Innomar SBP

Parametric Narrow-Beam Sub-Bottom Profilers

User's Manual

Quick Start Guide
SBP Installation
SESWIN
SES NetViewer
SES Convert

2023-01

My SBP Model: S/N:

Trademarks

INNOMAR is a registered trademark of INNOMAR Technologie GmbH.

Microsoft and Windows are registered trademarks of Microsoft Corporation.

Software License Agreement

The copyright for the SESWIN software is owned by INNOMAR Technologie GmbH ("INNOMAR"). The software license agreement ("Agreement") sets forth the terms and conditions under which the purchaser is licensed to use the SESWIN ("Software"). This is a license agreement and not an agreement for sale. INNOMAR continues to own the copy of the software and any other copy that you are authorised to make pursuant to this agreement.

INNOMAR grants to you a non-exclusive license to use the software together with an INNOMAR SBP system, provided that you agree to the following:

Use of the Software

1. The license only applies to the purchaser of an INNOMAR parametric sub-bottom profiler. The purchaser is not allowed to pass the Software to any other user without INNOMAR's written permission.

2. The purchaser may install one copy of the Software on the computer integrated in the SBP topside unit or another external data acquisition computer.

3. Neither the purchaser nor any other person is allowed to modify, adapt, translate, reverse engineer, decompile, disassemble or otherwise attempt to discover the source code of the Software.

Copyright and Trademark Rights

The Software is owned by INNOMAR. The Software is licensed and distributed by INNOMAR for surveying work (on-line and off-line) with the INNOMAR parametric sub-bottom profiler. Its structure, organization and code are the valuable trade secrets of INNOMAR. International treaty provisions also protect the Software. You may use trademarks only insofar as required to identify printed output produced by the Software, in accordance with accepted trademark practice, including identification of trademark owner's name. Such use of any trademark does not give you any rights of ownership in that trademark. Except as stated above, this Agreement does not grant you any intellectual property rights in the Software.

INNOMAR reserves the right to terminate this license if any terms of this Agreement are violated.

User's Manual
Innomar Parametric
Sub-Bottom Profilers

Quick Start Guide

SBP Installation

SESWIN 2.2.5.2

SES NetViewer 3.0.0.0

SES Convert 2.3.3.8

Innomar Technologie GmbH

2023-01

Innomar Technologie GmbH
Schutower Ringstr. 4
D-18069 Rostock
Germany

Tel: +49 381 44079-0

support@innomar.com

www.innomar.com

Disclaimer

THE SOFTWARE AND HARDWARE IS BEING DELIVERED AS IS AND INNOMAR MAKES NO WARRANTY AS TO ITS USE OR PERFORMANCE. INNOMAR DOES NOT AND CANNOT WARRANT THE PERFORMANCE OR RESULTS YOU MAY OBTAIN BY USING THE SOFTWARE OR DOCUMENTATION. INOMAR AND ITS SUPPLIERS MAKE NO WARRANTIES, EXPRESS OR IMPLIED, AS TO NONINFRINGEMENT OF THIRD-PARTY RIGHTS, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT WILL INNOMAR OR ITS SUPPLIERS BE LIABLE TO YOU FOR ANY CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, INCLUDING ANY LOST PROFITS OR LOST SAVINGS, EVEN IF AN INNOMAR REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY THIRD PARTY. SOME STATES OR JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, OR THE EXCLUSION OF IMPLIED WARRANTIES OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY MAY LAST, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

WHERE LIABILITY CANNOT BE LEGALLY EXCLUDED, BUT IT MAY BE LIMITED, INNOMAR'S LIABILITY AND THAT OF IT`S SUPPLIERS SHALL BE LIMITED TO THE AMOUNT PAID FOR THE SOFTWARE AND HARDWARE.

Remarks

INNOMAR did its best to make software, hardware and manual free of faults. However, if there should be a reason to complain or criticize, INNOMAR will always have an ear for your suggestions and hints and will try to help.

INNOMAR reserves the right to change technical data without prior notice.

To reduce the environmental footprint, INNOMAR usually provides manuals in electronic format (PDF) only. Printed copies are available on request.

Document History

2023-01	- New software versions (SESWIN 2.2.5.2, SES Convert 2.3.3.8, NetViewer 3.0) - New "Quick Start Guide" (section 2 on page 17) - All Innomar SBP models included, model descriptions/specs added and updated - Models *"light-plus"* and *"standard-plus"* obsolete (but still covered by the manual) - New Innomar product naming conventions ("SES-2000" removed) - Motion sensor formats updated (appendix A.19) - Status bar indicator description updated (section 5.8)
2020-09	- New software versions (SESWIN 2.2.3.9, SES Convert 2.3.3.0) - New: "Zoom" tab for zoomed echo print (section 5.3) - New: Data file size overview (section 13.1.6) 1-PPS time sync pulse updated (section 6.5) - Motion sensor formats updated (appendix A.19) - Procedures and screen shots for Windows XP removed - Section on transducer installation (3.2) split into pole-mount and hull-mount
2019-06	- New software versions (SESWIN 2.2.3.4, SES Convert 2.3.2.5) - New trigger options (section 6) 1-PPS time sync pulse - WiFi setup *"smart"* model (section 4) - Power supply requirements *"smart"* model - Typos corrected section 7.3 - Improved description Roll/Pitch Offset (section 5.11.14) - New: 24-bit versions for "medium-100" models (section 5.2.3) - New: FAQ (section 13) - New: user feedback form (appendix A.21)
2018-02	- New software versions (SESWIN 2.2.2.2, SES Convert 2.3.1.9) - New *"smart"* model added - Description of *"medium-100"*, *"light-plus"* and *"standard-plus"* models included - Description of *"compact"*, *"light"* and *"standard"* models updated - Transducer drawings included / updated - New sections on survey/processing workflow, data formats and remote-control
2016-02	- New software versions (SESWIN 2.2.0.9, SES Convert 2.3.0.7) - New section on bar-check procedure
2015-08	- Manuals for shallow-water models *"compact"* and *"light / standard"* merged - New software versions (SESWIN 2.2.0.8, SES Convert 2.3.0.5) - Document history added

Blank Page

Contents

Appendix

Blank Page

1   Important Hints – Attention Please!

1.1   Safety Rules

For the user's safety and the safety of any person nearby the INNOMAR SBP systems and for the non-damageable operation of the system it is strictly pointed out that:

➢   THE INNOMAR DEVICE MUST BE OPENED BY AUTHORIZED STAFF ONLY

➢   CABLES MUST BE CONNECTED OR DISCONNECTED ONLY WHEN THE POWER IS SWITCHED OFF; ESPECIALLY THE TRANSDUCER CABLE

➢   THE EQUIPMENT MUST BE USED ONLY IF THE TRANSDUCER IS CONNECTED AND IS SITUATED IN WATER

➢   IT IS FORBIDDEN TO SWIM OR DIVE WHILE THE INNOMAR SYSTEM IS WORKING

➢   THE INNOMAR TOPSIDE ELECTRONICS IS NOT WATERPROOF AND HAS TO BE USED IN A DRY AND WATER PROTECTED ENVIRONMENT

➢   ALLOW FREE ACCESS OF AIR TO THE COOLING SLOTS (FRONT, REAR, BOTTOM) TO AVOID OVERHEATING

➢   THE INNOMAR DEVICE IS A SENSITIVE INSTRUMENT AND SHOULD BE HANDLED CAREFULLY

➢   THE TRANSDUCER'S ACTIVE AREA HAS TO BE PROTECTED AGAINST MECHANICAL DAMAGES, PRESSURE, CHEMICALS AND SUNLIGHT

➢   DO NOT CHANGE THE SETUP OF THE SYSTEM'S OPERATING SYSTEM OR CONTROL-PC'S BIOS

➢   DO NOT INSTALL ANY OTHER SOFTWARE OR DEVICE DRIVER ON THE CONTROL COMPUTER

➢   UNUSED TOPSIDE UNITS SHOULD BE POWERED UP AT LEAST EVERY SIX MONTHS TO AVOID DAMAGES ON ELECTRONIC COMPONENTS

INNOMAR is not liable for any damages that result from disregard these safety rules or any other improper operation of the INNOMAR SBP systems.

1.2   Innomar SBP User Manual

This manual describes how to install and use the INNOMAR sub-bottom profilers and is applicable to all INNOMAR SBP models.

The manual is divided into a "QuickStart Manual" (chapter 2, page 17), a hardware orientated part (chapter 3, page 25) and a description of the INNOMAR control and data acquisition software SESWIN (chapters 4 to 8). First the SESWIN software is explained item by item (chapter 5), then use cases are discussed (chapters 6 and 7). For questions and trouble-shooting, please refer to chapters 8 and 13.

•   *Italics* is used for file and path names.
•   Keys belonging to the keyboard are enclosed in brackets. If some keys have to be pressed at the same time, they are separated by '+' (example: [Ctrl]+[Alt]+[Del]).
•   The symbol ➢ marks a very useful hint or key fact.

The "Quick Start Manual" (page 17) summarizes how to get good results. It might be a good idea to have these pages at hand during installation and operation of the INNOMAR sub-bottom profiler. Checklists are also given in Appendix A.20 on page 219.

1.3   What is shipped?

Most models are shipped in two boxes:

- **BOX 1:**
    - o   Topside unit
    - o   Bag with software and manuals on USB thumb drive
      (and optional ISE USB dongle)
    - o   Printed Quick-Start sheet
    - o   Accessories like cables, keyboard and mouse

- **BOX 2**
    - o   Transducer with cable
    - o   Extra ground wire
    - o   Printed handling instructions
    - o   Accessories like rubber washers, washers, hex nuts and tools

This picture illustrates how to use the provided
mounting material for the transducer

For model specific items detailed technical specifications, wiring diagrams, weights and dimensions as well as drawings of the transducers, please see the appendix as given in the tables on next page.

All items of the INNOMAR systems are shipped in strong transport boxes with anti-shock foam. These boxes are fitted for all kind of transportation, including air- and sea shipping and should be used during any transport and storage.

!   Before putting the system components back into the transport boxes after a survey, make sure all items are cleaned and in dry condition.
During storage in dry environment keep the boxes open to allow air circulation.

1.4   Innomar SBP Models

Shallow-Water Solutions	smart	compact	light	standard
• when portability matters • from less than one meter				
Mean Primary Frequency	~ 100 kHz	~ 100 kHz	~ 100 kHz	~ 100 kHz
Secondary Low Frequencies	10 kHz	4 – 15 kHz	4 – 15 kHz	4 – 15 kHz
Depth Below Transducer	0.5 – 100 m	0.5 – 400 m	0.5 – 400 m	0.5 – 500 m
Seabed Penetration	up to 20 m	up to 40 m	up to 40 m	up to 50 m
Heave / Roll / Pitch Comp.	✓ / – / –	✓ / – / –	✓ / – / –	✓ / ✓ / –
Technical Specifications	A.1, page 165	A.2, page 167	A.3, page 169	A.4, page 171

High-Power Solutions	medium-100	medium-70	deep-36	deep-15
• when penetration is a key requirement • for shallow and deep waters				
Mean Primary Frequency	~ 100 kHz	~ 70 kHz	~ 36 kHz	~ 15 kHz
Secondary Low Frequencies	4 – 15 kHz	3 – 12 kHz	2 – 7 kHz	1 – 4 kHz
Depth Below Transducer	2 – 2,000 m	2 – 2,500 m	5 – 6,000 m	10 – 11,000 m
Seabed Penetration	up to 70 m	up to 100 m	up to 150 m	up to 250 m
Heave / Roll / Pitch Comp.	✓ / ✓ / –	✓ / ✓ / (✓)	✓ / ✓ / (✓)	✓ / ✓ / ✓
Technical Specifications	A.8, page 181	A.10, page 187	A.11, page 191	A.12, page 195

Remotely Operated Solutions	Smart (*)	standard-usv	medium-usv	standard-rov
• when the focus is autonomy • for ASV / USV / ROV integration at all scales				
Mean Primary Frequency	~ 100 kHz	~ 100 kHz	~ 100 kHz	~ 100 kHz
Secondary Low Frequencies	10 kHz	4 – 15 kHz	4 – 15 kHz	5 – 15 kHz
Depth Below Transducer	0.5 – 100 m	0.5 – 500 m	2 – 2,000 m	0.5 – 500 m
Seabed Penetration	up to 20 m	up to 50 m	up to 70 m	up to 50 m
Heave / Roll / Pitch Comp.	✓ / – / –	✓ / ✓ / –	✓ / ✓ / –	✓ / – / ✓
Technical Specifications	A.1, page 165	A.5, page 173	A.9, page 185	A.7, page 177

* The "smart" model is also used within the Innomar "autonomous" ASV, see A.15 on page 205

Multi-Transducer and Sidescan Solutions	quattro	sixpack	sidescan-100	xxx-plus (**)
• when 3D sub-seabed data gives additional answers • for buried objects & cables			(for "compact")	
Mean Primary Frequency	~ 100 kHz	~ 100 kHz	100 kHz	250 / 410 / 600
Secondary Low Frequencies	4 – 15 kHz	4 – 15 kHz	–	–
Depth Below Transducer	0.5 – 30 / 500 m	0.5 – 30 / 900 m	1 – 50 m	1 – 30 m
Seabed Penetration	up to 20 / 50 m	up to 20 / 60 m	–	–
Heave / Roll / Pitch Comp.	✓ / – / –	✓ / – / –	✓ / – / –	✓ / – / –
Technical Specifications	A.13 on page 199		A.14, page 203	A.16, page 207

** The "light-plus" and "standard-plus" models are obsolete and out of production.

1.5   Innomar Training Courses

We strongly recommend to all users and technicians working with INNOMAR SBPs to attend the Innomar training courses as appropriate. INNOMAR offers the following courses:

Operators	Processors	Technicians
TR1 (max. 8 hours)	**TR2 (max. 8 hours)**	**TR4 (max. 4 hours)**
Basics • underwater acoustics • sub-bottom profiling • parametric acoustics • Innomar SBP models **Installation** • transducer mounting • topside installation • interfaces • noise & interference • software **Operation (SESWIN)** • typical settings • data formats	**2D Data Processing (SesConvert, ISE)** • data formats • data conversion (SesConvert) • ISE data (pre-) processing • quality assurance • reflectors & targets • data export **TR3 (max. 8 hours)** **3D Data Processing ("quattro" / "sixpack")** • processing workflow • data gridding • volume rendering • visualisation	**Maintenance and trouble-shooting** • Innomar SBP models • system components • system installation • system check • basic maintenance • repairs (board replacement) • special test tools and equipment (STE)
Also available with boat "hands on" training (TR5)	Note: TR3 requires TR2	Note: TR1 recommended

Please contact INNOMAR for more information and for customized training courses. Training is available at the INNOMAR main office in Germany (max. 10 attendees) or on-site or as online courses.

2   Quick Start Guide

2.1   Transducer Handling & Installation

See section 3.2 on page 26 for details on transducer handling and installation.

!
- **Make sure the transducer fits to the topside model** used (letter in s/n, see page 26).
- Check transducer visually (face, cable, connector) → do not use damaged equipment, there are high voltages used inside, which may be lethal!
- **The transducer must not be operated in air**.

Guidelines:

- Protect the transducer face (mechanical impact, chemicals, direct sunlight).
- Protect the cable (mechanical impact), avoid vibrations and strong bending → preferably route within pole.
- Protect the connector, it is NOT water-proof.
- For long-term deployments use zinc anodes and anti-fouling.
- **The transducer face has to be horizontal, the arrow pointing forward (to bow)**. (there are no arrows on the "smart" and "quattro"/"sixpack" transducers)
- Avoid vibrations; use rubber washers as provided and support the mounting pole.
- Place transducer as far as possible from noise sources → near vessel's bow.
- Avoid air bubbles washed beneath the transducer.
- **Use extra ground wire from transducer to topside unit** to reduce electrical noise.
- **During operation the transducer has to be covered by water at all times**.
- Connect / Disconnect to topside unit only if power is switched off.
- After demobbing clean with fresh water and dry before storage.

2.2   Topside Handling & Installation
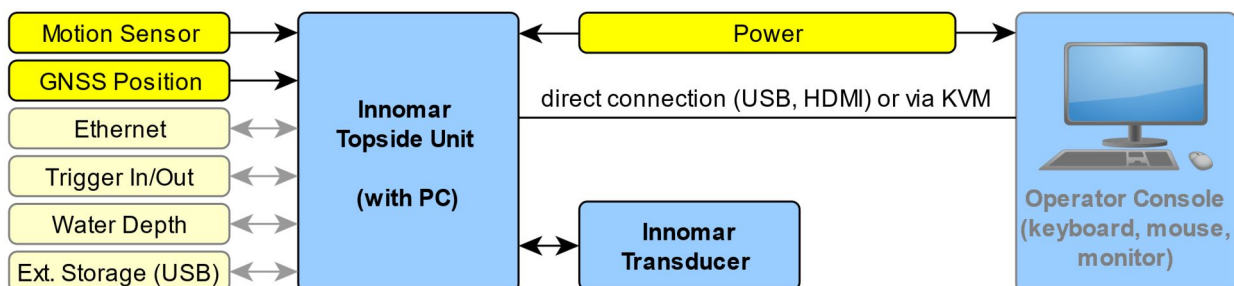
INNOMAR SBP general components (actuals depending on SBP model)

See section 3.3 on page 32 for details on topside unit handling and installation.

!
- Check topside visually (connectors, cables, housing) → do not use damaged equipment, there are high voltages used inside, which may be lethal!
- **Handle topside with care, keep clean, dry and secured; protect against water**.
- **Ensure proper airflow to avoid hot spots**.
- Secure all components and connections.

- GNSS position input (NAV-IN; Ethernet or serial port; update rate preferably 10Hz)
- Power (for most models mains 100–240 V, 50–60 Hz AC)
- Motion sensor input (Ethernet or serial COM port; update rate preferably 50Hz)
- Trigger / external synchronisation to reduce acoustic interference

TFT display + controls
PC interfaces
Status LEDs
Power switch
Transducer
GND

2.3   SESWIN Setup – Start & Interfaces

- Preferably use "seswin24bit.exe"
  → records 24-bit SES3 files **(6)**
- Start SESWIN from Windows desktop **(1)**
- SESWIN start screen opens:
  - optional: select setup / reset to factory defaults **(2)**
  - select "system control port" (for models with external PC) **(3)**
  - set interface ports (COM / UDP) **(4)**
- Click "OK" button → SESWIN app starts **(5)**

For models with external control PC, use the "Search" button to find the actual IP address of the topside unit.

Please see section 5.2 on page 38 for more details.

Menu Bar

Info Sidebar

Status Bar

Depth Display

Depth Ruler

Zoomed LF SBP echo plot

Signal Window

SBP echo plot area

Please see section 5.3 to 5.8 on pages 41 to 45 for more details.

The indicators in the Status Bar give a quick overview on the interface conditions.

🟢 Data received and interpreted OK

🟡 Data received, but warning

🟡 Traffic seen, but no usable data found

🔴 Port not available or no data / traffic

2.4   SESWIN Setup – General Settings
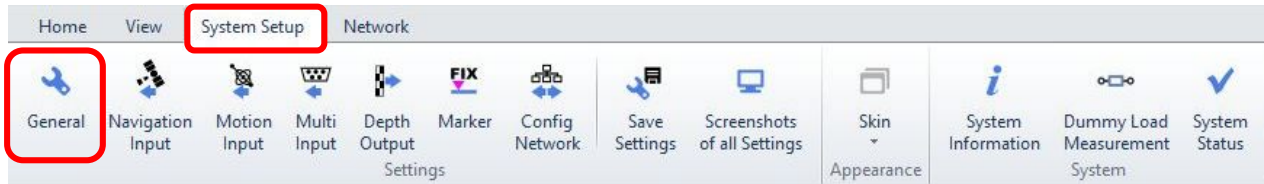
See also section 5.11.1 on page 58.

- Set transducer draught **(1)**

- Set average sound speed for time-to-depth conversion **(2)**

- Set HF source level → keep 100% **(3)**

- Set trigger / synchronisation as required **(4)**

- Set record file location **(5)** and naming **(6)**
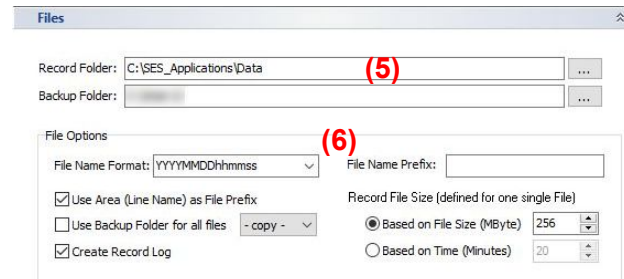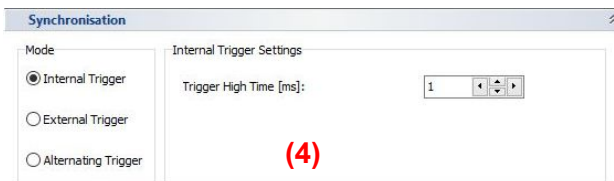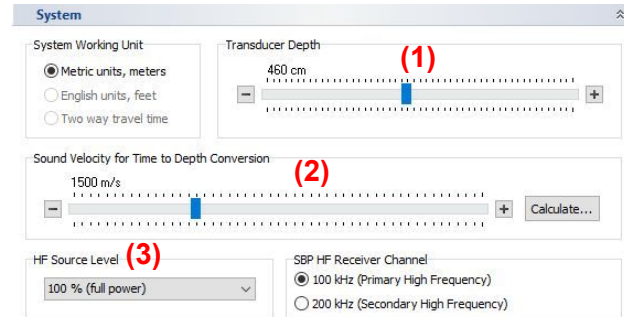
For trigger / synchronisation setting details see chapter 6 on pages 81 ff.

2.5   SESWIN Setup – Interface Configuration
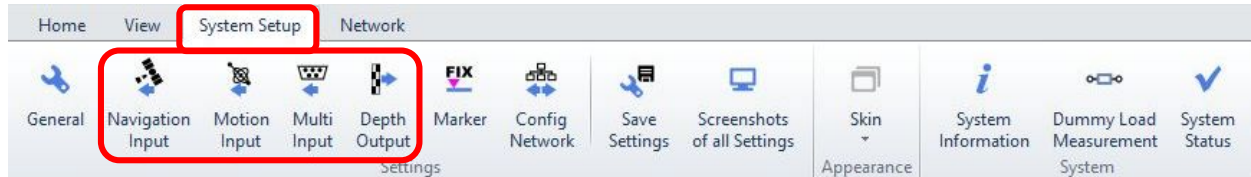
NAV Input (GNSS Position)
see section 5.11.8 on page 64

- Check port settings **(1)**
  for COM port set baud rate (as high as possible)

- Check incoming data with NAV input monitor **(2)**

- Set NMEA headers to be used and separator **(3)**

- Set what parts to be extracted and stored to SIS fields **(4)**

- Set PC clock synchronisation (preferably to "$xxZDA") **(5)**

- Optional: set geoid **(6)** and projection **(7)** parameters

- Optional: set processing **(8)**

- Optional: set offsets **(9)**
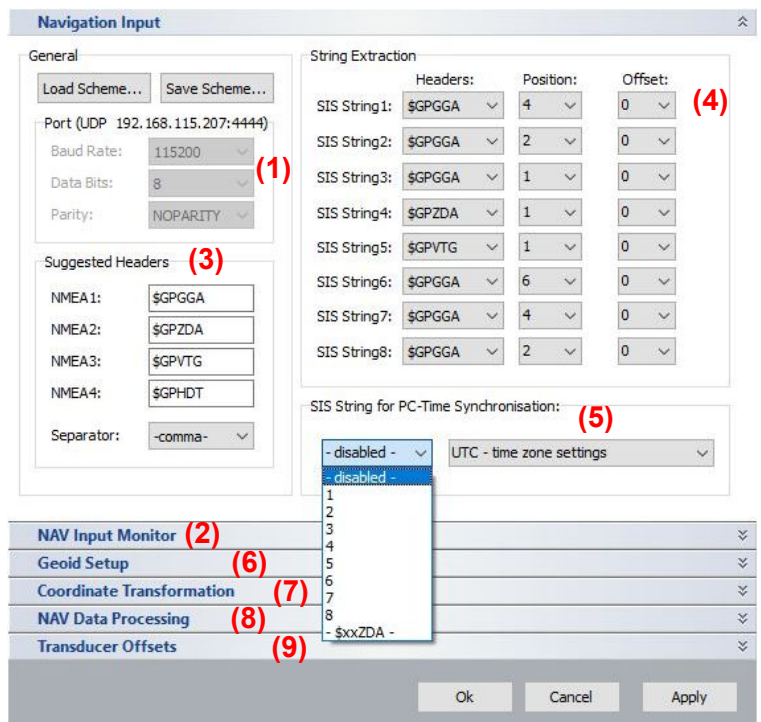
Motion Input
see section 5.11.14 on page 70

- Check port settings **(1)** for COM port set baud rate (as high as possible)

- Set protocol / format used **(2)**; preferably use a short format like EM3000

- Check incoming data with motion monitor **(3)** or in main window

- Optional: adapt heave scale factor or invert by "-1" **(4)**

- Optional: enable lever arm correction **(5)** and set lever arms **(6)**

- Optional: if motion data is via UDP Ethernet, the IP address of the microcontroller may need to be changed **(7)**
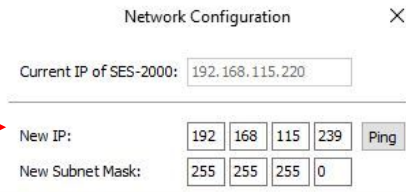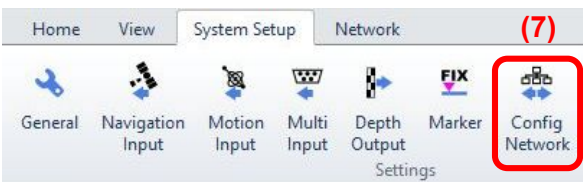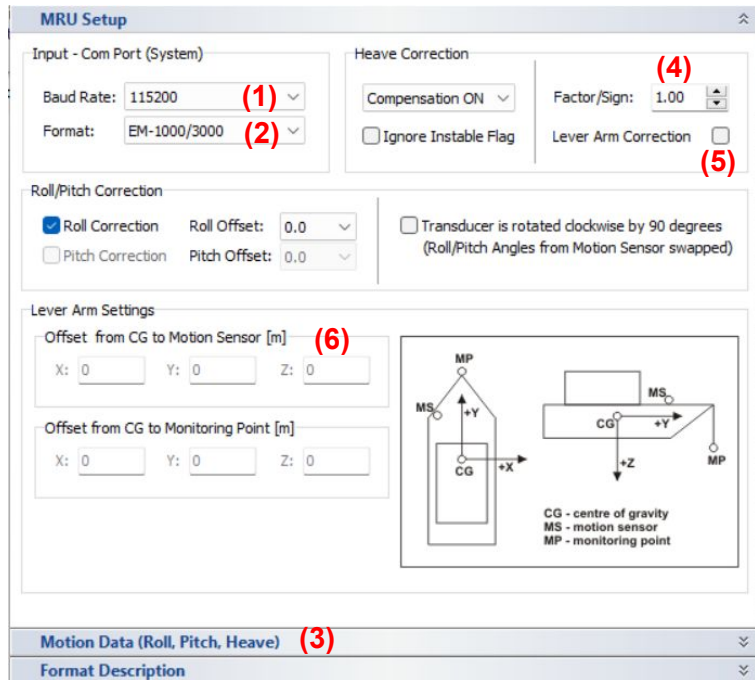
Multi Input (Optional)
see section 5.11.15 on page 73

- can be used for simple remote control, heading input or external (MBES) depth input
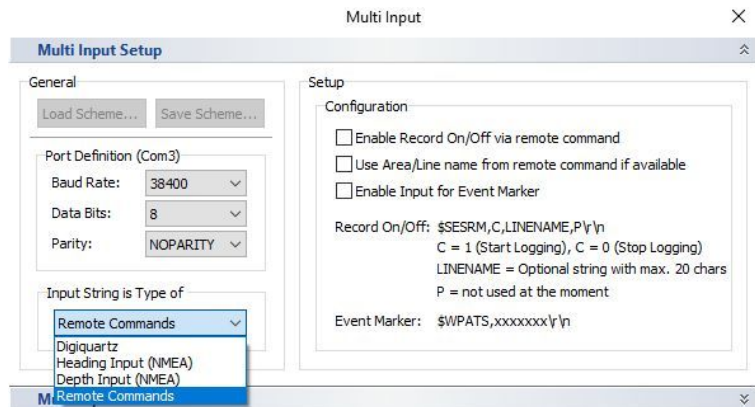
Depth Output (Optional)
see section 5.11.16 on page 75

- can be used to output online bottom track and other info
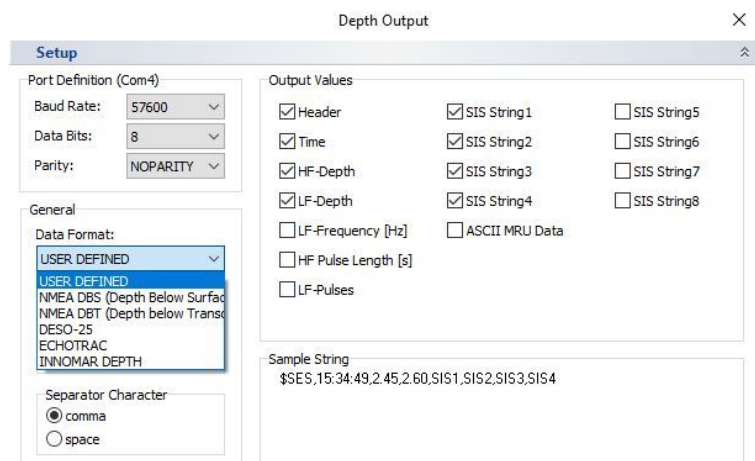
2.6 Sync (Trigger) IN/OUT & 1-PPS Input

Sync IN (1)

- BNC socket; TTL or RS232 level

Sync OUT (2)

- BNC socket; RS232 level (+/- 10V)

1-PPS Input (3)

- Used to check delay of position data; delay is shown in status, but not used for correction
- TTL, 5V positive, 1ms pulse at pin 1 of the "NAV IN" COM port (or dedicated BNC input)
- Works with serial NAV data only, not with UDP
- ZDA string needs to part of the NAV input and PC time sync must be set to "$xxZDA"
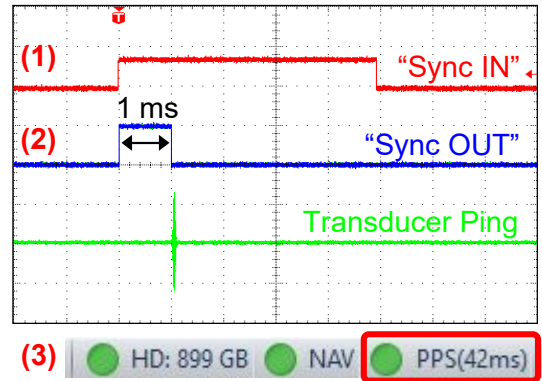
For details see chapter 6 on page 81.

2.7 Basic System & SESWIN Setup Check

Power ON

- Power switch changes from red to green
- Power LEDs → all turning on (1) (just "HV" & "SND" off)
- Sync OUT LED → starts flashing (2)
- Fans (rear panel) start working
- Windows starts up
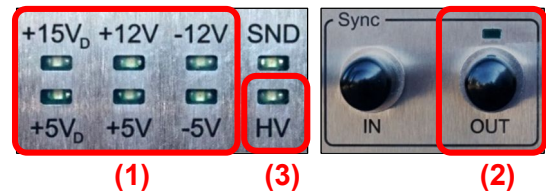
Start SESWIN

- "HV" LED → turns on (3)
- Echo plot area → starts scrolling, shows noise (if not, check trigger mode & ruler settings (4))
- Check "system status" → all green, temperature at reasonable value (5)
- Increase range → ping rate decreases (6)
- Increase gain → noise level increases (7)
- Check motion & GNSS interfaces
- Check "transmit" [F4] and data "record" [F5]
- Optional: check external trigger
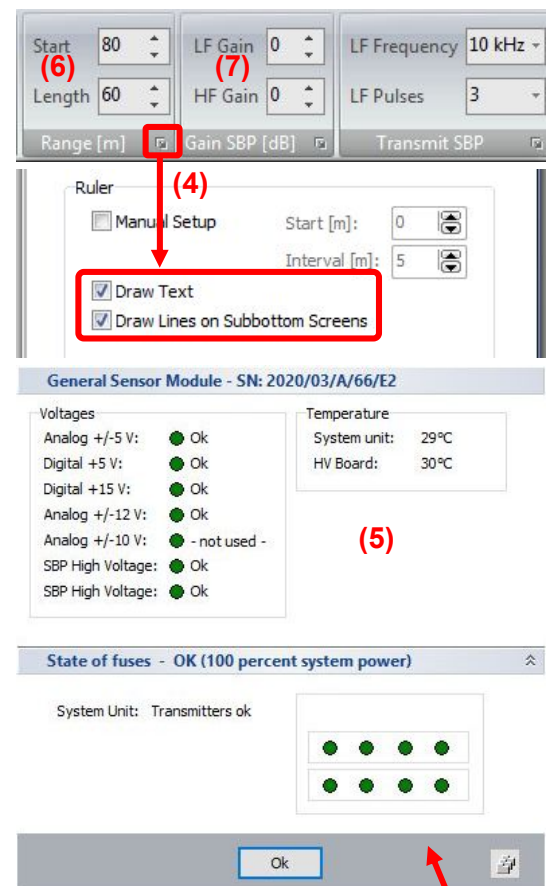
Reporting

- Save screenshots from the settings (8)
- Optional: save settings to new user profile (9)
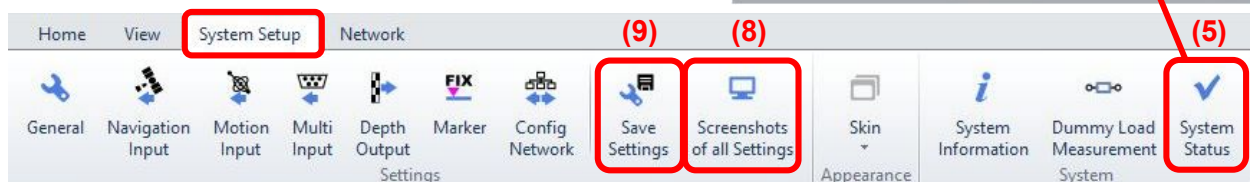
2.8   SESWIN Survey Settings
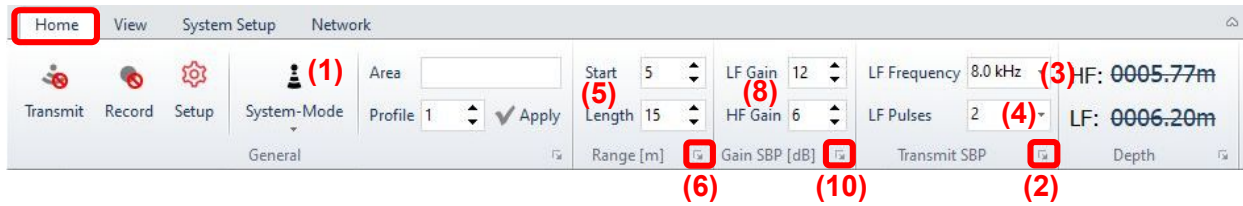
All settings outlined below will affect the data quality and cannot be changed in post-processing. For the "Home" menu please see section 5.9 on pages 46 ff.

Transmitter Settings

- **System Mode (1)**
    - o Usually "sub-bottom single frequency" or "sub-bottom multi ping mode" (in deep waters with internal trigger)

- **Ping Rate (2)**
    - o Keep as high as possible (system controlled)

- **LF centre frequency (3)**
    - o Start at middle of range and refine; higher frequencies for better resolution; lower frequencies for better penetration (but more noise and less resolution)

- **LF pulse length (4)**
    - o Number of cycles of centre frequency, start with "2" and refine; lower values improve resolution, higher values improve signal-to-noise ratio

- **HF power** (System Setup > General > System)
    - o Keep at 100% (the HF level directly affects the LF level and thus penetration: HF -3 dB → LF -6 dB)
    - o Soft start for marine mammal protection
    - o Not to be mixed up with the "HF Gain" setting

- **Trigger / Synchronisation**
    - o Internal → highest ping rate
    - o External → triggered from MBES to reduce acoustic interference; no multi-ping mode available
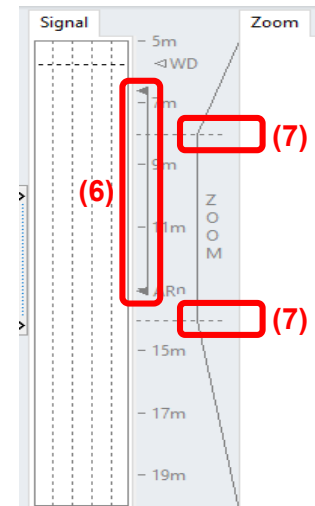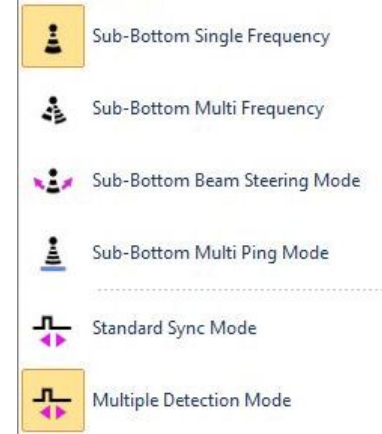
Receiver Settings

- **Range Start and Length (5)**
    - o Set *range length* to expected / required penetration, keep as short as possible (e.g. 20 m)
    - o Adapt *range start* to water depth (also automatic mode possible, thresholds shown in ruler (6))
    - o Use handles to adapt zoom (7)

- **HF & LF Gain (8)**
    - o Adapt to signal strength → c. 80% full scale (9) (LF: green, HF: black) use almost the full range, but avoid saturation
    - o Values will vary with water depth, seabed type and seabed shape (slopes) and need to be adapted
    - o Negative gain (attenuation) possible
    - o Automatic mode available (10)
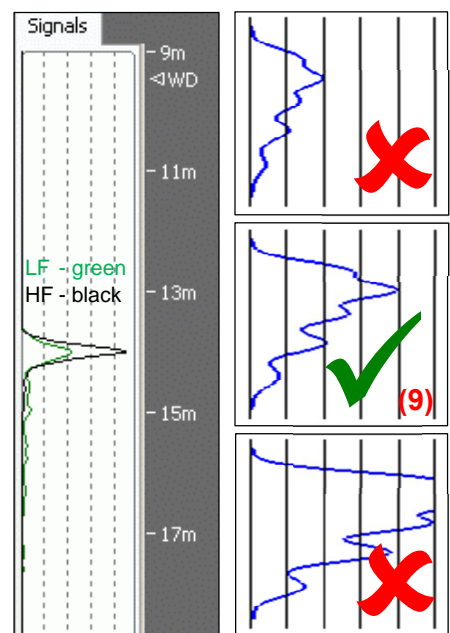
2.9   Online Data Visualisation
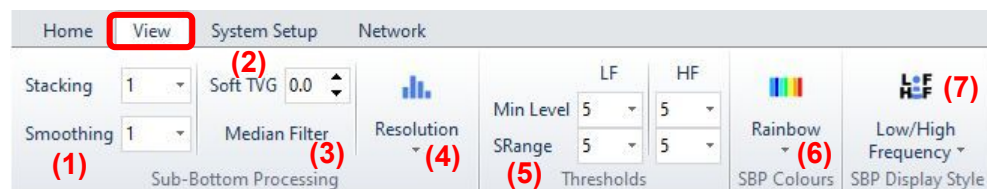
All settings outlined below will NOT affect the data quality and can be changed in post-processing. For the "View" menu please see section 5.10 on pages 55 ff.

- **Stacking & Smoothing (1)**
  - Used to reduce noise visible on screen
  - Higher values will better suppress noise, but may also remove small features, best keep values to "1" or "2"

- **TVG (time variant gain) (2)**
  - Compensates for propagation loss
  - Higher values may mislead in gain settings, best keep at low value (e.g. zero)

- **Median Filter (3)**
  - Removes spikes (e.g. interference), but may also remove small features; use with care

- **Resolution (4)**
  - "Amplitude" best for noisy data
  - "High Resolution" (default) best for general purpose
  - "Raw Data" best when looking for pipes/cables

- **HF & LF Thresholds (5)**
  - Defines the visible dynamic range
  - "Min Level" sets noise removal level
  - "SRange" sets dynamic range

- **Colours (6)**
  - Set colour mapping used for the echo plot (rainbow colours or shades of grey)

- **Display Style (7)**
  - Defines what echo plot(s) is/are shown (LF+HF / LF only / HF only)
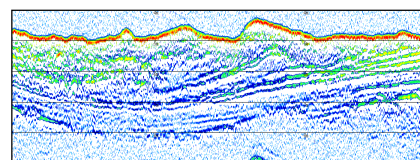
(1) original
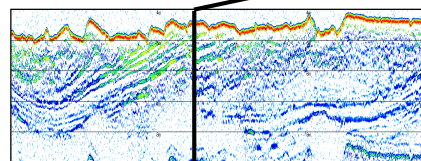
(2) stacking
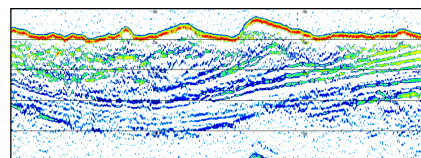
(3) smoothing
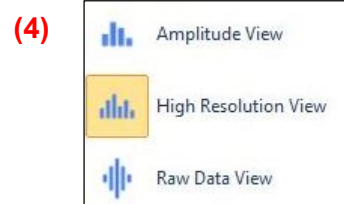
(4)

(6)
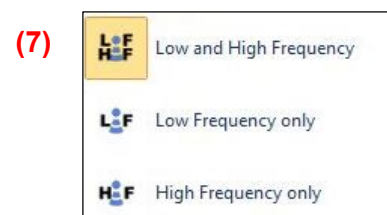
(7)

2.10 Safety Rules

- Do not use damaged equipment, check before operating.
- Do not plug / unplug the transducer if the system is powered.
- Do not operate the system when the transducer is outside water.
- Keep the transducer connector dry.
- Do not open the topside unit.
- Do not operate the system when people are in water near the transducer.

2.11 Checklists

Emphasis should be on the hardware installation and on system settings that cannot be altered during post processing: frequency, pulse length (number of pulses), range and gain.

Transducer Installation

☐   Correct transducer type is used.

☐   Transducer face, cable and connector checked for damages.

☐   Transducer is mounted horizontally in stiff frame or supporting structure.

☐   Transducer is decoupled acoustically from the ship's hull by elastic material (rubber).

☐   Transducer is located as far away as possible from noise sources.

☐   Transducer is covered by water at all times, even at rough sea conditions.

☐   An additional ground wire is going from the transducer's housing to the topside unit.

☐   The transducer cable is protected and will not vibrate.

☐   The draught of the transducer is measured and noted.

Topside Unit Installation

☐   Topside unit is placed in a dry environment.

☐   Cooling slots (bottom, front and rear panel) are free and there is space for airflow.

☐   Main power supply is checked. If a generator is used, a ground wire is connected.

☐   Power cable is plugged in.

☐   Transducer cable is plugged in.

☐   Ground wire from the transducer is connected to the topside unit.

☐   Additional sensors (Motion sensor / GNSS) are connected to the specified ports.

☐   Check if all connectors are fastened properly and all cables are fixed.

System power-up

☐   Make sure the transducer is below water level and covered by water all times.

☐   Switch on main power → the power switch and all power LEDs are lit green, "Sync OUT" starts flashing.

☐   Start the SESWIN software → "HV" LED turns on, SBP echo plot part of the SESWIN window starts scrolling from right to left. If not, check the synchronisation mode.

☐   SESWIN "System status" checked → OK.

SESWIN settings

☐   Set interface (GNSS, motion, …) ports.

☐   Set transducer's draught and offsets / lever arms as appropriate.

☐   Check incoming GNSS (navigation) data (SIS fields populated correctly).

☐   Check incoming motion sensor data.

☐   Check all other settings in the "System Setup" dialogues.

System check / preparing survey start

☐   Switch on the transmitter [F4] (make sure the transducer is below water level).

☐   Set the range appropriate to find the seafloor.

☐   Optimize the gain settings for both channels based on the seabed return's amplitude.

☐   Optimize the range settings based on water depth and required / expected penetration.

☐   Optimize frequency, pulse length (and gain) settings.

☐   Check and optimize the signal processing settings for online visualisation.

☐   Check the settings for annotation, profile number and marker counter.

☐   Check data record [F5].

3   Hardware / System Installation

3.1   System Overview

The INNOMAR SBP models described in this manual incorporate a parametric narrow-beam sub-bottom profiler (SBP) with echo sounder functionality and consist of one topside unit and (at least) one sub-bottom (SBP) transducer.
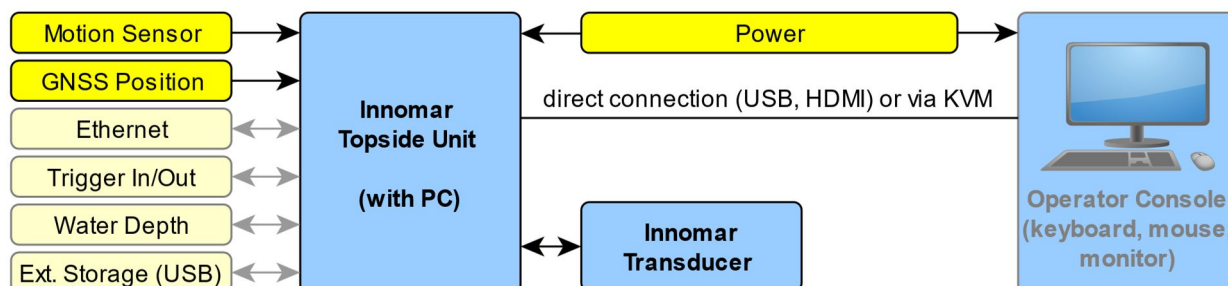
INNOMAR SBP general components (actuals depending on SBP model)

For the *"compact"* model there is an optional *"sidescan extension"* (transducer and software) available, please see appendix A.14 on page 203 for details.

For the *"standard"* and *"medium-100"* models there are *"-usv"* and/or *"-rov"* versions, which are mainly intended to be used on autonomous and uncrewed vehicles.

The control and data acquisition PC is built in for the *"light"*, *"standard"*, *"medium-100 / -70"* and *"deep-xx"* models. For the *"smart"*, *"compact"*, *"-usv"* and *"-rov"* models an external PC / laptop-PC / tablet-PC is required. The operating system of the control-PC has to be Microsoft® Windows® for all models.

For detailed technical specifications, wiring diagrams, weights and dimensions as well as drawings of the transducers, please see the appendix as listed on page 15.

3.2   Transducer Handling and Installation

3.2.1 General

The INNOMAR SBP models are fitted with a transducer for both, HF and LF operation. The transducer cable has a sea water resistant polyurethane sheet and is moulded non-removable to the transducer. Make sure the cable with connector can be routed to the topside unit without damaging anything. Cable and connector dimensions are summarized in the table below.

SBP model	smart	compact, light	standard	medium-xx	deep-xx
Transducer S/N starts with letter	M	C	A	E	G
OR the S/N ends with	R	B or C	A	E	G
Cable diameter	12 mm	20 mm	22 mm	22 mm	22 mm
Cable bending radius (min. static / min. dynamic / recommended)	30 / 60 / 120 mm	60 / 120 / 240 mm			
Connector dimensions	D40 mm x L90 mm	D55 mm x L100 mm			

! Make sure to use the correct transducer model (first letter of transducer serial number as shown in the table above); using the wrong transducer type may seriously damage the topside electronics.

3.2.2 Transducer Handling

The active area of the transducers must be protected against mechanical damages. Don't put the transducer on this (blue or black) area to avoid scratches or getting the transducer punctured. The SBP transducer has supports alongside the active area to make it possible to place the transducer directly on flat and clean surfaces, see figure below.

INNOMAR *"compact / light / standard"* SBP transducer with streamlined housing and supports to protect the active area
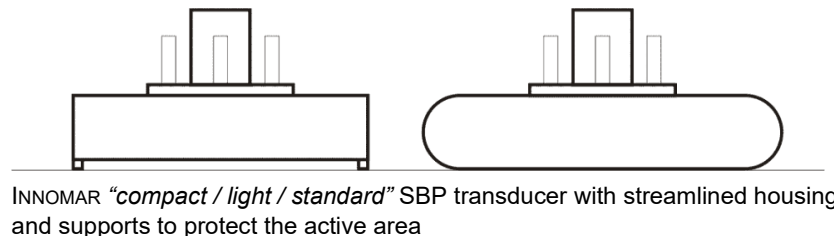
What to do

✓ Gently clean the transducer after usage and in intervals if in use for a longer period.
✓ Clean, rinse with fresh water and dry before put the transducer in store.
✓ Protect the active area against sunlight; UV-light may affect the materials used.
✓ Protect the active area against damages (mechanics or chemicals).
✓ Use the INNOMAR-approved (water-based) anti-fouling to prevent bio-fouling, especially when working in tropical waters. Hull-mounted transducers should be coated with anti-fouling.
✓ Protect the transducer cable; take care on the bending radius and vibrations.
✓ Protect the transducer connector against damages and water to avoid corrosion.

What to avoid

✗ Don't use sharp tools or chemicals for cleaning the active area.
✗ Don't store dirty or wet transducers; avoid corrosion and fouling.
✗ Don't lay the transducer "face-up" on deck; avoid sunlight on the active area.
✗ Don't use any chemicals to clean the transducer.
✗ Don't use any other paint than the INNOMAR-approved anti-fouling.
✗ Don't use a cable with damaged insulation; the voltages used may be lethal!
✗ Don't put sun-heated transducers into cold water; avoid thermal stress.

3.2.3 Pole-Mount Transducer Installation

Usually, the transducers of the INNOMAR shallow-water models SBP are installed over-the-side using a pole. Forward direction is shown by an arrow on top of the transducer. There are six studs on the transducer placed on a circle for the transducer mounting, see appendix for details.

For proper operation the transducer has to be fixed firmly and vertically because of the narrow sound beam. Do not use long pipes with small diameters that are vibrating when the ship is moving. It is important to decouple the transducer mechanically from the mounting structure by elastic materials like rubber to avoid vibrations going to the transducer. The whole transducer must be covered by water all the time, even during rough sea!

- Protect the transducer cable against damages, take care on the bending radius.
- Protect the transducer connector against damages and water to avoid corrosion. The connector is not water proof! For transport and storage, the connector should be sealed by the provided covers.
- Protect the active area against damages (mechanics or chemicals).
- Protect the active area against sunlight; UV-light may affect the materials used.
- Do not use a transducer with damaged face or damaged cable!
- The transducer face (active area) needs to be clean; no paint, oil or grease should be on the active area of the transducer.
- Avoid thermal stress (e.g. putting sun-heated transducers into cold water).
- After usage rinse the transducer with fresh water and dry the transducer before storage.
- If a transducer is placed into water for a longer period of time, use zinc anodes to prevent corrosion.
- If a transducer is used in tropic waters for a longer period, it is strongly recommended to use an anti-fouling paint (also on mobile transducer installations) to prevent biofouling, see section on hull-mounted transducers below.

For proper operation the transducer has to be fixed firmly and vertically because of the narrow sound beam. Do not use long pipes with small diameters that are vibrating when the ship is moving. It is important to decouple the transducer mechanically from the mounting structure by rubber to avoid noise produced by vibrations going to the transducer, see figure below. The whole transducer must be covered by water all the time, even during rough sea!
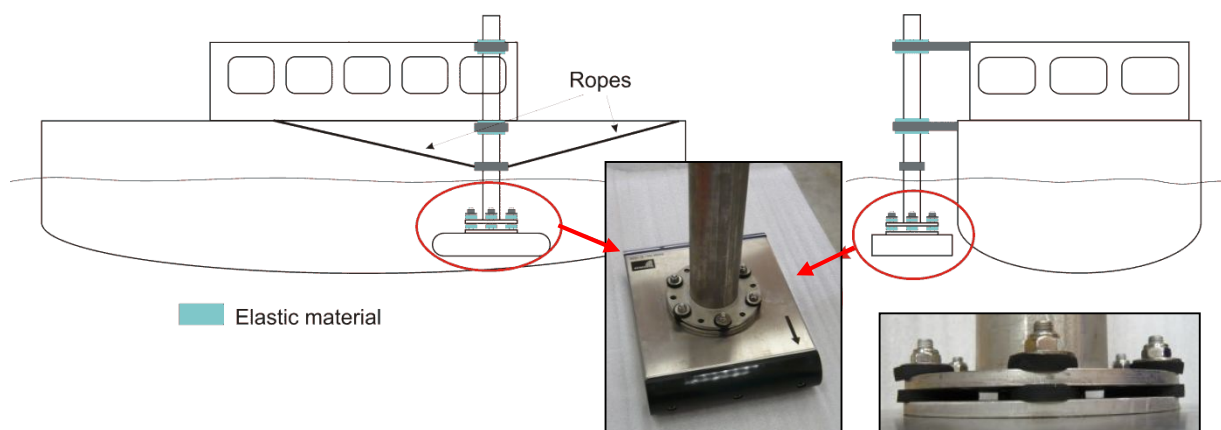
Acoustic decoupling of the transducer from the vessel using elastic material between all steel-to-steel connections. Rubber washers (provided by INNOMAR) to be used at the transducer. Note also the ropes to stabilize the pole. Please note the arrow on top of the transducer that points to forward direction.

! After the mounting of the transducer, measure the exact draught of the transducer. This value (distance from the water level to the bottom of the transducer) has to be adjusted in the SESWIN control software ("System Setup – Settings – General – System").

Pole-Mount transducer installation guidelines

Transducer depth: The upper water layers are filled with small air bubbles, especially in heavy seas. Air bubbles absorb acoustic energy and may block entirely the desired acoustic signal. Therefore, select a location as deep as possible for the transducers, where the water is less aerated and you have a wider weather window. On the other hand, in shallow waters the transducer should not be the lowest point to avoid damages by boulders etc. Also avoid sound from HF sidelobes hitting the ship's hull, this would produce ghost echoes.

Transducer location: Select a location as far away as possible from sources of noise. For sub-bottom profilers, usually the ship's engine is the dominating noise source. Prefer locations in the forward third of the vessel, which normally will provide less aerated water, less noise and less turbulence. At small boats the best place is at the bow. Heave will be lowest mid-ship since no angular components are added. Avoid locations near the ship's aft because of noise (propeller and engine) and aerated water.

Transducer orientation: There is an arrow on top of the transducers pointing to forward direction (ship's bow).

Bulbous bow: If the vessel has a pronounced bulbous bow, be aware that this will transport aerated water down. Tunnel thrusters in the bow will also produce aerated water in heavy seas.

Objects protruding from the hull: Any objects protruding from the hull as well as holes and pipe outlets generate turbulence and flow noise. Do not place the transducer in the vicinity of such objects, and especially not close behind them.

Mounting pole: Be aware of the need for a stiff connection between transducer and motion sensor. Also, be aware of limitations in vessel speed as well as weather window. Avoid small poles. Reduce vibrations and bending of the pole by proper supports and ropes. Long poles may need a rope below the ship's keel.

Transducer inclination: Transducers should be mounted horizontally (parallel to the water surface) to ensure best system performance, especially for narrow- beam sub-bottom profilers like the INNOMAR systems. A small positive inclination (bow up, max. 0.5°) is acceptable in order to ensure laminar water flow. Avoid negative inclination since this may cause turbulences.

Electrical connection / grounding: To reduce noise caused by the mains generator the transducer's housing should be electrically connected to the topside unit by an additional ground wire.

Acoustic coupling / vibration: To avoid structure-borne noise going from the ship's hull into the transducer, the transducer has to be decoupled acoustically by using rubber or other damping material. The steel-to-steel connections on the flange and on the pole should be decoupled using elastic material like rubber, plastics or wood.

Prevent corrosion: If the transducer is situated in water for a longer period of time, use zinc anodes to prevent corrosion. Proper grounding is also essential.

Prevent bio-fouling: To reduce bio-fouling, pole-mounted transducers may be painted with an approved water-based anti-fouling compound, see section on hull-mounted transducers below.

GNSS antenna
monitor, mouse, keyboard
motion sensor
GNSS receiver
topside unit
SBP transducer

INNOMAR "*standard*" installation on a small survey boat. The transducer is pole-mounted at the bow with GNSS antenna on top. The motion sensor is also placed close to the transducer. For system operation an external monitor is connected.
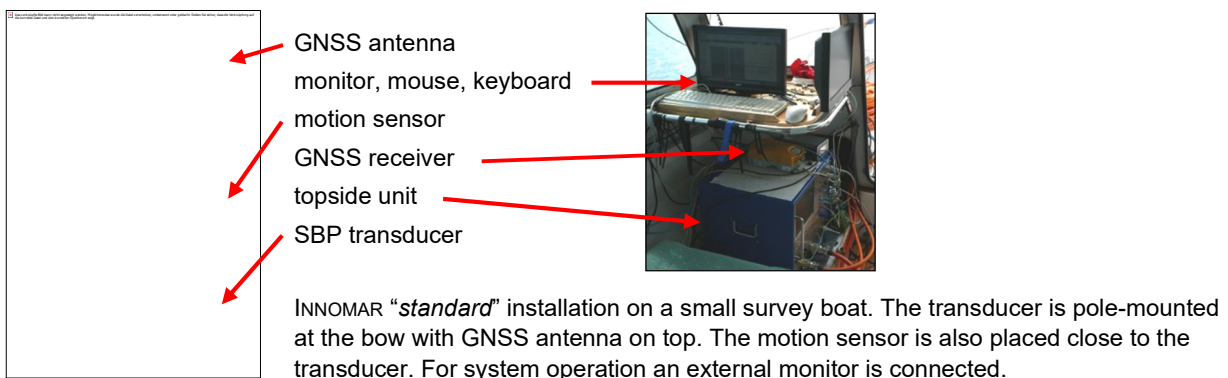
3.2.4 Hull-Mount Transducer Installation / Mounting Frame

Innomar provides also transducers with optimized shock absorbers for hull-mounting.

For proper operation the transducer has to be fixed firmly and vertically because of the narrow sound beam. The whole transducer must be covered by water all the time, even during rough sea!

- Protect the transducer cable against damages, take care on the bending radius.
- Protect the transducer connector against damages and water to avoid corrosion. The connector is not water proof! For transport and storage, the connector should be sealed by the provided covers.
- Protect the active area against damages (mechanics or chemicals).
- Protect the active area against sunlight; UV-light may affect the materials used.
- Do not use a transducer with damaged face or damaged cable!
- The transducer face (active area) needs to be clean; no paint, oil or grease should be on the active area of the transducer.
- Use zinc anodes to prevent corrosion and replace these anodes in regular intervals.
- To avoid biofouling, the transducer has to be coated using water-based anti-fouling (see below)
- Before starting usual dock work like sand blasting and painting the hull, protect the transducer by putting covers on the transmitting area.
- Before storage, rinse the transducer with fresh water and properly dry it.

Hull-Mount Transducer Installation Guidelines

Transducer depth: The upper water layers are filled with small air bubbles, especially in heavy seas. Air bubbles absorb acoustic energy and may block entirely the desired acoustic signal. Therefore, select a location as deep as possible for the transducers, where the water is less aerated and you have a wider weather window. On the other hand, in shallow waters the transducer should not be the lowest point to avoid damages by boulders etc.

Transducer location: Select a location as far away as possible from sources of noise. For sub-bottom profilers, usually the ship's engine is the dominating noise source. Prefer locations in the forward third of the vessel, which normally will provide less aerated water, less noise and less turbulence. At small boats the best place is at the bow. Heave will be lowest mid-ship since no angular components are added. Avoid locations near the ship's aft because of noise (propeller and engine) and aerated water.

Transducer orientation: There is an arrow on top of the transducers pointing to forward direction (ship's bow).

Bulbous bow: If the vessel has a pronounced bulbous bow, be aware that this will transport aerated water down. Tunnel thrusters in the bow will also produce aerated water in heavy seas. Accordingly, flush installations are more easily troubled by aerated water than blisters and gondolas that protrude from the hull.

Hull mounting: Installations flush with the hull will often cause problems due to aerated water going below the transducer. Therefore, blisters or gondolas should be used for hull mounting.

Vibration / Reverberation: To avoid/reduce structure-borne noise and vibrations picked up by the transducer, the INNOMAR mounting frame has integrated vibration isolators (shock absorbers). The sea chest's walls and ceiling should be lined by closed-cell foam (e.g. RS components 733-6750) to reduce reverberation.

Objects protruding from the hull: Any objects protruding from the hull as well as holes and pipe outlets generate turbulence and flow noise. Do not place the transducer in the vicinity of such objects, and especially not close behind them. For the same reason, it is very important that the hull area around the transducer face is as smooth and level as possible.

Transducer inclination: Transducers should be mounted horizontally (parallel to the water surface) to ensure best system performance, especially for narrow- beam sub-bottom profilers

like the INNOMAR systems. A small positive inclination (bow up, max. 0.5°) is acceptable in order to ensure laminar water flow. Avoid negative inclination since this may cause turbulences.

Electrical connection / grounding: To reduce noise caused by the mains generator the transducer's housing should be electrically connected to the topside unit by an additional ground wire.

Prevent bio-fouling: To reduce bio-fouling, hull-mounted transducers have to be painted with an approved water-based anti-fouling compound, see below.

Prevent corrosion: If the transducer is situated in water for a longer period of time, use zinc anodes to prevent corrosion. Proper grounding is also essential.

Sea Chest / Gondola Preparation

Legend

- Transducer with mounting frame and cable (provided by Innomar)
- Sea chest, stand pipe, flange (ship yard)
- Threaded mounting holes M10 in flange (ship yard)
- Water inlet holes in flange (ship yard)
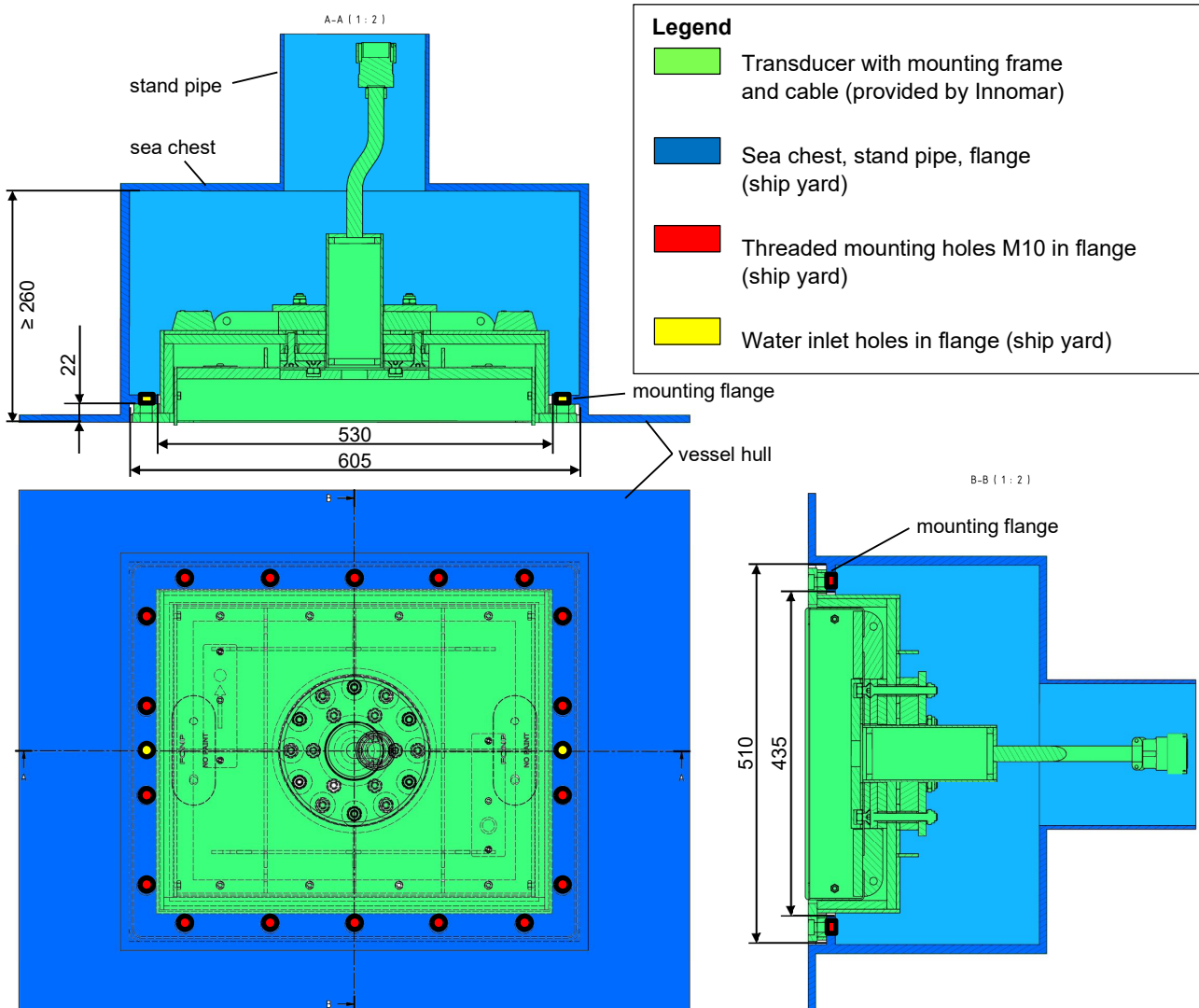
Sketch showing the INNOMAR "medium-100" hull-mount transducer with mounting frame as delivered by Innomar (green parts) and all parts to be prepared by the ship yard: sea chest with mounting flange and stand pipe (blue), threaded holes M10 (red) and water inlet holes (yellow) in the mounting flange.

To affix the transducer there are threaded holes (or drilled holes with hex nuts welded on top) in the flange (marked red in the sketch above). There are also two water inlets (marked yellow) in the flange to ensure the sea chest is flooded. Innomar provides a drilling template for all holes/threads in the flange. The holes should be drilled after welding the flange. The drilling template can also be used to verify if the transducer fits into the rectangular cut-outs.

After finishing all welding, the sea chest has to be cleaned and painted. To reduce reverberation the sea chest's walls and ceiling should be lined by closed-cell foam (10–20 mm thick, e.g. neoprene RS components 733-6750). This neoprene foam has to be provided by the ship yard.

! It is the solely responsibility of the shipyard to approve strength and thickness of all steel parts building the sea chest or blister/gondola.

Ensure proper flooding of the sea chest; additional air escape route may be required.
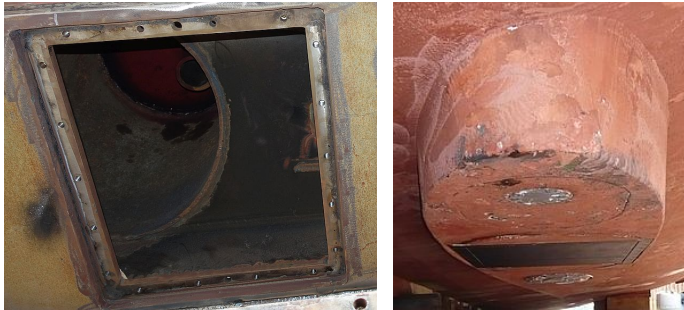
Sea chest with flange, threaded holes and the two (bigger) water inlet holes prepared by the ship yard (left) and transducer mounted into a dome/blister to prevent air bubbles washed below the transducer (right).

Cable Routing

There are one (or more) transducer cable(s) and one ground wire to be routed from the transducer to the topside unit. Preferably this is done via stand pipe with a diameter of at least 90 mm. Note the cable and connector dimensions given section 3.2.1 on page 26. Take care on the connector(s) during the cable routing. Depending on the height above water level the top end of the stand pipe might need to be sealed by ROXTEC cable sealings or similar. In any case the sea chest needs to be vented after flooding. Since air may also accumulating in the sea chest over time while travelling in rough sea, it's good to have some permanent air escape route.

! The cables should be routed to well above water level within a stand pipe of suitable diameter (depending on connector(s) and bending radii). A ROXTEC type cable sealing at top of the stand pipe might be necessary.

Hull-Mount Transducer Check / Antifouling

During and after installation, double check the orientation of the transducer (forward-pointing arrow). Any mistake made will significantly reduce the system performance. Transducer and drilling template have clear markings to indicate forward direction.

The sea chest needs to be flooded with sea water during operation. To ensure this, there are two water inlets in the flange of the mounting frame. These two holes must not be blocked.

! Transducer forward direction is marked (arrow) on top of the transducer.

There are 2 water-inlet holes in the mounting frame, which have to be free.

To avoid biofouling reducing the system performance, the transducer needs to be coated using preferably a **water-based primer and anti-fouling paint**. INNOMAR approved products:

- 1 x Hempel High Protect II, 1 x Hempel Conversion Primer, 2 x Hempel Hard Racing
- Jotun SeaQuantum Ultra S
- International Marine Intersleek 1100SR

The anti-fouling coating should be checked and renewed at each docking, preferably every second year.

3.3   Topside Unit Installation

Topside Unit Handling

As any electronic device the topside unit should be handled with care.

- The topside unit has to be placed in a dry and safe location.
- Fix the topside unit with a suitable method to avoid mechanical destructions during rough seas.
- Make sure not to cover the cooling slots. There are fans inside the unit and a proper airflow is necessary to avoid overheating during operation.
- The topside unit is NOT water protected. Therefore, avoid all situations where water can get into the system.
- During transport and storage, the transport cases provided by INNOMAR should be used. These boxes are splash-water proof and filled with anti-shock foam. Make sure the foam is dry and was not sprayed with water when the box was open on deck.
- Unauthorized persons must not open the topside unit!

!   Protect the unit against splash water!

!   Make sure that the cooling slots are open and the fans can get air! There are openings for air-intake at the front panel and at the bottom of the topside unit. Fans are installed in the rear panel.

!   Connect all external devices to the INNOMAR SBP before you plug the power cable into the topside unit. Use only the specified plugs and sockets.

!   Do not plug and unplug transducer connectors while the system is running!

The power supply voltage has to be in the range 100 – 240 V AC, 50 – 60 Hz. Having activated the INNOMAR system by switching the power on, check first if all power-supply LEDs are lit. If not, switch the system off immediately and contact your dealer/supplier or INNOMAR directly.

KVM Extender

On larger vessels the operator is often not in the same place as the topside unit. In theis case keyboard, mouse and monitor are usually connected to the unit via KVM extender. This consists of two parts (local and remote), both powered by its own power supply. Keyboard and mouse connections are USB; monitor connection is HDMI. Maximum Ethernet cable length is 50 m. Make sure a direct cable connection; the Ethernet cable must not be connected to a network.
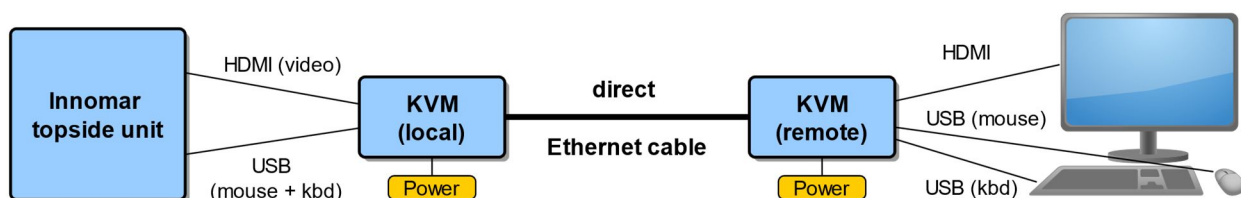
Motion Sensor

There is a serial input for motion sensors at the topside unit (DB9 male socket), a UDP Ethernet connection (RJ45 socket) is possible for most INNOMAR models, too. For motion sensor installation see chapter 7.5 on page 98. After installing the motion sensor some settings are necessary within the SESWIN software (System Setup – Settings – Motion Input), see section 5.11.14 on page 70.

GNSS / 1-PPS sync pulse

GNSS position data has to be feed into a serial input at the control computer (DB9 male connector) or via Ethernet UDP.

The serial COM port is also used to receive a 1-PPS time sync pulse from the GNSS receiver (positive TTL with 1ms high at pin 1 or pin 9). Newer systems also have a BNC connector for the 1-PPS pulse. For details of the 1-PPS pulse connection see also section 6.5 on page 88.

To use the position data within the INNOMAR systems, some settings have to be made within the SESWIN software. This is described in detail in section 7.3 on page 92.

To avoid position errors caused by antenna offsets, the GNSS antenna should be placed on top of the transducer. If this is not possible, an antenna offset correction can be applied within the SESWIN software.

3.4   Innomar SBP Front Panel: Connectors and Switches
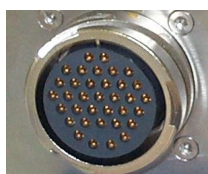
Transducer connector(s)

Connect the transducer(s) to the topside unit before switching on the power! The transducer cable has a sea water resistant polyurethane sheet and are moulded non-removable to the transducer.

Power connector, main fuse and switch

The main switch is used to switch the INNOMAR topside unit on and off. Prior to that the AC cable must be connected to the ship's power supply.

Please note that the switch will not disconnect from the power lines. There is high voltage inside the unit if the power cable is plugged in!

Power control LEDs

There are LEDs in the front panel, indicating if all voltages that are needed by the system are available.
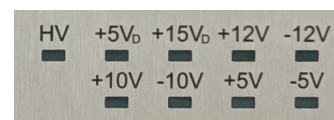
Ethernet Connector

For the *"smart"*, *"compact"* and *"xx-usv"* models the Ethernet interface is used for connecting to the external control PC. For all other models this interface can be used for data transfer / backup and for UDP data of external sensors (e.g. GNSS position, heading).

USB connectors

There are USB connectors to attach external hard disks for data backup/transfer.

Mouse and Keyboard connectors

For INNOMAR SBP models with integrated data acquisition PC there are a mouse device and a keyboard connected to the topside unit via USB.
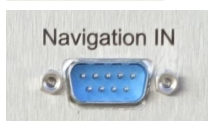
GNSS / Navigation Data Input

There is a RS232 input for navigation data from a GNSS receiver. It is also possible to use UDP data via Ethernet (connector "PC Network").
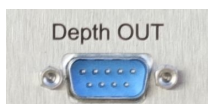
Depth Data Output

There is a RS232 output for the water depth values obtained from the HF- and LF-channel.

Multi-Purpose Data Input

There is a RS232 input which may be used for various purposes. This interface is configured within the SESWIN software.

HRP / Motion Sensor Data Input

There is a RS232 input for motion sensor data. A wide range of different data formats is supported. Next to this there is also a RJ45 Ethernet connector for motion sensor UDP data. This interface is configured within the SESWIN software.

NOTE: For most models the motion data is going to an internal microcontroller and not to the data acquisition PC.

GND Connector

There is a female banana ground connector to connect a separate ground wire to the transducer. Depending on the power supply on board of the vessel, this might reduce electrical noise visible in the SBP data.

Analogue Out / Analogue In

At the Analogue Output (BNC) the band limited LF-signal is available (voltage range ±4V). The (optional) Analogue Input (BNC) can be used to feed signals from other sources to the INNOMAR SBP (voltage range ±5V).
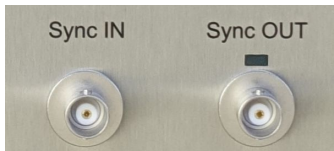
Sync IN: This is used to trigger the INNOMAR SBP from other equipment ('external synchronization')

Sync OUT: Output of pulses to trigger other systems.

Trigger LED: next to the Sync OUT connector flashing every time a sync pulse is generated.

TFT-Display / Display Buttons

Most INNOMAR topside units have an integrated 10.4-inch TFT-display for system operation. Next to the TFT display there are four buttons to control the TFT (brightness, contrast etc.).

Monitor / Video Output

INNOMAR topside units with integrated data acquisition PC can have an external monitor connected. Interface is HDMI. Older units used DVI or VGA interface connectors.

System Buttons

Some older models have buttons to control the main functions:
- SND – switch transmitting on/off
- REC – switch data acquisition (recording) on/off
- NPR – start new profile
- MRK – set manual marker ("event marker")

3.5 Innomar SBP Rear Panel

At the INNOMAR SBP rear panel there is some information about the system:
- INNOMAR SBP model,
- serial number,
- manufacturing date (month/year).

4 Ethernet / WiFi Setup (*"smart"*, *"compact"*, *"-usv"*)

To use the INNOMAR *"smart"*, *"compact"* and *"xx-usv"* models, a Microsoft® Windows® operated PC with properly set-up Ethernet connection is required. To connect this computer (laptop or any other PC) to the topside unit you need either a crossover network cable or a router/hub and normal network patch cables. For the first-time setup you should connect the control computer to the topside unit directly using the crossover cable (grey with red connectors).

The INNOMAR *"smart"* model also offers a Wi-Fi connection.

After connecting the network cable, a window pops up asking for the network location. This should be set to "Work network":
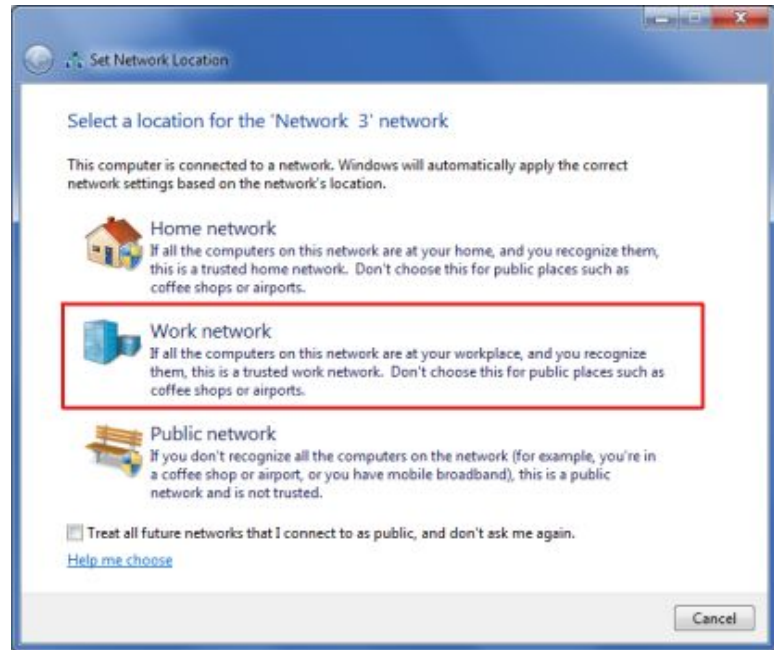
To make life easier you should change the Windows User Account Control (UAC) to "Never notify" (Control Panel – User Accounts – Change User Account Control Settings):
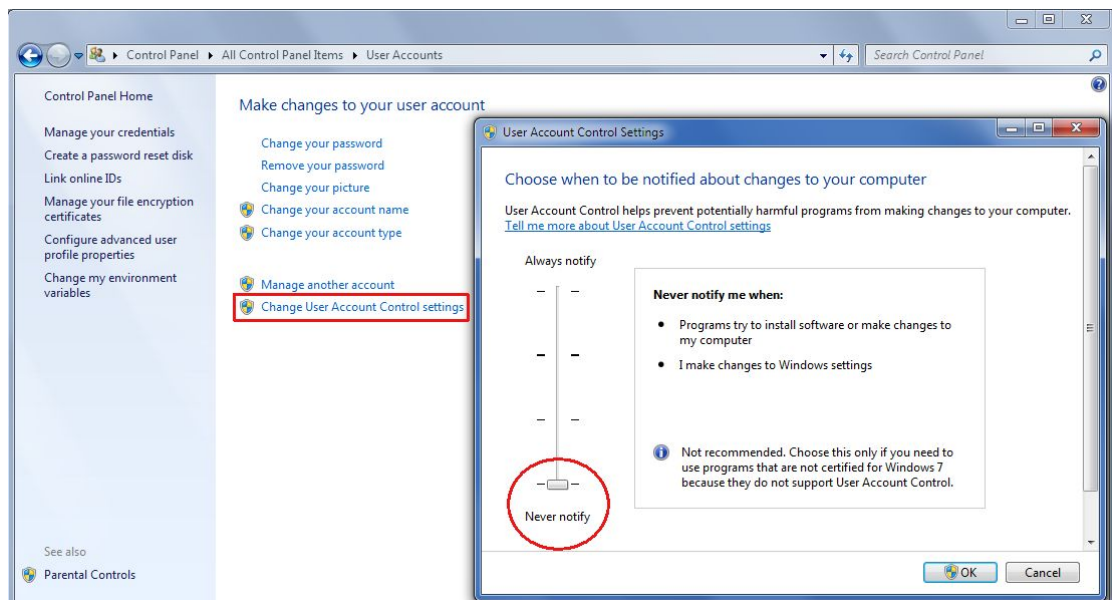
Topside unit and control computer need unique IP addresses within the same address range. Factory default address range is **192.168.115.xxx**. There is also a label on the topside unit.

On the Windows based control computer, the IP address is to be set up as follows:

- Right-click 'Local Area Connection' symbol in tool bar

- Press "Open Network and Sharing Center" and click the active network

- Open the "Internet Protocol (TCP/IP)" Properties settings

- Set IP address range (first 3 numbers) as above. The last number has to be unique in your network.

