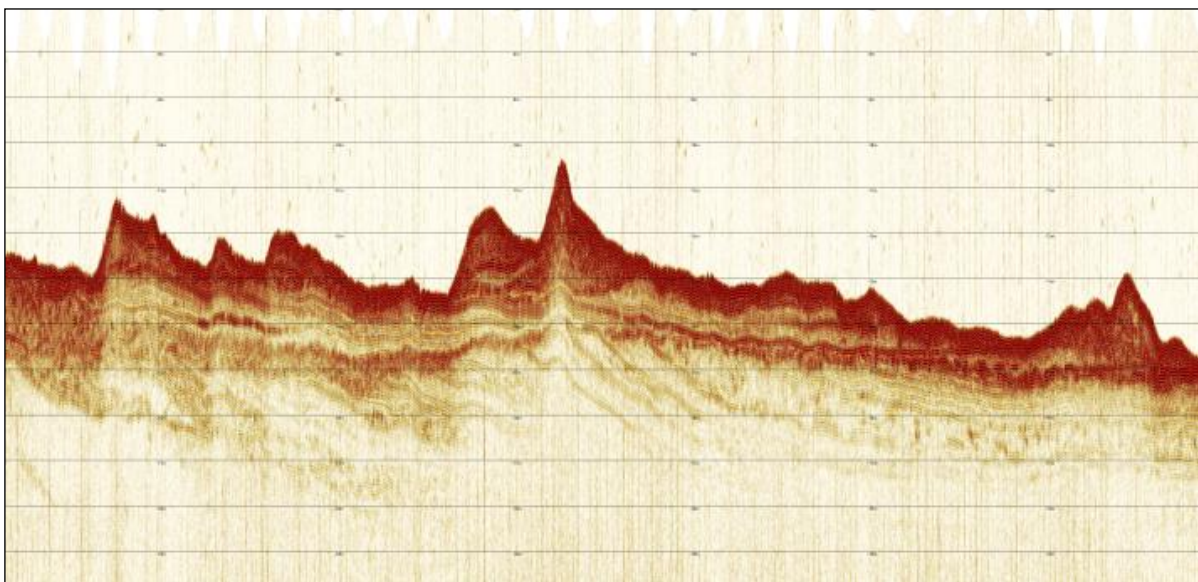


Quick Start Guide for Innomar SES medium on RV “Heincke”



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1.0 / 21.03.2010	First version
1.1 / 15.04.2013	Added Chapter 3: Synchronisation with EM710
1.2 / 14.01.2014	Function "HF Signal Damping" added
1.3 / 17.02.2017	Trimble-GPS lever arm updated; added chapter 5.1 Service Report
2.0 / 09.02.2022	System updated requiring new manual
2.1 / 25.04.2023	Minor changes regarding synchronization



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1 Innomar SES medium Hardware configuration

1.1 Sensor equipment

The following sensors are installed on the RV “Heincke”:

Table 1: Sensor specification

Sensor	Model	Details from Manufacturer
Inertial Navigation System (INS)	IXSea Phins	Heading accuracy: 0.05 deg (without aiding) Roll, Pitch accuracy: 0.01 deg Heave accuracy: 5 cm or 5%
Primary Positioning Unit	Trimble SP461	Primary Positioning system DGPS 0.5 – 3 m accuracy
Backup Positioning Sensor	SAAB R5	Backup Positioning system DGPS GPS: 3m, DGPS: 1m (2D RMS)

1.2 Sensor structure

Figure 1 shows the sensor structure of the sub-bottom profiler hardware. The processing unit is the main unit which controls the transducer and receives position information from the Trimble DGPS receiver as well as attitude data (heading, roll, pitch, heave) from the Ixsea PHINS III inertial navigation system (INS).

