Installation Manual

M-2 AIS Transponder System

35-060-001

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Contents

1 Preface

Applicability of this manual

This manual describes the installation of equipment to hardware build standard 02.02.

In accordance with McMurdo's policy of continual development and product improvement, hardware may be upgraded from time to time and future versions may therefore not correspond exactly with this manual. When necessary, upgrades will be accompanied by updates or addenda to this manual.

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

Once installed please read the Operation Manual fully to make sure you understand how to use your new AIS.

2 Installing the AIS Transponder System Safely

Installation

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

⚠ **CAUTION**: Do not connect the Transponder to a DC supply exceeding 32 V or reverse the supply polarity. Damage to the transceiver may result.

⚠ **CAUTION:** Do not bypass the built in fuse

⚠ **CAUTION:** The Transponder system is designed for operation in the temperature range -15 °C to +55 °C. Do not install (or use) the transponder system in environments which exceed this range.

⚠ **CAUTION**: The AIS Transponder is not water-resistant. Consequently, the Transponder must be installed in a dry place and must be protected from direct contact with water.

⚠ **WARNING:** Do not install the Transponder system in a position where;
a) the controls of your vessel may be obstructed.
b) it may obstruct your normal movement around your vessel.
c) it may cause bodily injury.
d) it cannot be easily accessed in an emergency.

Use

⚠ **WARNING:** Certain parts of the Transponder chassis, notably the rear panel, can become hot, particularly if the ambient temperature is high. Avoid touching these areas when the Transponder is operating.

⚠ **WARNING:** Do not remove the cover of the Transponder before the power is switched off. Do not touch the antenna connections when the Transponder is operating and do not touch the antenna whip (mast) or connecting cable when the Transponder is in operation, for RF exposure and electrical safety reasons. Refer to Radio Frequency Exposure Warning.

⚠ **WARNING:** Unauthorised opening of the Transponder system will invalidate the warranty.

Maintenance

⚠ **CAUTION:** Avoid using chemical solvents to clean the Transponder system as some solvents can damage the case material.

NOTE: Apart from the fuse located beside the connectors, the Transponder system contains no user serviceable parts. Contact your Service Agent for repair if replacing the fuse fails to make the equipment servicable.

Radio Frequency Exposure Warning

To meet the current requirements for Radio Frequency Exposure it is necessary to install the antenna mast correctly and operate the equipment according to the instructions.
The assumptions used in this assessment are: full transmit power is used, a good antenna is used (assumed to be a unity gain (0 dB) wideband omni-directional type).

Where no suitable structure exists to achieve a 3 metre vertical separation then the antenna base must be mounted at least 1 metre above the head of any person within range and all persons must stay outside the 3-metre safety radius.

Failure to adhere to these limits could expose persons within the 3 metre radius to RF radiation in excess of the MPE / SAR limits.

⚠ **WARNING:** The antenna mast must be mounted at a minimum distance (vertical separation) of 3 metres from the head of any person standing on deck to meet international safety directives on Maximum Permissible Exposure (MPE) / Specific Absorption Rate (SAR).

⚠ **WARNING:** Do not transmit when persons are closer than 3 metres to the antenna. If any person (e.g. the operator) must be closer, then a grounded RF shield should be interposed between that person and the antenna.

Rules of Operation

Licensing

IMPORTANT: In most countries the operation of the AIS Transponder is a part of the radio regulations and therefore the ship must possess a current VHF radio telephone licence which lists the AIS system, and the equipment must be registered (Call Sign and MMSI number). Please contact the relevant authority in your country for more information.

Refer to the AIS Transponder Operation Manual for the full operating procedure.

Good Practice

The installer is expected to be familiar with IMO SN/Circ.227 *Guidelines for the Installation of a Shipborne Automatic Identification System*, and to comply with these recommendations. The document contains detailed information which supplements the instructions in this manual.

Compass Safe Distances

Display	0.7 m for 1° deviation; 1.2 m for 0.3° deviation
Transponder:	1.3 m for 1° deviation; 2.1 m for 0.3° deviation

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3 Introduction

It is recommended that the vessel should be surveyed prior to commencing any installation work to determine the suitability of the existing on-board sensors. Section 8 of this Manual contains a 'Pre-Installation Inspection' form to assist this process.

Installation of the AIS Transponder has been designed to be as easy as possible and requires few tools. However as the AIS equipment forms a vital part of the ship's navigational equipment the installation must be performed with great care and with attention to detail.

The AIS is considered part of the ship's radio station and is surveyed together with the radio installation. Surveys on Convention ships should be carried out in accordance with the rules laid down in IMO Res. A 746(18) *Survey Guidelines under the harmonised system of survey and certification* and Protocol of 1988 relating to the International Convention for the Safety of Life at Sea 1974

For the AIS installation, it is likely that the following drawings will be required for the survey:

- Antenna layout for the VHF and the GNSS antenna installation
- AIS Arrangement drawing
- Block diagram showing the interconnection to other units

To assist in the preparation of this information, a Pre-installation Inspection Record is included in this manual at section 10. Completion of this Record will provide much of the required information.

It is also necessary to complete an installation report, which shall be kept on board.

3.1 About this manual

This manual provides step-by-step guidance through the installation of the AIS Transponder system. Please read the manual carefully and make sure to follow the instructions.

In this manual only the installation of the AIS stand-alone configuration will be described. If the AIS unit is to be connected to other display devices, refer to the manual for that display. However the setup must always be performed with the supplied Display unit.. Other display units will be additional to the IMO required installation.

The procedures required for installation can be summarised:

1. Obtain a copy of the AIS Pre-installation Inspection form; check that it is filled in with all the data necessary for the installation. If the form has not been filled in, it is advisable to do it at this stage, as this is a good way to make sure that all information is available for the installation.
2. The available AIS Transponder system building blocks are listed in section 4.3. Before starting the installation ensure that everything needed for the installation is to hand.
3. Locate the places to install the different units. The templates and the drilling instructions are provided in this manual.
4. Connect the units and the sensors as shown in this manual.
5. **DO NOT POWER UP THE SYSTEM AT THIS STAGE**. It is most important to read the Operation Manual, which contains the detailed commissioning information, before power is applied.
6. Once the operating procedures are understood, the system may be powered up and the permanent parameters may be set. A guide listing the steps in this procedure is provided as Section 12 of this manual.

The Warranty Registration & Acceptance Record, Section 9 at the rear of this manual, must be completed and signed when the system has been commissioned and accepted.

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4 AIS Transponder System

4.1 System Configuration

The M-2 may be installed as stand-alone AIS equipment or integrated with Electronic Charting Systems (ECS) or Integrated Bridge Systems (IBS).

Stand-Alone System The AIS transponder with Display unit is interfaced to the vessel's primary navigation sensors. The Display is used as both the AIS display unit and AIS control unit.

Electronic Chart System (ECS) with AIS In this arrangement the stand-alone AIS installation and ECS display have been integrated. The Display is used mainly to input own ship's information with the ECS having the ability to display AIS target information. This arrangement greatly enhances the presentation of information by displaying AIS targets in an environment normally used for navigation of the vessel.

Integrated Bridge System has the ability to display AIS target information directly on an Automatic Radar Plotting Aid (ARPA) or Electronic Chart Display and Information System (ECDIS). By combining these technologies the navigator is provided with the optimum navigational information, directly on the vessel's primary navigation display. Where approved for this purpose the ARPA or ECDIS equipment maybe used to directly control the function of the AIS transponder.

4.2 Installation accessories

An optional AIS installation cable kit contains all the basic installation materials and cables that are typically needed to ready a vessel for installation of the AIS equipment.

Other accessories include a VHF antenna and a range of antenna bracket options, an AC/DC power supply unit, a Gyro Interface Unit (Stepper/Synchro gyro input - RS422 output) and a remote IMO Pilot Plug kit. (The Pilot Plug may be supplied with the system, depending on the configuration ordered.)

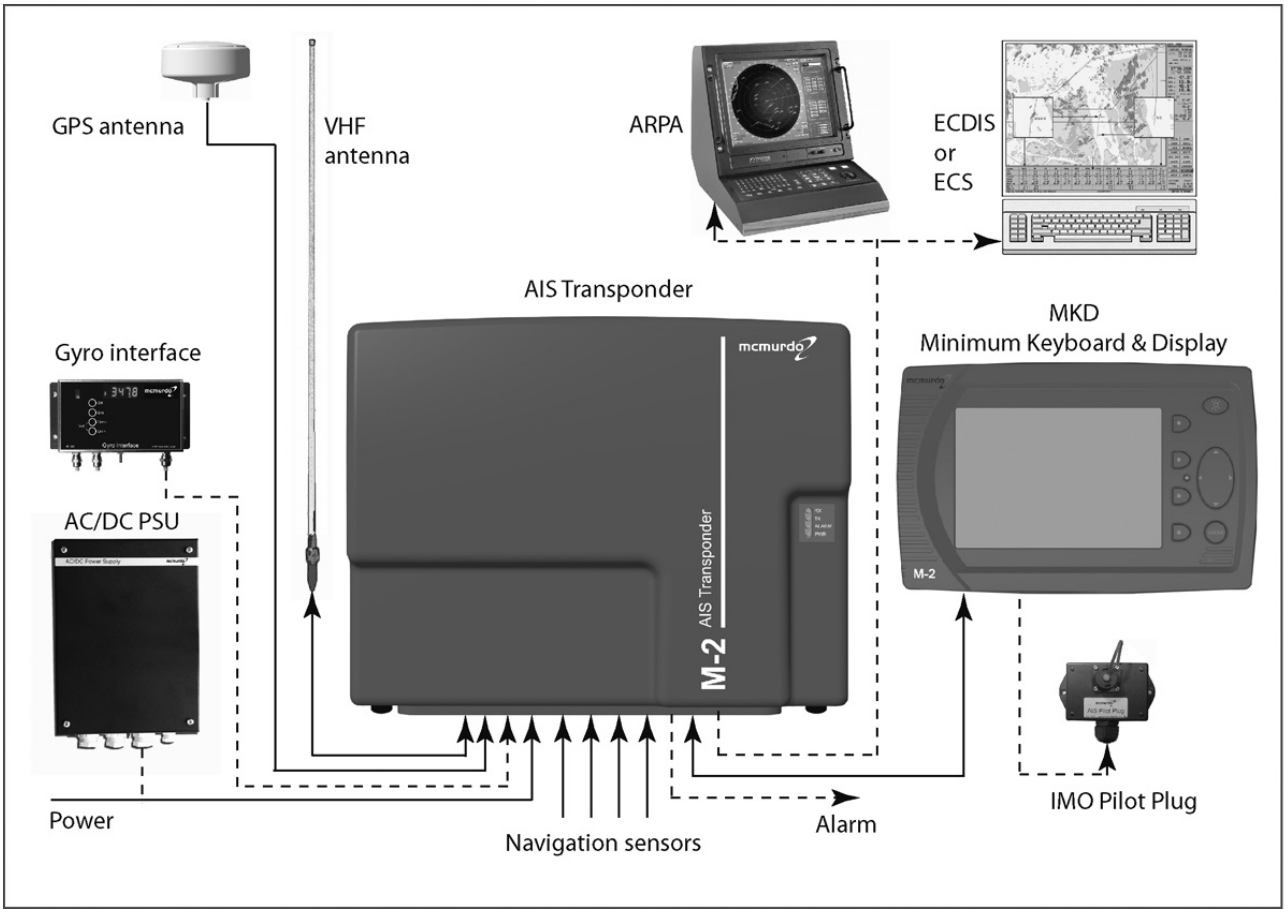
4.3 AIS building blocks

M-2 Class A AIS system, comprising: **Part 35-001-001A**

- AIS transponder unit
- Display unit
- GNSS antenna
- Connector kit
- Operator and installation manuals

M-2 Class A AIS system, comprising: **Part 35-001-002A**

- AIS transponder unit
- Display unit
- GNSS antenna
- Connector kit
- Operator and installation manuals
- Pilot plug kit (-002 version)



Packaging

M-2 Master Carton
Contains:-

1 x M-2 Transponder
2 x PL259 Plug for VHF Antenna
2 x TNC Plug for GNSS Antenna
4 x M6 x 40 mm Machine Screws for Bulkhead Mounting
1 x Display interconnect cable 5 m
1 x Set of screw terminal connectors (bagged)
1 x Installation Manual
1 x M-2 Display unit
1 x Trunion Mounting Bracket
1 x Flush Mounting Frame
4 x No.10 x 25 mm Self-Tapping Screws for mounting Trunnion Bracket
1 x Seal for Flush Mounting Frame
1 x Operation Manual
1 x GPS Antenna
1 x Stub mounting pole
2 x 'U' Bolts
1 x Back Plate
1 x Pilot Plug kit (-002 version) if part of system

Optional Extras:

Part	Description
89-020-001	AIS VHF antenna, 1.2 mtr 0 db Gain
903-01	Antenna bracket -stand off mast
903-02	Antenna bracket -stand off mast / Bulkhead
903-04	Antenna deck mount fitting
89-081-001	Pilot Plug kit to AIS Transponder, 25 m cable
89-081-002	Pilot Plug kit to Display, 5 m cable with D plug
89-028	Gyro Interface Unit - Stepper / Synchro input - RS422 output
89-029	AIS Power supply unit AC+DC input - 24 V DC output
89-038	AIS Installation cable Kit (standard); 20 mtrs x 2 mm 2-Core Flex Power Cable 30 mtrs x RG214 VHF Coax Antenna Cable 30 mtrs x RG58 GPS Coax Antenna Cable 60 mtrs x 0.5 mm 4-Twisted Pair + Drain Signal Cable 200 x Cable Ties 20 x Cable Markers 2 x Self Amalgamating Tape 2 x PL259 connector 2 x TNC connector

5 Mechanical mounting options and guidelines

5.1 Location

The transponder unit is classed as protected equipment and thus should be located inside in a dry environment. Normally the transponder is located in the Radio Room. The transponder compass safe distance is 2.1 m.

The recommended location should provide:

- A dry environment
- Access to connections (eg antennas, power, sensors)
- Minimal shock and vibration
- An ambient temperature between -15 °C and +55 °C
- A site clear of exhausts and vents
- Sufficient space to allow maintenance

The transponder does not require external illumination during operation. Naturally, some form of illumination should be provided while installing or maintaining the transponder.

The Display should be available to the mariner at the position from which the ship is normally operated. The Display compass safe distance is 0.7 m. The Display does not require external illumination during operation, as it has an internal backlight; the use of illuminated keys ensures that all controls are visible.

The Pilot Plug should be installed on the bridge near the pilot's operating position. It is recommended that a suitable mains outlet (3-pin 120 V AC) should be available at this location.

