Saab AB (publ) TransponderTech

R5 SUPREME

Navigation System

MkII

OPERATION & INSTALLATION MANUAL

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ii Disclaimer

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iii Software

This manual reflects the capabilities of the R5 Navigation Sensor with Software version 1.4.0 and R5 SUPREME Control & Display Unit (CDU) with software version 1.4.1.

If the system since delivery has been updated from this version, such change should be reflected on a label on the unit. Current software versions in the system can always be verified in the S/W info dialog as described in section 8.3.14.

iv Manual Part Number and Revision

Part number 7000 118-383, revision G1.

v 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.

vi Contact Information

For installation, service, ordering info and technical support please contact your local Saab AB (publ) TransponderTech representative. A list of dealers and service stations can be found on the corresponding product page at:

https://www.saab.com/maritime

TABLE OF CONTENTS

1 Safety Instructions 9
1.1 General 9
1.2 Installation and Service 9
1.3 Compass Safe Distances 9
1.4 Usage 9
2 Main System Components 10
3 General Overview 11
3.1 Product Description 11
3.2 Product Configuration 11
3.3 Main Features 12
4 Concepts and Terminology 14
5 Installation 16
5.1 Equipment 16
5.2 Equipment Installation Environment 17
5.3 Installation Cables 17
5.4 System interconnection overview 18
5.5 Installation Procedure 20
5.6 Mount the R5 SUPREME Control and Display Unit (CDU) 21
5.7 Mount the R5 Navigation Sensor 25
5.8 Mount the GNSS or DGNSS Navigation Antenna 26
5.9 Electrical Installation 28
6 System Overview 31
6.1 Buttons and LEDs on R5 SUPREME CDU 31
6.2 LEDs on R5 Navigation Sensor 33
6.3 Change Settings of a Parameter 34
6.4 System Views - Overview 35
6.5 Navigating in Menus 36
6.6 Status Bar 37
6.7 Alerts 39
7 Start up 40
7.1 Configuration Wizard 40
8 Operation functionalities 43

8.1 Navigate Menu 43
8.2 Voyage Menu 54
8.3 Status Menu 79
8.4 Alert Status 89
8.5 DGNSS Messages (DGNSS version only) 95
9 Web Interface 96
9.1 Status View 96
9.2 Configuration View 97
9.3 Version View 98
9.4 Maintenance View 98
10 Configuration 101
10.1 Configuration Parameters 101
10.2 IEC 61162-450 Counters 125
10.1 Serial Port Counters 125
10.2 RTK Base Setup 127
10.3 Correction Fallback 127
11 Slave Displays and Redundant Systems 129
11.1 R5 SUPREME Navigation System with Slave Display 129
11.2 Redundant Navigation Systems 133
11.3 Synchronized Items 134
12 Maintenance 135
12.1 Upgrade Software CDU 135
12.2 Upgrade R5 Navigation Sensor Software/Internal GNSS Firmware 136
12.3 License Upgrade 138
12.4 Save/Load Config to/from USB memory 139
12.5 Factory reset 143
13 Troubleshooting 144
13.1 Troubleshooting with the CDU Front Panel LEDs 144
13.2 Troubleshooting with the Sensor LEDs 145
13.3 Troubleshooting with Alert Messages 145
13.4 Troubleshooting via the CDU 148
13.5 Network Data Rate and Issue Counters 149
13.6 Contacting Support 149
14 Communication Interfaces 151
14.1 Serial Ports 151

14.2 Ethernet Ports 151
14.3 Serial to Network Gateway Function (SNGF) 152
14.4 Input Sentences 152
14.5 Output Sentences 153
15 Interpretations of ALERT Sentences 156
15.1 Output/Input Sentences, Alerts 156
16 Interpretations of Output Sentences 159
16.1 Output Sentences, GNSS 159
16.1 Output Sentences, GNSS 159
16.2 Output Sentences, Navigation 165
16.3 Output Sentences, Old NMEA Versions 170
17 Interpretations of Input Sentences 171
17.1 Input Sentences 171
17.2 Input Sentences, Old NMEA Versions 174
18 Alternate System Setups 175
18.1 Redundant Navigation Systems Connected by Network 175
18.2 Navigation System with Slave Displays 175
18.3 Combined AIS and Navigation system setup 176
19 Technical Specifications 178
19.1 R5 SUPREME CDU 178
19.2 R5 Navigation Sensor 179
19.3 Internal Alert Relay 180
20 Electrical Interfaces 181
20.1 CDU Interfaces: 181
20.2 R5 Navigation Sensor interfaces 185
21 Mechanical Drawings 192
21.1 CDU Physical Size and Mechanical Drawing 192
21.2 CDU Panel Mount Cutout Hole dimensions 193
21.3 CDU Mounting Frame cutout and dimensions 194
21.4 R5 Navigation Sensor Size and Mechanical Drawing 195
21.5 MGA-3 / MGL-5 / A43 Antenna Physical Size and Mechanical Drawing 196
21.6 A31 Antenna Physical Size and Mechanical Drawing 197
22 Glossary 198
23 Appendix A – Corrections 200
23.1 Real-Time Kinematic (RTK) 200

23.2 Atlas Correction Service 200
24 Appendix B - License 201
24.1 Copy of the GNU General Public License 201

1 SAFETY INSTRUCTIONS

1.1 General

Saab AB (publ) TransponderTech assumes no liability for customer not complying with requirements in this section or warnings and cautions elsewhere in this document.

This safety instruction section refers to all components of the R5 SUPREME Navigation System MkII, referred to as “equipment” in this section.

1.2 Installation and Service

Installation and servicing of equipment shall be done by qualified technician. Any electrical fuses shall be replaced with correct types.

To prevent electrical chock hazard and damage the equipment shall be connected to electrical ground. A power supply corresponding to the voltage rating of the equipment shall be used. Failure to comply with this requirement may damage the equipment.

To ensure proper functioning of the equipment, only signal cables and antennas specified in this document may be used. Failure to comply with this requirement may cause unexpected behavior of the equipment.

The equipment may not in any way be modified, doing so may cause fire, shock hazard or serious injury.

1.3 Compass Safe Distances

Equipment	Standard magnetic compass	Steering magnetic compass
R5 SUPREME CDU	0.75 m	0.5 m
R5 Navigation Sensor	0.6 m	0.3 m

1.4 Usage

The equipment is designed to be used as an aid to navigation and should not be relied upon as single navigation source for safe navigation. Saab AB (publ) TransponderTech cannot be held responsible for any damages caused by violation of this requirement.

2 MAIN SYSTEM COMPONENTS

R5 SUPREME
Control & Display Unit

R5 Navigation
Sensor

(D)GNSS
Antenna

NOTE: Delivered items may vary depending on customer choice

3 GENERAL OVERVIEW

3.1 Product Description

The R5 SUPREME Navigation System MkII features an IMO type approved GNSS Navigation sensor, providing robust and highly accurate position information to external equipment through a large number of integrated interfaces.

The R5 SUPREME Navigation System MkII is available in multiple versions, all with GNSS support but various capabilities of receive and generate correction data. One R5 Navigation Systems consists of an external antenna, a navigation sensor and a R5 Control and Display Unit (CDU).

The installation options are very flexible; It is possible to add an R5 Supreme AIS Transponder for a combined AIS and Navigation using a single CDU unit. Several Navigation systems can be combined in redundant configurations. Additionally passive CDUs may be connected to the navigation system using network interfaces.

The R5 CDU has a seven-inch colour touch display and provides a graphical interface to the system. Via the R5 CDU it is possible to create, edit and modify routes and waypoints, navigate following a route, plot the route, view sensor data, configure the system as well as supervise the system status. It is also possible to configure the R5 CDU for combined AIS MKD functionality when adding an R5 SUPREME AIS Transponder.

For installations without the R5 CDU, a web-interface is built-in to the R5 Navigation sensor. The Web-interface allows for status monitoring, interface configuration, change of positioning parameters and SW updates.

Although delivered in GPS only mode, the R5 Navigation sensors feature a powerful 372 channel receiver capable of combined GPS, GLONASS, BEIDOU and GALILEO reception with a 10Hz update rate. The combined use of several satellite based navigation systems can be enabled by the operator at any time. This increases robustness and reliability of the navigation solution, ensuring maximum possible coverage world-wide.

Approved antenna options are the MGA-3 GNSS antenna for the GNSS sensor, the combined GNSS/Beacon antennas MGL-5 or A31 for the DGNSS sensor and the multi frequency DGNSS antenna A43 is required for full performance when operate a Pro DGNSS system.

3.2 Product Configuration

System / Products	GPS	Glonass	Galileo	BeiDou	RTK	Atlas	Beacon
GNSS	X	X	X	X			
DGNSS	X	X	X	X			X
Pro DGNSS (RTK License)	X	X	X	X	X		X
Pro DGNSS (Atlas Subscription)	X	X	X	X		X	X
Pro DGNSS (RTK License + (Atlas Subscription)	X	X	X	X	X	X	X

Table 1 - System Combinations

3.3 Main Features

R5 Navigation Sensor

- RAIM capable GPS combined with GLONASS, BeiDou and GALILEO operation
- 8 output and 5 input ports configurable for serial data or digital I/O as needed
- Dual 1 Gbps network ports
- Dedicated 1PPS timing output port
- Built-in web server for easy configuration in black box operation
- Bridge Alert Management compliant (Type P)
- Integrated Junction Box
- Integrated IALA Beacon receiver option
- Options for high accuracy RTK and L-Band
- Atlas service operation

R5 CDU

- 7" high quality LCD with Touch or Keypad control
- Supports combined Nav & R5 Supreme AIS transponder operation
- 2 bidirectional serial data ports
- USB service port
- Route Navigation
- Route Logging to SD card memory
- Capability to handle and store up to 4000 individually named waypoints and up to 128 different routes.
- Man Over Board (MOB) and Event Mark functionality.
- Trip log counters with indication of average speed and accumulated time during motion.
- Anchor Watch position deviation alert.
- Scheduled Alerts, user configurable time alerts and time to ETA alerts.
- Time frame related to UTC or user defined local offset
- Tidal Station view
- Sun and Moon prediction
- Synchronization of waypoint/route database and settings with external R5 Navigation systems in redundant installations.
- Support for additional, view-only, R5 SUPREME CDUs connected in slave mode.

- Bridge Alert Management compliant (Type P)

4 CONCEPTS AND TERMINOLOGY

This chapter describes some of the commonly used terms of this manual, and the implied meaning when used in this manual.

Waypoint

A waypoint is a position on the earth's surface, represented by latitude and longitude, which is given a unique name. A waypoint is typically used for navigation direct to a certain position or as part of a route.

MOB Waypoint

A temporary waypoint created when using the Man Over Board (MOB) functionality. It is not possible to use MOB waypoints in routes.

Route

A route is a named, ordered sequence of waypoints, which together describes a path from the start to the end waypoint. The route currently being sailed is called the active route.

Active Route

The active route is the route currently being sailed and used for navigation. When starting to sail a route, a copy of the route is made into the active route. Changes made to the active route do not affect the source route, unless the active route is explicitly stored. Only one route can be active at any one point in time.

Leg

A leg is the segment of a route between two consecutive waypoints. A route with the waypoints A, B and C has two legs: “A to B” and “B to C”. For each leg in a route, the navigation algorithm, RAIM accuracy level and cross track distance (XTD) limit can be set.

RAIM

RAIM stands for “Receiver Autonomous Integrity Monitoring” and is a navigation solution integrity monitoring scheme that evaluates the quality of the position data and is able (under normal circumstances) to detect a satellite malfunction that results in a large range error. The user can specify a RAIM accuracy level and the system will give a warning if the range error is larger than this specified accuracy level.

RAIM Accuracy Level

The RAIM accuracy level is the radius that is used to calculate current RAIM status.

RAIM Status

The RAIM status can be one of safe, caution and unsafe, and is indicated by the RAIM LED on the front of the R5 SUPREME CDU. If the calculated range error is larger than the currently used RAIM accuracy level, the RAIM status will be “unsafe” and indicated with a red light on the RAIM LED. If the error is smaller than the accuracy level, the RAIM status will be “safe” and indicated with a green light on the RAIM LED. If not enough satellites are received to be able to perform the RAIM calculation, the RAIM status will be “caution” and indicated with yellow light on the RAIM LED.

Navigation Algorithm

The navigation algorithm is the algorithm used for calculating the course to steer to reach the next waypoint. It is also used for calculating the distance to the waypoint. The navigation algorithm can be either great circle or rhumb line.

Great Circle Navigation

The great circle navigation algorithm calculates a course line that is the shortest path between two points on the surface of the earth. The course to steer when navigating towards a waypoint is not constant using this navigation algorithm. The resulting track of this navigation algorithm will differ from the straight line drawn on a Mercator projected chart.

Rhumb Line Navigation

The rhumb line navigation algorithm calculates a course line that corresponds to a straight line on a Mercator projected chart, and cuts across all meridians at the same angle.

Waypoint Pass Criterion

The criterion used to determine when a waypoint in the active route is considered passed. The waypoint pass criterion can be any of Manual, Distance, Bisector Line and Perpendicular Line.

Manual Waypoint Pass Criterion

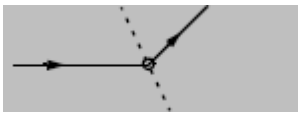
Using this pass criterion, the waypoint is only considered passed when the operator skips the waypoint.

Distance Waypoint Pass Criterion

Using this pass criterion, the waypoint is considered passed once the ship has reached an imaginary circle around the waypoint. See illustration to the right. The radius of the circle is configurable.

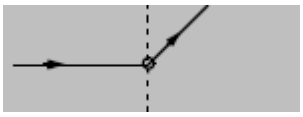
Bisector Line Waypoint Pass Criterion

Using this pass criterion, the waypoint is considered passed once the ship has reached an imaginary bisector line of the angle between current and next leg. See illustration to the right.



Perpendicular Line Waypoint Pass Criterion

Using this pass criterion, the waypoint is considered passed once the ship has reached an imaginary line perpendicular to current leg. See illustration to the right.



5 INSTALLATION

5.1 Equipment

The R5 Navigation System consists of the R5 SUPREME Control and Display Unit (CDU), a Navigation sensor, a Navigation sensor antenna and a number of accessories and optional additions.

Each delivery can be different depending on what options and accessories are ordered. Below is a list of the most common available parts.

Note: This is not a list of supplied parts, as contents may vary for each order depending on user needs

Name	**Part number**
R5 SUPREME CDU	7000 118-530
R5 Power Cable	7000 118-077
Navigation Sensor options R5 GNSS Navigation Sensor R5 DGNSS Navigation Sensor	 7000 118-770 7000 118-771
Navigation Sensor Antennas MGA-3 GNSS Antenna MGL-5 DGNSS Antenna (Combined GNSS / Beacon) A31 DGNSS Antenna (Combined GNSS / Beacon) A43	 7000 000-554 7000 000-555 7000 000-780 7000 000-651
R5 Ethernet Cable 5m IEC 60332-1, LSHF	7000 000-525
R5 CDU Flush mount frame	7000 118-367
5-Port Ethernet Switch Moxa EDS-205A	7000 000-526

Table 2 - R5 SUPREME Navigation System MkII and accessories

5.2 Equipment Installation Environment

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

Name	Part number	IEC 60945 installation category
R5 SUPREME CDU	7000 118-530	Protected
R5 GNSS Navigation Sensor	7000 118-770	Protected
R5 DGNSS Navigation Sensor	7000 118-771	Protected
MGA-3 GNSS Antenna	7000 000-554	Exposed
MGL-5 Combined GNSS / Beacon Antenna	7000 000-555	Exposed
A31	7000 000-780	Exposed
A43	7000 000-651	Exposed

5.3 Installation Cables

The following cables are used to install the standard R5 SUPREME Navigation System.

5.3.1 R5 Power Cable

Marking: 7000 118-077

Application: R5 CDU power port to R5 NAV Junction box or external power.

Type: Unshielded 4 wire cable x 1.3 mm2

Length: 2 m

Diameter: 6 mm

Minimum bending radius: 10 times cable diameter

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

Interconnection specification:

Pin	Cable Colour
1	Red
2	Black
3	*Brown*
4	*Orange*

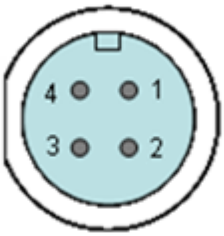


Table 3 – R5 Power Cable interconnection

5.3.2 R5 Navigation Sensor GNSS Antenna Cable

Type: See section 5.8.2

Length: See section 5.8.2

Connector: TNC (Male)

Minimum bending radius: 5 times cable diameter

5.3.3 R5 SUPREME Ethernet Cable

Type: Cat-7, LSZH-FR, IEC 60332-1

Length: 5 m

Diameter: 6,5 mm

Connector: RJ-45

Part number: 7000 000-525

5.3.4 External Cables

Power, alert relay and communication interface cables meant for connection to the screw terminals inside the R5 Navigation Sensor have a maximum diameter of 13mm, due to space limitations inside the box.

5.4 System interconnection overview

The R5 Navigation System can be set up in a number of different ways.

- As a standalone navigation system
  - One CDU unit, one sensor, one antenna
- As a Combined Navigation and AIS system
  - Same as above, plus a transponder with additional (D)GNSS and VHF antennas and an AIS junction box.
- As multiple redundant navigation systems
  - Several instances of the standalone navigation system connected to the same network, configured to synchronize navigation data.
- One system with extra Navigation displays in view only mode (Master-Slave Mode)
  - One instance of the standalone system, plus additional slave (view only) CDUs connected to the same network.

See Chapter 18 “Alternate System Setups” for system layouts and details of alternate setups.

5.4.1 Standalone R5 SUPREME Navigation System MkII

The R5 Navigation system is available in a GNSS- and DGNSS system configuration. Both the system configurations features the R5 CDU but have different requirements on the required R5 Navigation Sensor.

In the GNSS configuration is the systems requiring a R5 GNSS Navigation Sensor (7000 118-770) and in the DGNSS case a R5 DGNSS Navigation Sensor (7000 118-771). The difference between these two sensors is the beacon receiver included in the R5 DGNSS Navigation Sensor, which provides the unit with correction data and thereby improves its precision.

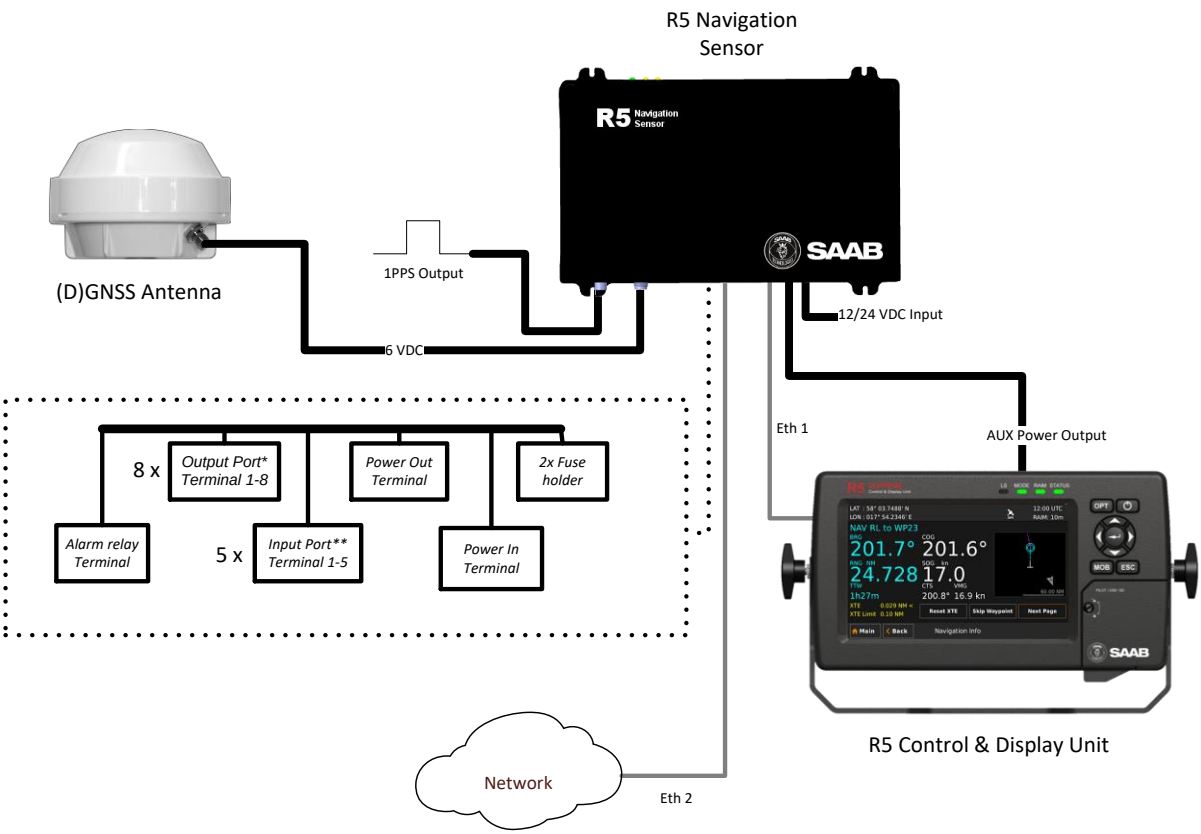


Figure 1 – Standalone setup, R5 SUPREME Navigation System MkII

5.5 Installation Procedure

When installing the R5 SUPREME Navigation System, it is recommended to follow the steps described in this manual. Details of the installation procedure can be found in the coming sections of the manual.

Recommended installation steps:

1) Mount the R5 SUPREME CDU at conning station
2) Mount the R5 Navigation Sensor
3) Mount the (D)GNSS antenna
4) For Standalone R5 Navigation System:
    a. Unmount the R5 Navigation Sensor lid
    b. Connect the R5 Navigation Sensor's Power Input to an external 24volts power source (Cable not supplied by Saab AB (publ) TransponderTech)
    c. Connect the R5 SUPREME CDU's R5 Power Cable to the R5 Navigation Sensor's CDU Power port
    d. Connect the R5 SUPREME CDU to the R5 Navigation Sensor by using a R5 Ethernet Cable
    e. Connect a (D)GNSS Antenna to the R5 Navigation Sensor by a (D)GNSS Antenna Cable
    f. Connect external systems via the internal serial (RS-422) in- and output terminals
    g. Match the cables to the suitable, T-shaped, strain relief on the unit's cover board and attach the cables with cable ties or equivalent.
    h. Connect Alert Relay signal to bridge alert (optional)
    i. Remount the R5 Navigation Sensor lid
5) For Redundant or Slave display configuration:
    a. Connect the CDU to a network, or directly to another CDU using the R5 Ethernet Cable or equivalent.
6) For Combined NAV and AIS configuration:
    a. Install the R5 Supreme Transponder as detailed in the R5 Supreme AIS System manual.
    b. Connect the CDU directly to the Transponder, or a common Ethernet network, using the R5 Ethernet Cable or equivalent.
7) Apply power to the system and allow the system to power up
8) Follow the CDU System setup, and select System mode corresponding to the current setup. Set network parameters if applicable.
9) Set configuration parameters.
10) For Combined AIS and NAV installation:
    a. See R5 Supreme AIS System manual for AIS configuration
11) Configure output sentences for external systems
12) Perform system functional check

5.6 Mount the R5 SUPREME Control and Display Unit (CDU)

The R5 Navigation Sensor's web-interface makes it easy to use/configure the navigation sensor without the R5 CDU as a black box unit. However, it should be taken into consideration that if the R5 Navigation system shall be integrated into a system applying BAM ("Bridge Alert Management") including CAM units, there are requirement of having redundant HMIs capable to interact with the R5 Sensor alerts.

This leads to the alternative of either use the R5 CDU as a redundant HMI to an installed CAM system or having two redundant CAM systems, to be compliant to the BAM requirements.

5.6.1 CDU Location

The R5 SUPREME CDU 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 SUPREME CDU, please consider the following:

- The temperature and humidity should be moderate and stable, +15ºC to +35ºC (Operating temperature: -15ºC to +55ºC.)
- Select a location away from excessive heat sources
- Avoid areas where there is a high flow of humid salt air
- Avoid places with high levels of vibrations and shocks
- Avoid mounting the R5 SUPREME CDU in direct sunlight. Prolonged exposure to direct sunlight may have adverse effects to the system.
- Ensure that there is enough airflow to avoid high ambient temperatures
- The units can affect magnetic compasses.
    - The minimum compass safe distance from the R5 SUPREME CDU is 0.75 meters to a standard magnetic compass and 0.50 meters to a steering magnetic compass.

5.6.2 R5 SUPREME CDU Mounting Options

The R5 SUPREME transponder and CDU are equipped with power and interface connectors designed to prevent water ingress.

However, the SD, USB and Pilot connectors under the CDU front hatch are protected by the hatch only; the connectors are NOT water proof.

It is therefore recommended to keep the CDU hatch closed when possible. The hatch has a locking mechanism designed to prevent unintentional opening. Depending on installation type it may be desired to keep this hatch locked.

It is recommended to install the system in an environment that is as protected from direct sunlight and water spray as possible. The R5 SUPREME CDU can be mounted in three different ways.

- Gimbal mount
- Panel mount
- Mounting frame panel mount – The CDU can be mounted in a frame that will cover a mounting hole from a previous R4 MKD flush mount installation.

5.6.2.1 CDU Gimbal Mount

The gimbal mount allows for a quick installation, and is suitable for panel as well as ceiling mounting. It will give the benefit of a tilt-able display and the possibility to mount and dismount CDU easily.

The gimbal mount is fastened with four screws in the mounting surface. The CDU is attached to the gimbal mount with two wing knobs.

5.6.2.2 Panel Mount

Panel mounting will reduce bridge clutter and reduce the space needed for installation. A cut-out fitting for the CDU profile must be made. See Chapter 21 for dimensions.

The CDU is fastened in place using the pin screw nut and washer nut from the mounting kit 7000 118-315, which are only delivered as a part of CDU package 7000 118-530.

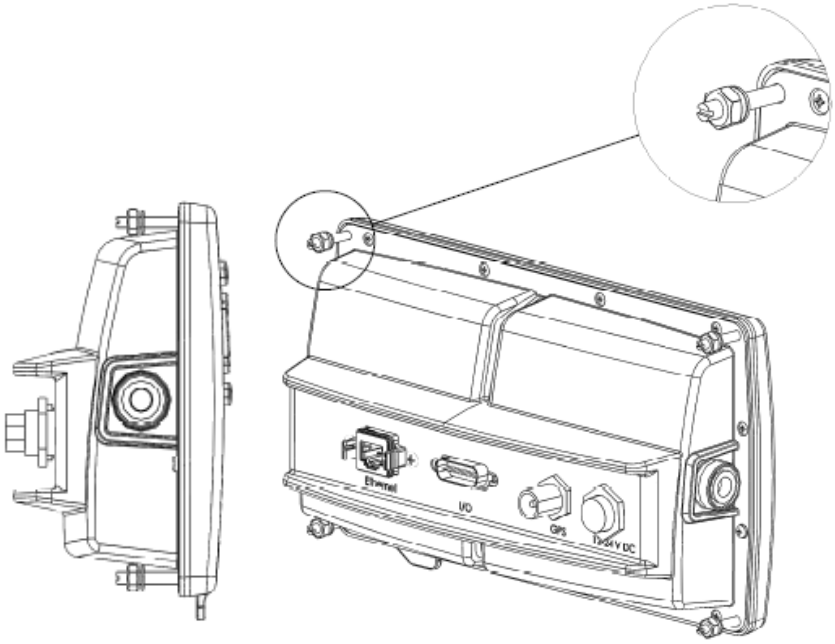


Figure 2 - R5 SUPREME CDU, Mounting mount screws

5.6.2.3 Mounting frame panel mount

The optional mounting frame, R5 CDU / R4 MKD Adapter Frame P/N: 7000 118-367, is ideal when upgrading from a panel mounted R4 Display, as it will cover the hole left by the R4 Display.

The CDU can be attached to the panel mount frame using the mounting screw kit 7000 118-315 included with the R5 CDU.

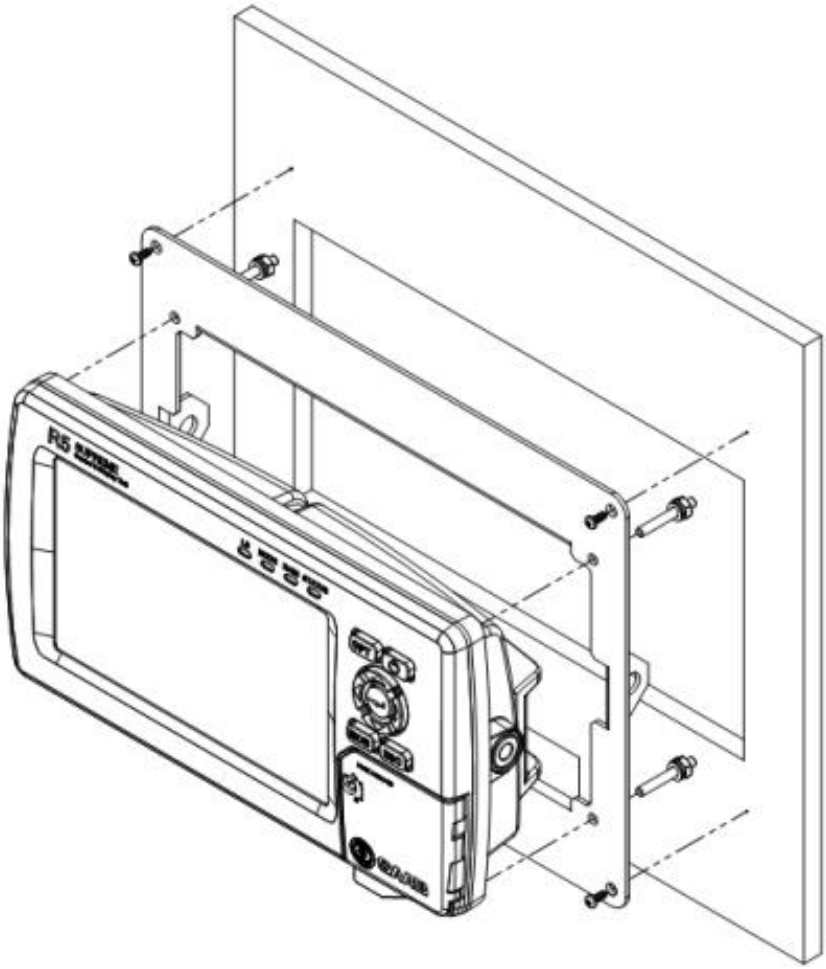


Figure 3 – R5 SUPREME CDU, Mounting frame panel mount

The cut-out dimensions may need to be increased somewhat compared to the R4 MKD cut-out, as the R5 CDU is slightly wider. See Section 21.3 CDU Mounting Frame cutout and dimensions.

5.6.3 R5 CDU clearance area

Leave a clearance around the R5 NAV Junction Box to facilitate service and installation. See below figure for recommended clearance area (measurements in mm).

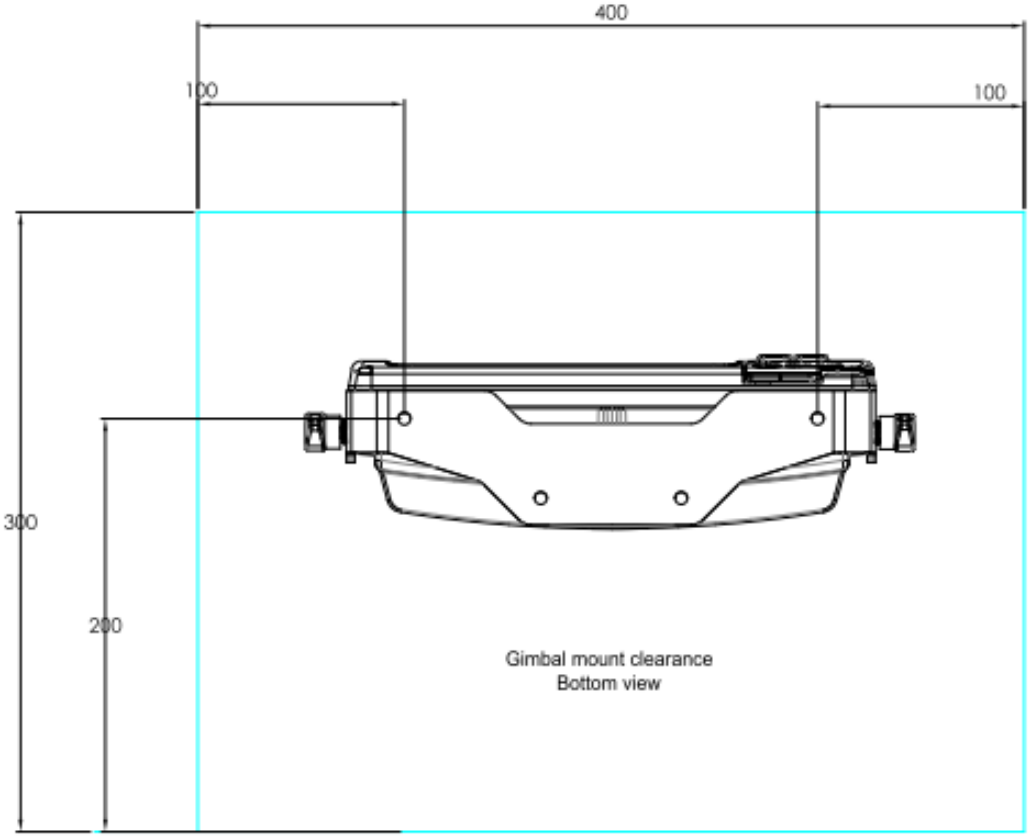


Figure 4 – CDU Gimbal mount clearance

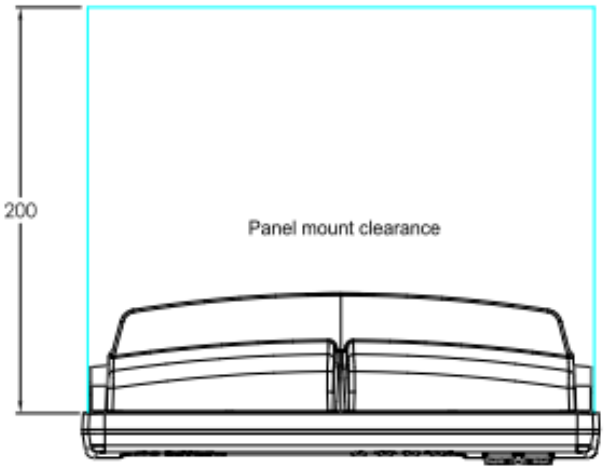


Figure 5 CDU Panel mount clearance

5.7 Mount the R5 Navigation Sensor

5.7.1 Sensor Location

The unit may be wall mounter or shelf mounted. When wall mounting, it is recommended to mount the unit with the LEDs facing up, and the cable opening downwards. This reduces the risk of water ingress.

When mounting the R5 Navigation Sensor, please consider the following:

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

5.7.2 Sensor Clearance Area

Leave a clearance around the R5 Navigation Sensor to facilitate service and installation. See recommended clearance area in figure below. Make sure the LEDs are visible on the front for easier system function verification. Minimum bending radius on the connected cables should also be observed as well (see section 5.3).

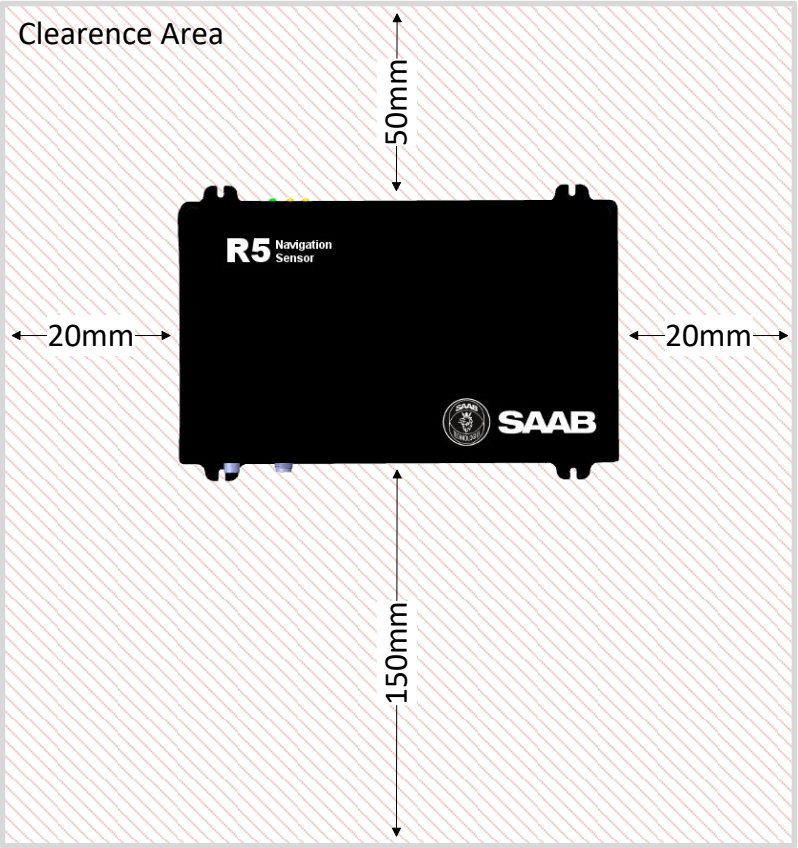


Figure 6 – Clearance Area for R5 Navigation Sensor

5.8 Mount the GNSS or DGNSS Navigation Antenna

The R5 Navigation Sensor shall be connected to the included antenna, which in the GNSS configuration is a MGA-3 GNSS antenna; in the DGNSS case a MGL-5 or A31 combined GNSS/Beacon antenna and for the DGNSS PRO an A43 antenna.

Attention should be paid to the location and installation of the different antennas on the ship in order to obtain the best possible signal reception. Installation of the Navigation Sensor's antenna is a crucial part of the system installation. How and where you install your antenna and cable will greatly affect its sensing efficiency.

Note: Observe that the antennas can work on different/multiple frequencies, for example 1575MHz for GPS and within the range 283.5kHz to 325kHz for Beacon.

5.8.1 Antenna Location

Mount the (D)GNSS antenna at a location with a clear, unobstructed view of the sky. For best beacon reception performance, mount the A31/MGL-5/A43 antenna so that the centre of the antenna is at least 8 cm (3 in) above any metal surface.

Local noise generated by your vessel or surroundings may affect your navigation system performance. To minimize this impact, you should locate the antenna outside the path of any radar beam, away from any transmitting antennas, and away from any other sources of interference such as motors, solenoids and other electronics. Failure to avoid high energy transmitting sources may result in permanent damage to the navigation system.

Do not, however, mount the antenna in the top of a mast or tower, as this may degrade the COG and SOG readings.

The MGA-3/MGL-5/A31/A43 all uses a 1-14-UNS thread for mounting. Mount the antenna on a standard US 1" 14 thread pipe or other standard antenna mount (not included).

Note: Antennas threaded onto a mount should be tightened only by hand. Do not tighten the antenna by turning on the antenna cover, instead hold the mounting shaft located at the bottom of the antenna and tighten by hand. Do not thread the pipe deeper than ¾ into the antenna. Do not use tools to install the antenna on the pipe as this may cause damage. Damage caused by over tightening is not covered by warranty.

Note: Once the system has been correctly mounted and connected, it is possible to monitor the R5 Navigation Sensor's performance via the graphical web interface or the R5 SUPREME CDU. This information can be used to locate the optimum placement of the antenna. This is further described in section 10.1.6.

5.8.2 Cabling

The maximum allowable cable loss is 18 dB for the MGA-3/MGL-5/A43 antennas. The maximum cable length depends on the attenuation of the cable and the chosen antenna.

Double shielded coaxial cable is recommended. The coaxial cable should be routed directly between the antenna and the R5 Navigation Sensor 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 any AIS VHF antenna cable. A separation of one meter or more is recommended to avoid interference due to RF-coupling. Crossing of antenna cables should be done at 90 degrees to minimize magnetic field coupling.

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

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

RG 225	0.3	10.9	23.3

Table 4 – GNSS Antenna Cables

For optimum performance of the R5 Navigation Sensor, 10 dB should remain after subtraction of cable loss from the antenna pre-amplifier gain. Thus, a maximum of 20 dB signal loss is allowed in the antenna cable, when using the 30 dB gain MGA-3 GNSS, MGL-5 or A31 Combined GNSS/Beacon and the A43 antenna. Given this criteria, the following recommended cable maximum lengths have then been calculated.

Recommended maximum cable length using standard antenna

Cable Type	Max length with MGA-3, MGL-5, A31 or A43
RG 58	22 m
RG 400	33 m
RG 223	33 m
RG 214	57 m
RG 225	66 m

Table 5 – Recommended Maximum GNSS Cable Length

Maximum cable length is calculated as:

Maximum cable length = allowed total loss / cable attenuation per meter

5.8.3 Cable Mounting

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

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

All outdoor installed connectors should be 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.

5.8.4 Grounding

The MGA-3, MGL-5, A31 and A43 antennas do not require any antenna ground connection.

5.9 Electrical Installation

5.9.1 Power Supply

The R5 SUPREME CDU and the R5 Navigation Sensor can be connected to an emergency power source. If connected to an emergency battery, a re-calculation must be made for the battery capacity. For power consumption, see chapter 19 “Technical Specifications”.

The R5 Navigation Sensor is designed to operate on 12-24 VDC. The nominal power consumed is up to 5.7 W. The R5 Navigation Sensor is internally fused (slow blow fuse) by a 2A fuse.

The R5 SUPREME CDU is designed to operate on 12-24 VDC. The nominal power consumed is up to 13 W. The R5 SUPREME CDU shall be fused by a 5A fuse.

The R5 Navigation Sensor has an internal 5A slow blow fuse used for optional powering of the R5 CDU directly from the sensor. The CDU must be externally fused if powered from any other source.

5.9.2 Sensor Interface ports

Below ports can be accessed in the R5 Navigation Sensor.

See Chapter 20 for electrical details.

5.9.2.1 Input Serial Ports

The sensor has five unidirectional ports. These ports can be used to connect to external sensors such as compass, gyro or depth sensors. This either for collecting heading data or for forwarding data on to the network.

The R5 Navigation Sensor's serial port supports IEC 61162-450 SNGF functionality (see 14.3) and can thereby forwarding data to the network. The serial port will identify them self by using a System Function Identity (SFI), which are dependent on how the R5 Navigations Sensors SFI configuration is set (see 10.1.20). The serial ports will always have the structure "SI YYYX" there "YYY" is the three first digits in the Sensors own SFI and "X" the number of the input port.

To receive data on a port, its RX signals shall be connected to the TX signals of an external equipment.

It is up to the user to configure the types of messages that shall be received on each port, as well as the baud rate used for communication.

See section 10.1.18 and 10.1.26 for information about the configurations mentioned above.

These ports are also configurable to detect a discrete alert acknowledgement, making it possible to acknowledge all active alerts at once using an external switch.

5.9.2.2 Output Serial Ports

The sensor has eight unidirectional ports that can be used to forward, addressed data, from the network or output internally generated data from the R5 Navigation Sensor to external equipment.

To forward data out on the serial port from the network the messages needs to be addressed to the serial ports SFIs which characteristics are described, above, in section 5.9.2.1.

The TX signals of the port shall be connected to the RX signals of the external equipment.

It is up to the user to configure the types of messages that shall be sent on each port, as well as the baud rate used for communication.

See section 10.1.27 for information about the configurations mentioned above.

Note: Combine one input and one output terminal for bidirectional communication

5.9.2.3 Alert Relay Port

The Alert Relay port is used to indicate navigational alerts to external alert signalling and alert monitoring systems.

The alert relay will be active as long as there are no alert which not received acknowledged and by that linking Normally Open/Common on the Alert Relay screw terminal. The relay will, when an alert (unacknowledged) gets active, be deactivated and thereby switch link state from Normally Open/Common, to Normally Closed/Common.

Note: Connection to the Alert Relay terminal depends of the alert systems functionality. A straight audible- or visual indication shall be connected to the Common and Normally Closed terminal pins.

5.9.2.4 1 PPS

Digital signal interface outputting a 5V pulse every second, when the sensor having “GNSS Fix”.

See section 20.2.5.1 for more information.

5.9.3 R5 CDU Interface ports

In R5 SUPREME Navigation System MkII, standalone configuration, the system uses mainly communication by the Ethernet interface (RJ-45 100 MBit – IEC 61162-450).

Besides that, the R5 CDU has a pilot port, user port 3, user port 4 and an I/O interface used in other system setups and configurations.

See 20.1.3 for more details.

User port 3 and 4 in the CDU does not support the IEC 61162-450 SNGF functionality but will forward data, received over the network, that are configured in the CDU together with internally generated alert messages.

Input on the user port 3 and 4 are restricted only allowing sensor input depth, WPT/RTE and alert commands with sentences as ACK/ACN.

The serial port will identify them self by using a System Function Identity (SFI), which are dependent on how the R5 Navigations Sensors SFI configuration is set (see 10.1.20). The serial ports will always have the structure “SI YYYX” there “YYY” is the three first digits in the Sensors own SFI and “X” is 0 for User Port 3 and 9 for User Port 4.

6 SYSTEM OVERVIEW

This chapter describes how to use and interpret the system's units as well as operate and navigate through the system menus.

6.1 Buttons and LEDs on R5 SUPREME CDU

Figure 7 – LEDs and Buttons on CDU

1. ***Status LED (multi-colour)***

This LED is constant green when the R5 Navigation System is operating and no alerts are active. The LED is constant red if there are one or more active alerts and it is flashing red if there are one or more unacknowledged alerts.

2. ***RAIM LED (multi-colour)***

This LED shows the current RAIM status of the R5 Navigation System.

Green = "Safe" state (Estimated position error smaller than RAIM level)

Yellow = "Caution" state (Position error is unknown)

Red = "Unsafe" state (Estimated position error is larger than RAIM level)

3. ***Mode LED (multi-colour)***

This LED is not used in the R5 Navigation System

4. ***LS***

Not used in this product

5. ***Arrow Keypad and ENTER***

The easiest way to navigate in menus, lists and edit fields in the R5 SUPREME CDU is by using the touch interface. However, the arrow keypad and *ENTER* button can also be used to control the R5 SUPREME CDU in e.g. rough seas. The arrow keypad (**< >** and **∧ ∨**) is used to navigate in menus, lists and edit fields. The centre button of the keypad is an *ENTER* button which is used to select the highlighted choice in a menu, list or edit control.

6. ***PWR***

The power button on the R5 SUPREME CDU is used to turn off the display and can also be used to quickly change the settings for backlight of LCD, buttons and LED's. A quick press of the *PWR* button will turn off all backlight but the R5 SUPREME CDU will still be running. If there is an active, unacknowledged alert in the system, the STATUS LED will still be blinking red. Otherwise all LEDs will be turned off.

If the *PWR* button is pressed for more than two seconds, a "Power Down Menu" will appear. Here it is possible to power off the R5 SUPREME CDU completely or to quickly change the Backlight Mode (see section 0 for information about Display Backlight Modes).

7. ***OPT***

This button is an "Option key" which is only active in some of the views. When pressed, it gives the user a list of options that can be performed on the highlighted item. In screens with parameters, the *OPT* button can be used to set the parameter to default value.

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

8. ***MOB***

Used to mark the spot of an event or when a person has fallen overboard. To mark an event, press the key momentarily. To activate the *Man Over Board (MOB)* function, press the key for at least 5 seconds.

9. ***ESC***

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

6.2 LEDs on R5 Navigation Sensor

The R5 Navigation Sensor has three LEDs that indicate its status.

Figure 8 – LEDs on R5 Navigation Sensor

1. Status LED (Multi-colour)

The *Status LED* is multi-coloured; it will either be red or green. When this LED is continuously lit green the system has position and no active alerts. If the LED is continuously lit red the system has active alerts that has been acknowledged. If an alert has not been acknowledged the status LED will instead be flashing red.

2. GNSS LED

The yellow *GNSS LED* indicates when continuously lit that the Sensor has obtained a solid GNSS lock and is able to provide position data.

3. DGNSS LED

The yellow *DGNSS LED* indicates when continuously lit that the Sensor has achieved a solid SBAS or radio beacon lock with marginal data error rate.

6.3 Change Settings of a Parameter

Several of the views in the R5 SUPREME CDU contain parameters that can be edited. To edit a parameter, click on it using the touch interface. A virtual keyboard will appear where it is possible to enter data. Click on the enter button of the virtual keyboard when the data input is done. To save all the changes made in the current view, press the Save button in the lower right corner of the screen.

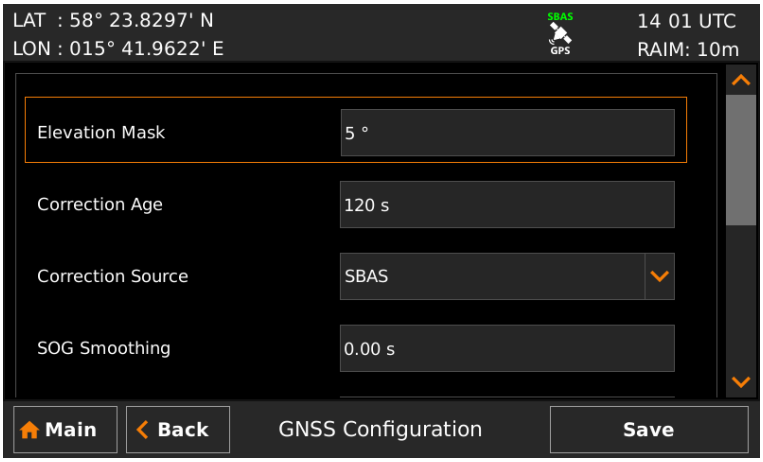


Figure 9 – Example of a Config View

It is also possible to use buttons on the front of the R5 SUPREME CDU to select and change a parameter. Use the *Arrow Keypad* to select a parameter, currently selected parameter will be marked with an orange rectangle (See figure above). Press *ENTER* to popup the virtual keyboard. Use the *Arrow Keypad* to highlight the desired character and press *ENTER* to select it. Navigate to enter button of the virtual keyboard and press *ENTER* when done.

