OPERATION & INSTALLATION MANUAL

AIS CTRX GRAPHENE

Class B AIS Transponder

TRUE HEADING

Version 1.4E

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REVISION

Version	Date	Responsible	Approved	Changes
1.0PE	2012-12-14	Anders Bergström	Nils Willart	Preliminary release
1.1PE	2013-03-08	Nils Willart		Update
1.2PE	2013-04-09	Nils Willart		Editorial
1.3PE	-	-	-	Intermediate, not used
1.4E	2013-05-21	Nils Willart		PGN list added

INTRODUCTION

We would like to thank you for choosing True Heading AB as supplier of your AIS Class B Transponder. The AIS CTRX GRAPHENE is a high quality AIS Class B Transponder using the latest technology. AIS CTRX GRAPHENE makes it possible to receive information from ships, buoys, lighthouses, SAR helicopters, Coastguard units, Pilot boats, Weather station etc. and to send information about your own ship to others that are equipped with Automatic Identification System (AIS) transponders or receivers. **SEE AND BE SEEN**

It is today, according to the IMO SOLAS regulation a requirement for all ships above 300 GT to carry AIS. This means that a large number of ships and other types of navigational information providers will be seen by your AIS CTRX GRAPHENE and contribute to enhanced safety in your navigation.

Picture 1 Real traffic scenario between Sweden and Bornholm (Denmark)

It is of utmost importance that you read this manual before you start to install and use your AIS CTRX GRAPHENE.

GLOSSARY

ACA	(AIS) Regional Assignment Channel Assignment Message
ACK	Acknowledgement
ACS	(AIS) Channel management information source messages
AFSK	Audio frequency-shift keying
ALR	(AIS) Alarm Message
A to N	Aid to Navigation
AIS	Automatic Identification System
ATC	Air Traffic Control
BIIT	Built In Integrity Testing
BNC	Bayonet fitting type RF connector
CSTDMA	Carrier Sense Time Division Multiple Access
COG	Course over Ground
CR	Carriage Return
CS	Carrier Sense
CSTDMA	Carrier Sense TDMA
DC	Direct Current
DGNSS	Differential Global Navigation Satellite System
DGPS	Differential Global Positioning System
DSC	Digital Selective calling
ETA	Estimated Time of Arrival
GALILEO	European equivalent to GPS
GLONASS	Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GMSK	Gaussian Minimum Shift Keying
GPS	Global Positioning Satellite / System
HF	High Frequency
IMO	International Maritime Organization
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
LF	Line Feed
LNA	Low-noise amplifier
MF	Medium Frequency
MKD	Minimum Keypad and Display
MMSI	Maritime Mobile Service Identity
MPE	Maximum Permissible Exposure
NM	Nautical Mile = 1852 m
NMEA	National Marine Electronics Association
PC	Personal Computer

PI	Presentation Interface
RF	Radio Frequency
RTCM	Radio Technical Commission for Maritime Services Commission
RX	Receive or Receiver
RFI	Radio frequency interference
SAR	Specific Absorption Rate
SELV	Separated Extra Low Voltage
SMA	Swedish Maritime Administration
SMS	Short Message System
SOG	Speed over Ground
SOLAS	Safety Of Life At Sea
SOTDMA	Self Organized Time Division Multiple Access.
SRM	Safety Related Message
SRT	Software Radio Technology
TDMA	Time-division Multiple Access
TNC	Threaded type BNC connector
TX	Transmit or transmitter
UTC	Universal Time Co-ordinated
VDM	(AIS) VHF Data Link Messages
VDO	(AIS) VHF data link own vessel messages
VHF	Very High Frequency
VTS	Vessel Traffic Services (Like ATC but for ships)
VSWR	Voltage Standing Wave Ratio

CONDITIONS

Before you start using the AIS CTRX GRAPHENE product from True Heading AB it is important that you read and fully understand the installation manual and its instructions. You should only proceed with the installation if you are confident that you will be able to do so.

True Heading AB cannot be held liable for any injury or damage caused by, during or because of the installation of AIS CTRX GRAPHENE. The AIS CTRX GRAPHENE is used at your own risk and it shall be remembered that AIS and GPS data depends on the full co-operation of other users and systems.

AIS CTRX GRAPHENE is a navigation aid and works in co-operation with other similar systems like e.g. radar, optical lookout etc. The AIS CTRX GRAPHENE installation should be inspected from time to time and checked on its operational quality frequently by the user. Remember that navigation and life at sea always requires proper seamanship and that the AIS CTRX GRAPHENE is not a replacement for such qualities.

NOT ALL VESSELS CARRY AIS. IT IS THEREFORE IMPORTANT TO KEEP PROPER LOOKOUT AT ALL TIMES AND TO USE ALL AVAILABLE MEANS TO AVOID COLLISIONS AND ACCIDENTS.

GPS MAY FROM TIME TO TIME INCLUDE ERRORS: THEREFORE, THE POSITION RECEIVED FROM THE GPS BUILT IN TO AIS CTRX GRAPHENE SHALL ALWAYS BE VERIFED WITH OTHER AVAILABLE MEANS.

WARRANTY

General

AIS CTRX GRAPHENE is developed and manufactured to meet high technical requirements and user demands. If installed correctly and with regular maintenance your AIS CTRX GRAPHENE should provide you with several years of operation and a very useful product. For further information provided in the manual and in this information sheet please consult the place where you purchased the AIS CTRX GRAPHENE or direct to our support.

Warranty conditions

- The warranty belongs to the person that purchased the product and cannot be handed over to a third party or person.

- The warranty is not valid if serial number is missing, seals broken or if the AIS CTRX GRAPHENE has been incorrect installed. Neither is the warranty valid if instructions for connection have not been followed, faults caused by wrong usage, own made modifications or service made from none authorized service stations.

- True Heading AB acknowledges that AIS CTRX GRAPHENE at delivery has been controlled and found operational.

- True Heading AB agrees to repair or replace any faulty unit without any cost according to the conditions set forth during a period of two (2) years from day of purchase.

- The warranty includes replacement or repair of faulty unit due to error in components or errors in relation to the production of the product.

- The warranty covers costs for spares, labor, and return shipment. It does not include shipment from to the repair facility.

- True Heading AB will never be liable under the warranty conditions for incorrect use, misuse, and incidental, indirect or consequential damages of the AIS CTRX GRAPHENE.

- Proof of purchase is required for any warranty claim of the AIS CTRX GRAPHENE.

Warranty procedures

True Heading AB repairs and replaces faulty parts or units. The customer is responsible for transport of the defect part or unit to True Heading or its retailer.

Warranty claims shall be made to the place where AIS CTRX GRAPHENE was purchased or direct to True Heading AB through mail, fax or e-mail to our support department.

Other issues

Proper seamanship and common sense is applicable when using AIS CTRX GRAPHENE and the products shall only be seen as a navaid. True Heading AB keeps the right to change the specification of the product without prior notice.

IF YOU ARE NOT ABLE TO ACCEPT THE TERMS ABOVE, PLEASE RETURN THE AIS CTRX GRAPHENE TO YOUR RETAILER FOR FULL CREDIT BEFORE OPENED AND USED.

SUPPORT

If you need support, please contact the closest reseller or the location where you acquired the product. The manufacturer will only provide support direct if these procedures are followed. The support case has to be registered properly through our webpage at www.trueheading.se .

In order to ensure receipt of important information and to protect your guarantee you can register your AIS CTRX GRAPHENE purchase at True Heading AB by sending an e-mail to register@trueheading.se where you indicate series numbers, purchase dates, your name, address and where you bought your equipment.

In accordance with our policy to always offer development and enhancements of our products, and future versions of AIS CTRX GRAPHENE may differ somewhat from this manual. Updated versions of the manual are always available for download at our homepage www.trueheading.se .

The information in this manual is subject to change without prior notice or information thereof.

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GENERAL NOTICE

The Automatic Identification System (AIS) unit mostly utilise a Global Navigation Satellite System (GNSS) system such as e.g. GPS or GLONASS to determine position.

The accuracy of these systems is variable and can be affected by factors such as the positioning of the antenna, the number of satellites available to determine a position and for how long satellite information has been received.

It is desirable as often as possible to verify both your vessel's AIS derived position data and other vessels AIS derived position data with visual or radar based observations.

The compass safe distance of this unit is 0.5m or greater for 0.3° deviation.

LICENSING

IMPORTANT: In most countries the operation of an AIS unit is included under the vessels marine VHF radio licence provisions. The vessel on to which the AIS unit is to be installed must therefore possess a valid VHF radiotelephone licence which lists the AIS system and the vessel Call Sign and MMSI number.

Please contact the relevant authority in your country for more information.

In accordance with our policy of continuous development and product improvement the AIS CTRX GRAPHENE hardware and/or software may be upgraded from time to time and future versions of the AIS CTRX GRAPHENE may therefore not correspond exactly with this manual.

