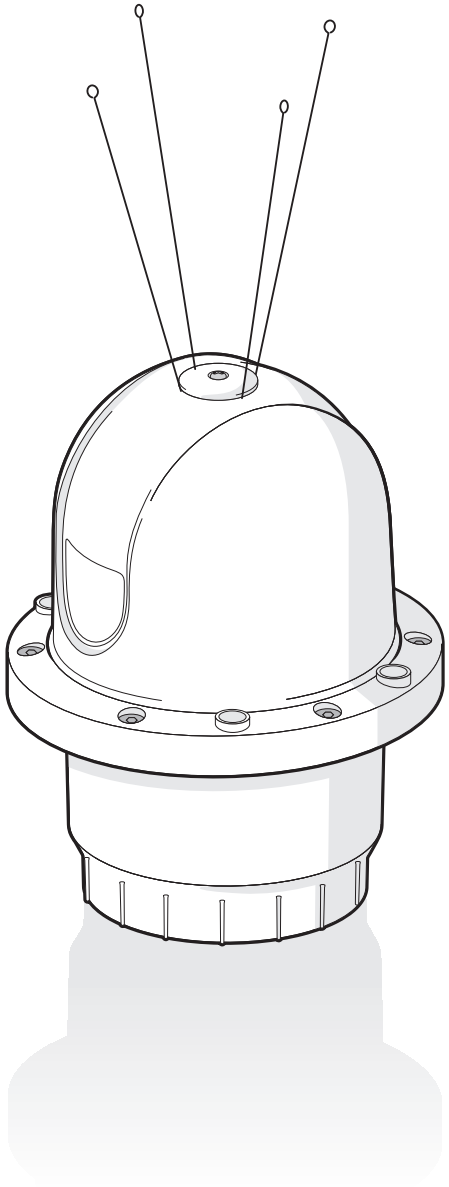
DigAtoN AIS Aids to Navigation Transceiver

Installation and operation manual



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1 Glossary

AIS	Automatic Identification System
AtoN	Aid to Navigation
BIIT	Built In Integrity Test
FATDMA	Fixed Access Time Division Multiple Access
GLONASS	Global Navigation Satellite System (term specific to the satellite navigation system operated by the Russian Federation)
GNSS	Global Navigation Satellite system (general term used to refer to any satellite navigation system)
GPS	Global Positioning System
IALA	International Association of Lighthouse Authorities
IEC	International Electrotechnical commission
ITU	International Telecommunication Union
MID (in the context of MMSI)	Maritime Identification Digits
MMSI	Maritime Mobile Service Identity
NMEA	National Marine Electronics Association
RACON	A radar transponder used to mark navigational hazards.
RATMDA	Random Access Time Division Multiple Access
RED	Radio Equipment Directives
RS232	Serial data communications standard - see TIA-232-F
RS422	Serial data communications standard see TIA-422-B
SART	Search And Rescue Transponder
SOLAS	Safety of Life at Sea
SDI-12	Serial Data Interface at 1200 Baud
USB	Universal Serial Bus
UTC	Coordinated Universal Time

VDL	VHF Data Link
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

2 Notices

When reading this manual please pay particular attention to warnings marked with the warning triangle symbol shown on the left. These are important messages for safety, installation and usage of the transceiver.

2.1 Safety warnings

This equipment must be installed in accordance with the instructions provided in this manual. Failure to do so will seriously affect its performance and reliability. It is strongly recommended that a trained technician installs and configures this product.

This equipment is intended as an aid to navigation and is not a replacement for proper navigational judgement. Information provided by the equipment must not be relied upon as accurate. User decisions based upon information provided by the equipment are done so entirely at the users own risk.

2.2 General notices

2.2.1 Position source

All marine Automatic Identification System (AIS) transceivers utilise a satellite based location system such as the Global Positioning Satellite (GPS) network. The general term for satellite based location systems is Global Navigation Satellite System or GNSS. This manual refers to either GNSS or GPS depending on context.

The accuracy of a GNSS position fix is variable and affected by factors such as the antenna positioning, how many satellites are used to determine a position and for how long satellite information has been received.

2.2.2 Product category

This product is categorised as 'exposed' in accordance with the definitions provided in IEC 60945.

2.2.3 Disposal of the product and packaging

Please dispose of this product in accordance with the European WEEE Directive or with the applicable local regulations for disposal of electrical equipment. Every effort has been made to ensure the packaging for the product is recyclable. Please dispose of the packaging in an environmentally friendly manner.

2.2.4 Accuracy of this manual

This manual is intended as a guide to the installation, setup and use of this product. Every effort has been made to ensure the accuracy of this manual, however due to continuous product development this manual may not be accurate in all respects, therefore no guarantee is offered. If you are in any doubt about any aspect of this product, please contact your supplier.

The part number and revision number of this manual are shown on the rear cover.

2.3 Regulatory information

2.3.1 Radio Equipment Directives

The manufacturer of this product is in compliance with the essential requirements and other provisions of the Radio Equipment Directive 2014/53/EU and as such, displays the CE mark. The RED declaration of conformity is provided as part of this documentation pack.

The manufacturer declares that this product complies with the United Kingdom Conformity Assessed requirements and as such, displays the UKCA mark. The UKCA declaration of conformity is provided as part of this documentation pack.

2.3.2 FCC notice

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2.3.3 Industry Canada notice

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

This Class B digital apparatus complies with Canadian ICES-003.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage, et
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le Fonctionnement.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

3 Introduction

3.1 About AIS

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 GNSS and communication between vessels is by Very High Frequency (VHF) digital transmissions.

There are a number of types of AIS device as follows:

- **Class A transceivers. These are designed to be fitted to commercial vessels such as cargo ships and large passenger vessels. Class A transceivers transmit at a higher VHF signal power than Class B transceivers and therefore can be received by more distant vessels, they also transmit more frequently. Class A transceivers are mandatory on all vessels over 300 gross tonnes on international voyages and certain types of passenger vessels under the SOLAS mandate.**
- **Inland AIS stations. Similar to Class A transceivers with additional features for use on Inland waterways.**
- **Class B transceivers. Similar to Class A transceivers in many ways, but are normally lower cost due to the less stringent performance requirements. Class B transceivers transmit at a lower power and at a lower reporting rate than Class A transceivers.**
- **AIS base stations. AIS base stations are used by Vessel Traffic Systems to monitor and control the transmissions of AIS transceivers.**
- **Aids to Navigation (AtoN) transceivers. AtoN's are transceivers mounted on buoys or other hazards to shipping which transmit details of their location to the surrounding vessels.**
- **AIS receivers. AIS receivers receive transmissions from Class A transceivers, Class B transceivers, AtoN's and AIS base stations but do not transmit any information about the vessel on which they are installed.**

This product is an AIS Aids to Navigation (AtoN) transceiver.

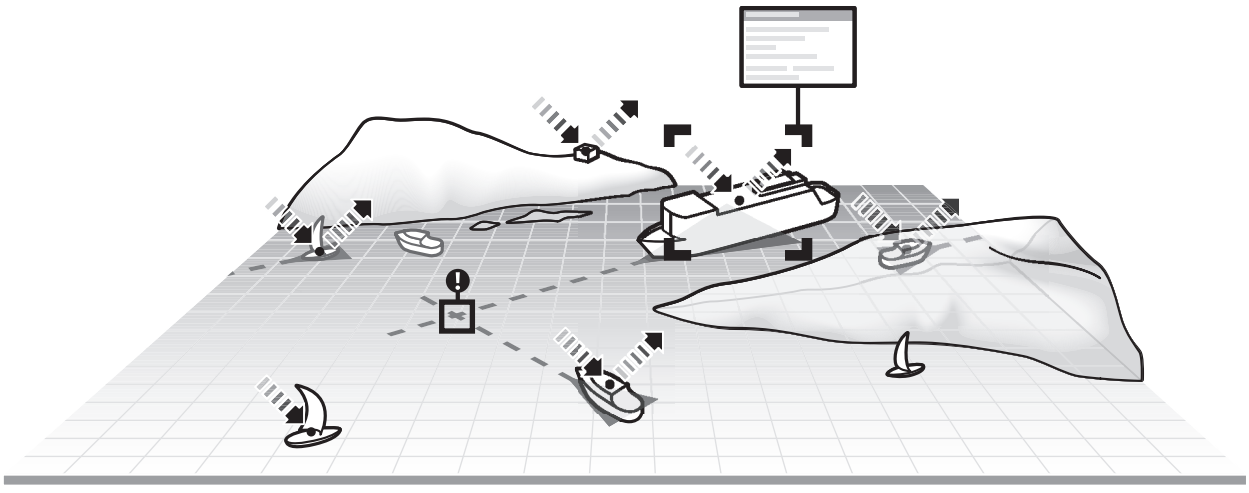


Figure 1 The AIS network

3.2 System overview

This AIS AtoN is a self contained device supporting both Type 1 (transmit only) and Type 3 (transmit and receive) operation. It is designed for installation in exposed locations on physical AtoN structures. The AIS AtoN can be supplied with an optional sensor interface platform which interfaces to sensors (such as weather instruments) and transmits measured data via AIS messages to surrounding vessels and shore stations.

The AIS AtoN has an exceptionally low power consumption making it suitable for installation on floating Aids to Navigation with solar charged power systems. The lowest power consumption is achieved when operating as a Type 1 AIS AtoN transmitting only position information. Further description of Type 1 and Type 3 operation is provided below.

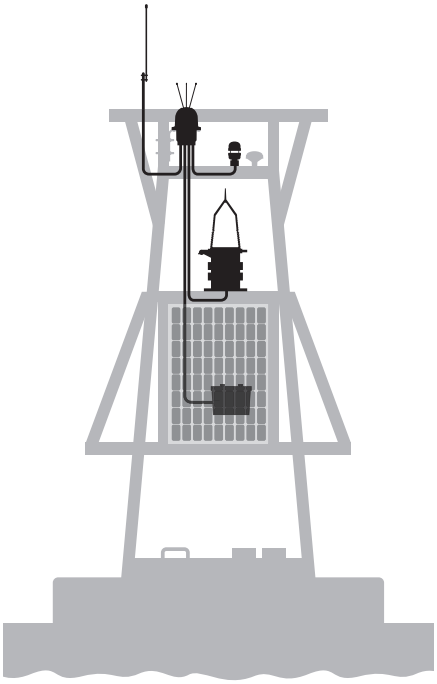


Figure 2 Typical AIS AtoN system

3.2.1 Type 1 AIS AtoN

A Type 1 AIS AtoN is a transmit only device using the FATDMA (Fixed Access Time Division Multiple Access) access scheme. This requires that the AIS AtoN is configured with fixed AIS time slots in which it will transmit AIS messages. Mobile AIS stations operating in the area where a Type 1 AIS AtoN is installed need to be aware of the time slots allocated to the AIS AtoN. The slots allocated to the AIS AtoN are 'reserved' by AIS Base Station transmissions covering the area in which the AIS AtoN is installed.

This mode of operation therefore requires that an AIS base station is operating in the same area as the AIS AtoN and is configured to make the necessary slot reservations.

3.2.2 Type 3 AIS AtoN

A Type 3 AIS AtoN has transmit and receive capability and can therefore use either the FATDMA or RATDMA (Random Access Time Division Multiple Access) access schemes. The RATDMA scheme allows the AIS AtoN to internally allocate slots for transmission of AIS messages without reservation from an AIS Base Station.

AIS receive capability also allows a Type 3 AIS AtoN to be configured and queried for status via AIS messages sent from a shore station (known as VDL configuration). An extension of VDL configuration is 'Chaining' where configuration and query commands are passed along a 'chain' of AIS AtoN stations to a distant station beyond the range of direct communication with a shore station.

3.2.3 GNSS systems

The AIS AtoN includes an internal GNSS receiver supporting the GPS system as standard.

3.3 Supported AIS messages

The transceiver supports the following AIS message types.

ITU-R M.1371-5 Message number	Description	Transmitted / Received by AtoN Transceiver	Application
#1	Position report message	Repeated*	Message #1 from a SART is repeated if it meets the configured parameters.
#6	Binary addressed message	Transmitted, received and repeated*	The transceiver uses message #6 to send binary data (relating to connected sensors and systems) to a specific shore station. The transceiver can also receive addressed binary messages for the purpose of configuration and control.
#7	Binary acknowledge message	Transmitted and received	This message is transmitted to acknowledge receipt of a binary message. The transceiver can also receive acknowledgments relating to its own addressed binary transmissions.
#8	Binary broadcast message	Transmitted and repeated*	The transceiver uses message #8 to broadcast binary data (relating to connected sensors and systems) to all other AIS stations in range.
#12	Addressed safety related message	Transmitted	The transceiver can be configured to transmit an addressed safety related message to a specific shore station to alert the operator to an off position, vessel proximity or built in test failure condition.
#13	Acknowledgement of received addressed safety related message	Received	The transceiver receives message #13 in acknowledgment of its transmission of message #12.
#14	Safety related broadcast message	Transmitted and repeated*	The transceiver can be configured to transmit a broadcast safety related message to all AIS stations in range to warn of an off position, vessel proximity or built in test failure condition.

ITU-R M.1371-5 Message number	Description	Transmitted / Received by AtoN Transceiver	Application
#20	Data link management message	Received	When operating as a Type 3 transceiver slot reservations made by a shore station using message #20 will be observed by the transceiver.
#21	Aids to Navigation report	Transmitted and repeated*	This is the primary message transmitted by the transceiver. It contains the position, identification and status of the transceiver.
#25	Single slot binary message	Transmitted and received	This message can be used for remote (over the air) configuration of the transceiver and configuration of a ‘chain’ of transceivers.

* when configured to do so; low power standby mode disabled.

4 AIS AtoN product variants

The transceiver is available in four variants with different AIS functionality and facilities for connection of external equipment. This manual describes features and functions for all possible product configurations.

The configuration of the AIS AtoN as Type 1 or Type 3 is selected when ordering the device. The possible configurations are listed below.

A system of icons is used throughout this manual to highlight which AIS AtoN configurations a particular section, paragraph or illustration applies to. Sections without any icons apply to all configurations.

- **Type 1 without sensor interfaces** T1
- **Type 1 with sensor interfaces** T1+S
- **Type 3 without sensor interfaces** T3
- **Type 3 with sensor interfaces** T3+S

Installation of an AIS AtoN transceiver without a Sensor Interface will limit the functionality of the installation to transmission of AIS message #21 including the following information:

- **Name of AtoN**
- **Position of AtoN**
- **Status of AtoN (including AtoN health, Light health and status and RACON status)**

Installation without a Sensor Interface is recommended when their is limited power availability and no requirement for the AIS AtoN to broadcast other information such as meteorological or hydrographic data.

- **When the AIS AtoN transceiver is installed with a Sensor Interface the capability is extended to enable the broadcasting of data from connected sensors and systems. However the power consumption of the combined AIS AtoN transceiver and Sensor Interface will be higher and therefore suited to an installation where power consumption is less critical.**

5 Installation T1 T1+S T3 T3+S

The AIS AtoN transceiver has been designed for ease of installation. The transceiver is self contained requiring only an external VHF antenna and power source for a basic installation. A typical system and connection diagram is provided in Figure 3.

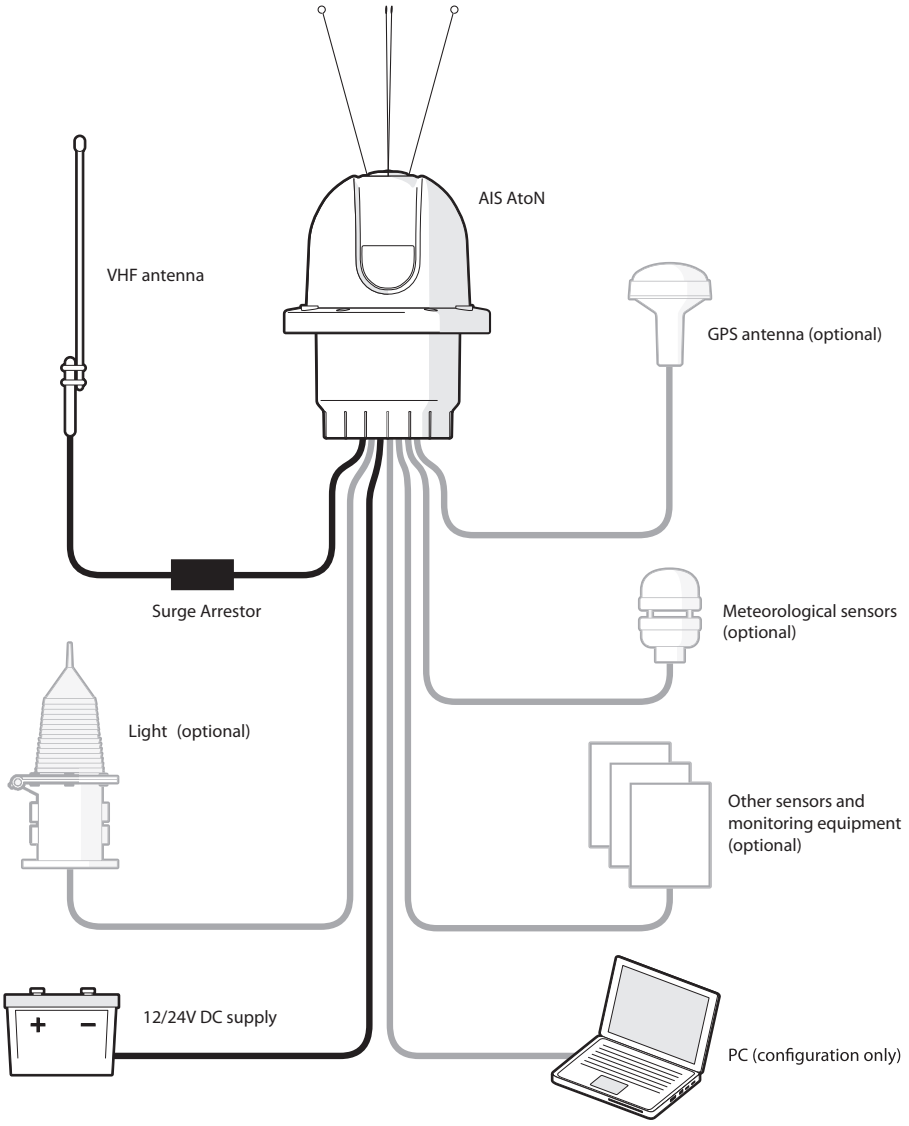


Figure 3 Typical AIS AtoN system connections

The main installation and commissioning steps are:

1. Mount the transceiver in a suitable location on the physical Aid to Navigation
2. Install a VHF antenna according to the manufacturers instructions
3. Connect any sensor interfaces and light / RACON monitoring signals
4. Connect power to the transceiver
5. Configure and commission the transceiver via USB (note that this step can be carried out on shore prior to installation in a remote location)

5.1 What's in the box

Figure 4 shows the typical items included with the AIS AtoN transceiver. Note that the box contents vary with the specific product configuration. The following section gives a brief overview of each item. Please ensure all items are present and if any are missing please contact your supplier.

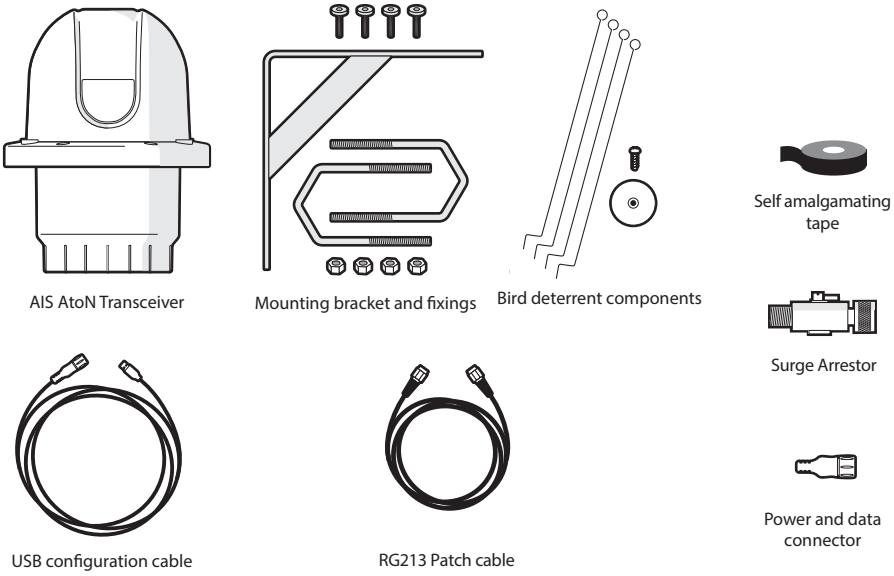


Figure 4 What's in the box - typical configuration

- **AIS AtoN transceiver**

  The main transceiver (incorporating internal GPS antenna).
- **Bird deterrent spikes**

  Can be affixed to the top of the transceiver if required.
- **Mounting bracket and fixings**

  Stainless steel bracket for mounting the transceiver to the physical AtoN structure.
- **Power and interface connector**

  A 19 way connector shell to supply power to the transceiver. This connector also carries some data interfaces and status signals for connection to external equipment.
- **USB configuration cable**

  A 2m (6.6ft) long USB cable for connection to a PC when configuring the transceiver.
- **Sensor interface cables** T1+S T3+S

  2m (6.6ft) long cables for interfacing the transceiver to external sensors and systems. These cables are optional items and supplied only with transceiver configurations that include a sensor interface. Depending on the supplied configuration a connector shell may be provided in place of the assembled cable.
- **Surge Arrestor**

  Lightning / Surge Arrestor with Gas Discharge Tube to help protect device from damage as a consequence of static build up and near lightning strike.
- **RG213 Patch Cable - 1 metre**
  1 metre RG213 cable with N type male/female connectors to facilitate installation of surge arrestor.

5.2 Preparing for installation T1 T1+S T3 T3+S

In addition to the items provided with the transceiver the following items will be required to complete the installation.

5.2.1 Tools and wiring accessories

The following tools and wiring accessories are required for installation:

- **A PoziDriv® No. 8 Screwdriver for assembly of the bird deterrent.**
- **A 5mm hex key for assembly of the enclosure to the mounting bracket, and assembly of the connector cover.**
- **A 10mm spanner for installation of the mounting bracket u-bolts.**
- **Suitable power supply cable (0.75mm^2 conductor cross section for power supply connections).**
- **5A rated fuse or breaker appropriate to the electrical installation.**
- **Zip ties to secure cables during installation.**
- **Additional self amalgamating tape to seal any coaxial cable joints.**

5.2.2 VHF antenna and cable

Connection of a suitable VHF antenna will be required for the AIS AtoN transceiver to operate. A robust marine band VHF antenna suited to the environment in which the AtoN will operate should be selected. The antenna cable should be terminated with a male N type connector. Any joins in the antenna cable should be made with co-axial connectors and sealed appropriately. It is recommended that RG-213 cable (or equivalent) is used to connect the VHF antenna.

Ensure that the supplied Surge Arrestor is installed in line with the VHF antenna and is correctly earthed. See section 5.5.7 for details on earthing the AtoN unit and section 5.7 for details on connecting and earthing the VHF antenna and surge arrestor.

Once in place, make sure that all cable / connector joints are properly sealed with self amalgamating tape.

Suggested antenna models are:

- **Shakespeare MD-70**
- **AC Marine CX4AIS, CELmar0-1AIS, CELmar1-1AIS**
- **Procomm CXL 2-3LW/hm, CXL 2-1/h-N**

5.3 Attaching the bird deterrent T1 T1+S T3 T3+S

The bird deterrent spikes are attached to the top of the transceiver using the fixing cap and screw provided. The bird deterrent is optional and if not required the fixing cap can be attached without the spikes.

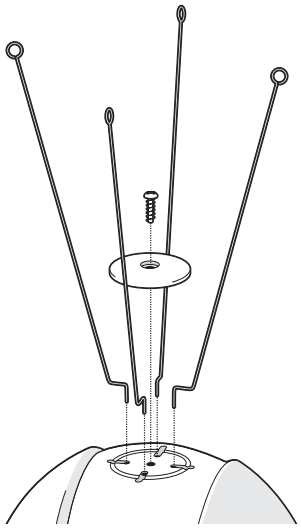


Figure 5 Attaching the bird deterrent

5.4 Mounting the transceiver T1 T1+S T3 T3+S

The transceiver can be mounted to a physical aid to navigation using either the supplied mounting bracket or directly to a metal plate with appropriate cut outs.

The installation location should provide a clear sky view to the internal GPS antenna which is located beneath the bird deterrent fixing point. Consideration should also be given to cable routing when selecting an installation location.

Overall dimensions for the transceiver are provided in Figure 36.

5.4.1 Using the mounting bracket

The supplied mounting bracket can be used to install the transceiver to a vertical or horizontal pole with diameter between 1 inch and 2 inches using the supplied 'U' bolts, or to a flat surface using standard bolts (not supplied). The fixing holes in the supplied bracket are also compatible with Stauff® pipe clamps (standard series, Group 7). A detailed drawing of the mounting bracket can be found in Figure 34.

The transceiver is attached to the mounting bracket using the four M4 nuts and bolts supplied.

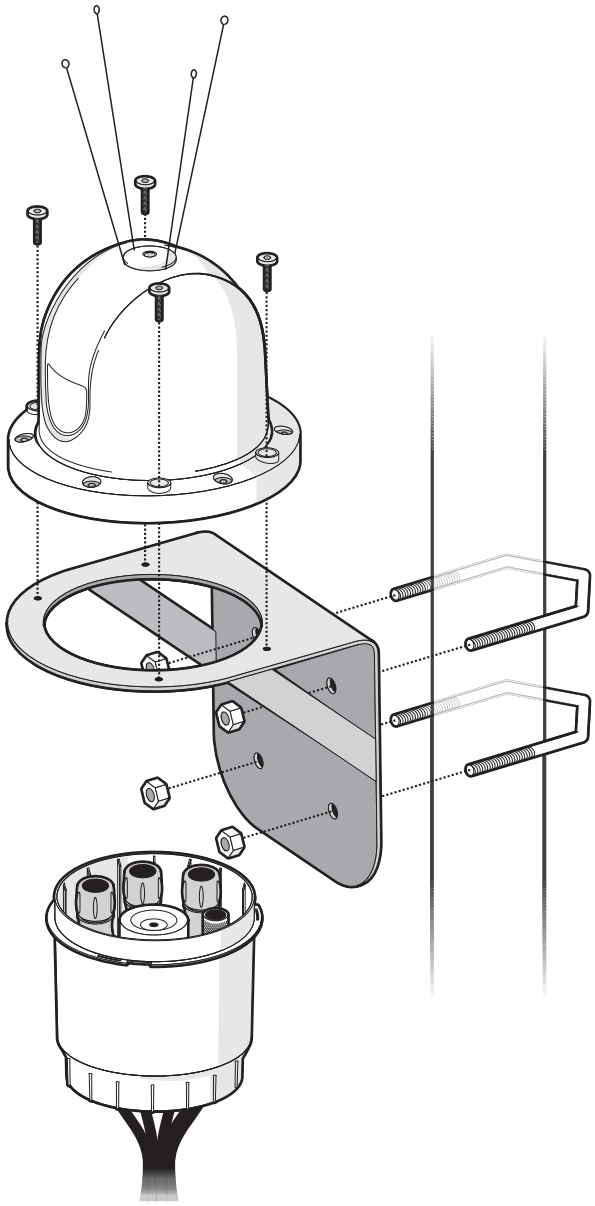


Figure 6 Using the mounting bracket

5.4.2 Mounting to a metal plate

The transceiver can be mounted directly to an existing metal plate with a 150mm diameter cut out and fixing points located to match the details for the mounting bracket provided in Figure 34.

The transceiver should be secured to the plate using four M4 fixing bolts.

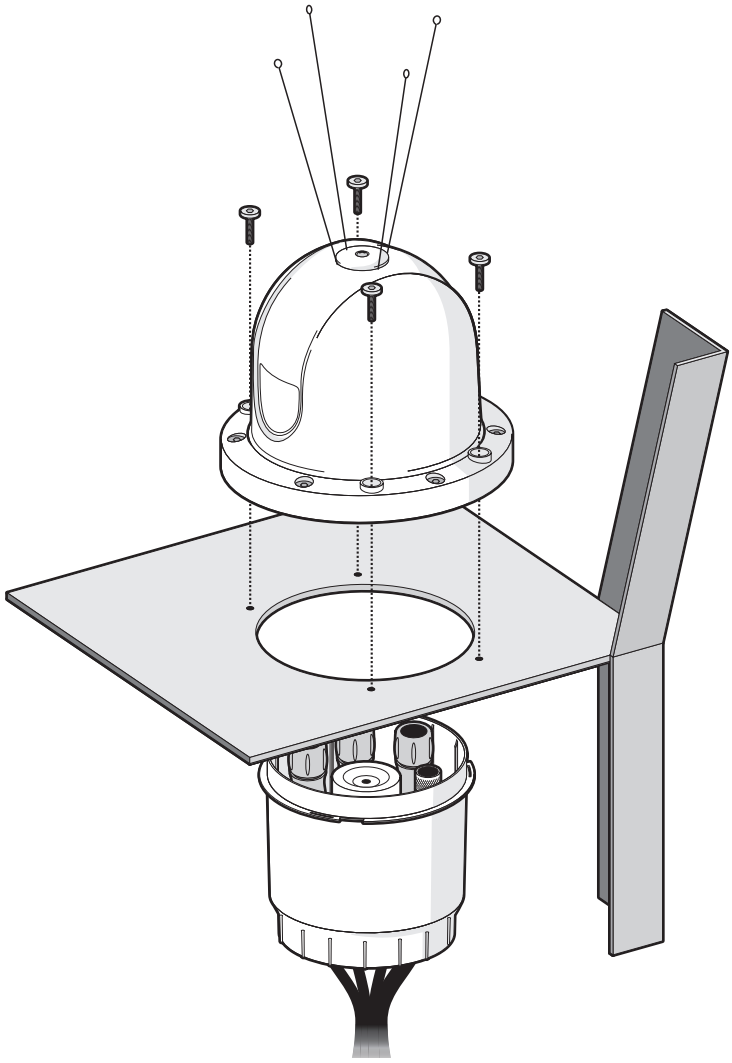


Figure 7 Mounting to a metal plate

5.5 Transceiver connections T1 T1+S T3 T3+S

The transceiver connections are protected by the connector cover. To access the connections first remove the cover as illustrated in Figure 8.

