



AzTechSat-1
Amateur Radio Instructions

AZT_ORR_BL_GS_ARI
Revision 2



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Universidad Popular Autónoma del Estado de Puebla

Puebla, México. 72410

AzTechSat-1

Amateur Radio Instructions



	<p style="text-align: center;"><i>AzTechSat-1</i> <i>Amateur Radio Instructions</i></p>	<p style="text-align: center;">AZT_ORR_BL_GS_ARI Revision 2</p>
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DOCUMENT HISTORY LOG

Document Revision	Effective Date	Description	Author
1	02/10/2020	Initial Release	AFA, JCL, CG
2	02/17/2020	Format, updates with figures and steps	AFA, JCL

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AzTechSat-1
Amateur Radio Instructions

AZT_ORR_BL_GS_ARI
Revision 2

Content

DOCUMENT HISTORY LOG	2
CONTENT	3
PURPOSE / SCOPE	4
SATELLITE RADIO CHARACTERISTICS	4
HARDWARE REQUIREMENTS	4
SOFTWARE REQUIREMENTS	5
SETUP PROCEDURE	5
Beacon Recorder.	5
Beacon Decoder	14
APPENDIX	18

	<p style="text-align: center;"><i>AzTechSat-1</i> <i>Amateur Radio Instructions</i></p>	<p style="text-align: right;">AZT_ORR_BL_GS_ARI Revision 2</p>
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PURPOSE / SCOPE

This procedure is intended for AzTechSat-1 satellite mission operations to receive beacon packets every 60 seconds from the spacecraft through the HAM radio operator's international community.

SATELLITE RADIO CHARACTERISTICS

- Downlink frequency **437.3 MHz**
- Modulation type **GFSK**
- Baud rate **9600 bps**
- Beacon transmission interval **60 seconds**
- Frame Format **ASM + Golay**
- Bit Codification **NRZ**, most significant bit first
- Codification Channel **Reed-Solomon + CRC32**
- **Left/Right** hand circular polarization

HARDWARE REQUIREMENTS

Description	QTY
Software defined radio module (recommended ADALM-PLUTO SDR Active Learning Module)	1
Computer	1
70 cm band preamplifier	1
70 cm band antenna	1



AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

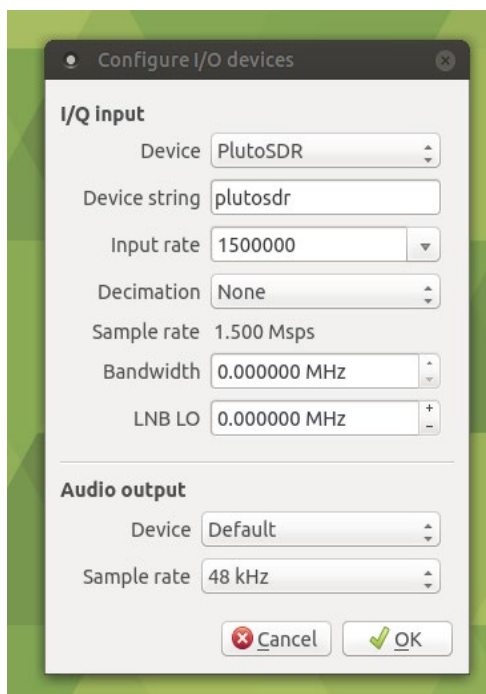
SOFTWARE REQUIREMENTS

- GNU/Linux 18.04.3 LTS (Bionic Beaver) Ubuntu Mate distribution
- GQRX Software Defined Radio
- GNU Radio Companion software 3.7.12 version
- Required sattools for GNU: ASM + Golay Decoder, Binary Slicer.

SETUP PROCEDURE

Beacon Recorder.

To capture the AztechSat-1 beacon at your Ground Station while running **Ubuntu Mate** on your computer you will need to connect the **SDR Module** (in this case SDR Pluto module) and open the **GQRX** program. The “**Configure I/O devices**” window will appear where you should configure the entry fields as follows, after that click OK.

