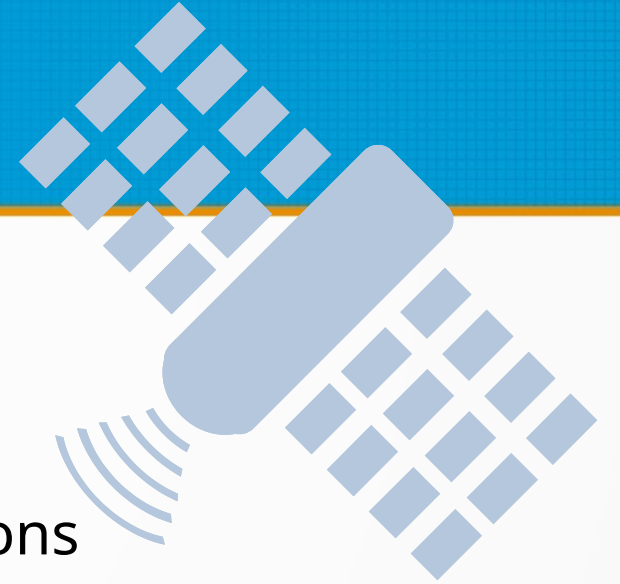


SatNOGS

**SATNOGS – Open Source global network of
satellite ground-stations**

SARTS talk by 9V1KG, Feb 2023

SatNOGS



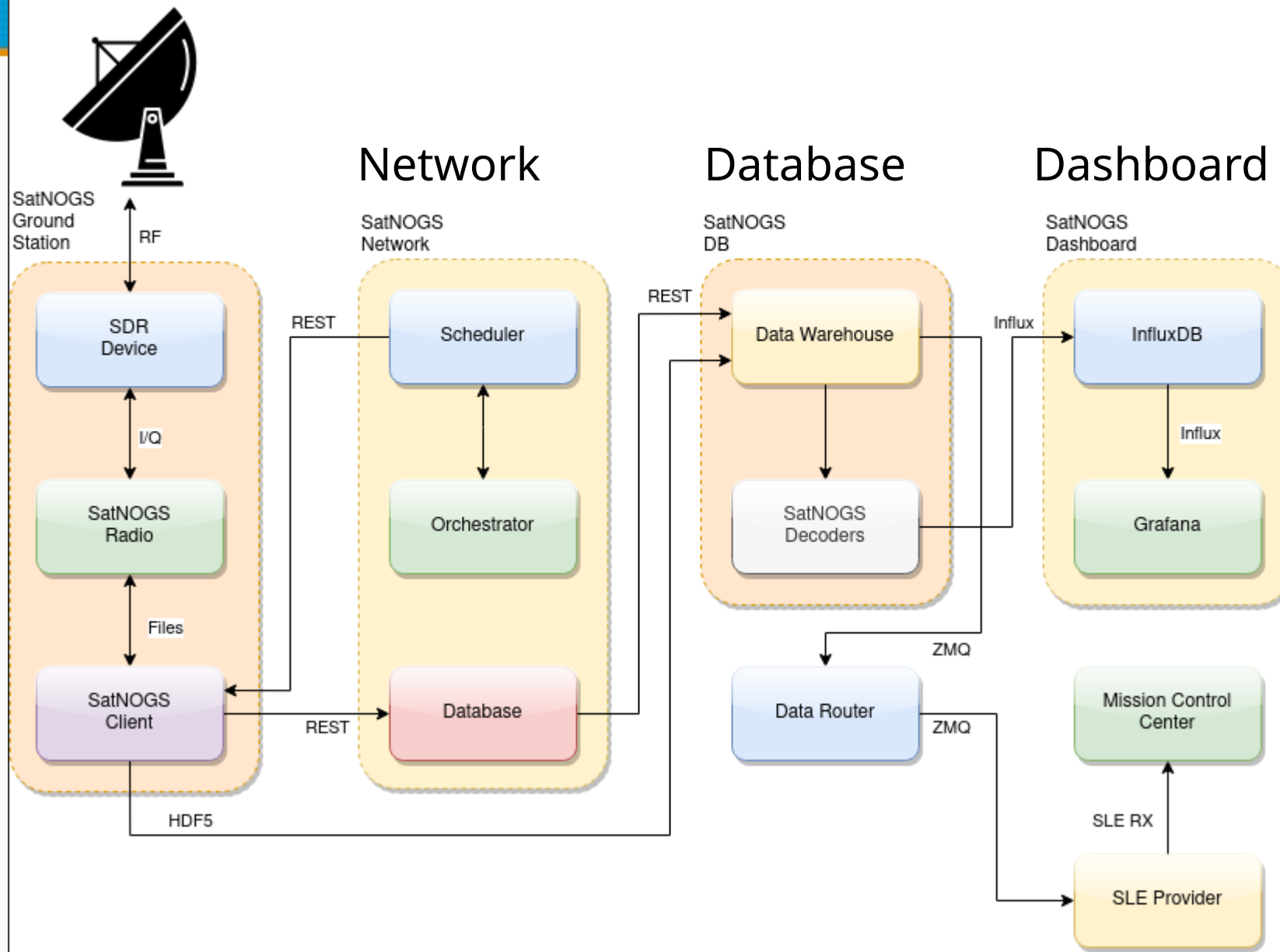
SatNOGS is the 'Open WebRX' for Satellites

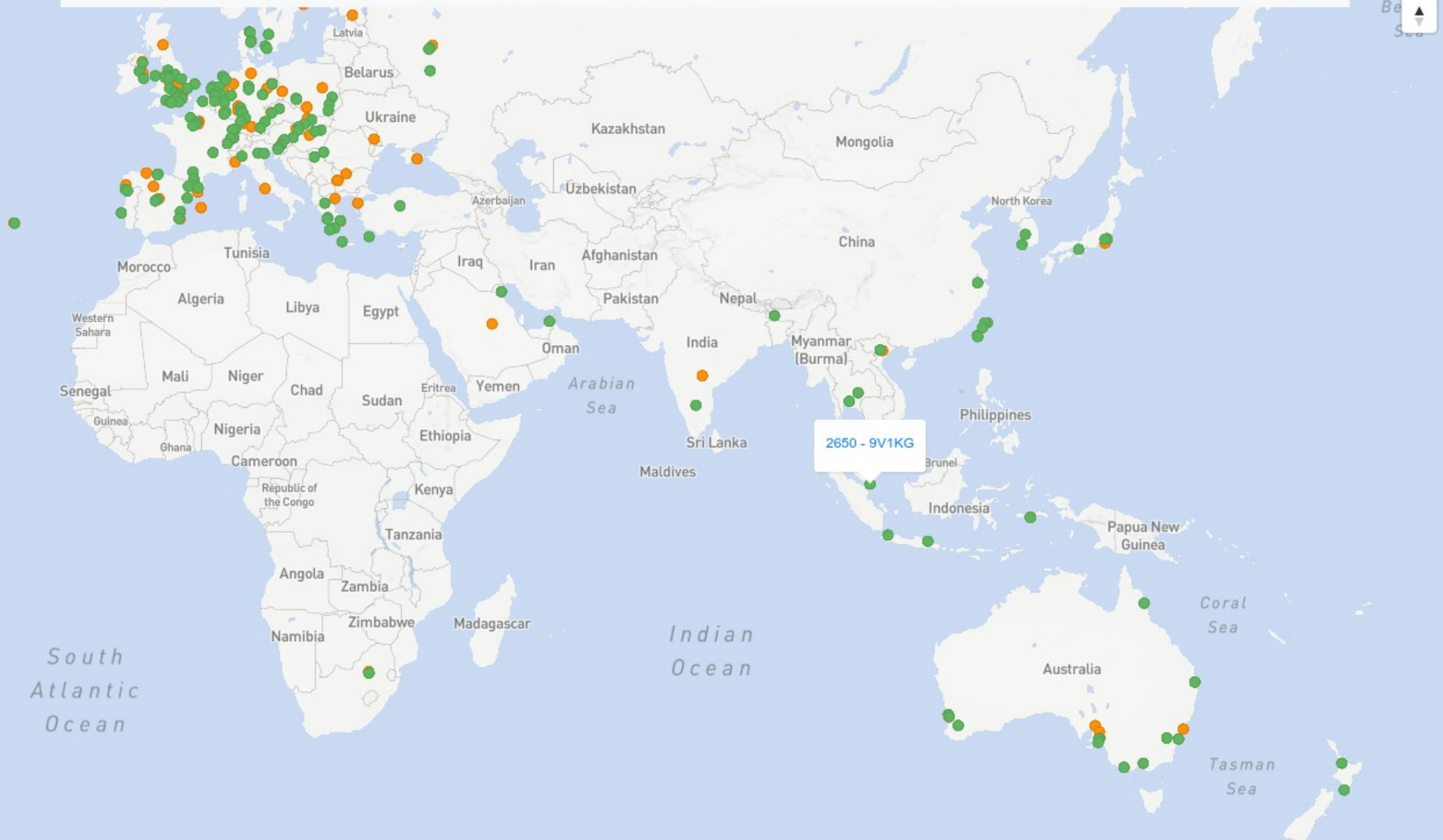
It is a network, where you can schedule satellite observations on any active SatNOGS ground station.

SARTS talk by 9V1KG, Feb 2023

SatNOGS Architecture Overview

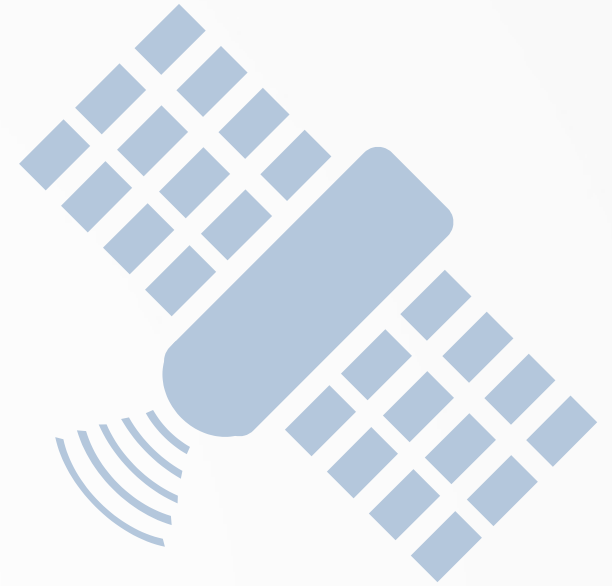
Ground
Station



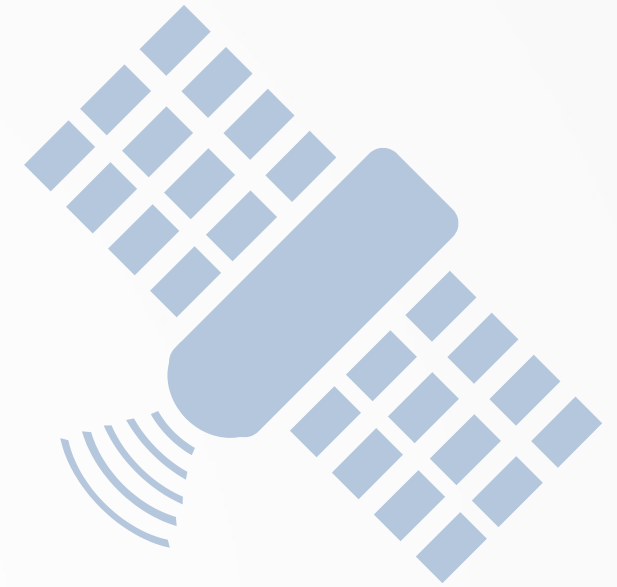


HW & SW Components

- Three major **Hardware** Components:
 - 1 **SDR** (e.g. RTL or Airspy Mini)
 - 2 **VHF/UHF Antenna**
 - 3 **Raspberry Pi**



HW & SW Components



- Three major **Hardware** Components:

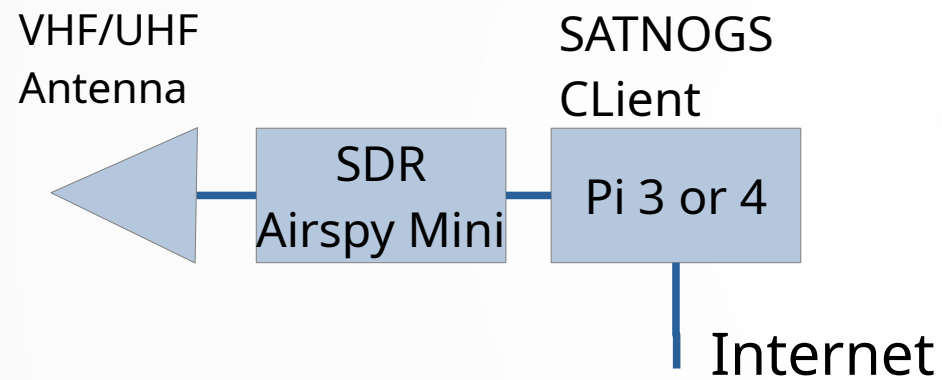
- 1 **SDR** (e.g. RTL or Airspy Mini)
- 2 **VHF/UHF Antenna**
- 3 **Raspberry Pi**

- Three major **Software** Components:

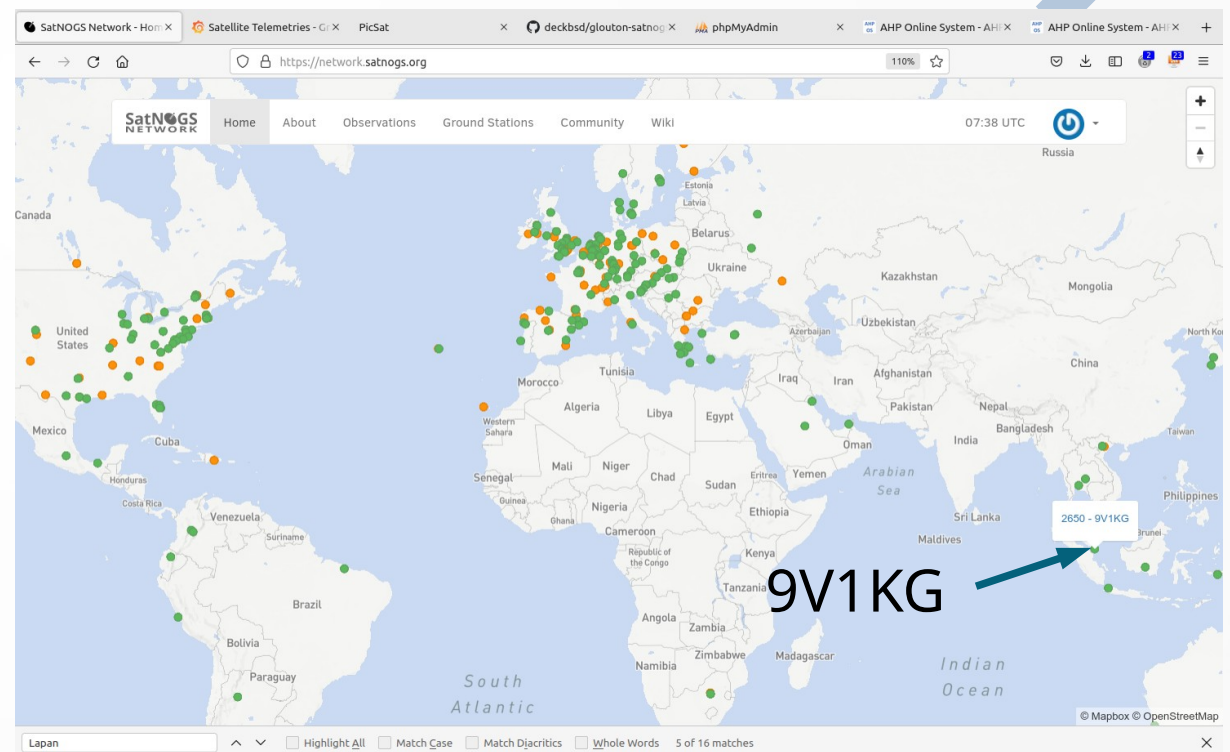
- 1 **Client:** satnogs client
- 2 **Decoder:** satnogs_gr-satellites (optional)
- 3 **Monitor:** satnogs_monitor (optional)

