WEGMATT LLC

dAISy AIS Receiver

Contents

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CE   RoHS

1   Disclaimer

dAISy is a reliable, single-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 to a computer

2.1   Windows 10 and newer

Good news! With Windows 10 or newer, no driver is required. When plugging the AIS receiver into USB, a new COM port will be detected. The port will automatically show up in the DataPort drop-down of OpenCPN. See the chapter about configuring OpenCPN below for more information.

2.2   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 https://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.

2.3   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: https://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.

2.4   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 and Raspberry Pi

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

You can verify the serial connection with a serial terminal program like for example *screen*. You may have to install *screen* first by running:

```
sudo apt-get install screen
```

With *screen* installed, connect to the dAISy with

```
screen /dev/ttyACM0 38400
```

If the serial port is properly configured, pressing *ESC* will bring up the configuration and debug menu. Pressing *ESC* again will return dAISy into receive mode. Exit *screen* by pressing *CTRL-A*, release the keys, then press *K* (kill session) and then *Y* to confirm.
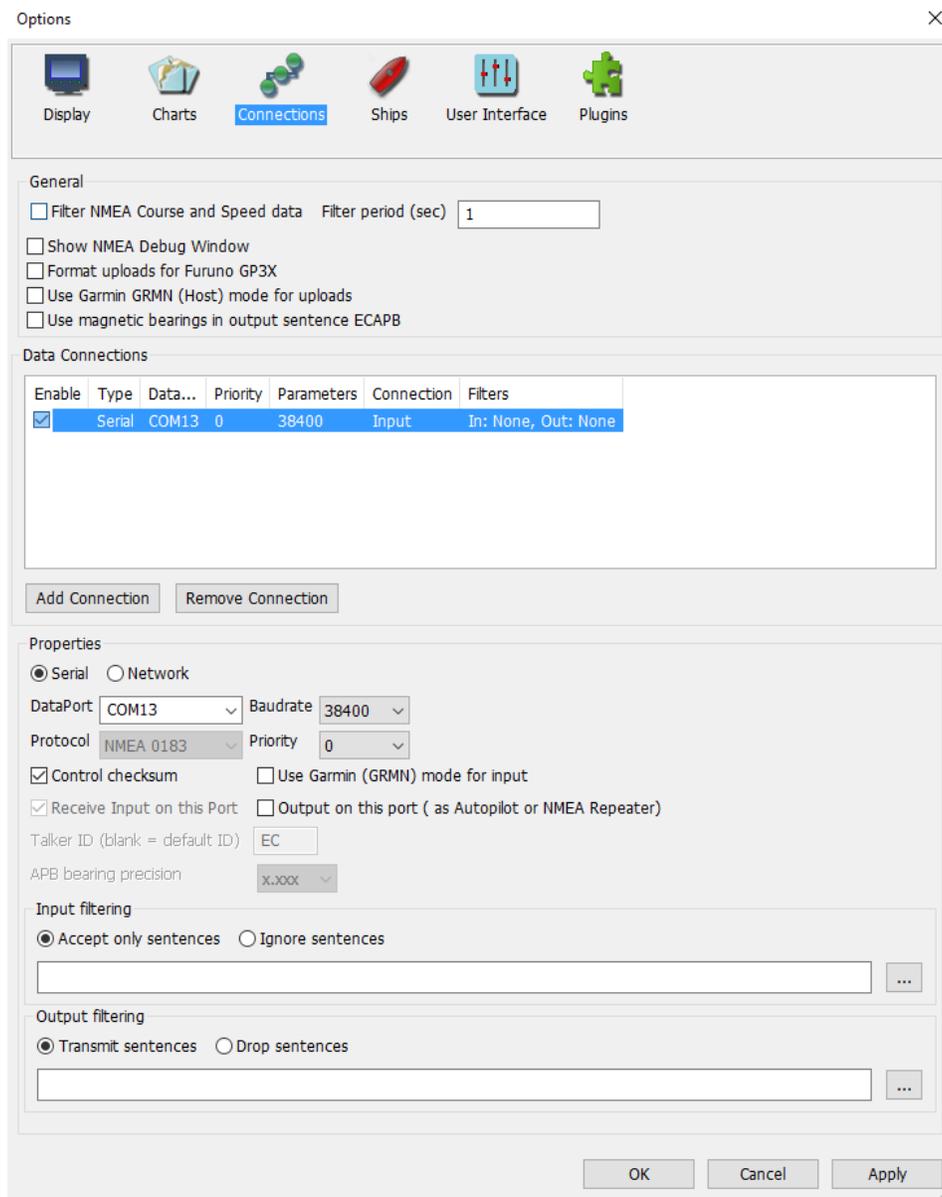
Also see the chapter about configuring OpenCPN below for more information.

