



# MarineTraffic

## SDR AIS DECODING USING A CHEAP USB DVB-T STICK

### INTRO:

There is a new trend in the SDR (Software Defined Radio) community which keeps getting more and more popular in the DIY scene.

It is SDR decoding of various signals & protocols (e.g. AIS, ADS-B, METEO-SAT, TETRA) using a cheap DVB-T USB stick (based on the RTL2832U demodulator chip) and software running on a PC. The fact that you can experiment with such an approach and achieve great results for a fraction of the cost of a commercial solution makes it very interesting. The DVB-T sticks cost about \$20 and the relevant software is available for free. However, you will need a relatively fast PC as the decoding operation is CPU intensive.

A list of compatible tuners can be found here:

<http://www.reddit.com/r/RTLSDR/wiki/compatibility>

You can purchase a unit from **Amazon** or (more common) on **eBay**:



R820T BASED



E4000 BASED



## BACKGROUND:

In the 2009 – 2010 period, during the Linux driver development for the RTL2832U based DVB-T tuners, V4L/DVB kernel developers Antti Palosaari & Eric Fry made three very interesting discoveries:

- 1.** The demodulator chip allows for raw I/Q sample transfer to the host which means the PC can handle the decoding by using special software.
- 2.** The chipset allows for direct control of the tuner from the host.
- 3.** The tuning frequencies span in a much wider range than what the DVB-T stick manufacturers claim in their documentation.

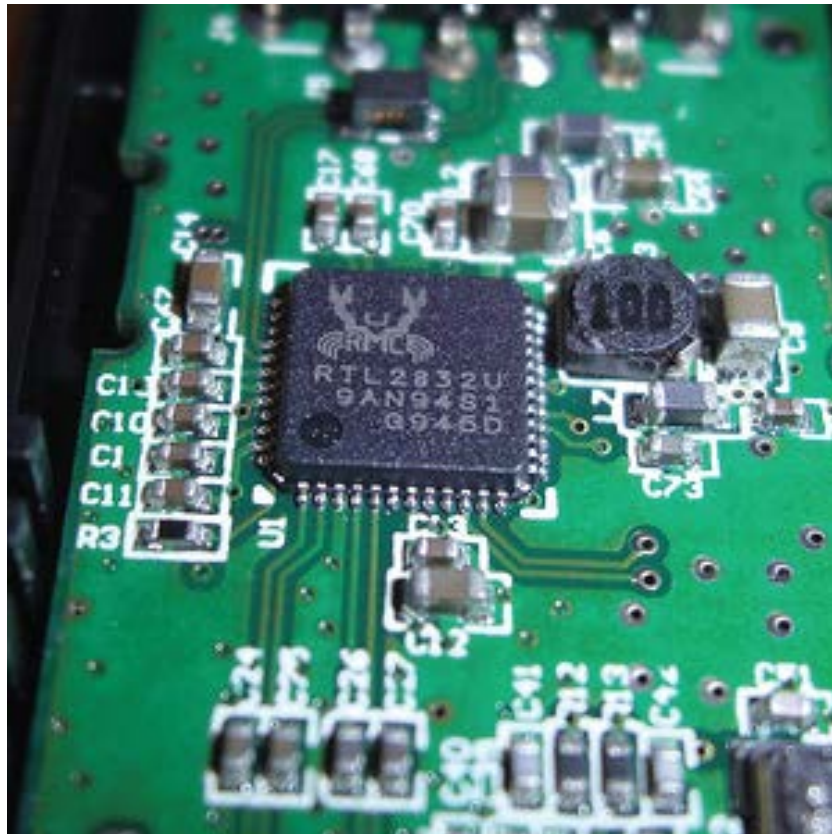
What makes Antti & Eric's feat remarkable is that all of the above features were undocumented!

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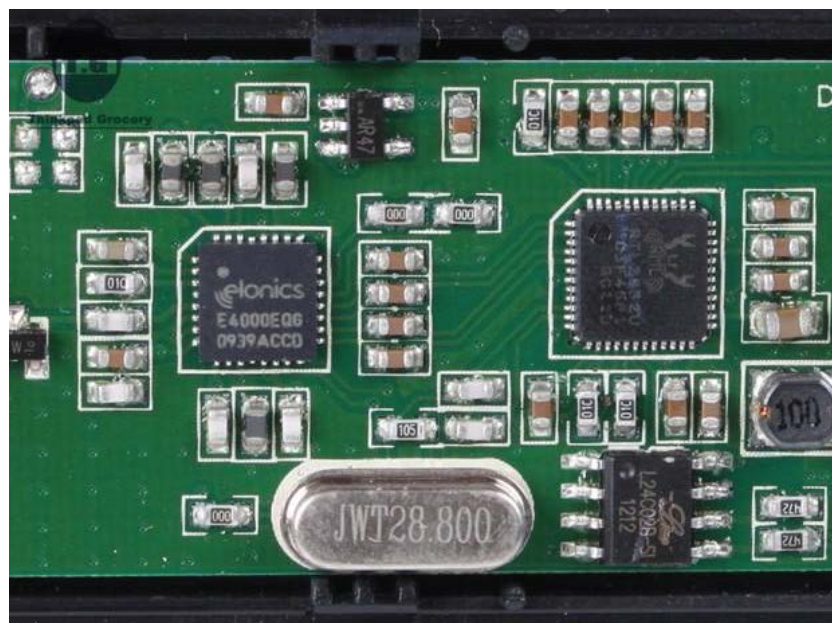
## TUNER TYPES & TUNABLE FREQUENCY RANGES:

The **RTL2832U** chip outputs unsigned **8-bit I/Q** samples and the highest theoretical sample rate is **3.2MSa/sec**. However the highest attainable rate tested so far without losing packets is **2.4MSa/sec**. The frequency range depends on the tuner chip used:

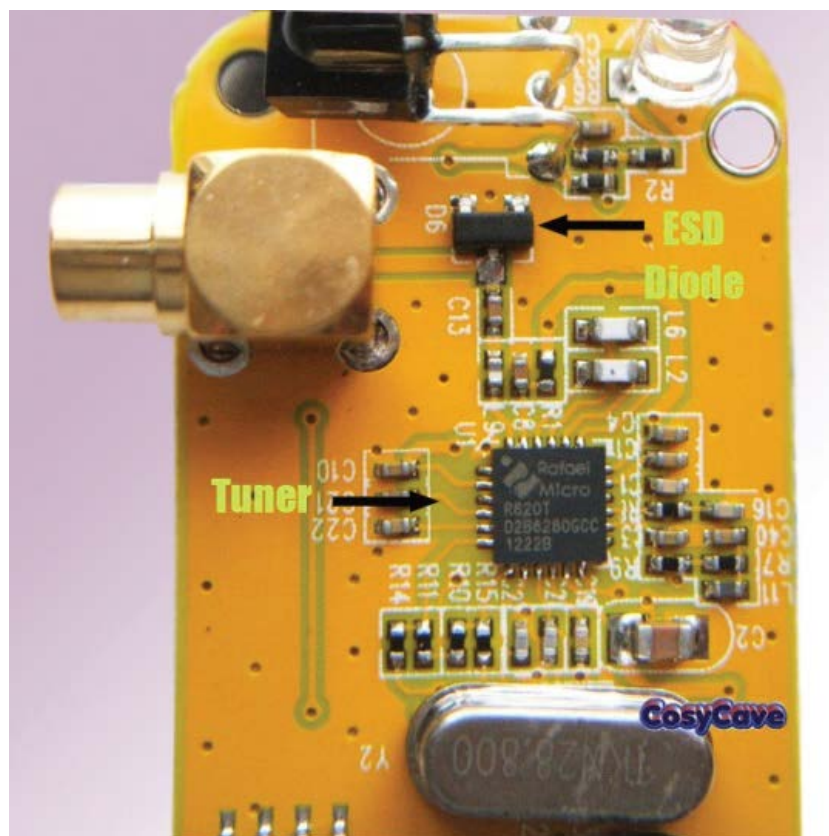
| TUNER               | FREQUENCY RANGE                                       |
|---------------------|---|
| ELONICS E4000 (E4K) | 52 – 2.200 MHz (with a gap between 1.100 – 1.250 MHz) |
| RAFAEL MICRO R820T  | 24 – 1.766 MHz  |
| FITIPOWER FC0013    | 22 – 1.100 MHz  |
| FITIPOWER FC0012    | 22 – 948.6 MHz  |
| FCI FC2580          | 146 – 308 MHz & 438 – 924 MHz                         |