SatNOGS Basic HW Setup

Basic Hardware setup

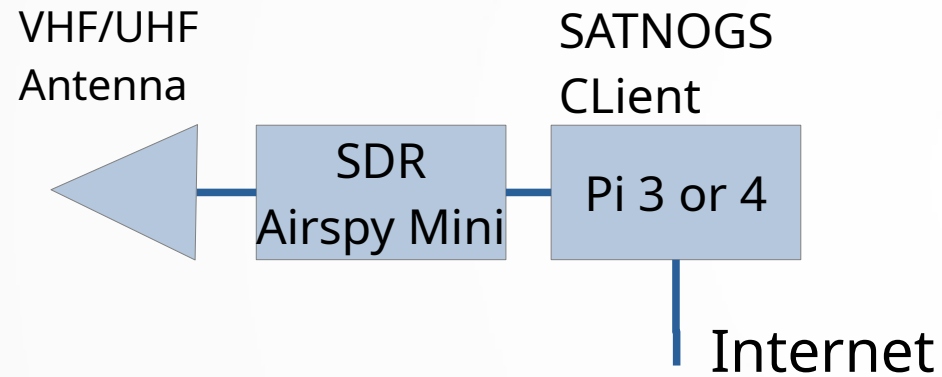


Web: <https://network.satnogs.org/>



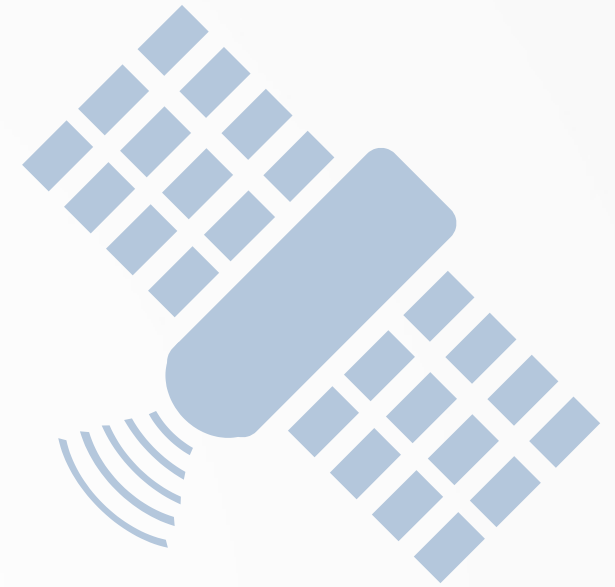
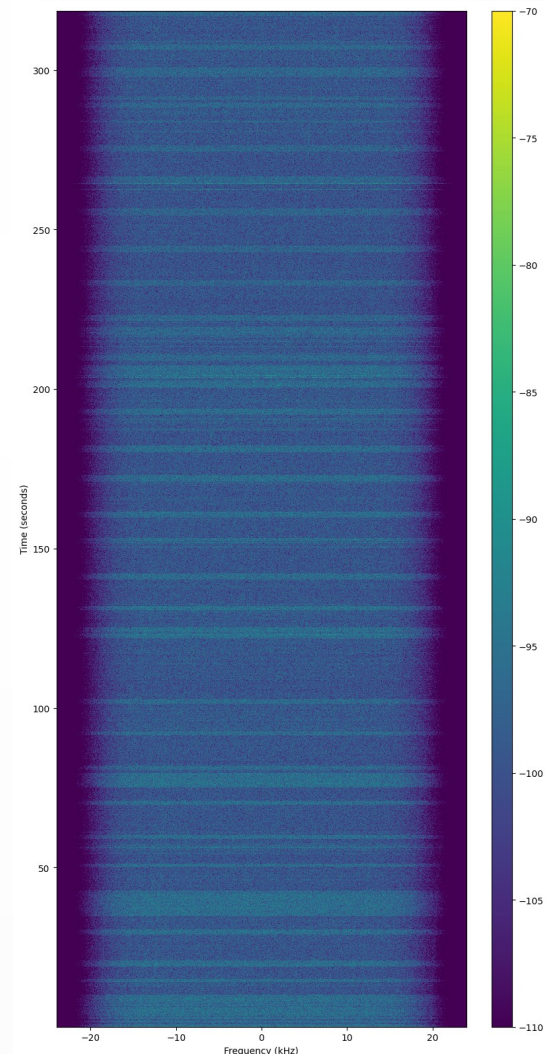
Airspy Mini

Basic Hardware setup



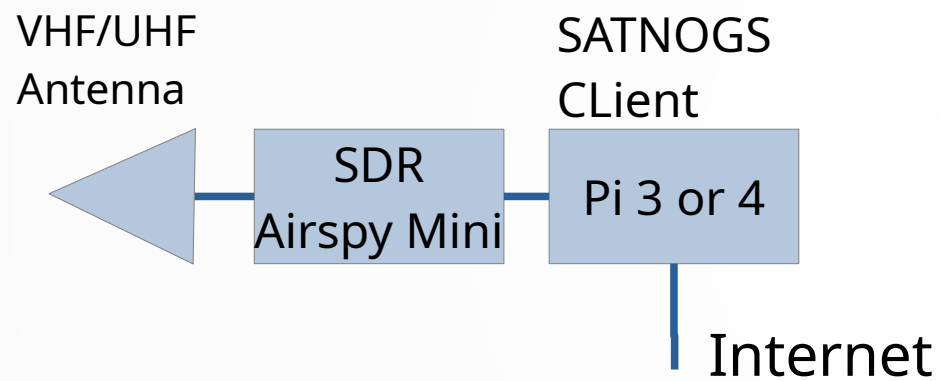
Setting Gain for Airspy:
LNA=11,MIX=9,VGA=7

Airspy Mini



Airspy Mini

Basic Hardware setup

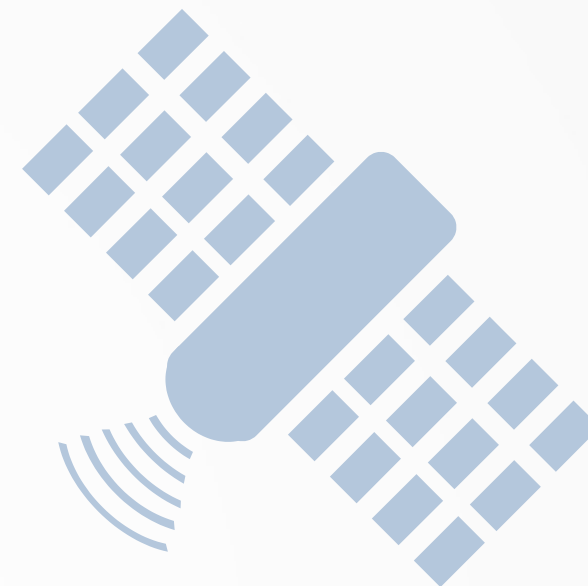
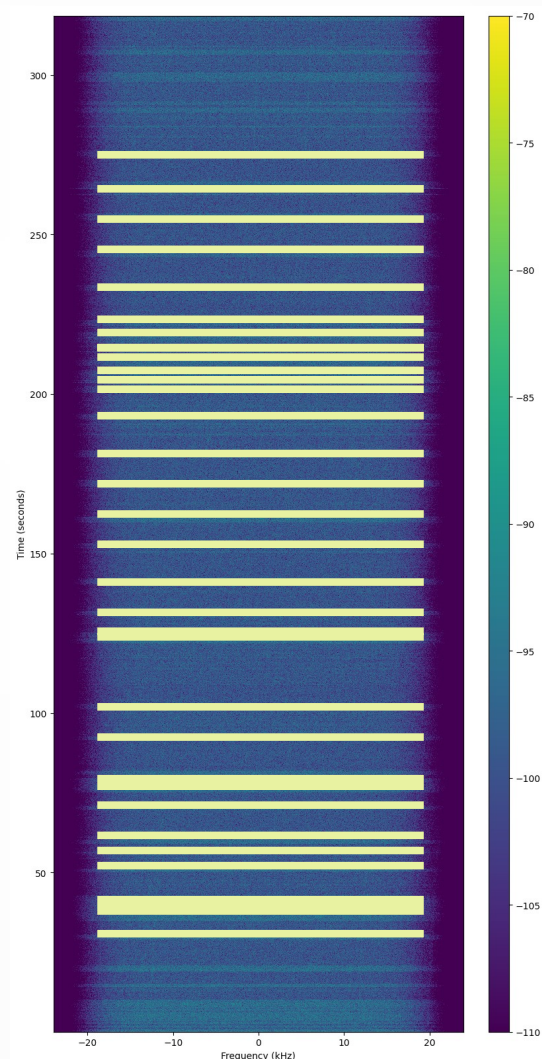


First waterfall results using
Airspy Mini with Yagi:

Lots of QRM very disappointing ...

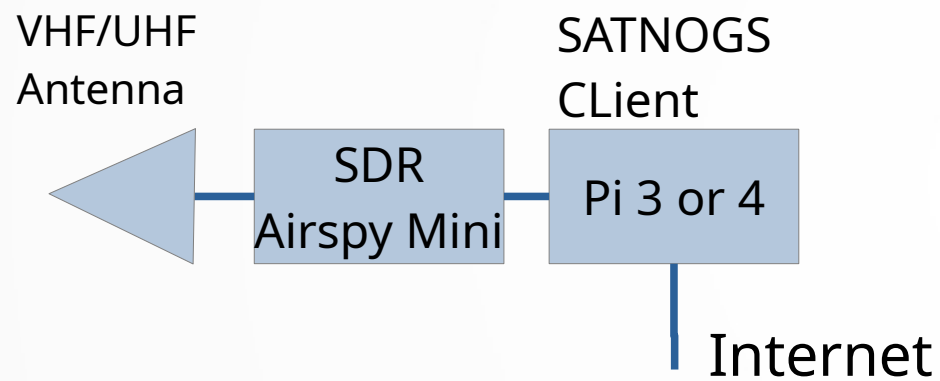


Airspy Mini



Airspy Mini

Basic Hardware setup

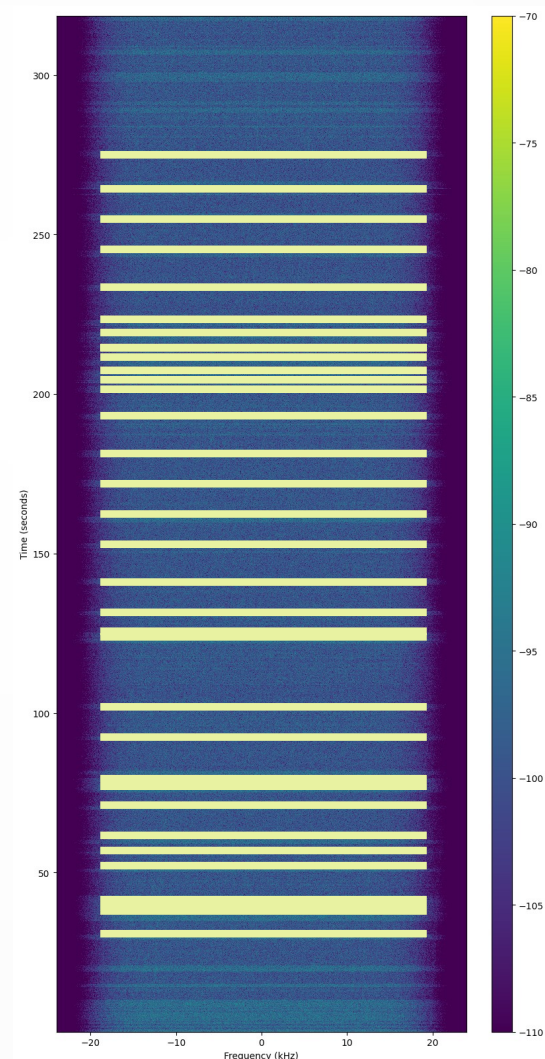


First waterfall results using
Airspy Mini with Yagi:

Lots of QRM very disappointing ...

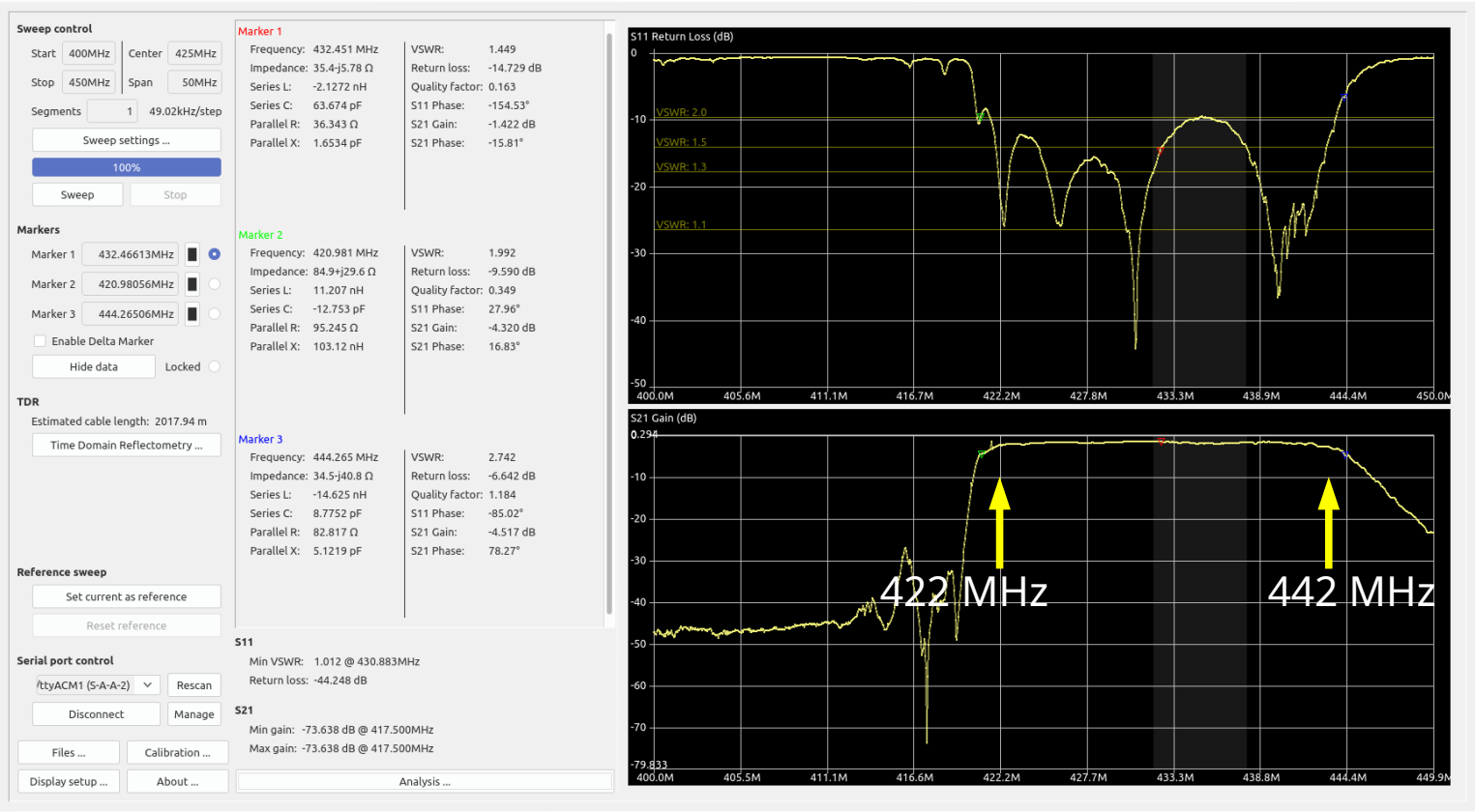
**... but in comparison the IC-9700
showed a 'clean' waterfall!?**

