Saab TransponderTech

R5 SOLID AIS System

OPERATION & INSTALLATION MANUAL

SAAB TECHNOLOGIES SAAB

This page is intentionally empty

i Copyright

ii Disclaimer

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

iii Software

This manual reflects the capabilities of the R5 SOLID AIS System with Software 1.0.1. If the system since delivery has been updated from this version, such change should be reflected on a label on the unit. Current software version can always be verified in the S/W info dialog as described in 4.23.

iv Manual Part Number and Revision

Part number 7000 118-200, revision A4.

v Safety Instructions

Note the following compass safe distances:

Equipment	Standard magnetic compass	Steering magnetic compass
R5 SOLID Transponder	0.60 m	0.45 m
GPS Antenna AT575-68	0.30 m	0.30 m
GPS Antenna MA-700	0.65 m	0.50 m
Combined VHF/GPS	0.65 m	0.50 m

vi Disposal Instructions

Broken or unwanted electrical or electronic equipment parts shall be classified and handled as ‘Electronic Waste’. Improper disposal may be harmful to the environment and human health.

Please refer to your local waste authority for information on return and collection systems in your area.

vii Contact Information

For installation, service, ordering info and technical support please contact your local Saab TransponderTech representative. A list of dealers and service stations can be found on the corresponding product page at www.saabgroup.com/transpondertech.

TABLE OF CONTENTS

1 THE AUTOMATIC IDENTIFICATION SYSTEM

The Automatic Identification System (AIS) is a safety information system that was proposed as a worldwide standard in 1997 and adopted by IMO in 1998. The AIS system is standardized by ITU, IEC, IALA and IMO and is subject to approval by a certification body. The first type approved AIS transponder in the world was Saab TransponderTech's R3 Class A Transponder in 2002.

AIS allows transceivers to automatically share static and dynamic data such as ship name, call sign, dimensions, position and sensor information on two dedicated data links in the upper marine VHF band. There are a number of different AIS devices that can send and receive information on the AIS data link:

- **Class A Transponder –** This type of transponder is used on open sea waters and is mandatory for ships of 300 gross tonnage or more on international voyages, all cargo ships of 500 gross tonnage or more and on passenger ships.
- **Class B Transponder –** Used on smaller vessels and pleasure crafts. It transmits with a lower power than the class A transponder and has lower priority on the data link.
- **Base Station –** Fixed shore station that is typically connected to an AIS network to collect information from all vessels at a certain port or shore line.
- **Repeater Stations –** Used to extend coverage range by repeating incoming messages. Can be implemented as a function in an AIS Base station or an AtoN station
- **SAR (Search and Rescue) Transponder –** Used on airplanes and helicopters in search and rescue missions.
- **AtoN (Aids to Navigation) –** A transceiver that is fitted on buoys and lighthouses in order to send information about their positions.
- **Inland AIS –** An European standardized extension to Class A systems for use on inland water ways. An inland transponder has additional messages to communicate with bridges, ports and locks and can also send some additional information that are useful on water ways such as blue sign indication, specific hazardous cargo etc.
- **SART (Search and Rescue Transmitters) –** Distress beacons for life rafts. An active SART unit will always be sorted on top of the target list in the R5 SOLID to accentuate its presence.

NOTE:

The R5 SOLID AIS SYSTEM can be operated in either Class A or Inland modes depending on user need.

2 SYSTEM OVERVIEW

2.1 Product Description

The R5 SOLID AIS System (R5 SOLID from here on) consists of a transceiver radio unit, a GPS receiver, a controller unit and a colour LCD with a numerical keypad. The radio has three receivers, two tuneable TDMA receivers and one DSC receiver. The transmitter alternates its transmissions between the two operating TDMA). The controller unit creates and schedules data packets (containing dynamic, static and voyage related data) for transmission based on the IMO performance standard for AIS.

The R5 SOLID shall be connected to the ship's sensors as required by the installation guidelines published by IALA. The R5 SOLID can interface external navigation and presentation systems that support required IEC 61162-1 sentences. Refer to chapter 8 "Interpretation of Input Sentences" for more information. The R5 SOLID is prepared for connection to Long Range systems like Inmarsat C.

The colour LCD and numerical keypad provides a graphical user-friendly interface to the system. It is possible to plot the location of other vessels, aids to navigation and search and rescue vessels. The LCD and numerical keypad can also be used to send and receive messages, perform configuration as well as supervise the systems status.

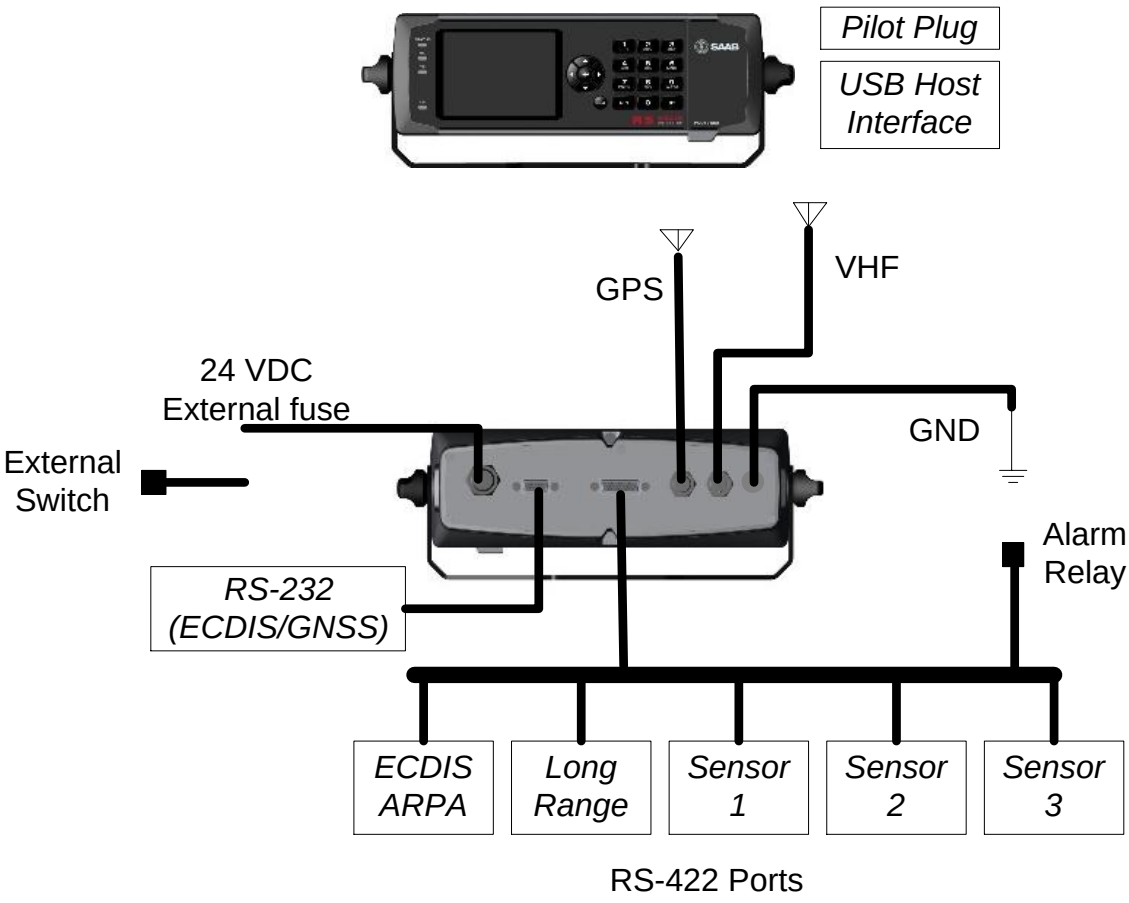


Figure 1 - System Overview

2.2 Main features

- Multi colour 3,5” LCD with numerical keypad interface
- USB Host interface for connection of USB keyboard and USB flash memories.
- Individual visual display settings for day and night operations.
- Broadcast of Dynamic, Static and Voyage related information.
- Standardized interface for connection to ship sensors e.g. GNSS, Gyro, Rate of Turn Indicator, ECDIS/ECS and ARPA.
- Plot capable of presenting up to 500 targets in the vicinity of the own ship.
- Messaging views for generation and presentation of safety related messages and text messages.
- Mandatory pilot plug integrated to the front of the transponder unit.
- Channel management capability for areas without access to the worldwide allocated AIS frequencies.
- Possibility to generate Long Range AIS reply over satcom equipment such as Inmarsat C.
- In addition to the normal high (12,5W) and low (1W) power mode, the R5 SOLID has a 1W tanker mode in accordance with requirements for tanker operations in port.
- Reception and processing of AIS messages 18,19 and 24A/B as transmitted by AIS Class B ‘CS’ Transponders.
- Easily upgraded with the latest software release from Saab using USB memory

3 INSTALLATION

3.1 Unpacking the Equipment

The R5 SOLID AIS System typically consists of the following parts:

Name	Part number	Qty.
R5 SOLID AIS Transponder SOLAS Class A & Inland AIS	7000 118-501	1
R5 Power Cable 2m	7000 118-077	1
R5 Signal Cable DSUB-Open 2m	7000 118-078	1
R5 SOLID System Delivery CD *Including* Installation & Operator Manual	7000 118-331 7000 118-200	1
R5 SOLID Printed Doc Set *Including* Installation short instruction Operator short instruction Certificate set	7000 118-330 7000 118-201 7000 118-202 7000 118-203	1

Table 1 – R5 SOLID Basic Equipment

Name	Part number
GPS antenna options	
MA-700	7000 000-485
AT575-68	7000 000-135
Combined VHF/GPS Antenna AC Marine	7000 000-435
Stainless Steel Antenna Mount 1" x 14	7000 000-472
AIS Alarm Relay Unit incl. socket	7000 100-132
R5 SOLID Upgrade CD	7000 118-332
VHF Antenna BA1012	7000 000-077
USB to Pilot plug cable/converter	7000 108-328

Table 2 – Accessories (Optional)

3.2 Installation Cables

The following cables are needed to install the R5 SOLID.

R5 Signal Cable, DSUB-Open

Type: Shielded Twisted Pair x 0.33 mm^2

Length: 2 m

Connector: 26-pole H.D.D-SUB (female)

Marking: 7000 118-078, A

R5 Power Cable

Type: Unshielded 4 wire cable x 1.3 mm^2

Length: 2 m

Connector: ConXall Mini-Con-X 6382-4SG-311 (female)

Marking: 7000 118-077, A

R5 SOLID VHF antenna cable

Type and length: See Section 3.5.2 VHF Cabling

Connector: BNC (Male)

R5 SOLID GPS Antenna Cable

The standard GPS antenna MA-700 for the R5 SOLID transponder system is prewired with an antenna cable. For other GPS antennas an extern GPS antenna cable is needed.

Type and Length: See Section 3.6.2 GPS Cabling

Connector: TNC (Male)

3.3 Installation procedure

When installing the R5 SOLID, it is recommended to follow the steps described in this Installation Manual. Details of the installation procedure can be found in the coming sections of the Installation Manual.

Recommended installation steps:

1. Mount the R5 SOLID at conning station
2. Mount the alarm relay unit
3. Mount the VHF antenna
4. Mount the GPS antenna
5. Connect all external systems and sensors to the R5 SOLID
6. Power up the system
7. Set configuration parameters
8. Perform system functional check

3.3.1 Equipment installation environment

The table below lists the IEC 60945 equipment classification for the system.

Name	**Part number**	**IEC 60945 installation category**
R5 SOLID Class A / Inland AIS unit	7000 118-501	Protected
MA-700	7000 000-485	Exposed
AT575-68	7000 000-135	Exposed
VHF/GPS Antenna:	7000 000-435	
VHF/GPS Antenna element		Exposed
VHF/GPS diplexer		Protected

Table 3 – Equipment installation environment

3.4 Mount the R5 SOLID

3.4.1 Location

The R5 SOLID should be mounted close to the position from which the ship is normally operated, preferably on the bridge console close to the conning position.

When mounting the R5 SOLID, please consider the following:

- The R5 SOLID shall be connected to ship ground using the earth terminal found on the rear plate.
- The temperature and humidity should be moderate and stable at the place of mounting, +15ºC to +35ºC (Operating temperature: -15ºC to +55ºC.)
- Select a location away from excessive heat sources
- Ensure that there is enough airflow to avoid high ambient temperatures
- Avoid areas where there is a high flow of humid salt air
- Avoid places with high levels of vibrations and shocks
- Avoid mounting the R5 SOLID in direct sunlight for the best readability
- Ensure that the cables can be connected without violating their maximum bending radius
- The unit can affect magnetic compasses. The minimum compass safe distance is 0.60 meters to a standard magnetic compass and 0.45 meters to a steering magnetic compass

3.4.2 Physical Size and Mechanical Drawing

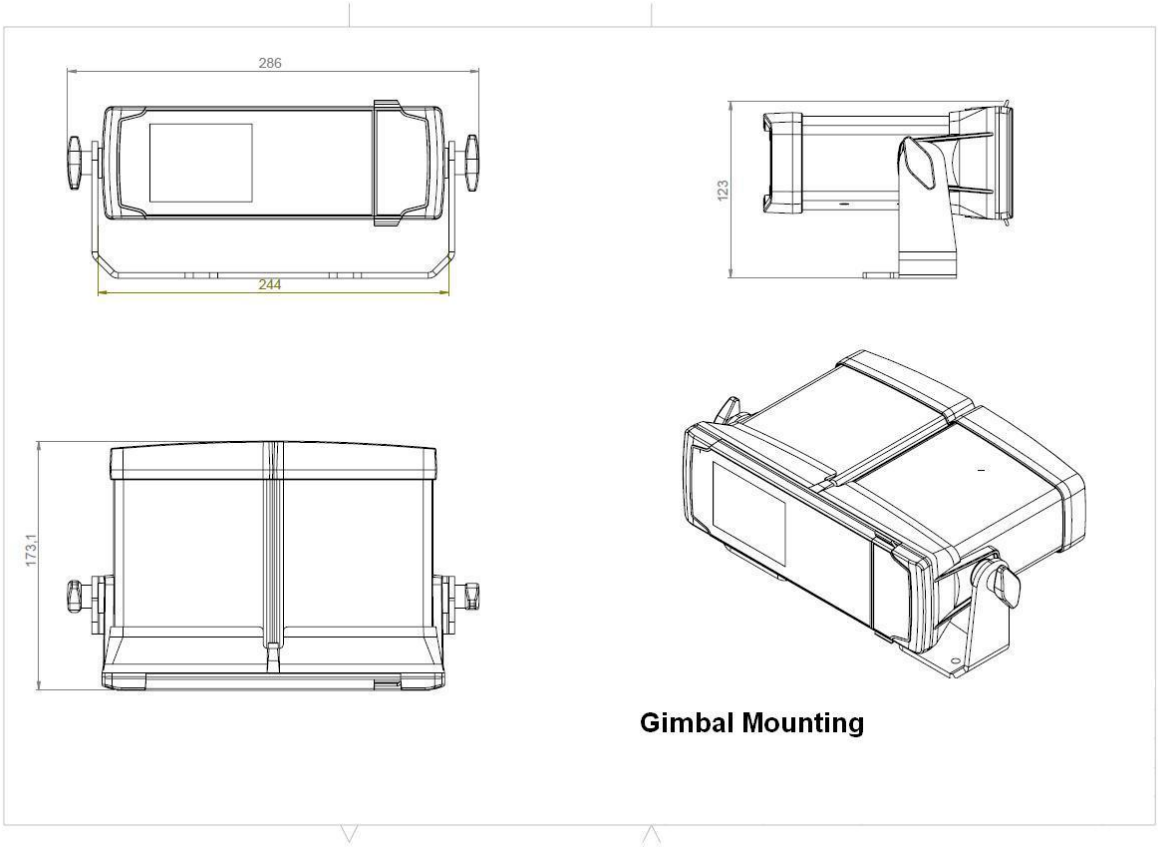


Figure 2 – Gimbal Mount

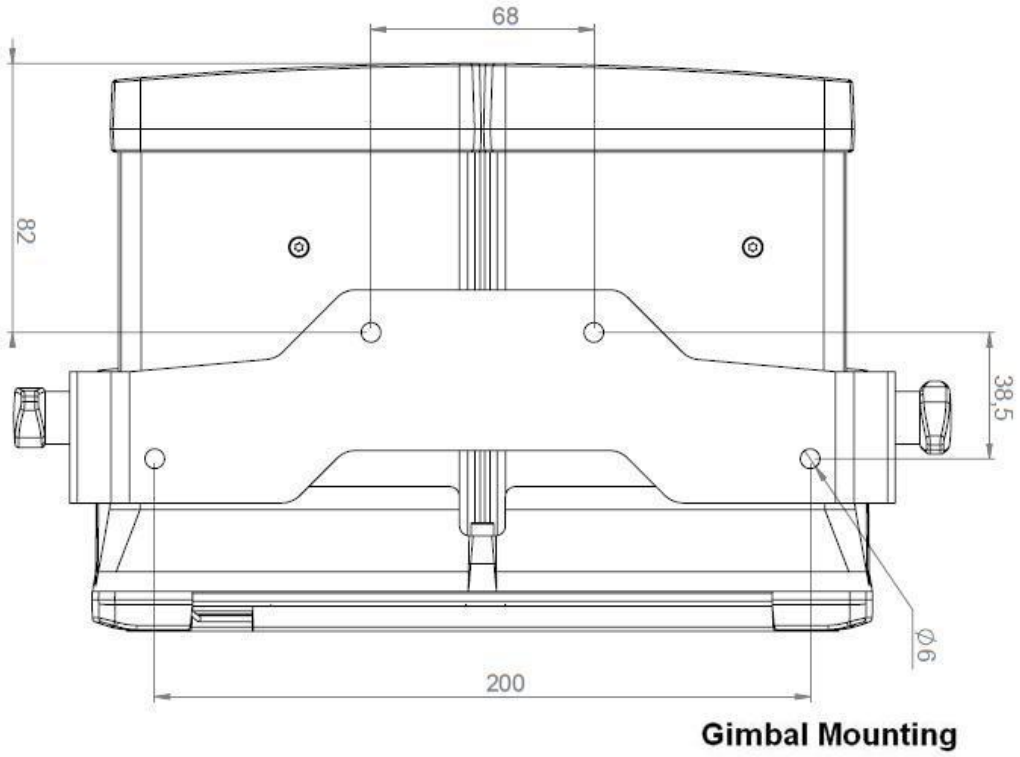


Figure 3 – Gimbal Mount (Bottom View)

