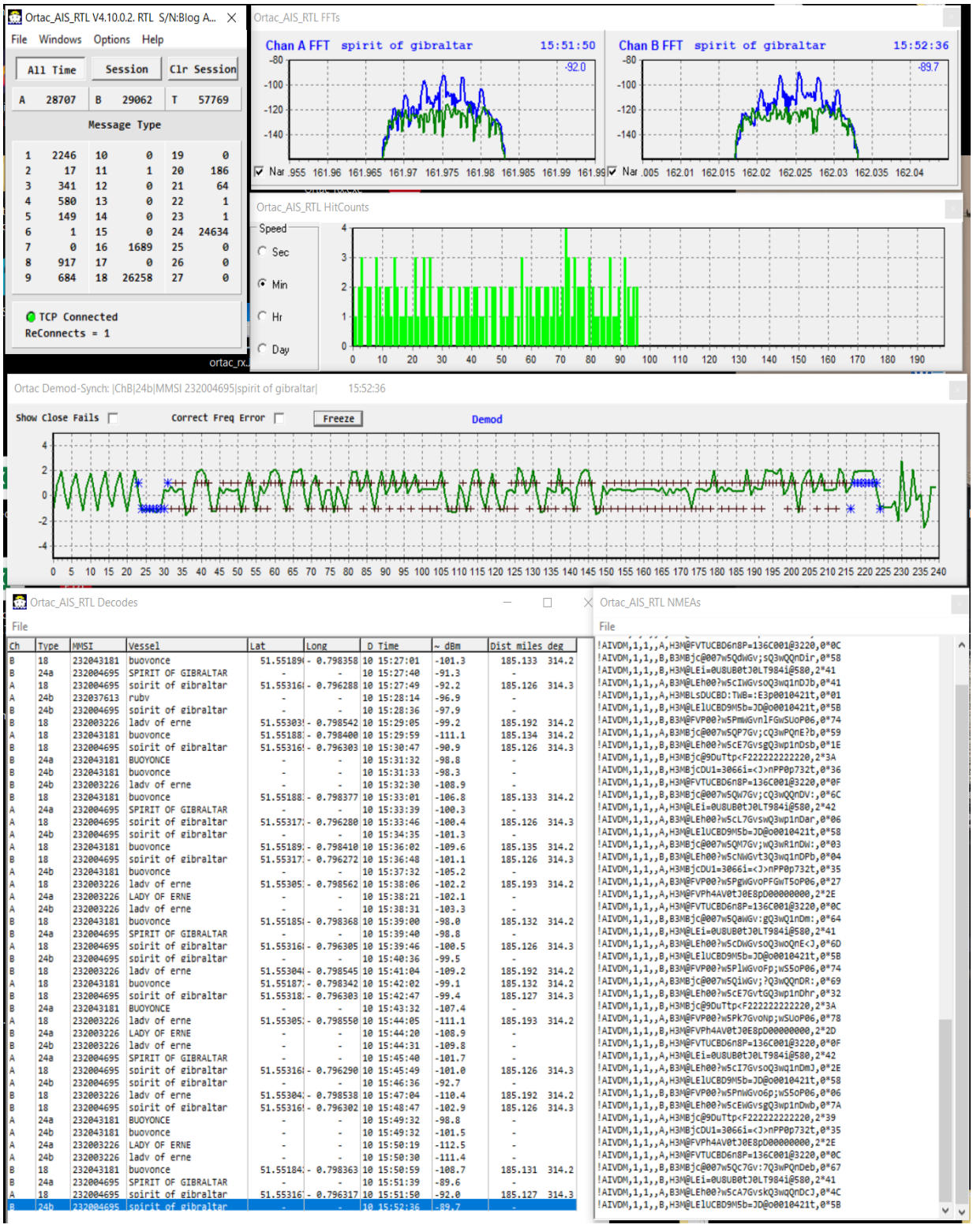


Ortac _AIS Manual

A 32 bit Windows AIS receiver-decoder

RFBits.com

Issue 1.2 November 27th 2022

CONTENTS

4.0 INTRODUCTION ORTAC_AIS_SPLAY ISSUE 5.1

Ortac_AIS is an advanced dual channel AIS DSP receiver and message decoder. It is capable of decoding up to 25 messages per second simultaneously on channels A and B.

There are three versions of the programme, each tailored for a family of radios SDRPlay, AirSpy or RTL-SDR.

Various intermediate workings of the receiver can be examined by opening the sub windows (forms).

This software is intended for educational and personal use only. The Ortac software must not be relied on for navigational purposes; or any other purpose that might have causal life threatening consequences that may be dependent on the failure or error of this software (Ortac_AIS).

In order to receive AIS signals it is recommended that some form of external antenna is used:- eg a Discone or ½ vertical wave dipole cut for 162MHz.

The outputs of the Ortac receiver are NMEA sentences that can be streamed via UDP and/or TCP to local mapping programs or externally to sites such as www.marinetraffic.com.

RFBits does not guarantee the validity of any data exported.

The software decodes both short and long messages. Vessel names are collected from class B Type 24 and class A Type 5 messages and stored in a text file 'Vessels.csv'.

