

SeaBat 8160
Multibeam Echo Sounder System
OPERATOR'S MANUAL



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1 INTRODUCTION

1.1 System Overview

The SeaBat 8160 is a 50kHz Multibeam Echo Sounder (MBES) system that measures relative water depths across a wide swath perpendicular to a vessel's track.

1.2 How to Use this Manual

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 the SeaBat 8160 system.

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

1.2.1 Standards of Measurement

All physical measurements represented in this document are based on the metric system. All temperatures are represented in degrees Celsius. Conversion tables may be found in *Appendix H Weights and Measures*.

1.2.2 Document Conventions

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

Table 1: Document Conventions

Convention	Definition
<i>Hyperlink</i>	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.

1.2.3 Notes and Warnings

All notes and warnings will be shown in the following format:

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 RESON system.

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

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

1.2.4 Chapter Arrangement

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

The following information is present in every RESON manual:

- **Introduction:** This section provides a short summary of your SeaBat™ system, as well as information as to how the manual may best be interpreted.
- **System Components:** This section provides information and technical specifications for each component of your SeaBat™ system.
- **Safety Precautions:** This section provides important safety information about your SeaBat™ system.
- **Installation Instructions:** This section provides detailed installation instructions for your SeaBat™ system.
- **System Operation:** This section provides detailed instructions for the operation of the software and hardware included with your SeaBat™ system.

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

- **Depth Gates and Head Tilt:** Detailed discussion of depth gates in relation to head tilt.
- **System Ping Rates:** Table of ping rates provided to aid in calculation of sounding density.
- **Interface Specifications:** Details as to the hardware and data interfaces applicable to this SeaBat™ system.
- **System Drawings:** Detailed design drawings of system components.
- **Options and Upgrades:** A brief listing of options and upgrades available with your SeaBat™ system.
- **Snippets / Sidescan Backscatter:** Detailed discussion of the snippets and sidescan functionality.
- **Warranty Information:** Information as to the standard warranty that comes with your SeaBat™ system.
- **Weights and Measures:** Standard conversions between the metric and imperial systems of measurement.
- **Glossary of Terms:** Definitions of acronyms and technical terms used in this manual.

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

2 SYSTEM COMPONENTS

2.1 Chapter Overview

This chapter outlines basic information and technical specifications for the components of your SeaBat 8160 system.

2.2 Sonar Processor

The sonar processor is a dedicated computer that is responsible for the following functions:

- Sends DC power and control signals to the transceiver unit.
- Receives digitized hydrophone signals and separates them into their component parts for beamforming and processing.
- Beamforms the received hydrophone signals.
- Processes the beamformed signals to produce bottom range information for each beam.
- Manages seafloor bottom detection, graphical user interface, and serial communications.
- Processes bottom detection data for export to peripheral systems such as bathymetric Data Acquisition Systems.
- Receives and processes operator input.
- Generates the graphical display.

2.2.1 Technical Specifications

The technical specifications of the sonar processor are listed in *Table 2*:

Table 2: Sonar Processor Technical Specifications

Specification	Value
Power Requirements	90 to 260VAC, 50/60Hz, 200W Maximum
Video Output	S-VGA, 800x600 @ 72Hz refresh rate
Display Format	S-VGA (default) or S-Video* Auxiliary outputs are RGB or Composite*

Specification	Value
Graphics Colors	256 (8-bit) Other graphics: 8-bit RGB
Input Device	Trackball, mouse, or remote commands
Mounting	19-inch rack
Dimensions	Width: 483mm Length: 496mm Height: 177mm (See <i>Figure 1</i> for details.)
Weight	20kg
Temperature	Operating: 0° to +40° C Storage: -30° to +55° C

* S-Video and Auxiliary outputs can be either NTSC or PAL format.

2.2.2 Illustrations

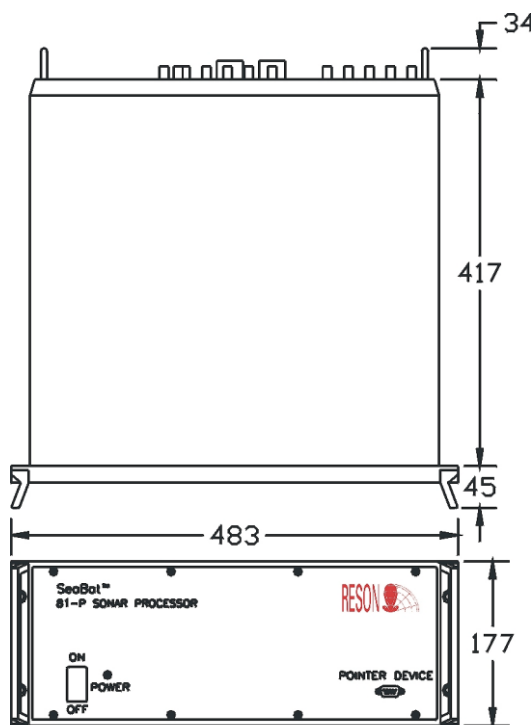


Figure 1: Sonar Processor Dimensions

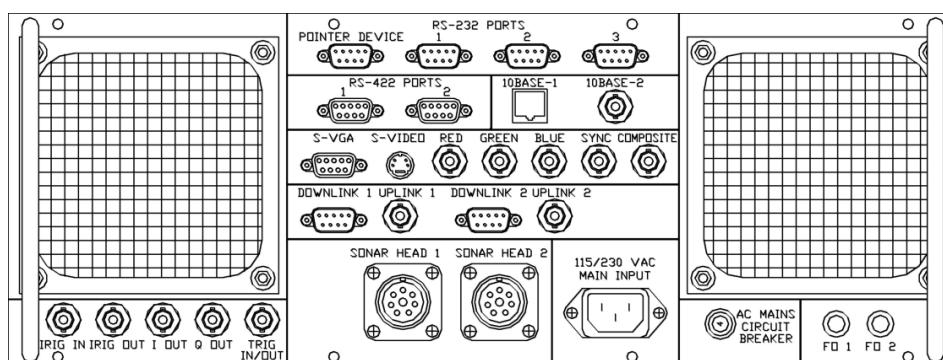


Figure 2: Sonar Processor Rear Panel

2.3 Transceiver Unit

The transceiver unit contains the system transmitter and receiver boards and is responsible for the following functions:

- Generates a synthesized calibration signal at power-on and injects it into the receivers for use by the sonar processor.
- Generates the transmit pulse and sends it to the projector array.
- Receives reflected acoustic pulses from the receive array.
- Amplifies, band-shifts, and multiplexes hydrophone signals, then sends them to the sonar processor via the signal and control cable.

NOTE

The only operator control on the transceiver unit is the On/Off power isolation switch on the rear panel. Once this switch is set to “On,” all power is controlled by the sonar processor.

2.3.1 Technical Specifications

The technical specifications of the transceiver unit are listed in *Table 3*.

Table 3: Transceiver Unit, Technical Specifications

Specification	Value
Power Requirements	24VDC (from sonar processor)
Mounting	19-inch rack

Specification	Value
Dimensions	Width: 483mm
	Length: 497mm
	Height: 267mm
	(See <i>Figure 3</i> for details)
Weight	13.6kg
Temperature	Operating: 0° to +40° C
	Storage: -30° to +55° C

2.3.2 Illustrations

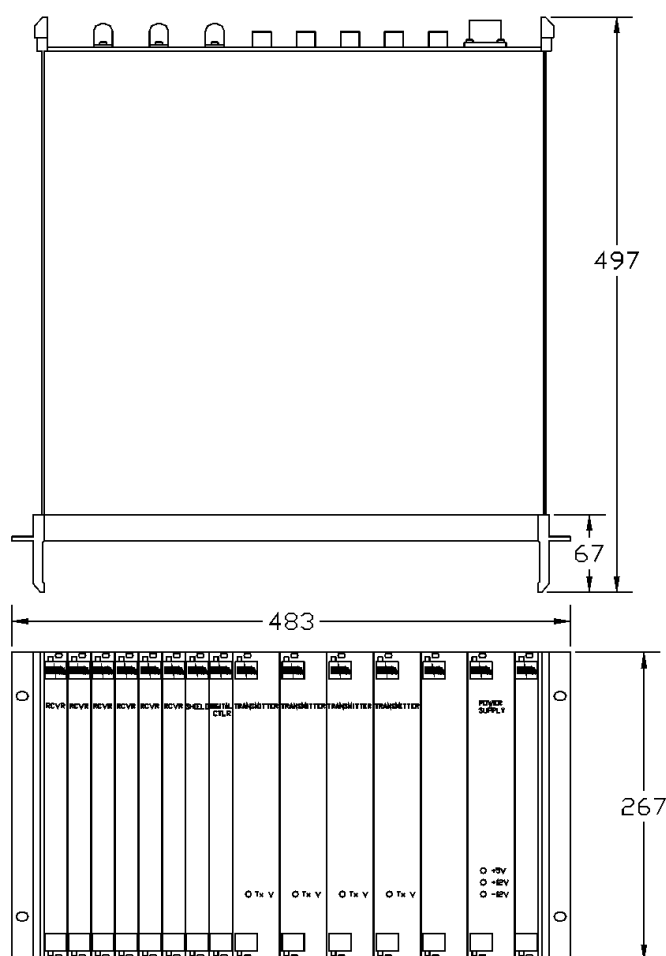


Figure 3: Transceiver Unit, Dimensions



Figure 4: Transceiver Unit

2.4 Processor to Transceiver Interconnection Cable

The processor to transceiver interconnection cable is a multiconductor cable that provides a power, signal, and control interface between the sonar processor and the transceiver unit. The standard cable length is 20 meters. Longer cables (up to 150 meters) may be ordered from RESON and will require adjustments to the hardware.

2.5 Sonar Array

The sonar array transmits acoustic energy then receives the returning signal, pre-amplifies it, and sends it to the transceiver unit. There are two distinct parts: the transmit array and the receive array, arranged in a “T” configuration (see *section 2.5.2 Illustrations*). Each array has an integrated 15 meter cable for connection to the transceiver unit.

2.5.1 Technical Specifications

The following tables provide information as to the technical specifications of the sonar array:

Table 4: Sonar Array Technical Specifications

Specification	Value	
Material	Molded polyurethane	
Depth Rating	100 meters	
Dimensions	Hydrophone: 127 x 1100 x 82mm Projector: 150 x 1350 x 100.5mm (See <i>Figure 33</i> for details)	
Weight (with integrated cables)	<u>Hydrophone</u> Air: 37kg Salt water: 19kg	<u>Projector</u> Air: 42kg Salt water: 17.5kg
Frequency	50kHz, nominal	
Bottom Detect Range Resolution	≤ 750 meters: 1.4cm 1,000 to 1,500 meters: 2.9cm 1,750 to 5,000 meters: 8.6cm	
Ping Rates	See <i>Appendix B</i>	
Swath Coverage	130° with maximum swath width* of approximately 4 times the water depth.	
Temperature	Operating: -5° to +40° C Storage: -30° to +55° C	

* Maximum swath width is reached at a depth of approximately 1,200 meters. Beyond that depth, the ratio of water depth to swath coverage decreases.

Table 5: Beamforming Specifications

Specification	Value
Across-Track Beam Width (at nadir beam*)	1.5°
Along-Track Beam Width	1.5°, 3.0°, 4.5°, or 6.0° (based on operator selection)
Beam Spacing	1.2°
Beam Pitch Stabilization	$\pm 15^\circ$

Specification	Value
Beam Roll Stabilization	$\pm 20^\circ$
Number of Horizontal Beams	126

* As the beams radiate away from the nadir, their width will increase to as much as 8.0° at the outer edges of the swath.

2.5.2 Illustrations

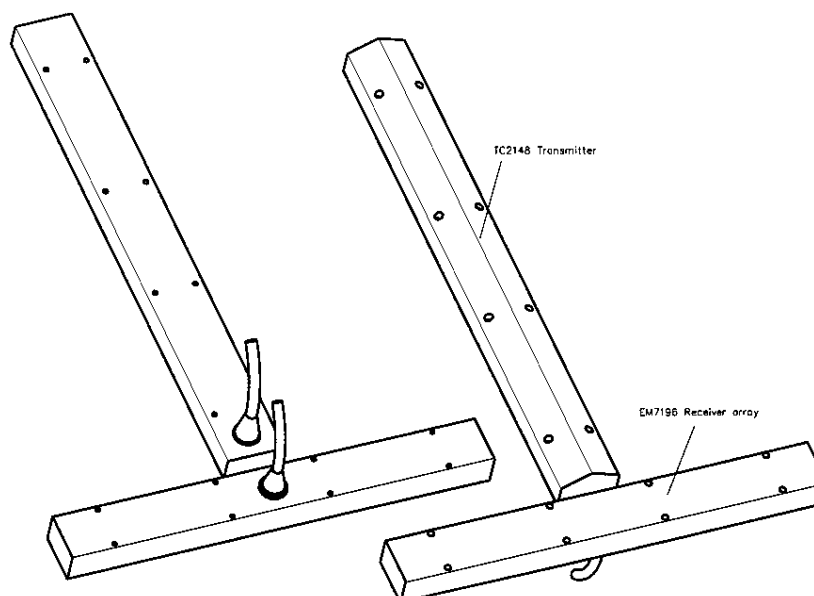


Figure 5: Sonar Array Assembly

2.6 Peripherals

2.6.1 Color S-VGA Monitor

The color monitor supplied with the SeaBat™ system is a standard PC-compatible monitor. Please refer to the manufacturer's user's guide for technical information. Other monitors, for applications requiring NTSC or PAL video, are available as a special option.

2.6.2 Trackball

The trackball supplied with the SeaBat™ system is a three-button unit that has been modified by RESON for use with the sonar processor. In the event of damage or failure, a replacement must be obtained from RESON.

3 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.
 RESON assumes no liability if this product is operated in an unsafe manner.

3.1 Chapter Overview

This chapter contains information as to the safety precautions that should be taken in handling and operating your SeaBat™ system.

3.2 Operator Safety

The SeaBat 8160 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 power on.
- **DO NOT** attempt to open and service the sonar array.
- **DO NOT** operate the system while divers are in the water.
- **DO NOT** touch or handle any internal printed circuit boards without specific instructions from RESON.
- **DO NOT** touch the projector face while the system is in operation, as the high-frequency vibrations can cause bodily harm.

3.3 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.

3.3.1 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 at the rear of the processor or from the sonar head while the processor is running. This can damage internal workings.
- Do not bend cables beyond the recommended limits.
- Do not place the sonar array 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.
- Do not smoke or spill ashes on or near the pointer device.
- Ensure that the equipment is properly secured before putting out to sea.
- While operating in air, set your SeaBat™ system to the lowest possible setting. A higher setting may damage the transmit array ceramics.
- Do not exceed operating and storage temperature limits.

CAUTION

Do not operate transmitters in air except during system checks for short durations.

3.3.2 Cleaning and Maintenance of Projector and Receiver Arrays

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:

SAFETY PRECAUTIONS

- 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 RESON. The antifouling paint will affect the acoustic performance. 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 PDS¹ and MSDS² are acquired prior to commencing the coating work.

¹ Product Data Sheet

² Material Safety Data Sheet

3.4 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, and high-density polyethylene sheets.

NOTE

Contact RESON for additional information on schemes for electrical isolation.

3.5 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.

3.6 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 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 RESON Customer Support (support@reson.com).

4 INSTALLATION INSTRUCTIONS

4.1 Chapter Overview

This chapter outlines basic information and technical specifications for the components of your SeaBat 8160 system.

4.2 Dry End Installation

Following are instructions for use when installing the dry end components of the SeaBat 8160 system.

4.2.1 Sonar Processor

The sonar processor may be either rack- or table-mounted. It must be in an area that is not exposed to the weather, but is within easy reach of both the operator and the 20 meter transceiver to processor interconnection cable. Allow clearance around the unit to provide adequate air circulation and easy access to the power switch.

Once the sonar processor is installed, the only interaction required should be to depress the power switch and energize the system.

4.2.2 Transceiver

Due to the 15 meter length of the sonar array to transceiver cables, the transceiver unit must be installed as close as possible to the sonar array. This may be in a dry, unmanned equipment room as long as the ambient temperature is taken into consideration (see *Table 3: Transceiver Unit, Technical Specifications*).

Allow clearance around the unit to provide adequate air circulation and to allow for connection of cables without the need for sharp bends.

4.2.3 Peripherals

The monitor and track ball are the primary tools for the operator and should be located in a comfortable work area near the sonar processor.

CAUTION

Do not install the monitor in a location near heat sources such as radiators or air ducts, or in a place subject to direct sunlight, excessive dust, mechanical vibration, salt spray, or shock.

Use equipment straps, clamps or other securing devices to ensure that the installation is seaworthy.

4.2.4 Cable Connections

There are several cable connections to be made at the dry end of the installation. These connections are between the sonar processor and its peripheral equipment and between the sonar processor and the transceiver.

The critical connections are shown in *Figure 6* and *Figure 12*. All dry-end cables come with factory-installed connectors and just need to be attached at the appropriate port(s).

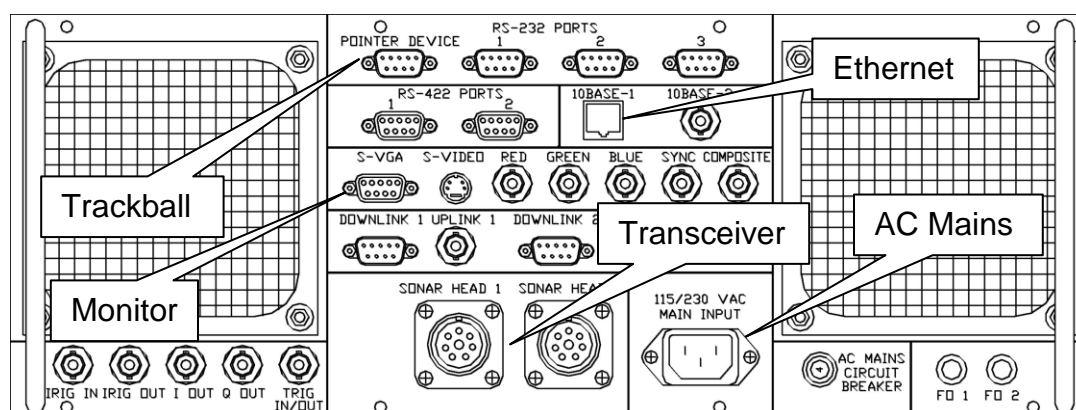


Figure 6: Sonar Processor, Rear Panel

CAUTION

When connecting the transceiver to processor cable, use a minimum bend radius of 125mm or a minimum bend diameter of 250mm. A smaller bend radius will result in damage to the cable.

4.3 Wet End Installation

Following are detailed instructions for use when installing the SeaBat 8160 system in a single-head configuration on a surface vessel. Detailed installation drawings are provided in *Appendix D* for reference.

NOTE

Prior to installation, wrap all dry-end connectors in a protective covering to prevent accumulation of dirt and moisture.

4.3.1 Mounting

The sonar array may be attached to a pole or mounting structure with the supplied mounting bracket, using M10 bolts.

Mounting may be over the side, over the bow, or through a moon pool. The sonar array should be immersed in water to a depth of at least 1.0 meter to ensure that noise from the surface (waves) and turbulence generated by the mounting structure do not degrade performance. The depth should also be sufficient to avoid shadows from the keel, hull or other obstacles.

4.3.2 Fairings

RESON strongly recommends the use of a hydrodynamically faired mounting assembly such as the optional unit shown in *Figure 7* and *Figure 8*.



Figure 7: Sonar Array Faired Mounting Assembly, Bottom View

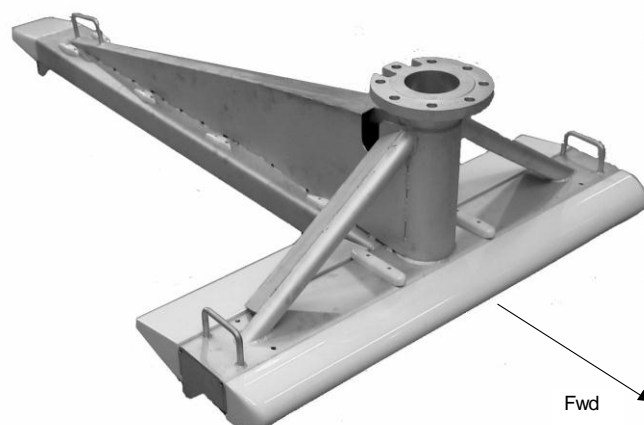


Figure 8: Sonar Array Faired Mounting Assembly, Top View

4.3.3 Orientation

The sonar array should be mounted with the faces of the arrays oriented vertically downwards. In the ideal configuration, the receive array will be mounted across-track, while the transmit array will be mounted along track and aft of the receive array.

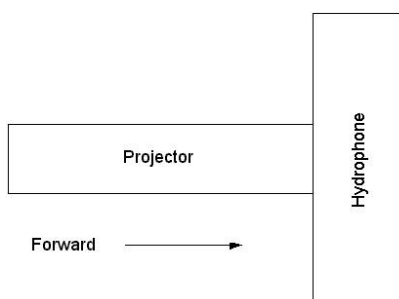
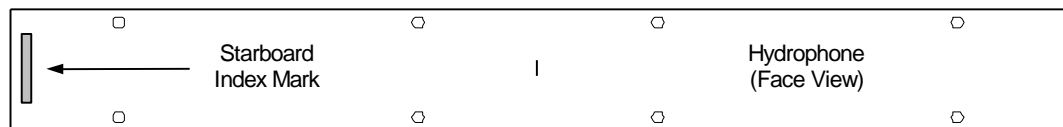


Figure 9: Recommended Sonar Array Orientation

CAUTION	
It is very important that the index mark on the face of the hydrophone be oriented to starboard.	
	
Figure 10: Hydrophone Face with Starboard Index Mark	

4.3.4 Acoustic Center

The acoustic center for the sonar array is located at the exact center of the projector array. This information is required for a Vessel Reference Point (VRP) measurement, as the point to which the offset measurements (in relation to the VRP) are made for the multibeam system.

Figure 11 provides a graphical representation of the acoustic center location. The acoustic center is located inside the projector array, at the intersections of lines “X,” “Y,” and “Z.”

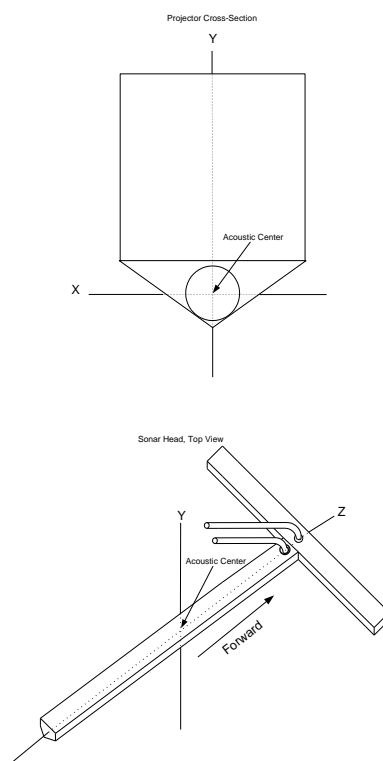


Figure 11: Sonar Array Acoustic Center

4.3.5 Cable Connections

When cables are mated, tighten the retaining screws to prevent accidental separation, and use a cable retaining fixture near the rear panel of the transceiver unit to provide strain relief.

There are eleven possible connect points at the rear of the SeaBat™ transceiver unit (*Figure 12*). These connect points are numbered J1 – J14 (note that J10, J11, and J12 are not used by this system).

