



## **NOAA and ROBUSTA-1B signal decoding procedure**

With the CSU portable ground station

**Par CINTAS Hugo**

En préparation du diplôme de : L3 EEA  
à : Fac des Sciences de Montpellier – Université de  
Montpellier  
supervisé par : Mario BALDINI





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## APPROVAL

|                  | PREPARED by   | CHECKED by   | RELEASED by   |
|------------------|---|--|---|
| <b>Name</b>      | Hugo Cintas   | Mario BALDINI  | Laurent DUSSEAU   |
| <b>Function</b>  | Stagiaire/Intern staff  | Supervisor   | CSU Director  |
| <b>Date</b>      | 12/10/2018  | 23/10/2018   | 23/10/2018  |
| <b>Signature</b> |  |  |  |

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## 2.2 LIST OF ABBREVIATIONS

|         |  |
|---------|--|
| AD      | Applicable Document                                    |
| CSU     | Centre Spatial Universitaire (University Space Centre) |
| ESA     | European Space Agency                                  |
| FFT     | Fast Fourier Transform                                 |
| GS      | Ground Station   |
| IQ file | In phase and Out-phase file                            |
| IR      | Infra-Red  |
| NOAA    | National Oceanic and Atmospheric Administration        |
| RD      | Reference Document                                     |
| RF      | Radio Frequency  |
| SDR     | Software Designed Radio                                |
| SMA     | SubMiniature version A                                 |
| SNR     | Signal Noise Rate                                      |
| UM2     | Université Montpellier 2                               |
| USB     | Universal Serial Bus                                   |
| VAC     | Virtual Audio Cable                                    |
| VHF     | Very High Frequency                                    |
| VFO     | Variable Frequency Operator                            |

## 3 INTRODUCTION

### 3.1 SCOPE AND CONTENT OF THE DOCUMENT

This document is entitled "Manual Decoding Procedure". It have the objective to allow every one who wants to decode NOAA pictures or Robusta-1B beacon to do it, if he/she has the necessary equipment listed in this document.

This document describes the Hardware and the Software needed to record and decode NOAA pictures or Robusta-1B beacon. Section 4 explains how to build the Hardware step by step, Section 5 describe how to download, install and configure the different software, and Sections 6 and 7 explain how to record and decode the NOAA pictures or the Robusta-1B beacon, respectively.

This procedure uses a code to number the steps of the procedure: a LETTER for each part from A to Q for the NOAA and from A to U from Robusta-1B, and a NUMBER for each sub-part.



## 4 MATERIALS

This part presents the hardware needed to run the procedure.

### 4.1 TURNSTILE ANTENNA

The Turnstile antenna is used to convert the electromagnetic waves into an electrical signal.

This output is this N female connector.

The Turnstile antenna for NOAA is set for 135 MHz and the one for CubeSats is set for 437.325 MHz.



**Figure 4-1 : Photo of the Turnstile antenna for VHF band.**

## 4.2 FUNCUBE DONGLE PRO +

The Funcube Dongle Pro+ is a Software Defined Radio (SDR). It converts electrical signal into computer data.

In reception the input is this SMA female connector and this exit is this USB male port.



**Figure 4-2 : Photo of the Funcube Dongle Pro +.**

### 4.3 LAPTOP

A laptop with Windows and an Intel CORE i5 or better.

On this laptop, you have to download and install some software. The software and how to download and install them are explained in part “Software” and “Need to be prepared before”



**Figure 4-3 : Picture of a laptop.**

## 4.4 CABLES

There are two cables.

The first one is a RF cable N male to SMA male. This cable is 15 cm long.



**Figure 4-4 : Picture of the RF cable N male to SMA male of 15 cm long.**

The second wire is USB cable USB female to male. This cable is 5 m long.



**Figure 4-5 : Picture of the USB cable USB female to USB male of 5 m long.**

## 4.5 QUADRIPOD

The quadripod that supports the Turnstile antenna.



**Figure 4-6 : Picture of the Quadripod pole.**

## 5 SOFTWARE

### 5.1 SDRSHARP

SDR# is an open source (license : “AS IS”) which allows to control the sdr connected to the computer.

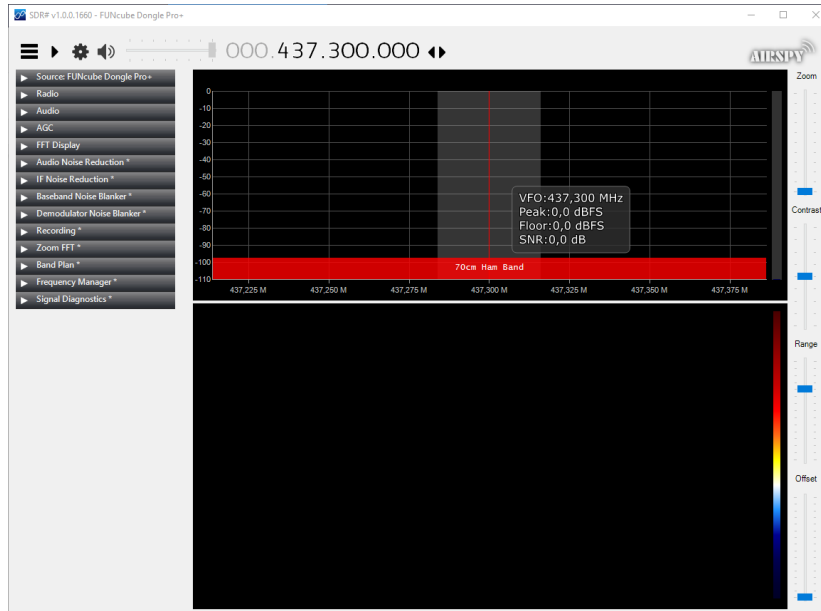


Figure 5-1 : Screenshot of the software SDRSharp.

#### 5.1.1 Menu

There is three little horizontal black line is the corner top left, this is the button to close or open the menu.

In this menu, there are numerous choices, as per figure 5-2. Only Source; Radio; Audio and Recording have to be customized to record NOAA signals.

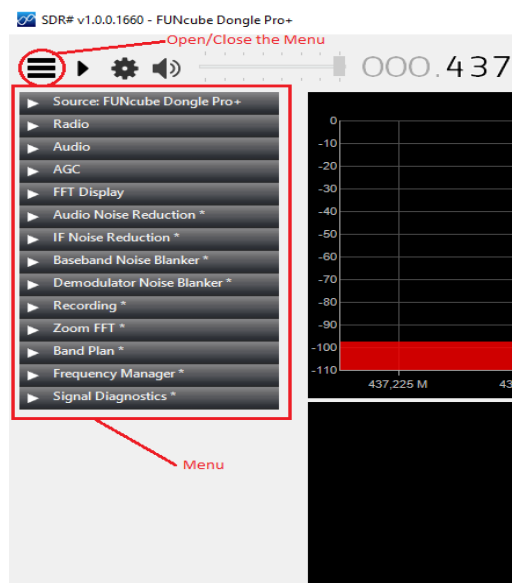


Figure 5-2 : Screenshot of the menu of SDRSharp

### 5.1.2 Source

This section is important because it fixes the way of the software will be used. So, there are two different ways:

The reception way with different type of sdr like: AIRSPY; RTL-SDR or FUNcube Dongle.