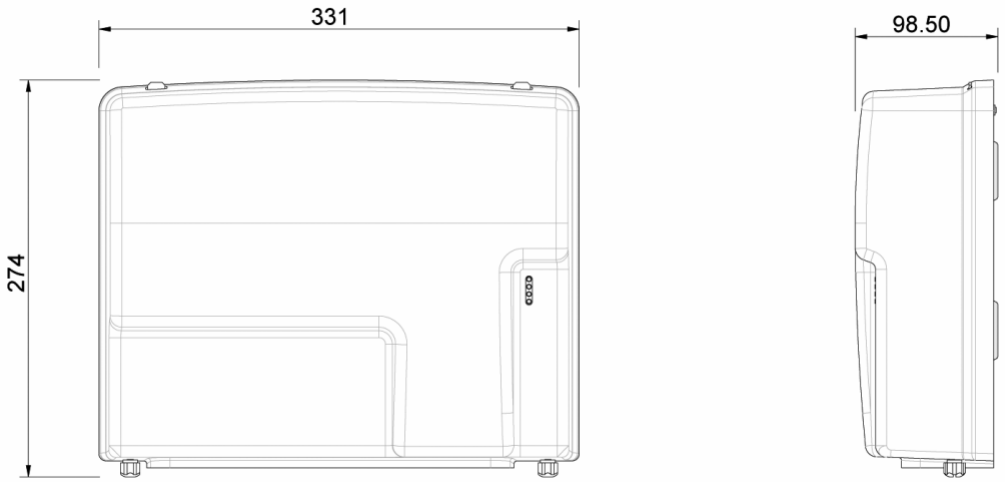
Special siting considerations apply to antennas. These principles are outlined in section 5.4; for detailed advice, see the IMO Guidelines.

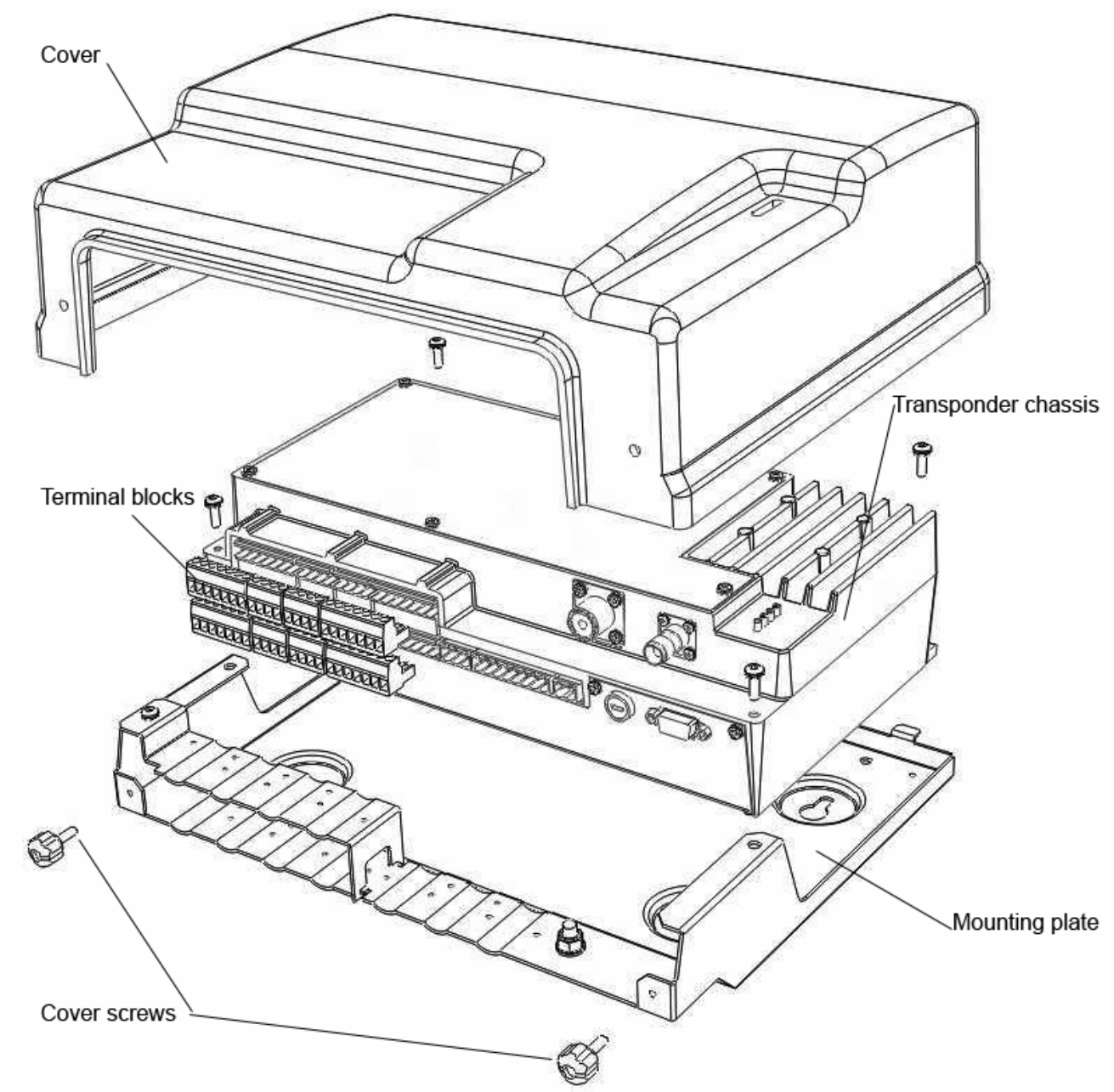
5.2 AIS Transponder unit

The transponder mounting plate is attached by four M6 screws. Keyhole slots in the plate allow two screws to be inserted in the mounting surface, then the plate to be mounted on the screws and to be self-supporting while the remaining screws are inserted and all screws are tightened. The transponder chassis is then attached to the plate using four screws, as shown overleaf. The transponder may be mounted at any angle.

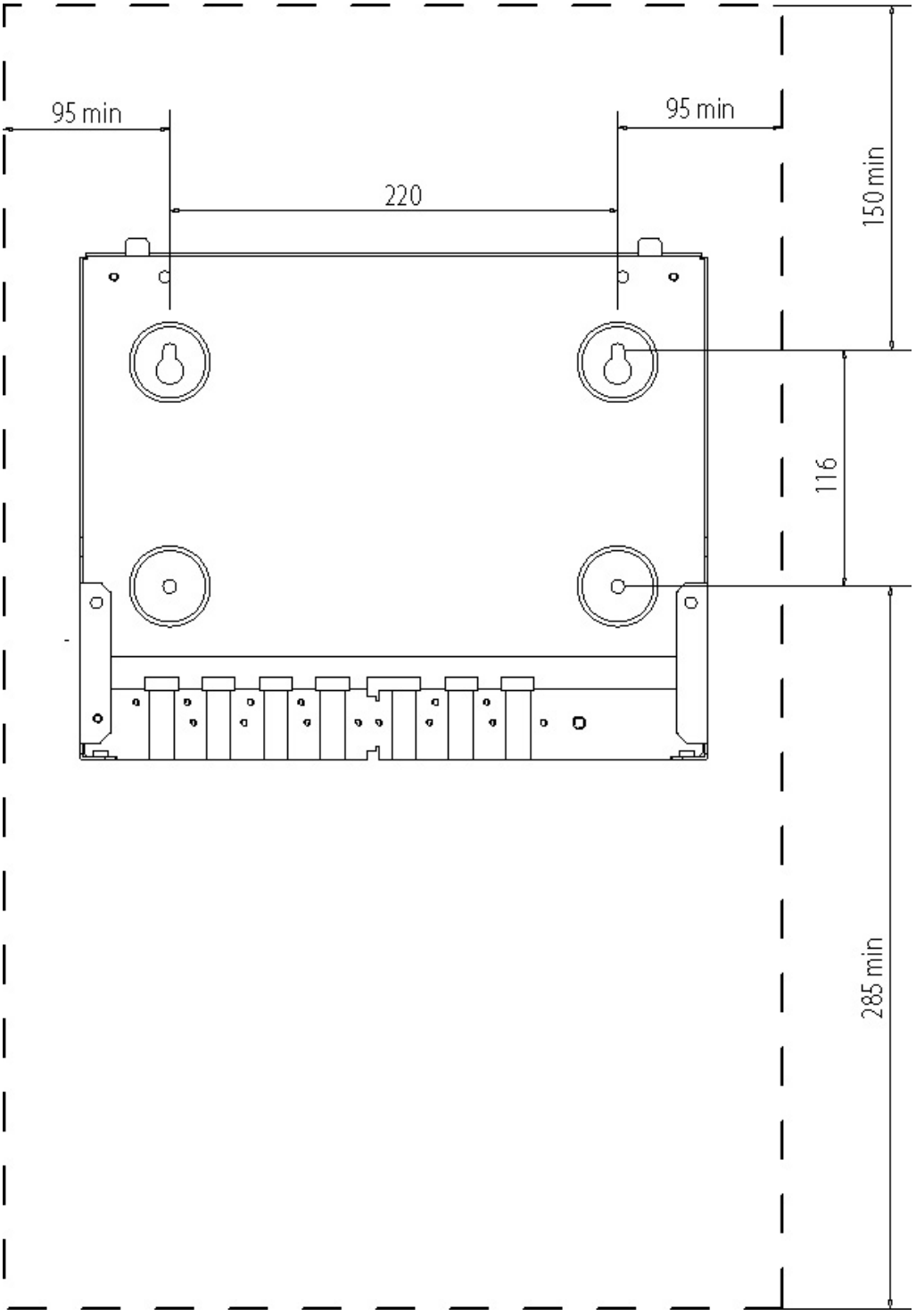
It is recommended to leave at least 300 mm free space around the terminals to allow for connection cables.

5.2.1 Transponder main dimensions





Exploded view of M-2 transceiver showing cover, detachable terminal blocks and mounting plate

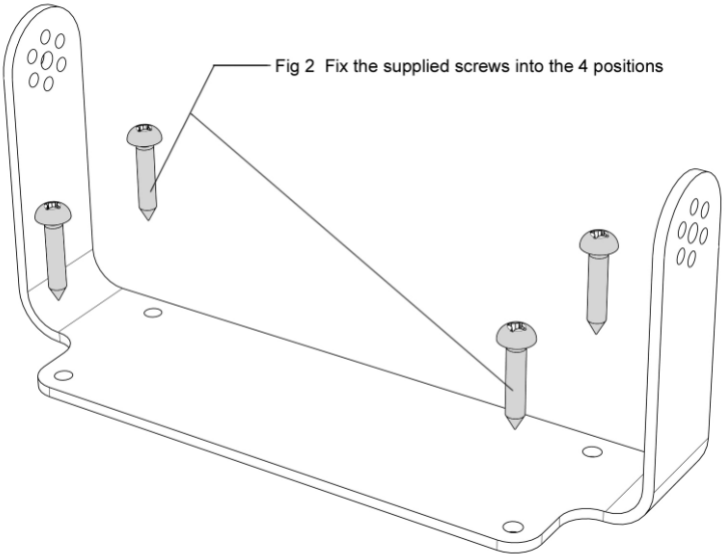


Transponder mounting plate drilling diagram and recommended clearances (mm)

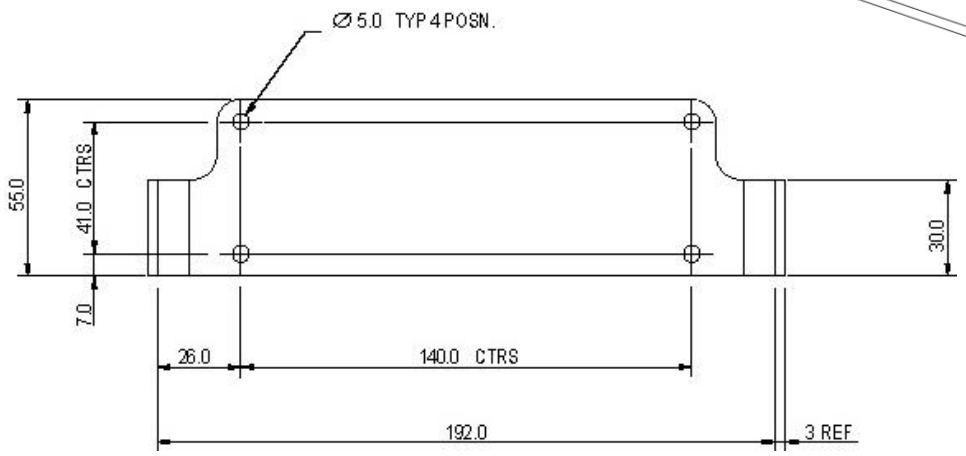
5.3 AIS Display

5.3.1 AIS Display trunnion assembly

The Display can be either trunnion mounted or flush mounted.

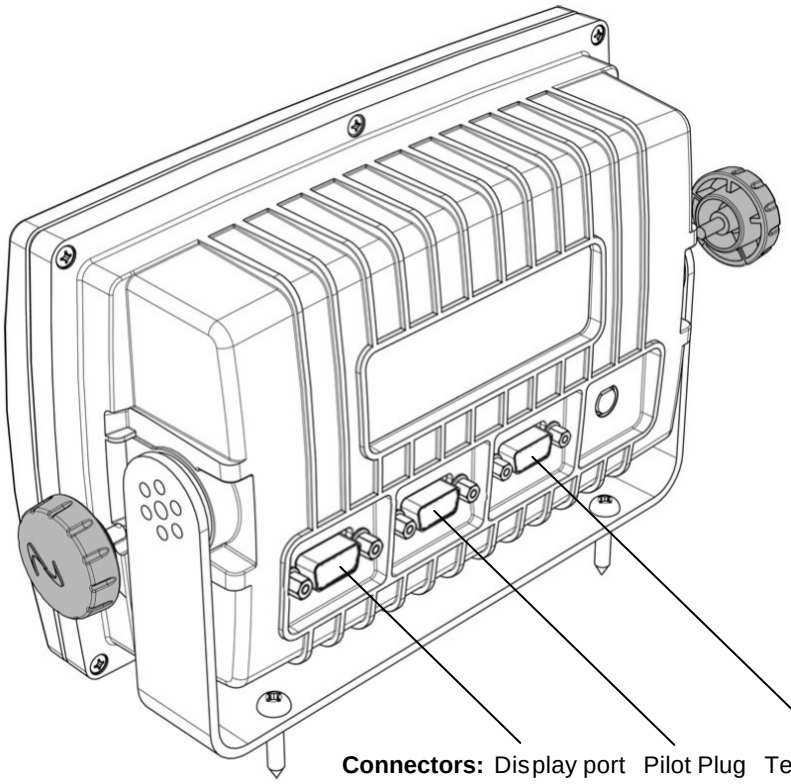


Hole size to fit #10 screw: 3.5mm



Drilling drawing (mm)

Select hole size to suit method of fixing mountings – clear or tapped holes.



