Saab TransponderTech

INSTALLATION MANUAL R4-AIS Shipborne Class A Transponder System

SAAB

i COPYRIGHT

Saab TransponderTech AB, SWEDEN

ii Safety instructions

Note the following compass safe distances:

Equipment	Compass safe distance [m]
R4 Transponder	0,2
R4 Display Unit	0,6

CONTENTS

1 INTRODUCTION

1.1 About this manual

This manual, together with Ref. [1], provides in-depth information to facilitate installation of the Saab TransponderTech R4-AIS Shipborne Class A Transponder System.

1.2 Unpacking the equipment

When unpacking the equipment, please check that the following is included in the delivered package. If any of the parts are missing, please contact the Saab TransponderTech dealer.

Standard package:

Name	Qty.
R4 Display Unit	1
R4 Transponder Unit	1
AIS Alarm Relay Unit incl. socket	1
R4 Display Power cable	1
R4 Transponder Power cable	1
R4 Display Signal cable	1
R4 Transponder Signal cable	1
Operators Manual	1
Installation Manual (this document)	1

Optional accessories:

Name	Qty.
GPS antenna, AeroAntenna, AT 575-68	1
VHF antenna SAAB 1012	1

1.3 System overview

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

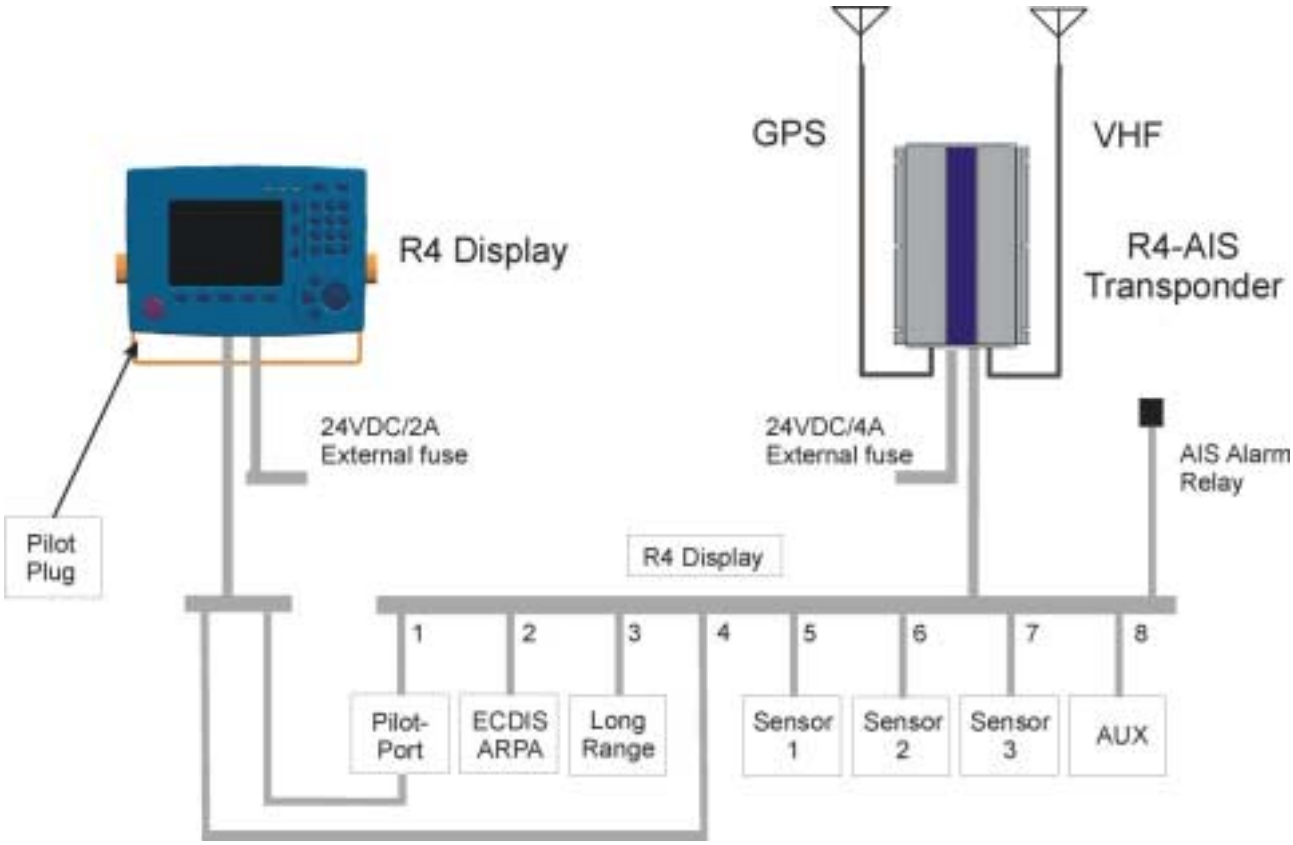


Figure 1: R4-AIS Transponder System overview

2 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

2: Mount the R4 Transponder

3: Mount the alarm relay unit

4: If the Pilot Plug on the R4 Display is not to be used, mount the external Pilot Plug

5: Mount the VHF antenna

6: Mount the GPS antenna

7: Connect the wiring to the R4 Transponder and R4 Display

8: Power up the system

9: Set configuration parameters

10: Initial functional check (done after steps 1-9 has been done).

Note: The procedure as described is a recommendation. Some steps can be made in another order.

2.1 R4 Display Unit

2.1.1 Location

The functionality of the R4 Display shall be available to the mariner at the position from which the ship is normally operated. It is therefore recommended to place the R4 Display on the bridge console at a suitable position, see schematic bridge installation in section 2.15. When mounting the R4 Display please consider the following:

- Mount the unit on a wall, in the ceiling 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 are a high flow of humid salt air
- Avoid 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.
- The unit can affect magnetic compasses. Use a minimum of 0,6 m to nearest magnetic compass.

2.1.2 Clearance area

Leave a clearance around the R4 Display to facilitate service and installation. See recommended clearance area in section 2.13.

2.1.3 Physical mounting measurements

See section 2.12.

2.1.4 Cabling

Use the cables included, one for power supply and one data cable for connection to the R4 Transponder unit. For wiring details, see section 2.7.1.

2.1.5 Power Supply

The R4 Display shall be connected to an emergency power source. If connected to a battery, power calculations must be made for the battery capacity. For power consumption, see section 3.2.

The R4 Display is designed to operate on 24 volts DC. To avoid power and voltage drops in the feed line it is important that sufficient size of cable is used.

Install according to section 2.7.1.

2.2 R4 Transponder Unit

2.2.1 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 are a high flow of humid salt air
- Avoid high levels of vibrations and shocks.
- Ensure that there is enough airflow to avoid high ambient temperatures.
- The unit can affect magnetic compasses. Use a minimum of 0,2 m to nearest magnetic compass.
- Install the R4 Transponder as close as possible to VHF/GPS antennas to minimise cable lengths.

2.2.2 Clearance area

Leave a clearance around the R4 Transponder to facilitate service and installation. See recommended clearance area in section 2.11.

2.2.3 Physical mounting measurements

See section 2.11.

2.2.4 Cabling

Use the cables included, one power supply and one for data cable for connection to interfacing equipment such as Display, sensors, etc. For wiring details, see section 2.7.2.

Connect the VHF and GPS antennas to the R4 Transponder.

2.2.5 Power Supply

The R4 Transponder shall be connected to an emergency power source. If connected to a battery, power calculations must be made for the battery capacity. For power consumption, see section 3.1.

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 2.7.2.

2.2.6 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).

2.3 AIS Alarm Unit

It is required that the 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 2.

Note: Detailed wiring diagrams with cable colours are included with the cable in the delivery package.

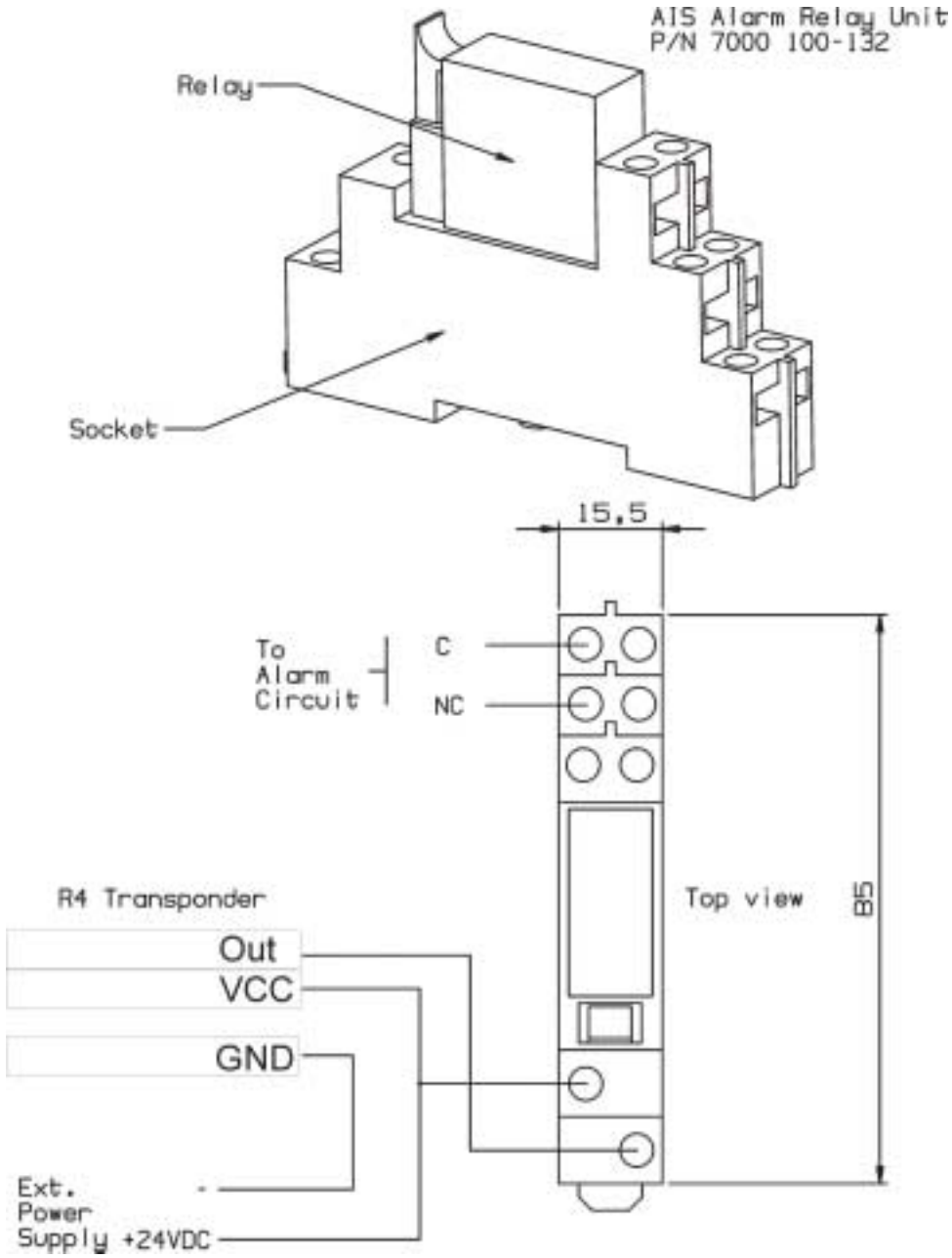


Figure 2: Alarm Relay Wiring

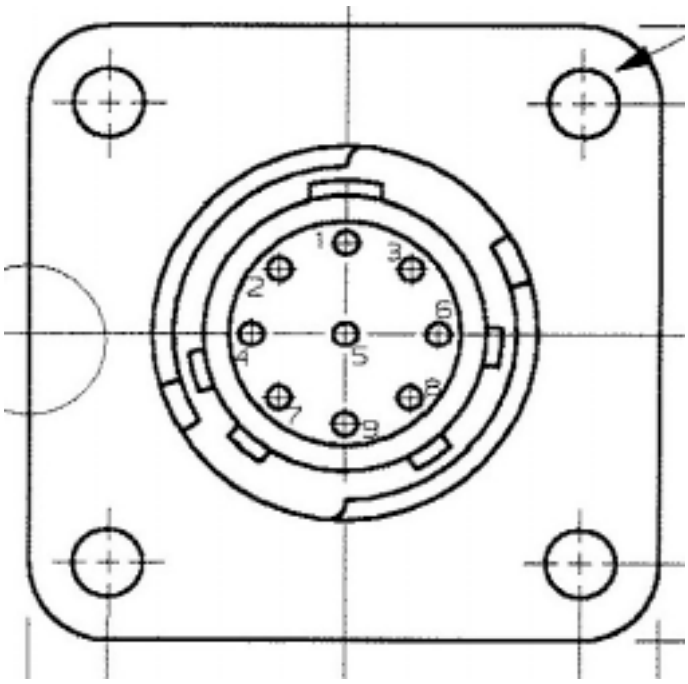
2.4 Pilot Plug

The pilot plug, for connecting the Personal Pilot Unit(PPU), is located on the front of the R4 Display, see Figure 3.

