

**Saab TransponderTech**

# R4 AIS Class B Transponder

**INSTRUCTION MANUAL**



**SAAB**

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**Saab TransponderTech AB, SWEDEN**

**ii Disclaimer**

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**iii Manual Part Number and Revision**

Part number 7000 112-020, revision A1.

**iv Disposal Instructions**

Broken or unwanted electrical or electronic equipment parts shall be classified and handled as 'Electronic Waste'. Improper disposal may be harmful to the environment and human health. Please refer to your local waste authority for information on return and collection systems in your area.

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## 1 PRODUCT DESCRIPTION

The R4 AIS Class B Transponder is intended for installation on vessels e.g. pleasure crafts and small ships. During operation it will autonomously transmit position reports that can be received by other AIS equipped vessels and shore stations.

The R4 AIS Class B transponder will receive transmissions from other AIS equipped vessels within VHF range. This data is made available on a serial data interface for connection to an AIS compatible external display or chart plotter. This enables the position of AIS equipped ships in the vicinity to be displayed in real time. No external display or chart plotter software is included in the R4 AIS Class B Transponder package.

Optionally, transmission from the R4 AIS Class B transponder can be disabled by means of an external switch (not included in the package). AIS transmissions from other ships will still be received in this mode. This feature can be used to conserve power and reduce emissions when transmission of the own ships position is not desired.

The R4 AIS Class B transponder is to be connected to a suitable GPS antenna, a marine band VHF antenna and a 12V DC power supply.

## 2 GENERAL WARNINGS

- The R4 AIS Class B Transponder utilise the Global Positioning Satellite (GPS) network to determine position. The accuracy of this network is variable and affected by several factors. It is desirable wherever possible therefore to verify both your vessels AIS derived position data and other vessels AIS derived position data with visual or radar based observations.
- The compass safe distance of this unit is 0.2 m or greater.
- In accordance with a policy of continual development and product improvement the R4 AIS Class B Transponder hardware and software may be upgraded from time to time. When necessary, upgrades to the product will be accompanied by updates or addenda to this manual.
- Please take time to read this manual carefully and to understand its contents fully so that you can install and operate your AIS system correctly.
- Information contained in this manual is liable to change without notice.

- 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
  - Reorient or relocate the receiving antenna.
  - Increase the separation between the equipment and receiver.
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  - Consult the dealer or an experienced radio/TV technician for help.
- The R4 AIS Class B Transponder does not contain any user serviceable parts. Repairs should only be made by an authorized Saab Transpondertech AB service agent. Unauthorized repairs or modifications could result in permanent damage to the equipment and void your warranty.

### **3 RF EMISSIONS NOTICE**

**CAUTION:** The R4 AIS Class B transponder generates and radiates radio frequency electromagnetic energy. This equipment must be installed and operated according to the instructions contained in this handbook. Failure to do so can result in personal injury and / or product malfunction.

**CAUTION:** Never operate the transponder unless it is connected to a VHF antenna.

To maximise performance and minimise human exposure to radio frequency electromagnetic energy you must make sure that the antenna is mounted at least 1.5 meters away from the transponder and is connected to the transponder before power is applied.

The system has a Maximum Permissible Exposure (MPE) radius of 1.5m. This has been determined assuming the maximum power of the transponder and using antennas with a maximum gain of 3dBi.

- The antenna should be mounted 3.5m above the deck in order to meet RF exposure requirements.
- Higher gain antennas will require a greater MPE radius.
- Do not operate the unit when anyone is within the MPE radius of the antenna (unless they are shielded from the antenna field by a grounded metallic barrier).
- The antenna should not be collocated of operated in conjunction with any other transmitting antenna.

This device has been designed to operate with standard marine VHF antennas having a maximum gain of 3dBi. Antennas having a gain greater than 3dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

## 4 LICENSING AND MMSI NUMBER

**IMPORTANT:** In most countries the operation of an AIS unit is included under the vessel's marine VHF license provisions. The vessel on to which the AIS unit is to be installed must therefore possess a current VHF radiotelephone license which lists the AIS system and the vessel Call Sign and Maritime Mobile Service Identity (MMSI) number.

An MMSI number is required in order for the R4 AIS Class B transponder to operate.

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

## 5 INSTALLATION

**WARNING:** Do not connect the R4 AIS Class B Transponder to a mains (line) AC electrical supply, as an electric shock or fire hazard could result.

**CAUTION:** Do not connect the R4 AIS Class B Transponder to a DC supply exceeding 15.6 V or reverse the supply polarity. Damage to the unit may result.

**CAUTION:** The R4 AIS Class B Transponder is designed for operation in the temperature range -25 °C to +55 °C. Do not install (or use) the unit in environments which exceed this range.

