320M SERIES ECHOSOUNDER

SOFTWARE INSTALLATION / UPGRADE MANUAL

Supports Software Package#: D429-03435

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KNUDSEN
ENGINEERING LIMITED

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1 INTRODUCTION

1.1 About this manual

This manual provides installation and upgrade details for the software package provided with a 320M Series Echosounder. It provides descriptions of the software applications, and the firmware. It explains what needs to be installed for a newly delivered system, and what needs to be done to upgrade an existing system.

1.2 320M Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 SOFTWARE DEFINITIONS

2.1 Overview

Virtually every aspect of the 320M Series Echosounder's functionality is defined and controlled by software. This software includes the "firmware" which resides in non-volatile FLASH memories within the echosounder itself, and a Windows-compatible support application which runs on the host PC.

2.1.1 Firmware

The term firmware refers to the software which resides in FLASH eproms within the Echosounder. Upgrades and revisions are distributed periodically as ".tag" files which can be re-programmed into the echosounder in the field by the user. With the Echosounder's modular design, there are three firmware packages used inside the 320M; one for the front panel user interface module(FPM), one for the printer module, and one for the main processor module (MPM). The MPM firmware is the main package that defines the actual functionality of the echosounder and its signal processing algorithms; this is the one package that is normally upgraded by the user when new features become available. The Printer firmware is mostly an interface package that only gets upgraded occasionally when new printer controls are made available. The Front panel firmware is a simple interface package with all controls fully defined; it does not require upgrades.

The echosounder preserves its operating parameters in on-board non-volatile memory (NVM), and will restore the stored parameters on power-up. Unless new NVM parameters have been defined in an MPM firmware upgrade, the system can preserve its customized configuration during a system upgrade. If new NVM parameters have been added in an MPM firmware upgrade, the system may have to restore the NVM to factory defaults. It is advisable to assume that a firmware upgrade will cause the NVM to revert back to factory defaults and to record the important unit settings before proceeding with the update.

2.1.2 Windows Support Application

There are two Windows applications provided with the 320M Series Echosounders for configuration and upgrade support purposes. These programs are Windows compatible, and are installed with a standard Setup.exe process.

2.1.2.1 Serial Configuration Utility (SerialControl.exe)

This program is a very simple Windows interface program. It communicates with the echosounder through the serial monitor port (COM3). It works with existing PC com port hardware (no special host adaptors are required), and provides basic configuration functions. It provides access to the serial port configuration controls used to set-up the echosounder to interface with external devices. Once the sounder's configuration parameters have been set, the program can be terminated and the sounder will retain the selected configuration.

2.1.2.2 Serial Upgrade Utility (SerialUpgrade.exe)

This program is a very simple Windows interface program. It communicates with the echosounder through the serial monitor port (COM3) and with the printer through its specialized serial port. It works with existing PC com port hardware (no special host adaptors required), and provides strictly firmware upgrade capabilities for both the main processor module and the printer module.

3 INSTALLATION / UPGRADE GUIDELINES

3.1 Initial Installation

A newly delivered echosounder has all the necessary firmware programmed into it. The user only needs to load the Window's support application supplied on the CD-ROM. The CD-ROM contains a Setup.exe Windows installation program that creates the directory and copies the files onto the user's hard disk. See Chapter 4 for a complete description of the installation process.

3.2 System Upgrades

Occasionally, a system that has already been operating out in the field will be provided an upgrade software package to provide additional operating features not available with the existing software. If the Echosoundes's MPM firmware is not D40-02000 V5.25 or printer firmware D40-02319 V1.14, the unit will need to be upgraded. See Chapters 4 and 5 for detailed descriptions of the installation processes.

NOTE: When performing the upgrade, always perform the Windows upgrade first, as this will extract the necessary files onto the hard disk required to proceed with the firmware upgrade.

4 PC SOFTWARE INSTALLATION

4.1 Setup Procedure

The CD-ROM provided either with a new system or in an upgrade package contains a typical Windows Setup.exe installation program. For most Windows systems, this Setup.exe will automatically run (autorun) when the CD-ROM is loaded in the drive. If it does not start automatically simply run the file Setup.exe.

