KONGSBERG

Kongsberg SBP 27 Sub-bottom Profiler

Operator Manual

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Disclaimer

Kongsberg Maritime AS endeavours to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omissions.

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to install, operate or work on the equipment.

Kongsberg Maritime AS disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Support

If you require maintenance on your equipment, contact Kongsberg Maritime AS using the following address:KM.Hydrographic.Support@km.kongsberg.com. If you need other information about this product, or any other Kongsberg Maritime AS products, visit http://www.km.kongsberg.com.

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About this manual

This manual complies to SBP 27 software version 1.7.1.

The purpose of this operator manual is to describe how to use the SBP 27 Sub-bottom Profiler system in a safe and efficient manner.

WARNING

Keep in mind that the SBP 27 generates signals in the audible range. At maximum power, the SBP 27 has a very high source level. Out of consideration to human beings (divers) and animals living in the sea, we recommend to gradually increase the source power.

Never start pinging in dry dock!

SBP 27

Topics

- *System overview* on page 10
- *System description* on page 12
- *System diagram* on page 15

System overview

Introduction

The SBP 27 is the upgraded version of the SBP 120 and SBP 300 which has been upgraded by exchanging the transceiver unit and the TX/RX junction box.

The SBP 27 Sub-bottom profiler is an optional extension to the highly acclaimed EM 122/302 Multibeam echo sounder. The receive transducer hydrophone array used by the EM 122/302 is wideband, and by adding a separate low frequency transmit transducer and appurtenant electronic cabinets and operator stations, the EM 122/302 can be extended to include the sub-bottom profiling capability provided by the SBP 27.

Refer to *System diagram* on page 15

Note

The SBP 27 can be used in combination with different multibeam echo sounder systems, EM 122/302. This implies that the SBP 27 can be interfaced to different receiver electronics and receiver arrays.

Purpose

The primary application of the SBP 27 is to do imaging of sediment layers and buried objects. Image quality is influenced by:

- The spatial resolution of the system; its ability to distinguish objects separated in angle and/or range. The spatial resolution is given by two separate system properties:
  1. The angular resolution given by the array geometry and dimensions.
  2. The range/time resolution given by the signal bandwidth.
- The ping rate relative vessel speed. Dense probing alongtrack makes it easier to identify weak layers in sediments with high volume reverberation.
- The angle of incidence of the transmit beam. The echoes received are essentially caused by specular reflections at interfaces between layers of different acoustic impedance. These specular echoes are only strong close to normal incidence.

Key specifications

The SBP 27 has significantly reduced beam widths compared to conventional sub-bottom profilers. This is obtained by one linear transmitter array mounted along the vessel keel, and one linear hydrophone array (shared with the EM 122/302) mounted orthogonal to the keel. The footprint of the transmitter array is wide acrosstrack and narrow alongtrack, whereas the opposite is the case for the receiver array. The combined beam pattern of the two arrays is a narrow beam.

Some of the consequences of using large arrays are:

- The larger the transmitter array, the more power can be injected (without risking cavitation). This implies an increased source level.
- The directivity of the transmitter also increases with the size of the transmitter, which implies a further increase of the source level.
- The reverberation volume is greatly reduced with reduced beam widths. (The reverberation volume roughly increases with the square of the beamwidth.)
- The increased directivity of the SBP 27 receiver array compared to smaller receivers improves the suppression of acoustic noise.

Because the transmit beam is wide acrosstrack and all hydrophones are sampled individually, the SBP 27 can make a fan of narrow beams acrosstrack per ping. This multibeam capability of the SBP 27 is useful for:

- Finding the specular return(s) in rough terrain in spite of the narrow beams.
- Resolving lateral specular returns in rough terrain
- Detecting buried objects
- Obtaining information about the sloping angle of sediments (which sometimes changes with range and may be completely different from that of the sea floor)

The normal transmit waveform is a linear chirp. The outer limits for the start and stop frequencies of the chirp are 2 to 9 kHz, providing a maximum vertical resolution of approximately 0.2 milliseconds. In addition to linear chirps, the transmitter offers CW pulses, hyperbolic chirps and Ricker pulses. The transmit array of the SBP 27 is offered

in three, six or twelve degree versions. The frequency dependent source level of a three degree transmitter is typically above 220 dB re 1 µPa @ 1 m. The peak electrical power consumption is less than 10 kW for the largest system.

Normally the SBP 27 transmit antenna is matched with a receive antenna of similar physical size, but it is possible to combine any SBP 27 transmit antenna with any EM EM 122/302 receive antenna. Various combinations of EM 122/302 and SBP 27 antennas are given in *EM 122/302 and SBP 27* on page 13.

Beam stabilisation

The beams are electronically stabilized for roll and pitch. They can also be steered to take into account bottom slope, and the generation of several athwartship beams is possible.

Ping rate

In the transmit mode “normal”, the SBP 27 pings once and then waits to collect the return signal. Maximum ping rate is 20 Hz. In the transmit mode “burst”, the system allows a number of pulses to be launched into the water before the first return signal. In the “unsynchronized burst” mode the system is set to ping at a constant rate: The transmit and receive periods are interlaced so that a high constant ping rate can be maintained even in deep waters.

The SBP 27 can be synchronized to the EM 122/302 or other external equipment by selecting external trigger. During synchronized operation the rule is that the SBP 27 can only ping while waiting for the first bottom return. In transmit mode “burst”, this means we will achieve a piecewise dense sampling of the bottom which sometimes can be very useful.

Data logging and real-time processing

The data produced by the SBP 27 are logged in the Topas raw format or in a **SEG Y** format allowing post-processing by some seismic processing software.

System description

Main units

The SBP 27 Sub-bottom Profiler consists of these main units:

- TX Transducer Array
- TX/RX Junction Box
- Transceiver Unit
- Operator Station

- Ethernet switch
- Remote Control Unit (K-Rem)

Transducer arrays

The SBP 27 transmit transducer has a physical width of 80 cm, a depth of 35 cm and a length depending on the requested beamwidth. The 3º, 6º, and 12º SBP 27 transmit arrays are 7.5, 3.8 and 1.9 meters long, respectively.

The transmit array is mounted in parallel with the vessel's keel, normally side by side with the multibeam echo sounder's transmit array. For a "best performance" SBP 27 system one should always select a three degree transmitter, but normally it will be inconvenient to have an SBP transmitter much longer than the EM transmitter.

The lengths of the 0.5º, 1º and 2º EM 122 transmitter are 15.2, 7.8 and 4 meters, respectively.

The lengths of the 0.5º, 1º and 2º EM 302 transmitter are 6.0, 3.0 and 1.5 meters, respectively.

The rows of the following table show what is expected to be the most common combinations of EM 122/302 and SBP 27 system sizes. Since the two systems share receiver array there is a fixed relation between RX opening angles. In the table are listed combinations of "best match" for the lengths of the EM and SBP transmitters .

Table 1 EM 122/302 and SBP 27

	EM	SBP 27
	TX x RX	**TX x RX**
EM 122	0.5º x 1º	3º x 3º
	1º x 1º	3º x 3º
	1º x 2º	3º x 6º
	2º x 2º	6º x 6º
	2º x 4º	6º x 12º
EM 302	0.5º x 1º	3º x 7º
	1º x 1º	6º x 7º
	1º x 2º	6º x 14º
	2º x 2º	12º x 14º

Cabinets and Operator Station

The transmitter and receiver electronic circuitry required for the SBP 27 Sub-bottom profiler is housed in a separate cabinet. The EM 122/302 Preamplifier Unit contains preamplifiers for the common receiver array and frequency splitting circuitry. The operator interface and display system is implemented on a dedicated Operator Station. The system drawing shows the relation between EM 122/302 and SBP 27

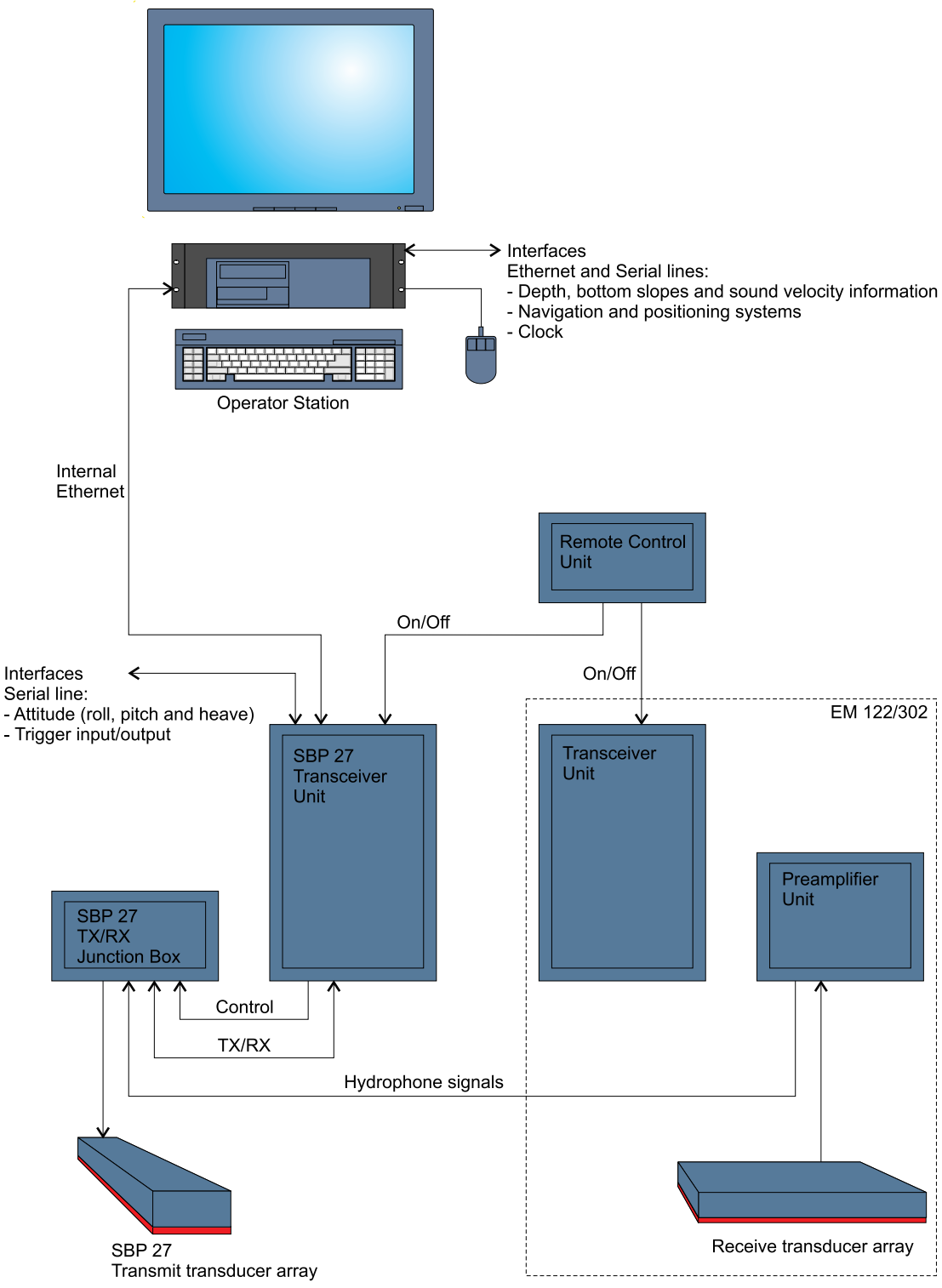
The **Operator Station** is a work station whose shape and dimensions will depend upon the actual model delivered. It will usually consist of a rack mountable chassis, an LCD monitor, a mouse and a keyboard. Additional peripherals may be included.

The Remote Control Unit is called **K-Rem**. It is prepared for remote control and interface to an external synchronization system for four Kongsberg echo sounders:

- One Sub-bottom profiler (SBP)
- Two EM multibeam echo sounders
- One EA single beam echo sounder

It has been designed to provide remote on/off switches with light indication and interface to a remote synchronizing system. K-Rem contains a terminal block and four switches with lamps mounted in the front.

System diagram



Operational procedures

This chapter presents the most important operational procedures required to operate the SBP 27 Sub-bottom Profiler.

Tip

When your system is satisfactory configured, make a copy of the configuration files for easy reload in case of troubleshooting. It is recommended to store at least one good configuration file and make this read-only.

Topics

- *Operational modes* on page 17
- *Operational principles* on page 17
- *How to start the SBP 27* on page 19
- *Preparing the system for use* on page 22
- *Check/configure the real-time processing* on page 26
- *Check/configure display properties* on page 28
- *Check the external inputs* on page 32
- *Check the basic operation* on page 33
- *How to run the survey* on page 34
- *How to shutdown the SBP 27* on page 34
- *Logging data* on page 35
- *Configuration files* on page 36
- *How to install the software updates* on page 37
- *Processing chain* on page 37
- *Built-In system tests (BIST)* on page 39
- *File conversion* on page 47

Operational modes

The SBP 27 is operated in **survey, replay, slave,** or **convert** mode.

Survey mode

The **survey mode** is used during the survey. The application is used to control the SBP 27 Sub-bottom Profiler, to store the beams, and to present the data.

Replay mode

The **replay mode** is used after the survey has been completed, and the data has been stored on disk. The replay mode is used for processing and presentation of stored data. Data acquisition cannot take place during replay operation. In this mode it is possible to adjust the replay speed so hardcopy devices are able to handle the processed data stream.

Slave mode

In **slave mode** the application can subscribe to the beams from a master system operating in survey or replay mode. This is the way to obtain a helmsman display.

Convert mode

The **convert mode** is used for conversion of a single file or a directory of files from the raw format to the SEG Y format or vice versa. In this mode it is also possible to extract a new file with a single beam from a file with many beams.

Operational principles

Start-up parameters

Start-up parameters must be given depending on type of operation and water depth.

You may start by loading a predefined set of parameters stored in a configuration file. While pinging, you can adjust parameters and observe the effect of the adjustments on the displayed data. A new set of parameters can be stored in a configuration file for later retrieval.

System interaction

All interactions with the SBP 27 Sub-bottom Profiler system take place via a windows based program on the Operator Station. Before operation of the system starts, it is assumed that all units are powered on.

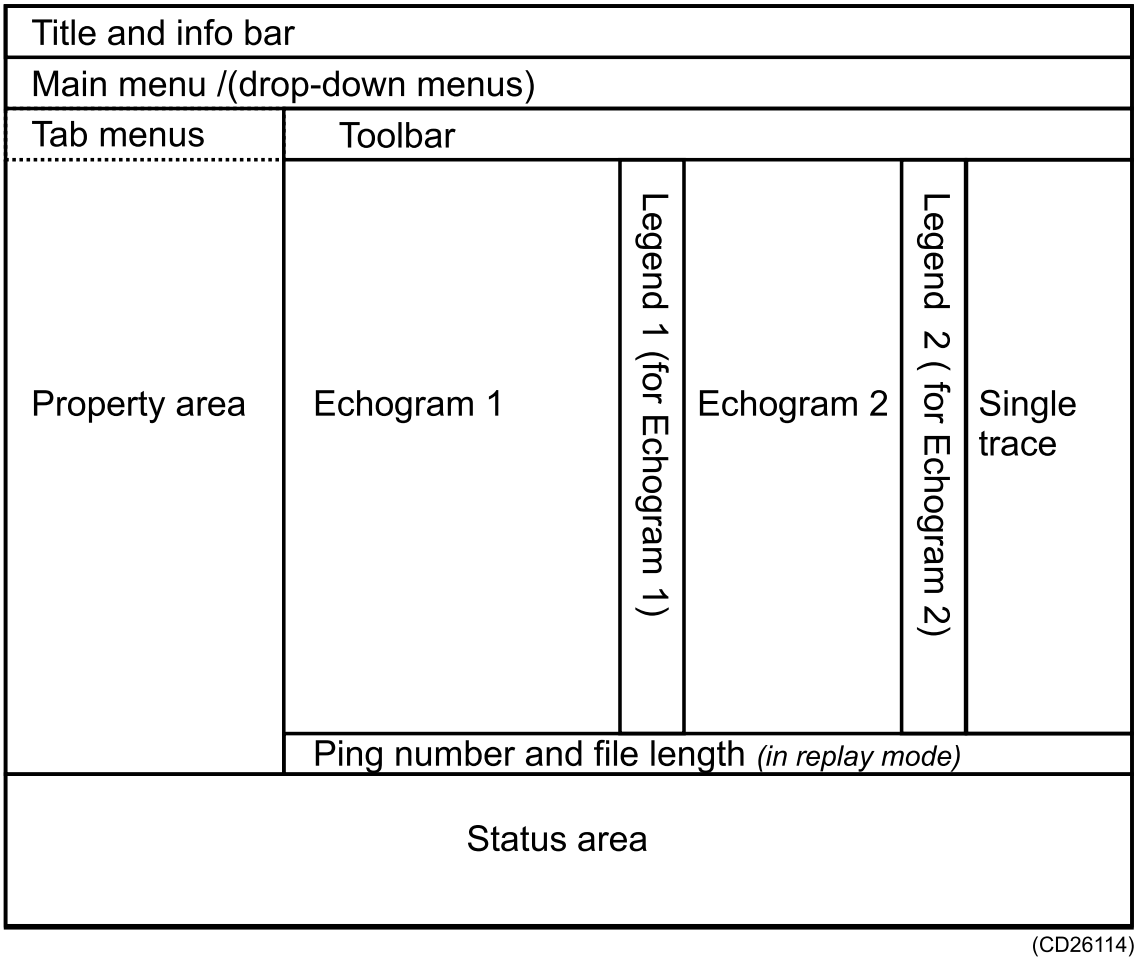
For information about switching power on, refer to *How to start the SBP 27* on page 19

Navigating in the menus and sub-menus is done by using the mouse. The keyboard is used for entering numerical and character strings into the parameter fields.

Application window

The SBP 27 application window is divided into several areas and menus - **parts** - that show different type of information. You may show or hide some of these parts as desired.

Figure 1 Application window



Brief descriptions of the various areas and menus are given as follows:

- *Title and info bar* on page 62
- *Property area* on page 67
- *Tool bar* on page 62
- *Echogram area 1, 2 & 3* on page 63
- *Legend area 1, 2 & 3* on page 70
- *Single trace area* on page 71
- *Ping number and file length* on page 72
- *Status area* on page 72

Survey mode procedures

To start the SBP 27 system, follow this procedure:

1. Power up the SBP 27 system, log in to the operator station and start the operator software.
   See *How to start the SBP 27* on page 19
2. Run the system tests
   See *System Tests (Built-In System Tests)* on page 22
3. Optionally: Load configuration file
   See *Load a configuration file* on page 22
4. Check the installation parameters
   See *Check the installation parameters* on page 23
5. Check/set the runtime parameters
   See *Check/set runtime parameters* on page 23
6. Check/set the real-time processing
   See *Check/configure the real-time processing* on page 26
7. Check/configure display properties
   See *Check/configure display properties* on page 28
8. Check the external inputs
   See *Check the external inputs* on page 32
9. Start pinging
   See *How to start the echo sounder (Start pinging)* on page 33
10. Check the local depth and the main echo sounder functions
    See *Check the basic operation* on page 34
11. Enter the survey parameters
    See *Run the survey* on page 34
12. Move the vessel to the start of the first survey line
13. Start logging
    See *Logging data* on page 35
14. Run the survey
15. Stop logging
16. Power down the SBP 27
    See *How to shutdown the SBP 27* on page 34

How to start the SBP 27

How to power up the SBP 27

1. Power up the SBP 27 Operator Station

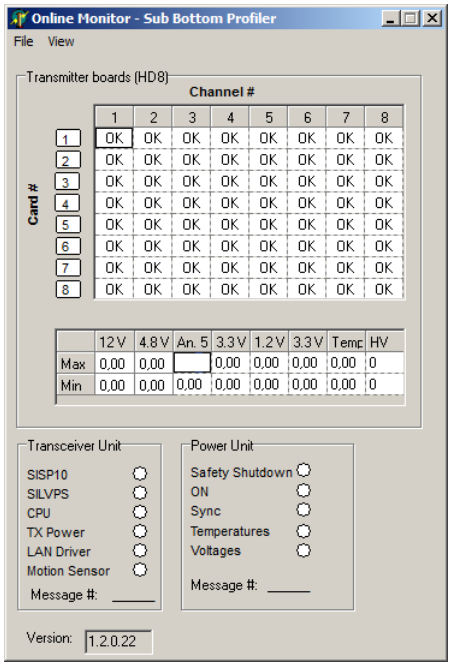
2 Initialize and log on to the SBP 27 software:

When the boot process of the operator station is finished, you must log on to the operator station. In the default configuration, Online Monitor and the beamformer application will be started automatically when you log into the computer.

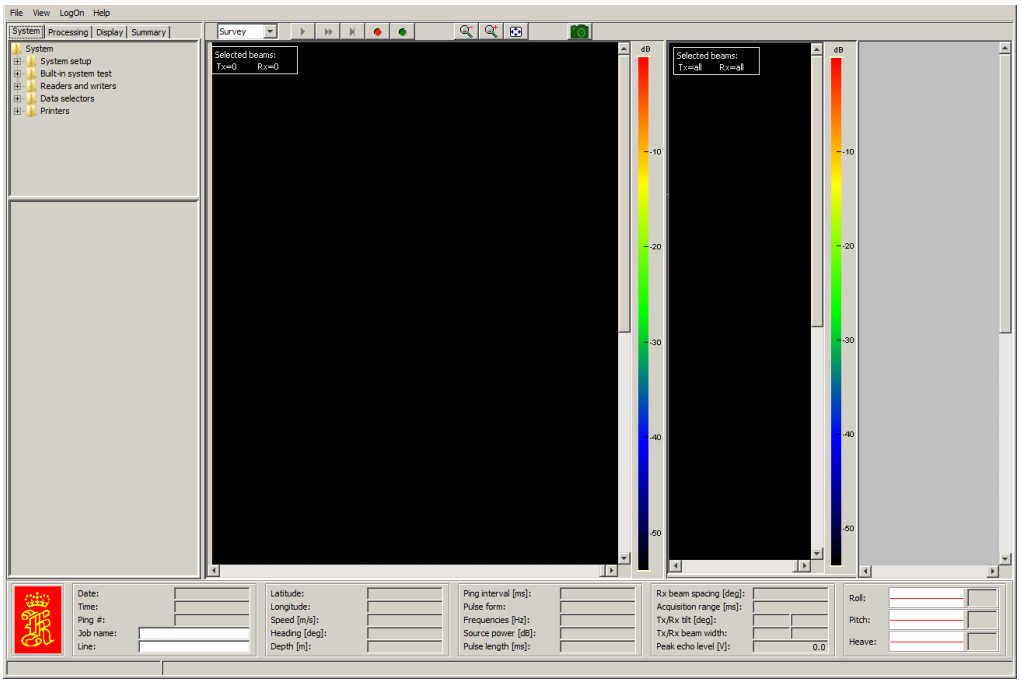
Note

*Shortcuts to the **Online Monitor** and the **beamformer application** are located in the startup folder, causing these applications to start by default when the computer is powered. If any of these programs are shut down, they can be restarted using shortcuts on the desktop.*

a If not already running, start the *Online Monitor* which can be accessed by an icon on the Operator Station's desktop



b Open the *KM SBP OPU* program from the desktop icon.



3 Power up the SBP 27 Transceiver Unit

4 For older installations with a dedicated Beamformer Unit, power this up

5 Power up the any peripherals devices to be interfaced to the SBP 27

Consult the applicable manufacturer's documentation for instructions.

User access level

There are three user levels of the SBP 27:

- User
- Root
- Super

You are automatically logged on as user **User**. After installation is completed included successful interfacing to ship/sensor networks it should normally not be necessary to enter a higher user level.

In the **LogOn** menu you can also log on as **Root** with the authority for instance to inspect the configuration of the NMEA readers, to modify the behaviour of the pop-up windows (System messages, Survey Warnings), and to add or remove items from the processing chain. The **Root** user is password protected. The **Root** password is: `root`

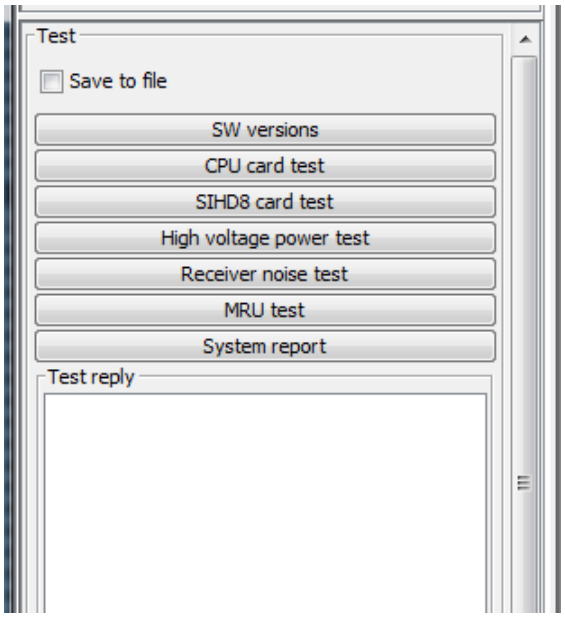
An even higher level of accessibility becomes visible in the **LogOn** menu when logged on as **Root**. This is the **Super** user. When logged on as **Super** parameters that are normally only entered during the installation process can be changed and stored to a configuration file. Some of the menus et cetera appearing at this user level are not documented; they are for use by Kongsberg Maritime only. When logged on as **Super** the **File** menu is extended to include "**Save/load installation**. The **Super** user is password protected. The **Super** password is: `super`.

WARNING

Do not enter user mode Super unless there is a good reason to so. Remember to leave Super mode when reconfiguration of the system setup is completed and the changes are saved to the configuration file.

System Tests (Built-In System Tests)

It is recommend that you routinely run the system tests located in the **Built-in system tests** folder to verify that the system has started successfully.



1. Check that all units reply to the **SW versions** request
2. Check that attitude is received by the **MRU Test**, and that there is no loss of attitude (the number of attitude messages received per second is displayed)
3. Check that the **High Voltage Power Test** is successful
4. Check that the outcome of the SIHD8 card test is **All units OK**
5. Check that the receiver noise levels are acceptable in the **Receiver Noise Test**.

   If the noise level is extremely low (<< 40 dB re 1 µPa), verify that the EM preamplifier is switched on

Note

The EM 122/302 Preamplifier Unit power supply is not controlled by the remote switch controlling the EM 122/302 Transceiver Unit. The EM 122/302 Preamplifer Unit should always be switched on.

More information is found in *Built-In system tests (BIST)* on page 39.

Preparing the system for use

Load a configuration file

When started, the system will load the installation parameters stored in `SBPInstall.xml` and the system configuration stored in `SBPConfig.xml`; both files are read from the working directory of the software. You may wish to load a predefined configuration file suitable for the planned operation. For more details, see *Configuration files* on page 36.

Note

Check that the system is in survey mode.

Check the installation parameters

The installation parameters are:

- For EM receiver type specify the EM the SBP is integrated to.
- installation angles and positions of arrays, motion reference unit and GPS antenna relative to the ship's coordinate system
- the water level relative to the ship's point of reference
- the number of transmitter and receiver channels

The installation parameters must not be tampered with. If they have been changed e.g. for experimental purposes, or in case the configuration file is damaged, it is necessary to restore the correct parameters. The easiest method is to load a configuration file with the correct set of parameters. Alternatively, the installation parameters must be entered manually, which can only be done if logged in as **Super** user.

If a backup of the valid `SBPInstall.xml` has been stored in a safe place as recommended, the easiest way to restore the correct parameters is to log on as user **Super**, choose **File/Load installation** and select this backup file. Next choose **File/Save installation** and store the loaded parameters as `SBPInstall.xml` in the working directory which is the default location when **Save installation** is selected.

Check/set runtime parameters

Check that the runtime parameters are set as expected from the selected configuration file. The table *Suggested Runtime parameters* on page 23 contains a suggestion for how to initialize the runtime parameters for a standard survey.

Note

The number of runtime parameters is large. In order to minimize the list, only the parameters relevant to the current settings are displayed.

Table 2 Suggested Runtime parameters

Runtime parameters	Symbol	Value	Unit	Note
Transmit mode	-	Normal	-	-
Transmit cycle mode	-	-	none	-
Synchronization	-	Fixed rate	-	13)
Ping interval	PIV	500	ms	1)
Acquisition delay	AWS	-	ms	2)
Acquisition window	AWL	200	ms	3)
Pulse form	-	Linear chirp up	-	4)
Sweep low frequency	FL	2500	Hz	5)

Table 2 Suggested Runtime parameters (cont'd.)

Runtime parameters	Symbol	Value	Unit	Note
Sweep high frequency	FH	6500	Hz	5)
Minimum pulse shape		Checked	-	12)
Pulse shape	-	N/A	%	
Pulse length	T	5	ms	15)
Source power	-	-	dB	6)
Power ramping rate	-	-	dB/min	7)
Beam widths TX	-	Full array	-	14)
Beam widths RX	-	Full array	-	14)
Number of RX beams	-	3	-	8)
Beam spacing	-	3	deg	8)
Acquire water column data	-	-	unchecked	-
Calculate delay from depth	-	-	checked	9)
Delay hysteresis	-	5	%	11)
Bottom screen pos.	-	30	%	-
Automatic slope corrections	-	off	-	10)

Notes

1 The system may find that only a larger ping interval is possible (in which case this larger ping interval will automatically be used)

2 Either:

- Specify the delay manually,

  or

- Enable **Calculate delay from depth** (check box in the runtime parameter sheet) and have the delay automatically calculated using:

  a external depth D input to an NMEA reader

  or

  b depth D entered manually

  Select between the two sources of depth in the depth selector (located in System/Data selectors)

3 At startup: If the uncertainty is high regarding the actual depth D used to initiate the AWS, use a large AWL until bottom is detected. In an area with no or little penetration you may want to reduce the AWL in order to save disk space. In very rough terrain it may be necessary to increase the AWL in order to acquire the interesting signals.

4 A chirp with bandwidth B and duration $T>>\frac{1}{B}$ is a standard pulse used for sediment profiling. Maximum bandwidth $B \approx FH - FL$ ensures maximum range resolution, and the long pulse length $T>>\frac{1}{B}$ improves signal-to-noise ratio by $10 \log 10 \left(BT\right) dB$ compared to short pulses of duration T and bandwidth $B \approx \frac{1}{T}$.

As an example, B=4 kHz and T=40ms gives an increase in SNR of 22 dB.

5 For best range resolution, choose the minimum and maximum allowed frequencies. The actual allowed sweep range can vary for different SBP 27 installation.

6 The dB unit is relative maximum power. Entering 0 dB means maximum power, -3 dB means half power.

7 For mammal protection you may increase the source power from lowest level (-30 dB) up to selected source power by a number of dB per minute.

If pinging is stopped for more than two minutes the source power will go back to minimum power level. When pinging resumes, the source power will increase by the set power ramping rate until desired source power is reached.

When set to 0 the power ramping is disabled.

8 A higher number of beams can be used, but it may be desirable to keep the amount of data collected at a moderate level. A high number of beams may also limit the ping rate. The choice of three beams will provide qualitative information about the across track sloping angle of the sediments (it can change through the sediments). Using more than one beam will also be an advantage either on a rough bottom or if the across track slope is unreliable/unknown because one is more likely to obtain normal incidence to the sea floor in one of the beams.

The beam spacing can be set equal to beam width of the RX beams as this will ensure some overlap. The nominal beam width of the SBP 27 systems is defined at 4 kHz, but the beam width is frequency dependent and decreases with increasing frequency. For example at 6 kHz the beam width is decreased by 4/6, so the beam width of a 3 degree antenna - which is defined at 4 kHz - is only 2 degrees at 6 kHz. Accordingly the beam spacing should be 2 degrees to ensure good overlap between the beams at the 6 kHz frequency. When half array is used, the beam spacing may be doubled.

9 This check box is checked to give an automatic calculation and adjustment of the acquisition delay. If a reliable external depth is not available this feature must be disabled until the internal bottom tracker is found to track bottom.

Note

Make sure that the internal bottom tracker is enabled. See information about the processing chain.

10 **Automatic slope correction** may be used if the SBP 27 receives bottom slope estimates from an EM echo sounder. The bottom slope information is part of the SRV datagram.

The slope estimates are good only if the seafloor topography varies slowly. In that case the "quality factor" accompanying the slope estimates will be less than 0.2. It is not recommended to use bottom slope correction unless the behaviour of the system is monitored closely. To aid the operator a slope quality threshold can be set in the NMEA readers to discard the slope information when this threshold is exceeded.

Note that even if the bottom slope correction works as intended and the center beam is steered perpendicular to the sea floor, imaging of sediments may be unsuccessful. Only when the sediment interfaces are close to parallel to the sea floor this feature may be useful.

For details about the SRV datagram, see *Depth – bottom – slope and sound velocity data* on page 196.

11 The delay hysteresis must be less than the "bottom screen position" in order to keep the bottom within the acquisition window.

12 When **Minimize pulse shape** is enabled, the value of **Pulse shape** (the percentage of the pulse length used for rise and fall time) is automatically adjusted to the minimum value permitted by the electronics for the given pulse length.

13 If the system is run synchronised (EM trigger or External trigger), we recommend checking the **Reduce EM<>SBP crosstalk** tick box that appears when EM or External trigger is selected.

14 The beam widths should be adapted to the water depth to avoid strong near field effects. Suggested thresholds:

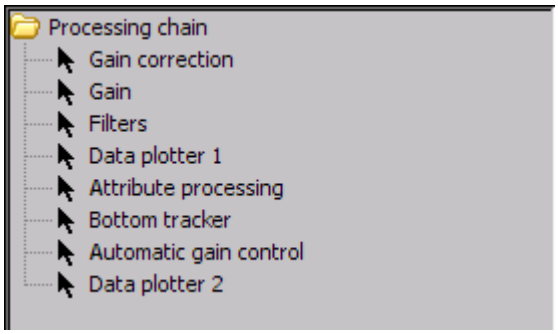
- 3 degree antenna:
  - Depth > 120 meters: Full array
  - Depth 30-120 meters: Half array
  - Depth < 30 meters: Quarter array
- 6 degree antenna:
  - Depths > 30 meters: Full array
  - Depths < 30 meters:: Half array

The option to cycle TX beam width should be useful to compare the results with the different beam widths, see *Transmit cycle modes* on page 164.

15 Typical pulse lengths may be in the range of 20-40 milliseconds, but in shallow water the pulse length must be reduced to allow transmission to complete before the first bottom return. If acquisition delay is too large to collect the bottom return and it cannot be reduced, it may be because the pulse length is too long.

Check/configure the real-time processing

The real-time processing and post-processing available in SBP 27 is located under the **Processing** tab in the property area.



Note

*The processing will be carried out in order specified by the **Processing chain**.*

The real-time processing does not directly affect the data logged by the raw data logger because the data are stored before any processing is applied. Nevertheless the processing is important because the output, displayed in the echogram area(s), is what tells the operator if good data is acquired and if adjustments of runtime parameters need to be done.

The list of objects in the processing chain contains more items than normally used during standard operation.

The following table suggests suitable settings for an ordinary survey. Objects not listed herein is recommended disabled, while those listed should be enabled. Enabled objects are displayed in black in the processing chain, while disabled objects are dimmed (gray).

Note

The sequence is important, except for the data plotters. The data plotters do not affect the final image. Their only purpose is to visualise the signal at various steps of the processing chain. Thus they can freely be moved up and down in the processing chain. Disabling both will cause the single trace area to be blank which may cause some confusion.

Table 3 Suggested processing chain (disabled items are not shown)

Processing chain	Setting	Note
Gain correction	-	1)
Gain	-	2)
Filters	Matched (for chirp pulses) Select ”Auto” for corner frequencies	3)
Data plotter 1	Enable	4)
Attribute processing	Instantaneous amplitude	5)
Bottom Tracker	Internal tracker control	6)
Automatic gain control	-	or TVG
Data plotter 2	Enable	8)

Notes

1 The gain correction compensates for spherical loss as the signal propagates. In addition to this time variable gain, the object also corrects for change in the source level due to changes in transmit power and/or transmit beam width.

2 Enable gain to add a fixed amount of gain to the data if necessary. Specify manually a positive (or negative) gain value whenever the signal appears weak (or saturated) in the echogram areas.

3 Chirp pulses require matched filter in order to get maximum resolution and an increase in SNR by $10\log_{10}BT$. For CW-pulses and Ricker: Apply bandpass filtering.

4 In this position, Data plotter 1 plots the signal after applied gain and matched filter.

5 Calculates the envelope of the signal.

6 Attempts to detect bottom. Check visually that it tracks the right echo.

7 This TVG is intended for application to sub-bottom echoes. Consequently, in TVG mode ”Auto” the start of the TVG locks to the bottom tracker. The gain [dB/ms] is always set manually.

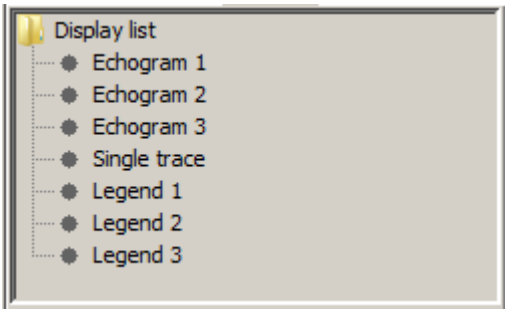
8 In this position, Data plotter 2 plots the signal at the end of the processing chain.

Check/configure display properties

For each available display area a number of parameters must be set. Applicable parameter sheets becomes available when display area is selected from the **Display list**.

The available displays are:

- Echogram 1
- Echogram 2
- Echogram 3
- Single trace
- Legend 1
- Legend 2
- Legend 3



Note

In the Single trace area, the last beam received is displayed. Data plotter 1 and data plotter 2 in the processing chain determine what will be shown. The grid is determined by the depth tic spacing which is set from ***display→display list→single trace****.*

Note

In the echogram areas, the output from the processing chain is shown. The layout of an echogram image is determined by its echogram and legend parameters available in the display property sheet.

The following suggestions are intended as guidelines for inexperienced users. Potential pitfalls are marked with Warning

Displaying an alongtrack profile in Echogram 1

Note

Any of the Echograms can be used for this purpose.

Table 4 Suggested settings for echogram image (Echogram 1)

Echogram image (Echogram 1)		
	Recommended setting	Note
Copy screen	-	10)
Trace width	1	1)
Checkbox ”Adjust range to last acquisition window”	Check this box	2)
Enable event lines	Uncheck this box	11)
Checkbox ”Grid enabled”	Check this box	3)
Grid depth unit	ms	4)
Ping tick spacing	for example 100	5)
Depth tick spacing	for example 10	6)
Show selected RX beam only	Check this box	-
Selected RX beam number	0	7)
Show selected TX beam only	Check this box	9)
Selected TX beam number	Check this box	9)
Checkbox “Bottom lock”	Uncheck this box	8)
“3D” enabled	Uncheck this box	

Notes

1 This determines width of each beam displayed in the echogram image.

2 May be unchecked in order to display terrain with high dynamics.

Note

If this feature is turned off, the min and max depth to be entered manually, determine which part of incoming data to be displayed. If the incoming data are completely outside the limits given by these depth parameters, nothing will be displayed!

3 Most users will prefer to have a grid in the echogram area.

4 Selecting meters (m) cause the range axis to be scaled using the sound velocity in the water column. This will position bottom accurately if the sound velocity is accurate. However, regarding penetration depth and the thickness of sediment layers, the meter axis will only give an estimate. Usually, this will give a lower estimate because the velocity of sound is normally higher sub-bottom than in the water column.

5 The vertical grid lines are drawn with this interval.

6 Choice dependent upon the length of the acquisition window (and the level of zoom).

7 Select 0 (zero) to view the centre beam. Step up and down to view the along track echogram as seen by other beams. Positive beam numbers are to the port side of the ship.

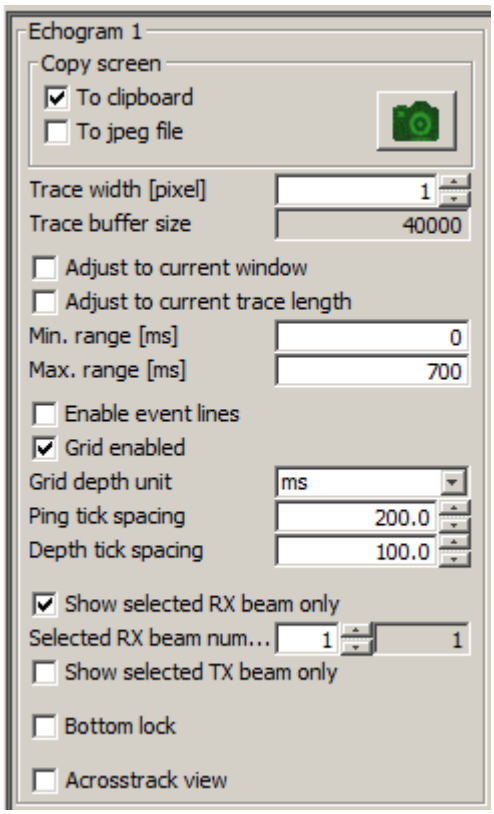
If a non-existent RX beam number is asked for, the nearest available beam will be displayed.

8 May be used to align all bottom echoes at a constant range position in the echogram area. Requires that the bottom tracker is locked on the seafloor echo.

9 No effect unless system is operated in one of the Transmit cycle modes. If a non-existent TX beam number is asked for, the nearest available beam will be displayed. Beam number is 0 if only one TX beam; and positive 1 to N if N TX beams.

10 When **Copy to file** is selected a `jpg` file is printed to the KM SBP Images folder.

11 External event lines can be displayed in the echogram area if CODA navigation strings are received.



Configuration of Legend 1

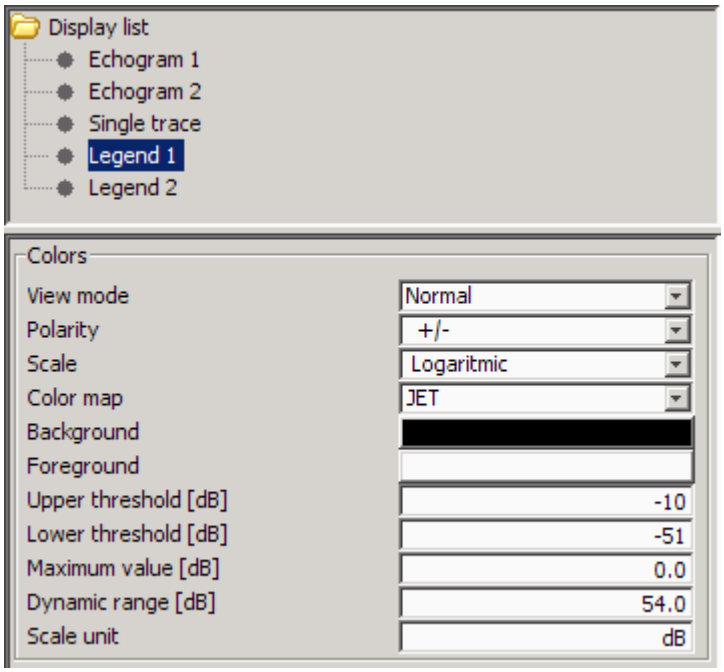
Table 5 Suggested legend settings (Legend 1)

Colours (Legend 1)		
-	Recommended setting	Note
View mode	Normal	-
Polarity	+/-	1)
Scale	Logarithmic	-
Colour map	Jet, Inverse greyscale, Greyscale	2)
Background	Black	-
Foreground	White	-
Upper threshold [dB]	0	
Lower threshold [dB]	-40	
Maximum value [dB]	0.0	
Dynamic range [dB]	54.0	
Scale unit	dB	

Notes

1 Warning: Selecting "-" means nothing will be displayed in logarithmic mode when instantaneous amplitude is calculated.

2 Other choices are available.



Displaying the acrosstrack swath in Echogram 2

Note

Note Any of the Echograms can be used for this purpose.

Echogram area 2 is enabled/disabled in the View drop-down menu, and it may be used to display the same data as that of **Echogram area 1** with different dynamic range, colour map, dynamic range, level of zoom, and so on.

To show the two echogram areas side by side, select the **Vertical split 1-2/3** in the **View** drop-down menu. When the vertical split is unchecked the two echogram areas are arranged one above the other.

Alternatively, you may configure **Echogram area 2** to view the fan of receiver beams.

To have a single receiver fan displayed per ping check **Acrosstrack view** on the **Echogram 2** parameter sheet.

Check the external inputs

Proper operation of the external sensors are vital for the SBP 27 operation.

Attitude

If you did not perform the **MRU test** as part of the system startup, do it now. See *System Tests (Built-In System Tests)* on page 22.

While pinging, verify that attitude information is received on the **Beam reader** parameter sheet or in the **Status** area.

NMEA readers

Check that the required information is received by the **NMEA readers**. To see the information received by an NMEA reader, highlight the reader you want to check (located in **System→Readers and writers→NMEA readers**) and the information received will be displayed in the lower part of the property area.

You should **always** receive position data through the **NMEA readers**.

For more information see *NMEA readers* on page 107.

SRV datagram

The **SRV datagram** is an NMEA like datagram available from the EM multibeam echo sounder. The SRV datagram contains the external depth used by the SBP 27 software for automatic adjustment of the acquisition window.

When the bottom is plane and sloping, the EM can estimate the local slope angles and inform the SBP 27 through the SRV datagram, so that the beams can be directed perpendicularly to the bottom, in order to get the best resolution and contrast for the seabed and sediments parallel to the seabed.

The SRV datagram also contains the sound velocity.

We strongly recommend to read the **SRV datagram** from the EM sounder. Note that the SRV datagram can only be received when the EM sounder is active.

For EMs working with SIS 3.7 and later versions the SRV datagram contains information that is used by the SBP to reduce crosstalk between the two systems when the SBP is run synchronized.

Note

Note that the model number of an EM providing SRV datagrams must be listed in the SRV shallow/deep water priority strings found under the NMEA readers. For details see NMEA readers on page 107

Check the basic operation

Make sure **Survey mode** is selected.

For more information about the available modes see *Operational procedures* on page 16.

How to start the echo sounder (Start pinging)

Press the **Start** button or select the desired transmit mode and push the **Send** button located on the bottom of the **Runtime parameters** sheet.

For description of the **Runtime parameters** see *Runtime parameters* on page 131

Check the basic operation

Before you start logging, you must make sure that the correct depth is provided externally, alternatively that the internal bottom tracker of the SBP 27 has locked on to the bottom .

Important

The SBP 27 must be running in **Transmit mode: Normal** until the internal bottom tracker has locked onto the bottom.

How to run the survey

Run the survey

For each survey line;

1. Enter **Job name** and **Line**

   In order to start a new survey, the **Job name** and **Line** parameters must be given. This is done in the **Status window**.
2. Move vessel to the beginning of the line
3. Start Logging

   We recommend to always log raw data in the **RAW** format.

   Caution

   Be careful not to overwrite an existing file by accident. This happens if you choose an existing filename.
4. Run the line
5. Stop logging at the end of the line.

How to shutdown the SBP 27

Software

Exit the SBP 27 by selecting the **Exit** from the **File** menu.

Hardware units

Operator Station

1. Locate the unit's mains switch, and switch off.
2. Switch off all the peripherals.

Transceiver Unit

Switch the power off by using the remote On/Off button.

Logging data

It is possible to log raw and processed data simultaneously in survey mode.

Depending on the settings of real-time processing and the position of the processed data logger in the processing chain, processed data may become worthless. By logging the raw beam data, no information is lost and the data can be post-processed to optimize the result.

When you start logging, you have to specify the name of the log file or a directory in which to store the data. We recommend logging to a directory: This minimizes the risk of overwriting existing files because the file names are then automatically generated based on date and time.