The playing way with different type of way to play an IQ file like: File Player or IQ File. File Player is an upgrade of IQ File, so use File Player.

### 5.1.3 Set the Frequency

You can change the frequency with a click on the figure you want to change: right click on it means 0 / left click on the top of it means +1 and left click on the bottom of it means -1.

The symbol on the right of the frequency value is the type of screen movement/display in/of the FFT.

**TIPS:** Choose a frequency a little bit different (+/- 50 kHz for 430 - 440 MHz) than the frequency to record, with the Funcube Dongle Pro+. The Funcube Dongle creates 5 dB of Noise in the central frequency.



**Figure 5-3 : Screenshot of the frequency set of SDRSharp.**

#### 5.1.4 Bandwidth on the FFT

Bandwidth is the area of the FFT where the audio will be created during an audio record.

“Audio: ON + “Record” “.

By the way, the SNR is calculated in the bandwidth.

You can move the bandwidth with a left click maintained on the red line on the middle of it.

The bandwidth is the grey area on the picture.

In Bandwidth some information you are provided:

VFO: the central frequency of the bandwidth

Peak: Max of the signal in the bandwidth in dB

Floor: Noise level in dB

SNR: Signal to Noise Ratio

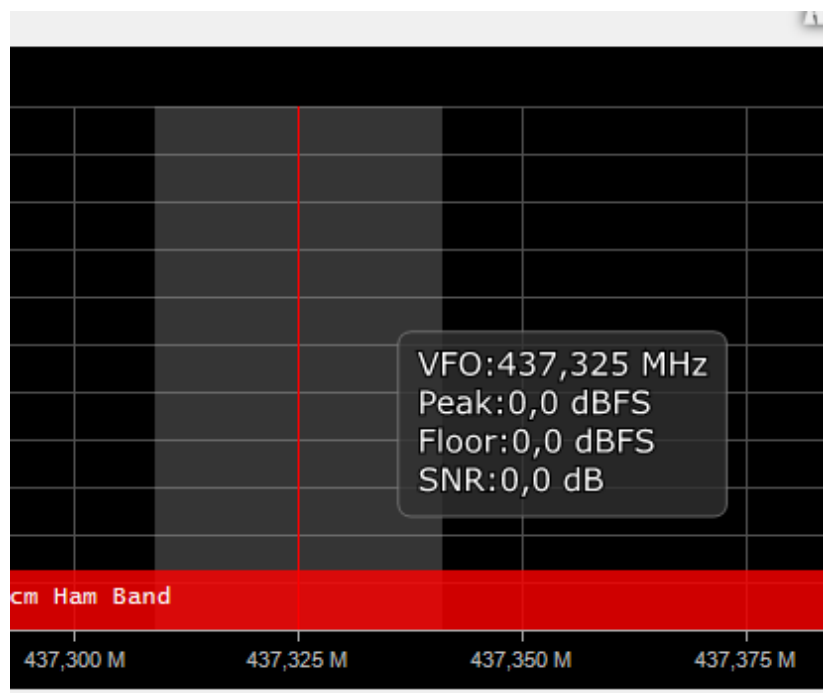


Figure 5-4 : Screenshot of the bandwidth of SDRSharp.

## 5.2 VIRTUAL AUDIO CABLE

Virtual Audio Cable (VAC) is a shareware software. VAC creates a connection in the soundcard between two parts of the computer. WXtoImg decodes the sound in data. So it is useful to remove the loss between the speakers and the microphone.

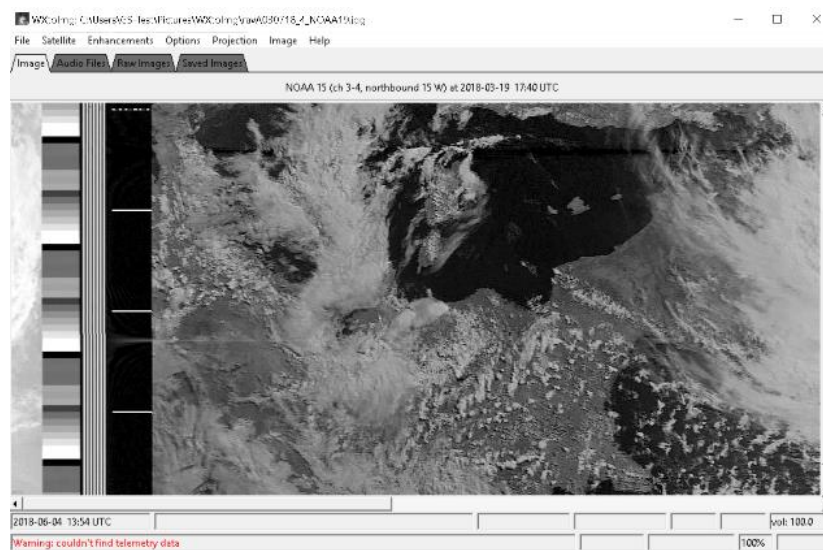


### 5.3 WXTOIMG

The website is at the moment of writing this document (July 2018) down, so to download it, it is needed to use a google drive box open to everyone because the backup on archive.org is not working.

WXtoImg is a free software. It converts a sound into pixel to create a picture. The picture is at 50% in IR and 50% in visible spectrum, but the both of them are in black and white.

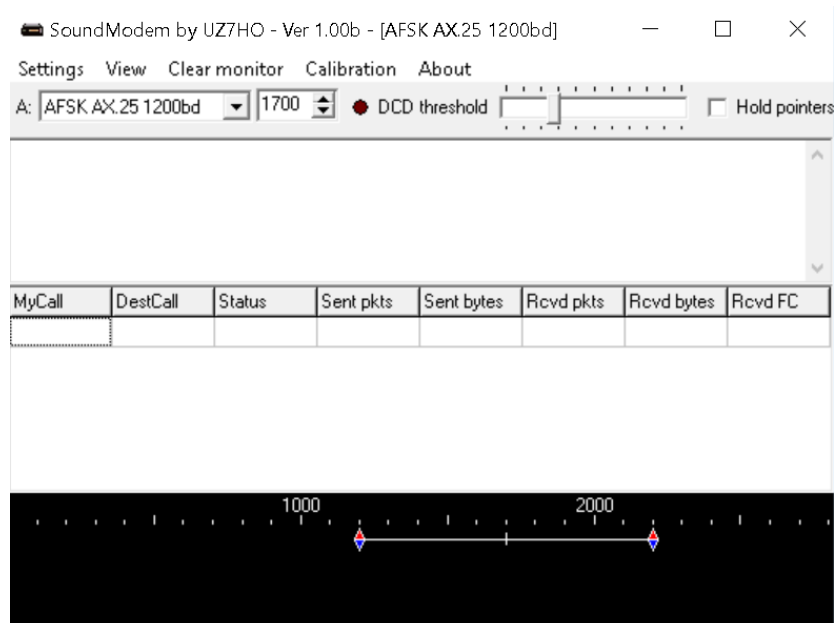
WXtoImg can decode by itself but this process add a lot of noise in the final result. So this document explains only the process to convert an audio file already created with SDRSharp into a picture.