When necessary upgrades to the product are made, these will be accompanied by updates or addenda to this manual.

Please take time to read this manual carefully to understand its contents fully so that you can install and operate your AIS system correctly.

Information contained in this manual is liable to change without notice.

True Heading AB disclaims any liability for consequences arising from omissions or inaccuracies in this manual and any other documentation provided with this product.

INFORMATION ABOUT AIS

General

AIS (Automatic Identification System) is the name of a system that makes it possible for ships to identify other ships and to monitor ship movements. The reason for implementing the AIS system is for the mariner to obtain more information about ships in the vicinity than what radar is able to provide. AIS gives e.g. information about a ships identity (name, call sign, IMO number and MMSI), size this even for ships behind Island or bends that radar cannot detect.

AIS is used to enhance safety for life at sea, improve safety and efficiency in navigation and protect the marine environment.

AIS-information transmitted from a ship contains of three (3) different main types:

- Static data that was programmed into the AIS equipment at installation and it only needs to be changed if the ship changes its name, flag or undergoes a major refit where size or ship type is changed;

- Dynamic data contains information that automatically is updated from ship sensors like the heading from the Gyro, Position and speed from GNSS equipment. Also navigational status belongs to the group of dynamic data but is updated manually by the crew; and

- Voyage related data that manually is updated by the crew along the voyage.

From the start AIS sometimes also was referred to as UAIS or as the 4S transponder system that meant Ship to Ship and Ship to Shore.

IMO adopted 1998 a performance standard for AIS within the SOLAS requirement that described in general how AIS should work. Below follows a brief description of the main requirements for AIS from the performance standard:

- Automatically provide information to AIS land stations, other ships and airborne units e.g. SAR helicopters about the ships identity, Type of ship, Position, Course, Speed, Navigational status (e.g. under way using engine, at anchor) and other safety related information of importance.
- Be able to receive the same type of information from other ships.
- Be able to monitor and track other ships.
- Exchange information with land based AIS systems.

AIS is an automatic system that continuously and simultaneously transmits on two channels in the maritime VHF frequency band.

AIS can handle several reports in a rapid consecutive flow. To accomplish this AIS uses a technique called Self Organized Time Division Multiple Access (SOTDMA) that guarantees high transmission safety and operational robustness.

AIS also allows for other types of information from e.g. sensors like Gyro, GPS and echo sounders etc. to be transmitted automatically.

Important areas where AIS is used are:

- Information exchange between ships within VHF range (normally 20-30 NM) to enhance safety at sea and to improve situation awareness.

- Information exchange between ships and AIS land stations as e.g. a VTS that controls and monitors maritime traffic in an area.

- Automatic reporting in areas with mandatory reporting of different kinds.

- Exchange of safety related information between ships and between ships and land stations.

- Services like e.g. meteorological information in real-time from areas of importance, identity and position of floating and fixed aids to navigation to improve identification and navigation.

How AIS Works

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 craft. Position is derived from a Global Navigation Satellite System (GNSS) network and communication between vessels is by Very High Frequency (VHF) digital transmissions. A sophisticated and automatic method of time sharing the radio channel is used to ensure that even where a large number of vessels are in one location blocking of individual transmissions is minimised, any degradation of the expected position reporting interval is indicated to the user and even if the unit suffers extreme channel overload conditions it will always recover to normal operation.

AIS Classes

There are two classes of AIS units fitted to vessels, Class A and Class B. In addition AIS base stations may be employed by the Coastguard, port authorities and other authorised bodies. AIS units acting as aids to navigation (A to N) can also be fitted to fixed and floating navigation markers such as channel markers and buoys.

Class A units are a mandatory fit under the safety of life at sea (SOLAS) convention to vessels above 300 gross tons or which carry more than 11 passengers in International waters. Many other commercial vessels and some leisure craft also fit Class A units.

Class B units are currently not a mandatory fit but authorities in several parts of the world are considering this. Class B units are designed for fitting in vessels which do not fall into the mandatory Class A fit category.

The AIS CTRX GRAPHENE is a Class B unit

Position Information Source

As noted above the marine AIS system uses position information derived from networks such as the Global Positioning Satellite (GPS) or the Global Navigation Satellite System (GLONASS) in order to determine the location of the AIS unit and thus the vessel to which it is fitted.

Short technical description of AIS

AIS operates primarily on two dedicated VHF-frequencies (AIS1 – 161,975 MHz and AIS2 – 162,025 MHz). In areas where these two channels are not available, AIS can automatically change to other alternatively available frequencies.

AIS uses two VHF radio channels, where the information is transmitted in short data packages or slots in predefined and synchronized time frames. The dynamic information (position, speed, heading etc) is transmitted in intervals from 2s up to 10s depending on the manoeuvres of the transmitting ship were the AIS is mounted. Static and voyage related information (type of ship, size, cargo, destination etc.) is transmitted every sixth minute or upon request from other units. Position, course and speed

normally are collected from the same sensor systems that provides the same information used in the navigation e.g. in radars or ECDIS and this is normally based on GPS or DGPS. All ships within VHF coverage will be able to receive AIS data and competent authorities that have installed networks with coastal AIS coverage can receive the information. The capacity for the ships to report is defined by the IMO performance standard to a minimum of 2000 data packages or slots per minute (see picture 2). ITU *(Technical Standard for the Universal AIS)* has been kind to double this and has provided AIS with 4500 data packages or slots per minute. The transmission is based on the (SO)TDMA (*Self-organized Time Division Multiple Access)* technique, that allows the system to overload with 400 till 500 % and still give almost a 100 % message throughput between ships that are closer to each other than 8 to 20 nautical miles. In such case the system overloads targets far away will be discriminated in favor of targets close to your own ship. In reality, the system capacity is unlimited and allows for a large number of ships to communicate simultaneously.
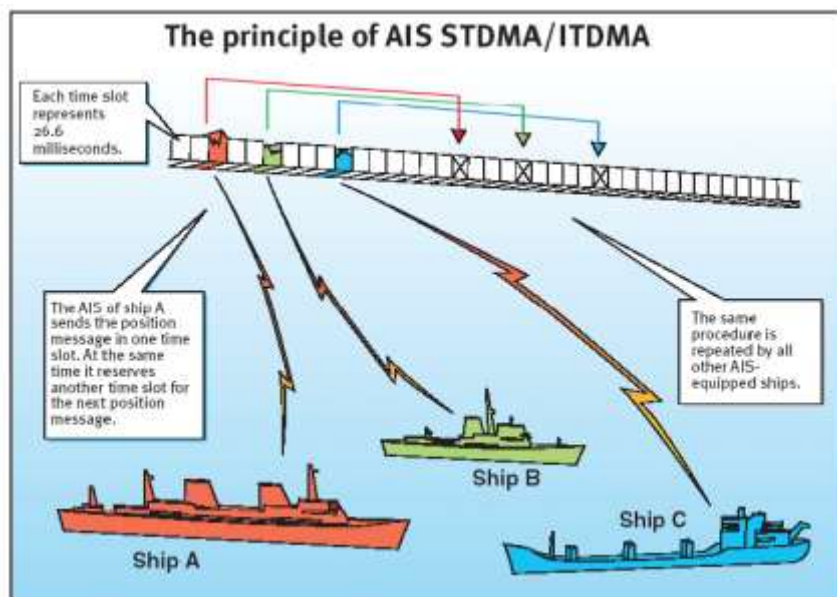
Picture 2 The principle of AIS technology on the two radio channels.

Limitations with AIS

You should always be aware that all ship others ships and in particular pleasure crafts, fishing boats, warships and some coastal stations and VTS not will be equipped with AIS. Ships that have been mandated to carry AIS can also under certain conditions turn of their AIS equipment at the master's disgrace. Therefore it is important to be aware that the information that AIS provides might not be the full and complete picture of the situation around your ship.

Users of AIS must also be aware that transmission of false data can occur and that this will be hazardous not only to your own ship but to other as well. The user is responsible for all data that is entered into the system and for information provided by external sensors. The accuracy of received AIS data is only as good as the information transmitted from the source of information.

You should always be aware that wrong configured or calibrated ship sensors (positions-, speed- or heading sensors) could lead to that wrong information will be transmitted. Dangerous situations can occur if faulty information is shown on another ship.