Connectors: Display port Pilot Plug Test port

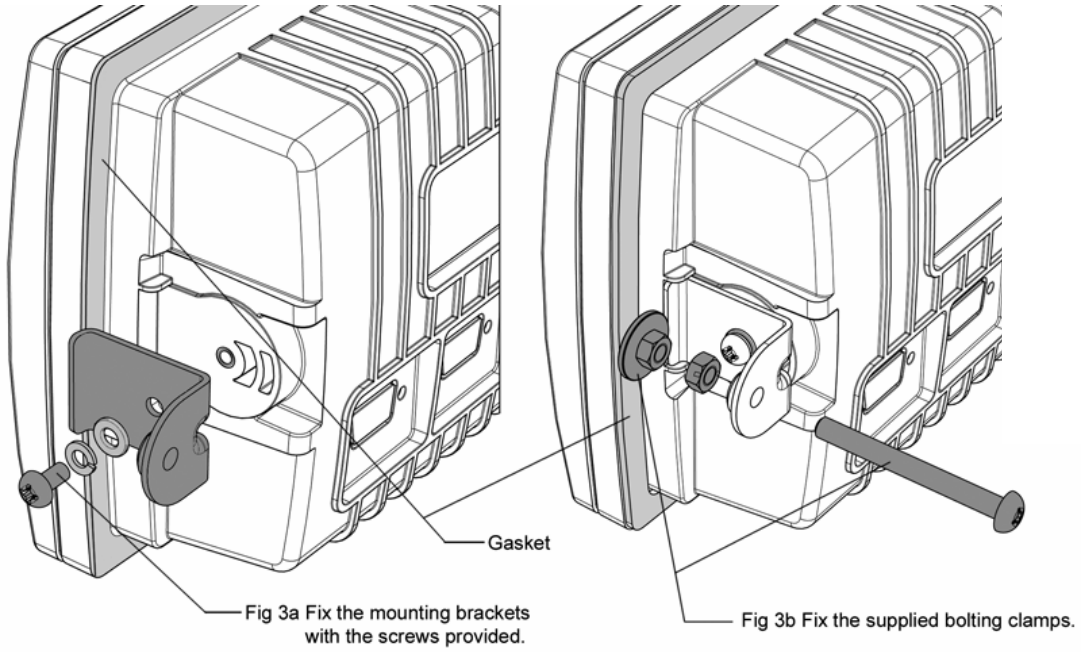
Mounted dimensions:

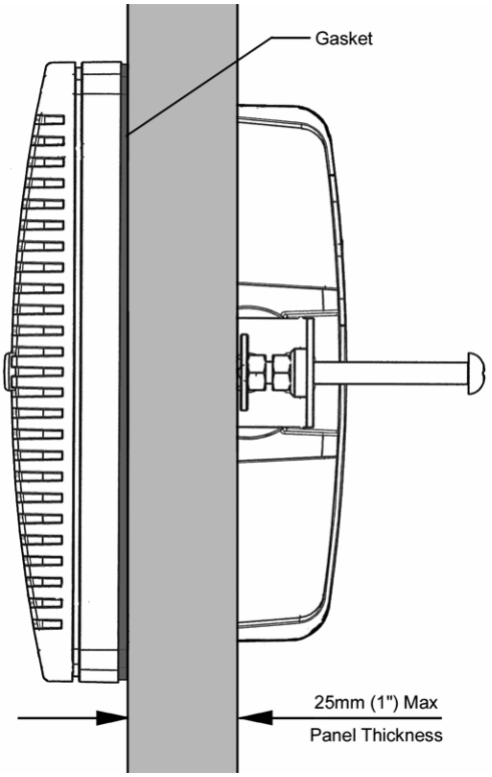
Height:	150 mm
Width:	270 mm
Depth:	120 mm (over connectors)

5.3.2 AIS Display flush mount assembly

NOTE: The Pilot Plug is intended to be connected to the Display, although an alternative connection is available on the transponder. The cabling arrangements should take this into consideration when flush mounting the Display.

A cutting template is supplied with the flush mounting kit. This template carries full fitting instructions.



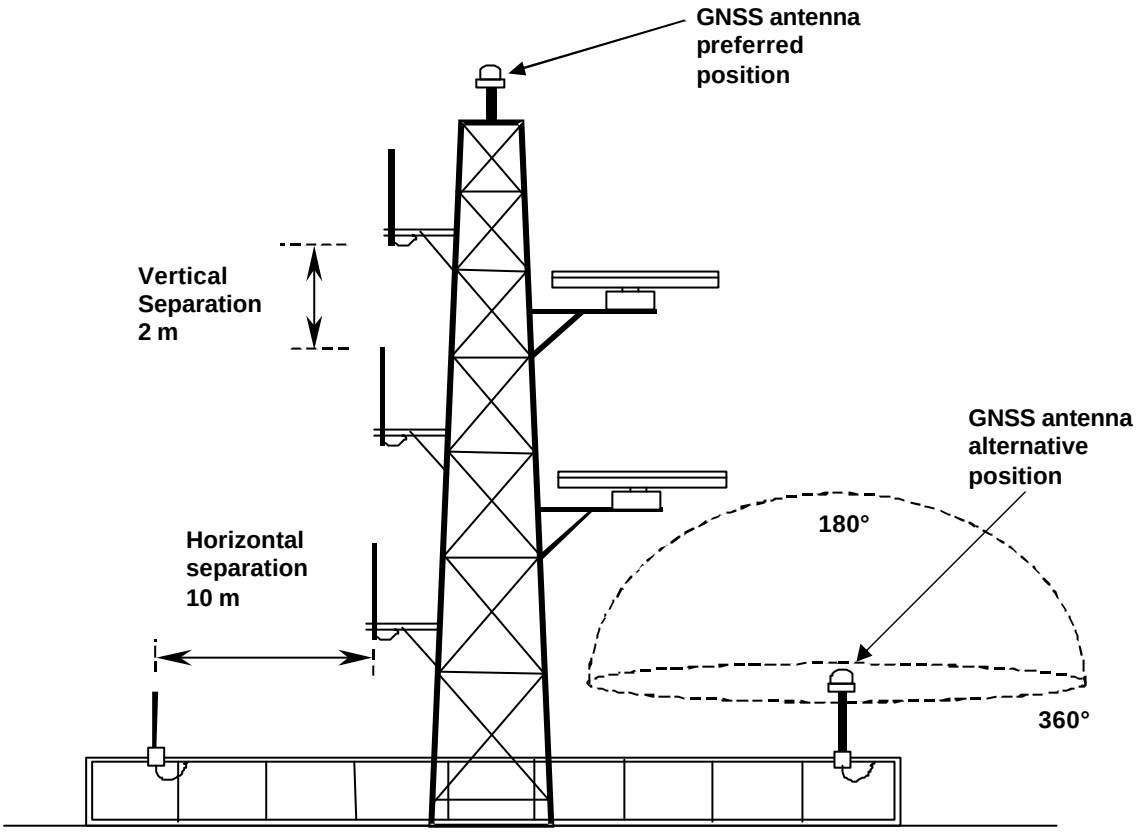


5.4 Antenna units

The AIS Transponder has to be connected to two antennas: a VHF antenna and a GNSS antenna. The GNSS (GPS) antenna is supplied as standard.

5.4.1 Antenna mounting position

In accordance with IMO guidelines, antennas should be mounted in positions which, as far as possible, minimise interaction between them. The sketch summarises the recommendations:



5.4.2 VHF antenna

The VHF antenna is an important part of the receiver and transmitter system; the reception range is heavily dependent on the antenna installation. The VHF antenna must be installed as high as possible and free of shadow effects from the ship superstructure; effective installation will maximise the range of the system. The antenna must also be mounted so as to achieve the safety standards detailed in Section 2.

WARNING: The antenna must have sufficient bandwidth to suit the AIS system, as otherwise the high VSWR produced may cause the transponder to shut down. It is recommended to use an omni-directional vertical polarised VHF antenna with unity gain (0 dB), and a bandwidth sufficient to maintain VSWR <1.5 over the frequency range 156 – 163 MHz. A suitable antenna is available from McMurdo as an option, part number 89-020-001.

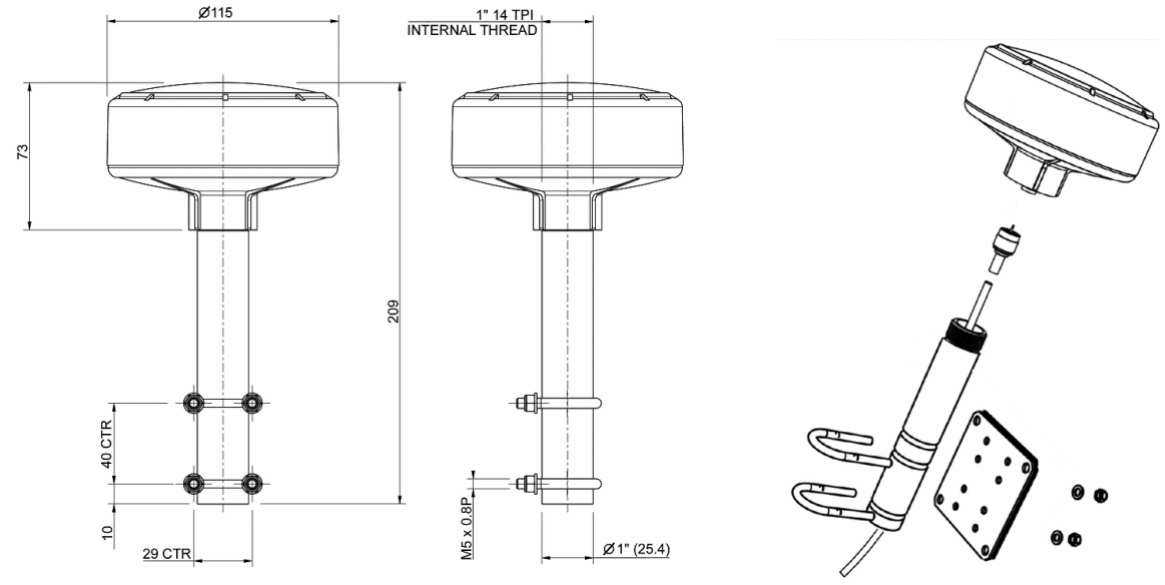
5.4.3 GNSS antenna

The Transponder package contains a GNSS antenna and a mounting bracket. The mounting bracket is designed for welding to the ship's superstructure.

Installation of the GNSS antenna is critical for the performance of the GNSS, which is used for timing of the transmitted time slots and for the supply of navigational information should the main navigational GNSS fail. We strongly recommend that the supplied antenna is used.

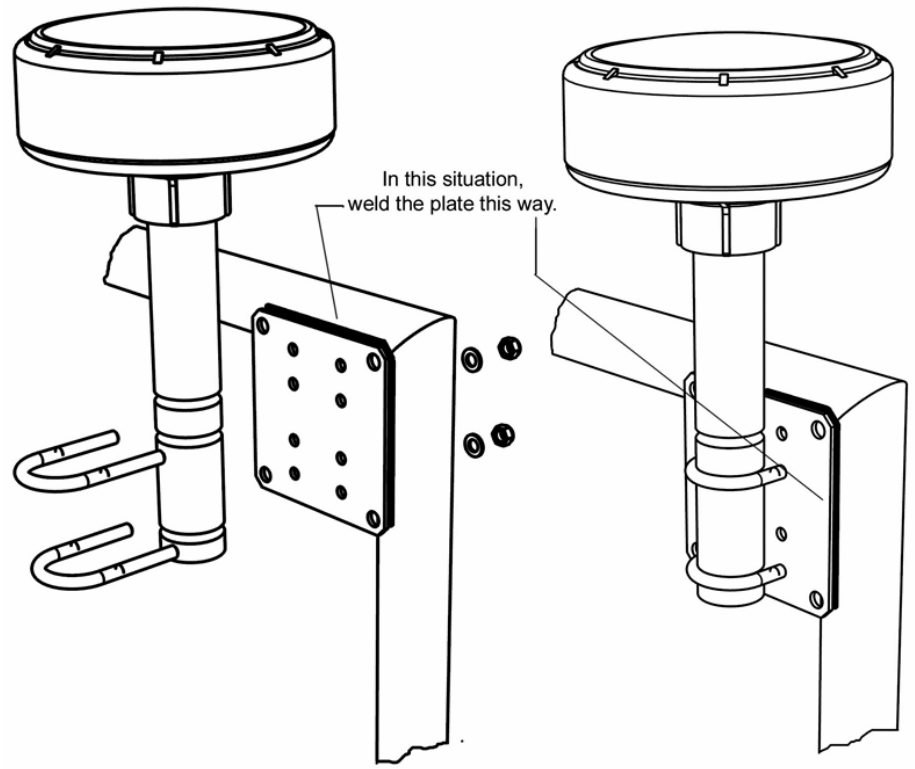
1. The GNSS antenna must be mounted in an elevated position and free of shadow effect from the ship's superstructure

2. The GNSS antenna must have a free view through 360 degrees with a vertical angle of 5 to 90 degrees above the horizon.
3. As the received GNSS signal is very sensitive to noise and interference generated by other onboard transmitters, ensure that the GNSS antenna is placed as far away as possible from Radar, Inmarsat and Iridium transmitters. Ensure the GNSS antenna is free from direct view of the Radar and the Inmarsat beam. It is also important that the MF/HF and other VHF transmitter antennas are kept as far away as possible from the GNSS antenna. It is good practice never to install a GNSS antenna within a radius of 5 meters from these antennas.

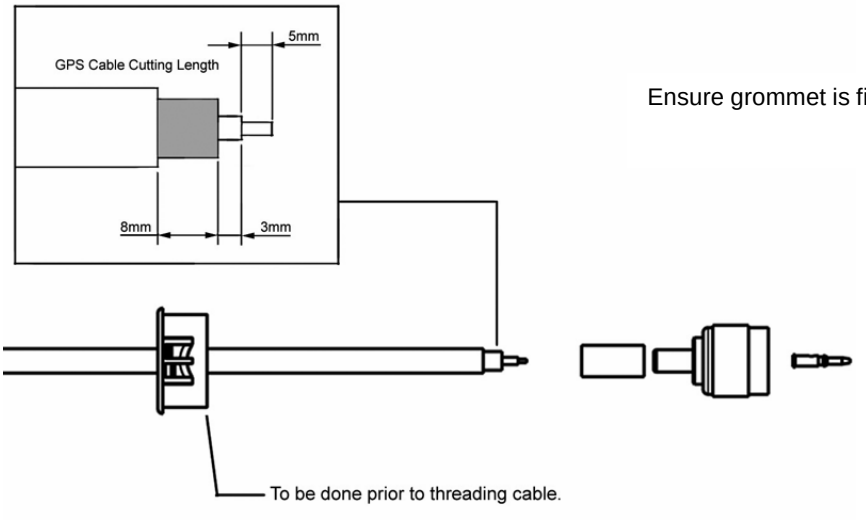


⚠ **WARNING:** Screw the rod into the GNSS antenna by turning the rod. Do not turn the GNSS antenna as this will twist the cable and damage the connection.

5.4.4 Weld on plate mounting of the GNSS antenna



5.4.5 Cable Preparation



Ensure grommet is fitted before connector

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6 Electrical connections

This installation guide takes into account the IMO “Guidelines for installation of Shipborne Automatic Identification System”. However both the IMO publication and these instructions must be taken as guidance only; individual circumstances must take precedence.

This guide is concerned only with the installation of the AIS transponder unit and does not cover the installation of any peripheral equipment connected to the transponder. For proper installation and connection of peripheral equipment to the transponder refer to the installation manuals for these products.

Connection	Must connect	Optional
24.0 VDC power supply*	Yes	
GNSS antenna	Yes	
VHF antenna	Yes	
Display system	Yes	
Position (external GNSS)	Yes	
Heading (vessel gyro)	Yes	
Pilot plug	See Note 1	See Note 1
Alarm Relay		Yes
ECDIS (Main port)		Yes
ARPA (Main port)		Yes
Long range function		Yes
RTCM, differential GNSS info.		Yes
Rate of turn		Yes
Speed and Course		Yes

***WARNING:** Ensure supply is compatible with voltage and current requirements.

Note 1: depends on IMO recommendations and local legislation.

6.1 Ground Connection

The earth stud on the transponder backplate must be connected to ship’s ground. The recommended connector wire is 4 mm^2, green/yellow colour.