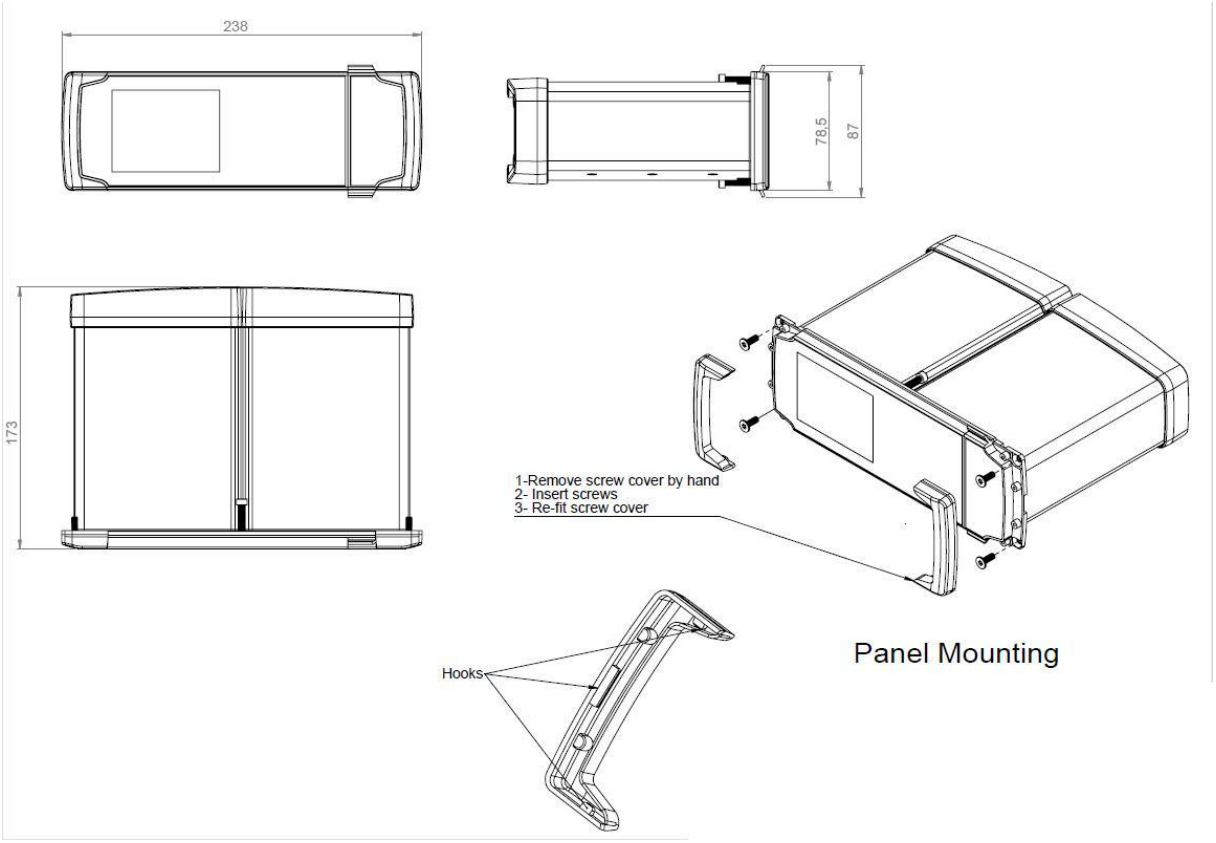


Figure 4 – Panel Mount

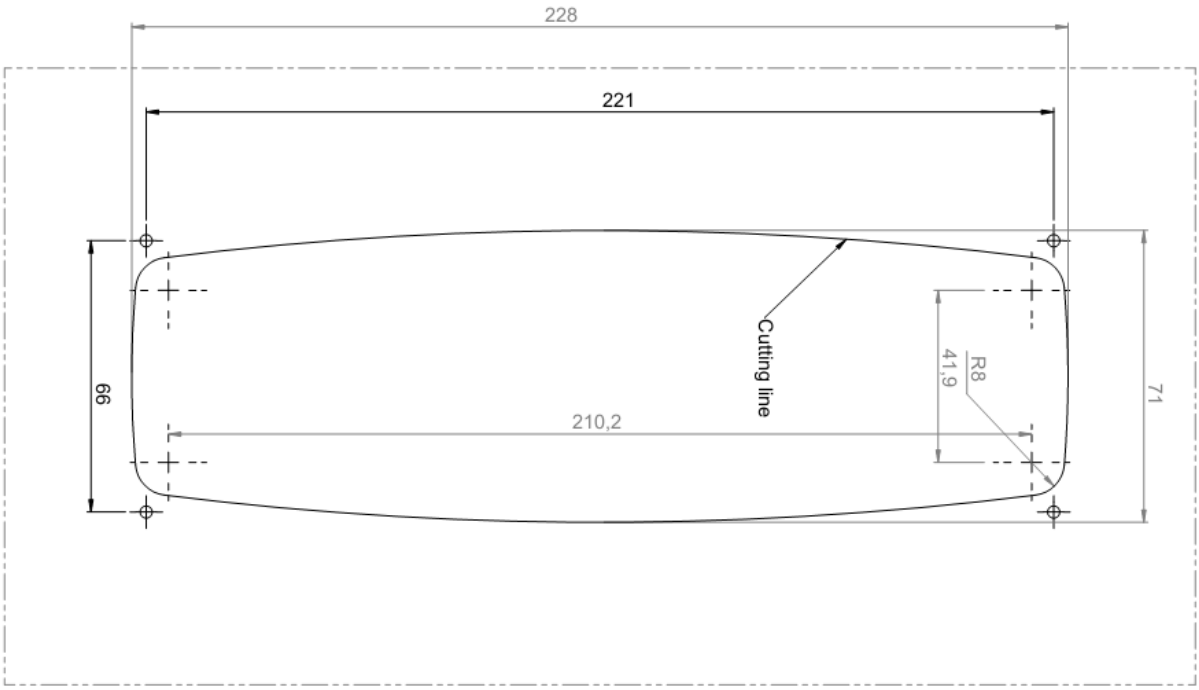


Figure 5 – Panel Mount Front View

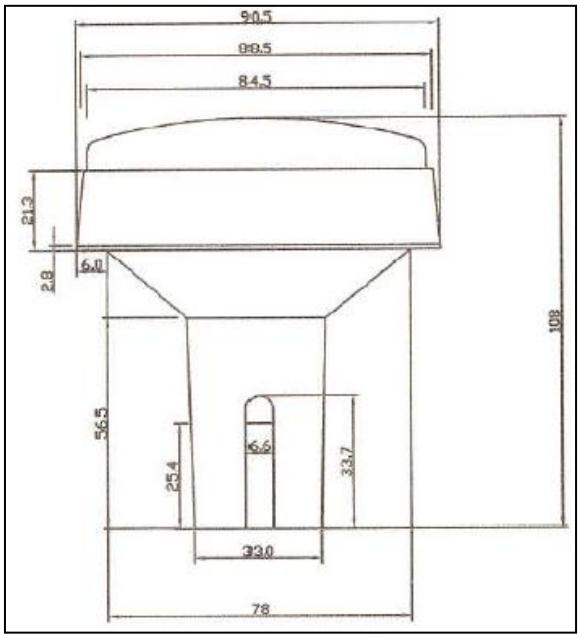


Figure 6 – GPS Antenna – MA-700

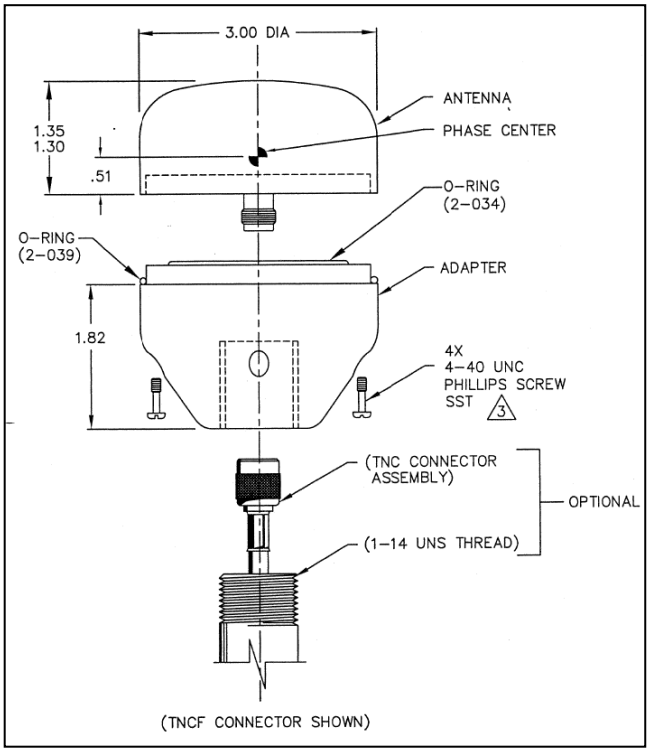


Figure 7 – GPS Antenna – AT575-68

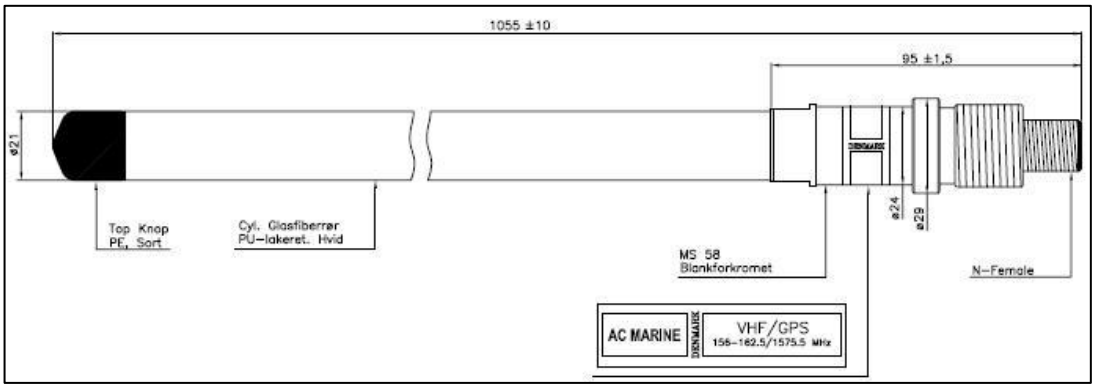


Figure 8 – Combined VHF / GPS Antenna – AC Marine

3.5 Mount the R5 SOLID transponder's VHF antenna

The R5 SOLID, like any other ship borne transceiver operating in the VHF maritime band, may cause interference to a ship's VHF radiotelephone. Because AIS is a digital system, this interference may occur as a periodic (e.g. every 10 second) soft clicking sound on a ship's radiotelephone. This effect may become more noticeable when the VHF radiotelephone antenna is located close to the AIS VHF antenna and when the radiotelephone is operating on channels near the AIS operating channels (e.g. channels 27, 28 and 86).

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

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

3.5.1 VHF 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 minimize 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

3.5.1.1 Antenna type

The AIS VHF antenna should have Omni directional vertical polarization providing unity gain.

3.5.1.2 Antenna separation

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

possible from the voice VHF installations used for main communication to avoid unnecessary interference.

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

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

3.5.1.3 Clear view of the horizon

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

3.5.1.4 VHF Antenna height

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

3.5.2 VHF Cabling

The cable should be kept as short as possible to minimize attenuation of the signal. Double shielded coaxial cable equal or better than RG214 is recommended to minimize the effects from electromagnetic interference from high power lines, radar or other radio transmitter cables.

The table below gives recommendation on cables that can be used for the VHF-antenna connections, the cables used should always be of marine approved type. 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

Table 4 – VHF Antenna cables

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

3.5.3 VHF 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 weather proofed, 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.

3.5.4 VHF Cable Grounding

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

3.6 Mount the R5 SOLID GPS antenna

The R5 SOLID shall be connected to a GPS antenna type MA-700, AT575-68 or a combined AC Marine GPS/VHF antenna. 5V DC is supplied through the antenna lead for the antenna preamplifier.

Please note the Compass Safe Distances in section 6.3 Environmental.

The diplexer for the combined AC Marine GPS/VHF antenna unit shall be installed in an indoor environment.

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.

3.6.1 GPS Antenna location

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

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

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

3.6.2 GPS Cabling

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

Double shielded coaxial cable is recommended. The coaxial cable should be routed directly between the GPS antenna and the R5 SOLID 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 1 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.

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

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

Table 5 – GPS Antenna Cables

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

Example:

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

Table 6 – GPS Antenna Cables - Example

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

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

3.6.3 GPS Cable mounting

Coaxial cables (marine approved type) 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 weather proofed, 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.

3.6.4 GPS Cable Grounding

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

3.7 Electrical Installation

The protocol of the serial port interfaces is compliant to IEC 61162-1Ed.4 (2010-11).

All serial ports in the R5 SOLID have the same capabilities with one exception, any Long Range equipment must be connected to the Long Range port.

The primary external position sensor should be to the Sensor 1 port since this port has the highest priority. The serial ports in the R5 SOLID can also receive differential corrections in RTCM format for correction of the internal GPS receiver. The ports in the R5 SOLID have different default baud rates but they can all be configured to any baud rate of 4800, 9600, 38400, 57600 or 115200 bps. The priority levels for input of sensor data on the different ports are listed below:

Priority	Identification	Default Baud Rate	Port direction
1 (Highest priority)	Sensor 1	4800 bps	Input (See note 1)
2	Sensor 2	4800 bps	Input
3	Sensor 3	4800 bps	Input
4	ECDIS	38400 bps	Input / Output (See note 2)
5	Long Range	9600 bps	Input / Output (See note 2)

6	Pilot	38400 bps	Input / Output (See note 2)
7 (Lowest priority)	RS-232	38400 bps	Input / Output (See note 2)

Table 7 Port priorities and default baud rates

NOTE 1. This means that if e.g. valid position data from external position sources are input on both sensor 1 and ECDIS port, the R5 SOLID will use the position data from Sensor 1.

NOTE 2. Output will be limited if baud rate is below 38400 bps. VDM and VDO messages will not be output.

3.7.1 Output Drive Capacity for serial ports

Each serial port transmitter in the R5 SOLID can have a maximum of 25 listeners consuming 2.0 mA each.

3.7.2 Input Load

Input impedance for each listener input is 6.4 kΩ.

3.7.3 Schematics of an R5 SOLID serial transceiver

Each of the RS422 serial interfaces on the R5 SOLID fulfils the requirements of IEC 61162-2 and IEC 61993-2. A detailed schematic of one of the serial ports in the R5 SOLID is shown below.