- Subnet mask has to be '255.255.255.0'

- Please note: 'Obtain IP address automatically' as set on many computers will only work if a DHCP server is running. **If the control computer is connected to the topside unit directly, you have to specify a unique IP address!**
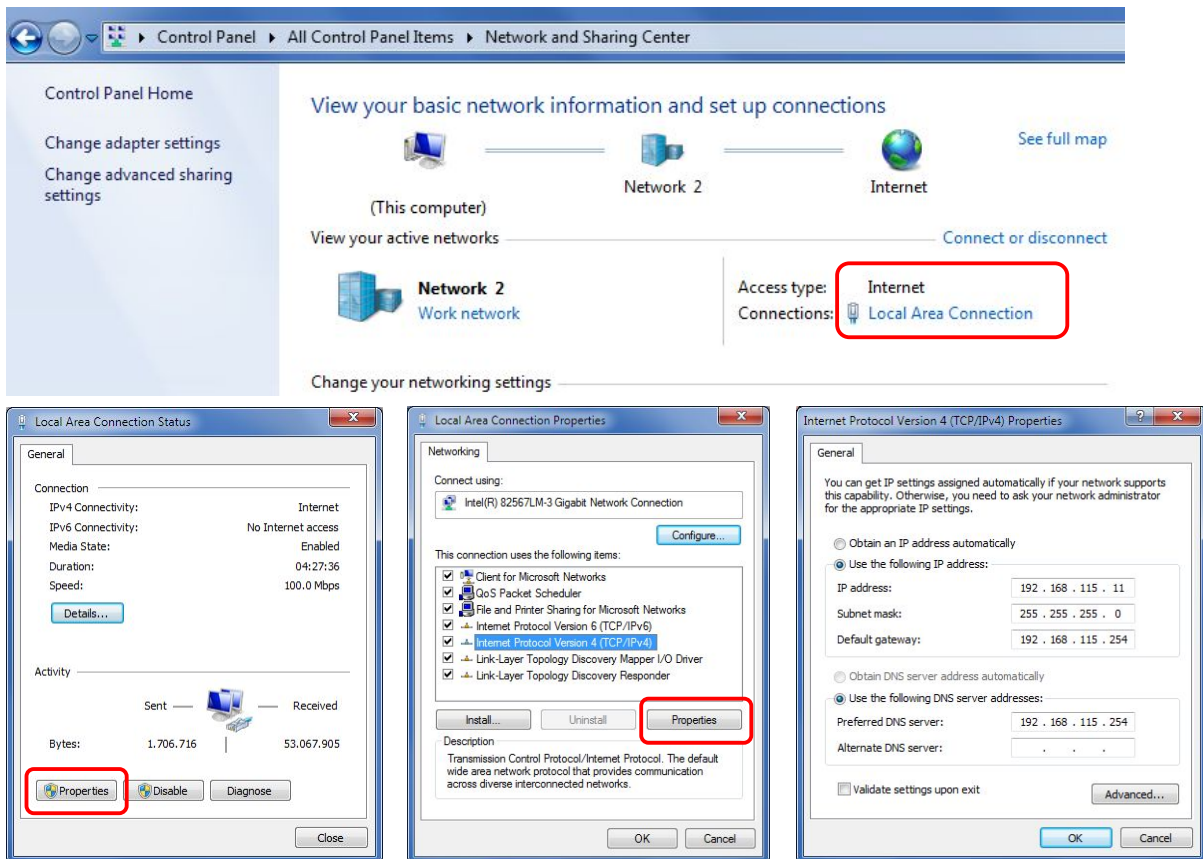
Innomar *"smart"* WiFi Settings (optional)

Security	WPA2-AES
SSID	airGateInnoX (X = last two numerical characters of serial number); example: airGateInno1 for S/N 2017/10/C/**01**/R
Password (WPA Key)	**Smartair**

5   SESWIN System Software

The INNOMAR "SESWIN" software is delivered together with the INNOMAR SBP and is unique to each topside unit. It is used for system control and data acquisition and must not be mixed between systems, even if systems are the same model and age.

This software is pre-installed on the built-in control PC. If the SBP model requires an external control PC, then it has to be installed there as described below.

For models with integrated control PC do not change the settings of the BIOS and the Windows OS and do not install any other software packages and device drivers to ensure proper operation. A backup of all the delivered software is within the folder "SBackup" on hard disk "C".

5.1   Installing / Updating the Innomar SESWIN Software

There is no installation required. Just copy all files from the SESWIN folder on the USB thumb drive or archive provided by INNOMAR into your SESWIN folder on hard disk. Remember to keep a copy of your old SESWIN and note all settings beforehand (e.g. take screenshots).

You should set a shortcut to the SESWIN application on your Windows desktop (right click → Send to ... → Desktop).

Windows may block some network features of the SESWIN application if the UAC is not set to a lower level: "WINDOWS Control Panel → All Control Panel Items → User Accounts → Change User Account Control Settings". After changing this to "never notify", please re-boot Windows.

Another option is to run SESWIN with administrator privileges as shown below.

For giving SESWIN administrator privileges, open the SESWIN folder and right-click seswin.exe. Then go to "Properties".
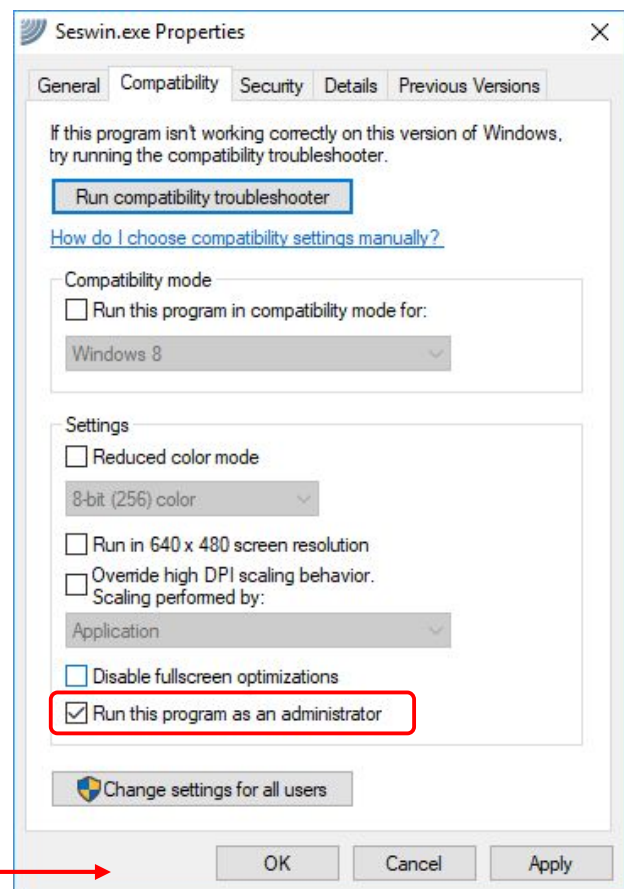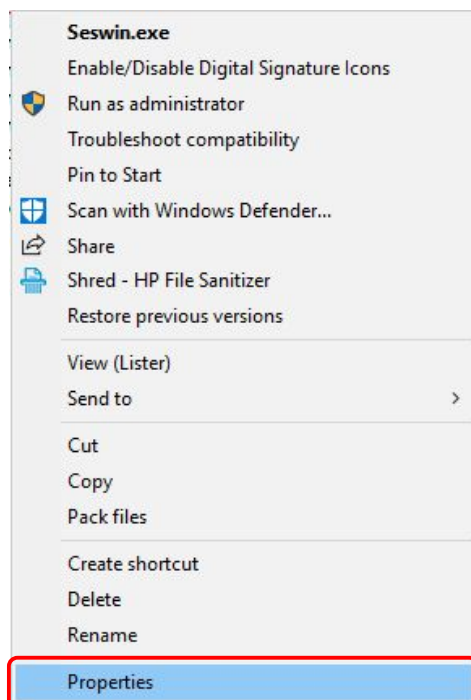
5.2   Starting the Innomar SESWIN Software

5.2.1   Innomar SBPs with external PC ("smart, "compact", "-usv", "-rov")

Make sure topside unit and control computer are connected to the same network. If the topside unit is connected directly to the control computer (without network hardware like hubs, switches etc.), then preferably use a crosslink cable. Although network adapters usually cross the lines automatically if two devices are directly connected, this sometimes fails. Using a cable with crossed lines helps to avoid this pitfall.

Usually, there is a SESWIN shortcut placed on the Windows desktop. To start the software, just double-click the icon.

There might be a Windows message box popping up and asking if the application is allowed to make changes to the system; simply press the "Yes" button.

After starting SESWIN, the "System Start-up Parameter" dialog is shown where the System Control Port (topside unit's IP address) and all other interface port settings are listed. You should check if these settings are correct. It is also possible to assign other COM or IP (TCP or UDP) ports.

These settings cannot be changed later; this is possible at the program's start only.

For IP port settings see 5.2.5 on page 40.

It is important to set the topside unit's IP address correctly. It is good practice to note a changed IP address on the topside unit itself.

If the current address is not known, you can try to find it by using the "Search" button:

Control Port: 192.168.115.241 Search

For details see next page.

If SESWIN accesses the network for the first time (like searching for the topside unit), the Windows firewall asks if SESWIN network access is allowed.

Tick both check boxes and press "Allow access" button.
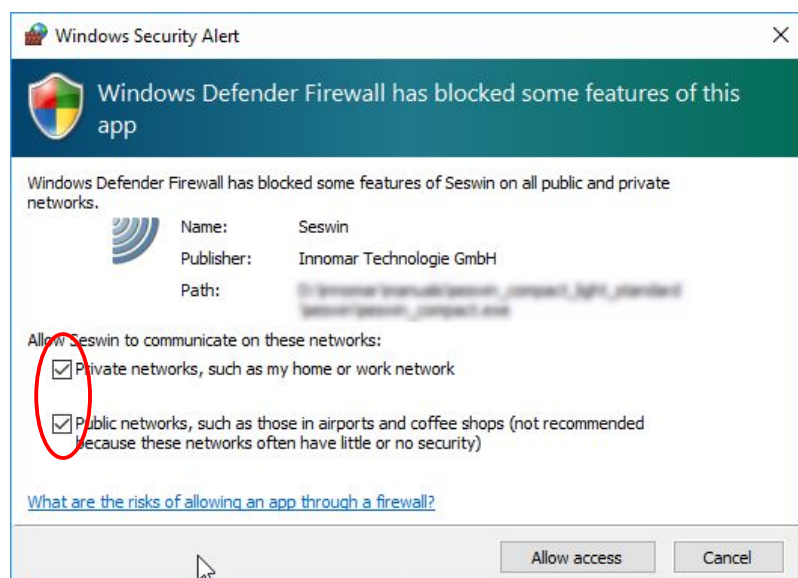
After pressing the "Search" button, the connected (and powered) topside unit should be found:

Control Port: 192.168.115.241 Search →

SES Config
Found SES2000 on Network-IP: 192.168.115.239. Would you like to use the new IP address?
Yes   No
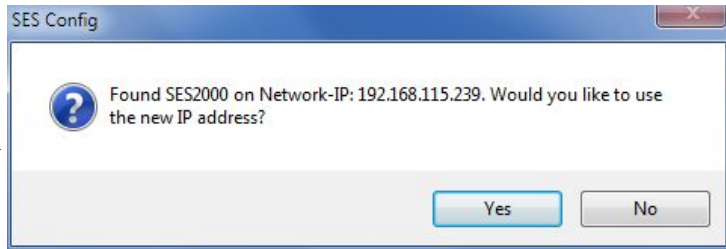
If the topside unit is not found, you will get this message:

Innomar - SESWIN 2.0
System not found...
OK

In case the system is found, but in another IP address range than the control computer, you need to change the IP address of the topside unit:

SES Config
Found SES2000 on Network-IP: 10.0.0.10. The IP address can not be used. Do you want to change SES2000 IP address?
Yes   No
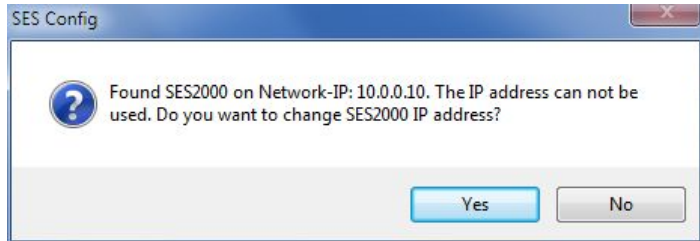
After pressing "YES" the software suggests a new IP address.
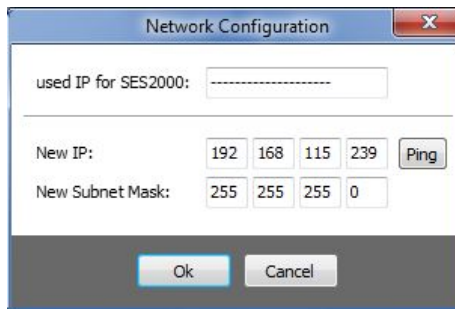
You can check if the suggested address is free or already used by pressing the "Ping" button. (On Windows 7/8/10 this "ping" needs to run the SESWIN application with administrator privileges!)

Network Configuration
used IP for SES2000:   ---------------------
New IP: 192 168 115 239   Ping
New Subnet Mask: 255 255 255 0
Ok   Cancel

If the address is specified by the user the system changes the topside unit's address and performs a new search:

Innomar - SESWIN 2.0
Re-search SES2000...
OK

SES Config
Found SES2000 on Network-IP: 192.168.115.239. Would you like to use the new IP address?
Yes   No
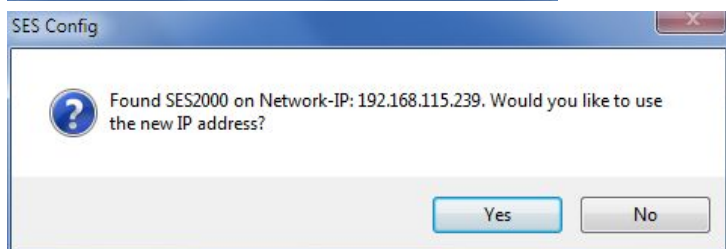
After pressing the "OK" button SESWIN starts up and connects to the topside unit see section 5.3 on page 41.

If the topside unit is already controlled by another computer, you will get an error message:

Connection not Accepted. Closing now...
System is controlled by another Client! (192.168.115.4)
Ok
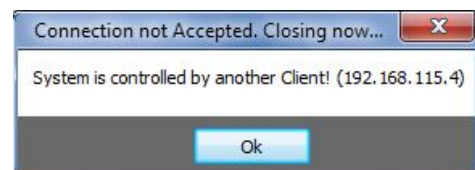
5.2.2 Innomar SBPs with integrated PC ("light", "standard", "medium", "deep")

Usually there is a SESWIN shortcut placed on the Windows desktop. To start the software, just double-click the icon.

There might be a Windows message box popping up and asking if the application is allowed to make changes to the system; simply press "Yes".

After starting SESWIN a "System Start-up Parameter" dialog is shown where all interface settings are listed. You should check if these settings are correct.

The "system control port" (COM1) cannot be changed.

Standard port assignment is:

- Navigation: COM2
- Multi-Purpose: COM3
- Depth Output: COM4

Note: motion data go to an internal microcontroller and **not** to the PC.

After pressing "OK", the SESWIN main screen shows up, see next page.
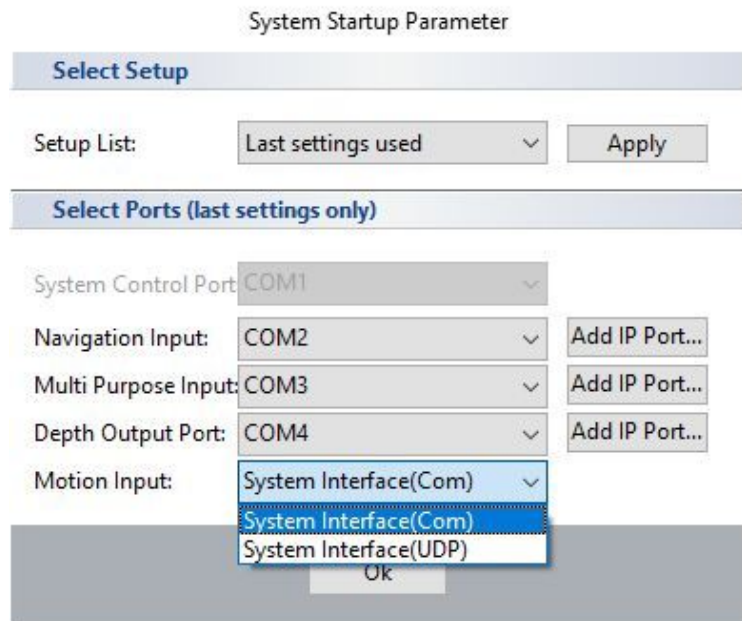
5.2.3 SESWIN with 24-bit data recording

! For the *"standard-xx"* "*medium-xx*" and "deep-xx" models, 24-bit data recording (*.ses3 data files) is possible and should be used as standard. For this SESWIN version "**Seswin24bit.exe**" is provided. This version shows a hint in the application bar:
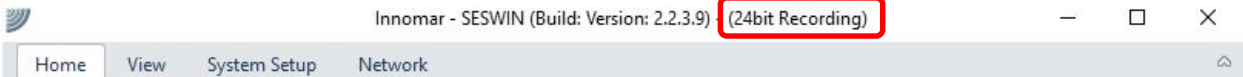
5.2.4 User Profiles / Reset to Factory Defaults

It is possible to store and re-use settings via "user profiles". If there are user profiles stored previously, they will be shown in the "Setup list" drop down box (default: "last settings used"). It is also possible to reset the system to "factory default" settings.
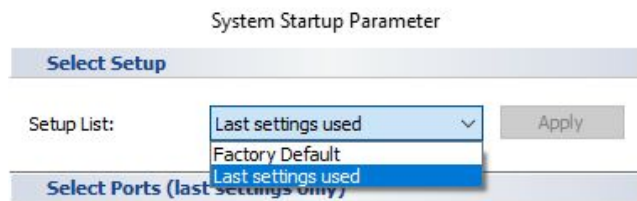
5.2.5 Serial/UDP Input/Output Connections

For the Navigation data input, "multi-purpose" input and the depth output of the INNOMAR system it is possible to assign COM or IP (TCP or UDP) ports. Factory defaults are COM2–4. These settings cannot be changed later; this is possible at the program's start only.

If the SESWIN PC has more than one Ethernet adapter, you have to select the correct IP address.
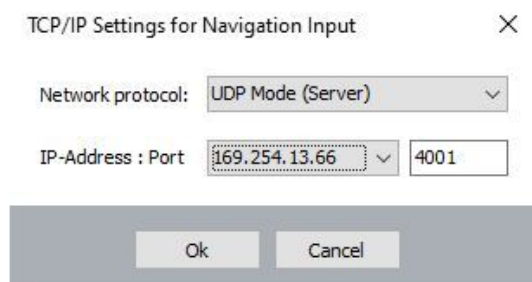
5.3   SESWIN Screen
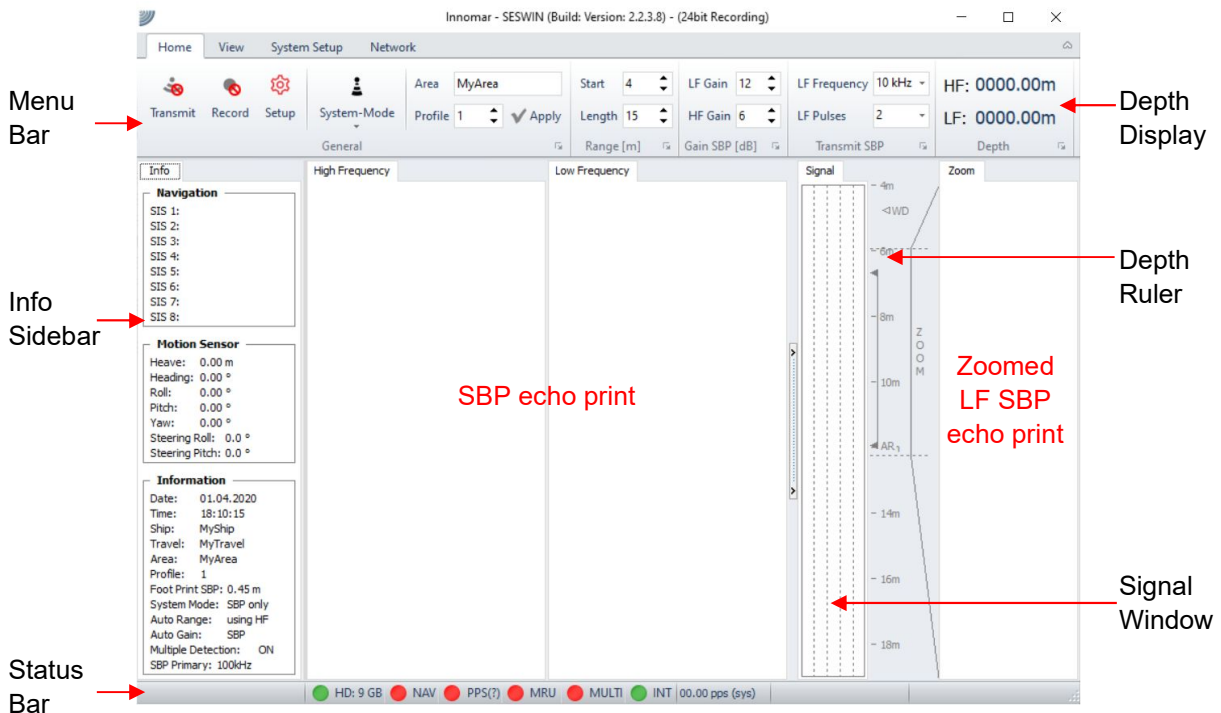
Factory default is to show the data of both, the LF and HF, channels. Mostly the main interest is the LF data. To enlarge the screen area available for the LF channel, the HF echo print can be switched off: **(1)** "View" → **(2)** "SBP Display Style" → **(3)** "Low Frequency only"
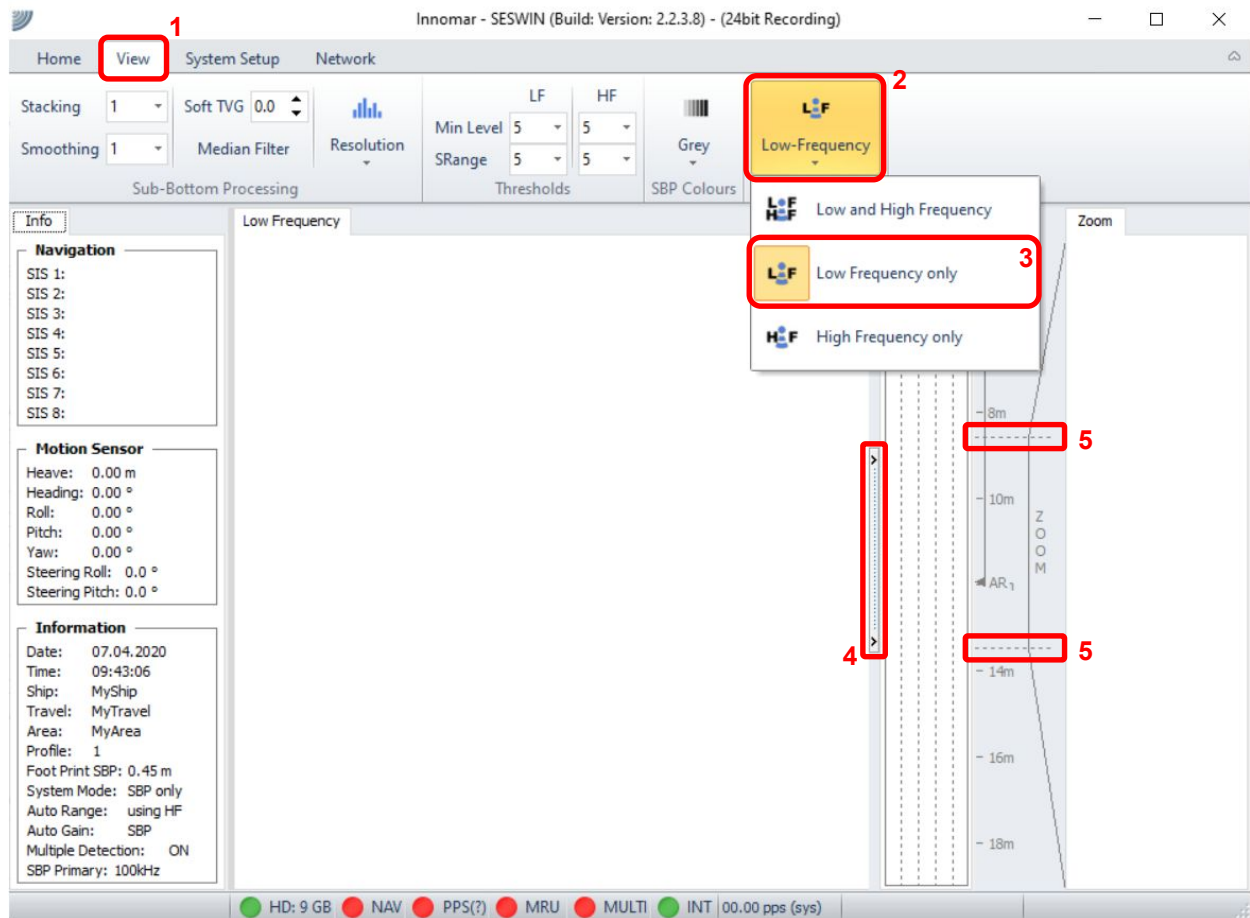
The echo print area can be further increased by reducing or hiding the "Signal" and "Zoom" tabs. For this the button **(4)** between the echo print tab and the "Signal" tab is used. Press and hold to

change the width; just press to hide the right part, press again to get the both tabs on the right back.

The "Zoom" tab is new with SESWIN version 2.2.3.8. The depth range to zoom in can be adjusted by moving the dotted lines **(5)** shown within the depth ruler. A click between the two dotted lines will centre the zoomed range on the bottom track.

For the INNOMAR *"light-plus"* and *"standard-plus"* models the echo print area is divided according to the system mode used (SBP only, sidescan only or SBP+sidescan). For sidescan gain settings there is an additional section within the "Home" menu:
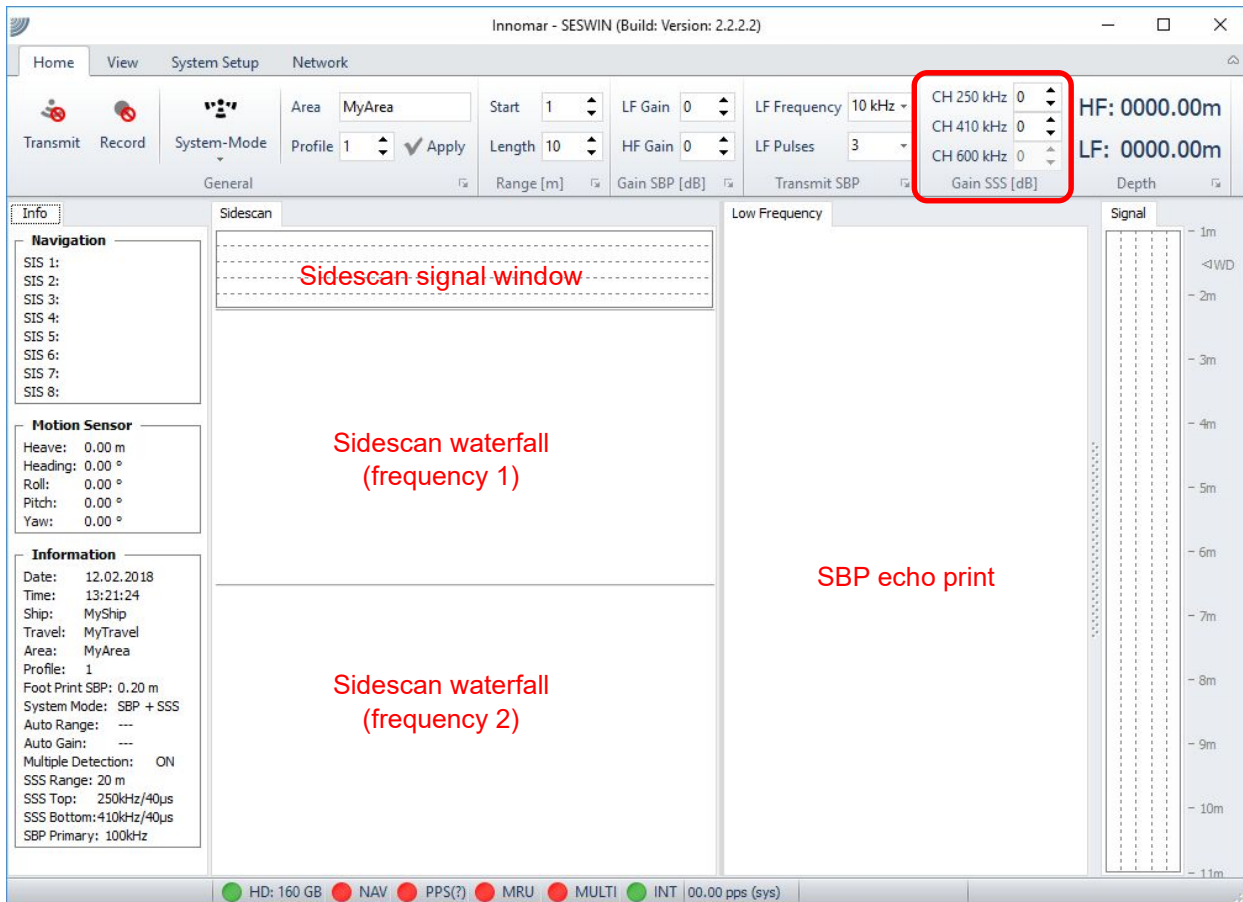
5.4 SESWIN Menu Bars

All settings are grouped into four menu bars:

- Home: all settings that might be changed during the survey.
- View: settings to control the online data representation (will not affect recorded data).
- System Setup: settings for the system and sensor interfaces that are usually made only once during mobilisation.
- Network: settings for special ethernet data transmission (broadcast server).
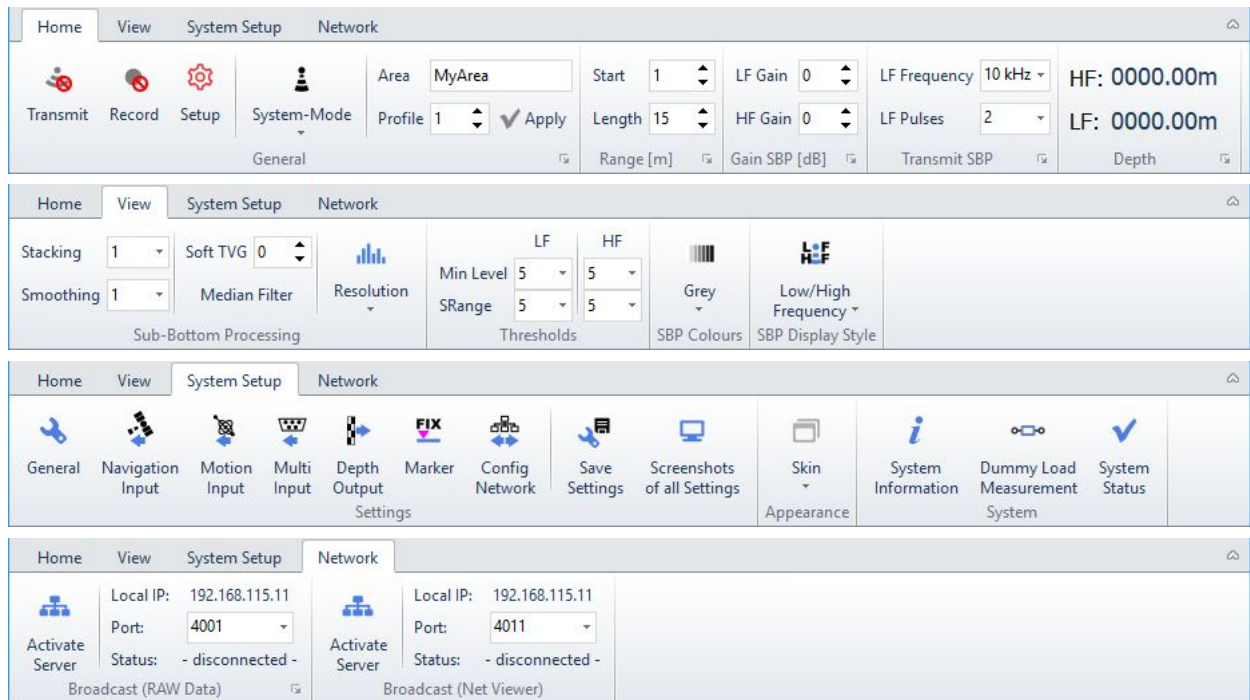
If all settings are made and you are working on a small screen, you may hide/unhide the menu bar; the "Transmit" and "Record" buttons are still available:
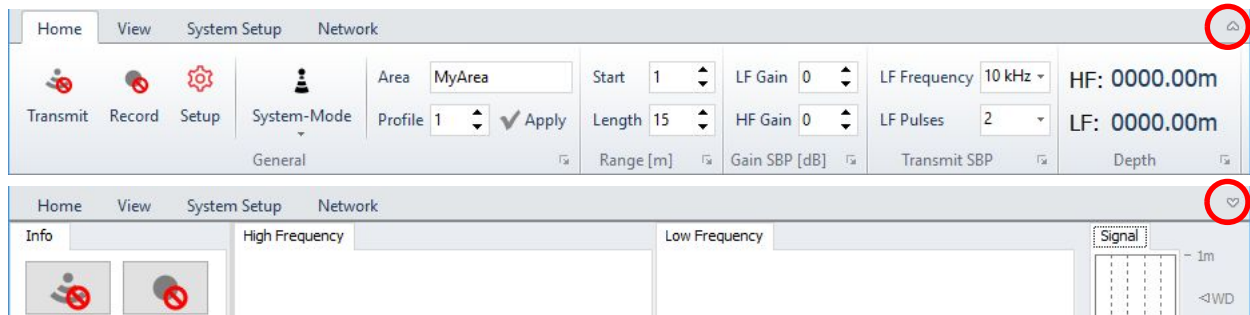
For the INNOMAR *"smart"* and *"light-plus"* / *"standard-plus"* models, the "Home" menu looks a bit different:
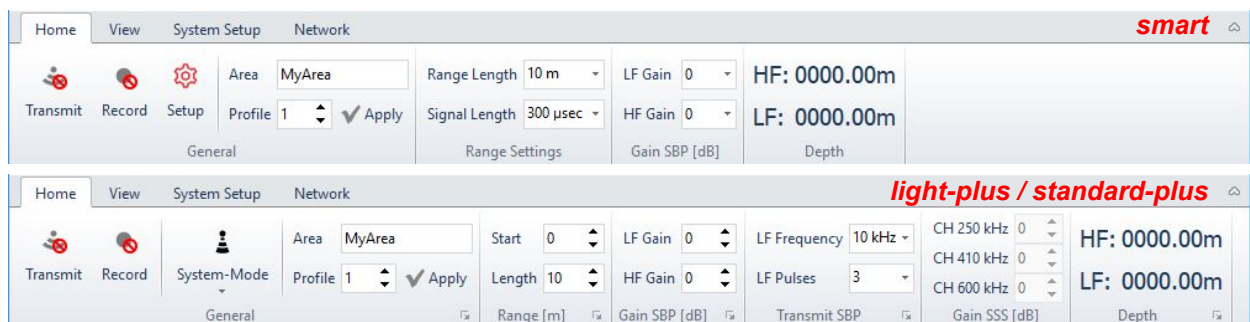
5.5   SESWIN Info Sidebar

On the left-hand part of the INNOMAR SESWIN application status information on external sensors and the SBP system is given:

- Navigation data (up to eight info strings can be stored with the INNOMAR data),

- Motion sensor data (heave, roll, pitch; if available also heading and yaw),

- Date and time from the PC clock,

- Data annotation like ship name, travel ID, area name, profile number,

- SBP foot print diameter,

- System status information like operation mode.

For the INNOMAR *"light-plus"* and *"standard-plus"* models, the "Information" tab also lists sidescan related items:

5.6   SESWIN SBP Signal Display and Depth Ruler
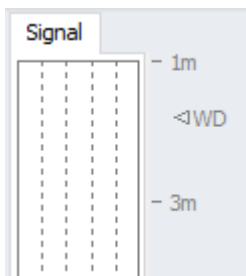
The depth ruler shows the SBP data acquisition range. Note that data outside this range will not be collected.

The "Signals" window shows the envelope (amplitude) data of the last received ping (LF: green, HF: black). This is an excellent tool to optimize the gain settings.

5.7   SESWIN Sidescan Signal Display (*"light-plus"* / *"standard-plus"*)
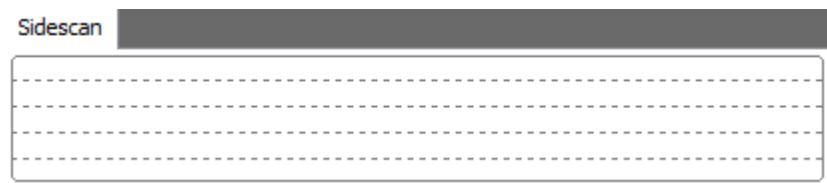
Similar to the SBP signal display, the envelope amplitude of the last received sidescan ping is shown as well to have feedback for gain settings.

This is for *"light-plus"* and *"standard-plus"* models only!

5.8   SESWIN Status Bar
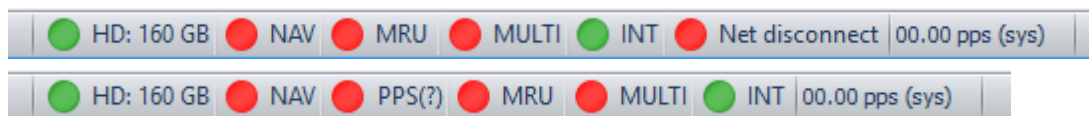
The Status Bar at the bottom of the SESWIN window shows:

- the status of the built in HD and the status of the sensor interfaces: navigation data (NAV), motion sensor (MRU), multi-purpose input (MULTI),
- trigger source (INTernal / EXTernal synchronization),
- actual ping rate,
- during data recording the actual data file name and size.

The coloured LEDs in the status bar are used to monitor the status of the connections to peripherals. The colours are

	Green	OK, data received and can be interpreted
	Green with yellow dot	Data received and can be interpreted, but warning: MRU: received data are flagged "unstable" by the sensor (settling condition) NAV: data lost due to baud rate not high enough → increase baud rate
	Yellow	Warning, there is traffic seen on the specified port, but no useful data found. Please check port (baud rate) and protocol settings.
	Red	Specified port not available or no data / traffic on this port

- **HD**: Hard Disc space. This shows the space remaining on the hard disc the data is being recorded on to. The colour will change to yellow with 250MB remaining, and then go to red when close to empty.
- **NAV**: Navigation (GNSS) data. The LED will be yellow if there is data received but the protocol is not recognised (e.g. due to wrong baud rate). The colour will be red if there is no incoming data.
- **MRU**: Motion Sensor. The colour will be yellow if there is a problem such as the data sent by the sensor is not recognised. It's turning red if the motion sensor is unplugged or not working (no data is received).
- **MULTI**: Multi-Purpose COM Port. The warning colour will be yellow if there is data coming in but is not recognised. The colour will be red if there is no incoming data.
- **INT / EXT / ALT**: Status of trigger settings.
- **NET**: connection status to topside unit (for *"smart"* and *"compact"* models only).
- **PPS**: status of PPS input and delay between PPS pulse and ZDA time string

5.9   SESWIN Home Menu Bar
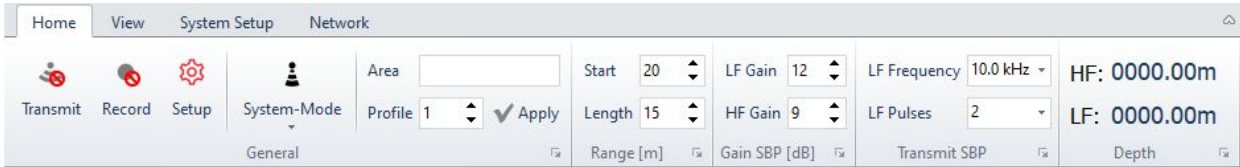
This menu bar collects all parameters and settings that might be changed during the survey.

It's slightly diffe-rent for the INNOMAR *"smart"* model:
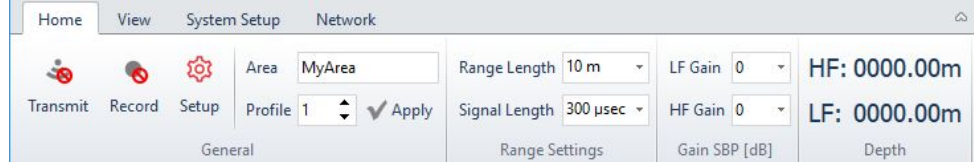
5.9.1 Home – General
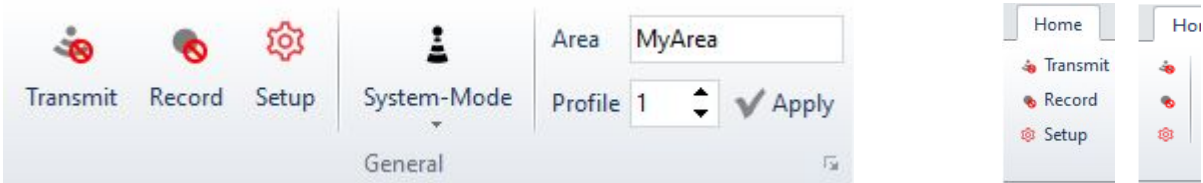
Transmit on/off [F4]

The *Transmit* button switches the transmitter on/off. If the *Transmit* button is activated, the transducer will transmit the frequency and pulses as defined in the "Transmit SBP" section of the Home menu.

If the *Transmit* button is active, the green "SND" LED at the front panel is lit. The system hot key "SND" at the front panel (older *"light"*, *"standard"*, *"medium-xx"* and *"deep-xx"* models only) can be used to switch on/off the transmitter, too.

! The transducer must be connected to the INNOMAR System unit and placed in water before the transmitters are switched on. Operating the transducer in air may cause serious damages! To remind you on this, a warning message pops up after pressing the "Transmit" button.
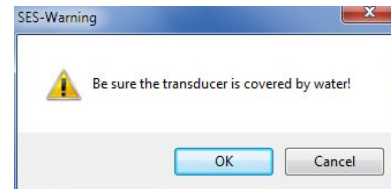
! Data Recording is **not** switched on/off automatically with transmitter on/off!

Record on/off [F5]

The *Record* button is used to switch on/off the digital recording of the received echo data. Data from the navigation system and the motion sensor will be recorded with the echo data, too. The file name is shown in the SESWIN status bar.

If the *Record* button is set, the green "REC" LED at the front panel is lit. The system hot key "REC" at the front panel (older *"light"*, *"standard"*, *"medium-xx"* and *"deep-xx"* models only) can be used to switch on/off the data recording as well.

! Transmitters are **not** switched on/off automatically with Record on/off!

! In case you have no write permission on the folder specified in "System Setup – Settings – General – Files", you will get an error message. In this case close the SESWIN application and change the "record folder", see section 5.11.4 on page 61.

Setup

This opens a dialogue for some settings that are usually just made once and that are rarely changed.

Setup – General Description

In this dialog some annotation can be set that will be stored within the recorded data:
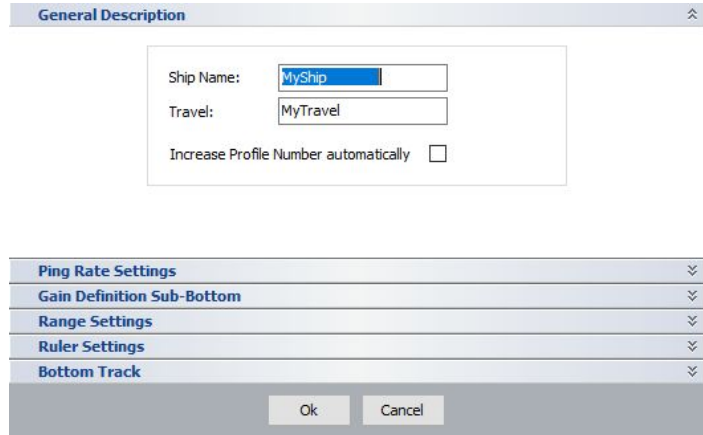
- ship's name and
- travel ID

There is a checkbox to enable an automatic increment of the profile number with each record start.

! Please note the length for the annotation strings (ship name, travel ID) is limited to 20 characters.

Setup – Ping Rate Settings

If required the ping rate can be limited manually. The default "System Controlled" ensures the ping rate (PR) to be kept as high as possible:

$$PR \approx \frac{750}{RS + RL + 7.5}$$

(RS – range start; RL – range length)

Please see section 5.9.6 on page 53 for details.
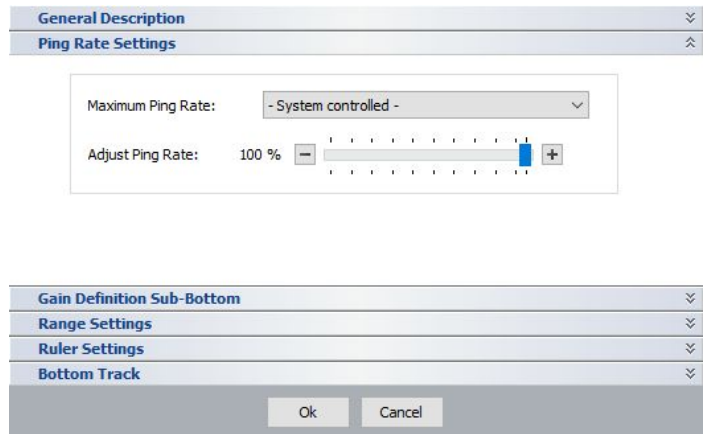
Setup – Gain Definition Sub-Bottom

This sets the increments for the gain controls (range 1–6dB). A good value would be an increment of 2 or 3dB.

The auto gain function is set up here as well.

Please see section 5.9.4 on page 52 for details.
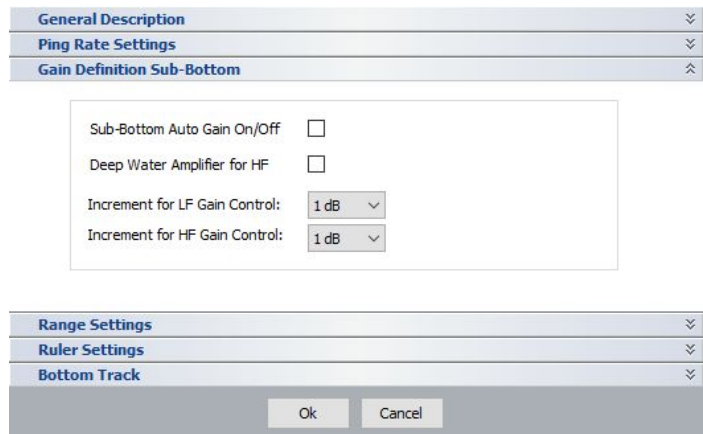
This item is not available with the INNOMAR "smart" model.

Setup – Range Settings

This sets the increments for the range controls and the auto range function.

Please see section 5.9.2 on page 51 for details.

This item is not available with the INNOMAR "smart" model.
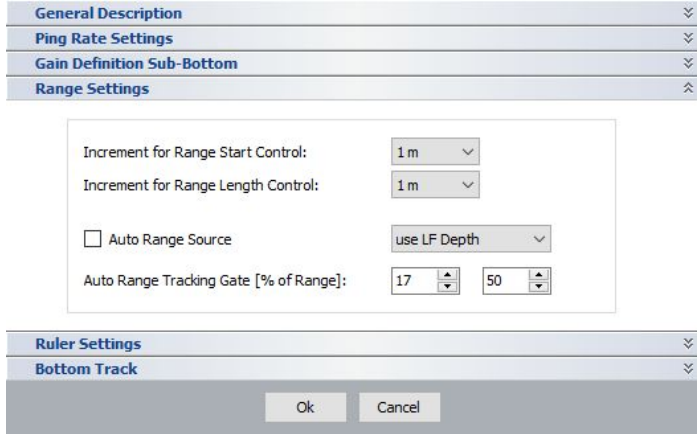
Setup – Ruler Settings

The Ruler Settings are used to customize the ruler lines shown in the online echo plots.

! Usually "Draw Text" and "Draw Lines" should be enabled.
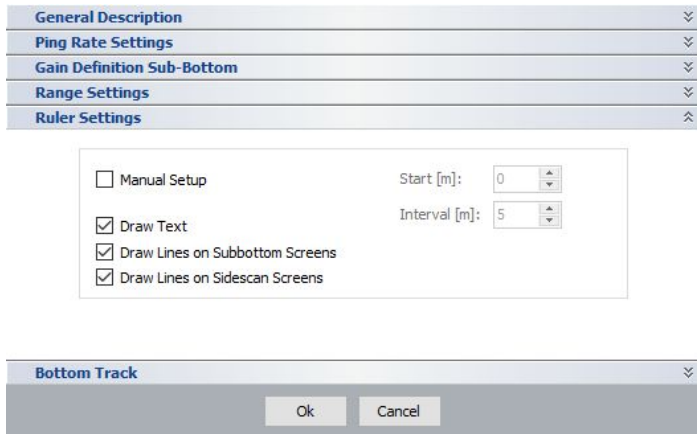
Setup – Bottom Track

The bottom track can be adjusted using the "Bottom Track" dialog.

Please see section 5.9.7 on page 54 for details.
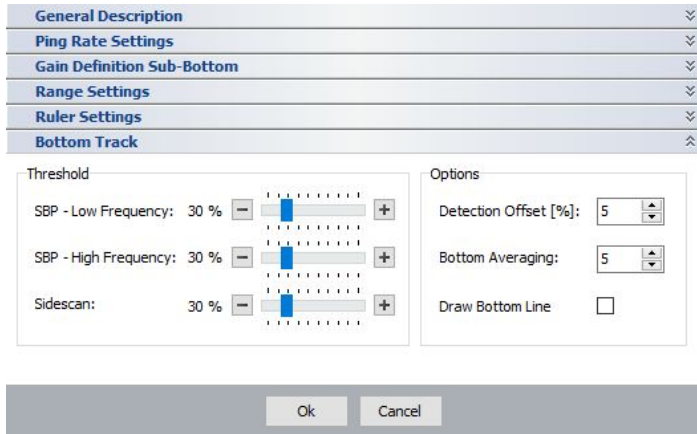
System Mode
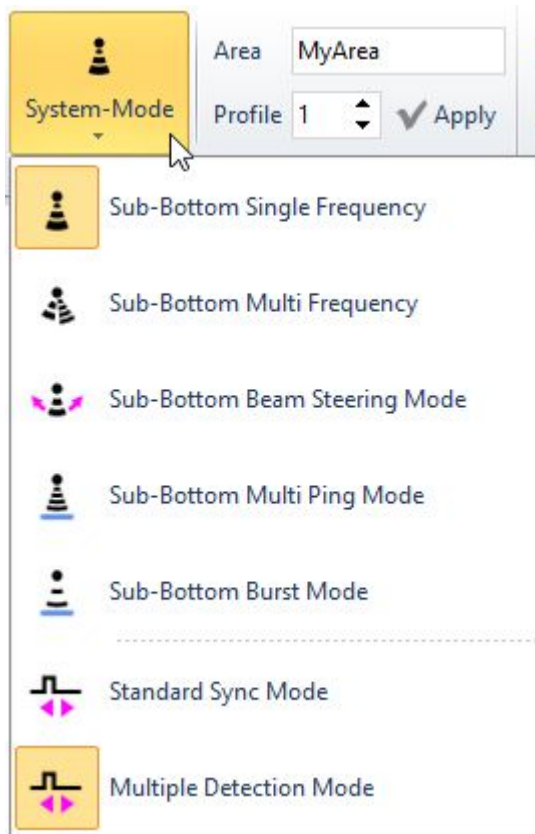
Here you select how you like to operate the system.

Echo print areas of the SESWIN window are shown according to these settings.

If data recording is switched on, you can't change the operation mode and this menu item is disabled.

This item is not available with the INNOMAR "smart" model.

For the INNOMAR *"light-plus"* and *"standard-plus"* models there are two additional system modes:

SBP transmit modes:

- *SBP Single Frequency*: used to transmit pings with same centre frequency and pulse width as set in the "Home – Transmit" menu. **This is the default SBP mode**.
- *SBP Multi Frequency*: used to transmit consecutive pings with different pulse settings (centre frequency and/or pulse width). Settings for this mode are made in the "System Setup – Settings – General – Special Transmit Modes" menu, see 5.11.6 on page 63.
- *SBP Beam Steering Mode*: used to transmit consecutive pings with same centre frequencies and pulse width as set in the "Home – Transmit" menu, but at different angles. Angle settings for this mode are made in the "System Setups– General – Special Transmit Modes" menu (INNOMAR *"standard"* and *"medium-100"* models only). **This is not for beam stabilisation**, for that feature see section 5.11.14 on page 70.
- *SBP Multi Ping Mode and SBP Burst Mode*: used to increase the ping rate in deeper waters, see section 6.4 on page 88 for details. This is not available for the INNOMAR *"smart"* and *"compact"* models.

Synchronisation modes:

- *Standard Sync Mode:* All pings are released with the same (equidistant) timing.
- *Multiple Detection Mode:* Every second ping is released with a small delay. This helps to detect (and remove) multiple reflections in (very) shallow waters, see below.

    If the range is set to twice the water depth and more, multiple reflections from the seafloor may be visible. At smaller ranges and high ping rates (typically for shallow water applications) you will see also multiples from previous pings that are "mapped" into the visible range (see sketch below). With "Multiple Detection Mode" these inter-ping multiples can be distinguished from real signals and may be removed by a median filter.

long range	shallow water, Standard Sync Mode	shallow water, Multiple Detection

water surface

direct seabed return

first multiple return

second multiple return
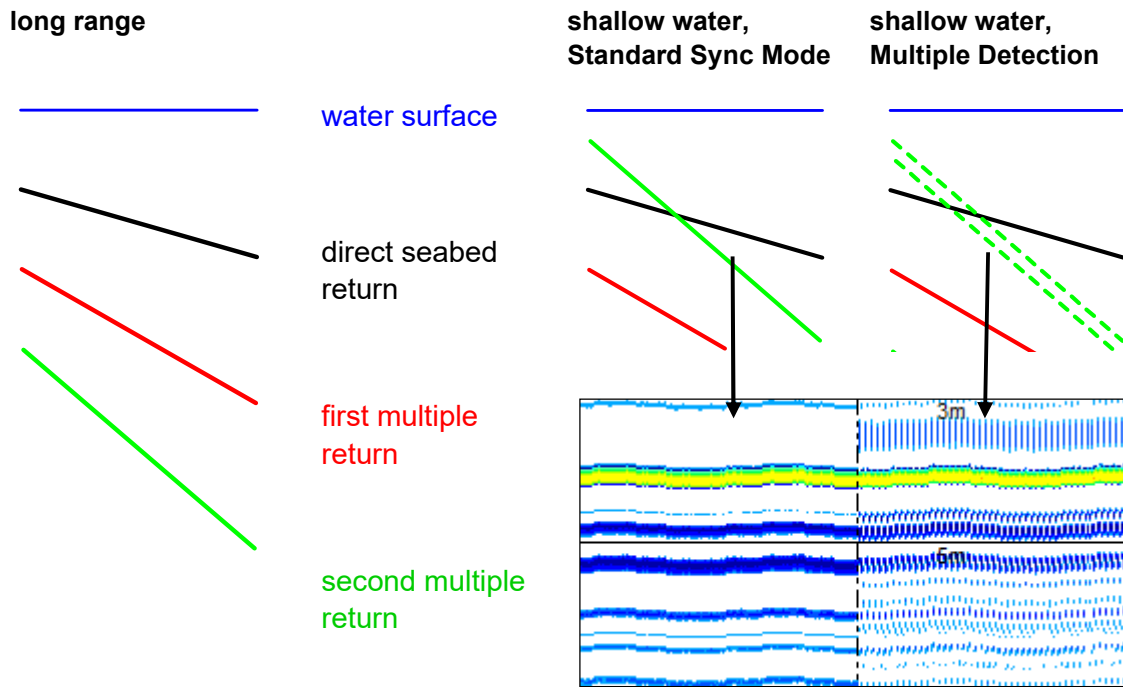
Area / Profile Counter

To annotate the recorded data, it is possible to set an area name and a profile number. The area name can also be used as data file name prefix. The profile number can be set to be increased automatically at each record start, see below.

! Changes will not take effect before the "Apply" button is pressed. To remind on changes not active yet, the tick mark is highlighted if anything has changed. Please note the length for the area name string is limited to 20 characters.

General Settings

In this dialog, some more annotation can be set that will be stored with the recorded data:

- ship's name and
- travel ID

This information will be stored with the recorded data and might be useful for data handling.

There is a checkbox to enable an automatic increment of the profile number with each record start.

! Please note the length for the annotation strings (ship name, travel ID, area name) is limited to 20 characters.

5.9.2 Home – Range Settings (*"smart"* model only)
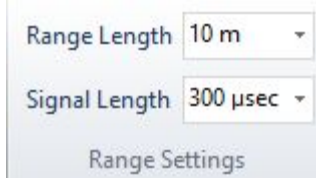
This defines the length of data to be recorded and the duration of the transmitted sound pulse. It <u>strongly affects the recorded data</u>: Any data outside of the specified window <u>will not be recorded</u>.

The menu shown is for the *"smart"* model only, it combines the "Range" and "Transmit" menus of the other models.

Range Length sets the (depth) range of the displayed and recorded SBP data. This cannot be changed while recording data. Data record starts ("Range Start") at zero and cannot be changed by the user. Thus the entire water column data is recorded.

Signal Length sets the length (duration) of the transmitted sound pulse. The centre frequency is fixed to 10 kHz for the *"smart"* model.

5.9.3 Home – Range (all other models)
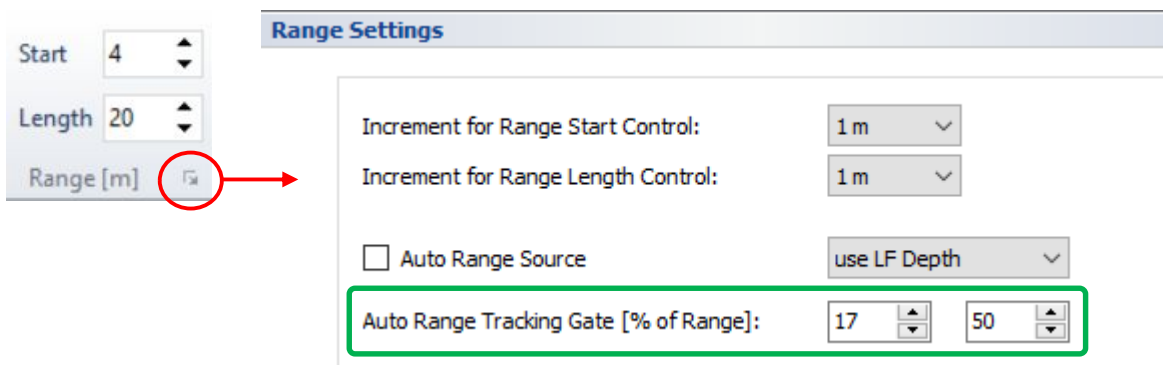
This defines the starting point and length of data to be recorded and <u>strongly affects the recorded data</u>: Any data outside of the specified window <u>will not be recorded</u>.
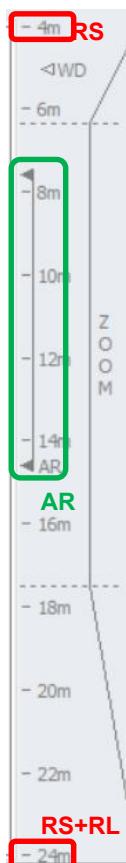
Start (RS) defines the start depth of the displayed echo print and the recorded data. This can be changed at any time (increment is defined in the range context menu). This is to prevent recording the entire water column in deeper waters and thus reducing the amount of data to process.

Length (RL) sets the (depth) range of the displayed and recorded SBP data. This cannot be changed while recording data. This "Length" starts at the given "Start", thus the recorded data is within the interval [RS … ($RS+RL$)], see picture.

If the water depth is not known, then initially a shallow starting point (*Start*) with large range (*Length*) should be used to determine the water depth. This will ensure that the true seabed (and not a multiple) will be recorded. Once the true water depth is known, the range should be reduced to record only the area of interest.

The *Increment* for range "Start" and "Length" settings can be defined separately.

The *Auto Range (AR)* function controls the automatic "Range Start" depending on the water depth. It should not generally be used. Be aware: if the system loses the seabed while using the "auto range" function, the continued seabed searching can result in data gaps. This may happen for instance at steep slopes. If the seabed is known to be relatively flat and you get a good bottom track, the auto-range function can be used safely. You can choose a SBP channel whose bottom track should be used ("LF", "HF", "External"). The "auto range" will keep the seabed (bottom track value) within the specified "tracking gate". This is given in percentage of range and visualised in the depth ruler, see picture.

5.9.4 Home – Gain SBP

Gain Definition Sub-Bottom

Sub-Bottom Auto Gain On/Off	☐
Deep Water Amplifier for HF	☐
Increment for LF Gain Control:	3 dB ∨
Increment for HF Gain Control:	3 dB ∨
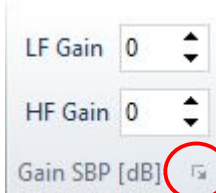
This is to manually set or adjust the gains on the LF and HF SBP channels. Gains employed during data acquisition are final, they are set by the hardware and cannot be changed later.

(not for *"smart"* model)

The ***Increments*** for Gain changes are set in the "Gain Definition" dialog (range 1 – 6 dB). A good value would be an increment of 2 or 3 dB. (Not available for the *"smart"* model.)

A ***Deep-Water Amplifier*** will be applied to the HF data separately if the check box is activated. This gives another 12dB gain for the high-frequency SBP data. (Not available for the *"smart"* model.)

LF Gain / HF Gain (range 0 – 60 dB for the *"smart"* model; 0 – 80 dB for the other models) have to be set to adapt the dynamic range of the (analogue) receiver signal to the ADC unit (analogue to digital converter) in order to ensure best data quality.

To optimize the gain settings, you should use the signal amplitude shown in the SBP signal window, which is divided by four lines. Thus, each of the five sections represent 20 percent of full scale (FS). Best is to maintain a maximum amplitude of 60 – 80% FS. This gives space for sudden peaks and ensures a good dynamic range, see below.
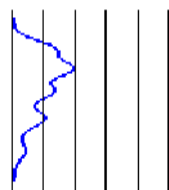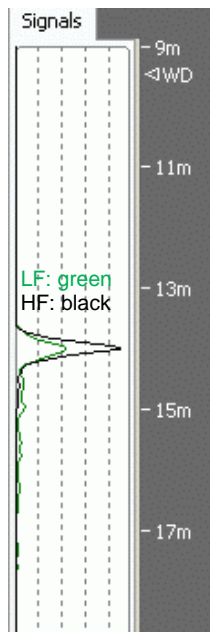
Gain too low, could be safely increased by 6dB.
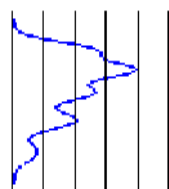
Gain almost ideal, there is room for sudden peaks and the dynamic range is used well.
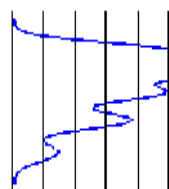
Gain too high, this will result in a distorted signal and should be avoided.

5.9.5 Home – Gain SSS (*"light-plus"* and *"standard-plus"* only)
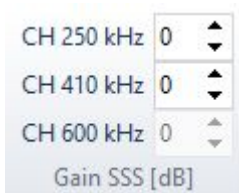
This is to manually set or adjust the gains on the Sidescan channels. Gains employed during data acquisition are final, they are set by the hardware and cannot be changed later.

The gain increment is fixed to 6dB. For optimal gain settings see above.

5.9.6 Home – Transmit SBP (not for *"smart"* model)
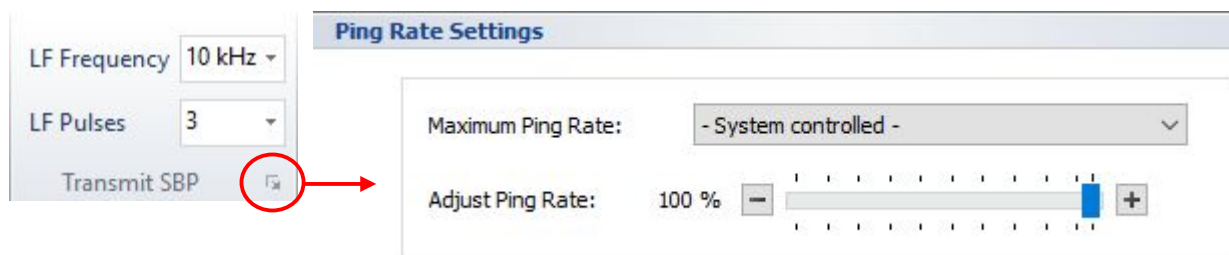
Here you set the centre frequency and pulse length of the SBP LF channel. <u>Frequency and pulse length chosen during data acquisition are final</u>, they affect the recorded data directly!

The HF frequency is fixed, see table below. The HF pulse length (in time) is the same as set in this menu for the LF pulse length.

SBP model	*smart*	*compact, light-xx, standard-xx, medium-100, medium-usv*	*medium-70*	*deep-36*	*deep-15*
Mean HF (kHz)	100	100	70	36	15
LF range (kHz)	10	4 – 15	3 – 12	2 – 7	1 – 4

The **LF Frequency** has to be chosen depending on the survey task. Lower frequencies will achieve better penetration than higher frequencies, but at reduced resolution. Higher frequencies will achieve better resolution, but with reduced penetration. Usually, higher frequencies are used due to better efficiency and better signal to noise ratio and better resolution.

! A good starting point for usual survey work is the centre of the given frequency range (10 kHz for the shallow-water models).

LF-Pulses represent the number of cycles of the LF centre frequency that are transmitted. The energy of the transmitted signal is increased if the number of pulses is increased. That improves the signal-to-noise ratio but decreases the resolution. The available range depends on the chosen frequency. The number of pulses should be as small as possible, if the detection of small reflectors or the resolution near the sediment surface are of high priority, but the higher bandwidth will be more prone to noise. A good starting point is in the middle of the given range.

The actual pulse width PW in milliseconds can be calculated from the number of LF pulses N and the frequency F in kHz: $PW = N/F$. Example: 10 kHz at 2 pulses results in 2/10 = 0.2 ms.

Ping Rate Settings

If required, the **Maximum Ping Rate** can be set manually. The default "System Controlled" ensures the ping rate as high as possible. The "system" ping rate can be estimated as follows. Between subsequent pings there is a dead time of approx. 10 ms. Supposing a sound velocity of 1500m/s, the resulting ping rate PR in "normal" ping mode (internal trigger) is:

$$PR \approx \frac{750}{RangeStart + RangeLength + 7.5}$$

In shallow water with short range settings the ping rate might be reduced to ensure the resulting duty cycle (pulse length relative to ping interval time) is not higher than the allowed maximum value of 1.4 percent.

Adjust Ping Rate: Using this slider one can reduce the ping rate. This may be useful in case of high reverberation or to check for multiples.

5.9.7 Home – Depth

The online calculated water depth (bottom track) from both SBP data channels (HF and LF) is displayed in right-hand part of the Home menu.

Note: If transmitters are not active, then the depth values are stroke trough to indicate that they are invalid.

The bottom is tracked on all data channels automatically. Water depth calculation is based on the transducer draught and sound velocity (see "System Setup – General – System").

Depth Ruler

The bottom track can be adjusted using the "Bottom Track" dialog shown above:

- *Threshold*: Use the sliders to set a threshold for the bottom track on the different data channels. In most cases the default value (40%) gives good results, but at difficult conditions like extensive marine growth this might be increased to detect the true seabed.

- *Detection Offset*: If there is much noise or reverberation above the seabed's return (e.g. in very shallow water), one can blank this area for bottom track by setting a start offset. If an offset is applied this is indicated in the depth ruler as shown above. It is the operator's responsibility to ensure that the offset is always above the true bottom line!

- *Bottom Averaging*: Bottom track values of the given number of consecutive pings are averaged (default 5).

- *Draw Bottom Line*: If this check box is activated, the tracked bottom line is shown in the echo plots.

5.10 SESWIN View Menu Bar
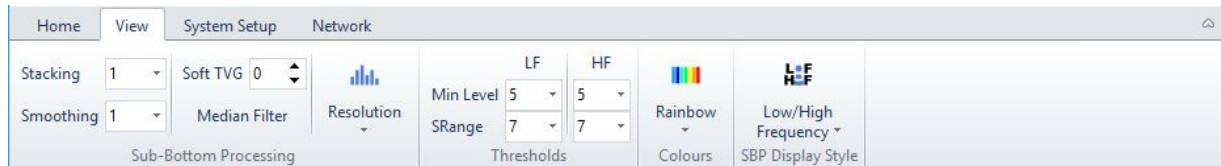
This menu bar collects all parameters and settings that control the online data display.

! All settings made in this menu will <u>not</u> affect the recorded data.

5.10.1 View – Sub-Bottom Processing

This is used to set the online SBP data processing. These settings are used for the online echo plot only and <u>will not affect the recorded data</u>.

Stacking / Smoothing are used to improve the signal to noise ratio (range 1-16, increment 1). A good starting point would be a rate of 2 to 3.

With "Stacking" set to $N > 1$ an average of N pings is ploted and then a new average block starts. This will reduce the ping update rate on screen. This effect is shown in the picture below (b), the black vertical line indicates the data part seen in (a).

With "Smoothing" set to $N > 1$ also an average of N pings is ploted, but this is a moving average. Thus, the ping update rate on screen is not changing, but high "Smoothing" values may have a blurring effect on the data seen on screen.

(a)

(b)

(c)
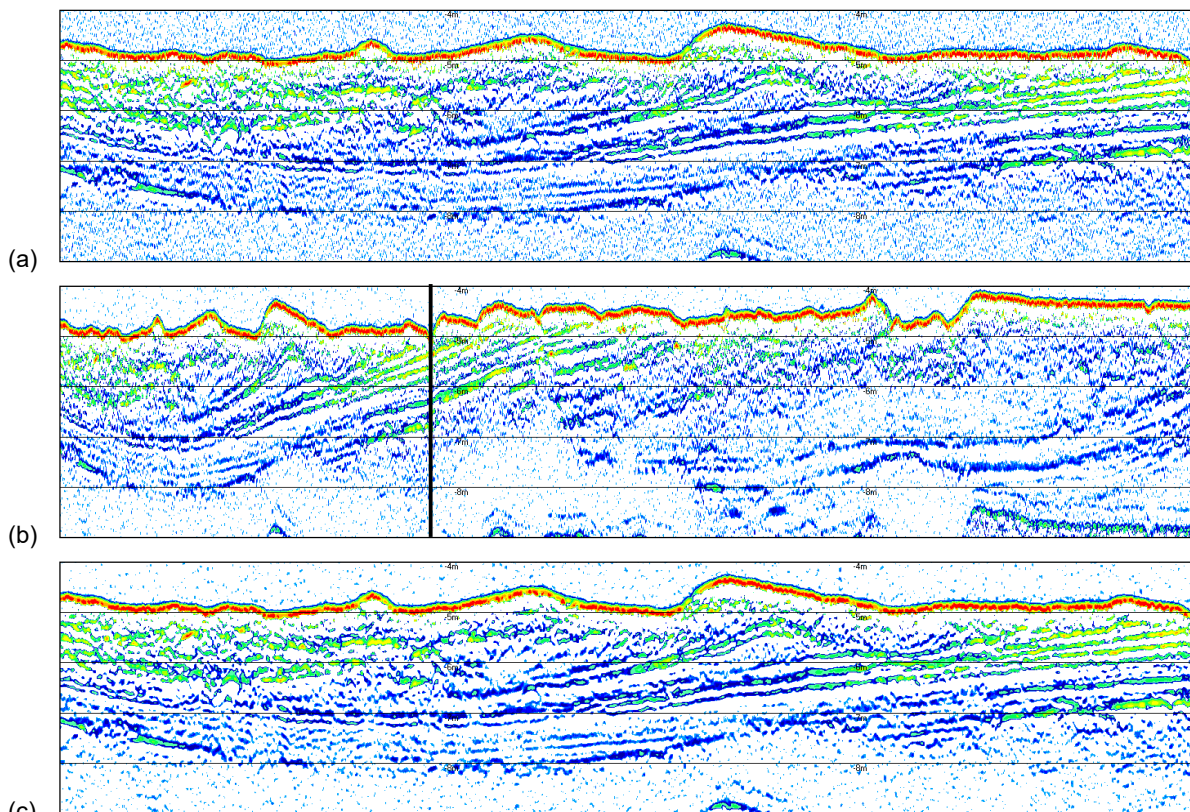
Echo print (a) without stacking/smoothing, (b) stacking by factor three and (c) smoothing by factor three (all other processing parameters are kept the same)

Soft TVG (time-variant gain) increases the gain with increasing time (distance) to compensate attenuation by absorption and spreading. TVG starts at the seabed (for bottom track see also "Home – Depth" menu). TVG values should generally be kept low, typically 0.2 or 0.4 dB/m.

Median Filter: If activated a digital filter is used to remove peak noise from the echo data. This filter will also help to remove noise caused by other acoustical systems, resulting in stripes or regular patterns due to their pinging regime.

Resolution:
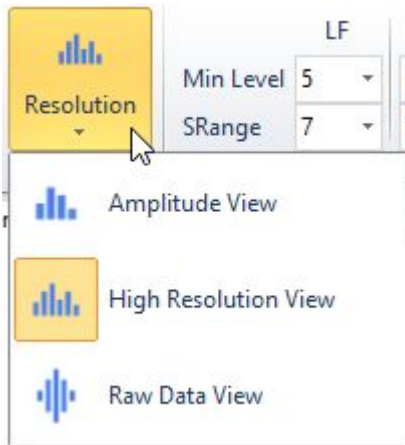
For processing the echo data there are different display modes available:

- "Amplitude View": shows the amplitude (magnitude) of the echo envelope,
- "High Resolution View": shows the (positive) gradient of the echo envelope to enhance amplitude changes,
- "Raw Data View": shows the (positive) raw (full waveform) data.

Amplitude View
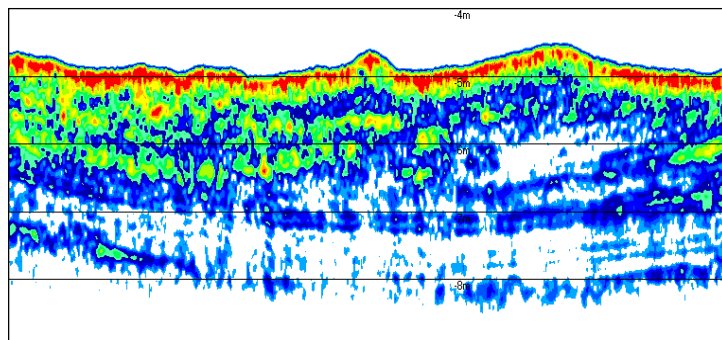
High Resolution View
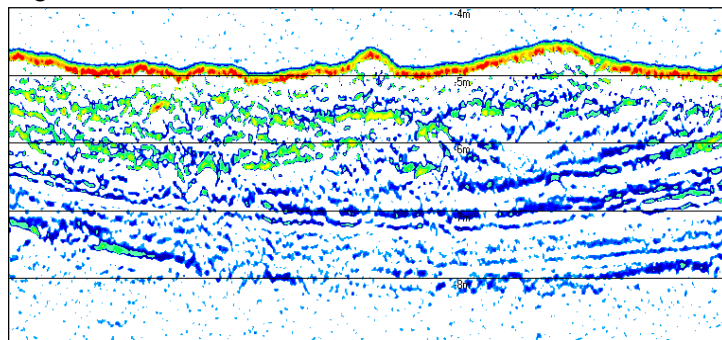
In general, "High Resolution View" should be used, it will provide the most detailed picture of sediment structures. The "High Resolution" processing reduces the signal-to-noise ratio slightly. Therefore "Amplitude" processing may be better if noisy data are processed. "Amplitude View" is also useful for getting an overview about major sediment packages or for water-column analysis, for instance when looking for clouds of gas-bubbles. "Raw Data View" is used when looking for small objects like pipelines or cables.

5.10.2 View – Sidescan Processing (*"light-plus"* and *"standard-plus"* only)
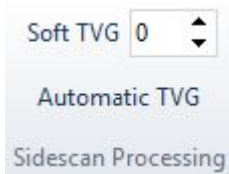
This is used to set the online Sidescan data processing. These settings are used for the online echo plot only and <u>will not affect the recorded data</u>.

Soft TVG (time-variant gain) increases the gain with increasing time (distance) to compensate attenuation by absorption and spreading.

Automatic TVG will set the TVG value automatically depending on range and frequency.

5.10.3 View – Thresholds
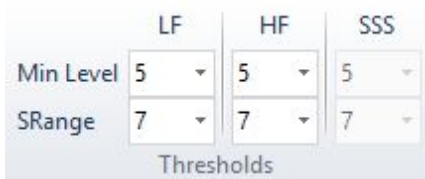
Thresholds are used to map the (processed) echo data to different colours or greyscale levels.

These settings are used for the online echo plots only and <u>will not affect the recorded data</u>.

Min Level*:* (range: 1-10, increment: 1) defines the lowest threshold level, higher values can be used to (visually) remove noise from the echo plot. The optimum setting is where most of the noise is removed, but with a small amount remaining. This will ensure that no genuine features are removed from the screen.

SRange*:* (range: 1-10, increment: 1) defines the upper threshold for echo plot calculation, it limits the visible dynamic range.

! Since these settings are not permanent and can be changed during post-processing, emphasis should be on acquiring good data by adjusting frequency, pulse width and gains before experimenting with the threshold values.

5.10.4 View – Colours
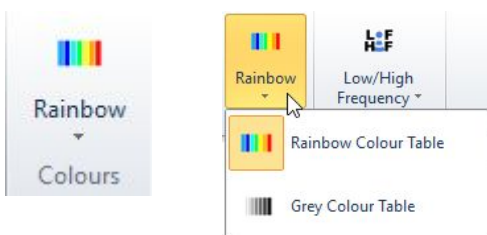
SBP echo plots can be shown using

- different colours or
- different shades of grey.

5.10.5 View – SBP Display Style
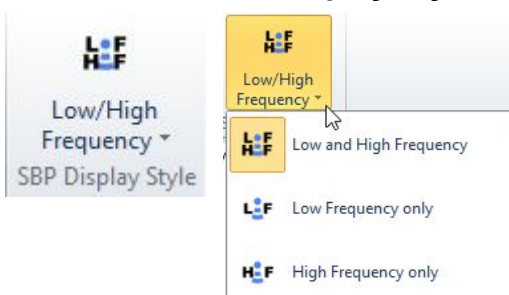
You can modify the SBP echo plot area to show

- both channels (LF and HF) side by side,
- the LF data only or
- the HF data only

5.11 SESWIN System Setup – Settings
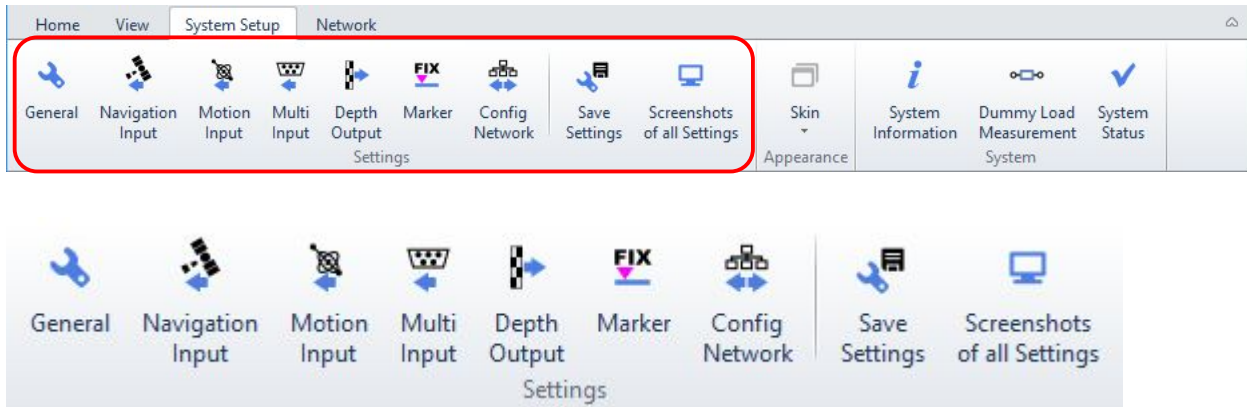
Several system parameters need to be properly set up within the "System Setup" menu before the survey starts. Most menu items are disabled once data logging has started.

5.11.1 System Setup – Settings – General
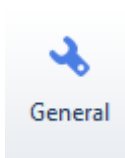
This is used to set general system parameters like transducer draught and synchronisation/trigger modes.

5.11.2 System Setup – Settings – General – System
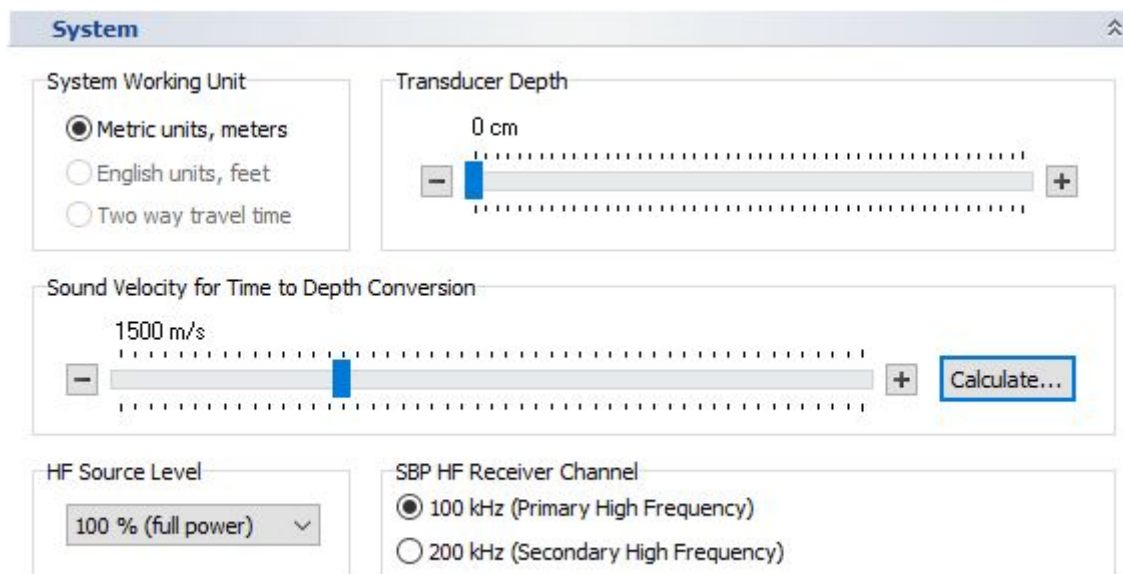
For this Dialog see also section 7.2 on page 90.

System Working Unit: Sets the base unit for the system's time regime. Is fixed to "meters" now, but other units may be available in future.

Transducer Depth: Draught of the transducer's bottom below water surface. This must be set properly to get correct water depths and echo plots related to water surface. If set to 0 (zero) all echo plots and depth values are related to the transducer's face (bottom).

Sound Velocity in Water: The measured or estimated sound speed is used for the travel time to depth conversion within SESWIN and has thus to be set properly. The SESWIN software can calculate water sound velocity depending on salinity, temperature and depth:
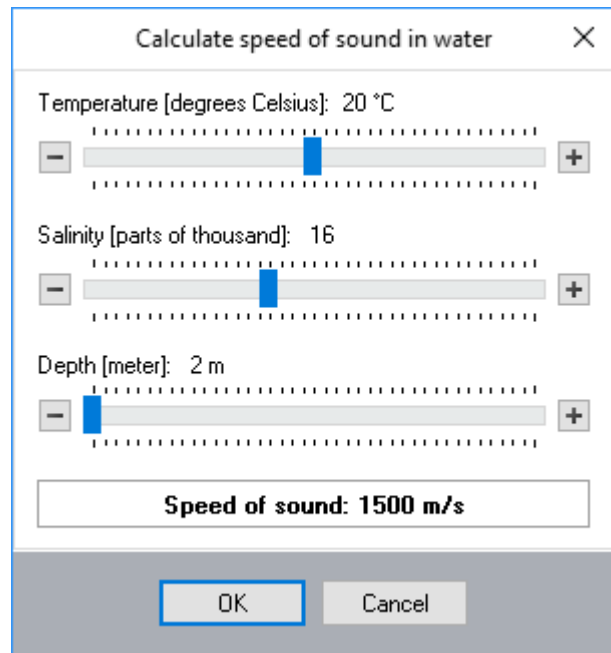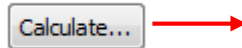
See also section 7.2 on page 90.