6.2 Signal cable connections for AIS Transponder

As shown in the table above, the AIS Transponder must be or may be connected to different types of peripheral units; these can be divided in three groups:

- Coax connection to the antennas
- signal cable connection to the sensors (GNSS, Gyro, Log)
- signal cable connections to the five-input/output ports (Main, AUX/Pilot, long-range, RTCM, Display)

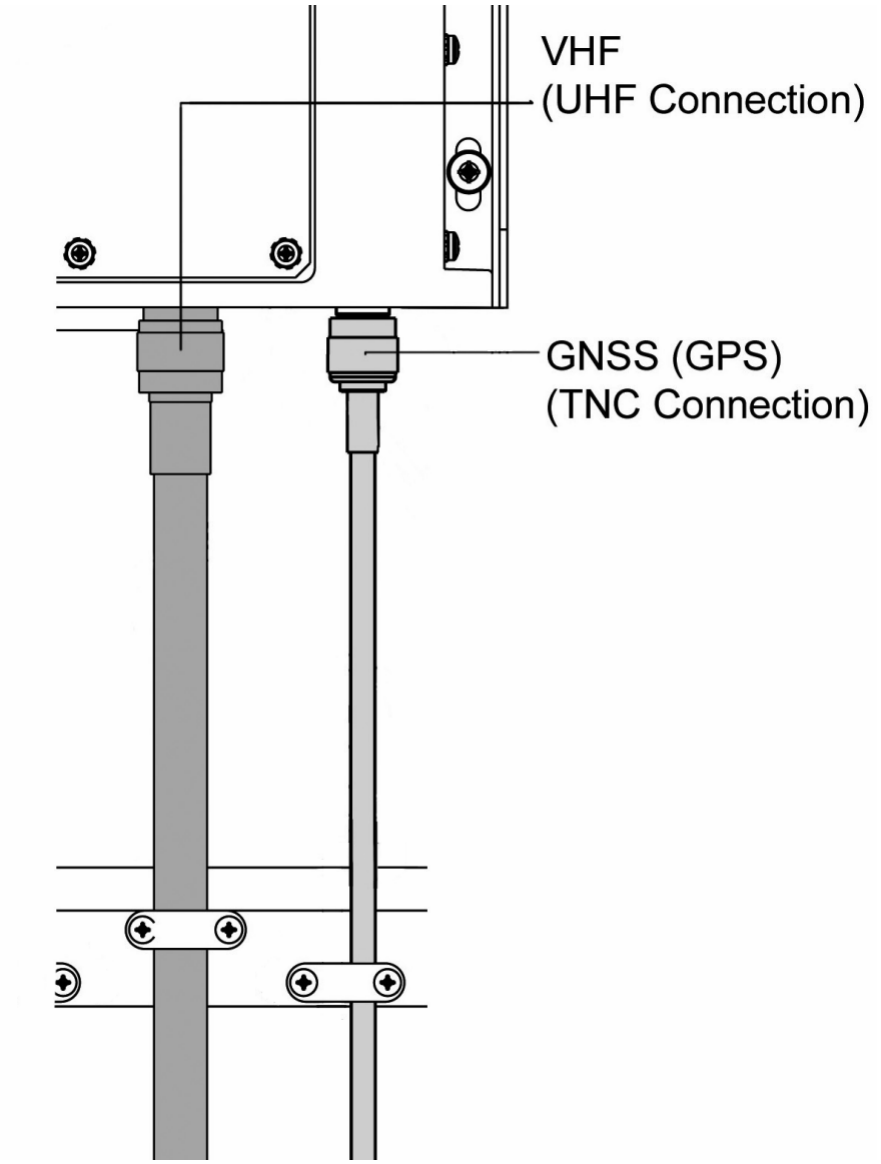
Connecting the three types of interfaces is described in detail in the following sections.
The signal connections are all connected via a serial RS422 type interface; data rates are normally 4800 or 38400 baud.

In some cases, particularly in retrofit installations, it may not be possible to connect the AIS directly to the required sensor, because some sensors do not provide the IEC 61162-2 (NMEA) sentences required by the AIS unit. In such cases a protocol converter is required between the sensor and the AIS unit. Converters are available from different manufacturers, either as direct protocol converters or frequently as repeater instruments for the sensor. A Gyro Interface Unit, P/N 89-028, is available from McMurdo as an optional extra.

6.3 VHF and GNSS (GPS) antenna cable connections

The VHF and the GNSS antenna cables are connected directly to the transponder through a UHF and a TNC plug respectively.

The coax cable plugs must be attached directly to the cables; the outer insulation must not be connected in the cable cleat but in the coax plug as illustrated below.

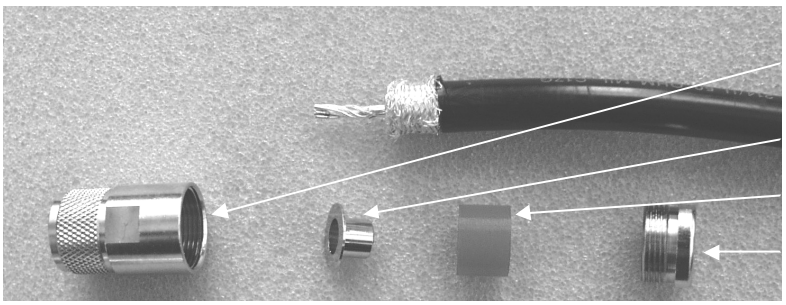


6.3.1 VHF antenna

To make sure that the transmitted and received VHF signal is not interfering with Radar signals, other VHF transmission or power lines it is important that the connection between the VHF antenna and the transponder is of a high quality double shielded coax cable. It is recommended to use a RG214 cable and PL259 connector.

If the cable has to be longer than 40 metres, it is recommended to use a cable with lower loss; a 40 metre RG214 coax cable has a signal attenuation of 3 dB at 150 MHz, thus the signal strength is reduced to half its value due to cable attenuation.

Detailed instructions for fitting the connector are provided with the installation kit. The illustration shows the preparation of the cable and the components of the connector.



6.3.2 GNSS (GPS) antenna

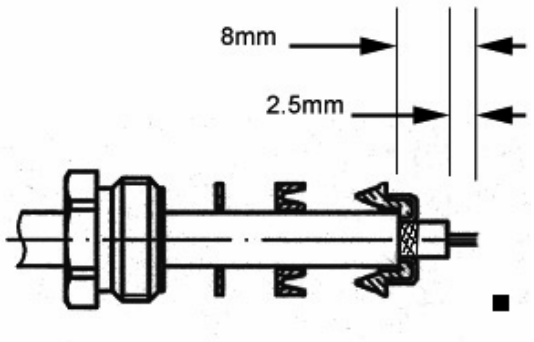
The GNSS operates in the ultra high frequency band (1.575 GHz). The signal attenuation in cables is therefore substantial and has to be taken into account when the coax cable between the antenna and the AIS unit is chosen. To compensate for signal attenuation the supplied GPS antenna includes a pre-amplifier with a gain of 30 dB.

The cable attenuation should not be greater than 30 dB for optimum results, because the aim is to have a total signal loss of less than 0 dB. The table shows the attenuation and the recommended maximum length of two types of coax cable.

Cable description	Attenuation / 100 metres @ 1.5 GHz	Recommended maximum cable length
RG 58	70 dB	40 metres
RG 214	37 dB	80 metres

Connectors used must be TNC throughout.

Detailed instructions for fitting the connector are provided with the installation kit. The illustration shows the preparation of the cable.



6.4 Connection terminals

The AIS Transponder has detachable terminal blocks for connection of cables. Dedicated connections are provided for power sources, sensors, the Display and other interfaces.

Refer to the wiring diagram, attached as an appendix, for details of connections to the terminal blocks.

6.4.1 Fuse values

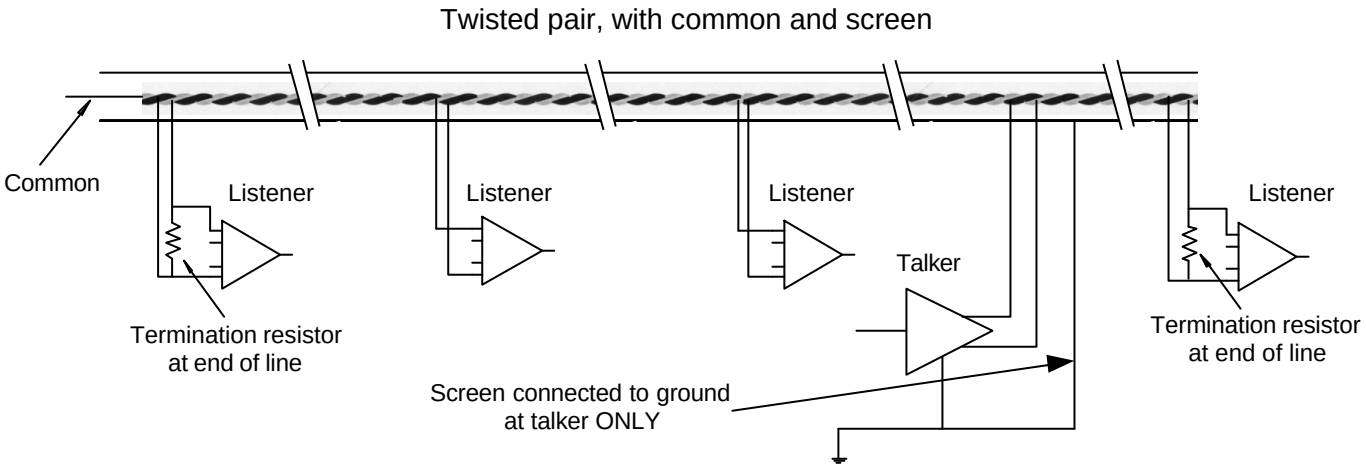
The main system fuse (3.15 Amp) is located beside the connectors on the transponder chassis.

Fuse description	Fuse value	Part No.
Main system fuse	3.15 Amp	99-084

6.4.2 Signal line termination

RS422 signal lines may need termination by resistors, depending on the length of connecting cable and the rate of data transmission. Suitable resistors are incorporated in the transponder listeners and can be switched in by wire links in the corresponding screw terminal blocks – see subsequent tables and section 6.4.4 for details. The talkers in the transponder have inbuilt termination resistors.

Whether termination at the transponder is required depends on many factors, including how the other units are connected and whether any of these other units provides termination for the signal line. The following sketch shows the principle:



Note: For clarity, the sketch shows the devices connected to the twisted pair by spurs; in practice, the twisted pair is looped through each device in turn.

There is only one talker per twisted pair; there can be several listeners. The intention is that terminations must be provided by the devices at the ends of the line, regardless of whether they are listeners or the talker, and that no other device should provide a termination.

A terminal is provided for the common connection at each port on the transponder; note that this is NOT a ground connection.

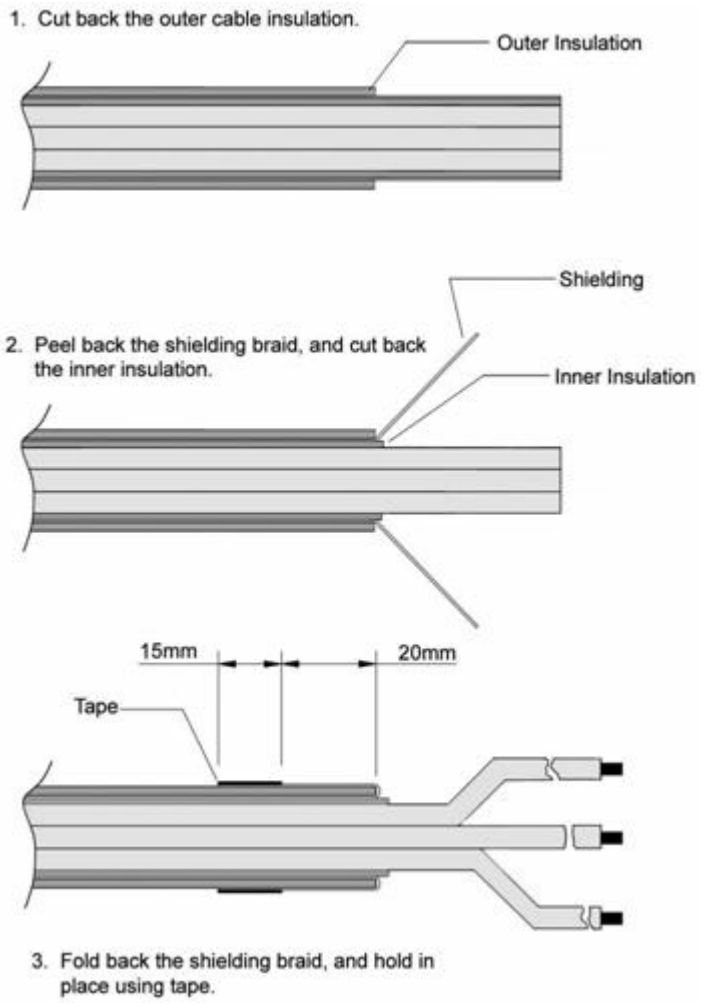
It is good practice to use screened cables in all ship cable installations. Take care to connect the cable screen to ship's ground at one end only of the cable, as connecting at both ends may cause ground loops and interference to the signals. The correct method of connecting the cable screen to ground is at the talker only, as shown in the diagram above.

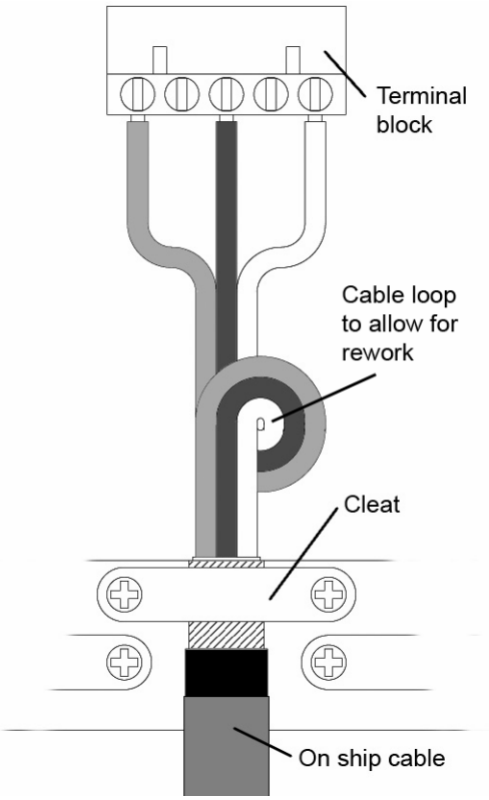
In the transponder unit the screen from some cable entries should be connected to ground at the transponder, as shown in the table. The technique of connecting the screen is illustrated below.

Function	Lines terminated by resistor	Connect screen at transponder
Display	Display (VDU) port	YES
LONG RANGE	Long Range port	PREFERRED
AUX / PILOT	Auxiliary or Pilot port	PREFERRED
MAIN	Main port	PREFERRED
RTCM	RTCM port for differential correction	PREFERRED
SEN 1	Sensor 1 port	NO
SEN 2	Sensor 2 port	NO
SEN 3	Sensor 3 port	NO
SEN 4	Sensor 4 port	NO

PREFERRED means that the screen may be connected either at the remote device or at the transponder; if no other considerations apply, connection at the transponder is recommended.