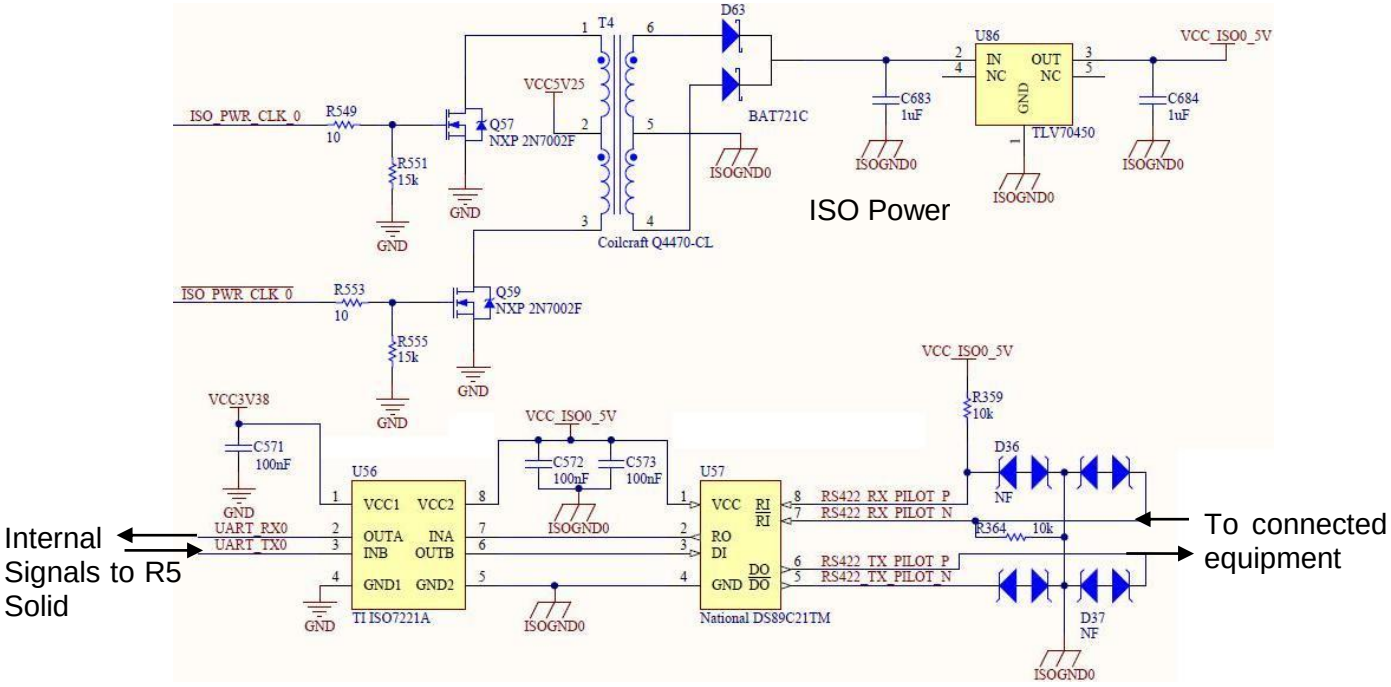


Figure 9 – Serial Port Schematics

3.7.4 R5 Signal Cable, DSUB-Open, 7000 118-078, B

Pin	In/Out	Signal Name	Signal Type	Colour
1	Out	ECDIS - TxB (+)	RS422	White
2	Out	ECDIS - TxA (-)	RS422	Brown
3	In	Sensor1 - RxB (+)	RS422	Green
4	In	Sensor1 - RxA (-)	RS422	Yellow
5	In	Sensor2 - RxB (+)	RS422	Grey
6	In	Sensor2 - RxA (-)	RS422	Pink
7	In	Long Range - RxB (+)	RS422	Blue
8	In	Long Range - RxA (-)	RS422	Red
9	-	Long Range - GND	RS422	Black
10	-	ECDIS - GND	RS422	Violet
11	In	ECDIS – RxB (+)	RS422	Grey / Pink
12	In	ECDIS – RxA (-)	RS422	Red / Blue
13	-	Sensor1 – GND	RS422	White / Green
14	-	Sensor2 – GND	RS422	Brown / Green
15	In	Sensor3 – RxB (+)	RS422	White / Yellow
16	In	Sensor3 – RxA (-)	RS422	Yellow / Brown
17	Out	Long Range – TxB (+)	RS422	White / Grey
18	Out	Long Range – TxA (-)	RS422	Grey / Brown
19	-	Alarm Relay – GND	-	White / Pink
20	Out	Alarm Relay – Out	-	Pink / Brown
21	-	GND	-	White / Blue
22	In	Unlock Tx	Binary	Brown / Blue
23	-	Sensor3 – GND	RS422	White / Red
24	-	Alarm Relay - VCC	-	Brown / Red
25	In/Out	CAN (+)	Differential CAN bus	N/A
26	In/Out	CAN (-)	Differential CAN bus	N/A

Table 8 – 26-pin High Density D-sub

3.7.5 RS232 Signal Cable

Pin	Signal Name
1	Not Connected
2	Tx (Transponder side)
3	Rx (Transponder side)
4	Not Connected
5	GND
6	Not Connected
7	Not Connected
8	Not Connected
9	Not Connected

Table 9 – 9-pin female D-sub

3.7.6 R5 Power Cable, 7000 118-077, A

Pin	Signal Name	Colour
1	24VDC positive	Red
2	GND	Black
3	External Switch (R)	Brown
4	External Switch (F)	Orange

Table 10 – 4-pin male circular ConXall

3.7.7 Blue Sign Connection

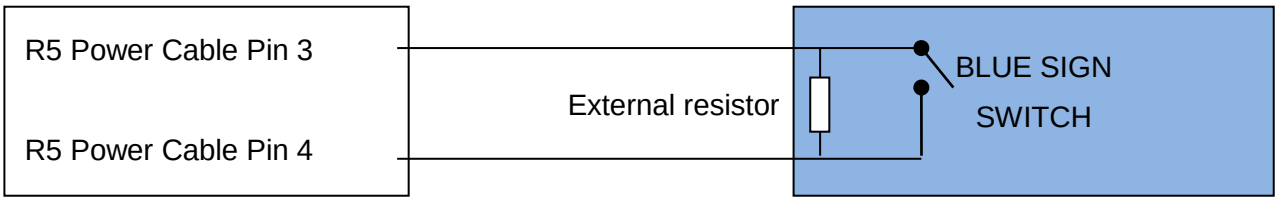
If the blue sign switch should be used, the parameter “External Switch” must be configured to “Blue Sign” in Misc. Interface view accessed from Main Menu → Config → Interfaces → Miscellaneous.

The status of the blue sign can be controlled by input on the brown and orange wires of the R5 Power Cable.

The status of the Blue Sign will be read by the R5 SOLID and output on the VHF data link when operating in “Inland Mode” (see section 4.4.16 for more details). Connect the blue sign switch to pin 3 (brown wire) and pin 4 (orange wire) of the R5 Power Cable together with an external parallel resistor. When the switch is open, blue sign will be off. When the switch is closed, blue sign will be on.

The external resistor value depends on the power supply voltage the R5 SOLID is using:

- 24V: 10kΩ resistor, 10% tolerance



3.7.8 Silent Switch

It is possible to connect a silent switch to the R5 SOLID to quickly turn off transmissions.

If a silent switch is to be used, the parameter “External Switch” must be configured to “Silent Switch” in Misc. Interface view accessed from Main Menu → Config → Interfaces → Miscellaneous.

The silent switch should be connected in the same way as the blue sign switch. However, the external resistor may be omitted for the silent switch.

When the circuit is closed (brown and orange wires connected with each other), the R5 SOLID will transmit as normal. When the circuit is open, the R5 SOLID will be completely silent.

3.7.9 Alarm relay

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

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

The alarm relay wires have the following colour codes in the 26-pole R5 SOLID signal cable:

RELAY VCC	Brown/Red
RELAY GND	White / Pink
RELAY OUT	Pink / Brown

Table 11 – Alarm Relay wires

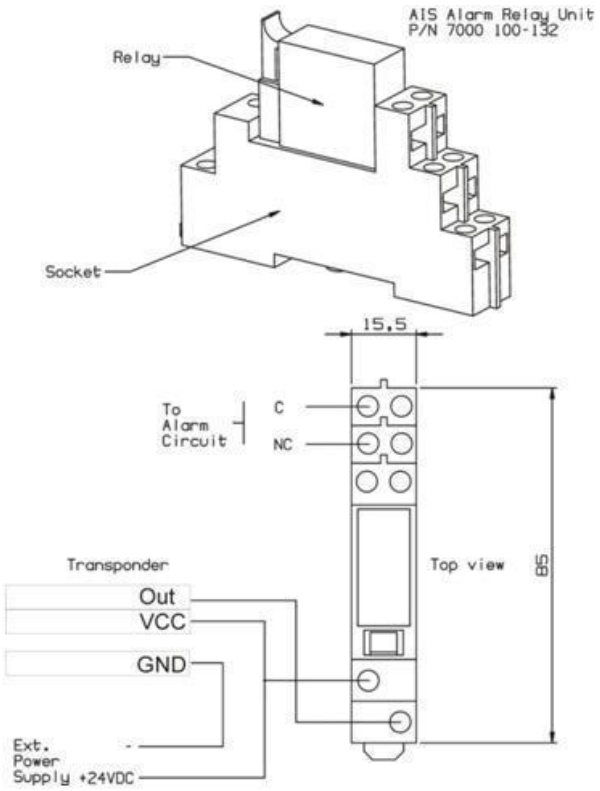


Figure 10 – Alarm Relay

3.8 System Configuration

When the physical and electrical installation of the system is complete, the R5 SOLID needs to be configured. The installer is required to set the parameters listed below. For detailed information about the configuration parameters and how to set them, refer to chapter 4.2.1 and 4.4.

- MMSI number (Maritime Mobile Service Identity)
- IMO vessel number (should be set to zero for Inland vessels)
- Call Sign (Should be set to ship's ATIS code for Inland vessels)
- Ship Name
- Height Over Keel
- Ship dimensions and antenna positions. Refer to chapter 4.4.4 Main Menu → Config →Ship Dimensions for more information.

If the R5 SOLID is operating in Inland mode, the following parameters also need to be configured:

- Euro Number (ENI, unique European Identifier)
- Euro Type (ERI code and standard AIS ship type will be set automatically by the R5 SOLID when selecting a Euro Type from list in Ship Static view.
- Quality setting for SOG, COG and HDG. Should be set to low if no type approved sensor (e.g. a gyro or speed log) is connected to R5 SOLID.

When the R5 SOLID has been installed according to procedures described in previous chapters, it is recommended to make a first functional check of the system. Check the following things to ensure that the R5 SOLID is fully functional.

- Check the Transmitted Own Ship Data view to make sure that the configured data is sent by the R5 SOLID on the VHF link, refer to chapter 4.10 "View Transmitted Own Ship Information" for more information.
- Make sure that there are no unexpected active alarms in the alarm list, see chapter 4.18 "Alarms".

Perform a communication test to ensure that the R5 SOLID can send and receive messages from another transponder. Refer to chapter 4.25 "Communication Test" for information on how to perform a communication test.

4 OPERATION

4.1 System Mode

The R5 SOLID can operate in two different system modes, Class A mode and Inland mode. The Class A mode should be used for vessels falling under the carriage requirements of Chapter V of the International Convention for the Safety of Life at Sea (SOLAS).

The Inland mode should be used for vessels traveling on European inland waterways that falls under the carriage requirements of European River Information Services (RIS). When Inland mode is enabled, additional views for ETA/RTA messaging and convoy settings will be enabled. The R5 SOLID will also output binary messages with Inland Static and Voyage data.

As default, the R5 SOLID will operate in Class A mode. It is possible to switch system mode in the System Settings view, see section 4.4.16 for more information.

4.2 LED's and Controls

This section describes the controls and status LED's on the front panel of the R5 SOLID. It is also possible to connect a USB keyboard via the USB Host interface that can be found under the hatch of the front panel.

1 - STATUS LED (multi-colored)

This LED is constant green when the transponder is operating and no alarms are active. The LED is constant red if there is an active alarm and it is flashing red if there is an unacknowledged alarm.

2 - RX LED (yellow)

This LED is flashing yellow when the transponder is receiving a message on the VHF link.

3 - TX LED (red)

This LED is flashing red when the transponder is transmitting a message on the VHF link.

4 - LIGHT SENSOR

The light sensor will automatically dim the backlight of the display depending on measured input light to the sensor.

5 - ARROW KEYPAD and ENTER

The arrow keypad (**< >** and ∧ ∨) is used to navigate in menus, lists and edit fields. The center button of the keypad is an ENTER button which is used to select the highlighted choice in a menu, list or edit control.

6 - ESC

The ESC button is used to return to the previous screen or to cancel an edit change of a data field.

7 - ALPHANUMERIC KEYS

These keys are used for entering text and numbers. To write a number in a numeric field, press the key once. To write a character in a text field, press once for the character associated with the key, twice for the second character and so on. When pressing twice on key "***1"*** when editing a text field, a popup view with special characters appears. Choose the desired special character by using the **ARROW KEYPAD** and **ENTER**.

When a USB keyboard is used, the normal letters, numbers and special characters can be used. Only American keyboard layout is supported.

8 - OPT

This button is an "Option key" which is only active in some of the dialogs. When pressed, it gives the user a list of options that can be performed on the highlighted item. In e.g. the Target List view the **OPT** button can be used to send an SRM to the highlighted target. In the Main Menu view, the **OPT** button is used to quickly change navigational status. When a USB keyboard is used, the **ALT** button of the keyboard corresponds to **OPT** button on the R5 SOLID keypad.

If the **OPT** button is pressed for more than 5 seconds, the visual settings in the R5 SOLID will be restored to default, i.e. LCD backlight, LED intensity and button backlight will all be 80% and day mode will be used.

9 - BACKSPACE

The **BACKSPACE** button is used to erase the character to the left of the marker in an edit field.

4.2.1 Change Settings of a Parameter

Several of the views in the R5 SOLID contain parameters that can be edited. To edit a parameter, select it by using the **ARROW KEYPAD** and press **ENTER**.

Then enter data in one of the following ways:

- **Numbers:** Press the **ALPHANUMERIC KEY** that corresponds to each digit. To delete a digit, press function key **BACKSPACE**. Some of the parameters are decimal numbers. The **OPT** button can then be used to insert a decimal point.
- **Text:** Press the **ALPHANUMERIC KEY** that corresponds to each character. Press the key once for the first character, twice for the second character and so on. Press the key "***1***" twice to, where allowed, bring up a menu for entering special characters. To delete a character, press function key **BACKSPACE**. When entering passwords both lower and upper case letters can be used. To change between upper and lower case letters, press function key **OPT** and choose "Caps Lock Off" or "Caps Lock On".

- **List of predefined values:** Use the ∧ ∨ keys to select between the predefined values.
- **List of predefined values and numeric input:**

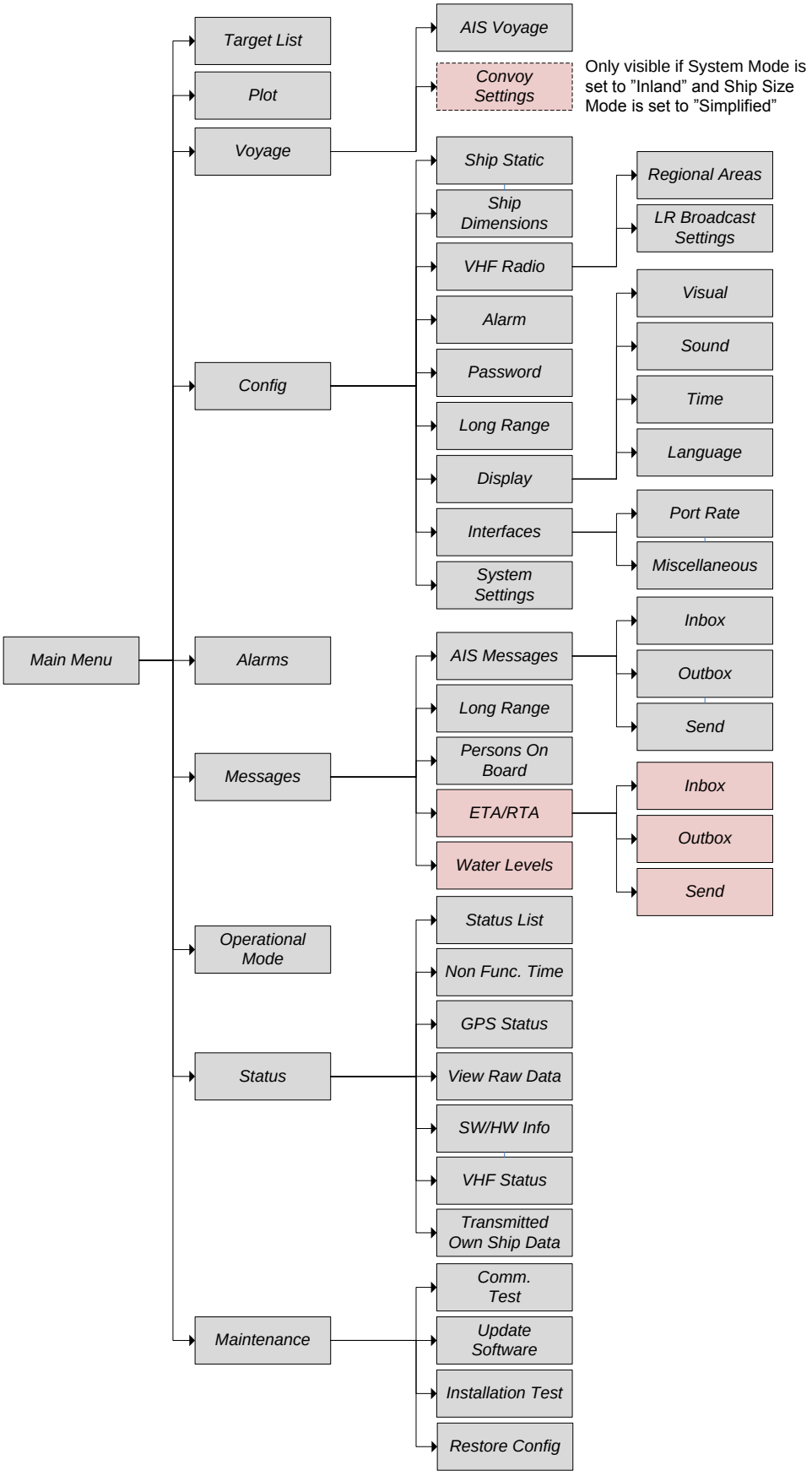
  In some of the views like the AIS Message Send view where it is possible to send an SRM to a target, it is possible to select an MMSI in a list of predefined values. The predefined MMSI values are the MMSI numbers that have been received by the transponder. It is also possible to enter a new MMSI number that has not been received yet. To do this, simply input a numerical value with the **ALPHANUMERIC KEYS.**

Press **ENTER** when done. If desired, use the **ARROW KEYPAD** keys to select a new parameter to be edited, or navigate to the Save/Send button located above the list of parameters and press **ENTER** to save the parameters / send the message.

Use the ***ESC*** key to undo changes and to return to the previous view.

NOTE: DO NOT TURN OFF TRANSPONDER WITHIN 2 SECONDS OF A PARAMETER CHANGE!

4.3 Main Menu – Tree View



4.3.1 Navigating in Menus

Use the **ARROW KEYPAD** buttons **< >** and **∧ ∨** to navigate between the view buttons in the different menus. Press the **ENTER** button to enter the currently selected view. It is also possible to directly select a view by pressing the **ALPHANUMERIC KEY** that corresponds to the number in the upper left corner of the view button.

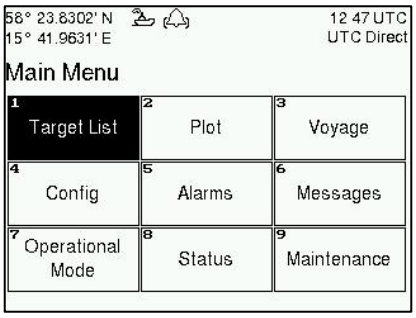


Figure 11 – Main Menu

4.4 Configuration Parameters

This section describes the different configuration parameters that can be set in the R5 SOLID. Some of the parameters will only be available when operating in “Class A” mode, these parameters are marked with blue color. Parameters that is only available when operating in “Inland” mode will be marked with red color. Parameters that are common for both system modes are white.

