WEGMATT LLC

dAISy 2+ AIS Receiver

Contents

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1 Disclaimer

dAISy 2+ is a reliable, dual-channel AIS Receiver. However, under no circumstances it should be solely relied on for collision avoidance or navigation. It's the user's responsibility to use the product prudently. Neither Wegmatt LLC nor its dealers accept responsibility or liability to the product user or their estate for any accident, loss, injury or damage whatsoever arising out of the use of this product.

2 Connecting dAISy 2+ to a computer

2.1 Windows 7, Vista and XP

Your user must have administrative rights on the Windows machine to install the USB driver.

To install the required driver on Windows 7, Windows Vista and Windows XP follow these steps:

1. Download the USB driver from http://www.wegmatt.com/files/daisyUSB%20inf%20v2.zip.

2. Extract the USB descriptor file (.inf) contained in the archive into a folder on your computer.

3. Plug dAISy into a free USB port.

4. Windows will detect a new USB device and start looking for a driver.

5. When prompted for a driver, select *"Browse my computer for driver software"* and select the folder containing the .inf file.

   a. When not prompted for a driver, open Device Manager and look for *"Other Devices > dAISy AIS Receiver"* and select *"Update Driver".*

6. Windows will warn you that the driver has no signature, i.e. is from a software vendor unknown to Microsoft. Acknowledge the warning about the unsigned driver.

   a. Note that the .inf file is a text file that tells Windows that a device with the name dAISy and a certain ID should be handled by the standard USB driver that comes with Windows. It does not contain any code.

7. After successful installation, "dAISy AIS Receiver" should show up in the Device Manager under *"Ports (COM & LPT)"*, note the assigned COM port number.

8. In OpenCPN create a new serial connection on *DataPort* COM** (where ** is the number Windows assigned) and with 38400 as baud rate. See the chapter about configuring OpenCPN below for more information.

2.2 Windows 8

Windows 8 requires to temporarily disable driver signature verification while installing dAISy's USB descriptor file. As preparation to the actual installation, follow the steps in this article: http://www.howtogeek.com/167723/how-to-disable-driver-signature-verification-on-64-bit-windows-8.1-so-that-you-can-install-unsigned-drivers/

Once driver signature verification is disabled, follow the instructions for Windows 7, Vista and XP.

For your safety, reboot your PC after completion of the installation. This will re-enable driver signature verification.

2.3   Windows 10

Good news! With Windows 10 no driver is required and a new COM port will automatically show up in the DataPort drop-down of OpenCPN. See the chapter about configuring OpenCPN below for more information.

2.4   Mac OS X

No driver is required for Mac OS X. dAISy will show be recognized a USB modem.

You can determine the ID of dAISy with the following steps:

1. Plug dAISy into a USB port
2. Launch Terminal.app
3. Type *ls /dev/*usb**
4. The system will return a list of USB devices, with names like "/dev/cu.usbmodemXYZ" where XYZ is a number.
5. Copy *"/dev/cu.usbmodemXYZ"* to the clipboard, where XYZ is substituted with specifics from your setup.
6. In OpenCPN.app create a new serial connection on DataPort using the copied string. See the chapter about configuring OpenCPN below for more information.

2.5   Linux

No driver is required for Linux. When plugged into the computer, dAISy will show up as a USB CDC device on */dev/ttyACM0*.

Detailed instructions for Linux can be found here: https://mvcesc.wordpress.com/2015/04/28/opencpn-on-the-raspberry-pi-2-with-ais/

Also See the chapter about configuring OpenCPN below for more information.

2.6   Configuration of OpenCPN

OpenCPN is a free chart plotter and navigation software. Among many other things, OpenCPN supports input from AIS receivers to display the position of ships on its charts.