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 following plug (or physical and electrical equivalent plug):

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

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



2.5 VHF antenna

The R4 Transponder shall be connected to a VHF antenna.

The R4-AIS Shipborne Class A Transponder System, 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 20 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 can greatly affect its efficiency.

2.5.1 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

2.5.2 Antenna type

The AIS VHF antenna should have omni directional vertical polarisation providing 3 to 5 dBi gain.

2.5.3 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 (162.025MHz)). 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.

2.5.4 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 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.

2.5.5 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.

2.5.6 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.6] – VHF-cable selector.

2.5.7 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.

2.5.8 Grounding

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

2.6 GPS antenna

The R4 Transponder shall be connected to a GPS AeroAntenna, AT 575-68 or equivalent GPS antenna.

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.

2.6.1 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 must not eclipse more than a few degrees of any given bearing.

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° horizontally from the array's center point) and/or Inmarsat systems (A, B, C, or M; typically ±10º from the array's center 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.

2.6.2 Cabling

To achieve optimum performance, 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 10 dB.

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.5] – GPS Cable Selector.

2.6.3 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.

2.6.4 Grounding

Coaxial down-leads must be used for all receiving antennas, and the coaxial shielding screen should be connected to ground at one end.

2.7 Wiring Input/Output connections

2.7.1 R4 Display cable connections

Figure 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 1: Detailed wiring diagrams with cable colours are included with the cable in the delivery package.

Note 2: The AUX port is normally not connected.

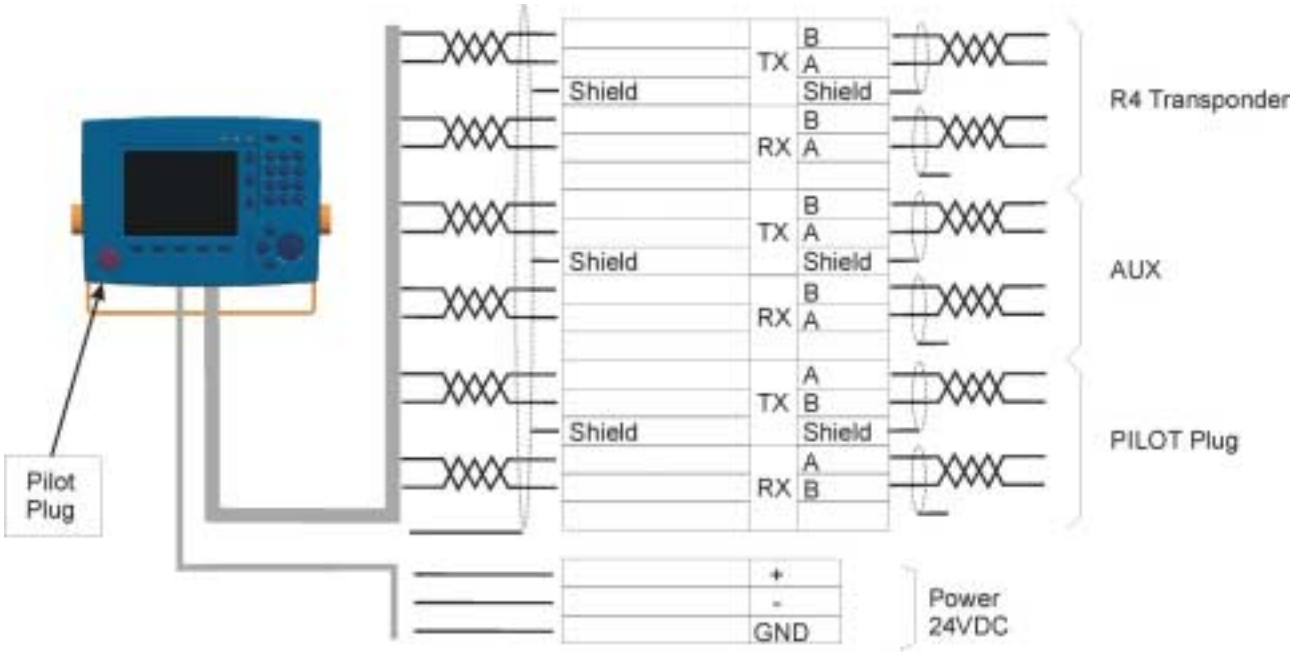


Figure 3: Wiring diagram for the R4 Display

2.7.2 R4 Transponder cable connections

Figure 4 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.

Note: Detailed wiring diagrams with cable colours are included with the cable in the delivery package.

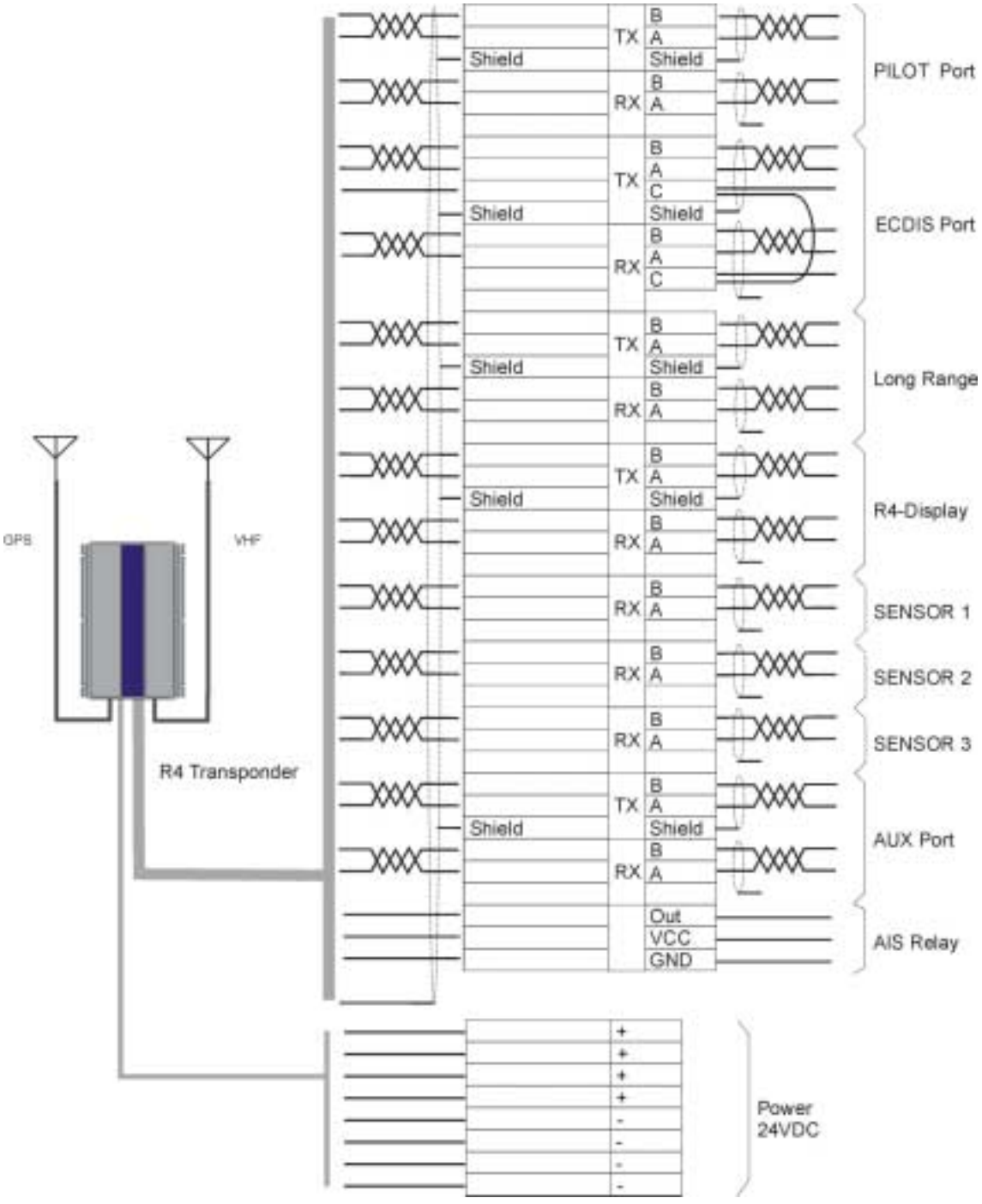


Figure 4 : Wiring diagram for R4 Transponder

2.7.2.1 Sensor 1, 2 and 3

Sensor ports 1, 2 and 3 should be connected to sensors for position, bottom track (BT) speed, heading and rate of turn (ROT). RX on the R4 Transponder should be connected to TX on the sensors. The R4 Transponder sensor ports meet IEC 61162-1/2. Section 2.16.3 should be consulted before doing the installation.

2.7.2.2 Pilot port

The pilot port should be connected to the port on the R4 Display designated PILOT Plug. Note, the TX should be connected to TX on the R4 Display pilot plug and the RX should be connected to RX on the R4 Display pilot plug, see Figure 3 and Figure 4.

2.7.2.3 ECDIS port

The ECDIS port should be connected to the ECDIS system. 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. Section 2.16.3 should be consulted before doing the installation.

2.7.2.4 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. Section 2.16.3 should be consulted before doing the installation.

2.7.2.5 R4 Display

The R4 Display port should be connected to the port on the R4 Display designated "R4 Transponder". The TX on the R4 Transponder cable should be connected to RX on the R4 Display and the TX should be connected to the RX on the R4 Display, see Figure 3 and Figure 4.

2.7.2.6 AUX port

This port is normally not connected!

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. Section 2.16.3 should be consulted before doing the installation.

2.8 System configuration and settings

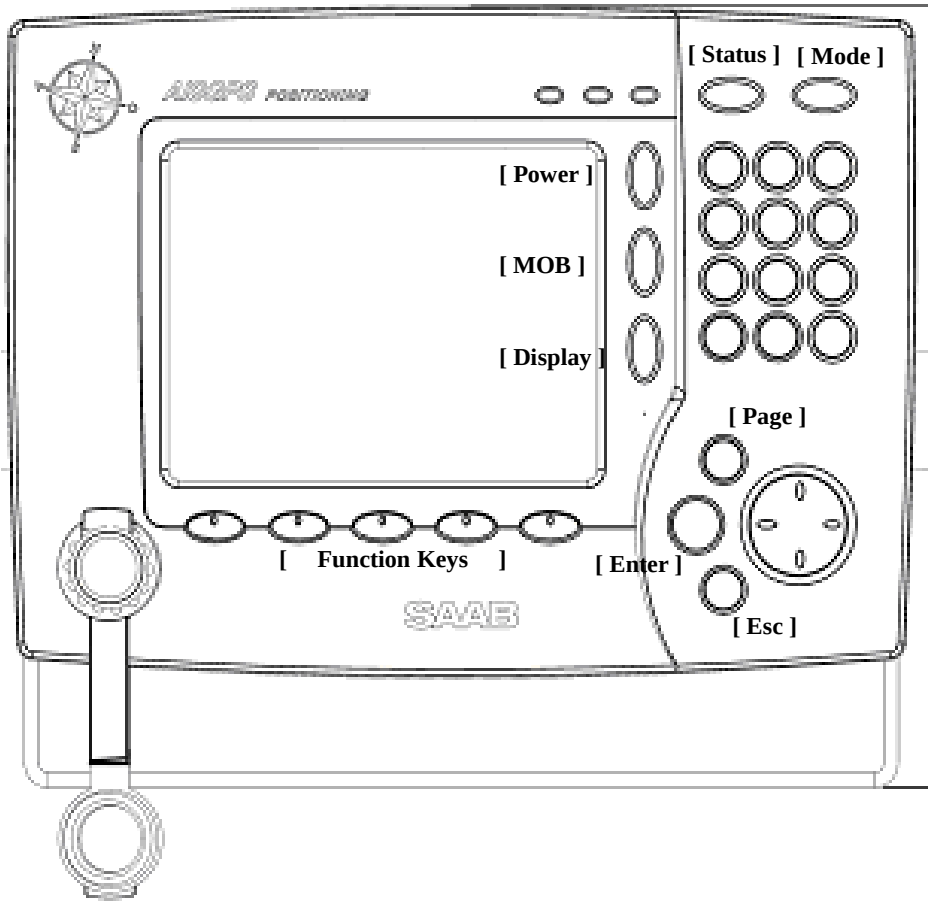
The installer is required to set the following parameters at the initial installation of the R4-AIS Shipborne Class A Transponder System:

- MMSI number (Maritime Mobile Service Identity)
- IMO vessel number
- Call Sign (Radio Call Sign)
- Ship Name
- Height Over Keel
- Type of ship
- GPS antenna position(s)
- Radio settings

All parameters are set via the R4 Display. To be able to set all parameters when configuring the system, Engineering Mode should be activated, see 2.8.3. To set the parameters, follow the steps as described in the following sections. Note that setting IMO, MMSI number and Radio Parameters requires the User to enter the User Password (default =user).