When this program is run, it displays a number of information and configuration prompts to all the user to customize the installation process if desired. Customization of the installation should be undertaken by advanced users only. The normal installation process proceeds as follows:

1. Welcome Box: proceed or cancel
2. Destination Folder: default: C:\Program Files\SounderSuite
3. Program Group: SounderSuite
4. Setup Type: Typical or Custom: typical installs predefined list of components, custom allows the user to select the desired components (advanced users only)
5: Select Components: available on Custom install only. See Table 4.1 for component details.
6. Ready to Install the Program: last chance to cancel before actual installation is performed.
7. ASPI installer: independent installer application which may ask to reboot PC. Select the option to reboot later and proceed with rest of SounderSuite installation
8. Computer Restart: it is recommend to accept the restart option at this time to ensure all drivers and registry modification are properly initialized for use.

If the installation process is being performed for a new unit, the process is now complete. The sounder will have been shipped with the appropriate firmware revisions. If this is an upgrade package, the firmware in the sounder will probably need to be upgraded as well. Please see Chapter 5 for detailed information regarding the firmware upgrade.

Table 4-1: Installation Components

Component	Description
SounderSuite	Windows applications and required support files
Firmware	Firmware TAG files used for system upgrade/restoration.
Documentation	Manual components in PDF format

5 FIRMWARE INSTALLATION

The firmware installation procedures are only required for system upgrades. Newly delivered systems do not need to have any firmware loaded. Upgrades are performed when new capabilities are added to the echosounder's functionality. Sometimes only the Windows support software is enhanced and firmware remains unaffected.

The 320M Echosounder has two controller boards, MPM and Printer, that have FLASH memories for storing the firmware used to run the system. There is also a FLASH memory used to store the transmit pulse generation codes used for transmitting a ping. Upgrading the 320M involves downloading new firmware into one or both controller boards, and the transmit memory.

5.1 Upgrading the MPM Firmware

There are three possible methods to use to upgrade the MPM firmware; one using the Serial Configuration Utility application, one using the Serial Upgrade Utility, and one using any other PC communications package interfacing to the sounder's monitor port on COM3.

NOTE: Sometimes the applications used to perform the firmware upgrade fail to directly reference the directory location for the firmware file(s). For the MPM, the firmware ".tag" can be located in the Firmware\MPM folder located in the destination folder specified during the Windows software installation. If the default location was used, the proper folder would be C:\Program Files\SounderSuite\Firmware\MPM.

5.1.1 Using Upgrade Utility: SerialUpgrade.exe

(NOTE: This application is not compatible with echosounder firmware versions that pre-date D40-02000 V1.01. If your original firmware version pre-dates this one, please use an alternate method to perform the upgrade.)

Run the SerialUpgrade application and select the options for Main Processor Module, the com port to use, and whether to use auto-detection for the com port settings. It is possible for extremely old firmware versions that the SerialUpgrade application may not be able to recognize its configuration properly, and will have difficulty determining the correct communications settings to use for the link. If this occurs, configure the PC port to match the echosounder manually using the Menu item **Com Ports** , sub menu **PC Port** command. Once the PC port has been properly configured, proceed with the firmware upgrade.

To load the new firmware into the sounder, select the menu option **Upgrades** and its submenu **Download Tag**. Select the appropriate Knnnnnn.tag file required for the upgrade and accept. The application will display a status box indicating the progress of the download process; this can take couple of minutes dependent upon the serial data rate. After the download is complete, the SerialControl application checks that the new firmware is responding properly, and reports its success or failure. If the tag file has downloaded successfully and the system configuration could be successfully read, the user can proceed with the upgrade process.

The **Download Tag** command simply loads the new firmware into the echosounder's SRAM memories. If the sounder were powered down at this point, the new firmware would be lost and the sounder would power

up with its original firmware version. To program the new firmware permanently into the sounder EPROM memories, select the menu option **Upgrades** and the submenu **Program PS**. The application will display messages received from the echosounder indicating the progress of the programming task.