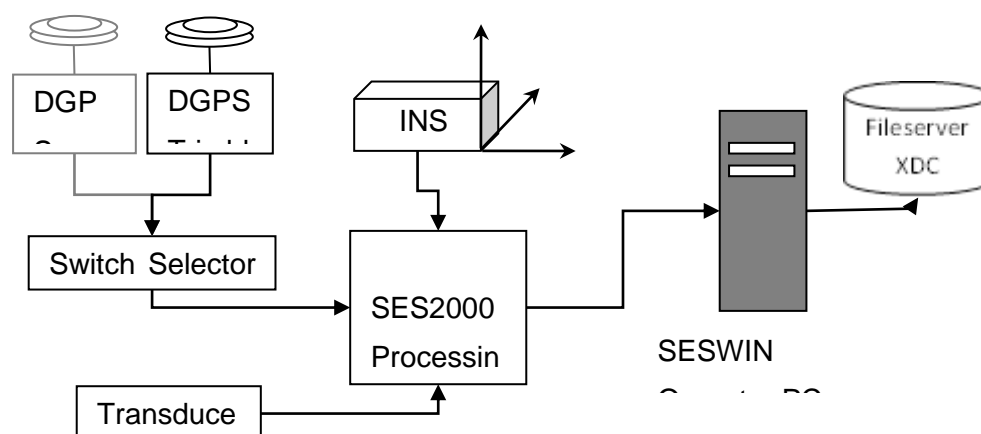


Figure 1: Sensor dependencies

2 SESWIN System Software

We strongly recommend reading the *Innomar SES medium Quick Start Manual* as it already gives a good overview of the system’s software and guides the operator to get good results. This manual is construed for the specific use of the Innomar SES medium on RV “Heincke” and focuses on the most important parameters to be looked after during data acquisition. If you want to have further instructions, please read the *SES2000-Manual_2020-09_smt-cpt-lgt-std-m100.pdf* and for post-processing the data refer to *ISE_Handbook_October2017Rev1.pdf*. Both manuals are available on the desktop of the SES computer.

2.1 Start Innomar SES medium

- Power up the sounder unit (*by captain*)
- Power up the SESWIN Operator Station (*by captain*) and switch on the monitor on the bridge. **For the dongle, username and password please ask the captain.**
- Click the *SESWIN_V2245_24bit* icon on the desktop, the following window will show up (Figure 2).

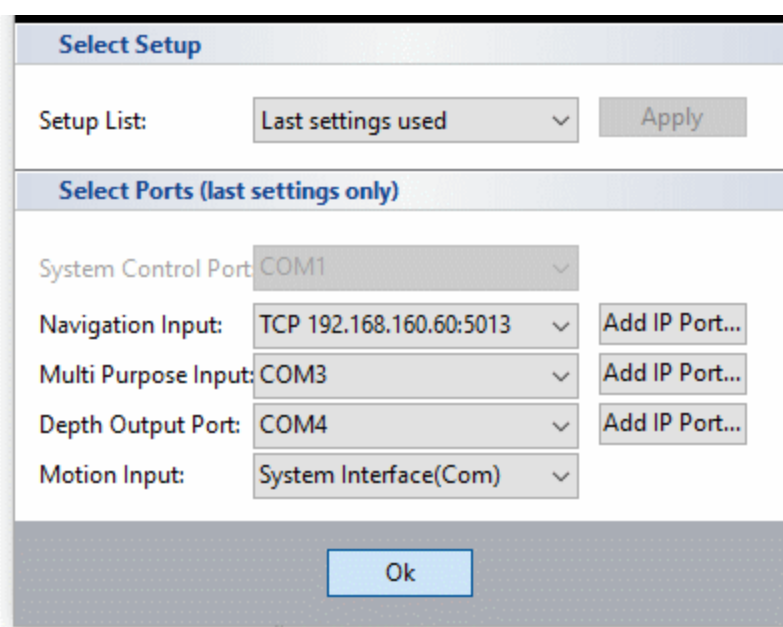


Figure 2: The SESWIN COM Port Setting

These are default settings. Don’t change! Click “ok”.

Figure 3 shows the home window of the SES data acquisition software. On the lefthand side data of the navigation and motion sensor are visible as well as some information on the journey. In the menu bar in the upper part the button “**Transmit**” will activate pinging and



data will become visible in the frequency windows. Button “**Record**” will start the data acquisition. High frequency (HF) data, low frequency (LF) data, signal strength and a LF zoom window will be shown by default. Range, gain, LF frequency and LF pulses can be directly changed in the home window menu bar in the upper part. Changes employed in the home window menu bar during data acquisition are final. They are set by the hardware and cannot be changed later.

Clicking on the small icons in the lower right part of the Range, Gain or Transmit windows will open up setting dialogs (see further below). These dialogs can also be accessed by pressing the Setup Button.

You can choose in which mode you want to run the system by pressing “System Mode” (Figure 4). Mostly, Sub-Bottom Single frequency will be used. However, Multi frequency mode allows you to acquire data of different frequency and therefore gather more information. Sub-Bottom Multi Ping Mode and Sub-Bottom Burst Mode is applied in deeper waters to increase horizontal resolution.

