TELEDYNE RESON

SeaBat 7125 AUV
Bathymetric Sonar System

OPERATOR'S MANUAL

Part Number 86010146

Version 3

August 2013

This page intentionally left blank.

Notice	The information contained in this document is subject to change without notice. Teledyne RESON makes no warranty of any kind with regard to this material, including (but not limited to) the implied warranties of merchant liability and fitness for a particular purpose. Teledyne RESON shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

SeaBat 7125 AUV Operator's Manual written by:

Teledyne RESON A/S
Fabriksvangen 35
3550 Slangerup
Telephone: +45 47 38 00 22
Facsimile: +45 48 38 00 66

Web: http://www.teledyne-reson.com
E-mail: sales@teledyne-reson.com
support@teledyne-reson.com

Version

August 2013 Version 3

Teledyne RESON strives to maintain up-to-date information and may, as necessary, review and revise this manual. If the information contained in this manual is unclear, please contact your nearest Teledyne RESON office for clarification.

Maintenance Release

Release FP3

This manual is consistent with the indicated software and firmware maintenance release.

Electronic File Version

This manual is available from Teledyne RESON in the Adobe® Acrobat® Portable Document Format (PDF). The selected PDF process preserves the interactive index and cross-reference features of the original Microsoft Word document.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

How to Use This Manual

This manual is valid for SeaBat 7125 AUV systems with maintenance release FP3. This manual is designed to accommodate both the first time user, who needs detailed instructions, and the experienced technician, who only requires a reference tool. It provides detailed procedures for the correct installation, operation, and maintenance of your Teledyne RESON system.

Read this manual thoroughly and follow the steps provided to maintain optimal safety standards and to obtain the best system performance.

Standards of Measurement

All physical measurements represented in this document are based on the metric system. All temperatures are represented in degrees Celsius.

Document Conventions

The following information will make it easier for the reader to interpret the text presented in this document.

Document Conventions

Convention	Definition
Hyperlink	Indicates a hyperlinked cross-reference. Click the word to be taken to the specified reference point.
Numbered list	Indicates stepwise instructions to be followed in a particular order.
Bulleted list	Indicates items of a list without any particular order.

Notes, Cautions, and Warnings

Notes, Cautions, and Warnings are included in this text to provide valuable information and to help the operator prevent damage to the sonar or to personnel. The following formats will be used:

NOTE
This is a Note. Notes provide explanatory information that may be useful to the operator, but is not necessarily vital to the operation of your Teledyne RESON system.

CAUTION
This is a Caution. Cautions provide important information regarding your Teledyne RESON system. Disregarding information provided in a Caution box may result in accidental misuse or damage to your Teledyne RESON system.

WARNING!

This is a Warning. Warnings provide important information regarding your Teledyne RESON system. Disregarding information provided in a Warning box may prove harmful to personnel working with or near the system.

Chapter Arrangement

All Teledyne RESON manuals are designed with the same basic structure. The following chapters are included in this document:

- ***Introduction*** provides a short summary of the SeaBat 7125 AUV sonar system, including an overview of the architecture and the main features.
- ***Safety Precautions*** provides important safety information about the SeaBat 7125 AUV sonar system.
- ***System Startup and Shutdown*** provides detailed information about how to start and shut down the SeaBat 7125 AUV sonar system.
- ***System Configuration with 7k User Interface*** provides detailed information about the configuration of the SeaBat 7125 AUV system.
- ***System Operation*** provides detailed information about the user interface and operation of the SeaBat 7125 AUV sonar system.
- ***Active Sonar Usage*** provides detailed information about the practical usage of the SeaBat 7125 AUV sonar system.
- ***System Performance and Data Types*** provides information about the types of data produced by the SeaBat 7125 AUV sonar system.

In addition to the above chapters, these appendixes have been included for reference:

- **Appendix A:** Troubleshooting
- **Appendix B:** Installation Instructions
- **Appendix C:** Reference Documentation
- **Appendix D:** System Options
- **Appendix E:** Available System Configurations
- **Appendix F:** Warranty Information
- **Appendix G:** Glossary of Terms

If you require additional information or need clarification of any part of this document, please contact Teledyne RESON Customer Support for assistance at support@teledyne-reson.com.

1 INTRODUCTION

1.1 System Overview

The SeaBat 7125 AUV is a high-resolution multibeam sonar system operating at either 200kHz or 400kHz that measures relative water depths over a 140° (or 165°) wide swath perpendicular to the vehicle's track. The SeaBat 7125 AUV is designed for mounting on an autonomous underwater vehicle.

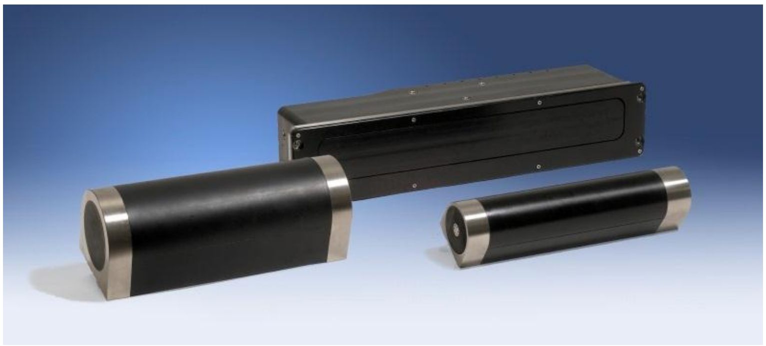


Figure 1: SeaBat 7125 AUV Sonar System Wet-End Components

1.2 System Architecture

The SeaBat 7125 AUV consists of an Integrated Control and Processor Unit (ICPU), a receiver unit, and a projector unit (or two projector units). The receiver and projector units each connects to the ICPU via a dedicated cable. In most cases the SeaBat 7125 AUV is installed and configured to operate autonomously requiring only a startup command to function. To feed power and control the operation of the sonar, the ICPU provides Ethernet and 48VDC power input connectors.

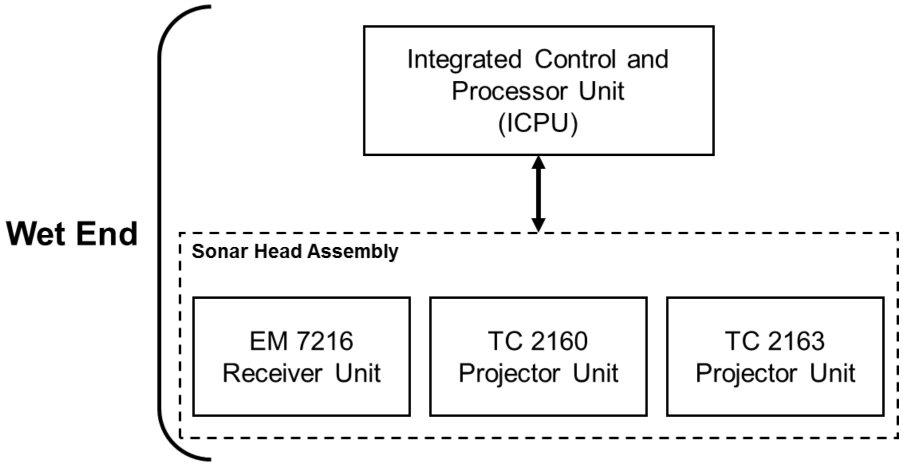


Figure 2: SeaBat 7125 AUV System Configuration[1]

[1] Receiver unit EM 7216 has replaced EM 7200.

1.3 System Operation

The projector unit of the sonar head assembly transmits a pulse of acoustic energy, which travels through the water medium and is reflected by the seafloor or any objects in its path. The reflected signal is detected by the receiver unit of the sonar head assembly, digitized by internal electronics, and sent to the ICPU for beamforming and processing.

1.4 System Features

The main features of the SeaBat 7125 AUV system are summarized below. Depending on the feature package purchased, all features may not be available (see *appendix E.2 Available Features*).

- **Resolution:** Dynamic, focused beamforming maintains ultra-high resolution, even at short ranges. A receiver sample rate of 34kHz provides excellent range resolution and complements the narrow beam, thus providing the user with ultimate data quality and resolution.
- **Fast update:** The swath is illuminated with a single transmission at an update rate of up to 50Hz (range selection dependent), maintaining 100% bottom coverage, even at high speed.
- **Depth rating:** The SeaBat 7125 AUV has a depth rating of 6000 meters.
- **Data output:** The SeaBat 7125 AUV exports the standard hydrographic records of bathymetry, side-scan, and snippets as well as water column data and other data for more scientific applications.
- **Beamforming:** The processor unit performs initial signal processing, a combination of time delay and phase rotation beamforming.
- **Bottom detection:** The special bottom detection algorithm uses a combination of center-of-energy and phase-zero crossing algorithms to detect the bottom in each individual beam with the highest possible accuracy.
- **Uncertainty output:** Uncertainty is computed for each sounding and made available in exported data.
- **Variable swath coverage:** This feature gives the operator control of the swath coverage. It includes swath width settings ranging from 45º to 140º (or 165º) in increments of 5º as well as a choice of beam density mode.
- **Steerable swath:** This feature allows swath to be steered electronically.
- **Head tilt:** This feature makes it possible to operate with a physically rotated sonar head, which allows for very flexible and specialized applications of the SeaBat 7125 AUV.
- **Tracker:** This feature is a complete automated mode of operation where the system sets sonar control parameters, including range, gain, power, and swath width based on the quality of the data being collected.
- **Auto Pilot:** This feature allows for automatic update of certain sonar settings. When Autopilot mode is initiated, the SeaBat analyzes bottom detection data to determine the average bottom depth and maximum usable swath angle,

then optimizes the sonar settings accordingly consistent with a user-configurable look-up table.

- **Operator selectable operating mode:** The choice of five different beam modes allows the operator to select a beam mode appropriate to the application thereby optimizing sonar operation. Wide mode yields a swath of 165º, while the other four modes yield a swath of 140º.
- **Beam distribution:** The SeaBat 7125 AUV offers the operator a choice between Minimum Beams (equiangular spacing), Intermediate, and Best Coverage (equidistant spacing) at both the 200kHz and 400kHz frequency. In addition, FlexMode provides settings for alternative beam distribution. All options are dynamically focused.
- **X-Range:** X-Range is a software and hardware feature using frequency modulated (FM) transmit pulses which provides extended range performance (for the 400kHz frequency) and also significantly improves system immunity to external noise.
- **Hardware sync pulse out:** A TTL pulse (synchronous with the transmitter pulse) is available from the processor unit.
- **1PPS pulse handling and time stamping:** Data time stamping is referenced to an incoming TTL level 1PPS and associated ZDA time message.
- **External trigger:** The system may be triggered using a standard 7k Center software remote command or by a TTL incoming trigger pulse.
- **Adaptive gating:** Three different gate settings are available for application to the bottom detection process: No Gates, Absolute Gates, and Adaptive Gates.
- **Beam data recording:** The SeaBat 7125 AUV produces an operator-configurable stream of beam data and may be written to the internal data drives which optionally can be configured as a RAID disk array, or exported in real time to connected clients. Data logging can be controlled remotely by a vehicle control computer using customer developed drivers. The included SeaBat software user interface allows for additional control including offline playback, and data storage functions.
- **Built-In Test Environment (BITE):** BITE is an integral part of the processor unit, monitoring the status of internal subsystems and wet-end units. BITE can be logged during a mission for off line analysis.

1.5 Typical Applications

The SeaBat 7125 AUV system provides support for a wide range of applications including:

- As-built surveys
- Breakwater mapping
- Coastal mapping
- Harbor mapping
- Hydrographic surveys to IHO Special Order and to U.S. Army Corps of Engineers Special Order
- Pipeline inspection surveys
- Pipeline route surveys
- Pre- and post-dredging and condition surveys
- Revetment surveys
- River surveys
- Search and recovery
- Site clearance surveys
- Underwater inspection and object location

2 SAFETY PRECAUTIONS

WARNING!
If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Teledyne RESON assumes no liability if this product is operated in an unsafe manner.

CAUTION
Use of the equipment in a manner not specified by the manufacturer may affect warranty situation (see *Appendix F Warranty Information*).

2.1 Operator Safety

The SeaBat™ system should be handled with attention to operator safety as well as protection of the hardware components. General precautions include:

- **DO NOT** connect or disconnect cables with the power on.
- **DO NOT** attempt to open and service the projector or receiver units.
- **DO NOT** attempt to open and service the ICPU without specific instructions from Teledyne RESON.
- **DO NOT** operate the system while divers are in the water and closer than two meters from the projector and receiver units. High-powered ultrasonic energy can be hazardous to human physiology.

2.2 Equipment Safety

Each SeaBat™ component is sufficiently robust for shipboard storage while in its own transit case or shipping box, which include handles and tie-down rings. Use appropriate discretion in lifting these components, as the cases may be awkward and heavy.

2.2.1 Safe Handling

To ensure safe handling of the equipment:

- Inspect each transit case or shipping box for physical damage prior to opening, and each component for physical damage before installation.
- Use original shipping boxes to provide adequate packaging and shock absorption when shipping or storing the equipment.
- Do not drop the equipment.
- Do not connect or disconnect cables from the ICPU or from the sonar head assembly while the ICPU is running. This can damage the internal workings.

- Do not bend cables beyond the recommended limits.
- Do not place the sonar head in an area where the face may be scratched or damaged. If an array must be placed on the ground, it should be placed on a flat surface and covered with a protective plastic sheet.
- Do not place liquids on or near the equipment.
- Ensure that the equipment is properly secured before putting out to sea.
- When the sonar head is in air and switched on, the transmit power should be switched off except when performing system checks, where power should be increased to a level which is audible for a short time only on a slow repetition rate and using very short pulse lengths. A higher setting may damage the transmit array ceramics. **The ICPU system can be operated in air for very short to medium periods of time.**

CAUTION
If the ICPU is run on deck for the purpose of offloading data it is recommended that a water bath, wet towels, or other heat mitigation solution is employed to prevent overheating of the computer electronics in the pressure housing. The temperature of the computer electronics can be monitored using the system's BITE feature while offloading data. A red LED indicator will notify the user that temperatures are approaching a critical level.

- Unused connectors should be sealed with dummy plugs.
- Do not exceed operating and storage temperature limits.

CAUTION
Do not operate transmitters in air except during system checks for short durations of less than one minute with minimum power and pulse lengths.

2.2.2 Cleaning and Maintenance

2.2.2.1 Projector and Receiver

The acoustic window molded over the front of the projector and receiver arrays is made of high-density polyurethane. A long range of chemicals will destroy the polyurethane, which include, but are not limited to:

- Acids
- Automotive brake fluid
- Base
- Grease
- Halogenated hydrocarbons (carbon tetrachloride, trichloroethylene)
- Hydraulic fluids
- Ketones (MEK, acetone)
- Nitro hydrocarbons (nitrobenzene, aniline)
- Oil
- Ozone
- Petrol
- Phosphate ester

The following recommendations are made to protect the arrays while in use and in storage.

- For cleaning, use a mild, nonabrasive soap, fresh lukewarm water, and a soft brush.
- Rinse the sonar with fresh water after every use.
- Do not clean the array or sonar by using hot or cold pressure washers. The high-velocity water spray will cut through the polyurethane or damage the interface between the polyurethane and the sonar metal housing.
- To scrape away marine growth from the arrays, use only a wooden tool.
- Do not apply any antifouling paint on the acoustic window unless the type is recommended by Teledyne RESON. The antifouling paint will affect the acoustic performance. Teledyne RESON recommends:
    - For high-frequency transducers (>100kHz) use International VC 17m.
    - For low-frequency transducers (<100kHz) use SigmaGlide.

NOTE
As these products are subject to technical modifications, it is recommended that the most up to date PDS[2] and MSDS[3] are acquired prior to commencing the coating work.

2.2.2.2 Wet-End Connectors

Regular maintenance should be performed to protect the wet-end connectors. Follow these guidelines:

- Lubricate mating surfaces with a silicone oil or equivalent (silicone oil based).

CAUTION
Female connectors must be lubricated every 5 matings. Observe the instructions provided with the maintenance kit.

- DO NOT grease mating surface.
- Avoid nicks and cuts around contacts as these are the sealing surfaces.
- Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time.
- Do not overtighten bulkhead nuts.
- Grip main body of connector during mating or unmating. Do not pull on cable to disconnect.
- Avoid sharp bends at cable entry to connector.

NOTE
Contact Teledyne RESON for information on PN 1007252: Wet connector lubrication kit.

[2] Product Data Sheet
[3] Material Safety Data Sheet

2.3 Electrical Isolation

Electrical isolation for both titanium and aluminum components may be achieved by using nonconductive bushings, washers, and isolation plates to insulate them from the mounting brackets. Common nonconductive materials include Delrin, G-10/FR4 glass fiber sheets, or high-density polyethylene sheets.

NOTE
Contact Teledyne RESON for additional information on schemes for electrical isolation.

2.4 Exposure to Sunlight

Do not allow the projector and receiver arrays to sit in direct sunlight when not in use, but cover the arrays with a bag. In addition to furthering corrosive effects, continued exposure to ultraviolet (UV) rays will damage the polyurethane array face.

2.5 Safe Disposal of Waste (WEEE Directive)

The use of the crossed-out dustbin logo indicates that this product is subject to directive 2002/96/EC, known as the Waste Electrical and Electronic Equipment Directive. The WEEE Directive specifies that used electric/electronic equipment may not be treated as household waste, but must be sorted separately for disposal. These rules concern all your Teledyne RESON products (computer, monitor, transducer, processor, probe, etc.) and also all accessories (keyboard, mouse, etc.). By ensuring this product is disposed of correctly, you will help protect the environment.

For more detailed information about the recycling of this product, please contact your local authority, your household waste disposal service provider, or Teledyne RESON Customer Support (support@teledyne-reson.com)

3 SYSTEM STARTUP AND SHUTDOWN

3.1 Chapter Overview

This chapter includes detailed instructions on the following subjects (click the emphasized hyperlink to be taken to the section):

- ***Pre-dive Checks:*** Consists of details on the procedure to follow prior to deploying the system.
- ***System Startup Instructions:*** Consists of startup details.
- ***System Shutdown Instructions:*** Consists of details on stopping the system.
- ***Post-dive Checks:*** Consists of details on the procedure to follow once the system has been recovered to deck.

NOTE
For information on configuration of the system (including I/O module configuration, remote operation, and folder management), see *section 4 System Configuration with 7k User Interface*. For information on the user interface and operation of the system, see *section 5 System Operation.* For information on the practical use of the sonar, see *section 6 Active Sonar Usage*.

3.2 Pre-dive Checks

Prior to deploying the SeaBat 7125 AUV into the water, perform the following checks.

1. Inspect all system cables for signs of chafing or damage.
2. Inspect the transducer arrays and the ICPU for security, signs of damage, or oil leakage.
3. Inspect the EM 7216 (or EM 7200) receiver for any damage or sign of oil leakage.

3.3 System Startup Instructions

After the SeaBat hardware has been installed (see *Appendix B Installation Instructions*), the system may be started.

1. Apply power to the ICPU. The SeaBat 7125 AUV will automatically start the AUV operating system.
2. The 7k Center will start. Once started, the 7k Center will configure itself to match the sonar operating parameters present when the system was last shut down. Thus, if the sonar was pinging when the system was last shut down, the sonar will resume pinging. However, the default power setting will always be set to Power OFF to prevent accidental damage of the projector.
3. Optional:
    a. Access the ICPU operating system via remote control software and configure the system operating parameters as appropriate for the mission (see *section 4 System Configuration with 7k User Interface*).
    b. Close the remote control software connection.
4. The system is ready to be deployed.

CAUTION
The ICPU is designed for operation under water. Operation in air for extended periods of time will result in overheating and severe damage to the system. Testing in air should be limited to low power levels and should be **no longer** than 1 minute in length with power ON.

NOTE
If the 7k Center is shut down during setup and test, it may be restarted by double-clicking the 7k Center icon on the Teledyne RESON desktop.

3.4 System Shutdown Instructions

Simply cutting power to the ICPU can result in corrupted data files and problems with restarting the ICPU's Windows® XP-based operating system. Follow the shutdown instructions in this section carefully to prevent this from happening.

To shut down the system via the VCC:

1. Send remote control command 1000 to the 7k Center.
   Please refer to the Data Format Definition document for instructions (see *appendix C.1 SeaBat 7125 AUV Documentation*).
2. Wait at least 10 seconds, and then remove power from the ICPU.

To shut down the system via the 7k UI:

1. Access the ICPU operating system via remote control software.
2. Activate the 7k Center application window.
3. Press Esc (on the keyboard). This will initiate shutdown of the sonar.
4. Once the 7k Center application window has closed, select Start and Shutdown from the task bar.
5. Once the ICPU operating system has shut down, power may be removed from the ICPU.

3.5 Post-dive Checks

Once the SeaBat 7125 AUV is recovered to deck, the following checks should be performed.

1. Shut off all power to the SeaBat 7125 AUV.
2. Using fresh water, wash down all system components to minimize salt accumulation and the development of localized corrosion pits.

CAUTION
Do not use hot or cold pressure washers. The high-velocity water spray will cut through the polyurethane or damage the interface between the polyurethane and the metal housings.

3. If necessary, schedule troubleshooting and/or repair of the suspected unit.
4. Inspect all cables for signs of twisting or abrasion.
5. Inspect the cables, transducer arrays, and the ICPU for security, signs of damage, or oil leakage.

4 SYSTEM CONFIGURATION WITH 7K USER INTERFACE

4.1 Chapter Overview

NOTE
This chapter pertains to operator use during system setup and test only. During system operation, all communication will be between the ICPU and the customer-provided control computer. The output during operation is a data stream in accordance with the Data Format Definition document (see *appendix C.1 SeaBat 7125 AUV Documentation*).

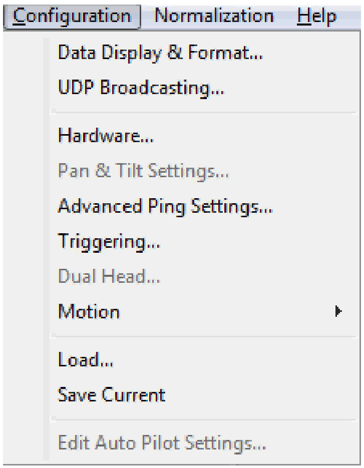
This chapter includes detailed instructions on the following subjects (click the emphasized hyperlink to be taken to the section):

- ***Configuration Menu Options:*** Consists of detailed instructions on setting up the parameters that determine the way the sonar system behaves.
- ***Channel Normalization:*** Consists of detailed instructions on how to use this feature.
- ***I/O Module Configuration:*** Consists of detailed instructions on setting up peripheral sensors (such as SVP and clock) and a presentation of the 7k external I/O monitor window.
- ***Remote Operation:*** Consists of instructions on how to control the sonar from a remote PC.
- ***Folder Management:*** Consists of instructions on file sharing and renaming of computer or workgroup.

NOTE
For information on starting, stopping, and setting up the SeaBat sonar system, see *section 3 System Startup and Shutdown*. For information on the user interface and operation of the system, see *section 5 System Operation.* For information on the practical use of the sonar, see *section 6 Active Sonar Usage.* For information on installation and details on the various system components, see *Appendix B Installation Instructions*.

4.2 Configuration Menu Options

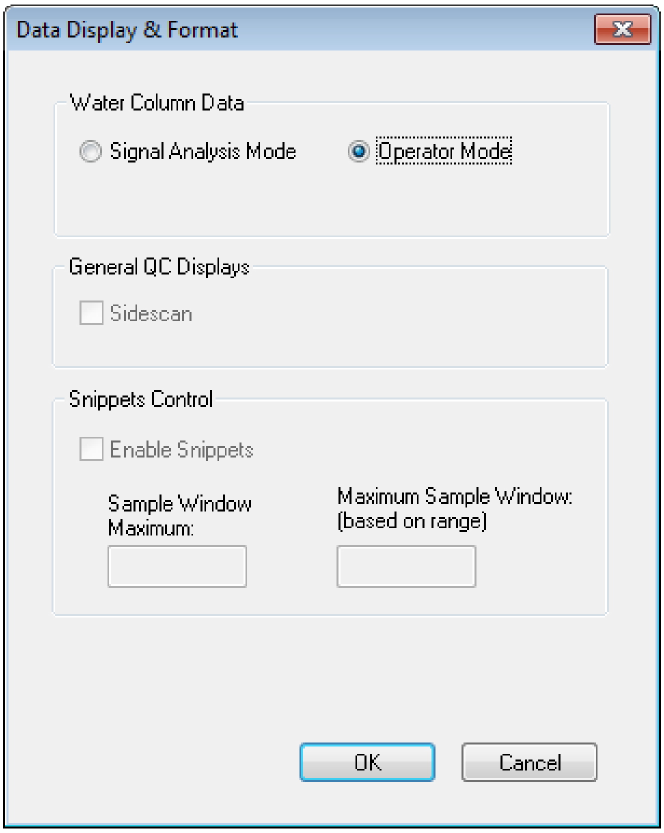
The various configuration options available for the SeaBat 7125 AUV sonar system are shown in the following illustration and are described in detail in the subsections below.



The menu options that appear dimmed are not available with the SeaBat 7125 AUV.

4.2.1 Data Display & Format

The Data Display & Format dialog controls the type of 7k records that are generated and displayed. These selections also determine what data is displayed.



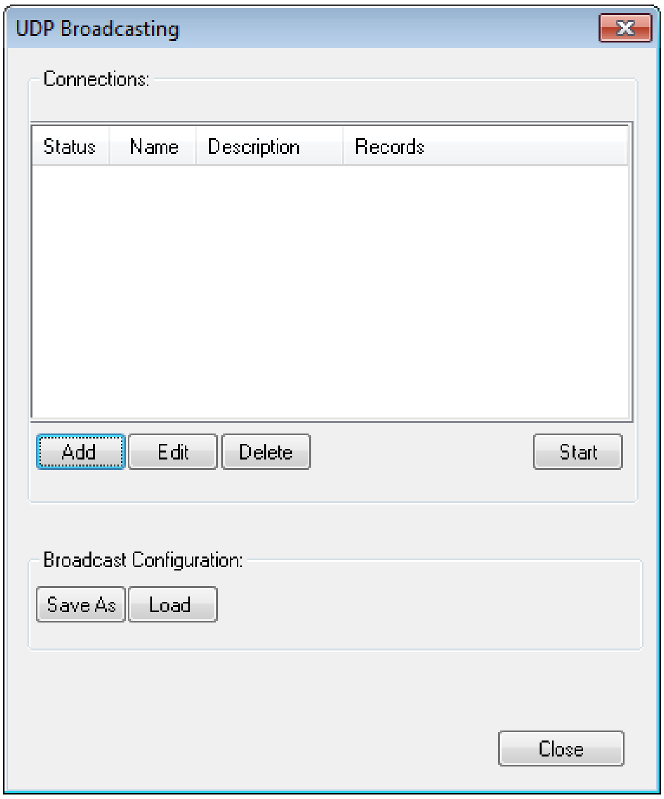
- **Water Column Data:** Use the radio buttons to select either amplitude only or full beam data for display in the A-scan window to the left of the sonar wedge and for output over the Ethernet broadcast or storage to a Windows file.
    - Signal Analysis Mode: Magnitude and phase data are both transmitted to the user interface. This allows for phase data to be analyzed in the A-scan displays. As this option increases the CPU usage for the SeaBat, Teledyne RESON recommends that this option only be used when inspecting phase data.
    - Operator Mode: The SeaBat extracts only the magnitude from the ping data. This data is then compressed to a maximum of 1024 samples. If less than 1024 samples are received in the ping, no compression occurs. This feature improves the performance of the system, but eliminates the ability to inspect the phase data.
- **General QC Displays:** Select additional displays:
    - Sidescan: Select the check box to display the Side Scan tab.
- **Snippets Control:** Select the check box to display the Snippets tab.
    - Sample Window Maximum: Not available.
    - Maximum Sample Window: Not configurable.

4.2.2 UDP Broadcasting

The UDP Broadcasting dialog allows the operator to broadcast selected records to a remote IP address and UDP port.

From this dialog, you can:

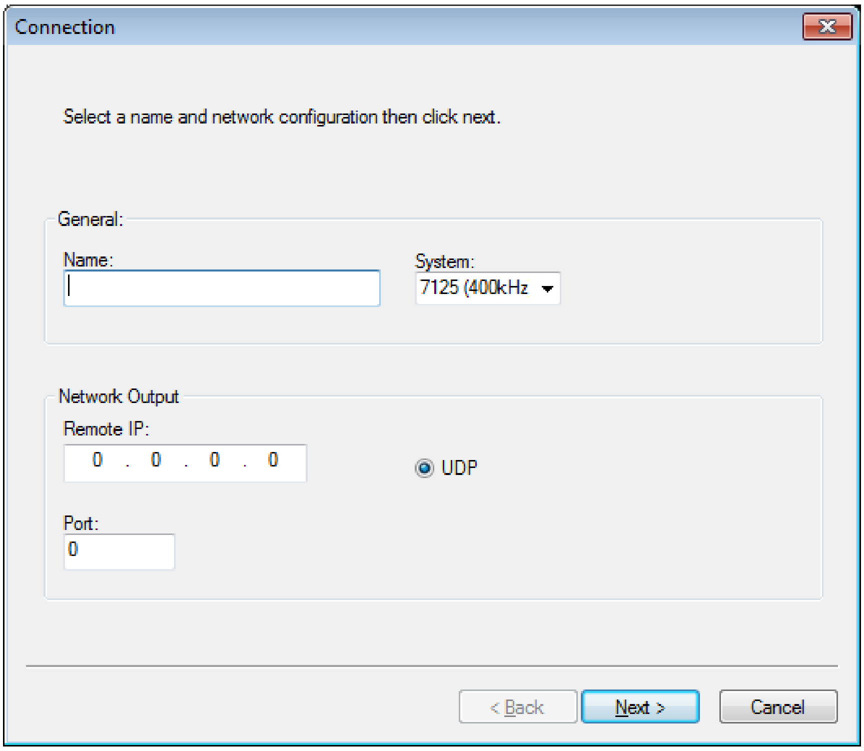
- Add, edit, or delete broadcast addresses.
- Start or stop the broadcast process.
- Save or load an existing broadcast configuration.



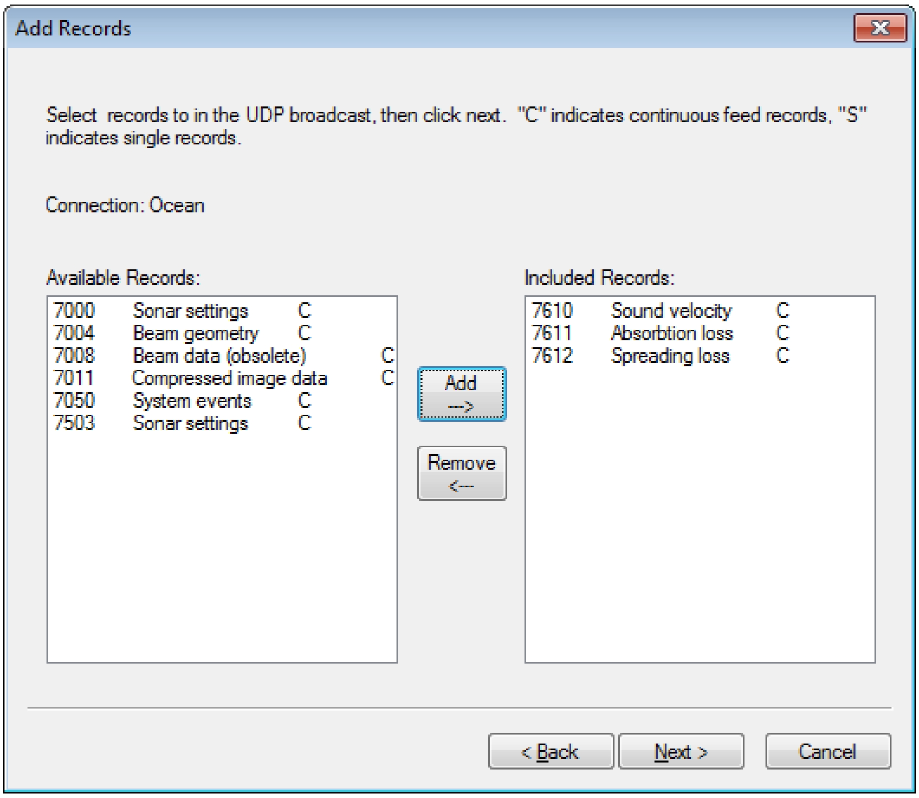
4.2.2.1 Add a New Broadcast

The Add button allows the creation of a new broadcast. To create a new broadcast:

1. Click the Add button to open the Connection dialog.



2. In the Connection dialog:
    a. Enter a name for the broadcast in the Name field.
    b. Enter the IP address of the target computer in the Remote IP field.
    c. Enter the port number for the target computer (a valid port number is required).
    d. Click Next to open the Add Records dialog.



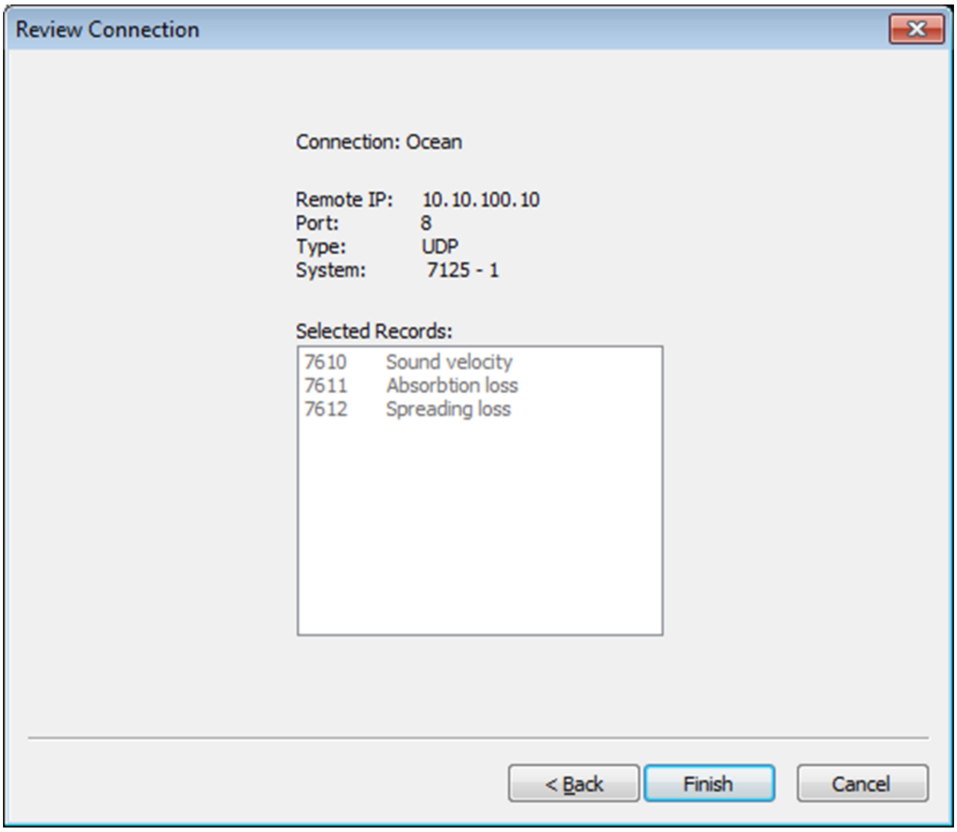
3. In the Add Records dialog:

   a. Select the records you want included in the broadcast by clicking on the record in the Available Records frame. Hold down the Ctrl key when selecting records, if you wish to add more than one record at a time.

   b. Click the Add button to add the selected record(s) to the broadcast. Successfully added records will appear in the Included Records frame.

   c. Once you have selected the records required for your broadcast, click Next to open the Review Connection dialog.

NOTE
Refer to the Data Format Definition document for information regarding the records you require (see *Appendix B Installation Instructions*).



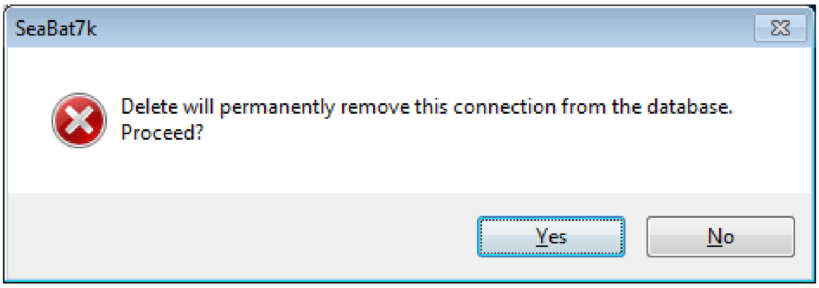
4. In the Review Connection dialog, review the information entered to make sure it is correct.
   a. If you want to make changes, click Back to move back through the previous steps.
   b. If you are satisfied that this is the connection you wish to create, click Finish to complete the process.
   c. If you decide not to create a broadcast at this time, click Cancel to terminate the process without creating the new broadcast.

4.2.2.2 Edit an Existing Broadcast

To edit an existing broadcast, select the broadcast you wish to edit in the UDP Broadcasting dialog and click the Edit button, and then follow the same instructions as in *section 4.2.2.1 Add a New Broadcast*.

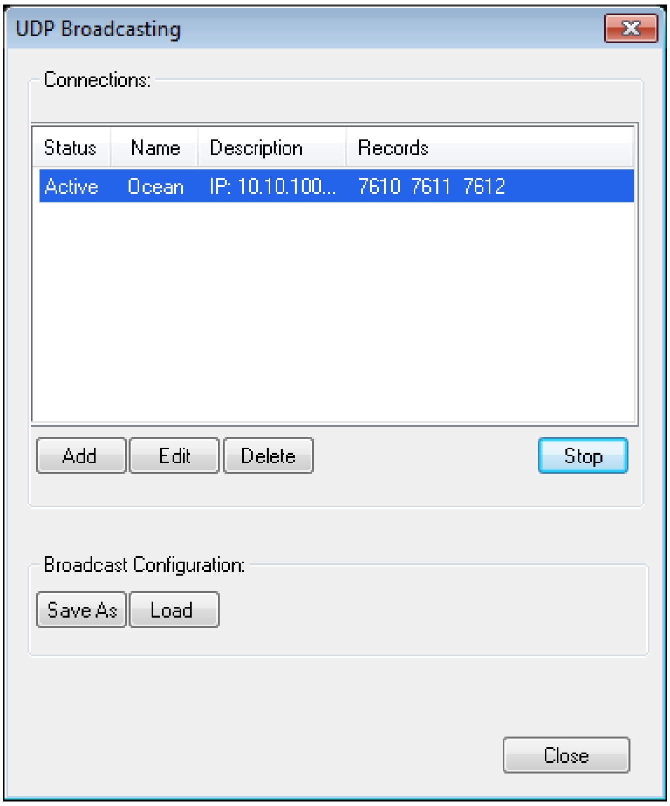
4.2.2.3 Delete a Broadcast

To delete an existing broadcast, select the broadcast you wish to delete in the UDP Broadcasting dialog and click the Delete button. A pop-up window will appear, asking you to confirm that you wish to delete the selected record. Click Yes to continue.



4.2.2.4 Start or Stop the Broadcast Process

To start a broadcast or stop an active broadcast, select the broadcast configuration from the UDP Broadcasting dialog list. The command button will indicate either Start for idle broadcast configurations or Stop for active configurations. Click the command (Start/Stop) button. The status indicates Active if the system is broadcasting messages to that address, or Idle if the system is not broadcasting messages to that address.



Active broadcast configurations are saved by the 7k Center software when it is stopped. On startup, these broadcasts are resumed. Active broadcasts may also be viewed in the Remote Connections list on the 7kCenter BITE tab (see *section 5.5.2.6 7kCenter*).

4.2.2.5 Save or Load an Existing Broadcast Configuration

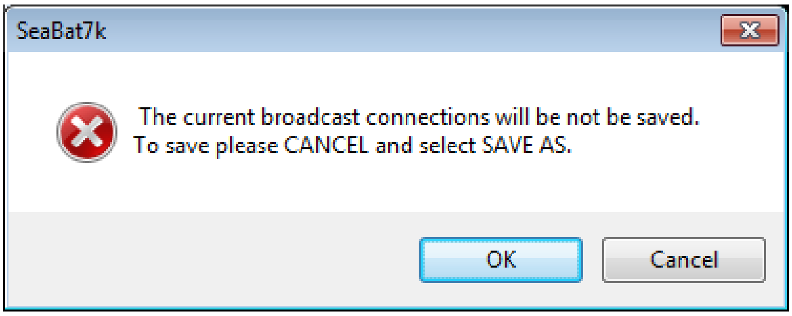
The most recent broadcast configuration is automatically saved and loaded whenever you start the SeaBat. In some cases, however, the operator may want to save a particular configuration for later use or load a different (previously saved) configuration instead of setting it up manually.

To Save a Configuration:

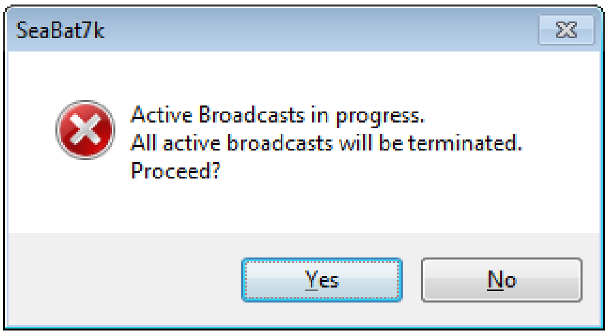
1. Make sure the configuration is set up correctly.
2. Click the Save As button.
3. Enter a file name and choose the location to which you want this file saved. The file extension is automatically set to (*.bcg).
4. Click Save.

To Load an Existing Configuration:

1. Click the Load button.
2. A warning box indicates that
   a. The new configuration file will completely overwrite the current configuration, if the system is not broadcasting (is idle). Click OK if you want to continue.



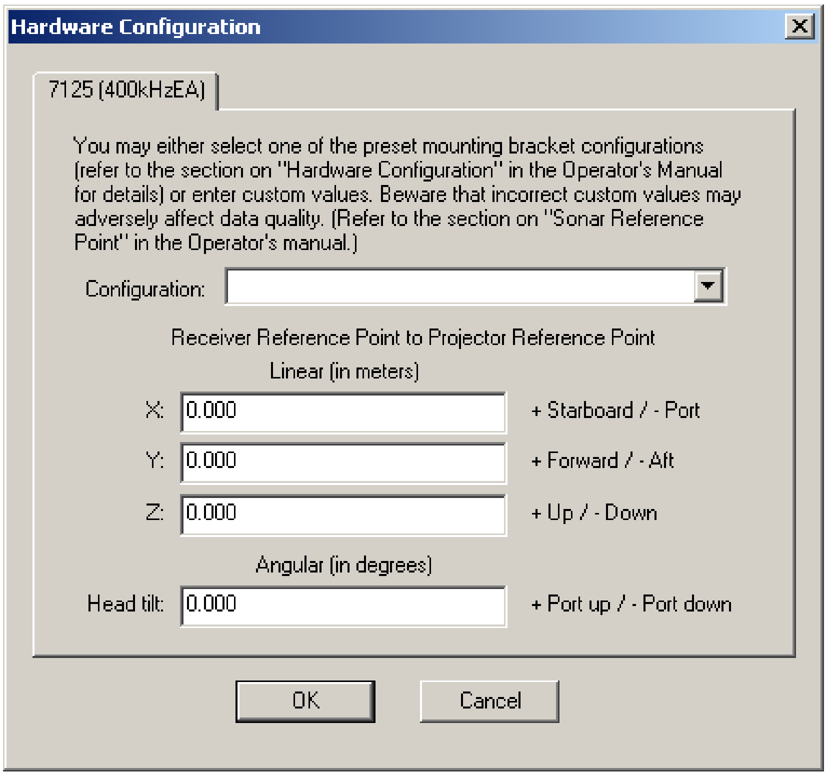
   b. The new configuration file will terminate active broadcasts. Click Yes if you want to continue. Click No if you want to stop and save a broadcast in progress.



3. Browse to the correct location and select the .bcg file you want to load.
4. Click Open.

4.2.3 Hardware Configuration

The Hardware Configuration dialog controls the one-time transmit array and projector settings. These settings should be set to reflect the initial installation of your system and should not require modification unless the physical installation changes. For details on sonar head installation, see *appendix B.7 Sonar Head Assembly Orientation*.



4.2.3.1 Configuration

- **Preset Configurations:**
  - Normal: When the receiver is mounted with the connector to the port side, the Configuration selection should be Normal (see *appendix B.7 Sonar Head Assembly Orientation*).
  - Reversed: When the receiver is mounted with the connector to the starboard side, the Configuration selection should be Reversed (see *appendix B.7 Sonar Head Assembly Orientation*).
- **Custom Configurations:**
  - For details on receiver and projector reference points, see *appendix B.8 Sonar Reference Point*.

4.2.3.2 Head Tilt

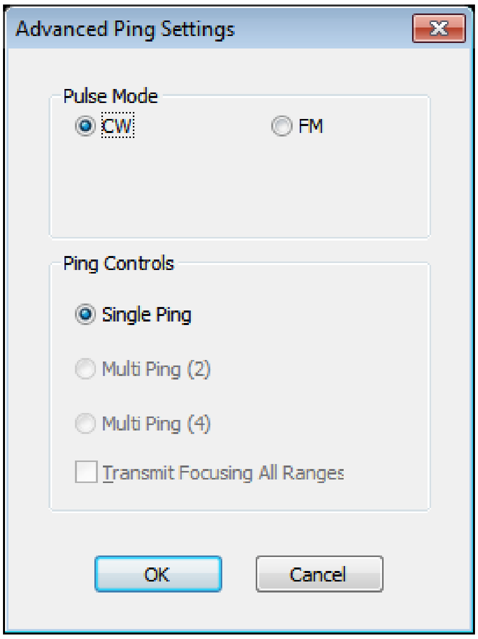
The feature allows the user to enter a tilt angle to compensate when the sonar arrays are installed at an angle. The maximum head tilt is +/- 45 degrees.

4.2.4 Advanced Ping Settings

The Advanced Ping Settings dialog gives the operator two pulse mode options. With CW (continuous wave), Single Ping is selected as default under Ping Controls.

With FM[4] (frequency modulation), the initial values for Start Frequency and Stop are as shown in *Figure 3*.

NOTE
When operating in FM pulse mode, it's important to be aware that too high a source level at short ranges might saturate the reflected signals. Saturation may appear as nadir variance across pings being higher than expected.



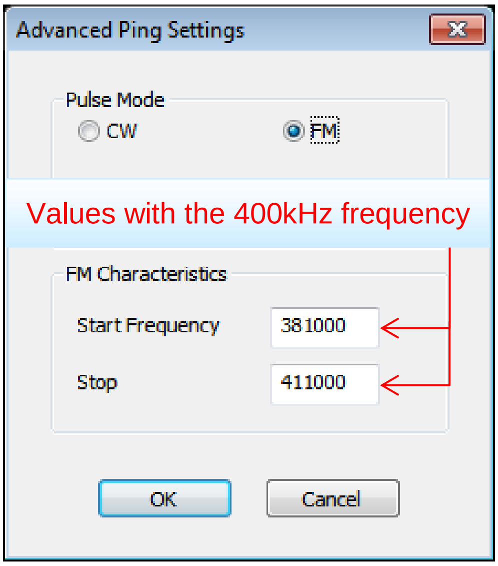


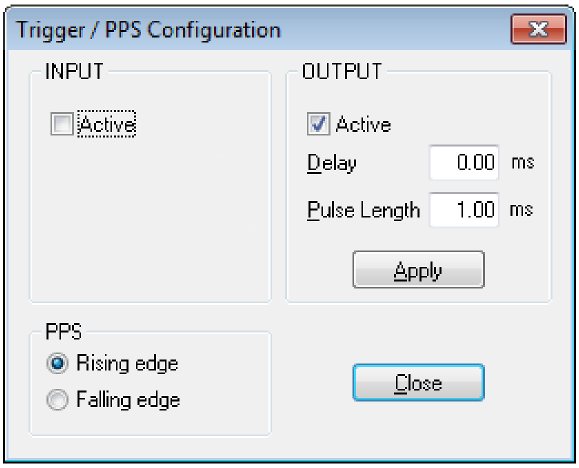
Figure 3: Advanced Ping Settings – FM Start and Stop Frequency Values

NOTE
Teledyne RESON recommends that these values are **not** changed. The only reason you may choose to reduce the bandwidth is when the range is very long and the quality of the outer beams not great. Reducing the bandwidth increases the equivalent footprint, which can help the phase detection process. In that kind of situation the bandwidth may be reduced to 1/2 or 1/4 of the initial values.

[4] X-Range (FM) is an optional add-on feature for the 400kHz frequency (see *Table 13*).

4.2.5 Triggering

The Trigger/PPS Configuration dialog allows the operator to control the pulse length and delay characteristics.



4.2.5.1 Trigger Input

- **Active:** The Active checkbox is not selected (inactive) by default. When selected, the ping will occur upon receipt of the input trigger pulse. If the trigger pulse rate exceeds the sonar's actual maximum ping rate for that range setting, some trigger input pulses may be dropped. Deselecting the checkbox will return to ping rate control based on the Max Rate slider on the Main Sonar Settings tab.

4.2.5.2 Trigger Output

A TTL trigger out pulse, approximately synchronous with the transmit pulse, is available via a BNC connector marked Trig Out on the panel of the ICPU. *Figure 4* shows a pulse example.

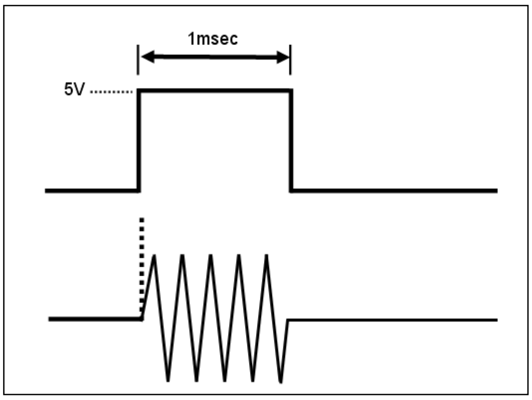


Figure 4: Example of Trigger Output

- **Active:** The Active check box is selected by default. When selected, a pulse will be generated in conjunction with the sonar ping.
- **Delay:** The default setting is 0.00ms. This setting allows the operator to specify how many milliseconds after the sonar ping the output pulse will be sent.
- **Pulse Length:** The default setting is 1.00ms. This setting allows the operator to change the pulse length of the transmitted output signal. For the SeaBat 7125, the pulse length plus the delay must be slightly less than 20ms.
- **Apply:** Click the Apply button to finalize changes.

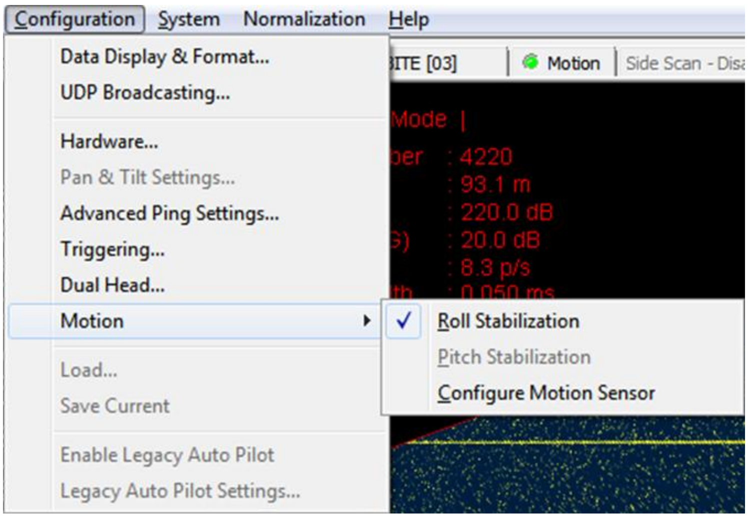
4.2.5.3 1PPS Polarity

- **Rising edge:** By default, the SeaBat 7125 accepts positively polarized (rising edge) 1PPS pulses to perform accurate time stamping.
- **Falling edge:** If a negatively polarized (falling edge) 1PPS is used, the Falling edge button in the Trigger/PPS Configuration dialog must be selected to ensure accurate timing.