### 5.1 Location

Select an appropriate location for the R4 AIS Class B Transponder in order to:

- Avoid direct exposure to water
- Avoid exposure to excessive heat and temperature gradients
- Avoid locations with high levels of vibration and shock
- Keep the unit well ventilated
- Avoid interference with ships magnetic compasses. Adhere to the minimum compass safe distance noted in the general warnings section above.
- Make it possible to view the front panel LEDs during system checks.

### 5.2 Physical Mounting

The unit can be attached to a flat surface with 4 mm screws. It is recommended that a clearance area of at least 90 mm is maintained behind the unit to facilitate mounting of connectors and limit bending of connecting leads. Refer to the Appendix section for drawings.

### **5.3 Power Supply connection**

The supplied power cable (p/n 7000 112-011) shall be used to connect the unit to a 12V DC supply (10.8-15.6V) capable of supplying 2A peak to the DC power leads. Refer to the Appendix section for a specification for this cable. It is recommended that an external fuse (slow blow) with 3A capacity is connected in line with the power supply.

### **5.4 Connection of external TX Off Switch (optional)**

An optional 'TX Off' switch (not supplied) can be connected to the switch lines of the supplied power cable (p/n 7000 112-011). Refer to the Appendix section for a specification for this cable. When the switch is closed, no position reports will be transmitted by the R4 AIS Class B Transponder. AIS data from other ships will still be received in this mode. Any low voltage on/off circuit breaker suitable for marine environment can be used for this purpose.

### **5.5 Serial Data Connection**

If an external display unit (chart plotter, PC etc) is to be used, connect a serial cable to the female 9-way D type COM connector on the transponder. Refer to the Appendix section for a definition of this port. Connect the other end of the serial cable to the display device. Note that the software in the display device must be configured for AIS operation. This serial cable and display unit is not part of the R4 AIS Class B Transponder package.

### **5.6 Antenna connections**

**CAUTION:** When connected to the transponder, the shield of the antenna leads will be in connection with 12V DC power return. For this reason the antenna down-lead shields shall not be connected to the ship's structure.

Connect the down-lead from a VHF antenna to the VHF antenna connector port (BNC connector) and connect the down-lead of a GPS antenna to the GPS antenna port (TNC connector). Please see the Appendix section for recommendations on antennas and antenna installation.

#### **GPS Antenna connector**

This is a TNC female bulkhead connector. This port provides 5V DC feed for an active GPS antenna as required by the R4 AIS Class B Transponder.

#### **VHF Antenna connector**

This is a BNC female bulkhead connector.

## 6 PROGRAMMING THE TRANSPONDER

Before the R4 AIS Class B Transponder can be used it requires configuration of the following parameters pertinent to the own ship:

- MMSI number
- Ship name
- Call sign
- Ship type
- Ship dimensions with respect to the GPS antenna location

This configuration is done via a programming software intended to be installed on a PC. The PC shall be connected to the R4 AIS Class B transponder RS232 serial port. If the PC being used for programming not is equipped with a serial port, a commercially available USB to RS232 serial adaptor may be required. Further instructions are provided with the programming software package.

The programming software package may not be provided with the R4 AIS Class B Transponder on all markets. If this is the case, consult your Saab Transpondertech dealer if your unit not has been properly configured before delivery.

## 7 USING THE TRANSPONDER

### 7.1 Front Panel LED Indicators

#### Operate

This is a green LED which indicates, when lit, that the transponder is operating properly. This includes that the internal GPS receiver is providing position data and that AIS transmissions occur at a regular basis.

#### No TX

This is a yellow LED which indicates, when lit, that the transponder is prevented to transmit. Reasons for this include the following:

- The transponder's internal GPS receiver does not provide position data (e.g. due to blockage of the GPS antenna)
- The transponder was unable to transmit an AIS message at the last two attempts due to the channel being already occupied, e.g. by transmissions from other AIS transponders
- Transmissions are deliberately disabled by means of an external 'Tx Off' switch
- Transmissions have been disabled due to receipt of an external command from an AIS base station



- **Error**

This is a red LED which indicates, when lit, that a failure has been detected. This includes:

- The internal GPS receiver has not provided position data for 30 minutes.
- VHF antenna mismatch (VSWR out of range)
- Power supply is out of range
- The R4 AIS Class B Transponder has not been programmed with an MMSI number (the 'No Tx' LED will also be lit in this case).

**Receive**

This is a blue LED that will momentarily light up each time an AIS transmission is received.

## 7.2 Normal Operation

The R4 AIS Class B Transponder will begin operation as soon as power is applied. The only user input is operation of the external 'TX Off' switch, if fitted.

**Start-up sequence**

When the 12V supply is switched on all four LEDs visible on the front panel of the unit will illuminate twice for a period of one second on each illumination. The green, red and blue LEDs will then go out. When the internal GPS receiver has acquired position information and the transponder transmits its first position report, the yellow LED will go out. This will typically occur within a few minutes but may in extreme cases take up to 30 minutes depending on the switch-on state of the GPS receiver. When the yellow LED goes out the green LED will illuminate indicating that the unit is now operating correctly.