4.4.1 Main Menu → Voyage →AIS Voyage

The parameters in AIS Voyage view are used for input of voyage specific information that is sent over the AIS link. These parameters should typically be configured before each voyage.

When the R5 SOLID system mode is set to “Inland”, additional voyage parameters for inland water way voyages are available. The system mode can be configured in the System Settings view described in section 4.4.16.

Parameter Name	Description
Navigational Status	Changes the navigational status reported by own ship. It is also possible to quickly change navigational status by pressing the **OPT** button when standing in the Main Menu.
Destination	The destination for the current voyage
Estimated Time of Arrival (ETA)	The estimated time of arrival to destination of current voyage
Draught (Class A)	The vertical distance measured from the lowest point of a ship’s hull to the water surface, in meters (two decimal precision)
Persons on Board	Total number of persons on board

Hazardous Cargo (X,Y,Z,OS)	Classification of current cargo according to X,Y,Z,OS
Draught (Inland)	The vertical distance measured from the lowest point of a ship's hull to the water surface, in meters (two decimal precision)
Air Draught	The vertical distance measured from the ship's waterline to the ship's highest point, in meters (two decimal precision)
Hazardous Cargo (Blue Cones)	Blue cone classification of cargo
Loaded / Unloaded	Specifies if the ship cargo is loaded or unloaded
Crew Members	Number of crew members on board
Passengers	Number of passengers on board
Personnel	Number of shipboard personnel on board

4.4.2 Main Menu → Operational Mode

Parameter Name	Description
Tx Mode	This parameter determines the transmission of the R5 SOLID. If set to "Silent", the R5 SOLID will be completely silent on the VHF radio and it will not answer on interrogations. If a silent switch is used, this parameter will be locked and "Silent Switch Used" will be displayed as parameter value.

4.4.3 Main Menu → Config →Ship Static

Parameter Name	Description
MMSI	Maritime Mobile Service Identity reported by own ship
IMO	International Maritime Organization number reported by own ship
Ship Name	Ship name reported by own ship
Call Sign	Call sign reported by own ship. Shall be set to ATIS code for Inland vessel installations.
Height over Keel	Height over keel in meters (one decimal precision). Height over Keel information is sent as a response to an "Extended Ship Static and Voyage Related Data" request message.

Ship Type (IMO)	Type of Ship according to ITU 1371-3. Both numerical input and selection in drop list is possible.
Euro Number	Unique European Vessel Identification Number reported by own ship
Euro Type	Ship or combination type according to numeric ERI classification
Quality Speed	Shall be set to low if no type approved speed sensor is connected to transponder
Quality Course	Shall be set to low if no type approved course sensor is connected to transponder
Quality HDG	Shall be set to low if no type approved heading sensor is connected to transponder

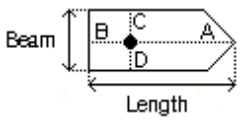
4.4.4 Main Menu → Config →Ship Dimensions

The parameters in the Ship Dimensions view depends on the configuration parameter "Ship Size Mode" in the Misc Interfaces view. The Ship Size Mode parameter can be set to either Standard or Simplified (default). The Ship Size Mode affects how the user should input ship size and antenna position information and how it is interpreted.

Standard Mode

In this mode the user must input:

- *Convoy/ship length* [m] (one decimal precision)
- *Convoy/ship beam* [m] (one decimal precision)
- *A, B, C, D* for internal antenna [m]
- *A, B, C, D* for external antenna [m]



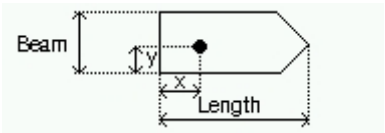
It is the users responsibility to input correctly rounded data (*A+B = Convoy/ship length* rounded up, *C+D = Convoy/ship beam* rounded up).

If the user inputs data which is not correctly rounded the "Ship size mismatch" alarm will be activated.

The output on the AIS data link will be exactly the values input by the user.

Simplified Mode (default)

In this mode the user inputs:

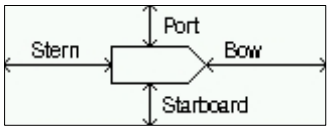


- *Ship length* [m] (one decimal precision)
- *Ship beam* [m] (one decimal precision)
- *X, Y* for internal antenna relative to ship [m] (one decimal precision)
- *X, Y* for external antenna relative to ship [m] (one decimal precision)

When operating in Inland Mode, extra convoy size can be added to ship dimension

Extra convoy size on each side (value = 0 if convoy not used):

- *Bow* [m] (one decimal precision)
- *Stern* [m] (one decimal precision)
- *Port side* [m] (one decimal precision)
- *Starboard* [m] (one decimal precision)



The extra convoy parameters can be configured from **Main Menu→Voyage→Convoy Settings** when the Ship Size Mode is set to “Simplified”.

In this mode there is no way for the user to input mismatching data, all parameters uses the same precision and each measurement is entered only once (in standard mode it is for example possible to enter three different lengths of ship: *Convoy/ship length, internal A+B* and *external A+B*). In simplified mode the transponder will automatically calculate and correctly round the A, B, C and D values reported on the VHF link.

4.4.5 Main Menu → Config →VHF Radio → Regional Areas

This view shows the regional areas set in the transponder. To make a new regional area or to edit or delete an existing regional area, press the **OPT** button and choose the desired action. The following parameters can be edited when “New Area” or “Edit Area” is chosen:

Parameter Name	Description
Channel A	The channel number for AIS channel A (2087 = default) that should be used in the regional area.
Channel B	The channel number for AIS channel B (2088 = default) that should be used in the regional area.
Zone Size	The transitional zone size of the regional area in nautical miles (NM).
Tx Mode	Decides which channels the transponder will use when transmitting in the regional area. When set to “None”, the transponder will stop automatic transmissions on AIS channels A and B but it will still answer when interrogated on the DSC channel.
Power	Transmission effect for the transponder in the regional area. High = 12,5 W, Low = 1 W.
LAT NE	The latitude coordinate for the North East corner of the regional area
LON NE	The longitude coordinate for the North East corner of the regional area
LAT SW	The latitude coordinate for the South West corner of the regional area

LON SW	The longitude coordinate for the South West corner of the regional area

4.4.6 Main Menu → Config → VHF Radio → LR Broadcast Settings

Parameter Name	Description
LR Broadcast Ch. 1	The channel A number for broadcasting long range message 27. The message is sent every 6 minute on each channel so if both channel A and B are configured a message 27 will be broadcasted every 3 minute. If this parameter is set to zero no long range broadcast transmissions will be sent on this channel.
LR Broadcast Ch. 2	The channel B number for broadcasting long range message 27. The message is sent every 6 minute on each channel so if both channel A and B are configured a message 27 will be broadcasted every 3 minute. If this parameter is set to zero no long range broadcast transmissions will be sent on this channel.

4.4.7 Main Menu → Config →Alarm

In this view all alarms can be configured to either “Enabled” or “Disabled”. When the alarm is enabled, an active alarm will affect the external alarm relay, the buzzer in the R5 SOLID and show a popup dialog in the display. When the alarm is set to disabled it will not affect anything when the alarm becomes active. For more information about the alarm view, refer to chapter 4.18 “Alarms”. For a list of all the alarms that can occur, refer to chapter 7.3 “Troubleshooting with alarm messages.”

4.4.8 Main Menu → Config →Password

Parameter Name	Description
New User Password	Changes the user level password for the R5 SOLID. **The default user level password is “user”**
New Admin Password	Changes the admin level password for the R5 SOLID. **The default admin level password is “admin”**
Restore Code	It is possible to restore both user password and admin password to the default values above with a secret restore code. To obtain the restore code, contact Saab TransponderTech Support and be prepared to provide the serial number of the transponder unit.

4.4.9 Main Menu → Config →Long Range

Parameter Name	Description

Reply Mode	When set to “Auto” the R5 SOLID will automatically respond to any Long Range interrogation messages. When set to “Manual” the operator should send a respond or refusal to any Long Range interrogation message. This can be done from the *Long Range* view that is accessed from *Main Menu → Messages → Long Range*. For more information see section 4.14 Long Range Interrogations. The information that is sent in a response is automatically filled in by the R5 SOLID depending on the Long Range filter settings (the parameters below).
Ship ID (A)	Filter setting that defines if a Long Range response message should include ship name, call sign and IMO number.
Message Date/Time (B)	Filter setting that defines if a Long Range response message should include information about date and time of message composition.
Latitude / Longitude (C)	Filter setting that defines if a Long Range response message should include position.
Course Over Ground (E)	Filter setting that defines if a Long Range response message should include COG.
Speed Over Ground (F)	Filter setting that defines if a Long Range response message should include SOG.
Destination And ETA (I)	Filter setting that defines if a Long Range response message should include destination and ETA.
Draught (O)	Filter setting that defines if a Long Range response message should include draught.
Ship Type And Cargo (P)	Filter setting that defines if a Long Range response message should include ship type and cargo information.
Ship Size And Type (U)	Filter setting that defines if a Long Range response message should include ship’s length, beam and type.
Persons On Board (W)	Filter setting that defines if a Long Range response message should include number of persons on board.

4.4.10 Main Menu → Config →Display → Visual

It is possible to completely turn off the backlight on LCD, buttons and LED’s. It may then be difficult to read the R5 SOLID display and find the way to the correct configuration parameter in order to increase the backlight again. If this should happen, it is possible to hold down the **OPT** button for 5 seconds to restore the backlight to 80%.

Parameter Name	Description
Dimming Mode	If set to “Manual”, the LCD backlight, button backlight and LED brightness are controlled by the user with the parameters described below. If set to “Automatic”, the LCD backlight, button backlight and LED brightness will automatically be controlled with the light sensor on the front of the R5 SOLID. The less ambient light registered by the light sensor, the lower percentage of backlight and brightness will be used.
Toggle Day/Night	Toggle between day or night mode. In Day mode the display background is white and in night mode the background is black. There are also separate settings for the LCD backlight, LED intensity and button backlight in the different day/night modes.
Backlight	Changes the LCD backlight where 0% is completely turned off and 100 % is maximum brightness.
LED Light Intensity	Changes the light intensity of the three LED’s on the front of the R5 SOLID. It is possible to turn off the LED’s completely by setting a 0% light intensity. However, if there is an active, unacknowledged alarm in the R5 SOLID, the light intensity of LED’s will temporarily be set to 10% until the alarm is acknowledged.
Button Illumination	Changes the brightness of the button backlight on the R5 SOLID.

4.4.11 Main Menu → Config →Display → Sound

Parameter Name	Description
Alarm Waiting For ACK	Determines how the R5 SOLID sound buzzer should behave when an alarm is active and waiting for acknowledgement. **This setting does NOT affect the behavior of the alarm relay or any external alarm system.**
Long Range Message	Controls the behavior of the R5 SOLID sound buzzer when an LR interrogation message is received.
AIS Message	Controls the behavior of the R5 SOLID sound buzzer when a SRM or binary text message is received.
Inland RTA	Controls the behavior of the R5 SOLID sound buzzer when an Inland RTA (Recommended Time of Arrival)

	message is received.

4.4.12 Main Menu → Config →Display → Time

Parameter Name	Description
Time Zone	This parameter defines if the times that are displayed in the R5 SOLID should be in UTC or LOC (local) time. If local time is chosen, the offset from UTC must be specified with the three parameters listed below.
Offset sign	The sign of the local time offset from UTC.
Hours	The local time hour offset from UTC.
Minutes	The local time minute offset from UTC.

4.4.13 Main Menu → Config → Interface → Language

Parameter Name	Description
Language	Changes the language in all the menus and views of the R5 SOLID. The changes will take effect immediately when pressing “Save”.

4.4.14 Main Menu → Config →Interface → Port Rate

Parameter Name	Description
Baud Rate	Changes the baud rate (bits per second) for the corresponding serial port.
Checksum	When set to “Required”, all messages that are input on the corresponding serial port to the R5 SOLID must have a valid checksum. When set to “Disabled”, messages both with and without checksum are accepted on the corresponding serial port.

4.4.15 Main Menu → Config →Interface → Miscellaneous

Parameter Name	Description
SSD Password	Changes the value of the SSD password level. When set to “None”, no password is required when configuring the transponder with an SSD sentence from e.g. an ECDIS via the serial port interface. When set to “User”, an SPW sentence with the correct user level password must be sent before the SSD on

	the serial port interface.
Ship Size Mode	This affects how the user should input the ship size, convoy size and antenna positions. See section 4.4.4 for more details.
AIS GPS Output Port	Defines on which serial port the R5 SOLID should output data from the internal GPS. When set to “None” no internal GPS data will be output.
External Switch	This parameter specifies if there is a blue sign switch or silent switch connected to the orange and brown wires of the R5 SOLID Power Cable. If no switch is used, set the parameter to “No Function”. See sections 3.7.7 and 3.7.8 for more information about the blue sign switch and silent switch.
Require Text Msg ACK	This parameter determines if an ACK msg is required as a response when sending addressed binary text messages to another target.

4.4.16 Main Menu → Config → System Settings

Parameter Name	Description
System Mode	Determines if the R5 SOLID should operate as a Class A transponder or as an Inland transponder. This parameter affects which config parameters and menus that are visible in the system.
Range Unit	This parameter determines the unit for the range value of targets in the Target List, Extended Info view and Plot view. The range value can be calculated in nautical mile (NM), kilometer (km) or statute mile (Sm).
Speed Unit	This parameter determines the unit for the SOG value of targets in Extended Info view and Plot view. The SOG value can be calculated in knots (kn), kilometer per hour (km/h) or miles per hour (mph).
Plot Compass	This parameter determines how the plot of AIS targets should be oriented. If set to “North Always Up”, the plot will always have north up and own ship will rotate according to heading input. If set to “Own Ship Bow Always Up”, the plot will always have own ship pointing up and rotate the rest of the plot according to heading input.

4.4.1 Main Menu → Maintenance → Installation Test

Parameter Name	Description
Position Source	This parameter specifies which port the R5 SOLID should use as its external position source. The default value of this parameter is “Automatic” which means that the R5 SOLID will accept position information on any port and use the information on the port with highest priority. If Position Source is set to anything else than “Automatic”, the R5 SOLID will only accept position information if it comes from the port specified by this parameter.
SART Test Mode	This parameter determines if SART Test targets should be displayed in target list and Plot of the R5 SOLID.

4.5 Alarm and Alert Pop-ups

The R5 SOLID features alarm and alert pop-ups that can appear any time during operation. To acknowledge an alarm or alert message, press **ENTER.** An example of an alarm message is shown below.

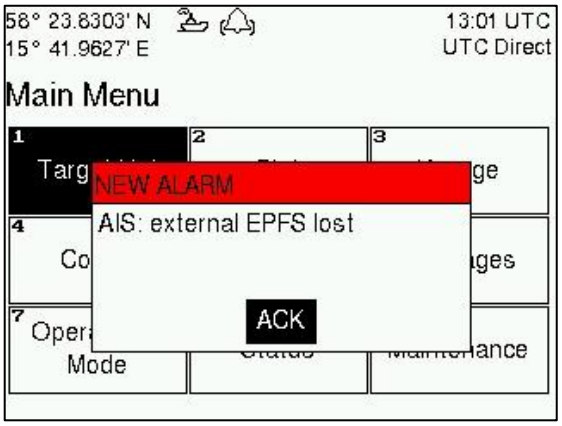
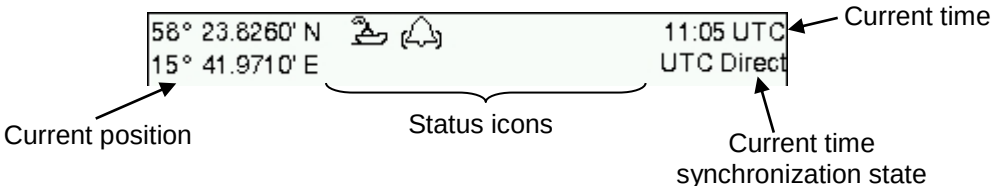


Figure 12 – Main Menu

4.6 Status Bar

The top of the screen of the R5 SOLID always displays a summary of the system’s status. See illustration below.



If a valid navigation position is available, it is displayed to the left. The status icons are displayed in the middle and the current time is shown to the right. Time is either UTC or local (LOC). Beneath the current time there is also information about the transponders synchronization state. The R5 SOLID features a graceful degradation of the synchronization state, which can be one of the following:

- **UTC Direct** – This is the normal state where the R5 SOLID gets the UTC time from its own internal GPS receiver.
- **UTC Indirect** – The R5 SOLID is synchronizing based on receipt of data from another transmitter that is working in UTC Direct.

  NOTE: It is possible to be in UTC Indirect but still have a valid position in the upper left corner of the status bar. In a Class A installation the position information from an external GPS sensor has higher priority, but the UTC time is always taken from the internal GPS receiver.
- **Base Station** – This state is used when neither direct nor indirect UTC synchronization can be obtained. The R5 SOLID will then synchronize to the nearest base station, if any.
- **Semaphore** – This is the last fallback state. The R5 SOLID will then synchronize to the transmitter that is indicating the largest number of other received transmitters. This station then becomes a 'semaphore' for the AIS data link.

4.7 Status Icons

The status icons that can be displayed are:

 Unread message (safety related message, text message or RTA)

 Unread Long Range message (auto reply)

 Unread Long Range message (manual reply)

 Active alarms

 1W mode (Indicates 1 Watt TX mode for Tankers is enabled.) See NOTE below for details.

 Blue Sign On (Only available when Inland Mode is active)

 Blue Sign Off (Only available when Inland Mode is active)

 Silent Mode activated, either with Tx Mode parameter or silent switch.

Navigational status, being one of:

 Navigational status is undefined

 At anchor or moored

 Under way using engine

 Navigational status is one of: Not under command, Restricted manoeuvrability, Constrained by her draught, Aground, Engaged in fishing, Under way sailing, Reserved for future use.