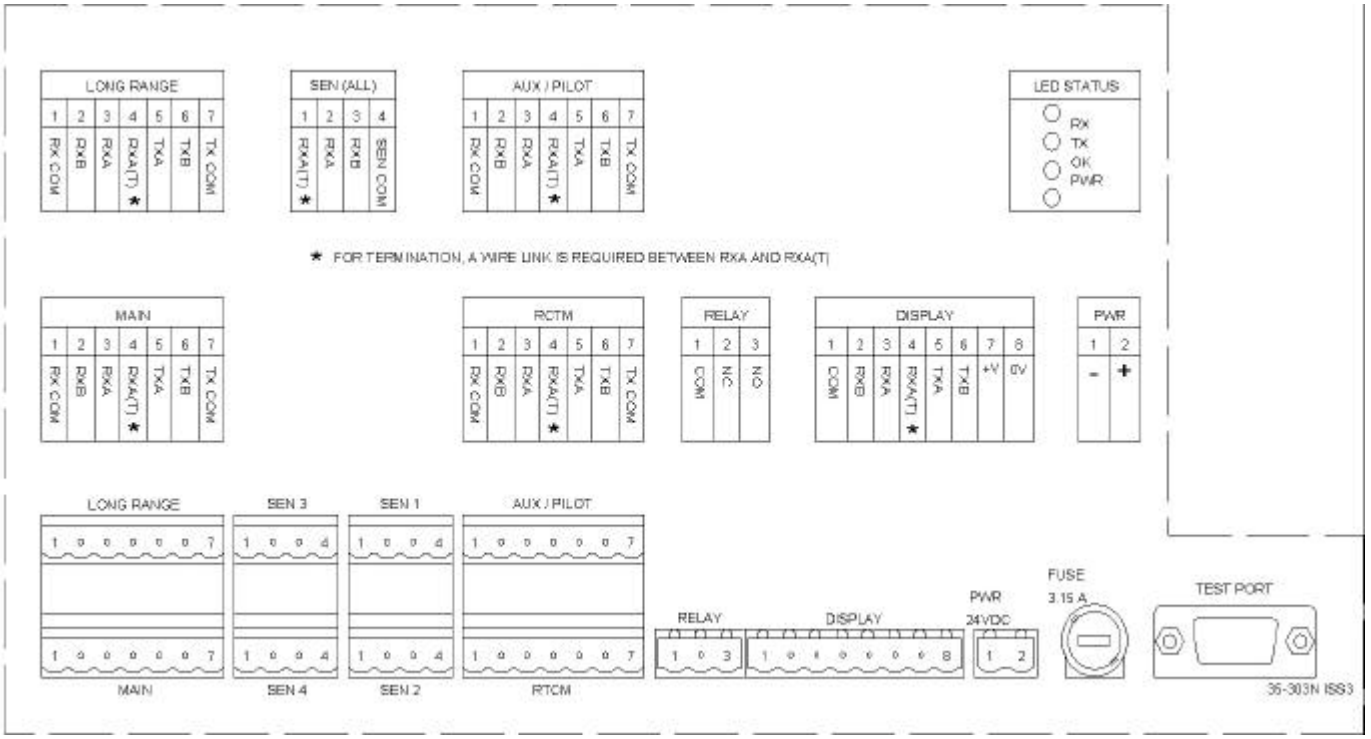
6.4.3 Method of connecting screens at the transponder





If the screen is not to be connected at the transponder, secure the cleat over the outer cable insulation.

6.4.4 Test and program connections



The connectors are 5mm pitch female screw terminal conectors. Manufacturer's numbers are given for the Hitaltech models, but any equivalent may be used.

Connectors used:

8 way	1 off	CIF08001
7 way	4 off	CIF07001
4 way	4 off	CIF04001
3 way	1 off	CIF03001
2 way RED	1 off	CIF02001OR

6.4.5 Power supply

Connect to the ship's 24 V DC emergency power source, which ideally should be an uninterrupted power supply (UPS), through a 2-pole switched fused supply to allow isolation for servicing. The power requirements are 24 V DC +30% -10%, 2.5 A minimum.

Standby power requirement	15 W; 0.6 Amp at 24 V DC
Peak power requirement	50 W; 2.0 Amp at 24 V DC

Required conductor area as a function of cable length

Power cable length	Required conductor area
0 – 10 metres	0.75 mm^2
10 – 20 metres	1.5 mm^2
20 – 30 metres	2.5 mm^2
30 – 40 metres	3.0 mm^2

Isolation between the power supply connections and any other connection to the transponder is 1 kV minimum.

The DC power source should comply with IMO guidelines for the class of vessel concerned. National authorities and classification societies may have their own power supply requirements; these should also be considered.

Power Supply Unit (optional)
An AC/DC + DC emergency backup power supply, P/N 89-029, is available as an option. Follow the installation instructions supplied with the equipment.

6.4.6 DISP port – Display

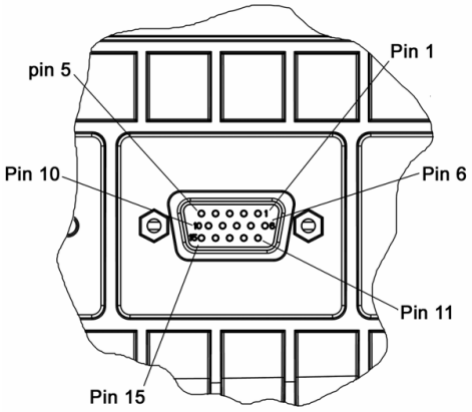
The DISP port connects the Display unit with the Transponder. The display connection cable is supplied ready for use, and needs only to be plugged into the appropriate ports on the transponder and the Display.

For installations where the Display cable needs to be extended, the connections are given below.

Display cable:
Four twisted pairs, screened, PVC sheathed. For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8104 or equivalent.

The connection between the transponder connector block and the Display unit is given below, Connection is to the 15-pin socket on the Display.

Function	Terminal	Display pin
Common	1	2
Rx A	2	6
Rx B	3	1
Tx A	5	12
Tx B	6	13
Termination	4 (link to 3)	8
+ Power out	7	3
- Power out	8	4



The twisted pairs are assigned as (Rx A/B), (Tx A/B), (common pair) and (power pair)

6.4.7 SEN 1, 2, 3, 4 ports - Sensors

Sensor input ports can be configured to receive serial data from the Gyro (or Gyro Converter), the external GNSS used for navigation and from the LOG. Each of the four sensor (SEN1, SEN2, SEN3 and SEN4) ports can be used to receive information from one of these sensors. Alternatively, all sensor information can be received at any one of the sensor ports provided that the information is first multiplexed.

The sensor ports require configuration before use; this is outlined in the Commissioning Guide, section 12, and described in detail in the Operation Manual.

The AIS must be connected to:
- The GNSS unit used for navigation
- The gyrocompass providing heading information

If available the following information can be connected to the AIS:
- Rate-Of-Turn (ROT)
- Speed over ground from bottom-referenced log

Sensor wire connection
The twisted pair shall be assigned as RxA and RxB

Recommended cable for connection of Sensors:
Single twisted pair, shielded, PVC sheathed.
(Note: The recommended sensor cable, as supplied in the optional Installation Kit 89-038, has four twisted pairs. Only one pair should be used.)
For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8102 or equivalent (2 pairs)

6.4.8 SEN Ports necessary sentences:

The basic requirements are:
IEC 61162-2 transmission standard
ITU-T V.11 electrical properties
Data bits 8, Stop bits 1, Parity none
Speed 4800 or 38400 baud (transponder speed is configurable)

All required as well as optional sentences are listed in the table; ensure that the connected sensor transmits at least the required sentences (as given by IEC 61162-1):

Data	IEC 61162-1 sentence format	
	Preferred	**Optional**
Reference datum	DTM	
Positioning system: Time of position Latitude/longitude Position accuracy	GNS, GLL	GGA, RMC
Speed over ground (SOG)	VBW	VTG, RMC
Course over ground (COG)	RMC	VTG, OSD
RAIM indicator	GBS	
Heading	HDT	
Rate of turn (ROT)	ROT	

6.4.9 Main and AUX high speed input/output ports

The Transponder has two high-speed communication ports. The ports are identical, the same information is input and output on these ports. All information received and transmitted on the VHF link will be reflected as correct IEC 61162 sentences. All error messages will also be transmitted.

The Main port will primarily be used to connect external equipment such as ECDIS and ARPA or another navigation information display system.

The AUX port is normally connected to the display unit, where it is looped through to drive the Pilot Plug connector on the display unit. If a Pilot Plug is not required, the AUX port may be disconnected from the display (at the transponder end) and may then be used as an additional Presentation Interface (PI) port.

6.4.10 MAIN port

Three twisted pairs, shielded, PVC sheathed.
For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8104 or equivalent

Main port wire connection
The twisted pairs shall be assigned as (RxA/RxB), (TxA/TxB) and (RxCom/TxCom).

6.4.11 AUX/Pilot port

Three twisted pairs, shielded, PVC sheathed.
For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8104 or equivalent

6.4.12 Pilot Plug connection

The Pilot Plug is designed to be connected to the Display. The Plug supplied with the AIS system has the connector fitted, and needs only to be fixed and plugged in.

6.4.13 Long Range Port

The AIS Long-Range Function requires a compatible long-range communication system e.g. Inmarsat-C. If this is available, a connection to the Inmarsat-C system can be made. It is required that the Inmarsat-C input/output port can be interfaced using IEC 61162-2 and understand the long-range sentences as required by IEC 61993.

Recommended cable for connection of Long Range port:
Three twisted pairs, shielded, PVC sheathed.
For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8104 or equivalent

The twisted pairs shall be assigned as (RxA/RxB), (TxA/TxB) and (RxCom/TxCom)

6.4.14 RTCM port, Differential GNSS correction input/output port

The RTCM-port is the input port for differential correction. The AIS Transponder can receive differential correction in two ways:

- The RTCM port can be connected to a DGNSS unit. The DGNSS unit will then provide differential correction to the AIS Transponder through the RTCM port.
- Through message 17 transmitted from a base station. The RTCM port will then work as an output port, which can supply differential correction in RTCM format to other units.

Recommended cable for connection of RTCM-port:
Three twisted pairs, shielded, PVC sheathed.
For lengths to 200 meters, use 0.22 mm^2 (7/32); Belden 8104 or equivalent

RTCM port wire connection
The twisted pairs shall be assigned as (RxA/RxB), (TxA/TxB) and (RxCom/TxCom)

6.4.15 Alarmrelay

The AIS requires that an alarm output (relay) be connected to an audible alarm device or to the ship's alarm system, if available.

If any failure or malfunction is detected that will significantly reduce integrity or stop operation of the AIS, an alarm is initiated. In this case:

- An alarm message is displayed on the display unit
- The alarm relay is activated
- The transponder health status LED turns off

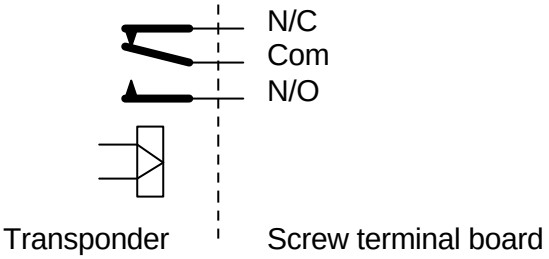
- An appropriate alarm message is output via the presentation interface (Main and AUX-ports) and repeated every 30 seconds.

The AIS transponder provides a relay connection which can be selected as normally closed or normally open contacts.

Recommended cable for connection of alarm relay:
One twisted pair, shielded, PVC sheathed. The required cable dimension is dependent on the current necessary to activate the alarm indicator.

Built in alarm relay ratings:

Absolute maximum ratings	
Maximum switching current in contacts	0.25 Amp
Maximum carry current	1.20 Amp
Maximum switching voltage	175 V (dc or ac peak)



Test Port
The test port is intended to allow easy field reprogramming of the transponder and should not be used in normal operation.

6.5 Completion of Installation

The foregoing provides the information necessary to perform the installation. Other useful information is contained in the sections following.

The Pre-Installation Inspection Record (Section 8) should have been completed before installation commenced.

It is most important that the installed system is not switched on at this stage. The inspection procedures given in the Operation Manual must be completed before power is applied.

The Warranty and Acceptance Record can only be completed after the system is configured, as detailed in the Operation Manual.

7 Specification

General Data:		
Power consumption:	50 W peak 15 W average	
Power supply:	24 V DC –10% +30%	
Default frequencies:	AIS1 (CH87B)	161.975 MHz
	AIS2 (CH88B)	162.025 MHz
	DSC (CH70)	156.525 MHz
Operating temperature:	-15 °C to +55 °C	
Storage temperature:	-20 °C to +70 °C	
Environmental:	IEC 60945 Protected Environment (Antennas: Exposed Environment)	
Transponder size/weight	331 x 274 x 100 mm, 4 kg	
VDU size/weight	220 x 150 x 72 mm, 1 kg	
GPS size/weight	∅ 115 mm x 76 mm, 0.25 kg	
Compass safe distance	Display: 0.7 m for 1° deviation 1.2 m for 0.3° deviation Transponder: 1.3 m for 1° deviation 2.1 m for 0.3° deviation	
GNSS receiver:	Used for TDMA timing. Optionally used for navigational information.	
GNSS antenna:	Patch antenna with built-in 30 dB pre-amplifier	
DSC Transmitter:		
Power output:	12.5 W or 2.0 W	
Frequency range:	156.025 – 162.025 MHz	
Antenna impedance:	50 ohms	
TDMA Receivers:		
Sensitivity:	(PER) < 20% at –107 dBm (25 kHz)	
Frequency range:	156.025 – 162.025 MHz	
Channel spacing:	12.5 or 25 kHz	
Modulation:	GMSK	
Data rate:	9600 bits/s	
Frequency stability:	< ± 1 ppm	
DSC Receiver:		
Sensitivity:	BER $<10^{-4}$ at 107 dBm	
Frequency range:	155.3 – 162.5 MHz	
Channel spacing	25 kHz	
Modulation	1300 Hz/2100 Hz - FSK	
Frequency stability	< ± 1 ppm	
Serial inputs/outputs:		
SENS1/2/3/4	IEC61162-1/2 (input only)	
LONG RANGE, MAIN, AUX/PILOT, RTCM	IEC61162-1/2 (input & output)	
Display	RS422 non-isolated	

7.1 Technical Information

7.1.1 RS-422 interfaces

The Transponder has eight RS-422 interfaces:

- **4 sensor data input ports SEN1, SEN2, SEN3 and SEN4**
- **2 Bi-directional input/output ports MAIN and AUX/Pilot**
- **1 Bi-directional input/output port RTCM**
- **1 Bi-directional input/output port Long Range**

All communication interfaces are compatible with IEC61162-1 (2000) and IEC61162-2 (1998) standards.

7.1.2 Termination

Termination resistors are required at each end of the RS-422 connection, to match the impedance of the line to minimise reflections. The figures quoted assume that the line is correctly terminated, and allow for that extra loading.

7.1.3 Output drive capability

Each talker output has a capability of driving a minimum of 12 listeners on a terminated cable.

7.1.4 Input loading

Each receiver presents a load of approximately 12 kohm to the line. Line termination resistors are 100 ohms.

7.1.5 Isolation

The interface isolation is 1 kV minimum throughout.

7.2 RTCM binary messages

The RTCM port on the transponder accepts incoming messages from a differential beacon receiver in RTCM binary format and outputs messages in RTCM binary format. Differential correction data received on the VHF data link (in message 17) is also output to the RTCM port in RTCM binary format.

7.3 NMEA sentences used

The ports on the M-2 transponder accept and output different combinations of NMEA sentences as follows:

Port	Input sentences	Output sentences
Main, Display and Aux ("Presentation ports")	ACA, ABM, BBM, ACK, AIR, AIQ, LRI, LRF	ABK, ACA, ACS, ALR, LRI, lRF, LR1, LR2, LR3, SSD, TXT, VDO, VDM, VSD
Long Range	LRI, LRF	LRI, LRF, LR1, LR2, LR3
S1, S2, S3 and S4 ("Sensor ports")	DTM, GBS, GGA, GLL, GNS, HDT, RMC, ROT, VBW, VTG	None

Decoded Sentences

The sentence types listed in the table below are decoded by the Transponder.