Figure 10 – Example of Virtual Keyboards

6.4 System Views - Overview

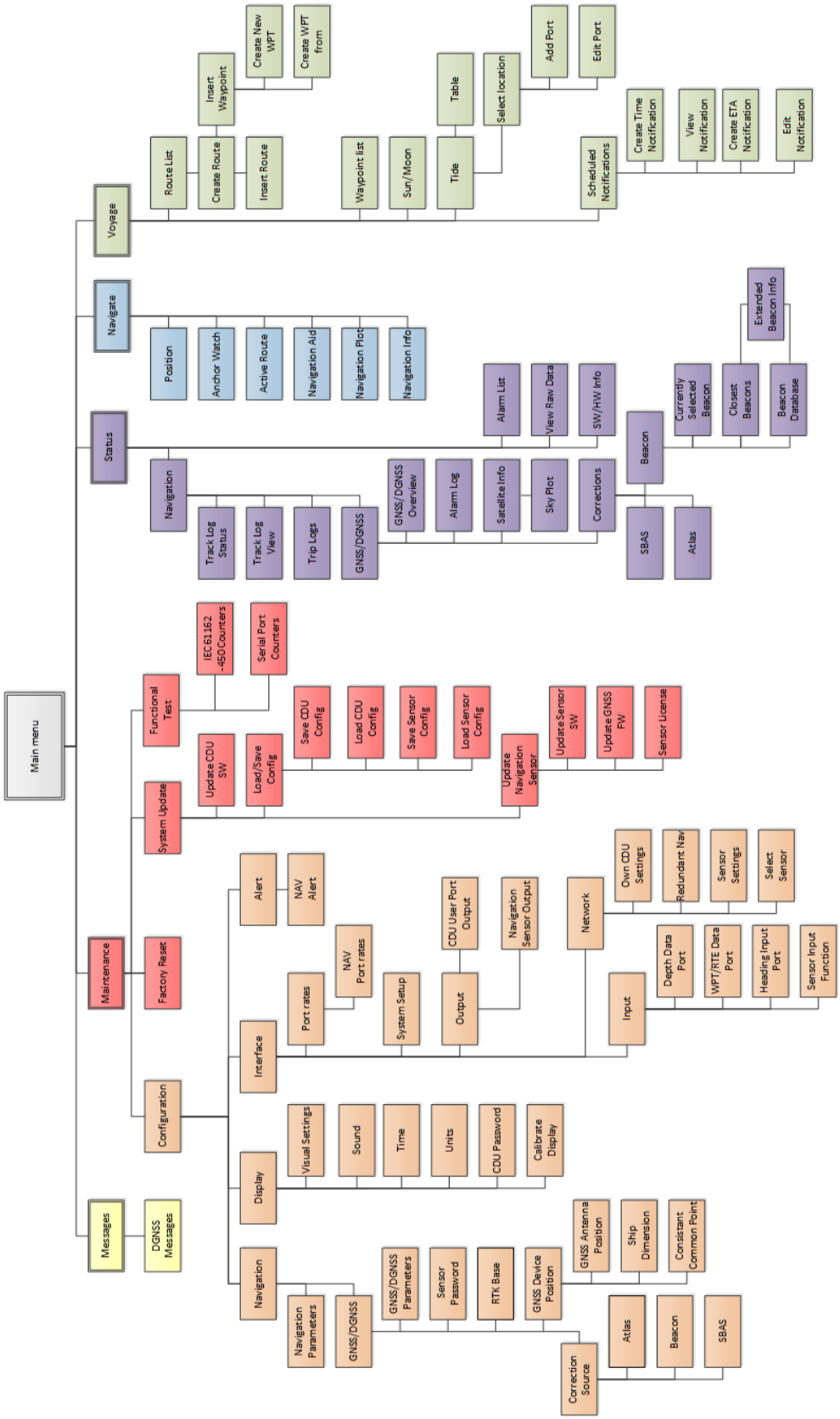


Figure 11 – R5 SUPREME Navigation System MkII, Tree View

The system tree view in Figure 11 shows all views that can be accessed by the “Control & Display Unit”. In the figure the views are divided into groups:

- Voyage, described in Section 8.2
- Navigate, described in Section 8.1
- Status, described in Section 8.3
- Configuration, described in Chapter 10
- Maintenance, described in Chapter 12
- Messages, described in Section 8.4

Note: All views are not possible to access without correct licenses or system settings.

6.5 Navigating in Menus

To navigate in the R5 SUPREME CDU menus, simply press the menu button corresponding to the desired view using the touch interface, or use the *ARROW KEYPAD* buttons **< >** and **∧ ∨** to navigate between the view buttons. The currently selected button will be marked with an orange outline and orange text. Press the *ENTER* button to enter the currently selected view. In the lower left corner of a view there is also a Back button to quickly go back to previous view and a Main button to go directly to the *Main Menu* view.

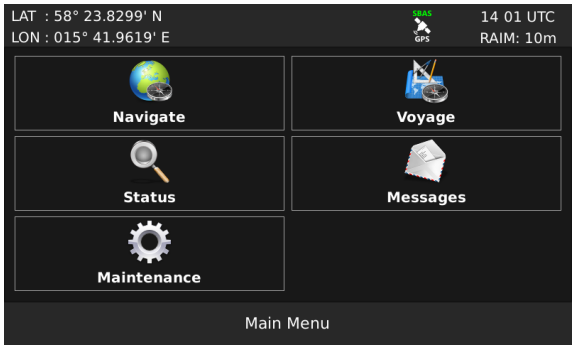


Figure 12 – Main Menu

Figure 13 – Navigate Menu

6.6 Status Bar

The top of the screen on the R5 SUPREME CDU always displays a summary of the system's status.

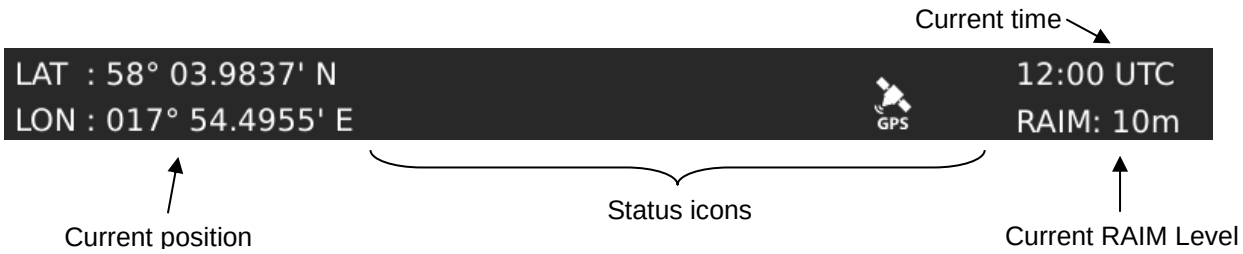


Figure 14 – Status Bar

The left part of the status bar can either show the current position in latitude and longitude, or the name of the next waypoint in the currently active route. This is configurable with the "Status Information" parameter described in section 10.1.1. The status icons are displayed in the middle of the status bar and on the right the current time and currently used RAIM level is displayed. The time is either UTC or local (LOC) depending on the time configuration parameters described in section 10.1.13.

Note: The only time the R5 SUPREME Navigation MkII system does not have, UTC synchronization, is when the unit has been rebooted/power cycled and not received any GNSS/GPS signals.

6.6.1 Status Icons

The status icons that can be shown in the R5 Navigation System

GNSS/DGNSS Mode Icons

Operating in GPS mode

Operating in GNSS mode

Navigating without differential corrections.

Using differential correction applied through Input Port 1 to 5.

Using differential correction applied through Input Port 1 to 5, Integrity Alert.

Using correction from internal radio beacon receiver (DGNSS version)

Using correction from internal radio beacon receiver (DGNSS version), Integrity Alert

Using differential corrections received from SBAS.

Using differential corrections received from SBAS, Integrity Alert.

Using differential corrections received from Atlas (PRO Subscription)

Using differential corrections received from Atlas (PRO Subscription), Integrity Alert.

No valid position information.

No communication with the Navigation Sensor.

HDOP status indication (active if HDOP is above 4).

Navigation Sensor configured to allow differential corrections but not receiving any valid correction signals.

Alert Icons

- Active unacknowledged alarm (Flashing)
- Active silenced alarm (Flashing)
- Active acknowledged alarm
- Active unacknowledged warning (Flashing)
- Active silenced warning (Flashing)
- Active acknowledged warning
- Active caution
- Active unacknowledged notification
- Active acknowledged notification

DGNSS Message Icon

- Unread DGNSS message

Synchronization status icon (Master/Slave Setups)

- CDU units are in sync.
- CDU units are synchronizing databases.
- CDU units are NOT in sync
- Lost connection to other units.
- The CDU is a slave display that is in sync with master.
- The CDU is a slave display that is synchronizing databases with master.
- The CDU is a slave display that is NOT in sync with master.
- The CDU is a slave display that has lost connection to master.

6.6.2 RAIM Accuracy Level

The RAIM accuracy level specifies (in meters) the desired position accuracy used to calculate current RAIM status. RAIM is an integrity monitoring scheme that evaluates the quality of position data and compares it to the specified accuracy level.

The RAIM LED on the front of the R5 SUPREME CDU will show the RAIM status. A green RAIM LED indicates safe state; the calculated position accuracy is better than the set accuracy level. A yellow RAIM LED indicates caution state; the system is unable to safely determine if the position accuracy is better or worse than the set accuracy level. The red RAIM LED indicates unsafe state; the calculated position accuracy is worse than the set accuracy level.

The used RAIM accuracy level is the latest specified accuracy level, either specified manually or by a leg setting in the active route.

6.7 Alerts

If the R5 Navigation Mk II system detects a malfunction or operational issue, an alert will be raised, indicated by an alert icon in the status bar (see section 6.6) and possibly audible signals.

The significance of an alert is presented with their different priority levels, some requiring immediate attention and an acknowledgement, some not.

To acknowledge alerts requiring acknowledgement or just see an overall view of all raised alerts, the user need to navigate to the "*Alert List*" view and if necessary preform actions by follow the instructions in section 8.3.12.

Note: For more detailed information about alert types and they affect the system, see section 8.4

7 START UP

When the physical and electrical installation of the system is complete, the R5 SUPREME Navigation System needs to be configured. This chapter describes what the installer is required to do before the R5 SUPREME Navigation System is ready to operate.

7.1 Configuration Wizard

The first time the R5 SUPREME CDU is started, a configuration wizard will be shown. This wizard is a helpful guide to configure the basic functionality of the R5 SUPREME System. The following sections describe the different steps in the configuration wizard.

Note: If any step of the "Wizard" not properly configured or the "Wizard" ended in a too early state, the system can malfunctioning.

For example, if the "SFI" not changed from default-value (9999) the sensor keeps all serial-ports disabled. If this already accidently been performed, the issue can be fixed by follow the instruction in Section 10.1.19 and 10.1.20 and configure the network parameters properly.

7.1.1 System Setup

The R5 SUPREME CDU can be used in a standalone AIS system, standalone Navigation system, Combined AIS and Navigation system or be used as a slave display to an existing R5 Navigation System. The Navigation system can be configured into two different types, either GNSS or DGNSS, and is compatible with both the R5- and the R4 Navigation sensor. It is up to the user to specify which equipment is connected to the R5 SUPREME CDU.

Note: Check which type of sensor you have before selecting system type!

Navigation System (DGNSS) requires either R4 DGNSS Navigation Sensor (7000 109-180) or R5 DGNSS Navigation Sensor (7000 118-771)

Navigation System (GNSS) requires either R4 GNSS Navigation Sensor (7000 109-181) or R5 GNSS Navigation Sensor (7000 118-770)

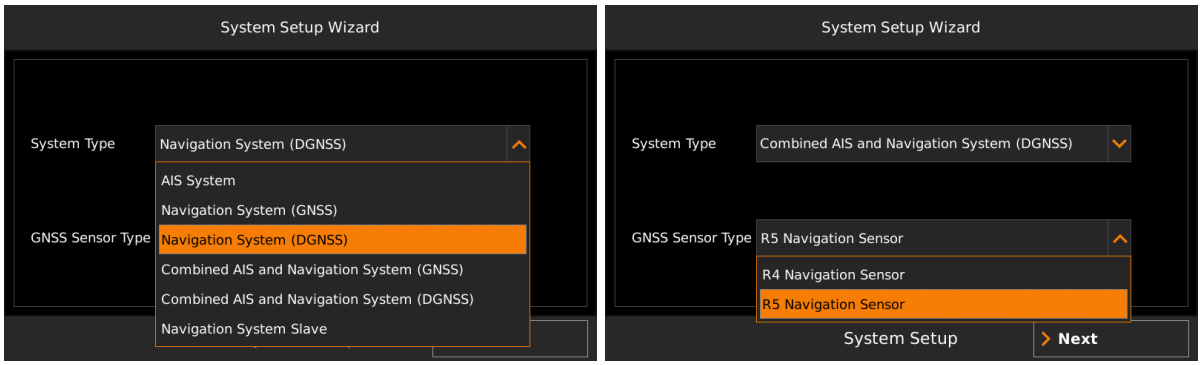


Figure 15 – System Setup

7.1.2 Network Configuration

The R5 SUPREME CDU uses network (Ethernet) to communicate with the R5 Navigation Sensor as well as other R5 SUPREME CDU units in multi-display or redundant configurations. It is therefore necessary to configure the IP numbers and a Light Weight Ethernet network IDs for both the R5 SUPREME CDU and the R5 Navigation Sensor. The SFI consists of two letters (always “SN” for the R5 SUPREME CDU and “GN” for the R5 Navigation Sensor) and four digits. The SFI must be unique for all equipment connected to the network.

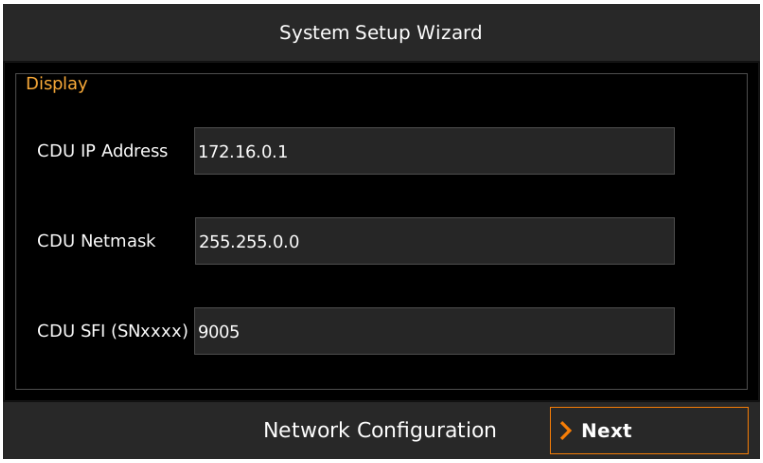


Figure 16 - Network Configuration

Note: Make sure the R5 Navigation Sensor target is properly connected to the R5 SUPREME CDU, either by Network or direct interconnection. If so, it shall appear as a target in the Select Navigation Sensor list. Otherwise control that the R5 Navigation Sensor is powered and double check the connection. Press the button “Refresh List”, to search for R5 Navigation Sensor units on the network.

Also remember to re-configure the “SFI” parameters from the systems default-value (9999), otherwise the system will not allow continuation.

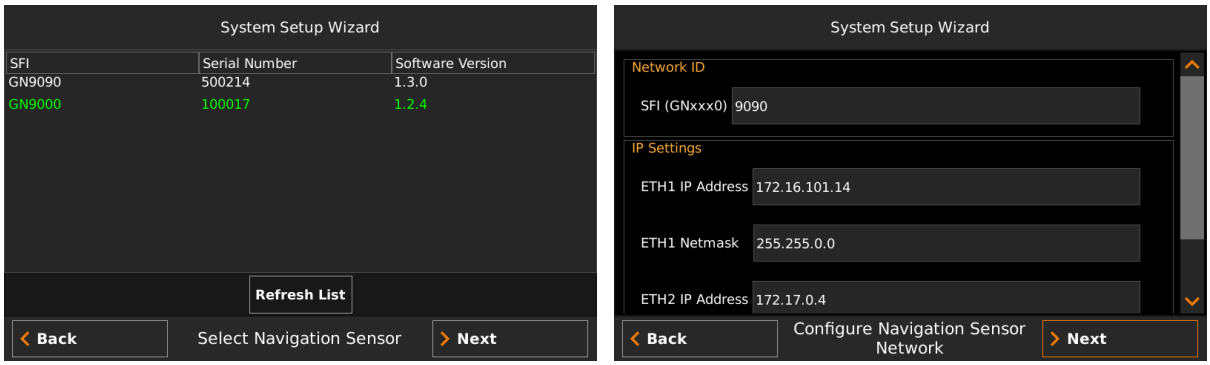


Figure 17 – Select Navigation Sensor/ Configure Navigation Sensor Network

7.1.3 Select CDU Master (Slave Mode Only)

If the R5 SUPREME CDU is configured to be used as a slave display to an existing R5 SUPREME Navigation system, the master CDU must be selected on the network in order to receive GNSS data and synchronize waypoints, routes and configurations.

Make sure that the master R5 SUPREME Navigation System is powered on and is connected to the network. On the slave display, press the button “Refresh List” in the *Select CDU Master* view to search for R5 SUPREME CDU units on the network. Select the R5 SUPREME CDU that shall provide GNSS data to the slave unit and press “Next”.

Note: The master R5 SUPREME CDU must also be configured to provide GNSS data on the network and the slave unit must be selected in the master R5 SUPREME CDU’s Redundant Nav view in order to synchronize the databases between slave and master unit. For a more detailed description how to connect and configure multi display and redundant systems, see chapter 11.

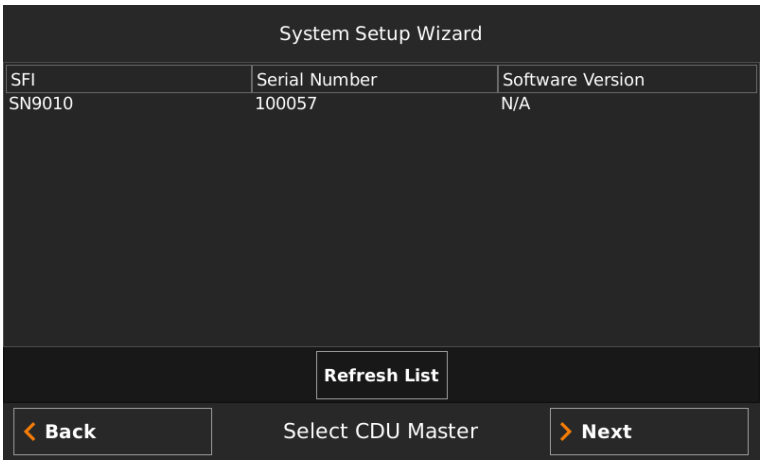


Figure 18 – Select CDU Master

7.1.4 Connection View

This view is shown while the R5 SUPREME CDU connects to external equipment and initializes the system. When the initialization is complete the R5 SUPREME CDU will automatically switch to the *Position* view when configured as a Navigation System.

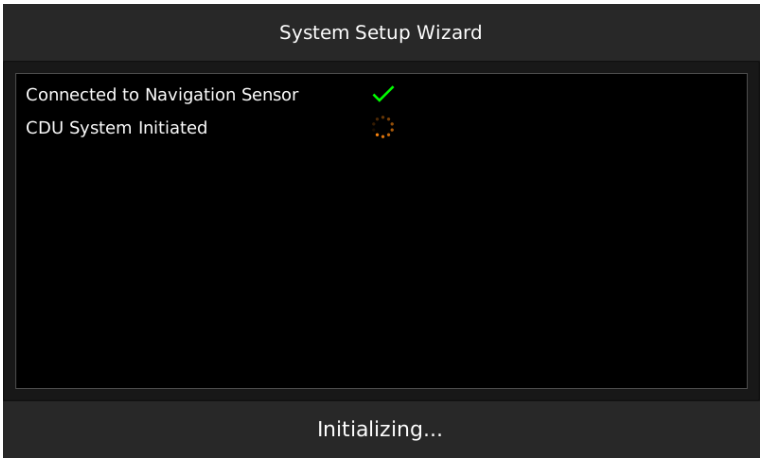


Figure 19 – Connection View

8 OPERATION FUNCTIONALITIES

8.1 Navigate Menu

The Navigate menu contains a set of views related to typical ship navigation tasks during normal voyage operation.

Figure 20 – Navigate Menu

8.1.1 Show Current Position

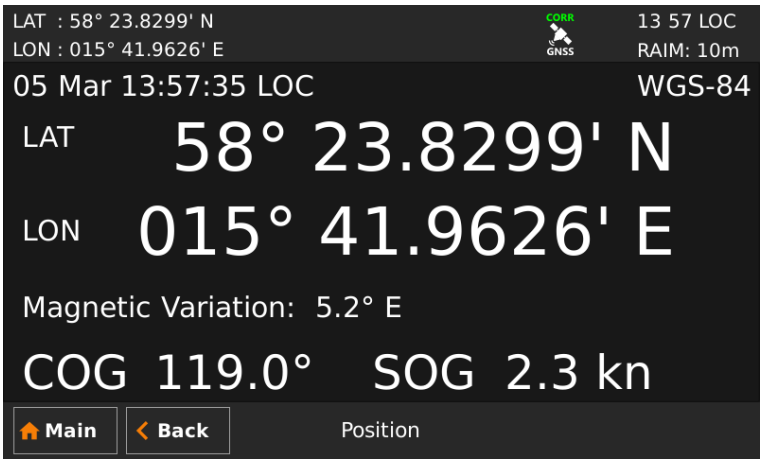


Figure 21 – Position View

The R5 SUPREME Navigation System will power up in the *Position* view. The *Position* view shows current position, speed over ground (SOG) and course over ground (COG) as reported by the Navigation Sensor. The position is represented by latitude and longitude. Current date and time, in UTC or local time, is also displayed.

If the navigation system is not able to calculate new position information, the latest valid information is shown in conjunction with the time when it was calculated. The red satellite icon in the status bar will indicate that no new position information is available. See section 6.6.1 “Status Icons” for further details on the icons.

This view also gives the user the possibility to enlarge COG/SOG/Position data, by a touch on the data, to enable greater visibility from a distance.

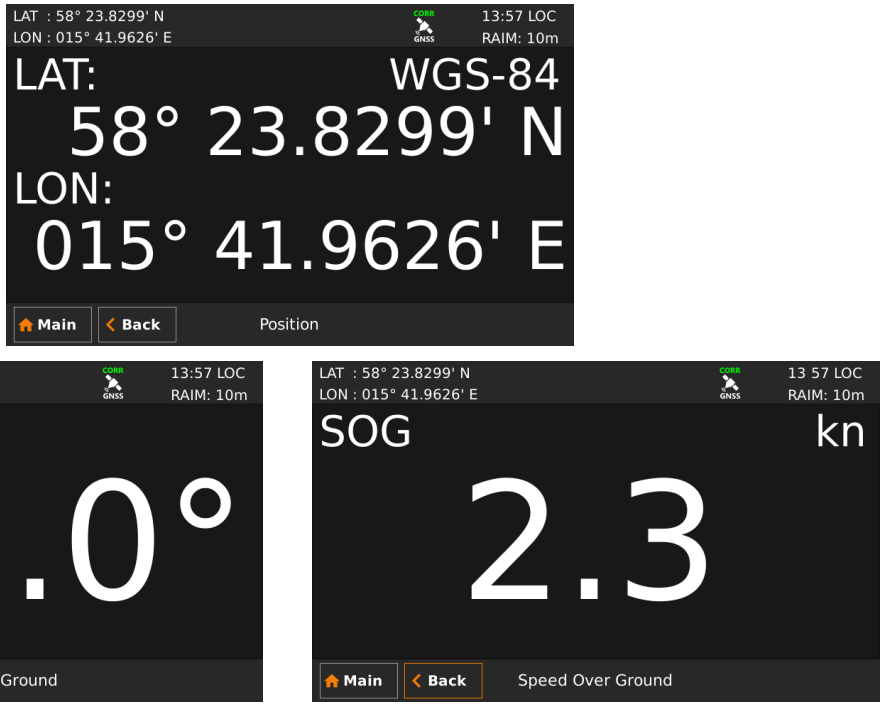


Figure 22 - Enlargement of data from the Positon View

Note: COG is based on track angle which requires that the ship is moving. Thus, COG data is not displayed when the SOG value is below 0.3 knots.

8.1.2 Anchor Watch

The *Anchor Watch* view provides functionality for activation of an alert when the displacement from a reference position exceeds a certain limit. The view is accessed from **Main Menu → Navigate → Anchor Watch**. In order for an external or audible anchor watch alert to be generated, the anchor watch alert must be enabled in the *Alert Config* view accessed from **Main Menu → Maintenance → Configuration → Alert**.

When entering the *Anchor Watch* view, the following will be displayed:

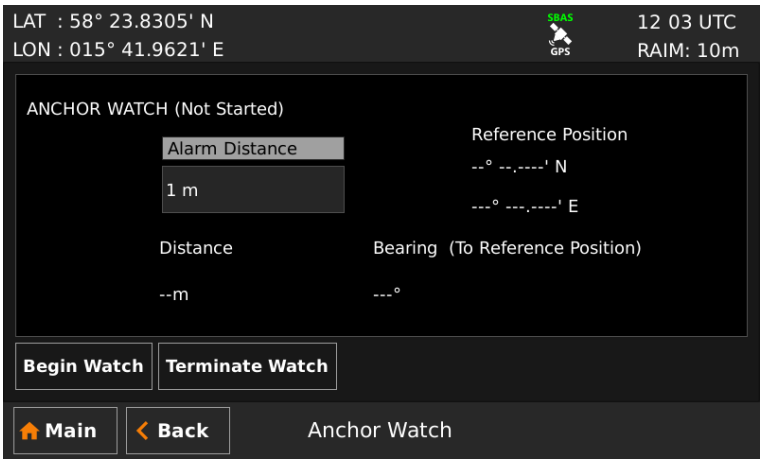


Figure 23 – Anchor Watch

8.1.2.1 Set Anchor Watch Alert Distance

To set the alert distance, click on the alert distance edit field (marked with an orange square in the picture above). A virtual numpad will appear where it is possible to set the new value for the anchor alert distance. Press on the enter button of the virtual numpad when done. The alert distance must be within 1 to 1500 meters. The unit used for definition of the anchor watch alert limit as well as for display of the current range to the reference position is configurable, as described in section 10.1.14 “Units”.

Figure 24 – Input of Anchor Watch Alert Distance

8.1.2.2 Activate Anchor Watch

Press the ”Begin Watch” button to activate the anchor watch function. The current position will be captured as the reference position. The distance to the reference position will be calculated and compared to the configured alert distance on a regular basis. The bearing and range from current position to reference position is displayed and illustrated below.

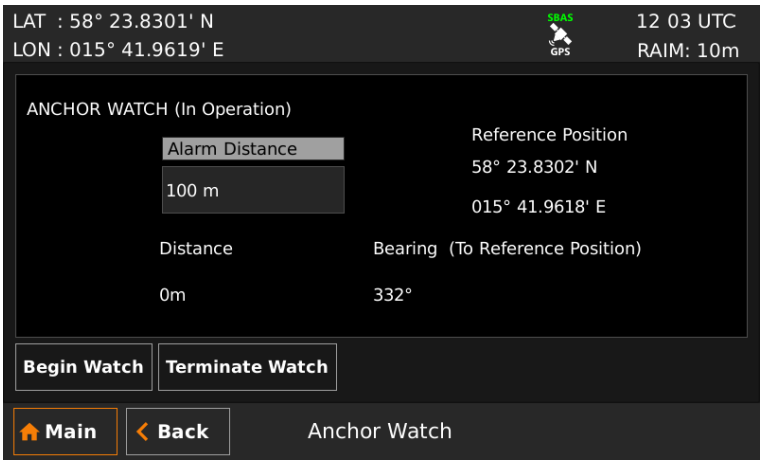


Figure 25 – Anchor Watch Activated

If the calculated range exceeds the alert distance, the anchor watch alert will be activated if configured to enabled in the *Alert Config* view. If the range subsequently falls below the configured alert distance, the anchor watch alert condition will be deactivated. It will re-activate any time the range exceeds the limit again.

8.1.3 Active Route

The *Active Route* view shows information on the active route, including route name, route length, number of total and remaining waypoints, ETA and details of the remaining waypoints.

From this view it is possible to access the *Edit Active Route*, *Set Target ETA* and *Set Next WPT* sub views. The *Edit Active Route* sub view can be used to modify legs and waypoints of the active route. The *Set Target ETA* view can be used to set a target for Estimated Time of Arrival. The *Set Next WPT* view can be used to change the waypoint in the active route that currently is being navigated towards. The latter is useful to quickly skip to a certain position in the active route or undo passage of previously passed waypoint.

The *Active Route* view is illustrated below. When entering the view, the list shows bearing and distance to the remaining waypoints in the active route.

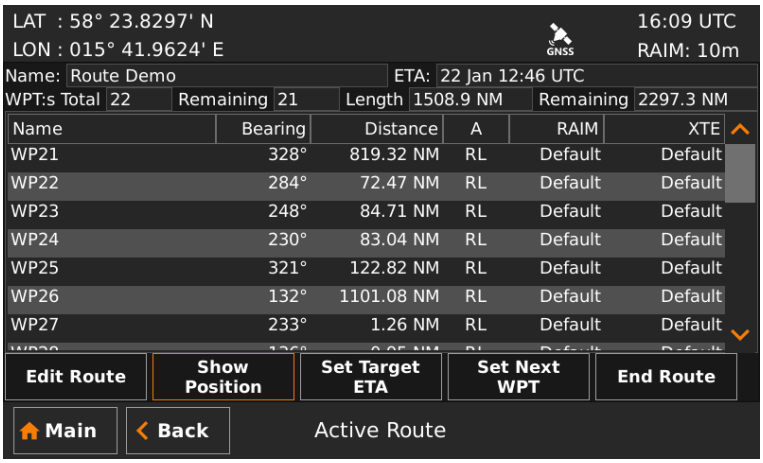


Figure 26 – Active Route (Bearing and Distance)

Press the button *"Show Position"* to show Latitude and Longitude for each waypoint.

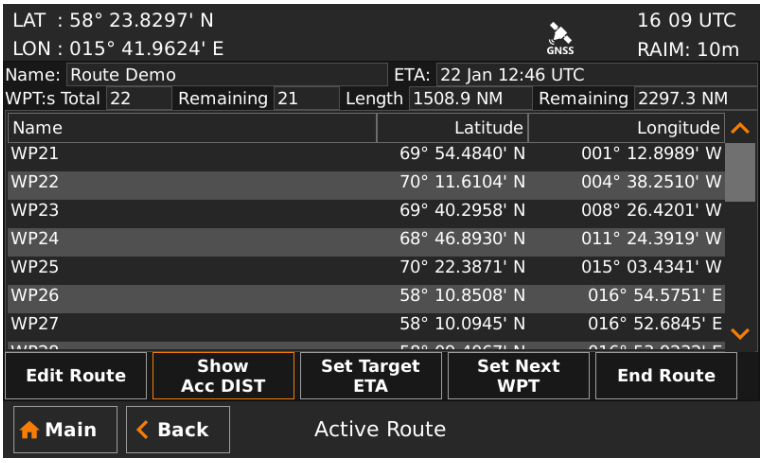


Figure 27 – Active Route (Position)

Press "*Show Acc. Dist.*" to show the accumulated distance along the route to each waypoint.

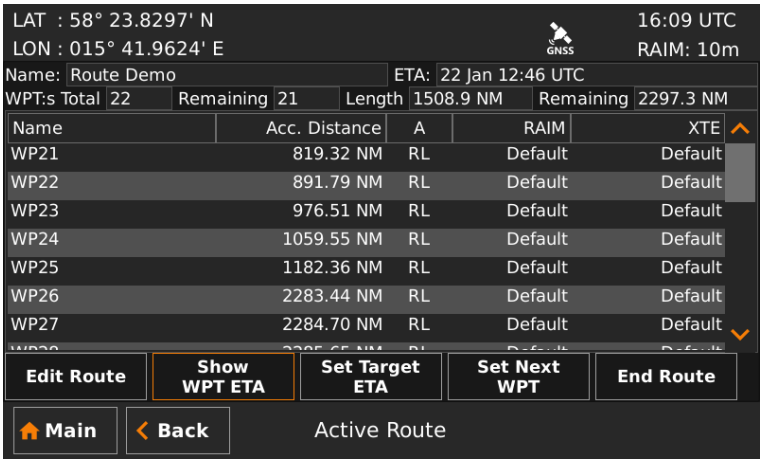


Figure 28 – Active Route (Accumulated Distance)

Press *"Show WPT ETA"* to show the estimated time of arrival to each waypoint in the route.

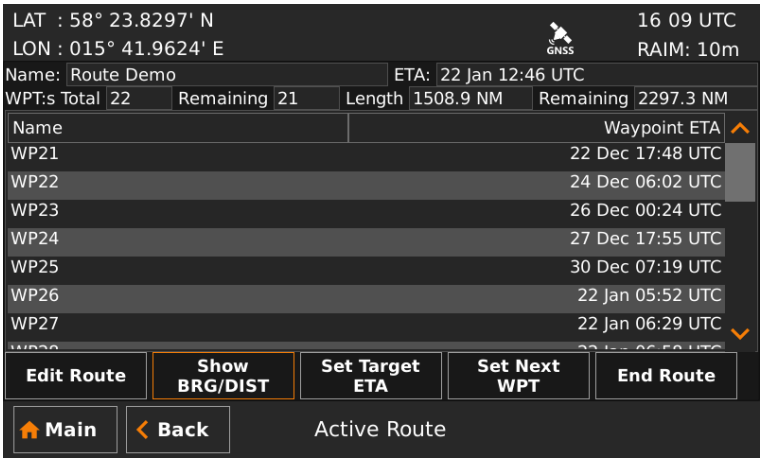


Figure 29 – Active Route (WPT ETA)

Press *"Show BRG/DIST"* to show the initial view again.

8.1.3.1 Edit Active Route

Press *"Edit Route"* to enter the *Edit Active Route* view. This view is used to modify the active route. It displays all waypoints and legs in the active route, regardless if they are passed or not and including waypoints created when resetting cross-track distance in the *Navigation Info* view. It is possible to modify navigation algorithm, cross-track distance limit and RAIM setting for each leg, as well as remove, modify and insert waypoints. When entered, the view displays all the waypoints of the route, as illustrated below.

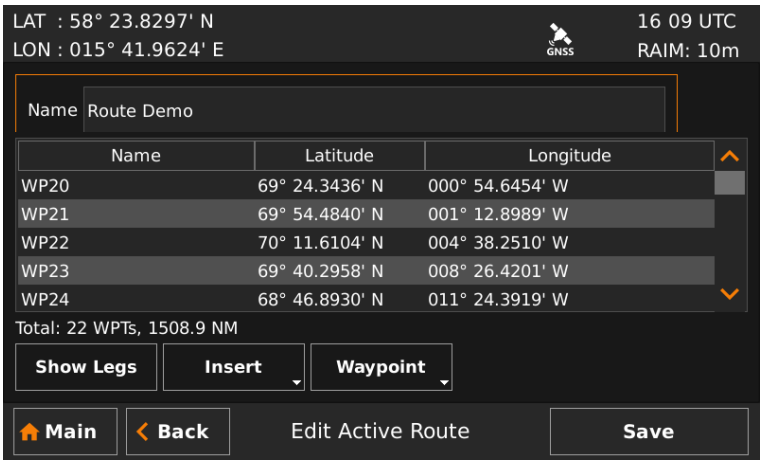


Figure 30 – Edit Active Route

When saving the active route, a popup will appear where it is possible to choose if a change made to the active route should leave the original route unaffected or if the changes should be saved in the route database as well. Press “Yes” to affect both active route and the route in the database. Press “No” to only affect the active route.

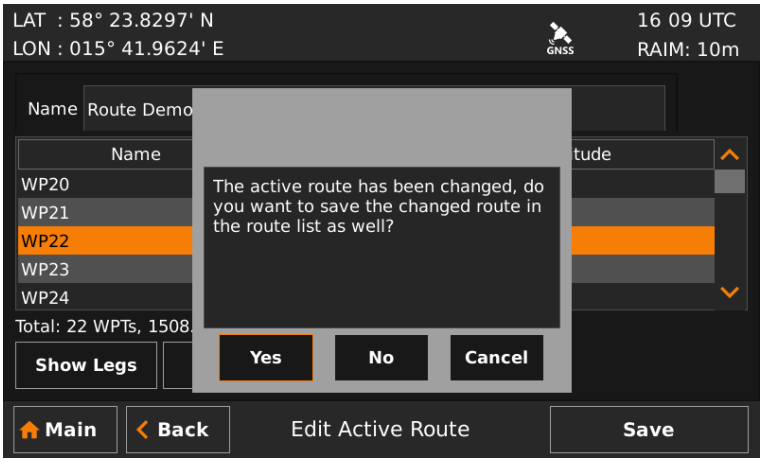


Figure 31 – Save changes in Edit Active Route

Note: Waypoints named “Reset XTD ...” have been inserted into the route when resetting the cross-track distance. When saving changes, they will not be stored. The original route will <u>not</u> be affected by changes made to legs towards or between such waypoints, nor will such legs be created in the original route. These waypoints are not viewed as part of the planned route.

8.1.4 Navigation Aid

The *Navigation Aid* view presents fundamental navigation data and aids the user in navigating towards a waypoint and following a route. It presents information such as the bearing and range to the next waypoint, the ship’s current course over ground (COG) and speed over ground (SOG) and current cross-track distance (if sailing on a route).

Figure 32 – Navigation Aid

The upper scale shows COG for own ship, indicated with a grey coloured triangle pointing upwards, as well as bearing to next waypoint relative north which is indicated with a cyan coloured triangle pointing downwards. The difference between present course and the "course to head" to exactly navigate towards next waypoint is illustrated by the distance between the two triangles. To steer towards the waypoint, make the waypoint symbol (cyan triangle) stand directly above the ship symbol (grey triangle).

If sailing on a route and having reached the first waypoint, the lower scale indicates the current cross-track distance, illustrated by the horizontal yellow coloured line. The vertical black and yellow indicators are the currently used cross-track distance limit. If the cross-track distance exceeds the limit on either side, the "XTD Limit" alert will become active. If the horizontal yellow coloured line is to the right of the centre line in the lower scale, it means that the ship is on the right side of the current leg.

To more quickly reduce the cross-track distance, steer back towards a point on current leg closer than the next waypoint. If the cross-track distance is to the right of the centre line in the lower scale, the grey triangle in the upper scale should be to the left of the cyan coloured triangle to reduce the cross-track distance as shown in the figure above.

8.1.5 Navigation Plot

The *Plot* view displays a plot over the active route, indicating the ship's position, waypoints, legs and cross-track distance limit range for the current leg. It also shows current navigation information which are further described in section 8.1.6

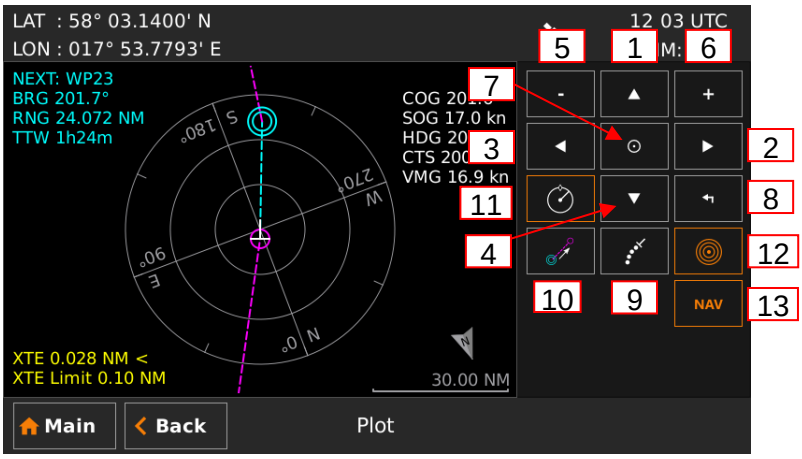


Figure 33 – Navigation Plot

The next waypoint in the route is marked with a double circle and the currently active leg is shown in cyan colour. Other legs are shown in magenta colour and their waypoints are marked with a single circle. In the bottom right corner of the plot is a compass indicator that points towards true north.

The buttons on the right side of the *Navigation Plot* view are described below.

1) Move the plot up
2) Move the plot to the right
3) Move the plot to the left
4) Move the plot down
5) Zoom out
6) Zoom in
7) Centre plot on own ship
8) Reset zoom
9) Enables/Disables ship track
10) Skip the next waypoint in route and switch to next leg
11) Switch between ship up / north up view in plot
12) Enables/Disables range rings
13) Enables/Disables active route

8.1.6 Navigation Info

The *Navigation Info* view presents fundamental navigation data and aids the user in navigating towards a waypoint and following a route. It presents information such as the bearing and range to the next waypoint, the ship's current course over ground (COG) and speed over ground (SOG) and current cross-track distance (if sailing on a route).

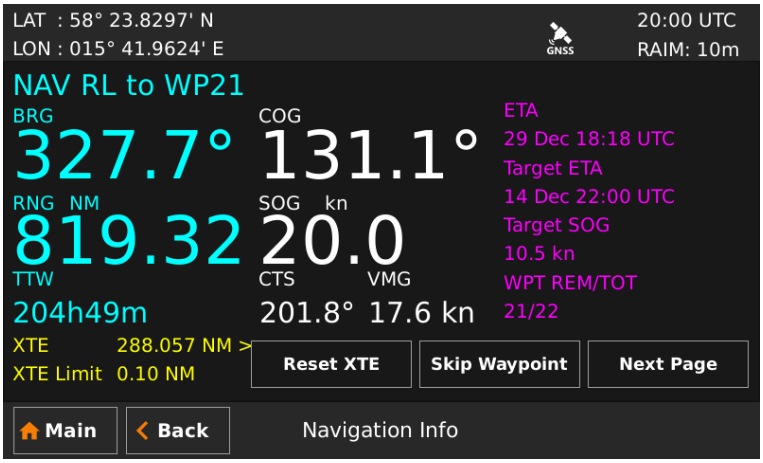


Figure 34 – Navigation Info View

The left part of the *Navigation Info* view presents current navigation information. In Figure Figure 34 – Navigation Info View, an example of the *Navigation Info* view is shown.

The information shown of the left side of the view explained below:

NAV RL to WP21

This means that the next waypoint in the current route is named "WP21" and we are currently using the navigation algorithm "Rhumb Line" (RL) to calculate range and bearing to the waypoint.

BRG

Bearing to the next waypoint.

COG

The ship's course over ground relative true north.

Note: COG is based on track angle which requires that the ship is moving. Thus, COG data is not displayed when the SOG value is below 0.3 knots.

RNG

Range to the next waypoint. The unit for range is configurable in the *Units* view, see section 10.1.14

SOG

The ship's speed over ground. The unit for SOG is configurable in the *Units* view, see section 10.1.14

TTW

Time To Waypoint – The estimated time left to next waypoint.

CTS

Course to steer – The calculated course to steer compensates for the current set and drift and calculates a course to steer to make the COG match the BRG. Heading sensor input is required to calculate CTS. This value is outputted as the heading to steer value in the APB and HSC sentences.

VMG

Velocity Made Good – The velocity component that is pointing towards the next waypoint. If the COG value is the same as the BRG to next waypoint, the VMG value will be the same as the SOG as all the ship's velocity is heading directly towards the waypoint.

XTD

Cross track distance– The distance between the ship's position and the current leg of the route. If the character "<" is displayed, it means that the ship's position is to the left of the leg and if the character ">" is displayed, the ship's position is to the right of the leg.

XTD Limit

The cross track distance limit that is used on the current leg. If the cross track distance value exceeds this limit, the XTD alert will be activated. All the legs of a route will automatically use the default XTD limit which is configurable in the *Navigation Configuration* view, see section 10.1.1. It is also possible to have a special XTD limit on a certain leg by editing the leg settings. This is described in section 8.1.3.1.

8.1.6.1 Reset XTD

The cross track distance can be set to zero by inserting a temporary waypoint at the current position in the active route. The temporary waypoint will not be saved if the active route. To reset the cross track distance, press the button "Reset XTD".

8.1.6.2 Skip Next Waypoint

To skip the next waypoint and manually switch leg on the active route, press the button "Skip Waypoint".

The right part of the *Navigation Info* view can show several different sub views which can be accessed by pressing the button "Next Page". The sub views are described below.

8.1.6.3 Estimated Time of Arrival (ETA)

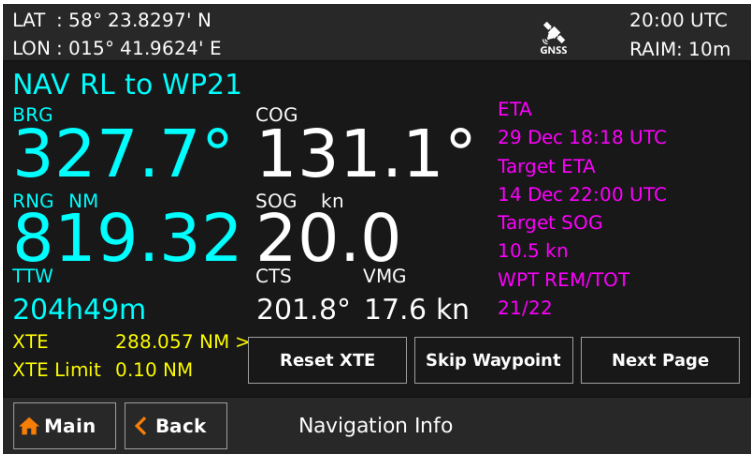


Figure 35 – Navigation Info View - ETA

This sub view shows the estimated time of arrival (ETA) to the last waypoint in the current route if the current speed over ground (SOG) is maintained.

It is also possible for the user to set a “Target ETA”, i.e. a desired time when the last waypoint in the current route should be reached. If a “Target ETA” is set, the sub view will show a “Target SOG” which is the average speed that must be maintained to reach the last waypoint of the route at the time specified by “Target ETA”. The “Target ETA” setting is accessed from **Main Menu → Navigate → Active Route → Set Target ETA.**

8.1.6.4 Waypoint Information

The waypoint information sub view shows the names of the active route, next waypoint and previous waypoint.

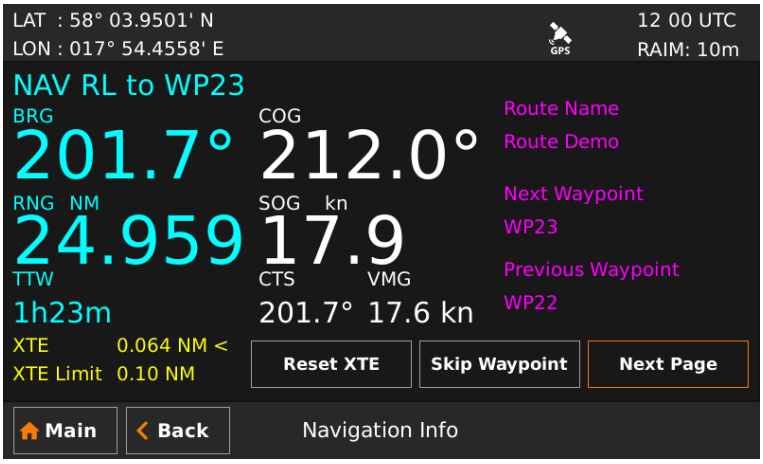


Figure 36 – Navigation Info View – WPT Info

8.1.6.5 Set and Drift

The Set and Drift sub view show information received from heading sensors, depth sensors and speed sensors. This information together with SOG and COG is also used to calculate set and drift. To receive information from heading and depth sensors, the input ports must be configured. See section 10.1.23 Heading Input port and 10.1.24 Depth Data Port for more information.

Figure 37 – Navigation Info View – Set and Drift

Note: Set and Drift calculations require speed through water and heading sensor inputs, as well as valid SOG and COG readings.

8.1.6.6 Next Waypoint Plot

This sub view shows a plot of the remaining part of the current leg as well as the next leg. The plot will automatically adjust the zoom level when the ship is closing on the next waypoint. To view a more detailed plot of the entire route and to zoom manually, see section 8.1.5.

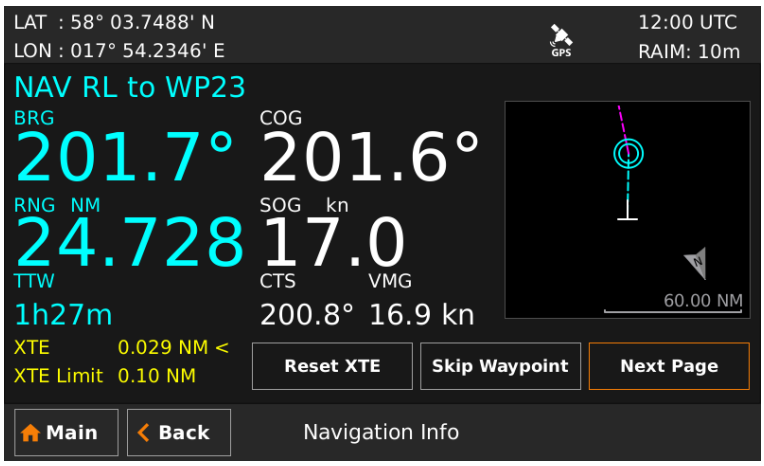


Figure 38 – Navigation Info View – Plot

8.2 Voyage Menu

The *Voyage Menu* can be accessed from the *Main Menu* and contains views for voyage planning, viewing and creating waypoints and routes as well as tidal predictions and scheduled alerts.

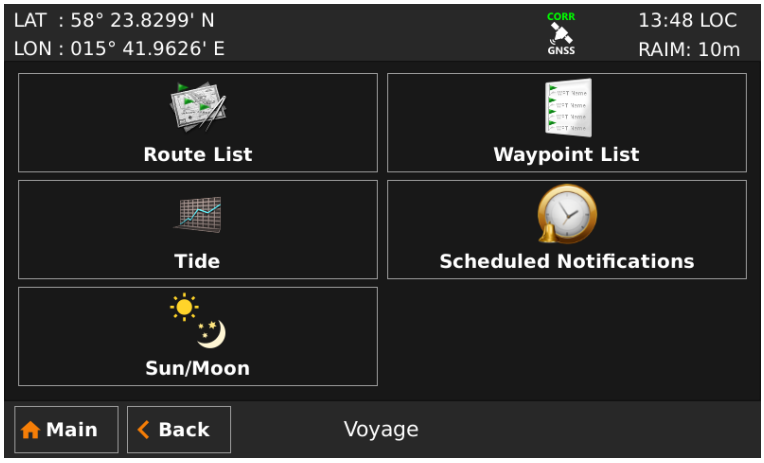


Figure 39 – Voyage Menu

8.2.1 Route List

A route is a sequence of waypoints, which is used to navigate from a start waypoint to an end waypoint. The R5 Navigation System supports up to 128 different routes and each route can consist of up to 512 waypoints (with a total maximum of 4000 unique waypoints in the system).