**Figure 5-5 : Screenshot of WXtoImg.**

## 5.4 SOUNDMODEM

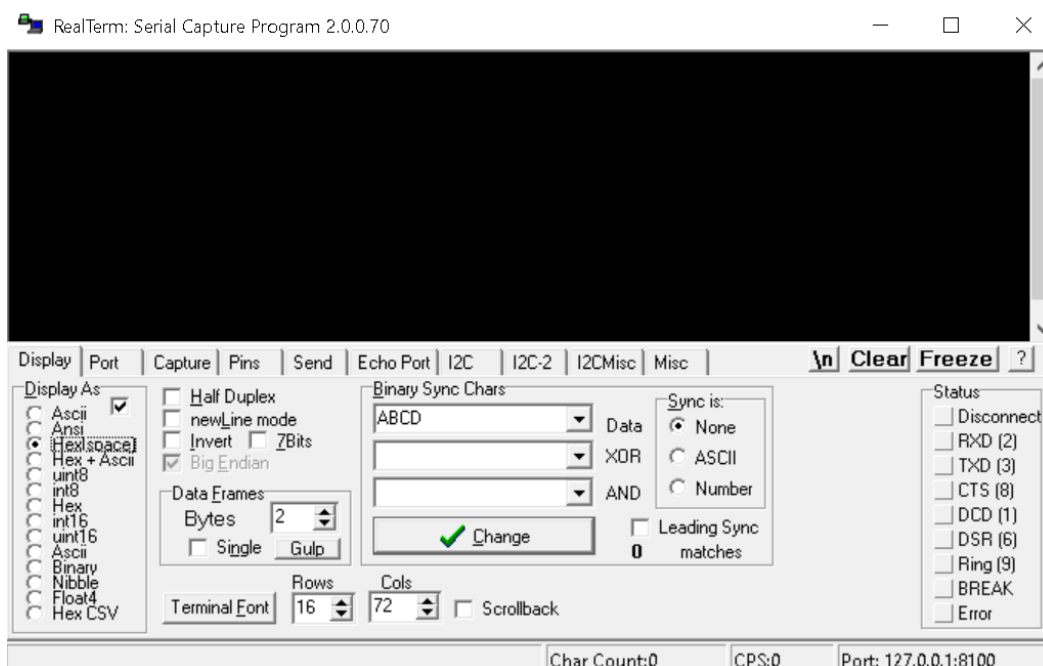
SoundModem is an open source software (license free software) created by a radio ham to convert audio file into data.



**Figure 5-6 : Screenshot of SoundModem.**

## 5.5 REALTERM

RealTerm is an open source software developed on GitHub, with the license BSD. This software converts a chains of data in ASCII into a chains of data in hexadecimal.



**Figure 5-7 : Screenshot of RealTerm.**

## 6 NOAA PICTURES RECORDING

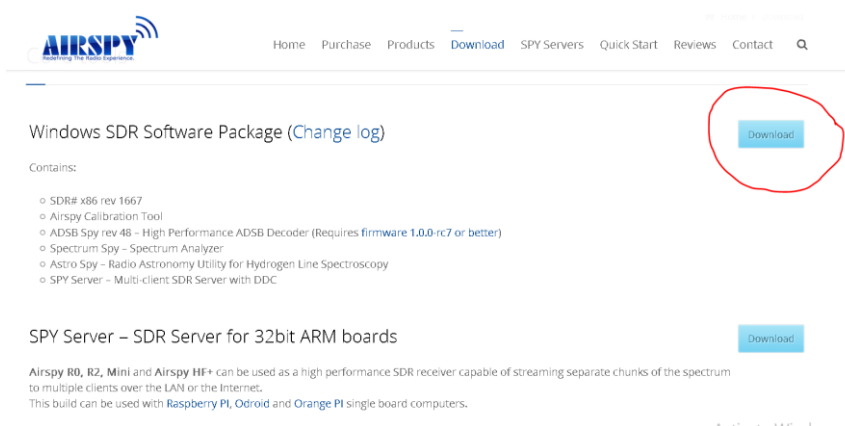
This part presents the procedure to decode NOAA pictures from the download of the software to the decoding of the audio file.

### 6.1 BEFORE THE PASS (GROUNDWORK)

#### 6.1.1 Download link

##### 6.1.1.1 A. SDRSharp

<https://airspy.com/download/>



**Figure 6-1 : Screenshot of the webpage used to download SDRSharp.**

1. Click on the "Download" button.
2. Choose "Save the file" on the pop-up windows.

### 6.1.1.2 B. Virtual Audio Cable

<https://www.vb-audio.com/Cable/>



Figure 6-2 : Screenshot of the page used to download Virtual Audio Cable.

1. Click on the "Download" button.
2. Choose "Save the file" on the pop-up windows.

### 6.1.1.3 C. WXtimg

<https://drive.google.com/file/d/1iycG0-boJQmgQ5RT5MOKqVpuGRMT54vX/view>

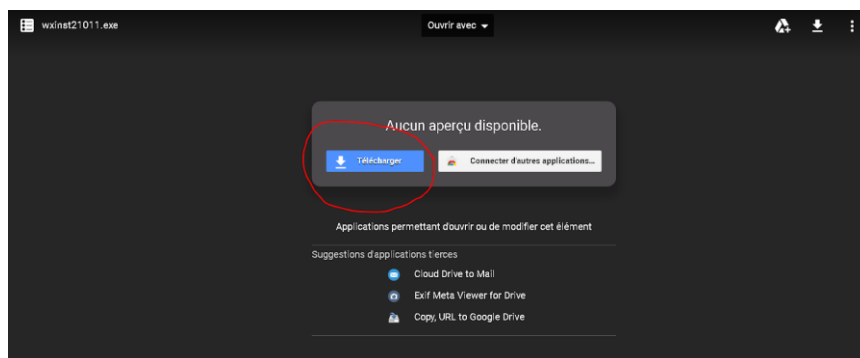


Figure 6-3 : Screenshot of the webpage used to download WXtomg.