Signal Source (optional, not shown in the screenshot above): either the transducer (default) or optionally an external signal fed to the Innomar SBP topside unit via the "Analogue Input" BNC connector.

HF Source Level: For some models the source level for the primary frequencies can be decreased to reduce reverberation in extremely shallow water.

! Be aware that a reduced primary (HF) source level will heavily affect the LF sound pressure level and hence the penetration (50% HF will result in 25% LF only). Thus, this feature should be used with care.
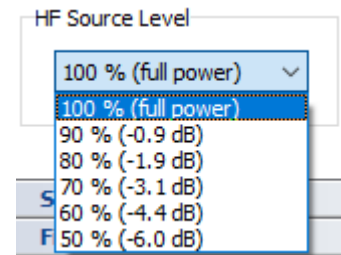
! This feature can be used to manually ramp up the transmit power as sometimes required by authorities to protect marine mammals. For some models there are predefine "soft-start" (power ramp-up) modes in this drop-down list, which may fulfil the marine mammal protection requirements.

SBP HF Receiver Channel (optional): Sets what frequency is used for the high-frequency SBP data channel: The Primary High Frequency (e.g. 100 kHz for the shallow-water models; default) or its first harmonic, the Secondary High Frequency (e.g. 200 kHz).

! This will change the receiver settings only; the transmitted frequency is not affected and remains to the value given in the specs for the used SBP model.

For the *"smart"* model there is an additional item to replace the missing "System Mode" section within the Home menu:
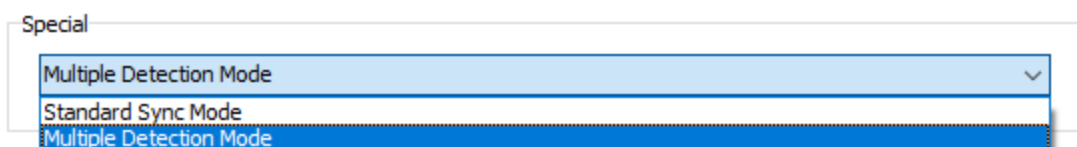
5.11.3 System Setup – Settings – General – Synchronisation

Synchronisation

Mode
- ● Internal Trigger
- ○ External Trigger
- ○ Alternating Trigger

Internal Trigger Settings

Trigger High Time [ms]:   1

Synchronisation

Mode
- ○ Internal Trigger
- ● External Trigger
- ○ Alternating Trigger

External Trigger Settings

Delay between sync pulse and ping [µs]:   1000   (= 2.45 m)

Delay as percentage of range [%]:   20

Number of pings for one sync pulse: 1

Synchronisation

Mode
- ○ Internal Trigger
- ○ External Trigger
- ● Alternating Trigger

Alternating Trigger Settings

Time frame of external device [µs]   40000   (= 30.00 m)

Time Frame as percentage of range [%]:   0

Internal pings prior to external device: 3

Number of external pings: 1

In this dialog there are settings for synchronizing with other acoustic systems. All settings are described in detail in section 6 starting on page 81.

Mode: There are three different modes for the INNOMAR SBP synchronisation:
- Internal (INNOMAR SBP stand-alone or "master" device; default setting)
- External (INNOMAR SBP "slave" device, triggered by other equipment)
- Alternating (INNOMAR SBP master device, pinging alternating with external device)
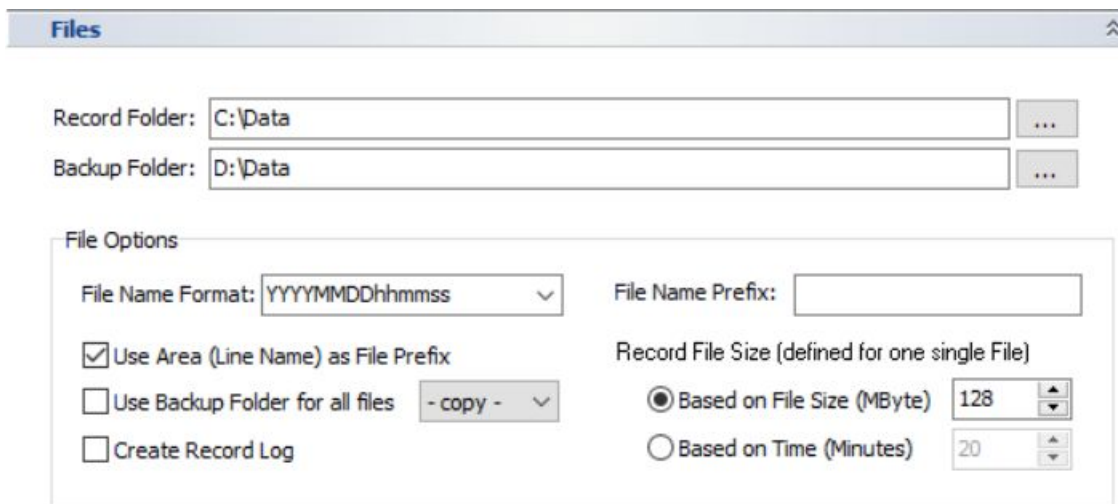
Internal Trigger Settings: If the INNOMAR SBP system is running as master, it is possible to set the length (high-time) of the trigger pulse generated on the "SyncOUT" BNC connector to trigger other equipment. This allows an adjustable trigger delay on the falling edge.

External Trigger Settings: If the INNOMAR system is triggered externally you can apply a trigger delay and/or transmit bursts of pings with each trigger event.

Alternating Trigger Settings: With "Alternating Trigger" the INNOMAR system is running as master and generates a trigger pulse at "Trigger OUT" when an external device shall ping rather than pinging itself.

5.11.4 System Setup – Settings – General – Files

Record Folder: Select where the recorded data shall be stored. File names are generated automatically; see "File Options" below.

! Make sure to have write permissions on the specified folder!

! Data has to be recorded on a local hard disk! Do not use network locations or external (USB) hard drives for direct data recording. Data can be automatically copied/moved to such drives, see below.

Backup Folder: Optionally, data files are copied or moved automatically to a remote location. This feature has to be enabled within the "File Options", see below.

! Make sure to have write permissions on the specified folder!

File Options:

File Name Format: Here you can select a pattern how the SESWIN software creates new file names using the current date and time.

File Name Prefix: optionally defines a static prefix that will be used for any filename created.

Use Area (Line Name) as File Prefix: check this if the file name should start with the area name set in the SESWIN "Home – General" menu. This helps to organise data files.

Use Backup Folder: If checked all data files will be transferred (copy or move as selected) to a second data folder defined above. This destination might be a remote computer or data server. Each data file is transferred immediately after recording. If "move" is selected the original data file will be deleted after successful transfer only.

Create Record Log: If activated, a log file "*sesrec.log*" will be created and every data record start/stop will be logged with date, time, profile number, area, LF-frequency (kHz), LF-pulses, range start, range length. If the multi frequency mode is active, the frequency combination will be logged as well. See also section 7.10.2 on page 112.

Record full-waveform (RAW) data files: [obsolete with SESWIN 2.2.3.8] If checked, the raw data (full waveform) of the received SBP signal will be recorded during data acquisition additionally to the "SES" data format (envelope) files.

! The "SES" data format is obsolete from SESWIN 2.2.3.8 onwards. The new default setting is either the "RAW" (16-bit full-waveform) or the "SES3" (24-bit full-waveform) format.

Record File Size: Determines the maximum size of one data file based either on file size or on time. If a data file reaches the limit, a new data file is started automatically. Please note that a new file will be started at midnight automatically regardless of the limits.

❗ Make sure the resulting file size cannot be larger than 2GB. Keep this in mind for time-based file size limit as file size depends also on range and ping rate.
For good file handling the resulting file size should not exceed 512MB.
This is also true for files to be later converted to SEGY format.

5.11.5 System Setup – Settings – General – Sidescan Options (*"xx-plus"* models)

This item is available with the INNOMAR *"light-plus"* and *"standard-plus"* models only.

In this dialog, the transmit and record parameters for sidescan operation are set.

Frequency: Specify if a single frequency or a combination of two different frequencies to be transmitted. There are 3 frequencies available: 250, 410 and 600 kHz. Any combination of these three frequencies is possible as well.

Sides: Usually both sidescan transducers are used in parallel (default). In special cases it might be beneficial to use only one transducer. This can be specified here.

Signal Length: Set the sidescan pulse width (40 or 80 µs). At longer ranges also a chirp (LFM) pulse is available (550 µs / bandwidth 35 kHz). Please note that the ping rate is reduced in chirp mode.

Range: Set the recording "Range Length" for sidescan data.

❗ The "Range Start" is set according to the SBP range start (see "Home – Range" menu).

5.11.6 System Setup – Settings – General – Special Transmit Modes
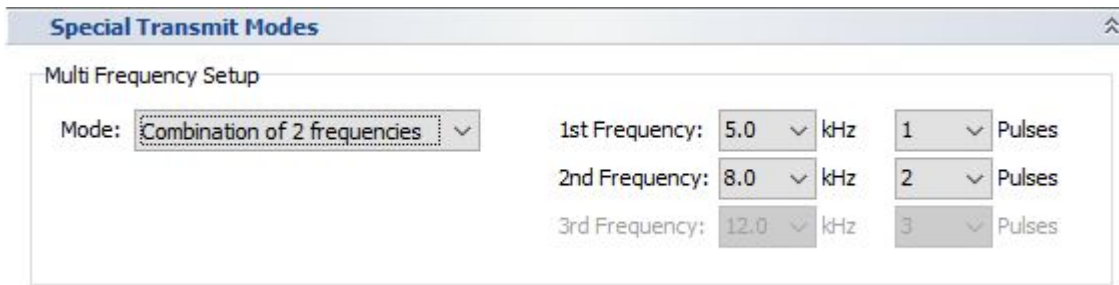
This item is not available with the INNOMAR *"smart"* model.

Multi Frequency Setup

It is possible to transmit two or three SBP frequency / pulse-width combinations sub-sequently. Centre frequency and pulse width can be chosen arbitrarily.

In Multi Frequency Mode the number of frequency/pulses combinations used reduces pulse repetition rate per frequency/pulse setting. If two settings are used, every second ping is using the first setting and the pings in between the second setting. This results in half the ping rate for each setting.

All necessary settings are made in this "Special Transmit Modes" dialog while the transmit mode itself is activated via "Home – General – System Mode" menu, see picture on the right and section 5.9.1 on page 46.
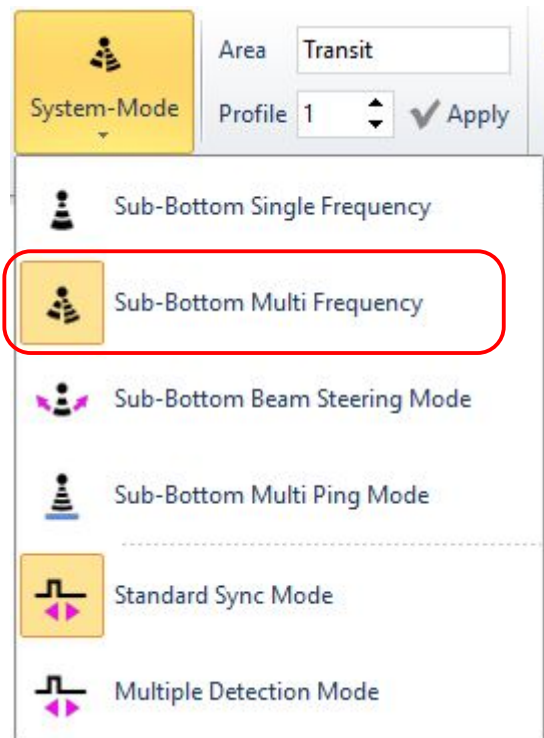
5.11.7 System Setup – Settings – General – Beam Steering Options
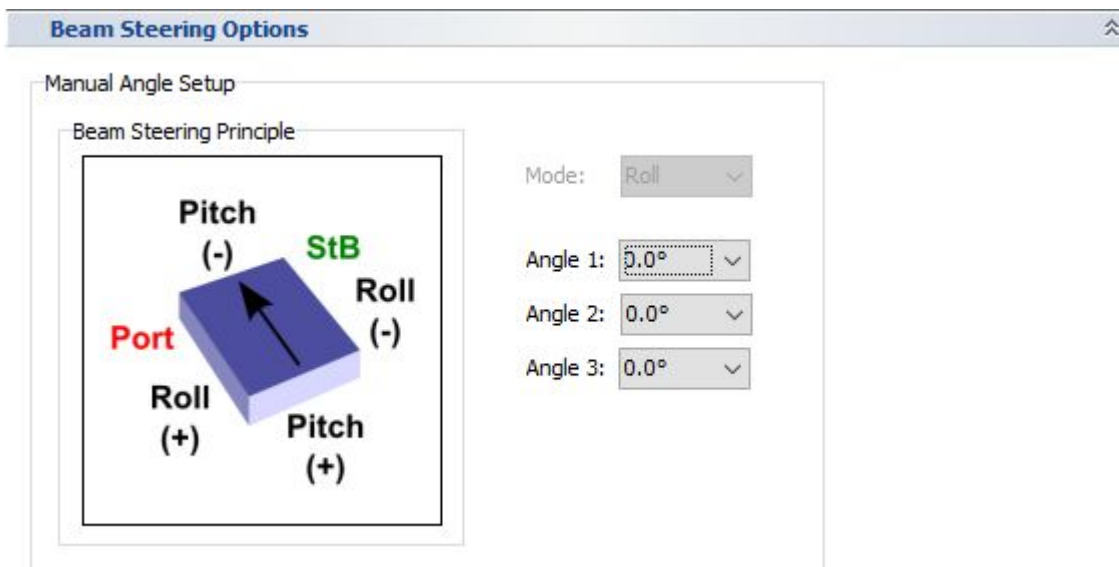
This item is not available with the INNOMAR *"smart", "compact"* and *"light"* models.

Manual Angle Setup

There can be three (3) different angles defined (range and steps depend on SBP model) for subsequent transmission. This reduces the pulse repetition rate per angle.

This feature may be used to scan the seabed, e.g. while following a submerged pipeline or cable.

All settings made in this "Beam Steering Options" dialog are activated via "Home – General – System Mode" menu, see picture on the right and section 5.9.1 on page 46.
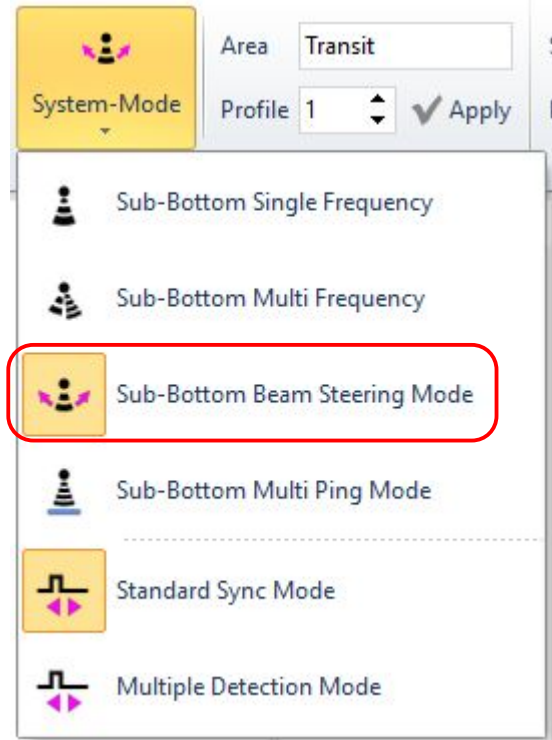
! **This is not for beam stabilisation!** That feature is defined and switched on/off in the "Motion Sensor" setup, see section 5.11.14.

5.11.8 System Setup – Settings – Navigation Input (GNSS)
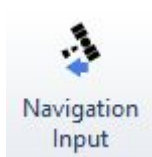
With every ping eight (8) "SIS strings" with up to 11 characters are recorded in the INNOMAR data files. Incoming GNSS data are written to those strings.

For details on NMEA data formats please see appendix A.18 on page 213.

! The navigation data input **COM port** is also used to receive a 1-PPS time sync pulse from the GNSS receiver, see section 6.5 on page 88.
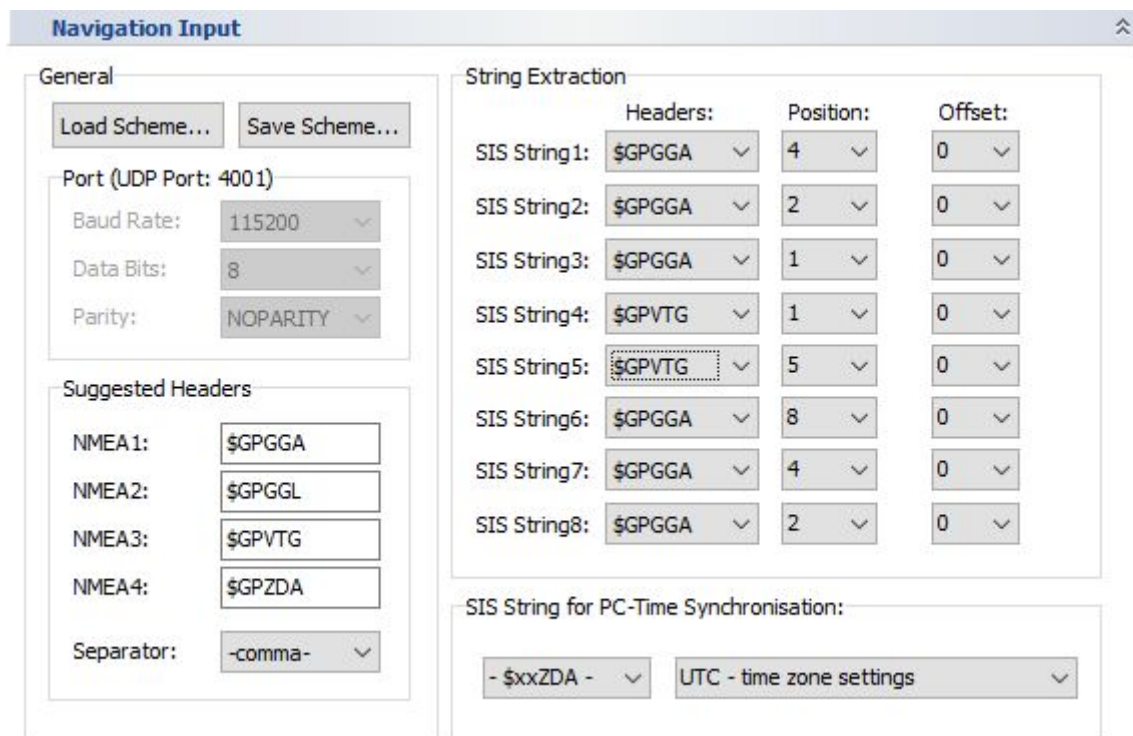
For this Dialog see also section 7.3 on page 92.

General – Save Scheme*:* All settings made in this dialog can be saved into a "*.nav" file. It saves a lot of time if a survey is done with the same GNSS equipment again. Save the data of the "Navigation Input" settings for example as "*NameOfShip.nav*" or "*NameOfGNSS.nav*"

General – Load Scheme*:* Saved schemes with the "Navigation Input" settings (*.nav files) are reloaded, see "Save Scheme" above.

General – Port Definition: These parameters have to be set according to the GNSS receiver currently used: *Baud Rate, Data Bits and Parity*. Mostly there are "8" data bits and "no parity" used, the baud rate may change. The port used is defined in the SESWIN start-up screen, see page 40.

! Use the highest possible baud rate to minimise latencies and to avoid position data artefacts.

General – Headers: Up to four different NMEA sentence headers can be recognized by the SESWIN software and have to be set in the "NMEA1" to "NMEA4" boxes. Please note, that for NMEA compatible datagrams the "$" char has to be defined as part of the header, too.

The field separator (comma or space character) can be defined separately.

String Extraction

Defines which parts of the incoming (NMEA) sentences to used and extracted:

- *Header*: From the drop box select the NMEA sentence ID to be used.
- *Position*: Number (logical position within the NMEA sentence) of the required value separated by comma (assuming the sentence ID has position 0).
- *Offset*: Usually the first character after the separating comma is taken as start position for string extraction (offset=0). Sometimes it is useful to apply an offset to start with another character position, for instance to drop leading zeros because of the length limit for the "SIS strings".

For details on NMEA data formats please see appendix A.18 on page 213.

SIS String for PC Time Synchronisation:

It is possible to synchronize the PC clock to the GNSS time obtained from one of the above-defined "SIS strings" or from the "$xxZDA" NMEA time string (even if not used on one of the 8 SIS fields above). The PC clock will be set to UTC or a synchronized local time (depending on the WINDOWS OS time zone settings).

If "-$xxZDA-" is selected, SESWIN will look for any ZDA datagram within the "Navigation IN" data and use this for time sync, independent on the "String Extraction" settings. This setting is required when using a 1-PPS pulse.

If you choose UTC the PC clock will be set to the time as received in the SIS string.

If you choose local the PC clock keeps local time synchronized to the received time string. For this the Windows time zone settings are used and the received time string is assumed to represent UTC. Not to change the local time is useful if you have to synchronize to other data with time stamps of the same time zone in post-processing, like data from tide gauges.

! This feature must not be used if the data acquisition PC's clock is already synchronized to a time server (e.g. the Windows NTP option)!

5.11.9 System Setup – Settings – Navigation Input – NAV Input Monitor
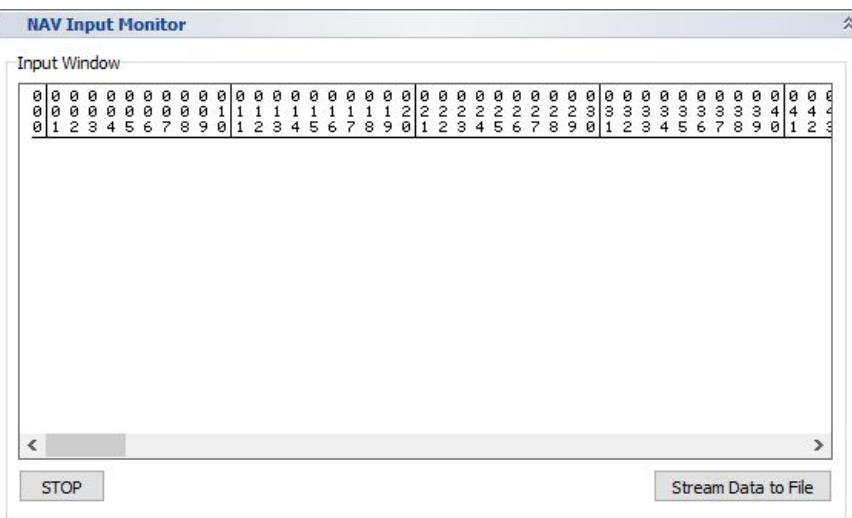
For checking the correct COM port settings and the incoming data on the "NAV Input" port, the integrated NAV Input Monitor can be used. It captures the input data of the assigned COM port.

5.11.10 System Setup – Settings – Navigation Input – Geoid Setup
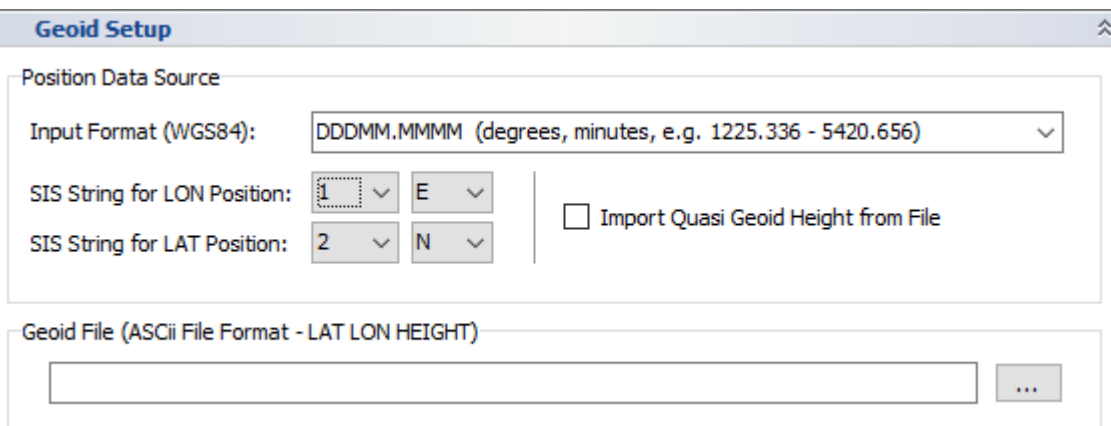
5.11.11   System Setup – Settings – Navigation Input – Coordinate Conversion

This is used to transform the GNSS receiver's WGS84 coordinates into other projections.

Position Data Source / Destination

You have to set the "SIS string" IDs for WGS84 position data: longitude (LON) and latitude (LAT) values as defined in the "Navigation Input" dialog. The correct hemisphere can be either detected automatically from the (GGA) NMEA data or has to be set manually. The destination "SIS string" IDs have to be set as well.

Enable On-line Conversion: if checked the conversion takes place and the X, Y values are written to the specified "SIS strings".

!   **IMPORTANT:** The new calculated values will replace the original values on the "Destination" IDs. Those original values are lost and cannot be restored!

Conversion Settings

Input Format: You can select an input format according to your GNSS data:

Output Format: Either UTM with automatic zone detection or another projection:

WKT Setup

There are many predefined projections available. Anyhow, you can change conversion parameters or define your own ones, using the WKT setup.

5.11.12   System Setup – Settings – Navigation Input – NAV Data Processing

Additional Z Value Options

You may calculate a new value from two other values using simple math operations (add, subtract, multiply, divide). This can be used for online calculation of Z height.

Generate Tide Values

This can be used to estimate water level changes due to tide using high-resolution information on GNSS antenna height (like RTK height).

It is also possible to monitor one SIS string for changes. This can be used to get a warning message if the GNSS data quality is reduced, e.g. if RTK is not available.

> **!** **IMPORTANT:** Recalculated values will replace the original ones. Those original values are lost and cannot be restored!

5.11.13   System Setup – Settings – Navigation Input – Transducer Offsets

You may correct offsets if your GNSS position data do not refer to the transducer's position.

> **!** **IMPORTANT:** If offset correction is applied, recalculated position data will replace the original ones. Those original values are lost and cannot be restored! It is much safer to apply offsets in post-processing.

Position and Heading Data Source

Selection of "SIS string" IDs for X, Y and Z position values as well as the heading data input. To avoid wrong position values as a result of transmission errors zero values can be excluded.

The position values are unit-free; preferably metric coordinates (UTM) should be used. There is an online conversion into UTM coordinates available, see previous section.

The heading value can be obtained either from the motion sensor connected to the topside unit or from any "SIS string" as defined in the "Navigation Input" dialog. In any case the heading value has to be in degrees as a number with decimals.

Offset Correction for Transducer

For the transducer an individual offset for the X, Y and Z value can be selected. The offset values are unit-free but should refer to the same coordinate system as the incoming "SIS data" defined in "Position and Heading Data Source" above (meters for UTM coordinates).

The offset values are pointing from GNSS antenna to transducer position, the GNSS antenna is supposed to be at the origin (0, 0); the x-axis points starboard and y-axis points forward.

!   Make sure to select the same coordinate system for the SIS and the offset values!

Coordinate Processing

The only option is to enable or disable the transducer offset correction. The correction is calculated online every time new position and heading values are received.

Take care! The system will use the heading information as specified by 'Heading Data Source'. If that data is incorrect (or does not exist), either incorrect position data will be stored or an error window will show up!

5.11.14   System Setup – Settings – Motion Input
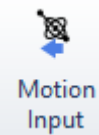
Defines the *data format* as well as the COM port *baud rate* of the motion sensor used. The port itself is defined in the SESWIN start splash screen.

Motion Input   Some heave processing including lever arm correction can be set up.

For this Dialog see also section 7.5 on page 98.

For naming conventions and directions refer to the picture below.
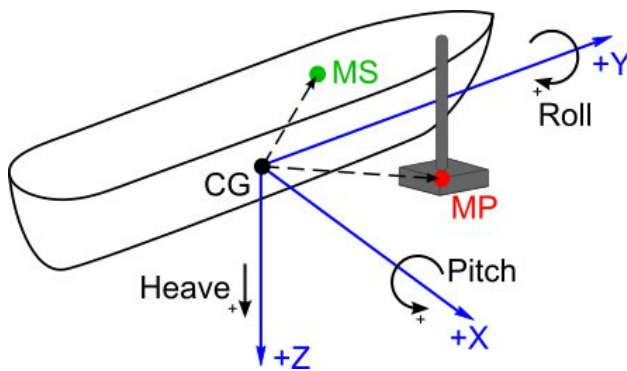
Vessel motions considered:

- Heave: positive going down
- Roll: positive port up
- Pitch: positive bow up

Locations of interest for lever arms:

- CG: vessel centre of gravity
     (centre of rotation)
- MS: motion sensor reference point
- MP: monitoring point
     (centre of transducer's face)

Input: The motion sensor data can be received either on a serial (RS232) or a UDP interface. For the RS232 port the baud rate needs to be defined whereas the UDP needs a port number. If you need to know the IP address, this can be checked or altered in the "Config Network" menu item.

Several data formats are supported. A brief description of the selected data formats is given in the "Format Description" box. you have to set the baudrate, all other port parameters are fix.

> **!** Motion data are usually not going to the data acquisition PC and are therefore not visible from Windows. The data are received by an internal micro-controller. For UDP this controller has to be in the correct IP address range (System Setup – Config Network), see section 5.11.18 on page 77.

Heave Correction

Compensation OFF: no heave compensation of the displayed data but the data from the motion sensor will be stored together with the echo data.

Compensation ON: the echo data will be displayed heave-corrected, but both the echo data and the data from the motion sensor will be stored separately.

Curve plot overlay: The heave motion will be shown on the display as a line (curve) in the echo print. In this case online heave compensation does not take place, but heave data is stored within the data files for post-processing.

Ignore Instable Flag: if checked, all motion sensor values are recorded and used, even if the motion sensor labels the data sent to being incorrect. Usually only "stable" data should be used. If checked, the motion sensor LED in the SESWIN status bar is encircled yellow to indicate this potentially dangerous setting.

Factor / Sign: sets a scale factor for the heave data; a factor of "-1" may be used to invert the sign.

Lever Arm Correction: switch on/off the lever arm correction as defined below.

Roll/Pitch Correction

Roll correction (electronic beam stabilization) is for the INNOMAR *"standard"* and *"medium-100"* models only.

Pitch correction is (optionally) available for the INNOMAR *"medium-70"* and *"deep-xx"* models only.

Roll/Pitch Offset: You may apply an additional static angle offset to correct alignment errors between motion sensor and transducer. Let's consider two cases:

(1) The transducer is mounted horizontally, but the motion sensor is mounted with positive (starboard down) roll offset. This can be corrected by a **positive** offset set in the dialogue.

(2) The motion sensor is mounted without offsets regarding the vessel, but the transducer is mounted with a positive (starboard down) roll offset. This can be corrected by a **negative** offset set in the dialogue.

See picture below for illustration.

No misalignement	Motion sensor misaligned (+5°)	Transducer misaligned (+5°)
Offset: 0°	Offset: 0° Offset: **+5°**	Offset: 0* Offset: **-5°**
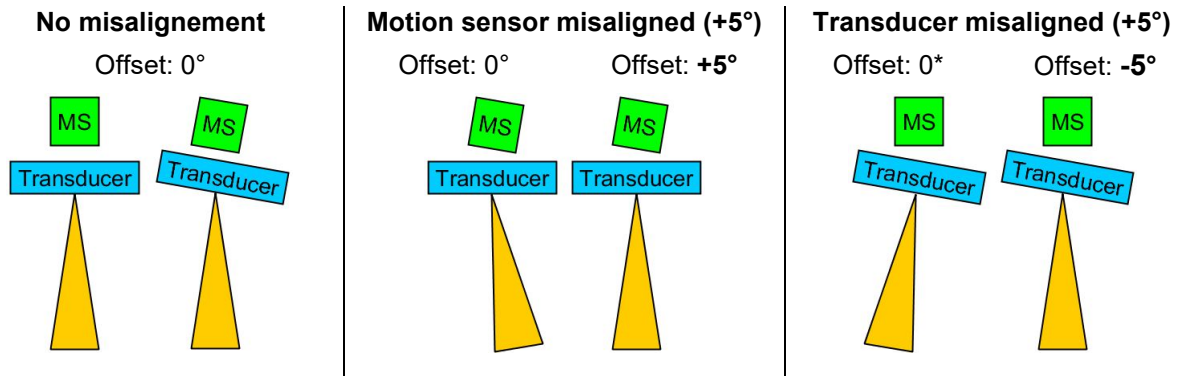
Transducer is rotatated by 90°: For the INNOMAR *standard-rov"* model the transducer is usually mounted with the arrow on top not pointing forward, but starboard to have pitch correction instead of roll correction. In this case, this check box needs to be ticked to swap roll and pitch angles from the motion sensor.

Lever Arm Settings

There are two vectors to be defined: One pointing from centre of gravity (CG) to the place there the motion sensor (MS) is located and one vector pointing from CG to the place there the heave has to be monitored (MP, usually the centre of the transducer).

Take care to use the right direction (CG in the origin of the coordinate system) and sign:

- X: across ship, positive pointing starboard
- Y: along ship, positive pointing forward to bow
- Z: vertical, positive pointing downwards

See also the picture above at the beginning of this section.

Check Motion Data

For checking the correct port settings and the incoming motion sensor data the integrated Motion Data Input Monitor can be used. It displays the actual received data.

To check the mounting orientation, you can perform the following motions with the sensor and observe the changed data in the MS window in the SESWIN screen:
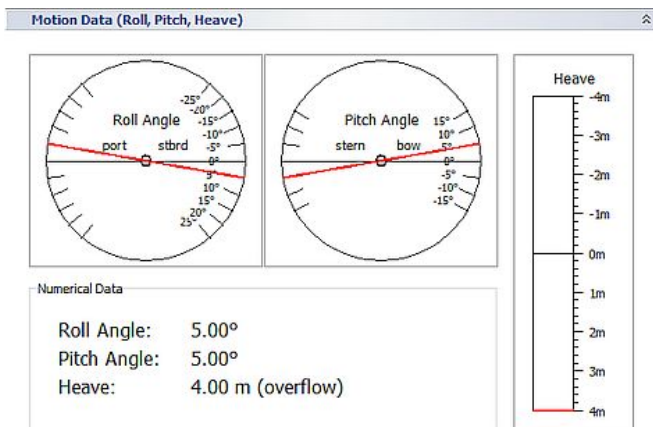
- lift the sensor
- → heave value goes negative

- tilt to starboard (right looking forward)
- → roll value goes positive and increases

- tilt backwards (bow up)
- → pitch value goes positive and increases

If the heave goes into the wrong direction, the heave sign can be changed, see above.

5.11.15   System Setup – Settings – Multi Input

There is a "Multi-Purpose Input" serial interface available that can be used to receive data from additional sensors (e.g. transducer depth, sound velocity, heading, MBES water depth values).

Multi Input

Multi Input Setup

General

Load Scheme...   Save Scheme...

Port Definition - not opened

Baud Rate: 38400

Data Bits: 8

Parity: NOPARITY

Input String is Type of

Heading Input (NMEA)

Setup

Heading Input Configuration

Data String Format: HDT String

Input Field ID: 2

Record Input Data

☐ SIS String Number to write data to   1
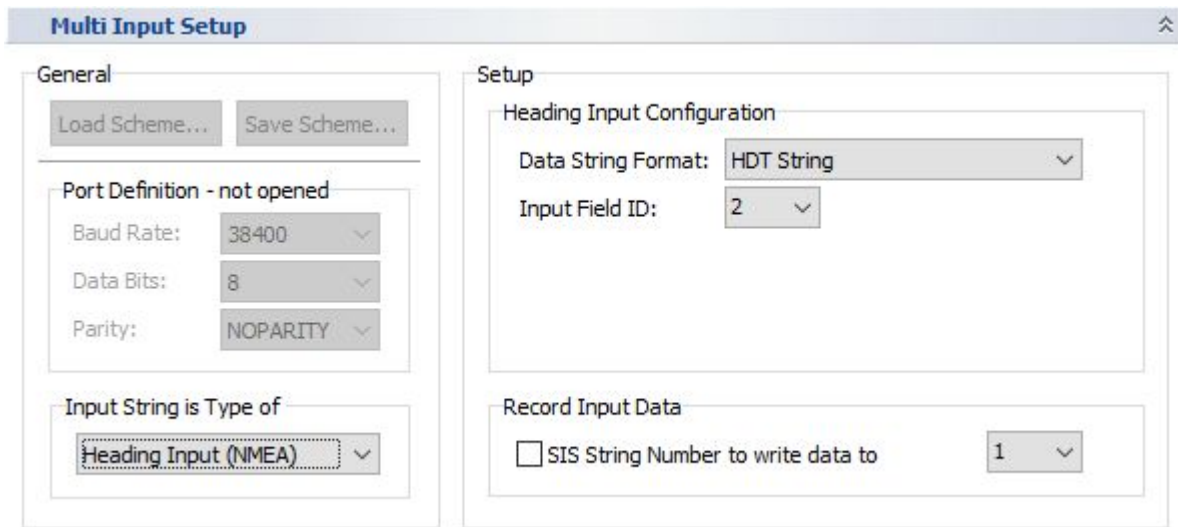
General – Save Scheme / Load Scheme: All settings made in this dialog can be saved into a file. Saved schemes can be reloaded.

General – Port definitions: Set port parameters according to the equipment you want to use: *Baud Rate, Data Bits and Parity*

Input String Type / Setup – Input Configuration

You have to choose the usage of the serial port from the drop-down list, the "Setup" section will change accordingly:

- *Digiquartz:* Get pressure values from a DIGIQUARTZ compatible pressure sensor and store the value (or a converted depth value) into a SIS string (string ID has to be chosen).

  Parameters

  Conversion factor for input: 0.7030696 m (fresh water)

  0.7030696 m (fresh water)
  0.683853 m (sea water)
  1.0 (no conversion)
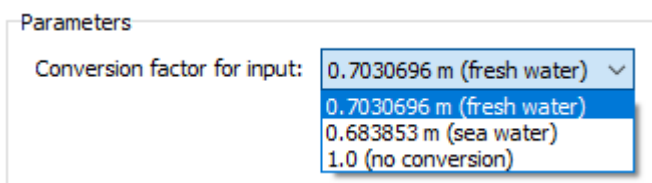
- *Heading Input (NMEA):* The multi-purpose port can be used to receive heading values and store the data into a specified SIS string ID. Heading values may be used for transducer-offset correction or side scan data processing.

  Heading Input Configuration

  Data String Format: HDT String

  Input Field ID: 2

  HDT String
  HDT String
  PTNL,AVR String
  NMEA TYPE
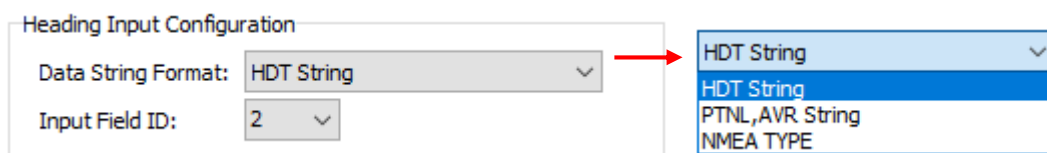
- *Depth Input (NMEA):* depth values from other devices can be stored with the INNOMAR data and/or used for the automatic range shift of the INNOMAR system. For the latter the correction factor and depth offset have to be set correctly! There are several data formats supported. "NMEA TYPE" can be any comma separated ASCII string starting with a dollar character ("$").
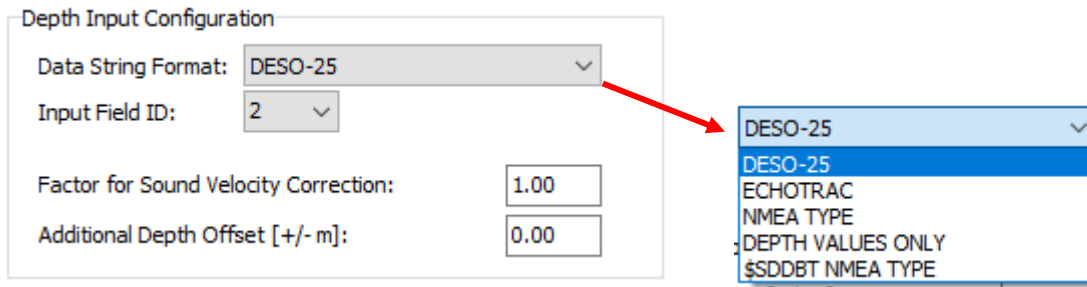
- _Remote Commands:_ Data logging can be switched on/off using a special NMEA sentence ($SESRM,c,linename,p) feed to the "multi-purpose port". The line (area) name can be changes also by the same command, but has to be set with record on/off, not independently! It's also possible to set event markers ($WPATS,xx). For details see also section 7.12.2 on page 114.
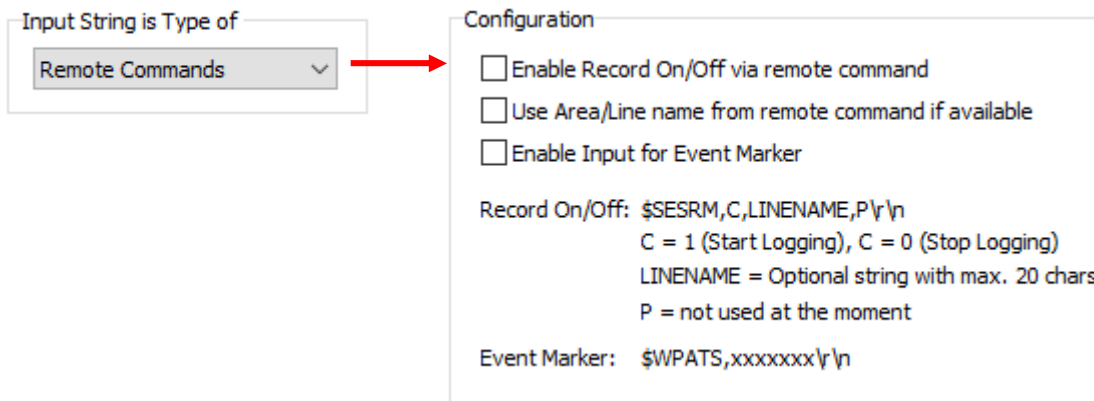
Setup – Record Input Data

If the checkbox is ticked, the data are stored into the specified SIS string. Any other value stored before in the same SIS string ID will be lost!
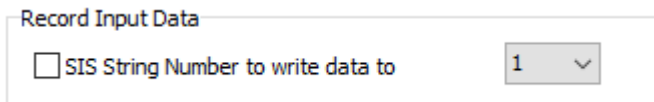
Multi Input Monitor

Similar to the navigation data monitor there is a box showing incoming data on the multi-input interface. It is also possible to log incoming data to a text file.
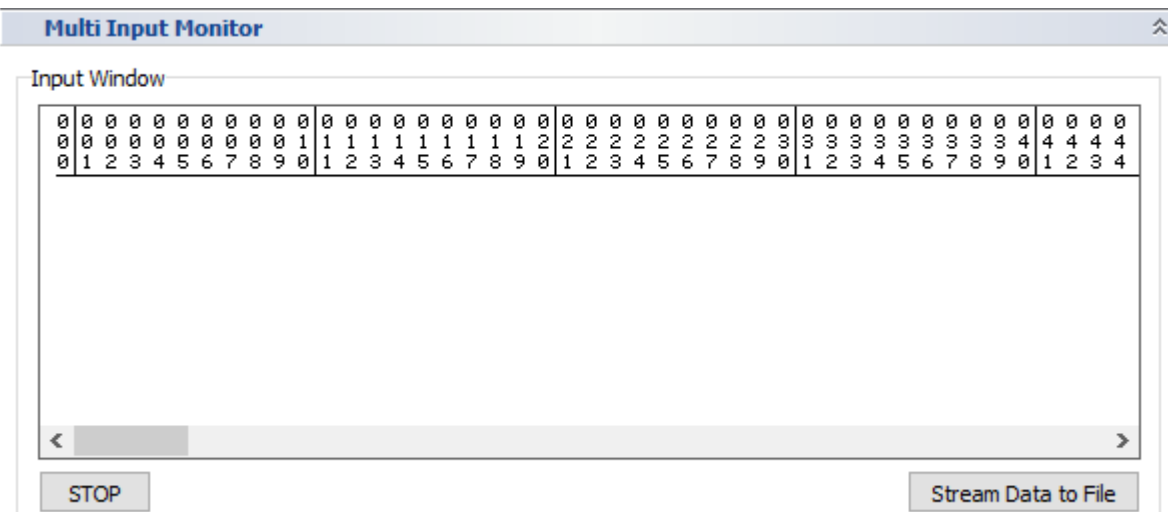
5.11.16   System Setup – Settings – Depth Output
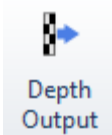
In this dialog the settings for the depth output (ASCII string) are made. You can send the online calculated water depth values (HF- and LF-channel bottom track) and position data via serial interface to other equipment.

Setup

Port Definition (Com4)
- Baud Rate: 57600
- Data Bits: 8
- Parity: NOPARITY

General
- Data Format: USER DEFINED

Depth Output
- ● every second
- ○ on new SIS data
- ○ every Subbottom ping

Separator Character
- ● comma
- ○ space

Output Values
- ☑ Header
- ☑ Time
- ☑ HF-Depth
- ☑ LF-Depth
- ☐ LF-Frequency [Hz]
- ☐ HF Pulse Length [s]
- ☐ LF-Pulses
- ☑ SIS String1
- ☑ SIS String2
- ☑ SIS String3
- ☑ SIS String4
- ☐ ASCII MRU Data
- ☐ SIS String5
- ☐ SIS String6
- ☐ SIS String7
- ☐ SIS String8

Sample String
$SES,1,2.45,2.60,SIS1,SIS2,SIS3,SIS4

Port Definitions: These parameters have to be set according to the receiving equipment you want to transmit the data to: *Baud Rate, Data Bits and Parity*

General – Data Format: The system supports several data formats; an example is given in the "Sample String" box.
- For the *USER DEFINED* ($SES) format the values can be defined separately in the "Output Values" group.
- The *NMEA DBS ($SDDBS), NMEA DBT ($SDDBT)*, *DESO-25* and *ECHOTRAC* formats simulate other echo-sounder data formats that are maybe recognized by third party survey software.
- The *INNOMAR DEPTH* ($SESDP) format contains not only depth values but also related system parameters: $SESDP, time, transducer draught (cm), sound velocity (m/s), xx, HF (kHz), HF depth (m), LF (kHz), LF depth (m).

General – Depth Output: Set the time interval for data output to the serial interface:
- *every second,*
- *on new SIS data*: on incoming navigation data only,
- *every SBP ping*: continuously at SBP ping rate.

General – Separator Character: Select the separator for the *USER DEFINED* format.

Output Values: Set the contents of the output string of the *USER DEFINED* format by activating the check boxes. The sentence header is "$SES".

Sample String shows a sample of the defined output format.

5.11.17 System Setup – Settings – Marker

FIX
▼
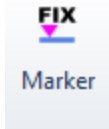
Marker

It is possible to set manual markers as well as have marker lines drawn automatically into the echo plot based on either track made good, time or KP.

Manual marker positions will be stored within the data file while automatic markers are for online orientation only and will not be stored (but can be generated in post-processing again).

Settings ⌃

Manual Marker

☑ Draw Marker by Mouse-Click (right button) or press [F12]   [Reset Marker Counter]

Position Data Source - Track based Marker

SIS String Positions for X/Y Position: 1 ⬍   2 ⬍

SIS String Input for FIX or KP Marker: 4 ⬍   FIX ⌄

☐ Draw Time based Marker [seconds]:   60 ⬍
☐ Draw Track based Marker [way units]:   100.000
☐ Draw FIX[Number] or KP Marker[m]:   100
☐ Draw Marker on Cross Line Positions

Start X	Start Y	End X	End Y	Name	
					Load
					Clear

Manual Marker: These can be set by using the right mouse button in the echo print (can be disabled here) or by pressing the **[F12]** key. There is a marker counter that can be reset to "1" by the "Reset Marker Counter" button.

Position Data Source: Select which SIS position contains the X and which one contains the Y position that shall be used for track (way unit distance) markers.

Draw Time Based Marker (seconds): If checked markers are drawn on the screen of the INNOMAR system and printed on the echo plots based on the time. The time between two marks has to be defined in a range of 1 to 600s.

Draw Track Based Marker (way units): If checked markers are drawn on the screen of the INNOMAR system and printed on the echo plots based on the track made good. The distance between two track marks has to be defined. Distance is calculated using SIS strings defined for X and Y coordinates regardless the units. Only by using a rectangular system (UTM for instance) these values will correspond to metres.

Draw Fix or KP Marker: If checked markers are drawn based on changes of a SIS string value specified above ("SIS ID for Fix or KP Marker"). Increments are given and used including decimals. The marker line will be labelled with this SIS string.

Draw Marker on Cross Lines: If set, vertical markers will be plotted on the crossings with the specified lines. Load a list with position information of specified lines that may cross the actual survey profiles. At any position, where these lines are crossed, a marker will be drawn into the echo plot together with the Cross-Line Name from the table.

5.11.18   System Setup – Settings – Config Network
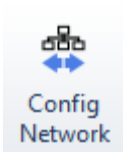
The computer running SESWIN is connected to the INNOMAR *"smart"*, *"compact"* and *"xx-usv"* topside units via Ethernet. For these models the "Config Network" section is used to change the IP address of the topside unit if necessary.

For the other models this section is used to change the IP address of the internal micro-controller for UDP motion data, if required (see section 5.11.14 on page 70).

The actual IP address used by the topside unit is displayed for reference.

You can check if the new address is already in use by the "Ping" button. (On Windows 7/8/10 this "ping" needs to run the SESWIN application with administrator privileges!)

In case the system gets an answer on the network ping, a message is shown that the chosen address is already used (see below).
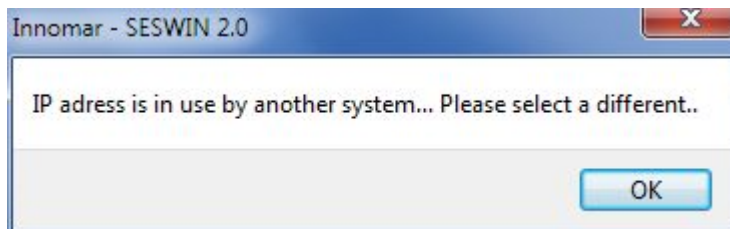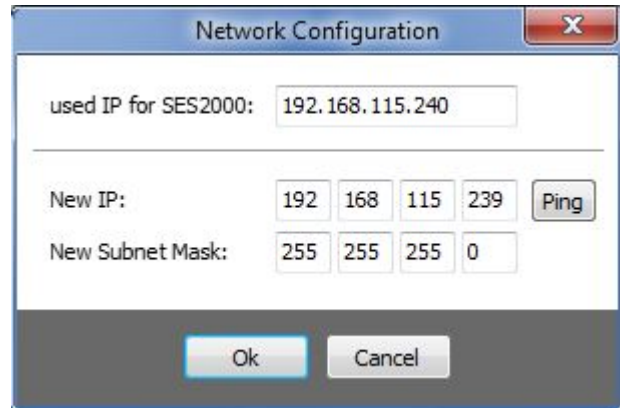
Before the address is changed on the topside unit, there is a warning message displayed. **Please note the new address on the topside unit, you need to know it for future connections to the kit.**
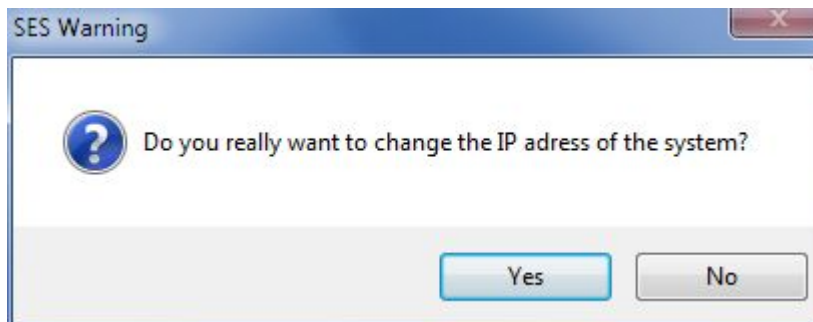
5.11.19   System Setup – Settings – Save Settings

It is possible to save settings either specific for a survey type or preferred by a user. These settings are available during SESWIN start-up, see section 5.2 on page 38.
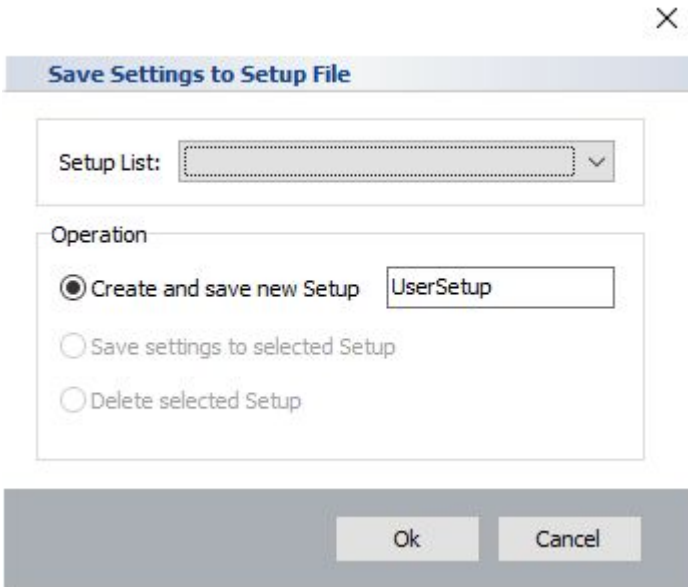
5.11.20   System Setup – Settings – Screenshot of all Settings
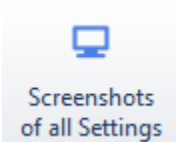
This can be used to get screenshots of all system settings placed in the SESWIN folder. Pictures are named with the dialog's name and date/time.

This should be done if all parameters for a survey are set in order to complete the documentation for further reference. Take care to re-do this if any settings have changed.

5.12 SESWIN System Setup – Appearance
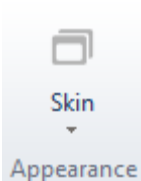
This is to change the colour scheme of the SESWIN application to fit your needs or preferences.

5.13 SESWIN System Setup – System
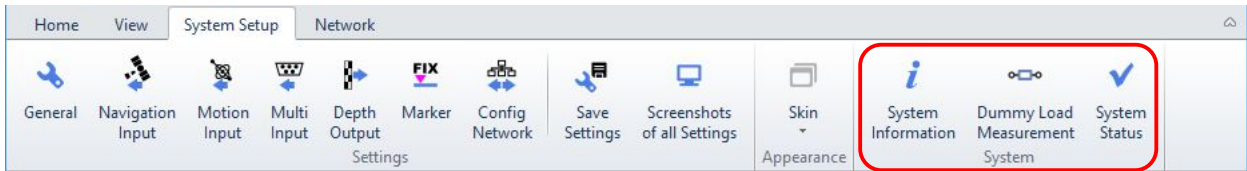
5.13.1 System Setup – System – System Information
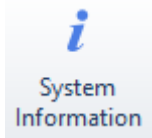
Shows the INNOMAR SBP serial number and SESWIN version that might be useful in case support is needed
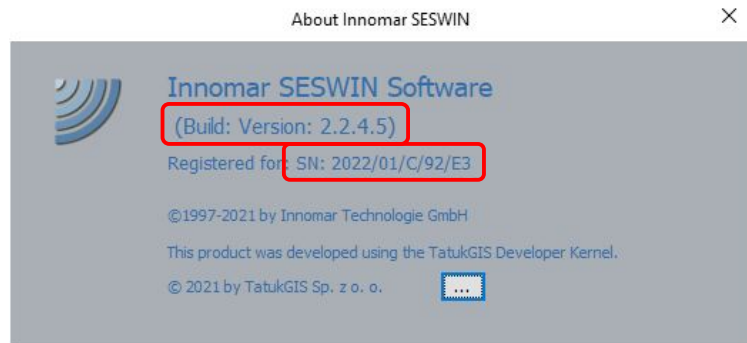
5.13.2 System Setup – System – Dummy Load Measurement

There is an optional dummy load available from INNOMAR to check the transmitters within the topside unit. To simplify the test procedure, system parameters can be set by this button to the required valus.

Settings for Dummy Load Measurement - ACTIVE

Transducer Depth:	0 m
Sound Velocity:	1500 m/s
Range Start:	0 m
Range Length	15 m
LF Frequency:	8 kHz
LF Pulse:	2
Multiple Detection:	OFF
Measuring Instrument:	Multimeter (Peaktech 2005)
Transmitter Status:	OFF
Expected Voltage (Standard-100):	1.2 Vdc (1.1-1.3Vdc)
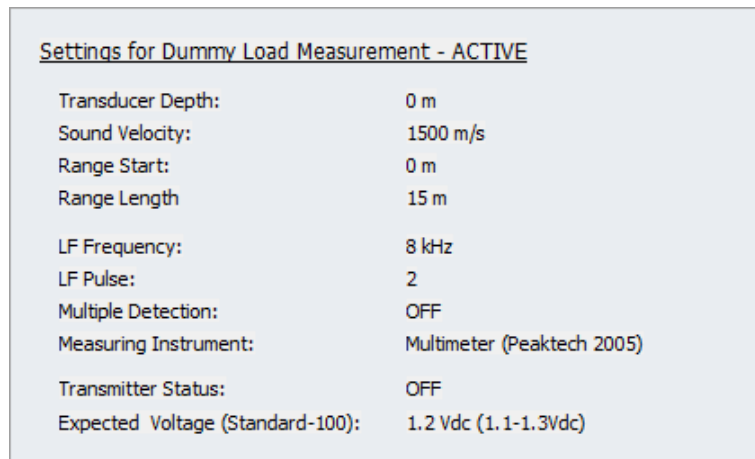
5.13.3 System Setup – System – System Status
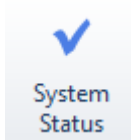
Show serial number and hardware sensor information like voltages, temperature, transmitter status, etc.

The transmitter status section may be different for different SBP models.

The button in the lower right corner can be used to get a screenshot of this dialog.
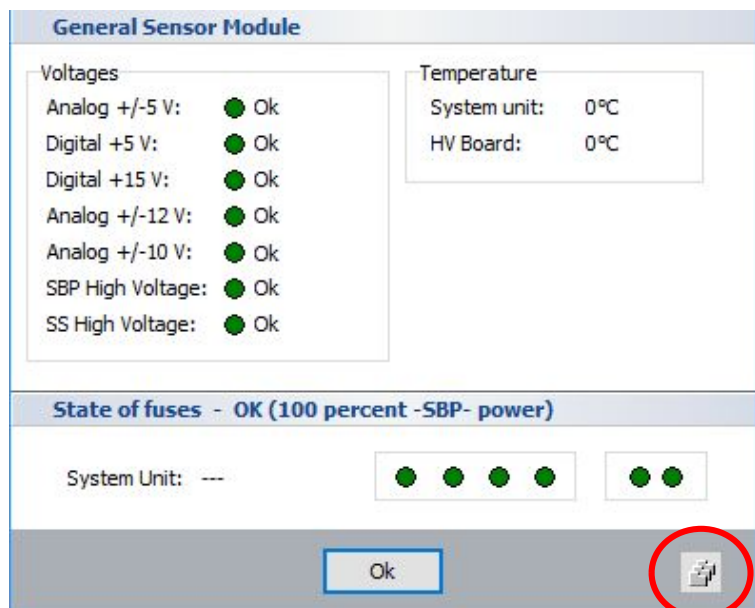
5.14 SESWIN Network
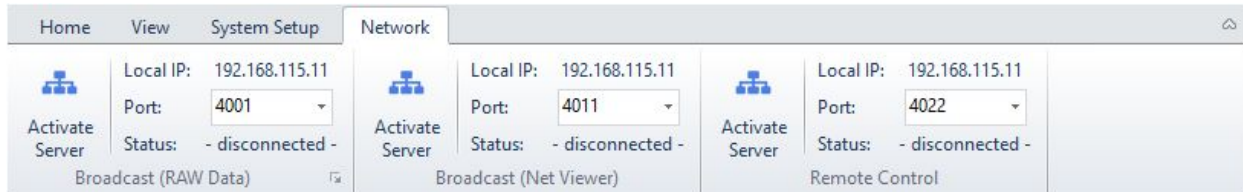
The SESWIN network tools allow to transfer SBP data in real time to other data acquisition software or to slave displays for quality check.

5.14.1 Network – Broadcast (RAW Data)
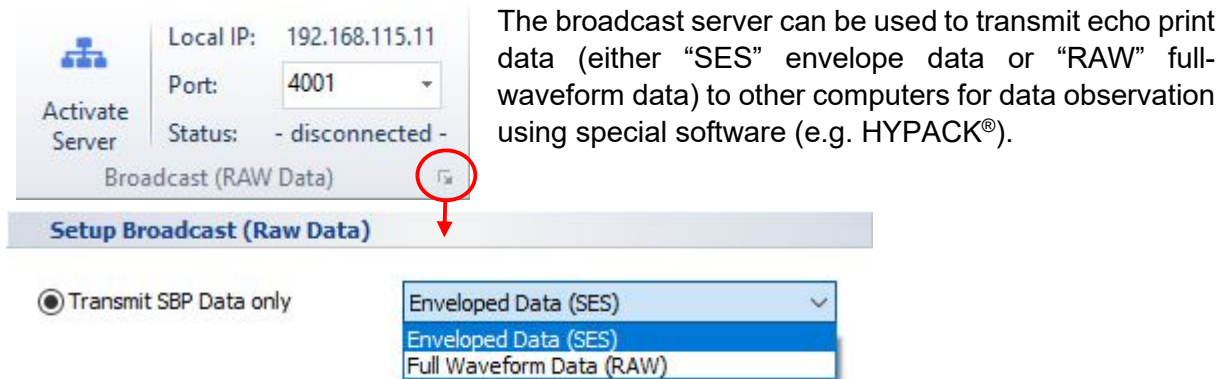
The broadcast server can be used to transmit echo print data (either "SES" envelope data or "RAW" full-waveform data) to other computers for data observation using special software (e.g. HYPACK®).

Local IP is given for information, has to be set in the client software used for data display.

Port has to be set according to network requirements.

Status gives the network status (connected / disconnected).

! Please note that the envelope "SES" data format is obsolete. Use the full-waveform "RAW" format instead. This connection cannot be used for remote controlling the INNOMAR SBP system!

5.14.2 Network – Broadcast (Net Viewer)

If additional echo print screens are required for QC, data of the SESWIN master channel is sent on a second port by the broadcast server that may be received by INNOMAR's "NetView" application. See also section 9 on page 131.

Local IP is given for information, has to be set in the client software used for data display.

Port has to be set according to network requirements.

Status gives the network status (connected / disconnected).

5.14.3 Network – Remote Control (Optional)
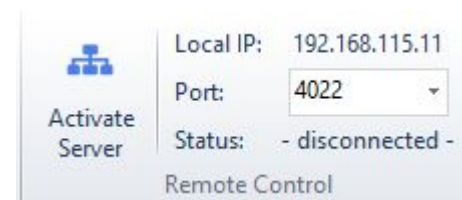
There is an optional feature to control the SESWIN software remotely via Ethernet.

Local IP is given for information, has to be set in the client software.

Port has to be set according to network requirements.

Status gives the network status (connected / disconnected).

6 SBP Synchronisation (Trigger modes) / 1-PPS

There are two BNC connectors ("**Sync IN**" and "**Sync OUT**") at the INNOMAR SBP front panel that can be used for the synchronisation of the SBP with other acoustical equipment to minimize inferences.
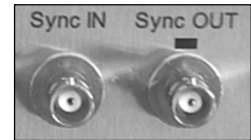
This must not be mixed up with time-syncing the INNOMAR system clock or data acquisition time-stamp to an external time source. For this you may feed a 1-PPS pulse into the topside unit, see section 6.5 on page 88.

The different modes for the INNOMAR system synchronisation

- Internal (INNOMAR SBP stand-alone or "master" device)
- External (INNOMAR SBP "slave" device, triggered by other equipment)
- Alternating (INNOMAR SBP master device, pinging alternating with external device)

have to be set in the dialog "System Setups – General – Synchronisation", see section 5.11.3 on page 60. These settings are described in the following subsections.

The actual trigger mode is indicated in the SESWIN status bar: INT / EXT / ALT
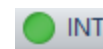
6.1 Internal Synchronisation
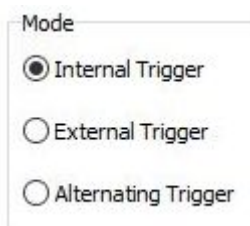
For this the "Synchronisation Mode" in "System Setups – General – Synchronisation" has to be set to "Internal Trigger". INNOMAR SBP runs free and may be used as master device to trigger other devices. The optimal ping rate, depending on the range settings, is calculated by the INNOMAR SBP.

"Sync Out" outputs a RS232 signal that can be used to trigger any other devices. **Voltage levels are up to -±10 V** (typ. ±6 V). Make sure these voltages can be applied to the device to be synchronized.

The "Sync OUT" pulse is active (high) for about 1ms and the **system pings at the falling edge** (high to low transition) of the "Sync OUT" signal, see figures below.

Any signal at "Sync IN" is ignored in this mode. But voltage levels applied to this input must not exceed ±15 V as higher voltage levels may destroy the electronics.
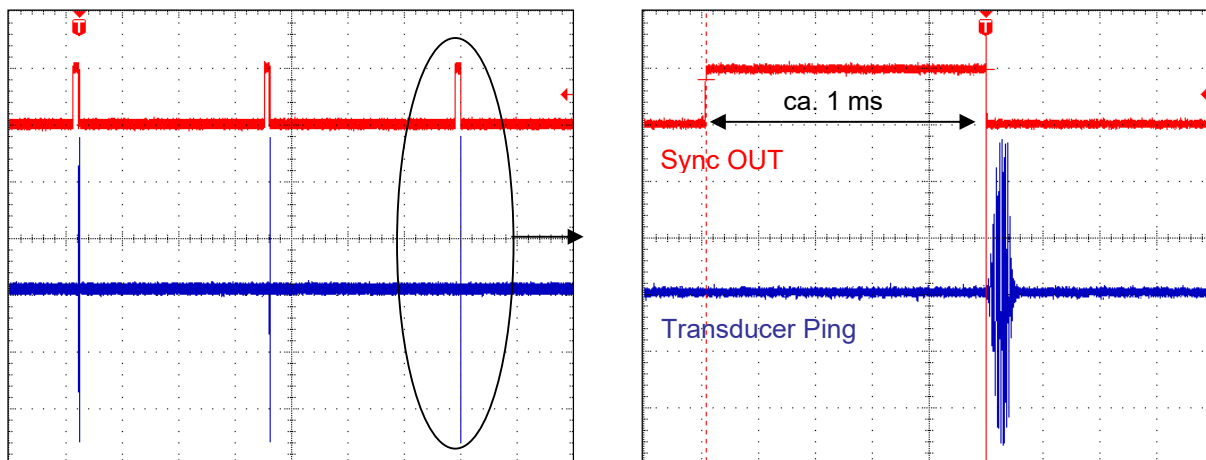
The ping rate can be estimated as follows. Between subsequent pings there is a dead time of approx. 10 ms. Supposing a sound velocity of 1,500m/s, the resulting ping rate PR in "normal" ping mode (internal trigger) is: $PR \approx 750/(RangeStart + RangeLength + 7.5)$

The trigger pulse at the "Sync OUT" connector can be set to be longer than 1 millisecond, but the INNOMAR SBP will still ping after 1 ms from the rising edge. This feature can be used to get a

delayed ping for the triggered system (triggering on the falling edge). If, for example the external device shall be triggered 10 ms after the INNOMAR SBP, set the trigger high time to 11 ms:

6.2 External Synchronisation

For this "Synchronisation Mode" in "System Setups – General – Synchronisation" has to be set to "External Trigger". The INNOMAR SBP is in slave mode and waits for trigger pulses at "Sync IN".

! **IMPORTANT**: The system will not work if no trigger pulse is detected at the "Sync IN" connector! There is no automatic switch-back to Internal Trigger, but an error message is shown after time-out.

The pulses fed to the "Sync IN" connector can be either **TTL/CMOS or RS232** compatible. The voltage levels applied to this input **must not exceed ±15 V** as higher voltage levels may destroy the electronics.

The INNOMAR SBP is **triggered by the rising edge** (low to high transition) of the trigger pulse at "Sync IN".

There is a **delay of about 1 ms** between the rising edge of the Sync IN signal and the actual INNOMAR SBP ping, see pictures in next section.

! There are some older INNOMAR SBP systems using different settings for the external synchronisation, like different voltage levels or using the falling edge!

6.2.1 Simple External Synchronisation

With this mode each external trigger pulse initiates one ping released by the INNOMAR SBP. To set the SBP for simple external synchronisation the delay must be set to the lowest possible value ("100 µs" and "0 %") and the number of pings to "1" in the "External Trigger Settings" as shown in the figure below.

When the external trigger signal gives a rising edge at the "Sync IN" input, this initiates a pulse at "Sync OUT". The ping will be released after a delay of 1 ms at the falling edge of this "Sync OUT" pulse, as described above for "internal synchronisation".
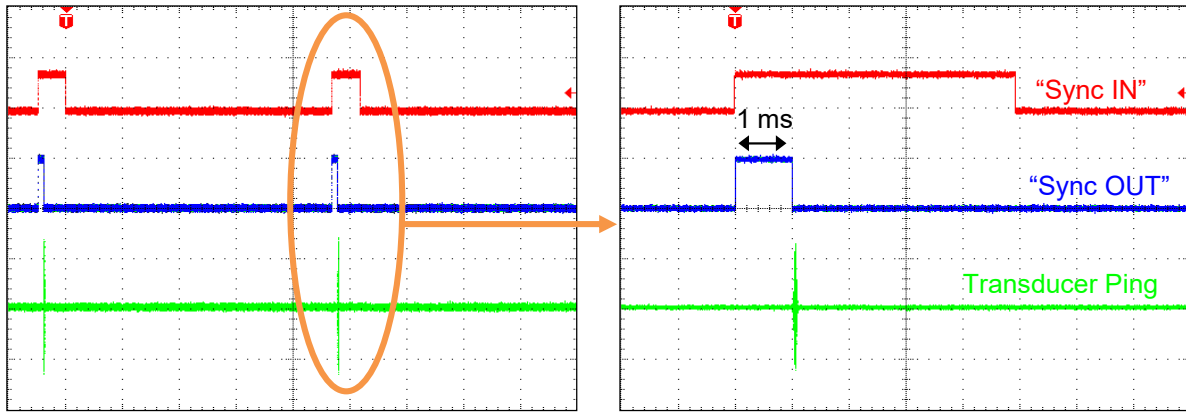
However, the external pulse can only become active if the previous cycle of transmitting and sampling is finished. Otherwise, this external trigger pulse is neglected and only the next one can cause the INNOMAR SBP to transmit its sound ping. The transmit cycle period is determined by the selected range. Depending on the selected range and external trigger period, it may happen that the INNOMAR SBP cannot ping with every trigger pulse. In this case the trigger information "EXT" in the SESWIN status bar starts to flash yellow.

6.2.2 External Synchronisation with Delay

It is possible to apply an additional time delay between the incoming trigger event and the sound ping transmission. This feature is useful if the triggering device (for instance a boomer) causes noise in the INNOMAR SBP data at the moments it transmits the shot.

The delay can be specified as

- absolute time in microseconds,
- percentage of range,
- percentage of external trigger period.
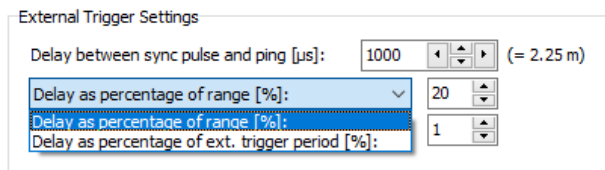
Please keep in mind that there is a fixed delay of about 1 ms before the sound ping is generated in external synchronisation mode in any case, see above. With external trigger there is another delay of 100 µs, which can be extended.

The figures below show the settings and trigger signals for a fixed delay set to 10 ms.
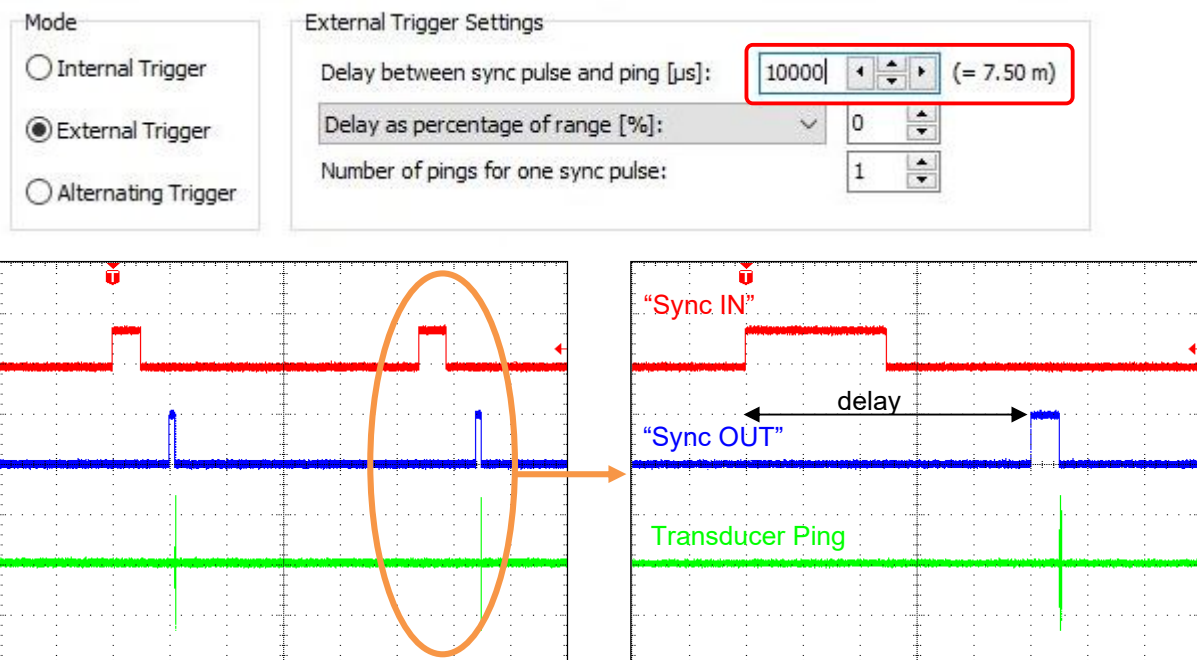
Beside this fixed delay, it is also possible to apply a delay that depends on the range currently used by the INNOMAR system, or on the external trigger period.

This feature is useful if the INNOMAR sub-bottom profiler is used together with a multibeam echo sounder (MBES) and triggered by the MBES. In that case the ping delay should be set to half the water depth to get the lowest impact of the INNOMAR system to the MBES data. This can be automated by setting the "Delay as percentage of range" to 50% and using the MBES water depth for automatic range shift within the SESWIN software. The resulting delay is given in meters.

It is also possible to combine fixed delay and delay based on used range:

6.2.3 External Synchronisation with Increased Ping Rate (Bursts)

If you have to use a master device with a very low ping rate, like a multi-beam echo sounder in deeper waters or a boomer, you may increase the ping rate of the INNOMAR SBP system to get optimal results.

With the "ping rate increase" feature of the INNOMAR system there is a burst of sound pings initiated, every time an external trigger event occurs. The user sets the number of pings within one burst; the time delay of the pings within one burst is set automatically depending on the range settings.

The following pictures illustrate what happens with different settings.

2 pings

3 pings

Due to the transmitted bursts of sound pings it may happen that the SESWIN echo screen scrolls not continuously, especially when using a small number of pings at large trigger intervals.

The INNOMAR SBP will transmit a full burst as defined in the synchronisation window at all conditions. If the number of pings per burst does not fit into the trigger interval, the next trigger event will be discarded. This may cause a sudden drop in the effective ping rate, even if the external ping rate changes slightly only!

If external trigger events are discarded due to high delay values or too many pings required per burst, the trigger information "EXT" in the SESWIN status bar starts to flash yellow.

The next figure illustrates what happens, if there are too many pings set to fit in one external trigger cycle.
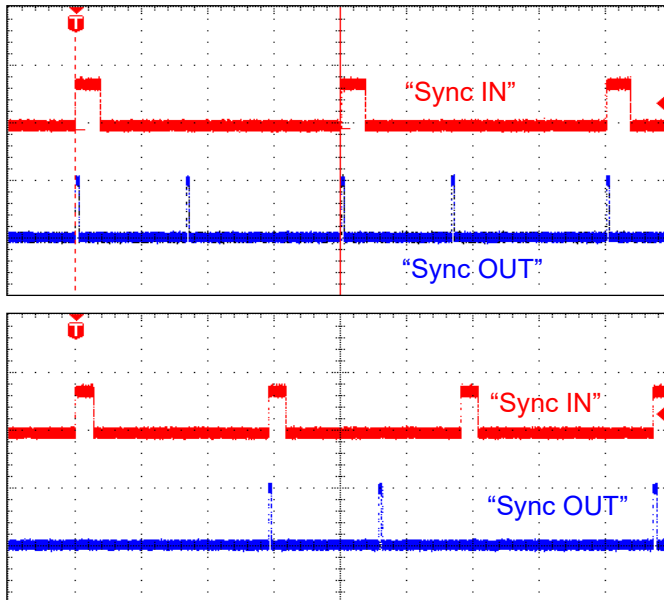
The two pings fit into the external trigger cycle.

Now the time between two external trigger events is too short, to transmit two pings in between. Therefore, every second external trigger event is discarded. How to calculate the maximum number of pings is described in the next subsection.

6.2.4 External Trigger with Delay and Ping Rate Increase
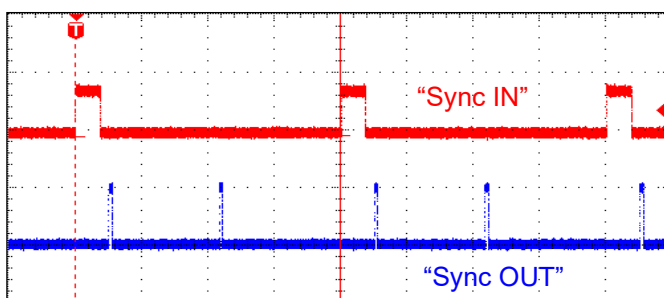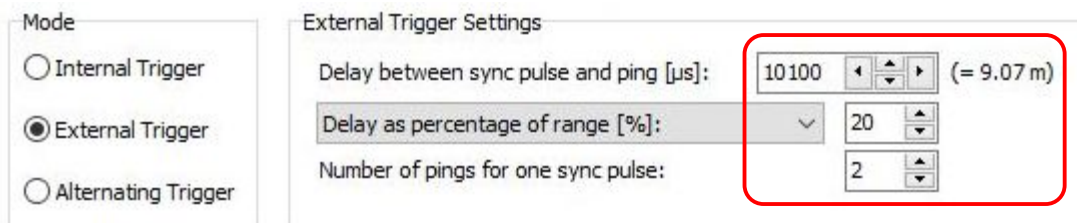
It is possible to combine both features as shown in the figure.

In this case the delay is applied before the burst starts. To avoid discarded trigger events, the delay and the number of pings specified have to fit between two (external) trigger events, see above.

If external trigger events are discarded due to high delay values or too many pings required per burst, the trigger information "EXT" in the SESWIN status bar starts to flash yellow.

The maximum number of pings N within one burst (avoiding lost trigger events) is:

$$N = \left\lfloor \frac{(ext.\,trigger\,period - delay - 1ms)}{SES\,trigger\,period} \right\rfloor$$

All values (trigger period, delay) are time values. Note the fixed delay of 1 ms. Only the integer part of the calculated result is used (decimals cut off, not rounded).

6.2.5 External Trigger – What to keep in mind

- The external trigger signal should be TTL or RS232 compatible pulses (**max. ±15 V**).

- If no appropriate trigger signal is fed to the system, no sound ping is generated and no data is collected. The SESWIN echo screen will not scroll.

- The INNOMAR SBP is triggered with the rising edge (low to high transition) of the trigger pulse.

- There is a time delay between trigger event and transmitted sound ping of ca. 1 ms.

- When using "ping rate increase", bursts of sound pings are transmitted. The time between two pings in the burst equals the ping rate that would be used at internal synchronisation.

- The total time required for all the pings per burst ("Number of pings" * ping period) + "Delay" has to be smaller than the external trigger period. Otherwise every second trigger event will be discarded.

! Older INNOMAR SBPs may have different behaviour regarding external synchronisation!

Please note that "Deep Sea Pulse Mode" and "Deep Sea Burst Mode" will not work if the INNOMAR SBP runs as slave (External Trigger). These transmission modes are for internal triggering only.

6.3   Alternating Trigger

There is a third basic trigger mode available, called "Alternating Trigger". In this mode the INNOMAR SBP is running as master device triggering other acoustic systems, similar to "Internal Trigger" mode. But with "Alternating Trigger" the trigger pulse at the "Sync OUT" connector is not generated when the INNOMAR SBP pings and there are some parameters to tune the trigger regime as described below.

"Alternating Trigger" is mainly intended for use at shallow water where high ping rates are achieved by the Innomar SBP and a system with much lower ping rate (like a sparker) shall be triggered.

For this mode the user has to set three parameters:

- time frame of external device (either as absolute value or as percentage of range),
- number of INNOMAR SBP pings ("internal pings"),
- number of external pings.

The external device that has to be triggered by the INNOMAR system should run in a fixed regime (fixed range). The resulting ping rate has to be determined and the time for one cycle has to be set as "time frame of external device" within the "Alternating trigger" settings.

These settings and their effect on the trigger regime are illustrated in the figures below. These examples assume the same ping rate of 25 PPS (40 µs ping interval) for both, the INNOMAR SBP and the external device.