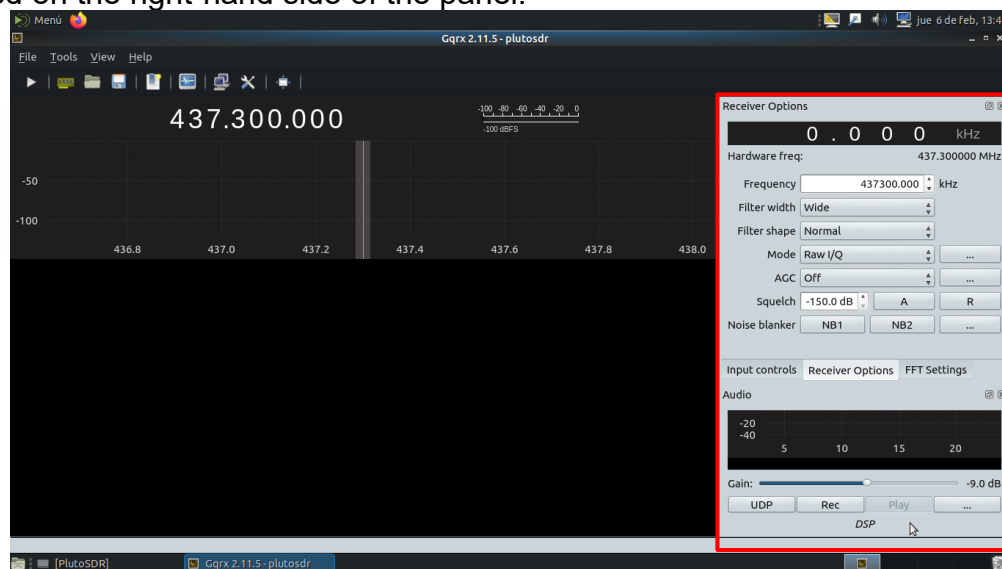




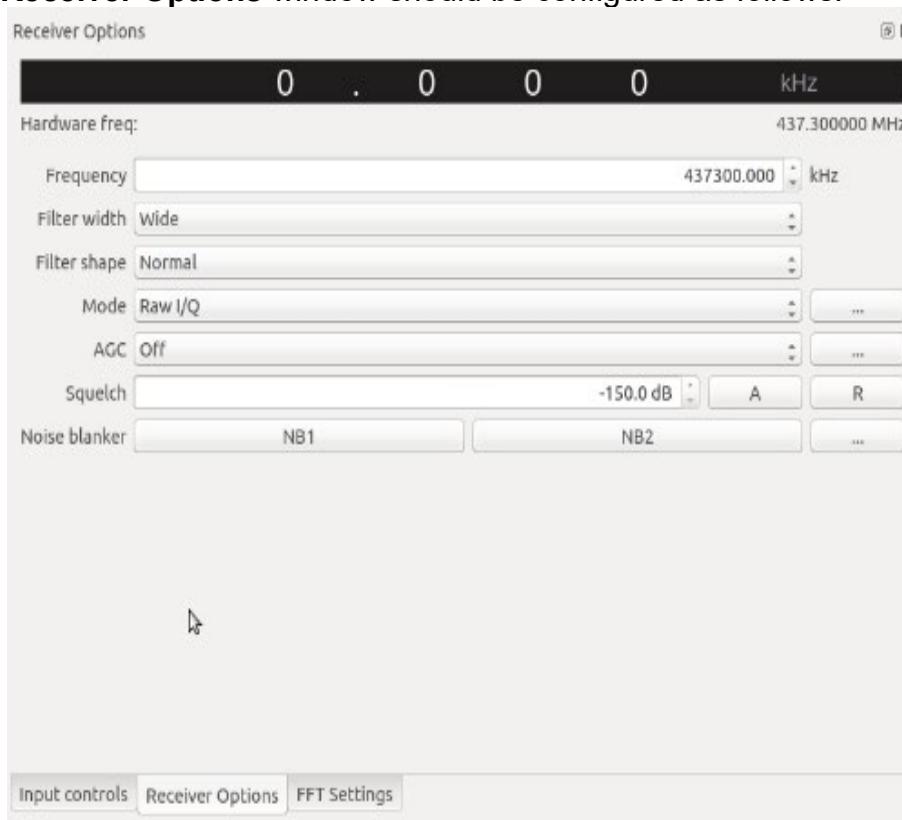
AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

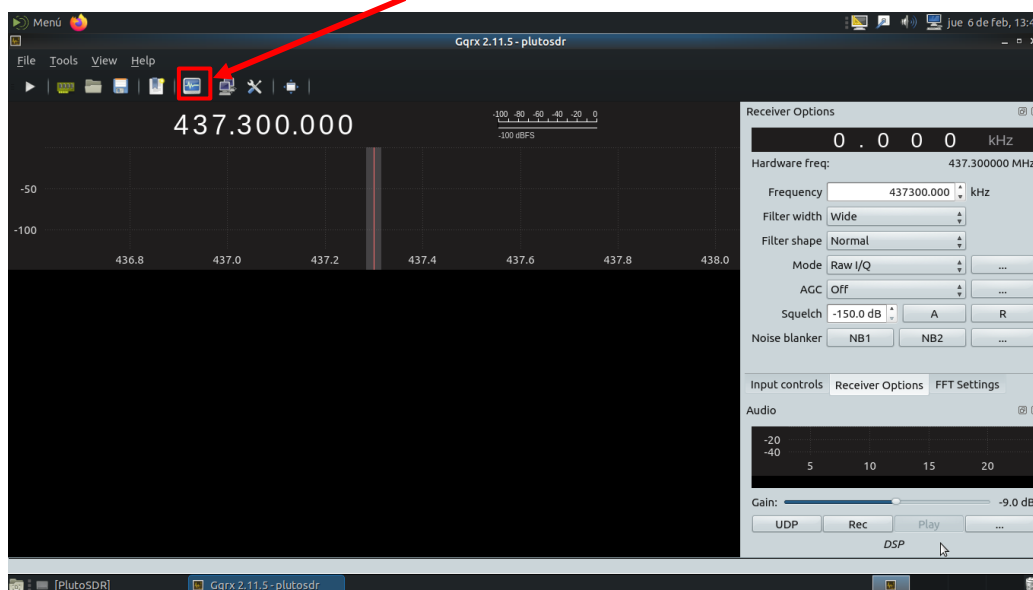
The **control interface panel** will then appear. The **Receiver Options** window is located on the right-hand side of the panel.



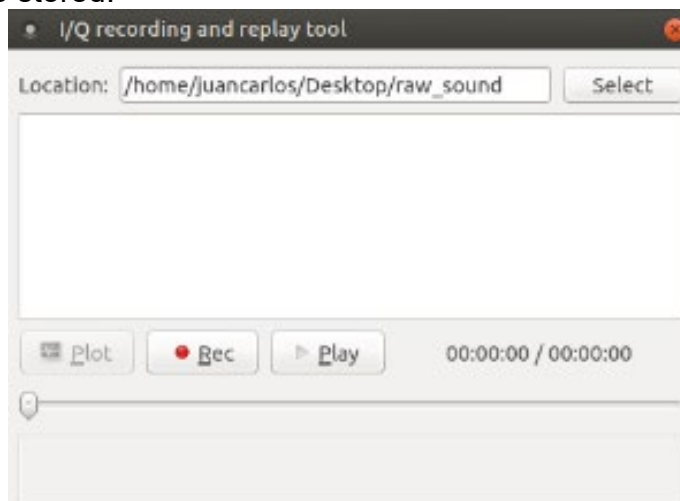
Next the **Receiver Options** window should be configured as follows:



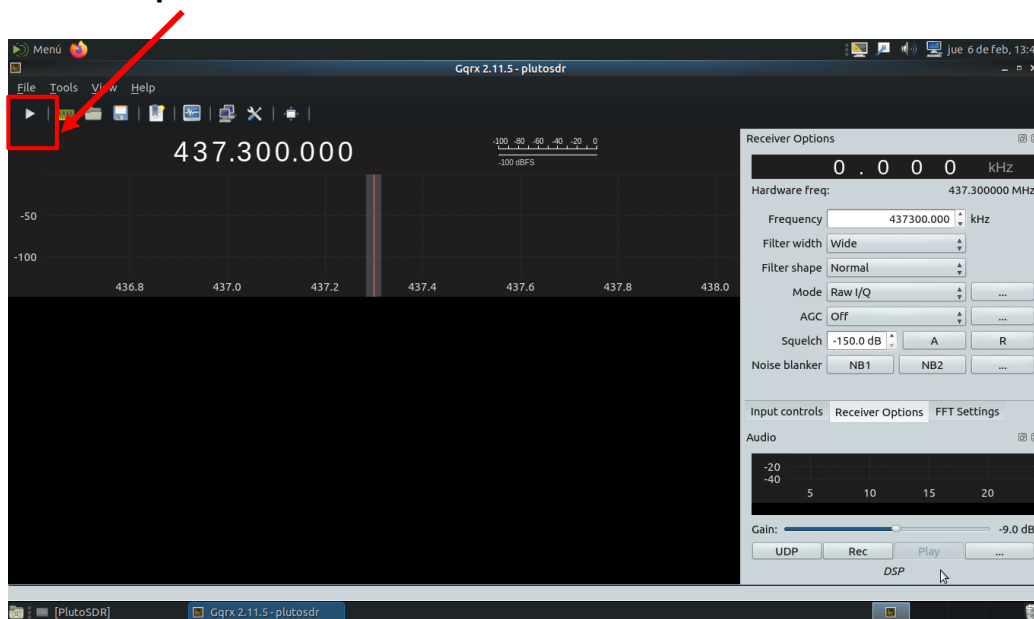
To be able to record the beacon **click** the following button as shown in the image.