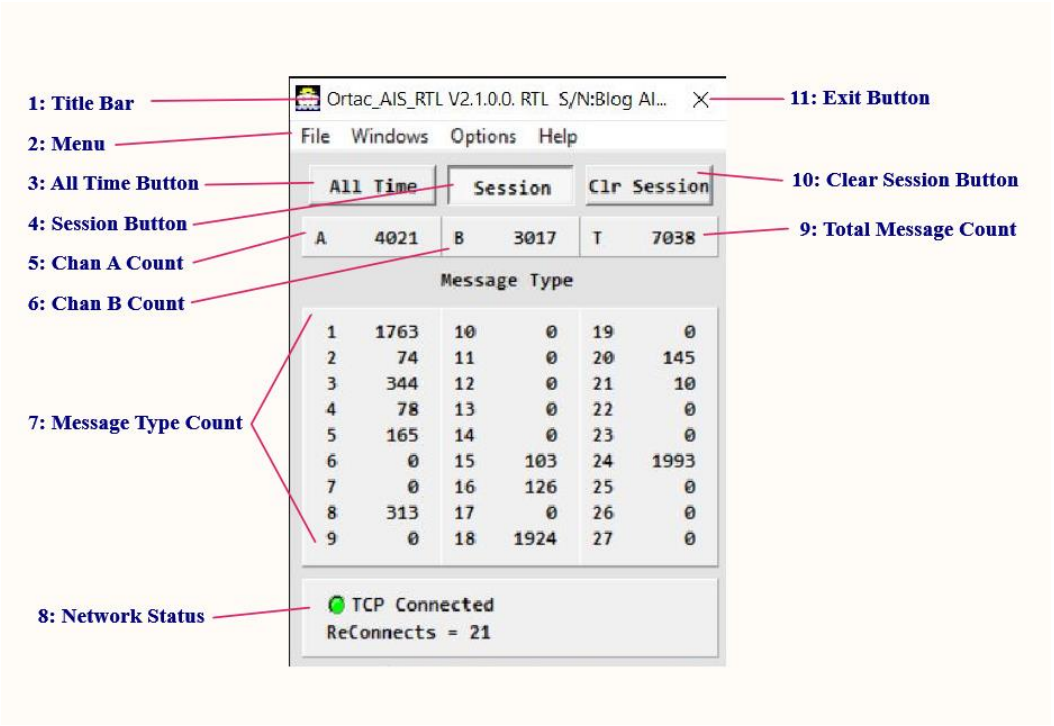
The Decodes window shows a log of decodes, displaying MMSI, vessel names, position and time stamp. If the Lat-Long of the receive station is added under the 'Distance Calc' option, then the distance and bearing can be displayed. A right click menu allows the position to be shown on Google Maps, looked up on marine Traffic or added to AIS filters.

Important note.

Issue (5.1) of the software has a kill date of 1st Feb 2023, please contact the Author at "RFBits.com@gmail.com" if you need this extended. There should however be a new version available at RFBits.com before that date.

2.0 MAIN RECEIVER FORM (RXFORM).

On starting the programme if a radio is detected the main form of the programme is shown. The main receiver form is designed to present a compact display of the decode progress. All settings and options are controlled from this form's menu.



The following paragraphs explain the functions of the numbered items.

2.1 **Title Bar**

Displays programme name and version number, with S/N of Rx.

2.2 **Menu.**

The are many settings and options under the four sub menus, they are detailed in the next section 3.0.

2.3 **All Time Button.**

Depress this button to show 'all time' counts, that is the sum of all session counts since the programme was installed.

2.4 **Session Button.**

If this button is depressed then the counts shown are for this run session only.

2.5 **Chan A Count.**

Number of messages received on channel A.

2.6 **Chan B Count**

Number of messages received on channel B.

2.7 **Message Type Count.**

Number of messages per message type 1..27, (ChA + ChB).

2.8 **Network Status.**

Shows status of the TCP network link and the number of reconnects that have occurred this session.

2.9 **Total Message Count.**

Total number of messages received (ChA + ChB).

2.10 **Clear Session Button.**

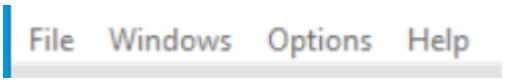
Zeroes the counts for this session only.

2.11 **Exit Button.**

Closes the programme, to prevent accidental closures the operation is queried.

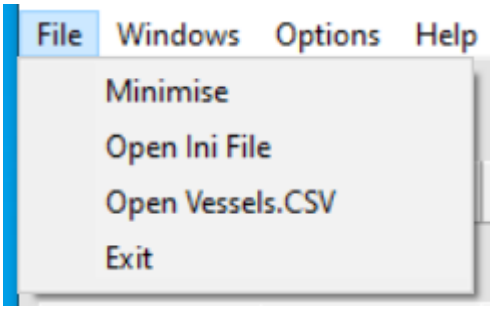
3.0 MENUS

There are four top level menus.



3.1 File Menu

Programme control and file functions.



3.1.1 Minimise.

This sends the programme and all of its sub-windows to the task bar.

3.1.2 Open Ini File.

This will open the programmes ini file in the default text editor. The ini file holds settings of the windows positions, radio settings, message counts etc.

3.1.3 Open Vessels.CSV

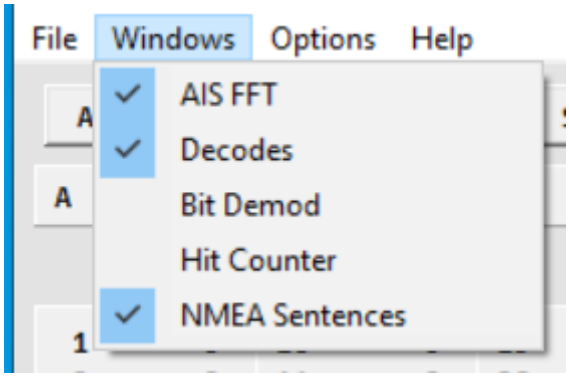
Opens the 'vessels.csv' file, which the programme uses to store captured MSSIs, vessel names and date time when first seen.