2.8.1 R4 Display Keys

The R4 Display has a number of keys that are used to navigate in the menus and enter values. Each key is described below.



[**Function keys**] These keys have different functions depending on the view. The function of the key is displayed above the key on the screen.

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

(**Enter**) Used for confirming data entry.

(**Page**) Returns display from a sub view to the main view.

(∧ ∨) Moves the field highlight up and down from field to field.

(< >) Moves the field highlight left and right from field to field.

(**Status**) Used for display and change status for the own ship.

(**Mode**) The different main views are displayed.

(**Mob**) Man over board.

(**Display**) Display back light and contrast.

(**Power**) Used for turning the M4 display on and off. For turning the power off press and hold the key for about 2 seconds.

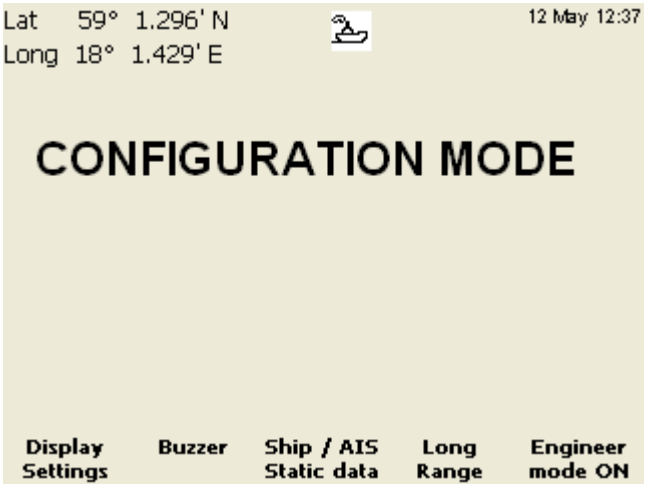
(**Numbers/Characters**) These keys are used when editing messages, passwords and so on. To write a number just press the key with the right number. To write a alphanumerical character press the key with the right character. Press two times for the first character, three times (before the cursor appeared) for the second character, four times for the third character and five times for the fourth character.

2.8.2 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. When the system is started, there may be some alarms displayed depending on what sensors that have been connected to the system. If any alarms are displayed, acknowledge/clear them by pressing the "Enter" key until the alarms are not displayed any more. To continue the system configuration, see the following sections.

2.8.3 Engineering Mode

Before configuring the system the user needs to enter the Engineering Mode. To do this press the MODE key and then press the function key “Config”. The following should be displayed:



Entering Engineering Mode:

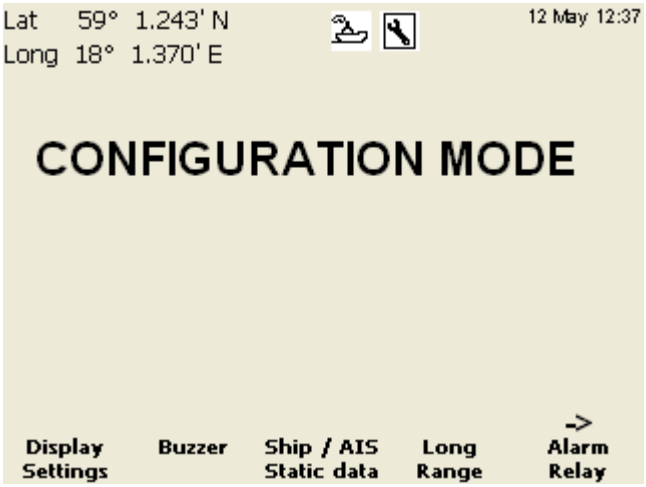
1. Enter Engineering Mode by pressing the function key “Engineering Mode ON”

2. Use (<>) to select “YES” or “NO” and press (Enter)

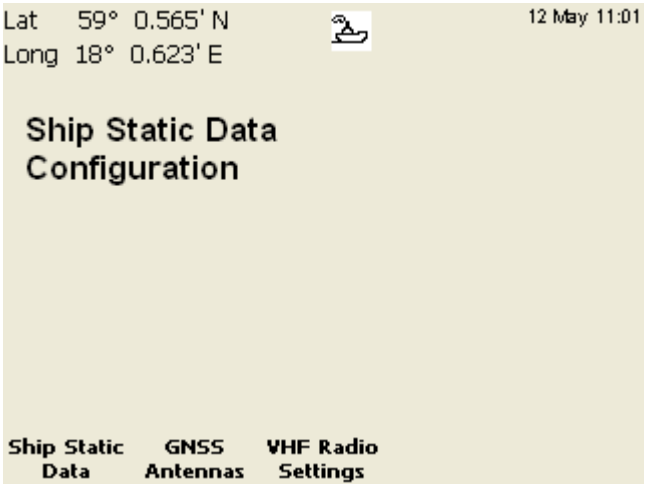
3. To set parameters etc. follow the steps as described in the following sections.

2.8.4 MMSI , IMO number, Call Sign, Ships Name, Height Over Keel

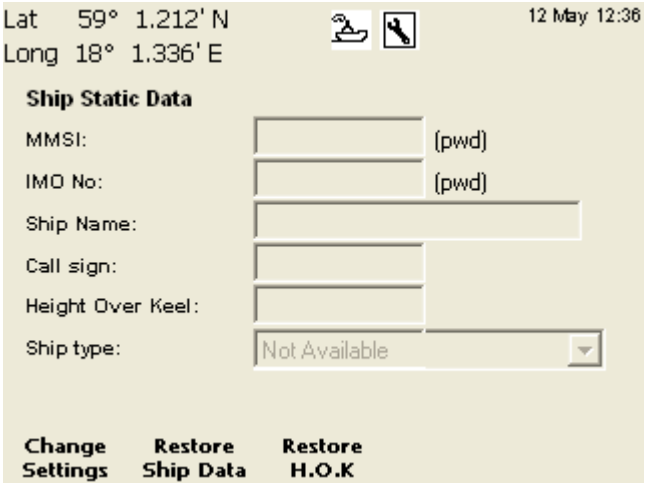
Go to the Configuration Menu by pressing the MODE key and then press function key “Config”. The following view should be displayed:



Press the function key “Ship / AIS Static”. The following view should be displayed:



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



Change Ship Static Data or Height Over Keel:

1. Enter edit mode by pressing function key “Change Settings”

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.

4. Repeat procedures 2-3 for every field.

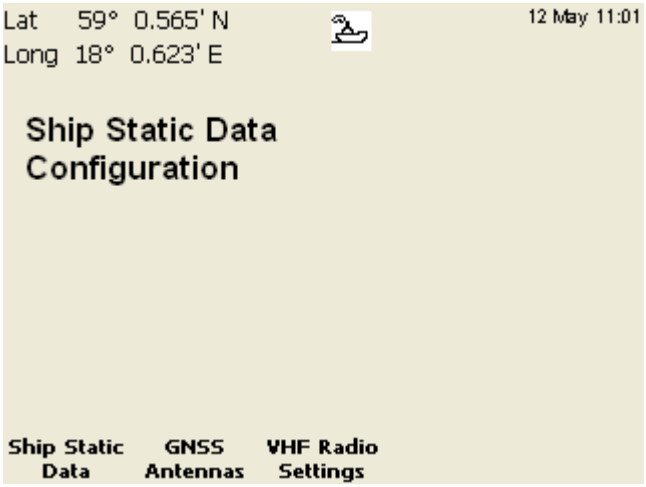
5. Exit edit mode by pressing function key “Apply and Exit”

Note: Changing MMSI or/and IMO number requires a User Password (default = user). Enter it in the pop up window that appears on the screen. Use the function key “Capslock” to choose between upper and lower case letters.

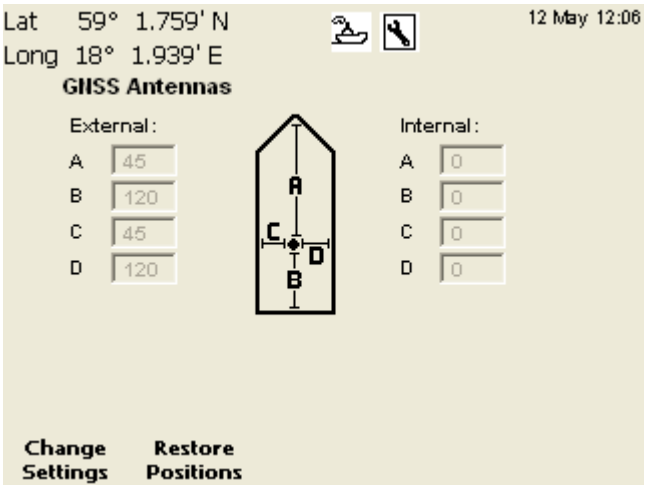
Press ESC to return to previous view.

2.8.5 GPS antenna position

The following view should be displayed:



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



Change ships Antenna Positions

Normally the R4 internal GPS is used. However, it is possible to connect an external GPS antenna to the system. To change external/internal GPS values follow the procedure below.

1. Enter edit mode by pressing function key “Change Settings”

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”

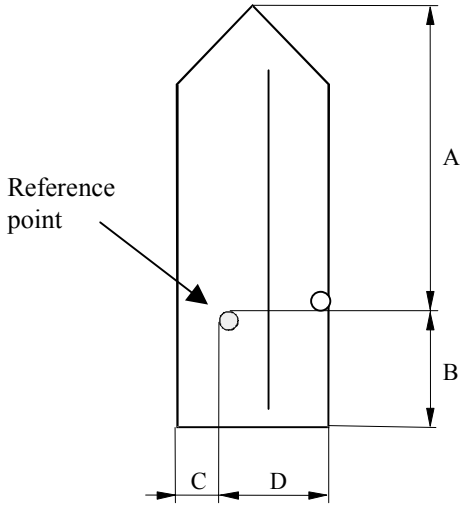
Press ESC to return to previous view.

Choosing values for A, B, C and D

The R4-AIS Shipborne Class A Transponder 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 5.

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 $B \neq 0$ and $D \neq 0$.
Neither reference point of reported position nor dimensions of ship available:
$A = B = C = D = 0$ (=default)

Figure 5 Reference point

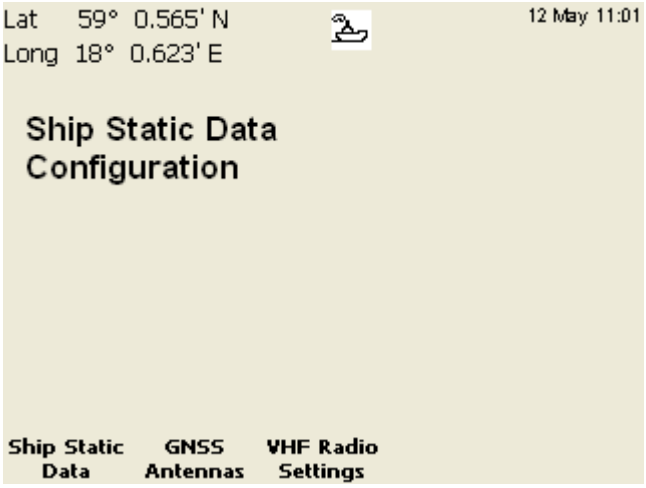
Note: If the GNSS antenna is installed in the portside corner of a rectangular bow, one of the values A or C should be set to 1.