1. Click on the "Download" button.
2. Choose "Save the file" on the pop-up window.

## 6.1.2 Install software

### 6.1.2.1 D. SDRSharp

1. Go to the download folder.
2. Extract the zip-file "sdrsharp-x86".

### 6.1.2.2 E. Virtual Audio Cable

1. Go to the download folder.
2. Extract the zip-file "VBCABLE\_Driver\_Pack43".

3. Run the file "VBCABLE\_Setup".
4. Follow the installation procedure

#### **6.1.2.3 F. WXtolmg**

1. Go to the download folder.
2. Run the file wxinst21011.
3. Follow the installation procedure

### **6.1.3 Build the Hardware**

#### **6.1.3.1 G. The Quadripod**

1. Unpack the quadripod pole.
2. Open the quadripod pole and put it on the ground. Be sure the ground is flat at this place.



**Figure 6-4 : Picture of the quadripod pole in transport configuration (before).**



**Figure 6-5 : Picture of the quadripod in reception configuration (after).**

#### **6.1.3.2 H. The antenna**

1. Unpack the antenna



**Figure 6-6 : Picture of the antenna packed (before).**



**Figure 6-7 : Picture of the antenna unpacked (after).**

2. Put the antennas fastening system around the pole of the quadripod pole.



**Figure 6-8 : Picture of the antenna fastening system around the quadripods pole**

3. Clamp the fastening systems with the 4 gears.



**Figure 6-9 : Picture of the fastening system with the 4 gear clamped.**

Check if the antenna is pointing the sky before to go to step 4. If not repeat steps 2 and 3. But if after several times, the antenna is not pointing the sky, check if the ground is flat (step G.2.).

4. Screw the 4 reflectors (longest metal pipe, with a gear) in the bottom of the antenna.



**Figure 6-10 : Picture of the antenna (before G.4.).**

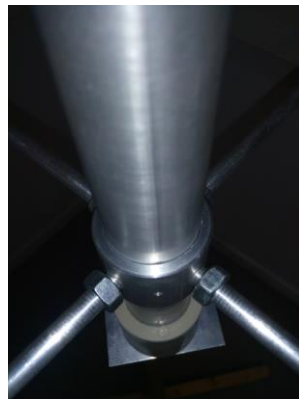


**Figure 6-11 : Picture of the antenna (during G.4).**



**Figure 6-12 : Picture of the antenna (after G.4).**

5. Screw the gear on the reflector . Do not force the reflector.



**Figure 6-13 : Picture of the antenna (before G.5).**





**Figure 6-14 : Picture of the antenna (after G.5.).**

6. Screw the 4 receivers (metal pipe, without a gear on it) in the top of the antenna.



**Figure 6-15 : Picture of the antenna (before G.6.).**



**Figure 6-16 : Picture of the antenna (during G.6.).**



**Figure 6-17 : Picture of the antenna (after G.6.).**

Check if the antenna is pointing the sky before to go the step I.1 because the weight of the receiver and reflector can change its orientation. If not repeat steps 2 and 3. But if after several times the antenna is not pointing the sky, check if the ground is flat (step G.2.).

#### **6.1.3.3 I. SDR and Cable**

1. Unpack the USB and RF cables.
2. Connect the RF N male to the N female connector in the bottom of the antenna.
3. Connect SDR SMA female connector to the SMA male connector of the RF cable.
4. Connect the USB female on the SDR USB male.
5. Plug the USB cables USB male connector on your laptop.

#### **6.1.4 Configure the software**

##### **6.1.4.1 J. SDRSharp**

1. Start SDRSharp
2. Go to the Radio part and enter these parameters.

Mod: WFM

Filter: Blackman-Harris 7

Bandwidth: 18 000 kHz

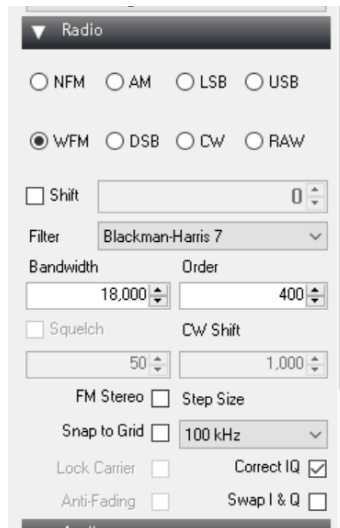
Order: 400

Snap to grid: OFF

Step Size: 100 kHz

Correct IQ: ON

Swap I & Q: OFF



**Figure 6-18 : Screenshot of the radio part of SDRSharp.**

3. Go to the Audio part and enter these parameters.

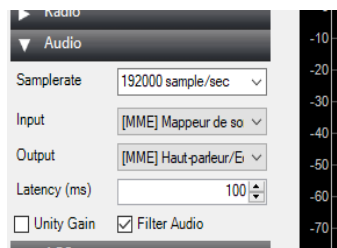
Sample Rate: 192 000 samples/sec

Input: [MME] Microsoft sound

Output: [MME] Speakers

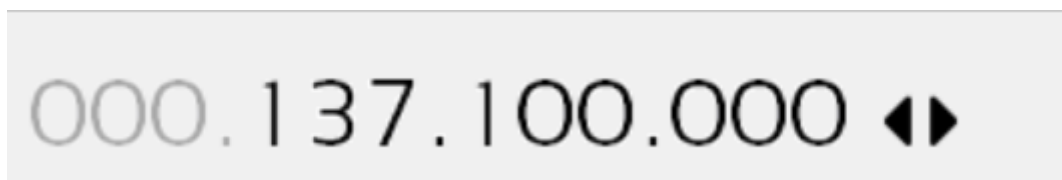
Unity Gain: OFF

Filter Audio: On



**Figure 6-19 : Screenshot of the Audio part of SDRSharp.**

4. Choose the frequency at which the SDR will work for example for NOAA 19 it is 137.100 MHz.



**Figure 6-20 : Screenshot of the frequency part of SDRSharp.**

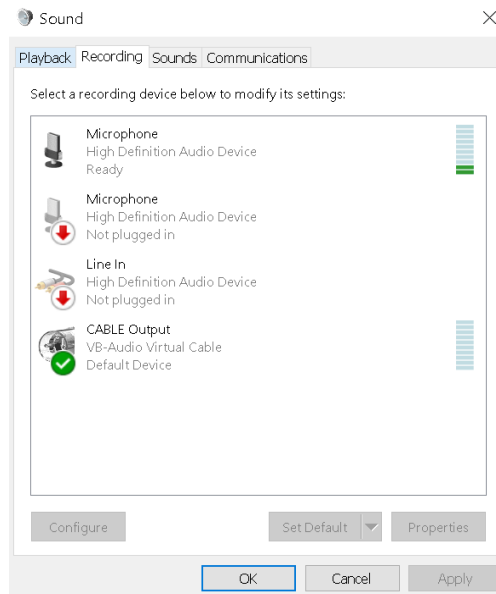
#### **6.1.4.2 K. Virtual Audio Cable**

1. Go to parameters / Audio in your laptop.
2. Click "Change the device or app volume".

3. Choose in "Choose your output device": "CABLE Input (VB-Audio Virtual Cable)".
4. Put the volume in 100 value.
5. Close the parameters windows.