3.1.4 Exit.

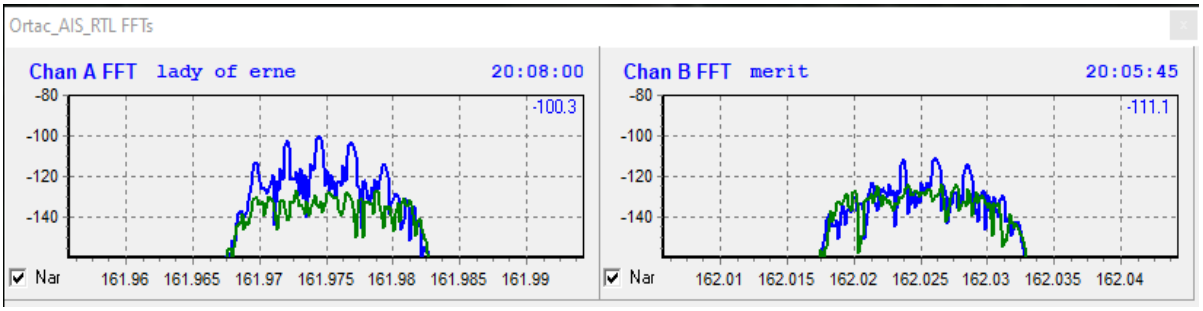
Close the programme always without query.

3.2 Windows / Forms Menu.

This menu opens the sub-forms or windows. The visibility and position of the sub-forms are remembered between runs.



3.2.1 AIS FFT



The AIS FFT window shows a dual FFT for the two AIS channels.

The green traces are real time, the blue traces show an FFT captured during the last valid decode.

Note the captured FFT is taken over the initial synch period of the AIS message. During this period the AIS signal has simple repetitive GMSK modulation which produces an FFT with relatively few sidebands. This allows the centre carrier frequency to be clearly seen and an estimate of the carrier frequency and power to be taken. The peak dBm power of the captured FFT is displayed in upper right-hand side of the graphs.

If the vessel name of the MMSI has been captured then the vessel name is displayed otherwise the MMSI is shown. If the vessel name is in capitals, then it was received in that AIS message, otherwise it was recalled from the vessels.csv history. Time of the capture is shown top right.

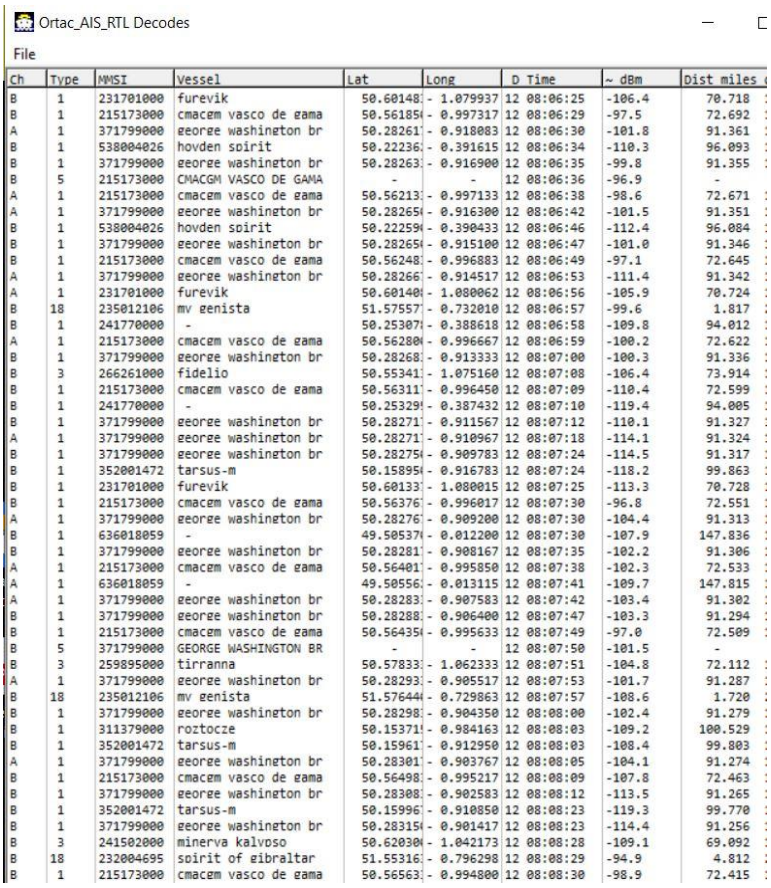
The 'Nar' check boxes in the left-hand corner of the graphs, will change the receiver bandwidth from $\pm$7.5kHz default to $\pm$5kHz. The narrower bandwidth may help reduce interference and will slightly increase the sensitivity, but might result in loss of decodes from off frequency stations.

The bandwidth setting is remembered between sessions.

3.2.2 **Decodes.**

The decodes window consists of a table showing the most recent decodes.

The MMSI is decoded for all 27 message types. If the message type also contains Vessel name or positional data this is also shown.