NOTE: The transponder will automatically engage 1W mode when the following conditions are met: Ship type = Tanker, Nav Status = Moored and SOG <= 3 knots, otherwise 1W mode will be automatically disengaged. The Tanker 1W mode is fully automatic cannot be disengaged by other external control.

4.8 View Remote Ship Information

The R5 SOLID will power up in *Target List* view. This view, also referred to as the *minimal display*, is accessed from the *Main Menu* view. The *Main Menu* view can be reached by pressing **ESC** repeatedly from any other view. The *Target List* view displays a list of all targets sorted by range from own ship (closest first). The list includes MMSI, ship's name, range (RNG) and bearing (BRG).

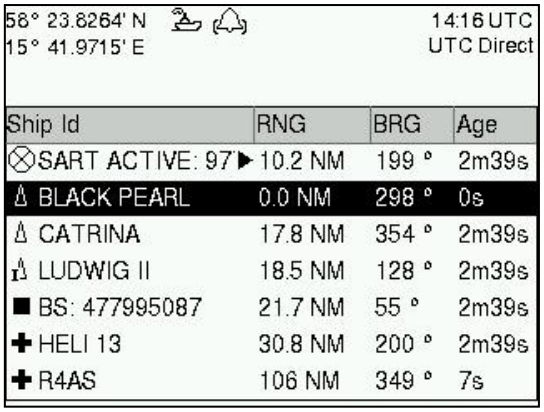


Figure 13 – Target List

For extended information about a target in the list, select the ship with the ∧ ∨ key and press **ENTER**.

The *Extended Information* view includes static, dynamic and voyage related data for the selected target.

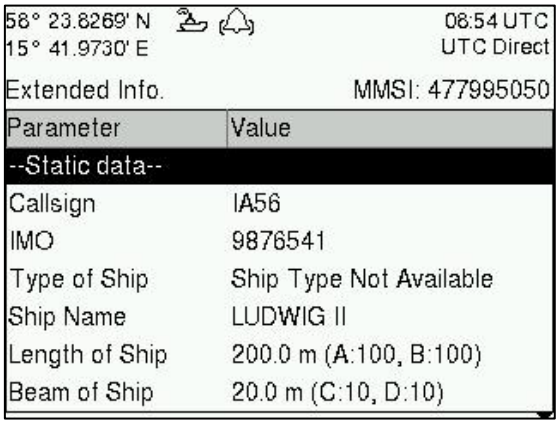


Figure 14 – Extended Info

Press ***ESC*** to return to *Target List* view.

The **OPT** button can be used in the *Target List* view to send a safety related message (SRM) to the selected target. For more information about AIS messages, refer to section 4.12.

4.9 View Plot of Targets

The location of targets relative to your own ship is visualized in the *Plot* view. The view is accessed from the *Main Menu* view. Use the ***ARROW KEYPAD*** **< >** to select any of the targets on the display or ∧ ∨ to Zoom In and Zoom Out.

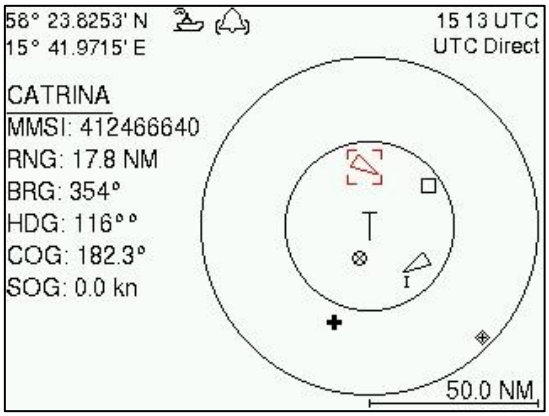


Figure 15 – Target Plot

For extended information about a target select it using the **< >** key and press **ENTER**.

The own ship target is displayed as a 'T' shaped symbol. Class B targets are indicated by a 'B' appended to the target icon and Inland targets are indicated by either an 'I' or by a blue sign symbol appended to the target (not shown in the figure above).

The **OPT** button can be used in the *Plot* view to send a safety related message (SRM) to the selected target. For more information about AIS messages, refer to section 4.12.

4.10 View Transmitted Own Ship Information

The information transmitted by the R5 SOLID on the VHF link is viewed in the *Transmitted Own Ship Data* view. This view is accessed from *Main Menu→ Status* view and includes the static, dynamic and voyage related data actually sent by the R5 SOLID. The view reflects the contents of the last transmitted AIS message, thus there may be some delay from the time the parameters are entered until they are displayed in the *Transmitted Own Ship Data* view.

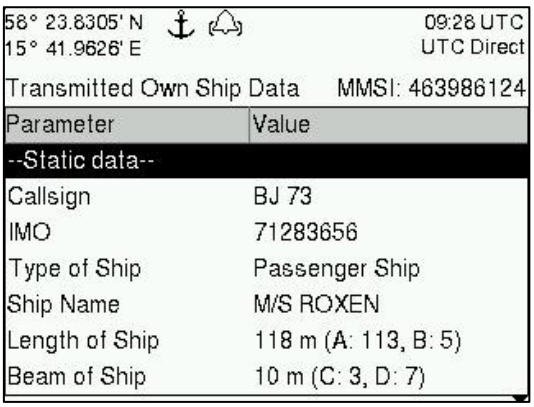


Figure 16 – Transmitted Own Ship Data

4.11 Enter and Read Voyage Related Information

Voyage related information (for transmit via AIS) is displayed in the *AIS Voyage* view. The view is accessed from *Main Menu→Voyage→AIS Voyage*. Voyage related data includes destination, estimated time of arrival (ETA) and number of people aboard.

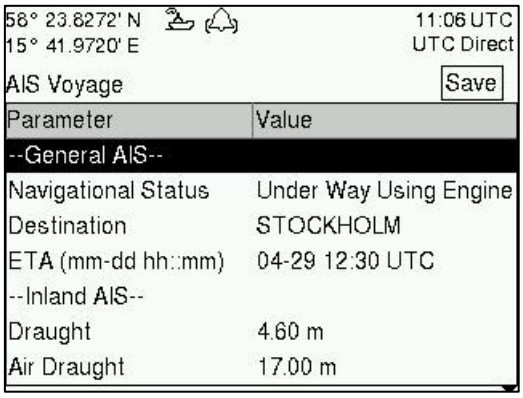


Figure 17 – AIS Voyage

4.12 Handling Safety Related Messages (SRM) and Text Messages

Safety related messages (SRMs) and text messages can be sent to specific targets (addressed messages) or broadcast to all targets. Inbox, Outbox and Send view for SRMs and text messages can be accessed from *Main Menu→Messages→AIS Messages*.

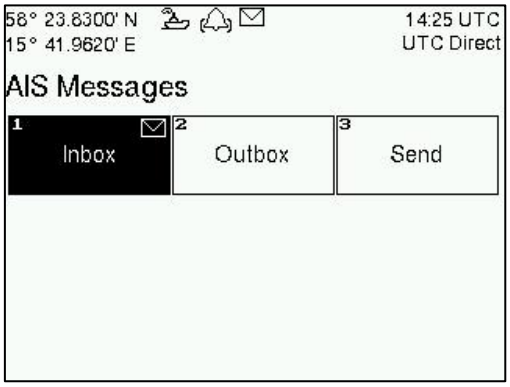


Figure 18 - AIS Messages

4.12.1 Read Received Messages

Received messages can be accessed in the *Inbox* view. Unread SRMs and text messages are indicated with a letter icon in the status bar and are marked with red color in the inbox.

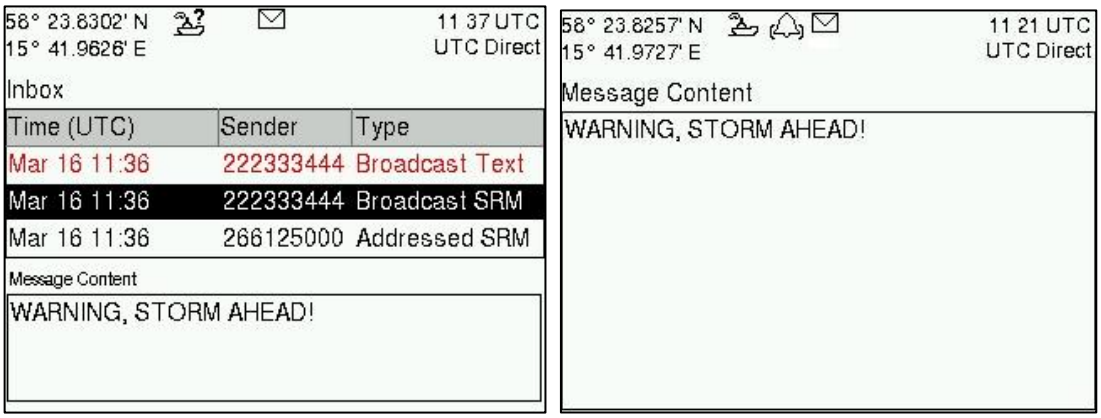


Figure 19 – AIS Message Inbox

Select a message with **ARROW KEYPAD** buttons ∧ ∨. A preview of the selected message is shown at the bottom of the screen. To read the entire message and mark it as being read, press **ENTER**. When the message is read, navigate back to the inbox by pressing **ESC**.

4.12.2 Send SRMs and Text Messages

SRMs are composed and sent in the *Send* view accessed from Main Menu→Messages→AIS Messages→Send. Use the **ARROW KEYPAD** buttons ∧ ∨ to navigate between the text input field, list of parameters and "Send" button.

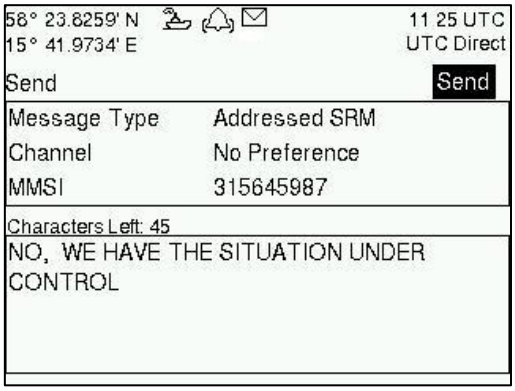


Figure 20 – AIS Message Send view

Sent messages can be viewed in the *Outbox* view accessed from *Main Menu→Messages→AIS Messages→Outbox*.

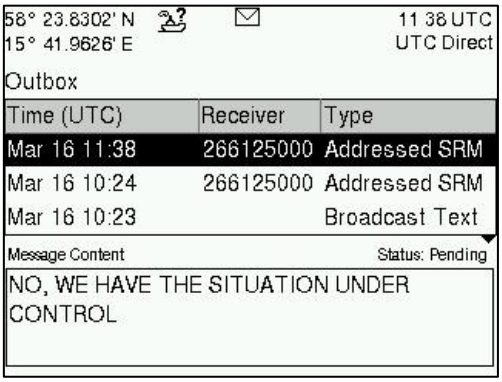


Figure 21 – AIS Message Outbox

4.13 Send Persons On Board

In the *Send Persons On Board* view it is possible to send information about number of persons on board (PoB) to another vessel. The PoB message can be sent as either addressed or broadcast. The PoB message can also be sent in two different versions:

- The IMO version sends the total number of persons on board as a binary message with international FI branch 16.
- The Inland (IWW) version sends a message with number of crew, personnel and passengers as a binary message with inland branch FI55. The information sent in the messages is automatically filled in by the R5 SOLID depending on the voyage configuration made in *Main Menu→Voyage→AIS Voyage.*

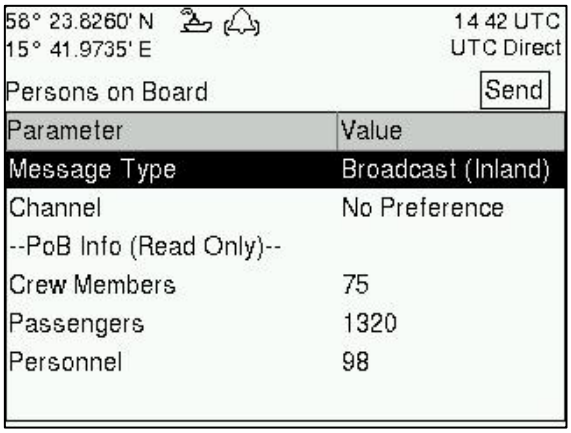


Figure 22 – Persons On Board

4.14 Long Range Interrogations

AIS base stations can send long range interrogation messages to poll for certain information from the R5 SOLID. A received interrogation message is indicated by a LR icon in the status bar. If the "Long Range Reply Mode" parameter has been configured to "Auto", the R5 SOLID will automatically send a response to the interrogating base station. If the "Long Range Reply Mode" parameter is set to "Manual", the operator must send a response or refusal from the *Long Range Message* view accessed from *Main Menu* → *Messages* → *Long Range*. For more information about the "Reply Mode" parameter and Long Range filter settings, see section 4.4.9.

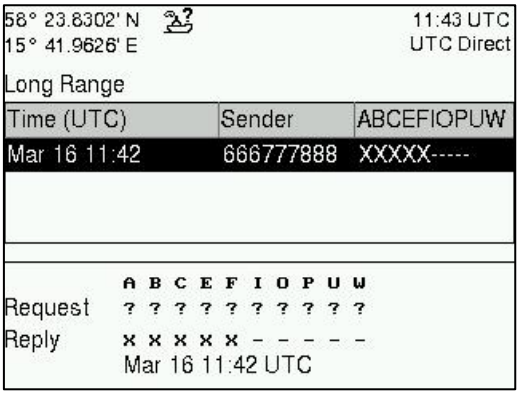


Figure 23 – Long Range

To send a reply or refusal to the interrogation or to delete an interrogation from the message list, use the **ARROW KEYPAD** buttons ∧ ∨ to mark the desired interrogation and then press the **OPT** button and choose the desired option.

The Long Range view uses the following symbols to indicate the status of a request or reply message:

? – The information is requested by the sender

X – The information is available and provided

! – The information request is refused.

4.15 Inland ETA and RTA

The R5 SOLID has capability to send Inland ETA (Estimated Time of Arrival) messages and receive Inland RTA (Recommended Time of Arrival) messages which are used when communicating with ports, locks and bridges on the inland water ways. This is done from the *ETA/RTA* view that can be accessed from *Main Menu → Messages → ETA/RTA*. Sent ETA messages can be viewed in the outbox, received RTA messages can be viewed in the inbox and new ETA messages can be composed in the *Send* view.

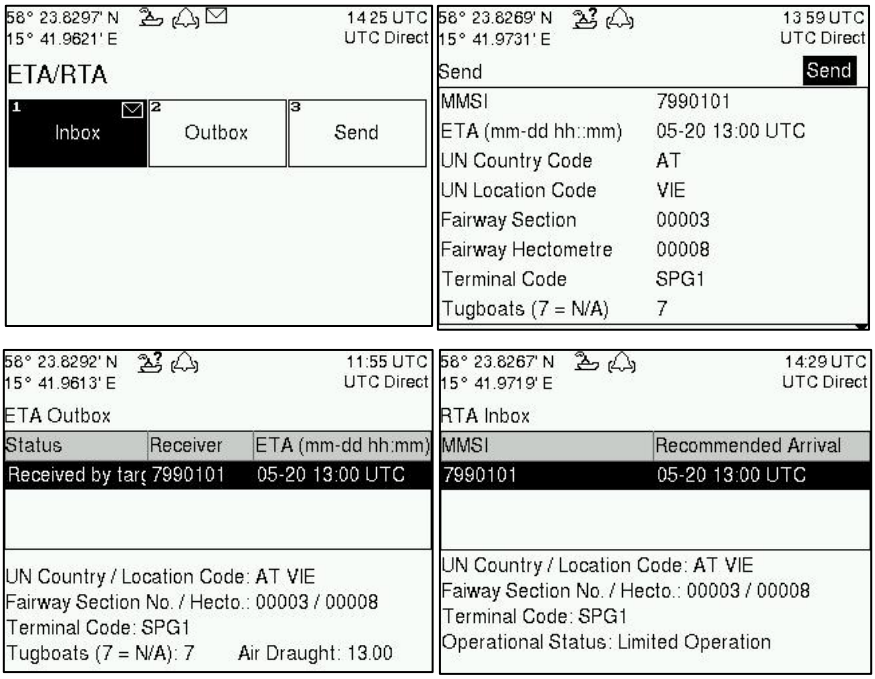


Figure 24 – ETA/RTA

4.16 Inland Water Levels

The R5 SOLID can receive and display Inland branch FI 24 water levels messages. All received water levels messages can be viewed in the *Water Levels* view that can be accessed from *Main Menu → Messages → Water Levels*.

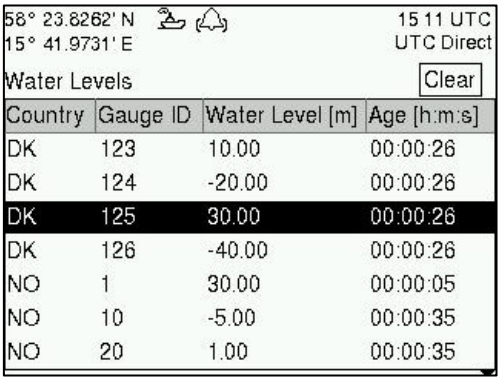


Figure - Inland Water Levels

4.17 Regional Areas

All regional areas that are set in the R5 SOLID can be viewed in the Regional Areas view which is accessed from *Main Menu → Config → VHF Radio → Regional Areas*. The list

shows the north east and south west corners of the area. The area is marked with blue color if the area is in use by the R5 SOLID. To view more information about the area, edit the area or create a new area, press the **OPT** button and choose the desired option.