#### 6.1.4.3 L. WXtoimg

1. Run WXtoimg
2. Go to "File / Update Keplers ".
3. Go to "Satellite Pass List..." and check when the satellite elevation for the next pass will be more than 40°. It will be a usable pass.
4. Go to "Mixer Control / Recording" and put "Cable Output" in default device.



**Figure 6-21 : Screenshot of Mixer Control/Recording.**

## 6.2 DURING THE PASS (RECORD)

### 6.2.1 Use the software

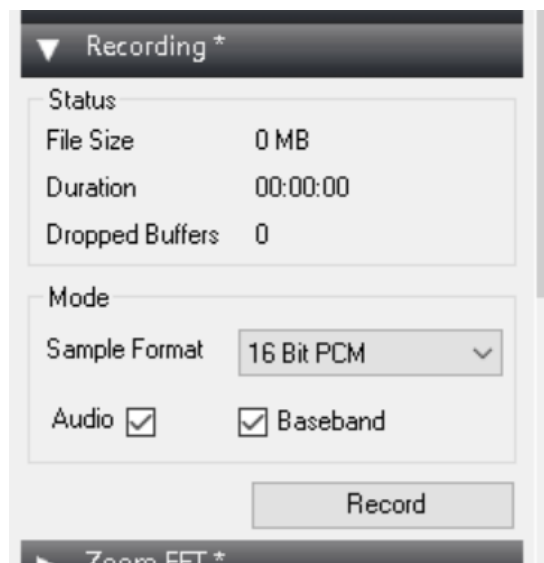
#### 6.2.1.1 M. SDRSharp

1. Check if the frequency is the one you want to record.
2. Go to source and choose "Funcube Dongle Pro +".
3. Click on the start button.
4. Go to the recording. Put this parameters and click on "Record".

Sample Format: 16 bit PCM

Audio: ON

Baseband: On



**Figure 6-22 : Screenshot of Recording part of SDRSharp (during M.4).**

## 6.3 AFTER THE PASS (CLOSE, PACK AND DECODE)

### 6.3.1 Dismount and pack the hardware

#### 6.3.1.1 N. Stop the record

1. Click on "Stop" in Recording.
2. Click on "Stop" in SDRSharp Menu (Corner in top and left).
3. Close SDRSharp.

#### 6.3.1.2 O. Pack the hardware

1. Follow the procedure from the step I. to step G in the opposite order and do the opposite of the tasks.

### 6.3.2 Decode the data

#### 6.3.2.1 P. Find the Audio file

1. Go to "sdrsharp-x86" folder.
2. Find the file "SDRSharp\_YYYYMMDD\_HHMMSSZ\_FFFFFFFFHz\_AF".  
Where YYYY = Year; MM = Month; DD = Day; HH = Hour; MM = Minute; SS = Second, F = Frequency, Z is not a variable and Hz (Hertz) for the unit is nor a variable.  
This the Audio file you have recorded.
3. Play it.

#### 6.3.2.2 Q. WXtolmg decoding

1. Go back to the Windows WXtolmg
2. Go to "File / Record" and click on "Manual test"
3. Now wait for the construction of the pictures.

## 7 ROBUSTA-1B BEACON DECODING

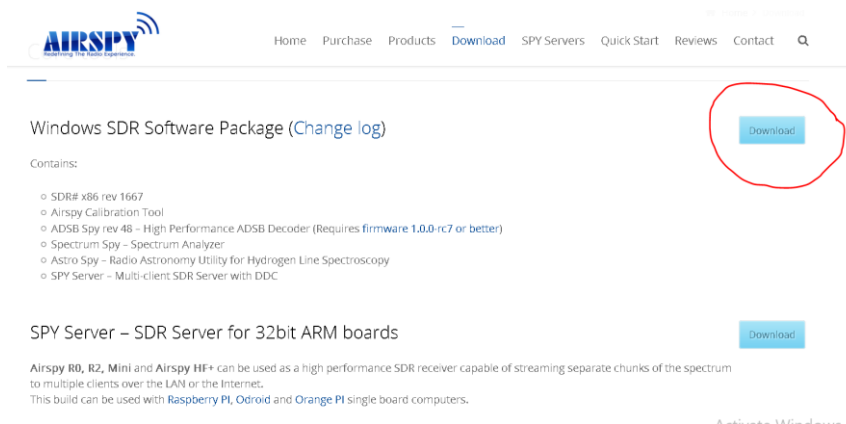
This part presents the procedure to decode Robusta-1B beacon from the downloading step of the software to the decoding step of the audio file for each beacon.