At this point the sounder has the new firmware permanently loaded, but the Transmit EPROM data may not correspond properly with it. To load the Transmit EPROM with matching data, select the menu item **Upgrades** and its submenu **Program TX.** The new firmware itself loads the Transmit EPROM with the appropriate data. The application will display messages received from the echosounder indicating the progress of the programming task; this can take significantly longer than the **Program PS** operation.

Sometimes the new firmware will contain new non-volatile memory (NVM) parameters that will result in an NVM error condition when the firmware initially runs. The NVM error condition must be acknowledge on the echosounder's front panel interface menu before the echosounder will be able to transmit and acquire.

5.1.2 Using Serial Configuration Utility: SerialControl.exe

(NOTE: This application is not compatible with echosounder firmware versions that pre-date D40-02000 V1.01. If your original firmware version pre-dates this one, please use an alternate method to perform the upgrade.)

Run the SerialControl application; if the firmware version on the echosounder is older than that fully supported by the application, a message box will appear indicating this condition. After the user acknowledges the message, all controls in the program will be disabled except those required for the firmware upgrade. It is possible for extremely old firmware versions that the Echo application may not be able to recognize its configuration properly, and will have difficulty determining the correct communications settings to use for the link. If this occurs, configure the PC port to match the echosounder manually using the Menu item **Com Ports**, sub menu **PC Port** command. Once the PC port has been properly configured, proceed with the firmware upgrade.

To load the new firmware into the sounder, select the menu option **Upgrades** and its submenu **Download Tag**. Select the appropriate Knnnnnn.tag file required for the upgrade and accept. The application will display a status box indicating the progress of the download process; this can take couple of minutes dependent upon the serial data rate. After the download is complete, the SerialControl application checks that the new firmware is responding properly, and reports its success or failure. If the tag file has downloaded successfully and the data setup could be successfully read, the user can proceed with the upgrade process.

The **Download Tag** command simply loads the new firmware into the echosounder's SRAM memories. If the sounder were powered down at this point, the new firmware would be lost and the sounder would power up with its original firmware version. To program the new firmware permanently into the sounder EPROM memories, select the menu option **Upgrades** and the submenu **Program PS**. The application will display messages received from the echosounder indicating the progress of the programming task.

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progress of the programming task; this can take significantly longer than the **Program PS** operation.

Sometimes the new firmware will contain new non-volatile memory (NVM) parameters that will result in an NVM error condition when the firmware initially runs. The NVM error condition must be acknowledge on the echosounder's front panel interface menu before the echosounder will be able to transmit and acquire.

5.1.3 Using the Monitor Port and a Communications Program

Make sure a null modem serial communications cable is attached to the COM3 connector on the 320M's connector panel and set up the baud, parity, and data format on COM3 to match that used by the PC. The typical settings are:

Baud Rate = 19200, Data bits = 8, Stop bits = 1, Parity = none

Step	Action	Keyboard Entry	Expected System Response
1	Start PC Communications Program	(Program Specific)	(Program Specific)
2	Power on 320M	none	SRAM Monitor sign-on message with prompt ">"
3	Switch to ROM	/GR[ENTER]	ROM Monitor sign-on message with prompt "*"
4	Start Download	/DT[ENTER]	"Waiting for TAG file."
5	Start ASCII transfer	(Program Specific)	(Program Specific)
6	Wait for transfer to complete	none	Download complete.
7*	Switch to SRAM	/GT[ENTER]	SRAM Monitor sign-on message with prompt ">"
8	Program permanently into EPROM	/PRGPS[ENTER]	Programming zeroes, erasing, programming, done.
9	Program Transmit EPROM to match new firmware	/PRGTX[ENTER]	Programming zeroes, erasing, programming LF, programming HF, done. (If only one frequency is installed, only the appropriate channel is programmed)

*Note: At this point the new software is in SRAM only. If a system power-down were to occur now, the new software would be lost. It MUST be programmed before the system can be power-down if the new code is to be preserved.