Alternating Trigger Settings

Time frame of external device [µs]	40000 ◄ ▲▼ ► (= 30.00 m)
Time Frame as percentage of range [%]:	0 ▲▼
Internal pings prior to external device:	1 ▲▼
Number of external pings:	1 ▲▼

Both systems pinging alternating. The INNOMAR SBP pings once and generates an external trigger pulse after finishing data acquisition. Then waits for the specified time after the external trigger pulse before starting the new transmission.
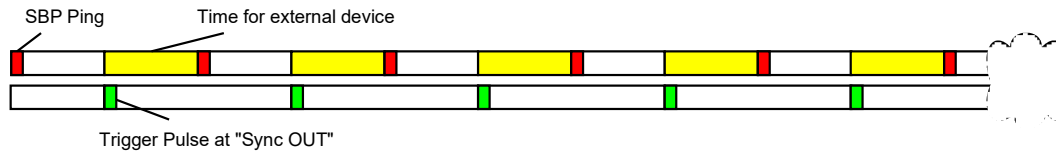
SBP Ping   Time for external device

Trigger Pulse at "Sync OUT"

Alternating Trigger Settings

Time frame of external device [µs]	40000 ◄ ▲▼ ► (= 30.00 m)
Time Frame as percentage of range [%]:	0 ▲▼
Internal pings prior to external device:	2 ▲▼
Number of external pings:	1 ▲▼

The INNOMAR SBP transmits twice per transmit cycle. Otherwise, the same as above.
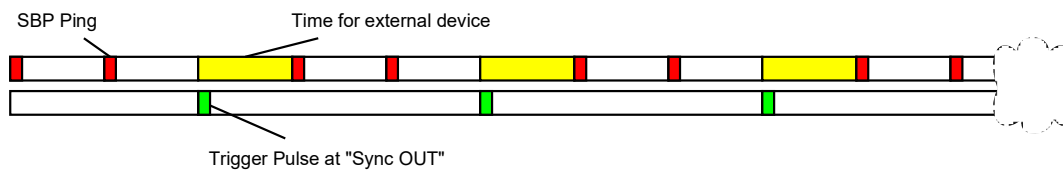
SBP Ping   Time for external device

Trigger Pulse at "Sync OUT"

Alternating Trigger Settings

Time frame of external device [µs]	40000 ◄ ▲▼ ► (= 30.00 m)
Time Frame as percentage of range [%]:	0 ▲▼
Internal pings prior to external device:	1 ▲▼
Number of external pings:	2 ▲▼

The INNOMAR SBP transmits once and generates two external trigger pulses (with specified delay) before starting pinging itself.

SBP Ping   Time for external device

Trigger Pulse at "Sync OUT"
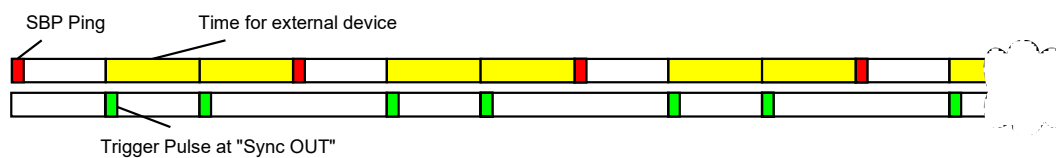
"Alternating Trigger" can also be used for asuring a fixed ping rate and synchronisation with other acoustic systems. An example is given in section 7.7 on page 105.

6.4   Sub-Bottom Multi-Ping Mode (not for *"smart"*)
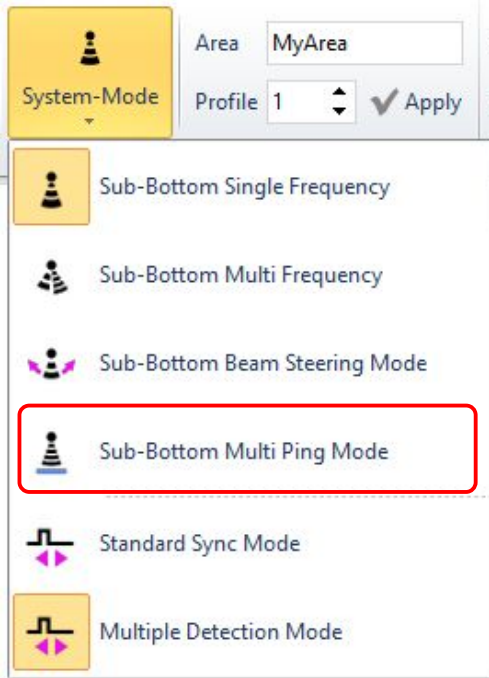
For most models there is a special "Multi-Ping Mode" available to ensure the highest possible ping rate even in deep waters. This will produce equidistant pings.

This mode is activated in the SESWIN "Home Menu – General – System Mode", see picture.

The "Multi-Ping Mode" is possible with internal trigger only.

In "Multi-Ping Mode" additional pings are placed between the "normal" pings, if possible. For this the "Range Start" has to be at least 40 m and larger than 3 times "Range Length".

If the "Multi-Ping Mode" is used, there may be artefacts visible in the data that are produced by water-column features (e.g., fish schools) or additional multiple echoes. To check if features visible are real, you should switch off deep-sea pulse mode temporarily.

It is also important to ensure the water depth is correct and the data collected are nut just from a multiple reflection.

6.5   1-PPS Input

The "1-PPS" pulse is expected at pin 1 of the "Nav IN" connector (serial DB9). On some systems is an additional dedicated BNC socket.

The "1-PPS" pulse needs to be TTL (5V positive) level, pulse width ideally 1ms duration.
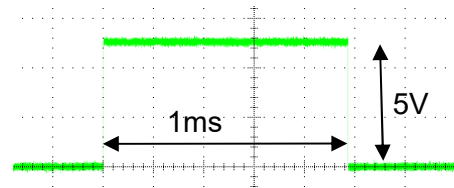
If such pulse is detected by SESWIN the "PPS" indicator in SESWIN's status bar turns yellow, independent on position data available at "Nav IN".

If a "$xxZDA" message is received within the "NavIn" data and the PC time sync set to "$xxZDA", the "PPS" indicator turns green and the delay between the "1-PPS" pulse and the next "ZDA" message is shown:

This "1PPS" delay value can be used for quality assurance. Anyhow, there is no correction for the position data applied based on the "1-PPS" pulse within SESWIN. The delay is not stored within the INNOMAR SES and RAW data formats, but with the SES3 data format.

!   There is no connection (neither physical nor logical) between the "Sync IN" trigger input and the "1-PPS" signal.

!   On older systems the "1PPS" was connected to pin 9 of the "Nav IN" socket.

!   The "1PPS" input works only if the position data is fed to the Innomar via the serial RS232 "Nav IN" socket, it is not working if the position data is sent via Ethernet/UDP.

7   How To ...

7.1   How to avoid the engine's noise / proper transducer mounting

General hints about transducer mounting are given in section 3.2 on page 26. The ship's engines often cause mechanical vibrations of the entire hull of the ship. These vibrations can go to the transducer via its support and the hull can emit sound that causes noise in the SBP receiver, too. The frequency range of the vibrations depends on several facts, like the vibration source and the resonance frequencies of the mechanical parts, for example the mounting pipe. Although the received signal is bandpass-filtered in the INNOMAR SBP, there may be still undesired frequency components within the used frequency range caused by the vibrating engine.

The engine's influence to the noise level for an unfavourable transducer mounting (close to the engine) is illustrated in the figures below. There is a dramatic change in the noise level when changing the revolution speed of the engine. From these figures, also a frequency dependence of the noise level can be seen. Since the engine's noise is mainly below 6 kHz and the receiver signals are band-limited according to the bandwidth of the transmitted pulse, the signal-to-noise ratio (SNR) gets better when the frequency and/or the pulse length is increased.
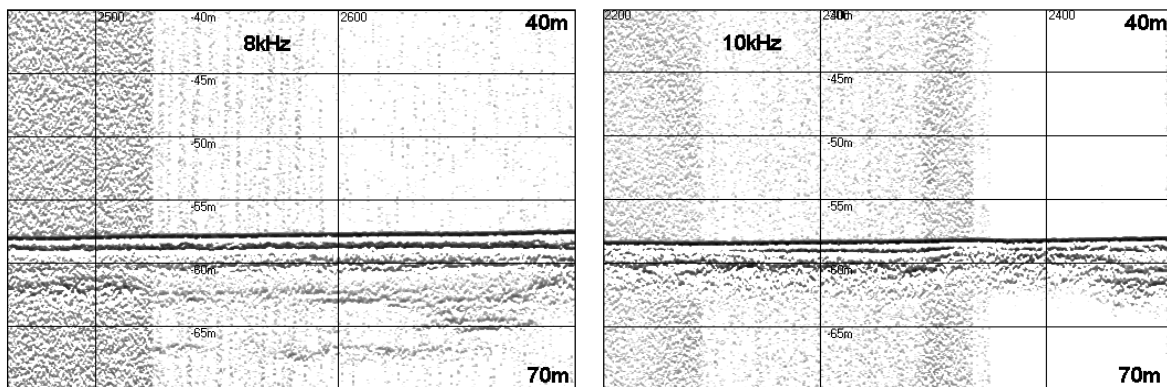
Engine revolution speed dependence of the noise level (gain constant 46 dB, pulse length 500 µs):
The SNR gets better with decreasing revolution speed. The noise level decreases with increasing centre frequency.
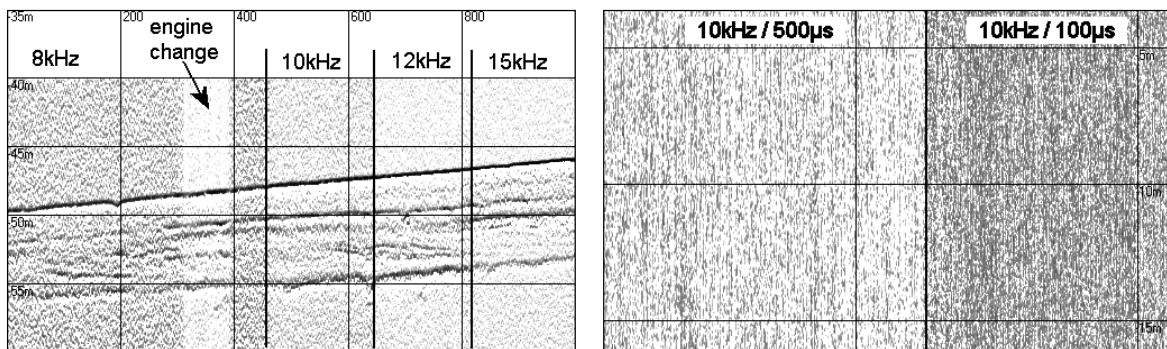
Frequency and pulse length dependence of the noise level (speed and gain constant)
left: pulse length constant 500 µs; The SNR gets better with increasing frequency.
right: frequency constant 10 kHz; The SNR gets better with increasing pulse length.

To avoid interferences with the noise that is produced by ship's engine the transducer should be placed as far away as possible from the engine. Since the engine (and the propeller) is at the rear end of the ship, the transducer should be placed at the front half of the ship. At small boats the best place for the transducer is at the bow.

To avoid the impact of noise by vibrations onto the transducer it should be mechanically decoupled from the vessel. Especially the steel-to-steel connections on the flange and on the pipe should be decoupled using elastic material like rubber, plastics or wood.

7.2   How to set up transducer draught and sound velocity

7.2.1   Where to set up transducer draught and sound velocity

Depth values given in the SESWIN software are related to water surface: $D=T+\frac{1}{2}\ c\ t$ (with D: depth below water surface; T: transducer draught below water surface; t: sound pulse two-way travel time from transducer and back to transducer; c: sound velocity in water).

To get correct depth values it is necessary to know and to set up transducer draught and sound velocity within the SESWIN software properly. Both values have to be set in "System Setup – Settings – General – System" as shown in the figure below.
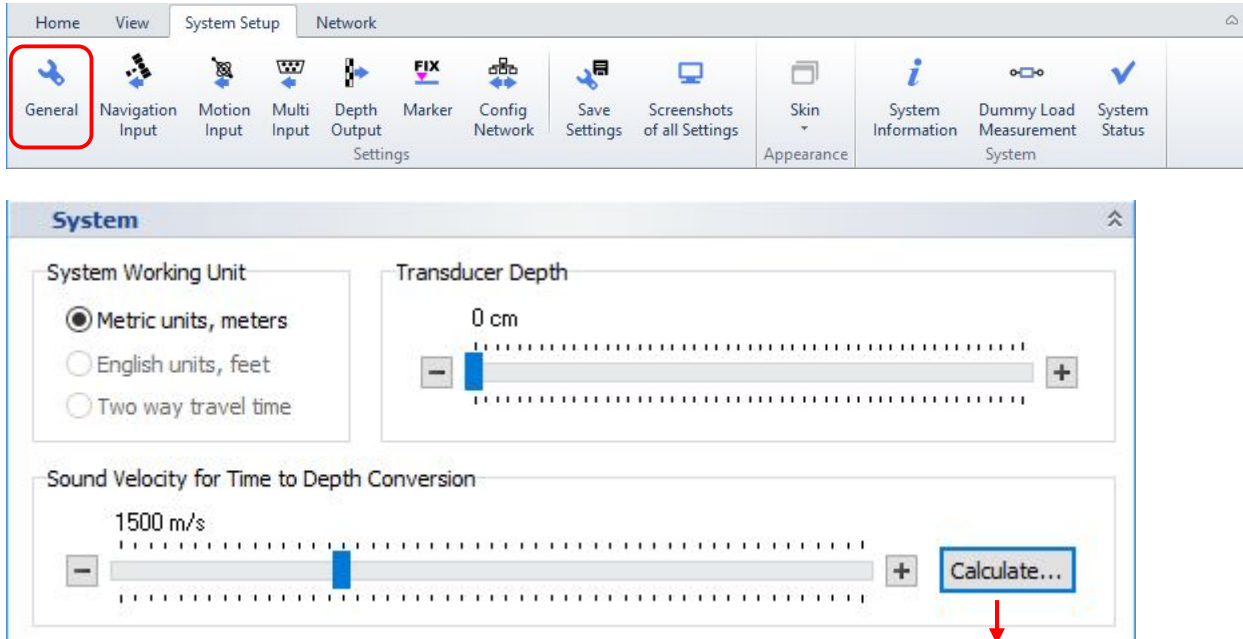
Transducer draught has to be set in cm, measured from water surface to the bottom of the transducer.

Sound velocity has to be set in meter per second.

Both values are set by sliders that can be moved by mouse or the arrow keys on your keyboard.
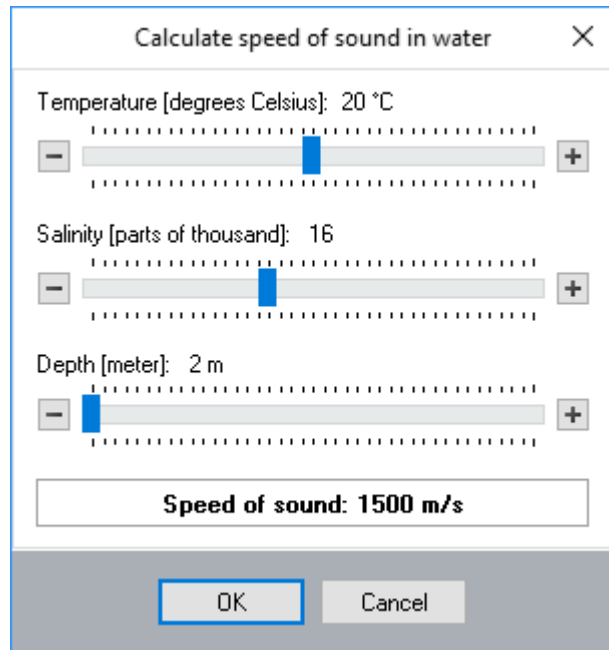
7.2.2 How to get the transducer draught

Transducer depth below water level should be known from the transducer installation. For mobile installations this value should be measured and noted during the installation. For hull-mounted installations the transducer draught can be obtained from the ship drawings.

It is also possible to get the transducer draught from a "bar check", see section 7.2.4 below.

7.2.3 How to get the sound velocity

The sound velocity value should represent the mean sound speed in the water column in order to get correct water depth. This sound velocity can be measured using a sound velocity probe (SVP). If you got a sound velocity profile than just calculate the mean value and use this.

If the water temperature and salinity is known or if you have a good estimation for these values the sound velocity can be calculated using the tool shown in the figure above. Depth should be set to roughly half the expected water depth. The value shown will be automatically transferred to the main dialogue if the OK button is pressed.

Sound velocity can be also obtained from a "bar check" as outlined in the next section.

7.2.4 How to perform a bar check to calibrate the system

The transducer draught and sound velocity settings can be verified by a "bar check".

The bar is made of a rigid material like aluminium and should be long enough to pass under the vessel's hull at the transducer's location. The lowering lines are made of low-stretch material like wire rope or Kevlar. There are marks in regular intervals (e.g. every meter) on the ropes. The classical bar check procedure is as follows:

1. First set the "sound velocity" value to your best guess.

2. Then lower the bar to the shallowest mark that fits below the transducer and adjust the "transducer draught" value to have the bar in the echo print at its true depth.

3. Then lower the bar by some meters and adjust the "sound velocity" value to have the bar in the echo print at its true depth.

4. You may verify (and refine) the settings while raising the bar in intervals.

Another way to get both values would be to locate the bar at two different depths below the transducer, note the true depths and corresponding depth readings from the echo print and doing some math using

$$c = \hat{c} \, \frac{D_1 - D_2}{\widehat{D}_1 - \widehat{D}_2}$$

$$T = D_1 - (\widehat{D}_1 - \widehat{T}) \, \frac{D_1 - D_2}{\widehat{D}_1 - \widehat{D}_2}$$

$D_{1,2}$: bar's depth below water surface
T: transducer draught below water surface
c: sound velocity
(D, T, c indicate the true values and $\widehat{D}, \widehat{T}, \hat{c}$ indicate values as set in SESWIN and read from echo plot)
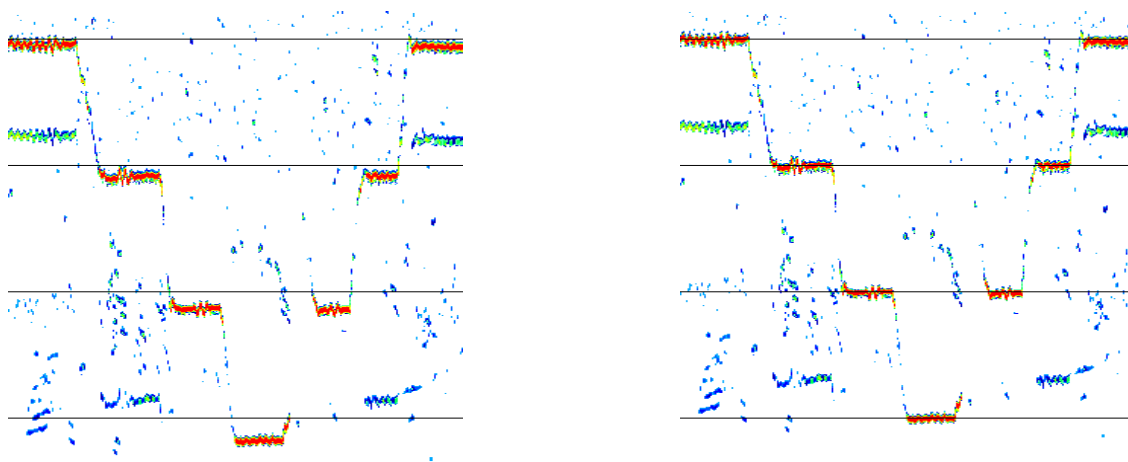
Bar check with depth intervals of 1 meter starting at 2 m water depth.
Left: wrong transducer draught (132 cm) and sound velocity (1500 m/s). Right: same echo print with corrected values according to above formulae (transducer draught 131 cm; sound velocity 1433 m/s); values for 2 and 5 meters used for calculations.

7.3   How to set up Navigation Data Interface (SIS)

For recording navigation data within the INNOMAR data files there are 8 so-called SIS strings available that can hold up to 11 characters each. This section describes how to set up the contents of these SIS strings.

7.3.1   Serial interface settings

First you have to set up the serial interface used for the navigation data within SESWIN "System Setup – Settings – Navigation Input":

Parameters have to be set according to the data fed into the "Navigation In" COM port at the control computer. The serial port used is set in the box showing up when SESWIN starts, see section 5.2 on page 38.

If the port settings are correct (and applied to the system by pressing the "Apply" button) you should see incoming data from the attached GNSS receiver in the "NAV Input Monitor":

This tool can be used to set up which values are to be recorded with the SBP data. For this press button "Stop" after the monitor is filled with data and follow the steps below.

7.3.2 Get values from NMEA data

In most cases you will get NMEA-like navigation data. That is an ASCII text string starting with a $-symbol and closing with carriage return and line feed. Values within the string are comma separated. Examples for typical NMEA data delivered by GNSS receivers are given in appendix A.18 on page 213.

Let's assume you get 3 different NMEA sentences (ZDA, GGA, VTG) like in the following example and you need position, time, speed and some information about GNSS data quality to be recorded with your SBP data:

```
$GPZDA,145601.60,04,01,2007,+00,00*4C
$GPGGA,145601.80,5406.62954,N,01204.13627,E,2,05,3.0,26.12,M,38.87,M,5,0000*6D
$GPVTG,008.96,T,007.10,M,000.16,N,000.30,K,D*23
$GPZDA,145601.80,04,01,2007,+00,00*42
$GPGGA,145602.00,5406.62958,N,01204.13624,E,2,05,3.0,26.23,M,38.87,M,5,0000*6B
$GPVTG,340.83,T,338.98,M,000.08,N,000.16,K,D*2C
```

Position is to be found in the GGA string:

- Latitude: position 2
- Longitude: position 4

```
$GPGGA,145601.80,5406.62954,N,01204.13627,E,2,05,3.0,26.12,M,38.87,M,5,0000*6D
```

Time can be taken either from ZDA (UTC) or from GGA (UTC time of position fix):

```
$GPZDA,145601.60,04,01,2007,+00,00*4C
$GPGGA,145601.80,5406.62954,N,01204.13627,E,2,05,3.0,26.12,M,38.87,M,5,0000*6D
```

Heading and speed can be taken from VTG string:

- Track (heading):   position 1; unit "T" on position 2 indicates true north heading
- Speed in knots: position 5; unit is given in position 6 ("N")
- Speed in km/h: position 7; unit is given in position 8 ("K"):

```
$GPVTG,008.96,T,007.10,M,000.16,N,000.30,K,D*23
```

Information about GNSS data quality can be found in the GGA string, in some cases the antenna height may be of interest as well to calculate values for tide correction:

- GNSS quality indicator   position 6
- Number of satellites in use   position 7
- Horizontal dilution of Position   position 8
- Antenna height in meters   position 9 (unit given in position 10, "M")

```
$GPGGA,145601.80,5406.62954,N,01204.13627,E,2,05,3.0,26.12,M,38.87,M,5,0000*6D
```

For recording the values within the SBP data there are 8 so-called SIS strings available that can hold up to 11 characters each. To get the values marked in the incoming NMEA data above into the SIS strings as follows

- SIS 1   Longitude (from GGA position 4)
- SIS 2   Latitude (from GGA position 2)
- SIS 3   Time (UTC from GGA position 1 **or** ZDA position 1)
- SIS 4   Heading (calculated from LAT/LON; from VTG position 1)
- SIS 5   Speed in knots (from VTG position 5)
- SIS 6   GNSS position error (GGA position 8)
- SIS 7   later for projected UTM-X; preliminary Longitude like SIS 1
- SIS 8   later for projected UTM-Y; preliminary Latitude like SIS 2

!   At least the three first items are required as minimum information (LON, LAT, UTC).

For the above example you need to set the values according to the screenshot below.

First set the "Suggested Headers" according to what is received from the GNSS (including the leading "$" character). Those headers will then appear in the "Header" drop-down lists in the "String Extraction".

"Position" is the field number of value in the NMEA sentence as seen in the SIS monitor. "Offset" is usually set to zero but may be used to omit leading characters that are not of interest, especially if 11 characters available in the SIS string would be too short to hold the full value.

7.3.3 Get values from Non-NMEA data

If there are data at the navigation port that are not NMEA compatible, they can be used as well as long as sentences are separated by <carriage return><line feed> and fields within the sentences separated by comma (",") or space (" ") characters. For this just set the "Suggested Headers" parameters to match your GNSS data stream.

7.3.4 Synchronize the PC clock to UTC

The Innomar SBP data are recorded with all 8 SIS strings as specified above and the PC time. To keep the PC clock up-to-date, it is possible to synchronize the clock to UTC obtained from the navigation data.

In the example above UTC is taken from the ZDA string, even if the ZDA time has not been assigned to a SIS string:

SIS String for PC-Time Synchronisation:

- $xxZDA -   UTC - time zone settings

If the $xxZDA string would not be available, one could also use the $xxGGA time already assigned to SIS3:

SIS String for PC-Time Synchronisation:

3   UTC - time zone settings

Time values from the GNSS are UTC. The PC clock can be either set to this time or the local PC time can be just synchronized to GNSS time keeping the time offset according to your Windows time zone settings.

UTC: the PC clock will be set to the GNSS time as received.

Local: the PC clock keeps its local time zone as set within Windows time zone settings. But the time is synchronized to GNSS time.
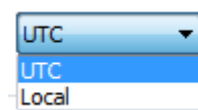
UTC
UTC
Local

! This feature must not be used if the data acquisition PC's clock is already synchronized to a time server (e.g. NTP)!

7.3.5 Save and Reload SIS Settings

General
Load Scheme...   Save Scheme...

All settings made in the "Navigation Input" dialog can be saved into a *.nav file and reloaded. It saves a lot of time if a survey takes place on the same ship with the same GNSS equipment once more. Save the data of the SIS settings for example as *NameOfShip.nav* or *NameOfGNSS.nav*

7.3.6 Replace SIS Strings with Other Data

SIS strings defined in the "NAV Input" dialogue may be replaced with other values by some other SESWIN features like

! If one of these features is used, take care not to overwrite any important SIS string!

7.4   How to set up UTM conversion

Within SESWIN it is possible to transform WGS84 Latitude / Longitude coordinates into UTM coordinates (Northing / Easting) by using either standard or user-defined transformation parameters. This feature has to be set up in the SESWIN – System Setup – Settings – Navigation Input – UTM Conversion tab, see section 5.11.11 on page 67.

7.4.1   Position Data Source / Destination

You have to set the SIS string IDs for WGS84 position data: longitude (LON) and latitude (LAT) values as defined in the "Navigation Input" dialog, see previous section. East/West and North/South hemisphere have to be specified or can be set to be detected from the GGA NMEA sentence automatically.

The destination SIS string IDs have to be set as well. The new calculated X and Y position values will replace any values that are stored at these IDs before!

Enable On-line Conversion: if checked the conversion takes place and the X, Y values are written to the specified SIS strings.

!   Make sure not to overwrite any important values at the destination IDs!

7.4.2 Conversion Settings

In this dialog you switch on/off the UTM conversion and specify the format of input data as well as the desired output data format.

Input Format: You can select an input format according to your GNSS data:
> DDD.DDDDDD (decimal degrees),
> DDDMM.MMMM (degrees decimal minutes),
> DDDMMSS.SSS (degrees minutes decimal seconds).

Output Format: There are a lot of possible output formats (projections). The UTM zone can by determined from the current coordinates.

UTM Zone can be determined automatically from the actual GNSS position.

Conversion settings can be checked and adapted if necessary, in the "WKT Setup".

7.5　How to install and set up a motion sensor

The INNOMAR SBPs are equipped with a serial interface to attach a motion sensor. There is no motion sensor integrated nor included in the standard delivery.

Please make sure The sensor is properly installed and powered and the SESWIN "motion sensor" interface is set-up correctly as described in this section.

7.5.1　Motion Sensor Installation

The sensor has to be fixed firmly and must not vibrate. It should be placed as close as possible to the INNOMAR SBP transducer. If that is not possible, make sure the offsets are measured and noted for setting up a lever arm correction (in the motion sensor or in SESWIN). It is also important to ensure the correct orientation of the motion sensor related to the transducer.

The performance of the motion sensor can be improved by providing additional information like heading/course or speed of the ship. Therefore, some motion sensors are able to use NMEA sentences sent by a GNSS receiver to get the necessary information. Often the VTG sentence is used to obtain the speed of the vessel.

7.5.2　SESWIN Motion Sensor Setup
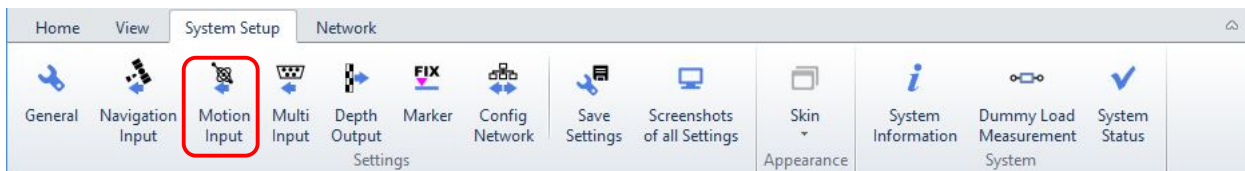
After installing the motion sensor some settings are necessary within the SESWIN software (System Setup – Settings – Motion Input), see section 5.11.14 on page 70.

Make sure to use the correct sensor model/format and baud rate! Use the highest possible baud rate.
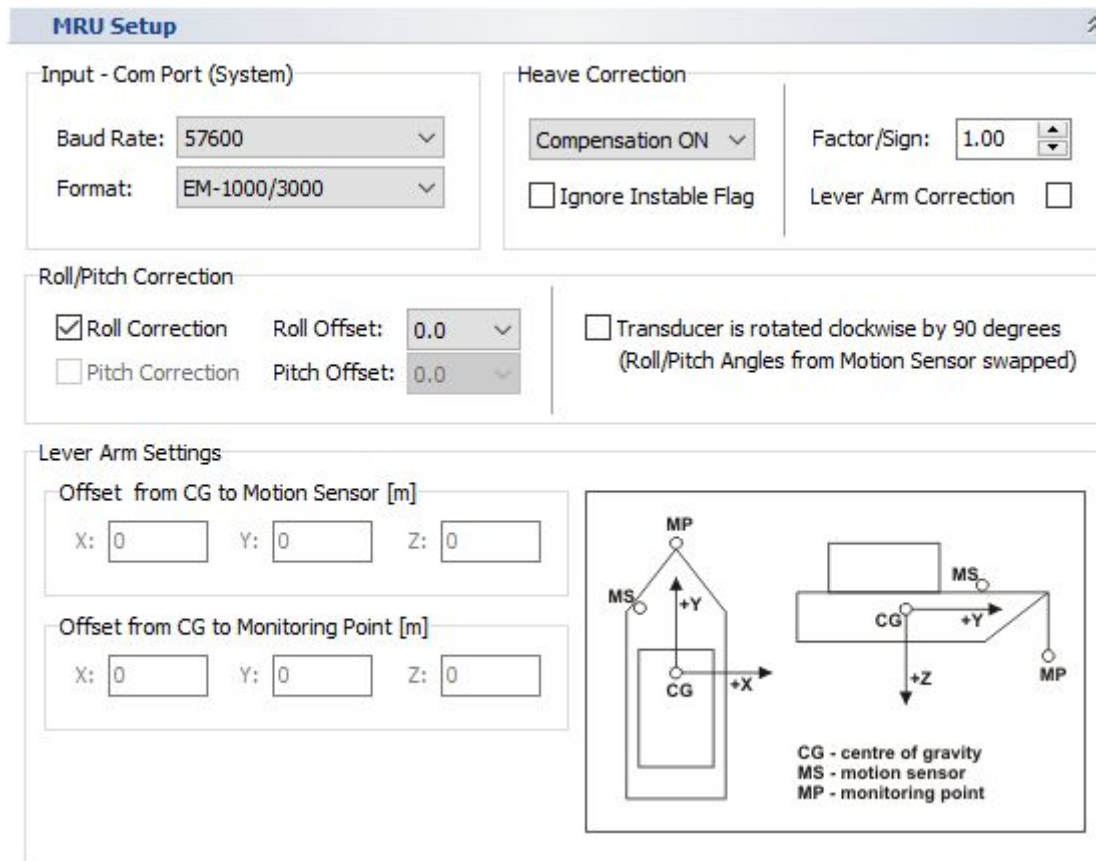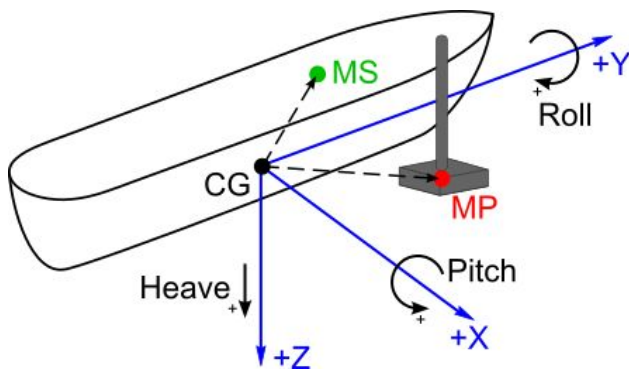
Vessel motions considered:

- Heave: positive moving down
- Roll: positive starboard down
- Pitch: positive bow up

Locations of interest for lever arms:

- CG: vessel centre of gravity (centre of rotation)
- MS: motion sensor centre point
- MP: monitoring point (transducer centre)

7.5.3 Motion Sensor Test

Within the SESWIN screen there are two possibilities to check if there are valid data from the motion sensor received by the INNOMAR system: The Motion Sensor section in the Info panel (left part of the SESWIN screen) and MRU LED in the status bar.

Green   received data OK

Yellow   received data are flagged "instable" by the sensor (Warning!) and will not be used.

Red   no data received or no motion sensor connected

It is possible to ignore the "in stable condition" flag set by the sensor by checking the related check box in the "System Setup – Settings – Motion Input" dialog. Be aware by doing this maybe faulty motion sensor data will be used. To indicate this, the motion sensor LED in the SESWIN status bar is encircled yellow if "ignore instable flag" is active.

To check the mounting orientation, you can perform the following motions with the sensor and observe the changed data in the motion data window in the SESWIN screen:

- lift the sensor   → heave value goes negative
- tilt to starboard (right looking forward)   → roll value goes positive and increases
- tilt backwards (transducer goes bow up)   → pitch value goes positive and increases

If the heave goes into the wrong direction, the heave sign can be changed within the SESWIN software (System Setup – Settings – Motion Input).

7.6   How to avoid interference with other acoustic systems

Often it is required to operate several acoustic systems at the same time to increase survey efficiency, for instance collecting multi-beam data and sub-bottom data together. To avoid interference and data quality issues you should generally try to use different frequencies for the different acoustic systems. If similar frequencies are used by the systems, interferences may occur and affect the data quality obtained seriously.

Sometimes even acoustic systems using higher frequencies than the INNOMAR SBP are affected, due to the harmonics of the primary frequencies of the SBP that are generated within the water.

There are different strategies to avoid or reduce interferences:

- Place the transducers at different locations and make the distance as large as possible.

- Free run all systems (i.e. without synchronizing them). This will result in uncorrelated interferences that may be removed by digital signal processing like stacking and spike removing (e.g. median filter).

- Synchronize all systems to a fixed ping cycle and give each system a fixed time slot for pinging. This results in determined interference that may not harm data quality or may be removed more easily than random interference.

A typical survey operation requires collecting multi-beam data and sub-bottom data at the same time. If both systems are working in a similar frequency range, interferences may cause wrong bottom detections in the multi-beam data sets. The INNOMAR data usually is not affected seriously by the MBES. Since the INNOMAR systems use a very narrow sound beam, in most cases only the centre (nadir and near-nadir) MBES beams are affected. To increase the signal-to-interference ratio and thus get better bottom detection for the MBES it is recommended to use the highest possible transmit energy (the longest pulse length) for the MBES.

If the systems are not synchronized, the wrong MBES depth values are mostly at random depths and can be edited or post-processed only with time consuming work.

To avoid random interferences and to put the spikes coming from the INNOMAR SBP to a certain depth level, the MBES and the INNOMAR system should be synchronized. For this either the INNOMAR or the MBES can be used as master to trigger the other system.

In most cases the multibeam data are of higher priority than the sub-bottom data. Therefore, the MBES runs a master device at full ping rate and the SBP has to fit into the given time slots. This is a perfect solution for shallow water applications (or low altitudes for ROV based operation) and will be discussed in section 7.6.2 on page 101.

7.6.1 Synchronizing / Triggering – General Remarks

It is possible to synchronize two or more systems via trigger pulses in order to reduce acoustic interference. There are "Sync IN" and "Sync OUT" BNC-connectors placed at the front panel of the INNOMAR SBP transceiver unit that can be used to get TTL compatible trigger pulses to/from other systems.

In the case of triggering another system, the "Sync OUT" has to be used. The triggered (slave) system has to be able to handle the (rather high) ping rates that are produced by the INNOMAR system.

It is also possible to trigger the INNOMAR system by another system using the "Sync IN" connector. Every time a trigger pulse is detected at Sync IN, the SBP is forced to transmit a sound ping (or a burst of sound pings). Please keep in mind that the ping rate of the INNOMAR SBP may be decreased significantly and therefore the lateral resolution and the data quality may be decreased, too.

The principle of the different trigger modes that are possible with the INNOMAR systems are described in chapter 6 on page 81 of this manual.

7.6.2 Running the INNOMAR SBP triggered by a Multi Beam System

In shallow water or in ROV applications the MBES should trigger the INNOMAR SBP. How to set up this is exemplified by the Reson SeaBat 7125 MBES that cannot be triggered externally and is typically used in shallow water.

Connecting Trigger Lines

The trigger output of the MBES has to be connected to the trigger input of the INNOMAR SBP ("Sync IN" BNC connector at the front panel).

If a Dual-Head version of the Reson SeaBat 7125 is used, keep in mind that the two topside units generate the trigger pulse. There are interleaved pulses from the starboard and portside unit. To ensure best SBP performance, both trigger lines should be OR-wired to get both trigger pulses to the INNOMAR SBP:
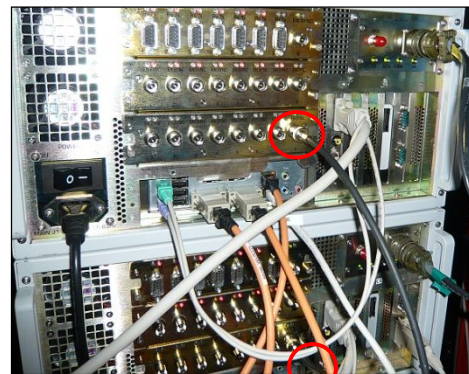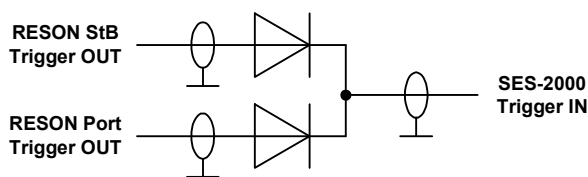
Trigger OUT connectors at SeaBat 7125 topside units (BNC connectors at rear panel)

Diodes should be of Schottky type to get lowest possible voltage drop.

INNOMAR SBP settings

Within the INNOMAR SESWIN control software a trigger delay (time offset) can be applied via the menu "System Setup – Settings – General – Synchronisation" if triggered externally:
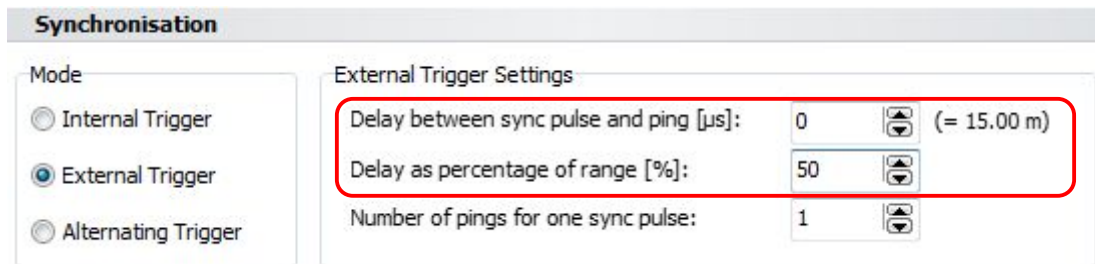
A general description of this dialog is given in section 5.11.3 on page 60. Options for external synchronisation are described in detail in section 0 on page 81.

This trigger delay shifts the interference caused by the SBP onto a certain depth level and the wrong depth values can be removed easily. The following pictures illustrate the shift of wrong water depth values of the centre beam(s) within the MBES screen with increasing trigger delay. An optimal setting for the trigger delay would be if the starting time for the INNOMAR SBP pulse were just half of the water depth (trigger delay about 40 – 60% of range as shown in the screen shot above). Please note that the delay can be given absolutely in microseconds and/or relative to range. Both values will be added to get the total delay.
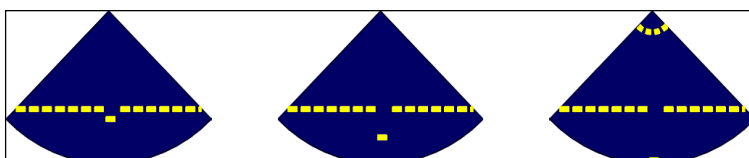
If the delay time increases, some interference from the transmitted signal of the INNOMAR SBP will be visible on top of the MBES Screen. All the interferences above and below the real seabed can cause wrong detected points and gaps in the seabed. Apart from post-processing steps to remove these wrong points, it is often possible to adjust a depth filter directly within the MBES operating software.

To get the highest possible ping rate with the INNOMAR system you should use the smallest useful range length for both systems (MBES and INNOMAR SBP).

MBES settings

To avoid the MBES picking up the SBP interference, it is possible to use gates for seabed detection within the RESON SeaBat MBES software. Please refer to the SeaBat manual how to set up these gates.

The following picture shows, how some areas are not used for the seabed detection. Once the depth filter is applied, the interferences are not causing wrong bottom detection anymore. The method will work as long as the depth filter setting is adjusted relating to the water depth and the selected operating range. The filter range should not be too large.
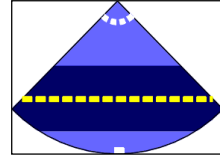
Screen shots below illustrate gate settings and interference on the SeaBat screen (dual head version).
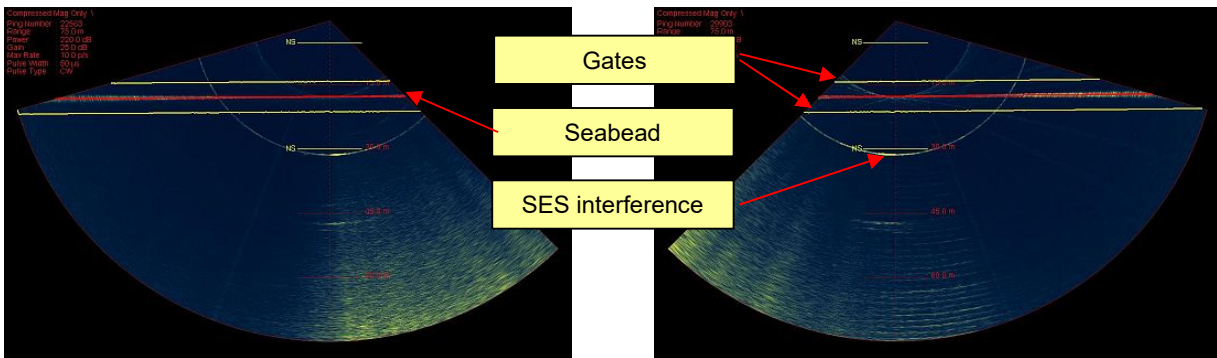
Please keep in mind to use smallest useful range and the highest possible transmit energy at the MBES to ensure highest data density and best bottom detection:
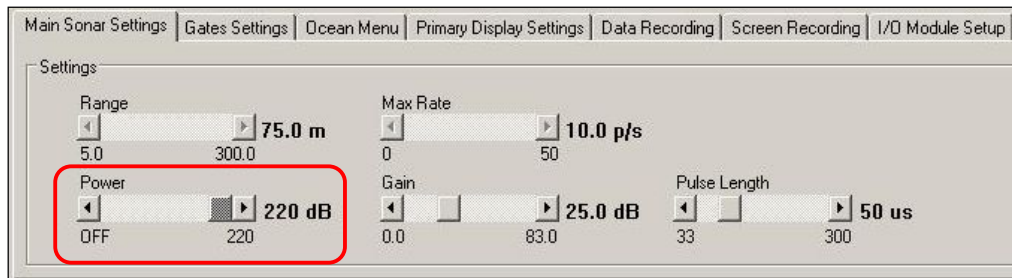
Getting the optimal INNOMAR SBP synchronisation settings

If the water depth and therefore the MBES ping rate changes, the system settings have to be adapted. In the following the optimal settings for different water depths are shown.

The Reson SeaBat 7125 MBES uses a swath of about 130° (±65° in single head configuration). Assuming a flat seafloor at about 100 m water depth, MBES bottom return would be received about 120 – 350 ms after pinging (taking ±10% water depth variation into account). The ping rate of the MBES, that will trigger the INNOMAR SBP, can be assumed to be about 2.7 Hz (370 ms). The range that should be avoided by the SBP HF bottom return is limited to the near-nadir MBES beams (let's say ±30°): 120 – 70 ms. The bottom return of the INNOMAR system can be expected in the range of 120 – 150 ms after pinging.

The best moment for the INNOMAR SBP to transmit its sound ping would be about 50 – 75% of the time of MBES centre beam bottom return. In the example a INNOMAR trigger delay of 66% (80 ms) was chosen.

With a range start of 80 m and a range length of 60 m we'll cover a possible sediment penetration of at least 30 m and get a ping rate of about 5 Hz (200 ms) for the INNOMAR SBP.
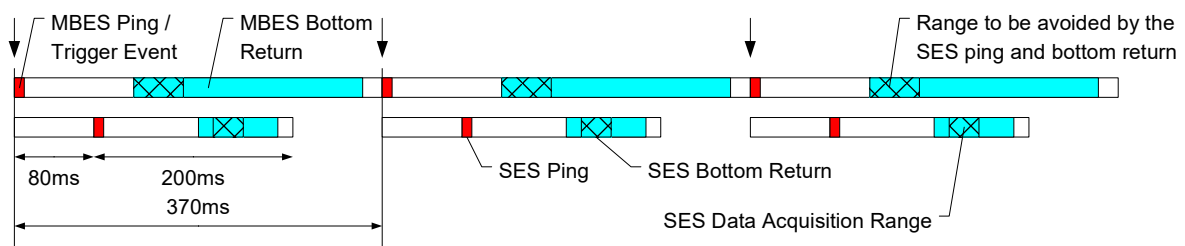
If the MBES would use a swath of about 150° (±75°) or if the MBES would be set to a longer range, two SBP pulses plus delay would fit within one MBES cycle assuming same conditions as above. This is shown in the picture below.
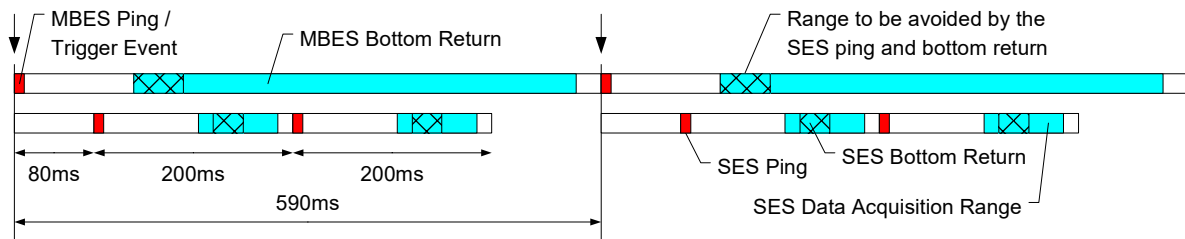
The effective swath is increased as well if the MBES is tilted, e.g. in dual-head configurations.

Delay and burst settings are made in the "External Trigger Settings" within the "System Setup – Settings – General – Synchronisation" tab, see figure.
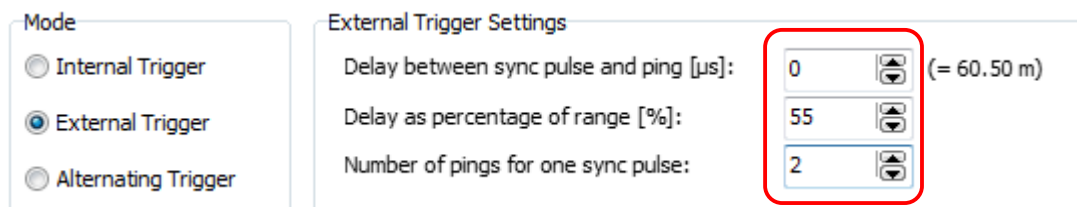
Please note that the delay can be given absolutely in microseconds and/or relative to range. Both values will be added to get the total delay. There will be an additional delay of about 1ms for external trigger applied by the system, see section 6.2.2 on page 83 for details.

Absolute (time based) delay is useful if transducer altitude above seafloor will not change during the survey like in ROV applications. In this case the interference caused by the SBP will be placed at a determined MBES range.

The range-related setting will automatically adapt the delay according to changed water depth. In this case the interference will be in a constant distance to the MBES seafloor. Please note that range-related trigger delay is given relative to the range centre. In the example given above range is 80 – 140 m; range centre is 110 m and 80 ms (60 m) delay equal 55% of range.

To get two SBP pings within one MBES cycle set "number of pings in one sync pulse" to "2" in the INNOMAR synchronisation settings. The number of pings should not be higher than the number of SBP cycles fit into one MBES cycle. Otherwise, the pulse train is generated at each recognized trigger event as explained in section 6.2.2 on page 83. This may result in increased interference with the MBES.

The following table summarizes calculations and system settings for different water depths. For all examples a MBES swath of 130° (like Reson SeaBat 7125) and a water depth of ±10% around the given mean is assumed, like in the example above.

All calculations based on smallest possible range for the MBES for the given water depth. If the actually used range is larger or the MBES head is tilted (dual-head system), maybe more than one SBP ping would fit into one MBES cycle.

To get best results, keep in mind to use smallest possible range length at the INNOMAR SBP.

Water depth	(m)	10	20	100
MBES bottom return	(ms)	12–35	24–70	120–350
MBES centre swath	(ms)	12–17	24–35	120–170
MBES max. ping rate	(ms)	50	85	370
MBES max. ping rate	(Hz)	20	11	2.7
SBP range start	(m)	8	16	80
SBP range length	(m)	15	20	60
SBP range end	(ms)	30	48	140
SBP bottom return	(ms)	12–15	24-30	120–150
max. SBP ping rate	(ms)	40	60	200
max. SBP ping rate	(Hz)	25	17	5
Trigger delay	(ms)	8	16	80
Trigger delay rel. range	**(%)**	**40**	**46**	**55**
Pings for one sync pulse		**1**	**1**	**1**

7.7 How to synchronize a sparker at a fixed ping rate

Let's assume a sparker shall run at a fixed ping rate of 160 ms and the SBP shall do 3 pings in between. For this you may set the SBP to a fixed ping rate and use "Alternating Trigger" mode, see section 6.3 on page 86ff.

For the given case the following values will do (assuming the sound velocity is set to 1500 m/s):

- Max. ping rate: 25 PPS (→ 40ms)
- Time frame for ext. device: 40000 µs
- Time Frame percentage of range: 0%
- Internal pings: 3
- External pings: 1
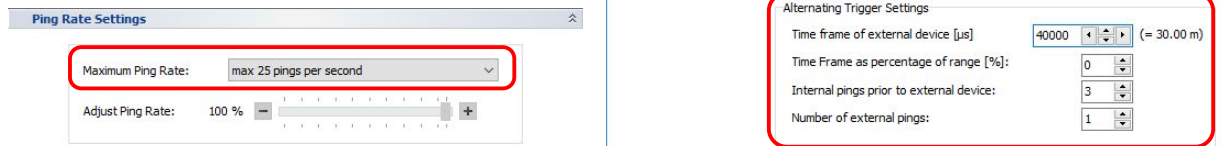
This will the SBP omit every three pings one ping and place the external trigger event in place of the omitted ping.
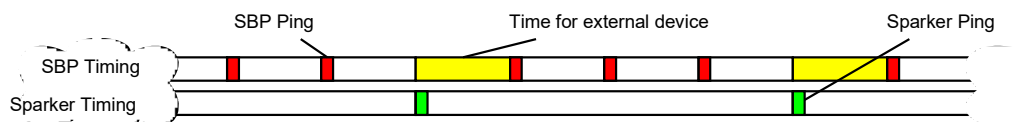
To make sure the ping rate does not go down due to range settings you have to check with the formula given in section 6.1 on page 81: PPS = 750 / (RangeStart + RangeLength + 7.5). Following this, the range end (RangeStart + RangeLength) should be less than 600 m / PPS; in our case 600 m / 25 PPS = 24m. Thus, any range setting with the sum of range start and range length is less than 24 m, e.g. range start at 10m and range length of 20m, will do.

To get a more uniform ping interval for the SBP, the "Time frame for ext. device" needs to be reduced (minimum is 5000 µs). Possible settings for the same sparker ping interval of 160 ms are:

- Max. ping rate: 20 PPS (→ 50ms)   26 PPS (→ 38.46ms)
- Time frame for external device: 10000 µs   6150 µs
- Time Frame percentage of range: 0%   0%
- Internal pings: 3   4
- External pings: 1   1
- Range length limit: 30 m   23 m
- Advantage compared to above: longer range   one extra SBP ping
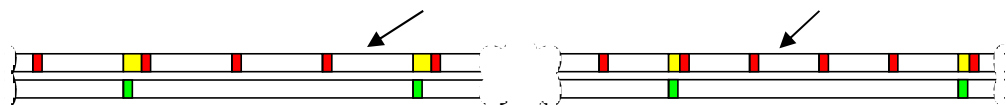
The desired values can be calculated as follows:
- SBP Ping Rate: PPS > (SBP_pings * 1000) / ExtInterval; with ExtInterval in ms
- Ext. Time Frame: time = [ExtInterval – (SBP_pings * 1000) / PPS] * 1000; time in µs
- Range Limit: (RangeStart + RangeLength) = 600 m / PPS

You may also start from the range limit to obtain the number of possible SBP pings first:
- SBP Ping Rate: PPS < 600 m / (RangeStart + RangeLength)
- Number SBP Pings: SBP_pings < (ExtInterval / 1000) * PPS; with ExtInterval in ms
- Ext. Time Frame: time = [ExtInterval – (SBP_pings * 1000) / PPS] * 1000; time in µs

All values to be integers (decimals cut off), note the "Ext. Time Frame" minimum of 5000 µs.

7.8 How to to brodcast data from SESWIN to HYPACK®

If HYPACK® survey software is used, the INNOMAR data can be sent to HYPACK® via Ethernet using the SESWIN Broadcast Server, see section 5.14.1 on page 80.

SESWIN and HYPACK® software should run on separate computers. An active ethernet connection should be established.

!   Please note: This connection cannot be used for remote controlling the INNOMAR SBP!

In the SESWIN software, inside the network tab, the Broadcast server can be set up. Before the server can be activated, a free network port address should be entered. It is recommended to transmit the full wave form data to transmit the maximum available data resolution.
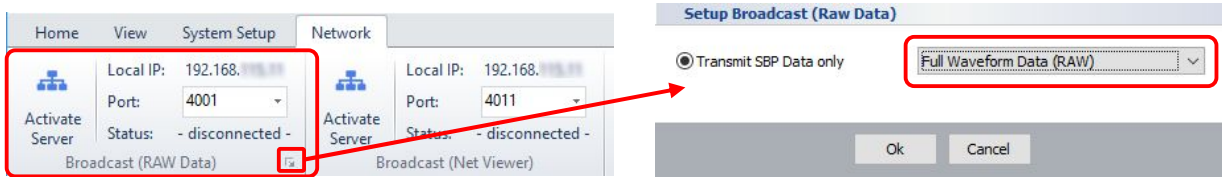
The given server IP address and the port number is later needed during the device driver set up in HYPACK®.

In HYPACK® the Innomar device driver can be added in the hardware setup. After a mobile is created the device driver "Sub-Bottom Driver" (Subbot.dll) can be found on the devices list and can be added to this mobile. To get the Innomar device driver active, select "Sub-bottom Driver" and choose "Innomar SES-2000" from the pull-down list in the SETUP. It is also possible to rename the device driver inside the name box, if desired.
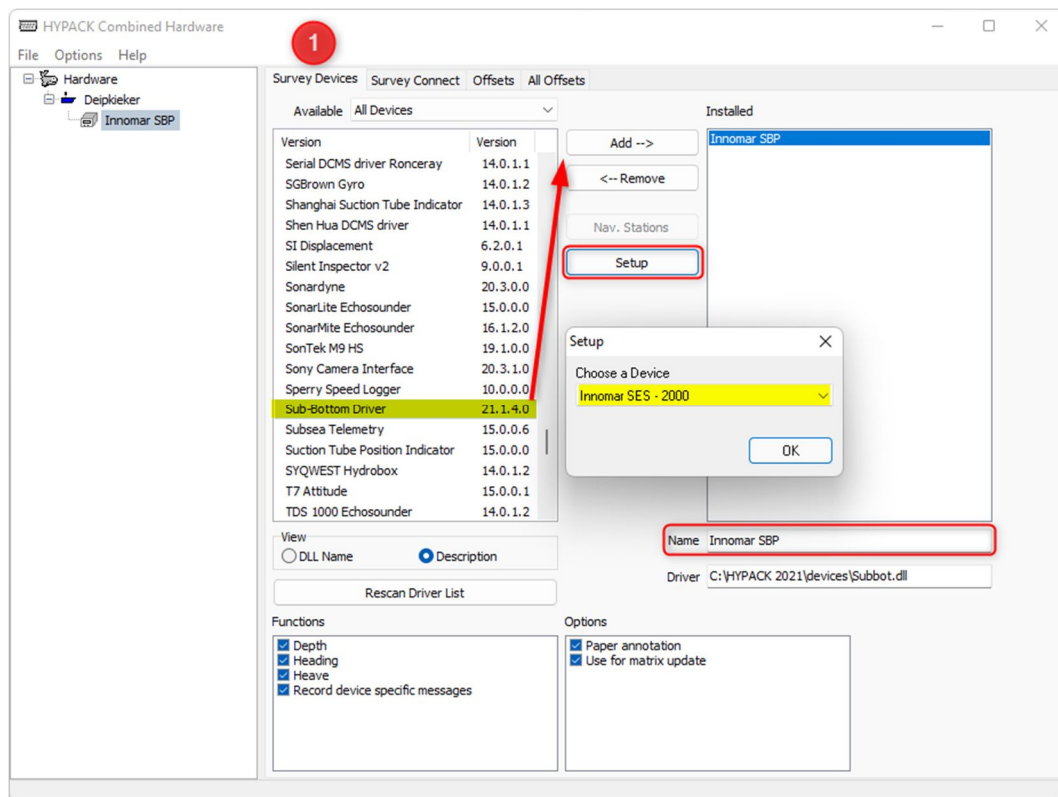
In the "Survey Connect" tab the parameter for the network connection can be set up. For this purpose, the IP address displayed in SESWIN and the port number are entered in the corresponding text fields. Furthermore, the protocol is set to TCP and the role as client.
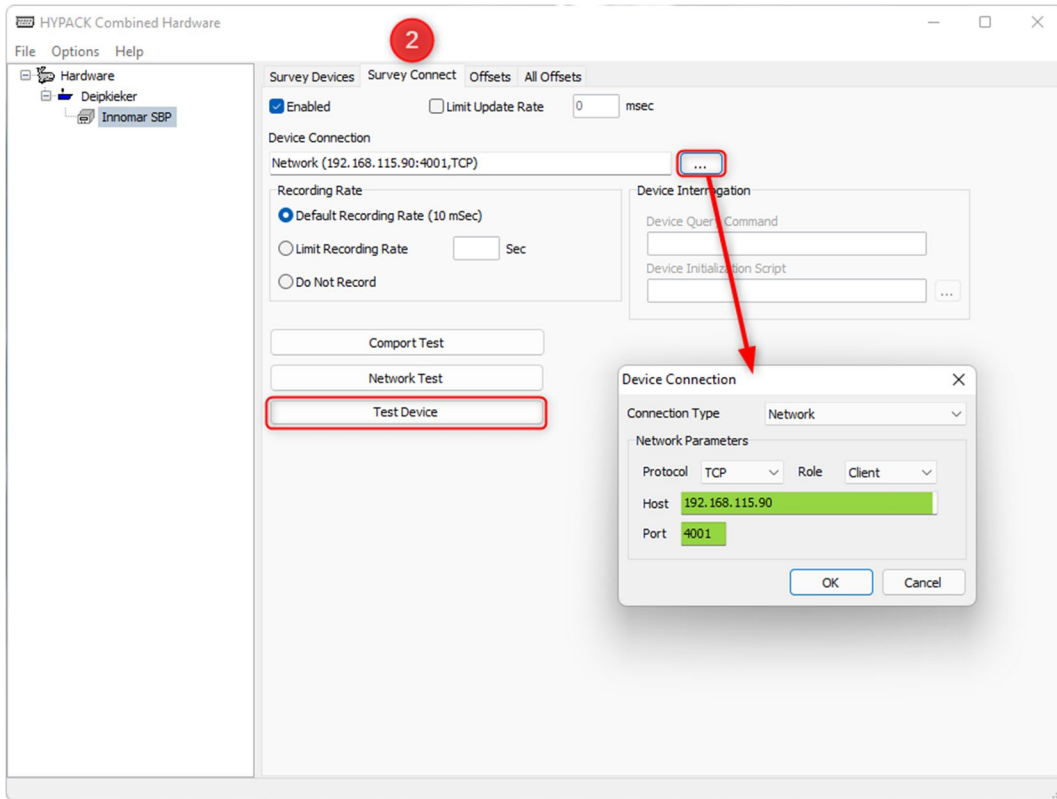
Once all needed parameters are entered, the connection can be tested to make sure it is working properly.

The Sub-bottom controls (flag button) provide a few options to optimize displaying the data. The amplitude values of the transmitted raw data are in 16bit which means the value range is between -32767 to 32767. In Color by Amplitude an auto scale can be applied to increase the contrast of the visualized data. It is also possible to set minimum and maximum values manually to get an even higher contrast. Also, there different visualization modes can be applied such as color, bipolar, unipolar and rectified (absolute). Furthermore, a band pass filter and a TVG can be applied if needed. All these parameters can be set up separately for both channels.
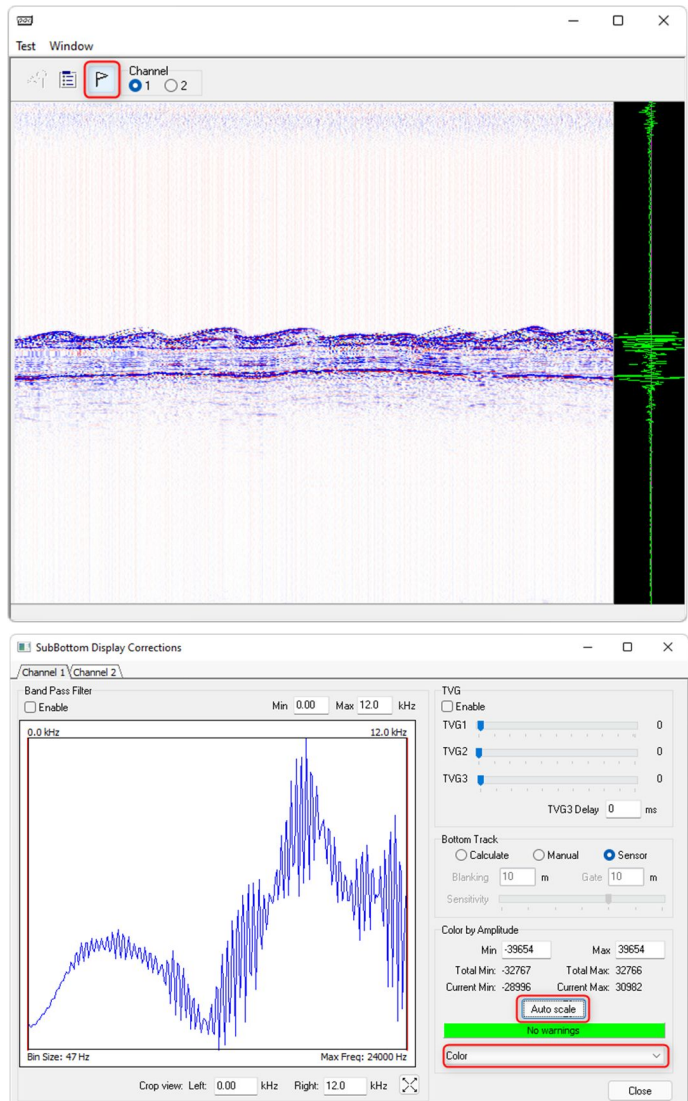
Important Notes

Although you store the data by HYPACK®, we strongly recommend logging the data by the SESWIN software, too.

Received data in HYPACK® are affected by the SESWIN settings. If the transducer draft is set within SESWIN, then all received data are draft corrected already and no additional offset in HYPACK® needs to be entered. If you want to do draft correction in HYPACK®, you should setup a draft of "0" (zero) in SESWIN.

If heave correction is enabled in SESWIN, then still all received data in HYPACK® are not heave corrected. It is up to the HYPACK® software to apply heave (e.g. from a motion sensor or from a GNSS RTK system).

You should always adjust the gain settings within SESWIN based on the signal window within the SESWIN software and not via the colours in the echo plot windows (HYPACK® or SESWIN). The echo plot is generated based on threshold values and may not represent the signal amplitude within the dynamic range correctly.

7.9 How to broadcast data from SESWIN to Beamworx NavAQ®

If the BeamworX software NavAQ® survey software is used, the INNOMAR data can be sent to to this via Ethernet using the SESWIN Broadcast Server, see section 5.14.1 on page 80.

SESWIN and BeamworX® software should run on separate computers. An active ethernet connection should be established.

!   Please note: This connection cannot be used for remote controlling the INNOMAR SBP!

In the SESWIN software, inside the network tab (1), the Broadcast server can be set up. Before the server can be activated, a free network port number should be entered (2). It is recommended to transmit the full wave form data (3) to transmit the maximum available data resolution. Then you can activate the Broadcast Server (4):
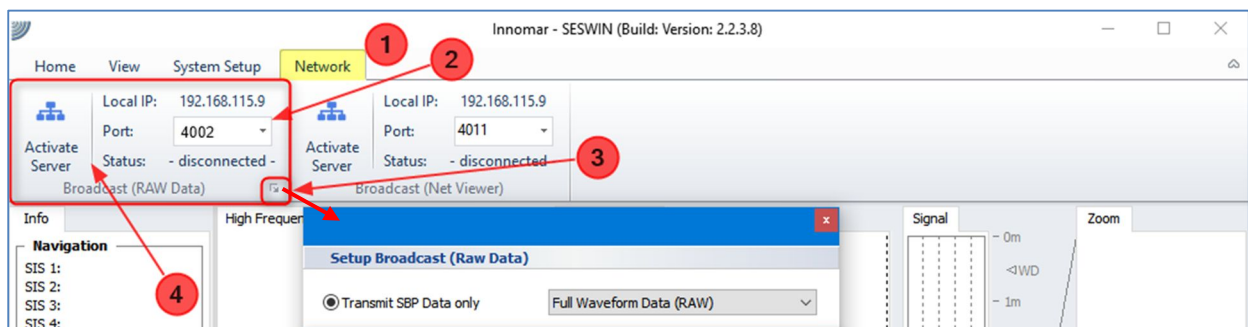
In NavAQ, open the "Survey Configuration Manager" (5) and press the "Add Device" button (6). Select the "Innomar SES-2000" device driver from the dropdown list (7) and name the new device appropriately. There are a few options which can be selected (A), such as the channels to be used (Channel 1 is the Innomar the low frequency data and Channel 2 the high frequency data). If a motion sensor is connected to the Innomar SBP, motion data will be passed to NavAQ as well and can be used to compensate heave in the echo data. The last option is to use either the draft which has been entered in the Innomar SBP or use the entered offsets from NavAQ. If everything is set up properly the OK button will add the new SBP to the device list.
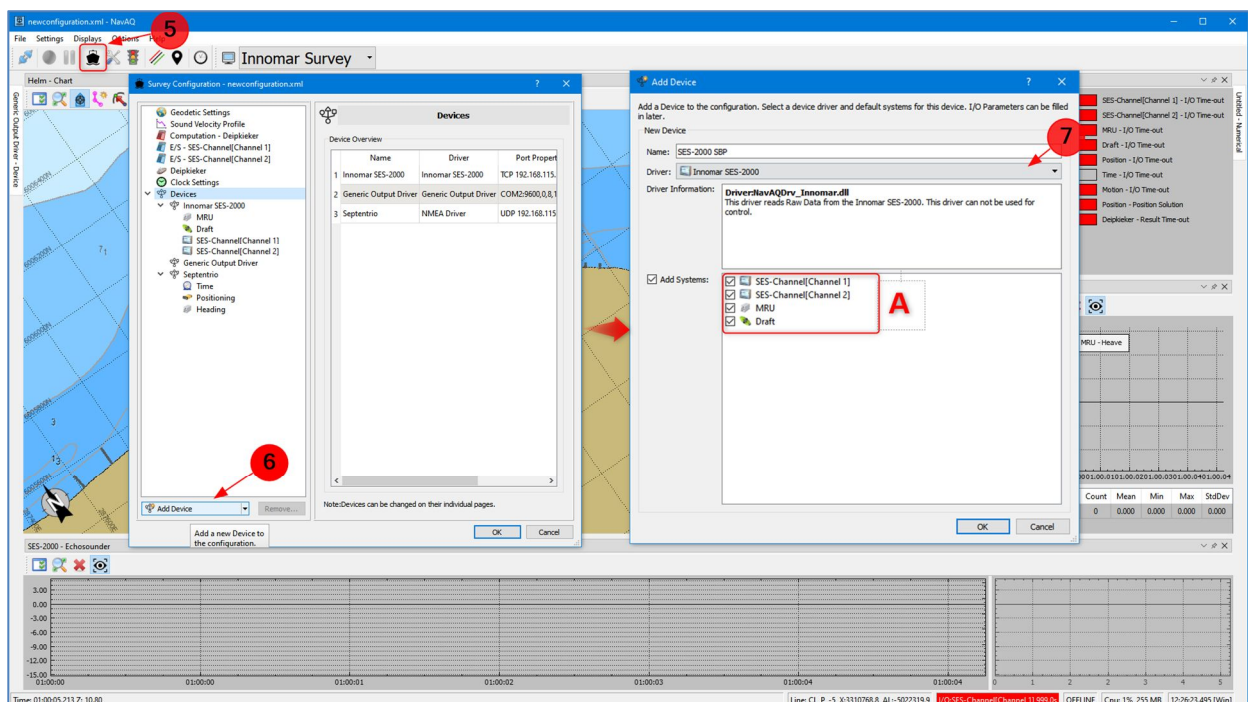
Before testing the connection in NavAQ, the network parameters must be set up (8). The IO Type is *Network TCP Client* and the *IP address and port* must fit to the Broadcast Server settings of the SESWIN software.
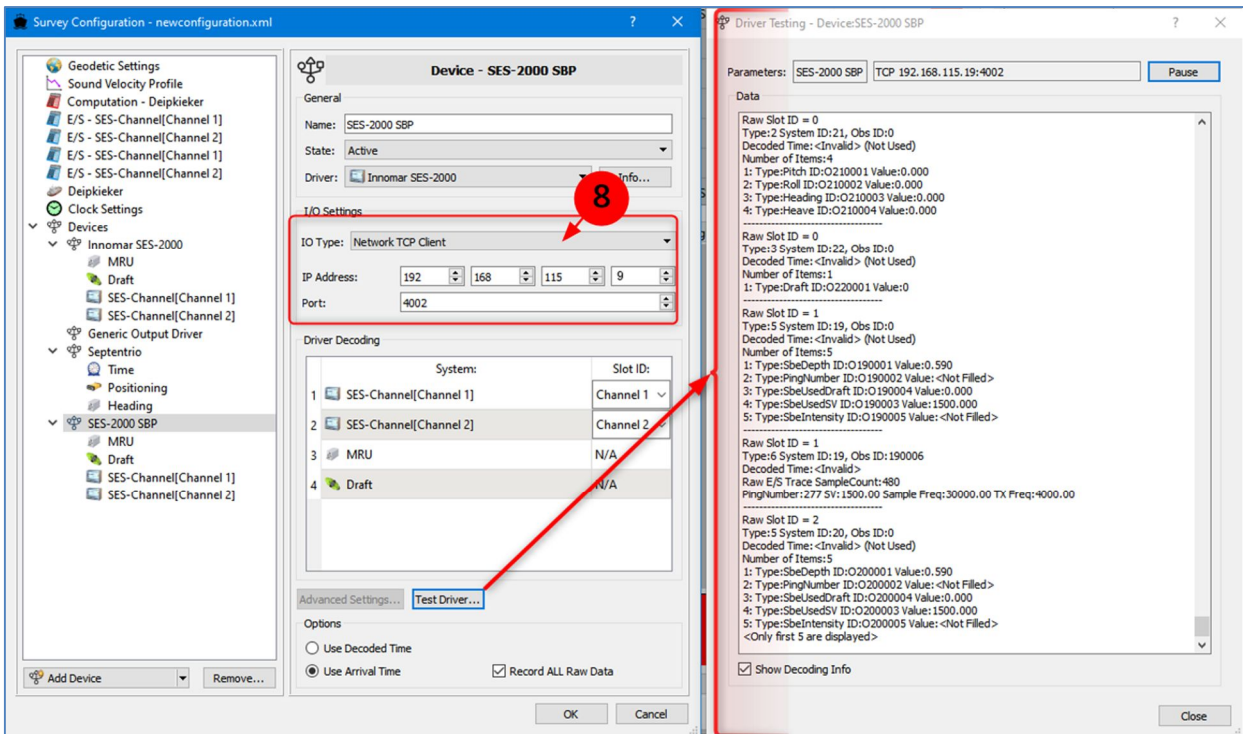
If the network interface is set up, it is possible to test all settings to confirm the selected parameters. The *Test Driver* button opens a window where all incoming data are shown.

Before NavAQ can be used in its online mode, a GPS system must be connected and configured. If this is not done, no echo data will be displayed, even if the Innomar SBP is operating properly and broadcasting data. To switch the NavAQ software to the online mode, press the *Go Online and Start I/O* buttons (9). Then incoming data will be shown in the *Echosounder* display window.
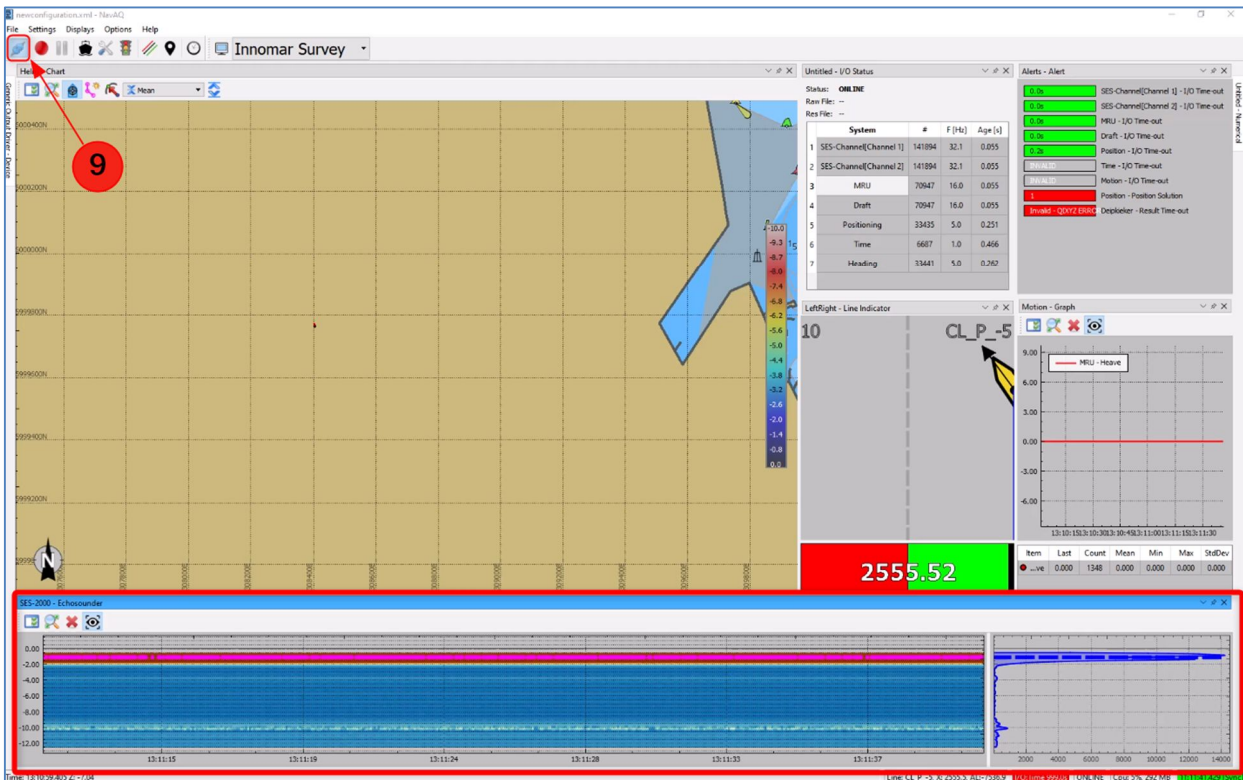
The visualization of the echo data can be configured via the "Setup Display" button (10) in the Echosounder Display window. Here, you can switch between the channels and the echo data window length in terms of time can be defined. Furthermore, colour and thickness of the digitized bathymetry line can be configured in this dialogue, as well as the setup of the colour mapping for the amplitudes of the signal traces. A drop-down list with several pre-configured colour maps is available. Contrast, colour range and transparency are adjustable, too.
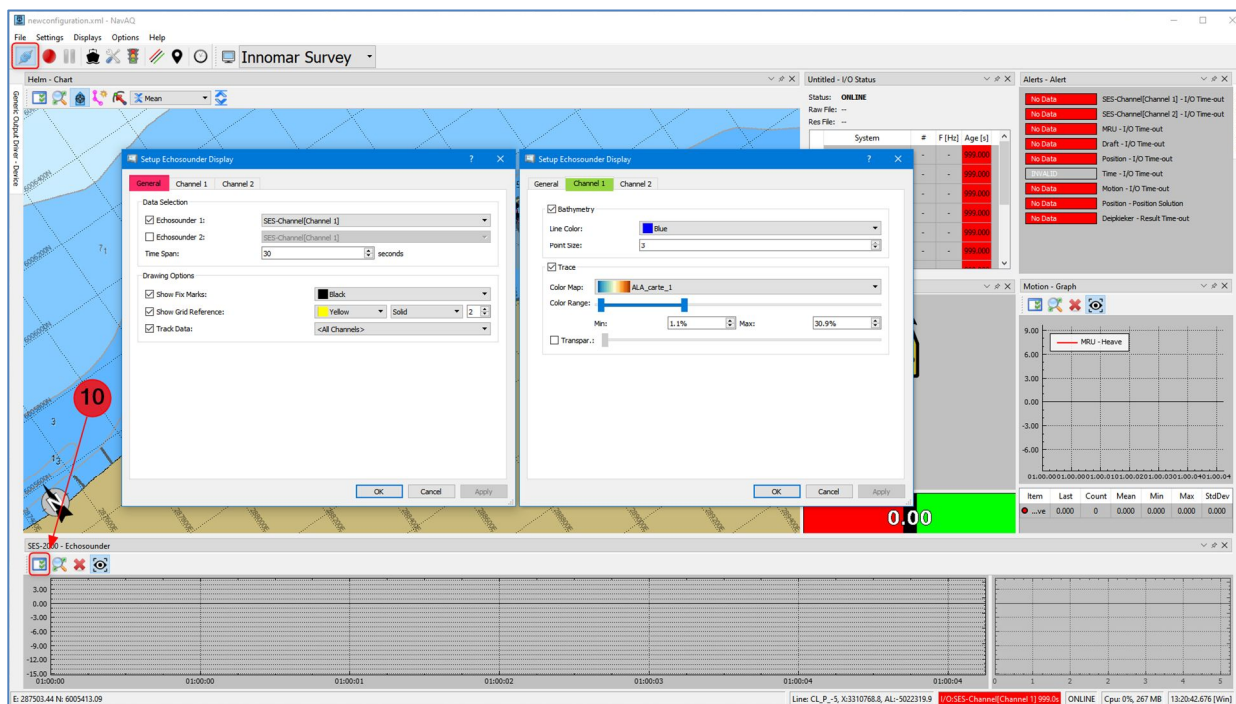
7.10   How to use SESWIN's documentation and report tools

There are several tools available within SESWIN that may be used to document system settings, creating profile lists and for troubleshooting.

7.10.1 Document SESWIN system and interface settings

There is a button "System Setup" menu to produce screenshots of all settings:
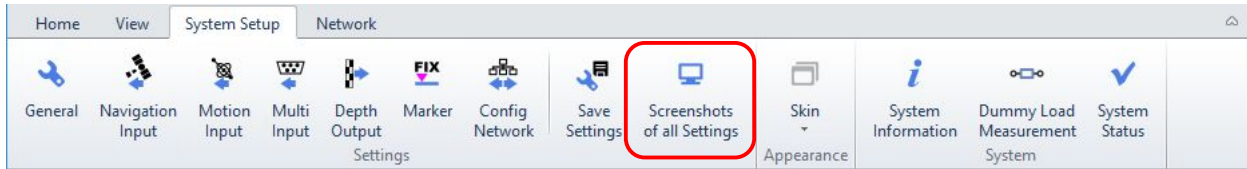
Pressing this button will generate screenshots of <u>all SESWIN menus and dialogs</u>. File names are set automatically. The Folder can be changed; default is set to the SESWIN folder.

Using this feature, you need just two clicks to document all system settings for future reference.

7.10.2 Log files for work reports / profile lists

It is possible to automatically log all data records within a log file called "sesrec.log" that is placed within the SESWIN folder. The generated log file will show the file name (incl. path) and date, time, profile number, area, SIS values, transmitter and range parameters for both, start (SOL) and end (EOL) of line/record. This is shown in the screen shot below.

```
C:\SES_Applications\Data\20081221203621.ses
SOL 21.12.2008 20:36:21 Profile 1 Area
    SIS 442609.45 7002352.64 21.12.2008 20:36:21 0.30615, 309.18 0.48, -8.62
    SET 15kHz 1pulses RStart 14m RLength 15m
EOL 21.12.2008 20:50:58 Profile 1 Area
    SIS 442751.24 7002269.42 21.12.2008 20:50:58 0.14174, 309.52 0.67, -1.07
    SET 15kHz 1pulses RStart 14m RLength 15m

C:\SES_Applications\Data\20081221205304.ses
SOL 21.12.2008 20:53:04 Profile 1 Area
    SIS 442756.71 7002270.39 21.12.2008 20:53:04 0.00000, 309.71 0.14, -4.52
    SET 5kHz 2pulses RStart 14m RLength 15m
EOL 21.12.2008 21:05:25 Profile 1 Area
    SIS 442619.53 7002348.31 21.12.2008 21:05:25 0.00000, 309.71 0.88, -0.61
    SET 5kHz 2pulses RStart 14m RLength 15m
```

To get this log file you have to activate logging within the "System Setup - General - Files" dialog:
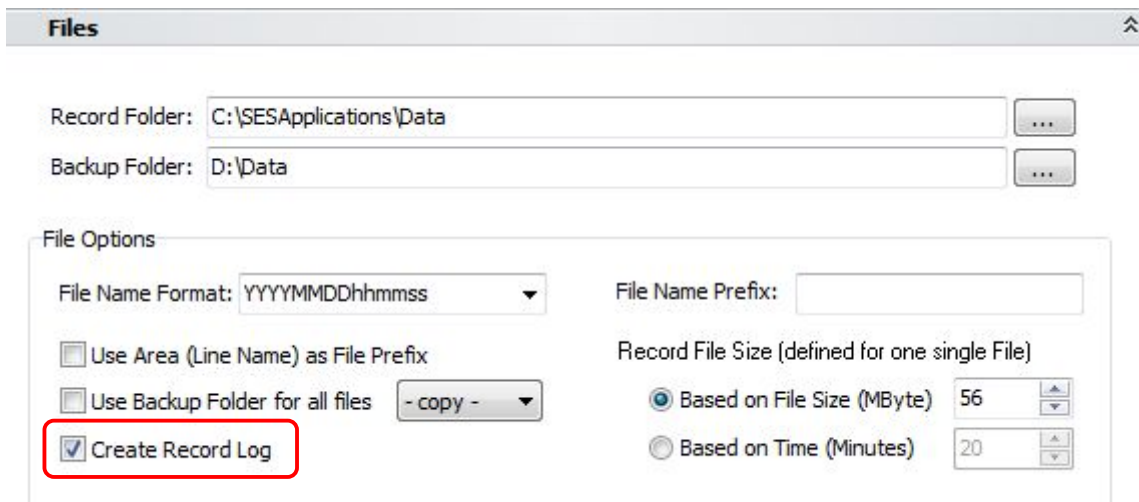
Profile lists can also be generated in post-processing using INNOMAR's ISE software.