All stored routes are edited and controlled in the *Route List* view and its sub views. This excludes the active route, which is the route that currently is being sailed and handled completely separate in the *Active Route* view, described in section 8.1.3.

The *Route List* view presents the routes currently stored in the R5 SUPREME CDU, and provides sub views to view and edit a route as well as creates new routes. The *Route List* view also contains functionality to delete routes and find a route by name.

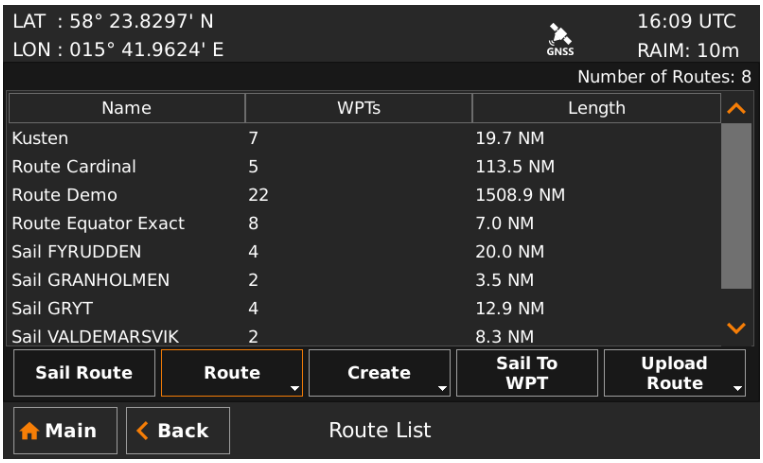


Figure 40 – Route List

8.2.1.1 Sail a Route

To start sailing a route, select the desired route in the *Route List* view and press the button ”Sail Route”. The *Sail Route* view will be shown.

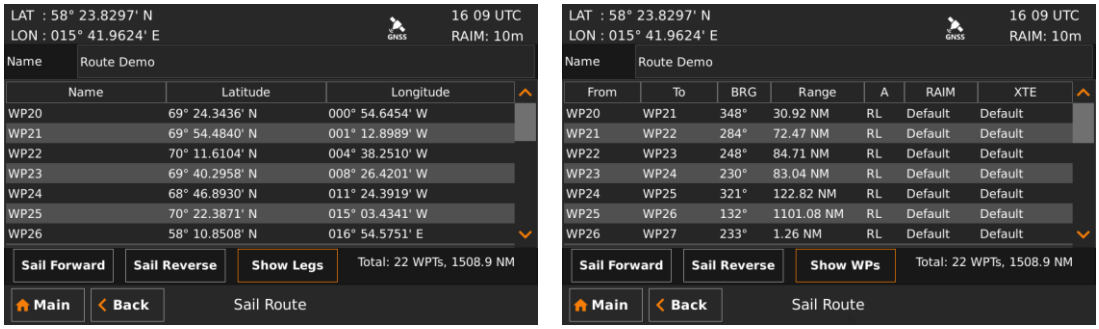


Figure 41 – Sail Route View

This view shows details of the selected route, including name, length, legs and waypoints. It provides functionality for sailing the route in forward or reverse direction. The view can either display the waypoints or the legs of the route. When viewing the legs, the specific leg settings for navigation algorithm, RAIM level and XTD limit are shown. The navigation algorithm can be either GC (Great Circle) or RL (Rhumb Line). The navigation algorithm used when sailing towards the first waypoint in a route or towards a single waypoint is determined by the default navigation algorithm parameter set in the *Navigation Configuration* view described in section 10.1.1.

The RAIM level and XTD limit can be set to a specific value for the leg or using the default settings determined by the parameters in the *Navigation Configuration* view.

Press the button “Sail Forward” to sail the route from the first waypoint to the last. Press the button “Sail Reverse” to sail the route from last waypoint to the first. A valid position is required to start sailing a route.

8.2.1.2 Sail Directly to a Specific Location (Waypoint)

In the *Route List* view, press the button “Sail To WPT” to show the *Sail To* view, which is used to sail from current position to a destination waypoint.

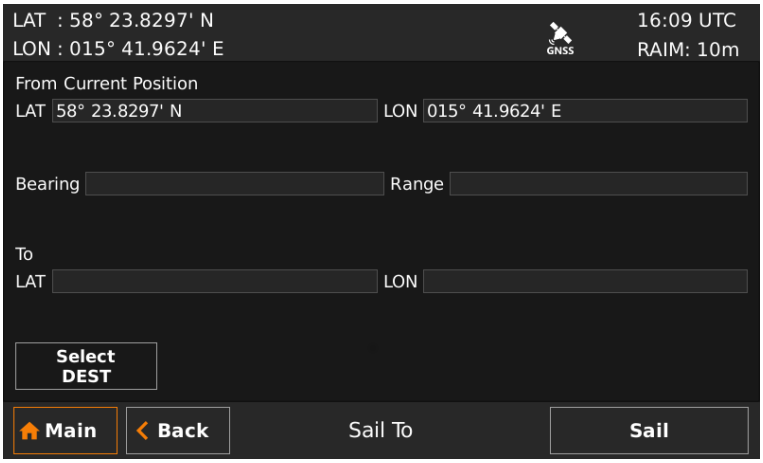


Figure 42 – Sail To View

Either an existing waypoint can be used, or a new destination waypoint can be created. The new waypoint can be created by either specifying latitude and longitude or by specifying range and bearing from current position. To select or create a destination, press the button "Select DEST". The *Insert Waypoints* view will be shown.

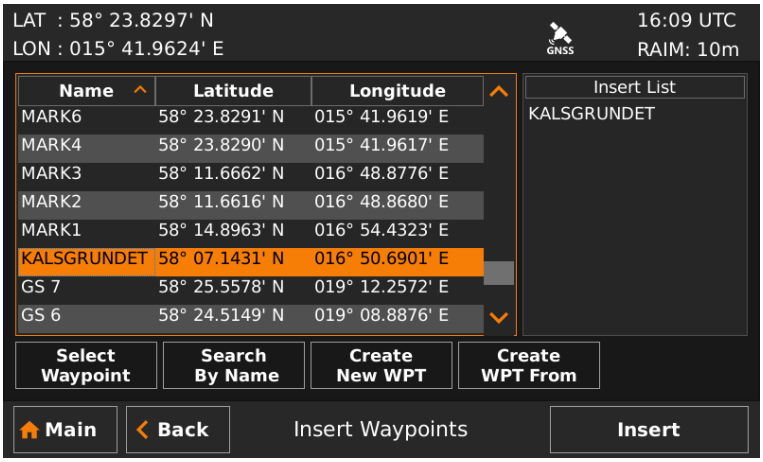


Figure 43 – Insert Waypoints View

Choose an existing waypoint

1. Select a waypoint in the list; it will be highlighted when selected.
2. Press the button "Select Waypoint" to transfer the waypoint to the "Insert List" to the right.
3. Press "Insert" to choose the waypoint as destination in the *Sail To* view.
4. Press "Sail" in the *Sail To* view to start sailing towards the chosen destination.

Create a new waypoint by specifying latitude and longitude

1. Press the button "Create New WPT" to show the *Create New Waypoint* view.
2. Press on the "Name" edit field and enter a new name for the destination.
3. Press the "LAT" edit field to input latitude.
4. Press the "LON" edit field to input longitude.
5. Press "Save" to choose the new waypoint as destination in the *Sail To* view.
6. Press "Sail" in the *Sail To* view to start sailing towards the chosen destination.

Create a new waypoint by specifying bearing and range

1. Press the button “Create New WPT” to show the *Create New Waypoint* view.
2. Press on the “Name” edit field and enter a new name for the destination.
3. Press the button “Bearing/Range”. A popup window will appear:

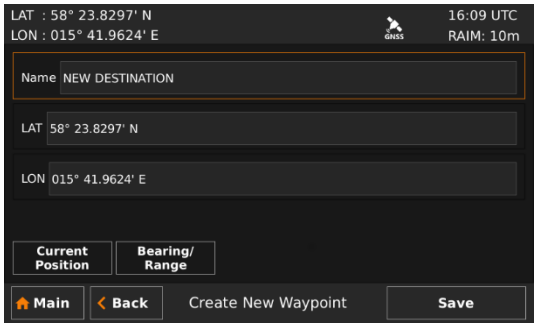


Figure 45 – Create New Waypoint – Latitude and Longitude

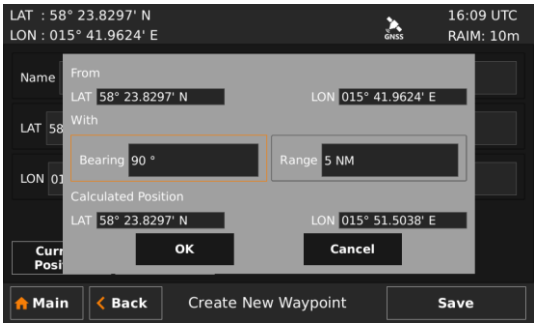


Figure 44 - Create New Waypoint – Range and Bearing

4. Press on the “Bearing” edit field and enter a bearing from the current position.
5. Press the “Range” edit field and enter a range from the current position.
6. The calculated position will be shown at the bottom of the popup window.
7. Press OK when done.
8. Press “Save” in the *Create New Waypoint* view to choose the new waypoint as destination in the *Sail To* view.
9. Press “Sail” in the *Sail To* view to start sailing towards the chosen destination.

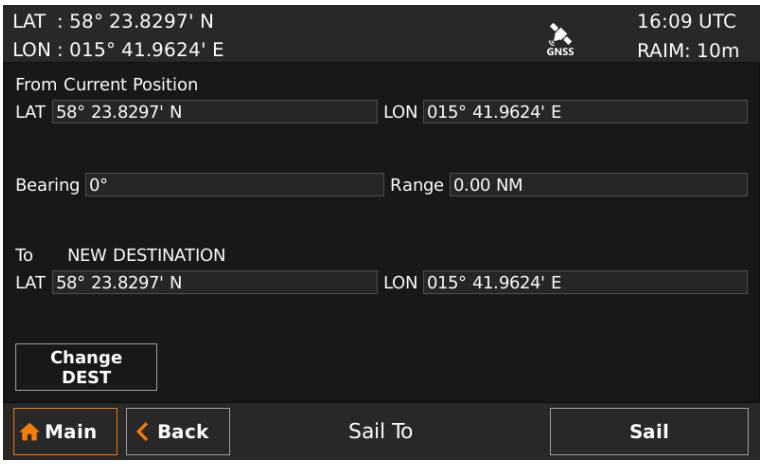


Figure 46 – Sail To View with Selected Destination

8.2.1.3 Edit a Route

The *Edit Route* view enables the user to modify a route. It is possible to insert waypoints as well as whole existing routes into the route being edited. It is also possible to remove and edit

waypoints and change settings such as navigation algorithm, RAIM level and XTD limit for each leg in the route. The route name can also be modified.

A waypoint or route inserted first or last in the route being edited results in the creation of a new leg connecting it to the edited route. Such a leg will initially have the default settings for navigation algorithm, RAIM level and XTD limit as described in section 10.1.1.

A waypoint or route inserted in between two existing waypoints is however seen as splitting the original leg in two. Both the connecting legs to the inserted waypoint or route will in this case have the same settings as the original leg had.

It is also possible to add multiple waypoints in one insert. In this case the legs connecting the inserted waypoints will have the same leg settings as the connecting leg(s).

To edit a route in the route list, enter the *Edit Route* view by selecting the route in the route list, then press on the button “Route” to popup a list of actions and select “Edit”.

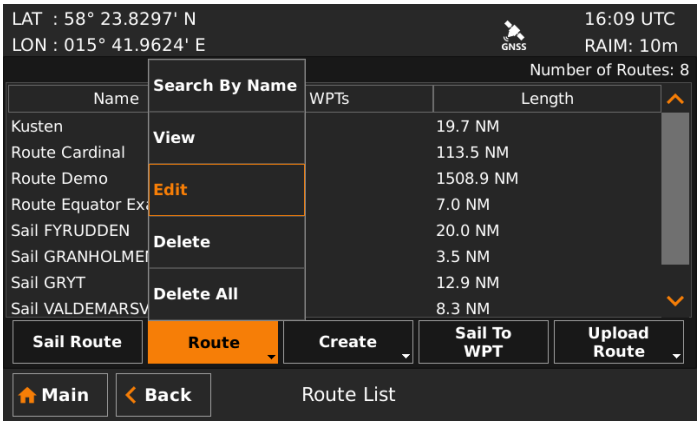


Figure 47 – Route List View – Edit

The *Edit Route* view can either show a list of all waypoints or a list of all legs in the route. When the waypoints are shown, it is possible to insert new waypoints or even complete routes into the existing route. When the legs are shown it is possible to change the navigation algorithm, RAIM level and XTD limit for each individual leg. To switch between waypoint view and leg view, press the button “Show Legs/Show WPs”.

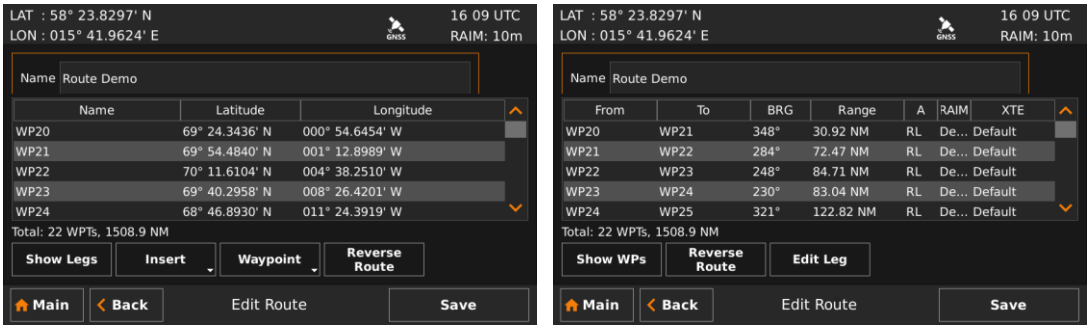


Figure 48 – Edit Route View

<u>Change name of route</u>

1. Press the “Name” edit field at the top of the *Edit Route* view. A virtual keyboard will appear.
2. Type in the new name on the virtual keyboard. Press the virtual keyboard enter button when done.
3. Press “Save” to save the route with the new name and exit to *Route List* view.

Insert waypoints into the route

1. Make sure that the *Edit Route* view shows the waypoints (press “Show WPs” if the leg view is shown).
2. Select the waypoint in the route which new waypoints should be inserted before or after.
3. Press the button “Insert” followed by “WPT Before” or “WPT After”. The *Insert Waypoints* view will be shown:

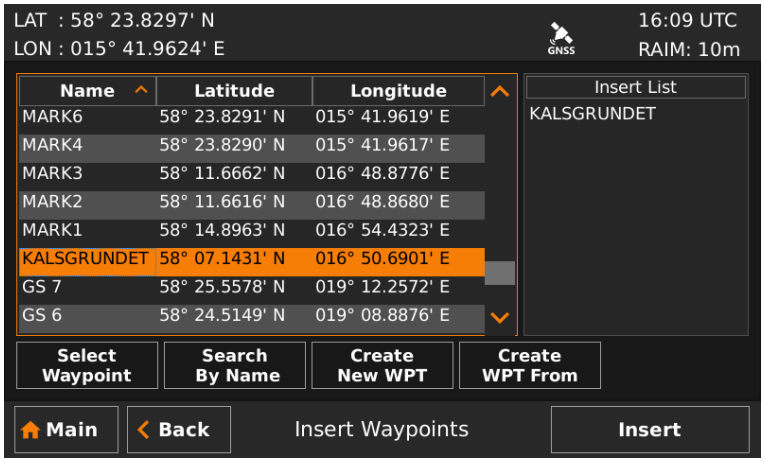


Figure 49 – Insert Waypoints View

4. Highlight the desired waypoint and press the button “Select Waypoint” to add it to the “Insert List” on the right of the *Insert Waypoints* view.
5. If more waypoints are to be inserted, repeat step ‘4’.
6. Press the button “Insert” to insert all the waypoints from the “Insert List” into the route being edited and exit to the *Edit Route* view.
7. Press “Save” in the *Edit Route* view to save changes in the edited route and exit to *Route List* view.

Insert existing route into the route being edited

1. Make sure that the *Edit Route* view shows the waypoints (press “Show WPs” if the legs are shown).
2. Select the waypoint in the route which the route should be inserted before or after.
3. Press the button “Insert” followed by “RTE Before” or “RTE After”.
4. The *Insert Route* view is displayed:

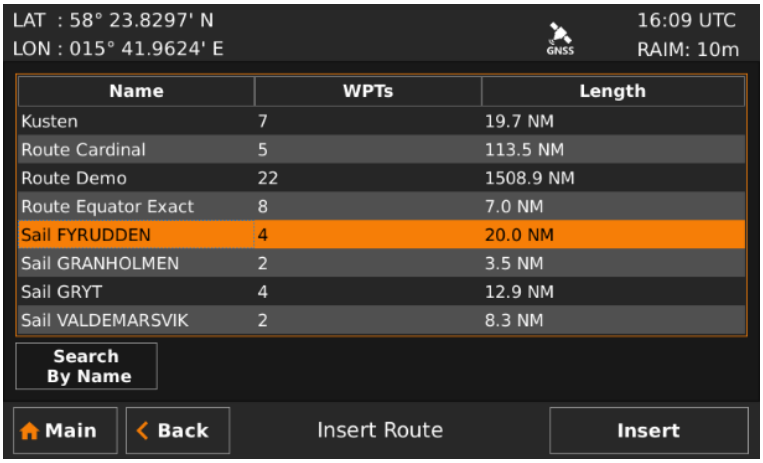


Figure 50 – Insert Route View

5. Highlight the desired route in the list and press “Insert” to insert all the waypoints from the chosen route into the route being edited.
6. Press “Save” in the *Edit Route* view to save changes in the edited route and exit to *Route List* view.

<u>Change navigation algorithm, RAIM level and XTD limit for a leg in the route</u>

1. Make sure that the *Edit Route* view shows the legs (press “Show Legs” if the waypoints are shown).
2. Select the leg to modify in the list and press the button “Edit Leg”. The *Edit Leg* view is displayed:

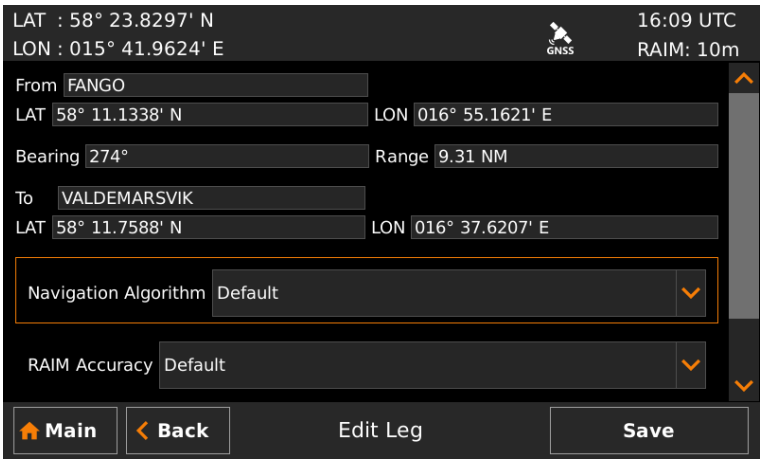


Figure 51 – Edit Leg View

3. The Navigation Algorithm, RAIM Accuracy and XTD Limit parameters can be set to “Default” or to a specific value. If set to default, the settings in the *Navigation Configuration* view will be used, as described in section 10.1.1.
4. To change the navigation algorithm, press the “Navigation Algorithm” drop list and choose “Algorithm”. A new drop list will appear where it is possible to choose between “Rhumb Line” and “Great Circle”. Select the desired value in the new drop list.
5. To change the RAIM accuracy level for the leg, press the “RAIM Accuracy” drop list and choose “RAIM Level”. A new edit field will appear. Click on the “Level” edit field to input a desired RAIM accuracy level in meters.

6. To change the XTD Limit for the leg, press the “XTD Limit” drop list and choose “XTD Limit”. A new edit field will appear. Click on the “Limit” edit field to input a desired XTD Limit.
7. Press the button “Save” to save changes made to leg and exit to the *Edit Route* view.
8. Press “Save” in the *Edit Route* view to save changes in the edited route and exit to *Route List* view.

Remove waypoint from the route

1. Make sure that the *Edit Route* view shows the waypoints (press “Show WPs” if the legs are shown).
2. Highlight the waypoint that is about to be removed.
3. Press the button “Waypoint” followed by “Remove”.
4. Press “Save” to save changes in the edited route and exit to *Route List* view.

Replace waypoint in the route

1. Make sure that the *Edit Route* view shows the waypoints (press “Show WPs” if the legs are shown).
2. Highlight the waypoint that should be replaced.
3. Press the button “Waypoint” followed by “Replace”. The *Replace Waypoint* view is shown:

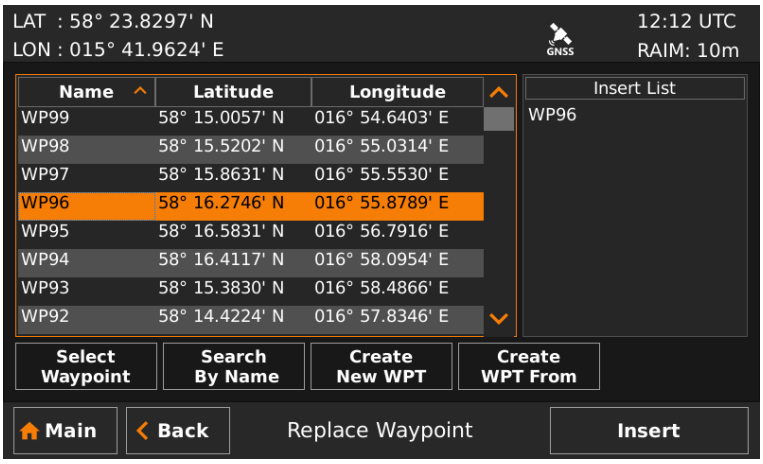


Figure 52 – Replace Waypoint View

4. Highlight the desired waypoint and press the button “Select Waypoint” to add it to the “Insert List” on the right of the *Replace Waypoint* view.
5. Press the button “Insert” to replace the original waypoint with the one from the “Insert List” and exit to *Edit Route* view.
6. Press “Save” to save changes in the edited route and exit to *Route List* view.

Reverse Route

1. To reverse the route, press the button “Reverse Route”.
2. Press “Save” to save changes in the edited route and exit to *Route List* view.

8.2.1.4 Create a New Route

The *Create Route* view is used to create a new route. A default name is supplied but should be changed to a descriptive name for the new route. A route can be created from the *Route List* view by pressing the button “Create” and then pressing on of the buttons “New RTE” or “RTE From”.

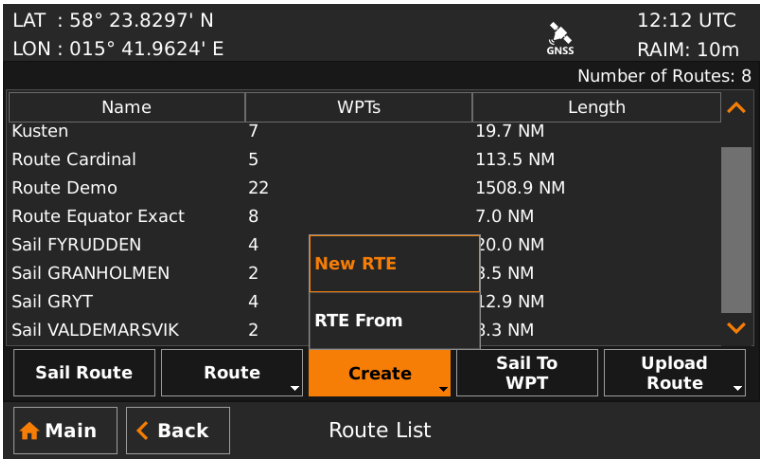


Figure 53 – Route List View – Create New Route

When pressing “RTE From” the *Create Route* view is displayed with information entered from the selected source route. When pressing “New RTE” the *Create Route* view will be empty.

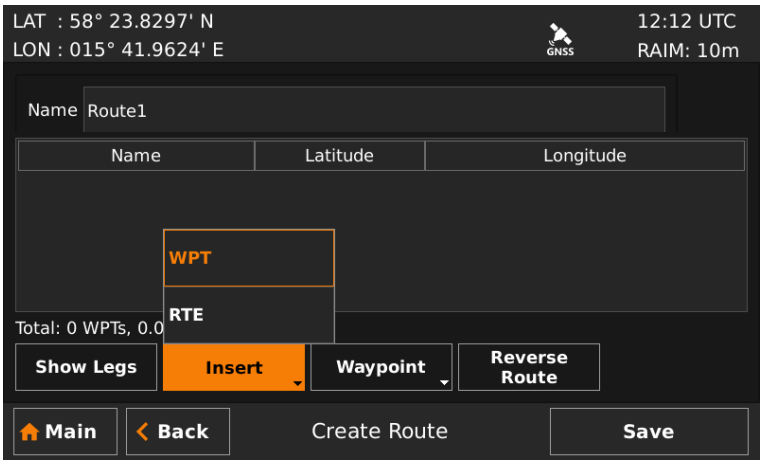


Figure 54 – Create Route View

<u>Specify name of route</u>

1. Press the “Name” edit field at the top of the *Create Route* view. A virtual keyboard will appear.
2. Type in the new name on the virtual keyboard. Press the virtual keyboard enter button when done.

<u>Insert waypoints and edit leg information</u>

Press the button “Insert” followed by “WPT” to insert waypoints or “RTE” to insert existing routes. The functions in the *Create Route* view are the same as in *Edit Route* view. See section 8.2.1.3 for more information.

8.2.1.5 Find a Route by Name

It is possible to search for a route in the route list by entering the name, if the route is found it will automatically be highlighted in the *Route List* view.

1. Press the button “Route” followed by “Search by Name”.
2. Enter the name of the route and press the enter button on the virtual keyboard.

8.2.1.6 View a Route

The *View Route* view is similar to the *Sail Route* view described in section 8.2.1.1, as it shows the same details of the route. Either the waypoints or the legs of the route are shown. Each waypoint is displayed with name and position, and for each leg the length and initial bearing is shown as well as the navigation algorithm, RAIM accuracy level and XTD limit.

To view a route, select it in the route list and press the button “Route” followed by “View”.

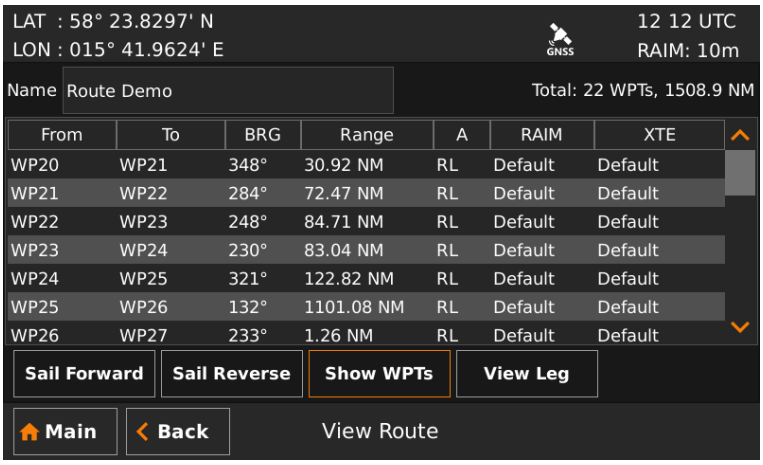


Figure 55 – View Route View

8.2.1.7 Upload Route to External Systems

The R5 SUPREME CDU can send routes and associated waypoints to an external system via one of the serial User Ports or via the Light Weight Ethernet network. In order to upload routes and waypoints the user ports must be configured with correct baud rate and the sentence “WPL/RTE (Upload)” must be enabled in the output configuration for each port where the routes and waypoints should be output. To configure the output ports, see section 10.1.27.

To upload a route and associated waypoints on the configured user ports, select a route in the route list; press the button “Upload Route” followed by “Selected”. The selected route will now be output on each port that has the sentence “WPL/RTE (Upload)” enabled. To upload all routes in the route list, press “Upload Route” followed by “All”.

8.2.1.8 Delete a Route

1. Select the route to be deleted in the route list.
2. Press the button “Route” followed by “Delete”.
3. A confirmation popup will appear, press “Yes” to delete the route. This will only delete the selected route; the associated waypoints will still be available.

8.2.1.9 Delete All Routes

1. Press the button “Route” followed by “Delete All”.
2. A confirmation popup will appear, press “Yes” to delete all the routes in the system. This will only delete the routes; the associated waypoints will still be available.

8.2.2 Waypoint List

Waypoints are the basis for ship navigation. A waypoint is a position on the earth surface that is given a unique name and stored in the memory of the R5 SUPREME CDU. Waypoints can be entered in several different ways, and used for building routes as well as for direct navigation to a specific position.

The *Waypoint List* view lists all the waypoints that are currently stored in the R5 Navigation System. Via this view it is also possible to create new waypoints and store them in the memory.

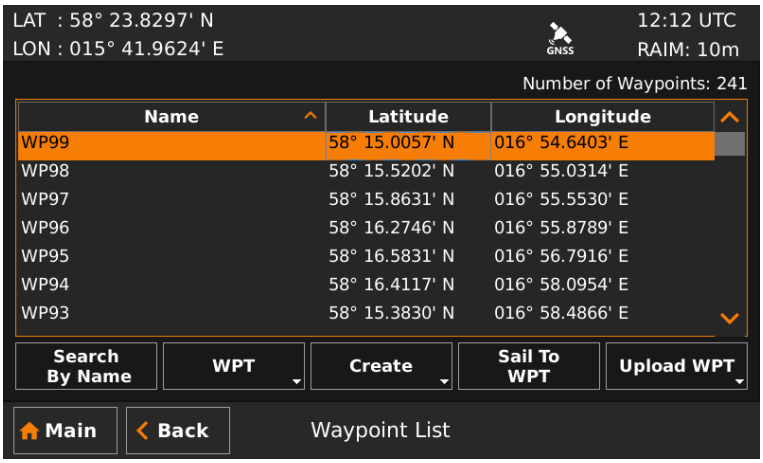


Figure 56 – Waypoint List View

8.2.2.1 Sail To Waypoint

1. Select the desired destination waypoint in the list.
2. Press the button “Sail to WPT”. The *Sail To* view will be shown:

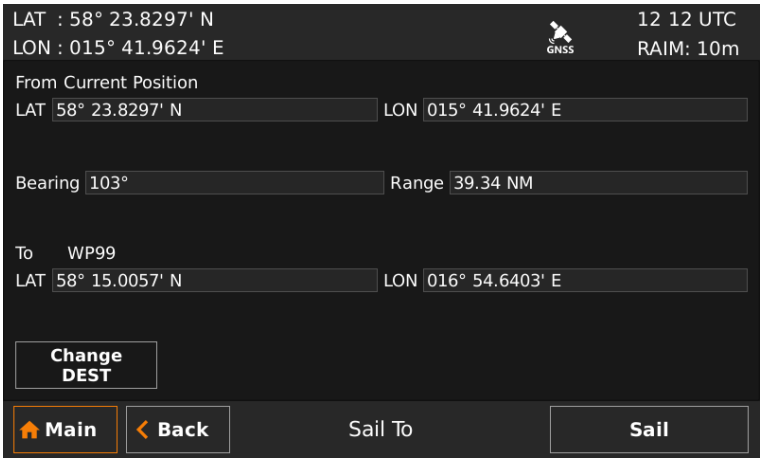


Figure 57 – Sail To View

3. Press the button “Sail” to start sailing towards the selected waypoint.

8.2.2.2 Edit a Waypoint

1. Select the desired waypoint in the list.
2. Press the button “WPT” followed by “Edit”.
3. Press the “Name” edit field to edit the name of the waypoint.
4. Press the “LAT” edit field to edit the latitude of the waypoint.
5. Press the “LON” edit field to edit the longitude of the waypoint.
6. Press the button “Current Position” to fill in the current position as latitude and longitude of the waypoint.
7. Press the button “Bearing/Range” to calculate a new latitude and longitude by specifying a range and bearing from the waypoint’s current position.
8. Press “Save” to save any changes made to the waypoint.

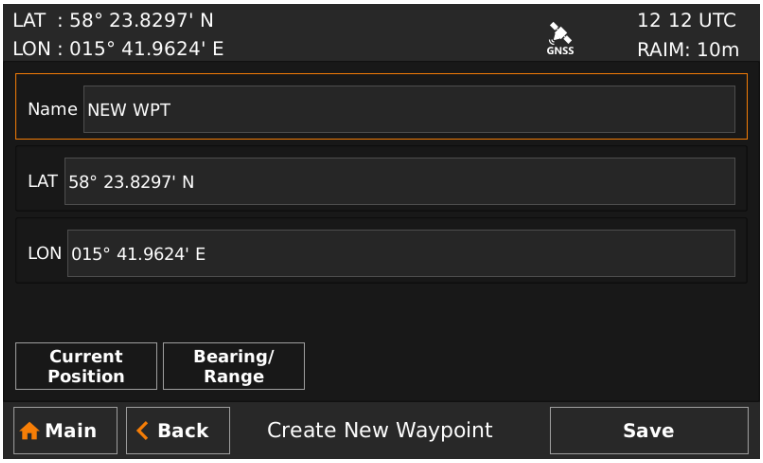


Figure 58 – Edit/Create Waypoint

8.2.2.3 Create a New Waypoint

1. Press the button ”Create” followed by ”New WPT”.
2. Press the “Name” edit field to enter the name of the waypoint.
3. Press the “LAT” edit field to enter the latitude of the waypoint.
4. Press the “LON” edit field to enter the longitude of the waypoint.
5. Press the button “Current Position” to fill in the current position as latitude and longitude for the waypoint.
6. Press the button “Bearing/Range” to calculate a new latitude and longitude by specifying a range and bearing from the waypoints current position.
7. Press “Save” to save the new waypoint.

8.2.2.4 Create a New Waypoint from an Existing Waypoint

1. Select a waypoint in the list to use as a base for the new waypoint.
2. Press the button ”Create” followed by ”WPT From”. The *Edit/Create Waypoint* view will be shown with the name, latitude and longitude copied from the selected waypoint.
3. Press the “Name” edit field to enter the name of the waypoint.

4. Press the “LAT” edit field to enter the latitude of the waypoint.
5. Press the “LON” edit field to enter the longitude of the waypoint.
6. Press the button “Current Position” to fill in the current position as latitude and longitude for the waypoint.
7. Press the button “Bearing/Range” to calculate a new latitude and longitude by specifying a range and bearing from the waypoints current position.
8. Press “Save” to save the new waypoint.

8.2.2.5 Find a Waypoint by Name

It is possible to search for a waypoint in the waypoint list by entering the name, if the waypoint is found it will automatically be highlighted in the *Waypoint List* view.

1. Press the button “Search by Name”.
2. Enter the name of the waypoint and press the enter button on the virtual keyboard.

8.2.2.6 Upload Waypoints to External Systems

The R5 SUPREME CDU can send waypoints to an external system via one of the serial User Ports or via the Light Weight Ethernet network. In order to upload waypoints, the user ports must be configured with correct baud rate and the parameter “WPL/RTE (Upload)” must be enabled for each port that the waypoints should be output. To configure the output ports, see section 10.1.27.

To upload a waypoint on the configured user ports, select a waypoint in the waypoint list; press the button “Upload WPT” followed by “Selected”. The selected waypoint will now be output on each port that has the parameter “WPL/RTE (Upload)” enabled. To upload all waypoints in the waypoint list, press “Upload WPT” followed by “All”.

8.2.2.7 Delete a Waypoint

1. Select the waypoint to be deleted in the waypoint list
2. Press the button “WPT” followed by “Delete”.
3. A confirmation popup will appear, press “Yes” to delete the waypoint. It is NOT possible to delete a waypoint that is used by any route. If the selected waypoint is included in one or more routes a popup will be displayed showing which routes includes it.

8.2.2.8 Delete All Waypoints and Routes

1. Press the button “WPT” followed by “Delete All”.
2. A confirmation popup will appear, press “Yes” to delete all the waypoints and all the routes in the system.

8.2.3 Tide

The R5 SUPREME CDU can be used for calculation of tidal predictions based on user input of data from the Admiralty Tide Tables published by the U.K Hydrographic Office.

The user is required to input data for the specific port and select the point in time for which the prediction is to be calculated.

The tidal prediction features can be accessed by pressing ***Main Menu → Voyage → Tide***.

Note that meteorological effects (e.g wind and barometric pressure) as well as other factors not accounted for in the generalized tidal models may cause significant deviation between actual and predicted tide.

8.2.3.1 Calculation Method and Source Data for Tide

The tidal predictions are calculated by the so called 'simplified harmonic method'. Harmonic constants and other parameters required are included in publications below. Note that the algorithms applied are specifically adapted for this data. Tidal parameters obtained from other sources shall not be used with the R5 SUPREME CDU tidal calculations.

Predictions calculated according to this method will not be fully consistent with the tabulated high/low and hourly predictions from the Admiralty tide tables. This is due to the fact that the tabulated values are based on a more extensive data set compared to the limited number of parameters used by the simplified harmonic method.

The source data is split between volumes with different geographical coverage as follows:

U.K Hydrographic Office ADMIRALTY TIDE TABLES (ATT)

- Volume 1 (NP 201): United Kingdom and Ireland (including European channel ports)
- Volume 2 (NP 202): Europe (excluding United Kingdom and Ireland), Mediterranean Sea and Atlantic Ocean
- Volume 3 (NP 203): Indian Ocean and South China Sea
- Volume 4 (NP 204): Pacific Ocean

Optionally, for European ports, ATT Volume 1 and European part of Volume 2 can be substituted by: TIDAL HARMONIC CONSTANTS, EUROPEAN WATERS (NP 160).

8.2.3.2 Input of Tidal Parameters

Tidal data for a new port is entered as follow:

1. Enter the *Tide Plot* view by pressing ***Main Menu → Voyage → Tide***. The *Tide Plot* view will be displayed as shown below:

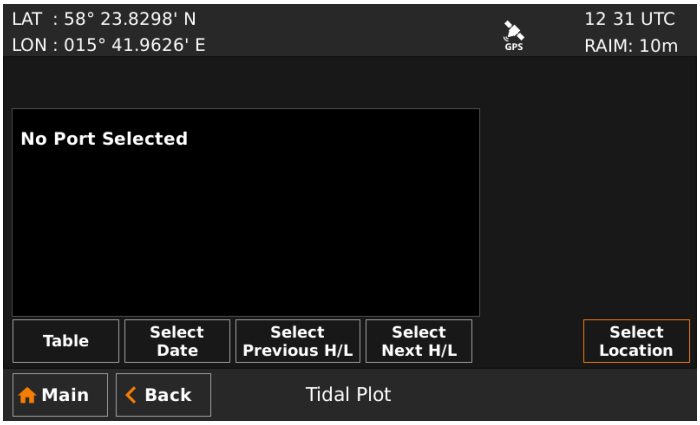


Figure 59 – Tide Plot with No Port Selected

2. Click on the button "**Select Location**" to enter the *Port List* view. This view will show all the ports that have been entered in the R5 SUPREME CDU.

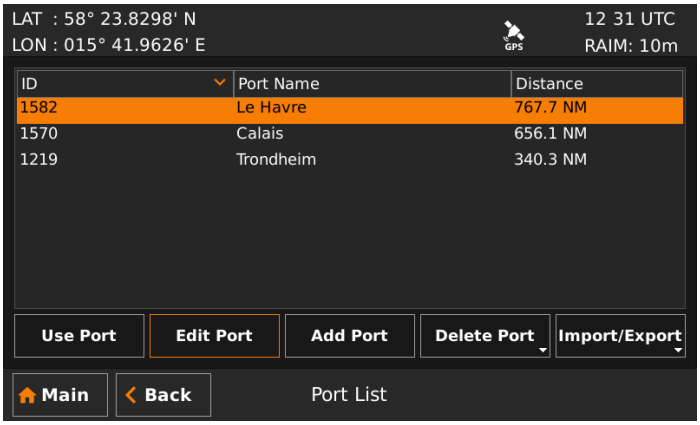


Figure 60 – Port List

3. Click on the button "**Add Port**" to enter the *Add Port* view. Input the data for the tidal parameters from the relevant volume of ATT, part III.

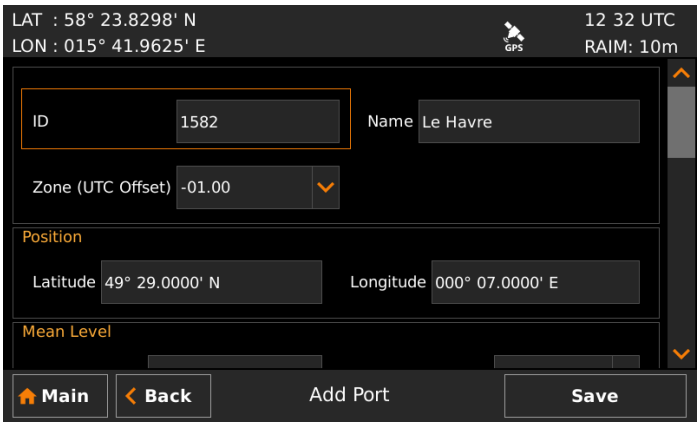


Figure 61 – Add Port

4. Some ports have season or fortnightly variations in mean level and harmonic constants. If so, such variations can be input by selecting “Use Table…” in the corresponding drop list for the parameter.

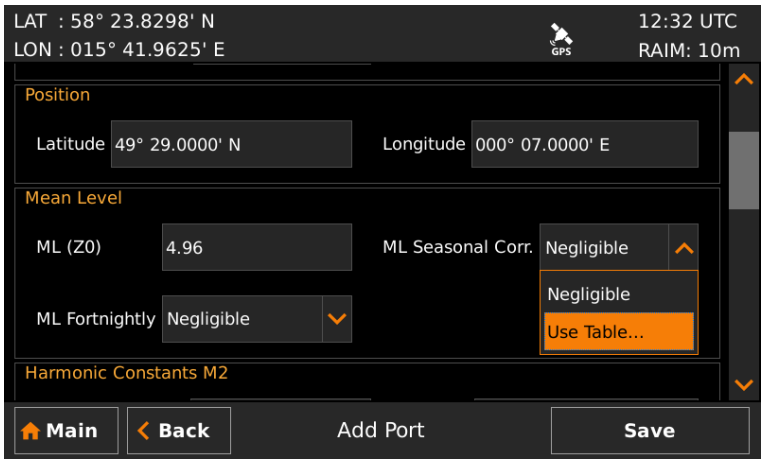


Figure 62 – Add Port – Input Seasonal Variations

A new view will be shown where the variation values from the “Admiralty Tide Tables” can be input. Press “Apply” to use the variation values and return to the *Add Port* view.

Figure 63 – ML Seasonal Variations

5. In the *Add Port* view, press the button “Save” when all data for the port has been entered in order to store the new port and return to the *Port List* view.

The following data can be input for each port:

ID	Port No. from ATT part III.
Name	Place name from ATT part III.
Zone	UTC offset time zone (UTC time – Local Time) in hours and minutes from ATT part III. This information is important since ATT data is referenced to a local time in port with this offset from UTC. Enter this data as defined in ATT regardless of adjustments for other local time offsets (e.g daylight savings time). See further notes on treatment of time offset in sections below.
Position	Latitude and longitude of port. This is optional information that is not required for calculation of tides. If entered, the current distance to the actual port will be shown in the list of tidal stations. Position is not listed in ATT part III.
ML Z0	This is mean level in meters from ATT part III. For most stations this is a fixed value. Tables of seasonal corrections and fortnightly variations as required for some stations can be entered as described below.
ML Seasonal	Seasonal corrections to the mean level value as defined for some ports. If so, this parameter shall be set to 'Use Table…' which will open a new view where values for each month can be input in accordance with the corrections listed in ATT part III.
ML Fortnightly	Fortnightly variations in mean level as defined for some ports. If so, this parameter shall be set to 'Use Table…' which will open a new view where parameters should be entered from a supplementary table in ATT.
M2 g	Harmonic constant from ATT part III.
M2 H.m	Harmonic constant from ATT part III. Fixed value used for most ports.
M2 Seasonal	Seasonal depending values of M2 H.m as defined for some ports. If so, this parameter shall be set to 'Use Table…' which will open a new view where values for each month can be input in accordance with values listed in ATT part III.
S2 g	Harmonic constant from ATT part III.
S2 H.m	Harmonic constant meters from ATT part III. Fixed value used for most ports.
S2 Seasonal	Seasonal depending values of S2 H.m as defined for some ports. If so, this parameter shall be set to 'Use Table…' which will open a new view where values for each month can be input in accordance with values listed in ATT part III.

K1 g	Harmonic constant from ATT part III.
K1 H.m	Harmonic constant from ATT part III.
O1 g	Harmonic constant from ATT part III.
O1 H.m	Harmonic constant from ATT part III.
f4	Shallow water correction from ATT part III.
F4	Shallow water correction from ATT part III.
f6	Shallow water correction from ATT part III.
F6	Shallow water correction from ATT part III.

8.2.3.3 Import/Export Tidal Ports

It is possible to export and import added ports to/from USB memory for backup. All available ports in the port list will be saved in a proprietary formatted XML file on the USB memory. When importing tidal ports, existing ports with same ID will be overwritten with data from the XML file.

To export tidal ports:

1. Enter the *Tide Plot* view by pressing **Main Menu → Voyage → Tide**
2. Click on the button “Select Location” to enter the *Port List* view.
3. Click on the button “Import/Export” and choose “Export to USB”.
4. Choose a location on the USB memory where to save the file.
5. Enter a file name in the “File Name” field and click on the button “Save”

To import tidal ports:

1. Enter the *Tide Plot* view by pressing **Main Menu → Voyage → Tide**
2. Click on the button “Select Location” to enter the *Port List* view.
3. Click on the button “Import/Export” and choose “Import from USB”.

8.2.3.4 Use Tidal Predictions

Once port data has been entered, tidal predictions can be generated for that port as follows:

1. Enter the *Tide Plot* view by pressing **Main Menu → Voyage → Tide**
2. Click on the button “Select Location” to enter the *Port List* view.
3. Select the desired port in the port list and click on the button “Use Port”. The *Tide Plot* view is shown with a graphical prediction for the current day or a previously selected date.

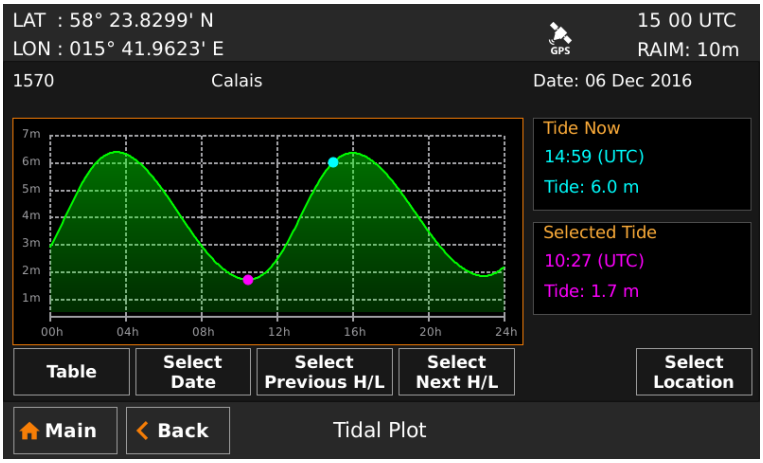


Figure 64 – Tide Plot

The *Tide Plot* shows the predicted tides for the selected port and date. The port id and the port name are shown above the plot. The plot date is shown in the upper right corner. The turquoise dot in the plot marks the current time as derived from GNSS. The current tide is updated every 30 second. The purple dot marks the time that is selected by the user. It is possible to click anywhere in the plot to move the purple dot or to click on the buttons “Select Previous H/L” and “Select Next H/L” to step between local high and local low points in the plot. It is also possible to move the marker with the *Arrow Keypad* button on the front of the R5 SUPREME CDU. Use the arrows to mark the plot and press *ENTER*. When the plot is selected the left and right arrow buttons can be used to move the purple dot.

In order to calculate predictions for another day, click on the button “Select Date” to access an almanac where any date can be chosen.

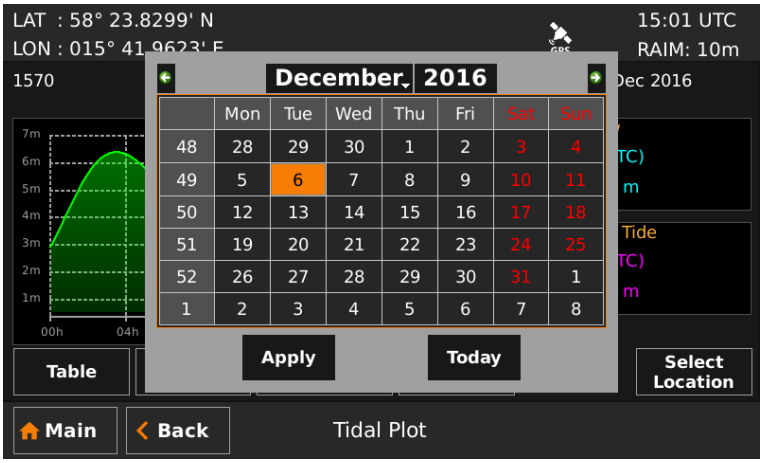


Figure 65 – Tide Plot, Select Date

The tide predictions can also be represented as a table by clicking on the button “Table”. The maximum and minimum values for the selected date will be highlighted.

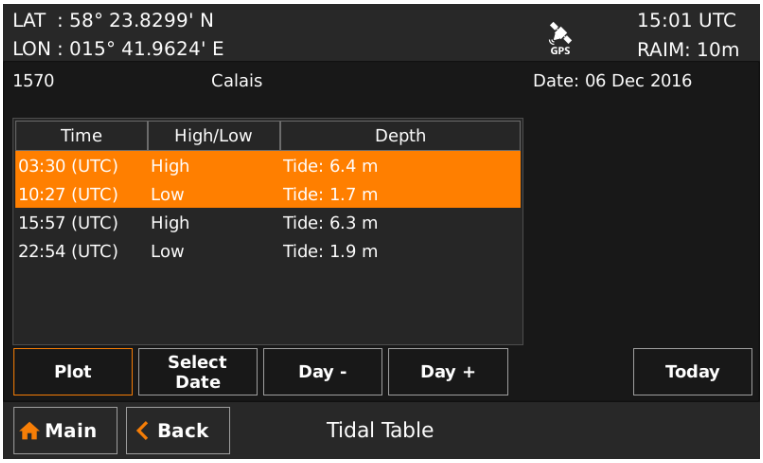


Figure 66 – Tide Table

8.2.3.5 Units of Predicted Tide

Predicted tide can be displayed in meters, feet or fathom units as defined by the 'Depth Unit' configuration parameter. This parameter is accessed from the *Units Configuration* view described in section 10.1.14.