Airspy Mini

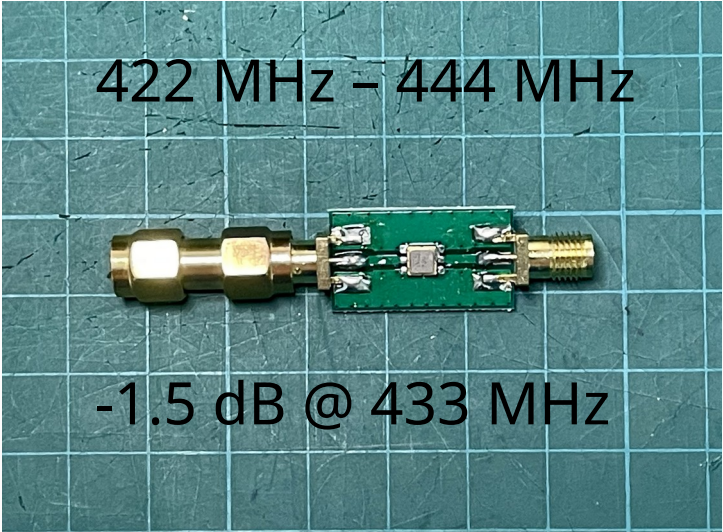


430 MHz Bandpass Filter

- Band pass filter

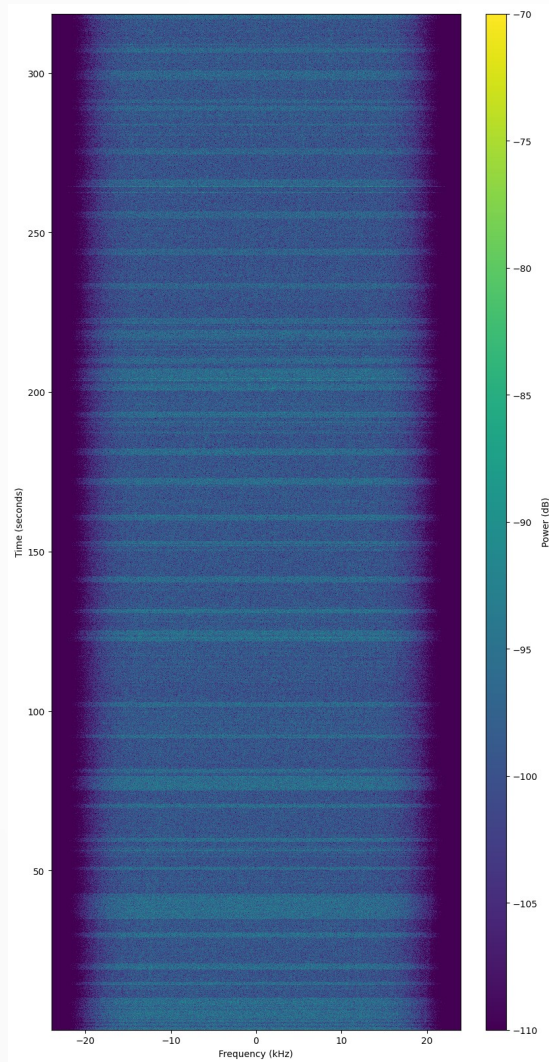


\$ 4.25

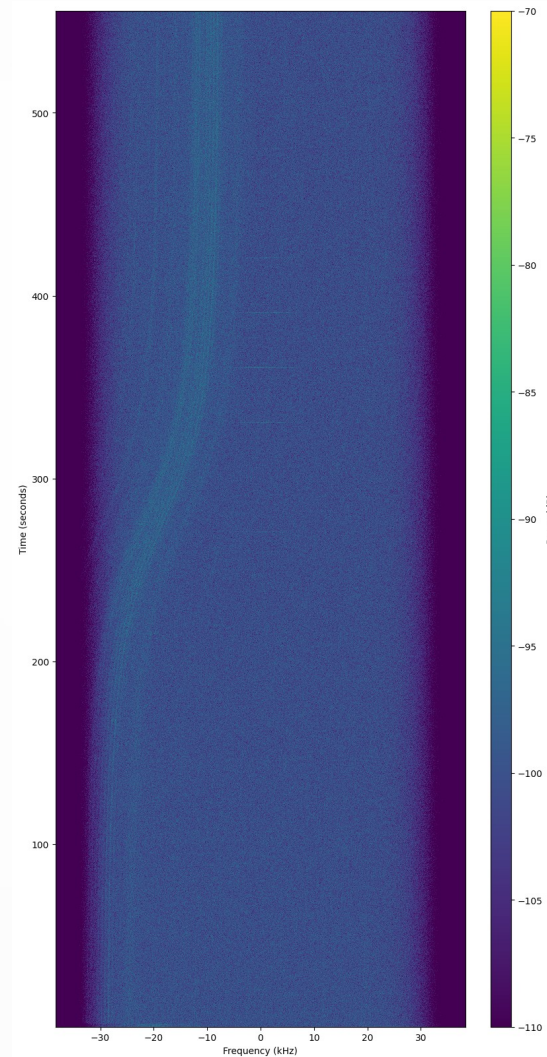


Airspy Mini

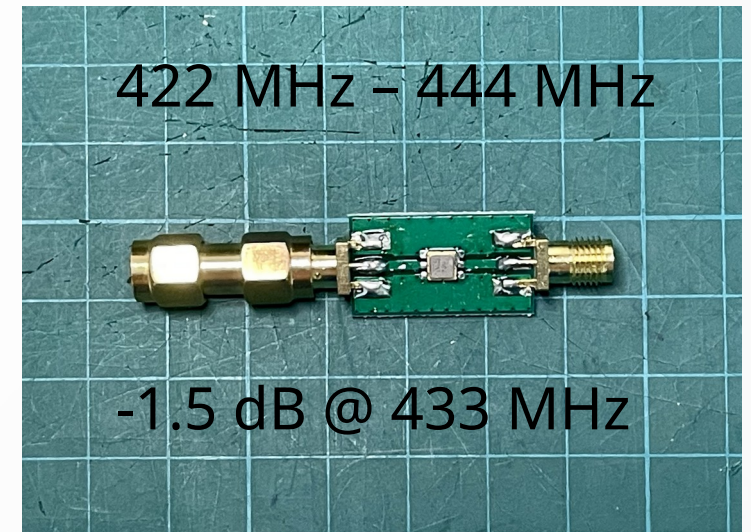
Airspy Mini



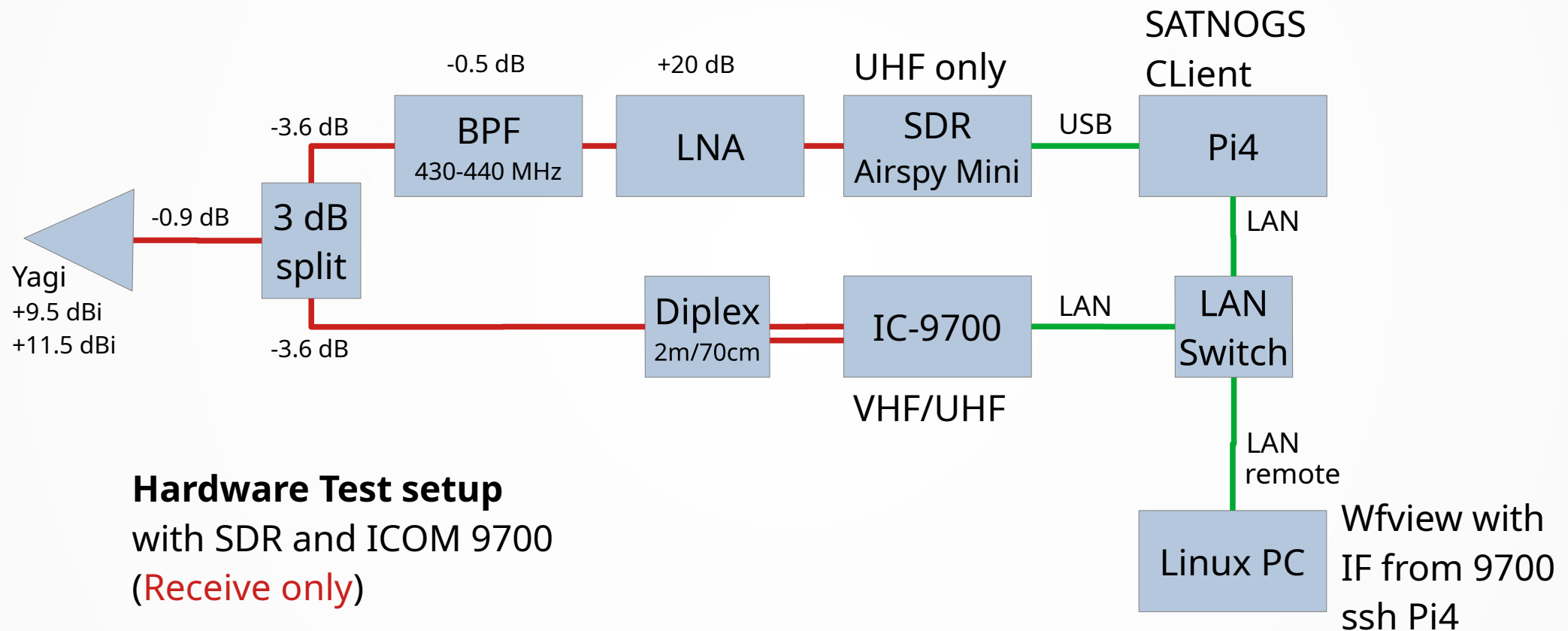
Airspy Mini w BPF



\$ 4.25



Test Setup for SatNOGS





Station Status

Observation

ONLINE

CPU46.6%

CPU Temp54.5°C

Mem8.4%

Next Job

+3' 12"

ID5982898

Vessel0 LI LACSAT 2

Start2022-05-24 10:35:10

End2022-05-24 10:44:37

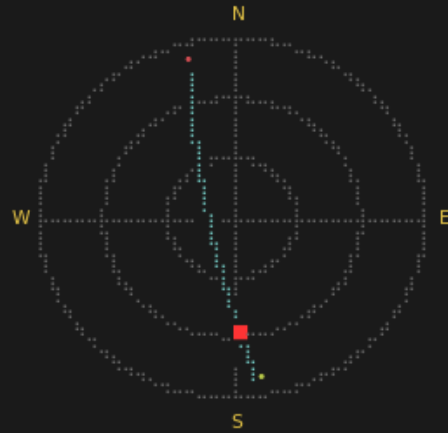
ModeGFSK

Frequency437.225 MHz

Rise171.000°

Max79.000°

Set346.000°



Satellite

Orbit36884

Latitude-4.950°

Longitude104.328°

Altitude525.645 km

Velocity7.598 km/s

Range895.181 km

Range Rate-5.928 km/s

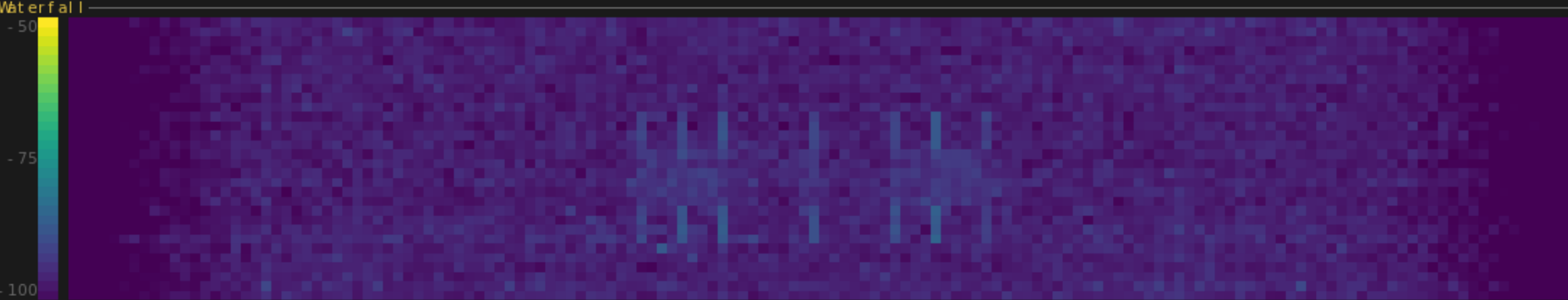
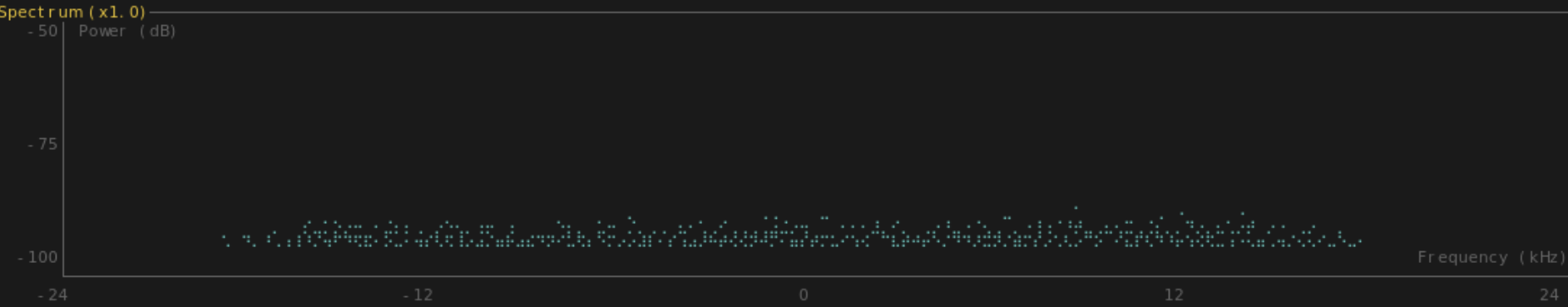
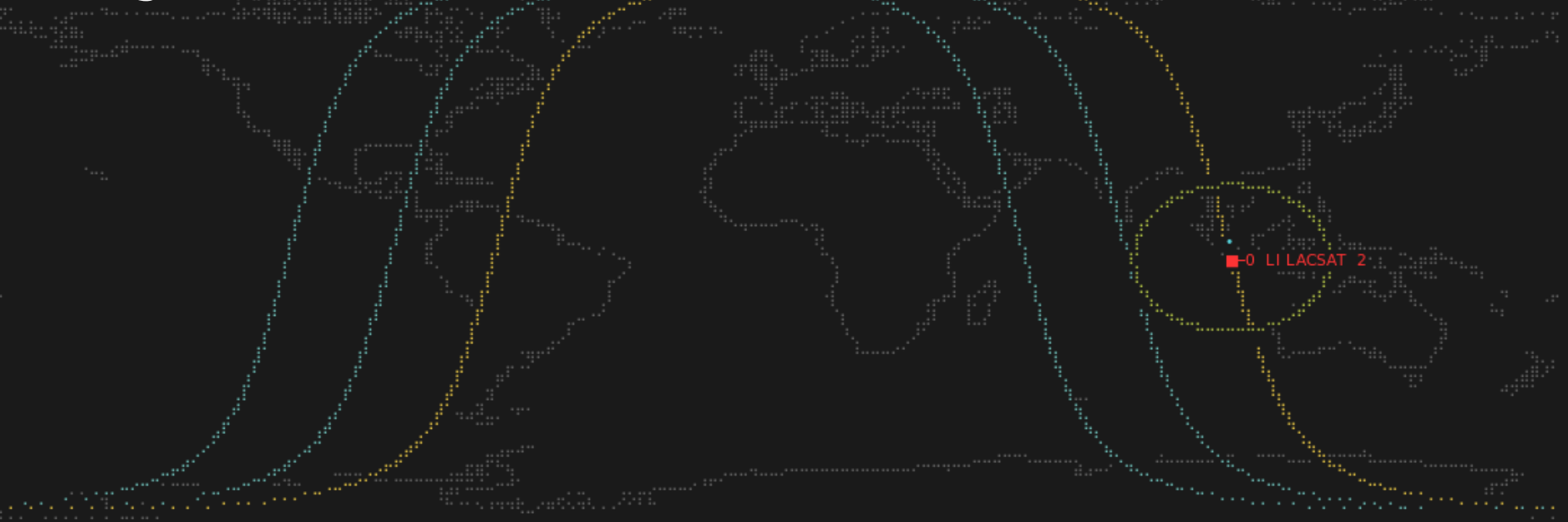
Azimuth176.400°

Elevation32.741°

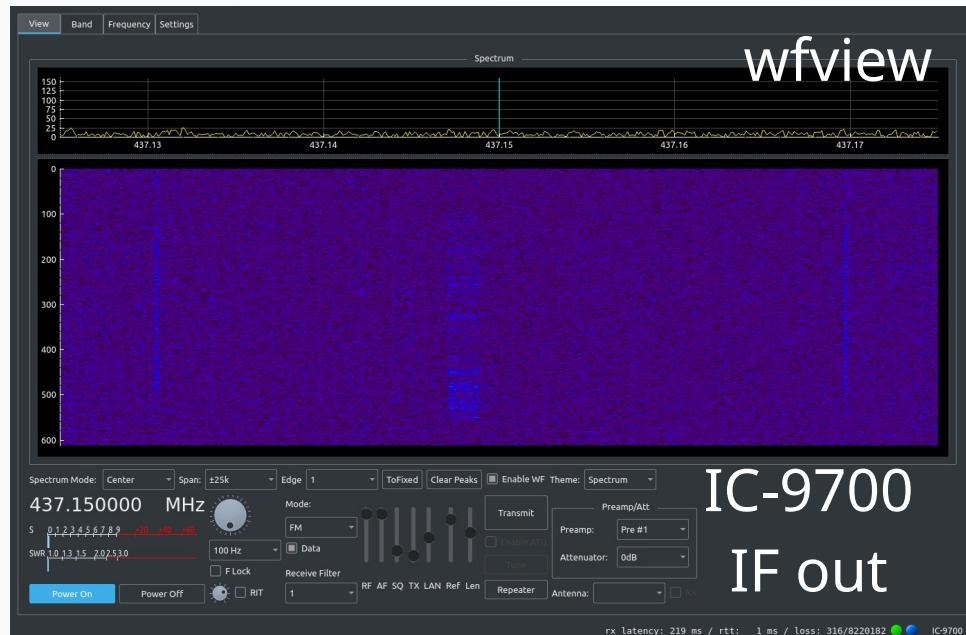
Future Jobs (29)

#5982898		0 LI LACSAT 2
3' 12"	GFSK	437.225 MHz
#5982996		0 XW 2B
20' 27"	CW	145.725 MHz
#5981815		BUGSAT-1
31' 1"	FSK	437.445 MHz
#5981832		GRI FEX
81' 44"	FSK	437.480 MHz
#5983067		ITUPSAT1
127' 46"	GFSK	437.320 MHz

Satnogs Monitor Terminal via SSH



IC-9700 Lan Connection



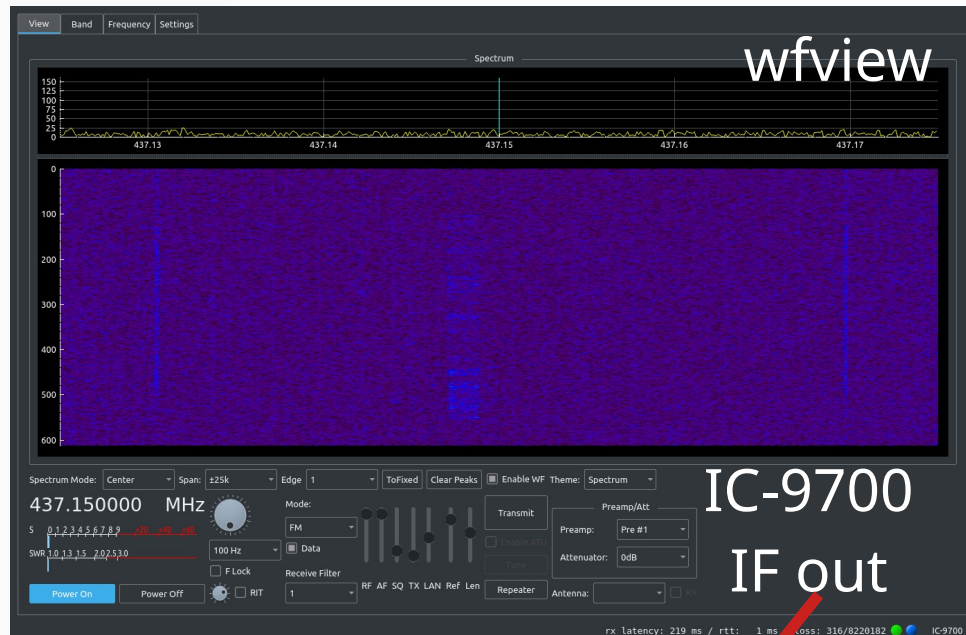
IF out
via LAN



AF max BW is 3 kHz!