Raw data can be logged in either the RAW format or the SEG Y format. Data logged in the RAW format contains information (heading, vessel speed and attitude) that is not logged in the SEG Y format. We recommend logging in RAW format, and later convert to SEG Y when needed, unless the extra information provided by the RAW format is considered redundant or not interesting.

Refer to *File conversion* on page 47 for more information.

If the Processed data logger is at the top of the Processing chain, the data logged will be truly raw beam data as is always the case for the Raw data logger. This means it is possible to log raw beam data simultaneously in both RAW and SEG Y format.

For more information about the Processed data logger, see *Processed data logger* on page 120.

Logging in survey mode

To start raw data logging in survey mode you can either use the red **Raw data logger** button  on the tool bar or the Raw data logger found on the System tab.

For more details, see *Raw data logger* on page 124.

To start logging of processed data in survey mode you can either use the green **Processed data logger** button  on the tool bar or the Processed data logger found on the Processing tab.

For more details, see *Processed data logger* on page 120.

Logging in replay mode

When you want to log in replay mode, you can either use the green **Log** button  on the tool bar or the Processed data logger found on the Processing tab.

For more details, see *Processed data logger* on page 120.

Configuration files

The SBP 27 is very flexible and contains many possibilities. Both in the setting of runtime parameters, which affect the acoustic signal, and in the configuration of the online processing and choice of data display, it is possible to ”get lost” for an inexperienced operator. Almost all configurable parameters, including the installation parameters and the setup of the network communication and the serial lines, are stored in two configuration files. On startup, the system loads a pair of configuration files located in the working directory of the program. The configuration files are described in the following sections.

Installation parameters

All installation parameters are stored in the file `SBPInstall.xlm`. This file contains installation parameters for array, motion sensor and antenna. It also contains the network configuration (IP addresses, UDP ports) and setup of NMEA readers and Printers.

Once the SBP system is properly configured one will rarely make changes to the installation parameters. When changes are to be made to the installation parameters, one must be logged on as **Root**. When the software is shut down, you will not get the option to save changes to `SBPInstall.xml`. Changes to the installation parameters must be stored to file using **File→Save Installation**, and this menu choice is only available when logged on as **Super**. For changes to have effect on next startup, changes must be saved to `SBPInstall.xml` in the working directory of the program.

Note

We advice that you make a read-only copy of `SBPInstall.xml` and store it in the `config` directory of the software installation.

Note

*If changes have been made to any of the installation parameters, use **File→Restart** to transmit the new installation parameters to the TRU and the receiver beamformer.*

System configuration

Almost all parameters not defined as installation parameters are stored in the file `SBPConfig.xml`. One exception is the runtime parameter power level; for safety reasons this parameter always reverts to the minimum value when the system is restarted. When the system is closed in a normal manner using **File→Exit**, you will get the question **Save current configuration to SBPConfig.xml file**.

We strongly recommend to store away one or more ”good” configuration files. As experience is gained, you may want to store away configuration files for various situations. There may be different configuration files for different combinations of deep or shallow water, rough or calm weather, externally triggered or internally triggered transmissions, etc.

Note

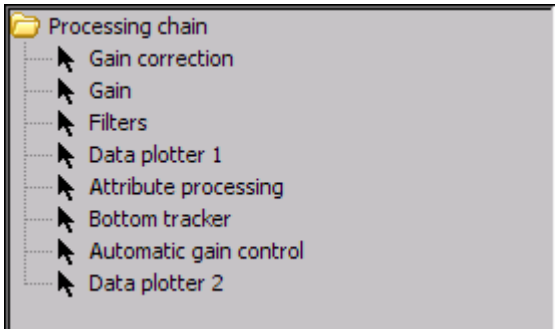
You are advised to write-protect some of the configuration files in order to avoid accidental destruction of carefully designed configurations. This is done from the Windows operator system of the operator unit.

How to install the software updates

Software updates will normally be distributed on CDs. Installation instructions will accompany the software. Software updates in the transceiver unit must be carried out by personnel from Kongsberg Maritime AS.

Processing chain

The real-time processing and post-processing available in SBP 27 is located under the **Processing** tab in the property area.



A large number of standard and more specialized processing objects are located here in a list. The sequence of the items in this list determines in which sequence the various processing steps are applied to the signals.

The signal processing starts according to the top item of the list, and the processing proceeds down the chain.

Any item can be Enabled/Disabled by checking/unchecking the **Enabled** checkbox. When disabled the item in the Processing chain will be displayed in gray.

Using the Move up/down arrows located in each object, all items can be moved freely up/down the processing chain.

Note

This does not imply that enabled items can be positioned in any sequence without serious consequences.

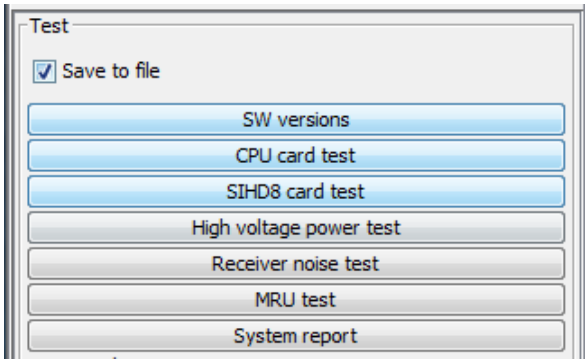
As an example: Calculating instantaneous amplitude (attribute processing) prior to matched filtering is a very bad idea. The signal output at the end of the chain is the input to the echogram areas.

Some of the objects in the processing chain may never or rarely be used. User **Root** is given access to an **Exclude** checkbox. Checking this check box for an object in the processing chain, will make the object invisible to the standard **User**.

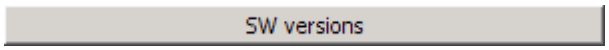
For more details, see *Processing chain* on page 123.

Built-In system tests (BIST)

In order to verify system operation, and as diagnostic tools in case of problems, a few software tests are available. They are located in the **Built-In System Test** folder under the property sheet **System**.



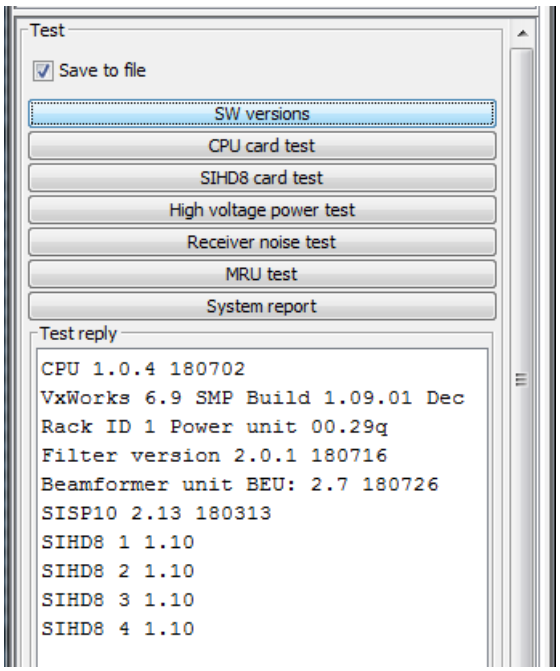
Software versions



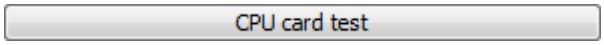
This test provides software version number and date for the major software components in the system.

One exception is the **operator unit software**, whose version number is given in the **About** box found under the **Help** menu. Another exception is the **Online Monitor** where version number is found in the lower left corner of the main window.

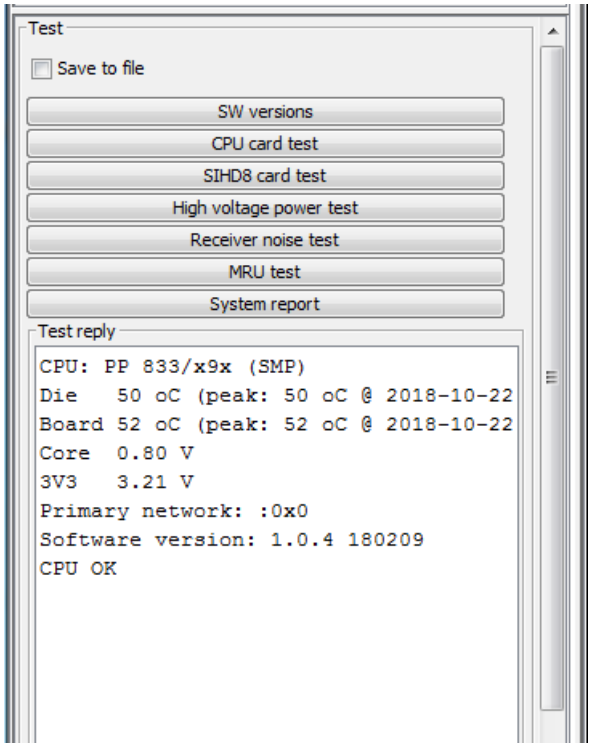
In addition to providing the software versions, a successful test shows that all units are switched on and that the main communication is established between all units.



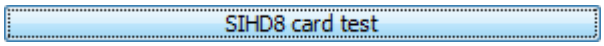
CPU Card Test



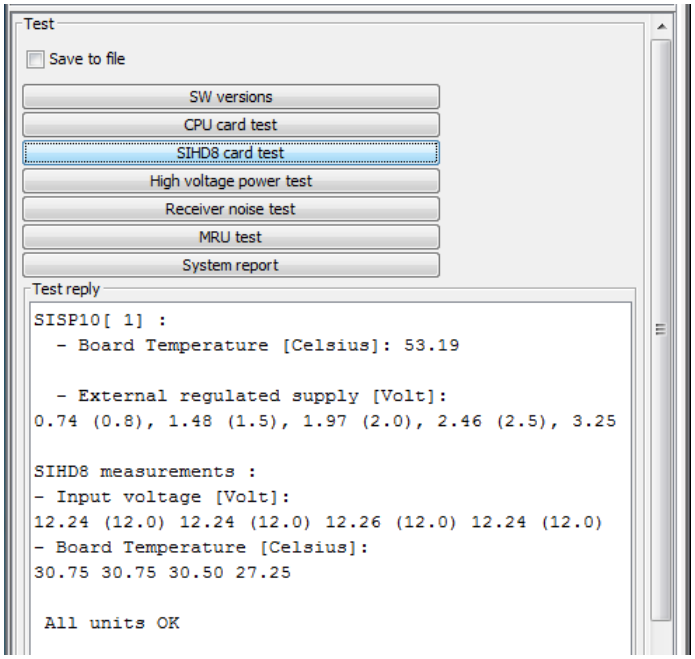
The CPU card test report temperatures, voltages, date/time, and software version.



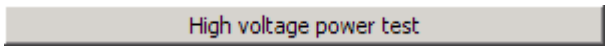
SIHD8 Card Test



This test reports board temperatures and voltages for the SIHD8 boards and also for the SISP10 board.

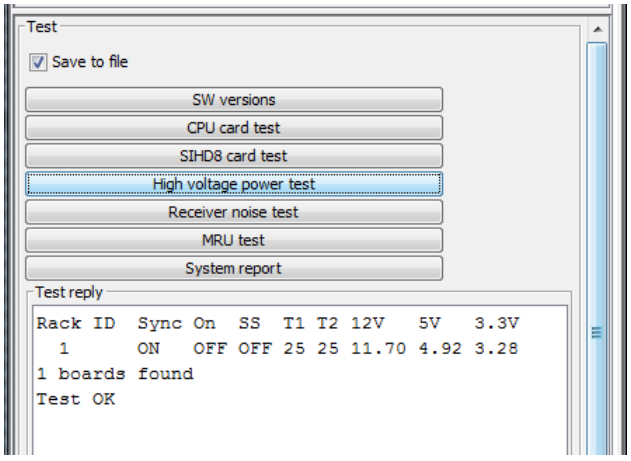


High Voltage Power Test

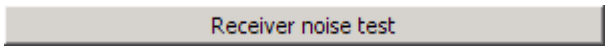


Temperatures and voltages of all installed high voltage power units are displayed.

- **Sync** shows if the switching frequency of a power unit is synchronized by the SISP10 board. The normal result is ON
- **On** shows whether or not a unit is active,. During a BIST test the normal result is **OFF**.
- **SS** refers to Safety Shutdown. The normal value is **OFF**. If this value is **ON** the high voltage power will refuse to ping. Check the switches on front of the power units if the result is **ON**.



Receiver Noise Test

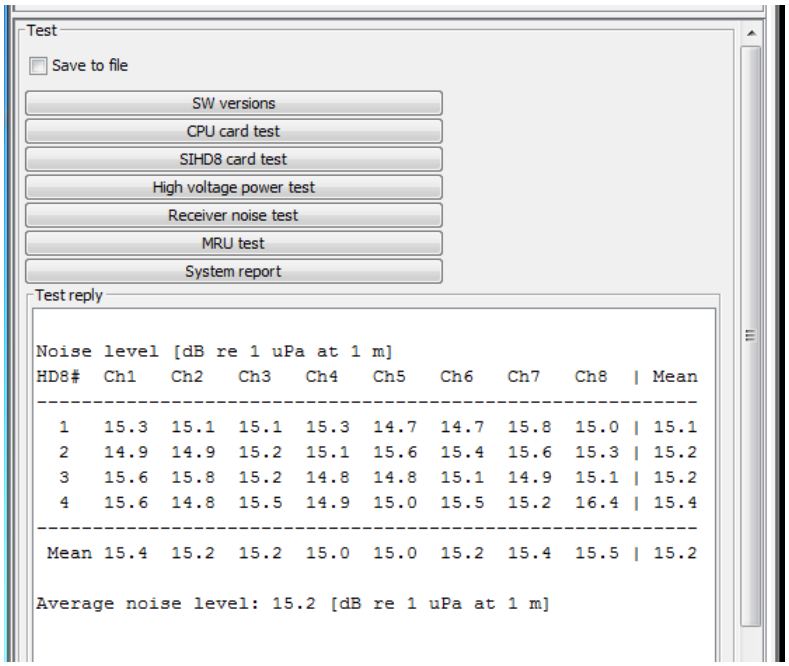


The rms voltage is a measure for all receiver channels within the frequency band from 2 kHz to 8 kHz. Time series of length 500 milliseconds are used. By correcting for the directivity index and the sensitivity of the hydrophone, the analog gain prior to analog-to-digital conversion, and the bandwidth, we find the noise level in the sea.

During the Factory Acceptance Test (FAT), where all inputs to the preamplifier unit are shortened, this test is used to calculate the equivalent noise level of the systems self noise.

Note

If all noise figures are much lower than what has previously been observed, check that the EM 122/302 preamplifier is turned on (which is the normal situation independent of whether the EM transceiver is switched on or not). The values reported should all be >40 dB re 1µPa @ 1m.

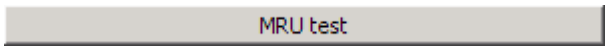


Note

If one channel repeatedly has a very high noise level compared to the others (tens of dB), this indicates an error on that particular channel. Be aware that a single channel with an extreme noise level may wipe out the good data provided by the other channels; it important to remove a board with such a noisy channel.

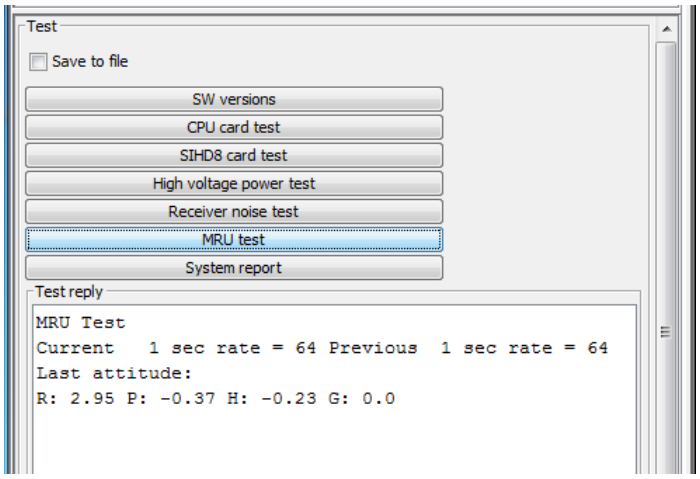
If a spare board is not at hand, it may be better to run with a reduced number of channels rather than running with a faulty board

MRU (Motion Reference Unit) Test



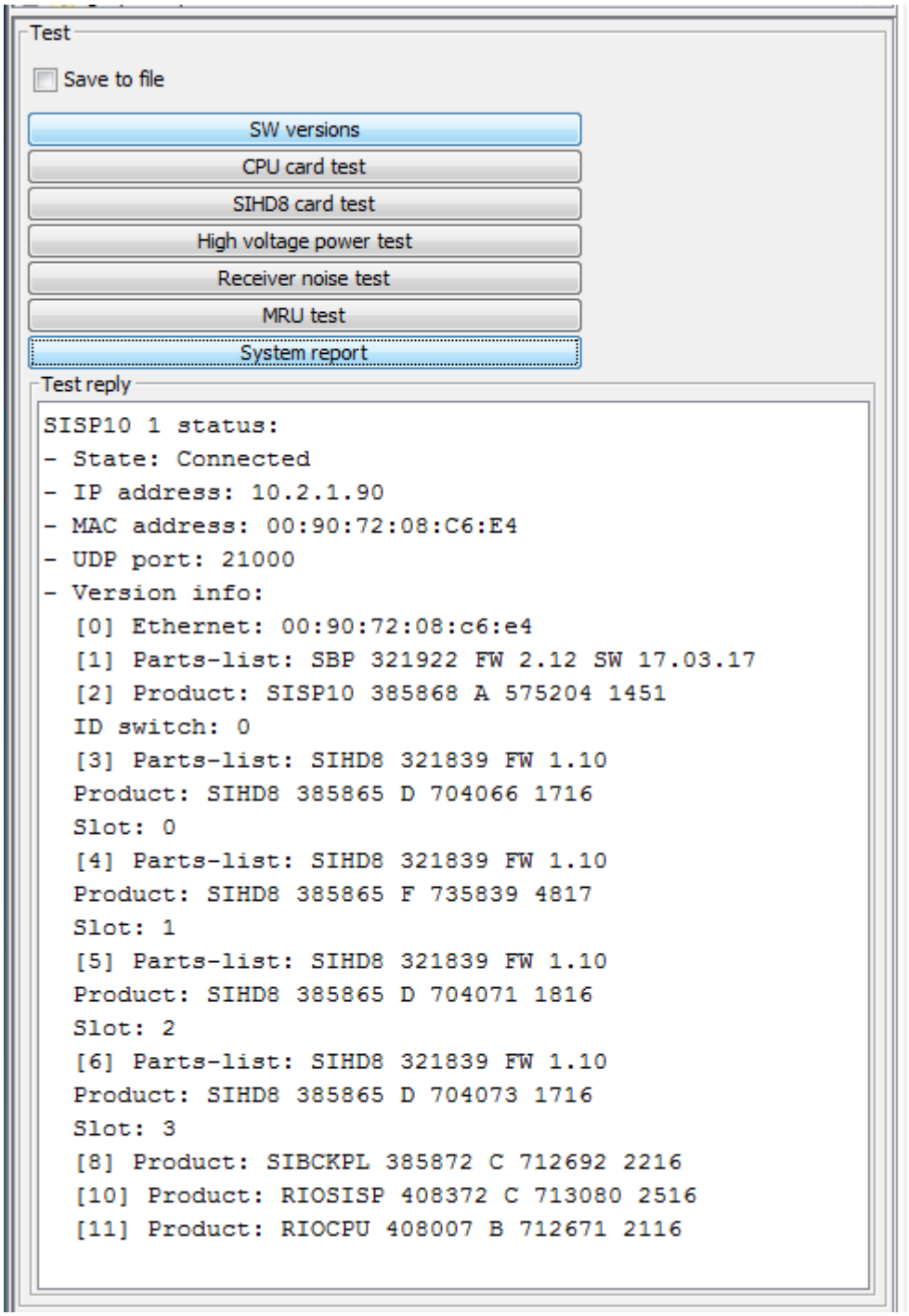
This test reports the number of attitude messages received by the transceiver unit in one second. The content of one of the attitude messages is displayed.

The test can be used to verify that attitude is received and read by the transceiver unit.



System Report

The System Report test will provide information about current system.



File conversion

Files can easily be converted from the **RAW** format to the **SEG Y** format from the SBP 27 operator unit. Using the file conversion utility you are allowed to easily:

- Convert a single file from one format to the other.
- Convert a directory of files of one format to a directory of files of the other format.
- Convert a directory of files of one format to a single file of the other format.
- Convert a single file of one format to a directory of files of the other format.

This utility also gives you the opportunity to:

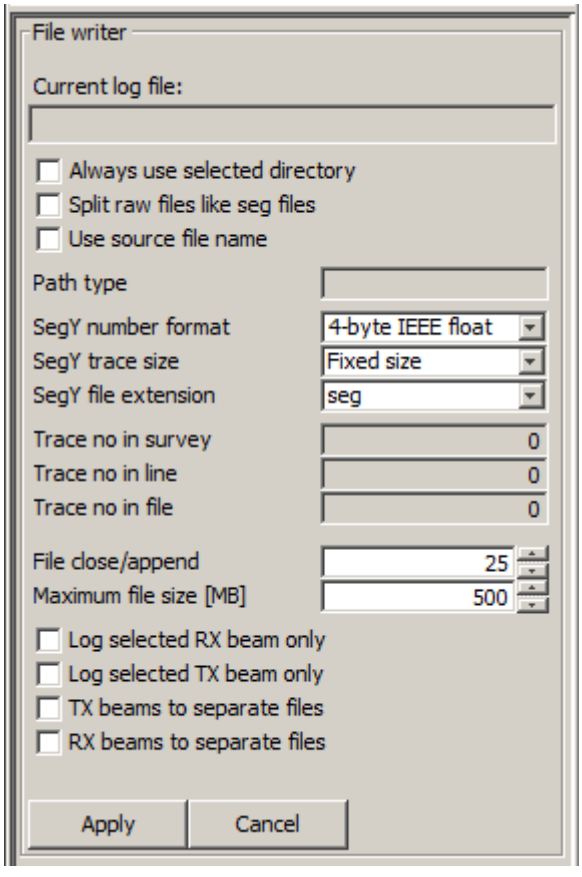
- Merge a number of files into a single file.
- Create a number of smaller files from a single file.
- Extract a single receiver beam from a file containing a fan of receiver beams.

A **Converter filter** can be enabled to apply either bandpass, matched or spiking filtering to the acquired data before they are converted to selected format.

How to convert a RAW data file

1 Choose **Convert** from the **Mode** drop-down menu on the **Tool bar**.

2



Configure the properties of **File writer** located in **System→File converter**.

- **Always use selected directory** should be unchecked
- If converting to SEG Y, configure the SEG Y parameters as desired
- Specify the maximum file size
- Uncheck/check the **Log selected beam** check boxes

  If you check that check box you must remember to set which beam number you want to extract
- If the input is multi-beam data and one or both **Log selected beam** checkboxes are unchecked, decide if the output should be one beam per file or many beams in a single file.

Note

If conversion to SEG Y format is selected, the multi-beam data will always be split into several files with one beam in each.

3 To initiate the file conversion process, press the >button of the Tool bar

4 Choose input file or directory

5 Choose output format and output file or directory

For more details refer to the *File writer* on page 93.

Menu system

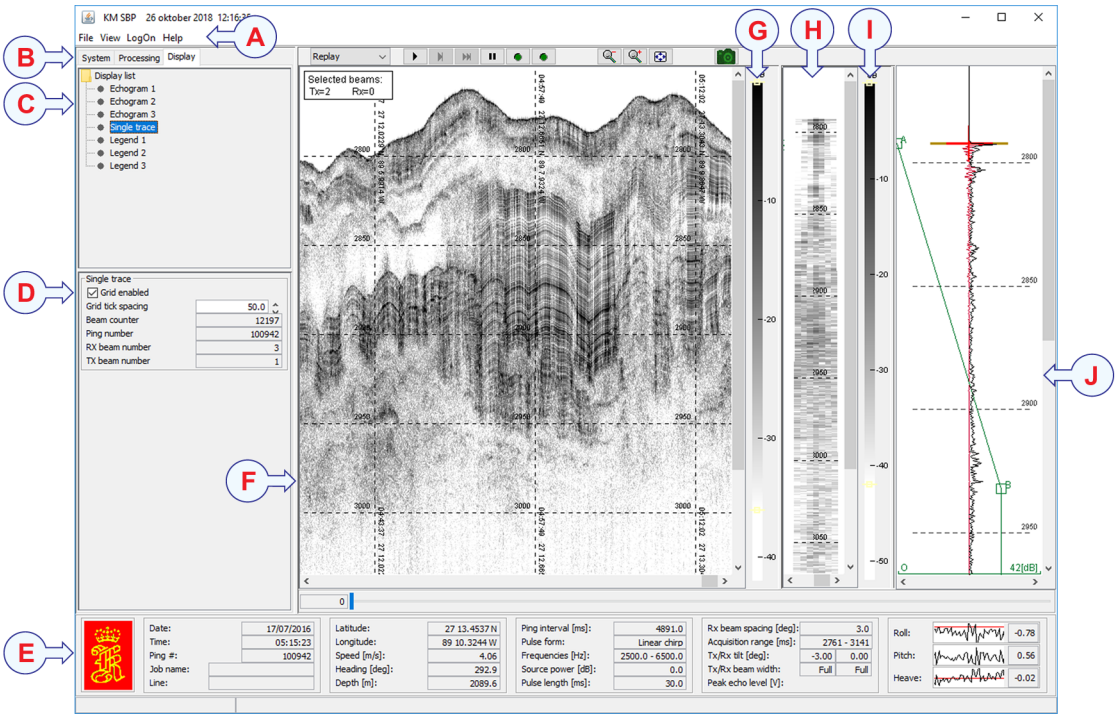
Topics

- *Principles* on page 50
- *Main menu* on page 51
- *Tab menu* on page 53
- *Tool bar* on page 62
- *Title and info bar* on page 62
- *Echogram area 1, 2 & 3* on page 63
- *Property area* on page 67
- *Legend area 1, 2 & 3* on page 70
- *Single trace area* on page 71
- *Ping number and file length* on page 72
- *Status area* on page 72

Principles

The SBP 27 is organized in a set of windows appearing on the screen. The windows will display a menu system, parameter settings and graphical display of the SBP 27 data. The various parameters and views are set and presented through the menu system.

Figure 2 SBP 27 application window, example



A Main menu

B Tabs menu

C Properties

D Parameter sheet

E Status

F Echogram 1

G Legend 1

H Echogram 2

I Legend 2

J Single trace

Main menu

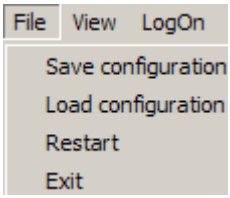
The main menu bar on the top of the window provides access to a number of drop-down menus.

Main menu

- File
- View
- LogOn
- Help

File menu

The File drop-down menu gives you the following choices



- **Save Configuration** – Save parameter configuration.

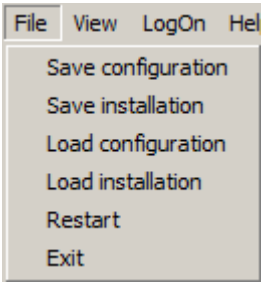
  See *Save configuration* on page 136
- **Load Configuration** – Load a previously saved parameter configuration.

  See *Load configuration* on page 102
- **Restart** – Reset the Transceiver Unit (TRU).

  See *Restart* on page 129
- **Exit** – Closes all programs controlled by SBP 27.

  See *Exit* on page 91

For user level **Super** you get the following additional choices



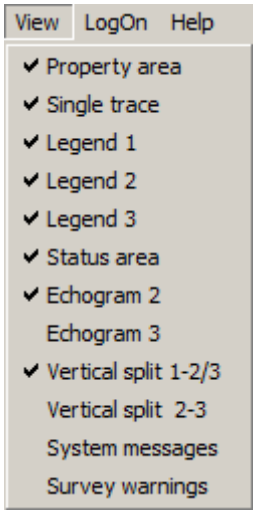
- **Save Installation** – In order to make changes to installation parameters permanent the values have to be stored in a configuration file SBPInstall.xml located in the working directory of the software.

  See *Configuration files* on page 36.

- **Load Installation** – If desirable an alternative configuration file, saved by save installation to another location than the working directory, can be loaded into the software without tampering with the default installation parameters. Remember to select **File→Restart** after loading the file in order for the new parameters to take effect.

View menu

The **View** drop-down menu enables/disables the different view areas.



- **Property area** – Contains tabs and related parameter sheets.

  See *Property area* on page 67
- **Single trace area** – Displays the trace data in “scope” mode.

  See *Single trace area* on page 71
- **Legend area 1, 2 & 3** – Displays a colour coded legend for the Echogram.

  See *Legend area 1, 2 & 3* on page 70
- **Status area** – Shows current parameters and status of the system during online operation.

  See *Status area* on page 72
- **Echogram area 1, 2 & 3** – Displays the processed realtime or replay data. A second Echogram area can be enabled for e.g. comparison purposes.

  See *Echogram area 1, 2 & 3* on page 63
- **Vertical split** – When enabled, and Echogram area 2 is enabled, the two Echogram areas will be shown side by side. When disabled, and Echogram area 2 is enabled, the two Echogram areas will be shown by a horizontal split.

  See *Vertical spilt* on page 147
- **System messages** – Display a separate window with all system messages given.

  See *View system messages* on page 149.
- **Survey warnings** – By default this window pops up whenever new information is printed to it.

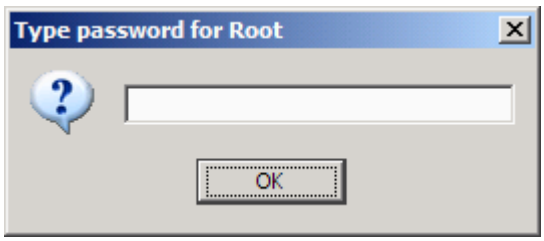
  See *View survey warnings* on page 148.

LogOn menu

The **LogOn** drop-down menu allows you to log on as a normal operational user, **User**, or as an expert user, **Root**.

Note

Root user is password protected.



When logged on as **Root** you will find **Super** as a third option in the **LogOn** menu list. **Super** is password protected and intended for Kongsberg Maritime internal use only.

Help menu

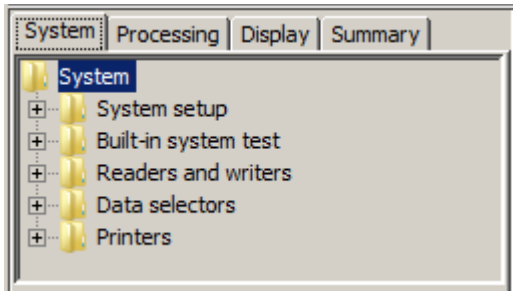
In the **Help** drop-down menu the following choices are available:

- **About**

  See *About* on page 75
- **Topics** – Opens **Online help**.

  See *Topics* on page 145

Tab menu



The tab menus contain tabs for selecting parameter sheets. The tab menus are found on top of the property area which is located on the left side of the screen. It provides the following choices:

- **System** – Presenting parameter area for basic configuration of the system hardware.

  See *The system tab* on page 56

- **Processing** – Presenting parameter area with processing functions.

  See *The processing tab* on page 60

- **Display** – Presenting parameter area for functions relevant for displaying the data.

  See *The display tab* on page 62

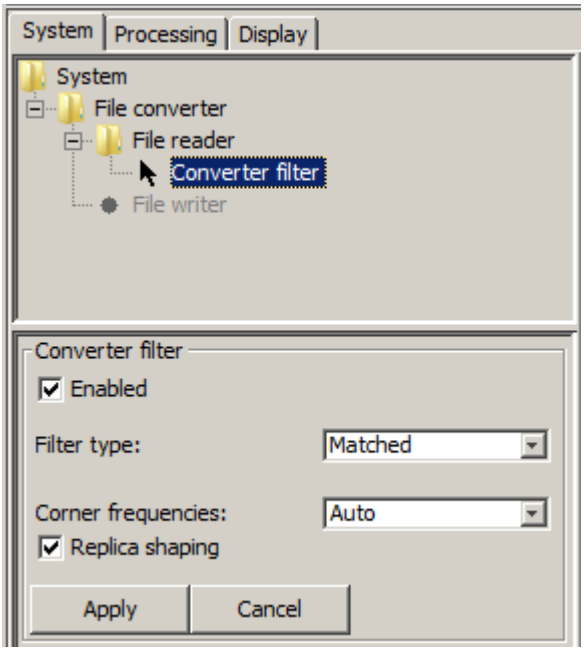
- **Summary** – This tab menu will only be visible when you are in survey mode. It is a shortcut menu to the most relevant parameters. When you change parameters from this menu, they will change immediately.

  See *The summary tab* on page 62

Each tab lists a tree structure which when expanded to lowest level will show available parameters for the object expanded.

By selecting the object in the list a parameter sheet becomes available.

Figure 3 Example of the tree structure, the selection of an object and the parameter sheet appearing for that object



Moving objects

Some of the objects can be moved up and down in the list they appear in using the arrow buttons in the parameter field. This applies to objects located in the different data selectors and to objects in the processing chain

Enabled

Some objects needs enabling by checking the **Enabled** checkbox in the parameter sheet. When an object is enabled, it will appear as black with an arrow icon in front. When disabled, it will appear gray. When an object is disabled (gray), the parameters it contains, are out of function.

The system tab

Depending on mode of operation, i.e, **survey mode**, **replay mode**, **slave mode** or **convert mode** different parameters are available within the **System** tree structure.

Figure 4 Survey mode

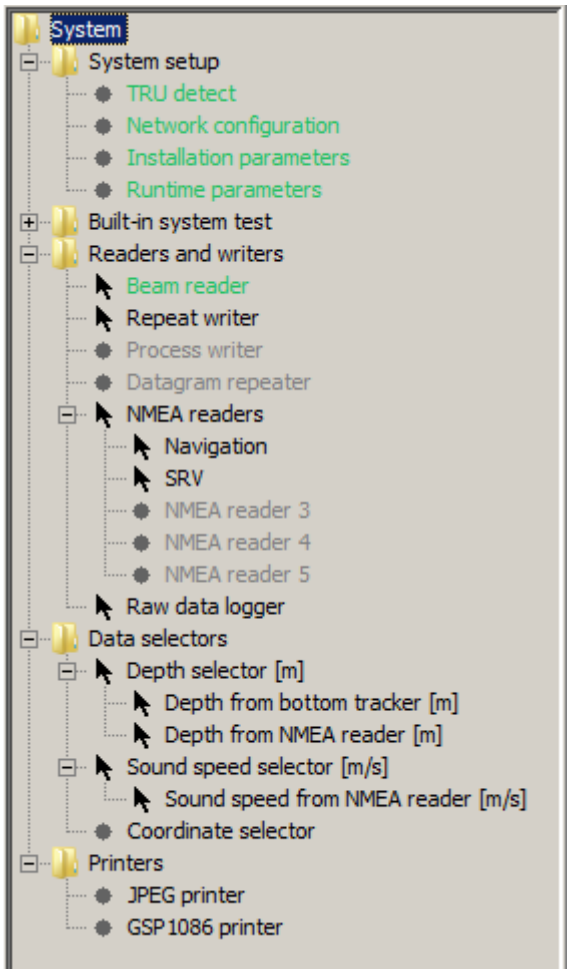


Figure 5 Replay mode

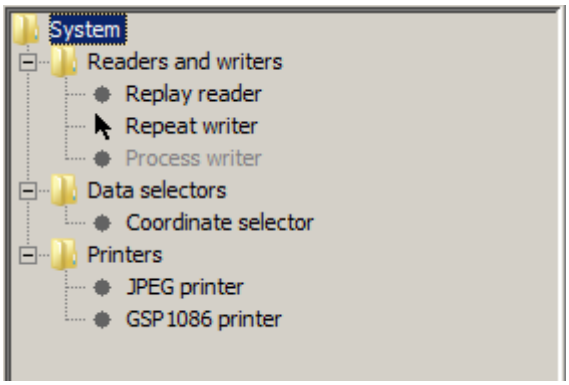


Figure 6 Slave mode

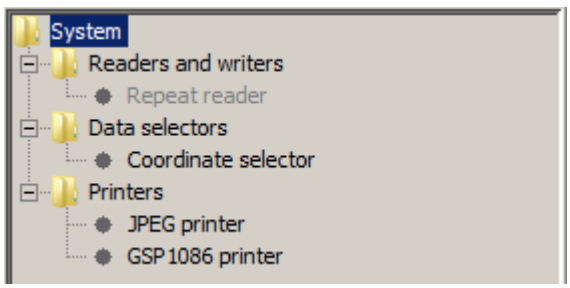


Figure 7 Convert mode

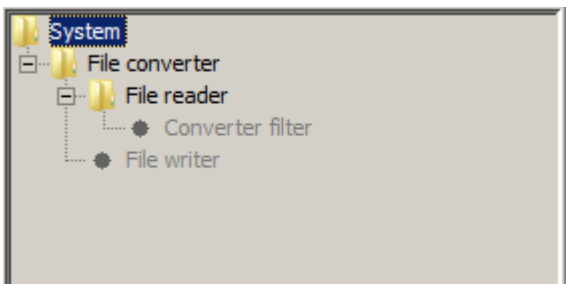


Table 6 System setup

Select	To	Applies to modes	Reference
TRU detect	Display parameters for the Transceivers Unit (TRU)	Survey mode	*TRU detect* on page 146
Network configuration	Display interface parameters for the network communication	Survey mode	*Network configuration* on page 104
Installation parameters	Display parameters applicable to the installation of the SBP 27	Survey mode	*Installation parameters* on page 99
Runtime parameters	Shows the SBP 27 runtime parameters	Survey mode	*Runtime parameters* on page 131

Table 7 Built-in system test

Select	To	Applies to modes	Reference
Test	Show the parameter sheet for performing the Built-In system tests	Survey mode	*Built-In system tests (BIST)* on page 39

Table 8 Readers and writers

Select	To	Applies to modes	Reference
Beam reader	Show the parameter sheet applicable to signal transmission and reception	Survey mode	*Beam reader* on page 78
Repeat writer	Enables a remote computer running the SBP 27 software in slave mode to subscribe to the raw beam data	Survey mode Replay mode	*Repeat writer* on page 127

Table 8 Readers and writers (cont'd.)

Select	To	Applies to modes	Reference
Process writer	Enable a copy of processed beam data to be sent to a remote computer on the network	Survey mode Replay mode	*Process writer* on page 119
Datagram repeater	Enable a copy of selected datagrams to be sent to a remote computer on the network	Survey mode	*Datagram repeater* on page 83
NMEA readers	Show parameter sheet for input of NMEA data	Survey mode	*NMEA readers* on page 107
NMEA reader 1 to NMEA reader 5	Enable or disable NMEA inputs	Survey mode	*NMEA reader 1 to 5* on page 110
Raw data logger	Show parameters for setting up raw data logging	Survey mode	*Raw data logger* on page 124
Replay reader	Display parameter values read from the file that is being replayed	Replay mode	*Replay reader* on page 129
Repeat reader	Read copy of beam data from a master computer on the network	Slave mode	*Repeat reader* on page 126

Note

NMEA Reader 1 - 5 must be given descriptive names reflecting what type of information they receive.

Table 9 Data selectors

Select	To	Applies to modes	Reference
Depth selector [m]	Show parameter sheet for selecting a depth to automatically adjust the observation window	Survey mode	*Depth selector* on page 86
Depth from bottom tracker [m]	Show parameter sheet for enabling depth from bottom tracker	Survey mode	*Depth from bottom tracker* on page 85
Depth from NMEA reader [m]	Show parameter sheet for enabling depth from NMEA	Survey mode	*Depth from NMEA* on page 85
Sound speed selector [m/s]	Show parameter sheet for setting manual sound speed	Survey mode	*Sound speed selector* on page 139
Sound speed from NMEA [m/s]	Show parameter sheet for enabling sound speed from NMEA	Survey mode	*Sound speed from NMEA reader* on page 138
Coordinate selector	Convert from Latitude/Longitude to e.g. Cartesian coordinates	All modes	*Coordinate selector* on page 82

Table 10 File converter

Select	To	Applies to modes	Reference
File reader	Display parameters read from a replayed file	Convert mode	*File reader* on page 92
Converter filter	Show filter parameters to be used for file converting	Convert mode	*Filters* on page 95
File writer	Show parameter sheet for writing a file	Convert mode	*File writer* on page 93

Table 11 Printers

Select	To	Applies to modes	Reference
JPEG printer	Show parameters for setting up printing to a JPEG file	All modes	*Printer* on page 112
Printer	Show parameters for setting up printing to a printer	All modes	*Printer* on page 112

Note

When a Printer is configured, the name will change to the name of that printer (e.g. "JPEG Printer", "Analog printer " or "EPC9800 printer").

Root user

When logged on as **Root** the different modes holds the same set of parameters. The following additional parameters becomes available:

Note

Applicable to all modes

Readers and writers

- **Repeat reader→Repeat reader port** – Sets up the port for reading beam data from a master computer on the network.

  See *Repeat reader* on page 126

- **Repeat writer→Repeat writer port** – Sets up the port for sending beam data to a slave computer on the network.

  See *Repeat writer* on page 127

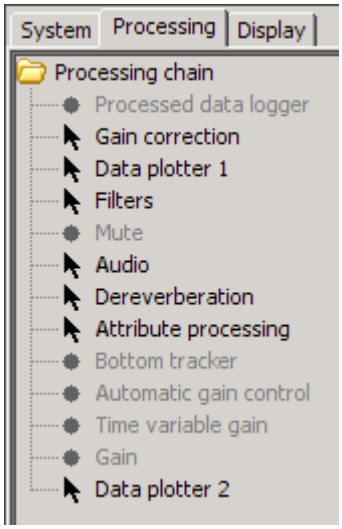
- **NMEA readers→NMEA reader 1** to **NMEA reader 5:** Enable or disable an NMEA and select input port type and configuration.

  See *NMEA reader 1 to 5* on page 110

  – **NMEA port n:** Define communication parameters for the NMEA input

The processing tab

The **Processing** tab contain a number of different methods and parameters, referred to as the **Processing chain**, that can be selected for SBP 27 processing. The objects may be manually enabled or disabled. The sequence in which the processing is carried out may also be changed in the configuration of the Processing chain.



Refer to *Processing chain* on page 37 for description of how to configure the processing.

The **Processing** tab menu gives you the following choices under Processing chain (in alphabetic order). References are made to the relevant descriptions.

- **Attribute processing** – See *Attribute processing* on page 75
- **Audio** – See *Audio* on page 76
- **Automatic gain control (AGC)** – See *Automatic gain control - AGC* on page 77
- **Bottom tracker** – See *Bottom tracker* on page 80
- **Data plotter 1 and 2** – See *Data plotter 1 and 2* on page 84
- **Dereverberation** – See *Dereverberation* on page 87
- **Filters** – See *Filters* on page 95
- **Gain** – See *Gain* on page 96
- **Gain correction** – See *Gain correction* on page 98
- **Mute** – See *Mute* on page 104
- **Processed data logger** – Applies to **Replay mode** only.

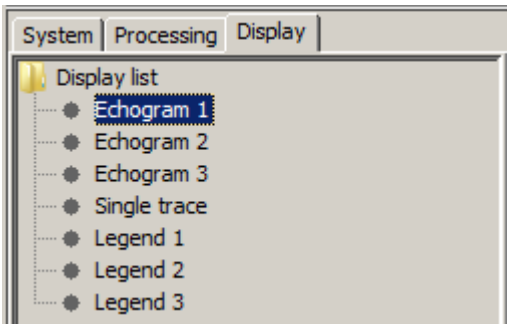
  See *Processed data logger* on page 120
- **Process writer** – See *Process writer* on page 119
- **Time variable gain (TVG)** – See *Time variable gain (TVG)* on page 145
- **Processed data logger** – Applies to all modes when logged on as **Root**.

  See *Processed data logger* on page 120
- **Swell filter** – See *Swell filter* on page 141
- **Stacking** – See *Stacking* on page 139
- **Time variable filter (TVF)** – See *Time variable filter (TVF)* on page 144
- **Synthetic aperture processing** – See *Synthetic aperture processing* on page 142

Root user

When logged on as **Root** some of above processing objects may be excluded from the **User's** list in order to avoid confusion and incorrect use.

The display tab



The Display tag menu allows you to change settings for the echogram areas. The following choices are available:

- **Echogram 1 and 2** – See *Echogram 1, 2 & 3* on page 88
- **Single trace** – See *Single trace* on page 137
- **Legend 1 and 2** – See *Legend 1, 2 & 3* on page 101

The summary tab

The Summary tag menu show you and allows you to change the most relevant SBP 27 parameters during a survey.

The **Summary tab** is only visible when you are in survey mode.

See *Summary tab* on page 140 for closer description.

Tool bar

The **Tool bar** is located underneath the main menu bar. It contains buttons for fast access to important functions. The following buttons are present

- Drop-down menu for selection of system mode
- Push buttons to control start/stop logging and recording. The buttons holds different functions depending on mode. These are described in *Replay buttons* on page 128
- Zoom buttons – See *Zoom buttons* on page 149
- Save screen to file button – See *Save screen to file* on page 137

Title and info bar

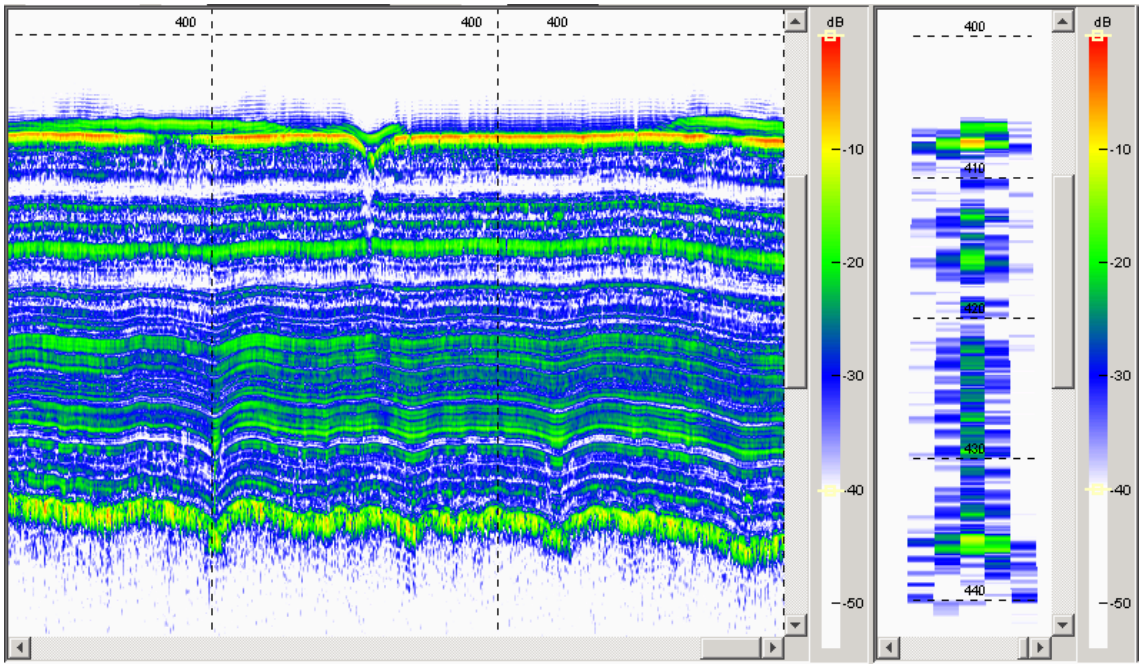
The **Title and Info bar** in the top line of the SBP 27 window shows the name of the program, date and time.

In replay mode the file name of the raw data file that is being replayed will be shown.

Echogram area 1, 2 & 3

Echogram area 1 and **Echogram area 2** (if enabled) are used to present the processed real-time or replay data.