Formatter	Source	Primary function	Optional function	Comment
ABK	AIS			VDL Ack
ABM	AIS			Addressed binary message
BBM				Broadcast binary message
AIR	AIS			Interrogation
ACA	AIS			Channel assignment
ROT	Sensor	Rate of turn		
HDT	Sensor	Heading		Heading
VBW	Sensor	SOG		
GNS	GNSS	Pos + time of pos		
GLL	GNSS	Pos + time of pos		
RMC	GNSS	COG	Pos + time of pos, SOG	
GBS	GNSS	RAIM indication		RAIM
VTG	GNSS		COG, SOG	
GGA	GPS		Pos + time of pos	
VSD	Display			Voyage data
SSD	Display			Static data
LRF	LR			Long range interrogation
LRI	LR			Long range interrogation
TXT				
ALR				
ACK	Display			Alarm ack

Position Sensor Priority List

Priority (Highest first)	Sources
External Differential GNSS	GNS, GLL, RMC, GGA
Internal Differential GNSS (msg17)	GNS, GLL, RMC, GGA
Internal Differential GNSS (RTCM)	GNS, GLL, RMC, GGA
External GNSS	GNS, GLL, RMC, GGA
Internal GNSS	GNS, GLL, RMC, GGA
Manual input	
None available	

Notes:
RAIM indication requires a valid GBS message from the sensor currently in use.

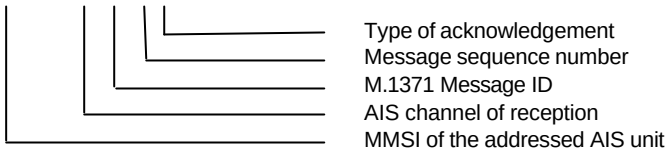
7.4 Message structures

Message structures are shown in the format used in IEC 61162-1

7.4.1 ABK - AIS addressed and binary broadcast acknowledgement

The ABK sentence is output by the transponder on the presentation ports in response to the receipt of an ABM, AIR or BBM sentence. Its purpose is to inform the requesting device about the success or failure of its request.

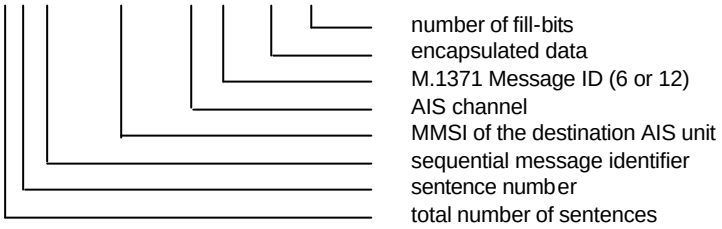
$--ABK,xxxxxxxxx,x,x.x,x,x*hh<CR><LF>



7.4.2 ABM – AIS addressed binary and safety related message

This sentence is used to transmit M.1371 messages 6 (binary addressed) or 12 (addressed safety related) via the AIS system by encapsulating the M.1371 message within one or more AIS sentences.

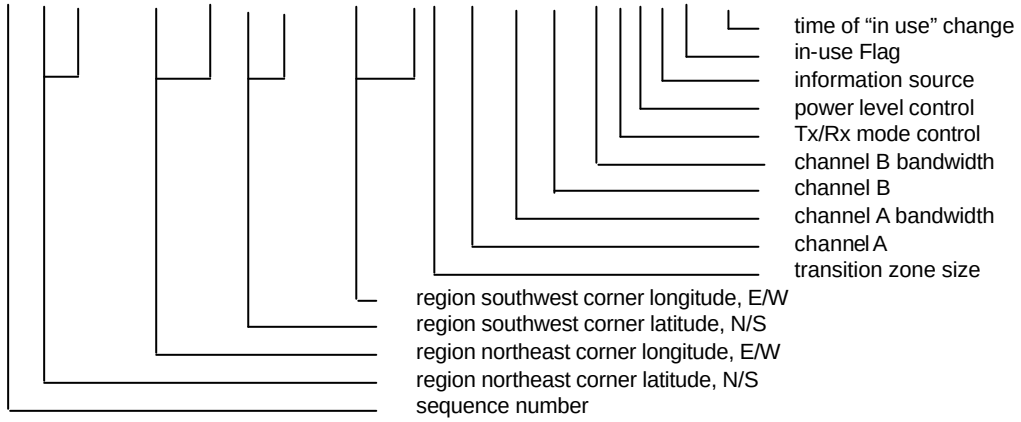
$--ABM,x,x,x,xxxxxxxxx,x,xx,s—s,x*hh<CR><LF>



When the transponder receives an ABM sentence from an external device, it will return an ABK sentence to indicate the success or failure of the transmission attempt.

7.4.3 ACA – AIS channel assignment message

$--ACA,x,llll.ll,a,yyyyy.yy,a,llll.ll,a,yyyyy.yy,a,x,xxxx,x,xxxx,x,x,x,a,x,hhmmss.ss*hh<CR><LF>

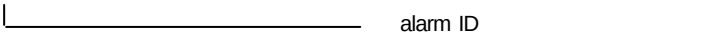


The ACA sentence is used both to send channel management information to the transponder and to obtain channel management information from it.

7.4.4 ACK – Acknowledge alarm

This sentence is used to acknowledge an alarm condition.

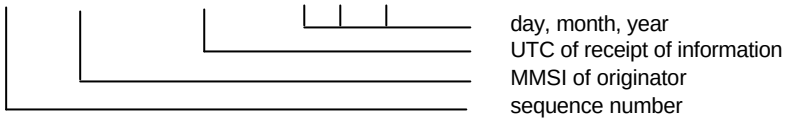
$--ACK,xxx*hh<CR><LF>



7.4.5 ACS - AIS channel management information source

This sentence is used in conjunction with the ACA sentence. It identifies the originator of the information contained in the ACA sentence and the date and time when the transponder received that information.

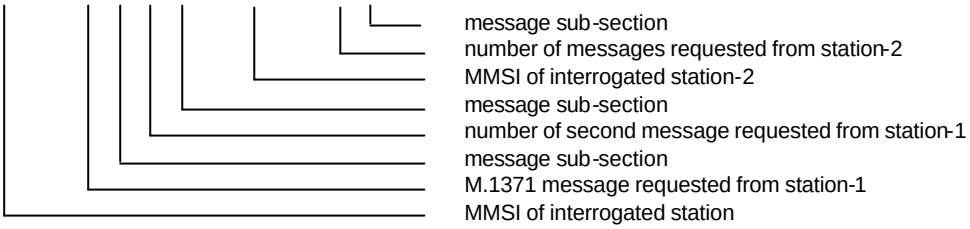
$--ACS,x,xxxxxxxxx,hhmmss.ss,xx,xx,xxxx*hh<CR><LF>



7.4.6 AIR – AIS interrogation request

The interrogation request sentence allows an external to request certain M.1371 messages from other remote devices via the AIS system.

$--AIR,xxxxxxxxx,x.x,x,x.x,x,xxxxxxxxx,x.x,x*hh<CR><LF>

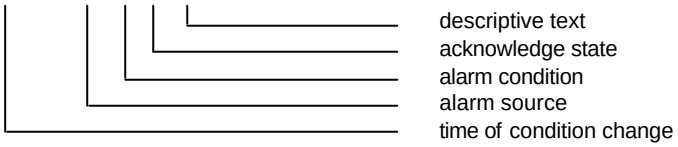


When the transponder receives an AIR sentence it sends M.1371 interrogation messages (type 15) to the addressed station(s) and returns an ABK sentence to the requesting device indicating that the transmission is complete.

7.4.7 ALR – Alarm condition and status

This sentence is sent by the transponder to all presentation ports order to report an alarm condition on a device. It identifies the source of the alarm, whether it has been acknowledged or not and the time at which the condition changed.

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

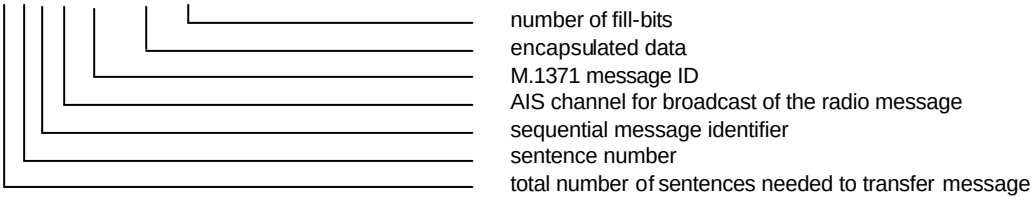


This sentence is sent by the transponder whenever a new alarm is raised or its condition changes state. It is also sent periodically even when there are no active alarms In order to provide a positive indication of the current status of each alarm.

7.4.8 BBM - AIS broadcast binary message

The BBM sentence allows an external device to instruct the transponder to broadcast a block of binary data in an M.1371 binary broadcast message (type 8) or a safety related broadcast message (type 14).

!--BBM,x,x,x,x,x.x,s—s,x*hh<CR><LF>



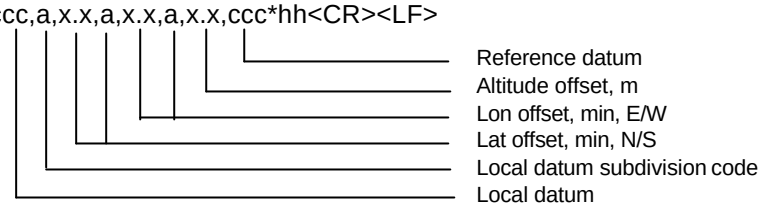
When the transponder receives one or more BBM sentences from an external device, is de-encapsulates the encoded data and re-assembles an M.1371 message of type 8 or 14 and then

transmits it over the VDL (if possible). It then sends an ABK sentence back to the requesting device to indicate whether the transmission of the message succeeded or failed.

7.4.9 DTM – Datum reference

Local geodetic datum and datum offsets from a reference datum.

$--DTM,ccc,a,x.x,a,x.x,a,x.x,ccc*hh<CR><LF>

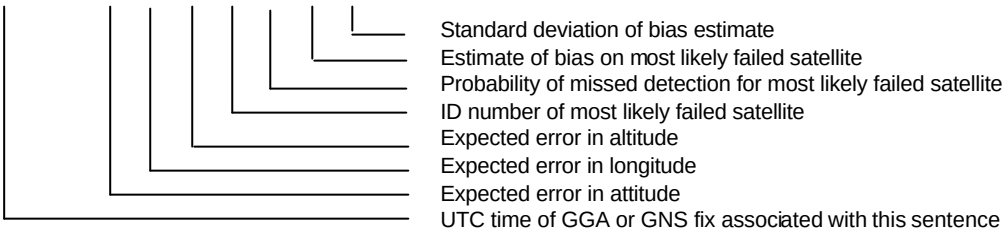


Note that the only datum supported by AIS is WGS84. The DTM sentence must be sent to the transponder at a frequency of more than once every 30 seconds otherwise any positional information sentences (eg GLL, GNS. RMC and GGA) will be ignored.

7.4.10 GBS – GNS satellite fault detection

This message is used to support receiver autonomous integrity monitoring (RAIM).

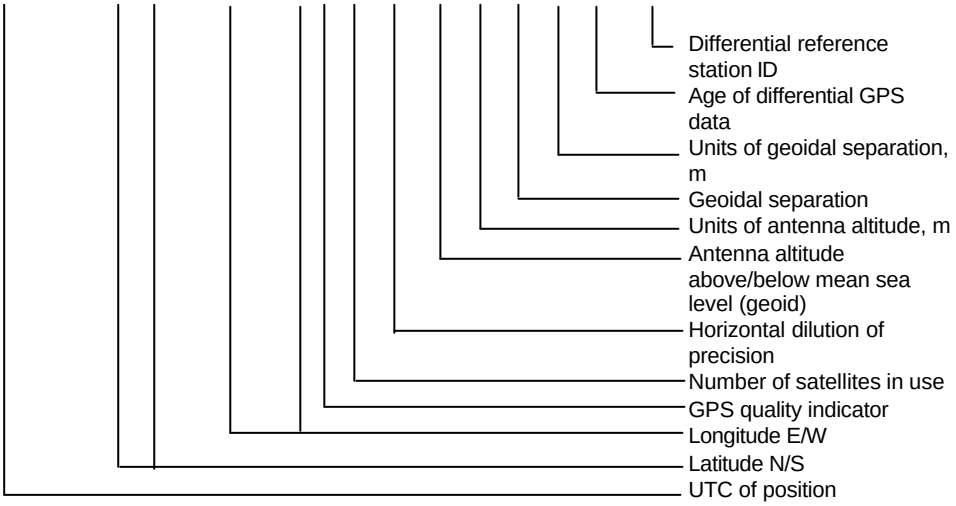
$--GBS,hhmmss.ss,x.x,x.x,x.x,xx,x.x,x.x,x.x,*hh<CR><LF>



7.4.11 GGA – Global positioning system (GPS) fix data

Time, position and fix-related data for a GPS receiver.

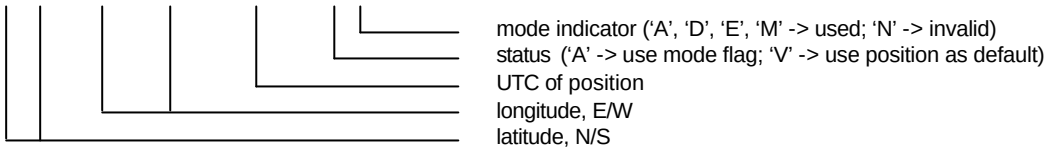
$--GGA,hhmmss.ss,IIII.II,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>



7.4.12 GLL – geographic position

This sentence is a primary source of position information for the transponder when connected to a functional GNSS system. In the absence of GNS sentences, longitude and latitude information may also be obtained from GNS, GGA or RMC sentences.

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

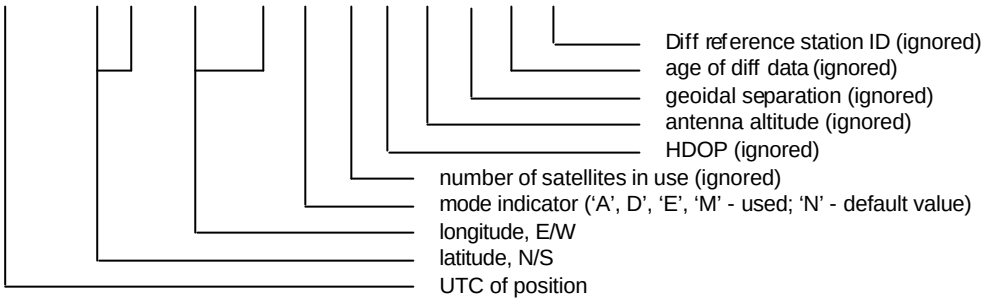


Note that DTM sentences must be received by the transponder at least once every 30 seconds in order for the GLL sentence to be accepted.

7.4.13 GNS – GNSS fix data

The transponder may receive this sentence from other sensors and uses the information in its own calculations of the ship’s current position.

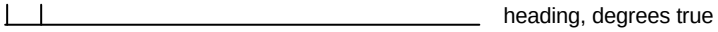
$--GNS,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c—c,xx,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>



7.4.14 HDT – heading true

This sentence provides the actual vessel heading and may be sent by any system or device that calculates true headings.