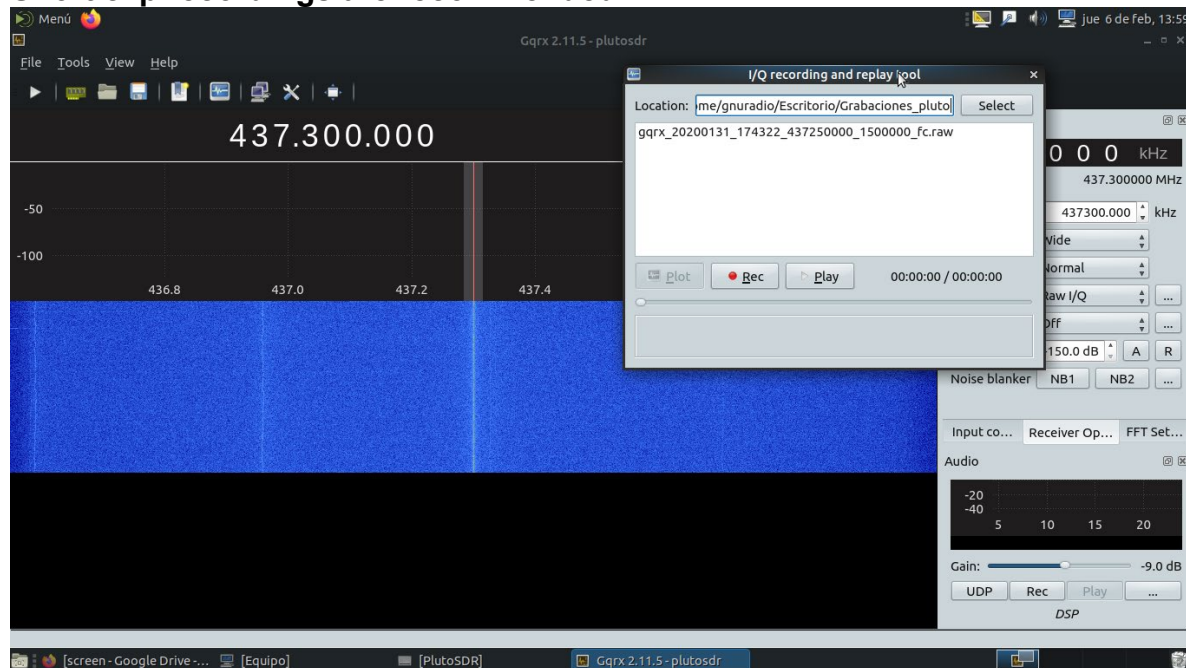
Next the “**I/Q recording and replay tool**” window will appear. To be able to record the beacon’s sound you first must specify a **Location**: where all the “raw” data recordings will be stored.



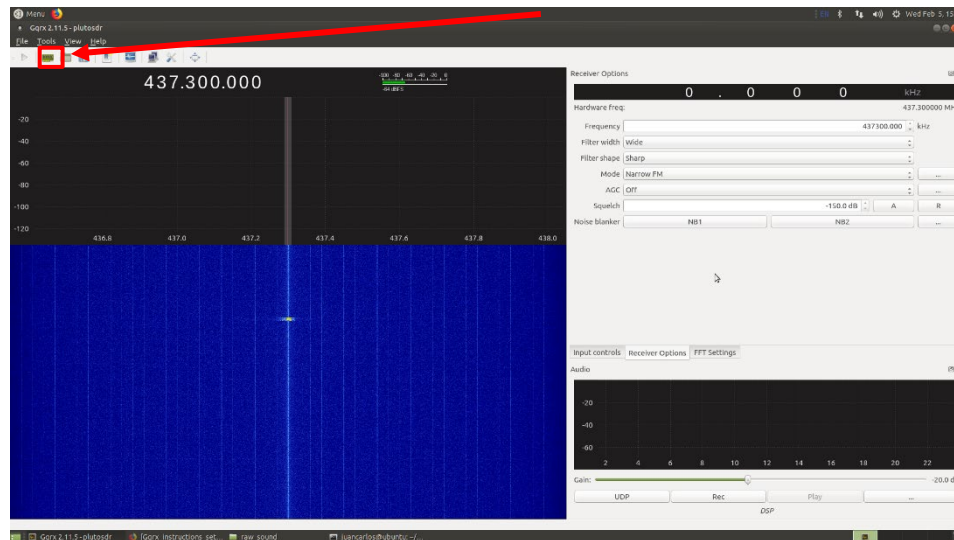
Look for the **play button** to start listening, which is located in the upper left-hand section of the **option bar** and **click it**.



When you are ready to record, click the **“Rec”** button to record a raw file. **NOTE: Short clip recordings are recommended.**



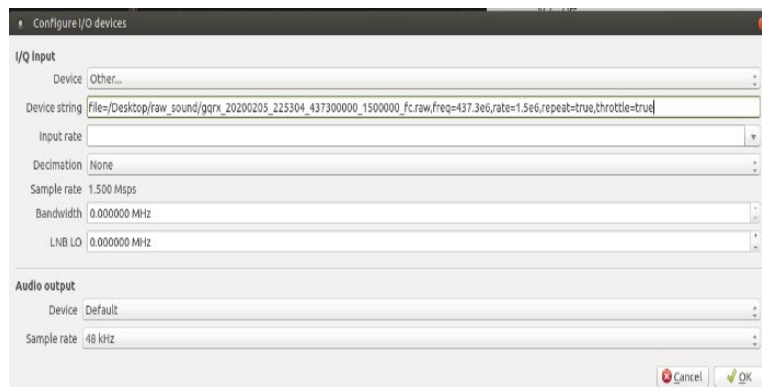
Once captured, go to **Configure I/O devices** window again by **clicking** the button as show in the image. Now is the time to convert the raw file into another format for later use in the **GNU** program. To do this you will replay the captured beacon in **GQRX** program.