IF out of the IC-9700 is a 16 kHz wide
AF signal centered at 12 kHz
Real, NOT I/Q!

IC-9700 IF Out

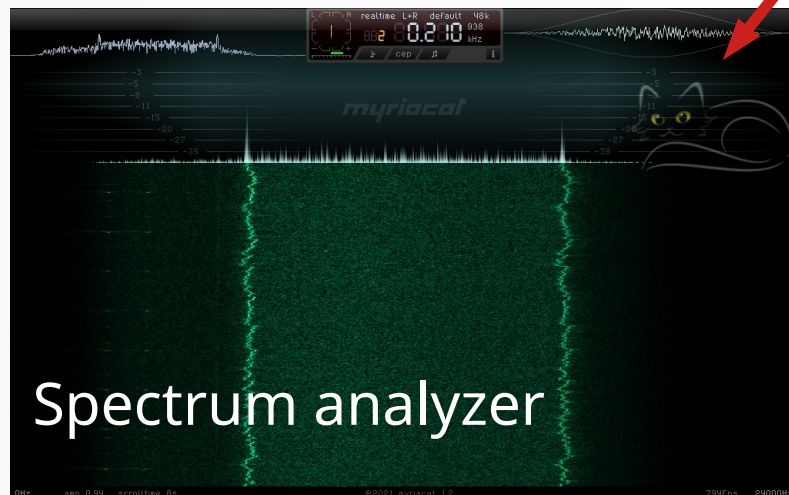


IF out
via LAN



AF max BW is 3 kHz!

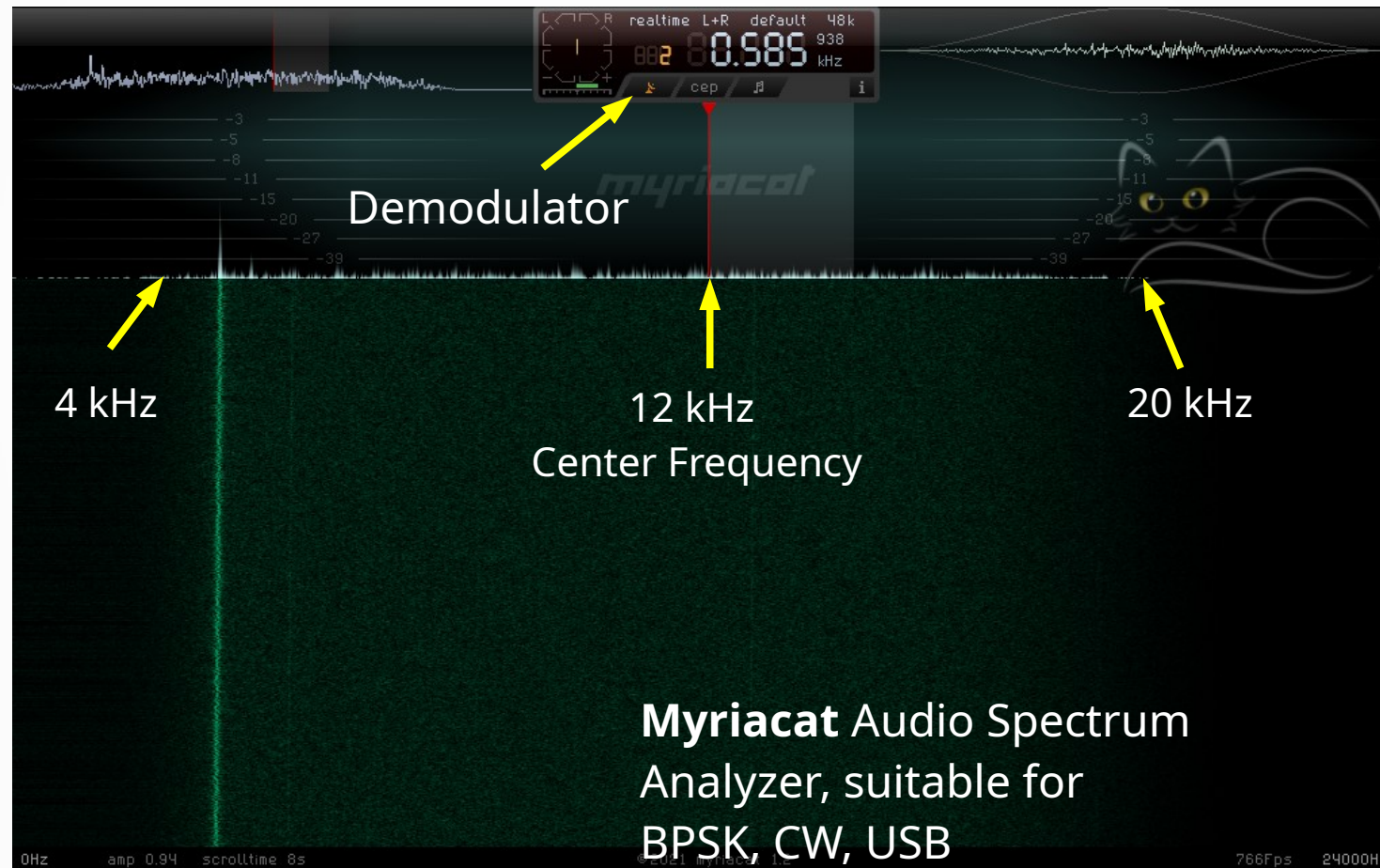
IF out of the IC-9700 is a 16 kHz wide
AF signal centered at 12 kHz
Real, NOT I/Q!



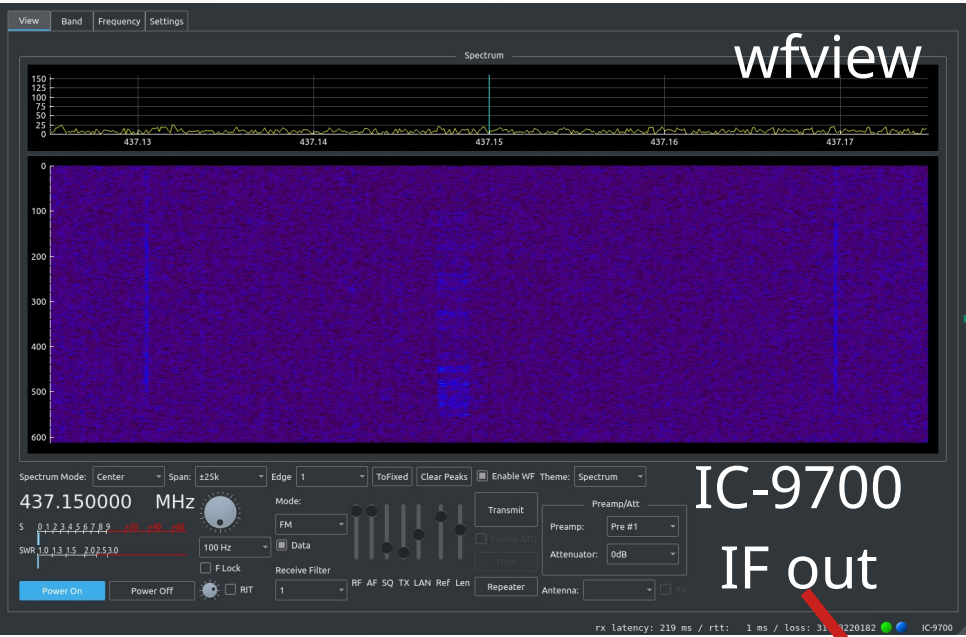
SDR

Myriacat Spectrum Analyzer

IC 9700 IF Out



Cubic SDR on IF

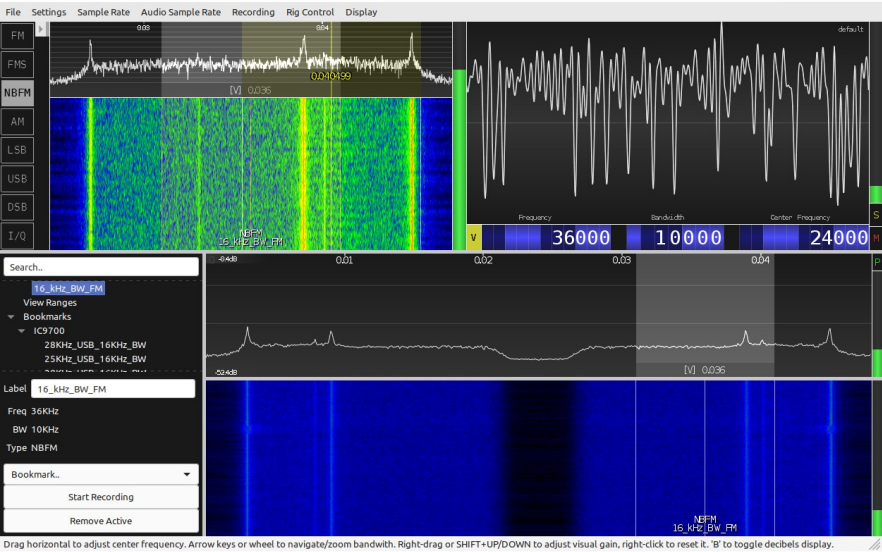


LAN
IF



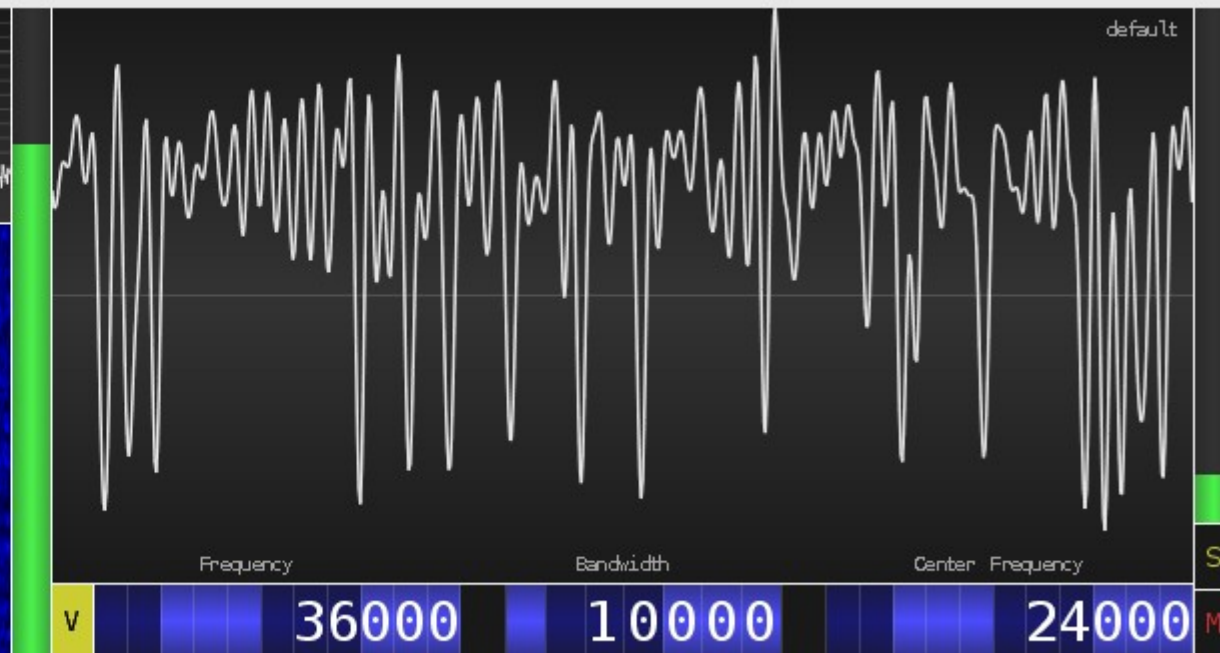
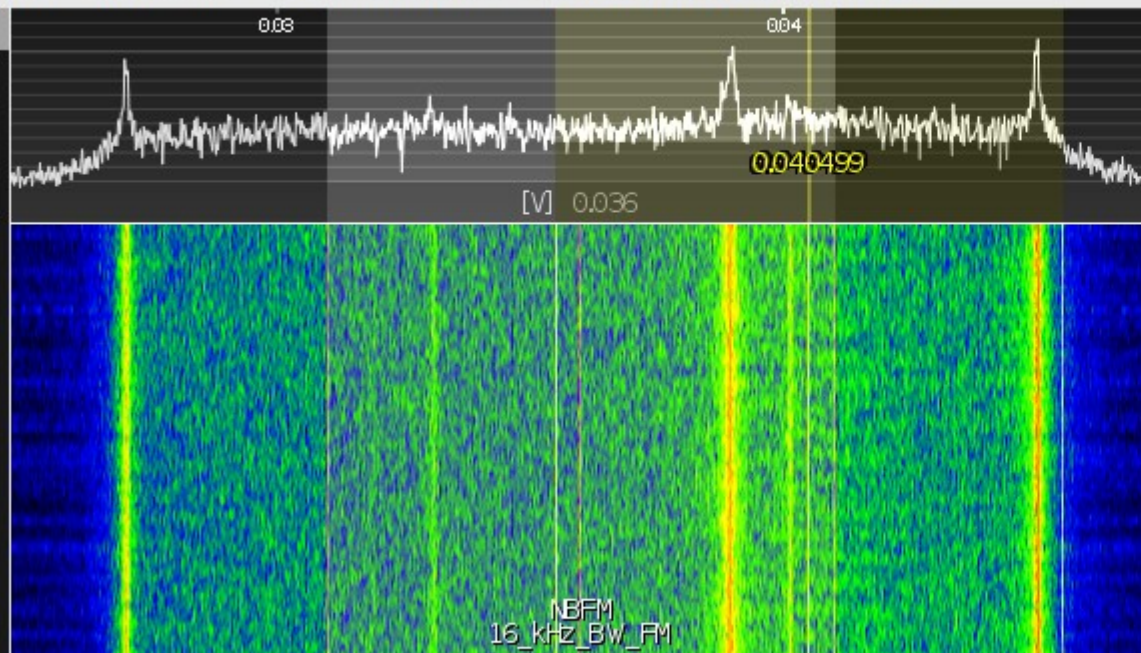
Only CubicSDR was able
to work with real audio
Instead of I/Q

Spectrum analyzer



File Settings Sample Rate Audio Sample Rate Recording Rig Control Display

FM
FMS
NBFM
AM
LSB
USB
DSB
I/Q



Search..

16_kHz_BW_FM

View Ranges

Bookmarks

IC9700

28KHz_USB_16KHz_BW

25KHz_USB_16KHz_BW

20KHz_USB_16KHz_BW

Label 16_kHz_BW_FM

Freq 36KHz

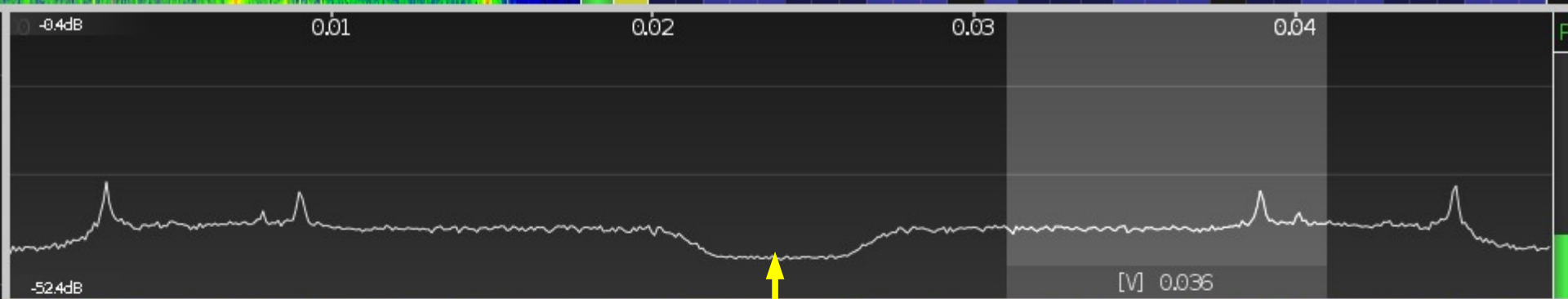
BW 10KHz

Type NBFM

Bookmark..