PRODUCT SPECIFICATION

Dimensions:	210 x 144 x 50 mm (L x W x H)
Weight:	0,45 kg GRAPHENE, 0,5 kg GRAPHENE+
Power:	DC 12-24V (min. 10V, max. 32V) Average power consumption 4W (GRAPHENE) Average power consumption 4.5 W (GRAPHENE+) 350 mA@12 VDC (receiving) Peak current rating: 1.2A @ 12VDC (transmitting)
GPS Receiver (AIS Internal):	IEC 61108-1 compliant 50 channels
Data Interfaces:	USB NMEA 2000 LEN (Load Equivalence Number) = 1 NMEA 0183, RS422 38400 baud
Connectors:	VHF Antenna connector = BNC (Female) GPS Antenna connector = TNC (Female) USB B serial data (USB mini connector) Combined NMEA 0183/DC power connector NMEA2000 connector VHF Radio = FME (Male) -GRAPHENE+ only
VHF Transceiver:	1 Transmitter, 2 Receivers Frequency: 156.025 to 162.025 MHz Receiver sensitivity: <- 110dBm @ 20% PER
RF Output Power:	2 W (50Ω)
Channel Bandwidth:	25 kHz
Data Bit rate:	9600 b/s ± 50 ppm (GMSK) AIS 1200 b/s ± 30 ppm (FSK) DSC
Environmental:	IEC 60945, Operating Temperature: -15ºC to +55ºC IEC 62287, Section 5, Cat c) exposed to the weather
Compass safe distance:	0.5m or more for 0.3° deviation.

LED indicators:

POWER -	**Green**
STATUS -	**Green**
TX STAT -	**Yellow**
ERROS -	**Red**
VHF TX -	**Yellow**
SILENT-	**Blue**

Standards

This product complies with all the necessary standards under the European R&TTE directive for Article 3.1(a), 3.1(b), 3.2 and 3.3(e). The following standards have been followed in pursuance of this:

IEC62287-1, Ed2: 2006-03 Maritime navigation and radio communication equipment and systems – Class B ship borne equipment of the automatic identification system (AIS) – Part 1: Carrier-sense time division multiple access (CSTDMA) techniques

IEC60945, Ed4: 2002-08 Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results

IEC61162-1, Ed2: Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners

IEC61108-1: GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) – Part 1: Global positioning system (GPS) -Receiver equipment - Performance standards, methods of testing and required test results

EN 301 843-1 v2.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for marine radio equipment and services; Part 1: Common technical requirements

EN 50383: 2002 Basic standard for calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunications system (110MHz – 40GHz)

EN60950-1:2002 Information technology equipment – Safety – Part 1: General requirements

NMEA2000 Edition 2.20

Declaration of Conformity

True Heading AB declares that this product is in compliance with the essential requirements and other provisions of the R&TTE directive 1995/5/EC.

The product carries the CE mark, notified body number and alert symbol as required by the R&TTE directive

This True Heading product can be used in the following European Community and EFTA Contries:

AT	BG	BE	CY	CZ	DK
EE	FI	FR	DE	GR	HU
IE	IT	LV	LT	LU	MT
NL	PL	PT	RO	SK	SL
ES	SE	GB	IS	LI	NO
CH					

Getting started.

Before AIS CTRX GRAPHENE is installed, you should check that you have all the equipment you need for the installation and that nothing is missing from your delivery. The AIS CTRX GRAPHENE comes in two versions the GRAPHENE and the GRAPHENE+ version. The plus version also contains a built in antenna splitter making it possible to use the same VHF antenna for both the AIS and the VHF radio.

AIS CTRX GRAPHENE comes with the following parts:

1	AIS CTRX GRAPHENE Class B Transponder	P/N 0012-001-000
1	Data and DC cable (1 m)	P/N 0012-770-000
1	USB cable 1 m	P/N 0012-980-000
1	BNC to UHF adapter	P/N 0012-989-000
1	CD incl. manual, set up software and AIS information	P/N 0012-972-000

AIS CTRX GRAPHENE + comes with the following parts:

1	AIS CTRX GRAPHENE Class B Transponder	P/N 0012-002-000
1	Data and DC cable (1 m)	P/N 0012-770-000
1	USB cable 1 m	P/N 0012-980-000
1	BNC to UHF adapter	P/N 0012-989-000
1	Cable (2 m) AIS to VHF with connectors	P/N 0010-980-000
1	CD incl. manual, set up software and AIS information	P/N 0012-972-000

The following may be needed to finish your installation but is *not included*:

1	VHF marine band antenna with cable and UHF or BNC type coaxial connector.	
1	GPS antenna (active antenna, built-in LNA, 20dB gain min., 5VDC) with cable and TNC coaxial connector	
2	3A Fuse with fuse holder	
1	DC cable, for the DC power installation	
4	Mounting screws	
1	Installation materials such as mounts for the antennas, cable ties, screws, connection blocks etc.	

Before you begin the installation, you should decide on where you want to place your AIS CTRX GRAPHENE unit.

Note the following:

Place the transponder in such a way that you will be able to see the LED's on the front. This will make it easy to monitor the functions and make sure that the unit is working properly.

The transponder should be installed in a place where the length of the antenna cables can be kept as short as possible, but also where DC power and access to other equipment you would want to connect the AIS to is conveniently available.

AIS CTRX GRAPHENE has 3 data ports. 2 of them are preferably used for the connection to a plotter (the NMEA0183/RS422 or the NMEA 2000 port). A USB port (mini type) is available for connection to a PC. This is used for the configuration of the unit as well as maintenance or use with a PC navigation solution.

If you are installing the AIS CTRX GRAPHENE+ version or using a Class B VHF splitter with the standard CTRX Graphene it is recommended that you connect the DC leads it to the same power source as your VHF.

There are antennas available specifically made for use with AIS equipment but any standard type marine band VHF antenna will work. Place your VHF antenna as high as possible but at least 2.5-3 m above the water surface. If you are installing a separate AIS antenna you should make sure that it is separated as much as possible from other VHF antennas to avoid interference.

GPS antennas should be installed in such a way that the antenna top surface has a free and unobstructed view of the horizon. Make sure that the antenna is not placed nearby metal objects in order to minimize reflections of the received signal. GPS antennas should not be placed in the vicinity of high power HF or satellite communications equipment.

INSTALLATION

Once you have unpacked the box and checked that your delivery is complete, proceed with the installation as follows:

Figure 5   AIS CTRX GRAPHENE + with its antennas and data/DC connectors

The 12 pole multi-pin connector mounted on the transponder has the following configuration of the pins:

Pin	Signal	Color marking
1	Signal ground	BROWN
2	Power supply Voltage GND (-)	BLUE
3	SILENT LED (Blue)	WHITE
4	Signal ground	GREEN
5	NMEA 0183/RS-422 TX B (-)	YELLOW
6	NMEA 0183/RS-422 TX A (+)	GREY
7	NMEA 0183/RS-422 RX A (+)	PINK
8	Power supply Voltage (+)	RED
9	Power supply Voltage GND (-)	BLACK
10	Power supply Voltage (+)	ORANGE
11	External SILENT switch	PURPLE
12	NMEA 0183/RS-422 RX B (-)	LIGHT GREEN

Table 1. Data/DC connector configuration

The transponder is secured to the bulkhead or deck by means of four screws. A template for the fixing of the screws is supplied in the box in the shape of a cardboard divider sheet. The transponder should be installed so that the six LEDs on the front panel are readily visible for monitoring of the AIS CTRX GRAPHENE functionality. Furthermore, the transponder may also be placed for easy access of the "S" –marked button, which is used to switch on and off the unit in "silent mode". Silent mode turns off the transmitter and places the transponder in in receive- only mode. A remote switch and LED indicator can be connected to the transponder through the DC/DATA cable as shown in table 1. A USB connector is also available.

For best performance and an easy installation a suitable place should be found were the installations can provide:

1. Short cable-runs for the VHF and GPS antenna.
2. Easy access to DC power.
3. Access to other equipment to which you would connect the transponder to.

To avoid interference from other equipment on board such as generators, compressors or electrical panels the unit should not be installed together or close to such equipment.
The accompanying installation software provides a diagnostic program which can be useful to diagnose a situation where the transponder is experiencing interference. Read more about this in the "*Diagnostics*" section in the chapter on programming AIS CTRX GRAPHENE.