Note that all connecting cables must be routed through the connector cover during installation. The supplied sealing caps must be fitted to any unused connections.

The function of each connector is identified in Figure 9 Note that the sensor interface connectors X and Y are only functional in product configurations including sensor interfacing. The function and pin allocation for each connector is described in the following sections.

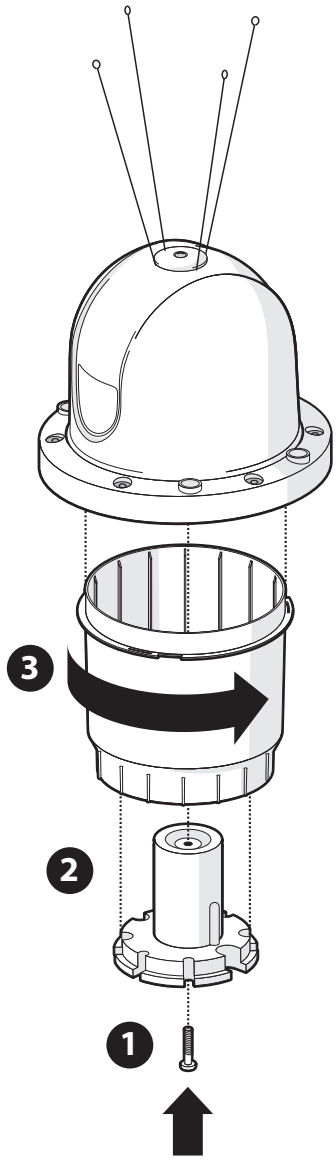


Figure 8 Removing the connector cover

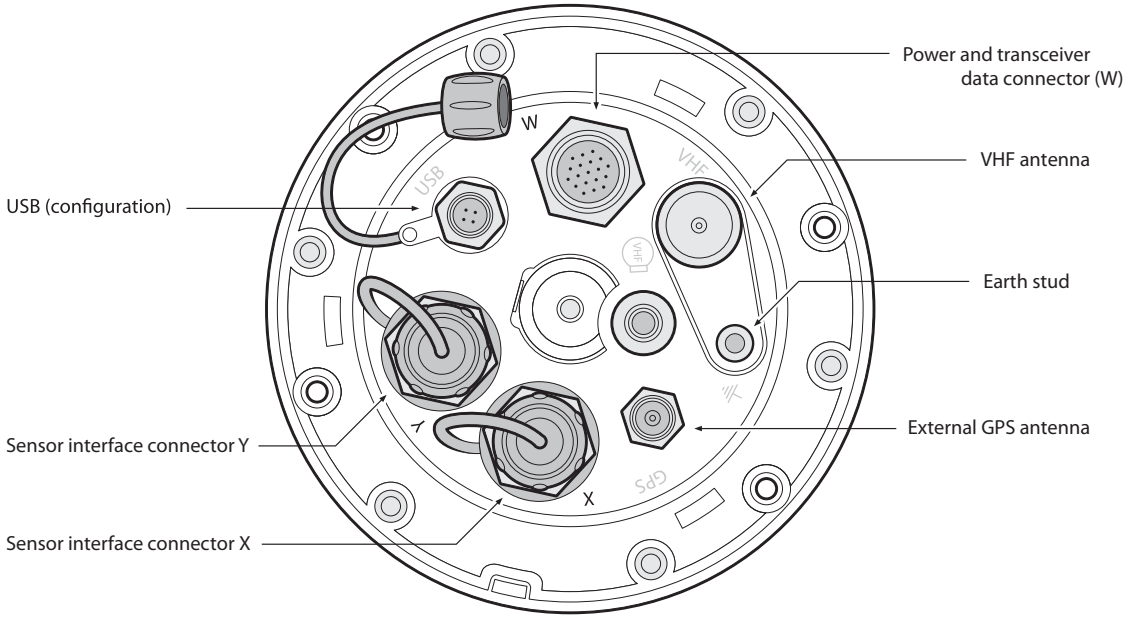


Figure 9 Transceiver connector locations

The transceiver incorporates cable routing and retention features in a screw fit component beneath the connectors. Cables should be routed through the channels provided as illustrated in Figure 10.

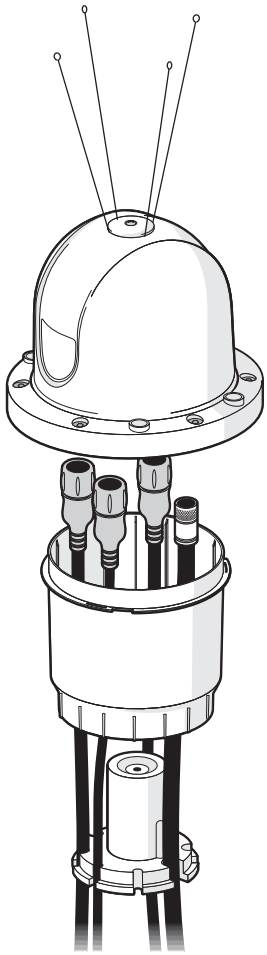


Figure 10 Cable routing

5.5.1 Power and transceiver interface connector T1 T1+S T3 T3+S

This connector provides power to the transceiver along with interface connections for basic transceiver connectivity. The connector is a Souriau UTS714D19PW32 with type W keying and the mating half is UTS6JC14E19SW. This connector is IP68 rated when mated or unmated.

Pin ID	Signal name	Function & Notes
A	VIN-	Transceiver power input return / 0V connection
B	USER_PWR	3.3V DC output to supply interface circuits. Maximum output current 200mA.
C	VIN+	Transceiver power input connection (10 to 32VDC)
D	NMEA0183_TX1_A	Transceiver NMEA0183 port 1 TX A+ signal
E	NMEA0183_TX1_B	Transceiver NMEA0183 port 1 TX B- signal
F	NMEA0183_RX1_B	Transceiver NMEA0183 port 1 RX B- signal
G	NMEA0183_RX1_A	Transceiver NMEA0183 port 1 RX A+ signal
H	NMEA0183_RX2_A	Transceiver NMEA0183 port 2 RX A+ signal
J	NMEA0183_RX2_B	Transceiver NMEA0183 port 2 RX B- signal
K	USER_IO_0	Transceiver user IO signal 0 (Light on/off input)
L	USER_IO_1	Transceiver user IO signal 1 (Light health input)
M	USER_IO_2	Transceiver user IO signal 2 (Racon health input)
N	GND	Signal ground
P	RELAY_DR_1	Relay drive output 1*
R	RELAY_DR_2	Relay drive output 2*
S	GND	Signal ground
T	USER_IO_3	Transceiver user IO signal 3 (Good health / alarm monitor)
U	USER_IO_4	Transceiver user IO signal 4
V	USER_WKUP	External wakeup input

* Only available when configuration includes a sensor interface, otherwise these pins are not connected.

** Use only under direction of your supplier

The transceiver may be supplied with an optional pre-wired power and transceiver interface cable.

Power connections should be kept as short as possible in order to minimise voltage drop. The cable used to connect power to the connector pins A and C should have conductors with a cross sectional area of 0.75mm^2.

The connections labeled GND are signal ground connections only and should not be connected to the incoming power supply VIN- (0V) rail. Doing so will bypass internal power supply protection and could result in permanent damage to the transceiver.

5.5.2 USB connector T1 T1+S T3 T3+S

The USB connector provides USB interfaces for configuration of the transceiver and sensor interface (if provided). Only the USB interface cable available from your supplier should be used to connect the transceiver to a PC during configuration. For further information on configuration of the transceiver and sensor interfaces refer to section 7. The USB connector should be left disconnected in the final installation and protected with the blanking cap supplied.

5.5.3 Sensor interface connector X T1+S T3+S

This connector provides a range of sensor interface connections. The connector is a Souriau UTS714D19PW32 with type X keying and the mating half is UTS6JC14E19SX. This connector is IP68 rated when mated or unmated.

Pin allocation	Signal name	Function & Notes
A	ISENSE-	Light current sense loop return (max 5A)
B	AN_1+	Non-isolated analogue input 1 positive connection
C	ISENSE+	Light current sense loop input (max 5A)
D	S_RS422_TX1_A	Sensor interface RS422 port TX A+ signal
E	S_RS422_TX1_B	Sensor interface RS422 port TX B- signal
F	S_RS422_RX1_A	Sensor interface RS422 port RX A+ signal
G	S_RS422_RX1_B	Sensor interface RS422 port RX B- signal
H	S_RS232_TX1	Sensor interface RS232 port 1 TX
J	S_RS232_RX1	Sensor interface RS232 port 1 RX
K	ISO_DI1+	Isolated digital input 1 positive
L	ISO_DI1-	Isolated digital input 1 negative
M	ISO_DI2+	Isolated digital input 2 positive
N	ISO_DI2-	Isolated digital input 2 negative
P	AN_1-	Non-isolated analogue input 1 negative connection
R	S_DIG_IO_1	Non-isolated digital IO 1
S	S_RS422_GND	Senor interface RS422 port ground
T	GND	Signal ground
U	S_DIG_IO_3	Non-isolated digital IO 3
V	S_DIG_IO_2	Non-isolated digital IO 2

The transceiver may be supplied with an optional pre-wired sensor interface cable.

5.5.4 Sensor interface connector Y T1+S T3+S

This connector provides a range of sensor interface connections. The connector is a Souriau UTS714D19PW32 with type Y keying and the mating half is UTS6JC14E19SY. This connector is IP68 rated when mated or unmated.

Pin allocation	Signal name	Function & Notes
A	S_RS232_TX2	Sensor interface RS232 port 2 TX
B	S_RS232_RX2	Sensor interface RS232 port 2 RX
C	S_DIG_IO_4	Non-isolated digital IO 4
D	EXT_WAKEUP	External wake up input
E	SDI_DATA	SDI Bus data signal
F	ISO_DI_3+	Isolated digital input 3 positive
G	ISO_DI_3-	Isolated digital input 3 negative
H	ISO_DI_4+	Isolated digital input 4 positive
J	ISO_DI_4-	Isolated digital input 4 negative
K	ISO_DI_5+	Isolated digital input 5 positive
L	ISO_DI_5-	Isolated digital input 5 negative
M	ISO_AN_1+	Isolated analogue input 1 positive
N	ISO_AN_1-	Isolated analogue input 1 negative
P	ISO_AN_2+	Isolated analogue input 2 positive
R	ISO_AN_2-	Isolated analogue input 2 negative
S	AN_2+	Non-isolated analogue input 2 positive connection
T	AN_2-	Non-isolated analogue input 2 negative connection
U	AN_3+	Non-isolated analogue input 3 positive connection
V	AN_3-	Non-isolated analogue input 3 negative connection

The transceiver may be supplied with an optional pre-wired sensor interface cable.

5.5.5 VHF antenna connector

The VHF antenna connector is a female 'N' type co-axial connector. The antenna ground is galvanically isolated from the AIS AtoN system ground. The connector and mating half must be sealed with self amalgamating tape once mated. The supplied surge arrestor should be installed in line with the VHF antenna connector. See section 5.7 for further information.

5.5.6 External GNSS antenna connector

The external GNSS antenna connector is a female 'TNC' co-axial connector. An external GNSS antenna can be connected here if the installation prohibits use of the internal GPS antenna. The connector and mating half must be sealed with self amalgamating tape once mated.

Refer to section 5.8 for further detail on the selection and installation of an external GNSS antenna. If the External GNSS antenna connector is not used it must be protected with the supplied blanking cap.

5.5.7 Earth connection stud

The earth connection stud is an M4 stud connected to the VHF antenna ground. This point should be connected to a common grounding point for lightning protection. Note that the earth stud is galvanically isolated from the incoming transceiver and power supply.

5.6 Connecting power T1 T1+S T3 T3+S

The transceiver requires a nominal 12VDC or 24VDC supply and will operate between 10V and 32VDC. The peak current drawn when operating from 12VDC is 3A and when operating from 24VDC is 2.5A. Power should be connected using either the supplied moulded interface connector and cable, or the appropriate Souriau connector mating half. It is recommended that 5A rated fuses are installed in line with the power supply positive and negative connections.

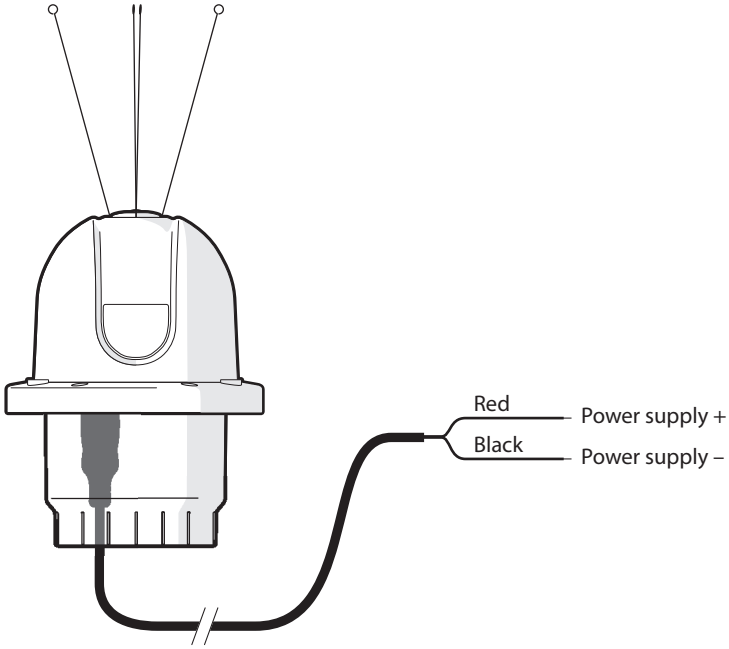


Figure 11 Connecting power

Overall power consumption is dependent on the configuration of the transceiver messaging and sensor interface. Minimum power consumption figures are provided in section 11.

5.7 Installing and connecting the VHF antenna T1 T1+S T3 T3+S

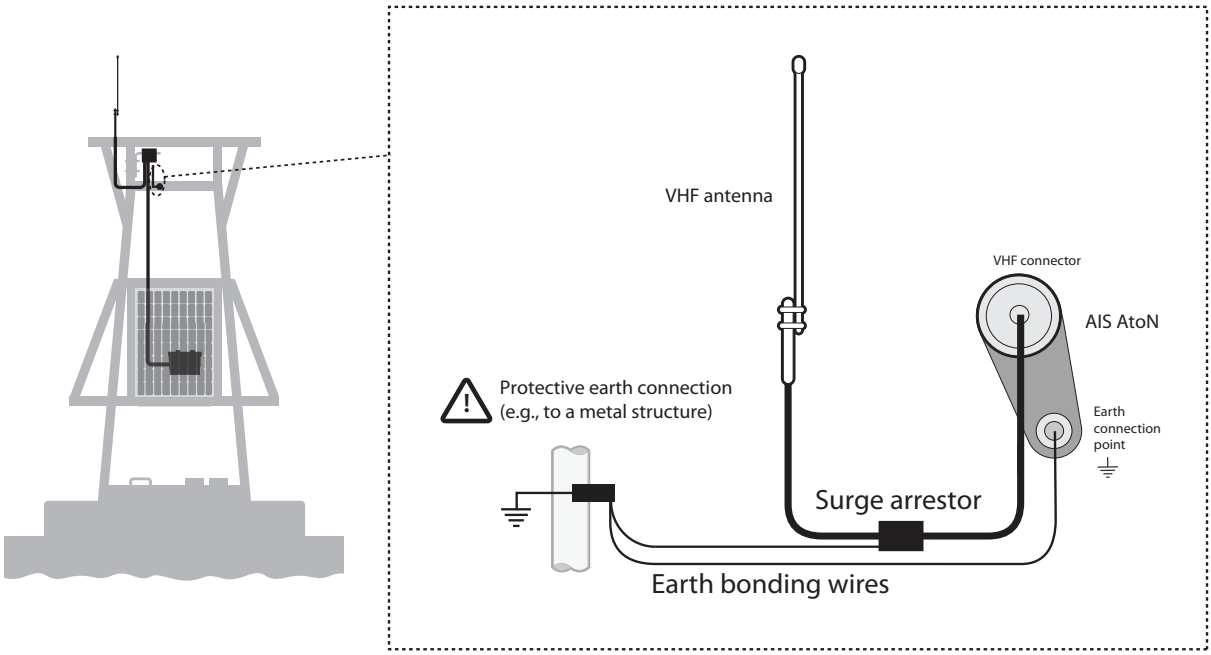


Figure 12 VHF antenna connection

It is essential that the earth connection point is used in <u>all installations</u>, regardless of what other equipment is connected. The supplied Surge Arrestor must also be installed in-line with your VHF antenna. The Surge Arrestor should also be grounded to an earthing point.

The VHF antenna should be installed according to the manufacturer's instructions.

The VHF antenna must be installed with at least 1 metre horizontal separation from any other VHF antenna mounted at the same level.

The performance and reliability of the VHF antenna is essential to correct operation of the transceiver. Ensure that a high quality antenna suitable for use in harsh environmental conditions is selected. Ensure all co-axial connections are well made and watertight.

The VHF antenna should have the following specification:

- **Centre frequency 159MHz**
- **VSWR < 2.0**
- **Impedance 50 Ohms**
- **Power handling 12.5 Watts**
- **Gain 3dBi or 6dBi**

It is recommended that high quality RG213 or RG214 co-axial cable is used to connect the VHF antenna to the transceiver. The antenna cable should be as short as possible and no more than 30 metres (100 feet) in length.

When selecting the installation location for the VHF antenna:

- **Install the antenna as high as possible on the physical aid to navigation**

- **Keep the antenna away from any large vertical metallic structures.**
- **Install the antenna with at least 1 metre horizontal separation from any other VHF antenna mounted at the same level.**

5.8 Installing and connecting an external GNSS antenna T1 T1+S T3 T3+S

The performance and reliability of the GNSS antenna is essential to correct operation of the transceiver. Ensure that a high quality antenna suitable for use in harsh environmental conditions is selected. Ensure all co-axial connections are well made and watertight.

The GNSS antenna should be installed according to the manufacturer's instructions.

The transceiver has an internal GPS antenna that is suitable for most applications and installation locations. The location of the internal GPS antenna is shown in Figure 13.

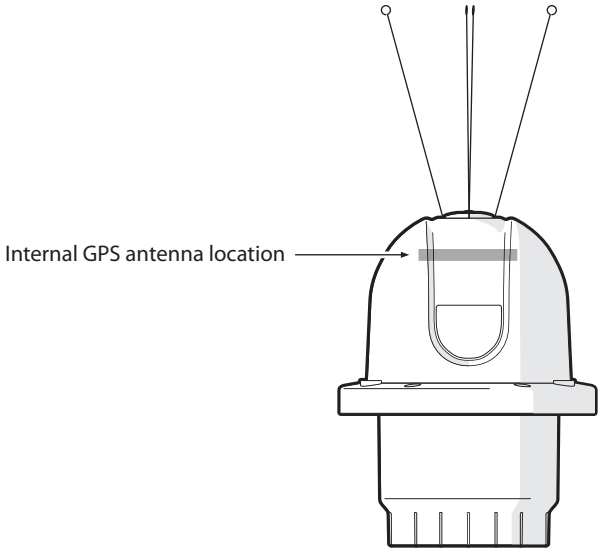


Figure 13 Internal GPS antenna location

If the installation requires an external GNSS antenna it should be specified as follows:

- **Centre frequency 1575.42MHz for GPS operation.**
- **Active antenna with overall gain of at least 20dB**
- **Bias voltage 3.3V**
- **Impedance 50 Ohms**
- **VSWR <2.0**

When installing the transceiver (using the internal GPS antenna) or an external GNSS antenna:

- **Make sure the antenna has a clear view of the sky with no overhead obstructions**
- **Position the antenna as far as possible from any VHF or other transmitting antennas**
- **Position the antenna as high as possible on the physical aid to navigation.**

It is recommended that high quality RG213 or RG214 co-axial cable is used to connect the GNSS antenna to the transceiver. The antenna cable should be as short as possible and no more than 10 metres (30 feet) in length.

6 Connecting external sensors and systems

The transceiver can be interfaced to external sensors and systems for the transmission of sensor data via the AIS network. Typically metrological and hydrological sensors are interfaced to the transceiver so that local conditions can be shared with other AIS users.

The transceiver is available with and without extended sensor interfaces as described in section 4. Section 6.1 describes the interfaces available without the extended sensor interface while section 6.2 describes the interfaces available with the extended sensor interface.

6.1 Basic transceiver interfacing T1 T1+S T3 T3+S

This section describes the interfaces available without the extended sensor interface. In this version of the transceiver only the power and transceiver interface connector is used for connection of external equipment. The interfaces available are:

- **Five user configurable input/output signals**
- **A bi-directional NMEA0183 port**
- **An input only NMEA0183 port**

The transceiver also has the ability to measure the incoming power supply voltage. This measurement is used by the transceivers BIIT (Built In Integrity Test) routines and can be used to trigger changes to the transceiver health flag in AIS message #21 (the AtoN position report) or additional AIS alert messages if so configured.

6.1.1 Basic user configurable input / output signals

The basic user I/O signals are 3.3V logic level signals and are mapped to the AtoN status bits in AIS message #21 (the AtoN position report). The default mapping of the signals is described in section 6.1.2. These connections are available at the 'Power and transceiver interface connector' described in section 5.5.1.

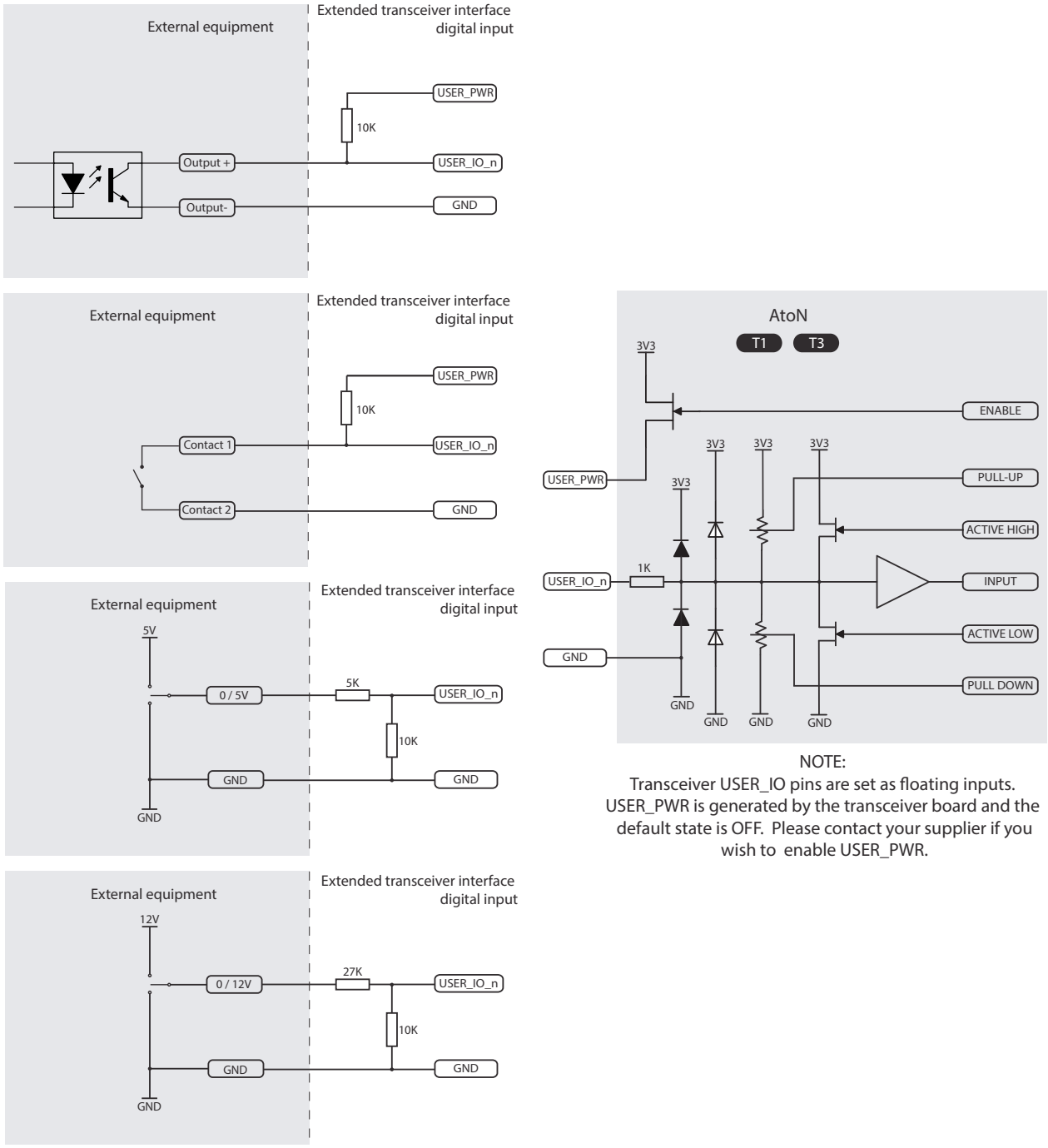
Configuration of the source and other settings for AtoN status information is described in section 6.1.4.

6.1.2 Basic Light and RACON status interfacing

Additional circuitry may be required to interface the light or RACON status outputs to the transceiver. Please contact your supplier with details of the light or RACON for further information.

Voltages above 3.3V must not be connected to these inputs. An external circuit and isolation may be required to interface external equipment. Isolated status inputs are available with the extended sensor interface and are described in section 6.2.

Figure 14 below shows the reference circuit for the USER_IO pins



NOTE:
Transceiver USER_IO pins are set as floating inputs. USER_PWR is generated by the transceiver board and the default state is OFF. Please contact your supplier if you wish to enable USER_PWR.

Figure 14 USER_IO pins reference circuit

The encoding of the connected equipment status to the light and RACON status is defined below.

- **Light on off - User IO 0 (logic high input = light on)**
- **Light health - User IO 1 (logic high input = light error)**
- **Racon Health - User IO 2 (logic high input RACON operational)**

When appropriately configured the status of the light and RACON signals will be sampled prior to each AtoN position report transmission and the status encoded in the message..When the Status bit source is sent to Sensor the input bits are polled once a minute and are not linked to the message #21 broadcast schedule.

6.1.3 Good health / Alarm monitoring

The good health / alarm state can be monitored using User IO 3. When it is operating normally the status is high. In the event of a failure where an alarm is activated, or an error is detected on a fitted light or Racon, the status will go low.

This status is also reflected in the corresponding status bit in Message 21.

Please note that the status will also go low when standby is entered. This can be mitigated by either disabling standby (contact your dealer for details), or by taking the regular low/alarm status into account at the monitoring station.

6.1.4 AtoN Status source and configuration

AIS AtoN position report messages (AIS message #21) contain status bits describing the status of a connected light and RACON. The general health of the transceiver is also provided as either 'good health' or alarm (see section 6.1.3). The transceiver can be configured to obtain status information from one of three sources:

- **Directly from the transceiver basic I/O signals described in 6.1.1**
- **From the extended sensor interface isolated digital inputs described in 6.2.4**
- **By input of an ACE (Extended General AtoN Station configuration command) sentence to one of the transceiver NMEA0183 ports. The ACE sentence is described in section 10.2.4. This sentence can be used to supply the status bits for transmission rather than sourcing from the hardware inputs.**

The source of the status information is configured using either proAtoN (see section 7). The following settings must also be configured using proAtoN:

- **Light fitted / not fitted**
- **Racon fitted / not fitted**
- **Racon monitored / not monitored**

Note that the AIS AtoN 'health' bit is generated internally by the transceiver. However, if the ACE sentence is configured as the source for status information then the AIS AtoN 'health' bit is the combination of the internal transceiver health and the ACE sentence health bit. In this configuration if either the internal transceiver health or the external health status provided by the ACE sentence is set to '1' (alarm) then the status will be transmitted as alarm.

6.1.5 Bi-directional NMEA0183 port

The bi-directional NMEA port (port 1) is available at the 'Power and transceiver interface connector' described in section 5.5.1. This port accepts and outputs NMEA0183/IEC61162-1 sentences for configuration of the transceiver and communication of binary message payload data (see section 7) to the transceiver for transmission in AIS messages. Whilst the transceiver is awake own position reports are also output to this port (as AIVDO messages) and in the case of a Type 3 transceiver remote vessel reports (as AIVDM messages) are also output.