Start Recording

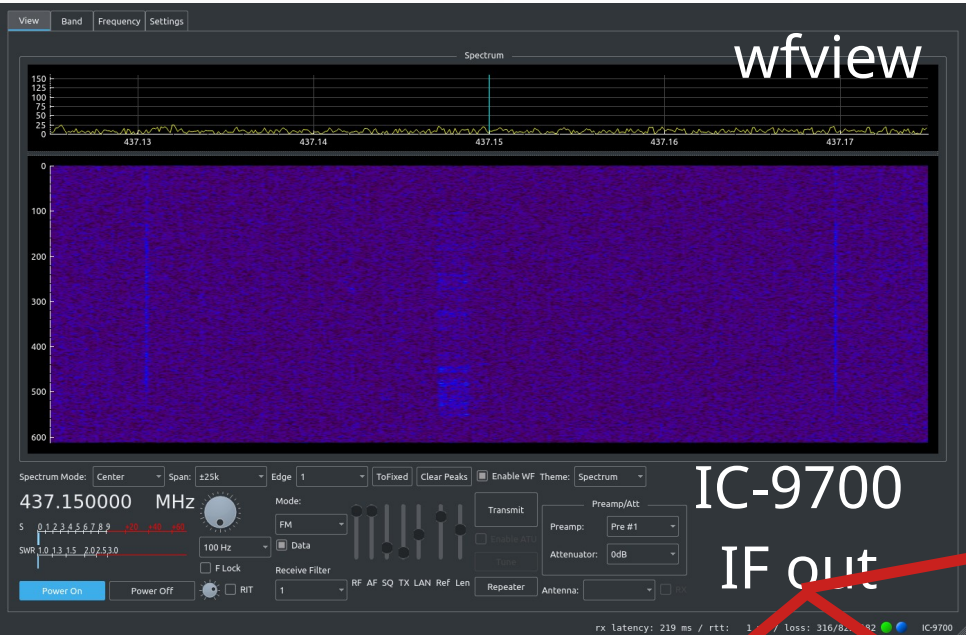
Remove Active



24 KHz

CubicSDR
IC 9700 IF Out

NBFM
16_kHz_BW_FM



Start recording 00:00:02 403.2 KB 0.0 0.2 0.4 0.6 0.8

File: 2022-07-17-17:43:04.wav Add.

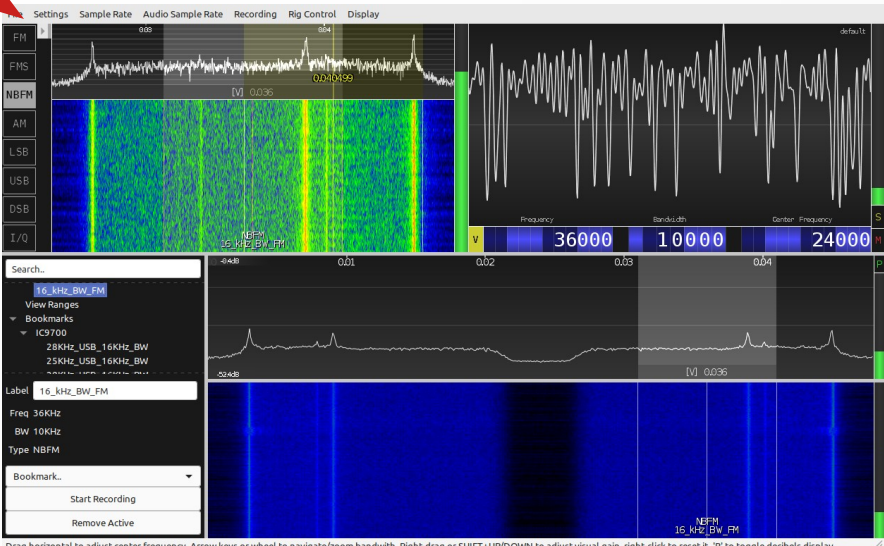
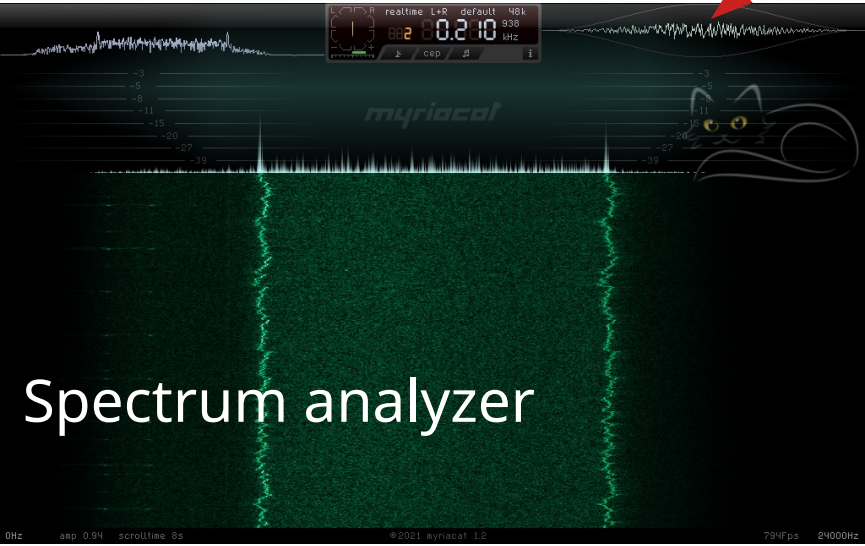
Timer.

Audio settings.

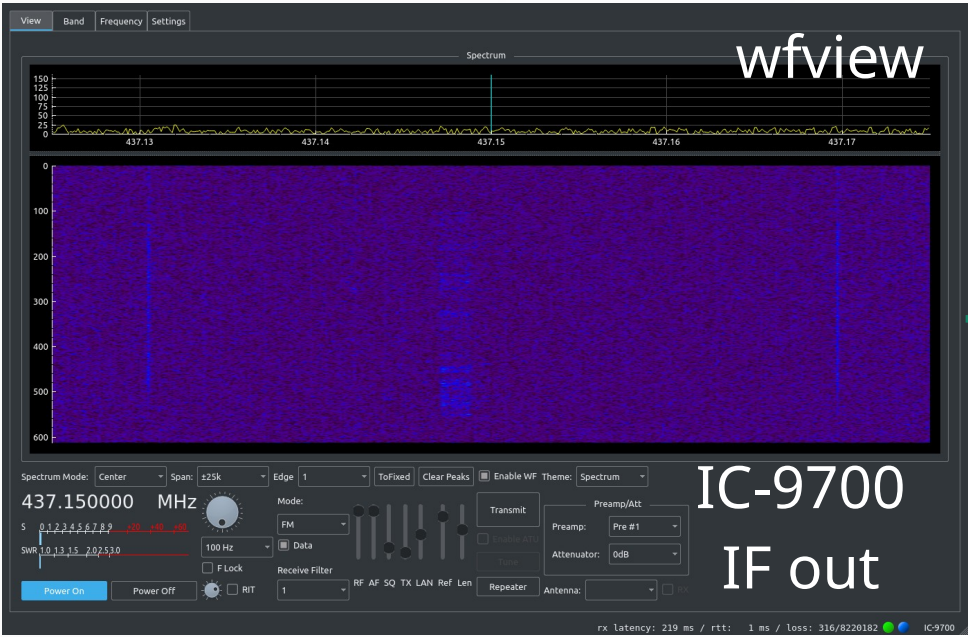
Source: Built-in Audio Analog Stereo (Audio output)

Format: .WAV (lossless wav 48khz)

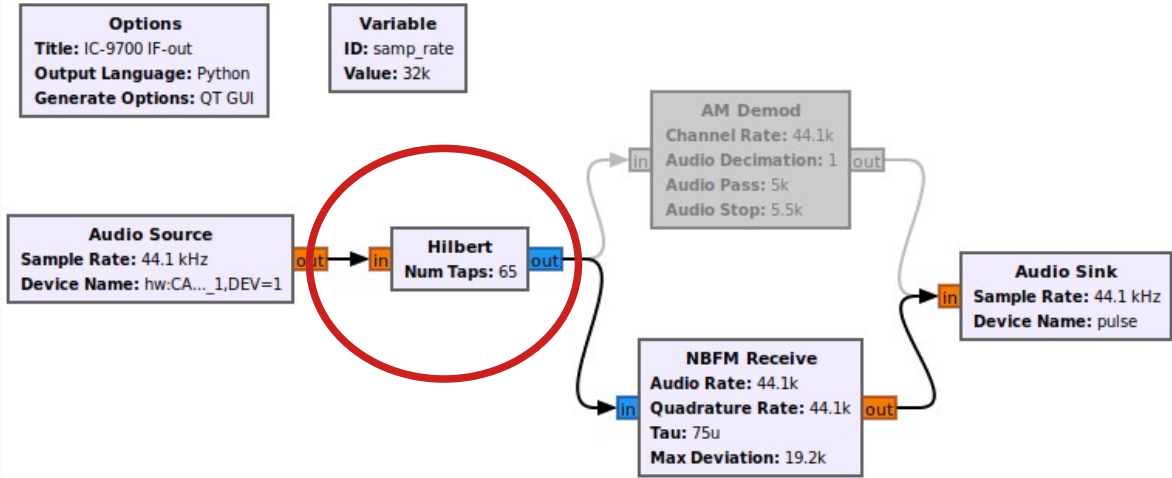
Additional settings



IC-9700 Lan Connection



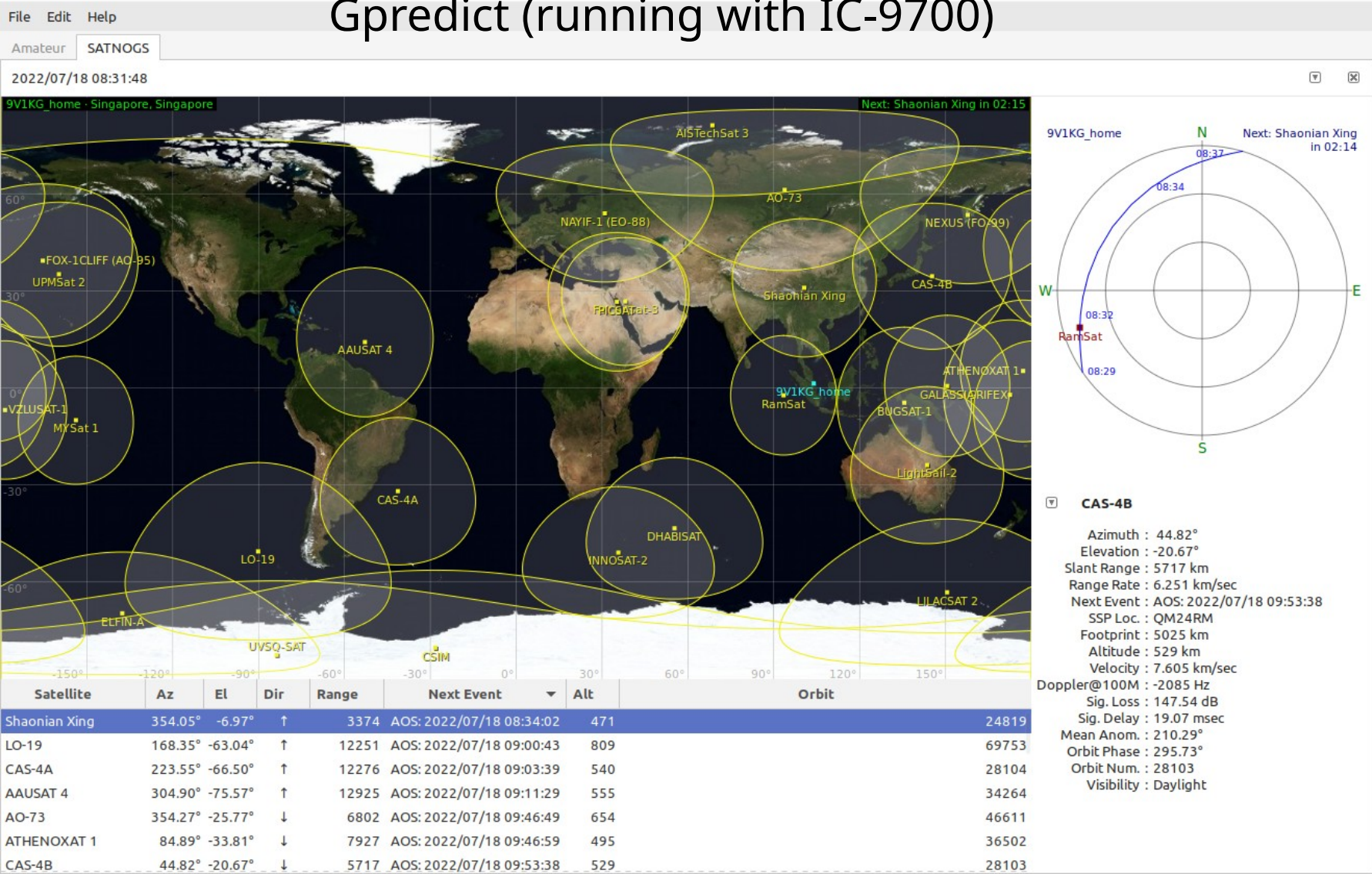
LAN
IF



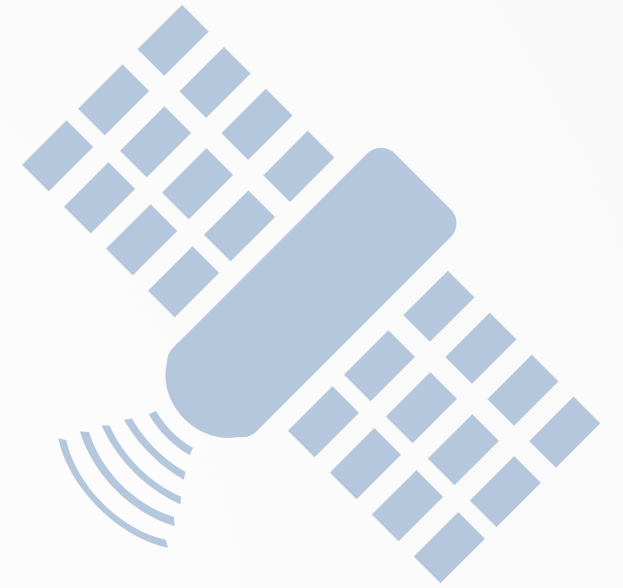
You can also use GNU Radio Companion and **convert Real to Complex I/Q** using Hilbert transform

Gpredict

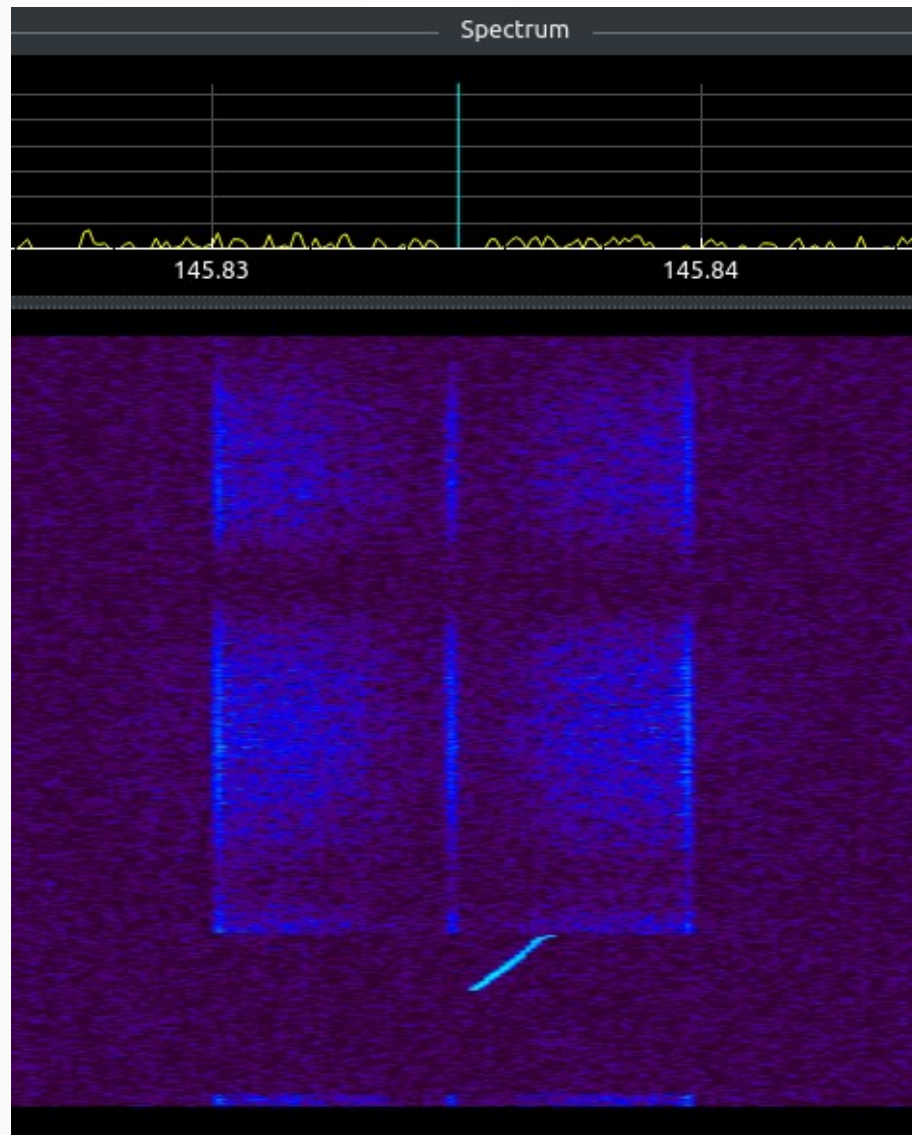
Gpredict (running with IC-9700)



