WEGMATT LLC

dAISy 2+ AIS Receiver

Contents

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 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 serial 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.
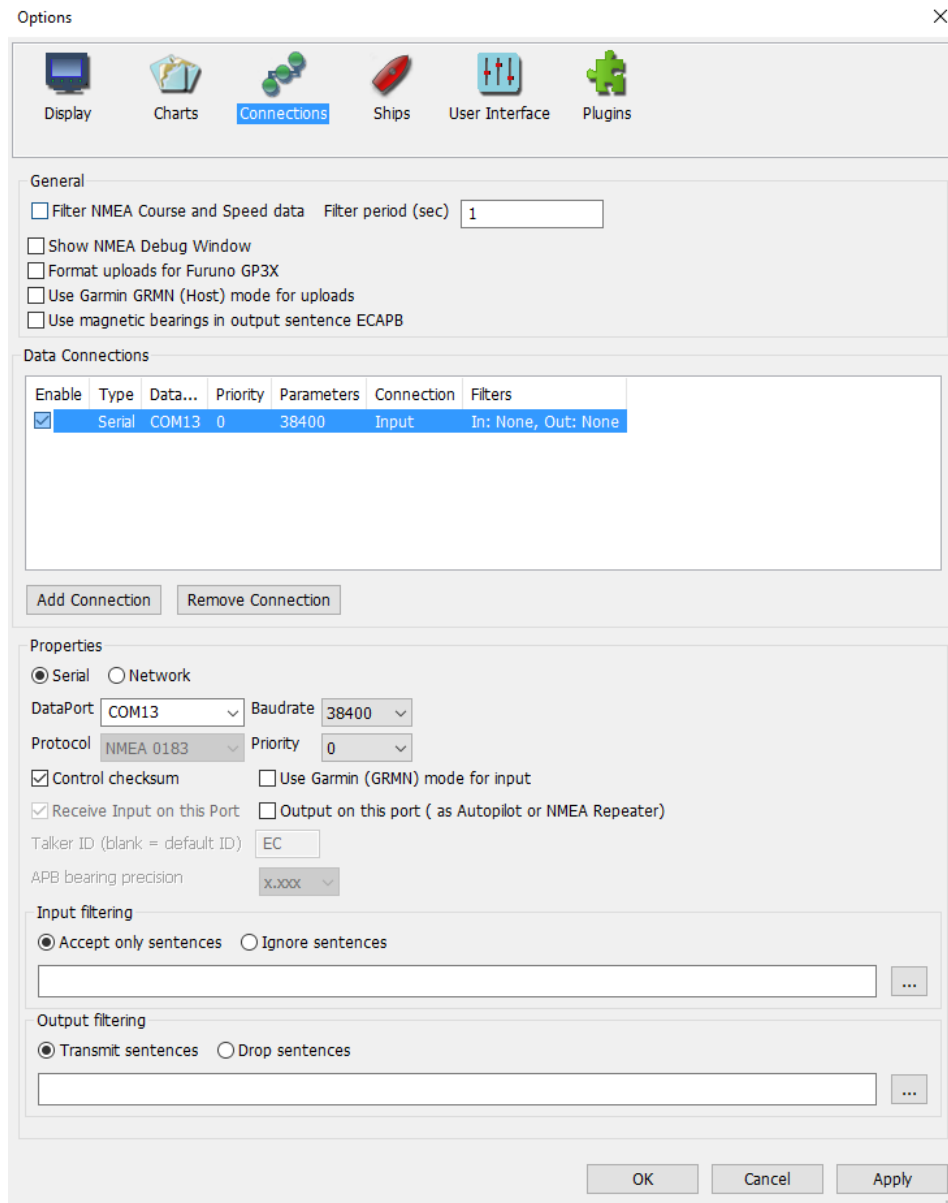
Configuration of a serial connection for dAISy in OpenCPN

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 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, has two two-color status LED, giving an indication about how it's doing. Each LED represents one of the two AIS channels.

Short GREEN flash every 5 seconds

dAISy is well and alive and in receive mode, listening for AIS messages.

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, the dAISy will output the received message as NMEA AIVDM sentence on the connected ports.

Long RED flash

dAISy received an invalid packet.