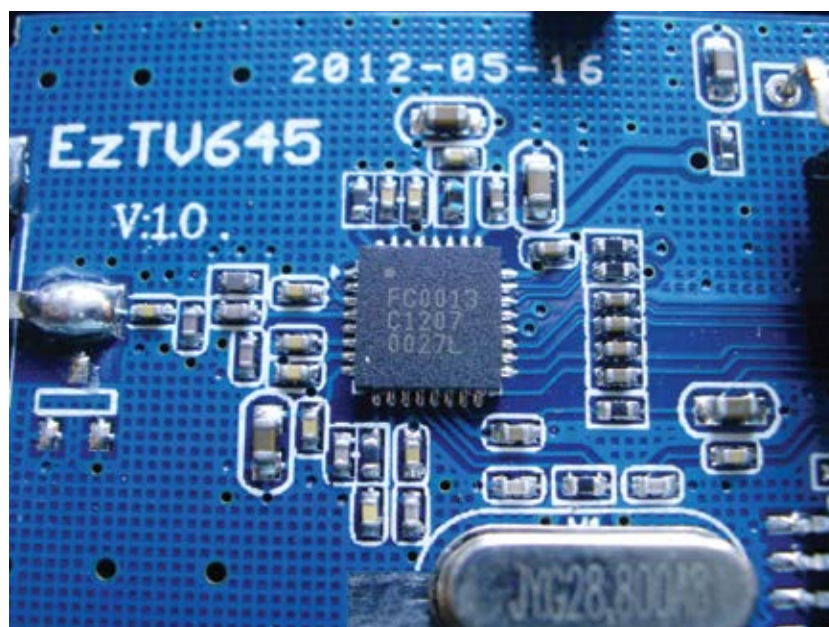
RTL2832U DVB-T COFDM Demodulator + USB 2.0 chip



ELONICS E4000 (E4K) Tuner chip

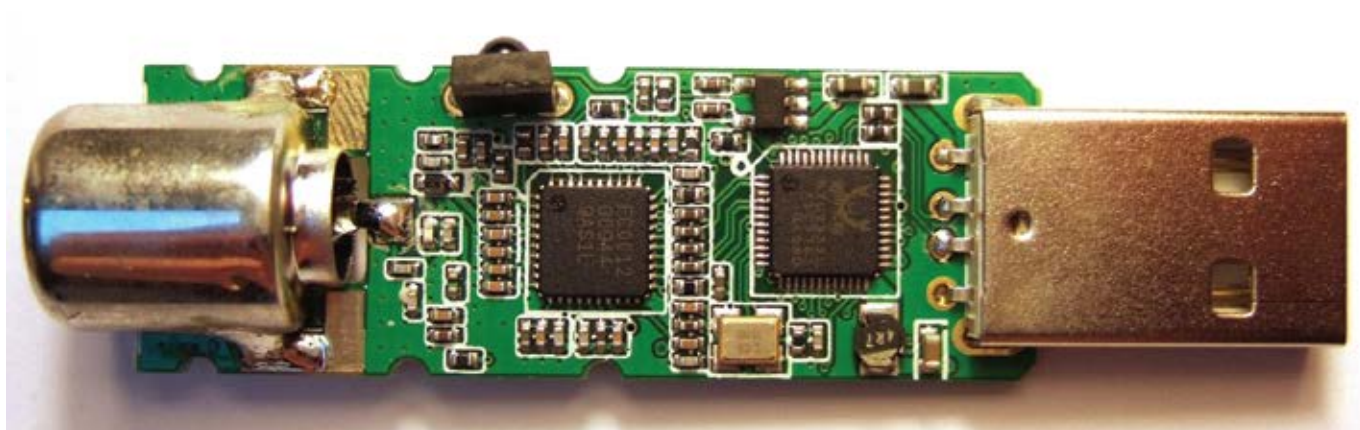


## RAFAEL MICRO R820T Tuner chip



## FITIPower FC0013 Tuner chip





FITIPOWER FC0012 Based board



FCI FC2580 Tuner chip

**For AIS decoding, the tuners have to be tuned to the following frequencies:**

| TUNER               | FREQUENCY RANGE |
|---------------------|-----------------|
| CHANNEL A (VHF 87B) | 161.975 MHz     |
| CHANNEL B (VHF 88B) | 162.025 MHz     |

All of the above-mentioned tuner types are capable of doing so. Thus, they can be used with ease.

## HOW TO INSTALL & SETUP THE REQUIRED SOFTWARE

The approach we are going to take involves firstly installing the special driver for your **RTL2832U based DVB-T stick** (also known as "Zadig" driver) and **NOT** the one that was shipped along with your unit. If you have already installed the latter, please remove it.