8.2.3.6 Treatment of Local Time Zones

For each port, a 'Zone' parameter shall be entered as defined in ATT part III. This parameter defines the relationship of data published in ATT with respect to UTC.

When a tide prediction is generated, a graph will be displayed for 00 to 24 hours of a selected date. This time will be in UTC or with any user selectable local time offset as defined in the *Time Zone Settings* view (see section 10.1.13). If UTC is used, times will be denoted 'UTC'. If a local time frame is used, times will be denoted 'LOC'. This is in analogy with how all times generally are treated by the R5 SUPREME CDU.

Thus, it is important to realize that a tide displayed in 'LOC' time is not necessarily the local time in the port (defined by the 'Zone' parameter). If this is desired, the user must manually define the local time in the *Time Zone Settings* view that corresponds to the 'Zone' value for the actual port.

To make things more complicated, the 'Zone' parameter in ATT part III is defined as (UTC time – Local Time) and thus being negative when moving eastwards from Greenwich. On the other hand, the local time offset in the *Time Zone Settings* view is to be added to UTC and therefore positive when moving eastwards. Thus, a negative 'Zone' value is equivalent to a positive offset of time configuration and vice versa.

In general: always enter 'Zone' for the port as indicated in ATT part III and select local time offset in *Time Zone Settings* view to obtain the desired local time frame for which the prediction is to be obtained.

Examples of 'Zone' setting and corresponding local time configuration are shown in the following two figures. Notice that the Zone setting for the port in this example is -01.00 hours as indicated by ATT part III while the corresponding local time configuration in the *Time Config* view is +01.00 hours. This will ensure that predictions in the *Tidal Plot* view are calculated and shown in the ports local time.

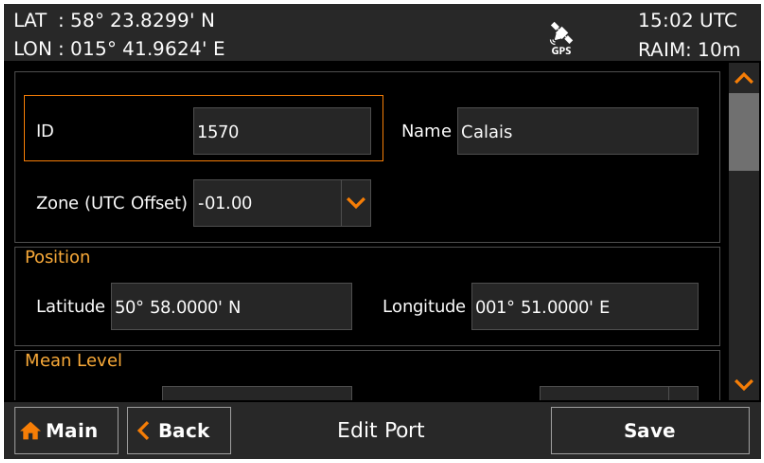


Figure 67 – Edit Port, Zone Setting

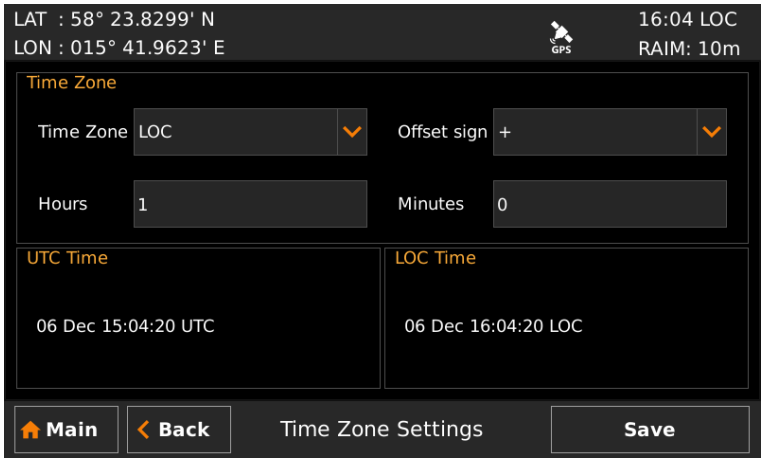


Figure 68 – Time Zone Settings for the R5 SUPREME CDU

8.2.4 Scheduled Notifications

The *Scheduled Notifications* view allows the user to create and inspect *notifications* scheduled to activate *notifications* at certain points in time.

There are two types of alerts that may be scheduled. Time notifications are activated at a specific time and can be set to be a single *notification* or a recurring*notification* with a certain time interval. ETA *notifications* will be activated at certain time prior to ETA of the current active route.

When a scheduled *notification* is activated, a popup will appear and the R5 CDU buzzer will be activated if scheduled *notification* sound parameter is set to “Beep” or “None” in *Sound Config* view as described in section 10.1.12.

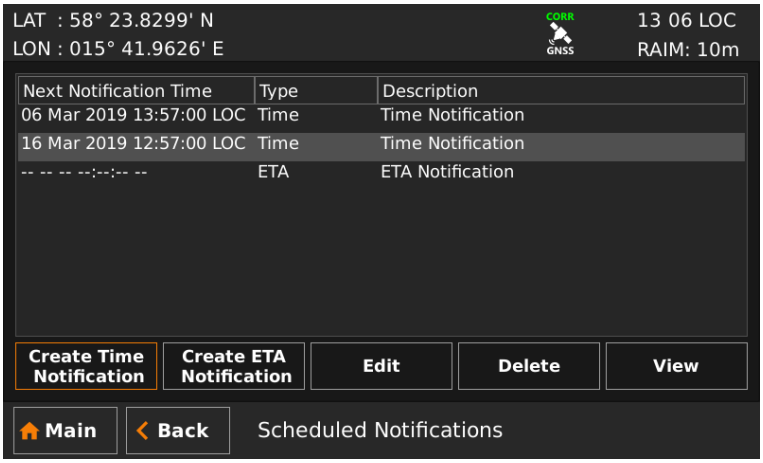


Figure 69 – Scheduled *Notifications* View

8.2.4.1 Create Time Notification

1. To create a new time alert, press the button “Create Time Notification”. The *Create Time Notification* view is shown:

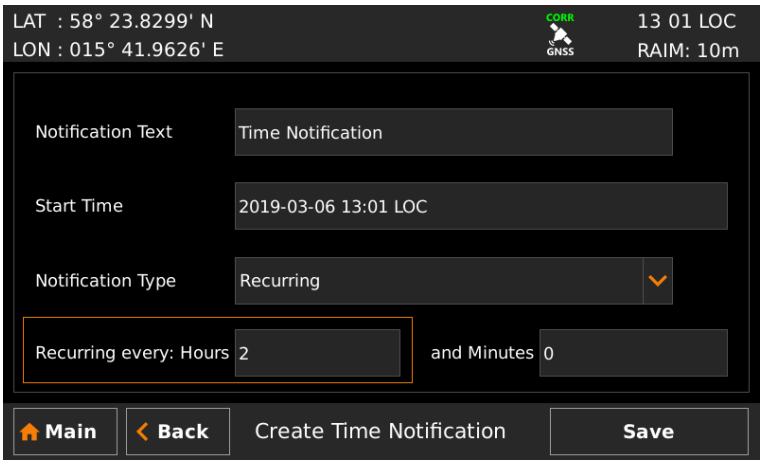


Figure 70 – Create Time Alert View

2. To edit the notification text that is shown in the popup, press the “Notification Text” edit field. A virtual keyboard will appear. Enter the desired notification text and press enter on the virtual keyboard.
3. Edit the start time of the alert by pressing the “Start Time” edit field. A virtual numpad will appear. Enter the desired date and time and press enter on the virtual numpad.
4. Select if the time notification should be a single notification or a recurring notification by pressing on the drop list “Notification Type”.
5. If the notification is recurring, select the time interval by pressing on the “Hours” edit field and “Minute” edit field.
6. Press “Save” to set the notification.

8.2.4.2 Create ETA Notification

1. To create a new ETA notification, press the button “Create ETA Notification ”. The *Create ETA notification* view is shown:

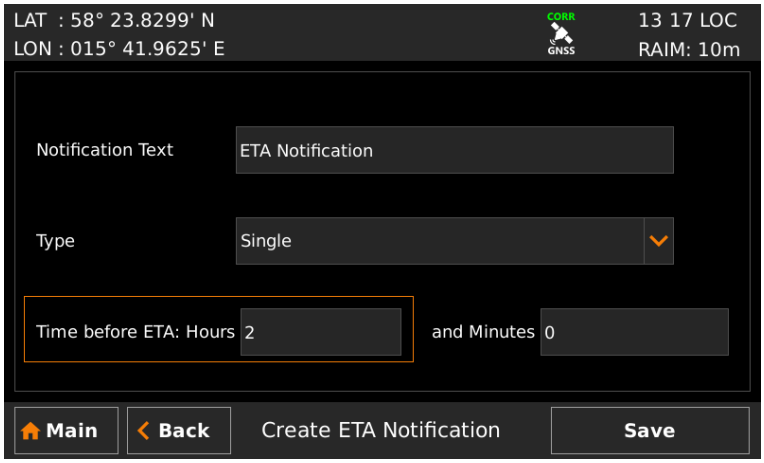


Figure 71 – Create ETA Notification View

2. To edit the notification text that is shown in the popup and, press the “Notification Text” edit field. A virtual keyboard will appear. Enter the desired notification text and press enter on the virtual keyboard.
3. Select if the ETA notification should be set for the current active route only or for all future active routes as well by pressing the drop list named “Type” and choose “Single” (Current route) or “Every Route”.
4. Edit the time before ETA of the active route when the ETA notification should be activated by pressing on the “Hours” edit field and “Minute” edit field.
5. Press “Save” to set the notification.

8.2.4.3 Edit Scheduled Notification

1. Select the alert to edit in the alert list of the *Scheduled Notifications* view.
2. Press the button “Edit Notification” to show the *Edit Notification*view.
3. Edit the parameters as described in sections 8.2.4.1 and 8.2.4.2.
4. Press “Save” to save the changes.

8.2.4.4 Delete Scheduled Notification

1. Select the notification to delete in the notification list of the *Scheduled Notifications* view.
2. Press the button “Delete Notification”.

8.2.4.5 View Scheduled Notification

1. Select the alert to view in the alert list of the *Scheduled Notifications* view.
2. Press the button “View Notification”. The *View Time Alert* view or *View ETA Notification* view will be shown where details about the selected notification are displayed.
3. Press “Back” to exit to the *Scheduled Notification*view again.

8.2.5 Sun/Moon

The *Sun and Moon* prediction features shows sun and moon states, calculated based on the current position and date.

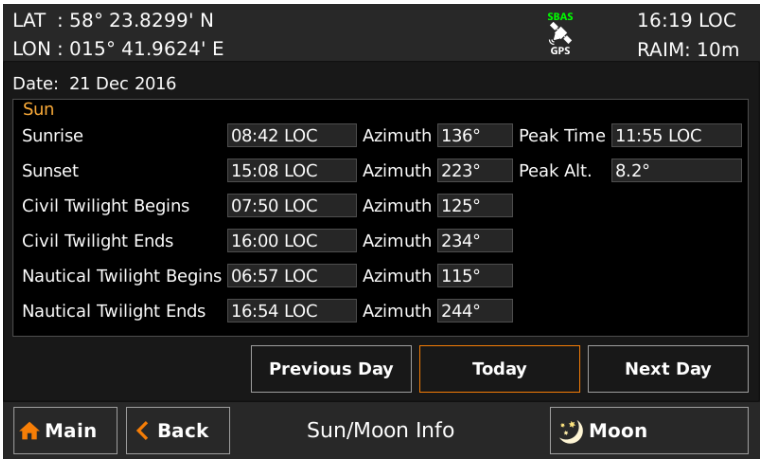


Figure 72 – Sun Info View

Sunrise

The estimated time of the appearance of the sun's upper circumferential edge as rises over the horizon.

Sunset

The estimated time of the disappearance of the sun's upper circumferential edge as it sets below the horizon.

Civil Twilight

Civil Twilight begins when the sun is less then 6° below the horizon in the morning and ends when reaching 6° below the horizon in the evening. This time is the approximated limit which the solar illumination suffices for the human eye to clearly distinguish terrestrial objects without aids.

Nautical Twilight

Nautical Twilight begins when the sun is less then 18° below the horizon in the morning and ends when reaching 18° below the horizon in the evening. This time is the approximated limit for which sailors can navigate via the horizon at sea.

Azimuth

Azimuth is the approximated horizontal angle, relative to north, the sun has in the certain state.

Peak Time

The estimated time when the sun is at its highest relative to the horizon.

Peak Alt.

The estimated time when the sun is at its highest relative to the horizon.

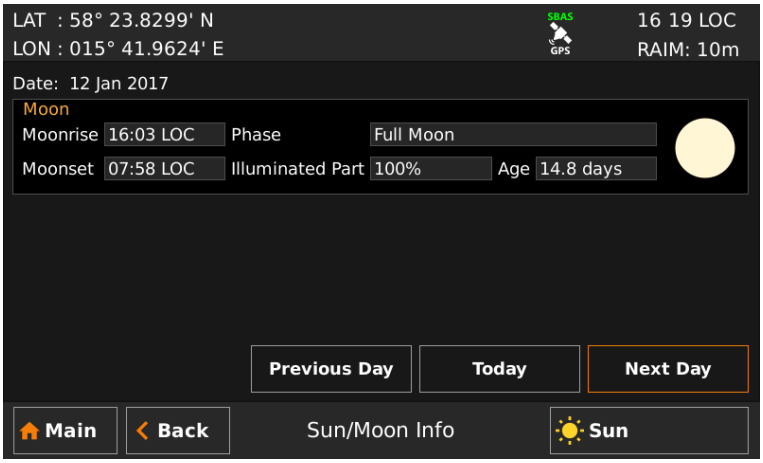


Figure 73 – Moon Info View

Moonrise

The estimated time of the appearance of the moon's upper circumferential edge as rises over the horizon.

Moonset

The estimated time of the disappearance of the moon's upper circumferential edge as it sets below the horizon.

Age

The estimated age since last “New Moon”.

Illuminated Part

The estimated percentage of the moon’s surface that is illuminated.

Phase

Name of the moon’s illumination phase, dependent on the moon’s expected illumination and age.

Phase	Illuminated Part
New Moon	0%
Waxing/Waning Crescent	1% - 49%
First Quarter	49% - 51%
Waxing/Waning Gibbous	51% - 99%
Full Moon	100%

8.3 Status Menu

The *Status Menu* can be accessed from the *Main Menu* and contains views of currently active alerts, raw data, navigation status and information about the equipment's hardware and software.

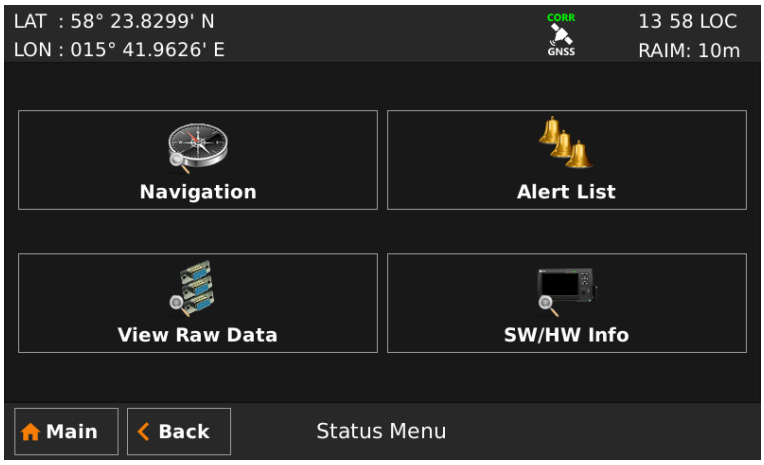


Figure 74 – Status Menu

8.3.1 GNSS / DGNSS Overview

The *GNSS/DNGSS Overview* view is accessible by **Main Menu → Status → Navigation → GNSS/DGNSS → GNSS/DGNSS Overview.**

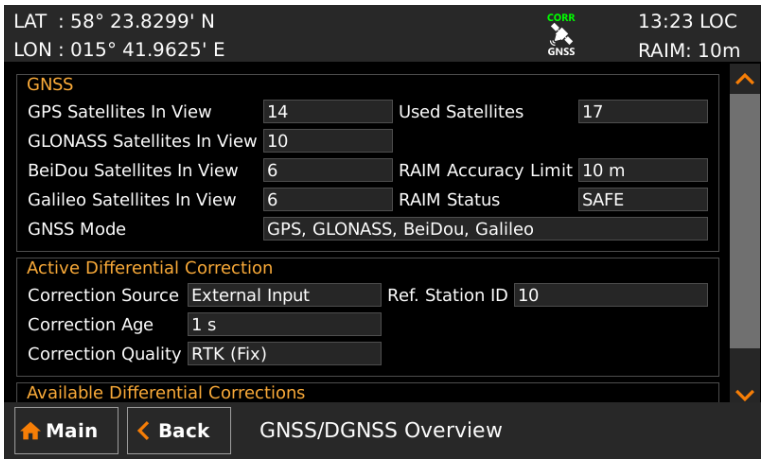


Figure 75 – GNSS/DGNSS Overview

The *GNSS/DGNSS Overview* displays information related to the current navigation solution:

Satellites In View (GPS, GLONAS, BeiDou, Galileo)

Number of satellites from which signal is received.

Used Satellites

Number of GNSS satellites currently used in the navigation solution.

GNSS Mode

Shows the Navigation Satellite Systems which are in use.

RAIM Accuracy Limit

The currently used RAIM accuracy limit used in the RAIM calculations. See chapter 4 “Concepts and Terminology” for more information.

RAIM Status

The current RAIM status result which can be Safe, Unsafe or Caution. The RAIM status is also indicated by RAIM LED on the front of the R5 SUPREME CDU. A green LED corresponds to the safe state, yellow to caution state and red to unsafe state.

Correction Source

The currently used correction source for differential correction which can be *Beacon, SBAS, External* or None (-).

Ref. Station ID

The reference identity of the currently applied differential corrections (if any).

Correction Age

The time difference between navigation solution and reference time for the applied corrections (if any).

Correction Quality

The quality indicator of the currently used corrections (if any).

Beacon Tuning

Manual or *Frequency Scan*. Only displayed when correction source is *Beacon*.

DGNSS warning

A warning that can be shown and which is related to an active DGNSS *Integrity Alert*. The warnings that can be displayed are:

- *No Signal*. A correction source for GNSS other than None has been selected in the *GNSS Configuration* view and more than ten seconds have passed since new differential corrections were applied to the navigation solution.
- *Station Unhealthy*. Correction source *Beacon* has been selected and the radio beacon station in use indicates an unhealthy status.
- *Station Unmonitored*. Correction source *Beacon* has been selected and the radio beacon station in use indicates an unmonitored status.
- *Poor signal*. Correction source *Beacon* has been selected and the word error rate of the received signal in use exceeds 10%.

Available Differential Corrections

Corrections sources that currently receives valid differential corrections and are configured to be allowed/enabled.

8.3.2 Closest Beacons

This view is accessible by **Menu → Status → Navigation → GNSS / DGNSS → Corrections → Beacon → Closest Beacon** and shows a list of the ten closest beacon stations. To show more information about a particular Beacon station, select it in the list and press “Extended Info”. The currently used beacon station is marked with green colour in the list.

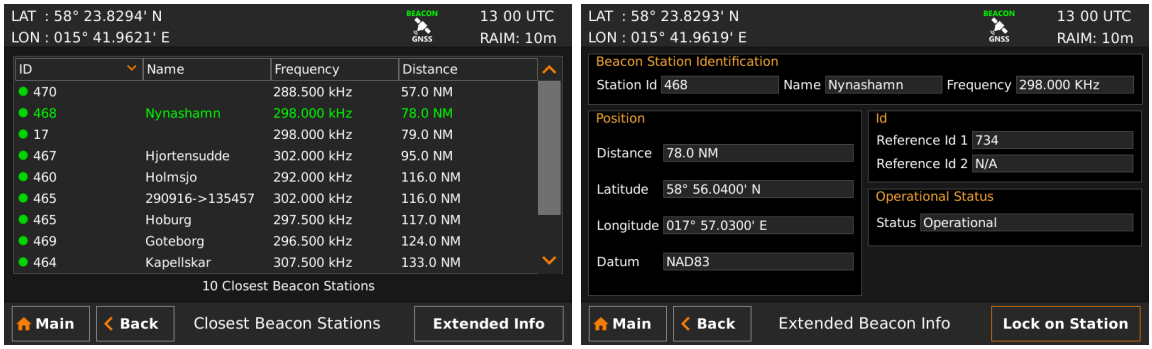


Figure 76 – Closest Beacon Stations

8.3.3 Currently Selected Beacon

The *Currently Selected Beacon* view is accessible by **Menu → Status → Navigation → GNSS / DGNSS → Corrections → Beacon → Currently Selected Beacon** and shows information related to the Navigation Sensor’s beacon reception. The view is only accessible if an R5 DGNSS Navigation Sensor is used.

Figure 77 – Currently Selected Beacon

The following information is displayed:

Station ID:	The reference identity of received corrections from the tuned beacon station.
Station Name:	Name of the beacon station.
Beacon Id:	The Id for the beacon transmitter from which corrections are received.
Range:	Current range to the beacon station from which currently used corrections are received.
Freq:	The frequency of the currently selected beacon station.

(Freq) Mode:	The frequency tuning mode which can be *Manual*, *Auto* or *Database*.
Bitrate	Beacon receiver bit rate.
(Bitrate) Mode:	Beacon receiver bit rate selection mode: *Manual* or *Auto.*
Signal:	Signal strength of the received beacon signal.
SNR:	Signal to noise ratio. All values above 15 are good SNRs for the beacon signal.
WER:	Word error rate, percentage of bad data words in the last 25 words received.
Health:	Health indication received from the tuned beacon station.
Firmware:	Firmware version for the internal beacon receiver.
Throughput:	Message throughput.

8.3.4 Beacon Database

The *Beacon Database* view is used for inspection of the radio beacon station database stored in the R5 DGNSS Navigation Sensor. The *Beacon Database* view is accessed from **Main Menu → Status → Navigation → GNSS / DGNSS → Corrections → Beacon → Beacon Database** and is only available when using the DGNSS version of the R5 Navigation Sensor.

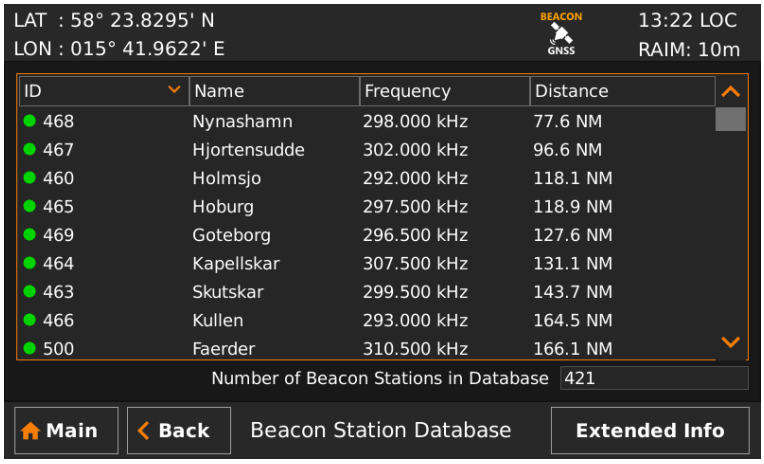


Figure 78 – Beacon Station Database

The beacon station list can be sorted by ID, Name, Frequency or Range by pressing the column headers in the view. The currently used beacon station is marked with green colour text in the list. Each beacon station is also marked with an operational status icon:

- Green icon, beacon station is operational
- Yellow icon, beacon station operational status is unknown
- Red icon, beacon station is NOT operational, do not use.

To view more information about a beacon station, select the station in the list and press “Extended Info”. The *Extended Beacon Info* view will be shown. In this view it also possible to manually lock on the selected station by pressing the button “Lock on Station”. Navigation Sensor will then try to tune the beacon receiver to the selected stations frequency. If the tuning was successful, the new station will be marked with green colour text in the beacon database list to indicate that it is currently used.

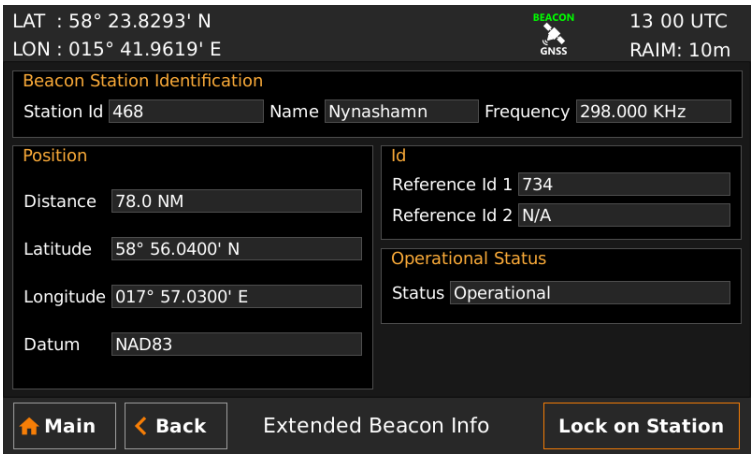


Figure 79 – Extended Beacon Info

8.3.5 SBAS

The *SBAS* view is accessible by **Main Menu → Status → Navigation → GNSS/DGNSS → Corrections → SBAS**

The *SBAS Information* view shows information relating to the one or more geostationary SBAS satellite from which the Navigation Sensor is receiving a signal or is expecting one. The view provides information about expected SBAS satellite, such as, identity (PRN number) together with its signals bit error rate, elevation and azimuth angle from the own current position to the satellites.

If SBAS is currently used as correction source, the applied satellite’s information will also be shown in the in the lower information box, otherwise ‘No SBAS Satellite In Use’ will be displayed.

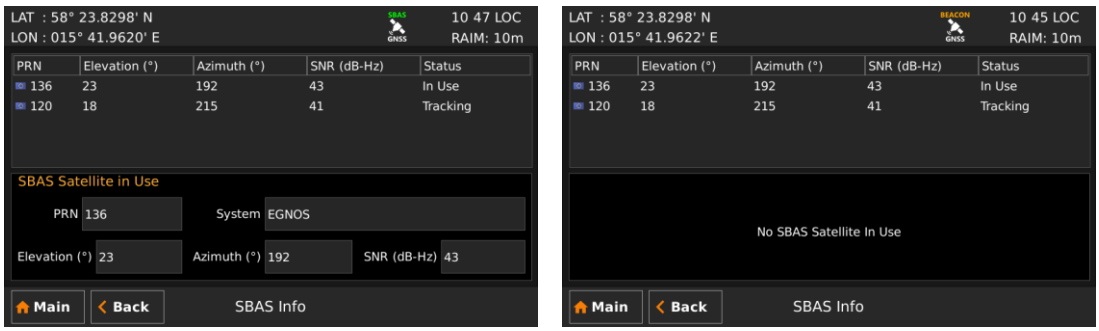


Figure 80 – SBAS Info

8.3.6 Atlas

The *Atlas* view is accessible, if the unit has a “PRO” license with an active “Atlas” subscription, by **Main Menu → Status → Navigation → GNSS/DGNSS Corrections → Atlas**

The *Atlas status* view shows information relating to the Atlas satellite from which the Navigation Sensor is receiving a signal or is expecting one. The satellite’s reference identity and its signals bit error rate are provide by the view, as well as the satellite’s longitude position, elevation and azimuth angle relative to the own position.

If Atlas not is used as correction source, the view will display “No Atlas Satellite In Use”.

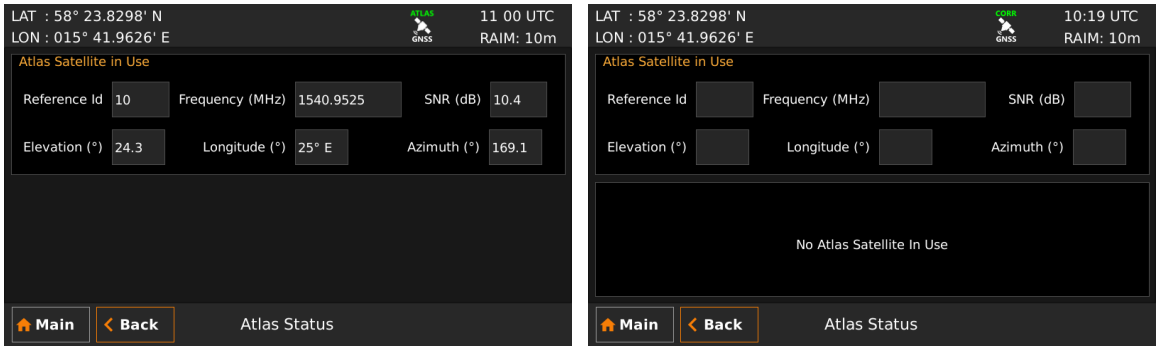


Figure 81 – Atlas status view

8.3.7 Satellite Info

The *Satellite Info* view is accessible by **Main Menu → Status → Navigation → GNSS/DGNSS → Satellite Info.**

The *Satellite Info* view shows information relating to GNSS satellites that the R5 Navigation Sensor is receiving or expecting to receive signals from. The view displays the ID, elevation and azimuth of each satellite, and current signal to noise ratio (SNR) of each satellite’s signal. A flag before the Satellite ID will indicate the GNSS system type (US flag = GPS, Russian flag = GLONASS, Chinese flag = BeiDou, European flag = Galileo). The elevation value represents the satellite’s angular height above the horizon. The azimuth value represents the satellite’s angular horizontal position, counted clockwise from north. The view also displays current operating mode and dilution of precision (DOP) values. The DOP values are a purely geometrical contribution to the uncertainty in a position fix, and is not affected by signal levels. Smaller values are better, and a PDOP < 2 is considered excellent.

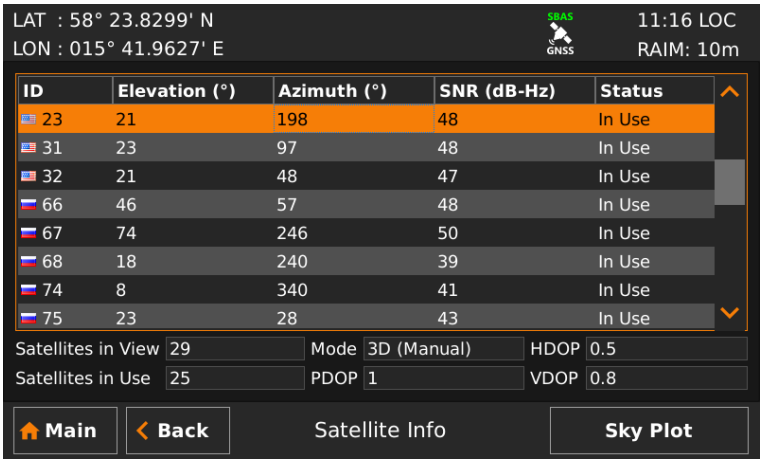


Figure 82 – Satellite Info

8.3.7.1 Sky Plot

From the *Satellite Info* view is the *Sky Plot* view accessible. In this view a sky maps is showing the estimated position of the satellites in form of colored targets/items, based on the received almanac. When clicking on a target/item, information is displayed about the related satellite in the *Selected Item* box.

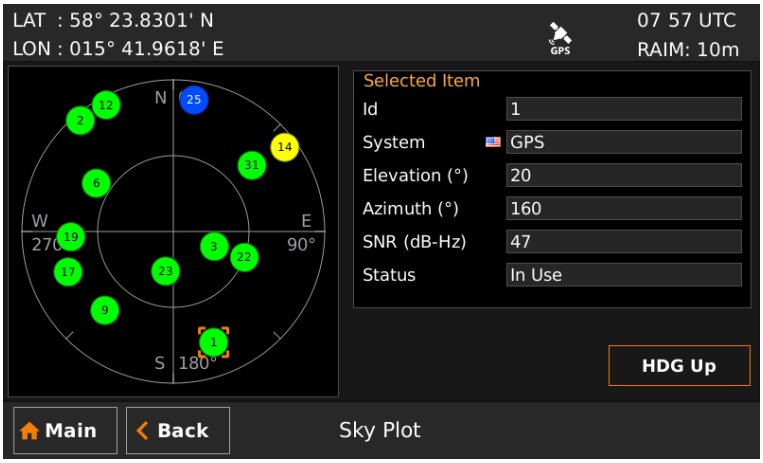


Figure 83 – Satellite Sky Plot

The information displayed are.

- Id: Satellite's identification number.
- System: Shows which global navigation system the satellite belongs.
- Elevation: The approximated vertical angel, relative to the horizon, pointing against the satellite position.
- Azimuth: The approximated horizontal angel, relative to north, pointing against the satellite position.
- SNR (Signal-to-Noise Ratio): Signal Strength relative to noise.
- Status: Shows if the target used by the unit or tracking for it.

Depending on how good signal ("SNR") received from a satellite will the targets/items change color:

- 🟢 - SNR over 40 dB-Hz and status *In Use*
- 🟡 - SNR below 40 dB-Hz and status *In Use*
- 🔵 - SNR 0 dB-Hz and status *Tracking*

8.3.8 Alert Log

The *Alert Log* view is accessible by **Main Menu → Status → Navigation → GNSS / DGNSS → Alert Log.**

The *Alert Log* shows a list with logs over the 146 last activations and in-activations of alerts, included with timestamps. Besides the list are two buttons are included in the view, which makes it possible to "Clear Log" and "Save Log to USB". When saving log to USB the log-list will be saved as a .txt file on the inserted USB.

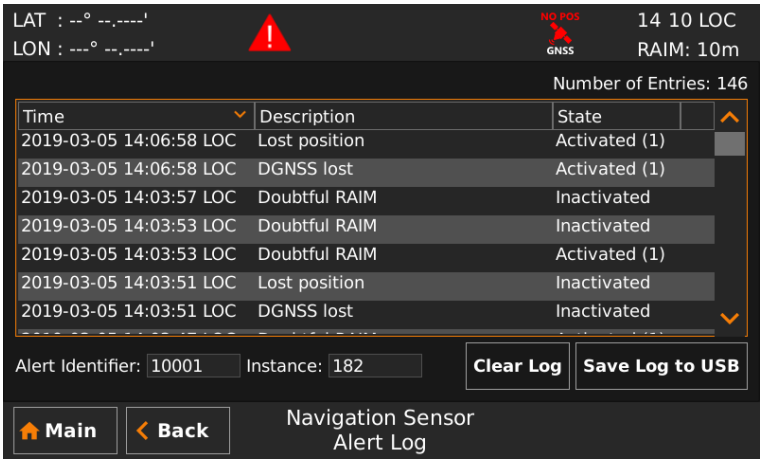


Figure 84 – Navigation Sensor Alert Log

8.3.9 Trip Logs

The *Trip Logs* view shows a status summary of the three trip logs in the system. Two individual trip logs (#1 and #2) are available as well as a 'total' trip log.

The trip logs accumulate travelled distance during the on time of the R5 SUPREME Navigation System. Trip logs #1 and #2 are individually resettable and will also provide accumulated time moving and average speed since last reset.

The *Trip Logs* view can be accessed from **Main Menu → Status → Navigation → Trip Logs.**

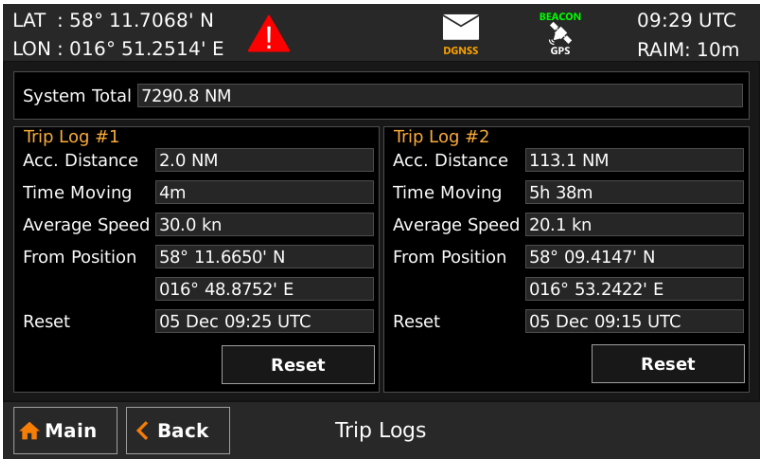


Figure 85 – Trip Logs

Press the button "Reset" to reset the trip log. If a valid position is available, it will be captured and used as the starting position for the trip log. If the system has no valid position, a start position will be captured the next time a valid position is available.

Note: Position displacement that occurs when the CDU is switched off will not be included in the accumulated trip distance. Position displacement that occurs when the CDU is switched on but no valid position is available will be included in the trip distance when a valid position is received, provided that a valid position has been available at least some time after the CDU was switched on.

8.3.10 Track Log Status

The *Track Log Status* view is accessible by **Main Menu → Status → Navigation → Track Log Status.**

This view shows status of SD-Card, if existing, status of track logging and which track log interval the R5 SUPREME CDU is configured to. The view also allows the user to start and stop a logging. The logging is saved on an existing SD-Card in the form of nmea-files containing RMC and WPL sentences/messages.

Note: Only one nmea-file is created for each day, therefore if multiple logs are performed during one day; all the logs will be merged together into the same file.

Warning! Stop logging before removal of SD-Card. Otherwise data may be corrupted.

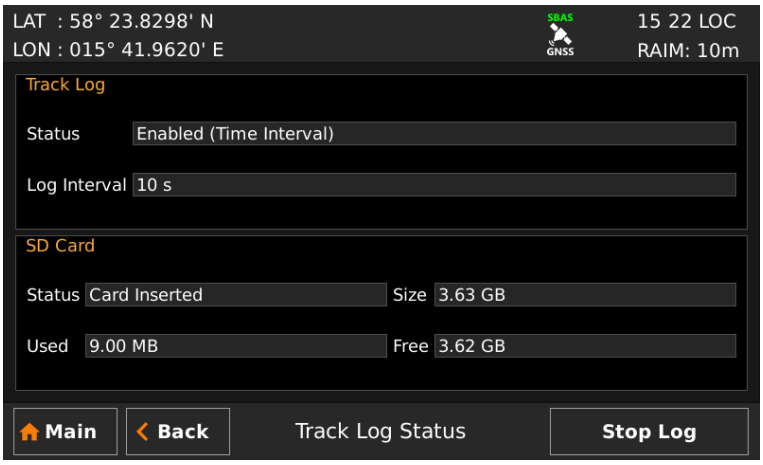


Figure 86 – Track Log Status

8.3.11 Track Log View

The *Track Log View* is accessible by **Main Menu → Status → Navigation → Track Log View.**

This view allows the user to watch the "Track Logs" on an existing SD-Card. The view list will just show the logs from an nmea-file including bypass of a waypoint.

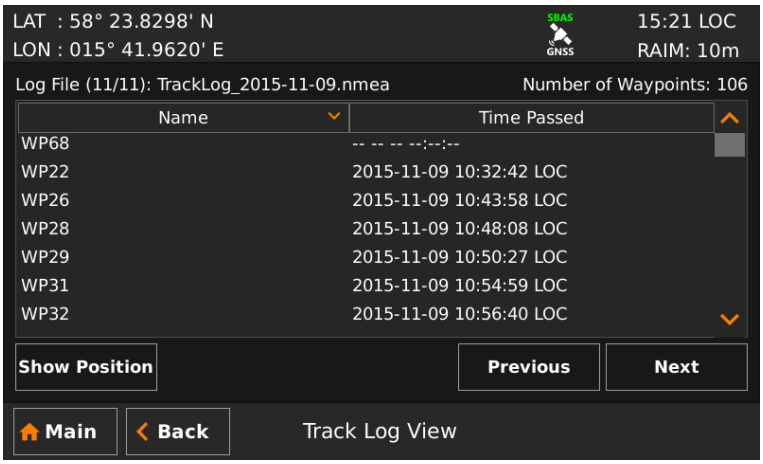


Figure 87 – Track Log View

8.3.12 Alert List

All currently active and enabled alerts are shown in the *Alert List* view that can be accessed from **Main Menu → Status → Alert List** or by clicking on the alert indication in the status bar.

When selecting an alert, extended information will be shown in the bottom of the view. For a list of all alerts and there extended information, see section 13.3 and 8.4.

If selecting an unacknowledged/silenced alert in the list the “Acknowledge” button in the right down corner will be enabled, allowing the user to acknowledge the alert. In other cases the ”Acknowledge” button will stay disabled either to non-selection or selection of already acknowledge alert.

Note: Not all alerts requires acknowledgement.

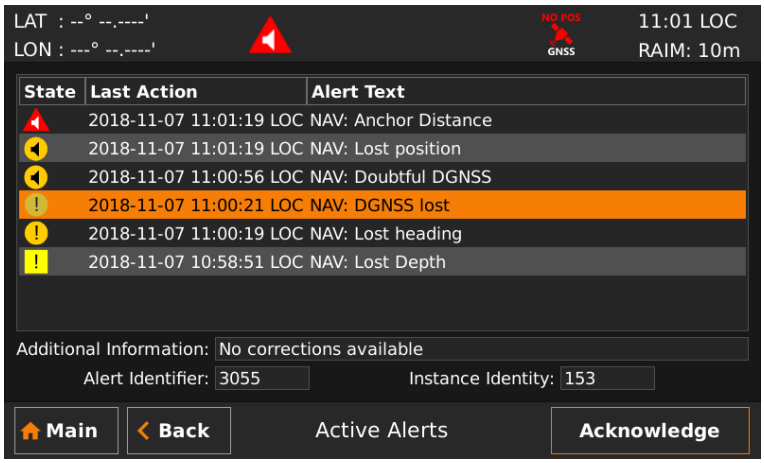


Figure 88 – Alert List View

8.3.13 View Raw Data

This view displays the incoming data on the selected serial port. It is also possible to pause the data on the screen by pressing the “Pause” button. The *View Raw Data* view can be a helpful tool when trouble shooting the system to see what sensor input is actually received on each port.

Characters are displayed as according to ISO 8859-1 (Latin-1). Non printable characters are displayed with symbol names as “<SYMBOL>”, e.g. carriage return and line feed are displayed as “<CR><LF>”.

Use ‘Clear View’ button to clear current log data.

The view can be accessed from **Main Menu → Status → View Raw Data**.

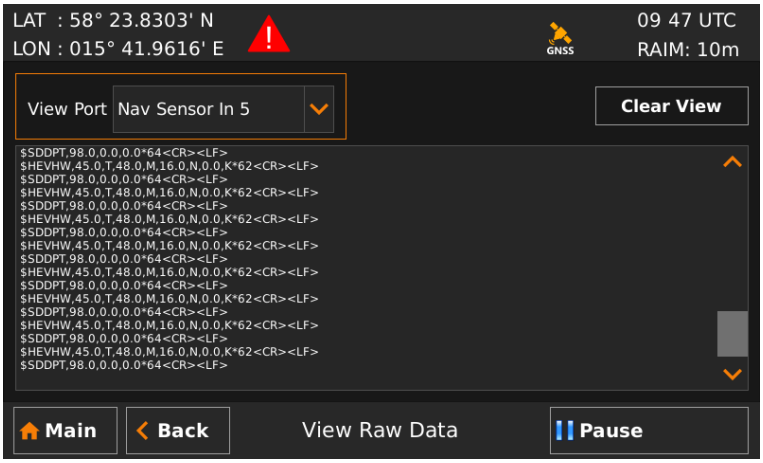


Figure 89 – View Raw Data View

8.3.14 SW/HW Info

This view is accessed from **Main Menu → Status → SW/HW Info** and displays the software and hardware revisions for the R5 SUPREME Navigation System. This information should always be provided when in contact with Saab AB (publ) TransponderTech support. The button “Show/Hide Ext. Info” is used to switch on/off additional information.

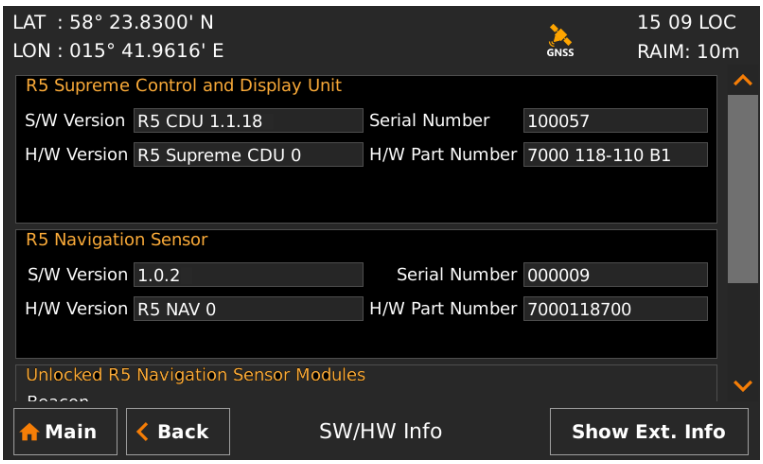


Figure 90 – SW/HW Info View

8.4 Alert Status

The R5 Navigation system is a “Bridge Alert Management” and “Legacy Alert” compliant system of “Type P” according to IEC 62923-1 ed.1. Capable to handle and generate necessary information for communication with old as well as new systems.

All active alert in the R5 CDU are both presented visually and by audio signals according to IEC 62923-1 ed. 1. The visual icon used for representing the alert states in both the “Alert List” –view and the “Status Bar”, can be seen in section 6.6.1. The audio signals behaviour is described in the subsection 8.4.1.

8.4.1 Priority

Each alert is prioritized to some of following priorities:

- **Alarm** – Highest alert level in the R5 Navigation system, requiring immediate attention and action. Unacknowledged causing three beeps audio signals each 7,5s.
- **Warning** – Condition requiring immediate attention, but no immediate action. Unacknowledged and escalated warning results in a two beeps audio signal. (Warnings escalates each two minutes as long as they are in the state "Active Unacknowledged".)
- **Caution** – Lowest alert level R5 Navigation system, requiring awareness out of the ordinary consideration of the situation or of given information and does not causing any audio signal.
- **Notification** – Non-alert level not causing any audio signal, notifying about upcoming events such as expiring subscriptions etc.

Note: Legacy alerts received in form of ALR sentence inputs are handled as priority level "Warning".

8.4.2 Category

Each alert is categorized to some of following classes:

- **A** - Alert for which graphical information at the task station directly assigned to the function generating the alert is necessary, as decision support for the evaluation of the alert related condition.
- **B** - Alert where no additional information for decision support is necessary besides the information which can be presented at the central alert management interface.
- **C** - Alert that cannot be acknowledged on the bridge but for which information is required about the status and treatment of the alert

Note: The R5 navigation system MkII only generates alerts of category B.

8.4.3 Grouping and Aggregation

The R5 Navigation MkII system does not apply these features.

8.4.4 Alert Commands

This section describes the effect of commands applicable on alerts in the R5 Navigation MkII system.

8.4.4.1 Acknowledgement

By acknowledge an active or silenced alert, the alert will still be present but not able to escalate and causing more audible alert signals. If the alert is in an other state the active or silenced the command will have no effect on the alert.

8.4.4.2 Silence

By silence an active alert it will still be present and unacknowledged but prevented from causing audible signals for 30 seconds. If the alert is in an other state the active the command will not affect on the alert.

Note: The CDU does not provide the functionality of this operation; it requires an external action/input of, for example, a CAM system.

8.4.4.3 Query

By query an alert, the alert will not get affected but will.But the alert will be output one additional time for the extrenal questioner.

8.4.4.4 Responsibility transfer

The R5 Navigation MkII system does not apply this feature.

8.4.5 Alert Identification List

In Table 6 all 19 alert that the R5 Navigation system can generate are listed with Alert identifiers, instance identity, Priority and texts for both “Alert Legacy” and “Bridge Alert Management”.

Observe that all alerts generated by the R5 SUPREME AIS system are of *“Category B”* and does not support responsibility transfer functionality**!**

Alert ID	Instance ID	Priority	Alert Text(BAM)	Description Text(BAM)	Alert Description (Legacy Alert)
3002	155	Warning	Lost GNSS	Check GNSS data stream	GNSS Connection Lost
3003	166	Caution	Lost Redundancy	Check GNSS redundancy	Redundant System Connection Lost
3008	171	Warning	GNSS Malfunction	Check GNSS, malfunctioning	Sensor Malfunction
3012	169	Warning	Doubtful DGNSS	Check DGNSS status	DGNSS Integrity Alert
3012	154	Warning	Doubtful GNSS	Check GNSS settings	GNSS Not Initialized
3013	163	Caution	Doubtful RAIM	Check GNSS, caution RAIM level	RAIM Status - Caution
3013	164	Caution	Doubtful RAIM	Check GNSS, unsafe RAIM level	RAIM Status - Unsafe
3015	152	Warning	Lost Position	Check GNSS, position data unavailable	Position Data Lost
3015	161	Warning	Lost Heading	Check GNSS, heading input	Heading Data Lost
3016	162	Caution	Lost Depth	Check GNSS, depth input	Depth Data Lost
3024	156	Alarm	XTD Limit	Cross-track distance too large	XTE Limit Exceeded
3032 (3031)	167	Warning (Alarm)	Anchor Distance	Anchor distance exceeded	Anchor Alert Distance Exceeded
3038	157	Warning	Approaching WPT	Waypoint distance exceeded	Approaching Waypoint (Distance)
3038	170	Warning	Approaching WPT	Waypoint time exceeded	Approaching Waypoint (Time)
3055	153	Warning	DGNSS Lost	No corrections available	DGNSS Position Data Lost

Alert ID	Instance ID	Priority	Alert Text(BAM)	Description Text(BAM)	Alert Description (Legacy Alert)
3056	151	Caution	HDOP Exceeded	HDOP precision exceeds limit	HDOP Limit Exceeded
3065	172	Warning	RTK Base Limit	Check GNSS RTK base position	RTK Position Invalid
10001	181	Caution	Out 1 degraded	Excessive buffering. Check data rates	Out 1 Serial Degraded
10001	182	Caution	Out 2 degraded	Excessive buffering. Check data rates	Out 2 Serial Degraded
10001	183	Caution	Out 3 degraded	Excessive buffering. Check data rates	Out 3 Serial Degraded
10001	184	Caution	Out 4 degraded	Excessive buffering. Check data rates	Out 4 Serial Degraded
10001	185	Caution	Out 5 degraded	Excessive buffering. Check data rates	Out 5 Serial Degraded
10001	186	Caution	Out 6 degraded	Excessive buffering. Check data rates	Out 6 Serial Degraded
10001	187	Caution	Out 7 degraded	Excessive buffering. Check data rates	Out 7 Serial Degraded
10001	188	Caution	Out 8 degraded	Excessive buffering. Check data rates	Out 8 Serial Degraded
10002	190	Warning	User 3 disabled	Data overload. Check data rates	User 3 Serial Disabled
10002	191	Warning	Out 1 disabled	Data overload. Check data rates	Out 1 Serial Disabled
10002	192	Warning	Out 2 disabled	Data overload. Check data rates	Out 2 Serial Disabled
10002	193	Warning	Out 3 disabled	Data overload. Check data rates	Out 3 Serial Disabled
10002	194	Warning	Out 4 disabled	Data overload. Check data rates	Out 4 Serial Disabled
10002	195	Warning	Out 5 disabled	Data overload. Check data rates	Out 5 Serial Disabled
10002	196	Warning	Out 6 disabled	Data overload. Check data rates	Out 6 Serial Disabled
10002	197	Warning	Out 7 disabled	Data overload. Check data rates	Out 7 Serial Disabled

Alert ID	Instance ID	Priority	Alert Text(BAM)	Description Text(BAM)	Alert Description (Legacy Alert)
10002	198	Warning	Out 8 disabled	Data overload. Check data rates	Out 8 Serial Disabled
10002	199	Warning	User 4 disabled	Data overload. Check data rates	User 4 Serial Disabled

Table 6 – Alert Identification List

Maximum number of alerts possible to occur: 36

Note: Identifiers and priorities within parentheses describes the alert after escalation, if there is none the alert, if escalation is possible, escalates to the same identifier and priority.