The 1PPS selection will appear on the sonar image control portion of the Primary Display (see also *section 5.4.4 1PPS Input Indicator*).

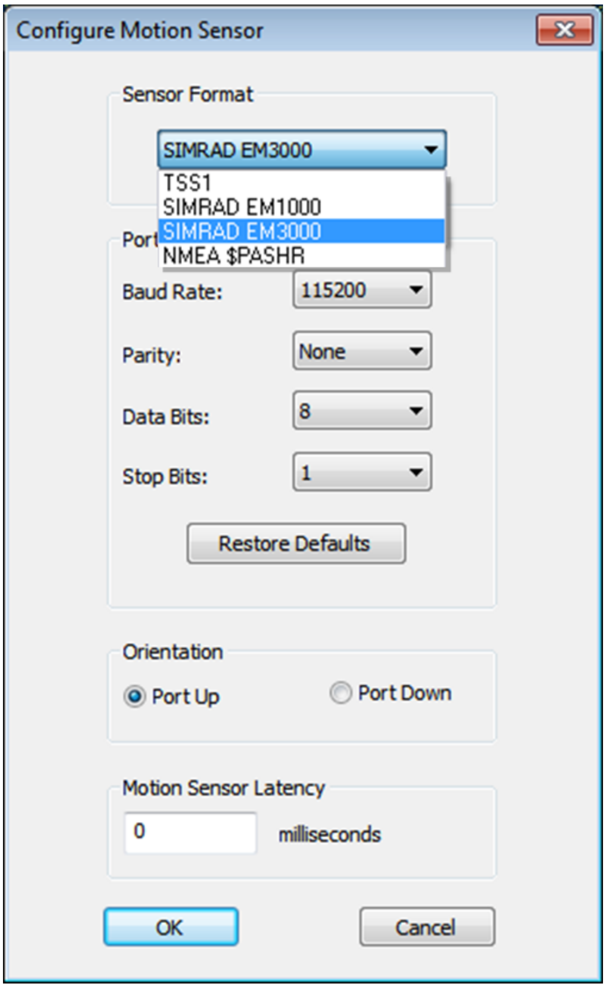
4.2.6 Motion

Electronic compensation for roll is included in the system, meaning that the system can operate with almost full performance within a +/-10° roll area, with the exception of the outer sectors/beams.



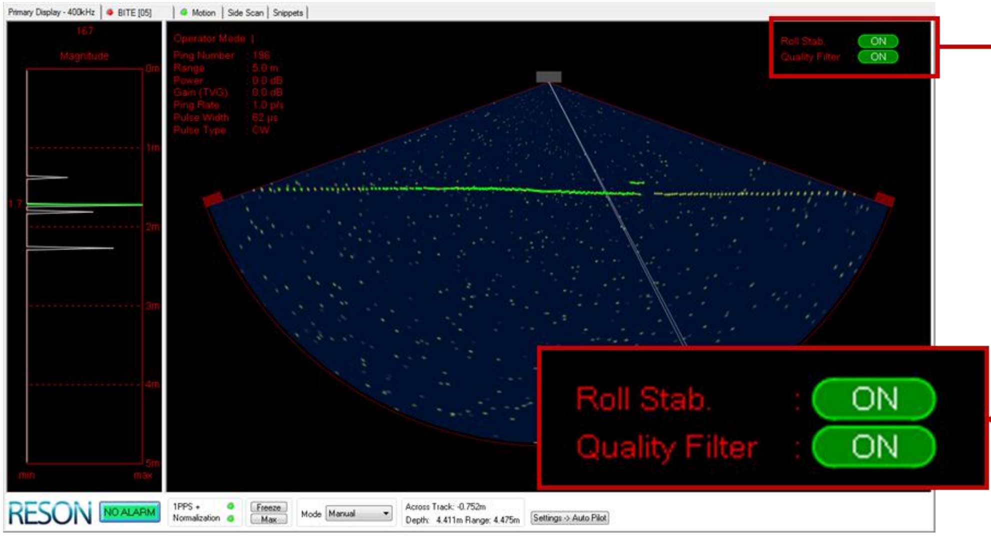
- Select Motion and then Roll Stabilization to activate (or deactivate) this functionality.

- Select Motion and then Configure Motion Sensor to open the following dialog.



  - From the Sensor Format drop-down menu, select the required option and any other control settings for the motion sensor.
  - From the Baud Rate drop-down menu, select the desired option. For best performance, the 115200 setting is recommended.

- The status of Roll Stab is reported on the Primary Display tab (see also *section 5.4 Primary Display Tab*).



- On the Motion tab it is possible to view motion format information and current data as well as a variable graphical display of roll history (see *section 5.6 Motion Tab*).

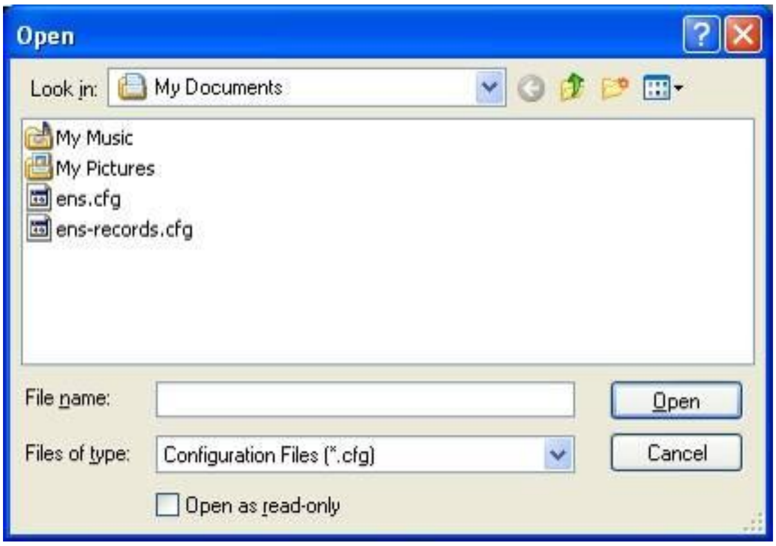
NOTE
The motion sensor update rate should be set to at least 50Hz.

NOTE
The system will recall the motion settings used during the last sonar operation. In the event that the default settings are used, Roll Stabilization will be enabled on startup.

4.2.7 Load

The Load option allows the operator to load a set of saved sonar settings from a file. For example, you may develop specific settings that are optimal for use in a certain location or region or for a specific task. Upon returning to that area, the saved settings can be loaded from a file. The sonar must be pinging to load a configuration.

1. Verify the Mode is set to Manual and the Max Rate slider on the Main Sonar Settings tab is not OFF (see appropriate subsections in *chapter 5 System Operation*).
2. Select the Load option from the Configuration menu to access the Open dialog.

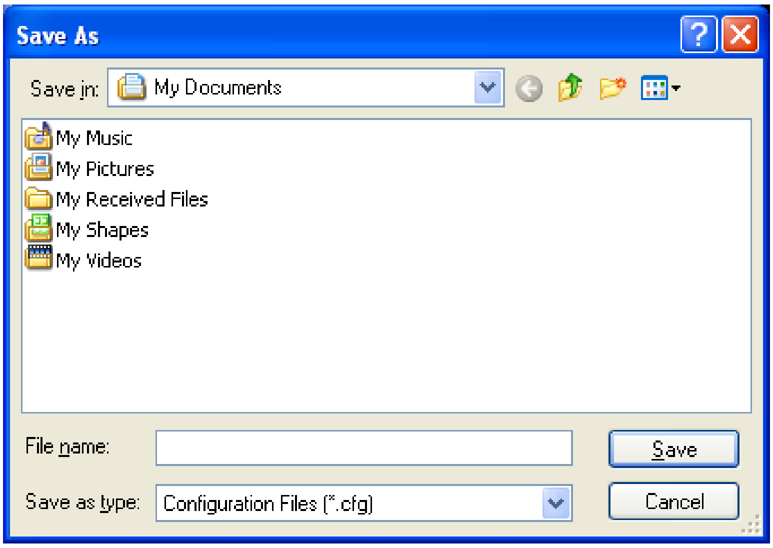


3. Browse to the correct location and select the .cfg file you want to load.
4. Click Open.

4.2.8 Save Current

The Save Current option allows the operator to save the current sonar settings to a file, to be loaded later in matching environments.

1. Verify the Mode is set to Manual and the Max Rate slider on the Main Sonar Settings tab is not OFF (see appropriate subsections in *chapter 5 System Operation*).
2. Select the Save Current option from the Configuration menu to access the Save As dialog.



3. Browse to the location where you want the file saved and enter a file name. The file extension is automatically set to (*.cfg).
4. Click the Save button.

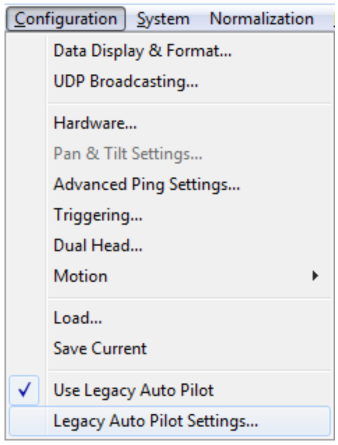
4.2.9 Legacy Auto Pilot Settings

The data contained within the Auto Pilot look-up table is specific to a sonar type and may be manually edited. These settings are specified by the operator ***prior*** to initiating Auto Pilot mode (see *section 5.4.11 Enable/Disable AutoPilot*).

NOTE

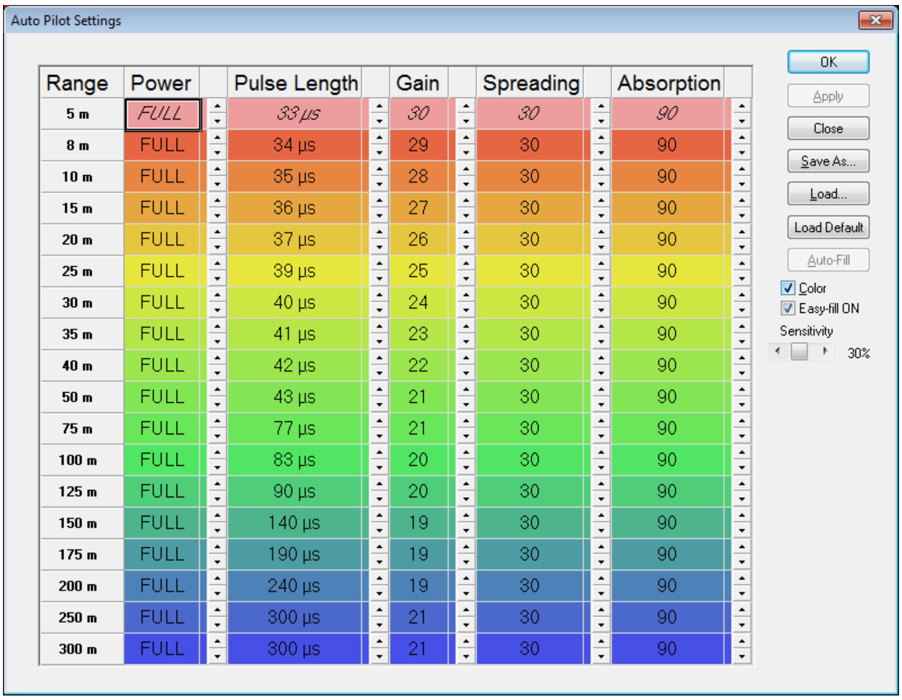
The Tracker and the LAP (Legacy Auto Pilot) are mutually exclusive. As the Tracker is active by default, first activate the LAP.

If the menu options are dimmed, the Tracker must be disabled (see *section 5.4.10 Enable/Disable Tracker*). The status of the Tracker/AutoPilot is reported on the Primary Display tab (see also *section 5.4 Primary Display Tab*).



A default set of values are included in the table which may require modification based on the specific conditions encountered. To modify the default parameters:

1. Select Legacy Auto Pilot Settings from the Configuration menu.
2. Make changes by using the arrow buttons next to the desired setting: Press one of the arrow buttons, and drag the pointer to pull the appearing slider up or down to modify the setting.

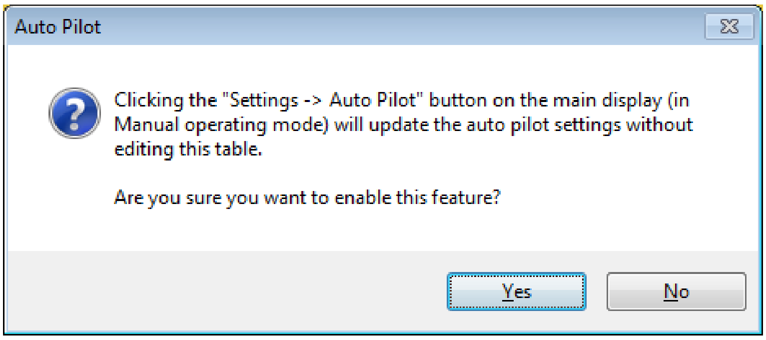


Range	Power	Pulse Length	Gain	Spreading	Absorption
5 m	FULL	33 µs	30	30	90
8 m	FULL	34 µs	29	30	90
10 m	FULL	35 µs	28	30	90
15 m	FULL	36 µs	27	30	90
20 m	FULL	37 µs	26	30	90
25 m	FULL	39 µs	25	30	90
30 m	FULL	40 µs	24	30	90
35 m	FULL	41 µs	23	30	90
40 m	FULL	42 µs	22	30	90
50 m	FULL	43 µs	21	30	90
75 m	FULL	77 µs	21	30	90
100 m	FULL	83 µs	20	30	90
125 m	FULL	90 µs	20	30	90
150 m	FULL	140 µs	19	30	90
175 m	FULL	190 µs	19	30	90
200 m	FULL	240 µs	19	30	90
250 m	FULL	300 µs	21	30	90
300 m	FULL	300 µs	21	30	90

3. Click Apply to carry out the changes. (Clicking OK will also close the dialog).

Additional options include:

- **Save As:** Store any number of user-defined tables.
- **Color:** Click the check box to display the dialog in color.
- **Easy-fill ON:** Click the check box to update the Auto Pilot settings automatically when in Manual operating mode.
    - Click Yes when asked to allow it.

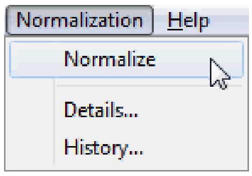


    - Click the Settings -> Auto Pilot button to update the table.

- **Sensitivity:** The slider bar controls how much “extra margin” the Auto Pilot allows when calculating the range setting to use based on the recent ping’s bathymetry detections.

4.3 Channel Normalization

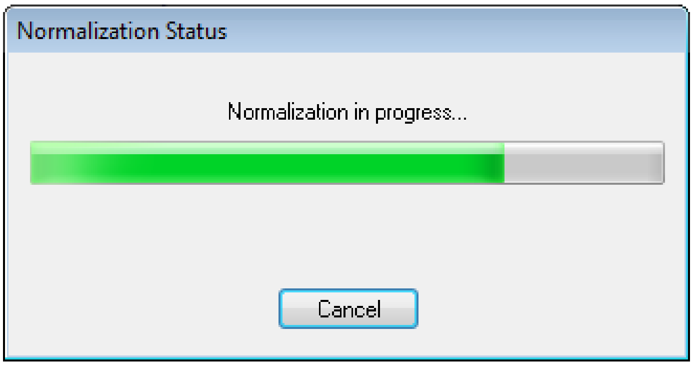
The channel normalization process is run automatically on initial power up, but may also be initiated at any time by the operator via the Normalization menu. The process completes in approximately 30 seconds.



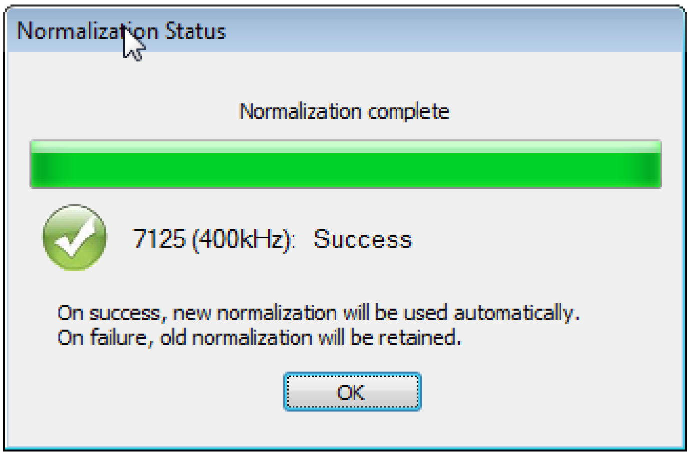
The channel normalization feature provides a method for correcting the output of each analogue receiver channel for minor variations in amplitude and phase prior to input to the beamformer to improve data quality. This is achieved by injecting a highly stable calibration tone into each analogue receiver channel and comparing the output of each channel to the average values for all the channels. This produces a much ‘cleaner’ input to the beamformer thereby reducing sidelobes and improving performance.

NOTE
Data output is suspended while the normalization process is running. In certain conditions the normalization may fail due to excessive noise or out-of-tolerance channels. The operator is informed of the failure cause and prompted to use the last normalization results.

- Selecting Normalize will start the channel normalization process. Normalize is unavailable with Tracker enabled (see *section 5.4.10 Enable/Disable Tracker*).

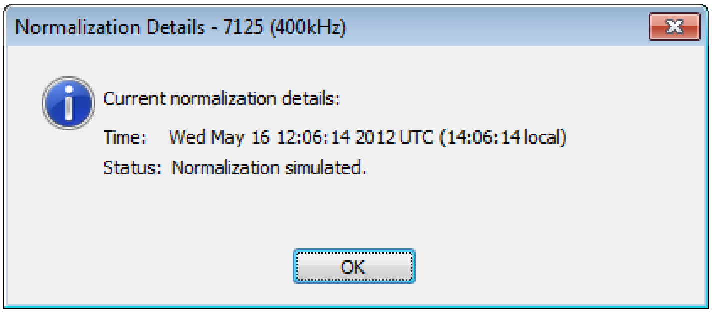


  - Clicking Cancel will return the display to the previous channel normalization state.
  - The Normalization Status display will update with new status once the process is complete.

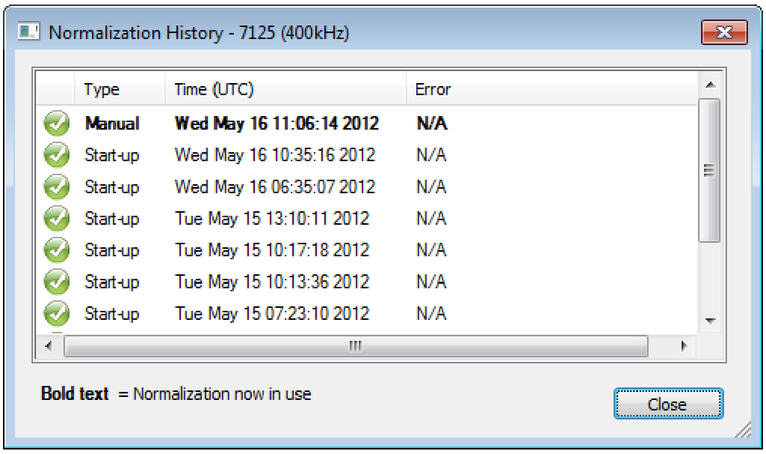


NOTE
If there is a significant change in water temperature (e.g., when surveying near strong currents or in enclosed bodies of water such as lakes), it is advisable to rerun the normalization process.

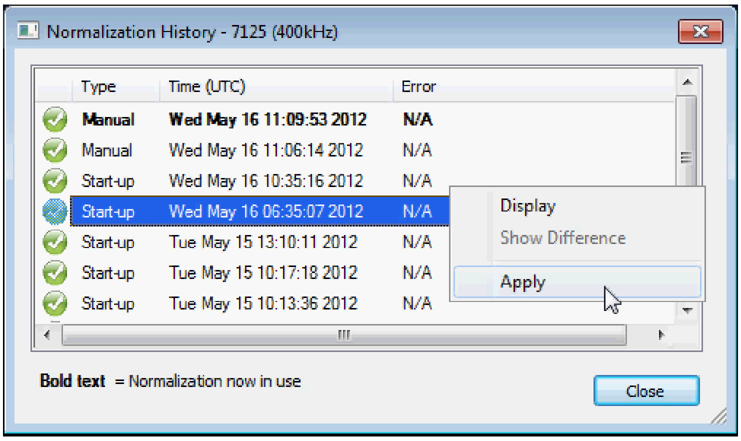
- Selecting Details from the Normalization menu will display the time and date of the last normalization.



- Selecting History from the Normalization menu will display the normalization history with time and date, and whether the process was automatically or operator initiated. The normalization in use will be indicated in **bold letters**.



  - By right-clicking any of the normalization runs it is possible to activate another normalization result.
  - Select Apply from the menu. The new selection will now be indicated in **bold letters**.



NOTE
Use of a “historic” normalization is ***not*** recommended. It should only be considered in case of a marginal normalization in a noisy environment and for the sake of comparing performance between two different normalizations.

The current channel normalization status of the system appears on the sonar image control portion of the Primary Display (see also *section 5.4.5 Normalization Indicator*.

4.4 I/O Module Configuration

The I/O Module Setup tab is the primary means of configuring data flow into the SeaBat from RS-232 devices attached to the system (such as online SV probe and/or clock). Configuration through this interface sets up the I/O module installed on the sonar processor. The data acquired by the I/O module is routed to the SeaBat in real time to allow for accurate time stamping and beamforming.

For instructions on how to monitor the I/O module devices, see *section 4.4.3 below.*

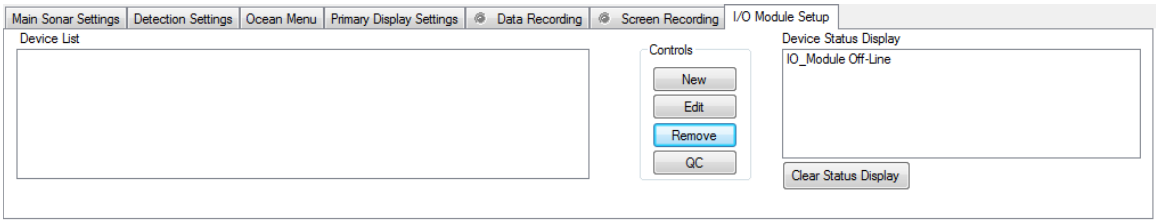


Figure 5: Sample of I/O Module Setup Tab

- **Device List:** This frame displays the current list of devices.
- **New:** Create a new I/O device.
- **Edit:** Edit an existing I/O device.
- **Remove:** Delete an I/O device from the list.
- **QC:** Launch the 7k I/O Module window (if the I/O Module is running.
- **Device Status Display:** Shows the status of the corresponding device in the Device List frame.
- **Clear Status Display:** Clears and resets the status display.

NOTE

Accuracy of the bathymetric data depends entirely on valid time sync and SVP input from this module, unless another solution such as PDS2000 is being used to perform this function.

In the absence of time sync, a software time stamp is employed. However, this usually results in poor data quality, as the time stamp is applied AFTER the last sample is received. Time stamping is not normally required for the sonar if it is used as a stand-alone system. However, if data is being broadcast to another system, PPS time synch should be used.

In the absence of online SVP input, the input through the Ocean Menu tab will be used (see *section 5.8.3.3 Set the Sound Velocity*).

4.4.1 Device Types

NOTE
If data is to be logged in the S7K format, it may be advantageous to log position and heading as well. To achieve this, position and heading sensors should be interfaced though the I/O module in addition to the mentioned sensors.

4.4.1.1 Sound Velocity Probe

To achieve correct beam steering in equidistant mode, the sonar needs to have an up-to-date online sound velocity measurement from the water in the area of the sonar head. The sound velocity ***must always*** be entered in the I/O module, even if PDS2000 or a different acquisition system is used.

4.4.1.2 Clock (1PPS)

To achieve correct time stamping of transmitted pulses it is necessary to send time to the sonar processor. The SeaBat uses the GPS PPS system to achieve this. The Data Acquisition System (DAC) should also be synchronized to this. From the GPS receiver, the SeaBat needs the TTL 1PPS pulse and the qualifying time message (normally ZDA). The clock synchronization must always be entered in the I/O module.

CAUTION
Ensure that the time synchronization is operating correctly. Failure to do so could compromise data quality. The maximum pulse length for the 1PPS is 100ms.

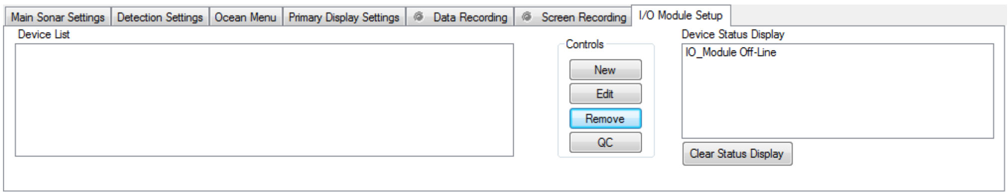
4.4.1.3 Motion Sensor (for Roll Stabilization)

To achieve roll stabilization the sonar needs to receive input from a motion sensor. The roll input to the sonar should be the observed roll at the sonar head. If PDS2000 or a different acquisition system is used, the motion sensor should not be entered in the I/O module. The motion sensor data for the roll stabilization is read directly from the FPGA.

4.4.2 Adding a Device

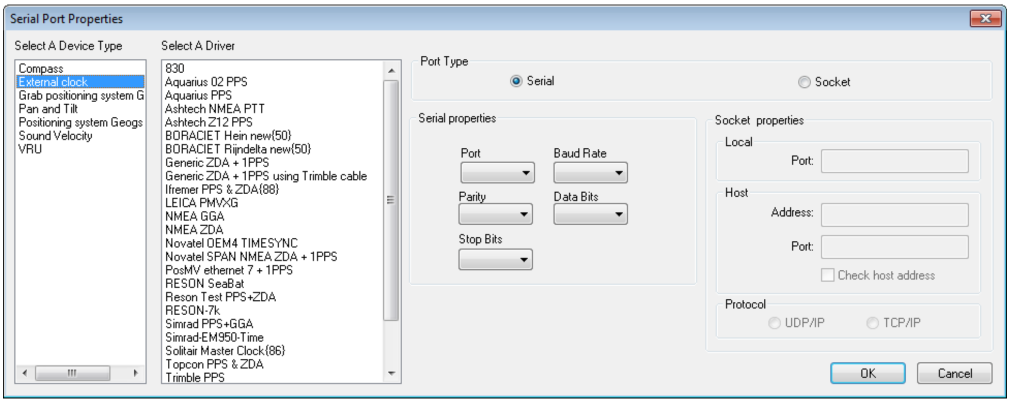
To add a new I/O module device, follow these steps:

1. Start the 7k user interface and select the I/O Module Setup tab.



2. Click New to add the relevant device (e.g. SVP, clock, motion sensor).
3. Select device type and driver.
4. Click the required Port Type.

5. Select the appropriate settings under Serial or Socket properties, Host, and Protocol (the settings may be preselected).
6. Click OK.



7. On the I/O Module Setup tab, click the QC button to bring up a 7k I/O Module window, which shows the raw data and the associated decoded data.

   The status should be green (see section *4.4.3 below*). If the status is not green, this might be due to:

   - An incorrect driver
   - An error in the port parameters
   - No data or 1PPS pulse coming in

If the PPS pulse is not detected during sonar operation, the PPS status LED changes from green to red.

4.4.3 I/O Module Setup Check

The I/O module devices can be monitored on the main 7k I/O Module window (see *Figure 6*). This window is a property sheet with one tab for each sensor, the Clock and Sound Velocity, and an Output and a Distribution tab.

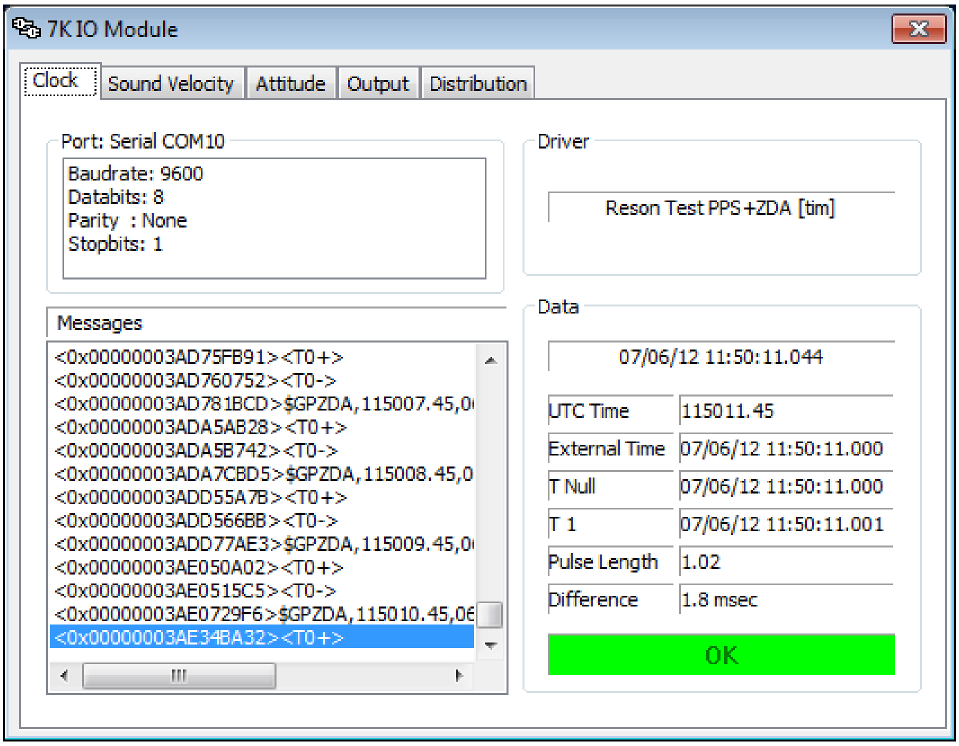
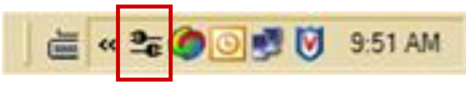


Figure 6: 7k I/O Module Window

NOTE
The 7k I/O Module window only monitors the I/O Module's operation. All user input (creating or changing the configuration) is done on the I/O Module Setup tab of the 7k user interface (see *section 4.4 above*). The I/O Module automatically saves configuration information and loads the last settings upon restart.



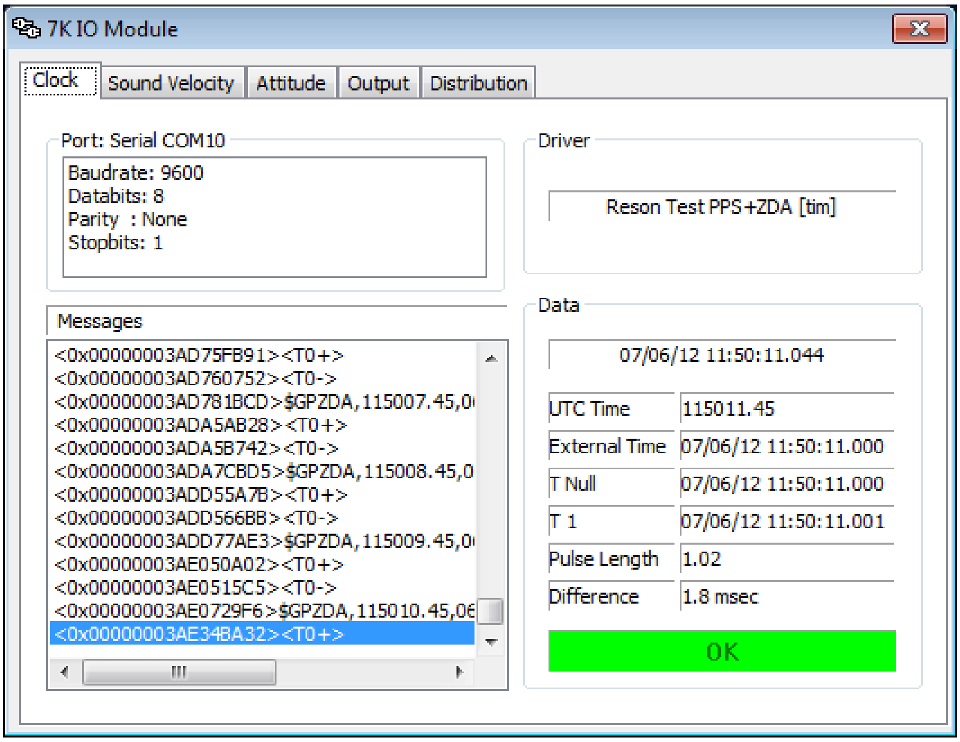
Right-clicking the I/O Module icon that appears in the Windows notification area opens the following menu.

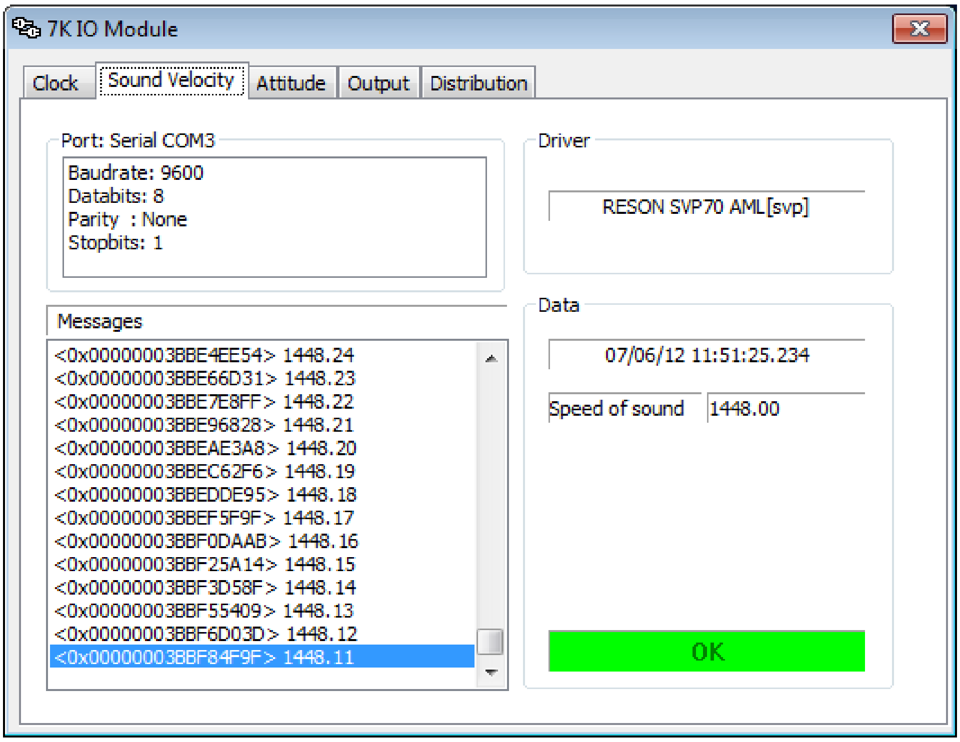
- **Show:** Displays the main window.[5]
- **Hide:** Hides the main window.
- **About:** Displays a dialog with version information.
- **Exit:** Stops the I/O Module.

The Clock tab and the Sound Velocity tab show the port settings, names of the selected driver, raw data messages, and decoded values of the incoming data and a status

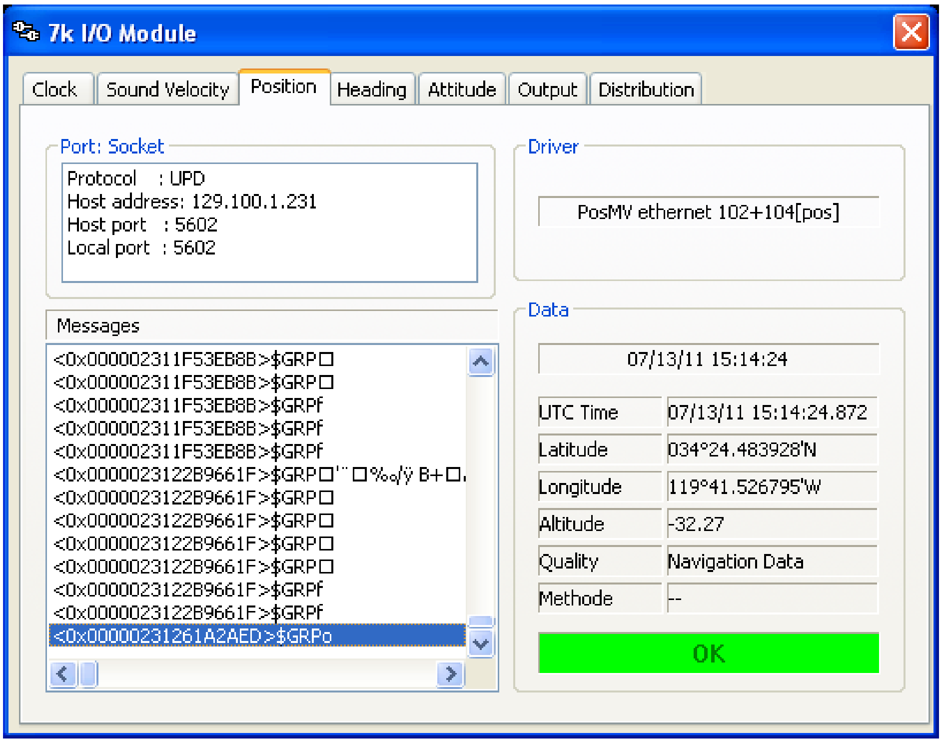
[5] Clicking the QC button on the I/O Module Setup tab will also launch the 7k I/O Module window.

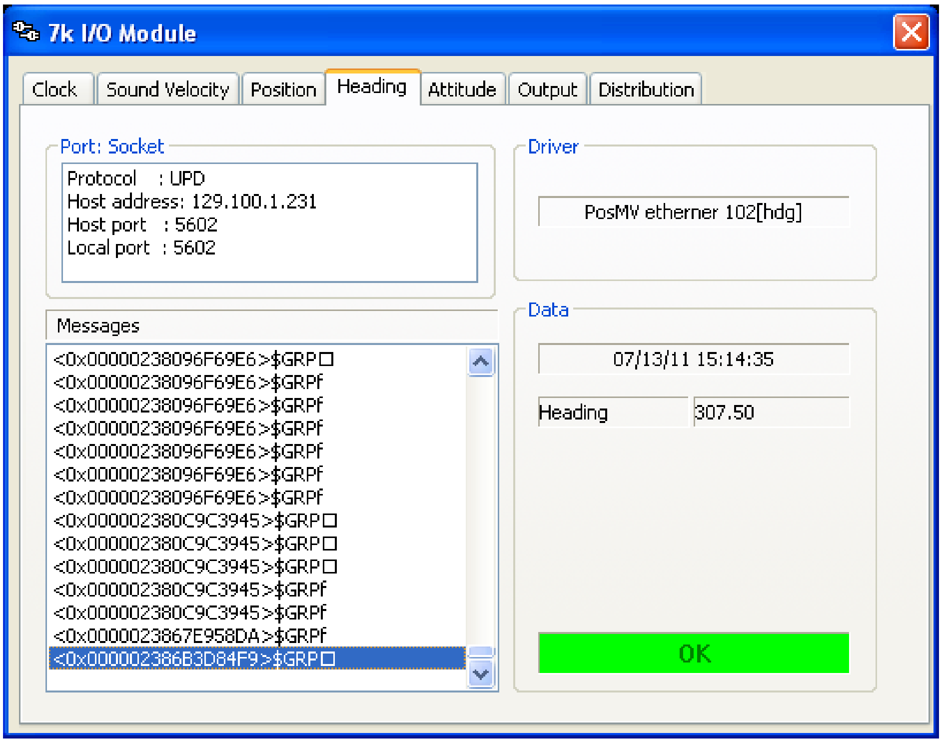
indicator. Once configured by the 7k user interface (see *section 4.4 above)* and running and receiving data, messages will begin to appear in the Messages frame.

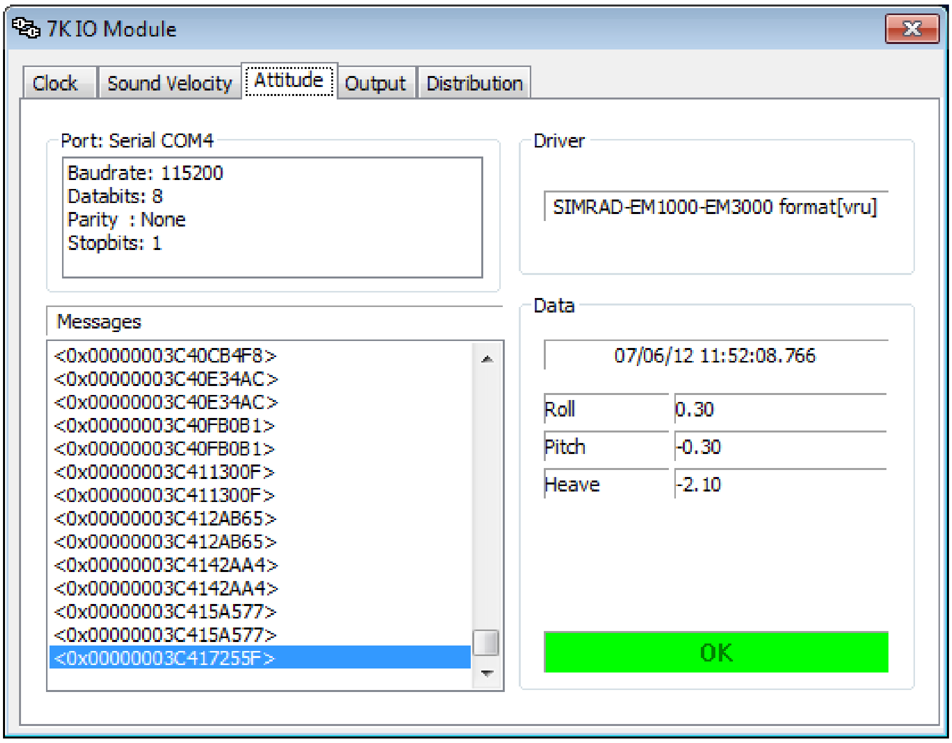




Various other tabs may be available depending on the auxiliary sensors connected.

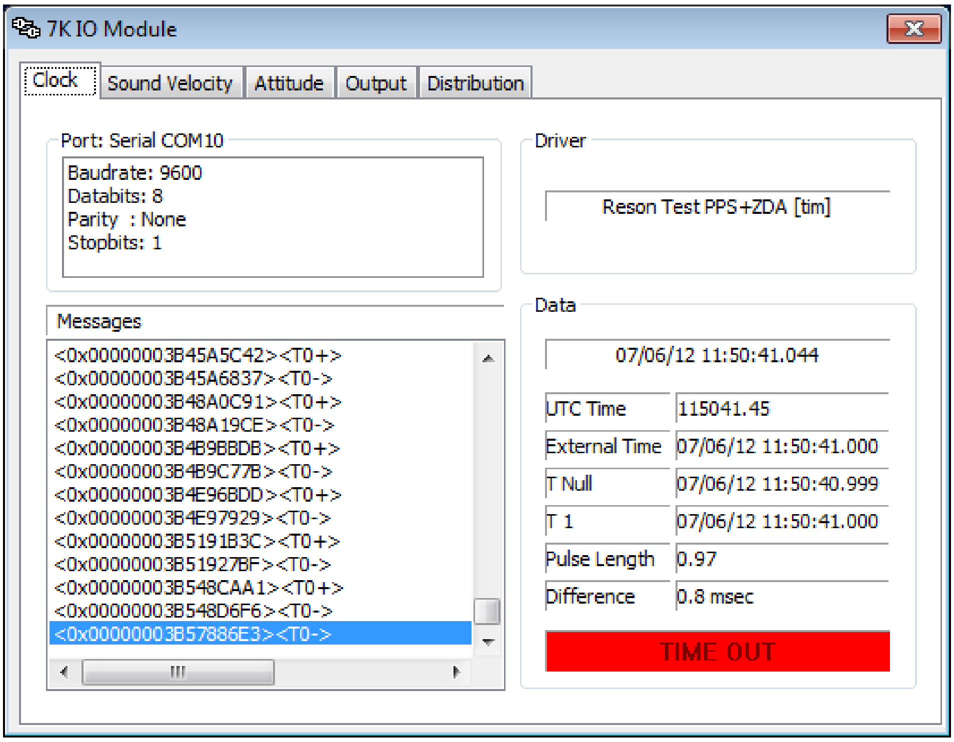




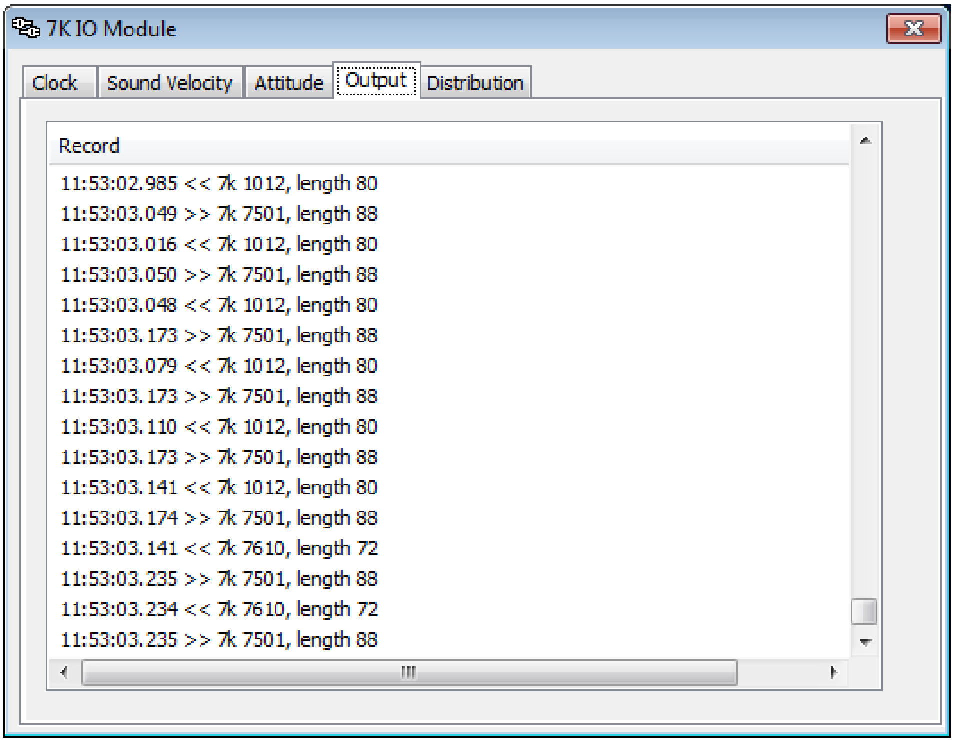


The status indicator shows OK in green when the data flow is normal.

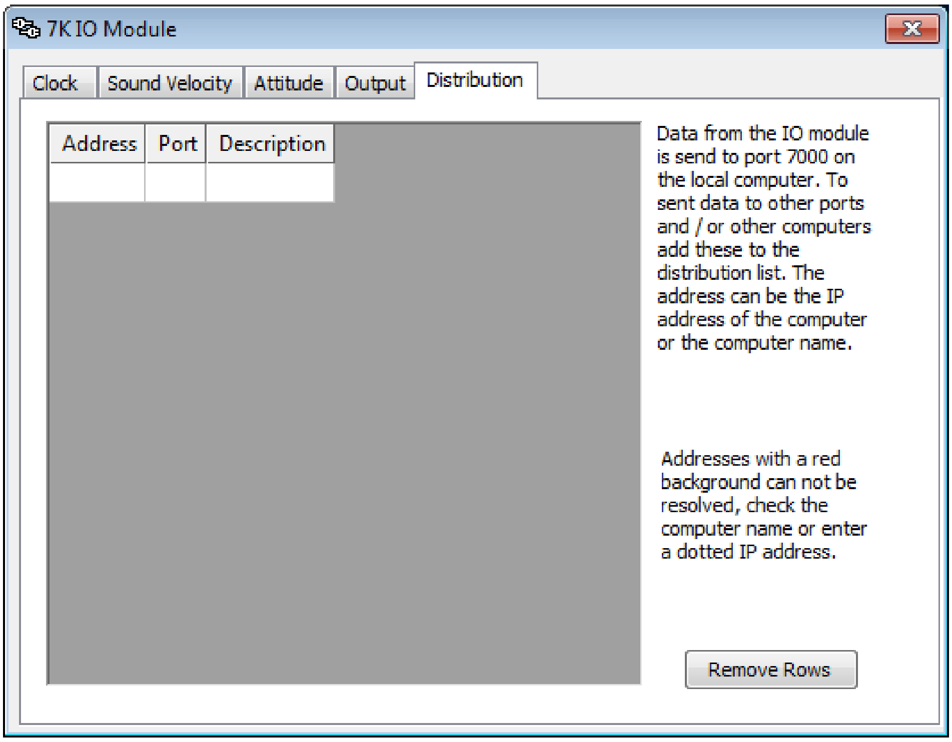
When a problem occurs in the data flow (for example, when a serial cable is disconnected or unexpected data is received), the status indicator changes to red and shows the new status. When the data flow has been recovered, the status returns to OK.



The Output tab shows the 7k messages that are being sent to the 7k Center. For example, when an external clock and a sound velocity device are connected and generating data, the Output tab will show 7400 messages (external clock) and 7610 messages (sound velocity).



The Distribution tab shows a list of additional ports and/or computers to which data is sent.



4.5 Remote Operation

The 7k series software architecture is built on a client/server concept. The 7k Center running on the ICPU controls the sonar, performs data processing, and exports data to external clients connected via TCP IP or UDP Ethernet connections. It is normal to run client applications such as the GUI (Graphical User Interface) on the 7k platform, but clients may also be run remotely.

If the 7k GUI (SeaBat7K.exe) is started on a remote machine which does not have a 7k Center running, the user is prompted to enter an IP address for the machine running the center. This way the GUI can be run remotely.

Depending on Ethernet bandwidth and traffic load, remote operation may result in reduced performance or, in some severe cases, data loss.

The following files, all from the RESON directory on the ICPU, must be copied to a directory on the remote PC (Teledyne RESON recommends placing these files in the "Program Files" directory).

SeaBat7k.exe   MathUtils.dll   TrueTimeSDK.dll   XGRAPH10.dll   RSBDirTree.dll

NOTE
A shortcut to SeaBat7k.exe can be placed on the desktop for easy program start.

