Saab TransponderTech

I6 IMU

OPERATION & INSTALLATION MANUAL

SAAB TECHNOLOGIES

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i Copyright

ii Disclaimer

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

iii Firmware

This manual reflects the capabilities of the I6 IMU (optional component of R6 Navigation System) with F/W version 1.1.0.

The unit has the ability to be firmware updated after delivery. Therefore, the product label can specify a firmware different from the actual firmware in the product. Current firmware versions in the system can always be verified in the F/W information view as described in section 4.4

iv Manual Part Number and Revision

Part number 7000 125-306, revision B1.

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, contact your local Saab TransponderTech representative. A list with dealers, OEM partners and service stations can be found at our website, listed under the corresponding product page.

www.saab.com/maritime

For the latest manual, firmware and certificates visit:
https://www.saab.com/transpondertechsupport

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1 SAFETY INSTRUCTIONS

1.1 General

Saab 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 I6 IMU, referred to as “equipment” in this section.

1.2 Installation and Service

Only qualified technicians shall do installation and servicing of equipment. Electrical fuses must be replaced with correct types.

To prevent electrical shock hazard and damage to the equipment, 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 behaviour of the equipment.

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

2 SYSTEM OVERVIEW

2.1 Product Description

The I6 IMU is a unit used for Inertial Navigation support. By input from a GNSS/Heading source (such as the R6 NAV Compass) the I6 IMU can calculate accurate speed, rate-of-turn, as well as, dead reckoning calculated heading and positions which can give supporting data outputs for shorter times of GNSS/heading loss.

A web-interface is built-in to the I6 IMU. The Web-interface allows status monitoring, change of configuration and FW updates.

3 INSTALLATION

3.1 Equipment part numbers

The I6 IMU's most common parts and accessories are listed below. Delivery note.

Name	Part number
I6 IMU	7000-125-602
Power cable M12 to open 2m	7000-125-544
Ethernet cable M12 to RJ45 2m	7000-125-550

Table 1 - R6 Navigation System and accessories

3.2 Equipment Installation Environment

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

Name	Part number	IEC 60945 installation category
I6 IMU	7000 125-602	Protected

Table 2 - IEC 60945 equipment classification

3.3 Cables

3.3.1 Power cable M12 to open 2m

Marking: 7000-125-544
Type: PVC, Metal, Non-shielded
Length: 2 m
Diameter: 6 mm
Connectors: M12 (A-Coding) / Open
Function: Power input/output

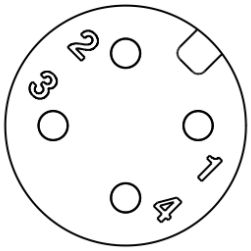

Figure 1 – Power Cable M12 Connectors 4 Pin, A-Coding

Function	Pin	Cable colour
12 / 24 VDC	**1**	**Brown**
12 / 24 VDC	**2**	**White**
0 VDC	**3**	**Blue**
0 VDC	**4**	**Black**

Table 3 - Power cable M12 to open Interconnection

3.3.2 Ethernet cable M12 to RJ45 2m

Marking: 7000-125-550
Type: Cat 6A, LSZH, Metal, Shielded
Length: 2 m
Connector: M12 (X-Coded) / RJ45
Electrical: 1GBps Ethernet

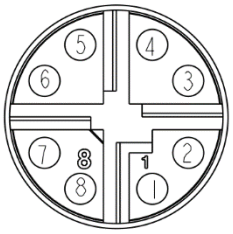

Figure 2 – Ethernet Cable M12 Connectors 8 Pin, X-Coding

Function	Pin	
MX1+	1	RJ45 - In/Out
MX1-	2	RJ45 - In/Out
MX1+	3	RJ45 - In/Out
MX1-	4	RJ45 - In/Out
MX1+	5	RJ45 - In/Out
MX1-	6	RJ45 - In/Out
MX1+	7	RJ45 - In/Out
MX1-	8	RJ45 - In/Out

Table 4 - ETH signals

3.3.3 Minimum cable bending radius

When installing the cables, the recommended minimum bending radiuses are as follows:

Signal and power cables:	10 times cable diameter
Coaxial cables:	5 times cable diameter