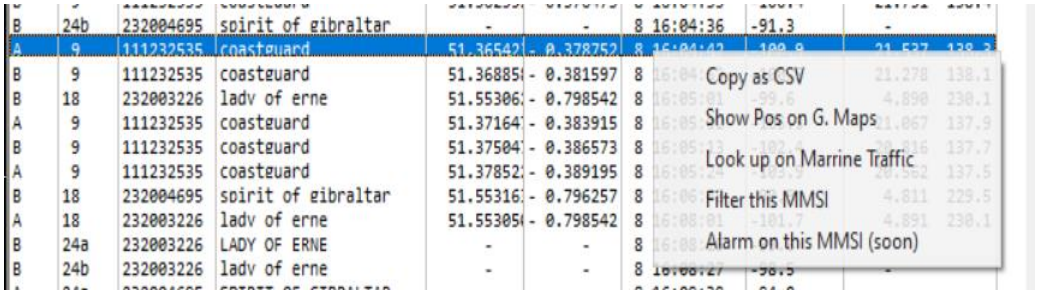


Ch	Type	MMSI	Vessel	Lat	Long	D Time	~ dBm	Dist miles
B	1	231701000	furevik	50.60148	- 1.079937	12 08:06:25	-106.4	70.718
B	1	215173000	cmacem vasco de gama	50.56185	- 0.997317	12 08:06:29	-97.5	72.692
A	1	371799000	george washington br	50.28261	- 0.918083	12 08:06:30	-101.8	91.361
B	1	538004026	hovden spirit	50.22236	- 0.391615	12 08:06:34	-110.3	96.093
B	1	371799000	george washington br	50.28263	- 0.916900	12 08:06:35	-99.8	91.355
B	5	215173000	CMACGM VASCO DE GAMA	-	-	12 08:06:36	-96.9	-
A	1	215173000	cmacem vasco de gama	50.56213	- 0.997133	12 08:06:38	-98.6	72.671
A	1	371799000	george washington br	50.28265	- 0.916300	12 08:06:42	-101.5	91.351
B	1	538004026	hovden spirit	50.22259	- 0.390433	12 08:06:46	-112.4	96.084
B	1	371799000	george washington br	50.28265	- 0.915100	12 08:06:47	-101.0	91.346
B	1	215173000	cmacem vasco de gama	50.56248	- 0.996883	12 08:06:49	-97.1	72.645
A	1	371799000	george washington br	50.28266	- 0.914517	12 08:06:53	-111.4	91.342
A	1	231701000	furevik	50.60140	- 1.080062	12 08:06:56	-105.9	70.724
B	18	235012106	mv genista	51.57557	- 0.732010	12 08:06:57	-99.6	1.817
B	1	241770000	-	50.25307	- 0.388618	12 08:06:58	-109.8	94.012
A	1	215173000	cmacem vasco de gama	50.56280	- 0.996667	12 08:06:59	-100.2	72.622
B	1	371799000	george washington br	50.28268	- 0.913333	12 08:07:00	-100.3	91.336
B	3	266261000	fidelio	50.55341	- 1.075160	12 08:07:08	-106.4	73.914
B	1	215173000	cmacem vasco de gama	50.56311	- 0.996450	12 08:07:09	-110.4	72.599
B	1	241770000	-	50.25329	- 0.387432	12 08:07:10	-119.4	94.005
B	1	371799000	george washington br	50.28271	- 0.911567	12 08:07:12	-110.1	91.327
A	1	371799000	george washington br	50.28271	- 0.910967	12 08:07:18	-114.1	91.324
B	1	371799000	george washington br	50.28275	- 0.909783	12 08:07:24	-114.5	91.317
B	1	352001472	tarsus-m	50.15895	- 0.916783	12 08:07:24	-118.2	99.863
B	1	231701000	furevik	50.60133	- 1.080015	12 08:07:25	-113.3	70.728
B	1	215173000	cmacem vasco de gama	50.56376	- 0.996017	12 08:07:30	-96.8	72.551
A	1	371799000	george washington br	50.28276	- 0.909200	12 08:07:30	-104.4	91.313
B	1	636018059	-	49.50537	- 0.012200	12 08:07:30	-107.9	147.836
B	1	371799000	george washington br	50.28281	- 0.908167	12 08:07:35	-102.2	91.306
A	1	215173000	cmacem vasco de gama	50.56401	- 0.995850	12 08:07:38	-102.3	72.533
A	1	636018059	-	49.50556	- 0.013115	12 08:07:41	-109.7	147.815
A	1	371799000	george washington br	50.28283	- 0.907583	12 08:07:42	-103.4	91.302
B	1	371799000	george washington br	50.28288	- 0.906400	12 08:07:47	-103.3	91.294
B	1	215173000	cmacem vasco de gama	50.56435	- 0.995633	12 08:07:49	-97.0	72.509
B	5	371799000	GEORGE WASHINGTON BR	-	-	12 08:07:50	-101.5	-
B	3	259895000	tirranna	50.57833	- 1.062333	12 08:07:51	-104.8	72.112
A	1	371799000	george washington br	50.28293	- 0.905517	12 08:07:53	-101.7	91.287
B	18	235012106	mv genista	51.57644	- 0.729863	12 08:07:57	-108.6	1.720
B	1	371799000	george washington br	50.28298	- 0.904350	12 08:08:00	-102.4	91.279
B	1	311379000	roztocze	50.15371	- 0.984163	12 08:08:03	-109.2	100.529
B	1	352001472	tarsus-m	50.15961	- 0.912950	12 08:08:03	-108.4	99.803
A	1	371799000	george washington br	50.28301	- 0.903767	12 08:08:05	-104.1	91.274
B	1	215173000	cmacem vasco de gama	50.56498	- 0.995217	12 08:08:09	-107.8	72.463
B	1	371799000	george washington br	50.28308	- 0.902583	12 08:08:12	-113.5	91.265
B	1	352001472	tarsus-m	50.15996	- 0.910850	12 08:08:23	-119.3	99.770
B	1	371799000	george washington br	50.28315	- 0.901417	12 08:08:23	-114.4	91.256
B	3	241502000	minerva kalvoso	50.62030	- 1.042173	12 08:08:28	-109.1	69.092
B	18	232004695	spirit of gibraltar	51.55316	- 0.796298	12 08:08:29	-94.9	4.812
B	1	215173000	cmacem vasco de gama	50.56563	- 0.994800	12 08:08:30	-98.9	72.415