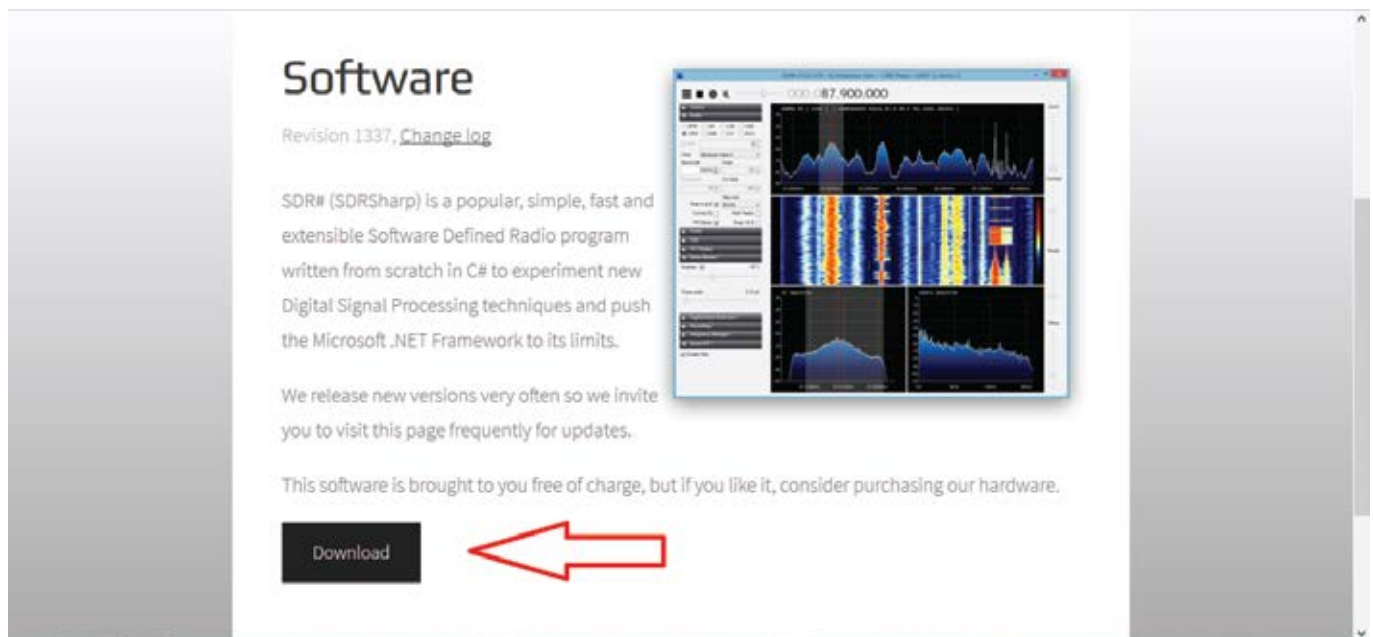
**NOTE:**  
*You will not be able to use your DVB-T stick for TV / FM / DAB tuning while the Zadig drivers are in use.*

Secondly, SDR# (a free application) has to be installed. It will be handling the tuning to the AIS channels and the audio extraction of the raw data packets.

The third step is to install an audio piping program that will be transferring that audio feed from SDR# to the actual AIS decoding application (AISMon or Shipploter).

**Finally, the AIS decoding application itself must be configured to send data to the MT servers. Does it sound complicated? Let's go through the whole procedure step-by-step:**

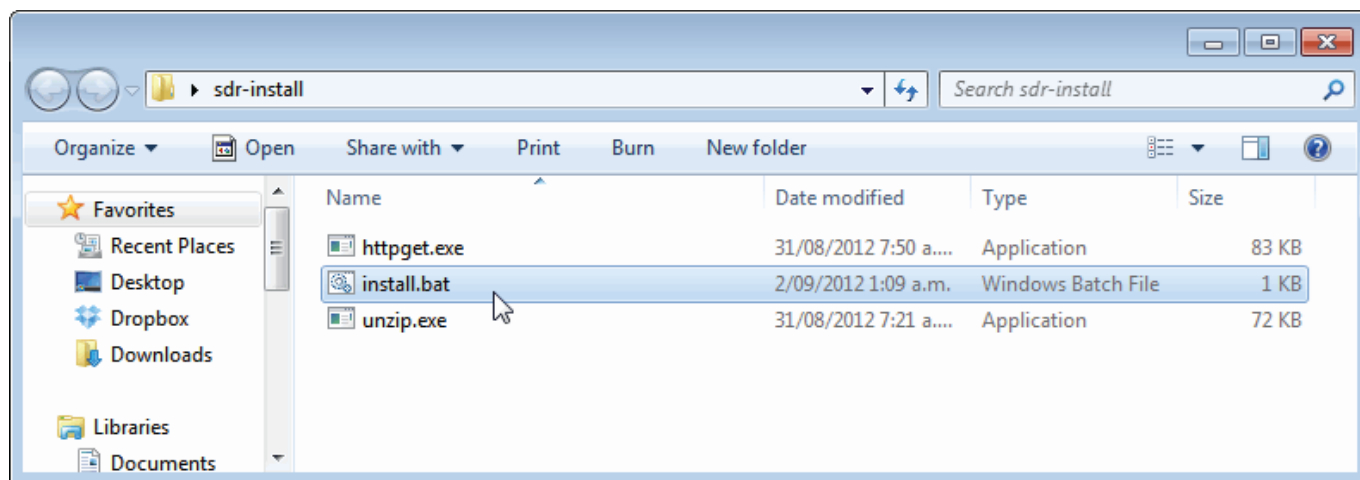
1. Purchase an RTL-SDR compatible DVB-T stick from either retail or eBay.  
We recommend the R820T tuner based ones because their frequency span is wide and are good, all-around performers.
2. Make sure you have .NET Redistributable (3.5 or greater) installed.  
If not, go [here](#) and [here](#) (download & install) or just apply all the latest updates for your Operating System from Windows Update. The method described here has been tested & working on XP / VISTA & 7 (both 32 & 64 bit).
3. Go to the SDR# download page ([here](#)). Download sdr-install.zip as shown below:



4. Extract sdr-install.zip to a folder on your disk.



5. Double click on the **"install.bat"** file from within that folder:



This will start a command prompt that will download the latest build of SDR# and all the required files to make it work with your DVB-T stick. Everything will be placed into a new folder inside the sdr-install folder named **"sdrsharp"**. Upon completion, the command prompt will automatically close. You can now move the **"sdrsharp"** folder to wherever you want.

6. Plug your DVB-T stick into a free USB port of your PC and do not install any of the software that came with it. Let the **"New Hardware Found"** wizard finish (and fail) trying to automatically install the Windows signed driver.



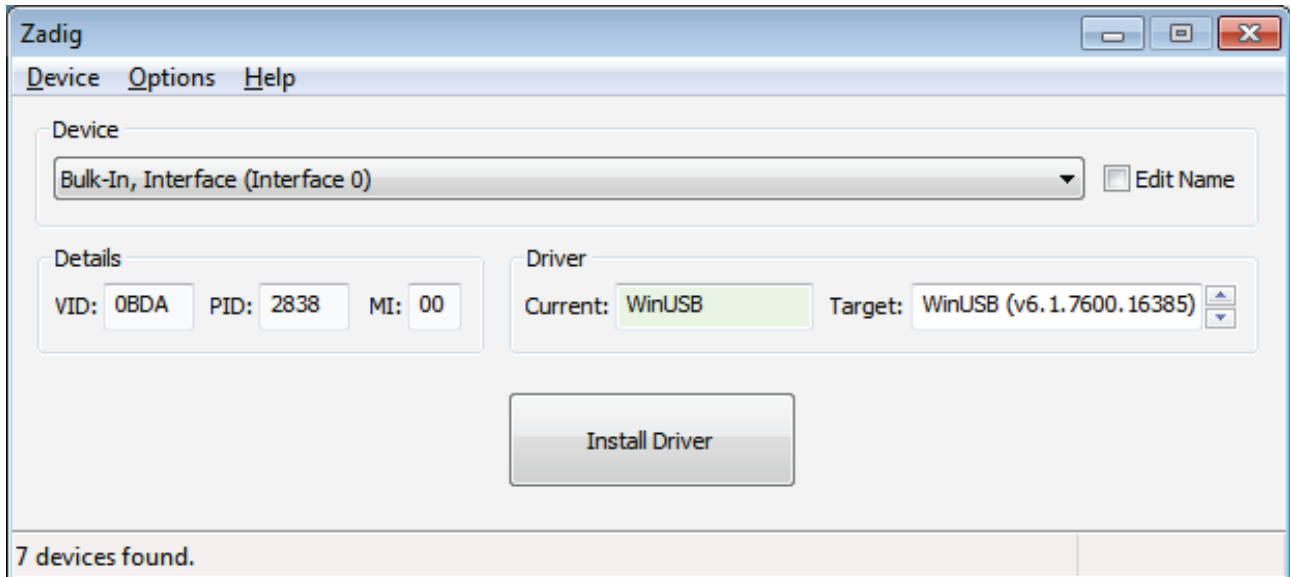
**IMPORTANT**

**IF YOU HAVE ALREADY INSTALLED THE SOFTWARE & DRIVERS THAT WERE SHIPPED WITH YOUR UNIT, UNINSTALL THEM FIRST BEFORE CONTINUING!**