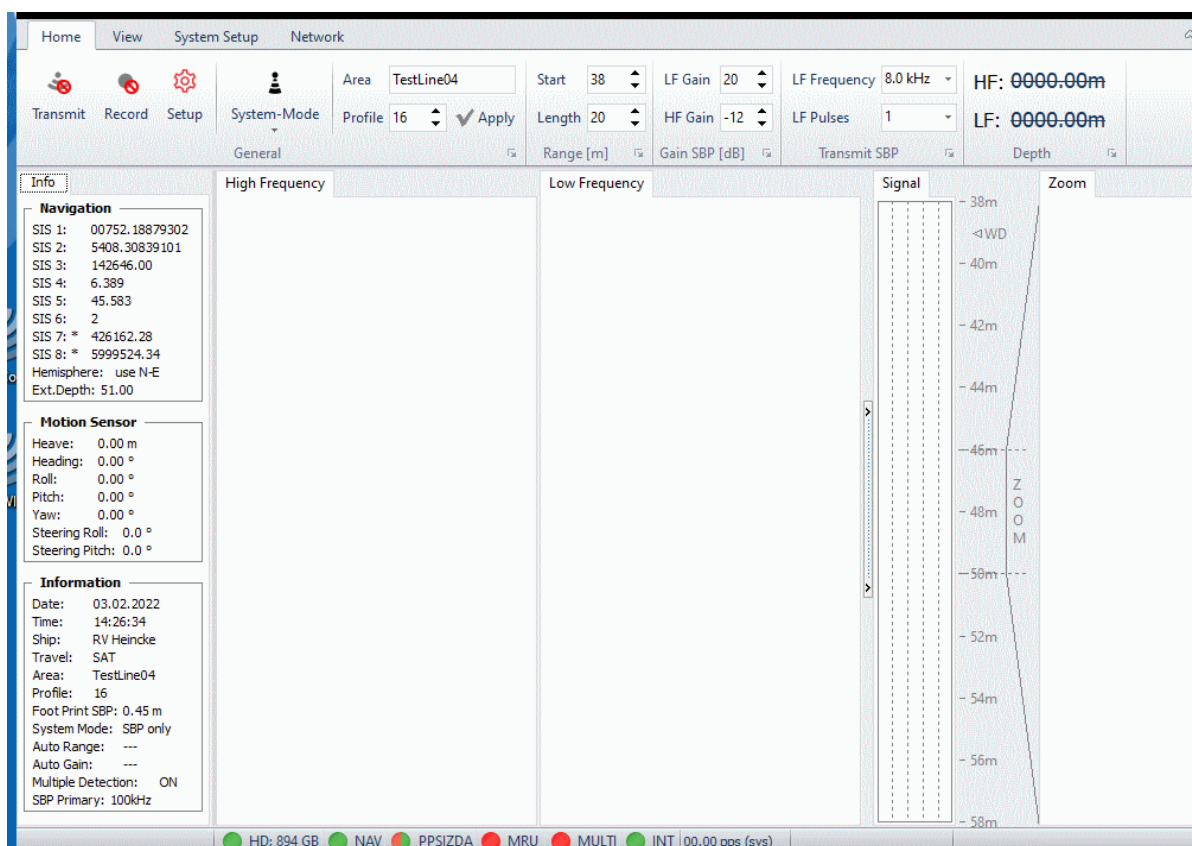


Figure 3: Home window of SES data acquisition software

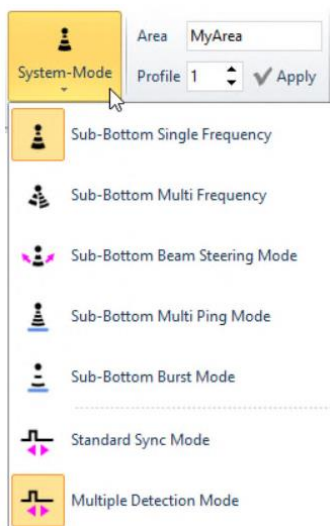


Figure 4: System mode options

2.2 Setup Menu

- **General description:** Information about the cruise can be entered (Figure 5)

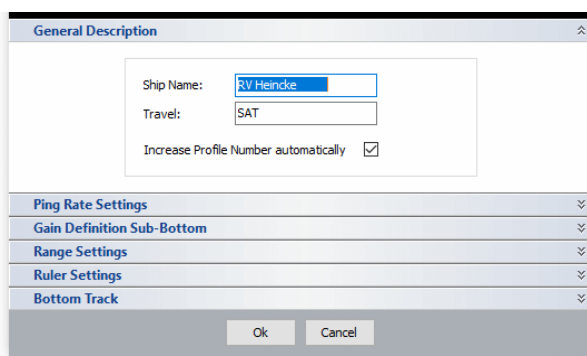


Figure 5: Setup menu, General description options

- **Ping rate settings:** In most cases you will allow the maximum ping rate possible by applying **-System controlled-** (Figure 6). You can reduce ping rate (for instance in shallow waters) by setting a fixed ping rate or allowing percentages of the maximum ping rate. Only LF frequency can be adjusted. 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 10 kHz. LF-Pulses represent the number of cycles of the LF center 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.