Note: When and way the alerts appears can be read in section 13.3

Note: When working with "Legacy alert" compatibility the Instance identity is the same as the "Unique Alarm Identifier"

8.5 DGNSS Messages (DGNSS version only)

It is possible to receive DGNSS messages via the beacon receiver (RTCM, Type 16 messages). When a new DGNSS message received, a DGNSS message icon will be displayed in the status bar. All received messages can be read in the *DGNSS Message* view, accessed from **Main Menu → Messages → DGNSS Messages**.

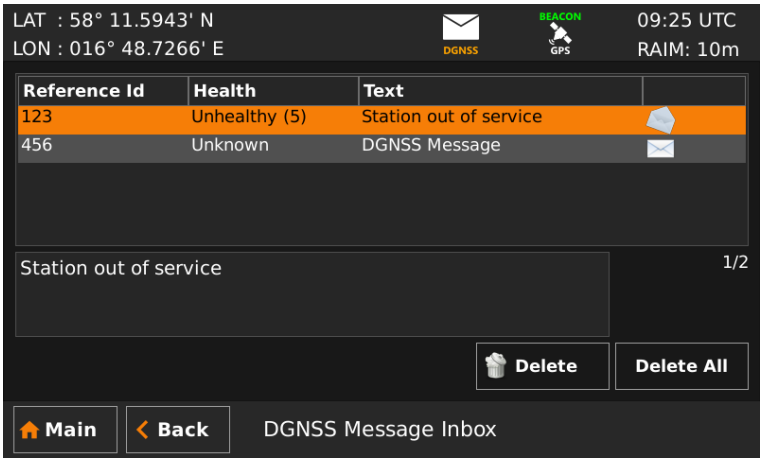


Figure 91 – DGNSS Message View

9 WEB INTERFACE

The R5 Navigation Sensor has a web interface, just requiring an Ethernet connection, which gives the user a possibility to operate and configure the sensor without needing a R5 SUPREME CDU. The interface is accessible by the most commonly browsers, by only enter the R5 Sensor's IP address which in default is set to be 172.16.0.4 on *Eth1* and 172.17.0.4 on *Eth2*.

9.1 Status View

In the *Status* view is information about how well the system preforms displayed. The view reports information about the GNSS- and Beacon receivers' performances together with alert status and satellite information.

For more information about:

- GNSS Fix see section 8.1.1 and 8.1.6
- Beacon Status see section 8.3.3
- Alerts Status see section 8.3.12 and 13.3
- Satellite Info see section 8.3.7
- Sky Plot se section 8.3.7.1

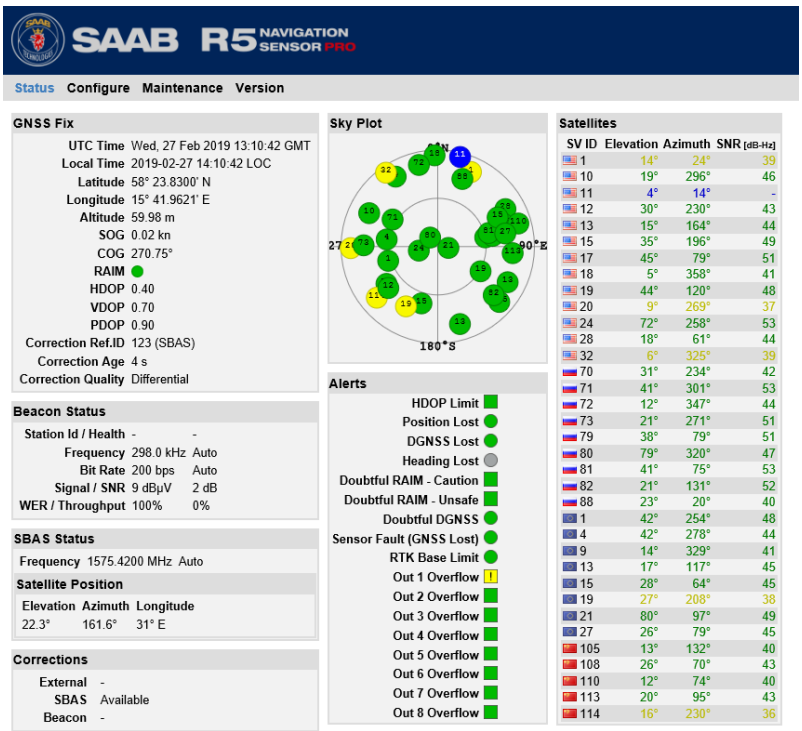


Figure 92 – Web Interface, Status view

9.2 Configuration View

In the *Configure* view the R5 navigation Sensor can be set to work as desired.

For more information about configuration parameters related to:

- GNSS, see section 10.1.1 and 10.1.2
- SBAS, see section 10.1.3
- Beacon, see section 10.1.4
- Device Position, see section 10.1.6
- Interface, see section 10.1.20
- Alerts, see section 10.1.17
- Out/In Ports, see section 10.1.18
- Output Sentences, see section 16.1

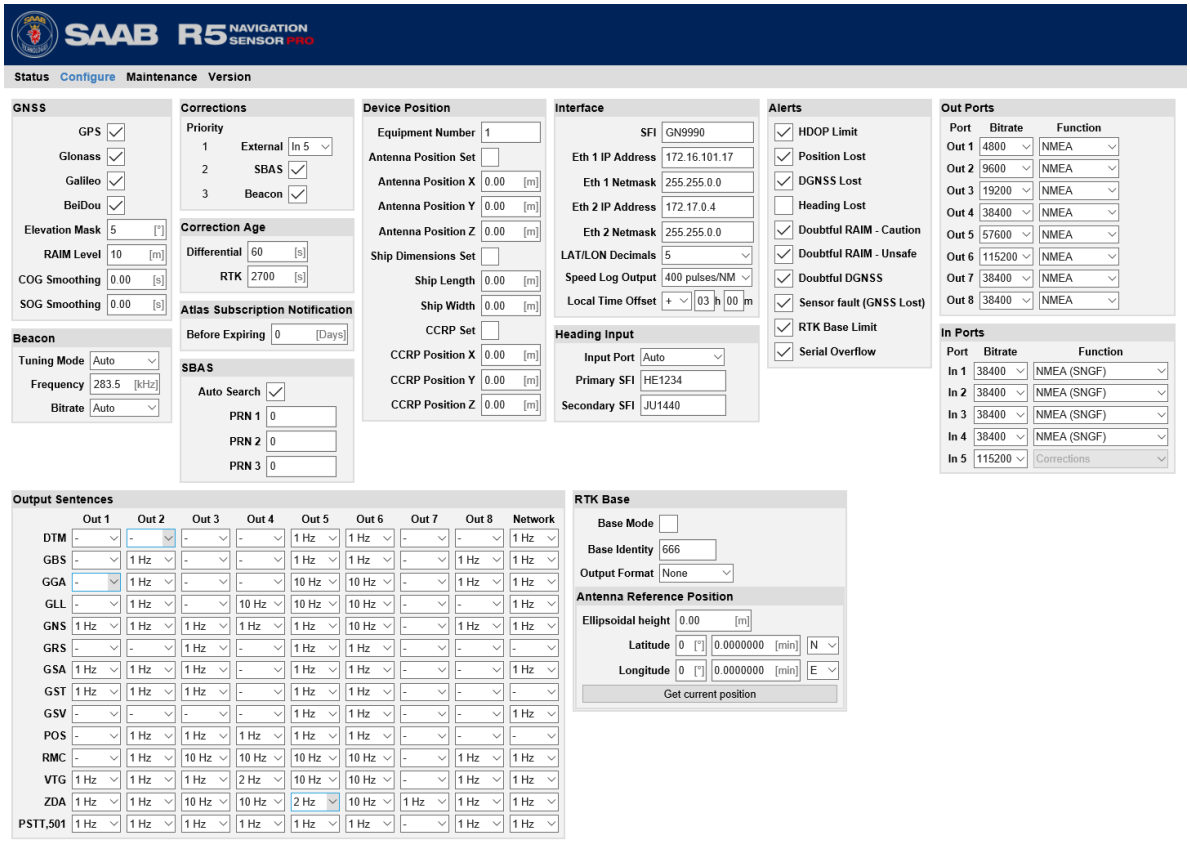


Figure 93 - Web Interface, Configure view

9.3 Version View

In the *Version* view information about the hardware and software, in both the main unit and the integrated receivers, is displayed. This information should always be provided when in contact with Saab AB (publ) TransponderTech support.

Figure 94 - Web Interface, Version view

9.4 Maintenance View

The *"Maintenance"* view's functionalities are the uploading of Software/Firmware, saving/loading/restoring configuration settings, license handling, alert logging and processing of password.

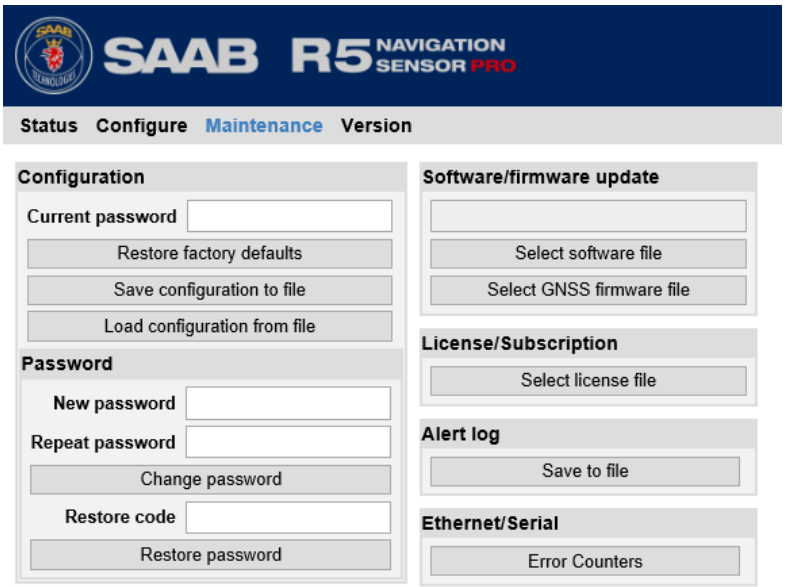


Figure 95 - Web Interface, Maintenance view

9.4.1 Configuration

This application in makes it possible to save the current configuration settings as a .navcfg file or load configuration settings form an already saved .navcfg file. It also provides the possibility to reset the sensor to default settings.

If a password has been set, the sensor will require that correct password is insert before proceeding with loading configurations or performing a factory reset. Refer section 12.2.

9.4.2 Upgrade/Update

The upgrade/update applications in the web interface makes it easy to upload new software/firmware versions. To perform an upgrade through the web interface:

- Download the latest software package from our website (see below)
- Connect the computer to the same network as the sensor
- Enter the web interface by a preferred browser and enter the sensors current IP address (Be sure that the computer has a valid/matching IP address)
- Enter the web interface's maintenance view
- Click either on the button "Select software file" and select the .bin file, or "Select GNSS firmware file" and select the .gnssfw file, form the software package to start an upgrade process

The newest packages can be found at: http://saab.com/security/maritime-traffic-management/traffic-management/R5-Supreme-NAV/. Both the software file "7000 118-709, R5_NAV-x.x.x.bin" and the GNSS firmware "7000 118-707, R5_NAV_GNSS-x.xAaxx " are included in the package, which should be uploaded to the R5 Navigation Sensor.

9.4.3 License

The web-interface provides the possibility to input license keys in an easy way, just:

- Connect the computer to the same network as the sensor
- Enter the web interface by a preferred browser and enter the sensors current IP address (Be sure that the computer has a valid/matching IP address)
- Enter the web interface's maintenance view
- Click on the button "Select license file" and select the .lic file that comes with the upgrade package

9.4.4 Password

The web interfaces provides the opportunity to set a new password or change the current password on a R5 Navigation Sensor. There is also a possibility to reset the unit's password to default (no password), but to be able to perform that operation one must contact Saab AB (publ) TransponderTech's Technical Support for receiving a restore code. Refer section 13.5.

9.4.5 Alert Log

The R5 Navigation Sensor logs the 146 latest activations and in-activations of alerts with timestamps. These logs can be exported by web interface's alert log functionality to a .txt file. Refer section 8.3.8.

9.4.6 Ethernet/Serial Error Counters

The R5 Navigation Sensor measures the rate of datagrams, detects and counts the amount of different defects on messages over the light weight Ethernet.

These counters also shows the amount of discarded messages on the output port for example caused by overflow.

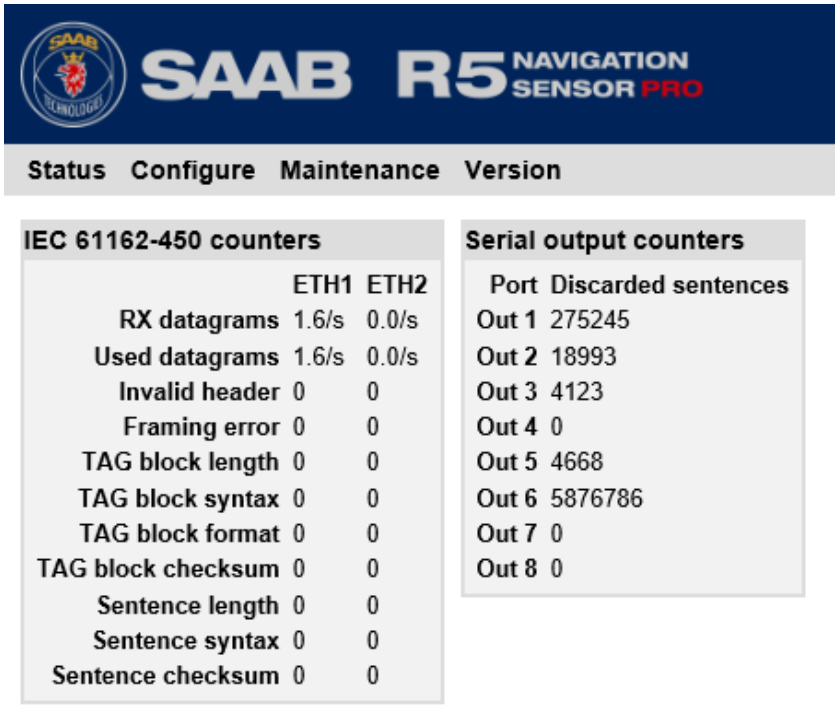


Figure 96 – Serial/Ethernet Error counters

10 CONFIGURATION

This chapter describes what configuration possibilities the R5 SUPREME Navigation System has.

10.1 Configuration Parameters

The following sections lists and describes all the parameters that can be configured in the R5 SUPREME Navigation System. All the configuration sub menus can be found under **Main Menu → Maintenance →Configuration**.

10.1.1 Navigation

The *Navigation Configuration* view is accessed by pressing **Main Menu → Maintenance → Configuration → Navigation → Navigation Parameters**

Parameter Name	Description
Waypoint Pass Criteria	The criteria that should be used to determine if a waypoint has been passed or not. Refer to chapter 4 for more information.
Waypoint Pass Distance	If the Waypoint Pass Criteria is set to “Distance”, this parameter specifies the distance that should be used to determine if the waypoint has been passed or not. Refer to chapter 4 for more information.
Start Sail From	This parameter determines how the system should behave when starting to sail a new active route. If set to “No Waypoint (t0)”, the system will navigate to the first waypoint in the active route without calculating a cross-track distance. It will also output current position as ‘from’ waypoint with identifier ‘t0’ in active route RTE message. If set to “Start Position (t1)”, the system will create a waypoint with identifier ‘t1’ at current position when starting to sail the new route and thus create a leg between ‘t1’ and the first actual waypoint in the route. Cross-track distance will be calculated while sailing towards the first waypoint and ‘t1’ will be output as ‘from’ waypoint in route RTE message. The newly created ‘t1’ waypoint will be visible in the active route but it will not be added to the waypoint database.
Default RAIM Level	This is the default RAIM level that will be used by the system if no specific RAIM level is set on the current leg of the active route. The currently used RAIM level is always shown in the upper right corner of the R5 SUPREME CDU. *For more information about RAIM, refer to chapter 4.*

	All legs of a newly created route as well as incoming routes on serial interface will use the default RAIM level unless specifically changed in the route.
Navigation Algorithm	This is the default navigation algorithm that will be used for bearing and range calculation by the system if no other navigation algorithm is set on the on the current leg of the active route. **All legs of a newly created route as well as incoming routes on serial interface will use the default navigation algorithm unless specifically changed in the route.** *See chapter 4 for more information about the navigation algorithms.*
Cross Track Distance Limit	This parameter determines the default cross track distance (XTD) limit that is used by the system if no other XTD limit is set on the current leg of the active route. **All legs of a newly created route as well as incoming routes on serial interface will use this default XTD limit unless specifically changed in the route.** If the distance between the own ship and the current active leg exceeds the currently used XTD limit, the "XTD Limit" alert will become active. The alert remains active until the cross track distance becomes less than the set XTD Limit, or navigation along the active route stops.
Approach Distance	The Approach Distance parameter specifies at which distance to next waypoint the Waypoint Approaching (Distance) alert is raised.
Approach Time	The Approach Time parameter specifies the estimated time (in minutes) before arrival to the next waypoint when the Waypoint Approaching (Time) alert is raised. The time is estimated by dividing the calculated distance to the waypoint with the average SOG value (calculated over the time specified by the "Average SOG Time" parameter). The estimated time is accurate if the course is directly towards to the waypoint.
Average SOG Time	The Average SOG Time parameter defines the time period over which average speed is calculated when estimating time of arrival (ETA) to the end of the active route and Time To Go (TTG) to the next waypoint.

RTE/Rnn WP Limit	Determines the maximum number of remaining waypoints in the active route that shall be transmitted in RTE and Rnn messages.
Status Information	The Status Information parameter defines whether current position (when available) from a navigation sensor or the name of the next waypoint is to be displayed in the status bar at the upper left corner of the R5 SUPREME CDU.
Track Log Interval	This interval parameter defines how often a track sample will be taken during track log operation. *See 8.3.10 and 8.3.11 for more information about "Track Log".*
Automatically Selection Closest Tide Port	Enables the system to automatically choose the nearest inputted port for calculation and reporting of tides. *See 8.2.3 for more information about "Tide".*

10.1.2 GNSS/DGNSS

This view is accessed by pressing **Main Menu → Configuration → GNSS / DGNSS → GNSS / DGNSS**

Parameter Name	Description
Elevation Mask	This parameter sets the elevation cut-off mask angle, in degrees, for satellites. Any satellites below this mask angle will be ignored, even if available. The value should be between 0° and 60°, and the default value is 5°.
SOG Smoothing	The SOG Smoothing parameter allows you to adjust the level of responsiveness of the speed over ground (SOG) measurement, as displayed by the R5 SUPREME CDU and provided in the $GPVTG and $GPRMC sentences. The default value is zero, and increasing the value will increase the level of SOG smoothing. The setting of this parameter depends upon the expected dynamics of the vessel. If a ship is highly dynamic, this value should be set to a lower value since the filtering window needs be shorter in time, resulting in a more responsive measurement. However, if a vessel is very large and has much more resistance to change in its motion, this value can be increased to reduce measurement noise. The

	following formula provides some guidance on how to set this value: SOG smoothing = 10 / maximum acceleration (in m/s²). **If unsure on which value to set, it's best to be conservative and leave this parameter at the default setting of 0.00 seconds.**
COG Smoothing	The COG Smoothing parameter allows you to adjust the level of responsiveness of the course over ground (COG) measurement, as displayed by the R5 SUPREME CDU and provided in the $GPVTG and $GPRMC sentences. The default value is zero, and increasing the value will increase the level of COG smoothing. As with the SOG smoothing parameter, the setting of this parameter depends upon the expected dynamics of the vessel. If a ship is highly dynamic, this value should be set to a lower value since the filtering window needs be shorter in time, resulting in a more responsive measurement. However, if a vessel is very large and has much more resistance to change in its motion, this value can be increased to reduce measurement noise. The following formula provides some guidance on how to set this value initially. It is however recommended that you test how the revised value works in practice. COG smoothing = 10 / maximum rate of change in course (in °/s). *Note: The ship needs to be moving to calculate a valid COG value. Do not use COG values output while the ship is at rest as a basis for adjusting this parameter.* **If unsure on which value to set, it's best to be conservative and leave this parameter at the default setting of 0.00 seconds.**
GPS Support	GPS support allows the system to include GPS satellites in the navigation solution. This functionality is set to “Enabled” by default and can be disabled only when GLONASS Support is enabled.
GLONASS Support*	GLONASS support allows the system to include GLONASS satellites in the navigation solution. This functionality is set to “Enabled” by default and can be disabled only when GPS Support is enabled.
BeiDou Support*	Enabling BeiDou support will allow the sensor to include BeiDou satellites in the navigation solution. It is recommended to enable this functionality that, by default, is set to “Disabled”.

Galileo Support*	Enabling Galileo support will allow the sensor to include Galileo satellites in the navigation solution. It is recommended to enable this functionality that, by default, is set to “Disabled”.
Position Accuracy (Decimal Places)	This parameter controls the number of decimals used in to present latitude and longitude in position sentences.
Correction Age (Differential/RTK)	This parameter sets the maximum allowed age (in seconds) for correction data. The R5 Navigation Sensor is able to use old correction data for extended periods of time. The default setting is 120 seconds for correction with quality “Differential” and 2700 seconds for “RTK”. The lowest allowed value is 10 seconds and the highest 2700 seconds. When increasing the allowed correction age, ensure that the new setting meets your requirements as accuracy will degrade with increasing correction age.
External Corrections	This parameter allows input port to forward externally inputted differential corrections. “IN1” → “IN5”. These settings will command the system to apply external differential corrections, received in RTCM SC-104 format, on the selected input port. *If the unit holds a “RTK” license it is also capable to handle following input formats as well:* • *ROX* • *CMR/CMR+* • *RTCM 2/2.3/3* “None” makes the system operate in autonomous mode, not using any externally inputted differential corrections.
SBAS Support	This setting allows the system use SBAS satellite signals as source for differential corrections.
Beacon Support	In this setting the system will allow signals from IALA radio *Beacon* stations to be used as source for differential corrections. *This setting is only available when using an R5 DGNSS Navigation Sensor.*
Atlas Support	In this setting the system will allow signals from *Atlas* satellites to be used as source for differential corrections. *This setting is only available when using an R5 Navigation Sensor holds a “PRO” license with an “Atlas” subscription.*

**The multi GNSS mode can improve reliability in areas with poor GPS reception, and also make the sensor less sensitive to interference*

Note: From SW Version 1.2.3, the correction source configuration has been changed and have a slightly different functionality.

10.1.3 SBAS

This view is accessible by pressing **Main Menu → Maintenance → Configuration → GNSS/DGNSS → Correction Source → SBAS**

Parameter Name	Description
PRN Search Mode	Change between Automatic or Manual search mode. In Manual search mode, the R5 Navigation sensor will try to acquire signals from satellites with id (PRN) numbers input by the parameters PRN 1 and PRN 2 in the view. If only one particular satellite is to be tracked, input same number for both parameters. In Automatic search mode, the R5 Navigation Sensor will try to identify and track SBAS signals without user control of satellite selection.
PRN 1 (Primary)	The PRN of the primary satellite that should be used when operating in Manual PRN Search Mode.
PRN 2 (Secondary)	The PRN of the secondary satellite that should be used when operating in Manual PRN Search Mode.
PRN 3	The PRN of the third satellite that should be used when operating in Manual PRN Search Mode.

10.1.4 Beacon

This view is only available when using a R5 DGPS/DGNSS Navigation Sensor. It is accessible by pressing **Main Menu → Maintenance → Configuration → GNSS/DGNSS → Correction Source → Beacon**

Parameter Name	Description
Tuning Mode	The Tuning Mode parameter sets the frequency selection mode of the R5 DGNSS Navigation Sensor internal radio beacon receiver. The mode can be Frequency Scan, Manual or Database (Auto). In Frequency Scan mode, the beacon receiver will search available frequencies and tune to the strongest beacon signal. In this mode, the Navigation Sensor continuously performs background search to discover higher quality differential signals. While performing background searches, the navigation Sensor

	continues to receive differential corrections from the current radio beacon station. In Manual tuning mode, the Navigation Sensor tunes to the specified beacon frequency for receiving DGNSS signals. In Database mode, the receiver will search for the closest station based on its current location and distance to the internal list of station locations. The frequency and bit rate specified in the station database will be used and therefore these parameters are hidden when the Tuning Mode parameter is set to Database (Auto).
Frequency (kHz)	The Frequency parameter is used to set the frequency to use for receiving DGNSS Beacon signals, when the frequency mode parameter is set to manual. Valid frequencies are between 283.5 and 325 KHz, at 0.5 kHz intervals. This parameter is only available when Tuning Mode is set to manual.
Bit Rate Mode	The Bit Rate Mode parameter sets the bit rate mode to either Automatic or Manual. In Automatic mode the R5 DGNSS Navigation Sensor will automatically select the correct bit rate to use for demodulating the radio beacon signal. In Manual mode, the R5 DGNSS Navigation Sensor will use the specified bit rate. This parameter is automatically set to Auto when Tuning Mode is set to Database (Auto) since the bit rate specified in the database will automatically be used.
Bit Rate (bps)	The Bit Rate parameter is used to set the bit rate used for demodulation of the DGNSS Beacon signal when using the manual bit rate mode. The bit rate can be set to one of 50, 100 or 200 bps. This parameter is only available when Bit Rate Mode is set to manual.

10.1.5 Atlas

The *Atlas configuration* view is accessible, if the unit has a “PRO” license with an active “Atlas” subscription, by **Main Menu → Maintenance → Configuration → GNSS/DGNSS → Correction Source → Atlas**

Parameter Name	Description

Days Before Expires	Parameter sets how long before the Atlas subscription expiration date the system will give a indication. Default this parameter is set to 0 days, which disables the output of a Atlas subscription notification. *This setting is only available when using an R5 Navigation Sensor holds a "PRO" license.*

10.1.6 GNSS Antenna Position

The GNSS Antenna Position feature can be configured for inform the environment about the exact location of the antenna on-board the ship. By enabling the Position, will the inputted position be included in the configurable output sentence "POS" (For more info about the POS sentence see section 14.5 and 16.1.13).

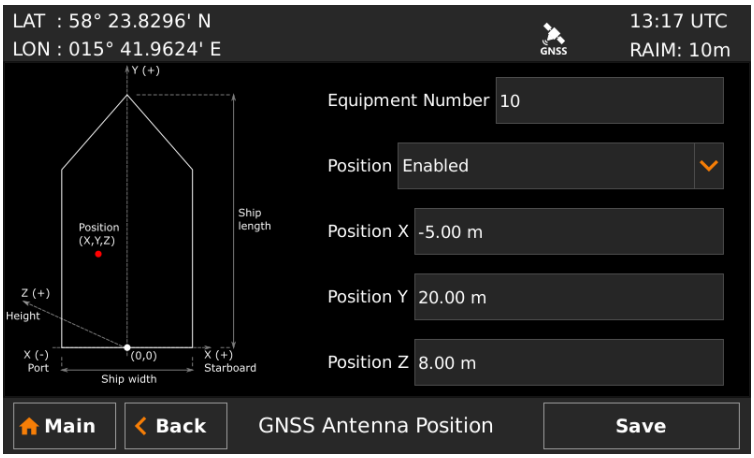


Figure 97 – Antenna Position

This view accessible by pressing **Main Menu → Maintenance → Configuration → GNSS/DGNSS → GNSS Device Position → GNSS Antenna Position**

Parameter Name	Description
Equipment Number	Device's identification number
Position	This parameter is used to enable/disable the GNSS antenna position function.
Position X	Parameter to set the GNSS antenna offset from the starboard centre. Positive value (starboard), negative value (port) or zero (centre).
Position Y	Parameter to set the GNSS antenna offset from the stern. Positive value or zero (forward distance from the ship's stern).

Position Z	Parameter to set the GNSS antenna height offset. Positive value (height from IMO summer load line).

10.1.7 Ship Dimension

The Ship Dimension feature can be configured for inform the environment about the ship's size. By enabling the Ship Dimension, will the inputted dimensions be included in the configurable output sentence "POS" (For more info about the POS sentence see section 14.5 and 16.1.13).

Figure 98 – Ship Dimension

This view accessible by pressing **Main Menu → Maintenance → Configuration → GNSS/DGNSS → GNSS Device Position → Ship Dimension**

Parameter Name	Description
Ship Dimension	This parameter is used to enable/disable the Ship Dimension function.
Ship Length	Parameter to set ship length.
Ship Width	Parameter to set ship width.

10.1.8 Consistent Common Reference Point

The Consistent Common Reference Point (CCRP) is a location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge.

This feature can adjust the system position in Latitude, Longitude and height using a preselected offset input.

This allows the GNSS antenna to be located anywhere on a vessel, and still have the position from a different reference point on the vessel.

This is feature is useful to prevent big shifts in position when a backup GNSS system takes over from a primary GNSS system, and the two systems have a large GNSS antenna separation.

By enabling the CCRP, the inputted offset will be included in the configurable output sentence "POS" if heading is available (For more info about the POS sentence see section 14.5 and 16.1.13).

NOTE: True heading data is required to calculate position offset. CCRP will be zero if there is no valid heading data.

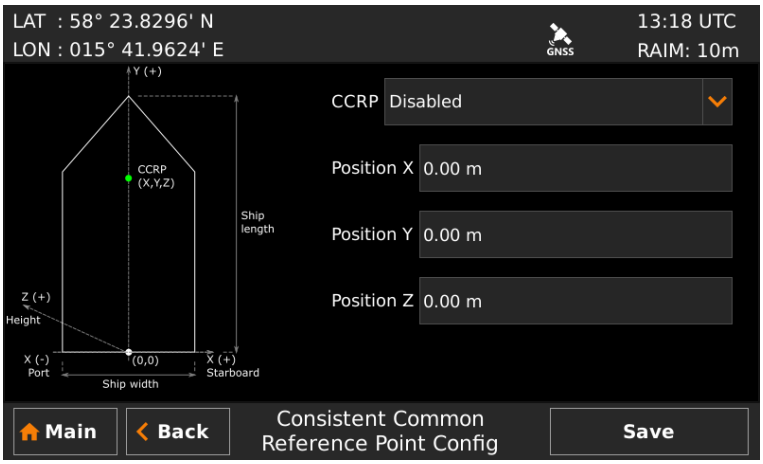


Figure 99 – Consistent Common Reference Point (CCRP)

This view accessible by pressing **Main Menu → Maintenance → Configuration → GNSS/DGNSS → GNSS Device Position → Ship Dimension**

Parameter Name	Description
CCRP	This parameter is used to enable/disable the Ship Dimension function.
Position X	Parameter to set the CCRP from the starboard centre. Positive value (starboard), negative value (port) or zero (centre).
Position Y	Parameter to set the CCRP offset from the stern. Positive value or zero (forward distance from the ship's stern).
Position Z	Parameter to set the CCRP height offset. Positive value (height from IMO summer load line).

10.1.9 Navigation Sensor Password

This view accessible by pressing **Main → Maintenance → Configuration → GNSS/DGNSS → Navigation Sensor Password**

Parameter Name	Description
New Password	Changes the password for the connected R5 Navigation Sensor.

	There is no default sensor password in the R5 Navigation Sensor. No password set, no password required.
Restore Password Key	It is possible to restore the Navigation Sensor's password with a secret restore key. To obtain the restore key, contact TransponderTech Support and be prepared to provide the serial number of the unit.

10.1.10 RTK Base

The *RTK Base configuration* view is accessible, if the unit has a "RTK" license, by **Main Menu → Maintenance → Configuration → GNSS/DGNSS → RTK Base**

Parameter Name	Description
Base Id	Parameter to set the reference id on the output corrections.
Base Mode	If this parameter is enabled the receiver will stop re-averaging of own position and no external RTK inputs will be included in the calculations of output corrections. *Recommended to use if setting up a R5 navigation Sensor as a RTK Base.*
Output Format	Parameter sets which format the corrections are output with. The selectable options are: • CMR • ROX • RTCM 3 • None If parameter set to "None" (default setting) no RTK data will be output on the configured output ports, refer to Section 10.1.27.
Ellipsoid height	Parameter sets the height for the RTK Base reference positon. *Input height above the reference ellipsoid approximating the earth's surface.*
Latitude	Parameter sets the geographical latitude for the RTK Base reference position. *The parameter is divided into three parts: degrees, minutes and cardinal direction.*

Longitude	Parameter sets the geographical longitude for the RTK Base reference position. *The parameter is divided into three parts: degrees, minutes and cardinal direction.*

Note: To get good corrections form a RTK Base set up, it is crucial that the reference position (Base position) is accurately determined.

10.1.11 Visual Settings

Press the OPT button for 5 seconds to reset the visual settings to default values.

To quickly turn off all backlight on the R5 SUPREME CDU, press once on the *PWR* button on the front of the CDU. This will completely turn off all backlight for the LCD; LEDs and buttons on the R5 SUPREME CDU. However, if there is an active, unacknowledged alert in the system, the STATUS LED will still be visible and blink with a red light. To return to previous light settings, press the *PWR* button again.

It is also possible to quickly change between day/night modes by pressing and holding down the *PWR* button for 2 seconds. This will enable the *PWR* button options menu, press “Night Mode” or “Day Mode” button to switch mode.

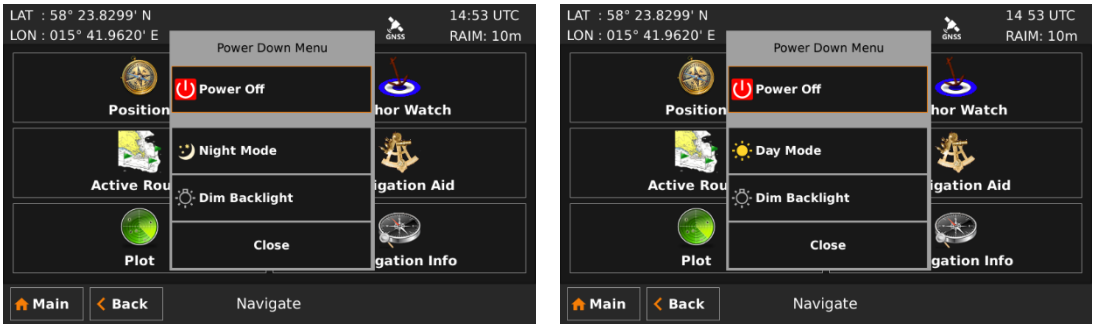


Figure 100 – Power Down Menu

The backlight master dimmer is quickly accessible by clicking on *Dim Backlight* in the *Power Down Menu*, which makes it easier and faster to making adjustments on the LCD’s illumination level.

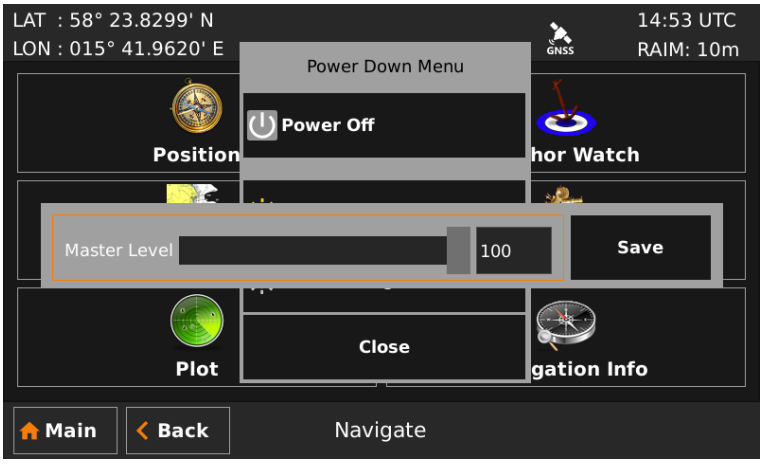


Figure 101 – Dim Backlight, Master Level

To switch between day/night mode and to tune backlight for buttons, LCD and LEDs, enter the *Visual Settings* view which is accessed from **Main Menu → Maintenance → Configuration → Display → Visual Settings**

Parameter Name	Description
Mode	There are two available display backlight modes; Day/Night. If set to “Day Mode” display parameters related to day mode as described below are used. If set to “Night Mode” display parameters related to night mode as described below are used.
Master Level	The master level controls the overall brightness level in percent of the selected maximum level for LCD Default: 80%
Day Mode LCD Backlight	Controls the maximum LCD backlight level in percent. Default: 80%
Day Mode LED Illumination	Controls the maximum LED illumination level in percent. Default: 80%
Day Mode Button Backlight	Controls the maximum button backlight level in percent. Default: 80%
Night Mode LCD Backlight	Controls the maximum LCD backlight level in percent. Default: 40%
Night Mode LED Illumination	Controls the maximum LED illumination level in percent. Default: 40%
Night Mode Button Backlight	Controls the maximum button backlight level in percent. Default: 40%

10.1.12 Sound

This view is accessed by pressing **Main Menu → Maintenance → Configuration → Display → Sound**

Parameter Name	Description
Volume	Determines the volume of the R5 SUPREME CDU internal speaker.
Scheduled Notification	Controls the behaviour of the R5 SUPREME CDU speaker when a new Scheduled Notification has been activated.
DGNSS Message	Controls the behaviour of the R5 SUPREME CDU speaker when a new DGNSS (RTCM, Type16) message has been received.
Man Over Board	Controls the behaviour of the R5 SUPREME CDU speaker when a MOB waypoint has been activated.

10.1.13 Time

This view is accessed by pressing **Main → Maintenance → Configuration → Display → Time**

Parameter Name	Description
Time Zone	This parameter defines if the times that are displayed in the R5 SUPREME CDU 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.

10.1.14 Units

This view is accessed by pressing **Main → Maintenance → Configuration → Display → Units**

Parameter Name	Description
Range Unit	This parameter determines the unit of the range values displayed in R5 SUPREME CDU like e.g. the range to the next waypoint. Range values can be calculated in nautical miles (NM), kilometers (km) or statute miles (Sm).
Speed Unit	This parameter determines the unit for the SOG values displayed in the R5 SUPREME CDU. The SOG value can be calculated in knots (kn), kilometers per hour (km/h) or miles per hour (mph).
Depth Unit	This parameter determines the unit for the depth values displayed in the R5 SUPREME CDU. The depth value can be calculated in meters (m), feet (ft) or fathoms (ftm).
Range Unit	This parameter determines the unit of the range value in the R5 SUPREME CDU. It can be calculated in meters (m) or feet (ft).

10.1.15 CDU Password

This view is accessed by pressing **Main → Maintenance → Configuration → Display → CDU Password**

Parameter Name	Description
New CDU Password	Changes the password for the R5 SUPREME CDU. **The default CDU password is "cdupwd"**
Restore Password Key	It is possible to restore the CDU password to the default value above with a secret restore key. To obtain the restore key, contact TransponderTech Support and be prepared to provide the serial number of the R5 SUPREME CDU unit.

10.1.16 Calibration

This view is accessed by pressing **Main Menu → Maintenance → Configuration → Calibrate Display**

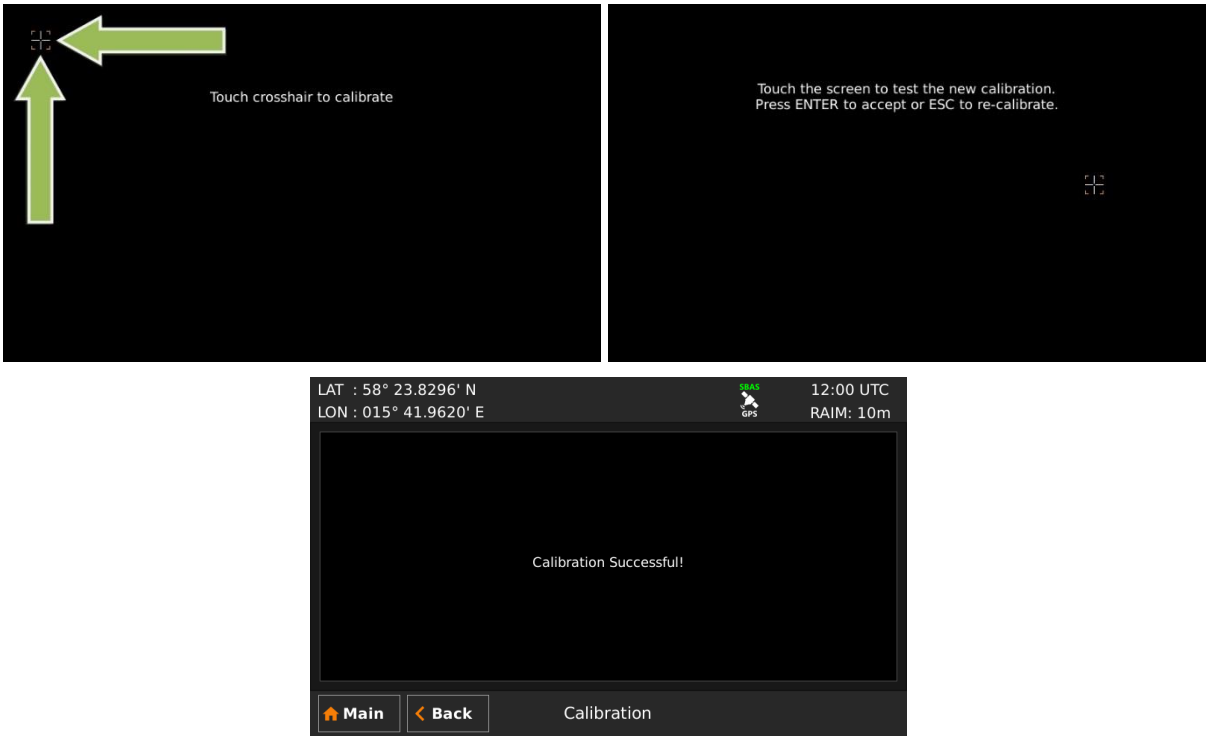


Figure 102 – Calibration View

Press on the crosshair each time it appears to calibrate the touch screen. Try to hit the centre of the cross as accurate as possible for the best possible calibration. When the calibration is done, a test screen will appear where the new touch settings can be tested. Press anywhere on the screen to move the crosshair. Accept the new calibration by pressing ENTER on the keypad or press ESC to re-calibrate.

10.1.17 NAV Alert

This view is accessed by pressing **Main Menu → Maintenance → Configuration → Alert → NAV Alert**

In this view all alerts can be configured to either “Enabled” or “Disabled”. When the alert is enabled, an active alert will trigger the external alert discrete output signal, activate the internal speaker in the R5 SUPREME CDU and a popup dialog will appear.

10.1.18 NAV Port Rates

This view is accessed by pressing **Main → Maintenance → Configuration → Interface → Port Rates → NAV Port Rates**

In this view it is possible to configure the individual baud rate for the five input- and eight output ports in the R5 Navigation System, R5 CDU user ports and the pulse rate of the Speed

The serial ports can be set to:

- 4800 bps
- 9600 bps
- 19200 bps
- 38400 bps
- 57600 bps
- 115200 bps

The higher the baud rate, the more sentences can be output on the specific port. In the "Output Config" views (see section 10.1.26) an estimated port load is calculated depending on the selected baud rate and the configured output sentences.

The Speed Log output can be set to:

- Disabled (default)
- 100 Pulses/NM
- 200 Pulses/NM
- 300 Pulses/NM
- 400 Pulses/NM

10.1.19 Own CDU Settings (Network)

This view is accessed by pressing **Main Menu → Configuration →Interface → Network → Own CDU Settings**

Parameter Name	Description
CDU IP Address	The Internet Protocol (IP) address of the R5 SUPREME CDU.
CDU SFI	The unique ID that is used on the Light Weight Ethernet network. For example, if this parameter is set to "3141" the R5 SUPREME CDU will transmit messages on the network with the SFI "SN3141". This ID must be unique for all equipment connected to the same network and reconfigured from the default value "9999".

10.1.20 Navigation Sensor settings (Network)

This view is accessed by pressing **Main Menu → Configuration →Interface → Network → Navigation Sensor Settings**

Parameter Name	Description
SFI	The unique ID that is used on the Ethernet network. For example, if this parameter is set to "3141" the R5

	Navigation Sensor will transmit messages on the network with the SFI “GN3141”. This ID must be unique for all equipment connected to the same network and reconfigured from the default value “9999”.
ETH1 IP Address	The Internet Protocol (IP) address of the R5 Navigation Sensor’s first Ethernet port.
ETH1 Netmask	A 32-bit netmask mask used to divide the IP address into subnets and specify the network's available for the R5 Navigation Sensor’s first Ethernet port.
ETH2 IP Address	The Internet Protocol (IP) address of the R5 Navigation Sensor’s second Ethernet port.
ETH2 Netmask	A 32-bit netmask mask used to divide the IP address into subnets and specify the network's available for the R5 Navigation Sensor’s second Ethernet port.

10.1.21 Select Navigation Sensor

This view is accessed by pressing **Main Menu → Configuration →Interface → Network → Select Navigation Sensor**

In a R5 SUPREME Navigation System MkII must a R5 Navigation Sensor be located and selected on the network. In the “Select Navigation Sensor” view, on the R5 SUPREME CDU, press the button “Refresh List” to search for R5 Navigation Sensor on the network. Select the R5 Navigation Sensor that the R5 SUPREME CDU should communicate with and press “Next” to go to the “Configure Navigation Sensor Network” view.

See 10.1.20 for further information about “Network Configuration”.

10.1.22 Redundant Nav

This view is accessed by pressing **Main Menu → Configuration →Interface → Network → Redundant Nav**

In this view the “Redundant Nav” mode can be activated and the selection list provides information of which available CDUs/Systems there are on the network.

See Chapter 11 for more information about the R5 SUPREME Navigation system’s Redundancy functionality.

Parameter Name	Description
Redundant Nav	Turning “on” this parameter will activate the R5 SUPREME Navigation System’s redundancy mode, which will require an additional setup of the R5 SUPREME Navigation System.

10.1.23 Heading Input Port

This view is accessed by pressing **Main → Maintenance → Configuration → Interface → Input → Heading Input Port**

Parameter Name	Description
Input Port	Specifies the input port that should be used for heading sensor data. Can be set to Input Port 1→5 or "Auto".
Primary SFI (Network)	Set to SFI of the primary Heading source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".
Secondary SFI (Network)	Set to SFI of the secondary Heading source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".

10.1.24 Depth Data Port

This view is accessed by pressing **Main → Maintenance → Configuration → Interface → Input → Depth Data Port**

Parameter Name	Description
Input Port	Specifies the input port that should be used for depth sensor data. Can be set to Input Port 1→5, User Port 3→4 or "Auto". Depth sensor data received on a port that does not correspond to this setting will be ignored.
Primary SFI (Network)	Set to SFI of the primary Depth source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".
Secondary SFI (Network)	Set to SFI of the secondary Depth source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".
Use NMEA Offset	If yes, any depth offset information available in the DPT sentence is added to the depth value taken from this sentence.
Use Manual Offset	If yes, the manually specified offset is added to the reported depth (regardless from which sentence it is taken).
Manual Offset	Specifies the size of the manual offset for depth.
Manual Offset Sign	Specifies the sign of the manual offset. If positive, the manual offset is added to the reported depth. If

	negative, the manual offset is subtracted from the reported depth.

10.1.25 WPT/RTE Data Port

This view is accessed by pressing **Main → Maintenance → Configuration → Interface → Input → Depth Data Port**

Parameter Name	Description
Input Port	Specifies the input port that should be used for input of waypoints and routes. Can be set to Input Port 1→5, User Port 3→4 or "Auto". Waypoints and routes received on a port that does not correspond to this setting will be ignored.
Primary SFI (Network)	Set to SFI of the primary Waypoint/Route source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".
Secondary SFI (Network)	Set to SFI of the secondary Waypoint/Route source used on the Light Weight Ethernet network. Only applied if "Input Port" is set to "Auto".

10.1.26 Sensor Input Function

This view is accessed by pressing **Main → Maintenance → Configuration → Interface → Input → Sensor Input Function**

Parameter Name	Description
In 1, In 2, In 3, In 4, In5	Specifies if the input port shall be used to receive "NMEA" messages or if it shall act as an "Alert Acknowledgement"/"Man Over Board" Button reacting on external switching. • NMEA (SNGF) • Validate NMEA (SNGF) • NMEA (no SNGF) • Alert Ack (see 20.2.5.2) • MOB Button (see 20.2.5.3)

10.1.27 Output

10.1.27.1 Navigation Sensor Output

The *Navigation Sensor Output* view is used to configure which NMEA sentences is output on the R5 Navigation Sensor's Output Ports and the Light Weight Ethernet port on both the R5 Navigation Sensor and the R5 CDU, and how often they are sent. The views are accessed by pressing **Main Menu → Maintenance → Configuration → Interface → Output → Navigation Sensor Output**.