2.8.6 Radio settings

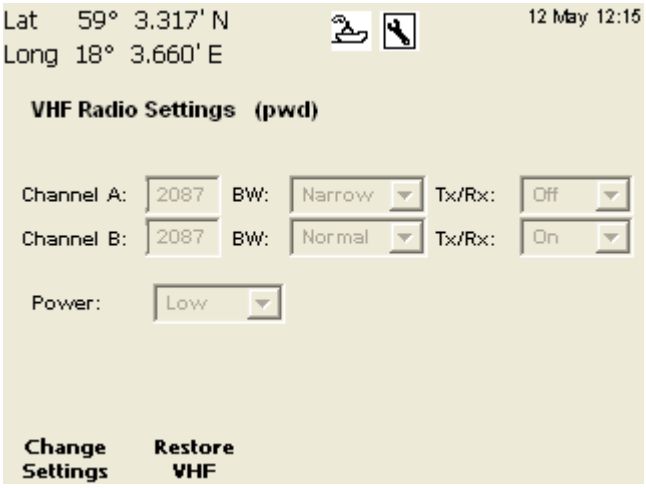
The radio parameters have a default setting. Normally it is not needed to update these settings. The default settings are:

AIS 1	Channel 2087
AIS 2	Channel 2088
DSC	Channel 70

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



Press the function key “VHF Radio Settings”. The following view should be displayed:



Change VHF Radio Parameters

1. Enter edit mode by pressing function key “Change Settings”

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.

4. Repeat procedures 2-3 for every field.

5. Exit edit mode by pressing function key “Apply and Exit”

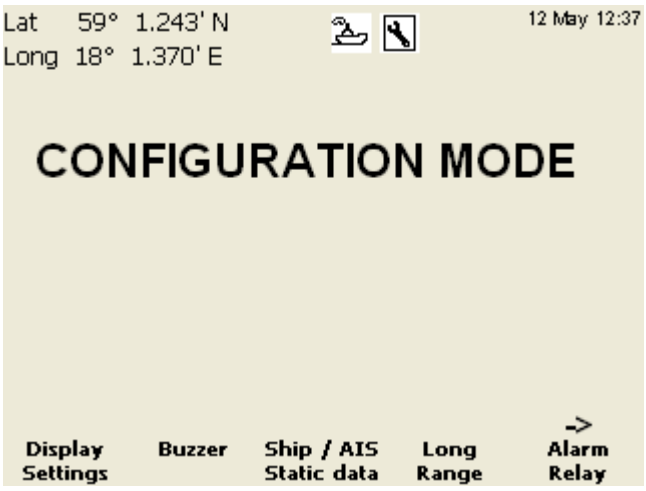
Note: To set the parameters, enter the User Password (default = user) in the pop up window that appears on the screen.

Press ESC to return to previous view.

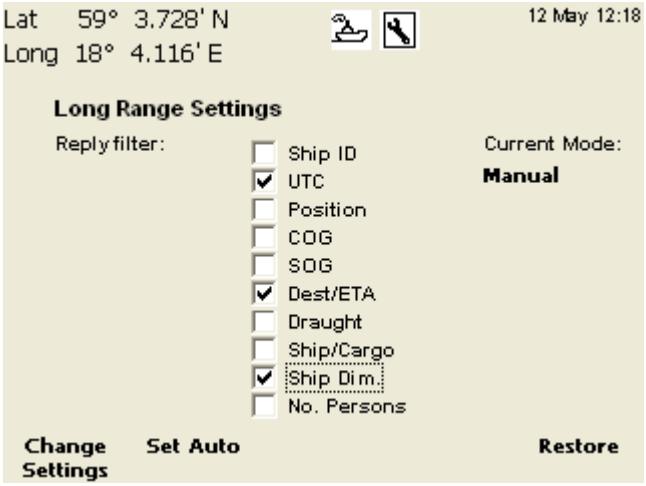
2.8.7 Long Range Settings

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 function key “Long Range”. The following view should be displayed:



1. Press function key “Change Settings”
2. Use the (∧ ∨ < >) keys to select the data to be edited
3. Change filter settings by pressing the function key “ON/OFF”
4. Repeat 2-3 for each filter setting.
5. Press function key “Apply and Exit”

To set the default Long Range settings, press function key “Restore”.

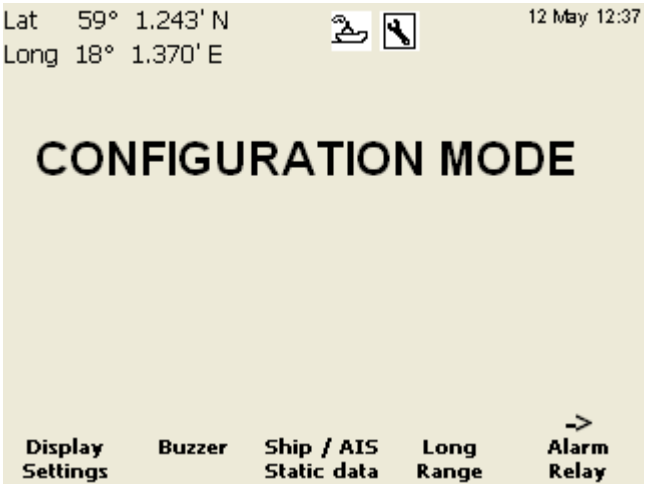
Auto or manual acknowledge

1. Use the function key “Set Auto/Man” to toggle between auto and manual acknowledge.

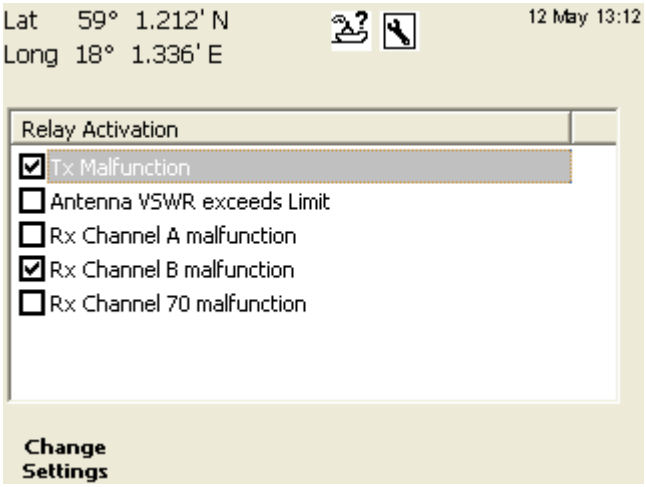
Press ESC to return to previous view.

2.8.8 Alarm Relay

The “Alarm Relay” view allows the user to turn alarms ON or OFF. To do this, start from the following view and follow the steps described:



Press the function key “Alarm Relay”. The following view should be displayed:



Turn an alarm ON/OFF

1. Enter edit mode by pressing function key “Change Settings”

2. Use (∧ ∨) to select an alarm

3. Turn the alarm on or off by pressing the function key “Enable/Disable”

4. Exit edit mode by pressing function key “Apply and Exit”

Press ESC to return to previous view.

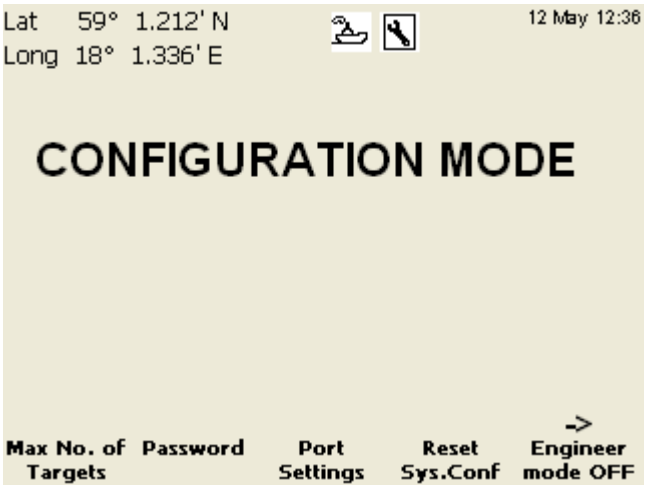
2.8.9 I/O port settings

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:

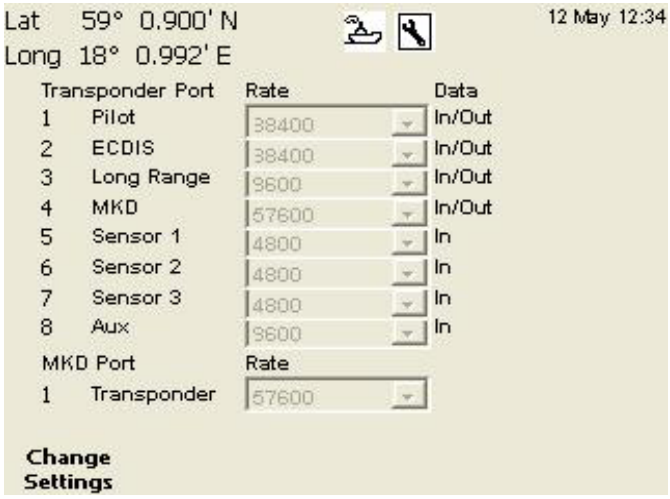
Table 2-1: Port settings

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 2-1 the corresponding port on the R4 must be configured at installation. If a change is needed, enter the “Configuration Mode” and press the function key “Page”. The “following view should be displayed:



Press the function key “Port Settings”. The following view should be displayed:



Edit port parameters

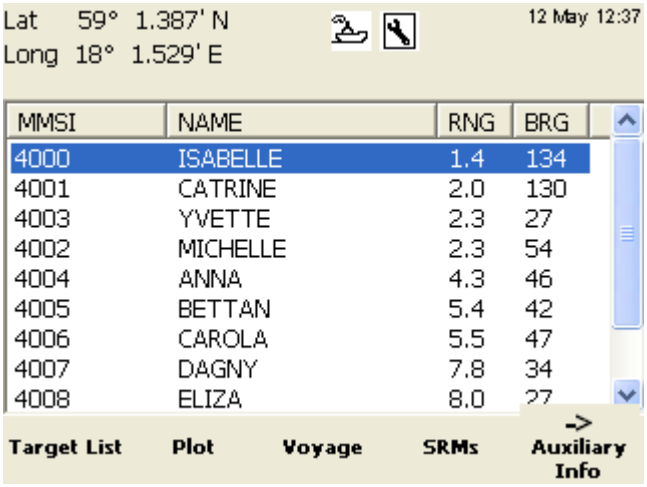
1. Enter edit mode by pressing function key “Change Settings”
2. Use (∧ ∨) to highlight the data to be changed and press (Enter).
3. Use (∧ ∨) to select the value and press (Enter)
4. Exit edit mode by pressing function key “Apply and Exit”

Press ESC to return to previous view.

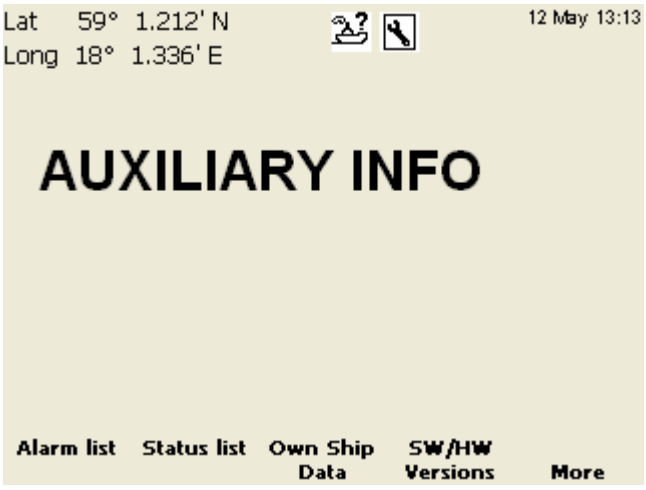
2.8.10 System functional check

When the R4 AIS System has been installed 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. Before doing this check, the system must be in “Engineering Mode”, see section 2.8.3.