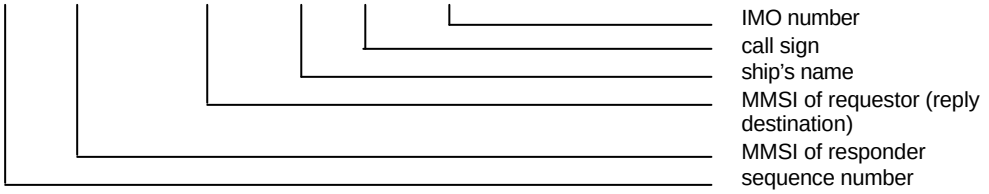
$--HDT,x.x,T*hh<CR><LF>



7.4.15 LR1 - AIS long-range reply 1

The LR1 sentence identifies the destination for the reply and contains the information items requested by the function identification character in the LRF sentence that requested the information.

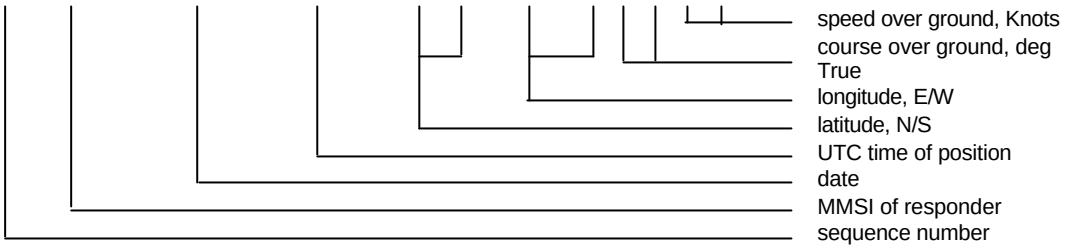
$--LR1,x,xxxxxxxxx,xxxxxxxxx,c—c,c—c,xxxxxxxxx*hh<CR><LF>



7.4.16 LR2 - AIS long-range reply 2

The LR2 sentence contains further information items that can be requested in an LRF sentence.

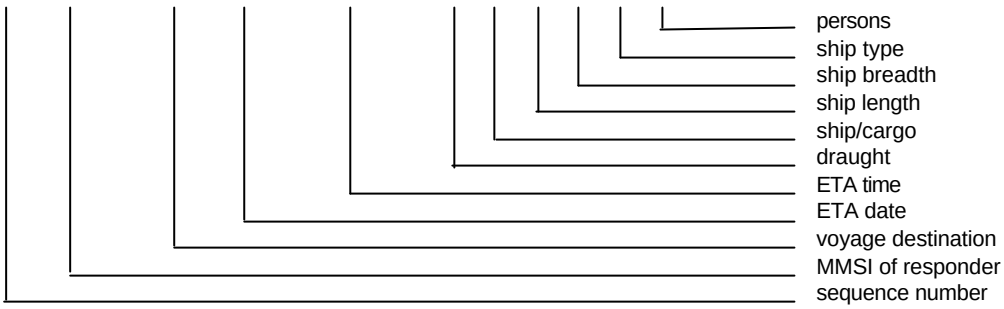
$--LR2,x,xxxxxxxxx,xxxxxxxx,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x.x,T,x.x,N*hh<CR><LF>



7.4.17 LR3 - AIS long-range reply 3

The LR3 sentence contains further information items that can be requested in an LRF sentence.

$--LR3,x,xxxxxxxxx,c—c,xxxxxx,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>

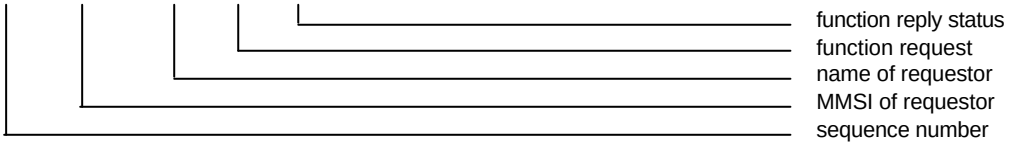


7.4.18 LRF - AIS long-range function

This sentence is used in both long-range interrogation requests and long-range interrogation replies. The LRF-sentence is the second sentence of the long-range interrogation request pair LRI and LRF.

The LRF sentence is also the first sentence of the long-range interrogation reply. The minimum reply consists of an LRF sentence followed by a LR1 sentence. The LR2 sentence and/or the LR3 sentences follow the LR1 sentence if information provided in these sentences was requested by the interrogation.

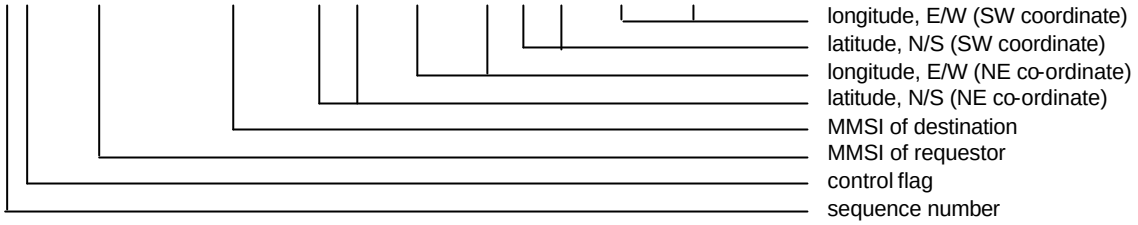
$--LRF,x,xxxxxxxxx,c—c,c—c,c—c*hh<CR><LF>



7.4.19 LRI - AIS long-range interrogation

Long-range interrogation is a mechanism that allows one AIS unit to request certain data from another AIS unit through the use of a number of interrogation and reply sentences.
When the transponder receives an LRI and LRF sentence pair on its Long Range port, it forwards them on to all the presentation ports. If the transponder has been configured to provide and automatic response to the interrogation then it does so; otherwise it waits for the sentences to be returned to it (on any presentation port) before responding.

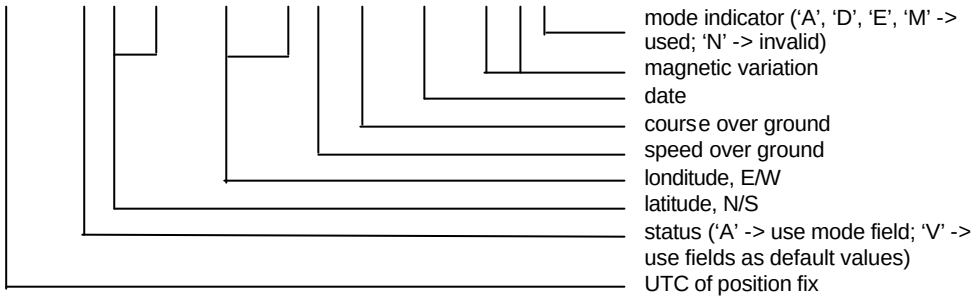
$--LRI,x,a,xxxxxxxxx,xxxxxxxxx,llll.ll,a,yyyyy.yy,a,llll.ll,a,yyyyy.yy,a*hh<CR><LF>



7.4.20 RMC – recommended minimum specific GNSS data

This sentence is used to transmit the time, data, position, course and speed data from a GNSS navigation receiver. The sentence is transmitted at least once every two seconds from GNSS device(s) and is always accompanied by an RMB sentence when a destination waypoint is active.

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>

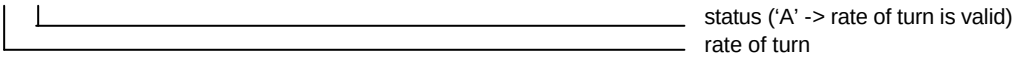


Note that RMC has priority over VTG.

7.4.21 ROT – rate of turn

This sentence provides the rate and direction of turn.

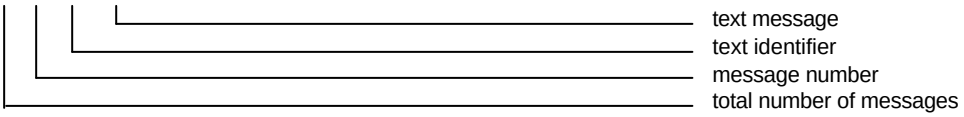
$--ROT,x.x,A*hh<CR><LF>



7.4.22 TXT – text transmission

This sentence is used for transmitting text messages such as alarm messages from a sensor or the transponder to any presentation display device such as the M-2 display unit.

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



7.4.23 VBW – Dual ground/water speed

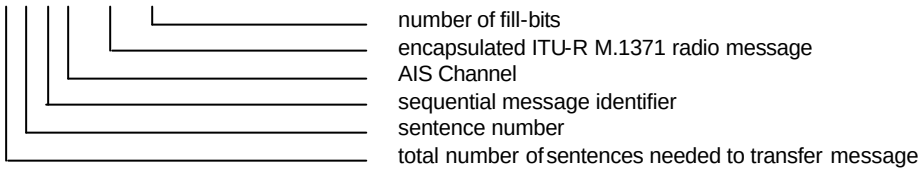
S—VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A*hh<CR><LF>

Longitudinal ground speed – used
Transverse ground speed – used
Status of ground speed - used
Other fields ignored

7.4.24 VDM – VHF data link message

This sentence is output by the transponder each time it receives an incoming message over the VHF data link. The VDM sentence encapsulates a part of an M.1371 message, and several VDM sentences may need to be decoded and re-assembled in order to re-construct the original M.1371 message.

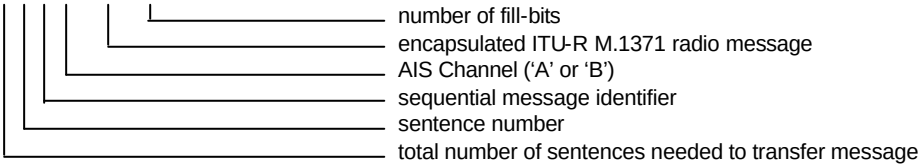
!--VDM,x,x,x,a,s—s,x*hh<CR><LF>



7.4.25 VDO - AIS VHF Data-link own-vessel report

This sentence is output to all the presentation ports at regular intervals and contains the contents of the transponders own-vessel report.
Each time the transponder transmits an own-vessel report, it encapsulates the M.1371 message in one or more VDO sentences and outputs them on its presentation ports.

!--VDO,x,x,x,a,s—s,x*hh<CR><LF>

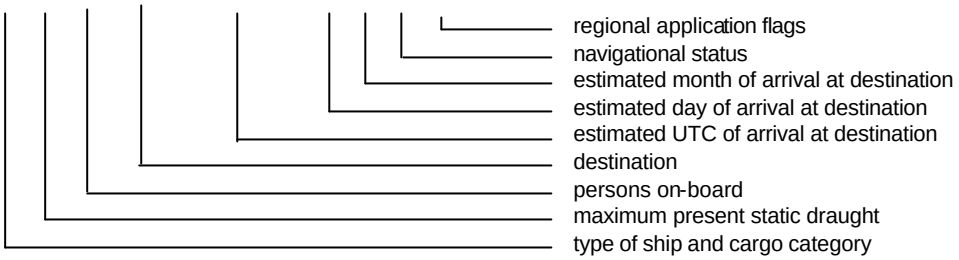


The transponder outputs one VDO sentence every second in addition to echoing all transmitted VDO sentences as they are transmitted in order to provide frequent updates to all connected presentation devices. VDO sentences which have also been transmitted contain the appropriate AIS channel indicator whereas VDO sentences that have not been transmitted contain a NULL field for the channel indicator.

7.4.26 VSD – AIS voyage static data

This sentence may be output by the transponder in response to a query.

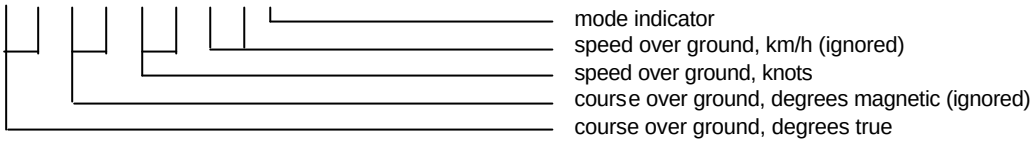
$--VSD,x.x,x.x,x.x,c—c,hhmmss.ss,xx,xx,x.x,x.x*hh<CR><LF>



7.4.27 VTG – course over ground and ground speed

This sentence contains the actual course and speed relative to the ground.

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>



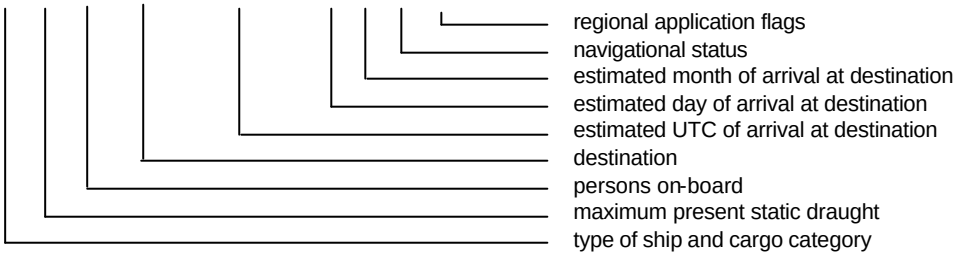
Note that RMC has priority over VTG.

.

7.4.28 VSD – AIS voyage static data

This sentence is output by the transponder in response to a query and contains the Ship's voyage data.

$--VSD,x.x,x.x,x.x,c—c,hhmmss.ss,xx,xx,x.x,x.x*hh<CR><LF>



7.5 General faults & error messages

An ALR-sentence is used to indicate a failure or malfunction that will significantly reduce integrity or stop operation of M2. The Alarm messages generated are IEC61162-1 compliant "$AIALR"-sentences on the Presentation Interface output ports.

The parameters of this sentence are:

- Time of alarm condition change (UTC)
- Unique alarm number (identifier) at alarm source
- Alarm condition
- Alarm acknowledge state
- Alarm description text

and are set according to the table following.

The "alarm condition" field is set to "A" when the alarm condition threshold is exceeded, and "V" when the alarm condition returns to a level that does not exceed the threshold. A continuing healthy status "V" is sent out at 1 minute intervals.
NOTE: When all alarm conditions are healthy, a special single message is sent at 1 minute intervals.

ALARM DESCRIPTION TEXT	ALARM ID OR TEXT DENTIFIER	REACTION OF THE SYSTEM TO THE ALARM CONDITION WHEN THRESHOLD EXCEEDED
AIS: Tx malfunction	001	Stop transmission
AIS: Antenna VSWR exceeds limit	002	Continue operation
AIS: Rx channel 1 malfunction	003	Stop transmission on affected channel
AIS: Rx channel 2 malfunction	004	Stop transmission on affected channel
AIS: Rx channel 70 malfunction	005	Stop transmission on affected channel
AIS: general failure	006	Stop transmission
AIS: Display connection lost	008	Continue operation with "DTE" set to "1"
AIS: external EPFS lost	025	Continue operation
AIS: no sensor position in use	026	Continue operation
AIS: no valid SOG information	029	Continue operation using default data
AIS: no valid COG information	030	Continue operation using default data
AIS: Heading lost/invalid	032	Continue operation using default data
AIS: no valid ROT information	035	Continue operation using default data

8 Serial interface communications protocols

The Transponder has eight RS-422 interfaces:

- **4 sensor data input ports SEN1, SEN2, SEN3 and SEN4**
- **2 Bi-directional input/output ports MAIN and AUX/Pilot**
- **1 Bi-directional input/output port RTCM**
- **1 Bi-directional input/output port Long Range**

8.1 Sensor data interface

The Sensor data input ports receive navigational data in NMEA–0183 format from the connected sensors. The connected sensors can be a GNSS unit used for navigation, a gyrocompass and a bottom track log. These data are processed in the AIS unit and transmitted as dynamic data. The data received by other stations over the VHF link form an image of the sensor data. It is therefore vital that the sensor data are correct and that the port is correctly configured.