**Receiving AIS Transmissions**

The blue LED will momentarily light up each time an AIS message from another transmitter is received.

**Transmission of AIS Data**

Provided that the R4 AIS Class B Transponder has been properly configured, regular transmissions will occur according to the rules set by the applicable standards for Class B AIS equipment.

Position reports (AIS message 18) including MMSI number, position, speed (SOG) and track angle (COG) will be sent with a reporting interval of 30 seconds if the speed is at least 2 Knots. At speeds below 2 Knots the reporting interval is 3 minutes.

Static data reports (AIS message 24A and 24B) including MMSI number, ship type, ship name, call sign and ship dimensions will be transmitted once every 6 minutes.

The R4 AIS Class B Transponder will sense that no other transmission occurs before own transmission is started. If the channel is already occupied, the transmission attempt will be abandoned. A maximum of three attempts will be made for each nominal transmission interval.

The R4 AIS Class B Transponder may transmit at other rates and also be prevented from transmission as a reaction to commands received from AIS base stations in accordance with applicable standards.

Unless commanded otherwise (by an AIS base station), each transmission will occur on one of two AIS-dedicated VHF channels within the international marine band allocation (channel 87B; 161.975MHz, or channel 88B; 162.025MHz).

### **TX Off switch function**

If an external 'TX Off' switch is connected to the unit, the AIS transmitter part of the transponder will be off as long as the switch is closed. When the transmitter is off, the yellow "No TX" LED will be illuminated and no AIS data will be broadcast to other vessels. Data from other vessels will still be received by the unit.

### **Serial data port messages**

The serial data port will output the following:

- Details of relevant AIS transmissions received
- Details of AIS transmissions sent
- Details of channel management messages received
- Alarm messages generated by the BIIT function
- Position data from the internal GPS receiver

The data port will accept the following inputs:

- Configuration information
- Alarm acknowledgements
- External input of true heading (NMEA THD message)

Refer to the Appendix section of this manual for more details of the data port messages.

## **7.3 Troubleshooting**

**CAUTION:** Always disconnect power from the R4 AIS Class B Transponder before inspections and trouble shooting activities.

### **The Yellow 'No TX' LED is lit after startup and will not go out**

#### The Tx Off switch is engaged

- Check that the external Tx Off switch (if installed) is properly connected and undamaged.
- If no Tx Off switch is connected, check that the switch leads of the transponder power cable are properly terminated and not in electrical contact with each other or another object.

#### Problems with GPS reception

- Verify that a suitable GPS antenna and antenna cable has been selected according to the Appendix section.
- Check that the GPS antenna cabling is undamaged and properly connected at both ends.
- Check that the GPS antenna has a clear view of the sky

#### **The Yellow ‘No TX ‘ LED is lit during operation**

##### Problems with GPS reception

- Refer to previous section above

##### High Load on the AIS network

- Transmissions will resume automatically when the load permits

##### Class B transmissions inhibited on command from an AIS base station

- No user remedy is possible. Transmissions will resume when allowed

#### **The red ‘ERROR‘ LED is lit and stays on (the Yellow ‘No Tx’ LED may also be lit)**

##### The unit has not been configured with an MMSI number

- Contact your Saab TransponderTech dealer if the unit not has been programmed with user data before delivery

##### Problems with GPS reception

- Troubleshoot as described for the same problem in the previous sections

##### VHF Antenna Problems

- Remove power from the transponder
- Verify that a suitable VHF antenna and antenna cable has been selected according to the Appendix section
- Check that the VHF antenna cabling is undamaged and properly connected at both ends
- Check that no foreign object is interfering with the VHF antenna and that it has an unobstructed view of the horizon
- Reapply power to the transponder

##### Hardware failure

- If the Red LED illuminates continuously and the actions per above does not help, the unit should be assumed to be faulty and should either be switched off (power removed) or if this is not practical any other vessel position information derived from the unit should not be used and it should also be assumed that the unit is not transmitting valid position information for your vessel

**The red 'ERROR' LED is lit intermittently and goes off**VHF antenna problems

- Troubleshoot as described for the same problem in the previous section

**No AIS targets displayed on a connected external display or chart system**No AIS Targets received

- Check that the blue 'Receive' LED is flashing indicating that AIS data is received by the transponder. If no data is received, this could be an indication that no AIS transmitter is within VHF range or a VHF antenna problem. In the later case, troubleshoot accordingly per the previous sections above.

Serial communication problem

- Verify that the cabling between the transponder COM port and the serial port of the external unit is connected in accordance with specifications in the Appendix section.
- Verify that the serial port parameters (e.g. baud rate) of the external device are set up according to the specifications in the Appendix section.

Compatibility problem

- Verify that the external device is compatible with the serial data messages transmitted by the R4 AIS Class B transponder per the Appendix section.

