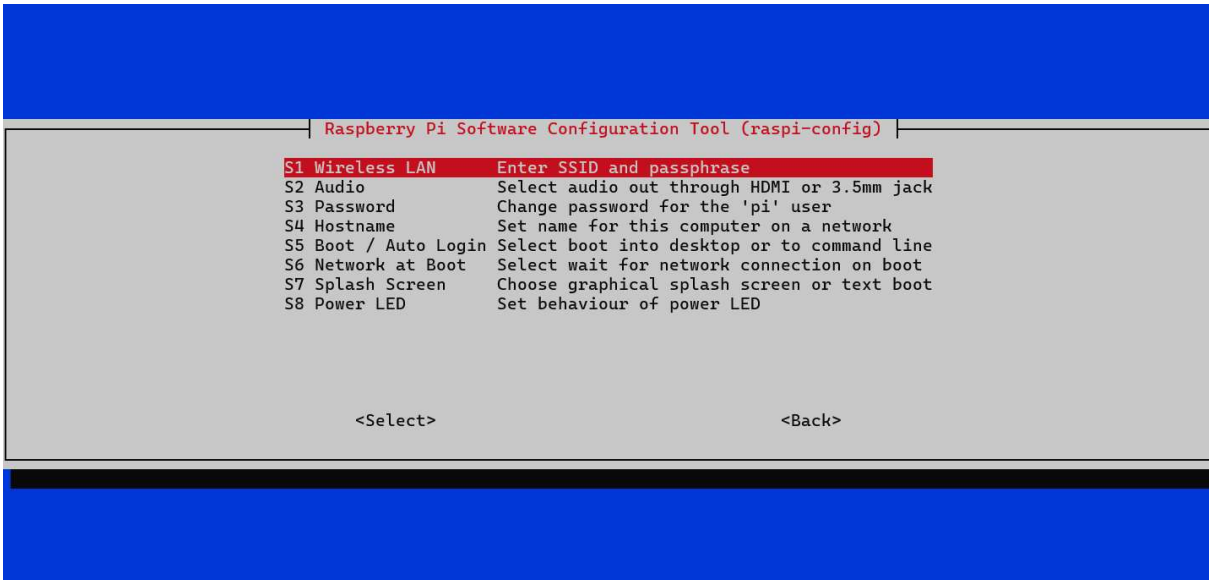
```
C:\Users\CUBESAT\Desktop\PFG\Juan\Ground Station\multimon-ng>rtl_fm -f 434.9M -s 22050 -g 48 - | multimon-ng -a AFSK1200 -A -t raw -
multimon-ng  (C) 1996/1997 by Tom Sailer HB9JNX/AE4WA
             (C) 2012-2014 by Elias Oenal
available demodulators: POCSAG512 POCSAG1200 POCSAG2400 Found 1 device(s):
EAS UFSK1200 CLIPFSK FMSFSK AFSK1200 AFSK2400 AFSK2400_2 AFSK2400_3 HAPN4800 FSK9600 DTMF ZVEI1 ZVEI2 ZVEI3 DZVEI PZVEI EEA EIA CCIR
MORSE_CW DUMPCSV
Enabled demodulators: AFSK1200
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM
Found Rafael Micro R820T tuner
Tuner gain set to 48.00 dB.
Tuned to 435153575 Hz.
Oversampling input by: 46x.
Oversampling output by: 1x.
Buffer size: 8.08ms
Exact sample rate is: 1014300.020041 Hz
Sampling at 1014300 S/s.
Output at 22050 Hz.
APRS: AMSAT-11>APCSS:=4317.34N/00158.57WOhi hi BAT 4.23 -534.8 OK BME280 28.04 960.13 451.92 29.87 MPU6050 -3.02 -1.47 1.39 -0.06 0.0
0 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00

APRS: AMSAT-11>APCSS:=4317.34N/00158.57WOhi hi BAT 4.24 -573.9 OK BME280 28.15 960.18 451.52 29.76 MPU6050 -2.93 -1.33 1.57 -0.06 0.0
0 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00

APRS: AMSAT-11>APCSS:=4317.34N/00158.55WOhi hi BAT 4.24 -570.8 OK BME280 28.70 960.12 452.03 29.05 MPU6050 -3.30 -1.33 1.40 -0.06 0.0
1 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00

APRS: AMSAT-11>APCSS:=4317.34N/00158.55WOhi hi BAT 4.24 -568.3 OK BME280 28.81 960.09 452.29 28.80 MPU6050 -2.95 -0.89 1.34 -0.06 0.0
0 1.02 GPS 0.0000 0.0000 0.00 TMP -1257.00
```