The **Configuration I/O devices** window will appear and select **Other** for device and in the **device string** field enter the path to your raw file recording. The exact name of raw file to be replayed should be entered in the **device string** field with the following format being used:

file=/path_to_your_file.raw,freq=437.3e6,rate=1.5e6,repeat=true,throttle=true

Configure the rest of the fields as shown in the image

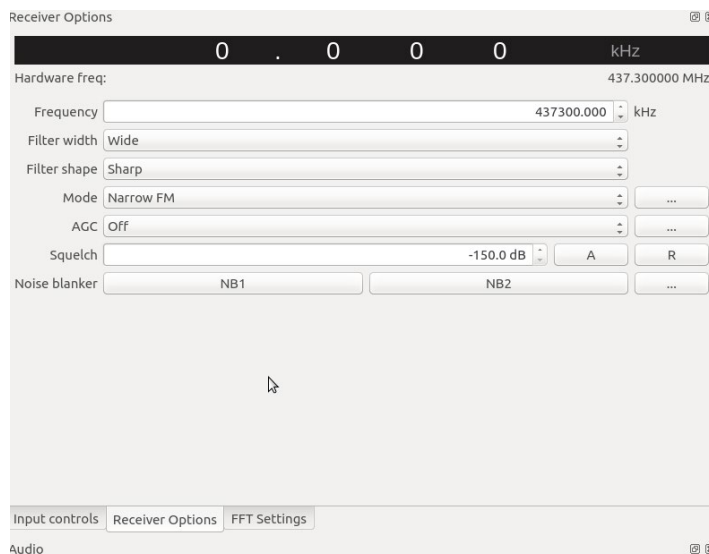




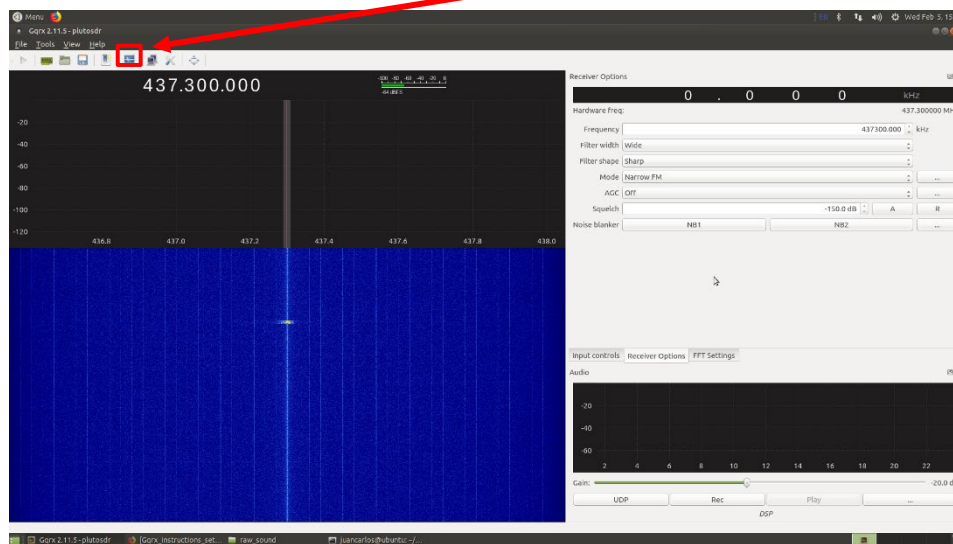
AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

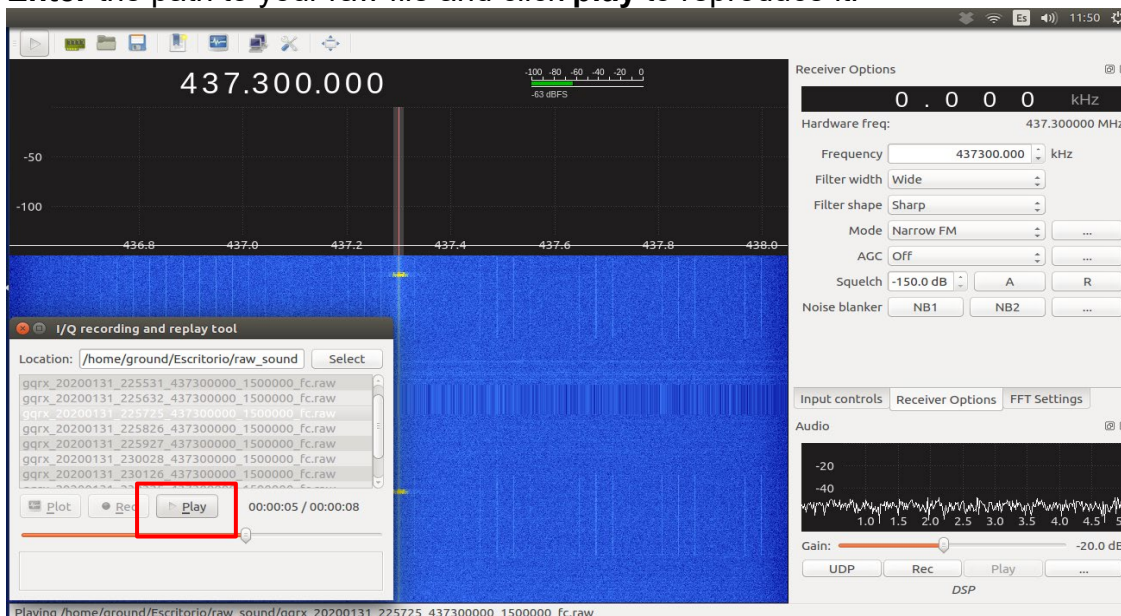
It will then be necessary to reconfigure the **Receiver Options** as show in the next image.



Next play the raw file recording. Click the **“screen”** icon in the upper left-hand side of the bar as shown.