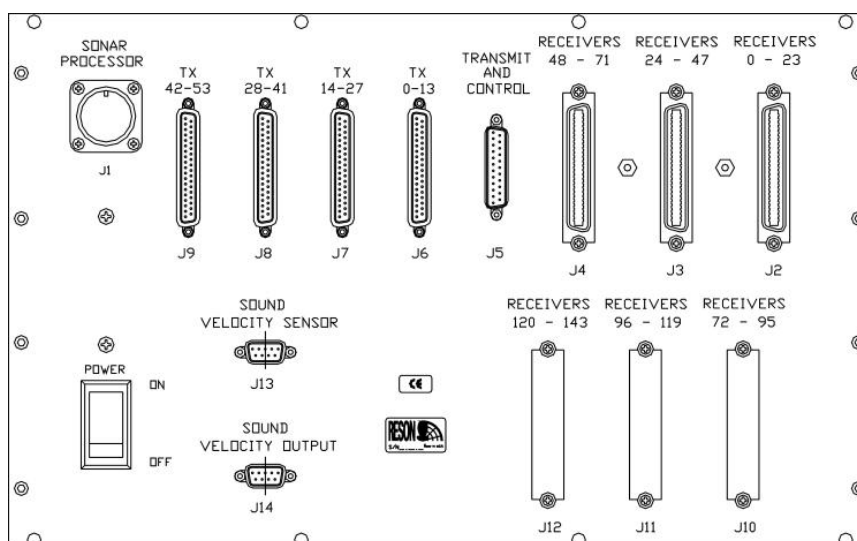


Figure 12: Transceiver Unit, Rear Panel

4.3.5.1 Receive Array Cable

The receive array cable (*Figure 41*) is molded to the receive array at the wet end and splits into four separate connectors at the dry end. Each connector cable will have a plastic collar indicating a connection number that begins with “P”. Each of these numbers will have a corresponding “J” number at the rear of the transceiver.

Example: Connector P5 on the cable matches the “Transmit and Control” Port (J5) on the transceiver rear panel (*Figure 12*).

4.3.5.2 Transmit Array Cable

The transmit array cable (*Figure 42*) is molded to the transmit array at the wet end and splits into four separate connectors at the dry end. Each connector cable will have a plastic collar indicating a connection number that begins with “J.” Each of these numbers will have a corresponding “J” number at the rear of the transceiver.

Example: Connector J6 matches the corresponding “Tx” port (J6) on the transceiver rear panel (*Figure 12*).

CAUTION

Use a minimum bend radius of 250mm or a minimum bend diameter of 500mm when positioning the cables. These cables are very stiff, and a smaller bend radius will result in damage to the cable.

4.3.5.3 Sound Velocity Probe Cable

The Sound Velocity Probe (SVP) is normally connected at the rear panel of the sonar processor. As a convenience, however, the Sound Velocity Probe may be connected to the transceiver rear panel and a second cable fabricated on-site to continue the link to the operating area. This precludes the requirement to have a special cable attached to the sensor.

4.4 System Checkout

Once the components of your SeaBat 8160 system have been installed, follow the steps in this section to ensure that the system is working properly.

1. Ensure all system cable connections are tight.
2. Verify that mains power is available.
3. Energize the monitor.
4. Ensure that the transceiver unit power switch is in the "On" position.
5. Press the power switch on the sonar processor to energize the system.
6. Immediately check the Transmit Power (TxPower) to make certain it is set to off. (Prolonged transmission in air – even at a low setting – will damage the transmit array ceramics.)
7. If a sound velocity probe and/or motion sensor are connected, ensure the data is being correctly read. Do this by accessing the BITE display and reading the values at the Sensor Input field. (See *section 5.3.5 Activate the BITE Display* for instructions.)

Once the system has been energized, perform the following checks to verify that the system is operating correctly:

1. Make certain the Transmit Power is set to "OFF".
2. Set the Range to "100".
3. Set AutoGain to "Off," GainMode to "TVG," and RxGain to "45."
4. Select the "Display" menu and ensure that "Color" is set to "BLU-YEL"
5. Perform a receiver check by vigorously rubbing the face of the receive array with fingertips while monitoring the display. A noise pattern should be visible on the display.
6. Gradually increase the Transmit Power while an assistant listens to the projector. Stop when there is an audible "clicking" sound.

INSTALLATION INSTRUCTIONS

7. While listening to the clicks, slowly decrease the range setting one step at a time. The click rate should increase as the range scale decreases.
8. As soon as the test is complete, turn the Transmit Power (TxPower) to the OFF setting, so as to avoid damage to the transmit array Ceramics.

<i>NOTE</i>
In a noisy environment, it may be difficult to hear the transmission, which should be a series of clicks at an approximate rate of 4Hz on the 100m range.

5 SYSTEM OPERATION

5.1 Chapter Overview

The SeaBat 8160 system is controlled by firmware that has been pre-loaded on the sonar processor. Information with regards to the operation of the firmware is contained in this chapter.

5.2 Start Up Procedure

Once the SeaBat™ hardware has been installed, the system may be started. To do this, press the power buttons on both the sonar processor and color monitor.

Once energized, the sonar processor will start the SeaBat™ firmware and calibrate the electronics associated with each of the ceramic elements in the receive array.

CAUTION

Do not power up, reboot, or calibrate the system when the sonar array is being deployed or retracted. The mechanical noise involved will have a negative impact on the calibration and result in inaccurate results.

5.3 Main Sonar Display Screen

When the software has successfully started, the Main Sonar Display Screen will appear. From this screen, you may complete the following functions:

1. View the sonar image.
2. Check Range and Bearing on the sonar image.
3. Read the Date and Time.
4. Change Menu Settings.
5. Activate the BITE display.

5.3.1 View the Sonar Image

The wedge-shaped image in the center of the main display screen is called the sonar image. This image shows the complete water column (swath) illuminated by a single transmitted “Ping”.

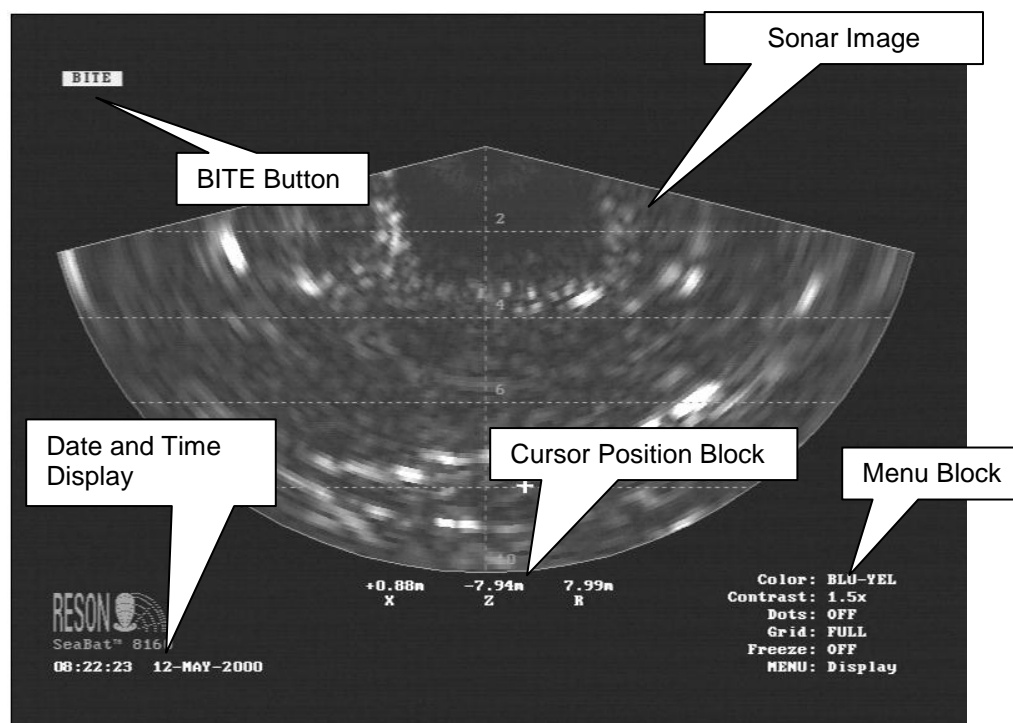


Figure 13: Main Sonar Display Screen

5.3.2 Identify Range and Bearing

Below the sonar image are the Across-Track (“X”), Depth (“Z”) and Range (“R”) of a particular point on the sonar image (see *Figure 13*). The Cursor Position Block will change as the mouse pointer passes over the sonar image, indicating the “X,” “Z,” and “R” of the pointer’s current position on the image.

5.3.3 Date and Time Display

The system date and time are displayed in the lower left corner of the Main Sonar Display (see *Figure 13*). This time is provided by a battery-powered clock/calendar within the sonar processor. To adjust the time setting, see *sections C.3.1.12 Date* and *C.3.1.45 Time*.

5.3.4 Menu Functions

The Menu Block (see *Figure 13*) is the primary control point for the SeaBat 8160 system. To modify items on this menu or on any sub-menus, place the mouse pointer over the item to be modified. A box will appear around the title and value. To change the value:

- Click the right mouse button to increase the value.
- Click the left mouse button to decrease the value.
- Hold the center mouse button while clicking the left or right mouse button to increase or decrease values at a faster rate.

NOTE

There are five separate menus that may be found in the Menu Block. Those are: Main, Ocean, Display, Filters, and Off.

5.3.5 Activate the BITE Display

The SeaBat 8160 includes a Built-In Test Environment (BITE) display that shows diagnostic and configuration information about the current sonar session. The BITE button (see *Figure 13*) will always be one of three colors:

- **Green** indicates normal operation.
- **Yellow** indicates that some levels are out of compliance or improperly calibrated, but the system is still in operation.
- **Red** indicates that the system has malfunctioned and is no longer operational.

To diagnose problems or view status, activate the BITE display by clicking the “BITE” button at the top left corner of the screen. (See *section 5.9 Built-In Test Environment (BITE) Display* for more information on this function.)

5.4 Main Menu

The Main menu is the primary sonar control point. The following functions may be performed from the Main Menu:

1. Set the Range.
2. Change the Ping Rate.
3. Change the Transmit Power.
4. Change the Pulse Width.
5. Change the Receiver Gain.
6. Change the Gain Mode.
7. Activate Automatic Gain.

5.4.1 Set the Range (Range)

The “Range” setting determines how far the SeaBat 8160 will “see”. The range settings are operator selected between 5 and 5,000 meters. See *Appendix B* for available range options and their associated standard ping rates.

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

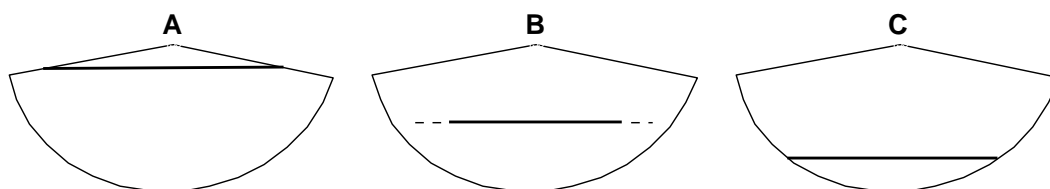


Figure 14: Swath Position

In *Figure 14* above:

- **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.

5.4.2 Change the Ping Rate (MaxRate)

In some instances it may be beneficial to force a lower ping rate than that 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 wishes to

eliminate redundant data; or when the vessel is in a high-reverb environment where echoes of the previous ping are contaminating the current ping.

The “MaxRate” function on the “Main” menu allows the operator to limit the number of Pings Per Second (PPS), making it lower than the standard ping rate for that Range setting. The ping range available is from 0.2 to 15 PPS. See *Appendix B* for available range options and their associated standard ping rates.

5.4.3 Change the Transmit Power (TxPower)

The “TxPower” setting allows the operator to increase or decrease the amount of power (acoustic energy) transmitted into the water. There are multiple increments, from “Off” to “Full”, each accounting for an increase of approximately 3dB. “Full” yields a source level of approximately 225dB 1μPa @ 1m.

5.4.4 Change the Pulse Width (TxPulse)

For a given power setting, a narrower Pulse Width will provide a higher resolution at a shorter range. A wider Pulse Width will provide maximum range with lower resolution image results.

The “TxPulse” setting allows the operator to change the Pulse Width of the transmitted signal. For a standard system, Pulse Widths available are from 0.2ms to 10ms in increments of approximately 0.1ms.

5.4.5 Change the Receiver Gain (RxGain)

The “RxGain” setting allows the operator to select the amount of Receiver Gain applied to the returned sonar signal. The settings available for “RxGain” depend on the Gain Mode (see *section 5.4.6 Change the Gain Mode (Gain Mode)*).

- **Fixed:** If Gain Mode is “Fixed,” the RxGain is selected by the operator as a specific amount.
- **TVG:** When the Gain Mode is “TVG,” the RxGain has a range of 1 to 45 in 1dB steps. The selected gain amount will be applied **in addition to** the calculated gain (see *section 5.4.6 Change the Gain Mode (Gain Mode)*).

These values will change automatically when AutoGain is enabled.

5.4.6 Change the Gain Mode (Gain Mode)

The Gain Mode selection provides the ability to dictate the type of gain that will be applied to the received signal. When switching between Gain Modes, the last gain value selected in each category will be restored upon selection.

The available types of Gain are:

- **Fixed:** This mode applies a specified gain amount that does not vary with time. This is normally only used for very short range operation (less than 10 meters).
- **TVG:** The Time Varied Gain (TVG) mode applies a variable gain to the signal, based upon the following formula:

$$\text{Receiver Gain} = 2 \alpha R + Sp \log R + G$$

Where:

α = Absorption Loss in dB/km Sp = Spreading Loss Coefficient
R = Range in meters G = Extra Gain from RxGain menu item

NOTE

Both the Absorption Loss (α) and Spreading Loss (SP) values may be modified using the “Absorb” and “Spread” items on the “Ocean” menu (see *section 5.5 Ocean Menu*).

5.4.7 Activate Automatic Gain (AutoGain)

The Automatic Receiver Gain function analyzes the bottom return and automatically adjusts the Receiver Gain accordingly. The AutoGain menu item controls the level of signal amplitude threshold to which the sonar return is compared.

Settings are “OFF” through “10” in increments of 1. The lower the selected number the lower the threshold, and the higher the gain setting selected by the sonar processor. A typical setting is “4,” however the optimal setting will vary with bottom type and other environmental conditions.

NOTE

The bottom detect process must have good quality return signals to allow AutoGain to work properly.

5.5 Ocean Menu

The Ocean menu allows for the entry of various correction factors to compensate for changing environmental conditions. With this menu, the operator can:

1. Change the Spreading Loss Coefficient
2. Change the Absorption Loss Value
3. Set the Sound Velocity

5.5.1 Change the Spreading Loss Coefficient (Spread)

This selection 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 60, with a recommended initial value of 30.

This coefficient value is used in conjunction with the Absorption Loss value (see *section 5.5.2 Change the Absorption Loss Value (Absorb)*) to compute the TVG curve applied to the returned signal (see *section 5.4.6 Change the Gain Mode (Gain Mode)*).

5.5.2 Change the Absorption Loss Value (Absorb)

This selection allows the operator to enter the amount of loss expected through the ambient water medium. The range available is from 0 to 120dB/km. If the exact value is not known, a value of 13dB/km for salt water and 2dB/km for fresh water is recommended.

This value is used in conjunction with the Spreading Loss Coefficient to compute the TVG curve as described in *section 5.5.1 Change the Spreading Loss Coefficient (Spread)*.

5.5.3 Set the Sound Velocity (Velocity)

The “Velocity” item displays externally measured the speed of sound through the local water. The value is represented in meters per second, and is used in range display and receiver beam steering.

This setting can only be modified if a sound velocity probe is not interfaced to the system. The range allowed is from 1350 to 1600m/sec. If the local sound velocity is not known, RESON recommends a value of 1480 to 1500m/sec for open sea areas and 1425m/sec for fresh water. See *Figure 15* as a general reference for typical surface sound velocity at different temperatures and salinity.

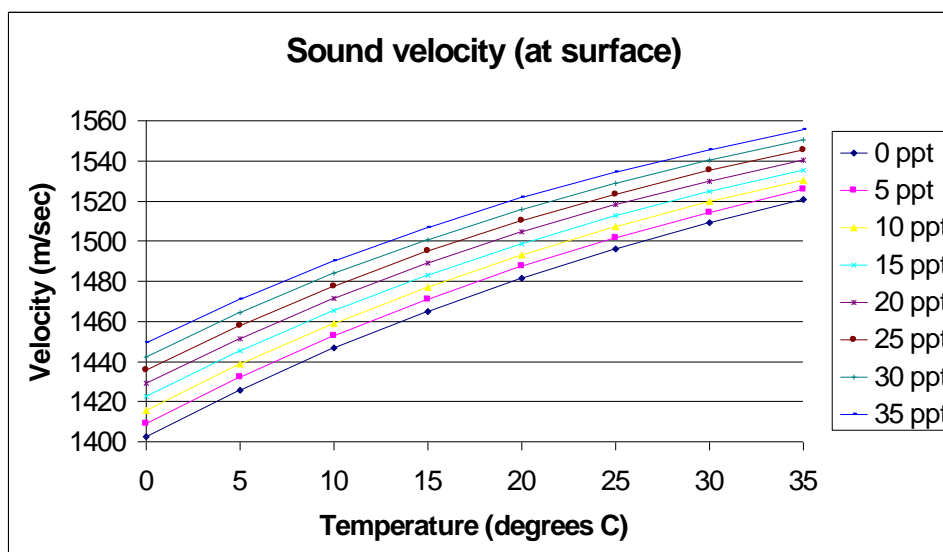


Figure 15: Typical Sound Velocity Values

5.6 Display Menu

The Display menu allows the operator to configure the display elements to suit individual tastes and operating conditions. With this menu, the operator can:

1. Change the Color Scheme
2. Set the Contrast
3. Display or Hide the Sonar Grid
4. Freeze the sonar image

5.6.1 Change the Color Scheme (Color)

Six pre-set color schemes are available. The color palette indicates the color-coded amplitude values for the sonar wedge area. This is a display setting only and has no effect on internal processing.

5.6.2 Set the Contrast (Contrast)

The “Contrast” option allows the operator to set the contrast level for the display. This is a display setting only and has no effect on internal processing.

5.6.3 Color-Code Sounding Dots (Dots)

The “Dots” menu item provides the option to color-code each sounding dot, depending on various factors. The choices available are:

1. **Off:** No dots are displayed.
2. **Normal:** Only soundings with a quality value of “3” are displayed. All dots are white.
3. **All:** All soundings are white, regardless of their quality or bottom detection process.
4. **Quality:** Each sounding is displayed based upon the quality value assigned.
 - a. **Gray:** Quality 0 (poor colinearity, poor brightness)
 - b. **Red:** Quality 1 (poor colinearity, good brightness)
 - c. **Green:** Quality 2 (good colinearity, poor brightness)
 - d. **Cyan:** Quality 3 (good colinearity, good brightness)
5. **Process:** Each sounding is color-coded based on the weighting used in the magnitude/phase bottom detection process.
 - a. **Red:** Magnitude detection
 - b. **Green:** Phase detection
 - c. **Cyan:** Blended magnitude/phase detection.

5.6.4 Display or Hide the Sonar Grid (Grid)

The Grid selection allows the operator to control the display of the border and scale lines that apply to the sonar wedge.

1. **Off** displays only the sonar image.
2. **Border** displays the sonar image with a border around the wedge.
3. **Lines** displays border and depth scale lines.
4. **Full** displays border, depth scale lines, and annotation of the depth scale in meters.

5.6.5 Freeze the Sonar Image (Freeze)

Selecting “Freeze” prevents the sonar image from being updated while all other sonar functions continue. This allows prolonged viewing of a particular item when the display is frozen. Select “Freeze” again to allow updates to continue.

5.7 Filters Menu

The Filters menu allows the operator to apply range and/or depth filters (depth gates) to the bottom-detect process to aid in noise reduction and to correct for a

tilted sonar array. These settings change in a non-linear manner. See *Appendix A* for a more detailed discussion of this feature.

5.7.1 Apply a Filter (Filter)

Determines whether or not a filter is applied to the bottom-detect process. The options are:

- **Range:** Applies minimum and maximum range values as entered in the “MinRange” and “MaxRange” fields.
- **Depth:** Applies the minimum and maximum depth values as entered in the “MinDepth” and “MaxDepth” fields.
- **Both:** Applies both the range and depth minimum and maximum values.
- **None:** No filters are activated.

5.7.2 Set Range Filter Limits (MinRange / MaxRange)

Only bottom returns within these range limits will be used in the bottom detection process.

5.7.3 Set Depth Filter Limits (MinDepth / MaxDepth)

Only bottom returns within these depth limits (depth gates) will be used in the bottom detection process. Use of a motion sensor is required to maintain constant depths during the ship’s normal pitch and roll action.

5.7.4 Correct for a Tilted Sonar Array (HeadTilt)

The value entered here rotates the layer formed by the depth gates. Use this function to compensate for a sonar array with a roll offset in its mounting structure. The adjustment range is plus or minus 180° in 1° steps.

NOTE

The increments for range, depth, and head tilt settings change depending on the current range value. The breakdown is as follows:

- Up to 100m: 0.1 meter increments
- 100m to 1,000m: 1.0 meter increments
- Beyond 1,000m: 10.0 meter increments

When selecting a filter value, use the middle track ball button to increase the increment rate by a factor of ten.

When filter values are set via a remote source, the increments can be reduced to 1/10 of the increments above.

5.8 Menu Off

Selecting this option will collapse the Menu Block (see *Figure 13*) into a single line. The Menu Block may be re-activated by clicking on the line.

5.9 Built-In Test Environment (BITE) Display

The Built-In Test Environment (BITE) display (see *Figure 16*) shows diagnostic and configuration information with regards to the current sonar session.

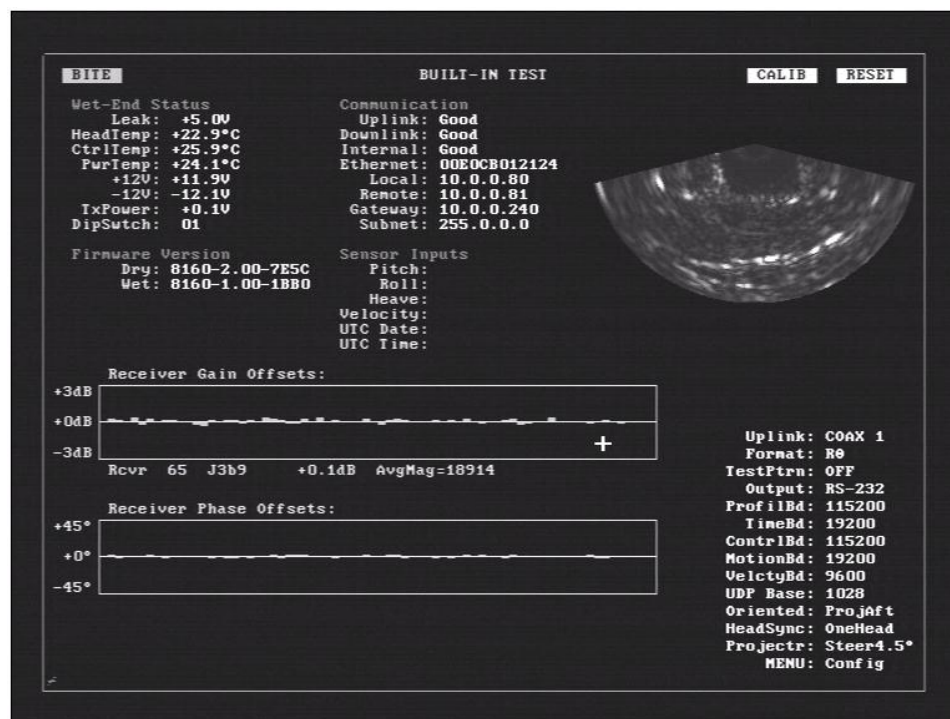


Figure 16: Built-In Test Environment (BITE) Display

The following tasks may be performed on the BITE screen:

1. Check the Wet-End Status.
2. Check the Firmware Version.
3. Check the Communication status.
4. Check the status of Sensor Inputs.
5. Review Offset graphs.
6. Configure the system to specific requirements.
7. Reset the system.
8. Calibrate the System.
9. Change the Display Mode.