Sometimes the new firmware will contain new non-volatile memory (NVM) parameters that will result in an NVM error condition when the firmware initially runs. The NVM error condition must be acknowledged on the echosounder's front panel interface menu before the echosounder will be able to transmit and acquire.

5.2 Upgrading the Printer Firmware

This upgrade requires a special interface cable to connect an external null modem serial cable to the special communications port header on the Printer Control Module. Please contact technical support if you do not have this cable.

NOTE: Sometimes the applications used to perform the firmware upgrade fail to directly reference the directory location for the firmware file(s). For the printer module, the firmware ".tag" can be located in the Firmware\Printer folder located in the destination folder specified during the Windows software installation. If the default location was used, the proper folder would be C:Program Files\SounderSuite\Firmware\Printer.

5.2.1 Using Serial SerialUpgrade: SerialUpgrade.exe

(NOTE: This application is not compatible with printer firmware versions that pre-date D40-01652 V3.43. If your original firmware version pre-dates this one, please use an alternate method to perform the upgrade.)

Run the SerialUpgrade application and select the option for Printer Processor module and the Com port to use.

To load the new firmware into the printer, select the menu option **Upgrades** and its submenu **Download Tag**. Select the Knnnnnnp.tag file required for the upgrade and accept. The application will display a status box indicating the progress of the download process; this can take couple of minutes dependent upon the serial data rate. After the download is complete, the SerialUpgrade application checks that the new firmware is responding properly, and reports its success or failure.

The **Download Tag** command simply loads the new firmware into the printer's SRAM memories. If the sounder were powered down at this point, the new firmware would be lost and the printer would power up with its original firmware version. To program the new firmware permanently into the printer EPROM memories, select the menu option **Upgrades** and the submenu **Program PS**. The application will display messages received from the printer indicating the progress of the programming task.

5.2.2 Using the Printer's Monitor Port and a Communications Program

Make sure a null modem serial communications cable is attached to the interface cable connected to the special communications port header on the Printer Control Module. Once the physical connection has been made, set up the baud, parity, and data format settings as follows:

Baud Rate = 38400, Data bits =8, Stop bits = 1, Parity = none

Step	Action	Keyboard Entry	Expected System Response
1	Start PC Communications Program	(Program Specific)	(Program Specific)
2	Switch to ROM	/GR[ENTER]	ROM Monitor sign-on message with prompt "*"
3	Start Download	/DT[ENTER]	"Waiting for TAG file."
4	Start ASCII transfer	(Program Specific)	(Program Specific)
5	Wait for transfer to complete	none	Download complete.
6*	Switch to SRAM	/GT[ENTER]	SRAM Monitor sign-on message with prompt ">"
7	Program permanently into EPROM	/PROG[ENTER]	Programming zeroes, erasing, programming, done.

*Note: At this point the new software is in SRAM only. If a system power-down were to occur now, the new software would be lost. It MUST be programmed before the system can be power-down if the new code is to be preserved.

320M SERIES ECHOSOUNDER

HARDWARE MANUAL

D10 - 02222
Revision 3.0
November 4, 1999

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WARNING!

The 320M series of echosounders are capable of generating hazardous voltages at the outputs of the transmitters.

Transducers, connectors, and cables should not be handled while the echosounder is operating.

Internal protective panels should not be removed except by qualified technical personnel.

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1 INTRODUCTION

1.1 About this manual

This manual provides an introduction to the installation and operation of the echosounder with important reference information for both the novice and the advanced user. It is advisable for all users to become familiar with the relevant sections in this manual to ensure that the echosounder is used to its optimum capability.

Section 1 provides a brief summary of the contents of this manual and a brief description of the echosounder technology itself.

Section 2 provides useful data for installation purposes and for interfacing the 320M Echosounder to external devices.