1. Press Mode key and then press function key “AIS”. If the system asks if you want to stay in “Engineering Mode”, answer “YES” by pressing “Enter”. When done, press the Page key. The following view should be displayed:



2. Press function key ”Auxiliary Info”. The following view should be displayed:



3. Press function key “Own Ship Data” The following view should be displayed:

4. Verify that the displayed parameters are correct.

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

2.9 Installation Cables

2.9.1 R4 Transponder Data Cable

Type: 15-Pair x 0,25 mm Shield – Wire AWG 24

Length: 2000 mm

Connector: 50-pole HD DSUB(female)

2.9.2 R4 Transponder Power cable

Type: 4-Pair x 0.5 mm^2 – Wire AWG 20

Length: 2000 mm

Connector: 9-pole DSUB(female)

2.9.3 R4 Display Data Cable

Type: 6-Pair x 0,25 mm Shield – Wire AWG 24

Length: 2000 mm

Connector: ConXall Maxi-Con-18pin(female)

2.9.4 R4 Display Power cable

Type: –3 x 0.5 mm^2 – Wire AWG 20

Length: 2000 mm

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

2.9.5 VHF antenna cable

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

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

Connector: BNC (Female)

2.9.6 GPS antenna cable

Type: See Appendix [A.5] – GPS-cable selector

Length: See Appendix [A.5] – GPS-cable selector

Connector: TNC (Female)

2.10 Mechanical drawing R4 Transponder

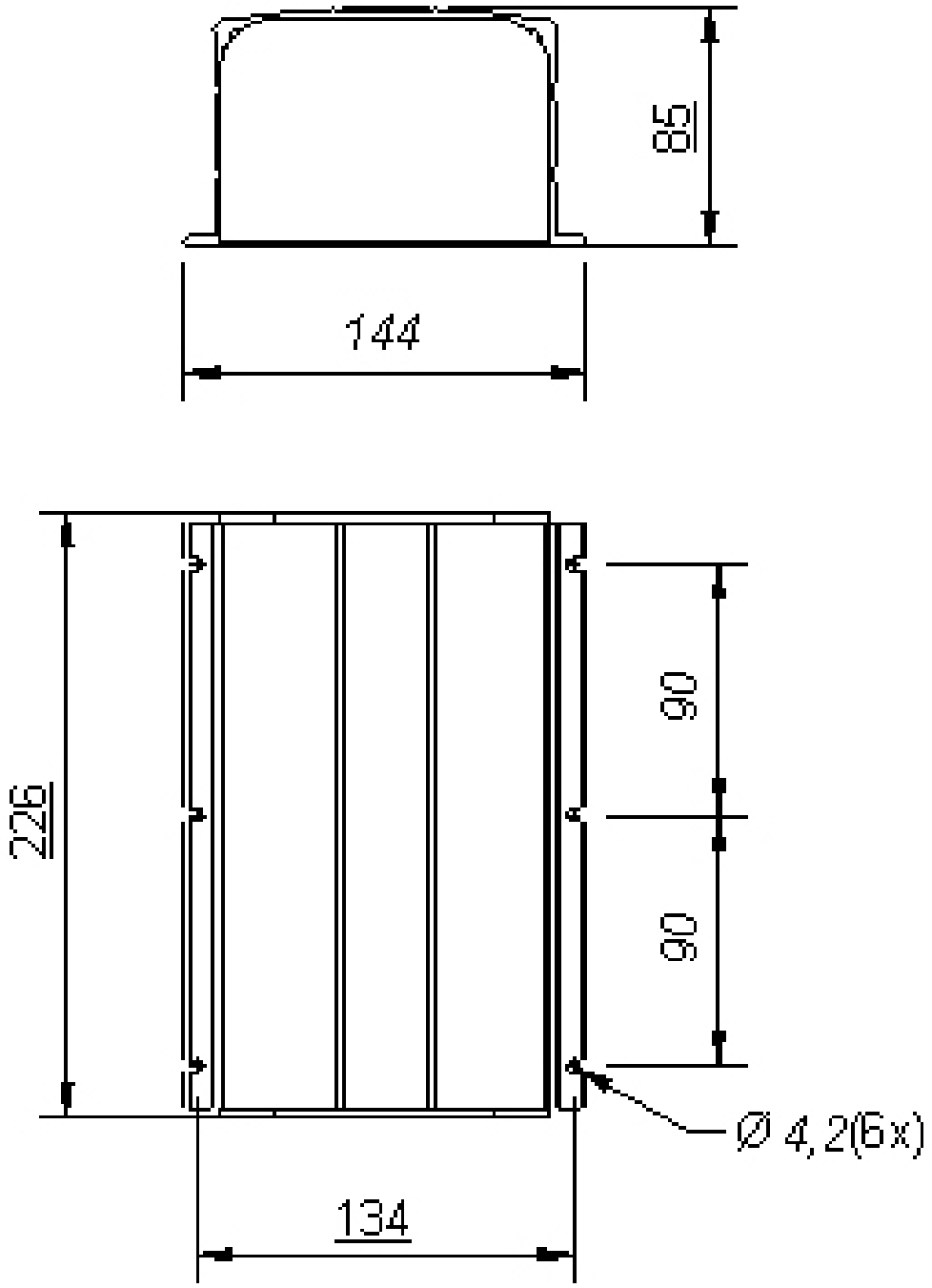


Figure 6: R4 Transponder mechanical drawing

2.11 Clearance area for R4 Transponder

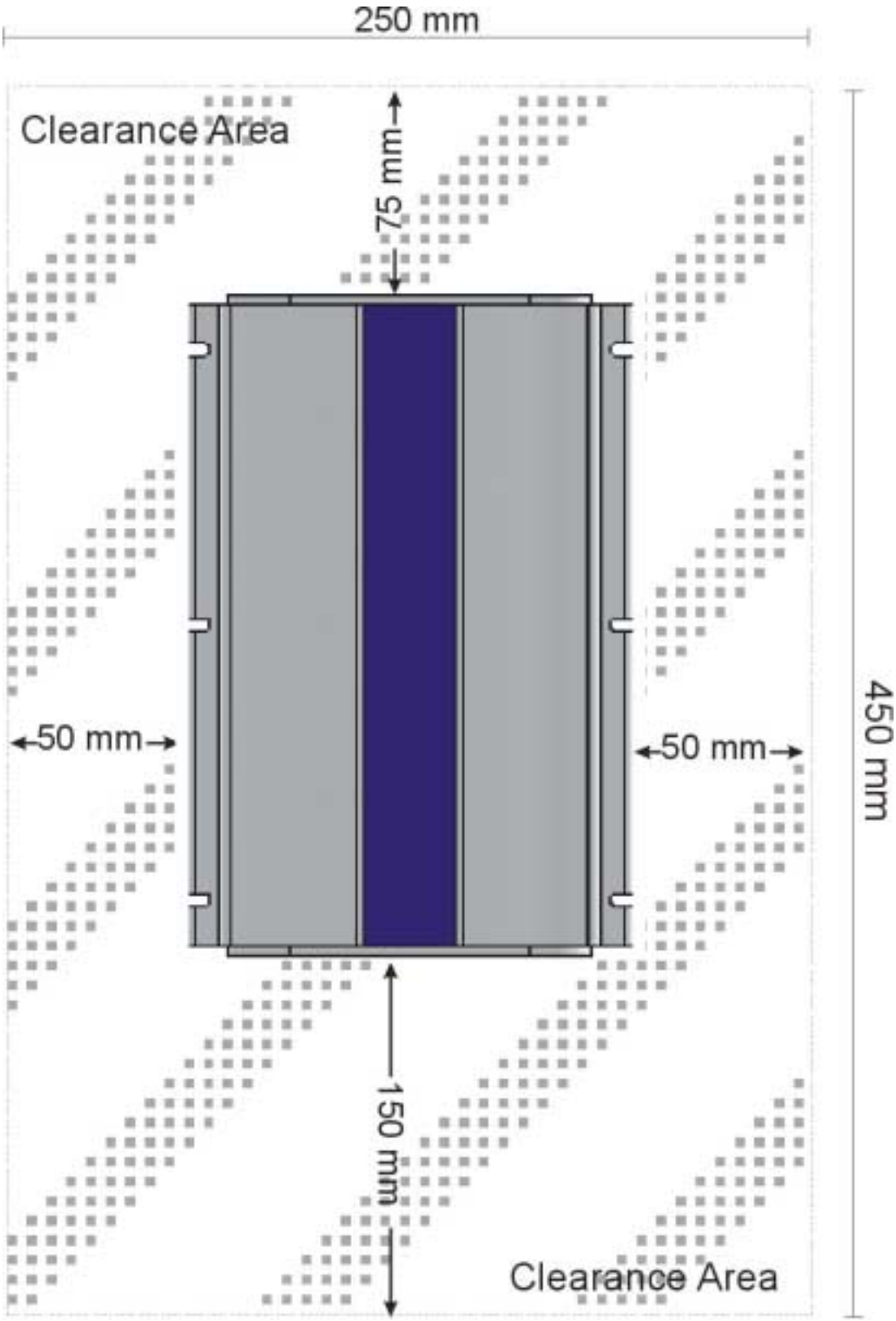


Figure 7: Clearance area for R4 Transponder

2.12 Mechanical drawing R4 Display

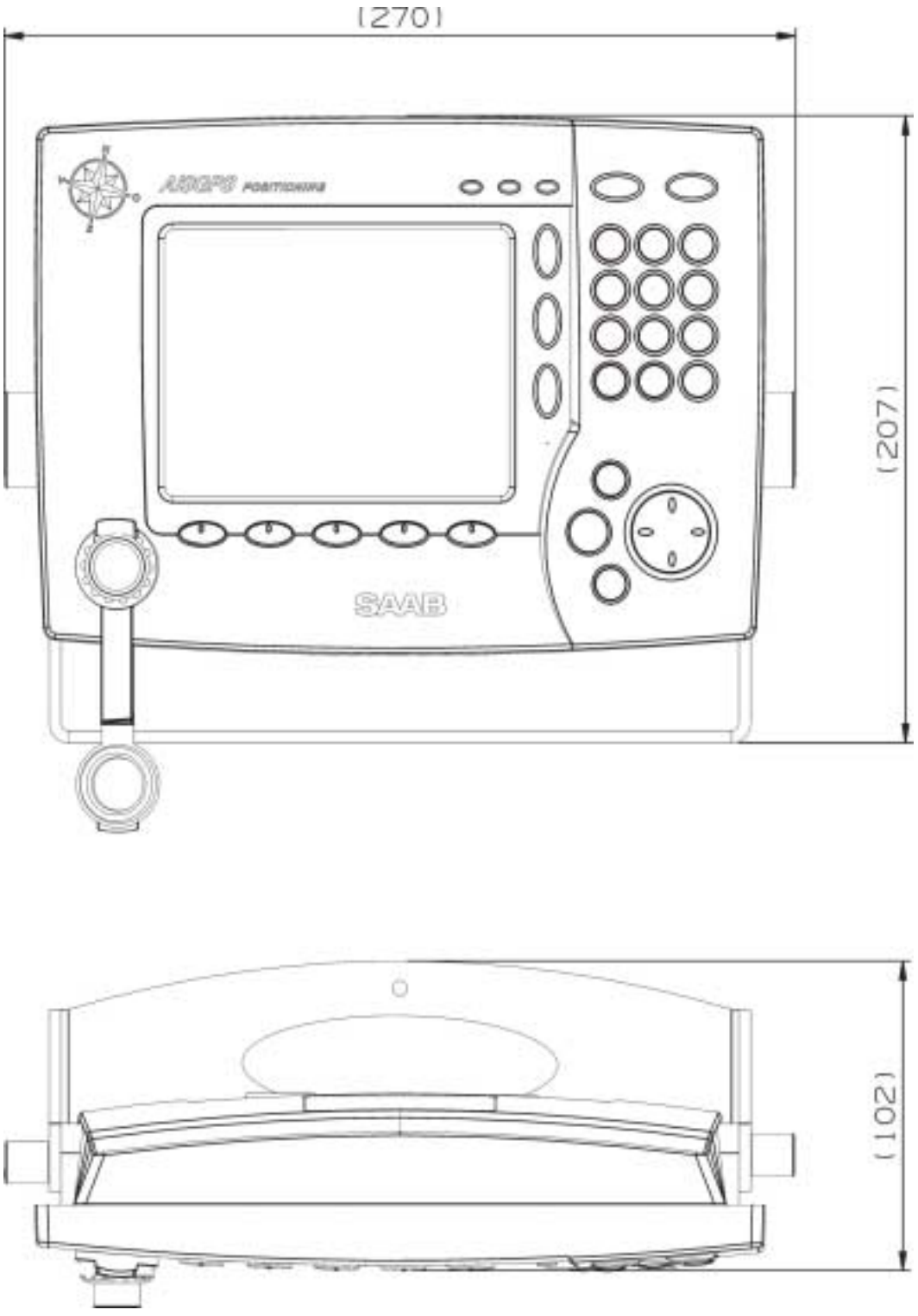


Figure 8: Mechanical Drawing R4 Display

2.13 Desktop 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 10.
2) Fasten the bracket mount with three screws on a flat surface see Figure 9. The type of screws has to be chosen considering the panel material. Note that the slots on the end of the bracket mount have to face the direction in which the R4 Display is to be mounted.
3) Place the two o-rings in the grooves around the screw holes, one on each side of the R4 Display. Slide the R4 Display into the slots on the end of the bracket mount. Secure the R4 Display onto the bracket mount using the bracket locking knobs without over tightening.
4) Attach the signal cable (18 pin plug) and the power cable (3 pin socket). Note that the power to the R4 Display must have a 2A fuse
5) Adjust the viewing angle after first loosening the bracket locking knobs. Securing the R4 Display without over tightening the bracket locking knobs.