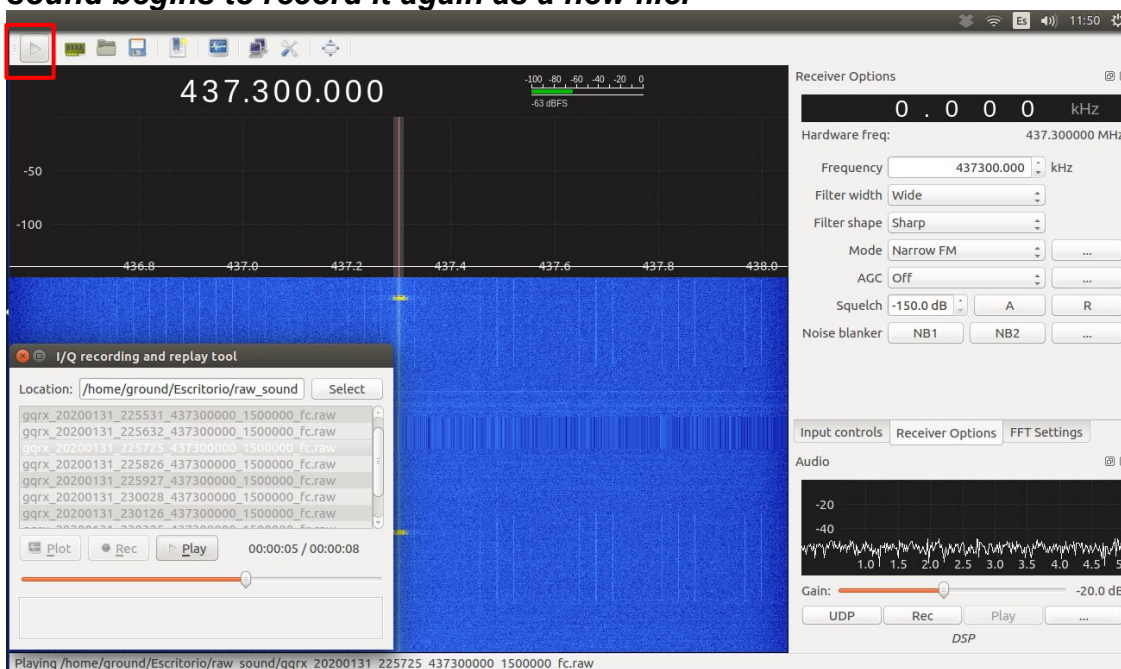


Enter the path to your raw file and click **play** to reproduce it.

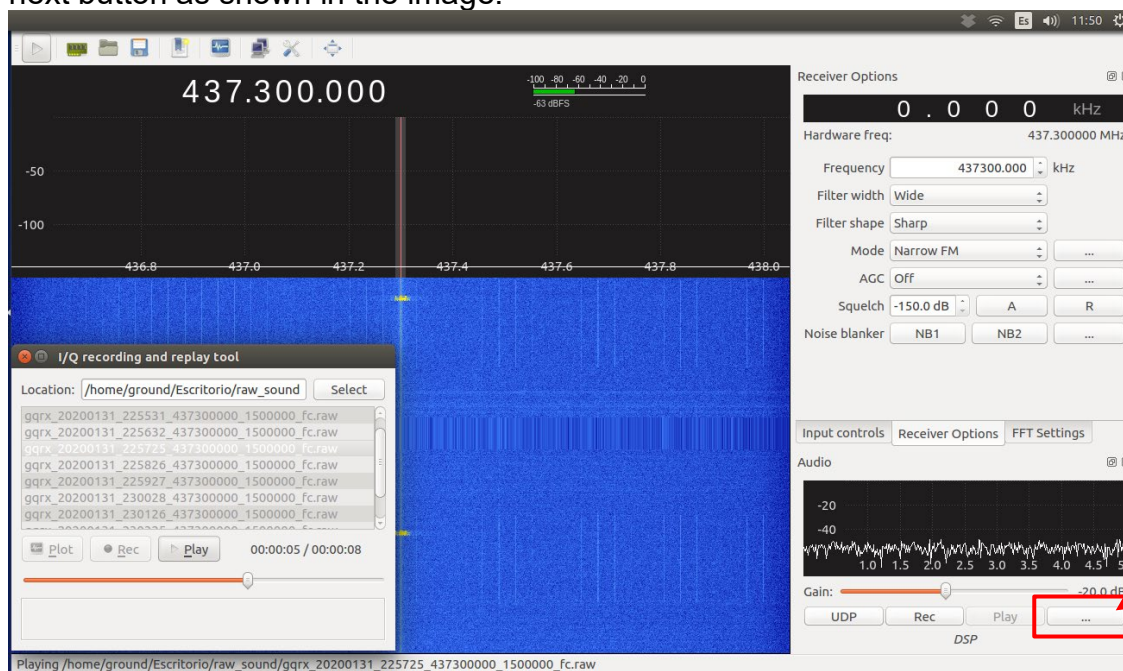


As soon as possible click the **play button** on the **GQRX** interface to start the listening portion of the pre-recorded beacon (raw file).

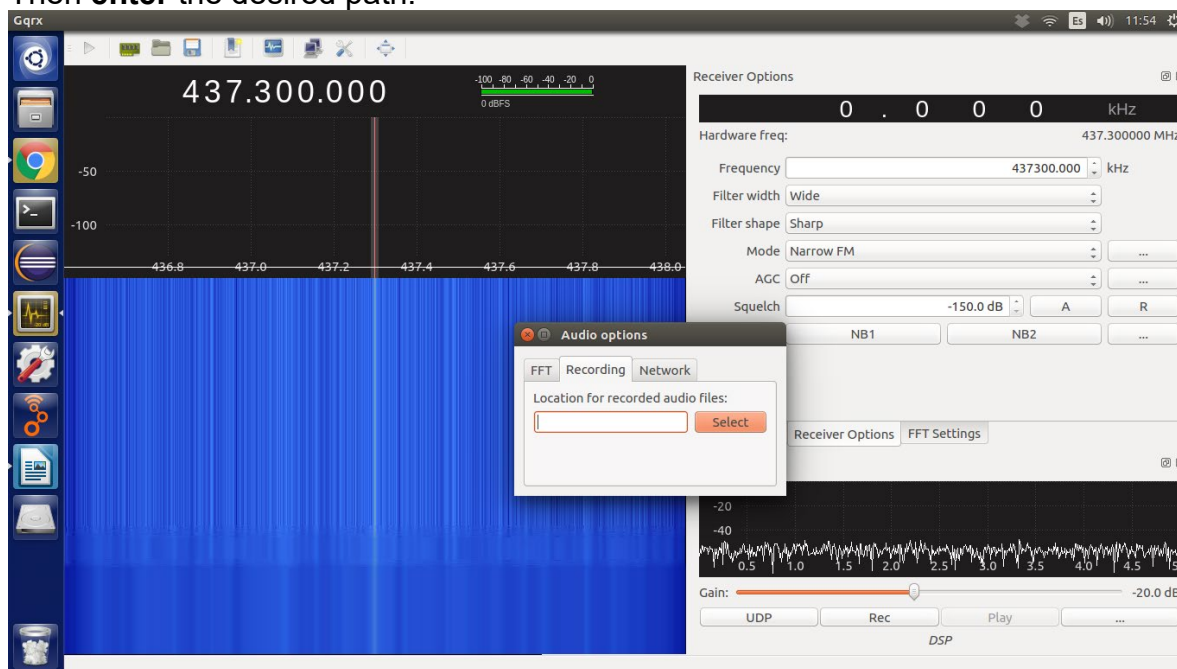
Note: you must be hearing the beacon at the exact moment in which beacon sound begins to record it again as a new file.