To ensure that best performance is obtained it is important to choose good antenna cables. For shorter lengths RG58C/U is sufficient. For cable lengths exceeding 10 m, a low loss cables should be used, such as type RG213, RG214, or LM400, depending on length. It is also important to use proper connectors, where crimp type connectors are preferred over soldered connections. Ready-made 10 m lengths of RG58C/U type cable can conveniently be used. Ready-made lengths with FME type connectors are available where adaptors for the different kind of coaxial connectors used can be fitted. In this way an easy-to-assemble cable/connector kit can be put together for a specific installation without any special tools. True Heading can provide ready-made kits, cables and connectors.
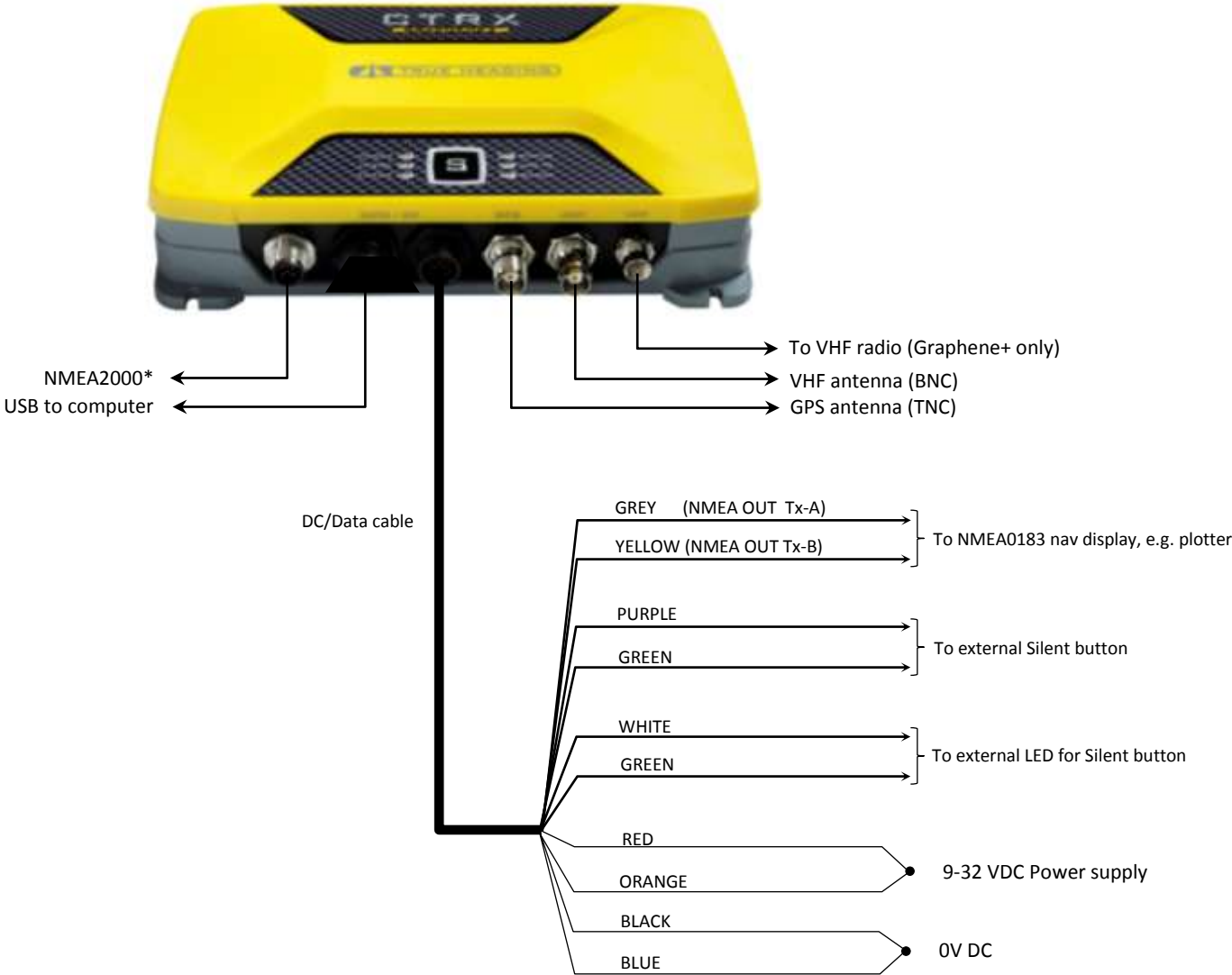
Figure 7.   **CTRX Graphene+:** From L to R: NMEA2000 connector, USB-mini connector, Data/DC circular connector, GPS antenna (TNC), VHF antenna (BNC) and VHF radio (FME).

Figure 7.   **CTRX Graphene**: From L to R: NMEA2000 connector, USB-mini connector, Data/DC circular connector, GPS antenna (TNC), VHF antenna (BNC).

After installation of the antennas the AIS CTRX GRAPHENE should be connected to the application where the AIS data from the transponder will be used. AIS CTRX GRAPHENE has three data ports, 1 NMEA2000, 1 USB and 1 NMEA 0183 to choose from.

CONNECTION, GENERAL OVERVIEW

NMEA2000*
USB to computer

To VHF radio (Graphene+ only)
VHF antenna (BNC)
GPS antenna (TNC)

DC/Data cable

GREY   (NMEA OUT Tx-A)
YELLOW (NMEA OUT Tx-B)
To NMEA0183 nav display, e.g. plotter

PURPLE
GREEN
To external Silent button

WHITE
GREEN
To external LED for Silent button

RED
ORANGE
9-32 VDC Power supply

BLACK
BLUE
0V DC

ANTENNA CONNECTIONS

VHF-antenna
E.g. AC Marine CX4

GPS-antenna
(RV76)

CTRX Graphene

Existing VHF radio

2m RG-58 cable w/connectors FME & UHF.

Existing VHF antenna cable in your boat

Cable, 5m, RG-58, attached to the GPS antenna

CTRX Graphene+

CONNECTION TO AN NMEA2000 NETWORK

The picture shows the CTRX Graphene+

NMEA2000*
Connection

RED
ORANGE   9-32 VDC (+)
BLACK
BLUE   0 VDC (-)

NMEA2000 Drop cable
Must not be longer than 6m

NMEA2000
End resistor
120 Ohm

NMEA2000 T-connection

NMEA2000
Power Tap

NMEA2000
End resistor
120 Ohm

NMEA2000 Backbone

9-16 VDC (+)

0 VDC (-)
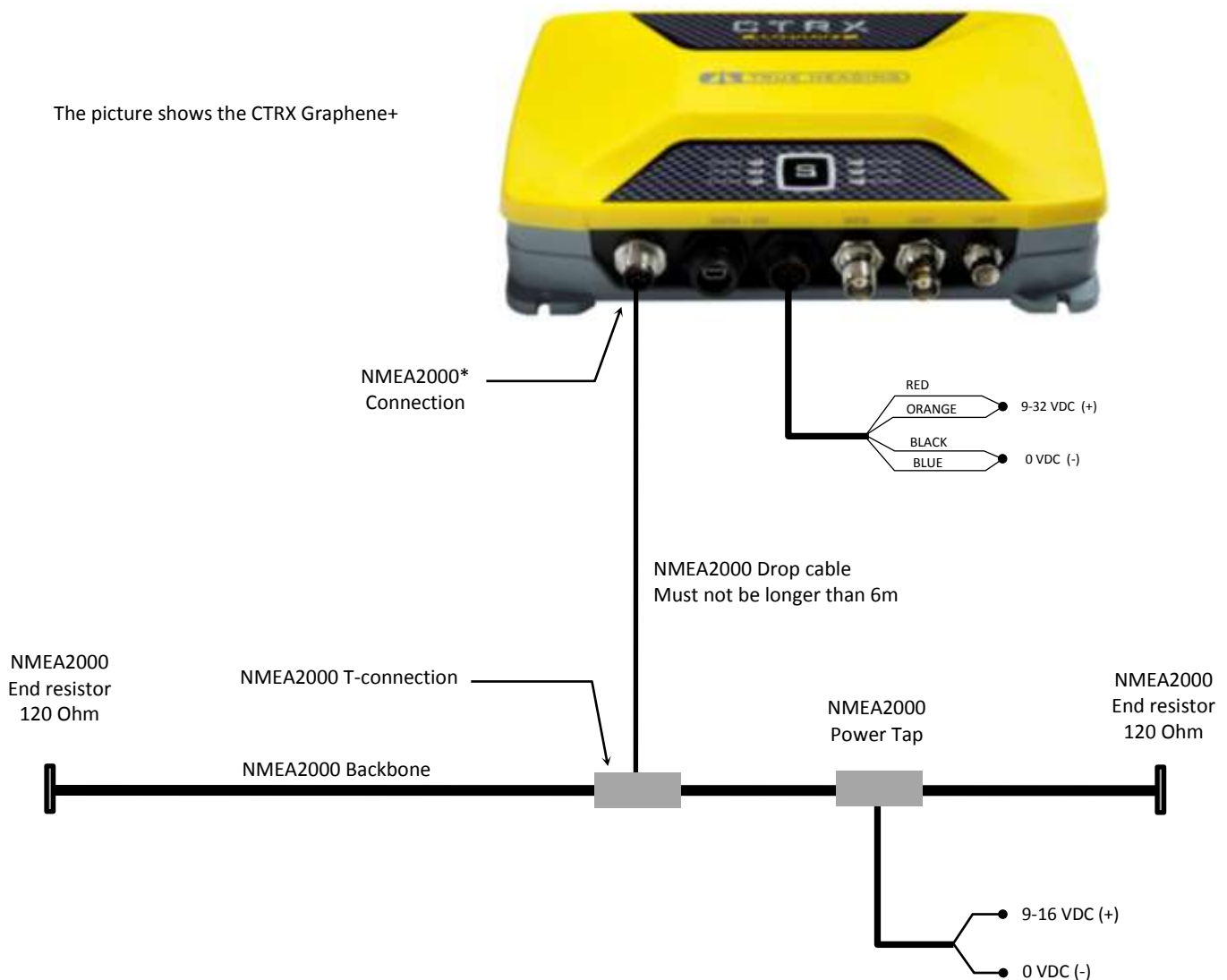
NOTE: The transponder must be connected to an external power source when connected to an NMEA2000 network. Even though some NMEA2000 devices can operate on the bus power, the transponder current consumption is higher than the maximum allowed and subsequently must use external power.