SatNOGS



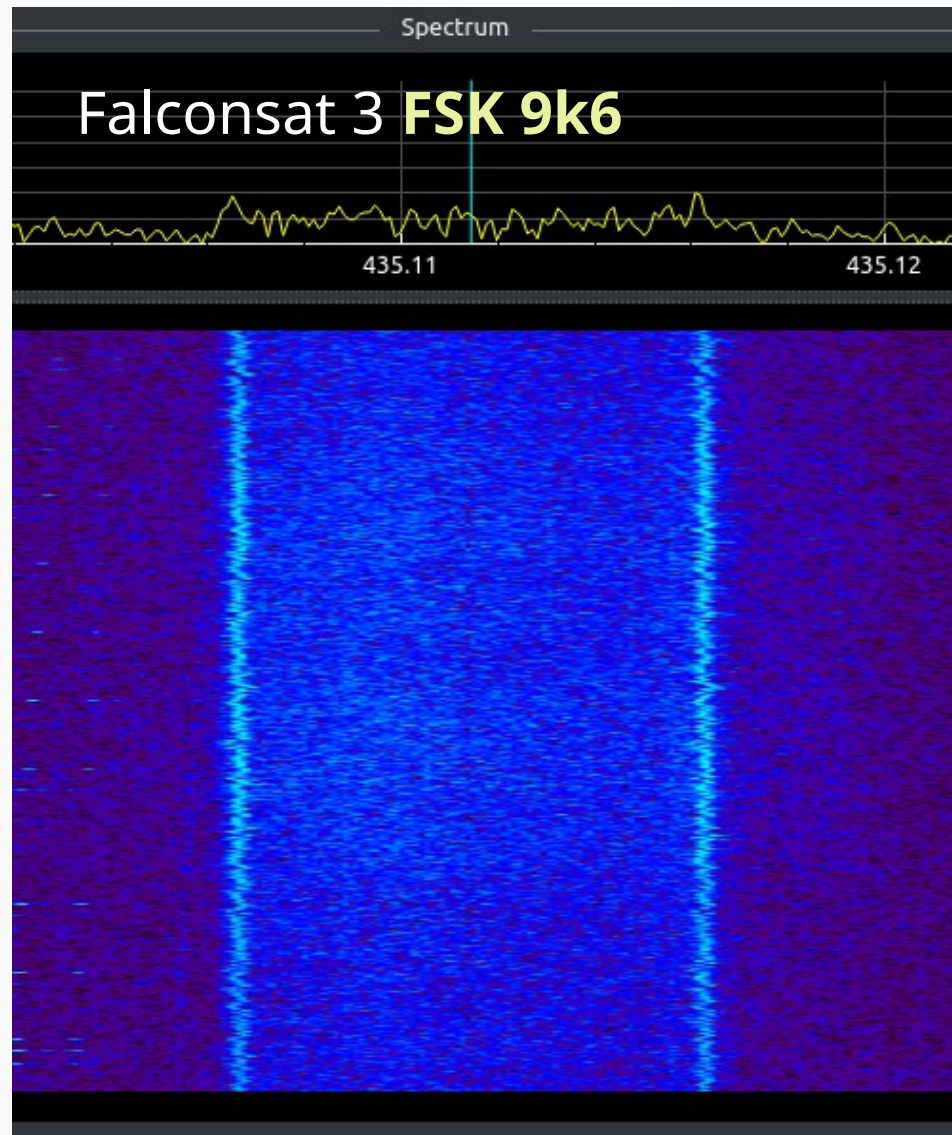
Examples



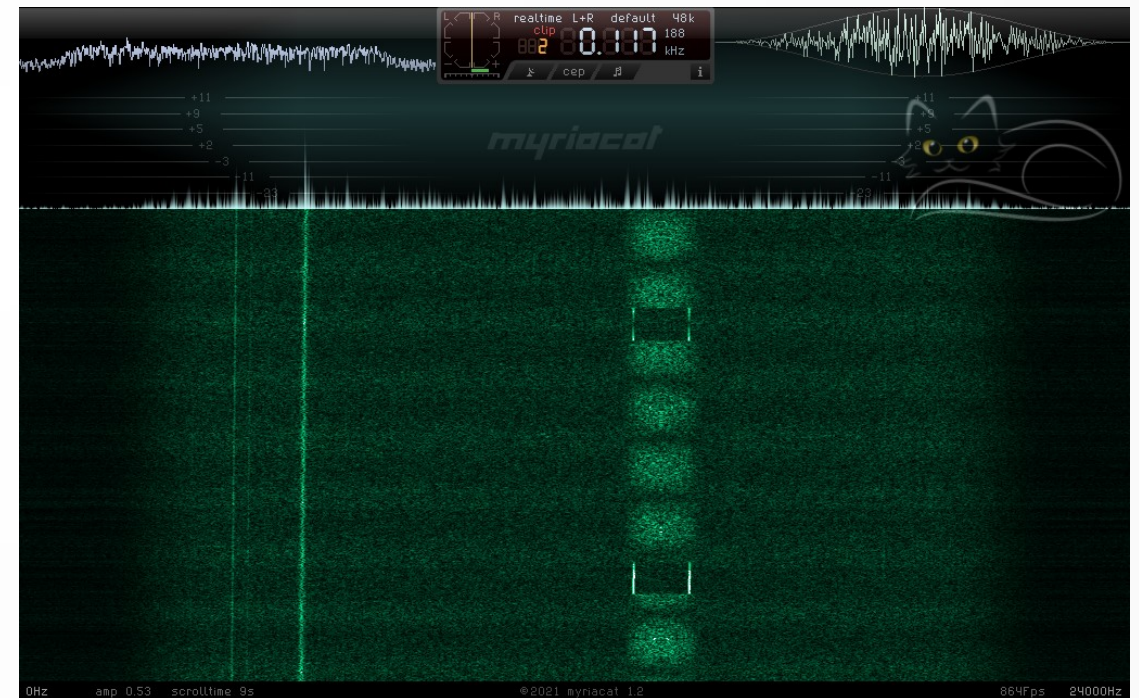
ZHUHAI-1 OVS-1B (CAS-4B)

GMSK 4k8

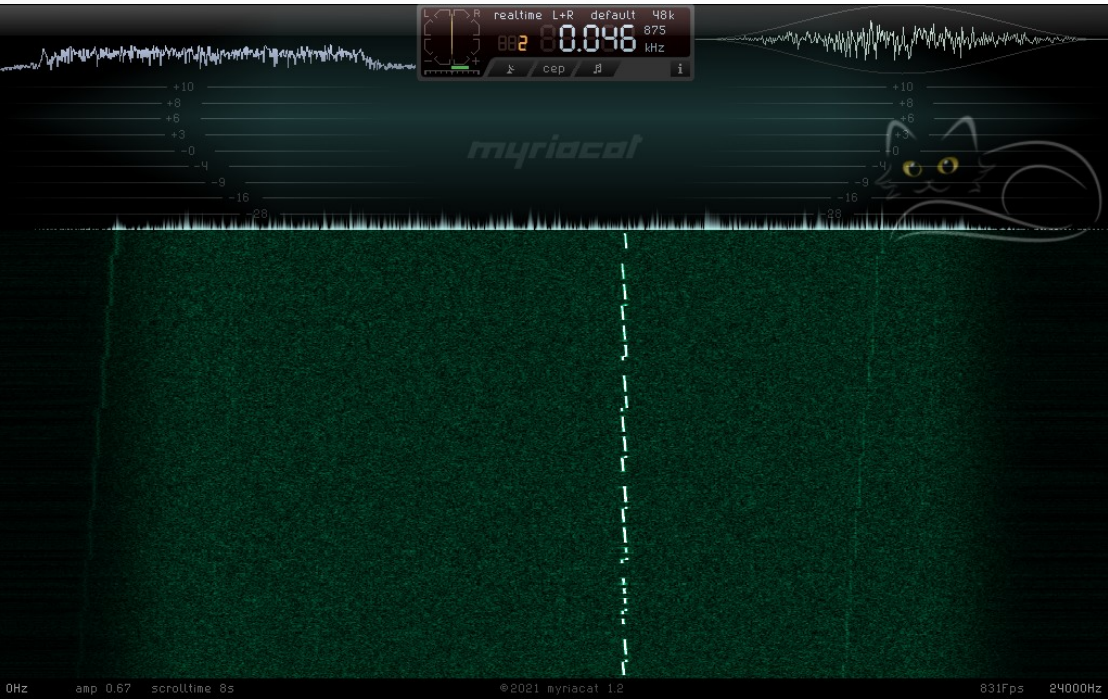




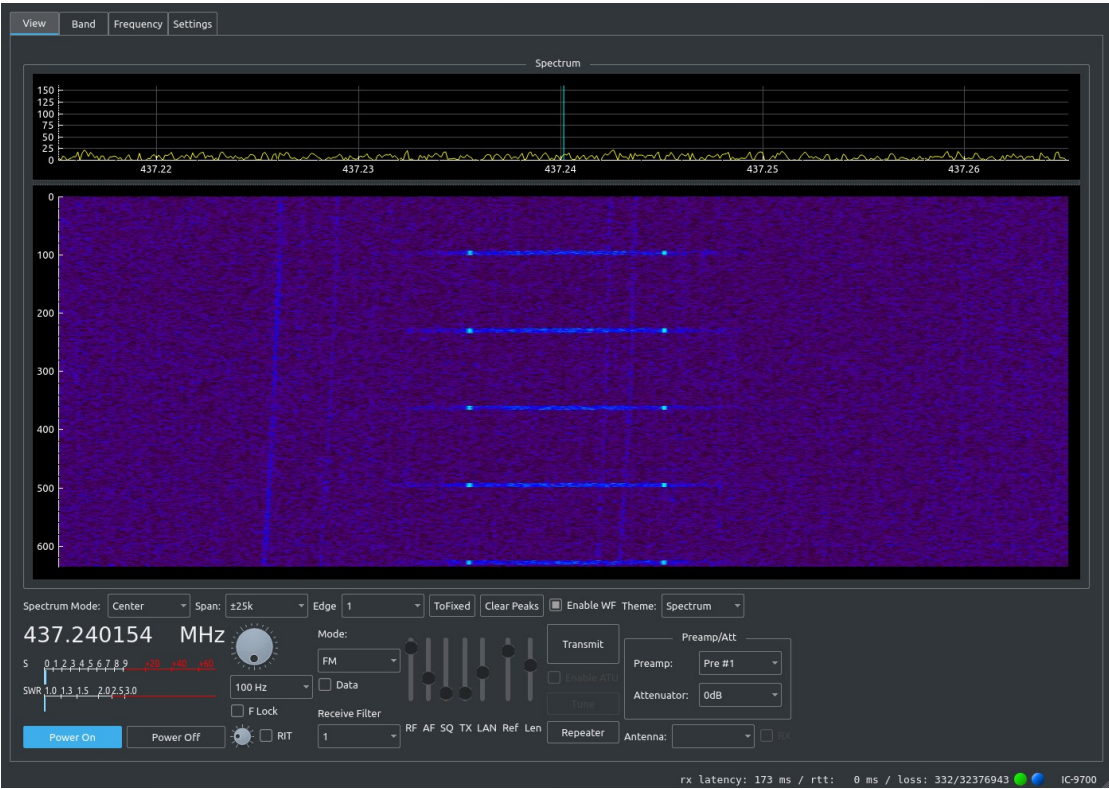
Funcube (AO 73)
BPSK 1200



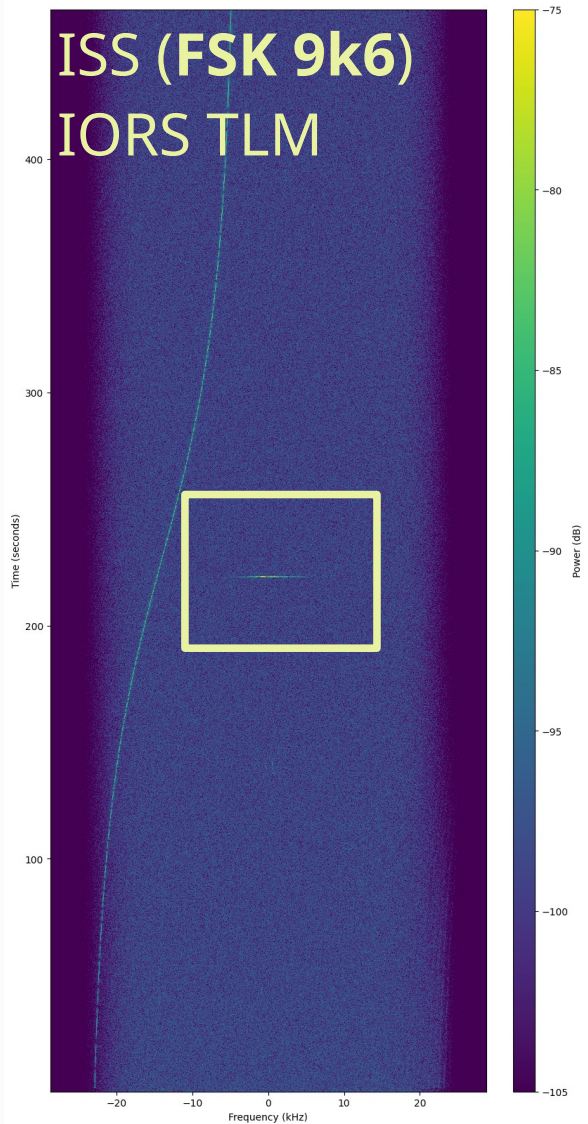
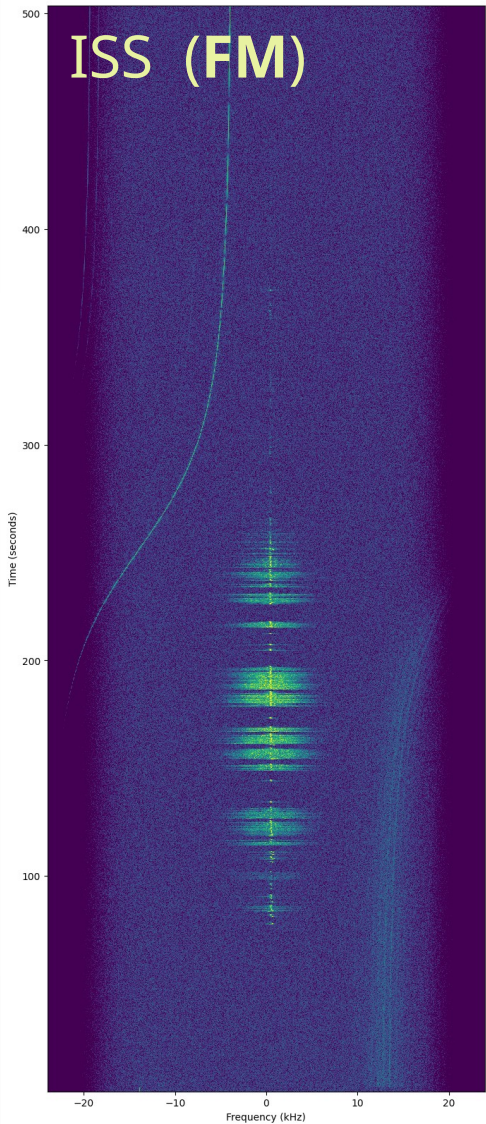
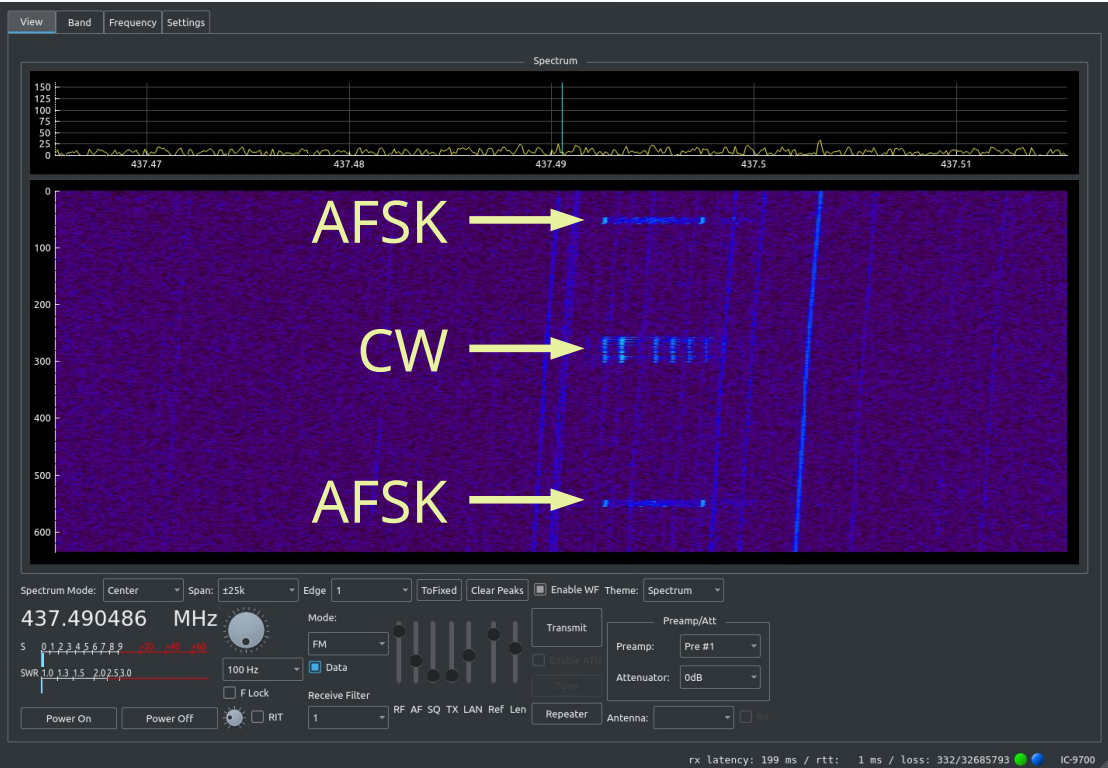
Prism (CW)