To **record** the new file, **enter a file location path** to save your files by clicking the next button as shown in the image.



Then **enter the desired path**.

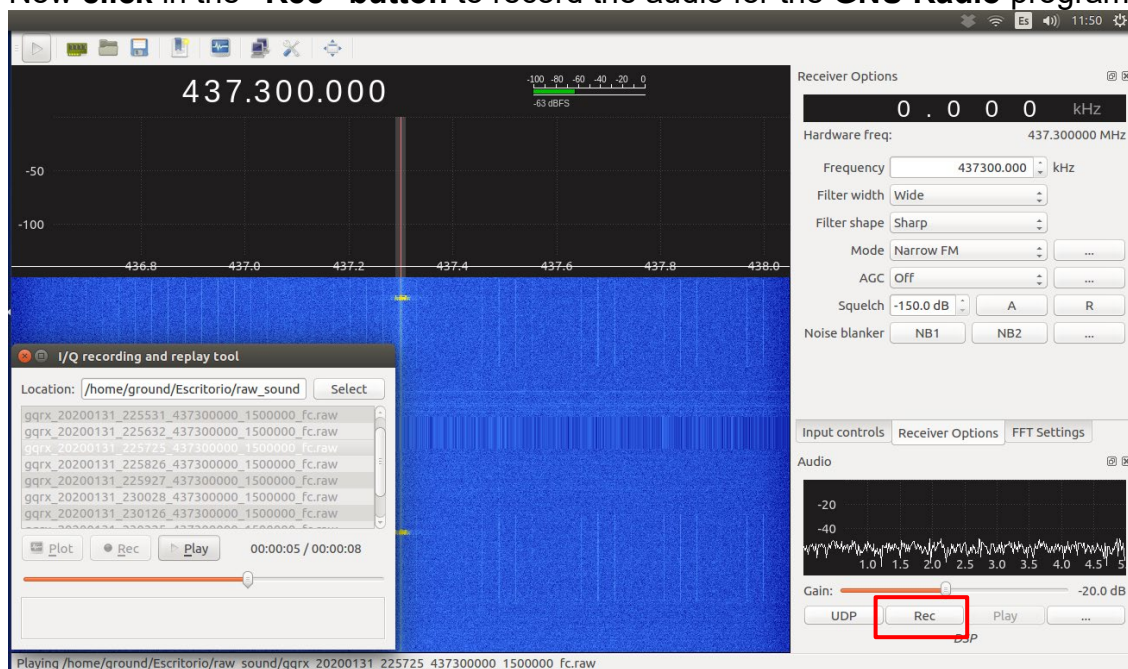




AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

Now **click** in the “**Rec**” button to record the audio for the **GNU Radio** program.



