QUARK-ELEC

QK-A028 Manual
NMEA 2000 AIS + GPS Receiver

Designed in UK

Features

- Two independent receivers monitor both AIS channels (161.975MHz &162.025MHz) and decode both channels simultaneously
- Sensitivity up to -106 dBm@30% PER
- AIS reception range: up to 45 nautical miles
- BNC connector for 50 Ohm VHF antenna
- Powered SMA connector for 50 Ohm GPS antenna. Built-in GPS module to provide positional data, simply connect GPS antenna
- Combined GPS and AIS messages output as a seamless stream of data through NMEA 2000/0183 RS422 and USB simultaneously
- NMEA 2000 message output to NMEA 2000 network
- NMEA 0183 message output through USB
- NMEA 0183 message output through NMEA 0183 RS422 cable (included)
- Plug & Play connectivity with chart plotters and PCs
- Compatible with Windows, Mac, Linux, Android and iOS (included driver may be required for Windows PCs)
- This device does not come pre-loaded with map data. We advise using openCPN for map data. Some Apps may charge for map use.

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1. Contents

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2. Set up Overview

⚠️ **This is an overview only. Familiarize yourself with the manual and the manuals of any connecting devices before installation. It is always recommended that electronic equipment be installed by an experienced installer.**

Before you leave your home:

Consider whether you will need to install a driver.

Drivers software is optional and only needed to access your data via USB.
● **Windows PC:** A driver is required if using Windows and may install automatically, if not, it is included on the FREE CD and Quark-elec.com.
● **Mac / Linux:** Drivers not required for Mac or Linux.

The software is included on the FREE CD and as a download from www.quark-elec.com.
Consider if you have a CD reader/internet access on site if you want to use the above features.

Installation:

1. Mounting: Consider your location…
● Dry, sturdy location in reach of your N2K backbone.
● Ensure you have the correct length of cables needed for VHF and GPS antennas. If drilling holes for your cabling, seal around any holes to prevent damage to your vessel or equipment.

2. Connect your Antennas: VHF and GPS
● **Connect VHF:** If you want to use one VHF antenna for both AIS and radio (or other purposes), then you will need an active splitter. An active splitter will protect the A028 and your other VHF equipment (VHF radio). If not, the two signals will significantly damage each device connected as well as reducing the signal. If using two VHF antennas, place them as far away from each other as possible (at least 3 metres).
● **Connect GPS if desired: For best results,** the GPS antenna should be located outside where the sky is visible.

3. Connect to NMEA 2000 Backbone
The A028 is powered through the NMEA 2000 backbone.

4. Check LED lights are working on the A028
Flashing green lights indicate a valid signal is coming through the A028 from either GPS or AIS.
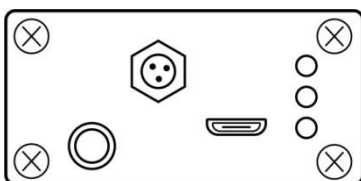
● **Power:** Top LED flashes at 3 second intervals
● **AIS:** Middle LED Flashes for each valid AIS message received
● **GPS:** Bottom LED Flashes every second while receiving a valid GPS message

5. Disconnect power and connect NMEA 0183 output if desired
Connect the '+' and '-' terminals of the NMEA output on the A028 to the '+' and '-' terminals of the input on the instrument to be connected.
The A028 outputs NMEA 0183 RS422. If your connecting device uses the older NMEA 0183 RS232 and you are having issues with your NMEA connection, you may find swapping these '+' and '-'terminals works for your device. Alternatively, connect it using a Quark-elec Protocol Bridge (QK-AS03).

6. Connect via USB if required. Windows PCs may require you to install a driver (on CD and www.quark-elec.com). Once the driver is installed simply input the COM port number from your Device Manager into your chart software.
If wishing to connect to a tablet or phone, this device will have to have USB OTG technology. Not all Phones and tablets have 'USB on the Go' functionality.

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3. Introduction

The marine Automatic Identification System (AIS) is a location and vessel information reporting system. It allows vessels equipped with AIS to automatically and dynamically share and regularly update their position, speed, course and other information such as vessel identity with similarly equipped vessels. Position is derived from the Global Positioning System (GPS) and communication between vessels is by Very High Frequency (VHF) digital transmissions. There are a number of types of AIS device, like Class A transceivers, Class B transceivers, AIS base stations, Aids to Navigation (AtoN) and AIS receivers.