The electrical and interface specification for this port is as follows:

- **Four wire NMEA0183 / IEC61162-1/2 port (RS422 levels)**
- **Baud rate 38,400baud**
- **Isolated receiver circuitry, non-isolated transmitter circuitry**

Port signal name	Function
NMEA0183_TX1_A	Transceiver NMEA0183 port 1 TX A+ signal
NMEA0183_TX1_B	Transceiver NMEA0183 port 1 TX B- signal
NMEA0183_RX1_B	Transceiver NMEA0183 port 1 RX B- signal
NMEA0183_RX1_A	Transceiver NMEA0183 port 1 RX A+ signal

6.1.6 Input only NMEA0183 port

The input only NMEA port (port 2) is available at the 'Power and transceiver interface connector' described in section 5.5.1. The electrical and interface specification for this port is as follows:

- **Two wire NMEA0183 / IEC61162-1/2 port (RS422 levels)**
- **Baud rate 38,400baud**
- **Isolated receiver circuitry**

Port signal name	Function
NMEA0183_RX2_A	Transceiver NMEA0183 port 2 RX A+ signal
NMEA0183_RX2_B	Transceiver NMEA0183 port 2 RX B- signal

6.2 Advanced transceiver interfacing T1+S T3+S

This section describes the interfaces available with the extended sensor interface. In this version of the transceiver all three 19 way connectors are used for connection of external equipment. The interfaces available in addition to those described in section 6.1 are:

- **Two fully isolated analogue inputs**
- **Three non-isolated analogue inputs**
- **A light current sense loop**
- **Five isolated digital inputs**
- **Four non-isolated digital inputs / outputs**
- **A fully isolated RS422 / NMEA0183 port**
- **Two RS232 ports**
- **An SDI-12 serial bus interface (one RS232 port is unavailable if this interface is used)**
- **Two relay drive outputs**

The following sections describe the hardware specification and interface to these inputs. The function of the sensor interface (in terms of translation of sensor data to AIS messages) is determined by the software configuration of the AIS AtoN. The default configuration and supported sensors are described in section 8 of this document. For alternate configurations please refer to the additional documentation supplied with the product or contact your supplier.

6.2.1 Isolated analogue inputs

The extended sensor interface includes two isolated analogue inputs. These inputs are available at "Sensor Interface Connector Y" described in section 5.5.4. The electrical and measurement specification of these inputs is as follows:

- **Differential input range 0 to 36V**
- **Impedance 620KΩ**

- **16 bit resolution**

The voltage to be measured should be applied across the differential positive and negative inputs.

6.2.2 Non-isolated analogue inputs

The extended sensor interface includes three non-isolated analogue inputs. The first of these inputs is available at the "Sensor Interface Connector X" described in section 5.5.3 and the remaining two inputs at the "Sensor Interface Connector Y" described in section 5.5.4. The electrical and measurement specification for these inputs is as follows:

- **Differential input range ± 35V**
- **Impedance 220KΩ**
- **12 bit resolution**

The voltage to be measured should be applied across the differential positive and negative inputs.

6.2.3 Light current sense loop

The extended sensor interface includes a light current sense loop. This facility is intended for health monitoring of a light on the physical aid to navigation. Connections for the light current sense loop are available at "Sensor Interface Connector X" described in section 5.5.3. The specification of the current sense loop is as follows:

- **Maximum current 5A**
- **12 bit resolution**

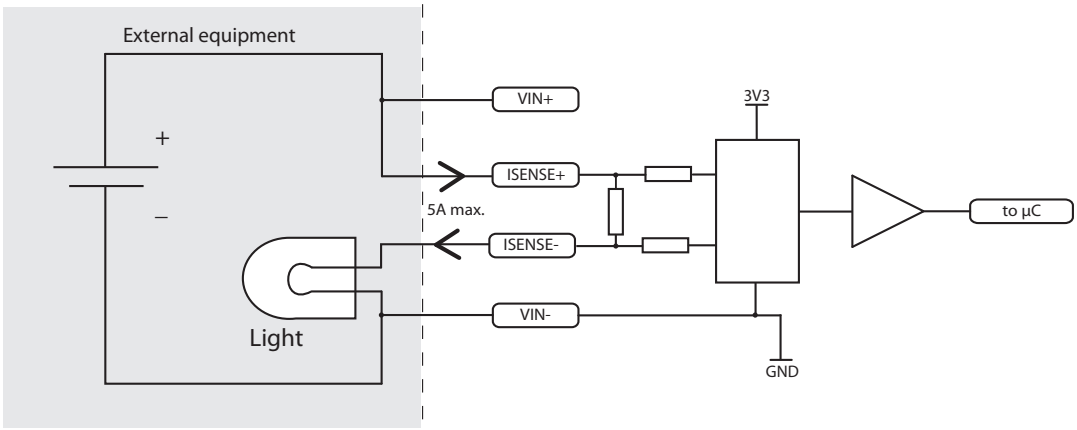


Figure 15 Light current sense loop circuit

A common ground is required between the lamp and the AtoN when using the ISENSE loop. The lamp must be connected in the "low" side of the loop. i.e. between ISENSE- and VIN-

6.2.4 Isolated digital inputs

The extended sensor interface includes five isolated digital inputs. These inputs are intended for use with status outputs from external equipment such as lights, RACONs and power supply monitoring systems. The first two inputs are available at the "Sensor Interface Connector X" described in section 5.5.3 and the remaining three inputs at the "Sensor Interface Connector Y" described in section 5.5.4. The specification for these inputs is as follows:

- **Maximum input voltage ±15V**

- **Input impedance 1KΩ**
- **Sensitivity 2.5V**

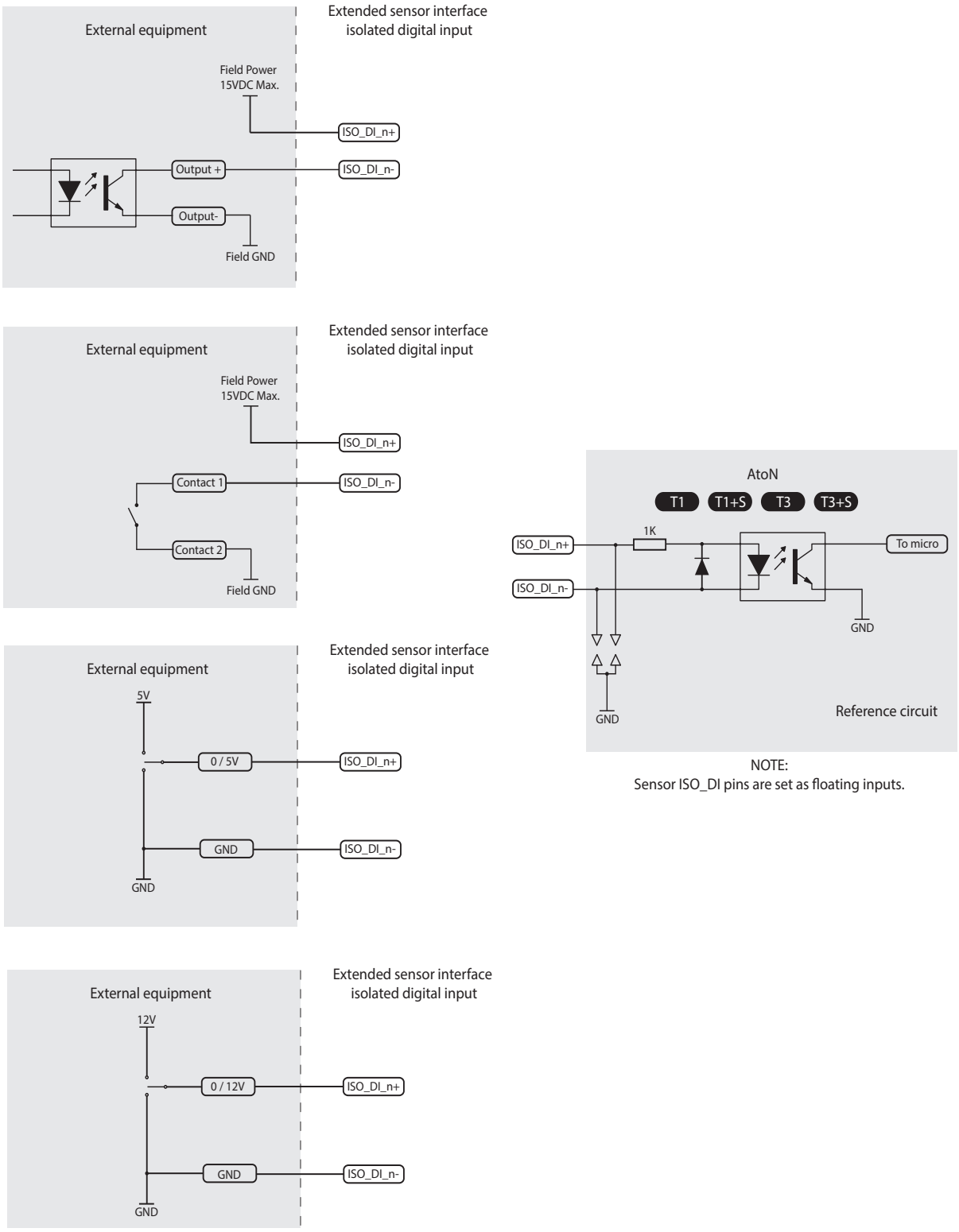
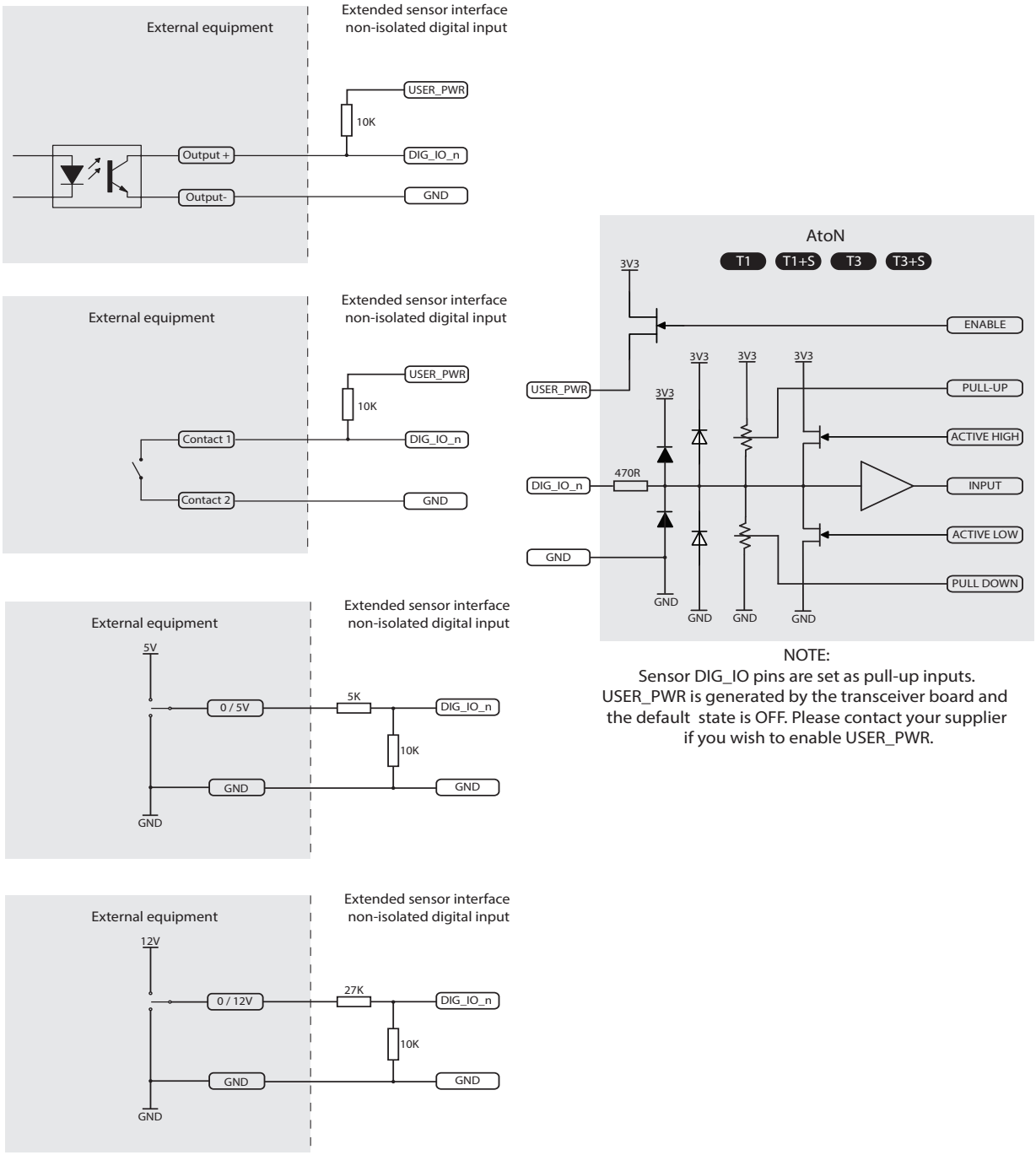


Figure 16 Isolated digital input reference circuit

6.2.5 Non-isolated digital inputs/outputs



NOTE:
Sensor DIG_IO pins are set as pull-up inputs.
USER_PWR is generated by the transceiver board and the default state is OFF. Please contact your supplier if you wish to enable USER_PWR.

Figure 17 Non Isolated digital input reference circuit

The extended sensor interface includes four non-isolated logic level digital interfaces. When configured as inputs the signal level must not exceed 3.3VDC referenced to the transceiver signal ground.The first three inputs are available at the "Sensor Interface Connector X" described in section 5.5.3 and the remaining three inputs at the "Sensor Interface Connector Y" described in section 5.5.4.

6.2.6 Isolated RS422 / NMEA0183 port

The extended sensor interface provides a fully isolated NMEA0183 (RS422 level) serial interface for connection of external equipment. Connections for the isolated NMEA0183 port are available at "Sensor Interface Connector X" described in section 5.5.3.

The port operates at 38,400baud by default. The data types accepted are determined by the configuration of the sensor interface.

6.2.7 RS232 ports

The extended sensor interface provides two non-isolated RS232 interfaces for connection of external equipment. The first of these ports is available at the "Sensor Interface Connector X" described in section 5.5.3 and the second at the "Sensor Interface Connector Y" described in section 5.5.4.

The port operates at 38,400baud by default. The data types accepted are determined by the configuration of the sensor interface.

RS232 port 2 shares hardware with the SDI-12 interface described in section 6.2.8 and is not available if the SDI-12 interface enabled by configuration.

6.2.8 SDI-12 interface

The extended sensor interface provides an SDI-12 for interface to external sensors supporting this bus. The extended sensor interface operates as an SDI-12 bus master. The electrical interface consists of three connections:

- **A serial data line**
- **A ground line**
- **A 12-volt line (used to power connected sensors)**

For further information on the SDI-12 interface please refer to the specification available at http://www.sdi-12.org/. Note that the 12V supply line is not provided by the sensor interface.

6.2.9 Relay drive outputs

The extended sensor interface provides two open drain relay drive outputs that default to the normally open state. The outputs are capable of switching 100mA at 12VDC or 50mA at 24VDC; a circuit diagram of the output driver is provided in Figure 18.

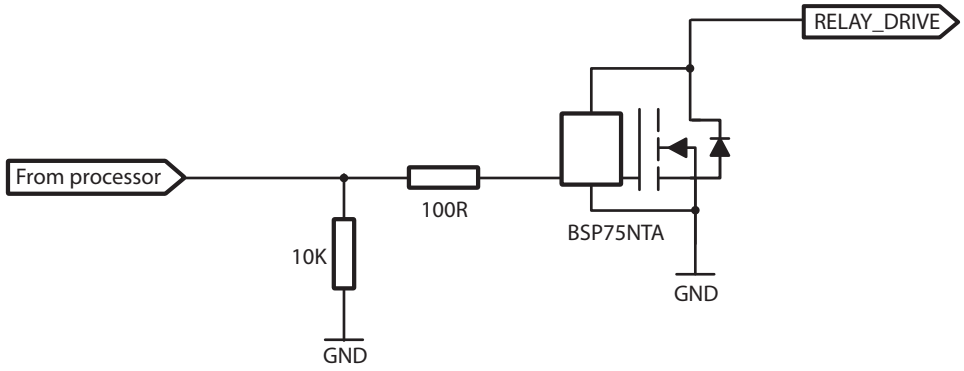


Figure 18 Relay drive output reference circuit

6.2.10 Input voltage monitor

The extended sensor interface has the facility to measure the incoming power supply voltage. This can be used to provide a measurement of the charge state of a battery supply to the transceiver. The voltage measured can be included in transmitted AIS measurements if so configured. No additional connections are required in order to make use of this facility.

7 Configuration using proAtoN T1 T1+S T3 T3+S

The application provides features for configuration of the transceiver and confirming correct operation before deployment. The main features of the application are:

- **Configuration of essential transceiver parameters such as MMSI, name and dimensions**
- **Configuration of reporting schedules**
- **Configuration of virtual and/or synthetic AtoN reporting schedules**
- **Configuration of other messaging features**
- **GNSS diagnostics**
- **System diagnostics and alarm display**
- **Configuration of the source for external equipment status information**

VDL configuration and chaining are also supported. For further information contact your supplier

7.1 proAtoN Installation

The steps to complete the installation are as follows:

1. Navigate to the *proAtoN* folder
2. Double click the ‘setup.exe’ item to start the installation process
3. Follow on screen instructions to complete the installation

Following successful installation the application can be launched from the proAtoN folder in the Windows start menu.

USB device drivers for the transceiver are installed automatically during installation of proAtoN.

7.2 Application layout

The basic layout of the proAtoN application is provided in Figure 19.

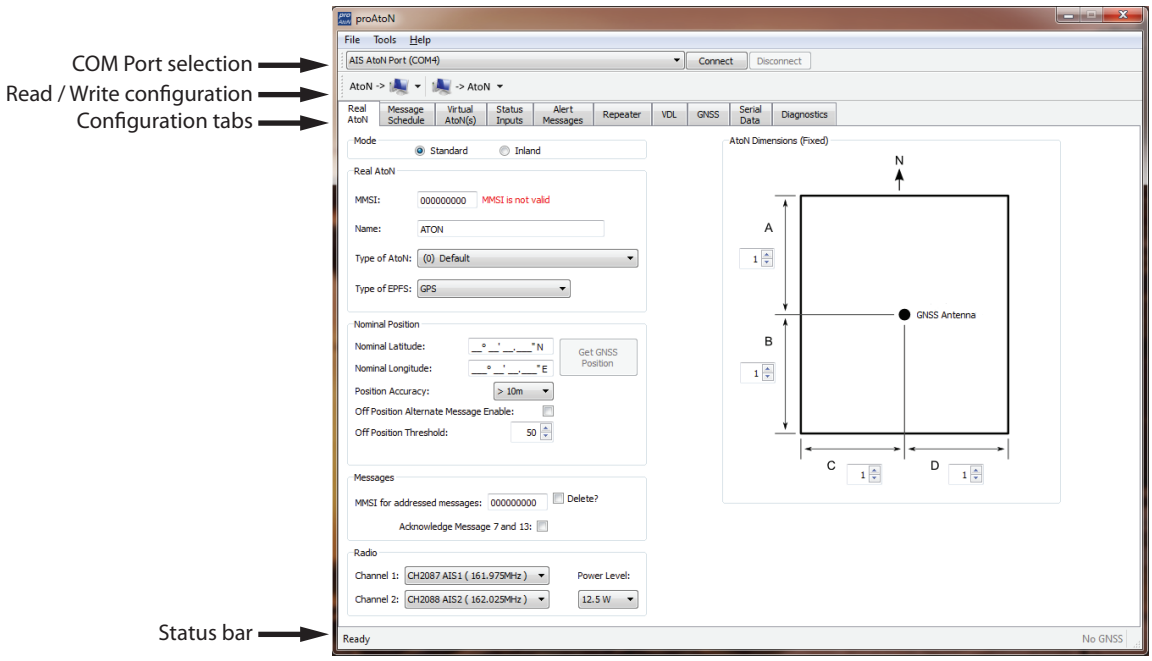


Figure 19 proAtoN application layout

COM Port selection

When connected via USB the COM port associated with the transceiver will be listed in the selection drop down. To connect to the transceiver select the 'AIS AtoN Port' option from the drop down and click the 'Connect' button.

Read / Write configuration

Clicking the left hand button will transfer current configuration information from the transceiver to proAtoN.

Clicking the right hand button will configure the transceiver with the information currently displayed in proAtoN.

It is possible to select transfer of configuration information relating only to the currently selected tab, or to all tabs by clicking the drop down arrow to the right of each button. The default operation for each button is to read or write data relating to the selected tab only. It is highly recommended that prior to deploying the AtoN the "Send all Configuration" option is used on the write button.

Configuration tabs

The configuration and status of the transceiver is displayed through a number of tabs.

- **Real AtoN tab**
  Configuration of AtoN MMSI, name, type, dimensions, position and radio parameters.
- **Message schedule tab**
  Configuration of FATDMA or RATDMA message schedules.
- **Virtual AtoN tab**
  Configuration of virtual and/or synthetic AtoN transmissions.
- **Status input tab**
  Configuration of the source for AtoN status information
- **Alert messages tab**
  Configuration of non-periodic messages (e.g., vessel proximity alert messages).
- **Repeater**
  Configuration of message repeats for messages #6, #8, #21 and SART messages.
- **VDL tab**
  Setup of the configuration over the VDL messages
- **GNSS**
  Displays signal strength and status information for the transceiver GPS receiver.
- **Serial data**
  Displays raw IEC61162 (NMEA0183) data output from the transceiver.
- **Diagnostics**
  Displays software version information, alarms and other key status information.

Synchronisation status

When connected to a AIS AtoN transceiver or Sensor Interface a synchronisation status icon is displayed alongside the title of each tab. This icon indicates the current synchronisation status of the information displayed in that tab with the internal configuration of the AIS AtoN transceiver or Sensor Interface. The synchronisation status icons are shown in Figure 20.

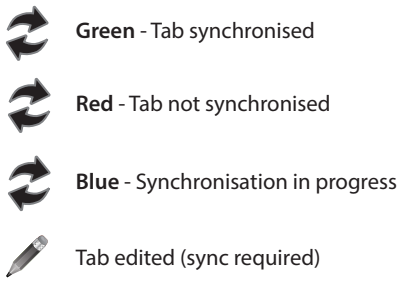


Figure 20 proAtoN tab synchronisation icons

Synchronisation is achieved by either writing the configuration displayed in proAtoN to the AIS AtoN transceiver or Sensor Interface (click the write configuration button), or reading the current configuration from the transceiver for display in proAtoN (click the read configuration button).

Status bar

The status bar displays the current connection status of the application (bottom left) and the current GPS time (if available, bottom right).

7.3 Transceiver configuration

The following sections describe the configuration options available and their effect on the behaviour of the transceiver. Configuration of an AIS AtoN transceiver requires knowledge of the local AIS environment and may require interaction with shore infrastructure. Familiarity with the current IALA guidelines on the use of AIS Aids to Navigation (IALA A-126) is assumed.

7.3.1 Configuration of 'Real' AtoN parameters

The following parameters associated with the 'real' AIS AtoN transceiver should be configured via the 'Real AtoN' tab:

- **Standard/Inland Mode**

  Standard mode is the default usage and the Type of AtoN list contains the types related to usage in a sea environment. Selecting inland mode changes the Type of AtoN list to types related to usage in an European inland waterways environment.

  Note that in inland mode the type of AtoN data is transmitted in the status bits field of message #21 so the lamp and RACON status (page ID 7) can not be sent and the related controls are disabled.

- **MMSI**

  The MMSI number associated with the 'real' AtoN. Typically the MMSI number for a 'real' AtoN station follows the format 99MID1XXX where MID is the appropriate national MID and XXX is a number unique to this station.

- **Name**

  The name of the AtoN station as broadcast to other AIS users. Up to 34 characters are available for the name.

- **Type of AtoN**

  Select from a list of possible types of AtoN. The types are as defined by IALA in IALA A-126.

- **Type of EPFS**

Select the type of EPFS (Electronic Position Fixing System) used by the transceiver. Note this selection does not affect the hardware configuration, only the contents of the ‘Type of EPFS’ field in transmitted AtoN position reports. The transceiver is equipped with a GPS module by default. Alternatively for a fixed or shore based transceiver a surveyed position type can be selected. Note that when the surveyed position is selected the surveyed position is broadcast to other AIS users and GNSS position information is ignored. Note that 'Undefined' is not a valid option and should not be selected, however it is required as the default EPFS type.

- **Nominal position**

  Enter the nominal or charted position of the AtoN. This is the position transmitted to other AIS users for a fixed AtoN when the ‘Surveyed’ EPFS type is selected. For all other configurations this position is used to perform ‘off position’ calculations only; the actual GNSS position is broadcast to other users.

  - The application can average the current GNSS position over 5 minutes and use this value for the nominal position. Click the ‘Get GNSS position’ button to the right of the latitude and longitude fields to begin this process.
  - The position accuracy can only be entered when the type of EPFS is set to ‘Surveyed’. The accuracy should be set in accordance with the accuracy of the surveyed position.

- **Off position alternate message enable**

  The current GNSS position is compared to the nominal position according to the algorithm defined in IALA A-126 Annex A, Example 1. The off position threshold distance is specified in metres. If the transceiver determines that it is ‘off position’ then the alternate reporting schedule for message #21 (index 2) is enabled. For example, the alternate reporting schedule could be configured to decrease the reporting interval if the AtoN has drifted off position. The off position flag in message #21 is set when off position regardless of this setting.

  The transceiver off position algorithm is always operational and compares the current GPS position to the nominal position of the transceiver.

It is essential that valid nominal position is entered and that a reasonable off position threshold is entered. If the default nominal position 00° 00’ 00.00”N / 000° 00’ 00.00”E is left unchanged then the transceiver will always be ‘off position’ resulting in the GPS receiver being permanently enabled. This will lead to significantly increased power consumption and the ‘off position’ flag in the Aids to Navigation report will be set.

- **MMSI for addressed messages**

  This is the destination MMSI used for all addressed message types generated by the transceiver. This is usually the MMSI of a shore station collecting status information from the transceiver. It is also possible to enable the acknowledgement of received binary messages (via message #7 or #13).

- **Dimensions**

  The dimensions of the AtoN should be entered to the nearest metre. Guidance on the appropriate configuration of dimensions for various types of AtoN can be found in IALA A-126.

- **Radio channels**

  Selection of alternative radio channels for AIS transmission and reception is possible, however in most cases the default channels (AIS1 and AIS2) should be used.

- **Transmitter power level**

  The transmitter power level for the transceiver can be selected as 1W, 2W, 5W or 12.5W. The default value of 12.5W is appropriate for most scenarios.

7.3.2 Message schedule configuration

The layout of the message schedule tab is described in Figure 21.

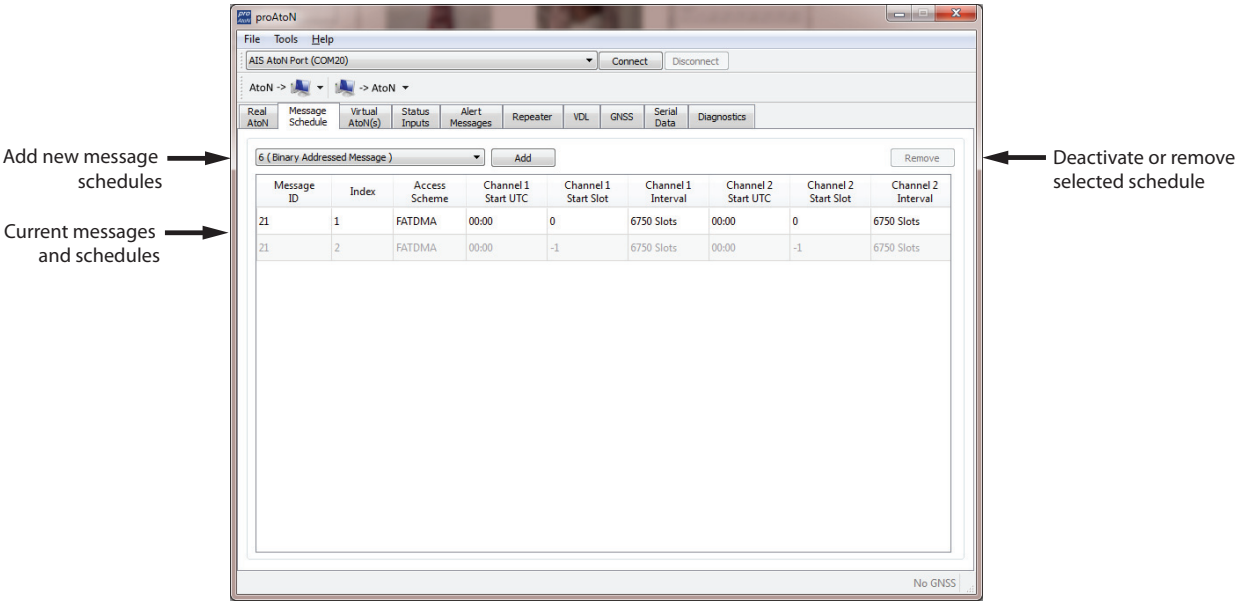


Figure 21 proAtoN message schedule tab layout

Default messages

An AIS AtoN position report is made using AIS message #21. This message occupies two AIS slots. The default configuration shown in proAtoN includes two message #21 schedule configurations. The first configuration, index 1, is the primary position reporting schedule for the transceiver. The second, index 2, is the alternate position reporting schedule selected when the 'off position' monitor is enabled and the AtoN is determined to be off position (see section 7.3.1). If the alternate 'off position' schedule is not required it can be deactivated by selecting the associated row in the message schedule table and clicking the 'Deactivate' button. When deactivated the alternate schedule will be greyed out.

Adding additional messages to the schedule

Additional binary data messages can be added to the schedule table by selecting the required message type from the drop down at the top of this tab, then clicking the 'Add' button. The available message types are:

- **Message #8 - for broadcast of binary data to all other stations in range. The binary data may be provided by the extended sensor interface (if present) or third party equipment connected to the transceiver. See section 8 for further information.**
- **Message #6 - for transmission of binary data to an individual destination MMSI. The destination MMSI is set on the 'Real AtoN' tab. The binary data may be provided by the extended sensor interface (if present) or third party equipment connected to the transceiver. See section 8 for further information.**
- **Message #12 - for transmission of text messages to an individual destination MMSI. The destination MMSI is set on the 'Real AtoN' tab. This schedule is used for transmission of alert messages (see section 7.3.7).**
- **Message #14 - for broadcast of text messages to all other stations in range. This schedule is used for transmission of alert messages (see section 7.3.7).**

Up to four separate schedules are available for each binary message type. Each individual schedule has an index from 1 to 4 which is used to identify that schedule (for example, message #8 index 2).