## **8 MAINTENANCE**

**WARNING:** Unauthorized opening of the R4 AIS Class B Transponder will invalidate the warranty.

**CAUTION:** Avoid using chemical solvents to clean the R4 AIS Class B Transponder as some solvents can damage the case material.

The R4 AIS Class B Transponder contains no user serviceable parts. Contact your Service Agent for repair if required.

## 9 PRODUCT SPECIFICATION

### Physical

Dimensions: 213 x 128 x 54 mm (L x W x H)

Weight: 650g

### Power

DC (10.8 - 15.6V)

Average power consumption 4W, peak current 2A

### GPS Receiver (AIS Internal)

EC 61108-1 compliant

### Electrical Interfaces

RS232 38.4kBaud bi-directional

RS422 NMEA 38.4kBaud bi-directional

### Connectors

VHF antenna connector (BNC-F)

GPS antenna connector (TNC-F)

Serial Data RS232/RS422 (DB9-F)

Power/Tx off switch (ConXall Mini-ConX)

### VHF Transceiver

Transmitter x 1

Receiver x 2 (One receiver time shared between AIS and DSC)

Frequency: 156.025 to 162.025 MHz in 25 kHz steps

Output Power: 33dBm  $\pm$  1.5 dB

Modulation:

25kHz GMSK (AIS, TX and RX), 25kHz AFSK (DSC,RX only)

Bit rate: 9600 b/s  $\pm$  50 ppm (GMSK), 1200 b/s  $\pm$  30 ppm (FSK)

### Environmental

IEC 60945 (protected equipment)

Operating temperature: -25°C to +55°C

### Indicators

Operate, No Tx, Error, Receive.

### Operator Controls

Connection for optional external transmit disable switch

### Compass Safe Distance

IEC 60945

Standard compass 0.2 m

Steering (emergency) compass 0.1 m

## Standards

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

- IEC62287-1: 2006-03 Maritime navigation and radiocommunication equipment and systems – Class B shipborne equipment of the automatic identification system (AIS) – Part 1: Carrier-sense time division multiple access (CSTDMA) techniques
- IEC60945: 2002-08 Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results
- IEC61162-1: Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners
- IEC61108-1: GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) – Part 1: Global positioning system (GPS) -Receiver equipment - Performance standards, methods of testing and required test results
- EN 301 843-1 v2.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for marine radio equipment and services; Part 1: Common technical requirements
- EN 50383: 2002 Basic standard for calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunications system (110MHz – 40GHz)
- EN60950-1:2002 Information technology equipment – Safety – Part 1: General requirements

## 10 DECLARATION OF CONFORMITY

Saab Transpondertech AB declares that this product complies with the essential requirements and other provisions of the R&TTE directive 1995/5/EC.

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

**CE0168!**

This product is intended to be used in international waters as well as coastal sea areas and inland waterways administered by countries of the E.U and E.E.A.

## 11 APPENDICES

## **APPENDIX A: INTRODUCTION TO AIS**

### **How AIS Works**

The marine Automatic Identification System (AIS) is a location and vessel information reporting system. It allows vessels equipped with AIS to automatically and dynamically share and regularly update their position, speed, course and other information such as vessel identity with similarly equipped craft. Position is derived from a Global Navigation Satellite System (GNSS) network and communication between vessels is by Very High Frequency (VHF) digital transmissions. A sophisticated and automatic method of time sharing the radio channel is used to ensure that even where a large number of vessels are in one location blocking of individual transmissions is minimised, any degradation of the expected position reporting interval is indicated to the user and even if the unit suffers extreme channel overload conditions it will always recover to normal operation.

### **AIS Classes**

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

Class B units are designed for fitting in vessels which do not fall into the mandatory Class A fit category.

The R4 AIS Class B Transponder is a Class B unit.

**APPENDIX B: GLOSSARY**

|         |  |
|---------|--|
| ACA     | (AIS) Regional Assignment Channel Assignment Message |
| ACK     | Acknowledgement                                      |
| ACS     | (AIS) Channel management information source messages |
| AFSK    | Audio frequency-shift keying                         |
| ALR     | (AIS) Alarm Message                                  |
| A to N  | Aid to Navigation                                    |
| AIS     | Automatic Identification System                      |
| BIIT    | Built In Integrity Testing                           |
| BNC     | Bayonet fitting type RF connector                    |
| CSTDMA  | Carrier Sense Time Division Multiple Access          |
| COG     | Course over Ground                                   |
| CR      | Carriage Return                                      |
| CS      | Carrier Sense  |
| CSTDMA  | Carrier Sense TDMA                                   |
| DC      | Direct Current                                       |
| DGNSS   | Differential Global Navigation Satellite System      |
| DSC     | Digital Selective calling                            |
| GLONASS | Global Navigation Satellite System                   |
| GNSS    | Global Navigation Satellite System                   |
| GMSK    | Gaussian Minimum Shift Keying                        |
| GPS     | Global Positioning Satellite / System                |
| HF      | High Frequency                                       |
| IMO     | International Maritime Organization                  |
| IEC     | International Electrotechnical Commission            |
| LED     | Light Emitting Diode                                 |
| LF      | Line Feed  |
| LNA     | Low-noise amplifier                                  |
| MF      | Medium Frequency                                     |
| MKD     | Minimum Keypad and Display                           |
| MMSI    | Maritime Mobile Service Identity                     |
| MPE     | Maximum Permissible Exposure                         |
| NMEA    | National Marine Electronics Association              |
| N/C     | No Connection  |
| PC      | Personal Computer                                    |
| PI      | Presentation Interface                               |