This means that the dAISy received bits that looks like the start of an AIS package, but the data did not pass other sanity checks like 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.
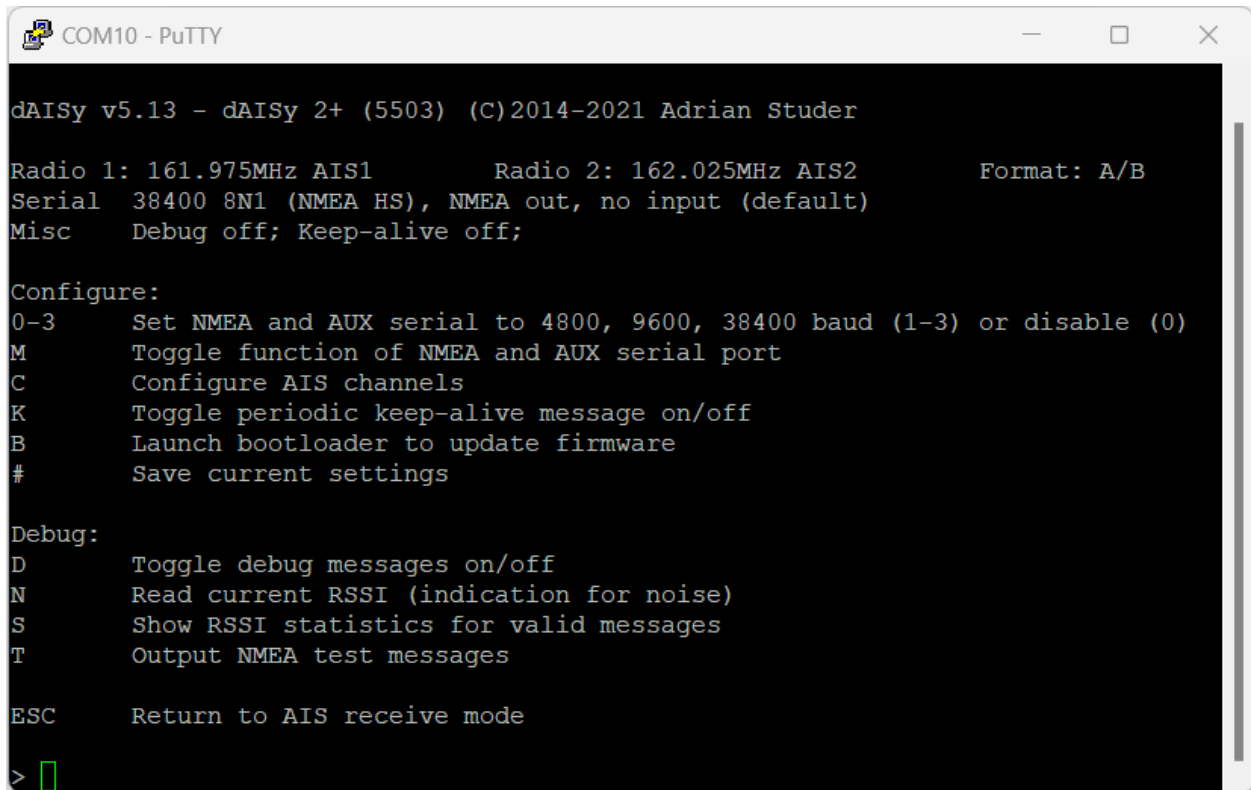
Or dAISy is not in receive mode because you are using the debug menu.

3.2 Configuration and debug menu

When connecting to dAISy with a serial terminal program (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.

```
COM10 - PuTTY                                              —    □    ✕

dAISy v5.13 - dAISy 2+ (5503) (C)2014-2021 Adrian Studer

Radio 1: 161.975MHz AIS1        Radio 2: 162.025MHz AIS2        Format: A/B
Serial  38400 8N1 (NMEA HS), NMEA out, no input (default)
Misc    Debug off; Keep-alive off;

Configure:
0-3     Set NMEA and AUX serial to 4800, 9600, 38400 baud (1-3) or disable (0)
M       Toggle function of NMEA and AUX serial port
C       Configure AIS channels
K       Toggle periodic keep-alive message 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

>
```

3.2.1 Configuration options

0-3: Control the speed of the NMEA and auxiliary serial ports at the back of the device. Pressing 1 enables the port with a speed of 4800 baud, 2 is for 9600 baud, and 3 is for 38400 baud. Pressing 0 turns the NMEA and aux serial ports off. **The recommended setting is 38400 baud.**

M: Selects the function of the auxiliary serial port.