NOTE

The text on the BITE display will be one of the following colors:

1. **White or Green:** This feature is functioning normally.
2. **Yellow:** This feature is out of compliance or improperly calibrated.
3. **Red:** This item has malfunctioned and is no longer operational.

The BITE button is a toggle. Click the button once to activate the BITE display, then click it again to return to the Main Sonar Display.

5.9.1 Ping Indicator

At the bottom left corner of the BITE screen is a small red dash that rotates 45° each time the transmit array emits a “ping.”



Figure 17: Ping Indicator

5.9.2 Check the Wet-End Status

This item displays information with regards to the status of the sonar array assembly.

- **Leak:** Shown as voltage, the leak sensor indicates the presence of water in the sonar array. If this indicator turns red, remove the sonar array from the water and contact a RESON Service Depot immediately.
- **Head Temp:** This feature is not currently enabled for the SeaBat 8160.
- **CtrlTemp:** Shown in degrees Celsius, this is the internal temperature of the transceiver unit.
- **PwrTemp:** Shown in degrees Celsius, this is the temperature of the transmitter power supply in the transceiver unit.
- **+12V:** Transceiver unit +12VDC power supply
- **-12V:** Transceiver unit –12VDC power supply
- **TxPwr:** Transceiver unit transmitter power supply output voltage.
- **DipSwitch:** Shows the settings of configuration switches in the sonar array. (This is a factory setting.)

5.9.3 Check the Firmware Version

This item shows the version number of the firmware on both the sonar processor and the transceiver unit. These numbers are necessary when contacting RESON for support.

NOTE
To ensure compatibility of the units, the sonar processor checks the version of the transceiver unit at power-on. If necessary, the sonar processor will upload the proper code to the transceiver unit.

5.9.4 Check the Communications Status

This item shows the status of the system communication functions.

- **Uplink:** Indicates the status of the uplink from the transceiver unit to the sonar processor. The indication will be either “Good” or “Bad”.
- **Downlink:** Indicates the status of the downlink from the sonar processor to the transceiver unit. The indication will be either “Good” or “Bad”.
- **Internal:** Indicates the status of the sonar processor internal self-test. The indication will be either “Good” or “Bad”.
- **Ethernet:** This is the Ethernet hardware address of the processor board within the sonar processor. The last six digits are the serial number of the board.
- **Local*:** This is the user-defined IP address of the sonar processor for Ethernet communication.
- **Remote*:** This is the user-defined IP address of the target computer for Ethernet communication.
- **Gateway*:** This is the user-defined gateway IP address for Ethernet communication. (Default is 0.0.0.0.) *This is required when the remote and local addresses are on different subnets.*
- **Subnet*:** This is the user-defined local network’s subnet mask, to be used for network communications.

** This may be changed by clicking on the numbers of the IP address to increment up or down.*

NOTE
If the status of the Uplink or Downlink is “Bad,” the system will be inoperable. Immediate steps need to be taken if a problem appears.

5.9.5 Check the Status of Sensor Inputs

This item indicates the current input value from the remote sensors interfaced to the system. If a sensor is not installed, its value will be blank.

- **Pitch:** Current pitch value in degrees as measured by the motion sensor (if installed).
- **Roll:** Current roll value in degrees as measured by the motion sensor (if installed).
- **Heave:** Current heave value in meters as measured by the motion sensor (if installed).
- **Velocity:** The current sound velocity in meters per second (m/sec) as measured by the velocimeter or CTD sensor (if installed).
- **UTC Date:** The current UTC date from an external date/time source (if installed).
- **UTC Time:** The current UTC time from an external date/time source (if installed).

NOTE

The velocity of sound, at the face of the projector, is required for proper Beam Steering angles and scaling of the sonar wedge in the Main Display.

UTC Date and Time are required for accurate time stamping of bathymetry and sidescan output data. In the absence of UTC, the included latency value may be used in lieu of the time stamp.

5.9.6 Review Offset Graphs

The two offset graph blocks (Receiver Gain Offsets and Receiver Phase Offsets) represent the uniformity of the receiving channels of the receive array. (Slight channel-to-channel variations are normal.)

Receiver Gain Offsets:

<u>Condition</u>	<u>Color</u>	<u>Value</u>
Acceptable	Green	$< \pm 2.0\text{dB}$
Marginal	Yellow	$\geq \pm 2.0\text{dB}$ to $< \pm 3.5\text{dB}$
Extreme	Red	$\geq \pm 3.5\text{dB}$

Receiver Phase Offsets:

Condition	Color	Value
Acceptable	Green	$< \pm 35^\circ$
Marginal	Yellow	$\geq \pm 35^\circ$ to $< \pm 60^\circ$
Extreme	Red	$\geq 60^\circ$

As the cursor is moved over the data, the Element number (receiver channel location), the Offset Value, and the Median Value are displayed below the selected graph block (see *Figure 18*).

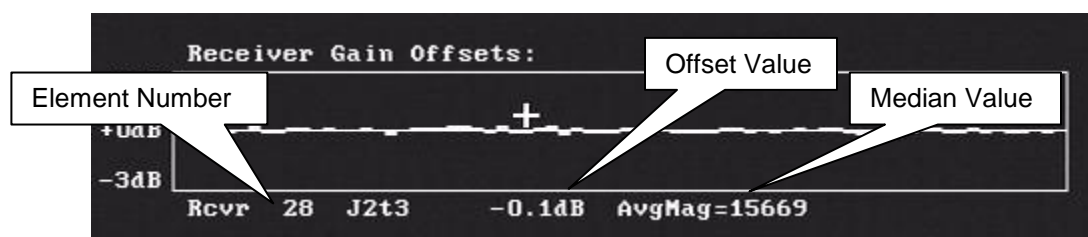


Figure 18: Receiver Gain Offsets

NOTE

The data initially shown in the offset graphs is the corrected Gain and Phase offsets of the main receive array elements after the application of offsets. These values should be close to zero for all channels. Click the "CALIB" button while holding down the center mouse button to present uncorrected values.

5.9.7 Configure System to Specific Requirements

The Config Menu allows the operator to integrate the SeaBat 8160 to any vessel's specific requirements.

5.9.7.1 Select Uplink Port (Uplink)

Select the uplink port to be used.

5.9.7.2 Select Output Method (Output)

Select the method by which measured profile is output from the sonar processor:

- **RS-232:** Output via Serial Port #1 at the rear of the sonar processor. Packets will be transmitted at the speed selected (ProfileBD) at an interval based on the selected range and data rate (MaxRate), and in

the format selected (Format). *Selection of faster ping rates may cause some packets to be lost due to baud rate constraints.*

- **Ethernet:** Output via Ethernet port at rear of sonar processor. Packets will be transmitted at an interval based on the selected range and data rate (MaxRate), and in the format selected (Format). *This allows for much higher transmission rates.*

5.9.7.3 Select RS-232 Baud Rate (ProfileBD)

Controls the baud rate for data packets when the system is in RS-232 output mode.

5.9.7.4 Select Time Synchronization Baud Rate (TimeBD)

Controls the input baud rate for time synchronization packets from a Data Acquisition System.

5.9.7.5 Select the Control Message Baud Rate (ContrIBD)

Allows control of the input baud rate for control messages from an external modem.

5.9.7.6 Select Motion Reference Unit Baud Rate (MotionBD)

Selects the baud rate to match the input from the Motion Reference Unit (MRU).

5.9.7.7 Select CTD Sensor Baud Rate (VelctyBD)

Selects the baud rate to match the input from a CTD sensor.

5.9.7.8 Select UDP Base Port Number (UDP Base)

Allows the user to define the base UDP Port number for Ethernet communications. All other UDP ports will be selected automatically. (See *Table 24: UDP Port Offsets.*)

5.9.7.9 Set Head Orientation (Oriented)

Defines whether the sonar array is oriented with the transmit array forward or aft of the hydrophone.

- **ProjFwd:** The transmit array is forward of the hydrophone.
- **ProjAft:** The transmit array is aft of the hydrophone.

5.9.7.10 Set Head Synchronization (HeadSync)

Enables the operator to define sonar operation as a stand-alone system or as part of a dual-head system.

- **OneHead:** Sonar operates as a stand-alone system with no synchronization.
- **Master:** Sonar operates in the dual-head mode as the master unit.
- **Slave:** Sonar operates in the dual-head mode as the slave unit.

NOTE

For single-array, single-head systems, the operator must select "OneHead" under the "HeadSync" option. Any other selection will result in up to a 50% reduction in ping rate.

5.9.8 Modes Menu

The Modes menu allows the integration of the system into any specific vessel or platform.

5.9.8.1 Select Packet Format (Format)

Controls the format / content of each output profile data packet.

- **Rθ:** R-Theta (range and beam angle) provides all soundings, their quality values, date/time, and the selected speed of sound.
- **Riθ:** RI-Theta (range, Intensity, and Beam Angle) provides the same information as R-Theta, with the addition of a 16-bit intensity value for each bottom detect sounding.

5.9.8.2 Select Test Pattern (TestPtrn)

Allows the selection of a test pattern for testing interfaces to a data acquisition system.

When set to "ON," a flat seafloor will be displayed with a block moving across the display from beam 0 to the last beam. The seafloor will be displayed at the widest part of the wedge, and the block height will be approximately 4% of that depth.

5.9.8.3 Activate Sidescan (Sidescan)

Selects the Sidescan operating mode. See *Appendix F* for details.

- **OFF:** No sidescan data is output by the sonar processor.
- **AVERAGE:** At longer ranges, sidescan data is compressed to 1024 samples for each side (port and starboard) using an average value process.
- **RMS:** At longer ranges, sidescan data is compressed to 1024 samples for each side (port and starboard) using an RMS value process.
- **FULL:** Sidescan data is not compressed. All data points are used for the sidescan image. This can result in a very large number of data points.

5.9.8.4 Activate Snippets (Snippets)

Selects Snippet settings. See *Appendix F* for details.

- **Off:** Disables the Snippet mode and returns the system to its normal operating condition.
- **Uniform:** Outputs snippets, the lengths of which are roughly proportional to the bottom detect point of any specific beam.
- **FlatBottom:** Outputs snippets, the lengths of which are roughly proportional to the size of each beam's footprint on the bottom.

5.9.8.5 Test the Projector (Projectr)

Allows for testing the transmit array and defining the operational opening angle for the transmitted beams.

- **ScanTest:** Reserved for maintenance testing.
- **SteerTest:** Reserved for maintenance testing.
- **Steer x.x°:** Where x.x° will be 1.5, 3.0, 4.5, or 6.0 degrees. The selected value will be steered beam opening angle. The recommended value is 1.5°, however a wider beam may be necessary to ensure full coverage when moving fast in shallow water.

5.9.8.6 Set Pitch Stabilization (PitchStab)

Although the projector moves with the vessel, the transmitted beam can be dynamically steered through pitch angles of $\pm 15^\circ$. The PitchStab menu option allows for the selection of Pitch Stabilization options.

- **OFF:** Pitch stabilization is not used.
- **STAB:** Pitch is stabilized using the most recent value from the Motion Sensor.

- **STAB+PRED:** Pitch is stabilized using an extrapolation of recent history values from the motion sensor. This is the preferred operating condition. A faster baud rate from the motion sensor usually provides a smoother extrapolation.

NOTE

Pitch Values from an external motion sensor are required to implement this functionality.

5.9.8.7 Set Roll Stabilization (RollStab)

As with the projector (see *section 5.9.8.6 Set Pitch Stabilization (PitchStab)*), the received beams can be dynamically steered to keep the nadir beam of the swath vertical. This process acts to keep the bottom display stable as the vessel rolls. Because of the effect on the outer beams of the swath, Roll Stabilization is limited to a practical value of $\pm 20^\circ$.

The RollStab menu option allows for the selection of Roll Stabilization options.

- **OFF:** Roll Stabilization is not used.
- **STAB:** Roll is stabilized using the most recent value from the Motion Sensor.
- **STAB+PRED:** Roll is stabilized using an extrapolation of recent history values from the motion sensor. This is the preferred operating condition. A faster baud rate from the motion sensor usually provides a smoother extrapolation.

NOTE

Roll Values from an external motion sensor are required to implement this functionality.

5.9.9 Reset the System (Reset Button)

Click this button to reboot the firmware in the sonar processor and initiate the calibration routine.

5.9.10 Calibrate the System (Calib Button)

Initiate the process which calibrates the electronics associated with each of the ceramic elements that constitute the receiver array.

5.9.10.1 How Calibration Works

A tone generator injects a tone of known amplitude and phase into the receiver channels. When this calibration signal is received, the processor generates a lookup table of both gain and phase offsets by comparing the received signal to that transmitted. All subsequent signals from that channel have these offsets applied to them before further processing. This compensates for minor inconsistencies in the analogue receiver channels.

5.10 Changing Display Mode

To change the display mode, move the cursor to the farthest point possible in the upper left corner of the screen and press the appropriate sequence of buttons. The sonar processor will recall the most recent setting upon power-up.

- Center and Right buttons: S-Video and Composite in NTSC format.
- Center and Left buttons: S-Video and Composite in PAL format.
- Left and Right buttons to return to S-VGA format.

NOTE
The standard S-VGA monitor issued with the SeaBat 8160 system is not compatible with NTSC and PAL formats and will be blank when either is selected. If an NTSC or PAL format is required, a separate compatible monitor must be used with the system.

APPENDIX A DEPTH GATES AND HEAD TILT

A.1 Introduction

On the “Filters” menu, the “Head Tilt” option is used to identify a known offset resulting from a port or starboard tilt in the sonar array mounting configuration. The entry of the “Head Tilt” value is required to guarantee that the depth gates will work properly.

A.2 Depth Gates

The depth gates, with no input from a motion sensor, will be oriented parallel to the horizontal plane of the sonar array, as shown by the Min and MaxDepth lines in *Figure 19*. In this series of illustrations, the bottom detect dots are shown as a horizontal line (“Line A” in *Figure 19*, *Figure 20*, and *Figure 21* or “Line B” in *Figure 22* and *Figure 23*) with dashed lines representing depth gates above and below the bottom.

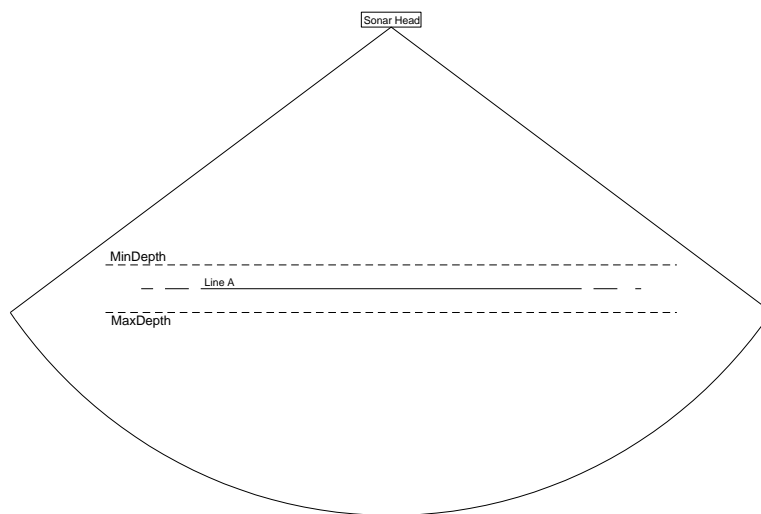


Figure 19: Depth Gates, No Roll

Figure 20 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 (no motion sensor applied) depth gates. In this figure and all remaining figures, the bottom is flat.

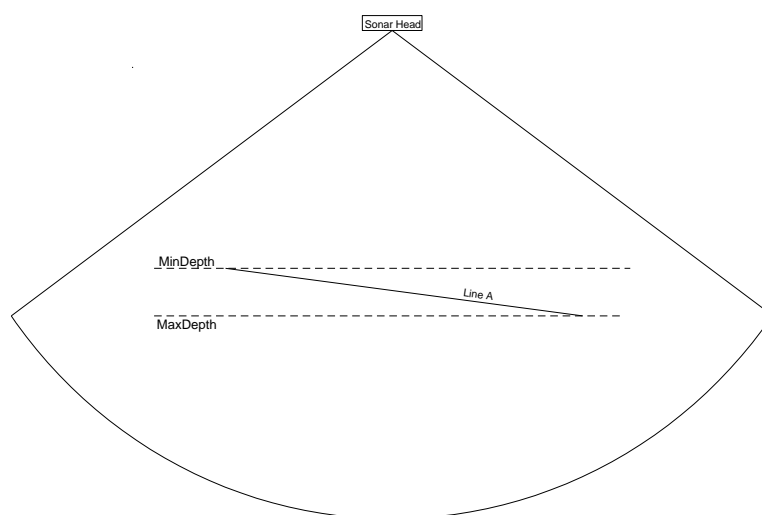


Figure 20: Depth Gates with Roll Input

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.

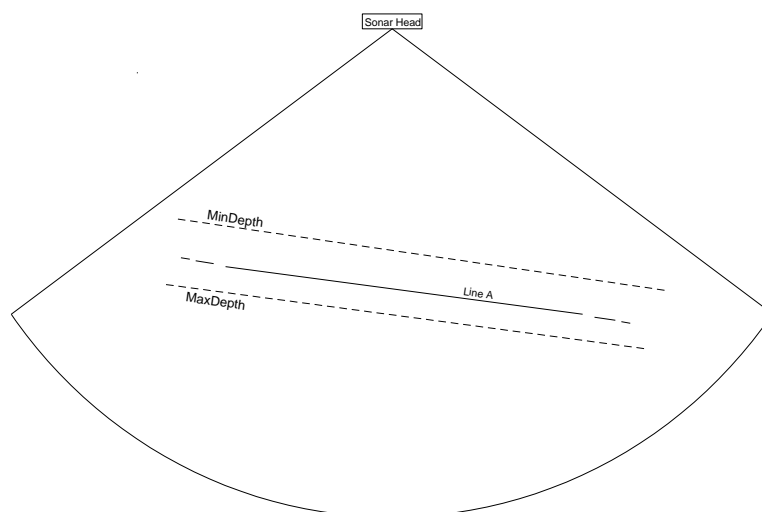


Figure 21: Depth Gates with Roll and Motion Sensor Input

A.3 Offsetting the Sonar Array

In the case of a sonar array mounted so as to look at a river bank or under a wharf structure, this discussion assumes a thirty degree offset to starboard. If the offset value of this mounting configuration is not identified properly, the ends of the swath may be cut off by one or both of the depth gates intersecting the bottom display even when a motion sensor is used.

In *Figure 22*, Line B represents the bottom as shown by a sonar array mounted thirty degrees offset looking to starboard. In this illustration, the depth gates are reacting properly to the motion sensor input, however, since the offset value of head tilt has not been added, the only area of this new swath that will be visible is within the small box; everything else will be removed by the action of the depth gates.

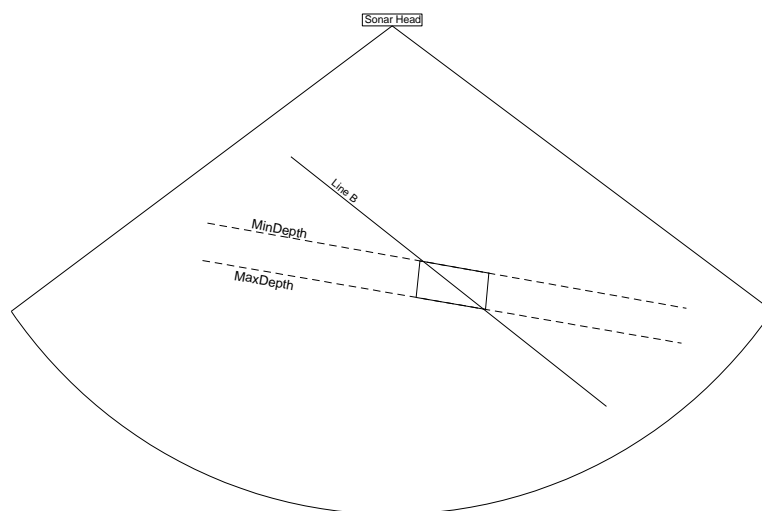


Figure 22: Depth Gates with No Offset

A.4 Head Tilt Function

If the degree of offset (thirty degrees for this discussion) is entered at the Head Tilt menu item, the layer formed by the depth gates will be rotated by the same thirty degrees, as shown in

For this discussion, the operator must enter negative numbers for a starboard offset and positive numbers for port.

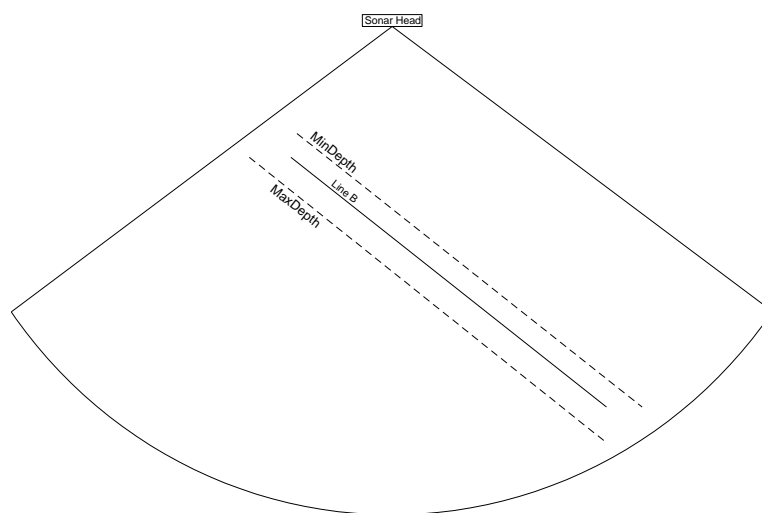


Figure 23: Depth Gates with Offset

CAUTION

The use of depth gates and other filters is a very delicate and potentially error-prone process. Exercise extreme caution when applying depth and range filters, as incorrect settings will result in erroneous and/or lost data.

APPENDIX B SYSTEM PING RATES

To aid in the calculation of sounding density, the following table provides ping rates for the SeaBat 8160 system. Sound Velocity = 1500 meters/sec, HeadSync = 1, MaxRate = 15 pings/sec. (Snippets mode reduces the ping rate on some range scales.)

Table 6: System Ping Rate Values

Range Scale	Ping Rate ¹	Ping Rate ²
5	14.94	14.94
7	14.94	14.94
10	14.94	14.94
15	14.94	14.94
20	14.94	14.94
25	14.94	14.94
30	14.94	14.94
35	14.94	14.94
40	14.94	13.26
50	12.88	10.84
75	8.84	7.41
100	6.73	5.62
125	5.44	4.53
150	4.56	3.81
175	3.92	3.27
200	3.44	2.87
250	2.77	2.31
300	2.31	1.93
350	1.99	1.65
400	1.74	1.45
500	1.40	1.16
750	0.935	0.777
1000	0.703	0.584
1250	0.563	0.467
1500	0.469	0.390
1750	0.402	0.334
2000	0.352	0.292
2500	0.282	0.234
3000	0.235	0.195
3500	0.201	0.167
4000	0.176	0.146
5000	0.141	0.117

Ping Rate¹: Snippets = OFF or UNIFORM

Ping Rate²: Snippets = FLAT BOTTOM

SYSTEM PING RATES

NOTE

The number of output profiles per second is primarily governed by the update (ping) rate which, in turn, is controlled by the range selected.