Figure 8 Echogram area 1 & 2



The data presentation in the Echogram area is controlled by Zoom buttons on the Tool bar, the Legend parameters and by the Echogram parameters.

See

- *Zoom buttons* on page 149
- *Legend 1, 2 & 3* on page 101
- *Echogram 1, 2 & 3* on page 88

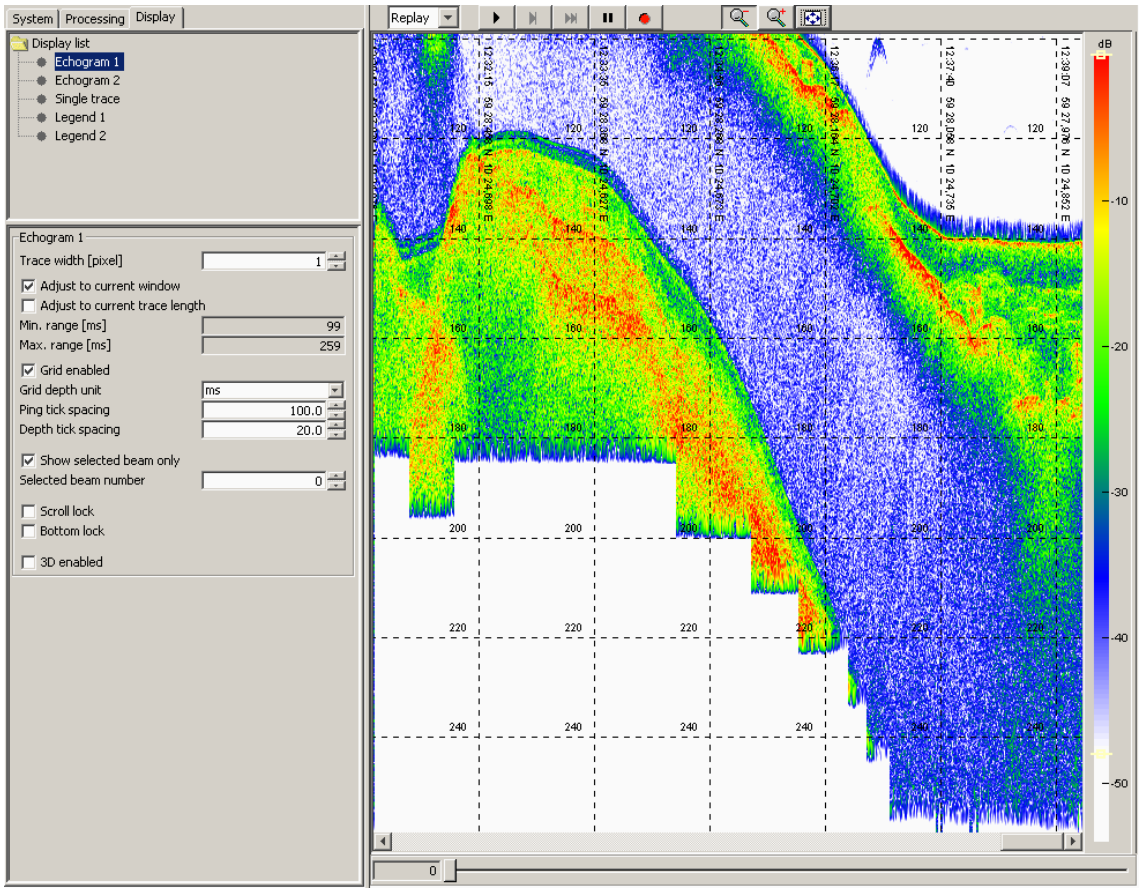
The Echogram area parameter sheet provides three options for displaying the data:

- **Adjust to current window**
- **Adjust to current trace length**
- **Bottom lock**

Adjust to current window

When checked the Echogram image is automatically adjusted to fit the depth range to current acquisition window.

Figure 9 The echogram area when "Adjust range to current window" is checked



Normally the check box **Adjust to current window** should be checked.

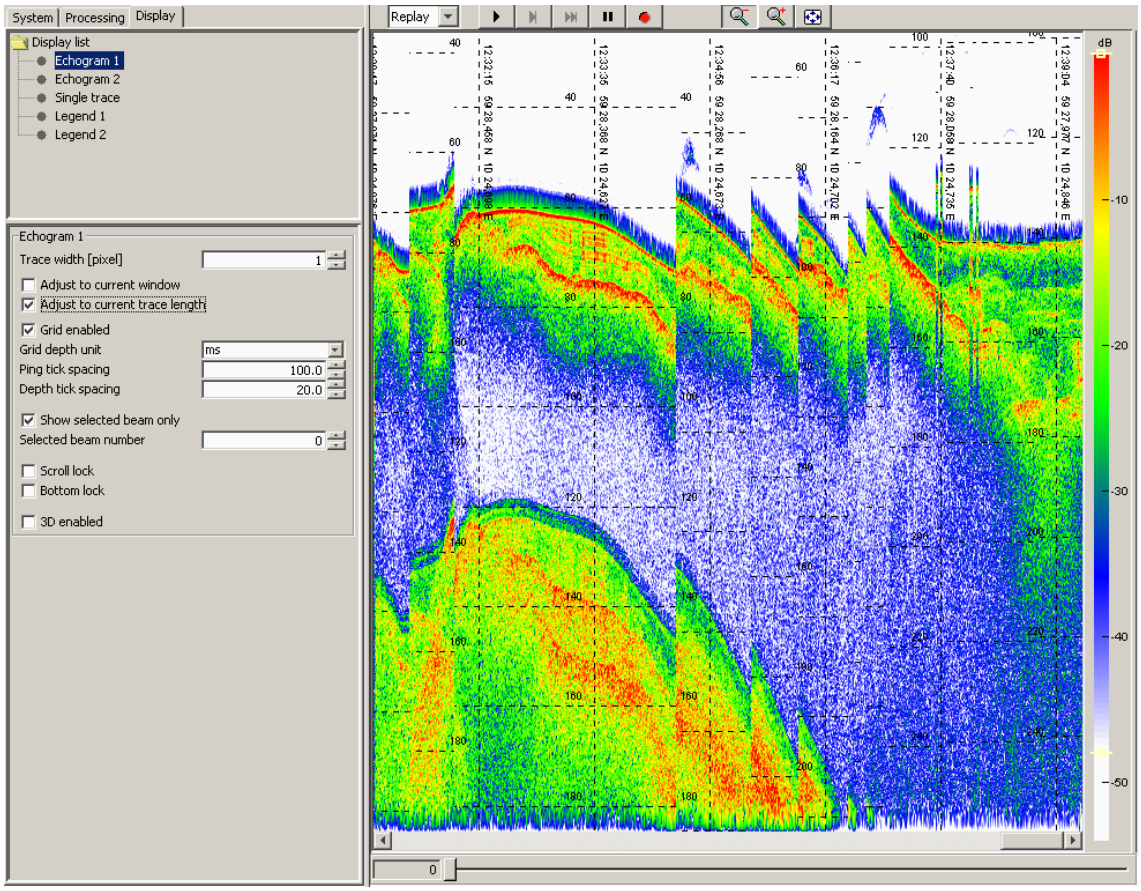
Note

If you choose to uncheck this box in order to manually set the minimum and maximum range, the incoming data will only be displayed if a part of the trace is within these limits.

Adjust to current trace length

When checked the Echogram image is automatically adjusted to fit the current trace length. The seabed will appear discontinuous when the depth changes significantly, causing the acquisition delay to change.

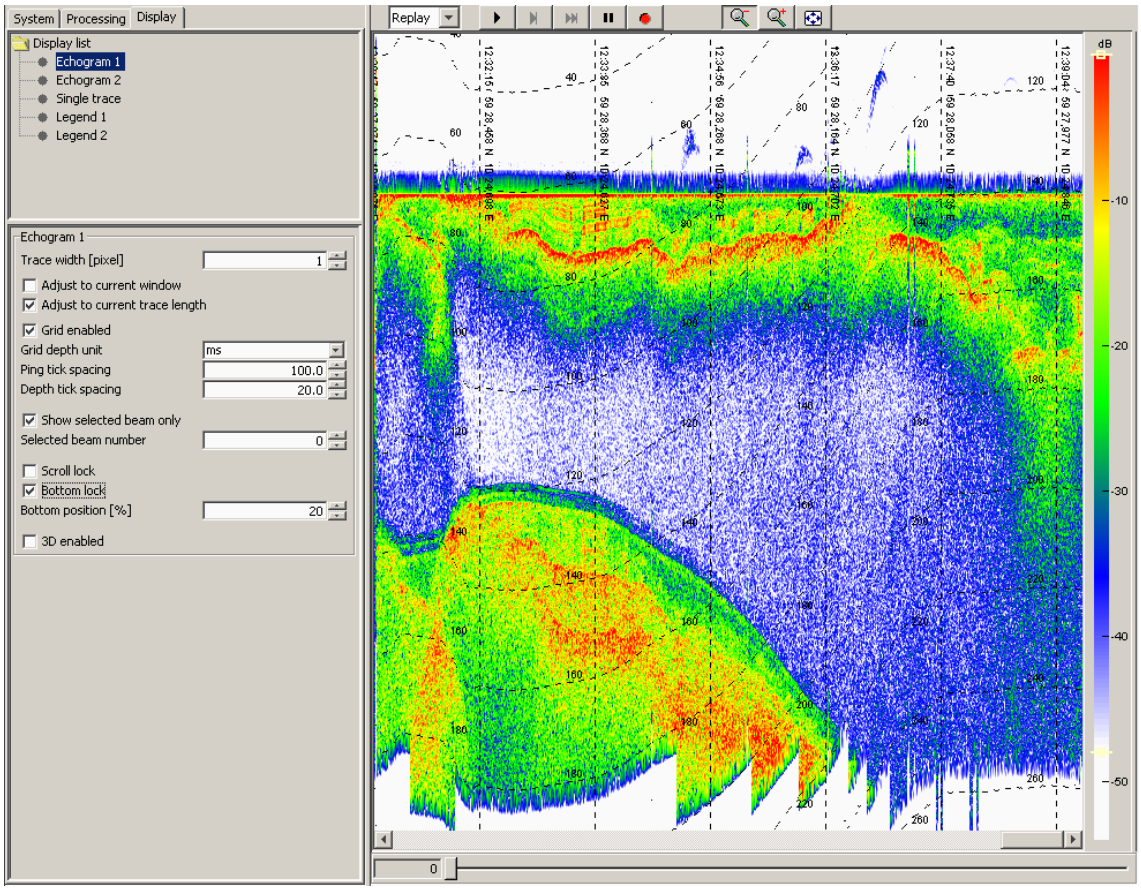
Figure 10 The echogram area when "Adjust range to current trace length" is checked



Bottom lock

When checked, the data traces will be aligned to make the detected bottom appear at a fixed horizontal position within the display.

Figure 11 The echogram area when "Bottom lock" is on



Displaying two echograms – Example configurations

Echogram area 2 can be useful when there is more than one beam in the data. The two areas can be displayed side by side or one above the other.

1 Displaying the two areas side by side, showing an alongtrack echogram in Echogram area 1 whilst Echogram area 2 is set up to display the acrosstrack echogram given by the fan of receiver beams

or

2 The echogram areas may be used to compare the alongtrack echograms provided by two different beams. The data presentation mode in an Echogram area is controlled by Zoom buttons on the Tool bar, the appurtenant Legend, and by Echogram area parameters.

Echogram keyboard and mouse functions

a **Access to Echogram parameters:** Click **left mouse button** within the echogram area to bring up the Echogram parameter sheet.

This shortcut requires the Property area to be visible

b **Deselecting the Zoom buttons:** Click **right mouse button** within one of the display areas (an echogram area or the single trace area).

The zoom functionality will no longer be active.

c **Access to Legend parameters:** Click **left mouse button** within the legend area to bring up the Legend parameter sheet.

d **Mouse position:** As the mouse is moved over an alongtrack echogram the depth and position of the pixel pointed at is displayed at the bottom of the application window.

In the single trace area depth and amplitude are displayed.

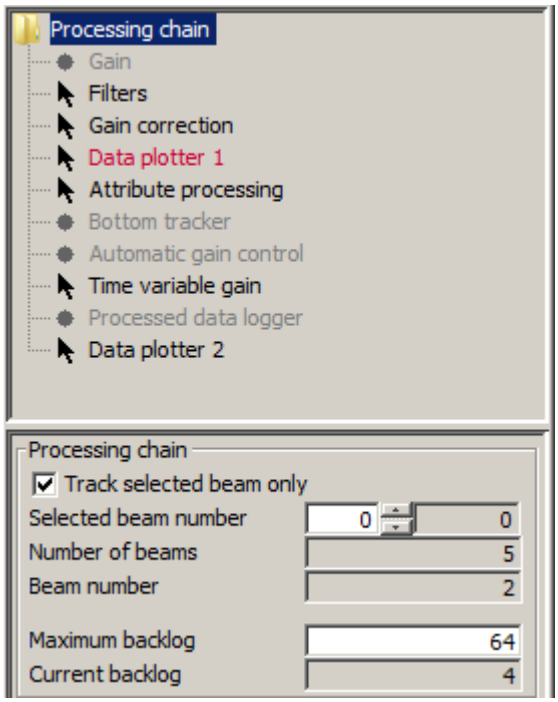
e **Horizontal and vertical distance:** Click, hold, and drag the mouse over an alongtrack echogram to have the horizontal and vertical distance over which the mouse has been dragged displayed at the bottom of the application window.

f **Beam pick:** To examine a particular beam in any of the echogram areas, position the mouse over the beam and click. The time series will be displayed in the single trace area, and the positioned you clicked at is marked with a horizontal blue line in the single trace area.

Property area

The property area is located on the left side.

- It contains tabs for selecting relevant parameter sheets.
- It contains parameter sheets related to the current tab selection.



There are three tabs in **Replay, Slave** and **Convert** modes

- System
- Processing
- Display

In **Survey mode** a fourth tab appears:

- Summary

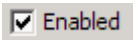
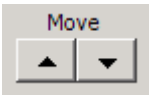
You may hide the property area in order to get a larger echogram area. Deselect the Property area from the **View** menu.

Parameter sheet area

The **Property area** comprises a function menu in the upper part with the corresponding **Parameter sheet** in the bottom part. Some of the parameters have a tree structure where sub-parameters are revealed when the next level is selected.

The Parameter sheets contains fields with one of the following properties:

Parameter type	Property
-10	Parameter value, text or number, is written directly in the box
9000.0	Parameter value, number, is, either, written in the box or incremented or decremented in fixed steps by using the up and down arrow buttons
Bandpass	Parameter is selected from the drop-down menu, which is presented by clicking the down arrow button

Parameter type	Property
	This parameter is selected by checking the check box
	The **Move** arrows are used to move the position of the selected parameter up or down in the property area. Applies to the **Processing** tab only.

Background colour codes and parameter sheet buttons

Gray: The value in a grey field can not be changed manually by a normal user. Can only be changed by **Root** user.

Yellow: You have changed the value, but the new value is not yet applied.

Red: The entered value is outside the allowed range .

White: The value is in use. In the parameter sheets where there are **Apply** and **Cancel** buttons, these buttons must be pressed to apply the value.

Apply: Button for accepting the modified parameter values. A yellow background colour in the parameter field indicates that the value has not been accepted yet.

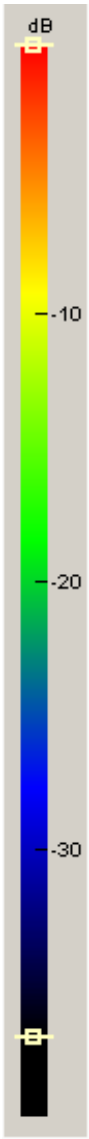
Note

New parameters will take effect without any additional warning.

Send: The Runtime parameter sheet contains a **Send** button below all the parameters. However, due to the automatic features of the SBP 27, some parameters are sent automatically if the value is within the allowed limits (otherwise the background colour becomes red after the value is entered). This applies to e.g. the acquisition delay and the acquisition window length. When these parameters have been accepted by the Transceiver Unit, the background colour of the updated parameter turns white. If a parameter doesn't turn white within seconds, you have to press the **Send** button to retry (this applies to e.g. all parameters related to configuration of the transmit pulse). Again, the yellow backgrounds of the updated fields turn white once they are accepted by the Transceiver Unit.

Cancel: Button for discarding the modified parameter. This is indicated by that the yellow background colour turns white, and the value returns to the original value.

Legend area 1, 2 & 3



The **Legend** areas show how intensity of the signal is colour coded in the Echogram areas.

You may hide the legend areas from the **View** menu in order to get larger echogram areas.

The parameters applicable to the legends are found on the Property sheet under the Display tab.

A shortcut to bring up the Legend parameter sheet is to click by left mouse button on the colour bar.

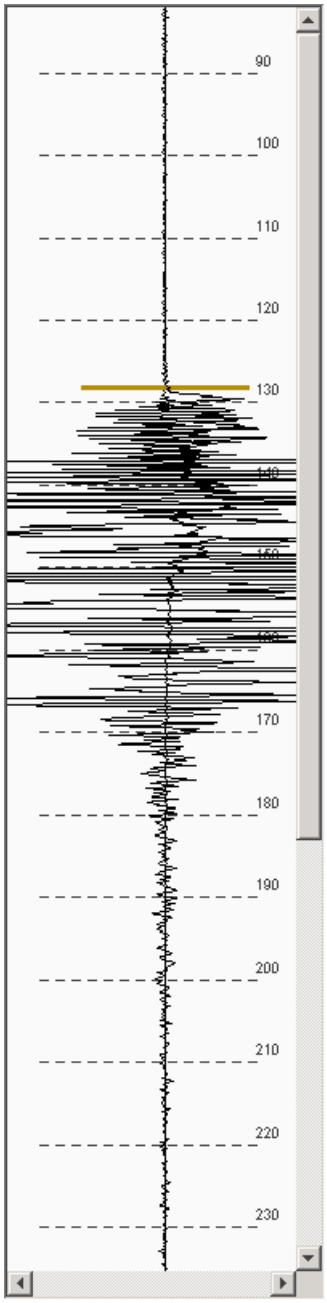
Two small horizontal bars are found on the colour bar. These bars show the maximum and the minimum signal level to be displayed. The bars may be grabbed by the mouse and moved up or down to change the display thresholds. These thresholds can also be changed by entering numerical values on the Legend parameter sheet.

On the Legend parameter sheet you also choose between linear and logarithmic scale, and you can choose from a number of colour maps.

The numbers given along the scale will be either in 10% steps or 6 dB steps for linear and logarithmic coding, respectively.

Any of Legends 1-3 and Echogram 1-3 can be adjusted simultaneously. Hold down the shift key while highlighting the objects to which you would like to apply the same changes.

Single trace area



On the right-hand side of the SBP 27 window, the **Single trace area** is located. This area is primarily used for QC check of the acquired signal.

The area displays the trace data in “scope” mode. Two curves can be displayed at the same time, showing the trace shape at different places in the processing chain. This area also shows graphical information for the TVG curve, seabed tracking, external depth and limits for automatic trigger delay change.

The data presented in the window is selected in the **Data plotter 1 & 2** functions in the Processing tab. Remember to place the Data plotter(s) in the desired position of the processing chain, using the Move buttons. This means that two curves may be displayed at the same time, taken from different locations in the processing chain.

The Zoom buttons can be used to zoom along the range axis. The tic spacing is set on the parameter sheet of the Display tab.

The parameter sheet may be brought up by clicking the mouse within the single trace area.

There are several markers in the area which are described in the following:

Horizontal red bar: When the seabed tracking function is enabled, a red horizontal bar is displayed at the location where the seabed is detected.

Vertical red bar: When the seabed tracking function is enabled, a red vertical bar is displayed indicating the search area for seabed detection in the next trace.

Horizontal yellow bar: This bar is present when **Show external bottom** is checked in the bottom tracker. When external depth is supplied to the system in survey mode the two-way range is computed based on this depth and a yellow bar is used to indicate the externally provided range. In replay mode the yellow bar shows the depth stored together with the beam data.

Horizontal blue bar: When using the beam picking feature of Echogram area 1, 2 & 3, a blue horizontal bar shows which sample the mouse pointed at when the beam was selected.

TVG: A green curve, with markers A, B, C and D (not shown) is shown when the TVG (Time Variable Gain) is enabled. This curve displays the TVG currently used. The different sections may be modified interactively by dragging the small squares using the mouse.

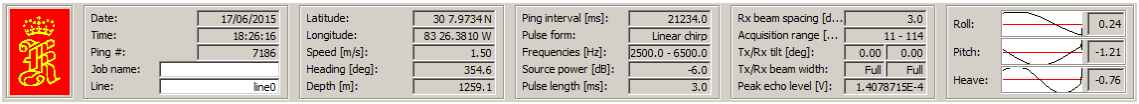
Ping number and file length

Note

This slide bar applies to Replay mode only.

The text field on the left indicates the number of the current ping. Use the slide bar to go backwards and/or forward in the file.

Status area



The **Status area** in the lower part of the SBP 27 window shows current parameters and status for the system during online operation, which also will be stored together with the recorded data. During replay the stored parameters will be displayed.

You may choose to show or hide the Status area may from the **View** menu.

During real-time operation, this area is updated once for each ping. In replay mode it is updated for each ping replayed. The information is grouped in the following main categories:

- When
- What - job info
- Where
- Transmitter parameters
- Receiver parameters
- Attitude information

In addition to numerical values for roll, pitch and heave for the last ping, the attitude information is displayed as time series. The graphic displays are scaled automatically depending on current range of values shown in the display.

By pointing the mouse to the curve, the value for that point is displayed in the text field on the right. You will also be given a peak-to-peak value.

Note that the background colour of the peak echo level field changes to yellow when the echo level is close to and red when it is into the non-linear regime of the preamplifier (causing distortion/clipping of the strongest parts of the signal). To avoid distortion reduce the transmit power level.

Parameter sheets, buttons and dialogue boxes

This chapter presents the parameter sheets, buttons and dialogue boxes for the SBP 27 main application.

Alphabetical list

All the parameter sheets, buttons and dialogue boxes are listed alphabetically below

- *About* on page 75
- *Attribute processing* on page 75
- *Audio* on page 76
- *Automatic gain control - AGC* on page 77
- *Beam reader* on page 78
- *Bottom filter* on page 80
- *Bottom tracker* on page 80
- *Convert buttons* on page 81
- *Converter filter* on page 82
- *Coordinate selector* on page 82
- *Datagram repeater* on page 83
- *Data plotter 1 and 2* on page 84
- *Depth from bottom tracker* on page 85
- *Depth from NMEA* on page 85
- *Depth selector* on page 86
- *Dereverberation* on page 87
- *Echogram 1, 2 & 3* on page 88
- *Exit* on page 91
- *File reader* on page 92
- *File writer* on page 93
- *Filters* on page 95

- *Gain* on page 96
- *Gain correction* on page 98
- *Installation parameters* on page 99
- *Legend 1, 2 & 3* on page 101
- *Load configuration* on page 102
- *Load installation* on page 103
- *Mute* on page 104
- *Network configuration* on page 104
- *NMEA readers* on page 107
- *NMEA reader 1 to 5* on page 110
- *Printer* on page 112
- *Printer configuration* on page 116
- *Process writer* on page 119
- *Processed data logger* on page 120
- *Processing chain* on page 123
- *Raw data logger* on page 124
- *Repeat reader* on page 126
- *Repeat writer* on page 127
- *Replay buttons* on page 128
- *Replay reader* on page 129
- *Restart* on page 129
- *Root* on page 130
- *Runtime parameters* on page 131
- *Save configuration* on page 136
- *Save installation* on page 137
- *Save screen to file* on page 137
- *Single trace* on page 137
- *Slave buttons* on page 138
- *Sound speed from NMEA reader* on page 138
- *Sound speed selector* on page 139
- *Stacking* on page 139
- *Summary tab* on page 140
- *Super* on page 140
- *Survey buttons* on page 141
- *Swell filter* on page 141
- *Synthetic aperture processing* on page 142
- *Test* on page 143

- *Time variable filter (TVF)* on page 144
- *Time variable gain (TVG)* on page 145
- *Topics* on page 145
- *TRU detect* on page 146
- *User* on page 147
- *Vertical spilt* on page 147
- *View echogram area 2* on page 147
- *View legend area 1 & 2* on page 147
- *View property area* on page 148
- *View single trace* on page 148
- *View status area* on page 148
- *View survey warnings* on page 148
- *View system messages* on page 149
- *Zoom buttons* on page 149

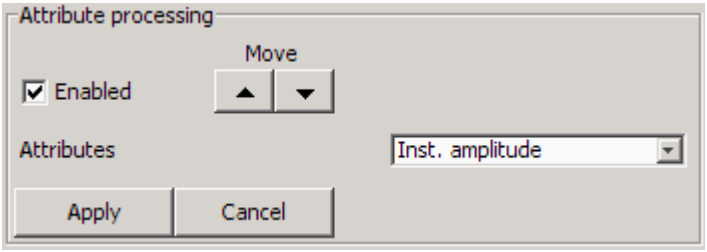
About

The **About** dialogue box is accessed from the **Help** menu.

This is where the version number and date of the operator software is found.

Attribute processing

The Attribute processing parameter sheet is accessed on the Processing tab.



Attributes are calculated based on the complex, analytical signal. Performing a FFT (Fast Fourier Transform) on the real signal, removing the imaginary part, multiplying the real part by two, and then taking the inverse FFT produces this signal. More information about Attribute calculation can be found in *Attribute calculation* on page 160.

Attribute processing parameters

Enable: Must be checked to enable the function

Move: Use arrows to move the function or down in the processing chain

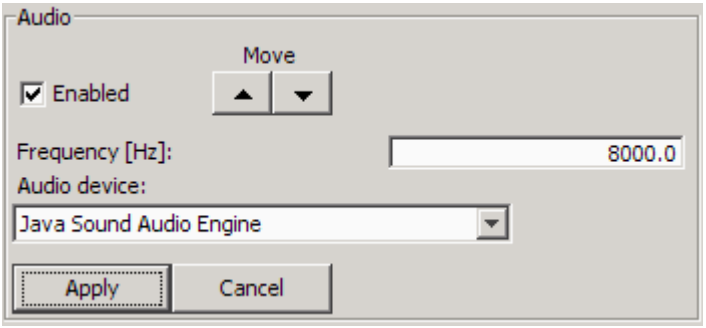
Attributes:

- **Inst. amplitude:** Instantaneous amplitude is the magnitude of the analytical signal which equals to the envelope of the real signal.
- **Inst. phase:** Instantaneous phase is the phase calculated based on the analytical signal.
- **Inst. frequency:** Instantaneous frequency is the local frequency content in the signal trace. The scale in the display is starting at zero Hz and ends at half the sampling frequency. The Gain parameter may be used to increase resolution if the gain function is located below the Attribute processing function. Setting Gain to 200% increases the frequency resolution by a factor of two.
- **App. polarity:** Apparent polarity shows the polarity of the real trace signal at local maxima in the instantaneous amplitude. The polarity is scaled by the instantaneous amplitude level.

Audio

The **Audio** parameter sheet is accessed from the **Processing** tab.

Audio processing is used for directing the processed signal to the audio output on the PC.



Audio parameter

Enable: Must be checked to enable the function

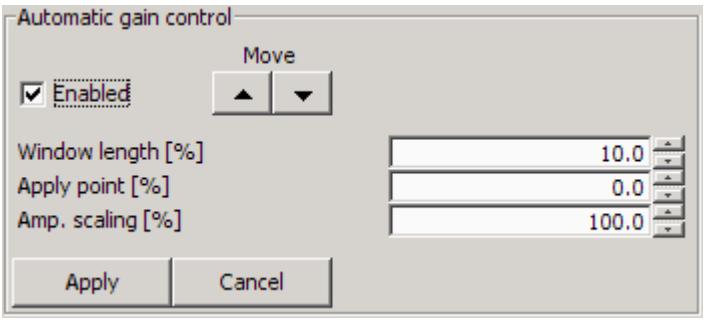
Move: Use arrows to move the function or down in the processing chain

Frequency [Hz]: Used for selecting the upper frequency in the down-shifted frequency band of the original acquired data.

Audio device [Hz]: Java Sound Audio Engine is the default audio device.

Automatic gain control - AGC

The **AGC** parameter sheet is accessed from the **Processing** tab.



The **AGC** or Automatic Gain Control function is used for optimizing the display of the data traces. The **AGC** adjusts the gain. Weak portions are amplified and strong portions are attenuated. The result is a filter effect, reducing noise and reverberation.

AGC parameters

Enable: Must be checked to enable the function

Move: Use arrows to move the function or down in the processing chain

Window length [%]: This parameter specifies the window length used for calculating the normalising or gain factor. The length is given in percent of the full trace length.

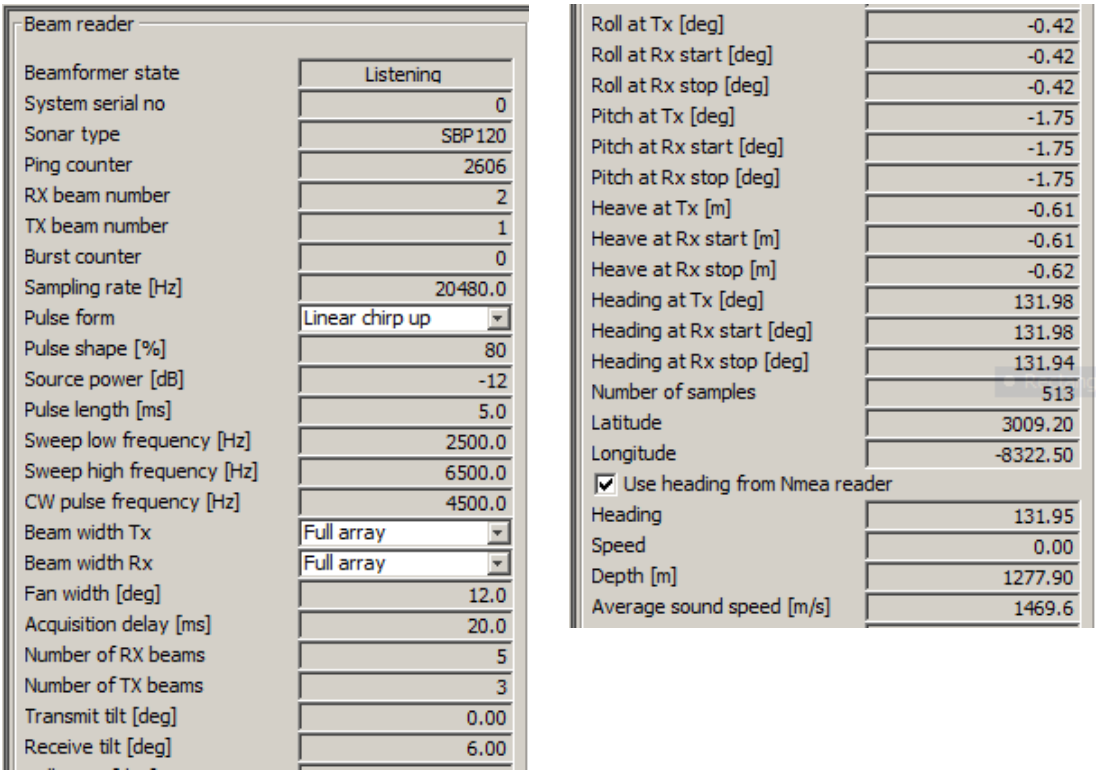
Apply point [%]: This parameter specifies which sample within the window the normalising and scaling shall be applied to. The value is given in percent of the window length. 0% and 100% refers to first and last sample, respectively.

Amp. scaling [%]: The scaling parameter is used to reduce the output of the amplitude to a suitable level for presentation. The scaling is given in percentage. 100% gives no amplitude reduction, 50% halve the amplitude, whilst if set to 0% no data will be shown.

Beam reader

The **Beam reader** parameter sheet is accessed from **Readers and writers** located under the **System** tab.

The beam reader displays the beam data read from the beam former unit. The data corresponds to the raw data format.



Beam reader parameters

Beamformer State: The state of the beamformer. It can be active or passive

System serial no

Ping counter

RX Beam number

TX Beam number

Burst counter

Sampling rate [Hz]: Fixed sampling rate. Set in the Installation parameter.

Pulse form: Transmit pulse form. Set in the Pulse Form parameter in the Runtime parameters.

Pulse shape [%]

Source power [dB]: Transmitted power. Set in the Source Power [dB] parameter in the Runtime parameters.

Pulse length [ms]: Transmitted pulse length. Set in the Pulse length [ms] parameter in the Runtime parameters.

Sweep low frequency [Hz]: Transmitted sweep low frequency. Set in the Sweep low frequency [Hz] parameter in the Runtime parameters. Only used when the pulse form is Chirp Up/Down.

Sweep high frequency [Hz]: Transmitted sweep high frequency. Set in the Sweep high frequency [Hz] parameter in the Runtime parameters. Only used when the pulse form is Chirp Up/Down.

CW pulse frequency [Hz]

Beam width Tx: TX beam width at transmission. Set in the Beam width TX parameter in the Runtime parameters.

Beam width Rx: RX beam width at transmission. Set in the Beam width RX parameter in the Runtime parameters.

Fan width [deg]: Width of beam fan. Determined by the beam spacing and the number of beams set in the Runtime parameters. Not used when the number of RX beams is one.

Acquisition delay [ms]: Start of acquisition after TX. Set in the Acquisition delay [ms] in the Runtime parameters.

Number of RX beams: Number of beams from the beamformer. Set in the Number of RX beams in the Runtime parameters.

Number of TX beams: This number is equal to the number of pings in a TX cycle mode. Either TX beam width or TX tilt angle is changed from beam to beam

Transmit tilt [deg]: Transmit tilt, along.

Receive tilt [deg]: Receive tilt, across.

Roll at Tx [deg]: Measured roll when transmitting.

Roll at Rx start [deg]: Measured roll at start of acquisition.

Roll at Rx stop [deg]: Measured roll at the end of acquisition.

Pitch at Tx [deg]: Measured pitch when transmitting.

Pitch at Rx start [deg]: Measured pitch at start of acquisition.

Pitch at Rx stop [deg]: Measured pitch at the end of acquisition.

Heave at Tx [deg]: Measured heave when transmitting.

Heave at Rx start [deg]: Measured heave at start of acquisition.

Heave at Rx stop [deg]: Measured heave at end of acquisition.

Heading at Tx [deg]: Measured heading when transmitting.

Heading at Rx start [deg]: Measured heading at start of acquisition.

Heading at Rx stop [deg]: Measured heading at end of acquisition.

Number of samples: Number of samples in each trace.

Latitude / Longitude: Information comes from the NMEA reader.

Use heading from NMEA reader: Uncheck this box if you want to use the heading received from the TRU.

Heading: Information comes from the NMEA reader.

Speed: Shows the current speed of the vessel.

Depth [m]: Depth relative to transducer. Parameter comes from the Depth selector.

Average sound speed [m/s]: Average sound speed.

Bottom filter

The **Bottom filter** is accessed from **Readers and writers→NMEA Readers** located under the **System** tab.

Bottom filter: A simple filter for Bottom incidence range is introduced:

BIR_{NMEA}	:	New value received by the NMEA reader
BIR	:	Value used to control the acquisition delay
α	:	The filter coefficient

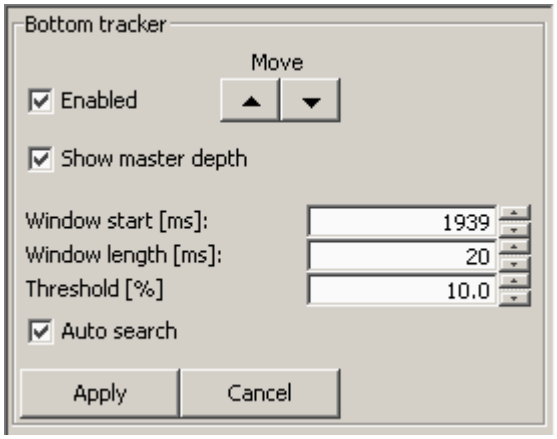
Formula:

$$BIR = BIR \times \alpha + (1 - \alpha) \times BIR_{NMEA}$$

The filter coefficient is entered on the NMEA readers parameter sheet. If the filter coefficient is set to zero this means no filtering. A large filter coefficient may be useful when the EM provide bad values under difficult survey conditions on a relatively flat seafloor, but will be bad for “steep” slopes and “rough” terrain.

Bottom tracker

The **Bottom tracker** parameter sheet is accessed from the **Processing** tab.



The **Bottom tracker** is used for finding and detecting the seabed. It's function is to track the seabed in profile data. This information can be used in several functions like TVG, swell filter, mute, bottom lock, dereverberation and in automatic trigger delay adjustments.

Bottom tracker parameters

Enable: Must be checked to enable the bottom tracker.

Move: Use arrows to move the Bottom tracker up or down in the processing chain

Show master depth: Check this to have the external depth displayed in the single trace area (horizontal bar).

Window start [ms]: Sets the starting point for searching for the seabed. This value is only used each time the tracker is enabled. Legal values are from 0 to 15,000 ms. Default value is 0 ms.

Window length [ms]: Sets the area in which the bottom is search for. Noise spikes etc in other parts of the trace will not be picked out as the bottom. Legal values are from 1 to 100 ms. Default value is 10 ms.

Threshold [%]: Sets the pick threshold in percent of the peak value in the trace, which normally will be the seabed return. Legal values are from 0% to 100%. Default value is 70%.

Auto search: If track is lost, the window will open up to allow for automatic re-establishing bottom track. When bottom is detected, the window will return to the specified value.

Tip

Looking at the centre beam only will normally give a better performance of the bottom tracker. Centre beam is selected by enabling **Track selected beam only** and **selecting beam number 0** from the **Processing chain** parameter sheet. See *Processing chain* on page 123

Convert buttons

The **Convert buttons** are located right above the Echogram area.

Convert mode

Click this button	To
	Start converting file formats
	Pause file conversion process

Converter filter

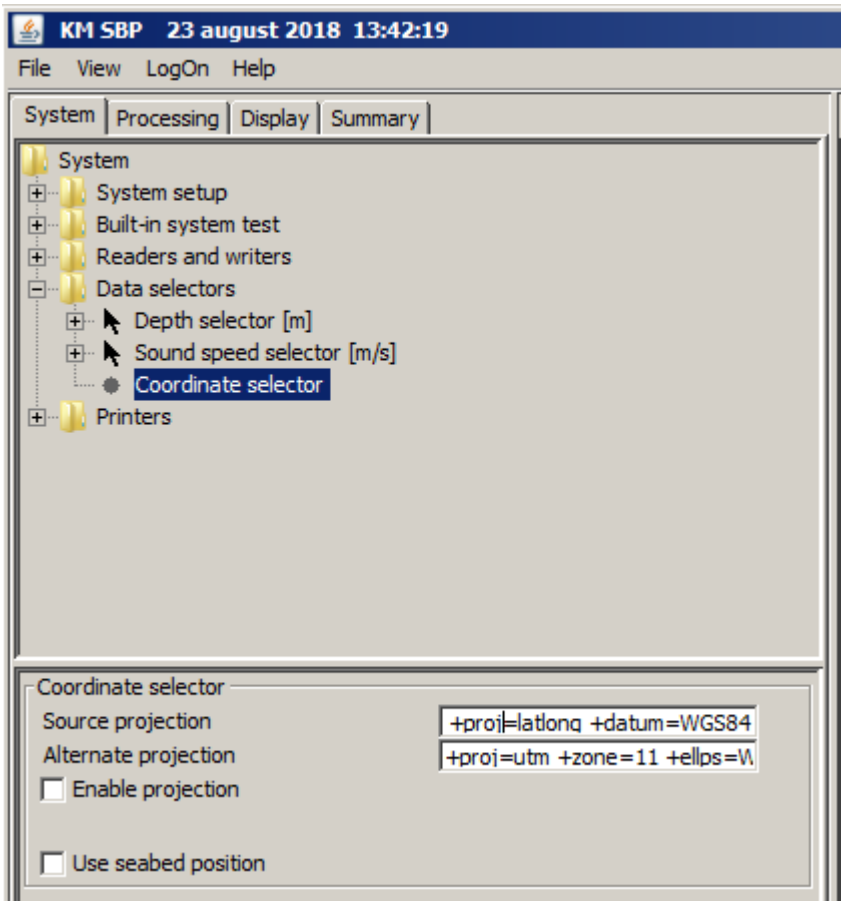
See *Filters* on page 95

Coordinate selector

The **Coordinate selector** parameter sheet is accessed from **Data selectors→Coordinate selector** located under the **System** tab.

When enabled the source input will be converted to datum and projection entered in the **Alternate projection** field.

The coordinate conversion function is based on the PROJ.4 Cartographic Projections library. PROJ4, which in the SBP operator software accesses as a library function, is a standard filter function which converts geographic longitude and latitude coordinates into Cartesian coordinates.



Coordinate selector parameters

Source projection: Datum and projection for input.

Alternate projection: Datum and projection for output.

Enable projection: Check to enable conversion to datum and projection entered in the **Alternate projection** field.

Use Seabed position: Check to give each beam a set of coordinates at the seabed incident point.

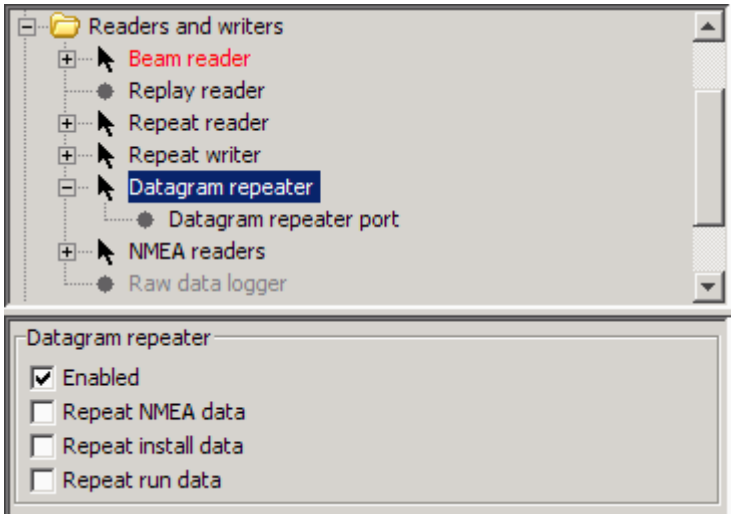
Datagram repeater

The **Datagram repeater** parameter sheet is accessed from **Readers and writers→Datagram repeater** located under the **System** tab.

When enabled selected datagrams will be copied from the SBP 27 to specified remote port. This may be useful e.g. for debug purposes.

To configure the **Datagram repeater** you must be logged on as **Root**. You will then have access to the **Datagram repeater port** parameters located under the **Datagram repeater**.

Datagram repeater parameters



Enable: Check to enable selected datagrams to be copied to remote computer.

Repeat NMEA data: Check to enable copy of all datagrams enabled under **NMEA readers**.

Repeat install data: Check to enable copy of all installation datagrams sent to the Transceiver Unit.

Repeat runtime data: Check to enable copy of all runtime datagrams sent to the Transceiver Unit.

Datagram repeater port parameters

Monitor messages: Check this box if you want to display all copied datagrams in a separate window. This window will also allow you to **Add a time stamp** to the datagrams and to **Log to file**.

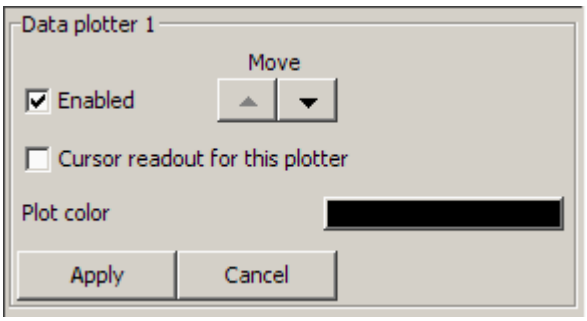
Status: Shows port status.

Remote port: Port number of remote computer.

Remote address: Port address of remote computer.

Data plotter 1 and 2

The **Data plotter** parameter sheet is accessed from the **Processing** tab.



The data plotter is used to display single ping data in the **Single trace area**.

Two plotters are available. **Data plotter 1** is often close to the top of the processing tree to display the raw data, after applied gain. **Data plotter 2** can be used at other locations in the processing tree to see effects of the various processing steps.

Data plotter parameters

Enable: Must be checked to enable plot in Single trace area.

Move: Use arrows to move the Data plotter up or down in the processing chain

Plot colour: Used to select the colour of the curve drawn in the Single trace area.

Cursor read out for this plotter: When checked the depth and the amplitude will be displayed at the bottom of the window as the mouse is moved along the data in the Single trace area. If unchecked, only depth will be displayed.

Refer to *Single trace area* on page 71 for information about the Single trace area.

Depth from bottom tracker

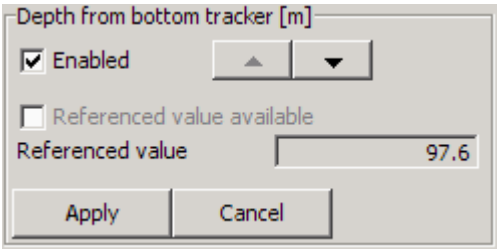
The **Depth from bottom tracker** parameter sheet is accessed from **Data selectors→Depth selector [m]→Depth from bottom tracker [m]** located under the **System** tab.

When enabled and given the highest priority, or if **Depth from NMEA reader** is unavailable, the **Depth from bottom tracker** will be used for automatic adjustment of the acquisition delay.

The source listed last of **Depth from bottom tracker** and **Depth from NMEA reader** has the highest priority.

Note

Calculate delay from depth *located in the* ***Runtime parameters*** *must be checked to activate automatic adjustment of the acquisition delay.*



Parameters

Enable: Must be checked to apply depth data from the bottom tracker.

 Use arrows to move **Depth from bottom tracker** up or down in the Depth selector list.

Referenced value available: Not selectable. Will automatically be checked if a value is available from the Bottom tracker.

Referenced value: The depth received from the Bottom tracker.

Depth from NMEA

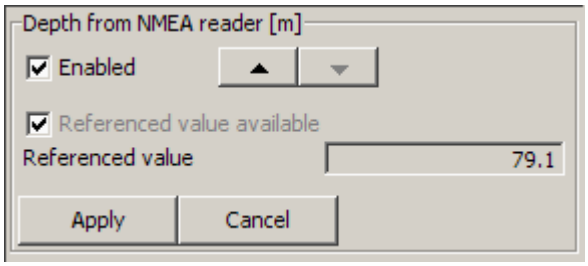
The **Depth from NMEA** parameter sheet is accessed from **Data selectors→Depth selector [m]→Depth from NMEA [m]** located under the **System** tab.

When enabled and given the highest priority the **Depth from NMEA** will be used for automatic adjustment of the acquisition delay.

The source listed last under **Depth selector** has the highest priority.

Note

Calculate delay from depth *located in the* ***Runtime parameters*** *must be checked to activate automatic adjustment of the acquisition delay.*



Parameters

Enable: Must be checked to apply depth data from NMEA.

Use arrows to move **Depth from NMEA** up or down in the Depth selector list.

Referenced value available: Not selectable. Will be automatically checked if a value is available from the NMEA readers.

Referenced value: Value received from the NMEA readers.

Depth selector

The **Depth selector** parameter sheet is accessed from **Data selectors→Depth selector [m]** located under the **System** tab. **Depth selector** should always be enabled.

When enabled the **Depth selector** will be used for automatic adjustment of the acquisition delay.

If the **Bottom tracker** is disabled, the value from the **Depth selector** is also used by the TVG in tracking mode, and it is the source of depth written into the beam data.