You can learn more about OpenCPN and download it on the OpenCPN web page: http://opencpn.org

To use dAISy with OpenCPN, go to the Options dialog, select the Connections icon and add a new connection. Set Properties to Serial. Enter or select the Dataport under which dAISy presents itself (see OS-specific chapters above to determine the correct port). Set Baudrate to 38400. Leave everything else as preset by OpenCPN.
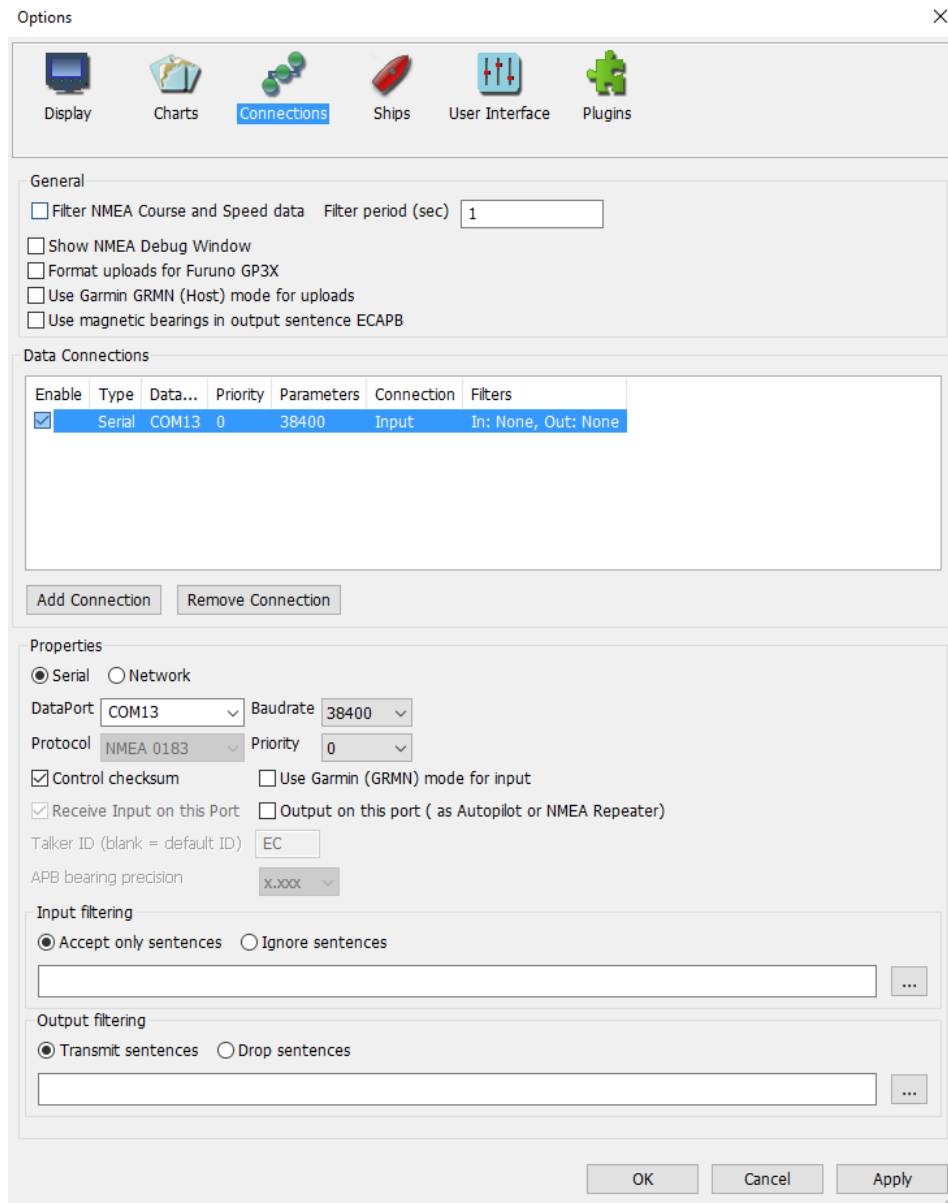
Configuration of a serial connection for dAISy in OpenCPN

2.7 Connecting dAISy with other software

dAISy presents itself to computers as a virtual serial port. See the OS-specific chapters above about installation to learn how to determine the serial port.

The serial communication parameters of dAISy are:

Baud rate	38400
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Depending on the software dAISy is used with, some or all of these parameters have to be configured. For details, please refer to the instruction manual of the respective application.

3 Using dAISy 2+

Using dAISy is as simple as connecting it with an antenna and a PC and powering up your AIS capable application of choice. When plugged in, dAISy automatically starts to listen for AIS transmissions.

3.1 Interpreting the status LED

dAISy has two, two-color status LED, giving us some indication about how it's feeling. Each LED represents the status of one of the two independent AIS channels.