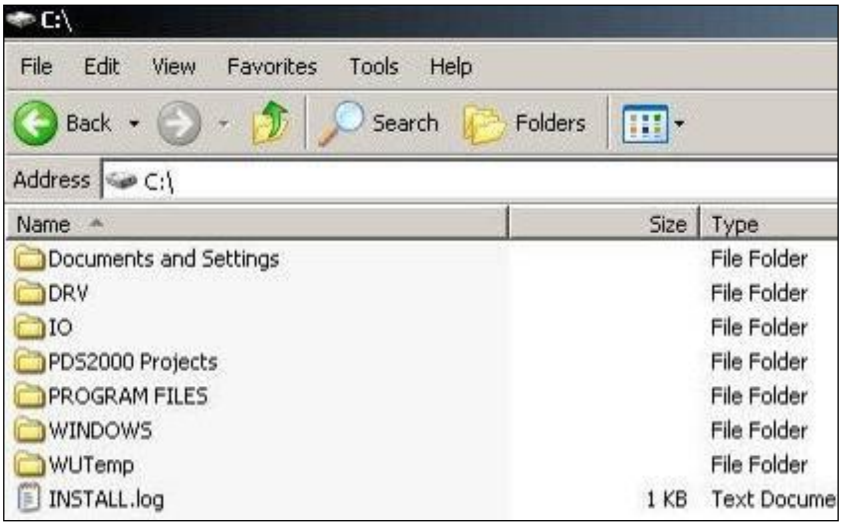
4.6 Folder Management

4.6.1 Sharing a Folder on a Network

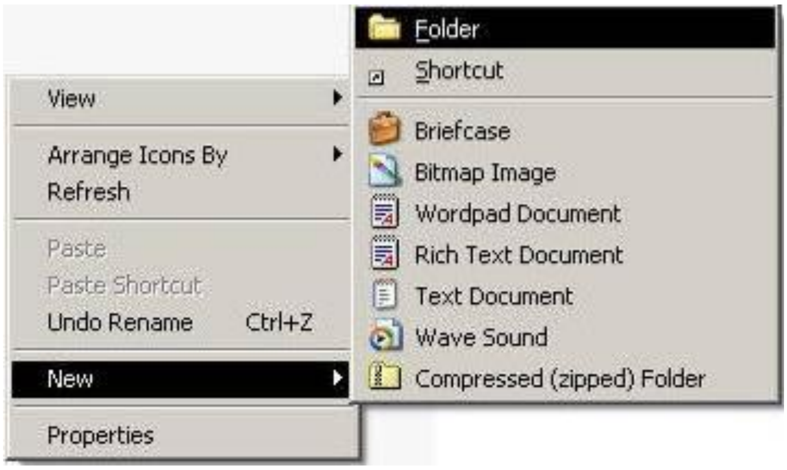
This section describes how to create a shared folder on the ICPU. Shared folders allow users to access and move data off the ICPU to another network-connected PC.

NOTE
A network switch is recommended for ease of file sharing and high-speed data transfer reliability.

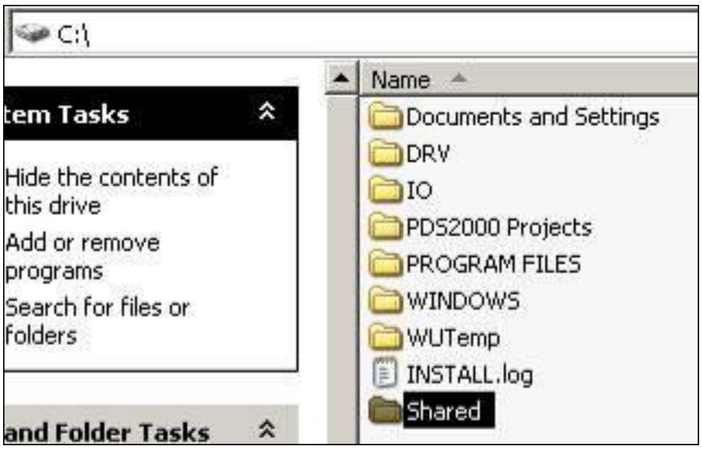
1. Go to My Computer and open the C:\ drive, and right-click on the blank area in the middle of the window.



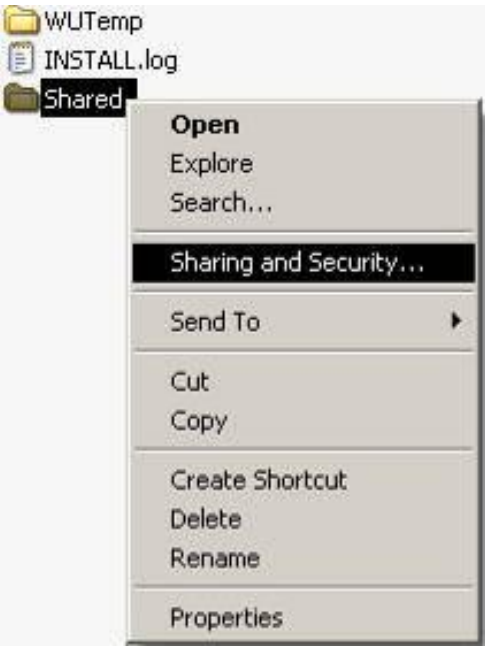
2. Select New | Folder.



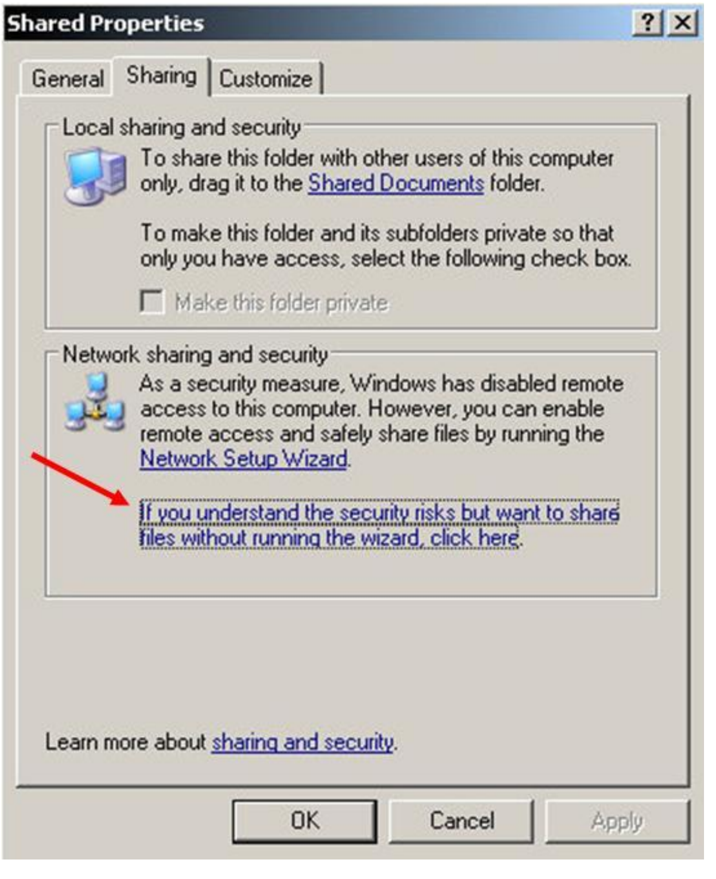
3. Change the name of the folder to Shared.



4. Right-click on the Shared folder and select Sharing and Security from the menu.

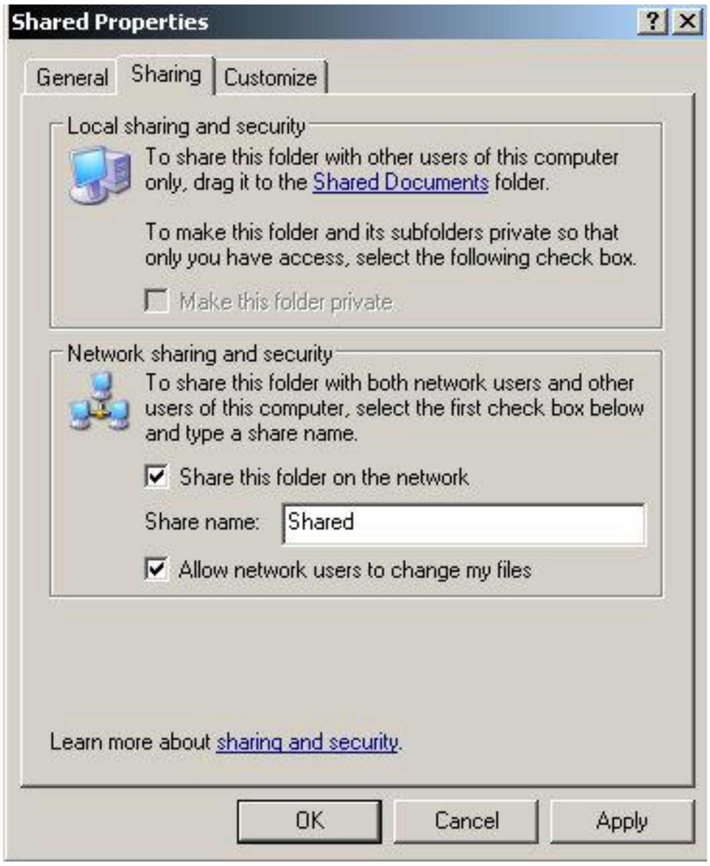


5. In the Shared Properties dialog, select the Sharing tab and click the hyperlink (indicated by the red arrow) in the Network sharing and security frame.

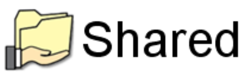


6. In the Enable File Sharing pop-up window, select the Just enable file sharing button and click OK.

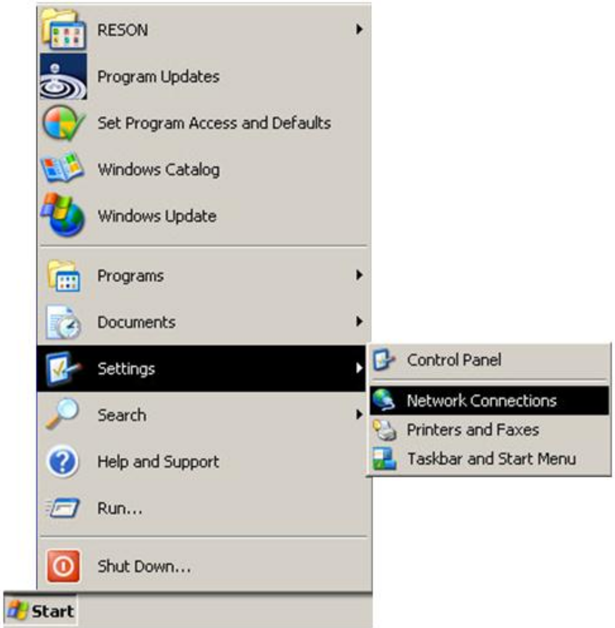
7. In the Shared Properties dialog, select the two check boxes in the Network sharing and security frame and click OK.



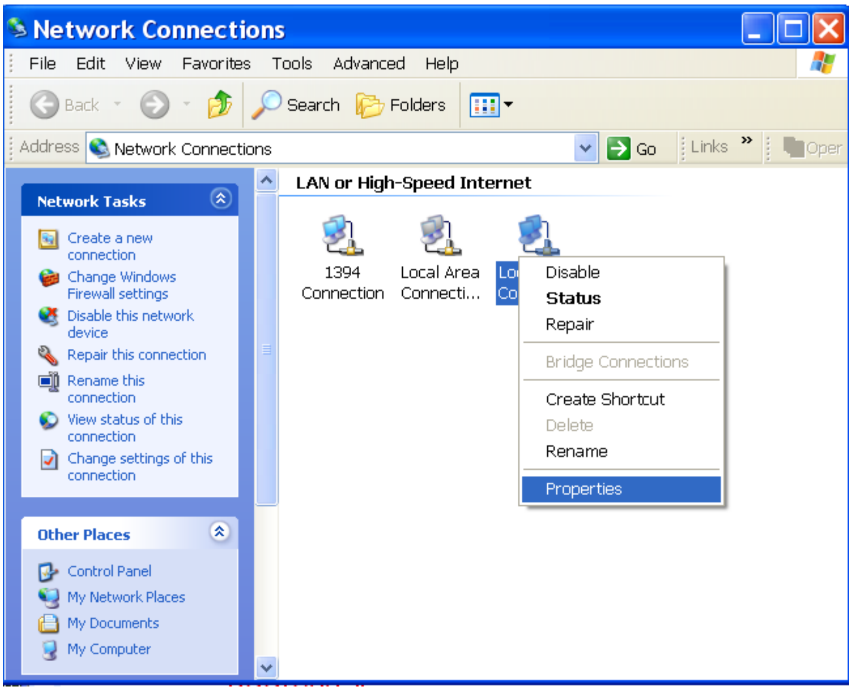
8. Navigate to the C:\ drive and verify that the folder Shared has a sharing icon (indicated by a hand holding a folder).



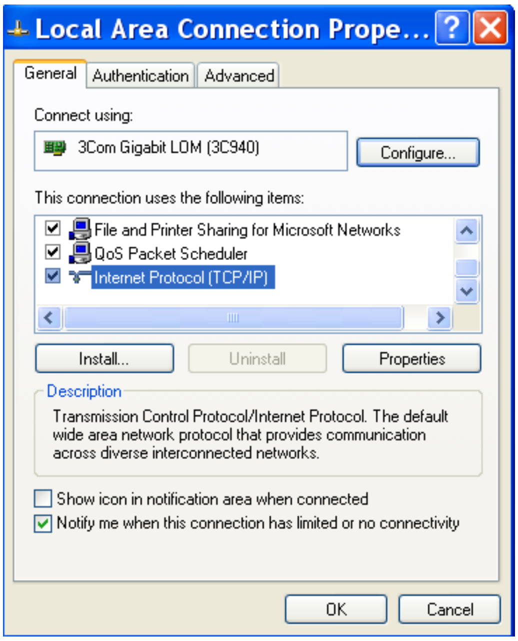
9. Go to the Start menu and select Settings | Network Connections.



10. In the Network Connections window, right-click on the active Local Area Connection and select Properties from the menu.



11. In the Local Area Connection Properties window, double-click the Internet Protocol (TCP/IP) selection.



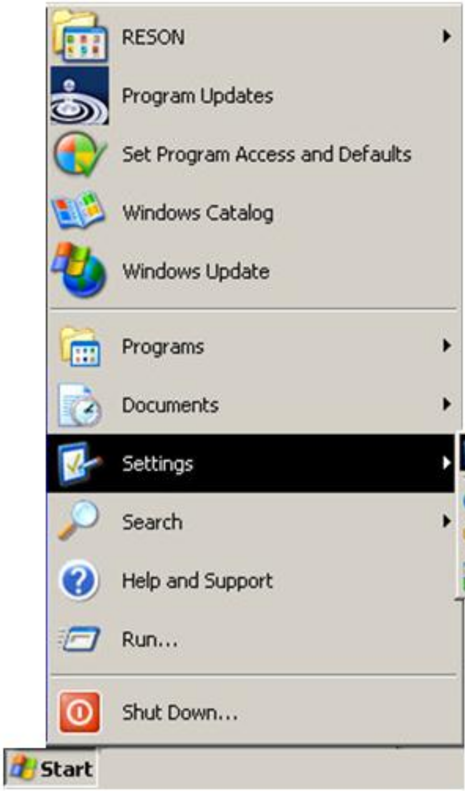
12. The Internet Protocol (TCP/IP) Properties window appears. By default, the processor automatically obtains an IP address. Click OK or set up your own parameters.

4.6.2 Verifying or Changing the Computer Name and/or Workgroup Name

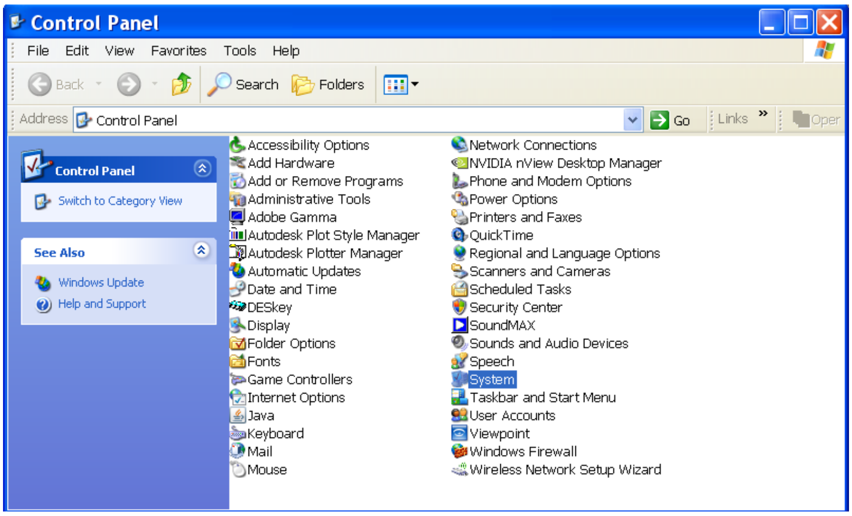
NOTE
If changing the Computer Name, a restart of the ICPU is required before the new name takes effect.

The default workgroup name for the ICPU is *Workgroup* and can be found on the network workgroups. Use the following steps to verify or change the computer name and/or workgroup name.

1. Go to the Start menu and select Settings | Control Panel.



2. Double-click on System.



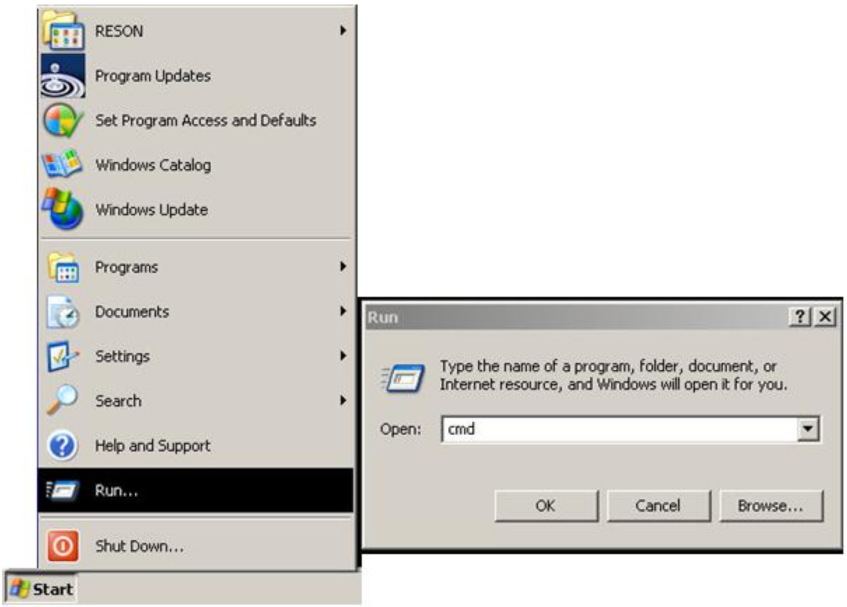
3. In the System Properties window, select the Computer Name tab to review the computer description, full computer name, and the workgroup name.

- To change the computer description: Enter the new description in the Computer description field and click OK.

- To change the computer name[6] or workgroup: Click the Change button and enter a new computer name or workgroup name and click OK. Changing either of these names does not affect the IP address.

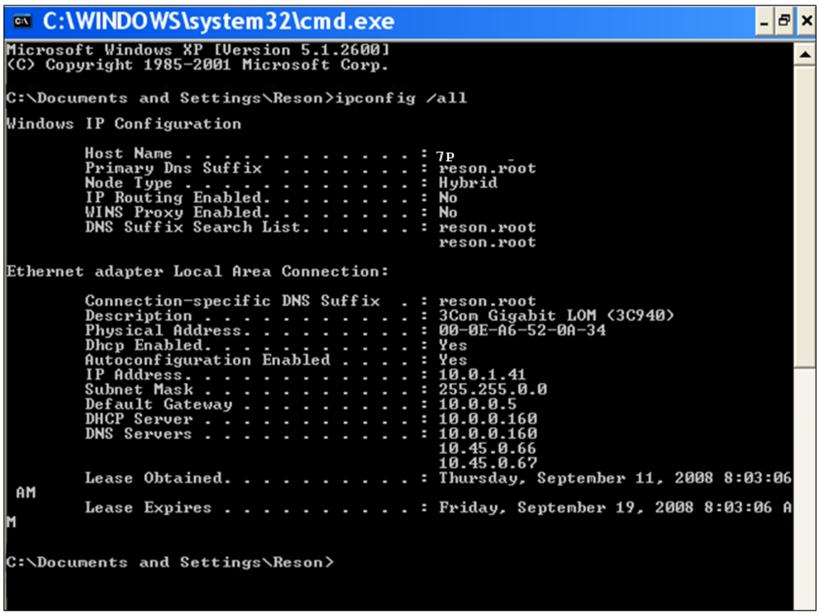
[6] Computer name is by default: SN xxxxxxx (7-digit serial number).

4. To view current IP address information, go to the Start Menu and select Run. Enter cmd in the Open field and click OK.

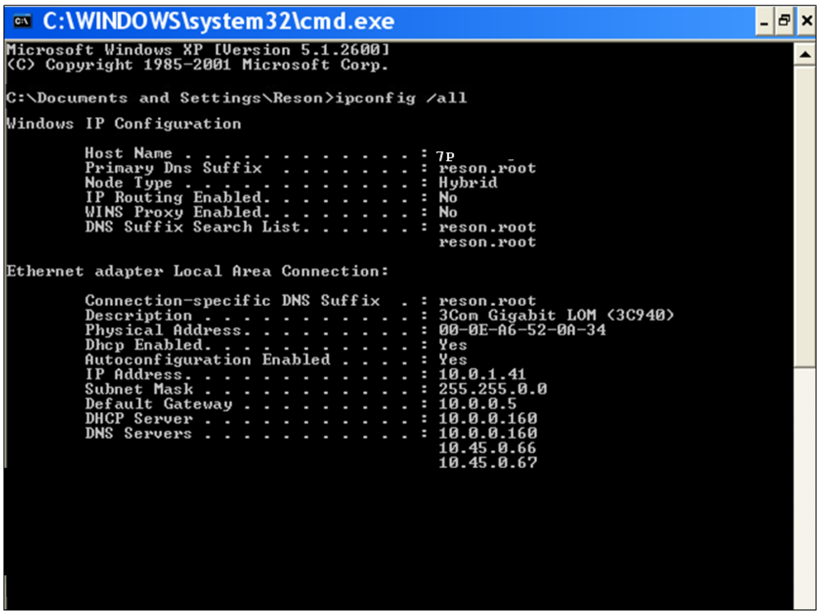


5. In the command screen, enter ipconfig /all (be sure to enter a single space before /all) and press Enter.

   - The screen displays the connection status of all the network connections, including IP Addresses as shown in the following example command screen.



- If all connections are disconnected, only the Media State and MAC address for each connection display. The following example command screen shows a typical disconnected ICPU.



5 SYSTEM OPERATION

5.1 AUV System Operation

The system will normally be operated autonomously. All communications will be via the Ethernet to/from the Vehicle Control Computer (VCC).

Normal mission sequence will be:

1. System installation, setup, and checkout – done through the 7k UI (see *Appendix B Installation Instructions*, *section 3 System Startup and Shutdown*, *section 4 System Configuration with 7k User Interface*, and *section 5 System Operation*).
2. Installation checkout – startup and diagnostics (BITE) performed by the VCC.
3. Power down and transit to deployment site (see *section 3 System Startup and Shutdown*).
4. Power up and repeat diagnostics (see step 2).
5. Vehicle deployment - sonar operates under control of the VCC.
6. Vehicle recovery – power down (see *section 3 System Startup and Shutdown*).
7. Data analysis – data is extracted from the disk drives for external analysis.

5.2 Chapter Overview

NOTE
The remaining parts of this chapter pertain to operator use during system setup and test only. During system operation, all communication will be between the ICPU and the customer-provided control computer. The output during operation is a data stream in accordance with the Data Format Definition document (see *appendix C.1 SeaBat 7125 AUV Documentation*).

The following sections cover the SeaBat 7k user interface in great detail and include the following subjects (click the emphasized hyperlink to be taken to the section):

- ***User Interface***: Consists of an overview of the various window elements.
- ***Primary Display Tab:*** Consists of a presentation of the different sonar image display formats and related indicators and controls.
- ***Built-In Test Environment (BITE):*** Consists of a presentation of the BITE displays.
- ***Motion Tab***: Consists of a presentation of the options available for viewing the roll data and motion format information.
- ***Snippets and Side Scan Tabs:*** Consists of a presentation of the options available for viewing the snippets and side-scan data.
- ***Sonar Control Tabs:*** Consists of a presentation of the settings available for controlling the sonar and viewing the sonar data.
- ***7k Center Console Window:*** Consists of a brief presentation of the function of this window.
- ***Help Menu:*** Consists of system information needed for reference.

NOTE
For information on starting, stopping, and setting up the SeaBat sonar system, see *section 3 System Startup and Shutdown*. For information on configuration of the system (including I/O module configuration, remote operation, and folder management), see *section 4 System Configuration with 7k User Interface*. For information on the practical use of the sonar, see *section 6 Active Sonar Usage.*

5.3 User Interface

The initial view presented to the user is for the default device. It comprises sonar data displays and relevant information. There are two sets of tabbed window elements. The upper tabs are for data display while the lower tabs are for sonar controls. A menu bar is located above the sonar data display area.

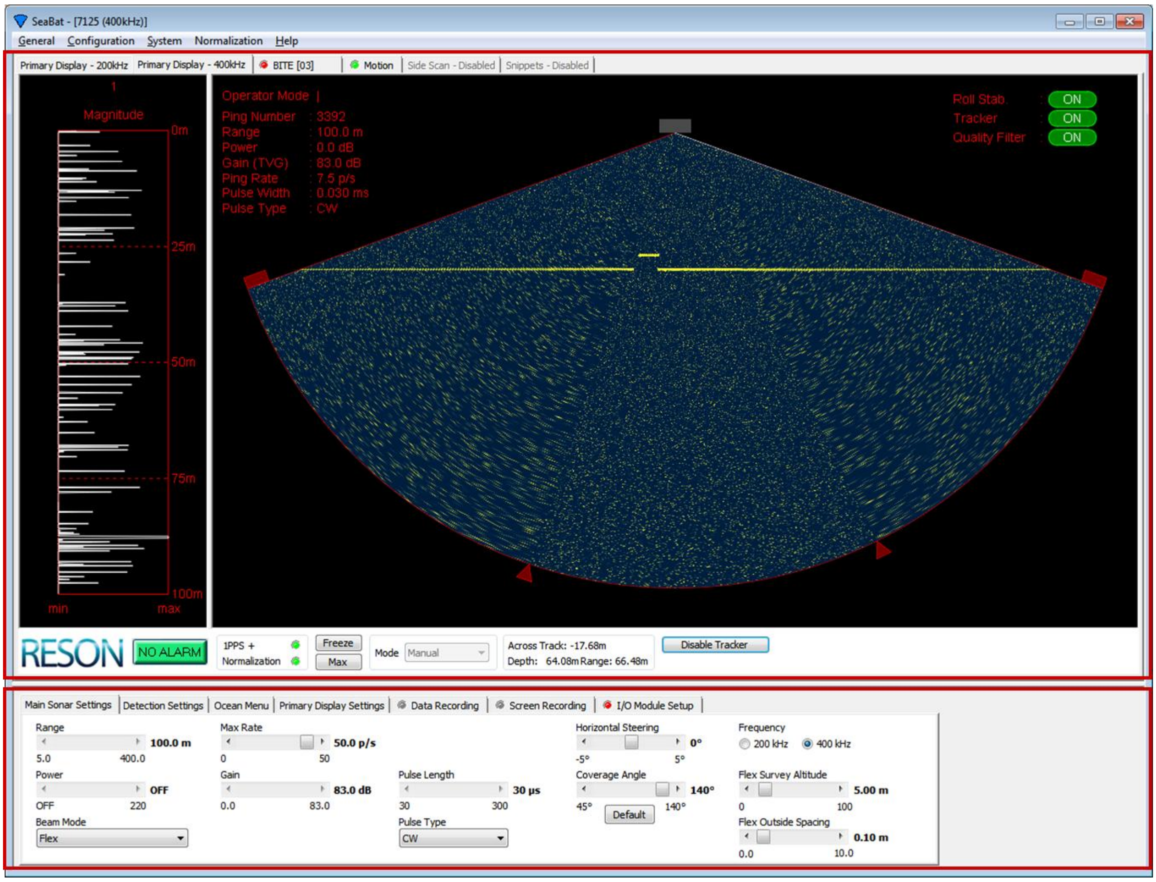


Figure 7: User Interface with Display and Control Areas

- **Upper display tabs** give access to different ways of displaying sonar data and system information. Some of the display tabs contain a separate set of tabs providing the operator with additional options for viewing the sonar data.
- **Lower sonar control tabs** give access to a number of menu settings for controlling the sonar and aiding the bottom detection process. Some of the control tabs provide recording options and I/O module settings.
- **Menu selections** include the Configuration menu with several options for system configuration (see *section 4 System Configuration with 7k User Interface)*.

5.4 Primary Display Tab

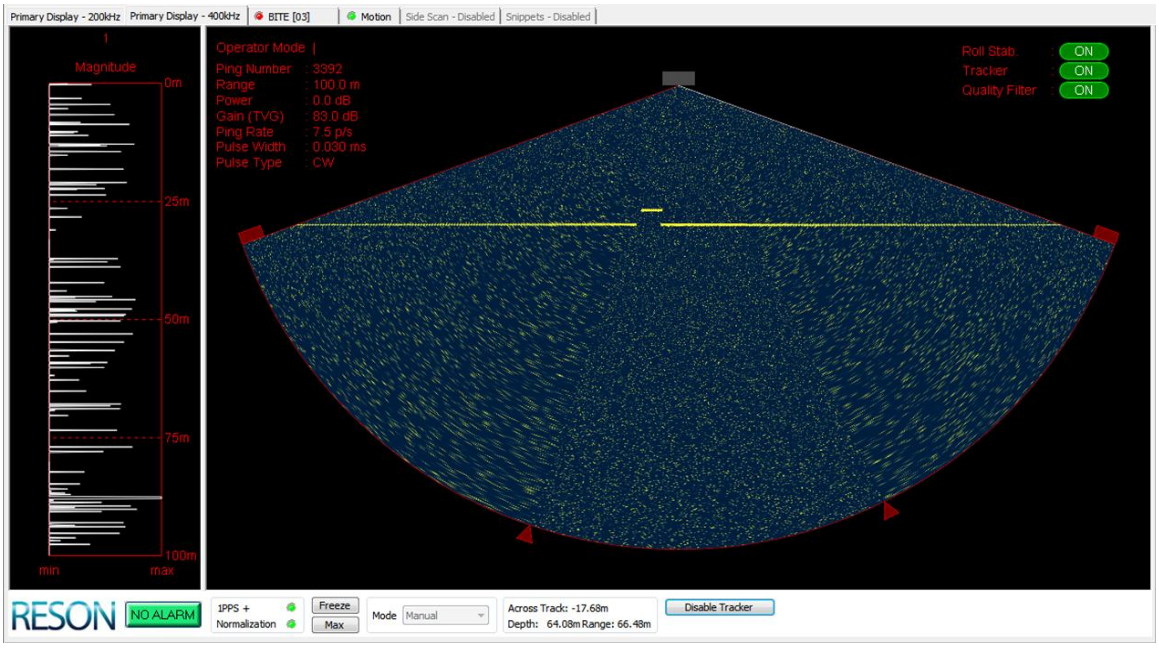


Figure 8: Primary Display Tab

The image on the right, in the center of the Primary Display tab is called the sonar image. The sonar image shows the complete sector illuminated by a single transmitted ping and can be represented in either Wedge format or Beam format (B-scan).

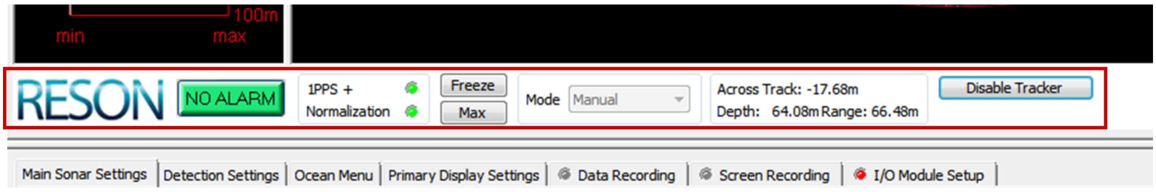
Current information is shown in the upper left corner of the sonar image frame and includes the following:

- Data Source
  - Signal Analysis Mode
  - Operator Mode
- Activity spinner (rotates 45° every time the sonar cycles)
- Ping Number (indicates the accumulated number of pings since the system was powered up)
- Range
- Power
- Gain
- Ping Rate (actual ping rate)
- Pulse Width
- Pulse Type

In the upper right corner of the sonar image frame, the status is shown of the following.

- The Roll Stab indicator reports one of the following:
  - ON (roll stabilization is active. Data output and wedge displays are roll stabilized to within ±0.025°)
  - OFF (roll stabilization is inactive)
  - WARNING (roll values exceed ±15°)
  - ERROR (roll values exceed ±35° or roll rates exceed 10°/sec)
- The Tracker[7] indicator reports one of the following:
  - ON (tracker is active and all parameters are set by the system)
  - OFF (tracker is inactive and all parameters are set by the operator)
- The Quality Filter indicator reports one of the following:
  - ON (quality filter is active)
  - OFF (quality filter is inactive)

The section of the Primary Display tab just below the sonar image and above the sonar control tabs is the sonar image control portion, which includes the following features:



- Alarm indicator (event messages)
- 1PPS input indicator
- Normalization indicator
- Button control for freezing the sonar image
- Button control for maximizing the sonar image
- Mode drop-down menu
- Track, depth, and range readings
- Button control for enabling/disabling the tracker

[7] When the Legacy Auto Pilot is active (see *section 4.2.9 Legacy Auto Pilot Settings*), the indicator reads AutoPilot, and not Tracker.

5.4.1 Sonar Image

5.4.1.1 Wedge Display

The sonar wedge is the default view for the SeaBat sonar systems.

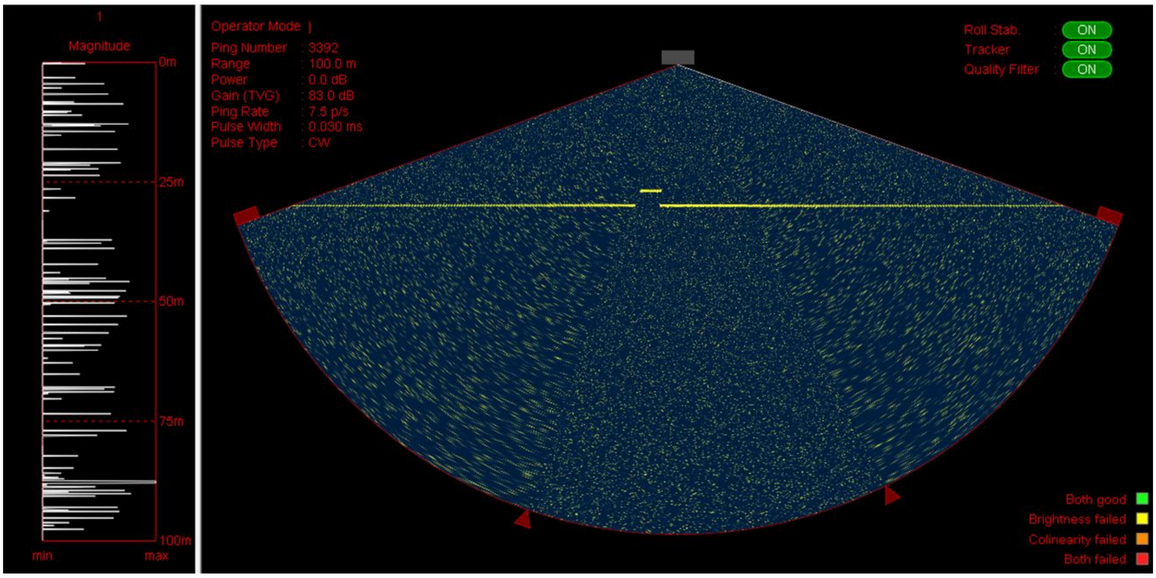
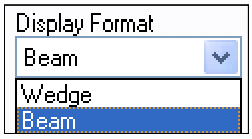


Figure 9: A-Scan and Sonar Wedge Display

5.4.1.2 B-Scan (Beam) Display

The sonar image can be changed from the traditional wedge display to a B-scan display by selecting Beam from the Display Format drop-down menu on the Primary Display Settings tab (see also *section 5.8.4 below).*



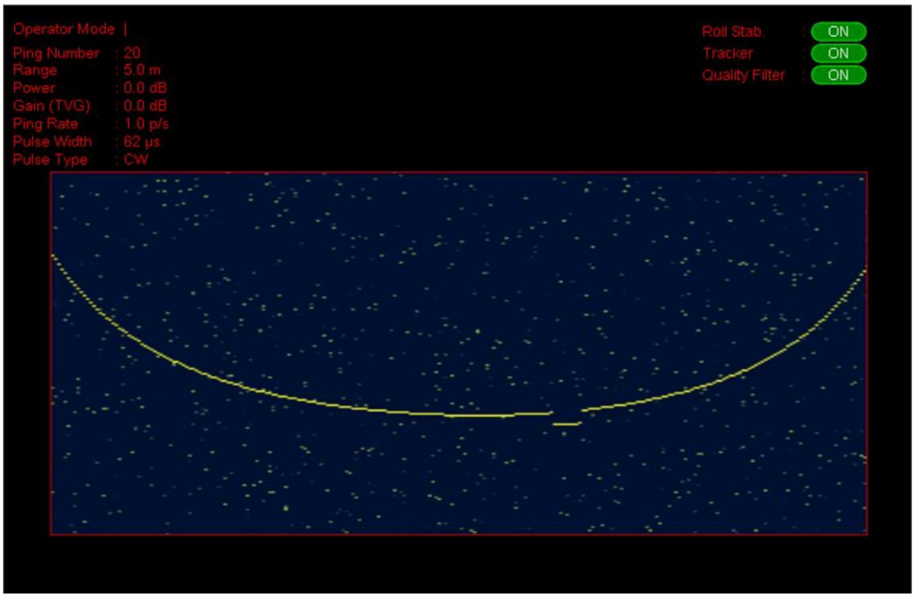


Figure 10: B-Scan Display

5.4.2 A-Scan Display

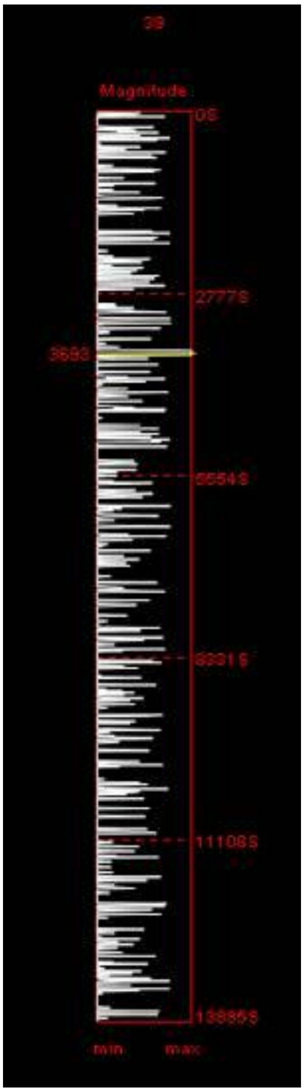
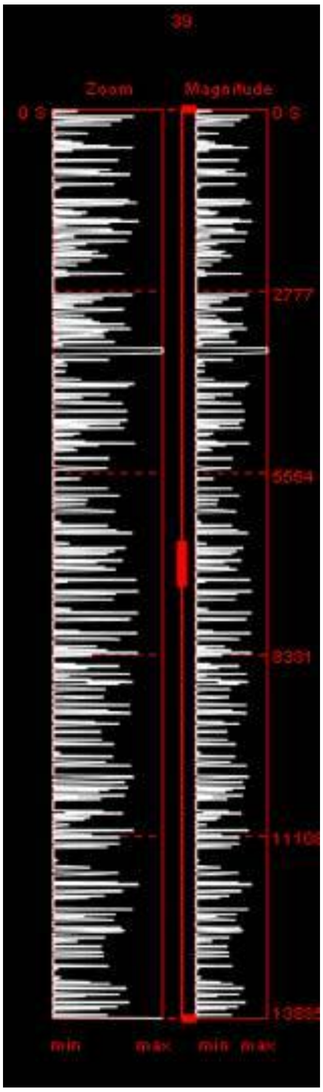
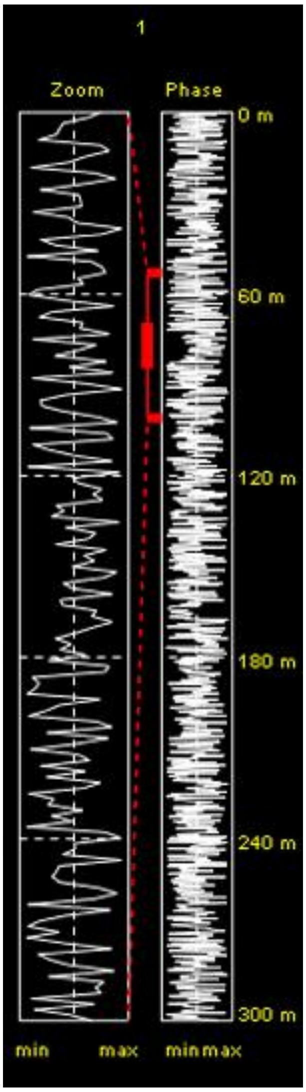
On the left side of the Primary Display (see *Figure 9*), next to the sonar wedge (or B-Scan) display, is the A-scan display. This display allows the operator to view the details of a single beam or group of beams.

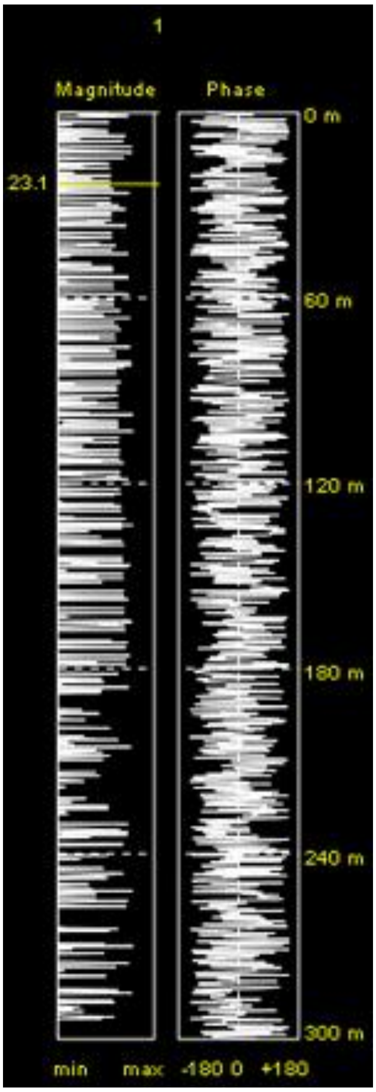
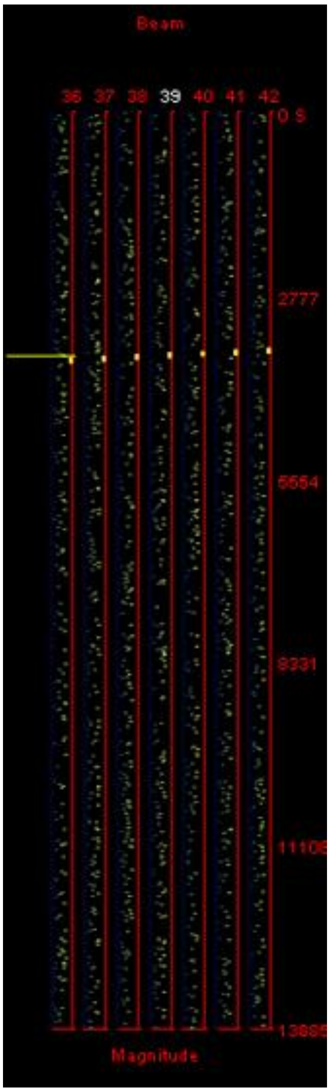
The default axis values are range vs. magnitude. Magnitude is scaled from minimum to maximum. Range labels can be changed to Time and Sample Number using the Label Format drop-down menu on the Primary Display Settings tab (see *section 5.8.4 below*).

5.4.2.1 Available Displays

Place the pointer over the A-scan display panel and right-click to switch between the available displays.

NOTE
All displays may not be available, depending on the type of data being received.

<table>
<tr>
<th>Single Beam Magnitude:</th>
<th>Single Beam Magnitude with Zoom:</th>
<th>Single Beam Phase with Zoom:</th>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Shows the selected beam’s range versus magnitude.</td>
<td>Shows the selected beam’s range versus magnitude with a zoom control for detailed inspection.</td>
<td>Shows the selected beam’s range versus phase with a zoom control for detailed inspection.</td>
</tr>
</table>

Single Beam Magnitude and Phase:	Multiple Beams:
	
Shows the selected beam's range versus magnitude and phase.	Shows the range versus magnitude of the selected beam and three beams on either side of the selected beam.

5.4.2.2 Using the Zoom Feature

Both the Magnitude with Zoom and the Phase with Zoom A-scan displays have a zoom feature. Three mouse controls located between the two plots are available to the user for controlling the zoom. They appear as three red rectangles and joining lines regardless of the user-defined color schemes.

- **Upper Window/Lower Window:** These control the zoom window for the plot. Clicking within the controls and sliding them up or down will shorten or lengthen the resulting zoom area to the left.

- **Window Slider:** Once a window size has been configured, the user can click and drag the center rectangular slider up or down the Y axis. This results in the zoom window being applied to different positions on the plot.

5.4.3 Event Messages

5.4.3.1 Event Message Display

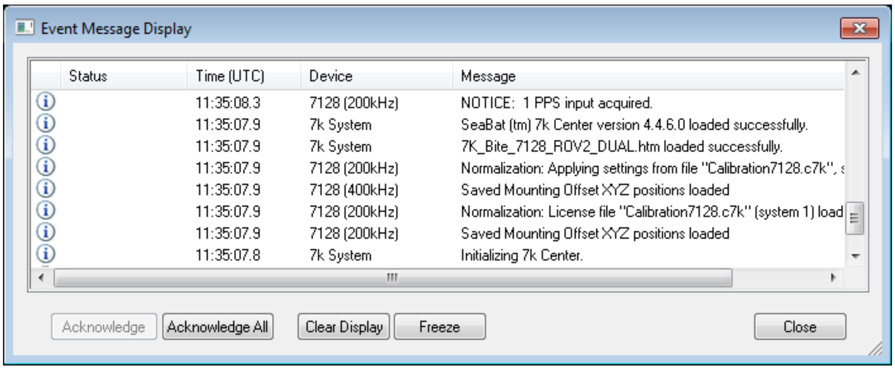
The alarm indicator appears during normal operation as a green button on the Primary Display tab and is labeled NO ALARM. This button will change based on the status of the SeaBat system to one of three states, indicated by colors:

- **Green:** The system is functioning normally, or all alarms have been acknowledged.

- **Yellow:** One or more features may need attention.

- **Red:** The system requires attention or is no longer operational.

To view event messages, click the Alarm button.



- **Acknowledge:** This button allows the operator to select an alarm or warning and change the status to Acknowledged. This is an informational change only. It does not have any effect on the function of the sonar itself.
- **Acknowledge All:** This button allows the operator to change the status of all warnings and alarms to Acknowledged. This is an informational change only and does not have any effect on the function of the sonar itself.
- **Clear Display:** This button allows the operator to change the status of all warnings and alarms to Acknowledged and remove them from the Event Message Display. This is an informational change only and does not have any effect on the function of the sonar itself.
- **Freeze:** This button allows the operator to freeze the display to examine individual messages.

When the status of all Warning or Alarm messages have been changed to Acknowledged, the Alarm button on the Primary Display tab will return to green.

5.4.3.2 Recommended Actions

In most cases, information is provided to the operator to rectify the problem. For instance an alarm indicating missing sound velocity input to the processor will require the operator to check the instrument and the input.

If errors occur that result in a condition where the systems in not operable the following actions are recommended.

1. Exit any active applications.
2. Shut down the sonar processor (ICPU or PC) completely.
3. Restart the sonar processor. (Use Shut Down from the menu rather than Restart.)
4. If the condition persists after a shutdown and restart, contact Teledyne RESON Service (support@teledyne-reson.com).

For a description of event messages and recommended actions, see *section Appendix A Troubleshooting*.

5.4.4 1PPS Input Indicator

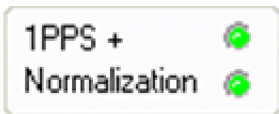
The 1PPS input indicator reveals the selection that has been made in the Trigger/PPS Configuration dialog (see *section 4.2.5.3 1PPS Polarity*).

- Plus sign (+) = Rising edge of the 1PPS signal will be used.
- Minus sign (-) = Falling edge of the 1PPS signal will be used.
- Green = 1PPS signal is being received.
- Yellow = 1PPS signal has been lost for at least 3 seconds.
- Red = 1PPS signal has been lost for at least 15 seconds.

5.4.5 Normalization Indicator

The Normalization indicator reveals the current channel normalization status of the system (see *section 4.3 Channel Normalization*).

- Green = System has been normalized.
- Yellow = Normalization is in progress.
- Red = System has not been normalized.



5.4.6 Freeze the Sonar Image

Clicking the Freeze button prevents the image on the Primary Display tab from being updated while all other sonar functions continue. This allows prolonged viewing of a particular item.

Click the Resume button to allow updates to continue.

5.4.7 Maximize the Sonar Image

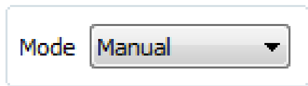
Clicking the Max button hides the lower set of tabs and enlarges the sonar image to fit the entire SeaBat window. This allows close inspection of data.

Click the Min button to return the image to normal size and display the lower set of tabs.

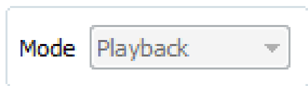
5.4.8 Operating Modes

The Mode menu informs the operator of the current operating mode. Only one of the two modes is listed at a time.

- **Manual:** The system is operating in manual mode with data being collected now. If the Tracker (or the Auto Pilot) is enabled, the menu is dimmed (see *section 5.4.10 below*).



- **Playback:** The system is operating in playback mode for viewing a previously collected data file. When in Playback mode the Playback tab is added to the lower set of tabs (while others are removed). For instructions on how to start the system in Playback mode, see *section 5.8.8 below*.



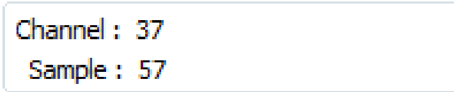
5.4.9 Identify Beam Track, Depth, and Range (or Channel and Sample)

To the right of the Mode drop-down menu the beam Across Track, Depth, and Range readings (in meters) are displayed for a particular point on the sonar wedge display.

These numbers change as the pointer passes over the sonar image, indicating the pointer's current position on the image.

- Range: Distance covered by beam to reach that point.
- Across Track:
    - Positive reading is distance from sonar head to starboard side.
    - Negative reading is distance from sonar head to port side.
- Depth: Vertical distance from sonar head.

When Beam has been selected from the Display Format drop-down menu, the readings will indicate channel and sample as the pointer passes over the B-scan display (see also *section 5.4.1.2 above*).



5.4.10 Enable/Disable Tracker

Clicking the Enable Tracker button to the right on the sonar image control portion of the Primary Display allows the system to set all parameters based on the quality of the data being collected.