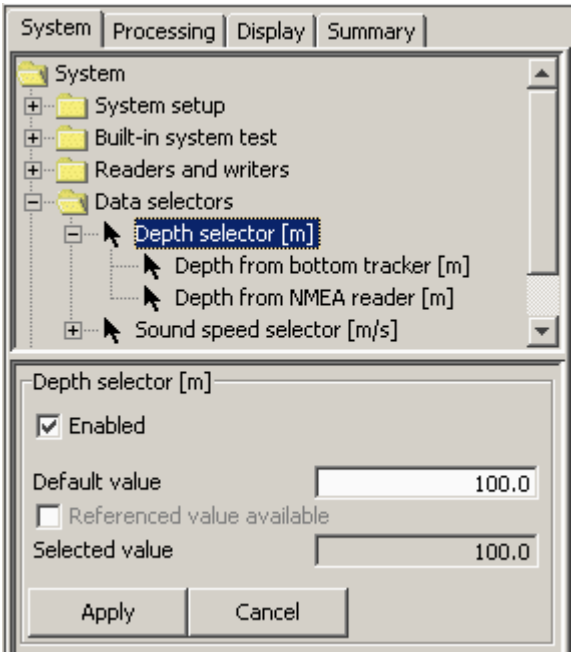
If depth from both the Bottom tracker and from an external NMEA input is present the reading with the highest priority will be used.

The source listed last of **Depth from bottom tracker** and **Depth from NMEA reader** has the highest priority.

It is recommended to give **Depth from NMEA** higher priority than **Depth from bottom tracker**.

Note

Calculate delay from depth *located in the* ***Runtime parameters*** *must be checked to activate automatic adjustment of the acquisition delay.*



Depth selector parameters

Enable: Must be checked to be active.

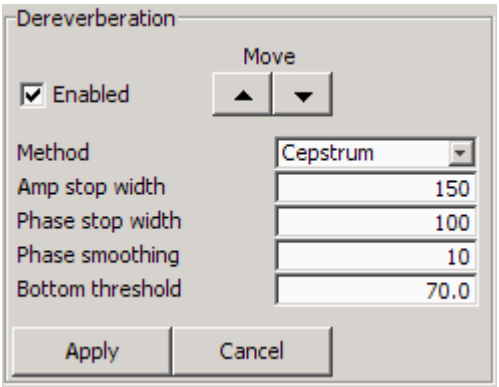
Default value: The default value is used if no other value is available. The acquisition delay will automatically be adjusted to the default value in case of a timeout of the external depth sensor. 0 (zero) will disable this automatic adjustment. We recommend you to use 0 (zero) as your default value.

Referenced value available: Not selectable. Will automatically be checked if depth information from either of the Bottom tracker or the NMEA readers is available.

Selected value: The depth value from the depth source of highest priority.

Dereverberation

The **Dereverberation** parameter sheet is accessed from the **Processing** tab.



The **Dereverberation** function performs a multiple reduction operation. This function is relevant to use in very shallow areas where the second bottom return masks sub-bottom features.

Two methods for doing the processing are implemented. The **Direct Method** uses a cross-correlation technique and the **Cepstrum** method operates in the cepstrum space. The latter method seems to be more robust and gives better results

Dereverberation parameters

Enable: Must be checked to enable the function

Move: Use arrows to move the Data plotter up or down in the processing chain

Method: Selects the processing method to be used. Choices are **Direct Method** and **Cepstrum**.

Amp. stop width: Defines an amplitude stop width in the cepstrum space given in frequency points for the filter.

Phase stop width: Defines a phase stop width in the cepstrum space given in frequency points for the filter.

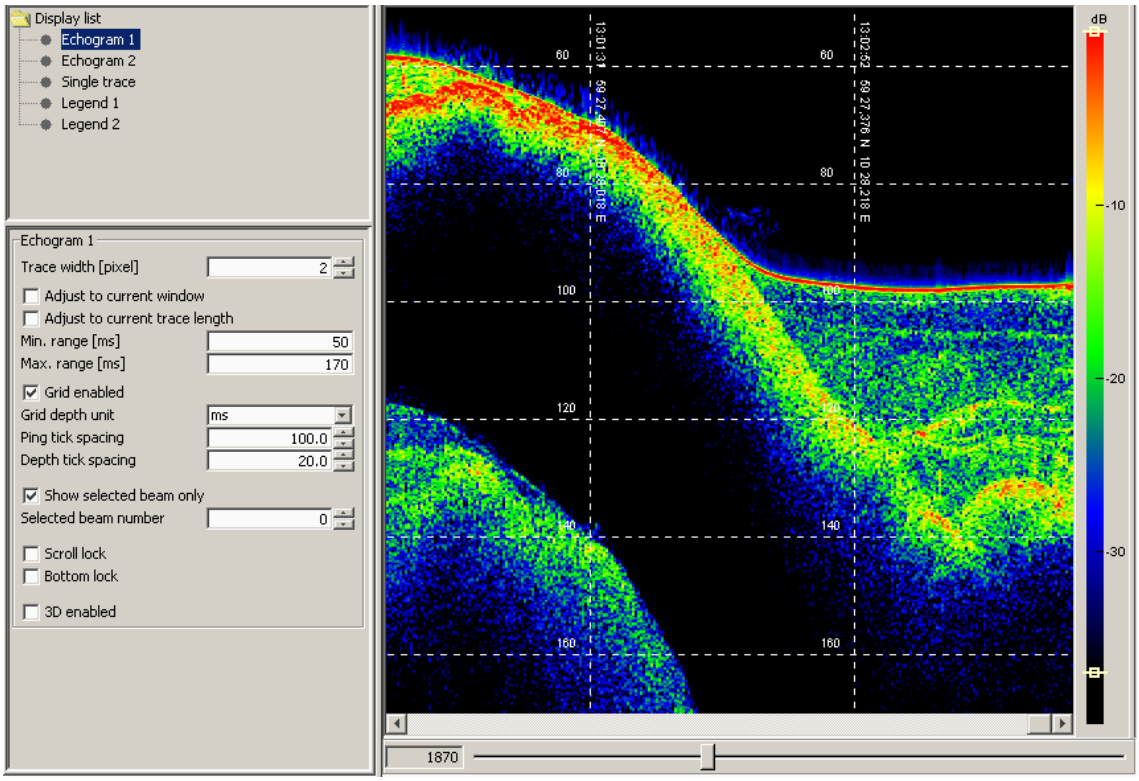
Phase smoothing: Defines a smoothing factor in the cepstrum space given in frequency points for the filter.

Bottom threshold: Sets the detection threshold for seabed detection in percents of the peak level.

Echogram 1, 2 & 3

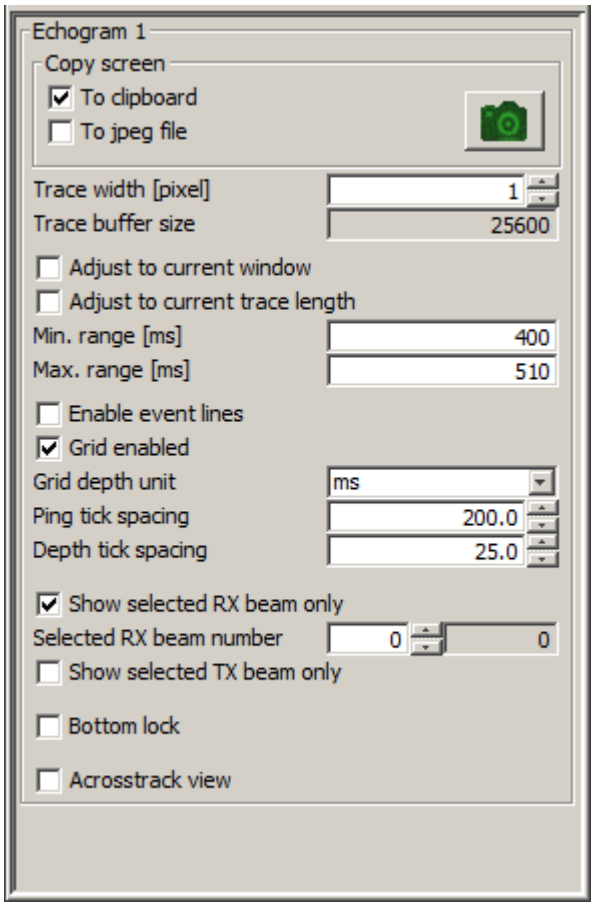
The **Echogram** parameter sheet is accessed either from the **Display** tab or by clicking left mouse button within the Echogram area.

Echogram 1 and optionally **Echogram 2** and **Echogram 3** are used to present the processed realtime or replay data.



Refer to *Echogram area 1, 2 & 3* on page 63 for examples of how the Echogram parameters may be used to optimize the displays.

Echogram parameters



- **Copy screen:** Press  to have what is displayed in the echogram area copied to a jpeg file or to the clipboard. The file is written to the images folder.
- **Trace width [pixel]:** Use the arrow buttons or the text field to enter the pixel width of each trace on the screen.

  This parameter provides a horizontal zoom. When the echogram area no longer fits inside the available part of the screen, a horizontal scrollbar appear at the bottom of the echogram area. This bar makes it possible to display traces that have disappeared on the left-hand side of the Echogram area.
- **Adjust range to current window:** Adjusts the echogram image automatically to fit the depth range to current acquisition window.
- **Adjust to current trace length:** Adjusts the echogram image automatically to fit current trace length. The seabed may appear discontinuous.
- If you want to adjust the depth yourself, uncheck the checkboxes and put your range values into the text boxes:
  - **Min. range [ms]:** Start displaying data from this point
  - **Max. range [ms]:** Stop display of data at this point

Note

If you manually set the minimum and maximum range, the incoming data will only be displayed if a part of the trace is within these limits.

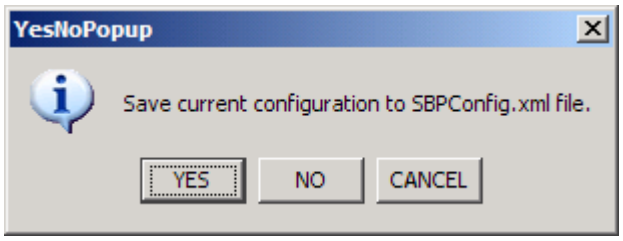
- **Enable event lines:** This is only in use if a CODA navigation string is received, see CODA navigation string for details. Whenever the fix number is incremented an event line is drawn over the echogram and the fix number printed next to it.
- **Grid enabled:** Used to enable display of a grid
  - **Grid depth unit:** Unit for vertical grid. Can be set to milliseconds or meters. *Not available in Acrosstrack view.*
  - **Ping tick spacing:** Distance between horizontal grid lines. *Not available in Acrosstrack view.*
  - **Depth tick spacing:** Distance between vertical grid lines

- **Show selected beam only:** Should normally be checked in order to be able to specify which receiver beam to display. *Not available in Acrosstrack view.*
  - **Selected beam number:** Enter the beam number you want to display. *Not available in 3D mode.*
- **Bottom lock:** When checked, the data traces will be aligned to make the detected bottom appear at a fixed vertical position within the display.
  - **Bottom position [%]:** Specifies the relative position of the locked bottom in the full trace display.
- **Acrosstrack view:** Check this to display a fan of RX beams. Leave **Geometric range** unchecked, and let the **Shift X/Y** values be zero.
- **Geometric range:** Compensates for beam angle when plotting data on the screen. *Only present in Acrosstrack view.*

Exit

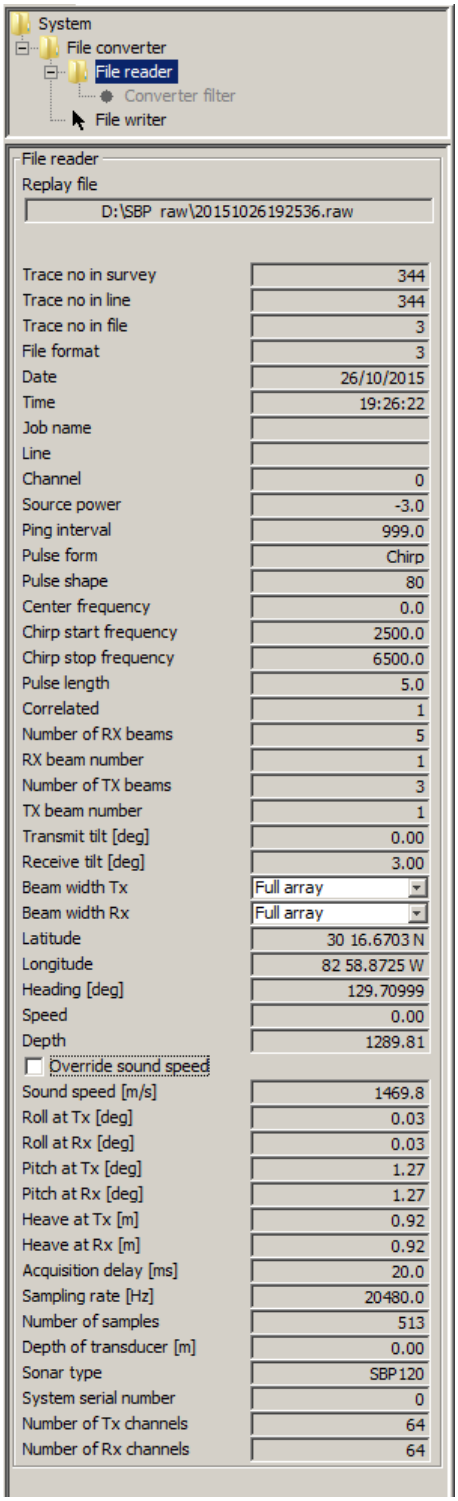
Exit is accessed from the **File** menu. This will shut down the system.

When you choose **Exit** you will be prompted whether you want to store current configuration or not, or whether you want to cancel the **Exit** command.



Exit will close all the programs controlled by the SBP 27. You will however still be logged on the work station.

File reader



The **File reader** parameter sheet is accessed from **File converter→File reader** located under the **System** tab.

The **File reader** displays the information contained in the file that is being converted, i.e. the replay file, which can be in raw data format or in SEG Y format.

File reader parameters

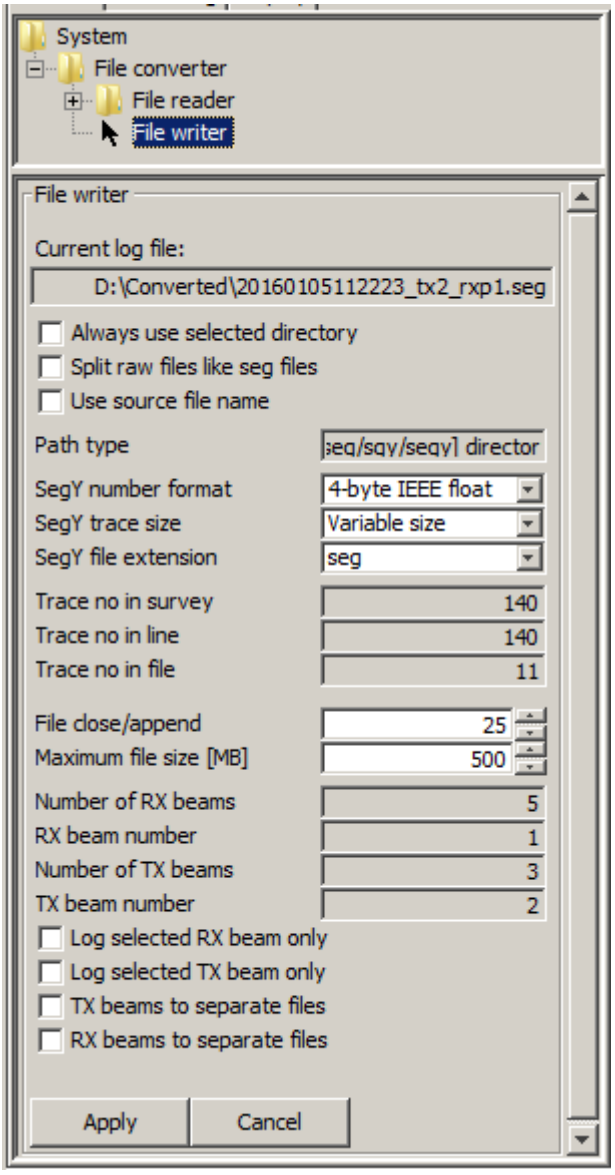
Replay file: Gives you information about which file is being replayed and where it is located.

Override sound speed: Checkbox for overriding the stored sound speed values during processing.

The remaining parameters displayed are header information in the traces stored on file.

See *File formats* on page 177 for description.

File writer



The **File writer** parameter sheet is accessed from **File converter→File writer** located under the **System** tab.

The **File writer** is used to set up file format, max file size etc. for the files being created by the file converting process.

File writer parameters

Current log file: Displays the name of the file running

Always use selected directory: When checked, logging is enabled without the pop-up dialogue; i.e. the log path and the file format (raw/SEG Y/pro) cannot be changed. Uncheck this to be able to change log path/file format.

- For Remote logging control to work without human interaction **Always use selected directory** must be checked. See – *Remote control datagram* on page 198

Split raw files like seg files: The binary trace header of the SEG Y format does not contain all information about the runtime parameters; some information is only stored in the file headers. For this reason, change of some runtime parameters causes a file break when logging in SEG Y format. If this box is checked the same events that trigger a SEG Y file break will trigger a file break also for data logged in the more complete raw data format.

Use source file name: During file conversion (i.e. in Convert mode) the old file name will be kept/included in the new file names if this is checked.

Path type: SEG Y/RAW file format or directory

SegY number format: Select between **4-byte IEEE float** (recommended) and **2-byte IBM integer**.

SegY trace size: Select between **Variable size** and **Fixed size**.

Note

Fixed size in combination with water column logging and automatic adjustment of trace length typically results in numerous small SEG Y files.

SegY file extension: Select between **seg**, **sgy**, or **segy**.

Trace no in survey: A counter for the current survey.

Trace no in line: A counter for the current line.

Trace no in file: A counter for the current file.

File close/append: Selects number of pings between close – append action to the log file. This will protect the system from losing a completed data file if the system crashes during operation. No more than the selected number of pings will in worst case become lost.

Maximum file size [MB]: Use the arrow buttons or the text field to enter the maximum size for your files.

Log selected RX beam only: Enable this if you want to log a selected RX beam only.

Selected RX beam number: When log selected RX beam only is checked, which beam to log must be specified.

Log selected TX beam only: Enable this to log a single TX beam of a transmit cycle. If a “transmit cycle mode” is enabled, the various beams in the cycle of N pings are numbered from 1 to N.

Selected TX beam number: When log selected TX beam only is checked, which beam to log must be specified.

TX beams to separate files / RX beams to separate files: Checking/unchecking these boxes has no effect when logging in SEG Y format. SEG Y data are automatically split into separate files for each combination of RX/TX beams.

Filenames are extended by _txN when **TX beams to separate files** is checked. If **RX beams to separate files** is checked _rxpN, _rx0, or _rxsN (N ≥0, p=port, s=starboard) is added to the file names to create unique filenames. Example showing what the file names will look like when both are checked; i.e. there will be one file for each combination of TX/RX beams:

- 20150617172546_tx1_rx0.segy
- 20150617172546_tx1_rxp1.segy
- 20150617172546_tx1_rxs1.segy
- 20150617172546_tx2_rx0.segy
- 20150617172546_tx2_rxp1.segy
- 20150617172546_tx2_rxs1.segy

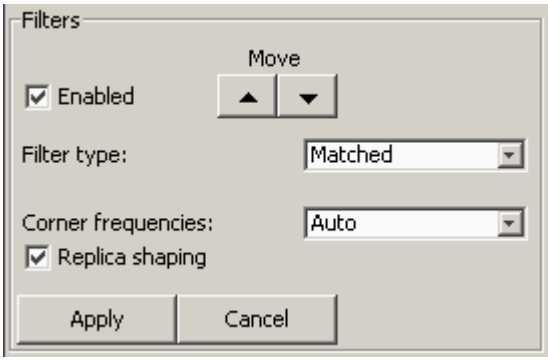
Filters

The **Filters** parameter sheet can be accessed from three different locations. Different names of the parameters are being used:

- **Filters** is accessed from the **Processing** tab
- **Converter filter** is accessed from **File converter→File reader→Converter filter** located under the **System** tab

Note

A flag is added to the raw format to distinguish between data that are matched filtered and data that are not.



The **Filters** are used for filtering the acquired data. The following filter types are implemented:

- Bandpass
- Matched
- Spiking

Matched filter processing results in pulse compression of long coded wavelets in order to increase the signal-to-noise ratio and resolution. When short pulses are used, reduced sidelobe levels may also be achieved. The filter is implemented in the frequency domain with flat response and 100% transmission within the pass band and 0% transmission in the stop-bands. The transition between the bands follows a raised cosine function.

See *Parameter definintion for digital bandpass filter* on page 96.

Filters parameters

Filter type: Choose between Bandpass, Matched and Spiking. Depending on what you choose, different parameters will appear.

Corner frequencies: Choose between Manual or Auto selection of corner frequencies in filter window.

- **Auto:** The frequencies are selected automatically depending on the start and stop frequencies of the relevant chirp signature. The window has a $\cos^2$ roll-off.
- **Manual:** The following fields are present:

Low stop [Hz]: Specifies the low stop frequency of the filter. Legal values are from 0 Hz to 30,000 Hz.

High pass [Hz]: Specifies the high pass frequency of the filter. Legal values are from 40 Hz to 30,000 Hz.

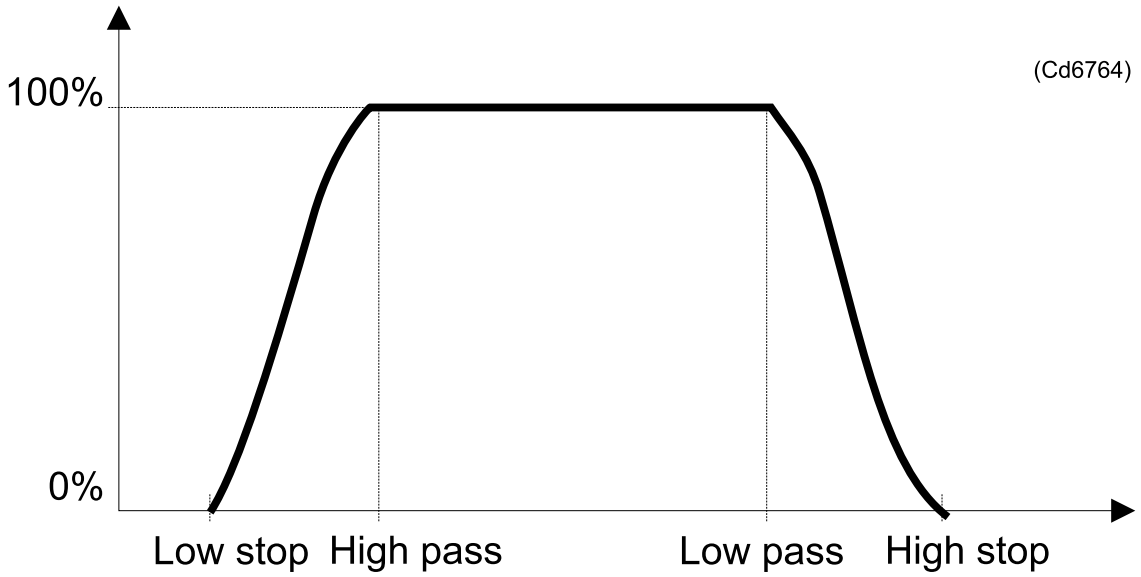
Low pass [Hz]: Specifies the low pass frequency of the filter. Legal values are from 100 Hz to 30,000 Hz.

High stop [Hz]: Specifies the high stop frequency of the filter. Legal values are from 100 Hz to 30,000 Hz.

Stability factor [ppm] (for spiking filter only): Add a constant to the filter denominator for stabilizing purposes in Spiking filter.

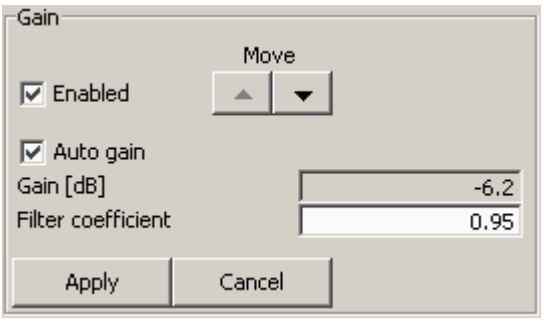
Replica shaping: Checkbox for enabling replica shaping in Matched filter. The shaping is performed by multiplying the filter by a Hanning window.

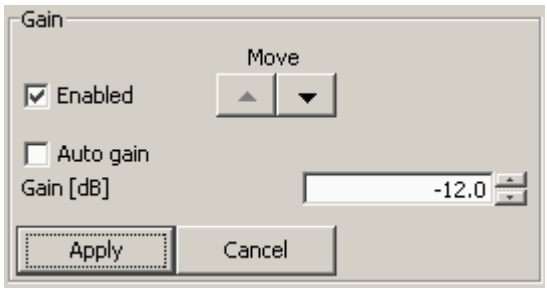
Figure 12 Parameter definintion for digital bandpass filter



Gain

The **Gain** parameter sheet is accessed from the **Processing** tab.





The **Gain** function is used to applying additional gain to the processed data in order to make presentation on display or printer as nice as possible.

Gain parameters

Enable: Must be checked to enable the function

Move: Use arrows to move the **Gain** up or down in the processing chain

Auto gain: When unchecked, the gain **G** can be specified manually (see below). When checked, the parameter filter coefficient **C** appears and the autogain function tries to use the dynamic range of the processing chain according the specified filter coefficient value. Gain **G** is calculated by the following formula:

$$G = (1 - C) / Peak_{new} + C * G_{previous}$$

where

- $Peak_{new}$ is the peak value of the current ping
- $G_{previous}$ is the gain applied to the previous pin
- C = 0 means no history. Typical values range from 0.9 up to 0.99.

Under difficult conditions (such as when the signal is lost due to air under the transducer) the autogain function does not behave properly and it is recommended that you switch to manual gain

Filter coefficient: This parameter will not be shown unless **Auto gain** is enabled. (See above).

$$NextGain = LastGain * Coef + ThisGain * (1 - Coef)$$

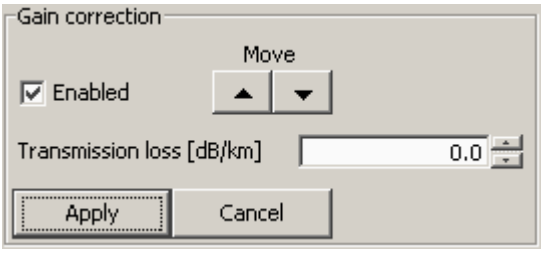
Gain [dB]: Sets the gain factor. The gain is given in dB. Zero dB does not influence the result at all.

Note

*The **Auto gain** option is of less interest since **Gain correction** was introduced. We recommend using the **Gain correction** functionality for automatic compensation for the spherical loss. See Gain correction on page 98 for description.*

Gain correction

The **Gain correction** parameter sheet is accessed from the **Processing** tab.



The gain correction compensates for spherical loss as the signal propagates. The gain correction also compensates for reduction in source power and source level.

If for instance source power is reduced by 12 dB, 12 dB gain is applied to the received signal. Or if you choose to run with transmit beam width “half array“, 6 dB gain is applied to compensate for reduced source level.

Gain correction parameters

Enable: Must be checked to enable the function

Move: Use arrows to move the **Gain correction** up or down in the processing chain

Transmission loss [dB/km]: TVG compensates the transmission loss (absorption coefficient [dB/km] may be specified to compensate for absorption).

Installation parameters

The **Installation parameters** parameter sheet is accessed from **System setup** located under the **System** tab.

The parameter sheet is visible when a normal **User** is logged on, but it can only be edited when **Super** is logged on.

Parameters sent to the Transceiver Unit (TRU) will be shown with yellow background until an acknowledgement from the TRU is returned.

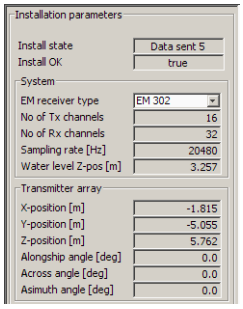
The **Installation parameters** are SBP 27 parameters used for initial system configuration and should normally not be changed during operation. The **Installation parameters** contains the following groups of parameters:

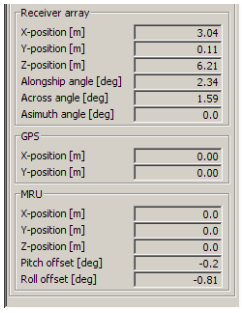
- System parameters – specification of your multibeam echo sounder system
- Transmitter array – mounting parameters of your transmitter array
- Receiver array – mounting parameters of your receiver array
- GPS – mounting parameters of your GPS antenna
- MRU – mounting parameters of your MRU

Note

X, Y and Z positions that are to be entered are defined as positive forward (X), starboard (Y) and downwards (Z) relative to the reference point.

Alongship, across and azimuth angles are defined as positive when bow up, port up and clockwise rotation, respectively.





Installation parameters

Install State: Install state reports response to the Installation parameters sent to the TRU.

The following states may be reported:

- No data sent
- Wait for ACK
- Data sent N – where N is incremented for each data package sent
- Retry N – where N is incremented for each retry
- Message error N – where N is incremented for each error message
- Write error N – where N is incremented for each write error
- Install disabled

Install OK: True when installation parameters are sent to and acknowledged by the TRU

System

- **EM receiver type:** Select your multibeam echo sounder system.
- **No of Tx channels:** Number of transmitter channels. Legal values are 16, 32 and 64.
- **No of Rx channels:** Number of receiver channels. Legal values are 16, 32 and 64.
- **Sampling rate [Hz]:** Fixed sampling rate/frequency.
- **Water level Z-pos [m]:** Water level relative to reference point.

Transmitter array

- **X-position [m]:** Transmitter array X-position.
- **Y-position [m]:** Transmitter array Y-position.
- **Z-position [m]:** Transmitter array Z-position.
- **Alongship angle [deg]:** TX alongship mounting angle.
- **Across angle [deg]:** TX across mounting angle.
- **Azimuth angle [deg]:** TX azimuth mounting angle.

Receiver array

- **X-position [m]:** Receiver array X-position.
- **Y-position [m]:** Receiver array Y-position.
- **Z-position [m]:** Receiver array Z-position.
- **Alongship angle [deg]:** RX alongship mounting angle.
- **Across angle [deg]:** RX across mounting angle.
- **Azimuth angle [deg]:** RX azimuth mounting angle.

GPS

- **X-position [m]:** GPS antenna X-position.
- **Y-position [m]:** GPS antenna Y-position.

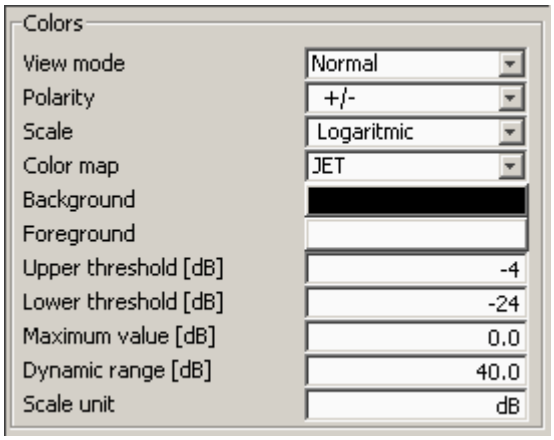
MRU

- **X-position [m]:** Motion sensors X-position.
- **Y-position [m]:** Motion sensors Y-position.
- **Z-position [m]:** Motion sensors Z-position.
- **Pitch offset [deg]:** Motion sensor pitch offset in degrees.
- **Roll offset [deg]:** Motion sensor roll offset in degrees.

Legend 1, 2 & 3

The **Legend 1 & 2** parameter sheets are accessed from the **Display** tab.

Legend 1 controls the settings for **Echogram area 1**, and **Legend 2** controls the settings for **Echogram area 2**.



Legend parameters

View mode: Choose between Normal and Wiggle mode.

Polarity: Drop-down menu for selecting which part of the processed signal to be displayed. The choices are +, - and +/-.

- + : displays positive parts of signal
- +/- : displays both positive and negative parts of signal
- - : displays negative parts of signal

Scale: Drop-down menu for selecting how the magnitude of the signal amplitudes is mapped to the colour scale. Choices are **Linear** and **Logarithmic**.

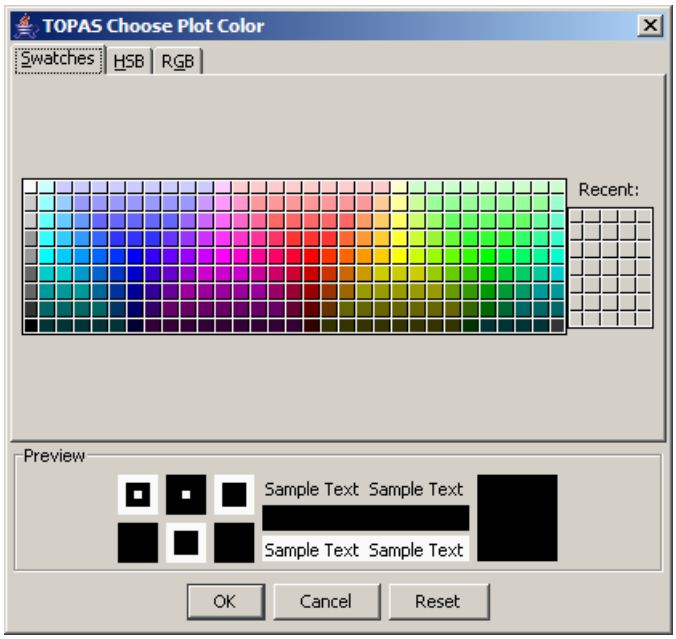
Colour map: Drop-down menu for selecting various colour-coding scales. Choices are JET, COOL, HOT, GRAY, INVGRAY, BONE, HSV and PINK.

Background: Button for selecting background colour menu. A new menu window is displayed when the button is pushed. This menu is shown in *Colour menu* on page 102.

Foreground: Button for selecting foreground colour menu. A new menu window is displayed when the button is pushed. This menu is shown in *Colour menu* on page 102. Select the colour you want on your grid.

Threshold: Parameter fields for setting the relative amplitude to be displayed. These values are used to suppress low-level noise in the presented data. Values are given in percent if linear mode is selected and in decibels if logarithmic mode is selected.

Figure 13 Colour menu



Maximum value Sets the maximum value referred to the top of the colour bar. The unit depends on which scale is selected; linear or logarithmic.

Minimum value: Sets the minimum value for the colour bar.

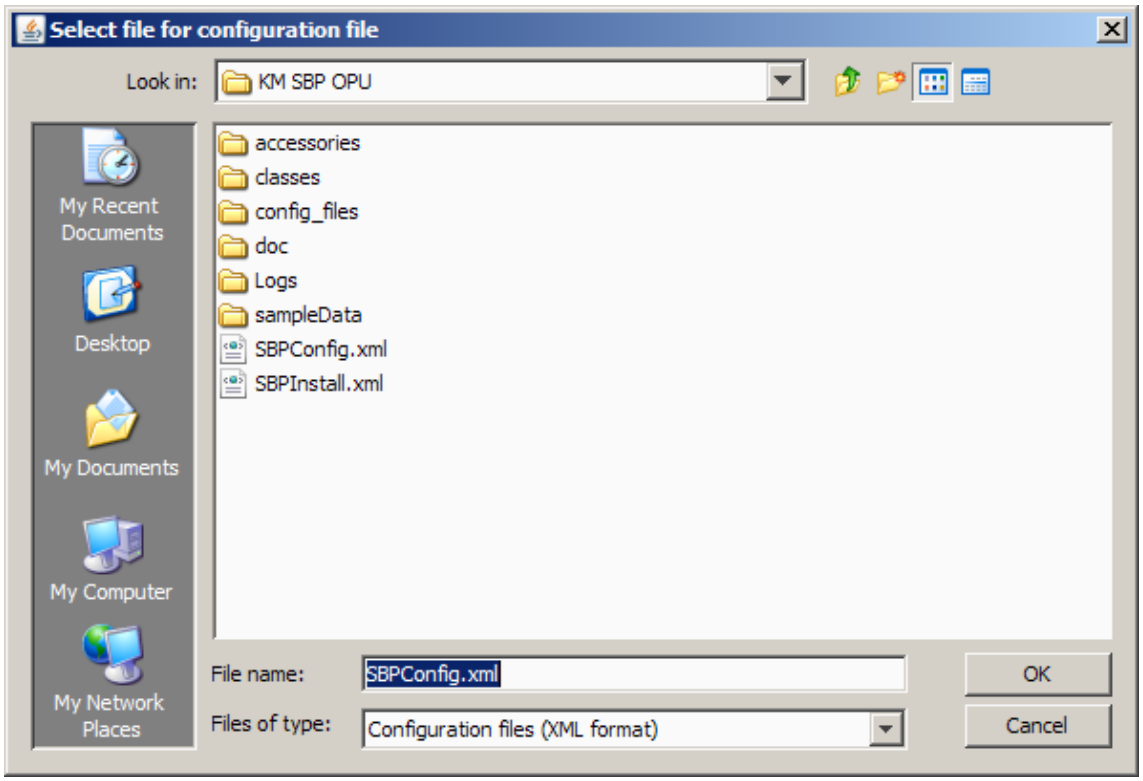
Scale gain: Sets a multiplication factor for the colour bar.

Scale unit: Defines the text printed at the top of the colour bar.

Load configuration

The **Load configuration** dialogue box is accessed from the **File** menu.

When using **Load configuration**, you can load different parameter configurations. It has to be a file saved in .xml format.



If you want to save a parameter configuration, use **Save configuration**.

Related topics

- *Save configuration* on page 136
- *Configuration files* on page 36

Load installation

The **Load installation** dialogue box is accessed from the **File** menu when logged on as **Super**.

When using **Load installation** you can load different installation parameter configurations. It has to be a file saved in .xml format.

At startup, the SBP software will automatically load `SBPInstall.xml`. If you want to use a different configuration, use can use **Load installation**.

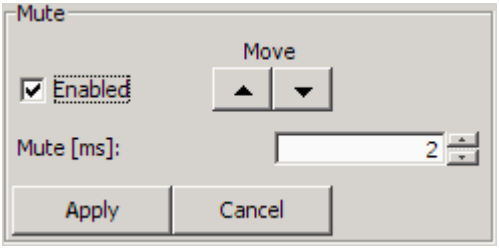
If you want to save installation parameter configuration, use **Save installation**.

Related topics

- *Save installation* on page 137
- *Configuration files* on page 36

Mute

The **Mute** parameter sheet is accessed from the **Processing** tab.



The mute function is used for muting or zeroing all trace values located from start of trace and to a specified offset before the seabed position.

Mute parameter

Enable: Must be checked to enable the function

Move: Use arrows to move **Mute** up or down in the processing chain

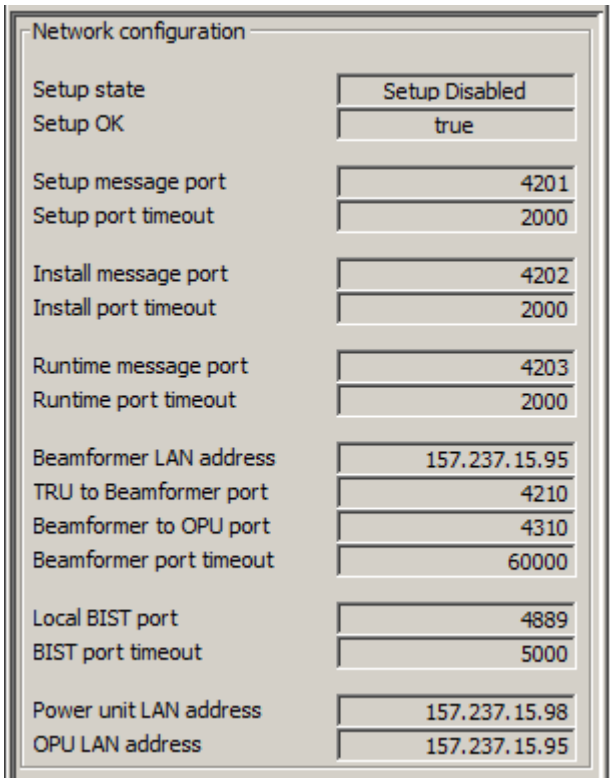
Mute [ms]: Sets the offset before the seabed position for the mute.

Network configuration

The **Network configuration** parameter sheet is accessed from **System setup→Network configuration** located under the **System** tab.

Note

*The parameter sheet is visible when a normal **User** is logged on, but it can only be edited when **Super** is logged on.*



Network configuration parameters

Setup State: Setup state reports response to the network communication between the operator unit and the TRU.

The following states may be reported:

- No data sent
- Wait for ACK
- Data sent N – where N is incremented for each data package sent
- Retry N – where N is incremented for each retry
- Message error N – where N is incremented for each error message
- Write error N – where N is incremented for each write error
- Setup disabled

Setup OK: True when setup datagram is sent to and acknowledged by the TRU

Setup message port: Port where the OPU is listening for acknowledge messages

Setup port timeout: Timeout in ms

Install message port: Port listening for acknowledge messages

Install port timeout: Timeout in ms

Runtime message port: Port listening for acknowledge messages

Runtime port timeout: Timeout in ms

Beamformer LAN address: LAN address for beamformer

TRU to Beamformer port: Port where beamformer listens for Transceiver Unit data

Beamformer to OPU port: Port where OPU listens for beamformed data

Beamformer port timeout: Timeout in ms

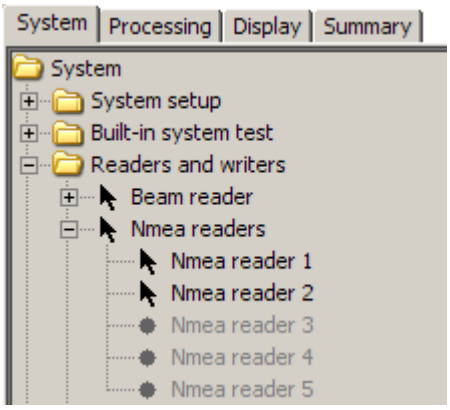
Local BIST port: Port for test response messages

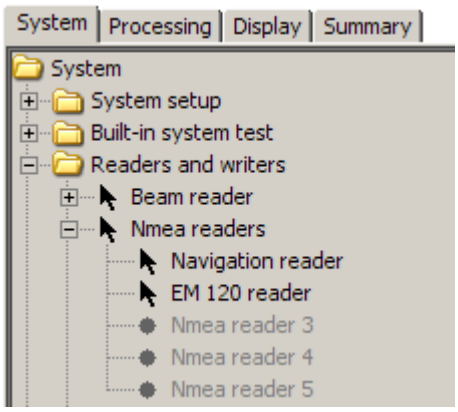
BIST port timeout: Timeout in ms

Power unit LAN address: LAN address for power unit. The address is 157.237.15.98

OPU LAN address: LAN address for the operator work station. In a standard setup the address is 157.237.15.95

NMEA readers





The **NMEA readers** parameter sheet is accessed from **Readers and writers→NMEA readers** located under the **System** tab.

There are five NMEA readers. These five readers have identical functionality, and they can be configured to receive information over serial lines or Ethernet. Their default names are NMEA reader 1-5, but the names can be changed to reflect the type or the source of the information they are receiving. See example in the figures.

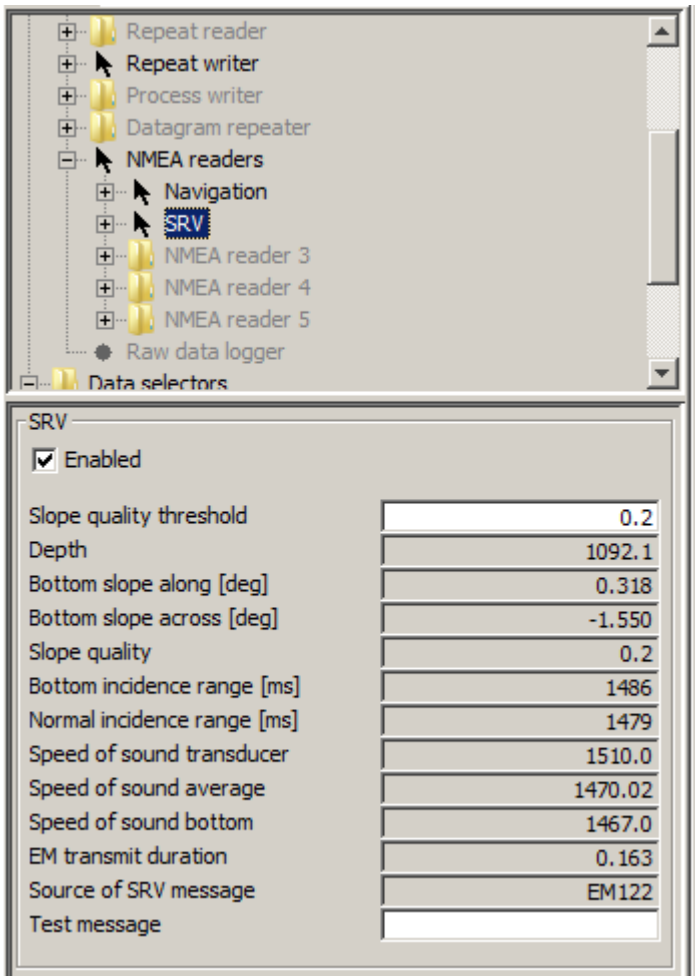
Note

*When logged on as **User** you are allowed to enable/disable the NMEA readers only.*

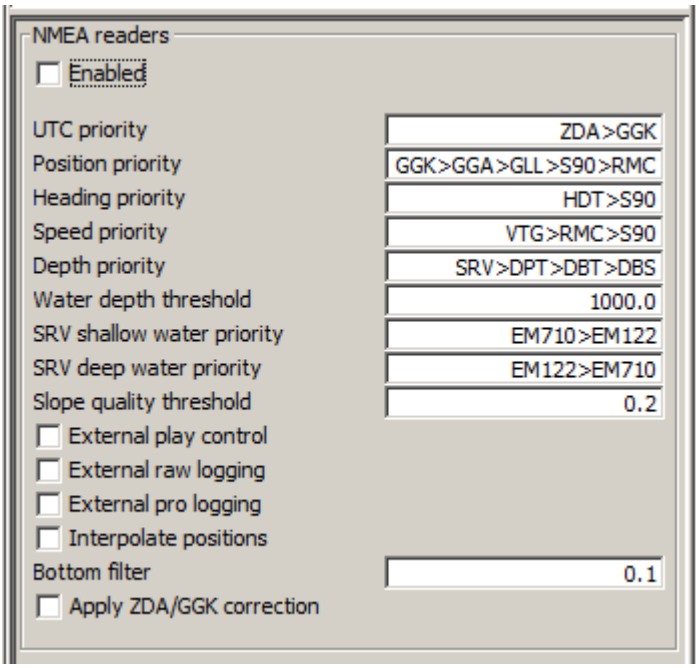
*To configure the communication parameters and save changes to `SBPInstall.xml` you need to be logged on as **Super**.*

*Note that when logged on as **Super** you also have access to change the names of the NMEA readers.*

To display the information read by all enabled NMEA readers, highlight the group NMEA readers. The NMEA input data is shown in the lower part of the property area.



If NMEA readers is highlighted, the **NMEA readers** parameters are displayed.



NMEA readers parameters

UTC priority: Priority of NMEA type datagrams for time reference

Slope quality threshold: The bottom slope is computed by the EM system connected and is used by the SBP 27 to adjust the tilt angles of the beams.

The slope calculation gives a quality measure that you can use to reject slope calculations with poor quality. Values higher than the **slope quality threshold** that you enter will be rejected, and last accepted slope values will be applied to the beams.

In the event of timeout of the EM slope data no tilt will be applied.