In the output sub view for each user port, estimated load for the port is displayed. This gives an indication on how much of the port's baud rate that is used up by the enabled sentences. The estimation is based on a worst case scenario thus it is possible to use a port load of more than 100% but may result in a degraded or disabled port. It is recommended to keep the estimation below 100% to avoid a degraded or disabled port. Turn only on the sentences that you intend to use.

For a list of output sentences available on the different serial ports, refer to section 14.5 and chapter 15.

Parameter Name	Description
Port	Specifies the output port that is under configuration
Mode	If set to "NMEA", the selected Output Port will output a message stream following the "NMEA 0183" Standard. *See section 16.2 for message examples and allowed sentences.* If set to "IALA Beacon", the selected Output Port will output correction data from the internal beacon receiver (RTCM2 format). *This function is available only if the R5 SUPREME CDU is used together with an R5 DGNSS Navigation Sensor.* If set to "RTK", the selected Output Port will, if RTK format configured, output correction data internally calculated. *This function is available only if the R5 Navigation Sensor has "RTK" license.* *See section 10.1.10 for configuration of RTK output.* If set to "Speed Log" Pulses, the selected Output Port will output a pulse signal which frequency is dependent on the current speed. *See section 10.1.18 for configuration alternatives.*
GGA/GLL/GNS/ZDA/VTG/RMC	GNSS sentences that the R5 Navigation Sensor is capable to output and has configurable output interval.

	The interval can be set between 10 time per second up to 1 per minute *See section 16.1 for message examples and explanatory.*
DTM/GBS/GRS/GSA/GST/GSV POS/PSTT,501	GNSS sentences that the R5 Navigation Sensor is capable to output and has configurable output interval. The interval can be set between 1 time per second up to 1 per minute *See section 16.1 for message examples and explanatory.*
AAM/APB/BOD/HCS/RMB/XTE WPL/RTE(Upload) WPL/RTE(Working) WPL/RNN(Working)	Navigation sentences that the R5 Navigation Sensor is capable to output. Either the sentences are *"Disabled"* and thereby not outputted or set to *"Every Second"* and outputted each second. *See section 16.2 for message examples and explanatory.*
BWC/BWR	Navigation sentence that the R5 Navigation Sensor is capable to output. Either the sentence is *"Disabled" and thereby not outputted or it can be set to BWC, BWR, Both or Auto*. If *BWC* or *BWR* is selected, will that sentence be sent each second. If Both is selected, will both the BWR and the BWC sentence be sent each second. If Auto is selected, will the BWR be sent each second if the configuration parameter "Navigation Algorithm" is set to "Rhumb line" or if it set to "Great Circle" the BWC sentence will be sent each second instead. *See section 10.1.1 for more information about configuration parameter "Navigation Algorithm" and 16.2 for message examples and explanatory.*
Alert (Control & Display Unit) Alert (Sensor)	Both the R5 Navigation Sensor and the R5 CDU is capable of output alert in two formats, Legacy Alarms (ALR) and Bridge Alert Management (ALF/ALC), as well as forwarding the others alerts. Default is both formats output. If set to "BAM", ALF sentences will be output on events and ALC each 30 second. If set to "Legacy", ALR sentences will be output each 60s if there is no active alert otherwise each 30s.

10.1.27.2 CDU User Port Output

The *CDU User Port Output* view is used to configure which NMEA sentences is output on the R5 CDU User Port 3 and 4 serial ports. The views are accessed by pressing **Main Menu → Maintenance → Configuration → Interface → Output → CDU User Port Output**.

In the output sub view for each user port, estimated load for the port is displayed. This gives an indication on how much of the port's baud rate that is used up by the enabled sentences. The estimation is based on a worst case scenario thus it is possible to use a port load of more than 100% but may result in a disabled port. It is recommended to keep the estimation below 100% to avoid a degraded or disabled port. Turn only on the sentences that you intend to use.

For a list of output sentences available on the different serial ports, refer to section 14.5 and chapter 15.

Parameter Name	Description
Port	Specifies the output port that is under configuration
GGA/GLL/GNS/ZDA/VTG/ RMC/DTM/GBS/GRS/ GSA/GST/GSV/POS/PSTT,501	GNSS sentences that the R5 CDU is capable to output. Either the sentences are *"Disabled"* and thereby not outputted or set to *"Every Second"* and outputted each second. *See section 16.1 for message examples and explanatory.*
AAM/APB/BOD/HCS/RMB/XTE WPL/RTE(Upload) WPL/RTE(Working) WPL/RNN(Working)	Navigation sentences that the R5 CDU is capable to output. Either the sentences are *"Disabled"* and thereby not outputted or set to *"Every Second"* and outputted each second. *See section 16.2 for message examples and explanatory.*
BWC/BWR	Navigation sentence that the R5 CD is capable to output. Either the sentence is *"Disabled" and thereby not outputted or it can be set to BWC, BWR, Both or Auto*. If *BWC* or *BWR* is selected, will that sentence be sent each second. If Both is selected, will both the BWR and the BWC sentence be sent each second. If Auto is selected, will the BWR be sent each second if the configuration parameter "Navigation Algorithm" is set to "Rhumb line" or if it set to "Great Circle" the BWC sentence will be sent each second instead.

	See section 10.1.1 for more information about configuration parameter "Navigation Algorithm" and 16.2 for message examples and explanatory.
Alert (Control & Display Unit) Alert (Sensor)	Both the R5 Navigation Sensor and the R5 CDU is capable of output alert in two formats, Legacy Alarms (ALR) and Bridge Alert Management (ALF/ALC), as well as forwarding the others alerts. Default is both formats output. If set to "BAM", ALF sentences will be output on events and ALC each 30 second. If set to "Legacy", ALR sentences will be output each 60s if there is no active alert otherwise each 30s.

10.2 IEC 61162-450 Counters

In this view, a monitor feature of the R5 Navigation System is visually displayed. The system monitors all the communication traffic on the network, within the transmission groups used and counts datagrams receive rate and detected issues. This view is accessed by pressing **Main → Maintenance → Functional Test → IEC 61162-450 Counters**

More information can be found in section 13.5.

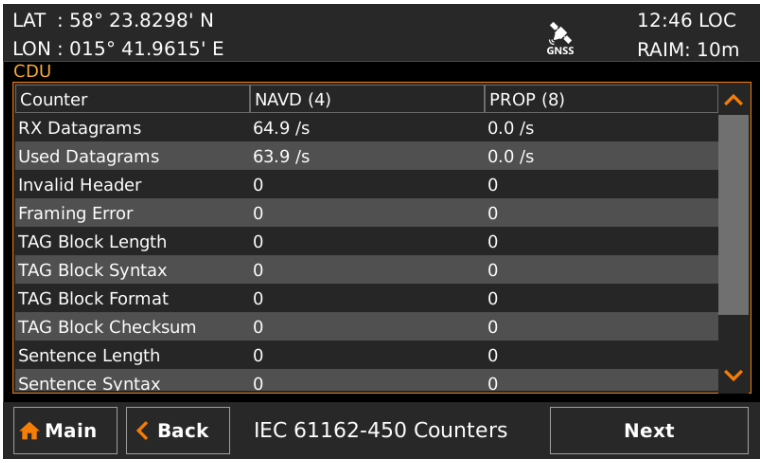


Figure 103 – Network error counters

10.1 Serial Port Counters

In this view, a monitor feature of the R5 Navigation System is visually displayed. The system monitors the output traffic on all the serial ports and counts the amount of sentences not able to be output because of for example overflow (too much output compared to configured baud rate). This view is accessed by pressing **Main → Maintenance → Functional Test → Serial Port Counters**

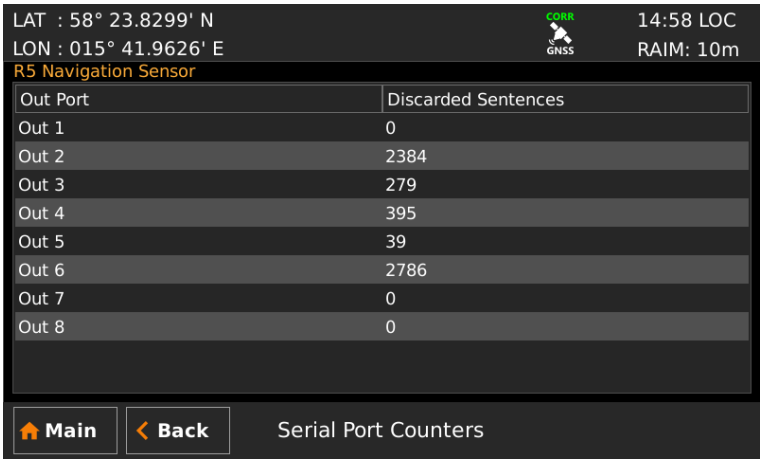


Figure 104 – Serial error counters

10.2 RTK Base Setup

This feature requires that the R5 Navigation Sensor is a PRO edition, which holds a “RTK” license.

Note: When setting up a static “RTK Base”, for calculation and output of RTK data, it is very important to measure the precise antenna position. Otherwise, the offset error will be passed on to all users of the RTK data.

Following steps is to be recommended when setting up a R5 Navigation Sensor as a *“RTK Base”:*

1. Mount the antenna solid at a well-defined reference point, so it remains static.
2. Install the R5 Navigation Sensor, refer to 5.7.
3. If the antenna position is unknown, this needs to be determined as accurately as possible and input in the “*RTK Base Configuration*” view.

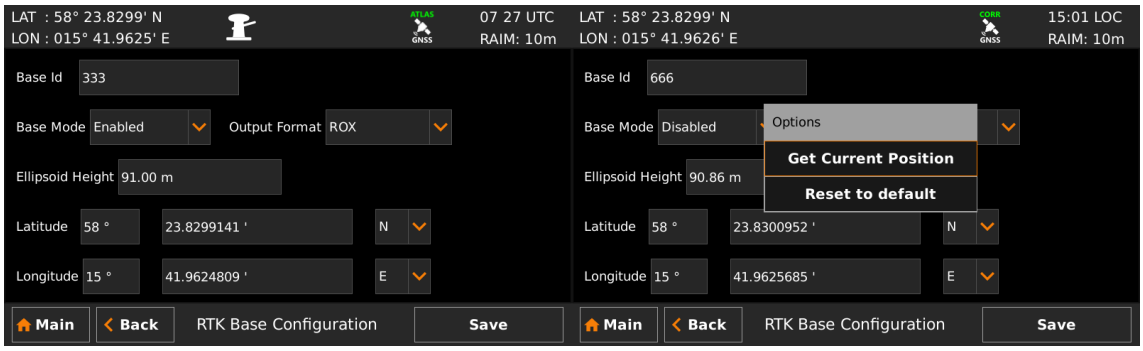


Figure 105 – RTK Base Configuration view

4. For identification set the “*Base Id”,* this will be reported as reference id in the RTK output.
5. Enable the “*Base Mode*” to instruct the sensor to use a fixed positon mode and prevent any external corrections received from being included in the RTK corrections generation.
6. Switch on the base feature by choosing an “*Output Format*” and go to the “*Output*” view to configure which ports the RTK correction data shall be output on, refer to 10.1.27.

For more information about RTK see Appendix A.

10.3 Correction Fallback

The R5 Navigation MkII System is capable of receiving correction data from several sources; the amount of accepted sources depends on the system configuration.

The different correction sources can be restricted to specific areas or temporarily unavailable for different reason; to maintain the stream of correction data the R5 Navigation Sensor is configurable to accept/allow multiple correction sources. This allowing another source to step in and provide corrections when the primary source is not available.

Priority	Source	System Requirement
1	External (RTK)	PRO (RTK license)
2	Atlas	PRO (Atlas Subscription)
3	SBAS	(D)GNSS
4	External (RTCM 2)	(D)GNSS
5	Beacon	DGNSS

Table 7 – Priority List of Correction Sources

As can be seen in Table 7, the different sources has different priority and only one correction source is used at the time.

Meaning, that the highest prioritized correction source is set as prime and if it is not available the second highest will take over if available/valid, and so on.

For example, if external RTK data are input on the R5 Navigation Sensor's configured input port (see section 10.1.2) the sensor will always use that as long as the data is valid/available. If the external data stream is lost or the data becomes invalid the next highest prioritized correction source, that is allowed and available, will back up and provide the system with correction data until the prime source's stream is reestablished.

11 SLAVE DISPLAYS AND REDUNDANT SYSTEMS

The R5 SUPREME Navigation System can be used in different system configurations such as slave display systems or redundant navigation systems. R5 SUPREME CDU units can use the network to synchronize configurations, waypoints and routes. This chapter describes how to setup and configure such systems.

Please see chapter 18 for schematics of alternate setups.

11.1 R5 SUPREME Navigation System with Slave Display

It is possible to connect one or more slave and master displays to an existing R5 SUPREME Navigation System. It is a suggested to only have one R5 SUPREME CDU on a network/system configured as master CDU, the other R5 SUPREME CDU units in the system should be set as slaves. The R5 Navigation Sensor will send GNSS data out to all the R5 SUPREME CDU and the CDU set as master will send out navigation data, for synchronization, with information such as active route, current position and navigation plot. The slave units will be “view only” units and can only show information received from the master unit and the (D)GNSS sensor. It is not possible to configure the R5 Navigation Sensor, edit waypoints and routes or start/stop sailing routes from the slave units only form the R5 SUPREME CDU configured as master.

1. Connect all R5 SUPREME CDU and the R5 Navigation Sensor by a network switch and make sure all of the units are powered up. Remember that the Ethernet ports on the R5 Navigation Sensor has different IP Addresses and thereby only one port should be used in a system setup with slaves.
2. Make sure that the master R5 SUPREME CDU has a configured IP address and a unique SFI. These parameters can be viewed and configured from **Main Menu → Maintenance → Configuration → Interface → Network → Own CDU Settings**

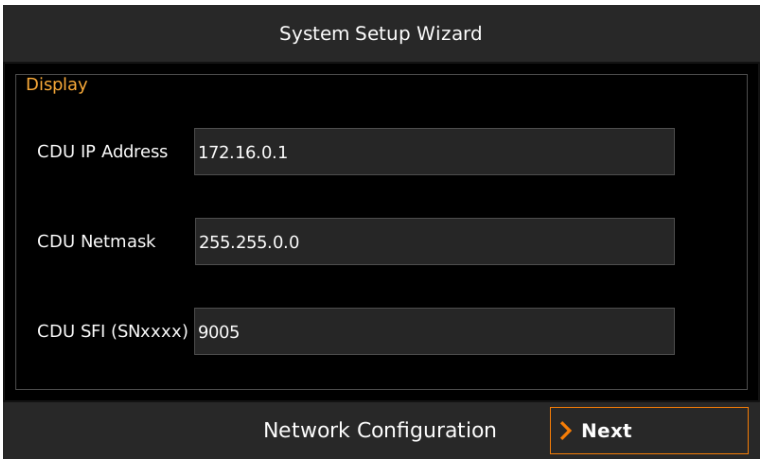


Figure 106 – Master, CDU Network Settings

3. Power up the R5 SUPREME CDU slave display in Wizard mode. If the R5 SUPREME CDU is a new unit it will automatically start in this mode.

   If the R5 SUPREME CDU already is configured, go to **Main Menu → Maintenance → Configuration → Interface → System Setup**. A popup warning about reboot will appear, press "Yes". Enter the CDU password (default = "cdupwd") and press the ENTER button on the virtual keyboard. The R5 SUPREME CDU will now reboot and start in Wizard mode in the *System Setup* view.

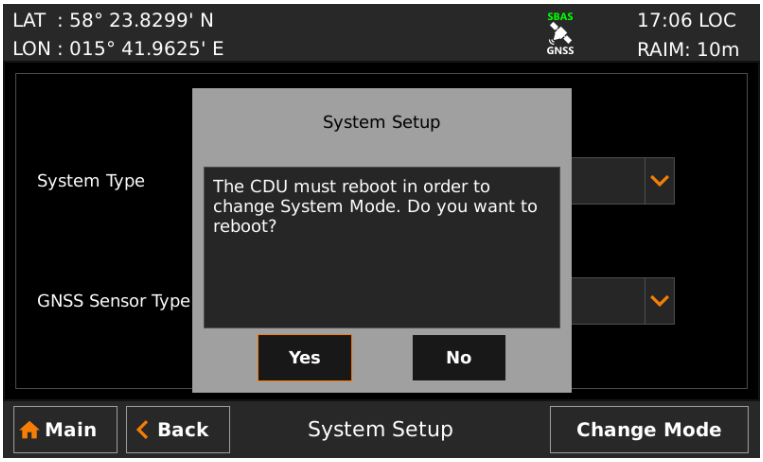


Figure 107 – System Setup

4. In the *System Setup* view, choose "Navigation System Slave" then continue forward by click "Next".

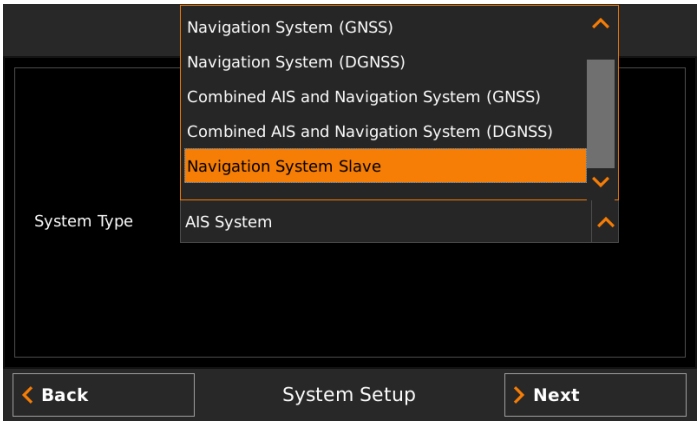


Figure 108 – System Setup, Navigation System Slave

5. Make sure that the R5 SUPREME CDU slave has a configured IP Address and a unique SFI.

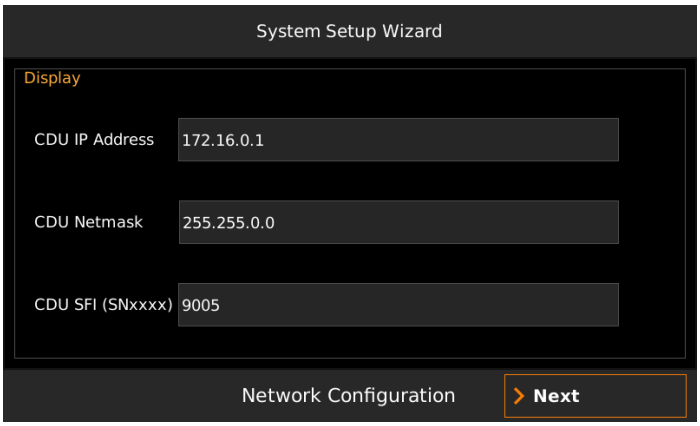


Figure 109 – Slave, Network Configuration

6. The R5 SUPREME CDU slave must now select the master R5 SUPREME CDU in the *Select CDU Master* view. Select the master and press “Next”.

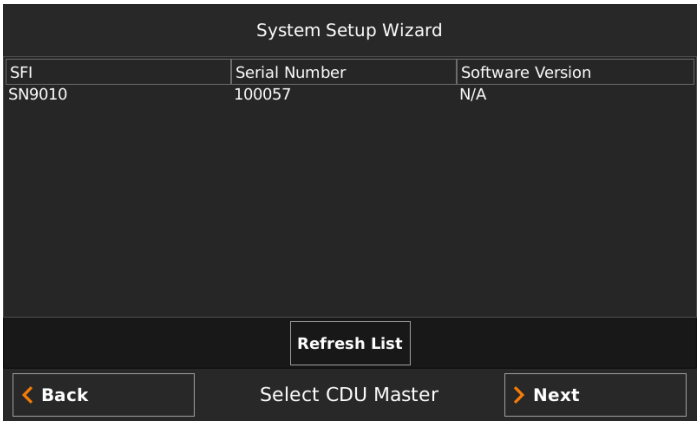


Figure 110 – Select CDU Master

7. R5 SUPREME CDU master must now also find all slaves on the network in order to synchronize configuration, waypoints, active route and route lists with slaves. This is done in the *Redundant Nav Config* view accessed from **Main Menu → Maintenance → Configuration → Interface → Network → Redundant Nav**.

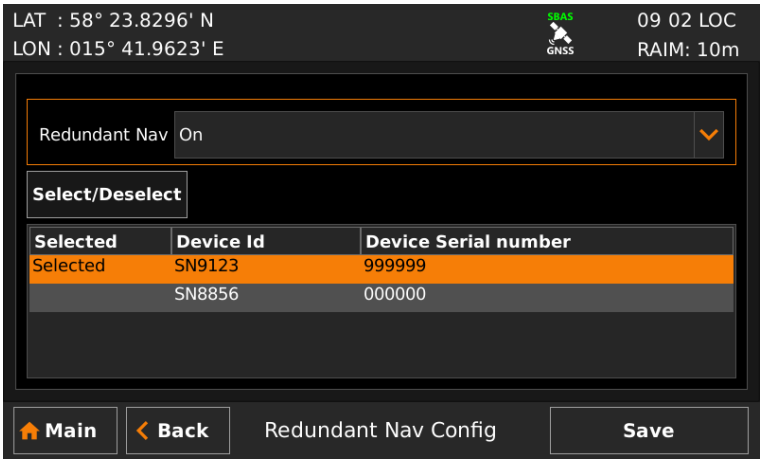


Figure 111 – Master, Redundant Nav Config

- Set the parameter “Redundant Nav” to On.
- Highlight each slave unit in the list, press on the “Select/Deselect” button, and make sure that all slaves that should be synchronized with the master are marked as “Selected” in the list.
- Press “Save”. Enter the CDU password (default = “cdupwd”) when prompted and press enter on the virtual keyboard to save the redundant settings.
- A synchronization icon should now appear in the status bar and the R5 SUPREME CDU units will now automatically synchronize all configurations, routes and waypoints, as described in section 11.3. If an irresolvable conflict occurs, a sync popup message will appear where the user must manually select the R5 SUPREME CDU “with the correct information” i.e. the unit that all other units should copy their configuration, waypoint and route databases from.

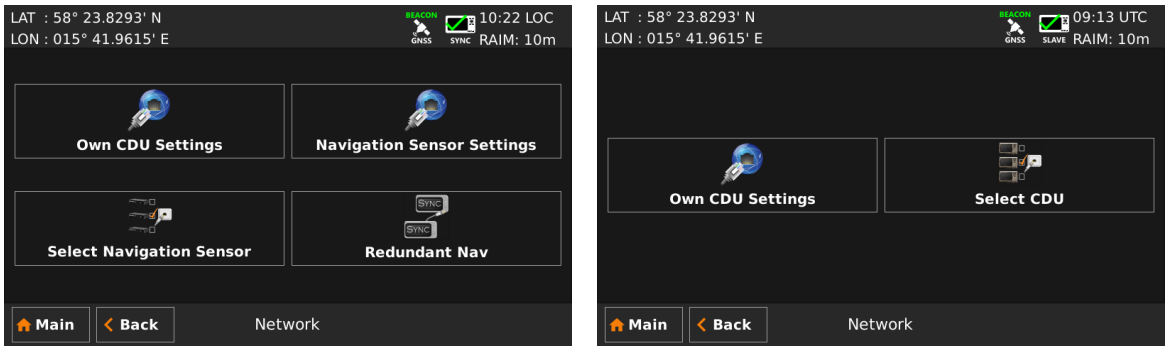


Figure 112 – Master and Slave CDU

11.2 Redundant Navigation Systems

In a redundant setup, each R5 SUPREME CDU shall be connected a separate R5 Navigation Sensor, by a common network, which provides the GNSS data. The common network is also need for the R5 SUPREME CDUs in order to synchronize configuration parameters, waypoint and route databases as well as the active route. This section describes how the R5 SUPREME Navigation Systems should be configured for the redundant setup to work properly. The following steps should be done on each R5 SUPREME Navigation System in the redundant setup:

- Connect all the R5 SUPREME CDU and the R5 Navigation Sensors to a common network, by a network switch for example, and make sure it is powered.
- Make sure that the all connected units has a configured IP address and a unique SFI. These parameters can be viewed and configured from **Main Menu → Maintenance → Configuration → Interface → Network → Own CDU Settings /Navigation Sensor Settings**

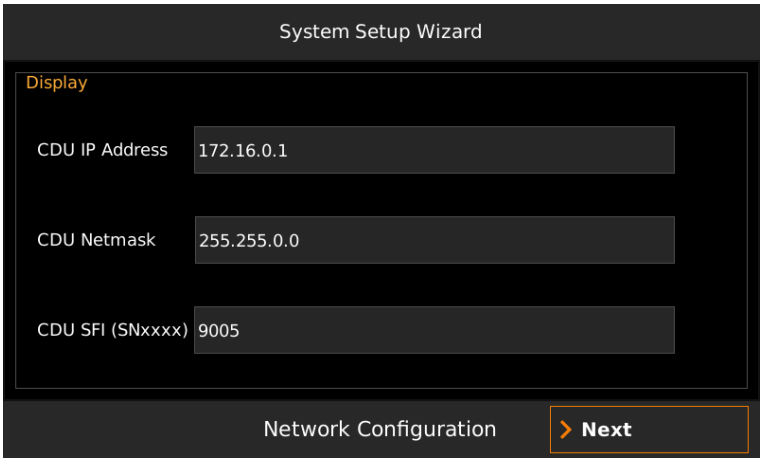


Figure 113 –CDU Network Settings

- The R5 SUPREME CDU must now also find all other R5 SUPREME Navigation Systems on the network in order to synchronize configuration, waypoints, active route and route lists. This is done in the *Redundant Nav Config* view accessed from **Main Menu → Maintenance → Configuration → Interface → Network → Redundant Nav**.

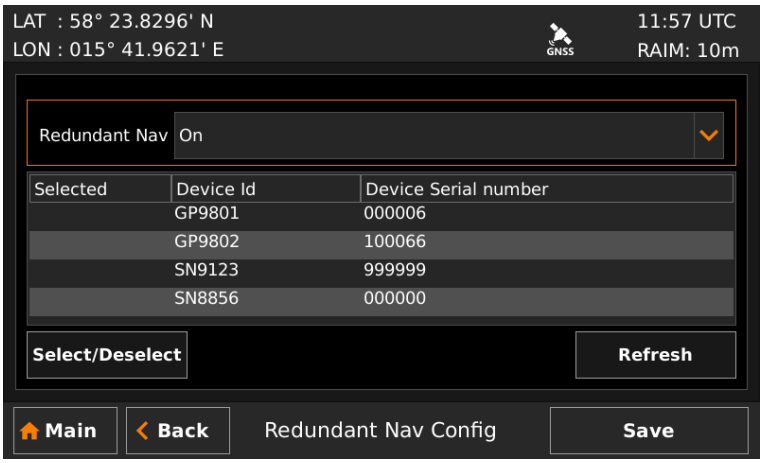


Figure 114 – Redundant Nav Config

- Set the parameter “Redundant Nav” to On.
- Highlight each unit that should be included in the redundant setup in the list and press on the “Select/Deselect” button and make sure that all units that should be synchronized are marked as “Selected” in the list.
- Press “Save”. Enter the CDU password (default = “cdupwd”) when prompted and press enter on the virtual keyboard to save the redundant settings.
- A synchronization icon should now appear in the status bar. When the above steps have been performed on each R5 SUPREME CDU in the redundant setup, they will now automatically synchronize all configurations, routes and waypoints, as described in section 11.3. If an irresolvable conflict occurs, a sync popup message will appear where the user must manually select the R5 SUPREME CDU “with the correct information” i.e. the unit that all other units should copy their configuration, waypoint and route databases from.

11.3 Synchronized Items

The following items will be synchronized when using R5 SUPREME Navigation Systems in a redundant configuration or using slave displays:

Synchronized Item	**Description**
Waypoint List	All waypoints shown in the *Waypoint List* view.
Route List	All routes shown in the *Route List* view as well as all leg settings (XTD Limit, RAIM Level and Navigation Algorithm) for each route.
Active Route	Each system will perform individual calculations on the active route such as cross track distance, time to next waypoint etc. The current leg will however be synchronized so when one system takes the decision that a waypoint has been passed, all other systems in the redundant configuration will be updated and switch to next leg as well.
Configuration Parameters	Waypoint Pass Criteria Waypoint Pass Distance Start Sail From Default RAIM Level Default Navigation Algorithm Default Cross Track Distance Limit Approach Distance Approach Time Average SOG Time

Parameters such as baud rates, NMEA sentence output on the ports and network and display settings are NOT synchronized between the systems.

12 MAINTENANCE

Saab AB (publ) TransponderTech is very keen to continue ensuring our products stay the best in the market. Therefore, the development of our products continues throughout their lifecycle, with SW featuring new features, fixes and compliance to new standards. Two to three SW releases per year is normal. It is important for our customers to keep a lookout for new software packages at: https://saab.com/security/maritime-traffic-management/navigation/r5-supreme-nav-mkii2/.

In this chapter will the upgrading procedure of the R5 SUPREME Navigation System be described.

12.1 Upgrade Software CDU

The R5 SUPREME CDU is easily upgraded via the USB host interface or SD card reader, both located behind the front hatch. To upgrade the software in the R5 SUPREME CDU, perform the following steps:

- Unzip the R5 SUPREME CDU upgrade package in the root folder of an USB memory stick / SD card. There should now be a folder called “cduswload” in the root folder of the storage media.
- Insert the storage media in appropriate interface located behind the front hatch.

Hold down the ‘Down Arrow’-button on the front of the R5 SUPREME CDU and reboot the system. The ‘Down Arrow’-button must be held down until the *RAIM LED* is blinking yellow.

The software upgrade is complete when the *STATUS LED* is lit green. The R5 SUPREME CDU 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 *RAIM LED* or *MODE LED* starts blinking. Should this happen, hold down the ‘Down Arrow’-button and reboot the R5 SUPREME CDU to try again.

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

Table 8 – LED Indicators during Software Upgrade

To perform a software update from inside the system, follow the instructions in the Update Software view, which are accessible from **Main Menu → Maintenance → Update CDU SW**.

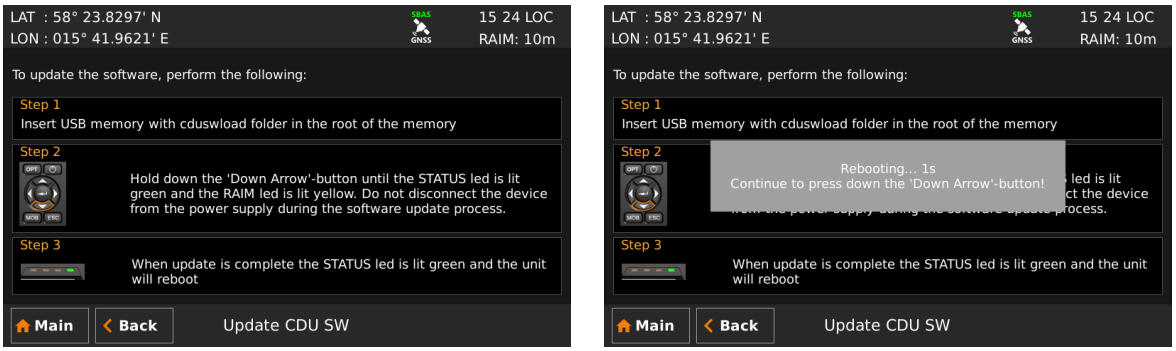


Figure 115 - Update Software

12.2 Upgrade R5 Navigation Sensor Software/Internal GNSS Firmware

The software/firmware in the R5 Navigation Sensor is easily upgraded either via the USB Host interface located behind the front hatch on the CDU, or the “Maintenance” view in the sensor’s web-interface.

To perform a software update via the CDU, follow the instructions in the update view, which is accessible by **Main Menu → Maintenance → System Update → Update Navigation Sensor → Update Sensor SW** or **Update GNSS FW**.

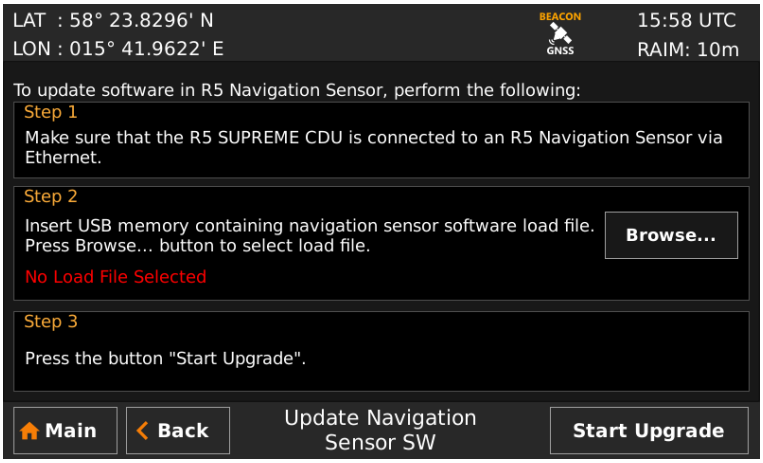


Figure 116 – Update Navigation Sensor SW

Insert an USB memory into the CDU’s front hatch, including the latest software/firmware version, click on the button “Browse…” and select the load file.

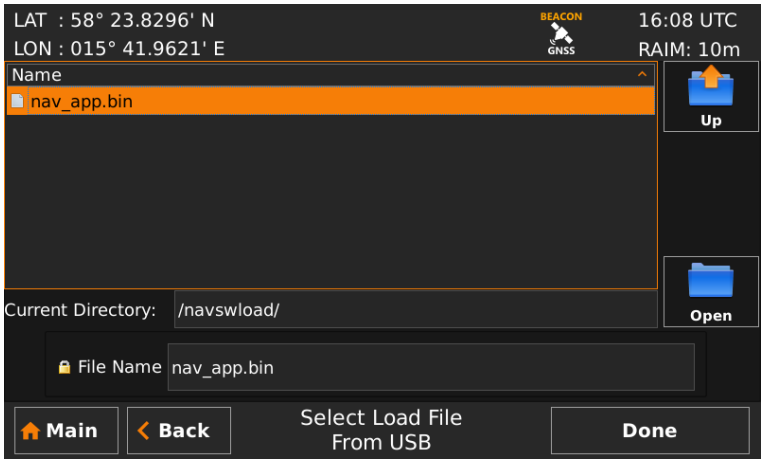


Figure 117 – Select Load File From USB

When the load file been selected press the “Done” button followed by the “Start Upgrade” button in the view and wait for the update process to finish.

Note: .bin file for updating sensor software and .gnssfw file for internal GNSS firmware. Updating the GNSS firmware is a bigger process and take about 10 minutes to finish.

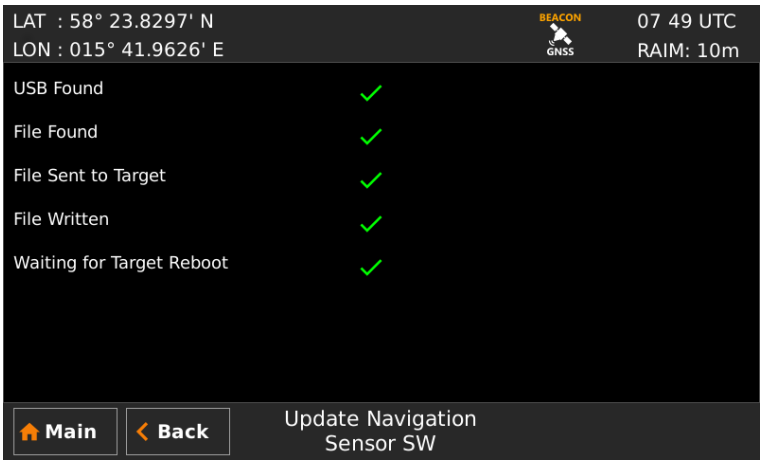


Figure 118 - Update Navigation Sensor SW, Update process

See section 9.4.2 for description of performing a software update via the web-interface.

12.3 License Upgrade

Some features in the R5 Navigation Sensor are license controlled and needs to be unlocked by a special license file. A license file is unique for each single sensor. The license file name has the following structure;

500001 - 7000 118-XXX [Navigation PRO].lic

In this example:

500001 – The serial number of the R5 Navigation Sensor unit this key works with.

7000 118-XXX – The part number of this license key.

To upgrade the license in the R5 Navigation Sensor, perform the following:

- Place the license file in the root of a FAT32 formatted USB memory. It is possible to put many license files on the same USB memory if upgrading several units.
- Make sure that the R5 SUPREME CDU and R5 Navigation Sensor communicates with each other via Ethernet. Several R5 Navigation Sensor may be available on the network. The currently selected transponder is marked with green colour in the *Select Transponder* view which can be accessed from **Main Menu → Maintenance → Configuration → Interface → Network → Select Sensor.**
- Insert the USB memory in the USB host interface located behind the front hatch of the R5 SUPREME CDU.
- Enter the view **Main Menu → Maintenance → System Update → Update Navigation Sensor → Sensor License** and press the button “Update License”.
- If the license is successfully set, a number of unlocked modules will appear:

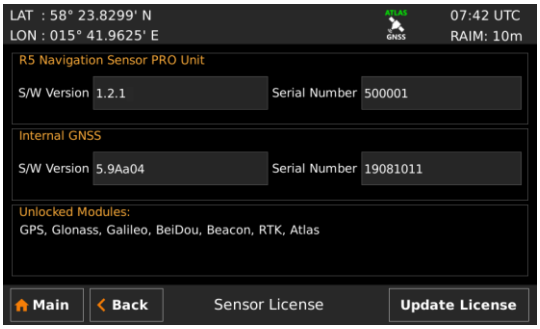


Figure 119 –License Upgrade Successful

- If a correct license file cannot be found on the USB memory, the pop-up warning will appear.

12.4 Save/Load Config to/from USB memory

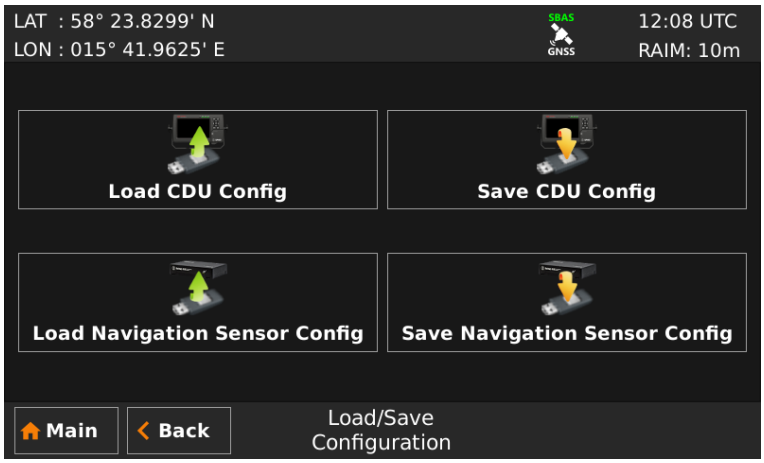


Figure 120 – Load/Save Configuration Menu

The R5 SUPREME Navigation System has the capability to save configuration of the CDU and the R5 Navigation Sensor to a USB memory. The configuration file can be used as backup so that can be restored to a previous configuration; however, during normal software upgrade of the SUPREME Navigation system the configuration parameters will NOT be changed so a backup is usually not needed. The saved configuration file can also be used to load several R5 SUPREME systems with the same settings.

The following sections describe how to save/load configuration to/from USB memory. The load/save configuration views can be accessed from **Main Menu → Maintenance → System Update → Load/Save Config**.

12.4.1 Save CDU configuration to USB memory

Do the following to save the CDU configuration to a file on a USB memory.

1. Insert a FAT32 formatted USB memory in the USB host interface port in the R5 CDU.
2. Enter the *Save CDU Config to USB* view.

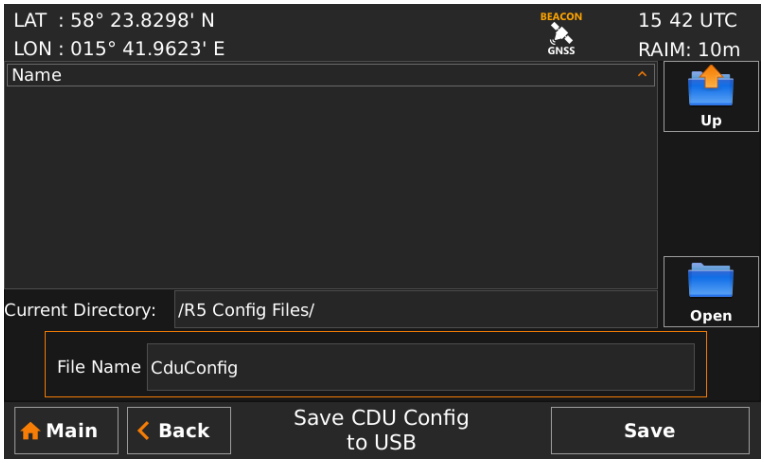


Figure 121 – Save CDU Config to USB

3. Open the folder on the USB memory where the CDU configuration file should be saved. The file will be saved in the folder shown in the “Current Directory” field.

   Use the touch interface or the arrow keypad to navigate between folders and files on the USB memory. Only folders and CDU configuration files will be listed in the view.

To view the contents of a sub folder, mark the folder in the list and press the button “Open” using the touch interface, or use the arrow keypad and press ENTER. To go back to the previous folder, use the touch interface or the arrow keypad to press the “Up” button in upper right corner of the view.

4. Select an existing CDU configuration file to overwrite it or enter a new file name by pressing the “File Name” edit field.
5. Press “Save“ to save the CDU configuration to the specified file and directory.
6. A popup will appear stating how many parameters that have been saved in the file on the USB memory.

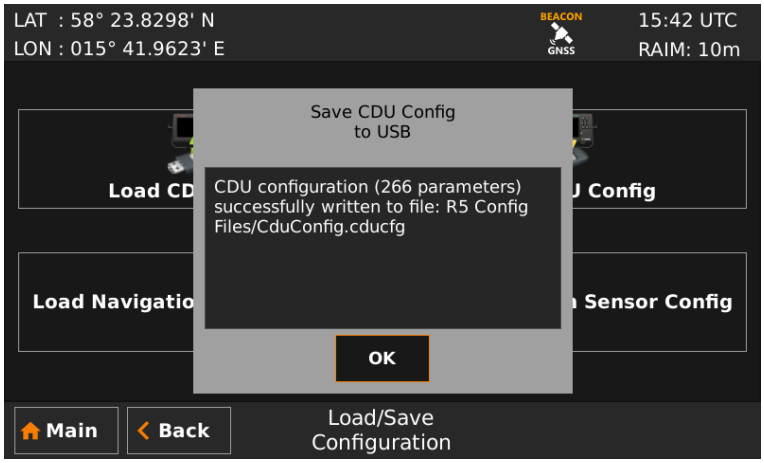


Figure 122 – CDU Config successfully saved

12.4.2 Load CDU configuration from USB memory

Do the following to load the CDU configuration from an existing config file on a USB memory:

1. Insert the USB memory in the USB host interface port in the R5 CDU.
2. Enter the *Load CDU Config from USB* view.

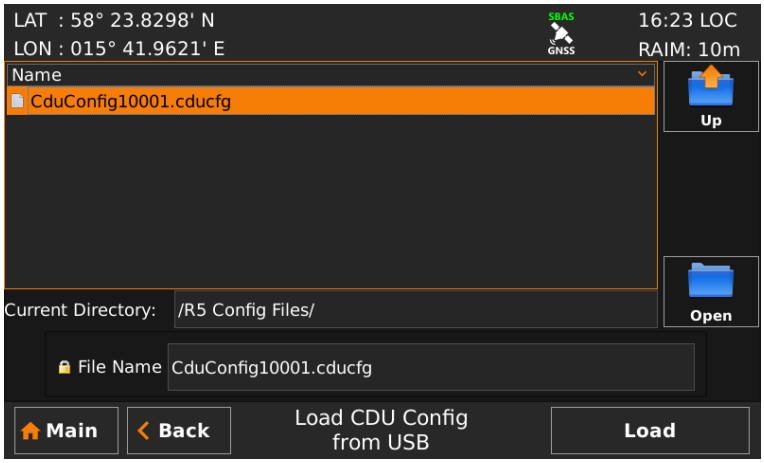


Figure 123 – Load CDU Config from USB

3. Select the desired configuration file.

   Use the touch interface or the arrow keypad to navigate between folders and files on the USB memory. Only folders and CDU configuration files will be listed in the view. To view the contents of a sub folder, mark the folder in the list and press the button “Open” using the touch interface, or use the arrow keypad and press ENTER. To go

back to the previous folder, use the touch interface or the arrow keypad to press the "Up" button in upper right corner of the view.

4. Press "Load" to load configuration from the selected file. A virtual keyboard prompting for the CDU password will appear. Enter the password (default = "cdupwd") and press ENTER on the virtual keyboard.
5. A popup will appear stating how many parameters that have been loaded. If the System Type parameter has been changed the CDU will reboot.

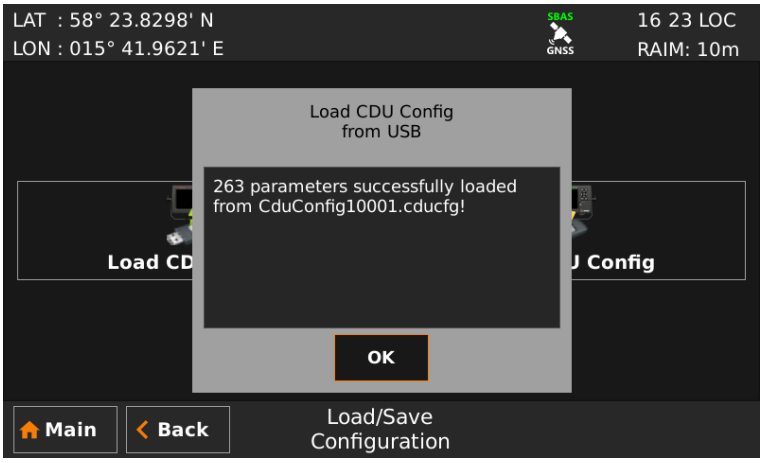


Figure 124 – CDU Config successfully loaded

12.4.3 Save Sensor configuration to USB memory

Do the following to save the CDU configuration to a file on a USB memory.

1. Insert a FAT32 formatted USB memory in the USB host interface port in the R5 CDU.
2. Enter the *Save Sensor Config to USB* view.

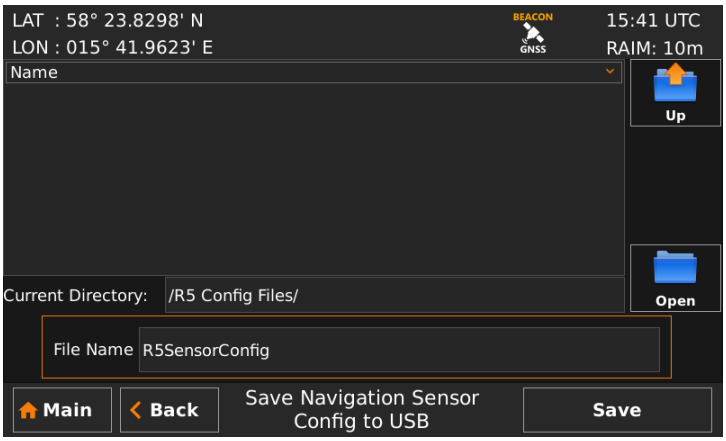


Figure 125 – Save Sensor Config to USB

3. Open the folder on the USB memory where the Sensor configuration file should be saved. The file will be saved in the folder shown in the "Current Directory" field.

   Use the touch interface or the arrow keypad to navigate between folders and files on the USB memory. Only folders and Sensor configuration files will be listed in the view. To view the contents of a sub folder, mark the folder in the list and press the button "Open" using the touch interface, or use the arrow keypad and press *ENTER*. To go

back to the previous folder, use the touch interface or the arrow keypad to press the “Up” button in upper right corner of the view.

4. Select an existing Sensor configuration file to overwrite it or enter a new file name by pressing the “File Name” edit field.
5. Press “Save“ to save the Sensor configuration to the specified file and directory.
6. A popup will appear stating how many parameters that have been saved in the file on the USB memory.

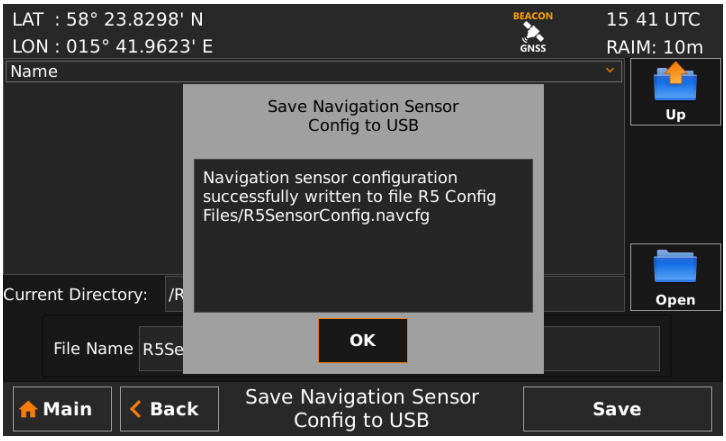


Figure 126 – Sensor Config successfully saved

Alternatively can the configuration settings be saved from the R5 Navigation Sensor’s web interface, see section 9.4.1.

12.4.4 Load Sensor configuration to USB memory

Do the following to load the Sensor configuration from an existing config file on a USB memory:

1. Insert the USB memory in the USB host interface port in the R5 CDU.
2. Enter the *Load Sensor Config from USB* view.

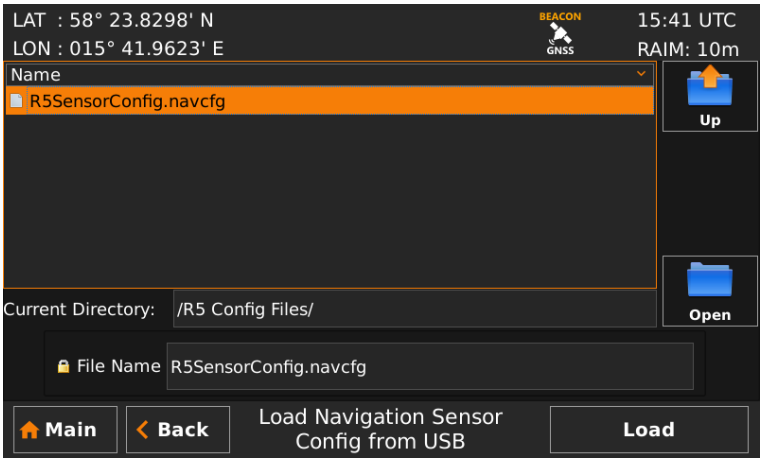


Figure 127 – Load Sensor Config from USB

3. Select the desired configuration file.

   Use the touch interface or the arrow keypad to navigate between folders and files on the USB memory. Only folders and Sensor configuration files will be listed in the view. To view the contents of a sub folder, mark the folder in the list and press the button

"Open" using the touch interface, or use the arrow keypad and press ENTER. To go back to the previous folder, use the touch interface or the arrow keypad to press the "Up" button in upper right corner of the view.