3.4 System interconnection overview

3.4.1 Basic system setup

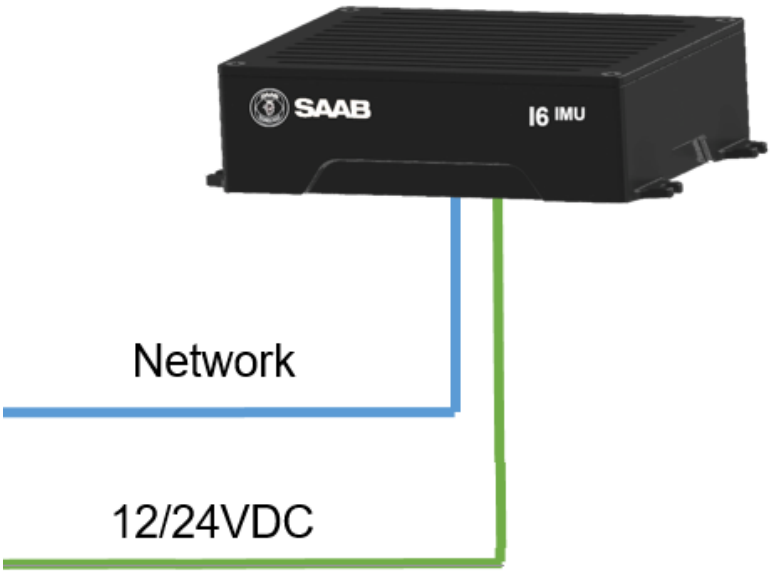

Figure 3 - Connection overview

3.4.2 Installation Procedure

When installing the I6 IMU, follow the steps described in this installation manual. Details of the installation procedure follows.

Recommended installation steps:

1. Mount the I6 IMU according to the specifications in 3.4.3
2. Connect the I6 IMU to the R6 NAV PRO Compass unit by the M12/RJ45 Ethernet cable. Match the Ethernet port 1 to 1/2 to 2 so that the units per default are on the same sub-network.
3. If applicable install other units included in the system setup
4. Connect the I6 IMU Power Input to an external 12/24V power source (such as the CDU PWR/PWR OUT on the R6 NAV PRO Compass)
5. Power up the system
6. Perform system configuration and functional verification.
7. For best trim / performance power cycle unit after re-configuration of installation parameters

3.4.3 Installing the I6 IMU

3.4.3.1 Sensor Location

When mounting the I6 IMU, please consider the following:

- The unit must either be mounted vertically (wall mount) or horizontally (shelf mount) on a permanent location. **The IMU unit needs to follow the motions of the vessel's hull. *(Important!)***
  Refer to Figure 4 - Vertical (Wall-mount) / Horizontally (Shelf-mount).
  If mounted vertically, the connectors must be facing down. ***(Important!)***
- Carefully level the unit's flat sides, ensuring it is aligned with the vessel in all directions.
- 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.
- Make sure that there is enough airflow to avoid high ambient temperatures.
- Make sure that the different cables can be connected without violating their minimum bending radiuses.

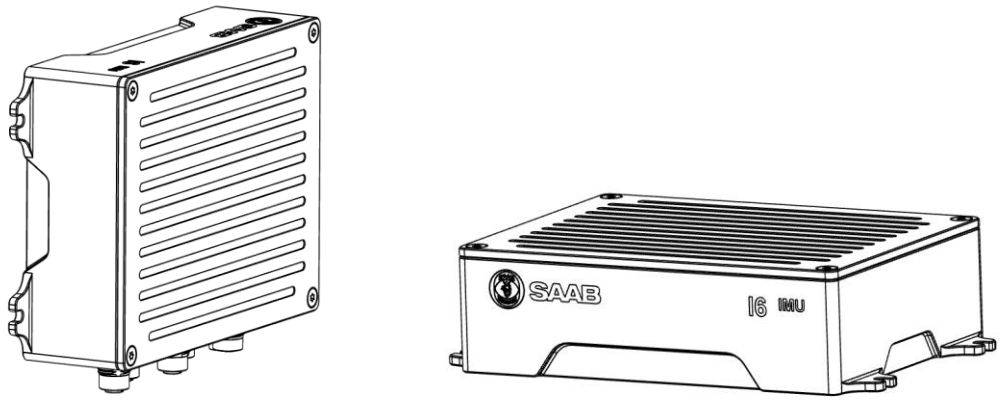

Figure 4 - Vertical (Wall-mount) / Horizontally (Shelf-mount)

Physically installation of the I6 IMU

4 WEB INTERFACE

The I6 IMU has a web interface, just requiring an Ethernet connection, which gives the user a possibility to maintain and configure the sensor. The interface is accessible in the most commonly used web browsers, enter the Navigation Sensor's IP address which in default is set to 172.16.0.5 on Eth1 and 172.17.0.5 on Eth2.

4.1 Status page

The status page displays information about how well the system performs. See List of available alerts.