1. **NMEA output**: Output AIS messages as NMEA AIVDM sentences.
2. **NMEA input**: Act as an input for NMEA sentences, for example from a GPS module. All NMEA sentences received through the auxiliary serial port will be forwarded to the other ports.

C: Configure the radios of the dAISy to listen to specific AIS channels. The dAISy 2+ has two radios, which by default are configured to listen on channel A at 161.975 MHz and channel B at 162.025 MHz respectively. The dAISy 2+ also supports receiving the less common "Long range AIS" channels at 156.775 and 156.825 MHz.

K: If keep-alive is enabled, the AIS receiver will periodically output a dummy message. This is only required in special setups, where another device may disconnect when there is no traffic.

B: Enter boot loader mode for firmware updates. dAISy exits this mode through power-cycling, after a 20 second timeout without further activity, or after completing firmware upgrade.

#: Save current settings (serial, AIS channel, and debug) as power-on defaults. This is particularly useful when you want to persist the settings for the NMEA and auxiliary serial output.

ESC: Resume receiving AIS messages.

3.2.2   Debug options

D: Toggles debug messages. When enabled and in AIS receive mode, signal strength and other information about valid and invalid AIS packets will be displayed. It is normal to receive a lot of broken packages as there always will be radio noise and ships just out of range. 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 AIS messages arrived (min, max, average).

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 do not have AIS reception at your current location. You can exit test mode by pressing **ESC** or power-cycling dAISy.

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 wire colors are not standardized and may be different depending on the manufacturer of your equipment.** Check the installation instructions of your chartplotter to identify the proper connections.

single-wire NMEA connection

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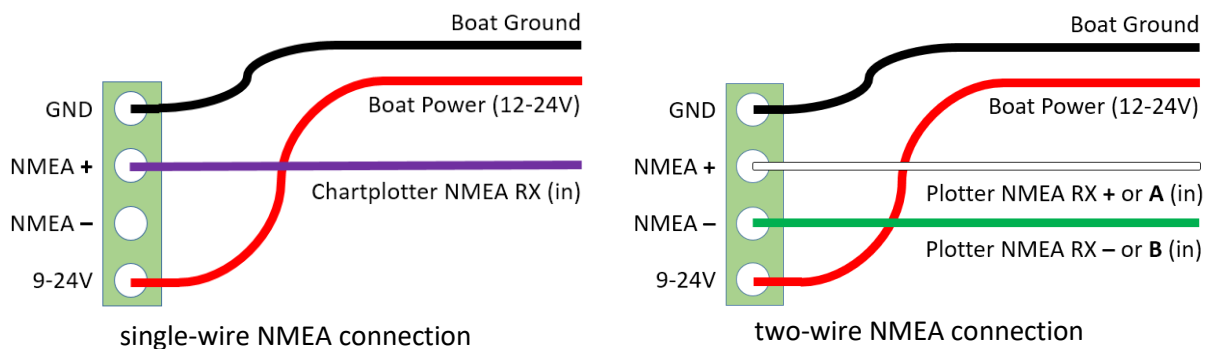
By default, dAISy is configured to output at 38400 Baud (NMEA high speed). This can be changed to other baud rates in the configuration and debug menu. You also need to check the configuration of your chartplotter. In many models, the NMEA port needs to be enabled in the settings menu and set to the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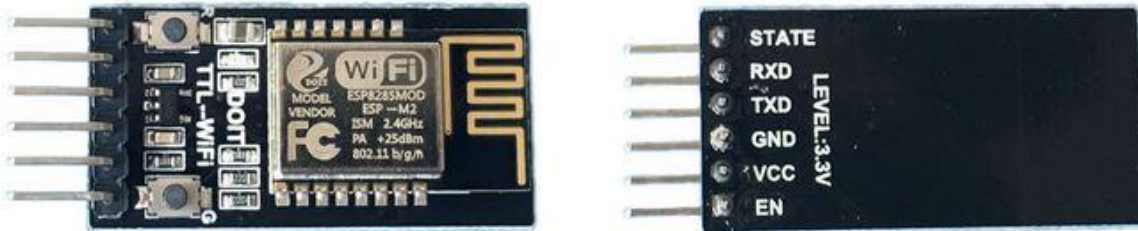
5.1.1   What you need

- 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 or Navionics. In this document, we will use OpenCPN, but configuration of other apps is very similar.