LEN=1 (LEN= Load Equivalence Number**)**

CONNECTION TO THE DC POWER SUPPLY

Now, the connection to the DC power supply is all that's left. The AIS CTRX GRAPHENE can be connected to any DC power supply providing between 12V to 24V DC. The lower limit is 10V. Should the supply voltage go below 10V the ERROR LED on the front panel will light up and the unit cease to transmit. The upper limit is 32VDC. This is the maximum allowable voltage. If the upper voltage limit is exceeded severe damage will be made to the transponder.

The DC supply point should be chosen with care. The recommended source should be the same as the VHF radio and/or other navigational equipment.

Even though the source may be protected with a circuit breaker the transponder must have its own fuse protection. The recommendation is to use two 3A fuses (one on the positive lead and one on the negative lead) to provide protection for the transponder.

Note that the negative lead (-) on the transponder is connected to the same part as the ground on the VHF and GPS antenna connector. This means that if either antenna (VHF or GPS) is bolted to a metal structure on board will connect this to the negative pole of the power supply (battery). If the unit is installed in a vessel with a metal hull it is highly recommended that a galvanic isolated DC/DC converter is connected between the battery and the transponder to prevent galvanic corrosion.

NOTE: Be careful not to reverse the polarity of the power supply leads, this may cause severe damage to the transponder.

The transponder is supplied with a combined Data/DC power cable. The power supply is connected as follows:

RED and **ORANGE** cable (twisted together) connects to *positive (+)*

BLUE and **BLACK** cable (twisted together) connects to *negative (-)*

Do not forget the fuses !

Connection of an external Silent switch with LED indicator

DC/DATA Cable

PURPLE

GREEN — Single pole, pushbutton switch

WHITE

LED (blue color recommended)

ORANGE

RED — 9-32 VDC

BLUE

BLACK — 0 VDC
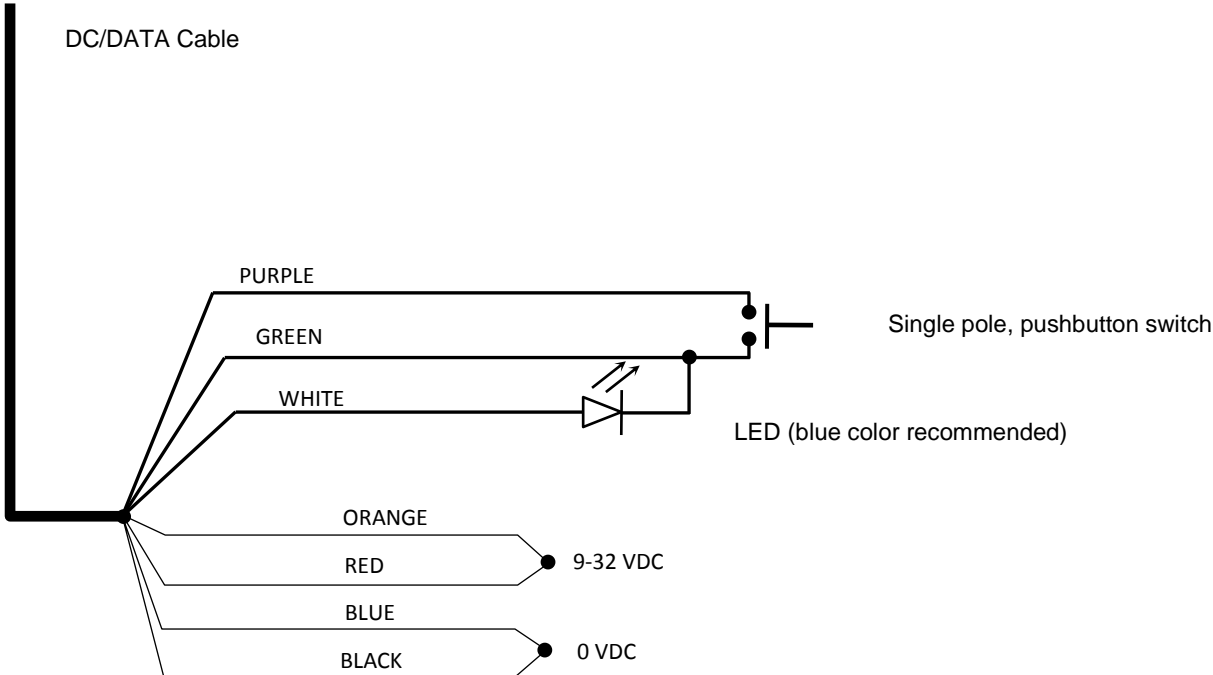
HOW TO PROGRAM THE AIS CTRX GRAPHENE

AIS CTRX GRAPHENE can be programmed with the software **proAIS2.** The data needed in order to program AIS CTRX GRAPHENE are:

MMSI number:											
Call sign:											
Vessel name:											
Type of vessel:						ex.: 37 Pleasure craft					
GPS ant. position:	A=		meters								
	B=		meters								
	C=		meters								
	D=		meters								
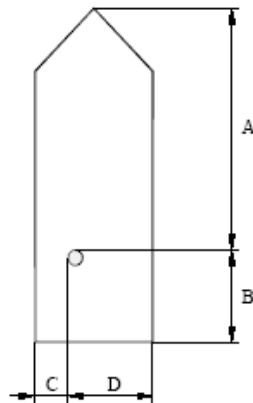
Table 6   Template to generate the static data for programing

The transponder kit includes the **proAIS2** software where all settings can be programmed. A valuable diagnostics tool is also available in proAIS2.

proAIS2 is developed to run on Windows XP (SP2), Windows Vista and Windows 7 & 8. A version for MacOS is also available on the product CD.

INSTALLATION

1. Insert the installation CD and locate the file "*Setup.exe*".
2. To start the installation double- click on the file icon "*Setup.exe*"
3. If required, follow the directions to install MS dotNet framework
4. When the security alert pop-up appears, select "Install"
5. proAIS2 will install and launch automatically.
6. A proAIS2 icon will be created and appear in the *Start Menu* folder.

Removal of ProAIS from the computer

The proAIS software can be removed at any time by using the "Add or Remove Programs" feature in the Control Panel (may differ depending on OS)

Connect to your AIS CTRX GRAPHENE with proAIS

When using the proAIS2 program with the transponder, the AIS CTRX GRAPHENE should be connected using the supplied USB cable. It will be powered from the USB cable during programming but cannot operate normally unless connected to a 12V or 24V DC power supply.

After starting the proAIS 2 application you should first select the communication port to which the transponder is connected. Select the port indicated as AIS transponder. If no port is shown the PC may need to have an updated driver for the USB port. Connect to the internet, disconnect the transponder USB cable and then connect it again. Windows will automatically search for a driver. When installed the port should be available to select. Then click on the **Connect-** button. The computer connects to the transponder and the data fields to be programmed will be appear on the **Configuration** page.

If the USB driver fails to install automatically, a USB driver is provided on the CD. Run the set-up in the USB driver folder to install the driver.
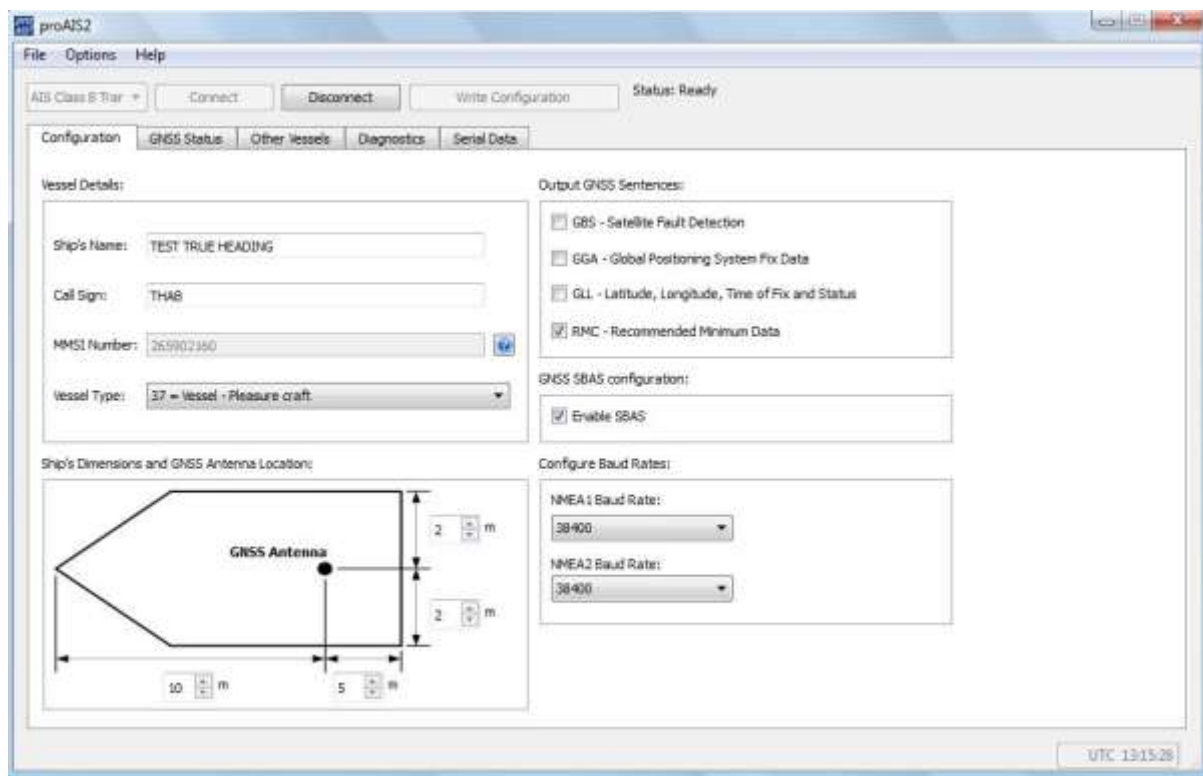
Figure 15   Connection of PC to AIS CTRX GRAPHENE takes place via choice of the correct port. *Normally the correct port will occur as the first choice stating AIS Class B AIS.*