Access scheme selection

The access scheme for each message must be selected as either FATDMA or RATDMA (see section 3.2). The selection is made by selecting the required row in the schedule table, then clicking on the current access scheme in that row. A drop down menu will then appear in that location allowing selection of the required access scheme.

- **FATDMA** T1 T1+S T3 T3+S
  Configuration of an FATDMA schedule continues in section 7.3.3.
- **RATDMA** T3 T3+S
  Configuration of an RATMDA schedule continues in section 7.3.4.

7.3.3 FATDMA Schedule configuration T1 T1+S T3 T3+S

Using the FATDMA (Fixed Access TDMA) access scheme the actual slot for each transmission made by the transceiver is specified. There are 2250 slots per minute (or frame) on each AIS channel. The scheduled slots must be reserved for the transceiver by an AIS base station operating in the same area using AIS message #20. Further information on FATDMA reservations and slot allocation schemes can be found in IALA A-124, Appendix 14.

The parameters required for an FATDMA schedule are as follows.

Channel 1 start UTC

This is the hour and minute for transmission on channel 1. This specifies the AIS frame (minute) within a day in which the start slot for channel 1 resides.

Channel 1 start slot

This is the slot number for the first transmission on channel 1. The slot number can range from -1 (transmission disabled on this channel) to 2249. Note that each message #21 transmission occupies two slots and associated base station slot reservations must therefore reserve two slots.

Channel 1 interval

This is the interval in slots between transmissions on channel 1. The interval can range from 0 to 3240000 slots, which equates to an interval of one day. Typically the interval is set to 13500 slots (6 minutes) on each channel which results in an overall interval of 3 minutes.

Channel 2 start UTC

This is the hour and minute for transmission on channel 2. This specifies the AIS frame (minute) within a day in which the start slot for channel 2 resides. Typically the channel 2 start time is offset by 3 minutes from the start time used for channel 1. With a 6 minute reporting interval on each channel this results in a transmission every 3 minutes on alternating channels.

Channel 2 start slot

This is the slot number for the first transmission on channel 2. The slot number can range from -1 (transmission disabled on this channel) to 2249. Note that each message #21 transmission occupies two slots and associated base station slot reservations must therefore reserve two slots.

Channel 2 interval

This is the interval in slots between transmissions on channel 2. The interval can range from 0 to 3240000 slots, which equates to an interval of one day. Typically the interval is set to 13500 slots (6 minutes) on each channel which results in an overall interval of 3 minutes.

Example FATDMA schedule

A typical transmission schedule requires that the AIS AtoN transceiver transmit AIS message #21 every three minutes on alternating channels. The transmission schedule is presented diagrammatically in Figure 22.

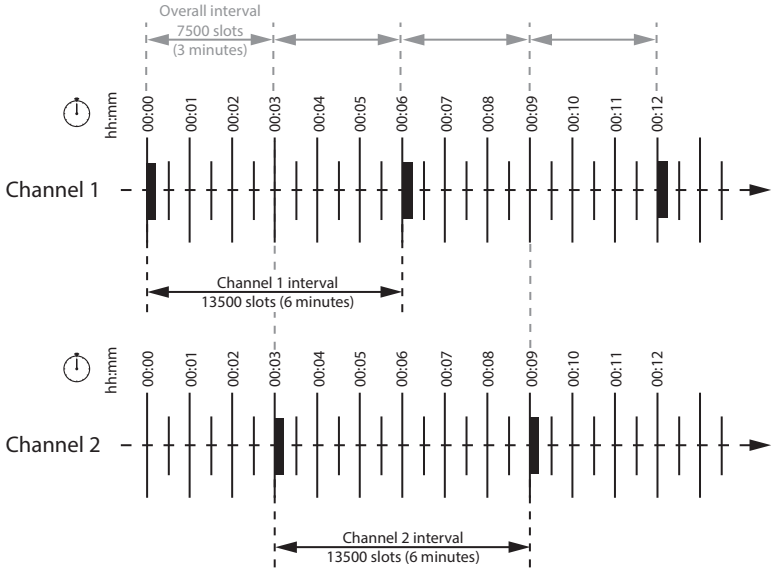


Figure 22 Example FATDMA schedule

This schedule can be configured using the following values:

- **Channel 1 start UTC = 00:00 (the first frame of every hour)**
- **Channel 1 start slot = 0 (the first slot in the frame, so slots 0 and 1 are used by the message #21 transmission)**
- **Channel 1 interval = 13500 slots (this equates to a 6 minute interval as there are 2250 slots per minute)**
- **Channel 2 start UTC = 00:03 (the third frame of every hour)**
- **Channel 2 start slot = 0 (the first slot in the frame, so slots 0 and 1 are used by the message #21 transmission)**
- **Channel 2 interval = 13500 slots (this equates to a 6 minute interval as there are 2250 slots per minute)**

The transceiver is now configured to report message #21 on channel 1 every 6th minute, and on channel 2 every 6th minute, but offset by three minutes from channel 1. This results in a transmission of message #21 every three minutes on alternating channels. The actual start slot selected for each channel will depend on the FATDMA allocations in the area of operation.

7.3.4 RATDMA Schedule configuration T3 T3+S

Using the RATDMA (Random Access TDMA) access scheme the time for each transmission made by the transceiver is specified. The transceiver will determine the actual slots used for transmission based on internal knowledge of the AIS environment gained from the AIS receivers.

The parameters required for an RATDMA schedule are as follows.

Channel 1 start UTC

This is the hour and minute of the frame in which transmission will occur on channel 1. The slot used within this frame will be determined by the transceiver.

Channel 1 interval

This is the interval in minutes between transmissions on channel 1. A typical value is 6 minutes.

Channel 2 start UTC

This is the hour and minute of the frame in which transmission will occur on channel 2. The slot used within this frame will be determined by the transceiver.

Channel 2 interval

This is the interval in minutes between transmissions on channel 1. A typical value is 6 minutes.

Example RATDMA schedule

A typical transmission schedule requires that the AIS AtoN transceiver transmit AIS message #21 every three minutes on alternating channels. The transmission schedule is presented diagrammatically in Figure 23.

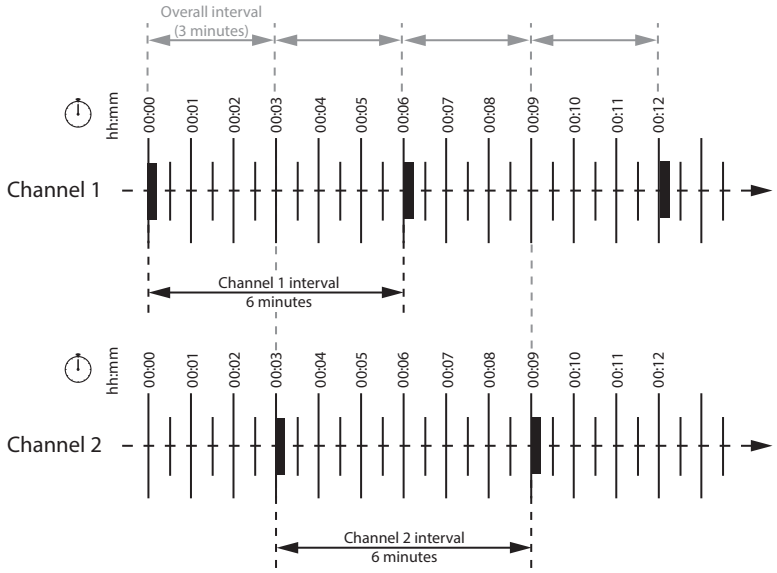


Figure 23 Example RATDMA schedule

This schedule can be configured using the following values:

- **Channel 1 start UTC = 00:00 (the first minute of every hour)**
- **Channel 1 interval = 6 minutes**
- **Channel 2 start UTC = 00:03 (the third minute of every hour)**
- **Channel 2 interval = 6 minutes**

The transceiver is now configured to report message #21 on channel 1 every 6th minute, and on channel 2 every 6th minute, but offset by three minutes from channel 1. This results in a transmission of message #21 every three minutes on alternating channels. The exact timings of the transmissions within the selected minute will vary as the transceiver selects available slots using RATDMA.

7.3.5 Virtual AtoN configuration

The transceiver can be configured to transmit position reports for up to ten virtual or synthetic Aids to Navigation. This configuration is carried out using the *Virtual AtoN(s)* tab in proAtoN. Within this tab there are sub-tabs relating to each of the virtual or synthetic AtoNs. The sub-tabs are visible at the left hand edge of the window. The layout of the virtual AtoN configuration tab is provided in Figure 24.

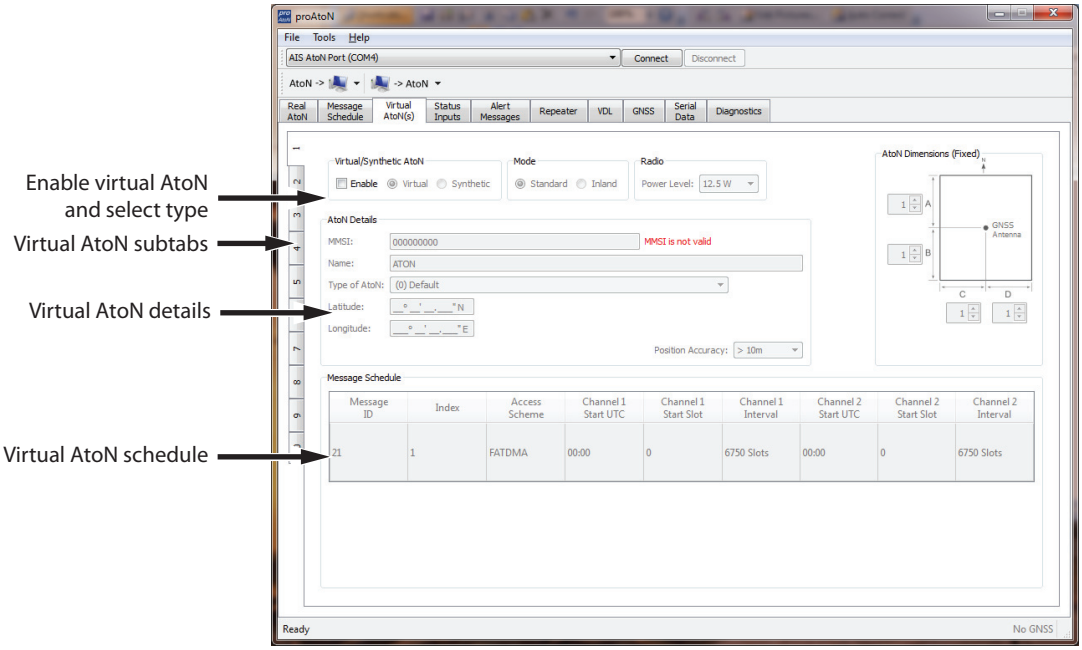


Figure 24 Virtual AtoN configuration tab layout

The following parameters are required to configure a virtual or synthetic AtoN. Note that the 'real' AtoN must be properly configured in order to make use of the virtual AtoN feature.

Virtual / Synthetic AtoN

Each virtual AtoN required must be separately enabled by checking the 'Enable' checkbox. The type of virtual AtoN can then be selected.

- **Virtual AtoN**

  A virtual AtoN is transmission of message #21 for an Aid to Navigation that does not physically exist. A virtual AtoN may be used to mark a temporary hazard to navigation, e.g., a wreck. For further information on the use of virtual AtoNs please refer to IALA A-126, IALA O-143 and IALA guideline 1081.

- **Synthetic AtoN**

  A synthetic AtoN is transmission of message #21 from an AIS station located remotely from the physical Aid to Navigation. An example of use is to provide an AIS AtoN target for a buoy or mark that is not capable of supporting AIS AtoN hardware.

Virtual / Synthetic AtoN Details

The basic configuration of a virtual or synthetic AtoN is comparable to that required for a 'real' AIS AtoN. Note that the MMSI number format is different:

- **A virtual AtoN MMSI has the format 99MID6XXX, where MID is the appropriate national MID and XXX is a number unique to this station.**
- **A synthetic AtoN MMSI has the same format as a real AtoN MMSI, e.g., 99MID1XXX, where MID is the appropriate national MID and XXX is a number unique to this station.**

The position of the virtual or synthetic AtoN must be configured appropriately to the position of the aid. Note that a virtual AtoN has no dimensions whereas the dimensions of a synthetic AtoN should be configured.

Virtual AtoN schedule

The transmission schedule for a virtual or synthetic AtoN must be configured in the same way as that for the 'real' AtoN. The TDMA access scheme, start times and intervals must be configured in the virtual AtoN tab following the guidance in section 7.3.3 or 7.3.4 as appropriate. When an FATDMA schedule is used it is important to ensure the slot allocations used for the virtual and real AtoNs are different in every case. Also note that two consecutive slots are used for each virtual AtoN report.

7.3.6 Status input configuration tab

AIS AtoN position reports (message #21) contain status information encoded as a bit sequence. The status bits contain the basic operational state of a connected light and RACON along with the overall health of the transceiver itself. Connection of a light and/or RACON is optional and requires equipment with a suitable health output. Interfacing of light and RACON status is described in sections 6.1.1, 6.1.4 and 6.2.4.

The status information can be obtained from one of three sources as described in section 6.1.4. The status input configuration tab is used to set the source and other associated parameters. The layout of the status input configuration tab is provided in Figure 25.

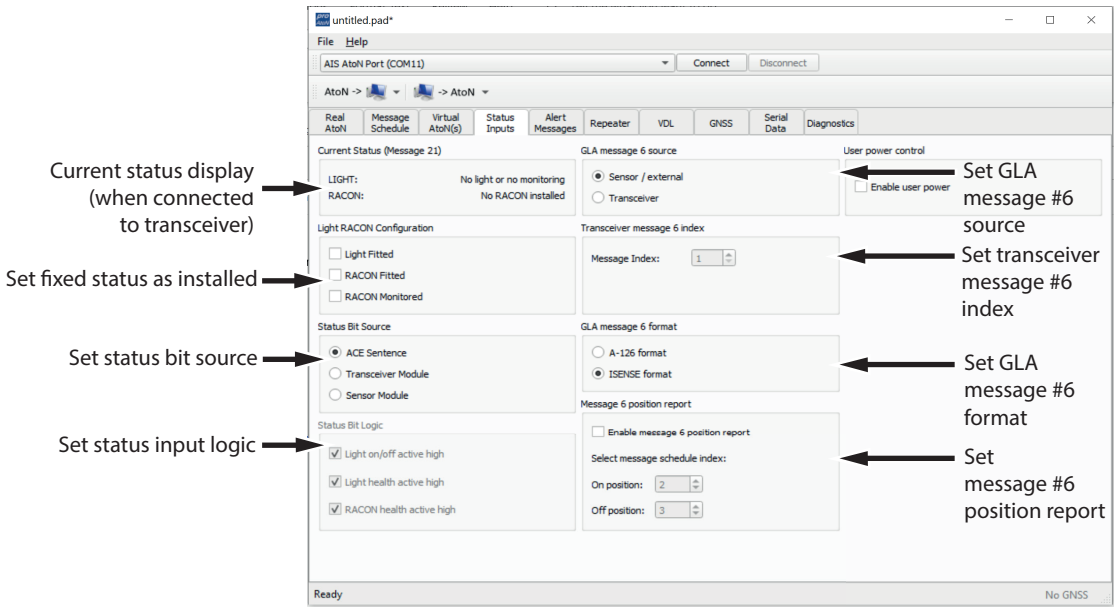


Figure 25 Status input configuration tab layout

Current status (message #21)

This section shows the current light and RACON status determined by the transceiver. The transceiver must be connected and powered from a DC supply in order for this display to operate correctly.

Light & RACON configuration

This section allows the fixed parameters of the light and RACON to be configured. The check boxes should be set according to the physical configuration. For example if a light status output is connected to the transceiver then the 'Light fitted' check box should be checked. If a RACON is connected it is also possible to define if the RACON is monitored or not.

Status bit source

Select the source for the status information to match the method used to provide status information to the transceiver (this is described in section 6.1.4).

Status bit logic

The logical sense of the physical status bit inputs (at either the basic or extended sensor interfaces) can be set here. This allows for interface of equipment with active high or active low status outputs.

- Light on off - User IO 0 **(active state = light on)**
- Light health - User IO 1 **(active state = light error)**
- RACON Health - User IO 2 **(active state = RACON operational)**

GLA message #6 source

In all cases the message schedule for the selected message index must be configured. The message #6 index usage is restricted to avoid clashes.

The GLA message #6 payload can be built by the sensor PCA or other external source. This is the default arrangement. The payload can also be built directly by the transceiver unit (with a reduced range of data input options). In the second case the battery voltage and transceiver input for lamp and RACON status bits are available for use in the message.

Transceiver message 6 index

Sets the message index when the Status Bit Source is set to 'Transceiver'. proAtoN detects and prohibits any message index clashes with other messages of the same type. An error will be displayed if the message index isn't set correctly.

GLA message 6 format

When the Status Bit Source is set to 'Sensor / external' there are two message formats available for selection: A-126 or ISENSE.

The A-126 format follows the specification in the IALA recommendation, which states that digital inputs are used to populate the external status bits field.

The ISENSE format outputs the status from the ISENSE interface in bit 5 of the external status bits field.

Full mappings for each format are detailed in section 9.2.8 Message #6 Data Mapping.

Message #6 position report

In all cases the message schedule for the selected message index must be configured. The message #6 index usage is restricted to avoid clashes.

This control enables the configuration of a special message #6 structure and the message index to indicate if the AtoN is off-position or on-position. The transmission frequencies of the two message indexes can be set as required to give a different update rate for on and off position scenarios.

User power control

Allows you to enable or disable the user power signal from the W connector.

7.3.7 Alert messages

The transceiver can be configured to transmit text messages for three different alert conditions.

- **An addressed or broadcast text message can be transmitted when the transceiver detects a Built-In Test (BIT) failure.**
- **An addressed text message can be transmitted to an approaching vessel if the vessel comes within a configurable distance of the transceivers location. This function is only available with Type 3 variants and with full time receiver operation.**
- **An addressed or broadcast text message can be transmitted when the transceiver determines that it is off position (see section 7.3.1). This message is in addition to use of the alternate schedule for off position reporting (if the alternate schedule is enabled) and does not replace that function.**

The layout of the alert messages configuration tab is provided in Figure 26.

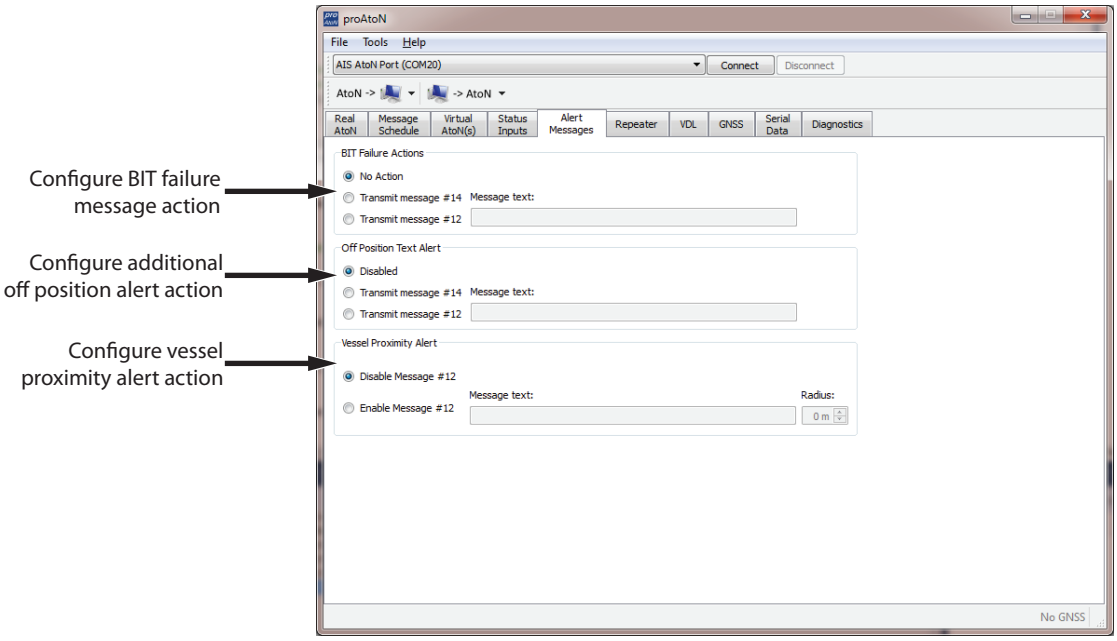


Figure 26 Alert messages configuration tab layout

BIT failure actions

This section allows configuration of the text message to be transmitted on detection of a Built-In Test failure (BIT failure). Such a failure may indicate a problem with the transceiver and it may be prudent to warn vessels not to rely on the information provided by the transceiver in this situation. Note that the health of the transceiver is always transmitted as part of the standard Aids to Navigation position report (message #21), however the status contained in that message may not be shown on all display systems.

The available actions on BIT failure are:

- **No action - no message is transmitted on detection of a BIT failure**
- **Transmit message #14. A broadcast text message is transmitted on detection of a BIT failure. The text content of the message must be defined in the 'Message text' box.**
- **Transmit message #12. An addressed text message is transmitted on detection of a BIT failure. The destination for the addressed message is configured on the 'Real AtoN' tab (see section 7.3.1)**

In addition to configuration of the BIT failure action a schedule for the associated message must be configured in the 'Message schedule' tab.

- **Message #14 Index 1 must be configured if the message #14 action is selected.**
- **Message #12 Index 1 must be configured if the message #12 action is selected.**

Off position alert

This section allows configuration of the text message to be transmitted when the transceiver detects that it is off position. The settings for off position detection are made on the 'Real AtoN' tab (see section 7.3.1). The configuration of an alternative off position message #21 reporting schedule is independent of the configuration of this text alert.

The available off position alert actions are:

- **Disabled - no text message is transmitted when the transceiver determines that it is off position**
- **Transmit message #14. A text message is broadcast when the transceiver detects that is off position. The text content of the message must be defined in the 'Message text' box.**

- **Transmit message #12. An addressed text message is transmitted on detection of an off position condition. The destination for the addressed message is configured on the 'Real AtoN' tab (see section 7.3.1)**

In addition to configuration of the off position alert a schedule for the associated message must be configured in the 'Message schedule' tab.

- **Message #14 index 2 must be configured if the message #14 action is selected**
- **Message #12 index 2 must be configured if the message #12 action is selected**

Vessel proximity alert

This section allows configuration of the text message to be transmitted on detection of vessel breaching a defined radius (or guard ring) around the transceiver. This message can be used to warn approaching vessels of potential collision with the AtoN. The addressed message is automatically sent to all vessels that breach the guard ring radius.

The available vessel proximity alert actions are:

- **Disable message #12 - the vessel proximity alert function is disabled**
- **Enable message #12 - the function is enabled and the text content of the message to be transmitted must be defined in the 'Message text' box. The guard ring radius for the proximity alert must also be configured in the 'Radius' box; note that the value is set in metres.**

In addition to configuration of the vessel proximity alert a schedule for the associated message must be configured in the 'Message schedule' tab.

- **Message #12 Index 3 must be configured if the message #12 action is selected.**

7.3.8 Message repeater function

The transceiver can be configured to repeat, or re-transmit, certain messages it receives. Note: messages from virtual AtoN's are not repeated. This feature applies to messages #6, #8, #21 and to SART specific messages #1 and #14. This feature is turned off by default for all message types but can be enabled and configured using the Repeater tab. The number of messages that are repeated is limited by the number of messages waiting to be repeated and the total number of transmissions made per UTC minute.

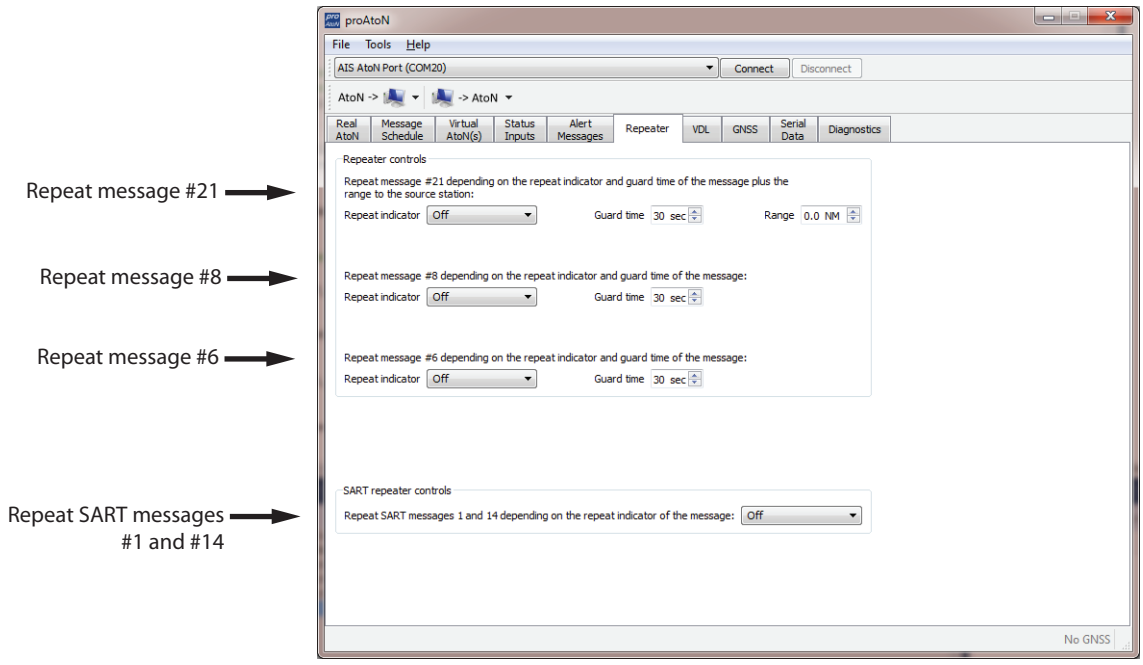


Figure 27 Message repeater tab layout

For each message type, the repeat function can be disabled - Off - or enabled to repeat received messages with a Repeat Indicator (RI) value equal to or less than 0, 1 or 2. The RI value states how many times the message has already been repeated where 0 means it was transmitted by the source.

For messages #6, #8 and #21, a Guard Time can be applied. This creates a period after a message is repeated, during which the same message type from the source MMSI will not be repeated again, regardless of the message's RI value. For example, if a message #6 from MMSI A is repeated then a second message #6 is received from MMSI A within the Guard Time, the second message shall be interpreted and acted upon as necessary but it will not be repeated; however, if a third message #6 from MMSI A is received after the Guard Time has expired, it will be repeated so long as its RI value is less than or equal to that configured for the AtoN.

For message #21, a Range constraint can also be applied. Any message #21 that meets the other criteria for repeating, shall be transmitted if the position reported is within the distance specified by the Range value of the receiving AtoN. A Range value of 0 indicates the restriction is disabled.

7.4 Transceiver diagnostics

The proAtoN application provides a number of features to assist with installation of an AIS AtoN and diagnosis of fault conditions. These features are available through the GNSS, Serial Data and Diagnostics tabs in proAtoN.

7.4.1 GNSS tab

The GNSS tab shows the status of the GNSS receiver built into the transceiver. This provides an indication of the quality of the GNSS satellite signals being received along with the current position of the transceiver.

At least four satellites with a carrier to noise ratio in excess of 40 dB Hz are required for an acceptable position fix. Relocating the transceiver or connecting an external GNSS antenna can help improve the signal quality and resulting position accuracy.

The internal GNSS receiver supports SBAS (Satellite Based Augmentation Service) to enable improved accuracy and integrity of GNSS position fixes. The availability of SBAS depends on the installation location of the transceiver (the WAAS SBAS service covers most of the US and the EGNOS service covers Europe).

7.4.2 Serial Data tab

The serial data page shows all data output from the transceiver in NMEA0183 / IEC61162-1 format. It is also possible to send NMEA0183 / IEC61162-1 commands to transceiver if required for technical support or custom configuration. A facility to record the data to a file is provided by clicking the ‘Log to File’ button.

Certain sentence types can be filtered out of the output window by checking the relevant sentence type in the ‘Filters’ section of this tab.

7.4.3 Diagnostics tab

The Diagnostics tab provides system version and status information. This information may be required when requesting technical support for the product. The Diagnostic tab does not work when proAtoN is connected to the NMEA0183 port, it only works when connected to the USB port.

AtoN Details

- **The connected AtoN Type is displayed as Type 1 or Type 3**
- **The application and bootloader software versions for the connected AtoN are displayed**
- **The serial number of the connected AtoN is displayed**

Power status

- **The VHF antenna VSWR (Voltage Standing Wave Ratio) as measured at the last AIS transmission is displayed. This value is for indication only. A value better than 3:1 is expected for a good antenna system. The alarm limit for antenna VSWR is set to 5:1. A perfect antenna would give a VSWR of 1:1.**
- **The system supply voltage is displayed in volts. The supply voltage must be between 9.6V and 32.6V for correct operation. The supply voltage alarm will activate outside of this supply voltage range.**

Report generation

Clicking the ‘Generate’ button will produce full report of the transceiver status. This report may be requested by technical support personnel. After clicking the button select a suitable file name and location for the report file before clicking save.

Reported messages

During operation the transceiver will output a variety of status messages relating to the current operating state. These messages are for information only and do not represent a fault condition.