Explanation of the Column titles

Ch	A or B, where the message was captured.
Type	1..27, note type 24 has two formats a and b.
MMSI	All messages have a nine-digit MMSI, this is the vessels ID and is unique.
Vessel	If included in this message will be shown in capitals, if previously captured then it is shown in small case, if not yet know is left blank.
Lat	Decoded Latitude position within the message, blank if no position in message.
Long	Decoded Longitude position within the message, blank if no position in message.
D Time	Day of the month and time stamp of the message, (time is from PC not message).
~ dBm	Measured signal strength of the message.
Dist deg	If the receiving station has its position setup in the options menu and the message has positional data, then the distance and bearing (0..360) to the vessel is calculated.

If you select an entry in the table, then right click the mouse the following pop-up menu appears:-



The functions of this pop-up menu are as follows :-

3.2.2.1 Copy as CSV

Copies to the windows paste buffer the details of this table entry eg:-

```
A, 9,111232535,coastguard          ,  51.365423,- 0.378752, 8 16:04:42,-100.9,   21.537  128.3,
```

3.2.2.2 Show Pos on G. Maps

Opens default web-browser directed at Google Maps and will place a dropped pin at the reported Lat-Long position.

3.2.2.3 Look up on Marine Traffic

Open the default web-browser with an MMSI search for the highlighted record.

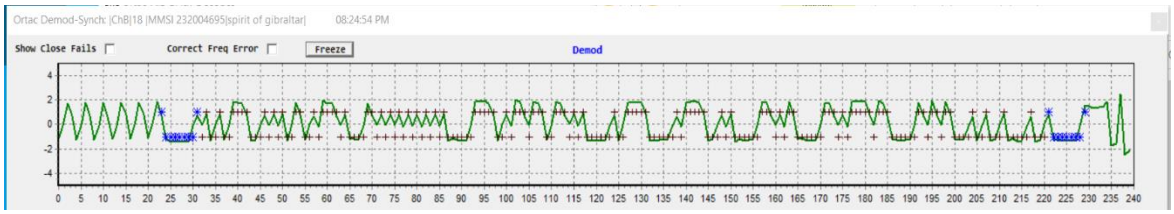
3.2.2.4 Filter this MMSI

Opens the Ortac_AIS filter settings window with an initial entry for selected MMSI. See para 3.3.1.4.

3.2.2.5 Alarm on this MMSI

Not implemented at this time!

3.2.3 **Bit Demod**

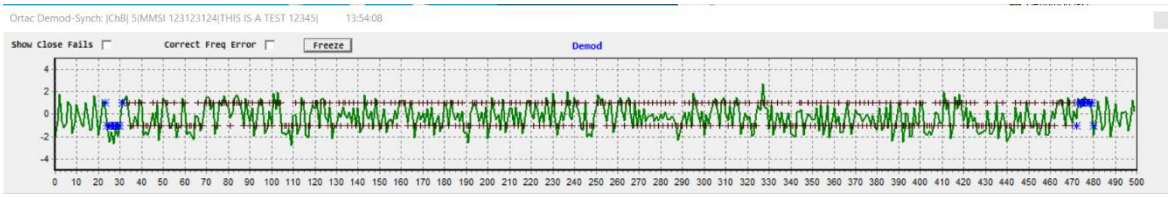


The Bit Demod window shows the output of the digital FM discriminator during the last valid decode.

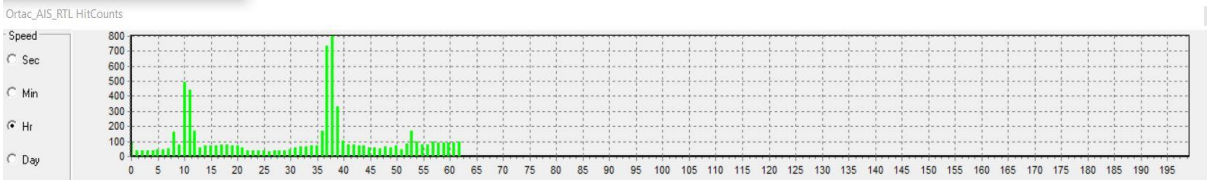
The left axis is kHz from centre frequency, the bottom axis shows sample point.

The blue '*'s show the start and stop flags, whilst the black '+'s show the bit decisions.