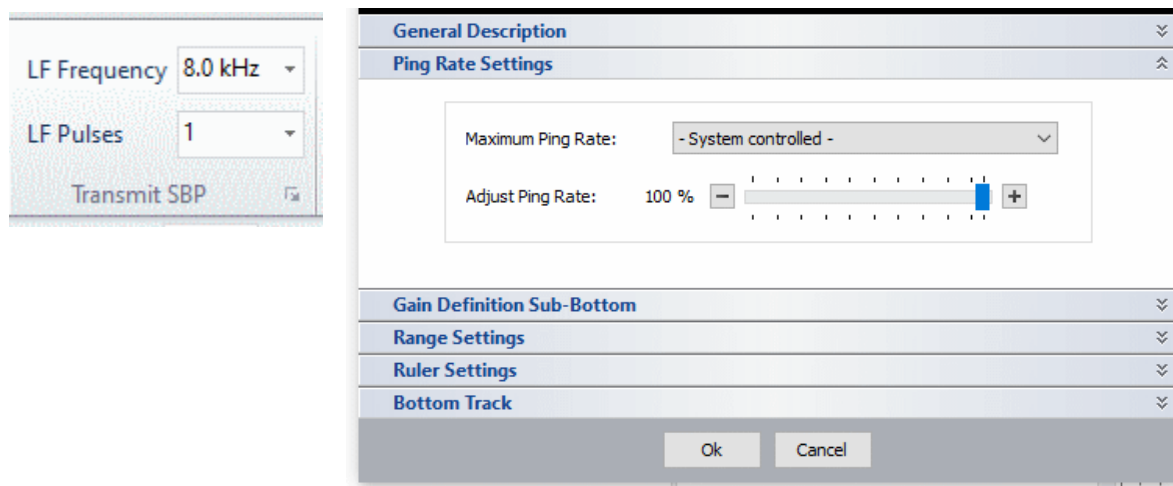


Figure 6: Setup menu, Ping Rate Settings

- Gain definition Sub-Bottom:** Gains employed in the home window menu bar during data acquisition are final. They are set by the hardware and cannot be changed later. You may set increments for the HF and LF gain controls (Figure 7). These increments apply to the LF and HF gain in the home window. A good starting value would be an increment of 2 or 3 dB.

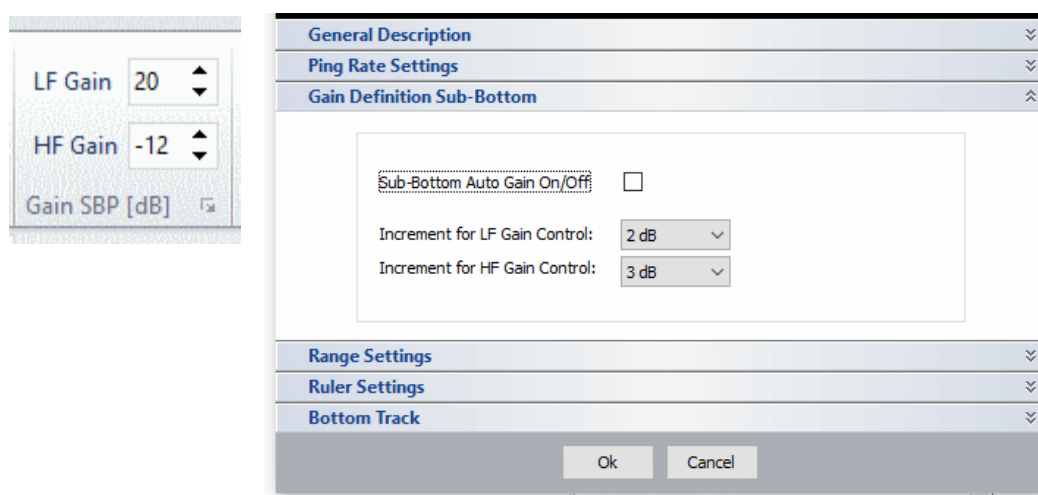


Figure 7: Setup menu, Gain definition

To optimize the gain settings, you should use the signal amplitude shown in the home screen signal window (Figure 8), 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.