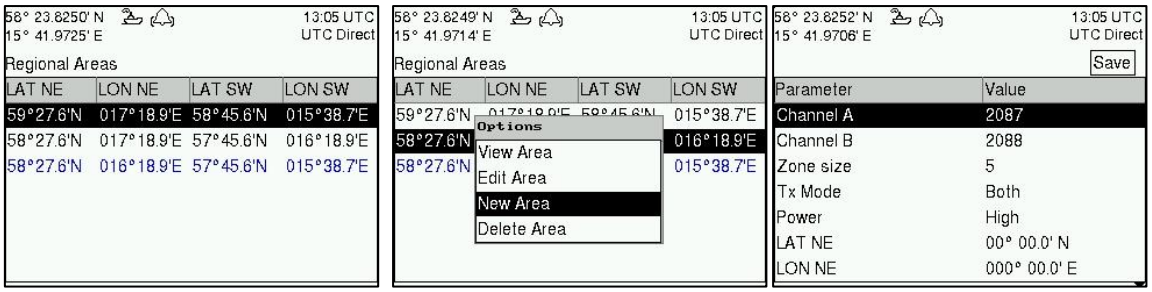


Figure 25 – Regional Areas

4.18 Alarms

All currently active and enabled alarms are shown in the *Alarm* view that can be accessed from *Main Menu→Alarms*. As default, only alarms that are configured as “Enabled” will be shown in the list. It is possible to also show disabled active alarms by pressing **OPT** button and choose “Show All Alarms”. For a list of all alarms, see chapter 7.3.

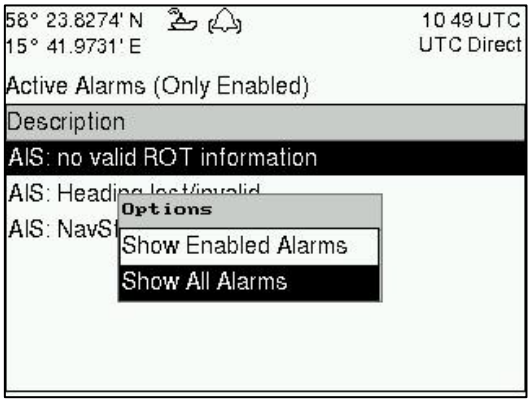


Figure 26 - Alarms

4.19 Status List

Current statuses of indications are listed in the *Status List* view that can be accessed from *Main Menu → Status → Status List*. The different status indications that can occur are listed in chapter 7.8.

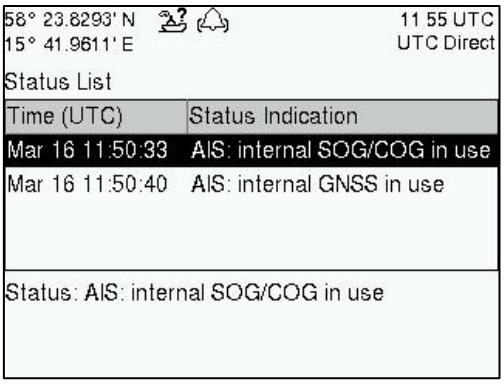


Figure 27 - Status List

4.20 Non Functional Time

This view displays information about times when the R5 SOLID has been turned off or not been transmitting for some other reason for more than 15 minutes. The view is accessed from *Main Menu → Status → Non Func. Time*.

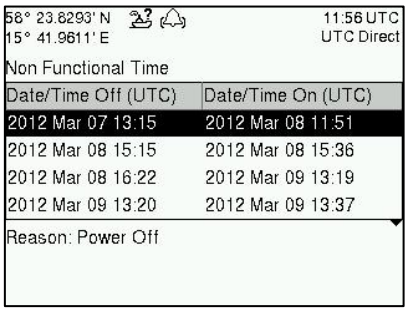


Figure 28 - Non Functional Time

4.21 GPS Status

This view displays the satellites received by the R5 SOLID internal GPS receiver. The list is sorted by the satellites ID (PRN number) and show elevation, azimuth and signal to noise ratio (SNR) for each satellite. The view also displays the total number of satellites in view and the total number of satellites used in the position calculation reported by GGA sentence.

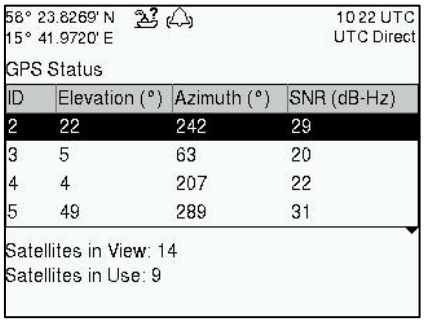


Figure 29 – GPS Status

4.22 View Raw Data

This view displays the incoming data to the R5 SOLID on the selected port. It is also possible to pause the data on the screen by pressing the Freeze button. Use the **ARROW KEYPAD** buttons ∧ ∨ to navigate to the Freeze button and press **ENTER**. The View Raw Data view can be a helpful tool when trouble shooting the system to see what sensor input the R5 SOLID is actually receiving on each port. The view can be accessed from **Main Menu →Status →View Raw Data**.

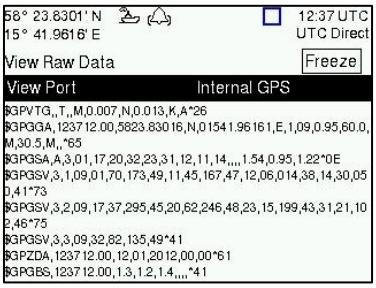


Figure 30 - View Raw Data

4.23 SW/HW Info

This view displays the software and hardware revisions for the R5 SOLID and is accessed from Main *Menu → Status → SW/HW Info*. ***NOTE: This information should always be provided when in contact with Saab TransponderTech support.***

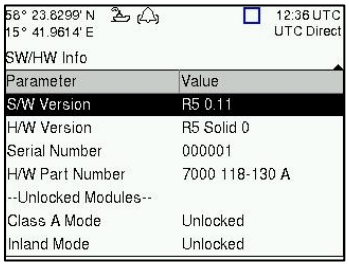


Figure 31 - SW/HW Info

4.24 VHF Status

The VHF Status view shows the currently used settings for the VHF radio. Channel number, frequency, power and operation mode are displayed for each VHF transceiver in the R5 SOLID. This information is useful when troubleshooting to make sure that the R5 SOLID transponder uses the expected VHF radio settings. If e.g. a regional area is set and in use, this will affect the parameters in the VHF Status view.

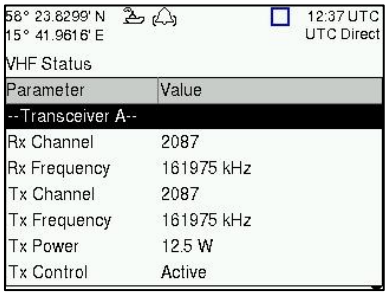


Figure 32 - VHF Status

4.25 Communication Test

When installing the R5 SOLID, or when performing annual testing, a communication test shall be done to ensure that other transponder system can receive the R5 SOLID transmissions. This can be done from the Communication Test view accessed from *Main Menu → Maintenance → Comm. Test*.

When entering the Communication Test view a suggested target with a suitable range (between 15 NM and 25 NM) will be selected in the MMSI parameter field if such a target

has been received by the R5 SOLID. It is however possible to select a different target for the communication test. To start the test, use the **ARROW KEYPAD** button ∧ to select the "Send" button and press **ENTER**. The status of the test will be shown beneath the parameter list. If no response is received within 15 sec from the selected target a fail message will be shown.

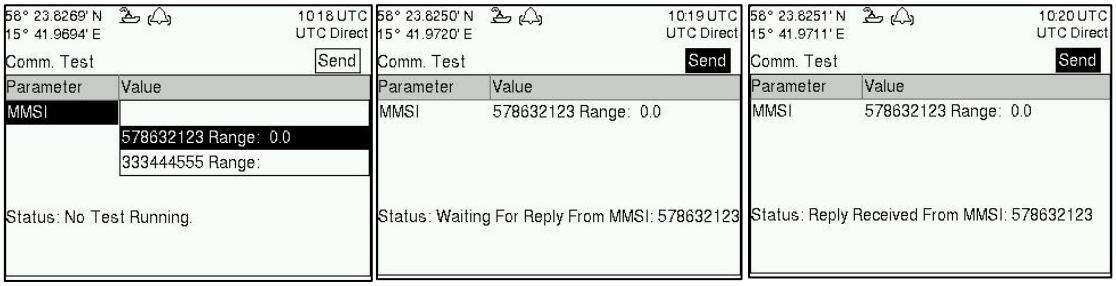


Figure 33 - Communication Test

4.26 Update Software

The software in the R5 SOLID is easy upgradable via the USB Host interface located behind the front hatch. To perform a software update, follow the instructions in the *Update Software* view which can be accessed from *Main Menu→Maintenance→Update Software*. For more information about the upgrade procedure, refer to chapter 5 Software Upgrade.

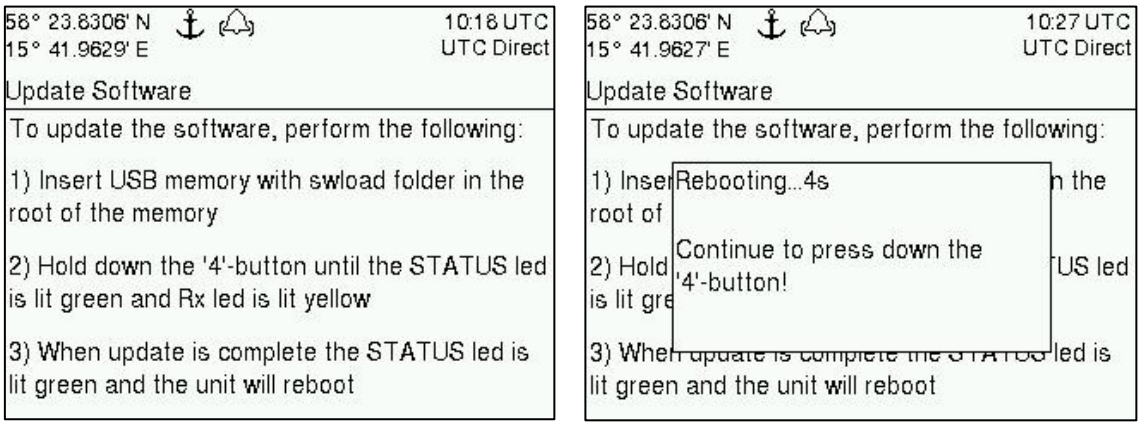


Figure 34 - Update Software

4.1 Restore Config

All config parameters described in section 4.4 "Configuration Parameters" can be set to default values from the *Restore Config* view which can be accessed from *Main Menu → Maintenance → Restore Config*.

NOTE: The MMSI parameter will also be reset to zero and therefore the transponder will stop transmitting and the alarm "Tx Malfunction" becomes active.

5 SOFTWARE UPGRADE

Note: After updating the software add a sticker stating the new software version close to the product label.

The R5 SOLID is easy upgradable through the USB host interface located behind the front hatch. To upgrade the software in the R5 SOLID, perform the following steps:

- Unzip the R5 SOLID upgrade package in the root folder of an USB memory stick. There should now be a folder called swload in the USB root folder.
- Insert the USB memory stick in the USB host interface located behind the front hatch.
- Hold down the '4'-button on the front of the R5 SOLID and reboot the system. The '4'-button must be held down until the **STATUS LED** is lit green and **Rx LED** is lit yellow.

The software upgrade is complete when the **STATUS LED** is lit green. The R5 SOLID will automatically reboot after 3 seconds. Check that correct SW has been loaded in the SW/HW Info view which can be accessed through *Main Menu → Status →SW/HW Info*.

If the upgrade process fails, The **STATUS LED** will be lit red and one of the **Rx LED** or **Tx LED** starts blinking. Should this happen, hold down the '4'-button and reboot the R5 SOLID to try again.

The software upgrade can also be initiated from the *Update Software* view in the R5 SOLID. Refer to chapter 4.26 Update Software for more information.

	STATUS	Rx	Tx
Upgrade mode started	GREEN	YELLOW	
Upgrade in progress		Blinking YELLOW	
Upgrade complete (automatic reboot after 3 sec)	GREEN		
Error: USB Not Found	RED	Blinking YELLOW 0.5Hz	
Error: No SW found on USB	RED	Blinking YELLOW 4Hz	
Error: Flash erase failed	RED		Blinking RED 0.5 Hz
Error: Flash write failed	RED		Blinking RED 4 Hz

Table 12 – LED Indicators during Software Upgrade

6 TECHNINCAL SPECIFICATIONS

6.1 Physical

Dimensions:	Height: 87 mm Width: 238 mm Depth: 173 mm
Weight:	1.8 kg

6.2 Electrical

Input Voltage:	24 VDC
Power Consumption:	17 W (0.7 A @ 24 VDC input voltage)

6.3 Environmental

Temperature:	-15˚C to +55˚C (Operational) -30˚C to +80˚C (Storage)
Vibrations:	IEC 60945 ed. 4
EMC:	IEC 60945 ed. 4
Radio Type Approval:	IEC 61993-2 ed. 2
Compass Safe Distance R5 SOLID	60 cm (for standard magnetic compass) 45 cm (for steering magnetic compass)
Compass Safe Distance GPS Antenna AT575-68W	30 cm (for standard magnetic compass) 30 cm (for steering magnetic compass)
Compass Safe Distance GPS Antenna MA-700	65 cm (for standard magnetic compass) 50 cm (for steering magnetic compass)
Compass Safe Distance Combined VHF/GPS-1	65 cm (for standard magnetic compass) 50 cm (for steering magnetic compass)

6.4 VHF Transceiver

Receivers:	156 – 163 MHz (TDMA) 156.525 MHz fixed (DSC, Channel 70)
Transmitter:	156 – 163 MHz

Channel bandwidth:	25 kHz	
Output Power:	High: Low: “Tanker 1W Mode”	12,5 W 1W 1W
VHF antenna connector:	BNC-Female	
Antenna Input Impedance:	50 ohm	

6.5 Internal GPS Receiver

Type:	GPS L1, C/A Code, 50 Channels SBAS: WAAS, EGNOS, MSAS, GAGAN
Update rate:	2 Hz
Accuracy:	< 2.5 m (GPS, CEP, 50%, 24 hours static) < 2.0 m (SBAS, CEP, 50% 24 hours static)
Antenna feeding:	5 VDC
GPS Antenna connector:	TNC-Female
Antenna Input Impedance:	50 ohm

6.6 AIS Alarm Relay

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

7 TROUBLESHOOTING

One of the basic ideas with troubleshooting is to solve a supposed problem on site instead of immediately sending the suspected part for a costly repair. Solving a supposed problem would in this aspect mean both to rectify the real problem, but it could also mean that the suspected part is confirmed to be working or no-working.

Historically, many of the parts sent to Saab TransponderTech for repair have in fact been confirmed working instead. Another common scenario is that the equipment has faulty I/O settings or other erroneous configurations, easy to fix on site. A proper troubleshooting would ideally prevent those unnecessary returns of fully functional equipment.

There are numerous ways to troubleshoot a transponder installation, much dependant on the skill and experience level of the troubleshooter. The preferred approach may probably also differ between different individuals, and there is no such thing as right or wrong.

This chapter is not intended to be a step by step troubleshooting instruction, but instead offer a toolbox with some different techniques on how to troubleshoot the R5 SOLID AIS System.

7.1 Troubleshooting prerequisites

A transponder operating environment may naturally differ widely, ranging from small high-speed RIB's to very large SOLAS tankers, military aircraft carriers and even submarines. The diversity of installation environments will of course have impact on the complexity of the troubleshooting, but it is always advisable to start with minimizing all possible interference sources in order to simplify the troubleshooting.

- Disconnect other NMEA equipment from the R5 SOLID (ECDIS, RADAR, NAV, etc.)
- Switch off other emission sources (RADAR, SATCOM, VHF, etc.)

We strongly encourage to always apply the latest software available for the R5 SOLID. It may contain bug-fixes and other improvements solving already known issues. Always check existing release notes to see if your problem is to be found.

7.2 Troubleshooting with the front panel LED's

It is very fast and effective to use the LED's to verify the status of the R5 SOLID. This should always be the first step in the troubleshooting.

7.2.1 STATUS LED (multi-colored)

- The STATUS LED is constantly lit green when the transponder is operating and no alarms are active.
- The STATUS LED is constantly lit red if there is one or more acknowledged active alarms in the transponder, but no unacknowledged alarms. Refer to chapter 7.3 for interpretation of the alarms.
- The STATUS LED is flashing red if there is one or more unacknowledged alarms in the transponder. Refer to chapter 7.3 for interpretation of the alarms.

If neither colours are lit, nor flashing, then check the power supply and make sure that:

- The voltage is correct and stable
- The polarity is correct and not switched
- The available current is sufficient for start up and transmission

- The external fuse is functional
- The power cable is undamaged
- The power connector is properly connected and secured

Also check so that the LED backlight is not completely turned off in the Visual Config view accessed from *Main Menu→Config→Display→Visual*.

7.2.2 Rx LED (yellow)

The Rx LED is flashing yellow when the transponder is receiving a message from the VDL. This can be intermittently.

If there is verified traffic on the VDL and the Rx LED still is dark, then check the alarm list for any active alarms. Refer to chapter 7.3 for interpretation of the alarms.

Lack of reception may be an indication of a VHF antenna problem or connectivity issues. Check the installation for problems.

7.2.3 Tx LED (red)

The Tx LED is flashing red when the transponder is transmitting a message to the VDL. The transmission interval is between 2 – 360 seconds. Refer to chapter 7.5.

If the Tx LED is completely dark, then check so that the transmission is not switched off either through an active regional area or by the Tx Mode parameter. It is possible to check the status on each transceiver in the VHF Status view described in section 4.24.

If the transmission is activated and there is still no red flashing, then check the alarm list for any active alarms. Refer to chapter 7.3 for interpretation of the alarms.

7.3 Troubleshooting with alarm messages

The R5 SOLID constantly monitors itself for failures, abnormal conditions and other important parameters. Some of the monitoring trigger alarms and those alarms are excellent aids in the troubleshooting process.