Short GREEN flash every 5 seconds

dAISy is well and alive and in receive mode.

While in receive mode, the mode dAISy starts in when powered up, it will very briefly blink green every 5 seconds to indicate that everything is ok.

Long GREEN flash

Yay! dAISy received a valid AIS packet.

For every packet received and passing all error checks, the LED will turn green for ¼ second. At the same time dAISy will send the received message over USB to the connected PC.

Long RED flash

dAISy received an invalid packet.

dAISy caught the start of a package, but the received data did not pass other sanity checks like encoding standard or checksum. It might be a ship just out of range, interference from another radio source, or just random noise.

Don't panic, you will see a lot of red even under optimal conditions.

Fast regular blinking RED

dAISy encountered an unexpected system error.

The most common cause is that it lost USB connection, which happens on some PCs (particularly Macs) when they go into sleep mode. Unplug dAISy and plug it in again to fix this condition.

If the condition persists, there might a hardware issue with your device. Please contact us.

No LED activity

dAISy failed to boot or crashed. Unplug dAISy and plug it in again to fix this condition. If the condition persists, there might a hardware issue with your device. Please contact us.

Or dAISy is not in receive mode because you are using the debug menu.

3.2 Configuration and debug menu

When connecting to dAISy with a serial terminal (e.g. Putty or Termite on Windows, screen on Linux and OS X), pressing ESC will bring up a menu with a few configuration and debug options.

```
COM13 - PuTTY                                          —   □   ✕

dAISy v5.04 - dAISy 2+ (5503) (C)2014-2017 Adrian Studer

Radio    Si4468   Channel A/B     RSSI detect     off
Serial   38400    Debug   off     Low power       off

Configure:
0-3      Enable output on auxiliary serial port
C        Toogle receiving channels A/B, B/A, A/A or B/B
L        Toggle CPU low power mode on/off
R        Toggle RSSI detection on/off
B        Launch bootloader to update firmware
#        Save current settings

Debug:
D        Toggle debug messages on/off
N        Read current RSSI (indication for noise)
S        Show RSSI statistics for valid messages
T        Output NMEA test messages

ESC      Return to AIS receive mode

>
```

The most commonly used options are:

D: Toggles debug messages, when in receive mode signal strength as well as information about invalid packets will be displayed. It's normal to receive a lot of broken packages, as there always will be radio noise and ships just barely out of reach. With some experience you can use the debug messages to analyze and improve reception issues.

N: Keep pressed to get an idea of the current noise level. -120 to -100 dBm is normal. dAISy will only be able to receive valid packets roughly 15 dBm above that level, consistent reception 25+ dBm above noise.

S: If valid packages were received, this gives a summary of the signal strength at which they arrived (min, max, average).

ESC: Resume receiving AIS messages.

Other options:

0-3: Controls serial output of AIS messages on the NMEA and Auxiliary Serial ports at the back of the device. 1 configures 9600 baud output, 2 is for 38400, and 3 is for 4800 baud. 0 turns serial output off.

T: Enter test mode. In this mode, dAISy outputs a test message every 5 seconds. You can enter your own message or have it output a preprogrammed AIS message. This mode is useful when you want to test dAISy but don't have AIS reception at your current location. You can exit test mode by pressing **ESC** or power-cycling dAISy.

C: Configure receiving channel. dAISy 2+ has two radios, which by default are configured to listen on channel A and B respectively. For experimental purposes, the channel assignment of the radios can be changed to A/A, B/B, A/B or B/A. **The recommended setting is A/B.**

R: Turn RSSI Detect on or off. When RSSI detect is on, dAISy will ignore signals that are too weak for reliable communication. This may increase the number of local messages received, but it will also reduce the maximum range. **The recommended setting is OFF.**

L: Turn Low Power Mode on or off: In low power mode, the CPU of dAISy will be powered down when idle. This will reduce power consumption by about 10-15%. As this is insignificant in typical applications, **the recommended setting is OFF.**

#: Save current settings (serial, C, L, R and D) as startup defaults. This is particularly useful when you want to persist the settings for the auxiliary serial output.