Section 3 provides important basic information about the operation of the echosounder and how to get started after the installation is complete.

Section 4 introduces the thermal printer; its operation and maintenance.

Section 5 offers simple maintenance and troubleshooting advice for operators and technicians. The goal of this section is the identification of common mistakes and help with isolation of faulty modules.

1.2 The 320M Echosounder

The 320M Marine Echosounder was designed and built in Canada by Knudsen Engineering Limited (KEL). The 320M is distinguished by compact size and high performance; with the flexibility, versatility and accuracy provided by Digital Signal Processing. The echosounder is configurable for one or two sounding channels with frequency of operation from 3.5 kHz to 250 kHz .

Five key technologies combine in the 320M to create an echosounding system of remarkable flexibility and performance:

- TMS320C25 Digital Signal Processing computer technology
- Thermal greyscale printer technology
- Field Programmable Gate Array (FPGA) technology
- MOSFET switchmode amplifier technology
- FLASH non-volatile computer memory

1.3 The 320M Survey Echosounder

The survey echosounder must produce a high quality and detailed hardcopy profile with demonstrable precision and accuracy. It must also digitize the bottom depth with reliable accuracy. The digitizer must be discriminating, yet track unpredictable bottom trends in the presence of fish, weeds, ledges, thermoclines and double reflections in order to minimize the need for post-survey checking and editing. In addition to the

basics, automatic time and position MARKs, interfaces to differential GPS positioning data and heave compensators are standard requirements on modern surveys in order to improve overall accuracy and productivity.

1.4 Technical Support

KEL can assist with transducer selection, special serial interfacing, and custom 320M functions. In addition, KEL extends the following support services to 320M owners:

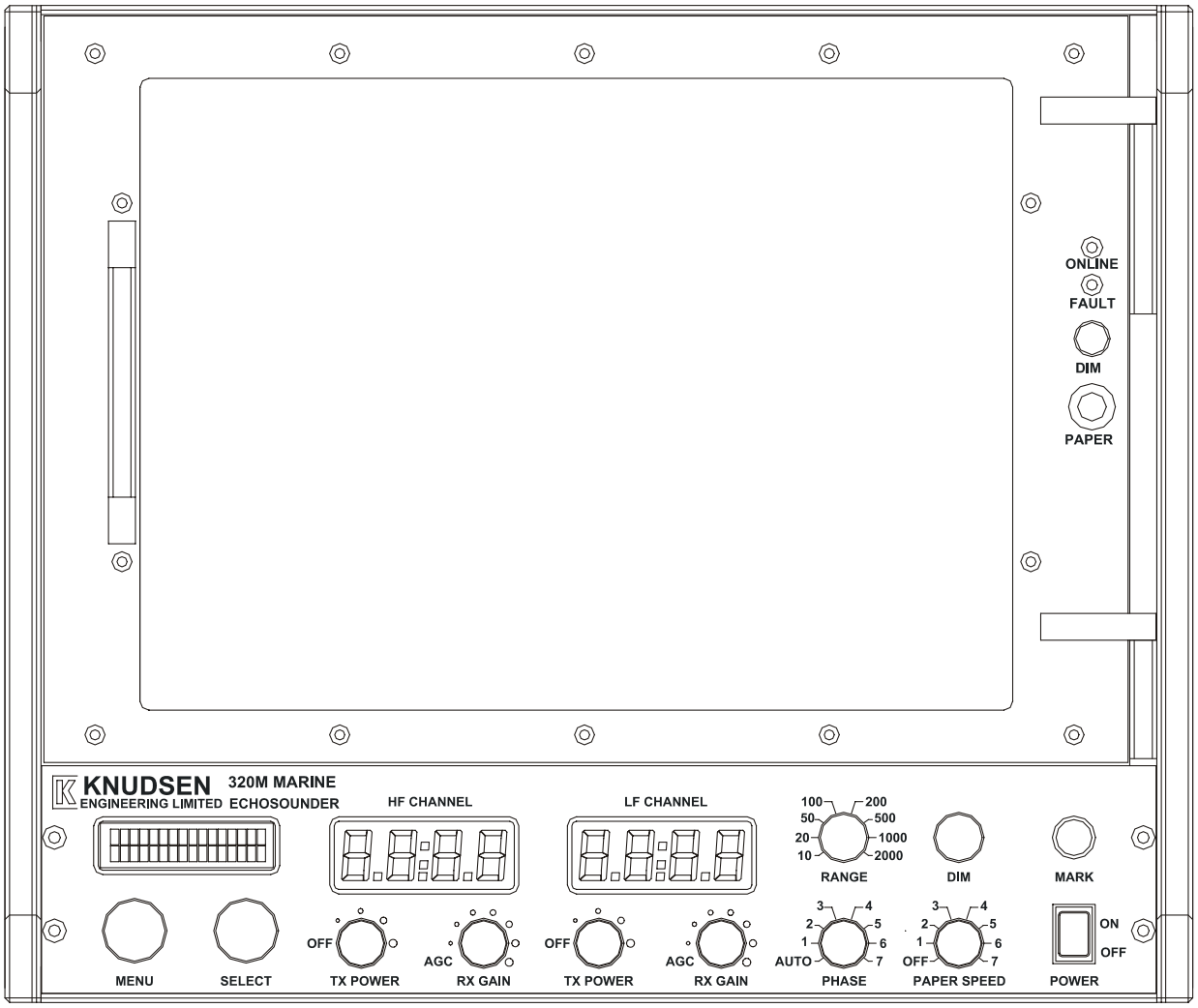
- KND320 Media
- Module swap under warranty
- Module repair, refurbishment or test
- Software modifications via the Internet to your field site
- Emergency 320M Spares
- Diagnostic assistance and consultation