Figure 8: Signal window

- Range Settings:** Here you can choose whether to use the external depth information for the automatic detection and tracking of the bottom by clicking on the Auto Range Source (Figure 9). If you do not want to use automatic tracking (for instance on steep slopes) depth window can be adjusted by using the Start and Length panels in the home window menu bar. The example shows a window start at 38m depth and a window length of 20m. Increments for the Range Start Control and Range Length Control can be adjusted in the range settings.

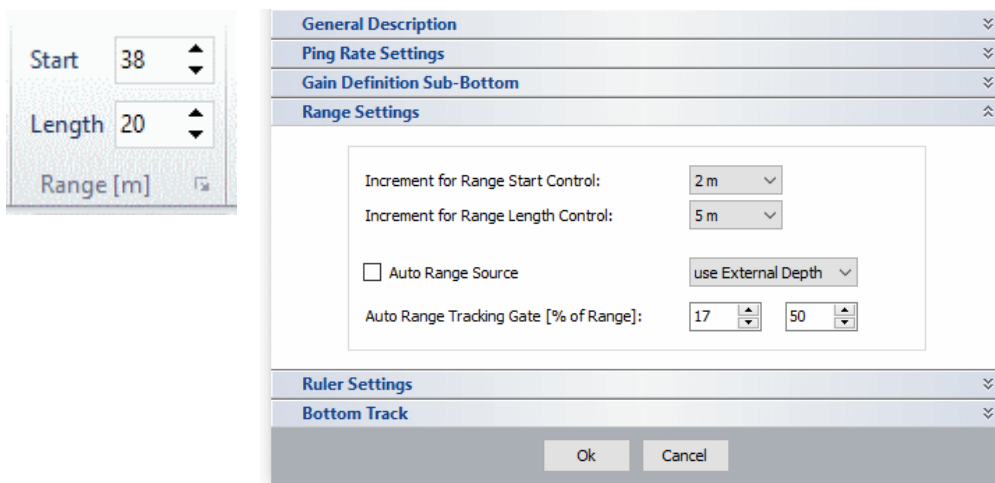


Figure 9: Setup menu, Range settings

- **Ruler Settings:** Here you can define the display of lines and text on the screens (Figure 10).

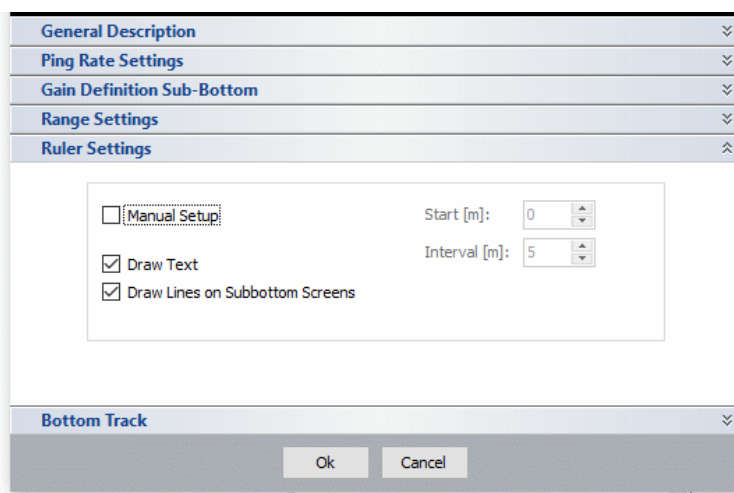


Figure 10: Setup menu, Ruler settings

- **Bottom track:** The online calculated water depth (bottom track) from both data channels (HF and LF) is displayed in right-hand part of the home window menu bar. Water depth calculation is based on the transducer draught and sound velocity (see “System Setup – General – System”). Define which threshold should be used for digitalisation of the bottom. However, 30% is a useful value and may not be changed probably only in case of extensive marine growth. Clicking on the Draw Bottom Line will result in a bottom line drawn on the echograms.