The above figure shows a short message, the x axis changes scale to show a long message, as shown below :-



3.2.4 **Hit Counter**



The hit counter shows the history of decodes. The vertical scale auto adjusts, the horizontal scale can be seconds, minutes, hours or days.

This count record is not carried over between sessions.

3.2.5 NMEA Sentences

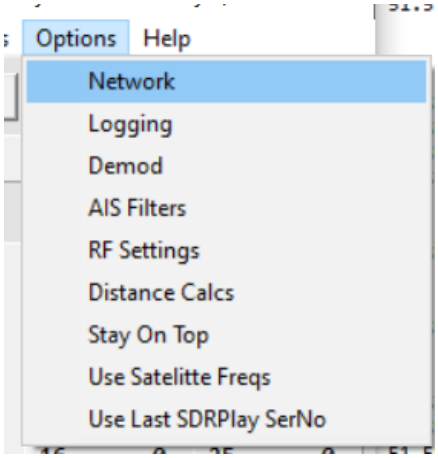
This form shows the NMEA sentences that have been generated for the AIS messages received.

The NMEA sentences contain the exact bit information of each message capture, formatted in a simple ASCII string, together with a checksum. (Note long messages can result in multiple sentences). This is the format normally exported by an AIS receiver.

Ortac_AIS can export this data via UDP and TCP, see under Options/Network, see para 3.3.1.1.

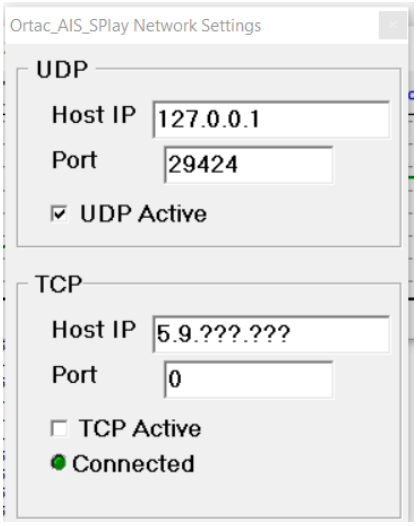
If requested a serial port option could be added.

3.3 Options Menu



3.3.1.1 Network.

Ortac_AIS offer UDP and TCP network output of the NMEA sentences.



UDP is usually used for local transport, in the above example the host IP set to 127.0.0.1, which is the local host alias IP for the host machine, this will allow communication to any programme running on the same PC. In this case it is being used to post data to 'OpenCPN' which plots positions of the received vessels.

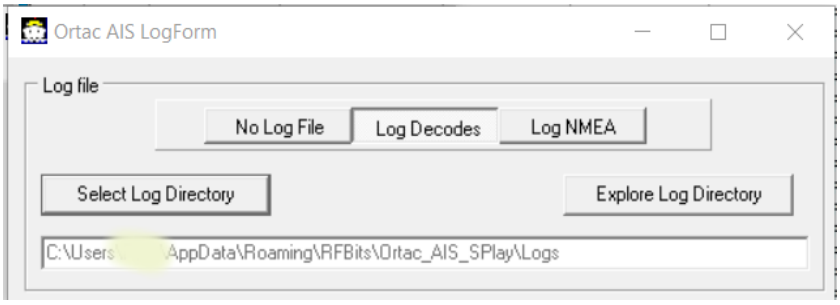
There is no handshaking with UDP, the data is always output, no errors are reported if it does not reach the destination.

TCP is more reliable, there is handshaking and if the connection is not made Ortac_AIS will not light the green LED. It will however keep trying to connect/re-connect every 10 seconds. TCP is suited to connected to remote stations such as 'MarineTraffic' via the internet.

UDP and TCP can operate simultaneously, the settings are store in the ini file and will be remembered next session.

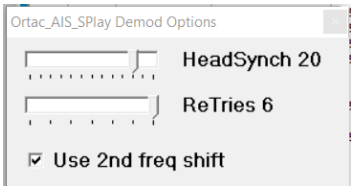
3.3.1.2 Logging

Ortac_AIS can keep a complete log of decodes or AIS sentences, the default is no log file.



If selected a new log file is created at midnight each day and stored in the selected directory. Note these files could grow to a very large size. The 'Explore Log Directory' button will open windows explorer in the logging directory, this can be used to view or delete the log files.

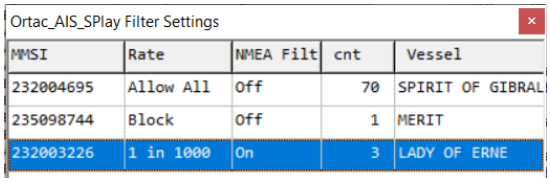
3.3.1.3 Demod



These options partially control the intensity of the decoder efforts.

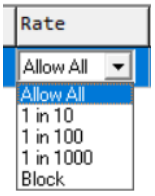
3.3.1.4 AIS filters

The idea of the 'AIS filters' form is to reduce the quantity of decodes from local shore stations that are constantly received.



MMSIs are added to this form by a right mouse click in the decode form.

Once added you can add a filter to reduce the reports from this station. Double clicking the rate entry will open a drop-down menu, with filter rate options. NMEA outputs and logging are also affected by this filter.



