Saab TransponderTech

INSTALLATION MANUAL
R4 AIS Class A
Transponder System

i Copyright

ii Disclaimer

While reasonable care has been exercised in the preparation of this manual, Saab TransponderTech AB shall incur no liability whatsoever based on the contents or lack of contents in the manual.

iii Software

This manual reflects the capabilities of R4 Display software version 5.3.x and R4 AIS Transponder software 5.3.x.

iv Installation Manual Part Number and Revision

Part number 7000 108-011, revision H.

This manual replaces earlier manuals from part number 7000 108-011, revision P8D1 onwards.

v Safety Instructions

Note the following compass safe distances:

Equipment	**Standard magnetic compass**	**Steering magnetic compass**
R4 Display	0.6 m	0.3 m
R4 Transponder	0.2 m	0.1 m

WARNING!

RF Exposure Hazard

For installation according to Industry Canada regulations please observe:

1. Minimum safe distance to antenna is **20 cm** (8 in).
2. If an antenna with more than +5dBi of antenna gain is installed, additional approvals may be required from Industry Canada.
3. Industry Canada approval is only valid for normal operation of the transponder.

vi 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.

vii Contact Information

For installation, service and technical support please contact your R4 AIS Shipborne Class A Transponder System dealer. A list of dealers and service stations can be found by searching for "R4 AIS" on www.saabgroup.com.

TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

1.1 About this Manual

This manual, together with the Operator's Manual, provides in-depth information to facilitate installation of the Saab TransponderTech R4 AIS Shipborne Class A Transponder System.

1.2 System Overview

Figure 1-1 shows an overview of the R4 AIS Shipborne Class A Transponder system. For details, see sections further on in this Installation Manual.

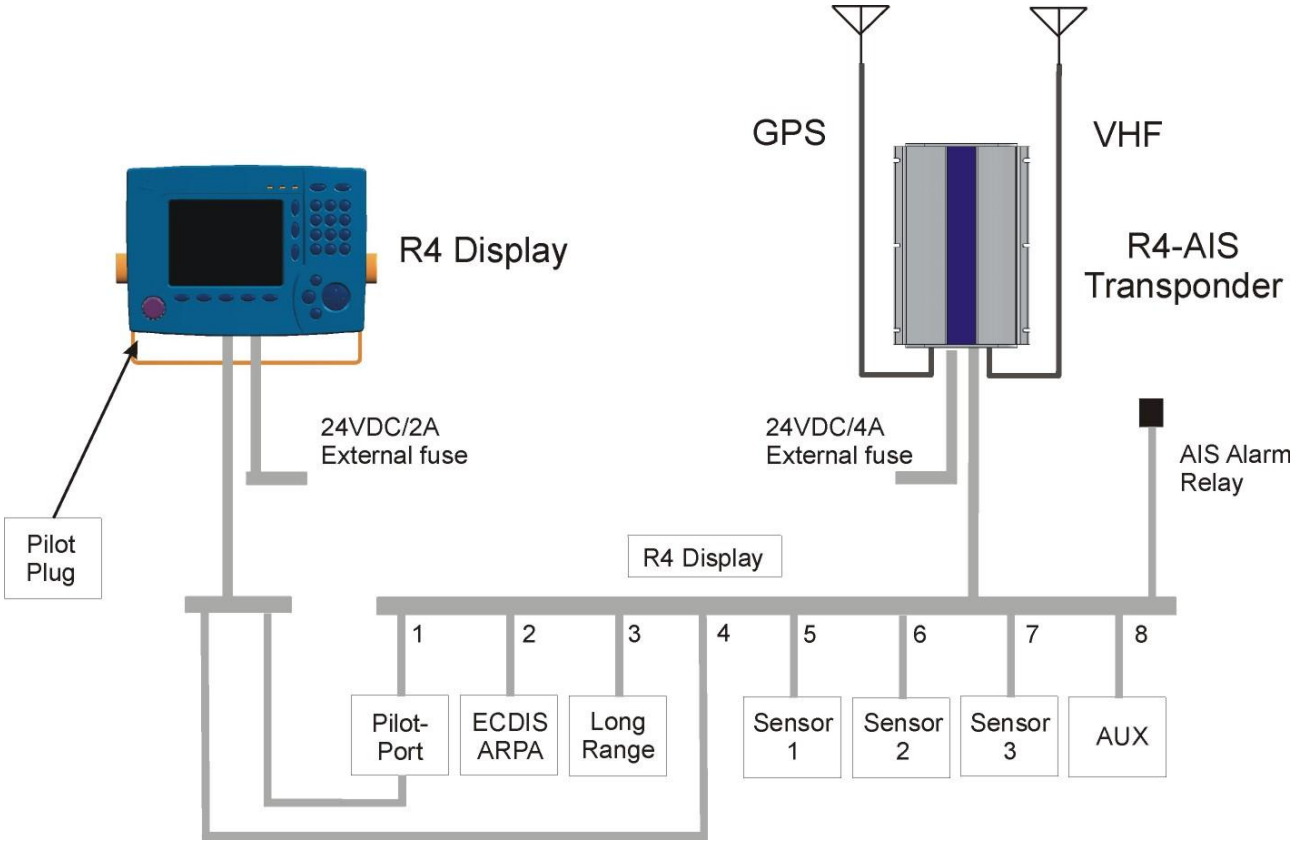


Figure 1-1: R4 AIS Transponder System overview

2 UNPACKING THE EQUIPMENT

The R4 AIS Shipborne Class A Transponder System consists of the following parts.

R4 AIS Shipborne Class A Transponder System Minimum Equipment

Name	**Part number**	**Qty.**
R4 Display Unit with Gimbal mount	7000 108-050	1
R4 Transponder Unit	7000 100-550	1
AIS Alarm Relay Unit incl. socket	7000 100-132	1
R4 Transponder Power cable	7000 108-032	1
R4 Transponder Signal cable	7000 108-031	1
R4 Display Power cable	7000 108-132	1
R4 Display Signal cable	7000 108-133	1
GPS antenna options MGA-2 (30 dB gain) AT575-68 (26 dB gain) AT575-68 (12 dB gain)	 7000 000-263 7000 000-135 7000 000-078	1
GPS antenna cabling (TNC-M/TNC-M)	Customer supplied	1
VHF antenna Celmar-1 (or equivalent)	7000 000-233 (or eq.)	1
VHF antenna cabling (Ant./BNC-M)	Customer supplied	1
Operator Manual	7000 108-131	1
Installation Manual (this document)	7000 108-011	1

Accessories (optional)

Name	Part number
R4 Display flush mount kit	7000 108-110
GPS antenna mounting tube	7000 000-117
J4 junction box [note 1,2]	7000 100-165
J4 junction box (cabled) [note 1,2,3]	7000 100-230
J4 junction box installation guide	7000 108-033
R4 Display signal cable, 10 m	7000 108-330
USB to Pilot plug cable	7000 108-328

Note 1: Installation with J4 junction box is not covered by this manual. Refer to the J4 junction box installation guide 7000 108-033.

Note 2: The J4 junction box includes an alarm relay with lower power rating that the AIS Alarm Relay Unit (7000 100-132).

Note 3: The cabled version of the J4 junction box includes the R4 Transponder Power cable (7000 108-032) and the R4 Transponder Signal cable (7000 108-031).

3 INSTALLATION CABLES

The following cables are needed to install the R4 AIS Shipborne Class A Transponder system.

R4 Display Signal Cable

Type: 6-Pair x 0,25 mm^2 Shield

Length: 2 m

Connector: ConXall, Maxi-Con-18pin (male)

Marking: 7000 108-133

R4 Display Power Cable

Type: 3 x 0.5 mm^2

Length: 2 m

Connector: ConXall, Mini-Con-3pin (female)

Marking: 7000 108-132

R4 Transponder Signal Cable

Type: 15-Pair x 0.38 mm^2 Shielded

Length: 2 m

Connector: 50-pole DSUB (female)

Marking: 7000 108-031

R4 Transponder Power Cable

Type: 4-Pair x 0.5 mm^2

Length: 2 m

Connector: 9-pole DSUB (female)

Marking: 7000 108-032

Transponder VHF antenna cable

Type: See Appendix [A.7] – Transponder VHF-cable selector

Length: See Appendix [A.7] – Transponder VHF-cable selector

Connector: BNC (Male)

Transponder GPS Antenna Cable

Type: See Appendix [A.6] – Transponder GPS-cable selector

Length: See Appendix [A.6] – Transponder GPS-cable selector

Connector: TNC (Male)

4 MOUNTING

When mounting the R4 AIS Transponder Class A System it is recommended to follow the steps as described in this Installation Manual. Details of the installation procedure are found in the coming sections of the Installation Manual.

Recommended installation steps:

1. Mount the R4 Display (section 4.1)
2. Mount the R4 Transponder (section 4.2)
3. Mount the alarm relay unit (section 4.3)
4. If the Pilot Plug on the R4 Display is not to be used, mount the external Pilot Plug (section 4.4)
5. Mount the VHF antenna (section 4.5)
6. Mount the GPS antenna (section 4.6)
7. Connect the wiring to the R4 Transponder and R4 Display (section 5 and Appendix [A.9])
8. Power up the system (section 6.3)
9. Set configuration parameters (section 6.6)
10. Perform system functional check (section 6.7)

4.1 Mount the R4 Display

4.1.1 Location

The R4 Display should be mounted close to the position from which the ship is normally operated, preferably on the bridge console close to the conning position. See the schematic bridge installation illustration in Figure 4-1 below.

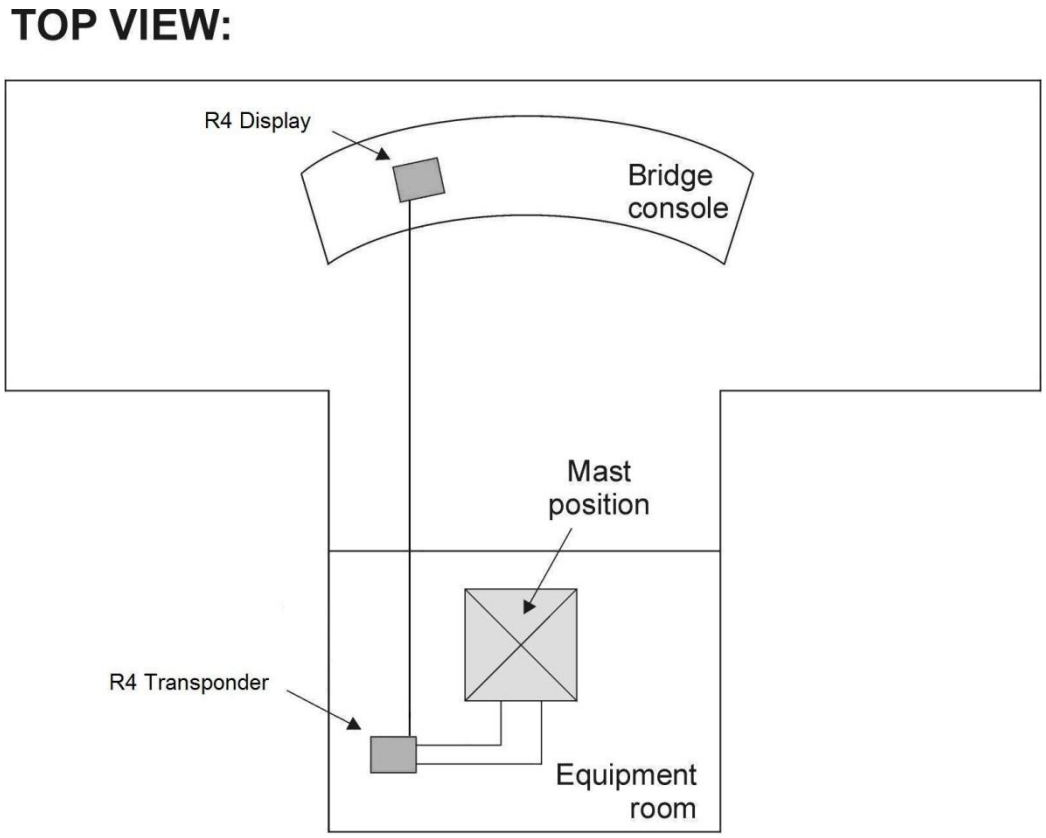


Figure 4-1: Bridge installation

When mounting the R4 Display please consider the following:

- The temperature and humidity should be moderate and stable, +15ºC to +35ºC.
  (Operating temperature: -15ºC to +55ºC.)
- Select a location away from excessive heat sources.
- Avoid areas where there is a high flow of humid salt air.
- Avoid places with high levels of vibrations and shocks.
- Avoid mounting the R4 Display in direct sunlight.
- Ensure that there is enough airflow to avoid high ambient temperatures.
- Ensure that the cables can be connected without violating their maximum bending radius.
- The unit can affect magnetic compasses. The minimum compass safe distance is 0.6 meters to a standard magnetic compass and 0.3 meters to a steering magnetic compass.

4.1.2 Physical Size and Mechanical Drawing

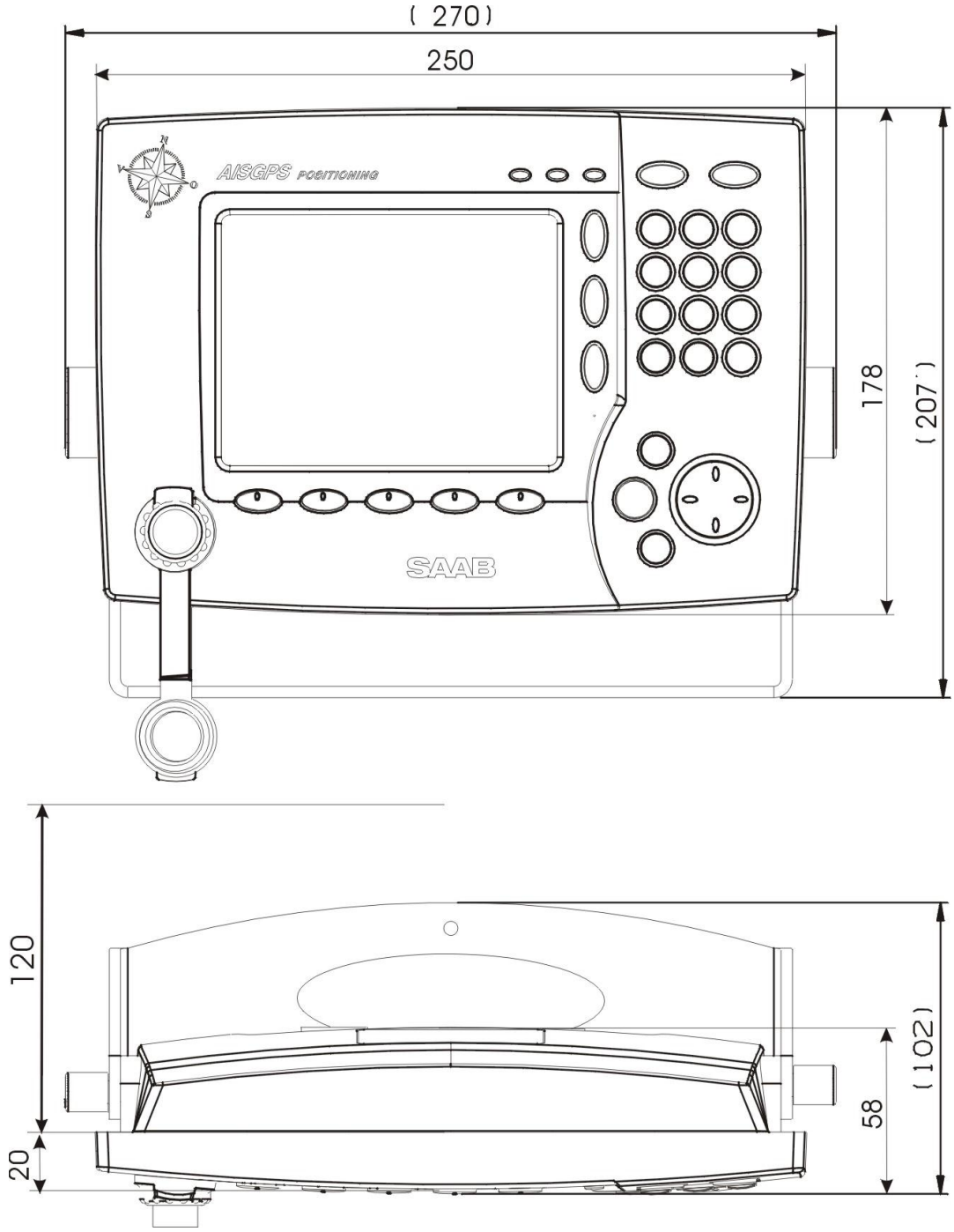


Figure 4-2: Mechanical drawing R4 Display

4.1.3 Gimbal Mounting

1. Determine where to install the R4 Display. The R4 Display can be mounted horizontally or vertically. Make sure there is enough space around the R4 Display, see Figure 4-3 below.

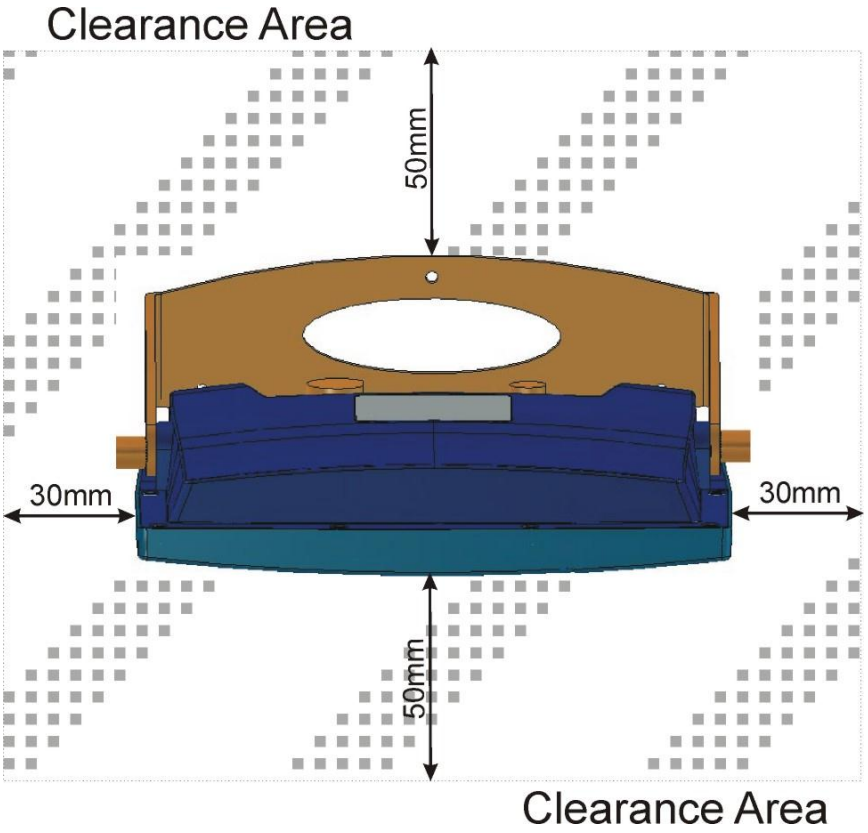


Figure 4-3: Gimbal mount clearance area

2. Fasten the gimbal mount on a flat surface with three screws, see Figure 4-4 below. The type of screws has to be chosen considering the panel material. Note that the slots on the end of the gimbal mount have to face the direction in which the R4 Display is to be mounted.