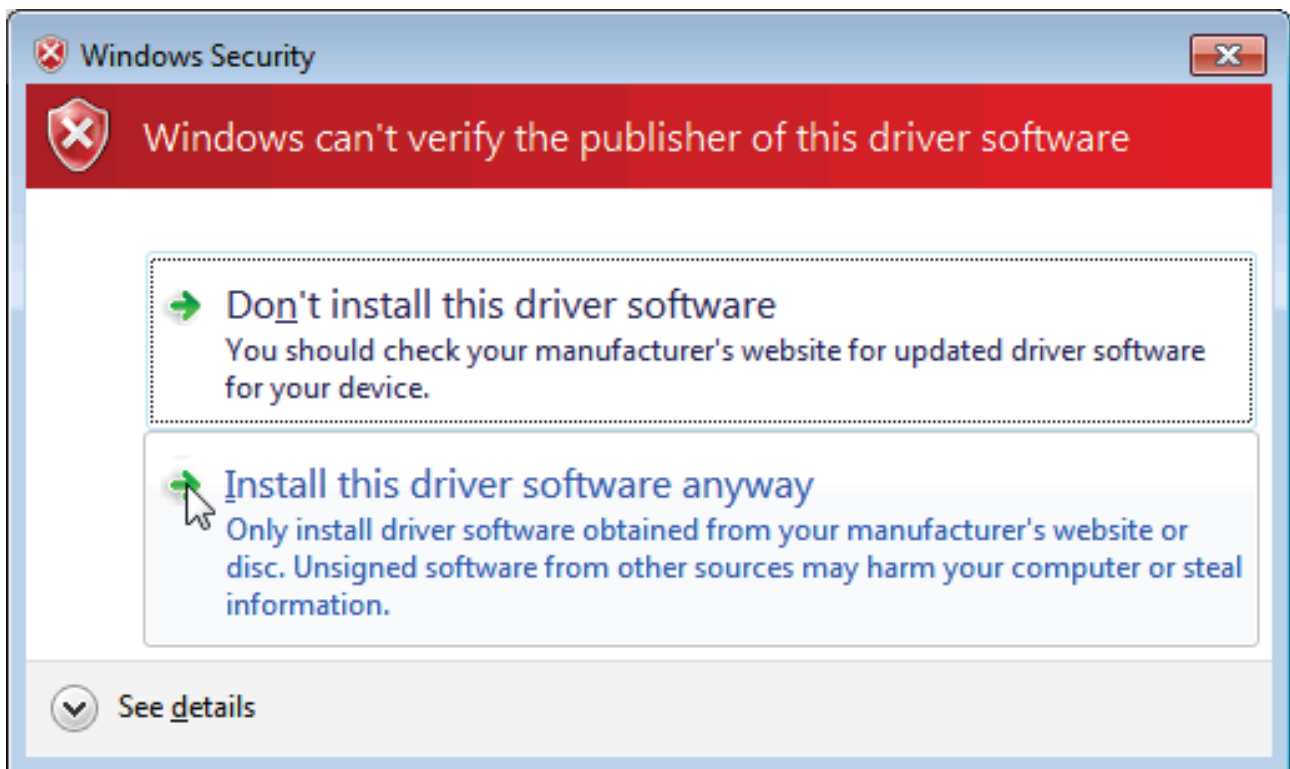
7. Open the **"sdrsharp"** folder. Find the **"zadig.exe"** file, right click on it and select **"Run as Administrator"** if you are using Windows Vista and above. For Windows XP, download the XP version from [here](#).
8. In Zadig GUI go to options > list all devices and make sure it is checked.



9. Select **"Bulk-In, Interface (Interface 0)"** from the drop-down list. In some cases the DVB stick is referred to as **"RTL2832U device"**. Choose that instead. Ensure that **"WinUSB"** is selected in the **"Driver"** box:



10. Click on the **"Install Driver"** button. You might get a warning that the publisher cannot be verified. If you do, just accept it by clicking on the **"Install this driver software anyway"** option:

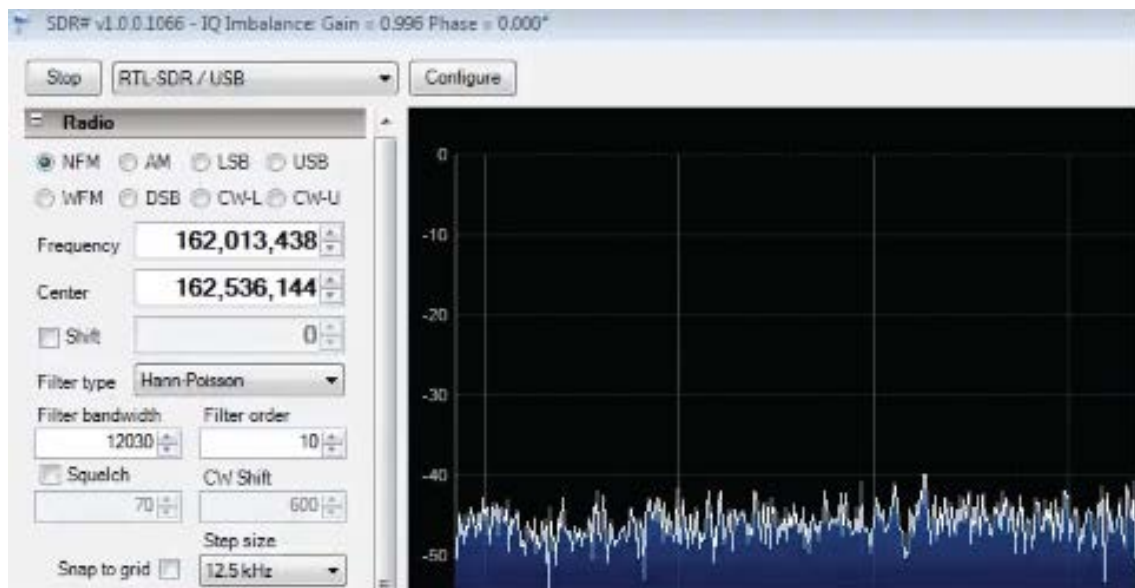
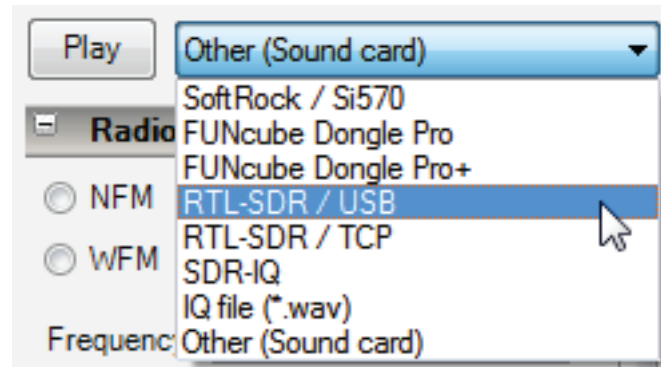






This will install the necessary drivers in order to use the DVB-T stick as an SDR device. **Note** that if you have moved the stick to another USB port or you want to use more than one sticks at the same time, you may need to run the Zadig installer again.