There are also individual slope quality thresholds for each of the NMEA reader 1 to 5. The applied slope quality threshold is the minimum value of slope quality threshold for the group of NMEA readers and the one entered for the particular NMEA reader 1 to 5 that receives the datagram.

Position priority: Priority list of NMEA type datagrams for position reference

Interpolate position: To compensate for the fact that position input are updated at different rate than the ping rate, you may enable an interpolation to compute coordinates for each ping location. If interpolation is disabled, all beams will be tagged with latest received position. If the ping rate is higher than the position input rate all beams between to position inputs will have the same position.

For each received position, the vessel speed is estimated based on the last two positions and the time interval between them. This speed is used to extrapolate positions for ping received after the last received position.

SRV shallow water priority is used to set priority between the various sources of SRV datagram in shallow water.

SRV deep water priority is used to set priority between the various sources of SRV datagram in deep water.

Water depth treshold defines the transition from shallow to deep in the context of SRV priorities.

A shallow water priority string may look like this: “EM2040>EM712>EM122” meaning SRV from the EM 2040 has priority over SRV from the EM 712, which in turn have priority over the SRV from an EM 122.

Note

Note that the model number of an EM providing SRV datagrams must be listed in the SRV shallow/deep water priority strings found under the NMEA readers.

Position filter: Filtering can be applied to reduce the effect of noisy positions. The strength of the filtering is controlled by the **Position filter** coefficient. When the **Position filter** is set to zero, no filtering is applied. If the filter coefficient is set to 0.9, the filtered vessel speed is given by 1/10 of the last speed estimate (based on the two last positions) and 9/10 of the previous value of filtered speed.

Bottom filter: A simple filter for Bottom incidence range is introduced:

BIR_{NMEA}	:	New value received by the NMEA reader
BIR	:	Value used to control the acquisition delay
α	:	The filter coefficient

Formula:

$$BIR = BIR \times \alpha + (1 - \alpha) \times BIR_{NMEA}$$

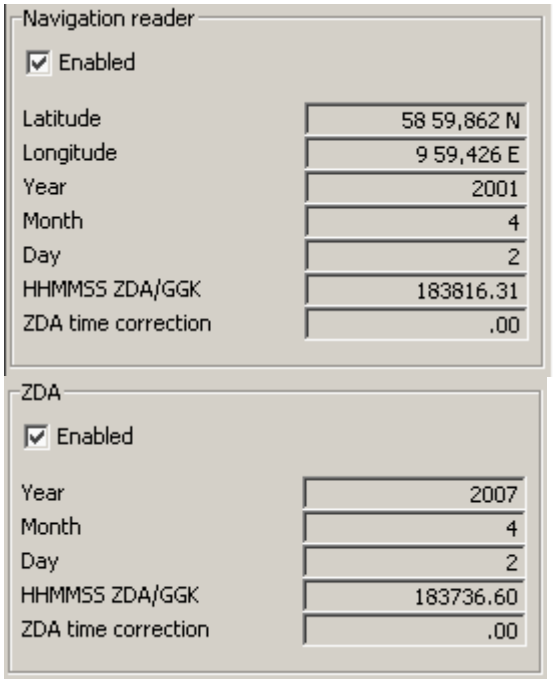
The filter coefficient is entered on the NMEA readers parameter sheet. If the filter coefficient is set to zero this means no filtering. A large filter coefficient may be useful when the EM provide bad values under difficult survey conditions on a relatively flat seafloor, but will be bad for “steep” slopes and “rough” terrain.

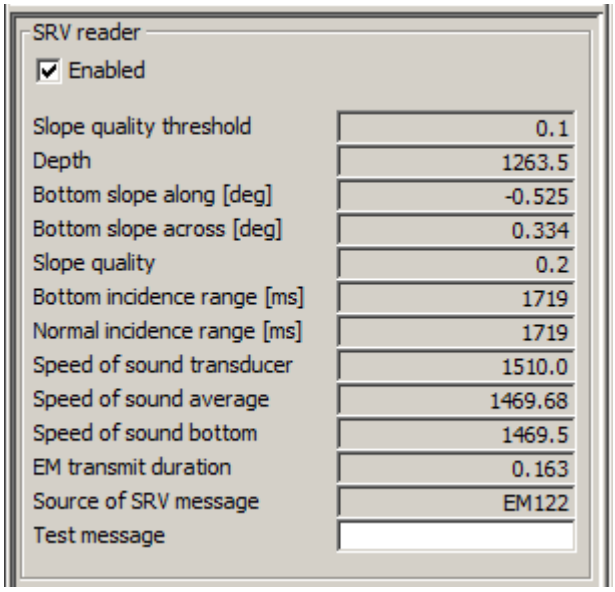
Apply ZDA/GGK correction: Checkbox for enabling or disabling the use of clock correction from the NMEA ZDA or GGK correction

NMEA reader examples

To see the information read by a specific NMEA reader only, highlight the reader of interest. Examples are shown on the next pages.

To avoid a large number of error messages, it is recommended to disable readers that are not being used.





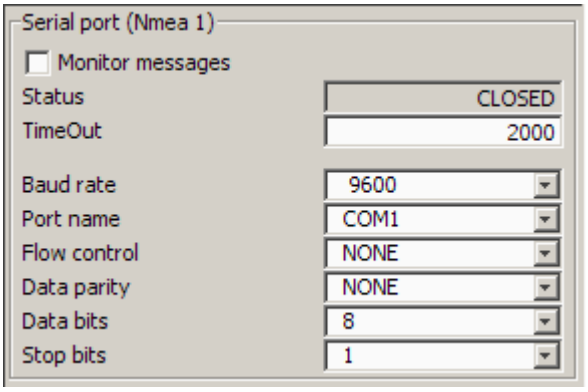
NMEA reader 1 to 5

The **NMEA reader 1 to 5** parameter sheets are accessed from **Readers and writers→NMEA readers→NMEA reader n** (where n is a number 1 to 5) located under the **System** tab.

When logged on as **User** you will only have access to enable or disable the NMEA input.

When logged on as **Root** the following parameter settings becomes available:

- **NMEA port n:** Select **Port type** from **Serial port** or **UDP port**
- **Serial port (NMEA n):**

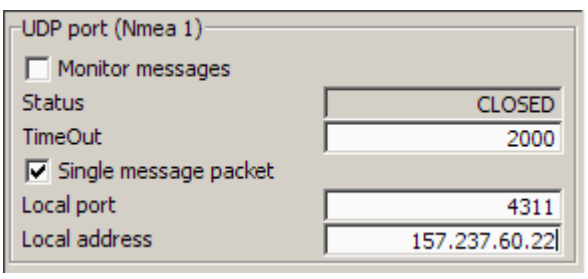


  - **Monitor messages:** Check this box if you want to display all NMEA datagrams in a separate window. This window will also allow you to **Add a time stamp** to the datagrams and to **Log to file**.
  - **Status:** Display current status of the COM port
  - **TimeOut:** Specify time-out of the port in milliseconds.
  - **Baud rate:** Specify baud rate of the input on the serial port
  - **Port name:** Select serial port for NMEA input. Can be set from COM1 to COM 8. Definition of the COM port names and addresses must be defined by your hardware and computer setup.
  - **Flow control:** Specifies whether flow control is being used. Can be set to *XON/XOFF* or *Hardware*
  - **Data parity:** Select data parity of the NMEA serial input. Can be set to *ODD*, *EVEN* or *NONE*
  - **Data bits:** Select data bits of the NMEA serial input.
  - **Stop bits:** Select number of stop bits of the NMEA serial input.

  Note

  Serial communication parameters must be set according to the setup used to output the NMEA data.

- **UDP port (NMEA n):**



- **Monitor messages:** Check this box if you want to display all NMEA datagrams in a separate window. This window will also allow you to **Add a time stamp** to the datagrams and to **Log to file**.
- **Status:** Display current status of the UDP port
- **TimeOut:** Specify time-out in milliseconds of the UDP port
- **Single message package:** Check this box if you want the NMEA datagrams to be sent message by message, which will assure that no messages are lost due to incomplete contents.
- **Local port:** Specify the port number for NMEA input on your computer
- **Local address:** Specify the port address for the NMEA input on your computer

Printer

The **Printer** parameter sheet is accessed from **Printers→Printer** located under the **System** tab.

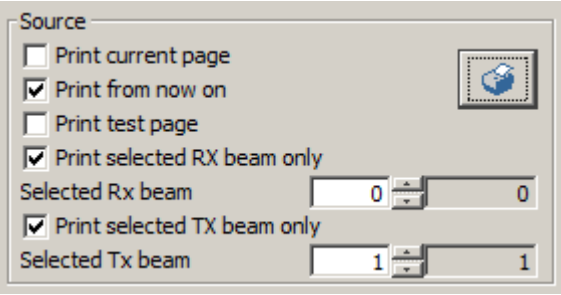
The **Printer** will print specified selection of the Echogram.

Two printers can be configured, and when they are configured the printer or drive name will be displayed; otherwise the names of these objects will be Printer 1 and Printer 2. Printer 1 is by default setup as a JPEG printer. A number of other printer types are available, but must be configured for each installation.

Note

*New printer types can be configured for use when logged on as **Super** user.*

Printer parameters



Source

- **Print current page** – prints current view
- **Print from now on**– prints from current trace (ping)
- **Print test page** – prints a test page demonstrating the colour scale

- **Print selected RX beam only** – prints data from selected RX beam only
  - Select RX beam number to be printed
- **Print selected TX beam only** – prints data from selected TX beam only
  - Select TX beam number to be printed
- Press  to start print

  If you are printing to the JPEG printer you will be prompted for file name and location.

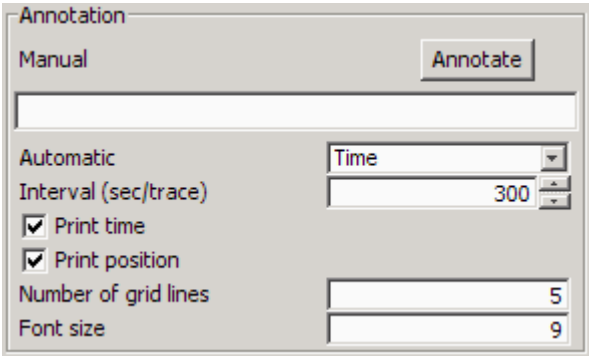
  Important

  File extension **.jpg** must be added to the file name for JPEG printing.

Colours

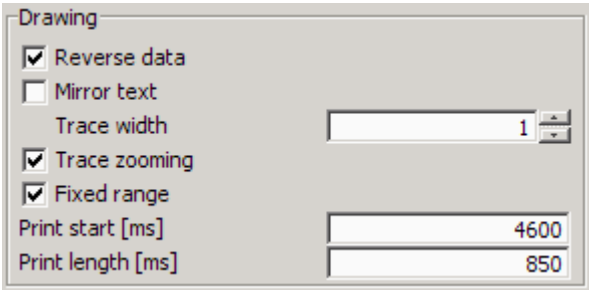
Set colour scheme of the prints.

The colour definitions are described in *Legend 1, 2 & 3* on page 101



Annotation

- **Manual:** Enter an annotation in the text field, e.g. describing what you see or parameter chenges. By pressing the **Annotation** button the annotation will be printed.
- **Automatic:** Select if annotation is active synchronized to **Time** or **Ping**
- **Interval (sec/trace):** Selects interval size for automatic annotation.
- **Print time:** Select if you want to print time/date info
- **Print position:** Select if you want to print position
- **Number of grid lines:** Sets the number of grid lines to be printed
- **Font size:** Select annotation font size



Drawing

- **Reverse data:** Select to print data in from right or from left
- **Mirror text:** Depending on your printer type, the text may need to be mirrored to be visible
- **Trace width:** Selects the print width for each ping in number of ”pixels” on the current printer
- **Trace zooming:** Select to enable printing of a reduced part of the full trace
- **Fixed range:** Select to enable printing of a fixed range of the full trace
- **Print start [ms]:** Sets start point of the trace to print
- **Print length [ms]:** Sets the length of the trace to print

Printer example settings

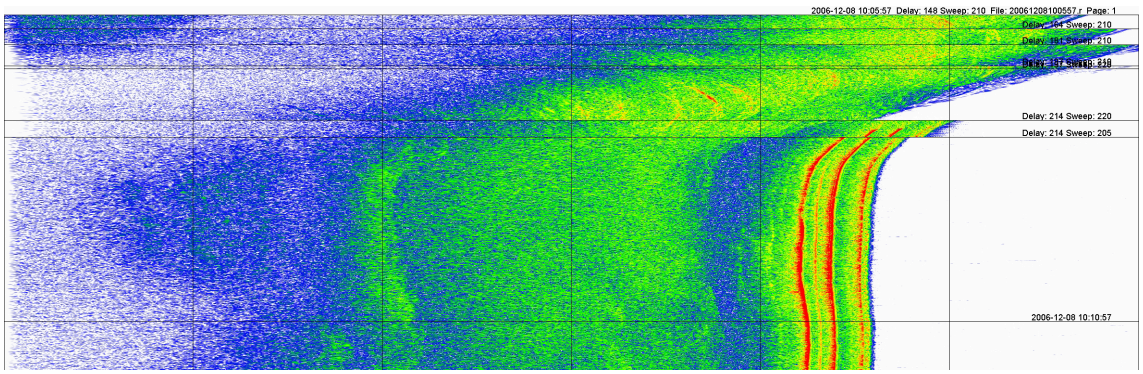
Below examples are prints of the same dataset, only using different printer parameters.

Trace zooming disabled

When **Trace zooming** is disabled the full paper width will be used for printing. For each time the acquisition window/acquisition delay is changed the origin of the print must be changed. An annotation showing the new delay is added to the print.

In areas with rapidly changing depth the prints will appear discontinuous, and may be difficult to read.

Figure 14 No trace zooming



Trace zooming enabled

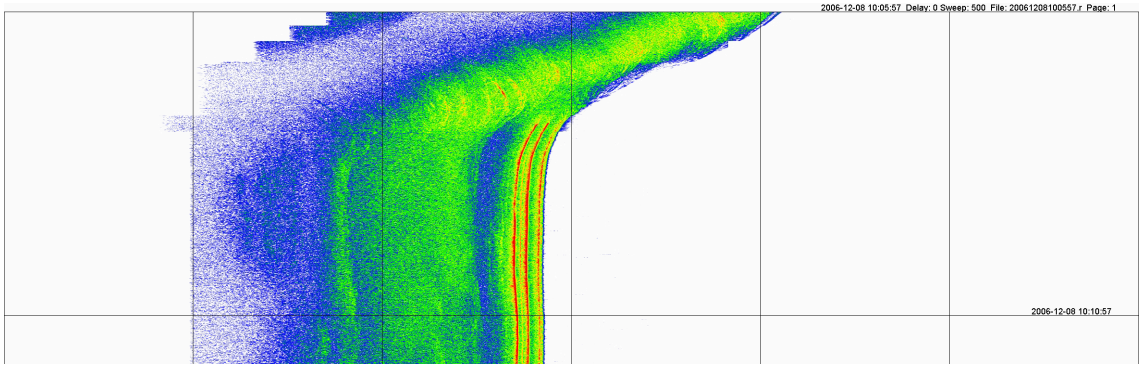
With **Trace zooming** enabled only a portion of the paper width is used for printing the trace. This allows the trace to shift within the paper width without discontinuity. However, if the trace exceeds the paper width the trace is shifted and printing is continued.

The print is scaled according to **Print start** and **Print length** where **Print length** sets the paper width in terms of trace length in milliseconds, whilst **Print start** sets the where in the trace to start printing.

Example below starts at 0 ms and is 500 ms wide.

This function will normally give best readability for online printing.

Figure 15 Trace zooming

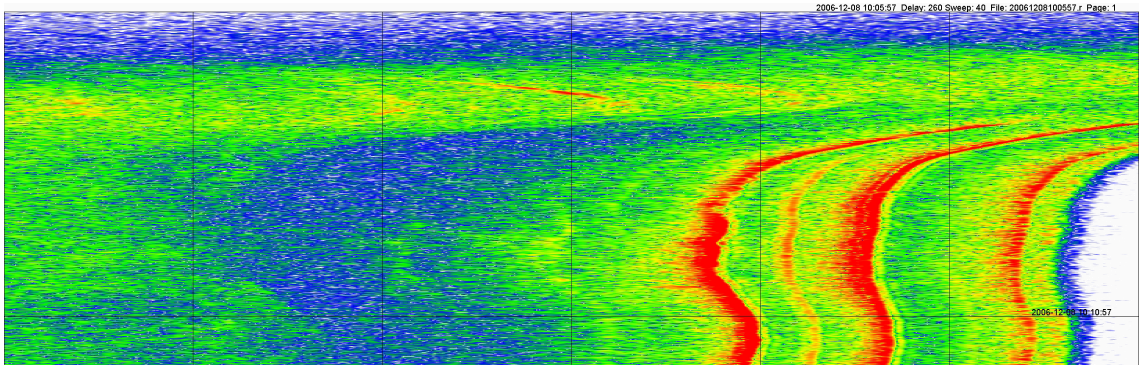


Trace zooming and fixed range enabled

With **Trace zooming** and **Fixed range** enabled, you may select an area of interest to print. This may in particular be useful to investigate e.g. artefacts during replay.

Example below shows a print selected with **Print start** at 260 ms and **Print length** at 40 ms

Figure 16 Trace zooming and fixed range



Printer configuration

Note

*You have to logged on as **Super** user in order to have access to **Printer configuration**.*

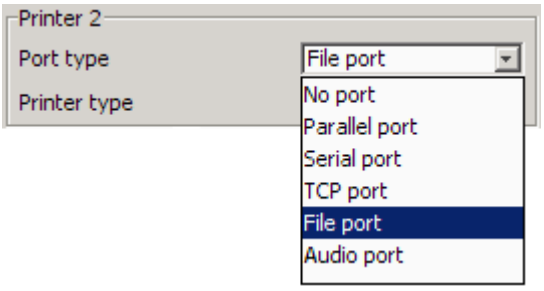
When logged on as **Super** a number of additional tabs becomes available. **Printer 1** and **Printer 2** configuration is accessed from **Printers** located under the **Setup** tab.

Maximum two printers may be used at the same time.

Printer 1 & 2 configuration parameters

The configuration sheet depends on Printer type selected.

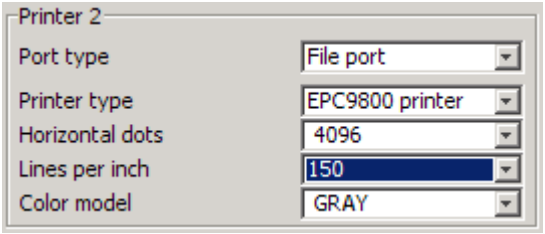
Port type: Select the port the printer is connected to.



Printer type: Specifies the printer model connected to the selected port. The choices are:

- No printer
- Analog printer (using Audio output)
- JPEG printer (for printing high resolution to file)
- GSP1086 printer (EPC)
- HSP100 printer (EPC)
- Ultra and Waverly printers (now Coda Octopus)
- EPC9800 printer
- Epson ESC/P2 printer
- PCL printer (HP DeskJet/LaserJet)

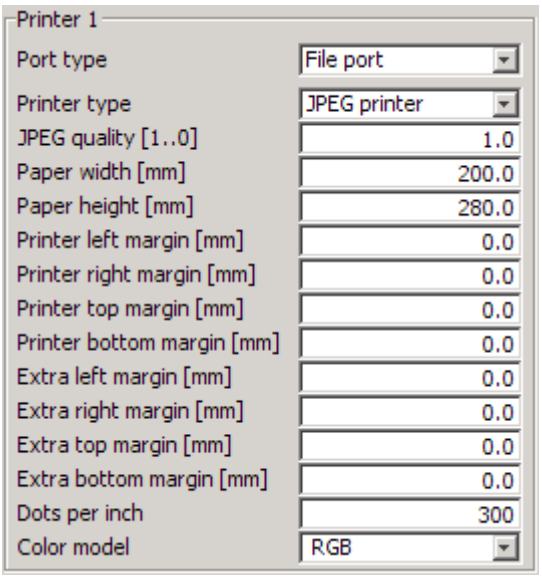
Gray scale recorder



- **Horizontal dots:** Number of dots per sweep on grey scale recorders.
- **Lines per inch:** Sets the lines per inch for the **EPC9800** printer. This item is only visible when **EPC9800** printer is selected.

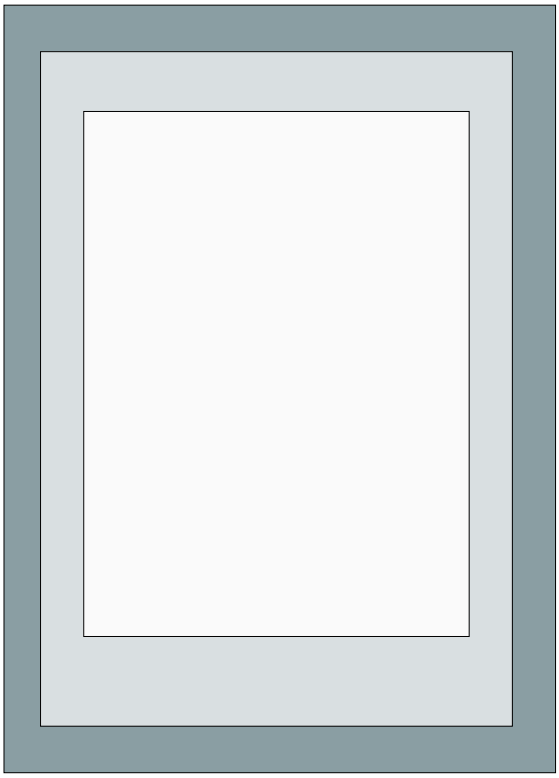
- **Colour model:** Colour model used; only **grey** for line scan recorders.

Colour printers



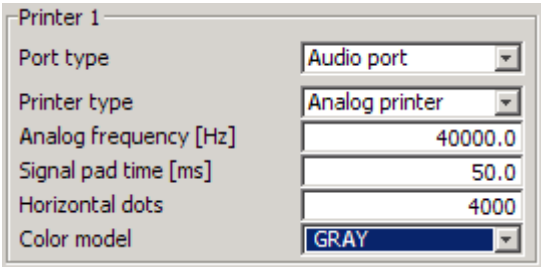
- **JPEG quality [1..0]:** Specifies print quality for printing to a file in JPEG format. Selecting 1 gives best quality. This option is only available when JPEG printer is selected.
- **Paper width [mm]:** Physical width of the paper the paper used.
- **Paper height [mm]:** Physical height of the paper used. A value of zero indicates continuous paper.
- **Paper left margin [mm]:** Width of the left hardware dependent margin.
- **Paper right margin [mm]:** Width of the right hardware dependent margin.
- **Paper top margin [mm]:** Width of the top hardware dependent margin.
- **Paper bottom margin [mm]:** Width of the bottom hardware dependent margin.
- **Extra left margin [mm]:** Width of the additional user defined left margin.
- **Extra right margin [mm]:** Width of the additional user defined right margin.
- **Extra top margin [mm]:** Width of the additional user defined top margin.
- **Extra bottom margin [mm]:** Width of the additional user defined bottom margin.
- **Dots per inch:** Sets the printer resolution on the paper. The values are depending on the printer model.
- **Colour model:** Specifies the colour model to use with the printer. Typical choices are (context sensitive): BW, CMY, CMYK, RGB.

The paper/margin description is shown in the following figure where the grey tones define relevant areas on the paper. Dark grey defines the physical paper, the light grey defines the area printable by the printer and the white area is the area where acoustic data are printed. The margin given as dark grey is given by the actual printer documentation.



cd22302

Analog printer

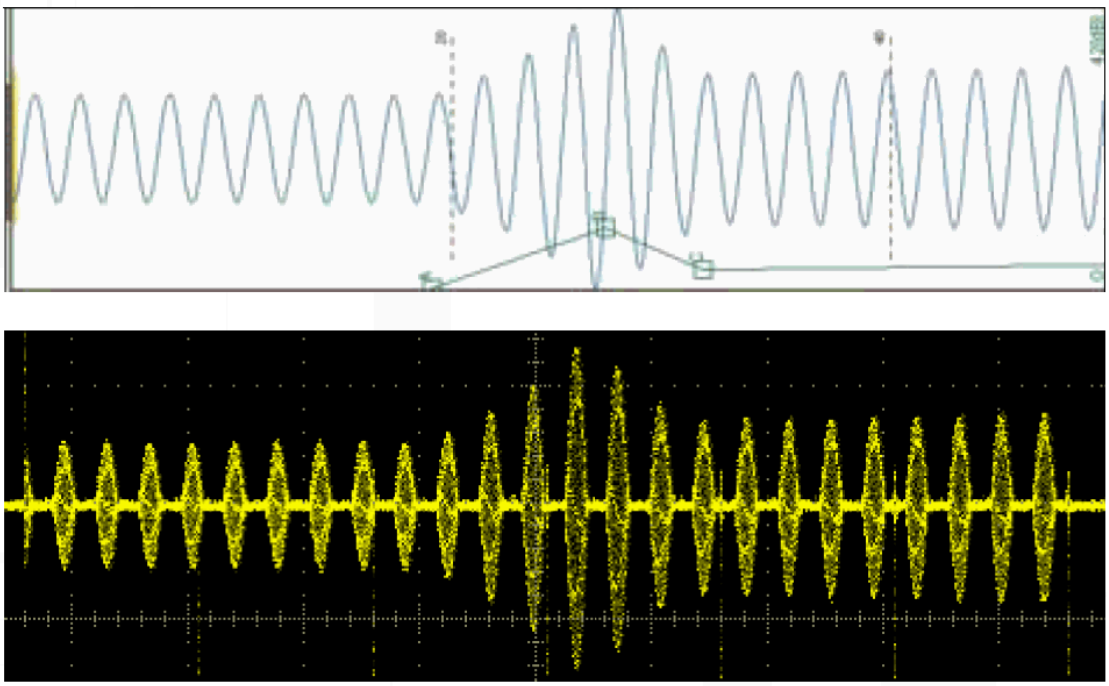


- **Analog frequency [Hz]:** Sampling frequency with which data are supplied to the audio output.
- **Signal pad time [ms]:** Padding of the signal trace for reducing problem with writing new data before old data are clocked out.
- **Horizontal dots:** Number of samples to send to the audio output. Duration of the output signal is fixed equal to <Horizontal dots>/<Analog frequency>. Any time duration of the recorded data is mapped into this fixed length.

The TOPAS data shown in the first of the two next figures is a snapshot of a 50 ms data trace from the QC display on the operator console.

The lower figure shows what is sent to the audio output for use by an analog printer. The system is here set up for printing negative signal values and a fixed duration of 90 ms (3600 samples at 40 kHz).

The analog printer must be set up for printing both positive and negative values.



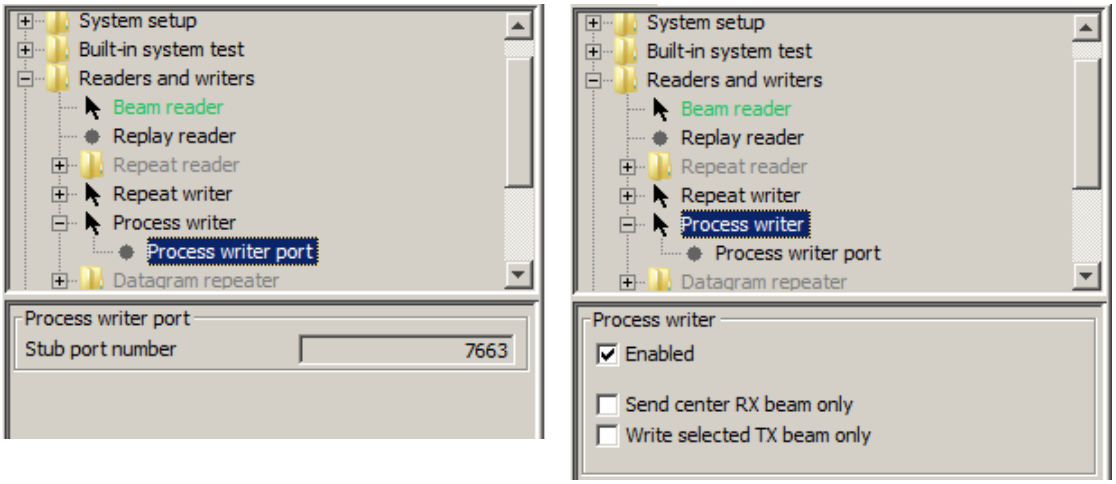
Process writer

The **Process writer** is found in the processing chain and its parameter sheet is accessed from **Readers and writers→Process writer** located under the **System** tab.

When the **Process writer** is enabled processed data will be copied to the port number specified in the parameter sheet. **Process writer** enables a remote computer running the SBP software in slave mode to subscribe to processed beam data.

The position of the **Process writer** in the **Processing chain** determines what processing is applied to the data. It can be moved freely up/down in the processing chain. If located at the bottom of the processing chain, the data received by a slave unit will be identical to the data displayed in the Echogram area of the master system. To configure the **Process writer** you must be logged on as **Root**.

Process writer port parameters



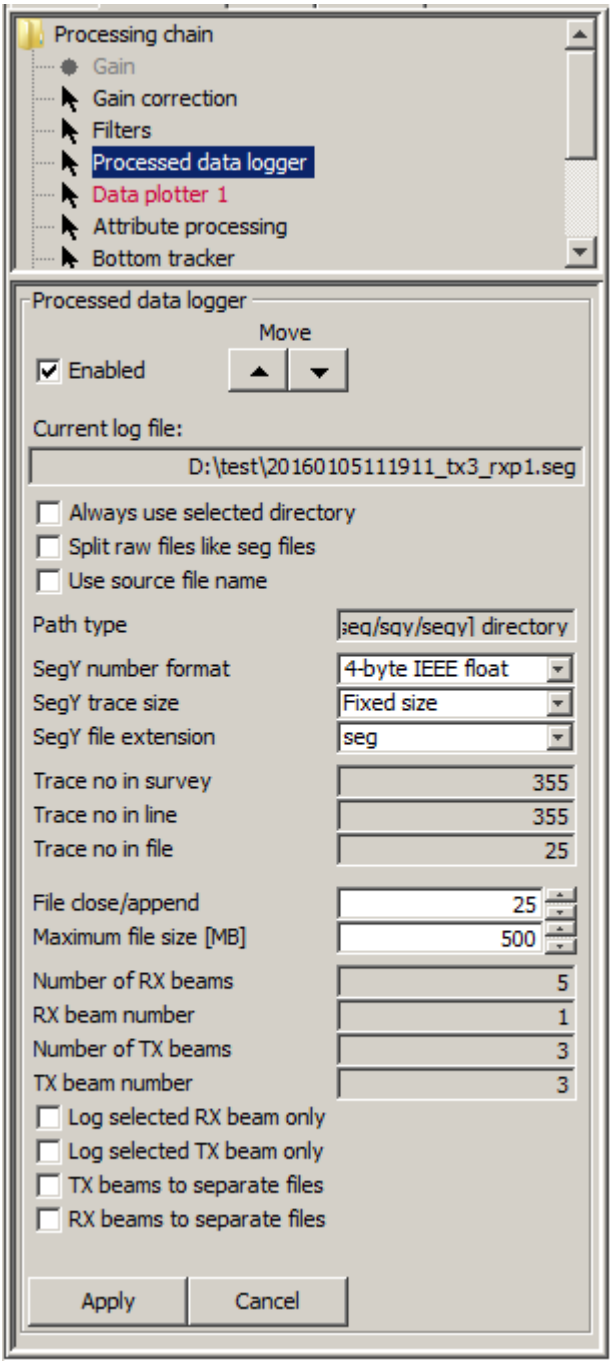
Stub port address: Port number for data transmission.

Processed data logger

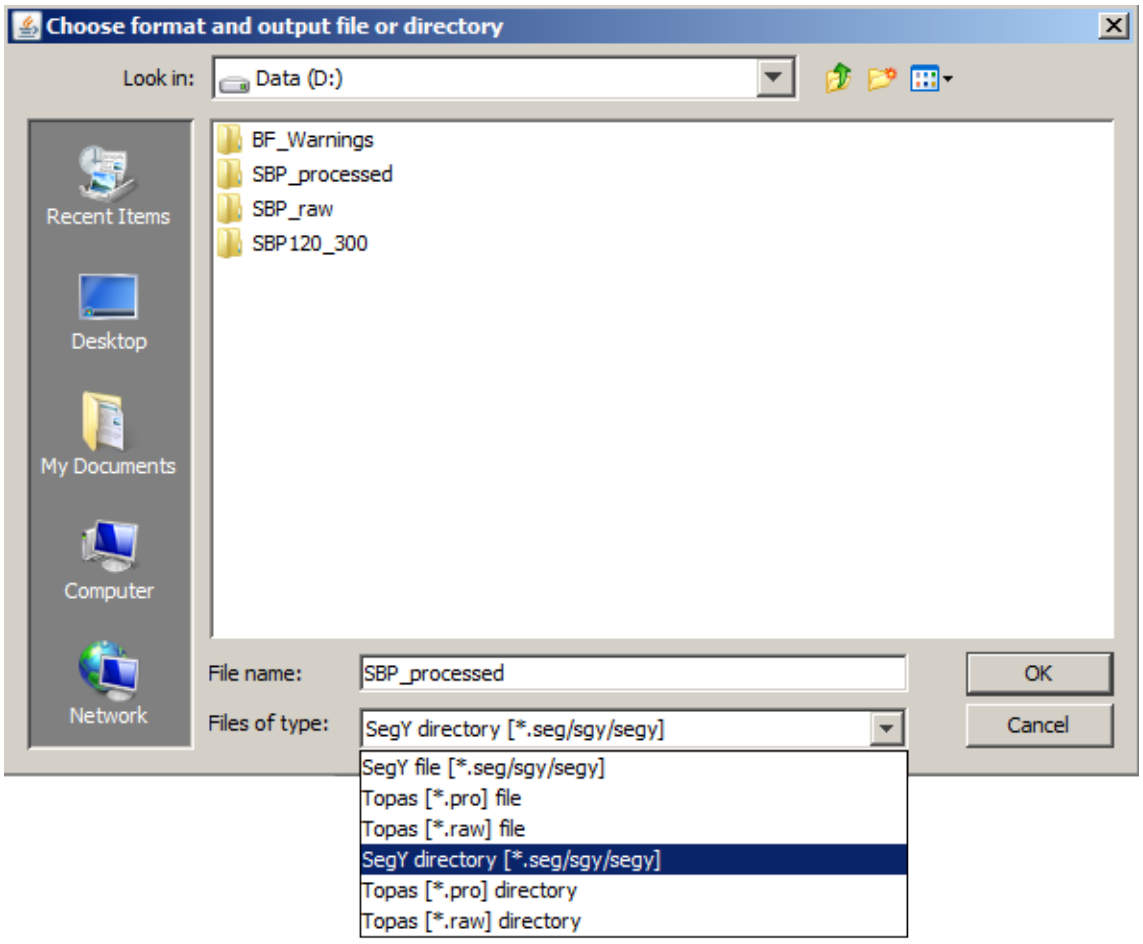
The **Processed data logger** parameter sheet is accessed from the **Processing** tab.

The **Processed data logger** is used for setting up data logging of processed data.

Note that the position of the parameter sheet in the processing chain determines what kind of data is stored. When the Processed data logger is positioned on top of all other enabled items in the processing chain, it logs data in the RAW format. This way the Processed data logger may be used to extract a part of an existing RAW file. If **Processed data logger** is positioned after the e.g. Matched filter is applied, it logs pulse compressed data.



When you check the **Enable** check box, a dialogue box will appear. Choose the format you want to log in, and select if you want to log to file or directory. Press OK when you are done.



Processed data logger parameters

Current log file: Path and name of the current log file

Split raw files like seg files: Checkbox for selecting file splitting based on parameter changes similar to the SEG Y format splitting.

Path type: Displays file format and whether it is a file or directory

Trace no in survey: A counter for the current survey

Trace no in line: A counter for the current line

Trace no in file: A counter for the current file

File close/append: Selects number of pings between close – append action to the log file. This will protect the system from losing a completed data file if the system crashes during operation. No more than the selected number of pings will in worst case become lost.

Max file size [MB]: Use the arrow buttons or the text field to enter the maximum file size you want for your files or directories. When the size of a file exceed this values, a new file will be created

Log selected RX beam only: Enable this if you want to log a single beam from data containing a number of receiver beams

Selected RX beam number: Select the RX beam you want to log.

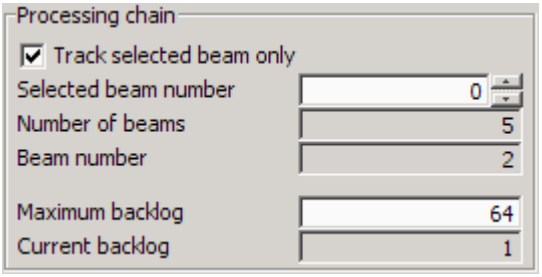
Log selected TX beam only: Enable this if you want to log a single beam from data containing a number of transmitter beams

Selected TX beam number: Select the TX beam you want to log.

Processing chain

The real-time processing and post-processing available in SBP 27 is located under the **Processing** tab in the property area.

The parameter sheet for the Processing chain contains parameters for selection of beams used for bottom tracker and for display in the single trace area.



Processing chain parameters

Track selected beam only: Enable this checkbox if you want to use one selected beam only for display and for the **Bottom tracker**.

Selected beam number: Select the beam you want to display or use for bottom tracking. This may often be the centre beam, i.e. beam number 0, which normally gives the best signal.

Number of beams: Shows number of beams in the data.

Beam number: Shows what beam is currently being processed.

Maximum backlog: Highest allowable number of beams that can be queued up in the memory of the Operator Station for processing.

Current backlog: Number of not yet processed beams in memory. If current backlog exceeds maximum backlog the computer is to heavy loaded, and data may be lost.

Note

To prevent loss of data in a case of queued up data in memory, maximum backlog must never be set smaller than number of beams. We also recommend adding a margin to number of beams.

Related topics

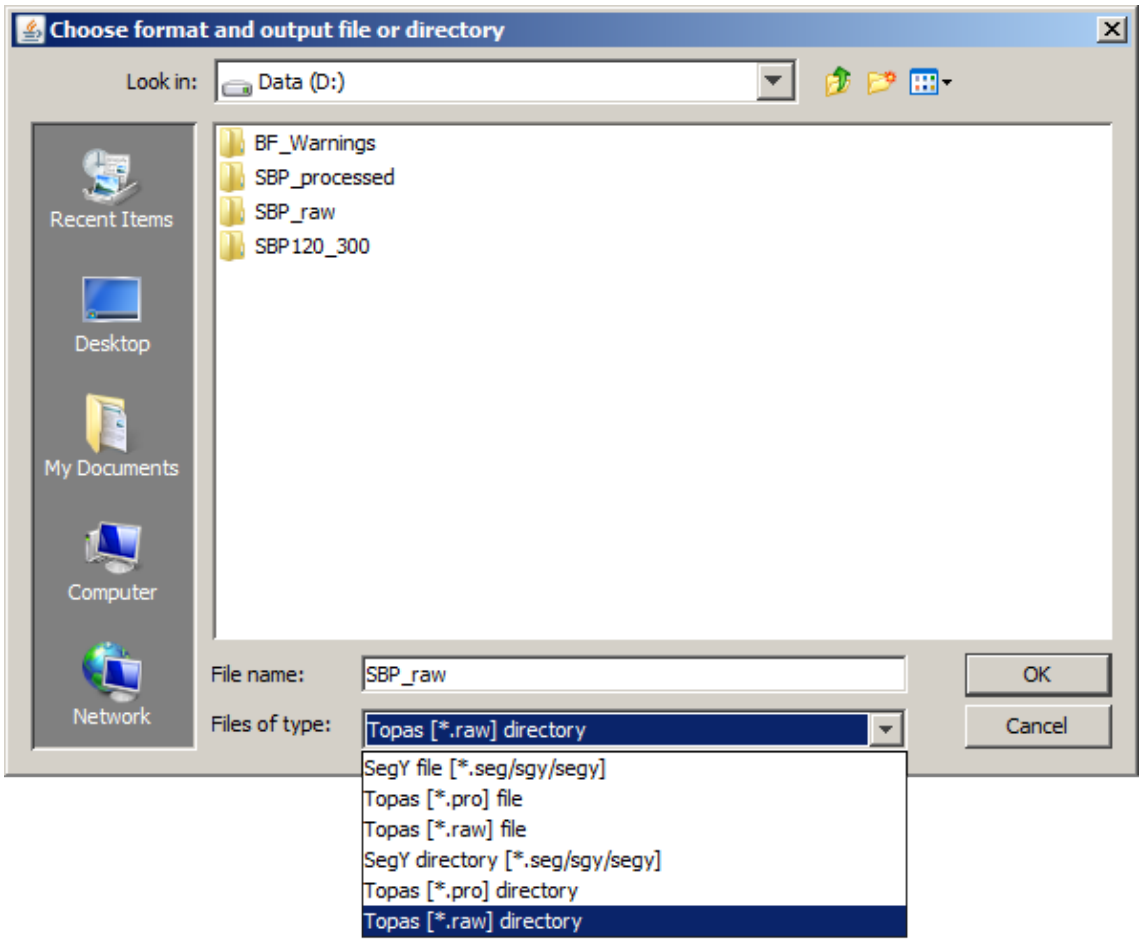
- *Bottom tracker* on page 80

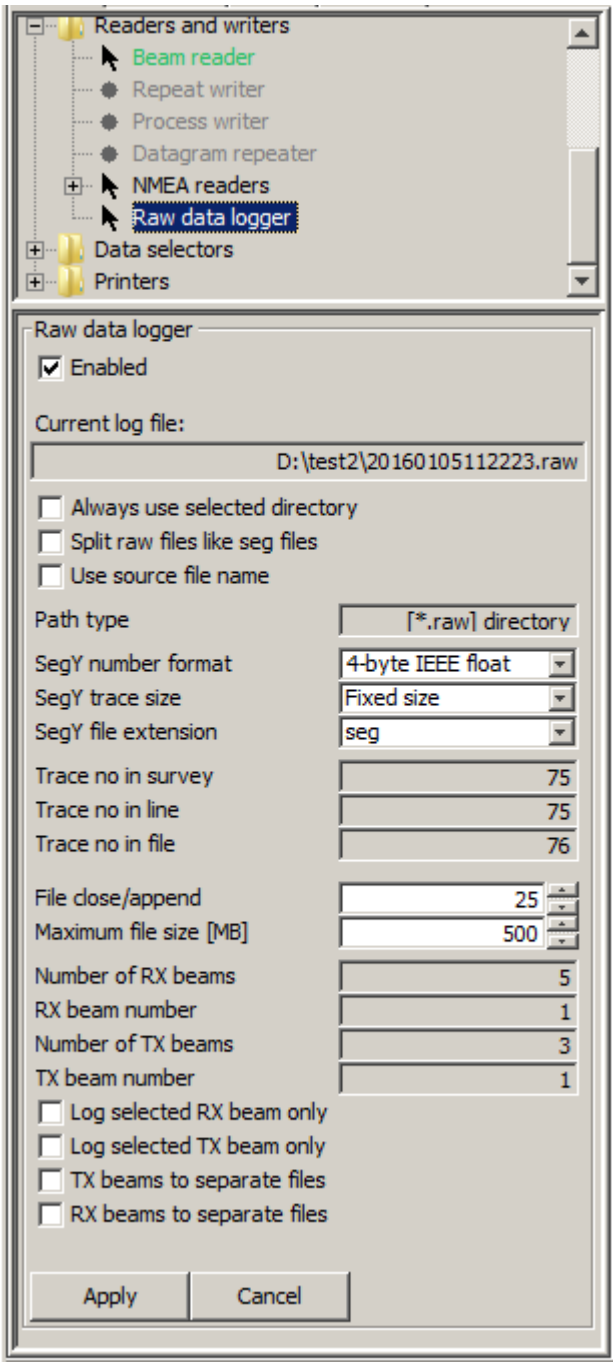
Raw data logger

The **Raw data logger** parameter sheet is accessed from **Readers and writers→Raw data logger** located under the **System** tab.

The **Raw data logger** is used for setting up raw data logging parameters.

When you mark the check box for **Enabled**, a file open dialogue box will appear. If the check box is already marked, uncheck it and check it again. Choose the format you want to log in. Select if you want to log to file or directory. Press **OK** when you are done.





Raw data logger parameters

Current log file: Path and name of the current log file

Split raw files like seg files: Checkbox for selecting file splitting based on parameter changes similar to the SEG Y format splitting.

Path type: Displays what kind of format and if it's a file or directory

Trace no in survey: A counter for the current survey

Trace no in line: A counter for the current line

Trace no in file: A counter for the current file

File close/append: Selects number of pings between close – append action to the log file. This will protect the system from losing a completed data file if the system crashes during operation. No more than the selected number of pings will in worst case become lost.

Max file size [MB]: Use the arrow buttons or the text field to enter the maximum file size you want for your files or directories. When the size of a file exceed this values, a new file will be created

Log selected RX beam only: Enable this if you want to log a single beam from data containing a number of receiver beams

Selected RX beam number: Select the RX beam you want to log.

Log selected TX beam only: Enable this if you want to log a single beam from data containing a number of transmitter beams

Selected TX beam number: Select the TX beam you want to log.

For more information about Logging, refer to *Logging data* on page 35.

Repeat reader

The **Repeat reader** parameter sheet is accessed from **Readers and writers→Repeat reader** located under the **System** tab.

Repeat reader is used in **slave mode** to read a copy of the beam data sent on the network as specified in *Repeat writer* on page 127. The slave computer can then run the SBP 27 software with the same beam data as the master system, but independently with respect to realtime and post processing.

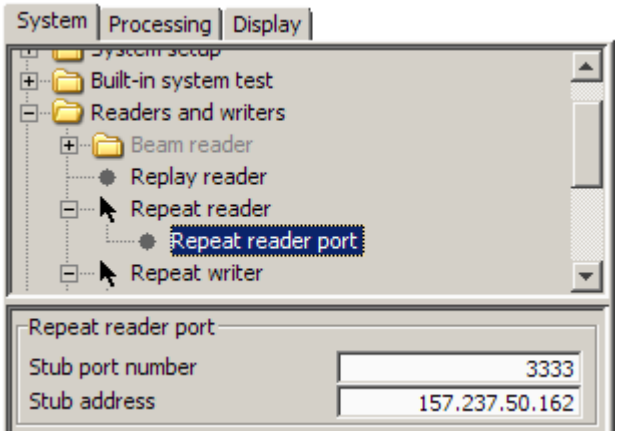
The beam data from the master system can either be realtime, i.e. the master system operates in survey mode, or it can be replayed data from the master system.

When you mark the check box for **Enabled** beams from the master system will be read. Data that are read will be displayed in the **Repeat reader** parameter sheet.

For parameter description refer to *File reader* on page 92

To configure the **Repeat reader** you must be logged on as **Root**. Then you will have access to the **Repeat reader port** parameter sheet located under the **Repeat reader**.

Repeat reader port parameters



Stub port number: Enter the stub port number for the repeat writer on the master system.

Stub address: Enter the IP address of the master system.