4. Press "Load" to load configuration from the selected file. A virtual keyboard prompting for the Sensor password will appear, if set (Enter the password and press ENTER on the virtual keyboard).
5. A popup will appear stating how many parameters that have been loaded.

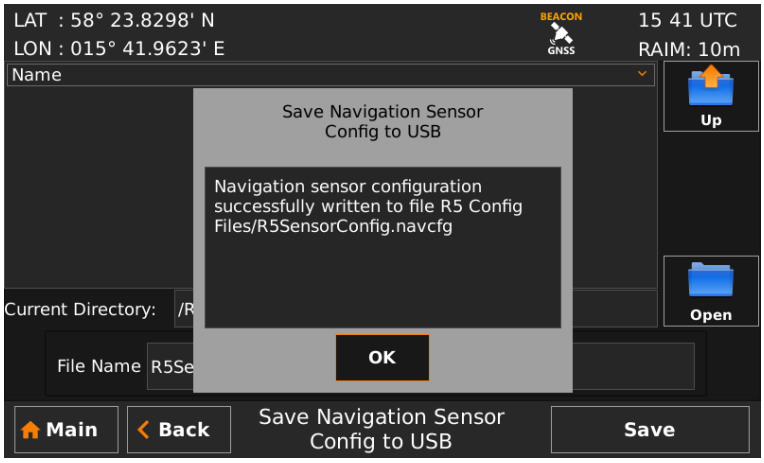


Figure 128 – Sensor Config successfully loaded

Alternatively, can the configuration settings be loaded; by the R5 Navigation Sensor's web interface, see section 9.4.1.

12.5 Factory reset

All configuration parameters described in section 10.1 can be set to default values from the *Factory Reset* view which can be accessed from **Main Menu → Maintenance → Factory reset**.

Input the CDU Password (default=cdupwd) and press the Reset button to reset all parameters on both CDU and Navigation Sensor.

NOTE: All saved waypoints, routes, MOB events, tidal ports and DGNSS Messages will also be deleted from the system!

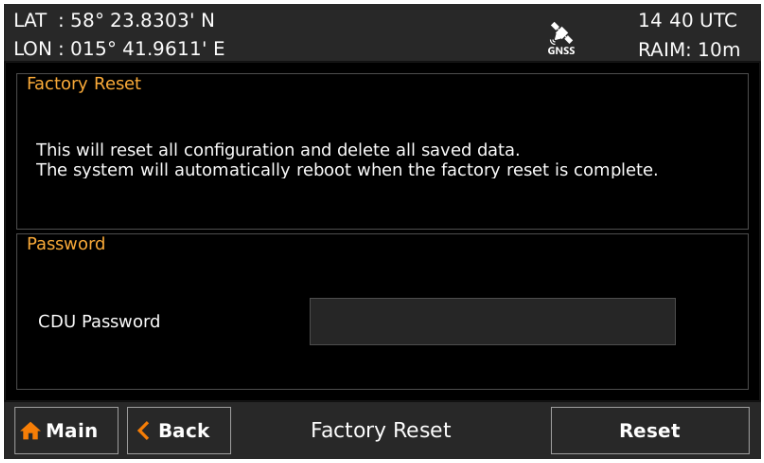


Figure 129 – Restore Config

13 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 not.

Historically, many of the parts sent to 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 navigation system installation, much dependant on the skill and experience level of the trouble-shooter. 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 SUPREME Navigation System.

13.1 Troubleshooting with the CDU Front Panel LEDs

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

13.1.1 STATUS LED (multi-coloured)

- The STATUS LED is constantly lit green when the R5 SUPREME Navigation System is operating and no alerts are active.
- The STATUS LED is constantly lit red if there is one or more acknowledged active alerts in the system, but no unacknowledged alerts. Refer to section 14.5 for interpretation of the alerts.
- The STATUS LED is flashing red if there are one or more unacknowledged alerts in the transponder. Refer to section 14.5 for interpretation of the alerts.

If neither of the 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
- 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 Settings* view accessed from **Main Menu → Maintenance → Configuration → Display → Visual Settings**.

13.1.2 RAIM LED (multi-coloured)

This LED shows the current RAIM status of the R5 Navigation System.

Green = “Safe” state, estimated position error is with a 95% probability smaller than the currently used RAIM level (shown in the upper right corner beneath the time in the CDU).

Yellow = “Caution” state, position error is unknown.

Red = “Unsafe” state, estimated position error is with a 95% probability larger than the currently used RAIM level.

13.1.3 MODE LED (multi-coloured)

This LED is not used in the R5 SUPREME Navigation System.

13.2 Troubleshooting with the Sensor LEDs

If the sensor’s status LED is continuously lit red and the DGNSS and GNSS is flashing yellow, the sensor has failed to enter the primary software application and instead start up in backup mode. *In backup mode will all system settings been returned to default and locked down.*

13.3 Troubleshooting with Alert Messages

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

An active alert can appear in different states, silenced, unacknowledged or acknowledged. The highest prioritized state will affect the behaviour of the STATUS LED.

The active alerts can be found in the “Active Alert” view. Refer to section 8.3.12.

All active alerts can be output by all output ports (Ethernet 1 & 2 included) on the R5 navigation sensor depending on the output configurations, refer to section 10.1.27. The alerts can for example for interfacing centralized alert management systems or be monitored/recorded for troubleshooting purposes by other terminal application.

All the alerts that can occur in the R5 SUPREME Navigation System are listed below:

13.3.1 HDOP Exceeded (Alert Identifier: 3056 Instance: 151)

This *Caution* is active when the HDOP (horizontal dilution of precision) exceeds 4.0.

NOTE: Generated by the R5 Navigation Sensor.

13.3.2 Lost Position (Alert Identifier: 3015 Instance: 152)

This alert is active when no valid position information is available from the R5 Navigation Sensor.

NOTE: Generated by the R5 Navigation Sensor.

13.3.3 DGNSS Lost (Alert Identifier: 3055 Instance: 153)

This alert is active when a differentially corrected position is not available.

NOTE: Generated by the R5 Navigation Sensor.

13.3.4 Doubtful GNSS (Alert Identifier: 3012 Instance: 154)

The alert is active when the display is not able to configure or receive the current configuration from the R5 Navigation Sensor.

NOTE: Generated by the R5 Control and Display Unit.

13.3.5 Lost GNSS (Alert Identifier: 3002 Instance: 155)

This alert is active if the communication between the GNSS and the R5 SUPREME CDU does not work.

NOTE: Generated by the R5 Control and Display Unit.

13.3.6 XTD Limit (Alert Identifier: 3038 Instance: 156)

This alert is active if the current cross-track distance is greater than the configured cross-track distance limit.

NOTE: Generated by the R5 Control and Display Unit.

13.3.7 Approaching WPT – Distance (Alert Identifier: 3038 Instance: 157)

This alert is active when the distance to next waypoint is shorter than the approach distance configured in the *Navigation Configuration* view, described in section 10.1.1.

NOTE: Generated by the R5 Control and Display Unit.

13.3.8 Approaching WPT - Time (Alert Identifier: 3038 Instance: 170)

This alert is active when the estimated time to go to next waypoint is shorter than the waypoint approach time configured in the *Navigation Configuration* view, described in section 10.1.1.

NOTE: Generated by the R5 Control and Display Unit.

13.3.9 Lost Heading (Alert Identifier: 3015 Instance: 161)

This alert is active when no valid heading data is received.

NOTE: Generated by the R5 Navigation Sensor.

13.3.10 Lost Depth (Alert Identifier: 3016 Instance: 162)

This alert is active when no valid depth data is received.

NOTE: Generated by the R5 Control and Display Unit.

13.3.11 Doubtful RAIM - Caution (Alert Identifier: 3013 Instance: 163)

This *Caution* is active when the RAIM status is caution.

NOTE: Generated by the R5 Navigation Sensor.

13.3.12 Doubtful RAIM - Unsafe (Alert Identifier: 3013 Instance: 164)

This *Caution* is active when the RAIM status is unsafe.

NOTE: Generated by the R5 Navigation Sensor.

13.3.13 Lost Redundancy (Alert Identifier: 3003 Instance: 166)

No connection to an external R5 SUPREME Navigation system in redundant system configuration.

NOTE: Generated by the R5 Control and Display Unit.

13.3.14 Anchor Distance (Alert Identifier: 3032/3031 Instance: 167)

This alert is active when the anchor watch function is in operation and the range limit has been exceeded.

NOTE: Generated by the R5 Control and Display Unit.

13.3.1 Doubtful DGNSS (Alert Identifier: 3012 Instance: 169)

This alert is active when any of the following conditions apply:

- No DGNSS Signal: A correction source for GNSS other than None has been selected in the *GNSS Configuration* view and more than ten seconds have passed since a new set of differential corrections were applied to the navigation solution.
- Station Unhealthy: Beacon been selected as correction source for GNSS and the radio beacon station in use indicates an unhealthy status.
- Station Unmonitored: Beacon been selected as correction source for GNSS and the radio beacon station in use indicates an unmonitored status.
- Poor Signal: Beacon been selected as correction source for GNSS and word error rate of the received signal in use exceeds 10%.

NOTE: Generated by the R5 Navigation Sensor.

13.3.2 GNSS Malfunction (Alert Identifier: 3008 Instance: 171)

This alert is active if a hardware issue has occurred in the R5 Navigation Sensor.

NOTE: Generated by the R5 Navigation Sensor.

13.3.3 RTK Base Limit (Alert Identifier: 3065 Instance: 172)

This alert is active if the R5 Navigation Sensor is configured to output correction data and has a reference position that is further away than 500 meters from the own position.

NOTE: Generated by the R5 Navigation Sensor.

13.3.4 Out (X) Degraded (Alert Identifier: 10001 Instance: 181-188)

These *Cautions* is active when the R5 Navigation Sensor's output ports have a high load causing delays or loss of less significant data (does not affect highly significant sentences, see Note 3 below)

NOTE 1: Generated by the R5 Navigation Sensor.

NOTE 2: The last digit in the instance (18X) maps to which output port that the alert relates to (OUT X).

NOTE 3: Sentences considered as highly significant are:

DTM/GBS/GGA/GLL/GNS/GRS/GSA/GST/GSV/POS/RMC/VTG/ZDA

13.3.5 Out (X) Disabled (Alert Identifier: 10002 Instance: 191-198)

These *Warnings* are active when too much NMEA data is output on the R5 Navigation Sensor's Out ports in relation to their configured baud rate.

NOTE 1: Generated by the R5 Navigation Sensor.

NOTE 2: The last digit in the instance (18X) maps to which output port that the alert relates to (OUT X).

13.3.6 User (X) Disabled (Alert Identifier: 10002 Instance: 190/199)

These *Warnings* are active when too much NMEA data is output on the R5 Control and Display Unit's User ports 3-4 in relation to their configured baud rate.

NOTE 1: Generated by the R5 Control and Display Unit.

NOTE 2: Instance 190 relates to User Port 3 and 199 relates to User Port 4.

13.4 Troubleshooting via the CDU

There is a lot of information and data accessible via the R5 SUPREME CDU that can be useful for troubleshooting, and that can help finding a presumed problem. The following items are just a few examples what to look for.

13.4.1 Current Time

The time (UTC or LOC) in the upper right corner of the display is provided by the Navigation Sensor. If the time is not correct, the Navigation Sensor does not have a position fix. This will also be indicated by the alert "Position Data Lost". 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.

13.4.2 View Raw Data

The *View Raw Data* view in the R5 SUPREME CDU is used to verify that data is received on the ports and that the connected external sensors provide the correct sentences.

The view shows the incoming data on the selected serial port. It is possible to pause the data on the screen by pressing the "Pause" button. Received data during "Pause" will be discarded. The *View Raw Data* view can be a helpful tool when trouble shooting the system to see what sensor input is actually received on each port.

Characters displayed as according to ISO 8859-1 (Latin-1). Non-printable characters displayed with symbol names as "<SYMBOL>", e.g. carriage return and line feed displayed as "<CR><LF>".

Use 'Clear View' button to clear current log data.

The view is accessible from **Main Menu → Status → View Raw Data**.

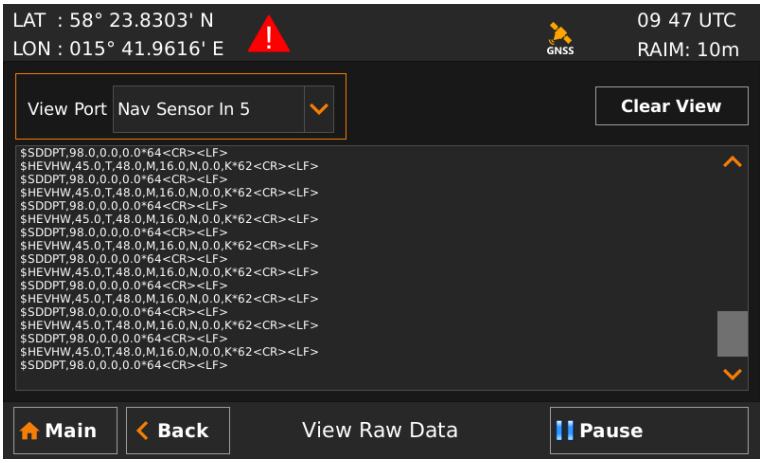


Figure 130 – View Raw Data view

13.5 Network Data Rate and Issue Counters

The R5 Navigation system has an integrated feature that monitors the data traffic within the transmission groups used by the system.

This feature checks the rate of received and used datagrams per second and counts the amount of different issues detected on received datagrams since start up, such as:

- Invalid header according to the IEC 61162-450 standard
- Framing issues (missing TAG starters/enders etc.)
- TAG-blocks longer than 80 characters (Length)
- TAG-blocks with unexpected/invalid characters (Syntax)
- TAG-blocks with missing sources, out of range values or sequence error (Format)
- TAG-blocks with mismatching checksum
- Sentences longer than 80 characters (Length)
- Sentences with unexpected/invalid characters (Syntax)
- Sentences with mismatching checksum

Note: That a datagram has issues according to the IEC 61162-450 does not mean that it is rejected or not used.

13.6 Contacting Support

The primary source for support and RMA issues should for end customers be the 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. A list with our dealers, OEM partners and service stations can be found at our website, http://saab.com/, listed under the corresponding product.

https://saab.com/security/maritime-traffic-management/traffic-management/

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

We recommend contacting us via email at support.transpondertech@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. 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 are accessible from **Main Menu → Status → SW/HW Info**.
- Detailed fault description

14 COMMUNICATION INTERFACES

This section describes the characteristics of the communication interfaces in the R5 SUPREME Navigation System, as well as supported IEC 61162-1, IEC 61162-2 and IEC 61162-450 input/output sentences.

14.1 Serial Ports

The R5 SUPREME Navigation MKII system has 10 serial ports, which uses the RS-422 interface for broadcasting:

- Five bidirectional (IN/OUT 1 – 5), ports on the R5 Navigation Sensor
- Three unidirectional output ports (OUT 6-8), on the R5 Navigation Sensor
- Two bidirectional (User Port 3-4), on the R5 Control and Display Unit.

For more detailed information about these ports, see section 5.9, 20.1.3 and 20.2.

14.2 Ethernet Ports

There are two Ethernet ports on the R5 Navigation Sensor and one on the R5 Control and Display Unit. All these ports handles datagrams according to the IEC 61162-450 standard on the NAVD transmission group, addressed as well as broadcasted.

(The R5 SUPREME Navigation System Mk II supports IGMP versions 1, 2 and 3).

To be able to identify source/destination of a datagram on the Ethernet, each datagram is tagged with SFIs. The R5 SUPREME Navigation Mk II system has multiple SFIs for ease internal routing of data. The main SFIs for the R5 Sensor and the R5 CDU are configurable; the other SFIs used for routing/forwarding data to serial port are set with a dependent characteristics to the R5 Sensors SFI. The list below shows the SFIs characteristics and the dependencies.

Unit	Function	System Function Identity
R5 CDU	Main function	**SN***YYYY*
R5 CDU	User Port 3	**SI***XXX***0**
R5 CDU	User Port 4	**SI***XXX***9**
R5 Navigation Sensor	Main function	**GN***XXX***0**
R5 Navigation Sensor	OUT/IN 1	**SI***XXX***1**
R5 Navigation Sensor	OUT/IN 2	**SI***XXX***2**
R5 Navigation Sensor	OUT/IN 3	**SI***XXX***3**
R5 Navigation Sensor	OUT/IN 4	**SI***XXX***4**
R5 Navigation Sensor	OUT/IN 5	**SI***XXX***5**
R5 Navigation Sensor	OUT 6	**SI***XXX***6**

R5 Navigation Sensor	OUT 7	**SI***XXX***7**
R5 Navigation Sensor	OUT 8	**SI***XXX***8**

Table 9 – System Function Identity List

NOTE: The "YYYY " is the four configured digit in the CDU's SFI (see 10.1.19) and the "XXX" is the three first digit configured in the Sensor's SFI (see 10.1.20).

14.2.1 Load Capacity

The R5 CDU is compliant to IEEE 802.3u and can handle following rates of received datagrams:

- 800 datagram/s intended for processing by the unit
- 6000 datagram/s not intended for processing by the unit
- 400 datagram/s intended for processing (50% of the unit max load) and 3500 datagram/s not intended for processing

The R5 Navigation Sensor is compliant to IEEE 802.3ab and can handle following rates of received datagrams:

- 2000 datagram/s intended for processing by the unit
- 10000 datagram/s not intended for processing by the unit
- 1000 datagram/s intended for processing (50% of the unit max load) and 8000 datagram/s not intended for processing

14.3 Serial to Network Gateway Function (SNGF)

The R5 Navigation sensor's serial ports supports IEC 61162-450 SNGF functionality. They communication on the network on the IEC 61162-450 NAVD transmission group.

Each serial output port has a 40kB buffer for output of internally generated data as well as addressed data from the network.

The sensor's input ports can forward all incoming serial data to the network depending on the unit's configuration (see 10.1.26)

There is three ways to configure how the R5 navigation sensor's input ports should forward the received serial data:

- NMEA (No SNGF) - Received data is only used internally in the sensor, no forwarding of SNGF data onto the network
- NMEA (SNGF) - All received serial data is output on the network, including broken and incorrect NMEA sentences.
- Validated NMEA (SNGF) – All NMEA sentences with correct checksum received on the serial port will be forwarded to the network.

14.4 Input Sentences

The interfaces of the R5 SUPREME Navigation System supports receiving and interpreting the input sentences described in the table below. The user can configure which port that should receive which messages for interpretation. Refer to sections 10.1.23 until 10.1.26.

Sentences receivable on the Input Ports.

Sentence	Name
ACK	Acknowledge Alert (Note 1)
DBT	Depth below transducer
DPT	Depth
HDG	Heading, deviation and variation
HDT	Heading, true
VHW	Water speed and heading
RTE	Routes
Rnn	Routes (for old NMEA compliance)
THS	Heading, true
WPL	Waypoint location

Table 10 – Interpreted IEC 61162-1 Input Sentences

Note 1: The ACK message alert identifier must be identical to the identifier field in the ALR output message relating the acknowledgment to the alert.

14.5 Output Sentences

The serial interfaces of the R5 SUPREME Navigation System support transmission of the sentences described in the tables below. All sentences are transmittable on both the network and the Output Ports.

The user can configure which sentences to output on each serial interface and the output rate, as described in the sections 10.1.18 and 10.1.27.

Sentences containing position information (GGA, GLL, GNS and RMC) are possible to output with or without GNSS antenna offset. One must be caution when enabling these sentences, as it is possible to output position sentences with and without GNSS antenna offset on the same port, this is not recommended. See section 10.1.6 for configuration of GNSS antenna offset.

Sentence	Description
GGA	GPS fix data
GGA + Offset	GPS fix data with GNSS antenna offset
GLL	Geographic position, latitude/longitude
GLL + Offset	Geographic position, latitude/longitude with GNSS antenna offset
GNS	GNSS fix data
GNS + Offset	GNSS fix data with GNSS antenna offset
RMC	Recommended minimum specific GNSS data
RMC + Offset	Recommended minimum specific GNSS data with GNSS antenna offset

Sentence	Description
VTG	Course over ground and ground speed
ZDA	UTC time and date
DTM	Datum reference
GBS	GNSS satellite fault detection
GRS	GNSS range residuals
GSA	GNSS DOP and active satellites
GST	GNSS pseudo range error statistics
GSV	GNSS satellites in view
PSTT,501	RAIM Status (proprietary message)

Table 11 – Supported GPS Output Sentences

Sentence	Description
ACN	Alert command
ALC	Cyclic alert list
ALF	Alert sentence
ALR	Legacy Alert state
ARC	Alert command rejection
AAM	Waypoint arrival alert
APB	Heading/track controller (Autopilot) sentence B
BOD	Bearing, origin to destination
BWC	Bearing and distance to waypoint (great circle)
BWR	Bearing and distance to waypoint, rhumb line
BWC/BWR Auto	BWC or BWR messages output depending on the navigation algorithm used for current leg in working route. (see Note 2)
HSC	Heading steering command
RMB	Recommended minimum navigation information
XTD	Cross-track distance, measured
WPL/RTE Working	Working routes and associated waypoint locations (see Note 3)
WPL/RNN Working	Working routes and associated waypoint locations (see Note 1)
WPL/RTE Upload	Complete routes and associated waypoint locations, and individual waypoints (see Note 4)
POS	Device position and ship dimensions report or configuration command

Table 12 – Supported Navigation Output Sentences

Note 1: Supported for NMEA backwards compliance. The recommendation is to use `WPL/RTE`.

Note 2: BWC or BWR messages (as determined by the selected default navigation algorithm) with null data will be transmitted when no working route is selected.

Note 3: The previous waypoint and up to the configured number of waypoints of the working route will be transmitted (see “RTE/Rnn WP limit” parameter in section 10.1.1). When sailing towards the first waypoint in the working route, the first transmitted waypoint will be the

current position (t0) or the position when the working route was started (t1), depending on the “Start Sail From” parameter, see section 10.1.1.

Note 4: Route or waypoint(s) to be uploaded are manually selected and transmitted once.

15 INTERPRETATIONS OF ALERT SENTENCES

15.1 Output/Input Sentences, Alerts

15.1.1 ACN– Alert command

$--ACN,hhmmss.ss,ccc,x.x,x.x,c,c

Field	Format	Name	Note
1	--ACN	Sentence Id	
2	hhmmss.ss	UTC time	
3	ccc	Manufacturer mnemonic code, STT = Proprietary Alert Null = Standard Alert	
4	x.x	Alert identifier	
5	x.x	Alert instance	
6	c	Alert command, A = Acknowledge Q = Request S = Silence	
7	c	Sentence status flag (C Always)	

15.1.2 ALC– Cyclic alert list

$--ALC,xx,xx,xx,x.x,ccc,x.x,x.x,x.x,…

Field	Format	Name	Note
1	--ALC	Sentence Id	
2	xx	Number of sentences	
3	xx	Sentence number	
4	xx	Sequential identifier	
5	x.x	Number of alert entries	
		Fields for one alert entry, repeats "*Number of alert entries*" times	
6,10, 14,..	ccc	Manufacturer mnemonic code STT = Proprietary Alert Null = Standard Alert	
7,11, 15,..	x.x	Alert identifier	
8,12, 16,..	x.x	Alert instance	
9,13, 17,..	x.x	Revision counter	

15.1.3 ALF– Alert sentence

$--ALF,x,x,x,hhmmss.ss,a,,a,a,aaa,x.x,x.x,x.x,c-c

Field	Format	Name	Comment
1	--ALF	Sentence Id	
2	x	Number of sentences	
2	x	Sentence number	
3	x	Sequential identifier	
4	hhmmss.ss	UTC time of change	
5	c	Alert category	
4	c	Alert priority W = Warning C = Caution	
5	c	Alert state N = Normal V = Active, Unacknowledged A = Active, Acknowledged S = Active, Silenced	
6	ccc	Manufacturer mnemonic code	
7	x.x	Alert identifier	
8	x.x	Alert instance	
9	x.x	Escalation Counter	
10	x	Revision Counter	
11	c-c	Alert/Description text	

15.1.4 ALR– Alert state

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

Field	Format	Name	Comment
1	--ALR	Sentence Id	
2	hhmmss.ss	UTC time of alert condition change	
3	xxx	Unique alert identifier	
4	c	Alert condition A = Active, V = Inactive	
5	c	Acknowledgment state A = acknowledged, V = unacknowledged	
8	c-c	Alert description text	

15.1.1 ARC– Alert command rejection

$--ARC,hhmmss.ss,ccc,c,c,c

Field	Format	Name	Comment
1	--ARC	Sentence Id	
2	hhmmss.ss	UTC time of alert condition change	
3	ccc	Manufacturer mnemonic code STT = Proprietary Alert Null = Standard Alert	
4	x.x	Alert identifier	
5	x.x	Alert instance	
6	c	Alert command, A = Acknowledge Q = Request S = Silence	

15.1.2 ACK – Acknowledge alert

$--ACK,xxx

Field	Format	Name	Comment
1	--ACK	Sentence Id	Used
2	xxx	Alert identifier number	Corresponds to ALR message for alert to acknowledge

16 INTERPRETATIONS OF OUTPUT SENTENCES

16.1 Output Sentences, GNSS

All GNSS output sentences use the talker identifiers that can be seen in the table below. All of them starting a message with a '$'-character.

Talker identifier	System/Systems
GP	Global Position System (GPS)
GL	GLONASS
GN	GPS/GLONASS
GA	Galileo Position System
GB/BD	BeiDou

16.1 Output Sentences, GNSS

16.1.1 DTM – Datum Reference

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

Field	Format	Name	Comment
1	--DTM	Sentence Id	
2	ccc	Local datum	Always W84
3	a	Local datum subdivision code	Null field
4	x.x	Lat offset, min	Always zero
5	a		
6	x.x	Lon offset, min	Always zero
7	a		
8	x.x	Altitude offset	Always zero
8	ccc	Reference datum	Always W84

16.1.2 GBS – GNSS Satellite Fault Detection

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

Field	Format	Name	Comment
1	--GBS	Sentence Id	
2	hhmmss.ss	UTC time of GGA or GNS	
3	x.x	Expected error in latitude	
4	x.x	Expected error in longitude	
5	x.x	Expected error in altitude	

6	xx	ID number of most likely failed satellite	
7	x.x	Probability of missed detection for most likely failed satellite	
8	x.x	Estimate of bias	
9	x.x	Standard deviation of bias estimate	
10	h	GNSS System ID	Always one (1)
11	h	GNSS Signal ID	Always one (1)

16.1.3 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	
2	hhmmss.ss	UTC of position	
3	llll.ll	Latitude	
4	A		
5	yyyy.yy	Longitude	
6	a		
7	x	GPS quality indicator	
8	xx	Satellites in use	
9	x.x	Horizontal dilution of precision	
10	x.x	Antenna altitude	
11	M	Units of antenna altitude, meter	
12	x.x	Geodial separation	
13	M	Units of geodial sep.	
14	x.x	Age of differential GPS data	
15	xxxx	Differential reference station ID	

16.1.4 GLL – Geographic position, latitude/longitude

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

Field	Format	Name	Comment
1	--GLL	Sentence Id	
2	llll.ll	Latitude	
3	a		
4	yyyy.yy	Longitude	

5	a		
6	hhmmss.ss	UTC of position	
7	A	Status	
8	a	Mode indicator	

16.1.5 GNS – GNSS fix data

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

Field	Format	Name	Comment
1	--GNS	Sentence Id	
2	hhmmss.ss	UTC of position	
3	llll.ll	Latitude	
4	a		
5	yyyy.yy	Longitude	
6	a		
7	c—c	Mode indicator	
8	xx	Total number of satellites	
9	x.x	HDOP	
10	x.x	Antenna altitude, meter	
11	x.x	Geodial separation	
12	x.x	Age of differential corrections	
13	x.x	Differential reference station ID	
14	a	Navigational Status Indicator	

16.1.6 GRS – GNSS range residuals

$--GRS,hhmmss.ss,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,h,h

Field	Format	Name	Comment
1	--GRS	Sentence Id	
2	hhmmss.ss	UTC time of associated GGA or GNS fix	
3	X	Mode	
4	x.x	Range residuals (1)	
5	x.x	Range residuals (2)	
…	…	…	
15	x.x	Range residuals (12)	
16	h	GNSS System ID	
17	h	GNSS Signal ID	

16.1.7 GSA – GNSS DOP and active satellites

$--GSA,a,x,x.x,x.x,…,x.x,x.x,x.x,x.x

Field	Format	Name	Comment
1	--GSA	Sentence Id	
2	A	Mode	
3	X	Mode	
4	x.x	Satellite ID (1)	
5	x.x	Satellite ID (2)	
…	…	…	
15	x.x	Satellite ID (12)	
16	x.x	PDOP	
17	x.x	HDOP	
18	x.x	VDOP	
19	h	GNSS System ID	

16.1.8 GST – GNSS pseudorange error statistics

$--GST,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x

Field	Format	Name	Comment
1	--GST	Sentence Id	
2	hhmmss.ss	UTC time of associated GGA or GNS fix	
3	x.x	RMS value	
4	x.x	Standard deviation of semi-major axis	
5	x.x	Standard deviation of semi-minor axis	
6	x.x	Orientation of semi-major axis	
7	x.x	Standard deviation of latitude error	
8	x.x	Standard deviation of longitude error	
9	x.x	Standard deviation of altitude error	

16.1.9 GSV – GNSS satellites in view

$--GSV,x,x,xx,xx,xx,xxx,xx……,xx,xx,xxx,xx,h

Field	Format	Name	Comment
1	--GSV	Sentence Id	
2	x	Total number of messages	

3	x	Message number	
4	x	Total number of satellites in view	
5	xx	Satellite ID number (Satellite 1)	
6	xx	Elevation, degrees (Satellite 1)	
7	xxx	Azimuth, degrees true (Satellite 1)	
8	xx	SNR (Satellite 1)	
…	…	…	Fields for all satellites are used
21	h	Signal ID	Always one (1)

16.1.10 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,a

Field	Format	Name	Comment
1	--RMC	Sentence Id	
2	hhmmss.ss	UTC of position	
3	A	Status	
4	llll.ll	Latitude	
5	a		
6	yyyy.yy	Longitude	
7	a		
8	x.x	Speed over ground, knots	
9	x.x	Course over ground, degrees true	
10	xxxxxx	Date	
11	x.x	Magnetic variation	
12	a		
13	a	Mode indicator	
14	a	Navigational Status	

16.1.11 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	
2	x.x	Course over ground, degrees true	
3	T		

4	x.x	Course over ground, degrees magnetic	
5	M		
6	x.x	Speed over ground, knots	
7	N		
8	x.x	Speed over ground, km/h	
9	K		
10	a	Mode indicator	

16.1.12 ZDA – Time and date

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

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

16.1.13 POS – Device position and ship dimensions report or configuration command

$--POS,cc,xx,a,x.x,x.x,x.x,a,x.x,x.x,a

Field	Format	Name	Comment
1	--POS	Sentence Id	
2	cc	Equipment identification	
3	xx	Equipment number	
4	a	Position validation flag	
5	x.x	Position X-Coordinate	
6	x.x	Position Y-Coordinate	
7	x.x	Position Z-Coordinate	
8	a	Ship's width/length validation flag	
9	x.x	Ship's width	
10	x.x	Ship's length	
11	a	Sentence status flag	

16.2 Output Sentences, Navigation

All navigation output sentences use SN as talker identifier.

16.2.1 AAM – Waypoint arrival alert

$--AAM,A,A,x.x,N,c--c

Field	Format	Name	Comment
1	--AAM	Sentence Id	
2	A	Status	
3	A	Status	
4	x.x	Arrival circle radius	
5	N	Units of radius, nautical miles	
6	c--c	Waypoint ID	

16.2.2 APB – Heading/Track Controller (Autopilot) Sentence B

$--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,x.x,a,x.x,a,a

Field	Format	Name	Comment
1	--APB	Sentence Id	
2	A	Status	
3	A	Status	
4	x.x	Magnitude of XTE	
5	a	Direction to Steer	
6	N	XTE units	
7	A	Status	
8	A	Status	
9	x.x	Bearing origin to destination	
10	a		
11	c--c	Destination waypoint ID	
12	x.x	Bearing, present position to destination	
13	a		
14	x.x	Heading to steer to destination	
15	a		
16	a	Mode indicator	

16.2.3 BOD – Bearing, origin to destination

$--BOD,x.x,T,x.x,M,c--c,c--c

Field	Format	Name	Comment
1	--BOD	Sentence Id	
2	x.x	Bearing, degrees true	
3	T		
4	x.x	Bearing, degrees magnetic	
5	M		
6	c--c	Destination waypoint ID	
7	c--c	Origin waypoint ID	

16.2.4 BWC/BWR – Bearing and distance to waypoint

$--BWC,hhmmss.ss,llll.ll,a,yyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c,a

$--BWR,hhmmss.ss,llll.ll,a,yyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c,a

Field	Format	Name	Comment
1	--BWC --BWR	Sentence Id	
2	hhmmss.ss	UTC of observation	
3	llll.ll	Waypoint latitude	
4	a		
5	yyyy.yy	Waypoint longitude	
6	a		
7	x.x	Bearing, degrees true	
8	T		
9	x.x	Bearing, degrees magnetic	
10	M		
11	x.x	Distance, nautical miles	
12	N		
13	c--c	Waypoint ID	
14	a	Mode indicator	

16.2.1 HBT – Heartbeat supervision sentence

$--HBT,x.x,c,x

Field	Format	Name	Comment
1	--HBT	Sentence Id	
2	x.x	Repeat interval (Always 30s)	
3	c	Equipment in normal operation, V = no A = yes	
4	x	Sequential sentence identifier	

16.2.2 HSC – Heading steering command

$--HSC,x.x,T,x.x,M

Field	Format	Name	Comment
1	--HSC	Sentence Id	
2	x.x	Commanded heading, degrees true	
3	a		

4	x.x	Commanded heading, degrees magnetic	
5	a		

16.2.3 RMB – Recommended minimum navigation information

$--RMB,A,x.x,a,c--c,c--c,llll.ll,a,yyyy.yy,a,x.x,x.x,x.x,A,a

Field	Format	Name	Comment
1	--RMB	Sentence Id	
2	A	Status	
3	x.x	Cross track error, nautical miles	
4	a	Direction to steer L/R	
5	c--c	Origin waypoint ID	
6	c--c	Destination waypoint ID	
7	llll.ll	Destination waypoint latitude	
8	a		
9	yyyy.yy	Destination waypoint longitude	
10	a		
11	x.x	Range to destination, nautical miles	
12	x.x	Bearing to destination, degrees true	
13	x.x	Destination closing velocity	
14	A	Arrival status	
15	a	Mode indicator	

16.2.4 RTE – Routes

$--RTE,x.x,x.x,a,c--c,c--c,…,c--c

Field	Format	Name	Comment
1	--RTE	Sentence Id	
2	x.x	Total number of messages being transmitted	
3	x.x	Message number	
4	a	Message mode	
5	c--c	Route identifier	
6	c--c	Waypoint identifier (first)	
…	…	…	
n	c--c	Waypoint identifier (last)	

16.2.5 WPL – Waypoint location

$--WPL,llll.ll,a,yyyy.yy,a,c--c

Field	Format	Name	Comment
1	--VPL	Sentence Id	
2	llll.ll	Waypoint latitude, N/S	
3	a		
4	yyyy.yy	Waypoint longitude, E/W	
5	a		
6	c--c	Waypoint identifier	

16.2.6 XTE – Heading steering command

$--XTE,A,A,x.x,a,N,a

Field	Format	Name	Comment
1	--XTE	Sentence Id	
2	A	Status	
3	A	Status	
4	x.x	Magnitude of cross-track error	
5	a	Direction to steer, L/R	
6	N	Units, nautical miles	
7	a	Mode indicator	

16.3 Output Sentences, Old NMEA Versions

All these output sentences use SN as talker identifier.

16.3.1 Rnn – Routes (old NMEA versions)

Can only be used for output of working (active) route. It is recommended to use the `RTE` sentence instead if this sentence.

$--Rnn,cccc,cccc,…,cccc

Field	Format	Name	Comment
1	--Rnn	Sentence id and route identifier	'nn' is always 00
2	cccc	Waypoint identifier (first)	
..	…	…	
15	cccc	Waypoint identifier (last)	

17 INTERPRETATIONS OF INPUT SENTENCES

Per default, any talker identifier is accepted.

17.1 Input Sentences

17.1.1 DBT – Depth below transducer

The displayed depth will be adjusted according to depth input configuration parameters. The used depth (in the correct unit) is calculated from field 2.

$--DPT,x.x,f,x.x,M,x.x,F

Field	Format	Name	Comment
1	--DPT	Sentence Id	Used
2	x.x	Water depth, feet	Used
3	f		
4	x.x	Water depth, meter	Not used
5	M		
6	x.x	Water depth, fathoms	Not used
7	F		

17.1.2 DPT – Depth

The displayed depth will be adjusted according to depth input configuration parameters.

$--DPT,x.x,x.x,x.x

Field	Format	Name	Comment
1	--DPT	Sentence Id	Used
2	x.x	Water depth relative to transducer, meter	Used
3	x.x	Offset from transducer, meter	Used if configured
4	x.x	Max range scale in use	Not used

17.1.3 HDG – Heading, Deviation and Variation

$--HDG,x.x,x.x,a,x.x,a

Field	Format	Name	Comment
1	--HDG	Sentence Id	Used
2	x.x	Magnetic sensor heading, degrees	Used
3	x.x	Magnetic deviation, degrees E/W	Used
4	a		
5	x.x	Magnetic variation, degrees E/W	Used
6	a		

17.1.4 HDT – Heading, True

$--HDT,x.x,T

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

17.1.5 RTE – Routes

$--RTE,x.x,x.x,a,c--c,c--c,…,c--c

Field	Format	Name	Comment
1	--RTE	Sentence Id	Used
2	x.x	Total number of messages being transmitted	Used
3	x.x	Message number	Used
4	a	Message mode	Used
5	c--c	Route identifier	Used
6	c--c	Waypoint identifier (first)	Used
…	…	…	…
n	c--c	Waypoint identifier (last)	Used

17.1.1 THS – True Heading and Status

$--THS,x.x,a

Field	Format	Name	Comment
1	--THS	Sentence Id	Used
2	x.x	Heading, degrees true	Used if Status is set to 'A'
3	a	Status	Used

17.1.2 WPL – Waypoint location

$--WPL,llll.ll,a,yyyy.yy,a,c--c

Field	Format	Name	Comment
1	--WPL	Sentence Id	Used
2	llll.ll	Waypoint latitude, N/S	Used
3	a		
4	yyyy.yy	Waypoint longitude, E/W	Used
5	a		
6	c--c	Waypoint identifier	Used

17.1.3 VHW – Water speed and heading

$--VHW,x.x,T,x.x,M,x.x,N,x.x,K

Field	Format	Name	Comment
1	--VHW	Sentence Id	Used
2	x.x	Heading, degrees true	Used
3	T		
4	x.x	Heading, degrees magnetic	Used
5	M		
6	x.x	Speed, knots	Used
7	N		
8	x.x	Speed, km/h	Not used
9	K		

17.2 Input Sentences, Old NMEA Versions

17.2.1 Rnn – Routes (old NMEA versions)

Can only be used for input of working (active) route. It is recommended to use the `RTE` sentence instead if this sentence. Per default, any talker ID is accepted.

$--Rnn,cccc,cccc,…,cccc

Field	Format	Name	Comment
1	--Rnn	Sentence id and route identifier	'nn' is interpreted as route identifier (00 – 99).
2	cccc	Waypoint identifier (first)	Used
..	…	…	…
15	cccc	Waypoint identifier (last)	Used

18 ALTERNATE SYSTEM SETUPS

18.1 Redundant Navigation Systems Connected by Network

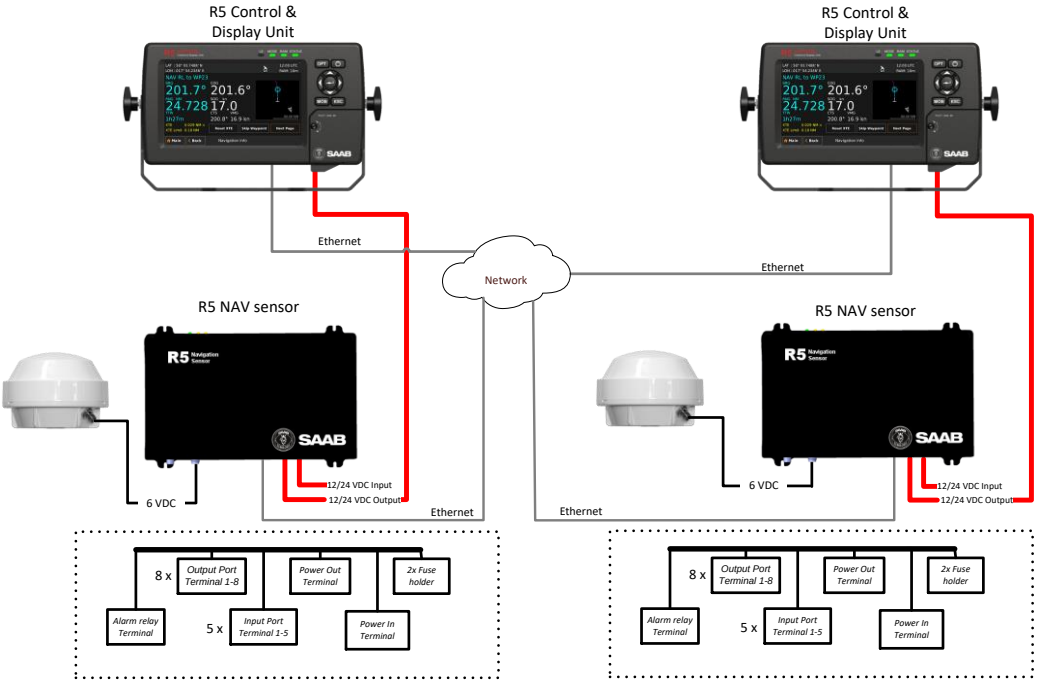


Figure 131 – Redundant NAV, Network interconnection.

18.2 Navigation System with Slave Displays

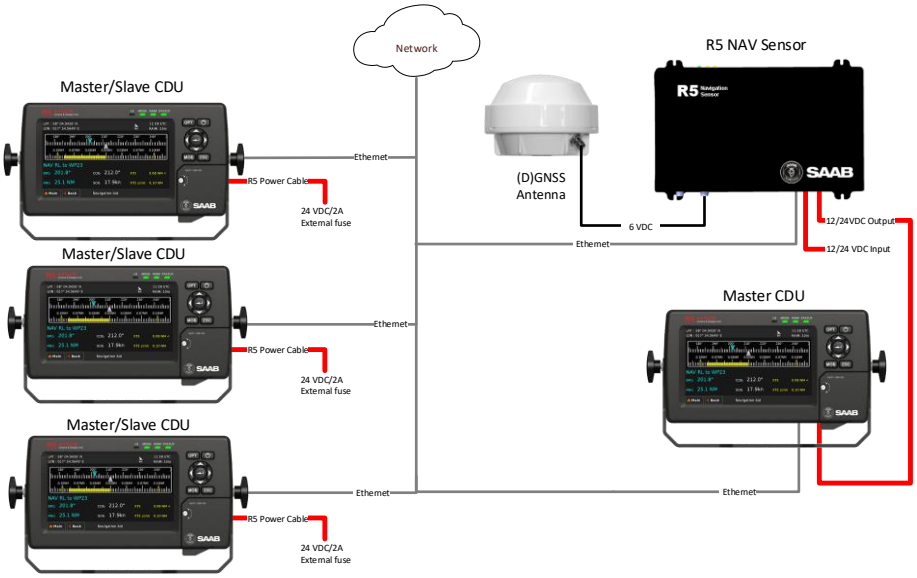


Figure 132 – Slave display interconnection

See section Chapter 11 for information about Slave Display and Redundant Navigation System.

18.3 Combined AIS and Navigation system setup

Below details how to install a combined AIS and Navigation system, using one CDU.

The CDU can act as both AIS MKD and Navigation system at the same time. The initial system setup wizard will activate the correct dialogs and menus.

Running the CDU in this mode will activate many more functions and views in the system, not detailed in this manual. For information about AIS functions and setup, please see the navigation system manual:

7000 118-300, R5 SUPREME AIS System manual.

In addition to the standard R5 NAV parts, the following are needed in addition:

Name	**Part number**	**Qty.**
R5 SUPREME Transponder	7000 118-501	1
R5 Power Cable 2m	7000 118-077	1
R5 Signal Cable DSUB-DSUB 2m	7000 118-286	2
R5 AIS Junction box	7000 118-120	1
R5 SUPREME Ethernet Cable 5m. or equivalent.	7000 000-525	1
Printed document set *Including:* *AIS Installation Short Instruction* *AIS Operators Short Instruction* *AIS Certificate set*	7000 118-370 *7000 118-363* *7000 118-364* *7000 118-365*	1
Transponder GPS antenna MA-700 or AT575-68 or Combined VHF/GPS Antenna AC Marine	 7000 000-485 7000 000-135 7000 000-435	1
AIS VHF Antenna BA1012 or equivalent	 7000 000-077	1

18.3.1 R5 SUPREME Combined

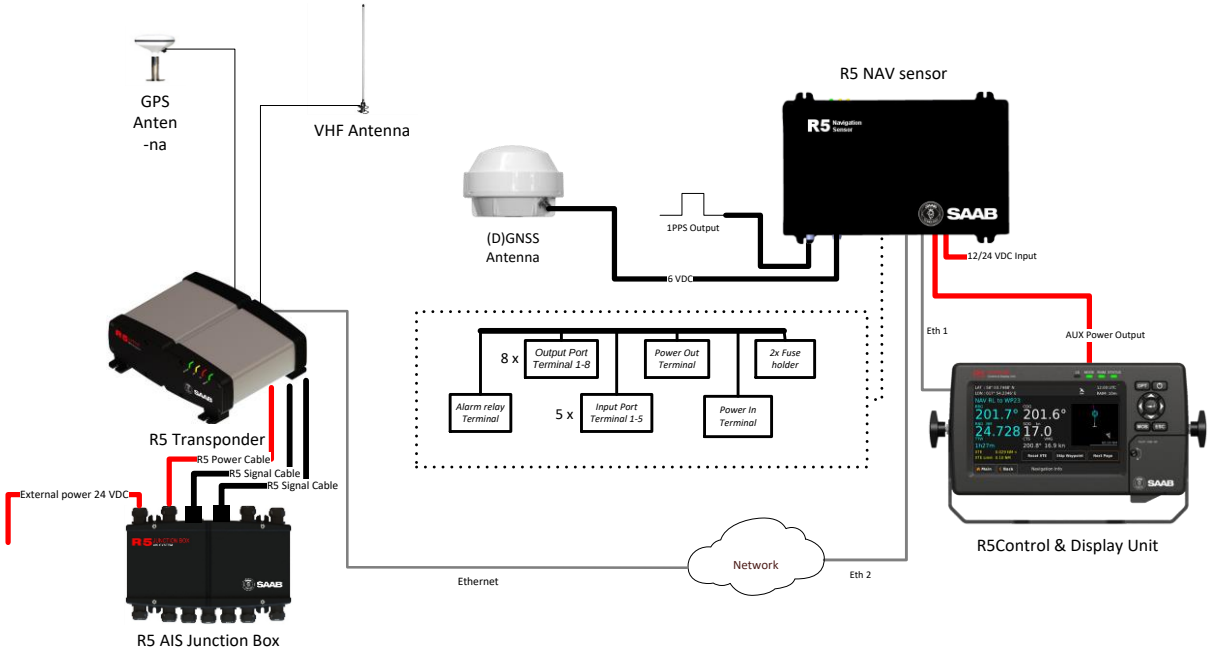


Figure 133- Combined AIS and Navigation system

19 TECHNICAL SPECIFICATIONS

19.1 R5 SUPREME CDU

19.1.1 Physical

Dimensions:	Height: 140 mm Width: 255 mm Depth: 84 mm
Weight:	1.6 kg
Dimensions (incl. gimbal mount)	Height: 170 mm Width: 295 mm Depth: 84 mm
Weight (incl. gimbal mount):	1.8 kg

19.1.2 Electrical

Input Voltage:	12-24 VDC
Power Consumption:	13 W

19.1.3 Environmental

Temperature:	-15˚C to +55˚C (Operational) -30˚C to +80˚C (Storage)
Vibrations and EMC:	IEC 60945 ed. 4
Compass Safe Distance:	75 cm (for standard magnetic compass) 50 cm (for steering magnetic compass)

19.2 R5 Navigation Sensor

19.2.1 Physical

Dimensions:	Height: 52 mm Width: 261 mm Depth: 177 mm
Weight:	1.75 kg
Antenna Connector:	TNC-Female

19.2.2 Electrical

Input Voltage:	24V DC (12 to 24 VDC)
Nominal Power:	5.3 W (GNSS Version) 5.7 W (DGNSS Version)
Nominal Current:	0.22A @ 24 VDC input (GNSS Version) 0.24A @ 24 VDC input (DGNSS Version)
Antenna feeding:	+6 VDC
Antenna input impedance:	50Ω

19.2.3 Environmental

Temperature:	-15˚C to +55˚C (Operational) -30˚C to +80˚C (Storage)
Vibrations:	IEC 60945 ed. 4
EMC:	IEC 60945 ed. 4
Compass Safe Distance:	60 cm (for standard magnetic compass) 30 cm (for steering magnetic compass)

19.2.4 Internal GNSS Receiver

Type:	GPS, GLONASS, BeiDou, GALILEO L1/L2/L5, C/A code, 372 channel, parallel tracking
Update Rate:	10 Hz max
Horizontal Accuracy*:	<0.4m, (95%), DGNSS < 1.3 m, (95%), GNSS
Vertical Accuracy*:	< 0.7 m, (95%), DGNSS < 2.5 m, (95%), GNSS

19.2.5 Internal Beacon Receiver (DGNSS Version only)

Channels:	2 independent channels
Frequency Range:	283.5 to 325.0 kHz
Channel spacing:	500 Hz
MSK bit rate:	50, 100 and 200 bps
Input sensitivity:	2.5 µV/m for 6 dB SNR @ 200 bps MSK Rate

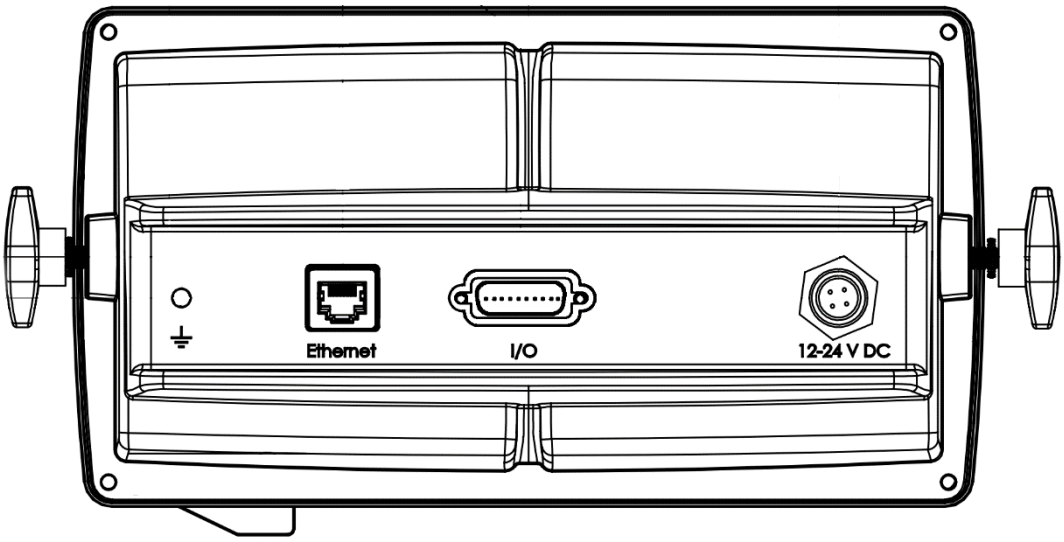
19.3 Internal Alert Relay

Max switching current:	2 A
Max switching voltage s:	24 VDC or VAC
Max switching power:	60W (DC) or 62.5 VA (AC) resistive load

20 ELECTRICAL INTERFACES

20.1 CDU Interfaces:

20.1.1 CDU back:



20.1.1.1 Ethernet port – RJ-45 100 MBit – IEC 61162-450

20.1.1.2 I/O port

Pin	In/Out	Signal Name	Signal Type	R5 Signal Cable DSUB-OPEN
1	Out	Sensor Port – TxB (+)	RS422	White
2	Out	Sensor Port – TxA (-)	RS422	Brown
3	In	User Port 4 – RxB (+)	RS422	Green
4	In	User Port 4 – RxA (-)	RS422	Yellow
5	Out	User Port 4 – TxB (+)	RS422	Grey
6	Out	User Port 4 – TxA (-)	RS422	Pink
7	In	User Port 3 – RxB (+)	RS422	Blue
8	In	User Port 3 – RxA (-)	RS422	Red
9	-	User Port 3 – GND	RS422	Black
10	-	Sensor Port – GND	RS422	Violet
11	In	Sensor Port – RxB (+)	RS422	Grey / Pink
12	In	Sensor Port – RxA (-)	RS422	Red / Blue
13	-	User Port 4 – GND	RS422	White / Green
14	Out	General I/O 1 – Out	Binary	Brown / Green
15	Out	General I/O 0 – Out	Binary	White / Yellow
16	In	General I/O 1 – In	Binary	Yellow / Brown
17	Out	User Port 3 – TxB (+)	RS422	White / Grey
18	Out	User Port 3 – TxA (-)	RS422	Grey / Brown
19	In	General I/O 2 – In	Binary	White / Pink
20	-	GND	Binary	Pink / Brown

Pin	In/Out	Signal Name	Signal Type	R5 Signal Cable DSUB-OPEN
21	-	GND	Binary	White / Blue
22	In	General I/O 0 – In	Binary	Brown / Blue
23	Out	General I/O 3 - Out	Binary	White / Red
24	-	NOT CONNECTED	-	Brown / Red
25	-	NOT CONNECTED	-	
26	-	NOT CONNECTED	-	

Table 13 – 26-pin High Density D-sub

20.1.1.3 Power port

Pin	In/Out	Signal Name	Signal Type	R5 Power Cable
1	In	PWR +	24 VDC	Red
2	In	PWG GND	0 VDC	Black
3	-	-	-	*Brown*
4	-	-	-	*Orange*

Table 14 – CDU Power port

20.1.1.4 GND Screw – M6

20.1.2 CDU Front hatch:

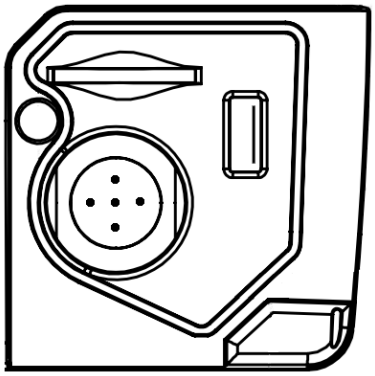


Figure 134- CDU Front ports

20.1.2.1 USB Host Type A

USB 2.0.