**11.** After the installation has finished, run "**sdrsharp.exe**". Select "**RTLSDR / USB**" from the top of the drop-down list and press the "**Play**" button. If everything has gone smoothly you should be able to start tuning to different frequencies and listen to the audio through your speakers. Also, make sure you have adjusted the gain settings by clicking on the "**Configure**" button up the top:



**IMPORTANT**

**YOU COULD USE THE SMALL VHF ANTENNA SUPPLIED WITH YOUR DVB-T TUNER FOR TESTING PURPOSES. HOWEVER FOR MEANINGFUL AIS RECEPTION & DECODING PERFORMANCE YOU WILL NEED A GOOD QUALITY PURPOSE-BUILT ANTENNA WITH THE PROPER CABLES AND CONNECTORS / ADAPTERS. REFER TO OUR [GUIDELINES HERE](#) .**



**12.** The next step is to install the audio piping application (you can close SDR# for now). We recommend using **"VB\_CABLE"**, a free app that is tested and works well. You can download it from [here](#) :



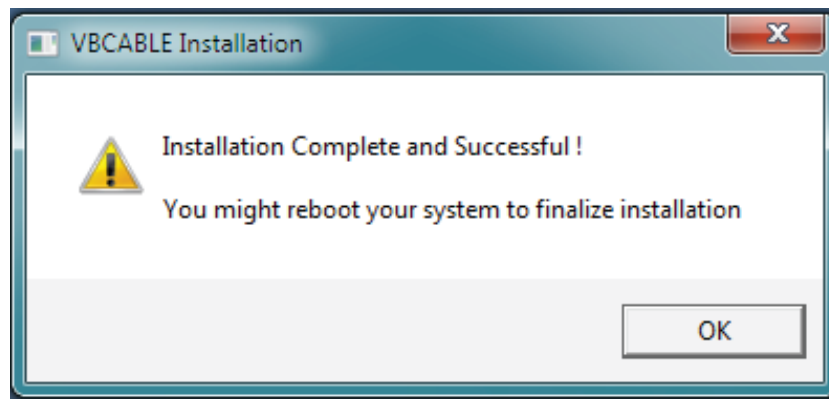
Unzip the file in a folder anywhere on your hard drive and launch the setup program from there (in administrator mode or the installation **WILL** fail!) :

**VBCABLE\_Setup.exe** will install the driver on 32 bit Windows OS (will do nothing on 64 bit).

**VBCABLE\_Setup\_x64.exe** will install the driver on 64 bit Windows OS (will not run on 32 bit).

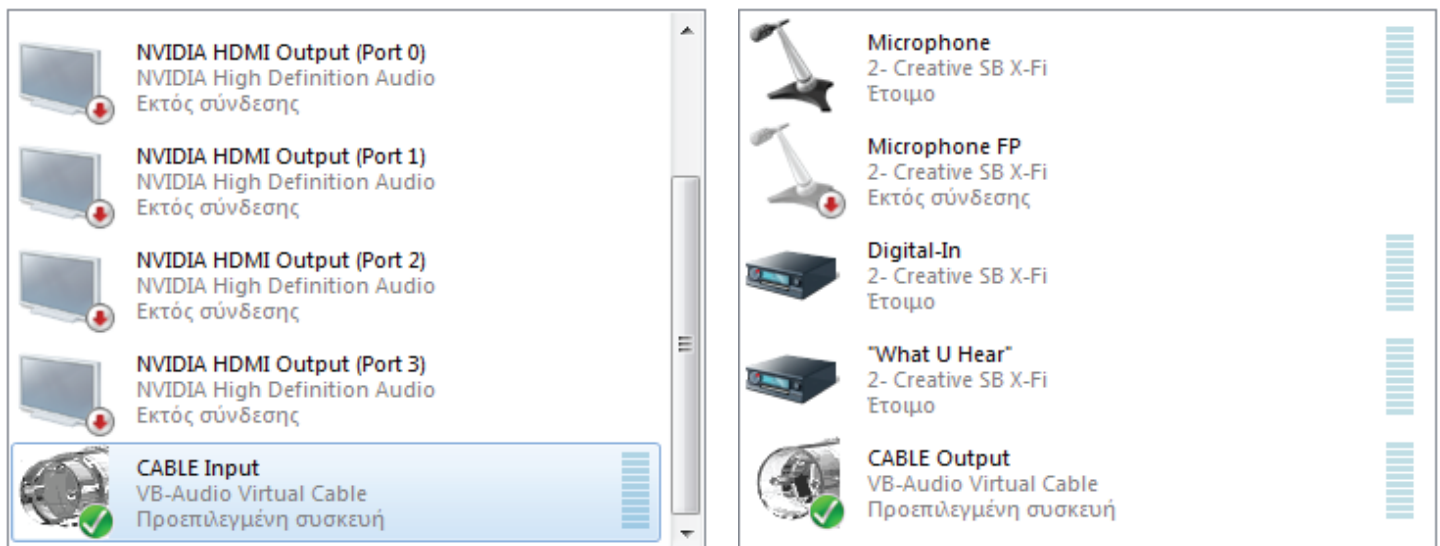
During installation, the setup application can be shown as **"Not Responding"** for a few seconds. That's normal. Just wait and a dialog box will appear notifying you that the installation has finished:



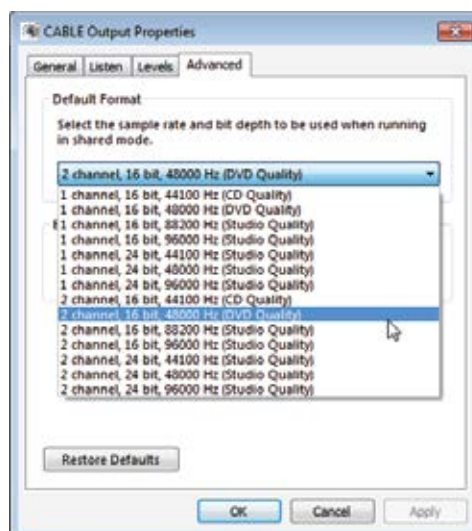


**Reboot your PC for the changes to take effect.**

**13.** You should now have 2 new audio devices in your **"Sound Devices"** panel in Windows. A **"CABLE Input"** in playback tab and a **"CABLE Output"** in recording tab:



Configure both to be your default audio devices. Under the **"Advanced"** tab, set the sampling rate to 48000 Hz:





```
<add key="minOutputSampleRate" value="48000" />
```

```
<?xml version="1.0" encoding="utf-8"?>
<configurations>
  <configSections>
    <section name="FrontendPlugins" type="System.Configuration.NameValueSectionHandler,System, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" />
    <section name="sharpPlugins" type="System.Configuration.NameValueSectionHandler,System, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" />
  </configSections>
  <appSettings file="">
    <clear />
    <add key="fftOffset" value="-40.0" />
    <add key="automaticIQBalancePasses" value="5" />
    <add key="pllPhaseAdjM" value="0.0" />
    <add key="pllPhaseAdjB" value="-1.75" />
    <add key="deemphasizeTime" value="50" />
    <add key="gradient"
value="4A0000,750000,9F0000,C60000,FF0000,FE6D16,FFFF00,1E90FF,000091,000050,000030,000020,000000,000000,000000,000000" />
    <add key="SpectrumAnalyzerGradient" value="FFFFFF,ADDE6,1E90FF,000050,000000" />
    <add key="SpectrumAnalyzerColor" value="FFFFFF" />
    <add key="FillSpectrumAnalyzer" value="yes" />
    <add key="funcubeFrequencyCorrection" value="-21.0" />
    <add key="softrockFrequencyMultiplier" value="4" />
    <add key="RTLBufferLength" value="16384" />
    <add key="minOutputSampleRate" value="48000" />
    <add key="timestampInterval" value="100" />
    <add key="SDRIRQReadBlockCount" value="1" />
    <add key="SDRIQOutFifoBlockCount" value="0" />
    <add key="scanMsPause" value="100" />
    <add key="freqMgrGroupsWindow" value="300,300|100,100" />
    <add key="freqMgrBrowseWindow" value="832,534|136,349" />
    <add key="freqMgrEditWindow" value="480,504|149,345" />
    <add key="freqMgrBrowseLiveTrack" value="False" />
    <add key="freqMgrBrowseColumnsConfig"
value="AAEAAGG//////////AQAAAAAQAIAAAA5TRfJTaGFycC5GcmVxTWdyLCBwZXJzaw9uPTEuMC40NzIOLjYyMDQ2LDBbdwx0dXJlPW5ldXRYWwIFB1YmtpY0t1evrVaZVuPW5lbGEWAQAAAI0BU31zdGVtLKnbvBgXIY3Rpbn25zkdlbmlyamVudTg1dzdxZWl0dXJlLnRlcGltaGRvcy5GcmVxTWdyLCBwZXJzaw9uPTEuMC40NzIOLjYyMDQ2LDBbdwx0dXJlPNb24RM5dWUjg3mjQMjWINDYsIEINIBHRlcmU9bmVlOHJhbHcwUHVVibGls25V5VG9rZW49bnVsbfIdAwAAAAZFaxR1bXMFIX3NpemUIX3Z1cnNpb24EAAAAUORSU2hhcnAuRn1jc1Unc15Db2xzbnBmeZWl0CAAAACAgJAwwABUAIAAAAYAAAAABAIAAAQAIAAAAEAFNEUlNoYXJwclkZyZXFZN3tuQ29sSW5mbWIwIAAAAJBAAAAAAFAAAAQYAAAAJBwAAAAAkIAAAACQKAAAAJCgAAAKLAAAAACQwAAAAJDQAAAAKOAIAAACQ8AAAAJEAAAAAAAAKRAAAACRTAAAAJEwAAAAKUAAAAARUAAAAJFGAAAAAXAAACRGAAAAANCUEAAAAAGFNEUlnOYXJwclkZyZXFZN3tuQ29sSW5mbWIwMAAAAVPE5hbWU+aa19rfomja21uz0zpZwnkfjkxbmrleD5rx19CYWNrawSnrmllbgQWPFPdpZHROpmTFx0JhyZtpbmdGawVsZAEEAAAGTagAAAAYZAAAAAklAAAAAQAAAAABBQAAAAQAAAAAGggAAAAIGcmVxdWVuy3KBAAAAAZAAAAEGAABAAAAAAYAAAAABKNlbnRlcGIABBBAAAAAQCAAAAEAAABHMAAAALRGVyY3phCRpb24DAAAALAEAAEIATAAAABAAAAAYdaAAABElVZGUAAAAZAAAAAEAAAAABAAAAAYAAAAACFByb3RvY29sBQAAAGQAAAAACgAAAAAQAAGhwAAAlDYwxsIFNP24GA AAAAZAAAAELAAAAABAAAAAYAAAAAB1ncnpy2UhAAAAAZAAAAEMAAAAABAAAAAYAAAAAbkdby3VwcxcwAAABkAAAAAQ0AAAAEAAAABJIAAAAANq4AAAAQAAAAFAFU2hpZnQKAAAAZTA3AAAAEPAAAAABAAAAAYKAAAAAC0ZpbHRlcglBuexblCwAAAGQAAAABEAAAAQAAAAAGJQAAAABBGAWw0ZXlgqmFuZHpdpZHRODAAAAAGQAAAAEBEQAAAAQAAAAAGJgAAAAAGawX0ZlXiGT3
```

Save your changes and close Notepad.

**14.** Run SDR# and select **"CABLE Input"** in the audio output drop-down list.

Tune to one of the AIS frequencies (161.975 MHz or 162.025 MHz). In SDR# the signals may not appear exactly in the dialed-in values, since the RTL-SDR method is not extremely accurate due to the quality of the hardware used (cheap DVB-T sticks are inferior to purpose-built receiver systems).

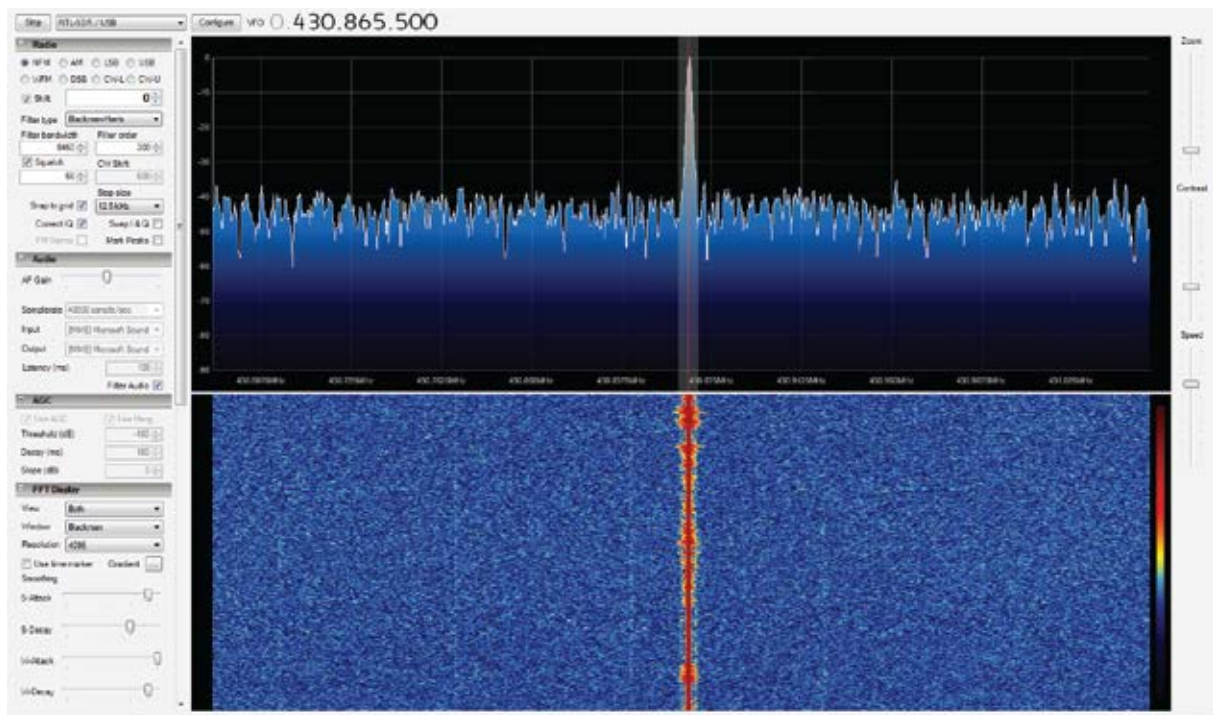
You need to choose one of the AIS frequencies and tune in to it - try the one with the less interference and stronger signal in your area. Play with the RF gain (press the **"Configure"** gear button to access it) until you get good and clear packet reception.