B: Enter boot loader mode for firmware updates. dAISy only exits this mode through power-cycling or after completing firmware upgrade. Firmware updates and instructions are available at https://github.com/astuder/dAISy/tree/master/Firmware

4   Using the NMEA 0183 connector

dAISy 2+ comes with a NMEA 0183 connector. This allows to connect the AIS receiver to chartplotters and other marine equipment. The connector also allows to power dAISy from the boat's power system instead of USB.

dAISy NMEA connector	Chartplotter / boat	Comment
NMEA +	NMEA + or A RX	
NMEA -	NMEA - or B RX	If your device only has one RX wire per port, leave NMEA - unconnected
GND	Ground	If your device has only one RX wire or you connect external power, ground must be connected.
9-36V	Boat 12-36V power system	External power for dAISy if you are not using USB.

Below is an illustration on how to connect the dAISy NMEA connector with a compatible device using single-wire or two-wire NMEA 0183 connection. Note that the colors may be different. Check the installation instructions of your chartplotter to identify the proper connections.

single-wire NMEA connection

two-wire NMEA connection
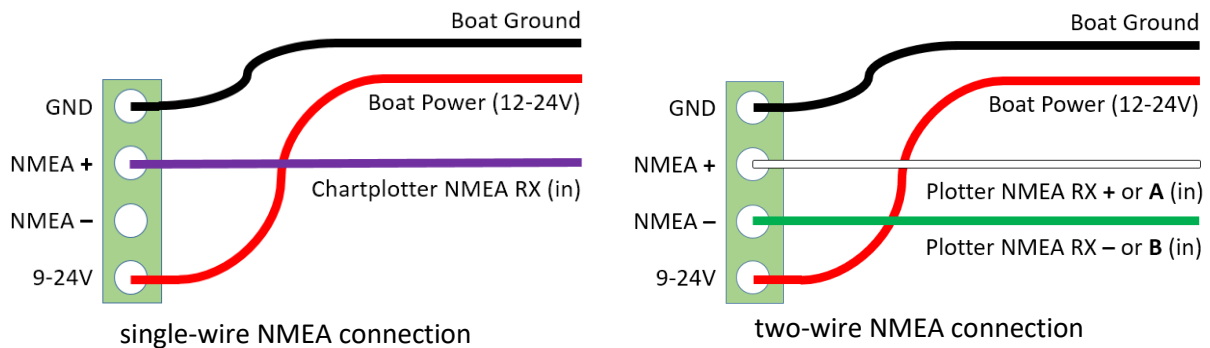
By default, dAISy is configured to output at 38400 Baud (NMEA high speed). This can be changed to other baud rates in the configuration and debug menu. You also need to check the configuration of your chartplotter. In many models, the NMEA port needs to be enabled in the settings menu and set to the correct protocol, like for example NMEA high speed.

NMEA 0183 is compatible with RS-422, which means that the NMEA connector can also be used to connect dAISy with RS-422 to serial, RS-422 to Ethernet and other RS-422 compatible equipment. You may need to swap the NMEA + and NMEA - leads.

5   Using the Auxiliary Serial connector

For tinkerers, dAISy 2+ provides an auxiliary serial port on the rear of the unit. This connector can be used to process AIS messages with other devices.
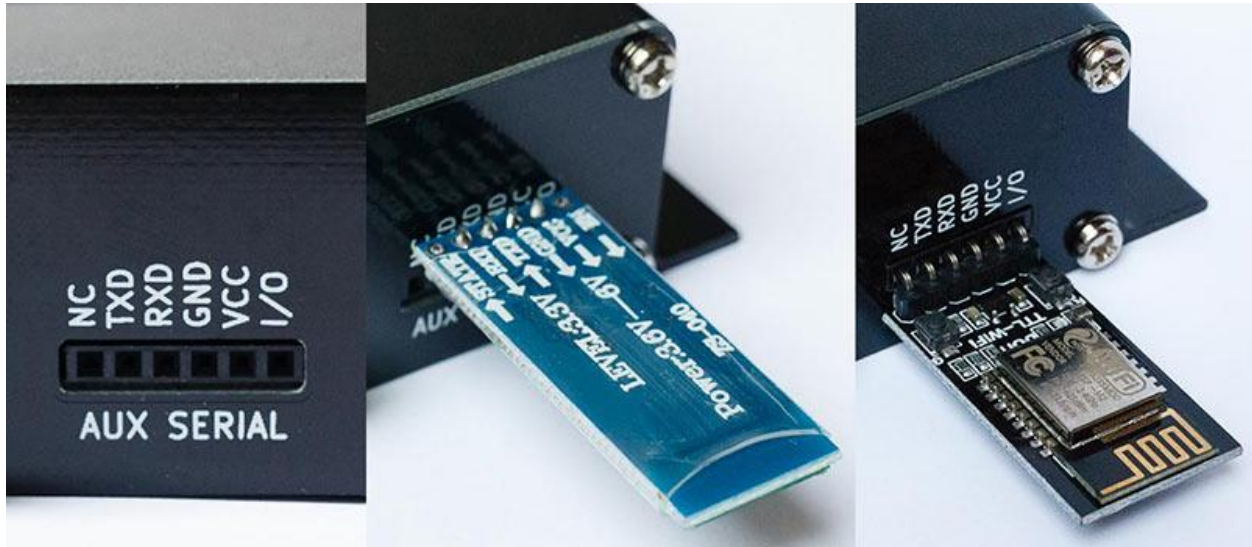
The pinout of the serial connector is compatible with HC-05/HC-06 Bluetooth modules and DT-06 WiFi modules widely available on eBay. It can also be used to connect dAISy with other devices like data loggers, Arduinos etc.