### 7.1 BEFORE THE PASS (GROUNDWORK)

#### 7.1.1 Download link

##### 7.1.1.1 A. SDRSharp

<https://airspy.com/download/>

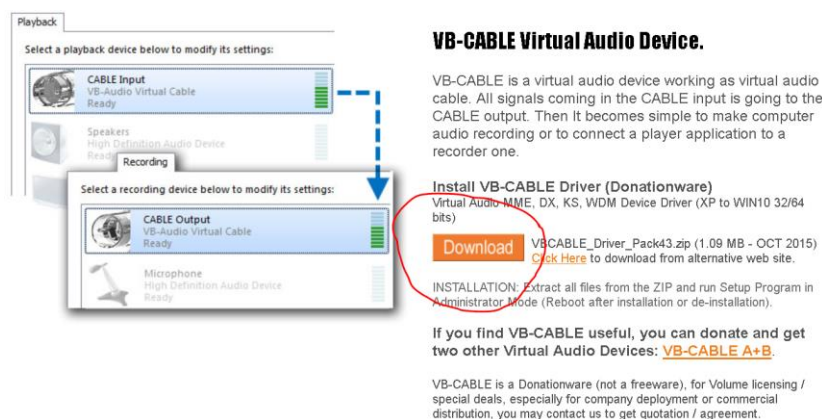


**Figure 7-1 : Screenshot of the webpage used to download SDRSharp.**

1. Click on the "Download" button.
2. Choose "Save the file" on the pop-up windows.

##### 7.1.1.2 B. Virtual Audio Cable

<https://www.vb-audio.com/Cable/>

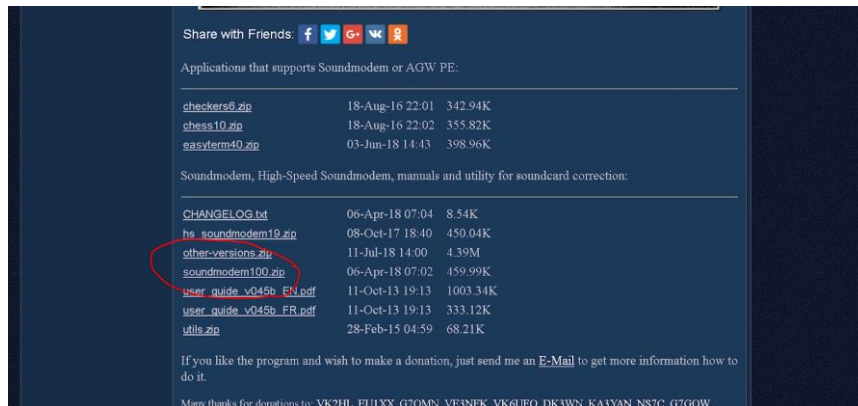


**Figure 7-2 : Screenshot of the page used to download Virtual Audio Cable.**

1. Click on the "Download" button.
2. Choose "Save the file" on the pop-up windows.

### 7.1.1.3 C. SoundModem

<http://uz7.ho.ua/packetradio.htm>

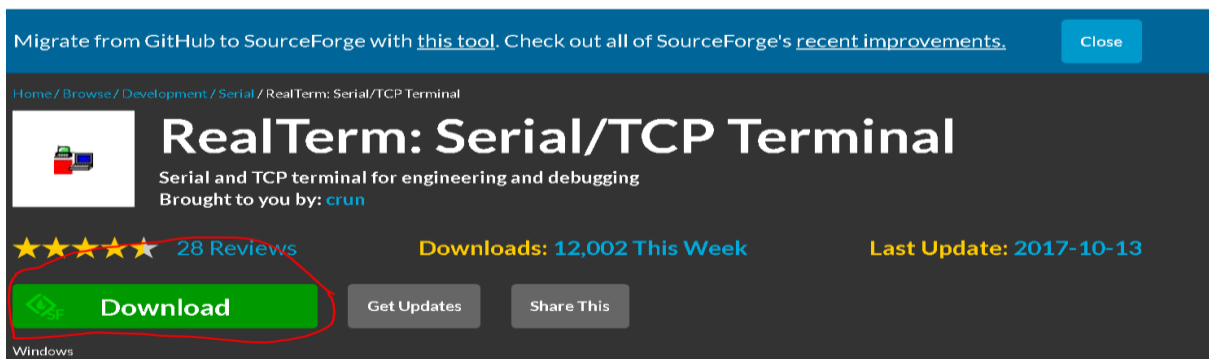


**Figure 7-3 : Screenshot of the webpage used to download SoundModem.**

1. Click on the “soundmodem100.zip” link.
2. Choose “Save the file” on the pop-up windows.

### 7.1.1.4 D. RealTerm

[https://sourceforge.net/projects/realterm/?source=typ\\_redirect](https://sourceforge.net/projects/realterm/?source=typ_redirect)



**Figure 7-4 : Screenshot of the webpage used to download RealTerm.**

1. Click on the “download” button.
2. Choose “Save the file” on the pop-up windows.

## 7.1.2 Install software

### 7.1.2.1 E. SDRSharp

1. Go to the download folder.
2. Extract the zip-file “sdrsharp-x86”.



#### **7.1.2.2 F. Virtual Audio Cable**

1. Go to the download folder.
2. Extract the zip-file "VBCABLE\_Driver\_Pack43".
3. Run the file "VBCABLE\_Setup".
4. Follow the installation procedure.

#### **7.1.2.3 G. SoundModem**

1. Go to the download folder.
2. Extract the zip-file "soundmodem100.zip".

#### **7.1.2.4 H. RealTerm**

1. Go to the download folder.
2. Run the file "Realterm\_2.0.0.70\_Signed\_Wrapper\_setup.exe".

### **7.1.3 Build the Hardware**

#### **7.1.3.1 I. The Quadripod**

1. Unpack the quadripod.
2. Open the quadripod and put it on the ground. Be sure to ground is flat at this place.



**Figure 7-5 : Picture of the quadripod in transport mode (before I.2.)**



**Figure 7-6 : Picture of the quadripod in reception mode (after I.2.)**

### 7.1.3.2 J. The antenna

1. Unpack the antenna



**Figure 7-7 : Picture of the antenna packed (before J.1.).**



**Figure 7-8 : Picture of the antenna unpacked (after J.1.).**

2. Put the antennas fastening system around the pole of the quadripod.



**Figure 7-9 : Picture of the antenna fastening system around the quadripod pole.**

3. Clamp the fastening systems 4 gears.



**Figure 7-10 : Picture of the fastening system with the 4 gears clamped.**

Check if the antenna is pointing the sky before to go the step 4. If not repeat steps 2 and 3. But if after several times the antenna is not pointing the sky, check if the ground is flat (step G.2.).

4. Screw the 4 reflectors (longest metal pipe, with a gear) in the bottom of the antenna.



**Figure 7-11 : Picture of the antenna (before G.4.).**

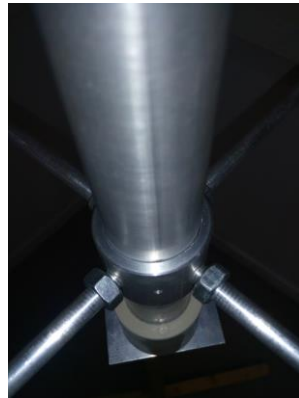


**Figure 7-12 : Picture of the antenna (during G.4.).**

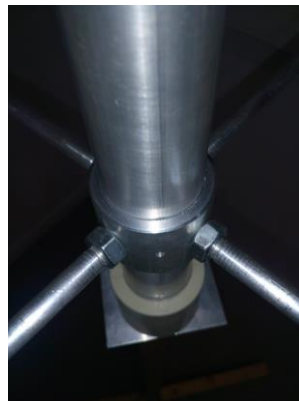


**Figure 7-13 : Picture of the antenna (after G.4).**

5. Screw the gear on the reflector. Do not force.



**Figure 7-14 : Picture of the antenna (before G.5).**



**Figure 7-15 : Picture of the antenna (after G.5).**

6. Screw the 4 receivers (metal pipe, without a gear on it) in the top of the antenna.



**Figure 7-16 : Picture of the antenna (before G.6.).**



**Figure 7-17 : Picture of the antenna (during G.6.).**



**Figure 7-18 : Picture of the antenna (after G.6.).**

Check if the antenna is pointing the sky before to go the step I.1 because the weight of the receiver and reflector can change its orientation. If not repeat steps 2 and 3. But if after several times the antenna is not pointing the sky, check if the ground is flat (step G.2.).