Try to adjust it in such a way that the signal is strong but the noise floor is low:

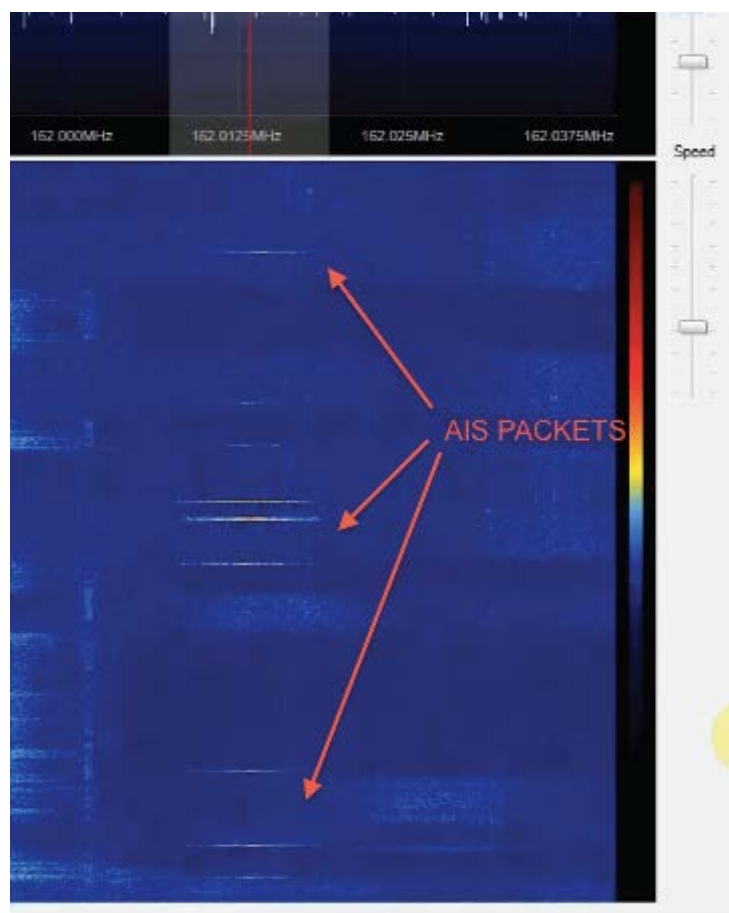




MarineTraffic



SDR# Main Program Window



Tune & Waterfall view of AIS packets



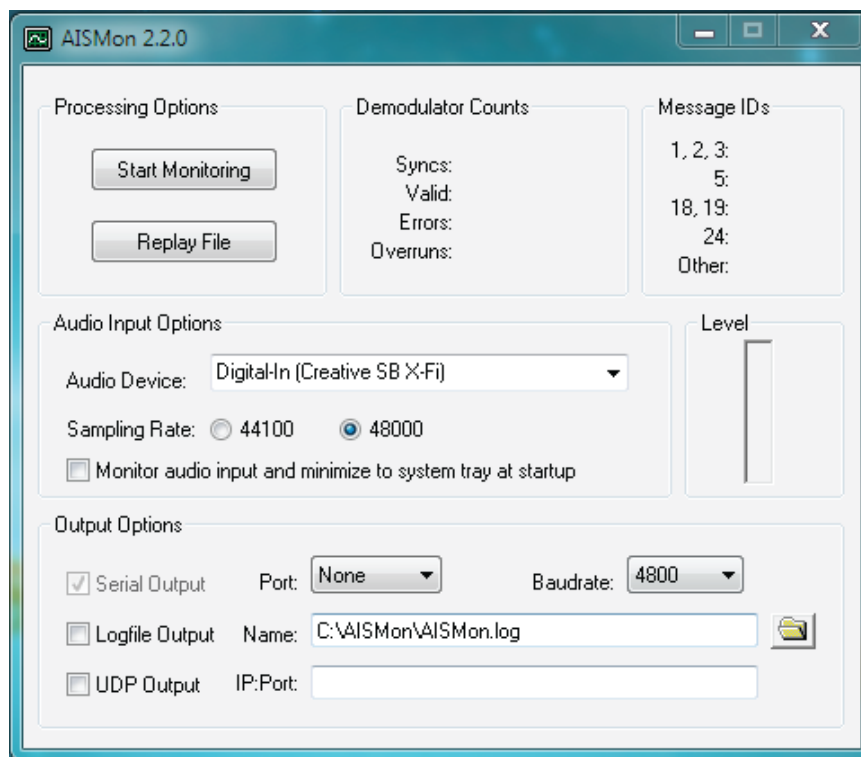
Set the receive mode to **"NFM"**, bandwidth to **"12.5 KHz"** (or "25 KHz" since some AIS broadcasts use a larger bandwidth signal), filter order to **"10"**, filter audio to **"OFF"** and squelch to **"OFF"**.

**15.** Now that you have properly set-up the AIS reception, the next (and final) task is to configure the actual AIS decoding software to accept, decode and forward the AIS data to MarineTraffic. As mentioned before, there are two alternatives to choose from: AISMon & Shipploter. The first one is free and allows for data forwarding only, while the second one isn't (it offers a 21 day trial period though) but it allows for local contact plotting and has some other nice features. Since the scope of the guide is to keep the implementation cost of SDR AIS decoding to a minimum, it makes sense to focus on AISMon. The procedure, however, is not that different for both programs and is almost identical to our existing setup guides found [here](#) and [here](#) with the sole exception of the audio source input selected.

## SEND DECODED AIS DATA TO MT USING AISMON:

- First of all download **AISMon** from [here](#).
- Save the file on your Desktop. When the download has finished, double click on the installer file. Allow for elevated rights if asked.
- When the installation has finished run the **"AISMon"** application by double clicking on the icon created on your Desktop.