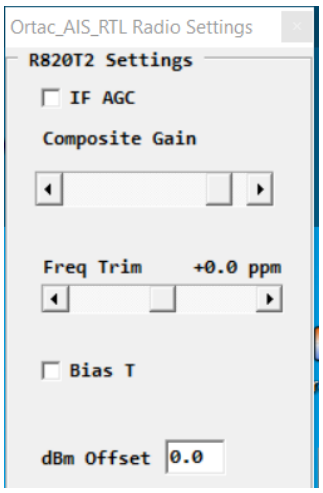
The filter can also be switched on or off by double clicking the 'NMEA Filt' entry. Double click the MMSI to delete the whole entry.

The form also displays the unfiltered count of the MMSI. These filter settings are stored in the ini file and are remembered between sessions.

3.3.1.5 RF Settings

This will open the form that controls the setting of the radio hardware. The RF Settings form is tailored for the connected radio.

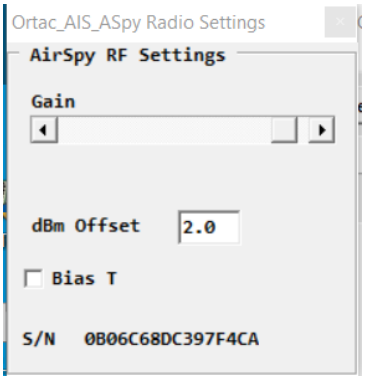
RTL-SDR



'IF AGC' is implemented within the RTL2832u, for AIS reception this should be turned off, as it is not fast enough for AIS signals.

The 'Composite Gain', adjusts the RF, mixer and IF gains within the R820T2. The gain steps are ~10dB and are compensated for in the dBm reports. Generally, unless you are seeing exceptionally strong signals, leave this setting 1 step down from max gain. This position has minimal effect on the noise figure.

AirSpy



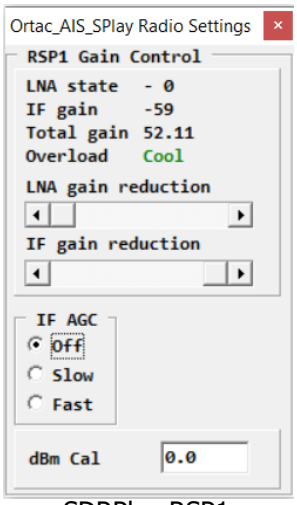
The AirSpy also uses the R820T2 receiver, but it is controlled via the AirSpy DLL.

SDRPlay RSPs.

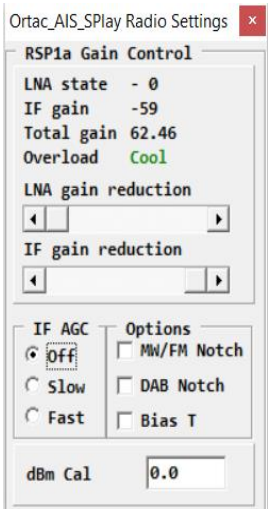
Ortac_AIS_Splay will auto detect which RSP is connected and if there is more than one found, will offer a choice of which radio to use.

SDRPlay uses 'gain reduction' to set the gain of the LNA RF amp and the IF gain. The less gain reduction the higher the gain. The current gain and overload state are reported back from the SDRPlay API and displayed here, the reported gain is used to calculate the reported dBms.

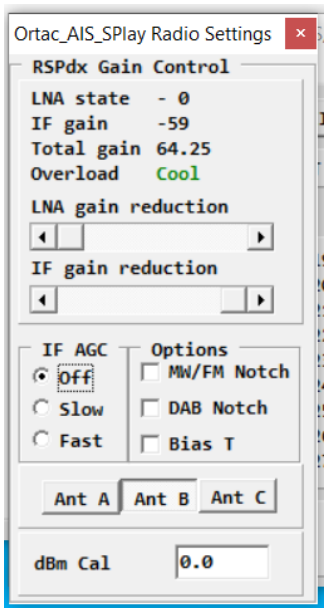
Generally, I have found that unless there are very strong local transmissions, AIS reception is best with the LNA gain reduction set to minimum, (max gain), to achieve the best noise figure. The IF AGC should be turned off and the IF gain reduction set to max, this does not seem to reduce the noise figure and ensures that the ADC is not overloaded. If you still see an overload warning, then the LNA gain reduction should be increased one step.



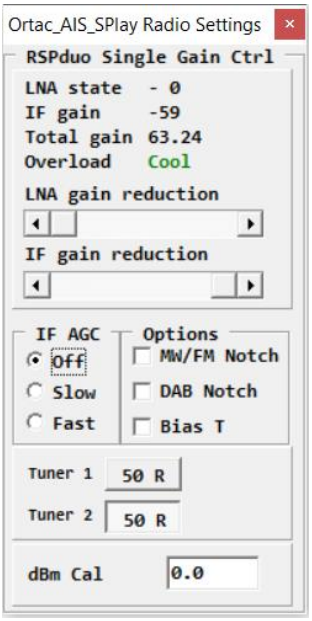
SDRPlay RSP1



SDRPlay RSP1a



SDRPlay RSPdx



SDRPlay RSPDuo

Bias T

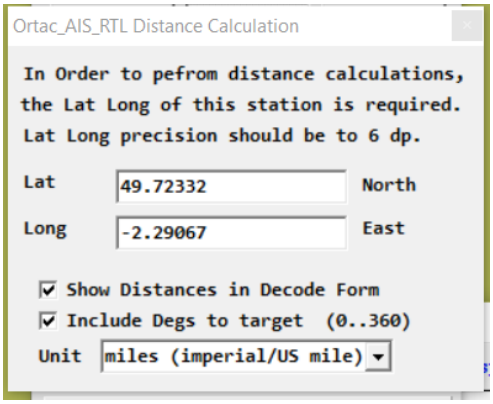
If the radio supports it, there is a Bias T checkbox. This will enable the ~5V output on the RF connector of the radio. This is designed to power a pre-amp via the coax. It is important that before enabling this option, the user should check that any antenna connected does not present a DC short. This can damage the radio, even those that protection.

dBm Cal

This only affects the reported dBm by the programme. If you have a calibrated signal generator you can adjust this number to correct the dBm reported in the AIS_FFT form.