7.10.3 System information and LOG files for troubleshooting
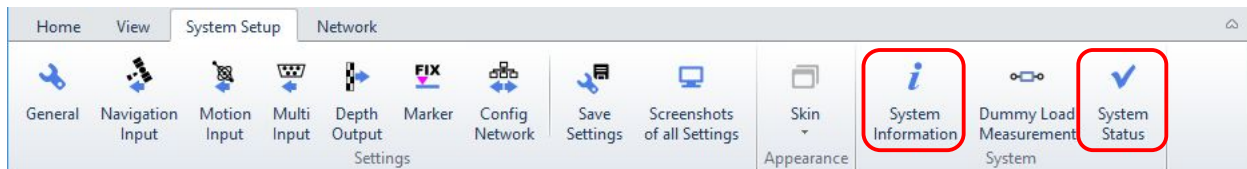
The System Information box shows serial numbers and SESWIN version.

The System Status box shows hardware sensor information like voltages present and temperature inside the topside unit.

There is another log file generated automatically, the "_ses_sys.log" located in the SESWIN folder. This file contains information of each SESWIN start together with all error messages and is mainly intended for use by INNOMAR's technicians if you need assistance for troubleshooting.

7.11 How to reset to factory defaults
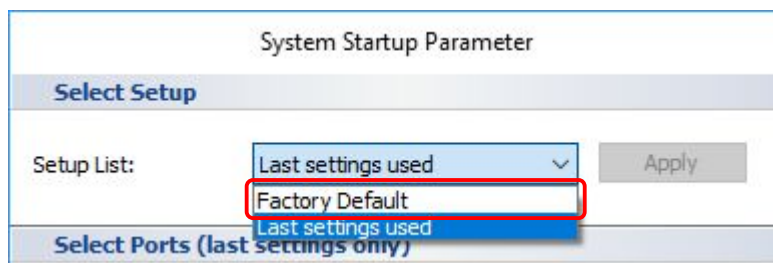
The SESWIN software starts by default with the last used settings. If for any reason these settings are faulty it is possible to reset to "factory defaults". Just select the corresponding item from the drop-down list during SESWIN start, as shown above.

Be aware that all your settings, also for auxiliary in-/outputs like GNNS data, are lost. Please document all settings you made before, e.g. by using the "screenshot" function of the SESWIN software.
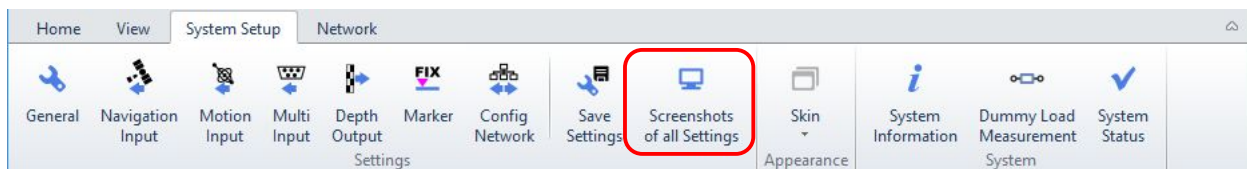
If there are still problems with old settings, you may delete the SESWIN key in the WINDOWS registry:

- Start the Windows registry editor: Start menu → Run → type "regedit" (Win XP) or Start menu → type "regedit" (Win 7/8/10)
- Delete the following Registry Keys:
  - HKEY_CURRENT_USER\Software\Innomar\SES for Windows
  - HKEY_CURRENT_USER\Software\Innomar\SESWIN_2
  (menu entry "Edit | Delete…" or mouse right-click → "Delete")
- Close the Registry Editor

7.12 How to remote-control an Innomar SBP

If it is not possible or inconvenient to have the system operator in front of the INNOMAR SBP transceiver unit, the system can be remote-controlled by:

- KVM extension (recommended),
- serial interface (only basic operation commands possible),
- VPN, TeamViewer® etc.

7.12.1 Operating the Innomar system via KVM extender

Using a KVM extender is the easiest way to operate INNOMAR sub-bottom profilers fully remote-controlled. There is no other computer required and no additional delay if system parameters have to be changed. KVM extension should hence be the preferred solution if remote operation is required.

There are KVM extenders on the market, allowing a distance of several hundred meters, see figure below. KVM switches can be used to control different computers by one set of keyboard, mouse, and video. Such devices are often used to switch between different systems that are not operated simultaneously.
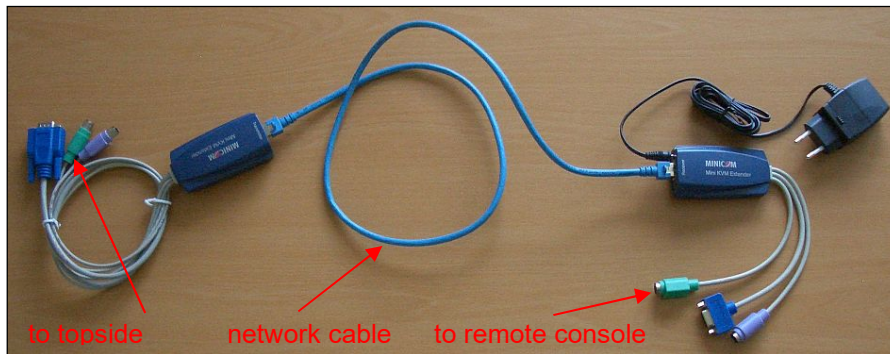
7.12.2 Operating the Innomar system via RS232/Ethernet connection

It is possible to switch on/off data record using a serial interface (COM port) or an Ethernet connection. This feature is not intended to provide full remote-control but to switch on/off data recording controlled by a central computer. For this the "Multi Input" is used (labelled "Serial 1" on some systems, see also section 5.11.15 on page 73).

There is a special NMEA sentence ($SESRM,c,linename,p) sent to the "multi-input" port

If used for remote-control, this port cannot be used for any other purpose.
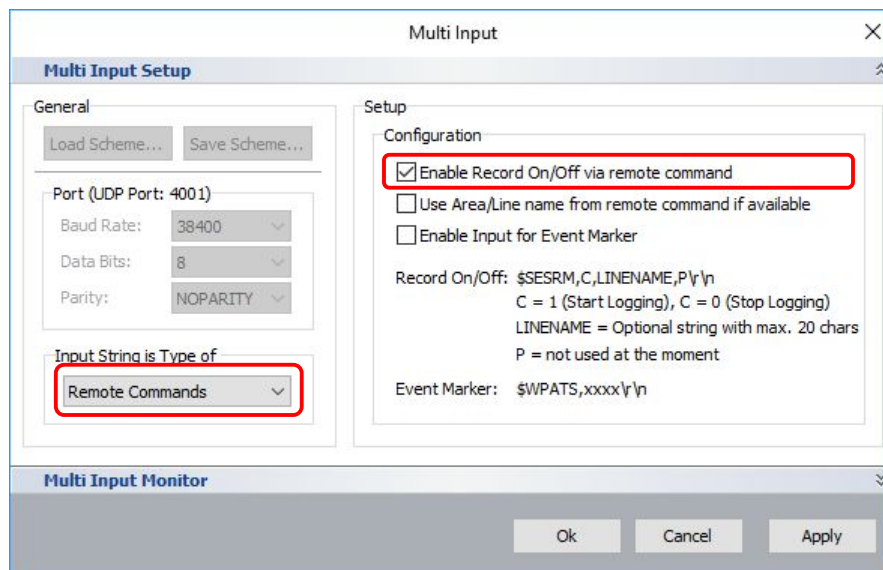
8   Maintenance and Error Handling

In this chapter some problems are discussed, which could occur while operating the system. The hints should help you to solve these issues by yourself. If you have other issues or questions, please do not hesitate to contact INNOMAR directly or an authorised person.

Please check this chapter for any hints regarding your problem before contacting INNOMAR. Please have also a look into the FAQ (section 13 on page 153).

In any case you should reboot the system (topside unit and control computer) and see if the problem persists. For re-booting you should power-off the system for at least 1 minute. This is also true for the control computer; a simple Windows restart is often not sufficient.

In case you need assistance from INNOMAR you should have the following information available:

- serial number of your system (can be read of the topside unit's rear panel or from SESWIN "System Setup – System Information"; the last two parts, a two-digit number and a letter, is sufficient to identify the system)
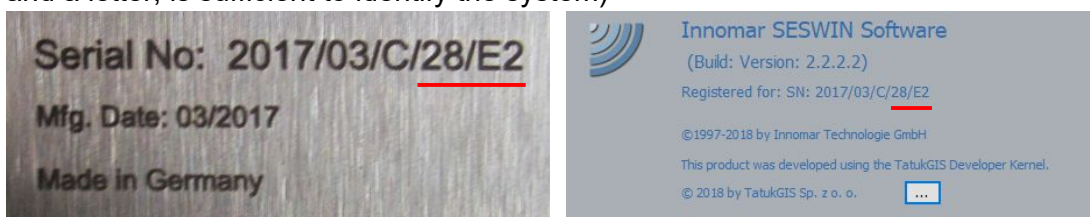
- logfile "_ses_sys.log" located in the SESWIN folder
- a detailed description of the issue and how to reproduce it

Please use the Innomar Helpdesk / Ticket system on our website:
www.innomar.com/support

Emails to
support-ticket@innomar.com
will also go directly into the ticket system.

Innomar Technologie GmbH
Schutower Ringstr. 4
D-18069 Rostock
Germany

support@innomar.com
Tel: +49 381 440 790
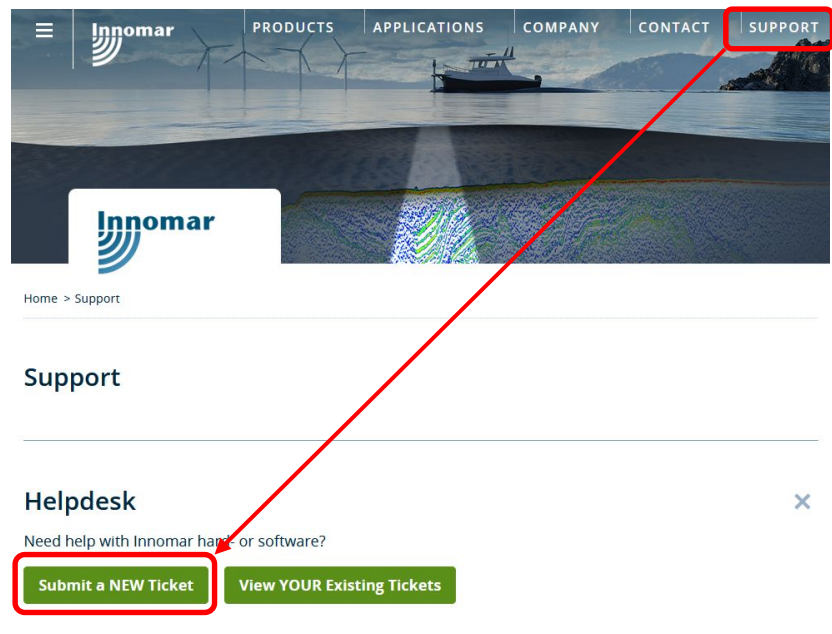
We strongly recommend for all users and technicians to attend the INNOMAR training courses as appropriate, see section 1.5 on page 16.

8.1 Hardware Handling and Maintenance

8.1.1 Transducer

For transducer handling and installation, see section 3.2 on page 26.

- Check the transducer and cable before using.
  Do not use a transducer with damaged face or damaged cable!

- The transducer should be clean while using. If the transducer is situated in water for a longer time without using it, please check if the active area of the transducer is clean before using the system again. The transducer can be damaged if you work with it and there are for instance mussels, seaweeds, filth or mud on the active area. In any case there will be a high loss of the acoustical power!

- Be careful during cleaning the active area of the transducer. Don't use sharp tools.
  The surface of the transducer must not be damaged! No paint, anti-fouling (if not approved by INNOMAR, see next page), oil or grease should be on the active area of the transducer.

- Do not expose the active area of the transducer to strong sunlight for a longer period since UV light affects the chemical and mechanical properties of the material used.

- Avoid thermal stress (e.g. putting sun-heated transducers into cold water).

- After usage rinse the transducer with fresh water and dry the transducer before storage.

- If a transducer is placed into water for a longer period of time, use zinc anodes to prevent corrosion.

- If a transducer is used in tropic waters for a longer period, it is strongly recommended to use an anti-fouling paint (also on mobile transducer installations) to prevent biofouling, see section on hull-mounted transducers next page.

8.1.2 Transducer Visual Inspection

Before putting the transducer in store make sure it is cleaned, rinsed with fresh water and dried. Please also check if the anti-shock foam within the transport box is dry. It is best to keep the transport box open in store to have some air exchange.

Before and after each survey the transducer should be visually checked for any damages:

- Inspect the transducer for nicks, scratches and dents. Pay particular attention to the transmitting face as impacts here can damage the internal elements.

- Check also the cable for any damages. The transducer is operated at high voltages, a damaged cable insulation might be lethal.

- Check the connector contacts for corrosion and damages.

- Check the transducer mounting bolts for damaged threads.

- Check the rubber washers used on the bolts for vibration damping and replace missing or damaged ones. Each bolt is equipped with two rubber washers, one steel washer and one nut.

transmitting face

six mounting bolts

cable with plug
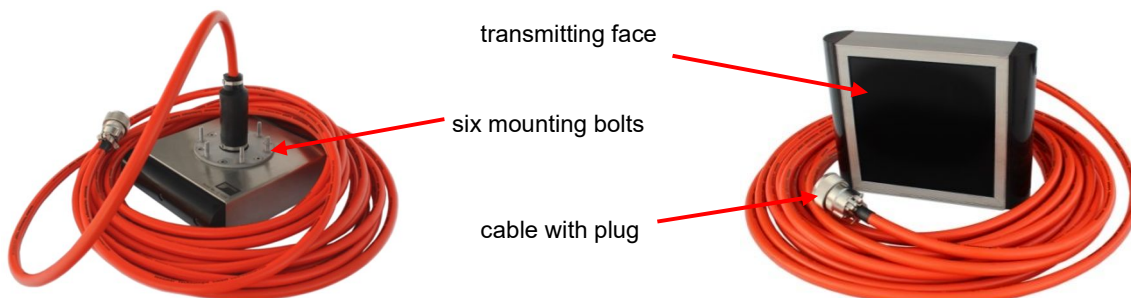
8.1.3 Hull-mounted Transducers

Transducers mounted permanently into the ship's hull should be inspected and cleaned (see above) as often as possible, at least every two years (e.g. when the ship is in dry dock).

Additional handling and maintenance for hull-mounted transducers:

- Before starting usual dock work like sand blasting and painting the hull, protect the transducer by putting covers on the transmitting area.

- Replace the zinc anode within the sea chest regularly to prevent electrolytic corrosion.

- To avoid biofouling reducing the system performance, the transducer needs to be coated using preferably a **water-based primer and anti-fouling paint**.
  INNOMAR approved products:

  - 1 x Hempel High Protect II, 1 x Hempel Conversion Primer, 2 x Hempel Hard Racing
  - Jotun SeaQuantum Ultra S
  - International Marine Intersleek 1100SR

  The anti-fouling coating should be checked and renewed at each docking, preferably every second year.

8.1.4 Topside Unit Handling

As any electronic device the topside unit should be handled with care.

- The topside unit has to be placed in a dry and safe place.

- Fix the topside unit with a suitable method to avoid mechanical destructions during rough seas.

- Make sure not to cover the cooling slots. There are fans inside the unit and a proper airflow is necessary to avoid overheating during operation.

- The topside unit is not water protected. Therefore, avoid all situations where water can get into the system.

- During transport and storage, the transport cases provided by INNOMAR should be used. These boxes are splash-water proof and filled with anti-shock foam. Make sure the foam is dry and was not sprayed with water when the box was open on deck.

- Unauthorized persons must not open the topside unit!

8.1.5 Topside Unit Maintenance

Maintenance work includes:

- If the system is not used for a longer period of time, you should **power on the electronic units at least every six months** to avoid damages at the capacitors.

- All connectors should be checked and cleaned regularly. Contacts showing corrosion should be cleaned or replaced.

- Fan(s) in the rear panel should be checked and cleaned regularly.

- Air-intake filters at the front-panel should be cleaned or replaced regularly, especially if the system was operated in dusty environments.

- Check the voltage indicators at the front panel.

All maintenance work, especially any work which requires to open the unit, to be carried out by trained and authorized persons only!

8.1.6 System-Check

Before starting the survey, you should check the equipment in the lab, especially if the system was not used for a longer period of time:

- ***Check system power***
  Connect the topside unit to a suitable power supply (and connect the control computer, if not built-in). Then switch the system on, the power control LEDs (but the HV LED) should be lit. The trigger (SyncOut) LED should start flashing.

- ***Check receiver data transfer to SESWIN***

  After booting WINDOWS and invoking the SESWIN software, the SESWIN echo print area should scroll from right to left. That is ruler lines appear and maybe noise is visible (depending on gain settings)

  If no ruler lines are visible check at Home – Setup – Ruler Settings:
  "Draw Text" and "Draw Lines" have to be ticked on (see picture).

  If the screen is not scrolling, please check synchronisation settings in System Setup – General – Synchronisation (should be set to "Internal Trigger" in most cases, see picture below).
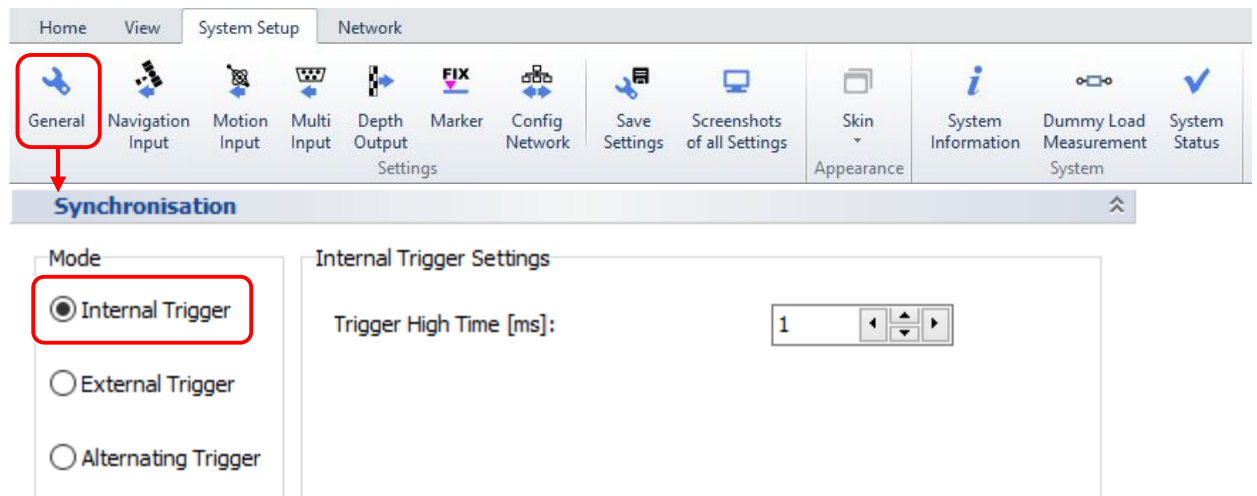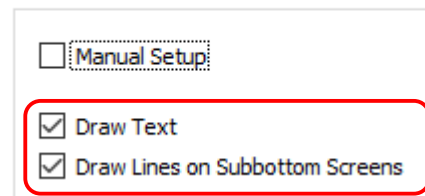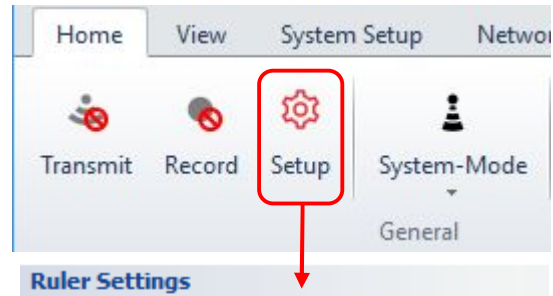
  If this is still not working, **reset the unit to factory defaults**.

- ***Check command data transfer from SESWIN***
  Changing the ping rate (either by using the slider "Home – Transmit SBP – Adjust Ping Range" or just increasing the range) should affect the scrolling speed. This indicates that SESWIN commands are properly recognised by the topside unit.

- ***Check data recording***
  Now you should test if data recording works.

- ***Check additional sensors***
  You should also check data transfer from external sensors (GNSS, motion sensor).
  Please refer to the regarding chapters of this manual for setup of these sensors.

8.2   Hardware Related Issues

This section briefly describes some known hardware-related issues.

8.2.1   The voltage indicators (LEDs) at the front panel are not illuminated

Please check:

- The mains connection for the correct voltage range (100 – 240 V AC / 50 – 60 – Hz).
- The main fuse.
- The topside unit's power switch is switched on.

8.2.2   The internal display is switched off if an external monitor is connected

The internal display will switch off automatically if the screen resolution is set too high for this display. The internal native resolution is 1024 × 768 pixels. Highest possible resolution for both, internal and external display is 1680 × 1050 pixels. Above this resolution the display is switched off if an external monitor is connected.

8.2.3   The internal display is white. The PC seems not to boot.

Please check if an external monitor connected to the monitor output at the front panel is working.

- If yes, the internal display is either switched off (see above) or defective.
- If not, please check/replace the motherboard's CMOS battery. An empty battery may cause the PC not to boot properly and not to drive the display output.

8.3   SESWIN Error Messages at System Start

During the SESWIN start some system tests are performed which may result in error messages as below.

"Critical Error (H): The controller software is incompatible with this unit"

At start-up SESWIN checks the hardware serial number. If this is not compatible with the SESWIN version used, the error message shows up and no operation of the system is possible. Please use the SESWIN version shipped with the system. The numbers are given for reference in the error message, too.

"Critical Error (S): The SESWIN software is incompatible with this unit"

At start-up SESWIN checks the firmware version running on the internal controller. If this is not compatible with the SESWIN version used, the error message shows up and no operation of the system is possible. Please use the SESWIN version shipped with the system. The numbers are given for reference in the error message, too.

"Control Port at COM1 failed …"

The serial port COM1 is used for internal communication within the *"light"*, *"standard"* and *"medium-100"* models and cannot be changed. If this port cannot be opened by SESWIN, no operation is possible.

"xxx COM Port not opened"

SESWIN tries to open all selected I/O ports during start up. If this is not possible, an error message shows up.

- Another program may be active that occupies the serial port. SESWIN has no access to that COM port. Exit SESWIN and that other program. After 10 seconds, invoke SESWIN once again. If this does not help, rebott the entire system.

- If the message "SIS COM Port not opened!" appears maybe GNSS data were connected to the control computer during booting and WINDOWS might assume an additional mouse device has been detected. The COM port is then occupied by a mouse driver and can't be accessed by the SESWIN software. Disconnect the "NAV Input" before booting can avoid this.

"System running in External Trigger Mode..."

If the system detects the synchronization is set to "external trigger" at start-up, this message is shown to remind the user on this fact.

- If you not intend to use this mode, change to "Internal" at "System Setup – Settings – General – Synchronisation" See also section 5.11.3 on page 60.

- If you have to use "External Trigger", make sure there is a synchronisation signal fed to the "*Sync IN"* input. The synchronisation modes and the necessary trigger signal are described in section 6 on page 81.

"System running with reduced Ping Rate. Would you like to change it?"

Usually the INNOMAR system should operate at the highest possible ping rate. This is set automatically by the system itself. However, it is possible to reduce the ping rate. If this was done and active during shut down, the system reminds you on this fact at the next program start to avoid unfortunate settings made by mistake.

"IO_Port not found ..."

This warning messages shows up if the hardware sensor port is not available. This results in missing sensor values at System Setup – System Status, but the system is usually fully operational.

"No Setup selected from the Setup List!"

By default, SESWIN starts with the last used settings. However, it is possible to save the current SESWIN settings to user profiles. Settings saved can be selected during SESWIN start. If no user profile is selected, this message shows up.

"The system and SESWIN setup will be reset to factory default and restart again …"

By default, SESWIN starts with the last used settings. However, it is possible to reset the system settings to factory default. This is useful if the system behaves strange. To avoid resetting the system by mistake, this warning message shows up.

"Detect changes of WKT Files. Please check Settings …"

It is possible to use user-defined conversion of position data, see section 5.11.11 on page 67. If SESWIN detects changes on the definition files during start-up, this warning message is shown. You should check if the settings are correct.

"Network cable seems not to be connected."

This message is shown by the INNOMAR *"compact"* model, if no Ethernet cable is plugged to the control computer.

"NetControl failed to connect."

This message is shown by the INNOMAR *"smart"* and *"compact"* models, if no Ethernet connection could be established between the control computer and the topside unit.

8.4   SESWIN Error and Warning Messages at System Setup

During system setup (menu "System Setup – Settings") some error or warning messages my show up as below.

"Switch transmitting Mode to Sub-Bottom Single Frequency ..."

"Multi-Ping" and "Burst" modes are possible with "internal trigger" only. If synchronisation is set to "external trigger" or "alternating trigger" these system modes are not available.

"xxx Port was not opened ..."

This warning message shows up if settings of one of the serial I/O ports (Navigation Input, Multi Input or Depth Output) are changed, but the related port could not be opened at system start-up.

"The length of one or more SIS Strings is set to zero. Please check your settings."

This warning message shows up if at least one of the SIS strings is set to length "0". This means that at this position no information is stored. See sections 5.11.8 (page 64) and 7.3 (page 92) for details.

"PC-Time Synchronisation is not available. Please turn off User Account Control (UAC) or run SESWIN as Administrator ..."

The SESWIN function to synchronize the PC clock to the GNSS time needs Windows permission to access the PC clock. This permission is by default given to the administrator only. Therefore, you have either to run SESWIN with administrator privileges or to change the settings at "Control Panel -> All Control Panel Items -> User Accounts -> Change User Account Control Settings". After changing this to "never notify", please re-boot Windows.

"Input and Output positions are the same. Are you sure?"

If you set up the "Coordinate Conversion" (see section 5.11.11 on page 67) this message warns you when source and destination SIS string ID is the same, because in this case the original GNSS position data is lost. You should keep the original position data and write the converted data to another SIS string.

"Determining Failed"

This is shown if the local UTM zone could not be determined from the current GNSS position data. See section 5.11.11 on page 67.

"Offset Correction was turned on. The applied Motion Sensor Format is TSS-1. This format does not include true heading information. Please configure settings ..."

Transducer offset correction requires true heading values. If heading source is set to "motion sensor" and the motion sensor format used is "TSS1" this message shows up.

"Motion Sensor data is not present. Please connect MRU first …"

Within the motion sensor setup dialogue, it is possible to search for the sensor and obtain port settings automatically. If no incoming data is detected on the selected COM port, this message is shown since automatic detection is not possible without data present.

"System should be running in Internal Trigger Mode. Please activate first …"

Within the motion sensor setup dialogue, it is possible to search for the sensor and obtain port settings automatically. This works only if the system is running with internal trigger.

"Missing description to save the new setup. Abort ..."

It is possible to save the current SESWIN settings to user profiles. For this the user profile needs to have a unique name/description.

"Record Folder is not allowed or missing. Please select a different.",

"Backup Folder is not allowed or missing. Please select a different."

If you specify a folder for data logging or data backup that you have no write permission or that does not exist, the message is shown. At Windows 7/8/10, the system drive ("C") it is usually forbidden to write to for users without administrator privileges. Just select or create another folder. Make sure to set the "Record Folder" to a folder on the internal local hard disk. USB or network drives should not be used. See also section 5.11.4 on page 61.

"New Record Path created ….",

"New Backup Path created …."

If you specify a folder for data logging or data backup that is not yet existing, it is created automatically.

"System is not connected. Configuration is not possible … Abort."

This message is shown by the INNOMAR *"smart"* and *"compact"* models, if one tries to change the Network Configuration without connected topside unit.

8.5   Other SESWIN Error and Warning Messages

"SYSTEM-ERROR on Low-Voltage Sensors ... TURN OFF SYSTEM IMMEDIATELY!"

The system power supply detects that one of the voltages used in the system fails, this error message shows up. Afterwards the "system status" screen is shown and you should save a screen shot (button in the lower right corner of that dialog. SESWIN is turned off automatically. You should turn off the topside unit immediately and contact INNOMAR.

"No incoming data. Please check synchronization mode …"

If SESWIN gets no data from the system, there is a timeout after some time and this message shows up. Often this is due to synchronization is set to "external trigger" and no trigger pulse is received.

- Look at "System Setup – Settings – General – Synchronisation" and change the mode to 'Internal'. See also section 5.11.3 on page 60.

- If you have to use "External Trigger", make sure there is a synchronisation signal fed to the "*Sync IN*" input. The synchronisation modes and the necessary trigger signal are described in section 6 on page 81.

"xxx Transducer is not plugged. Abort action …"

"Sub-bottom Transducers and/or Junction Box not plugged. Abort action …"

"Junction Box not plugged. Abort action …"

Every time the transmitters are switched on, the system checks if the transducer cables are plugged in. If no transducer is plugged, the transmitters are not switched on.

- Check if the transducer is connected properly. Unplug and plug again.

- This message might be also shown if there is some data/communication problem between SESWIN and the internal controller, in this case the echo print screen is not scrolling from left to right.

"xxx Transducer is not plugged. Continue?"

Every time the transmitters are switched on, the system checks if the transducer cables are plugged in. For some models and system variants with more than one transducer cable it is possible to operate the system at reduced performance with just a part of the transducer. This message shows up to remind you that not all the cables are plugged and thus the system will not operate at full power.

"Reset on Control port detected. Transducer switched off."

If the internal firmware controller is reset, SESWIN shows this message. This might happen if the controller crashes due to faulty parameters that were not detected by the built-in parameter check. Please check the range settings and the transducer depth.

"Recording ERROR SES-File", "Recording ERROR RAW-File",

"Record Folder is not allowed or missing. Please select a different."

This message shows up, if the data cannot be logged on the specified drive/folder. Please check the settings in "System Setup – Settings – General – Files", see also section 5.11.4 on page 61. The current folder does either not exist or you have no permission to create and change files in this folder. Make sure to set the "Record Folder" to a folder on the internal local hard disk. USB or network drives should not be used.

"Backup Path not found. Disabled function ..."

This indicates that the data backup folder specified was not found while doing the backup. The data backup function will be disabled, the data logging is still operational. Please check the settings in "System Setup – Settings – General – Files" and if the destination folder is accessible. See also section 5.11.4 on page 61. The current folder does either not exist or you have no permission to create and change files in this folder.

"Sub-Bottom Beam Steering Mode running with 3 equal angles"

If "Beam Steering Mode" is activated and all angles are set to the same value this warning message is shown. Usually this mode is used to transmit subsequent pings with different angles (different directions).

8.6   No incoming sensor data

8.6.1   No data or instable from the Motion Sensor

The motion sensor is connected to the INNOMAR SBP "Motion Sensor" connector, but the "Motion Sensor" values shown in the SESWIN "Info" area permanently show '0.0' or seem not be correct. The MRU indicator within the SESWIN status bar is not green.

Solutions:

- Check the settings in the "System Setup – Settings – Motion Input".
- Check if the motion sensor is set to the right protocol and to the right parameters. To do that, the manufacturer's configuration utility should be used. For further details refer to the motion sensor manual.
- It takes some time for the motion sensor to stabilize, allow some minutes for that process. A stable state has been achieved if the MRU status indicator in the SESWIN status bar is green. A yellow indicator means that data are received that are either marked unstable by the sensor or that are not recognized due to wrong interface settings.

General hints how to setup the motion sensor properly, are given in section 7.5 on page 98.

8.6.2   No incoming position data

The GNSS connector is plugged to the "Navigation In" socket, but you can't see any position data in the "Navigation" part of the SESWIN "Info" area. The NAV indicator within the SESWIN status bar is not green.

Solutions:

- Check if your GNSS receiver is switched on.
- Check the SIS settings made in "System Setup – Settings – Navigation Input", see section 5.11.8 on page 64.
- Check if data is received by the system ("System Setup – Settings – Navigation Input – NAV Input Monitor")

Some more detailed information on this topic is given in section 7.3 on page 92.

8.7   SESWIN functions seem not to work

8.7.1 Transmitters can't be switched on

- If the transducer is switched on there is a warning message to remind you that the transducer has to be covered by water during operation. If you are sure that the transducer is installed properly, click "OK" to proceed.

- The transducer connector might not be plugged in correctly. There is a safety circuit that detects, if the transducer is plugged in or not. If no transducer is detected by the system, an error message "Sub bottom Transducer is not plugged" pops up.

- Inside the topside unit there is a temperature sensor to detect overheating electronics. To prevent damages transmitters are switched off in case of too high temperatures and a warning message is shown on screen. To avoid this problem, you should take care of proper cooling and free airflow around the topside unit. In very warm environments the topside unit should be placed in air-conditioned rooms. A faulty fan in the rear panel of the electronic unit might also cause overheating. It should be replaced as soon as possible.

8.7.2 Changing the "Range" is impossible

- The "Range Length" cannot be changed while recording data. Switch off "Record" before changing the "Range Length".

- The "Range Start" cannot be smaller than the transducer draught as set in the "System Setup – Settings – General – System" dialog.

8.7.3 Data-Recording is not possible

- There might be not enough space on the hard disk. The available space is shown in the SESWIN status bar. The colour of the HD indicator should be green.

- The record folder ("System Setup – Settings – General – Files") does not exist or there is no permission to create files in that folder. Change the folder accordingly.

8.7.4 The Output "Depth Out" does not work

It seems that there is no data available at *Depth OUT*. The external device connected to that output does not show any reaction.

- Depth OUT is a serial interface; its settings have to be made according to the requirements of your external device in the "System Setup – Settings – Depth Output" dialog. Select the appropriate settings for the COM port, data format, depth output mode and for the separator characters required by your external device.

- The settings in the field *"Depth Output"* of the above-mentioned dialog determine when the depth data string is transmitted. If '*on new SIS data*' is selected, changing SIS data (navigation data) must be recognized by the system. Otherwise no data is fed to *Depth OUT*! To output depth data anyway, choose 'every second'.

- Check if depth data are sent by the Depth OUT port of the INNOMAR system by using another computer and a terminal program like 'Windows Hyper Terminal'.

- To modify the settings of your external device, refer to its manual.

8.8   Signal detection problems

8.8.1 No seafloor on the screen

The system is running, transmitters are switched on, but there is no echo on the screen representing the seafloor.

* One reason for that might be that the range and / or the range start have been set improperly. Modify the range settings. Choose at first a longer range to find the seafloor and decrease the range then to the interesting length. Often it is better to look for the bottom signal in the HF channel at first.

* The gain might be too low. Modify the gain settings.

8.8.2 The echo signal is too small

If the received signal is too small, there are several possibilities:

* *Weak bottom material (mud)* If there is a layer of mud or fluid mud, the LF bottom signal is very weak. Check the amplifier settings and look at the HF channel, if you can get there a better seafloor signal.

* *Survey areas with steep slopes* If you are working in an area with steep slopes of the bottom, you can have small signals from the sea bottom due to the narrow sound beam. Use the AGC function in such areas while operating in a long range.

* *Dirty water (dredging activities)* You are working in an area with very dirty water, for instance during dredging activities. Such conditions cause a very bad signal to noise ratio and you will get a high noise level at normal gain settings. To get a better signal to noise ratio and therefore a better picture you should increase the stacking rate and you should slow down the ship.

* *Dirty active area of the transducer* You have clear water and flat bottom and you cannot get the sea bottom signal with common gain settings. If the transducer is situated in water for a longer time please check if the active area of the transducer is clean. The transducer can be damaged if you work with it and there are for instance mussels, seaweeds, filth or mud on the active area! You will have a high loss of the acoustical power. Be careful during cleaning the active area of the transducer. Don't use sharp tools. The surface of the transducer must not be damaged! Furthermore, no oil or grease should be on the active area of the transducers.

* *Transmitters might not work* If you have checked all items above and you cannot get a better signal then a transmitter board might be faulty. Switch off the system and wait for at least 3 minutes. Check the fuses at the rear panel. If a fuse has blown, replace it. Make sure you feel a slight 'click' when the fuse is pushed in to guarantee a good contact. Switch on the system to see if there is a better result. If the fuse is blown again please contact INNOMAR or an authorized person.

8.9   Firmware Update

Within the INNOMAR topside unit there is a microcontroller. If new features are available within the SESWIN software a firmware update for this microcontroller might be also necessary. In this case INNOMAR will provide a new firmware data file together with the new SESWIN version. The steps listed below cover a full software update SESWIN and microcontroller Firmware:

1   Save your current SESWIN settings

Take screenshots of all your current SESWIN settings (red below). You may also save all settings to a SESWIN *.ini file (green below), but the INI file format may have changed, so saving the screenshots is recommended in any case.
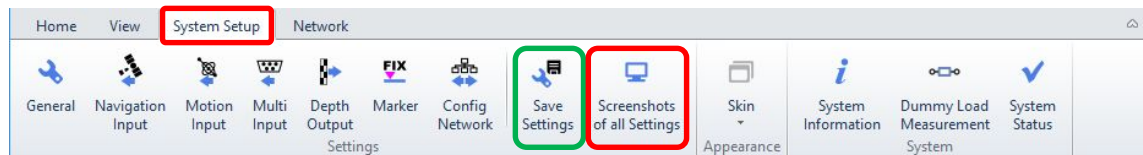
2   Keep a copy of your old SESWIN

You should keep a copy of your old SESWIN folder. You may just rename your current folder or copy/move it into your software archive.

3   Remove the old SESWIN including all settings

This step can be usually omitted, but if you wish to start from scratch to have a clean system without artefacts from older SESWIN versions, then remove the SESWIN key in the Windows registry:

- Start the Windows registry editor: Start menu → Run → type "regedit" (Win XP) or Start menu → type "regedit" (Win 7/8/10/11)
- Delete the following Registry Keys:
  - HKEY_CURRENT_USER\Software\Innomar\SES for Windows
  - HKEY_CURRENT_USER\Software\Innomar\SESWIN_2
  (menu entry "Edit | Delete…" or mouse right-click → "Delete")
- Close the Registry Editor

4   Copy the new software and update links

Create a new SESWIN folder and copy the provided Innomar software into this folder. The software is usually provided as ZIP archive file.

If the new SESWIN folder is now in another place, then you have to update the links at your Windows desktop pointing to SESWIN and the manuals. Please be aware that the manuals may have new names because of new releases.

5   Update the microcontroller firmware

For updating the firmware, start the INNOMAR "Firmware" application from the SESWIN folder:

- A. "InnomarFirmware.exe" for all models with new SESWIN version.
- B. "NetworkFirmware.exe" for older SESWIN and models with external data acquisition PC ("smart", "compact", "standard-rov", "standard-usv", "medium-usv")
- C. "FirmwareCX.exe" for older SESWIN and models with internal data acquisition PC ("light", "standard", "medium-100", "medium-70", "deep-xx", "quattro", "sixpack")

See below the procedure for the different variants.

A **"InnomarFirmware.exe" for all models with new SESWIN version**

- For models with external PC, make sure the topside is connected to the same Ethernet as your PC.
- Start the "InnomarFirmware" app and follow the instruction given by the software.

B **"NetworkFirmware.exe": Models with external data acquisition PC (older SESWIN)** ("smart", "compact", "standard-rov", "standard-usv", "medium-usv")

- Make sure the topside unit is connected to the same Ethernet as your PC.

- In the "Open Firmware File" dialogue (1), select the provided data file (2) and press the "Open" button (3).
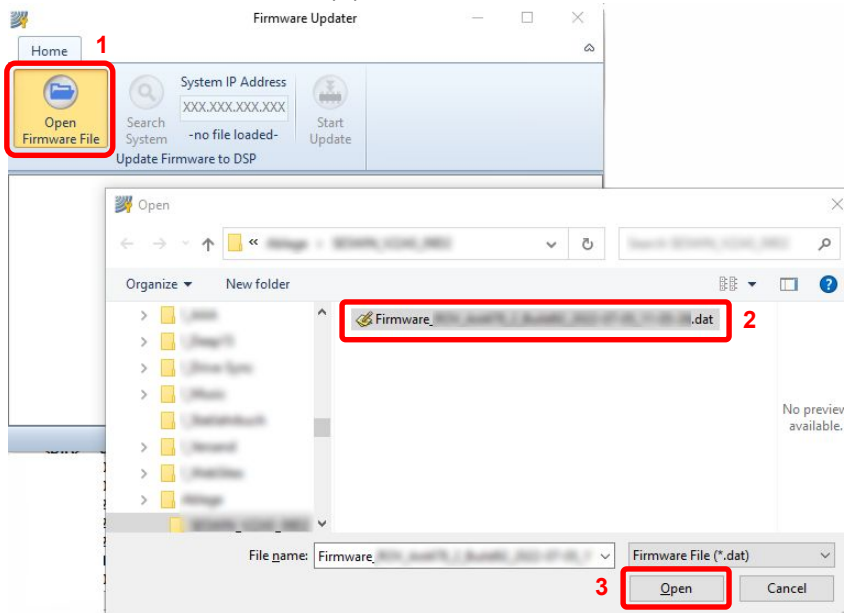
- Press the "Search System" button to set the IP address of the topside unit (4) and acknowledge the IP address found (5). If the system is not found, reboot the topside unit.

- Press the "Start Update" button (6). The update starts and the progress is shown in the text area (7).

- The update process may take a while, the software will show a message if the firmware update is finished. Then you can close the updater software (8).

- Reboot the topside unit (power off, wait for one minute, then power on).

C   "FirmwareCX.exe": Models with internal data acquisition PC (older SESWIN)
("light", "standard", "medium-100", "medium-70", "deep-xx", "quattro", "sixpack")

- In the "Open Firmware File" dialogue (1), select the provided data file (2) and press the "Open" button (3).

- Press the "Start Update" button (4). The update starts and the progress is shown in the status bar (5). The update process may take a while, the software will show a message "Update finished" (6) if the firmware has been applied. Then you can close the updater software (7)

6   Start SESWIN and reset your settings

- As there may be new or changed features, some settings may be different from the SESWIN version you were updating from. Please refer to the release notes.

Blank Page

9   Innomar NetViewer Software

Sometimes it is useful to have echo print data and main system settings available on other (remote) screens in order to give a second operator or supervisor the possibility to QC the online data acquisition. For this INNOMAR provides a small software tool "NetViewer" that can be copied to any computer on the same network as the SBP control computer. There is no installation required and the software will not do any changes to the system.

After starting the "NetViewer" application you get the main screen as shown below.
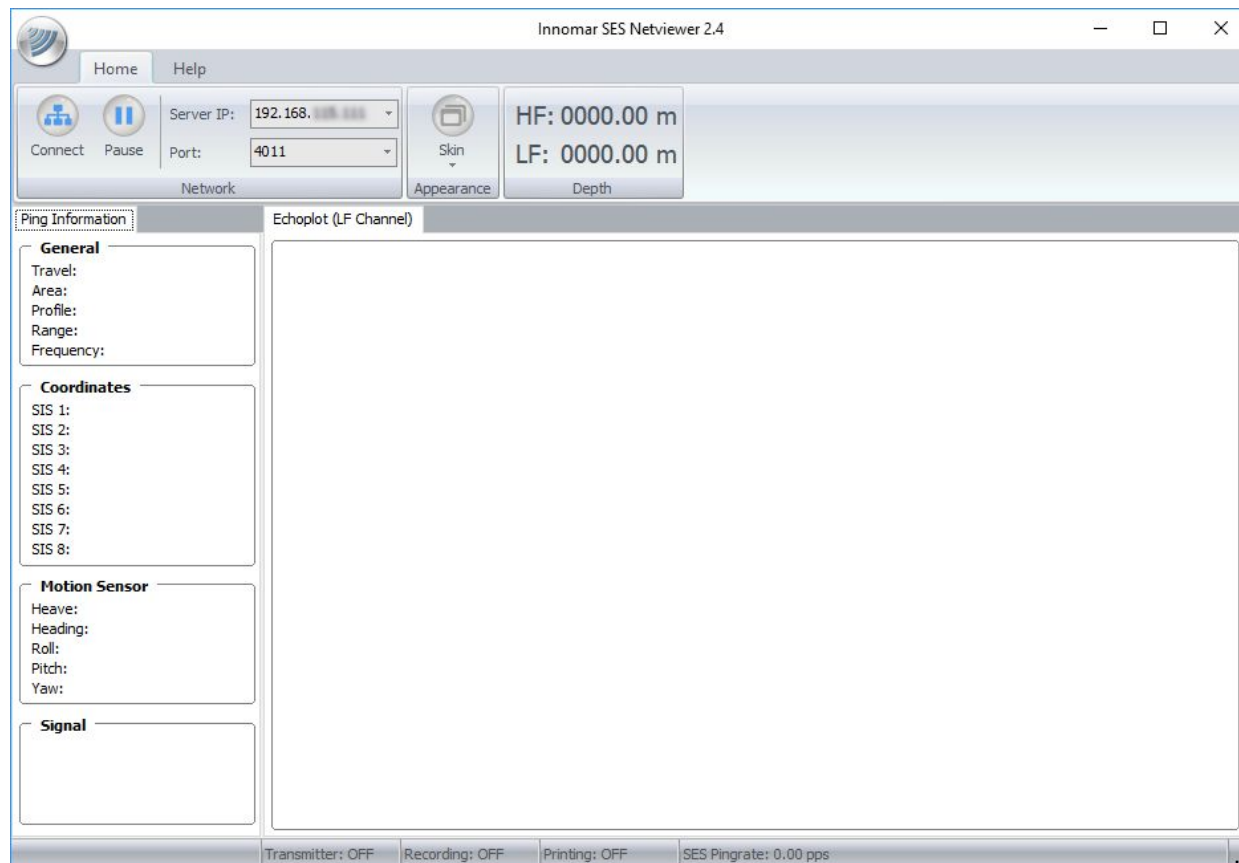
Within the SESWIN software, the Broadcast Server has to be activated, see section 5.14.2 on page 80.
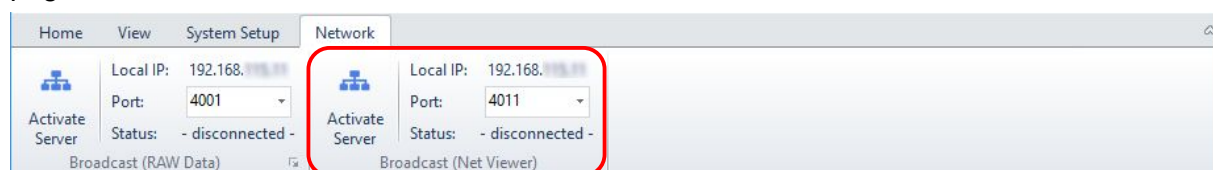
The server IP address is shown because it has to be set within the "NetViewer" client. The port number can be changed if necessary, default is 4011. Pressing the button "Activate Server", starts the server looking for clients.

In the "NetViewer" software the IP address and port number have to be set according to the values shown in the SESWIN Network dialog. Pressing the "Connect" button will start the data connection to the SBP control computer.

Blank Page

10 Innomar SES-Convert Software

This chapter describes how INNOMAR data files can be converted into the SEG-Y data format, which is often used by seismic processing software. Make sure to convert the "RAW" or "SES3" data files; "SES" data files are not sufficient for SEG-Y data processing.

10.1 Example data at Innomar's ISE post-processing software

The following picture shows a INNOMAR SBP data example as viewed using the INNOMAR ISE post-processing software (processed RAW data file: envelope / amplitude view).
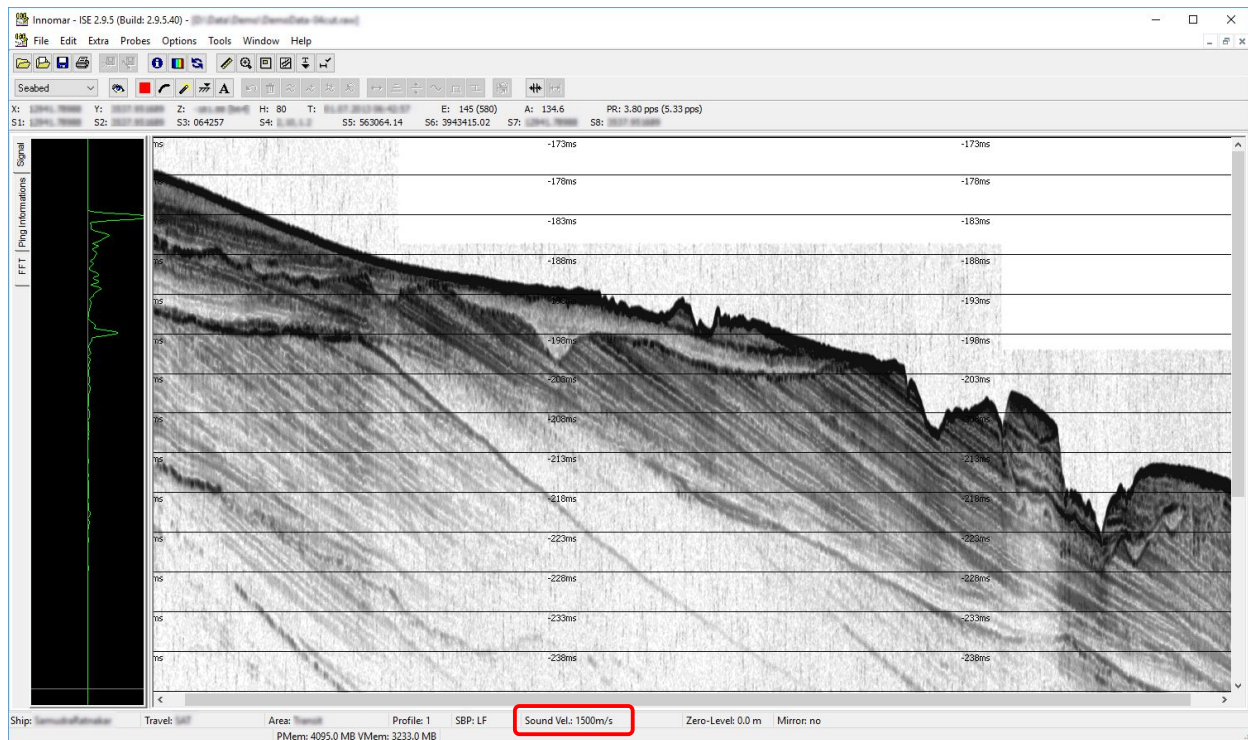
The screen shot on top shows data with TWT lines in ms-scale to have a better comparison with the SEG-Y data shown later on.

According to the screen shot on the right, there are 5445 traces with 5120 samples each within the data file. Data were sampled in a range of 60 m (80 ms), starting between 130 m (173 ms) and 150 m (200 ms).

Sample frequency was 48 kHz (data were recorded with the INNOMAR *"deep-36"* model).

10.2 Convert Innomar data into SEG-Y format using SESCONVERT
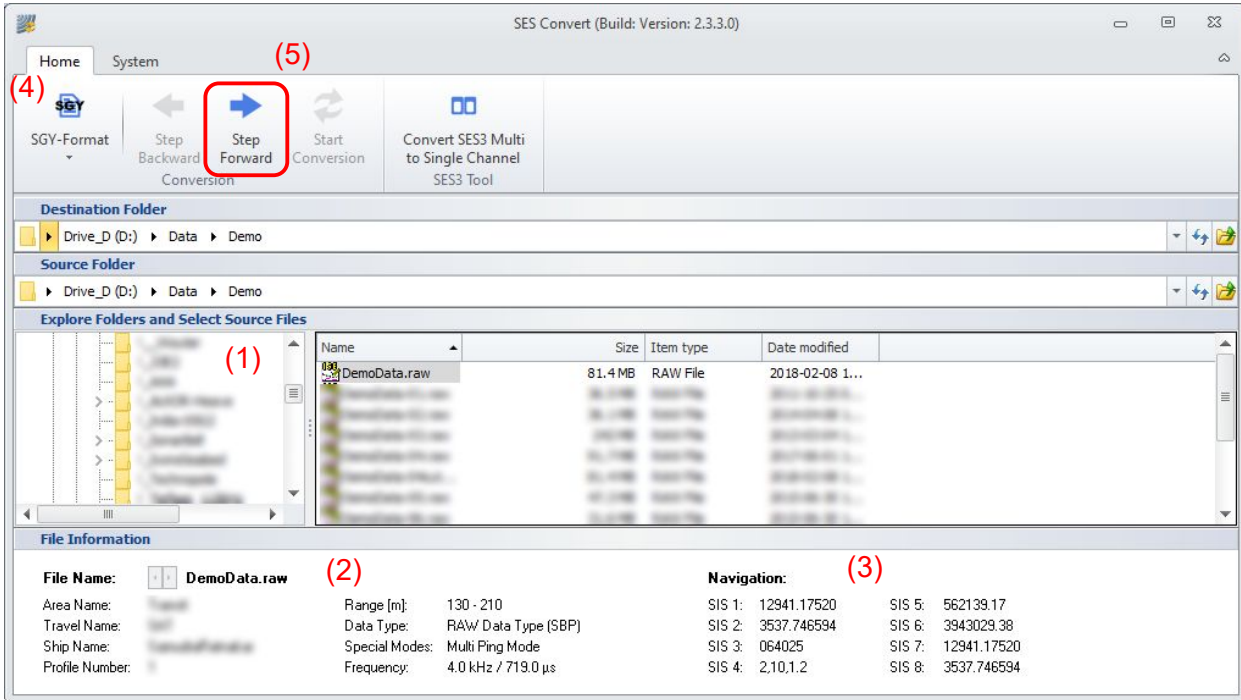
(1) Use the file browser to navigate to the location of the files to be converted.

(2) If a single file has been selected, there is some file information shown.

(3) Check the SIS-IDs and note the IDs used for time and position data.

(4) Select the desired file format from the "Home" menu, SEG-Y format is the default.

(5) Press "step forward" to proceed.
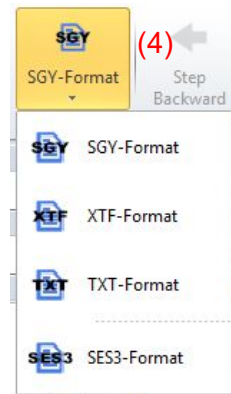
If everything has been selected, the red highlighted button "Step Forward" will proceed to the next window.

If no destination folder has been selected until now, a warning message shows up.
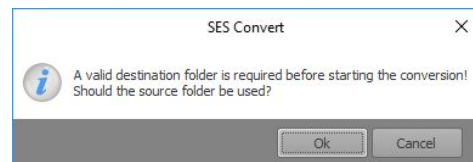
10.2.1 SEG-Y Conversion Settings

Navigation Source

First, set up the data format and SIS-IDs used for position data coordinates within the Innomar data file. Take care on correct LAT/LON settings.

Time Source

Select the SIS-ID of recorded GNSS timestamp or use the PC time stored within the data file.

Please note that there are a lot of different time formats possible within the Innomar data files. Most, but not all, time formats are supported by the sesconvert tool. To avoid error messages due to wrong time format the PC time stored within the Innomar data file can be used instead.

Coordinate Scale Factor

In the data example above there are metric navigation data within the data file that should be handled as float values and written as metric data into the SEG-Y file. Navigation data is handled as integer values within SEG-Y files. In order not to degrade position resolution or accuracy by truncating float values to integers the position data are usually scaled by a constant factor. For metric data you should use a scale factor of 100 (centimetre accuracy) since some SEG-Y tools cannot handle sub-centimetre positions.

Conversion Parameter

Within the SEG-Y data files data may be stored in different byte-order, depending on the requirements of the target software: INTEL format (little endian; least significant byte first) or MOTOROLA format (big endian; most significant byte first).

It is possible to convert only one data channel (LF data only or HF data only) or both data channels. There will be one SEG-Y file per data channel and (in case of multi-frequency Innomar data files) per frequency. Thus, there might be multiple SEG-Y files generated from one Innomar data file.

10.2.2 SEG-Y Processing Settings
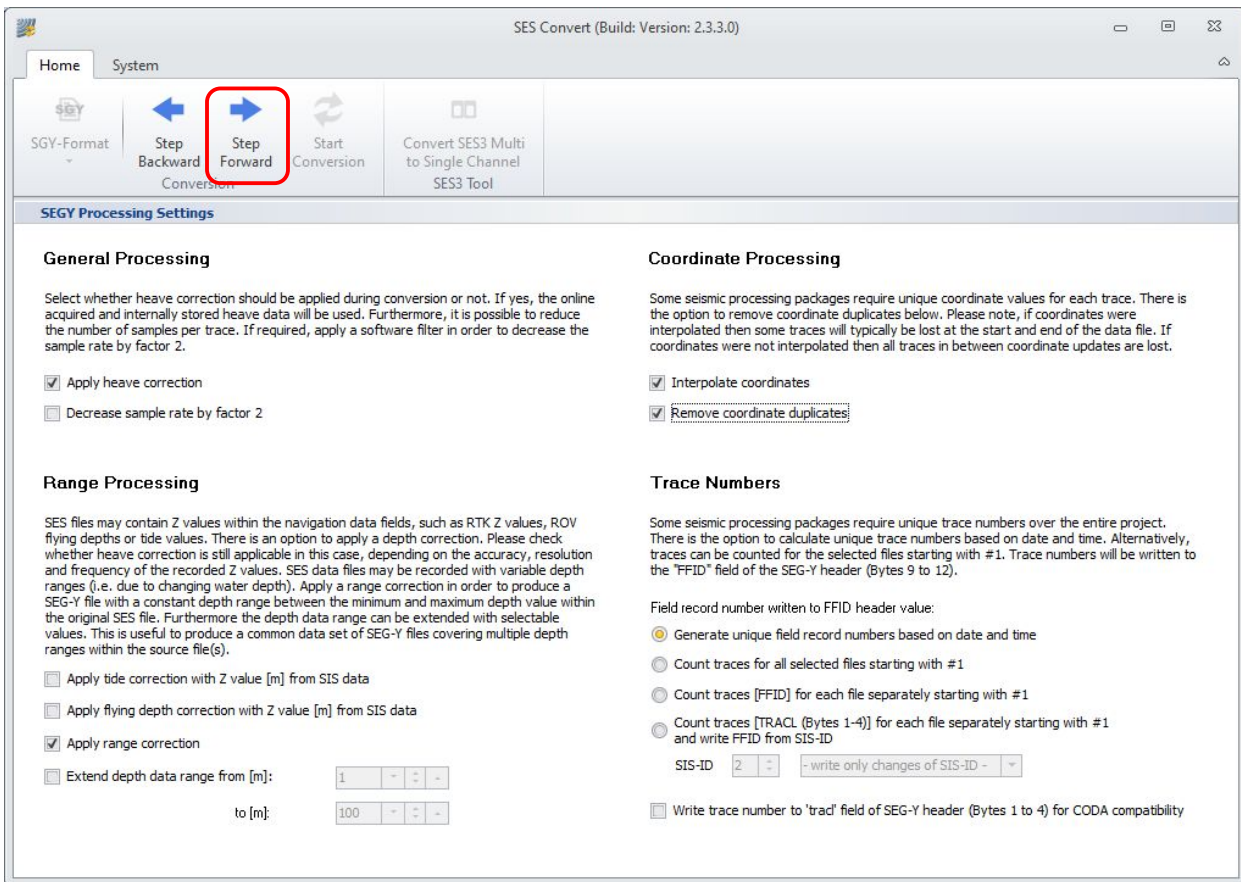
General Processing

Data written to the SEG-Y file will be heave-compensated by default using the heave data stored within the INNOMAR data file. If for any reason the heave values are assumed to be faulty, heave correction can be omitted. If required, there is also a possibility to decrease the number of samples per trace, to reduce the size of the output file.

Range Processing

There are three options within the "Range Processing":

- The first option is to apply a depth correction if Z-values such as RTK-Z, ROV altitude or tide values are available.
- Range correction is applied by default since some SEG-Y processing software does not support changing trace start offsets.
- The extend depth data range option fills data by zeros to have the same start for all traces within different data files.

Coordinate Processing

Some seismic software requires unique position data for each ping. Therefore, we recommend interpolating the position data (if not already done using the ISE software). Anyhow you should activate to remove coordinate duplicates here.

Trace Numbers

Some seismic software needs unique trace numbers within the entire project (over all data files acquired). Within INNOMAR data files trace numbers start with each profile. There are options to generate unique trace numbers based on ping date and time or to count traces over all INNOMAR data files converted.

10.2.3 Data Conversion

All files, which have been selected in the file browser, are going to be converted using the same settings, if the "Start Conversion" button has been pressed. File names are generated automatically using the INNOMAR data file name and a channel identifier. Optionally, there is an ASCII export of the coordinates.

If both channels were selected to be converted ("LF-HF Channels"), there will be two SEG-Y files generated. If there are multi-frequency INNOMAR data files converted, there will be one SEG-Y file per frequency.

Please note, that existing files (same file name) will be replaced without warning message.

10.3 Checking the SEG-Y files

Before a larger amount of data files is converted, one should check, if a test file is read correctly by the target SEG-Y processing software.
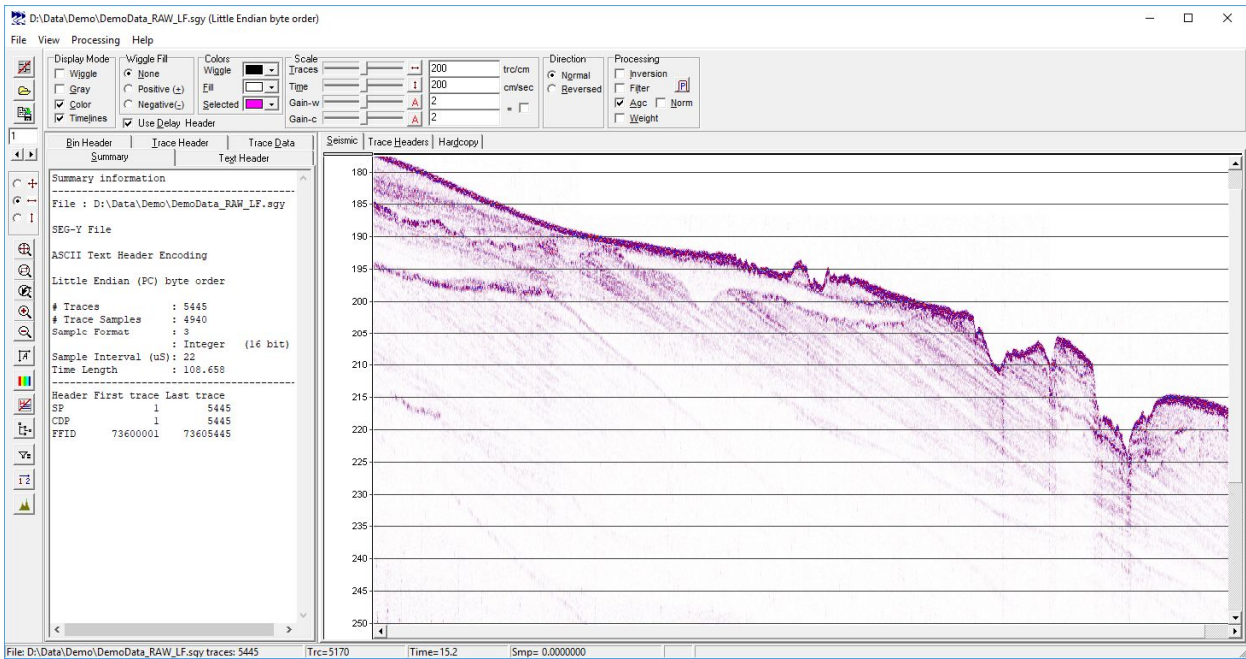
10.4 Store / Reload Conversion Settings

As seen above there are many settings to comply with a special target software. These settings can be saved and reloaded in the "System - Settings" menu:
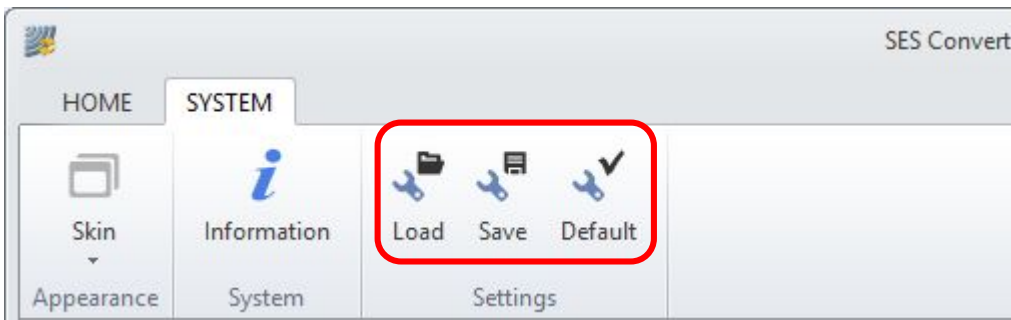
11 Innomar ISE Post-Processing Software

Note, this section refers to ISE2, there is also a newer version, called ISE3.

ISE is a post-processing software tool for INNOMAR's parametric sub-bottom profilers. There is a separate manual for this software, this chapter gives a short overview about possible data processing.

With ISE you can load the digitally stored data, apply different processing algorithms and processing methods to the data, print the data, digitise layers and objects and extract these data to common file formats, like ASCII. Data files can also be converted to SEG-Y, XTF and ASCII format for processing with third party software.
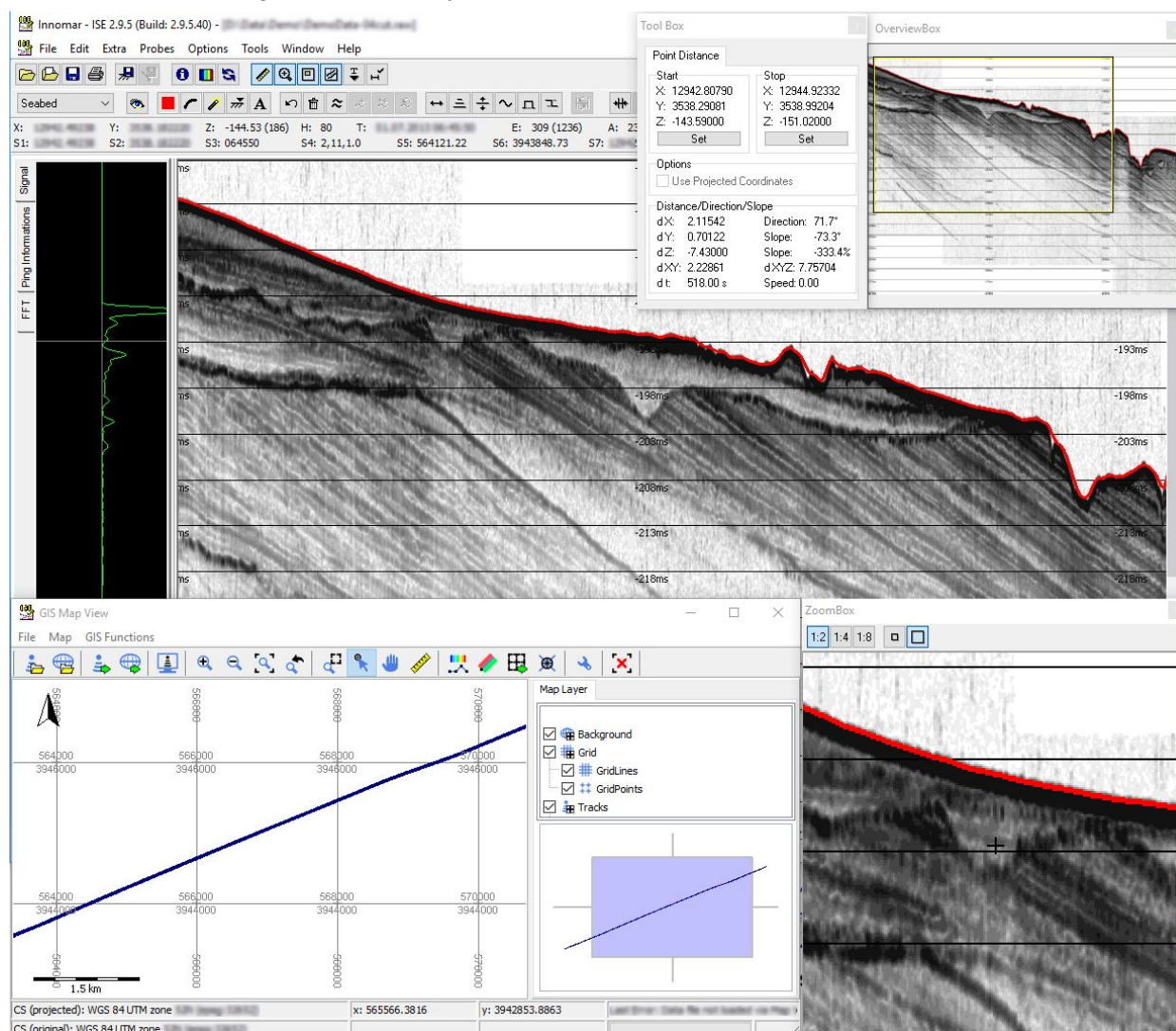
ISE screen dump (example with different toolboxes opened)

The ISE screen consists of the following parts:

- main menu,
- button bar,
- info bar: shows information about trace or sample at current cursor position (e.g., xyz position, time, trace number, amplitude),
- echo print area: shows calculated echo print,
- trace envelope / general trace information: shows envelope graph or information from trace at current cursor position (e.g., motion sensor data, transmitter and gain settings),
- status bar: shows information about data file.

There are some toolboxes available that may be used to

- show the entire echo print (data file) in reduced size and indicate the area visible in the ISE echo print area (overview box),
- calculate distance, slope, direction, velocity between two cursor positions (tool box),
- show a magnified part of the echo print around current cursor position (zoom box),
- show position track of the entire data file and indicate position at cursor (track box),
- pick and digitize object positions and dimensions (target picker).

Some of these toolboxes are also shown in the picture above.

To recalculate echo prints there are different signal processing options like:

- equidistant mapping along track,
- tide correction,
- heave compensation and swell filtering,
- applying sound velocity profiles,
- noise reduction (different filters and stacking/smoothing algorithms),
- spike and ghost removal,
- normalize gain,
- different colour mapping,
- instantaneous amplitude, phase, frequency or apparent polarity (full waveform data only),
- digitize water depth, sediment layers as well as object positions and dimensions,
- overlay probe data (e.g., sediment or density probes),
- convert / improve position data or other auxiliary data.

It is also possible to cut or assemble INNOMAR data files. There are also tools available to assist geophysical interpretation.

Calculated data can be stored in different formats for documentation or for further processing with ISE or third-party software:

- echo print graphic (different graphic formats),
- track info, position data (ASCII),
- digitized layer data (ASCII xyz, CODA, PIPE, DXF, SVG),
- digitized object data (ASCII),
- Trace data (ASCII, different INNOMAR formats).

12 Data Acquisition and Post-Processing Workflow

This chapter outlines a typical workflow for a geological SBP survey, like a pipe/cable route survey to determine the thickness of the top sediment layer. Both, data acquisition and post-processing of the acquired data set is covered. This chapter is not intended to replace a training course, but should give an overview on the steps necessary to ensure good data quality.

12.1 Survey preparation and survey line planning

For a proper survey planning it is necessary to know the location and size of the area to be surveyed. Based on this one has to choose a suitable vessel which meets the requirements to conduct a safe survey, especially in open water with fast changing weather conditions. It is also important to select additional sensors like motion sensor ore tidal observation systems and to ensure a suitable power supply.

For a systematic survey, run lines should be planned to cover the area. Line spacing depends on the expected seabed variability and the client requirements. Spacing should be chosen to get the data density to meet all requirements. Cross lines should be done for quality assurance. The spacing of these cross lines can be much larger than the regular run lines. Based on the line planning and mean survey speed the time consumption can be estimated.
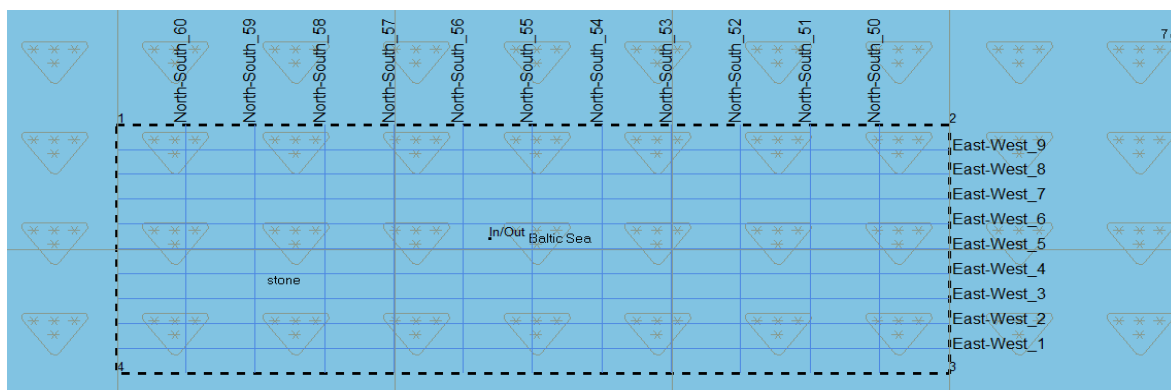
Example for a line planning using HYPACK® software, different line spacing for long and cross lines.

12.2 System setup and mobilisation

Before survey starts the INNOMAR SBP and all sensors have to be mobilised aboard the survey vessel:

- SBP topside unit: Needs to be placed in dry environment. Make sure no fan or any cooling slots are blocked and there is enough space for air circulation. Connect keyboard, mouse and monitor. Make sure to have a proper power supply.
- SBP transducer: The transducer is either hull-mounted or mounted over the side with a bracket and pole. Make sure the transducer is properly mounted onto a rigid frame or pole and avoid any vibrations of the mounting structure. The transducer face needs to be horizontal (inclination less than 0.5 degrees). Note the transducer draught. Use a separate ground wire from the transducer to the topside unit.
- GNSS system: Make sure GNSS position accuracy meets the survey requirements.
- Motion sensor: Used to compensate the wave-induced heave movements, it will improve the accuracy of the soundings. Depending on the SBP model, there might be also a roll and/or pitch movement compensation available.
- Survey software: Used to guide the skipper along the pre-planned run lines.
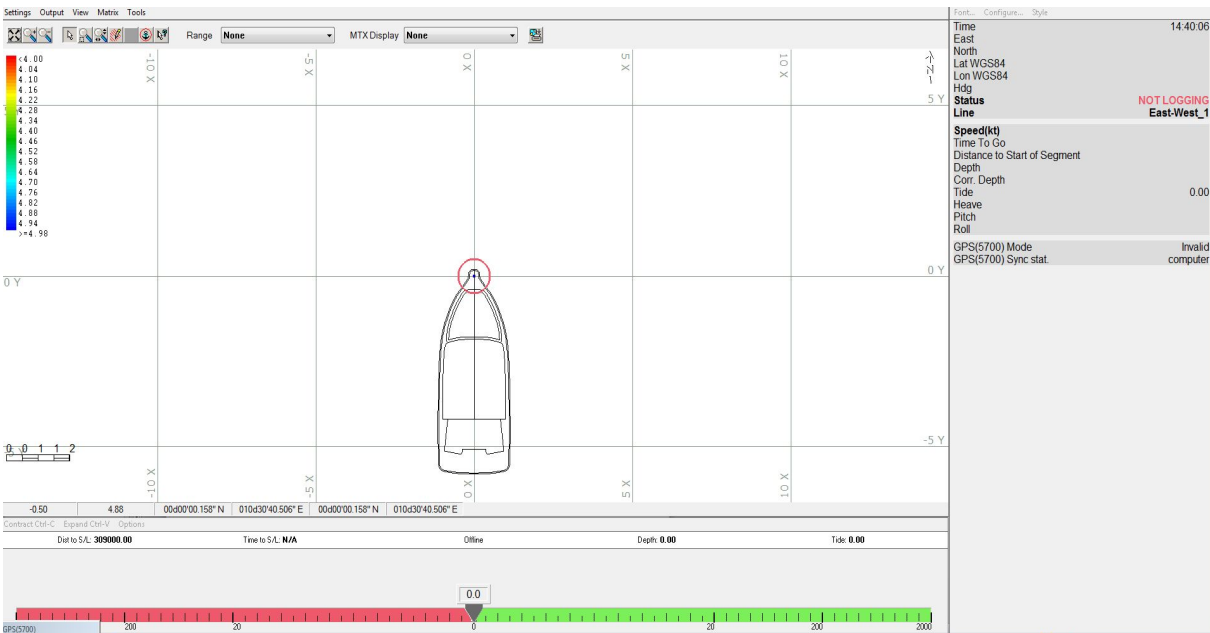
Example screen dump of the HYPACK® navigation software, map view, left-right indicator and data view

Connect auxiliary sensors (GNSS, motion) and configure the SESWIN online software to store sensor data within the SBP data file. It is possible to apply correction for offsets between positions of transducer and GNSS antenna as well as between positions of transducer and motion sensor. For this measure all offsets and set up the SESWIN software accordingly ("System Setup → Navigation Input", "System Setup → Motion Input").
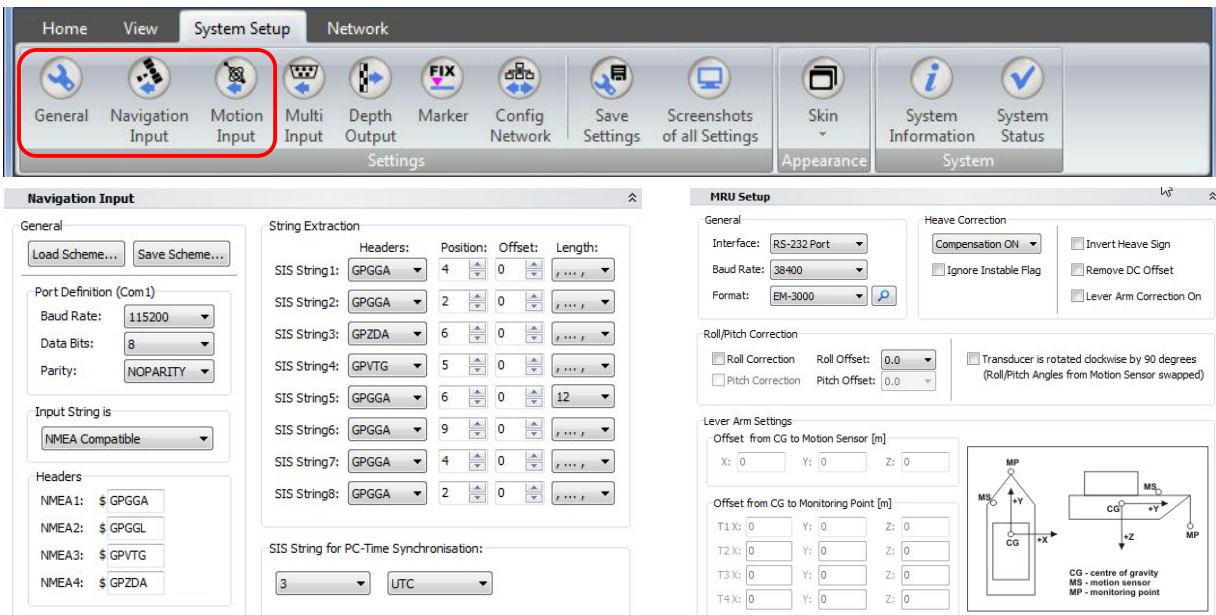
SESWIN "System Setup" toolbar (top) and dialogs for setting up the GNSS interface (bottom left) as well as the motion sensor interface (bottom right).

To get water depth values related to water surface the measured transducer draught has to be set in the SESWIN software, too ("System Setup → General").

Please see also the checklists given in appendix A.20 on page 219.

12.3 Data acquisition

INNOMAR sub-bottom profilers exploit parametric sound generation to achieve narrow low-frequent sound beams without side lobes and to transmit wide-band pulses to get high-resolution data. Due to this sound generation principle to data channels are available: the primary frequency (about 100 kHz) is used to determine the bathymetry and the secondary frequency (user selectable frequencies; range 4 – 15 kHz) is penetrating the sea bed and is used to determine the sub-seafloor strata.
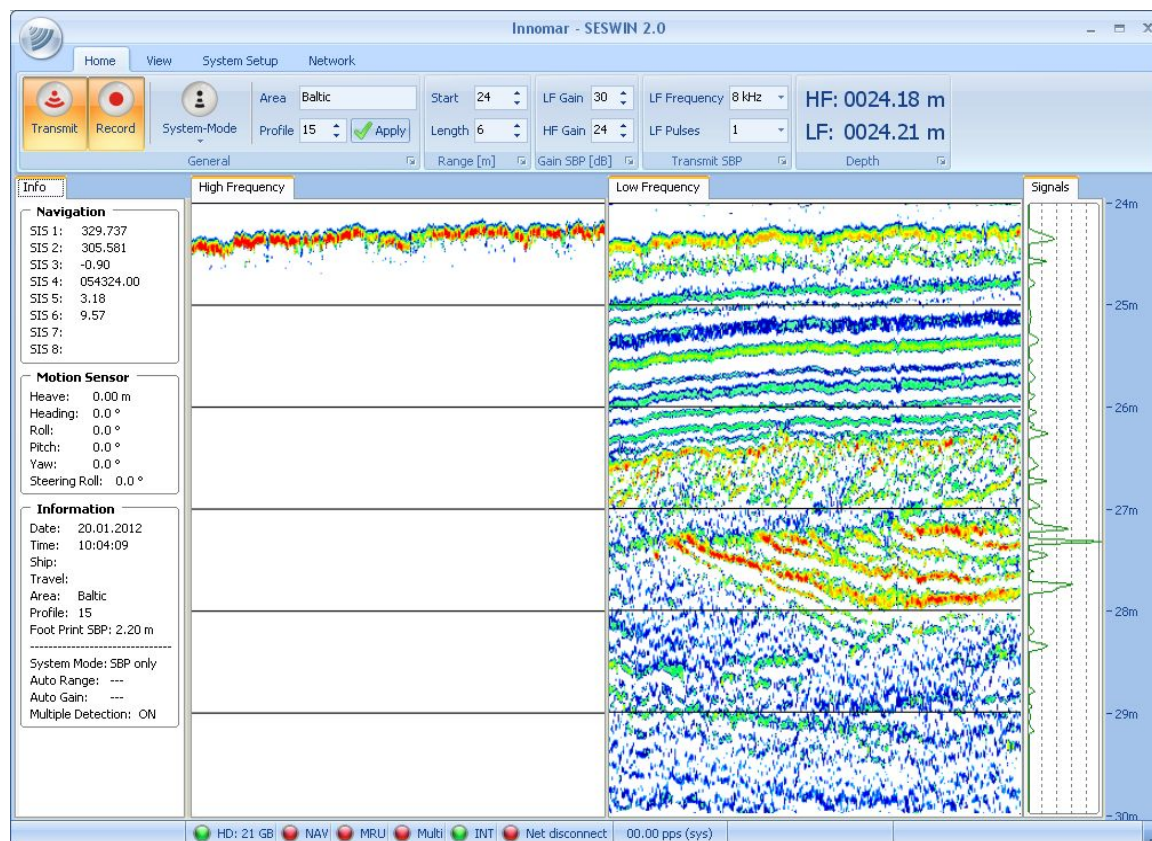
Example screen dump of INNOMAR's SESWIN data acquisition software. Transmitter and receiver settings (top), sensor information, high-frequency echo plot, low-frequency echo plot, amplitude of last ping (bottom, left to right)

Before the survey starts, some test lines should be done to ensure all sensors are working and to find best SBP settings (e.g. frequency, pulse width) for the current application, vessel, survey area and environmental conditions.