The A028 is a compact dual channel, VHF AIS receiver and is able to receive information from both AIS frequencies simultaneously. It includes an integrated GPS module that can track up to 22 satellites on 66 channels. This single data stream is then transmitted synchronously via USB and NMEA 0183 RS422.This single data stream is also converted into NMEA 2000 PGNs and then output through NMEA 2000 to the NMEA 2000 network. The A028 is the perfect entry level AIS Receiver for the latest generation of chart plotters that have an NMEA2000 interface.
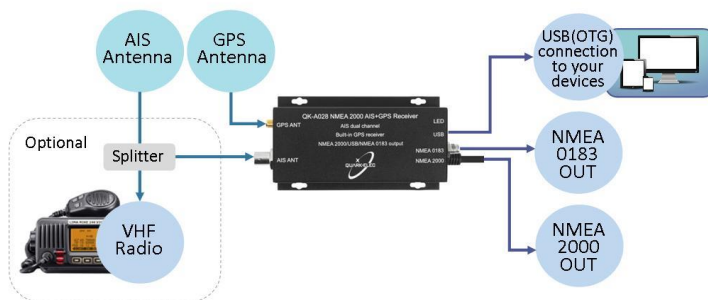

Figure 1: Contents of A028 packaging.

Figure 2: Connections diagram

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4. NMEA 2000 and NMEA 0183

NMEA 0183 is a serial data interface operating at 4800 bit/second utilizing standard asynchronous communications.

NMEA 2000 on the other hand is a serial data network operating at 250 Kbit/second utilizing the Controller Area Network (CAN). The CAN bus was originally developed for the automotive industry but is now used in numerous industrial applications.

The key difference, apart from the obvious one of operating speed, is that NMEA 0183 is an interface while NMEA 2000 is a network.

The NMEA 2000 network allows multiple electronic devices to be connected together on a common channel for the purpose of easily sharing information. Because it is a network, and because multiple devices can transmit data, a more comprehensive set of rules is required that dictate the behaviour of the members of the network. The CAN automatically provides some of these rules – mostly for control of access to the network, packet transmission, and for error detection.

Similar to NMEA 0183, NMEA 2000 defines standard data formats and definitions, but in addition provides more extensive network management rules for identifying nodes on the network, sending commands to devices, and for requesting data. Besides the greater amount of control and integration provided, NMEA 2000 replaces with a single cable the wiring of up to 50 NMEA 0183 interconnections and can handle the data content of 50 to100 NMEA 0183 data streams.

5. Mounting

A028 is designed to be securely mounted to a suitable bulkhead or shelf in an indoor environment and needs to be placed where it is well protected from humidity and water.

Although A028 comes with an extruded aluminium enclosure to shield it from external RF interference, it should not be fitted close to generators or compressors (e.g. refrigerators) as they can generate substantial RF noise. It is designed to be installed in a protected indoor environment. Generally, a suitable placement of A028 is together with other types of navigation equipment and the PC or chart plotter that will be used to display the output data. The following diagram shows an overview of the QK-A028.
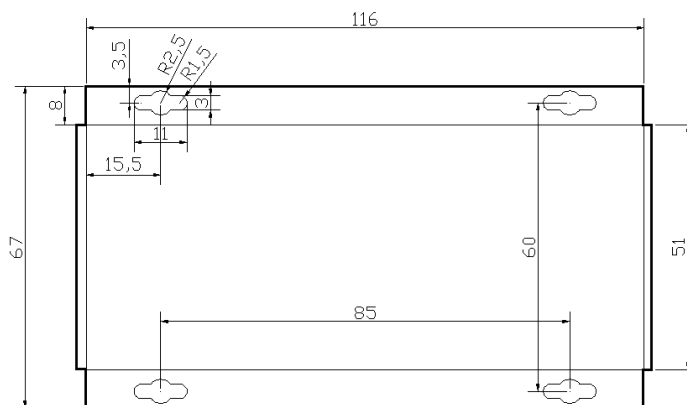

Figure 3: Dimensions of case.