Clicking the Disable Tracker button returns selection of sonar settings to the operator.

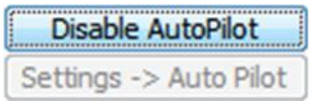
When operating in Tracker mode, the Mode menu is dimmed (see *section 5.4.8 above*) together with all sonar settings now controlled by the tracker.

For examples on how to use this feature, see *section 6.3.1 Tracker*.

5.4.11 Enable/Disable AutoPilot

When the Legacy Auto Pilot is active (see *section 4.2.9 Legacy Auto Pilot Settings*), the Enable AutoPilot button appears to the right on the sonar image control portion of the Primary Display.

When enabling auto pilot mode, the Disable AutoPilot button appears, and sonar settings are adjusted automatically based on the bottom detection data. The Settings > Auto Pilot button will be dimmed briefly before disappearing completely.



When operating in Auto Pilot mode, the Mode menu is dimmed (see *section 5.4.8 above*) together with all sonar settings now controlled by the auto pilot.

For examples on how to use this feature, see *section 6.3.2 Legacy Auto Pilot*.

5.4.12 Automatic Update of Auto Pilot Settings

The Settings –> Auto Pilot button appears to the right on the sonar image control portion of the Primary Display below the Enable AutoPilot button.

Clicking this button when running in Manual operating mode updates the settings in the Auto Pilot Settings dialog (see *section 4.2.9 Legacy Auto Pilot Settings*).

When operating in Auto Pilot mode the button is not available.

5.5 Built-In Test Environment (BITE)

5.5.1 BITE

BITE is an integral part of the system and monitors several subassemblies within the system for firmware version, temperature, voltage, communications status, and other parameters.

Each subassembly is displayed on a separate tab on the BITE tab.

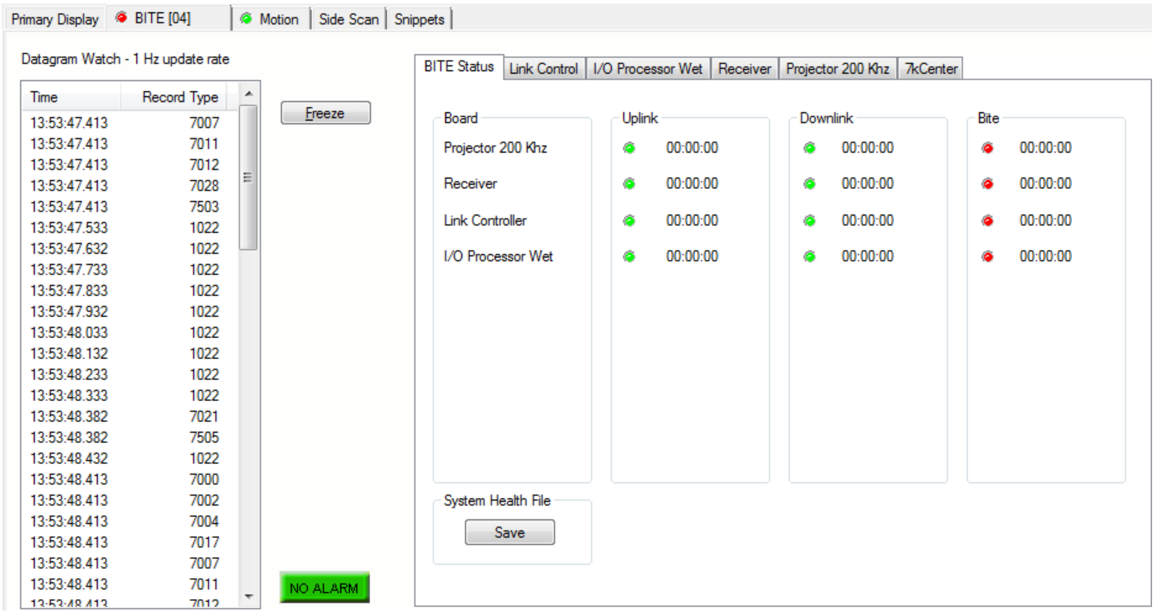


Figure 11: BITE Tab

An out-of-tolerance parameter turns the LED to red on the BITE Status tab and the individual board tabs to alert the operator.

The BITE tabs can also be used to verify an installation, firmware update, or to diagnose installation problems. For instance, if no wedge display is present after software startup, checking the BITE tabs can help localize the failure.

If a firmware update is done in the field, the BITE tabs are useful for verifying that the new version has been accepted.

5.5.2 BITE Tabs

5.5.2.1 BITE Status

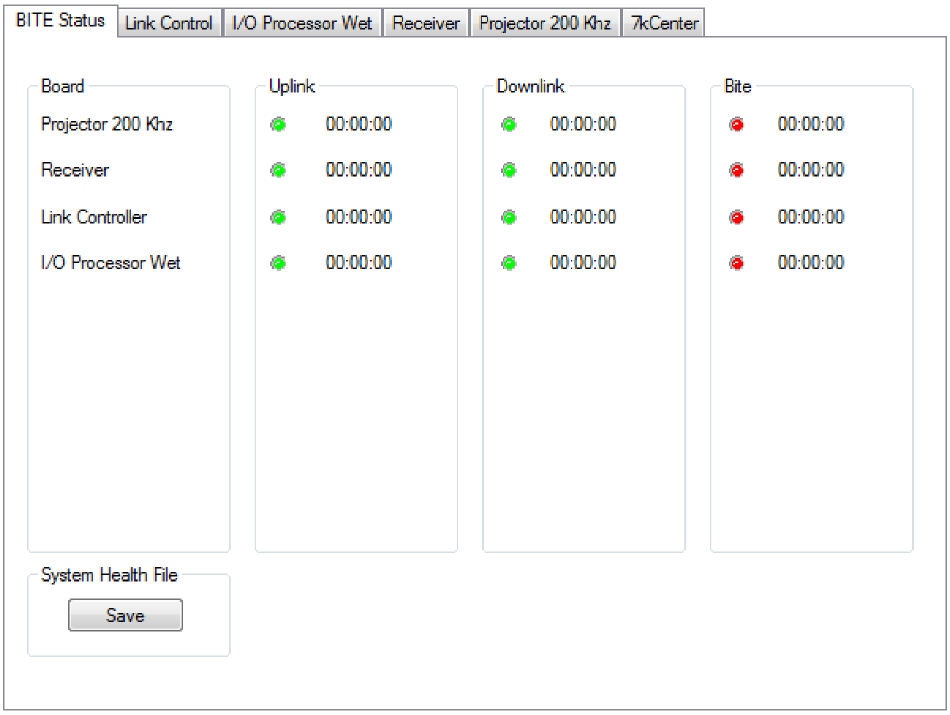


Figure 12: BITE Status Tab

The System Health File Save button produces a snapshot of various system versions, hardware configuration, registers, and other information. This file is saved in the SessionData folder[8] and named SystemHealth_date_time.txt. This file aids in troubleshooting and may be requested by service and support.

[8] Windows 7: C:\ProgramData\Reson\SeaBat\SessionData
Windows XP: C:\Documents and Settings\All Users\Application Data\Reson\SeaBat\SessionData

5.5.2.2 Link Control

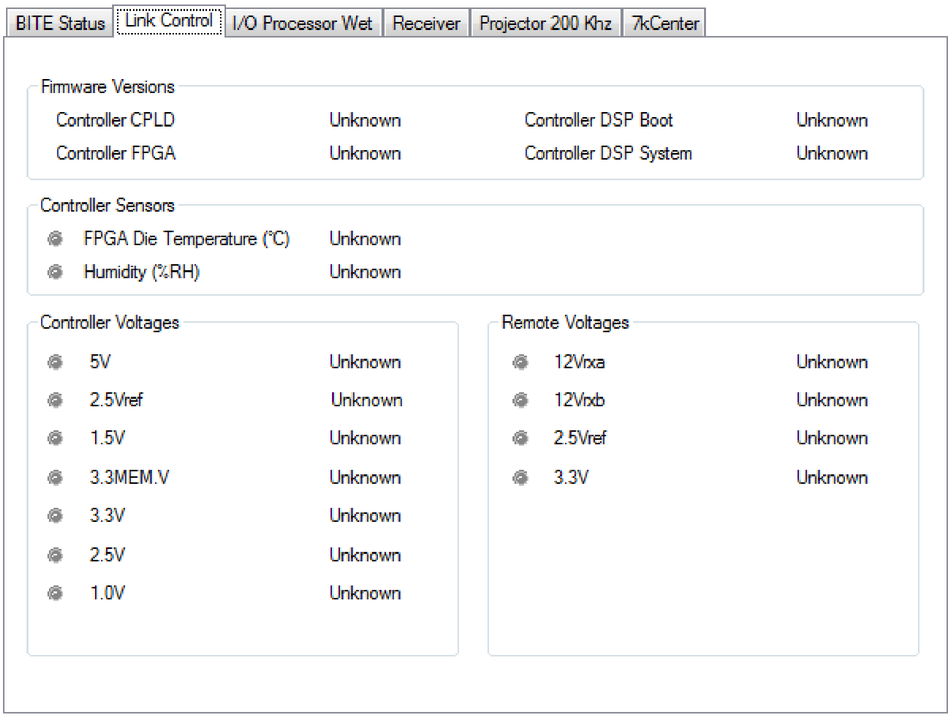


Figure 13: BITE – Link Control Tab

5.5.2.3 I/O Processor Wet

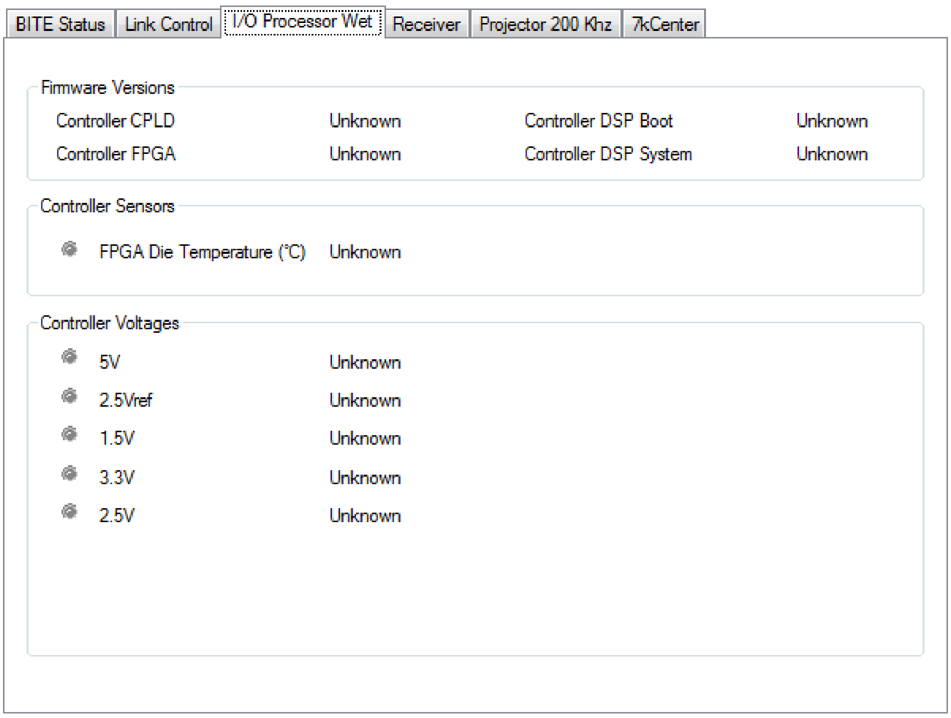


Figure 14: BITE – I/O Processor Wet Tab

5.5.2.4 Receiver

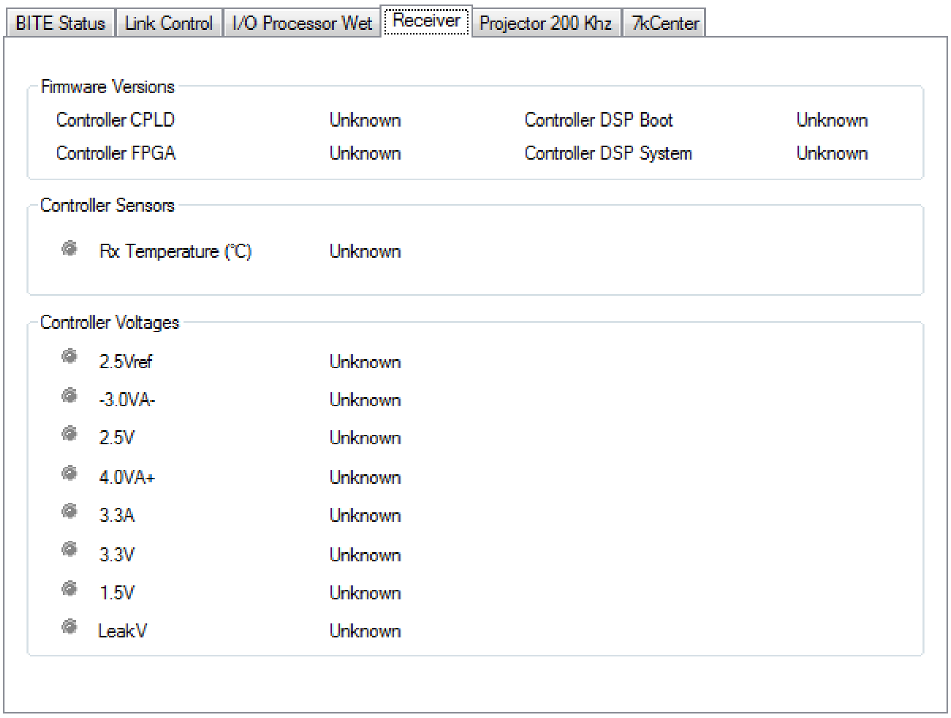


Figure 15: BITE – Receiver Tab

5.5.2.5 Projector

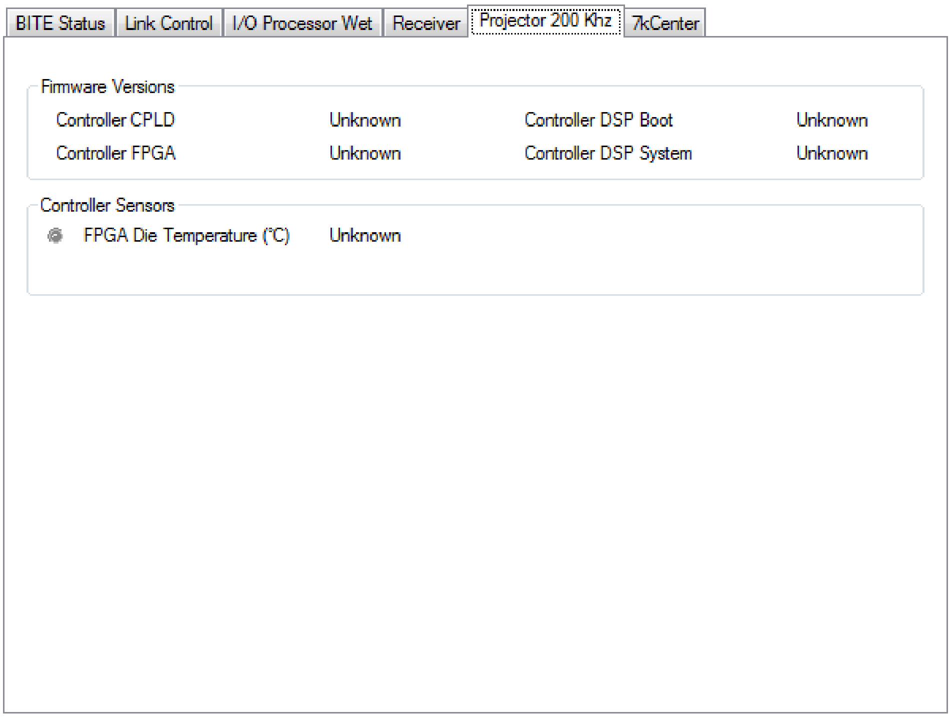


Figure 16: BITE – Projector Tab

5.5.2.6 7kCenter

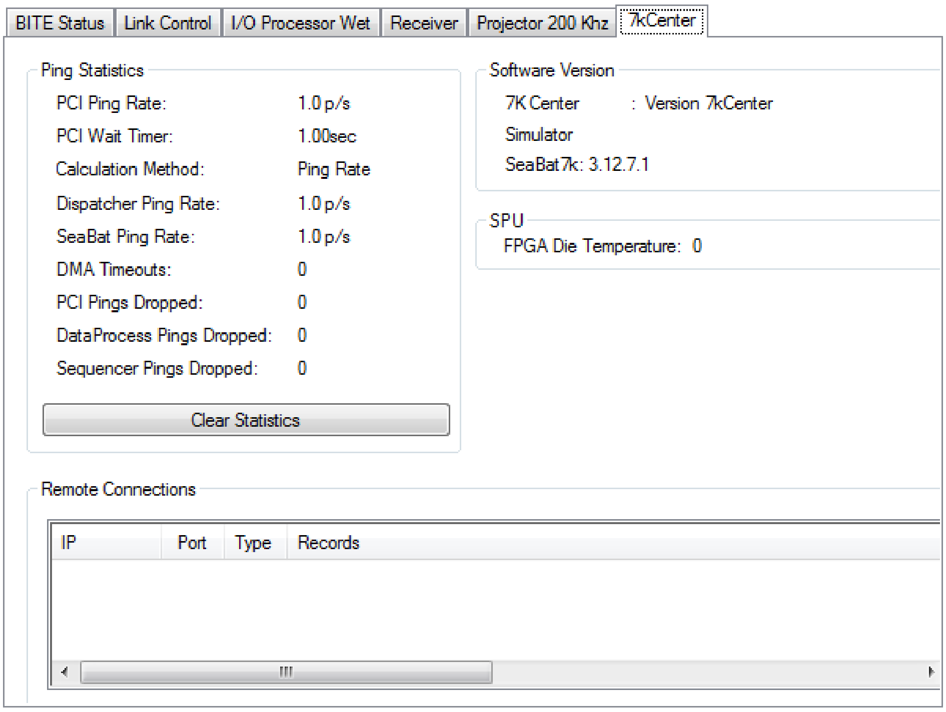


Figure 17: BITE – 7kCenter Tab

The 7kCenter tab shows:

- The ping rate averaged over a number of pings. Note that changing the range will not immediately result in a change to a new ping rate.
- The remote connections shows the Ethernet data connections currently running with the sonar.
- The software version shows the build numbers of the various software components in the system.

5.6 Motion Tab

When the Roll Stabilization option has been enabled, the sonar wedge display (see *section 5.4.1.1 above*) will display motion compensated data with a precision of within ±0.025°.

NOTE
Care should be taken to ensure that roll stabilization is correctly configured and operational prior to collecting survey data.

If the compensated data does not appear, select the Motion option from the Configuration menu to enable it (see *section 4.2.6 Motion*).

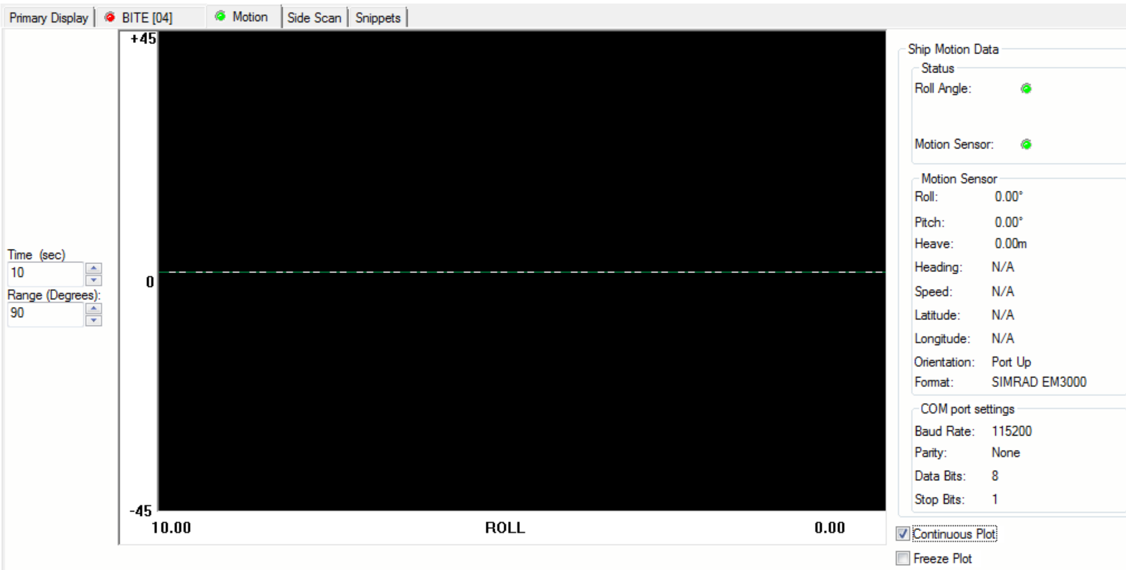


Figure 18: Motion Tab

The Motion tab has three different sections for displaying roll history, motion format information, and current data:

- **Time (sec):** If set to value T the display will show the last T seconds of roll data.
- **Range (Degrees):** Set to desired vertical scale of display. For example, if the roll varies between +/-5 degrees, set this value to 10.
- **Graphical display:** Displays roll value applied by the beamformer per sonar sample.
    - Continuous Plot:
        - When checked, connects the adjacent data sets.
        - When not checked, shows the time gap between adjacent data sets.
    - Freeze Plot: When checked, prevents the plot from updating.
- **Ship Motion Data:**
    - Status:
        - Roll Angle: Green if roll is less than 15 degrees; yellow if between 15 and 35 degrees; and red if above 35 degrees.
        - Motion Sensor: Green if good input from motion sensor; red if bad or no input.
    - Motion Sensor: Current values from motion sensor.
    - COM port settings: Current motion sensor configuration (see also *section 4.2.6 Motion*).

For examples on how to use this feature, see *section 6.3.3 Roll Stabilization*.

5.7 Snippets and Side Scan Tabs

The Snippets tab displays the snippets data and the Side Scan tab displays the side-scan data currently being collected or played back. If the Snippets and Side Scan tabs do not appear in the displayed tabs (are disabled), select the Data Display & Format option from the Configuration menu to unhide them (see *section 4.2.1 Data Display & Format*).

For information on the data types, see *section 7 System Performance and Data Types*.

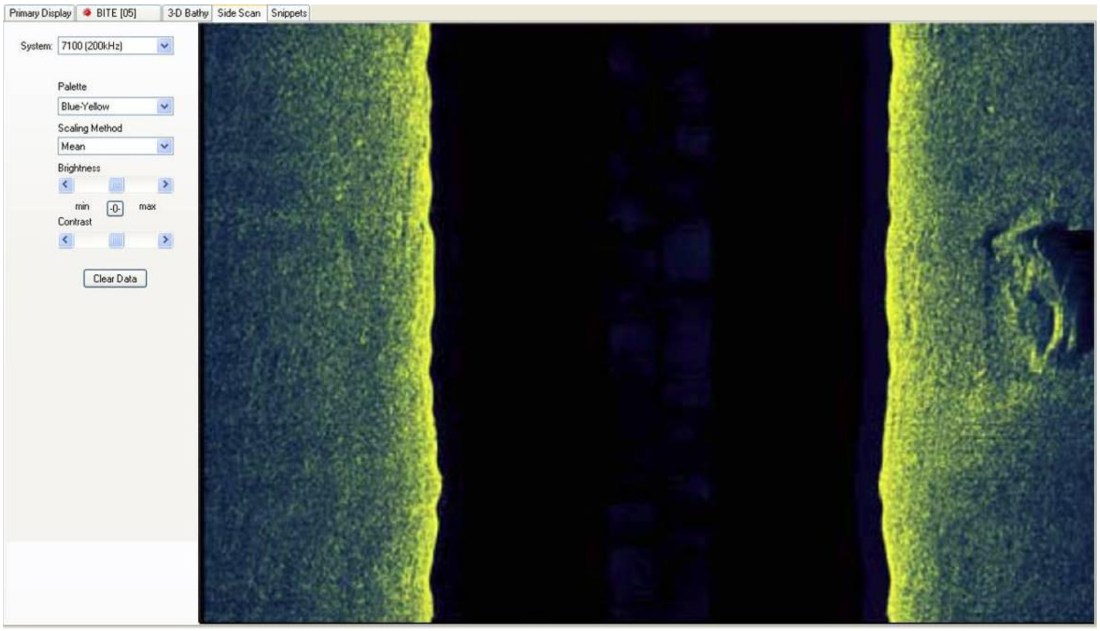


Figure 19: Typical Side-Scan Display

The Snippets and the Side Scan tabs have a separate and identical set of controls to the left of the displays.

- **System:** Select the system for which you would like to view the data.
- **Palette:** Change the color scheme applied to the display.
- **Scaling Method:** Select the scaling method for data.
    - Mean
    - Peak
    - RMS
- **Brightness:** Move the slider to change the brightness level of the display. The center position indicates no adjustment.
- **Contrast:** Move the slider to change the contrast level of the display. The center position indicates no adjustment.
- **-0-:** Click this button to return the Brightness and Contrast bars to the no adjustment position.
- **Clear Data:** Clear the data history from the screen.

5.8 Sonar Control Tabs

5.8.1 Main Sonar Settings

The Main Sonar Settings tab is the control point for the projector and receiver units.

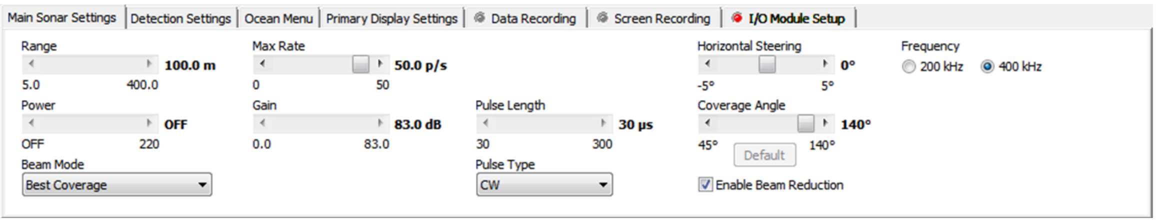


Figure 20: Sample of Main Sonar Settings Tab

NOTE
For all sliders on the Main Sonar Settings tab, except the Power control, the new settings will not be sent until the mouse has released control of the sliders.

5.8.1.1 Set the Range

The Range setting determines how far the SeaBat will "see". The range settings are operator selected. There are multiple settings in discrete increments ranging from 5 to either 300 meters for 400kHz operation or 750 meters for 200kHz operation.

Select the appropriate range scale to keep the horizontal bottom image at or above the widest part of the sonar wedge:

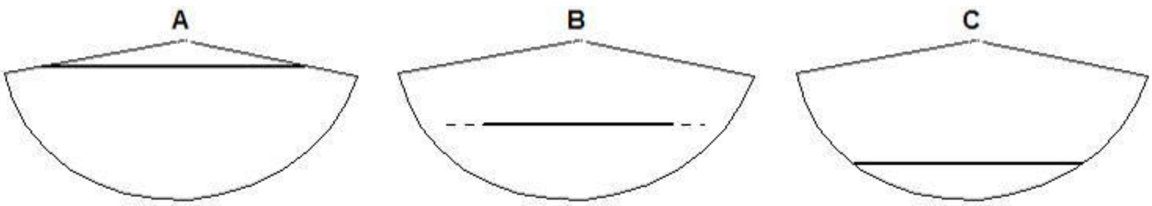


Figure 21: Range Setting Diagrams

Diagram A depicts a proper range setting. Diagram B depicts an acceptable range setting for a swath that is beginning to fade due to the effects of attenuation and spreading loss. Diagram C depicts an incorrect range setting. Notice that the still-useable ends of the swath are being cut off by the limits of the range setting.

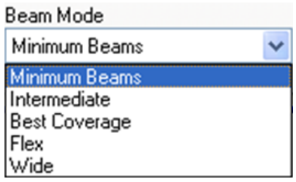
For additional examples on incorrect range settings and possible solutions, see *section 6.2.6 Correct Range Setting*.

5.8.1.2 Set the Transmit Power (Power)

The Power setting allows the operator to increase or decrease the amount of power (acoustic energy) transmitted into the water. There are multiple increments (OFF to maximum value), each accounting for an increase of approximately 1dB.

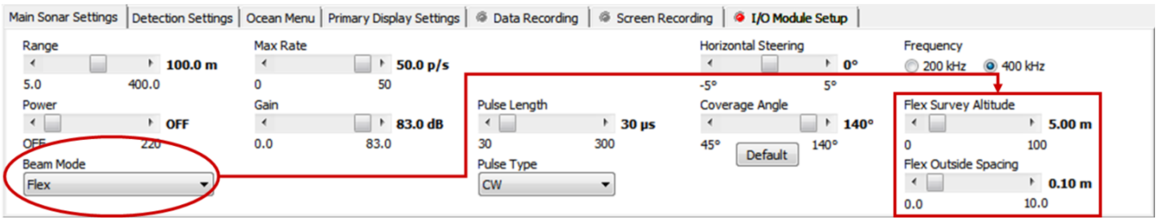
For examples on how to use this setting, see *section 6.2.2 Transmit Power OFF*.

5.8.1.3 Set the Beam Mode



The beam mode can be switched on the fly without restarting the 7k Center. The various options appear in a drop-down menu on clicking the arrow. Click to select the desired option (for details, see *section 7.1 Beam Modes*). This feature is used in conjunction with Vari-Swath (see *section 5.8.1.8 below*).

Flex[9] mode adds two extra settings to the Main Sonar Settings tab:



- **Flex Survey Altitude:** This setting allows the operator to set the survey altitude.
- **Flex Outside Spacing:** This setting allows the operator to define the sounding spacing in the outer low-density swath (see *section 7.1 Beam Modes*).

5.8.1.4 Set the Maximum Ping Rate (Max Rate)

The Max Rate setting allows the operator to limit the number of pings per second (p/s), independent of the current range setting. The ping range available is from 0 to 50p/s in increments of 1. The normal value is 50 to ensure unhindered operation of the sonar.

For examples on how to use this setting, see *section 6.2.3 Lower Ping Rate*.

NOTE
If Max Rate is set to 0, the system will not ping or receive data. If Max Rate is set to a value higher than the range-determined ping rate, the sonar will ping at the rate determined by the range setting. If Max Rate is set to a value lower than the range-determined ping rate, the sonar will ping at the rate specified by Max Rate.

[9] FlexMode is an optional add-on feature (see *Table 13*).

5.8.1.5 Set the Gain

The Gain setting allows the operator to select the amount of receiver gain applied to the returned sonar signal (in addition to the calculated gain). The gain range available is from 0 to 83dB, and is applied throughout the range as a fixed gain value.

For examples on how to use this setting, see *section 6.2.4 Receiver Gain*.

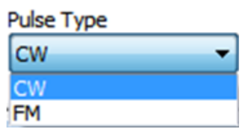
5.8.1.6 Set the Pulse Length

The Pulse Length setting allows the operator to change the pulse length of the transmitted signal. The pulse lengths available are from 33µs to 300µs for pulse type CW in increments of approx. 10µs (steps larger at higher end of the scale), and from approx. 300µs to 10ms for pulse type FM (only 400kHz).

For examples on how to use this setting, see *section 6.2.1 Pulse Length and Image Resolution*.

5.8.1.7 Set the Pulse Type

The Pulse Type setting allows the operator to switch between CW (continuous wave) and FM (frequency modulation). The choice made is also reflected in the Advanced Ping Settings dialog (see *section 4.2.4 Advanced Ping Settings*).



5.8.1.8 Set Vari-Swath

Three settings allow the operator to control the swath coverage (using slider or mouse):

- **Horizontal Steering:** This setting allows the operator to steer the swath electronically at an angle between -63° to 63° (max.) in increments of 5° (or less if using the mouse controls on the wedge display). The achievable steering angle depends on the coverage angle selected (see also *section 6.2.5.2 Horizontal Steering*).
- **Coverage Angle:** This setting allows the operator to change the swath width from maximum 140° (or 165°) to 45° in increments of 5°.
- **Default:** This button resets all Vari-swath selections:
    - Horizontal Steering will be set to 0.
    - Coverage angle will be set to max. dependent on Beam Mode selection.
- **Enable Beam Reduction:** Select this check box to form only the number of beams necessary to populate the given coverage sector. (The check box is not available with FlexMode.)

This feature is used in conjunction with Beam Mode (see *section 5.8.1.3 above*).

For examples on how to use this setting, see *section 6.2.5 Vari-Swath*.

5.8.2 Detection Settings

The Detection Settings tab allows the operator to apply range and/or depth filters (depth gates) to the bottom detection process to aid in noise reduction and to correct for a tilted sonar head. Gate lines (filter lines) can be optionally displayed on the sonar image. For details, see *section 5.8.4 below*.

A yellow highlight of text fields and check boxes indicates that the data was changed since last update and has not yet been applied.

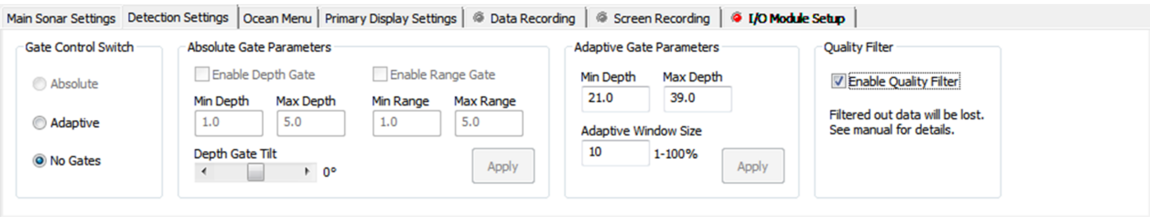


Figure 22: Sample of Detection Settings Tab

The last user settings are stored and will be recalled upon system startup.

For examples on how to use this setting, see *section 6.2.8 Use of Gates*.

5.8.2.1 Gate Control Switch

There are three gate modes:

- Absolute
- Adaptive
- No Gates (gate functionality is turned off)

5.8.2.2 Absolute Gate Parameters

When Absolute gating is selected, either gate range or depth is entered in this section. Select the Enable Depth/Range Gate check box for the type of gate desired.

- **Depth:** Applies the minimum and maximum depth values as entered in the Min Depth and Max Depth fields. Only soundings within these depth limits will be used in the bottom detection process.

  The two depth gates can also be moved individually with the mouse/trackball. This will update the Min Depth and/or Max Depth fields.

  Use of a motion sensor is required to rotate the depth gates with the rolling motion of the vessel to ensure soundings are not clipped as the seabed rotates with respect to the sonar (see *section 4.2.6 Motion*).

- **Range:** Applies the minimum and maximum range values as entered in the Min Range and Max Range fields. Only soundings within these range limits will be used in the bottom detection process.

The two range gates can also be moved individually with the mouse/trackball. This will update the Min Range and/or Max Range fields.

- **Depth Gate Tilt:** Applies a tilt value to the depth gates as manually specified on the slider control in the range between -30° and 30° in increments of 1°. For examples on how to use this setting, see *section 6.2.8.2 Depth Gate Tilt*.

Click the Apply button to finalize changes.

5.8.2.3 Adaptive Gate Parameters

When Adaptive gating is selected, the bottom is tracked based on window size and search criteria from beam to beam within a ping.

- **Depth:** Applies the minimum and maximum nadir depth values as entered in the Min Depth and Max Depth fields to refine the initial search for the strongest bottom return from the nadir beam. As the gate/filter limits approach the nadir search (NS) limits, the NS gates are automatically updated to center the nadir search on the detected seafloor.

  The NS gates can be moved by right-clicking the sonar wedge and selecting Move Nadir Gate; this will center the gates on the spot clicked. The two NS gates can also be moved individually with the mouse/trackball. Both “moves” will update the Min Depth and/or Max Depth fields.

- **Adaptive Window Size:** Applies the percentage value as entered in the Adaptive Window Size based on the total samples in the ping. Once the initial bottom detection point is located, the gates are propagated in each direction using this number. The bottom detection from beam to beam is therefore based on the results from the previous beams. Increasing this window size allows more samples to be included in the detection process, but may also introduce noise. Decreasing this window size too much may degrade performance, when the bottom is not flat.

Click the Apply button to finalize changes.

5.8.2.4 Quality Filter

- **Enable Quality Filter:** Allows the operator to prevent export and display of any data which does not exceed a predetermined quality threshold.

CAUTION
Filtered out data will be lost.

For details on the quality testing, see *section 7.5 Quality*.

5.8.3 Ocean Settings

The Ocean Menu tab allows the operator to enter various correction factors to compensate for changing environmental conditions.

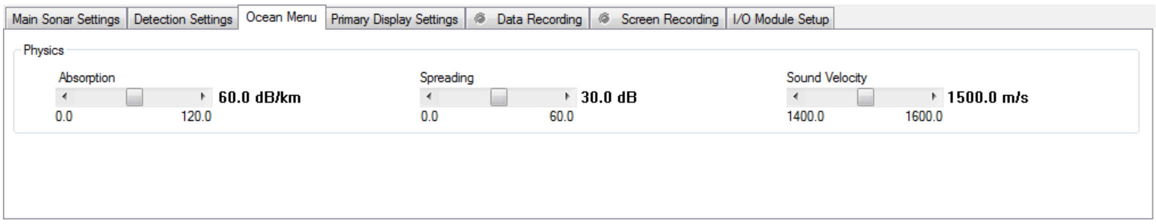


Figure 23: Sample of Ocean Menu Tab

NOTE
For all sliders on the Ocean Menu tab, the new settings will not be sent until the mouse has released control of the sliders.

5.8.3.1 Change the Absorption Loss Value (Absorption)

The Absorption slider allows the operator to enter the amount of loss expected through the ambient water medium. The range available is from 0 to 120dB/km.

This value is used in conjunction with the spreading loss coefficient to compute the TVG curve as described in *section 5.8.3.2 below*.

For examples on how to use this setting, see *section 6.5.1 Loss of Sound by Absorption*.

5.8.3.2 Change the Spreading Loss Coefficient (Spreading)

The Spreading slider allows the operator to enter the amount of cylindrical and spherical spreading loss that is expected through the ambient water medium. The range available is from 0 to 60dB, with a recommended initial value of 30.

This coefficient value is used in conjunction with the absorption loss value (see *5.8.3.1 above*) to compute the TVG curve applied to the returned signal.

For examples on how to use this setting, see *section 6.5.2 Loss of Sound by Spreading*.

5.8.3.3 Set the Sound Velocity

The Sound Velocity slider allows the operator to enter the externally measured speed of sound through the local water. This value is represented in meters per second, and is used in Range display and Receiver Beam Steering. The range allowed is from 1400 to 1600m/s.

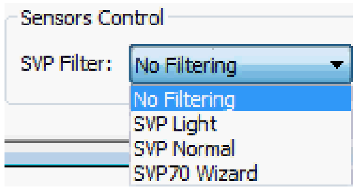
The Override check box is only available, if an external sound velocity source is detected.

For examples on how to use this setting, see *section 6.5.3 Sound Velocity*.

NOTE
If a sound velocity probe is interfaced to the ICPU, the velocity value is controlled by the probe. It can be changed by the operator, but will automatically be overridden by the value from the probe.

5.8.3.4 Sensors Control – SVP Filter

The speed of sound impacts the beam angles. If a sonar ping is processed with a sound velocity value that is not reflecting the speed of sound right in front of the receiver, the beam angles will be wrong and hence the targets or bottom detects will have wrong coordinates.



Some software packages allows post-compensation of wrong sound velocity, but it is typically possible to avoid this extra complication of processing by setting a proper filter on the SVP data during real-time recording.

The SVP Filter drop-down menu provides four options.

- **No Filtering:** Although this setting does not filter data in the classical sense, it still ignores readings outside the range 1350m/s to 1800m/s.

  Use this filter if there is a requirement for immediate response to sound velocity changes. When using this filter any false reading will cause distinct false output. This filter may be preferred for certain scientific sonar work.
- **SVP Light:** Removes occasional false readings.

  Use this filter if there is a need for fast filter response, for instance in regions with mixing waters.

  If the SVP update rate is less than 10Hz it may be preferred to use this filter as the standard filter.
- **SVP Normal:** Removes single and double false readings and outliers, and smoothens the SVP value across 10 readings.

  The filter is recommended for most sonar work on systems using an SVP (SVP 70) with no internal filtering and an update rate of 10-20Hz.

NOTE
The SVP Normal filter is typically the best filter to use.
- **SVP 70 Wizard:** This filter only works with the SVP 70 if the internal SVP 70 filter is set to mode 1 (low pass filtering).

  Sensors with a low pass filter cause a special artifact in the output in case of outliers and invalid readings. The SVP 70 Wizard filter removes these artifacts and makes the system work well despite of the low pass filter.

  It is recommended to change the SVP 70 filter mode to 0 when convenient and reset the SVP Filter to SVP Normal.

For access to filtered and unfiltered values, please see the DFD messages R7510 and R7610. Refer to the Data Format Definition document for information (see *Appendix C Reference Documentation*).

5.8.4 Primary Display Settings

The Primary Display Settings tab allows the operator to customize some of the visual properties of the sonar image.

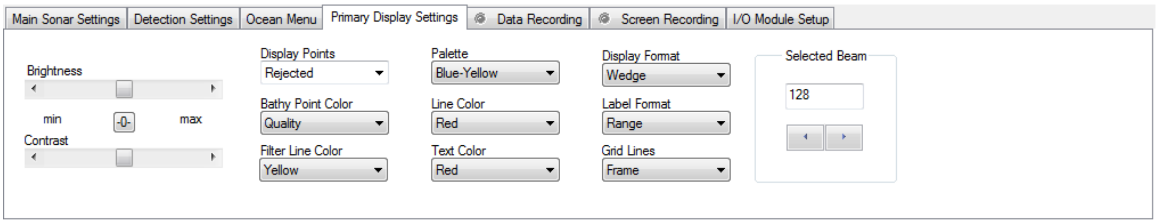
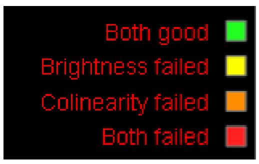


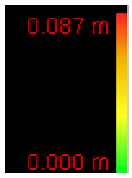
Figure 24: Sample of Primary Display Settings Tab

- **Brightness:** Move the slider to change the brightness level of the sonar wedge display. The center position indicates no adjustment.
- **Contrast:** Move the slider to change the contrast level of the sonar wedge display. The center position indicates no adjustment.
- **- 0 -:** Click this button to return the Brightness and Contrast bars to the no adjustment position.
- **Display Points / Filters:** Select the items to display in the wedge display.
    - Bathy: Display bathymetry points.
    - Gates: Display gates/filter lines.
    - Rejected Items[10]: Display points that do not pass the quality filtering.
- **Bathy Point Color:** Change the color of the bathymetry points in the wedge display or display the color-coded bottom detection method or quality or uncertainty reporting.
    - Red, Yellow, Green, Blue, or White: Dots will appear on the screen in the selected color.
    - Process: Each sounding is color-coded based on the weighting used in the magnitude/phase bottom detection process.
        - Blue: Magnitude
        - Green: Phase
        - Orange: Magnitude and Phase blend

    - Quality: Uses a two-part test for brightness and colinearity with color-coded results. For further details, see *section 7.5 Quality*.
        - Green: Good brightness, good colinearity
        - Yellow: Poor brightness, good colinearity
        - Orange: Good brightness, poor colinearity
        - Red: Poor brightness, poor colinearity



[10] Right-clicking the wedge display and selecting Show Rejected from the menu will do the same.



- Uncertainty: Uses a Green-Yellow-Orange-Red transition palette to display uncertainty. Green indicates the lowest uncertainty and red the highest. For further details, see *section 7.6 Uncertainty Estimation*.

- **Filter Line Color:** Change the color of the filter lines in the wedge display.
- **Palette:** Change the color scheme applied to the Primary Display.
- **Line Color:** Change the color of the frames and gridlines in both the sonar image and A-scan displays.
- **Text Color:** Change the color of the text in both the sonar image and A-scan displays.
- **Display Format:** Switch the sonar image display between Wedge and Beam (B-scan) modes.
- **Label Format:** Change the labels in both the sonar image and A-scan displays to reflect units of range (in meters), time (in seconds), or samples.
- **Grid Lines:** Activate or deactivate grid lines on the Primary Display.
    - All: Show the frame around the sonar image, as well as the selected units of measure.
    - Frame: Hide the units of measure, leaving only the frame around the sonar image.
    - None: Hide all frames.
    - Beam Select: Hide the frame around the sonar image and the units of measure. Show only the frame around the selected beam.
- **Selected Beam:** View the number of the currently selected beam in this field, or change the beam selection by either entering a beam number or clicking the arrow buttons to cycle through the beams.

5.8.5 Data Recording

The Data Recording tab is divided into three general sections:

- Recording Control
- Advanced
- Recording Status

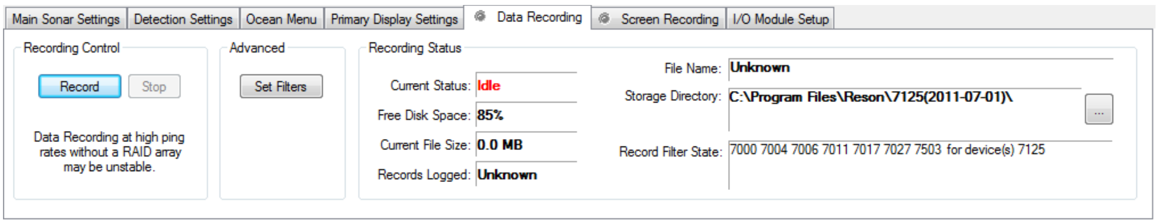
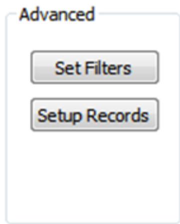


Figure 25: Sample of Data Recording Tab

5.8.5.1 Recording Control

The Recording Control section of the Data Recording tab allows you to start and stop the data recording process. Click the Record and Stop buttons to start and stop recording.

5.8.5.2 Advanced

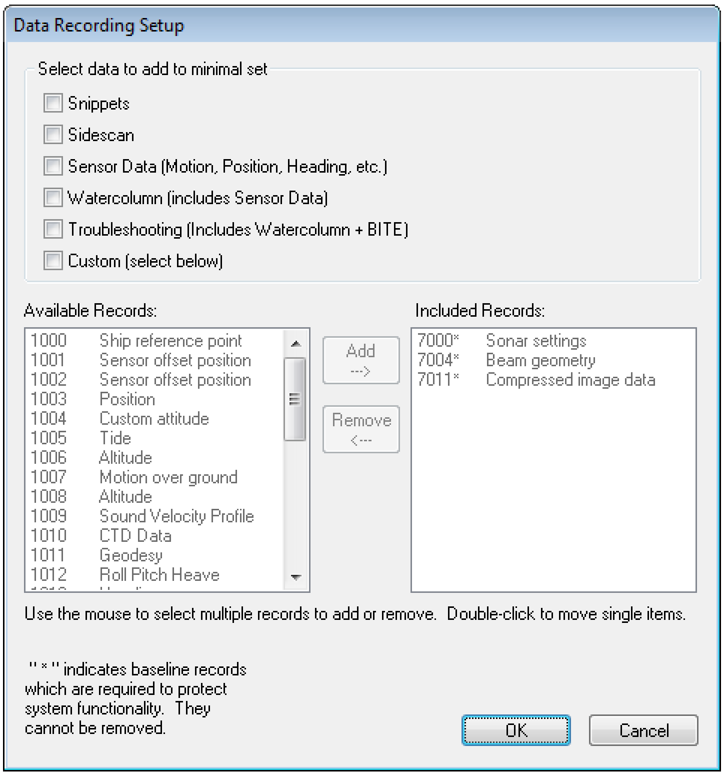


The Advanced section of the Data Recording tab has two utilities:

- **Set Filters:** This utility allows the operator to select particular records from the Data Recording Setup dialog to be included in the recorded data.
- **Setup Records:** This utility allows the operator to configure advanced records for the recording.

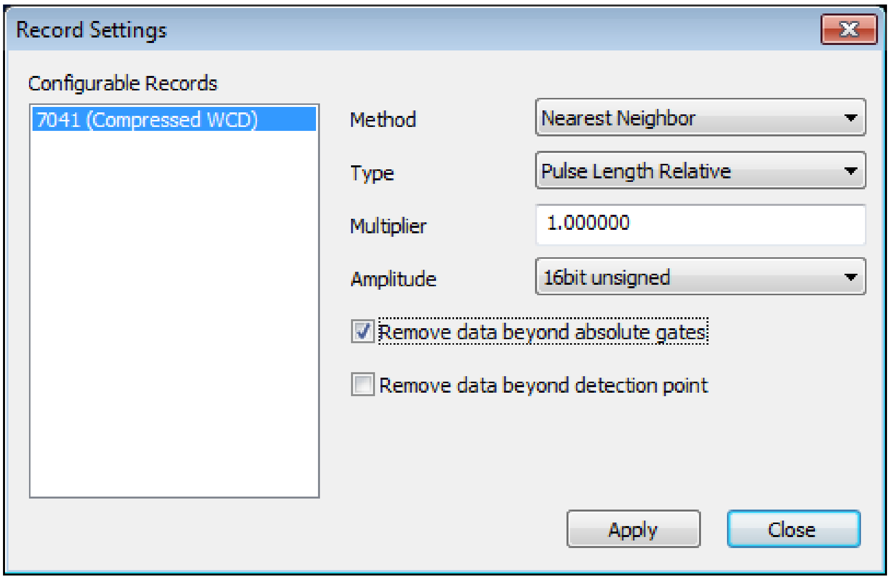
<u>To use Set Filters:</u>

- A minimal mandatory set is already selected and cannot be removed.
- Select one or more of the predefined sets of records:
  - The Troubleshooting set includes the Sensor Data and Water column sets.
  - The Water column set includes the Sensor Data set.
- Select the Custom set and then use the Add and Remove buttons to move records between the Available Records and Included Records frames.



NOTE
Refer to the Data Format Definition document for information regarding the records you require (see *Appendix C Reference Documentation*).

To use Setup Records:



- **Configurable Records:** Select the record to be configured in the list to the left. The items on the right side of the dialog will appear, once a selection has been made.

Record 7041 (Compressed WCD)

- **Method:**
  - No Downsampling: No downsampling is performed and magnitude data is recorded unchanged.
  - Nearest Neighbor: For each new sample the nearest original sample within the same beam is picked.
  - Linear Approximation: Each new sample is calculated as linear approximation of two original neighboring samples.
  - Averaging: Each new sample is an average of all original samples within half new sampling period.
- **Type:**
  - Pulse Length Relative: New sampling period will be set to the transmit pulse length (see *section 5.8.1.6 above*) times the value in the Multiplier field.
  - Sampling Rate Relative: New sampling period will be set to the original sampling period times the value in the Multiplier field.
  - Absolute: Total number of samples is set to a fixed number, from which the sampling period is calculated.

NOTE
If new sampling rate is calculated higher than original then the record will contain original data as there is no upsampling.

- **Multiplier:** Supplies multiplier for both of the relative types.
- **Max. Size:** Supplies integer number of maximum samples for absolute type.
- **Amplitude:**
    - 16bit unsigned (magnitude is preserved in the original format)
    - 8bit dB (magnitude is encoded as 40*log10(magnitude), i.e., ½dB)
- **Remove data beyond absolute gates:** If checked and absolute gates are enabled, magnitude series will be recorded only to maximum depth or range gate, whichever is less. This does not work with adaptive gates or detection mask since those depend on bottom's quality and detection.
- **Remove data beyond detection point:** If checked and bottom detection was successful (regardless of quality) for the beam, data series will be recorded only to detection point plus one full sample period.