During the survey all pre-planned run lines will be sailed. Data recording should be started and stopped at each survey line start and end, respectively. This will give one data file (*.raw / *.ses3) for every survey line. Avoid to log data in the obsolete "*.ses" data format when using older systems.

At any time, the status of all sensors should be observed and in case one or more sensors don't work properly, the run line has to be repeated after the sensors are back.

Some acquisition parameters have to be set correctly during data acquisition – they cannot be changed during data post-processing. The main parameters for the operator to think about and to look at are:

- Frequency
- Pulse length
- Range
- Gain

These parameters affect the achievable resolution (i.e. vertical layer to layer resolution), the penetration (i.e. how deep can we look into the sediments), the ping rate (i.e. how many pings

are generated per time unit and distance travelled) and the signal to noise ratio of the received echo signals (i.e. what is the weakest detectable reflector).

There are several relations of the above-mentioned parameters to be familiar with in order to choose a proper parameter set for a specific survey task. Some of the relationships require a trade-off, there is no perfect world in acoustics!

Frequency

- The lower the frequency the more penetration could be achieved (due to less attenuation of lower frequencies within the water column and sediments).
- The higher the frequency the better resolution could be achieved.
- However, the lower the frequency the lower the signal to noise ratio (i.e. low-frequent sound pressure level is lower and more noise is picked up, such as vessel noise, propeller noise, ambient noise etc.)

→ Therefore, not the lowest frequency is the best one for good penetration, but the frequency which is as low as possible and provides an acceptable signal to noise ratio at the same time. This would allow to detect weak reflectors with a high frequency which would be hidden behind the noise at low frequency settings.

It is best to start in the middle of the given frequency range (8 – 10 kHz for the INNOMAR shallow-water models) and then try to lower or increase frequency according the survey requirements.

Pulse Length

- The shorter the pulse length the better the vertical layer to layer resolution.
- The longer the pulse length the better the signal to noise ratio and thus the better the penetration.

→ Therefore, often it will be necessary to choose a slightly longer pulse to improve the signal to noise ratio of the data at the cost of vertical resolution, especially for lower frequency settings. Use the shortest pulse length which is possible for the required penetration to ensure best resolution.

Range

- The range settings affect the ping rate. In normal transmission mode (shallow water) the ping rate decreases with increasing range start and range length (the deeper the water the lower the ping rate). In multi-ping mode (also called deep-sea pulse mode), ping rate decreases with increasing range length, the range start has nearly no effect (the longer the range length, the lower the ping rate).
- The higher the ping rate the better the lateral resolution and the more stacking could be applied during data processing for noise rejection.
- However, sometimes it might be necessary to choose a longer range for easier adjustment of the operating window (e.g. at steep slopes) or if deep penetration is available and shall be recorded.

Important Note: All data outside the operating range (i.e. the range window visible on the screen) will not be recorded! Tus make sure the "Range Length" is large enough to cover the entire depth required for data logging.

The "Range Length" cannot be changed while logging data.

→ The "Range Start" can be changed with Mouse and Keyboard, the best way is to use the [PageUp] and [PageDown] keys. Steps can be set up in the SESWIN software.

→ If possible, avoid the "Auto Range" function – this function will easily fail on slopes or when you pass through other vessel's keel water etc.

Gain

The gain is set for both data channels (LF and HF) separately. As a rule of thumb, the gain should be set in a way that the received signals use the whole dynamic range available.

- Adjust the gain based on the signal monitoring window and not on the colour of the seabed and reflectors within the echo plot!
- Avoid to use "Auto Gain", this will level the seabed reflectivity and we are interested to see those changes due to changing sediment properties.
- Do not change the Gain to often – the signal will always fluctuate a bit. Change at significant increase/decrease of water depth or when other settings are changed, such as frequency or pulse length.
- Do not over-amplify the signal, this will clip raw signals, you lose near-seabed resolution and you may introduce false reflectors near to the seabed echo.
- Gain changes do not change the signal to noise ratio, i.e. noise and signal will both be amplified.

12.4 Data Acquisition: Example Settings

Some example parameter sets are given below. The parameters may be different from vessel to vessel due to different background noise level and characteristics. The given settings should be used as a starting point with different survey conditions and application requirements kept in mind. Please see also the checklist given in appendix A.20 on page 219.

Survey of upper sediments (about 10 m to 20 m) with highest possible resolution

Frequency: highest frequency of the system with the best signal to noise ratio (15 kHz for the shallow-water models).

Pulse Length: 2

Gain: depends on water depth and needs to be adjusted by using the signal window

Range Length: as small as possible (e.g. 25 m) in order to maintain a high ping rate, but would require longer ranges (e.g. 50 m) for areas with changing topography for easier tracking of the seabed and adjustment of the operating window

Survey to detect bedrock below the sediments as far down as possible

Frequency: 6 kHz or 8 kHz

Pulse Length: longest possible setting (depends on frequency)

Gain: depends on water depth and needs to be adjusted by using the signal window

Range Length: as small as possible (e.g. 40 m) in order to maintain a high ping rate, but would require longer ranges (e.g. 100 m) for areas with changing topography for easier tracking of the seabed and adjustment of the operating window

Site Survey in areas with relatively constant water depth (e.g. change of ±20 m only)

Frequency: 8 kHz or 10 kHz (for good resolution)

Pulse Length: 2 (for good resolution)

Gain: depends on water depth and needs to be adjusted by using the signal window

Range Length: could be set very small, because the water depth doesn't change much, e.g. 20 to 30 m, this will result in very high ping rates for good lateral resolution, especially in shallower water depths where the foot print is small as well.

12.5 Data Quality Check (Innomar ISE Software)

For a quick check and quality assurance (QA) of the recorded INNOMAR data files immediately after acquisition, it is useful to open the data files with the INNOMAR ISE software from the operator's workstation. Below, some basic settings are proposed which may not be optimised for interpretation purposes, but should give a full profile overview in full resolution.

This section briefly describes how to use INNOMAR ISE software for QA, for a full description of the processing capabilities and features see the INNOMAR ISE manual.

The INNOMAR ISE software needs no installation, you can just copy the files to any hard disk folder and start "ISE2.exe". Do not operate ISE from a network or USB drive, since this would result in significant slow-down due to file operations. Although the ISE software needs an USB dongle for most post-processing features, it can be used without dongle for quality assurance ("file view mode"). In this case you will get two error messages during ISE start-up which can be ignored:
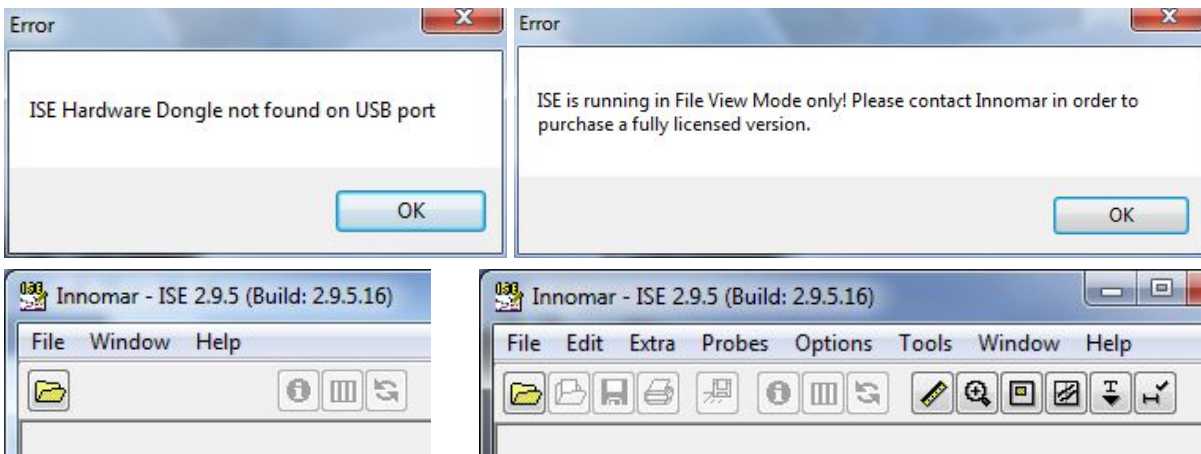
ISE error messages if the license dongle is not found, just click "OK" for using ISE file view mode (top) and limited options in in "file view mode" (bottom left) compared to full license (bottom right)

1) Open the file open dialogue by pressing the "load data" button or by shortcut ("Ctrl-L") or via menu ("File → Load Echo Data…"). Depending on the ISE settings, either the standard Windows dialogue will show up or the ISE file selector, which gives some more information on the data files. In the following we assume the ISE file selector is used.
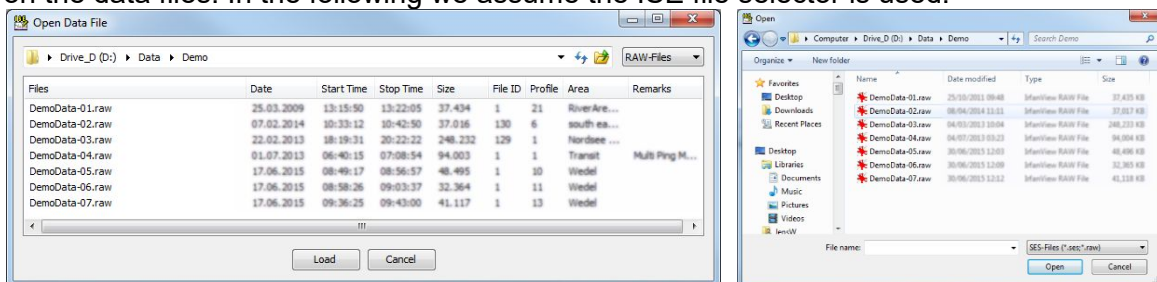
ISE file selector already giving some additional information on the data files (left) and standard Windows file open dialogue (right)

2) Navigate to the file folder where the data files are stored, choose the "RAW" file format in the upper right corner of the file selector dialogue window, choose the file you want to load and press the button "Load". Once you return to the file selector, the cursor will point on the last file opened.

3) The dialogue to load RAW data files gives a number of options and parameters. A possible setup is given in the screenshot below, where the following parameters were altered from the default settings.
Stacking: 2. The higher the stacking the better the signal to noise ratio due to averaging of pings, the stacking value determines the lateral shrinking of the echo plot, i.e. 2 means half of the original traces are shown on the echo plot.

PreFilter: Optimized Filter, *Demodulate*: Envelope plus PostFilter, *Algorithm*: 1P. These three functions will process the full wave form signal and create an envelope picture with reduced noise, the filter settings are automatically optimized to the system transmit pulse settings (frequency, pulse length) applied during data acquisition.

Threshold Table Minimum: 5. The higher the threshold value the less noise is shown in the echo plot, the threshold table is logarithmic, choose a setting where some noise is still visible in the echo plot in order to keep weak reflectors visible.

Threshold Table Maximum: 5. Choose high values for data with high dynamic and low values for data with low dynamic, however, typical values are between 2 and 5.

SIS-ID for X-Position and Y-Position: Here you choose the SIS-IDs where the SESWIN software has recorded the coordinates, several ISE functions, such as distance markers, require metric coordinates, the small buttons with the three dots will give a preview of the SIS-IDs stored within the data file. This is not needed for QA, so we can keep the defaults. This and the next two settings are not available in "file view mode".

Median Filter: on. This filter provides a noise reduction, particularly for noise spikes.

Decrease Sample Rate: 3. The higher the sample rate reduction, the higher the vertical shrinkage of the echo plot.

ISE Load RAW File dialogue with recommended settings for QA. The lower part of this dialogue (black rectangle) is not available if ISE is operated without dongle (in "file view mode"). "Heave Correction" is switched on by default.

4) Once the data file is loaded and shown in a separate data window you may drag around the echo plot by using the right mouse button. With the menu item "Options → Toolboxes…" you can enable an overview window ("OverviewBox") of the entire echo plot and also a tool to measure distances and slope angles ("ToolBox").
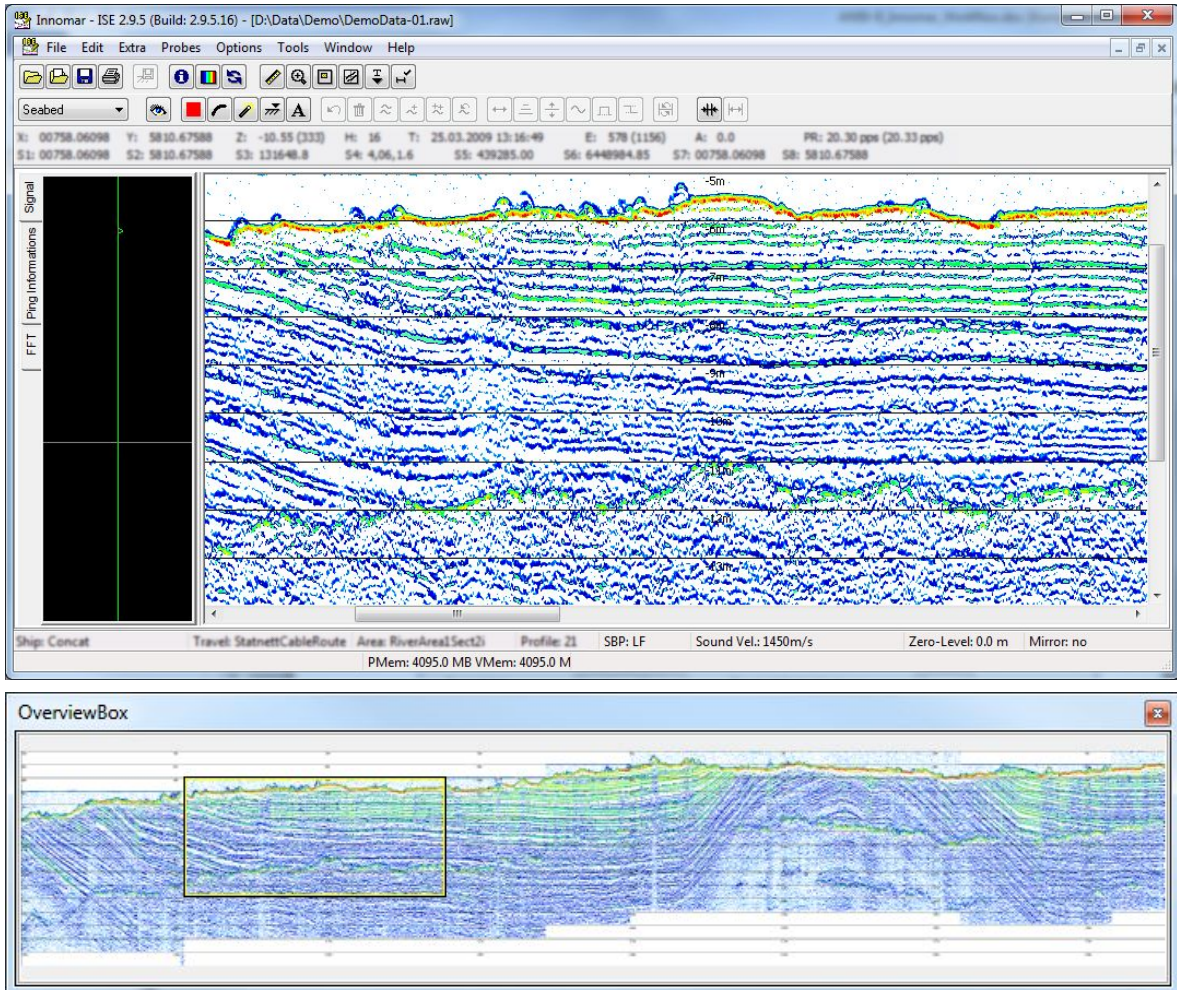
Data file opened in ISE main window (top) and entire echo print in the ISE "Overview Box" with rectangle marking the part visible in the main window (bottom)

5) You should also check the sensor data (GNSS position data and motion sensor data):

12.6 Post Processing (Innomar ISE Software)

This section briefly shows basic post-processing using the ISE software, for a full description of the processing capabilities and features see the INNOMAR ISE manual. During the processing the data will be converted into a colour (or greyscale) coded picture which is used to digitise the sediment layers or positions of targets like buried pipelines or cables. For post-processing the INNOMAR ISE software needs to be started with USB dongle to enable all features.

First check sensor data, especially GNSS position, for gaps and outliers. For this the recorded data can be visualized within the ISE software ("Extra → View SIS value graph").

Usually the INNOMAR SBP ping rate during data acquisition is much higher than the GNSS position update rate. Thus, in the data file several pings have the same position and time stamps. For processing there should be unique positions and time stamps for every ping. For this the ISE software provides a processing tool which works on all data files within a file folder: ISE menu "Tools → SIS Process".
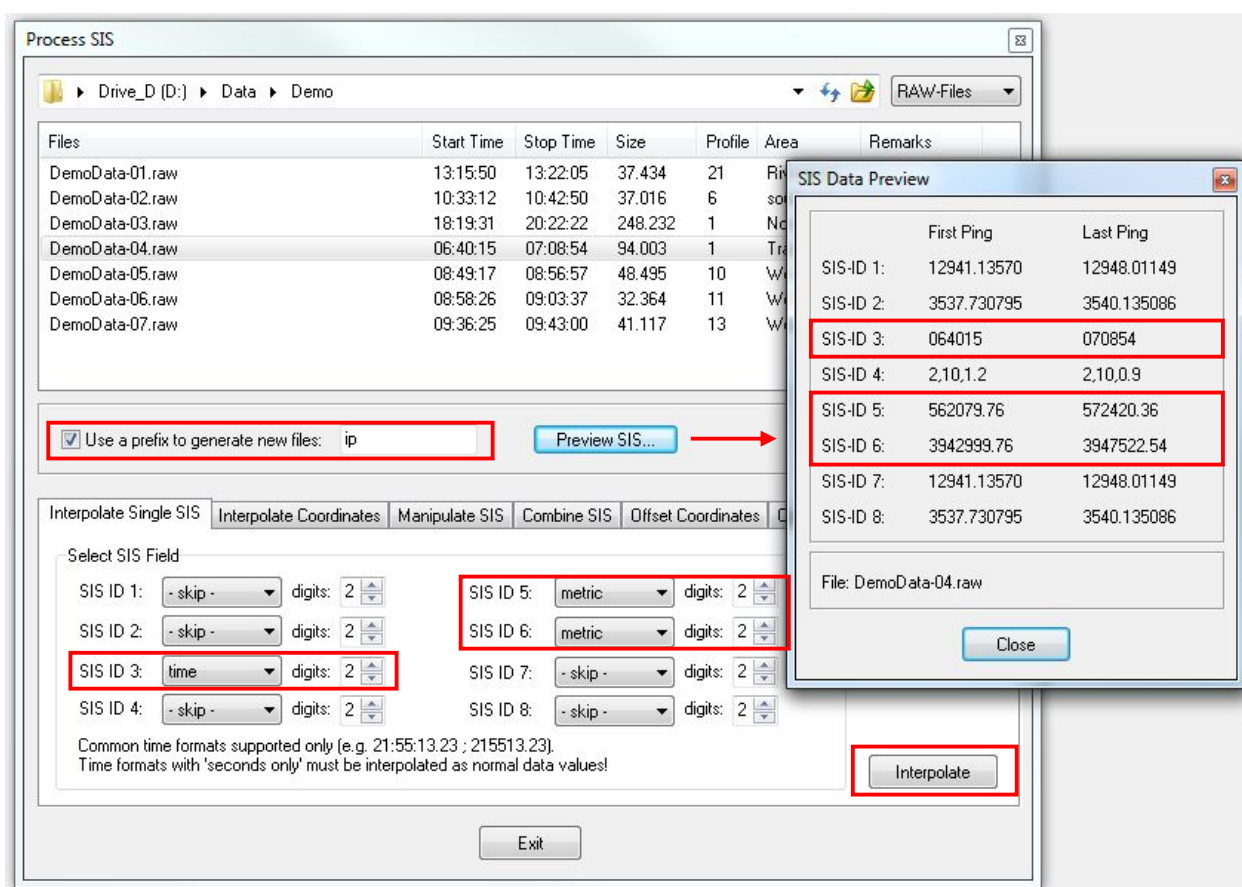
SIS data processing to interpolate GNSS position and time stamps to provide unique data for each ping. Check SIS IDs ("Preview SIS" button) and set processing as required. In the example there are metric UTM positions on SIS IDs 5 and 6 and GNSS UTC time stamp on SIS ID 3. Be aware that the data files will be touched, therefore either make a backup beforehand or tick the "Use prefix …" check box to generate a data copy automatically. It is possible to process all files in the folder ("Ctrl-A"), there will be a summary shown as soon as the conversion processing is finished.

Single data files to be processed are loaded with the "File Load" dialogue, see picture on next page. Make sure to select the correct SIS-IDs for position data and to apply tide correction if appropriate. Metric position data and PC time stamp can be interpolated during the file open process, too. But it is recommended to do this as standard processing step at the very beginning for all data files, see above.
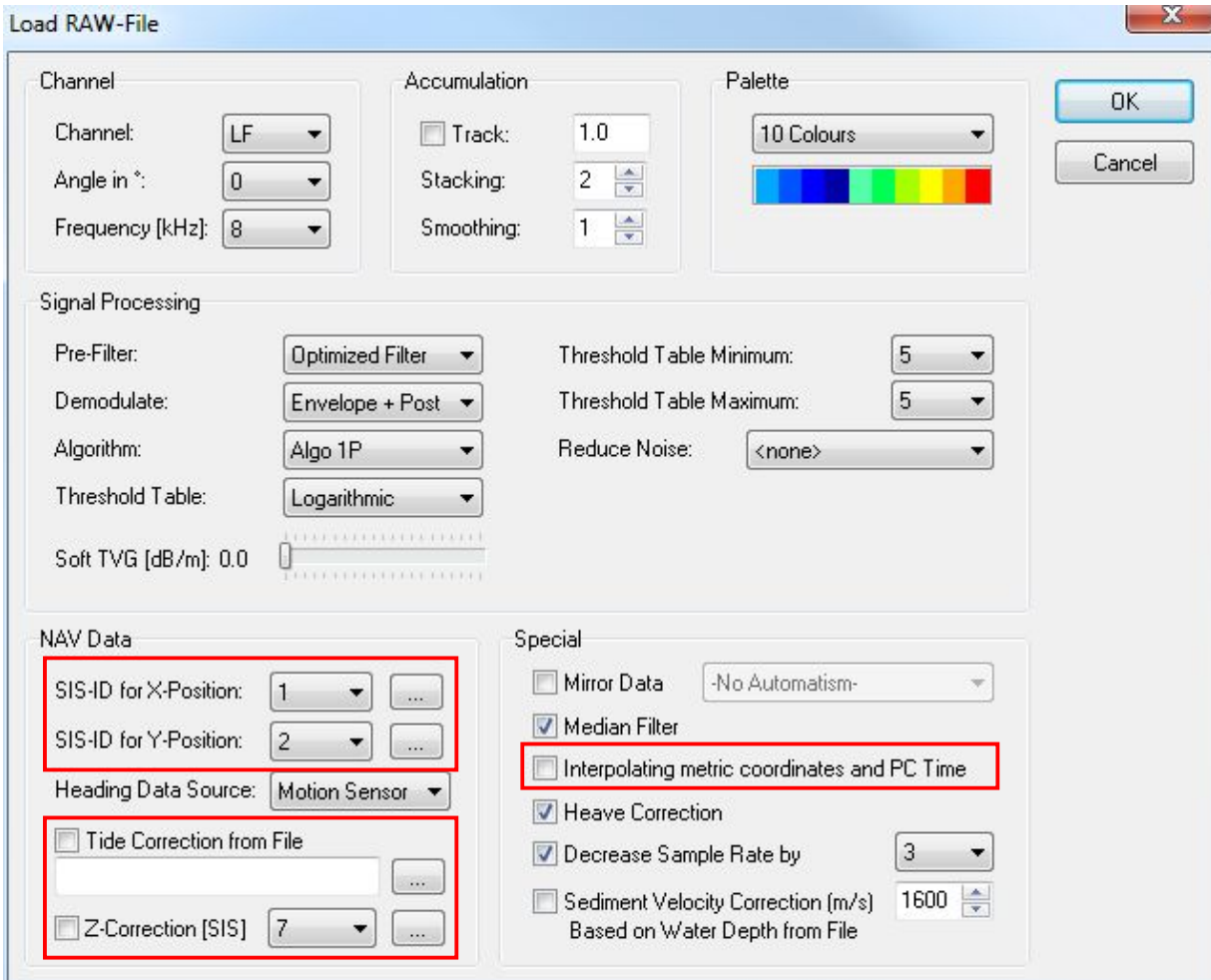
ISE Load RAW File dialogue. Processing settings needs to be verified, most of these be changed via the ISE "Signal Processing" and "Colour Palette" dialogues, see buttons on the right.

To get the thickness of a sediment layer or to estimate dredging volumes you need to digitize the layer boundaries of interest and to export xyz-data of these interfaces.

Let's start with the water/seabed interface. For this an automatic bottom track can be used. It's best to do this on the high-frequency data channel. Therefore, we load both, LF and HF, channels via the ISE file load dialogue. In the HF echo print we can use the automatic bottom track, see figure below.

The result of the automatic layer track needs to be verified and cleaned of spikes or outliers. For this some tools are available from the ISE toolbar:

Sediment layers will be digitized in the low-frequency data. Therefore, copy the HF bottom track into the LF data window ([Ctrl]+[C] in HF window and [Ctrl]+[V] in LF window). Now the seabed layer (black line) is in the LF echo print, too.

To digitize sub-seafloor sediment layers ISE provides a semi-automatic capture tool, see figure below. The user has to define a vertical gate and a certain amplitude level as a sort of threshold for the layer detection and has to move the cursor over the layer border. The capture tool detects the layer within the cursor limits on the defined amplitude level. It would be also possible to mark layer boundaries free-hand using the left mouse button to draw lines.

It is good practise to use different layers and colours for different geological interfaces. Names and line properties (colour, thickness) can be defined in ISE "Options → Environment → Data Windows" dialogue.

The resulting layer data plotted into the LF echo print is shown below.
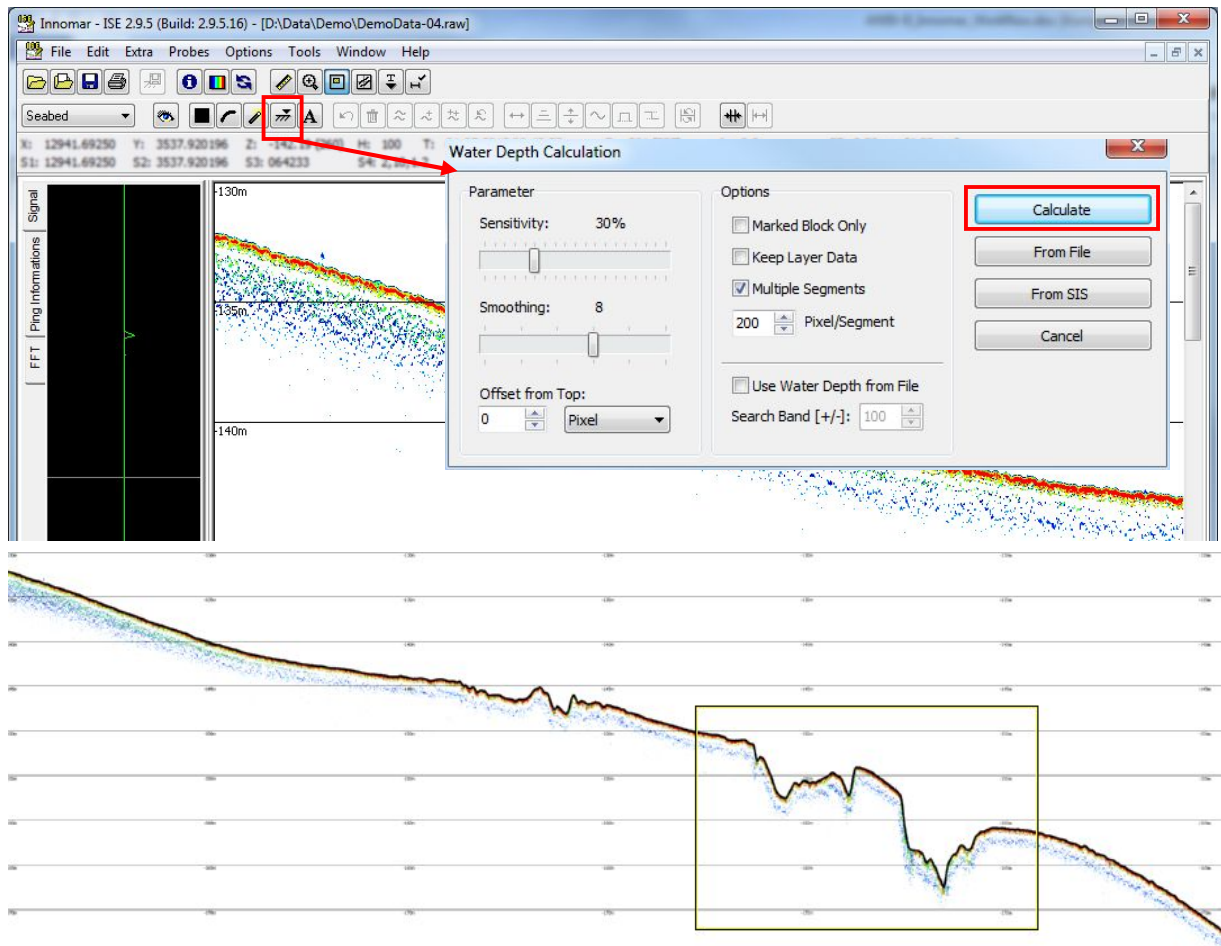
ISE automatic bottom track applied on the HF (100 kHz) channel. ISE operation (top) and result (black line marking the seabed) on the entire echo print as seen in the ISE overview box (bottom).
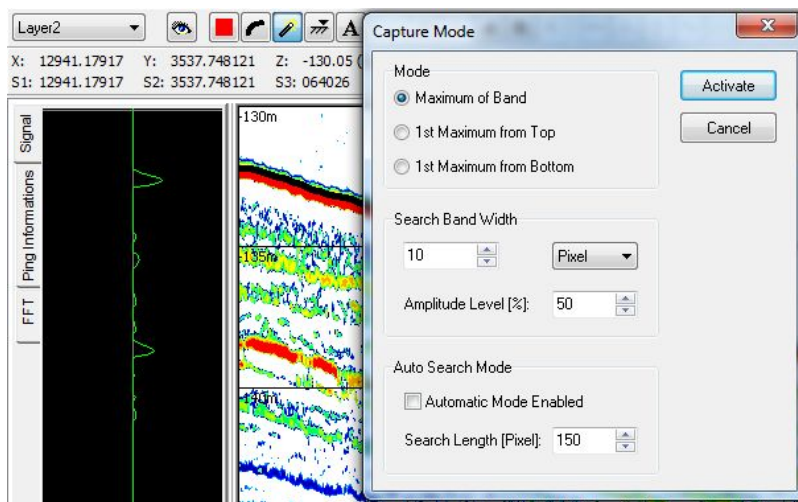
ISE layer capture tool.

The digitised layer interfaces can be exported in combination with interpolated position data to separated XYZ ASCII files ("File → Export Layer Data"), see picture below. Layer data can be also exported as CODA, Pipe, SVG or AutoCAD DXF files. The calculated echo prints can be saved in different graphics formats, including GeoTiff.
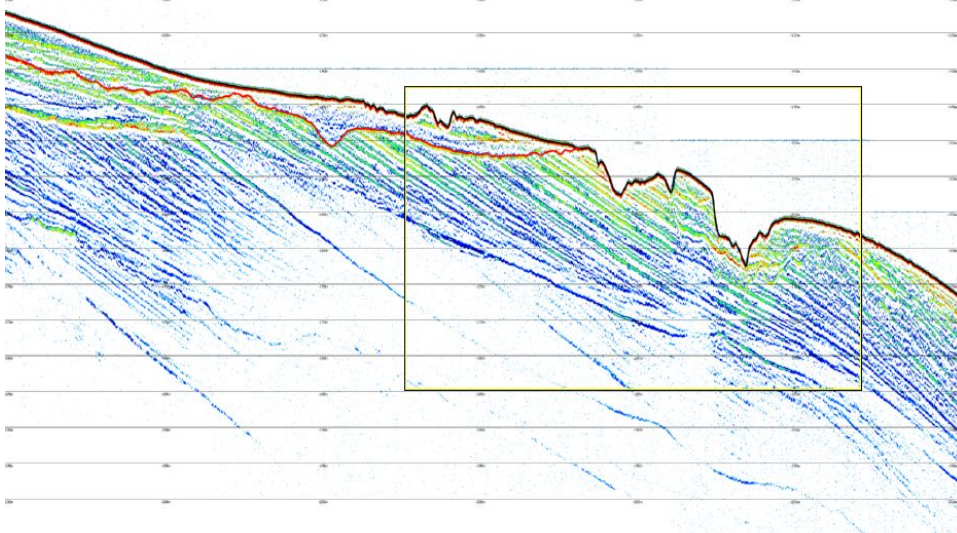
Entire LF echo print as seen in the ISE overview box with automatic bottom track from HF channel (black) and sub-seafloor layer (red).
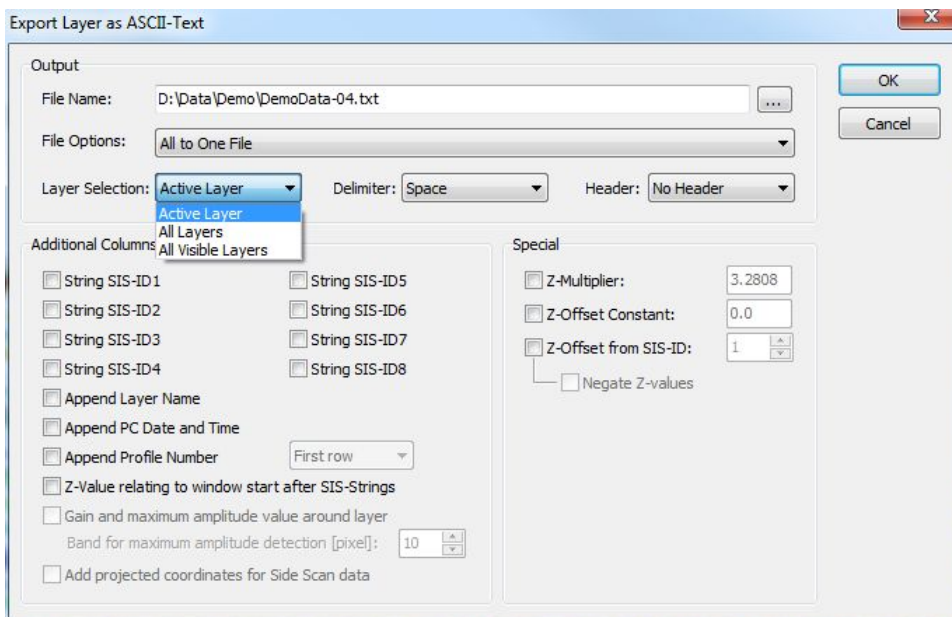
ISE Layer export (ASCII) dialogue

The INNOMAR ISE software provides also a tool to calculate the differences between different layers, called "Layer combination". It calculates the differences between the z-values on the same position. As result a ASCII file with X, Y and the difference will be written to the hard disk. With these data a volume can be calculated by third party software packages.

Often the same processing steps need to be applied to several data files. For this the ISE software provides batch processing of several files in one folder ("Tools → Process Script").

Please see also the data post-processing checklist given in appendix A.20 on page 219.

12.7 SEGY Data Export (Innomar SES-Convert Software)

If third-party software shall be used for data processing, the SBP data files have to be converted to SEG-Y data format. Again, the first step is to ensure unique position data and time stamp for each ping, see above. Since the ISE software may be only available for a limited time after the survey, make sure this interpolation is done as soon as possible.

For the data export INNOMAR's SES-Convert tool is used, which is available as freeware. Make sure to convert the "RAW" or "SES3" data files, the obsolete "SES" data files are not sufficient for SEG-Y data processing. For details on using this software, please see chapter 10 on page 133.

13 FAQ (Frequently Asked Questions)

13.1 System Performance

13.1.1 I do not get the seabed echo.

Q: When I start pinging there is no seabed visible on the echo plot screen.

This may have different reasons:

- **The seabed is out of range.** Check "Range Start" and "Range Length" settings and set to appropriate values. If in doubt, start with a low (shallow) "Range Start" and a large "Range Length".
- **The amplifier gain is too low.** Check if acoustic noise is visible on your echo plot screen. If not, increase the "Gain" value of the affected channel until noise is shown.
- **The thresholds for colour mapping are inappropriate.** Check if acoustic noise is visible on your echo plot screen. If not and the gain values look reasonable, check the threshold settings in the "View" menu tab. Defaults are 5 / 5.
- **There are gas bubbles washed down below the transducer.** Reduce the vessel speed and/or change the course regarding the waves to reduce bubble wash-down. Re-consider the transducer mounting location.

13.1.2 I do not get a seabed echo in the HF channel.

Q: When I start pinging there is no seabed visible on the HF channel, but it is shown in the LF channel.

Again, there are different reasons possible:

- **The water depth is to deep.** The HF channel energy dissipates much faster than the LF energy while travelling through water. Thus, the HF range capability is more limited and you might lose the HF seafloor bottom track in deep water.
- **The amplifier gain is too low.** Check if acoustic noise is visible on your HF data. If not, increase the "HF Gain" value until noise is shown.
- **There are gas bubbles washed down below the transducer.** HF and LF channels might be affected differently by gas bubble wash-down. Reduce the vessel speed and/or change the course regarding the waves to reduce bubble wash-down. Re-consider the transducer mounting location.

13.1.3 There is no data file recorded.

Q: I did a survey line and got good data on the screen, but there is no data file on the hard disk.

There are several possible explanations:

- Make sure the data destination is set properly in "System Setup – General – Files" and that you have write permissions on the selected folder.
- Data recording is not switched on/off automatically with the transmitters going on/off. You have to start/stop recording separately using the "Record" button.
- Check if the "Record" button is highlighted during recording and if there is a file name shown in the SESWIN status bar. The file size is also shown and should increase over time.

13.1.4 Transmitters are not switched on during data recording.

Q: I start data record, but the transmitters are still off.

Transmitters are not automatically switched on/off with data recording start/end. This has to be done separately. This behaviour is on purpose to be able to record (noise) data without pinging.

13.1.5 How can I reduce acoustic interference with MBES?

Q: In my multibeam data I see artefacts caused by acoustic interference from the Innomar SBP. How can I avoid or reduce this interference?

Interference is usually caused by the INNOMAR primary (HF, ~100 kHz) frequencies or its harmonics (~200 kHz, ~300 kHz, ~400 kHz). To reduce acoustic interference, you can

- synchronize the systems to have dedicated time slots, see section 6 on page 81,
- use another frequency for the MBES (many newer models can tune the operating frequency), a good frequency would for instance around 360 kHz,
- increase the MBES transmit power,
- use the MBES in chirp mode,
- use and adapt gates for the MBES bottom track.

13.1.6 What is the difference between the Innomar data formats?

Q1: My SESWIN support SES and RAW data, what format should I use?

Q2: My SESWIN records SES3 data, what is the difference to SES and RAW data?

Q3: How many data is collected and which file size can be expected?

There are three data formats used with the INNOMAR sub-bottom profilers:

	SES	RAW	SES3
Number of Channels	2	2	2 ... 80
Bits	16	16	24 / 16
Sample rate	Depends on range	Full	Full
Samples per trace	480	Depends on range	Depends on range
Waveform	Processed (magnitude only)	Full raw data (magnitude + phase)	Full raw data (magnitude + phase)
Post-Processing	INNOMAR ISE 2.x INNOMAR SESConvert	INNOMAR ISE 2.x INNOMAR SESConvert	INNOMAR ISE 3.x INNOMAR SESConvert
Notes	Due to the range-dependent sample rate, the resolution is lower than for RAW and SES3 formats.	Full sample resolution; mostly better than for SES data.	Sample resolution like for RAW data, but higher dynamic range. Supports multi-channel data.
File Size Estimate in MB/hour	$FS \approx 7.5 \; PR$	$FS \approx (1.1 + 1.8 \; RL) \; PR$	$FS \approx (1.7 + 2.7 \; RL) \; PR$

The file size (FS) depends on ping rate (PR) and recording range length (RL). The ping rate depends on range start (RS) and range length (RL). Please note that the sum of range start and range length gives the range end ($RE = RS + RL$). At normal internal trigger the ping rate is:

$$PR \approx \frac{750}{RS + RL + 7.5}$$

At external trigger the ping rate is lower and defined by the trigger period. The actual file size is limited by the value set up in the "System Setup – General – Files" menu.

> **!** The SES format should not be used for new projects because of the limited resolution, especially at longer ranges. Use the RAW or the SES3 format instead.
> **The SES file format is obsolete and not supported since SESWIN 2.2.3.8.**

The SES3 data format is not supported by all INNOMAR systems yet, but by "quattro" / "sixpack" and new "standard" / "medium-xx" / "deep-xx" models. For SES3 data you have to use the "seswin24bit.exe".

For more information on the different INNOMAR data formats see appendix A.17 on page 211.

For older systems with SES and RAW formats, please **enable RAW data recording**:
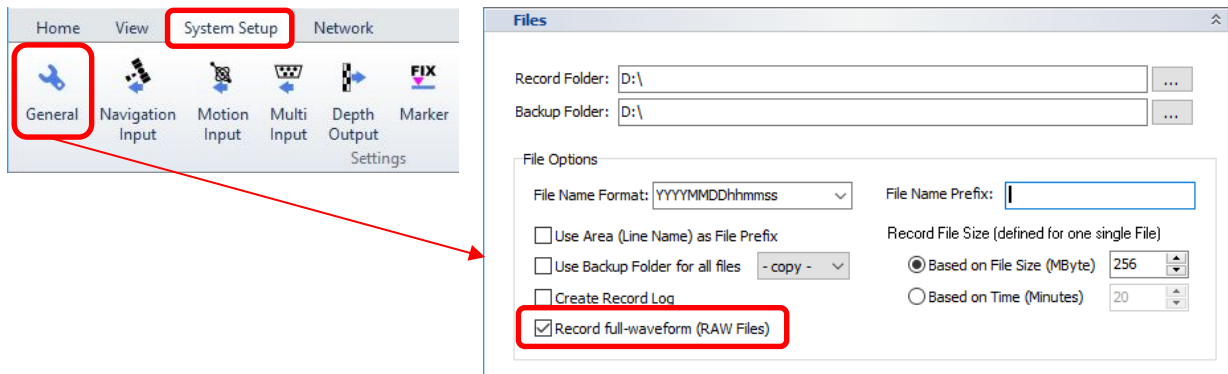
13.1.7 How do I get "SES" like echo plots from "RAW" and "SES3" data files?

Q: So far, I'm using the ".ses" data files, but these are not available with my latest SESWIN version, what I get is either "*.raw" or "*.ses3" files. How do I get echo plots like from the "*.ses" file format?*

The SES file format ("*.ses" files) is obsolete and is not supported by the latest SESWIN versions. The RAW file format ("*.raw" files) provides much higher resolution, especially when using larger ranges, and the full-waveform record gives more information on the reflectors.

Below there is the same acoustic profile (record range set to 60m) shown from SES data (480 samples per trace) and from RAW data (3800 samples per trace). It is obvious that the RAW file format preserves much more details than the SES file format.

Echo plot from SES file format (480 samples per trace of 60m) and zoom (100% original size).
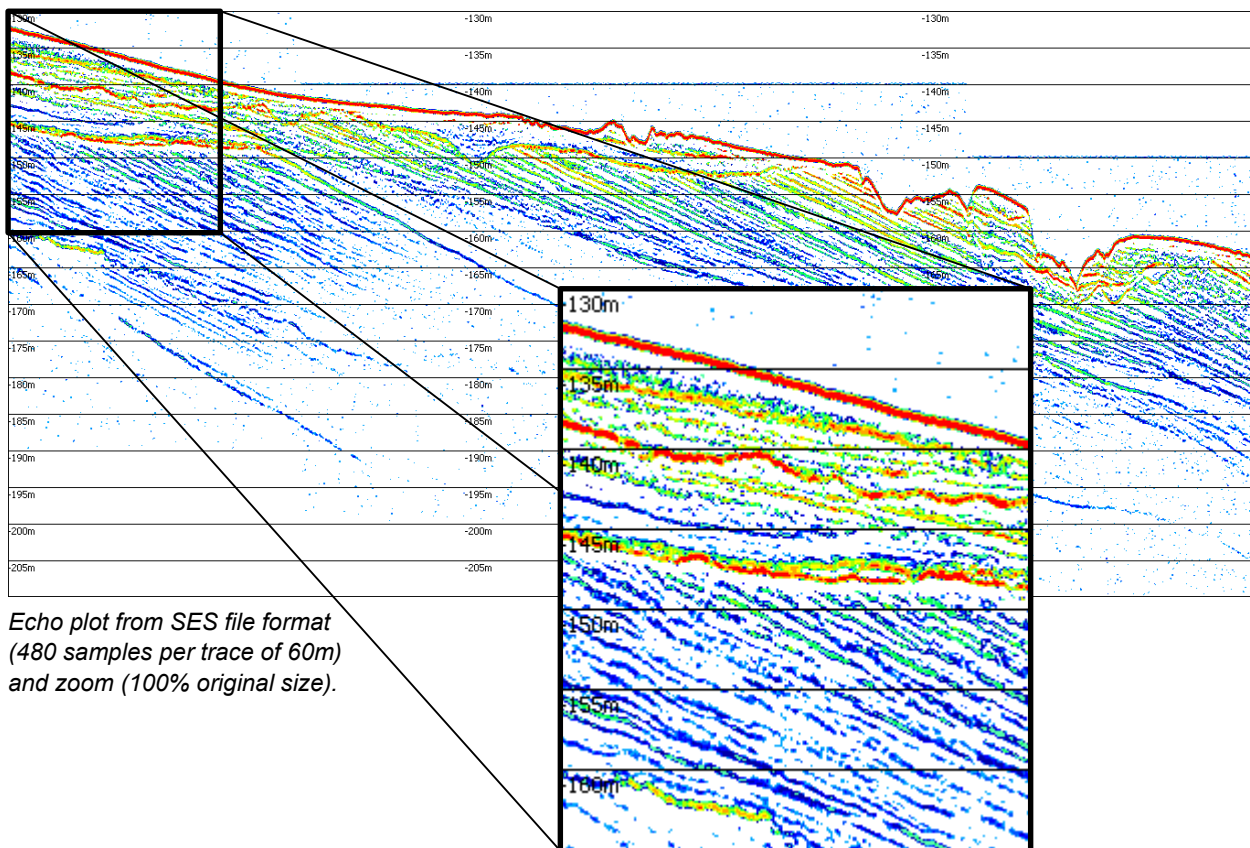
The SESWIN online echo plots are not affected by the new data formats, but when looking at the files in the INNOMAR ISE software, the echo plots look different. Anyhow, it is simple to get almost the same data visualization as you might be familiar with from the SES data files.
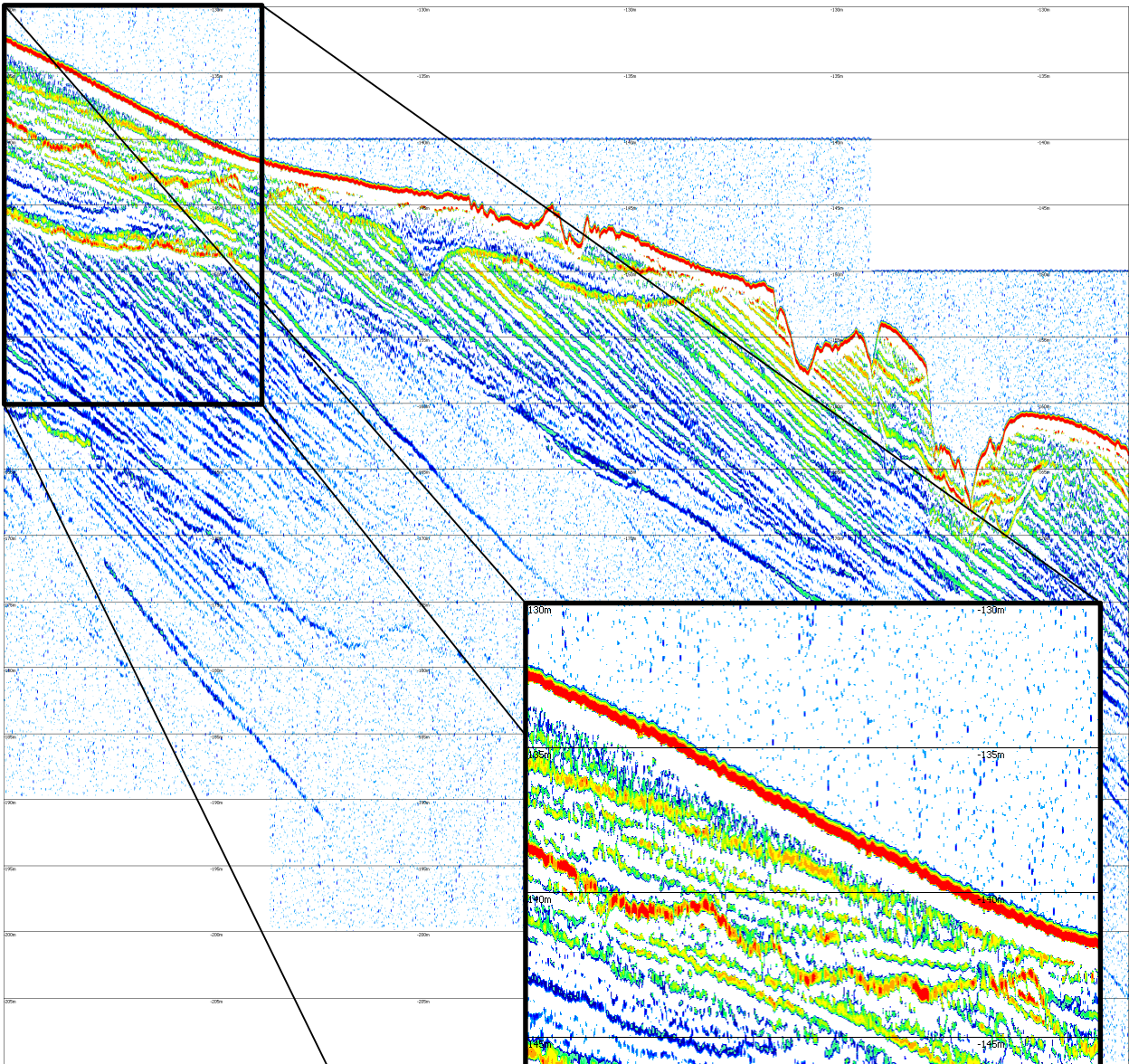
*Echo plot from RAW file format
(3800 samples per trace of 60m)
and zoom (25% original size).*

In the ISE "Load RAW File" dialogue,

- set "Demodulate" to "Envelope" or "Envelope + Post Filter"
- use a colour "Palette"
- "Pre-Filter" might be at any setting, but
  "Optimized Filter" is a good choice.

13.1.8 Are there shortcuts to operate SESWIN with the keyboard?

Q: On a moving vessel it's sometimes hard to operate SESWIN with the mouse, are there any keyboard shortcuts?

Yes, there are shortcuts for the most important tasks during the survey:

[F4]	Toggles transmitter on/off.
[F5]	Toggles data recording on/off.
[Page UP]	Decrease range start (shift recording window up).
[Page DOWN]	Increase range start (shift recording window down).
[+]	Increase LF gain
[-]	Decrease LF gain
[Ctrl]+[F11]	Save screenshot to the SESWIN folder, file name generated automatically from the current date and time (ScreenDumpYYYMMDD_hhmmss.gif) A WINDOWS notification shows up in the system tray.
[F12]	Set event marker.
[Alt]	Windows short cuts shown to select menu items, see below.

Most shortcut keys are also shown in the mouse-over tooltips:
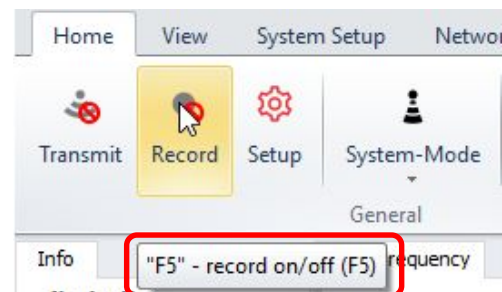
As with other ribbon-based Windows applications, pressing the [Alt] key will show short cuts to move along the (ribbon) menues:
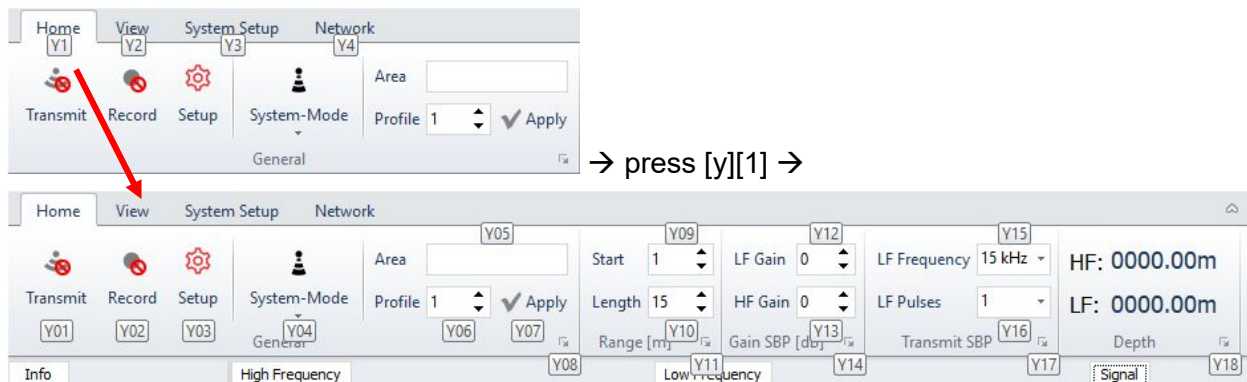
→ press [y][1] →

→ press [y][0][9] → focus is set to range start

13.1.9 How can I get a mouse pointer that is better to recognize?

Q: Especially on sunny days it's hard to see the mouse pointer on the screen, is there a way to get more prominent or easier to detect?

Yes, there are different possibilities within the Windows operating system.

To make the mouse pointer more prominent on the screen you may change its size or colour:

Go to Windows Settings → Ease of Access → Cursor & pointer size

On the (almost bright) screen a black cursor will be better visible than a white one. You may also wish the cursor to have inverting colour based on the background.

These settings are also available in the "old" way: Control panel → Mouse → Pointers:
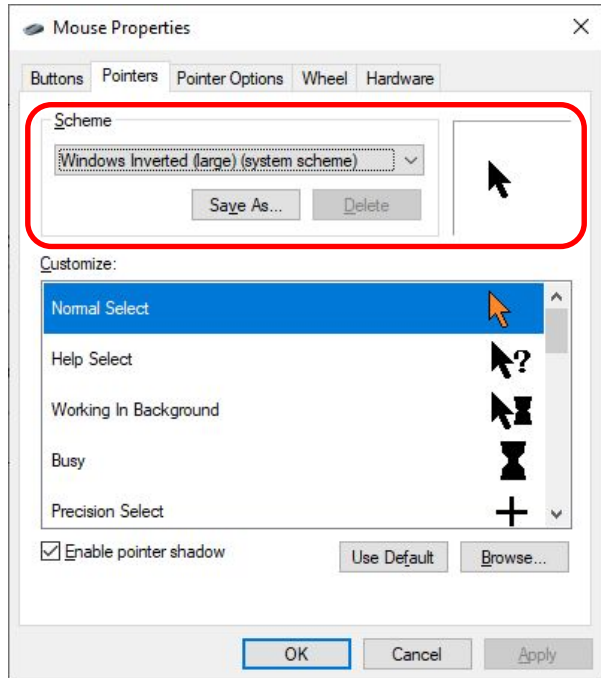
To make the mouse pointer easier to detect, you may set Windows to generate concentric circles popping up at the cursor position when pressing the [Ctrl] key:

Go to Control panel → Mouse → Pointers:
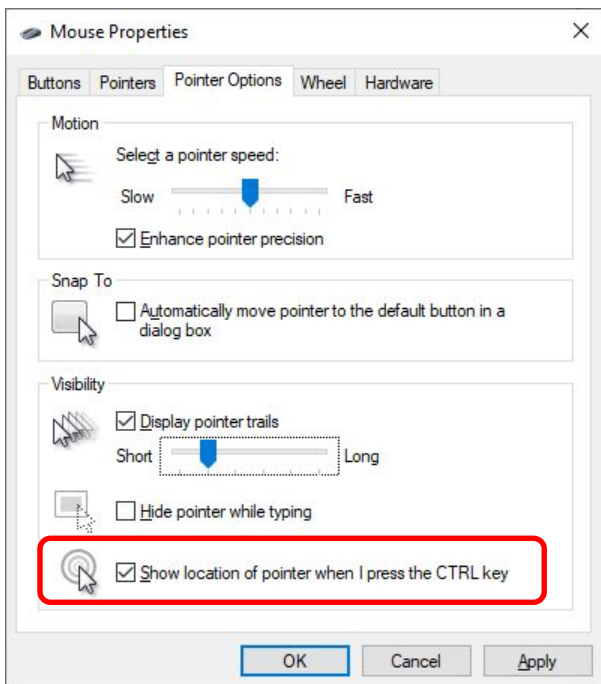
13.2 HF (100 kHz) Data Channel

13.2.1 How can I switch off the HF channel?

Q1: I do not need the data from the HF channel, I'm interested in the LF data only. Thus, I would like to switch off the HF channel entirely and transmit LF only.

Q2: The HF channel causes interference with my multibeam, I need to switch this channel off to improve MBES data quality.

The HF channel cannot be switched off independently from the LF channel. The high (primary) frequencies (~100kHz) are necessary to generate the low frequencies (LF channel) used to penetrate the seabed and get sub-seafloor information. If no HF ping is transmitted, there is no LF ping produced.

To reduce acoustic interference, see section 13.1.5 on page 154.

13.2.2 How can I switch off HF data recording?

Q: I do not need the data from the HF channel, I'm interested in the LF data only. If I cannot switch off the HF channel, can I switch off data recording for this channel to save storage space?

The INNOMAR data formats contain both, LF and HF data in one file. Switching off one channel is not possible.

If the INNOMAR data files are converted to third-party data formats, like SEG-Y, you can select which channel(s) to convert.

For the (new) SES3 INNOMAR data format it is possible to split the data files into their separate channels to separate SES3 files for each data channel. Afterwards you may delete the unwanted data files.

13.2.3 How can I reduce the HF transmit power?

Q1: In my multibeam data I see artefacts caused by acoustic interference from the INNOMAR SBP HF channel, especially in shallow water. How can I reduce the HF transmit power in shallow water?

Q2: In extremely shallow water the HF data amplitudes are too high and clipped. How can I reduce the HF transmit power to avoid this?

The LF transmit power depends on the HF transmit power. To ensure best performance for the LF channel, the HF ping is transmitted at the highest possible power.

With the latest "medium-100" models it is possible to reduce the HF power. Please note, that reducing the HF power by 6dB (signal amplitude 50%) will cause the LF power to drop by 12dB (signal amplitude 25%). This will seriously affect seabed penetration.

To reduce acoustic interference, see section 13.1.5 on page 154.

13.3 Trigger / Synchronization

13.3.1 How can I reduce the ping rate?

Q: I'm working in extremely shallow water and the system's ping rate is too high.

In normal operation the ping rate is calculated by the system based on the range settings, see section 6.1 on page 81. If a lower ping rate is desired, you may reduce it by a certain factor within the "Ping Rate Settings" dialogue, see section 5.9.6 on page 53 for details.

13.3.2 How can I get a fixed ping rate?

Q: I need a fixed ping rate that is not changing with range settings.

In normal operation the ping rate is calculated by the system based on the range settings, see section 6.1 on page 81. If required, the ping rate can also be set to a fixed value within the "Ping Rate Settings" dialogue, see section 5.9.6 on page 53 for details.
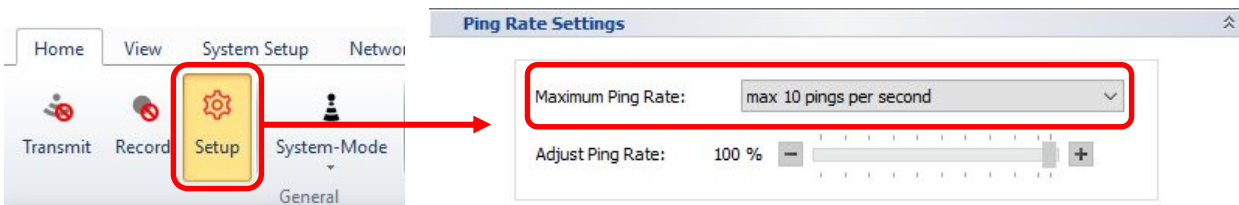
13.3.3 How can I synchronize a sparker that runs at a lower ping rate?

Q: I want to trigger a sparker from the INNOMAR SBP. The sparker should run at a lower ping rate, let's say every 160ms. The INNOMAR SBP shall do 3 pings in between.

For this you may set the SBP to a fixed ping rate as above and use "Alternating Trigger" mode, see section 6.3 on page 86ff and section. The sparker case is discussed in section 7.7 on page 105.

13.4 Motion Sensor / Motion (Heave/Roll/Pitch) Compensation

13.4.1 Do I need a motion sensor?

Q1: What is a motion sensor and what is it used for?

Q2: I do not have a motion sensor yet; do I need one?

The position and orientation of a rigid body in space (like a vessel afloat in water) is defined by three components of translation and three components of rotation, which means that it has six degrees of freedom. For vessels, usually the centre of gravity is considered to be the centre of rotation.
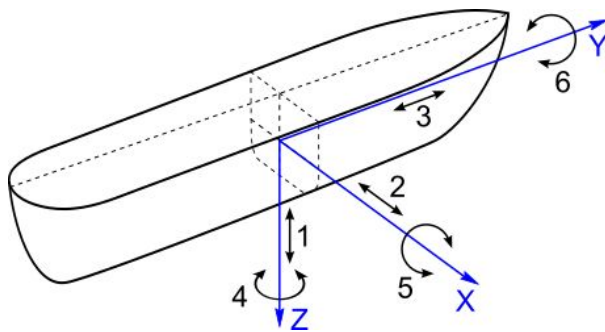
Translation:

1. Heave: moving up and down
2. Sway: moving left and right
3. Surge: moving forward and backward

Rotation:

4. Yaw: swivel left and right
5. Pitch: tilt forward and backward
6. Roll: pivot side to side

In case of operating an SBP, the motion components affecting data quality are (in decreasing order): heave (up and down, H), roll (pivoting side to side, R) and pitch (tilt forward/backward, P).

To improve data quality the motion effects can be corrected if the components are known. For this the components are measured by a motion sensor, which is sometimes also called HRP (or RPH) sensor.

All INNOMAR SBP models feature heave compensation. Active roll compensation is possible with the "standard" and "medium" models. Active pitch compensation is optionally available with the INNOMAR deep-water SBP models only. "Active" roll/pitch compensation means actively changing the direction of the transmitted (and received) sound ping to compensate the vessel's rotation (beam stabilization). Passive roll/pitch compensation in post-processing is possible with all INNOMAR SBP models.

It is strongly recommended to use and connect a motion sensor to the INNOMAR SBP topside unit, see section 7.5 on page 98.

13.4.2 Is a motion sensor included in the Innomar SBP?

Q: My INNOMAR SBP features heave and roll compensation. Is a motion sensor integrated in the unit or part of the delivered package?

No, there is no motion sensor integrated within the INNOMAR SBP, nor included within the standard delivery. A motion sensor can be included as paid option into the delivery.

13.4.3 What does "beam steering" or "beam stabilization" mean?

Q1: My INNOMAR SBP features "beam stabilization". What does this mean?

Q2: What is the difference between "beam steering" and "beam stabilization"?

Normally a transducer transmits a sound ping (beam) perpendicular to the transducer surface.

"Beam steering" means the capability to actively change the direction of the transmitted sound beam. This can be used for directing the sound ping towards slopes to improve data quality.

"Beam stabilization" means compensating the vessel's rotation due to the sea state (waves) by changing the direction of the transmitted sound ping to have a vertical beam for optimal data quality. For this the rotation angle(s) have to be known from a motion sensor, see above.

13.5 Shipping / Transport / Storage

13.5.1 Shall I remove / declare lithium batteries?

Q1: Are the lithium batteries within the system?

Q2: Do I need to remove any lithium batteries from the system for safe air freight?

Q3: Which labels on the package and which declarations (e.g. on AWB) are required?

Generally, all lithium cells and batteries are dangerous goods and need to be handled with care. For transportation, especially by airfreight, there are international regulations and packing instructions (PI) to conform with.

All INNOMAR SBP models with integrated data acquisition PC ("light", "standard", "medium-xx", "deep-xx") do have a CMOS backup-battery (lithium-metal button-cell, type CR2030) built in (UN 3091 – Lithium metal batteries contained in equipment).

Usually all dangerous goods, including lithium cells and batteries, needs to be declared. But for built-in button-cell batteries (like the PC CMOS backup battery) there is an exemption: "This requirement does not apply to: packages containing only button cell batteries installed in equipment (including circuit boards); and packages containing no more than four cells or two batteries installed in equipment, where there are not more than two packages in the consignment" (PI970 section II.2). Thus, **declaration and labelling of the CMOS battery are not required**. Even if this exemption would not exist, a single built-in button cell would not be required to be declared, because the amount of lithium contained is less than 1 g per cell (PI970 section II); one CR2032 contains about 0.07 g lithium (from Varta MSDS).

Furthermore, removing this backup battery from the motherboard would cause damage to the system, since the CMOS settings have usually been altered from the defaults and will be lost. **The CMOS backup-battery must not be removed**, the SBP will not work properly with the CMOS defaults!

Models with external data acquisition PC ("smart", "compact", "xx-usv", "standard-rov") may be shipped with a laptop-type computer, which may have not only a CMOS backup battery (Lithium-metal button-cell type CR2030, see above), but also a Lithium-ion battery for power. This (power) battery needs not to be declared, if all of the following conditions apply (PI967 section II):

- battery placed within the computer and no spare batteries placed in the package
  (UN 3481 – Lithium ion batteries contained in equipment);
- battery capacity less than 100 Wh (watt hours);
- less than 2 batteries or 4 cells per package (larger batteries require completed "Lithium Battery" mark;
- maximum 5 kg net weight of lithium ion batteries per package;
- less than 2 packages per consignment containing lithium batteries;
- there are effective means of preventing accidental activation of the equipment.

Since these requirements are usually fulfilled, the **laptop computers shipped along with the INNOMAR SBPs need no lithium labelling and declaration, the consignment is allowed for passenger and cargo aircrafts (PAX)**.

If there are more laptops or spare batteries within the consignment, labelling and declaration is required and other packing instructions as well as cargo aircraft only (CAO) transport may apply.

Since regulations may change and are differently handled by the airlines, INNOMAR usually ships laptops without any batteries. The topside unit needs mains power anyway and the control computer can use the same power source.

Do not place lithium labels on packages if this is not required! Some freight forwarders will refuse the consignment as "over declared". Labelled packages have to be declared on the AWB and a special shipper's declaration might be required, too. In addition, in most cases transport restrictions (like CAO – cargo aircraft only) and surcharges will apply.

More information can be found on the following web pages and PDF documents:

- **IATA**: https://www.iata.org/en/publications/newsletters/iata-knowledge-hub/what-to-know-about-how-to-ship-lithium-batteries/
- **UPS**: https://www.ups.com/assets/resources/media/en_GB/pack_ship_batteries.pdf
- **FedEX**: https://www.fedex.com/content/dam/fedex/us-united-states/logistics/Lithium-Battery-Shipping-Tool.pdf
- **DHL**: https://www.dhl.com/content/dam/dhl/local/us/dhl-ecommerce/documents/pdf/us-ecommerce-battery-shipping-policy.pdf

13.5.2 How do I pack the equipment for transport?

Q1: I want to ship the equipment to another place. What packing is required?

If possible, use the transport boxes delivered by INNOMAR with the system. These boxes are suitable for all means of transport (land, sea, air) and protect the equipment against damages.

If the original boxes are not available, you may ask INNOMAR for spares.

If the system was delivered in one-way packaging (e.g. wooden boxes for permanently installed systems), you may ask INNOMAR for advice.

13.5.3 How shall I put the SBP in store?

Q1: I finished my survey and have to put the equipment in store for some time. What do I have to take care of?

Whenever the system is put in store, make sure it has been cleaned, is in dry condition and shows no faults, see section 8.1 on pages 116ff. If possible, use the transport cases provided by INNOMAR.

If the topside (electronics) unit is not used for a longer period, it should be powered every 6 months to avoid damages.

After storage, before using the system again, you should do a basic system check, see section 8.1.6 on page 118.

13.5.4 Do I need an RMA number for sending the equipment to factory?

Q1: I need to send the SBP to factory for maintenance / repair. What labelling is required? Do I need an RMA number?

There is no RMA number required. Please label all boxes with the last two parts of the serial number of the topside unit. Example: S/N 2018/03/A/160/C2 → Label "**INNOMAR 160/C2**"

Blank Page

A.1   Innomar *smart* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 90 – 110 kHz)
Primary Source Level / Acoustic Power	> 235 dB//µPa re 1m / c. 2 kW
Secondary Low Frequency (SLF)	10 kHz (centre frequency, band with user selectable)
SLF Total Frequency Band	5 – 15 kHz
SLF Source Level	c. 200 dB//µPa re 1m
SLF Pulse Type	Ricker, CW
SLF Pulse Width	0.07 – 0.5 ms (CW, user selectable)
Beam Width (-3dB)	about ±2.5° for all frequencies (footprint c. 9% of water depth)
Heave / Roll / Pitch compensation	Heave only; depending on external sensor data
Water Depth Range	0.5 – 100 m below transducer
Sediment Penetration	soft clay: 20 m, sand: 2 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	c. 1 cm / up to 8 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 16 bit / 70 kHz; full waveform ("RAW" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 100 kHz / 5 cm @ 10 kHz) + 0.1% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	47 cm × 38 cm × 17 cm / weight 9 kg
Transducer Dimensions / Weight	27 cm × 21 cm × 6 cm / weight in air 10 kg (incl. 15 m cable)
Power Supply / Power Consumption	10 – 30 V DC / <100 W; recommended 24 V DC (optional ext. AC power supply 100 – 260 V AC / 50 – 60 Hz)
Environmental Conditions	Storage: -10…+60°C / splash water proof IP67 Operation: 0…+40°C / splash water proof IP67 transducer depth rating: surface (10 m)
Control & Data Acquisition PC	External PC / Laptop / Tablet (MS Windows® 10 OS) Recommended Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors as required
First / Latest Product Generation	2017 / 2022

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

! If the system is DC powered from a mains power supply unit (PSU) and not from battery, make sure the PSU can handle the power-on inrush current (e.g. a 24V / 5A PSU is fine).

System Components / Wiring Schematic
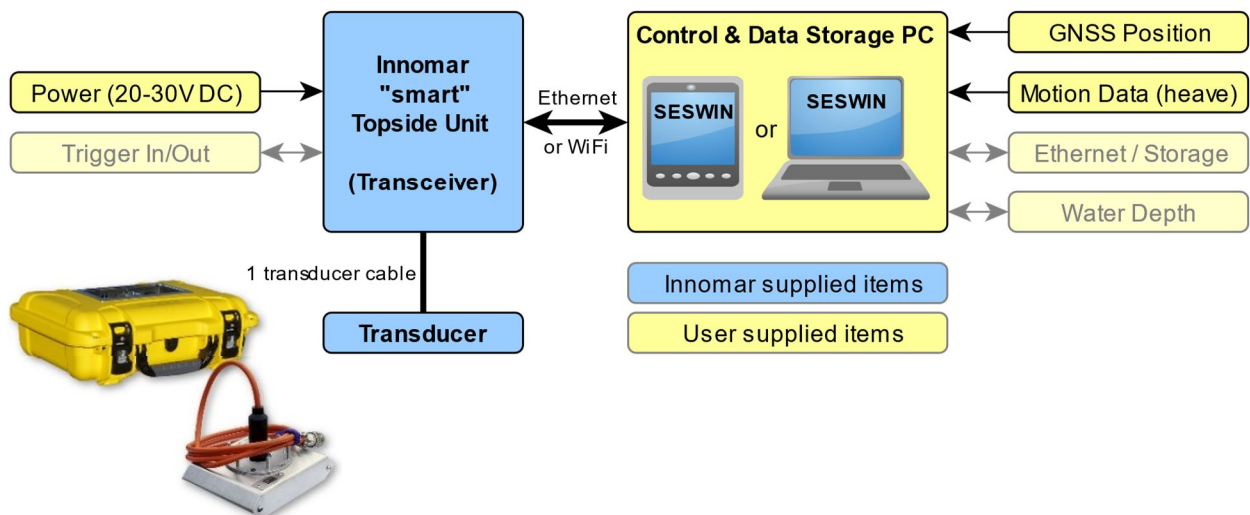
Topside Unit

Dimensions (W×D×H)	47 cm × 36 cm × 17 cm
Housing	Plastic case IP65
Weight	c. 9 kg

For operating the topside unit an external control computer (tablet or laptop PC; MS Windows® operating system) is required. This PC is not part of the supply, but may be ordered separately.

Trigger IN / OUT connector

Power ON/ OFF switch

Transducer connector

Power connector

Ethernet connector (M12)

Status LEDs
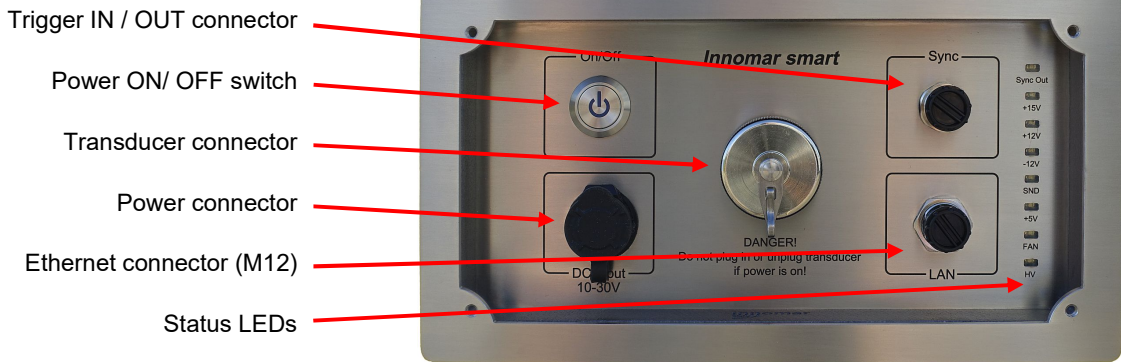
Transducer

Dimensions (W×D×H)	27 cm × 21 cm × 6 cm
Weight in air incl. 15m cable	c. 10 kg
Cable / Connector Diameter	c. 12 mm / c. 37 mm

S/N starts with **"M"**

The transducer is used for transmitting and receiving. It may be pole- or hull-mounted or used in a moon-pool. There is no towed equipment.

The transducer cable is moulded non-removable to the transducer. The default cable length is 15 meters.
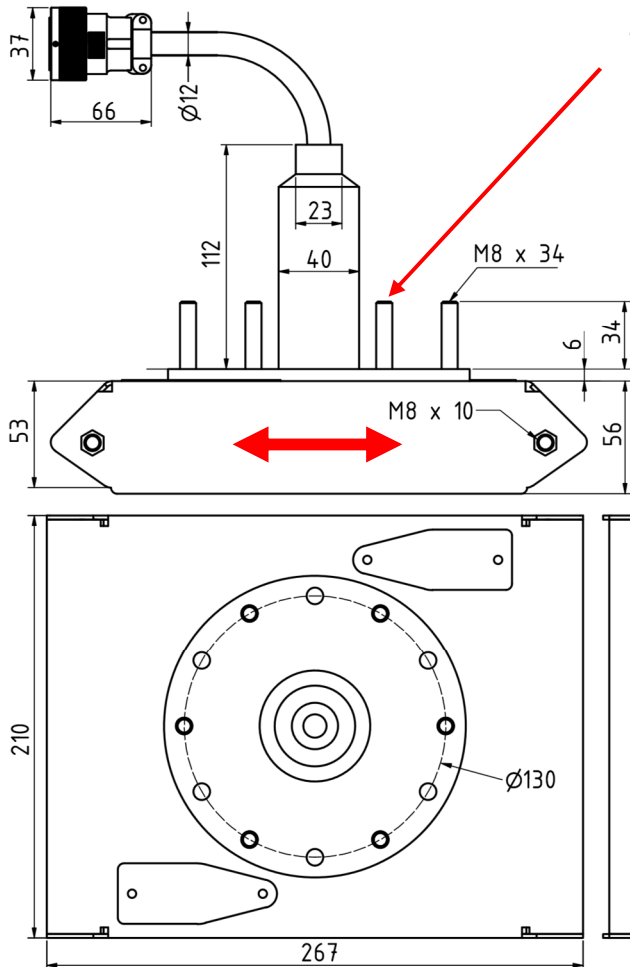
Transducer mounting via six threaded studs (M8 x 34 mm) arranged on a 130 mm circle. Make sure the correct orientation along vessel (transducer front and aft are the same).

A.2   Innomar *compact* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 238 dB//µPa re 1m / c. 2.3 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 205 dB//µPa re 1m
SLF Pulse Type	Ricker, CW
SLF Pulse Width	0.07 – 1 ms (CW, user selectable)
Beam Width (-3dB)	about ±2.0° for all frequencies (footprint c. 7% of water depth)
Heave / Roll / Pitch compensation	Heave only; depending on external sensor data
Water Depth Range	0.5 – 400 m below transducer
Sediment Penetration	soft clay: 40 m, sand: 4 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 16 bit / 70 kHz; full waveform ("RAW" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 100 kHz / 5 cm @ 10 kHz) + 0.06% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	30 cm × 40 cm × 20 cm (½ 19'' / 4U) / weight 15 kg
Transducer Dimensions / Weight	34 cm × 26 cm × 8 cm / weight in air 22 kg (incl. 20 m cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz; optional external DC power inverter (12 V **or** 24 V)
Power Consumption	<150 W
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	External PC / Laptop (MS Windows® 10/11 OS) Recommended Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors as required
First / Latest Product Generation	2002 / 2021

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
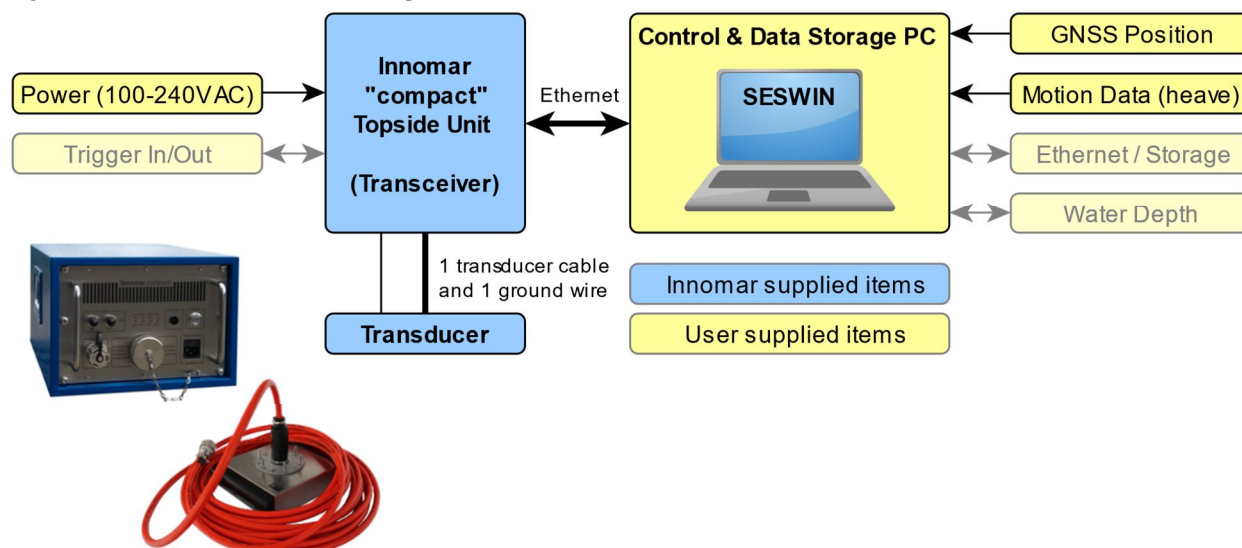
Topside Unit

Dimensions (W×D×H)	30 cm × 40 cm × 20 cm
Housing	½ 19 inch / 4U
Weight	c. 15 kg

For operating the topside unit an external control computer (MS Windows® operating system) is required. This PC is not part of the supply, but may be ordered separately.

- Power indicators
- Trigger IN / OUT (BNC)
- Ethernet (RJ45)
- Ground wire socket
- Power ON/ OFF switch (push-button)
- Transducer connector
- Power connector (mains)

Transducer

S/N starts with **"C"**

Dimensions (W×D×H)	34 cm × 26 cm × 8 cm
Weight in air incl. 20m cable	c. 22 kg
Cable / Connector Diameter	c. 20 mm / c. 54 mm

The transducer cable is moulded non-removable to the transducer. The default cable length is 20 meters.

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers.

Transducer mounting via six threaded studs (M8, length c. 34 mm) arranged on a 130 mm circle.