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6. Connecting

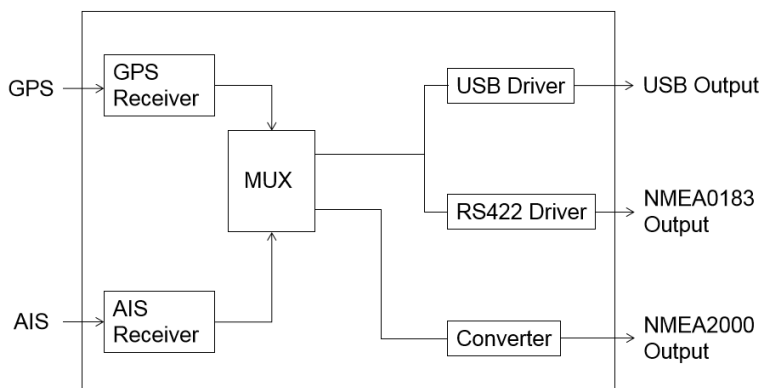A028 has the following electrical connections/indicators and outputs:

Figure 4: Data flow diagram

- **AIS antenna connector**. Standard BNC female 50 Ohm connector. An active VHF antenna splitter is required if one VHF antenna is shared by the A028 and VHF voice radio.

- **GPS antenna connector**. Standard powered SMA female 50 Ohm connector to connect with an active GPS antenna.

- **NMEA 2000 output BUS connectors**. The A028 can be connected to the standard NMEA 2000 network through NMEA 2000 output connector.

- **NMEA 0183 output connectors.** The A028 can be connected to other AIS compatible equipment, like chatter plotter, via the NMEA 0183 RS422 output. The A028 outputs NMEA 0183-RS422. If your connecting device uses the older NMEA 0183-RS232 and you are having issues with your NMEA connection, you may find swapping these '+' and '-' terminals works for your device. Alternatively, connect it using a Quark-elec Protocol Bridge (QK-AS03 https://www.quark-elec.com/product/qk-as03-nmea0183-to-garmin-bridge-board/).
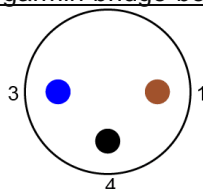

Figure 5: NMEA 0183 connector

1. **Brown**: NMEA 0183 OUT-
3. **Blue**: NMEA 0183 OUT+
4. **Black**: NC

- **USB connector**. A micro USB connector outputs the NMEA messages. A028 sends out NMEA 0183 messages via USB. Windows PCs may require you to install a driver (on CD and www.quark-elec.com). Once the driver is installed simply input the COM port number from your Device Manager into your chart software (see chapter Connection via USB port).
If wishing to connect to a tablet or phone, this device will have to have USB OTG technology. Not all Phones and tablets have 'USB on the Go' functionality.

The A028 is **not** supplied with a VHF or GPS antenna as the type of antenna and cable requirements differ from vessel to vessel. A suitable VHF or GPS antenna will need to be connected before the receiver will operate fully.

6.1. Power up
The **A028 runs on 12.0V DC and is powered through the NMEA 2000 network, this allows a much cleaner supply and an improvement in signal reception.**

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7. Antennas

AIS communication systems use frequencies in the maritime VHF band, which is considered to be 'line of sight' radio. This means that if the A028 antenna cannot 'see' the antennas of other vessels, the AIS signals from vessels will not reach A028. In practice, this is not a strict requirement, a few buildings and trees between them will be fine. Large obstacles such as hills and mountains, on the other hand, will significantly degrade the AIS signal.

To have the best possible receiving range, the AIS antenna should be placed as high as possible with a relatively clear view of the horizon. Large obstructions might shade the AIS radio communication from certain directions, giving uneven coverage.

AIS communication system frequencies are close to the duplex channels used for marine communication, so the antenna should be separated as much as possible (ideally at least 3.0 meters) from the voice communication VHF antenna to avoid unnecessary adjacent channel interference.

⚠️ **If you want to use one VHF antenna for both AIS and radio (or other purposes), then you will need an active splitter. An active splitter will protect the A028 and your other VHF equipment (VHF radio). If not, the two signals will significantly damage each device connected as well as reducing the signal strength. If using two VHF antennas, place them as far away from each other as possible (at least 3 metres).**
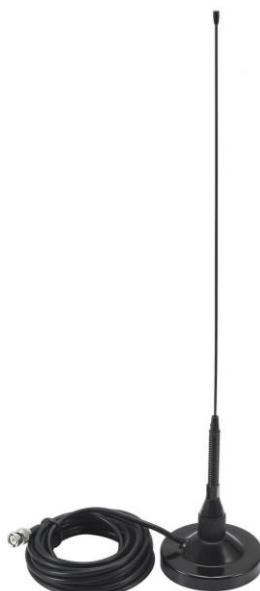