The program window will be displayed:

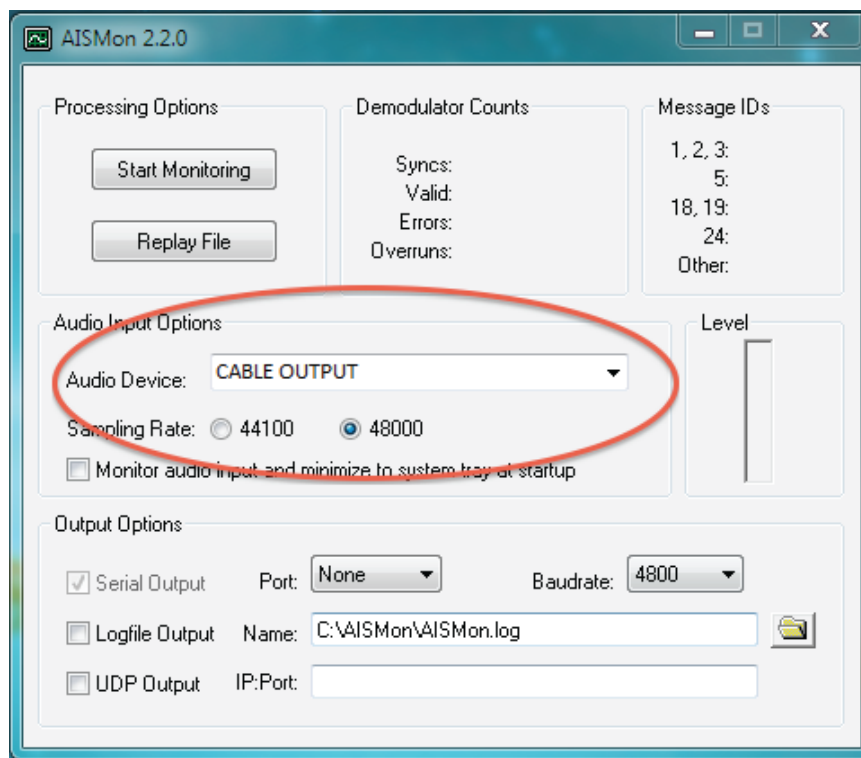




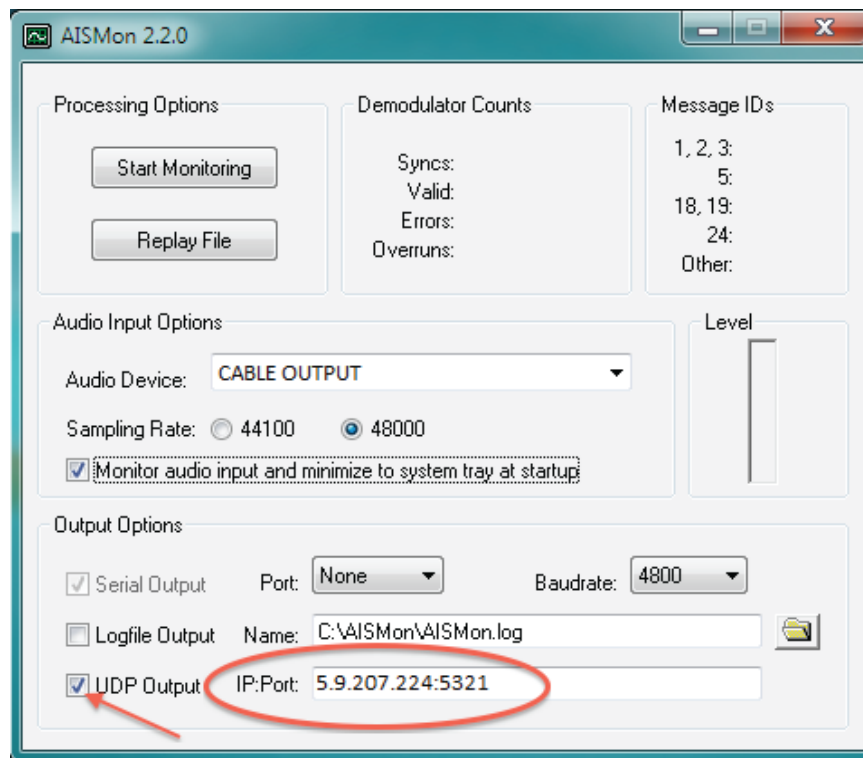
## IMPORTANT

If you haven't done this already, please visit the MarineTraffic website (<http://www.marinetraffic.com>) and register yourself by creating a New Account. Upon registration, sign-in to your account (top right corner) and click on My Account > My Stations > Add Receiving Station to add your Station to the MarineTraffic Network. This way, you will get a new Station ID and a unique Port Number to send your data to.

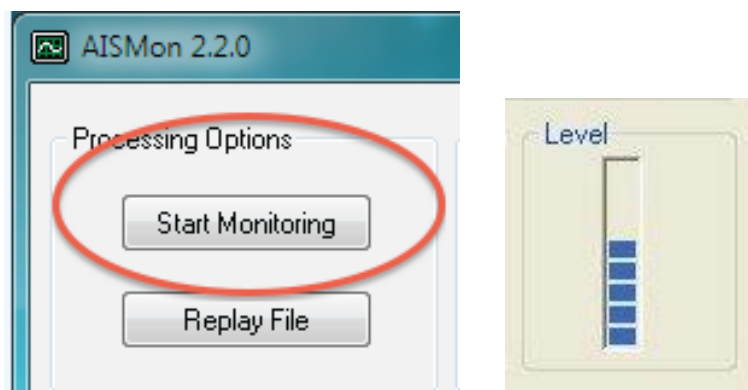
- Make sure you select the correct audio input in the **"Audio Device"** menu. You should select **"CABLE Output"** and also select 48000Hz as your sampling rate:



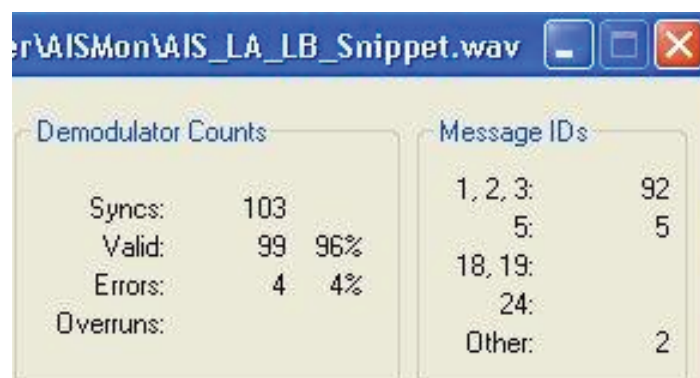
- Tick the **"UDP Output"** checkbox and enter MarineTraffic homepage's IP and your unique port number separated by a colon as shown below:



- Click the **"Start Monitoring"** button to allow AIS data packets to flow from SDR# to the **"dummy"** audio input port. Make sure your audio levels are preferably in the middle for optimal operation.




- You should now see data packets being received and decoded:







- Finally visit your station's statistics page and make sure your station status is **"ONLINE"** (it may take a few minutes for that to happen):

| Current Status & Statistics          |  |
|--------------------------------------|--|
| Status                               | ONLINE  |
| Availability                         | 100% (2159 hours online / 2161 total hours)  |
| Reception distance in nautical miles | Average: 9.2 / Max: 32.9   |
| Records received in 1 hour           | Distinct Vessels: 219 / Positions: 1962  |
| Area Covered                         | 3321 km <sup>2</sup>   |

**That's it!**

**You are now sharing your data with us.**

We sincerely appreciate your contribution to our site and your help to expand our services and coverage.