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: https://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

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 a single, two-color status LED, giving us some indication about how it's feeling.

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 me.

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.

```
COM5 - PuTTY                                       —  □  ×

dAISy USB v4.07 - dAISy USB 3 (5503) (C)2014-2016 Adrian Studer

Configure:
0-3     Enable serial output for auxiliary device
C       Toggle receiving on channel A, B or both
L       Toggle CPU low power mode on/off
R       Toggle RSSI detection on/off
B       Launch bootloader to update firmware over USB
#       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: Enables auxiliary serial output of AIS messages on the TX pad on the PCB. Advanced users can connect dAISy with other devices, like for example Bluetooth modems, by soldering a few wires. 1 provides 9600 baud output, 2 is for 38400, and 3 is for 4800 baud. 0 turns serial output off. The serial output is also used by the optional dAISy NMEA 0183 / RS-422 adapter.

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 has only one radio. To receive on both AIS channels, it continuously switches between the two radio frequencies until a signal is detected. This option controls whether dAISy hops between the channels, only listens to channel A, or only listens to channel B. In some situations, only listening to one channel can increase the number of messages received. **The recommended setting is hopping between A and 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 breakout header

The circuit board of the dAISy AIS Receiver exposes several signals on an unpopulated 0.1" header. Advanced users can use these pads to connect the auxiliary serial port of dAISy with other devices like for example WiFi and Bluetooth modules.

The speed of the serial port is configured in the debug menu.

The 5V pad is connected to the 5V USB power rail. When dAISy is not connected to USB, the 5V pad can be used to power the AIS Receiver. When running standalone, the AIS Receiver will draw a maximum current of 20mA in receive mode.

The 3.3V pad is connected to the 3.3V power rail of dAISy. It can be used to power peripherals connected to dAISy. If you want to power dAISy through this pad, the LDO must be removed or modified.
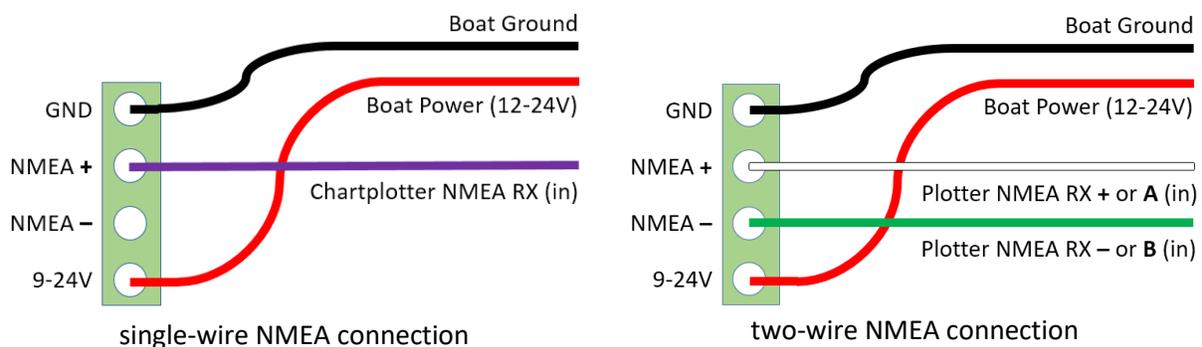
Pad	Function	Comment
5V	5V USB power rail	Can be used to power a peripheral. Can be used to power dAISy when not connected to USB.
3V3	3.3V power rail	Can be used to power peripherals. 150mA max current, 50mA continuous. This pad CANNOT be used to power the receiver, unless the LDO is removed!
GND	GND	Connected to GND plane of receiver
TX	Serial data out	3.3V signal level, configurable speed
RX	Serial data in	3.3V signal level, configurable speed
TST	SBW	Debug and programming of MCU
RST	SBW, reset	Debug and programming of MCU

5   Using the NMEA 0183 adapter

If you purchased dAISy with the optional NMEA 0183 adapter, the receiver can be connected to chartplotters and other marine equipment.

dAISy NMEA adapter	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.
9-24V	Boat 12-24V power system	External power for dAISy if you are not using USB.

Below is an illustration on how to connect the dAISy NMEA adapter 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 adapter 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.

6 Tips for good AIS reception

dAISy is not the most sensitive AIS receiver out there. But you we can help it to excel with some basic measures.

6.1 Antenna