Note: For more detailed about the meaning of each alert see section 8.3

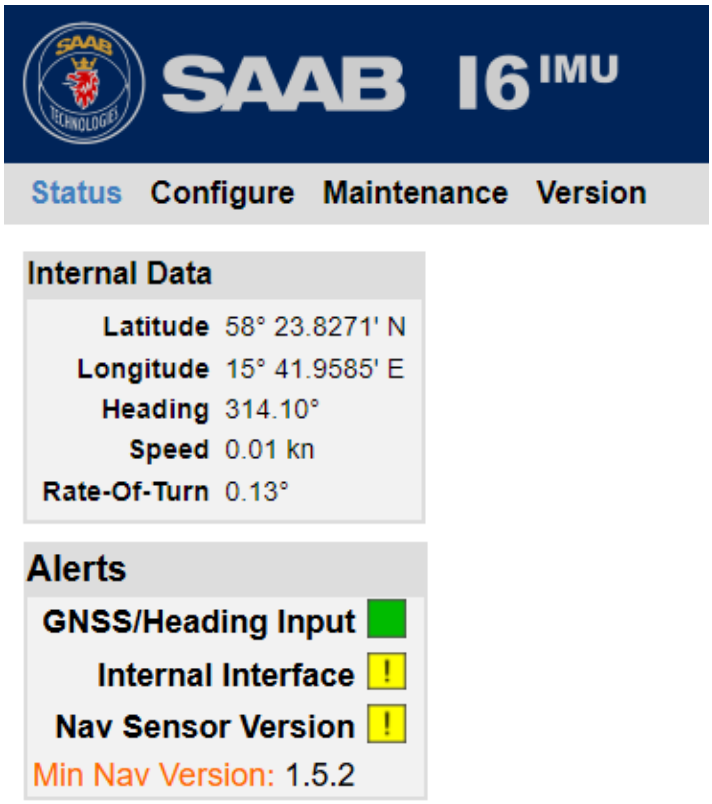

Figure 5 - Web Interface, Status page

4.2 Configuration Page

In the Configure page the I6 IMU can be set to work as desired.

For more information about configuration parameters related to:

- Network Interface, see section 5.1.4
- GNSS Input, see section 5.1.6
- Mounting Option, see section 5.1.3
- Output Sentences, see section 5.1.4

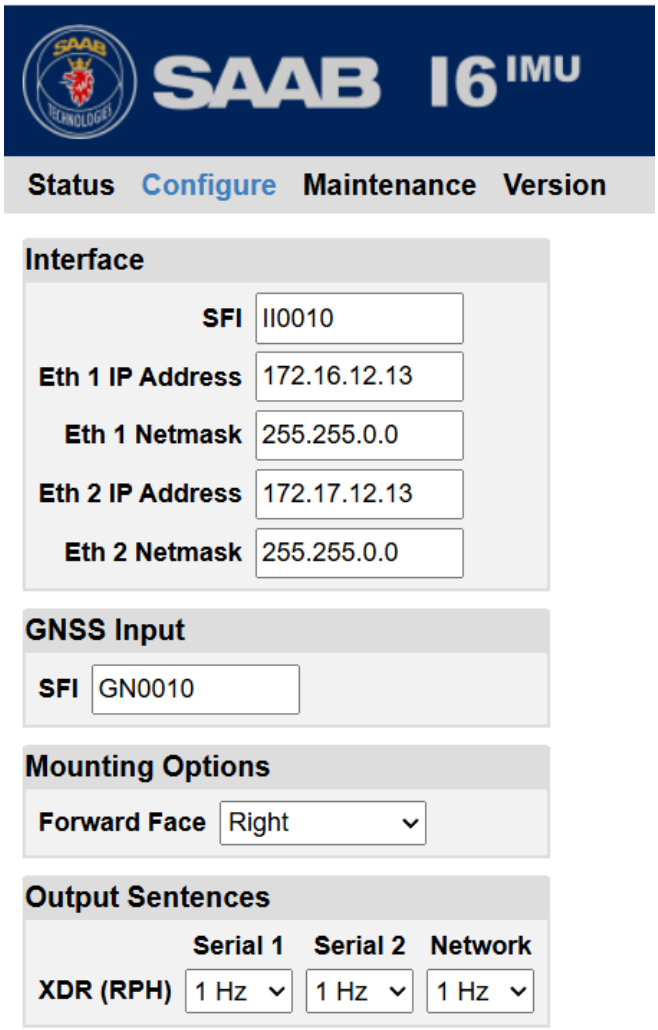

Figure 6 - Web Interface, Configure page

4.3 Maintenance Page

The “Maintenance” pages functionalities are the uploading of Firmware, saving/loading/restoring configuration settings.