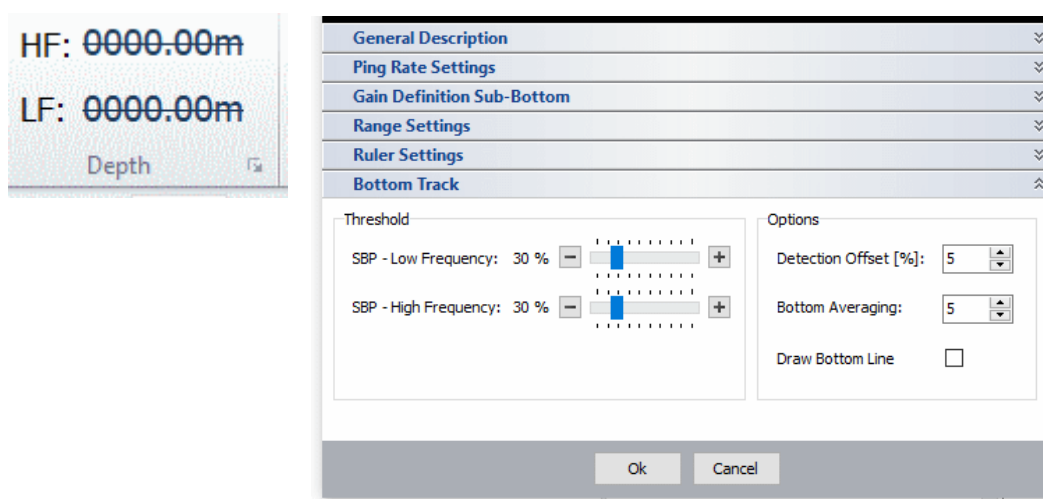


Figure 11: Setup menu, Bottom Track

2.3 System Setup

Several system parameters need to be properly set up within the “System Setup” menu (Figure 12) before the survey starts. Most menu items are disabled once data logging has started. Some of the entries (Navigation and Motion sensor setup) are fixed and should not be changed at all.

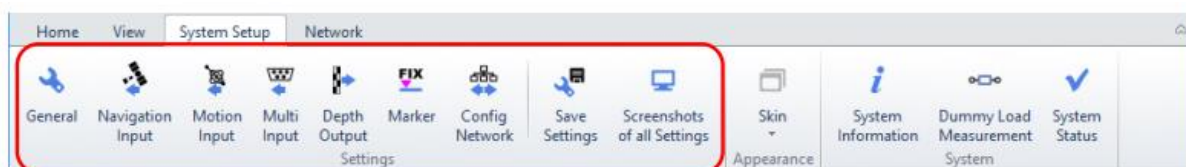


Figure 12: System Setup menu bar

- **General**

- **System:** Transducer Depth is the depth of the transducer’s bottom below water surface. If set to 0 (zero) all echo plots and depth values are related to the transducer’s face (bottom). Measured or estimated sound speed is used for all depth calculations and has to be set properly. A value of 1500 m/s is adequate (Figure 13) in most cases. HF source level can be reduced in very shallow waters. You can switch between primary and secondary frequency to be received by the HF data channel. However, transmitted frequency will always be ca. 100kHz.

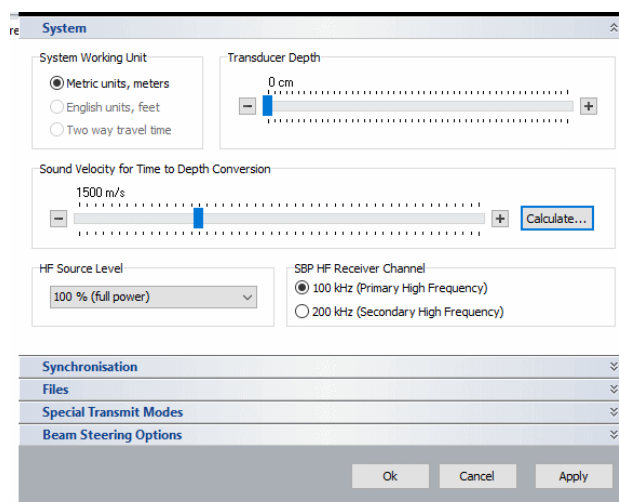


Figure 13: System Setup, General - System

- **Synchronization:** These settings are important if you want to use the SES together with the Kongsberg Multi Beam EM712. Please refer to section 3 “Synchronization with Multibeam Echosounder EM712” on page 15 for a detailed description.

- **Files:** On board of RV “Heincke” the data will be stored under **C:\SES_Applications\Data**. You may create a cruise folder in this directory and choose it for data storage. A backup folder on **N:\Scientists\HE***** can be defined as well (Figure 14). File names are generated automatically, based on the File Options. Furthermore, file size can be limited by automatically beginning a new file after a certain time or by reaching a certain file size.