Configuración Raspberry Pi:

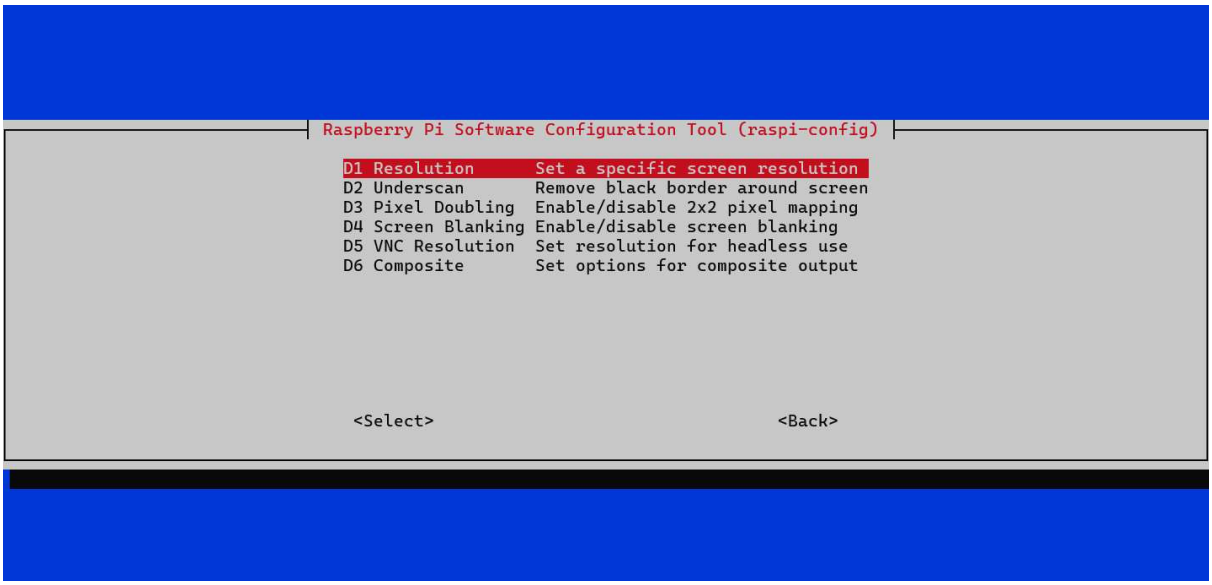
sudo raspi-config


Raspberry Pi Zero W Rev 1.1
Raspberry Pi Software Configuration Tool (raspi-config)
1 System Options Configure system settings
2 Display Options Configure display settings
3 Interface Options Configure connections to peripherals
4 Performance Options Configure performance settings
5 Localisation Options Configure language and regional settings
6 Advanced Options Configure advanced settings
8 Update Update this tool to the latest version
9 About raspi-config Information about this configuration tool
<Select>
<Finish>

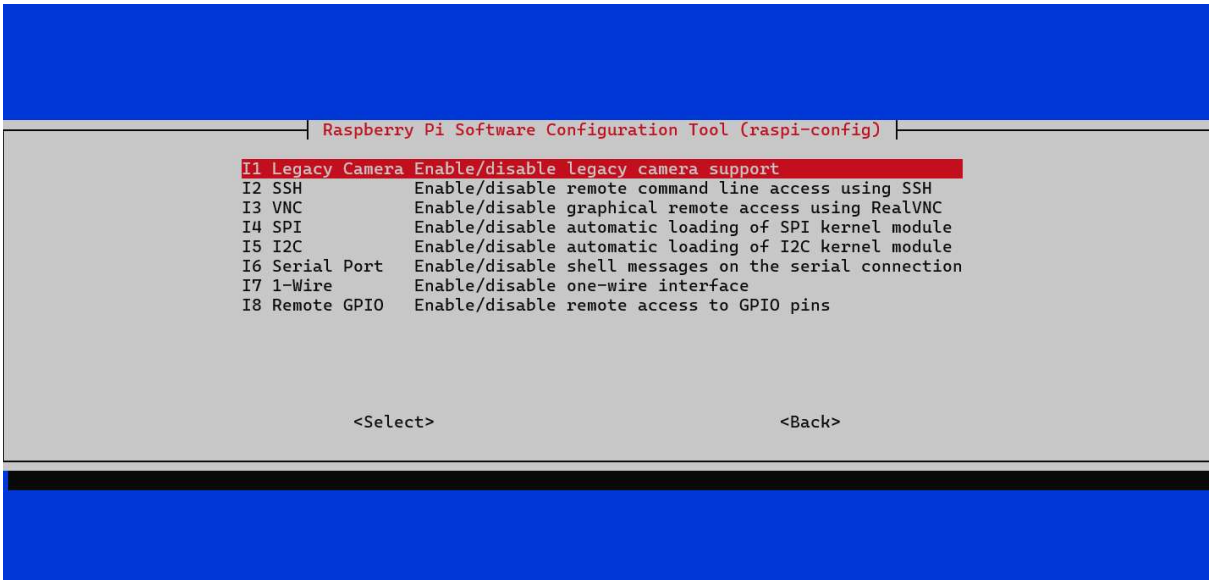
1.