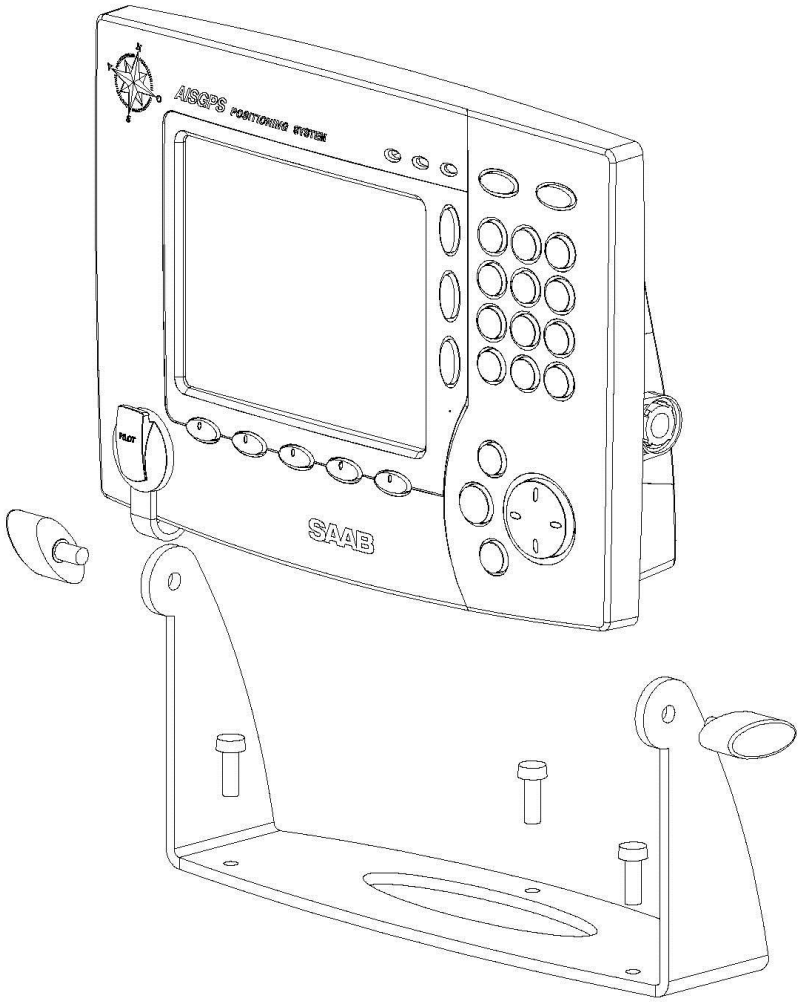


Figure 4-4: Gimbal mount

3. Slide the R4 Display into the slots on the end of the gimbal mount. Secure the R4 Display onto the gimbal mount using the locking knobs without over-tightening.
4. Attach the signal cable (18 pin plug) and the power cable (3 pin socket), as described in section 4.1.5.
5. Adjust the viewing angle after first loosening the gimbal locking knobs. Securing the R4 Display without over-tightening the gimbal locking knobs.

4.1.4 Panel Mounting

1. Determine where to install the R4 Display, see Figure 4-5 below for dimensions. Make sure that there is enough depth behind the panel, see Figure 4-6. Please note that the signal cable has a maximum bending radius of 10 centimeters.

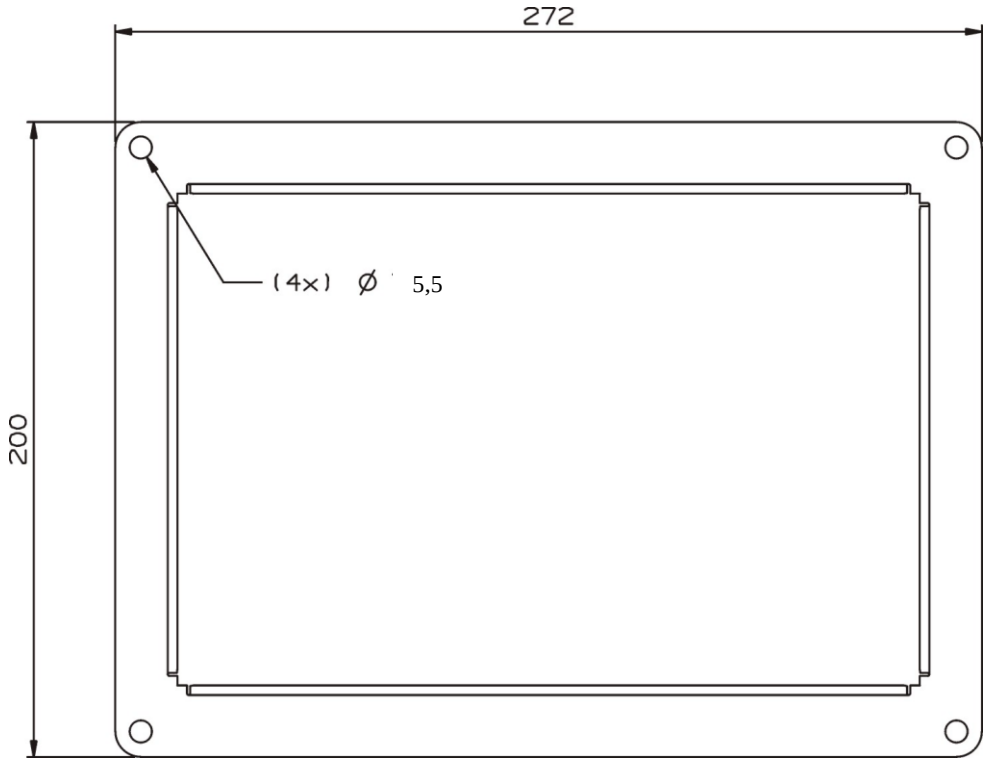


Figure 4-5: Panel mount frame dimensions

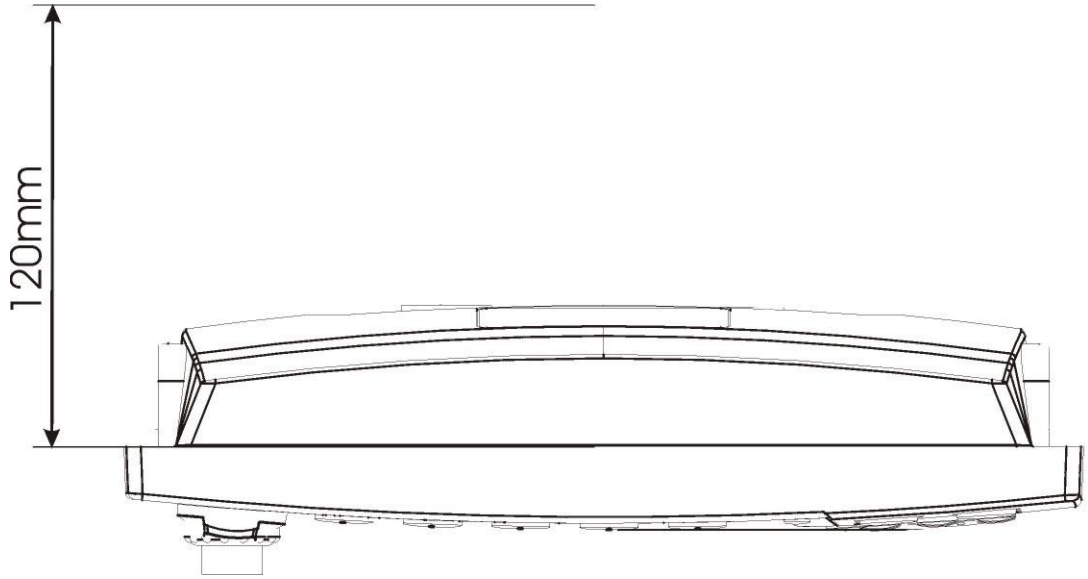


Figure 4-6: Clearance distance behind the display

2. Make one rectangular hole and four round holes in the panel, as illustrated in Figure 4-7. (If the hole template is available, place the template in the right position and drill and saw according to the template. If this method is used, exclude step 3 and 4 in this instruction.)

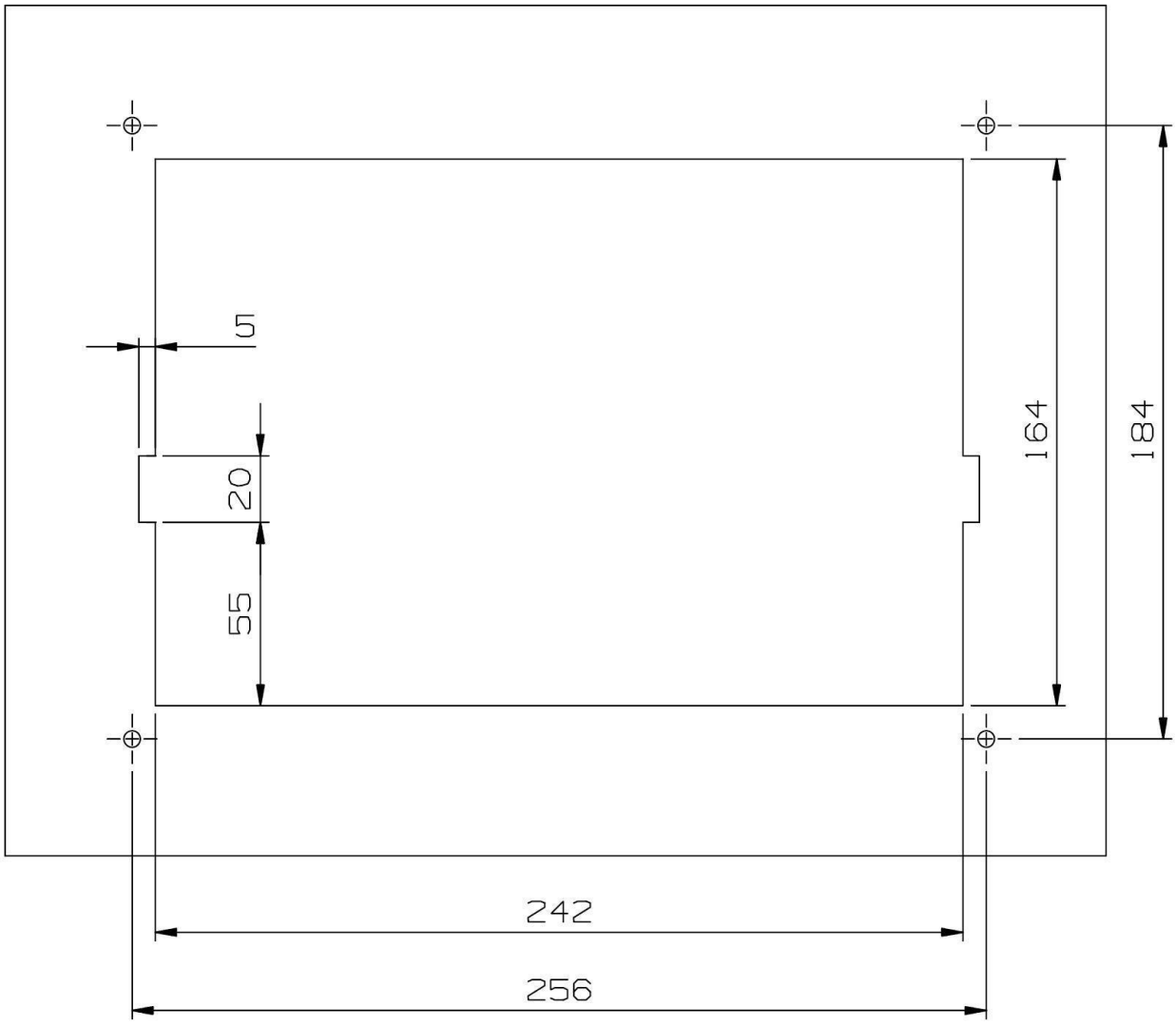


Figure 4-7: Panel mount hole dimensions

3. Place the panel mount frame in the rectangular hole and mark the location of the four screw holes in the bedding.
4. Remove the panel mount frame and drill four screw holes where marked in the panel.
5. Place the seal onto the back of the R4 Display. Make sure that it aligns with the R4 Display body. Place the R4 Display in the panel mount frame. Press the R4 Display and the frame together and install the two securing screws, one on each side of the R4 Display.
6. Attach the signal cable (18 pin plug) and the power cable (3 pin socket), as described in section 4.1.5. Note that the power to the R4 Display must have a 2A fuse.
7. Slide the R4 Display with the panel mount frame into the rectangular hole in the panel and fasten it to the panel with four screws, as illustrated in Figure 4-8 and Figure 4-9 below.

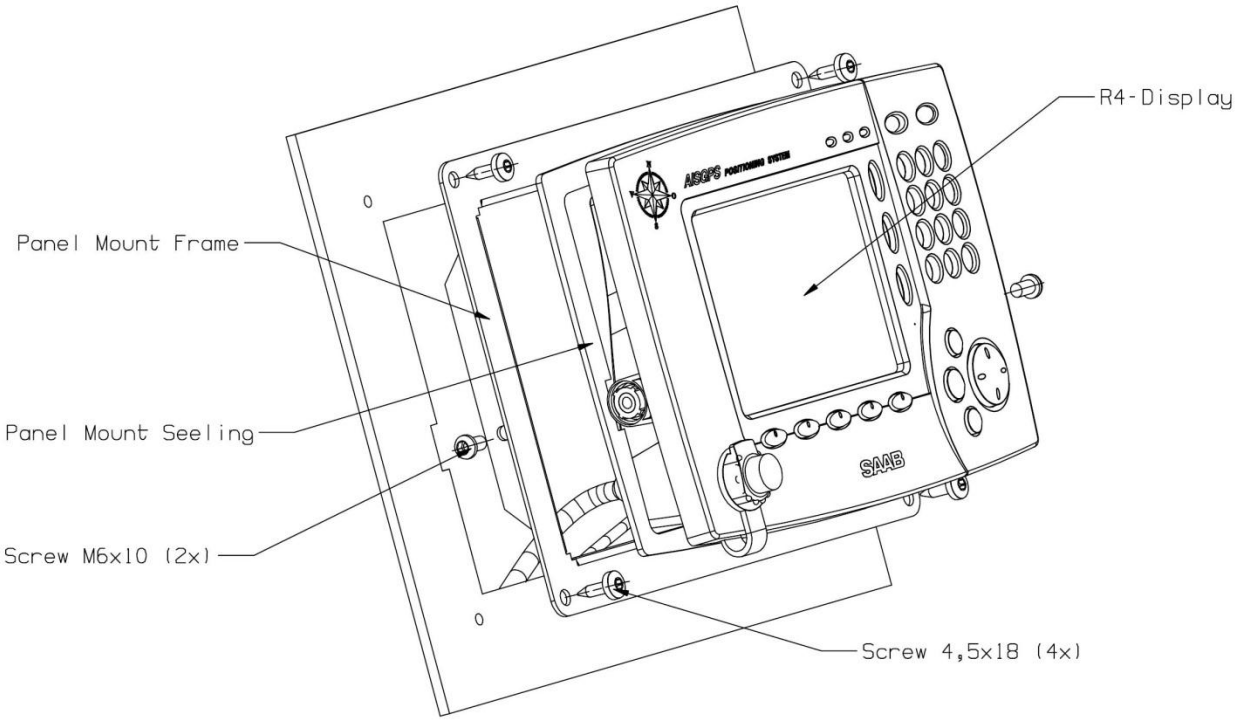


Figure 4-8: Panel mounting R4 Display

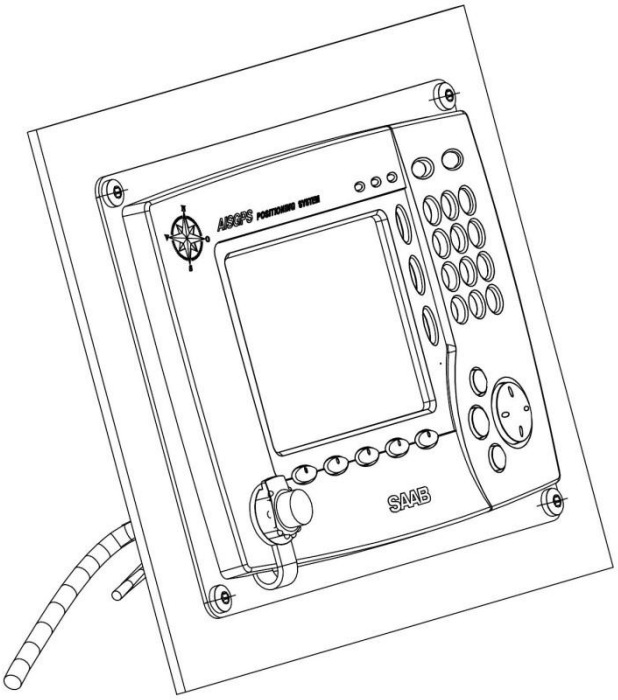


Figure 4-9: R4 Display panel mounted

4.1.5 Cabling

Use the cables included, one for power supply and one signal cable connection to the R4 Transponder unit. Note that the signal cable has a maximum bending radius of 10 cm.

Connect the R4 Display Power Cable, marked “7000 108-132”, and the R4 Display Signal Cable, marked “7000 108-133”, to the corresponding Conxall connectors on the back of the R4 Display. See Figure 4-10 below (illustrating a gimbal mounted R4 Display).

Wire the open end of the cables as described in section 5.2 and Appendix [A.9].

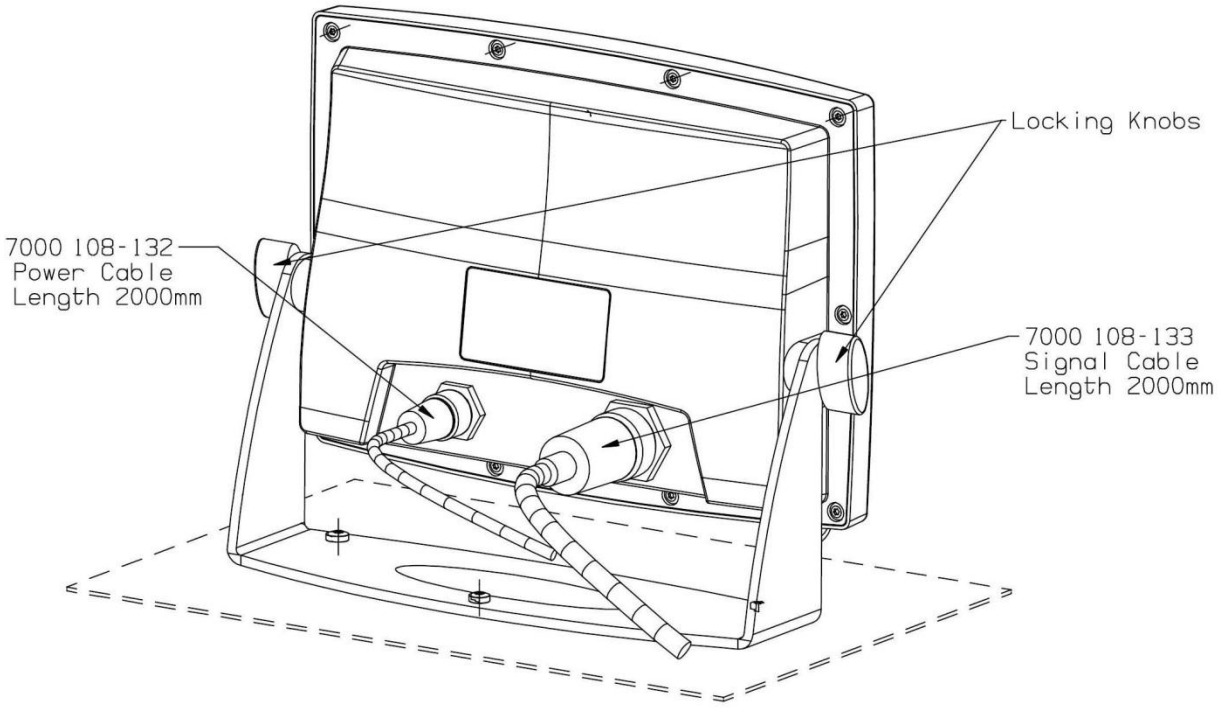


Figure 4-10: Connecting the power cable and the signal cable to the R4 Display

4.1.6 Power Supply

The R4 Display shall be connected to an emergency power source. If connected to an existing emergency battery, a re-calculation must be made for the battery capacity. For power consumption, see section 8.1.

The R4 Display is designed to operate on 24 VDC. The nominal power used is 8.5 W. The R4 Display shall be externally fused (slow blow fuse) with a 2 A fuse.

Install according to section 5.2 and Appendix [A.9].

4.2 Mount the R4 Transponder

4.2.1 Location

When mounting the R4 Transponder please consider the following:

- Mount the unit on a wall or on top of a bench.
- The temperature and humidity should be moderate and stable, +15ºC to +35ºC.
  (Operating temperature: -15ºC to +55ºC.)
- Select a location away from excessive heat sources.
- Avoid areas where there is a high flow of humid salt air.
- Avoid places with high levels of vibrations and shocks.
- Ensure that there is enough airflow to avoid high ambient temperatures.
- The unit can affect magnetic compasses. The minimum compass safe distance is 0.2 m.
- Install the R4 Transponder as close as possible to the Transponder's VHF/GPS antennas to minimise cable loss.

4.2.2 Clearance Area

Leave a clearance around the R4 Transponder to facilitate service and installation. See recommended clearance area in Figure 4-11 below.