Repeat writer

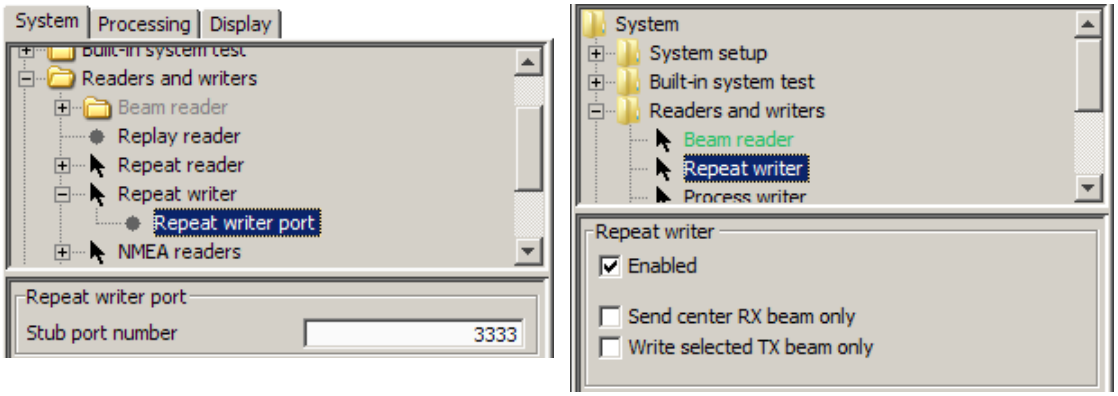
The **Repeat writer** parameter sheet is accessed from **Readers and writers→Repeat writer** located under the **System** tab.

When you mark the check box for **Enabled** beams from the master system will be copied to the specified port number. .

Repeat writer enables a remote computer running the SBP 27 software in slave mode to subscribe to the raw beam data.

To configure the **Repeat writer** you must be logged on as **Root**. You will have access to the **Repeat writer port** parameter sheet located under the **Repeat writer**.

Repeat writer port parameters



Stub port address: Port number for data transmission.

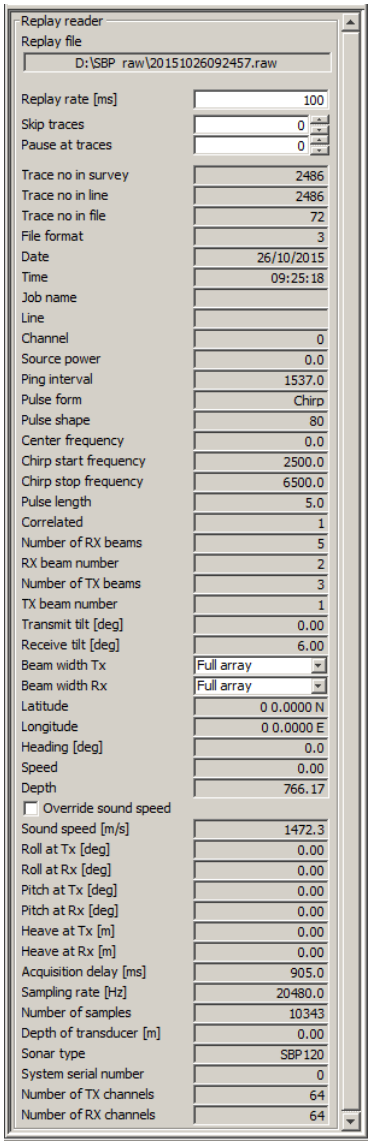
Replay buttons

The **Replay buttons** are located right above the Echogram area.

Replay mode

Click this button	To
	Start replay
	Do single step replay
	Do single fan step replay
	Hold replay
	Log processed data – enables **Data logger** in **Processing chain**

Replay reader



The **Replay reader** parameter sheet is accessed from **Readers and writers→Replay reader** located under the **System** tab.

The **Replay reader** parameter sheet display parameter values read from the file that is being replayed.

Replay reader parameters

Replay file: Gives you information about which file is replayed and where it is located

Replay rate (ms): Sets minimum time interval between reading pings from file

Skip traces: sets the number of traces to skip in order to compress the data horizontally.

Pause at trace: Stops replay at trace number specified.

Override sound speed: Checkbox for overriding the stored sound speed values during processing.

The remaining parameters displayed are header information in the traces stored on file.

See *File formats* on page 177 for description.

Restart

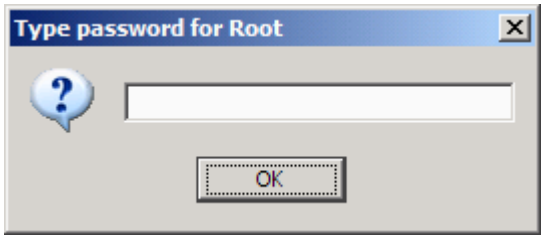
Restart is accessed from the **File** menu.

When you select **Restart**, a reset command is sent to the Transceiver Unit to perform a software restart.

If the TRU has been subject to a power reset, the connection between the TRU and the operator unit is lost, and the TRU starts broadcasting “here-I-am”-messages. There is no need to restart the operator software. Using the Restart command will make the operator unit listen for these messages so that the connection between the units of the system can be re-established.

Root

The **Root** dialog box is accessed from the **LogOn** menu.



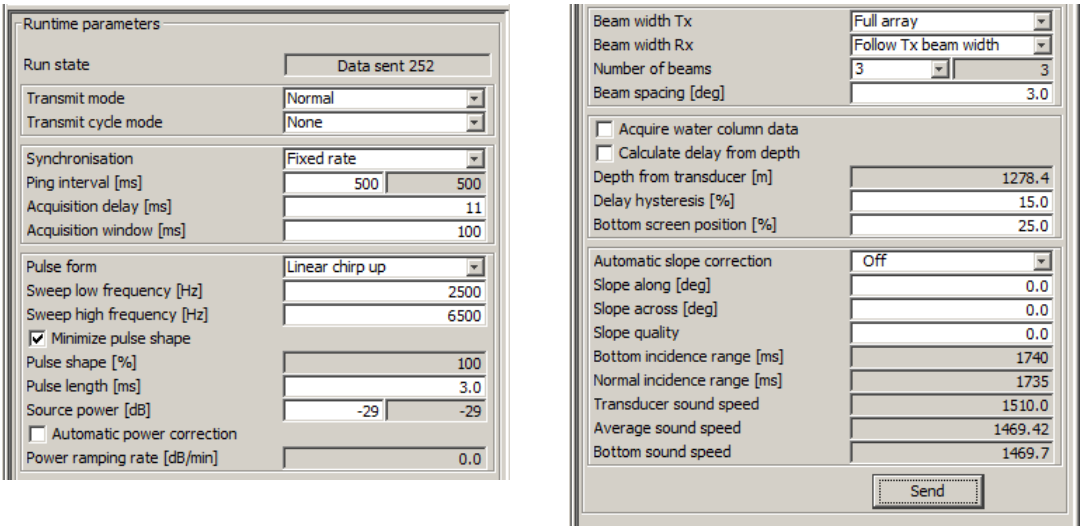
When logged on as **Root**, you get access to most of the parameters. The parameters that are grey when a normal user is logged on will turn white as an indication of this.

Runtime parameters

The **Runtime parameters** parameter sheet is accessed from **System setup→Runtime parameters** located under the **System** menu.

Note

The runtime parameters are visible in Replay mode only when Root is logged on.



White fields can be changed, grey fields can not. Changed, but not yet applied parameters are displayed with yellow background. Applied parameters are white, whilst illegal parameters are shown with a red background.

Note

Note that the parameter sheet will appear differently depending on transmit mode and pulse form selected.

Runtime parameters

The runtime parameters are explained in more details in *Main operational modes* on page 162.

Run state: Install state reports response to the Runtime parameters sent to the TRU.

The following states may be reported:

- No data sent
- Wait for ACK
- Data sent N – where N is incremented for each data package sent
- Retry N – where N is incremented for each retry
- Message error N – where N is incremented for each error message
- Write error N – where N is incremented for each write error
- Runtime disabled

Transmit mode

- **Transmit mode:** Choose between *Normal*, *Burst*, *Single pulse* or *Off*
- **Max burst pulses:** Applicable to *Burst* mode only. Enter the desired maximum number of pulses per burst cycle in the first text field. Legal values are from 1 to 20. The second text field shows the achieved number of pulses per burst cycle.
- **Burst pulse delay [ms]:** Time between burst pulses
- **Transmit cycle mode:** Choose between None, Cycle tilt angle and Cycle beam width.

  Note

  NOTE for systems with a 12 degree TX the Cycle beam width option is not available

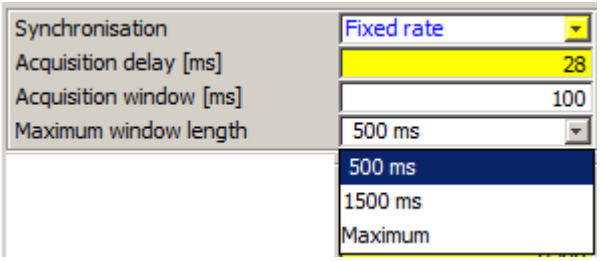
  See *Transmit cycle modes* on page 164 for technical details.
- **Pings in cycle:** Visible when Cycle tilt angle is selected. Choose from 2 to 11 pings
- **Tilt step [deg]:** Visible when Cycle tilt angle is selected. Specify the desired tilt step angle. Maximum tilt angle allowed is 15 degrees.
- **Beam widths:** Visible when Cycle beam width is selected. Choose between 3°/6°, 6°/12°, 3°/12° and 3°/6°/12° degrees for a 3 degree transmit array. For a 6 degree transmit array only 6°/12° is available.

Synchronization

- **Synchronisation:** Choose between *EM trigger*, *External trigger* or *Fixed rate*. To run the system independently of other systems select *Fixed rate*.
- **Ping interval:** Applicable to *Normal* mode only. Enter desired ping interval in first text field. Legal values range for Ping interval is from 200 ms to 120 000 ms. The actual value depends on wavelet type, water depth and operation mode. Typical values in shallow areas are 300 to 500 ms in Burst and Ricker modes, and 1000 ms in Chirp mode. Actual ping interval will be shown in second text field.
- **Acquisition delay [ms]:** Time from transmit start to start of data acquisition. See figure *Acquisition delay and acquisition window* on page 136.The maximum legal value is 20000 ms. The minimum legal value is depending on the pulse length.
- **Acquisition window [ms]:** Duration of a single data acquisition [ms]. See figure *Acquisition delay and acquisition window* on page 136. Legal values are from 5 ms to **Maximum window length**.

- **Maximum window length [ms]:** For **Super** Three values are available:
  - 500 ms for backwards compatibility
  - 1500 ms for compatibility with SEG Y (default)
  - 15000 ms (Maximum) for studies of noise/reverberation

  Factory default is 1500 ms. Note that a longer maximum trace length is not compatible with SEG Y. To change the maximum trace length, log on as **Super** and the following drop-down menu will appear on the runtime parameter sheet.



- **Reduce EM<>SBP crosstalk:** Visible only when the system is set to be synchronized. We recommend to keep this checked.

Pulse form

- **Pulse form:** Choose between *CW pulse*, *Linear chirp up*, *Linear chirp down*, *Hyperbolic chirp up*, *Ricker pulse* and *No pulse*.
  - **CW pulse:** Continuous wave pulse of constant amplitude and frequency.
  - **Chirp:** A chirp is a signal in which the frequency linearly or hyperbolical increases (up-chirp) or decreases (down-chirp) with time. This wavelet is a coded wavelet where the signal energy is stretched out in time. The bandwidth is determined by the start and stop frequencies for the sweep. On reception of this wavelet, matched filtering is required in order to concentrate the energy into a narrow pulse
  - **Ricker:** The Ricker wavelet is a single pulse with nice time domain behaviour for high-resolution work. This wide-band wavelet requires a high signal-to-noise ratio for optimal performance
- **CW pulse frequency [Hz]:** Applicable to **CW** pulse only.
- **Sweep low frequency [Hz]:** Applicable to **Chirp** pulse only. Start frequency determining the bandwidth.
- **Sweep high frequency [Hz]:** Applicable to **Chirp** pulse only. Stop frequency determining the bandwidth.
- **Minimize pulse shape:** Check this to have the taper minimized automatically when pulse length is changed.
- **Pulse shape [%]:** If this parameter is set to 100 a Hanning window of length equal to the pulse length is used to taper the pulse. When **Minimize pulse shape** is checked minimum shaping is applied and this parameter is updated automatically if the pulse length is changed. A harder taper can be applied by unchecking the **Minimize pulse shape** and specifying the Pulse shape percentage manually. See *Amplitude shaping – and pulse shape parameter* on page 176 for details.

- **Pulse length [ms]:** Transmitted pulse length. Will be rounded to an integral number of wavelength. Legal values are from 2 ms to 100 ms
- **Source power [dB]:** Source power measured in dB. Legal values are from -30 dB to 0 dB

  Selected value is displayed in the left field, whilst current value is displayed in the right.
- **Automatic power adjustment:** Check this to have the transmit power level automatically adjusted to reduce amount of clipping in the pre-amplifier when the return signals are very strong. Typically the strongest signal is is the bottom return and possibly reflections from shallow sediment interfaces of high contrast.

  Note

  In the raw files, data for each trace are stored with unscaled amplitude when the transmit power level varies so accurate information is preserved.

  In the SEG Y files the transmit power level is only stored in the file header. To avoid numerous small files as the transmit power level is varying this is what happens:

  – *The desired power level is stored in the SEG Y data file header.*

  – *The trace samples are scaled to compensate for the difference between desired power level and actual power level.*

  If this is unacceptable refrain from using the option of automatic power adjustment.

- **Power ramping rate [dB/min:]** For mammal protection you may increase the source power from lowest level (-30 dB) up to selected source power by a number of dB per minute.

  When you stop pinging the source power will after a timeout threshold of 2 minutes decrease the source power to lowest level by the set number of dB per minute.

  When set to 0 the power ramping is disabled.

Beams

- **Beam width Tx:** Choose between Full array, Wide 10/20/30, Focused, Half array, Quarter array and Follow TX beam width
- **Beam width Rx:** Choose between Full array, Wide 10/20/30, Focused, Half array, Quarter array and Follow TX beam width.
- **Number of Rx Beams:** Number of beams from beamformer. Choose between 1, 3, 5, 7, 9 and 11.
- **Beam spacing [deg]:** Angle between RX beams. Legal values are up to 15 degrees

Depth

- **Acquire Water Column data:** Check this box to run with minimized acquisition delay. Minimum acquisition is 8 milliseconds more that the pulse length. To have the minimum acquisition delay possible use pulse length 2 milliseconds.

Note

– ***Calculate delay from depth*** *changes to* ***Calculate trace length from depth*** *when this option is checked.*

– *If both* ***Acquire Water Column data*** *and* ***Calculate trace length from depth*** *are checked the field* ***Acquisition window*** *changes to* ***Sub-bottom window****.*

- **Calculate delay from depth:** Check this box if you want to calculate the acquisition delay from external depth.
- **Depth from transducer [m]:** Depth relative to transducer from either an EM system or Bottom tracker
- **Delay hysteresis [ms]:** Will not change delay unless step is larger than this [ms]
- **Bottom screen pos [%]:** Set where you want to start displaying the bottom on the screen. Example: bottom screen set to 20% will make the first 20% of the trace be occupied by the water column. 0% means that bottom is shown at start of trace, 100% means end of trace. Legal values are from 0 to 100

Slope

- **Automatic slope correction:** Perform automatic or manual bottom slope correction
- **Slope alongship [deg]:** Bottom slope alongship from an EM system
- **Slope across [deg]:** Bottom slope across from an EM system
- **Slope quality:** Bottom slope estimated quality from an EM system

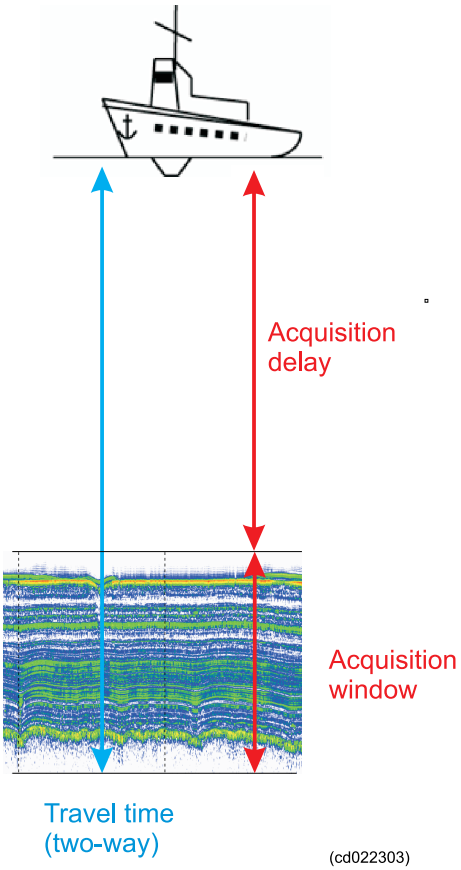
Range

- **Bottom Incidence Range BIR [ms]:** Bottom delay normal to surface from an EM system
- **Normal Incidence Range NIR [ms]:** Bottom delay normal to bottom from an EM system

Sound speed

- **Transducer sound speed:** Sound of speed in m/s at transducer from an EM system
- **Average sound speed:** Sound of speed in m/s in water from an EM system
- **Bottom sound speed:** Sound of speed in m/s at bottom from an EM system

Figure 17 Acquisition delay and acquisition window



Save configuration

The **Save configuration** dialogue box is accessed from the **File** menu.

When using **Save configuration**, current parameters are stored into the file **SBPConfig.xml**.

You can save different parameter configurations with different names. It has to be in .xml format.

If you want to use a different configuration, use the **Load configuration**.

Related topics

- *Load configuration* on page 102
- *Configuration files* on page 36

Save installation

The **Save installation** dialogue box is accessed from the **File** menu when logged on as **Super**.

When using **Save installation**, current installation parameters can be stored into the file **SBPInstall.xml** located in the working directory.

This file contains installation parameters for array, motion sensor and antenna. It also contains the network configuration (IP addresses, UDP ports) and setup of NMEA readers and Printers.

You can save different installation parameter configurations with different names. It has to be in .xml format.

At startup, the SBP software will automatically load `SBPInstall.xml`. If you want to use a different configuration, use the **Load installation**.

Note

We advice that you make a read-only copy of `SBPInstall.xml` and store it in the `config` directory of the software installation.

Note

*If changes have been made to any of the installation parameters, use **File→Restart** to transmit the new installation parameters to the TRU and the receiver beamformer.*

Reference

- *Configuration files* on page 36

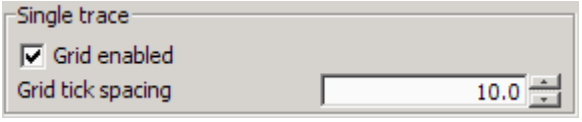
Save screen to file

The **Save screen to file** button is located on the Tool bar above the Echogram area.

When pushed an image of the application window is written in the `Images` folder in jpeg format. A keyboard shortcut for this command is `CTRL+S`.

Single trace

The **Single trace** parameter sheet is accessed from the **Display** tab.



Single trace parameters

Grid Tic Spacing: Sets the spacing between the horizontal grid lines of the **Single trace area**, given in number of pixels.

Slave buttons

The **Slave buttons** are located right above the Echogram area.

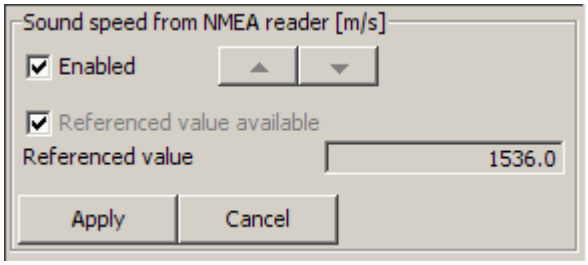
Slave mode

Click this button	To
	Start reading
	Log processed data – enables **Data logger** in **Processing chain**

Sound speed from NMEA reader

The **Sound speed from NMEA** parameter sheet is accessed from **Data selectors→Sound speed selector [m/s]→Sound speed from NMEA reader [m/s]** located under the **System** tab.

The sound speed is used for converting external depth to travel time for automatic adjustment of runtime parameters.



Sound speed from NMEA parameters

Enable: Must be checked to apply sound speed data from NMEA.

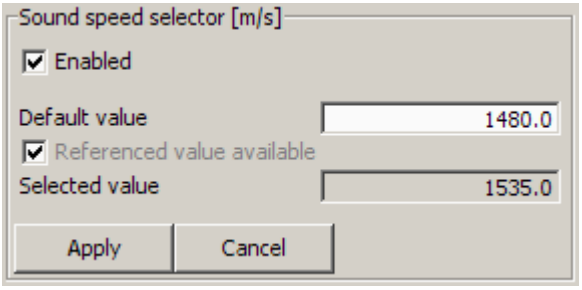
Referenced value available: Check to enable the use of a reference value.

Referenced value: Enter the average sound velocity.

Sound speed selector

The **Sound speed selector** parameter sheet is accessed from the **System** tab.

The **Sound speed selector** is used for selecting which sound speed value to use (if more that one is available) for converting between depth and time delay.



Sound speed selector parameters

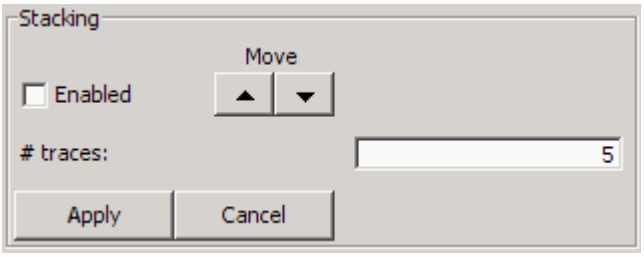
Default value: The default value is selected if no other value is available

Referenced value available: Makes the sound speed relative to transducer available

Selected value: The selected sound speed measured relative to the transducer.

Stacking

The **Stacking** parameter sheet is accessed from the **Processing** tab.



The stacking or trace mixing function is used for reducing incoherent noise in adjacent traces. A given number of traces are averaged sample by sample to produce a new trace of averaged samples. Optimal performance is achieved when reflecting horizons are fairly parallel and horizontal. The improvement in signal-to-noise ratio for correlated signals will be approx. $10 \times \log(N)$ where N is number of traces used in the processing.

Stacking parameter

Enable: Must be checked to enable the function

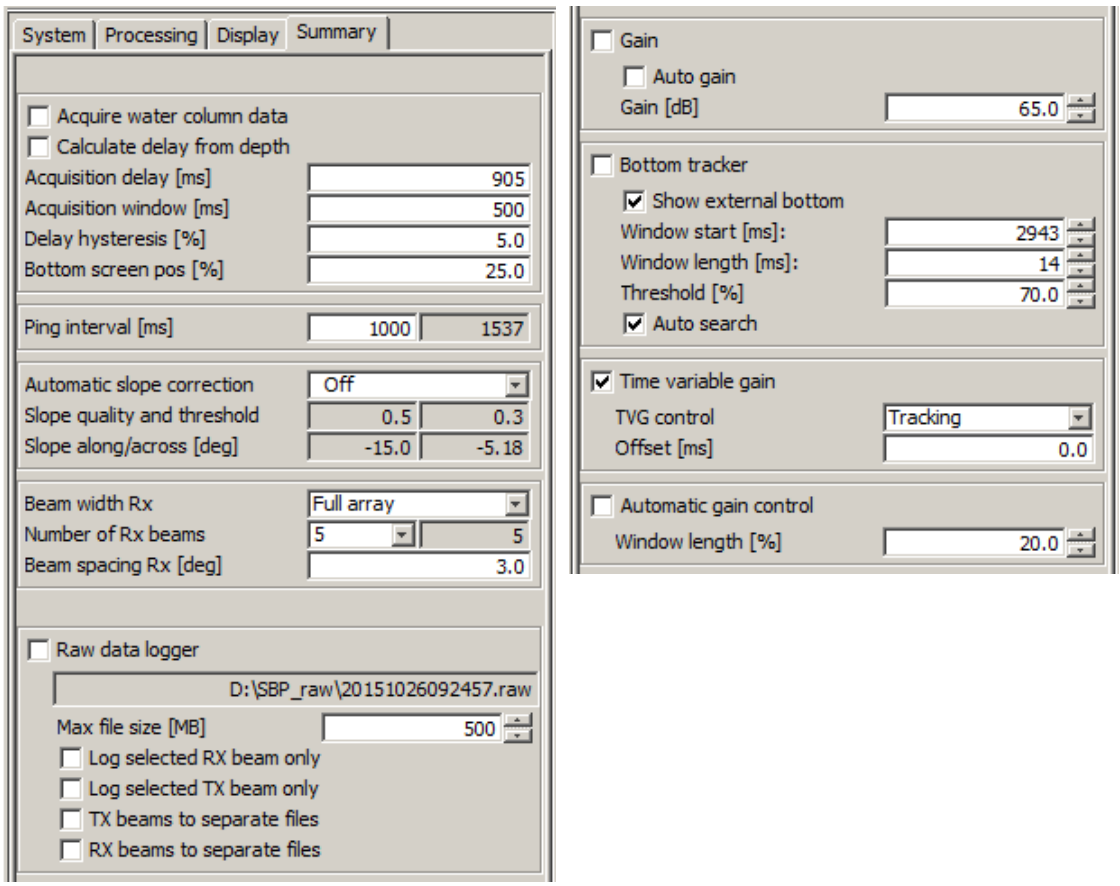
Move: Use arrows to move **Stacking** up or down in the processing chain

 # Traces: Sets the number of adjacent traces to be used in the averaging.

Summary tab

The **Summary tab** is only visible when you are in survey mode.

It is a shortcut menu to most relevant parameters in survey mode.



The parameters are a subset of parameters from the following parameter sheets:

- **Runtime parameters** – See *Runtime parameters* on page 131
- **Raw data logger** – See *Raw data logger* on page 124
- **Gain** – See *Gain* on page 96
- **Bottom tracker** – See *Bottom tracker* on page 80
- **Time variable gain** – See *Time variable gain (TVG)* on page 145
- **Automatic gain control** – See *Automatic gain control - AGC* on page 77

Super

Super user is intended for Kongsberg Maritime internal use only.

When logged on as **Root** the **Super** dialog box can be accessed from the **LogOn** menu.

When logged on as **Super** you are given access to additional settings and configuration of the SBP 27.

For normal operation configuration via Super user is not required. However, you may during initial configuration of your system need access as Super user for the following:

- Configuration of printers
- Giving descriptive names to the NMEA readers

Survey buttons

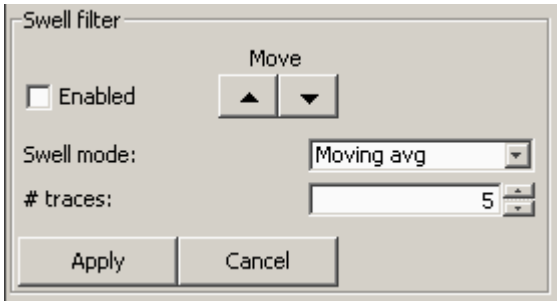
The **Survey buttons** are located right above the Echogram area.

Survey mode

Click this button	To
	Start transmission mode normal
	Start transmission mode burst
	Start transmission mode single ping
	Log sampled raw data for later replay – enables **Raw data logger** in **Readers and writers**

Swell filter

The **Swell filter** parameter sheet box is accessed from the **Processing** tab.



The swell filter is used to reduce the influence of the heave movement of the vessel on sub-bottom data when a VRU is not integrated in the system. The system detects the current seabed location and compares it with previous locations. If there is an offset, the last location is moved to the average of a number of previous locations.

Note

The swell filter may remove information about sand waves on the seabed and must therefore be used with care.

Swell filter parameters

Enable: Must be checked to enable the function

Move: Use arrows to move **Swell filter** up or down in the processing chain

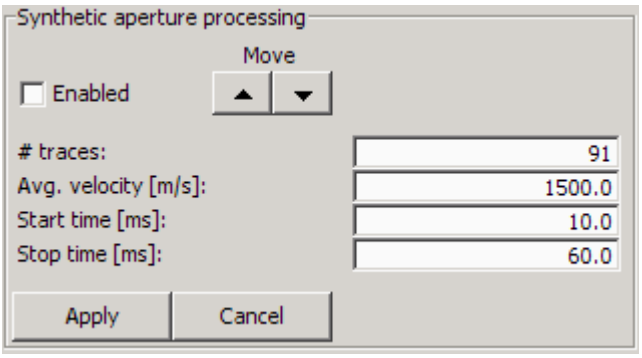
Swell Mode: This drop-down menu contains options for the filtering function:

- **Moving avg:** The seabed position is calculated as the average of the seabed position in the last N number of pings. Each position has the same weighting factor.
- **Linear weight:** The seabed position is calculated as the average of the current position plus the previous N detected positions minus the previous average position.

 # traces: The number of traces used in the calculations.

Synthetic aperture processing

The **Synthetic aperture sonar (SAS)** processing parameter sheet is accessed from the **Processing** tab.



Synthetic Aperture Sonar (SAS) processing is used to increase lateral resolution of the SBP 27 system. It is primarily used where small features and objects buried in the sediments are of special interest.

In order to get good results, accurate vessel speed and heave compensation has to be present.

SAS parameters

Enable: Must be checked to enable the function

Move: Use arrows to move **Synthetic aperture processing** up or down in the processing chain

 # traces: Sets the number of traces/pings to be used in the SAS processing.

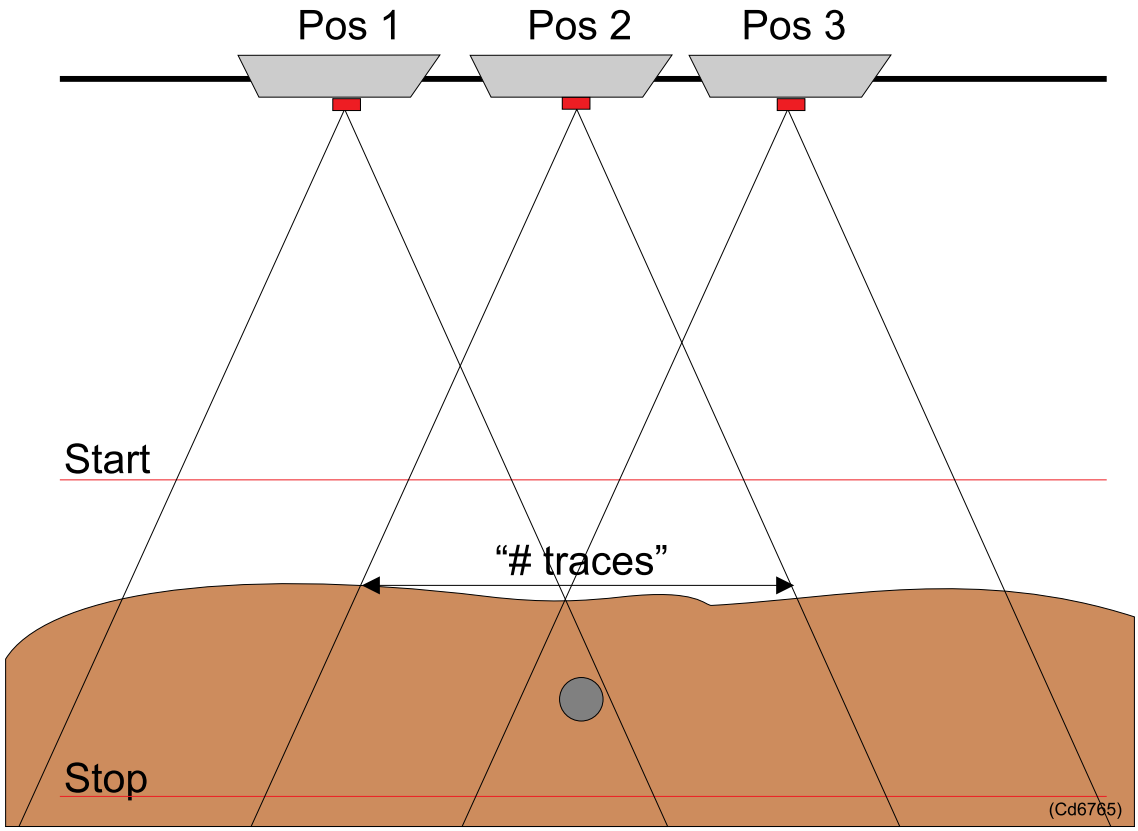
Avg. velocity [m/s]: Average sound speed in the water used in the processing.

Start time [ms]: Start time for the part of the traces to be used for processing. The reason for selecting only a part of the trace is to reduce CPU requirement as the SAS processing is quite CPU consuming.

Stop time [ms]: Stop time for the SAS processing window.

Figure *SAS parameters* on page 143 shows definition of parameters. Number of traces is approximately the number of pings recorded during the passage from position 1 to position 3. As seen, all pings in between will get an echo from the spherical "object" buried in the seabed. For each ping, the position is compensated for the varying distance between the sensor and the object thereby accumulating reflected energy from individual resolution cells in the processing window limited by the start and stop times and the length. The physical length is approx. $\#traces \times pinginterval \times vesselspeed$.

Figure 18 SAS parameters



Test

The **Test** parameter sheet is accessed from **Built-in system test→Test** located under the **System** tab.

Refer to *Built-In system tests (BIST)* on page 39 for more information about the system tests.

Test parameters

SW versions: This test provides version number/date for the major software components in the system.

MSP CPU Card Test: This test verify that contact with the main processor on the MSP board is established, which is also done in the SW versions test.

HD8 Card Test: The response to this test is a matrix with information about measured voltage and temperature on each HD8 board – one row per HD8 board.

High Voltage Power Test: The HV power unit attempts to increase the high voltage in steps of 30 volts up to 210 volts, while measuring the resulting voltage.

Receiver Noise Test: Noise level in the sea.

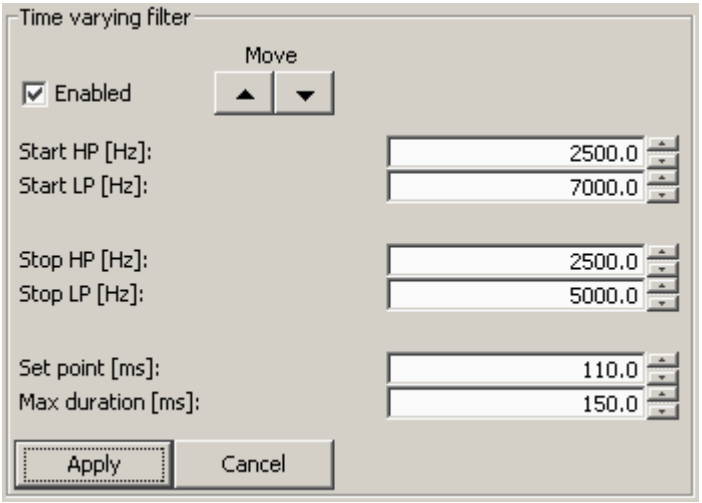
MRU (Motion Reference Unit) Test: This test reports the number of attitude messages received by the transceiver unit during one second.

Time variable filter (TVF)

The **TVF parameter** sheet is accessed from the **Processing** tab.

To make the **TVF** active, check the **Enabled** box on the top of the dialogue box.

The time varying filter is used for band pass filtering of the acquired data using a linearly varying bandwidth as a function of position in the trace.



TVF parameters

Start HP [Hz]: Sets the high pass corner frequency at the filter start.

Start LP [Hz]: Sets the low pass corner frequency at the filter start.

Stop HP [Hz]: Sets the high pass corner frequency at the filter end.

Stop LP [Hz]: Sets the low pass corner frequency at the filter end.

Set point [ms]: Sets the starting point of the linear change in the trace in absolute time.

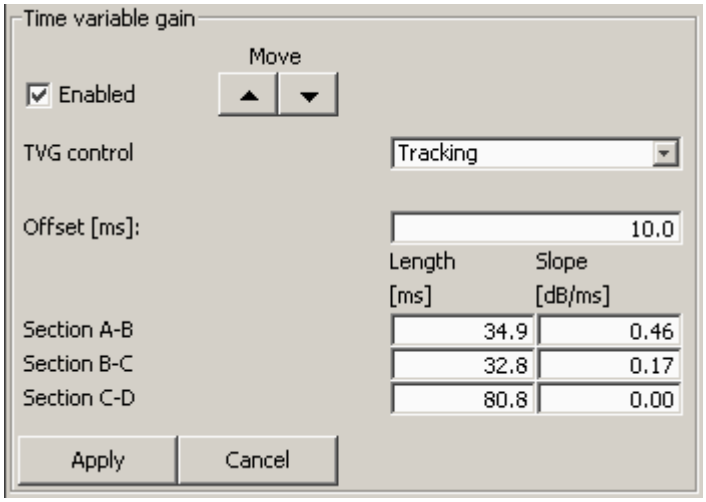
Max duration [ms]: Sets the duration of the linear change in the trace in milliseconds.

Time variable gain (TVG)

The **TVG** parameter sheet is accessed from the **Processing** tab.

To make the **TVG** active, check the **Enabled** box on the top of the dialogue box.

The TVG is mainly used for compensating propagation attenuation of the signal. Due to the high dynamic range of the analogue-to-digital converter, the TVG is applied digitally.



Three different slopes may be used.

TVG parameters

TVG Control: Selects how the start position of the TVG curve is controlled. The choices are **Manual** and **Tracking**.

- **Manual:** The start position is fixed until the operator specifies a new start value.
- **Tracking:** The start position follows the **Bottom tracker** or an **External depth input** with a specified offset.

  The **Bottom tracker** will be used if it is enabled and if it is placed above the **TVG** in the **Processing chain**.

TVG Start A: Gives an offset for the start point in tracking modes.

Section A-B / Section B-C / Section C-D: Specifies the various slope sections in the TVG curve.

Length [ms]: This parameter determines the starting point for the TVG curve sections relative to the start of the ping. Legal values are from 0 to 15,000 ms.

Slope [dB/ms]: This parameter sets the slopes of the gain curves for the TVG. Legal values are from 0 to 20 dB/ms.

Topics

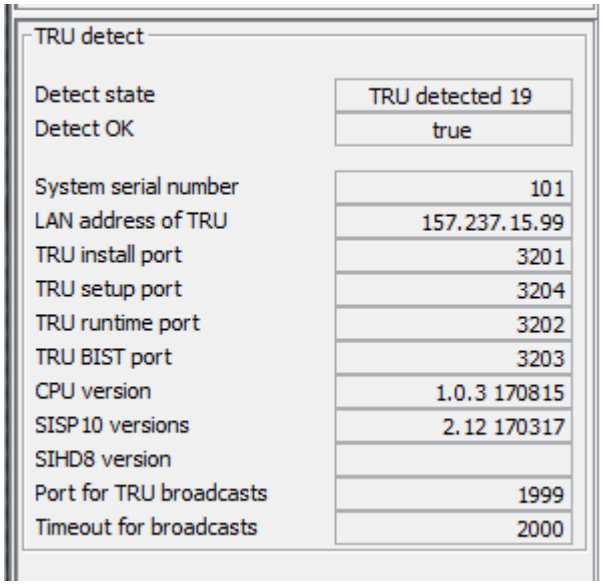
Topics is accessed from the **Help** menu. This is the online help

TRU detect

The **TRU detect** parameter sheet is accessed from **System setup→TRU detect** located under the **System** tab.

Note

The parameter sheet is visible when a normal User is logged on, but it can only be edited when Root is logged on.



TRU detect parameters

Detect state: Reports the state of contact between the Operator station and the TRU.

The following states may be reported:

- No TRU detected
- Listening
- TRU detected N – where N is incremented for each time the TRU is sending
- Message error N – where N is incremented for each error message
- Read error N – where N is incremented for each read error
- Detect disabled

Detect OK: TRU broadcast received on port 1999.

System serial number: System serial number

LAN address of TRU: LAN address of the Transceiver Unit

TRU install port: This port is used for the Transceiver Unit installation parameters

TRU setup port: This port is used for the Transceiver Unit setup parameters

TRU runtime port: This port is used for the Transceiver Unit runtime parameters

TRU BIST port: This port is used for the Transceiver Unit Built-In System Test

CPU version: Software version and date

SISP10 versions: Firmware version and software date

SIHD8 version: Firmware version

Port for TRU broadcasts: This local port listens for TRU broadcasts – always port number 1999

Timeout for broadcasts: Timeout in ms

User

User is accessed from the **LogOn** menu.

There can only be one user logged on the system.

Vertical spilt

Vertical split is enabled from the **View** menu.

Use this if you want to align the echogram areas side by side.

View echogram area 2

Viewing **Echogram 2** is enabled from the **View** menu.

If desired, the status area can be removed from the screen. This is done by un-checking **View→Echogram 2**. The checkmark will disappear.

To get the status area back, check **View→Echogram 2**. The checkmark will return.

View legend area 1 & 2

Viewing **Legend 1** or **Legend 2** is enabled from the **View** menu.

If desired, the legend area can be removed from the screen. This is done by un-checking **View→Legend 1 or 2**.

To get the legend area back, check **View→Legend 1 or 2**.

Legend 1 applies to Echogram 1, Legend 2 is for Echogram 2.

View property area

viewing the **Property area** is enabled from the **View** menu.

If desired, the property area can be removed from the screen. This is done by un-checking **View→Property area**.

To get the property area back, check **View→Property area**.

View single trace

Viewing the **Single trace** is enabled from the **View** menu.

If desired, the data area can be removed from the screen. This is done by un-checking **View→Single trace**.

To get the data area back, check **View→Single trace**.

View status area

Viewing **Status area** is from the **View** menu.

If desired, the status area can be removed from the screen. This is done by un-checking **View→Status area**. The checkmark will disappear.

To get the status area back, check **View→Status area**. The checkmark will return.

View survey warnings

By default this window pops up whenever new information is printed to it.

Note

It is possible to disable the "auto pop-up" feature temporarily or permanently. Think twice before disabling permanently. These warnings are introduced in response to unfortunate events.

- If after five minutes of pinging logging is still not activated the following message is printed in the Survey warnings window:

  Survey running without raw data logging!

- If after five minutes of pinging power level is at minimum level the following message is printed in the Survey warnings window:

  Survey running on minimum ping power!

- When the acquisition delay reaches or is set to a minimum allowed value limited by the pulse length, the following message is printed in the Survey warnings window:

  Minimum acquisition delay reached. Consider reducing pulse length

  For chirp and CW pulses the minimum acquisition delay is pulse length plus 8 ms. To achieve this minimum acquisition delay of 10 ms the pulse length must be reduced to its minimum of 2 milliseconds.

View system messages

Viewing the **System messages** is enabled from the **View** menu.

Use this if you want to view the system messages.

If you want to remove them from the screen you can either select **View→System messages** or click the **OK** button on the dialogue box. The checkmark will disappear.

Zoom buttons

The **Zoom buttons** are located right above the Echogram area.

These buttons are used for zooming in and out of the Echogram areas and the Data area. There is one set of buttons for each of the two display areas. Each push on the buttons zooms in or out of the display by a factor of 1.5.

Note

The zooming is only performed in the vertical time axis.

The **Full trace button** is located right above Echogram area 1.

This button selects display of the full trace length for both the Echogram areas and for the Single trace area.

Software applications

Topics

- *Online Monitor* on page 150

Online Monitor

Online Monitor is a utility program to SBP 27 used for monitoring and logging of status of the system hardware. **Online Monitor** is also useful for troubleshooting of the SBP 27.

Note

Status messages received by the Online Monitor are logged to the directory `Logs` *in the working directory of the operator software. The full path is typically* `C:\ProgramData\Kongsberg Maritime\KM SBP OPU\Logs`

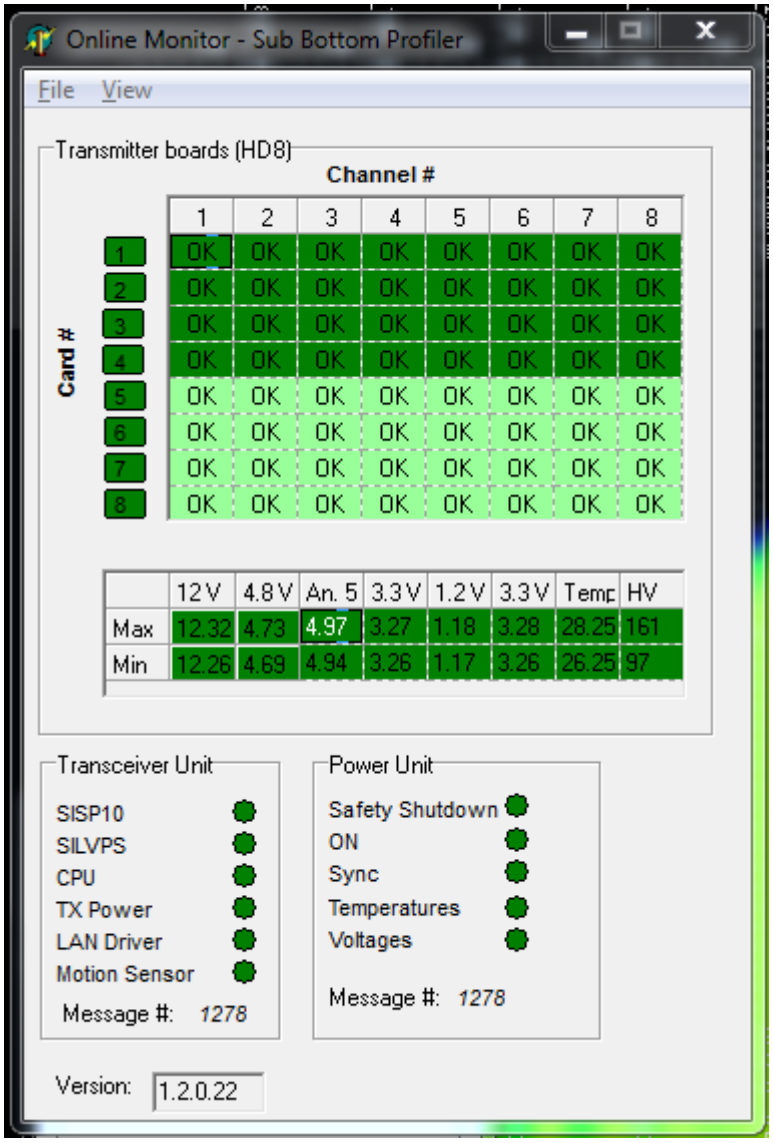
Online Monitor is by default launched automatically when the operation station is started. If Online Monitor is not running it must be started separately from the desktop of your Operator Station before SBP 27 is started. We recommend that the Online Monitor is running before the SBP 27 transceiver is started in order to collect all status information from the transceiver.

Note

SBP 27 will start even if ***Online Monitor*** *is not started, but if Online Monitor is not running no status information from the transceiver will be logged.*

If the Online Monitor isn't already running, start **Online Monitor** by selecting the  icon from the desktop of the Operator Station.

Main window


Online Monitor - Sub Bottom Profiler
File View
Transmitter boards (HD8)
Channel #
Card #
1 2 3 4 5 6 7 8
OK
12 V 4.8 V An. 5 3.3 V 1.2 V 3.3 V Temp HV
Max 12.32 4.73 4.97 3.27 1.18 3.28 28.25 161
Min 12.26 4.69 4.94 3.26 1.17 3.26 26.25 97
Transceiver Unit
SISP10
SILVPS
CPU
TX Power
LAN Driver
Motion Sensor
Message #: 1278
Power Unit
Safety Shutdown
ON
Sync
Temperatures
Voltages
Message #: 1278
Version: 1.2.0.22

The main window of Online Monitor consists of three sub sections:

- **Transmitter boards (HD8):** Displays status of each channel of the SIHD8 cards. Depending on system size two, four, or eight SIHD8 cards are installed in the Transceiver Unit (TRU)

  An additional status window shows the max/min values of the following SIHD8 readings:

  – Input voltage 12V
  – Analog 4.8V
  – Analog 5V
  – Aux voltage 3.3V
  – Digital 1.2V
  – Digital 3.3V
  – Temperature °C
  – High Voltage V
    * This is the peak output voltage measured during transmission
- **Transceiver Unit:** Shows status of the following units of the TRU:
  – **SISP10**, signal processor board interfacing the SIHD8 boards
  – **SILVPS**, Low Voltage Power Supply
  – **CPU**, Interfaces the operator station, SISP10, external sensors and synchronization
  – **TX power**
  – **LAN Driver**
  – **Motion sensor**
- **Power Unit:** Shows status of the High Voltage Power Units (HVPU) of the Transceiver Unit:
  – **Safety Shutdown:** Red if enabled by one or more switch knobs in front of the HVPUs. If enabled, the HVPUs are deactivated and both the “TX power” status of the Transceiver unit and the “ON” status of the HVPUs will turn red in this case
  – **ON:** Ready to ping
  – **Synchronization:** Green means the switching frequencies of the HVPUs are controlled by SISP10
  – **Temperatures**
  – **Voltages**

  Note

  There is only one status common to all HVPUs. If one HVPU has an error, the status will be red even if all but one unit is OK.