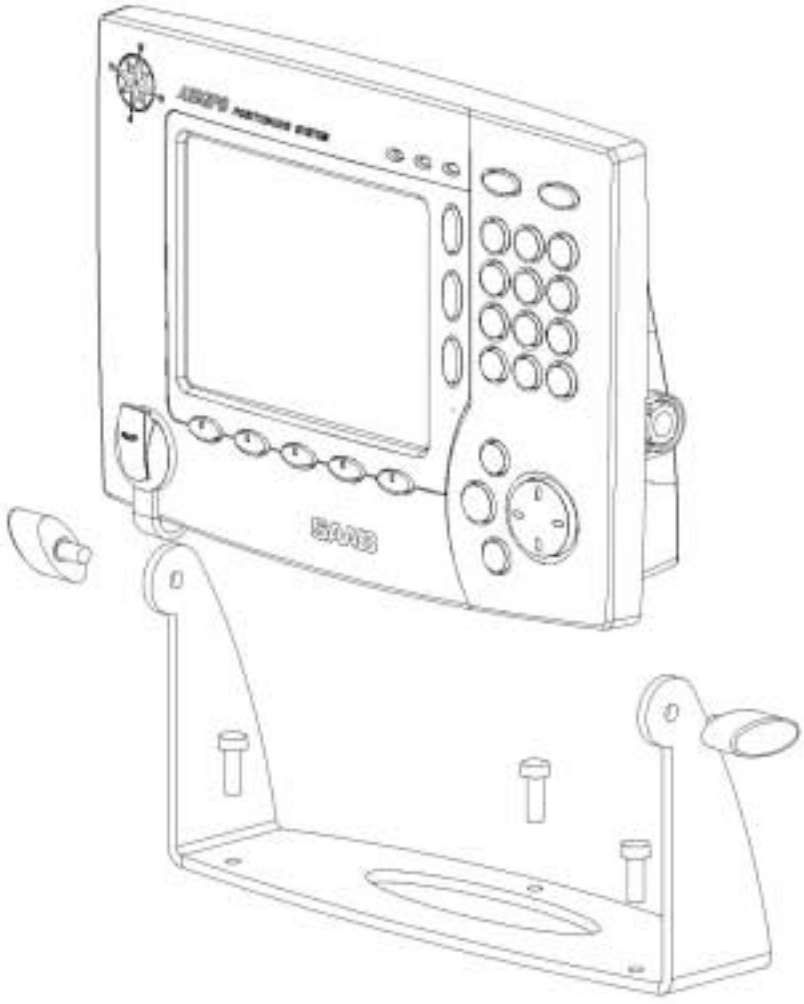


Figure 9: Bracket mount

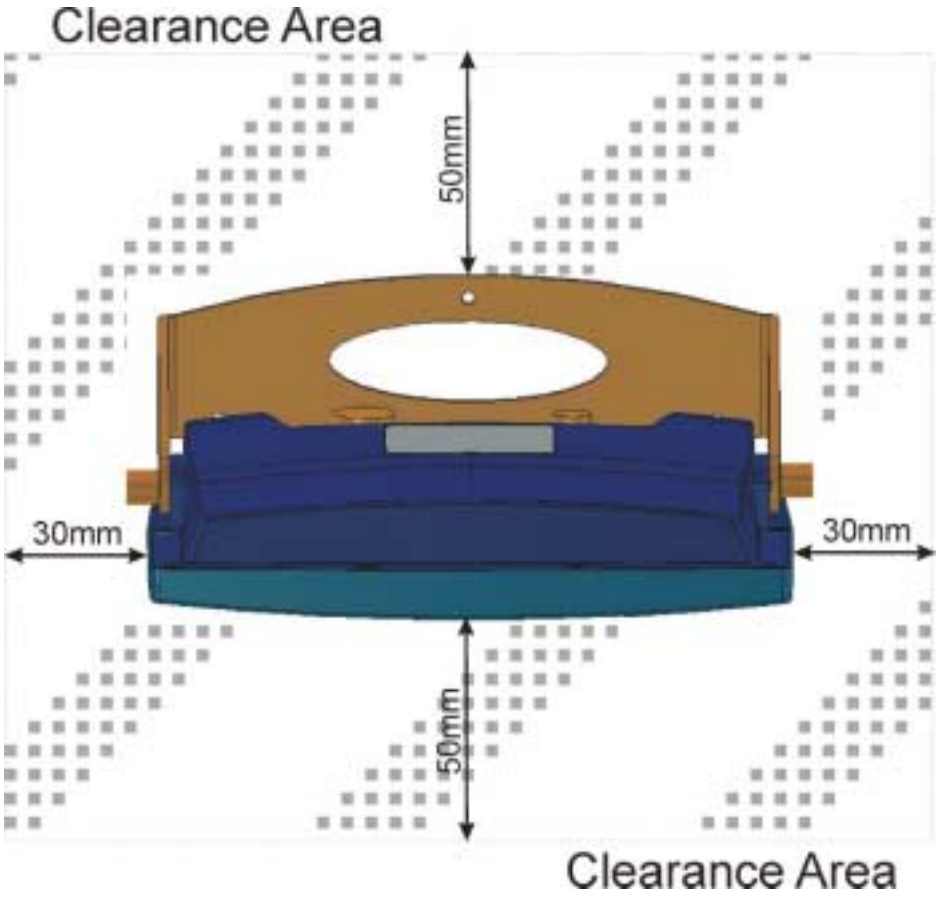


Figure 10: Clearance distance

2.14 Panel mounting

1) Determine where to install the R4 Display, see Figure 11 for dimensions. Make sure that there is enough depth behind the panel, see Figure 14.
2) Make one rectangular hole and four round holes, according to Figure 12 in the panel. (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.
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). 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.

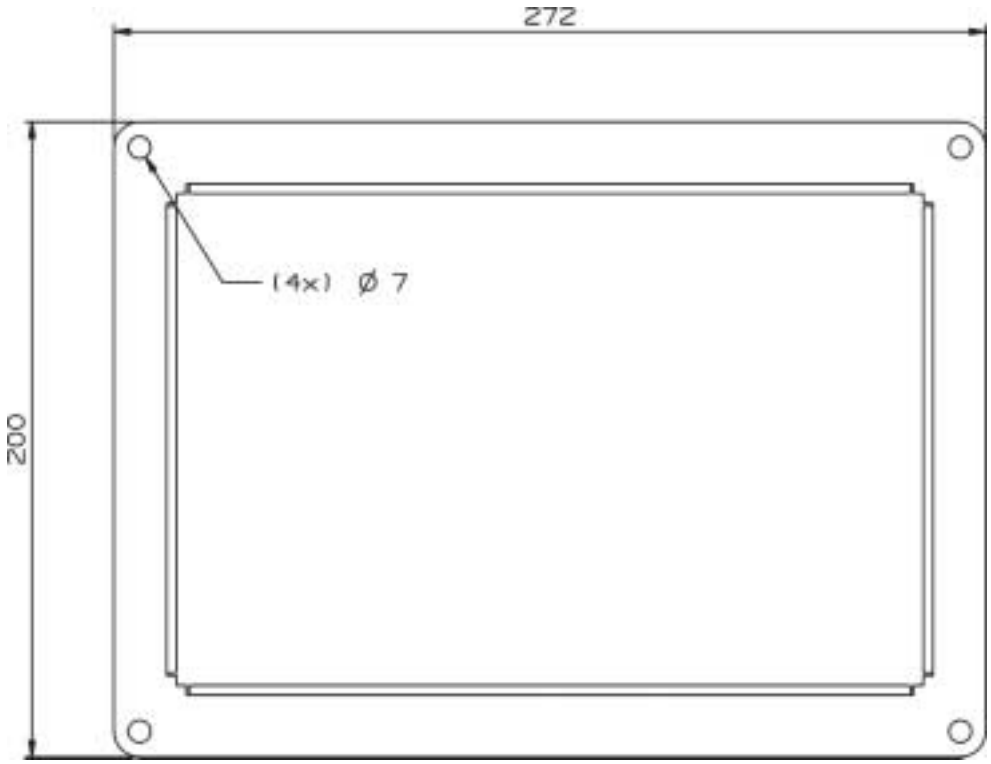


Figure 11 Panelmount frame dimensions

(mm)