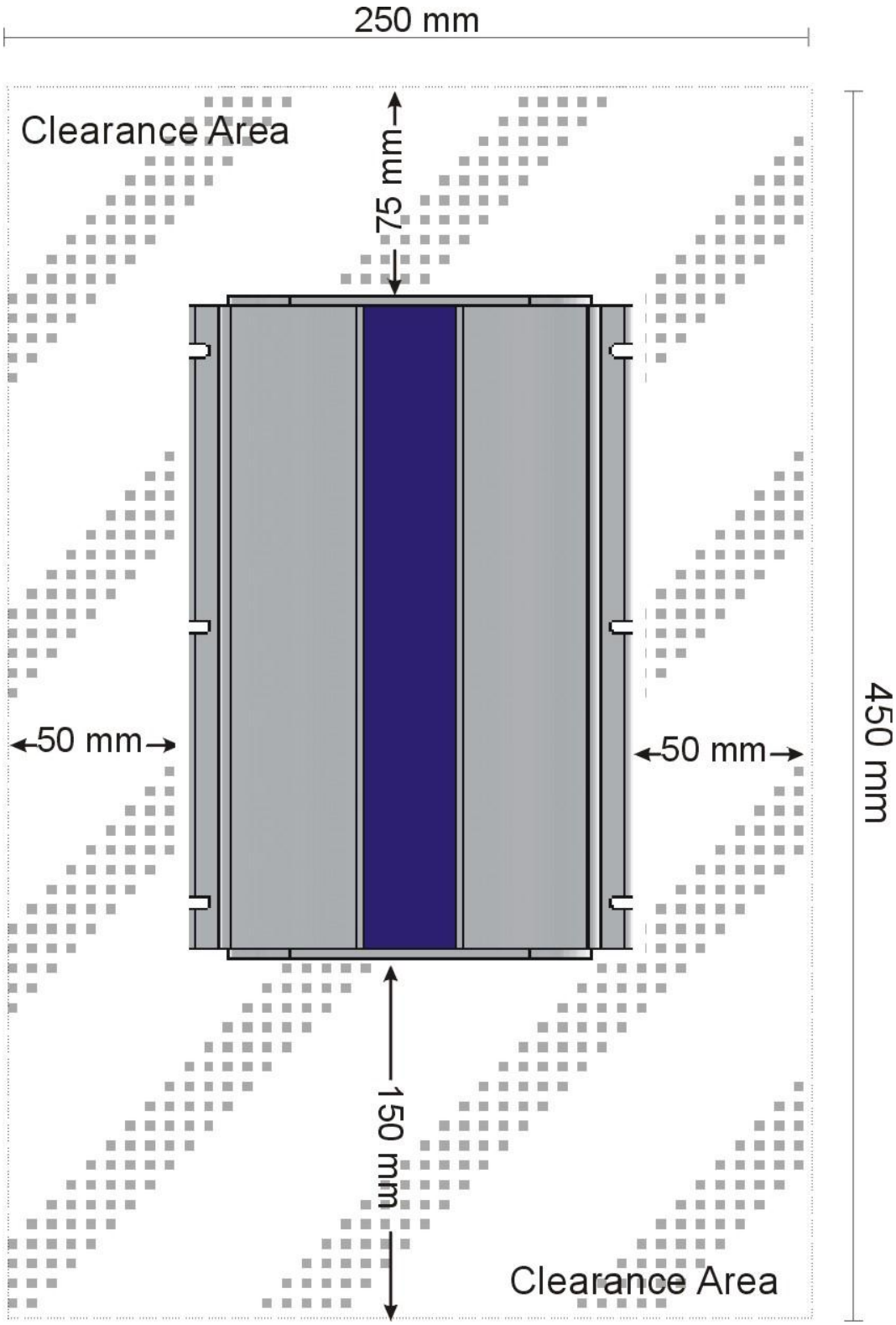


Figure 4-11: Clearance area for R4 Transponder

4.2.3 Physical Size and Mechanical Drawing

See figure below.

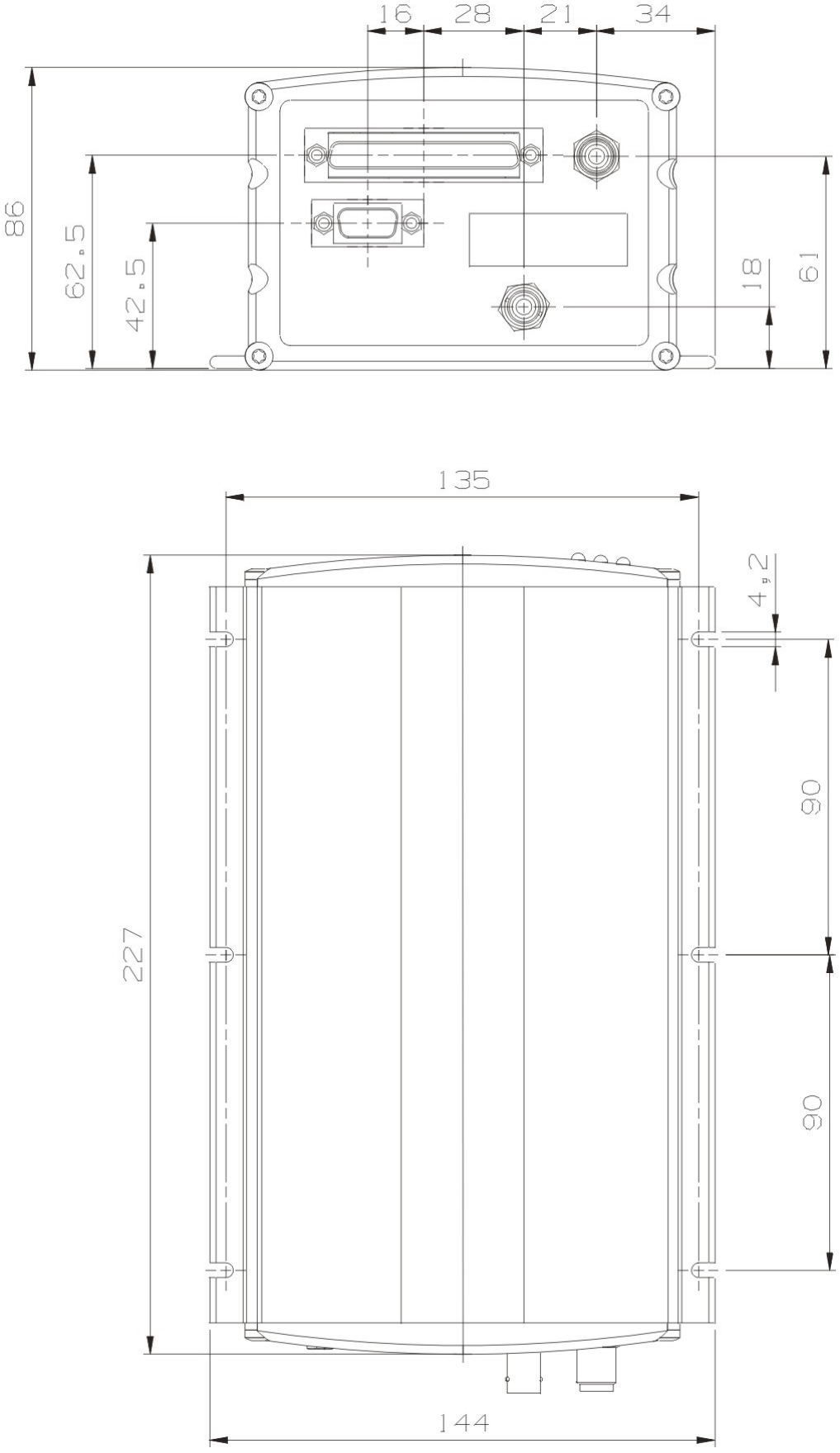


Figure 4-12: R4 Transponder mechanical drawing

4.2.4 Cabling

Use the cables included, one power supply and one signal cable for connection to the R4 Display and interfacing equipment such as sensors, ECDIS, etc. Note that the signal cable has a maximum bending radius of 20 cm. Wire the open end of the cables as described in section 0 and Appendix [A.9].

Connect the Transponder's VHF and GPS antenna to the R4 Transponder. See the figure below.

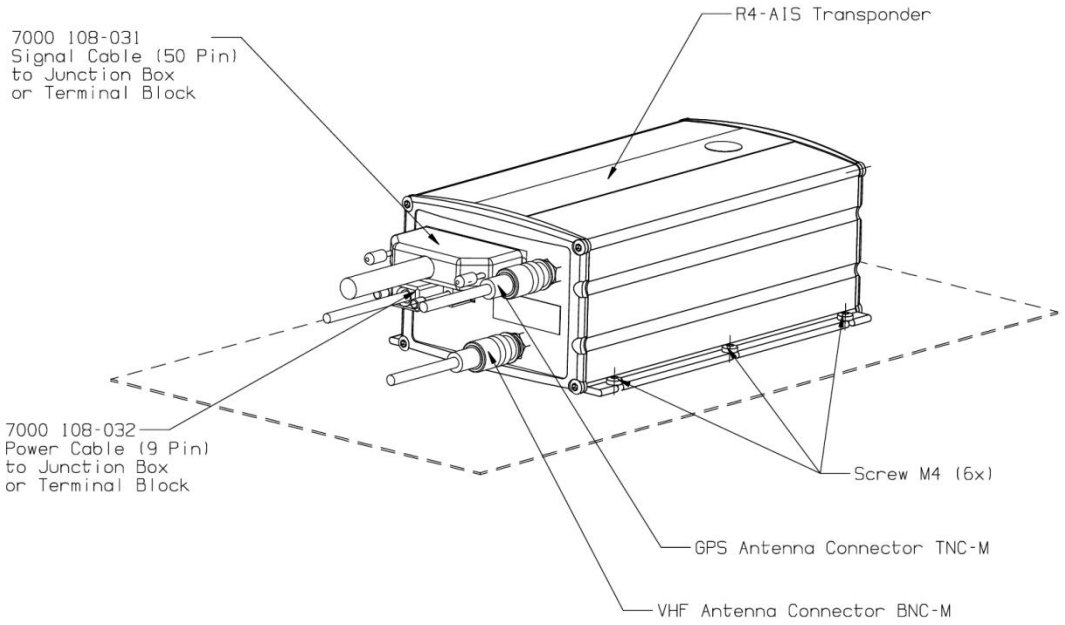


Figure 4-13: R4 Transponder Cable Connections

4.2.5 Power Supply

The R4 Transponder shall be connected to an emergency power source. If connected to an emergency battery, a re-calculation must be made for the battery capacity. For power consumption, see section 8.2.

The R4 Transponder is designed to operate on 24 volts DC. The nominal power used is 16W in receiving mode and maximum power needed is approx. 55 Watts while transmitting. The R4 Transponder shall be externally fused (slow blow fuse) with a 4 Amperes fuse. To avoid power and voltage drops in the feed line it is important that sufficient size of cable is used.

Install according to section 5.1 and Appendix [A.9].

4.3 Mount the AIS Alarm Unit

It is required that the AIS alarm output (relay) is connected to an audible alarm device or the ship's alarm system, if available.

Alternatively, the ship's BIIT alarm system may use the alarm messages output on the AIS Presentation Interface (PI) provided the alarm system is AIS compatible. The AIS Alarm Relay is either mounted on a DIN mounting rail or direct on the wall. Wire connections according to Figure 4-14.

See section 5.1 and Appendix [A.9] for detailed wiring diagram and cable colours.

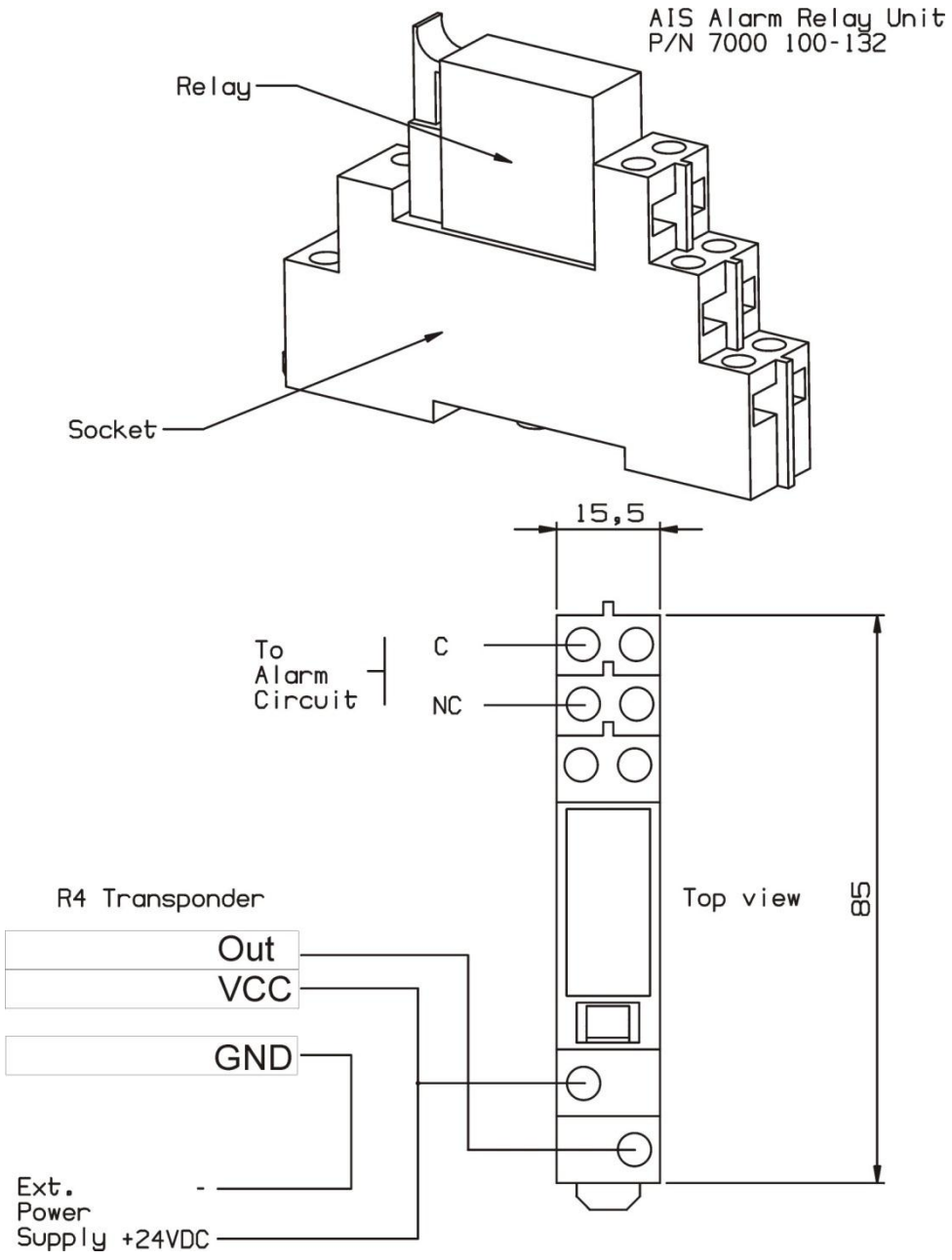


Figure 4-14: Alarm Relay Wiring

4.4 Mount External Pilot Plug (optional)

The pilot plug, for connecting the Personal Pilot Unit (PPU), is located on the front of the R4 Display. The installer may choose to install a separate pilot plug so that a pilot can connect a Personal Pilot Unit (PPU). This pilot plug should be connected in parallel with the R4 Display pilot plug. Use the below plug (or physical and electrical equivalent plug).

See Figure 4-16 below and section 5.2 for wiring details.

Note: Rx on the R4 Transponder side shall be connected to Rx on the Pilot Plug. Tx on the R4 Transponder side shall be connected to Tx on the Pilot Plug.

Table 4-1 External Pilot Plug item list

Item	Type	Manufacturer	Part number
1	Receptacle, shell size 11, 9 pin std	AMP/Tyco	206486-1, Square Flanged
1.1	Receptacle, alternative	AMP/Tyco	206486-2, Free Hanging
2	Contact pin (5 pcs used)	AMP/Tyco	66570-3, solder type

Table 4-2 Pilot plug description

Pin	Connection
1	Transmit A
4	Transmit B
5	Receive A
6	Receive B
9	Shield (GND)

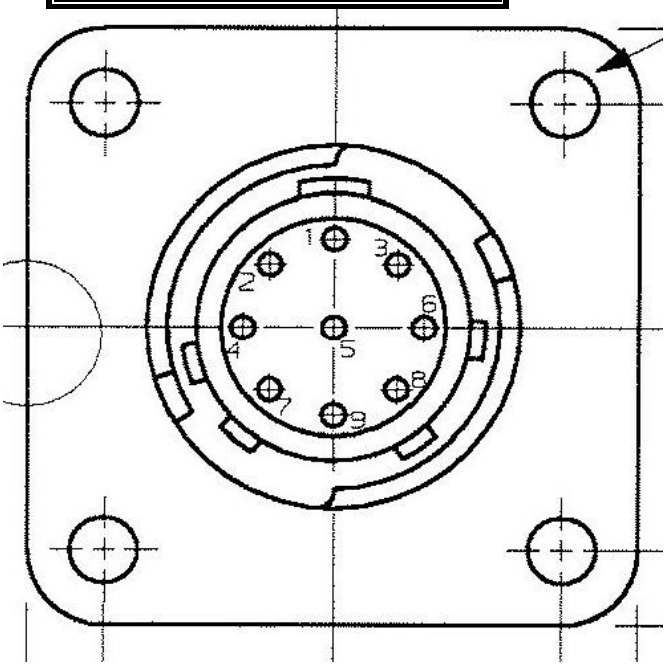


Figure 4-15: External Pilot Plug

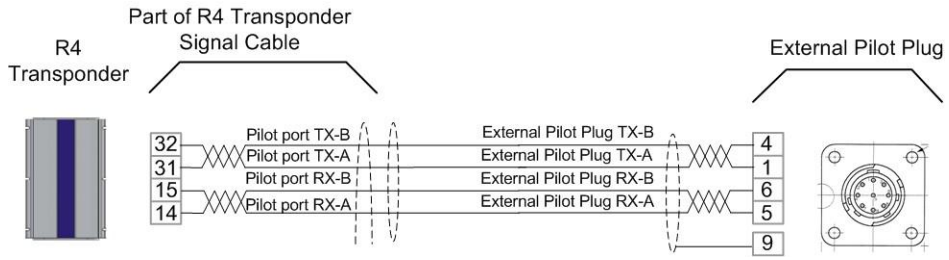


Figure 4-16: Connection of External Pilot Plug

4.5 Mount the R4 Transponder's VHF antenna

The R4 Transponder shall be connected to a VHF antenna.

The R4 AIS Transponder, like any other shipborne transceiver operating in the VHF maritime band, may cause interference to a ship's VHF radiotelephone. Because AIS is a digital system, this interference may occur as a periodic (e.g. every 10 second) soft clicking sound on a ship's radiotelephone. This effect may become more noticeable when the VHF radiotelephone antenna is located close to the AIS VHF antenna and when the radiotelephone is operating on channels near the AIS operating channels (e.g. channels 27, 28 and 86).

Attention should be paid to the location and installation of different antennas in order to obtain the best possible efficiency. Special attention should be paid to the installation of mandatory antennas like the AIS antennas.

So, installing the AIS VHF antenna is also a crucial part of the system installation. How and where you install your AIS VHF antenna and cable will affect its efficiency.

4.5.1 Antenna location

Location of the mandatory AIS VHF antenna should be carefully considered. Digital communication is more sensitive than analogue/voice communication to interference created by reflections in obstructions like masts and booms. It may be necessary to relocate the VHF radiotelephone antenna to minimise the interference effects. Installing the VHF antenna for AIS on a vessel is a compromise between the following items:

- Antenna type
- Antenna separation
- Clear view of the horizon
- Antenna height

4.5.2 Antenna type

The AIS VHF antenna should have omni directional vertical polarisation providing unity gain.

4.5.3 Antenna separation

The AIS transponders are using simplex channels at frequencies on the high side of the marine mobile band (AIS channel A = 2087 (161.975 MHz) and AIS channel B = 2088 (162.025 MHz)). These channels are close to the duplex channels used for shore to ship marine communication. The AIS VHF antenna should be separated as much as possible from the voice VHF

installations used for main communication to avoid unnecessary interference.

There should not be more than one antenna on the same level. The AIS VHF antenna should be mounted directly above or below the ship's primary VHF radiotelephone antenna, with no horizontal separation and with a minimum of 2 meters vertical separation. If it is located on the same level as other antennas, the distance apart should be at least 10 meters.

The AIS VHF antenna should be installed safely away from interfering high-power radiating sources like radar and other transmitting radio antennas, preferably at least 3 meters away from and out of the transmitting beam.

4.5.4 Clear view of the horizon

The AIS VHF antenna should be placed in an elevated position that is as free as possible with a minimum distance of 2 meters in horizontal direction from constructions made of conductive materials. The antenna should not be installed close to any large vertical obstruction. The objective for the AIS VHF antenna is to see the horizon freely through 360 degrees.

4.5.5 Antenna height

The AIS is using VHF radio frequencies, which propagation characteristics are close to line of sight. The higher antenna location is, the longer the range will be.

4.5.6 Cabling

The cable should be kept as short as possible to minimise attenuation of the signal. Double shielded coaxial cable equal or better than RG214 is recommended to minimise the effects from electromagnetic interference from high power lines, radar or other radio transmitter cables, see Appendix [A.7] – VHF-cable selector.

4.5.7 Cable mounting

Coaxial cables should be installed in separate signal cable channels/tubes and at least 10 cm away from power supply cables. Crossing of cables should be done at right angles (90°).