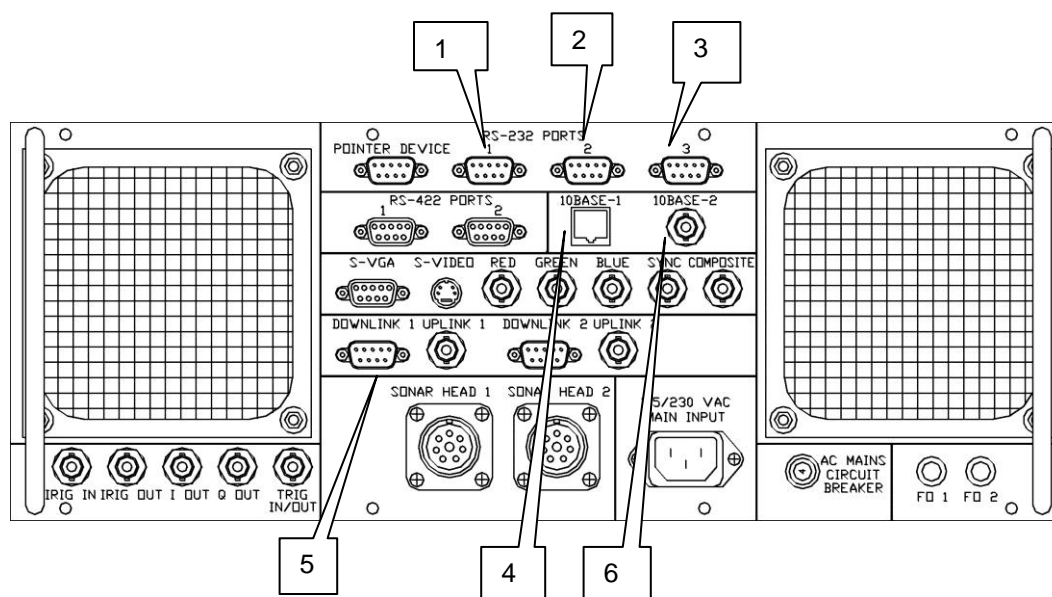
Ping Rate is determined by the Round Trip Time. This time is strongly affected by the local speed of sound in water.

APPENDIX C INTERFACE SPECIFICATIONS

C.1 Introduction

The sonar processor rear panel is the connection point for the data communication interface. There are two primary means of communicating with the sonar processor. The first is via the Network port used for transmitting bathymetric or sidescan data to the Data Acquisition System. The second is via the serial ports that are assigned different tasks and data. This section will cover six of the rear panel ports. The network interface can only use one port at a time.

1. RS-232 Serial Port 1 – IN: Time Stamp, OUT: Bathy Data
2. RS-232 Serial Port 2 – IN: Command Messages, OUT: Command Acknowledgments
3. RS-232 Serial Port 3 – IN: Motion Sensor Data, OUT: None
4. Ethernet Port (10 Base T): - IN: Command Messages / Firmware download, OUT: Bathy Data / Sidescan
5. Downlink 1 – IN: Sound Velocity Data OUT: Downlink Head 1
6. Ethernet Port (10 Base 2): - IN: Command Messages / Firmware download, OUT: Bathy Data / Sidescan. Use either 4 or 6, do not use both at the same time.



C.2 Hardware Interface Settings

Each interface has an individual setting and is dedicated to specific tasks.

C.2.1 Serial Ports

A NULL Modem RS-232 (9-Pin D-Sub) cable should have the following configuration:

Table 7: Serial Cable Configuration

Pin	I/O	Pin
1 (Not Used)		1 (Not Used)
2 (RX, Receive Data)	<	3 (TX, Transmit Data)
3 (TX, Transmit Data)	>	2 (RX, Receive Data)
4 (DTR, Data Terminal Ready)	>	6 (DSR, Data Set Ready)
5 (GND, Signal Ground)		5 (GND, Signal Ground)
6 (DSR, Data Set Ready)	<	4 (DTR, Data Terminal Ready)
7 (RTS, Request To Send)	>	8 (CTS, Clear To Send)
8 (CTS, Clear To Send)	<	7 (RTS, Request To Send)
9 (Not Used)		9 (Not Used)

Serial interface cables must not be longer than 50m.

NOTE
A single serial port can handle different I/O speeds. For example, the port might be configured for a 9600 baud outgoing data rate, but a 19200 baud incoming data rate.

C.2.1.1 Serial Port 1

Port 1 is used for sending bathymetric and receiving time stamp data.

Table 8: Serial Port 1 Specifications

Description	Setting
Connector Label	RS-232 Port 1
Baud Rate IN	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200

Description	Setting
Baud Rate OUT	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Data Bits	8
Parity	None
Stop Bits	1

C.2.1.2 Serial Port 2

Port 2 is used for receiving and replying to command messages.

Table 9: Serial Port 2 Specifications

Description	Setting
Connector Label	RS-232 Port 2
Baud Rate IN	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Baud Rate OUT	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Data Bits	8
Parity	None
Stop Bits	1

C.2.1.3 Serial Port 3

Port 3 is used for collecting Motion Sensor Data. The sonar processor supports four different Motion Sensors: TSS DMS-05, TSS 335B, TSS332B, and Seatex MRU5.

Table 10: Serial Port 3 Specifications

Description	Setting
Connector Label	RS-232 Port 3
Baud Rate IN	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Baud Rate OUT	N/A
Data Bits	8
Parity	None
Stop Bits	1

C.2.1.4 Downlink 1

Downlink 1 is used for collecting CTD Data. Currently, only the SeaBird data format is supported (see *section C.3.3 CTD Data*).

Table 11: Downlink 1 Specifications

Description	Setting
Connector Label	Downlink 1
Baud Rate IN	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Baud Rate OUT	19200
Data Bits	8
Parity	None
Stop Bits	1

NOTE

Downlink Port 1 continuously transmits downlink commands. If the Sound Velocity Sensor receives this transmission, the uplink from the probe will become corrupted. Make certain that the cable from the probe to the sonar processor has only pin 5 (ground) and pin 2 (data) connected. The sonar processor transmits the downlink on pin 3 and ground on pin 5.

C.2.1.5 Ethernet

Select either 10 Base-T (RJ45 connector) or 10 Base-2 (BNC connector) for network communication.

INTERFACE SPECIFICATIONS

C.2.1.5.1 10 Base-T

Use an unshielded, twisted-pair, Category 5 cable. It must be no more than 100 meters in length and must have an RJ45 connector. When connecting the sonar processor directly to a PC, use a cross-over cable. Use a straight-through cable when connecting to a Hub.

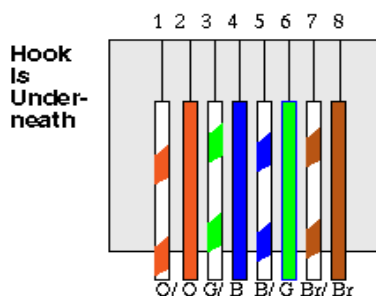


Figure 24: Straight-Through Cable Diagram

Table 12: Straight-Through Cable Specifications

Connector 1	Pin	Connector 2
White/Orange	1	White/Orange
Orange	2	Orange
White/Green	3	White/Green
Blue	4	Blue
White/Blue	5	White/Blue
Green	6	Green
White/Brown	7	White/Brown
Brown	8	Brown

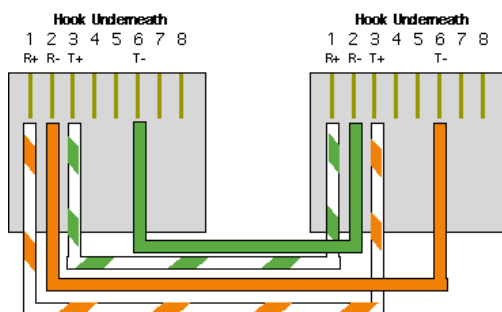


Figure 25: Cross-Over Cable Diagram

Table 13: Cross-Over Cable Specifications

Connector 1	Pin	Connector 2
White/Orange	1	White/Green
Orange	2	Green
White/Green	3	White/Orange
Blue	4	Blue
White/Blue	5	White/Blue
Green	6	Orange
White/Brown	7	White/Brown
Brown	8	Brown

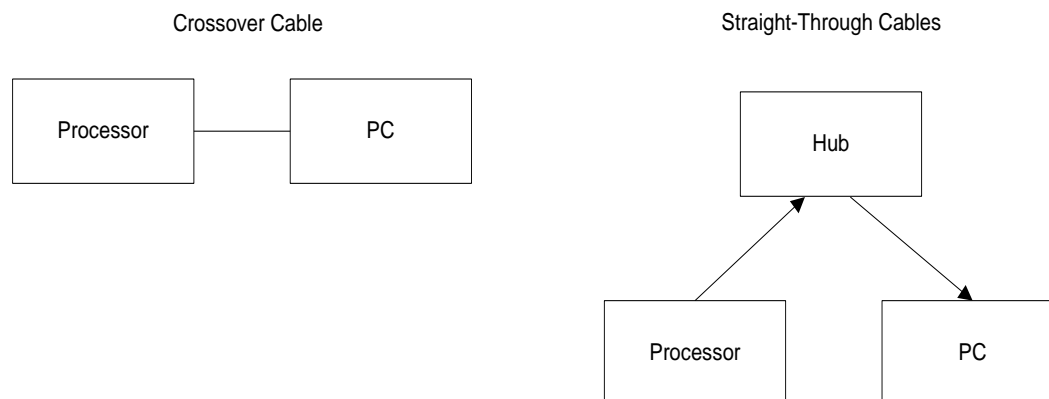


Figure 26: Crossover vs. Straight-Through Configurations

C.2.1.5.2 10 Base-2

Use an RG-58 cable (Coax) no more than 150m with T-Shaped BNC connectors. Create a Bus Topology network with terminators at the end of the cable.

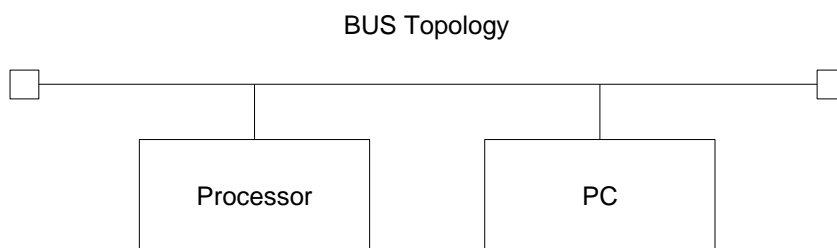


Figure 27: BUS Topology

C.3 Messages and Data Format

Messages and data are based on certain structures. Each structure is described below.

C.3.1 Command Messages

All command messages are based on ASCII strings and built on the following syntax:

Command Message: * <TYPE>,PARAM1,PARAM2, ... <CR><LF>

Where:

Table 14: Command Message Syntax

Field	Description
*	Start of Message (Asterisk)
TYPE	Message Type
PARAMxxx	Parameters for the Message
<CR><LF>	Carriage Return, Line Feed

There are three different replies on a Command Message followed by <CR> and <LF>

Table 15: Command Message Reply Types

Field	Description
Reply String	Reply String
OK	OK Message
NG	No Good Message

Example:

Sent: *RANG,100<CR><LF>
Reply: (RS-232 only): OK<CR><LF>

C.3.1.1 Automatic Gain Message

This message controls the automatic gain in the sonar processor.

Syntax: *AGAN,N<CR><LF>

Parameters: N = 0: Off
N = 1 to 10: Set out threshold equal to selected numeric value.

Example: *AGAN,1<CR><LF>
This example turns automatic gain on and sets out the threshold 1.

C.3.1.2 Annotation Message

This message prints strings on the sonar screen.

Syntax: *ANNO,N,STRING<CR><LF>

Parameters: N = 1: String Number 1
N = 2: String Number 2

STRING = Text to be displayed on the sonar screen.

Example: *ANNO,1,RESON<CR><LF>
This example will print the text "RESON" on the sonar screen display.

C.3.1.3 Bathymetric Baud Rate

This message controls the OUT baud rate for Serial Port 1. Serial Port 1 OUT transmits bathymetric data.

Syntax: *BAUD,N,<CR><LF>

Parameters: N = Desired Baud Rate
Valid rates are: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Example: *BAUD, 115200<CR><LF>
This example will set the OUT baud rate on Serial Port 1 to 115200.

C.3.1.4 BITE Screen

This message controls which screen should be presented.

Syntax: *BITE,N<CR><LF>

Parameters: N = 0: Show Main Sonar Display
 N = 1: Show BITE Display

Example: *BITE,1,<CR><LF>
This example will display the BITE screen.

C.3.1.5 Maximum Range Filter

This message sets the maximum value for the range filter.

Syntax: *BMAX,N<CR><LF>

Parameters: N = Max Range Filter (m).
The parameter may be any number from 0 to the maximum range, as long as it is greater than or equal to the minimum range.

Example: *BMAX,100,<CR><LF>
This example sets the maximum range filter value to 100m.

C.3.1.6 Minimum Range Filter

This message sets the minimum value for the range filter.

Syntax: *BMIN,N<CR><LF>

Parameters: N = Min Range Filter (m).
The parameter may be any number from 0 to the maximum range, as long as it is less than or equal to the maximum range.

Example: *BMIN,10,<CR><LF>
This example sets the minimum range filter value to 10m.

C.3.1.7 Contrast

This message sets contrast (brightness) for the screen.

Syntax: *BRIT,N<CR><LF>

Parameters: N = 0: 1.00 times
 N = 1: 1.25 times
 N = 2: 1.50 times
 N = 3: 2.00 times

Example: *BRIT,1,<CR><LF>
This example sets the contrast to 1.00 times.

C.3.1.8 Calibrate

This message calibrates the system.

Syntax: *CALB<CR><LF>

Parameters: N/A

Example: *CALB<CR><LF>
This example initiates the system calibration sequence.

C.3.1.9 Color

This message sets color palette for the screen.

Syntax: *COLR,N<CR><LF>

Parameters: N = 0: Black and White
 N = 1: Black
 N = 2: Dark
 N = 3: Dim
 N = 4: Blue and Yellow
 N = 5: Vivid

Example: *COLR,1<CR><LF>
This example sets the screen to appear in black and white.

C.3.1.10 Command Baud Rate

This message selects the baud rate for reception of command messages on serial port 2.

Syntax: *CTBR,N<CR><LF>

Parameters: N = Desired Baud Rate

Valid rates are: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Example: *CTBR,115200<CR><LF>
This example sets both the IN and OUT baud rates on serial port 2 at 115200 baud.

C.3.1.11 Cursor

This message moves the cursor on the screen to a particular position based on the X and Y axis.

Syntax: *CURS,X,Y<CR><LF>

Parameters: X = X coordinate
Y = Y coordinate

Example: *CURS,0,0<CR><LF>
This example moves the cursor to the upper left corner of the screen.

C.3.1.12 Date

Use this message to set the date (not used for time stamping any data).

Syntax: *DATE,Year,Month,Day<CR><LF>

Parameters: Year: In four digits.
Month: Month, 1 – 12.
Day: Day, 1 – 31.

Example: *DATE,2001,3,8<CR><LF>
This example sets the date to 8 March 2001.

C.3.1.13 Dot Check

This message controls the bottom detection dots on the sonar screen.

Syntax: *DCHK,N<CR><LF>

Parameters: N = 0: Off (No Dots)
N = 1: Normal (Displays all dots except those of poor quality.)
N = 2: All (Displays all dots in white, even the quality dots.)
N = 3: Quality (Displays all dots, color-coded with quality).
N = 4: Process (Displays all dots, color coded depending on the bottom-detection algorithm.)

Example: *DCHK,0<CR><LF>
This example turns the dots off.

C.3.1.14 Maximum Depth Filter

This message sets the maximum value for the depth filter.

Syntax: *DMAX,N<CR><LF>

Parameters: N = Max Depth Filter (m).
The parameter may be any number from 0 to the maximum depth, as long as it is greater than or equal to the minimum depth.

Example: *DMAX,100<CR><LF>
This example sets the maximum depth filter to 100 meters.

C.3.1.15 Minimum Depth Filter

This message sets the maximum value for the depth filter.

Syntax: *DMIN,N<CR><LF>

Parameters: N = Min Depth Filter (m).
The parameter may be any number from 0 to the maximum depth, as long as it is less than or equal to the maximum depth.

Example: *DMIN,10<CR><LF>
This example sets the minimum depth filter to 10 meters.

C.3.1.16 Bathymetric Data Output Selection

This message selects the output port for bathymetric data.

Syntax: *DOUT,N<CR><LF>

Parameters: N = 0: RS-232
N = 1: Ethernet

Example: *DOUT,1<CR><LF>
This example sets the sonar processor to send bathymetric data output to the Ethernet port.

C.3.1.17 Maximum Ping Rate

This message sets the maximum ping rate in pings per second.

Syntax: *DRAT,N<CR><LF>

Parameters: N = Max data pings goes from 10 to 400 (= 1.0 to 40.0 pings per second).

Example: *DRAT,200<CR><LF>
This message sets processor to output a maximum of 20 pings per second.

C.3.1.18 Filter Setting

This message selects the filters to be used.

Syntax: *FILT,N<CR><LF>

Parameters: N = 0: No Filter
N = 1: Range Filter Only
N = 2: Depth Filter Only
N = 3: Both Filters

Example: *FILT,1<CR><LF>
This example sets the sonar processor to use the range filter only.

C.3.1.19 Flip

This message tells the sonar processor the orientation for the head.

Syntax: *FLIP,N<CR><LF>

Parameters: N = 0: Projector forward/up.
N = 1: Projector aft/down.

Example: *FILP,0<CR><LF>
This message tells sonar processor that the head is mounted with projector forward.

C.3.1.20 Freeze

This message freezes the data in the wedge on the sonar screen.

Syntax: *FREEZ,N<CR><LF>

Parameters: N = Freeze selection. 0 for OFF and 1 for freeze.

Example: *FREEZ,1<CR><LF>
This example freezes the data on the screen.

C.3.1.21 Manual Gain

This message sets the manual gain for the sonar processor.

Syntax: *GAIN,N<CR><LF>

Parameters: N – Manual gain value.

Example: *GAIN,1<CR><LF>
This example sets the 81-P processor to the minimal manual gain, 1.

C.3.1.22 Grid

This message sets different grid options

Syntax: *GRID,N<CR><LF>

Parameters: N = 0: Off, no grid.
 N = 1: Just the border.
 N = 2: Border and lines.
 N = 3: Full.

Example: *GRID,1<CR><LF>
This example sets the processor to display only the border around the wedge.

C.3.1.23 Gain Mode

This message sets the gain mode.

Syntax: *GTYP,N<CR><LF>

Parameters: N = 0: Fixed
N = 1: TVG

Example: *GTYP,1<CR><LF>
This example sets the processor to gain mode, TVG

C.3.1.24 Menu

This message sets the menu.

Syntax: *MENU,N<CR><LF>

Parameters: N = 0: Main.
N = 1: Filters.
N = 2: Ocean.
N = 3: Off.
N = 4: Display

Example: *MENU,0<CR><LF>
This message sets the current menu to main menu.

C.3.1.25 Motion Sensor Baud Rate

This message controls the IN baud rate for Serial Port 3. Serial Port 3 IN receives motion sensor data.

Syntax: *MSBR,N<CR><LF>

Parameters: N = Baud Rate.

Valid Rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Example: *BAUD,19200<CR><LF>
This message sets the IN baud rate on serial port 3 to 19200.

C.3.1.26 Network

This message sets the different network addresses used and the UDP Port.

Syntax: *NADR,N,PARAM<CR><LF>

Parameters: N = 0: Local IP address (processor box).
PARAM = IP address (XXX.XXX.XXX.XXX)

N = 1: Remote IP address (data collection system).
PARAM = IP address (XXX.XXX.XXX.XXX)

N = 2: UDP port.
PARAM = UDP Port (XXXXXX)

N = 3: Gateway IP address (router).
PARAM = IP address (XXX.XXX.XXX.XXX)

N = 4: Subnet mask.
PARAM = Subnet mask (XXX.XXX.XXX.XXX)

Example: *NADR,1,10.0.1.245<CR><LF>
This example sets the 81-P processor IP address to 10.0.1.245.

C.3.1.27 Power

This message sets the sonar transmitter power.

Syntax: *POWR,N<CR><LF>

Parameters: N = The power value.

Example: *POWR,0<CR><LF>
This message sets the power to OFF.

C.3.1.28 Projector

This message selects the projector type.

Syntax: *PROJ,N<CR><LF>

Parameters: N = 0: Steer 1.5
 N = 1: Steer 3.0
 N = 2: Steer 4.5
 N = 3: Steer 6.0
 N = 4: Steer Test
 N = 5: Scan Test

Example: *PROJ,0<CR><LF>
For a SeaBat 8160, this example selects Steer 1.5.

NOTE
The projector selection varies for different SeaBat™ models. This setting will only apply to the SeaBat™ model for which this manual was written.

C.3.1.29 Pitch Stabilization

This message sets pitch stabilization mode.

Syntax: *PSTB,N<CR><LF>

Parameters: N = 0: Not Stabilized.
 N = 1: Stabilize using the most recent value from motion sensor.
 N = 2: Stabilize using a motion prediction.

Example: *PSTB,2<CR><LF>
Sets pitch-stabilization to mode 2.

C.3.1.30 Bathymetric Packet Format

This message sets the bathymetric packet format.

Syntax: *PTYP,N<CR><LF>

Parameters: N = 0: R-theta
N = 1: RI-theta

Example: *PTYP,0<CR><LF>
Sets the sonar processor to output bathymetric packets in the R-theta format.

C.3.1.31 Pulse Width

This message sets the Pulse Width in seconds.

Syntax: *PWID,N <CR><LF>

Parameters: N = Pulse width value in seconds.

Example: *PWID,0.0017<CR><LF>
Sets transmit pulse-width to 0.0017 seconds.

C.3.1.32 Range

This message changes the range setting.

Syntax: *RANG,N <CR><LF>

Parameters: N = Range value in meters

Example: *RANG,5<CR><LF>
This example sets the range setting to 5m.

C.3.1.33 Raw Output Beam Selection (raw output only)

This message sets the first exported beam.

Syntax: *RAWB,N<CR><LF>

Parameters: N = First exported beam
Valid entries are 0 to one less than the maximum number of beams. (If beam count = 101, valid entries are 0 to 100)

Example: *RAWB,0<CR><LF>
This message sets the first exported beam to be 0 (first beam).

C.3.1.34 Raw Output Mode Selection (raw output only)

This message sets the raw output mode.

Syntax: *RAWM,N<CR><LF>

Parameters: N = 0: No data exported.
N = 1: 16 bits magnitude, 20 beams exported.
N = 2: 16 bits magnitude and 16 bits phase, 10 beam exported.
N = 3: 8 bits magnitude, 40 beams exported.

Example: *RAWM,1<CR><LF>
This message sets the raw output mode to 1 where 16 bit magnitude data (20 beams) are being exported.

C.3.1.35 Reset

This message resets the sonar processor.

Syntax: *RSET<CR><LF>

Parameters: N/A

Example: *RSET<CR><LF>
This message resets the sonar processor.

C.3.1.36 Roll Stabilization

This message sets roll stabilization mode.

Syntax: *RSTB,N<CR><LF>

Parameters: N = 0: Not Stabilized.
N = 1: Stabilize using the most recent value from motion sensor.
N = 2: Stabilize using a motion prediction.

Example: *RSTB,1<CR><LF>
Sets roll-stabilization to mode 1.

C.3.1.37 Snapshot

This message tells the sonar processor to transmit a complete snapshot of beamformed magnitude and phase data over the network.

Syntax: *SNAP<CR><LF>

Parameters: N/A

Example: *SNAP<CR><LF>
Initiates transmission of a snapshot in several UDP packets.