WARNING: We received reports that some DT-06 modules offered on Ebay and AliExpress don't work. Specifically, modules branded DM DIY MORE do not work! We buy our modules from these vendors:
power5.0 on Ebay: https://www.ebay.com/itm/364553704431
szdoit on AliExpress: https://www.aliexpress.com/item/32813585141.html
Geekcreit on BangGood: https://www.banggood.com/DT-06-Wireless-WiFi-Serial-Port-Transparent-Transmission-Module-TTL-To-WiFi-With-bluetooth-HC-06-Interface-ESP-M2-p-1141047.html

5.1.2   Installing the WiFi module

Remove power from the dAISy AIS receiver before installing the module.

Plug the WiFi module into AUX Serial so that the VCC and GND pins of the WiFi module line up with the respective labels on dAISy. With that, dAISy TXD will be connected to WiFi RXD, and dAISy RXD to WiFi TXD. **Note: The module may be upside down compared to the picture**, that's ok if the pins are connected as described above.
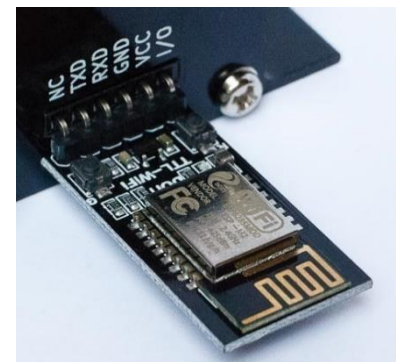
Connect dAISy to power. The LED on the WiFi module should light up.

At any time, the module can be reset to factory default settings by keeping the button labelled **G** pressed until the LED turns off.

5.1.3   Configuring the WiFi module

When first powered up, the module will show up as a WiFi access point with the name **Doit_WiFi_x**, where **x** 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 in the address bar type **http://192.168.4.1** and press enter. You will see the configuration menu of the WiFi module.

First, configure the communication between the WiFi module and dAISy.

Navigate to **MODULE > Serial**. Set **BaudRate** to **38400**. Leave the remaining fields at their defaults (8, NONE, 1, 50).

Click **Save**.

STATUS	MODULE	MORE

BaudRate

38400

DataBits

8

Parity

NONE

StopBits

1

Serial Split timeout(ms)

50

Save

Next, configure protocol, address, and port on which AIS data will be broadcasted.

Navigate to **MODULE > Networks**. In the field **Socket Type** at the top of the page, select **UDP Broadcast** from the drop down.

Further down the page, in the fields below the blue section title **UDP Broadcast**, enter the IP address **192.168.4.255** and the port number **9000**.

Click **Save**.

Write down the IP address and the port number on a piece of paper. You will need them for the configuration of the navigation apps on PCs and mobile devices.

STATUS	MODULE	MORE

Networks

Socket Type

UDP Broadcast

TCP Server Local Port

9000

TCP Client

192.168.1.100

6000

UDP Server

9000

UDP Broadcast(eg:192.168.x.255)

192.168.4.255

9000

UDP Client

192.168.1.100

6000

Save

We recommend protecting access to the WiFi module by setting a password.

Navigate to **MODULE > WiFi**. In the section **SOFT AP Settings** enter the desired password into the field **Password**. The password must be 8-63 characters.

Optionally, you can change the name of the WiFi module by updating the field **SSID Name**.

Leave the other fields unchanged.

Scroll to the bottom of the page and click **Save**.

If you ever forget the password, you can reset the WiFi module to factory configuration by keeping the button labelled G pressed until the LED turns off.

To activate the settings the module needs to be restarted. Navigate to **MORE > Restart**. The settings you've made are now active.