The serial output is enabled by default and can be configured in the debug menu (see chapter 3.2). It shares the port with the NMEA 0183 output. This means, that both will always output the same data and at the same data rate.

Pin	Function
NC	This pin is not connected
TXD	Transmit data, output, 3.3V – dAISy transmits data on this pin. Typically, this signal is connected to the RXD pin on the other device.
RXD	Receive data, input, 3.3V – dAISy receives data on this pin. Typically, this signal is connected to the TXD pin on the other device.
GND	Ground – This pin must always be connected to GND on the other device.
VCC	Power – Use this pin to power your device from dAISy. The output voltage can be set to 3.3V or 5V with a switch inside dAISy. Maximum current is 150mA at 3.3V or 300mA at 5V. This pin can also be used to power dAISy from an external 5V or 3.3V power source. If doing so, double-check the voltage selection switch to avoid damaging dAISy. Note, that the voltage selection switch does NOT change the voltage level of the other pins. All other pins are 3.3V only!
I/O	Spare input or output pin, 3.3V – This pin is currently not in use.
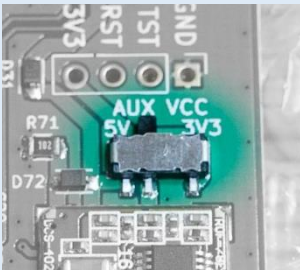
5.1 AIS over WiFi with the DT-06 WiFi module

The auxiliary serial port is pin-compatible with the inexpensive DT-06 WiFi module. With the module, dAISy 2+ can make data available wirelessly to mobile devices like laptops, tablets and smartphones.
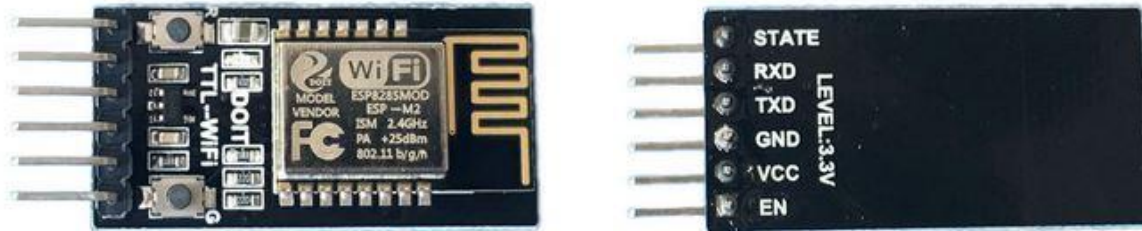
5.1.1 What you need

- DT-06 WiFi module, available for US$4 to $10 on Ebay and other online shops
- An app that accepts AIS from a network connection, like for example OpenCPN, BoatBeacon or SailGrib. In this document, we will use OpenCPN.

5.1.2 Setup the basics

Remove power from dAISy. Plug the WiFi module into AUX Serial so that VCC and GND on the WiFi module line up with labels on dAISy 2+. dAISy TXD will be connected to WiFi RXD, and dAISy RXD to WiFi TXD. Connect dAISy to power. A blue light on the WiFi module turns on.