Raspberry Pi Software Configuration Tool (raspi-config)
S1 Wireless LAN Enter SSID and passphrase
S2 Audio Select audio out through HDMI or 3.5mm jack
S3 Password Change password for the 'pi' user
S4 Hostname Set name for this computer on a network
S5 Boot / Auto Login Select boot into desktop or to command line
S6 Network at Boot Select wait for network connection on boot
S7 Splash Screen Choose graphical splash screen or text boot
S8 Power LED Set behaviour of power LED
<Select>
<Back>

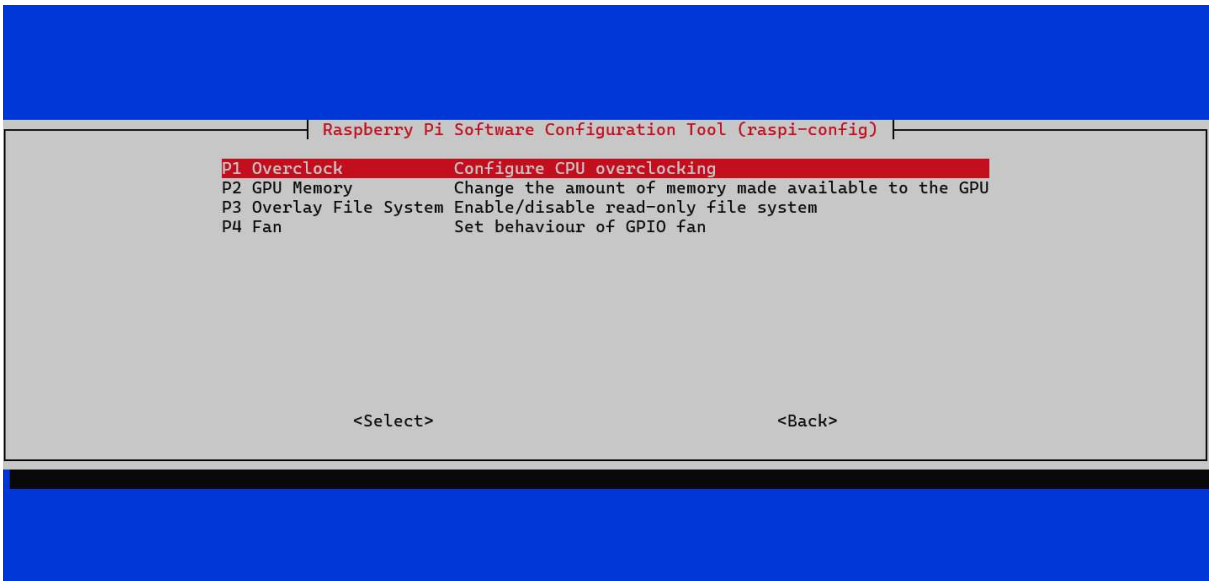
2.


Raspberry Pi Software Configuration Tool (raspi-config)
D1 Resolution Set a specific screen resolution
D2 Underscan Remove black border around screen
D3 Pixel Doubling Enable/disable 2x2 pixel mapping
D4 Screen Blanking Enable/disable screen blanking
D5 VNC Resolution Set resolution for headless use
D6 Composite Set options for composite output
<Select>
<Back>