Figure 14: System Setup, General - Files

- **Special Transmit Modes:** It is possible to transmit two or three frequency/pulse width combinations subsequently. 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. Frequencies that are used if you run the system in Sub-Bottom Multi Frequency mode are defined here in the Special Transmit Modes (Figure 15).

Figure 15: System Setup, General – Special Transmit Modes

- **Beam Steering Options:** Changes here will have influence if you are using the system in Beam Steering Mode. Please refer to the SESWIN-Operation-Installation Manual for further information.
- **Navigation and Motion Sensor Setup:** All entries in these menus concern handling of the navigation data and motion data. **Don't change** items unless there are problems that require it! Navigation Input has been changed to TCP/IP instead of serial input.
- **Multi Input Setup:** The incoming external depth (NAVL0T) is defined here. **Don't change!**
- **Depth output:** The bottom depth is transferred to the DShip data acquisition system and can be extracted from there. **Don't change!**
- **Marker:** It is possible to set manual markers (Figure 16) 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.

Figure 16: System Setup, Marker

- **Config Network:** Not relevant on Heincke
- **Save Settings:** You can save your settings here for later re-use.
- **Screenshot of all settings:** This can be used to get screenshots of all system settings placed in the SESWIN folder. This should be done if all parameters for a survey are set in order to complete the documentation for further reference.
- **System status:** Check if all LEDs are green to make sure the system is running properly.

2.4 View Menu Bar

With the view menu bar (Figure 17), you can control the online data display. ***It will not affect the recorded data so place emphasis on acquiring good data instead of make them look good by adjusting settings here!***

Stacking / Smoothing are used to improve the signal to noise ratio. A good starting point would be a rate of 2 to 3. Stacking influences update rate on the screen while high smoothing values may have a blurring effect.

Applying the **Median Filter** will remove peak noise from the echo data and may also be helpful in removing noise caused by other acoustical devices.

Under **Resolution** different views can be chosen. High resolution view will provide the most detailed picture of the sediment. Amplitude view is better for getting an overview over the major sediment packages and for water column analysis. Raw data view is advised when looking for small objects like pipelines or cables.

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

Colours allow you to change between a Rainbow or a Grey Scale colour table.

Low / High Frequency: Define whether you want both frequencies to be displayed or HF / LF only.

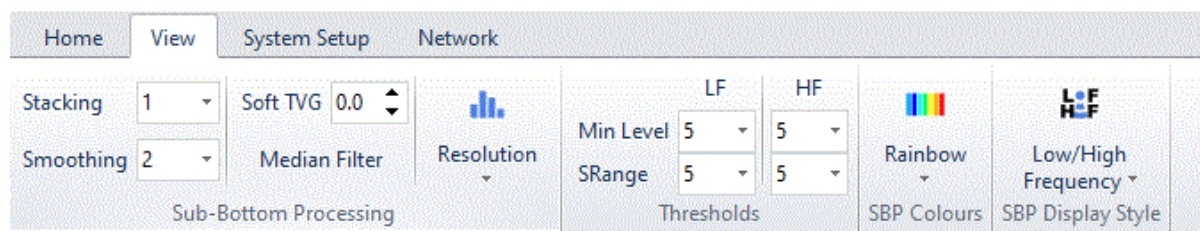


Figure 17: View menu bar

2.5 Record Data

System check / preparing survey start:

- Switch on the **Transmitter**. Please note that the transmitter is not switched on/off automatically when recording is switched on/off. The transmitter has to be switched on separately before starting data logging.
- Adjust **Frequency**: For most applications 10kHz and above should be used. If penetration is the main goal then a good starting point would be 8kHz or 6kHz (depending on the noise level). If resolution is the main goal then a good starting point would be a frequency of 12kHz.



- Adjust **Pulses**: If resolution is the main goal then a good starting point would be 1 or 2 pulses. If there is a high noise level or the survey is in deeper waters the pulse length (number of pulses) should be increased.
- Find the seabed and optimize the **Range** settings. In general, the range length should be set as small as possible. This will give the best resolution, especially on systems without raw data storage. A good starting point is a range start a few meters above seabed and a range length of not more than 20 meters, unless good penetration is achieved and the goal is to see sediment layers in deeper parts of the sub-seabed.
- Optimize the **Gain** settings for both channels. The rule of thumb is to set the gain for each frequency (HF/LF) in a way that the signal is not over-amplified but uses almost the whole dynamic range. The signal window should be observed and the gain should be increased from 0dB until the signal peaks hit the top of the window occasionally.
- Check and adjust data storage entries under **System Setup / General / Files**.
- Start data recording by pressing **Record**.
- Adjust range and gain settings according to changes of water depth and signal strength.
- To finish data recording, depress **Record**.