If everything else is optimal, almost any antenna tuned to the VHF band will do. I used a simple wire cut to length for my first prototypes. 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 bucks. 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 (3.5ft) long. While bulky, these don't cost much more than the "rubber duck" but provide superior results. Personally, I use the TRAM 1600-HC which cost around US $40.

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

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

IMPORTANT: Do NOT directly connect the dAISy HAT to the same antenna as your VHF radio, this will damage the AIS receiver. To share an existing antenna with a VHF radio, use an ACTIVE splitter. Active splitters protect the AIS receiver by automatically disconnecting it when the VHF radio is transmitting. Several customers reported good results with the inexpensive Glomex RA201 VHF/AIS/Radio Splitter.

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 my experience the most important factor is the height of the antenna above sea-level (or lake-, river-, wherever-level the ships are). 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

The main weakness of dAISy, and probably most low-cost and SDR-based AIS receivers, is susceptibility to radio noise. The effect of noise is reduced range and few successfully received packets.

Unfortunately, there's not much we can do except finding a spot that's less impacted by noise. Outdoors is better than indoors (computers, power-supplies, wireless networks, ...). Country-side is better than down-town (taxi radios).

dAISy has an integrated 12 MHz wide bandpass filter to reduce the impact of radio noise outside the 162 MHz target frequency. However, to keep cost and size down, the integrated filter is rather simple. A very narrow-band antenna or an external bandpass filter can improve reception. Please report back any results if you go down this route.

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 sec 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 (1/4 sec 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, don't hesitate to contact us.

8   Specifications

Power	
Power input ports	USB, debug header
Input voltage USB	5V
Input voltage debug header	5V
Input current USB	< 25 mA
Input current debug header	< 25 mA
Power output ports	Debug header
Output voltage debug header	3.3V or 5V
Maximum output current debug header (3.3V)	100mA
Maximum output current debug header (5V)	300mA (powered via USB)
Radio	
Independent receivers	1
Frequency bands	161.975MHz and 162.025MHz
AIS channels	A, B, smart hopping, 50:50 hopping
Bandpass filter	LC filter, ~ 10MHz BW
RF connector	BNC
Input impedance	50Ω
Data I/O	
AIS message encoding	NMEA 0183 (!AIVDM)
Supported AIS message types	1-27
Serial speed USB (generic CDC serial device)	38400 Baud fixed
Serial speed debug header (UART, 3.3V)	4800, 9600, 38400 Baud configurable
Serial protocol	8 data bits, no parity, 1 stop bit (8N1)
Serial mode USB	NMEA out fixed
Serial mode debug header	NMEA out fixed
Dimensions	
Enclosure with connectors	62mm x 44mm x 24mm
Enclosure without connectors	43mm x 44mm x 24mm
Circuit board without connectors	40mm x 40mm
Circuit board with connectors	61mm x 40mm x 20mm
Circuit board mounting holes	None
Weight	
Product in enclosure	50g
Circuit board only	27g

10 Source code and schematics

Currently dAISy is only partially open source.

The core of dAISy, how the Silicon Labs Si4362 radio IC is programmed to receive AIS, is available on GitHub. While the project does not include all the functionality of dAISy as sold, 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. https://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!

11 Contact

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

Please don't hesitate to contact us if you need support. We also love to hear about your projects and are happy to share your related blog posts, videos, and pictures on our social media.

You can also reach us on GitHub and Twitter.

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