For drawings see also pages 175 f.

A.3 Innomar *light* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 238 dB//µPa re 1m / c. 2.3 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 205 dB//µPa re 1m
SLF Pulse Type	Ricker, CW
SLF Pulse Width	0.07 – 1 ms (CW, user selectable)
Beam Width (-3dB)	about ±2.0° for all frequencies (footprint c. 7% of water depth)
Heave / Roll / Pitch compensation	Heave only; depending on external sensor data
Water Depth Range	0.5 – 400 m below transducer
Sediment Penetration	soft clay: 40 m, sand: 4 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 16 bit / 96 kHz; full waveform ("RAW" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2 cm @ 100 kHz / 4 cm @ 10 kHz) + 0.06% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	52 cm × 40 cm × 26 cm (19'' / 5U) / weight 25 kg
Transducer Dimensions / Weight	34 cm × 26 cm × 8 cm / weight in air 22 kg (incl. 20 m cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz; optional external DC power inverter (12 V **or** 24 V)
Power Consumption	<250 W
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS) with 10'' TFT display Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2000 / 2021

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
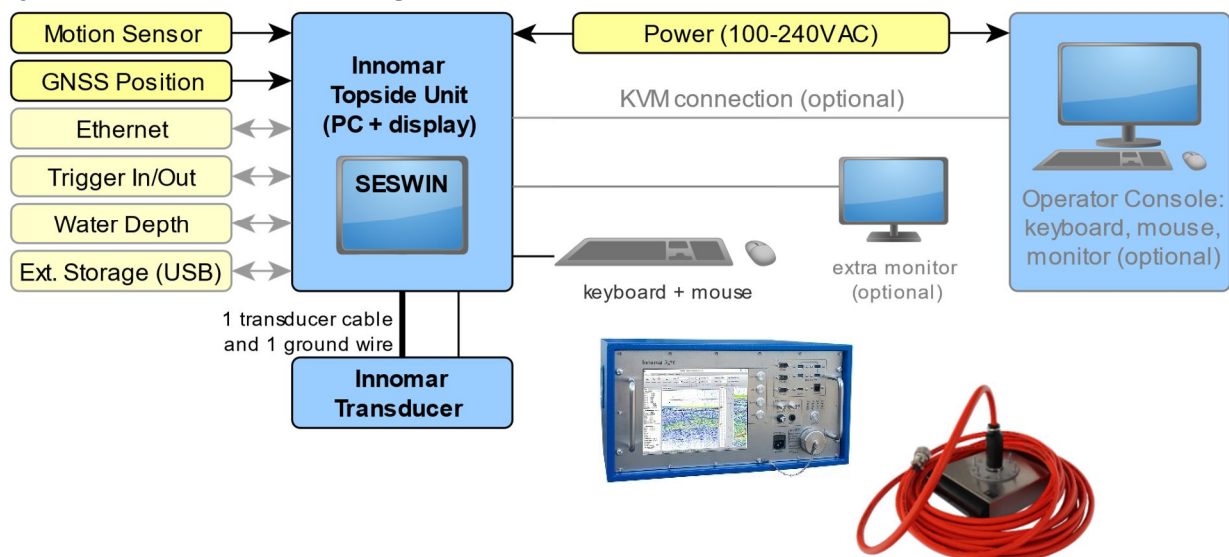
Topside Unit

Dimensions (W×D×H)	52 cm × 40 cm × 26 cm
Housing	19 inch / 5U
Weight	c. 25 kg

The control- and data acquisition PC is integrated into the topside unit. If required, this PC can be remote-controlled.

TFT display + control buttons

Trigger IN / OUT + LF out (BNC), ground wire

Power connector (mains)

PC interfaces (RS232 COM ports, USB, HDMI monitor, RJ45 Ethernet)

Power ON/ OFF + power indicators

Transducer connector

Transducer

S/N starts with **"C"**

Dimensions (W×D×H)	34 cm × 26 cm × 8 cm
Weight in air incl. 20m cable	c. 22 kg
Cable / Connector Diameter	c. 20 mm / c. 54 mm

The transducer cable is moulded non-removable to the transducer. The default cable length is 20 meters.

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers.

Transducer mounting via six threaded studs (M8, length c. 34 mm) arranged on a 130 mm circle.

For drawings see also pages 175 f.

A.4 Innomar *standard* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 240 dB//µPa re 1m / c. 3.5 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 208 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM Chirp
SLF Pulse Width	0.07 – 1.0 ms (CW, user selectable); 1.5 ms (chirp)
Beam Width (-3dB)	about ±2.0° for all frequencies (footprint c. 7% of water depth)
Heave / Roll / Pitch compensation	Heave + Roll (±15°) @ TX+RX; depending on ext. sensor data
Water Depth Range	0.5 – 500 m below transducer
Sediment Penetration	soft clay: 50 m, sand: 6 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 50 pings/s
Data Acquisition and Recording	digital 24 bit / 96 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2 cm @ 100 kHz / 4 cm @ 10 kHz) + 0.06% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	52 cm × 40 cm × 34 cm (19'' / 7U) / weight 35 kg
Transducer Dimensions / Weight	34 cm × 26 cm × 8 cm / weight in air 30 kg (incl. 30 m cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz; optional external DC power inverter (12 V **or** 24 V)
Power Consumption	<300 W
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS) with 10'' TFT display Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	1997 / 2020

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
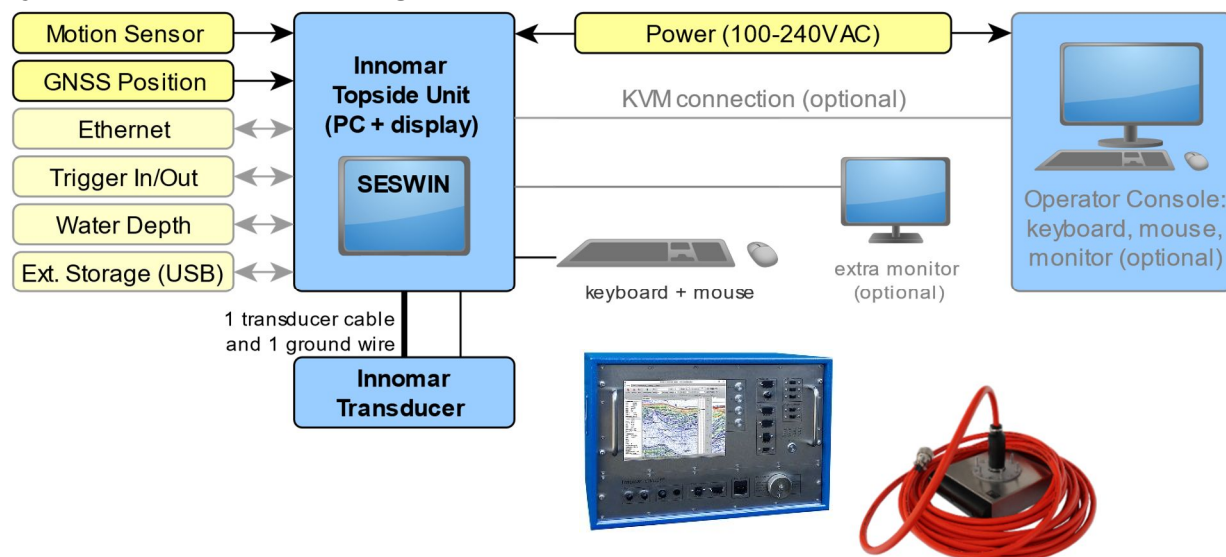
Topside Unit

Dimensions (W×D×H)	52 cm × 40 cm × 34 cm
Housing	19 inch / 7U
Weight	c. 35 kg

The control- and data acquisition PC is integrated into the topside unit. If required, this PC can be remote-controlled.

TFT display + control buttons

Motion IN

LF out (BNC), ground wire

Trigger IN / OUT

PC interfaces (RS232 COM ports, USB, HDMI monitor, RJ45 Ethernet)

Power ON/ OFF + power indicators

Power connector

Transducer connector

Transducer

S/N starts with **"A"**
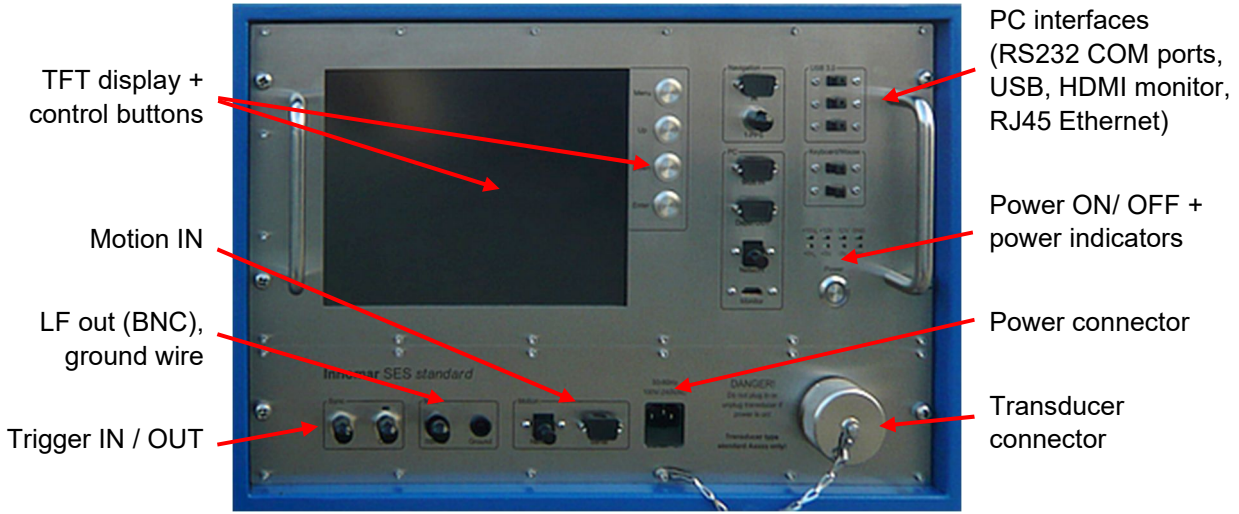
Dimensions (W×D×H)	34 cm × 26 cm × 8 cm
Weight in air incl. 30m cable	c. 30 kg
Cable / Connector Diameter	c. 22 mm / c. 54 mm

The transducer cable is moulded non-removable to the transducer. The default cable length is 30 meters.

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers.
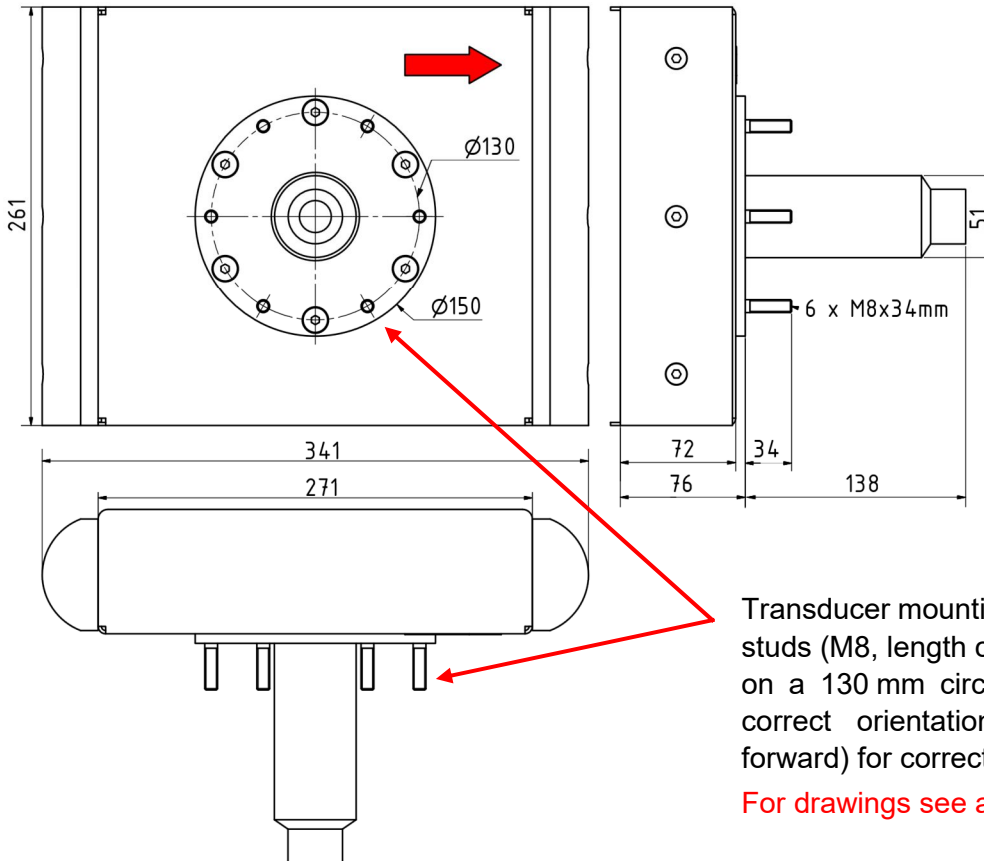
Transducer mounting via six threaded studs (M8, length c. 34 mm) arranged on a 130 mm circle. Make sure the correct orientation (arrow pointing forward) for correct beam-steering.

For drawings see also pages 175 f.

A.5   Innomar standard-usv SBP

The *"standard-usv"* model is basically the *"standard"* model without the integrated control PC. There is a simplified data acquisition without beam-forming and the control PC is connected via Ethernet.

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 240 dB//µPa re 1m / c. 3.5 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 208 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM Chirp
SLF Pulse Width	0.07 – 1.0 ms (CW, user selectable); 1.5 ms (chirp)
Beam Width (-3dB)	about ±2.0° for all frequencies (footprint c. 7% of water depth)
Heave / Roll / Pitch compensation	Heave + Roll (±15°) @ TX only; depending on ext. sensor data
Water Depth Range	0.5 – 500 m below transducer
Sediment Penetration	soft clay: 50 m, sand: 6 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	c. 1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 70 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 100 kHz / 5 cm @ 10 kHz) + 0.06% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	45 cm × 36 cm × 18 cm (19'' / 4U) / weight 16 kg
Transducer Dimensions / Weight	34 cm × 26 cm × 8 cm / weight in air c. 9 kg (excl. cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	20 – 30 V DC external AC power converter (100 – 240 V AC, 50 – 60 Hz)
Power Consumption	<200 W
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	External PC (MS Windows® 10/11 OS). Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2020

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic

Topside Unit

Dimensions (W×D×H)	45 cm × 36 cm × 18 cm
Housing	19 inch / 4U rack-mountable
Weight	c. 16 kg

This unit requires an external Windows® based control- and data acquisition PC, which connects via Ethernet to the topside. Please note, the air-intake openings at the bottom must not be blocked.

Motion IN

Trigger IN / OUT

Voltage indicators (LEDs)

Transducer connector

Power input

Transducer

Dimensions (W×D×H)	34 cm × 26 cm × 8 cm
Weight in air	c. 15 kg (excl. cable)
Cable / Connector Diameter	c. 22 mm / c. 54 mm

The transducer cable is moulded non-removable to the transducer. The cable length is 7 to 15 meters (default 10m).

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers.

S/N starts with **"A"**

Ø130

Ø150

261

341

271

51

6 x M8x34mm

72

34

76

138

Transducer mounting via six threaded studs (M8, length c. 34 mm) arranged on a 130 mm circle. Make sure the correct orientation (arrow pointing forward) for correct beam-steering.

For drawings see also pages 175 f.
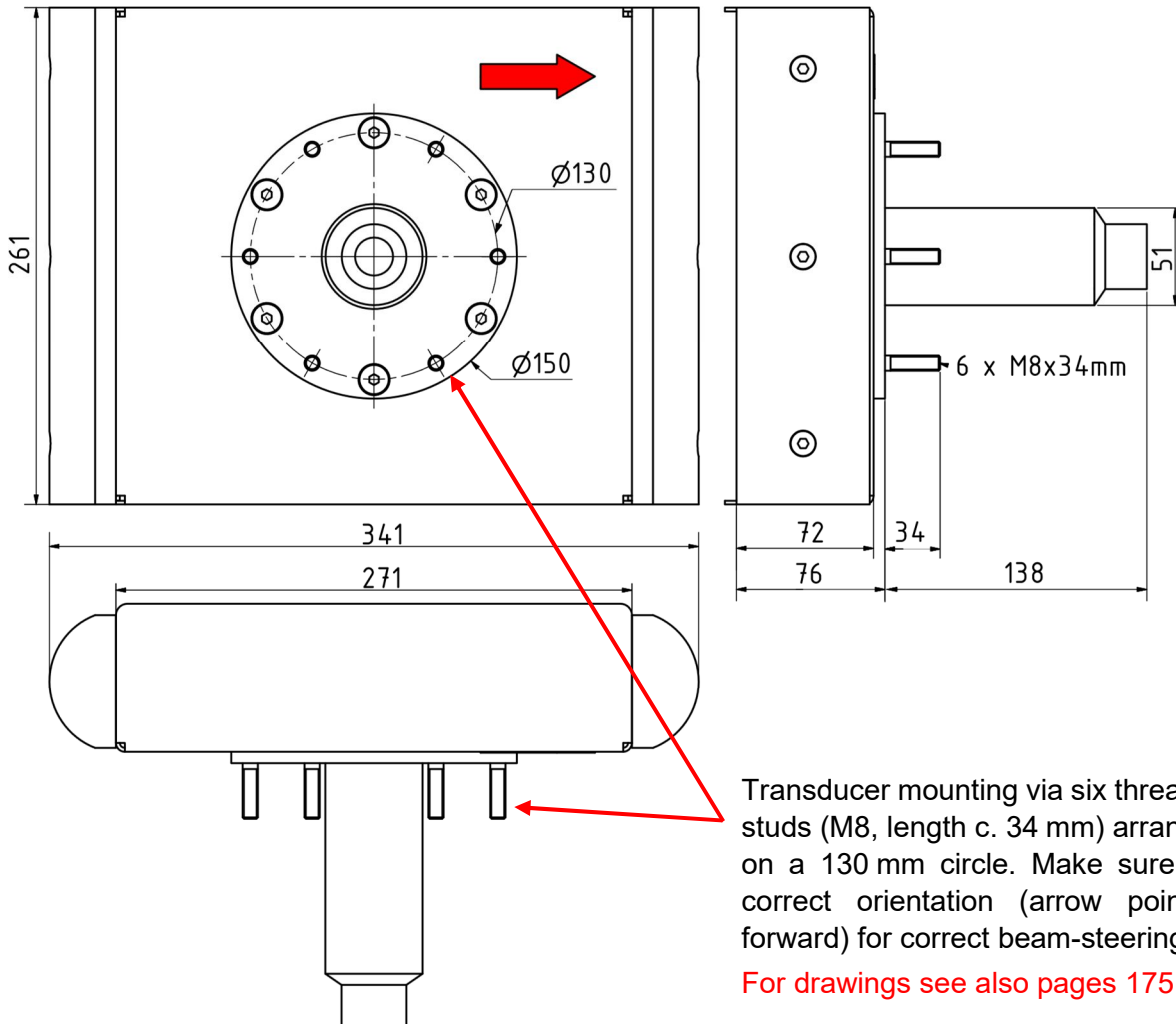
A.6   Transducers Innomar *compact / light / standard*

Pole-Mount Transducer
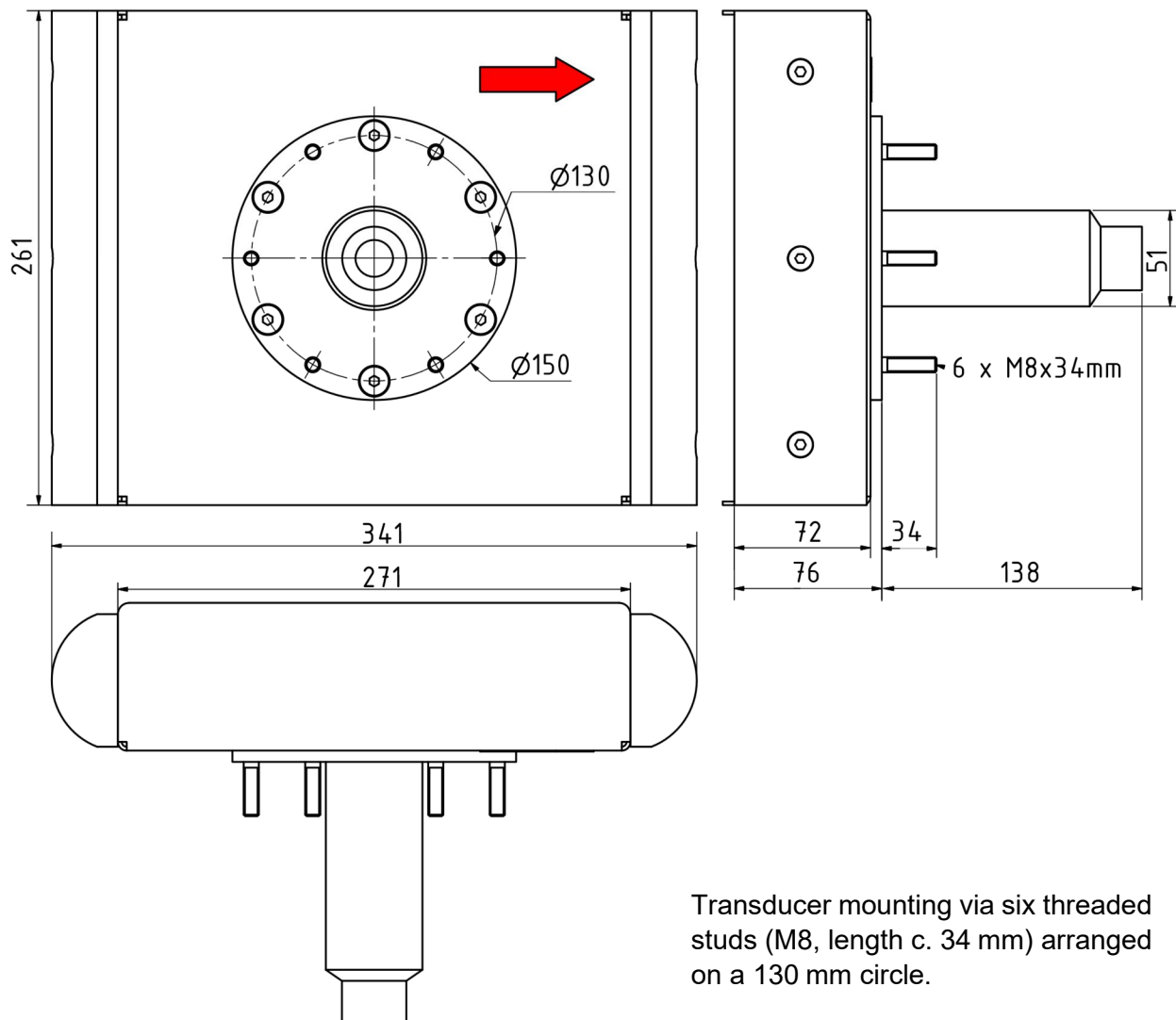
Transducer mounting via six threaded studs (M8, length c. 34 mm) arranged on a 130 mm circle.

Dimensions (L×W×H)	34 cm × 26 cm × 8 cm
Weight *"compact"* and *"light"*	c. 22 kg (incl. 20 m cable)
Weight *"standard"*	c. 30 kg (incl. 30 m cable)
Cable / Connector Diameter	c. 20 (22) mm / c. 54 mm

The cable is moulded non-removable to the transducer, the standard cable lengths are given in the table.

For hull- or moon-pool installations there is also a special mounting frame available, see next page. The fairings (black plastic parts) at the transducers must not be removed by the user. Please ask INNOMAR for advice if you need them removed, e.g. for mounting into a moon-pool.

Transducers for the INNOMAR *"compact"*, *"light"* and *"standard"* models have the same dimensions, but differ in electrical connections. Make sure to use the correct transducer and check the serial number!

For the "standard" transducer the correct orientation (arrow pointing forward to the vessel's bow) is important for correct beam stabilisation!

Hull-Mount Transducer (Mounting Frame)

The frame is mounted via six bolts M8. The other two larger holes in the frame are left open to ensure water filling of the sea chest.
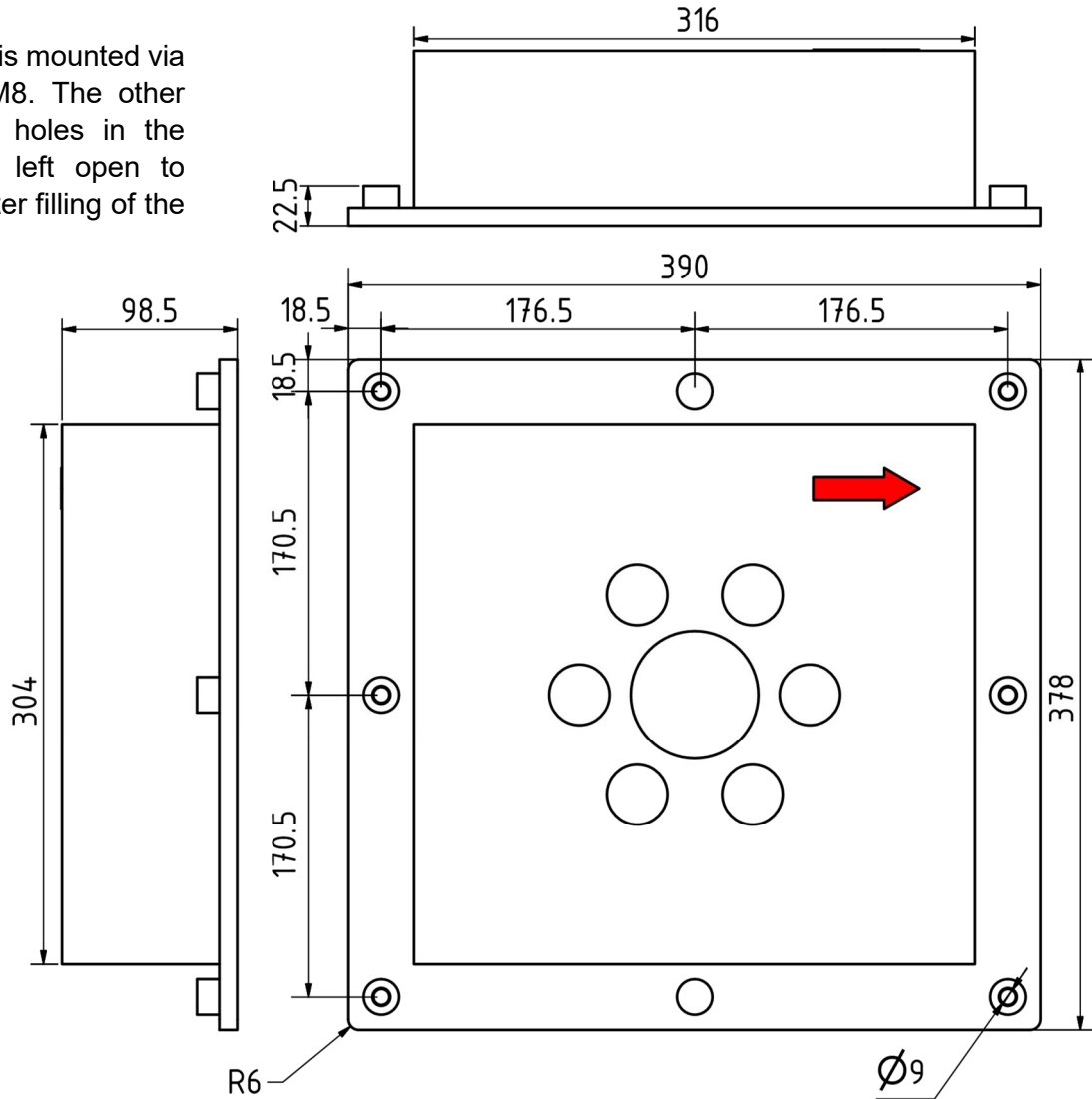
Dimensions (L×W×H)	39 cm × 38 cm × 10 cm
Additional Frame Weight	c. 10 kg

The pole-mount transducer (see previous page) is delivered without the fairings and mounted into a shock-absorbing frame to reduce structure-borne noise. This is suitable for mounting the transducer directly to the vessel's hull (sea chest), into blisters or gondolas.

For drilling the mounting threads into the flange at the correct positions, INNOMAR provides a drilling template.

Please note that the M8 mounting studs on the transducer have to be longer (54 mm) for the frame-mount than shown on the prev. page.

Transducers for the INNOMAR *"compact"*, *"light"* and *"standard"* models have the same dimensions, but differ in electrical connections. Make sure to use the correct transducer and check the serial number!

For the "standard" transducer the correct orientation (arrow pointing forward to the vessel's bow) is important for correct beam stabilisation!

To avoid biofouling reducing the system performance, **hull-mounted transducers have to be coated using an INNOMAR approved anti-fouling paint**. Please do not use any other paint since this might destroy the transducer. We also recommend anti-fouling if a pole-mounted transducer is operated in tropical waters for a longer period. See section 8.1.3 on page 117 for details.

A.7   Innomar standard-rov SBP

The *"standard-rov"* model is basically the *"standard"* model without the integrated control PC and all transceiver electronics within a pressure-proof subsea housing. There is a simplified data acquisition without beam-forming and the control PC is connected via Ethernet, like with the *"standard-usv"* model.

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 240 dB//µPa re 1m / c. 3.5 kW
Secondary Low Frequency (SLF)	5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	4 – 22 kHz
SLF Source Level	c. 208 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM Chirp
SLF Pulse Width	0.07 – 1.0 ms (CW, user selectable); 1.5 ms (chirp)
Beam Width (-3dB)	about ±2.0° for all frequencies (footprint c. 7% of range)
Heave / Roll / Pitch compensation	Heave + Roll (or Pitch) (±15°) @ TX only; depending on external sensor data
Water Depth Range	1 – 500 m below transducer
Sediment Penetration	soft clay: 50 m, sand: 6 m; depending on noise, pulse settings and geological conditions
Range Resolution / Layer Resolution	c. 1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 70 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 100 kHz / 5 cm @ 10 kHz) + 0.06% of distance
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	D 28 cm × L 75 cm (titanium subsea housing) / weight 58 kg
Transducer Dimensions / Weight	D 47 cm × H 6 cm / weight in air 32 kg (excl. cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	85 – 260 V AC / 50 – 60 Hz or 115 – 370 V DC
Power Consumption	<250 W
Environmental Conditions	Storage: -10…+60°C Operation: 0…+40°C / depth rating 200 bar (2,000 m)
Control & Data Acquisition PC	External PC (MS Windows® 10/11 OS). Recommended specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2003 / 2017

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.
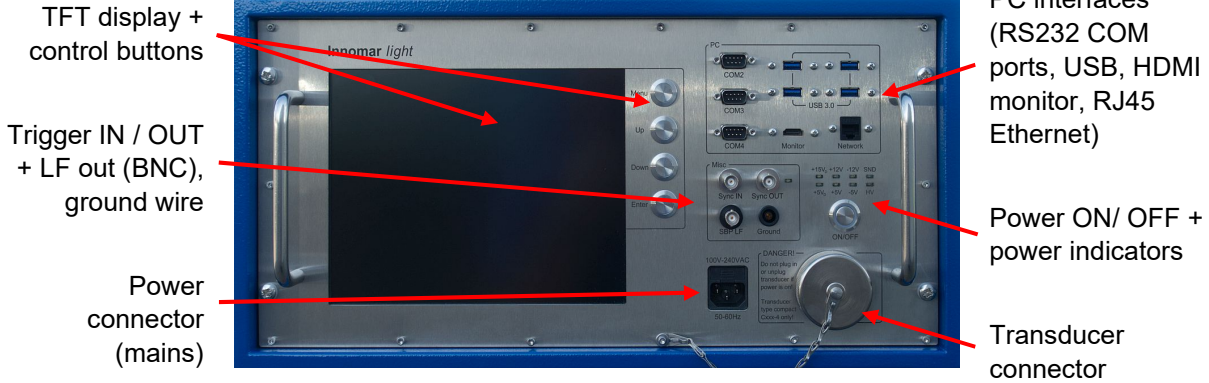
System Components / Wiring Schematic
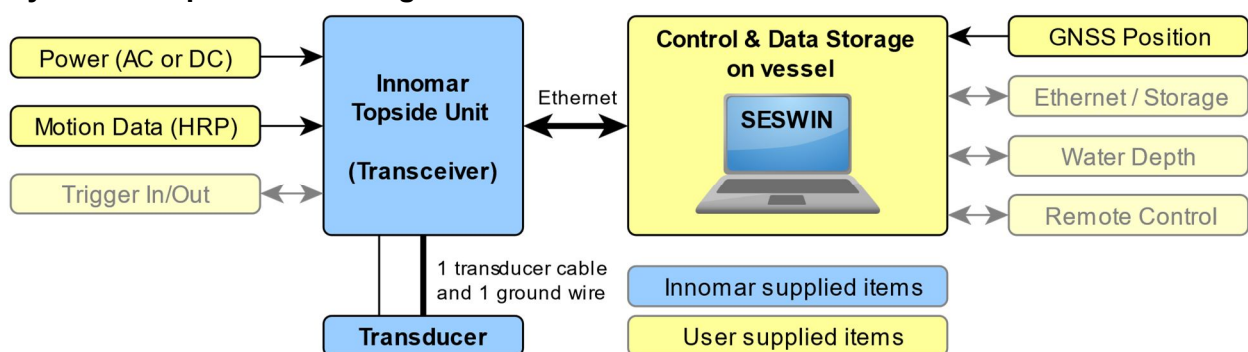
Subsea Unit

Dimensions (D×L)	∅ 278 mm x 743 mm
Weight in air / water	c. 58 kg / c. 15 kg
Material / Depth Rating	Titanium Grade 5 / 200 bar (2,000 m)

The control- and data acquisition PC is connected via Ethernet. There is no data stored within the subsea unit.
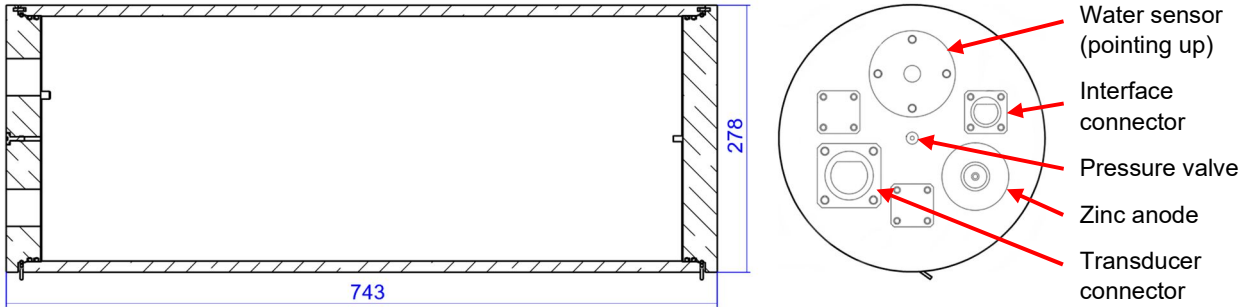
Interface Connector (Power, Ethernet, Motion Sensor, Trigger)

Burton 5506-2013 13 pins male connector on pressure pod. Please use Burton 5501-2013-**E**0xx pigtail with **twisted-pair Ethernet** connection.

Pin 1	X	Power L (+)	
Pin 2	X	Motion sensor RX data (RS232)	
Pin 3	X	Motion sensor GND (RS232)	
Pin 4	X	Power N (GND)	
Pin 5	X	Ethernet TX+	RJ45 pin#1 orange/white
Pin 6	X	Ethernet TX-	RJ45 pin#2 orange
Pin 7	X	Chassis Ground (Screen)	
Pin 8	X	Ethernet RX+	RJ45 pin#3 green/white
Pin 9	X	Ethernet RX-	RJ45 pin#6 green
Pin 10		Trigger OUT (RS232 levels)	
Pin 11		Trigger IN (RS232 levels)	
Pin 12		GND Trigger IN	
Pin 13		GND Trigger OUT	
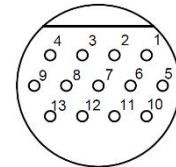
X → required connection

Deck Test Cable

Innomar does not provide the cable needed for interfacing to the vehicle, this cable depends on the connectors at the vehicle itself and should be prepared specifically for the vehicle used.

For system test purposes Innomar provides a deck test cable (not water proof), only.

- Interface connector (Burton 13-pin)
- Power (100 – 240 V AC)
- Ethernet connector (RJ45)
- Motion data input (RS232 DB9)
- Trigger in/out (BNC)
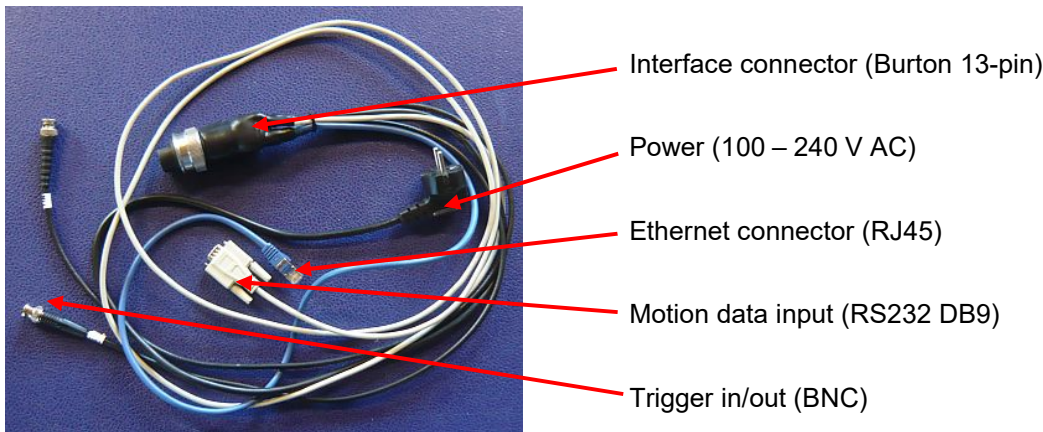
Transducer

Dimensions (D×H)	∅ 470 mm x 55 (145) mm
Weight in air / water	c. 32 kg / c. 24 kg
Material / Depth Rating	SS 1.4571 (316Ti) / 200 bar (2,000 m)

The transducer is used for transmitting and receiving.

The transducer cable is plugged on both ends, the standard cable length is 5 meters.
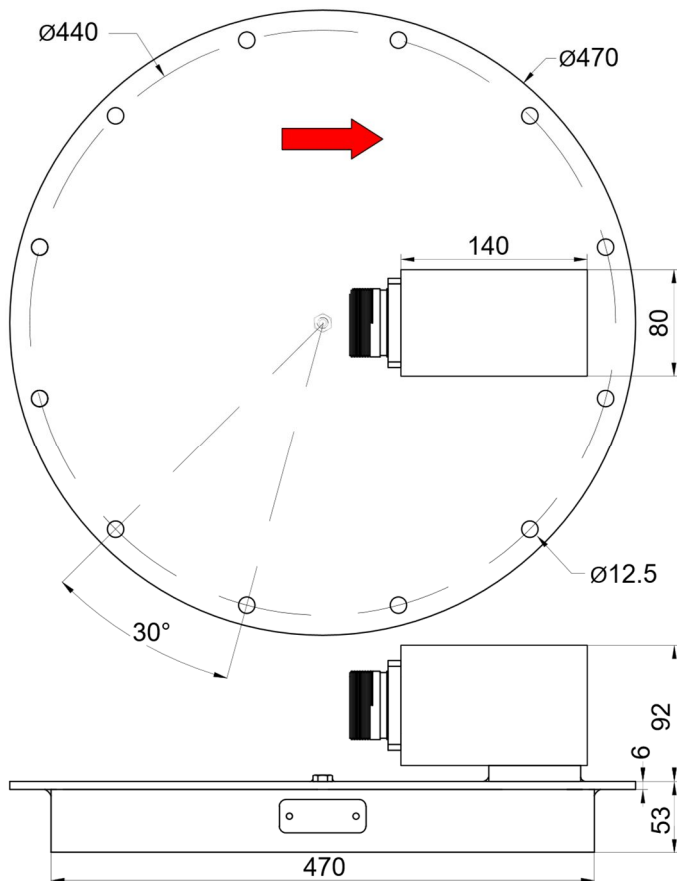
Transducer mounting is via 12 bolts M8.

Make sure the correct orientation (arrow pointing forward) for correct beam-steering. With the orientation shown on the left (arrow and connector box pointing forward), the system will correct for pitch and not for roll.

For acoustic isolation there are rubber tubes and rubber washers provided, which have to be put on the bolts as shown in the picture:

Important notes for system handling and installation

- The subsea unit needs to be laced firmly onto a rigid support structure of the ROV.
- Install and transport the pressure pod with the "water sensor" pointing upwards (see arrow in picture above).
- All connectors have to be protected by pressure caps or dust caps during installation, transport and storage.
- Before diving, make sure all plugs are connected tightly and all unused connectors are protected by dummy plugs (BURTON pressure caps turned out not to be sufficient).
- The cable's connectors have to be protected by dust caps if not used.
- Never plug and unplug connectors when power is switched on.
- During transport and storage, the provided transport cases have to be used.
- The "water sensor" disables the transmitters if the pressure pod is not below water level. This shall prevent running the system in air, which would destroy the transducer and harm the electronics due to insufficient heat transfer.

Transducer Cable

Two BURTON connectors (6611-3239 and 5511-3239) wired one to one, cable with 19 twisted pairs and common screen.

Pins 1-2 ... 11-12	Twisted pairs (transmitters 1 ... 6)
Pins 13-14	"Transducer Plugged" safety circuit
Pins 15-16 ... 17-18	Twisted pairs (transmitters 7 ... 8)
Pins 19-20	GND
Pins 21-22 ... 35-36	Twisted pairs (transmitters 9 ... 16)
Pins 37-38	not used
Pin 39	Cable screen
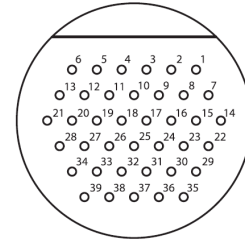
Dust Caps and Dummy Plugs for Connectors and Cables

	Qty	Dummy Plug	Dust Cap (hard rubber)
transducer connector at subsea unit	1	6601-3239-0000 A	6700-0520-0000
transducer connector at transducer	1	5501-3239-0000 A	6700-0124-0321
interface connector at subsea unit	1	5501-2013-0000 A	6700-0124-0201
interface cable connector	1		6700-0125-0201
transducer cable connectors	2		6700-0125-0321

The use of dust caps will keep the connectors clean and help prevent accidental damage both during storage and service. Anyhow, these caps are not water proof! Therefore, dummy plugs should be used on all unused connectors if the system is mounted on the ROV.

Special "standard-rov" SESWIN Settings

On ROVs usually the main transducer tilt is in Pitch and not in Roll direction. Therefore, the default transducer mounting as shown on the previous page, is for pitch compensation. For this mounting the "transducer is rotated" check box has to activated in the SESWIN "Motion Sensor Setup".
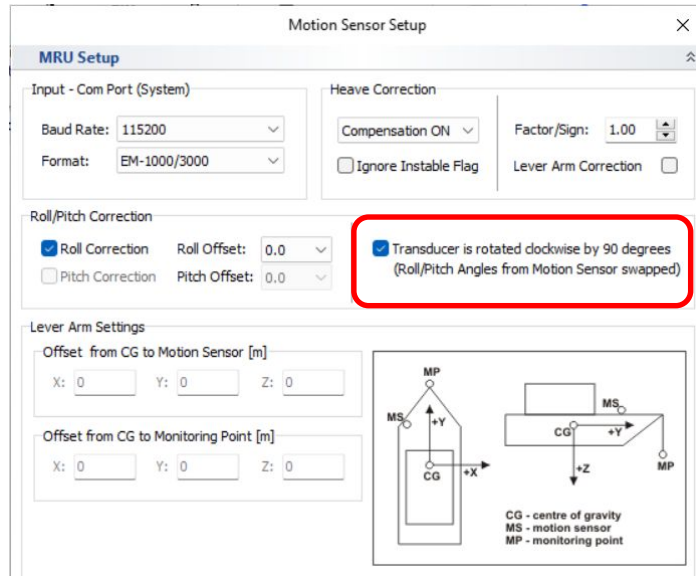
There are some additional sensors, those status is shown in the "System Status":

• Internal connectors plugged
• Fans working
• "System in Water" sensor status
• Power consumption
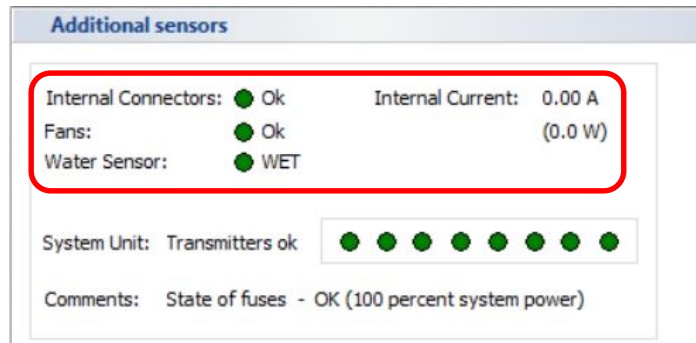
A.8   Innomar *medium-100* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 247 dB//µPa re 1m / c. 5.5 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 215 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM chirp (5 – 15 kHz)
SLF Pulse Width	0.07 – 1.0 ms (CW, user selectable); 3.5 ms (LFM chirp)
Beam Width (-3dB)	about ±1.0° for all frequencies (footprint c. 3.5% of water depth)
Heave / Roll / Pitch compensation	Heave + Roll (±15°) @ TX+RX; depending on ext. sensor data
Water Depth Range	2 – 2,000 m below transducer
Sediment Penetration	soft clay: 70 m, sand: 10 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 96 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2 cm @ 100 kHz / 4 cm @ 10 kHz) + 0.02% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	52 cm × 40 cm × 44 cm (19'' / 9U) / weight c. 44 kg
Transducer Dimensions / Weight	50 cm × 50 cm × 12 cm / weight c. 60 kg (incl. 30 m cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power Consumption	<400 W (max. power-on inrush current 25 A / <100 ms)
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS) with 10'' TFT display Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2004 / 2020

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
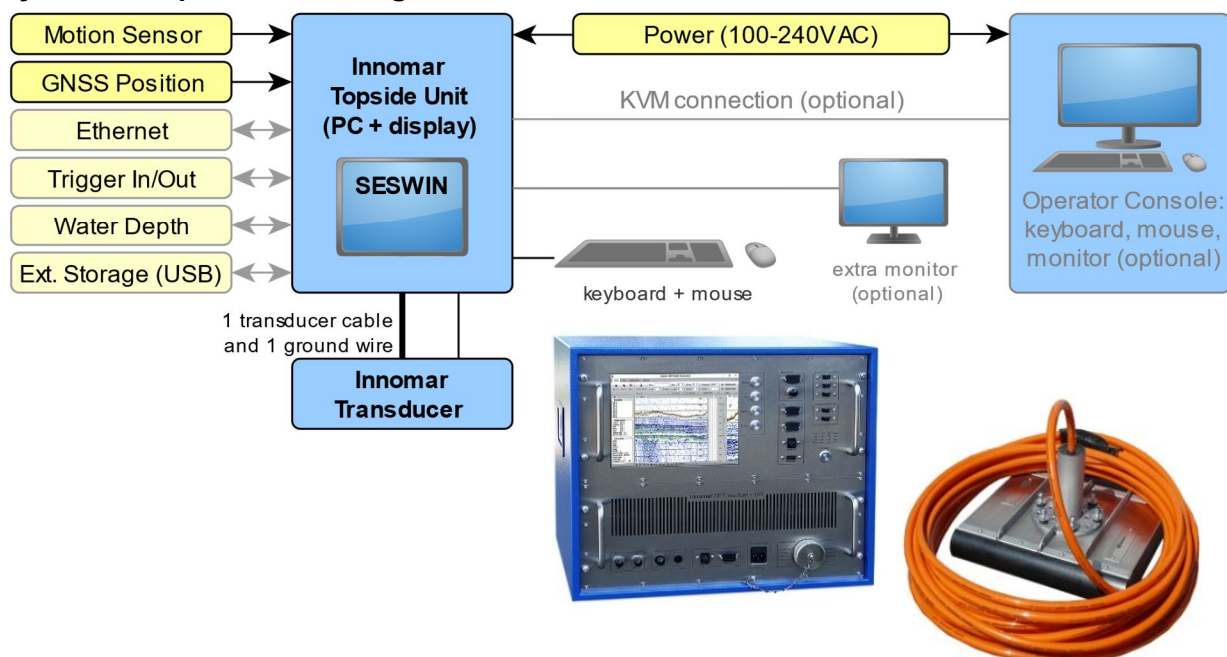
Topside Unit

Dimensions (W×D×H)	52 cm × 40 cm × 44 cm
Housing	19 inch / 9U
Weight	c. 44 kg

The control- and data acquisition PC is integrated into the topside unit. If required, this PC can be remote-controlled.

This topside unit should be preferably installed within an air-conditioned room. There has to be enough space for connections and maintenance as well as air venting around the unit.

TFT display + control buttons

Motion IN

LF out (BNC), ground wire

Trigger IN / OUT

PC interfaces (RS232 COM ports, USB, HDMI monitor, RJ45 Ethernet)

Power ON/ OFF + power indicators

Power connector

Transducer connector

The topside unit has to be installed on a dry and safe place and should be fixed to avoid mechanical destructions during rough sea.

! Protect the unit and the installation place against water!

Make sure that the air-intake openings at the front panel and bottom are open and not blocked. Fans are installed in the rear panels.

Keyboard, mouse and monitor are usually connected to the unit via KVM extender. This consists of two parts (local and remote), both powered by its own power supply. Keyboard and mouse connections are USB; monitor connection is HDMI. Maximum Ethernet cable length is 50 m. Make sure a direct cable connection; the Ethernet cable must not be connected to a network.
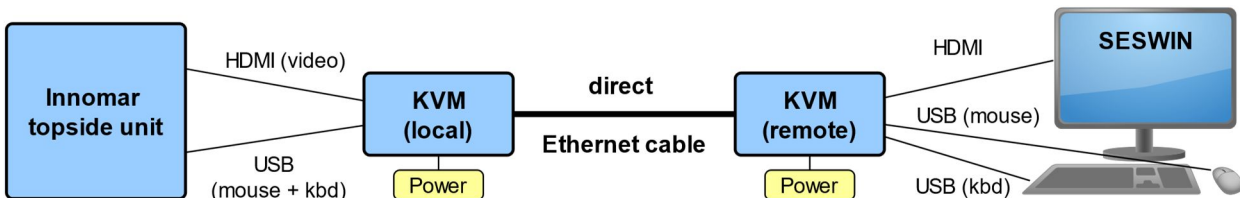
Pole-Mount Transducer

Transducer mounting via six threaded studs (M10 x 36 mm) arranged on a 170 mm circle.

Make sure the correct orientation (arrow pointing forward) for beam-steering. There is also a small notch at the bottom skids, indicating the transducer's front.

75

Ø54

Ø22

Ø76

6 x M10x36

25

72

79

198

4

36

forward indicator (notch)

Ø 200

Ø 170

484

104

390

486

Dimensions (L×W×H)	49 cm × 49 cm × 11 cm
Weight in air	c. 60 kg (incl. 30 m cable)
Cable / Connector Diameter	c. 22 mm / c. 54 mm

S/N starts with **"E"**

The transducer cable is moulded non-removable to the transducer. The standard cable length is 30 meters.

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers, see next page.

Hull-Mount Transducer

Transducer mounting via 18 bolts M10 arranged on the mounting flange.

Make sure the correct orientation (arrow pointing forward and notch in the skids) for beam-steering.
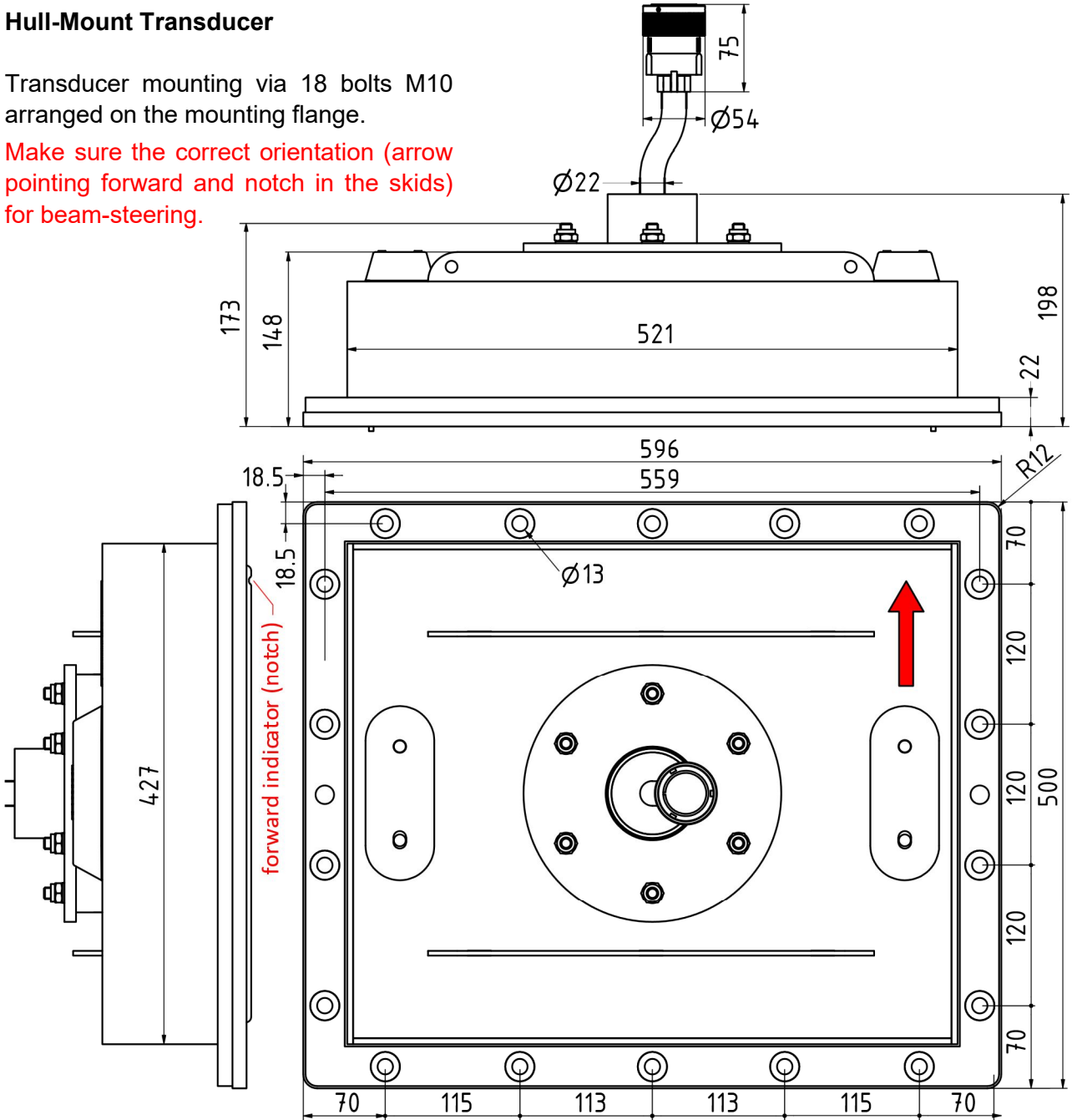
Dimensions (L×W×H)	60 cm × 50 cm × 20 cm
Weight in air	about 90 kg (incl. 30 m cable)
	about 110 kg (incl. 50 m cable)
Cable / Connector Diameter	c. 22 mm / c. 54 mm

S/N starts with **"E"**

The pole-mount transducer (see previous page) is delivered without the fairings and mounted into a shock-absorbing frame via an extra flange to reduce structure-borne noise. This frame is mounted by 18 bolts M10 and is suitable for mounting the transducer directly to the vessel's hull (sea chest), into blisters or gondolas.

The cable is moulded non-removable to the transducer, the standard cable length is 30m.

To avoid biofouling reducing the system performance, **permanently-mounted transducers have to be coated using an INNOMAR approved anti-fouling paint**. Please do not use any other paint since this might destroy the transducer. We also recommend anti-fouling if a pole-mounted transducer is operated in tropical waters for a longer period. See section 8.1.3 on page 117 for details.

A.9   Innomar *medium-usv* SBP

The *"medium-usv"* model is basically the *"medium-100"* model without the integrated control PC. There is a simplified data acquisition without beam-forming and the control PC is connected via Ethernet.

Main Technical Specifications

Primary High Frequencies (PHF)	c. 100 kHz (band 85 – 115 kHz)
Primary Source Level / Acoustic Power	> 247 dB//µPa re 1m / c. 5.5 kW
Secondary Low Frequency (SLF)	4, 5, 6, 8,10,12,15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Source Level	c. 215 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM chirp (5 – 15 kHz)
SLF Pulse Width	0.07 – 1.0 ms (CW, user selectable); 3.5 ms (LFM chirp)
Beam Width (-3dB)	c. ±1.0° for all frequencies (footprint c. 3.5% of water depth)
Heave / Roll / Pitch compensation	Heave + Roll (±15°) @ TX only; depending on ext. sensor data
Water Depth Range	2 – 2,000 m below transducer
Sediment Penetration	soft clay: 70 m, sand: 10 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	c. 1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 70 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 100 kHz / 5 cm @ 10 kHz) + 0.02% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	45 cm × 36 cm × 31 cm (19'' / 7U) / weight c. 24 kg
Transducer Dimensions / Weight	50 cm × 50 cm × 12 cm / weight in air c. 40 kg (excl. cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	20 – 30 V DC
Power Consumption	<300 W
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	External PC (MS Windows® 10/11 OS), not included Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2020

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
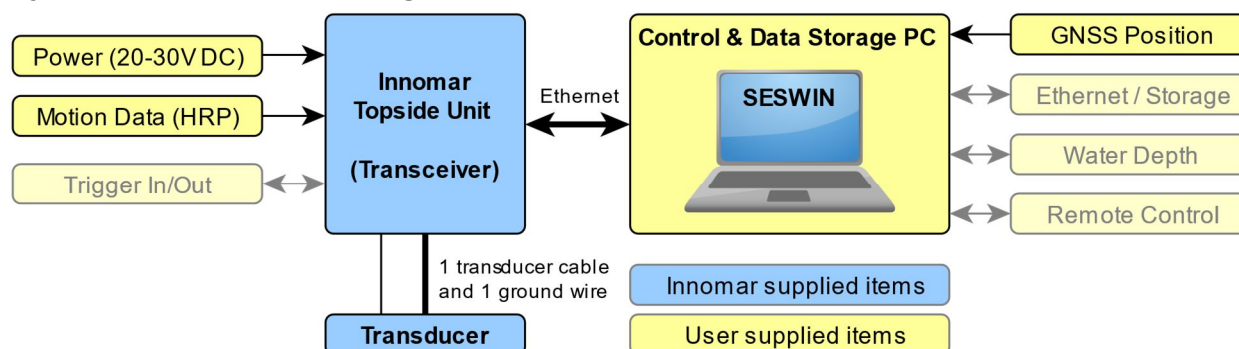
Topside Unit

Dimensions (W×D×H)	45 cm × 36 cm × 31 cm
Housing	19 inch / 7U rack-mountable
Weight	c. 24 kg

This unit requires an external Windows® based control- and data acquisition PC, which connects via Ethernet to the topside.

The topside unit has to be installed on a dry and safe place and should be fixed to avoid mechanical destructions during rough sea.

! Protect the unit and the installation place against water!

Make sure that the cooling slots are open and the fans can get air! There are openings for air-intake at the front panels of the topside units. Fans are installed in the rear panels.

Transducer

S/N starts with **"E"**

Dimensions (L×W×H)	50 cm × 50 cm × 12 cm
Weight in air	c. 40 kg (excl. cable)
Cable / Connector Diameter	c. 22 mm / c. 54 mm

The transducer cable is moulded non-removable to the transducer. The cable length can be chosen from 7 to 15 meters (default 10m).

The fairings (black parts) can be removed for hull-mounting; ask INNOMAR for instructions. There is also a hull-mount frame with shock absorbers.

A.10 Innomar *medium-70* SBP

There are two model versions, one with heave and roll compensation ("Basic") and one with additional pitch compensation ("RP").

Main Technical Specifications

Primary High Frequencies (PHF)	c. 70 kHz (band 60 – 80 kHz)
Primary Source Level / Acoustic Power	> 246 dB//µPa re 1m / c. 7.5 kW
Secondary Low Frequency (SLF)	3, 4, 5, 6, 8,10,12 kHz (centre frequency, user selectable)
SLF Total Frequency Band	1.5 – 15 kHz
SLF Source Level	c. 212 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM chirp (3|–|12 kHz)
SLF Pulse Width	0.08 – 1.0 ms (CW, user selectable); 5 ms (LFM chirp)
Beam Width (-3dB)	c. ±1.5° for all frequencies (footprint c. 5.5% of water depth)
Heave / Roll / Pitch compensation	"Basic" version: Heave + Roll (±15°) @ TX+RX "RP" version: Heave + Roll (±15°) + Pitch (±10°) @ TX+RX; depending on external sensor data (for both versions)
Water Depth Range	2 – 2,500 m below transducer
Sediment Penetration	soft clay: 100 m, sand: 12 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 7 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 96 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(2.5 cm @ 70 kHz / 5 cm @ 8 kHz) + 0.04% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	"Basic" vers.: 52 cm × 40 cm × 44 cm (19'' / 9U) / c. 52 kg "RP" version: 52 cm × 50 cm × 63 cm (19'' / 13U) / c. 64 kg
Transducer Dimensions / Weight	60 cm × 60 cm × 25 cm / weight c. 140 kg (excl. cable)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power Consumption	<450 W (max. power-on inrush current 25 A / <100 ms)
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS) with 10'' TFT display Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2012 / 2021

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.
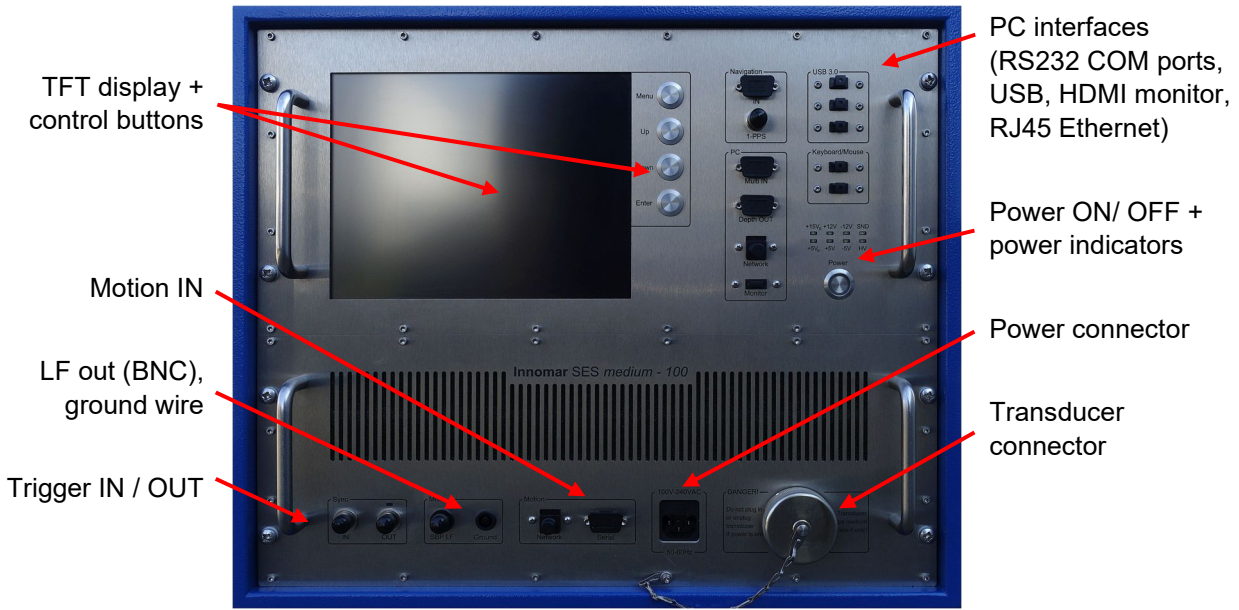
System Components / Wiring Schematic

Topside Unit

(picture shows "Basic" version)

There is one (1) topside unit, which contains all transceiver electronics, data acquisition and the Windows based control PC. Dimensions and weight depend on the model version:

	"Basic" version (Heave + Roll)	"RP" version (Heave + Roll + Pitch)
Dimensions (L×W×H) Housing Weight	52 cm × 40 cm × 50 cm 19 inch / 9 U c. 52 kg	52 cm × 50 cm × 63 cm 19 inch / 13 U c. 64 kg

The topside unit is preferably installed using shock absorbers (provided by Innomar) in an air-conditioned room. There has to be enough space for connections and maintenance as well as air venting around the unit.

The topside unit has to be installed on a dry and safe place and should be fixed to avoid mechanical destructions during rough sea.

! Protect the unit and the installation place against water!

Make sure that the cooling slots are open and the fans can get air! There are openings for air-intake at the front panels of the topside units. Fans are installed in the rear panels.
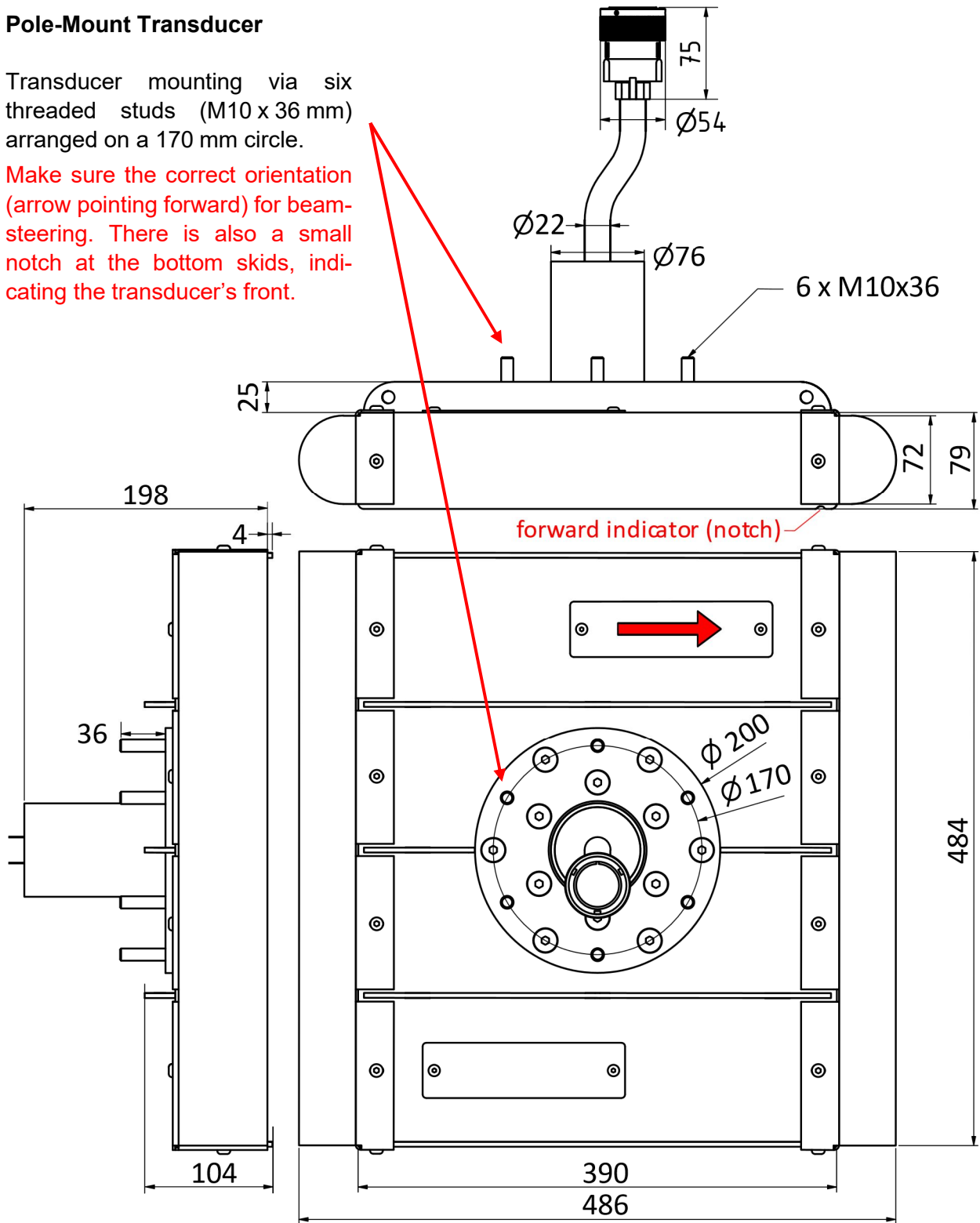
Keyboard, mouse and monitor are usually connected to the unit via KVM extender. This consists of two parts (local and remote), both powered by its own power supply. Keyboard and mouse connections are USB; monitor connection is HDMI. Maximum Ethernet cable length is 50 m. Make sure a direct cable connection; the Ethernet cable must not be connected to a network.

Transducer

Dimensions (L×W×H)	69 cm × 75 cm × 22 cm
Weight in air	c. 140 kg (excl. cable)
Cable / Connector Diameter	c. 22 mm / c. 54 mm

This transducer can be mounted into a sea chest, blister or gondola using 18 bolts M12. It can also be used in a moon-pool or drop-keel.

This transducer incorporates optimized shock absorbers to avoid structure-borne noise picked up and a zinc anode to prevent corrosion. Please note that the cable is moulded non-removable to the transducer, its default length is 30 meters.

For drilling the mounting threads into the flange at the correct positions, INNOMAR provides a drilling template.

2 x connectors

Ø22

Ø76

Make sure the correct orientation (arrow pointing forward) for beam-steering.

220
24

40

73.5
150
150
474
150
150
73.5

Ø13 Ø25 Ø18

20

73.5 180 180 180 73.5 20

687
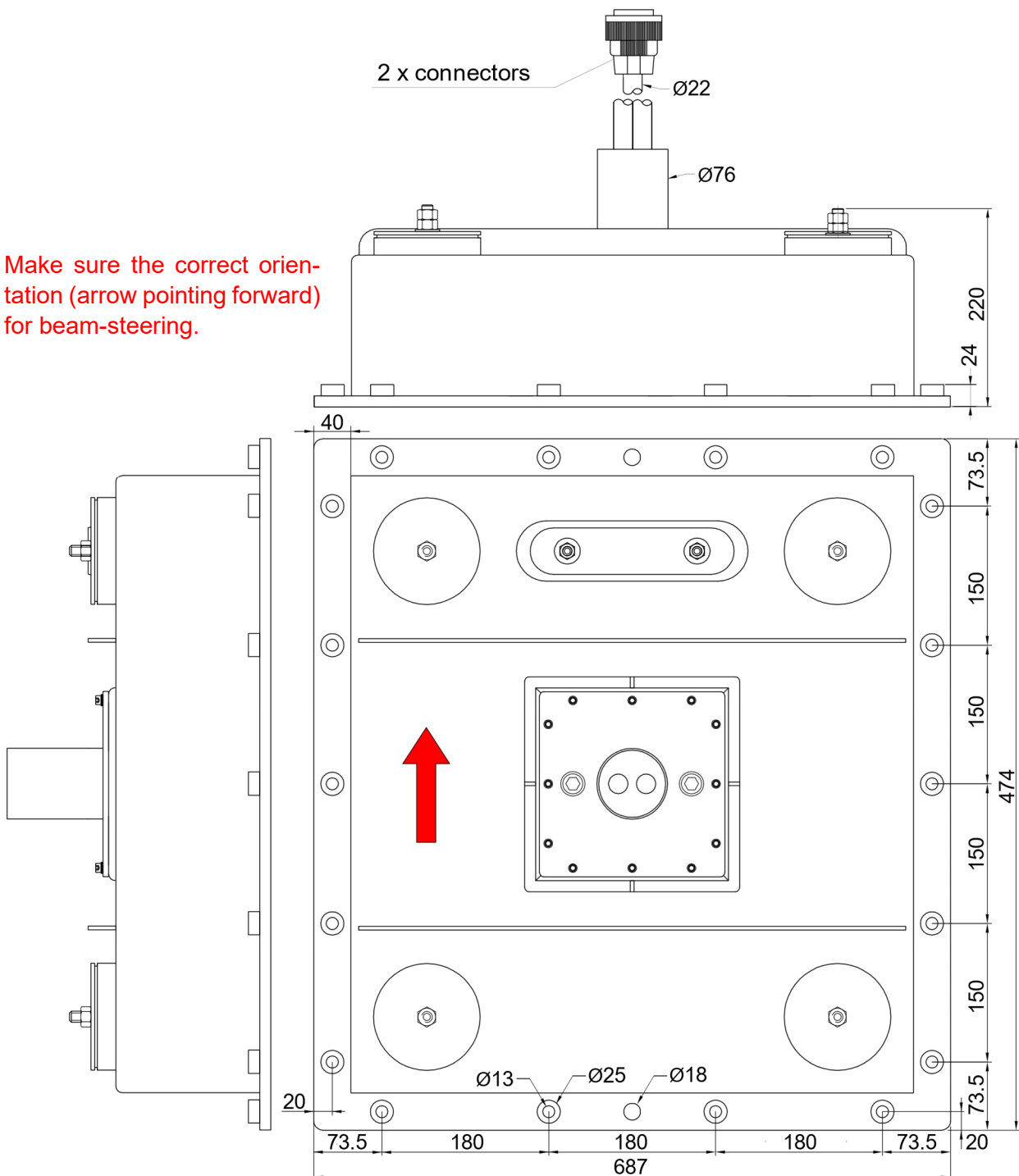
Blank Page

A.11 Innomar *deep-36* SBP

There are two model versions, one with heave and roll compensation ("Basic") and one with additional pitch compensation ("RP").

Main Technical Specifications

Primary High Frequencies (PHF)	c. 36 kHz (band 30 – 42kHz)
Primary Source Level / Acoustic Power	> 246 dB//µPa re 1m / c. 9 kW
Secondary Low Frequency (SLF)	2, 3, 4, 5, 6, 7 kHz (centre frequency, user selectable)
SLF Total Frequency Band	1 – 10 kHz
SLF Source Level	c. 210 dB//µPa re 1m
SLF Pulse Type	Ricker, CW, LFM chirp (2 – 7 kHz)
SLF Pulse Width	0.15 – 1.5 ms (CW, user selectable); 5 ms (LFM chirp)
Beam Width (-3dB)	about ±1.5° for all frequencies (footprint c. 5.5% of water depth)
Heave / Roll / Pitch compensation	"Basic" version: Heave + Roll (±15°) @ TX+RX "RP" version: Heave + Roll (±15°) + Pitch (±10°) @ TX+RX; depending on external sensor data (for both versions)
Water Depth Range	5 – 6,000 m below transducer
Sediment Penetration	soft clay: 150 m, sand: 20 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<1 cm / up to 15 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 75 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(6 cm @ 36 kHz / 12 cm @ 3.6 kHz) + 0.06% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	"Basic" vers.: 52 cm × 50 cm × 50 cm (19'' / 10U) / c. 56 kg "RP" version: 52 cm × 50 cm × 63 cm (19'' / 13U) / c. 66 kg
Transducer Dimensions / Weight	88 cm × 92 cm × 18 cm / c. 245 kg (excl. cables), see below
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power Consumption	<900 W (max. power-on inrush current 25 A / <100 ms)
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS), proc. I5 or better, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, 3×USB3.0, 2×USB2.0, 4×RS232, 1×HDMI1.4a
First / Latest Product Generation	2007 / 2021

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
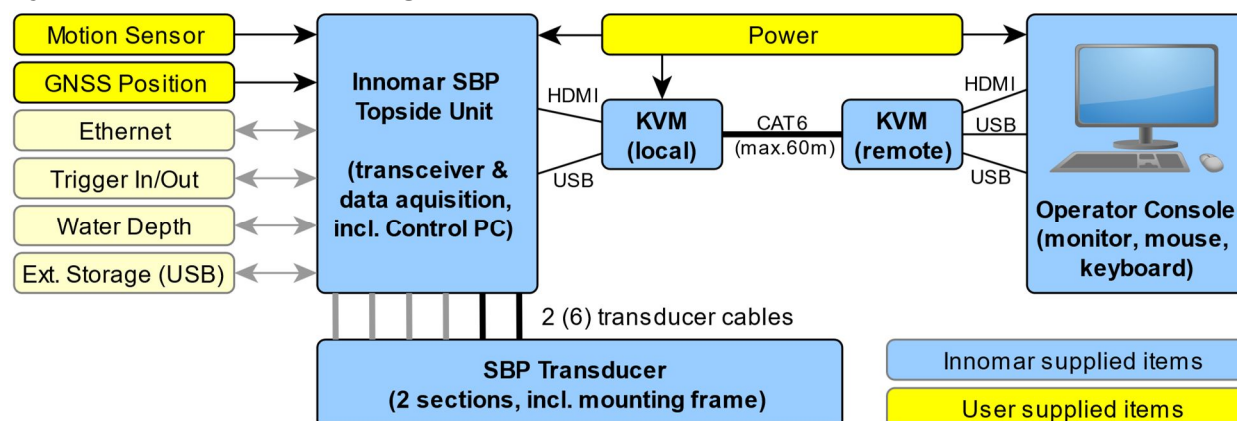
Topside Unit

(picture shows "Basic" version)

There is one (1) topside unit, which contains all transceiver electronics, data acquisition and the Windows based control PC. Dimensions and weight depend on the model version:

	"Basic" version (Heave + Roll)	"RP" version (Heave + Roll + Pitch)
Dimensions (L×W×H)	52 cm × 50 cm × 50 cm	52 cm × 50 cm × 63 cm
Housing	19 inch / 10 U	19 inch / 13 U
Weight	c. 56 kg	c. 66 kg

The topside unit is preferably installed using shock absorbers (provided by Innomar) in an air-conditioned room. There has to be enough space for connections and maintenance as well as air venting around the unit.

The topside unit has to be installed on a dry and safe place and should be fixed to avoid mechanical destructions during rough sea.

! Protect the unit and the installation place against water!

Make sure that the cooling slots are open and the fans can get air! There are openings for air-intake at the front panels of the topside units. Fans are installed in the rear panels.

Keyboard, mouse and monitor are usually connected to the unit via KVM extender. This consists of two parts (local and remote), powered by its own power supply (depending on actual model power may be required only on one end or at both ends, local and remote). Keyboard and mouse connections are USB; monitor connection is HDMI. Maximum Ethernet cable length is 60 m. Make sure a direct cable connection; the Ethernet cable must not be connected to a network.
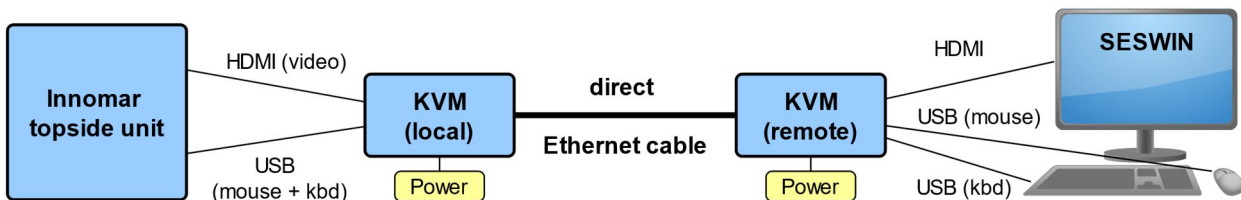
Transducer
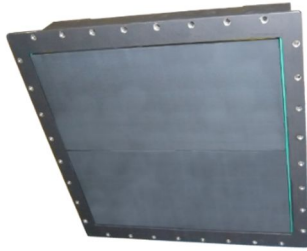
	excl. mounting frame	incl. mounting frame
Dimensions (L×W×H)	75 cm × 80 cm × 16 cm	88 cm × 92 cm × 18 cm
Weight (excl. cables)	c. 165 kg	c. 245 kg
Weight (incl. cables)	c. 215 kg ("Basic" ver.)	c. 300 kg ("Basic" vers.)
	c. 300 kg ("RP" version)	c. 380 kg ("RP" version)
Cable / Connector Ø	c. 22 mm / 54 mm	c. 22 mm / 54 mm

The transducer consists of two sections and there is one cable moulded non-removable to each transducer section. For the "RP" model version there are three cables per section.

The default cable length is 30 meters.

The transducer sections are mounted into a frame with shock absorbers to avoid structure-borne noise picked up. This frame can be mounted into a sea chest, blister or gondola using 32 bolts M12. It can also be used in a moon-pool or drop-keel.
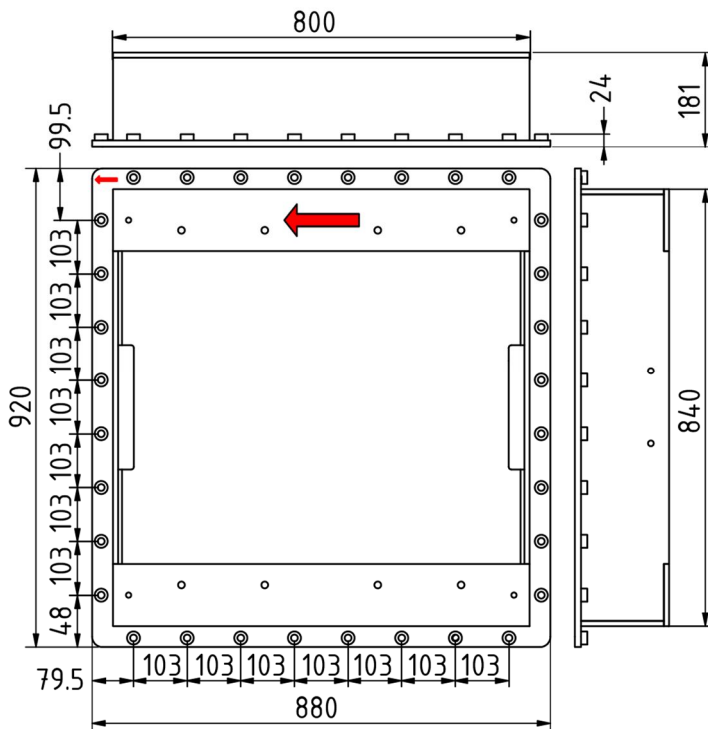
Make sure the correct orientation (arrow pointing forward) for beam-steering.

Transducer mounting frame without transducer sections
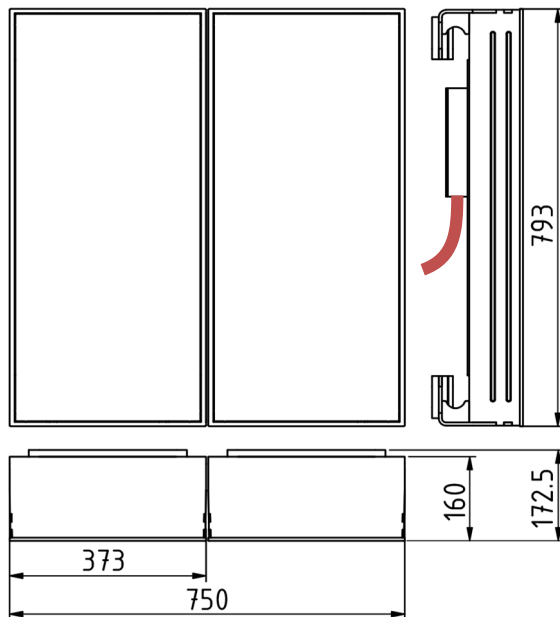
Two transducer sections (seen from below). The cable (orange) is moulded to the section and cannot be disconnected. Please note that at delivery the sections are usually already mounted into the frame.