Message text	Description / Resolution
TX attempt failed (msg #6 no payload re-broadcast data)	A transmission of message #6 has failed as the payload data required for this message was not provided (by either the extended sensor interface, or an external system). The likely cause is a configuration error relating to data capture.
TX attempt failed (msg #8 no payload re-broadcast data)	A transmission of message #8 has failed as the payload data required for this message was not provided (by either the extended sensor interface, or an external system). The likely cause is a configuration error relating to data capture.
TX attempt failed (msg #12 no payload re-broadcast data)	A transmission of message #12 has failed as the payload data required for this message was not provided (by either the extended sensor interface, or an external system). The likely cause is a configuration error relating to data capture.
TX attempt failed (msg #14 no payload re-broadcast data)	A transmission of message #14 has failed as the payload data required for this message was not provided (by either the extended sensor interface, or an external system). The likely cause is a configuration error relating to data capture.
Standby blocked: Off position algorithm	The transceiver can’t enter standby (low power) mode because the ‘off position’ algorithm has detected an off position condition. Moving the transceiver within the configured operating radius will resolve this.
Standby Blocked: Acquiring GPS	The transceiver can’t enter standby (low power) mode because it is currently acquiring a GNSS position fix. Standby operation will resume when a fix is acquired.
Standby disabled	Standby mode (low power operation) is disabled by configuration.
Standby Blocked: USB connected	The transceiver will not enter standby (low power) mode whilst the USB interface is connected to a PC.
Standby Blocked: Shell running	The transceiver will not enter standby (low power) mode whilst the configuration shell is active.
Standby Blocked: Receivers enabled	The transceiver can’t enter standby mode if the current configuration requires that the receivers are active.

Message text	Description / Resolution
Standby Blocked: Repeater enabled	The transceiver cannot enter standby mode if the current configuration has the message repeater function enabled.
Exiting standby	Information only on exit of standby mode.
Entering standby for xx seconds	Information only on entry to standby mode.

Active alarms

The transceiver incorporates BIT (Built-In Test) routines which continuously monitor key operating parameters. Should an integrity test fail the failure will be indicated in the active alarms area.

Alarm text	Description / Resolution
Tx Malfunction	A transmitter malfunction has been detected - please contact your supplier.
Antenna VSWR exceeds limits	The VHF antenna VSWR is above the permitted limit. Check the VHF antenna, cable and connections are sound. The VSWR measured at the last transmission is displayed on the proAtoN diagnostics tab.
Rx Channel 1 malfunction	A receiver malfunction has been detected - please contact your supplier.
Rx Channel 2 malfunction	A receiver malfunction has been detected - please contact your supplier.
EPFS failure	No position is available from the internal GNSS receiver - please contact your supplier.
DGNSS input failed	No data is available from the external source of differential GNSS correction data. Please check connections, baud rate and equipment configuration.
Supply voltage	The transceiver power supply voltage is outside of the permitted range. The measured supply voltage is displayed on the proAtoN diagnostics tab.
Low forward power	The transmitter forward power is below a preset limit - please contact your supplier.
Synchronisation lost	Timing information is not available from the internal GNSS receiver - please contact your supplier.

7.5 Sensor configuration T1+S T3+S

The sensor configuration tabs are displayed when the sensor port is selected in the COM Port selection menu. Five tabs are displayed in this mode; 'Sensor Settings', 'ADC Settings', 'Message Settings', 'System Information' and 'Live Data'. Details for each of these tabs are given in the following sections. Where necessary reference is made to the underlying command from which details of the control behaviour can be found.

7.5.1 Sensor settings

This tab displays controls as appropriate to the configuration set. It is necessary to download this information from the Sensor Interface. Connect to the sensor port and use the 'Retrieve all Configuration' control to retrieve the information. The opening screen contains a message to this effect (see Figure 28). On retrieving the information the screen will change to show the controls for the sensor configuration in use (see Figure 29).

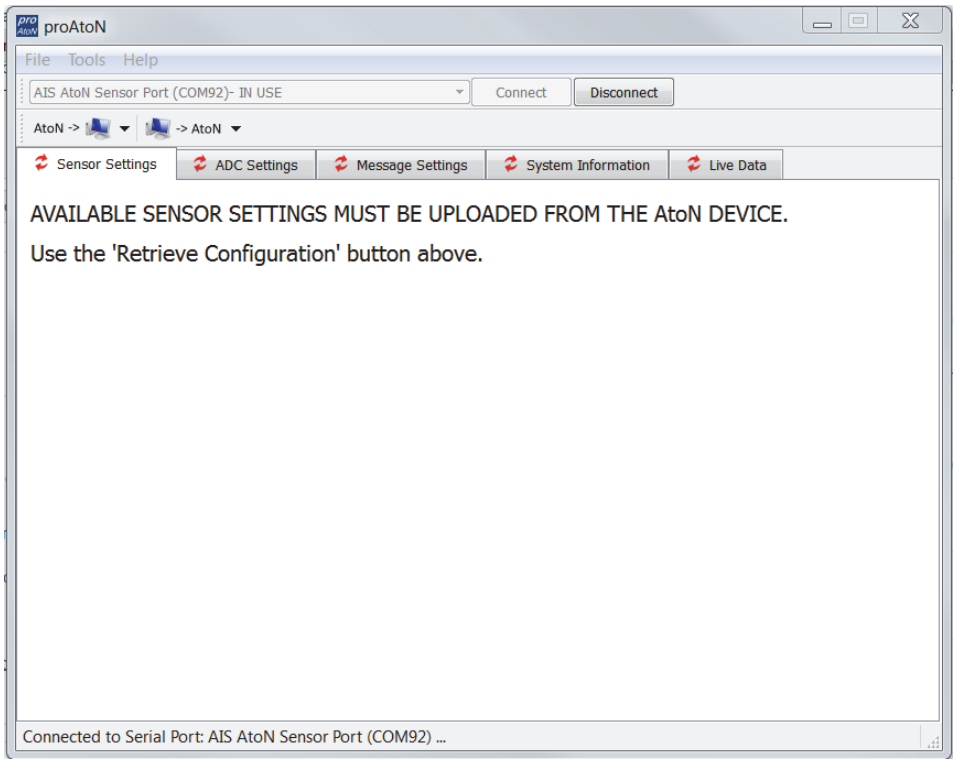


Figure 28 Initial sensor settings tab

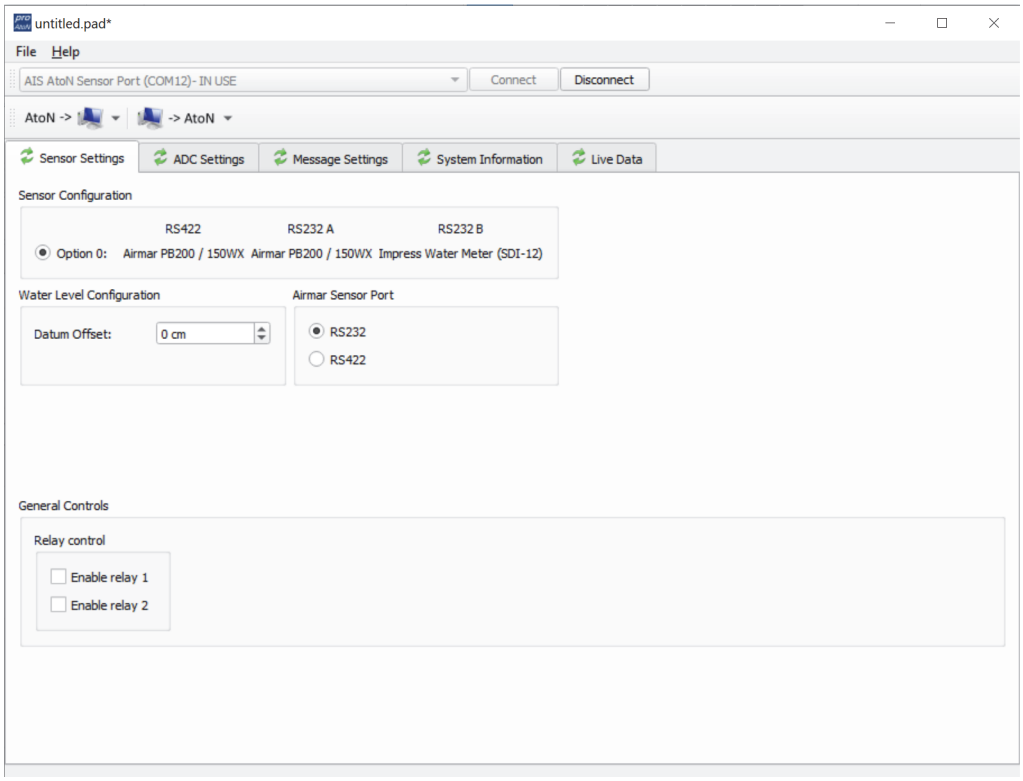


Figure 29 Sensor settings tab

Relay control

Allows you to enable or disable Relay 1 or 2. See section 6.2.9 for detail on connecting the relays.

7.5.2 ADC settings tab

This tab contains controls for the light current sense and ADC scaling parameters. There are three groups of controls on this tab; 'Light Current Sense', Current Sense ADC Scaling' and 'Voltage Measurement Scaling' (see Figure 30).

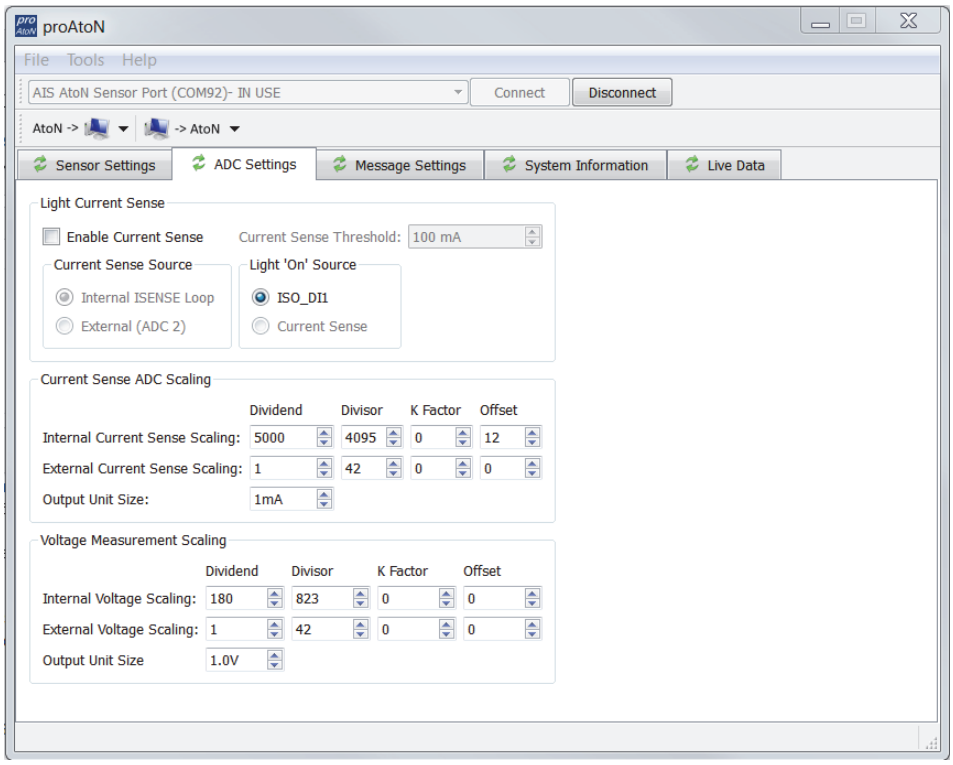


Figure 30 ADC settings tab

Light Current Sense group

Checking the 'Enable Current Sense' box will enable the controls listed below. The function of each control can be found in the corresponding command details.

- **Current Sense Threshold (see 'isensethresh' in ‘ADC configuration commands’ table)**
- **Current Sense Source (see 'altisource' in ‘ADC configuration commands’ table)**
- **Light On Source (see 'lightonsource' in Zeni Lite Message #6 configuration commands’ table)**

Current Sense ADC Scaling

These controls allow the setting of the scaling parameters for the two current sense sources. Details for these parameters can be found in section . The underlying commands are 'setisensescale' and 'setaltisensescale' detailed in Table 6. Switching between these two sources is controlled by the Current Sense Source control in the Light Current Sense group box above.

Voltage Measurement Scaling

These controls allow setting of the scaling parameters for the two voltage measurement sources. Details for these parameters can be found in section . The underlying commands are 'setvoltscale' and 'setaltvoltscale' detailed in . Switching between these two sources is controlled by the Voltage Measurement Source control of the Message Settings tab.

7.5.3 Message settings tab

The message settings tab, shown in Figure 31 contains controls related to message #6 and message #8 payloads. The control groups are based on these message types.

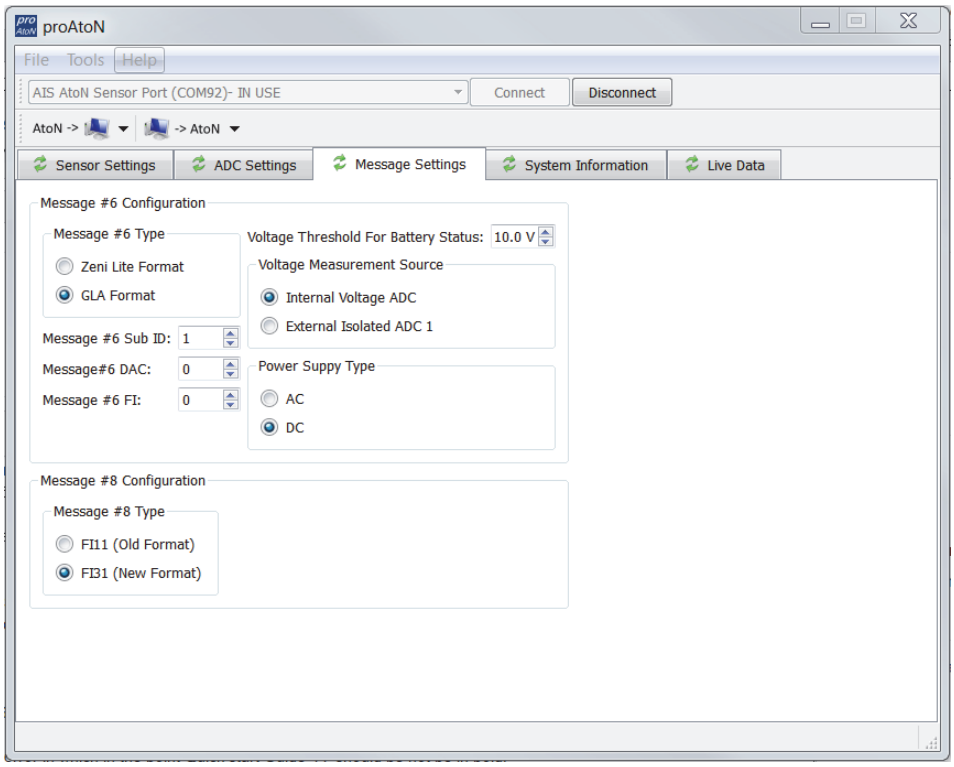


Figure 31 Message settings tab

Message #6 Configuration

This group contains controls for:

Message #6 type (see 'msg6ver' in ‘General Sensor Interface configuration commands’ table)

Voltage Threshold For Battery Status (see 'voltthresh' in ‘Zeni Lite Message #6 configuration commands’ table)

Voltage Measurement Source (see 'voltsource' in ‘ADC configuration commands’ table)

Power Supply Type (see 'pwrtype' in ‘Zeni Lite Message #6 configuration commands’ table)

Message #6 Sub ID (see 'msg6subid' in ‘Zeni Lite Message #6 configuration commands’ table)

Message #6 DAC (see 'msg6dac' in ‘Zeni Lite Message #6 configuration commands’ table)

Message #6 FI (see 'msg6fi' in ‘Zeni Lite Message #6 configuration commands’ table)

Message #8 Configuration

This group contains a single control for selecting the message #8 type (see 'msg8ver' in ’General Sensor Interface configuration commands’ table).

7.5.4 System information

This tab displays data from the Sensor PCA. There are three groups of data; System Information, Digital Input Status and Sensor Health. See Figure 32 below.

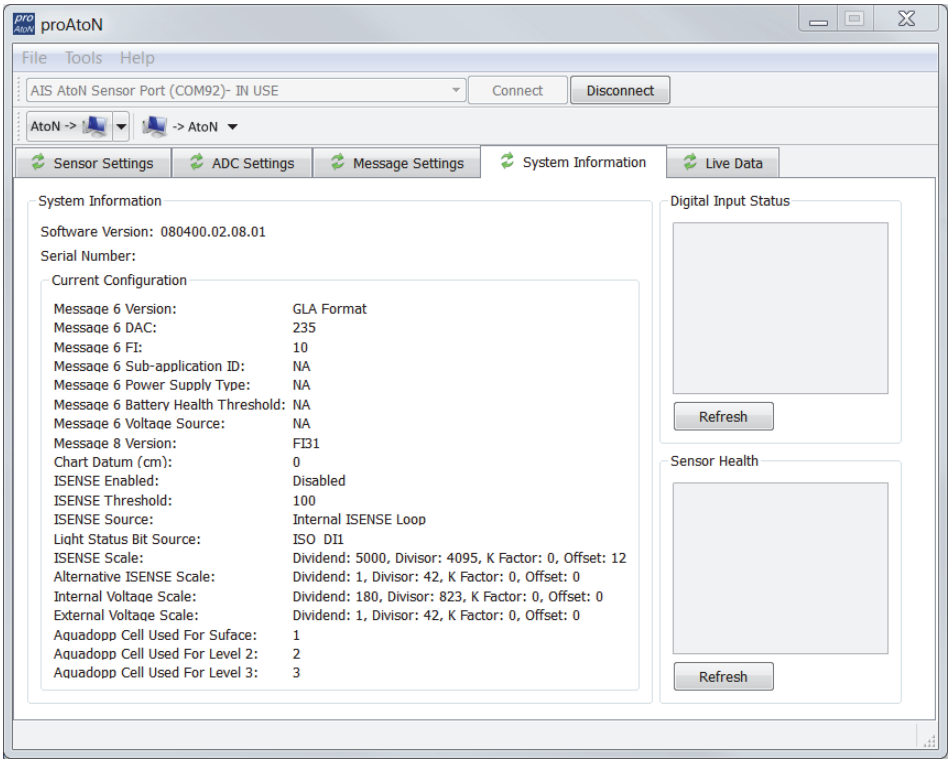


Figure 32 System information tab

System Information

This section displays the Software Version, Serial Number and details of the current configuration. The underlying command is 'showvalues' (see ‘General Sensor Interface configuration commands’ table). This section is updated using the 'Retrieve All Configuration' control.

Digital Input Status

This section displays the current status of each of the Sensor Interface’s digital inputs. The data can be refreshed using the related 'Refresh' button. The underlying command is 'getdistates' (see ‘General Sensor Interface configuration commands’ table). Note that this data is taken from the current state of the DI and not the stored state used in messages.

Sensor Health

This section displays the health of each sensor in the current option. The data can be refreshed using the related 'Refresh' button. The underlying command is 'sensorhealth' (see ‘General Sensor Interface configuration commands’ table).

7.5.5 Live data tab

This tab displays the selected data. Two data types are available; ADC data and Wave Meter data (see Figure 33 below).

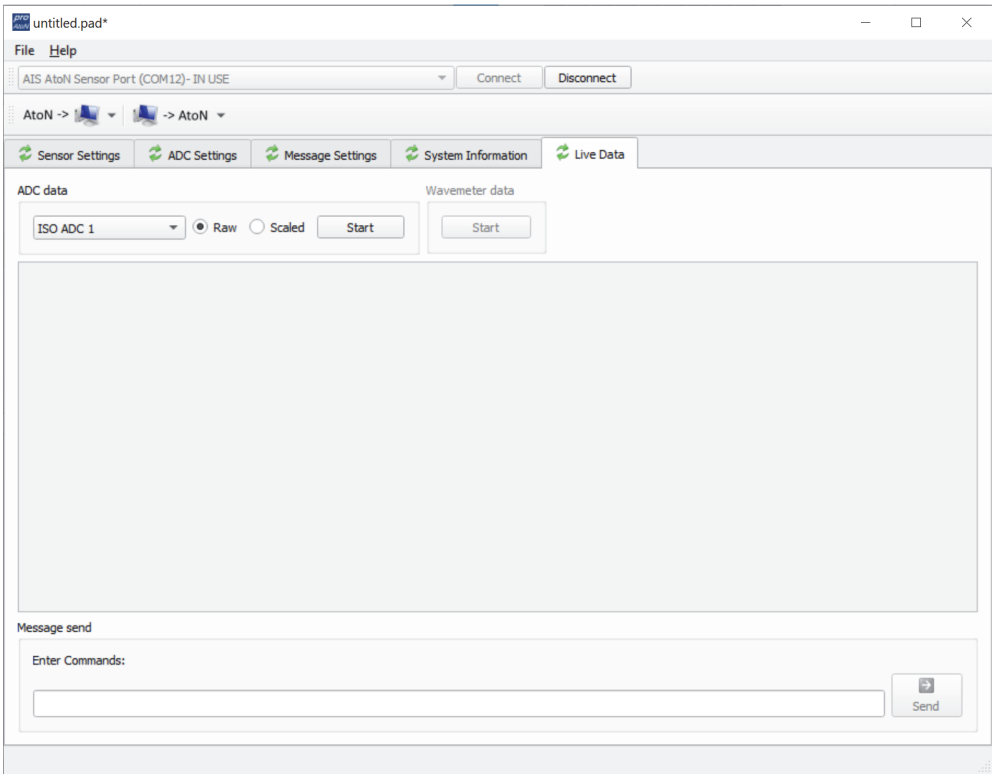


Figure 33 Live data tab

7.5.6 ADC Data

The ADC to be used is selected with the drop down menu. The Raw and Scaled radio buttons select the type of data to be output from the selected ADC. The Start/Stop button controls the flow of data. Note that when this data flow is enabled all other commands are inaccessible.

7.5.7 Command line

Allows you to send commands to the sensor if required for technical support or custom configuration.

7.6 Other features

The proAtoN application provides the following additional features to support transceiver installation and upgrade.

7.6.1 Off-line configuration (applies to transceiver configuration mode only)

The AIS AtoN transceiver configuration including all schedule parameters, virtual AtoN configuration and other settings can be saved to a file. This feature allows a configuration file to be created without access to the transceiver hardware. The file can be loaded at a later time and synchronised with the transceiver hardware.

This feature is available using the ‘Save File’ and ‘Load File’ items available on the File menu. The configuration is saved as a .pad file using a format proprietary to the proAtoN application.

When the proAtoN application is launched a new blank configuration file is created. You will be prompted to save this file if changes are made without saving the file prior to closing the application, or if a ‘New file’ is created from the File menu.

8 Operation T1 T1+S T3 T3+S

Once configured and connected to a power supply and antennas the transceiver will operate autonomously. Correct operation can be confirmed by checking for reception of Aids to Navigation reports (message #21) using another AIS device.

8.1 Standby operation

During operation the transceiver will enter a low power standby mode between scheduled transmissions. The unit will not enter standby mode under the following conditions.

If entry into standby mode is blocked by one or more of these conditions the power consumption of the transceiver will increase significantly.

- **USB interface connected - the transceiver will not enter standby mode whilst the USB interface is connected to a PC. The USB interface should be disconnected once the AtoN is configured and deployed.**
- **GPS acquisition - the transceiver will not enter standby mode for the first 12 minutes of operation with GPS position available after power is first applied. This period is used to acquire the current number of UTC leap seconds from the GPS system. This only occurs at initial power up and subsequently on four occasions during each calendar year when it is possible for the number of leap seconds to change.**
- **Off-position algorithm - the transceiver will not enter standby mode when the off position algorithm is active and the transceiver is determined to be off position. Whilst off position the GPS receiver is permanently enabled in order to monitor the position according to the algorithm provided in IALA A-126 Annex A1. Should the transceiver return on position standby operation will resume**
- **Schedule configuration - the transceiver will not enter standby mode if the configured reporting schedule prevents standby operation. The transceiver will only enter standby mode when there is a minimum of 15 seconds between scheduled FATDMA transmissions or 1 minute and 5 seconds between scheduled RATDMA transmissions.**
- **Vessel Proximity Alert - the transceiver will not enter standby mode when the vessel proximity alert message is enabled. In this scenario, the unit will be continually monitoring AIS messages to establish the proximity of vessels.**
- **Enabling repeating of messages will also block standby mode.**

During operation the transceiver will output AII TXT sentences to the NMEA0183 port 1 indicating any conditions blocking entry to standby mode.

9 Data messages and data sources

The transceiver can be configured to transmit a range of data messages in addition to the standard AIS AtoN position report. The purpose, content and means of configuring supported message types is described in the table below.

ID	Message type	Description and use	Content sources
6	Addressed binary data	This message is addressed to another individual AIS station, usually an AIS base station, which is configured to decode the message content. The message content is binary data in a standardised or proprietary format. The message may be used to communicate status information about the AtoN and / or metrological and hydrological data captured at the AtoN.	The binary content for this message can be generated by the extended sensor interface, or provided by suitably configured third party equipment. See sections 9.1 and 9.2 for further information.
8	Broadcast binary data	This message is broadcast to all other AIS stations. The message content is binary data in a standardised or proprietary format. The message may be used to communicate status information about the AtoN and / or metrological and hydrological data captured at the AtoN.	The binary content for this message can be generated by the extended sensor interface, or provided by suitably configured third party equipment. See sections 9.1 and 9.2 for further information.
12	Addressed safety related message	This message is addressed to another individual AIS station and contains safety related text. The text can warn of a failure of the AtoN equipment, alert an approaching vessel to danger of collision with the AtoN or indicate that the AtoN is operating off position	See section 7.3.7 for further information.
14	Broadcast safety related message	This message is broadcast to all other AIS stations and contains safety related text. The text can warn of a failure of the AtoN equipment or indicate that it is operating off position	See section 7.3.7 for further information.

Configuration of the AtoN for capture of data for messages #6 and #8 is described in the following sections. The options available for data capture depend on the transceiver variant.

9.1 Configurations without the extended sensor interface T1 T3

The data payload for binary messages #6 or #8 must be provided by external equipment interfaced to the transceiver using the transceiver NMEA0183 port 1 available at the Power and transceiver interface connector described in section 5.5.1. The payload data for the message is requested by the transceiver using a proprietary MCR sentence and provided by the external equipment using the MPR sentence defined in section 10.2.18.

9.2 Configurations with the Sensor Interface T1+S T3+S

The Sensor Interface supports the construction of data payloads for the following messages:

- **Message #6**
  - UK GLA AtoN monitoring message DAC 235, FI 10 UK (default)
  - Zeni Lite Buoy Co. AtoN monitoring message DAC 000, FI 00 (optionally configured with required DAC and FI)
- **Message #8 IMO Metrological and Hydrological data**
  - DAC 001, FI 31 (default)
  - DAC 001, FI 11 (optionally configured for use with legacy systems)
- **Message #8 Environment message / Air gap**
  - DAC 367 FI 33

9.2.1 AIS AtoN transceiver configuration

In order to transmit the supported binary messages the transceiver must be configured as described below.
For message #6:

- **The AIS AtoN transceiver must be configured with a schedule for message #6 index 1.**
- **The schedule can be either FATDMA or RATDMA. The recommended interval for this message is 12 minutes (27000 slots). Configure the AIS AtoN transceiver with a schedule for message #6 index 1 using proAtoN following the guidance in section 8.3.2.**
- **The destination MMSI for addressed messages must also be configured as described in section 8.3.1. This should be the MMSI of a shore station that will receive and display the monitoring message.**
- **Note that each message #6 occupies one slot.**

For message #8:

- **The AIS AtoN transceiver must be configured with a schedule for message #8 index 1.**
- **The schedule can be either FATDMA or RATDMA. The recommended interval for this message is 12 minutes (27000 slots). Configure the transceiver with a schedule for message #8 index 1 using proAtoN following the guidance in section 8.3.2.**
- **Note that each message #8 FI 31 occupies two slots.**

9.2.2 Configuration of the Sensor Interface T1+S T3+S

The extended sensor interface is configured using a range of simple shell commands or via the proAtoN application as detailed in section 7. Configuration via shell commands are detailed in this section. Commands related to specific external devices are detailed in the documents for those devices.

9.2.3 Accessing the Sensor Interface shell

- **Connect to the Sensor Interface using a terminal emulator (TeraTerm for example) running on a PC. The PC COM port for the Sensor Interface can be found from the Device Manager or Serial Connection drop down menu of proAtoN, if connected. The port's friendly name is "AIS AtoN Sensor Port".**
- **The following terminal configuration is required.**
  - Baud rate:38400
  - Data: 8 bit
  - Parity: None
  - Stop: 1 bit
  - Flow Control:None
  - New line Termination Characters: Receive: <CR>, Transmit: <CR><LF>
- **Once connected, the shell can be entered using the +++ command. This command will cause the shell prompt '>' to appear.**

9.2.4 General Sensor Interface configuration commands

General commands used to configure the Sensor Interface are detailed in the table below.

Command	Parameter	Description
option	Int: option	Select either Zeni Lite configuration option 0,1, 2, 3 or 4. Defaulted to option 1. Valid option parameter values 0 to 4.
msg6ver	int: version	Selects the version of message #6 to build. 1 = GLA version (Default) 2 = Zeni Lite version
msg8ver	int: version	Selects the version of message #8 to build. 1 = Circ.236 version, FI 11 2 = Circ.289 version, FI 31(Default)
showvalues	none	Displays the current values for all optional configuration parameters.
sensorhealth	none	Displays the health status of external devices for the current configuration option.
getdistates	none	Displays the current state of the digital inputs.

9.2.5 Zeni Lite Message #6 configuration commands

The Zeni Lite message #6 has a range of configurable parameters as detailed in the table below.