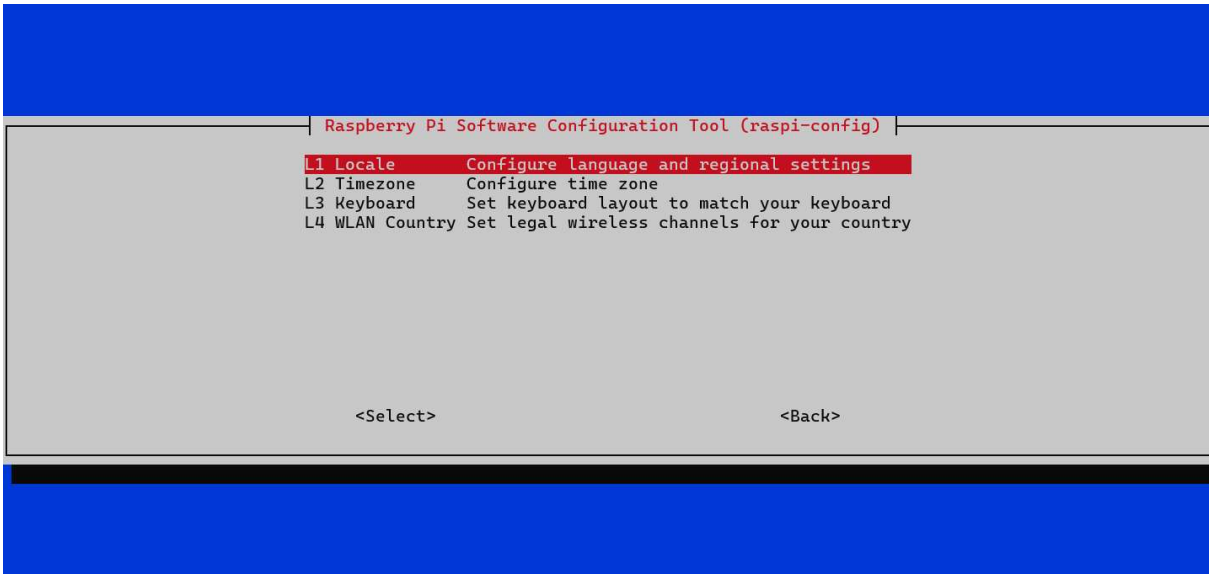
3.


Raspberry Pi Software Configuration Tool (raspi-config)
I1 Legacy Camera Enable/disable legacy camera support
I2 SSH Enable/disable remote command line access using SSH
I3 VNC Enable/disable graphical remote access using RealVNC
I4 SPI Enable/disable automatic loading of SPI kernel module
I5 I2C Enable/disable automatic loading of I2C kernel module
I6 Serial Port Enable/disable shell messages on the serial connection
I7 1-Wire Enable/disable one-wire interface
I8 Remote GPIO Enable/disable remote access to GPIO pins
<Select>
<Back>

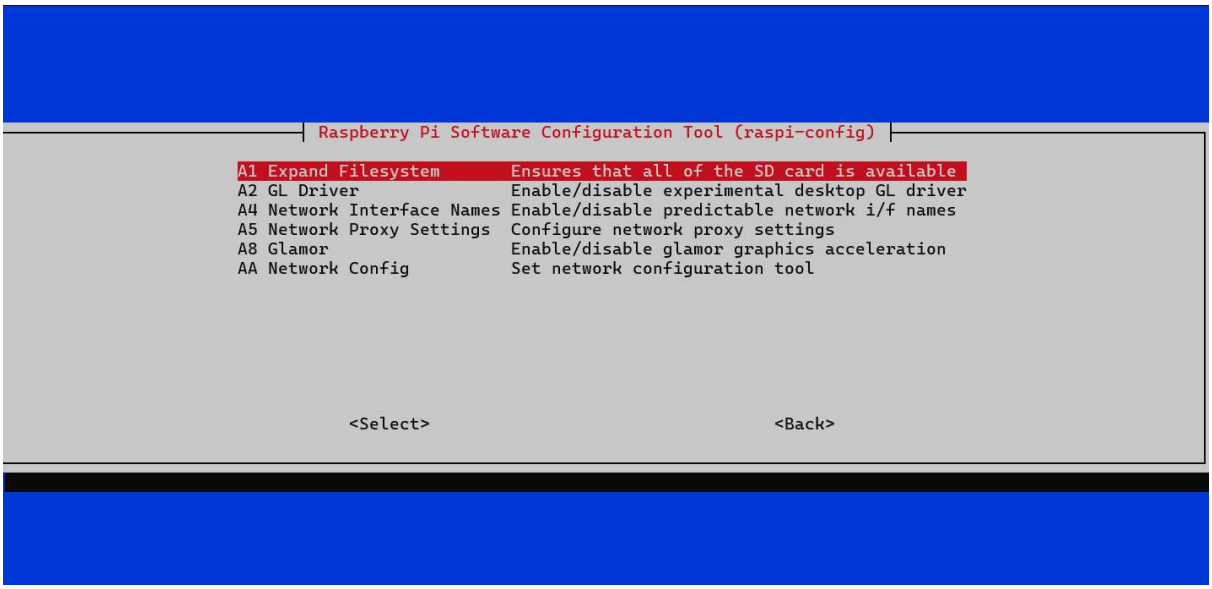
4.