Coaxial cables should not be exposed to sharp bends, which may lead to a change of the characteristic impedance of the cable. The minimum bending radius should be 5 times the cable's diameter.

All outdoor installed connectors should be weatherproofed, e.g. with shrink tubing, watertight seal tape or butyl rubber tape and plastic tape sealing, to protect against water penetration into the antenna cable.

Secure the cable properly, close to the cable ends.

4.5.8 Grounding

Coaxial down-leads must be grounded. The coaxial shielding screen should be connected to ground at one end.

4.6 Mount the R4 Transponder's GPS antenna

The R4 Transponder shall be connected to a GPS antenna type MGA-2, AT575-68 or equivalent. 5V DC is supplied through the antenna lead for the antenna preamplifier.

Attention should be paid to the location and installation of the different antennas on the ship in order to obtain the best possible efficiency. Special attention should be paid to the installation of mandatory antennas like the AIS antennas.

So, installation of the GPS antenna is a crucial part of the system installation. How and where you install your GPS antenna and cable will greatly affect its sensing efficiency.

4.6.1 Antenna location

The GPS antenna must be installed where it has a clear view of the sky. The objective is to see the horizon freely through 360 degrees with a vertical observation of 5 to 90 degrees above the horizon. Small diameter obstructions, such as masts and booms, do not seriously degrade signal reception, but such objects should not eclipse more than a few degrees of any given bearing. Do not mount the antenna in the top of a mast or tower, as this may degrade the COG and SOG readings.

Locate the GPS antenna at least 3 meters away from and out of the transmitting beam of high-power transmitters such as S-Band Radar (typically ±15° vertically from the array's centre point) and/or Inmarsat systems (A, B, C, or M; typically ±10º from the array's centre point in any of the possible transmitting directions).

Locate the GPS antenna at least 3 meters away of a HF or VHF radios or their antennas. This includes the ship's own AIS VHF antenna if it is designed and installed separately.

4.6.2 Cabling

The gain of the GPS antenna built-in pre-amplifier shall match the cable attenuation. The resulting installation gain (pre-amplifier gain - cable attenuation) shall be within 0 to 26 dB. A minimum value of 10 dB is recommended for optimum performance.

Double shielded coaxial cable is recommended. The coaxial cable should be routed directly between the GPS antenna and the R4 Transponder GPS connector in order to reduce electromagnetic interference effects. The cable should not be installed close to high-power lines, such as radar or radio-transmitter lines or the AIS VHF antenna cable. A separation of one meter or more is recommended to avoid interference due to RF-coupling. Crossing of antenna cables should be done at 90 degrees to minimise magnetic field coupling.

Recommendations on cable types and lengths can be found in Appendix [A.6] – GPS Cable Selector.

4.6.3 Cable mounting

Coaxial cables should be installed in separate signal cable channels/tubes and at least 10 cm away from power supply cables. Crossing of cables should be done at right angles (90°).

Coaxial cables should not be exposed to sharp bends, which may lead to a change of the characteristic impedance of the cable. The minimum bending radius should be 5 times the cable's diameter.

All outdoor installed connectors should be weatherproofed, e.g. with shrink tubing, watertight seal tape or butyl rubber tape and plastic tape sealing, to protect against water penetration into the antenna cable.

Secure the cable properly, near the cable ends.

4.6.4 Grounding

Coaxial down-leads must be used. The coaxial shielding screen should be connected to ground at one end.

5 WIRING CABLE CONNECTIONS

A detailed installation wiring diagram for the R4 AIS-System is available in Appendix [A.9]. This diagram includes cable connections for R4 Display, R4 Transponder, power supply, alarm relay and RS422 ports.

The following chapters give a detailed description of the cable connections for R4 Display and R4 Transponder.

5.1 R4 Transponder Cables Connections

Figure 5-1 shows how to connect the R4 Transponder data and power cables. Note that TX on the R4 Transponder should be connected to RX on interfacing equipment and RX on the R4 Transponder should be connected to TX on interfacing equipment. Note that the PILOT Plug on the R4 Display is interfaced to the R4 Transponder by connecting TX to TX and RX to RX.

CAUTION

This wiring diagram is only valid for:

- R4 Transponder Signal cable **7000 108-031 rev. C**
- R4 Transponder Power cable **7000 108-032 rev. C**

Detailed wiring diagrams with cable colors for signal and data cables with other revisions are included with the cables in the delivery package.

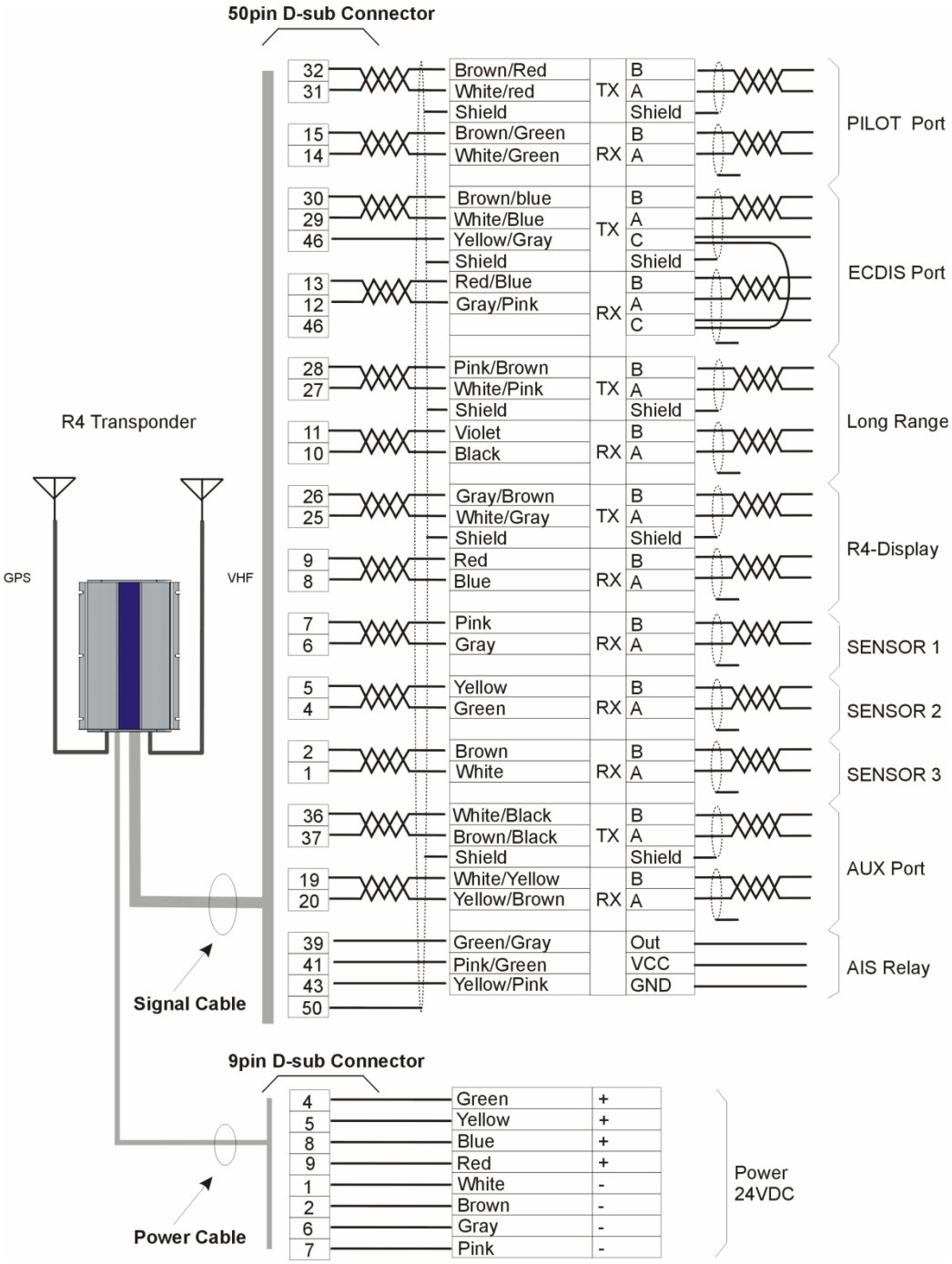


Figure 5-1: Wiring for R4 Display Signal cable 7000 108-031 rev. C and Power cable 7000 108-032 rev. C

5.1.1 Sensor 1, 2 and 3

Sensor ports 1, 2 and 3 shall be connected to sensors for position, bottom track (BT) speed, heading and rate of turn (ROT). RX on the R4 Transponder shall be connected to TX on the sensors. The R4 Transponder sensor ports meet IEC 61162-1/2. See section 7.3 before doing the installation.

5.1.2 Pilot port

The pilot port should be connected to the port on the R4 Display designated PILOT Plug. Note, the TX shall be connected to TX on the R4 Display pilot plug and the RX shall be connected to RX on the R4 Display pilot plug, see

Figure 5-3 and Appendix [A.9].

5.1.3 ECDIS port

The ECDIS port can be connected to the ECDIS system, ARPA and/or VDR. RX should be connected to the TX on the ECDIS and the TX should be connected to the RX on the ECDIS. The R4 Transponder ECDIS port meets IEC 61162-1/2. See section 7.3 before doing the installation, and section 5.1.8 below if using the common line C wires of the port.

5.1.4 Long Range

The Long Range port should be connected to the Long Range system. RX should be connected to the TX on the Long Range system and the TX should be connected to the RX on the Long Range system. The R4 Transponder Long Range port meets IEC 61162-1/2. See section 7.3 before doing the installation.

5.1.5 R4 Display

The R4 Display port shall be connected to the port on the R4 Display designated "R4 Transponder". The TX on the R4 Transponder cable shall be connected to RX on the R4 Display and the TX shall be connected to the RX on the R4 Display, see

Figure 5-3 and Appendix [A.9].

5.1.6 AUX port

The AUX port can be connected to a system that provides differential corrections to the internal R4 GNSS receiver. RX on the R4 Transponder should be connected to the TX on the external system. The input of the R4 Transponder AUX port meets RTCM SC-104. See section 7.3 before doing the installation. When the transponder receives RTCM input from message 17 via the VHF link, it will automatically be output on the AUX port.

5.1.7 AIS Relay Binary Port

The AIS Relay binary port shall be connected to the AIS Alarm Relay, as described in section 4.3.

5.1.8 Using the C Wires of the ECDIS Port

If using the common signal ground C wires when connecting the ECDIS port (in addition to the A and B signal wires), wire them as illustrated in the below figure.

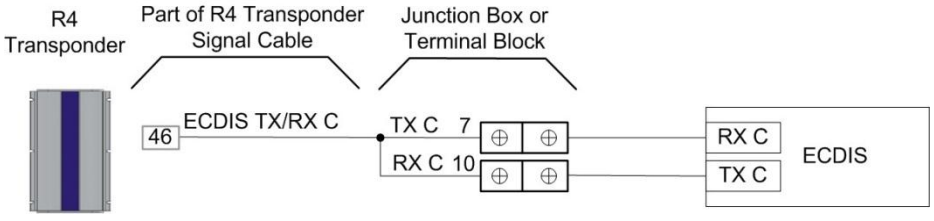


Figure 5-2: Connecting the common signal ground C wires of the ECDIS port

5.2 R4 Display Cable Connections

Figure 5-3 shows how to connect the R4 Display data and power cables. Note that for the port designated "R4 Transponder" the TX lines on the R4 Display should be connected to the RX lines on the Display port of the R4 Transponder and vice versa. The TX lines for the PILOT Plug should however be connected to the TX lines of the PILOT Port on the R4 Transponder and the same principle applies for the RX lines.

Note: The AUX port is not connected. This port is referred to as "R4 Sensor Port" in a R4 Combined AIS & Navigation System.

CAUTION

This wiring diagram is only valid for:

- R4 Display Signal cable **7000 108-133 rev. A**
- R4 Display Power cable **7000 108-132 rev. B**

Detailed wiring diagrams with cable colors for signal and data cables with other revisions are included with the cables in the delivery package.

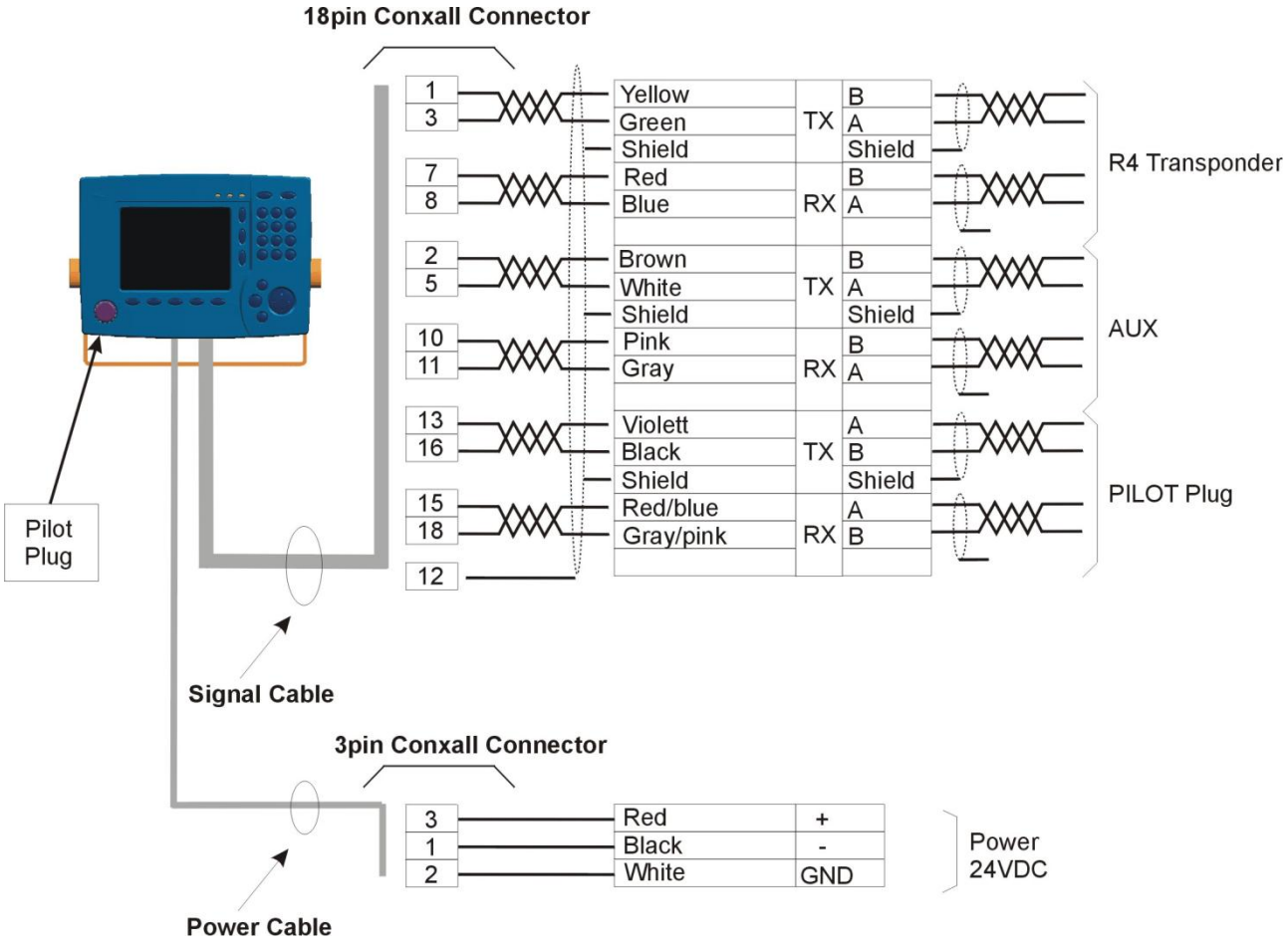


Figure 5-3: Wiring for R4 Display Signal cable 7000 108-133 rev. A and Power cable 7000 108-132 rev. B

6 SYSTEM CONFIGURATION AND SETTINGS

The installer is required to set the following parameters at the installation of the R4 AIS Shipborne Class A Transponder System:

- MMSI number (Maritime Mobile Service Identity)
  - Must be in the range 200000000 to 799999999
- IMO vessel number
- Call Sign (Radio Call Sign)
- Ship Name
- Height Over Keel
- Type of ship
- GPS antenna position(s)

All parameters are set via the R4 Display. To set the parameters, follow the steps as described in the following sections. Note that setting IMO, MMSI number and Radio Parameters requires a password (default = “user”).

6.1 R4 Display Keys

The R4 Display has a number of keys that are used to navigate in the menus and enter values. The locations of the keys are illustrated in Figure 6-1.

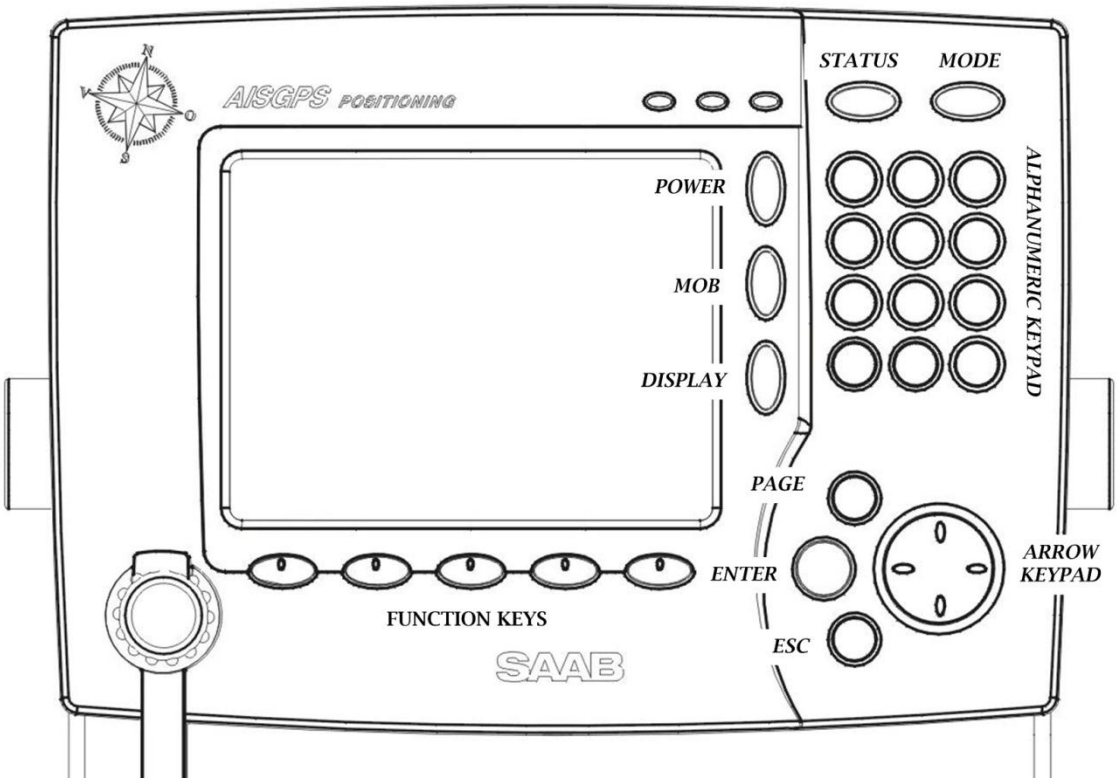


Figure 6-1: R4 Display key names and location

The keys are described below:

POWER Used for turning the M4 display on and off. To turn the power off, press and hold the key for about 3 seconds.

MOB Not used in the R4 AIS Shipborne Class A Transponder System.

DISPLAY Provides controls for fast configuration of backlight, contrast, LED and button illumination.

STATUS Used for fast change of navigational status for the own ship.

MODE Used for toggling between the *Navigate, Plan Voyage, Alarms and Msgs* and *Config* mode.

ALPHANUMERIC KEYS These keys are used for entering text and numbers. To write a number in a numeric field press the key once. To write a character in a text field press once for the first character associated with the key, twice for the second character and so on.

PAGE Toggles page of function keys shown in views having more than 5 function keys.

ENTER Used to start editing a field and for confirming data entry.

ESC Returns display to previous page, or restores a data field's previous value.

∧ ∨ (Up and down on ***ARROW KEYPAD***) Moves the field and list highlight up and down, and the cursor position when editing a field.

< > (Left and right on ***ARROW KEYPAD***) Moves the field highlight left and right, and the cursor position when editing a field.

FUNCTION KEYS These keys have different functions depending on the current view. The function is displayed above each key on the screen.

6.2 Status LEDs

6.2.1 Transponder status LED:s

The green LED indicates that power is applied to the R4 transponder. A flashing yellow LED indicates that the R4 Transponder is receiving data. A flashing red LED indicates that the R4 Transponder is transmitting on the radio link (transmission starts approximately 1 minute after power on). The LED's are located on the front of the R4 Transponder.