|      |   |
|------|---|
| RF   | Radio Frequency   |
| RTCM | Radio Technical Commission for Maritime Services Commission |
| RX   | Receive or Receiver   |
| RFI  | Radio frequency interference                                |
| SAR  | Specific Absorption Rate                                    |
| SMS  | Short Message System  |
| SOG  | Speed over Ground   |
| SRM  | Safety Related Message                                      |
| TDMA | Time-division Multiple Access                               |
| TNC  | Threaded type RF connector                                  |
| TX   | Transmit or transmitter                                     |
| UTC  | Universal Time Co-ordinated                                 |
| VDM  | (AIS) VHF Data Link Messages                                |
| VDO  | (AIS) VHF data link own vessel messages                     |
| VHF  | Very High Frequency   |
| VSWR | Voltage Standing Wave Ratio                                 |

## **APPENDIX C: GPS ANTENNA SELECTION AND MOUNTING**

The GPS antenna used must be of the active type (i.e. it should incorporate an amplifier) and must be suitable for marine shipboard applications (index of protection, ruggedness, means of mounting, etc.). An antenna should be selected with a gain (in dB) depending on the length of cable between the antenna and the AIS unit; after subtraction of cable and connector losses a minimum total gain of 12 dB should be available at the R4 AIS Class A Transponder GPS antenna connector.

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

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

- The GPS antenna is mounted in an elevated position and free of shadow effect from the ship's superstructure
- The GPS antenna has a free view through 360 degrees with a vertical angle of 5 to 90 degrees above the horizon.
- As the received GPS signal is very sensitive to noise and interference generated by other onboard transmitters, ensure that the GNSS antenna is placed as far away as possible from radar, Inmarsat and Iridium transmitters and ensure the GPS antenna is free from direct view of the radar and the Inmarsat beam.
- It is also important that the MF/HF and other VHF transmitter antennas are kept as far away as possible from the GNSS antenna. It is good practice never to install a GNSS antenna within a radius of 5 meters from these antennas.

## **APPENDIX D: VHF ANTENNA SELECTION AND MOUNTING**

The VHF antenna employed for AIS use:

- Must be a dedicated antenna, i.e. not shared with any other VHF transmitter/receiver.
- Must be suitable for marine shipboard applications (index of protection, ruggedness, means of mounting, etc.)
- Should be omni-directional and vertically polarised with maximum gain of 3dBi and bandwidth sufficient to maintain VSWR <1.5 over the frequency range 156 – 163 MHz. As a minimum the 3dB bandwidth must cover the two AIS channels and the DSC Channel.
- Should be mounted with at least a two metre vertical separation distance from any other VHF antenna used for speech or DSC communication but see also the section “Radio Frequency Exposure Warning” below.

### **Warnings**

#### VHF Antenna Connection

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

#### Radio Frequency Exposure

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

## **APPENDIX E: SERIAL DATA INTERFACE**

### **Data Connection**

The default baud rate of the data link is 38.4kBaund with 8 data bits, one stop bit and no parity. No handshaking is used.

The data interface conforms to IEC 61162-1.

VDM, VDO, ACA, ACS, ALR, TXT and ACK messages conform to NMEA 0183. Please refer to NMEA 0183 for full details of these AIS messages.

### **Serial Port Input/Output**

The R4 AIS Class B Transponder is equipped with two serial ports with different electrical characteristics. The RS-232 port use single lines for transmit and receive with a common ground whereas the RS-422 port has two-wire differential pairs for each data direction. Functionally, the ports are equivalent and data can be input from either or both ports.

The serial port interface(s) output:

- At power-up boot-loader and main application splash text screens including version numbers and memory status.
- As a VHF Data Link Message (VDM) all incoming VHF Data Link (VDL) data received by the R4 AIS Class B Transponder.
- The VHF data link own vessel (VDO) messages sent by the R4 AIS Class B Transponder over the VHF Data Link.
- AIS regional channel assignment messages (ACA) received. These are derived from an incoming VHF Data Link message (message 22) or a DSC message.
- AIS channel management information source (ACS) messages.
- Alarm messages (ALR, TXT).
- Internal GPS receiver navigation solution and fault detection data (GPRMC, GPGBS)

The data interface will accept:

- Configuration programming messages
- Alarm acknowledgement messages (ACK)
- True heading from external direction sensor (HDT)

### **Power up messages**

On power up the unit will report details of the firmware versions residing in the unit.