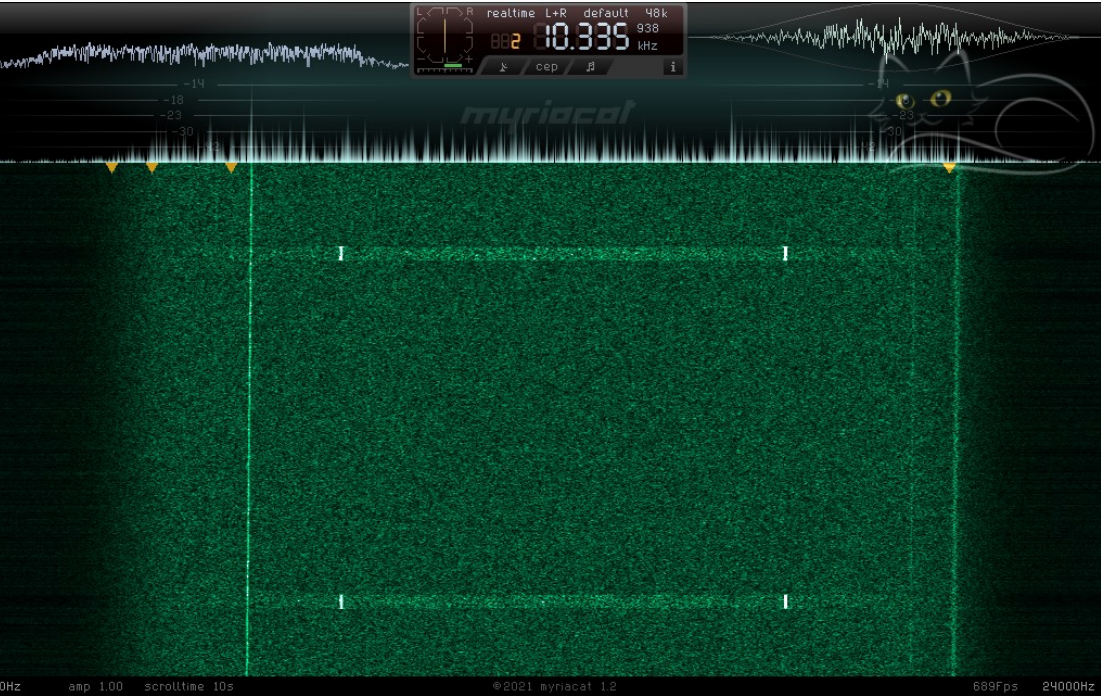
CSIM-FD (GFSK 9k6)



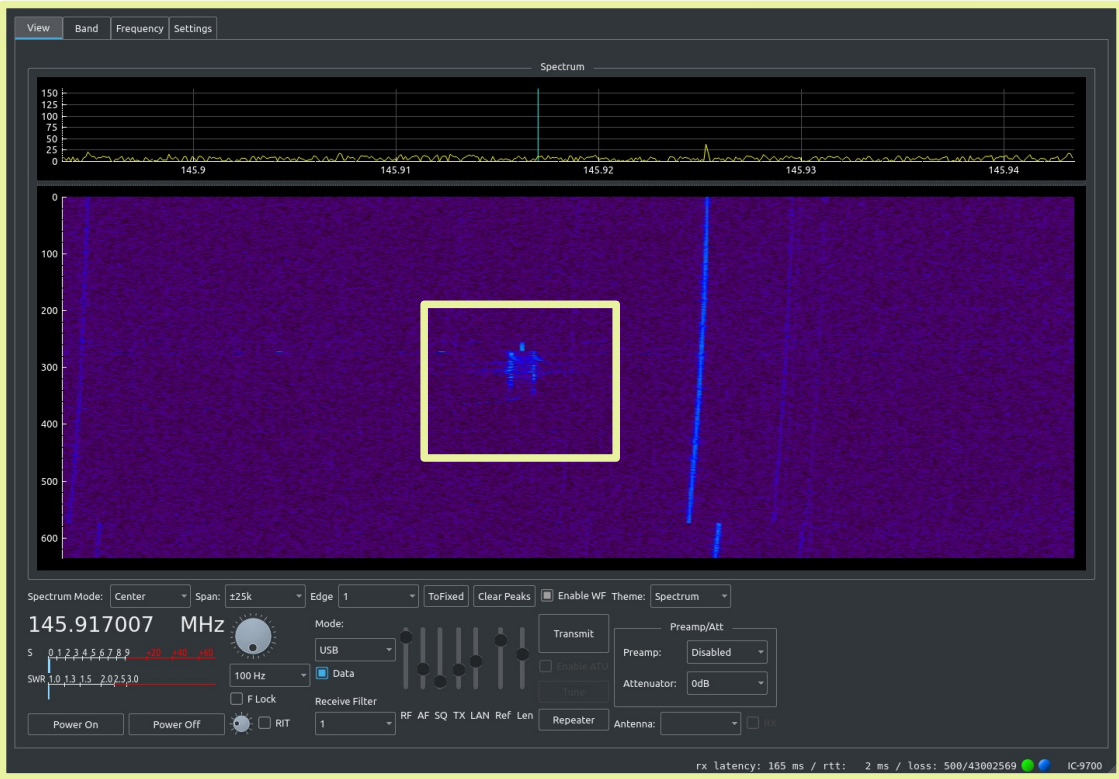
Athenoxat (**AFSK 4K8**)



Lightsail 1 (FSK 9K6 AX.25)



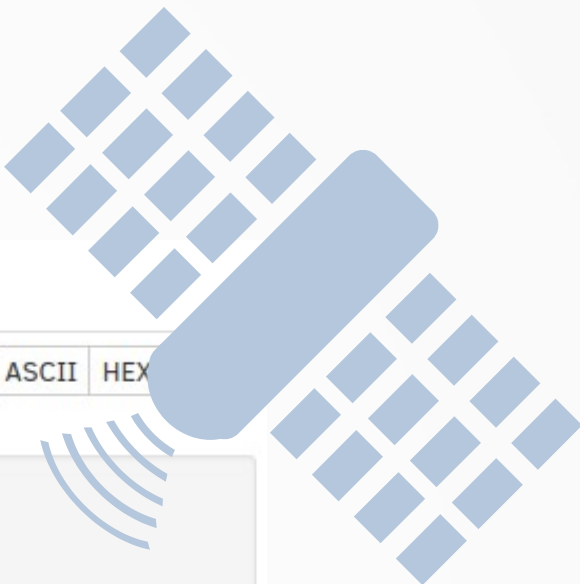
FOX-1 Cliff (DUV)



Manual Decoding

- Download audio file (format: ogg) and convert to raw or wav
- Demodulator/Decoder Software:
 - gr_satellites
 - multimon-ng (AFSK, CW)
 - Direwolf (AFSK, AX25)
 - FoxTelem (Fox satellites)

Decoded AX25



Waterfall

Audio

Data 1

ASCII

HEX

data_obs/2022/7/16/20/6224679/data_6224679_2022-07-16T20-45-11

Source Callsign	CQ
Destination Callsign	W4SKH
Source SSID	0
Destination SSID	0
Ctl	3
Pid	240
Monitor	RSBeac:,2022-07-16T20:4 4:13.07Z,808, 98,0, -7, 2, 10, -5, 13, 13, 3, 7, 808, 31,809, 3,333, 42,503, 64, 139, 161, 178,-290,- 622,-275,-424, 0, 0, 0, 0, 0, 0, 0, 0, 17798,- 16868, 11168,0000, 10005, 149,3466

AO-73 Funcube

Fitter Message 2

To request a FITTER message, please email operations@funcube.org.uk

Fitter Message 3

Hello from Space to Gabija Bosaite, Harris Lodhi, D Wait, T Lynch G Newns and The Heathland School A Level Physicists

Fitter Message 4

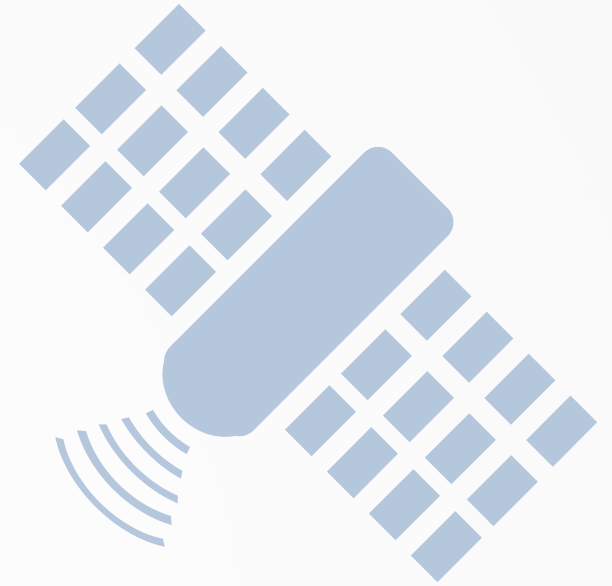
**CQ CQ de Milly, Caitlin & Alice, aiming for our foundation licences.
Pls send a QSL card see QRZ for Hilderstone G0HRS club**

Fitter Message 5

A073 was launched 8 years ago on Nov 21st 2013 - now more than 43000 orbits completed

Fitter Message 7

This message is sent via the AO-73 satellite by AMSAT-UK to congratulate Her Majesty Queen Elizabeth II on her Platinum Jubilee. Reception at ...



CERTIFICATE OF ACHIEVEMENT

This certificate goes to

Klaus D Goepel

For directly receiving & uploading the
FUNcube-1 AO-73 Jubilee fitter message.

Jim Heck

Jim Heck
Hon Sec

29/07/2022

Date



AO-73 Funcube

Realtime telemetry:

Container:

eps = Container:

photovoltage = ListContainer:

4645
3996
3650

photocurrent = 318

batteryvoltage = 7531

systemcurrent = 219

rebootcount = 1463

softwareerrors = 0

boostconvertertemp = **ListContainer:**

0
0
1

batterytemp = 0

latchupcount5v = 0

latchupcount3v3 = 0

resetcause = 3

MPPTmode = 1

rf = Container:

rx doppler = 156

rx rssi = 180

temp = -1.7239999999999895

rx current = 23.532

tx3v3current = 31.164

tx5vcurrent = 29.256

pa = Container:

revpwr = 41.07569599642216

fwdpwr = 330.25757624255573

boardtemp = 197

boardcurr = 106.41789999999999

ants = Container:

temp = ListContainer:

166
166

deployment = ListContainer:

True
True
True
True

bob = Container:

sunsensor = ListContainer:

554
268
135

paneltempX+ = 2.3494000000000003

paneltempX- = 0.08580000000000061

paneltempY+ = 1.91800000000000064

paneltempY- = -6.8714999999999975

3v3voltage = 3280

3v3current = 140

5Voltage = 4962

sw = Container:

seqnumber = 16630688

dtmfcmdcount = 43

dtmflastcmd = 0

dtmfcmds success = True

data valid = ListContainer:

True
True
True
True

eclipse = False

safemode = False


hwabf = True

swabf = False

deploymentwait = False

SATNOGS Dashboard

Satnogs Dashboard



Satellite Telemetries

🔍

☰

↶

?

SUID

All

Count interval

1h

Filters

+

SatNOGS Community

SatNOGS Network

SatNOGS DB

Dashboard Documentation

📄

Last 7 days UTC

🔍

🔄

⌵

Welcome to SatNOGS Dashboard

On this page you will find links to some of our production dashboards. These are crowd-sourced dashboards which visualize data that has been collected and decoded through the [SatNOGS Network](#) and [SatNOGS DB](#). Documentation for editing these dashboards can be found on the [SatNOGS Wiki](#). If you would like to get involved with helping us in building dashboards, please [contact us](#)

Inactive Satellites

Active Satellites

ACRUX-1

Telemetry

☆

AMSAT CubeSat Simulator

Telemetry

☆

Bobcat-1

Telemetry

☆

DELFI-N3XT

Telemetry

☆

DUCHIFAT-3

Telemetry

☆

ELFIN

Telemetry

☆

EntrySat

Telemetry

☆

EQUIiSat

Telemetry

☆

GASPACS

Telemetry

☆

AAUSAT4

Telemetry

☆

AmicalSat

Telemetry

☆

AMSAT FOX Telemetry

Telemetry

☆

ARMADILLO

Telemetry

☆

AzaadiSAT-2

Telemetry

☆

BDSat

Telemetry

☆

BDSat-2

Telemetry

☆

BUGSAT-1

Telemetry

☆

CAS-4A + CAS-4B

Telemetry

☆

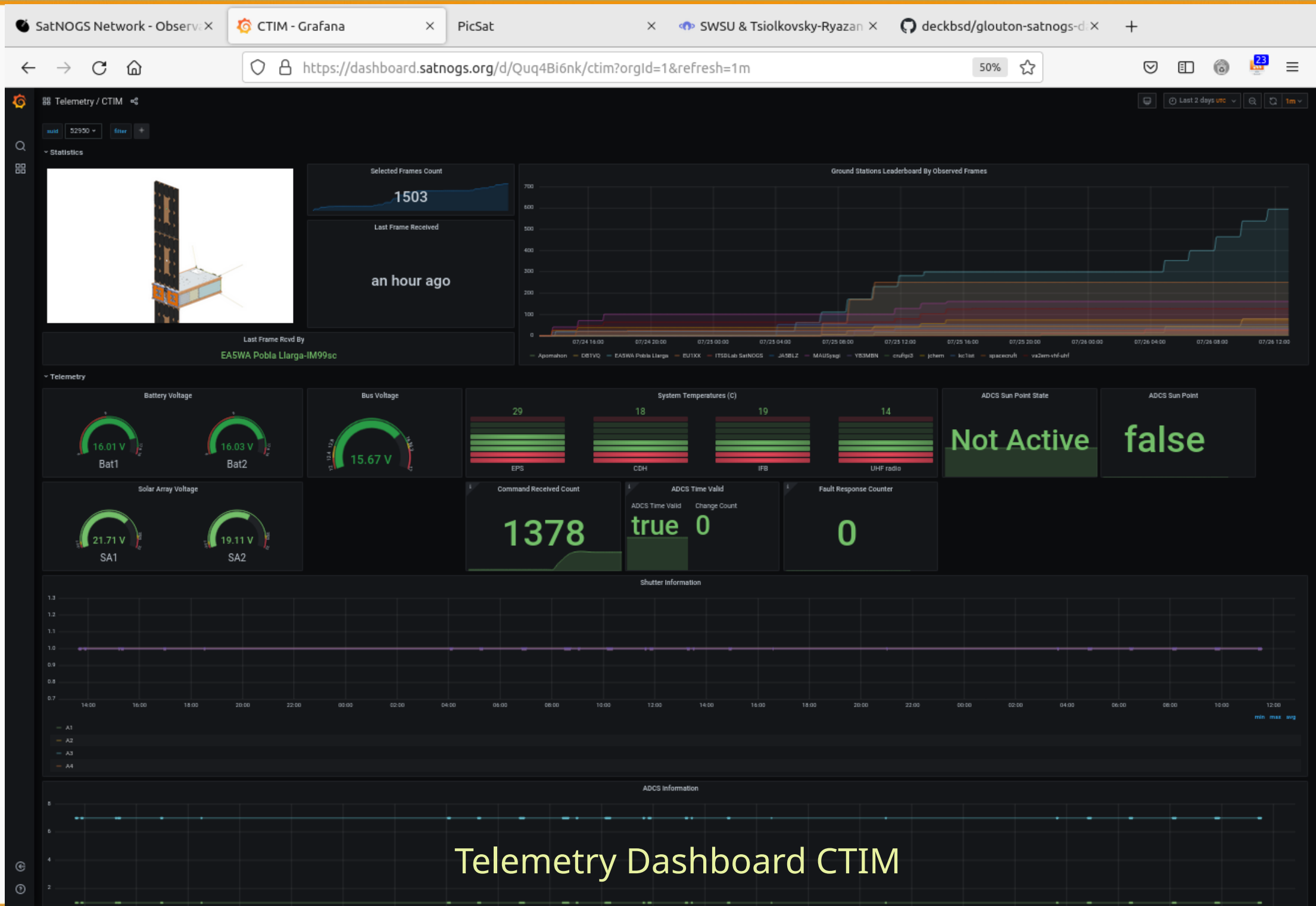
Framecount Totals

Last 5 years

Satellite	Framecount
CAS-4A	8219655
CAS-4B	5343309
FALCONSAT 3	2102065
GRIFEX	1964235
ZHUHAI-1 OVS-01	1067446
BUGSAT-1	981843
FOX-1B	666131
FOX-1D	425480
OPS-SAT	407325
CTIM	371395
CSIM-FD	333123
UNISAT-6	283575
ZHUHAI-1 OVS-1B	254096
XW-3	248687
SiriusSat-1	243479
SiriusSat-2	231588
I IWF-4	204136