Navigational data must be received via the sensor ports within certain intervals; the maximum intervals are listed in the table below. If NMEA sentences containing identical information arrive at the sensor input ports, the AIS Transponder will choose the information with the highest priority level.

The built-in GNSS unit will under normal conditions only be used for TDMA slot timing. However if no data are received from the external sensors, the built-in GNSS unit can be set to take over automatically and supply navigational information for the VHF data link transmission. The changeover between internal GNSS information and external sensor information happens automatically. Information received from the external sensors has priority and will always be used when available.

Messages received and interpreted from sensors:

Data type	Max update interval [s]	NMEA application	Default parameter value
Date	3	RMC	Year 2000, month. 0, day 0
UTC	3	GNS, RMC, GGA, GLL	24:60:60
Lat, Lon	3	GNS, RMC, GGA, GLL	91°00′00″ nl, 181°00′00″ wl
Datum	30	DTM	Not defined
SOG, COG	3	RMC, VBW	102.3, 360°
Altitude	3	GNS	4095
Heading	10	HDT	511
Turn rate	10	ROT	-128
RAIM	10	GBS	Ok

Route plans with positions are transmitted in RTE (Routes) and WPL (Waypoint location) sentences. There is no update interval for these data, therefore the last updated Route plan will be kept in memory until data are updated or the power is switched off, as the data are not kept in the permanent memory.

8.2 Main and AUX port reception and transmission of AIS data

Specific AIS Transponder functions are available via the Main and AUX ports. The ports are identical and will transmit all received VDL (VHF Data Link) messages as well as Transponder

error messages. A request for information may be sent from equipment connected to the Main and AUX ports, ether a request for information or a request for the Transponder to carry out a specific task. The communication protocol is text, but in non-readable sentences which contain compressed binary data.

The Transponder Main/AUX input port can accept requests:

- To send a short text message or a small binary data array to a specified address (MMSI) or as a broadcast message
- To send a static or voyage information request to a specified address (MMSI)
- To change AIS radio frequencies and/or parameters of access to AIS channels (radiating power, frequency band etc.)

The Transponder Main/AUX input port can accept:

- Static and voyage related data
- Navigation or dynamic data, similar to sensors data interface
- Error situation message acknowledgement

The Transponder Main/AUS output port can transmit:

- Notifications about every VHF message received and transmitted via AIS channels with the VHF message included
- Acknowledgement of requests from other stations

9 Warranty Registration & Acceptance Record

IMPORTANT! To validate product warranty, please fax a completed copy of this form to: - McMurdo Customer Services on +44 23 9262 3824

Vessel Data			
Vessel Name		Flag State	
Owner / Company		Radio Call Sign	
On-Board Contact 1 Name		Telephone Number(s)	Office:
			GSM:
On-Board Contact 2 Name		Telephone Number(s)	Office:
			GSM:

Scope Of Supply				
Part No.	Description	Serial No.	Qty	Location
35-081-001A	Transponder			
35-080-001A	Display unit			
89-028	Gyro Interface Unit			
89-029	AC/DC Converter			

General Setup										
MMSI (Maritime Mobile Service Identity)										
IMO (International Maritime Organisation)										
RAIM Present (Automatically Selected)	Yes					No				
User password (20 characters max)										
Operator Password (20 characters max)										
Service Password (20 characters max)										

Vessel Name	

Vessel and GNSS dimensions				
Vessel length				**Metres**
Vessel beam				**Metres**
	Internal GNSS	**External GNSS A**	**External GNSS B**	
GNSS antenna distance to Stern				**Metres**
GNSS antenna distance to Port side				**Metres**

RS-422 Setup									
Port	**General**		**Baud rate**		**Port**	**General**		**Baud rate**	
Main	**On**	**Off**	**4800**	**38400**	**Sen 1**	**On**	**Off**	**4800**	**38400**
Aux	**On**	**Off**	**4800**	**38400**	**Sen 2**	**On**	**Off**	**4800**	**38400**
LR	**On**	**Off**	**4800**	**38400**	**Sen 3**	**On**	**Off**	**4800**	**38400**
RTCM	**On**	**Off**	**4800**	**38400**	**Sen 4**	**On**	**Off**	**4800**	**38400**

Installers Data		
Company Name		**Stamp:**
Technician's Name		
Address Line 1		
Address Line 2		
City / Town		
Province / State		
Post / Zip Code		
Country		

This is an acceptance record of the installation and commissioning of the AIS on-board the above-mentioned vessel. 24-months Warranty is valid on signing this form.

Installer's Signature	**Owners Representative's Signature**	**Commissioning Date**
Installer's Name	**Owners Representative's Name**	

10 Pre-Installation Inspection Record

1. Vessel Data (• *Tick appropriately*)			
Vessel Name		**IMO Number**	
Flag State		**MMSI Number**	
Owner / Company		**Radio Call Sign**	
On-Board Contact		**Telephone Number(s)**	Office:
Name & Position			GSM:
Shore-based Contact		**Telephone Number(s)**	Office:
Name & Position			GSM:
Type of Vessel		**Gross Tonnage**	gt
L.O.A	m	**Beam**	m
Comments:			

2. Installation (• *Tick appropriately*)	
Ship's Emergency Power Source & Location Cable length to Transponder = m • Optional AC to DC Converter (89-029) Required	• 12 V DC • 24 V DC • 110 V AC • 220 V AC • 50 Hz • 60 Hz
AIS Transponder Proposed Location	
AIS Display Proposed Location 4 Twisted Pair + Drain Cable length to Transponder m	
AIS GNSS Antenna Proposed Location RG58 Cable length to Transponder = m • Optional Antenna Adapter (89-362) Required	
AIS VHF Antenna Proposed Location RG214 Cable length to Transponder = m • Optional VHF Antenna (89-020-001) Required • Optional Antenna Mast Mount (903-01) Required • Optional Antenna Mast/Bulkhead Mount (903-02) Required	
AIS Pilot Plug* Proposed Location Cable length to Transponder = m	
Ship's Ground Connection Location Cable length to Transponder = m	
Ship's Alarm Panel Location Cable length to Transponder = m	
** If a Pilot Plug is fitted, a mains power supply for a PC should be made available nearby* • Optional Installation Kit (89-038) Required **Comments:**	

Bridge Layout Drawing: *Position of all parts & interface pick-off points*

3. Heading Sensor(s)* (• *Tick appropriately*)		
Source	**Option A**	**Option B**
Manufacturer		
Model		
Type	• GyroCompass • GNSS Compass • Fluxgate Compass • Transmitting Magnetic Compass	• GyroCompass • GNSS Compass • Fluxgate Compass • Transmitting Magnetic Compass
Output NMEA Message *IEC 61162-2 RS422*	Required:- • HDT • ROT** Optional:- • OSD	Required:- • HDT • ROT** Optional:- • OSD
If no NMEA • Optional Gyro Interface Unit (89-028) Required	• Synchro Reference Voltage = Phase Voltage = Frequency = Ratio - • 90:1 • 180:1 • 360:1	• Synchro Reference Voltage = Phase Voltage = Frequency = Ratio - • 90:1 • 180:1 • 360:1
	• Stepper • Positive Step • Negative Step Step Voltage = Ratio - • 90:1 • 180:1 • 360:1	• Stepper • Positive Step • Negative Step Step Voltage = Ratio - • 90:1 • 180:1 • 360:1
Location		
Cable length to Transponder	m	m

** Heading information is a mandatory sensor input to the AIS. A converter will be needed if the ship's compass has no IEC61162 output.*

*** If a rate-of-turn indicator is available and it includes an IEC61162 output it should be connected to the AIS*

Comments:

4. Position Sensor(s)* (• *Tick appropriately*)			
Source	**Option A**		**Option B**
Manufacturer			
Model			
Type	• GPS • GLONASS • Differential		• GPS • GLONASS • Differential
Output NMEA Message *IEC 61162-2 RS422*	Required:- • DTM • GNS • GLL • RMC • GBS • RTE • WPL Optional:- • GGA		Required:- • DTM • GNS • GLL • RMC • GBS • RTE • WPL Optional:- • GGA
Location			
Cable length to Transponder	m		m
Antenna Location	**External Position Source GNSS Antenna**	**AIS Internal Position Source GNSS Antenna**	**Dimension Limits**
A = Distance to Bow	m	m	**0- 511 m**
B = Distance to Stern	m	m	**0 – 511 m**
C = Dist. to Port-Side	m	m	**0 – 63 m**
D = Dist. to Starboard	m	m	**0 – 63 m**
** Position information is a mandatory sensor input to the AIS.*			
Comments:			

5. Speed Sensor(s)* (• *Tick appropriately*)		
Source	**Option A**	**Option B**
Manufacturer		
Model		
Type	• Bottom Track Log	• Bottom Track Log
Output NMEA Message *IEC 611622-2 RS422*	Required:- • VBW	Required:- • VBW
Location		
Cable length to Transponder	m	m
** If a Bottom Track Log is available and it includes an IEC61162 output it should be connected to the AIS.*		
Comments:		

6. ARPA / ATA RADAR(s) *(• Tick appropriately)*		
Source	**Option A**	**Option B**
Manufacturer		
Model		
Type		
In/Output NMEA Message *IEC 61162-2 RS422*		
Location		
Cable length to Transponder	m	m
Comments:		

7. ECDIS / ECS(s) *(• Tick appropriately)*		
Source	**Option A**	**Option B**
Manufacturer		
Model		
Type		
In/Output NMEA Message *IEC 61162-2 RS422*		
Location		
Cable length to Transponder	m	m
Comments:		

8. Notes Include comments relative to installation: Cable routing, Deck glands to be opened, Hot work required, Interfacing, Mounting, Earthing, etc…

11 Glossary

4S	Ship-to-Ship & Ship-to-Shore
AIS	Automatic Identification System
ALM	Alarm
ANT	Antenna
ARPA	Automatic Radar Plotting Aid
ATA	Automatic Tracking Aid
AtoN	Aid to Navigation
AUTO	Automatic
AUX	Auxiliary
BAT	Battery
BIIT	Built-In Integrity Test
BRG	Bearing
BRILL	Display Brilliance
CG	Coast Guard
CH	Channel
CHG	Change
CLR	Clear
CNCL	Cancel
CNS	Communication, Navigation & Surveillance
COG	Course Over Ground
CONTR	Contrast
CPA	Closest Point of Approach
CPU	Central Processing Unit
CSE	Course
DEL	Delete
DEST	Destination
DG	Dangerous Goods
DGLONASS	Differential GLONASS
DGNSS	Differential GNSS
DGPS	Differential GPS
DISP	Display
DIST	Distance
DSC	Digital Selective Calling
DTE	Data Terminal Equipment
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Chart System
EGNOS	European Geo-stationary Navigational Overlay System
ENC	Electronic Navigation Chart
ENT	Enter
EPA	Electronic Plotting Aid
EPFS	Electronic Position Fixing System
EPIRB	Electronic Position Indicating Radio Beacon
ERR	Error
ETA	Estimated Time of Arrival
EXT	External
FCC	Federal Communications Commission
FREQ	Frequency
GLO or GLONASS	Global Orbiting Navigation Satellite System
GMDSS	Global Maritime Distress and Safety System
GND	Ground
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GYRO	Gyro Compass
HDG	Heading
HS	Hazardous Substances
HSC	High Speed Craft
I/O	Input / Output
IBS	Integrated Bridge System
ID	Identification
IEC	International Electotechnical Commission
IMO	International Maritime Organisation
IN	Input
INFO	Information
INS	Integrated Navigation System
ITU-R	International Telecommunications Union – Radiocommunications Bureaux

KN	Knots
L/L	Latitude / Longitude
LAT	Latitude
LON	Longitude
LOST TGT	Lost Target
M	Metres
MAG	Magnetic
MAN	Manual
MED	Marine Equipment Directive
MF/HF	Medium Frequency/High Frequency
MID	Maritime Identification Digit
MIN	Minimum
MKD	Minimum Keyboard and Display
MMSI	Maritime Mobile Service Identity
MOB	Man Overboard
MP	Marine Pollutant
NAV	Navigation
NM	Nautical Mile
NUC	Not Under Command
OOW	Officer Of the Watch
OS	Own Ship
OUT	Output
PI	Presentation Interface
POSN	Position
PPU	Portable Pilot Unit
PWR	Power
RAIM	Receiver Autonomous Integrity Monitoring
RNG	Range
RORO	Roll On, Roll Off
ROT	Rate Of Turn
RR	Range Rings
RTCM	Radio Technical Commission for Maritime services
RTE	Route
Rx	Receive / Receiver
SAR	Search And Rescue
SEL	Select
SOG	Speed Over Ground
SPD	Speed
SPEC	Specification
STBD	Starboard
STBY	Standby
STW	Speed Through Water
TCPA	Time to Closest Point of Approach
TDMA	Time Division Multiple Access
TGT	Target
TPR	Transponder
TRK	Track
TSS	Traffic Separation Scheme
TTG	Time To Go
Tx	Transmit / Transmitter
Tx/Rx	Transceiver
AIS	Universal Automatic Identification System
UHF	Ultra High Frequency
UTC	Universal Time Co-ordinate
VDU	Visual Display Unit
VHF	Very High Frequency
VOY	Voyage
VSWR	Virtual Standing Wave Ratio
VTS	Vessel Traffic Systems
WAAS	Wide Area Augmentation System
WCV	Waypoint Closure Velocity
WGS	World Geodetic System
WIG	Wing In Ground
WPT	Waypoint

This page contains no other data

12 Commissioning guide

The sequence of operations given here MUST be performed in order to set essential parameters of the AIS system, and to make it operational.

The Operation manual contains detailed information on the method of setting these parameters. Refer to that manual if difficulty is found with any of the outline steps given below.

1. select “Setup mode: Ship's static data” by pressing and holding 'ENTER'
2. select “edit SHIP'S DATA”
3. enter service mode by using the service password (default 'SERVICE')
4. go to page "Setup mode: Configuration"
5. change the baud rate of each serial port in turn to match the baud rate of the external equipment connected to that port
6. go to page “Setup mode: Ship’s static data”
7. enter valid data for 'MMSI', 'IMO', 'vessel' & 'call sign'
8. select 'vessel type'
9. enter 'beam' & 'length'
10. enter internal & external GNSS antenna positions
11. press 'Save SHIP'S DATA' to save settings

CAUTION: as soon as a valid MMSI number is saved, the AIS will begin operation. Allow at least 2 minutes for the system to initialise and obtain a valid GNSS fix.

The next stage is to check that the sensors are operational.

12. select “Voyage mode: Current status”
13. check that all available sensors are recognised
14. temporarily disconnect the external GNSS signal (This will cause an alarm.)
15. check that the internal GNSS is providing data, and that the display indicates the GNSS source as internal
16. reconnect the external GNSS signal. Check that the GNSS source is now external

Now change the service password:

17. select “Setup mode: Ship's static data”
18. select “edit SHIP'S DATA”
19. enter current service password (default 'SERVICE')
20. enter new password in 'change password' field
21. enter new password in ‘confirm password' field
22. press 'verify password' to store the new service password

This completes the entry of required parameters. The M-2 system is now fully operational.

If it becomes necessary to disable an alarm, refer to the Operation manual.