Blank Page

A.12 Innomar *deep-15* SBP

Main Technical Specifications

Primary High Frequencies (PHF)	approx. 15 kHz (band 10 – 20kHz)
Primary Source Level / Acoustic Power	> 242 dB//µPa re 1m / c. 10 kW
Secondary Low Frequency (SLF)	0.75 – 3.7 kHz (centre frequency, user selectable)
SLF Total Frequency Band	0.5 – 5.5 kHz
SLF Source Level	c. 208 dB//µPa re 1m (depending on settings)
SLF Pulse Type	Ricker, CW, LFM chirp (0.5 – 5.5 kHz)
SLF Pulse Width	0.25 – 5 ms (CW, user selectable); 20 ms (LFM chirp)
Beam Width (-3dB)	c. ±2.3° for all frequencies (footprint c. 8% of water depth)
Heave / Roll / Pitch compensation	Heave + Roll (±30°) + Pitch (±15°) @ TX+RX; depending on external sensor data
Water Depth Range	20 – 11,000 m below transducer
Sediment Penetration	soft clay: 250 m, sand: 30 m; depending on noise, pulse settings and geological conditions
Sample Resolution / Range Resolution	<2 cm / up to 20 cm (depending on pulse settings)
Pulse Rate	up to 40 pings/s
Data Acquisition and Recording	digital 24 bit / 48 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(12 cm @ 15 kHz / 24 cm @ 1.5 kHz) + 0.08% of water depth
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	TX: 52 cm × 50 cm × 74 cm (19'' / 16U) / weight c. 95 kg RX: 52 cm × 40 cm × 44 cm (19'' / 9U) / weight c. 40 kg
Transducer Dimensions / Weight	140 cm × 140 cm × 35 cm / weight c. 925 kg (excl. cables)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power Consumption	<1,000 W (max. power-on inrush current 25 A / <100 ms)
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS); Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	2019

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.
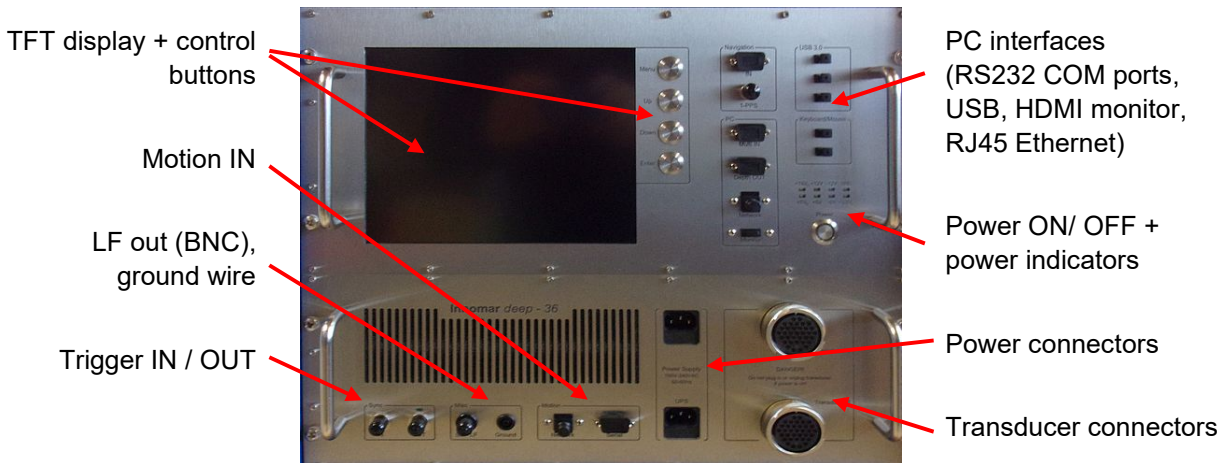
System Components / Wiring Schematic
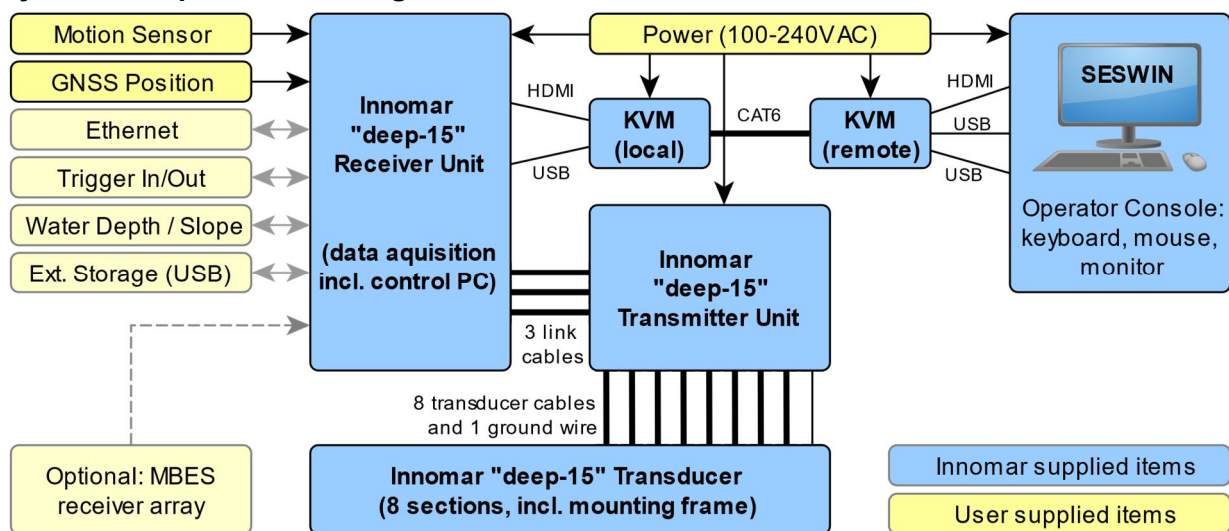
Transceiver Units

There are two topside units: one transmitter unit (19''/16U) and one receiver unit (19''/9U). Both units have to be placed close together, preferably on shock-absorbers (provided by Innomar, not shown on the photo) into an air-conditioned room. There has to be enough space for connections and maintenance as well as air venting around the units.

For operating the system there is an operator console with monitor, keyboard, mouse connected to the receiver unit via KVM (provided by Innomar, dedicated Ethernet cable required, distance up to 100 m).

	Transmitter Unit	Receiver Unit	Operator Console
Dimensions (L×W×H)	0.52 m × 0.50 m × 0.74 m	0.52 m × 0.40 m × 0.44 m	n/a
Housing type	19 inch / 16U	19 inch / 9U	n/a
Weight	c. 95 kg (incl. cables)	c. 40 kg (incl. cables)	c. 25 kg

Transmitter Unit

This unitnit contains all the transmitter electronics with power supply and there are eight (8) connectors for the transducer cables (one cable per module, see below). Make sure to connect according to the labels.

Transmitter power supply

Transducer connectors

Power control LEDs

Sync OUT/IN (BNC connectors)

Motion data IN (serial RS232 or Ethernet)

Link to Receiver Unit (3 cables)

Power switch and mains connectors

Receiver Unit
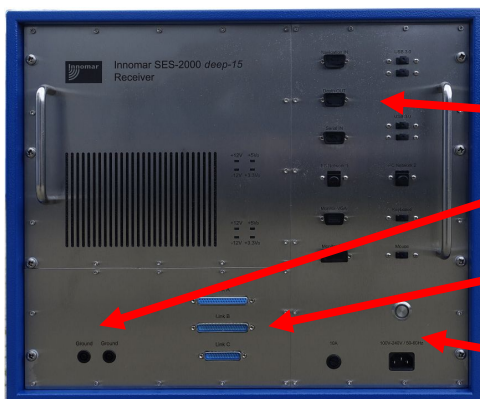
This unit contains the receiver electronics and the data acquisition & control computer.

PC interfaces (UART, USB, HDMI, ...)

Ground cable to Transmitter Unit

Link to Transmitter Unit (3 cables)

Power switch and mains connector, main fuse

Transducer

The transducer is used for transmitting and receiving, no towed equipment is necessary.

The transducer consists of eight (8) modules with one cable (standard length 30 meters) moulded unremovable to each module; one module is shown on the left. These modules are mounted into a frame with shock absorbers to avoid structure-borne noise picked up.

To avoid gas bubbles going below the transducer it is strongly recommended to place it into a gondola or blister.

	QTY	Dimensions (L×W×H)	Weight
Transducer module with shock absorbers (excl. cable)	8	33 cm × 61 cm × 22 cm	103 kg
Transducer cable	8	30 m	22 kg
Mounting material	4	33 cm × 140 cm × 12 cm	25 kg
Total transducer array incl. mounting material	**1**	**1.40m × 1.40m × 0.35m**	**1,100 kg**

There are 8 transducer cables (diameter 22 mm, connector D54 x L75 mm) and 1 ground wire to be routed from the transducer to the topside units. Preferably this is done via stand pipe with a diameter of at least 200 mm. The recommended cable bending radius is 200 mm.

The transducer is mounted using 24 bolts M12. The gaps around the transducer are closed by metal plates (not shown) after installation.
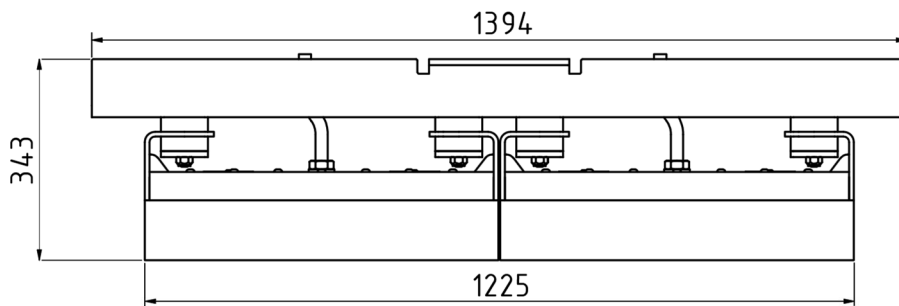
Make sure the correct orientation for proper beam-steering (arrow pointing forward).
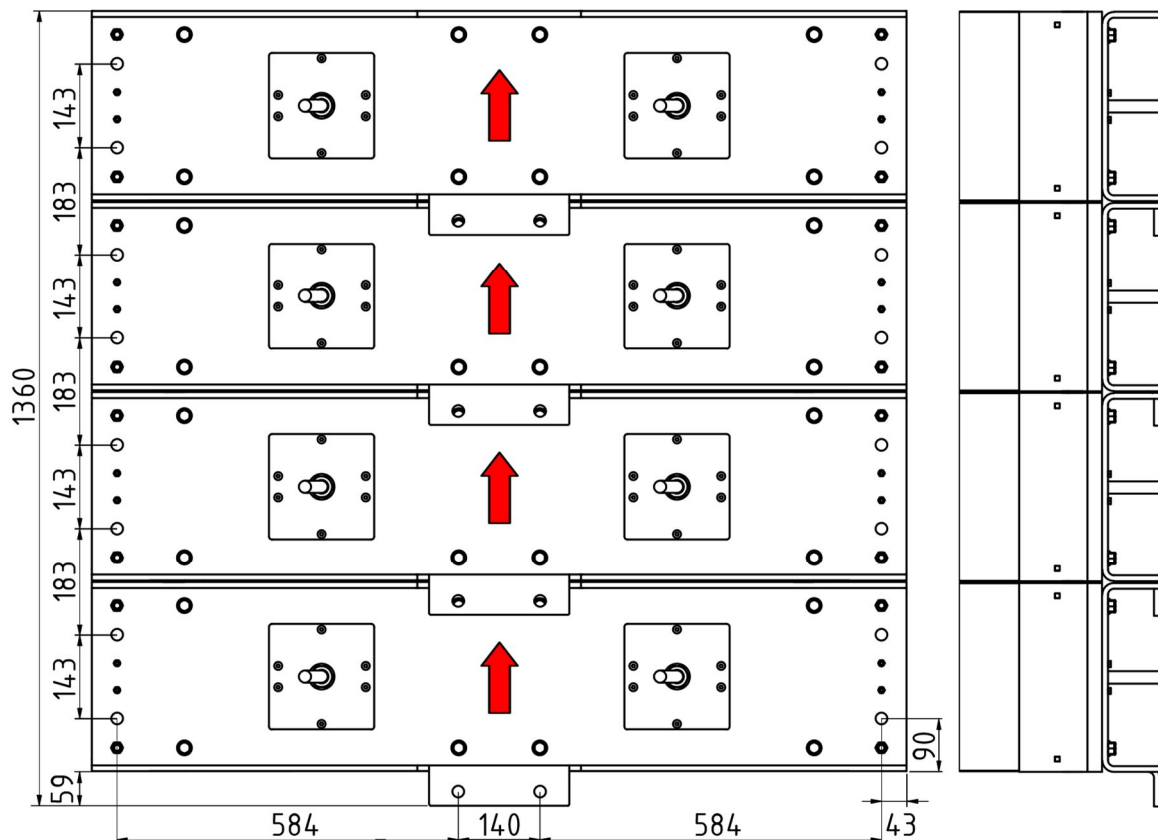
Special "deep-15" SESWIN Settings

Home Menu: Transmit SBP (Transmit Pulse Settings)
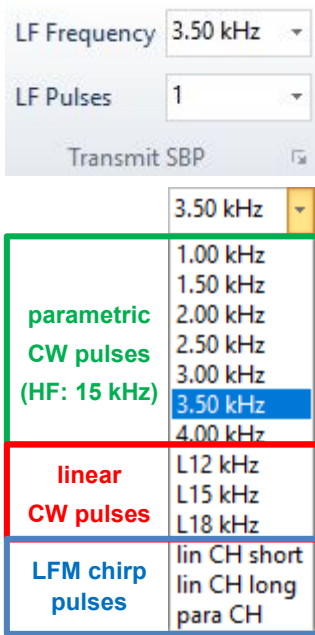
The Innomar *"deep-15"* SBP can transmit

- parametric CW pulses (1 – 4 kHz; "HF" c. 15 kHz),
- linear CW pulses (12, 15, 18 kHz),
- linear and parametric LFM chirp pulses:
  - Lin CH short: 12 – 18 kHz (linear) / 10ms
  - Lin CH long: 12 – 18 kHz (linear) / 20ms
  - Para CH: 1 – 4 kHz (parametric) / 20ms

Notes:

- The values given are the centre or sweep-frequency limits, not the 3dB bandwidth.
- Parametric CW pulses with "LF Pulses" set to "1" are Ricker wavelets.
- In the linear CW and Chirp pulse modes the "LF Gain" is disabled since the used frequency range is considered as HF (same frequency band as the parametric "HF")

Home Menu: Depth / Depth Check
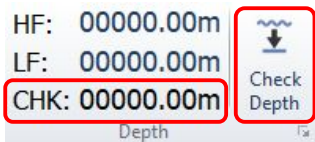
There are three depth values shown:

- the HF and LF bottom tracks (as with all other models),
- the result of a special water-depth check, see below.

In deeper waters mostly "multi-ping" mode will be used to ensure a high ping rate. This greatly improves the data quality, but there is a potential risk to lose the true seabed and following a multiple return instead. To prevent this, there is the possibility to check if the bottom track is still correct by transmitting a special sound pulse, that can be clearly distinguished from all other sound pulses and noise picked up. After receiving the bottom return from this test pulse, the result is shown as "CHK" depth value.

To invoke this water depth check, there are two options:

- a periodic automatic check at a certain time interval and
- a manual check by pressing the "Check Depth" button.

The **automatic check interval** is set in "System Setup – General – Special Transmit Modes".

The interval should fit the expected water depth range, preferably use larger intervals. A shorter interval will detect fast changes on slopes, but might interfere with other acoustic systems. If switched off, you can still use the manual check.
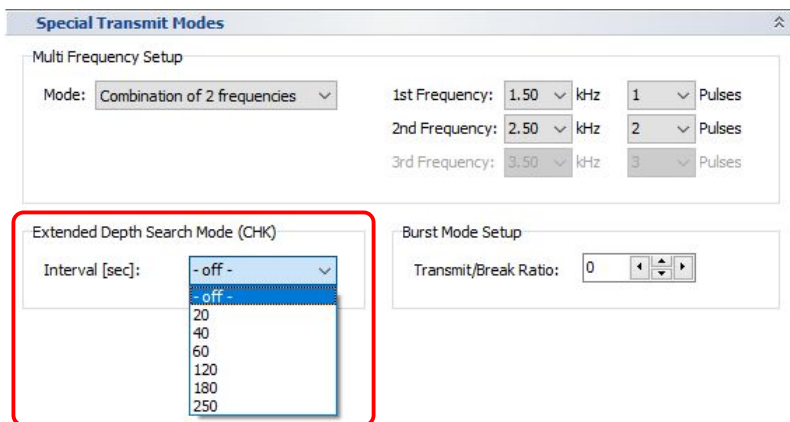
The **manual depth check** is started by pressing the "Check Depth" button. This starts a count-down and the result is shown after approx. 20 seconds.

If transmitters are off, then an info message is shown to turn on transmitter first.
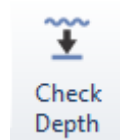
A.13 Innomar *quattro / sixpack* Multi-Transducer SBPs

The INNOMAR *quattro* and *sixpack* models are parametric narrow-beam sub-bottom profiler (SBP) with four/six transducers and echo sounder functionality. The main application is to acquire sub-bottom data at high resolution in extremely shallow waters at high sounding density and to produce three-dimensional visualization of these data sets. In deeper waters the transducers can be combined to provide better range and/or penetration capability.

Main Technical Specifications

Primary High Frequencies (PHF)	approx. 100 kHz (band 85 – 115kHz)
Primary Source Level	>235 dB//µPa re 1m (single transducer; QBM/HBM) >240 dB//µPa re 1m (2 transducers combined; DBM/TBM/PBM) >245 dB//µPa re 1m (4 transducers square matrix, SBM) >248 dB//µPa re 1m (6 transducers matrix, SBM)
Secondary Low Frequency (SLF)	4, 5, 6, 8, 10, 12, 15 kHz (centre frequency, user selectable)
SLF Total Frequency Band	2 – 22 kHz
SLF Pulse Type / Width	Ricker, CW / 0.07 – 1 ms (user selectable)
Beam Width (-3dB)	about ±2.5° (single transducer) for all frequencies about ±1.5° (four-transducer 2×2matrix) for all frequencies
Heave / Roll / Pitch compensation	yes / yes / yes (roll/pitch values applied for 3D rendering only); there is no active beamforming during transmitting and receiving
Water Depth Range	0.5 – 100 m (single transducer; QBM/HBM; for 3D data sets the water depth should not exceed 30 meters) 1 – 500 m (two-transducer 1×2 matrix, DBM/TBM/PBM) 1 – 1,000 m (four-transducer 2×2 square matrix, SBM) 1 – 1,500 m (six-transducer 2×3 matrix, SBM)
Sediment Penetration	up to 20m (single transducer) up to 50 m (four-transducer 2×2 square matrix) up to 70 m (six-transducer 2×3 matrix)
Sample Resolution / Range Resolution	<1 cm / up to 5 cm (depending on pulse settings)
Pulse Rate	up to 60 pings/s
Data Acquisition and Recording	digital 24 bit / 96 kHz; full waveform ("SES3" file format)
External Sensor Interfaces	HRP (motion), GNSS position, depth (all RS232 / UDP), trigger
Bottom Detection	internal (HF and LF data) or external depth
Depth Accuracy	(3 cm @ 100 kHz / 6 cm @ 10 kHz) + 0.1% of water depth;
Remote Control / Survey Integration	KVM / basic functions via COM or Ethernet (UDP), NMEA
Transceiver Dimensions / Weight	"*quattro*": 52 cm × 40 cm × 34 cm (19'' / 7U) / c. 32 kg "*sixpack*": 52 cm × 40 cm × 34 cm (19'' / 7U) / c. 34 kg
Transducer Dimensions / Weight	21 cm × 21 cm × 8 cm / c. 5 kg (single transducer, excl. cables)
Survey Vessel Speed	up to 15 knots (depending on survey goal, weather conditions)
Power Supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power Consumption	"*quattro*": <300 W "*sixpack*": <350W (max. power-on inrush current 25 A / <100 ms)
Environmental Conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+40°C / <70% non-condensing rel. Humidity
Control & Data Acquisition PC	Integrated PC (MS Windows® 10/11 OS) with 10'' TFT display Min. Specs: proc. I5, 8 GB RAM, 1 TB SSD, Geforce GT710 1 GB graphics card, 1 Gbit Ethernet, connections to auxiliary sensors
First / Latest Product Generation	20015 / 2021

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
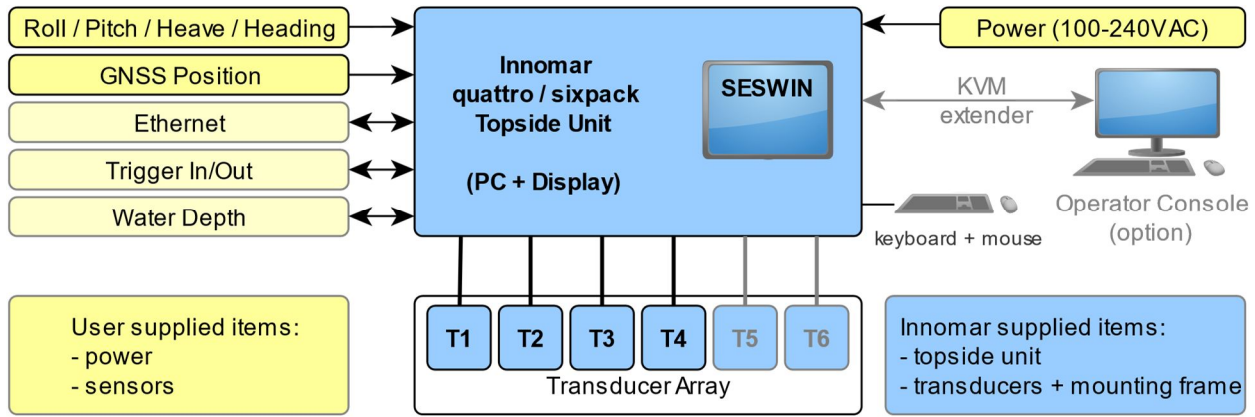
Topside Unit

There is one (1) topside unit, which contains all transceiver electronics, data acquisition and the Windows based control PC.

	quattro	*sixpack*
Dimensions (L×W×H)	52 cm × 40 cm × 34 cm	52 cm × 40 cm × 34 cm
Housing	19 inch / 7U	19 inch / 7U
Weight *sixpack* model	c. 32 kg	c. 34 kg
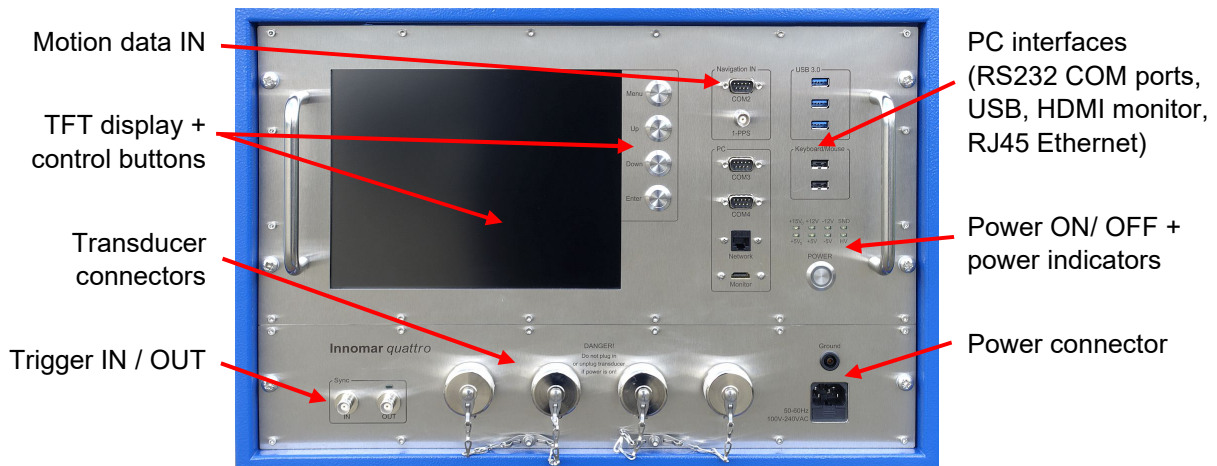
Transducers
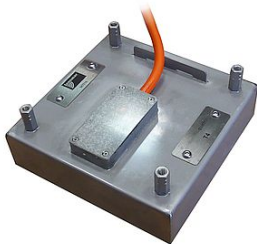
Dimensions (L×W×H)	21 cm × 21 cm × 8 cm
Weight (excl. / incl. 15m cable)	c. 5 kg / c. 8 kg
Connector / Cable Diameter	37 mm / 12 mm

The transducer cables are moulded non-removable to the transducers, the standard cable length is 15 meters.

There are two different transducer mounting frames provided by INNOMAR, one to build a line array (for HBM, QBM, TBM, …) and one to build a compact square array for SBM.
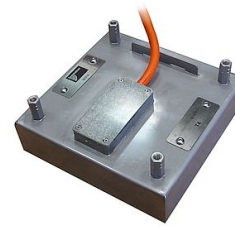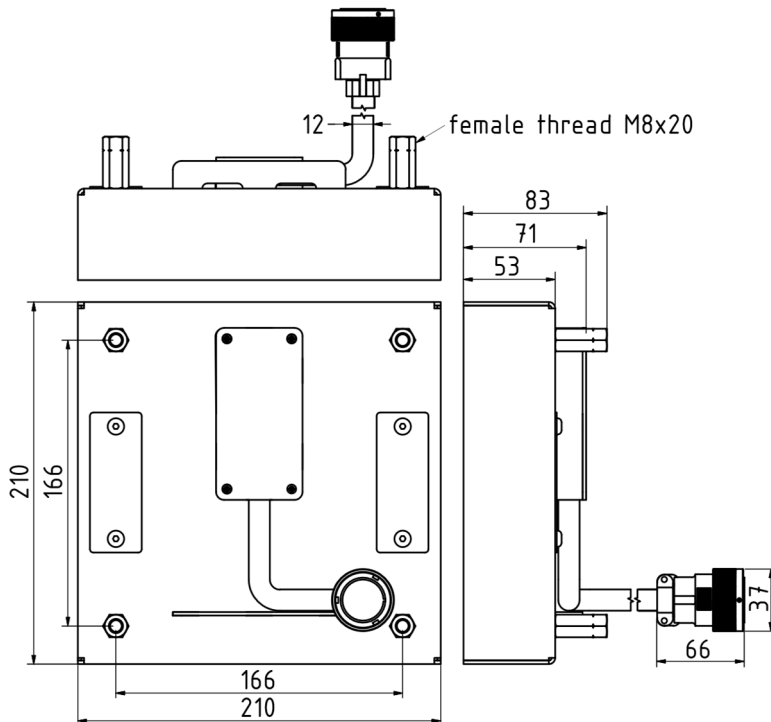
Transducer mounting via 4 bolts M8. There is no required forward direction.

The transducers can be arranged in different configurations and can operate either subsequently for high across-track data density (quad beam mode, hex beam mode) or simultaneously (single beam mode) for more power if increased sediment penetration or increased range is required. There are also several combined modes available which provide both, higher data density and higher power.

	quattro	*sixpack*
single (variable transducer separation)	4 × 1: Quad Beam Mode (QBM)	6 × 1: Hex Beam Mode (HBM)
combined (transducers arranged close together)	3 × 2: Triple Beam Mode (TBM)	5 × 2: Penta Beam Mode (PBM)
grouped (variable group separation)	2 × 2: Dual Beam Mode (DBM)	2 × 3: Triple Beam Mode (TBM) 3 × 2: Dual Beam Mode (DBM)
all as matrix (transducers arranged close together)	1 × 4: Single Beam Mode (SBM)	1 × 6: Single Beam Mode (SBM)

red: transducers transmitting; green: transducers receiving

For mounting the individual transducers as line or square array, Innomar provides mounting frames. Sketches below show those mounting frames for the 4 transducers of the *quattro* model. The mounting frames have the same flange as the compact / standard transducers with six threaded studs M8, so the same pole can be used.

quattro line array 4x1
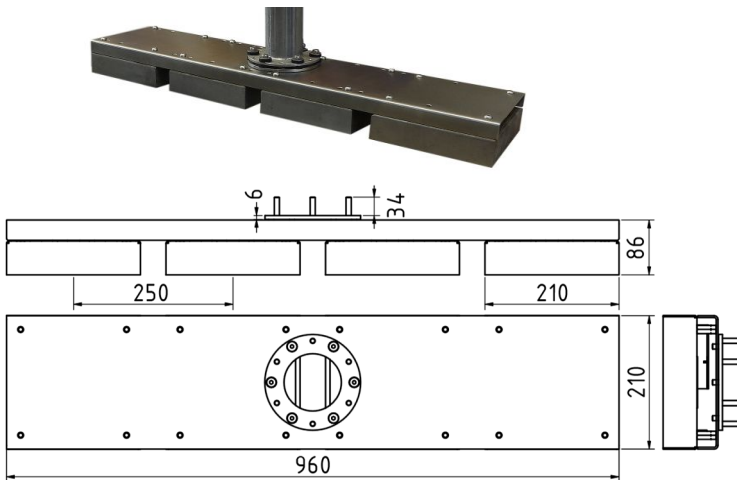
quattro square array 2x2
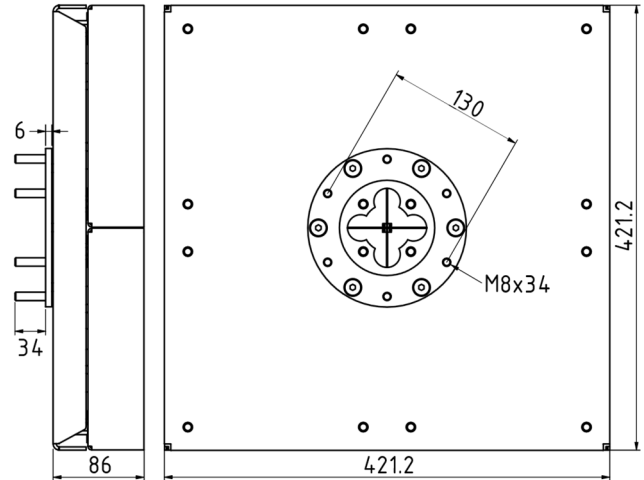
Considerations for Operation (Acquiring Data for 3D Visualization)

- **Water depth**: ideally less than 10 meters, should not exceed 20 meters (ping rates!)
- **Burial depth**: less than 5 meters, depending on sediments
- **Positioning and Motion**: ideally RTK with centimetric X, Y, Z or at least 10 cm lateral and accurate tide measurements, true heading required, motion sensor for roll / pitch / heave required
- **Coverage**: full coverage is required for good 3D models, plan time for infills, a vessel must have good navigability, typical survey speed is less than 4 knots, 1 m line spacing for the standard array with 25 cm spacing, other transducer arrangements with larger spacing are possible
- **Mounting**: stable platform, pole or moon-pool mounting (consider retractable device in case of long transits), no air bubbles below transducer, cable length is 15 m

Processing Workflow

- **Generate full set of standard 2D sections** from multi-transducer data file (Innomar ISE):
  - apply array geometry and XYZ-offsets,
  - apply/change lever arm correction,
  - interpolate coordinates for every single trace.

- **Export individual traces to XYZ Amplitude (voxel) files** (Innomar ISE):
  - apply signal processing such as filters, noise reduction, tide correction etc.

- **Transform irregularly distributed data set into uniform XYZA grid** (Innomar Gridder):
  - apply clipping rectangle,
  - define cell size,
  - interpolate with user adjustable search radius,
  - no extended migration processing required.

- **Visualize data set in 3D** (3rd party volume renderer):
  - apply colour and opacity maps,
  - apply clip planes to visualize time slices or sub-volumes,
  - manipulate volumetric data in 3D,
  - measure features,
  - do segmentation,
  - create movies.

A.14 Sidescan Extension for Innomar *compact* SBP

Overview

The INNOMAR sidescan extension can be operated ship based (over the side installation) in shallow water (up to 30m water depth). It consists of a sidescan transducer and a SESWIN software update. There is also a software tool included to generate mosaic pictures from the collected sidescan data. For the sound ping generation and reception as well as data collection the INNOMAR *"compact"* hardware is used. Therefore, it is not possible to run both, sidescan and sub-bottom profiler, at the same time.
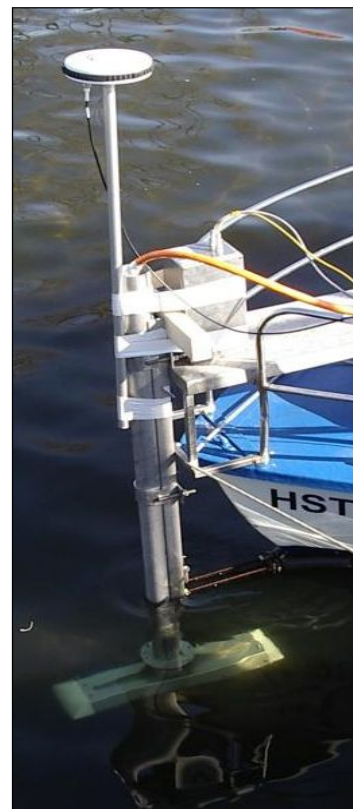
Technical Specification

Frequency	100 kHz	
Transmit pulse power	>2 kW / >220 dB//µPa re 1 m	
Pulse type	CW / 100 – 250 µs	(adjustable)
Pulse rate	up to 25 s^{-1}	
Beam width	1.8° / 55°	(along / across track)
Depression angle	40° or 60°	(depending on housing)
Swath	±65° or ±85°	(depending on housing)
Range	20 – 100 m	(adjustable)
Dimensions (WHD)	ca. 60 cm × 10 cm × 15 cm	
Weight in air	ca. 20 kg	(incl. 20 m cable)

There is no active beam stabilisation (roll/pitch/yaw correction)

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

Sidescan Transducer

The sidescan transducer has the same mounting flange using six M8 bolts as the *"compact"* SBP transducer. Older INNOMAR sidescan transducers have the flange rotated by 30 degrees and for using the same pole for both, SBP and sidescan, the pole's flange needs 12 holes as shown at the right.

Ø 90mm.
Ø 11mm.
Ø 130mm.

It is not possible to tow the transducer; it has to be fixed firmly at the boat/ship. The cable length is fixed to 20 m.

To change the transmission angle, there are two different housings available.
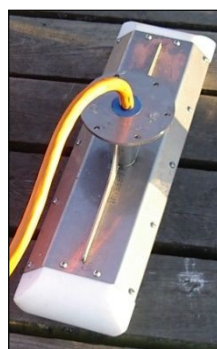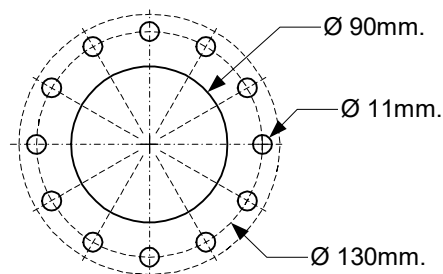
! **This sidescan option is available for the INNOMAR *"compact"* model only!**

Data Examples
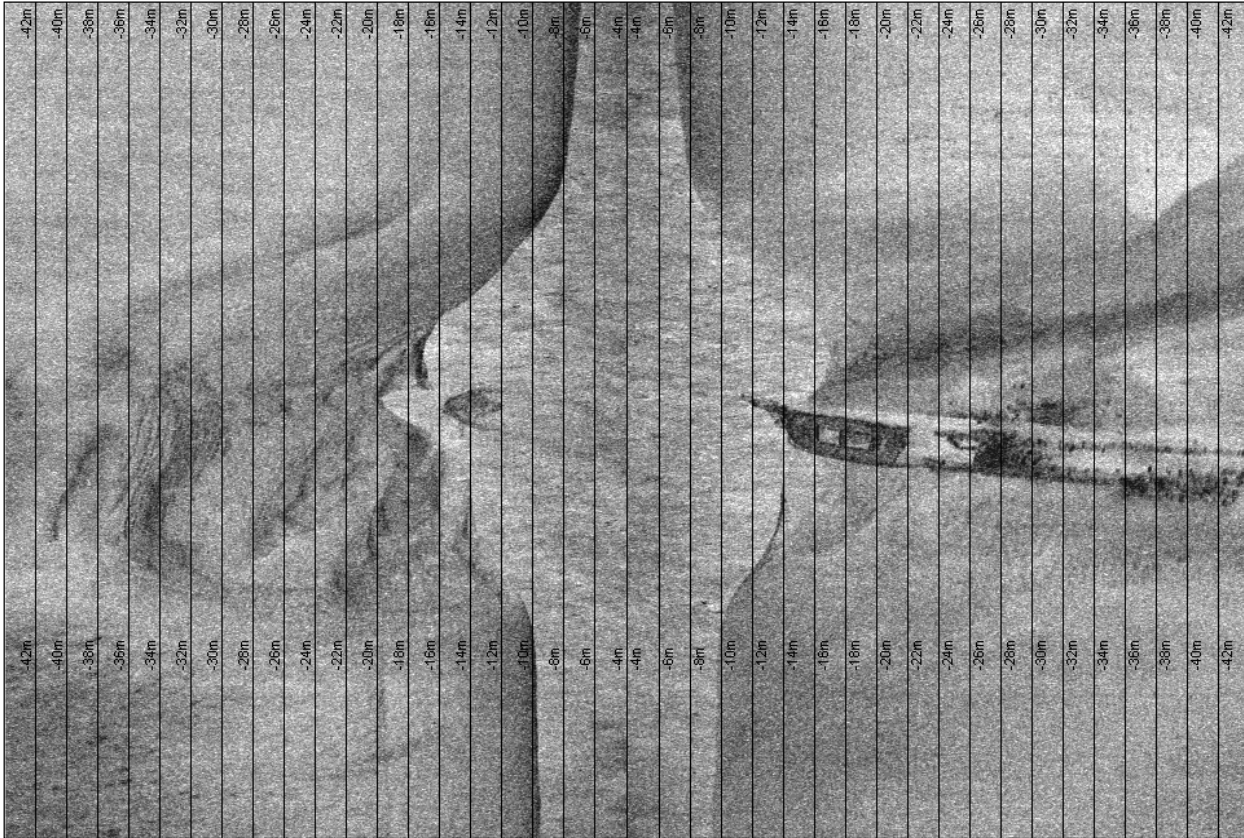
Waterfall data example while crossing a wreck site (100 kHz / 125 µs; range 4 – 44 m; water depth about 10 m).

Side Scan Data
Example from a River Survey

Mosaic of three parallel survey lines, covering the whole river bed and showing sand ripple areas and targets on the bottom.

Water Depth: around 5m
Frequency: 100kHz
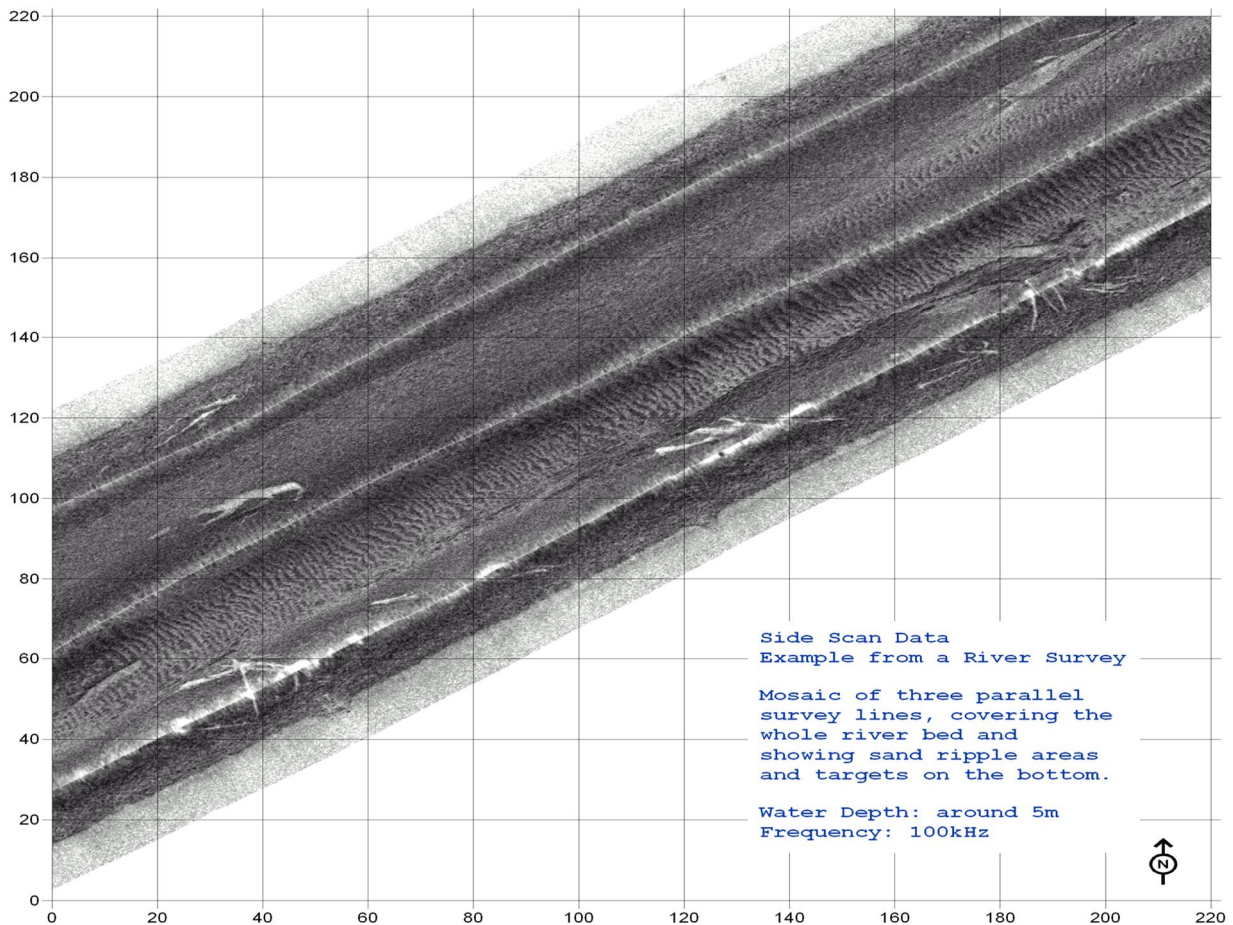
Data example of a river survey (sidescan mosaic of three parallel lines).

A.15 Innomar *autonomous* Inflatable ASV

The INNOMAR *"autonomous"* model is an inflatable uncrewed / autonomous surface vehicle (USV / ASV), which is delivered with the INNOMAR *"smart"* SBP already integrated. On request it is also possible to deliver with other INNOMAR SBPs, like the *"compact"* model. The inflatable platform can be used to integrate other sensors as well.

Main Technical Specifications

Vehicle Dimensions / Weight	L 180 cm × W 93 cm × H 20 cm / 16 kg
Payload Capacity	max. 150 kg
Under Keel Clearance	25 cm
Speed	max. 3 knots
Sensor Mount	via moon-pool or detachable bracket
Control Box	W 66 cm × D 52 cm × H 38cm / 29 kg (weight excl. battery) incl. control electronics and data acquisition PC with UPS
Payload Battery Box	W 43 cm × D 33 cm × H 23 cm / 4 kg (weight excl. battery)
Innomar Payload	Innomar "smart" or "compact" SBP
First / Latest Product Generation	

Technical specs are subject to change without prior notice, see www.innomar.com/products for latest infos.

System Components / Wiring Schematic
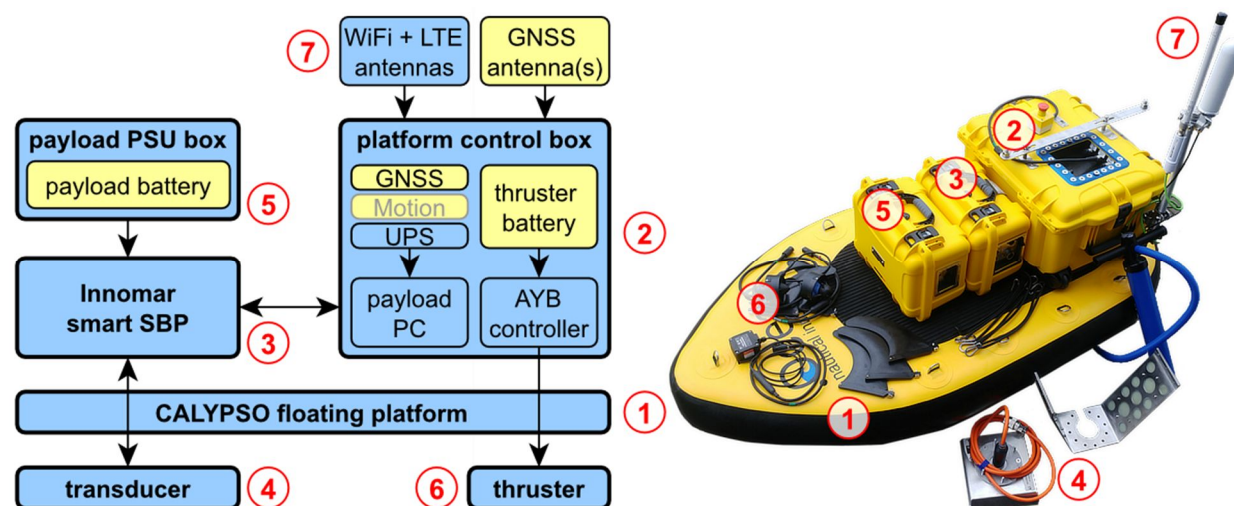
(1)   dotOcean "Calypso" inflatable survey platform
(2)   control box with electronics and thruster battery, including:
       - dotOcean "AYB" with "Atlantis" cloud auto-navigation
       - payload PC and sensors with uninterrupted power supply (UPS)
(3)   Innomar "smart" parametric sub-bottom profiler
(4)   transducer with mounting bracket
(5)   payload battery box
(6)   underwater thrusters and fins
(7)   WiFi and LTE/4G antennas

Optional: dual-antenna GNSS for position and heading

Note: due to shipping restrictions, batteries are usually not included in the delivery.

front fins — Innomar "smart" transducer

transducer mounting
bracket — rear fins with thrusters

Applications

- surveys in very shallow waters
- surveys in sensible environments such as reservoirs for drinking-water
- automatic data acquisition in pre-defined areas with narrow line spacing for shallow-seismic 3D modelling
- users may integrate various third-party equipment, such as MBES, ADCP or sidescan sonar

There is a separate manual for this model.

A.16 Innomar *light-plus* & *standard-plus* SBP with Sidescan (OBSOLETE)

System Components / Wiring Schematic
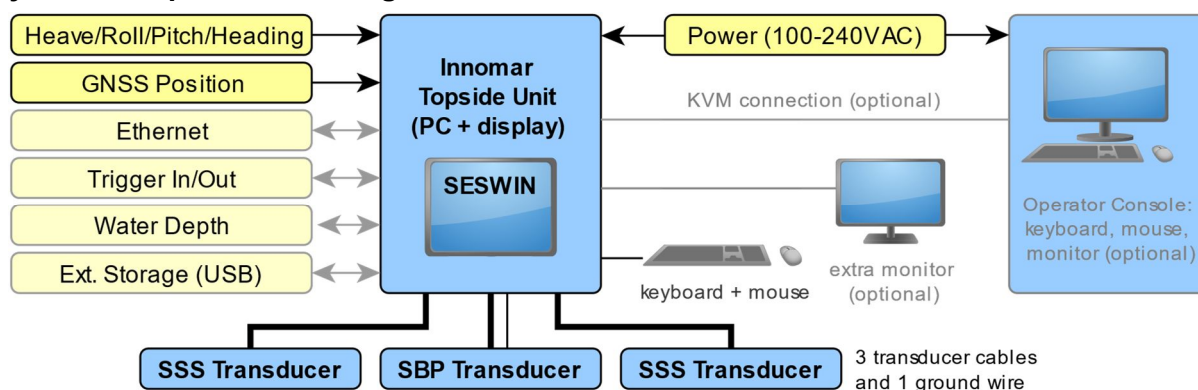
Main Technical Specifications *"light-plus"*

Sub-Bottom-Profiler (SBP)	
SBP primary frequency range (PHF)	approx. 100 kHz (band 85 – 115 kHz)
SBP primary source level	> 238 dB//µPa re 1m
SBP secondary low frequencies (SLF)	4, 5, 6, 8,10,12, 15 kHz (centre frequency, user selectable)
SBP SLF total frequency band	up to 2 – 22 kHz
SBP SLF pulse type	Ricker, CW
SBP SLF pulse width	0.07 – 1 ms (user selectable)
SBP beam width (-3dB)	about ±2° for all frequencies / footprint <7% of water depth
SBP heave / roll / pitch compensation	heave; depending on external sensor data
SBP water depth range	0.5 – 400 m
SBP sediment penetration	up to 40 m (depending on sediment type and noise)
SBP sample / range resolution	<1 cm / up to 5 cm (depending on pulse settings)
Sidescan Sonar (SSS)	
SSS water depth range	1 – 30 m
SSS frequency	250, 410, 600 kHz
SSS source level	> 210 dB//µPa re 1m
SSS beam width (-3dB)	approx. 0.8° × 58° for all frequencies
SSS pulse type / width	CW (40, 80 µs); LFM chirp (500 µs / 35 kHz bandwidth)
General	
Pulse rate	up to 50 pings/s (multi-ping mode available)
Data acquisition	digital 24 bit / 96 kHz; envelope or full waveform
External sensor interfaces	HRP sensor, GNSS, Depth
Bottom detection	internal (HF and SLF data) or external depth
Depth accuracy	(2 cm @ 100 kHz / 4 cm @ 10 kHz) + 0.06% of water depth
Power supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power consumption	<250 W (max. power-on inrush current 20 A / <100 ms)
Environmental conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity
	Operation: 0…+35°C / <70% non-condensing rel. Humidity
Production Start / End	2009 / 2017

Topside Unit

Dimensions (L×W×H)	52 cm × 40 cm × 35 cm
Housing	19 inch / 7U
Weight	about 35 kg

Main Technical Specifications *"standard-plus"*

Sub-Bottom-Profiler (SBP)

SBP primary frequency range (PHF)	approx. 100 kHz (band 85 – 115 kHz)
SBP primary source level	> 240 dB//µPa re 1m
SBP secondary low frequencies (SLF)	4, 5, 6, 8,10,12, 15 kHz (centre frequency, user selectable)
SBP SLF total frequency band	up to 2 – 22 kHz
SBP SLF pulse type	Ricker, CW
SBP SLF pulse width	0.07 – 1 ms (user selectable)
SBP beam width (-3dB)	about ±2° for all frequencies / footprint <7% of water depth
SBP heave / roll / pitch compensation	heave; depending on external sensor data
SBP water depth range	0.5 – 400 m
SBP sediment penetration	up to 50 m (depending on sediment type and noise)
SBP sample / range resolution	<1 cm / up to 5 cm (depending on pulse settings)

Sidescan Sonar (SSS)

SSS water depth range	1 – 30 m
SSS frequency	250, 410, 600 kHz
SSS source level	> 210 dB//µPa re 1m
SSS beam width (-3dB)	approx. 0.8° × 58° for all frequencies
SSS pulse type / width	CW (40, 80 µs); LFM chirp (500 µs / 35 kHz bandwidth)

General

Pulse rate	up to 60 pings/s (multi-ping mode available)
Data acquisition	digital 24 bit / 96 kHz; envelope or full waveform
External sensor interfaces	HRP sensor, GNSS, Depth
Bottom detection	internal (HF and SLF data) or external depth
Depth accuracy	(2 cm @ 100 kHz / 4 cm @ 10 kHz) + 0.06% of water depth
Power supply	100 – 240 V AC / 50 – 60 Hz (fuse 16 A / slow)
Power consumption	<350 W (max. power-on inrush current 20 A / <100 ms)
Environmental conditions	Storage: -10…+60°C / <90% non-condensing rel. humidity Operation: 0…+35°C / <70% non-condensing rel. Humidity
Production Start / End	2011 / 2018

Topside Unit

Dimensions (L×W×H)	52 cm × 40 cm × 44 cm
Housing	19 inch / 9U
Weight	about 43 kg

System Interfaces

Motion data IN

TFT display and control buttons

SBP transducer connector

Sidescan transducer connectors

Navigation data IN

PC interface

Power indicators (LEDs)

Power connector and switch

Trigger In/Out
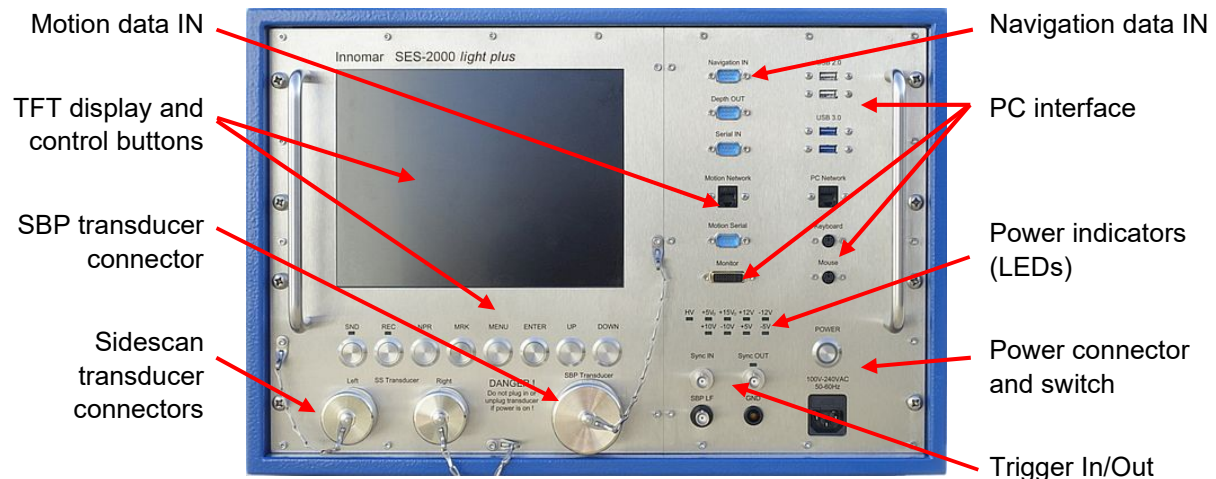
Transducers

SBP Transducer

Dimensions (L×W×H)	34 cm × 26 cm × 8 cm
Weight "light-plus"	c. 22 kg (incl. 20 m cable, letter "A")
Weight "standard-plus"	c. 30 kg (incl. 30 m cable, letter "C")

Sidescan Transducers

Dimensions (L×W×H)	52 cm × 6 cm × 6 cm
Weight incl. 20 m cable	about 10 kg

There are arrows at the transducers, which have to point in forward direction (to the bow).

All transducer cables are moulded non-removable to the transducer, standard cable length is 20 meters for the sidescan transducers. The fairings at the transducers (black plastic parts) must not be removed by the user. Please ask INNOMAR for advice if you need them removed.

For SBP transducer drawings see page 175.

The sidescan transducers are attached to the SBP transducer using a mounting plate (provided by INNOMAR).
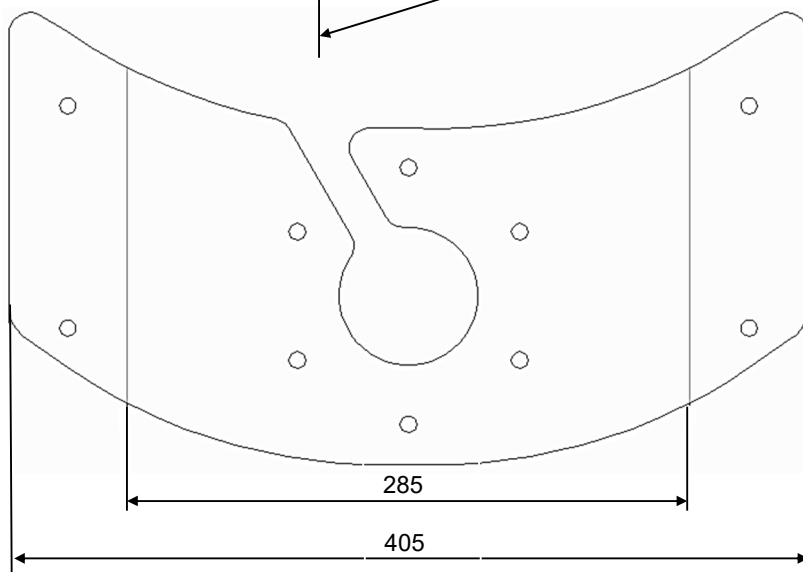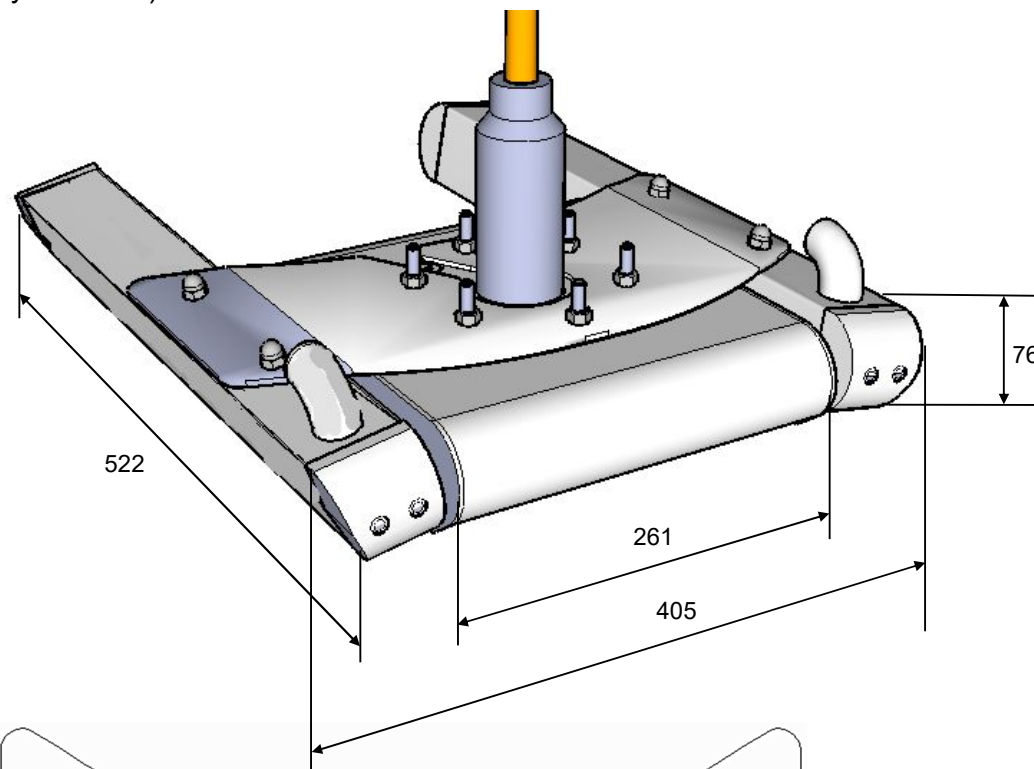
All holes diameter 8.2mm.

Blank Page

A.17 Innomar SBP Data Acquisition and File Formats

Innomar Data Acquisition

Most INNOMAR SBPs digitise the received signal of the LF channel at a sample rate of 96 kHz. The received HF signal is shifted into the LF band and data is then sampled similar to the LF data. For best signal-to-noise ratio all data is band-pass filtered. Filter settings are automatically chosen by the system to match the transmit pulse settings currently used.

Innomar Data Formats

There are three data formats used with the INNOMAR sub-bottom profilers:

- **SES**: envelope (magnitude) data (16 bit) at reduced sample rate (i.e. sample rate depends on range settings), number of samples is fixed to 480 samples per trace.
  Note: **This format is obsolete** and not supported since SESWIN version 2.2.3.8.
- **RAW**: full-waveform data (16 bit) at full ADC sample rate, number of samples per trace depends on range settings.
- **SES3**: full-waveform data (24 bit) at full ADC sample rate, number of samples per trace depends on range settings, multi-channel capability.

The SES3 file format supports multi-channel systems such as the INNOMAR *"quattro"* model and stores 24-bit data for enhanced processing as required by an increasing number of customers. Today, this data format is supported by *"quattro"* and new *"medium-xx"* and "*deep-xx*" models only, but will become available for the other models in future, too.

All Innomar data files can be converted to SEGY data for using third-party post-processing software packages. Conversion done with our SESConvert tool, see below for details.

The following table shows a summary of the available file formats and sampling details for all INNOMAR SBP models.

Innomar SBP model	Recorded sample rate and resolution	Available File Formats
compact (before 2011)	max. 70 kHz (depends on range setting), 16-bit	SES
compact (since 2011 with option RAW)	70 kHz, 16-bit	SES, RAW (option)
compact (since 2016)	70 kHz, 16-bit	(SES), RAW
light, light plus	96 kHz, 16-bit	(SES), RAW
standard, standard plus	96 kHz, 16-bit / 24 bit	(SES), RAW, SES3
quattro, sixpack	96 kHz, 16-bit / 24-bit	SES3
medium-100, medium-70	96 kHz, 16-bit / 24-bit	SES3
deep-36, deep-15	96 kHz, 16-bit / 24-bit	SES3
ROV, AUV	70 kHz, 16-bit	(SES), RAW

! The SES format should not be used for new projects because of the limited resolution, especially at longer ranges. Use the RAW or the SES3 format instead.
The SES file format is obsolete and not supported since SESWIN 2.2.3.8.

How to get 24-bit data

In order to acquire and save data in full 24-bit resolution you have to use the "seswin24bit.exe" provided by INNOMAR (NOT "seswin.exe").

This SESWIN version will record data in the new SES3 data file format only. There are no SES or RAW files as with the other SESWIN versions.
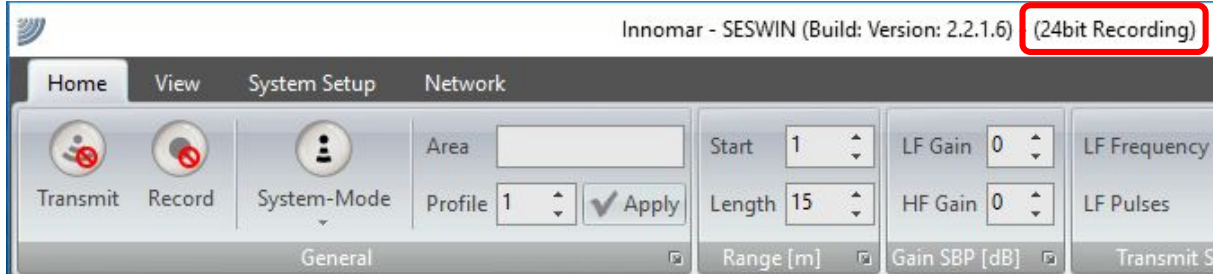
How to convert 24-bit SES3 data files to SEG-Y format

For using third-party post processing software, convert the SES3 files to SEG-Y format using Innomar's "SESConvert" software, see chapter 10 on page 133. Make sure to enable "Interpolate Coordinates" and "Remove Coordinate Duplicates".

How to process 24-bit SES3 data files in ISE2
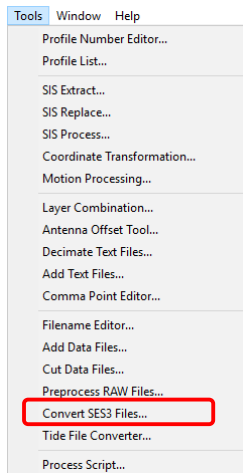
For full processing of SES3 files, use ISE3.

The INNOMAR ISE2 post-processing software is limited to 16-bit data and SES3 files need to be converted to RAW files first when the ISE is used for data processing: Tools → Convert SES3 Files

You may select multiple files for batch conversion.

Coordinate interpolation and motion sensor data corrections (lever arms) should be applied on the RAW data files after conversion.

With recent ISE2 versions it is possible to handle position and motion data processing for SES3 files, too.

In "General Settings" **disable** the "Interpolate Coordinates" feature.

Check that all options are disabled in the "Motion Sensor" tabs.

Press "Convert" Button in the "Conversion" tab
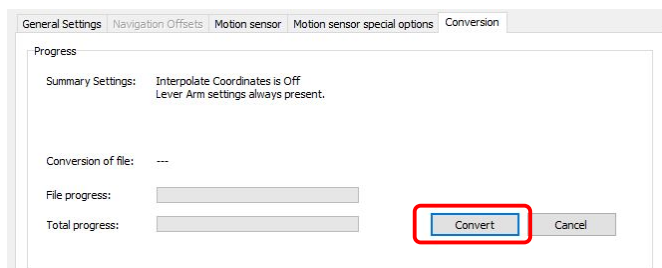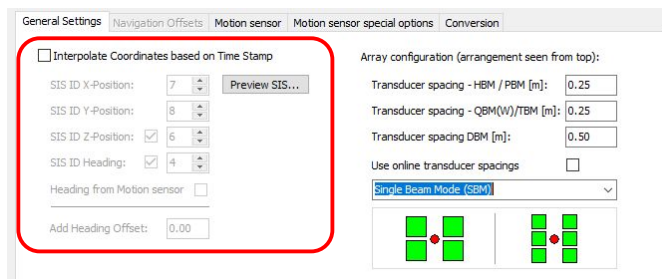
A.18 (GNSS) NMEA Sentences

In this section NMEA 0183 sentences often used by GNSS receivers are given for reference. Some more NMEA sentences, related to motion sensors, are described in section A.19 on page 215.

In general, each sentence is ASCII data and consists of a dollar sign ($), two letters to identify the sender (talker ID), three letters naming the data set (sentence ID), the sentence data itself, an optional checksum (*cc), followed by carriage return and line feed ASCII symbols (<CR><LF>, 0D0Ah). The checksum is calculated by exclusive-ORing (XOR) all characters between the '$' and the '*' characters and formatted as HEX value.

A detailed, but rather technical description of the NMEA 0183 standard can be found at this web site: https://gpsd.gitlab.io/gpsd/NMEA.html

GGA (Global Positioning System Fix Data)

`$--GGA,HHMMSS.ss,DDMM.mm,a,DDDMM.mm,a,Q,SS,x.x,h.h,m,x.x,m,t.t,nn*cc<CR><LF>`

Ex $GPGGA,145502.40,5406.62680,N,01204.13713,E,2,05,2.9,22.08,M,38.87,M,4,0000*67

1   UTC of position fix
2   Latitude (DD degrees, MM,mm minutes)
3   'N' or 'S' (North or South) hemisphere
4   Longitude (DD degrees, MM,mm minutes)
5   'E' or 'W' (East or West) hemisphere
6   Quality indicator   (0: invalid; 1: GPS; 2: diff. GPS; 3: GPS PPS; 4: RTK; 5: float RTKt;
                                  6: estimated; 7: manual input; 8: simulation mode)
7   Number of satellites in use (00 – 12)
8   Horizontal dilution of precision (HDOP in meters)
9   Antenna altitude above/below mean sea level (geoid) in meters
10   'M' (Antenna height unit, meters)
11   Geoidal separation (Diff. between WGS-84 earth ellipsoid and mean sea level.)
12   'M' (Units of geoidal separation, meters)
13   Age of differential position data in seconds (time since last update from diff. reference station)
14   Diff. reference station ID (0000 – 1023)

ZDA (Time & Date)

`$--ZDA,HHMMSS.ss,dd,mm,yyyy,xx,xx*cc<CR><LF>`

Ex $GPZDA,145502.40,04,01,2007,+00,00*4E

1   UTC time
2   Day of month (1 ... 31)
3   Month of year (1 ... 12)
4   Year (4 digits)
5   Local zone hours description (00 ... +-13 hours)
6   Local zone minutes description (00 ... 59), apply same sign as local hours

VTG (Actual track made good and speed over ground)

`$--VTG,cc.cc,T,cc.cc,M,ss.ss,N,ss.ss,K*cc<CR><LF>`

Ex $GPVTG,187.08,T,185.22,M,000.07,N,000.12,K,D*28

1   Course over ground in degrees, true
2   'T' indicates that course is relative to true North
3   Course over ground in degrees, magnetic; often not used
4   'M' indicates that course is relative magnetic North; often not used
5   Speed over ground in knots
6   'N' indicates that speed over ground in in knots
7   Speed over ground in kilometers/hour
8   'K' indicates that speed over ground is in kilometers/hour

GLL (Geographic Position – Latitude/Longitude)

`$--GLL,DDMM.MM,a,DDDMM.mm,a,HHMMSS.ss,a,m*cc<CR><LF>`

1   Latitude (DD degrees, MM,mm minutes)
2   'N' or 'S' (North or South) hemisphere
3   Longitude (DD degrees, MM,mm minutes)
4   'E' or 'W' (East or West) hemisphere
5   UTC of position fix
6   Data status ('A' – active and data valid; 'V' – data invalid)
7   FAA Mode indicator

RMA (Recommended Minimum Navigation Information)

`$--RMA,A,llll.ll,N,lllll.ll,W,,,ss.s,ccc,vv.v,W*cc<CR><LF>`

1   Data status ('A' – active and data valid; 'V' – data invalid)
2   Latitude
3   'N' or 'S' (North or South) hemisphere
4   Longitude
5   'E' or 'W' (East or West) hemisphere
6   Time difference A; often not used
7   Time difference B; often not used
8   Speed over ground in knots
9   Course over ground in degrees, true North
10   Magnetic variation, degrees
11   'E' or 'W', direction of variation

RMC (Recommended Minimum Specific GPS/TRANSIT Data)

`$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,ddmmyy,x.x,a*cc<CR><LF>`

1   UTC time of position
2   Data status ('A' – active and data valid; 'V' – data invalid)
3   Latitude
4   'N' or 'S' (North or South) hemisphere
5   Longitude
6   'E' or 'W' (East or West) hemisphere
7   Speed over ground in knots
8   Course over ground in degrees, true North
9   Date
10   Magnetic variation, degrees
11   'E' or 'W', direction of variation
12   FAA mode indicator

HDT (True Heading) / HDM (Magnetic Heading)

`$--HDT,ddd.dd,T*cc<CR><LF>`

1   Heading in degrees
2   'T' indicates true heading; 'M' indicates magnetic heading

DBS (Depth Below Surface)
DBT (Depth Below Transducer)

`$--DBS,x.x,f,x.x,M,x.x,F*cc<CR><LF>`

`$--DBT,x.x,f,x.x,M,x.x,F*cc<CR><LF>`

1   Depth in feet
2   Unit for item 1 ('f' = feet)
3   Depth in meters
4   Unit for item 3 ('M' = meters)
5   Depth in fathoms
6   Unit for item 5 ('F' = Fathoms)

A.19 Motion Sensor Data Formats

There are several motion sensor data formats supported by the INNOMAR sub-bottom profilers. A short description of the different data format settings is given below.

Some protocols use other orientation conventions than the INNOMAR SBPs:

- heave positive going down   (± 15 m),
- roll positive port up   (± 90°),
- pitch positive bow up   (± 90°),
- heading positive clockwise   (0.00 ... 359.99 degrees)

In this case the received sensor values are converted internally to match the INNOMAR conventions. **Received values exceeding the limits given above are considered invalid**.

! Many INNOMAR SBP models use the motion data for real-time beam forming and need them without delay. **Generally, use the fastest protocols, such as the TSS or EM1000/3000 formats sent at a high baud rate (e.g. 115200)**. Motion data update rate should be higher than the SBP ping rate, the short protocols work at 100 Hz and above.

The Innomar SBPs support several motion data protocols, which are organized in three groups:

- **Kongsberg Simrad**
  - EM-1000
  - EM-3000
- **Teledyne TSS**
  - TSS1
  - TSS2
  - TSS3
  - TSS HHRP2
  - TSS Binary (experimental)
- **iXblue Octans**
  - NAVBHO ($PASHR)
  - Octans Standard 1

Kongsberg Simrad EM-1000 / EM-3000

Binary protocol, fixed length (10 bytes).

Byte #	0 1		
	1234567890		
Format	QTRRPPHHhh		
	Description	**Range**	**Units**
Q	**Sensor status**	00h	EM1000: (fix value, no sensor status)
		90h	EM3000: valid data, full accuracy
		91h ... 99h	EM3000: valid data, reduced accuracy
		9Ah ... 9Fh	EM3000: instable data
T	Fixed token	90h	
RR	**Roll angle**	±179.99°	(positive port up)	0.01 °
PP	**Pitch angle**	±179.99°	(positive bow up)	0.01 °
HH	**Heave**	±99.99m	(positive going up)	1 cm
hh	**Heading**	0° ... 359.99°	(positive clockwise)	0.01 °

Notes: All values in 2'complement 16-bit integer format (LSB first).

TSS1 / TSS2 / TSS3

ASCII protocol, fixed length (27 bytes).

Byte #	0 1 2		
	123456789012345678901234 5 6 7		
Format	:XXXXXXSMHHHHQMRRRRSMPPPP<CR><LF>		
	Description	**Range**	**Units**
:	Start of packet	3Ah	
XXXXXX	TSS1: vert. acceleration	not used	
	TSS2: delayed heave		
	TSS3: remote heave		
S	Space character	20h	
Q	**Sensor status**	upper case letters or ' ' (space) valid data (OK)	
		lower case letters or '?' instable data, settling	
M	**Sign**	either '-' (negative) or ' ' (space, positive)	
HHHH	**Heave**	±99.99m; positive going up	1 cm
RRRR	**Roll angle**	±99.99°; positive port up	0.01°
PPPP	**Pitch angle**	±99.99°; positive bow up	0.01°
<CR><LF>	End of packet	0D0Ah	

TSS HHRP2

ASCII protocol, fixed length (27 bytes).

Byte #	0 1 2		
	123456789012345678901234 5 6 7		
Format	:hhhhhSMHHHHQMRRRRSMPPPPq<CR><LF>		
	Description	**Range**	**Units**
:	Start of packet	3Ah	
S	Space character	20h	
Q	**Sensor status**	upper case letters or ' ' (space) valid data (OK)	
		lower case letters or '?' instable data, settling	
M	**Sign**	either '-' (negative) or ' ' (space, positive)	
hhhhh	**Heading**	0 ... 359.99°	0.01°
HHHH	**Heave**	±99.99m; positive going up	1 cm
RRRR	**Roll angle**	±99.99°; positive port up	0.01°
PPPP	**Pitch angle**	±99.99°; positive bow up	0.01°
q	Heading status	Not used	
<CR><LF>	End of packet	0D0Ah	

TSS Binary

Binary protocol, fixed length (13 bytes).
Note: this format is implemented experimentally and might not work as intended.

Byte #	0 1		
	1234567890123		
Format	SSLRRPPhhHHQC		
	Description	**Range**	**Units**
SS	Start of packet	AA3Ah	
L	Packet length (bytes to follow)	09h (9 bytes follow until checksum)	
RR	**Roll angle**	±180°; positive port up	180/32768 °
PP	**Pitch angle**	±90°; positive bow up	90/32768 °
hh	**Heading**	0° … 359.9°; clockwise	360/65536 °
HH	**Heave**	±32.76m; positive going up	1 mm
Q	**Sensor status**	Depends on sensor (not used)	
C	Checksum	LSB of bytewise XOR of bytes 4 ... 12	

Notes: All values in 2'complement 16-bit integer format (LSB first).

iXblue Octans NAV-BHO ($PASHR)

ASCII protocol, several NMEA compatible sentences.

!   The INNOMAR motion input only uses the **$--SHR** datagram.

$--SHR,HHMMSS.sss,hhh.hh,T,RRR.RR,PPP.PP,HHH.HH,r.rrr,p.ppp,y.yyy,d,e*cc<CR><LF>		
Field	**Description**	**Range**
1	UTC time	HHMMSS.sss (not used)
2	**Heading**	0 ... 359.99°
3	'T', indicating true North	'T'
4	**Roll angle**	±99.99°; leading sign '+' or '-'
5	**Pitch angle**	±99.99°; leading sign '+' or '-'
6	**Heave**	±99.99m; leading sign '+' or '-'
7	Roll angle accuracy	not used
8	Pitch angle accuracy	not used
9	Heading accuracy	not used
10	GNSS position mode	not used
11	**Sensor status**	0 OK
		1 error

Note: The RPH orientation (up/down) is not specified and depends on the sensor used.

iXblue Octans Standard 1

ASCII protocol, several NMEA compatible sentences.
This format sends a lot of data and is thus generally not recommended to use.

!   The INNOMAR motion input only uses a subset of the datagrams that may be sent by the sensor, either "**$--HDT**, **$--TRO**, **$--LIN, $--INF**"
                    or "**$--HDT**, **$--TRO**, **$--POS, $--INF**"
                    or "**$--HDT**, **$--TRH**, **$--INF**".
If the same value is received in different datagrams, the latest is used. Otherwise, the order of datagrams received does not matter.

$--HDT,h.hh,T*cc<CR><LF>	1	**Heading angle** in degrees
	2	'T' (fix value for true north)
$--TRO,PP.PP,p,RR.RR,r*cc<CR><LF>	1	**Pitch angle** in degrees (unsigned)
	2	sign: 'M' for bow up or 'P' for bow down
	3	**Roll angle** in degrees (unsigned)
	4	sign: 'B' for port down or 'T' for port up
$--LIN,x.xxx,y.yyy,H.HHH*cc<CR><LF>	1	Surge in meters (signed)
$--POS,x.xxx,y.yyy,H.HHH,,,*cc<CR><LF>	2	Sway in meters (signed)
	3	**Heave** in meters (signed)
	(4	surge without lever arms → not used)
	(5	sway without lever arms → not used)
	(6	heave without lever arms → not used)
$--TRH,P.PP,p,R.RR,r,H.HH,h*cc<CR><LF>	1	**Pitch angle** in degrees (unsigned)
	2	sign: 'M' for bow up or 'P' for bow down
	3	**Roll angle** in degrees (unsigned)
	4	sign: 'B' for port down or 'T' for port up
	5	**Heave** in meters (unsigned)
	6	sign: 'U' for going up or 'O' for going down
$--INF,QQQQQQQQ*cc<CR><LF>	1	Sensor status (hex value); used:
	bit	0–3, 27 invalid data
	bit	5 sensor alignment
	bit	15 sensor error

Note: Some older INNOMAR firmware versions required a certain order of the datagrams.

Blank Page

A.20 Checklists (Setup, Data Acquisition, Processing)

Transducer Installation

○ Correct transducer type is used (transducer S/N for *"compact"* and *"light"* starts with "C"; for *"standard"* with "A", for *"medium-100"* with "E").

○ Transducer face, cable and connector checked for damages.

○ Transducer is mounted horizontally in stiff frame or supporting structure.

○ Transducer is decoupled acoustically from the ship's hull by elastic material (rubber).

○ Transducer is located as far away as possible from noise sources.

○ Transducer is covered by water at all times, even at rough sea conditions.

○ An additional ground wire is going from the transducer's housing to the topside unit.

○ The transducer cable is protected and will not vibrate.

○ The draught of the transducer is measured and noted.

Topside Unit Installation

○ Topside unit is placed in a dry environment.

○ Cooling slots (bottom, front and rear panel) are free and there is space for airflow.

○ Main power supply is checked. If a generator is used, a ground wire is connected.

○ Power cable is plugged in.

○ Transducer cable is plugged in.

○ Ground wire from the transducer is connected to the topside unit.

○ Additional sensors (Motion sensor / GNSS) are connected to the specified ports.

○ Check if all connectors are fastened properly and all cables are fixed.

System power-up

○ Make sure the transducer is below water level and covered by water all times.

○ Switch on main power → the power switch and all power LEDs are lit green, "Sync OUT" starts flashing.

○ Start the SESWIN software → "HV" LED turns on, SBP echo plot part of the SESWIN window starts scrolling from right to left. If not, check the synchronisation mode.

○ SESWIN "System status" checked → OK

SESWIN settings

○ Set interfaces (GNSS, motion, …) ports.

○ Set transducer's draught and offsets / lever arms as appropriate.

○ Check incoming GNSS (navigation) data (SIS fields populated correctly).

○ Check incoming motion sensor data.

○ Check all other settings in the "System Setup" dialogues.

System check / preparing survey start

○ Switch on the transmitter [F4] (make sure the transducer is below water level).

○ Set the range appropriate to find the seafloor.

○ Optimize the gain settings for both channels based on the seabed return's amplitude.

○ Optimize the range settings based on water depth and required / expected penetration.

○ Optimize frequency, pulse length (and gain) settings.

○ Check and optimize the signal processing settings for online visualisation.

○ Check the settings for annotation, profile number and marker counter.

○ Check data record [F5].

Checklist Data Processing

ISE Data Cleaning

This should be done immediately after the survey, even if the data will be later converted into SEG-Y data format and processed using third-party software:

○   Check GNSS position data for outliers and clean if necessary.
○   Interpolate GNSS position data and time stamps to have unique position/time for each ping.
○   Check motion sensor data.
○   Convert position data to required datum, if not done online.
○   Check if antenna offsets were correctly applied. If not, re-process position data.
○   Check motion sensor lever arm correction. If there is still a large heave visible in the data after heave correction, usually lever arms were not correctly set up. In this case find suitable values and re-process heave data.
○   Check tide data.

ISE Data Post-Processing

○   Get a clean HF bottom track and store as layer file or write back to data file.
○   Find suitable settings for the "Load file" dialogue which fits the processing requirements of the LF data:
    o   Stacking / Smoothing
    o   Thresholds
    o   Colours
    o   Signal Processing: Filter / Algorithm
    o   SIS-IDs for GNSS position data
    o   Locate tide file if needed
    o   Set sample rate reduction where suitable
    o   Usually enable "Heave Correction" and "Median Filter"
○   Pick sediment layers as required
○   Pick positions of buried objects as required
○   Export picked XYZ data as required
○   Export echo plots as graphic files for QA

SEG-Y / XTF Data Export

If required export data to SEG-Y or XTF format for third-party processing:

○   Set correct SIS-IDs for GNSS position data and time stamp
○   Set coordinate scale factor (100 for metric position data)
○   Set byte order (usually "Motorola")
○   Set heave correction and sample rate reduction as required
○   Check/set range processing parameters
○   Set trace number generation
○   Export sample data files and ensure these can be opened and processed by the target processing software

A.21 User Feedback Form

Please help us to improve the quality of our documentation by returning your comments on this manual.

Your information on any inaccuracies or omissions (with page reference):

Your suggestions for improvements:

Name: ....
Company: ....
Address: ....
Telephone: ....
E-mail: ....
Date: ....
Manual: ....
Revision: ....

Please send this form to: INNOMAR Technologie GmbH
                               Schutower Ringstr. 4
                               D 18069 Rostock
                               Germany

                               E-mail: support@innomar.com