Command	Parameter	Description
msg6dac	int: decimal DAC value	Sets the DAC value to be used in the Zeni Lite version of message #6. Range: 0 (default) to 1023.
msg6fi	int: decimal FI value	Sets the FI value to be used in the Zeni Lite version of message #6. Range: 0 (default) to 63
msg6subid	int: decimal Sub-id value	Sets the Sub-application ID value to be used in the Zeni Lite version of message #6. Range: 0 to 65535. Default = 1.
pwrtype	int: power supply type	Sets the power type value to be used in the Zeni Lite version of message #6. 1 = DC (Default), 0 = AC
voltthresh	int: decimal threshold value	Sets the battery voltage threshold at which the good health flag is set. Range: 0 to 360 (in 0.1volt steps). Default = 100. (Value is only used when pwrtype is 1, DC.)
lightonsource	int source	Selects the source to use for light on bit. 0 = Current sense (as set by altisource) 1 = ISO DI1 (Default)

9.2.6 ADC configuration commands

Two possible ADC sources are used for voltage and current values. The source is selected and the scaling details can be entered using the commands detailed in the table below. Note that installers are responsible for designing and installing the necessary external interface circuitry to make use of the alternate data sources and for setting the scaling values to match the input to output ranges and optimise the output accuracy.

Command	Parameter	Description
voltsource	int: source	Sets the source for voltage data message #6 1 = internal voltage ADC 2 = external isolated ADC 1
setvoltscale	int dividend int divisor int kfactor int offset	User accessible command to set the scaling for the Internal voltage ADC values See section for details of the scaling method.
setaltvoltscale	int dividend int divisor int kfactor int offset	User accessible command to set the scaling for the ISO ADC 1 values See section for details of the scaling method.
enableisense	int: on/off	Enables the current sense functionality. This is disabled by default for power and processing efficiency, 1=on, 0=off.
altisource	Int: on/off	Selects the source for current sense values. 0 = internal ISENSE loop (default) 1 = ADC 2
isensethresh	int: decimal threshold value	Sets the threshold (in mA) at which the current OK flag is set / value reported in message #6. Default 100mA as defined for the GLA message #6.
setisensescale	int dividend int divisor int kfactor int offset	User accessible command to set the scaling for the ISENSE ADC values. See section for details of the scaling method.
setaltisensescale	int dividend int divisor int kfactor int offset	User accessible command to set the scaling for the ISO ADC 1 ADC values. See section for details of the scaling method.

9.2.7 ADC Scaling

The raw values read from isolated ADC 1 and 2 can be scaled to suit the input and output ranges and to optimise the accuracy of the reported value. There are a range of factors that influence the accuracy of the scaled value and installations may need to be optimised on a case-by-case basis.

The formula used to scale values is:

Scaled_value = (((Raw_value - offset) * dividend) /divisor) + kfactor

Where:

- **offset = the adjustment for raw ADC values that are not zero when the input voltage is zero (a situation that can be caused by some connection circuits).**
- **dividend = the output range**
- **divisor = the input range (resolution)**
- **kfactor = zero**

The isolated ADCs (as described in section 6.2.4) have 16 bit resolution. The non-isolated ADCs, used for internal voltage and ISENSE measurements, have 12 bit resolution.

Installers will need to establish the required scaling values theoretically depending on the use case, input them using the relevant shell commands described in section 10.2 and adjust the values experimentally to optimise the result.

Additional sensor shell commands, getadccont <ADC number; 0 = ISO ADC 1, 1 = ISO ADC 2> and getadccontscaled <ADC number> can be used to evaluate the results. getadccont is particularly useful for testing the raw output for the ADCs when zero input voltage is applied. This value can be used as the offset.

For reference, and to enable resetting the values, the default values for the ADCs are:

- **Isolated ADC 1 and ADC 2**
  - offset = 0, dividend = 1, divisor = 42, kfactor = 0
- **Internal ISENSE non-isolated ADC**
  - offset = 12, dividend = 5000, divisor = 4095, kfactor = 0
- **Internal supply voltage ADC**
  - offset = 0, dividend = 180 divisor = 823, kfactor = 0

9.2.8 Message #6 Data Mapping

Mapping of data sources to the message #6 fields are shown in the tables below.

Message #6 DAC 235, FI 10 data field	Data Source	Notes
Analogue voltage (internal)	Supply voltage to the transceiver	No additional connections are required for this measurement
Analogue voltage (external 1)	Sensor Interface isolated analogue input 1	See section 6.2. Note that the default scaling values for this ADC are set for this message.
Analogue voltage (external 2)	Sensor Interface isolated analogue input 2	See section 6.2. Note that the default scaling values for this ADC are set for this message.

Message #6 DAC 235, FI 10 data field	Data Source	Notes
Status bits (internal, 5 bits)	The light and RACON status bits. These values will also be used in message #21 when the sensor is used as the status bit source.	See section 7.3.6 for information on configuration of status source.
Status bits (external, 8 bits)	**ISENSE format** Bit 0 - Isolated digital input 1 Bit 1 - Isolated digital input 2 Bit 2 - Isolated digital input 3 Bit 3 - Isolated digital input 4 Bit 4 - Isolated digital input 5 Bit 5 - Set to 1 if light current sense >=100mA, else set to 0 Bit 6 - Non-isolated digital input 1 Bit 7 - Non-isolated digital input 2 **A-126 format** Bit 0 - Transceiver user I/O signal 0 Bit 1 - Transceiver user I/O signal 1 Bit 2 - Transceiver user I/O signal 2 Bit 3 - Isolated digital input 4 Bit 4 - Isolated digital input 5 Bit 5 - Non-isolated digital input 1 Bit 6 - Non-isolated digital input 2 Bit 7 - Non-isolated digital input 3	See section 6.2. The light current sense bit can use the internal ISENSE loop (default) or ISO ADC 2
Off position status	Transceiver off position algorithm	Transceiver off position algorithm

Message #6 Zeni Lite Format	Data Source	Notes
DAC	User Input	See section 9.2.5
FI	User Input	See section 9.2.5
Sub-application ID	User Input	See section 9.2.5
Voltage Data	Internal Voltage or External Isolated ADC 1	See sections 9.2.6 and
Current Data	Internal ISENSE loop or External Isolated ADC 2	See sections 9.2.6 and
Power Supply Type	User Input	See section 9.2.5
Light Status	Isolated DI 1 or ISENSE ADC 2	
Battery Status	Voltage Data value compared with user input threshold.	Only functions if power supply type is DC
Off-position Status	Transceiver off position algorithm	Transceiver off position algorithm

9.2.9 External device support

The unit currently supports the following external devices which can be configured in number of combinations (“options”) and the data used to populate message #8 Meteorological and Hydrological data. Two formats of this message are supported; DAC 001, FI 31 and DAC 001, FI 11.

- **Airmar PB200 / 150WX and 200WX Weather Station**
- **Impress S12C Water Pressure and Temperature gauge**
- **RM Young Wind Monitor**
- **JFE Advantech Co. Current Meter AEM-RS**
- **Vaisala Weather Transmitter WXT520**
- **Sealite Light Serial Interface**
- **RM Young Weather Station**
- **Nortek AS Aquadopp Profiler**
- **Gill Metpak Weather Station**
- **Valeport TideMaster Tide Gauge**
- **SonTek-SL3000 Current Meter**
- **Nile Radar Sensor**
- **Biral SWS100A Visibility Sensor**
- **Gill Maximet 500 (with GPS) Weather Station**
- **Seaview SVS603 Wave Sensor**
- **Airmar DT800 Water Sensor**
- **Biral VPF 710 Visibility Sensor**

Separate guides are available for each device detailing the connection and configuration arrangements. Only certain arrangements of sensors are possible due to the limitations of the Sensor Interface as shown in the table below.

RS422	RS 232 A	RS 232 B	SDI 12**
Airmar PB200 / 150WX /200WX*			Impress Pressure & Temperature Gauge
RM Young Wind Meter	Advantech Current Meter		
RM Young Wind Meter	Aquadopp Current Profiler		
Vaisala Weather Station	Advantech Current Meter		
Vaisala Weather Station	Aquadopp Current Profiler		
	SeaLite Light serial interface		
RM Young Weather Station			
MetPak Weather Station	Valeport Tide Gauge		
Vaisala Weather Station			SonTek-SL3000 Nile Radar Sensor!
Biral SWS100A	Gill Maximet 500 with GPS	Seaview SVS603	
Airmar DT800	Gill Maximet 500 with GPS	Seaview SVS603	
MetPak Weather Station	Biral VPF 710		

* this device can be connected via RS422 or RS232

** using SDI-12 disables RS232 B

! air gap data is output in message #8 FI33 repeat type 10

By default the Sensor Interface is configured to connect to the Airmar weather station via either the RS422 or RS232 A port and the Impress water meter via the RS232 B port. Please contact your supplier for details of how to configure the Sensor Interface to operate with other devices.

The Sensor Interface can also be adapted to support almost any equipment that might be encountered in an AtoN application. If your application requires interface to equipment other than that listed here please contact your supplier to discuss your requirements.

10 Manual configuration T1 T1+S T3 T3+S

The transceiver is configured using standardised NMEA0183 v4.10 sentences developed for configuration of AIS Aids to Navigation transceivers.

10.1 Basic Type 1 AIS AtoN configuration (FATDMA operation)

The following information is the minimum required configuration for a Type 1 AIS AtoN reporting message #21 only.

- **The AtoN station must be configured with the 'real' AtoN MMSI using the AID command.**
- **The AtoN station must be configured with an Name, Charted position, operating radio channels and dimensions using the ACF and ACG commands.**
- **The AtoN should be configured to broadcast message #21 using the CBR command. Note that the slots selected for the AIS AtoN transmissions in FATDMA mode must be reserved by a base station operating in the area in which the AIS AtoN will be deployed.**

10.2 NMEA0183 / IEC61162 configuration sentences

The following section documents the standardised NMEA0183 sentences used for AIS AtoN configuration and control.

Please refer to NMEA0183 v4.10 for complete details of the configuration sentence structure.

The configuration sentence formats described in this section are used to both configure the device and as the response format from the device when queried for current status. The query command format is as follows:

$--ANQ,ccc*hh<CR><LF>

Sentence formatter of data being requested (e.g.,AAR)

For example the query command $ECANQ,AAR*21 requests the transceiver output an AAR sentence containing the currently configured broadcast rates for the AtoN station.

Configuration sentences are communicated using the transceiver USB interface.

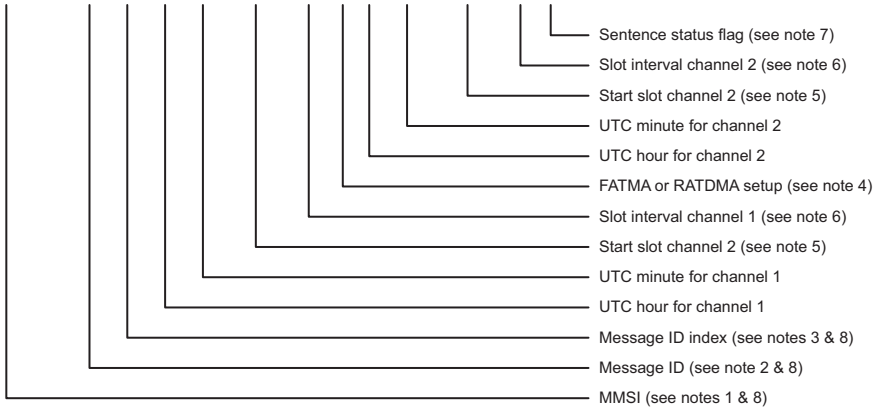
10.2.1 AAR - Configure broadcast rates for AtoN station

Note: This sentence is superseded by sentence CBR. (See section 10.2.14) but is supported for legacy purposes.

This sentence assigns the schedule of slots that will be used to broadcast Message #21 and other allowed AIS AtoN Station messages. It provides the start slot and interval between the slots used for consecutive transmissions for the message. The AIS AtoN Station should apply the information provided by this sentence to autonomously and continuously transmit the VDL messages until revised by a new AAR sentence. The AIS AtoN Station, upon receipt of an AAR Query for this information, will generate sentences for configured messages providing the current broadcast schedule. New AAR assignments will override existing AAR assignments

.

$--AAR,xxxxxxxxx,xx,xx,xx,xx,xxxx,x.x,x,xx,xx,xxxx,x.x,a*hh<CR><LF>



Note 1 The MMSI is defined in the AID sentence. This field contains the linkage between the MMSI definition (AID), Message #21 configuration (ACF, and ACE) and scheduling (AAR) of Message #21 transmissions.

Note 2 Message ID is the message identification of the message being scheduled. When Message ID is 0 this indicates that the slots being defined will be used for chaining messages. These slots are not reserved on the VDL via a message #20 until the competent authority requires their use and will reserve the slots at that time for the proper duration. These slots can be used for chaining or for MPR single transmission.

Note 3 Message ID Index is used when there are multiple versions of a Message ID. This index value should start at 1.

Note 4 Used to select whether the AAR is configuring an FATDMA schedule or RATDMA/CSTDMA schedule (0 indicates FATDMA, 1 indicates RATDMA)

Note 5 For all messages which need to be transmitted in FATDMA mode, starting slot ranging from −1 to 2249 should be used. A value of –1 discontinues broadcasts of the message when the AAR sentence is sent to the AtoN Station, and indicates that no message has been broadcast if the AAR sentence is received from the AtoN Station. A null field indicates no change to the current start slot setting when sent to the AtoN Station, and indicates that the start slot has not been set, i.e. is unavailable, when the AAR sentence is received from the AtoN Station. For an RATDMA transmission schedule, this field will be Null.

Note 6 For all messages which need to be transmitted, in FATDMA mode slot Interval ranging from 0 to (24*60*2250;once per day) and in RATDMA/CSTDMA mode, time interval ranges from 0 to (24*60*60) s. A null field indicates no change to the current slot interval setting when sent to the AtoN Station, and indicates that the slot interval has not been set, i.e. is unavailable, when the AAR sentence is received from the AtoN Station.

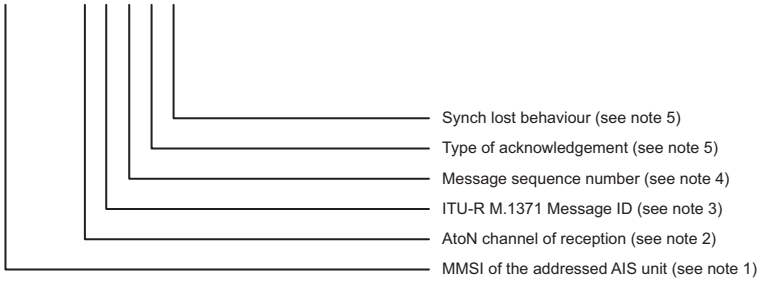
Note 7 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a query response
“C” = sentence is a configuration command to change settings.

Note 8 The MMSI/Message ID/Message ID index are used to reference a table of messages loaded using MPR, ACF/ACE; this sentence defines the broadcast schedule for each message. Each message in this table is referenced by the combination of MMSI, Message ID, and Message ID index.

10.2.2 ABK – AIS Addressed and Binary Broadcast Acknowledgement

The ABK-sentence is generated when a transaction, initiated by reception of an ABM, AIR, or BBM sentence, is completed or terminated. This sentence provides information about the success or failure of a re quested ABM broadcast of either ITU-R M.1371 messages #6 or #12. The ABK process utilizes the information received in ITU-R M.1371 messages #7 and #13. Upon reception of either a VHF Data-link message #7 or #13, or the failure of messages #6 or #12, the AIS unit delivers the ABK sentence to the external application. This sentence is also used to report to the external application the AIS unit's handling of the AIR (M.1371 message #15) and BBM (M.1371 messages #8, #14) sentences. The external application initiates an interrogation through the use of the AIR-sentence, or a broadcast through the use of the BBM sentence. The AIS unit generates an ABK sentence to report the outcome of the AIR or BBM broadcast process.

$--ABK,xxxxxxxxx,a,x,x,x,x,*hh<CR><LF>



Note 1 Identifies the distant addressed AIS unit involved with the acknowledgement. If more than one MMSI are being addressed (M.1371 message #15), the MMSI of the first distant AIS unit, identified in the message, is the MMSI reported here. This is a null field when the ITU-R M.1371 message type is #8 or #14.

Note 2 Indication of the VHF Data Link channel upon which a message type #7 or #13 acknowledgement was received. An "A" indicates reception on channel A. A "B" indicates reception on channel B.

Note 3 This indicates to the external application the type of ITU-R M.1371 message that this ABK sentence is addressing. Also see the Message IDs listed in Note 4.

Note 4 The Message sequence number, together with the Message ID and MMSI of the addressed AIS unit, uniquely identifies a previously received ABM, AIR, or BBM sentence. Generation of an ABK-sentence makes a sequential message identifier available for reuse. The Message ID determines the source of the Message sequence number. The table below lists the source by Message ID:

ITU-R M.1371 Message ID	Message sequence number source
6	sequential message identifier from ABM-sentence
7	addressed AIS unit's message #7, sequence number, ITU-R M.1371
8	sequential message identifier from BBM-sentence
12	sequential message identifier from ABM-sentence
13	addressed AIS unit's message #13, sequence number, ITU-R M.1371
14	sequential message identifier from BBM-sentence
15	No source, the Message sequence number shall be a null field
25	Sequential message identifier from ABM or BBM sentence
26	Sequential message identifier from ABM or BBM sentence

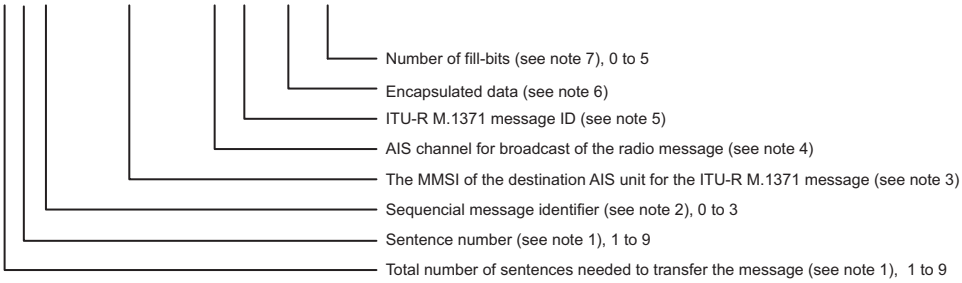
Note 5 Acknowledgements provided are:
0 = message (#6 or #12) successfully received by the addressed AIS unit,
1 = message (#6 or #12) was broadcast, but no acknowledgement by the addressed AIS unit,
2 = message could not be broadcast (i.e. quantity of encapsulated data exceeds five slots),
3 = requested broadcast of message (#8, #14, or #15) has been successfully completed,
4 = late reception of a message #7 or #13 acknowledgement that was addressed to this AIS unit (own-ship) and referenced a valid transaction.

10.2.3 ABM – AIS Addressed Binary and Safety Related Message.

This sentence supports ITU-R M.1371 messages #6, #12, #25 and #26 and provides an external application with a means to exchange data via an AIS transponder. Data is defined by the application only, not the AIS unit. This sentence offers great flexibility for implementing system functions that use the transponder like a communications device. After receiving this sentence via the NMEA 0183 interface, the transponder initiates a VDL broadcast of message #6, #12, #25, or #26. The AIS unit will make up to four broadcasts of message #6 and #12. The actual number will depend on the reception of an acknowledgment from the addressed "destination" AIS unit. The success or failure of reception of this transmission by the addressed AIS unit for

messages #6 and #12 is confirmed through the use of the "Addressed Binary and safety related message Acknowledgment" ABK sentence formatter, and the processes that supports the generation of an ABK sentence. The AIS transponder determines the appropriate communications state for transmission of message #26 over the VHF data Link.

!--ABM,x,x,x,xxxxxxxxx,x,xx,s--s,x,*hh<CR><LF>



Note 1 The total number of sentences required to transfer the binary message data to the AIS unit.
• The first field specifies the total number of sentences used for a message, minimum value 1.
• The second field identifies the order of this sentence in the message, minimum value 1.
• All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4, 5, and 6.

Note 2 This sequential message identifier serves two purposes. It meets the requirements as stated in Section 5.3.4 of this standard, and it is the sequence number utilized by ITU-R M.1371 in message types #6 and #12. The range of this field is restricted by ITU-R M1371 to 0 - 3. The sequential message identifier value may be reused after the AIS unit provides the "ABK" acknowledgement for this number. (See ABK Sentence).

Note 3 The MMSI of the AIS unit that is the destination of the message.

Note 4 The AIS channel that shall be used for the broadcast:
0 = no broadcast channel preference,
1 = Broadcast on AIS channel A,
2 = Broadcast on AIS channel B,
3 = Broadcast message on both AIS channels A and B.

Note 5 The ITU-R M.1371 message Id for the following addressed messages:
6 = Binary addressed message,
12 = Addressed safety related message,
25 = Single slot binary message #25 (binary data coded using the 16-bit Application identifier),
70 = Single slot binary message #25 (unstructured binary data),
26 = Multiple slot binary message #26 with Communications State (binary data coded using the 16-bit Application identifier),
71 = Multiple slot binary message #26 with Communications State (unstructured binary data).

Note 6 This is the content of the "binary data" parameter for ITU-R M.1371 message #6, or the "Safety related Text" parameter for message #12, or the “binary data” parameter for message #25, or the “binary data” parameter for message #26. The first sentence may contain up to 48 valid Six Bit codes (288 bits). Following sentences may contain up to 60 valid Six Bit codes (360 bits), if fields 4, 5, and 6 are unchanged from the first sentence and set

10.2.4 ACE - Extended general AtoN Station configuration

Note: This sentence is superseded by sentence ACG. (See section 10.2.6) but is supported for legacy purposes.

This sentence and the ACF sentence are used to configure the AtoN Station parameters when it is initially installed, and later in order to make changes to the way it operates. This sentence supports system administration of the AIS AtoN Station operation.

$--ACE,xxxxxxxxx,hh,xxxx,x,x,x,c--c,xxxxxxxxxx,a,*hh<CR><LF>

Note 1 AtoN status bits, indication of the AtoN status, default “00hex”: for a Virtual AtoN, this field should be 00hex. The three most significant bits represent the page ID.

Note 2 The off-position indicator is generated when this threshold is exceeded (distance in metres).

Note 3 Determines the behaviour of AtoN for message acknowledgement (Message #7 and #13):
0 will provide acknowledgement as defined by manufacturer,
1 will not provide acknowledgement.

Note 4 Off-position behaviour:
0 – maintain current transmission schedule,
1 – use new reporting interval configured by AAR using message ID index.

Note 5 Synch lost behaviour:
0 – silent,
1 – continue as before.

Note 6 Name of the AtoN: maximum 34 characters.

Note 7 Reference point of reported position; should be given as dimension (aaabbbccdd) of the buoy.
(See IALA A-126)

Note 8 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a query response,
“C” = sentence is a configuration command to change settings.

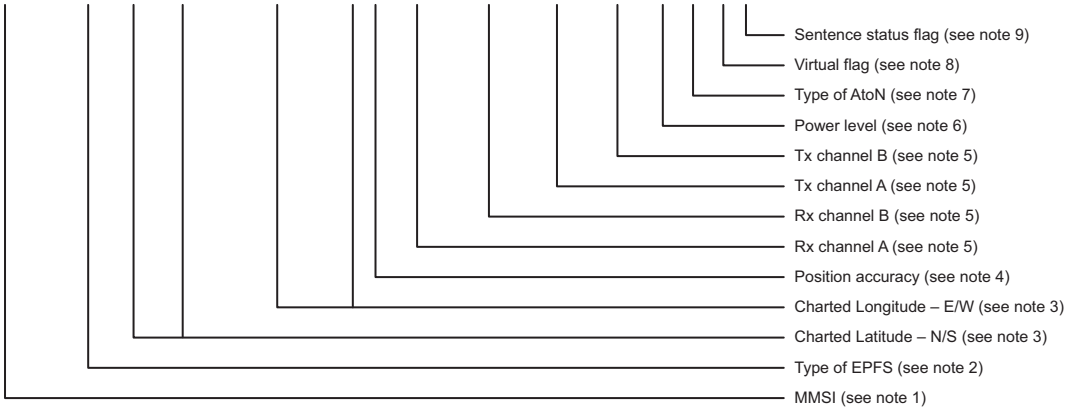
10.2.5 ACF - General AtoN Station configuration

This sentence and the ACE sentence are used to configure message #21 content for Real, Synthetic, and Virtual AIS AtoN Stations.

Content of message #21 is determined by the AIS AtoN station as configured by the ACG and ACF sentences and other processes monitoring the status of the AtoN (See IEC 62320-2).

This sentence can be queried

$--ACF,xxxxxxxxx,x,llll.llll,a,yyyyy.yyyy,a,x,xxxx,xxxx,xxxx,xxxx,x,xx,x,a*hh<CR><LF>



Note 1 This sentence should be accepted only if the MSSI matches a previously input MMSI (See AID sentence)

Note 2 Identifies the source of the position, see ITU-R M.1371 Message #21 parameter (type of electronic position fixing device).

Note 3 Charted position (see IALA.A.126). If EPFS is “7 (surveyed),” this parameter is the broadcast position. Otherwise the EFPS position is broadcast.

Note 4 0 = low > 10 m,
1 = high < 10 m; differential mode of DGNSS.

Note 5 VHF channel number, see ITU-R M.1084. Default values, Rx channel A = 2087 (simplex on AIS1), Tx channel A = 2087 (simplex on AIS1), Rx channel B = 2088 (simplex on AIS2), and Tx channel B = 2088 (simplex on AIS2)

Note 6 0 = default manufacturer power level (nominally 12,5 W),
1 to 9 as defined by the manufacturer.

Note 7: See ITU-R M.1371,Message #21, “Type of aids-to-navigation” parameter:
0 = Type of AtoN not specified (default)
1 to 31 = Type as defined in ITU-R M.1371, Message #21, Table 71 (“The nature and type of AtoN can be indicated with 32 different codes”)

Note 8 See ITU-R M.1371,Message #21, “Virtual AtoN flag” parameter and “Repeat indicator” parameter
0 = Set “Virtual AtoN flag” to “0” and “Repeat indicator” parameter to “0,” for a real AtoN at the indicated position. This is the default value.
1 = Set Virtual AtoN flag to “1,” for a Virtual AtoN at the indicated position.
2 = Set Virtual AtoN flag to “0” and Repeat indicator parameter to value other than “0,” for a Synthetic AtoN at the indicated position.

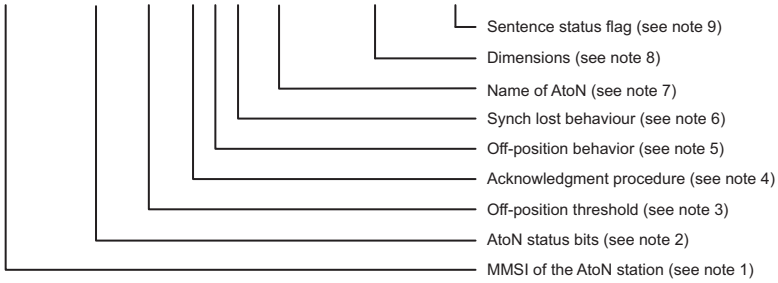
Note 9 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a status report of current settings (use for a reply to a query),
“C” = sentence is a configuration command to change settings. A sentence without “C” is not a command.

10.2.6 ACG - Extended general AtoN station configuration command

This sentence and the ACF sentence are used to configure the AtoN Station parameters when it is initially installed, and later in order to make changes to the way it operates. This sentence supports system administration of the AIS AtoN Station operation.

This sentence can be queried.

$--ACG,xxxxxxxxx,hh,xxxx,x,x,x,c--c,xxxxxxxxx,a*hh<CR><LF>



Note 1 This sentence should be accepted only if the MSSI matches a previously input MMSI (See AID sentence)

Note 2 AtoN Status Bits, Indication of the AtoN Status, default “00 hex”: For a Virtual AtoN this field should be “00 hex”: The three most significant bits represent the Page ID. (See IEC 62320-2, Annex C, Message #21 – AtoN status bits)

Note 3 Off-position indicator is generated when this threshold is exceeded (distance in meters) – (See IEC 62320-2,Off-position monitoring)

Note 4 Determines behaviour of AtoN for message acknowledgement (replying using Message #7 and #13).
0 = will provide acknowledgement as defined by manufacturer (If an acknowledgement procedure is implemented, it is enabled.).
1 = will not provide acknowledgement (If an acknowledgement procedure is implemented, it is disabled.).

Note 5 Off-position behaviour:
0 = Maintain current transmission schedule (use message ID Index 0)
1 = Use transmission schedule configured by CBR using, affected MMSI, message ID 21, message ID index 1. When the transmission schedule for Index 1 has not been configured, the off-position maintains the message ID Index 0 schedule.

Note 6 Synch lost behaviour (UTC source lost):
0 = Silent (no transmissions)
1 = Continue operation

Note 7: Name of the AtoN: maximum 34 characters

Note 8 Reference point of reported position; Should be given as dimension (aaabbbccdd) of the buoy (see ITU-R M.1371,Message #21)

Note 9 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
R = Sentence is a status report of current settings (use for a reply to a query).
C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

10.2.7 ADS - Automatic device status

This sentence is used to output, autonomously and periodically, the device’s current status of the time source and time synchronization method, position source, and the general alarm state of the device. The ADS sentence is output at the defined interval or when there is a change in status. The equipment standard or manufacturer’s documentation should identify the status values supported.

The individual equipment standards are responsible for defining the alarm conditions under which the Alarm status is active or not active.

When this sentence is used with AIS Base stations, the interval for automatic output of this sentence is defined using the BCG sentence, and null data fields are not allowed.