An active alarm can have two states, unacknowledged or acknowledged. The state of an alarm will affect the STATUS LED. Refer to chapter 7.2.1.

A new alarm (unacknowledged) will raise a pop-up window that needs to be acknowledged by the user. The active alarms can be found in the alarm view. Refer to chapter 4.18.

All alarms, active and inactive, are outputted on all the serial interface ports. The alarm status can for example be used in interfacing ECDIS systems or centralized alarm systems. The alarms can also be monitored or recorded for troubleshooting purposes by for example a terminal application.

The status of an alarm can be identified by two letters in the alarm sentence, "**A**" and "**V**". The alarm sentence is constructed as: ***$AIALR,hhmmss.ss,xxx,A,A,c-c**, where:*
***Hhmmss.ss** = Time (UTC) of alarm condition change*
***xxx** = Unique alarm identifier*
***A** = Alarm condition (A = Active, V = Inactive)*
***A** = Alarm's acknowledge state, A = acknowledged, V = unacknowledged*
***c-c** = Alarm's description text*

*$AIALR,hhmmss.ss,xxx,**V**,A,c-c: Tx malfunction*: Alarm is **Inactive**

*$AIALR,hhmmss.ss,xxx,**V**,V,c-c: Tx malfunction*: Alarm is **Inactive**

*$AIALR,hhmmss.ss,xxx,**A**,**A**,c-c: Tx malfunction*: Alarm is **Active** and **Acknowledged**

*$AIALR,hhmmss.ss,xxx,**A**,**V**,c-c: Tx malfunction*: Alarm is **Active** and **Unacknowledged**

The alarms that can occur in the R5 SOLID are listed below:

7.3.1 AIS: Tx Malfunction (ID 001)

A Tx Malfunction alarm is generated if there is a malfunction in the radio transmitter hardware or if the antenna VSWR exceeds an allowed ratio. If the radio transmitter returns to normal operation or if VSWR returns to a value below the allowed threshold, the alarm is cleared. The Tx Malfunction alarm is also generated when the MMSI is configured to “0”, in which case the R5 SOLID will not transmit.

7.3.2 AIS: Antenna VSWR Exceeds limit (ID 002)

The VSWR (Voltage Standing Wave Ratio) of the antenna is checked for every transmission and if it exceeds a given ratio then a VSWR alarm is generated. If the VSWR goes below the allowed threshold, the alarm is cleared.

7.3.3 AIS: Rx Ch A Malfunction (ID 003)

7.3.4 AIS: Rx Ch B Malfunction (ID 004)

7.3.5 AIS: Rx Ch C Malfunction (ID 005)

The radio receivers are continuously monitored and if any part of the receivers’ hardware should malfunction, an Rx Malfunction alarm is generated for that receiver. If the radio receiver returns to normal operation, the alarm is cleared.

7.3.6 AIS: General Failure (ID 006)

This alarm is generated if the R5 SOLID fails to initiate the radio or if a severe hardware failure has occurred. If this alarm occurs, contact your retailer.

7.3.7 AIS: UTC Sync Invalid (ID 007)

This alarm is generated when the R5 SOLID have lost UTC direct synchronization (cannot synchronize from internal GPS receiver).

7.3.8 AIS: MKD connection lost (ID 008)

This alarm is active if the communication between the control unit and the display unit in the R5 SOLID does not work.

7.3.9 AIS: Internal/External GNSS position mismatch (ID 009)

This alarm is generated if the difference between the internal and external GNSS position is more than 100 m for more than an hour.

7.3.10 AIS: NavStatus incorrect (ID 010)

This alarm is generated if the navigational status is incorrect. If e.g. the navigational status is set to “At Anchor” but the ship is moving faster than 3 knots, the NavStatus incorrect alarm will become active.

7.3.11 AIS: Heading sensor offset (ID 011)

This alarm is active when SOG (Speed Over Ground) is greater than 5 kn and the difference between COG (Course Over Ground) and HDT (True Heading) is greater than 45˚ for 5 min.

7.3.12 AIS: Active AIS SART (ID 014)

This alarm is generated when the R5 SOLID has received an AIS SART position report.

7.3.13 AIS: External EPFS Lost (ID 025)

This alarm is generated if the position from the external Electronic Position Fixing System is invalid (i.e. no external GNSS). Due to the fallback arrangement for the positioning sensor this alarm can be inactive up to 30 seconds (during which the internal GNSS is used) before the alarm is activated.

7.3.14 AIS: No Sensor Position In Use (ID 026)

This alarm is active if the R5 SOLID does not have a valid position (latitude/longitude) from any sensor.

7.3.15 AIS: No Valid SOG Information (ID 029) / No Valid COG Information (ID 030)

These alarms are active if the R5 SOLID does not have a valid SOG (Speed Over Ground) or a valid COG (Course Over Ground) from any sensor. The SOG and COG is based on the speed log (if external GNSS is used and a valid heading is available) or the GNSS currently in use.

7.3.16 AIS: Heading Lost/Invalid (ID 032)

This alarm is generated if either the heading information is lost/invalid (from external sensors) or if the heading is undefined.

7.3.17 AIS: No Valid ROT Information (ID 035)

This alarm is active if ROT (Rate of Turn) is undefined or if no valid ROT information is available from external sensor or internal calculations.

7.3.18 IAIS: Ship Size mismatch (ID 060)

This alarm is active when the inland parameters length and beam of ship does not match the antenna position parameters A, B, C and D.

7.4 Troubleshooting via the display

There is a lot of information and data accessible via the display that can be useful for troubleshooting, and that can help finding a presumed problem. The following items are just a few examples of what to look at.

7.4.1 Transmitted Own Ship Data view

When the transponder transmits data on the VDL, it also simultaneously outputs this data on all the serial ports. This information is displayed in the Transmitted Own Ship Data view.

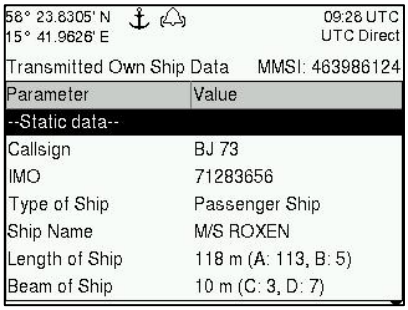


Figure 35 – Transmitted Own Ship Data

7.4.2 Target list

The target list is primarily useful when analyzing the receiving functionality. The propagation characteristics of VHF radio frequencies are close to line of sight. A harsh radio environment, reflections in cables, connectors or the antenna will shorten the effective range.

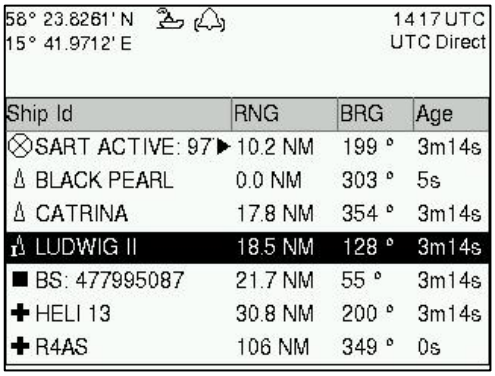


Figure 36 – Target List

7.4.3 Date and time

The date and time (UTC) in the upper right corner of the display is provided by the transponder. If the date and time are not correct, the transponders internal GPS does not have a position fix. This will also be indicated by the alarm “UTC sync invalid”. This problem is normally caused by a GPS-antenna failure or damaged antenna cables. This problem may also be caused by interference from radio equipment on-board.

7.4.4 View Raw data

The *View Raw Data* view can be used to see received data on the ports of the R5 SOLID. It is useful for troubleshooting to make sure that connected sensors provide correct data to the R5 SOLID unit. The “View Port” parameter determines from which port the data displayed in the view are taken. It is possible to pause the view by pressing the “Freeze” button. All data that is received while the view is paused will not be displayed in the view.

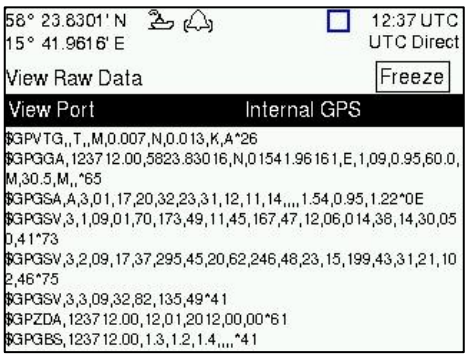


Figure 37 – View Raw Data

7.4.5 Status List

The status list view is used to display status indications that are stored in the transponder. The indications are created when an important event has occurred in the transponder. Time of occurrence and status indication text are shown in the view. A list of all possible indications can be found in section 7.8 “Indication Messages”.

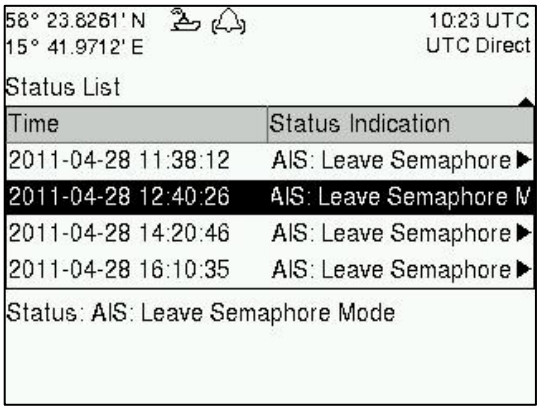


Figure 38 – Status List

7.5 Reporting intervals for Class A transponders

The different information types are valid for different time periods and therefore they need different update intervals. These update intervals are defined in the AIS standard (ITU-R M 1371-3) and should be applied by all transponders. There are however some exceptions from this, which can be found in the standard. Class B transponders have for example different intervals than the Class A transponder.

All this needs to be taken in consideration while troubleshooting thus it affects the anticipated behaviour of a transponder.

Information type / Condition	Nominal reporting interval
Static Information	6 min, on amendment, on request
Voyage related information	6 min, on amendment, on request
Dynamic information (See conditions below)	
- Ship at anchor or moored and not moving faster than 3 knots	3 min
- Ship at anchor or moored and moving faster than 3 knots	10 sek
- Ship 0-14 knots	10 sek
- Ship 0-14 knots and changing course	3 1/3 sek
- Ship 14-23 knots	6 sek
- Ship 14-23 knots and changing course	2 sek
- Ship > 23 knots	2 sek
- Ship > 23 knots and changing course	2 sek

Table 13 – Reporting Intervals

7.6 F.A.Q

7.6.1 I cannot see the vessel on the Internet AIS service

Websites providing AIS services like e.g. www.marinetraffic.com does not cover all the seas of the world, but only specific coastal areas where AIS receivers have been installed and that upload the data to the websites. The vessel must be in reception range of these AIS receivers to show up on the Internet AIS service.

7.6.2 I can "see" the other vessel, but they do not "see" my vessel

There are several reasons why this might happen. The first thing to check is if the R5 SOLID is transmitting at all or if is transmitting in low power mode. In *VHF Status* view described in section 4.24 it is possible to check the status on all R5 SOLID VHF transceivers. Make sure that correct channels and power mode are used. There might be a regional area set in the transponder that changes the operating mode of the R5 SOLID. Regional areas are listed in the *Regional Area* view (see section 4.17).

The MMSI must also be configured in order for the R5 SOLID to transmit. If the MMSI is zero, the R5 SOLID will be silent.

Another possibility is that the other vessels' transponder requires a shorter reception range in order to receive the R5 SOLID transmissions. In the *Target List* view and the *Plot* view it is possible to see the range and bearing to other vessels.

7.6.3 The VHF range seems to be low

As a general rule, the VHF range is equal to line of sight from the antenna position, which means that the higher the antenna is installed, the longer the range will be. It is also important to follow the guide lines for an antenna installation as thorough as possible. Section 3.5 describes how to best install the VHF antenna.

7.6.4 I can only receive a few GPS satellites

The position of the GPS antenna is of high importance to optimize the GPS reception. Follow the guide lines of GPS antenna installation described in chapter 3.6 "Mount the R5 SOLID GPS antenna" as thorough as possible.

If the ship is close to a harbour or shore with high structures or traveling in an area with high terrain, the GPS reception might be lowered. 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.

The GPS antenna cable should also be as short as possible and with 50 Ω impedance. A very long antenna cable or faulty impedance can heavily reduce the GPS reception.

7.7 Contacting Support

The primary source for support and RMA issues should for end customers be the local dealer where the equipment was purchased in the first place. Another option is to contact one of our OEM partners or affiliate service stations and request help. An updated list with our dealers, OEM partners and service stations can be found at our website, listed under the corresponding product. www.saabgroup.com/transponder

It is also possible to contact Saab TransponderTech's technical support if this is preferred.

We recommend contacting us via email at support.transpondetech@saabgroup.com for most accurate and detailed help. If the situation is very urgent then it is of course also possible to call us at normal Swedish workdays and working hours (UTC +1h/+2h). Telephone **+46-13-189420**.

Before contacting support, always check the following information and include it in the first email, or have it ready at the phone call:

- All the information provided by the SW/HW Info view which can be accessed from *Main Menu→Status→SW/HW Info*.
- Detailed fault description

7.8 Indication Messages

The indication messages, with identity and type information, are listed below:

ID	Type	Message text
021	Status	External DGNSS in use
022	Status	External GNSS in use
023	Status	Internal DGNSS in use (beacon)
024	Status	Internal DGNSS in use (msg 17)
025	Status	Internal GNSS in use
027	Status	External SOG/COG in use
028	Status	Internal SOG/COG in use
031	Status	Heading valid
033	Status	Rate of Turn Indicator in use
034	Status	Other ROT source in use
036	Event	Channel management parameters changed
056	Event	Channel management zone memory changed
061	Status	Enter semaphore mode
062	Event	Leave semaphore mode
063	Event	NVM Checksum errors
064	Event	RATDMA overflow
066	Status	Tanker Low VHF Power Mode
067	Status	Beacon correction received
068	Status	VDL correction received
069	Status	No correction received

7.9 Long Range Definitions

A = Ship’s name, call sign, and IMO number
B = Date and time of message composition
C = Position
E = Course over ground (COG)
F = Speed over ground (SOG)
I = Destination and Estimated Time of Arrival (ETA)
O = Draught
P = Ship/Cargo
U = Ship’s length, breadth, type
W= Persons on board

8 INTERPRETATION OF INPUT SENTENCES

All interface ports accepts the full set of input listed below sentences, except the sentences listed in section 8.4.1 that is unique to the Long Range interface port.

The protocol of the serial input sentences shall be compliant to IEC 61162-1Ed.4 (2010-11) for maximum interoperability.

8.1 GPS and Sensor Input Sentences

8.1.1 DTM - Datum Reference

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

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

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

8.1.2 GBS - GNSS Satellite Fault Detection

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

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

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

8.1.3 GGA - Global Positioning System Fix Data

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

Field	Format	Name	Comment
1	--GGA	Sentence Id	Used
2	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
3	llll.ll	Latitude	Used
4	a		
5	yyyy.yy	Longitude	Used
6	a		
7	x	GPS quality indicator	Used, 1 -> Position with Low Accuracy 2 -> Position with High

			Accuracy 3 -> Position with Low Accuracy 6 -> Dead Reckoning with Low Accuracy 7 -> Manual mode with low accuracy OTHER -> No Position Used when the GPS is the internal GPS (Used in proprietary sentences)
8	xx	Satellites in use	Ignored
9	x.x	Horizontal dilution of precision	Ignored
10	x.x	Antenna altitude	Ignored
11	M	Units of antenna altitude, meter	Ignored
12	x.x	Geodial separation	Ignored
13	M	Units of geodial sep.	Ignored
14	x.x	Age of differential GPS data	Ignored
15	xxxx	Differential reference station ID	Ignored

8.1.4 GLL – Geographic position, latitude/longitude

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

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

8.1.5 GNS – GNSS fix data

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

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

Field	Format	Name	Comment
1	--GLL	Sentence Id	Used
2	hhmmss.ss	UTC of position	UTC Second is used to indicate Time Stamp
3	llll.ll	Latitude	Used
4	a		
5	yyyy.yy	Longitude	Used
6	a		
7	c--c	Mode indicator	A, P -> Position with low accuracy D, R, F -> Position with high Accuracy E -> Dead Reckoning Mode with Low accuracy M -> Manual Mode with low accuracy OTHER -> No Position
8	xx	Total number of satellites	Used when the GPS source is the internal GPS (used in proprietary sentences)

9	x.x	HDOP	Ignored
10	x.x	Antenna altitude, meter	Ignored
11	x.x	Geodial separation	Ignored
12	x.x	Age of differential corrections	Ignored
13	x.x	Differential reference station ID	Ignored

8.1.6 HDT - Heading, True

The use of this sentence is talker identifier dependent.

$--HDT,x.x,T

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

NOTE: HDT input must be sent at least every 3 seconds for the R5 SOLID to calculate ROT from the HDT input.