**VHF data link messages (NMEA 0183 VDM)**

Receipt of a VHF Data Link (VDL) message on either AIS radio channel causes a VDM message to be output via the data port. Please see IEC 61193-2, Annex B for a list of messages.

**VDM Message Format**

```
!--VDM,x1,x2,x3,a,s--s,x*hh<CR><LF>
```

Where:

- x1 = Number of sentences needed to transfer the message , 1 to 9
- x2 = Sentence number, 1 to 9
- x3 = Sequential message identifier, 0 to 9
- a = AIS Channel, "A" or "B"
- s - - s = Encapsulated ITU-R M.1371 radio message
- x = Number of fill-bits , 0 to 5

**VDM Message Types**

For example, the information contained in the s - - s portion of the VDM = Encapsulated ITU-R M.1371 radio message. Note that messages 5 and 19 may be sent as multi part messages using the x1, x2 and x3 parameters for message sequence control.

| <b>VDL Message number</b>             | <b>VDM Message description</b> |
|---------------------------------------|--------------------------------|
| <b>AIS Target Display Information</b> |                                |
| 1, 2, 3, 9,18, 21                     | position report                |
| 4                                     | base station report            |
| 5*                                    | voyage related data            |
| 19*                                   | Class B – extended data        |
| <b>Safety message handling</b>        |                                |
| 12                                    | addressed safety related       |
| 14                                    | broadcast safety related       |
| <b>External Application handling</b>  |                                |
| 6                                     | binary addressed               |
| 8                                     | binary broadcast               |
| <b>System control</b>                 |                                |
| 7                                     | binary acknowledge (INFO)      |
| 10                                    | UTC and data inquiry (INFO)    |
| 11                                    | UTC and data response (INFO)   |
| 13                                    | safety related ack (INFO)      |
| 15                                    | interrogation (INFO)           |
| 16                                    | assignment mode command (INFO) |

|    |                             |
|----|-----------------------------|
| 17 | DGNSS corrections (INFO)    |
| 20 | data link management (INFO) |
| 22 | channel management (INFO)   |

\*Note that messages 5 and 19 may be sent as multi part messages.

### **VHF data link own vessel messages (NMEA 0183 VDO)**

This message describes the own vessel message being sent.

#### **VDO Message Format**

!-VDO,x1,x2,x3,a,s--s,x\*hh<CR><LF>

Where

- x1 = Number of sentences needed to transfer the message , 1 to 9
- x2 = Sentence number, 1 to 9
- x3 = Sequential message identifier, 0 to 9
- a = AIS Channel, "A" or "B"
- s - - s = Encapsulated ITU-R M.1371 radio message 4
- x = Number of fill-bits , 0 to 5

| <b>VDO Message number</b>             | <b>VDO Message description</b>  |
|---------------------------------------|---|
| <b>AIS Target Display Information</b> |   |
| 13                                    | Safety Related Acknowledgement  |
| 18                                    | Standard Class B position report (Includes MMSI, SOG, position accuracy, lat, long, COG, true heading,) |
| 24a                                   | Class B "CS" Static data Part A (Includes MMSI and vessel name)   |
| 24b                                   | Class B "CS" Static data Part B (MMSI, ship type, cargo type, call sign, ship dimensions)               |

### **Regional Assignment Channel Assignment (NMEA 0183 ACA)**

An R4 AIS Class B Transponder can receive regional channel management information in two ways: ITU-R M.1371 message 22 or a DSC telecommand received on channel 70,

#### **ACA Message Format**

\$--

ACA,x,llll.ll,a,yyyyy.yy,a,llll.ll,a1,y1y1y1y1y.y1y1,a2,x1,x2x2x2x2,x3,x4x4x4x4,x5,x6,x7,a3,x8,hmmss.ss\*hh <CR><LF>

Where

- x = Sequence Number , 0 to 9
- IIII, II, a = Region Northeast corner latitude – N/S
- yyyyyy.yy,a1 = Region Northeast corner longitude – E/W
- llll.II,a = Region Southwest corner latitude – N/S
- y1y1y1y1y1.y1y1,a2 = Region Southwest corner longitude – E/W
- x1 = Transition Zone Size
- x2x2x2x2 = Channel A
- x3 = Channel A bandwidth
- x4x4x4x4 = Channel B
- x5 = Channel B bandwidth
- x6 = Tx/Rx mode control
- x7 = Power level control
- a3 = Information source
- x8 = In-Use Flag
- hhmmss.ss = Time of "in-use" change

#### **Channel management information source messages (NMEA 0183 ACS)**

This sentence is used in conjunction with the ACA sentence and identifies the originator of an ACA message.