$--ADS,c--c,hhmmss.ss,a,x,a,a*hh<CR><LF>

Note 1 The Unique Identifier is used for system level identification of a station, 15 characters maximum. When used with AIS stations, on output, this data field is the AIS Station’s Unique Identifier (See the SID sentence formatter). For devices other than AIS Base Stations this field may be null.

Note 2 Alarm status:
A = active
V = not active

Note 3 Method of time synchronization
0 = UTC direct
1 = UTC indirect (AIS equipment)
2 = synchronized to an AIS Base Station
3 = semaphore (AIS equipment)
4 = no VDL synchronization reference (AIS equipment)
5 = manual
6 to 9 = reserved for future use

Note 4 I = internal
E = external
S = surveyed
N = none

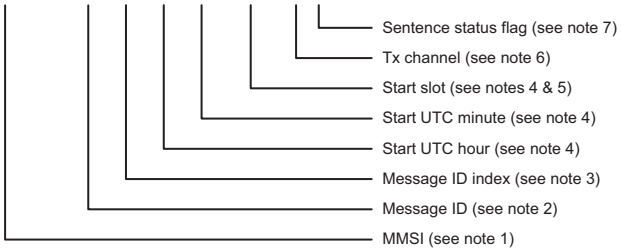
Note 5 E = external
I = internal
N = none

10.2.8 AFB - Forced broadcast

This sentence is used to force a transmission of the indicated VDL message previously input into the AIS AtoN station using the ACG, ACF, or MEB sentences.

This sentence cannot be queried.

$--AFB,xxxxxxxxx,xx,xx,xx,xx,xxxx,x,a*hh<CR><LF>



Note 1	This sentence should be accepted only if the MMSI matches a previously input MMSI (See AID sentence).
Note 2	Message ID is the number of the message being scheduled (See ITU-R M.1371).
Note 3	Message ID Index is used to distinguish multiple occurrences of the same MMSI and Message ID combination. Valid range is 0 to 7.
Note 4	Nominal start slot is determined by the combination of Start UTC hour, Start UTC minute, and Start slot.
Note 5	Starting slot valid range is -1 to 2249. If start slot is null, the AtoN Station will use RATDMA for transmission.
note 6	(Also see ACF sentence Data Fields “Tx channel A” and “Tx channel B”) 1 = Tx channel A as configured by ACF sentence 2 = Tx channel B as configured by ACF sentence

10.2.9 AFC - AtoN function ID capability

This sentence is used to provide the capability information of implemented function ID by the EUT. This sentence is initiated with a QAFC and the response is the AFC.

$--AFC,xxxxxxxxx, hhhhhhhhhhhhhhhh*hh<CR><LF>

Note 1	Each bit corresponds to the function ID number and the bit value “0” indicates the function ID number is not supported and “1” indicates supported. The most significant bit is function ID “0”.

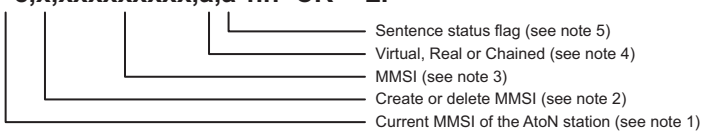
10.2.10 AID - MMSI configuration

This sentence is used to load, for an AtoN Station, its Real, Virtual or synthetic, and chained (parent or child) MMSI(s). The Real MMSI from the factory should be as defined by manufacturer. Each AtoN Station will maintain a table of its MMSI(s). (Reference IEC 62320-2)

For an AIS AtoN Station, this sentence must input a MMSI prior to configuring the parameters for the MMSI (See: CBR, ACG, ACF, AFB, DCR, CEK, COP, MCR, MEB, and TPC sentences).

This sentence can be queried. When queried, the query response will continue until all known AtoN MMSIs and types have been transferred.

$--AID,c--c,x,xxxxxxxxx,a,a*hh<CR><LF>



Note 1	Unique Identifier of the AtoN Station. The Unique Identifier is used for system level identification of a station, 15 characters maximum. On input, this sentence should be accepted only if this data field matches the AtoN Station’s Unique Identifier. On output, this data field is the AtoN Station’s Unique Identifier. (To address an AtoN station, this should be the Real MMSI of the AIS AtoN Station being addressed. The initial factory setting of the Real MMSI should be defined by manufacturer, for example 990000000.
Note 2	0 = delete MMSI provided in field 3; 1 = add MMSI provided in field 3 If the Real MMSI is deleted, the AIS AtoN Station’s Real MMSI should revert to the factory setting. When a MMSI is deleted, all associated messages and transmission schedules for that MMSI should be deleted.
Note 3	MMSI to be added or deleted.

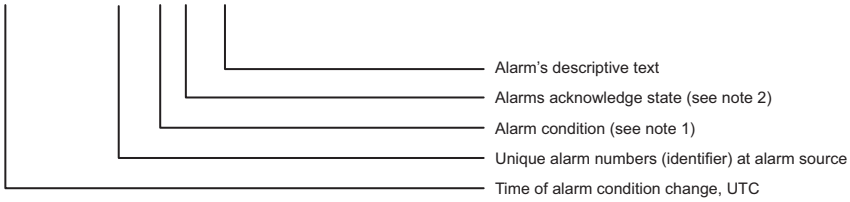
Note 4 Real AtoN, chained, or Virtual AtoN: Real AtoN is own station (AIS AtoN Station may have one Real MMSI). Chained indicates an MMSI that this station is responsible for relaying messages to and from. Virtual AtoN indicates an MMSI that this station is responsible for generating at least a Message #21.
R = Real AtoN
V = Virtual or Synthetic AtoN
P = Parent AtoN Station that is a member of a chain
C = Child AtoN Station that is a member of a in the chain
M = Maintenance

Note 5 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
R = Sentence is a status report of current settings (use for a reply to a query).
C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

10.2.11 ALR - Set alarm state

Local alarm condition and status. This sentence is used to report an alarm condition on a device and its current state of acknowledgment.

$--ALR,hhmmss.ss,xxx,A,A,c--c*hh<CR><LF>



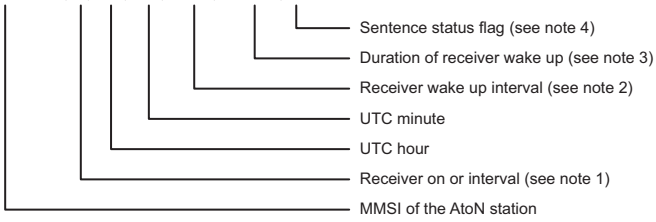
Note 1 A = threshold exceeded
V = not exceeded)

Note 2 A= acknowledged,
V= unacknowledged

10.2.12 ARW -Configure the receiver turn-on times

Note: This sentence is superseded by sentence COP (See section 11.2.16) but is supported for legacy purposes.
This sentence defines the operational period for the receivers. When chaining the duration of receiver wake up time must be sufficient to allow correct operation of a chain.

$--ARW,xxxxxxxxx,x,xx,xx,xxx,xxxx,a*hh<CR><LF>



Note 1 0 = use interval setting as defined below;

Note 1 0 = use interval setting as defined below;
1 = turn receiver on.

Note 2 Interval between receiver activation:
1 – 60 min if UTC hour is set to 24;
1 – 256 h if UTC hour is 0- 23;
(Note: 168 h is once per week).

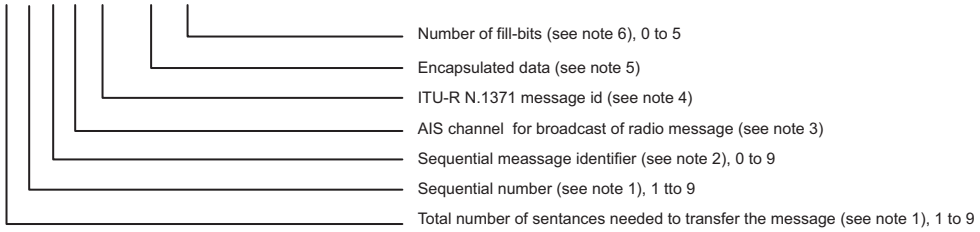
Note 3 Maximum awake time (1 440 min is 24 h).

Note 4 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a query response,
“C” = sentence is a configuration command to change settings.

10.2.13 BBM - AIS Broadcast binary message

This sentence supports generation of ITU-R M.1371 binary messages #8, #14, #25, and #26. This provides the application with a means to broadcast data, as defined by the application only. Data is defined by the application only not the AIS. This sentence offers great flexibility for implementing system functions that use the transponder like a digital broadcast device. After receiving this sentence via the NMEA 0183 interface, the transponder initiates a VHF broadcast of message #8, #14, #25, or #26 within four seconds. See the ABK sentence for acknowledgement of the BBM with messages #8 and #14. The AIS transponder determines the appropriate communications state for transmission of message #26 over the VHF data Link.

!--BBM,x,x,x,x,xx,s--s,x*hh<CR><LF>



Note 1 The total number of sentences required to transfer the contents of the binary message to the AIS unit.
• The first field specifies the total number of sentences used for a message, minimum value 1.
• The second field identifies the order of this sentence in the message, minimum value 1.
• All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4 and 5.

Note 2 The Sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This value is used by the ABK sentence to acknowledge a specific BBM sentence.

Note 3 The AIS channel that shall be used for the broadcast:
0 = no broadcast channel preference,
1 = Broadcast on AIS channel A,
2 = Broadcast on AIS channel B,
3 = Broadcast the message on both AIS channels A and B.

Note 4 The ITU-R M.1371 message Id for the following broadcast messages:
8 = Binary broadcast message,
14 = Safety related broadcast message,
25 = Single slot binary message #25 (binary data coded using the 16-bit Application identifier),
70 = Single slot binary message #25 (unstructured binary data),
26 = Multiple slot binary message #26 with Communications State (binary data coded using the 16-bit Application identifier),
71 = Multiple slot binary message #26 with Communications State (unstructured binary data).

Note 5 This is the content of the "binary data" parameter for ITU-R M.1371 message #8, or the "Safety related Text" parameter for message #14, or the “binary data” parameter for message #25, or the “binary data” parameter for message #26. The first sentence may contain up to 58 valid Six Bit codes (348 bits). Following sentences may contain up to 60 valid Six Bit codes (360 bits), if fields 4 and 5 are unchanged from the first sentence and set to null. The actual number of characters must be such that the total number of characters in a sentence does not exceed the "82-character" limit.

Note 6 This cannot be a null field.

10.2.14 CBR - Configure broadcast rates for AIS AtoN station message command

This sentence configures slots and transmission intervals that will be used to broadcast AIS AtoN Station messages (See IEC 62320-2). The sentence supports scheduling of messages with real, virtual, and synthetic MMSI’s (See AID Sentence). The messages are assigned to the AIS AtoN Station for each channel.

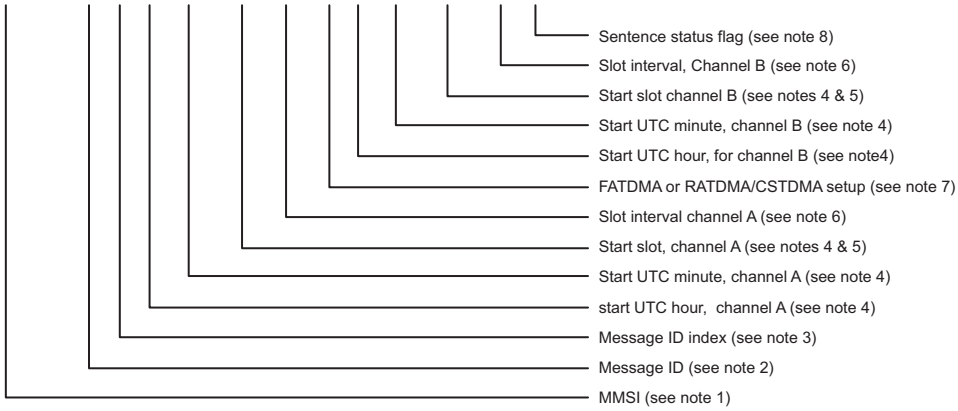
Message #21 is defined by the content of the ACG and ACF sentences and is identified by the MMSI and the message ID 21. Message ID Index = 0 is reserved to define the on-position message #21 transmission schedule. Message ID Index = 1 is reserved to define the off-position message #21 transmission schedule. The off-position schedule is optional (see ACG sentence, Off-position behavior).

Other than message #21, the combination of MMSI, Message ID, and Message ID Index are used to: (1) configure, (2) reference the AIS AtoN stations transmission slots, and (3) link to the MEB sentence. Each message's transmission schedule is defined by the combination of Start UTC Hour, Start UTC Minute, Start Slot, and Slot Interval.

The AIS AtoN Station should apply this sentence to autonomously and continuously transmit VDL messages until revised by a subsequent CBR sentence. Subsequent CBR assignments override existing CBR assignments.

This sentence can be queried. The query response may contain one or more sentences and will continue until the transfer of all current schedule information is complete.

$--CBR,xxxxxxxxx,xx,x,xx,xx,xxxx,x.x,x,xx,xx,xxxx,x.x,a*hh<CR><LF>



Note 1	This is a MMSI previously defined for the AIS AtoN station (See AID Sentence.).
Note 2	Message ID is the number of the message being scheduled (See ITU-R M.1371). When Message ID is 0 this indicates that the slots being defined will be used for either chaining messages or MEB single transmissions (See IEC 62320-2).
Note 3	Message ID Index is used to distinguish multiple occurrences of the same MMSI and Message ID combination. Valid range is 0 to 7.
Note 4	Nominal start slot for each channel is determined by the combination of Start UTC hour, Start UTC minute, and Start slot.
Note 5	Starting slot valid range is -1 to 2249. • A value of –1 clears the schedule and discontinues the broadcasts for the indicated channel(s). For FATDMA, a null field indicates no change to the current start slot when set to the AtoN station. For RATDMA. a start slot defines the first slot of the RATDMA selection interval. For RATDMA, a null field indicates that the selection interval randomly selected within the frame. In response to a query this field cannot be null. • In response to a query, a value of -1 indicates that the message is not scheduled for broadcast on the indicated channel. The query response for the start slot selection interval when in RATDMA mode does not distinguish between a previous commanded value or a random chosen value. • The current start slot of the selection interval (the value as specified by a previous CBR command sentence). • The current start slot of the selection interval (the value chosen randomly by the AIS device as specified by a previous CBR command sentence)>
Note 6	Message transmission slot interval, valid range is -1 to 3 240 000 slots (24*60*2250 = 3 240 000 is once per day). When configuring a AtoN station with an RATDMA/CSTDMA schedule the valid range is: 0 to (24*60*60) slots. A null field indicates no change to the current slot interval setting when sent to the AtoN Station. In response to a query this field cannot be null, -1 indicates that the slot interval is not set.
Note 7	Used to select whether the CBR is configuring a FATDMA schedule or RATDMA/CSTDMA schedule (0 indicates FATDMA, 1 indicates RATDMA, and 2 indicates CSTDMA). For RATDMA/CSTDMA modes, scheduled transmissions are between the slot interval and the slot interval plus 150.
Note 8	This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without "C" is not a command.

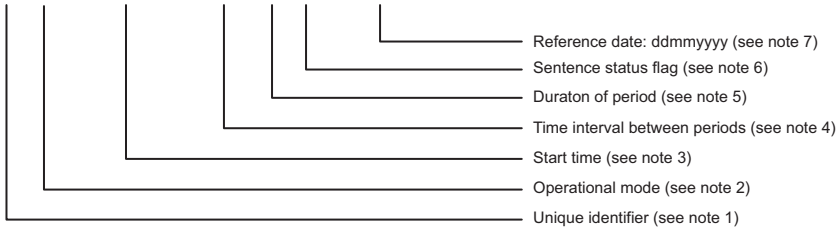
10.2.15 COP - Configure the operational period, Command

This sentence configures the operational schedule of a device. This includes directly enabling ordisabling device operation, or having the device operation controlled by an internal process.

For example, this is used to coordinate operation of an AtoN chain as specified in IEC 62320-2. (See “Optional chaining of AIS AtoN Stations”). When chaining, the duration of AIS AtoN Station’s receiver wake up time must be sufficient to allow correct operation of a chain.

This sentence can be queried.

$--COP,c--c,x,hhmmss.ss,x.x,x.x,a,xxxxxxxx*hh<CR><LF>



Note 1	The Unique Identifier is used for system level identification of a station, 15 characters maximum (see the AID sentence formatter). On input, this sentence should be accepted only if this data field matches the AtoN Station’s Unique Identifier. On output, this data field is the AtoN Station’s Unique Identifier.
Note 2	0 = operation controlled by internal process using the defined operating schedule. 1 = enable operation 2 = disable operation
Note 3	Start time used to calculate the operational schedule. This is also the beginning time of the first operational period.
Note 4	Time Interval between the beginning times of the operational periods in units of seconds.
Note 5	Duration of operational period in units of seconds. (86400 seconds equals 24 hours).
Note 6	This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null. R = Sentence is a status report of current settings (use for a reply to a query). C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.
Note 7	The reference date specifies the date for Time Intervals greater than 24 hours when choosing a start day of schedule that is different than the current day.

10.2.16 DCR - Device capability report

This sentence is used to report the capabilities of a device. The identification of the device’s capabilities is specified in the appropriate equipment standard. A capability is indicated using a binary-state (0 or 1).

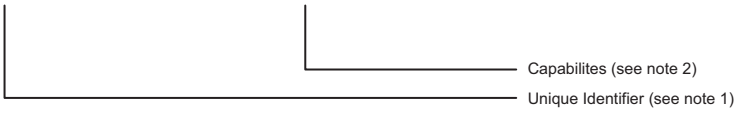
The binary-states are coded using a mask represented as a hexadecimal field (hhhh…). Each bit position of a hexadecimal character is assigned to a specific capability. This provides four capabilities per each hexadecimal character. The assignment of bit positions to capabilities is not contained here. The association of a capability to a bit position should be specified in the equipment’s standard.

Generally, as in the NRM sentence the association of capability to bit position begins with the least significant bit (LSB) of the hexadecimal field.

This sentence can be used to report an AIS AtoN Station’s capabilities (See IEC 62320-2, Annex B, Table B.3, “Function identifier” column). There are thirty-four capabilities listed in this table beginning with “000000.” The capability represented by Function identifier “000000 (dec 0)” is reported by the LSB of the hexadecimal field. The thirty-fourth capability would be reported by the second bit of the 9th hexadecimal character.

This sentence can be queried.

$--DCR,c--c,hhhhhhhhhhhhhhhhhhhhhhhhhhhhhhhh*hh<CR><LF>



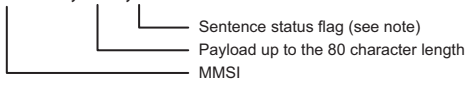
Note 1	The Unique Identifier is used for system level identification. When provided, this is the Unique Identifier of the device. • For an AIS AtoN Station, see the AID sentence formatter. The Unique Identifier for an AIS AtoN Station is the Real MMSI.

Note 2 The Capabilities mask is defined as a 128 bit hex field where the least significant bit represents the first capability, the next bit represents the second capability and so on up to bit 128 (most significant bit) which is the 128th capability. This data field is fixed length containing 32 hexadecimal characters.
0 = Capability not supported or not defined
1 = Capability supported

10.2.17 MCR - Configure proprietary AtoN control

The payload of this sentence will be proprietary information used to control the AtoN Station.

$--MCR,xxxxxxxxx,c--c,a*hh<CR><LF>



Note 1 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a query response,
“C” = sentence is a configuration command to change settings.

10.2.18 MEB - Message input for broadcast, Comand

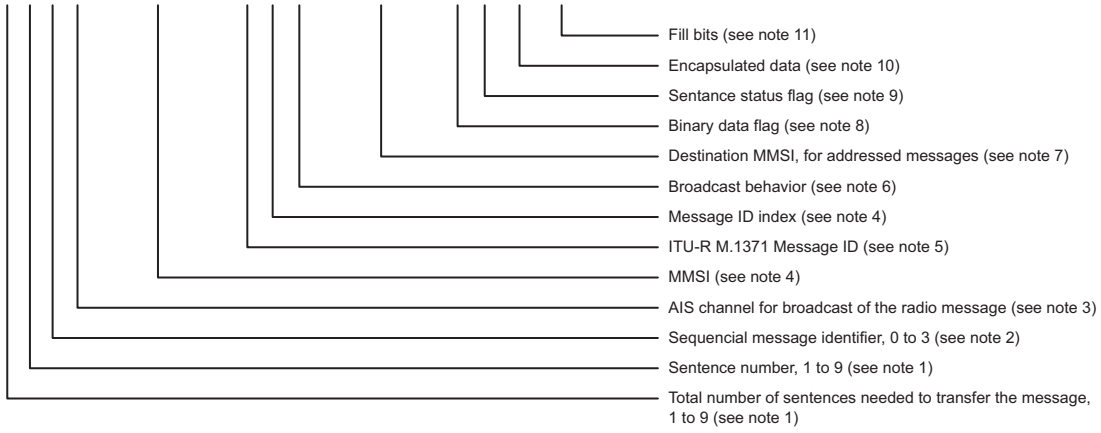
This sentence is used to input a message for storage or immediate broadcast. The sentence associates messages with real, virtual, and synthetic MMSI’s (See AID sentence).

The stored message is associated by the MMSI, Message ID, and Message ID Index. The combination of MMSI, Message ID, and Message ID Index are used to reference the stored message and link the message to a transmission schedule as defined by a CBR sentence. The stored message’s broadcast begins when both the message content and schedule (See CBR sentence) have been entered.

For immediate message broadcast, the binary data will be broadcast using the slots reserved by the CBR sentence with both Message ID and Message ID Index = 0, or will be broadcast using the next available slot. The channel for the immediate message broadcast is specified by the “AIS channel for broadcast of the radio message” (parameter field 4).

This sentence can be queried. When queried, the query response may contain one or more sentences and will continue until the transfer of all stored information is complete.

!--MEB,x,x,x,x,xxxxxxxxx,xx,x,x,xxxxxxxxx,x,a,s--s,x,*hh<CR><LF>



Note 1 The total number of sentences required to transfer the binary message data to the AIS unit. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. All sentences contain the same number of fields.
Successive sentences may use null fields for fields that have not changed, such as fields 4, 5, 6, 7, 8, 9, and 10.

Note 2 This sequential message identifier serves two purposes. It meets the requirements as stated in Section 5.3.4 and it is the sequence number utilized by ITU-R M.1371 in message types #6 and #12. The range of this field is restricted by ITU-R M1371 to 0 - 3. The sequential message identifier value may be reused after the AIS unit provides the "ABK" acknowledgement for this number. (See ABK Sentence).

Note 3 The AIS channel that should be used for the broadcast:
0 = no broadcast channel preference, -
1 = broadcast on AIS channel A,
2 = broadcast on AIS channel B,
3 = broadcast message on both AIS channels A and B,
For an immediate message broadcast, this cannot be null. For a stored message it should be null.

Note 4 For the message to be broadcast, this MMSI must match a previously entered a real, virtual, or synthetic MMSI (See AID and CBR Sentences).

Note 5 ITU-R M.1371 messages supported by this sentence: #6, #8, #12, #14, #25, and #26. See IEC 62320-2 for the ITU-R M.1371 messages that are supported by an AIS AtoN Station.

Note 6 0 = For an AtoN device, the message is stored in volatile memory for autonomous continuous transmission as defined by a CBR sentence. The message is identified by the combination of MMSI, Message ID, and Message ID Index.
1 = For an AtoN device, a single transmission (not stored in the “message table”) using the next available slot following slot selection priority:
- If a MEB is received for a given MMSI, Message ID, and Message ID Index, and the MMSI, Message ID and Message ID Index, already has a broadcast schedule then that schedule is used to send the new message.
- If a MEB is received for a given MMSI, Message ID and Message Index and the MMSI, Message ID, and Message ID Index, does not have a broadcast schedule, then the message is transmitted using the available slot using the following priority scheme.
  - Use CBR definition, Message ID = 0, Message ID Index = 0 (if available).
  - Use RATDMA if supported by AtoN unit

2 = For continuous transmission in non-volatile memory
3 = Delete the stored message (this includes volatile and non-volatile)
4 – 9 = reserved for future use.

Note 7 The “Destination MMSI, for Addressed Messages” should be a null field when the message is not destination specific, and is intended to be destination broadcast on the VHF Data Link.

Note 8 The “Binary data flag” field has a range from 0 to 1 with the following meaning:
0 = unstructured binary data (no Application Identifier bits used)
1 = binary data coded as defined by using the 16-bit Application Identifier (See ITU-R M.1371, messages #25 and #26)

Note 9 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
R = Sentence is a status report of current settings (use for a reply to a query).
C = Sentence is a configuration command to change settings. A sentence without “C” is not a command.

Note 10 This is the content of the “binary data” parameter for either ITU-R M.1371 Messages #6, #8, #25, or #26, or the “Safety related Text” parameter for either message #12 or #14. The actual number of “6-bit” symbols in a sentence must be adjusted so that the total number of characters in a sentence does not exceed the “82-character” limit.

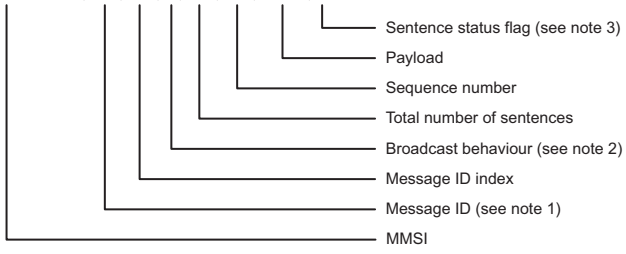
Note 11 This field cannot be null.

10.2.19 MPR - Message configuration of payload re-broadcast

Note: This sentence is superseded by sentence MEB (See section 10.2.18) but is supported for legacy purposes.

This message will be used to command the AIS AtoN Station to rebroadcast the payload or to define a new message for autonomous, continuous transmission. The AAR configuration with message ID/message ID index for a specific MPR must precede the MPR to identify it as autonomous continuous transmission. If it is a single transmission, this payload will be broadcast using the slots reserved by the AAR with message ID/message ID Index = 0, or it will use the next available slot.

$--MPR,xxxxxxxxx,xx,xx,x,xx,xx,c--c,a*hh<CR><LF>



Note 1 The following messages are supported by ITU-R M.1371 Messages #6, #8, #12, #14, #25, #26 and other appropriate messages.

Note 2 0 = use AAR definition,
1 = use next available slot.

Note 3 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
“R’ = sentence is a query response,
“C” = sentence is a configuration command to change settings.

10.2.20 NAK - Negative Acknowledgement

In general, the NAK sentence is used when a reply to a query sentence cannot be provided, or when a command sentence is not accepted.

Sentences currently with NAK support are AAR, ACE, ACF, AFB, AID, CBR, COP, and MEB.

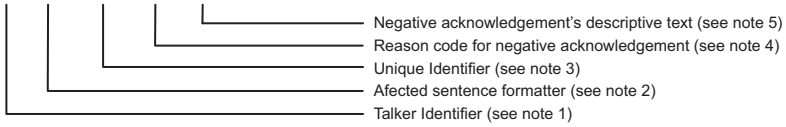
The NAK sentence reply should be generated within one (1) second.

A NAK can be used with or without a TAG Block. When the TAG Block feature is active, the NAK should use a TAG Block when appropriate. The NAK sentence is not used to report an “error” in the TAG Block portion of a “line”.

Use of NAK should be specified by the equipment standard.

This sentence cannot be queried.

$--NAK,cc,ccc,c--c,x.x,c--c,*hh<CR><LF>



Note 1 Talker identifier from the sentence formatter that caused the NAK generation. This field should not be null.

Note 2 Affected sentence formatter is either:
• The “approved sentence formatter of data” being requested in a query that cannot be processed or accepted, or
• The sentence formatter of the control or configuration sentence that cannot be processed or accepted.
This field should not be null

Note 3 The Unique Identifier is used for system level identification of a device, 15 characters maximum. This is the Unique Identifier for the device producing the NAK sentence, when available. (See the SID sentence).

Note 4 Reason codes:
0 = Query functionality not supported
1 = Sentence formatter not supported
2 = Sentence formatter supported, but not enabled
3 = Sentence formatter supported and enabled, but temporarily unavailable (e.g. data field problem, unit in initialize state, or in diagnostic state, etc.)
4 = Sentence formatter supported, but query for this sentence formatter is not supported.
5 = Access denied, for sentence formatter requested
6 = Sentence not accepted due to bad checksum
7 = Sentence not accepted due to listener processing issue
8 to 9: reserved for future use
10 = Cannot perform the requested operation.
11 = Cannot fulfill request or command because of a problem with a data field in the sentence.
12 to 48: reserved for future use
49 = other reason as described in data field 5.
Values greater than 50 may be defined by equipment standards.
This field should not be null.

Note 5 The length of this field is constrained by the maximum sentence length. This field may be null.

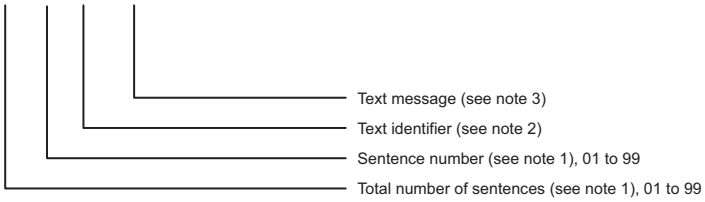
10.2.21 TXT - Text transmission

For the transmission of short text messages, longer text messages may be transmitted by using multiple sentences.This sentence is intended to convey human readable textual information for display purposes.

The TXT sentence shall not be used for sending commands and making device configuration changes. Specific methods have been designed and developed for this purpose; see section 10.3.

.

$--TXT,xx,xx,xx,c--c*hh<CR><LF>



Note 1 Text messages may consist of the transmission of multiple sentences all containing identical field formats when sending a complete message. The first field specifies the total number of sentences, minimum value 1. The second field identifies the order of this sentence (sentence number), minimum value 1. For efficiency it is recommended that null fields be used in the additional sentences when the data is unchanged from the first sentence.