6.3 System Power Up

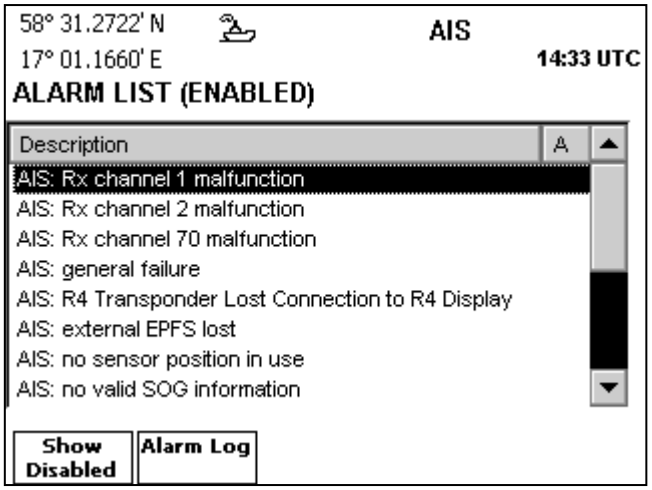
The system is turned on, by applying power to the R4 Transponder and the R4 Display. The R4 Transponder does not have a switch for turning it on. It starts when power is applied via the cable. The R4 Display is turned on, by pressing the ***POWER*** key. The LEDs on the R4 Display should blink momentarily indicating that it is starting.

When the system is started, there may be some alarms displayed depending on which sensors that have been connected to the system. If any alarms are displayed, take notice of the alarms displayed and then acknowledge them by pressing the ***ENTER*** key until the alarms are not displayed any more.

To continue the system configuration, see the following sections.

6.4 Viewing Active Alarms

In addition to being indicated by pop-up dialogs, the currently active alarms can be seen in the *Alarm List* view in the *Alarms & Msgs* mode. The view is accessed by pressing the ***MODE*** key followed by the function key **ALARMS & MSGS**, and then pressing function key **Alarm List**. The view is illustrated below.



On entrance, the view only displays the enabled alarms. To view the status of alarms that have been disabled (if any), press function key **Show Disabled.**

Active alarms are indicated with an exclamation mark (!).

6.5 R4 Transponder Connection Lost Troubleshooting

The R4 Display continuously monitors the serial connection to the R4 Transponder. If the connection is lost or never established, the R4 Display will show the icon and activate one of the alarms "R4 Display Lost Connection to R4 Transponder" or "R4 Transponder Lost Connection to R4 Display". There are three possible malfunctions:

1. The R4 Transponder does not receive the R4 Display data but the R4 Display receives the R4 Transponder data. The alarm "R4 Transponder Lost Connection to R4 Display" will be raised.
2. The R4 Display does not receive the R4 Transponder data. The alarm "R4 Display Lost Connection to R4 Transponder"" will be raised.
3. The communication between the R4 Display and Transponder does not work in any direction. The alarm "R4 Display Lost Connection to R4 Transponder" will be raised.

Perform the following steps to troubleshoot the condition:

1. Verify that power is correctly applied to the R4 Transponder, indicated by the green LED being lit on the Transponder. If not, check the wiring of the positive and negative power wires.
2. Verify the wiring of the interconnection between the R4 Display and R4 Transponder. Ensure that the TX lines of the R4 Transponder port on the R4 Display are connected to the RX lines of the Display port on the R4 Transponder, and vice versa. Ensure that TX-A is connected to RX-A, TX-B to RX-B and so on, as illustrated in Table 6-1.

Table 6-1. Connections between R4 Display and R4 Transponder

The "R4 Transponder" port on the R4 Display		The "Display" port on the R4 AIS Transponder
TX-A	⇔	RX-A
TX-B	⇔	RX-B
RX-A	⇔	TX-A
RX-B	⇔	TX-B

See the wiring diagram in appendix [A.9].

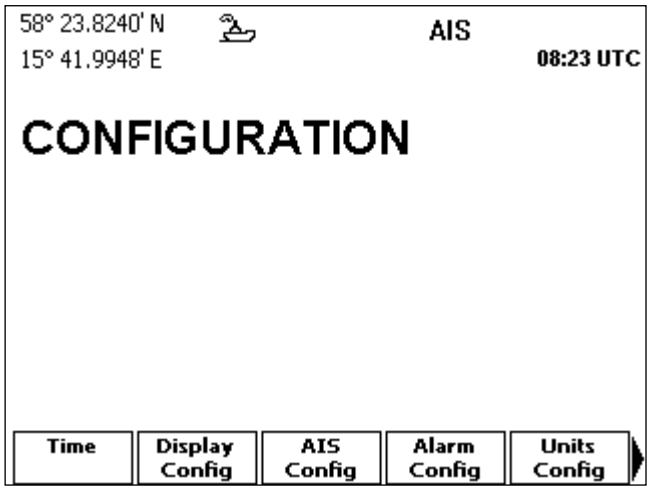
3. The *View Raw Data* view can be used to monitor the traffic on the R4 Transponder port, which gives information on if any data is received from the R4 Transponder. The *View Raw Data* view is described in section "Port Rate Config" in the Reference chapter of the Operator's Manual. If the *View Raw Data* screen displays garbage characters, it is possible that the A and B wires of the interconnection between the R4 Display and R4 Navigation Sensor have been interchanged. See step 2 above. If this does not help, contact your R4 AIS Transponder System dealer.

6.6 Configure AIS Settings

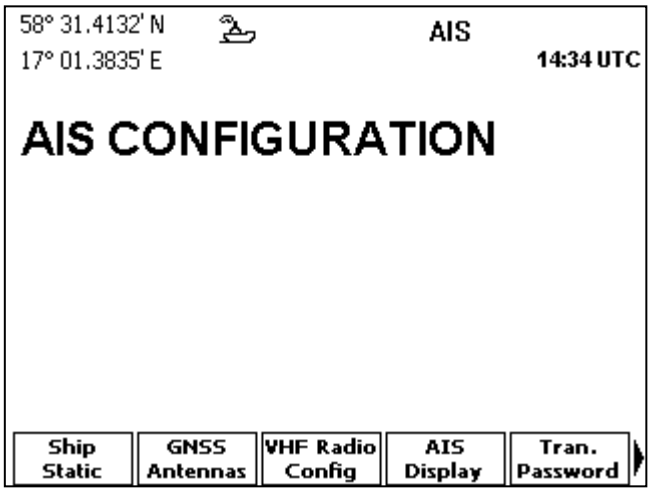
This section describes how to configure mandatory AIS settings.

6.6.1 MMSI, IMO number, Call Sign, Ship Name, Height Over Keel

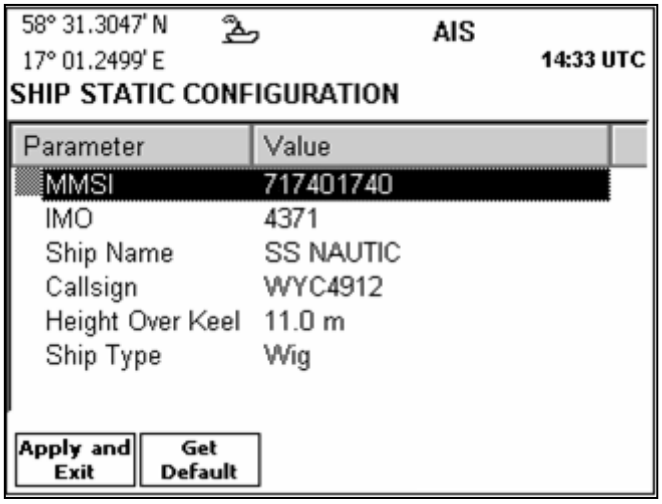
Go to the Configuration Menu by pressing the ***MODE*** key and then press function key **Config**. The following view should be displayed:



Press the function key **AIS Config**. The following view should be displayed:



Press the function key **Ship Static**. The following view should be displayed:



Change Ship Static Data:

1. Use ∧ ∨ to select the field to change and press ***ENTER***
2. Enter the desired value using the number keys. To delete a character, use the function key **Backspace**. Press ***ENTER*** when done.
   Note: "Height Over Keel" should be in meters.
3. Repeat steps 1-2 for every field.
4. Exit edit mode by pressing function key **Apply and Exit**
5. A view requesting a password will be displayed, type "user" (in small caps) using the alphanumeric keys and press ***ENTER*** to store the new settings.

Note 1: Setting "Ship Type" to "Numerical input" allows the user to change type according to ITU-R M.1371. See Table 6-2 for detailed information about the numerical representation of ship types.

Note 2:MMSI must be in the range 200000000 to 799999999.

Table 6-2. Identifiers to be used by ships to report their ship type

Identifier No.	Special craft		
50	Pilot vessel		
51	Search and rescue vessels		
52	Tugs		
53	Port tenders		
54	Vessels with anti-pollution facilities or equipment		
55	Law enforcement vessels		
56	Spare – for assignments to local vessels		
57	Spare – for assignments to local vessels		
58	Medical transports (as defined in the 1949 Geneva Conventions and Additional Protocols)		
59	Ships according to Resolution No 18 (Mob-83)		
Other ships			
First digit(1)	**Second digit(1)**	**First digit(1)**	**Second digit(1)**
1 – Reserved for future use	0 – All ships of this type	–	0 – Fishing
2 – WIG	1 – Carrying DG, HS, or MP, IMO hazard or pollutant category X(2)	–	1 – Towing
3 – See right column	2 – Carrying DG, HS, or MP, IMO hazard or pollutant category Y(2)	3 – Vessel	2 – Towing and length of the tow exceeds 200 m or breadth exceeds 25 m
4 – HSC	3 – Carrying DG, HS, or MP, IMO hazard or pollutant category Z(2)	–	3 – Engaged in dredging or underwater operations
5 – See above	4 – Carrying DG, HS, or MP, IMO hazard or pollutant category OS(2)	–	4 – Engaged in diving operations
	5 – Reserved for future use	–	5 – Engaged in military operations
6 – Passenger ships	6 – Reserved for future use	–	6 – Sailing
7 – Cargo ships	7 – Reserved for future use	–	7 – Pleasure craft
8 – Tanker(s)	8 – Reserved for future use	–	8 – Reserved for future use
9 – Other types of ship	9 – No additional information	–	9 – Reserved for future use

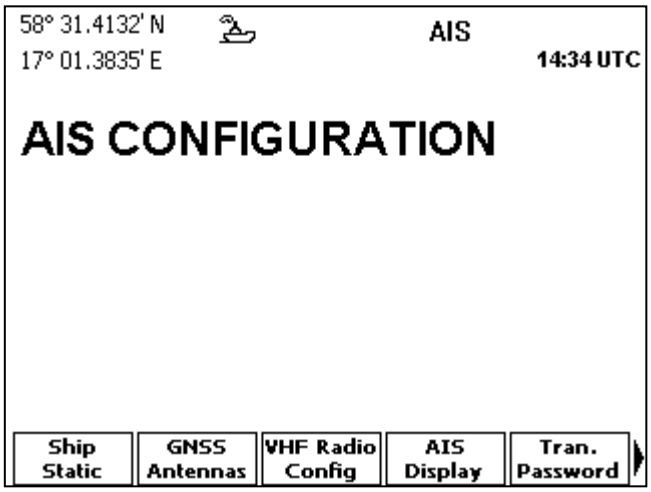
DG (Dangerous Goods), HS (Harmful Substances) and MP (Marine Pollutants)

NOTE 1 – The identifier should be constructed by selecting the appropriate first and second digit

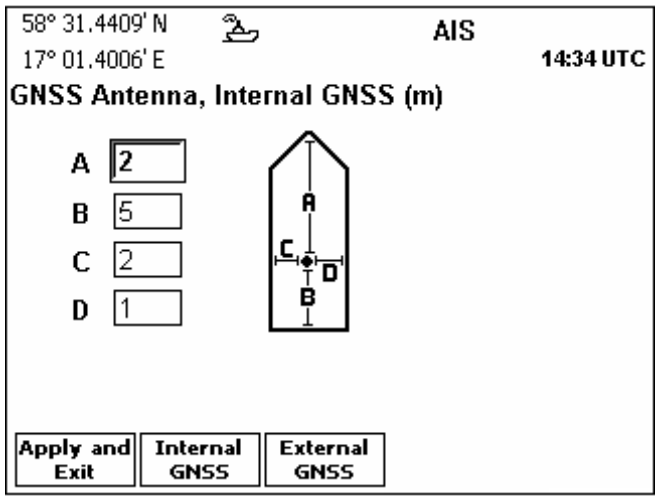
NOTE 2 – The digits 1, 2, 3 and 4 reflecting categories X, Y, Z and OS formerly were categories A, B, C and D.

6.6.2 GPS antenna position

The following view should be displayed:



Press the function key **GNSS Antennas**. The following view should be displayed:



Normally an external GPS is connected to the system. This view allows the operator to change positioning values for the external and internal GPS. To change values follow these steps:

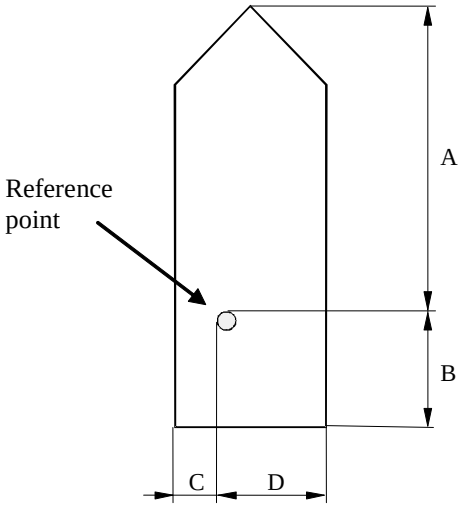
1. Select the GPS to edit values for, by pressing either the function key **Internal GNSS** or **External GNSS**
2. Use (∧ ∨) to select the field to change and press ***ENTER***
3. Enter the desired value using the number keys. To delete a character, use the function key **Backspace**. Press ***ENTER*** when done.
   Note: for details on what values to enter for A, B, C and D see next page.
4. Repeat procedures 2-3 for every field.
5. Exit edit mode by pressing function key **Apply and Exit**
6. A view requesting a password will be displayed, type “user” (in small caps) using the alphanumeric keys and press ***ENTER*** to store the new settings.

Choosing values for A, B, C and D

The system stores one ”external reference point” for the external (D)GNSS’ antenna positions and one ”internal reference point” for the internal AIS GPS, which is used as fallback for position reporting.

The locations of these reference points have to be set using values A, B, C and D, see definition in Figure 6-2.

Ship’s dimensions, i.e. overall length and width of the ship, are given automatically by the values A, B, C, and D. Note that ship’s dimensions (A+B and C+D) must be identical when entering external and internal reference points.



	Distance (m)
A	0 - 511
B	0 - 511
C	0 - 63; 63 = 63 m or greater
D	0 - 63; 63 = 63 m or greater

The dimension A should be in the direction of the transmitted heading information (bow).
Reference point of reported position not available, but dimensions of ship are available:
A = C = 0 and B ≠ 0 and D ≠ 0.
Neither reference point of reported position nor dimensions of ship available:
A = B = C = D = 0 (=default)

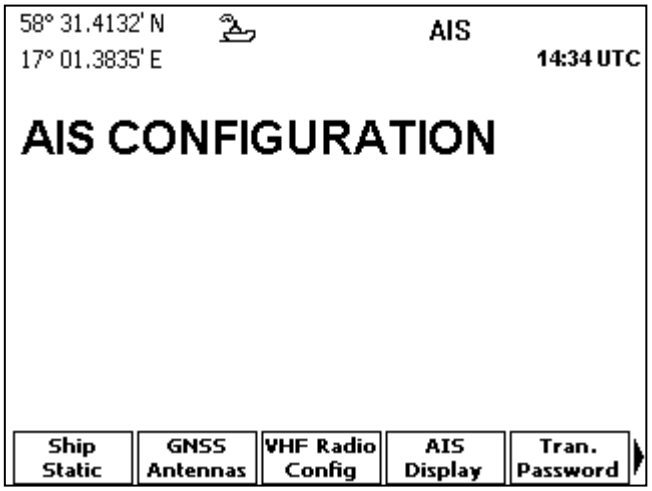
Figure 6-2: Reference point

6.6.3 Radio settings

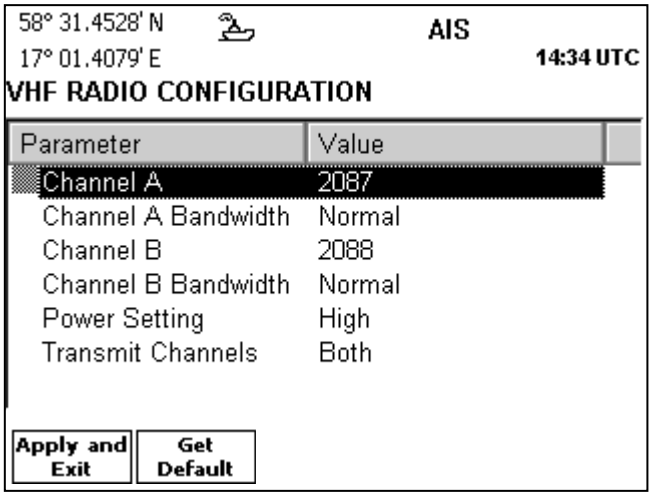
The radio parameters have a default setting. Normally it is not needed to update these settings. The default settings are:

AIS 1	Channel 2087
AIS 2	Channel 2088
Channel A/B Bandwidth	Normal (25 kHz)<
Power Setting	High (12.5w)
Transmit Channels	Both

If a change is needed, start from the following view and follow the steps described:



Press the function key **VHF Radio Config**. The following view should be displayed:



To change VHF Radio Parameters:

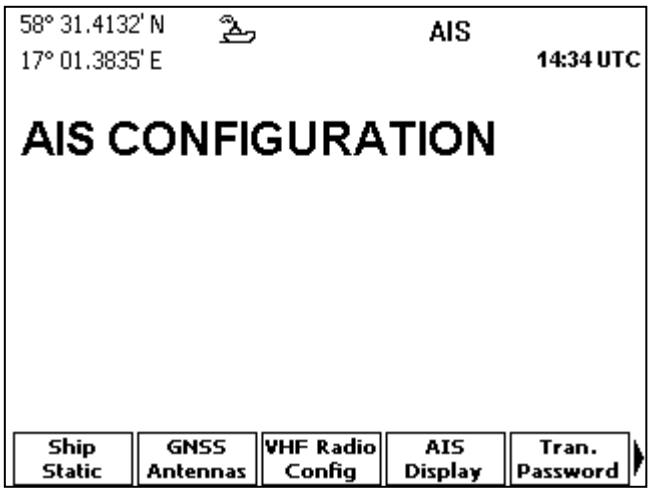
1. Use ∧ ∨ < > to select the field to change and press ***ENTER***
2. Enter the desired value using the number keys. To delete a character, use the function key **Backspace**. Press ***ENTER*** when done.
3. Repeat steps 1-2 for every field.
4. Exit edit mode by pressing function key **Apply and Exit**

5. A view requesting a password will be displayed, type “user” (in small caps) using the alphanumeric keys and press ***ENTER*** to store the new settings

6.6.4 Long Range Settings

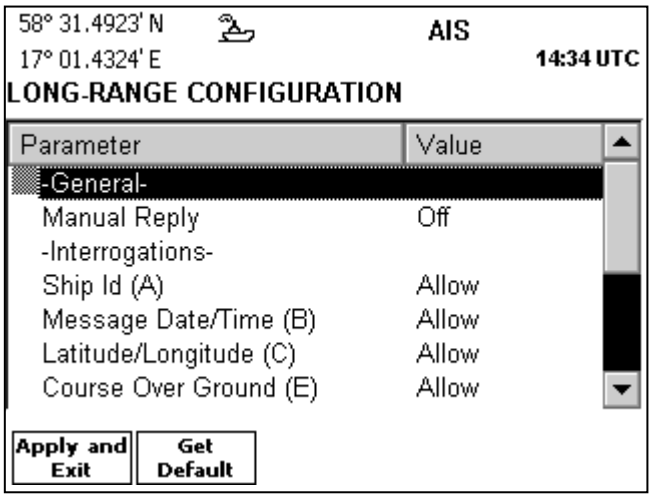
If a Long Range System has been connected to the R4 Transponder, some settings may have to be done. The user can set up the R4 to automatically acknowledge or to let the user manually acknowledge any Long Range (LR) interrogation.

To change LR Settings, start from the following view and follow the steps described:



Press the Page key**.** The following function keys are shown.

Press the function key **Long Range**. The following view should be displayed.