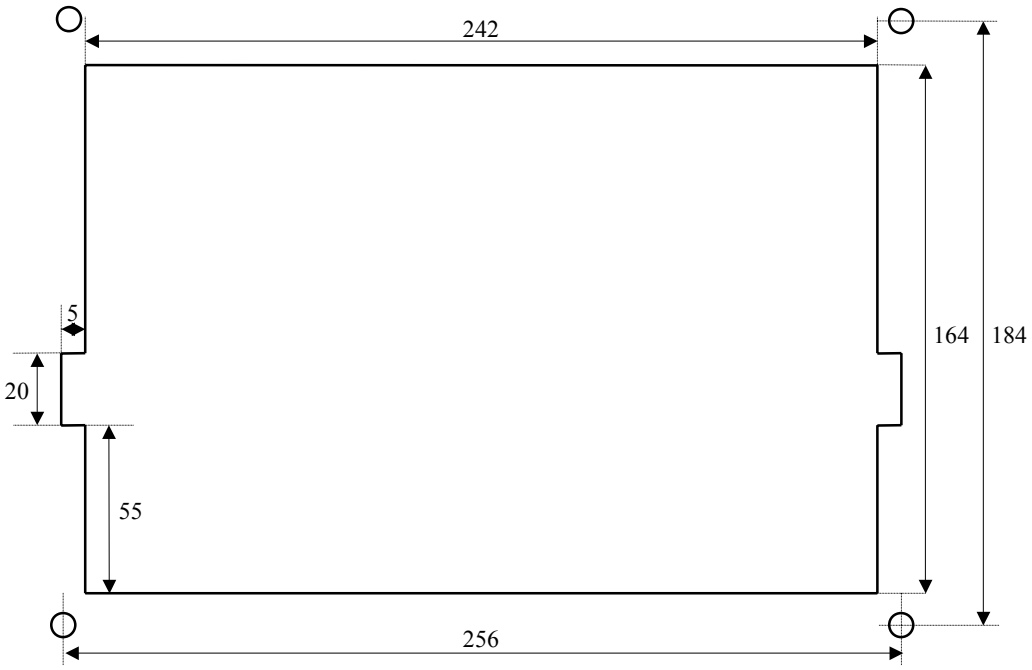


Figure 12: Panel mount hole dimensions

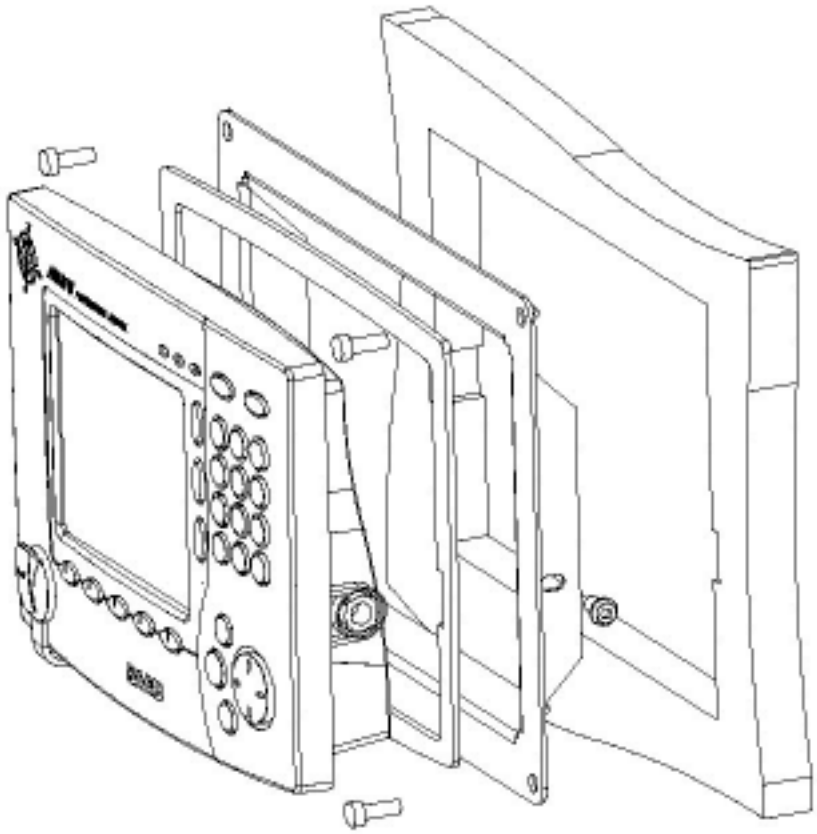


Figure 13: Panel mount

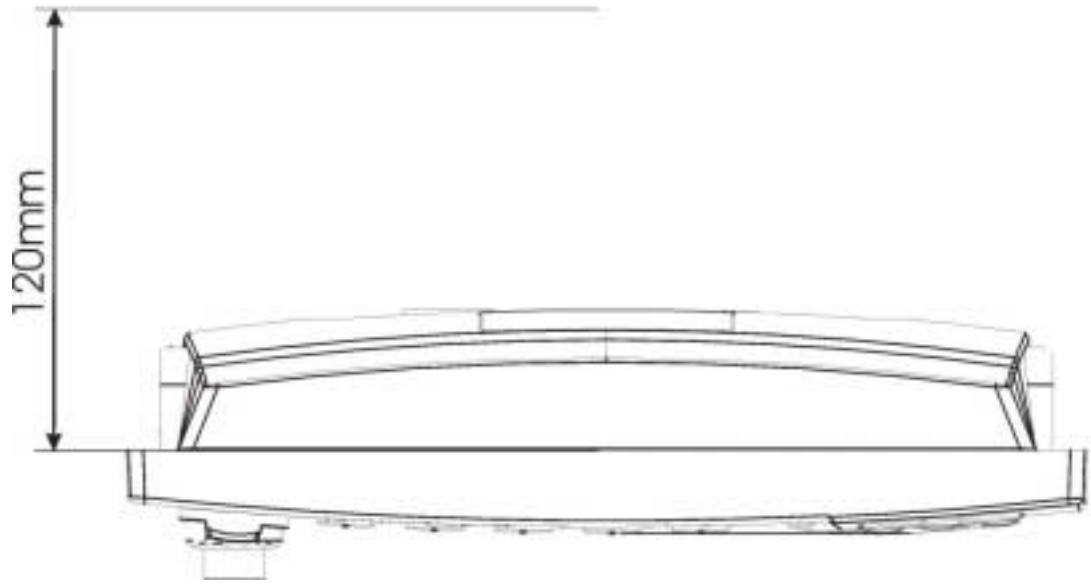


Figure 14: Clearance distance behind the display

2.15 Schematic arrangement for bridge installation

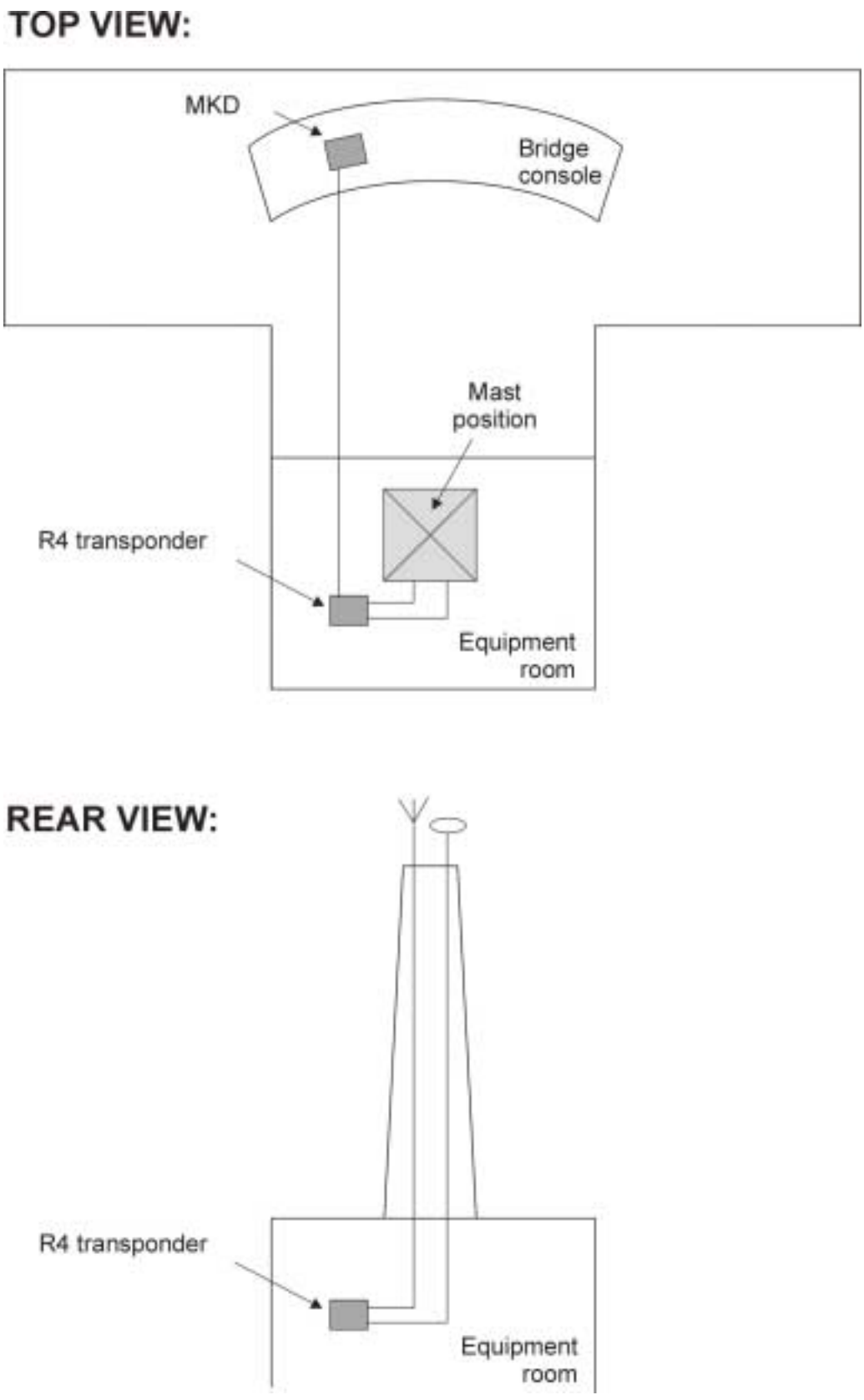


Figure 15: Bridge Installation

2.16 Serial Communication Interfaces

2.16.1 Electrical Characteristics

2.16.1.1 Output Drive Capacity

Each talker output can have a maximum of 25 listeners drawing 2,0 mA.

2.16.1.2 Input Load

Input impedance for each listener input is 68 kΩ.

2.16.1.3 Termination

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

2.16.1.4 Schematics

Each of the RS422 serial interfaces on the R4 Transponder fulfils the requirements as specified in Ref[5] and Ref[6]. For details of the schematics, see Figure 16.

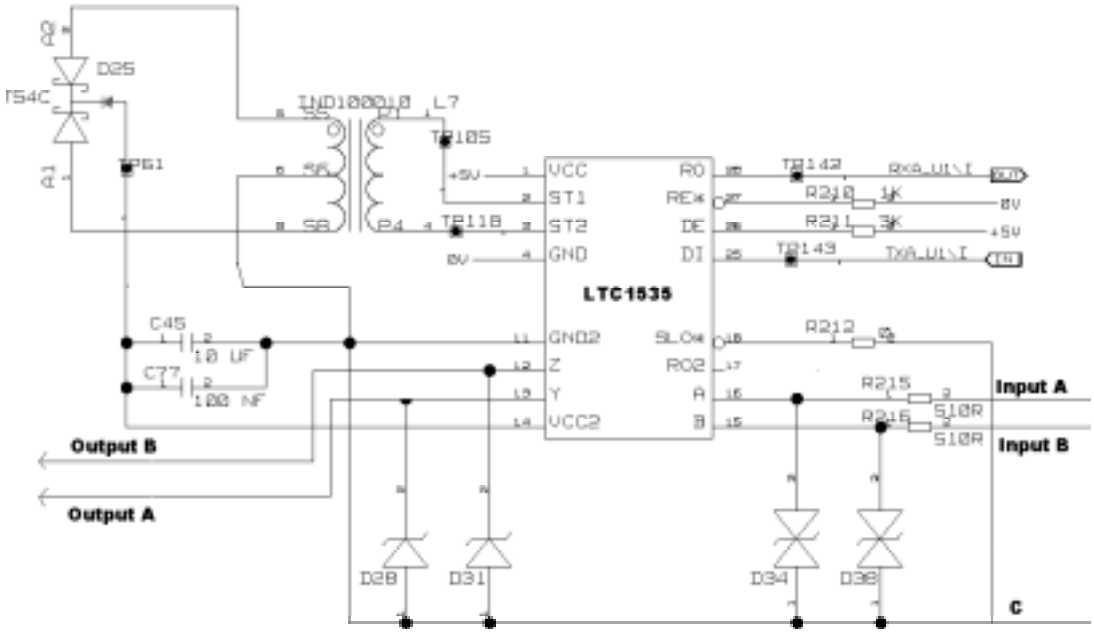


Figure 16: Serial interface schematics

2.16.2 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 (= navigation data + 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.

2.16.2.1 ECDIS / Pilot systems input data and formats

The input data and formats are shown in Table 2-2 below. Details of each sentence can be found in Ref. [3].

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

Table 2-2. 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

2.16.2.2 ECDIS / Pilot systems output data and formats

The output data and formats are shown in Table 2-3 below. Details of each sentence can be found in Ref. [3].

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

Table 2-3. 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

2.16.3 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.

2.16.3.1 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 2-4. Details of each sentence can be found in Ref. [3].

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

Table 2-4. 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
Rate-of-Turn Indicator	Rate Of Turn (ROT)	ROT

2.16.3.2 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 Shipborne Class A Transponder System 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 2.8.5). 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.

2.16.3.3 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 2.16.3.4), 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.

2.16.3.3.1 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.

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

2.16.3.4 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.

2.16.3.4.1 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 2.16.3.3)
- 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.

2.16.3.4.2 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.

2.16.3.4.3 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]).

2.16.3.5 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.

2.16.4 Long Range equipment interface

2.16.4.1 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.

2.16.4.2 Long Range function

The Long Range reply can be set in either:

- automatic mode (AUTO)
- manual mode (MANUAL) or
- manual mode 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).

2.16.4.3 LR input data and formats

The input data and formats are in form of two Long Range interrogation sentences - LRI and LRF, see Table 2-5.

- 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. [3].

Table 2-5. 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

2.16.4.4 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 2-6.

- 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.

Details of each sentence can be found in Ref. [3].

Table 2-6. 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

2.16.5 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. [4].

3 TECHNICAL SPECIFICATIONS

3.1 R4 Transponder

PHYSICAL

Dimensions:	Height: 85 millimeters Width: 144 millimeters Depth: 226 millimeters
Weight:	2.3 kilograms

POWER

Input Voltage:	24 VDC The primary side of the transponder is floating with reference to chassis.
Current need:	Transmit: 2.3 A (55 W) @ 24 VDC input Receive: 0.7 A (16 W) @ 24 VDC input

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:	12.5 and 25 kHz
Output Power:	High: 12.5 W Low: 2 W
VHF antenna connector:	BNC-Female

INTERNAL GPS RECEIVER

Type:	L1, C/A Code, 12 Channel
Update rate:	Once per second
Accuracy:	< 2 meters, Horizontal, 2 sigma (95%), DGPS < 30 meters, Horizontal, 2 sigma (95%), GPS The position outputs meets accuracy specification under dynamic conditions of 500 m/s and linear acceleration of up to ±4g.
Antenna feeding:	5 VDC
GPS Antenna connector:	TNC-Female

3.2 R4 Display

PHYSICAL

Dimensions:	Height: 207 millimeters Width: 270 millimeters Depth: 102millimeters
Weight:	1,1 kilograms

POWER

Input Voltage:	24 VDC
Current need:	0,35 A (8,4 W) @ 24 VDC input

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:	53cm @ 0.094 uT (5.4°/H) and 28 cm @ 0.313 uT (18°/H)

3.3 AIS Alarm Relay

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

4 APPENDICES

APPENDIX A.1 – REFERENCE DOCUMENTS

Ref. [1]	7000 108-131	Operator's Manual
Ref. [2]	Deleted	Deleted
Ref. [3]	IEC 61162-1	Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners.
Ref. [4]	RTCM SC-104	RTCM Recommended Standards for Differential GNSS Service.
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
Ref. [6]	IEC 61162-2	Maritime navigation and radio communication equipment and systems – Digital interfaces – Part 2: Single talker and multiple listeners, high-speed transmission

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.