C.3.1.38 Sound Speed

This message sets the sound speed.

Syntax: *SSPD,N<CR><LF>

Parameters: N – Sound speed value from 1350 to 1600m/s.

Example: *SSPD,1480<CR><LF>
This example sets the sound speed to 1480m/s.

C.3.1.39 TVG Coefficients

This message sets the sonar processor TVG coefficients.

Syntax: *STVG,SPREADING,ABSORPTION<CR><LF>

Parameters: SPREADING = The value is represented in quarters of a dB. The value should be multiplied by 4 (0 to 240 = 0.0 to 60.0 * log (Range))

ABSORPTION = The absorption value. Range from 0 to 120 dB/km.

Example: *STVG,20,60<CR><LF>
This message sets Spreading Loss to 5dB and the absorption to 60 dB/km.

C.3.1.40 Sidescan

This message sets the sonar processor sidescan output format.

Syntax: *STYP,N<CR><LF>

Parameters: N = 0: Off
 N = 1: Average new
 N = 2: RMS new
 N = 3: Full new
 N = 4: Off.
 N = 5: Average old
 N = 6: RMS old
 N = 7: Full old

Example: *STYP,1<CR><LF>
This message sets the sidescan output to "Average New".

C.3.1.41 CTD Baud Rate

This message controls the IN baud rate for Downlink Port 1. The port IN receives CTD data.

Syntax: *SVBR,N<CR><LF>

Parameters: N = Baud rate.

Valid rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Example: *SVBR,9600<CR><LF>
This example sets the IN baud rate on Downlink Port 1 to 9600.

C.3.1.42 Version

This message returns the wet end and dry end software version.

Syntax: *SVER<CR><LF>

Parameters: N/A

Example: *SVER<CR><LF>
*The message returns *SVER, ???-?.?-???, ???-?.?-???<CR><LF>, where the ?.? are the version numbers.*

C.3.1.43 Synchronization

This message selects the synchronization method between the sonar processors.

Syntax: *SYNC,N<CR><LF>

Parameters: N = 0: Stand-alone.
 N = 1: Slave.
 N = 2: Master.

Example: *SYNC,0<CR><LF>
The example sets the sonar processor to stand-alone.

C.3.1.44 Head Tilt

This message sets the head tilt angle.

Syntax: *TILT,N<CR><LF>

Parameters: N = Tilt angle from -180° to +180°

Example: *TILT,-1<CR><LF>
This example sets the head tilt angle to -1°.

C.3.1.45 Time

This message sets the processor time (not used for time stamping any data).

Syntax: *TIME,HH,MM,SS<CR><LF>

Parameters: HH = Hours (0 – 23)
 MM = Minutes (0 – 59)
 SS = Seconds (0 – 59)

Example: *TIME,13,42,1<CR><LF>
The example sets the processor time to 13:42:01.

C.3.1.46 UTC-Time Baud Rate

This message controls the IN baud rate for serial port 1. The port IN receives UTC-time data.

Syntax: *TMBR,N<CR><LF>

Parameters: N = Baud rate.

Valid rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Example: *TMBR,19200<CR><LF>
This message sets the In baud rate on Serial Port 1 to 19200.

C.3.1.47 Test Pattern

This message tells the sonar processor to output a test pattern. The test pattern represents a flat seafloor and a bump moving from beam to beam.

Syntax: *TPAT,N<CR><LF>

Parameters: N = 1: Turns the test pattern ON
N = any other value: Turns the test pattern OFF.

Example: *TPAT,1<CR><LF>
The message sets the test pattern ON.

C.3.1.48 Uplink

This message selects the uplink port.

Syntax: *UPLK,N<CR><LF>

Parameters: N = 0: COAX 1
N = 1: COAX 2
N = 2: FIBER 1
N = 3: FIBER 2

Example: *UPLK,1<CR><LF>
The example tells the sonar processor to receive uplink on port coax 2.

C.3.1.49 Video Mode

This message selects the video mode.

Syntax: *VMOD,N<CR><LF>

Parameters: N = 0: NTSC
N = 1: PAL.
N = 2: SVGA.

Example: *VMOD,1<CR><LF>
This example sets the video mode to PAL.

C.3.2 Time Stamp Message

This message is used for time stamping the bathymetric and sidescan data that is output to the network. The time should be in UTC format with the following syntax. If no UTC is available, latency values will be put in data packets.

Message - \$UTC,YYYYMMDD,HHMMSS.TTTT<CR><LF>

Table 16: Time Stamp Message Format

Field	Description	Range
\$UTC	Start of Message	
YYYY	Year	0000-9999
MM	Month	01-12
DD	Day	01-31
HH	Hour	00-23
MM	Minute	00-59
SS	Second	00-59
TTTT	Tenths of Millisecond	0000-9999

C.3.2.1 Time Synchronization of SeaBat Data

The SeaBat output message packets will always include a latency time, the time interval between the sonar ping and the output of the first element of the data packet by the sonar. These latency times will be independently generated and entered into the packets for each type of data output: bathymetry, sidescan, and snippets data.

If the data collection system is using the time of receipt of the data packet to determine the sonar ping time for the data packet, the latency should be subtracted from the time of receipt to determine the ping time.

If the data collection system is outputting the UTC time synchronization message to the sonar and using the time reported within the data packet to determine the ping time associated with the data set, the latency offset should NOT be applied to the time.

C.3.3 CTD Data

The processor currently accepts data in the following formats.

C.3.3.1 SeaBird CT

Message - TTT.TTTT,CC.CCCCC,SSSS.SSSS,VVVVV.VVV<CR><LF>

Table 17: SeaBird CT Message Format

Field	Description	Unit
TTT.TTTT	Temperature	Celsius
CC.CCCCC	Conductivity	Siemens Per meter
SSSS.SSS	Salinity	Parts per Thousand
VVVVV.VVV	Sound Velocity	Meter per Second

C.3.3.2 SeaBird CTD

Message:

TTT.TTTT,CC.CCCCC,PPPPP.PPP,SSSS.SSSS,VVVVV.VVV<CR><LF>

Table 18: SeaBird CTD Message Format

Field	Description	Unit
TTT.TTTT	Temperature	Celsius
CC.CCCCC	Conductivity	Siemens Per meter
PPPP.PPP	Pressure	Decibars
SSSS.SSS	Salinity	Parts per Thousand
VVVVV.VVV	Sound Velocity	Meter per Second

C.3.3.3 AML Smart Sensor

Message: SVVVV.VVS<CR><LF>

Table 19: AML Smart Sensor Message Format

Field	Description	Unit
VVVV.VV	Sound Velocity	Meter per Second
S	Space Character	

C.3.4 Motion Sensor Data

Valid motion sensor messages are shown in the following sub-sections. The sign convention for the sonar processor is:

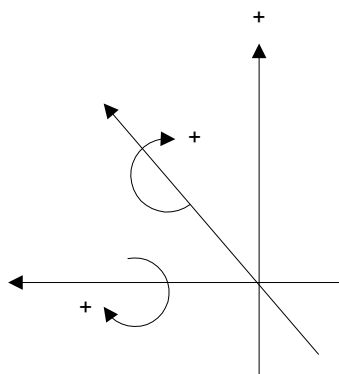


Figure 28: Sign Convention for Sonar Processor

C.3.4.1 TSS DMS05

Message = :XXAAASMHQHRRRSMPPPP<CR><LF>

Table 20: TSS DMS05 Message Format

Field	Description	Range	Units
:	Start of Message		
XX	Horizontal Acceleration	0 to 9.81m/s ²	3.83cm/s ²
AAAA	Vertical Acceleration	-20.48 to 20.47m/s ²	0.0625cm/s ²
S	Space Character		
MHHHH	Heave	-99 to 99m	1cm
Q	Status Flag	u, U, g, G, h, H, f, F	
MRRRR	Roll	-90° to 90°	0.01°
MPPPP	Pitch	-90° to 90°	0.01°
M	' ' if positive or '-' if negative		

C.3.4.2 TSS 335B

Message = :XXAAAASMHHHSMRRRRSMPPPP<CR><LF>

Table 21: TSS 335B Message Format

Field	Description	Range	Units
:	Start of Message		
XX	Horizontal Acceleration	0 to 9.81m/s ²	3.83cm/s ²
AAAA	Vertical Acceleration	-20.48 to 20.47m/s ²	0.0625cm/s ²
S	Space Character		
MHHHH	Heave	-99 to 99m	1cm
S	Space Character		
MRRRR	Roll	-90° to 90°	0.01°
MPPPP	Pitch	-90° to 90°	0.01°
M	' ' if positive or '-' if negative		

C.3.4.3 TSS 332B

Message = MRRRRMPPPP<CR>

Table 22: TSS 332B Message Format

Field	Description	Range	Units
MRRRR	Roll	-90° to 90°	0.01°
MPPPP	Pitch	-90° to 90°	0.01°
M	' ' if positive or '-' if negative		

C.3.4.4 Seatex MRU

The binary format consists of a fixed-length message using single-byte unsigned and 4-byte IEEE floating point data elements. For the multi-byte elements, the most significant byte is transmitted first.

Note: Each <> indicates one byte of data.

INTERFACE SPECIFICATIONS

<71>	<11>	<2f>	<3d>	<50>	<e5>	<60>	<bd>	<50>	<e5>	<60>	<be>	<50>	<e5>	<60>	<3f>	<9d>	<f3>	<b6>	<cb>
				Roll				Pitch				Yaw				PosMonD			
				=0x3d50e560				=0xbd50e560				=0xbe50e560				= 0x3f9df3b6			
				IEEE float				IEEE float				IEEE float				IEEE float			V
				-> 0.051 rad				-> -0.051rad				-> -0.204 rad				-> 1.234m			check

=>user selected token (associated with this configuration)

=>length is 4 * sizeof(float) + 1 (token) = 4 * 4 + 1 = 17 = hex 11

=>header ('q'), replaced with 'Q' when data is unstable (i.e. at startup).

Table 23: Seatex MRU Message Format

Field	Units	Format	Bytes	Value
Header		ASCII	1	ASCII 'q' or 'Q'
Length		Unsigned	1	0x11
Token		Unsigned	1	0 - 255
Roll	radians	Float	4	
Pitch	radians	Float	4	
Yaw	radians	Float	4	
Heave	meters	Float	4	
Checksum		Unsigned	1	0 - 255

C.3.4.5 Octans STD 1

Standard: Output NMEA 0183 compatible

Data sent: Heading, roll, pitch, position, linear speed, compensation values and status

Data frame:

Syntax: \$HEHDT,x.xx,T*hh<CR><LF>

Parameters: x.xx = true heading in degrees
hh = checksum

Syntax: \$PHTRO,x.xx,a,y.yy,b*hh<CR><LF>

INTERFACE SPECIFICATIONS

Parameters: x.xx = pitch in degrees

a = M: bow up

a = P: bow down

y.yy = roll in degrees

b = B: port down

b = T: port up

Syntax \$PHLIN,x.xxx,y.yyy,z.zzz*hh<CR><LF>

Parameters x.xxx = surge (X1) in meters (signed)

y.yyy = sway (X2) in meters (signed)

z.zzz = heave (X3) in meters (signed)

Syntax \$PHSPD,x.xxx,y.yyy,z.zzz*hh<CR><LF>

Parameters x.xxx = X1 speed in m.s⁻¹ (signed)

y.yyy = X2 speed in m.s⁻¹ (signed)

z.zzz = X3 speed in m.s⁻¹ (signed)

Syntax \$PHCMP,llll.ll,a,xx.xx,b,N*hh<CR><LF>

Parameters llll.ll = latitude in degrees (two first l) and in minutes (four last l)

a = N: Northern hemisphere

a = S: Southern hemisphere

xx.xx = speed in knots

Syntax \$PHINF,hhhhhhhh*hh<CR><LF>

Parameters hhhhhhhh = hexadecimal value of Octans status

Bit 0	Heading not valid
Bit 1	Roll not valid
Bit 2	Pitch not valid
Bit 3	Position not valid
Bit 4	Position calculation started
Bit 5	Previous alignment
Bit 8	FOG X1 error
Bit 9	FOG X2 error
Bit 10	FOG X3 error
Bit 11	Optical source error
Bit 12	Accelerometer X1 error
Bit 13	Accelerometer X2 error
Bit 14	Accelerometer X3 error
Bit 15	Analog input A or B error
Bit 16	Serial input A error
Bit 17	Serial input B error
Bit 18	Serial input C error
Bit 20	Serial output A full
Bit 21	Serial output B full
Bit 22	Serial output C full

C.3.5 UDP Ports

All data on the Ethernet uses different UDP Ports. The Base UDP port is the one you have selected for the sonar processor. The others are offsets to the base.

Table 24: UDP Port Offsets

UDP PORT OFFSET	TYPE OF DATA
0	Bathymetric Data
+1	Sidescan (optional)
+2	Control / Status
+3	Alarm
+4	Snapshot
+5	Raw Beam Data (optional)
+6	Snippet Data (optional)

The download port for new firmware is fixed at 8100.

C.3.6 Bathymetric Data

There are two different bathymetric data formats: R and RI Theta. The two formats are described in structures. The data types that are used are defined as follows and are Big Endian.

Table 25: Bathymetric Data Types

DATA TYPE	BYTES
Char	1
Short	2
Long	4

C.3.6.1 Time Stamp

The DATA_TIME Struct are used for time stamping:

```
struct DATA_TIME
{
    unsigned long Seconds;    //Seconds since 00:00:00, 1 January 1970
    unsigned long Millisecs;  //Milliseconds, LSB = 1ms
};
```

The time in the DATA_TIME Struct is based on UTC message from GPS passed through the DAC System to the processor.

C.3.6.2 Sonar Latency

The drawing below shows the ping timing sequence. It illustrates the sonar processor's three-ping latency.

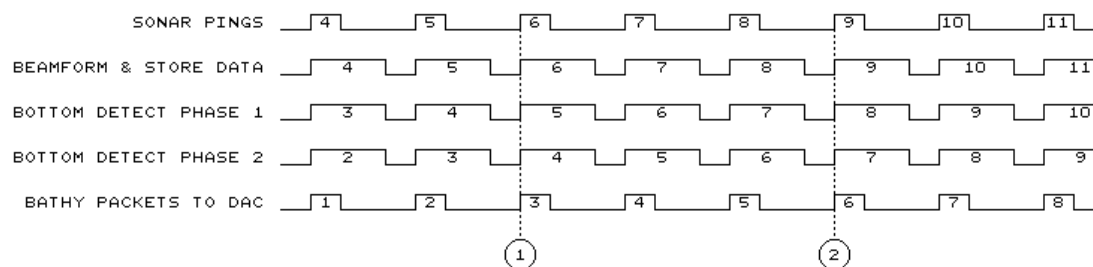


Figure 29: Sonar Latency Drawing

C.3.7 R Theta Packets

C.3.7.1 Packet Type 0x17

```

struct R_THETA_DATA
{
    char          synch_header[4];    // synch header {0xff, 0xff, 0x00, 0x00}
    char          packet_type;        // identifier for packet type (0x17)
    char          packet_subtype;     // identifier for packet subtype
    unsigned short latency;           // time from ping to output (milliseconds)
    DATA_TIME    data_time;          // time of ping for data packet
    unsigned long ping_number;        // sequential ping number from sonar startup/reset
    unsigned long sonar_id            // least significant four bytes of Ethernet address
    unsigned short sonar_model        // coded model number of sonar
    unsigned short frequency          // sonar frequency in kHz
    unsigned short velocity;          // programmed sound velocity (LSB = 1m/sec)
    unsigned short sample_rate;       // A/D sample rate (samples per second)
    unsigned short ping_rate;         // ping rate (pings per second * 1000)
    unsigned short range_set;         // range setting for SeaBat (meters)
    unsigned short power;             // power setting for SeaBat
    unsigned short gain;              // gain setting for SeaBat
                                     // bits 0-6 gain (1 - 45)
                                     // bit 14 (0 = fixed, 1 = tvg)
                                     // bit 15 (0 = manual, 1 = auto)
    unsigned short pulse_width;       // transmit pulse width (microseconds)
    unsigned char tvg_spread;         // spreading coefficient for tvg * 4
                                     // valid values = 0 to 240 (0.0 to 60.0 in 0.25
                                     // steps)
    unsigned char tvg_absorp;         // absorption coefficient for tvg
    unsigned char projector_type;     // bits 0-4 = projector type
                                     // bit 7 = pitch steering (1 = enabled, 2 = disabled)
    unsigned char projector_beam_width // along track transmit beam width (degrees * 10)
    unsigned short beam_spacing_num;  // receive beam angular spacing numerator
    unsigned short beam_spacing_denom; // cross track receive beam angular spacing
                                     // denominator
                                     // beam width degrees = numerator / denominator
    short         projector_angle;    // projector pitch steering angle (degrees * 100)
    unsigned short min_range;         // sonar filter settings
    unsigned short max_range;
    unsigned short min_depth;
    unsigned short max_depth;
    unsigned char filteredrs_active;  // range/depth filters active
                                     // bit 0 – range filter (0 = off, 1 = active)
                                     // bit 1 – depth filter (0 = off, 1 = active)
    unsigned char flags;              // bit 0 – Roll stabilization flag (0 = off, 1 = on)
    unsigned char spare[2];           // spare field for future growth
    short         temperature;        // temperature at Sonar Array (deg C * 10)
    short         beam_count;         // number of sets of beam data in packet
    unsigned short range[n];          // range for beam N = beam_count
                                     // range units = sample cells * 4 ("14.2" format)

```

INTERFACE SPECIFICATIONS

```

        unsigned char    quality[cnt];

        unsigned short    checksum;
    };

```

//packed quality array (two 4 bit values/char)
 //cnt = n/2 if beam count even, n/2 +1 if odd.
 //cnt then rounded up to next even number
 //e.g. if beam count = 101, cnt = 52
 //unused trailing quality values set to zero
 //bit 0 – brightness test (0 = failed, 1 = passed)
 //bit1 – colinearity test (0 = failed, 1 = passed)
 //bit2 – amplitude bottom detect used
 //bit3 – phase bottom detect used
 //bytes are populated in high order nibble first
 //with the higher 4 bits for the first sounding and
 //the lower 4 bits for the second sounding
 //bottom detect can be amplitude, phase or both
 //checksum for data packet

C.3.8 RI Theta Packets

C.3.8.1 Packet Type 0x18

```

struct RI_THETA_DATA
{
    char        synch_header[4];
    char        packet_type;
    char        packet_subtype;
    unsigned short latency;
    DATA_TIME  data_time;
    unsigned long ping_number;
    unsigned long sonar_id;
    unsigned short sonar_model;
    unsigned short frequency;
    unsigned short velocity;
    unsigned short sample_rate;
    unsigned short ping_rate;
    unsigned short range_set;
    unsigned short power;
    unsigned short gain;

    unsigned short pulse_width;
    unsigned char  tvg_spread;

    unsigned char tvg_absorp;
    unsigned char projector_type;

    unsigned char projector_beam_width;
    unsigned short beam_spacing_num;
    unsigned short beam_spacing_denom;

    short        projector_angle;
}

```

// synch header {0xff, 0xff, 0x00, 0x00}
 //identifier for packet type (0x18)
 //identifier for packet subtype
 //time from ping to output (milliseconds)
 //time of ping for data packet (0 if no UTC input)
 //sequential ping number from sonar startup/reset
 //least significant four bytes of Ethernet address
 //coded model number of sonar
 //sonar frequency in kHz
 //programmed sound velocity (LSB = 1m/sec)
 //A/D sample rate (samples per second)
 //ping rate (pings per second *1000)
 //range setting for SeaBat (meters)
 //power setting for SeaBat
 //gain setting for SeaBat
 //bits 0-6 gain (1 - 45)
 //bit 14 (0 = fixed, 1 = tvg)
 //bit 15 (0 = manual, 1 = auto)
 //transmit pulse width (microseconds)
 //spreading coefficient for tvg * 4
 //valid values = 0 to 240 (0.0 to 60.0 in 0.25 steps)
 //absorption coefficient for tvg
 //bits 0-4 = projector type
 //bit 7 = pitch steering (1 = enabled, 0 = disabled)
 //along track transmit beam width (degrees * 10)
 //receive beam angular spacing numerator
 //cross track receive beam angular spacing denominator
 //beam width degrees = numerator / denominator
 //projector pitch steering angle (degrees * 100)

INTERFACE SPECIFICATIONS

```

unsigned short  min_range;           //sonar filter settings
unsigned short  max_range;
unsigned short  min_depth;
unsigned short  max_depth;
unsigned char   filters_active;      //range/depth filters active
                                     //bit 0 – range filter (0 = off, 1 = active)
                                     //bit1 – depth filter (0 = off, 1 = active)
                                     //bit 0 – Roll stabilization flag (0 = off, 1 = on)
unsigned char   flags;              //spare field for future growth
unsigned char   spare[2];
short          temperature;         //temperature at Sonar Array (deg C * 10)
short          beam_count;          //number of sets of beam data in packet
unsigned short  range[n];           //range for beam N = beam_count
                                     //range units = sample cells * 4
unsigned char   quality[cnt];       //packed quality array (two 4 bit values/char)
                                     //cnt = n/2 if beam count even, n/2 +1 if odd.
                                     //cnt then rounded up to next even number
                                     //e.g. if beam count = 101, cnt = 52
                                     //unused trailing quality values set to zero
                                     //bit 0 – brightness test (0 = failed, 1 = passed)
                                     //bit1 – colinearity test (0 = failed, 1 = passed)
                                     //bit2 – amplitude bottom detect used
                                     //bit3 – phase bottom detect used
                                     //bytes are populated high order nibble first
                                     //with the higher 4 bits for the first sounding and
                                     //the lower 4 bits for the second sounding
                                     //bottom detect can be amplitude, phase or both
unsigned short  intensity[n];       //intensities at bottom detect * 8
unsigned short  checksum;           //checksum for data packet
};

```

C.3.9 Sidescan Imagery Packets

When the sidescan option is enabled, the sonar will output a left and right sidescan packet for each sonar ping. The sidescan data will be generated using the same ping as the bathymetry so it will be possible for the data collection system or subsequent processing to use the bathymetry data to geographically register the imagery. Since the sidescan data will be output by the sonar on Ethernet, and this type of output has a limitation of 1,500 bytes or less, the ping data from each beam may be broken up into multiple packets. The information for the two beams will be output as a series of amplitude values, starting from the outermost sample cell on the port side, through the center to the outermost sample cell on the starboard side. The network transport protocol used is UDP/IP.

The number of amplitude values output for each packet will vary with range. if RMS or average modes are used, the data will be compressed to a maximum of 1024 samples per channel.

INTERFACE SPECIFICATIONS

The data from the sonar will not be slant range corrected. Determining the altitude of the sonar array and performing slant ranged correction is the responsibility of the Data Acquisition System.

The sonar imagery data will not be compensated for changes in power and gain.