### 7.1.3.3 K. SDR and Cable

1. Unpack the USB and RF cable.
2. Connect the RF N male to the N female connector in the bottom of the antenna.
3. Connect SDR SMA female connector to the SMA male connector of the RF cable.
4. Connect the USB female on the SDR USB male.
5. Plug the USB cables USB male connector on the laptop.

## 7.1.4 Configure the software

### 7.1.4.1 L. SDRSharp

1. Start SDRSharp
2. Go to the Radio part and enter these parameters.

Mod: NFM

Filter: Blackman-Harris 4

Bandwidth: 18 770 kHz

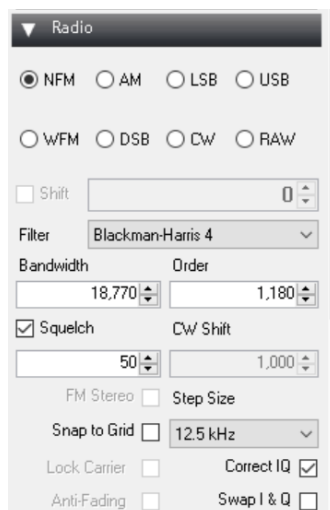
Order: 1180

Snap to grid: OFF

Step Size: 12.5 kHz

Correct IQ: ON

Swap I & Q: OFF



**Figure 7-19 : Screenshot of the radio part of SDRSharp.**

3. Go to the Audio part and enter these parameters.

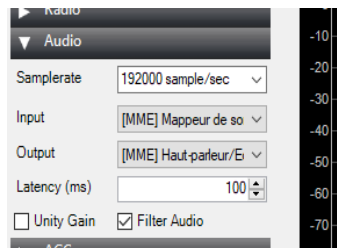
Sample Rate: 192 000 samples/sec

Input: [MME] Microsoft sound

Output: [MME] Speakers

Unity Gain: OFF

Filter Audio: ON



**Figure 7-20 : Screenshot of the Audio part of SDRSharp.**

4. Choose the frequency at which the SDR will work for example for NOAA 19 it is 137.100 MHz.



**Figure 7-21 : Screenshot of the frequency part of SDRSharp.**

#### **7.1.4.2 M. Virtual Audio Cable**

1. Go to parameters / Audio in the laptop.
2. Click "Change the device or app volume".
3. Choose in "Choose your output device": "CABLE Input (VB-Audio Virtual Cable)".
4. Put the volume in 100 value.
5. Close the parameters windows.

### 7.1.4.3 N. SoundModem

1. Run SoundModem.
2. Go to Settings/Devices and enter these parameters.

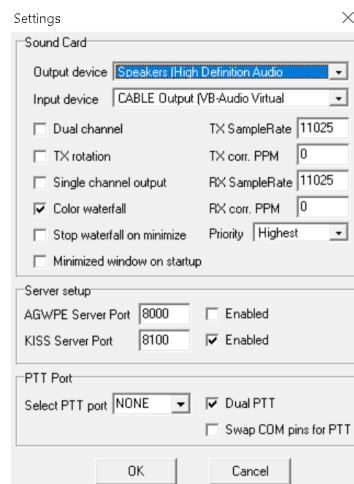
Output device: Speakers

Input device: Cable Output (VB-Audio Virtual

Color waterfall: ON

KISS Server Port: 8100

Enabled: ON



**Figure 7-22 : Screenshot of Settings/Devices (after N.2.).**

3. Go back in the main window and put that configuration.

A: AFSK AX 25 1200 bd 1700



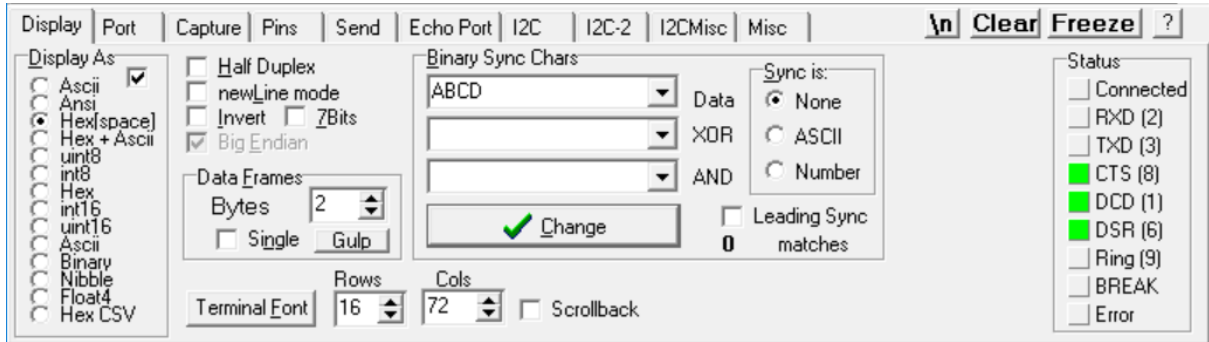
**Figure 7-23 : Screenshot of SoundModem (after N.3.).**



#### 7.1.4.4 O. RealTerm

1. Run RealTerm.
2. Go to display and enter these parameters.

Display As: ON Hex [Space]

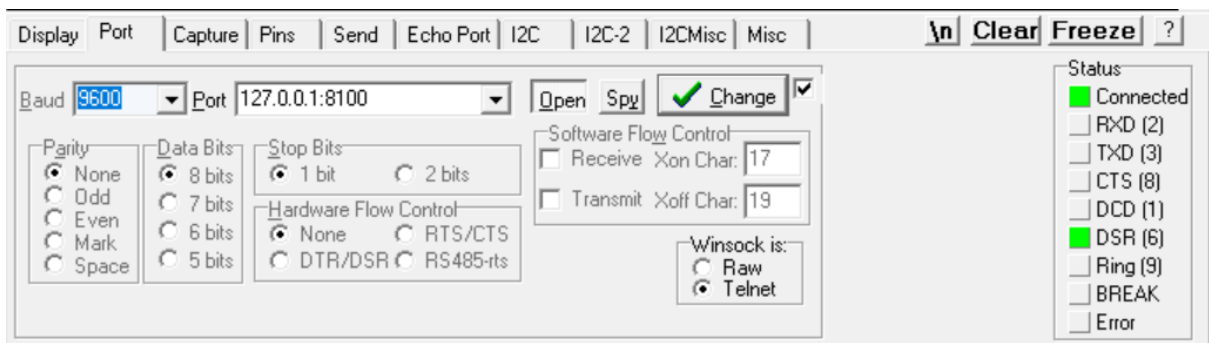


**Figure 7-24 : Screenshot of Display of SoundModem.**

3. Go to Port and enter these parameters.

Baud: 9600

Port: 127.0.0.1:8100



**Figure 7-25 : Screenshot of Port of SoundModem.**

4. Click on the "Open" button twice. You should have green lights in "Connected" and in "DSR(6)" in the right of the window.