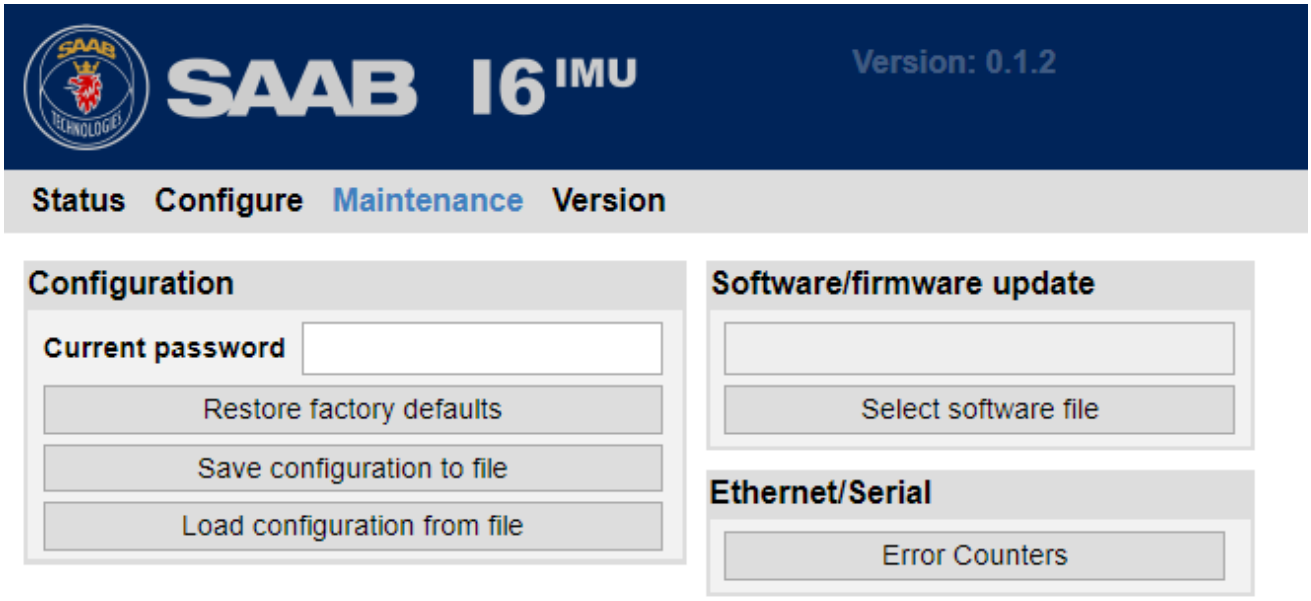

Figure 7 - Web Interface, Maintenance page

4.3.1 Configuration

This application makes it possible to save the current configuration settings as an .i6imucfg file or load configuration settings form an already saved .i6imucfg file. It also provides the possibility to reset the sensor to default settings.

4.3.2 Update

For installation, service, ordering info and technical support please contact your local Saab TransponderTech representative. A list with dealers, OEM partners and service stations can be found at our website, listed under the corresponding product page, www.saab.com/maritime .

To perform a firmware update through the web interface:

- Connect the computer to the same network/subnet as the I6 IMU
- Enter the web interface by a preferred browser and enter the current I6 IMU IP address (Be sure that the computer has a valid/matching IP address)
- Enter the web interface’s maintenance page
- Click either on the button “Select firmware file” and select the .i6pkg, form the firmware package to start an upgrade process

4.4 Version Page

The Version page displays information about the hardware and firmware of the unit. This information should always be provided when in contact with Saab TransponderTech support.

Figure 8 - Web Interface, Version page

5 CONFIGURATION

When the physical and electrical installation of the system is complete, the I6 IMU needs to be configured. This section describes what the installer is required to do before the I6 IMU is fully operational.

This section describes the different configuration parameters that can be set in the I6 IMU web interface.

5.1.1 Network Interface

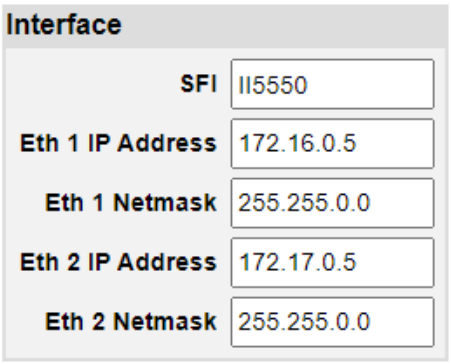

Figure 9 - Network Settings

Parameter Name	Description
SFI	The unique ID that is used on the network. This ID must be unique for all equipment connected to the same network. **SFI should not end with 9999, because these SFI:s is not valid during normal operation in accordance with IEC 61162-450.**
Eth 1 IP Address	The IP Address and network mask used for the I6 IMU port ETH1. *Example: 172.16.0.5 (default setting)*
Eth 1 Netmask	IP-address Subnet mask used for port ETH1 of the I6 IMU
Eth 2 IP Address	The IP Address and network mask used for the I6 IMU port ETH2. *Example: 172.17.0.5 (default setting)*
Eth 2 Netmask	IP-address Subnet mask used for port ETH2 of the I6 IMU

Table 5-5 - NAV Network Parameters

5.1.2 GNSS Input

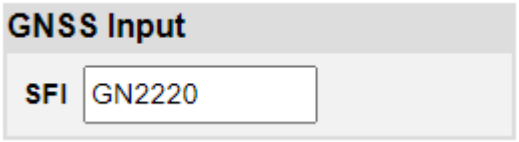

Figure 10 - GNSS Input SFI

Note: Read more about received/transmitted NMEA messages in section 11.