When connected to proAIS 2, the static data is presented on the *Configuration* page. If the fields are empty, the transponder is un-programmed.

Type in *Ship's Name* **(**use **ONLY A-Z** and **–)**, *Call Sign* and *MMSI* number.

Select *Vessel type*, the type of vessel on which the transponder is installed on. We recommend that all types of leisure craft is set as *37 = Vessel -Pleasure craft.*

Ships dimensions are determined by the position of the GPS antenna. The length of the vessel is set by the distance measured from fore to the GPS antenna and from aft to GPS antenna. The beam is measured as the distance from starboard to the GPS antenna and from port to the GPS antenna. All distances are in meters. Even the distance upwards to the nearest meter.

When finished click on *Write Configuration*. Follow the instruction on the screen.

Note that the MMSI number can only be programmed *ONCE!*

If the transponder has been programmed with incorrect MMSI data True Heading must be contacted.

Before data is stored you will be prompted to make sure that the data is correct before you can proceed to write the data permanently. This is the last chance to correct any errors, so make absolutely sure that MMSI, Name and Call sign are correctly entered in their respective fields before you press the button.

In the *Configuration* field you can also select which type of GPS data that should be output on the data port. The default set message is the NMEA sentence *RMC* (Recommended Minimum speCific GNSS data) which contains the essential position, course, speed and time data. GPS data. Enable SBAS (EGNOS or WAAS) selects if DGNSS corrections is to be used or not. The baud rate of the NMEA data port is also

changeable. The default settings (38400 baud) is set for AIS and should **NOT** be changed.

The next menu is **GNSS status** which is a valuable tool for monitoring the built-in GPS receiver function. This tool can conveniently be used during installation to check that the GPS antenna has been placed in a good location for reception and that cables and connections are properly put together and not damaged. When the transponder receives signals from the satellites a vertical bar will appear representing the received satellite. The bar will change colour depending on the status of the satellite. When the receiver is locked to a satellite the bar will change from blue to green, indicating that the satellite is used for navigation. If SBAS is used the satellites involved in tracking the SBAS data will show up in yellow.

The reception quality is displayed as a C/N value (carrier to noise), which means that the higher the value, the higher the signal quality is. A mean value for a reasonable reception quality should be not less than 30 dBHz.
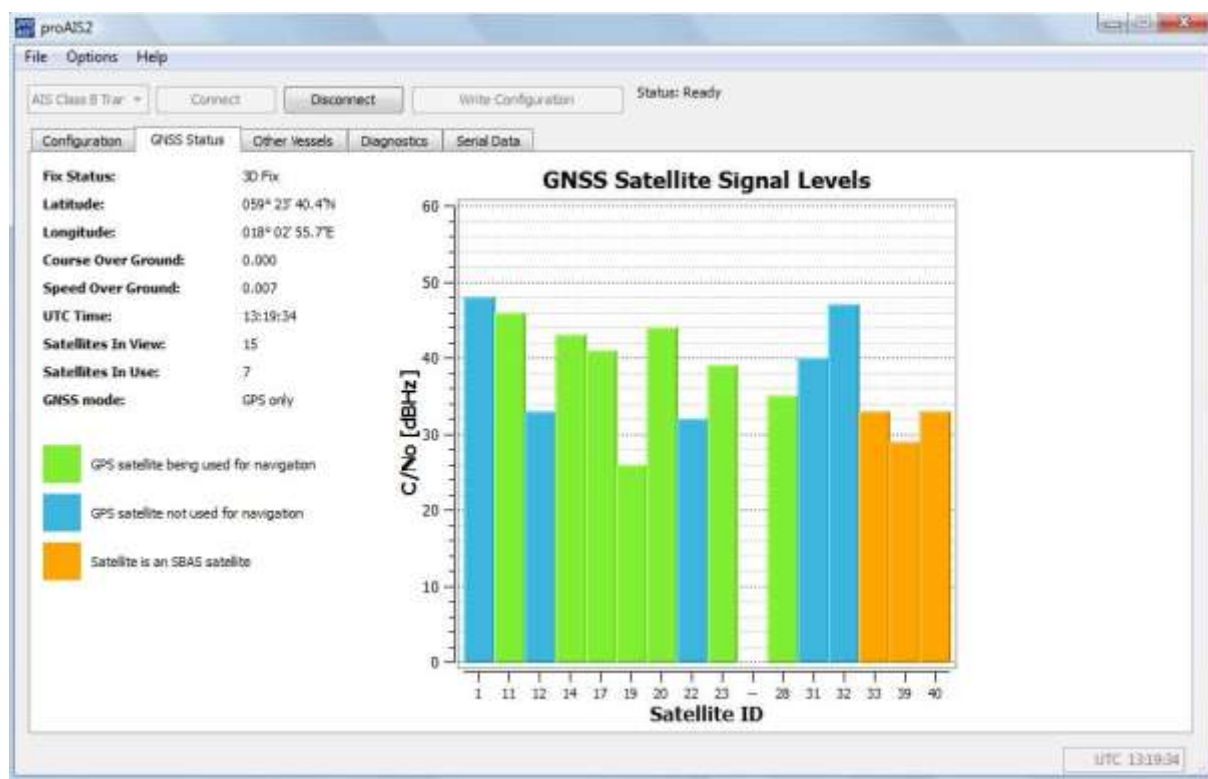
Figure 16   AIS CTRX GRAPHENE GNSS Status field showing satellites being used as well as not being used plus DGNSS satellites using SBAS.

Selecting the tab **Other Vessels**" provide you with an easy way to check that your AIS CTRX GRAPHENE receives data from other AIS transponders. By clicking on each column, the table can be arranged in falling or increasing order depending on the column of interest.

Figure 17   In the [Other Vessels] field, information is present about all AIS units that can be seen by the connected AIS CTRX GRAPHENE transponder.

The next menu is **Diagnostics**. Here you will find several functions and tools to check that the AIS CTRX GRAPHENE transponder works properly and facilities to monitor functionality and performance during and after installation. In the window **Checklist**, you can check the main functions of the transponder. This includes Programming (**Transponder MMSI valid),** GPS functionality (**GPS Position Fix),** transmission (**AIS has transmitted a position report),** antenna function (**AIS antenna),** reception **(AIS has received a report)** and power supply **(Power supply OK).** Once the items have a green tick the function is checked and validated.

The **Internal data** window shows the version numbers for firmware and bootcode, as well as the product code and internal serial number. The serial number is the same as on the bottom label and should be referred to should it be necessary to contact True Heading for support. Also the VSWR value (antenna matching factor) is shown here as well as the power supply input voltage.

The **Status** window show the status of the LED's on the front panel. Normal operation should have the green LED light. Once in a while, depending on the operational situation (AIS traffic load) the status may change to yellow, which means that the transponder has not been able to transmit during the last transmission period. Once the units have transmitted the LED lights will go back to green.