To toggle between auto and manual reply:

1. Use the ∧ ∨ keys to select highlight the “Manual Reply” parameter. Press ***ENTER*** .
2. Select manual or automatic reply using the ∧ ∨ keys in the drop down list. Press ***ENTER*** when desired setting is selected.
3. Press function key **Apply and Exit**

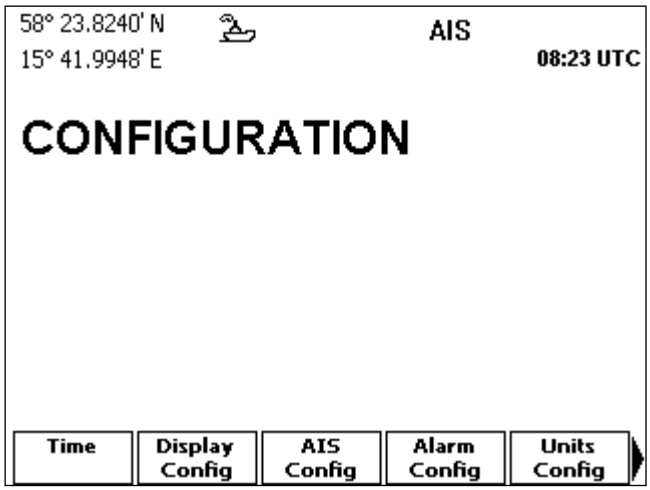
To change which Long Range interrogations to allow:

1. Use the ∧ ∨ keys to select the interrogation to be edited and press ***ENTER***.
2. Select to allow or disallow reply to the interrogation, using the ∧ ∨ keys in the drop down list. Press ***ENTER*** when desired setting is selected.
3. Repeat 1-2 for each interrogation to change.
4. Press function key **Apply and Exit**

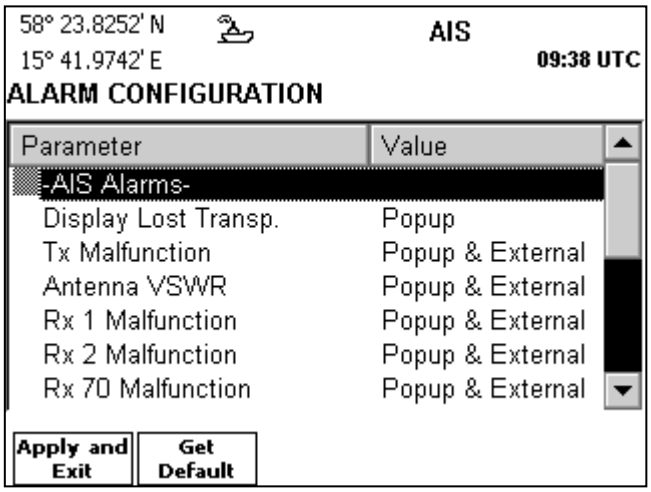
To set the default Long Range settings, press function key **Restore Defaults**.

6.6.5 Alarm Relay and Popups

The *Alarm Configuration* view allows the user to enable and disable alarm relay activation for specific alarms. This also makes it possible to disable alarms that are not applicable for the current system installation. To do this, start from the following view and follow the described steps.



Press the function key **Alarm Config**. The following view should be displayed:



Each alarm can be set to “Disabled”, “Popup”, “External” or “Popup & External”. For an AIS alarm, “External” means that the AIS Alarm Relay will be activated when the alarm is active.

To disable or enable popup and / or alarm relay for alarms do the following.

1. Use ∧ ∨ to select the alarm to modify and press ***ENTER***.
2. Use ∧ ∨ to select the desired setting in the drop down list, and press ***ENTER***.
3. Repeat step 1-2 for each alarm to modify.
4. Finish editing by pressing function key **Apply and Exit** when done.

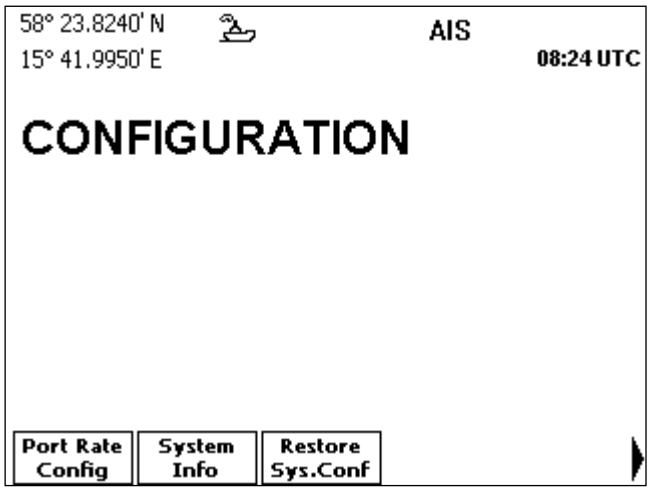
6.6.6 I/O Port Settings

The I/O ports must be configured to the settings used by the actual equipment (sensors, LR, ECDIS etc) connected to the R4 unit. The default settings for the I/O ports are as follows:

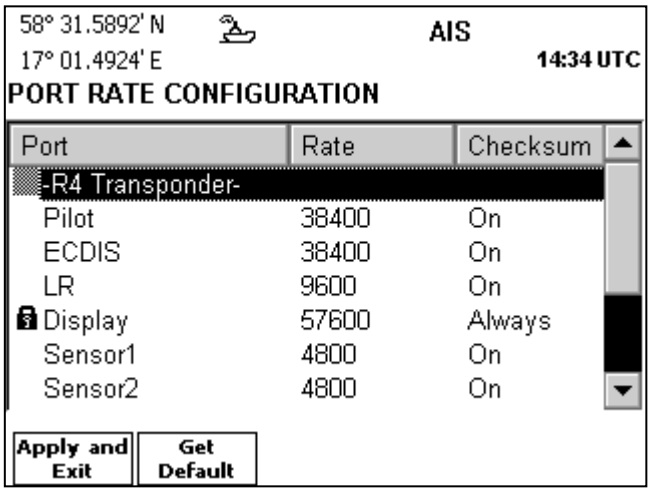
Table 6-3. Port settings

Port	Name	Baudrate
1	PILOT	38400
2	ECDIS	38400
3	LR	9600
4	R4 Display	57600
5	Sensor 1	4800
6	Sensor 2	4800
7	Sensor 3	4800
8	Aux	9600

For the equipment that uses settings other than the ones stated in Table 6-3 the corresponding port on the R4 must be configured at installation. If a change is needed, enter *Configuration* mode and press the ***PAGE*** key. The following view should be displayed:



Press the function key **Port Rate Config**. The following view should be displayed:

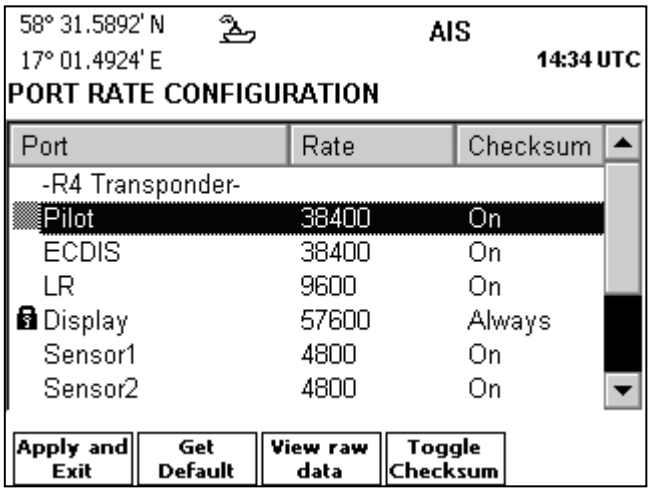


To edit port rate for a port:

1. Use ∧ ∨ to highlight the port to change rate for and press ***ENTER***.
2. Use ∧ ∨ to select the correct port rate and press ***ENTER***
3. Save changes by pressing function key **Apply and Exit**
4. A view requesting a password will be displayed, type “user” (in small caps) using the alphanumeric keys and press ***ENTER*** to store the new settings.

Checksum Setting

Normally the Checksum control is enabled for all serial interfaces. If the connected equipment does not send the checksum the R4 Transponder will ignore the data. If this type of equipment must be connected to the R4 Transponder, the Checksum control needs to be disabled.



To configure checksum settings:

1. Use the ∧ ∨ to highlight the port to disable checksum for

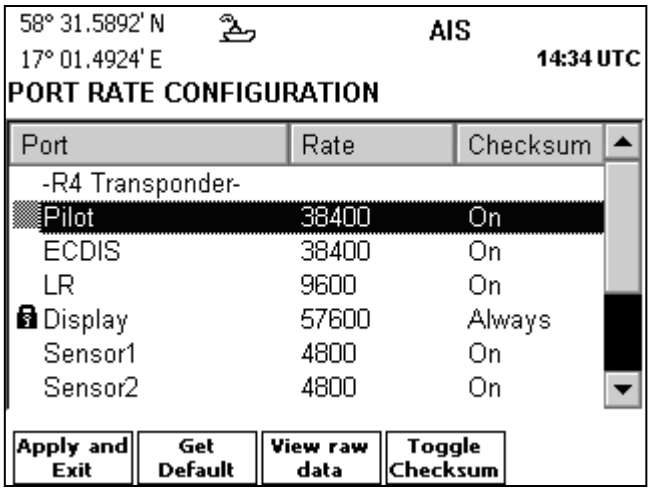
5. Toggle checksum On/Off by pressing function key **Toggle Checksum**

6. When done configuring checksum settings, apply changes by pressing function key **Apply and Exit**

7. A view requesting a password will appear, type “user” using the alphanumeric keys (in small caps) and press ***ENTER*** to store the new settings.

Raw Data Mode

It is possible to view raw the data that the R4 is receiving. This is a helpful tool when installing the system. The *View Raw Data* view allows the user to see the data that is received on the serial ports.



To view raw data:

1. Use the ∧ ∨ to highlight the port to view received data on

2. Press function key **View Raw Data**.

3 To stop press the function key **Freeze** and resume by pressing **Resume**

5. Press the ***ESC*** key to return to normal operation.

If no data is displayed or appears garbled in the Raw Data Mode, check the following:

1. Connection of data cables, RX and TX
2. Disable the checksum for the selected port (see Checksum Settings above) and redo the steps for viewing Raw Data
   Note: If the checksum control is not re-enabled, the ability to verify the integrity of the received data is reduced.
3. If data is garbled, change the polarity of the signal cables
4. Data speed on the connected sensor

If the data strings are readable in the Raw Data Mode, but appears not to be used (EPFS lost, SOG, COG missing etc.), check the content of the NMEA sentences used. A description of the required contents of the NMEA sentences can be found in section 7.3. Verify that the incoming NMEA sentences fulfil these requirements A complete description of the interface and NMEA/IEC 61162 sentences used for the AIS can be found in Ref. [2] and Ref. [4].

6.7 System Functional Check

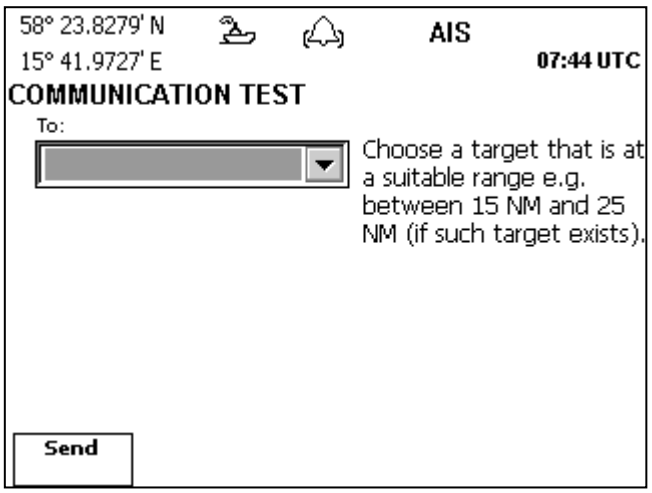
When the R4 AIS Class A System has been installed and configured according to procedures described in previous sections, it is recommended to make a first functional check of the system. This can be done following the procedure as described below.

NOTE: For sw 5.1.2 and above, MMSI must be setup before radio transmissions are enabled. Systems with version 5.3.0 and above will activate Alarm Id 001: "TX Malfunction" if an invalid MMSI is used.

6.7.1 Verify VHF communication

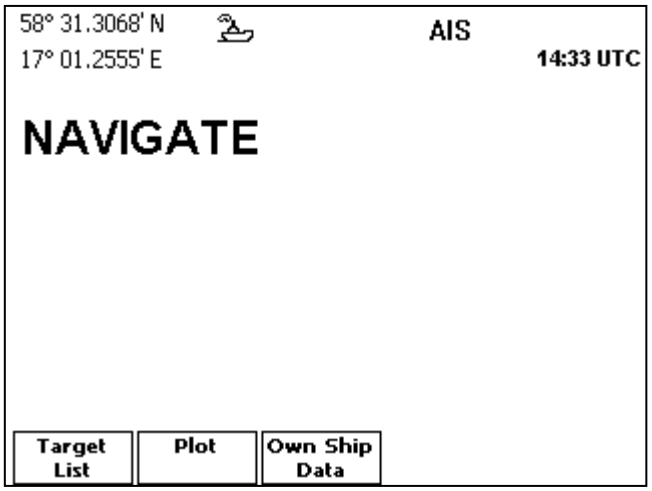
A VHF communication test dialogue has been added in R4 AIS sw version 5.3.0. This test is only possible if there is another Class A transponder unit within receiving range. A successful test will verify TX and RX functionality of the installation. It will poll a remote unit and wait for a response back.

Go to the VHF Communication test dialoge. Choose a remote target in the drop down list and wait for a result.



6.7.2 Verify own vessel data

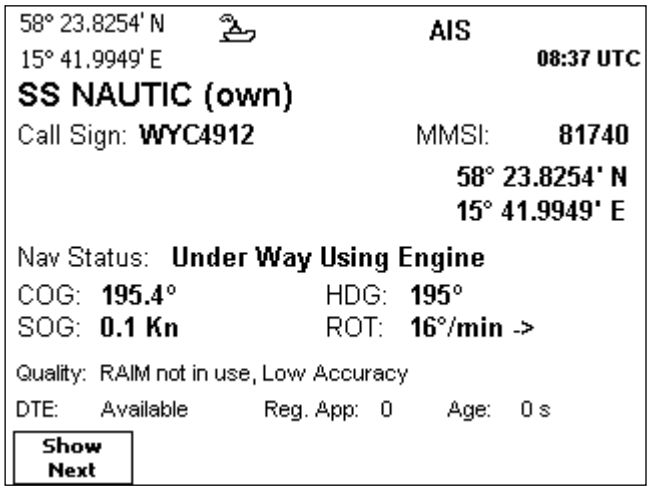
1. Press ***MODE*** key and then press function key **NAVIGATE**. The *Navigate* top view is shown.



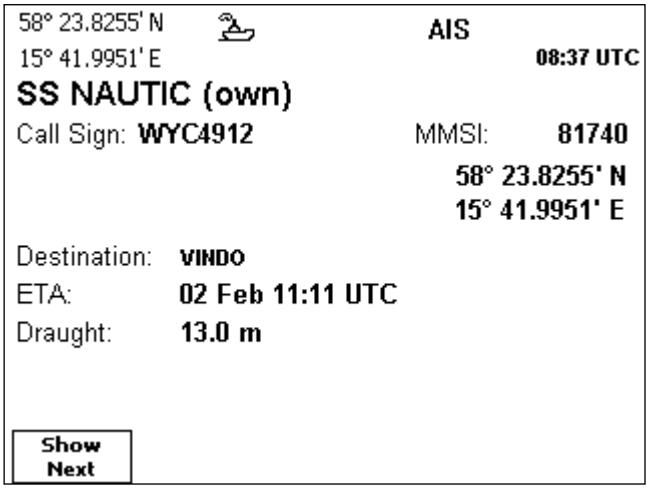
2. Press function key **Own Ship Data**. The below view should be displayed. The view presents the information about the own ship which is being transmitted.

Note 1: Data presented here are only examples of data. All data are unique for each vessel.

Note 2: *The Own Ship Data* view reflects the contents of the last transmitted AIS message. Thus there may be some delay from the time the parameters are entered until they are displayed in the view.

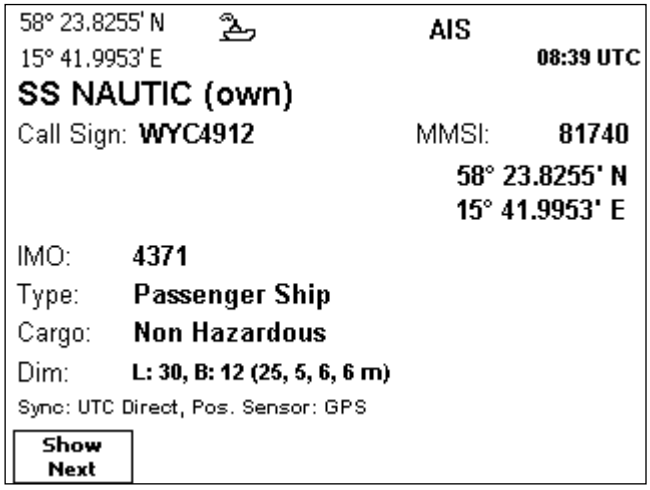


Press Show **Next**



.

4. Press **Show Next** again.



5. Verify that the displayed data is correct. See Table 6-4 for details about the different fields.

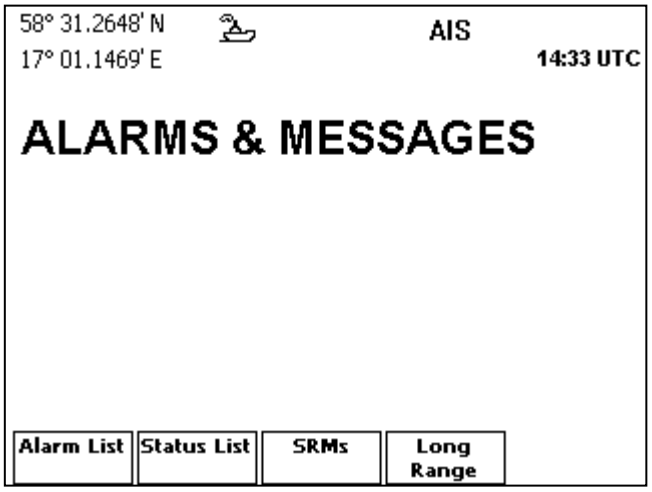
Note: Some of the values may be incorrectly shown. The reason for this could be that not all sensor ports have been connected.

Table 6-4. Own ship data field explanation

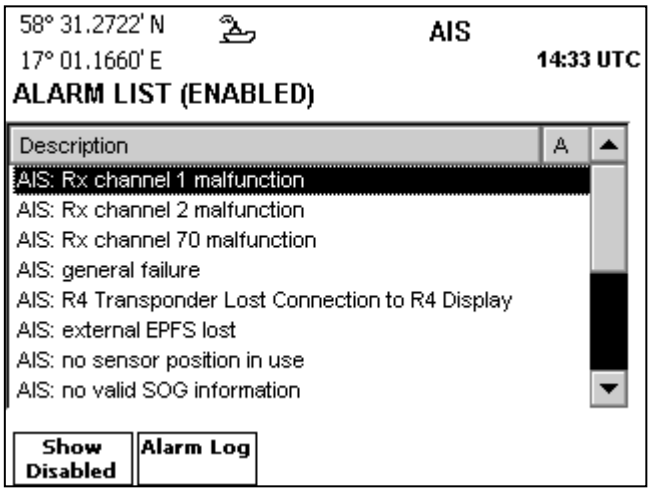
Field	Explanation
SOG	Speed Over Ground
COG	Course Over Ground
HDG	Heading
ROT	Rate Of Turn
Nav Status	Current navigation status
Quality	Quality of the own position, RAIM in use or not
Sync	Time synchronization state (usually UTC Direct, which means synchronization via own GPS)
Pos	Type of External Position Fixing System
Dim	The GPS reference position (see 6.6.2)
Age	The information age in seconds, reset each time new information is acquired
Name, MMSI, IMO, Callsign, Type	Ship Static information (see 6.6.1)
ETA, Draught, Destination	Ship Voyage related information, set in the *AIS Voyage* view (see the Operator's Manual)
Reg. App	Data field reserved for regional applications, set to zero if not used for any regional application. Set in the *AIS Voyage* view (see the Operator's Manual)
DTE	Data terminal ready, true if the display is properly connected to transponder and ready

6.7.3 Check Active Alarms

1. Enter the *Alarms & Msgs* mode by pressing ***MODE*** followed by the function key **ALARMS & MSGS**. The following view should be displayed.