Parameter Name	Description
SFI - GNSS Input	The *GNSS Input* is to specify which GNSS source that the I6 IMU shall collect heading and position data from.

Table 5-6 - GNSS Input SFI Parameter

5.1.3 Mounting Option

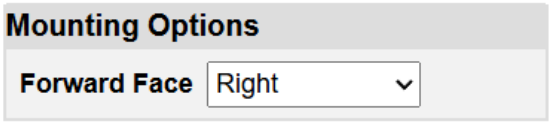

Figure 11 – Mounting Options Configuration

Parameter Name	Description
Face Forward	This parameter should be configured so it describes which side of the unit that faces against the front/bow of the vessel. *Note: Reminder of considering other installation requirements, see section 3.4.2 / 3.4.3*

Table 5-7 – Face Forward Parameter

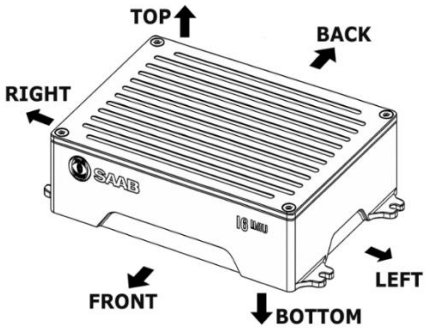

Figure 12 – I6 IMU orientation description

5.1.4 Output Sentences

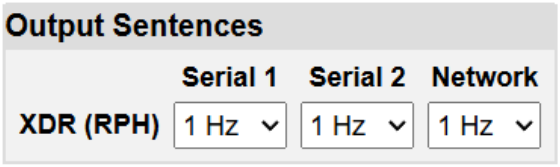

Figure 13 – Output Sentences

Note: Read more about received/transmitted NMEA messages in section 11.

Parameter Name	Description
XDR – Roll / Pitch / Heave	NMEA sentence that the I6 IMU is capable to output and has configurable output interval. The interval can be set between 10 time per second up to 1 per minute Sentence description at section 9.3

Table 5-8 – XDR Output Parameters

5.1.5 LEDs on I6 IMU

Figure 14 - LEDs on I6 IMU

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 receives the expected data and no internal issues are detected. If the LED is continuously lit red the system has active alerts.

2. **Power LED (12-24 VDC)**

   The green "*12-24 VDC"* LED indicates when the unit is provided with correct power input by getting continuously lit.

3. **Ethernet 1/2 LEDs**

   The green "*Ethernet"* LED flashes when data is received or transmitted.

6 FIRMWARE UPGRADE

The combination of an I6 IMU unit with a different unit (such as R6 NAV PRO Compass), may require a Firmware upgrade to make sure that the FW versions are fully aligned.

The I6 IMU can be upgraded over Ethernet web interface.

Make sure to carefully read the release notes for the Firmware upgrade package first.

For the latest manual, firmware and certificates please visit:

https://www.saab.com/transpondertechsupport

6.1 Upgrade Firmware in I6 IMU via Web

To update the I6 IMU firmware, simply use the file upload tool on the Web servers "Maintenance" category page.

To perform a Firmware upgrade, perform following steps:

- Click the **Select Firmware file** button.
- Browse the file structure to find and select the .i6imupkg-file for upload. Click on the **Upload** button (or similar in your language). The upgrade process will start.
- The file is uploaded to the I6 IMU. A progress bar displays the data transfer.
- Once the file is uploaded it will be written to the device. A progress bar is shown.
- When written the device will reboot, and the Web page will reload. The upgrade process is thereafter finished.

NOTE: This is the procedure to follow regardless of type of update. The contents of the .i6imupkg-file controls what is updated.

7 TECHNICAL SPECIFICATIONS

7.1 I6 IMU

7.1.1 Physical

Dimensions:	Height: 53 mm Width: 205 mm Depth: 150 mm
Weight:	1.1 kg

7.1.2 Electrical

Input Voltage:	24V DC (12 to 24 VDC)
Nominal Power:	4.8 W
Nominal Current:	0.20A @ 24 VDC input
Antenna input impedance:	50Ω

7.1.3 Environmental

Temperature:	-15˚C to +55˚C (Operational) -30˚C to +80˚C (Storage)
EMC / Vibration:	IEC 60945 ed. 4
Compass Safe Distance:	30 cm (for standard magnetic compass) 30 cm (for steering magnetic compass)

7.1.1 Inertial Measurement

Gyro Bias Instability	≤ 1.2°/hr
Angular Random Walk	≤ 0.08°/√hr

8 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-working.