We also strongly suggest you to read chapter 11 “Data Acquisition and Post-Processing Workflow” in the SES2000-Manual_2020-09_smt-cpt-lgt-std-m100.pdf available on the computer.

2.6 Stop Innomar SES

- Stop recording and transmitting
- Close SESWIN
- Shut down computer and system
- Shut off monitor

3 Synchronization with Multibeam Echosounder EM712

The SES2000 and the EM710 are two independent echosounders with their own signal output. On the RV Heincke it is possible to synchronise the SES and the EM712 over a trigger unit to avoid interferences. Some changes have to be performed in the SESWIN- and the EM712 Software in order to use the synchronisation. The trigger system is arranged that the SES can act as the master unit or the triggered unit. In the SESWIN Software go to System Setup – General – Synchronisation: Switch from Internal Trigger to External Trigger

or Alternating Trigger (for using the synchronisation and sending the trigger to another device) (Figure 2, Figure 18 and Figure 19). Triggering needs to be tested. Following settings have been tried so far. Check if usable!

The screenshot shows a 'Setup' dialog box with a close button (X) in the top right. It has two expandable sections: 'System' and 'Synchronisation'. The 'Synchronisation' section is expanded to show 'External Trigger Settings'. On the left, under 'Mode', there are three radio buttons: 'Internal Trigger' (unselected), 'External Trigger' (selected), and 'Alternating Trigger' (unselected). The 'External Trigger Settings' panel contains three fields: 'Delay between sync pulse and ping [µs]' with a value of 100000 and a note '(= 75.00 m)'; 'Delay as percentage of ext. trigger period [%]' with a value of 50; and 'Number of pings for one sync pulse' with a value of 2.

Figure 18: Preliminary External Trigger Settings

The screenshot shows a 'Setup' dialog box with a close button (X) in the top right. It has two expandable sections: 'System' and 'Synchronisation'. The 'Synchronisation' section is expanded to show 'Alternating Trigger Settings'. On the left, under 'Mode', there are three radio buttons: 'Internal Trigger' (unselected), 'External Trigger' (unselected), and 'Alternating Trigger' (selected). The 'Alternating Trigger Settings' panel contains four fields: 'Time frame of external device [µs]' with a value of 5000 and a note '(= 8.95 m)'; 'Time Frame as percentage of range [%]' with a value of 40; 'Internal pings prior to external device' with a value of 1; and 'Number of external pings' with a value of 1.

Figure 19: Preliminary Alternating Trigger settings

4 Data Quality Check with Post Processing Software (ISE)

Innomar ISE Software and Innomar SES-Convert Software are installed as well. ISE software requires an USB dongle, which is stored with the captain. For detailed instructions on data processing read *ISE_Handbook_October2017Rev1.pdf* available on the computer. 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 by clicking on the “ok” buttons.

1. Open the file open dialogue (File → Load echo data)



2. Navigate to the folder where data are stored and choose the file you want to look at. At the moment only SES3-file formats can be loaded. This will be changed in the next software update. Press “Load”
3. There are several options and parameters that you can alter according to your needs in the load dialog window.
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”).
5. You should also check the sensor data (position data and motion sensor data).

5 SES Convert Software

SES Convert Software can be used to convert INNOMAR data files 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.

1. Define a target folder where converted files will be stored.
2. Use the file browser to navigate to the location of the files to be converted. Several files can be chosen to be processed the same way.
3. If a single file has been selected, there is some file information shown.
4. Check the SIS-IDs and note the IDs used for time (3) and position data (1 and 2).
5. Select the desired file format from the “Home” menu, SEG-Y format is the default.
6. Press “step forward” to proceed.

You will be directed to the SEG-Y Conversion Settings where you can define the SIS-IDs of the navigation and time input and decide on the Coordinate Scale Factor and Conversion Parameter depending on the requirements of the target software.

By pressing “step forward” again you will come to the Processing settings. Heave corrections is applied by default. If required, there is also a possibility to decrease the number of samples per trace, to reduce the size of the output file. There are three options for 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. The second option - range correction - is applied by default. The extend depth data range option fills data by zeros to have the same start for all traces within different data files. Coordinate interpolation and removal of duplicate coordinates should be activated. “Generate unique field record numbers based on date and time” is advisable to choose.



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.