In the **Statistics** window received and transmitted messages on the two channels will be shown. The values are accumulated from the time the transponder was connected up to proAIS program. The values will be reset as soon as the connection is disconnected.
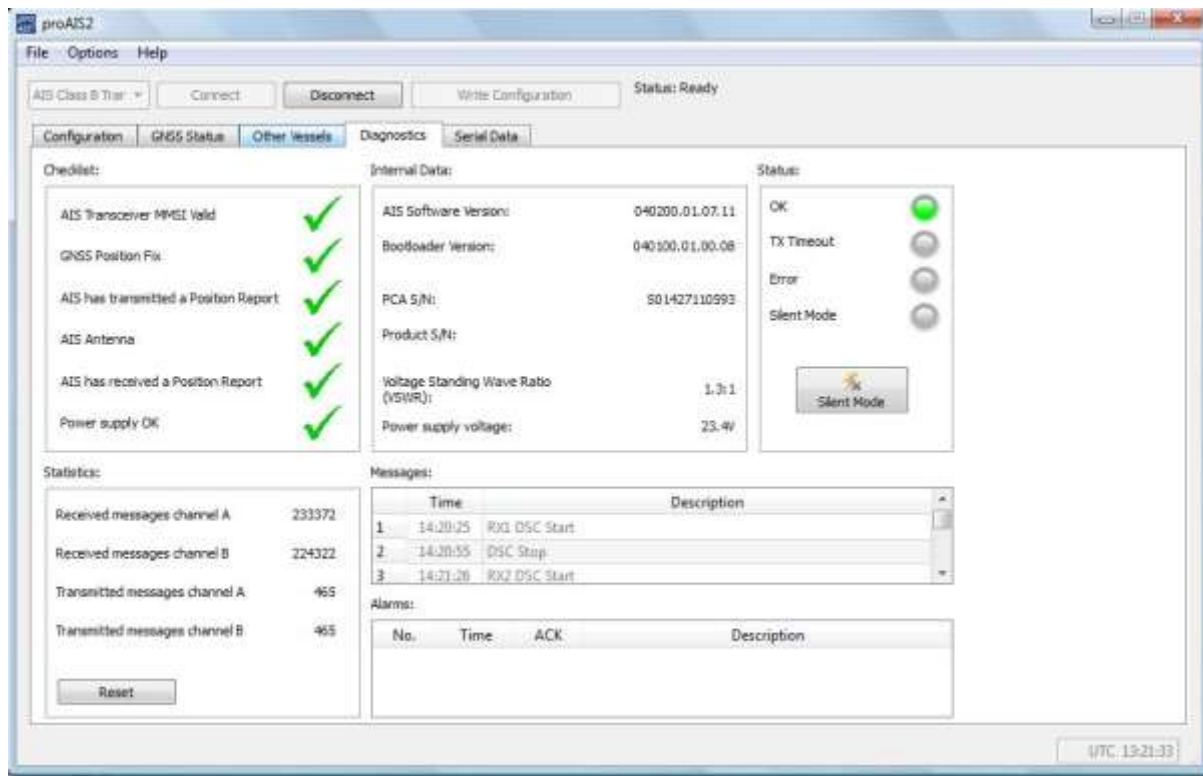
Figure 18   AIS CTRX GRAPHENE Diagnostics field provides good information about the transponder's status and the software version.

Before the AIS CTRX GRAPHENE has been programmed, both the yellow and red LED's will light, indicating that the unit is not programmed (no valid MMSI number). This is shown both on the transponder and on the status panel in proAIS2. The most common fault is however, that the transponder has no valid MMSI, so always check this first.

The red **ERROR** LED can also have the following meaning:
- The transmitter is stuck in transmit (transmitted longer than 1 s).
- The GPS has not started to navigate after 30 minutes
- Excessive VSWR value (> 3:1) (faulty antenna or cable problem).
- Background noise is too high which prevents the transponder from transmitting.
- Faulty transmitter (no power output)

The yellow LED will light to indicate a change in the operating status. The situation has called for the transmitter to stop transmitting.

The yellow **TX TIMEOUT** LED can mean the following conditions:
- The transponder GPS has not started to navigate or does not navigate which means that the transponder cannot transmit as the position data is not valid.
- The transponder cannot transmit because the channel is occupied by another transponder transmitting

The blue *SILENT* LED will light when AIS CTRX GRAPHENE is set in silent mode, which turns off the transmitter. This puts the transponder in receive-only mode. This is referred to as "SILENT MODE".

The transponder can be switched to SILENT mode by either holding the "S" button on the front panel down for 3 seconds or by using an external switch (see page 21 for wiring instructions) To switch off the SILENT mode hold the "S" button down for 3 seconds. The blue LED will turn off after approximately 1 second.
A third way to switch the unit to SILENT MODE is to use the software button (marked Silent Mode) in proAIS2 status window were the function can be remotely switched on and off.

NOTE that this is a special function in proAIS2 and that it is separate from the hardware control to set the silent mode with the switch.

The green *STATUS* LED means that everything is OK.

The last page in proAIS is *Serial data*. This window offers the more experienced installer a valuable tool to monitor the data output from the transponder. Data is output in NMEA0183 format. Received data will appear as !AIVDM strings, transmitted data as !AIVDO and GPS data as $GPRMC. The field *Enter commands below* is used for input data to the transponder. This field is only used for diagnostics, service functions etc.

The data shown in the window can be logged and recorded in file format for later recovery and analysis.
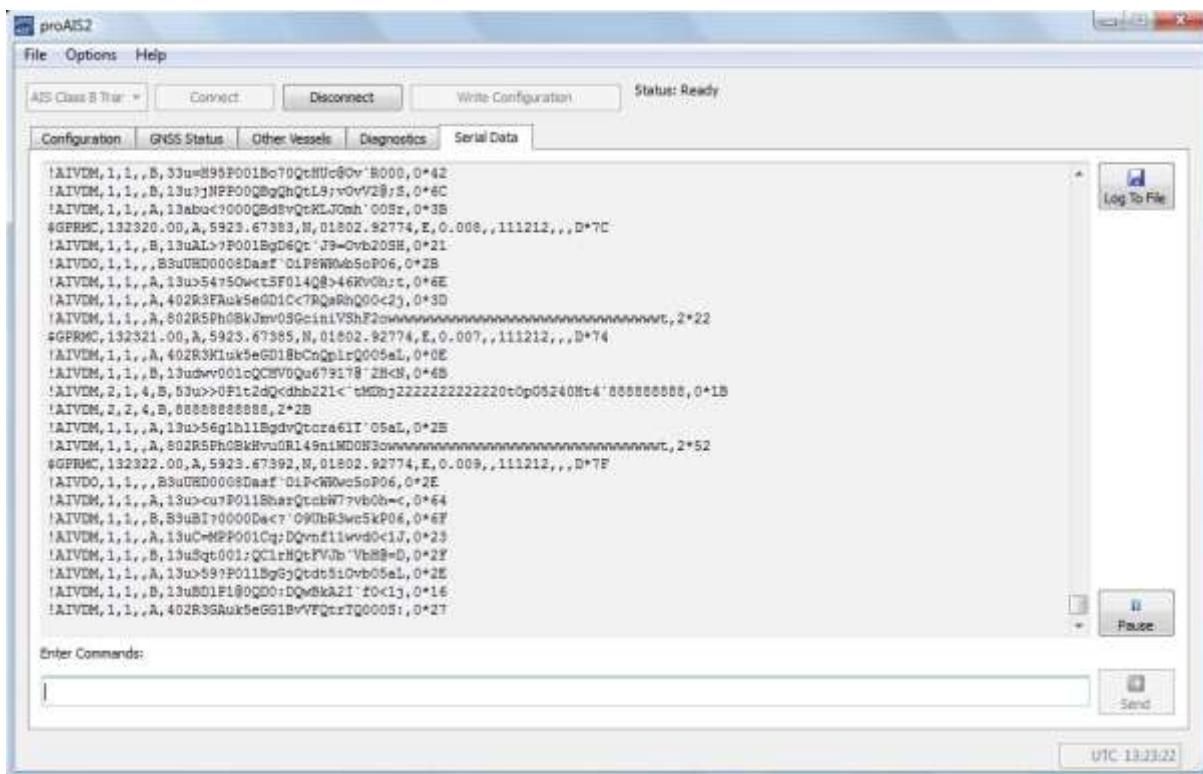

Figure 19   In the field Serial data the data the transponder transmits is displayed on its port and from this data, important information can show that the transponder functions correctly.

SOME FREQUENTLY ASKED QUESTIONS

Q: Is it possible to use an existing VHF antenna for my AIS CTRX GRAPHENE+?

A: The AIS CTRX GRAPHENE+ has a built-in antenna switch which makes it possible to share the antenna between the transponder and the VHF radio. Sharing the antenna will add some attenuation of the signal in receive mode but during transmission with either the VHF radio or the transponder full power will reach the antenna. The antenna height is extremely important for range, especially on a sailboat where the antenna can be placed on top of the mast. If a separate antenna is used, it should be placed at least 3 m above the water to be able to cover a range of 10 nm.

Q: Can an existing GPS antenna be used for my AIS CTRX GRAPHENE, i.e. the one which I already have to my plotter?