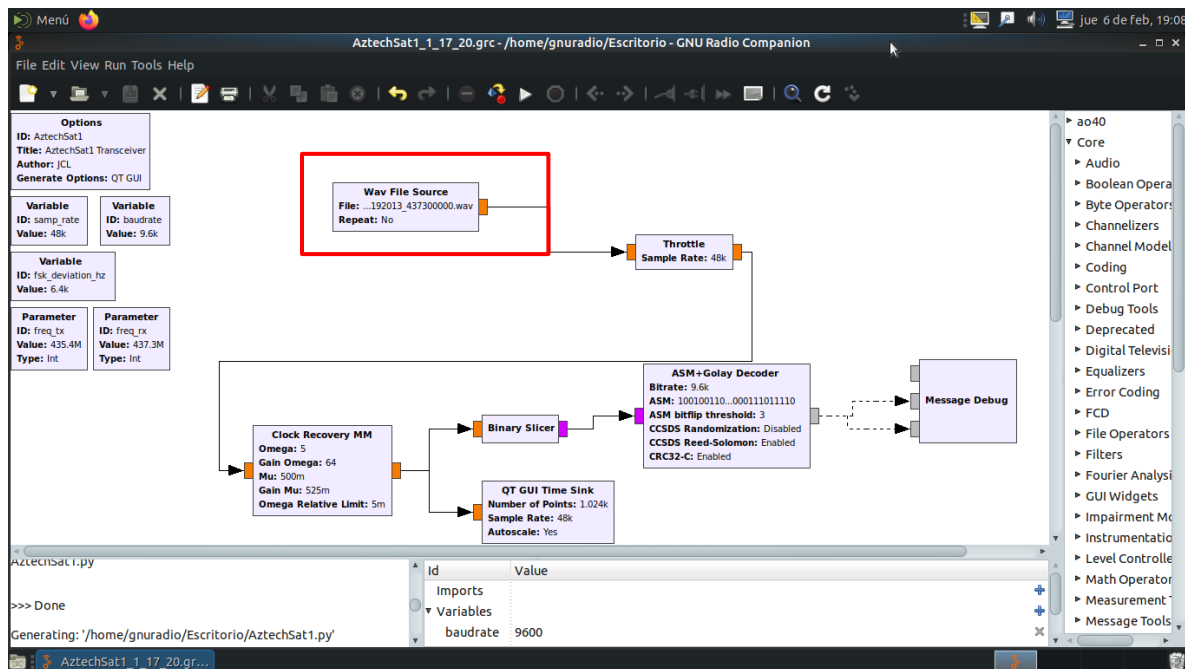


AzTechSat-1 Amateur Radio Instructions

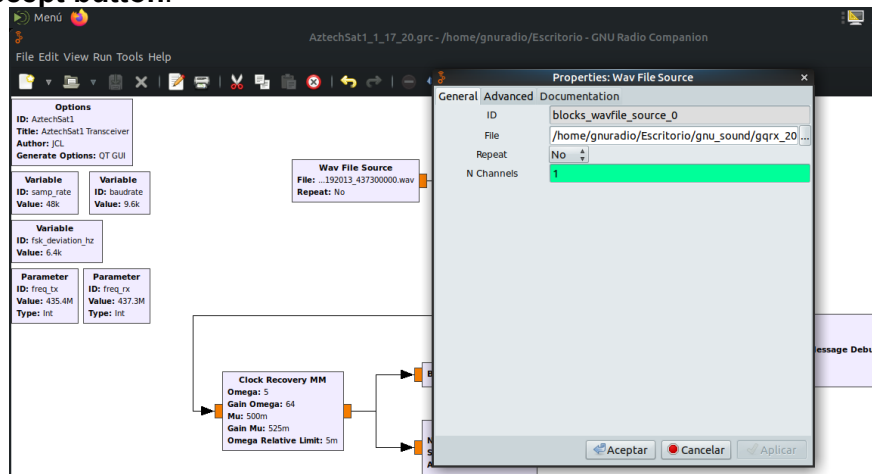
AZT_ORR_BL_GS_ARI
Revision 2

Beacon Decoder

Once you have the final .wav audio file, open the **GNU** program called “AztechSat_decoder.grc” (you can download it from the Mission Operations webpage <https://upaep.mx/aztechsat/missionoperations>). Next **select the block** shown in image below to load the audio file.



A new window for “**Properties: Wav File Source**” will appear. Look for the audio file and click the **accept** button.

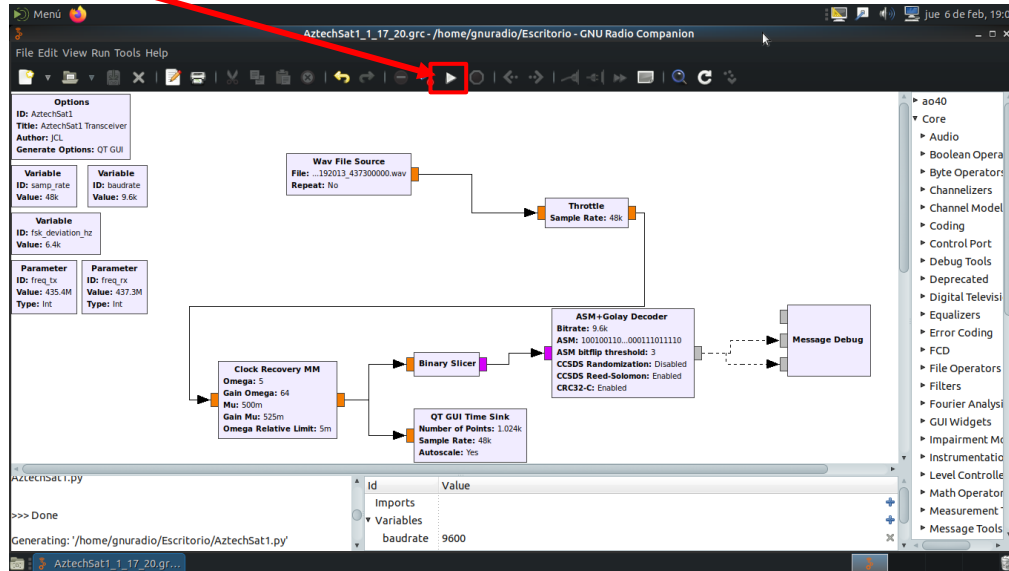




AzTechSat-1 Amateur Radio Instructions

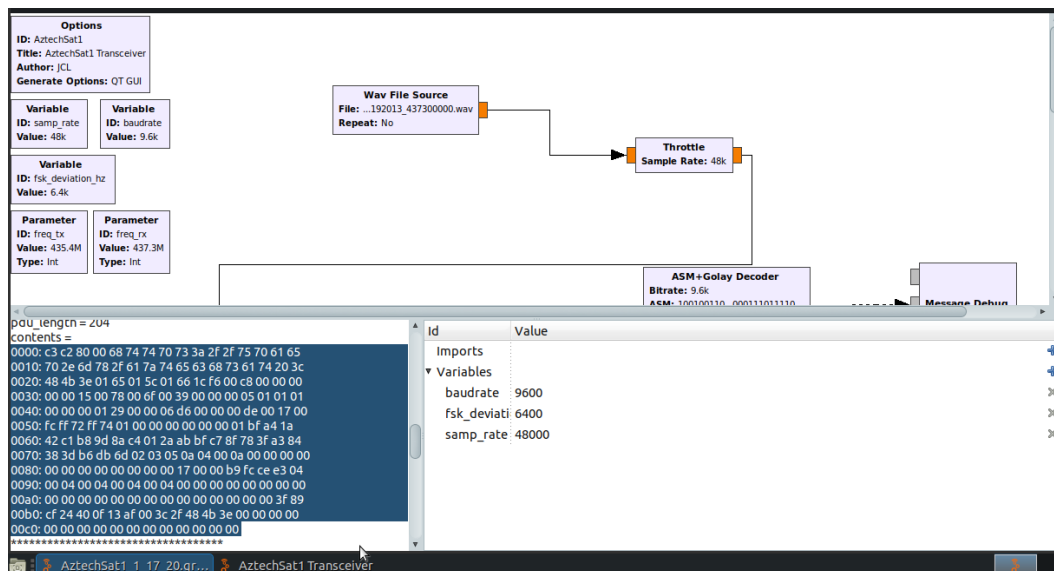
AZT_ORR_BL_GS_ARI
Revision 2

Click the **play** button in the options bar to start the conversion from audio to hexadecimal characters.