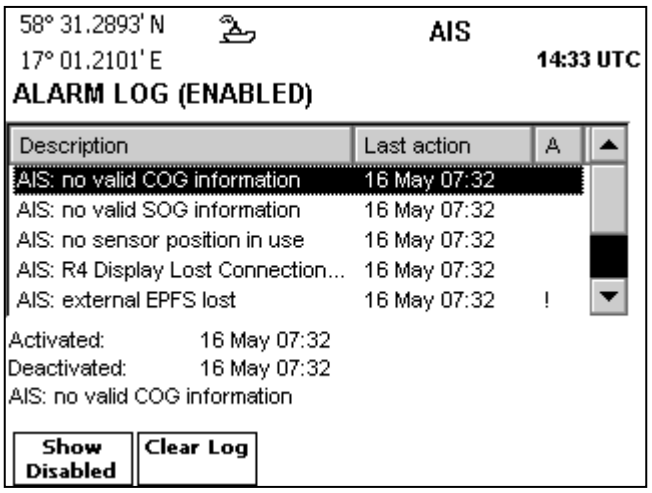


2. Press function key **Alarm List**. The following view should be displayed (an exclamation mark "!" is displayed if a given alarm is active).



The view shows the active alarms of the system. Verify that no unexpected alarms are shown.

3. Press function key **Alarm Log**. The following view should be displayed.



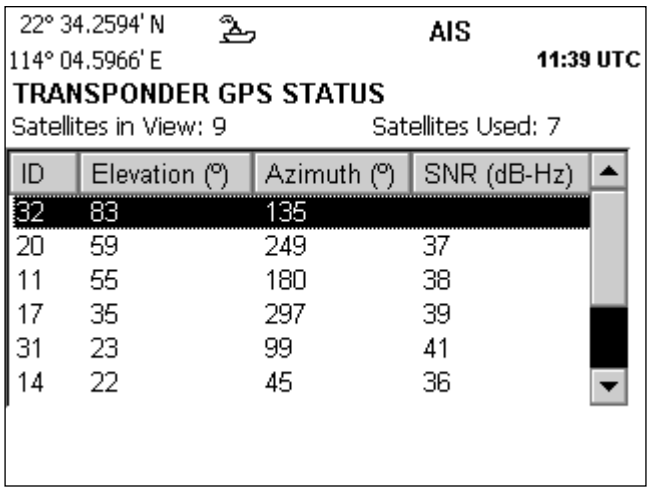
4. Press **Clear Log** to clear the alarm log from alarms that have been activated and deactivated during installation.

Note: Active alarms are not removed when the log is cleared.

6.7.4 Check Transponder's internal GPS Status

With an R4 AIS Transponder with sw version 5.2.0 or higher it is possible to monitor the internal GPS reception. Wait up to 10 seconds for information to be displayed in this view.

Enter the *Transponder GPS Status* view by pressing
MODE → **CONFIG** → **PAGE** → **System Mode** → **Transpon.GPS**.
The *Transponder GPS Status* view should be displayed:



The *Elevation* field presents each satellite's height in degrees above the horizon. The *Azimuth* field presents the satellite's angular horizontal position, counted clockwise from the north.

The *SNR* column shows the SNR for each received satellites signal. A good antenna installation should receive three or more satellites with SNR values above 50. If few satellite signals are received, and / or the received signals have low SNR ratings, this could indicate that the GPS reception is poor and that the position of the antenna needs to be adjusted. See section 4.6.1 for antenna placement guidelines.

6.8 Adjusting System Settings

The R4 AIS Transponder System is fully operational once correctly mounted, connected and configured, as have been described in this document. However, it may be desired to adjust some system characteristics to the operating environment and the preferences of the users of the system. System settings that can be adjusted includes the maximum targets shown in the plot and target list views, and enabled and disabled alarms. For information on adjustable parameters please refer to the Operator's Manual, section "Adjusting Settings" in the Reference chapter.

7 SERIAL COMMUNICATION INTERFACES

This section describes the electrical characteristics of the serial interfaces in the R4 AIS Transponder System, as their usage.

7.1 Electrical Characteristics R4 Transponder

7.1.1 Output Drive Capacity

Each talker output can have a maximum of 25 listeners drawing 2.0 mA.

7.1.2 Input Load

Input impedance for each listener input is 68 kΩ.

7.1.3 Termination

If needed, 1 kΩ line termination resistors can be placed in the terminal block on the input ports.

7.1.4 Schematics

Each of the RS422 serial interfaces on the R4 Transponder fulfils the requirements as specified in Ref. [4] and Ref. [5]. For details of the schematics, see Figure 7-1.

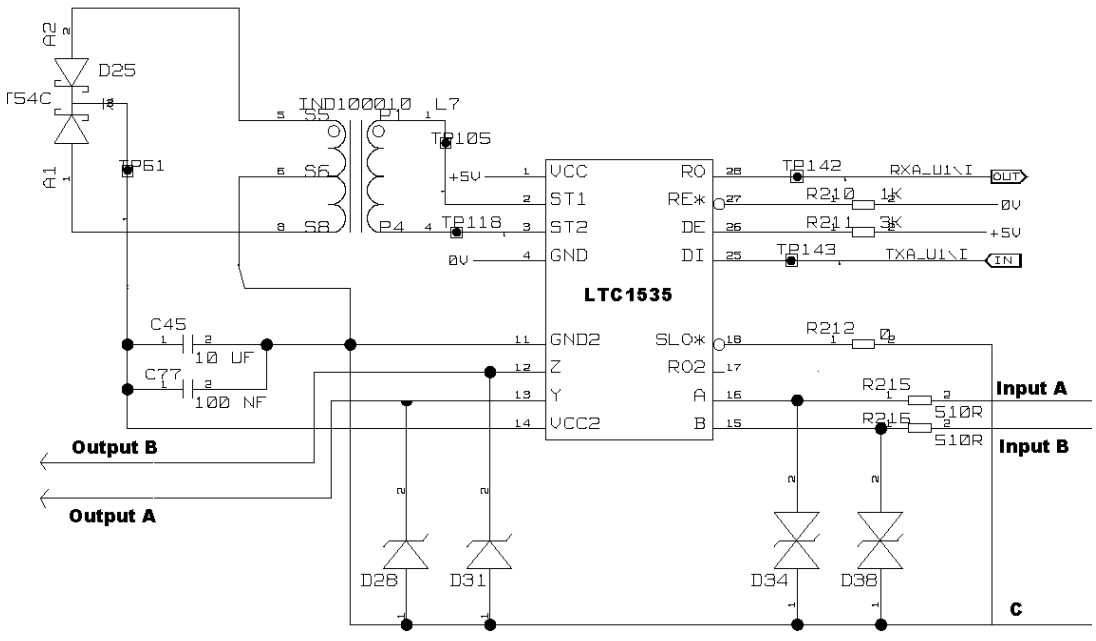


Figure 7-1: Serial interface schematics

7.2 ECDIS / Pilot systems interfaces

The two high-speed ECDIS/Pilot ports can be used to connect systems like ECDIS, ECS, ARPA-radar or stand-alone AIS displays and pilot carry aboard equipment.

The ECDIS / Pilot systems interface supports the following application functions:

- Navigation data of the own station.
- Automatic exchange of navigation data between vessels and between vessels and VTS stations and networks.
- Communication ship to ship and ship to shore in broadcast or addressed mode.
- Input of certain static and voyage related data of the own station, e.g. destination, ship size and cargo.
- Interrogation of remote transponder for specific data.
- Output of certain system and station data.

Depending on the chart system implementation the user can be provided a powerful tool to display the own ship data as well as other ships data (including navigation, static and voyage related ship data) within radio range. A chart system that fully exploits the transponder features will in addition provide application information communicated by binary messages and text communication (possibly by “clicking” predefined text strings in a communication window) between ships and shore stations.

VTS centres using a transponder system may use the same facilities as described above possibly added with additional features such as Navigation Reports and Broadcast of Radar Targets. The latter enables ships receiving this data to get the VTS radar information on display on the own ships chart system. The system allows for local applications to exchange data by using the binary messages yet not impairing any of the basic AIS functions.

Input messages are received from the application system, e.g. Electronic Chart System. The transponder system processes the input data and executes the appropriate tasks and events such as transmission on the VHF data link.

7.2.1 ECDIS / Pilot systems input data and formats

The input data and formats are shown in Table 7-1 below. Details of each sentence can be found in Ref. [2].

Additional information is given in Appendix [A.2] – Interpretation of IEC 61162-1 sentences.

Table 7-1. High-speed input data and formats

Data	IEC 61162-1 sentences
Normal access - parameter entry	
Static station information: (- Vessel name) (- Call sign) - Antenna location - Length and beam	SSD - Station Static Data (- not used, field sets to null by the R4) (- not used, field sets to null by the R4) - used to set the antenna location for the external GPS only (saved in the R4 memory)
Voyage information: - Vessel type and cargo category - Navigational status - Draught, max. actual static - Destination - ETA date and time - Regional application flags	VSD - Voyage Static Data
Long Range acknowledgement	
External manual LR acknowledgement	LRF - Long Range Function
Initiate VHF Data Link broadcasts	
Safety messages	ABM - Addressed Binary Message BBM - Broadcast Binary Message
Binary messages	ABM - Addressed Binary Message BBM - Broadcast Binary Message
Interrogation message	AIR - AIS Interrogation information
Channel setting	
Channel assignment message (set frequency)	ACA - AIS Channel Assignment message
BIIT input	
Alarm / indication acknowledgement	ACK - Acknowledgement message
Own station settings queries	
Query messages	AIQ,ACA - Query AIS Channel Assignment AIQ,SSD - Query Station Static Data AIQ,VSD - Query Voyage Static Data

7.2.2 ECDIS / Pilot systems output data and formats

The output data and formats are shown in Table 7-2 below. Details of each sentence can be found in Ref. [2].

Additional information is given in Appendix [A.2] – Interpretation of IEC 61162-1 sentences.

Table 7-2. High-speed output data and formats

Data	IEC 61162-1 sentences
Prepared by AIS transponder	
Notification that a session initiated by messages ABM, BBM, ACA, AIR is terminated	ABK - Acknowledgement message
AIS Own-ship broadcast data (all transmissions available)	VDO - VHF Data-link Own-vessel message
Query response messages	ACA - AIS Channel Assignment SSD - Station Static Data VSD - Voyage Static Data
BIIT results	
AIS equipment status	ALR - Alarm message TXT - Status/indication message
Received from Long Range equipment	
LR Interrogation	LRI - Long Range Interrogation
LR Function identification	LRF - Long Range Function
Received on VHF Data Link by AIS transponder	
All VDL AIS messages received - Broadcast or - Addressed to own station	VDM - VHF Data link Message

7.3 Sensor interfaces

The R4 Transponder unit has three interfaces (meeting IEC 61162-1 and 61162-2) for position, bottom track (BT) speed, heading and rate of turn (ROT) sensors.

In general, sensors installed in compliance with other carriage requirements of SOLAS Chapter V should be connected to the AIS. Although the fact that AIS comes on board does NOT establish a need to install additional sensors above carriage requirements.

The sensor information transmitted by the R4 AIS Shipborne Class A Transponder System should be the same information being used for navigation of the ship.

7.3.1 Sensor input data and formats

The three sensor ports support data sentences input from various types of ship sensors. The input data and format are shown in Table 7-3. Details of each sentence can be found in Ref. [2].

Additional information is given in Appendix [A.2] – Interpretation of IEC 61162-1 sentences.

Table 7-3. Sensor input data and formats

Sensor	Data	IEC 61162-1 sentences
GNSS	Positioning system: - Time of position - Latitude / Longitude - Accuracy [and integrity status] Course Over Ground (COG) Speed Over Ground (SOG) RAIM indicator	DTM, GBS, GGA, GLL, GNS, GSA, GSV, HDT, RMC, ROT, VBW, VTG, ZDA
Log	Course Over Ground (COG) Speed Over Ground (SOG)	VBW
Gyro	Heading Rate Of Turn (ROT)	HDT, ROT,THS
Rate-of-Turn Indicator	Rate Of Turn (ROT)	ROT

7.3.2 Position (GGA, GLL, GNS, RMC, DTM etc.)

GNSS position sensors normally have IEC 61162 outputs suitable for directly interfacing the R4 Transponder. However, it is important to note the following:

The Geodetic Datum of the position data transmitted by the sensor shall be WGS84 and the IEC 61162 DTM sentence should be configured.

R4 AIS Transponder is able to process two reference points for its antenna position, one for external and one for an internal sensor. Each antenna's reference point needs to be input to the AIS via the R4 Display (see section 6.6.2). The R4 AIS Transponder automatically selects the position source with the highest priority available. The priority scheme is defined by the AIS standard (Ref. [5]). The appropriate information will be used accordingly.

7.3.3 Heading (HDT)

All ships will not carry a gyrocompass according to IMO A.526. However, if a gyrocompass, which provides heading information (and possibly ROT data, see section 7.3.4), is available and it includes an IEC 61162 interface, it shall be connected to the R4 Transponder.

If the ship's gyrocompass does not provide an IEC 61162 output, a converter unit (e.g. stepper to NMEA) will be needed to connect to the R4 Transponder.

7.3.3.1 Heading Sensor Fallback Condition

The R4 transponder automatically selects the heading source with the highest priority, based on the talker identifier of the sensor sentence. The priority is according to table below.

Table 7-4. Heading sensor fallback priority

Talker Id	Priority
$HE---	Highest Priority
$HC---	
$-----	Any talker identifier. Lowest Priority

7.3.4 Rate of Turn (ROT)

All ships will not carry a Rate-of-Turn (ROT) Indicator according to IMO A.526. However, if a Rate-of-Turn Indicator is available and it includes an IEC 61162 interface, it shall be connected to the R4 Transponder.

7.3.4.1 Other ROT sources

If ROT information is not available from a Rate-of-Turn Indicator, it may (optionally) be derived through:

The gyrocompass itself (see section 7.3.3)

Other external sources giving ROT or heading

The AIS itself based on external heading

However, in any of the above cases, the AIS will only indicate the rate of turn direction (not the ROT value).

ROT data shall not be derived from COG information.

7.3.4.2 No ROT available

If no ROT information is available, the AIS will transmit default values indicating not available. ROT data will not be derived from COG information.

7.3.4.2.1 ROT sensor fallback conditions

The R4 Transponder automatically selects the ROT source with the highest priority available. The priority scheme is defined by the AIS standard (Ref. [5]).

7.3.5 Log (VBW)

If a Bottom Track (BT) Log (hereafter referred to as Speed Log) for Speed Over Ground (SOG) is available, it shall be connected to the R4 Transponder.

The R4 Transponder will derive Course Over Ground (COG) from this information.

Note that the R4 Transponder needs heading information to be able to derive SOG and COG from Speed Log data. The R4 Transponder will use the Speed Log as source for SOG and COG as long as heading information is available.

If heading information is not available, Speed Log data will not be used. In this case the R4 Transponder will use the position sensor as source for SOG and COG.

7.4 Long Range equipment interface

7.4.1 Long Range communication system

The AIS' Long Range function needs a compatible long-range communication system (e.g. Inmarsat-C or MF/HF radio).

If this is available, a connection between that communication system and the R4 Transponder can be made. This connection is needed to activate the LR function of the AIS. Its input/output port must meet the requirement of IEC 61162-2.

7.4.2 Long Range function

The Long Range reply can be set in either:

- automatic mode (AUTO)
- manual mode (MANUAL) or
- manual mode using external application (EXT APPL).

The Long Range reply, when in AUTO mode, is made as soon as a request is received on the Long Range communication port.

The Officer on the Watch must approve the Long Range reply, when in MANUAL mode, by a means of pressing a keyboard button on the display before the reply is performed.

The Long Range reply, when in EXT APPL mode, is made by the display upon reception of confirmation / acknowledgement from the external application via the high-speed ports. The external application acknowledge the interrogation by returning the LRF sentence (updated with reply information).

Current reply mode is determined by the 'Manual Reply' parameter in the *Long-Range Configuration* view. When set to 'Off', reply mode will be AUTO. If set to 'On', reply mode will be MANUAL or EXT APPL depending on whether the replies are generated by manual inputs from the display keyboard or input through the serial interface.

7.4.3 LR input data and formats

The input data and formats are in form of two Long Range interrogation sentences - LRI and LRF, see Table 7-5.

The LRI-sentence contains the information needed to determine if a reply needs to be constructed.

The LRF-sentence identifies the information items that are being requested.

Details of each sentence can be found in Ref. [2].

Table 7-5. LR input data and formats

Data	IEC 61162-1 sentences
Long Range Interrogation Type of request: - Geographic area request - AIS transponder request	LRI - Long Range Interrogation
Long Range Function identification Requestor MMSI and Name Request for: - Ship's name, call sign and IMO number (A) - Date and time of message composition (B) - Position (C) - Course over ground (E) - Speed over ground (F) - Destination and ETA (I) - Draught (O) - Ship / Cargo (P) - Ship's length, breadth and type (U) - Number of persons on board (W)	LRF - Long Range Function

7.4.4 LR output data and formats

The output data and formats are in form of four Long Range reply sentences – LRF, LR1, LR2 and LR3, see Table 7-6.

- The LRF sentence provides the ”Function Reply Status” for the requested information. Following is a list of ”Function Reply Status” characters with the status:
  2 = Information available and provided in the following LR1, LR2 and LR3 sentences.
  3 = Information not available from the AIS system.
  4 = Information is available but not provided (i.e. restricted access determined by ship’s master).
- The LR1 sentence identifies the destination for the reply and contains the information items requested by the "A" function identification character in the LRF sentence.
- The LR2 sentence contains the information items requested by the "B, C, E, and F" function identification characters in the LRF sentence.
- The LR3 sentence contains the information items requested by the "I, O, P, U and W" function identification characters in the LRF sentence.

Table 7-6. LR output data and formats

Data	IEC 61162-1 sentences
Long Range Function identification Requestor MMSI and Name Request for: - Ship's name, call sign, and IMO number (A) - Date and time of message composition (B) - Position (C) - Course over ground (E) - Speed over ground (F) - Destination and ETA (I) - Draught (O) - Ship / Cargo (P) - Ship's length, breadth and type (U) - Number of persons on board (W)	LRF - Long Range Function
MMSI of Responder MMSI or Requestor Ship's name Ship's call sign IMO number	LR1 - Long Range Response, line 1
MMSI of Responder Date and time of message composition Position Course over ground Speed over ground	LR2 - Long Range Response, line 2
MMSI of Responder Destination and ETA Draught Ship / Cargo Ship's length, breadth and type number of persons on board	LR3 - Long Range Response, line 3

7.5 RTCM interface

The AUX port (normally not used) on the R4 Transponder handles input of differential corrections in the RTCM format. When this port is configured for RTCM input (default) it accepts the following RTCM messages:

Message type 1 – Differential GPS Corrections Fixed

Message type 2 – Delta Differential GPS Corrections Fixed

Message type 9 – Partial Satellite Set Differential GPS Corrections Fixed

These messages are the ones used in the Radio Beacon Long Wave systems operated by coastguards and lighthouse authorities throughout the world. For the definition and data encoding of these messages see Ref. [3].

8 TECHNICAL SPECIFICATIONS

8.1 R4 Display

PHYSICAL

Dimensions:	Height: 207 mm Width: 270 mm Depth: 102 mm
Weight:	1.1 kg

POWER

Input Voltage:	24 VDC Nominal (21-32V)
Power Consumption:	8.4W (0.35A @ 24 VDC input)

ENVIRONMENTAL

Temperature:	-15°C to +55°C (Operational) -30°C to +80°C (Storage)
Vibrations:	IEC 60945 ed. 4.
EMC:	IEC 60945 ed. 4
Compass Safe Distance:	53 cm (for standard magnetic compass) and 28 cm (for steering magnetic compass)

8.2 R4 Transponder

PHYSICAL

Dimensions:	Height: 85 mm Width: 144 mm Depth: 226 mm
Weight:	2.3 kg

POWER

Input Voltage:	24 VDC Nominal (21-32V) The primary side of the transponder is floating with reference to chassis.
Power Consumption:	Transmit: 55W (2.3A @ 24 VDC input) Receive: 16W (0.7A @ 24 VDC input) Peak current at start up: 4A

ENVIRONMENTAL

Temperature:	-15°C to +55°C (Operational) -55°C to +85°C (Storage)
Vibrations:	IEC 60945 ed. 4.
EMC:	IEC 60945 ed. 4
Radio Type Approval:	IEC 61993-2
Compass Safe Distance:	15 cm @ 0.094 uT (5.4°/H) and 9 cm @ 0.313 uT (18°/H)

VHF TRANSCEIVER

Receivers:	156 – 163 MHz, selectable in 12.5 kHz steps (TDMA) 156.525 MHz fixed (DSC, Channel 70)
Transmitter:	156 – 163 MHz, selectable in 12.5 kHz steps
Channel bandwidth:	25 kHz
Output Power:	High: 12.5 W Low: 1 W "Tanker 1W Mode": 1W
VHF antenna connector:	BNC-Female
Antenna Input Impedance	50 ohm

INTERNAL GPS RECEIVER

Type:	L1, C/A Code, 16 Channel
Update rate:	Once per second
Accuracy (SA Off):	< 2.0 meter, Horizontal, (CEP) DGPS < 2.5 meters, Horizontal, (CEP), GPS Antenna feeding: 5 VDC
GPS Antenna connector:	TNC-Female
Antenna Input Impedance	50 ohm

8.3 AIS Alarm Relay

Max switching current:	0,1 – 5 A
Max switching voltage:	30 VDC, 250 VAC
Max switching power:	1250 VA, 150 W

9 APPENDICES

APPENDIX A.1 – REFERENCE DOCUMENTS

Ref. [1]	7000 108-131	Operator's Manual
Ref. [2]	IEC 61162-1 amended by IEC/PAS 61162-100	Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners.
Ref. [3]	RTCM SC-104	RTCM Recommended Standards for Differential GNSS Service.
Ref. [4]	IEC 61162-2	Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high-speed transmission
Ref. [5]	IEC 61993-2	Maritime navigation and radio communication and systems – Automatic Identification System (AIS), Part 2: Class A shipborne equipment of the Universal AIS – Operational and performance requirements, methods of test and required test results

APPENDIX A.2– INTERPRETATION OF IEC 61162-1 SENTENCES

GPS and Sensor Input Sentences

DTM - Datum Reference

If local code is other than WGS84, then the positions report from that port is discarded.