5.1.4   Configure OpenCPN

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

Connect your computer or mobile device to the WiFi access point of the dAISy 2+ AIS receiver.

Start OpenCPN. Go to **Options > Connections**. Click **Add Connection** to create a new connection. Select the **Network** radio button, and under **Protocol** select **UDP**. In the field **Address**, enter the IP address you noted down. In the field **DataPort** enter the port you noted down.

Optionally, you can give the connection a name by entering the desired name in the field **User Comment**.

Leave the remaining fields at their defaults. Press **OK** to save and activate the new connection. If there are AIS targets in range, OpenCPN will now start receiving AIS data.

5.1.5 Configure Navionics Boating App

Garmin Boating, also known as Navionics, is a popular app for mobile devices that in its paid version also supports AIS.

Connect your mobile device to the WiFi access point of the dAISy 2+ AIS receiver.

Open the Navionics app. Go to **Menu > Paired Devices**. Press **+** to connect a new device, and press **ADD DEVICE** at the bottom of the screen. Give the device a name, for example dAISy. In the field **Host** enter the IP address you noted down. In the field **Port Number** enter the port you noted down. Press **UDP** to select the correct protocol.

Press **Save** to complete the configuration.

Note that Navionics will report the AIS receiver as **Disconnected** if there is no active AIS traffic.

‹ Back	**Add device**	Save

Name

dAISy

Host

192.168.4.255

Port Number

9000

TCP	UDP

6 Tips for good AIS reception

Due to their low-cost architecture, dAISy AIS receivers are not as sensitive as some higher priced receivers. The following basic measures can be taken to improve performance.

6.1 Antenna

If everything else is optimal, almost any antenna tuned to the VHF band will work. We 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. If 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 90 centimeters (3ft) long. While bulky, these don't cost much more than the "rubber duck" but provide superior range. 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 AIS receiver with strong transmissions by other devices, 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 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 buildings 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. 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 frequency noise

The main weakness of the dAISy AIS receivers, and probably most low-cost and SDR-based AIS receivers, is susceptibility to out-of-band RF noise. The effect of noise is reduced range, and fewer 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, LED lights ...). Countryside is better than down-town (taxi radios).

The dAISy 2+ has an integrated bandpass filter to reduce the impact of radio frequency noise outside the marine VHF band frequency.

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   Specifications

Power	
Power input ports	USB, NMEA connector, AUX serial
Input voltage USB	5V
Input voltage NMEA0183 connector	9-24V (36V max)
Input voltage AUX Serial	3.3V or 5V selectable
Input current USB	< 80 mA
Input current NMEA0183 connector	< 45 mA (@12V)
Input current AUX Serial	< 75 mA (@5V)
Power output ports	AUX serial
Output voltage AUX serial	3.3V or 5V selectable
Maximum output current AUX serial (3.3V)	100mA
Maximum output current AUX serial (5V)	300mA (powered via USB or NMEA)
Radio	
Independent receivers	2
Frequency bands	161.975MHz, 162.025MHz, 156.775MHz, 156.825MHz
AIS channels	2, freely configurable
Bandpass filter	SAW 156.3 - 162.025MHz pass band
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 AUX Serial (logic-level UART, 3.3V)	4800, 9600, 38400 Baud configurable
Serial speed NMEA (RS-422/NMEA-0183)	4800, 9600, 38400 Baud configurable
Serial protocol	8 data bits, no parity, 1 stop bit (8N1)
Serial mode USB / NMEA	NMEA out fixed
Serial mode AUX Serial	NMEA out, NMEA in configurable
Dimensions	
Enclosure without connectors	150mm x 52mm x 28mm
Enclosure with connectors	150mm x 97mm x 28mm
Enclosure mounting holes	2x Size: 4mm x 10mm Distance: 95mm
Circuit board without connectors	76mm x 49.5mm
Circuit board with connectors	76mm x 97mm x 20mm
Circuit board mounting holes	4x Size: 2.75mm (M2.5) Distance: 68mm x 42mm
Weight	
Product in enclosure	125g
Circuit board only	40g

9 Source code and schematics

The dAISy project is partially open source.

The core of dAISy, how Silicon Labs Si4362 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

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!

10 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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