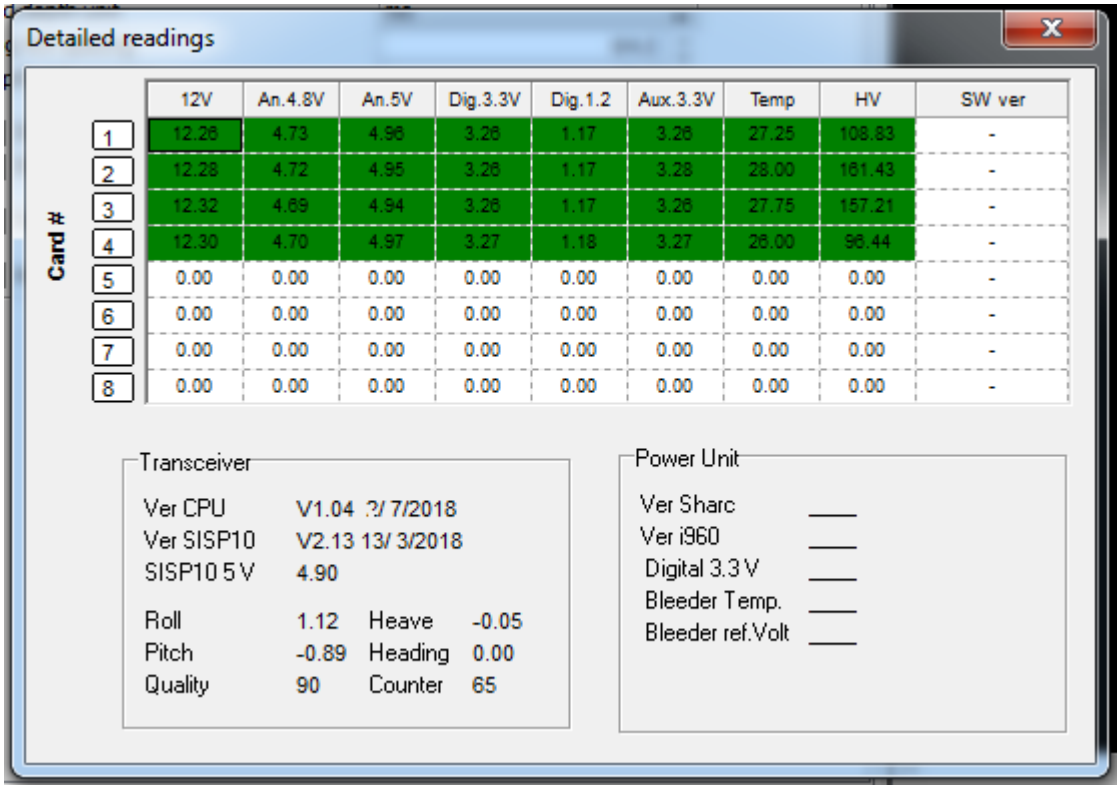
The status will be displayed in green, yellow or red as follows:

- Green – good data received
- Yellow – data is received, but with poor quality

- Red – no data received
- Light green – no data expected (the above image is from a 32 channel transceiver)

Detailed readings

Detailed readings are accessed from the **View→Details** menu.



The **Detailed readings** displays current values for each channel of each of the HD8 boards as follows:

- Input voltage 12V
- Analog 4.8V
- Analog 5V
- Aux voltage 3.3V
- Digital 1.2V
- Digital 3.3V
- Temperature °C
- High Voltage V
  - This is the peak output voltage measured during transmission

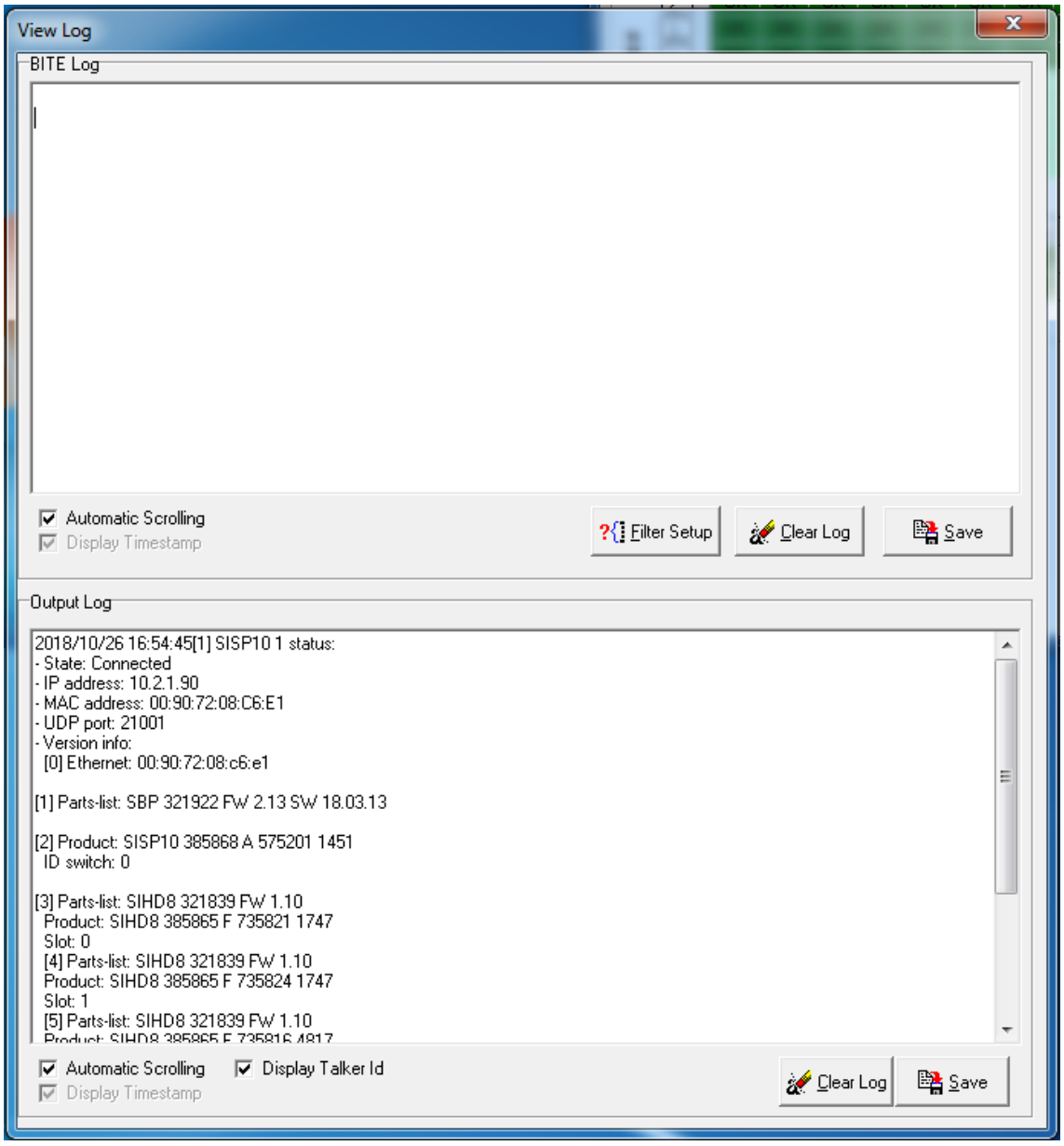
In addition, some information from the CPU and SISP10 processing boards is shown.

The Power Unit section is not yet adapted to SBP 27. To retrieve information about the HVPUs use the Built-in system test of the operator software.

Log view

Log view is accessed from the **View→Log View** menu.

The **Online Monitor** software automatically write messages displayed in the **Log View** to text files tagged with date and time.

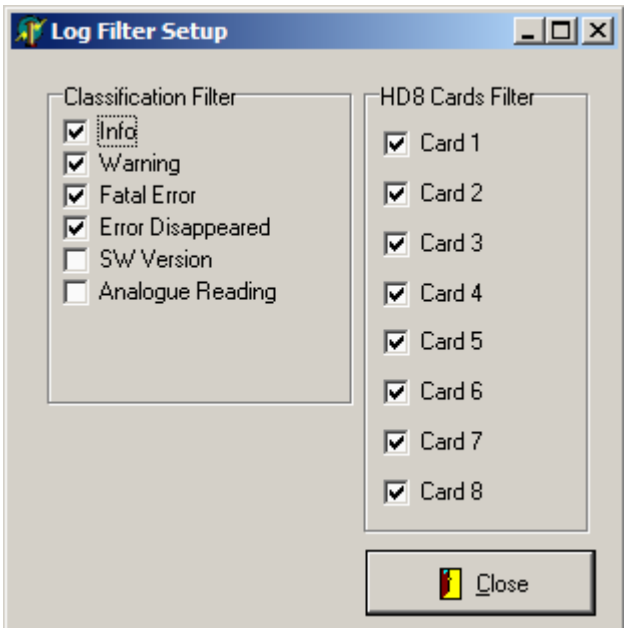


The **Log view** window contains two log windows useful for debugging

- **BITE Log:** All messages related to Transceiver Unit (TRU) hardware status
- **Output Log:** All messages related to TRU activity

The **Log view** holds the following buttons:

- **Filter setup:** Applies to the BITE log only.

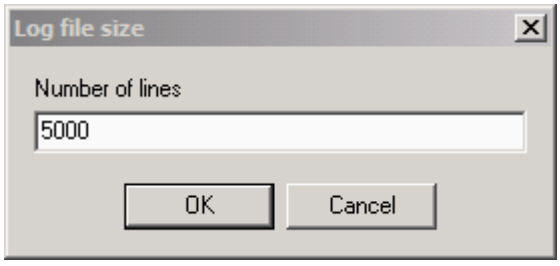


Select the parameters and board(s) you want to register events for. For an SBP 27 with less than eight SIHD8 boards you must uncheck the boards you do not have.

- **Clear log:** Clear all previous events from the log
- **Save log** Save events in the log

Log size

Log size is accessed from the **View→Log Size** menu.



Use **Log size** to specify the size of your log files in terms of number of survey lines. When given number of lines are reached and new log file will be generated.

Technical references

This chapter describes the theoretical background and features relevant for SBP 27 Sub-bottom Profiler.

Topics

- *Digital signal processing* on page 157
- *Main operational modes* on page 162
- *System operation* on page 171
- *Transmit waveforms* on page 174
- *File formats* on page 177

Digital signal processing

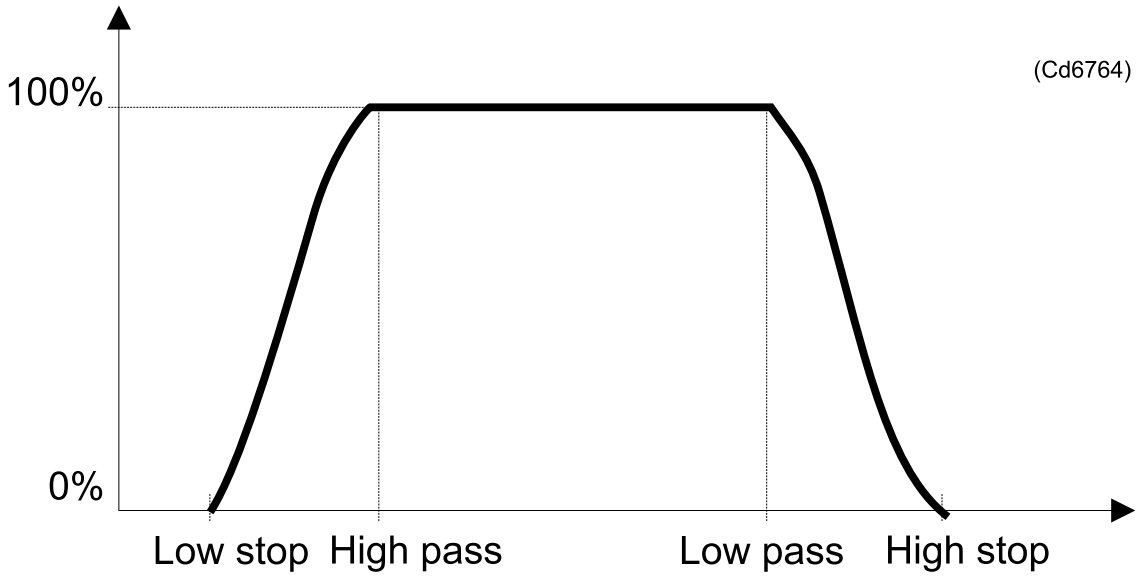
To enhance the presentation of the information contents in the acquired data, various processing steps are introduced. The simplest step is an amplitude scaling of the data. Two scaling function are implemented. The first is in 1 dB steps and is only used for interpolation between the 6 dB gain-steps selected in hardware. The other scaling function is a multiplication by a factor which is given as a number between 0% and 100000%. The other main processing steps are described individually in the following paragraphs.

Bandpass filtering

The SBP 27 system is very flexible regarding selection of output signature. When operating in a noisy environment it is important to optimize the signal-to-noise ratio. This can be done by bandpass filtering over a bandwidth that covers the spectrum of the received signal.

The bandpass filtering is performed in the frequency domain by applying a window to the complex Fourier transformed time series of the acquired signal and perform a subsequent inverse Fourier transform. The window characteristic, which is displayed in Figure 10, is defined by four frequencies: lowstop (LS), highpass (HP), lowpass (LP) and highstop (HS). These frequencies are defining full stop and full pass points. The transition between these points has a cosine shape.

Figure 19 Characteristics of the digital bandpass filter



Deconvolution

There are various ways to increase the signal-to-noise ratio in the SBP 27 system. One is to transmit coded wavelets. An example of such wavelet is the FM-sweep or chirp signal. Typical for this wavelet is that the long duration in time increases the transmitted energy. Without processing, the resolution will be reduced. In order to compress the signal energy in time it has to go through a deconvolution process or a matched filter. The filter used is described by the following formula:

$$F(f) = \frac{W^*(f)}{[W(f)]^2 + c}$$

where **W(f)** is the complex Fourier transform of the transmitted wavelet, ***** indicates the complex conjugated, and **c** is a stabilising factor for the filter depending on the power spectrum of the wavelet and the noise power spectrum. The filter is weighted by the current bandpass filter envelope. When the Fourier transform of the acquired data trace is given by **T(f)** then the output of the filter will be given by

$$S(f) = F(f) * T(f)$$

In an ideal case where the received wavelet is identical to an attenuated sample of the transmitted wavelet and the noise level is negligible, W(f) = T(f) and c = 0. Substituting into the expression for the deconvolution filter yields S(f) = 1 which is equivalent to a delta pulse in time domain.

The deconvolution can also be applied to a normal Ricker pulse resulting in reduced sidelobes around the central peak.

Variable gain functions

There are two main reasons for using variable gain functions in the processing: Time Variable Gain (TVG) is used to compensate for spherical spreading losses and signal attenuation primarily in the sediments, while Automatic Gain Control (AGC) is used for enhancing low level parts of the data trace on display and hardcopy. TVG maintains amplitude information in the trace while AGC destroys the real amplitude information.

TVG follows a predefined gain curve as a function of time. Typical gain curves may be proportional to 10•log R, 20•log R, 30•log R etc. where R is the distance from the transducer. Time t is R/c where c is the speed of sound. The TVG can also be set up in automatic mode where the gain curve is calculated based on the average signal level in several sections along the trace.

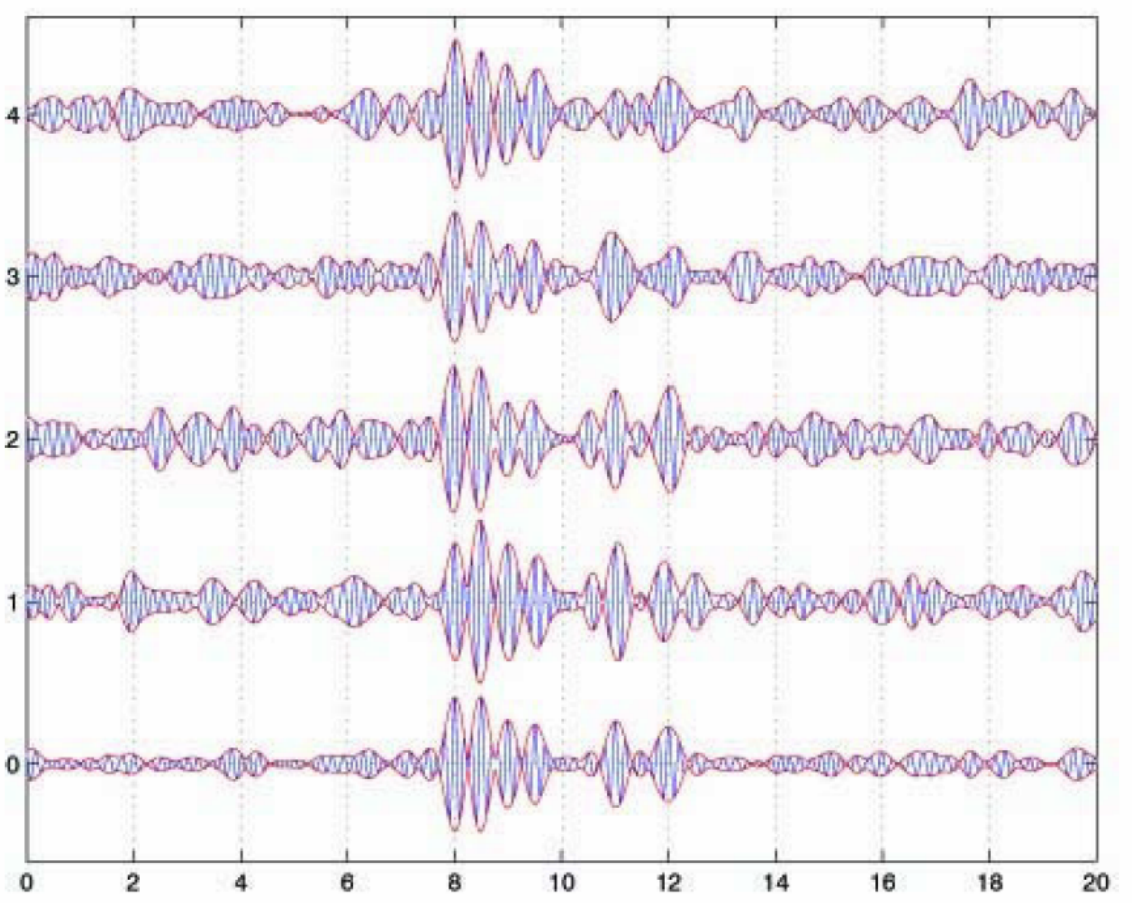
AGC is a sliding scaling function where the scaling factor is the inverse of the average signal amplitude in a window around the point to be scaled. The position in the window of the point to be scaled can be selected by the operator. The result of this scaling is that signal level in low level parts of the trace is amplified more than signals in high level parts of the trace.

Stacking

Trace stacking or trace mixing is a process that is regularly used in multi-channel seismic processing. In single channel systems, it is basically used to reduced influence of uncorrelated noise in the trace. The processing is done on trace-by-trace basis where a sample of the processed trace is the average of corresponding samples in 2 to **N** of the previous traces. Sample number *i* in trace number *k* is given by the following expression

$$s_i^k = \frac{1}{N} \sum_{j=k-N}^{k} s_i^j$$

where *N* is number of traces. Noise reduction is approximately proportional to **√N**. If the sea floor or sub-bottom structures have steep and abrupt changes, care must be taken using stacking processing since it tends to smear out such features.



Swell filtering

Swell filtering is used if no external heave compensation is available, to handle the influence of vertical vessel or transducer movements caused by the undulations of the swell. In principle this is done by first performing sea floor detection on the received data and then adjusts the trace up or down so that the position of the detected sea floor matches the position detected in the previous trace. In order to allow for variation in the bathymetry, an average of previous N detected sea floor locations is used as the location in the trace where the last trace is shifted. Using a large N may result in loss of details regarding the ability to follow the sea floor whilst a small N may not remove the swell completely. N is a sort of time constant for the filter, which also depends on the shot interval.

For a properly configured SBP swell filtering will not be necessary. The beamformer performs real time heave compensation based on knowledge of transducer lever arms and sensor input from the MRU.

Attribute calculation

In order to make interpretation of seismic signals easier, attributes can be calculated based on a complex seismic trace analysis. The attributes of interest are

- Instantaneous amplitude or reflection strength
- Instantaneous phase
- Instantaneous frequency
- Apparent polarity

The complex trace is computed as

$$F(t) = f(t) + jf^*$$

where *f* is the real trace, $j = \sqrt{-1}$ and * indicates the complex conjugated.

The complex trace is calculated by inverse transforming the real part of the Fourier transformed real trace multiplied by two. The various attributes are now calculated as follows:

Instantaneous amplitude is given by

$$A(t) = \left[f^2(t) + f^{*2}(t)\right]^{\frac{1}{2}} = |F(t)|$$

Instantaneous phase is given by

$$\Theta(t) = \arctan\left[\frac{f^*(t)}{f(t)}\right]$$

Instantaneous frequency is given by

$$\omega(t) = \frac{d\Theta(t)}{dt}$$

Apparent polarity is defined as the sign of *f(t)* when *A(t)* has a local maximum. Positive or negative sign is assigned assuming a zero-phase wavelet and a positive or negative reflection coefficient, respectively.

The significance of the calculated attributes are described in the following:

Instantaneous amplitude

Reflection strength or instantaneous amplitude is independent of phase. It may have its maximum at phase points other than peaks or troughs of the real trace, especially where an event is the composite of several reflections. High-reflection strength is often associated with major lithologic changes between adjacent sediment layers, such as across non-conformities and boundaries associated with sharp changes in sea level or decompositional environments. High-reflection strength also is often associated with gas accumulation.

Instantaneous phase

The instantaneous phase emphasises the continuity of events. It is a value associated with a point in time and thus is quite different from phase as a function of frequency as given by a Fourier transform. Because phase is independent of reflection strength,

it often makes weak coherent events clearer. Phase displays are effective in showing discontinuities, faults, pinch-outs, angularities and events with different dip attitudes, which interferes with each other.

Instantaneous frequency

The instantaneous frequency is a value associated with a point in time like the instantaneous phase. Most reflection events are the composite individual reflections from a number of closely spaced reflectors, which remains nearly constant in acoustic impedance contrast and separation.

The superposition of individual reflections may produce a frequency pattern, which characterises the composite reflection. Frequency character often provides a useful correlation tool. The character of a composite reflection will change gradually as the sequence of layers gradually changes in thickness or lithology. Variations, as at pinch-outs and edges of hydrocarbon-water interface, tend to change the instantaneous frequency more rapidly.

Apparent polarity

Apparent polarity is very sensitive to data quality. Interference may result in reflection strength maximum occurring near a zero crossing of the seismic trace so the polarity may change sign as noise causes the zero crossing of the trace or the location of the reflection strength maximum to shift slightly. The analysis of apparent polarity assumes a single reflector, a zero-phase wavelet and no ambiguity due to phase inversion. Bright spots associated with gas accumulation in sediments usually have lower acoustic impedance than the surrounding beds and hence show a negative polarity for reservoir top reflections and a positive reflection for reflections from gas-to-water or gas-to-sediment interfaces.

Main operational modes

The main operational modes are selected by the runtime parameters **Transmit mode** and **Synchronization**.

The various **Transmit modes** are:

- **Off:** In transmit mode *Off* the system is not transmitting (nor receiving). It is in a standby mode.
- **Normal:** In *Normal* mode there will only be one single pulse in the water at a time (multipath neglected).
- **Burst:** In *Burst* mode several pulses are transmitted before the return signal from the first transmission is returned.
- **Single pulse:** *Single pulse* mode is not to be used during surveys. It allows the transmission of a single pulse whenever this is desired.

Synchronization mode

Synchronization of SBP 27 to other equipment is provided by external trigger inputs. The purpose of synchronization is to avoid, or at least have control over, interference with other acoustic systems.

In **Synchronisation mode** there is basically the choice between internal trigger (i.e. fixed rate) and external trigger. Two external triggers inputs are available. One is being connected to the EM, whilst the other method is to be connected to other external equipment such as a synchronization unit.

Standard combinations of transmit mode and synchronization are discussed in the following. But first it is necessary to introduce a few other runtime parameters:

Acquisition window: This parameter (unit milliseconds) specifies the length of the acquisition window. This observation window must be long enough to collect all interesting return signals. In order to reduce the amount of data to store during survey, it may be sensible to reduce this window in areas with poor penetration.

Note that the operator specifies the desired window length after pulse compression. When chirp pulses are employed, the actual acquisition window used internally by the system must be lengthened by the amount of the pulse length in order to image the desired window length properly.

Acquisition delay: This parameter specifies where to position the acquisition window relative to the time of transmission. The position of the acquisition window should normally be such that the first bottom return is located somewhere at the first half of the acquisition window

Tip

If the depth measured relative the transducers is 75 m and the average velocity of sound in the water column is 1500 m/s, the first bottom return will arrive after t = 2*75/1500 [m/(m/s)] = 100 ms. Note that we are working with two-way travel times! If the acquisition window length is 40 ms, a suitable acquisition delay could be 90 ms

---

It is possible to have the acquisition delay calculated automatically either

1 from the depth detected by the bottom tracker of the SBP 27

or

2 from the depth input from EM EM 122/302 or another echo sounder

This feature is enabled by checking the check box **Calculate delay from depth**. Further information about this feature is found in *Calculate delay from depth* on page 170.

To control which depth to use, see the description of the *Depth selector* on page 86.

Ping interval: This parameter is used to set the minimum/desired interval between two consecutive pings. The actual ping interval used is displayed next to the desired/minimum ping interval input by the user. The ping interval used is calculated taking maximum power duty cycle, acquisition delay, acquisition window, pulse length and maximum ping rate into consideration.

Max burst pulses: Used by the operator to specify the maximum number of pulses per burst. The actual number of pulses per burst is determined by the system, and it is display beside the maximum number input by the operator.

Burst pulse delay: This parameter is calculated by the system, and it is the interval between two transmissions in burst mode.

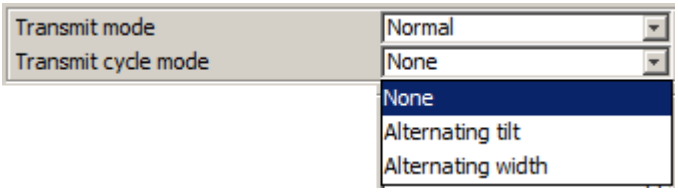
Steering parameters

This is introduced as a generic term for pulse length, acquisition window start and acquisition window length. These parameters have the highest priority when timing schemes are composed in the various modes discussed below.

Transmit cycle modes

When the sediment slope angle exceeds the beam width of an SBP the specular return from sediment interfaces will be weak or even lost. The optional transmit cycle modes are added in response to this challenge.

To activate one of these modes either select **Cycle tilt angle** or **Cycle beam width** from the drop-down curtain

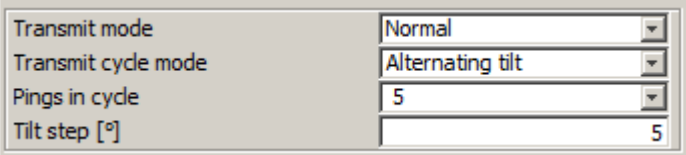


Each stage of the cycle provides a different way of imaging. To facilitate separation of these into different echograms (and files) a *transmit beam number* is defined and included in the raw file format. Also the *number of TX beams* (i.e. the number of stages in the transmit cycle) is written in the raw file.

A SEG Y file will not contain more than one “transmit beam”; the data are split into as many files as there are combinations of TX and RX beams (if all combinations are logged). Still the *transmit beam number* and *number of transmit beams* are included in the SEG Y files.

When the transmit cycle mode is “none” (i.e. the system is operated in the standard way) the *transmit beam number* will be 0 (zero) and the *number of transmit beams* will be 1. When the transmit cycle mode is active the beam numbers are all positive starting at 1.

Cycle tilt angle

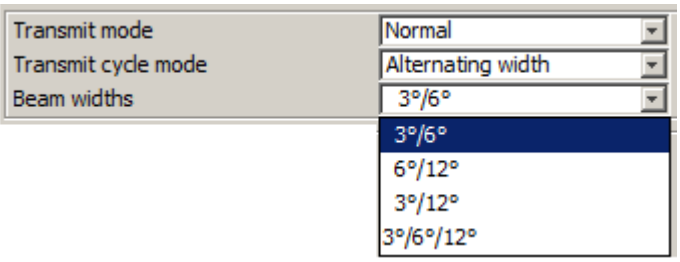


Make a “transmit swath” to cover along track slopes by cyclic scanning of the tilt angle.

Specify the desired number of ping in the cycle and the tilt step. Since the vertical beam typically is the best you might want to have an odd number of beams symmetrically around the vertical. A suitable tilt step can be equal to the beam width of transmit beam. As an example: Using the full array of a 3 degree SBP transmitter with tilt step 3 degrees and 5 pings in the cycle will cover well slopes in the range ± 3°x5 /2= ± 7.5°.

The transmit beam pointing most to the aft (with the most negative tilt angle) is number 1 and the beam number increases as the tilt angle increases; i.e. the beam with the largest positive tilt angle will have the highest beam number.

Cycle transmit beam width



Keep the transmit beam vertical while varying the transmit beam width.

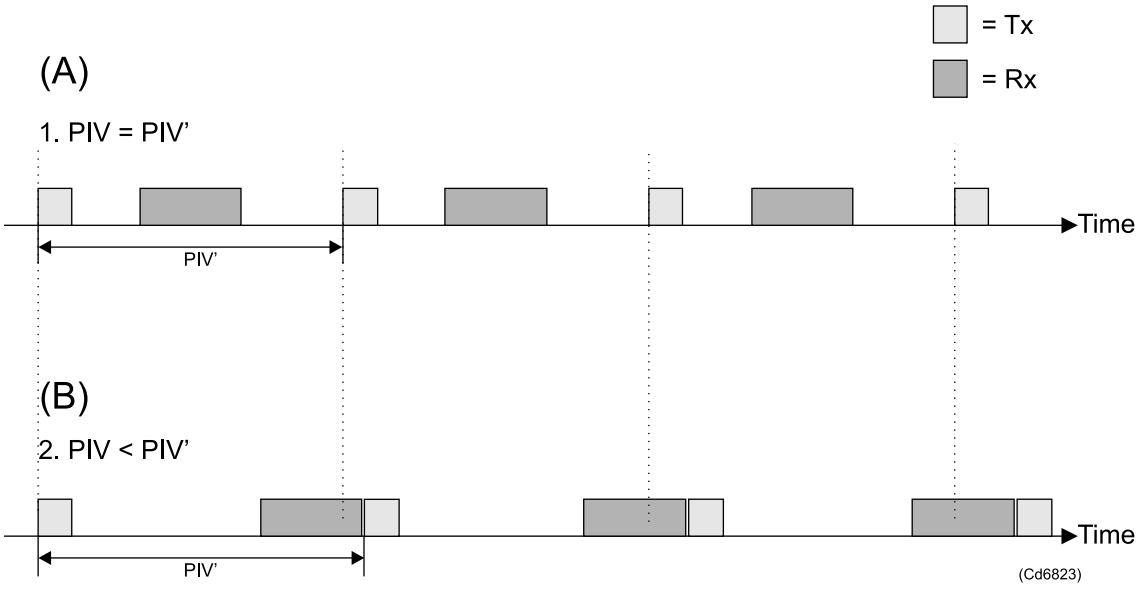
The menu above is the one available for a 3 degree SBP 27 system. For a 12 degree system this transmit cycle mode is not available.

The narrowest beam will be transmit (TX) beam number 1. The TX beam number increases with increasing TX beam width.

Normal mode and internal trigger

In normal mode, the transceiver unit transmits a single pulse and then wait for the return signal. A new pulse will not be transmitted until the return signal from the previous ping is acquired. Depending on the relation between operator specified ping interval and the steering parameters, the SBP 27 may be considered as operating in one of two submodes. If the steering parameters allow it, the SBP 27 will be pinging at a fixed rate with the ping interval specified by the operator. If the user specified ping interval is too short considering the steering parameters, the system will give the shortest ping interval possible. In combination with the **calculate delay from depth** feature, this will cause the system to be “free running”, which means that the ping rate in normal mode will be as high as possible.

Figure 20 Internally triggered normal mode: The SBP 27 allows the user to specify a minimum ping interval (PIV). If feasible this ping interval will be provided (a). If the ping interval is too short for the system to collect the desired return signal, the system will provide the shortest ping interval (PIV) possible (b).



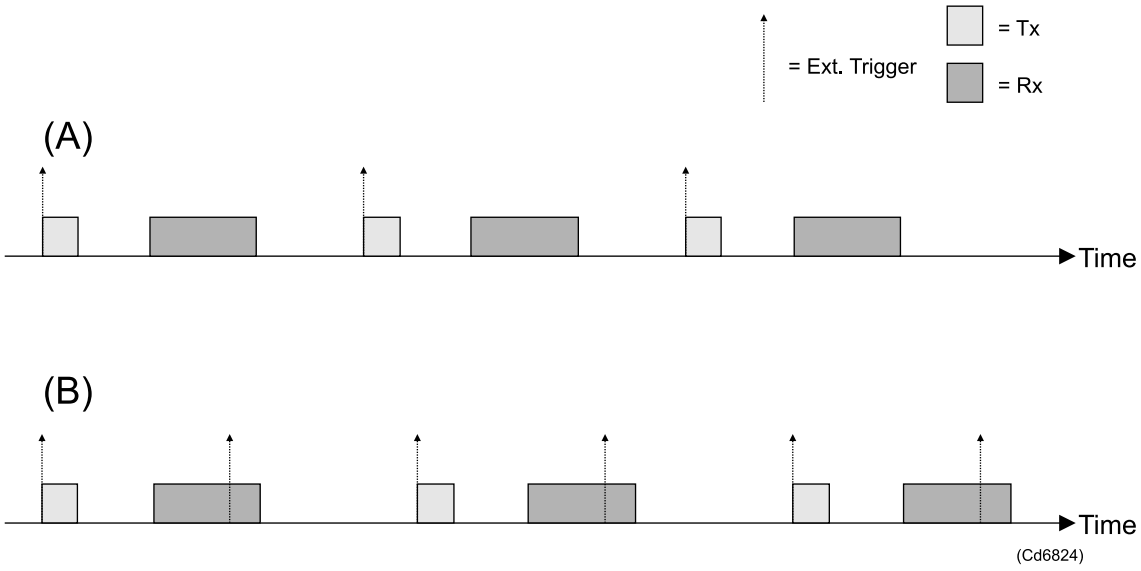
Normal mode and external trigger

The SBP 27 can be triggered from an external source in order to avoid (control) interference between the SBP 27 and other acoustic systems.

In this mode, the SBP 27 will ping at a fixed rate provided the external trigger is running at fixed rate. The SBP 27 will possibly ping at a lower, fixed rate than the one given by the external trigger. This will be the case whenever the next trigger signal comes before the system has finished acquiring data from the ping initiated by the previous trigger signal.

This is illustrated in figure below where we can see that for a given set of the steering runtime parameters, increasing the rate of external trigger signal actually causes a decrease in the ping rate of the SBP 27.

Figure 21 Externally triggered normal mode: In this case the ping rate is determined by external equipment (a). Once the SBP 27 has transmitted in response to a trigger signal, it does not accept a new trigger until it has finished receiving the echo from the previous transmission. Accordingly the ping rate of the SBP 27 might be lower than one should expect from the external trigger signal (b)

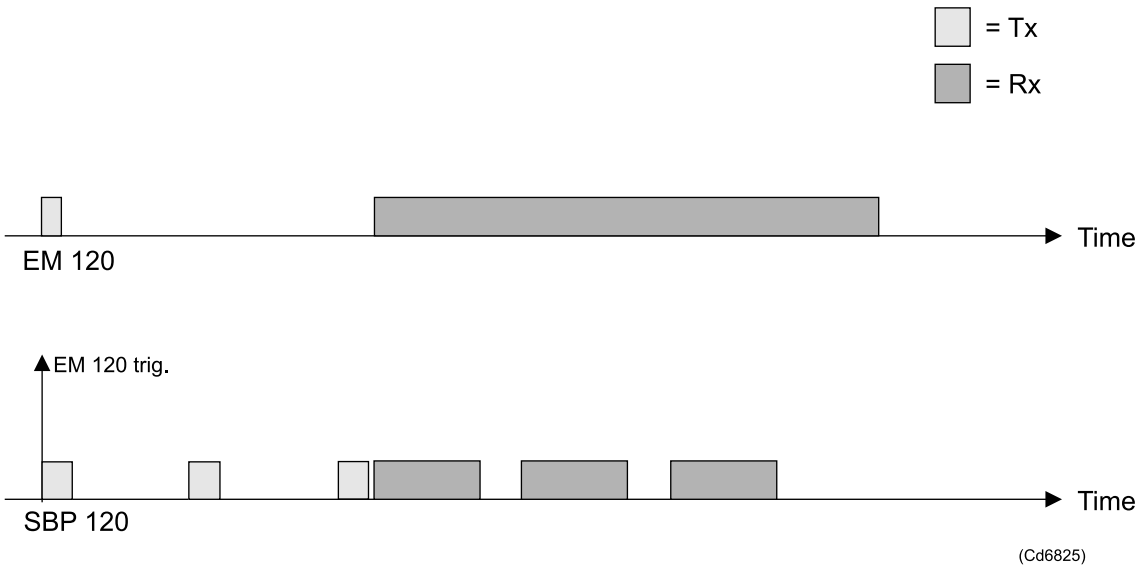


Burst mode and external trigger

For hydrographic echo sounders, both multibeam and single beam, it should be acceptable to have the SBP 27 transmit until the first bottom echo is returned. Using burst mode, it is possible to have several pulses transmitted during this period which is equal to the acquisition delay. This operational mode is illustrated in next figure. After the last pulse in the burst is transmitted, the first observation window is returned. The maximum (or desired) number of pulses in the period is specified by the operator, and the system tries to squeeze in as many pulses as the steering parameters, power duty cycle and maximum ping rate permit.

Of course, this will lead to non-uniform sampling of the bottom alongtrack. However, the alternative in synchronized operation is to have just one ping per trigger pulse. Under many circumstances this will not be sufficient to image sediments. We believe it is better to have several short segments of high alongtrack resolution than to have uniform probing alongtrack with poor resolution.

Figure 22 Externally triggered burst mode: This mode may be useful when the SBP 27 is synchronized with equipment with long receptions windows; typically a multibeam echosounder. It is assumed that the SBP 27 is allowed to transmit until the first bottom return arrives. For each external trigger, the SBP 27 transmits as many burst pulses as possible under given constraints such as maximum duty cycle of the transmitter and the length of the reception windows. This gives a piecewise much denser sampling of bottom than the externally triggered normal mode would.



Burst mode and internal trigger

When the system is triggered internally, there is no need to limit the period of transmission to the acquisition delay of the first ping in the burst. We can have TX pulses and acquisition windows interlaced within one burst, as shown in figure (a) below. In principle the number of pulses requested by the operator can always be provided. In practice we limit the number of pulses in a burst to the number that fit in the water columns (which is three in figure (a)). The reason for this will be given shortly.

If we were to finish one burst before continuing with the next, the result would be non-uniform probing of bottom alongtrack as in the externally triggered burst mode. Unless runtime parameters affecting timing have been changed, we can continue with the next burst before the previous burst is finished as shown in figure (b). In this way, bottom will be probed at a uniform rate provided vessel speed is constant. We refer to this operation mode as multi-pulse. The multi-pulse mode can provide high alongtrack sampling rate almost independent of depth and vessel speed.

Sometimes the acquisition delay changes so much that the timing of the burst pulses has to be changed. In order to avoid collisions between periods of transmission and periods of reception (which is necessary because we have combined transmitter/receiver channels), the SBP 27 will have to finish one burst before continuing with the next. This is illustrated in figure (c), where the burst interval is recalculated during transmission of burst number N. We see that in this case the system finish burst number N completely before continuing with burst number N+1.

To allow this adjustment of the acquisition delay to take effect as soon as possible, the number of pulses allowed per burst will not exceed the number of pulses that can be transmitted during one acquisition delay. As a consequence, the transmit period do not overlap with the corresponding reception period.

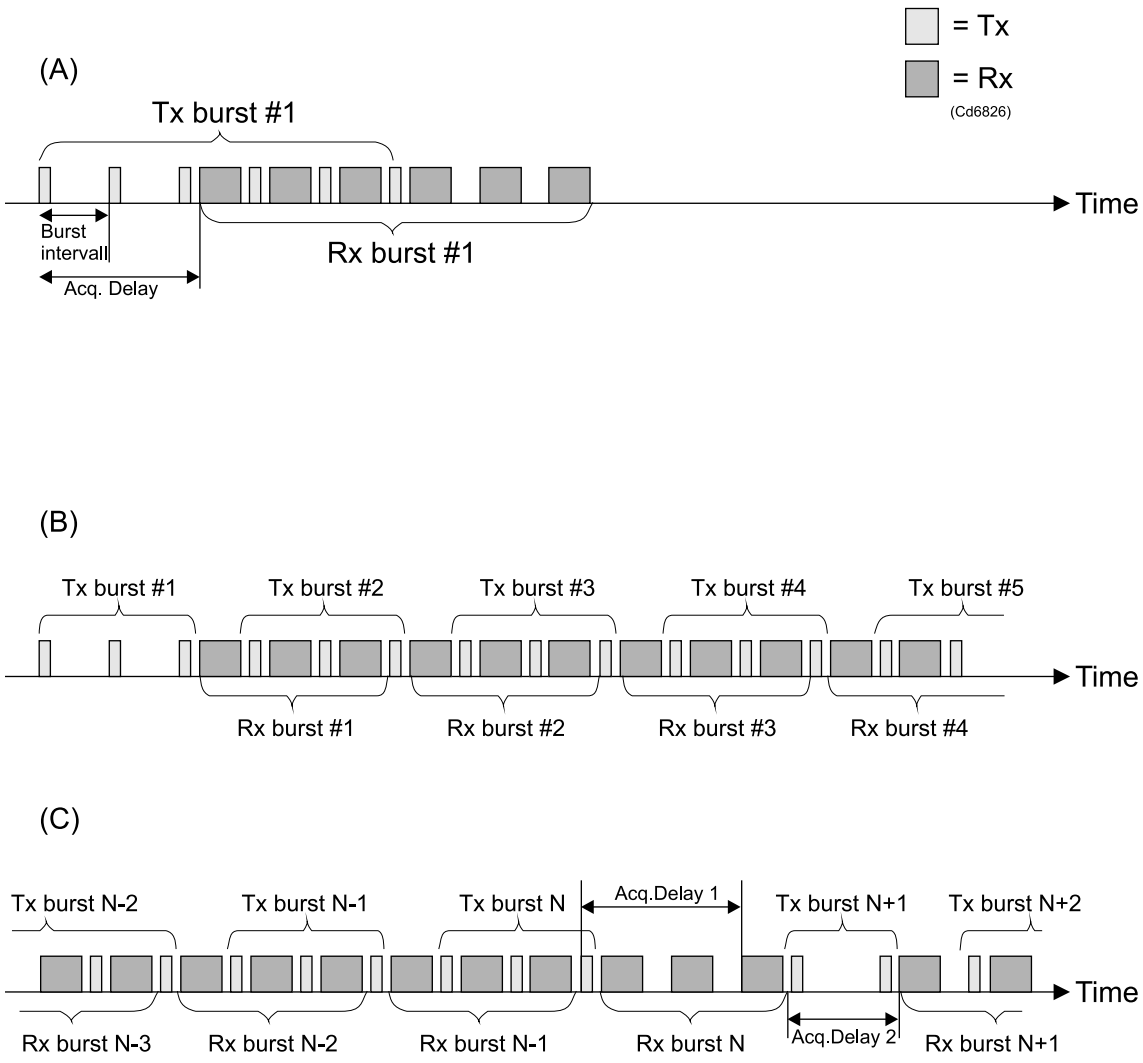
Note

Unless depth is input externally, it is recommended not to start pinging in burst mode. We recommend to start pinging in normal mode, and stay in this mode until bottom is found. Then switch to burst mode.

Note

There is a chance that the second return from one pulse will arrive in the reception window of another. Due to strong attenuation of the direct signal sub-bottom, the strongest parts of the second return may well be stronger than parts of the primary echo. Hence the second return may appear as sediments with high reflection coefficients. Generally it may be hard to tell when this happens. The exception is in rough weather, where these "false" sediments will be undulating because they will not be properly heave corrected. If the sub-bottom image changes "dramatically" when changing operating mode to burst mode, this is an indication of a problem with second returns. To get out of this situation, change the number of burst pulses (or change an essential parameter) in order to obtain a different burst interval.

Figure 23 Internally triggered burst mode: In (a) we see how a timing scheme can be composed so that the period of transmissions can overlap with the corresponding period of listening. By allowing the next burst to start once the transmissions of the previous burst has finished, we may have a high uniform ping rate even in deep waters as shown in (b). If the acquisition delay changes, or the reception window is increased/-decreased, the timing scheme may have to be changed and the transmissions will halt for an acquisition delay as shown in (c).



Calculate delay from depth

There is a checkbox with this text on the runtime parameters property sheet, and the delay this is referring to is the acquisition delay. Once the SBP 27 has detected bottom, the range found by the bottom tracker can be used to position the acquisition window. Two user configurable parameters determine how this feature will behave. There is the delay hysteresis which determines how much the bottom range must change before the acquisition delay is adjusted, and there is the bottom screen position which is controlling where to position bottom in the acquisition window.

Unless external input depth/bottom range is used, the bottom tracker of the SBP 27 must be locked on to bottom before this feature can be enabled. That is; initially the operator must manually enter an acquisition delay and an acquisition window length that will contain the echo from the bottom. Once the bottom tracker is locked to bottom, the automatic mode can be enabled.

With bottom range input from EM 122/302or another echo sounder, this automatic adjustment of acquisition window will function instantly.

We recommend to have this option enabled during most surveys. An exception is when the bottom tracker and/or the externally input depths are unreliable. This may be the case when the seafloor is changing rapidly or in rough weather conditions when air bubbles may block the acoustic signals. In such cases it may be necessary to enter the acquisition delay manually and perhaps also to use a long acquisition window.

Depth selector

The depth selector is used to choose the source to use for automatic adjustment of the acquisition delay. This selector is found under **Data selectors→Depth selector** located under the **System** tab. The sequence of the **depth from** items determines the priority of the depth sources. Further down in the chain means higher priority, i.e. when **depth from NMEA** is below **depth from bottom tracker**, the preferred source of depth information is depths from the NMEA reader.

System operation

Array geometry and related properties

The smaller the transducer array, the wider the beam width. The transducer arrays of most sub-bottom profilers have much smaller dimensions and therefore much wider beam widths than the SBP 27 do. The SBP 27 achieves a small footprint with a Mills cross configuration just as the EM 122/302 does. In fact, the SBP 27 shares the receiver array with the EM 122/302.

The beamwidth is inversely proportional to frequency. The SBP 27 operates at about one third of the frequency of the EM122 and one seventh of the frequency of the EM 302. This implies that a 1° EM 122 receiver array will naturally lend itself to SBP 27 as a 3° receiver and a 1° EM 302 receiver array will naturally lend itself to SBP 27 as a 7° receiver. The hydrophone signals are amplified and bandpass filtered (cut-off frequencies at 2 kHz and 7kHz) in the EM 122/302 preamplifier, and then routed to the SBP 27 RX/TX junction box.