Note 2 The text identifier is a number, 01 to 99, used to identify different text messages

Note 3 .ASCII characters, and code delimiters if needed, up to the maximum permitted sentence length (i.e., up to 61 characters including any code delimiters).

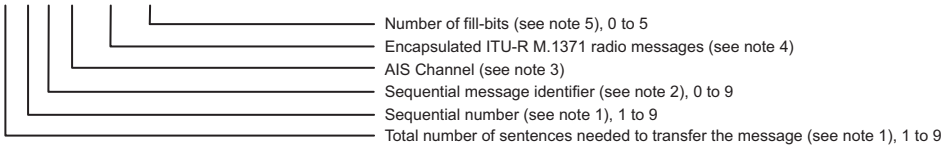
For Example: A GPS receiver sends a text alarm message (message ID 25, DR MODE - ANTENNA FAULT!) upon reverting to dead-reckoning mode due to an antenna fault. (note; the use of "^21" to indicate "!")

$GPTXT,01,01,25,DRMODE - ANTENNA FAULT^21*38<CR><LF>

10.2.22 VDM – AIS VHF Data-link Message

This sentence is used to transfer the entire contents of a received AIS message packet, as defined in ITUR M.1371 and as received on the VHF Data Link (VDL), using the "Six Bit" field type. The structure provides for the transfer of long binary messages by using multiple sentences.

!--VDM,x,x,x,a,s--s,x,*hh<CR><LF>



Note 1 The length of an ITU-R M.1371 message may require the transmission of multiple sentences.
• The first field specifies the total number of sentences used for a message, minimum value 1.
• The second field identifies the order of this sentence in the message, minimum value 1.
These cannot be null fields.

Note 2 The Sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This may be a null field for messages that fit into one sentence.

Note 3 The AIS channel is indicated as either A or B. This channel indication is relative to the operating conditions of the transponder when the packet is received. This shall be a null field when the channel identification is not provided. The frequencies for channels A and B are obtained by a query (See Section 5.3.5) of the AIS unit for an ACA sentence(s).

Note 4 This field supports a maximum of 60 valid characters for messages transferred using multiple sentences, and 62 valid characters for messages using a single sentence.

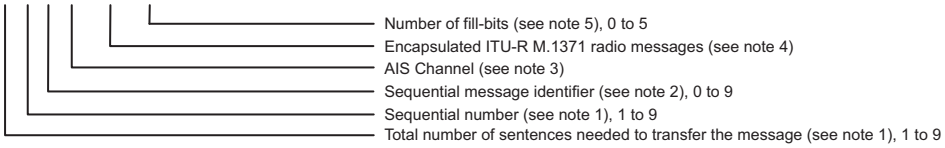
Note 5 This cannot be a null field.

10.2.23 VDO - AIS VHF Data-Link Own-Vessel Report

This sentence is used to transfer the entire contents of an AIS unit's broadcast message packet, as defined in ITU-R M.1371 and as sent out by the AIS unit over the VHF Data Link (VDL), using the "Six Bit" field type. The structure provides for the transfer of long binary messages by using multiple sentences.

The sentence uses the same structure as the VDM sentence formatter.

!--VDO,x,x,x,a,s--s,x,*hh<CR><LF>



Note 1 The length of an ITU-R M.1371 message may require the transmission of multiple sentences.
• The first field specifies the total number of sentences used for a message, minimum value 1.
• The second field identifies the order of this sentence in the message, minimum value 1.
These cannot be null fields.

Note 2 The Sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This may be a null field for messages that fit into one sentence.

Note 3 The AIS channel is indicated as either A or B. This channel indication is relative to the operating conditions of the transponder when the packet is received. This shall be a null field when the channel identification is not provided. The frequencies for channels A and B are obtained by a query (See Section 5.3.5) of the AIS unit for an ACA sentence(s).

Note 4 This field supports a maximum of 60 valid characters for messages transferred using multiple sentences, and 62 valid characters for messages using a single sentence.

Note 5 This cannot be a null field.

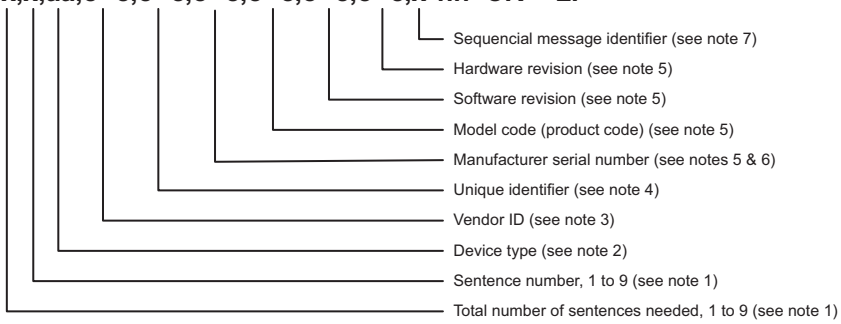
10.2.24 VER - Version

This sentence is used to provide identification and version information about a device. This sentence is produced as a reply to a query sentence.

In order to meet the 79-character requirement, a “multi-sentence message” may be needed to convey all the Data Fields.

For an AIS Base Station the VER sentence shall be output autonomously upon power-up. For other equipment the VER sentence may be output autonomously upon power-up.

$--VER,x,x,aa,c--c,c--c,c--c,c--c,c--c,c--c,c--c,x*hh<CR><LF>



Note 1 Depending on the number of characters in each Data Field, it may be necessary to use a “multi-sentence message” to convey a “VER reply.
• The first Data Field specifies the total number of sentences needed, minimum value 1. This is the total number of sentences required to transmit the information.
• The second Data Field identifies the sentence number, minimum value 1.
Sentence number refers to the sequence number of the sentence within the total number of sentences. The tenth Data Field provides the sequential message identifier (see Note 7).

Note 2 The device type is used to identify the manufactured purpose of the device. Choice of the device type identifier is based upon the designed purpose of the device. It is set into the equipment based upon the primary design of the device and remains constant even if the user defined talker identifier feature is used (See BCG Sentence). For AIS device types, (See Section 9).

Note 3 Vendor identification (Example: either the NMEA 0183, 3-character “Manufacturer’s Mnemonic Code” or NMEA 2000, 5-digit “Numeric Manufacturer’s Code”, 5 characters maximum.).

Note 4 The Unique Identifier is used for system level identification of a device, 15 characters maximum.
When used with AIS stations, on output, this data field is the AIS Station's Unique Identifier (See the SID sentence). When an MMSI is used as the Unique Identifier, it should be the MMSI of the station (for example, the "Real MMSI" of an AtoN station)

Note 5 The data field length may be 32 characters maximum. The length of 32 characters was chosen in order to be consistent with similar data field lengths in the NMEA 0183 standard. When large character lengths are used and the 80 character sentence limit would be exceeded for a single sentence, a series of successive VER sentences should be used to avoid the problem (using Data Fields 1, 2, and 10 to ensure the multiple VER sentences are properly associated by the listener). Though null fields can be used for data fields contained in other sentences of the series, the Unique Identifier field should always contain the same value in every sentence of the series.

Note 6 The manufacturer's serial number for the unit. Note, this "internal" manufacturer's serial number may or may not match the physical serial number of the device. Maximum length 32 characters.

Note 7 The sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This Data Field may be a null field for messages that fit into one sentence.

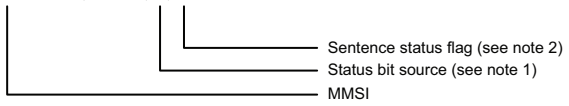
10.3 Proprietary configuration sentences

The following section documents the major proprietary NMEA0183/IEC61162 sentences used for AIS AtoN configuration and control. These sentence relate mainly to configuration of data capture and integration with external equipment.

10.3.1 Status Bit Source

The MCR SBS command is used to set the source for the AtoN status bits which are transmitted in AIS AtoN position reports (message #21). Refer to sections 6.1.1 and 6.1.4 for further information on the available interfaces for status information.

$--MCR,xxxxxxxxx,SBS,x,a*hh<CR><LF>



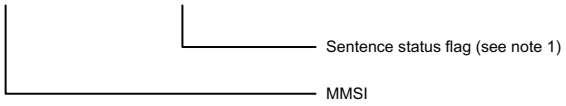
Note 1 Status bit source is either:
0 = ACG sentence provides status bits
1 = Transceiver basic IO connections provide status bits
2 = Extended sensor interface provides status bits (applies only to variants including the extended

Note 2 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
"R' = sentence is a query response,
"C" = sentence is a configuration command to change settings.

10.3.2 Status Bit Source Query

This command issued to query the transceiver for the current Status Bit Source configuration. The response will be in the format described in 10.3.1.

$--MCR,xxxxxxxxx,Q,SBS,a*hh<CR><LF>

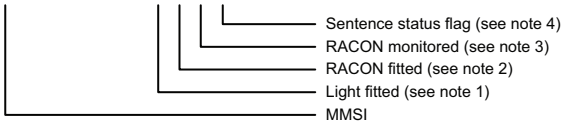


Note 1 This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.
"R' = sentence is a query response,
"C" = sentence is a configuration command to change settings.

10.3.3 Light / RACON configuration

The MCR LRC command is used to configure the fixed status of a connected Light and / or RACON. This affects the setting of the related status bits transmitted in message #21.

$--MCR,xxxxxxxxx,LRC,x,x,x,a*hh<CR><LF>

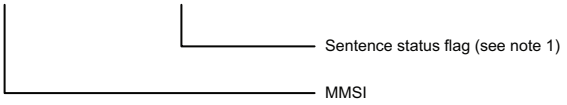


Note 1	Set the light fitted status, 1 = light fitted, 0 = light not fitted
Note 2	Set the RACON fitted status, 1 = RACON fitted, 0 = RACON not fitted
Note 3	Set the RACON monitored status, 1 = RACON monitored, 0 = RACON not monitored
Note 4	This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null. “R’ = sentence is a query response, “C” = sentence is a configuration command to change settings.

10.3.4 Light / RACON configuration query

This command issued to query the transceiver for the current Light / RACON configuration. The response will be in the format described in 10.3.3.

$--MCR,xxxxxxxxx,Q,LRC,a*hh<CR><LF>



Note 1	This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null. “R’ = sentence is a query response, “C” = sentence is a configuration command to change settings.

10.3.5 General MCR query

$--ANQ,MCR*hh

This query command will return all the MCR commands as used for direct transceiver configuration.

A general query for MCR using $--ANQ,MCR will also return ACQ (Acquisition Configuration) information for all messages. This is used as part of the configuration of a complete AtoN that includes a sensor module; the information within the ACQ details the acquisition time the sensor module needs from the transceiver before a transmission is going to take place, thus allowing the sensor module sufficient time to collect and average data as required for a transmission.

When the AIS Transceiver is not configured with a sensor module the ACQ data is not required but will still get displayed when queried.

10.4 Tag blocks

Talker TAG blocks are supported, as per the optional requirements described in IEC 62320-2:2016.

For further information contact Customer Support.

11 Technical specification

11.1 Applicable equipment standards

IEC62320-2 Edition 2.0, 2016	Maritime navigation and radio communication equipment and systems – Automatic identification system (AIS) – Part 2: AIS AtoN Stations – Operational and performance requirements, methods of testing and required test results
ITU-R M.1371-5 February 2014	Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band
IEC61162-1 Edition 4.0, 2010	Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners
IEC61162-2 Edition 1.0, 1998	Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high-speed transmission
IEC61108-1 Edition 1.0, 2002	Global Navigation Satellite Systems (GNSS) –Part 1: Global positioning system (GPS) - Receiver equipment - Performance standards, methods of testing and required test results
IEC60945 2002	Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results
SDI-12 Version 1.3, 2009	A Serial-Digital Interface Standard for Microprocessor-Based Sensors

11.2 AIS Transceiver specification

11.2.1 Physical

Transceiver dimensions	288mm (height) x 180mm (maximum diameter), excluding bird deterrent. See also section 11.4.
Transceiver weight	1.3Kg excluding mounting bracket, cables and accessories.

11.2.2 Environmental

Operating temperature range	-25°C to +55°C
Water ingress rating (enclosure)	IPx6 and IPx7
Water ingress rating (power and data connectors)	IP68 mated or unmated
Water ingress rating (RF connectors)	IPx6

11.2.3 Electrical

Nominal supply voltage	12 to 24VDC
Absolute min and max supply voltages	10 to 32VDC *Reverse polarity protection up to 100V *Short circuit protection *On-board surge protection up to 100V
Power consumption at 12VDC supply	Type 1 (FATDMA) with message #21 transmission every 3 minutes, 0.1Ah/day Type 3 (RATDMA) with message #21 transmission every 3 minutes, 0.8AH/day

11.2.4 Internal GPS

Receiver channels	50
Time to first fix (cold start)	<36 seconds
Frequency	L1 band, 1575.42MHz
Accuracy	2.5m CEP / 5.0m SEP without differential correction 2.0m CEP / 3.0m SEP with SBAS or RTCM DGPS correction
Antenna requirement	Internal antenna or active external antenna (3.3V bias) with gain >20dB

11.2.5 TDMA transmitter

Frequency range	156.025MHz to 162.025MHz
Channel bandwidth	25kHz
Output power	Configurable 1W, 2W, 5W or 12.5W
Data transmission rate	9600 bits/s
Modulation mode	25kHz GMSK

11.2.6 TDMA receivers

Number of receivers	2
Frequency range	156.025MHz to 162.025MHz
Channel bandwidth	25kHz
Sensitivity	<-107dBm for 20% PER
Modulation mode	25kHz GMSK
Adjacent channel sensitivity	70dB
Spurious response rejection	70dB

11.2.7 Supported AIS messages (transmission)

Message #6	Binary data for addressed communication
Message #8	Binary data for broadcast communication
Message #12	Safety related data for addressed communication

Message #14	Safety related data for broadcast communication
Message #21	Position and status report for aids-to-navigation
Message #25	Short unscheduled binary data transmission (Broadcast or addressed)
Message #26	Scheduled binary data transmission (Broadcast or addressed)

11.2.8 Connector types

Power and basic transceiver interfaces	Souriau UTS714D19PW32 with type W keying. Mating half UTS6JC14E19SW.
USB configuration	Souriau UTS78D4P32 Mating half is UTS6JC8E4S.
Extended sensor interfaces A	Souriau UTS714D19PW32 with type X keying. Mating half is UTS6JC14E19SX.
Extended sensor interfaces B	Souriau UTS714D19PW32 with type Y keying. Mating half is UTS6JC14E19SY.
VHF antenna	Female ‘N’ type co-axial connector.
External GPS antenna	Female TNC type co-axial connector.
Earth stud	M4 threaded stud

11.2.9 Transceiver data interfaces

USB	USB interface for configuration and diagnostics
NMEA0183 / IEC61162 / RS422	1x bi-directional RS422 level interface carrying IEC61162 sentences for configuration, diagnostics and sensor data interface (receiver optically isolated) 1x input only RS422 level interface configuration and sensor data interface (optically isolated)
Non-isolated digital I/O	5x 3.3V logic level I/O signals, Inputs 0 – 2 mapped to AtoN status bits in message #21.

11.2.10 Extended sensor interface specification T1+S T3+S

USB	USB interface for configuration and diagnostics
RS232	Two RS232 level interfaces for connection of external equipment*
NMEA0183 / IEC61162 / RS422	One fully optically isolated RS422 level interface for connection of external equipment
SDI-12	One SDI-12 compliant interface for connection of external sensors supporting the SDI-12 protocol*
Non-isolated digital I/O	4x non-isolated logic level I/O signals (3.3V logic levels)
Isolated digital inputs	5x optically isolated digital inputs, sensitivity 2.5V, max input voltage ±15V.
Isolated analogue inputs	Two isolated analogue inputs. Range ±13.75V, 16 bit resolution.
Non-isolated analogue inputs	Three non-isolated analogue inputs. Range ±37.2V, 12 bit resolution.
Current sense loop	Light current sense loop, max 5A. Measurement of currents up to 0.5A with 12bit resolution.
Relay drive	2x relay driver outputs, max load 200mA at 60VDC.

*Only one RS232 port is available when the SDI-12 interface is enabled.

11.3 Configuration interface specification

The transceiver is configured via a USB interface and compatible Virtual COM Port (VCP) driver. One VCP is created for the transceiver configuration interface and a second VCP for the extended sensor interface configuration port (if the extended sensor interface is present). A USB configuration cable is available from your supplier.

All configuration is performed via the USB VCP using the standardised and proprietary IEC61162 sentences defined in section 10.2.

11.4 Drawings and dimensions

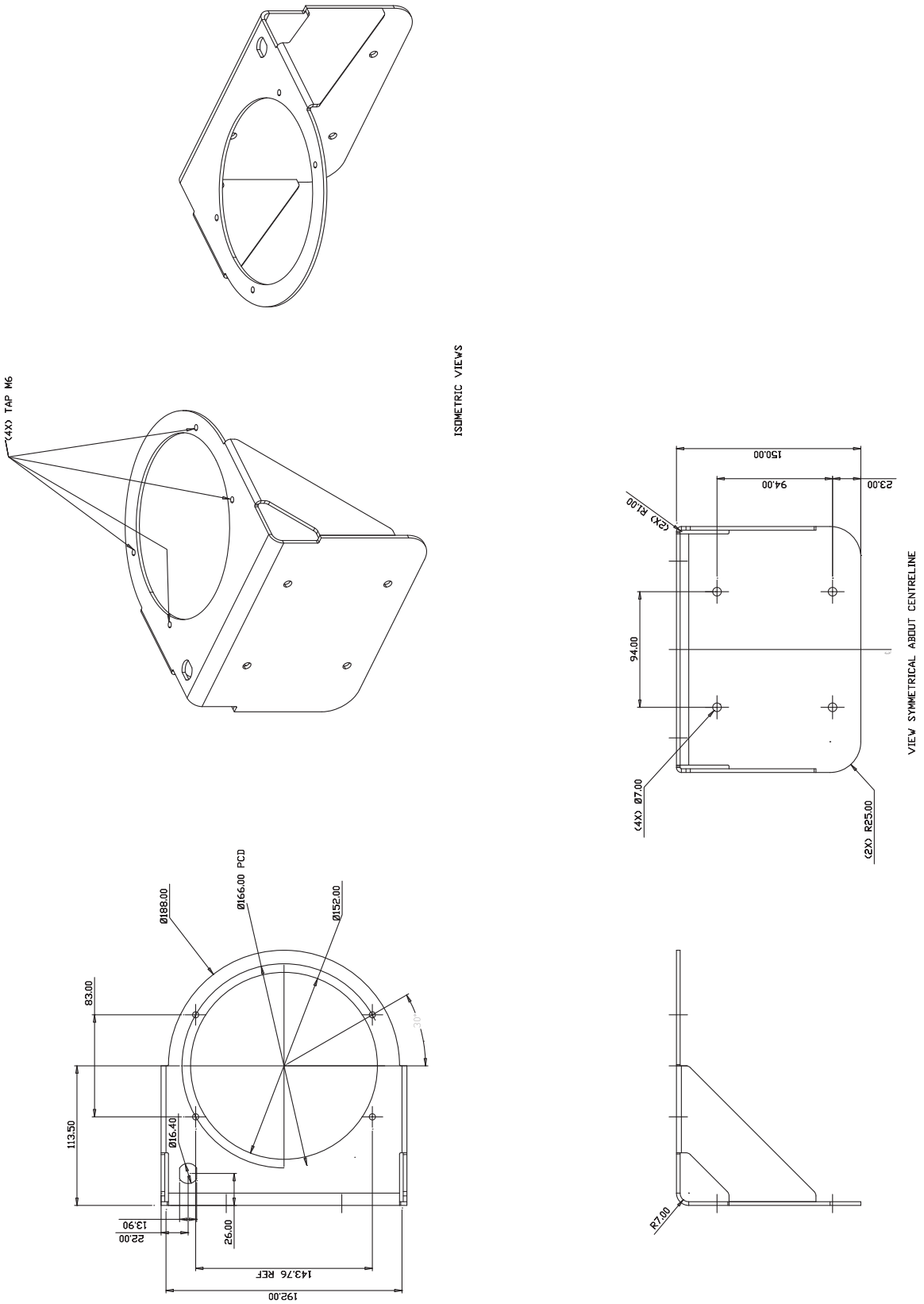


Figure 34 Transceiver mounting bracket dimensions

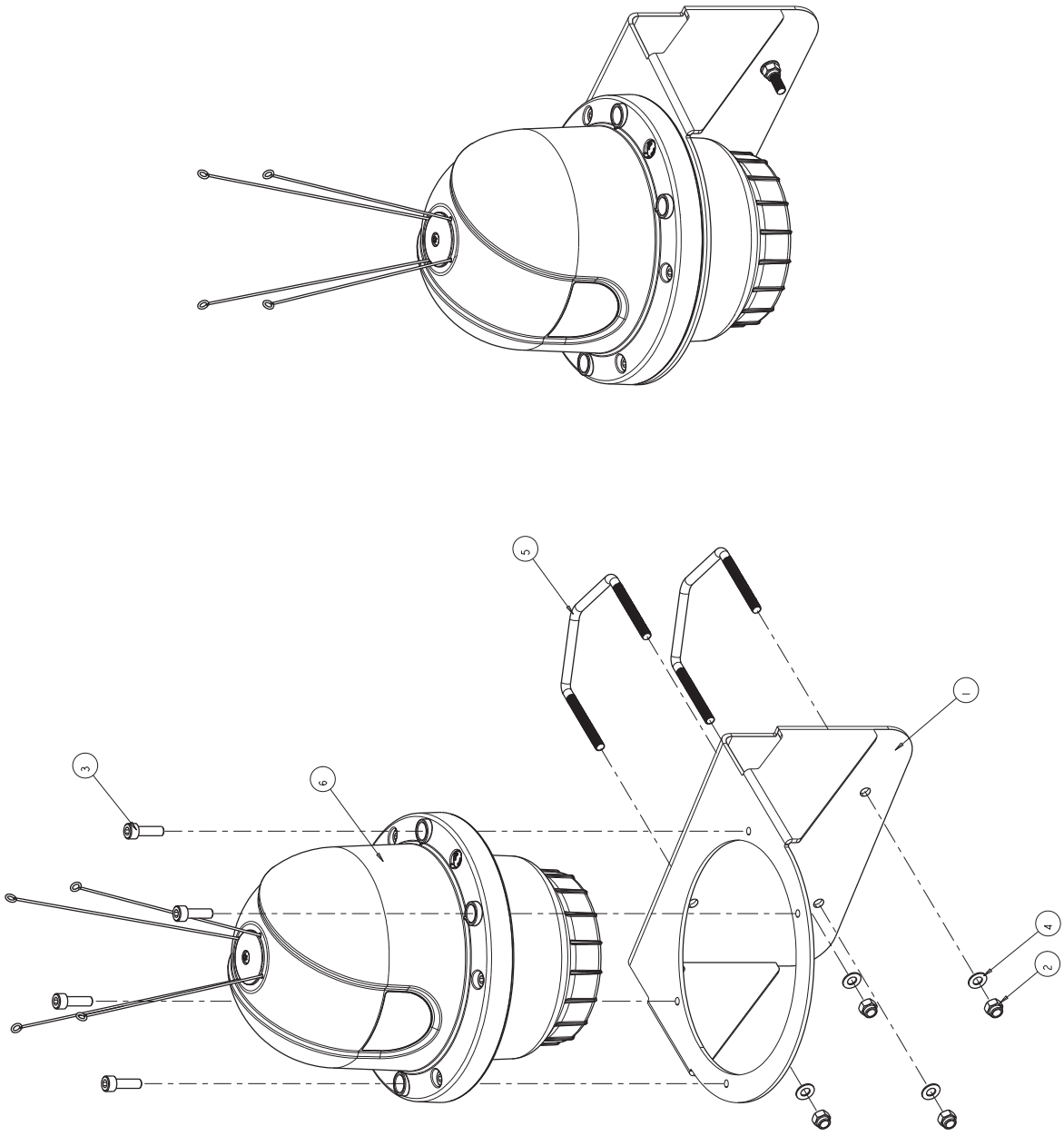


Figure 35 Transceiver general assembly

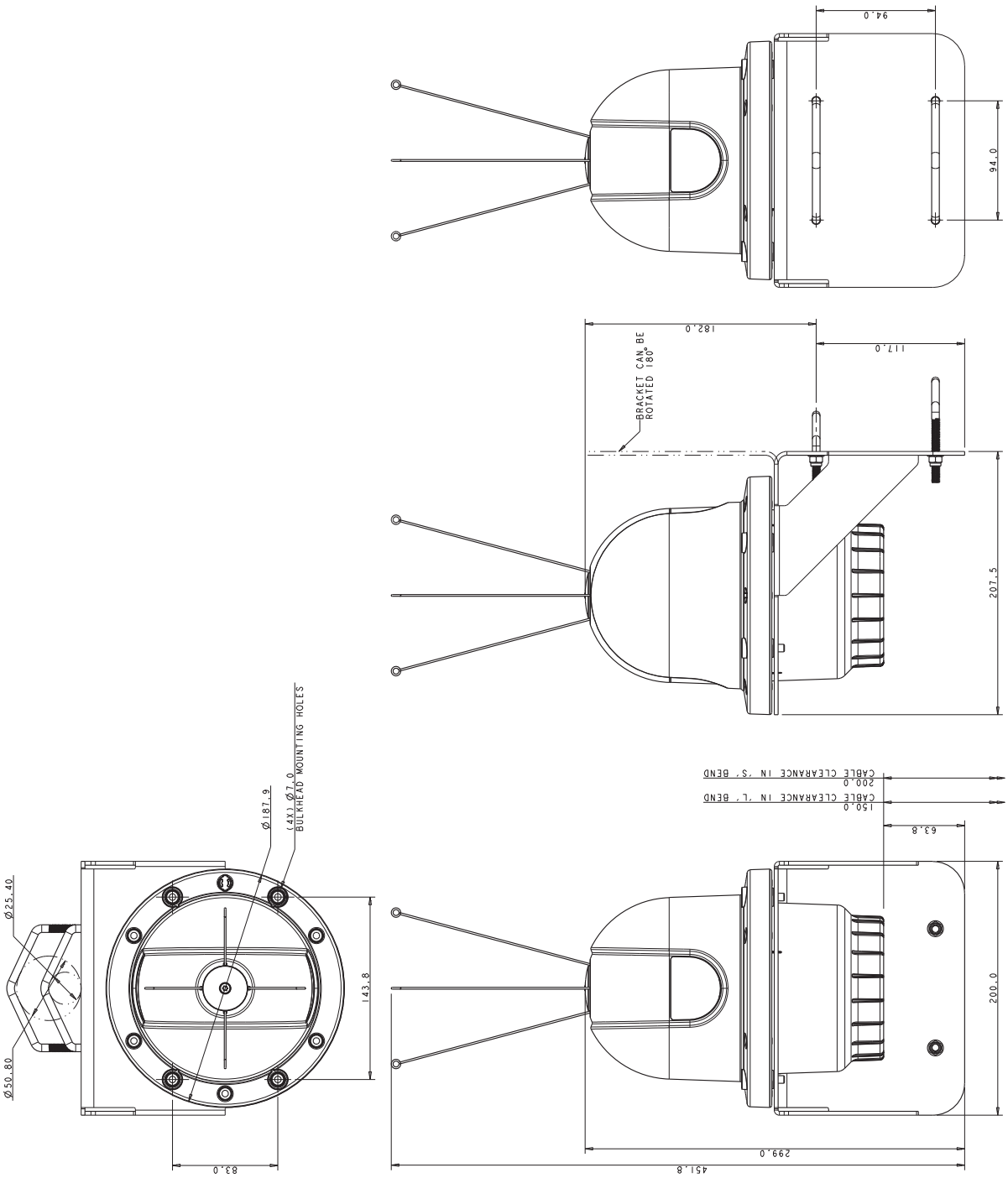


Figure 36 Transceiver dimensions

12 Firmware upgrade procedure T1 T1+S T3 T3+S

The transceiver firmware can be updated should a new version be made available. The firmware update is transferred to the transceiver using the USB interface. The pre-requisites for carrying out a firmware update are:

- **AIS AtoN Transceiver, connected to a 12 or 24V power supply. The power supply must not be interrupted during the software update.**
- **The USB configuration cable supplied with the AIS AtoN transceiver**
- **A PC running Windows (Windows 7, 8 or 10) with a spare USB port**
- **Prior installation of the USB driver for the AIS AtoN transceiver.**
- **A software update file for the AIS AtoN transceiver (available from your supplier)**
- **The 'vxsend' PC software update utility (available from your supplier)**

To update the firmware carry out the following steps:

1. Apply power to the transceiver and connect the USB configuration cable to the transceiver and PC
2. Install and run the 'vxsend' utility (screenshot shown in Figure 37)
3. Click the Browse (…) button for the Image file, then navigate to and select the appropriate update file.
4. Select the 'AIS NMEA Port' option and the virtual COM port associated with the transceiver. **Do not select the ‘AIS USB Port’ option.**
5. Select the 115200 baud rate option
6. Click 'Start' and wait for the update to complete. Notification is given when the update has completed successfully.
7. Power cycle the transceiver and confirm normal operation before it is deployed.

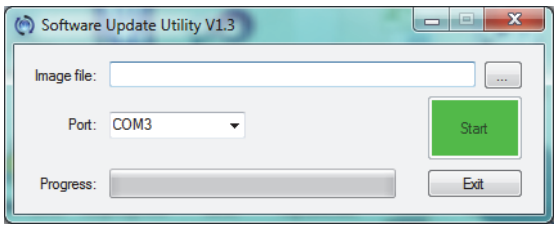


Figure 37 vxsend utility screenshot

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