Figure 6: QK-AS02 VHF antenna by Quark-elec

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8. Connection to Output Devices

The A028 provides two NMEA message output types using 3 different connections

8.1. Connection via NMEA 2000
The NMEA 2000 outputs converted AIS messages in NMEA 2000 PGNs. Many modern on-board electronic systems now utilize the NMEA 2000 interfacing standard to allow inter-connectivity between systems. This is an easy plug 'n play solution that allows reliable on board data sharing with simple common connectors. NMEA 2000 devices connect on a cabled "backbone" with a "T-connector" used to spur off to each device. The A028 comes with an integrated NMEA 2000 cable which can be connected directly to the N2K backbone.

Figure 7: N2K connector

8.2. Connection via NMEA 0183
The NMEA0183 connector provides the links to a chart plotter and other instruments. It consists of two differential output wires. The NMEA 0183 output operates at a baud rate of 38400bps. The connected chart plotter should also be configured at this rate to receive accurate data.

Figure 8: NMEA 0183 connection

8.3. Connection via USB Port
The A028 is supplied with a USB connector. This connector provides AIS and GPS data output as standard (multiplexed information from other instruments will also be sent via these connections). This USB connector can be linked directly to a USB port on the PC. It can also be connected to other mobile devices if they have a USB OTG (On the Go) connection using the supplied cable.

Figure 9: USB plug

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8.3.1. Will your device need a driver?

Windows: To enable the USB data connection of A028 to other devices, related hardware drivers may be needed dependent on your system requirements.

Windows 7,8,10 the driver can be found on the CD in the packing box or be downloaded from https://www.quark-elec.com

The A028 registers itself to the computer as a virtual serial com port.

The drivers usually install automatically to your device if it is running an original Windows 10 version. A new COM port will automatically show up in the device manager after plug in.

Mac: For Mac OS X, the A028 will be recognized and shown as a USB modem. The ID can be checked with the following steps:

1. Plug the A028 into a USB port and launch Terminal.app.
2. Type: less /dev/*sub*
3. The Mac system will return a list of USB devices. A028 will display as - "/dev/tty.usbmodemXYZ" where XYZ is a number. Nothing further needs to be done if it is listed.

Linux: No driver is required for Linux. When plugged into the computer, A028 will show up as a USB CDC device on /dev/ttyACM0.

8.3.2. Checking the USB connection (Windows)

After the driver is installed, run the Device Manager and check the **COM number** (this is the number associated with the USB port you are using. The port number is the number that Windows assigns as an input device. These can be generated randomly by your computer). Your chart software may require your COM number in order to access the data.

The port number for the A028 can be found in Windows 'Control Panel->System->Device Manager' under 'Ports (COM & LPT)'. Find the A028 in the list for the USB variant. To change this number, double click the A028 and select the 'Port Settings' tab. Click the 'Advanced' button and change the port number to the one required.

Checking the USB data flow: If desired, the USB data can always be checked with a terminal monitor application, like Putty or HyperTerminal. To do this, enter the following into the COM port settings: **Bits per second: 38400bps**, **Data bits: 8**, **Parity: None**, and **Stop bits: 1**.
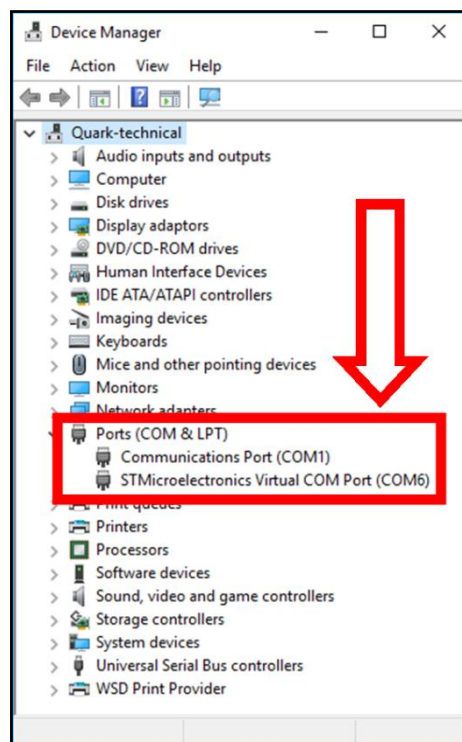