#### **ACS Message Format**

\$--ACS,x,xxxxxxxxxx, hhmmss.ss,xx,xx,xxxx\*hh <CR><LF>

- x = Sequence Number , 0 to 9
- xxxxxxxxxxx =MMSI of originator
- hhmmss.ss = UTC of receipt of channel management information
- xx = UTC Day, 01 -31
- xx = UTC Month, 01 -12
- xxxx = UTC Year

#### **AIS Alarm Messages (NMEA 0183 ALR, Text)**

#### **ALR message format**

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

Where

- hhmmss.ss = Time of alarm (UTC)
- xxx = Unique alarm number
- A = Alarm condition
- A = Alarm acknowledge state

- c--c = alarm description, text

Alarms descriptions presented are:

- AIS: TX malfunction
- AIS: Antenna VSWR exceeds limit
- AIS: Rx channel 1 malfunction
- AIS: Rx channel 2 malfunction
- AIS: general failure
- AIS: no sensor position in use
- AIS: no valid SOG information
- AIS: no valid COG information
- AIS: 12V alarm
- AIS: 5V alarm
- AIS: Loss of serial interface integrity
- AIS: Background noise above -77dBm

#### **Alarm Acknowledge messages**

An ACK message can be generated by a minimum keypad and display (MKD) unit, chart plotter or other display device connected to the R4 AIS Class B Transponder to acknowledge an alarm condition reported by the R4 AIS Class B Transponder.

#### **ACK message format**

\$--ACK,xxx\*hh <CR><LF>

Where

- xxx = unique alarm number

#### **Recommended minimum specific GNSS Data (NMEA 0183 RMC)**

This sentence provides the navigation solution from the internal GPS receiver.

#### **RMC Message Format**

\$--RMC,aaaaaa.aa,b,cccc.cc,d,eeeeee.ee,f,g.g,h.h,iiiiii.j,j,k,l\*hh<CR><LF>

Where

- a = UTC of position fix (hhmmss.ss)
- b = Status (A = data valid, V = navigation receiver warning)
- c = Latitude
- d = North (N) / South (S)
- e = Longitude
- f = East (E) / West (W)
- g = Speed over ground [knots]
- h = Course over ground [degrees true]
- i = Date (ddmmyy)
- j = Magnetic variation [degrees]



- k = East (E) / West (W)
- l = Mode indicator (A=Autonomous, D=Differential, E=Dead Reckoning, N=Not Valid)
- hh = Checksum

See NMEA 0183 specification for complete description

### **GNSS Satellite fault detection (RAIM) data (NMEA 0183 GBS)**

This sentence provides fault detection information from the internal GPS receiver.

#### **GBS Message Format**

`$--GBS,aaaaaa.aa,b.b,c.c,d.d,ee,f.f,g.g,h.h*hh<CR><LF>`

Where

- a = UTC time of the fix associated with this sentence (hhmmss.ss)
- b = Expected error in latitude [m]
- c = Expected error in longitude [m]
- d = Expected error in altitude [m]
- e = ID number of most likely failed satellite
- f = Probability of missed detection for most likely failed satellite
- g = Estimate of bias in meters on most likely failed satellite
- h = Standard deviation of bias estimate
- hh = Checksum

See NMEA 0183 specification for complete description.

### **True Heading input data (NMEA 0183 HDT)**

This sentence can be used for input of true heading from an external direction sensor e.g. gyrocompass.

#### **HDT Message Format**

`$--HDT,aaa.a,T*hh<CR><LF>`

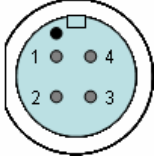
Where

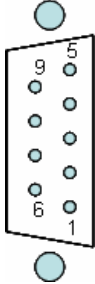
- a = Heading [degrees true]

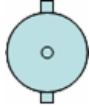
### APPENDIX F1: EXTERIOR DRAWING




**APPENDIX F2: TRANSPONDER CONNECTOR SPECIFICATIONS**

| <b>TRANSPONDER POWER CONNECTOR</b> |   |  |
|------------------------------------|---|---|
| Type                               | 4-pole pin circular chassis mount, ConXall Mini-Con-X |   |
| # 1                                | + 12V Supply power input                              |   |
| # 2                                | Supply power return                                   |   |
| # 3                                | Remote switch return                                  |   |
| # 4                                | Remote switch output                                  |   |