Raspberry Pi Software Configuration Tool (raspi-config)
P1 Overclock Configure CPU overclocking
P2 GPU Memory Change the amount of memory made available to the GPU
P3 Overlay File System Enable/disable read-only file system
P4 Fan Set behaviour of GPIO fan
<Select>
<Back>

5.


Raspberry Pi Software Configuration Tool (raspi-config)
L1 Locale Configure language and regional settings
L2 Timezone Configure time zone
L3 Keyboard Set keyboard layout to match your keyboard
L4 WLAN Country Set legal wireless channels for your country
<Select>
<Back>

6.

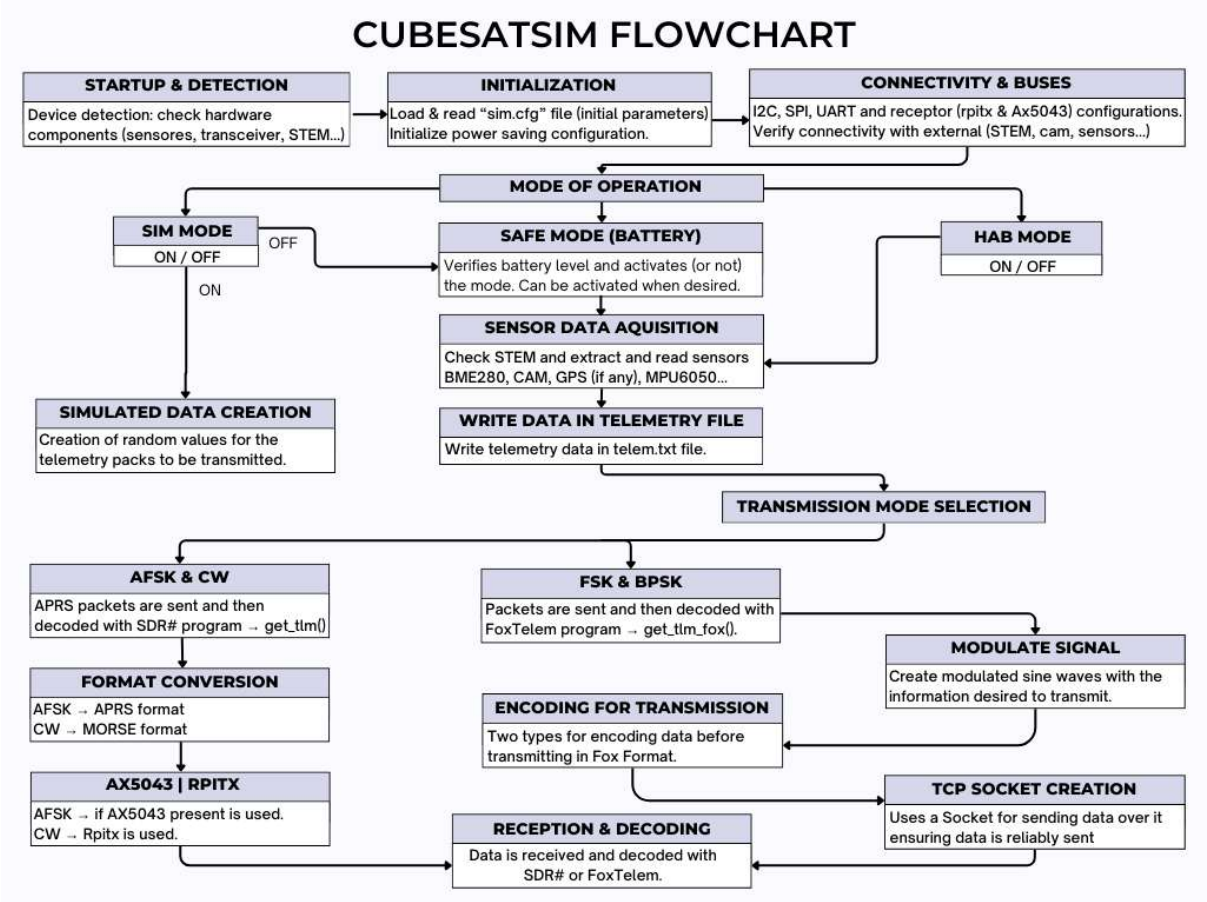

Raspberry Pi Software Configuration Tool (raspi-config)
A1 Expand Filesystem Ensures that all of the SD card is available
A2 GL Driver Enable/disable experimental desktop GL driver
A4 Network Interface Names Enable/disable predictable network i/f names
A5 Network Proxy Settings Configure network proxy settings
A8 Glamor Enable/disable glamor graphics acceleration
AA Network Config Set network configuration tool
<Select>
<Back>

9.