C.3.9.1 Sidescan Packet

```
struct SIDESCAN_IMAGE
{
    char          STX;           //start character (0x02)
    char          id;           //packet id (0x48)
    unsigned short packet_size;  //size of packet – next field through last
                                //Amplitude value
    unsigned long ping_no       //sequential ping number since sonar
                                //power-up / reset
    DATA_TIME    data_time;     //time of ping for data packet
    unsigned short total_samples; //total number of amplitude samples for ping
    unsigned short ping_packet;  //sequence number – (0 to n)
    unsigned short velocity;     //programmed sound velocity (LSB = 1m/sec)
    unsigned short sample_rate;  //A/D sample rate (samples per second)
    unsigned short ping_rate;    //ping rate (pings per second *1000)
    unsigned short range_set;    //range setting for SeaBat (meters)
    unsigned short power;        //power setting for SeaBat
    unsigned short gain;         //gain setting for SeaBat
                                //bits 0-6 gain (1 - 45)
                                //bit 14 (0 = fixed, 1 = tvg)
                                //bit 15 (0 = manual, 1 = auto)
    unsigned char pulse_width;   //transmit pulse width (microseconds)
    unsigned char tvg_spread;    //spreading coefficient for tvg *4
                                //valid values = 0 to 240
                                //(0.0 to 60.0 in 0.25 steps)
    unsigned char tvg_absorp;    //absorption coefficient for tvg
    unsigned char flags;         //bit 0 – Roll stabilization flag (0 = off, 1 = on)
    unsigned short spare1(2);    //more spares
    short projector;            //projector setting
    unsigned short sample_count; //number of amplitude samples in packet
    unsigned short amplitude[n]; //amplitude data N = sample_count
                                //12 bit amplitude stored in 12 most
                                //significant bits
    unsigned char spare2;        //spare to align ETX and checksum
    char ETX;                   //packet end character (0x03)
    unsigned short checksum;     //checksum for data packet
};
```

C.3.10 Snippet Data Format

The sonar processor outputs snippet data via UDP/IP (base port + 6). Each ping generates a burst of Ethernet packets containing one SNP0 header followed by BeamCnt Snippets (one snippet per beam). Each snippet consists of one or more fragments. The sonar processor packs fragments into large, efficient Ethernet

INTERFACE SPECIFICATIONS

packets. Each fragment consists of one SNP1 header followed by many samples of unsigned short magnitude data. Every Ethernet packet begins with either a SNP0 or SNP1 header.

Below are the C structures for the SNP0 and SNP1 headers. The SNP0 header is similar to a bathymetry header. All integers are Big-Endian (MSB first). All structures are packed (no alignment gaps). Short has 16 bits. Long has 32 bits. GainStart and GainEnd are currently set to zero and reserved for future use.

C.3.10.1 Header Formats

```

/* ID values for the SNP0 and SNP1 headers */
#define SNIPPET_ID_SNP0 0x534E5030 /* 'SNP0' */
#define SNIPPET_ID_SNP1 0x534E5031 /* 'SNP1' */

struct SNP0
/* ping header (there are BEAMS Snippets per ping) */
{
    Unsigned long    ID;                /* identifier code */
    unsigned short   HeaderSize;        /* header size, bytes */
    unsigned short   DataSize;          /* data size following header, bytes */
    unsigned long    PingNumber;        /* sequential ping number */
    unsigned long    Seconds;           /* time since 00:00:00, 1-Jan-1970 */
    unsigned long    Millisec;
    unsigned short   Latency;           /* time from ping to output (milliseconds) */
    unsigned short   SonarID[2];        /* least significant four bytes of Ethernet
                                         address */

    unsigned short   SonarModel;        /* coded model number of sonar */
    unsigned short   Frequency;         /* sonar frequency (kHz) */
    unsigned short   SSpeed;            /* programmed sound velocity (m/sec) */
    unsigned short   SampleRate;        /* A/D sample rate (samples/sec) */
    unsigned short   PingRate;          /* pings per second, 0.001Hz steps */
    unsigned short   Range;             /* range setting (meters) */
    unsigned short   Power;             /* power */
    unsigned short   Gain;              /* gain (b15=auto, b14=TVG, b6..0=gain) */
    unsigned short   PulseWidth;        /* transmit Pulse Width (microseconds) */
    unsigned short   Spread;            /* TVG spreading, n*log(R), 0.25dB steps */
    unsigned short   Absorp;            /* TVG absorption, dB/km, 1dB steps */
    unsigned short   Proj;              /* b7 = steering, b4..0 = projector type */
    unsigned short   ProjWidth;         /* transmit beam width along track, 0.1 deg
                                         steps */

    unsigned short   SpacingNum;        /* receiver beam spacing, numerator,
                                         degrees */

    unsigned short   SpacingDen;        /* receiver beam spacing, denominator */
    short            ProjAngle;         /* projector steering,
                                         degrees*PKT_STEER_RES */

    unsigned short   MinRange;          /* range filter settings */
    unsigned short   MaxRange;
    unsigned short   MinDepth;          /* depth filter settings */
    unsigned short   MaxDepth;
    unsigned short   Filters;           /* enabled filters: b1=depth, b0=range */
    struct           Status;            /* one byte containing eight status flags */
}

```

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```

{
    unsigned      Spare   : 12;
    unsigned      SnipMode : 3;      /* menu item setting */
    unsigned      RollStab : 1;      /* bit0: roll stabilization enabled */
} bFlags;
    short      HeadTemp;      /* head temperature, 0.1C steps */
    unsigned short BeamCnt;    /* number of beams */
};