$--DTM,ccc,a,x.x,a,x.x,a,x.x,ccc

Field	Format	Name	Comment
1	--DTM	Sentence Id	Used
2	ccc	Local Datum Code	Interpret if it's WGS84 or not
3	a	Local Datum Subdivision Code	Ignored
4	x.x	Lat Offset (2 fields)	Ignored
5	a	Long Offset (2 fields)	Ignored
6	x.x	Altitude Offset	Ignored
7	a	Reference Datum Code	Ignored
8	x.x	Local Datum Code	Interpret if it's WGS84 or not
8	ccc	Local Datum Subdivision Code	Ignored

GBS - GNSS Satellite Fault Detection

If this sentence is received once a second from the position source in use, the RAIM flag will be set to TRUE.

$--GBS,hhmmss.ss,x.x,x.x,x.x,xx,x.x,x.x,x.x

Field	Format	Name	Comment
1	--GBS	Sentence Id	Used
2	hhmmss.ss	UTC Time of GGA or GNS	Ignored
3	x.x	Expected Error in latitude	Ignored
4	x.x	Expected Error in longitude	Ignored
5	x.x	Expected error in altitude	Ignored
6	xx	ID number of most likely failed satellite	Ignored
7	x.x	Probability of missed detection	Ignored
8	x.x	Estimate of bias in meters	Ignored
9	x.x	Standard Deviation of bias estimate	Ignored

GGA - Global Positioning System Fix Data

$--GGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx

Field	Format	Name	Comment
1	--GGA	Sentence Id	Used
2	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
3	llll.ll	Latitude	Used
4	a		
5	yyyy.yy	Longitude	Used
6	a		
7	x	GPS quality indicator	Used, 1 -> Position with Low Accuracy 2 -> Position with High Accuracy 3 -> Position with Low Accuracy 6 -> Dead Reckoning with Low Accuracy 7 -> Manual mode with low accuracy OTHER -> No Position Used when the GPS is the internal GPS (Used in proprietary sentences)
8	xx	Satellites in use	Ignored
9	x.x	Horizontal dilution of precision	Ignored
10	x.x	Antenna altitude	Ignored
11	M	Units of antenna altitude, meter	Ignored

12	x.x	Geodial separation	Ignored
13	M	Units of geodial sep.	Ignored
14	x.x	Age of differential GPS data	Ignored
15	xxxx	Differential reference station ID	Ignored

GLL – Geographic position, latitude/longitude

$--GLL,llll.ll,a,yyyy.yy,a,hhmmss.ss,A,a

Field	Format	Name	Comment
1	--GLL	Sentence Id	Used
2	llll.ll	Latitude	Used
3	a		
4	yyyy.yy	Longitude	Used
5	a		
6	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
7	A	Status	Ignored
8	a	Mode indicator	NULL -> Message is ignored A -> Position with Low Accuracy D -> Position with High Accuracy E -> Dead Reckoning Mode with Low Accuracy M-> Manual Mode with Low Accuracy OTHER -> No Position

GNS – GNSS fix data

If the Mode Indicator is a NULL field, the sentence is ignored.

$--GNS,hhmmss.ss,llll.ll,a,yyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,x.x

Field	Format	Name	Comment
1	--GLL	Sentence Id	Used
2	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
3	llll.ll	Latitude	Used
4	a		
5	yyyy.yy	Longitude	Used
6	a		
7	c--c	Mode indicator	A, P -> Position with low accuracy D, R, F -> Position with high Accuracy E -> Dead Reckoning Mode with Low accuracy M -> Manual Mode with low accuracy OTHER -> No Position
8	xx	Total number of satellites	Used when the GPS source is the internal GPS (used in proprietary sentences)
9	x.x	HDOP	Ignored
10	x.x	Antenna altitude, meter	Ignored
11	x.x	Geodial separation	Ignored
12	x.x	Age of differential corrections	Ignored
13	x.x	Differential reference station ID	Ignored

HDT - Heading, True

The use of this sentence is talker identifier dependent.

$--HDT,x.x,T

Field	Format	Name	Comment
1	--HDG	Sentence Id	Used
2	x.x	Heading, degrees true	Used if Valid indicator is T
3	T		

OSD – Own ship data

$--OSD,x.x,A,x.x,a,x.x,a,x.x,x.x,a

Field	Format	Name	Comment
1	--OSD	Sentence Id	Used
2	x.x	Heading, degrees true	Used if heading status is 'A'
3	A	Heading status	Used
4	x.x	Vessel course, degrees true	Used as COG
5	a	Course reference	Used1
6	x.x	Vessel speed	Used as SOG
7	a	Speed reference	Used1
8	x.x	Vessel set	Ignored
9	x.x	Vessel drift	Ignored
10	a	Speed units	Used to convert SOG to knots

RMC – Recommended minimum specific GNSS data

$--RMC,hhmmss.ss,A,llll.ll,a,yyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a

Field	Format	Name	Comment
1	--RMC	Sentence Id	Used
2	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
3	A	Status	Ignored
4	llll.ll	Latitude	Used
5	a		
6	yyyy.yy	Longitude	Used
7	a		
8	x.x	Speed over ground, knots	Used
9	x.x	Course over ground, degrees true	Used
10	xxxxxx	Date	Ignored
11	x.x	Magnetic variation	Ignored
12	a		
13	a	Mode indicator	NULL -> Message is ignored A -> Position with low accuracy D -> Position with high accuracy E -> Dead Reckoning Mode with Low accuracy M -> Manual Mode with low accuracy OTHER -> No Position

ROT – Rate of turn

The rate of turn value is only used if the talker identifier is TI. Otherwise the value will only be used to determine the direction, i.e. "Moving Right" or "Moving Left".

$--ROT,x.x,A

Field	Format	Name	Comment
1	--ROT	Sentence Id	Used
2	x.x	Rate of turn	
3	A	Status	

VBW - Dual Ground / Water Speed

The current position source must be external GPS, and heading must be available for the transponder to accept this sentence.

$--VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A

Field	Format	Name	Comment
1	--ROT	Sentence Id	Used
2	x.x	Longitudinal water speed	Ignored
3	x.x	Transverse water speed	Ignored
4	A	Status: water speed	Ignored
5	x.x	Longitudinal ground speed	Used if Status is set to A
6	x.x	Transverse ground speed	Used if Status is set to A

[1] SOG and COG are used if both COG reference and SOG reference are set to either: B, P, R

7	A	Status: ground speed	Used
8	x.x	Stern transverse water speed	Ignored
9	A	Status stern water speed	Ignored
10	x.x	Stern transverse ground speed	Ignored
11	A	Status stern ground speed	Ignored

VTG – Course over ground and ground speed

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a

Field	Format	Name	Comment
1	--VTG	Sentence Id	Used
2	x.x	Course over ground, degrees true	Used
3	T		
4	x.x	Course over ground, degrees magnetic	Ignored
5	M		
6	x.x	Speed over ground, knots	Used
7	N		
8	x.x	Speed over ground, km/h	Ignored
9	K		
10	a	Mode indicator	Used

ZDA – Time and date

This message is only interpreted if it's received from the internal GPS (the time synchronisation source).

$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx

Field	Format	Name	Comment
1	--ZDA	Sentence Id	Used
2	hhmmss.ss	UTC	Used
3	xx	Day (UTC)	Used
4	xx	Month (UTC)	Used
5	xxxx	Year (UTC)	Used
6	xx	Local zone hours	Ignored
7	xx	Local zone minutes	Ignored

AIS Specific Input Sentences

ABM – Addressed Binary and Safety-Related Message

!--ABM,x,x,x,xxxxxxxxx,x,x.x,s--s,x

Field	Format	Name	Comment
1	--ABM	Sentence Id	Used
2	x	Total nr of sentences	Used if in interval 1..9, otherwise the sentence is ignored
3	x	Sentence number	Used if in interval 1..total sentences, otherwise the sentence is ignored
4	x	Sequential message identifier	Used if in interval 0..3, otherwise the sentence is ignored
5	xxxxxxxxxx	MMSI of Destination	Used
6	x	AIS Channel	Used
7	x.x	Message Id	Used if 6 or 12, otherwise the sentence is ignored
8	s--s	Encapsulated Data	Used
9	x	Number of filled bits	Used

ACA – AIS Regional Channel Assignment Message

The zone created of this sentence must be accepted by the channel management rules (size of zone, distance to own position, valid channel number etc). If the zone isn't accepted, the zone will be ignored.

$--ACA,x,llll.ll,a,yyyy.yy,a,llll.ll,a,yyyy.yy,a,x,xxxx,x,xxxx,x,x,x,a,x, hhmmss.ss

Field	Format	Name	Comment
1	--ACA	Sentence Id	Used
2	x	Sequence number	Ignored
3	llll.ll	NE latitude (2 fields)	Used
4	a		
5	yyyy.yy	NE longitude (2 fields)	Used
6	a		
7	llll.ll	SW latitude (2 fields)	Used
8	a		
9	yyyy.yy	SW longitude (2 fields)	Used
10	a		
11	x	Transitional zone size	Used
12	xxxx	Channel A	Used
13	x	Channel A bandwidth	Used
14	xxxx	Channel B	Used
15	x	Channel B bandwidth	Used
16	x	Tx/Rx mode	Used
17	x	Power level	Used
18	a	Information source	Ignored
19	x	In use flag	Ignored
20	hhmmss.ss	Time of In use change	Ignored

ACK – Acknowledge Alarm

$--ACK,xxx

Field	Format	Name	Comment
1	--ACK	Sentence Id	Used
2	xxx	ID of the alarm source	Used

AIQ – Query Sentence

$--,AIQ,ccc

Field	Format	Name	Comment
1	--	Talker ID of requester	Used
2	AIQ	Talker ID for device	Used
3	ccc	Approved sentence formatter of data being requested	It's possible to query the following sentences: ACA, ALR, LRI, SSD, TXT and VSD

AIR – AIS Interrogation Request

This sentence can also be used to do a "UTC Request". It's always sent on both Channel A and Channel B (due to that this is a multiple addressed sentence).

$--AIR,xxxxxxxxx,x.x,x,x.x,x,xxxxxxxxx,x.x,x

Field	Format	Name	Comment
1	--AIR	Sentence Id	Used
2	xxxxxxxxx	MMSI 1	Used
3	x.x	Message ID 1.1	Used
4	x	Message sub section	Ignored
5	x.x	Message ID 1.2	Used, may be NULL
6	x	Message sub section	Ignored
7	xxxxxxxxx	MMSI 2	Used, may be NULL
8	x.x	Message ID 2.1	Used, may be NULL
9	x	Message sub section	Ignored

BBM – Broadcast Binary Message

$--BBM,x,x,x,x,x.x,s--s,x

Field	Format	Name	Comment
1	--BBM	Sentence Id	Used
2	x	Total number of sentences	Used if in interval 1..9, otherwise rejected
3	x	Sentence number	Used if in interval 1..total number of sentences, otherwise rejected.
4	x	Sequential message identifier	Used if in interval 0..9, otherwise rejected
5	x	AIS channel	Used
6	x.x	Message Id	Used if 8 or 14
7	s--s	Encapsulated data	Used
8	x	Number of filled bits	Used

SSD – Ship Static Data

$--SSD,c--c,c--c,xxx,xxx,xx,xx,c,aa

Field	Format	Name	Comment
1	--SSD	Sentence Id	Used
2	c--c	Call sign	Used, may be NULL
3	c--c	Name	Used, may be NULL
4	xxx	Pos ref A	Used to change position reference for the position source in use. May be NULL.
5	xxx	Pos ref B	Used to change position reference for the position source in use. May be NULL.
6	xx	Pos ref C	Used to change position reference for the position source in use. May be NULL.
7	xx	Pos ref D	Used to change position reference for the position source in use. May be NULL.
8	c	DTE	Ignored
9	aa	Source identifier	Ignored

VSD – Voyage Static Data

$--VSD,x.x,x.x,x.x,c--c,hhmmss.ss,xx,xx,x.x,x.x

Field	Format	Name	Comment
1	--VSD	Sentence Id	Used
2	x.x	Type of ship and cargo	Used
3	x.x	Maximum present draught	Used
4	x.x	Persons on-board	Used
5	c--c	Destination	Used
6	hhmmss.ss	Est. UTC of arrival	Used
7	xx	Est. day of arrival	Used
8	xx	Est. month of arrival	Used
9	x.x	Navigational status	Used
10	x.x	Regional application flags	Used

APPENDIX A.3 – PROPRIETARY INDICATIONS (TXT)

Additional to the standardised text transmissions / indications – TXT (described in IEC 61993-2) the R4 Transponder is able to output the following proprietary indications.

Text Message	Text Id	Type	Comment
AIS: SOG from External Position Source	53	Status	
AIS: SOG from Log Sensor	54	Status	
AIS: UTC Clock Ok	55	Status	
AIS: Channel Management Zone Memory Changed	56	Event	Output when the transponder has updated the zone memory.
AIS: Enter Semaphore Mode	61	Status	Output when the transponder has become semaphore.
AIS: Leave Semaphore Mode	62	Event	Output when the transponder stops being semaphore.
AIS: NVM Checksum Error	63	Event	A checksum error in the NVM.
AIS: RATDMA Overflow	64	Event	Indicates when the priority FIFO RATDMA queue is full. No more messages will be accepted until some of them have been sent.
-AIS: Tanker Low VHF Power Mode	66	Status	Output when the transponder is in 1 W VHF Power Mode.

APPENDIX A.4 – PROPRIETARY OUTPUT SENTENCES (PSTT)

Additional to the standardised IEC sentences (described in IEC 61993-2) the R4 AIS Transponder is able to output the following proprietary sentences.

$PSTT,10A – UTC Date and Time

This sentence provides UTC Date and Time, i.e. R4MkII System Time (based on internal GNSS time). It is output approximately once every 10 seconds (± 1 s).

$PSTT,XXX,YYYYMMDD,HHMMSS

Field	Format	Name	Type	Range
1	10A	Sentence Id	Unsigned char	10A always
2	YYYYMMDD	Date	Char[8]	Year, month and day in decimal notation. (00000000 = Not available)
3	HHMMSS	Time	Char[6]	Hour, minute and second in decimal notation. (999999 = Not available)

Example: `$PSTT,10A,19961028,135230*<FCS><CR><LF>`

= Date October 28, 1996

= Time 13:52:30 UTC

$PSTT,10C – Data Link Status

This sentence provides information about the traffic on the VHF data link. It is output approximately once every 60 seconds. Traffic load is calculated over the last frame (i.e. 60 seconds). Number of units is derived from the internal user list and is generally the number of received units within the last few minutes.

$PSTT,10C,C,S,LLL,NNNN

Field	Format	Name	Type	Range
1	10C	Sentence Id	Unsigned char	10C always
2	C	Channel	Unsigned char	A = VDL channel A B = VDL channel B
3	LLL	Traffic Load	Unsigned short	Data link traffic load in percent, 0-100, which equates to 0 to 100%.
4	NNNN	No of Units	Unsigned short	No of units occupying the data link.

$PSTT,1F3 – Transponder Restart

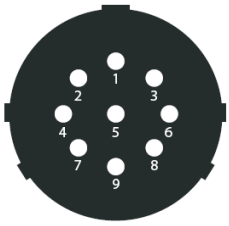
This sentence will be output when the transponder has restarted.

$PSTT,1F3,R

Field	Format	Name	Type	Range
1	1F3	Sentence Id	Unsigned char	1F3 always
2	R	Restart Reason	Unsigned char	0 = Unknown 1 = Cold Start 2 = General Protection Fault 3 = Power Fail 4 = Warm Start

APPENDIX A.5 – PILOT PLUG CONNECTOR CHARACTERISTICS

This appendix describes the connections of the Pilot Plug port and the Pilot Plug connector located on the front of the R4 Display. The connections of the Pilot Plug port are directly forwarded to the 9-pin connector plug available on the front of the R4 Display. The pin numbering of the front plug is described in the figure below.



Front plug pin numbering

The connections between the signal cable and the front plug are listed in following table.

Internal Signal to Pilot plug connections in the R4 Display

Pilot plug	Signal plug	Color in signal cable
PIN 9	PIN 12	Shield
PIN 1	PIN 13	Violet
PIN 5	PIN 15	Red/blue
PIN 4	PIN 16	Black
PIN 6	PIN 18	Gray/pink

APPENDIX A.6 – TRANSPONDER GPS-CABLE SELECTOR

The table below gives recommendation on cables that can be used for the Transponder GPS-antenna connections. Due to the high frequency it's important that the attenuation in the cable is low for the specific frequency (1.5 GHz).

Type	Attenuation @ 1.5 GHz (dB/m)	∅ (mm)	Weight (kg/100m)
RG 58	0.9	5	3.7
RG 400	0.6	4.95	6.3
RG 223	0.6	5.40	5.5
RG 214	0.35	10.8	18.5
RG 225	0.3	10.9	23.3

For optimum performance of the transponder approximately +10dB gain should be available when the cable attenuation has been subtracted from the GPS-antenna preamplifier gain. The net gain shall not exceed +26dB.

Example:

Cable type	Preamplifier Gain (dB)	Required min cable length (m)	Recommended max. cable length (m)
RG 58	12	0	2
RG 58	26	0	18
RG 58	30	4.5	22
RG 223	12	0	3.5
RG 223	26	0	26.5
RG 223	30	6.5	33.5
RG 214	12	0	6
RG 214	26	0	46
RG 214	30	11.5	57

Min length = (Preamp. Gain – 26 dB)/Cable attenuation per meter

Max length = (Preamp. Gain – 10 dB)/Cable attenuation per meter

APPENDIX A.7 – TRANSPONDER VHF-CABLE SELECTOR

The table below gives recommendation on cables that can be used for the VHF-antenna connections. The cable attenuation shall be kept as low as possible, a 3 dB loss is the same as a reduction of the input and output signal to a half.

Type	Attenuation @ 150 MHz (dB/100m)	∅ (mm)	Weight (kg/100m)
RG 214	7	10.8	18.5
RG 217	5	13.8	30.1
RG 225	8	10.9	23.3

Ex: A cable of 40 meter RG 214 has a cable attenuation of 2.8 dB.

APPENDIX A.8 – GLOSSARY

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
AUX	Auxiliary port – A communication port on the AIS transponder, which can be used for RTCM input
BIIT	Built In Integrity Test
COG	Course Over Ground
dB	Decibel
DGNSS	Differential Global Navigational Satellite System
DC	Direct Current
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information System
EPFS	Electronic Position Fixing System
GNSS	Global Navigation Satellite System – A common label for satellite navigation systems (such as GPS and GLONASS)
GPS	Global Positioning System
HF	High Frequency
IALA	International Association of Lighthouse Authorities
IEC	International Electro-technical Commission
IMO	International Maritime Organization
ITU	International Telecommunications Union
LED	Light Emitting Diode
LR	Long Range
MKD	Minimum Keyboard and Display
MMSI	Maritime Mobile Service Identity
N/A	Not Applicable
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
PI	Presentation Interface
RATDMA	Random Access Time Division Multiple Access
ROT	Rate Of Turn
RTCM	Radio Technical Commission for Maritime Services
Rx	Receive
PPU	Personal Pilot Plug
SAR	Search And Rescue
SOG	Speed Over Ground

SOLAS	International Convention on the Safety of Life at Sea, 1974
SRM	Safety Related Message
TDMA	Time Division Multiple Access – An access scheme for multiple access to the same data link
Tx	Transmit
UTC	Universal Time Coordinated
VDL	VHF Data Link
VHF	Very High Frequency – A set of frequencies in the MHz region
VSWR	Voltage Standing Wave Ratio
VTS	Vessel Traffic Service

APPENDIX A.9 – INSTALLATION WIRING DIAGRAM