When first powered up, the module will show up as a WiFi access point with the name Doit_WiFi_x, where are the last 6 characters of the module's MAC address. Connect to this access point with a computer or mobile device.

Open a browser and enter http://192.168.4.1 in the address bar. After pressing enter you will see the configuration menu of the WiFi module.

Go to MODULE > Serial to configure the communication between the module and dAISy. Change BaudRate to 38400 and leave the remaining fields at their defaults (8, NONE, 1, 50). Click Save.

Go to MODULE > WiFi. In the section Soft AP Settings, we recommend entering a Password to restrict access to the module. The password must be 8-63 characters. Write down the password, as losing it may permanently lock you out of the configuration of the WiFi module.

5.1.3 Configure as standalone WiFi access point with a TCP server

In this mode, dAISy creates its own WiFi network. To receive AIS data, mobile devices must be connected to this network.

Go to MODULE > WiFi. In the section SOFT AP Settings, select Enable. Leave the other settings at their defaults. Click Save.

Go to MODULE > Networks. For Socket Type select TCP Server. Set TCP Server Local Port to 9000. Leave the other settings at their defaults. Click Save.
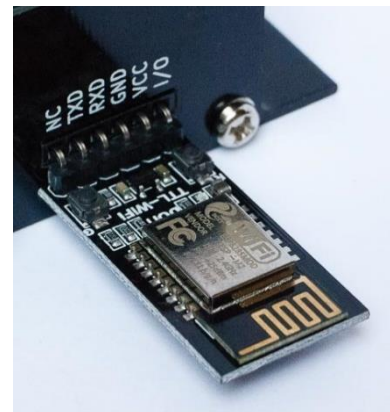
Go to MORE > Restart. The module restarts and the settings you've made are now active.

5.1.4   Configure as a TCP server connected to your existing WiFi network

In this mode, dAISy uses your existing WiFi network. To receive AIS data, mobile devices will use that same network.

Go to MODULE > WiFi. In the section Station Settings, select Enable. Enter or select the SSID name of your WiFi network. Enter the password of your WiFi network. Select Enable DHCP. Click Save.

Go to MORE > Restart. The module now restarted and the settings you've made are now active.

Go to STATUS and note down the Station IP Address. This is the IP address your WiFi network assigned to the module.
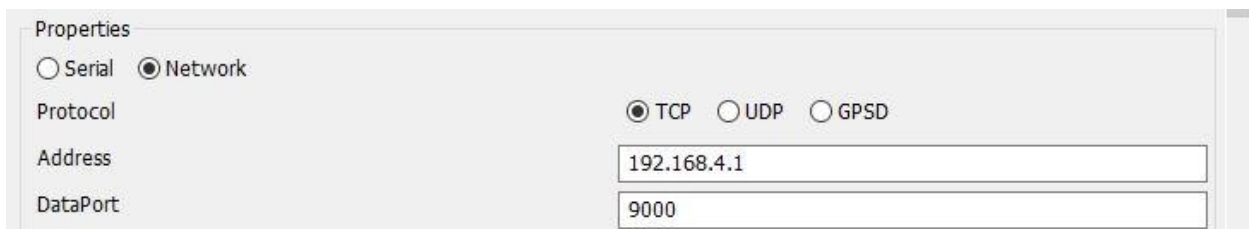
Go to MODULE > Networks. Select Socket Type TCP Server. Set TCP Server Local Port to 9000. Leave the other settings at their defaults. Click Save.

Go to MORE > Restart. The module restarts and the settings you've made are now active.

5.1.5   Configure OpenCPN

Applications that process the AIS data must be configured to receive data from the TCP server with IP address you noted down on port 9000. Here we use OpenCPN, but the procedure will be similar with other applications.

Start OpenCPN. Go to Options > Connections. Click Add Connection to create a new connection. Select Network, Protocol TCP. If you configure the WiFi module as standalone access point, enter 192.168.4.1 as Address. Otherwise, enter the Station IP Address your network assigned. Enter 9000 as DataPort.

Press OK to save and activate the new connection. OpenCPN should now start receiving AIS data.

6 Tips for good AIS reception

dAISy 2+ is not the most sensitive AIS receiver out there. But you can help it to excel with a few basic measures.

6.1 Antenna

If everything else is optimal, almost any antenna tuned to the VHF band will do. In a pinch, we use simple wires cut to length. However, a good antenna will greatly improve results.