3.3.2 Distance Calcs

Entering your stations position into this form allows Orat_AIS to calculate the distance and bearing to the received vessel positions.



The calculated distances and bearings are displayed in the decodes window, it does not alter the AIS sentences.

3.3.3 Stay On Top

Setting this option force the main form to stay on top of other windows.

3.3.4 Use Satellite Frequencies

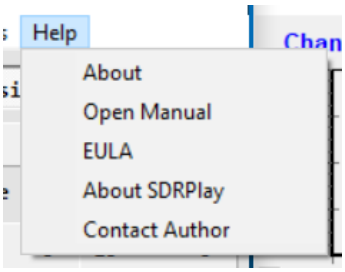
There are two additional AIS frequencies intended for satellite reception. These are channels C 156.775MHz and channel D 156.825MHz. If this option is checked then Ortac AIS will use these frequencies as shown in the AIS_FFT.

(This setting is not presently remembered).

3.3.5 Use Last SDRPlay SerNo. (SDRPlay only)

Check this option to force Ortac_AIS_SPlay to start up using the current SDRPlay radio, this will avoid the radio selection form if multiple SDRPlays radios are available.

3.3.6 **Help Menu**



3.3.6.1 About Ortac_Rx

This displays a brief note describing the programme.

3.3.6.2 Open Manual

This should open this document.

3.3.6.3 Show EULA

This re-opens the End User License Agreement (EULA), that must have been accepted for the programme to run.

3.3.6.4 Contact Author

Should open an email client, with address field populated.

4.0 COMPATIBLE HARDWARE AND INSTALLATION

4.1 SDRPlay RSP receivers

RSP1

RSP1A

RSPdx

RSPduo

Ortac_AIS_SPlay 'plays' with the SDRPlay RSP1, RSP1A, RSPDx and RSPDuo.

It uses the SDRPlay_api.dll, which in turn uses the 'SDRPlayAPIService'. A copy of the sdrplay_api.dll is installed in the Ortac_Rx_SPlay directory, but the SDRPlayAPIService must be also be installed.

The SDRPlayAPIService is installed by the SDRPlay SDRuno software, please ensure that SDRuno is installed before running Ortac_Rx_Splay.

With SDRuno is installed, but not running, to install Ortac_Rx_SPlay, all that is needed is to run the RFBits installer Setup_AIS_SPlay_Iss_p_p_.exe.

By default Ortac_Rx_Splay will install to:-

C:\Program Files (x86)\RFBits\Ortac_AIS_Splay

It will store its ini file, channel memory files and any recordings at:-

\Users\UserName\AppData\Roaming\RFBits\Ortac_AIS_SPlay

4.2 AirSpy Receivers

AirSpy Mini

AirSpy R2

Ortac_AIS_ASpy will work with either the AirSpy mini or the AirSpy R2, it does not support the Airspy HF versions.

Ortac Rx uses the airspy.dll which in turn uses the libusb-1.0.dll and Pthreadvce2.dll, all of which are installed in the program directory during the Oratac_AIS_Apsy install.

The radio uses the WinUSB hardware device driver, AirSpy have arranged that the correct driver is installed, there should be no driver installation required.

This means that to install Ortac_Rx_ASpy, all that is needed is to run the RFBits installer Setup_Rx_ASpy_Iss_p_p_.exe.

By default Ortac_Rx_ASpy will install to:-

C:\Program Files (x86)\RFBits\Ortac_AIS_ASpy

It will store its ini file, channel memory files and any recordings at:-

\Users\UserName\AppData\Roaming\RFBits\Ortac_AIS_ASpy

4.3 **RTL2832u R820T2 Dongles**

Examples are :-

RTL-SDR BLOG V3

NooEleccom NESDR SMArt v4

Ortac_Rx_RTL requires the RTL2832u device to have the Rafael Micro R820T, R820T2 or R860 RF tuner, the programme is not compatible with devices using alternative now less common tuners such as the Elonics E4000.

Ortac Rx uses the libusb-1.0.dll, which in turn requires the WinUSB hardware device driver. The RTL2832u dongle will initially default to a device driver that does not work with lib-usb-1.dll. There are many places on the web that describe the process to change the default driver to WinUSB using the "Zadig" utility, some examples are:-

https://www.rtl-sdr.com/rtl-sdr-quick-start-guide/

https://zadig.akeo.ie/

Once the correct driver has been configured all that is necessary to install Ortac Rx is to run the RFBits installer 'Setup_Ortac_Rx_RTL_Iss_p_p_.exe'.

By default Ortac_Rx_RTL will install to:-

C:\Program Files (x86)\RFBits\Ortac_AIS_RTL

It will store its ini file, channel memory files and any recordings at:-

\Users\UserName\AppData\Roaming\RFBits\Ortac_AIS_RTL