Field	Comment
Local Datum Code	Interpret if it's WGS84 or not
Local Datum Subdivision Code	Ignored
Lat Offset (2 fields)	Ignored
Long Offset (2 fields)	Ignored
Altitude Offset	Ignored
Reference Datum Code	Ignored

GBS - GNSS Satellite Fault Detection

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

Field	Comment
UTC Time of GGA or GNS	Ignored
Expected Error in latitude	Ignored
Expected Error in longitude	Ignored
Expected error in altitude	Ignored
ID number of most likely failed satellite	Ignored
Probability of missed detection	Ignored
Estimate of bias in meters	Ignored
Standard Deviation of bias estimate	Ignored

GGA - Global Positioning System Fix Data

Field	Comment
UTC Of Position	UTC Second is used to indicate Time Stamp
Latitude (2 fields)	Used
Longitude (2 fields)	Used
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
Number of Satellites in use	Used when the GPS is the internal GPS (Used in proprietary sentences)
Horizontal Dilution of precision (HDOP)	Ignored

Altitude re: main sea level (2 fields)	Ignored
Geoidal Separation (2 fields)	Ignored
Age of Diff Data	Ignored
Diff Reference Station	Ignored

GLL - Geographic Position - Latitude / Longitude

Field	Comment
Latitude (2 fields)	Used
Longitude (2 fields)	Used
UTC of Position	UTC Second is used to indicate Time Stamp
Status	Ignored
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.

Field	Comment
UTC of Position	UTC Second is used to indicate Time Stamp
Latitude (2 fields)	Used
Longitude (2 fields)	Used
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
Tot Number of Satellites in Use	Used when the GPS source is the internal GPS (used in proprietary sentences)
HDOP	Ignored
Antenna Altitude	Ignored
Geoidal Separation	Ignored
Age Of Diff Data	Ignored
Diff Reference Station ID	Ignored

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HDT - Heading, True

The use of this sentence is talker identifier dependent.

Field	Comment
Heading	Used if Valid indicator is T
Valid Indicator	Used

OSD- Own Ship Data

Field	Comment
Heading, Degrees TRUE	Used if heading status is 'A'
Heading Status	Used
Vessel Course	Used as COG
Course Reference	Used[1]
Vessel Speed	Used as SOG
Speed Reference	Used[1]
Vessel Set	Ignored
Vessel Drift	Ignored
Speed Units	Used to convert SOG to knots

RMC - Recommended Minimum Specific GNSS Data

Field	Comment
UTC of Position Fix	UTC Second is used to indicate Time Stamp
Status	Ignored
Latitude (2 fields)	Used
Longitude (2 fields)	Used
SOG, knots	Used
COG, degrees	Used
Date	Ignored
Magnetic Variation (2 fields)	Ignored
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".

Field	Comment
Rate of turn	Used when status is A. The value is rounded to the closest integer.
Status	Used

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

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.

Field	Comment
Longitudinal Water Speed	Ignored
Transverse Water Speed	Ignored
Status: Water Speed	Ignored
Longitudinal Ground Speed	Used if Status is set to A
Transverse Ground Speed	Used if Status is set to A
Status: Ground Speed	Used
Stern Transverse Water Speed	Ignored
Status Stern Water Speed	Ignored
Stern Transverse Ground Speed	Ignored
Status Stern Ground Speed	Ignored

VTG - Course Over Ground and Ground Speed

Field	Comment
COG, degrees True (2 fields)	Used
COG, degrees Magnetic (2 fields)	Ignored
SOG, knots (2 fields)	Used
SOG, km/h (2 fields)	Ignored
Mode Indicator	Used

ZDA - Time & Date

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

Field	Comment
UTC	Used
Day	Used
Month	Used
Year	Used
Local Zone Hours	Ignored
Local Zone Minutes	Ignored

AIS Specific Input Sentences

ABM - Addressed Binary and safety-related Message

Field	Comment
Total Number of Sentences	Used if in interval 1..9, otherwise the sentence is ignored
Sentence Number	Used if in interval 1..total sentences, otherwise the sentence is ignored
Sequential Message Identifier	Used if in interval 0..3, otherwise the sentence is ignored

MMSI of Destination	Used
AIS Channel	Used
Message Id	Used if 6 or 12, otherwise the sentence is ignored
Encapsulated Data	Used
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

Field	Comment
Sequence Number	Ignored
NE Latitude (2 fields)	Used
NE Longitude (2 fields)	Used
SW Latitude (2 fields)	Used
SW Longitude (2 fields)	Used
Transitional Zone Size	Used
Channel A	Used
Channel A Bandwidth	Used
Channel B	Used
Channel B Bandwidth	Used
Tx/Rx Mode	Used
Power Level	Used
In Use Flag	Ignored
Time of In Use Change	Ignored

ACK - Acknowledge Alarm

Field	Comment
ID of the alarm source	Used

AIQ - Query Sentence

Field	Comment
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).

Field	Comment
MMSI 1	Used
Message Id 1.1	Used

Message Sub Section	Ignored
Message Id 1.2	Used, may be NULL
Message Sub Section	Ignored
MMSI 2	Used, may be NULL
Message Id 2.1	Used, may be NULL
Message Sub Section	Ignored

BBM - Broadcast Binary Message

Field	Comment
Total Number of Sentences	Used if in interval 1..9, otherwise rejected
Sentence Number	Used if in interval 1..total number of sentences, otherwise rejected.
Sequential Message Identifier	Used if in interval 0..9, otherwise rejected
AIS Channel	Used
Message Id	Used if 8 or 14
Encapsulated Data	Used
Number of filled bits	Used

SSD - Ship Static Data

Field	Comment
Call Sign	Used, may be NULL
Name	Used, may be NULL
Pos Ref A	Used to change position reference for the position source in use. May be NULL.
Pos Ref B	Used to change position reference for the position source in use. May be NULL.
Pos Ref C	Used to change position reference for the position source in use. May be NULL.
Pos Ref D	Used to change position reference for the position source in use. May be NULL.
DTE	Ignored
Source Identifier	Ignored

VSD - Voyage Static Data

Field	Comment
Type Of Ship And Cargo	Used
Maximum Present Draught	Used
Persons On-Board	Used
Destination	Used
Est. UTC of arrival	Used
Est. Day of arrival	Used
Est. Month of arrival	Used
Navigational Status	Used
Regional Application Flags	Used

APPENDIX A.3 – PROPRIETARY INDICATIONS (TXT)

Additional to the standardised text transmissions / indications – TXT (described in IEC 61993-2) the R4MkII-AIS 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 R4MkII-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 – GPS-CABLE SELECTOR

The table below gives recommendation on cables that can be used for the 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 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.

Example:

Cable type	Preamplifier Gain (dB)	Recommended min cable length (m)	Recommended max. cable length (m)
RG 223	12	0	20
RG 223	26	20	45
RG 223	36	45	60
RG 214	12	0	35
RG 214	26	35	70
RG 214	36	70	100

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

Max length = Preamp. Gain/Cable attenuation per meter

APPENDIX A.6 – 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.7 – GLOSSARY

AIS	Automatic Identification System
AUX	Auxiliary port – A communication port on the AIS transponder, which can be used for RTCM input.
dB	Decibel
GNSS	Global Navigation Satellite System – A common label for satellite navigation systems (such as GPS and GLONASS).
GPS	Global Positioning System.
IEC	International Electro-technical Commission.
LED	Light Emitting Diode.
N/A	Not Applicable.
NMEA	National Marine Electronics Association.
RTCM	Radio Technical Commission for Maritime Services.
TDMA	Time Division Multiple Access – An access scheme for multiple access to the same data link.
VDL	VHF Data Link
VHF	Very High Frequency – A set of frequencies in the MHz region.
VTS	Vessel Traffic Service

APPENDIX A.8 – GLOBAL PRODUCT SUPPORT

For Installation, Service and Technical Support:

Please use our home page www.transponertech.se
"Product and Service" headline "Customer Support and Repairs".
Fill out the Problem Report form and fax/mail to us.

E-mail:	support@transpondertech.se
Telephone, support:	+46 8 627 49 20
Fax, support:	+46 8 627 49 49

For Sales of Accessories:

Address: SAAB TransponderTech AB
P O Box 4113
SE-171 04 Solna
Sweden

Telephone:	+46 13 18 80 00
Fax:	+46 8 627 49 49
E-mail:	info@transpondertech.se
Home page:	www.transpondertech.se

APPENDIX A.9 – AIS CLASS A CERTIFICATE

Bundesrepublik Deutschland
Federal Republic of Germany

Bundesamt für Seeschifffahrt und Hydrographie
Federal Maritime and Hydrographic Agency

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

EC TYPE EXAMINATION (MODULE B) CERTIFICATE

This is to certify that:

Bundesamt für Seeschifffahrt und Hydrographie, specified as a "notified body" under the terms of „Schiffssicherheitsgesetz" of 9 September 1998 (BGBl. I, p. 2860) modified last 19 December 2002 (BGBl. I, p. 4690), did undertake the relevant type approval procedures for the equipment identified below which was found to be in compliance with the Navigation requirements of Marine Equipment Directive (MED) 96/98/EC as modified by Directive 2002/75/EC.

Applicant	**Saab Transpondertech AB**
Address	P O Box 4113 SE-171 04 Solna, Sweden
Manufacturer	**Saab Transpondertech AB**
Address	P O Box 4113 SE-171 04 Solna, Sweden
Annex A.1 Item (No & item designation)	**4.32 Automatic Identification System (AIS)**
Product Name	**Saab R4 AIS Class A Transponder System**
Trade Name(s)	see appendix 1

Specified Standard(s)

IMO MSC.74(69) Annex 3	IEC 61993-2 (2002)
ITU-R M.1371-1 (Class A)	IEC 61162-1 (2000), -2 (1998)
IALA Technical Clarifications of Rec. ITU-R M.1371-1 (Edition 1.3)	IEC 60945 (1996)
ITU-R M.825-3	IEC 61108-1 (1998)
ITU-R M.1084-3	

This certificate remains valid unless cancelled, expired or revoked.

Date of issue: 30.04.2003
Expiry date: —

Issued by: **Bundesamt für Seeschifffahrt und Hydrographie**
Bernhard-Nocht-Str. 78, 20359 Hamburg, Germany
Notified body 0735

Certificate No.: **734.2/0057/2003**

This certificate consists of 3 pages.

by order
Preuß

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

This certificate is issued under the authority of the „Bundesministerium für Verkehr, Bau- und Wohnungswesen".

Components necessary for operation:

R4 Transponder AIS Transponder unit	Part Number:	**7000100-550**	Software Version: **4.0x**
R4 Display Keyboard and Display unit	Part Number:	**7000108-050**	Software Version: **1.0x**
GPS antenna AT575-68	Part Number:	**7000000-078**	or equivalent
VHF antenna SAAB 1012	Part Number:	**7000000-677**	or equivalent

The internal GPS sensor of the Saab R4 AIS is used as a backup sensor for position reporting.

Documentation:

Installation Manual 7000 108-011

Operation Manual 7000 108-131

Limitations on the acceptance or use of the product:

Places of production:

Notes:

The manufacturer shall inform Bundesamt für Seeschifffahrt und Hydrographie, as the notified body, of any modifications to the type-tested product(s) that may affect compliance with the requirements or conditions laid down for use of the product(s).

In case the specified regulations or standards are amended during the validity of this certificate, the product(s) must be re-certified before being placed on board vessels to which such amended regulations or standards apply.

The Mark of Conformity (wheelmark) may only be affixed to the type approved equipment, and a Manufacturer's Declaration of Conformity may only be issued, if the product quality system fully complies with the Marine Equipment Directive and is certified by a notified body against ANNEX B module D, E, or F of the Directive.

Example for the Application of the "Mark of Conformity":

xxxx number of the Notified Body responsible for quality surveillance module
yy Last two digits of the year in which the mark is affixed.

Notice on legal remedies available:

Objection to this document may be filed within one month after notification. The objection must be filed in writing to, or put on record at, Federal Maritime and Hydrographic Agency, Bernhard-Nocht-Str. 78, 20359 Hamburg, Germany