struct SNP1      /* fragment header (one or more fragments per Snippet) */
{
    unsigned long   ID;          /* identifier code */
    unsigned short  HeaderSize;  /* header size, bytes */
    unsigned short  DataSize;    /* data size following header, bytes */
    unsigned long   PingNumber;  /* sequential ping number */
    unsigned short  Beam;        /* beam number, 0..N-1 */
    unsigned short  SnipSamples;  /* Snippet size, samples */
    unsigned short  GainStart;    /* gain at start of Snippet, 0.01dB
                                steps, 0=ignore */
    unsigned short  GainEnd;      /* gain at end of Snippet, 0.01dB
                                steps, 0=ignore */
    unsigned short  FragOffset;   /* fragment offset, samples from ping
                                */
    unsigned short  FragSamples;  /* fragment size, samples */
};

```

C.3.11 Alarms

The Alarm message is network-based and is transmitted if there is an alarm condition. The message is in ASCII format.

Syntax: !ALARM, V<\r><\n>Alarm Messages

Parameters: N = Number of Alarms in Message.
Alarm Messages = See Below

C.3.11.1 Leak

Syntax: !LEAK, V<\r><\n>

Parameters: V = Voltage in sonar array

C.3.11.2 Uplink Bad

Syntax: !UPLINKBAD, V<\r><\n>

Parameters: N/A

C.3.11.3 Downlink Bad

Syntax: !DOWNLINKBAD,<\r><\n>

Parameters: N/A

C.4 Internal Interfaces

C.4.1 Introduction

This section provides a description of the internal interfaces between the sonar processor and the transceiver unit. There are three interfaces for standalone operation: Power, Uplink Data and Downlink Data. Those interfaces are described below.

C.4.2 Power

The transceiver unit requires a nominal 24VDC for operation, however a voltage range of 22 to 30 volts is acceptable.

C.4.3 Uplink Data

The uplink between the transceiver unit and the sonar processor is a high-speed digital data stream running at 36.4Mbps. Each frame contains 512 bytes transmitted at a frame rate of 7.109kHz.

Each byte is split into two 4-bit nibbles with the low nibble sent first. Nibbles are 4-to-5 encoded, NRZI modulated, and uplinked at 36.4Mbps. The uplink driver generates 0.7Vp-p signal into a 75-ohm coaxial cable.

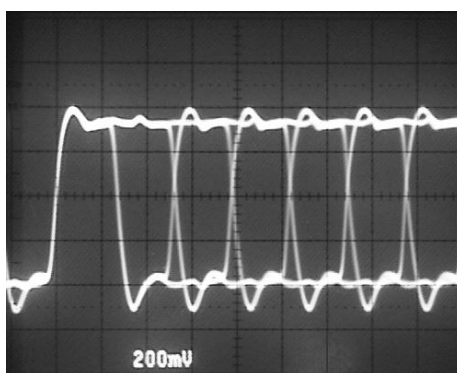


Figure 30: Uplink Example

Table 26: Uplink Frame Format

Byte	Function
0	Frame synchronization bit pattern: J-sync followed by K-sync.
1	Various telemetry and status messages.
2	LSB of frame up-counter. Reset to zero during ping.
3	MSB of frame up-counter. Reset to zero during ping.
4	I value of receiver 0.
5	Q value of receiver 0.
6	I value of receiver 1.
7	Q value of receiver 1.
510	I value of receiver 253.
511	Q value of receiver 253.

Table 27: Uplink Encoding Scheme From 4-Bit Nibbles to 5-Bit Codes

Nibble	4-to-5 (first – last)
0000	10101
0001	01001
0010	10100
0011	11110
0100	01010
0101	01011
0110	01110
0111	01111
1000	10010
1001	10011
1010	10110
1011	10111
1100	11101
1101	11011
1110	11100
1111	11010
J-Sync	11000
K-Sync	10001

C.4.3.1 Uplink NRZI Modulation

The Non-Return-to-Zero Invert-Ones (NRZI) modulator toggles when the 4-to-5 bit is “1”. This action attenuates the low-frequency component of the 4-to-5 signal, making it suitable for passage through AC-coupled uplink circuitry.

CAUTION

The maximum cable length between the transceiver unit and the sonar processor is 20m. Care should be taken to ensure that all cable and connectors in the uplink path are correctly terminated and shielded. It is particularly important that a 75 ohm impedance be maintained throughout. If impedance is mismatched, it will cause signal degradation regardless of the cable length.

C.4.4 Downlink Data

The downlink from the sonar processor to the transceiver unit commands the transceiver circuits into various states and modes. Nominal amplitude is $\pm 12V$ and packets are transmitted at irregular intervals. The downlink receiver is opto-isolated for protection. Some data delay is tolerated by the transceiver.

Table 28: Downlink Technical Specifications

Description	Setting
Signal Type	RS232
Baud Rate IN	N/A
Baud Rate OUT	19200
Data Bits	8
Parity	None
Stop Bits	1

APPENDIX D SYSTEM DRAWINGS

The following documents are included for reference:

System:

SeaBat 8160 System, Sheet 1
SeaBat 8160 System, Sheet 2

Drawing #11337
Drawing #11337

Wet End:

Array, Installation Template
Array, Outline and Installation Drawing
Array, Section 1
Array, Section 2
Array, Section 3
Four Inch Flange
Projector
Hydrophone

Drawing #11411
Drawing #0416M011_001

Drawing #0416E121_003
Drawing #2148M011_001
Drawing #7196M011_001

Cables:

Cable, Hydrophone, Dry End Termination
Cable, Projector, Dry End Termination
Cable, Processor to Transceiver (shielded)

Drawing #7196C021_002
Drawing #2148C021_002
Drawing #11124

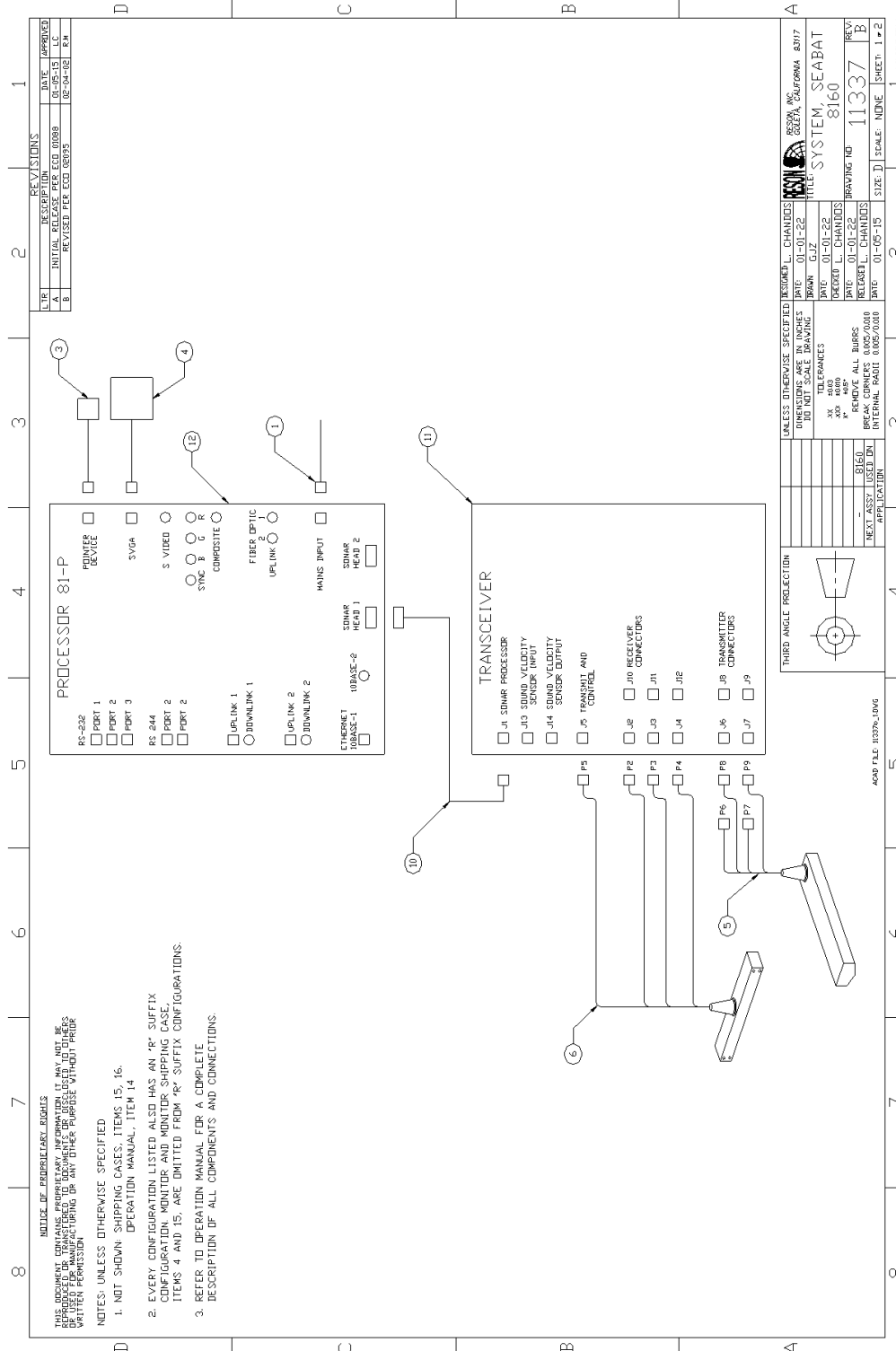


Figure 31: SeaBat 8160 System, Sheet 1

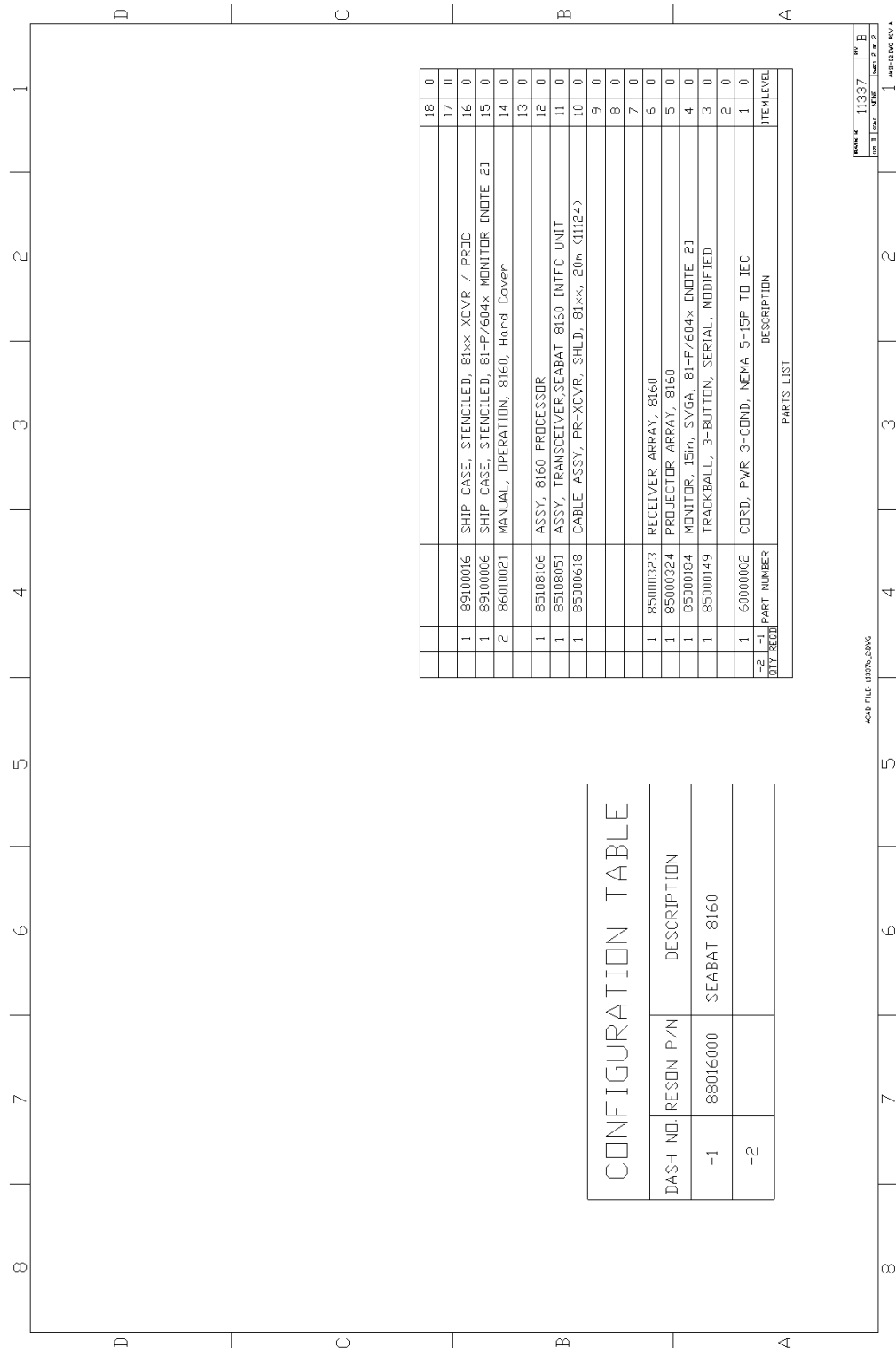


Figure 32: SeaBat 8160 System, Sheet 2

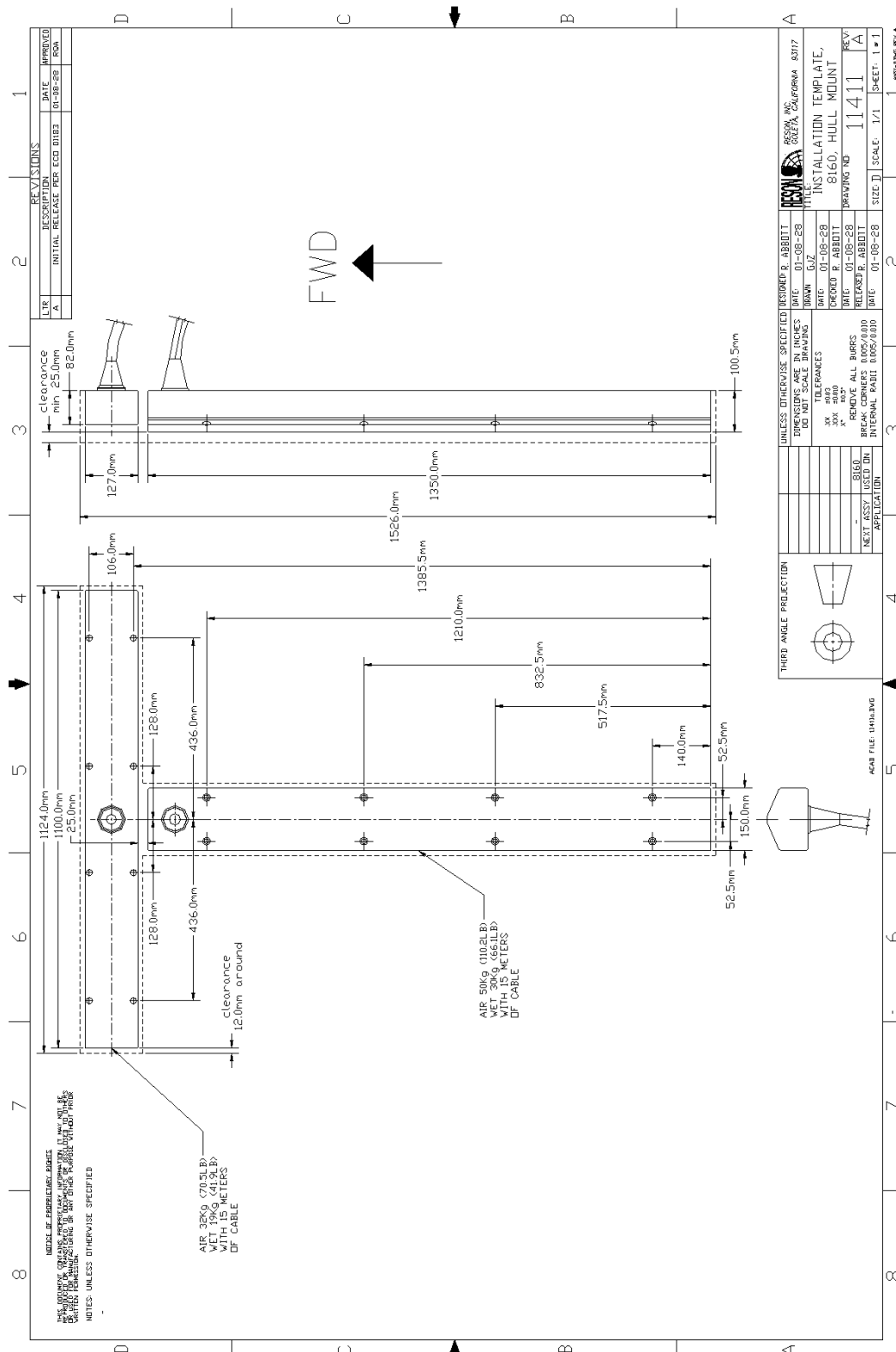


Figure 33: Array, Installation Template

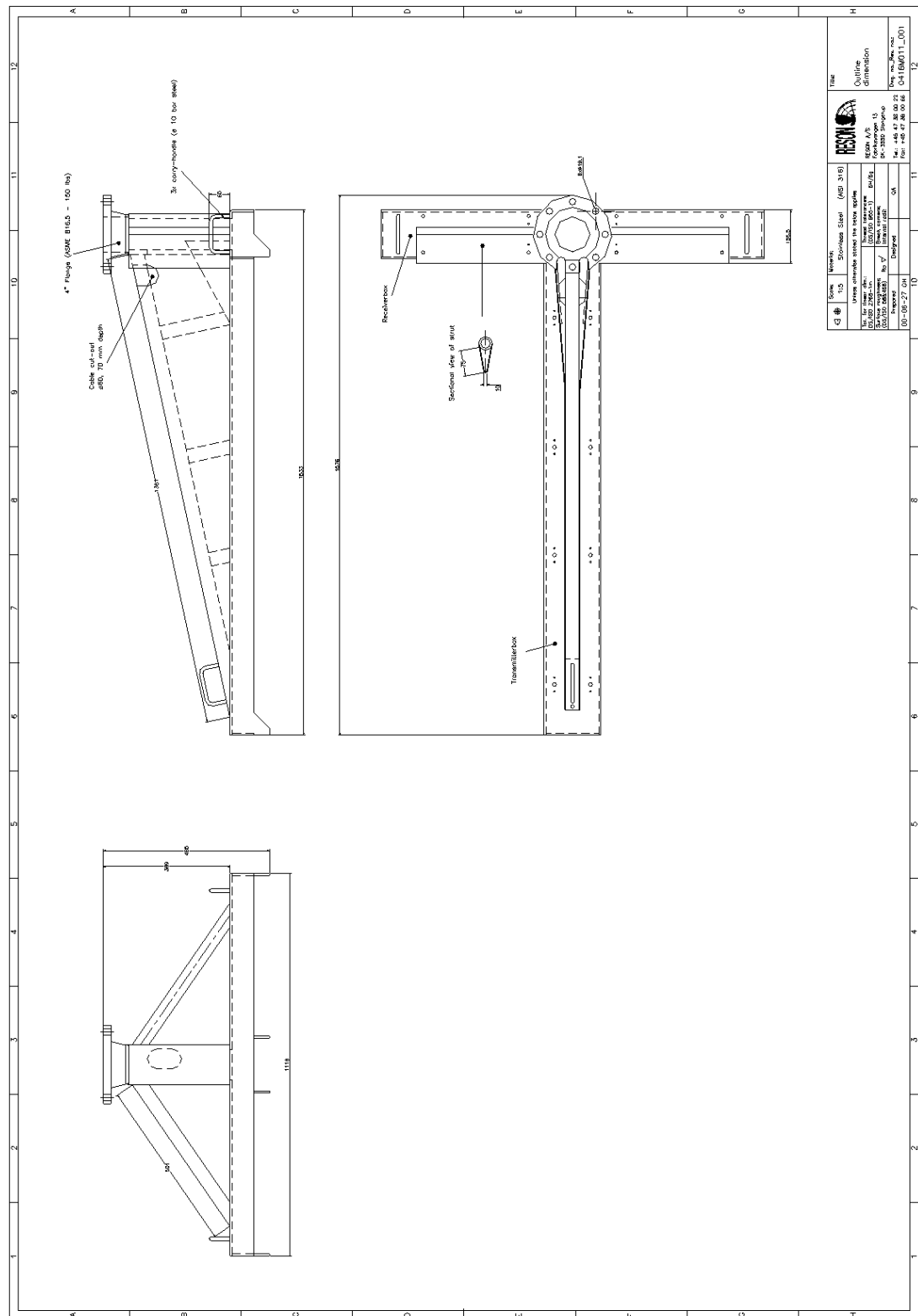


Figure 34: Array, Outline and Installation Drawing

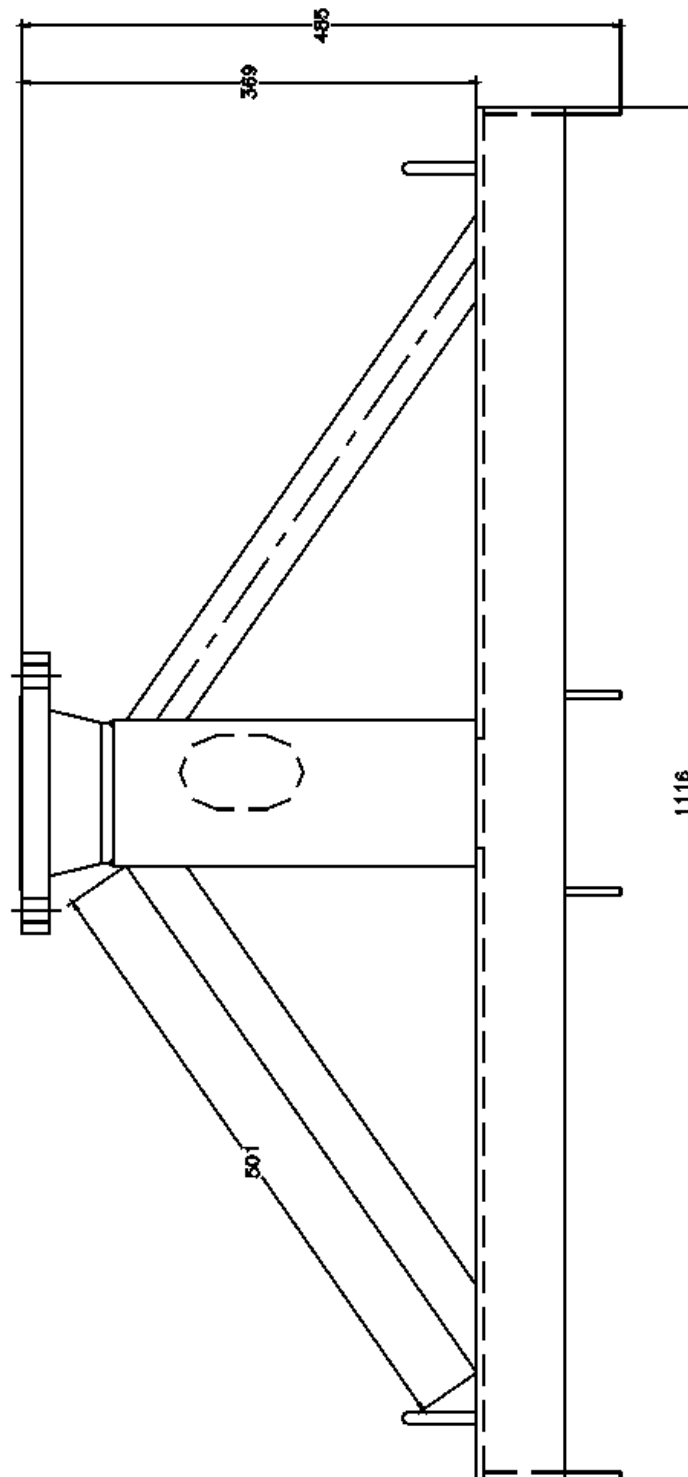


Figure 35: Array, Section 1

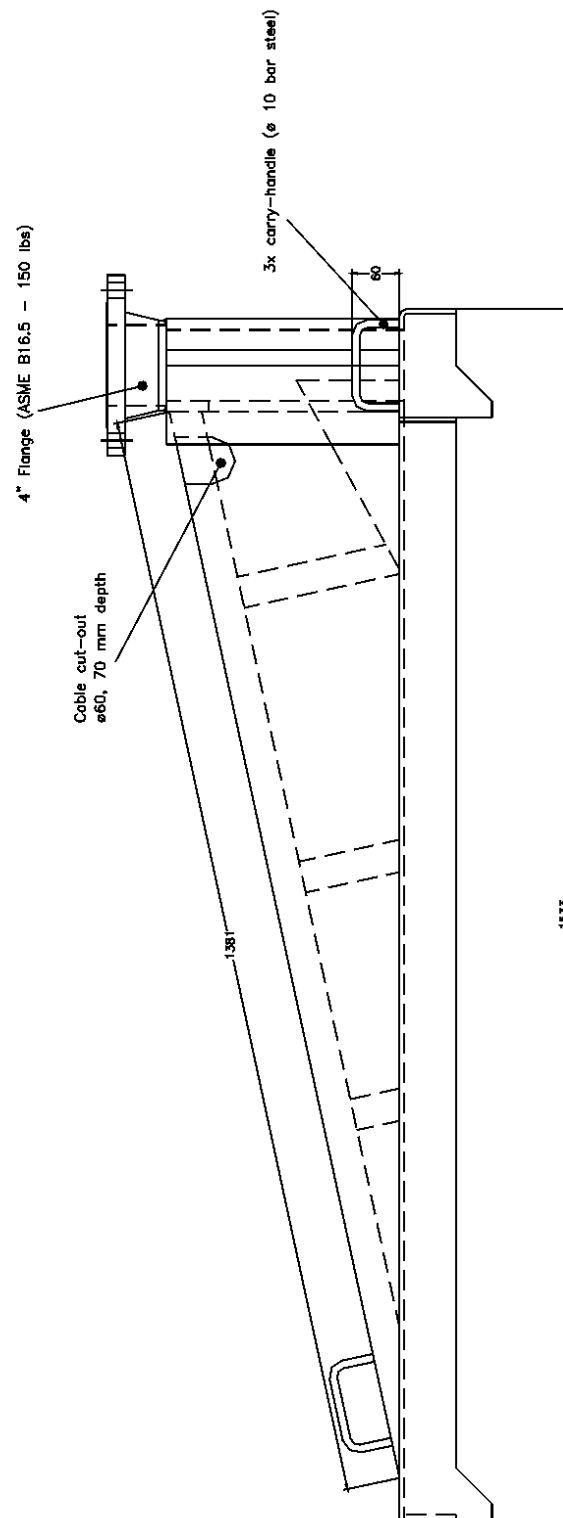


Figure 36: Array, Section 2

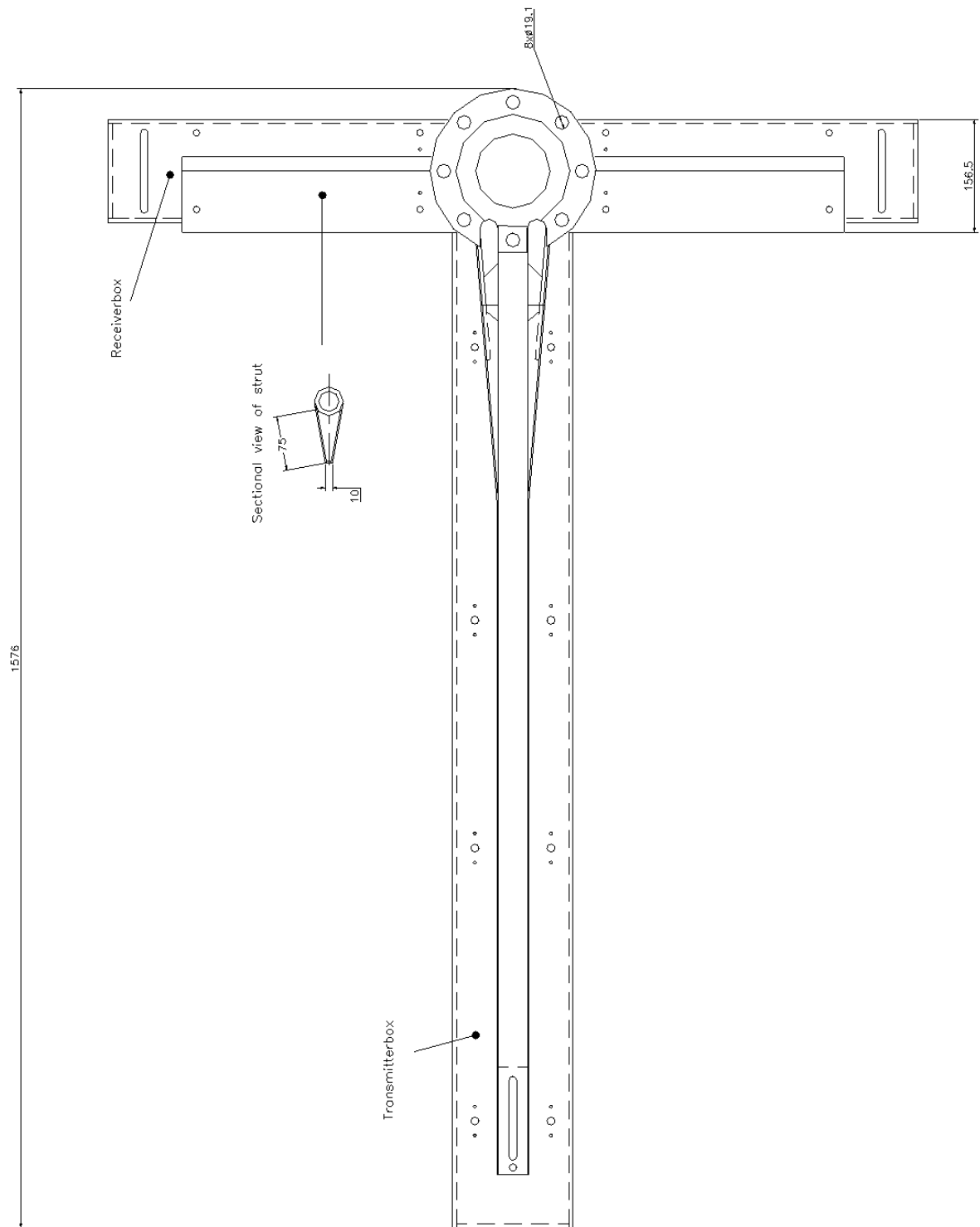
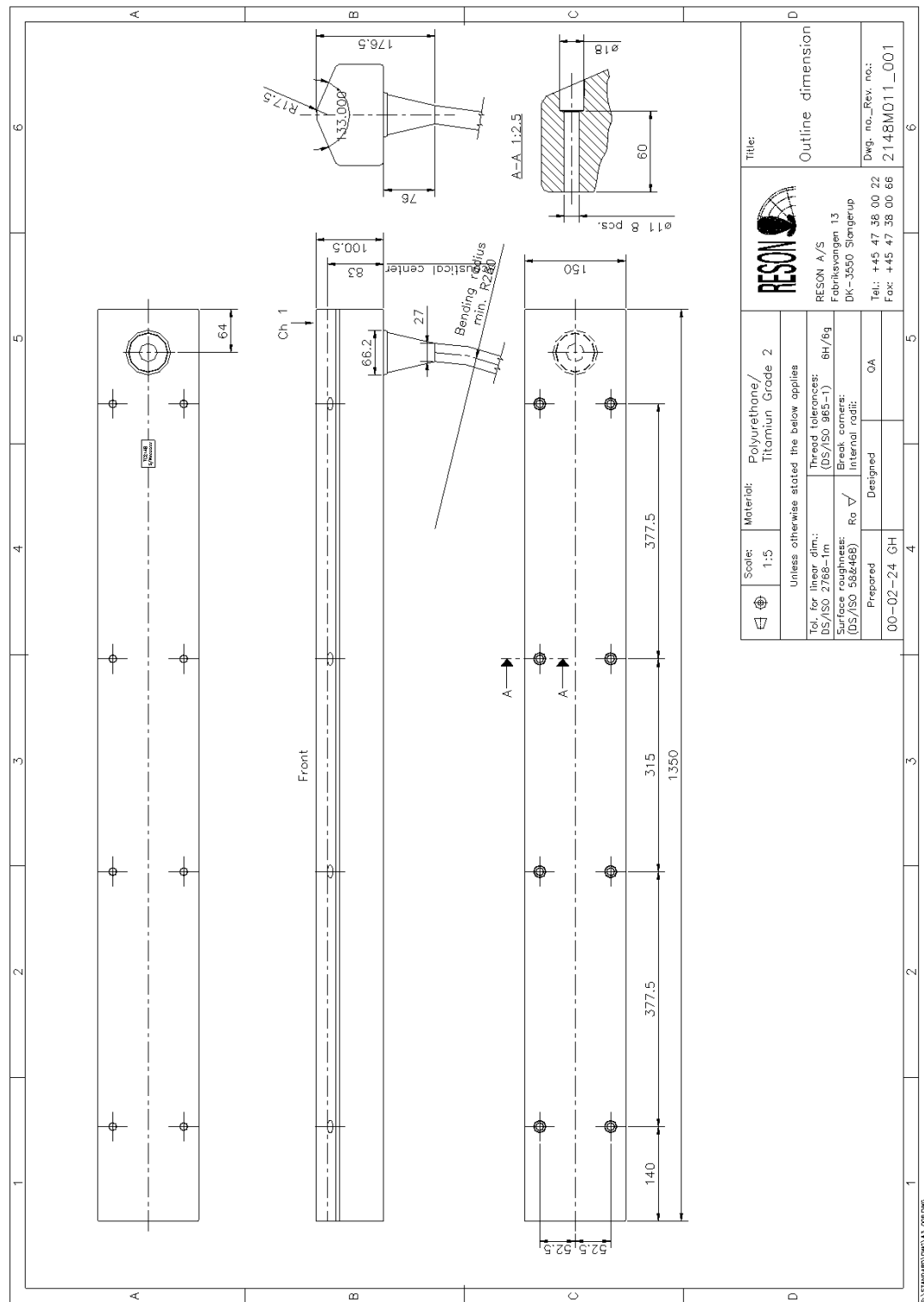


Figure 37: Array, Section 3





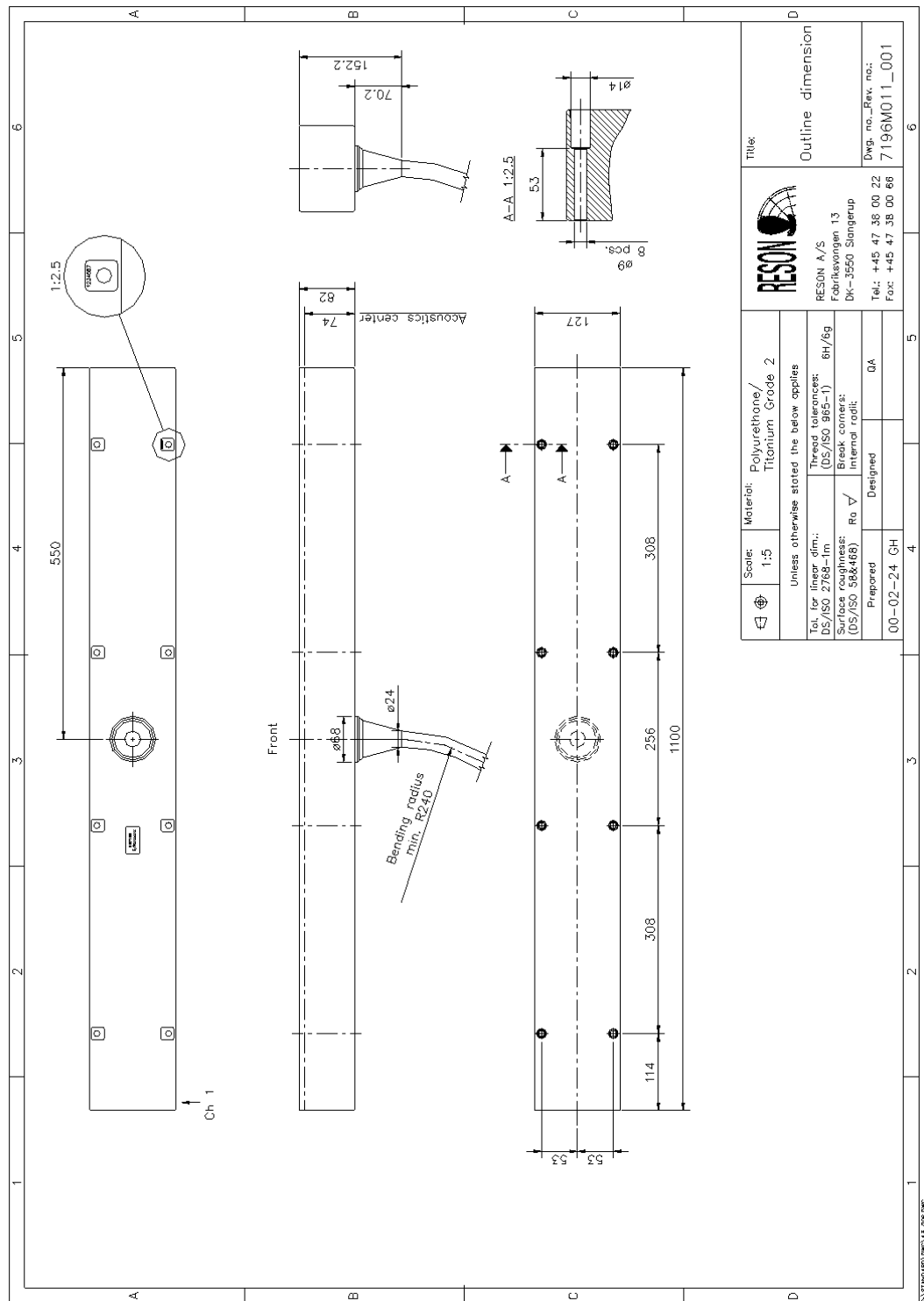


Figure 40: Hydrophone

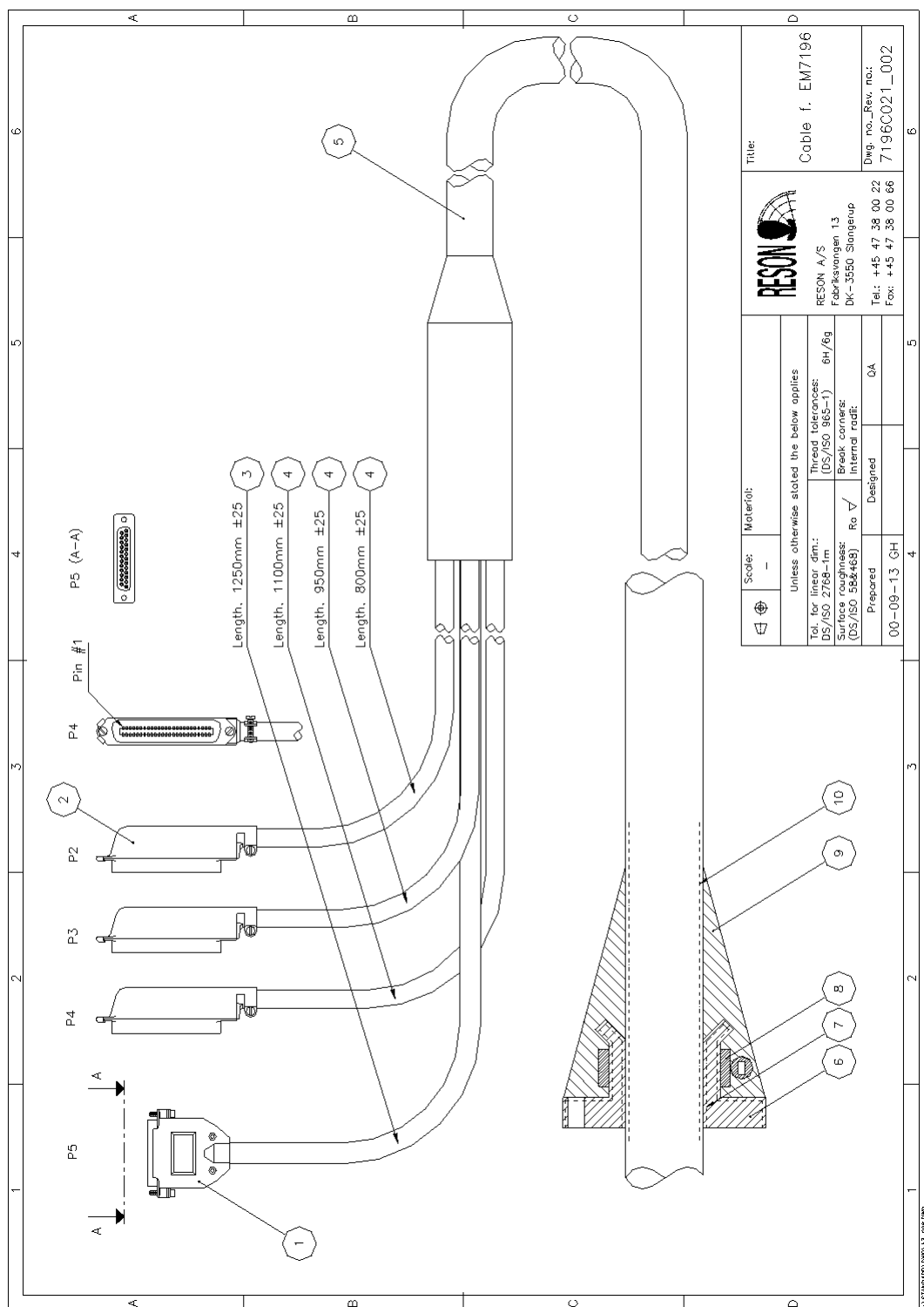


Figure 41: Cable, Hydrophone, Dry End Termination

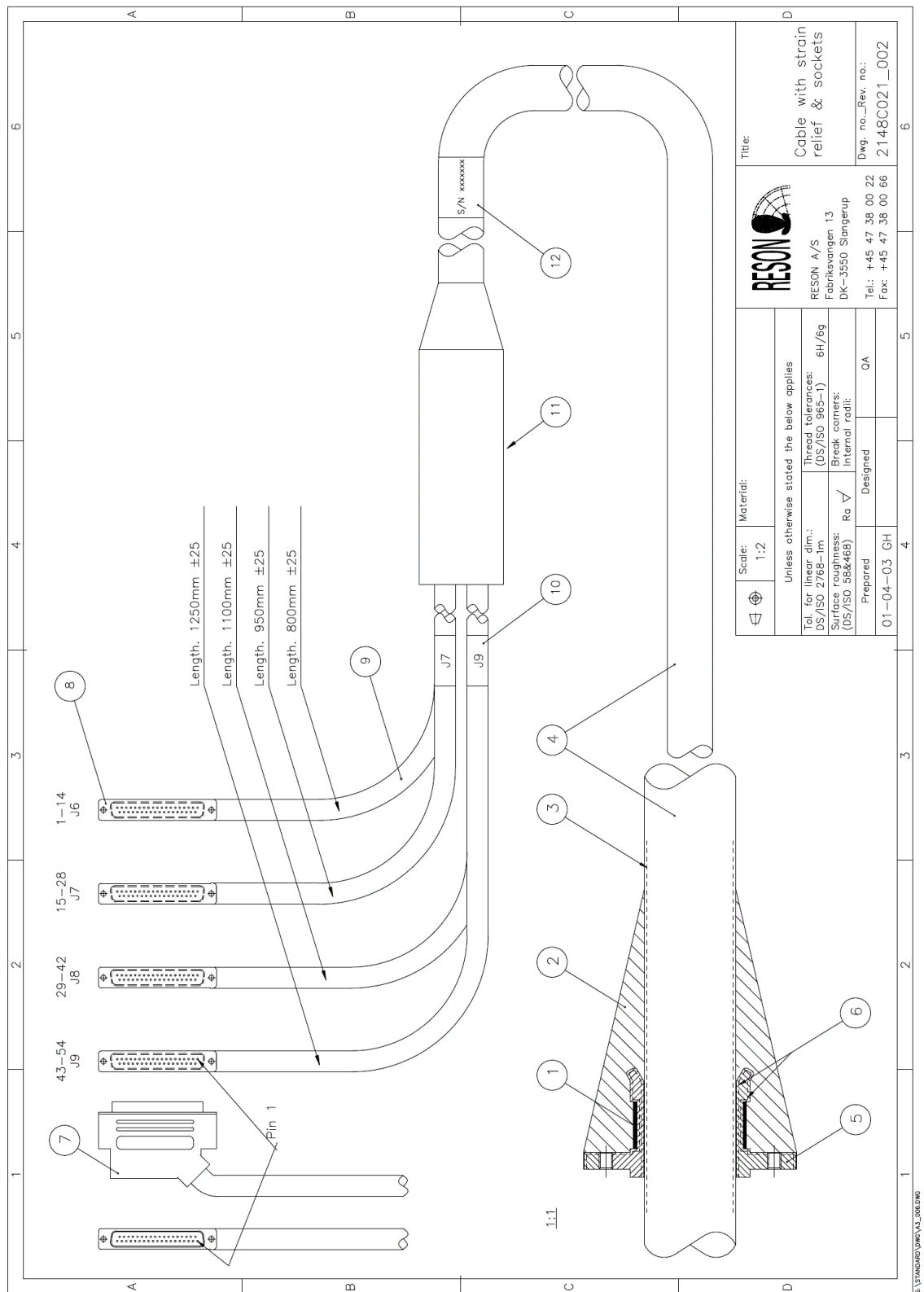


Figure 42: Cable, Projector, Dry End

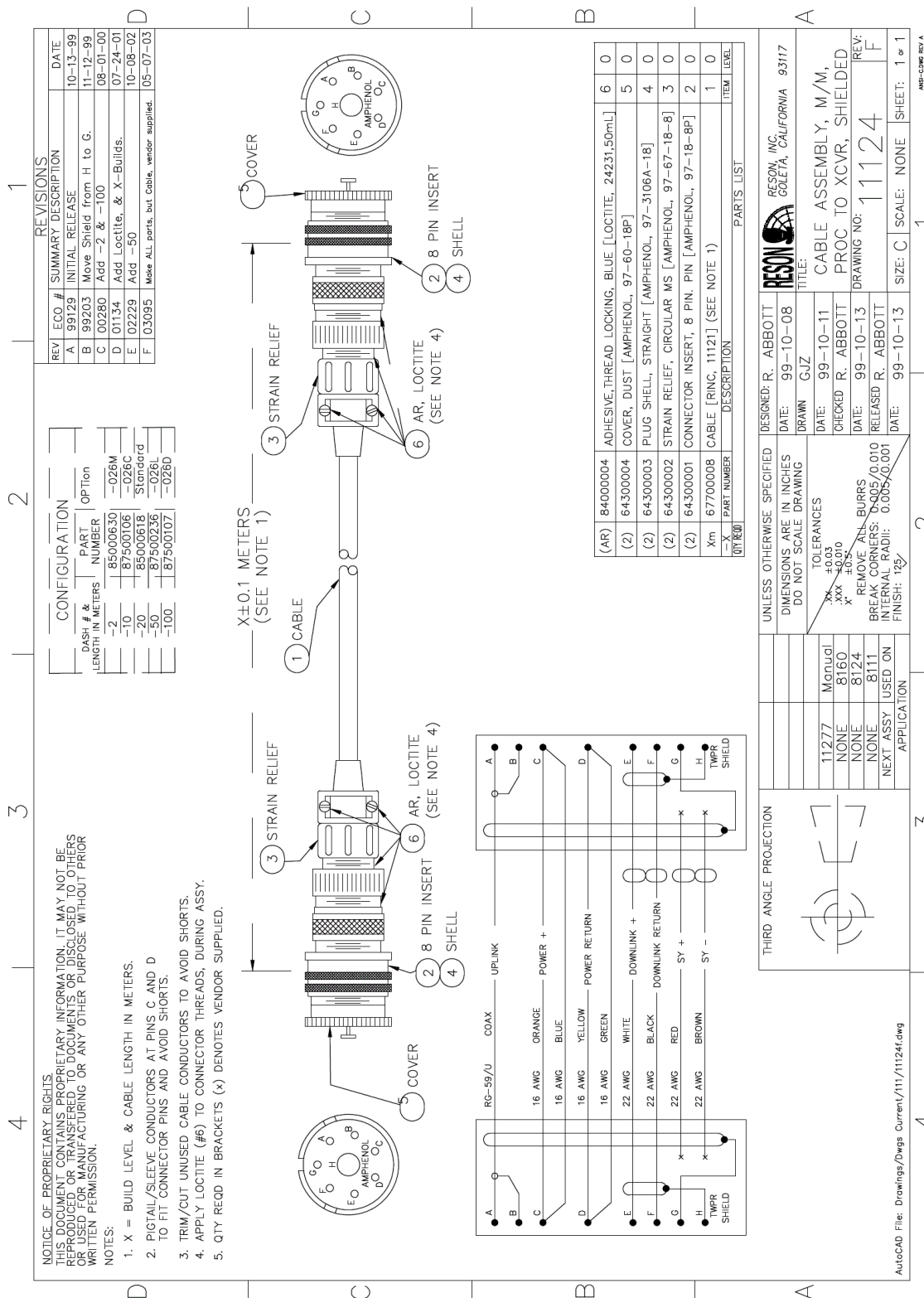


Figure 43: Cable, Processor to Transceiver (shielded)

APPENDIX E OPTIONS AND UPGRADES

E.1 Overview

The following options are available with the SeaBat 8160 system. If you require more detailed information with regards to any of these options, please contact RESON Sales for assistance.

E.2 Yearly Upgrades for SeaBat Firmware

This option provides all firmware upgrades that are released over the period of one year. This would normally be purchased at the time of initial order for the second and third year period.

E.3 Extended Warranty Contract

All SeaBat™ systems are provided with a standard twelve month warranty (see *Appendix G Warranty Information*). This option provides the ability to purchase additional annual support.

E.4 Telephone Support and Firmware Upgrades

This option provides the user with additional telephone support and as-required firmware upgrades beyond the initial twelve month warranty period.

E.5 SeaBat Cables

You may purchase additional cables and/or non-standard-length cables.

E.6 System Integration and Tuning

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

E.7 24VDC Power Supply for Sonar Processor*

This option provides the ability to use a DC power source such as two or more 12VDC batteries. With this option installed, both AC power supply modules in the sonar processor are replaced with two DC-to-DC converters that will function with an input voltage range of 18 to 72VDC. At a nominal 24VDC, the system requires a maximum of 240 watts.

E.8 Faired Mounting Assembly

This option provides a faired frame for the receiving and transmitting arrays. The structure allows quick and easy installation without the need to fabricate a precision mounting frame on-site.

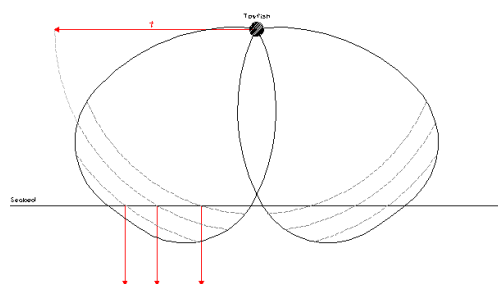
NOTE

For all options that appear with a star (*) beside the title: New SeaBat systems may be ordered from the factory with this option installed. Existing systems must be returned to RESON for installation.

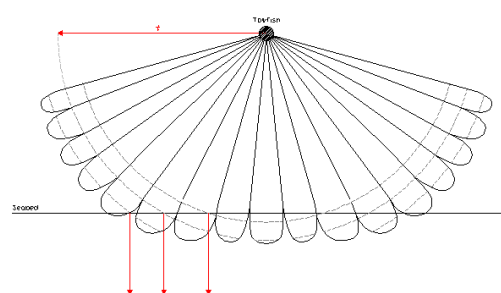
APPENDIX F SNIPPETS / SIDESCAN BACKSCATTER

F.1 Overview

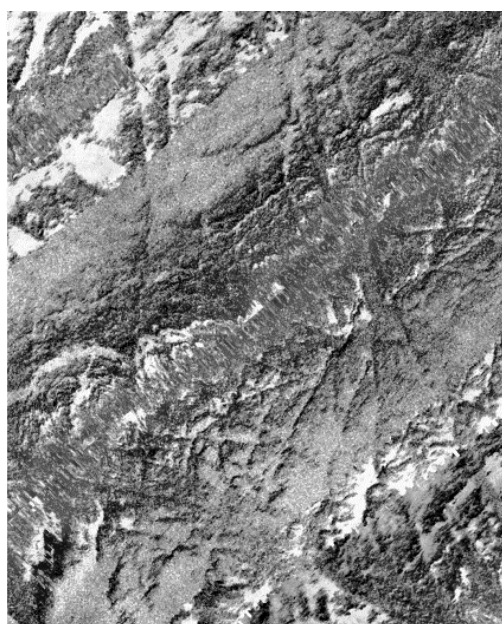
With the backscatter / sidescan functionality, a sidescan swath is measured and output from the sonar processor without degrading any of the traditional survey capabilities.



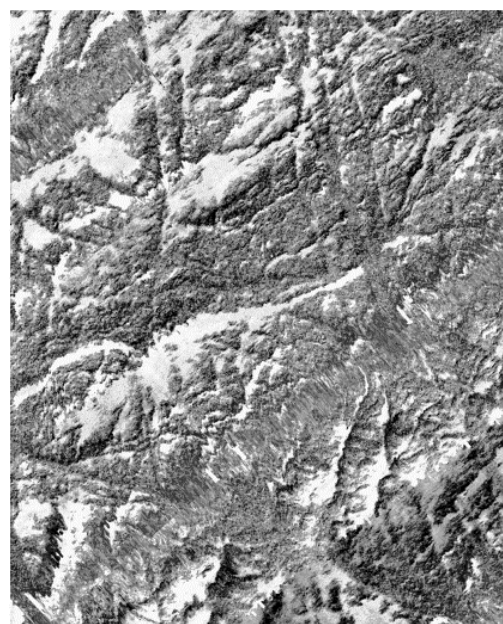
MBES Sidescan Backscatter Sampling



Snippets Backscatter Sampling



MBES Sidescan Imagery



Snippets Imagery

Figure 44: Sidescan vs. Snippets Data Comparison

F.2 Snippets Imagery Data

A snippet is the series of amplitude values in the signal reflected from a beam's footprint on the seafloor (see *Figure 45*). One snippet will be produced for each beam for each sonar ping. The length of each snippet will vary as a function of the individual beam angle, seafloor depth, and the snippets operating mode.

If the snippet data for each swath is concatenated, with each individual beam centered at its corresponding bottom detect point (footprint) location, the combined series will provide a result similar to slant range corrected sidescan imagery (see *Figure 44*). In most cases, this will provide 100% coverage of the sea floor.

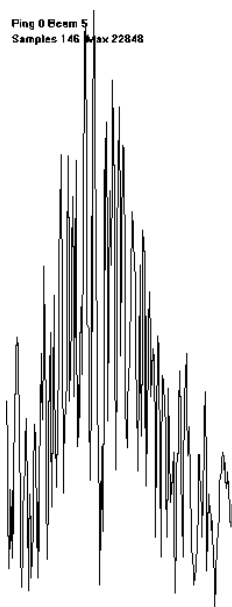


Figure 45: Snippets Data Sample

NOTE

The snippets feature satisfies the USGS survey requirements for high-resolution backscatter data. With snippets and the proper processing software, surveyors have additional information to allow better classification of bottom properties.

F.3 Sidescan Imagery Data

Sidescan forms an image of the sea floor 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 are combined and displayed, as the vessel moves along the track, a two-dimensional image is formed which provides a detailed picture of the bottom along either side of the vessel.

The sidescan data is output as an array of amplitude values which represent the amplitudes for each sample cell in the beam from a single ping. The sidescan beam is designed with a much wider beam width than the bathymetry beams so that each beam has a wider field of view from very near the vessel out to the maximum slant range of the sonar.

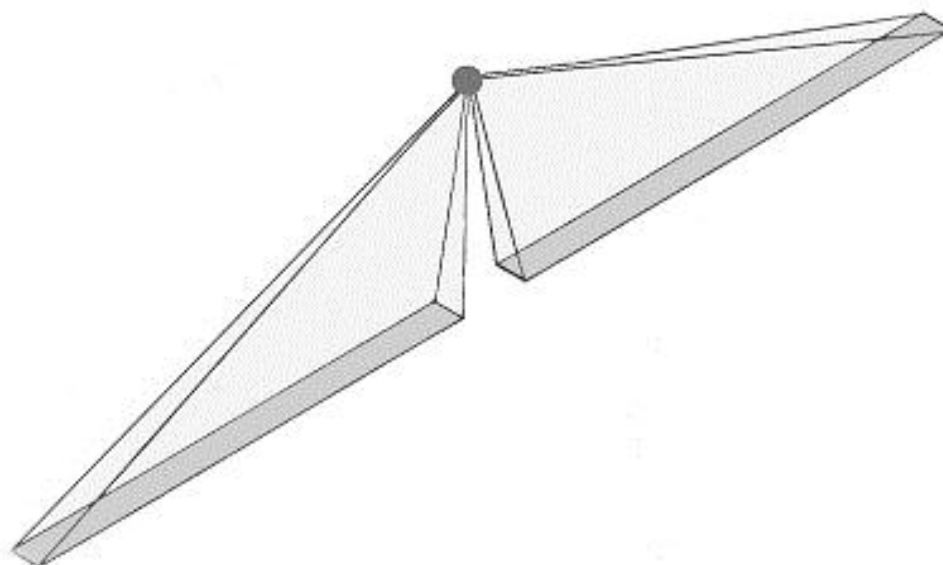


Figure 46: Sidescan Beam Geometry

Once the sidescan data is measured, it is transferred to the topside processor where it is processed separately from the bathymetry data to ensure data integrity. The final sidescan data is output from the SeaBat sonar processor via an Ethernet UDP protocol.