A: A GPS Signal can also be divided using a signal splitter which often is a more expensive alternative compared to installing a separate antenna for the AIS transponder. With AIS CTRX GRAPHENE and a separate GPS antenna the transponder will provide a backup source for position, speed and course, which can be used with the onboard navigational system.

Q: What type of GPS and VHF antenna should I use with my AIS CTRX GRAPHENE?

A: The antennas should meet the following requirements:

The GPS antenna should have the following performance:

Antenna type:	RHCP, patch or quadrifilar type.
Power feed:	5V DC
LNA gain:	20 dB (min)
Impedance:	50 ohm
Connector type on AIS CTRX GRAPHENE:	TNC female

The VHF antenna shall have the following performance:

Antenna type:	Vertical radiator (dipole)
Antenna gain :	0 – 3 dBd
Impedance:	50 ohm

There are specially tuned AIS antennas available today which provide better performance because they are tuned to the frequencies used by the AIS transponder. Contact True Heading AB for more information.

Q: Can I connect my AIS CTRX GRAPHENE to my plotter?

A: Today there are a number of plotters that can present AIS or that can receive AIS data. Furuno, Garmin, Interphase, Seiwa, Raymarine and VDO now have support for AIS. Several other plotter manufacturers are working on being able to handle AIS data in a near future. For additional information about this, contact your plotter supplier and inquire about the AIS interface. Just as with PC based programs there are large difference between the suppliers in their ability to handle different AIS messages. Weather data messages (message 8) may not appear in some applications.

Q: Which sea chart programs can display AIS targets?

A: Today, most electronic sea chart programs can display AIS targets. All programs that can handle the NMEA message VDM will be able to make use of the AIS information and display the data on the screen or display. AIS, however consist of a number of messages and different capabilities among the different suppliers are the rule regarding AIS data. Ask your supplier for more information about your system. Special software is also available, such as AIS YACHT from Y-tronic where AIS is presented on a radar-like display.

Q: Will AIS CTRX GRAPHENE work with network-type systems on board?

A: All networks that can handle NMEA VDM data at 38400 b/s should be able to manage AIS data. Furuno says their Navnet can do this, while Raymarine's Seatalk and Silva's Nexus does not. AIS CTRX GRAPHENE is NMEA 2000 approved and should connect with most systems compatible with AIS functionality. Ask your supplier for additional information about your system.

NOTES

Fixing Template
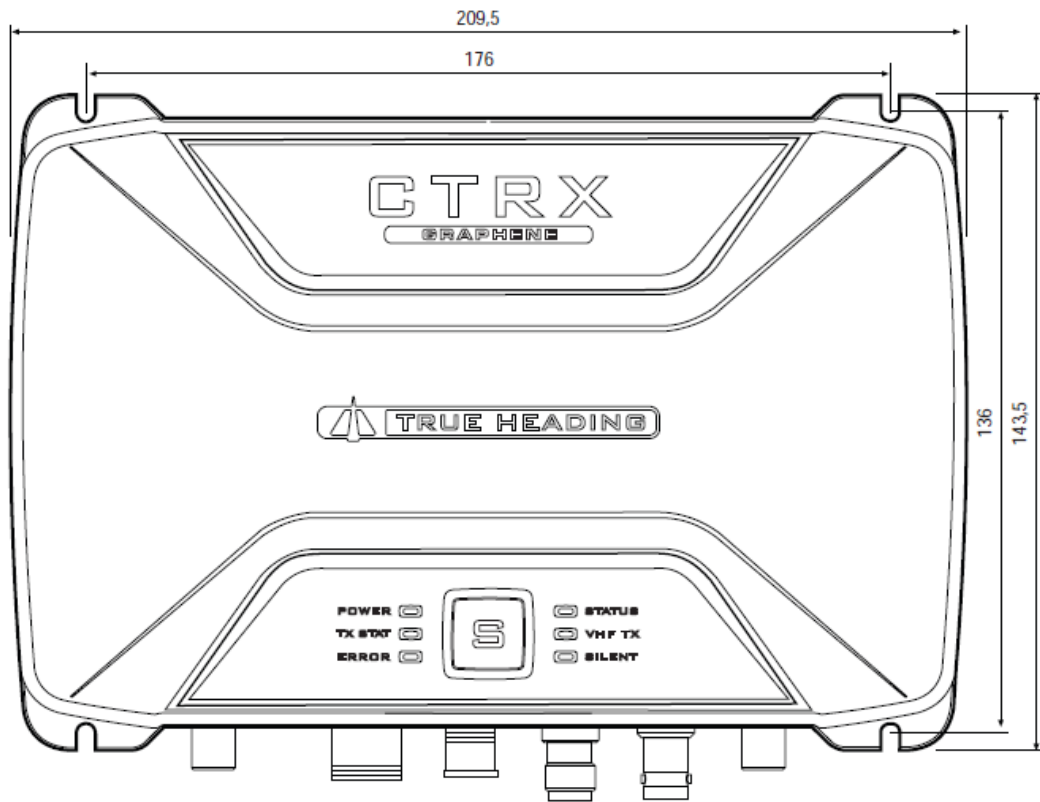
NOTE: NOT drawn to scale !

APPENDIX A   ANTENNAS AND ANTENNA MOUNTING

GPS Antenna

The GPS antenna used must be of the active type (i.e. it should incorporate an LNA) and must be suitable for marine shipboard applications (index of protection, ruggedness, means of mounting, etc.). An antenna should be selected with a gain (in dB) depending on the length of cable between the antenna and the AIS unit; after subtraction of cable and connector losses a minimum total gain of 25 dB should be available at the AIS CTRX GRAPHENE unit GPS antenna connector.

The GPS antenna to be used for AIS use must be a dedicated antenna, i.e. not shared with any other GPS receiver.

Installation of the GPS antenna is critical for the performance of the built in GPS receiver which is used for timing of the transmitted time slots and for the supply of navigational information should the main navigational GPS fail. We strongly recommend that:

1.   The GPS antenna is mounted in an elevated position and free of shadow effect from the ship's superstructure

2.   The GPS antenna has a free view through 360 degrees with a vertical angle of 5 to 90 degrees above the horizon.

3.   As the received GPS signal is very sensitive to noise and interference generated by other onboard transmitters, ensure that the GNSS antenna is placed as far away as possible from radar, Inmarsat and Iridium transmitters and ensure the GPS antenna is free from direct view of the radar and the Inmarsat antenna beam.

4.   It is also important that the MF/HF and other VHF transmitter antennas are kept as far away as possible from the GNSS antenna. It is good practice never to install a GNSS antenna within a radius of 5 Metres from these antennas.

VHF antenna for AIS use

The VHF antenna employed for AIS use:

- Must be a dedicated antenna, i.e. not shared with any other VHF transmitter/receiver.

- Must be suitable for marine shipboard applications (index of protection, ruggedness, means of mounting, etc.)

- Should be omni-directional and vertically polarised with unity gain (0 dB) with a bandwidth sufficient to maintain VSWR <1.5 over the frequency range 156 – 163 MHz. As a minimum the 3dB bandwidth must cover the two AIS channels and the DSC Channel.

- Should be mounted with at least a two metre vertical separation distance from any other VHF antenna used for speech or DCS communication but see also the section "Radio Frequency Exposure Warning" below

- Should be mounted at least 2-3 metres above sea level for full performance.

WARNINGS

VHF Antenna Connection

Connecting a badly mismatched VHF antenna, leaving the VHF antenna port disconnected, or shorting the VHF antenna port will activate the VSWR alarm, cause the unit to stop sending position reports or cause damage to the transponder.

Radio Frequency Exposure

To meet the requirements for Radio Frequency Exposure it is necessary to install the VHF antenna correctly and operate the AIS equipment according to the instructions.

The table below shows suitable safety distances to other equipment that could cause interference with the AIS Class B Transponder.

Object	Safety distance
Radar antenna, X-band	1, 5 m (5 ft)
High efficiency engines	1 m (3 ft)
HF or VHF antennas	3 m (10 ft)
AC power cables with high currency	1 m (3 ft)
Satellite communication antennas	4 m (13 ft)

APPENDIX B   CTRX GRAPHENE NMEA 2000 PGN LIST

PGN description	PGN number	Comments
Class A Position Report	PGN129038	
Class B Position Report	PGN129039	
AIS UTC and Date report	PGN129793 output	From AIS message #4 base station messages
AIS Class A Static and Voyage Related Data	PGN129794	
AIS SAR Aircraft Position Report	PGN 129798	
AIS Broadcast Safety Message	PGN129802	
AIS Class B static data part A	PGN129809	
AIS Class B static data part B	PGN129810	
AtoN position report	PGN129041	
NMEA2000 group function	PGN126208	
NMEA2000 product info	PGN126996	
ISO request	PGN059904	
ISO Acknowledge	PGN059392	
ISO address claim	PGN060928	
ISO Address command	PGN 065240	
GPS position, rapid update	PGN 129025	Added in V1.7
COG and SOG, rapid update	PGN 129026	Added in V1.7