AIS messages are broadcast on two channels around 162 MHz, which is in the maritime VHF band. This means that any antenna sold as "*marine VHF antenna*" will be a good start.

The short VHF "rubber duck" antennas are cheap and will work at short distance. As long as you check whether 162 MHz is inside the supported frequency range, you can even ignore the "marine" and save a few dollars. However, the more broadband the antenna, the worse the reception quality.

A step up are VHF whip antennas. These are steel rods about 1 meter (3ft) long. While bulky, these don't cost much more than the "rubber duck" but provide superior results. Personally, we use the TRAM 1600-HC which cost around US $40.

There are many more options, which we did not explore ourselves yet. This article gives a great overview of the topic: http://sdrformariners.blogspot.com/2013/08/ais-antenna-shootout.html

Note: dAISy 2+ uses a BNC connector for its antenna input. Depending on the antenna you buy (or build), you might need an adapter. In the U.S. we recommend coaxrf.com for a good selection, reasonable prices and fast shipping.

The AIS antenna should be placed as far away as possible from the voice VHF antenna to avoid interference. The best separation is achieved either by vertically separating the antennas, or by mounting them on opposite sides of a vessel.

To avoid damaging dAISy's receiver, the antenna should be mounted at least 3 meters apart or outside of the transmitting beam of high-power transmitters such as radars or other VHF antenna installations.

6.2 Location, location, location

Good AIS reception requires line of sight.

A few building and trees between you and your targets aren't ideal, but you will still be able to catch a few messages. Hills and mountains however are almost certain showstoppers. A clear view of the water and your targets is ideal.

In our experience, the most important factor is the height of the antenna above sea-level. Sitting at the beach or on the deck of a boat will work. Mounting the antenna on the mast of your boat, or standing on the observation deck of a cruise ship is better. A hill overlooking the harbor is great. Climbing that 2000m mountain that towers over the coast is AIS heaven.

In a nutshell: The farther you can see, the better.

6.3   Radio noise

dAISy has an integrated bandpass filter to optimize performance. Never the less, the main weakness of dAISy, and other low-cost and SDR-based AIS receivers, is susceptibility to radio noise. The effect of noise is reduced range and fewer successfully received packets.

To minimize interference, place the antenna away from sources of electromagnetic noise like computers, monitors, switching power supplies, wireless routers, etc. Performance may also be impacted by nearby VHF transmitters.

7   Troubleshooting

Problem	Solution
No activity of the status LED	Verify the USB connection, also try a different USB cable.
Device in reception mode, but not valid AIS messages received (no ¼ second green flashes)	Verify the antenna connection and location. Good AIS reception requires line-of-sight, verify your setup from a location that is certain to have traffic, e.g. near a harbor.
Device indicates valid AIS messages (¼ second green flashes), but no messages received on PC	Verify that the serial port shows up on the PC. Try a different USB cable if this is not the case. Verify the serial configuration of your software. Verify the serial communication with a serial terminal program like Putty or screen.
Software receives positions, but fewer than expected and/or with worse range than expected.	Verify the antenna connection and location. Good AIS reception requires line-of-sight, so the higher up the antenna is positioned the better the range. Move the antenna away from sources of electrical noise.
After some time, dAISy indicates a device error (fast blinking red LED)	Sometimes the device is not properly initialized when the connected computer wakes up from sleep mode. Unplug dAISy and plug in again to resolve the error.

If a problem persists, please don't hesitate to contact us.

8   Source code and schematics

The dAISy project is partially open source.

The core of dAISy, how Silicon Laboratories EzRadioPRO radio ICs are programmed to receive AIS, is available on Github. While the project does not include all the functionality of dAISy 2+, we do backport any bug fixes that are relevant to the task of receiving AIS. https://github.com/astuder/dAISy

There is also a long thread on 43oh that documents the journey of dAISy from its humble beginnings. http://forum.43oh.com/topic/4833-potm-daisy-a-simple-ais-receiver/

If you want to experiment with the real code, brick your device with custom firmware or even build your own dAISy from scratch, contact us. Tinkerers welcome!

9   Contact

The best way to reach us is by email: daisy@wegmatt.com

You can also contact the designer of dAISy via Github, 43oh or Tindie.

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