Refer to *System diagram* on page 15

To obtain a symmetric footprint the transmitter array should have a similar length as the receiver array. The 3° transmitter array of the SBP 27 has 96 transducers in a 32 x 3 configuration. The three transducers acrosstrack must be weighted in order to

obtain a suitable beam width and to reduce sidelobe levels. We obtain this by using two transmitter channels per three elements; the centre element has a dedicated channel while the other channel is shared by the two outer elements.

The footprints of the EM 122/302 and SBP 27 arrays are outlined in figure *Footprints* on page 173. The transmitter arrays are large in the alongtrack dimension and consequently they produce narrow footprints alongtrack. The receiver array is large in the acrosstrack dimension and consequently the receiver footprint is narrow acrosstrack. The footprint of the system is the product of the transmitter footprint and the receiver footprint.

Attitude compensation

Echoes are mainly caused by specular reflections which are strong close to normal incidence. Because of the narrow beamwidths of the SBP 27, attitude corrections are necessary in order to maintain strong echoes when the ship is pitching and rolling. Both the transmit beam and the receiver beams are tilted, accounting for the array installation angles and the ships attitude, aiming at keeping the beams vertically in global coordinates.

The data are heave corrected, accounting for heave at transmission and reception.

Bottom slope corrections

In sloping terrain it is possible to have the EM 122/302 calculate the bottom slopes alongtrack and acrosstrack. This information is passed on to the SBP 27 operator unit, and the operator can choose to use this information to the steer the beams in order to obtain normal incidence. In this way it is possible to maintain strong specular echoes from the seabed and sediments parallel to the seabed in spite of the narrow beamwidth of the SBP 27.

Rough terrain

When a plane is a poor approximation for the sea floor, the bottom slope corrections will not work well. In such a situation, the SBP 27 offers transmit/receive modes with wide angles. In these wide beam modes it is more likely that a portion of the transmit beam will give a specular return, and that the receive beam(s) will be able to detect this return.

Multiple receiver beams

Because the receiver channels are sampled independently, we can generate many receiver beams for each set of receiver data. This feature may be used in rough terrain, in order to intercept a specular return from an unknown direction. The operator can specify the number of beams (max. 11) and a fan width (max. 30°). The beams are spaced equiangle within the specified fan width.

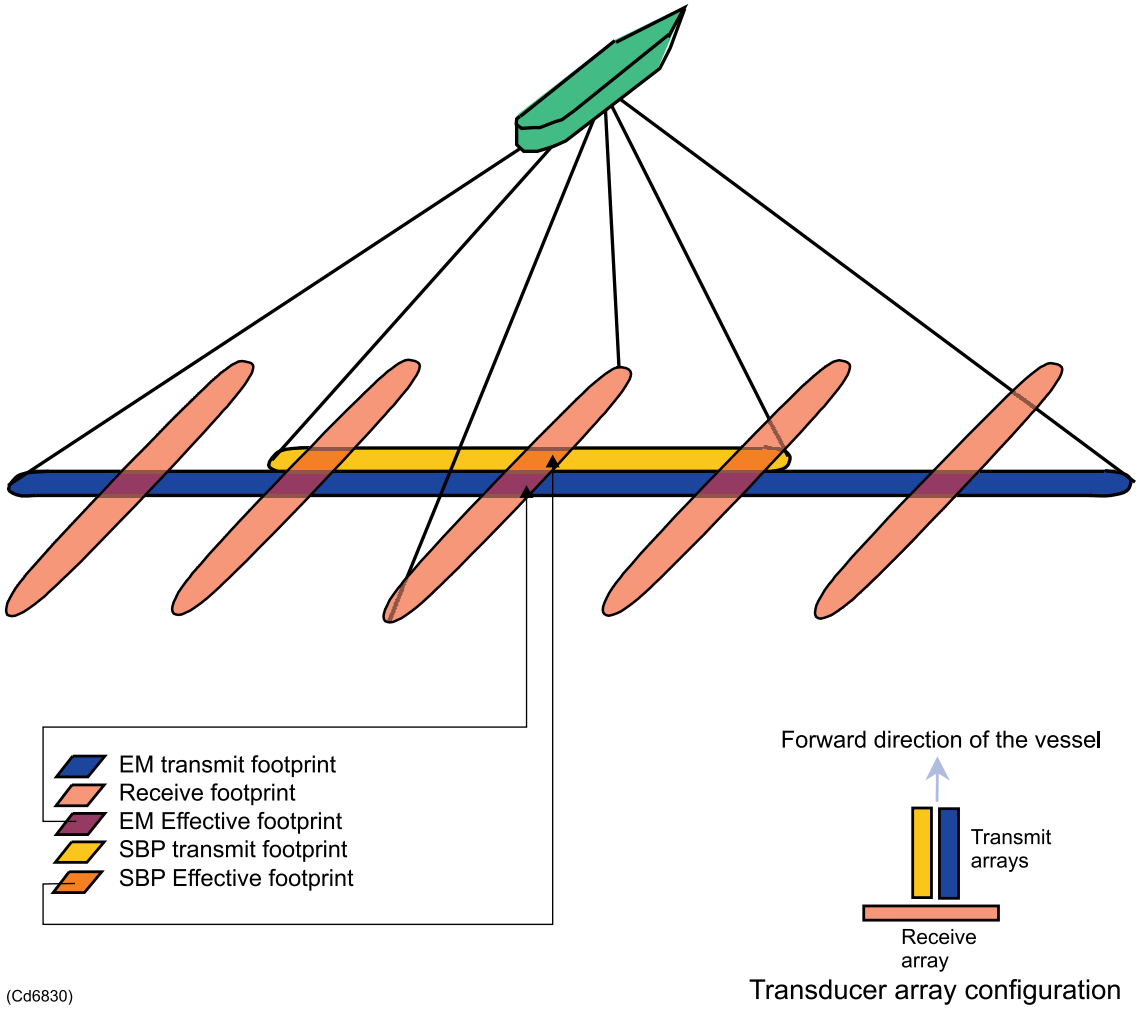
Also, sediments sub-bottom need not be parallel to the seafloor. Accordingly, a different receiver beam than the one with normal bottom incidence may receive the strongest specular return from sub-bottom interfaces.

We expect this feature to be useful for the detection of buried objects. As shown in figure *Footprints* on page 173, the transmit beam is wide acrosstrack. The transmitted energy will penetrate into bottom over the width of the transmit footprint. If an object of sufficient target strength is located sub-bottom outside the beam collecting specular returns, but inside the 30° wide footprint of the transmitter, it should be possible to detect this object in one of the outer receiver beams.

Note

Above description applies to the largest system configurations.

Figure 24 Footprints



Transmit waveforms

We can categorize the transmit waveforms into **non-chirp signals** and **chirp signals**. Non-chirp signals have a range resolution given by their pulse length. Chirp signals (frequency modulated signals) has a range resolution roughly given by the inverse of the sweep range. To obtain the range resolution in the image, one must use matched filter (pulse compression) in the processing.

For non-chirp signals we recommend bandpass filtering the data to remove noise outside the bandwidth used by the signal

In the following the various signals are described in more detail. For an accurate description of cw and chirp pulses one must also consider the amplitude shaping of the signals. Amplitude shaping is described in a separate section after a description of the unshaped signals.

Non-chirp signals

No pulse

Pulse parameters: None

Choosing **No pulse** enables listening without pinging. This "transmit waveform" is used for testing. For instance you may use this mode to listen for interference from other acoustic systems.

Ricker pulse

Pulse parameters: Source power

The **Ricker pulse** is a short pulse of high bandwidth. There is no matched filter for the Ricker pulse; the echo directly provides maximum resolution. A bandpass filter (2.5 kHz to 7 kHz) should be applied in the processing.

CW pulse

Pulse parameters: Source power, centre frequency f_c, pulse length T, pulse shape S.

The **CW pulse** is a signal consisting of a sinusoidal wave of frequency f_c enclosed by an envelope of duration T. Assuming a rectangular envelope and unit amplitude the CW pulse is

$$S_{CW}(t) = \sin(2\pi f_c t), 0 \leq t \leq T$$

The bandwidth bw of a CW pulse is in principle given by T^{-1}. The properties of the electronics and the transducers, and also application of a pulse shape parameter S≠0, will in practice make $bw < T^{-1}$. The shape of the envelope can be manipulated by the pulse shape parameter S, see *Amplitude shaping – and pulse shape parameter* on page 176.

Chirp signals

Pulse parameters: Source power, sweep low frequency f_L, sweep high frequency f_H, pulse length T, pulse shape S.

By sweeping the carrier frequency of a pulse we can make long pulses of high bandwidth. Compared to short pulse of the same bandwidth and the same amplitude, this gives an increased signal-to-noise ratio because there will be more energy in each pulse. Whenever the image shows that the signals are weak, you should first check that the transmitter is operating at the maximum allowed power level. If that is the case, one may increase the pulse length to see if this improves the quality of the image. Because of the movement of the ship during transmission and reception, the pulse shape is distorted and the matched filter result will be distorted. In practice it is therefore far from guaranteed that an increased pulse length will provide a better signal-to-noise ratio.

In principle a sweep up and a sweep down should result in identical images. One might, however, prefer to use one direction rather than the other to reduce interference to/from other equipment applying chirps in the same frequency range. Also, during post-processing, if matched filter is applied after time variable gain, frequencies at the end of the sweep is amplified more than frequencies at the start of the sweep.

Linear chirp up/down

First we define:

$$\alpha = \frac{f_H - f_L}{2T}$$
$$f_c = f_L + \frac{f_H - f_L}{2}$$

Then we write the expression for the linear chirp up/down signals with rectangular envelopes and unit amplitudes as:

$$S_{LMF,Up/Down}(t) = \cos\left(2\pi\left\{f_c \pm \alpha\left(t - T\right)\right\}t\right), 0 \leq t \leq T$$

The instantaneous frequency is given by the time derivative of the phase:

$$f(t) = \frac{d}{dt}\left(\left\{f_c \pm \alpha\left(t - T\right)\right\}t\right) = f_c \pm \alpha\left(2t - T\right), 0 \leq t \leq T$$

Hyperbolic chirp up

The hyperbolic chirps are less exposed to Doppler distortion than linear chirps. Compared to the linear chirps, the hyperbolic sweep up spends more time at the lower frequencies. This may provide better penetration at the expense of poorer resolution.

We define:

$$G = 2\pi\frac{f_H f_L}{f_H - f_L}T$$

The expression for the upsweep hyperbolic chirp signal with rectangular envelope and unit amplitude is:

$$S_{HFM,Up}(t) = \cos\left(S_{HFM,Up}(t)\right) = \cos\left(-G \times \ln\left(1 - \frac{(f_H - f_L) \times t}{f_H \times T}\right)\right), 0 \leq t \leq T$$

The instantaneous frequency is given by the time derivative of the phase:

$$f(t) = \frac{1}{2\pi}\frac{d}{dt}\left(-G \times ln\left(1 - \frac{(f_H - f_L) \times t}{f_H \times T}\right)\right) = \frac{f_H f_L T}{f_L t + f_H (T - t)}, 0 \leq t \leq T$$

Hyperbolic chirp down

We define (as for the hyperbolic upsweep):

$$G = 2\pi \frac{f_H f_L}{f_H - f_L} T$$

The expression for the hyperbolic chirp down signal with rectangular envelope and unit amplitude is

$$S_{HFM,Down}(t) = \cos\left(G \times \ln\left(1 + \frac{(f_H - f_L)\, t}{f_L T}\right)\right), 0 \leq t \leq T$$

The instantaneous frequency is given by the time derivative of the phase:

$$f(t) = \frac{1}{2\pi}\frac{d}{dt}\left(G \times \ln\left(1 + \frac{(f_H - f_L)\, t}{f_L T}\right)\right) = \frac{f_H f_L T}{f_H t + f_L (T - t)}, 0 \leq t \leq T$$

Amplitude shaping – and pulse shape parameter

To generate a signal with rectangular envelope would require infinite bandwidth. In practice the pulse is shaped on transmission by the transfer function of the transmit transducers. There is also a minor shaping on reception caused by the hydrophones.

In addition to these unavoidable contributions to distortion of the transmit pulse, there is a built-in minimum rise and fall time in the transmitter in order to protect the electronics against damage. An effect of the electronic shaping is less deviation between the applied voltage signal and the acoustic signal because the shaped signal is physically more realizable.

The pulse shape parameter

The value of the pulse shape parameter stored with the beam data reflects the electronic shaping of the transmit signal applied by the transmitter electronics. Its value is in percent and it specifies how large part of the pulse length will be used for shaping. If for instance 50 % shaping is specified, the transmitter calculates a Hanning window of length half the pulse length, an the first half of the Hanning window is used for making a smooth transition from zero to maximum power level, and the second half is used for making a smooth transition from maximum to zero power level.

In the runtime menu, the value of the pulse shape parameter can be adjusted automatically with changing pulse lengths. The value will then be set to the minimum value allowed by the transmit electronics. Unselecting this automatic adjustment, the operator may increase the value of the pulse shape parameter. The reason for doing this would be a desire to reduce sidelobes in range out of the matched filter process. This is achieved at the expense of reduced range resolution

File formats

Beam data logged by the operator software can be logged either in the **TOPAS/SBP raw file format** or in a **SEG Y format**.

The raw file format

In the following the data structure used for storing SBP 27 data in the **RAW** format is shown. The structure contains all necessary information for replaying a file containing data from a survey line.

The block length in the file varies with number of samples in an acquisition window (data trace). The size of one ping is:

384 + #samples * 4 bytes

In the table below the following definitions are used:

- **byte** variables are defined as 1 byte
- **short** variables are defined as 2 bytes
- **int** variables are defined as 4 bytes
- **float** variables are defined as 4 bytes.
- **double** variables are defined as 8 bytes

Table 12 The raw file format

Bytes	Data type	Variable name	Comment
0	short	trace in file	starts at 1
2	short	format	3
4	short	year	yyyy

Table 12 The raw file format (cont'd.)

Bytes	Data type	Variable name	Comment
6	short	month	
8	short	day	
10	short	hour	
12	short	minute	
14	short	sec	
16	short	msec	
18	byte[16]	filename	
34	byte[18]	line number	(or line name)
52	byte[20]	survey name	
72	short	channel number	0
74	float	power attenuation	dB relative maximum
78	float	ping interval	[ms]
82	short	pulse form	0 = no pulse 2 = ricker 3 = LFM 8 = HFM
84	short	HRP compensation	Always on
86	float	sec_Freq	
90	float	sweep start	[Hz]
94	float	sweep stop	[Hz]
98	float	pulse length	[ms]
102	short	correlated	1 = not correlated 2 = spiked/matched
104	float	beam dir along	TX tilt angle re MRA
108	float	scan sec along	TX fan sweep width
112	float	scan step along	TX beam spacing
116	float	beam dir athwart	RX roll angle relative MRA
120	float	scan sec athwart	RX fan width
124	float	scan step athwart	RX beam spacing
128	double	latitude	DDMM.mmmm
136	double	longitude	DDDMM.mmmm
144	double	zone lon	
152	float	heading	Vessel heading
156	float	speed [m/s]	Vessel speed
160	short	system	0 = geo. Coord (Lat/Lon) 1 = UTM
162	short	zone number	UTM zone no.
164	float	depth [m]	Depth from transducer
168	float	TX heave [m]	Heave value at transmission
172	float	TX roll	Roll value at transmission
176	float	TX pitch	Pitch value at transmission
180	float	RX heave [m]	Heave value at reception

Table 12 The raw file format (cont'd.)

Bytes	Data type	Variable name	Comment
184	float	RX roll	Roll value at reception
188	float	RX pitch	Pitch value at reception
192	float	delay	Acquisition delay
196	float	length [ms]	Trace length
200	float	sample rate	[Hz]
204	float	gain	Front end gain
208	short	spare	
210	float	hp_filter	High pass (low cut) frequency
214	float	lp_filter	Low pass (high cut) frequency
218	float	roll dir	RX roll angle relative vertical
222	float	pitch dir	TX pitch angle relative vertical
226	float	transducer draft	
230	short	beam width TX	0 = full array 1 = focused 2 = wide 10 3 = wide 20 4 = wide 30 5 = half array 6 = quarter array
232	short	beam width RX	0 = full array 1 = focused 2 = wide 10 3 = wide 20 4 = wide 30 5 = half array 6 = quarter array
234	short	RX beam number	Centre beam is always 0 (neg. ones to starboard)
236	short	number of beams	Odd number <= 11
238	short	pulse shape	[%]
240	float	sound speed [m/s]	
244	int	trace in survey	starts at 1 when a new survey name is given
248	int	trace in line	reset to 1 when a new line name is given
252	int	TRU ping number	ping number since transceiver unit startup
256	float	RX Sensitivity	-XX dB re (approx)
260	float	source level	Maximum for system
264	short	External delay	From CODA navigation string
266	int	Event mark counter	From CODA navigation string
270	float	External kilometerpoint	From CODA navigation string
274	short	TX beam number	Used in transmit cycle mode
276	short	Number of TX beams	Used in transmit cycle mode
278	short	System serial number	For future use
280	short	Number of TX channels	16,32 or 64

Table 12 The raw file format (cont'd.)

Bytes	Data type	Variable name	Comment
282	short	Number of RX channels	16,32 or 64
284	float	power attenuation target	dB re maximum. May differ from power attenuation (bytes 74-77) if mammal protection or automatic power adjustment is enabled.
288	byte	Synchronization	0:None, 1:Trig 1, 2: Trig 2
289	byte	Transmit cycle mode	0:off, 1:beam width, 2:tilt
290	byte	Spare	
291	byte	Composite beam number	>0 for a composite beam
292	short	Composite filter	
294	byte[78]	Spare bytes	
372	int	trace size N	Used when number of samples >= 64k (k=1024)
376	short	trace size N	Used when number of samples <64k
378	float[N]	Data	N
378+4*N	byte[6]	Sonar model	SBP120 or SBP300

The SEG Y file format

SBP 27 use of the SEG Y format

We follow revision 1 of the SEG Y format , but we do not make use of the option of having variable length of traces within a file. Nor do we make use of the extended textual headers. The composition of an SBP 27 SEG Y file is as follows:

- A 3200 byte textual file header
- A 400 byte binary file header
- 3. Repeated entries of
  - **a** a 240 byte binary trace header followed by
  - **b** a data trace

The first 3200 byte Textual File Header record contains 40 lines of textual information, providing a human-readable description of the seismic data in the SEG Y file. This information is free form.

The **binary file header** contains information that applies to the whole SEG Y file.

The **binary trace header** contains trace attributes, which are defined as two-byte or four-byte, two’s complement integers.

This revision is described in detail in the document

SEG Y rev 1 Data Exchange Format

SEG Technical Standards Committee

Release 1.0, May 2002

Editors: Michael W. Norris and Alan K. Faichney

Note

The SEG Y format does not include all of the parameters stored in the native RAW format (for instance vessel speed, roll, pitch and heave). If this information is of interest, the raw format described in the previous section must be used.

Note

The SEG Y file extension is configurable to either sgy, segy, or seg in the data loggers.

Note

Several RX beams into a single SEG Y file has to our knowledge NOT been used by SBP 27 users. As a consequence of this the various RX beams are separated into individual files when logging.

The SEG Y binary file header

Table 13 The SEG Y binary file header

Offset	Data type	Variable name/Fixed values	Comment
3201	int	job identification number / 0	
3205	int	line number / 0	
3209	int	reel number / 1	
3213	short	number of beams per ping	The number of beams may be 1, 3, 5, 7, 9, or 11
3215	short	number of auxiliary traces per ensemble / 0	
3217	short	sample interval in microseconds	NOTE: Not recommended for use due to insufficient time resolution. Use sampling frequency located at offset 3263
3219	short	as above	
3221	short	number of samples per trace	
3223	short	as above	
3225	short	data sample format code / 3 or 5	3 = 2-byte, two's complement integer 5 = 4-byte IEEE floating point
3227	short	number of RX beams per ping	Same as 3213
3229	short	trace sorting code / 1	
3231	short	vertical sum code / 1	
3233	short	sweep frequency start	[Hz], zero if Ricker or "no pulse"
3235	short	sweep frequency end	[Hz], zero if Ricker or "no pulse"
3237	short	sweep length	[ms] zero (0) if non-chirp signal

Table 13 The SEG Y binary file header (cont'd.)

Offset	Data type	Variable name/Fixed values	Comment
3239	short	sweep type	1: LFM & CW, 3: HFM, 4: Ricker and ”noPulse”
3241	short	trace number of sweep channel / 0	
3243	short	sweep taper length start /0	See pulse shading parameter at offset 3525
3245	short	sweep taper length end /0	See pulse shading parameter at offset 3525
3247	short	taper type /2	2=Hanning (Cosine squared)
3249	short	correlated data	1 = no 2 = yes
3251	short	binary gain recovered / 2	1 = yes 2 = no
3253	short	amplitude recovery method / 1	1 = none
3255	short	measurement system / 1	1 = Meters
3257	short	impulse signal polarity /2	
3259	short	vibratory polarity code /1	1 = 337.5° to 22.5°
3261	short	spare	
3263	int	sampling frequency	[Hz]
3267	short[116]	spare	
3501	short	SEG Y format revision / 0x0100	
3503	short	fixed length trace flag / 0 or 1	0 = Variable trace length 1 = Fixed trace length
3505	short	number of extended textual headers / 0	
3507	short	power attenuation relative maximum	[dB]
3509	short	RX fan width	[1/10 of degrees]
3511	short	RX beam spacing	[1/10 of degrees]
3513	short	Number of TX beams	
3515	short	TX beam number	
3517	short	Beam width TX	0 = full array 1 = focused 2 = wide 10 3 = wide 20 4 = wide 30 5 = half array 6 = quarter array
3519	short	Beam width RX	0 = full array 1 = focused 2 = wide 10 3 = wide 20 4 = wide 30 5 = half array 6 = quarter array
3521	short	Number of TX channels	16, 32, or 64
3523	short	Number of RX channels	16, 32, or 64
3525	short	TX pulse shading	% of pulse length
3527	short[37]	Spare	

The SEG Y binary trace header

Table 14 The SEG Y binary trace header

Bytes	Data type	Variable name/Fixed values	Comment
1–4	int	trace no. in line	reset to 1 when a new line name is given
5-8	int	trace no. in file	starts at 1 in every file
9-12	int	trace no. in survey	starts at 1 when a new survey name is given
13-16	int	transceiver ping no.	starts at 0 when the transceiver unit is first switched on and is incremented by one for every transmission. Reset of the TRU will also reset this counter
17-20	int	energy source point number /0	
21-24	int	ensemble number / 1	
25-28	int	beam number	Centre beam is always 0. Legal values are from $-(N_B-1)/2$ to $(N_B-1)/2$ where N_B is the number of beams
29-30	short	Trace id code / 1	
31-32	short	number of vertical sum traces / 1	
33-34	short	number of horz. stacked traces / 1	
35-36	short	data use / 1	
37-40	int	distance center src to receiver / 0	
41-44	int	receiver group elevation / 0	
45-48	int	surface elevation at src / 0	
49-52	int	transducer draft	unit meter (as given by 3255-3256 in binary file header) divided by scalar at offset 68
54-56	int	datum elevation at recvr group / 0	
57-60	int	datum elevation at src / 0	
61-64	int	depth	unit meter (as given by 3255-3256 in binary file header) divided by scalar at offset 68
65-68	int	water depth at group / 0	
69-70	short	elevation scalar / -100	Fixed gain to be applied to values in bytes 41-68 of the trace header. (A negative sign means gain = 1/100, a positive sign means gain = 10)
71-72	short	coordinate scalar / -1000	Gain to be applied to values in bytes 73-88 and 181-188 of the trace header. Depending on coordinate units, bytes 89-90. (A negative sign means gain = 1/100, a positive sign means gain = 10)

Table 14 The SEG Y binary trace header (cont'd.)

Bytes	Data type	Variable name/Fixed values	Comment
73-76	int	X	If the coordinate units are in seconds of arc, the X values represent longitude and the Y values latitude. A positive value designates east of Greenwich Meridian or north of the equator and a negative value designates south or west.
77-80	int	Y	
81-88	long	0	
89-90	short	1 or 2	1 = length [m], 2 = seconds of arc
91-104	short[7]	0	
105–106	short	external delay	From CODA navigation string
107-108	short	0	
109-110	short	acquisition delay	time in ms from transmission to start of recording
111-114	int	0	
115-116	short	number of samples	trace length
117-118	short	sample interval	in microseconds. **NOT RECOMMENDED USED; USE sample rate found at offset 3263 of the binary file header**
119-120	short	1	fixed instrument gain
121-122	short	0	instrument gain [dB] (value approx. 21)
123-124	short	0	
125-126	short	correlated	1 = no, 2 = yes
127-128	short	chirp start frequency	Hz
129-130	short	chirp stop frequency	Hz
131-132	short	chirp length	unit milliseconds (will be incorrect if the pulse length is different from an integer number of milliseconds)
133-134	short	sweep type	1 = linear chirp & CW 3 = hyperbolic chirp 4 = ricker & “no Pulse”
135-138	int	0	
139-140	short	3	3 = hanning, degree of tapering determined by the pulse length and the pulse shape parameter.
141-148	long	0	
149-150	short	2000	lower cut-off frequency (-3dB) of preamplifier in Herz
151-152	short	8000	upper cut-off frequency (-3dB) of preamplifier in Herz
153-154	short	18	low-cut slope (dB/octave)
155-156	short	30	high-cut slope (dB/octave)
157-158	short	year	

Table 14 The SEG Y binary trace header (cont'd.)

Bytes	Data type	Variable name/Fixed values	Comment
159-160	short	day of year	
161-162	short	hour	
163-164	short	minute	
165-166	short	second	
167-168	short	time basis code/ 2	2 = GMT
169-196	int[7]	0	
197-200	int	event mark counter	From CODA navigation string
201-202	short	0	
203-204	short	trace value measurement unit / 2	2 = volt
205-210	byte[6]	transduction constant	Receiving sensitivity level: Transduction Constant. The multiplicative constant used to convert the Data Trace samples to the Transduction Units (specified in Trace Header bytes 211-212). The constant is encoded as a four-byte, two's complement integer (bytes 205-208) which is the mantissa and a two-byte, two's complement integer (bytes 209-210) which is the power of ten exponent (i.e. Bytes 205-208 * 10**Bytes 209-210). TO DO
211-212	short	transduction units / 1 (= Pascal)	trace value unit after multiplication by the transduction constant.
213-214	short	0	
215-216	short	time scalar / 1	Scalar to be applied to times specified in Trace Header bytes 95-114 to give the true time value in milliseconds
217-218	short	source type/orientation / 5 (1)	1 = vibratory vertical orientation 5=impulsive-cross-line
219-222	int	RX roll angle re vertical	in tenth of degrees
223-224	short	0	
225-230		source level / 0	
231-232	short	measurement unit / 3	3 = Pascal
233-236	int	TX pitch angle re vertical	in tenth of degrees
237-240	float	Kilometer point KP	From CODA navigation string NOTE: Breach of SEG Y standard that all number should be 2's complement integers. Note: Use of bytes 237-240 is changed since OPU sw version 1.5.3. Information of TX/RX beam widths are moved to the binary file header

Datagram formats

The communication between the SBP 27 Sub-bottom Profiler and external devices is performed through an interchange of datagrams. This chapter describes the SBP 27 datagrams.

For more information about the EM 122/302 datagrams, refer to the EM datagram manual, doc. no. 160692.

Topics

- *SBP 27 Datagram formats* on page 186
- *Navigation input* on page 188
- *Attitude data* on page 194
- *Depth – bottom – slope and sound velocity data* on page 196
- *Remote control datagram* on page 198

SBP 27 Datagram formats

Overview

The following datagram type is included:

- **Navigation input:** Data received from external navigation (positioning) systems.
- **Attitude input:** Data received by the transceiver unit from an external motion sensor.
- **Depth, bottom slope and sound velocity inputs:** Data received by the operator station from the EMs. Optionally, depht may be received from a single beam echo sounder.

Description of the datagrams

The message part of the datagram is divided into several data fields, each consisting of one or more data bytes. The message part is described according to this form:

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	

Message contents and definitions

1 **Description:** Short-form description of a data field.

2 **Res:** Resolution.

3 **Units:** Defines how to interpret the contents of a data field. The contents are described either by function or by units of measurement. A field may contain one or more units.

4 **Format:**

Note

This document uses a number and a lowercase h to describe a hexa-decimal value. Example: 02h is equal to 2 in hexadecimal representation.

This data field defines the coding of each unit. Two coding methods are used:

- **ASCII**
- **BINARY**

ASCII (American Standard Code for Information Interchange)

ASCII values are transmitted with the most significant byte first, i.e.:

Transmitted value 1234 = 31h32h33h34h

- Byte 1: 31h
- Byte 2: 32h
- Byte 3: 33h
- Byte 4: 34h

ASCII numeric values may be signed or unsigned. A signed value has a + (positive) or a - (negative) in its first byte. The value is signed if the table field valid range includes both positive and negative values.

ASCII numeric values may be with or without decimals. Decimal no-tation is either positional or by a decimal character. The decimal nota-tion is positional if the maximum valid value, not counting the deci-mal, is equal to the number of bytes available. Otherwise the value is given with a decimal point (.) included. The position of the decimal point is given in the field valid range.

BINARY

Binary values are transmitted with the least significant byte first, i.e.:

Transmitted value: 1234 = 04D2h

- Byte 1: D2h
- Byte 2: 04h

Binary values may be signed or unsigned. A signed negative value is given in two's complement representation. Unsigned values may use all bits for positive representation of a number. The value is signed if the field valid range includes both positive and negative values.

5 **Bytes:** The bytes field gives the number of bytes for one unit in column marked #, and the total number of bytes for a field in column marked Σ.

6 **Valid range:** The valid range field defines a units valid range in the format defined by the format field. Text enclosed by <> is used for describing the contents and not the actual value (i.e. <TEXT> is a text string consisting of any character in the current format). _ is used as notation for a space.

7 **Note:** Corresponds to notes applicable to the table.

Navigation input

The SBP 27 Sub-bottom Profiler supports input from a range of positioning systems. This document describes the datagram formats accepted by the TOPAS series.

Positioning datagrams are accepted on the RS-232 serial line on the multiport connection box supplied with the Operator Unit.

Recommended serial port setup is 4800 baud, 8 data bits, 1 stop bit, no parity, except where noted. This baud rate is high enough for the accuracy required and the necessary throughput, and it is low enough to avoid errors that might occur due to computer workload.

The following formats are accepted:

- Simrad 90 (Position, heading and speed)
- NMEA 0183
  - GLL (Position)
  - GGA (Position)
  - RMC (Position and speed)
  - HTD (Heading)
  - VTG (Speed)
- CODA navigation string

Simrad 90 position input

This input format is supported by all systems. It is the recommended format with the TOPAS sub-bottom profiler.

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	—	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z S90	Old format: xxxxx
Date	1 1 1 —	DD-days MM-months YY-years field separator	ASCII ASCII ASCII	2 2 2 1	7	1–31 1–12 0–99 ,	

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Time	1 1 1 0.01 —	HH-hours MM-minutes SS-seconds hh-seconds	ASCII ASCII ASCII ASCII	2 2 2 1	9	0–23 0–59 0–59 0–99 ,	
Latitude	1 0.001 — —	degrees minutes North/South field separator	ASCII ASCII ASCII ASCII	2 7 1 1	11	0–90 0–59.9999 N or S ,	
Longitude	1 0.001 — —	degrees minutes East/West field separator	ASCII ASCII ASCII ASCII	3 7 1 1	12	0–180 0–59.9999 E or W ,	
UTM Northing	0.1 —	meters field separator	ASCII ASCII	11 1	12	0–xxxxxxxxx.x	
UTM Easting	0.1 —	meters field separator	ASCII ASCII	9 1	10	0–xxxxxxx.x	
UTM zone no	1 —	time zone field separator	ASCII ASCII	2 1	3	1–60 ,	
UTM zone longitude	1 0.001 — —	degrees minutes East/West field separator	ASCII ASCII ASCII ASCII	3 7 1 1	12	0–180 0–59.9999 E or W ,	1)
System	1 —	— field separator	ASCII ASCII	1 1	2	0–2 ,	2)
Q factor	1 —	— field separator	ASCII ASCII	1 1	2	0–9 ,	3)
Speed	0.1 —	m/s field separator	ASCII ASCII	4 1	5	0–99.9 ,	4)
Heading	0.1 —	degrees field separator	ASCII ASCII	5 1	6	0–360.0 ,	
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Notes

1 The UTM zone longitude field is only valid if East/West is set to E or W

2 Determines which co-ordinate system is valid:

- 0 = lat/long
- 1 = UTM Northern hemisphere
- 2 = UTM Southern hemisphere

3 The Q factor should be related to positioning standard deviation as follows:

- 9 = <1m
- 8 = <3m
- 7 = <10m
- 6 = <30m
- 5 = <100m
- 4 = <300m
- 3 = <1000m

- 2 = <3000m
- 1 = <10000m
- 0 = not valid position

4 This speed may be used for estimation of horizontal distance in display

NMEA 0183 position input

The GLL, GGA, RMC, HDT and VTG datagrams are supported on all systems.

Table 15 GLL structure

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	— — —	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z GLL ,	
Latitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	2 3-n 1	6-n	0-90 0-59.99 ,	1)
Hemisphere	— —	North / South field separator	ASCII ASCII	1 1	1 1	N or S ,	
Longitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	3 3-n 1	7-n	0-180 0-59.99 ,	1)
Hemisphere	—	East / West	ASCII	1	1	E or W	
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Table 16 GGA structure

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	— — —	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z GAA ,	
Time	1 1 1 — 1 —	HH–hours MM–minutes SS–seconds separator hh–hundreds field separator	ASCII ASCII ASCII ASCII ASCII ASCII	2 2 2 0-1 0-2 1	6-10	0-23 0-59 0-59 . 0-99 ,	1) 2)
Latitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	2 3-n 1	6-n	0-90 0-59.99 ,	1)
Hemisphere	— —	North / South field separator	ASCII ASCII	1 1	1 1	N or S ,	

Table 16 GGA structure (cont'd.)

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Longitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	3 3-n 1	7-n	0-180 0-59.99 ,	1)
Hemisphere	—	East / West	ASCII	1	1	E or W	
Quality indicator	1 —	— field separator	ASCII ASCII	1 1	2	0-2	2)
Used satellites	1 —	— field separator	ASCII ASCII	2 1	3	don't care ,	2)
HDOP	variable —	— field separator	ASCII ASCII	n 1	n+1	don't care ,	2)
Antenna altitude	variable — — —	meters field separator Meters field separator	ASCII ASCII ASCII ASCII	n 1 1 1	n+3	don't care , M, ,	2)
Geoidal separation	variable — — —	meters field separator Meters field separator	ASCII ASCII ASCII ASCII	n 1 1 1	n+3	don't care , M, ,	2)
Age of DGPS data	variable —	seconds field separator	ASCII ASCII	n 1	n+1	don't care ,	2)
DGPS station ID	1	—	ASCII	4 1	5	0-1023 ,	2)
Checksum	— —	delimiter —	ASCII ASCII			*	2)
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Table 17 RMC structure

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	— — —	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z RMC ,	
Time	1 1 1 —	HH–hours MM–minutes SS–seconds field separator	ASCII ASCII ASCII ASCII	2 2 1 1	6	0-23 0-59 0-59 ,	2)
Data status	1 —	— field seperator	ASCII ASCII	1 1	2	A or V ,	
Latitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	2 3-n 1	6-n	0-90 0-59.99 ,	1)
Hemisphere	— —	North / South field separator	ASCII ASCII	1 1	1 1	N or S ,	

Table 17 RMC structure (cont'd.)

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Longitude	1 variable —	degrees minutes field separator	ASCII ASCII ASCII	3 3-n 1	7-n	0-180 0-59.99 ,	1)
Hemisphere	—	East / West	ASCII	1	1	E or W	
Speed over ground	variable —	knots field separator	ASCII ASCII	5-n 1	6-n	0-99.9 ,	1)
Course made good	variable —	degrees field separator	ASCII ASCII	4-n 1	5-n	0-360.0 ,	1)
Date	1 1 1 —	dd-day mm–month yy–year field separator	ASCII ASCII ASCII ASCII	2 2 2 1	7	01-31 01-12 00-99 ,	2)
Magnetic variation	variable — — —	degrees field separator East / West field separator	ASCII ASCII ASCII	n 1 1 1	n+3	-180.0-180.0 , E or W ,	1) 2)
Checksum	— —	delimiter —	ASCII ASCII			*	2)
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Table 18 HDT structure – heading datagram

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	— — —	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z HDT ,	
Heading	variable — — —	degrees field separator true field separator	ASCII ASCII ASCII ASCII	5-n 1 1 1	8-n	0-360.0 , T ,	1)
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Table 19 VTG structure – speed datagram

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Start character	—	Start of Sentence	ASCII	1	1	$	
Address	— — —	talker identifier sentence formatter field seperator	ASCII ASCII ASCII	2 3 1	6	0–9 and A-Z RMC ,	
True track made good	variable — — —	degrees field separator field separator	ASCII ASCII ASCII ASCII	5-n 1 1 1	8-n	0-360.0 , T ,	1) 2)

Table 19 VTG structure – speed datagram (cont'd.)

Description	Res	Units	Formats	Bytes		Valid range	Note
				#	Σ		
Magnetic track made good	variable — — —	degrees field separator field separator	ASCII ASCII ASCII ASCII	5-n 1 1 1	8-n	0-360.0 , M ,	1) 2)
Speed, knots	variable — — —	knots field separator field separator	ASCII ASCII ASCII ASCI	5-n 1 1 1	8-n	0-99.9 , N ,	1)
Speed, km/ hour	variable — — —	km/hour field separator field separator	ASCII ASCII ASCII ASCII	5-n 1 1 1	8-n	0-360.0 , K ,	1) 2)
Termination	— —	Carriage Return Line Feed	ASCII ASCII	1 1	2	Dh Ah	

Notes

1 The length depends on the precision available.

2 Optional

The fields are not used by the sub-bottom profiler

See NMEA 0183 manual for description.

CODA navigation string

Only the fixed form of the CODA navigation string outlined below is supported.

Data Description	Format	Note
Start characters	CODA	Always CODA in capital letters
Easting	x.x	1)
Northing	x.x	1)
Kp	x.x	2)
Vessel speed	x.x	In knots, 3)
Vessel heading	x.x	4)
Line name	A	Maximum 18 characters, 5)
Fix number	N	0 - …, 6)
Delay	x.x	7)
Time	hh:mm:ss	8)
Date	dd:mm:yy	8)
Checksum	*hh	9)
end of sentence	<CR><LF>	0Dh 0Ah

Note

Unlike standard NMEA datagrams this datagram does not start with a '$' and the fields are separated by space.

Note

*Uncheck **Single message packet** for the UDP port receiving this datagram.*

Notes:

1 CODA must be present and prioritized under NMEA readers/Position priority.

2 Kilometer point Kp is written to field "Kilometer point" in raw/seg y files.

See *File formats* on page 177.

3 CODA must be present and prioritized under NMEA readers/Speed priority.

4 Used if "Use heading from NMEA readers" is checked (located in the Beam reader) and CODA is present and prioritized under NMEA readers/Heading priority.

5 Line name is written to the raw/seg y files.

See *File formats* on page 177.

6 Fix number is written to field "Event mark counter" in raw/seg y files; see section 6.2 . The event marks (fix numbers) will also be marked on the display.

7 Delay is written to field "External delay" in raw/seg y files.

See *File formats* on page 177.

8 Date and time is not used/stored.

9 The checksum is optional. The checksum is calculated as for NMEA datagrams, except also the first character is included in the checksum.

Attitude data

Attitude data is accepted as roll, pitch, heave and heading on one serial port labelled Attitude at the bottom plate of the transceiver unit.

The data update rate should be as for the multibeams (typically 100 Hz).

The accepted format is a 10 byte long message originally defined in the EM 1000 for use with digital motion sensors. It is supported by the following sensors:

- Applied Analytics POS/MV
- Photokinetics Octans
- Seatex MRU
- Seatex SeaPath
- TSS DMS-05

The serial line set-up must be 19200 baud, 8 data bits, 1 stop bit, no parity.

EM Attitude input format

(From the EM Series Datagram formats)

The EM attitude format is a 10-bytes long message defined as follows:

- Byte 1: Sync byte 1 = 00h, or Sensor status = 90h-AFh
- Byte 2: Sync byte 2 = 90h
- Byte 3: Roll LSB
- Byte 4: Roll MSB
- Byte 5: Pitch LSB
- Byte 6: Pitch MSB
- Byte 7: Heave LSB
- Byte 8: Heave MSB
- Byte 9: Heading LSB
- Byte 10: Heading MSB

where LSB = least significant byte, MSB = most significant byte.

All data are in 2's complement binary, with 0.01_ resolution for roll, pitch and heading, and 1 cm resolution for heave.

- Roll is positive with port side up with ±179.99° valid range
- Pitch is positive with bow up with ±179.99° valid range
- Heave is positive up with ±9.99 m valid range
- Heading is positive clockwise with 0 to 359.99° valid range.

Non-valid data are assumed when a value is outside the valid range.

How roll is assumed to be measured is operator selectable, either with respect to the horizontal plane (the Hippy 120 or TSS convention) or to the plane tilted by the given pitch angle (i.e. as a rotation angle around the pitch tilted forward pointing x-axis). The latter convention (called Tate-Bryant in the POS/MV documentation) is used inside the system in all data displays and in logged data (a transformation is applied if the roll is given with respect to the horizontal).

Note that heave is displayed and logged as positive downwards (the sign is changed) including roll and pitch induced lever arm translation to the system's transmit transducer.

This format has previously been used with the EM 950 and the EM 1000 with the first synchronisation byte always assumed to be zero. The sensor manufacturers have been requested to include sensor status in the format using the first synchronisation byte for this purpose. It is thus assumed that:

- 90h in the first byte indicates a valid measurements with full accuracy
- any value from 91h to 99h indicates valid data with reduced accuracy (decreasing accuracy with increasing number)
- any value from 9Ah to 9Fh indicates non-valid data but normal operation (for example configuration or calibration mode)
- and any value from A0h to AFh indicates a sensor error status

Depth – bottom – slope and sound velocity data

When operating the SBP 27, it is a great advantage to have external depth input form a hydrographic echosounder. This input can be used by the operator SW to automatically position the acquisition window which is necessary when the depth changes. See the operator manual for details. The depth information can be received in either the **SRV** or the **DPT** format described below.

The multibeams calculate the slopes of the seafloor along track. If desired, the operator may choose to use this information to obtain normal incidence of the beams. Information about the bottom slopes are included in the SRV datagram.

The soft ware for the SBP 27 does not perform ray-tracing. For a vertical beam, the knowledge of the average sound velocity is sufficient for depth calculation. For tilted receiver beams, the operator specified tilt is the angle of the beam relative to the vertical at the sea floor. In order to achieve this, we need to know the sound velocity by the seafloor and the sound velocity at the transducer face. The three sound velocities mentioned here are given to the SBP 27 by an EM sounder in the SRV datagram.

SRV format

The SBP 27 was originally designed to work together with the EM 122/302, but this datagram may now be generated by any EM sounder, which is useful in shallow water. The SRV datagram contains the information listed in the table below:

Data Description	Format	Note
Start identifier	$	
Talker identifier, two characters (KS=Kongsberg Simrad)	aa	
Datagram identifier string (Slope, Range, Velocity)	SRV,	
bottom slope alongship [°]	BSX=x.x,	1)
bottom slope acrosstrack [°]	BSY=x.x,	1)
quality estimate factor[%]	QEF=x.x	1)
bottom incidence range re reference point [ms]	BIR=x.x,	2)
normal incidence range re reference point [ms]	NIR=x.x,	
speed of sound at transducer [m/s]	SST=x.x	3)
average speed of sound in water column [m/s]	SSA=x.x	4)
speed of sound at bottom [m/s]	SSB=x.x	5)
Source of SRV information	EMX=x- -x	6)
duration of EM transmission [s]	EMD=x.x	
Checksum	*hh	
end of sentence	<CR><LF>	

Notes:

1 The bottom slope angles are calculated by fitting EM 122/302 data to a plane. The quality factor QEF is (100 times the standard deviation of the distance between the detections and the plane) / (bottom incidence range in meters), meaning that if the data fit the plane perfectly – a very unlikely event – the QEF will be zero. If the standard deviation is 2 meters and the depth straight down is 200 meters, the QEF = 0.01 = 1.0 %. That is: The lower the QEF, the more reliable are the bottom slope angles. Note: The detections used are from within a fan of limited width centered about the vertical. A few pings are needed, the ship must be moving, and EM 122/302 must have information about position in order to calculate the bottom slopes

2 When the automatic adjustment of acquisition window feature is enabled (checkbox ”Calculate delay from depth” on the runtime parameter sheet (found under ”System setup” located in the tab ”System” in the property area of the OPU sw)), BIR is used to position the acquisition window according to the parameter ”Bottom screen position [%]” that is set on the runtime parameters sheet. Note that the ”Delay hysteresis parameter [ms]”, that is used to prevent the SBP 27 from adjusting the acquisition delay for every little change in bottom incidence range, should be somewhat smaller than ”acquisition window” x ”Bottom screen position [%]” / 100 in order for this automatic feature to behave properly.

3 Used for steering of the beams.

4 Used to convert range in [seconds] to range in [meters] and vice versa wherever necessary.

5 Used for steering of the RX beams. Together with speed of sound at transducer, this parameter is used in the RX beamformer to get a desired angle of incidence on the seafloor.

6 SIS can generate SRV messages based on data from any EM sounder, thus valid values of EMX are i.e. 120, 122, 710, 302

DPT format

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always DPT,	–	–
Depth in meters from the transducer	x.x,	0.1 -	–
Offset of transducer from waterline in meters	x.x,	0 -	1
Maximum range scale in use	x.x	–	–
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Notes

1 A negative value implies that the offset is from the keel should not be used.

Remote control datagram

Partial support for the remote control datagram defined for the EM has been added.

To enable use of remote control datagrams, the checkbox **External play control** located in the NMEA parameter sheet must be checked.

The table below summarized the supported fields.

Data Description	Format	Note
Start identifier	$	
Talker identifier, two characters , (e.g. KM=Kongsberg Maritime)	Aa	
Datagram identifier string	Rxx,	1)
Job name (survey Identifier)	SID=aaaaa,	Maximum 20 characters
Line name / line number	PLL=aaaaa,	Maximum 18 characters
Checksum	*hh	2)
end of sentence	<CR><LF>	0Dh 0Ah

Caution

The NMEA reader used for reception of these datagrams must be configured so that it does not time out during operation. One or more datagrams will be lost after a timeout.

The timeout of an NMEA reader is specified in milliseconds; a value of 0 means it will never time out.

1 Rxx defines what action the system is to take with respect to pinging and logging

- R00: System to stop pinging and stop logging
- R10: System to start or continue pinging and stop logging

  Note

  The system will start pinging in mode Normal. If an R10 is received while pinging in Burst mode, the system will switch to pinging in Normal mode

- R12 System to start logging

  Note

  – *To enable logging, checkbox **External raw logging** and optionally checkbox **External pro logging** must be checked. They are located in the **NMEA readers** parameter sheet.*

  – *To activate pinging and logging, always send R10 before R12 (since R10 will stop logging).*

  – *For logging to start without any user interaction (i.e. no dialogue box will pop up when R12 is received) the data loggers must be configured to **Always use selected directory**.*

  * *see for instance Processed data logger on page 120*

2 The checksum is calculated as for standard NMEA datagrams.

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