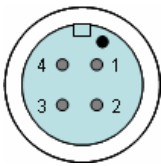
| <b>TRANSPONDER COM CONNECTOR</b> |                                  |  |
|----------------------------------|----------------------------------|--|
| Type                             | 9-pole jack D type chassis mount |  |
| # 1                              | RS422 TX B (+)                   |  |
| # 2                              | RS232 TX                         |  |
| # 3                              | RS232 RX                         |  |
| # 4                              | N/C                              |  |
| # 5                              | RS232 Signal GND                 |  |
| # 6                              | RS422 RX B (+)                   |  |
| # 7                              | N/C                              |  |
| # 8                              | RS422 RX A (-)                   |  |
| # 9                              | RS422 TX A (-)                   |  |

| <b>TRANSPONDER VHF ANTENNA CONNECTOR</b> |  |  |
|--|--|---|
| Type                                     | BNC centre jack, chassis mount             |   |
| Centre jack                              | VHF RF Input                               |   |
| Shield                                   | GND  |   |
| Note:                                    | GND is in connection with 12V Power Return |   |

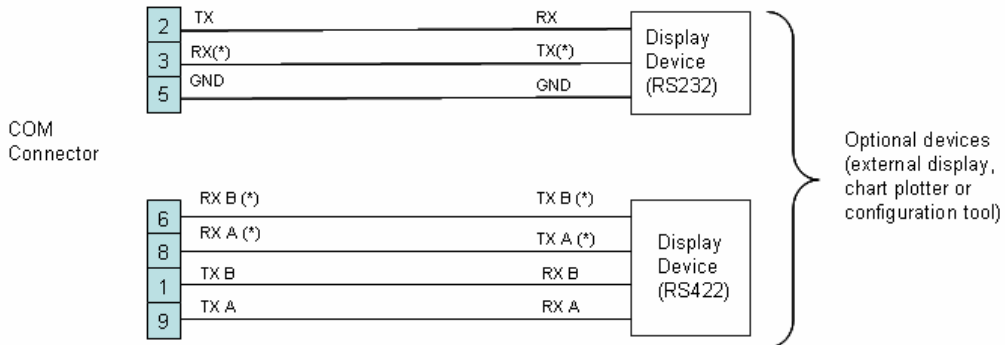
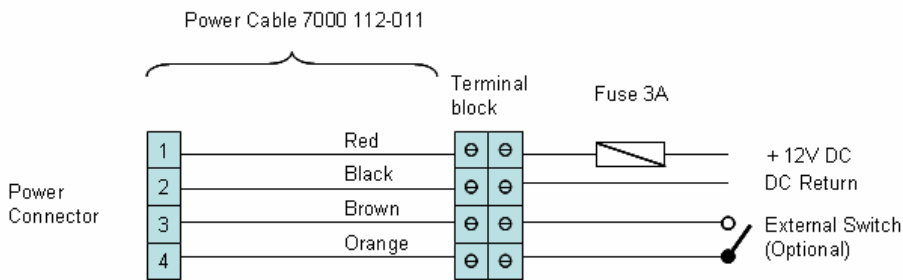
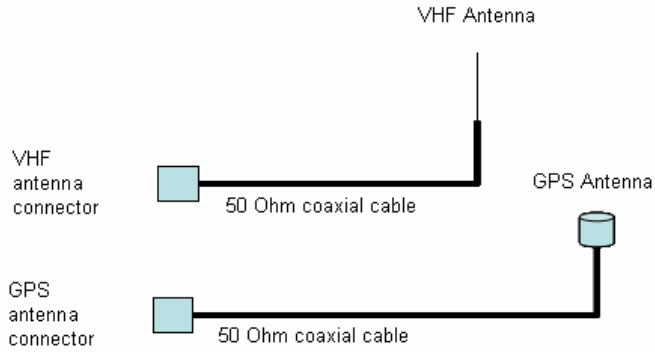
| <b>TRANSPONDER GPS ANTENNA CONNECTOR</b> |  |  |
|--|--|---|
| Type                                     | TNC centre jack, chassis mount             |   |
| Centre jack                              | GPS RF Input, 5V DC output                 |   |
| Shield                                   | GND  |   |
| Note:                                    | GND is in connection with 12V Power Return |   |

**APPENDIX F3: POWER CABLE SPECIFICATION**

| <b>R4 AIS CLASS B TRANSPONDER POWER CABLE</b>   |                          |             |
|---|--------------------------|-------------|
| Cable type: 4x0.5 mm <sup>2</sup> , length 2 m<br>Connector: 4-pole jack, ConXall Mini-Con-X<br>Marking: 7000 112-011 |                          |             |
| <b>Colour</b>   | <b>Function</b>          | <b>Jack</b> |
| RED   | + 12V Supply power input | #1          |
| BLACK   | Supply power return      | #2          |
| BROWN   | Remote switch return     | #3          |
| ORANGE  | Remote switch output     | #4          |

A circular diagram of a 4-pole jack connector. It shows four terminals arranged in a square pattern, labeled 1, 2, 3, and 4. Terminal 1 is at the top right, 2 is at the bottom right, 3 is at the bottom left, and 4 is at the top left. A small square notch is located at the top of the circle.

### APPENDIX F4: INSTALLATION WIRING DIAGRAM



(\*) = These lines can be omitted if the data flow is to be one directional output from the transponder only