NOTE

Sidescan cannot be used to accurately measure true depths, but it can provide a more detailed picture of the sea floor. 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.

F.3.1 Survey Considerations

The survey procedures for the collection of multibeam bathymetry and sidescan data are different. For multibeam bathymetry, the transducer should ideally be

located high above the seafloor, so a wide swath can be measured. For best sidescan measurements, the transducer should ideally be close to the seafloor, looking out sideways to measure reflection and create shadows from a low incident angle.

Because of these varying procedures, a decision should be made as to the requirements of the survey and one of the techniques compromised accordingly.

F.3.2 Technical Specifications

The following table provides information regarding the technical specifications of the sidescan feature.

Table 29: MBES Sidescan Specifications

Specification	Value		
Swath Width	See Table 4		
Range Resolution	Range	Sample Rate	Resolution
	5-750m	7109.375Hz	10cm
	1,000 – 1,500m	3554.688Hz	20cm
	1,750 – 5,000m	1184.896Hz	60cm
Along-Track Beamwidth	1.5°		
Output Format	Digital, Ethernet, UDP Protocol		

F.3.3 Technical Details

The bathymetry and sidescan data are independent both in the beamforming process and in how the output data is used.

F.3.3.1 Sidescan Beamforming

The beamforming process combines one half of the bathymetry beams (beams 0 to 62 for port and beams 63 to 125 for starboard) into two sidescan beams. The process combines adjacent pairs of beams by averaging and then combining the averages by selecting the brightest points from the averaged beams. The combination process uses peak detect determination and yields a less “noisy” output.

F.3.3.2 Sidescan Data Output

The array of intensity values is a series of amplitudes, one for each sample interface for each sidescan beam. See *Table 29* for the different sample rates as they relate to range resolution.

The number of intensity values reported in a sidescan packet is a function of range. At a 1,000 meter setting, using a 1,500 meter per second sound velocity, the packet will have 4,738 values per sidescan beam.

The data is output in a series of binary packets via a network connection. These packets are separated from the bathymetry packets, although they are sent over the same network link.

The receiving program must accept the packet over the network and properly interpret it. The packet includes the time of the ping used to generate the data (only if a UTC input is provided), which beam the data is from, an array of sidescan data values, and other supporting information.

APPENDIX G WARRANTY INFORMATION

G.1 One-Year Limited Warranty

RESON warrants your RESON system against defects in materials and workmanship for a period of one year from acceptance of the system. During the warranty period, 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 RESON system must be serviced by the RESON office that sold it. The customer shall prepay shipping charges (and shall pay all duty and taxes) for products returned for service. RESON shall pay for the return of the products to the customer, not including any duty and taxes.

G.2 Exclusions

The warranty on your 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 RESON authorized service facility.
- Service provided by anyone but a RESON authorized service facility (see *section G.6 below*).

G.3 Warranty Limitations

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

G.4 Servicing During Warranty Period

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

G.5 Equipment Return Procedure

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

1. Contact a 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 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.

G.6 Service

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

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

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

APPENDIX H WEIGHTS AND MEASURES

H.1 Metric Conversion

All measurements in this manual are referenced in metric terms. To convert measurements from metric (cm, m, km) to imperial (in, ft, yd), utilize the following reference table:

Table 30: Metric Conversion Table

Metric Unit	Imperial Unit
Millimeter (mm)	0.0394in
Centimeter (cm)	0.3937in
Meter (m)	1.0936yd
Kilometer (km)	0.6214mi
Kilogram (kg)	2.2046lb

H.2 Temperature Conversion

All temperatures in this manual are referenced in degrees Celsius. The formula for converting Celsius to Fahrenheit is as follows:

$$\text{Fahrenheit} = (1.8 * \text{Celsius}) + 32^{\circ}$$

Example:

If Temperature = 30° Celsius then:

$$\text{Fahrenheit Temperature} = (1.8 * 30^{\circ}) + 32^{\circ}$$

OR

$$\text{Fahrenheit Temperature} = 86^{\circ}$$

APPENDIX I GLOSSARY OF TERMS

The following terms are used frequently in this manual and are defined here for your convenience:

Term	Definition
Absorption	The removal of energy from a sonar beam as it propagates through the water. Absorption is one of the factors in limiting the range of a sonar system underwater. For lower <u>side scan</u> sonar frequencies, the chemical relaxation of magnesium sulfate in sea water is a major factor in absorption. The higher frequencies are more affected by the physics of shear and viscosity.
AC	Alternating Current
Array	Piezoelectric Ceramic elements arranged in a series/parallel configuration. An array can be designed for either transmitting (projector) or receiving (hydrophone).
Bathymetry	The measurement of the depths of oceans, seas or other large bodies of water, typically using narrow swath acoustic systems. Some modern <u>side scan</u> type of sonar systems use two <u>transducers</u> per side to produce bathymetric, data along with wide area imaging. These systems, although producing both types of data, leave much to be desired when compared with systems dedicated to either one or the other. Co-registered <u>side scan</u> and bathymetric data from a single instrument is a goal of many sonar designers.
Beam Width	The distance between two opposite sides of a beam at a specific range from its source. Beam width widens with distance from the <u>transducer</u> array. Horizontal beam width determines the transverse resolution (the minimum distance between two objects parallel to the line of travel that will be displayed as two separate objects in the data) of a sonar system.
Big-Endian	A computer architecture in which, within a given multi-byte numeric representation, the most significant byte has the lowest address (the word is stored 'big-end-first').
BITE	Built-In Test Environment
CPU	Central Processing Unit - the processor or micro-processor in a computer
CTD	Salinity Temperature and Depth sensor
DAC	Digital-to-Analog Converter
DC	Direct Current

GLOSSARY OF TERMS

Term	Definition
Downlink	Serial data stream sent 'down' from the sonar processor to the sonar array
Ethernet	Shipboard, or platform, Local Area Network (LAN) for the distribution of digital data.
Hydrophone	The unit of the sonar array that receives the acoustic energy reflected from the seafloor (see Receive Array).
LAN	Local Area Network (see Ethernet)
Mains	The source of primary operating power for the SeaBat™ system (either 120 or 240VAC).
MBES	Multibeam Echosounder
MRU	Motion Reference Unit
NTSC	Format of the video signal transmitted from the SeaBat (operator selected). This format is used throughout the United States and Japan.
PAL	Format of the video signal transmitted from the SeaBat (operator selected). This format is used throughout Europe and other countries, excluding the United States and Japan.
PC	Personal Computer
Projector	The unit of the sonar array that transmits acoustic energy into the water (see Transmit Array).
Pulse Width	The distance of the ensonified water, in the range dimension, at a given point in time, expressed in meters and determined by multiplying the <u>pulse</u> length by the speed of sound through the water. <u>Pulse</u> widths are measured to determine the maximum theoretical resolution of an imaging sonar. Some side scan sonars have variable <u>pulse</u> widths although most do not.
Range	A sonar setting which represents a distance, usually measured in meters, that is the maximum distance from the towfish that the sonar will display (the range setting on the sonar also determines the time between outgoing sonar <u>pulses</u>); also synonymous with the cross-track dimension. Once the range setting on the system is set, when returning echoes arrive from that distance away from the <u>transducer</u> , the ping cycle starts again and a new acoustic <u>pulse</u> is transmitted in to the water.
Receive Array	See Hydrophone
RGB	Red-Green-Blue - the primary colors used in a color video display
Round Trip Time	The time taken for the acoustic energy from the transmit array to travel to the maximum range selected and return to the receive array.

GLOSSARY OF TERMS

Term	Definition
Sonar Array	The combination of the receive array and the transmit array.
Sonar Processor	The primary computer that controls the SeaBat™ system
S-VGA	Super Video Graphics Adapter
SVP	Sound Velocity Profile, or Profiler
SYNC	Synchronize or Synchronization
Transmit Array	See Projector
TVG	Time Variable Gain control intended to vary the gain of an amplifier over a pre-determined time period. Usually from a low gain state to high gain.
UDP	User Datagram Protocol
Uplink	Serial data stream or digitized multiplexed data sent 'up' from the sonar array to the sonar processor
UTC	Coordinated Universal Time (UTC) is the international time standard. It is the current term for what was commonly referred to as Greenwich Meridian Time (GMT).
VAC	The Voltage of an Alternating Current circuit
VGA	Video Graphics Adapter
VRP	Vessel Reference Point



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