8.1.7 OSD – Own ship data

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

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

8.1.8 RMC – Recommended minimum specific GNSS data

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

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

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

8.1.9 ROT – Rate of turn

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

$--ROT,x.x,A

Field	Format	Name	Comment
1	--ROT	Sentence Id	Used
2	x.x	Rate of turn	Used if Status is set to ‘A’
3	A	Status	Used

8.1.10 VBW - Dual Ground / Water Speed

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

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

Field	Format	Name	Comment
1	--ROT	Sentence Id	Used
2	x.x	Longitudinal water speed	Ignored
3	x.x	Transverse water speed	Ignored
4	A	Status: water speed	Ignored
5	x.x	Longitudinal ground speed	Used if Status is set to A
6	x.x	Transverse ground speed	Used if Status is set to A
7	A	Status: ground speed	Used
8	x.x	Stern transverse water speed	Ignored
9	A	Status stern water speed	Ignored
10	x.x	Stern transverse ground speed	Ignored
11	A	Status stern ground speed	Ignored

8.1.11 VTG – Course over ground and ground speed

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

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

8.1.12 ZDA – Time and date

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

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

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

8.2 General Input Sentences

8.2.1 ACK – Acknowledge Alarm

$--ACK,xxx

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

8.2.2 EPV – Command or report equipment property value

$--EPV,a,c--c,c--c,x.x,c--c,

Field	Format	Name	Comment
1	--EPV	Sentence Id	Used
2	a	Sentence status flag	Used
3	c--c	Destination equipment type	Used, AI or STT
4	c--c	Unique Identifier	Used, may be null
5	x.x	Property identifier	Used
6	c--c	Value of property to be set	Used

8.2.1 SPW – Security Password Sentence

$--SPW,ccc,c--c,x,c--c

Field	Format	Name	Comment
1	--SPW	Sentence Id	Used
2	ccc	Password protected sentece	Used
3	c--c	Unique Identifier	Used, may be NULL
4	x	Password level	Used
5	c--c	Password	Used

8.2.1 HBT – Heartbeat Supervision Sentence

$--HBT,x.x,A,x

Field	Format	Name	Comment
1	--SPW	Sentence Id	Used
2	x.x	Configured repeat interval	Used (Limited to 60 sec)
3	A	Equipment status	Used
4	x	Sequential sentence identifier	Ignored

8.3 AIS Specific Input Sentences

8.3.1 ABM – Addressed Binary and Safety-Related Message

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

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

8.3.2 ACA – AIS Regional Channel Assignment Message

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

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

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

8.3.3 AIQ – Query Sentence

$--AIQ,ccc

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

8.3.4 AIR – AIS Interrogation Request

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

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

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

7	xxxxxxxxx	MMSI 2	Used, may be NULL
8	x.x	Message ID 2.1	Used, may be NULL
9	X	Message sub section	Ignored

8.3.5 BBM – Broadcast Binary Message

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

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

8.3.6 SSD – Ship Static Data

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

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

8.3.7 VSD – Voyage Static Data

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

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

8.4 Long range input sentences

8.4.1 On Long range port

The LR sentences can only be used with the Long Range interface port.

8.4.1.1 LRF – AIS long-range function

$--LRF,x,xxxxxxxxx,c—c,c—c,c—c

Field	Format	Name	Comment
1	--LRF	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxxxx	MMSI of requestor	Used
4	c--c	Name of requestor	Used
5	c--c	Function request	Used
6	c--c	Function reply status	Used

8.4.1.2 LRI – AIS long-range interrogation

$--LRI,x,a,xxxxxxxxx,xxxxxxxxx,llll.ll,a,yyyyy.yy,a,llll.ll,a,yyyyy.yy,a

Field	Format	Name	Comment
1	--LRI	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxxxx	MMSI of requestor	Used
4	xxxxxxxxx	MMSI of destination	Used
5	llll.ll	Latitude	Used
6	a	N / S	Used
7	yyyyy.yy	Longitude	Used
8	a	E / W	Used

8.4.2 On other input ports

8.4.2.1 LRF – AIS long-range function

$--LRF,x,xxxxxxxxx,c—c,c—c,c—c

Field	Format	Name	Comment
1	--LRF	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxxxx	MMSI of requestor	Used
4	c--c	Name of requestor	Used
5	c--c	Function request	Used
6	c--c	Function reply status	Used

8.5 Proprietary Input Sentences

All Saab TransponderTech Proprietary Sentences will have talker ID PSTT.

8.5.1 Proprietary Query message PSTT,101

$PSTT,101,c--c,

Field	Format	Name	Comment
1	PSTT	Proprietary SAAB TranspondeTech Sentence	Used
2	101	Sentence Query	Used
3	c--c	Proprietary sentence to query	Used

9 INTERPRETATION OF OUTPUT SENTENCES

9.1 Proprietary Output Sentences (PSTT)

In addition to the standardized IEC sentences, the R5 SOLID is able to output the proprietary sentences listed below. All Saab TransponderTech Proprietary Sentences will have talker ID “PSTT”.

9.1.1 $PSTT,10A – UTC Date and Time

This sentence provides UTC Date and Time, i.e. R5 SOLID system time (based on internal GNSS time). It is output approximately once every 10 seconds (± 1 s).

$PSTT,10A,YYYYMMDD,HHMMSS

Field	Format	Name	Comment
1	10A	Sentence Id	10A always
2	YYYYMMDD	Date	Year, month and day in decimal notation. (00000000 = Not available)
3	HHMMSS	Time	Hour, minute and second in decimal notation. (999999 = Not available)

Example: $PSTT,10A,20121028,135230*<FCS><CR><LF>

= Date October 28, 2012

= Time 13:52:30 UTC

9.1.2 $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,LLL,NNNN

Field	Format	Name	Comment
1	10C	Sentence Id	10C always
2	C	Channel	A = VDL Channel A B = VDL Channel B
3	LLL	Traffic Load	Data link traffic load in precent, 0-100.
4	NNNN	Number of Units	Number of units occupying the data link

9.1.3 $PSTT,146 – System Operational Mode Status

This sentence reports the system operational mode. This sentence is output on change, periodically every minute and on request using PSTT,101.

$PSTT,146,x,x,x*hh<CR><LF>

Field	Format	Name	Comment
1	**146**	**Sentence Id**	**146 always**
2	**X**	**1 W Mode**	**0 = Default** **1 = 1 Watt**
3	**X**	**System Mode**	**0 = Class A** **1 = Inland**
4	**X**	**Transmit mode**	**0 = Normal** **1 = Silent**

9.1.4 $PSTT,1F3 – Transponder Restart

This sentence will be output when the transponder has restarted.

$PSTT,1F3,R

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

9.2 Long range output sentences

9.2.1 On Long range port

9.2.1.1 LR1 – AIS long-range reply sentence 1

$--LR1,x,xxxxxxxxx,xxxxxxxxx,c—c,c—c,xxxxxxxxx

Field	Format	Name	Comment
1	--LR1	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxxxx	MMSI of responder	Used
4	xxxxxxxxx	MMSI of requestor (reply destination	Used
5	c--c	Ship's name	Used
6	c--c	Call sign	Used
7	xxxxxxxxx	IMO Number	Used

9.2.1.2 LR2 – AIS long-range reply sentence 2

$--LR2,x,xxxxxxxxx,xxxxxxxx,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x.x,T,x.x,N

Field	Format	Name	Comment
1	--LR2	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxxxx	MMSI of responder	Used
4	xxxxxxxx	Date	Used
5	hhmmss.ss	UTC time of position	Used
6	llll.ll	Latitude	Used
7	a	N / S	Used
8	yyyyy.yy	Longitude	Used
9	a	E / W	Used
10	x.x	Course over ground	Used
11	T	Validity of COG	Used
12	x.x	Speed over ground	Used
13	N	Validity of SOG	Used

9.2.1.3 LR3 – AIS long-range reply sentence 3

$--LR3,x,xxxxxxxxx,c—c,xxxxxx,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x

Output rate: On event

Field	Format	Name	Comment
1	--LR3	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxx	MMSI of responder	Used

	xx		
4	c--c	Voyage destination	Used
5	xxxxxxx x	ETA Date	Used
6	hhmmss. ss	ETA time	Used
7	x.x	Draught	Used
8	x.x	Ship / Cargo	Used
9	x.x	Ship length	Used
10	x.x	Ship width	Used
11	x.x	Ship type	Used
12	x.x	Persons	Used

9.2.1.4 LRF – AIS long-range function

$--LRF,x,xxxxxxxxx,c—c,c—c,c—c

Output rate: On event

Field	Format	Name	Comment
1	--LRF	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxx xx	MMSI of requestor	Used
4	c--c	Name of requestor	Used
5	c--c	Function request	Used
6	c--c	Function reply status	Used

9.2.2 On all other output ports

9.2.2.1 LRF – AIS long-range function

$--LRF,x,xxxxxxxxx,c—c,c—c,c—c

Output rate: On event

Field	Format	Name	Comment
1	--LRF	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxx xx	MMSI of requestor	Used
4	c--c	Name of requestor	Used
5	c--c	Function request	Used
6	c--c	Function reply status	Used

9.2.2.2 LRI – AIS long-range interrogation

$--LRI,x,a,xxxxxxxxx,xxxxxxxxx,llll.ll,a,yyyyy.yy,a,llll.ll,a,yyyyy.yy,a

Output rate: On event

Field	Format	Name	Comment
1	--LRI	Sentence Id	Used
2	x	Sequence number	Used
3	xxxxxxx xx	MMSI of requestor	Used
4	xxxxxxx x	MMSI of destination	Used
5	llll.ll	Latitude	Used
6	a	N / S	Used
7	yyyyy.y y	Longitude	Used
8	a	E / W	Used

9.3 AIS output sentences

9.3.1 ABK – AIS Addressed and binary broadcast acknowledgement

$ -- ABK,xxxxxxxxx,x,x.x,x,x

Output rate: On event.

Field	Format	Name	Comment
1	--ABK	Sentence Id	Used
2	xxxxxxxxx	MMSI of the addressed AIS unit	Used
3	x	AIS channel of reception	Used
4	x.x	ITU - R M.1371 Message ID	Used
5	x	Message sequence number	Used
6	x	Type of acknowledgement	Used

9.3.2 ACA – AIS Regional Channel Assignment Message

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

Output rate: On event. On request.

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

9.3.3 ALR – Set alarm state

$--ALR,hhmmss.ss,xxx,A, A,c--c

Output rate: On event, on request, and automatically. Output every 30s for active alarms and every 60s when no active alarms.

Field	Format	Name	Comment
1	--ALR	Sentence Id	Used
2	hhmmss.ss	Time of alarm condition change, UTC	Used
3	Xxx	Unique alarm number (identifier) at alarm source	Used

4	A	Alarm condition A = threshold exceeded V = not exceeded	Used
5	A	Alarm's acknowledge state A = acknowledged V = unacknowledged	Used
6	c--c	Alarm's description text	Used

9.3.4 EPV – Command or report equipment property value

$--EPV,a,c--c,c--c,x.x,c—c

Output rate: On request.

Field	Format	Name	Comment
1	--EPV	Sentence Id	Used
2	a	Sentence status flag	Used
3	c--c	Destination equipment type	Used
4	c--c	Unique Identifier	Used
5	x.x	Property identifier	Used
6	c--c	Value of property	Used

9.3.5 NAK – Negative acknowledgement

$--NAK,cc,ccc,c--c,x.x,c—c

Output rate: On event

Field	Format	Name	Comment
1	--NAK	Sentence Id	Used
2	cc	Talker identifier	Used
3	ccc	Affected sentence formatter	Used
4	c--c	Unique Identifier	Used
5	x.x	Reason code for negative acknowledgement	Used
6	c--c	Negative acknowledgement's descriptive text	Used

9.3.6 SSD – Ship Static Data

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

Output rate: On request.

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

9.3.7 TRL – AIS transmitter non functioning log

$--TRL,x.x,x.x,x,xxxxxxxx,hhmmss.ss,xxxxxxxx,hhmmss.ss,x

Output rate: On request. Up to 10 sentences in a burst.

Field	Format	Name	Comment
1	--TRL	Sentence Id	Used
2	x.x	Total number of log entries	Used
3	x.x	Log entry number	Used
4	x	Sequential message identifier	Used
5	xxxxxxxx	Switch off date	Used
6	hhmmss.ss	Switch off UTC time	Used
7	xxxxxxxx	Switch on date	Used
8	hhmmss.ss	Switch on UTC time	Used
9	X	Reason code1	Used

9.3.8 TXT – Text transmission

$--TXT,xx,xx,xx,c--c

Output rate: On request, on event.

Field	Format	Name	Comment
1	--TXT	Sentence Id	Used
2	xx	Total number of sentences	Used
3	xx	Sentence number	Used
4	xx	Text identifier	Used
5	c--c	Text message	Used

9.3.9 VDM – AIS VHF data-link message

!--VDM,x,x,x,a,s—s,x

Only output on serial port when baudrate is 38400 bps or higher.

Output rate: On VHF message receive event.

Field	Format	Name	Comment
1	--VDM	Sentence Id	Used
2	X	Total number of sentences needed to transfer the message	Used
3	X	Sentence number	Used
4	X	Sequential message identifier	Used
5	A	AIS channel	Used
6	s—s	Encapsulated ITU-R M.1371 radio message	Used
7	X	Number of fill bits	Used

9.3.10 VDO – AIS VHF data-link own-vessel report

!--VDO,x,x,x,a,s—s,x

Only output on serial port when baudrate is 38400 bps or higher.

Output rate: On VHF transmission event. “Dummy” messages once per second.

Field	Format	Name	Comment
1	--VDO	Sentence Id	Used
2	X	Total number of sentences needed to transfer the message	Used

3	X	Sentence number	Used
4	X	Sequential message identifier	Used
5	A	AIS channel	Used for transmission event. Not used for "dummy" position messages.
6	s–s	Encapsulated ITU-R M.1371 radio message	Used
7	X	Number of fill bits	Used

9.3.11 VSD – Voyage Static Data

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

Output rate: On request.

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

10 GLOSSARY

ACK	Acknowledgement
AFSK	Audio Frequency Shift Keying
AIS	Automatic Identification System
Ant	Antenna
App	Application
ARPA	Automatic Radar Plotting Aid
BRG	Bearing
BS	Base Station
Ch	Channel
COG	Course Over Ground
Comm	Communication
DGNSS	Differential Global Navigational Satellite System
Disp	Display
DTE	Data terminal equipment
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information System
EGNOS	European Geostationary Navigation Overlay Service
EPFS	Electronic Position Fixing System
ETA	Estimated Time of Arrival
Ext	External
GALILEO	European GNSS
GLONASS	Russian GNSS
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigational Satellite System
GPS	Global Positioning System
HDG	Heading
HDOP	Horizontal Dilution Of Precision
Hecto	Hectometre
H/W	Hardware
IALA	International Association of Lighthouse Authorities
ID	Identifier
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
Int	Internal
ITU	International Telecommunications Union
LAT	Latitude
LED	Light Emitting Diod

LOC	Local
LON	Longitude
LR	Long Range
Msg	Message
MKD	Minimum Keyboard and Display
MSAS	MTSAT Satellite Augmentation System (Japan)
NMEA	National Marine Electronics Association
MMSI	Maritime Mobile Service Identity
N/A	Not available
NE	North East
No	Number
NVM	Non-Volatile Memory
PoB	Persons on board
Pos	Position
RAIM	Receiver Autonomous Integrity Monitoring
RNG	Range
RATDMA	Random Access Time Division Multiple Access
ROT	Rate Of Turn
RTA	Recommended Time of Arrival
Rx	Receive
SAR	Search And Rescue
SART	Search And Rescue Transmitter
SBAS	Satellite Based Augmentation System
SNR	Signal to Noise Ratio
SOG	Speed Over Ground
SRM	Safety Related Message
Sync	Synchronization
SW	South West
S/W	Software
TDMA	Time Division Multiple Access
Transp	Transponder
Tx	Transmit
UN	Unitied Nation
UTC	Universal Time Coordinated
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio. (A low value indicates a problem with the antenna or connections/cables to the antenna.)
WAAS	Wide Area Augmentation System (United States)

10.1 Units

bps	Bits per second
W	Watt
m	Meter
kHz	Kilo Herz
dB-Hz	Decibel-Hertz
NM	Nautical Mile
Km	Kilometer
Sm	Statute Mile
Kn	Knots
km/h	Kilometer per Hour
mph	Miles per Hour
mm-dd hh:mm	month-day hour:minute
h:m:s	hours:minutes:seconds

11 APPENDIX A - LICENSE

The R5 SOLID AIS Transponder System runs on a Linux operating system which is licensed with GNU General Public License. The source code of the linux kernel can be obtained by contacting Saab TransponderTech AB:

Saab TransponderTech AB
Låsbläcksgatan 3
589 31 Linköping
Sweden

Email: support.transpondetech@saabgroup.com

11.1 Copy of the GNU General Public License

GNU GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS

0. Definitions.

“This License” refers to version 3 of the GNU General Public License.

“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”. “Licensees” and “recipients” may be individuals or organizations.

To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.

A “covered work” means either the unmodified Program or a work based on the Program.

To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.

A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

a) The work must carry prominent notices stating that you modified it, and giving a relevant date.

b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to “keep intact all notices”.

c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.

d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an “aggregate” if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.

b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.

d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.

e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A “User Product” is either (1) a “consumer product”, which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, “normally used” refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

“Installation Information” for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

“Additional permissions” are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or

b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or

c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or

d) Limiting the use for publicity purposes of names of licensors or authors of the material; or

e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or

f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered “further restrictions” within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's “contributor version”.

A contributor's “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others' Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the “copyright” line and a pointer to where the full notice is found.

APPENDIX A - LICENSE

<one line to give the program's name and a brief idea of what it does.>

Copyright (C) <year> <name of author>

This program is free software: you can redistribute it and/or modify

it under the terms of the GNU General Public License as published by

the Free Software Foundation, either version 3 of the License, or

(at your option) any later version.

This program is distributed in the hope that it will be useful,

but WITHOUT ANY WARRANTY; without even the implied warranty of

MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the

GNU General Public License for more details.

You should have received a copy of the GNU General Public License

along with this program. If not, see <http://www.gnu.org/licenses/>.

Also add information on how to contact you by electronic and paper mail.

If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode:

<program> Copyright (C) <year> <name of author>

This program comes with ABSOLUTELY NO WARRANTY; for details type `show w'.

This is free software, and you are welcome to redistribute it

under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, your program's commands might be different; for a GUI interface, you would use an “about box”.

You should also get your employer (if you work as a programmer) or school, if any, to sign a “copyright disclaimer” for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see <http://www.gnu.org/licenses/>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read <http://www.gnu.org/philosophy/why-not-lgpl.html>.