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

There are numerous ways to troubleshoot an 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 section 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 I6 IMU unit and the whole R6 Navigation System.

8.1 Troubleshooting Prerequisites

An I6 unit's operating environment may naturally differ widely, ranging from small high-speed vessels to very large SOLAS tankers, military aircraft carriers and even submarines. The diversity of installation environments will of course have impact on the complexity of the troubleshooting, but it is always advisable to start with minimizing all possible interference sources in order to simplify the troubleshooting.

- Start with disconnect all other equipment able to communicate with the unit.

We strongly encourage to always use the latest Firmware available for the I6 IMU. It may contain bug-fixes and other improvements solving already known issues. Always check existing release notes to see if your problem is to be found.

8.2 Troubleshooting with the Sensor LEDs

If the sensor's status LED flashes red, the sensor has failed to enter the primary firmware application and instead start up in backup mode. In backup mode all system settings are returned to default and are locked down.

8.3 Troubleshooting with Internal Indications

The I6 IMU constantly monitors itself for failures, abnormal conditions and other important parameters. The monitoring trigger internal alerts and those are excellent aids in the troubleshooting process.

No alerts are output by the I6 IMU, but the HBT Sentence which are output will state if there is an issue in the unit.

NOTE: The R6 NAV PRO Compass will observe the HBT sentence and indicate for the user if the connected I6 IMU has any issues.

8.3.1 NMEA Input

This indication is activated when the I6 IMU isn't provided with the required NMEA data, such as GNS and THS (both in 10Hz).

8.3.2 Nav Sensor Version

This indication is activated when the I6 IMU has identified that the Navigation Sensor who that the unit is paired with doesn't have a compatible firmware.

8.4 Contacting Support

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

It is also possible to contact Saab 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 "FW/HW Information" views (Unit).
- Detailed fault description.

For the latest manual, firmware and certificates please visit https://www.saab.com/transpondertechsupport

9 COMMUNICATION INTERFACES

This section describes the characteristics of the communication interfaces in the I6 IMU.

The unit is equipped with two Ethernet network interfaces and two RS-422 serial ports.

9.1 Serial Ports

The I6 IMU has two RS422 serial ports initially unused, but they can be utilized for upcoming firmware features.

9.2 Ethernet Ports

There are two Ethernet ports on the I6 IMU. These ports handle datagrams according to the IEC 61162-450 standard and is mainly for bidirectional communication between the R6 NAV PRO Compass and the I6 IMU.

Note: Communication on the network is on the IEC 61162-450 NAVD transmission group.

9.3 Input/output Sentences

The interfaces of the I6 IMU supports transmitting, receiving and interpreting of different standard NMEA sentences described in the table below.

Sentence	Description
VTG	Track Made Good and Ground Speed (Input-Serial/Output-WiFi)
GGA/GNS	Global Positioning System Fix Data (Input-Serial/Output-WiFi)
HDT	Heading, True (Input-Serial/Output-WiFi)
ROT	Rate-Of-Turn (Input-Serial/Output-WiFi)
XDR	Transducer output of Roll, Pitch and Heave

Table 9 -9 - Supported Output Sentences

10 INTERPRETATIONS OF SENTENCES

10.1 Talker Identifier

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)
II	Integrated Instrument

10.2 Sentences

10.2.1 HDT - True heading of the vessel

$--HDT,x.x,T

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

10.2.2 ROT - Rate of turn

$--ROT,x.x,a

Field	Format	Name	Comment
1	--ROT	Sentence Id	Used
2	x.x	Rate of turn, °/min, "-" = bow turns to port	Used
3	a	Status: A = data valid V = data invalid	Used

10.2.3 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	

10.2.1 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	

10.2.1 XDR - Transducer measurements

$-- XDR,A,x.x,D,ROLL,A,x.x,D,PITCH,D,x.x,M,HEAVE

Field	Format	Name	Comment
1	--XDR	Sentence Id	
2	A	Angular Roll in degrees	
3	x.x		
4	D		
5	ROLL		
6	A	Angular Pitch in degrees	
7	x.x		
8	D		
9	PITCH		
10	D	Distance Heave in meters	
11	x.x		Will always be null for FW 1.1.0 and earlier
12	M		
13	HEAVE		