IF YOU WANT TO SAVE THE DATA IN A FILE.

5. Go to Capture, choose the file where you want to save the data. (the file has to be already created)
6. Select "Capture as Hex".
7. Click on "Start: Overwrite" button.

## 7.2 DURING THE PASS (RECORD)

### 7.2.1 Use the Software

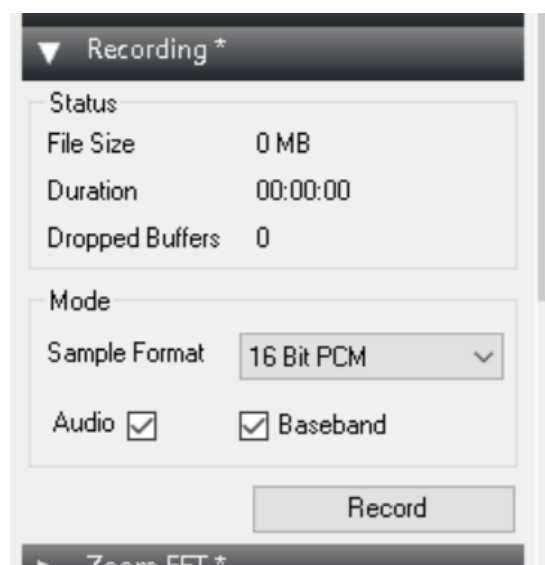
#### 7.2.1.1 P. SDRSharp

1. Check if the frequency is the one you want to record.
2. Go to source and choose "Funcube Dongle Pro +".
3. Click on the start button.
4. Go to the recording. Enter these parameters and click on "Record".

Sample Format: 16 bit PCM

Audio: OFF

Baseband: ON



**Figure 7-26 : Screenshot of Recording of SDRSharp.**

## 7.3 AFTER THE PASS (CLOSE, PACK AND DECODE)

### 7.3.1 Dismount and pack the hardware

#### 7.3.1.1 Q. Finish the record

1. Click on "Stop" in Recording.
2. Click on "Stop" in SDRSharp Menu (Corner in top and left).

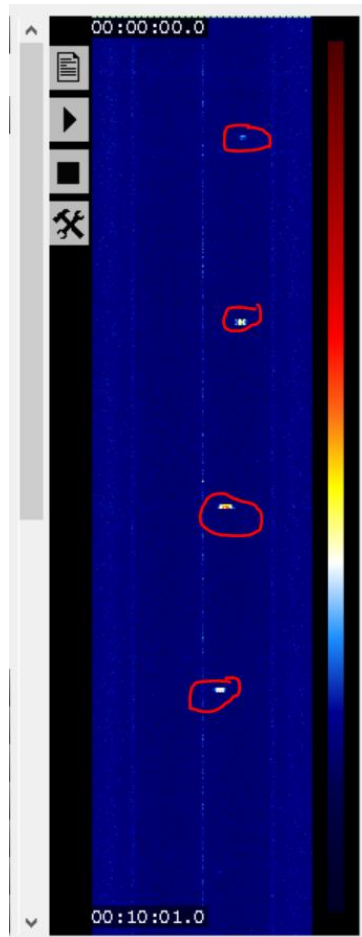
#### 7.3.1.2 S. Pack the hardware

1. Follow the procedure from step I. to G. in the opposite order and do the opposite of the task.

### 7.3.2 Decode the data

#### 7.3.2.1 Create an audio file for a beacon

1. Go to Source and choose "File player"
2. Select the file "SDRSharp\_YYYYMMDD\_HHMMSSZ\_FFFFFFFFHz\_IQ".  
Where YYYY = Year; MM = Month; DD = Day; HH = Hour; MM = Minute; SS = Second;  
F = Frequency, Z is not a variable and Hz (Hertz) for the unit is not variable.  
This the baseband file you recorded.
3. Now in the waterfall in the left of the screen you can see all the beacon you have recorded.



**Figure 7-27 : Screenshot of the waterfall of SDRSharp.**

4. Click before a beacon in the waterfall.
5. Click on the play button, watch the beacon in the FFT and remember where the beacon appears in the FFT. Click on pause.
6. Place the bandwidth where the beacon appears to have all of the beacon in.
7. Click before the beacon in the waterfall.
8. Go to recording and select Audio.
9. Click on the Record button
10. Click on play, watch the beacon appears in the bandwidth wait for 3 seconds, click on pause. (Else do the step T.6. again).
11. Click on the stop button for the recording.

#### **7.3.2.2 U. Find the Audio file**

1. Go to "sdrsharp-x86" folder.
2. Find the file "SDRSharp\_YYYYMMDD\_HHMMSSZ\_FFFFFFFFHz\_AF".  
Where Y = Year; M = Month; D = Day; H = Hour; M = Minute; S = Second and F = Frequency  
This the Audio file you recorded.
3. Play it. You can see now in SoundModem some ASCII data and in RealTerm some Hexadecimal data.

IF YOU SEE NOTHING: The problem can come from a poor SNR.



The Project Presentation: [DEDALOS SAT - Distance Extended Device for Accurate Land ObservationS – Satellite communications extension](#) by Mirko Antonini and Marco Sartori published on April 3<sup>rd</sup>, 2018 in [business.esa.int](#)

The Video: [Using A RTL-SDR To Learn About The GSM Network Around You, Hak5 1621](#) by Hak5 published on July 9<sup>th</sup>, 2014 in [youtube.com](#)

The Article: [DelfiC3 cubesat recording](#) by [PA1EJO](#) published on February 28<sup>th</sup>, 2018 in [wordpress.com](#)

The Video: [Chasing Satellites By Doug Tabor - N6UA](#) by [NCARC](#) published on January 22<sup>nd</sup>, 2018 in [youtube.com](#)

The Video: [How to Pull Images from Satellites in Orbit \(NOAA 15,18,19 and METEOR M2\)](#) by [The Thought Emporium](#) published on March 7<sup>th</sup>, 2017 in [youtube.com](#)

The Article: [Software-Defined Radios](#) by Paul Lutus updated on March 5<sup>th</sup>, 2018 in [arachnoid.com](#)

The Video: [5 Cool Things You Can Do With An RTL SDR Receiver](#) by [Tech Minds](#) published on October 26<sup>th</sup>, 2017 in [youtube.com](#)

The Article: [FOSDEM 2017/2018 SDR Conference Videos: Passive Radar, Radio Telescopes, SatNOGS and Wireless Traffic Lights](#) from by Jean-Michel Friedt, Martin Braun, Manolis Surligas and Bastian Bloessl published on March 7<sup>th</sup>, 2018 in [rtl-sdr.com](#)