The settings entered in the dialog are preserved by the UI between sessions. All settings are sent to the 7kCenter once recording is started.

NOTE
If recording is started by any application other than SeaBat UI, that application must send appropriate record settings to the 7kCenter. Alternatively, the operator can manually send all the settings by clicking the Apply button in the Record Settings dialog prior to recording.

5.8.5.3 Recording Status

The Recording Status section of the Data Recording tab provides information on the current recording:

- **Current Status:** Shows whether the system is Idle, Recording, Stopping, or Buffering.
- **Free Disk Space:** Amount of free space available for storage of recorded files.
- **Current File Size:** The size of the currently recording file.
- **Records Logged:** The number of records that have been added to the recorded file.
- **File Name:** The file name for the current file. The file name is automatically generated using the following naming convention: YYYYMMDD_<System ID>_SystemName.s7k. Refer to the Data Format Definition document for further description (see *Appendix B Installation Instructions*).
- **Storage Directory:** The storage location for the current file. To change this location, click the Browse button and select the folder where the recorded files should be saved.
- **Record Filter State:** The record types currently being included in the recording.

CAUTION

With increased range and/or ping rates, the files will become very large very quickly. It is best to monitor the file sizes and ensure that 10% of disk space is always left available for system operation.

For instructions on playing back recorded sonar data, see *section 5.8.8 below*.

5.8.6 Screen Recording (Video Recording)

The Screen Recording tab is divided into two general sections:

- Recording Control
- Recording Status

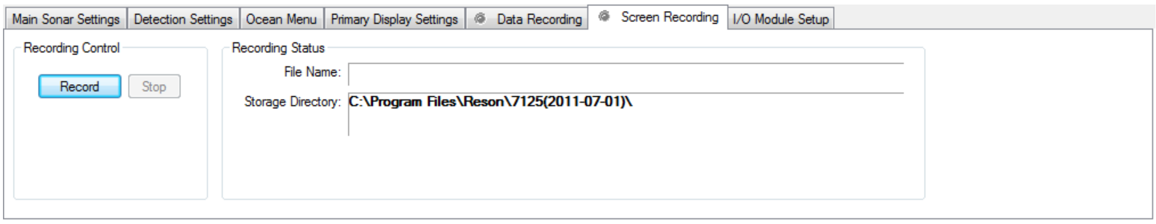


Figure 26 Sample of Screen Recording Tab

NOTE

Screen recording records the entire window and not just the sonar display area.

5.8.6.1 Recording Control

The Recording Control section of the Screen Recording tab allows you to start and stop the screen recording process. Click the Record button to start recording and the Stop button to stop recording.

5.8.6.2 Recording Status

The Recording Status section of the Screen Recording tab provides information on the current recording:

- **File Name:** The name of the current file. The file name is automatically generated using this naming convention: YYYYMMDD_HHMMSS.avi. The file name is shown only during recording.
- **Storage Directory:** The directory location of the current file. To change this location, go to the Data Recording tab and click the Browse button to select the folder where the recorded files should be saved.

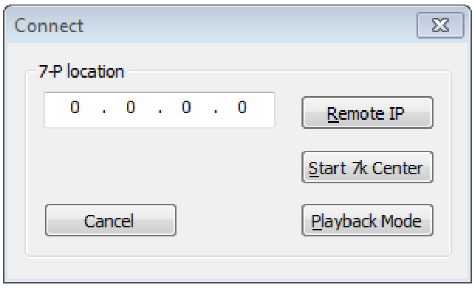
5.8.6.3 Play Back Recorded Video Data

You can use any media player to play back .avi files.

5.8.7 I/O Module Setup

See *section 4.4 I/O Module Configuration*.

5.8.8 Data Playback



The Data Playback tab is hidden when the SeaBat is real-system or simulator mode.

Data playback is achieved by starting the SeaBat7k.exe user interface while the 7kCenter application is not running on the ICPU, or by starting the SeaBat7k application on a PC where data has been transferred to.

When starting the SeaBat 7k application the user is prompted to select the operation. Select “Playback Mode” to enter the user interface with playback functions enabled.

The Data Playback tab is divided into three general sections:

- Playback Control
- Advanced
- Playback Status

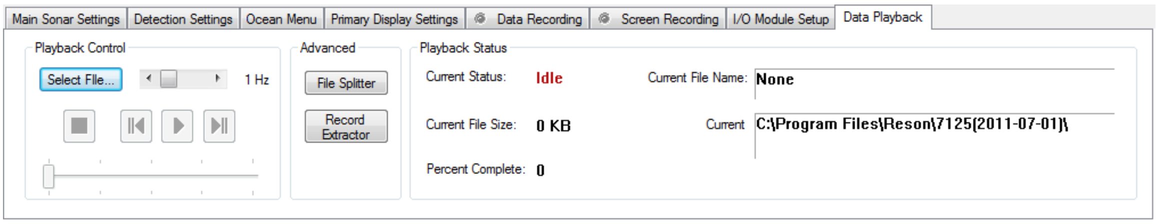


Figure 27: Sample of Data Playback Tab

5.8.8.1 Playback Control

The Playback Control section of the Data Playback tab allows you to start and stop the playback process. Click the Select File button to select the file to play back, and then click the Play button to start playback. The Stop button will stop the playback.

The Playback Rate option is not enabled for this system. Playback will always be at the system’s maximum speed.

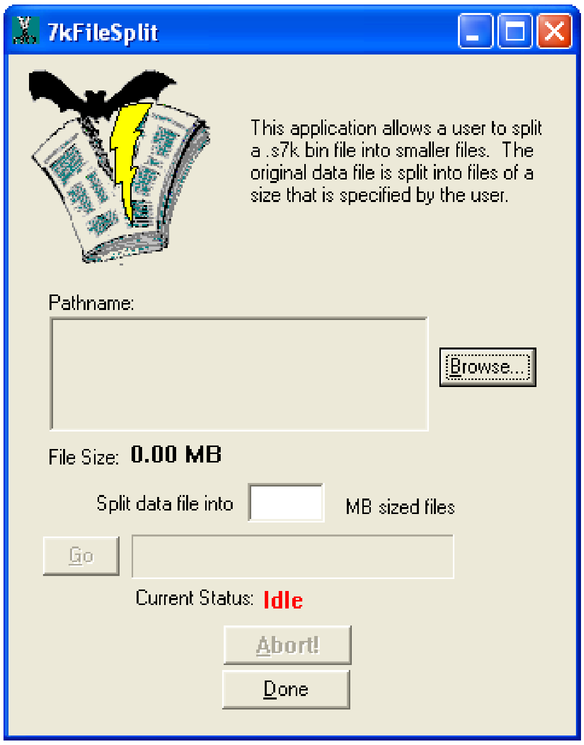
5.8.8.2 Advanced

The Advanced section of the Data Playback tab has two utilities:

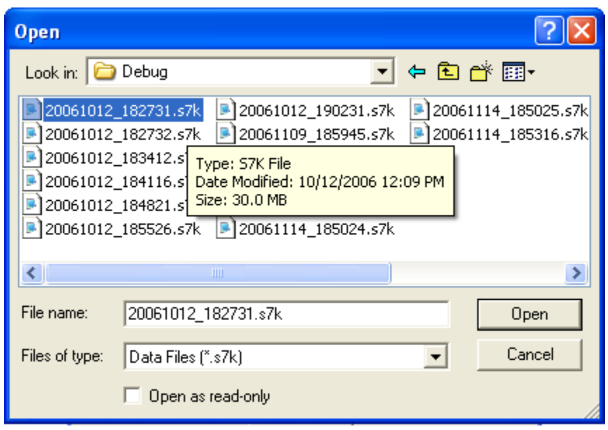
- **File Splitter:** This utility allows the operator to split recorded data files into smaller files.
- **Record Extractor:** This utility allows the operator to extract an individual record or groups of records in order to analyze sections of recorded data files.

To use File Splitter:

1. Click the File Splitter button to launch the utility.
2. Click the Browse button to locate the desired file.

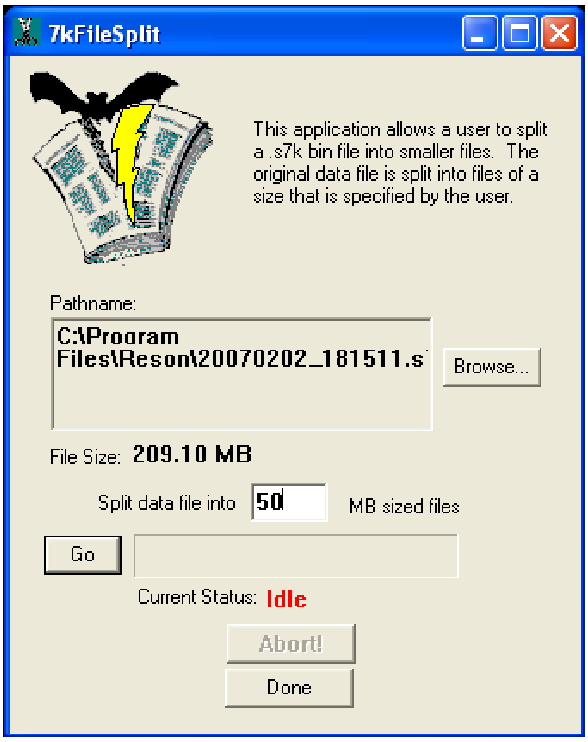


3. Select a file and click Open.



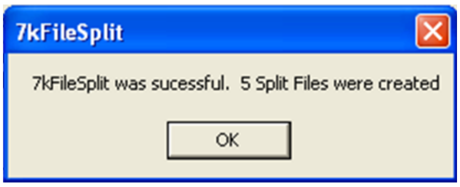
The 7kFileSplit utility window updates with the name and size of the selected file.

4. Enter a value in the field, Split data file into, and click the Go button.



The progress bar shows the status of the operation as new split files are created.

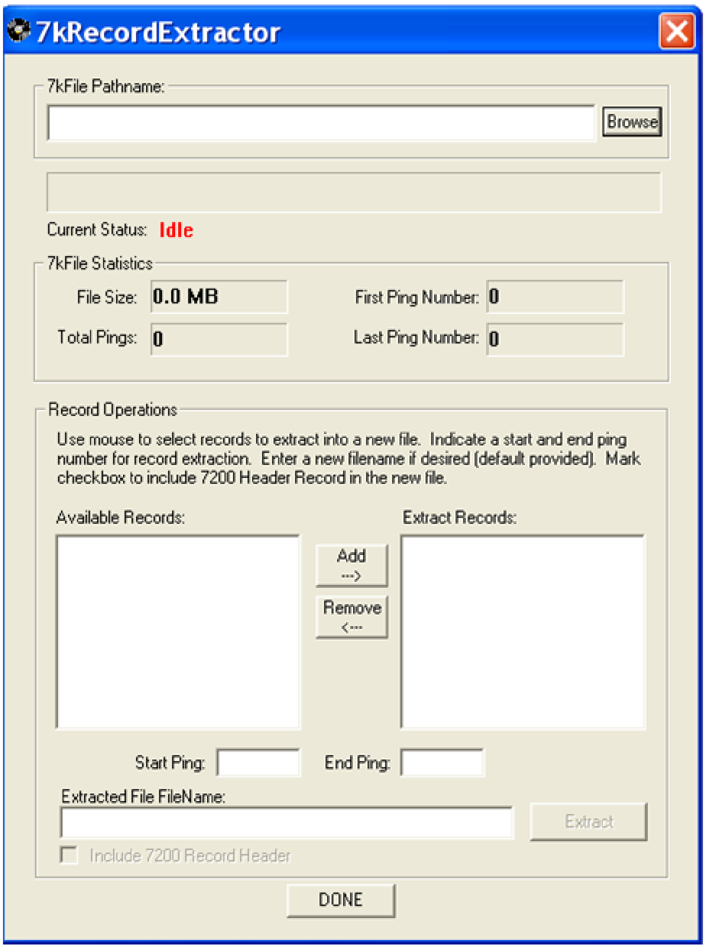
5. When complete, a message displays the number of split files generated. Click OK.



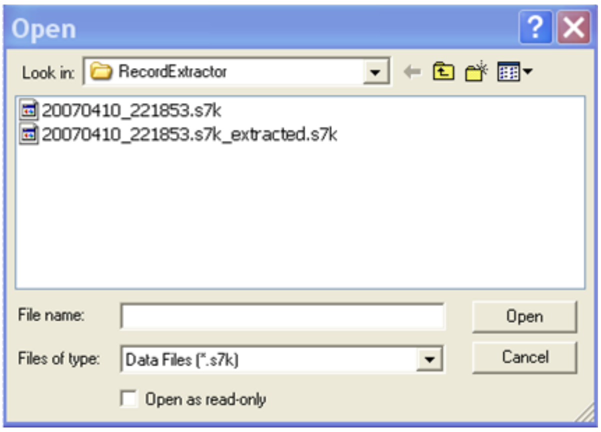
The new files are located in the same location as the original input file.

To use Record Extractor:

1. Click the Record Extractor button to launch the utility.
2. Click the Browse button to locate the desired file.

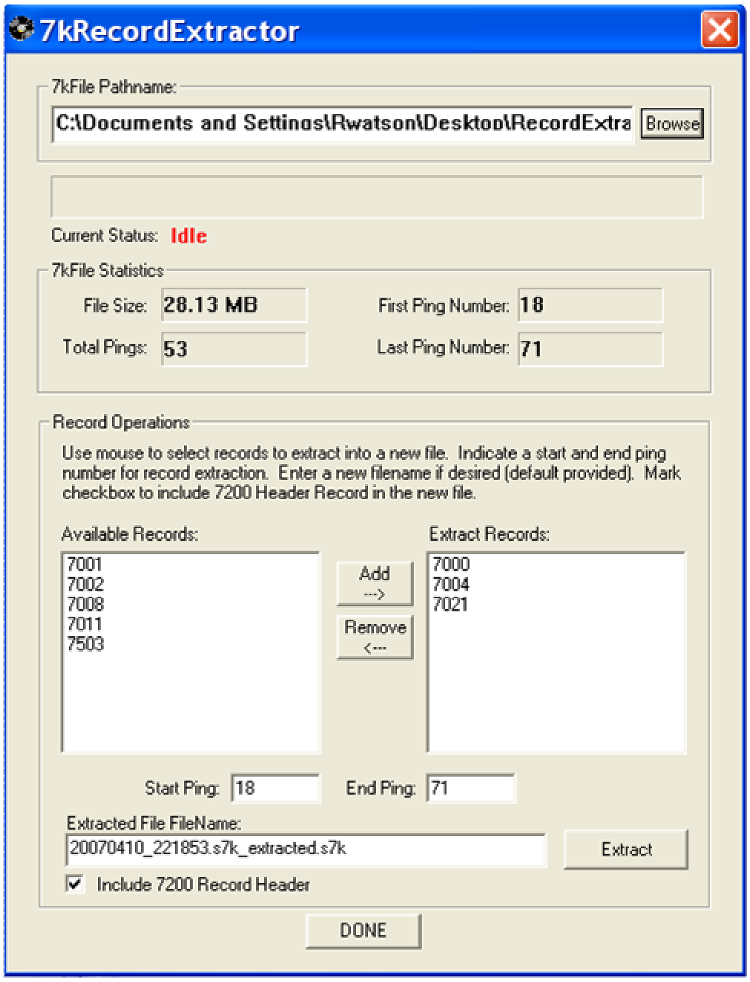


3. Select a file and click Open.



The 7kRecordExtractor utility window updates with the name of the selected file and available records.

4. Select a record from the Available Records list and click Add to move it to the Extract Records list. Repeat this for each desired record.



5. Click Extract to start the file extraction process.

   The “Extracted Record to new file” message briefly appears on the Current Status progress bar before returning to Idle status.

6. Click DONE.

   The extracted files are located in the same location as the original input file.

5.8.8.3 Playback Status

As the Playback progresses, the Playback Status section of the Data Playback tab will display information regarding the file being played.

- **Current Status:** Indicates the status of the system.
  - Playback: The system is playing a file.
  - Idle: Playback has stopped.
  - Loading: A file is loading.
  - Unknown: A playback file has not been selected.

- **Current File Size:** The size of the selected file.
- **Percent Complete:** The percent of the file that has played.
- **Current File Name:** The name of the selected file.
- **Current Directory:** The directory location of the selected file.

NOTE
Most communication with the sonar processor is disabled when in Playback mode. Alerts will continue to be received and displayed, however any alerts stored in the playback file will also be displayed. The time stamp on the alert will indicate whether it is a current or pre-recorded alert. In addition, recording and playback can be done simultaneously.

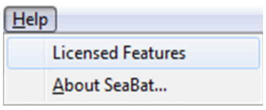
5.9 7k Center Console Window

The 7k Center runs in console mode only. The non-resizable black console window is active while controlling the sonar. On startup and shutdown progress information is posted to this window. All other sonar information is obtained from the status display in the UI. However, if there is a problem with the system, errors may be reported in the console window as well.

5.10 Help Menu

5.10.1 Licensed Features

An information window listing which features are enabled is available via the Help menu.



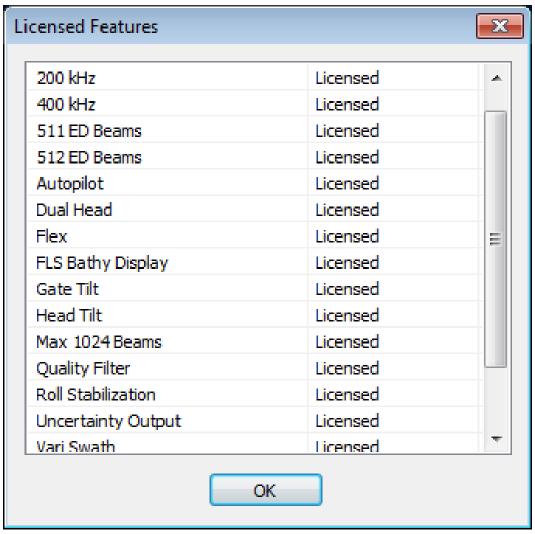


Figure 28: Licensed Features Information (Example Only)

5.10.2 Software Release Information

The software release information box available via the Help menu contains important information about your system that should be noted if you need to contact Teledyne RESON. In addition, please note all firmware versions from the BITE tabs.

- Version: SeaBat version number
- 7k Center: Version number and Beamformer ID
- Data Format Protocol

NOTE
The file SystemHealth_date_time.txt, which is generated in the exe folder, may conveniently be sent to Teledyne RESON. (See *section 5.5.2.1 above*.)

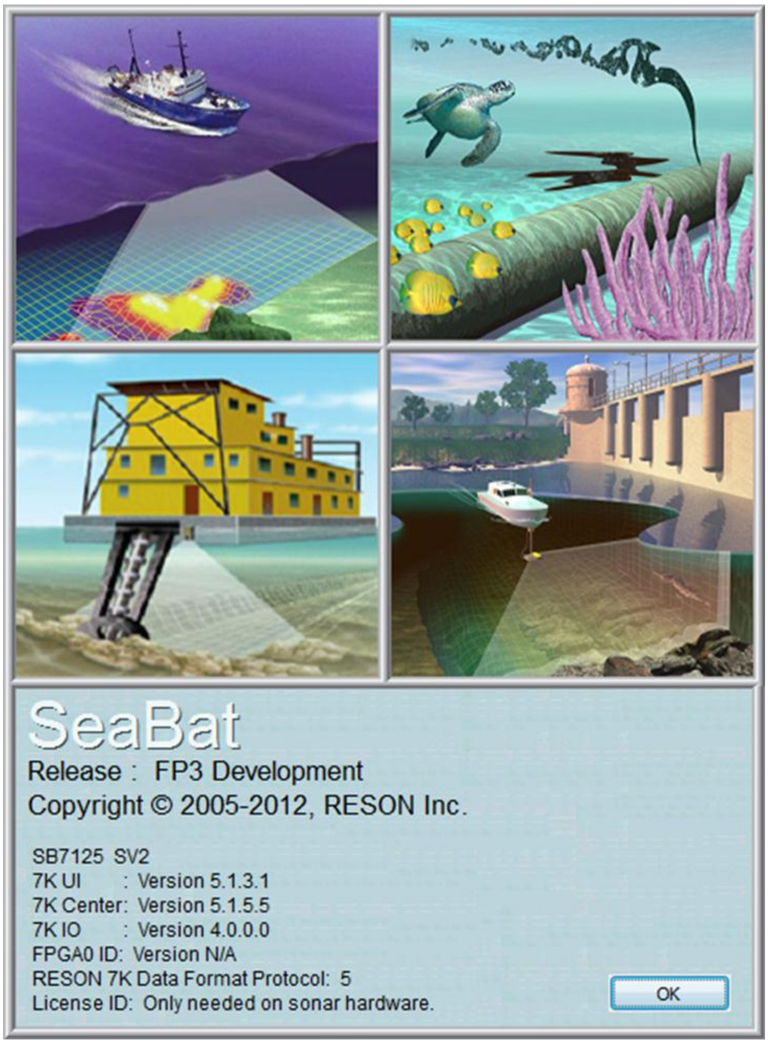


Figure 29: Software Release Information (Example Only)

6 ACTIVE SONAR USAGE

6.1 Chapter Overview

This chapter includes detailed instructions on the following subjects (click the emphasized hyperlink to be taken to the section):

- ***Enhancing the Sonar Image:*** Consists of examples on how to use the UI controls to enhance the sonar image.
- ***System Efficiency:*** Consists of examples on how to use the auto pilot and roll stabilization features.
- ***Use of Displays:*** Consists of descriptions on when to use the available displays.
- ***Compensation for Environmental Conditions:*** Consists of a thorough introduction into the environmental parameters that may affect sonar operation.
- ***Limitations:*** Consists of examples on the various physical limitations that may affect sonar operation.

NOTE
For information on starting, stopping, and setting up the SeaBat sonar system, see *section 3 System Startup and Shutdown*. For information on configuration of the system (including I/O module configuration, remote operation, and folder management), see *section 4 System Configuration with 7k User Interface*. For information on the user interface and operation of the system, see *section 5 System Operation.*

6.2 Enhancing the Sonar Image

6.2.1 Pulse Length and Image Resolution

For a given power setting, a narrower pulse length will provide a higher resolution at a shorter range. A wider pulse length will provide better range but a lower resolution image.

In certain conditions, for example in turbid waters, the narrower pulse length may not operate well. In such circumstances, the wider pulse length may give better short-range performance. This may also be achieved by changing from higher to lower frequency operation.

For instructions on how to adjust this setting, see *section 5.8.1.6 Set the Pulse Length*.

6.2.2 Transmit Power OFF

If the Power is set to OFF, the system will not ping, but it will continue to receive data provided that the max ping rate is not set to 0 (see also *section 5.8.1.4 Set the Maximum Ping Rate (Max Rate)*).

With the transmit power OFF, the sonar system will act as a passive sonar by only receiving data. This is a feature that is very useful for monitoring the ambient water in order to assess the level of background noise and interference from the vessel itself.

For instructions on how to adjust this setting, see *section 5.8.1.2 Set the Transmit Power (Power)*.

6.2.3 Lower Ping Rate

In some instances it may be beneficial to force a lower ping rate than the normal rate associated with a particular range.

Examples of this would be instances when the vessel is moving at a very slow rate, and the operator wants to reduce the quantity of data generated; or when the sonar is operating in a high-reverb environment where echoes of the previous ping are contaminating the current ping.

For instructions on how to adjust this setting, see *section 5.8.1.4 Set the Maximum Ping Rate (Max Rate)*.

6.2.4 Receiver Gain

The SeaBat system utilizes Time-Varied Gain (TVG) by applying a variable gain to the signal, based upon the formula in *Table 1*.

Table 1: TVG Formula

Receiver Gain = 2 α R_{km} + Sp log R_m + G
Where:
α = Absorption loss in dB/km
Sp = Spreading loss coefficient
R_{km} = Range in kilometers
R_m = Range in meters
G = Extra gain from RxGain menu item

For details on environmental conditions such as absorption and spreading, see section *6.5 below*.

For instructions on how to adjust this setting, see *section 5.8.1.5 Set the Gain*.

6.2.5 Vari-Swath

Vari-swath is a feature which allows the operator to select a swath width appropriate to the application in addition to electronically steering the selected swath.

Vari-swath is available with both EA and ED beam spacing and may be used in conjunction with roll stabilization and FlexMode[11]. It does not work in conjunction with Wide mode. (For details on the various beam modes, see *section 7.1 Beam Modes*.)

For instructions on how to adjust this setting, see *section 5.8.1.8 Set Vari-Swath*, or refer to the SeaBat UI User Manual (*see Appendix C Reference Documentation*).

6.2.5.1 Variable Swath

The benefits of the variable swath feature are twofold:

- Increased sounding density in a small sector may be used when tracking pipes or other linear features, where the operator is not interested in data outside a defined sector. The increased sounding density helps define small targets.
- A reduced swath width allows an increase in ping rate for any given depth.

[11] FlexMode is an optional add-on feature (see also *Table 13*).

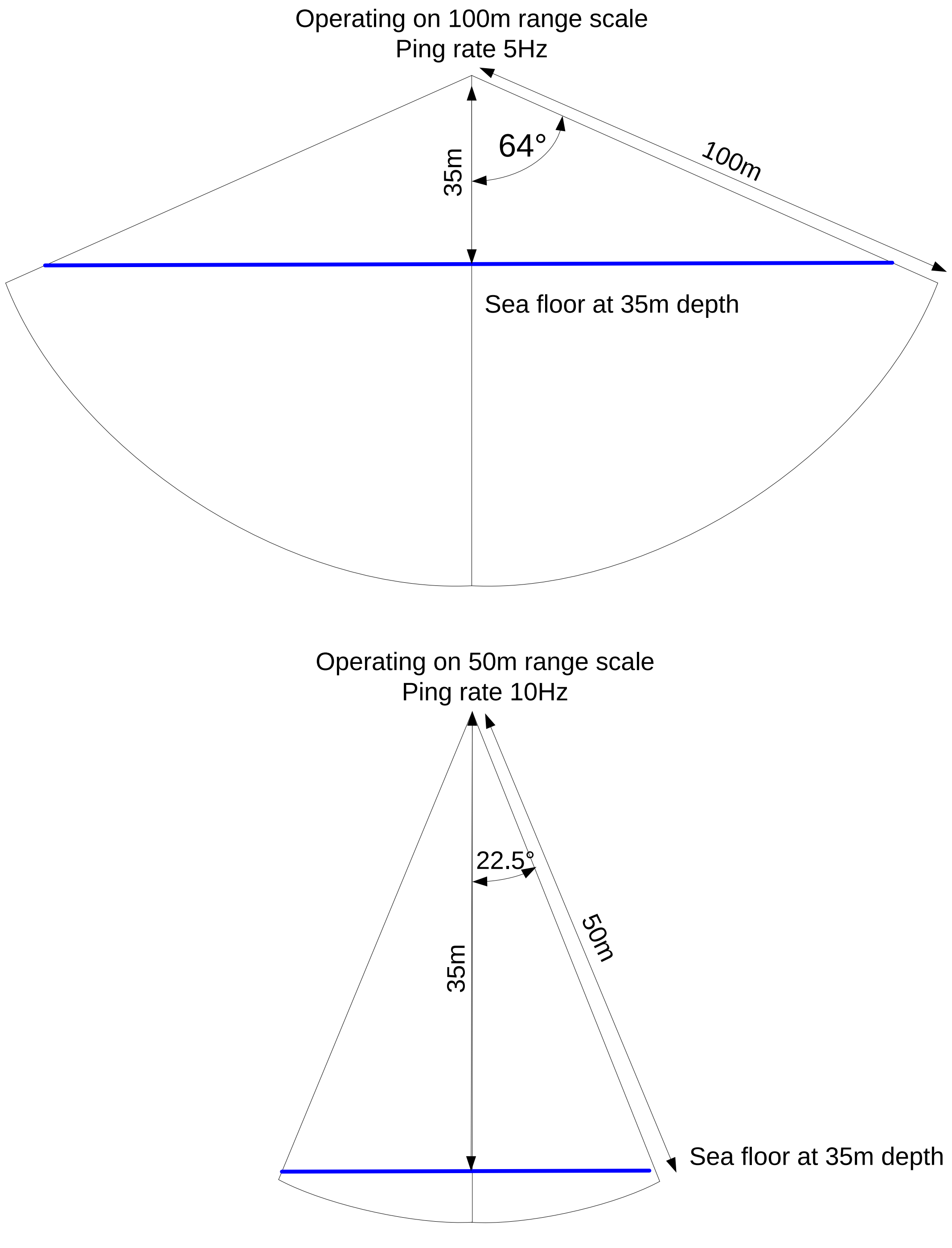
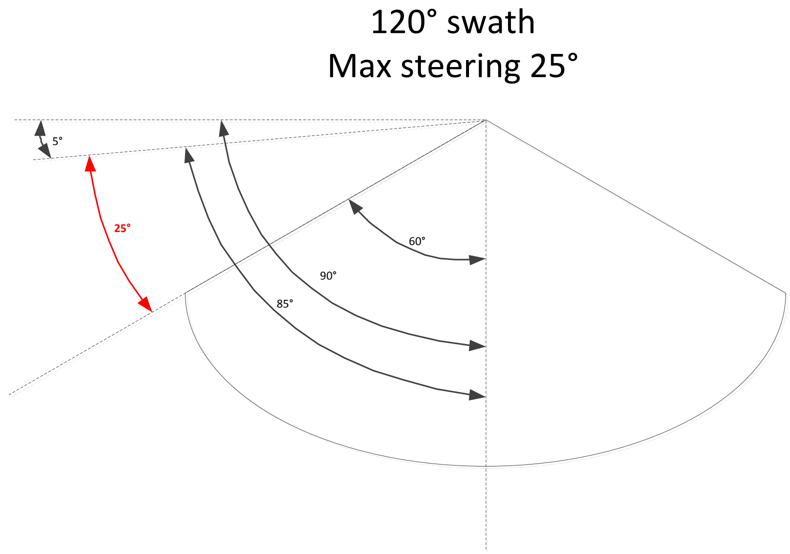


Figure 30: Example of Reduced Swath Width

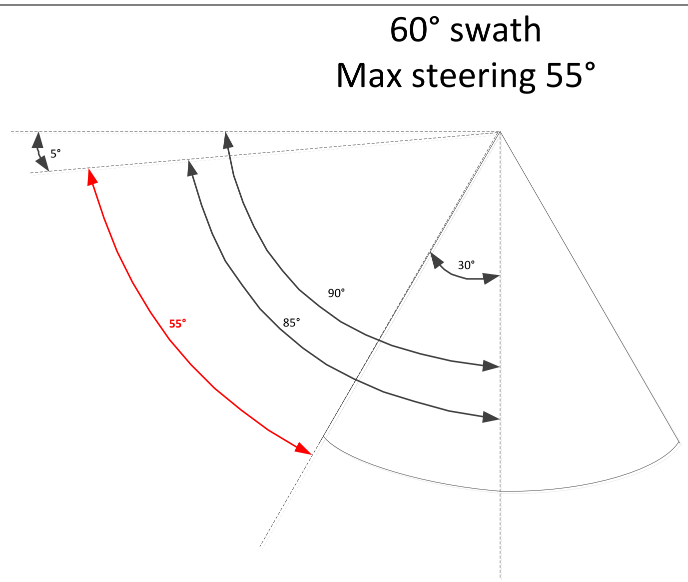
For instructions on how to adjust this setting, see *section 5.8.1.8 Set Vari-Swath*.

6.2.5.2 Horizontal Steering

This setting allows the operator to steer the swath independently of the sonar head physical angle. The extent of steering is determined by the angle selected. The limitation is that the outer beam cannot be steered past 5° from the horizontal (see *Figure 31*). When the swath is steered this way, the individual beam widths increase with the steering angle. A beam steered at 60° is twice the width of a beam steered at 0°.



With a swath of 120° the maximum steering angle is ±25° ((85°-(swath/2)).



With a swath of 60° the maximum steering angle is ±55° (85°-(swath/2)).

Figure 31: Horizontal Swath Steering

6.2.5.3 Minimum Grazing Angle

The minimum grazing angle is a limitation for the non-equiangular beam modes of the sonar. This limitation is especially noticeable for a sonar with a tilted head (see *section 6.3.4 below*).

With a tilted head for an equiangular beam mode (Minimum Beams or Wide), there is no minimum grazing angle and the outer beams can look 'upwards'. With a tilted head for the other beam modes the sonar is limited and <u>cannot</u> look 'upwards'.

For the beam mode Intermediate, the minimum grazing angle is 5°, and for Best Coverage and Flex, the angle is 15°. For these three beam modes the outer beam cannot go higher. *Figure 32* provides a graphic illustration of the minimum grazing angle.

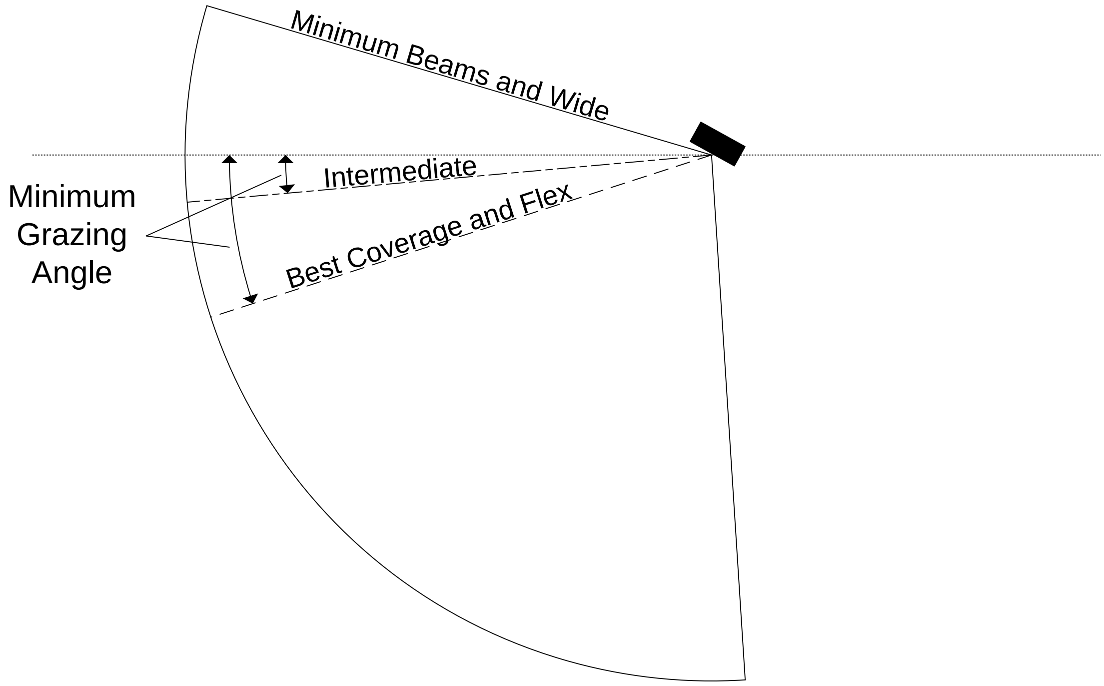


Figure 32: Outer Beams for the Different Beam Modes with a Tilted Sonar Head

NOTE
When you want to look up with a tilted sonar head you have to select an equiangular beam mode (Minimum Beams or Wide).

6.2.6 Correct Range Setting

Table 2: Incorrect Range Settings – Examples and Solutions

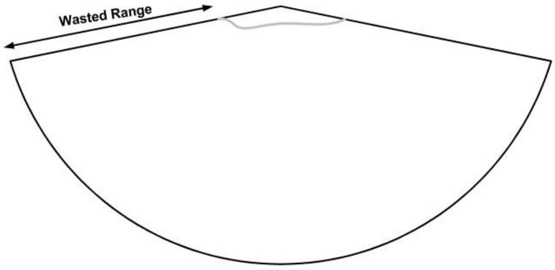


Figure 33: Range Setting – Too Long

With the range set too long, the receivers are "open" for too long and the system is recording long after the acoustic returns from the seabed have been received. Spurious background noise can be amplified, especially when TVG is used, and this can give noisier data. The ping rate is also reduced thereby reducing sounding density. This should not be used to artificially reduce the ping rate, rather the range should be set correctly, and the ping rate should be capped using Max Rate (see *section 5.8.1.4 Set the Maximum Ping Rate (Max Rate)*).

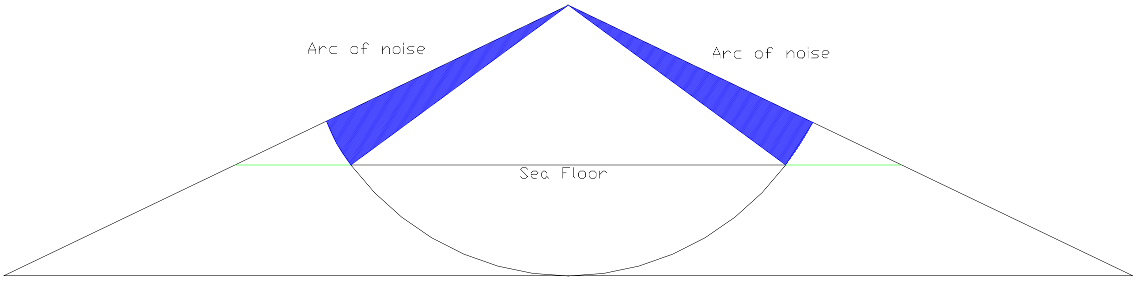


Figure 34: Range Setting – Too Short

With the range set too short, the outer beams formed are not long enough to reach the seabed. With no seabed in these beams the bottom detection process can only lock onto the noise in the water column. An exception to this is if the seafloor to the outer parts of the swath is of no interest and the user wishes to concentrate on a smaller seafloor coverage thereby increasing the ping rate and hence sounding density. In this case the user should r educe the swath coverage of the sonar (see *section 5.8.1.8 Set Vari-Swath*).

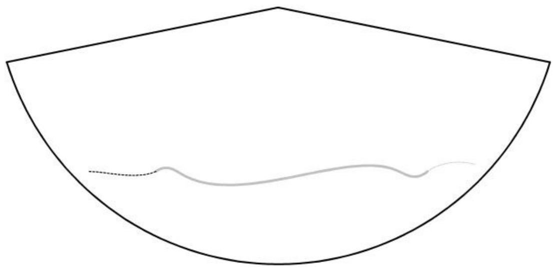


Figure 35: Range Setting – The Exception

If you are operating in relatively deep water to the limits of operation and the outer parts of the swath exceed the acoustic range of the sonar, the user should reduce the swath coverage (see *section 5.8.1.8 Set Vari-Swath*) to cover the seabed that is visible only. This will increase the ping rate and reduce noise picked up for these visible beams.

6.2.7 Minimum Beams, Intermediate, and Best Coverage Modes

Teledyne RESON offer three kinds of beam distribution in a Normal mode (the others being FlexMode and Wide, see *section 7.1 Beam Modes*) in the SeaBat range of multibeam echosounders: Minimum Beams, Intermediate, and Best Coverage.

With Minimum Beams the beam center-center angular spacing is constant across the swath and with Best Coverage the spacing is modified to maintain an equal horizontal distance between soundings on the seafloor assuming a flat bottom. It is recommended that Best Coverage be used for general survey applications where the requirement to achieve a specific number of sounding per cell in the across-track is critical, or where the seafloor is generally flat.

In areas of significant relief and in particular when surveying features such as wrecks and vertical structures such as harbor walls, Minimum Beams should be used in preference to Best Coverage. In extreme conditions, using Best Coverage over complex structures can cause magnified artifacts due to the large overlap between beams towards the edge of the sector.

In short, these are the pros and cons for the three modes, keeping in mind that in each case the negative effect is much more dramatic with a wide swath (see also *section 7.3 Best Coverage and Intermediate Modes*):

PRO	CON
• Minimum Beams (equiangular spacing):	
○ Low number of beams	○ Very wide spacing at large angles
• Best Coverage (equidistant spacing):	
○ Constant spacing even at large angles	○ Very large number of beams
• Intermediate (the better compromise):	
○ Moderate beam number	
○ Moderate spacing at large angles	

6.2.8 Use of Gates

6.2.8.1 Depth Gates

The depth gates, with no input from a motion sensor, will orient themselves parallel to the horizontal plane of the sonar head, as shown by the Min and Max Depth lines in *Figure 36*. In this series of illustrations, the bottom detect dots are shown as a horizontal line (Line A or B) with dashed lines representing depth gates above and below the bottom and no vessel roll present. Visualize the bottom as being in the 'layer' formed by the depth gates.

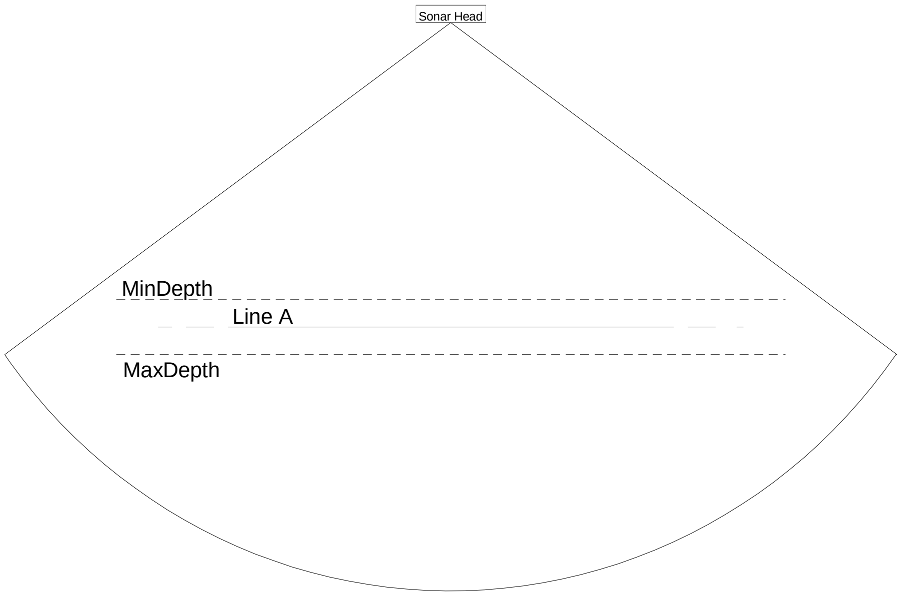


Figure 36: Depth Gates, With No Roll

Figure 37 shows the same bottom image with a small roll value to port. Notice that the ends of the swath have been cut off due to the action of the static depth gates (no motion sensor applied). In this figure, and all remaining figures in this discussion, the bottom is flat.

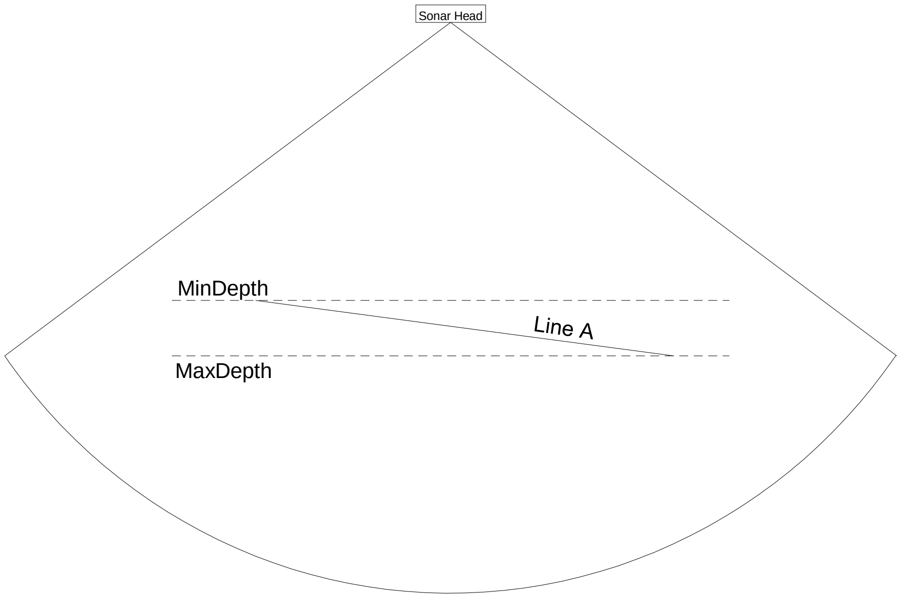


Figure 37: Depth Gates, With Roll

When controlled by a motion sensor, the depth gates will be parallel to the local horizontal plane of the earth even as the vessel rolls. *Figure 38* shows the same bottom image with dynamic depth gates applied.

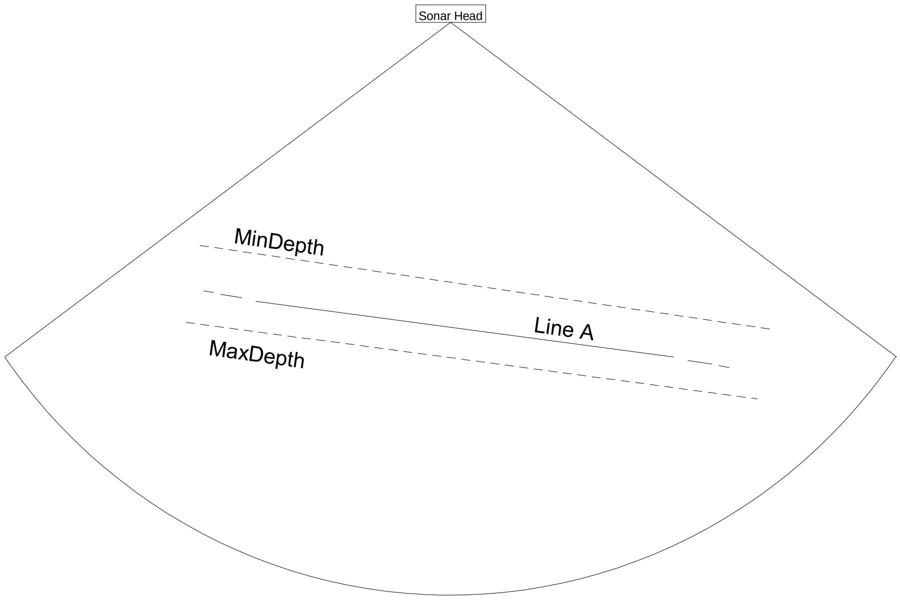


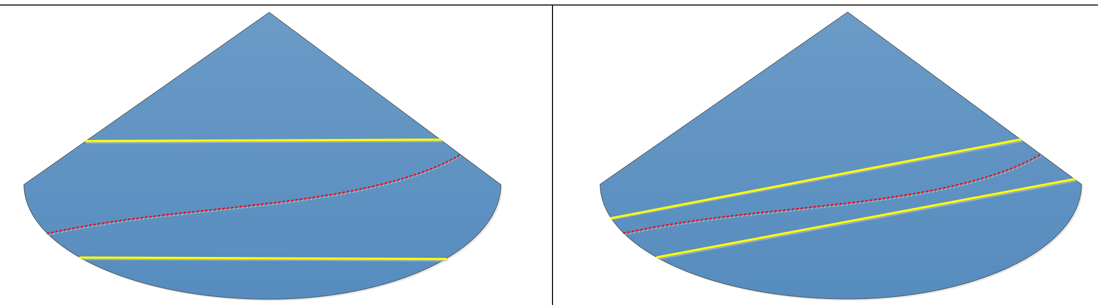
Figure 38: Depth Gates, With Roll and Motion Sensor Input

For instructions on how to adjust this setting, see *section 5.8.2 Detection Settings*.

6.2.8.2 Depth Gate Tilt

Depth Gate Tilt is a feature that allows the operator to manually specify a tilt value for absolute gates. Tilted depth gates are beneficial when it is desirable to concentrate bottom detect operation efforts, e.g. on a sloping seafloor (see *Figure 39*).

For instructions on how to adjust this setting, see *section 5.8.2 Detection Settings*, or refer to the SeaBat UI User Manual (*see Appendix C Reference Documentation*).



Manual gates with 0° tilt on a sloping seafloor | Manual gates with -15° tilt on a sloping seafloor

Figure 39: Depth Gate Tilt

6.3 System Efficiency

6.3.1 Tracker

“Tracker” is a fully automated mode of operation. Sonar control parameters, including range, gain, power, and swath width are set by the system on the basis of the quality of data being collected. Once Tracker has been selected, no further operator input is required.

As there is a slight delay while tracker is being activated or deactivated, enabling/disabling the feature should not be done in the middle of the survey line.

For instructions, see *section 5.4.10 Enable/Disable Tracker*, or refer to the SeaBat UI User Manual (*see Appendix C Reference Documentation*).

For an alternative and limited automated mode of operation, see *section 6.3.2 below*.

6.3.2 Legacy Auto Pilot

The Legacy Auto Pilot is a semi-automated mode of operation. Sonar parameters such as power, gain, pulse length, and maximum ping rate are adjusted by the system according to a user-editable table. This is made up of rows corresponding to each range setting of the sonar. Depending on the automatically selected range, the corresponding parameters from the table will be copied to the sonar settings. This way, critical sonar settings as well as range are all automatically adjusted when in Auto Pilot mode.

Once Auto Pilot mode is initiated, the 7k Center analyzes bottom detection data from a series of pings. If a certain amount of those pings are judged to have good bottom detection quality, the average bottom depth and maximum usable swath angle are determined. Then an appropriate range setting is determined and commanded to the sonar.

The process then repeats for the next series of pings. If too few of the analyzed pings are judged to be good (for example, if the water depth exceeds the current range), the Auto Pilot will command the next greater range setting to the sonar before analyzing the next series of pings. This way Auto Pilot mode can be reset to the minimum range and it will incrementally try greater ranges until the bottom is found.

For instructions, see *section 5.4.11 Enable/Disable AutoPilot*.

NOTE
The user always has full control of what the Auto Pilot settings will be.

6.3.2.1 Auto Pilot Routine

The following routine is suggested for populating the Auto Pilot table in cases when the default values are not optimal:

1. In the Auto Pilot settings dialog select the Easy-fill ON check box and click OK.

   When the Easy-fill ON check box is selected, the Settings -> Auto Pilot button on the Primary Display will be enabled.

2. Continue operating in Manual mode and click the Settings -> Auto Pilot button to transfer the current sonar settings to the row in the Auto Pilot table that corresponds to the current range setting.

   This procedure allows the operator to quickly and easily build an Auto Pilot table while running the sonar over the range of water depths the table needs to cover.

3. Once the desired number of range scale values is populated, open the Auto Pilot Settings dialog and save the settings to a file.

For further instructions, see *section 4.2.9 Legacy Auto Pilot Settings*.

6.3.2.2 Auto Pilot Sensitivity

In general, the greater the sensitivity setting is, the greater the range. While this lowers the risk of losing part of the swath due to range, it also lowers the maximum ping rate.

- Lower sensitivity settings would be appropriate for roll-stabilized systems or very calm conditions without roll stabilization.
- Higher sensitivity settings (>20%) would be safer for non-roll-stabilized systems and/or highly featured bottoms.

6.3.2.3 Auto Pilot Limitations

The Auto Pilot functionality is difficult to optimize for all imaginable conditions and it should be expected that occasionally, the functionality will fail when subjected to marginal conditions. Occurrences such as rapidly changing seafloor topography, poor signal-to-noise ratio (possibly when operating at extreme ranges) and environmental conditions such as flow noise, bubbles around the array, and bio activity could all cause intermittent failure of Auto Pilot. See also *section 6.6 below.*

6.3.3 Roll Stabilization

Roll stabilization is an important feature related directly to system efficiency which allows the swath width on the seafloor to be maximized, thus increasing line spacing and reducing vessel time.