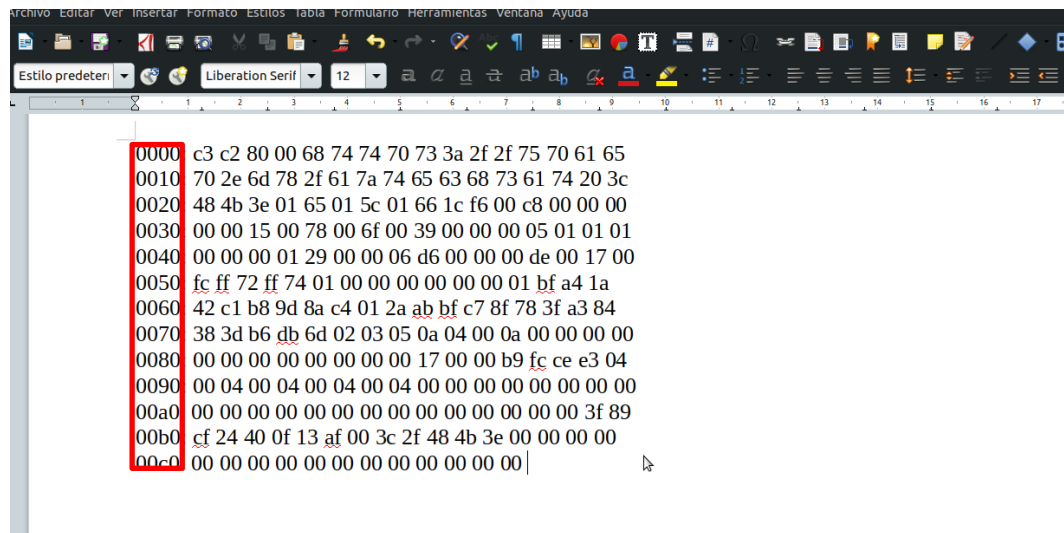


Note: in previous tests we captured the conversion from audio to hexadecimal characters in one out of five .wav file capture tests. You may need to try more than once to capture the hexadecimal characters.

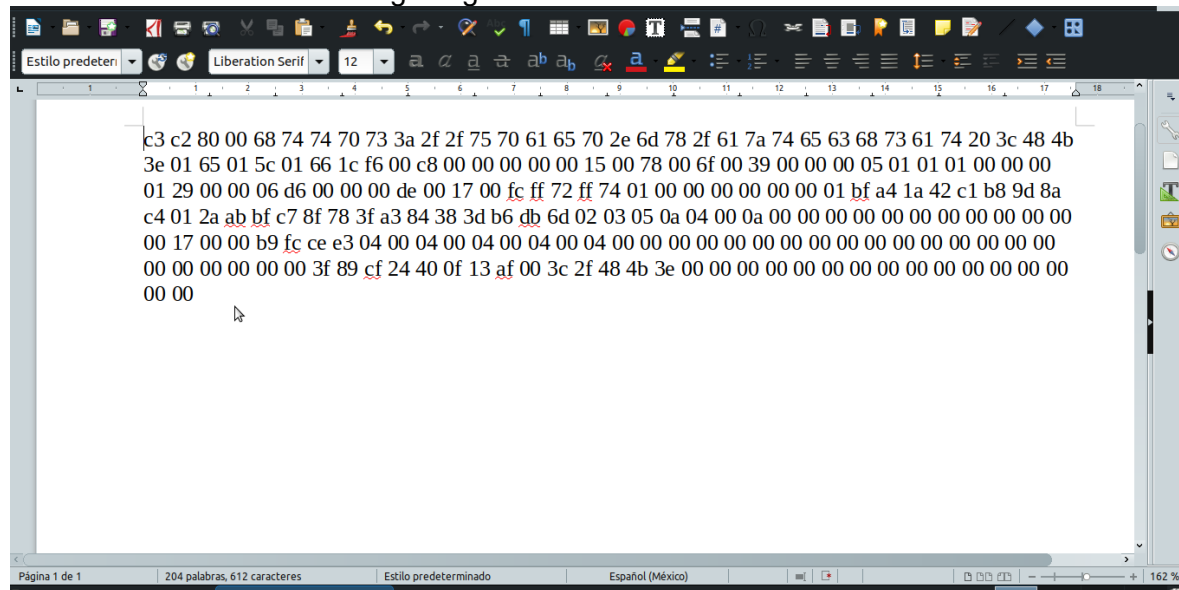
If the conversion from audio file to hexadecimal is successfully you should see hexadecimal characters in the lower left corner as shown.



Next **copy** the **hexadecimal characters** into a **text editor** to format properly. The formatting consists of **eliminating all csp-headers** (outlined in the red rectangle below) from each hexadecimal line and removing the spaces between each line.



It should look like the following image





AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

Finally look for a **hexadecimal to ASCII converter** (<https://www.rapidtables.com/convert/number/hex-to-ascii.html>) and paste the formatted hexadecimal lines into the converter. If the process was done correctly you will be able to see our web page address <https://upaep.mx/aztechsat/> in front of the other ASCII characters.

Paste hex numbers or drop file

```
74 01 00 00 00 00 00 01 bf a4 1a 42 c1 b8 9d 8a c4 01 2a ab  
bf c7 8f 78 3f a3 84 38 3d b6 db 6d 02 03 05 0a 04 00 0a 00 00  
00 00 00 00 00 00 00 00 17 00 00 b9 fc ce e3 04 00 04 00  
04 00 04 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
00 00 00 00 00 3f 89 cf 24 40 0f 13 af 00 3c 2f 48 4b 3e 00  
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Character encoding

ASCII

Convert Reset Swap

AA https://upaep.mx/aztechsat
<HK>re r\ rLo E + x o 9 | rrr r) -0 D | ðÿrÿtr r¿H-B
A. SÄ *αζCx?Eα8=9Üm
J
| üiä+ J J J J ?%
I\$@0!! - </HK>

Copy Save

ASCII to hex converter

- ASCII text to hex converter
- Base converter
- Binary converter
- Binary to ASCII text converter
- Binary to decimal converter
- Binary to hex converter
- Date to roman numerals converter
- Decimal to fraction converter
- Decimal to percent converter
- Decimal to binary converter
- Decimal to octal converter
- Decimal to hex converter
- Degrees to deg,min,sec converter
- Deg,min,sec to degrees converter
- Degrees to radians converter
- Fraction to decimal converter
- Fraction to percent converter
- Hex/decimal/octal/binary converter

Please then paste the character encoded line(s) onto our Amateur Radio Operations Dashboard form by clicking the Amateur Radio Operators button on the right side of the webpage: <https://upaep.mx/aztechsat/missionoperations> and send. **You should receive a Certificate of Capture once we have received your input and a QSL once it has been verified.**

**Thank you for supporting our mission! Feel free to
send comments to us at our email address:
missionoperations@upaep.mx**



AzTechSat-1 *Amateur Radio Instructions*

AZT_ORR_BL_GS_ARI
Revision 2

Appendix

This is how the waterfall analyzer looks like when a beacon sent by the AzTechSat-1 is received over **GQRX**.