11 ELECTRICAL INTERFACES

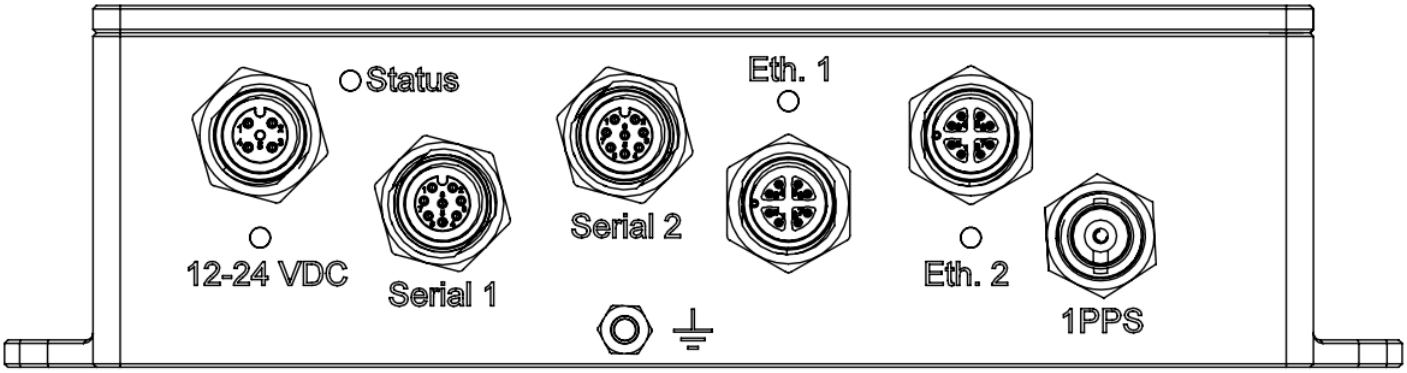

Figure 12-1 - I6 IMU connectors (rear view)

11.1.1 12-24 VDC interface

Connector Type: M12 - A Coded

Function: Power input

Note: For pinout and more information see section 3

11.1.2 RS-422 Serial interfaces

Connector Type: M12 - A Coded

Function: Serial output/input

Note: For pinout and more information see section 3

11.1.3 Ethernet interfaces

Connector Type: M 12 - X Coded

Function: IEC 61162-450 Data Protocol Communication and web-interface access

Note: For pinout and more information see section 3

11.1.4 1PPS interface

Connector Type: TNC (Female)

Electrical: Coaxial

11.1.5 GND symbol interface

Type: M6 hex nuts and threaded rod

Function: Connection to ground

11.1.5.1 Schematics

Each of the RS-422 serial interfaces on the I6 IMU fulfils the requirements as specified in IEC 61162.