Under zero roll conditions, the swath is vertical and the center of the swath is directly below the vessel.

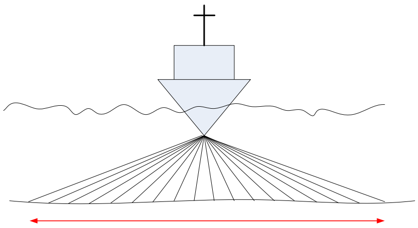


Figure 40: Swath under Zero Roll Conditions

When the vessel rolls the swath is rotated and the projected swath on the seafloor is laterally displaced.

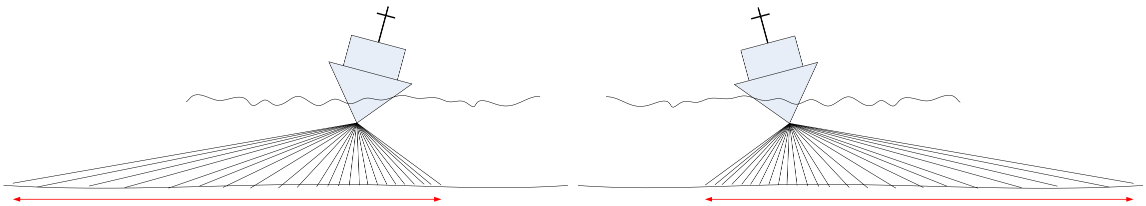
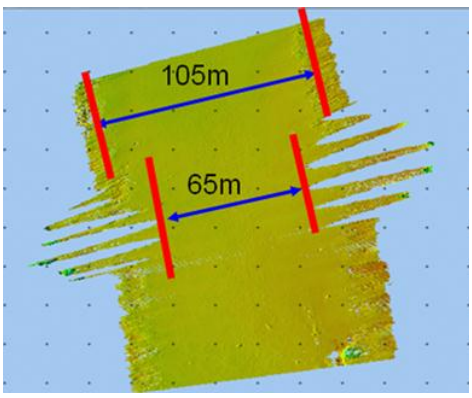


Figure 41: Laterally Displaced Swaths under Roll Conditions

This has the effect of reducing the usable swath width due to the distortions on the edge.



With the input from a motion sensor (and roll stabilization enabled) to steer each receive beam dynamically for every sample, the swath stays vertical irrespective of vessel motion thereby maximizing swath.

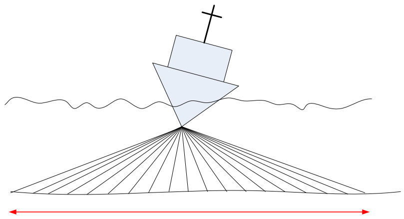


Figure 42: Swath under Roll Stabilization

It is recommended that the motion sensor data update rate is at least 50Hz and preferably 100Hz. Baud rate and protocol details may be set in the Configure Motion Sensor dialog (see *section 4.2.6 Motion*), but it should be ensured that the baud rate is sufficient to allow the desired update rate.

Monitor motion data and roll history on the Motion tab (see *section 5.6 Motion Tab*).

6.3.4 Head Tilt

In certain applications it is desirable to physically rotate the sonar head. Instances of this are pipeline surveys where a dual head normally mounted on an ROV are inclined inwards to maximize the number of hits on a pipe. Another application is survey of harbor walls where the desire is to survey as close to the waterline as possible.

For instructions on head tilt configuration, see *section 4.2.3 Hardware Configuration*.

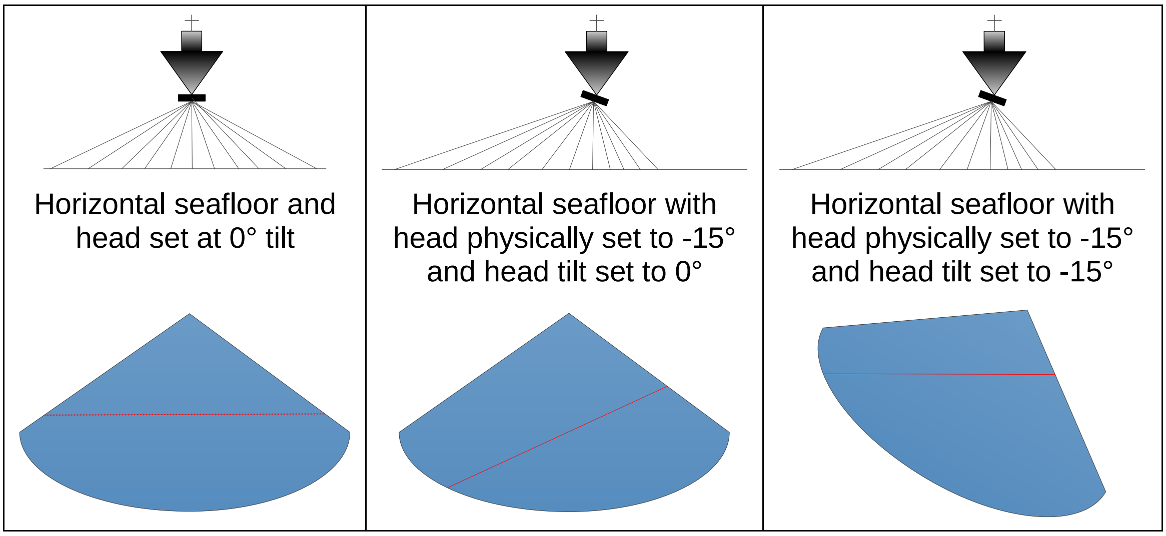


Figure 43: Head Tilt Functionality

6.3.4.1 Harbor Inspection (Quaysides, Breakwaters)

In this application a single head is typically tilted up to 30° (max. setting is +/-45°) from normal to register soundings as close to the waterline as possible.

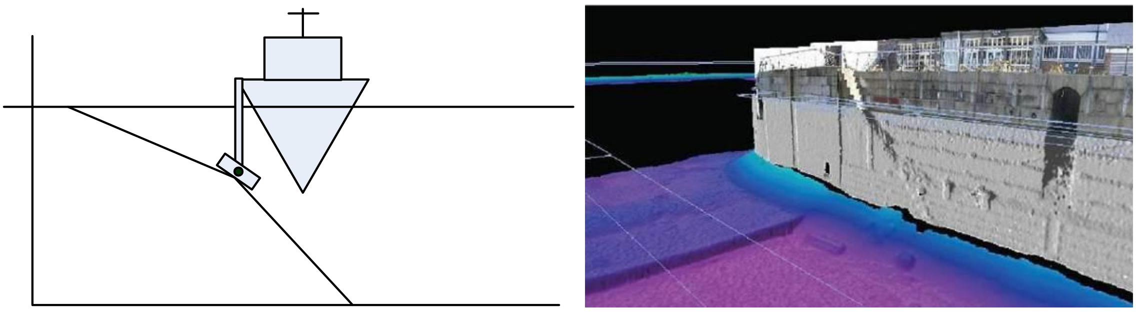


Figure 44: Head Tilt for Harbor Inspection

6.4 Use of Displays

6.4.1 Wedge versus B-Scan Display

The sonar wedge is the default view of the SeaBat sonar system. Change to B-scan view when operating long distance. For further details on wedge and B-scan displays, see *section 5.4 Primary Display Tab*.

6.4.2 A-Scan, Phase and Magnitude Displays

With the A-scan displays it is possible to analyze the signal in a single beam (or group of beams) to determine whether the target detection point is trustworthy.

The magnitude display is suitable to use for analysis of the middle beams and the phase display is suitable to use for analysis of the outer beams of the swath. Signal Operator Mode must be selected to make the phase display available (see *section 4.2.1 Data Display & Format*).

For instructions on how to switch between the available A-scan displays, see *section 5.4.2.1 Available Displays*.

6.4.3 Mouse-Controllable Swath Width, Steering, and FlexMode Sector

By dragging the mouse the operator may adjust the following:

- Total swath width
- Overall swath steering
- High-resolution sector width
- High-resolution sector steering

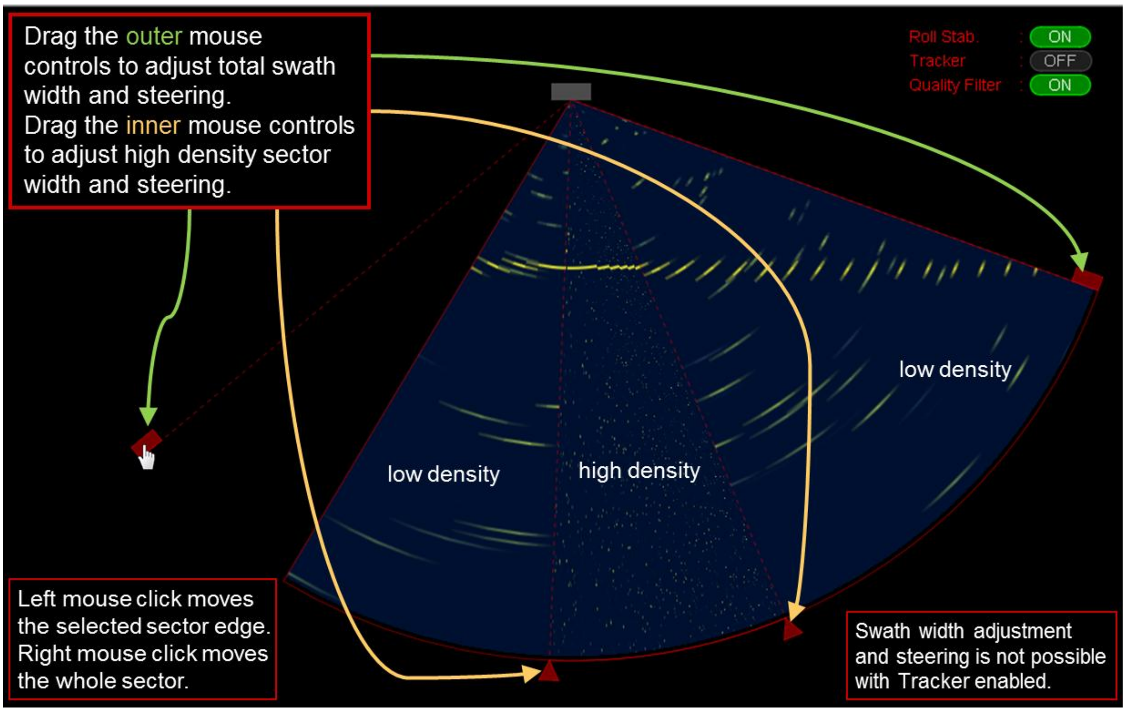


Figure 45: Mouse Controls for Swath and FlexMode Sector Widths, and Steering

6.5 Compensation for Environmental Conditions

As sound propagates through the underwater environment, the energy is absorbed by the liquid caused by molecular interactions that convert acoustic energy into heat. A propagating sound field also spreads geometrically, which means that the sound pressure decreases with increasing distance from the sonar. Other mechanisms such as bubbles, plankton, tidal currents, currents from rivers etc. may influence sound propagation, but these mechanisms are difficult to measure and model, as they vary with time and only appear in a limited number of areas. However, as absorption and geometrical spreading exist everywhere in the underwater environment, they are considered to be the most important loss mechanisms.

In the SeaBat system it is possible to compensate for loss caused by absorption and geometrical spreading. In addition, the SeaBat system allows for changes in the speed of sound, a parameter which is important in the beamforming process.

For instructions on how to adjust these settings, see *section 5.8.3 Ocean Settings*.

6.5.1 Loss of Sound by Absorption

The amount of loss of sound through absorption in water depends on the water conditions and the sound frequency. As sound moves through the water, the water absorbs it by converting some of the acoustic energy to heat. The absorption loss is proportional with the salinity of the water and the sound frequency: the higher the salinity or frequency, the greater the loss (see *Figure 46*). The figure also shows that an increased temperature will increase the absorption loss.

The absorption loss value is part of the formula that the SeaBat system uses to calculate the amount of gain to apply to the sonar return signal (see *section 6.2.4 above*).

If the exact absorption loss value is not known, a value of 110dB/km for salt water and 70dB/km for fresh water is recommended for 400kHz operation, and a value of 50dB/km for salt water and 20dB/km for fresh water is recommended for 200kHz operation. For instructions on how to adjust this setting, see *section 5.8.3.1 Change the Absorption Loss Value (Absorption)*.

Figure 46 provides a general reference for acoustic absorption at different frequencies and salinity in three different temperature environments.

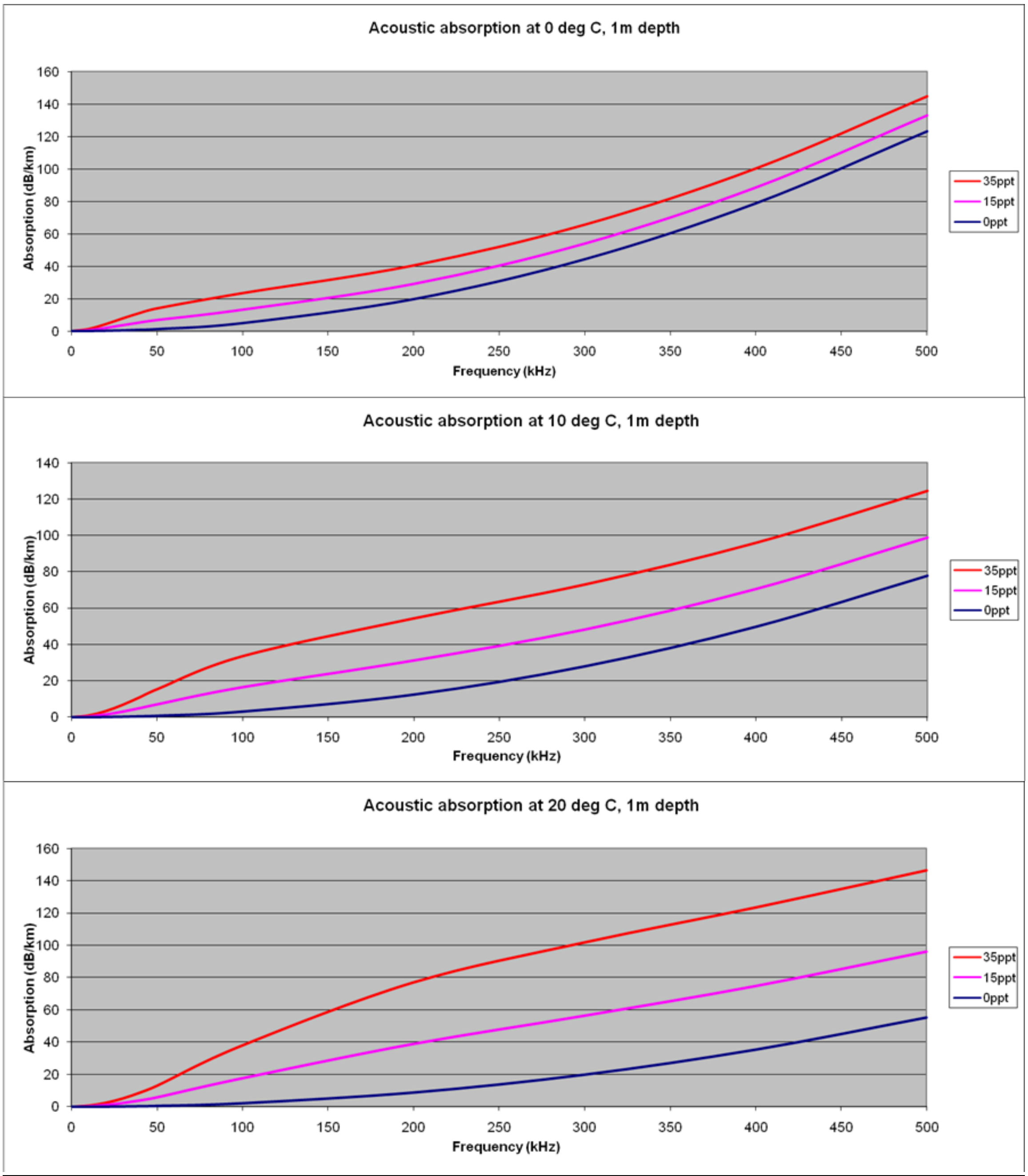


Figure 46: Acoustic Absorption Reference

6.5.2 Loss of Sound by Spreading

Spreading of sound through water may be the greatest contributor to the loss of sound. As sound moves away from its source in all directions, the acoustic pressures will decrease with range.

In deep water, where the acoustic propagation is not bounded by the sea surface or the seafloor, the spreading loss is spherical. In this case the pressure decrease is proportional to 1 divided by the range R from the sonar to a given object or surface.

Thus, the acoustic pressure decays as 1/R. As the sound is scattered back to the sonar the backscattered field also decreases as 1/R. Consequently, for a two-travel path the acoustic pressure in a free field decays as $1/R^2$.

In shallow waters, on the other hand, the sound propagation is bounded by the sea surface and the seafloor, and the spreading loss is cylindrical. In cylindrical spreading the sound pressure only decreases as $1/R^{½}$, and the two-way travel path decays as 1/R.

In practical situations the transmission loss will lie between 20 and 40dB; in other words, the spreading loss will neither be perfectly spherical nor perfectly cylindrical. Finally, if the sonar operates very close to the seabed or very close to objects in general, near-field effects may yield a transmission loss less than 20dB.

The spreading loss value is part of the formula that the SeaBat system uses to calculate the amount of gain to apply to the sonar return signal (see *section 6.2.4 above*). If the exact spreading loss value is not known, an initial value of 30dB is recommended.

For instructions on how to adjust this setting, see *section 5.8.3.2 Change the Spreading Loss Coefficient (Spreading)*.

6.5.3 Sound Velocity

Sound velocity varies with pressure, temperature, and salinity. An increase in these three levels increases the sound velocity. The sonar data presented in the SeaBat system is dependent on the sound velocity profile provided.

If the local sound velocity is not known, Teledyne RESON recommends a value of 1480 to 1500m/s for open sea areas and 1425m/s for fresh water. *Figure 47* provides a general reference for typical surface sound velocity at different temperatures and salinity.

For instructions on how to adjust this setting, see *section 5.8.3.3 Set the Sound Velocity*.

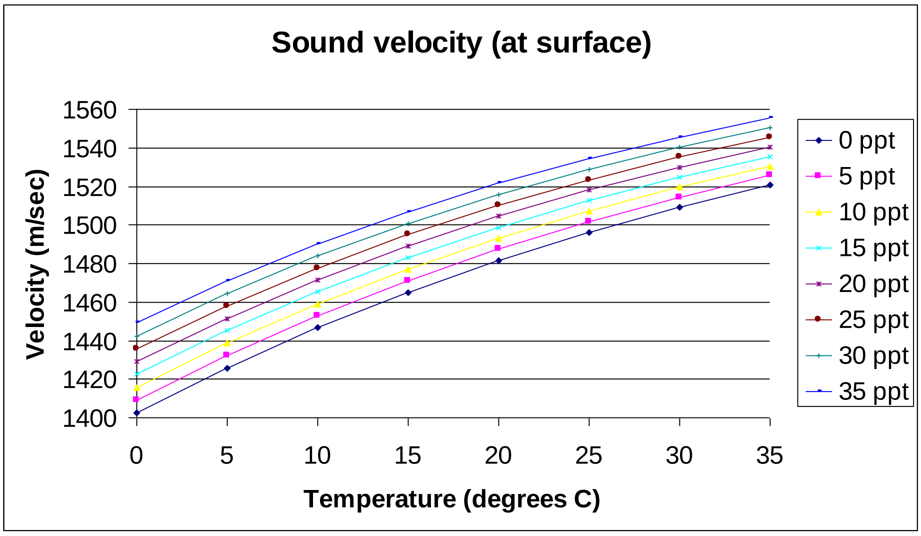


Figure 47: Typical Sound Velocity Values

6.6 Limitations

Physical limitations in the functionality of the system have to be taken into consideration when operating sonar systems, including SeaBat systems. Some of the limitations are absolutes; others can to some degree be overcome.

The following subsections provide examples of different kinds of limitations.

6.6.1 Cavitation

Some reduction in the transmitted source level is expected to be caused by cavitation. For means of compensating for this, see subsections in *6.2 above*.

6.6.1.1 Propeller Cavitation

Propeller cavitation can be a significant concern for two reasons. First, the frequency of propeller cavitation noise is in the operating frequency band of most sonar equipment. Second, the source levels of the propellers installed are expected to be high unless special quieting techniques have been implemented.

Propeller energy typically propagates to the forward area sonar systems via a direct or hull-grazing path. The other arrival path of propeller energy is by the bottom bounce path. This path will be more significant in shallow water depths (less than 500 meters). The potential impact can be further quantified for particular bottom depths of proposed operational test sites.

6.6.1.2 Appendage Cavitation

Appendage cavitation can result from rough or unfaired edges on the hull and can even be present at lower speeds. If the source is located near the sonar installation area, it can be a significant noise deficiency. It is difficult to predict the occurrence of appendage cavitation without under-hull drawings, pictures, or visual inspection of the ship when in dry-dock.

6.6.2 Machinery Noise

Machinery noise should not be a major factor for sonars that operate at frequencies above 5kHz. Mechanical machinery noise is usually prevalent at 2kHz and below, though it is occasionally detected at higher frequencies when fluid flow through pipes or cavitating pumps are involved.

Typically, the most important consideration for machinery noise is the proximity of the acoustic sensor to the machinery source. There has been one observed case where diesel engine piston frequency harmonics have been the controlling noise source at 12kHz, but in this situation, the engine room and the sonar compartment shared a common bulkhead. Normally, acoustic devices are sufficiently distanced from major machinery noise sources that machinery noise does not interfere.

A concern remains that there may be some auxiliary machinery (or other unusual equipment) located near the sonar that could produce noise interference. An inspection of the installation site and ship drawings to verify the position and proximity of all shipboard equipment should be conducted to determine if there is a potential for machinery interference prior to conducting at-sea testing. For means of compensating for this, see subsections in *6.2 above*.

6.6.3 Interference from Other Sonar Systems

Interference from other sonar systems can be seen as radial lines, typically moving away the minimum to maximum range scale as these pings are not correlated with the ping repetition rate of the SeaBat system. The most typical source of interference of this type is navigational sonars (often 50kHz systems) and Doppler velocity logs.

Synchronization of acoustic systems is one means to mitigate this effect. The most effective approach is to remove the source of interference entirely, either by moving the equipment away from the SeaBat or turning it off.

6.6.4 Speed

Hydrodynamic flow noise can be a concern when operating at higher speeds. Externally mounted acoustic sensors should have fairings that are as flush (or near-flush) mounted to the ship hull as is practically possible. This way the hydrodynamic flow-induced vibration noise should be minimal. For means of compensating for this, see subsections in *6.2 above*.

NOTE
A poorly designed sonar fairing can degrade the system performance by a factor of 4 for speeds above 8-10 knots. Typically, this noise source is the most common problem on all sonar installations.

6.6.5 Air Bubbles

Bubble sweep-down can be another potential noise problem. The significance of this problem is associated with the noise generated as the bubbles cascade along the hull after being ingested in the bow wave of the ship and, more importantly, with the baffling produced by the entrained air layer between the face of the sonar sensor and the water environment.

If air bubbles are present between the sonar and the water, the system will not function properly. This phenomenon is transient in nature occurring only for a few seconds per wave period. It is typically most prevalent on shallow draft ships and increases in intensity at higher sea states and ship speeds.

Modeling of this problem only indicates that air bubble noise may be present by determining the transmission vehicle of potential bubbles. Actual at-sea measurements are usually required to fully determine the presence and severity of bubble sweep-down. At-sea diver viewing has been very successful in the past to capture the bubble sweep-down characteristics of a particular ship hull on film.

Air bubbles mask some or all of the view of the sonar where the affected area will completely blank out. Common causes for bubble masking include:

- The vessel props when thrusting into reverse and pours a stream of bubbles over the sonar.
- The sonar has not been deployed deeply enough and there is bubble wash from the sea surface.
- Bubble ingestion as the vessel pitches into the sea.

6.6.6 Environment

A high-reverb environment where echoes of the previous ping are contaminating the current ping may prove to be difficult. For means of compensating for this, see *section 6.2.3 above*.

7 SYSTEM PERFORMANCE AND DATA TYPES

NOTE
There are several factors that can have a significant effect on acoustic performance. For this reason, product performance estimates are indicative of standardized conditions for temperature, salinity, bottom type or target strength, sound velocity, installation type, and assume no affect from adverse environmental conditions such as wind, precipitation, sea state, ambient or traffic noise, refraction, temporal changes or other surface effects. (Read also *section 6 Active Sonar Usage.)* To determine actual in-situ performance predictions requires a site or vessel survey and environmental measurements with performance modeling based on the resulting measurements. Costs for this survey may be quoted as part of a contract or independently.

The SeaBat 7125 AUV sonar system produces three types of data, bathymetry, side-scan, and snippets, suitable for the generation of high-resolution hydrographic charts that exceed international standards.

A single transmission from the projector unit illuminates the entire swath on the seafloor. The seabed return signal is received by the receiver unit, digitized, and transmitted to the ICPU, where it is formatted for data and display output. Sonar data is stored locally or displayed remotely via the Ethernet connection or through TCP/IP connection (see *section 4.5 Remote Operation*).

A Windows®-based user interface controls the system, allowing the operator to select system configuration, data output, and storage options. This also provides built-in test environment (BITE) displays to assist the operator.

NOTE
For information on the data records, refer to the Data Format Definition document (see *appendix C.1 SeaBat 7125 AUV Documentation*).

NOTE
For information on externally controllable sonar operating parameters, refer to the Data Format Definition document (see *appendix C.1 SeaBat 7125 AUV Documentation*).

Table 3: SeaBat 7125 AUV Technical Specifications

Parameters	400kHz	200kHz
Sonar operating frequency	400kHz	200kHz
Across-track beam width (nominal values[12])	Transmit: >145° Receive: 0.54° ±0.03° (center)	Transmit: >142° Receive: 1.1 ±0.05° (center)
Along-track beam width (nominal values[12])	Transmit: 1.0° ±0.2° Receive: 31° ±3.5°	Transmit: 2.2° ±0.5° Receive: 28.5° ±3.8°
Across-track beams	240, 512, or 511	140, 320, 512, or 321
Swath coverage	140° or 165°	140° or 165°
Depth, typical[13]	0.5-150 meters	0.5-400 meters
Depth, max.[14]	175 meters	450 meters
Ping rate (range dependent)	Up to 50 pings/s	Up to 50 pings/s
Pulse length	33-300µs (CW) 300µs-10ms (FM)	33-300µs (CW)
Range resolution	6mm	6mm
Depth rating	6000m	

7.1 Beam Modes

Beam mode selection is made on the fly via the sonar user interface. For instructions, see *section 5.8.1.3 Set the Beam Mode*, or refer to the SeaBat UI User Manual (*see Appendix C Reference Documentation*).

- **Normal mode:** In this mode the operator is presented with a standard wedge of 140° and GUI controls. Selection may be made between Minimum Beams, Intermediate, and Best Coverage.

200kHz

- Minimum Beams: 140 EA
- Intermediate: 320 ID
- Best Coverage: 320 ED

400kHz

- Minimum Beams: 240 EA
- Intermediate: 512 ID
- Best Coverage: 512 ED

[12] All beam widths measured at -3dB, unsteered with a sound velocity of 1480m/s.
[13] This is a depth range within which the system is normally operated, from the minimum depth to a depth value corresponding to the max. swath -50%.
[14] This is a single value corresponding to the depth at which the swath is reduced to 10% of its max. value.

- **Wide mode:** In this mode the system is started with a 165° wedge.

200kHz		**400kHz**	
○ Wide:	512 EA	○ Wide:	512 EA

- **FlexMode:** In this mode the system is started with a 140° wedge and an alternative beam distribution is used which concentrates the majority of beams into a central sector.

200kHz		**400kHz**	
○ Flex:	321	○ Flex:	511

7.1.1 Minimum Beams

Minimum Beams is intended to provide full swath coverage using the minimum number of beams required to fill the selected sector using the natural beam width and spacing. Spacing between the beams is equiangular.

7.1.2 Intermediate

Intermediate mode is designed for general purpose survey operations and provides high-density soundings over the entire swath.

7.1.3 Best Coverage

Best Coverage provides equally spaced soundings across the entire swath and should be used when it is critical to maintain a certain number of hits per cell across the maximum possible swath.

7.1.4 FlexMode[15]

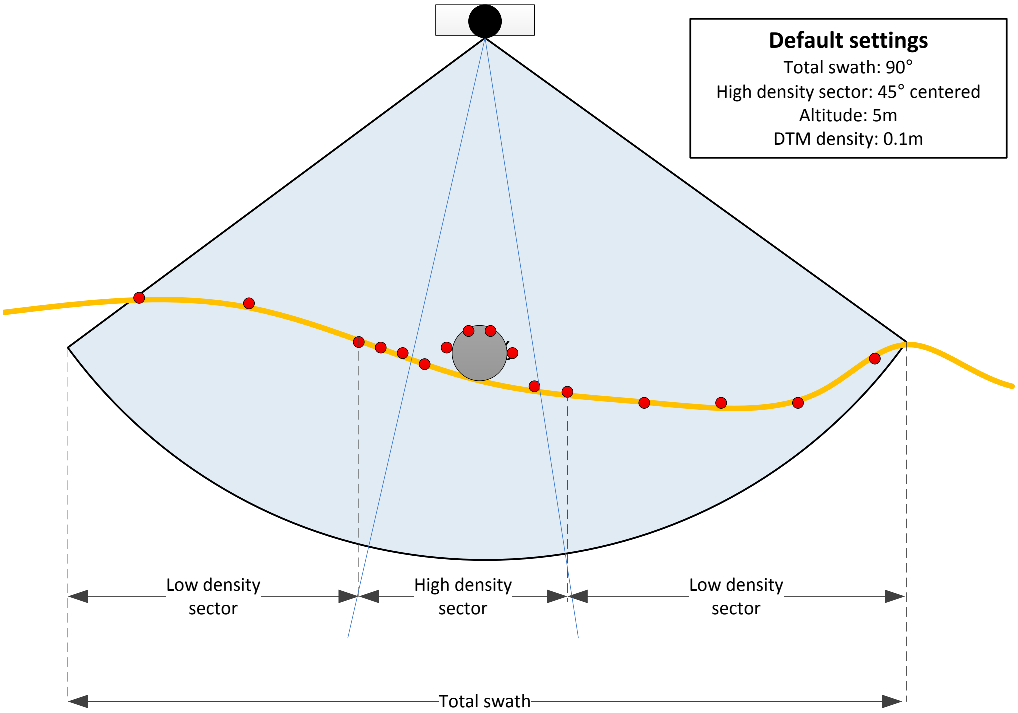


Figure 48: Graphic Illustration of FlexMode

FlexMode provides a combination of a high density of beams on and around the object location and a reduced density of soundings for the rest of the swath. The low density spacing is defined by the operator and the high density spacing is computed by optimization based on survey parameters.

For instructions on how to adjust this setting, see *section 5.8.1.3 Set the Beam Mode*, or refer to the SeaBat UI User Manual (*see Appendix C Reference Documentation*).

7.2 Data Types

7.2.1 Bathymetry Data

At 400kHz, the SeaBat 7125 generates 240 or 512 soundings per ping. At 200kHz, the system generates 140, 320, or 512 soundings per ping.

The system broadcasts from the processor to the data acquisition software, where they are corrected for mechanical offsets, motion, heading, refraction, tide or depth, and position. To perform these corrections, the appropriate sensors must be interfaced to the data acquisition software (see *section 4.4 I/O Module Configuration*).

Depending on the beam angle, bottom type, and signal characteristics, the bottom detection method employed may be magnitude center-of-energy, phase slope zero-

[15] FlexMode is an optional add-on feature (see *Table 13*).

crossing, or a blend of the two methods. The bottom detection method can vary from ping to ping and beam to beam.

7.2.2 Side-Scan Data

Side-scan swath is measured and displayed without degrading any of the traditional survey capabilities of the SeaBat.

7.2.2.1 Side-Scan Imagery Data

Side-scan forms an image of the seafloor which can be used to locate and identify features and bottom conditions. Each sonar ping is used to generate a line of data. Each line contains a series of amplitudes representing the signal return versus time or range. When a series of these lines is combined and displayed as the vessel moves along the track, a two-dimensional image is formed, providing a detailed picture of the bottom along either side of the vessel.

The side-scan data can be viewed on a waterfall display representing the results of a peak-detect search through the left and right beams of the swath.

NOTE
Side-scan cannot be used to accurately measure true depths, but it can provide a more detailed picture of the seafloor. This image can be used together with bathymetry to identify features and to help ensure that the survey does not miss any small but significant targets.

7.2.2.2 Side-Scan Process

The side-scan process averages adjacent pairs of beams to eliminate noise and then carries out a peak detection over beams from the left and right sides of the swath. The peak detection is done at the sample rate of the sonar.

The bathymetry and side-scan data are independent in the beamforming process and in how the output data is generated.

7.2.2.3 Side-Scan Data Output

The array of intensity values is a series of amplitudes, one for each sample interface for each side-scan beam. A sampling rate of 34482 samples per second provides approximately one measurement for every 2.5 centimeters of range.

The number of intensity values reported in a side-scan packet is a function of range. The number of values per packet can be calculated using the following formula:

$$\left(\frac{Range}{½SoundVelocity}\right) * SampleRate = SamplesPerBeam$$

Side-scan is one of the many records available for subscription from the 7k Center software. Refer to the 7k Data Format Definition for further information regarding side-scan data output (see also *Appendix C Reference Documentation*).

7.2.3 Snippets Data

Snippets data is available from the SeaBat 7125 AUV. Each snippet consists of a windowed selection of amplitudes taken from the bottom detection point of each beam.

A snippets data sample contains corrected backscatter data from the 'footprint' on the seabed illuminated by a single sonar ping. The number of snippets in a swath is a function of the number of sonar beams. The length of each snippet depends on the operating mode, beam number, and depth. All of these settings may be selected by the operator.

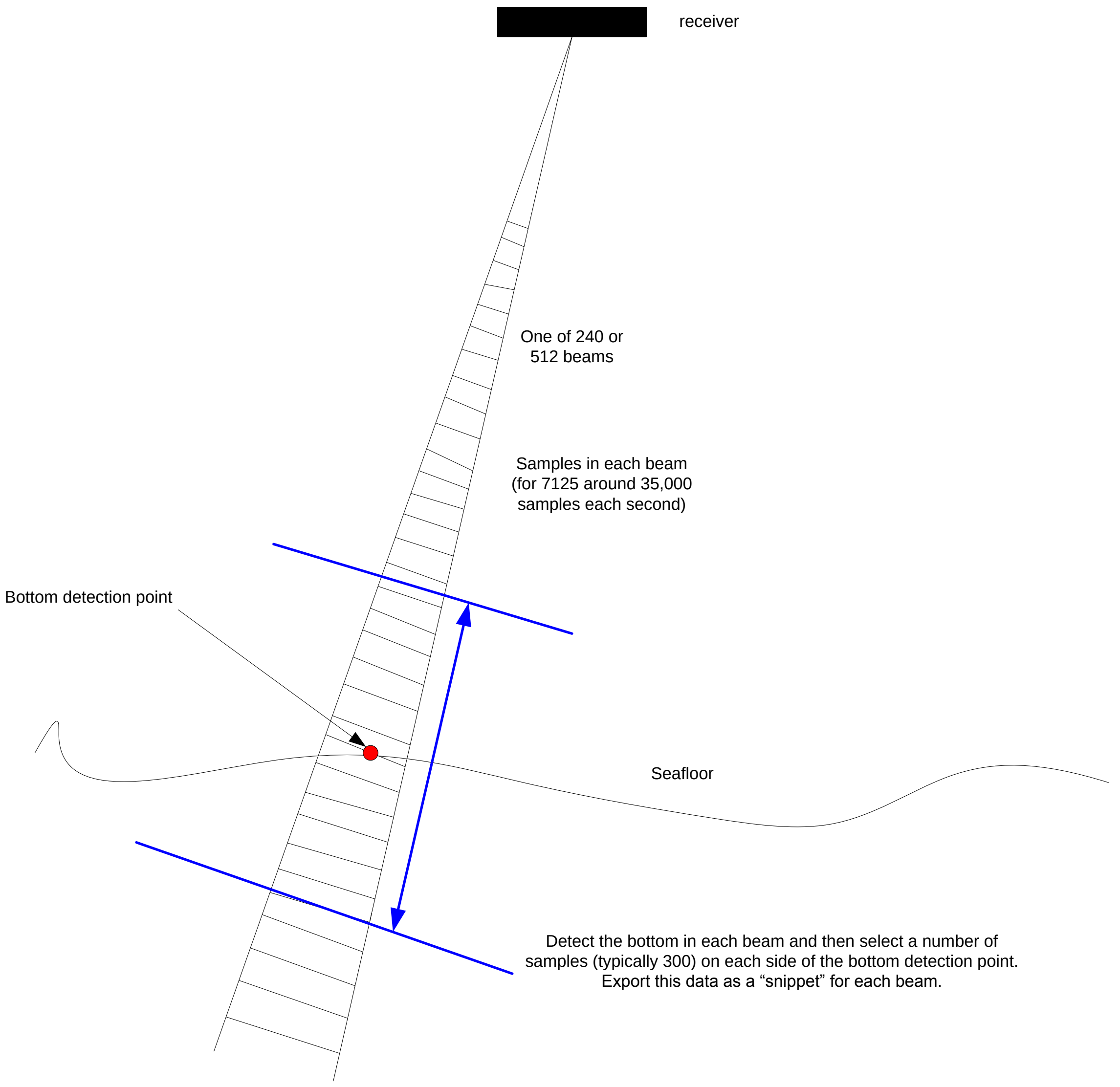


Figure 49: Graphic Illustration of Snippets Data

Each snippets data packet contains pertinent information such as time stamp, sequential ping number, sample rate, sound velocity, and operator settings such as power, gain, absorption, and range scale.

7.3 Best Coverage and Intermediate Modes

As the beam steering angle increases from nadir, the number of beams per degree of swath stays constant for equiangular spacing (Minimum Beams mode) while it increases for equidistant spacing (Best Coverage mode). *Figure 50* presents the number of beams as a function of steering angle for a 1° nadir beam spacing.

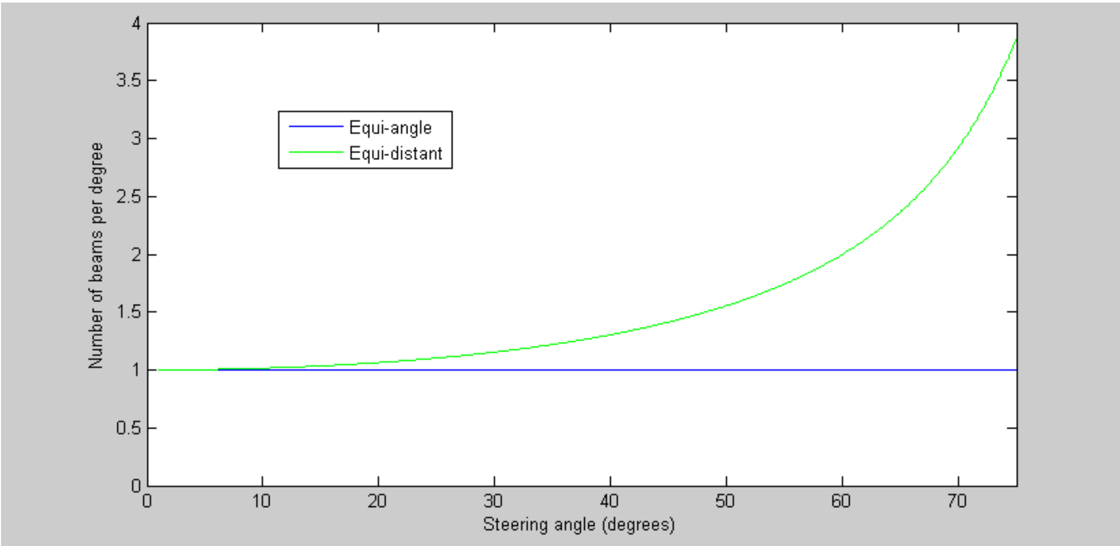


Figure 50: Beam Density

Figure 51 shows that the horizontal spacing of the Intermediate mode increases with beam angle, unlike Best Coverage mode (equidistant) where the spacing stays constant. However, the Intermediate mode increases the spacing much slower than the Minimum Beams mode (equiangular spacing) so the outer beam density is still quite good.

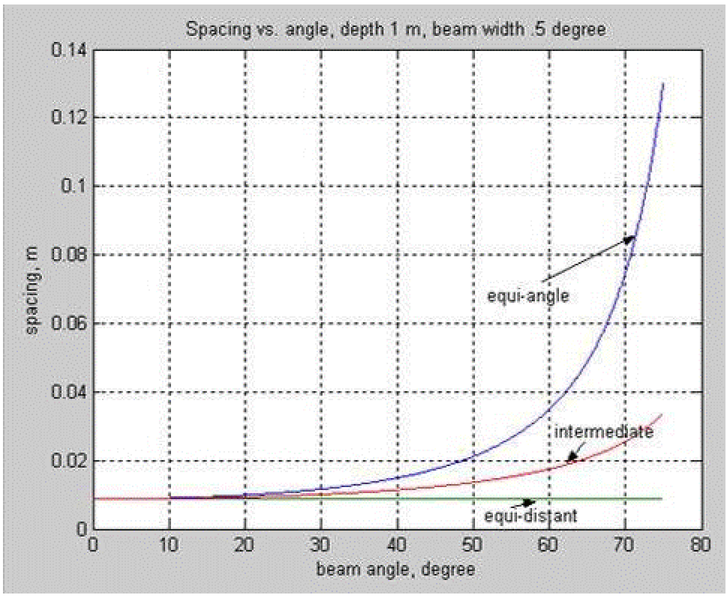


Figure 51: Beam Spacing vs. Beam Angle

Assuming a flat bottom and using the beam footprint generated by the nadir beam, it may be seen that the center-to-center spacing for each beam successively reduces as the departure from nadir increases until at ±65° the beam density is approximately 2.5 times greater than at nadir.

Assuming one sounding is generated from the intersection of the beam center with the seafloor, with equidistant spacing, the appropriate number of beams is formed to maintain this nadir sounding spacing across the entire swath. See also *Figure 52*.

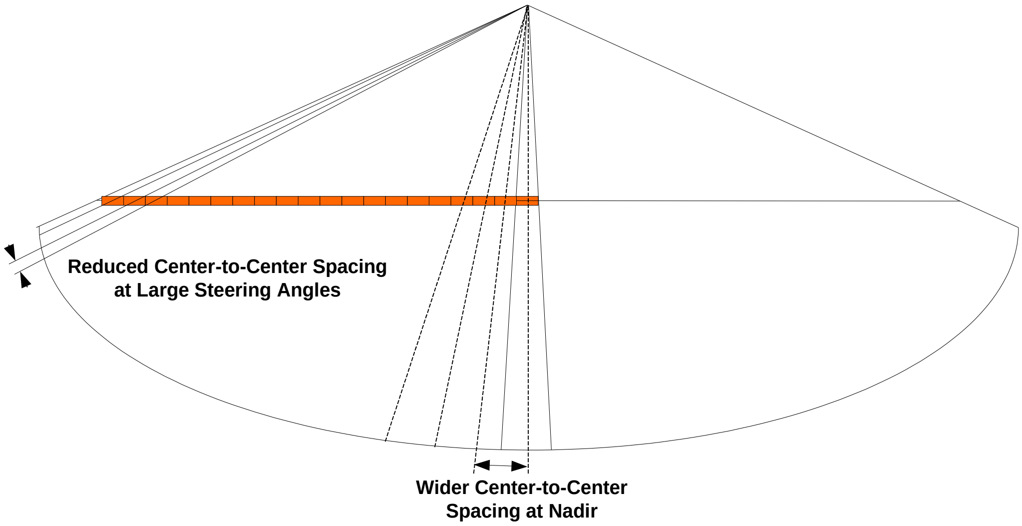


Figure 52: Beam Spacing

In order to achieve this uniform sounding spacing, it is necessary to decrease the beam center-to-center spacing which requires a significant increase in the number of beams formed. As an example, in the SeaBat 7125 AUV 400kHz system 256 EA beams are formed and 512 ED beams over the same swath.

The beamformer is able to generate a receive beam centered on any angle within the available swath and with equidistant spacing a set of coefficients is selected that form a set of receive beams that are centered on the midpoints of the footprints.

Figure 53 shows the difference in distribution between equiangular and equidistant spacing.

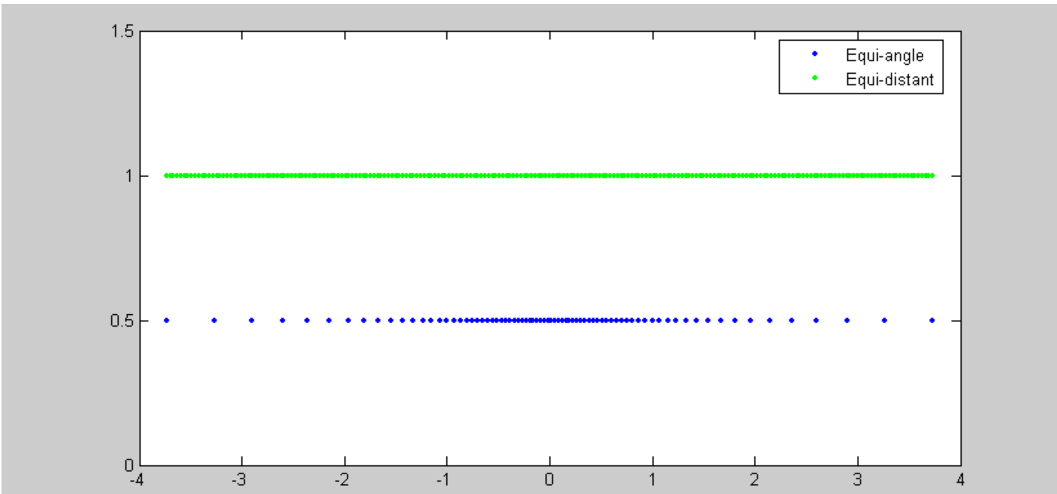


Figure 53: Across-Track Sounding Location on a Flat Bottom

7.4 X-Range[16] Performance

X-Range is a feature that provides extended range performance at 400kHz and also significantly improves system immunity towards external noise. The basis of the X-Range feature is a frequency-modulated (FM) transmission combined with advanced signal processing techniques to extract the maximum possible performance from the system.

Figure 54 and *Figure 55* compare swath performance for standard and X-range.

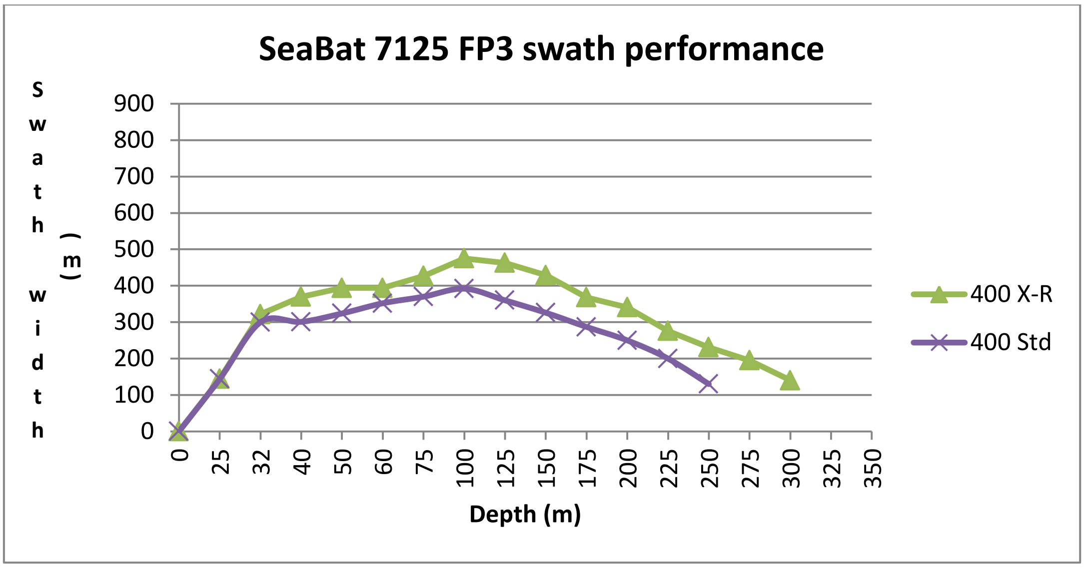


Figure 54: X-Range Swath Performance

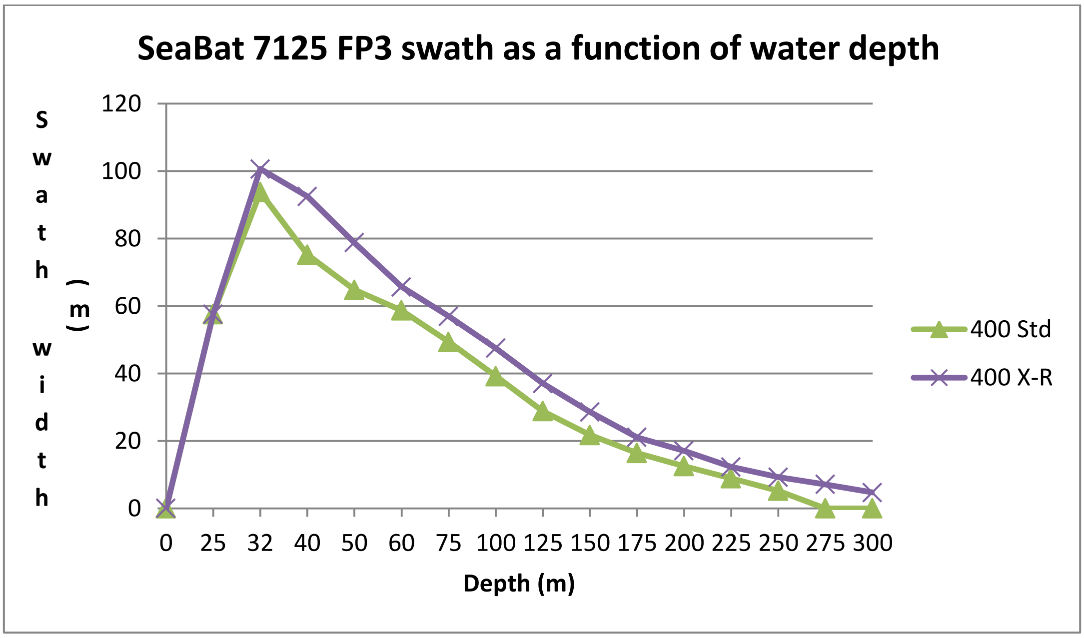


Figure 55: X-Range Swath as a Function of Water Depth

[16] X-Range (FM) is an optional add-on feature for the 400kHz frequency (see *Table 13*).

7.5 Quality

The quality of each bathymetric bottom detection point is evaluated by the 7k Center (see Bathy Point Color in *section 5.8.4 Primary Display Settings*).

7.5.1 Brightness Test

The brightness test measures the signal-to-noise ratio (SNR) of the signal strength (magnitude) near the bottom detection point (as determined by the bottom detection algorithm) versus the background noise in the rest of the beam.