Figure 10: Device Manager in Windows

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9. Status LED'S

LED lights. The A028 features three LEDs which indicate power, AIS and GPS status respectively. The three LEDs turn on and then off after initialization. When operating, these LEDs flash as below:
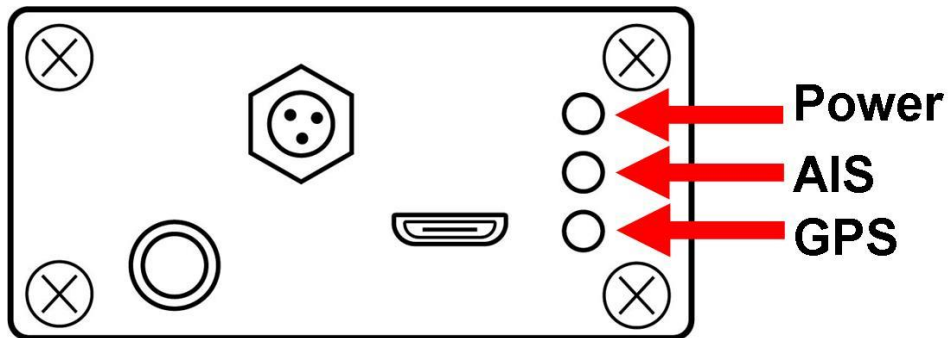

Figure 11: LED's

- **Power:** Top LED flashes at 3 second intervals.
- **AIS:** Middle LED Flashes for each valid AIS message received.
- **GPS:** Bottom LED Flashes every second while receiving a valid GPS message

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10. Chart software

There is a wide range of chart software available such as Imray, PolarView and OpenCPN.

- https://opencpn.org/ OpenCPN (Open Chart Plotter Navigator) is a free software project to create concise chart plotter and navigation software, for use underway or as a planning tool. OpenCPN is developed by a team of active sailors using real world conditions for program testing and refinement.

- http://www.polarnavy.com/main/download

- https://www.imray.com/imray-navigator-app/

We will use OpenCPN for our example; other software will require similar setup.

10.1. OpenCPN example USB setup

1. When you first open the software you will be greeted with a page similar to the one below. This is the main view of openCPN software. You now need to add data to openCPN via your Quark-elec instruments. Click on the 'Options' tab at the top. The settings tab looks like a spanner as seen below in the highlighted image.
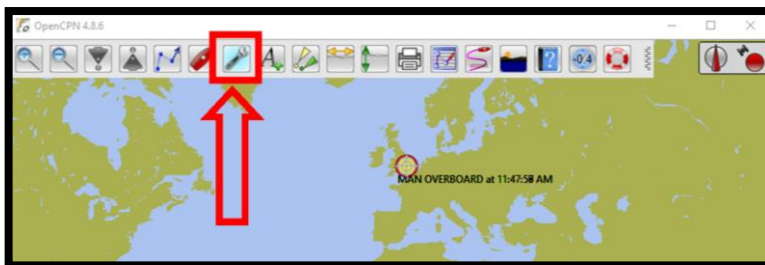
2. In the options at the top of the menu will be a tab/button that says '**Connections**'. Click on this

3. Click on '**Add Connection**' button highlighted in the picture below.

4. Select **'Serial'**

5. Select from the drop down the **COM** number assigned to your A028 (See connecting via USB to find com port in device manager). Adjust the Baud rate accordingly (38400 covers AIS)