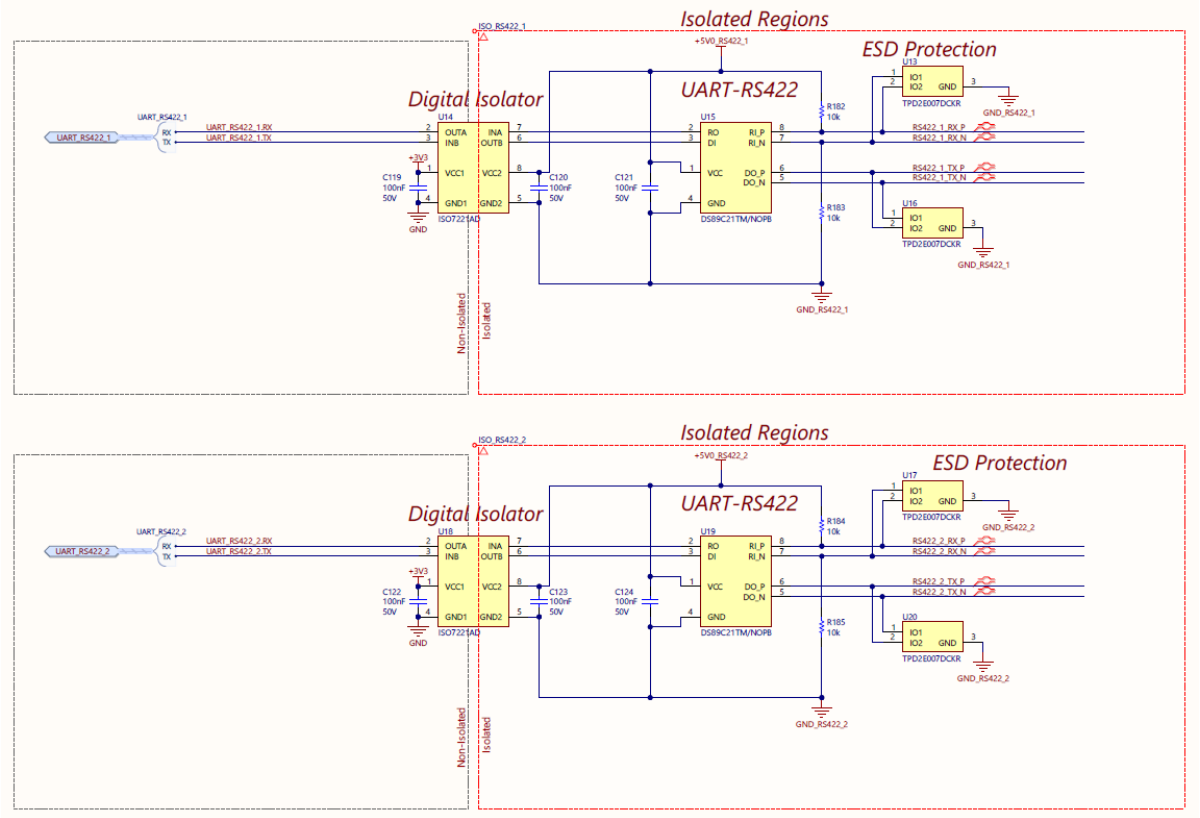

Figure 15 - I6 IMU Serial Interface Input Schematics

12 MECHANICAL DRAWINGS

12.1 I6 IMU Size and Mechanical Drawing

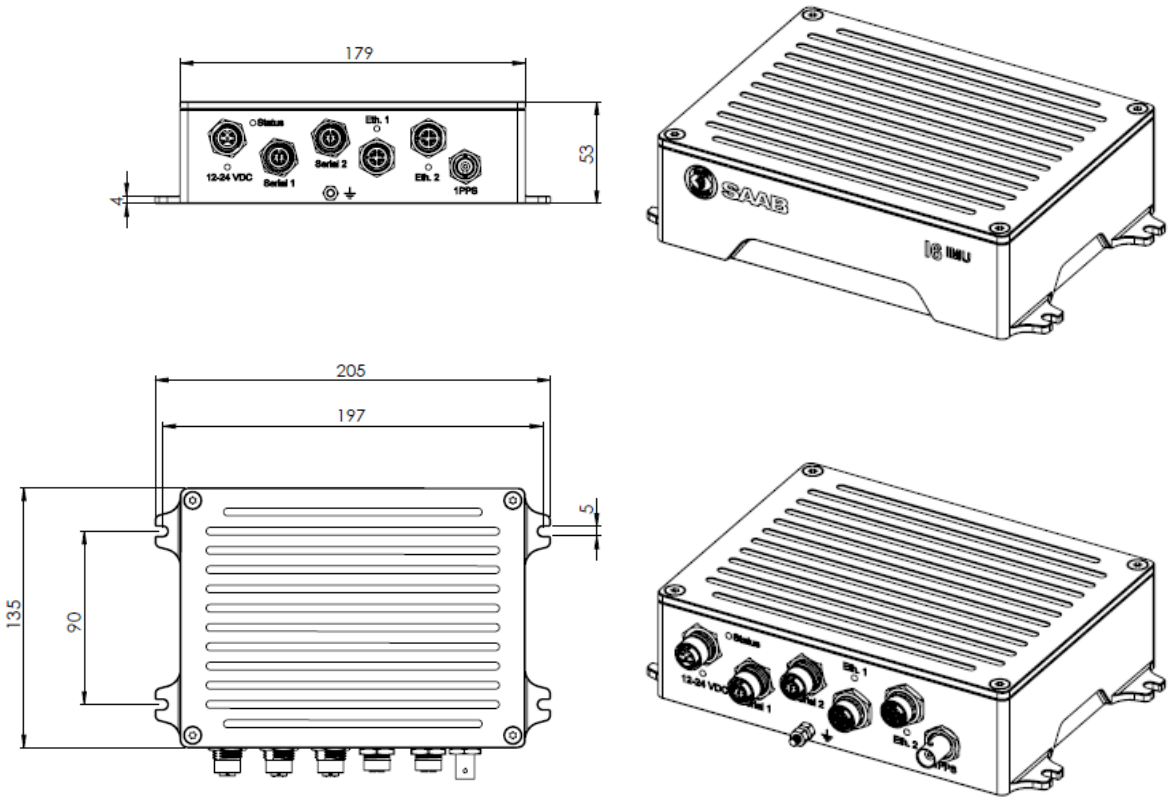

Figure 16 - I6 IMU Measuements [mm]

13 GLOSSARY

Term	Description
Ext	External
FW	Firmware
GNSS	Global Navigational Satellite System
HDG	Heading
HW	Hardware
ID	Identifier
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
Int	Internal
IP	Internet Protocol (address)
ITU	International Telecommunications Union
LED	Light Emitting Diode
LWE	Light Weight Ethernet
MSG	Message
NMEA	National Marine Electronics Association
N/A	Not available
NVM	Non-Volatile Memory

Table 10 - Abbreviation List

13.1 Units

bps	Bits per second
W	Watt
kHz	Kilo Hertz

Table 11 - Units List