1

2



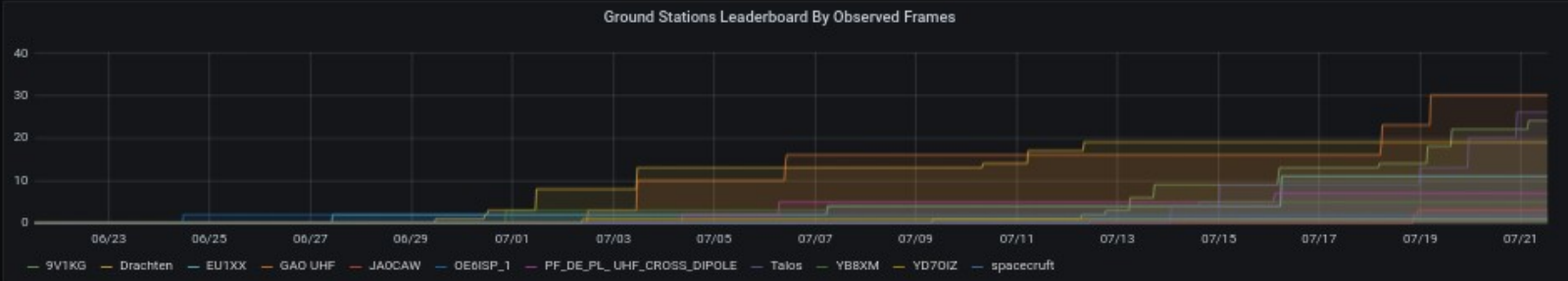
subid 44045 ▾

Clock (UTC)

2022-07-21

12:47:55

UTC



Selected Satellite

MySat-1

Frame count

129 frames

Last Frame Rcvd at

2022-07-21 03:35:40

Last Frame Rcvd By

9V1KG-OJ11xi



Uptime

24 minutes, 2 seconds, 0 milliseconds

OBC Reset Counter

Safe Mode

EPS Last Boot Cause

255

OBC Clock

2022-07-20 01:10:21

EPS Battery Mode

nominal

OBC Reset Counter

1008

EPS Reset Counter

0

Messages

Time ▾	44045.message
2022-07-21 03:34:36	Hello world! MYSat-1 from YahSat Space Lab, Khalifa University, Abu Dhabi, UAE is back for the 3rd time!
2022-07-19 05:02:55	Hello world! MYSat-1 from YahSat Space Lab, Khalifa University, Abu Dhabi, UAE is back for the 3rd time!
2022-07-18 23:00:36	Hello world! MYSat-1 from YahSat Space Lab, Khalifa University, Abu Dhabi, UAE is back for the 3rd time!
2022-07-16 06:17:33	Hello world! MYSat-1 from YahSat Space Lab, Khalifa University, Abu Dhabi, UAE is back for the 3rd time!
2022-07-16 05:01:30	Hello world! MYSat-1 from YahSat Space Lab, Khalifa University, Abu Dhabi, UAE is back for the 3rd time!



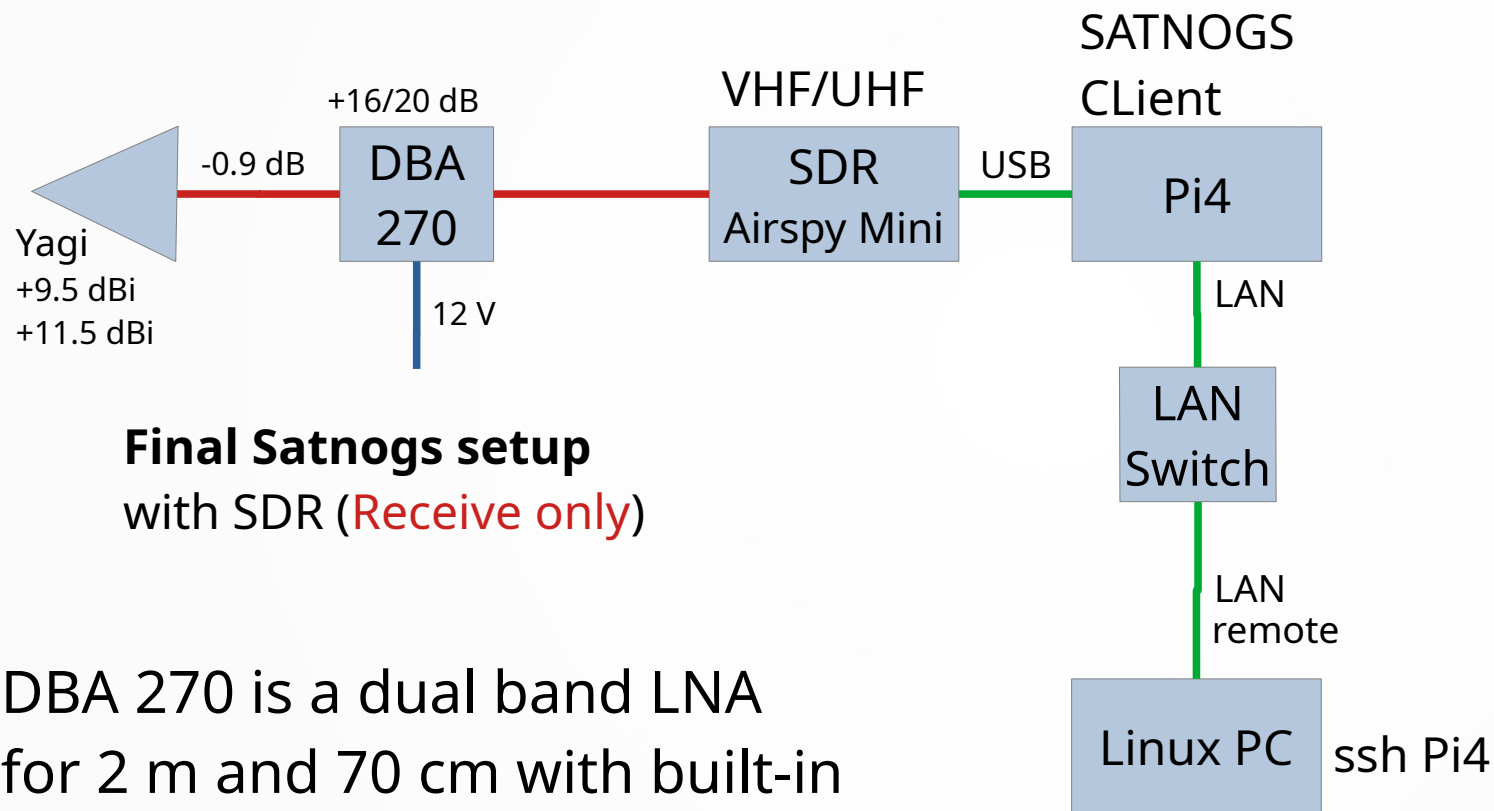
Telemetry Dashboard MYSAT-1

Satellites decoded via SatNOGS

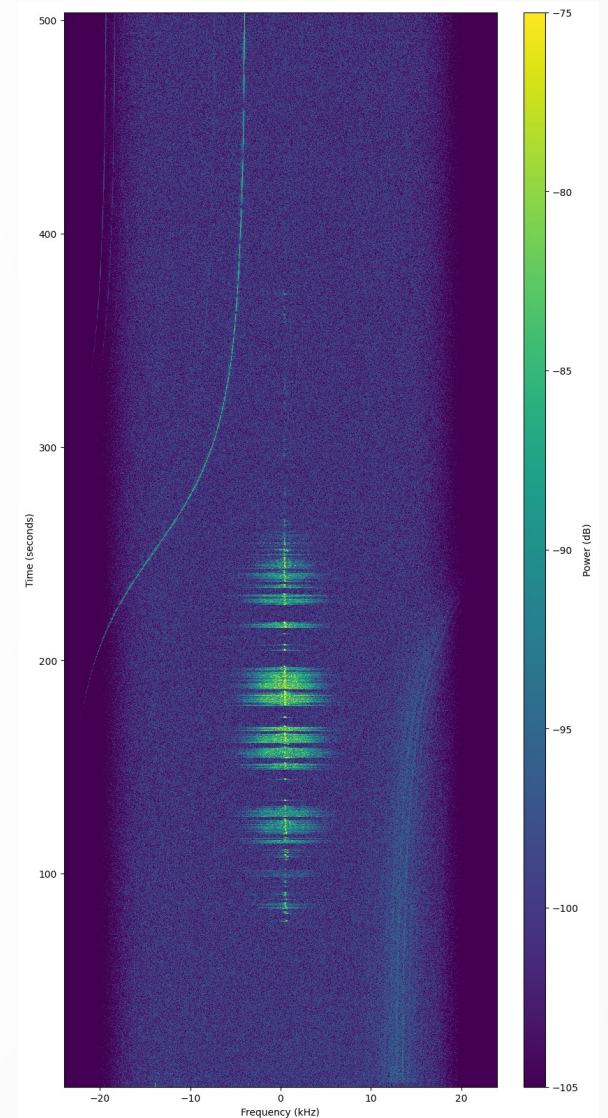
Satellite		Framecount ▾
BUGSAT-1	FSK 9600	149
PICSAT	BPSK 1200	59
DhabiSat	BPSK 1200	54
MySat-1	BPSK 1200	30
AAUSAT 4	GMSK 2400	20
GRIFEX	FSK 9600	16
CTIM	GFSK 9600	12
FOX-1C		7
INSPIRESat-1	GFSK 9600	4
FOX-1D		2
RamSat	FSK 9600	2
ELFIN-A	GFSK 9600	2
CTIM		1
CSIM-FD	GFSK 9600	1
ISS	FSK 9600	1

- >20 Satellites decoded
- Some more with other SW
- Where to find the transmitter power and antennas for the different satellites?
- Would be interesting, to do some calculations

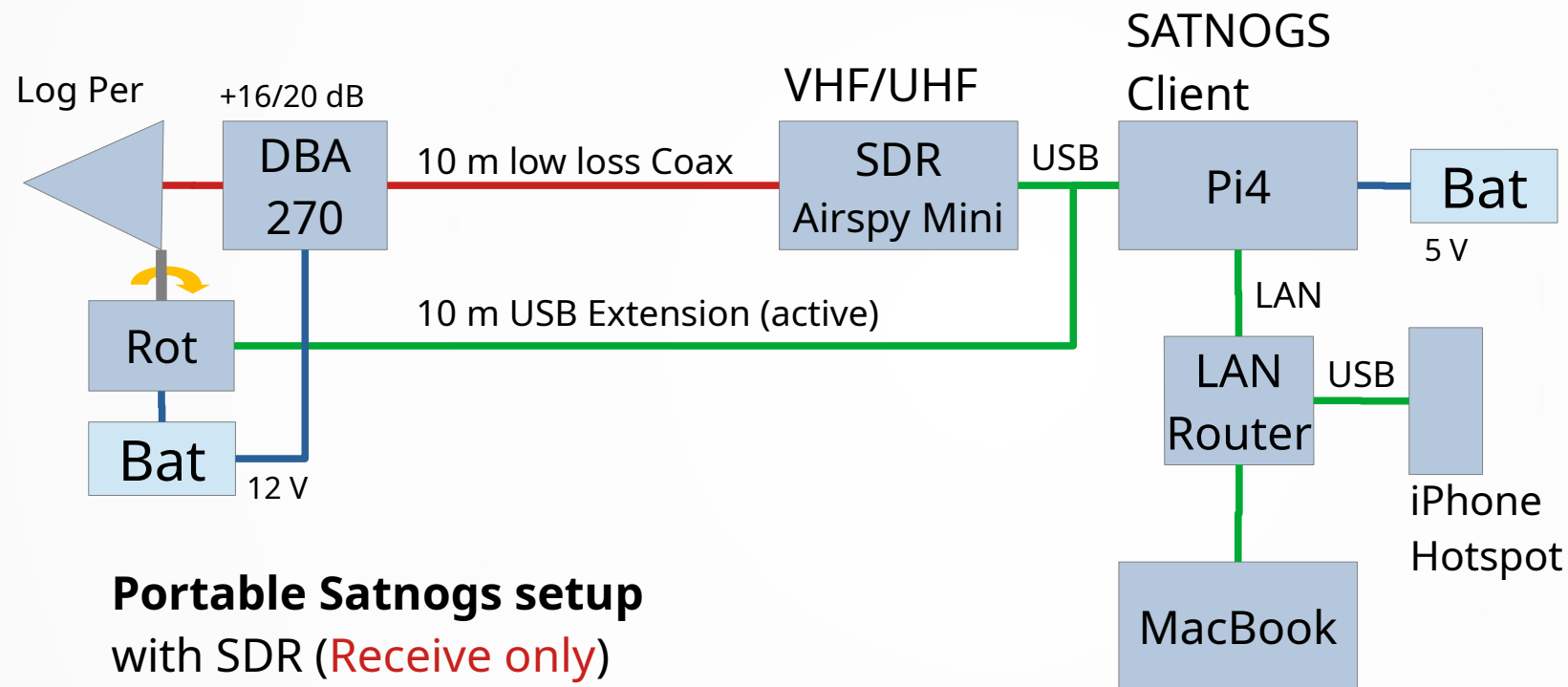
Final SatNOGS Setup



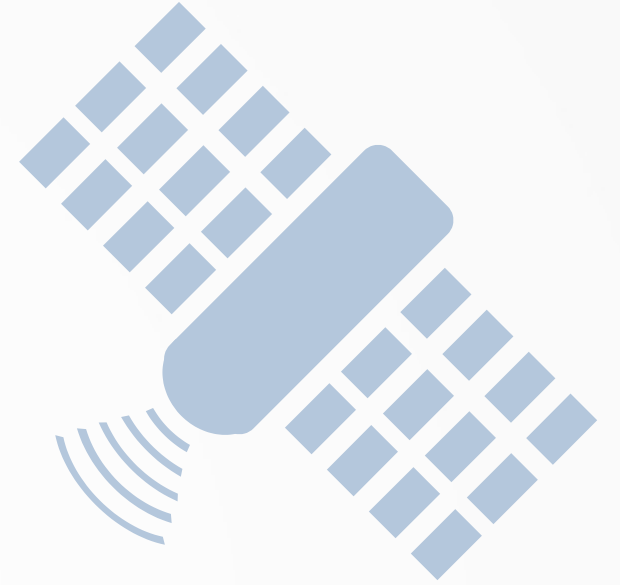
DBA 270 is a dual band LNA
for 2 m and 70 cm with built-in
VOX (SSB Elektronik)
Suitable for IC-9700 TX/RX ops



SatNOGS Setup Portable



SatNOGS



Thank You!