6. Click **'Apply'** and then **'OK'**
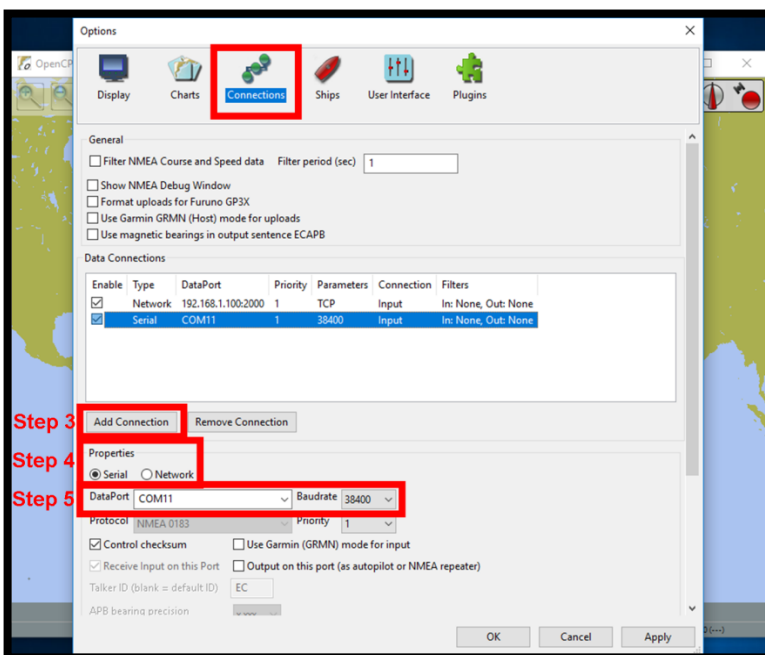
Figure 12: OpenCPN Settings menu

10.2. Maps

OpenCPN interface comes with a basic map view. You can easily download more detailed maps.

There is a wide range of free and licensed charts available in different formats via the OpenCPN website at https://opencpn.org/OpenCPN/info/chartsource.html.

A worldwide directory of free nautical charts can also be found on openseachart.org. The collection and the updates are community driven.

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11. Support AIS message.

The A028 receives all class A/B messages transmitted on two AIS channels. The following messages (above 95% of all AIS messages) will be converted to NMEA 2000 PGNs and sent to the NMEA 2000 network. However, the operator can still monitor and receive the rest in NMEA 0183 format through USB and the NMEA 0183 port.

NMEA 0183 sentence Formatter	Description	NMEA 2000 PGNs that are sent when this sentence is received
VDM	AIS message 1,2,3	129038
VDM	AIS message 4	129793
VDM	AIS message 5	129794
VDM	AIS message 9	129798
VDM	AIS message 18	129039
VDM	AIS message 19	129040
VDM	AIS message 24	129809,129810

12. Specification

Item	Specification
Frequency bands	161.975MHz &162.025MHz
Operating temperature	-25°C to +80°C
Storage temperature	-25°C to +85°C
DC supply	12.0V(+/-0.5V)
Maximum supply current	75mA
AIS receive sensitivity	-105dBm@30%PER
GPS receiver sensitivity	-162dBm
NMEA data format	ITU/ NMEA 0183 format and NMEA 2000 PGNs
NMEA output data rate	38.4kbps

13. Limited Warranty and Notices

Quark-elec warrants this product to be free from defects in materials and manufacture for one year from the date of purchase. Quark-elec will, at its sole discretion, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts and labour. The customer is, however, responsible for any transportation costs incurred in returning the unit to Quark-Elec. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alteration or repairs. A returns number must be given before any unit is sent back for repair.
The above does not affect the statutory rights of the consumer.

Disclaimer
This product is designed to aid navigation and should be used to augment normal navigational procedures and practices. It is the user's responsibility to use this product prudently. Neither Quark-, nor their distributors or dealers accept responsibility or liability either to the products user or their estate

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for any accident, loss, injury or damage whatsoever arising out of the use or of liability to use this product.

Quark- products may be upgraded from time to time and future versions may therefore not correspond exactly with this manual. The manufacturer of this product disclaims any liability for consequences arising from omissions or inaccuracies in this manual and any other documentation provided with this product.

Document history

Issue	Date	Changes / Comments
1.0	14-10-2018	Initial release
2.0	15-1-2019	Product release
	10/05/2021	

14. Glossary

- **NMEA 2000 / N2K:** is a serial data network operating at 250 Kbit/second utilizing the Controller Area Network (CAN). The CAN bus was originally developed for the automotive industry but is now used in numerous industrial applications. It is a communications standard used for connecting marine sensors and display units within ships and boats and is generally plug-and-play.
- **N2K backbone:** Used with NMEA 2000, the backbone is the main BUS supplying data and power to all the devices on the boat.
- **USB:** cable for communication and power supply between devices.
- **NMEA 0183:** is a serial data interface operating at 4.8 Kbit/second utilizing standard asynchronous communications. It is an electrical and data standard for communication between marine electronics.
- **PGN:** Packet group number – used in the NMEA 2000 protocol instead of sentences
- **Sentences:** Used in NMEA 0183 protocol to transfer data between marine equipment.

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