Supports FAT32 file systems and USB keyboards

20.1.2.2 CDU Pilot Plug RS-422

Only active in “AIS” or “Combined” installations.

This bidirectional port is routed over Ethernet to the Transponder.

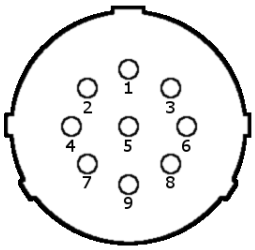


Figure 135 - CDU Pilot plug pin numbering

Pilot plug	Signal Type
PIN 9	RS-422 GND
PIN 1	RS-422 TX-A
PIN 5	RS-422 RX-A
PIN 4	RS-422 TX-B
PIN 6	RS-422 RX-B

Table 15 – CDU Pilot port signals

20.1.2.3 Secure Digital Card Reader

Supports SD and SDHC cards with FAT32 file systems.

20.1.3 Electrical Characteristics of CDU Serial ports

The serial ports in the R5 SUPREME CDU are the Sensor Port, User Port 3 and User Port 4.

20.1.3.1 Output Drive Capacity

Each serial port transmitter in the R5 SUPREME CDU can have a maximum of 25 listeners drawing 2.0 mA each.

20.1.3.2 Input Load

Input impedance for each listener input is 6.4 kΩ.

20.1.3.3 Termination

The R5 NAV Junction Box has built in termination resistors. If needed, the termination resistors can be connected by flipping the respective termination switch in the junction box. If the junction box is not used, a 1kΩ termination resistor can be used close to the receiver end.

20.1.3.4 Schematics

Each of the RS422 serial interfaces on the R5 SUPREME CDU fulfils the requirements of IEC 61162-2. All serial ports on the R5 SUPREME CDU support communication rates up to 115200 bps.

A detailed schematic of the serial ports in the R5 SUPREME CDU is shown in Figure 136.

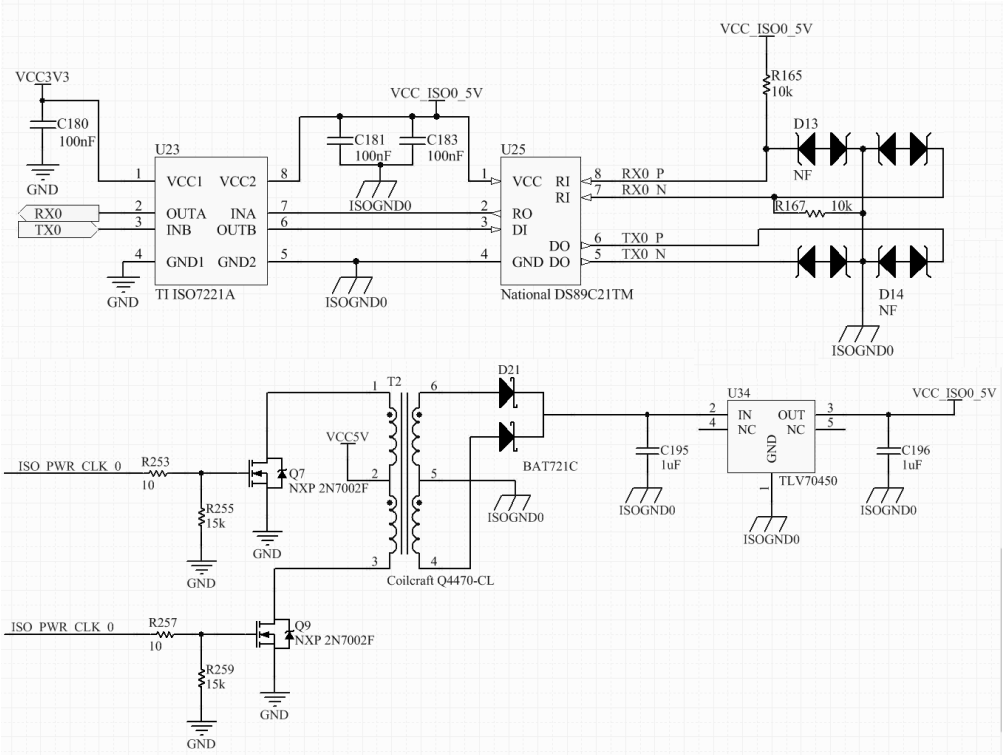


Figure 136 – R5 SUPREME CDU Serial Port Schematics

20.2 R5 Navigation Sensor interfaces

20.2.1 Internal circuit board layout:

For detailed description of routed signals, see R5 Navigation Sensor interface specifications.

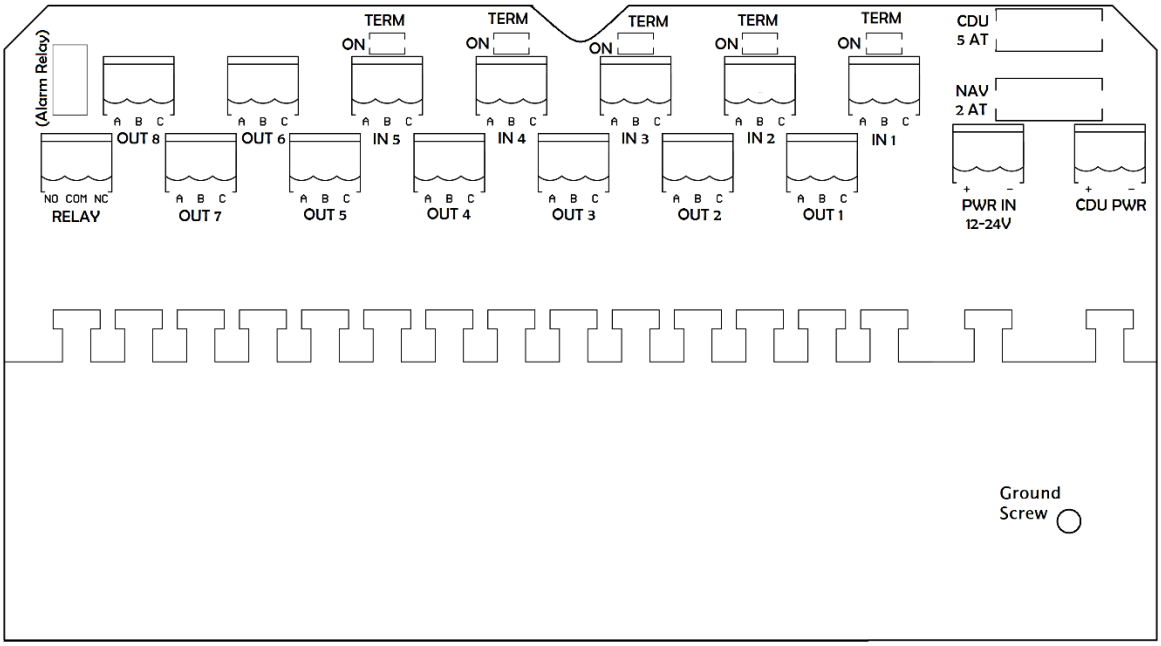


Figure 137 Circuit Board Layout with additional Cover Board

Marking	Description
PWR IN	Terminal block for External 12-24VDC Isolated Input Power
CDU PWR	Terminal block for 12-24VDC Output Power, intended for the R5 Control & Display Unit
OUT 1	Terminal block for output to Sensor 1
OUT 2	Terminal block for output to Sensor 2
OUT 3	Terminal block for output to Sensor 3
OUT 4	Terminal block for output to Sensor 4
OUT 5	Terminal block for output to Sensor 5
OUT 6	Terminal block for output to Sensor 6
OUT 7	Terminal block for output to Sensor 7
OUT 8	Terminal block for output to Sensor 8

IN 1	Terminal block for input from Sensor 1 (Isolated)
IN 2	Terminal block for input from Sensor 2 (Isolated)
IN 3	Terminal block for input from Sensor 3 (Isolated)
IN 4	Terminal block for input from Sensor 4 (Isolated)
IN 5	Terminal block for input from Sensor 5 (Isolated)
RELAY	Terminal block for Alert Relay
CDU 5 AT	5A fuse for CDU PWR Terminal
NAV 2 AT	2A fuse for PWR IN Terminal
TERM	Termination Switch
Ground Screw	Connection for box grounding
1 PPS	BNC Female Connector for PPS Output
GPS	TNC Female Connector for GPS Antenna
Ethernet 1	Ethernet Port 1 (Default IP-address 172.16.0.4)
Ethernet 2	Ethernet Port 2 (Default IP-address 172.17.0.4)

Table 16 Terminals and Components

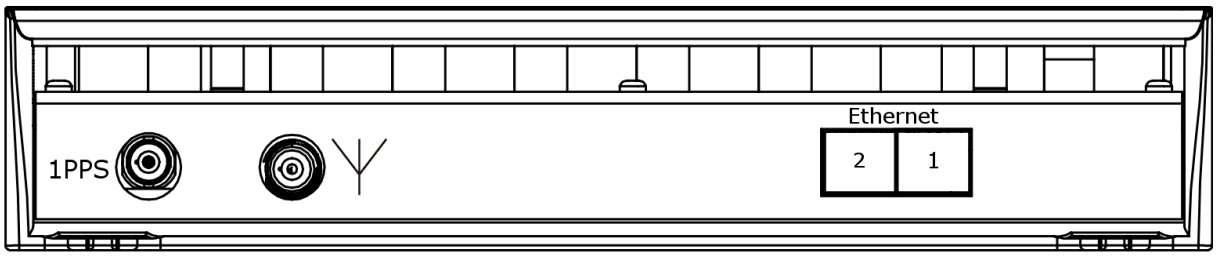


Figure 138 R5 Navigation Sensor Connectors (rear view)

20.2.2 Signal and Power port

Table 17 shows the terminal blocks that are available on the R5 Navigation Sensor circuit board. Default baud rate for serial data is 38400 bps.

Table 17 Terminals/Signal Names

Terminal Marking	Terminal Pin	Signal Name
PWR IN	+	Vs+
PWR IN	-	Vs-
CDU PWR	+	Vs+
CDU PWR	-	Vs-
RELAY	NC	Normally Closed
RELAY	COM	Common
RELAY	NO	Normally Open
OUT 1	A	Tx -
OUT 1	B	Tx+
OUT 1	C	Signal GND
OUT 2	A	Tx -
OUT 2	B	Tx+
OUT 2	C	Signal GND
OUT 3	A	Tx -
OUT 3	B	Tx+
OUT 3	C	Signal GND
OUT 4	A	Tx -
OUT 4	B	Tx+
OUT 4	C	Signal GND
OUT 5	A	Tx -
OUT 5	B	Tx+
OUT 5	C	Signal GND
OUT 6	A	Tx -
OUT 6	B	Tx+

Terminal Marking	Terminal Pin	Signal Name
OUT 6	C	Signal GND
OUT 7	A	Tx -
OUT 7	B	Tx+
OUT 7	C	Signal GND
OUT 8	A	Tx -
OUT 8	B	Tx+
OUT 8	C	Signal GND
IN 1	A	Rx -
IN 1	B	Rx+
IN 1	C	Signal GND
IN 2	A	Rx -
IN 2	B	Rx+
IN 2	C	Signal GND
IN 3	A	Rx -
IN 3	B	Rx+
IN 3	C	Signal GND
IN 4	A	Rx -
IN 4	B	Rx+
IN 4	C	Signal GND
IN 5	A	Rx -
IN 5	B	Rx+
IN 5	C	Signal GND

20.2.3 Antenna connector

Connector: TNC (Female)

Output: +6 VDC (referenced to VCC input GND)

20.2.4 Electrical Characteristics of R5 Navigation Sensor serial ports

The serial ports in the R5 Navigation Sensor are all the IN- and OUT ports.

20.2.4.1 Output Drive Capacity

Each talker output can have a maximum of 10 listeners drawing 2.0mA.

20.2.4.2 Input Load

Each listener draws less than 2mA @ 2V input voltage.

20.2.4.3 Termination

The R5 Navigation Sensor has built-in termination resistors. If needed, the termination resistors can be connected by flipping the respective termination switch on the sensors circuit board (see Figure 137).

20.2.4.4 Schematics

Each of the RS-422 serial interfaces on the R5 Navigation Sensor fulfils the requirements as specified in IEC 61162-1. All port bit rates are configurable between 4800 bps and 115200 bps.

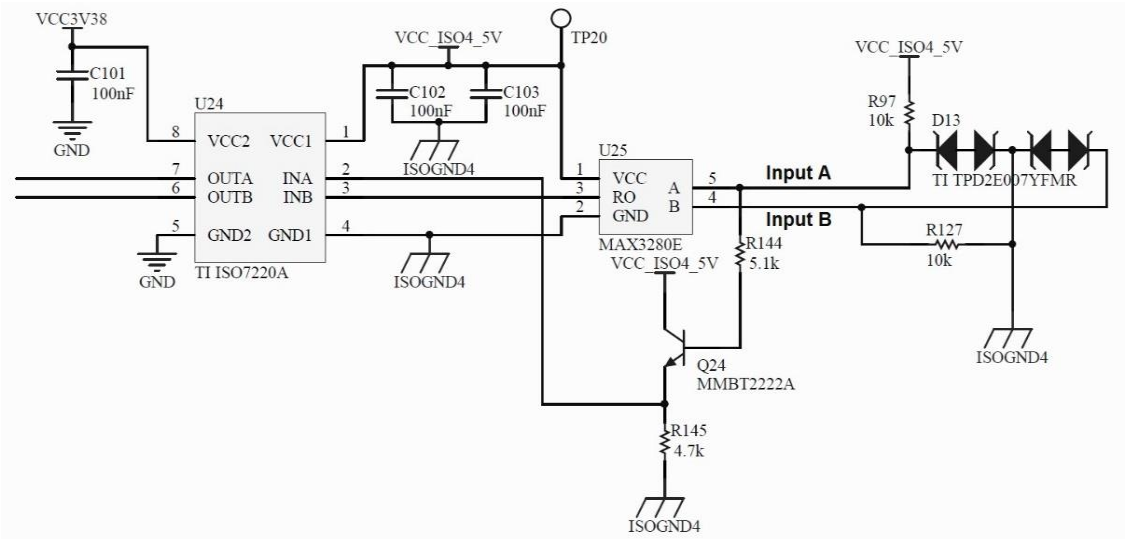


Figure 139 – R5 Navigation Sensor Serial Interface Input Schematics

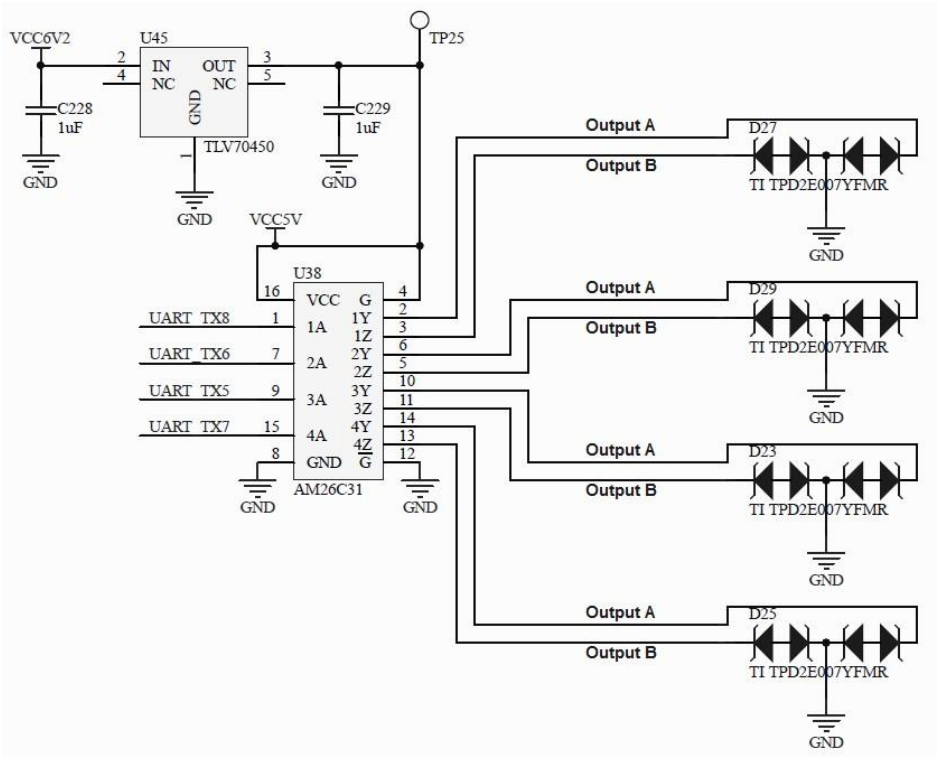


Figure 140 – R5 Navigation Sensor Serial Interface Output Schematics

20.2.5 Electrical Characteristics of R5 Navigation Sensor digital ports

20.2.5.1 1PPS Port

The 1PPS port send out a 5V clock pulse every second, lasting for 1ms, when the system has “GNSS Fix”, with an accuracy of 50 ns and detection on rising edge.

20.2.5.2 Alert Acknowledge Port (Configuration for Input Ports)

The Input Port’s Rx+ should be connected via an external normally open momentary switch, capable of handling a 1mA current, to the signal GND for this application. If the input port configured to have the function “Alert Ack” the system detects if the port’s Rx+ signal is drawn low, by its own isolated ground, and thereby acknowledge all active alerts.

20.2.5.3 MOB Button Port (Configuration for Input Ports)

The Input Port’s Rx+ should be connected via an external normally open momentary switch, capable of handling a 1mA current, to the signal GND for this application. If the input port configured to have the function “MOB Button” the system detects if the port’s Rx+ signal is drawn low for a second, by its own isolated ground, and thereby the sensor outputs a MOB message.

20.2.5.4 Speed Log Pulses (Configuration for Output Ports)

If an output is configured to this functionality, it outputs 5V pulses with 50ms duration (approx.). How frequently the pulses are sent, depends on the vessel’s speed. It is configurable how many pulses the unit will send per Nautical mile: 100, 200, 300 or 400 pulses/Nm.

20.2.5.5 Alert relay Port

When the R5 Navigation Sensor has, unacknowledged alerts the alert relay will contact Common to Normally Open. If all alerts are acknowledged or inactive, the alert relay will instead contact Common to Normally Closed.

21 MECHANICAL DRAWINGS

21.1 CDU Physical Size and Mechanical Drawing

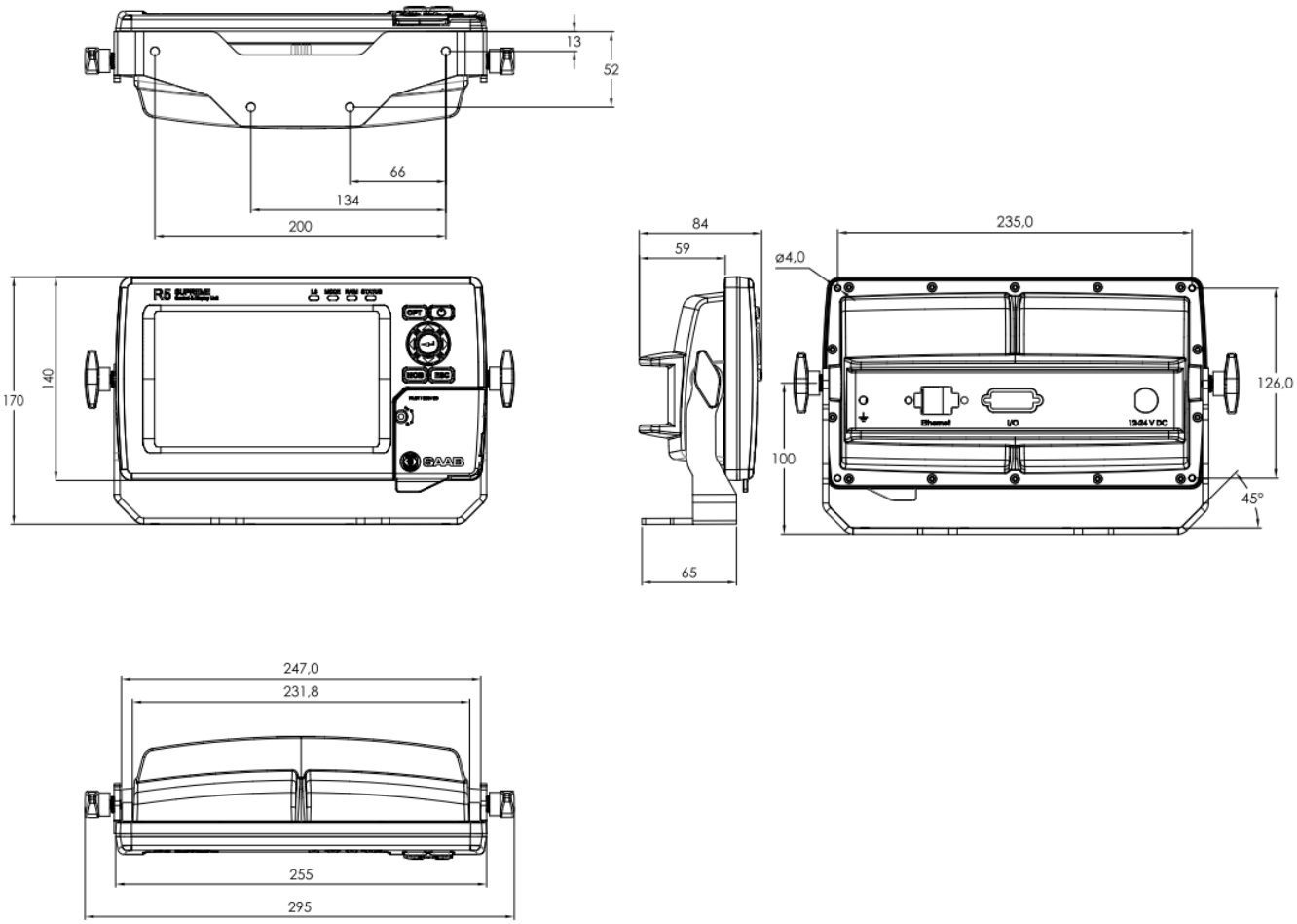
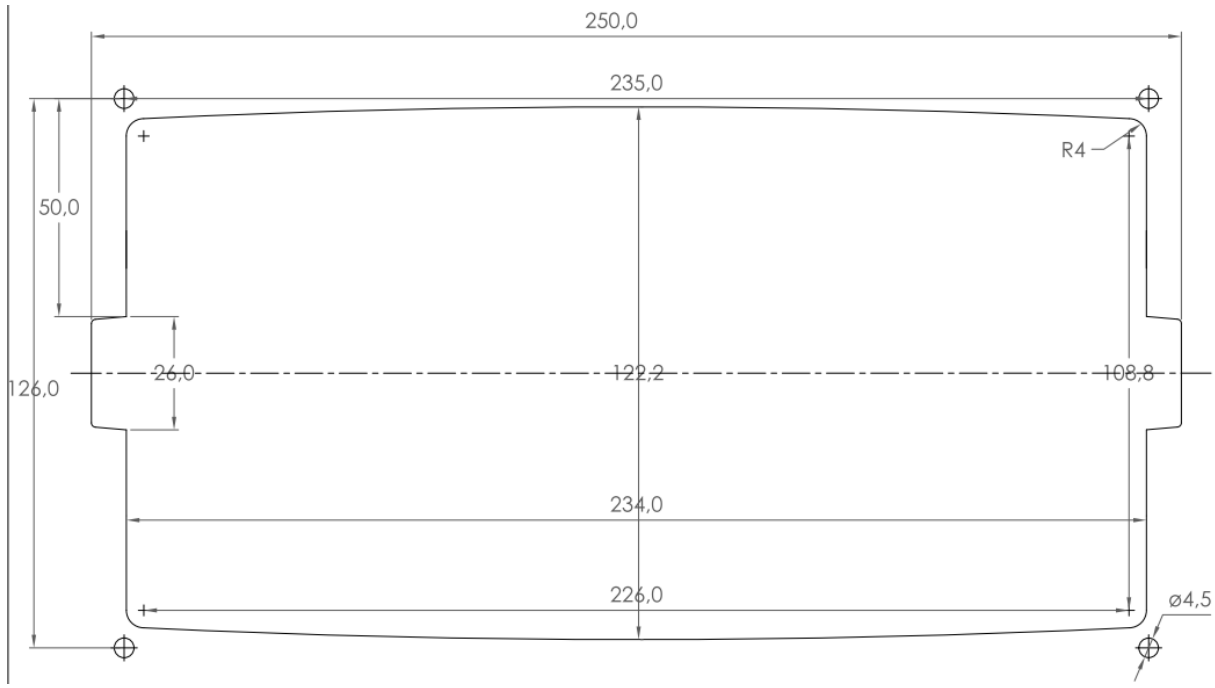


Figure 141 – R5 SUPREME CDU Mechanical Drawing (mm)

21.2 CDU Panel Mount Cutout Hole dimensions



21.3 CDU Mounting Frame cutout and dimensions

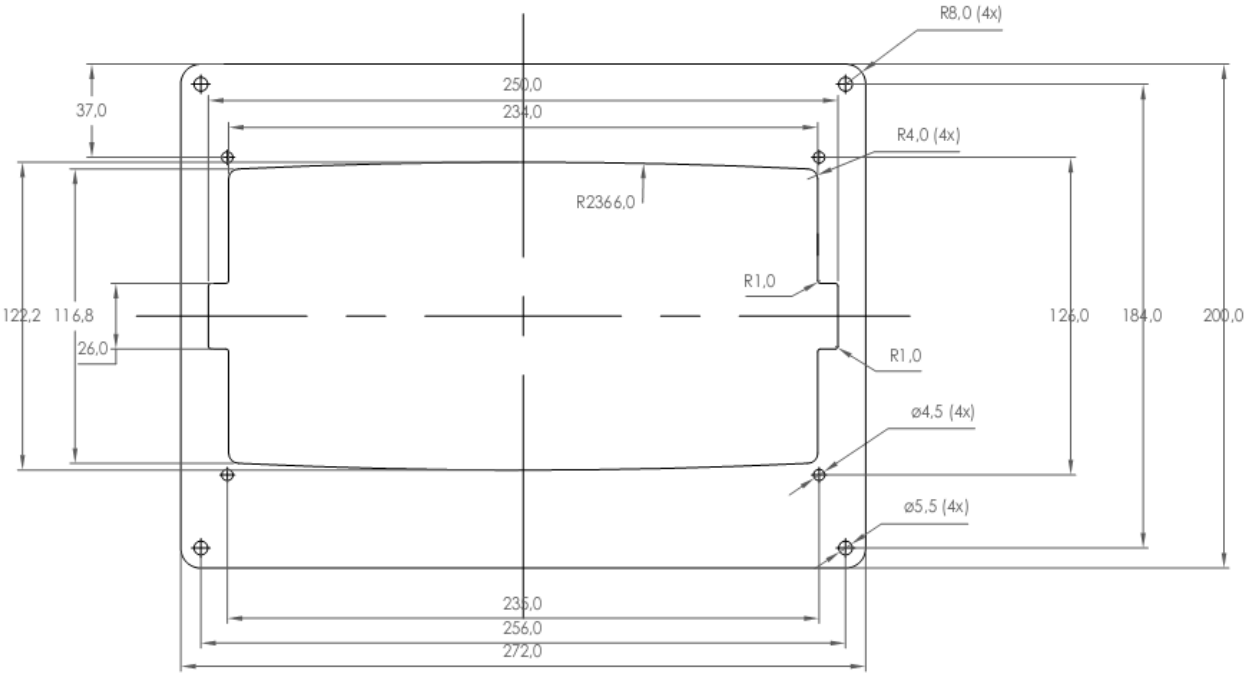


Figure 142 – R5 SUPREME CDU, Mounting frame dimensions

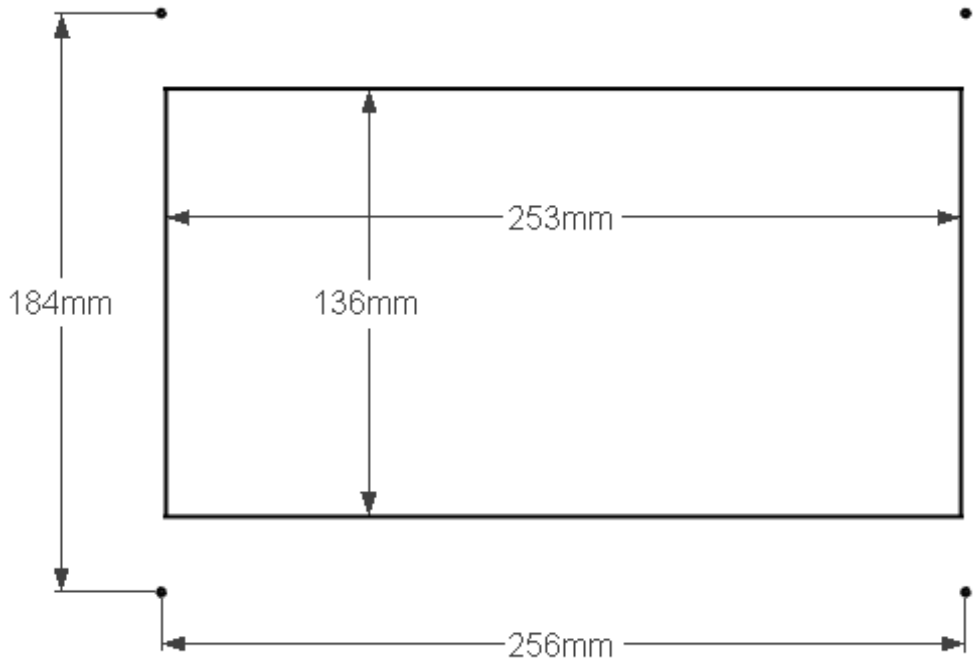


Figure 143 – R5 SUPREME CDU, Cut-out Measurements for Panel Flush Mount (mm)

21.4 R5 Navigation Sensor Size and Mechanical Drawing

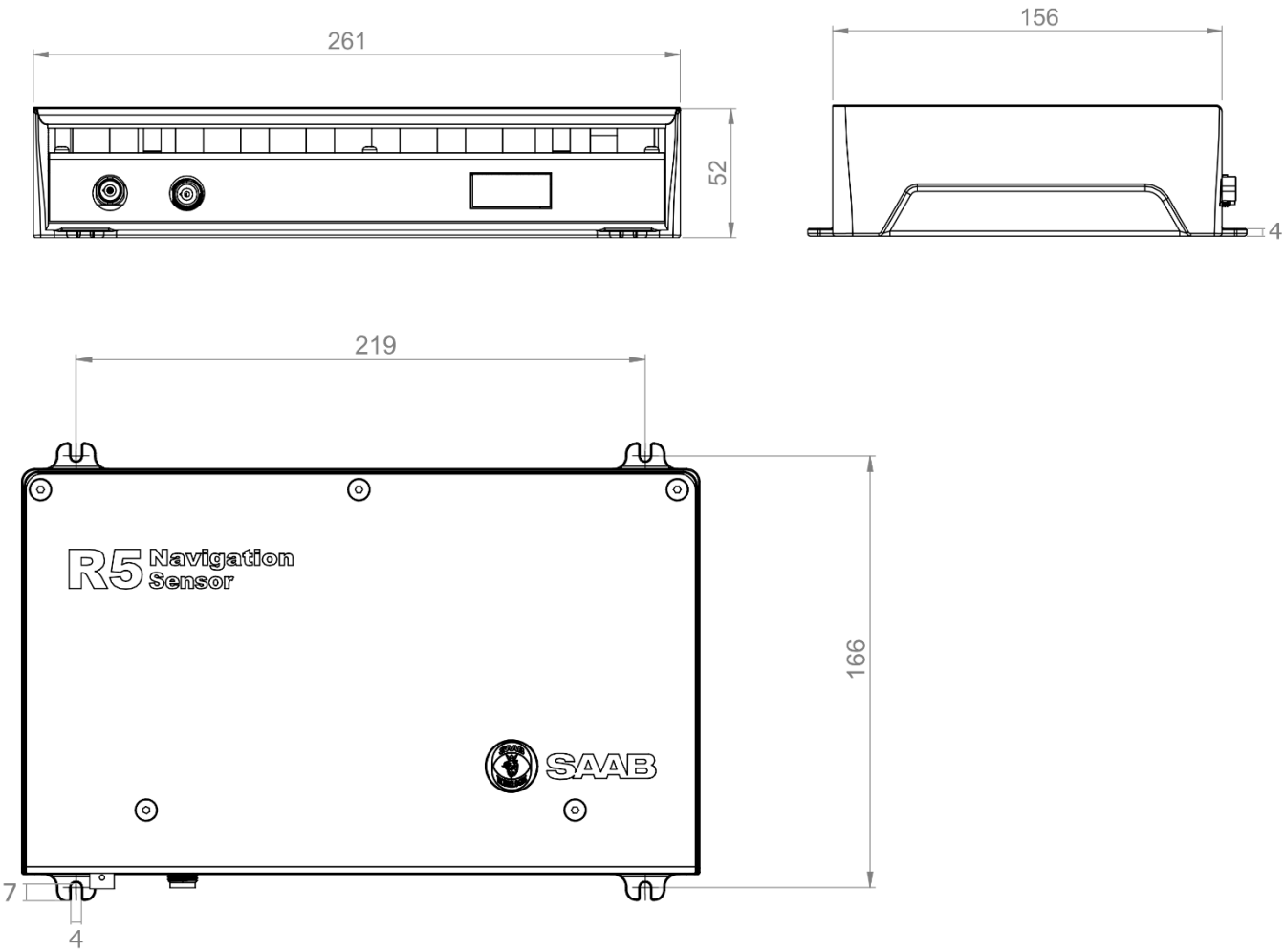
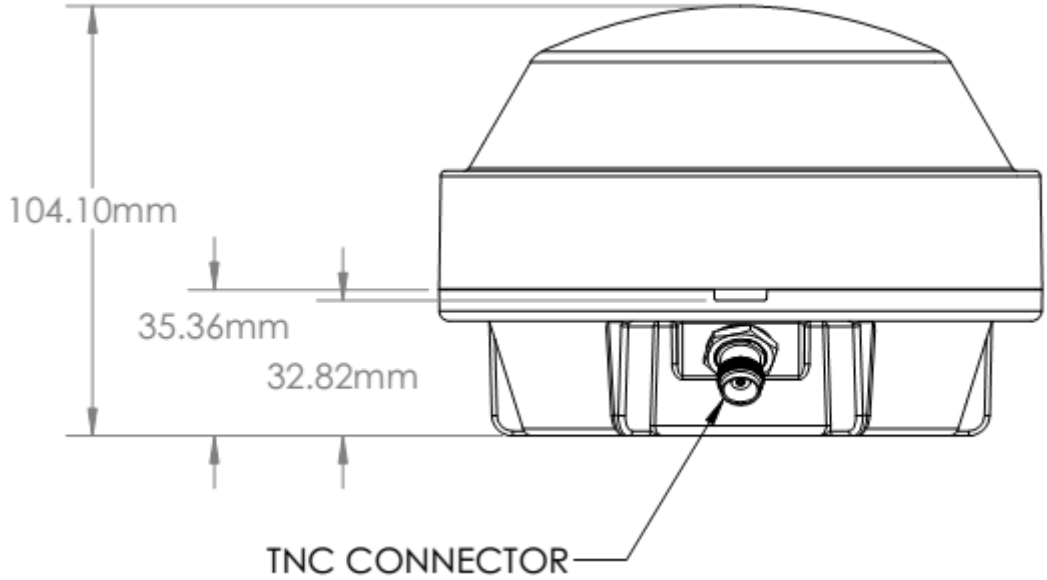
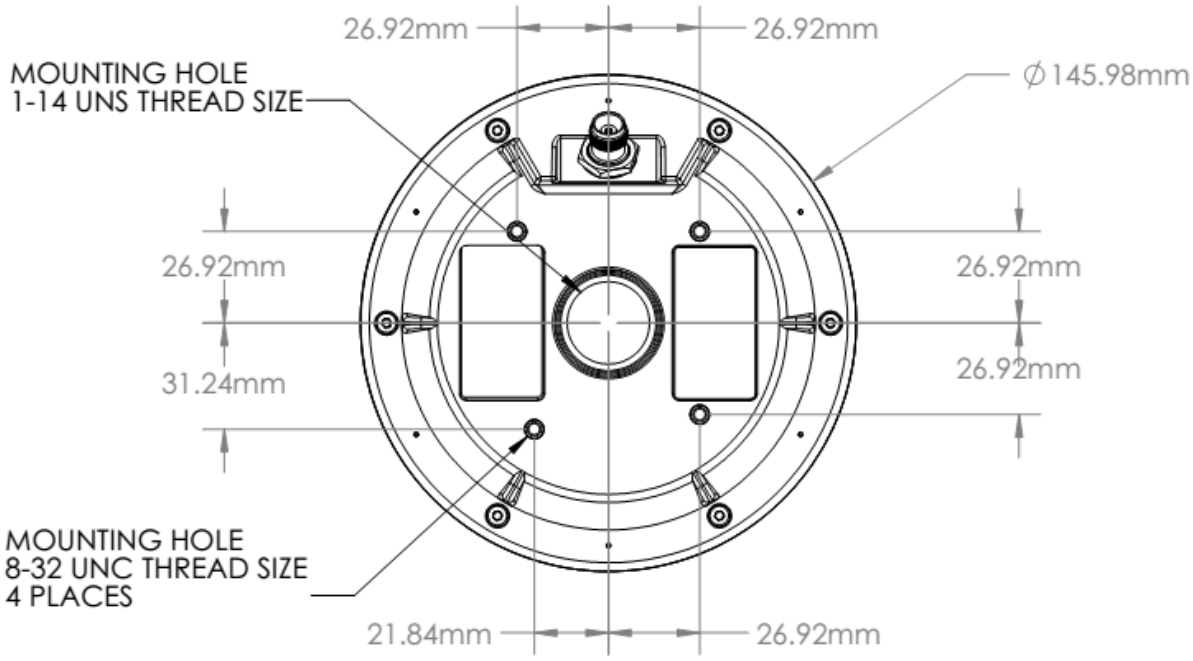


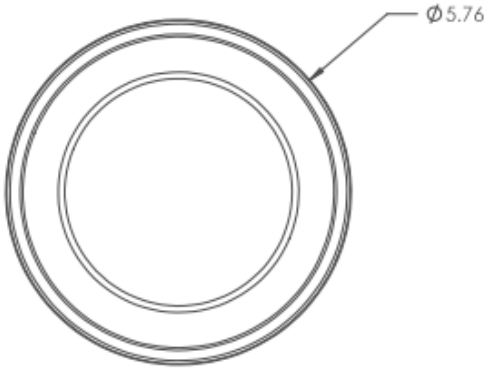
Figure 144 – R5 Navigation Sensor Measuements (mm)

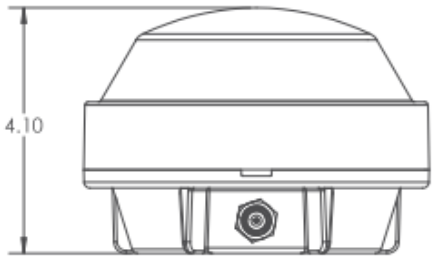
21.5 MGA-3 / MGL-5 / A43 Antenna Physical Size and Mechanical Drawing

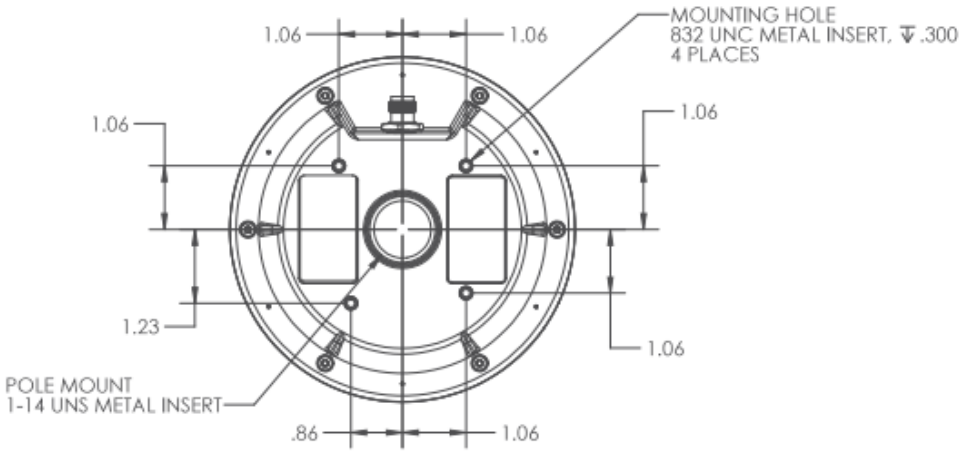




21.6 A31 Antenna Physical Size and Mechanical Drawing







22 GLOSSARY

ACK	Acknowledgement
AFSK	Audio Frequency Shift Keying
AIS	Automatic Identification System
Ant	Antenna
App	Application
ARPA	Automatic Radar Plotting Aid
BAM	Bridge Alert Management
BRG	Bearing
BS	Base Station
CAM	Central Alert Management
CDU	Control and Display Unit
Ch	Channel
COG	Course Over Ground
Comm	Communication
DGNSS	Differential Global Navigational Satellite System
Disp	Display
DOP	Dilution Of Precision
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
HMI	Human Machine interface
H/W	Hardware
IALA	International Association of Lighthouse Authorities
ID	Identifier
IEC	International Electro technical Commission
IMO	International Maritime Organization

Int	Internal
IP	Internet Protocol (address)
ITU	International Telecommunications Union
LAT	Latitude
LED	Light Emitting Diode
LOC	Local
LON	Longitude
LWE	Light Weight Ethernet
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
NVM	Non-Volatile Memory
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
SFI	System Function Identity
SNR	Signal to Noise Ratio
SNGF	Serial to Network Gateway Function
SOG	Speed Over Ground
RTK	Real Time Kinematics
SRM	Safety Related Message
Sync	Synchronization
SW	South West
S/W	Software
UTC	Universal Time Coordinated
VDOP	Vertical Dilution Of Precision
WAAS	Wide Area Augmentation System (United States)

23 APPENDIX A – CORRECTIONS

23.1 Real-Time Kinematic (RTK)

Real-Time Kinematic is a technic used to improve position accuracy, by the inclusion of correction data, from reference stations or a reference network, in the solutions.

A RTK reference base station (normally just mention as "*base*" in RTK terms) can be seen as a GNSS receiver that is not interested about the information included in the signal, with exception for identity. Instead, the base uses each satellite signal's carrier wave to gain insight about the current atmospheric effects and calculate the relative position- and clock error. This data is normally referred to as corrections.

Considering this, one can see that there are high demands when setting up a RTK reference base station, due to the usage of relative errors.

A mobile GNSS receiver (in RTK terms often-called "*rover*") can receive correction data in multiple ways, but most commonly over the UHF-band by an integrated/external UHF receiver or over an internet connection. The received correction data is included in the position solution by individually correcting the data received from each satellite in the GNSS systems. By minimizing each error individually, the total position error rapidly decreases and a more precise position solution is achieved.

When make use of RTK it is to prefer as local corrections as possible, to get the best result.

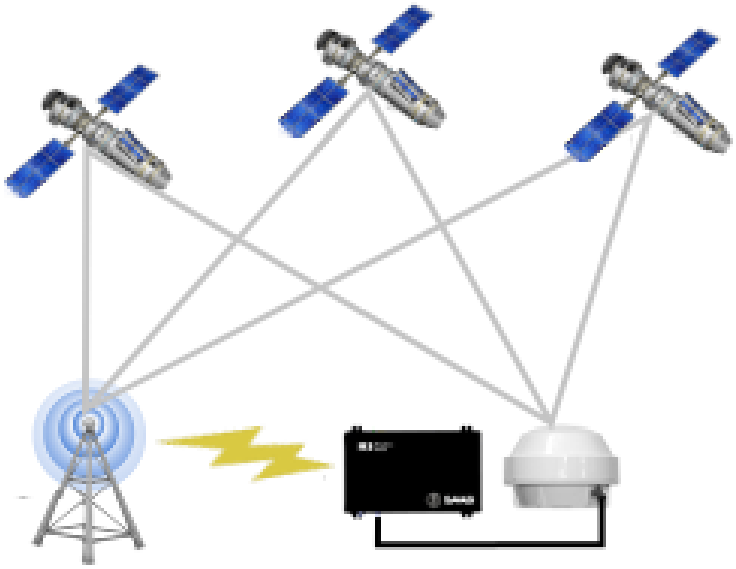


Figure 145 – Real-Time Kinematic

23.2 Atlas Correction Service

Atlas is a RTK satellite network that virtually span the entire globe; providing GNSS receivers with correction via L-Band satellite signals. It collects it data through more than a hundred RTK reference base stations uploading correction data worldwide (for more information about RTK bases/networks see Section 23.1).

With "Atlas Correction Service" the user can obtain centimetre-level positioning accuracy without being directly tied to a local reference system.

To obtain full accuracy the system may need a converging time of up to 20 minutes during the start-up process.

24 APPENDIX B - LICENSE

The R5 SUPREME CDU 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 AB (publ), TransponderTech AB:

Saab AB (publ),TransponderTech
Låsblecksgatan 3
589 41 Linköping
Sweden

Email: support.transpondertech@saabgroup.com

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