This tool provides a straightforward way of doing initial configuration of the Raspberry Pi. Although it can be run at any time, some of the options may have difficulties if you have heavily customised your installation.
Version: 20231012~bullseye
<Ok>

FLUJO Y PARTES DEL CÓDIGO

Flujo:



CubeSat Software Flowchart Breakdown

1. Startup & Initialization

- **Device Detection**
  - Check hardware components (sensors, camera, transceiver, STEM board, etc.)
  - Validate system integrity
- **Load Initial Configuration**
  - Load telemetry mode (FSK, BPSK, AFSK, CW)
  - Set default transmission parameters
  - Initialize power-saving settings

2. Transmission Mode Selection

- **SIM Mode or HAB Mode?**
  - If SIM mode → Simulated telemetry data
  - If HAB mode → Real-time telemetry data
- **Telemetry Mode Configuration**

    - Configure transmission mode (AFSK, BPSK, FSK, CW)
    - Load transmission parameters

3. Hardware & Bus Availability Checks

- **Check Available Buses**
    - I2C, SPI, UART
    - Verify connectivity with external components (STEM, sensors, camera, transceiver)
- **Camera Detection**
    - If present, prepare for image processing
    - If absent, skip camera-related tasks

4. Sensor Data Acquisition & Processing

- **Read Sensors & Initialize Variables**
    - Gather data from sensors (temperature, pressure, altitude, battery, etc.)
    - Process raw sensor data into usable telemetry packets
- **Extract STEM Payload Data**
    - If STEM board is connected, read and process additional payload data

5. Telemetry Storage & Transmission

- **Write Telemetry Data to .TXT File**
    - Log all collected telemetry for later transmission
- **Select Transmission Path Based on Mode**
    - If **AFSK or CW** → Call `Get_tlm()`
    - If **FSK or BPSK** → Call `Get_tlm_fox()`

6. Transmission Signal Generation

- **Create Modulated Signal**
    - Generate sine waves with the appropriate modulation based on the selected transmission mode
- **Encoding & Processing**
    - Apply necessary coding schemes to prepare telemetry for transmission

7. Image Processing & Data Handling

- **Image Detection & Processing**
    - If an image has been captured, process it for transmission
- **Transmission & Reception Radio Configuration**
    - Configure AX-5043 transceiver for uplink/downlink communication

8. Power Management & Optimization

- **Battery-Saving Mode**
    - Adjust transmission power based on available energy reserves
    - Reduce sensor polling frequency if battery is low

Decision Flow Example

1. **Start CubeSat** → Detect Devices
2. **Choose Mode (SIM/HAB)** → Load corresponding settings
3. **Check Buses & Camera** → Initialize sensors & payload
4. **Gather & Store Telemetry** → Process for transmission
5. **Determine Transmission Mode** → Encode & Modulate Signal
6. **Transmit Telemetry** → Save power if needed

Partes del código:

- Device detection
- Loading initial configuration
- SIM / HAB mode on
- Comprobación buses disponibles
- Config Modo telemetría
- Config e inicialización modo AFSK con transceptor AX-5043
- Config e inicialización LEDs (puertos, pines)
- Config buses I2C
- Check for camera
- Conexión con placa STEM
- Config modo simulated telemetría
- Config modos FSK and BPSK
- Lectura de sensores e inicializacion de variables
- Uso simulated telemetría
- Extraccion datos STEM payload
- Escritura telemetría .txt
- Transmisión telemetría según modo de operación
- Get_tlm() -> Envío datos telemetría CW y AFSK
- Get_tlm_fox() -> Envío datos telemetría FSK y BPSK (FoxTelem)
- Creación ondas sinusoidales con modulaciones según condiciones de modo y rango
- Codificador
- Verifica funcionalidad de un buses
- Detección y procesado de imágenes (ya tomadas)
- Configuracion modulo radio de transmision y recepcion
- Configuración modo ahorro de batería