The signal strength is the mean of the square of the sample intensity around the bottom detection point. The number of samples used is marked ‘A’ in *Figure 56* and is a small percentage of the total number of samples. The noise is based on a mean of the square of the samples in the second half of the “tail” of the detection window (marked ‘B’ in *Figure 56*) and the square of the samples in the “head” of the water column (before the first return – marked ‘C’ in *Figure 56*).

Beams, whose SNR is greater than a predetermined threshold, will be flagged as passing the brightness test.

For instructions on how to display the test results, see Quality in *section 5.8.4 Primary Display Settings*.

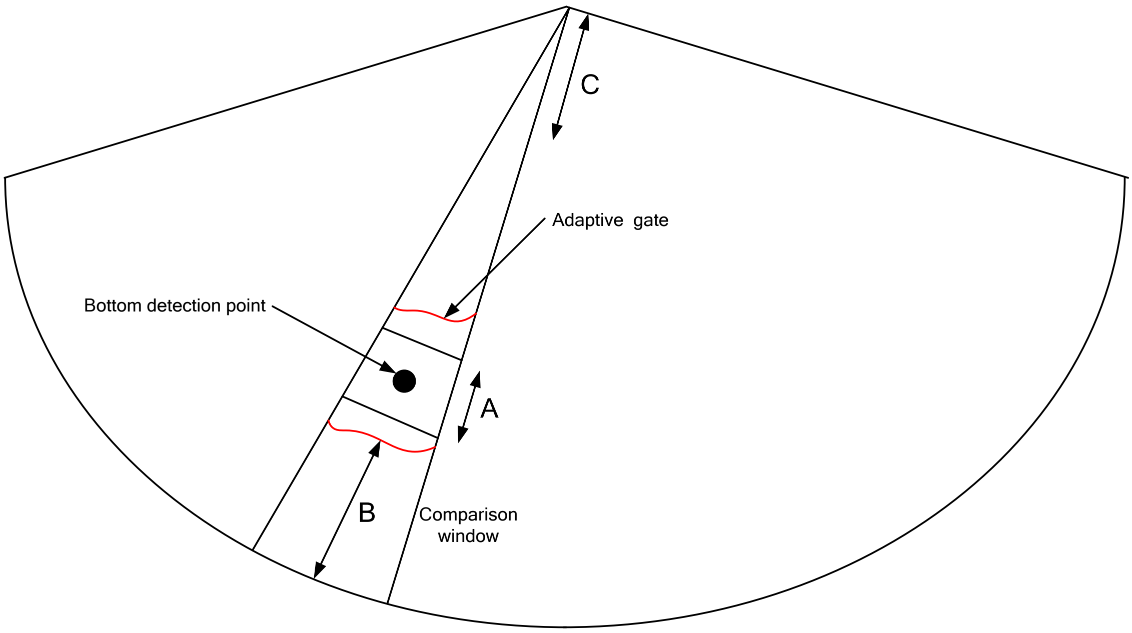


Figure 56: Brightness Test

7.5.2 Colinearity Test

In general terms, this test will pass if a bottom detection point sample number for a given beam falls on or near a line drawn through its neighboring beams' bottom detection points. This is achieved using a moving polynomial fit of the points on either side of each point. If a given point is within the window of the line fit, it is marked colinear.

This process is done in stages that begin with the central beams and moving outward on each side of the wedge in turn.

For instructions on how to display the test results, see Quality in *section 5.8.4 Primary Display Settings*.

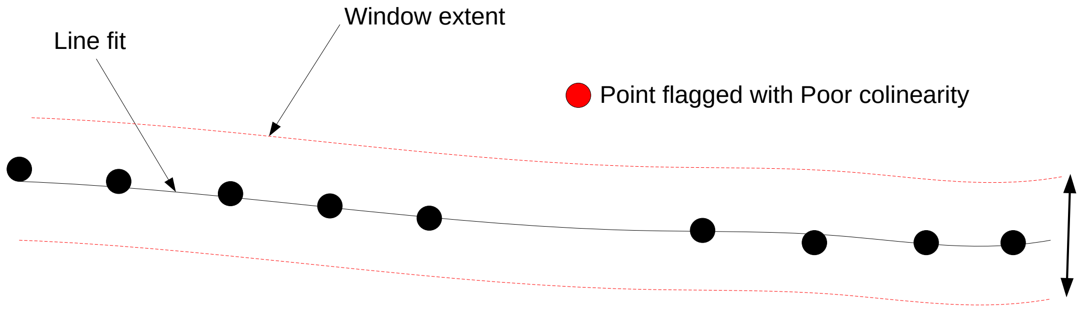


Figure 57: Colinearity Flags

7.5.3 Quality Filter

A quality filter makes it possible to not display or export bottom detection points which do not pass the quality criteria. Enabling the quality filter (see *section 5.8.2.4 Quality Filter*) has the following effects:

- The corrected bathymetric data record will only contain the detection points that pass the quality filtering. A flag will be set in the record to indicate that the quality filter was applied.
- The dedicated snippets record will only contain the detection points that pass the quality filtering. A flag will be set in the records to indicate that the quality filter was applied.
- The Primary Display wedge and Snippets displays will only show points that pass the quality filtering.
- The options Show Rejected (selected by right-clicking the wedge display) and Rejected Items (in the drop-down menu on the Primary Display Settings tab) will be disabled (see Display Points / Filters in *section 5.8.4 Primary Display Settings*).

For details on settings for the quality filter, see *section 5.8.2 Detection Settings*.

7.6 Uncertainty Estimation

The calculation of Total Propagated Uncertainty (TPU) is used to aid the surveyor determine the sounding quality of the bottom detection point. The calculation is done by statistical methods, typically in the data acquisition software. One of the inputs into the TPU calculation is the sounding measurement error as computed in the sonar system. Other error sources include position, draft, squat, load, tide geodetic calculations, lever arms calculations, timing offsets, speed, heading, attitude, and sound velocity.

In the sonar processor, the error associated with bottom detection is computed separately for amplitude, phase, and blended detection methods. This value is exported as a field in both raw and corrected bathymetry records.

The uncertainty value is normalized to the detection point by dividing the absolute range error (number of samples) by the detection point (fractional sample number). For example:

- Absolute range error: 0.8 samples
- Fractional sample number of detection point: 120.2
- Uncertainty = 0.8/120.2 = 0.006655574

When the Uncertainty option is active, a color legend is shown on the wedge display.

For instructions on how to display the uncertainty, see Bathy Point Color in *section 5.8.4 Primary Display Settings*.

7.7 Ping Rate Table

Table 4: Ping Rate Table

Range setting (m) (slant range)	Theoretical max ping rate (1500m/s)[17]	Realized ping rate [Hz], nominal	
		200kHz, 256 EA beams	400kHz, 512 ED beams
5	150	50.0	50.0
8	93.7	50.0	50.0
10	75.0	50.0	45.6
15	50.0	36.5	33.0
20	37.5	28.7	25.9
25	30.0	23.7	21.1
30	25.0	20.0	18.0
35	21.4	17.5	15.4
40	18.8	15.4	13.6
50	15.0	12.4	11.0
75	10.0	8.5	7.3
100	7.5	6.4	5.5
125	6.0	5.0	4.4
150	5.0	4.4	3.7
175	4.3	3.7	3.1
200	3.8	3.3	2.6
250	3.0	2.5	2.1
300	2.5	2.1	1.8
350	2.1	1.8	n/a
400	1.9	1.7	n/a
500	1.5	1.3	n/a
750	1.0	0.9	n/a

NOTE
The table reflects the ping rate performance on a processor only running the 7kCenter. If PDS2000 is running on the same processor, the ping rate performance may be marginally lower.

[17] The ping rate is limited to 50p/s (see *section 5.8.1.4 Set the Maximum Ping Rate (Max Rate)*).

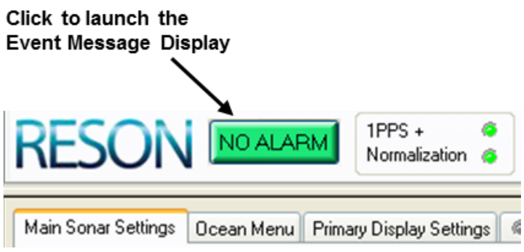
APPENDIX A TROUBLESHOOTING

A.1 System Warnings and Alarm Messages

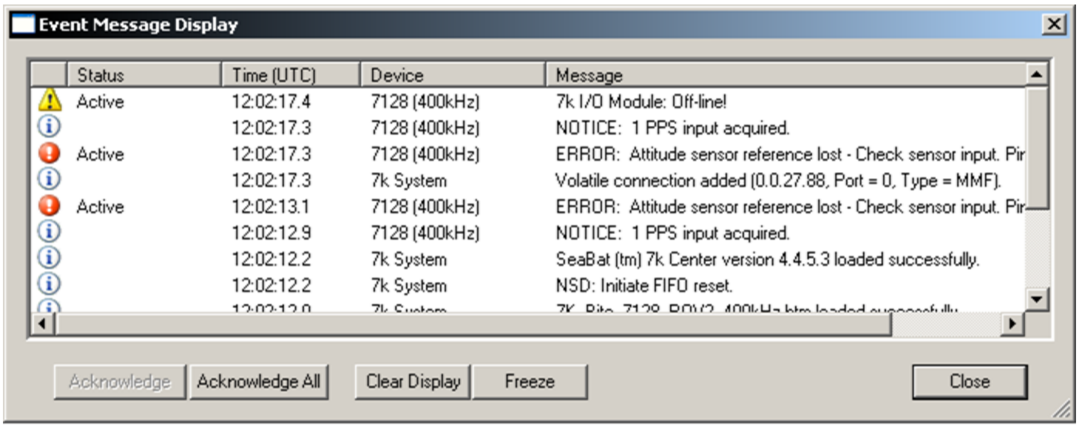
NOTE
Most alarms and warnings do not result in a system failure. In the case of repeated alarms or warnings, contact Teledyne RESON Customer Support (support@teledyne-reson.com).

This chapter contains a global list of warning and alarm event messages generated by the 7k Center software. The event messages appear in the Event Message Display window.

To launch the Event Message Display window, click the alarm button on the Primary Display tab.



No alarm/information is marked with an as shown in the following sample window.



A.2 Responding to Errors and Alarms

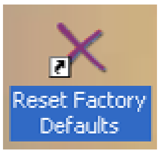
When an error occurs:

1. Examine the lists of errors in *section A.3 below* to decide course of action.

   or, if that fails,

1. Shut down the software.

2. Double-click the Reset Factory Defaults icon on the desktop.

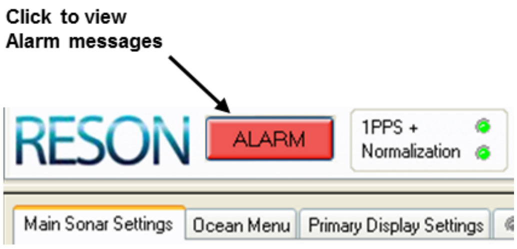


3. Restart the software.
4. If the problem continues after restarting the software, reboot the processor.
5. If the condition still persists, contact Teledyne RESON Customer Support (support@teledyne-reson.com).

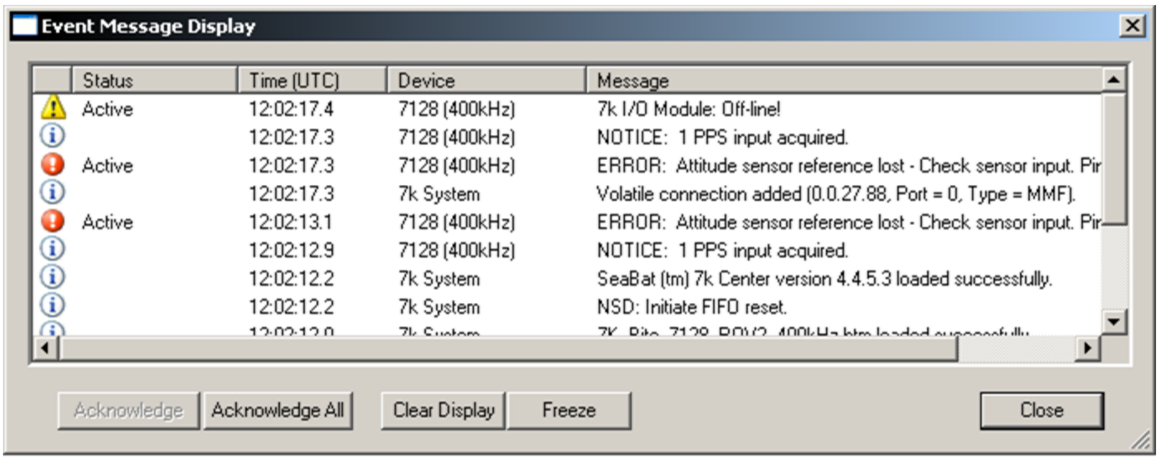
A.3 Alarm Messages

NOTE
The alarm messages listed in this section are accurate up to the document release date. For a complete list of up-to-date alarm messages, contact Teledyne RESON Customer Support (support@teledyne-reson.com).

Click the alarm button to view alarm messages in the Event Message Display window.



Alarms are marked with a red as shown in the following sample window.



A.3.1 General System Startup Alarms

Message	Description	Action
ADMXRC configuration failed	The software failed to detect or configure the primary processing card.	Check PCI bus drivers for ADMXRC card.
Could not create UDP server	Indicates a network resource was unavailable to the software from the operating system.	Check user permissions, network drivers.
Could not create TCP server		
Could not create PCI server	Software detected a failure to configure the main data acquisition and distribution module (PCI). This can be caused by errors in the configuration files, or corrupted installation.	Reboot the PC, call Teledyne RESON support.
Error creating PCI Reader thread		
Error creating PCI Copier thread		
Create TCP socket failed, code…	Operating system did not allow creating of network resources.	Check Windows installation, user settings, and network resources.
Error creating non-sonar data reader thread	BITE module has failed to initialize.	Check Windows installation and resources.
Failed to allocate memory for ADMXRC read	The software could not allocate enough system memory to perform the operation.	Make sure no other software is running on the 7-P. Reboot the system.
Failed to allocate memory for ADMXRC transfer		
Failed to set up DMA Card 0	The software could not access the processing card device.	Check ADMXRC drivers.
Failed to set up DMA Card 1		
Internal 7k Center error	One or more startup conditions have failed.	Check previous alarms or warnings & verify software installation.
Internal error, 7kCenter NOT fully operational		
Inbound memory initialization failed	PC resources are inadequate.	Check RAM or virtual memory resources
MMF Outbound memory creation …		
Required file: "7k_0.xml" or "7k.xml" Not found.	A critical startup configuration file was missing or too many were found.	Reinstall the software.
Required file: "7k_Bite.htm" Not found.		
SET UP: NO TOP BIT FILE MATCH for Device <x>, Enumerator <x>		

Message	Description	Action
SET UP: TOO MANY BIT FILES (Max = x)		
SET UP: FAILED TO LOAD BIT FILE "<x>" for Device <x>, Enumerator <x>		
SET UP: TOO MANY BIT FILES (Max = x)		
SET UP: FAILED TO LOAD BIT FILE "XXX" for Device <x>, Enumerator <x>		
Socket initialization failed, error code <x>	Windows has failed to allocate a network resource.	Check network permissions and resources or Reinstall operating system.

A.3.2 PCI Card Related (ADMXRC) Alarms

The ADMXRC refers to the drivers that control the main processing unit within the 7-P. This processing card sits on the motherboards PCI bus and acts as a signal processing layer between the hardware and software.

Message	Description	Action
2nd ADMXRC card not found	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.
ADMXRC card not found, ERROR =		
ADMXRC.dll not found.		
Configure FPGA failed.		
Incorrect ADMXRC board found, card_1		
Failed to set up DMA Card 0, ERROR =		
Failed to allocate memory for ADMXRC transfer.		
Failed to set ADMXRC clock, Card_1, ERROR =		
Failed to get ADMXRC space info, Card_1, ERROR =		
Failed to configure 1st FPGA with <x>, ERROR =		
Failed to find ADMXRC info, card_0, ERROR =		
Failed to set ADMXRC clock, Card_0, ERROR =		

Message	Description	Action
Failed to get ADMXRC space info, Card_0, ERROR =		
Failed to configure 1st FPGA with <x>, ERROR =		
Failed to find ADMXRC info, card_1, ERROR =		

A.3.3 Data Reading Alarms

Message	Description	Action
DMA Transfer Timeout. <x> of <x> bytes received	This error generally indicates that the uplink from the receiver is interrupted at some point.	Check the BITE tab for receiver BITE values to try and localize the failure to a component. Check uplink cable connections. Check temperature of the ICPU via BITE. Restore factory defaults. Reboot the PC.
FATAL: DMA Read size limitation reached.	A general error occurred while transferring data to the software.	Reboot the system.
Lost sync with DMA read		

A.3.4 System Resource Alarms

Message	Description	Action
Error starting I&Q Reader thread.	A module has failed to start correctly.	Reboot the system.
Error starting IQ thread.		
Error starting PCI Copier thread.		
Error starting PCI Reader thread		
Error creating IQ thread		
Error starting I&Q threads		

A.3.5 Input Signal (Timing and Triggers) Alarms

Message	Description	Action
Failed to register external trigger, ERROR =	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.
Failed to unregister external trigger, ERROR =		
FIRMWARE does not support External Trigger. Pinging is OFF		

Message	Description	Action
External triggering has failed. Check/update software installation.		
FATAL ERROR: PPS Timestamp error Check 1 PPS input		

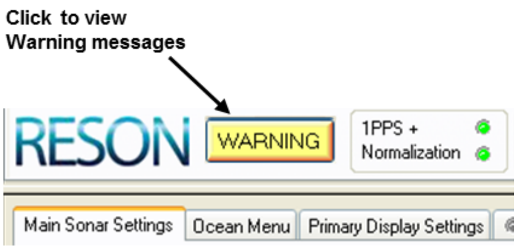
A.3.6 Calibration Alarms

Message	Description	Action
Calibration Failed: Too much noise	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.
Calibration Failed: Over 10% dead Rx channels.		
Calibration Failed: Magnitude Error		
Calibration Failed: Phase Error		
Calibration Error: Calibration might be invalid. Repeat the calibration.		

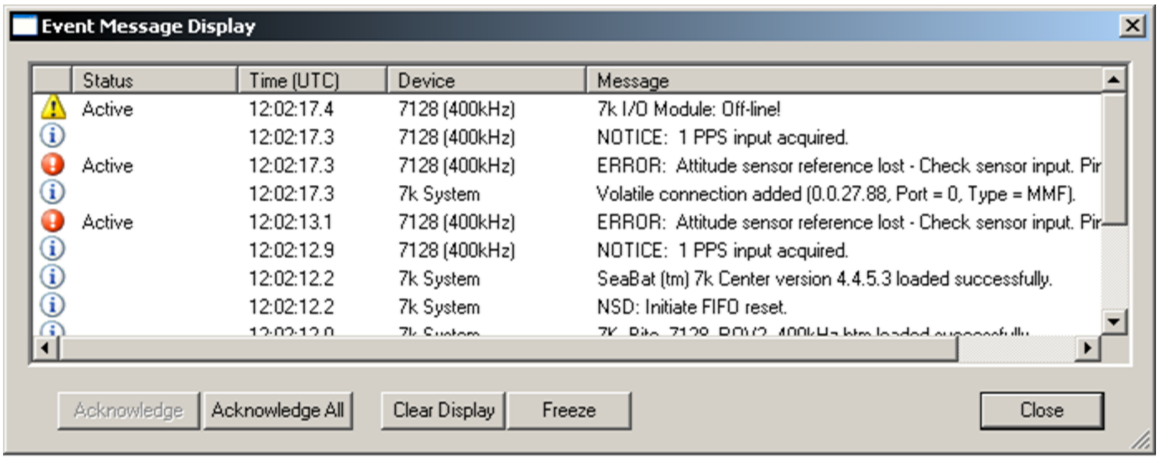
A.4 Warning Messages

NOTE
The warning messages listed in this section are accurate up to the document release date. For a complete list of up-to-date alarm messages, contact Teledyne RESON Customer Support (support@teledyne-reson.com).

Click the warning button to view warning messages in the Event Message Display window.



Warnings are marked with a yellow ⚠ as shown in the following sample window.



A.4.1 Configuration Warnings

Message	Description	Action
7K Bite File cannot be Read	Software installation is corrupt.	Restore factory defaults. Reinstall software.
Cannot Read UDP Configuration file <x> Error		
Cannot Open or Create UDP Configuration file		
UDP Configuration file not available		

A.4.2 Startup Warnings

Message	Description	Action
Failed to start PCI Reader thread	One or more PCI bus or network resources has failed to initialize.	Check user permissions and 7-P network hardware.
Failed to start PCI Copier thread		
PCI interface status: Down		
TCP interface status: Down		
UDP interface status: Down		

A.4.3 Data Processing Warnings

Message	Description	Action
***** (xxx) Dropping out-of-order ping #<x>	The data processing chain has been delayed and stale data has been discarded.	Check 7-P hardware and resources.
PING <x> :(Lost FPGA sync...sample	One or more pings have been lost due to an error on the uplink between the receiver and the software.	Reboot. Check 7-P hardware.
PING <x> :(Lost FPGA sync...sample		

Message	Description	Action
DMA Transfer Timeout. <x> of <x> bytes received	The system is becoming unstable and data transfer is corrupted on the PCI bus.	

A.4.4 Data Recording Warnings

Message	Description	Action
WARNING: Critical Disk Level: RDR - Data recording stopped	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories, as well as permissions on target files/directories.
RDR - Already in Playback/Record mode.		
RDR Record failed - No Filename		
RDR Record failed - Set file name failed: <x>		
RDR - Data recording failed to start. filename:		
RDR - Data <x> failed to stop.		
RDR - <x> already in progress.		
RDR Playback failed - No Filename		
RDR Playback failed - Set file name failed:		
RDR - Data playback failed, filename =		
RDR - Data delete failed: in Record/Playback mode.		
RDR Data delete failed - Filename not available		
RDR - Set new file name failed		
RDR - Set Data path Failed		
Disk Level Threshold: X%.		

A.4.5 BITE Data Warnings

Message	Description	Action
ERROR : NSD	An error has occurred in reading of BITE data. The data buffer has overflowed.	No action needed.
Non Sonar Data FIFO overflow (x packet)		

A.4.6 Input Signal Warnings

Message	Description	Action
Roll Compensation is not available.	The input data for motion is	Check device inputs

Message	Description	Action
Pitch Compensation is not available.	not available or the feature is not enabled.	and cabling.

A.4.7 System Stability Warnings

Message	Description	Action
WARNING: PPS Time-stamp error	The internal clock may not be disciplined properly resulting in incorrect time stamp of data.	Check 1-PPS connections and GPS output. If uncorrected sonar data cannot be time stamped to 1 millisecond.
WARNING: Reduce Ping Rate or Range - DROPPING ping	The system is overloaded processing data. A ping has been lost because the processing queue is full.	Restart the software. Reboot PC.

A.4.8 Data Subscription Warnings

Message	Description	Action
Subscriber UDP sendto() failed	The software was unable to send data to a connected client.	Check network resources and user permissions.
Subscriber send() failed		
Subscribers outbound MMF buffer memory overwrite error!	The link to the user interface running on the 7-P has detected a non-critical error.	Check system resources, shutdown all non-critical software applications. Reboot processor.
Subscribers outbound MMF buffer read error!		
Subscribers outbound MMF buffer memory overwrite error!		

A.4.9 Network Components Warnings

Message	Description	Action
TCP Server - Unknown packet type	A connected client has sent an unrecognized command to the software.	Review client software source code or definitions for correct implementation of Reson 7k Data Format.
UDP Server - Unknown packet type		
TCP Server - Warning max connections reached	The network module has become saturated with client connections and will refuse any further connections.	Close some of the connected clients.
UDP Server - Warning max connection reached		

A.4.10 External Trigger Warnings

Message	Description	Action
Trigger out length (x) is invalid	An unsupported value was received for trigger setup.	Check settings in user interface.
Trigger out offset (x) is invalid		
Trigger out offset + length (x) exceed limit of 20ms		

A.5 Alarm Messages – Master List in Alphabetical Order

Message	Description	Action	Alarm Type
2nd ADMXRC card not found	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
ADMXRC card not found, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
ADMXRC configuration failed	The software failed to detect or configure the primary processing card.	Check PCI bus drivers for ADMXRC card.	General System Startup
ADMXRC.dll not found.	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Calibration Error: Calibration might be invalid. Repeat the calibration.	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.	Calibration
Calibration Failed: Magnitude Error	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.	Calibration
Calibration Failed: Over 10% dead Rx channels.	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.	Calibration
Calibration Failed: Phase Error	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.	Calibration

Message	Description	Action	Alarm Type
Calibration Failed: Too much noise	Calibration has failed. Check BITE page and hardware and cable installation to the receiver.	Check environmental noise. Contact Teledyne RESON Customer Support.	Calibration
Configure FPGA failed.	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Could not create PCI server	Software detected a failure to configure the main data acquisition and distribution module (PCI). This can be caused by errors in the configuration files, or corrupted installation.	Reboot the PC, call Teledyne RESON support.	General System Startup
Could not create TCP server	Indicates a network resource was unavailable to the software from the operating system.	Check user permissions, network drivers.	General System Startup
Could not create UDP server	Indicates a network resource was unavailable to the software from the operating system.	Check user permissions, network drivers.	General System Startup
Create TCP socket failed, code…	Operating system did not allow creating of network resources.	Check Windows installation, user settings, and network resources.	General System Startup
DMA Transfer Timeout. <x> of <x> bytes received	This error generally indicates that the uplink from the receiver is interrupted at some point.	Check the BITE page for receiver BITE values. Restore factory defaults. Reboot the PC.	Data Reading
Error creating IQ thread	A module has failed to start correctly.	Reboot the system.	System Resource
Error creating non-sonar data reader thread	BITE module has failed to initialize.	Check Windows installation and resources.	General System Startup

Message	Description	Action	Alarm Type
Error creating PCI Copier thread	Software detected a failure to configure the main data acquisition and distribution module (PCI). This can be caused by errors in the configuration files, or corrupted installation.	Reboot the PC, call Teledyne RESON support.	General System Startup
Error creating PCI Reader thread	Software detected a failure to configure the main data acquisition and distribution module (PCI). This can be caused by errors in the configuration files, or corrupted installation.	Reboot the PC, call Teledyne RESON support.	General System Startup
Error starting I&Q Reader thread.	A module has failed to start correctly.	Reboot the system.	System Resource
Error starting I&Q threads	A module has failed to start correctly.	Reboot the system.	System Resource
Error starting IQ thread.	A module has failed to start correctly.	Reboot the system.	System Resource
Error starting PCI Copier thread.	A module has failed to start correctly.	Reboot the system.	System Resource
Error starting PCI Reader thread	A module has failed to start correctly.	Reboot the system.	System Resource
External triggering has failed. Check/update software installation.	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.	Input Signal (Timing & Triggers)
Failed to allocate memory for ADMXRC read.	The software could not allocate enough system memory to perform the operation.	Make sure no other software is running on the 7-P. Reboot the system.	General System Startup
Failed to allocate memory for ADMXRC transfer.	The software could not allocate enough system memory to perform the operation.	Make sure no other software is running on the 7-P. Reboot the system.	General System Startup

Message	Description	Action	Alarm Type
Failed to allocate memory for ADMXRC transfer.	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to configure 1st FPGA with <x>, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to configure 1st FPGA with <x>, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to find ADMXRC info, card_0, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to find ADMXRC info, card_1, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to get ADMXRC space info, Card_0, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to get ADMXRC space info, Card_1, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to register external trigger, ERROR =	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.	Input Signal (Timing & Triggers)
Failed to set ADMXRC clock, Card_0, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card

Message	Description	Action	Alarm Type
Failed to set ADMXRC clock, Card_1, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to set up DMA Card 0	The software could not access the processing card device.	Check ADMXRC drivers.	General System Startup
Failed to set up DMA Card 0, ERROR =	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Failed to set up DMA Card 1	The software could not access the processing card device.	Check ADMXRC drivers.	General System Startup
Failed to unregister external trigger, ERROR =	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.	Input Signal (Timing & Triggers)
FATAL ERROR: PPS Timestamp error Check 1 PPS input	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.	Input Signal (Timing & Triggers)
FATAL: DMA Read size limitation reached.	A general error occurred while transferring data to the software.	Reboot the system.	Data Reading
FIRMWARE does not support External Trigger. Pinging is OFF	The pulse is not being detected. Time stamping will be done using system time only. 1 millisecond accuracy not possible.	Check input signal cabling.	Input Signal (Timing & Triggers)
Inbound memory initialization failed.	PC resources are inadequate.	Check RAM or virtual memory resources	General System Startup

Message	Description	Action	Alarm Type
Incorrect ADMXRC board found, card_1	One or more of the processing cards has failed to initialize or is non-functional within the 7-P.	Reboot 7-P and try again.	PCI Card
Internal 7k Center error	One or more startup conditions have failed.	Check previous alarms or warnings & verify software installation.	General System Startup
Internal error, 7kCenter NOT fully operational.	One or more startup conditions have failed.	Check previous alarms or warnings & verify software installation.	General System Startup
Lost sync with DMA read	A general error occurred transferring data to the software.	Reboot the system.	Data Reading
MMF Outbound memory creation …	PC resources are inadequate.	Check RAM or virtual memory resources	General System Startup
Required file: "7k_0.xml" or "7k.xml" Not found.	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
Required file: "7k_Bite.htm" Not found.	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
SET UP: FAILED TO LOAD BIT FILE "<x>" for Device <x>, Enumerator <x>	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
SET UP: FAILED TO LOAD BIT FILE "XXX" for Device <x>, Enumerator <x>	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
SET UP: NO TOP BIT FILE MATCH for Device <x>, Enumerator <x>	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
SET UP: TOO MANY BIT FILES (Max = x)	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup
SET UP: TOO MANY BIT FILES (Max = x)	A critical startup configuration file was missing or too many were found.	Reinstall the software.	General System Startup

Message	Description	Action	Alarm Type
Socket initialization failed, error code <x>	Windows has failed to allocate a network resource.	Check network permissions and resources or Reinstall operating system.	General System Startup

A.6 Warning Messages – Master List in Alphabetical Order

Message	Description	Action	Type
***** (xxx) Dropping out-of-order ping #<x>	The data processing chain has been delayed and stale data has been discarded.	Check 7-P hardware and resources.	Data Processing
7K Bite File cannot be Read	Software installation is corrupt.	Restore factory defaults. Reinstall software.	Configuration
Cannot Open or Create UDP Configuration file	Software installation is corrupt.	Restore factory defaults. Reinstall software.	Configuration
Cannot Read UDP Configuration file <x> Error	Software installation is corrupt.	Restore factory defaults. Reinstall software.	Configuration
Disk Level Threshold: X%.	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
DMA Transfer Timeout. <x> of <x> bytes received	One or more pings have been lost due to an error on the uplink between the receiver and the software. The system is becoming unstable and data transfer is corrupted on the PCI bus.	Reboot. Check 7-P hardware.	Data Processing
ERROR : NSD	An error has occurred in reading of BITE data. The data buffer has overflowed.	No action needed.	BITE Data
Failed to start PCI Copier thread	One or more PCI bus or network resources have failed to initialize.	Check user permissions and 7-P network hardware.	Startup
Failed to start PCI Reader thread	One or more PCI bus or network resources have failed to initialize.	Check user permissions and 7-P network hardware.	Startup

Message	Description	Action	Type
Non Sonar Data FIFO overflow (x packet)	An error has occurred in reading of BITE data. The data buffer has overflowed.	No action needed.	BITE Data
PCI interface status: Down	One or more PCI bus or network resources have failed to initialize.	Check user permissions and 7-P network hardware.	Startup
PING <x> :(Lost FPGA sync...sample	One or more pings have been lost due to an error on the uplink between the receiver and the software. The system is becoming unstable and data transfer is corrupted on the PCI bus.	Reboot. Check 7-P hardware.	Data Processing
PING <x> :(Lost FPGA sync...sample	One or more pings have been lost due to an error on the uplink between the receiver and the software. The system is becoming unstable and data transfer is corrupted on the PCI bus.	Reboot. Check 7-P hardware.	Data Processing
Pitch Compensation is not available.	The input data for motion is not available or the feature is not enabled.	Check device inputs and cabling.	Input Signal
Pitch Compensation is not available.	The input data for motion is not available or the feature is not enabled.	Check device inputs and cabling.	Input Signal
RDR - <x> already in progress.	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Already in Playback/Record mode.	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Data <x> failed to stop.	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording

Message	Description	Action	Type
RDR - Data delete failed: in Record/Playback mode.	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Data playback failed, filename =	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Data recording failed to start. filename:	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Set Data path Failed	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR - Set new file name failed	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR Data delete failed - Filename not available	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR Playback failed - No Filename	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR Playback failed - Set file name failed:	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
RDR Record failed - No Filename	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording

Message	Description	Action	Type
RDR Record failed - Set file name failed: <x>	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
Roll Compensation is not available.	The input data for motion is not available or the feature is not enabled.	Check device inputs and cabling.	Input Signal
Roll Compensation is not available.	The input data for motion is not available or the feature is not enabled.	Check device inputs and cabling.	Input Signal
Subscriber send() failed	The software was unable to send data to a connected client.	Check network resources and user permissions.	Data Subscription
Subscriber UDP sendto() failed	The software was unable to send data to a connected client.	Check network resources and user permissions.	Data Subscription
Subscribers outbound MMF buffer memory overwrite error!	The link to the user interface running on the 7-P has detected a non-critical error.	Check system resources, shutdown all non-critical software applications. Reboot processor.	Data Subscription
Subscribers outbound MMF buffer memory overwrite error!	The link to the user interface running on the 7-P has detected a non-critical error.	Check system resources, shutdown all non-critical software applications. Reboot processor.	Data Subscription
Subscribers outbound MMF buffer read error!	The link to the user interface running on the 7-P has detected a non-critical error.	Check system resources, shutdown all non-critical software applications. Reboot processor.	Data Subscription
TCP interface status: Down	One or more PCI bus or network resources has failed to initialize.	Check user permissions and 7-P network hardware.	Startup
TCP Server - Unknown packet type	A connected client has sent an unrecognized command to the software.	Review client software source code or definitions for correct implementation of Reson 7k Data Format.	Network Components

Message	Description	Action	Type
TCP Server - Warning max connections reached	The network module has become saturated with client connections and will refuse any further connections.	Close some of the connected clients.	Network Components
Trigger out length (x) is invalid	An unsupported value was received for trigger setup.	Check settings in user interface.	External Trigger
Trigger out offset (x) is invalid	An unsupported value was received for trigger setup.	Check settings in user interface.	External Trigger
Trigger out offset + length (x) exceed limit of 20ms	An unsupported value was received for trigger setup.	Check settings in user interface.	External Trigger
UDP Configuration file not available	Software installation is corrupt.	Restore factory defaults. Reinstall software.	Configuration
UDP interface status: Down	One or more PCI bus or network resources have failed to initialize.	Check user permissions and 7-P network hardware.	Startup
UDP Server - Unknown packet type	A connected client has sent an unrecognized command to the software.	Review client software source code or definitions for correct implementation of Reson 7k Data Format.	Network Components
UDP Server - Warning max connection reached	The network module has become saturated with client connections and will refuse any further connections.	Close some of the connected clients.	Network Components
WARNING: Critical Disk Level: RDR - Data recording stopped	The hard drive is getting full. One or more errors have occurred in conjunction with data recording.	Check user permissions and available disk space. Check file names and recording directories	Data Recording
WARNING: PPS Time-stamp error	The internal clock may not be disciplined properly resulting in incorrect time stamp of data.	Check 1-PPS connections and GPS output. If uncorrected sonar data cannot be time stamped to 1 millisecond	System Stability

Message	Description	Action	Type
WARNING: Reduce Ping Rate or Range - DROPPING ping	The system is overloaded processing data. A ping has been lost because the processing queue is full.	Restart the software. Reboot PC.	System Stability

APPENDIX B INSTALLATION INSTRUCTIONS

B.1 Installation Checklist

NOTE
This checklist only covers the most basic, standard system installation. Depending on the system configuration or specific customer requirements, this list may or may not apply.

Follow these basic steps to install and configure your new SeaBat sonar system:

- Install the wet-end components:
  - Transducer arrays
  - ICPU
- Install and connect cables:
  - Projector to ICPU cable
  - Receiver to ICPU cable
  - Auxiliary sensor cables
  - Optional ICPU to AUV cable
- Power up the system
- Test the system

B.2 Integrated Control and Processor Unit

The Integrated Control and Processor Unit (ICPU) consists of a single-board sonar processor and other electronics required for beamforming and control. The ICPU is housed inside an aluminum frame that acts as a heat sink and air plenum while supporting and cushioning the electronics against shock and vibration.

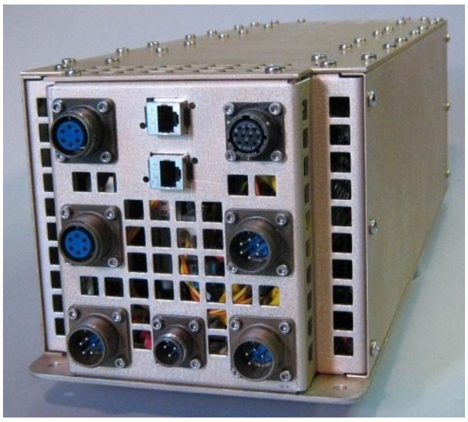


Figure 58: ICPU in Aluminum Frame

The ICPU frame is typically installed within a pressure bottle (optional); however, other possible configurations include a more robust frame for custom integrations where a pressure housing may not be required.

Figure 59: ICPU in Pressure Bottle

The ICPU accepts commands from the AUV control system and exports imagery data over gigabit Ethernet to the AUV data logging system.

While on deck, the operator may configure and control the sonar by connecting an Ethernet cable to the ICPU.

The ICPU performs the following functions:

- Accepts remote commands.
- Sends commands and power to the sonar head assembly.
- Receives and processes acoustic signals, then forms them into beams.
- Prepares and exports beamformed data.
- Accepts system configuration data.
- Records data.

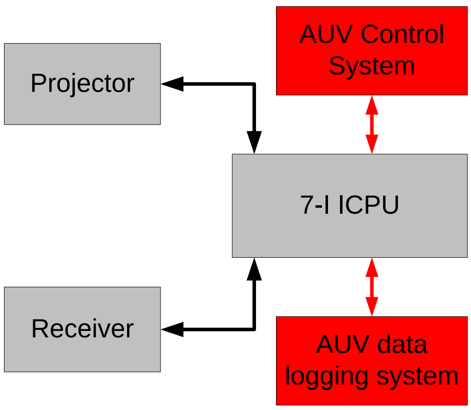


Figure 60: AUV Configuration

The ICPU pressure housing[18] should be mounted in a convenient location within easy reach of the projector to ICPU and receiver to ICPU cables. The ICPU housing may be secured with straps.

Table 5: ICPU Technical Specifications (Alu Frame)

Specification	Value
Power requirements	42-54VDC, 300W max (FM), average 180W (CW)
Data communication	Gigabit Ethernet
Dimensions	Height: 172mm Length: 497mm Width: 166mm
Weight	Air: 6.0kg (excl. pressure housing)
Depth rating	6000m
Temperature	Operating: -2° to +40°C Storage: -30° to +55°C

The ICPU may be supplied as a frame only to be installed in the customer's housing, or optionally as a complete unit integrated into a titanium pressure housing with a depth rating of 6000 meter (see *appendix D.8 Titanium Pressure Housing for ICPU)*.

[18] Pressure housing is to be provided by customer or Teledyne RESON (see a*ppendix D.8 Titanium Pressure Housing for ICPU*).

B.3 EM 7216 Receiver Unit[19]

The EM 7216 dual-frequency receiver unit receives acoustic signals from the water, digitizes them, and sends the digitized signals to the ICPU.

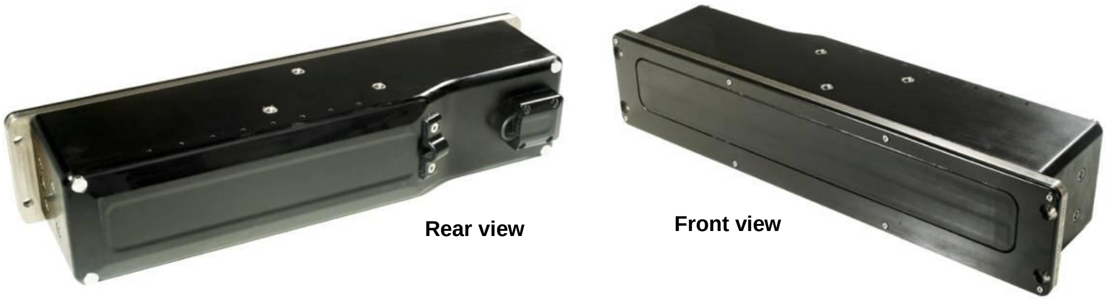


Figure 61: EM 7216 Receiver Unit

Table 6: EM 7216 Receiver Unit Technical Specifications

Specification	Value
Material	Titanium (grade 2) Polyurethane acoustic window
Dimensions	Height 137.5mm Length: 496.0mm Depth: 102.0mm
Weight	Air: 10.7kg Water: 5.7kg
Temperature	Operating: -2° to +35°C Storage: -30° to +70°C

The mounting flange on the front of the EM 7216 receiver unit is designed to accommodate four M8 machine screws in a rectangular pattern.

[19] The EM 7216 receiver unit is the successor of EM 7200.

B.4 Projector Units

B.4.1 TC 2160 Projector Unit

The TC 2160 bathymetry projector unit operates at the frequency of 400kHz and produces a narrow beam that is approximately 1° along-track by 145° across-track. The entire swath is illuminated in one transmission, with the maximum ping rate of 50Hz, providing 100% bottom coverage even at high vessel speed.

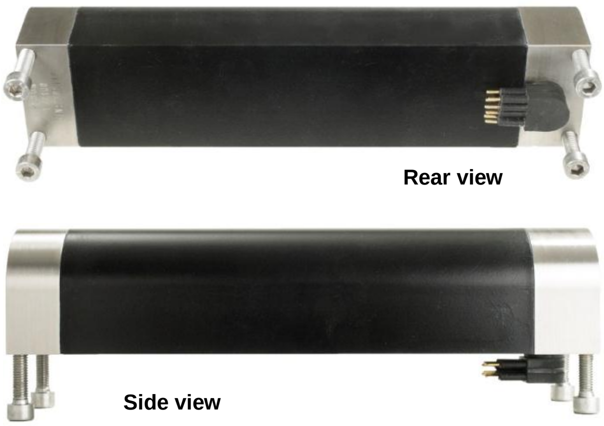


Figure 62: TC 2160 Projector Unit

Table 7: TC 2160 Projector Unit Technical Specifications

Specification	Value
Material	Titanium (grade 2) lid Polyurethane acoustic window
Dimensions	Height: 77mm Width: 62mm Depth: 285mm
Weight	Air: 2.75kg Water: 1.75kg
Temperature	Operating: -5° to +40°C Storage: -30° to +70°C

The TC 2160 projector unit mounts to the vehicle or mounting plate using four M10 machine screws of appropriate length, arranged in a rectangular pattern.

B.4.2 TC 2163 Projector Unit

The TC 2163 bathymetry projector unit operates at the frequency of 200kHz and produces a narrow beam that is approximately 2° along-track by 142° across-track. The entire swath is illuminated in one transmission, with the maximum ping rate of 50Hz providing 100% bottom coverage even at high vessel speed.

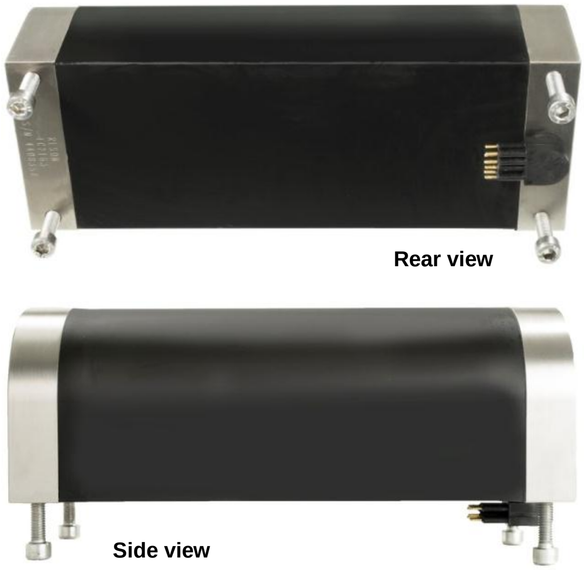


Figure 63: TC 2163 Projector Unit

Table 8: TC 2163 Projector Unit Technical Specifications

Specification	Value
Material	Titanium (grade 2) lid Polyurethane acoustic window
Dimensions	Height: 115mm Width: 100mm Depth: 280mm
Weight	Air: 7.5kg Water: 5.0kg
Temperature	Operating: -5° to +40°C Storage: -30° to +70°C

The TC 2163 projector unit mounts to the vehicle or mounting plate using four M10 machine screws of appropriate length, arranged in a rectangular pattern.

B.5 SeaBat 7125 AUV Cables

CAUTION
The units must not be suspended from own outside plugs and cables. Ensure that strain relief on the cable (cable grip) is used. If the cable is very long, use an external wire or cable covered with steel flex.

B.5.1 SeaBat 7125 AUV Standard Cables

A standard cable set is provided to connect the SeaBat 7125 AUV system components.

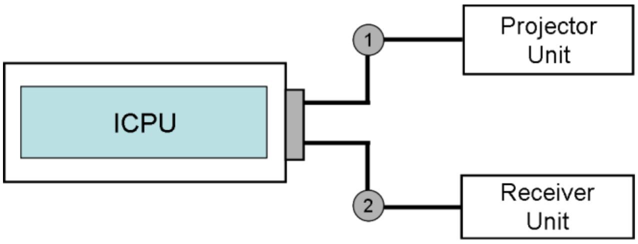


Figure 64: SeaBat 7125 AUV System Cables

- **Projector to ICPU cable (1):** This cable allows power and data to be passed between the projector and ICPU. This cable has a standard length of three meters and a minimum bend radius of 63.5mm.
- **Receiver to ICPU cable (2):** This cable allows power and data to be passed between the receiver and ICPU. This cable has a standard length of three meters and a minimum bend radius of 63.5mm.

B.5.2 AUV Interface Cables

- **ICPU to AUV cable:** An optional pigtail cable allows for power and data to be passed between the ICPU and the AUV systems. This cable is 5 meters in length and has a minimum bend radius of 152.4mm.

B.6 Wet-End Mounting

- Take care that the sonar head assembly is electrically isolated from the structure to avoid corrosion problems.
- The head should be immersed in water to a depth of at least 0.8m. This ensures that noise from surface waves and turbulence generated by the mounting structure does not degrade performance.

NOTE
The sonar head is not designed to be hydrodynamic at speeds in excess of two knots. Vibration and oscillation will become evident, if the projector and receiver are not rigidly mounted. To minimize the unsupported length, place a support as close to the waterline as possible. Fairings can also be used to improve hydrodynamic performance.

B.7 Sonar Head Assembly Orientation

The sonar head assembly should be mounted with the faces of the arrays oriented vertically downwards. Ideally, the receiver is mounted across track, while the projector (or projectors) is mounted along track and aft of the receiver. If necessary, the projector may be oriented forward or the head rotated away from vertical with allowances made in the processor setup and data acquisition software.

CAUTION
An alternate mounting makes the projector more susceptible to impact damage and collection of trailing debris.

- The faces of the projector and receiver must be aligned in the vertical (“Z”) plane within +/-2.0mm.
- The alignment along-ship (“Y”) plane and across-ship (“X”) plane should be within +/-250.0mm.

NOTE
To ensure proper beamforming, the receiver unit must be mounted with the connector oriented to the port (left) side of the vehicle on which it has been installed.

The actual sonar head assembly installation must be reflected in the user interface settings (see also *section 4.2.3 Hardware Configuration*).

B.8 Sonar Reference Point

The following axis convention is applied for the sonar reference point convention.

- X = across ship
- Y = along ship
- Z = vertical (up-down)

There is a single sonar reference point to which all output is related. This point is normally defined in the data acquisition software as a node or offset point. The point is in the center of the receiver face in both X and Z directions and in the center of the projector in the Y direction. For details, refer to *Figure 75* and *Figure 76*. It is important to note that the sonar reference point may not be a physical point on the sonar system.

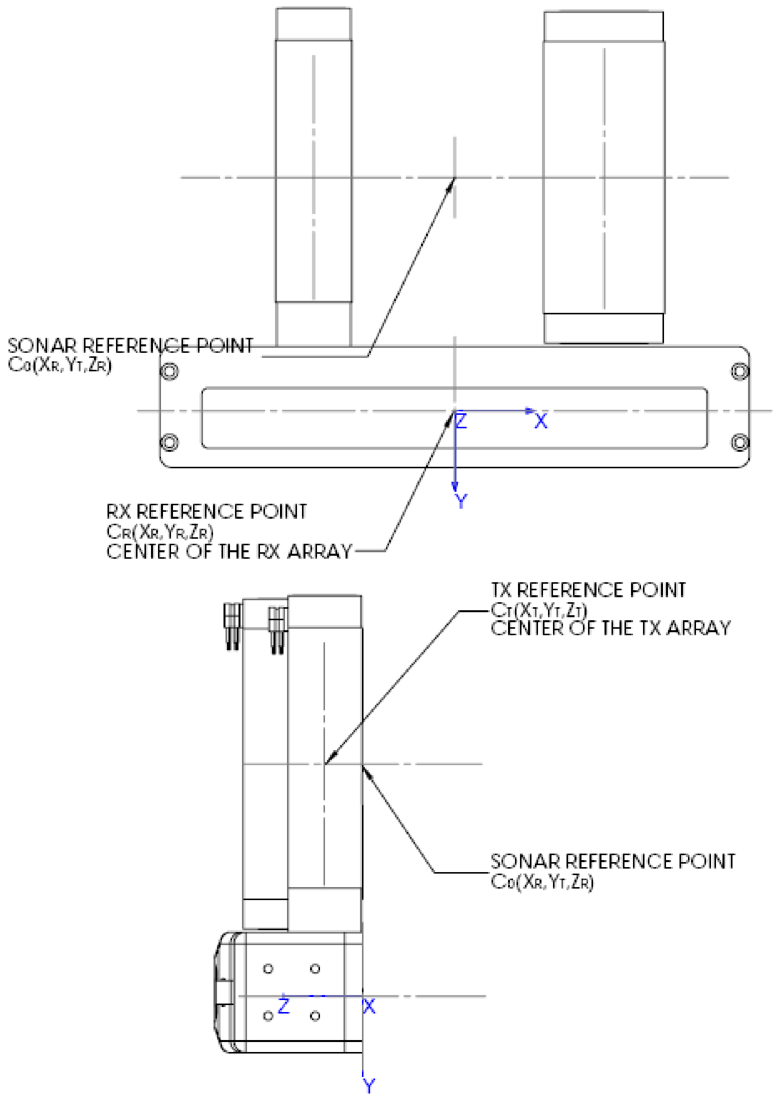


Figure 65: Sonar Reference Point

B.9 Wet-End Cable Connections

- The cable connections from the receiver unit and projector units to the ICPU should be made prior to immersing the unit in water.
- A light lubrication coating on the connector face will ensure sealing (see *section 2.2.2.2 Wet-End Connectors*).
- Unused connectors should be sealed with dummy plugs.
- Verify that all cables are securely fastened and that strain relief is provided to prevent cable damage.

CAUTION
Take care to avoid impact to the projector unit and receiver unit faces, as damage could degrade system performance.

To avoid damage to the system components, the ICPU connections **must** be made in of the two following ways (depending on installation):

- **Connector J2:**
  Receiver to ICPU cable
- **Connector J3:**
  Projector to ICPU cable

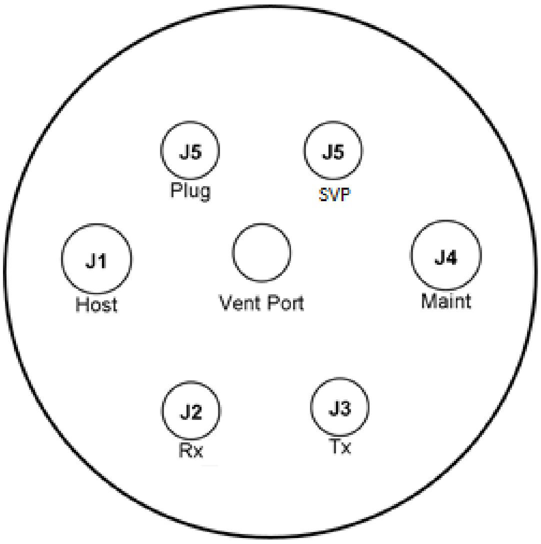


Figure 66: ICPU Pressure Bottle Connections

AUX: Auxiliary signals for timing and sync

DC PWR: DC Power to the ICPU and chassis ground for the ICPU housing

NET 1: Primary Ethernet port for the single board computer

NET 2: Secondary Ethernet port for the single board computer (if one exists)

PROJ 1: Transmitter output signals to drive the primary projector

RCVR: DC power and downlink commands to the receiver, uplink data from the receiver

SER 1: Primary RS232 serial port for the single board computer
(RS422 if converter is installed)

SER 2: Secondary RS232 serial port for the single board computer
(RS422 if converter is installed)

SER 3: SVP serial port with 12V probe power

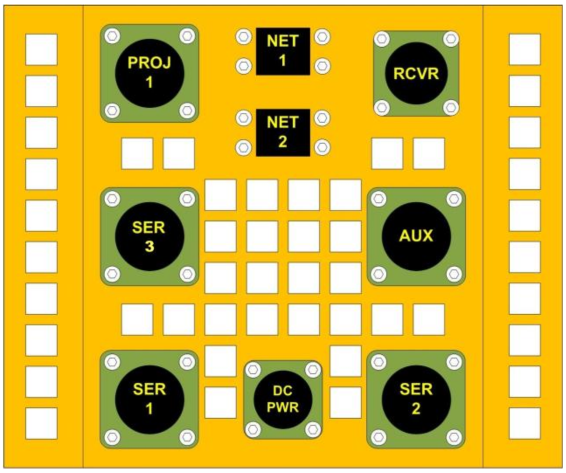


Figure 67: ICPU Connections in Non-pressure Housing Systems

CAUTION
Do not bend the cables beyond the recommended limits when positioning the cables. These cables are very stiff, and a smaller bend radius will damage the cable.

CAUTION
To disconnect wet-end cables from the ICPU, first unscrew the locking sleeves before pulling the cables out.

B.10 System Check

Once the SeaBat 7125 AUV has been installed, follow these steps to ensure that the system is working properly. For information on the settings, see *section 5.8 Sonar Control Tabs*.

NOTE
Communication with the ICPU requires the use of a secondary computer and Windows® Remote Desktop via a crossover Ethernet cable.

1. Ensure that all system cable connections are mated properly.
2. Apply power to the system. The Windows® operating system will boot up and the 7kCenter (sonar control software) will start automatically.
3. With Windows® Remote Desktop Connection, connect to the ICPU using the factory-supplied IP address, user name, and password.
4. Start the SeaBat7k user interface program by double-clicking the icon on the operator desktop.
5. Verify that the Power setting on the Main Sonar Settings tab is set to OFF.
6. Once the system has been energized, follow these steps to verify that the system is operating correctly:
    a. Set the Range to 150.
    b. Set Max Rate to 4.
    c. Set the Gain to 20.
    d. Select Blue-Yellow from the Palette drop-down menu on the Primary Display Settings tab.
    e. Perform a receiver check by vigorously rubbing the face of the receiver unit with fingertips while monitoring the display. A noise pattern should be barely visible on the display.
    f. Gradually increase the Power setting on the Main Sonar Settings tab while an assistant presses an ear against the projector face. Continue to increase the power until the assistant can hear pings (ticking sounds) emitting from the front of the projector to just below FULL for a very short period.
    g. Turn transmit Power to OFF as soon as possible.

CAUTION
Transmitting into air for any period of time may result in the damage of the ceramics of the projector and will result in degraded performance.

APPENDIX C REFERENCE DOCUMENTATION

C.1 SeaBat 7125 AUV Documentation

In addition to this document, the following SeaBat documentation is available in Adobe Portable Document Format (.pdf) for printing.

Document Title	Document Number	Document Description
SeaBat 7125 AUV Operator's Manual	OM15278	Version 2 or higher
SeaBat UI User Manual	OM14950	Version 1.0.0 or higher
Data Format Definition	11542	Version 2.22 or higher

Each system contains a link in the Start menu to system documentation.

To access these documents click Start | Reson Documentation and a list of documents appears.

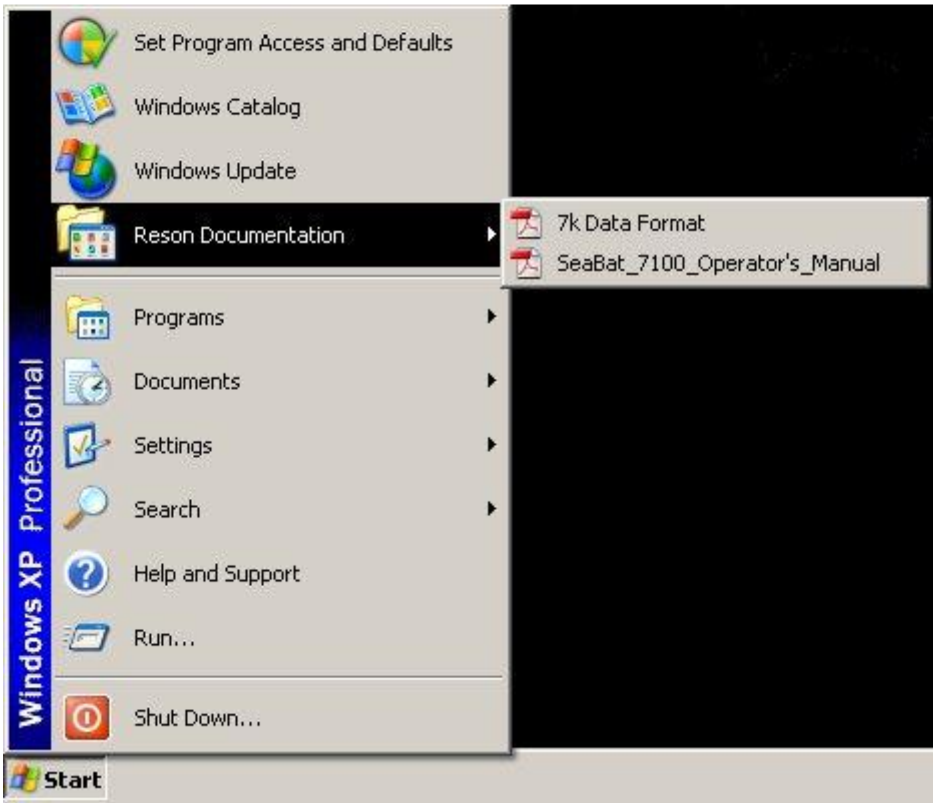


Figure 68: System Documentation Link (Example Only)

C.2 SeaBat 7125 AUV Design Documents

The following design documents and drawings are provided for reference purposes.

Document Title	Document Number
Outline Receiver, EM7216 7125/28	7216M011
TC2160 Outline dimension	2160M011
TC2163 Outline dimension	2163M011
Cable Assembly, Rx, HD-PV, Water Blocked, 7k	85001851B011
Cable Assembly, Tx, HD-PV, Water Blocked, 7k	85001850B011
Cable Assembly, Pigtail, TP, MIL-16-MP, 7k (optional)	12019
General Sonar Reference Point Definition	GD12899

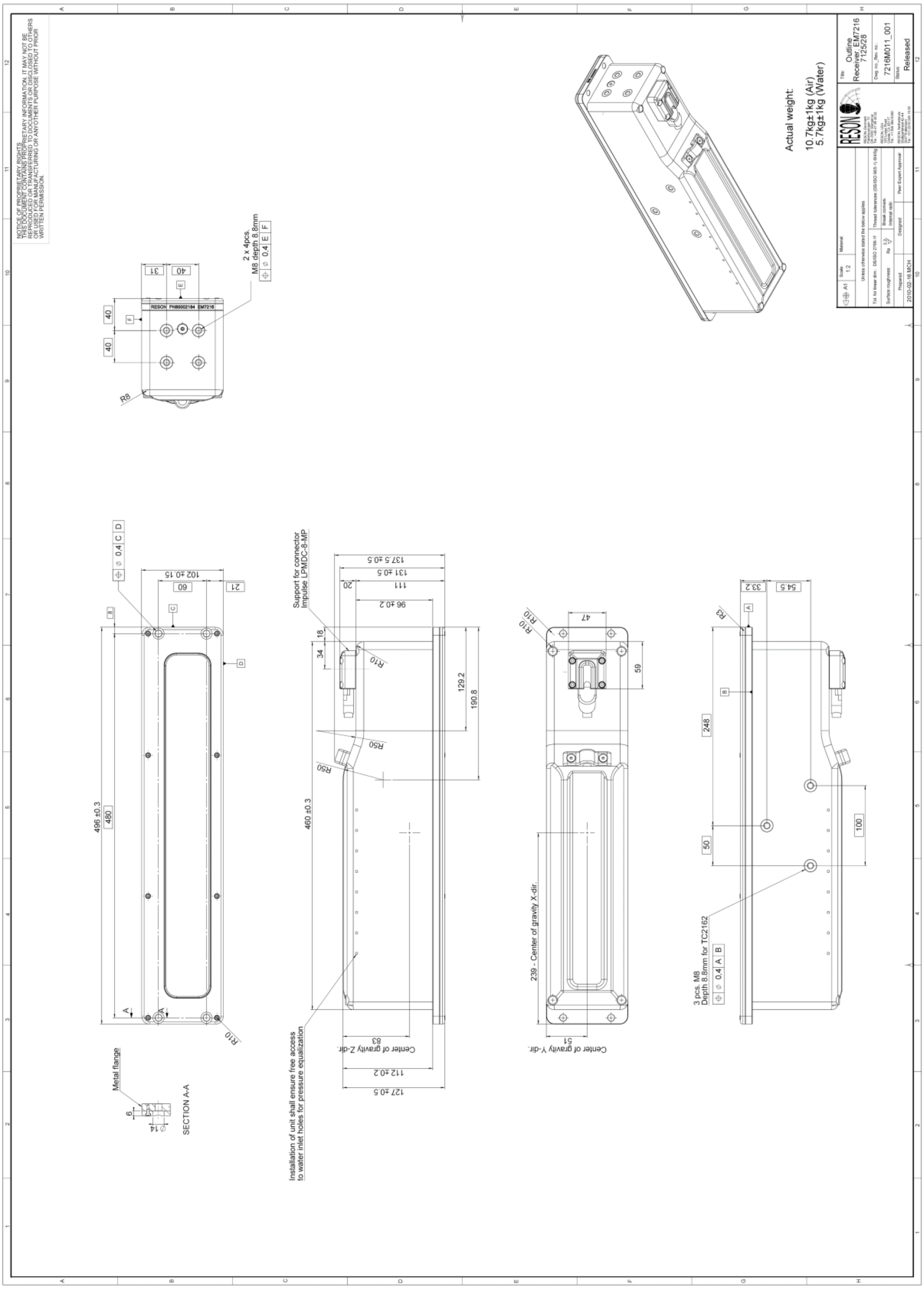


Figure 69: EM 7216 Outline Dimensions (new receiver)

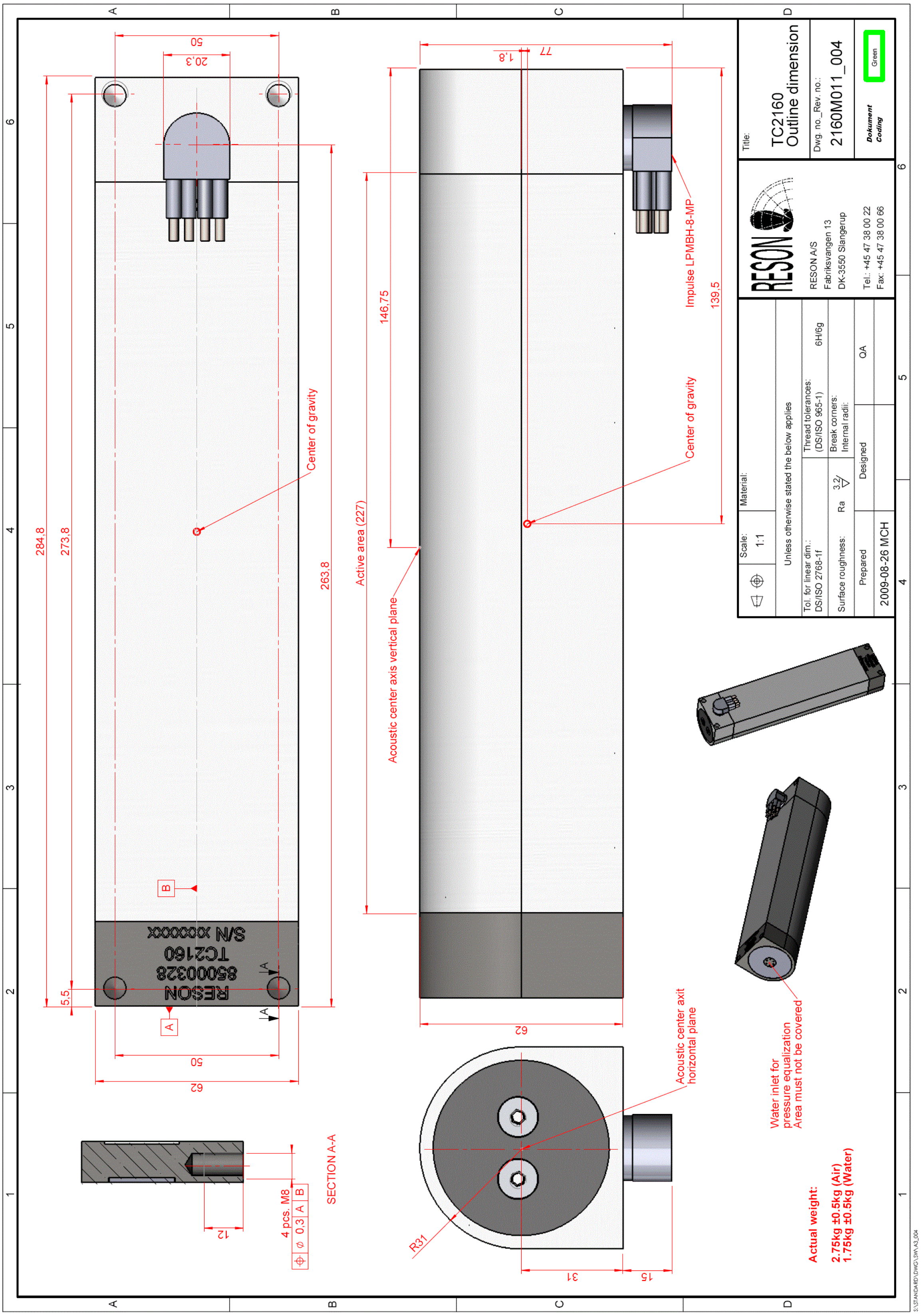


Figure 70: Projector, TC 2160 Outline Dimensions

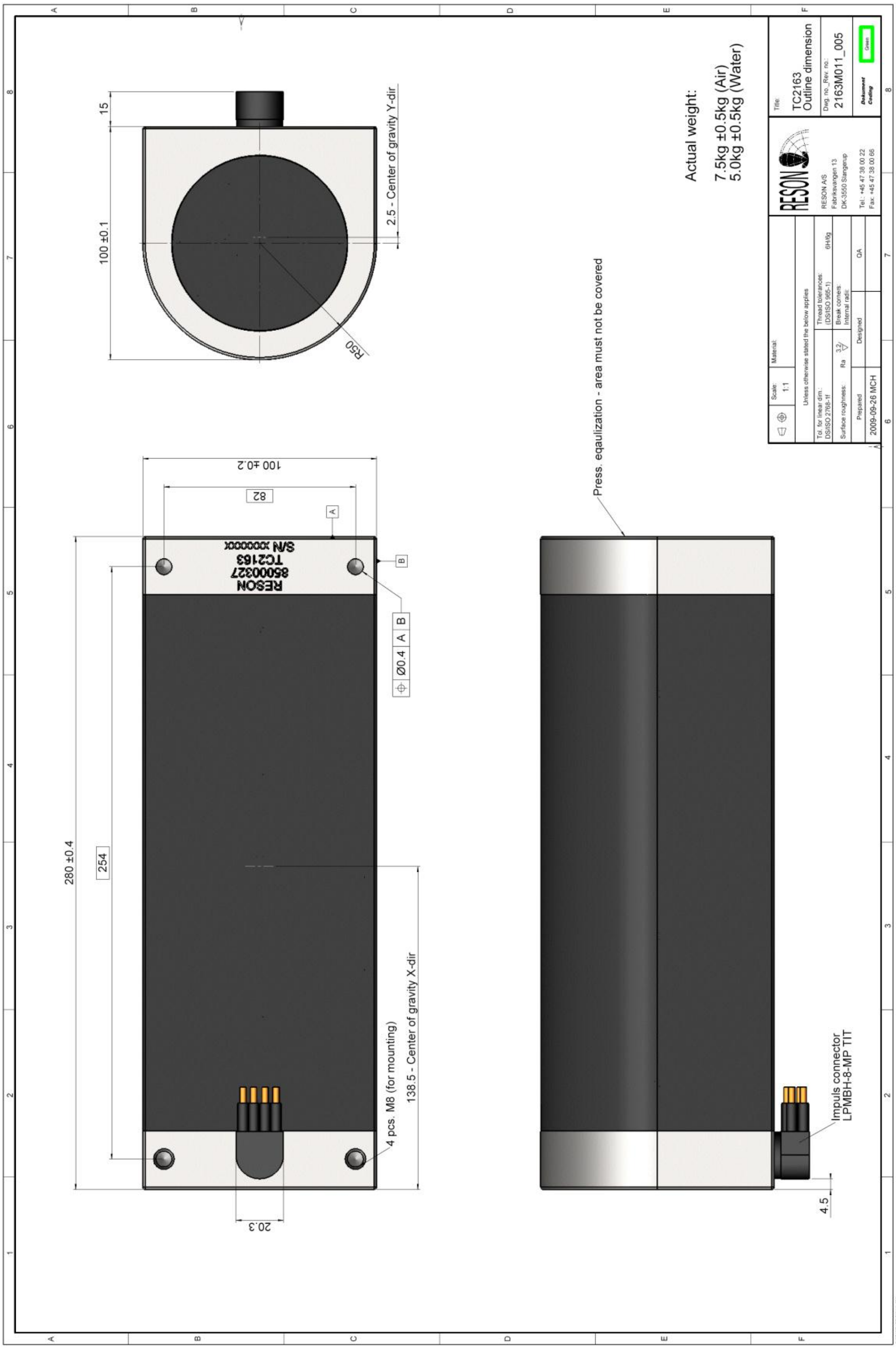


Figure 71: Projector, TC 2163 Outline Dimensions

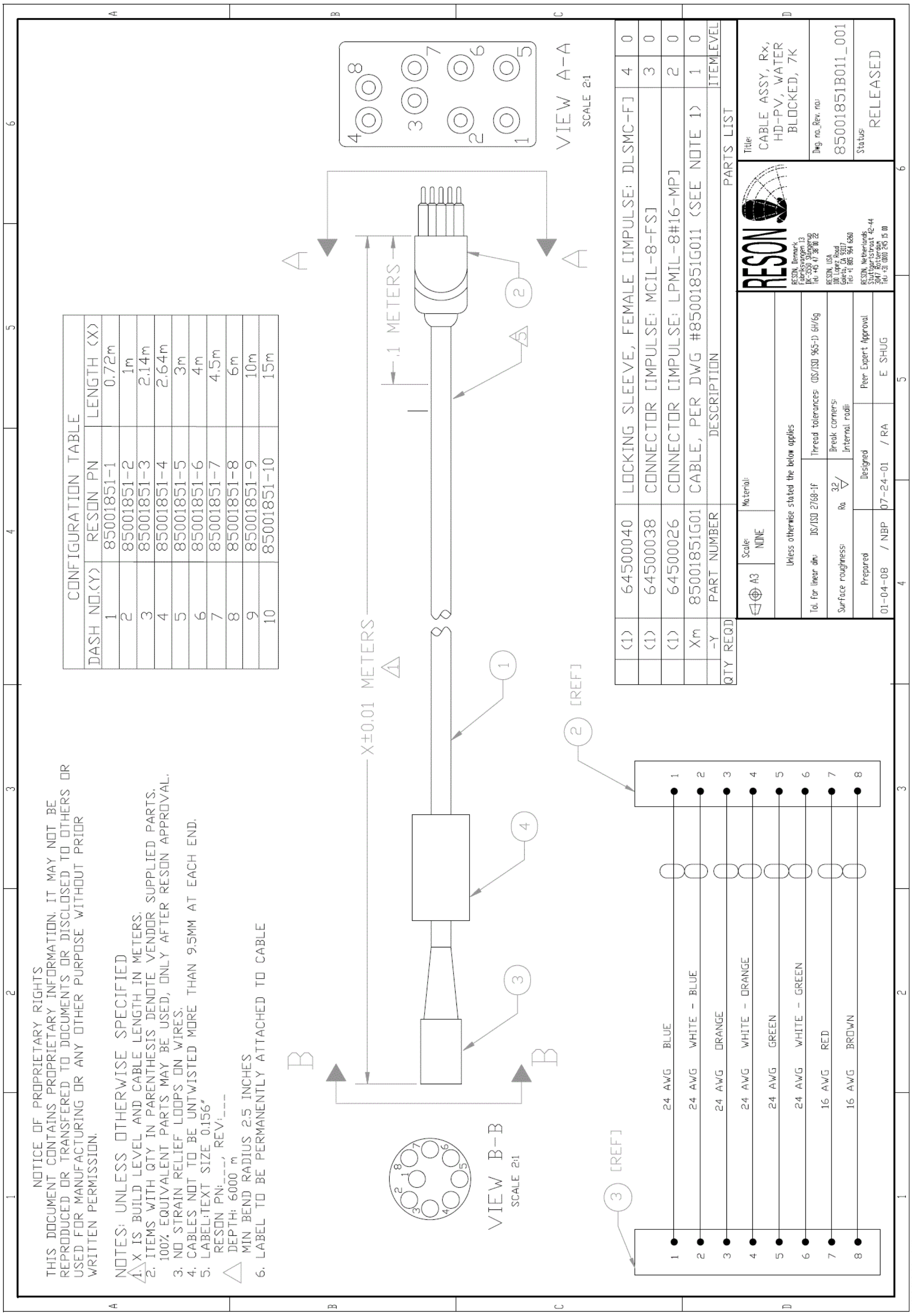


Figure 72: Cable Assembly, Receiver to ICPU

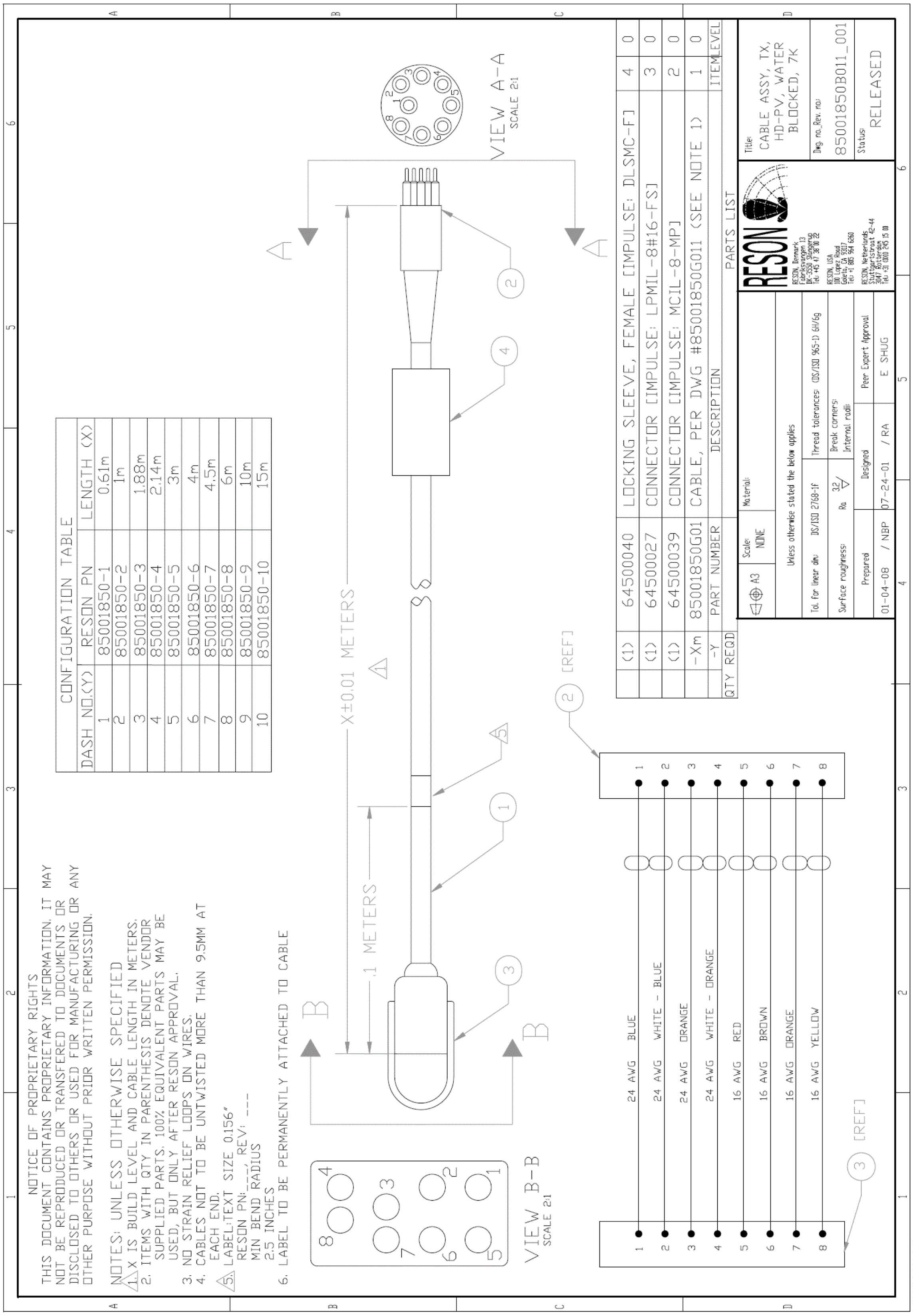


Figure 73: Cable Assembly, Projector to ICPU

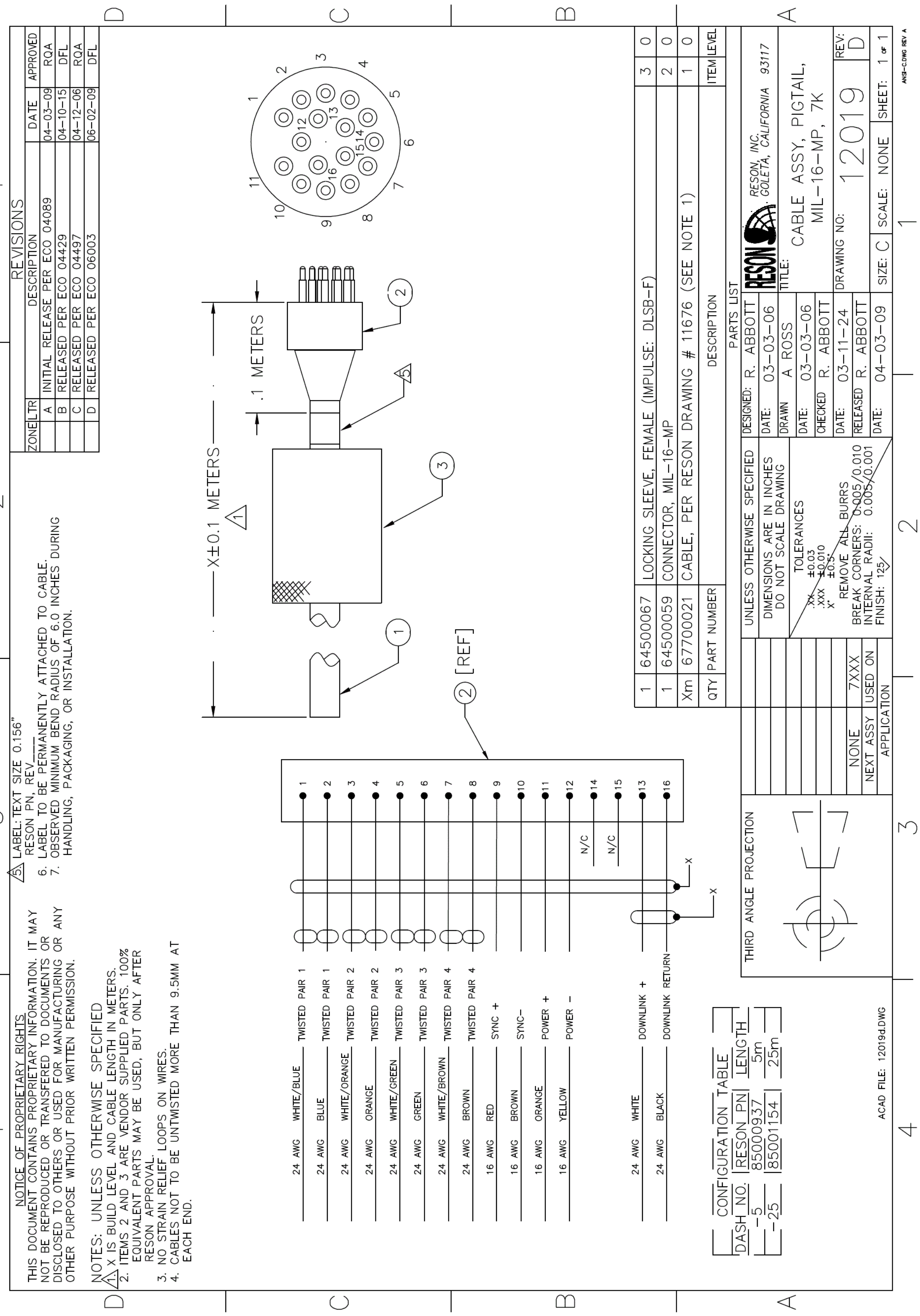


Figure 74: Cable Assembly, Pigtail, ICPU to AUV (optional)

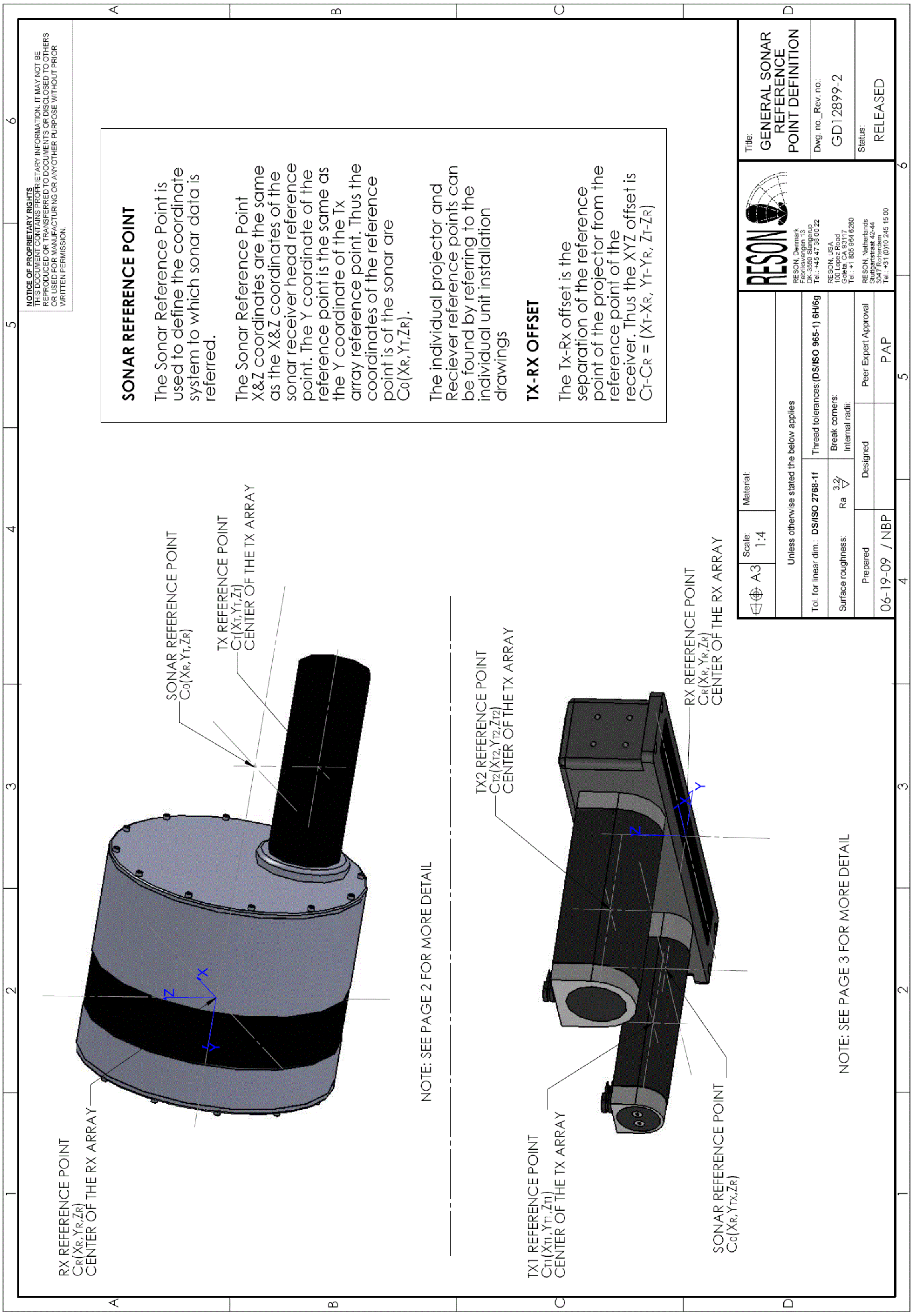


Figure 75: Sonar Reference Point Definition, sheet 1

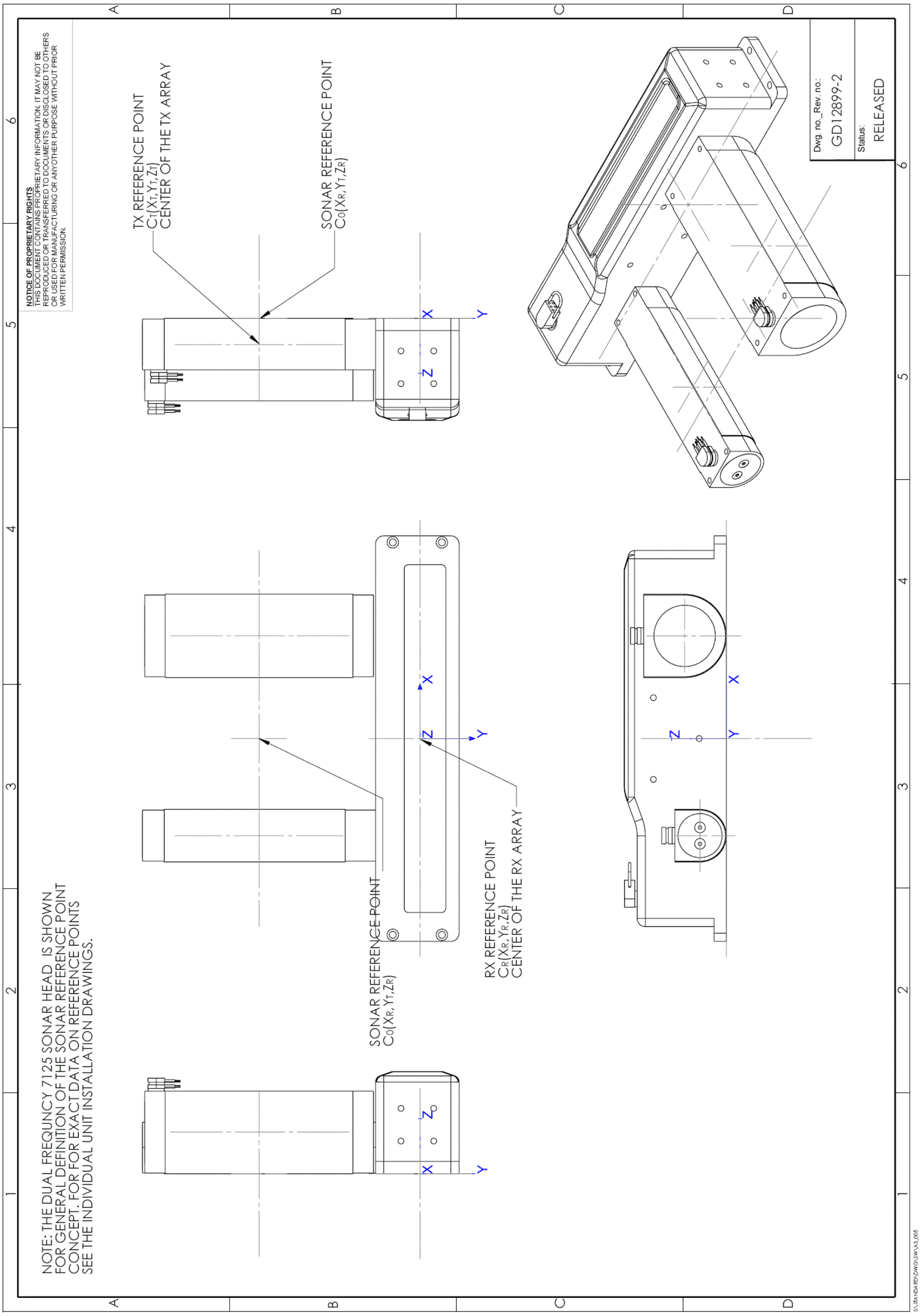


Figure 76: Sonar Reference Point Definition, sheet 2

APPENDIX D SYSTEM OPTIONS

The following options are available with the SeaBat 7125 AUV system. If you require more detailed information about any of these options, please contact Teledyne RESON Sales for assistance.

- Extended Warranty Contract
- External RAID Drive
- PDS2000 Data Acquisition Software
- SeaBat Cables
- Service and Support Agreements
- Sound Velocity Probe
- System Integration and Training
- Titanium Pressure Housing

D.1 Extended Warranty Contract

All SeaBat™ systems are provided with a standard twelve-month warranty (see *Appendix F Warranty Information*). This option provides the user with the possibility of purchasing additional annual support.

D.2 External RAID Drive

A one Terabyte (TB) external RAID hard disk array may be purchased to offer additional storage space for the data recording function.

Figure 77: RAID Hard Disk Array

Table 9: RAID Hard Disk Array Technical Specifications

Specification	Value
Form factor	1U, 19-inch rack mount with rails
Base capacity	1.0 Terabyte
Protocol support	CIFS, NFS, NCP, HTTP, and FTP
Max RAID capacity	1.0 Terabyte
Operating system	Windows® Storage Server 2003
Processor	Intel Pentium 4 2.8GHz at 800MHz 1MB
Memory	512MB Dual Channel DDR400 SDRAM
RAID environment	Integrated Marvell 4 port RAID controller
Hot swap	4 bays

Specification	Value
Included drives	4 x 250GB SATA 8MB Cache
Ethernet	Dual Intel Gigabit controller 2x 10/100/1000
Load balancing	Load balancing, teaming and failover
Power supply	350W

D.3 PDS2000 Data Acquisition Software

Teledyne RESON PDS2000 software provides a wealth of displays and data processing options. The software can be configured to run on a separate computer with direct network interface to the sonar. PDS2000 also handles all commonly interfaced sensors.

For further information, please refer to the appropriate manual.

D.4 SeaBat Cables

Additional standard- or non-standard-length cables are available for purchase.

D.5 Service and Support Agreements

Service and Support Agreements (SSA) run for annual terms of 12 months at a time, and cover a wide range of services as listed here:

- Telephone and email support
- Product and software fault repair services
- Software and firmware updates
- Annual system health check
- Backup system (availability depending on system)
- Spare part allowance
- Factory refurbishment (preventive maintenance procedure)

D.6 Sound Velocity Probe

To ensure proper beam steering, the sonar requires the input of the local sound velocity in the area of the transmitter and receiver arrays. The sound velocity probe (SVP) is used to continuously report this value to the processor unit.

The unit described below may be purchased from Teledyne RESON as an option, or a SVP of similar specifications may be supplied by the customer.

Table 10: SVP Technical Specifications

Specification	Value
Type	SVP 70
Sound velocity	Range: 1350-1800m/s Resolution: 0.01m/s Accuracy: ±0.05m/s (0-50m) Accuracy: ±0.25m/s (0-6000m)
Sampling rate	20Hz and lower, programmable
Depth	6000m
Baud rate	2400-115200
Supply	9-55VDC
Power	2w
Housing	Titanium
Dimensions	Diameter: 44mm (max) Length: 165mm (excl. connector) End cap height: 69mm (max)
Weight	1.0kg (excl. cable)
Temperature	-20° to +55°C

D.7 System Integration and Training

Onsite installation, integration with a data acquisition system, calibration, and training of operating personnel are available from Teledyne RESON.

D.8 Titanium Pressure Housing for ICPU

The optional titanium pressure housing for the Integrated Control and Processor Unit has a depth rating of 6000 meters.

Table 11 below contains technical specifications of the Integrated Control and Processor Unit (ICPU) and its pressure housing:

Figure 78: ICPU in Pressure Housing

Table 11: ICPU Technical Specifications

Specification	Value
Power requirements	42-54VDC, 300W max (FM), average 180W (CW)
Data communication	Gigabit Ethernet
Dimensions	Length: 702mm Diameter: 230mm
Weight	Air: 37.9kg Water: 12.0kg
Depth rating	6000m (3500m if connectors not mated)
Temperature	Operating: -2° to +40°C Storage: -30° to +55°C

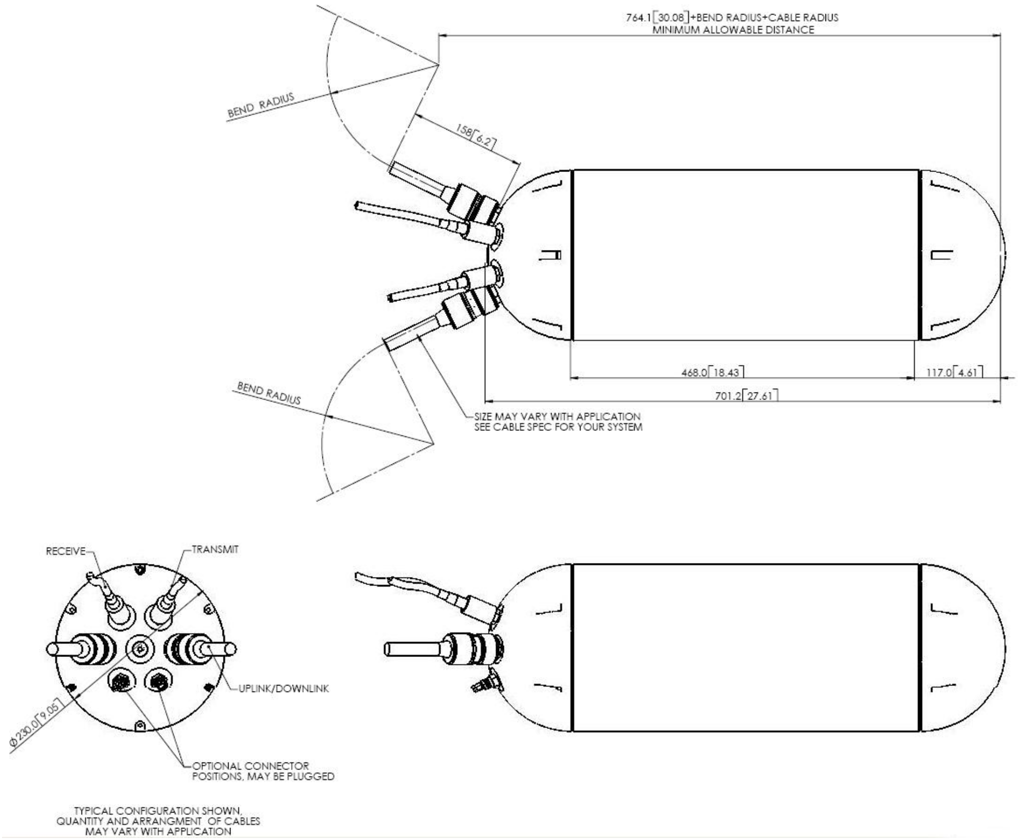


Figure 79: Optional ICPU Pressure Housing Dimensions

APPENDIX E AVAILABLE SYSTEM CONFIGURATIONS

E.1 SeaBat 7125 AUV Configurations

The SeaBat 7125 AUV is available in various configurations based on single or dual frequency and depth rating:

Table 12: SeaBat 7125 AUV Available Configurations

System	Frequency (kHz)	Depth rating (meters)
7125 AUV – single frequency	400 or 200	6000
7125 AUV – dual frequency	200/400	6000

The standard depth rating for the SeaBat 7125 AUV is 400 meters. However, customers requiring a deeper rating can order the system rated to 6000 meters, where a titanium ICPU pressure housing is used instead of the standard aluminum frame.

E.2 Available Features

Each SeaBat 7125 AUV configuration is available with a Base license package and various optional add-on features, the license to each of which will be installed on the system you have purchased.

Table 13: SeaBat 7125 AUV Available Features

Feature	Base	Optional
Channel normalization	✓	
FlexMode		✓
Head tilt	✓	
Manual gates	✓	
Normal mode (Minimum beams)	✓	
Normal mode (Intermediate, Best coverage)	✓	
On the fly frequency change[20]	✓	
On the fly mode selection	✓	
Quality filter	✓	
Roll stabilization	✓	
SeaBat User Interface	✓	
Tracker	✓	
Uncertainty output	✓	
Vari-swath	✓	
Wide mode	✓	
X-Range (FM) (for 400kHz frequency only)		✓
XYZ offsets	✓	
Integrated PDS2000		✓

NOTE
The Base feature package can be upgraded after installation.

[20] Dual-frequency systems only

APPENDIX F WARRANTY INFORMATION

F.1 One Year Limited Warranty

Teledyne RESON warrants your Teledyne RESON system against defects in materials and workmanship for a period of one year from acceptance of the system. During the warranty period, Teledyne RESON will, at its option, either repair or replace components which prove to be defective.

The warranty period begins on the day the system is accepted by the customer. Your Teledyne RESON system must be serviced by the Teledyne RESON office that sold it. The customer shall prepay shipping charges (and shall pay all duty and taxes) for products returned for service. Teledyne RESON shall pay for the return of the products to the customer, not including any duty and taxes.

F.2 Exclusions

The warranty on your Teledyne RESON system shall not apply to defects resulting from:

- Improper use.
- Improper or inadequate installation or maintenance by the customer.
- Unauthorized modifications, alterations, or repairs.
- Accidental damage.
- Improper storage or transportation.
- Operation outside the environmental specifications of the product.
- Improper site preparation or maintenance.
- Opening of any parts of the equipment by anyone other than a Teledyne RESON authorized service facility.
- Service provided by anyone but a Teledyne RESON authorized service facility (see *section F.6 below*).

F.3 Warranty Limitations

The warranty set forth above is exclusive and no other warranty, whether written or oral, is express or implied. Teledyne RESON specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

F.4 Servicing During Warranty Period

If your system should fail during the warranty period, please contact your nearest Teledyne RESON representative immediately (see *section F.6 below*) to protect your warranty rights.

F.5 Equipment Return Procedure

Before returning any equipment for service, you must follow the Teledyne RESON equipment return procedure stated below:

1. Contact a Teledyne RESON office to obtain an approved Return Material Authorization (RMA) number.
2. Follow the instructions in the supplied document and pack the equipment in the original shipping containers.
3. Ship the equipment to your Teledyne RESON representative to the applicable address.
4. Ensure that the RMA number is included on all shipping documents and, most importantly, marked on the shipping container's address label.
5. Include a note with a brief, but thorough, description of the problem.

F.6 Service

If you are experiencing difficulty with your Teledyne RESON system, please contact Teledyne RESON Service Department at one of the following addresses for further instructions:

DENMARK
Teledyne RESON A/S
Fabriksvangen 13
3550 Slangerup
Denmark
Tel: +45 47 38 00 22
e-mail: support@teledyne-reson.com

UNITED STATES
Teledyne RESON, Inc.
100 Lopez Road
Goleta, CA 93117
USA
Tel: +1 805 964 6260
e-mail: support@teledyne-reson.com

APPENDIX G GLOSSARY OF TERMS

Entry	Definition
7k	SeaBat 7000 series of multibeam sonars
AUV	Autonomous Underwater Vehicle
BITE	Built-In Test Environment
CE	Conformité Européenne
CFE	customer-furnished equipment
CW	Continuous wave
Cylindrical loss	The loss of sound by spreading in the form of a cylinder
DAC	Data Acquisition System
DFD	Data Format Definition
DWG	Drawing
EA	Equiangular
ED	Equidistant
FP	Feature package
FM	Frequency modulation
GUI	Graphical User Interface
ICPU	Integrated Control and Processor Unit
KVM	Keyboard/video/mouse
LED	light-emitting diode
MR	Maintenance Release
MSDS	Material Safety Data Sheet
N/A	not available or not applicable
PDS	Product Data Sheet
PN	Part Number
PSU	Power Supply Unit
RDC	Receiver Digital Controller
RH	relative humidity
RMA	Return Material Authorization
ROV	Remotely Operated Vehicle
Rx	receiver
SB	SeaBat
SNR	signal-to-noise ratio

Entry	Definition
Spherical loss	The loss of sound by spreading in the form of a sphere
SPU	Sonar Processing (or Processor) Unit
SV	sound velocity (or surface vessel)
SVP	Sound Velocity Probe
TBD	To Be Defined
TPU	Total Propagated Uncertainty (previously Error)
TVG	Time-Varied Gain is a control intended to vary the gain of an amplifier over a predetermined time period (usually from a low to a high gain state)
Tx	transmitter
UI	user interface
UUV	Unmanned Underwater Vehicle
VCC	Vehicle Control Computer
WEEE	Waste Electrical and Electronic Equipment
ZDA	Time and date identifier

SeaBat 7125 AUV Operator's Manual

Produced by

Teledyne RESON A/S
Fabriksvangen 13
3550 Slangerup
Denmark

Tel: +45 47 38 00 22
Fax: +45 47 38 00 66

Document Number: OM15278-3
Part Number: 86010146