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

Figure 1-1. The 320M Survey Echosounder



2 INSTALLATION

2.1 Shipment, Storage and Unpacking

The 320M Survey Echosounder System is securely packed in a plastic shipping/storage case. In the standard shipment will be the following items:

- 320M Survey Echosounder
- 2m detachable DC power cable
- Transducer cable connector(s)
- RS-232 null modem serial communications cable
- 2 rolls KND320 thermal media
- 320M Series Echosounder User Manual
- Software CD-ROM
- Bulkhead Mounting Hardware Kit (optional)
- Rackmount Hardware Kit (optional)

The Echosounder is shipped with no paper installed in the printer and with the printhead "unloaded" from the print roller. The only action required prior to operating the system after installation is to load the paper and release the "head unload" lever. There is one important precaution required for long term storage of the Echosounder System. The printhead should be unloaded whenever the Echosounder is to be left unused for an extended period, to avoid damage from media sticking or flat-spotting the print roller. Note that the printhead is equipped with a microswitch which prevents the unit from printing while the head is unloaded - operation is otherwise unaffected. The "head unload" lever is located on the printer mechanism and is accessible through the printer door (see Figure 3-1).

2.2 Physical Characteristics

Outline drawings showing external dimensions, locations of connectors and controls, and location and specification of mounting points are provided in Figures 2-1 through 2-3. A summary of significant dimensions and weights of the Echosounder follows:

Height	355 mm
Width	437 mm
Enclosure Depth	216 mm
Total Depth (incl. handles)	250 mm
Weight	18 kg

The 320M Survey Echosounder is designed to accept hardware for a 4-point bulkhead mounting scheme (Figure 2-1) or a standard 19" rackmount scheme (Figure 2-2). Hardware kits for either scheme are available upon request. There are a few details that must be considered for proper mounting of the Echosounder. Access to the connector panel on the bottom (or back) of the enclosure is required for cable routing: approximately 6 inches of clear space should be adequate. Clearance must be provided directly in front of the echosounder for operator access to the controls and displays, and for opening the printer door for replacement of paper rolls. Plan view dimensions with the printer door fully open are shown in Figure 2-3.

Figure 2-1. 320M Mounting Dimensions - Bulkhead Mount

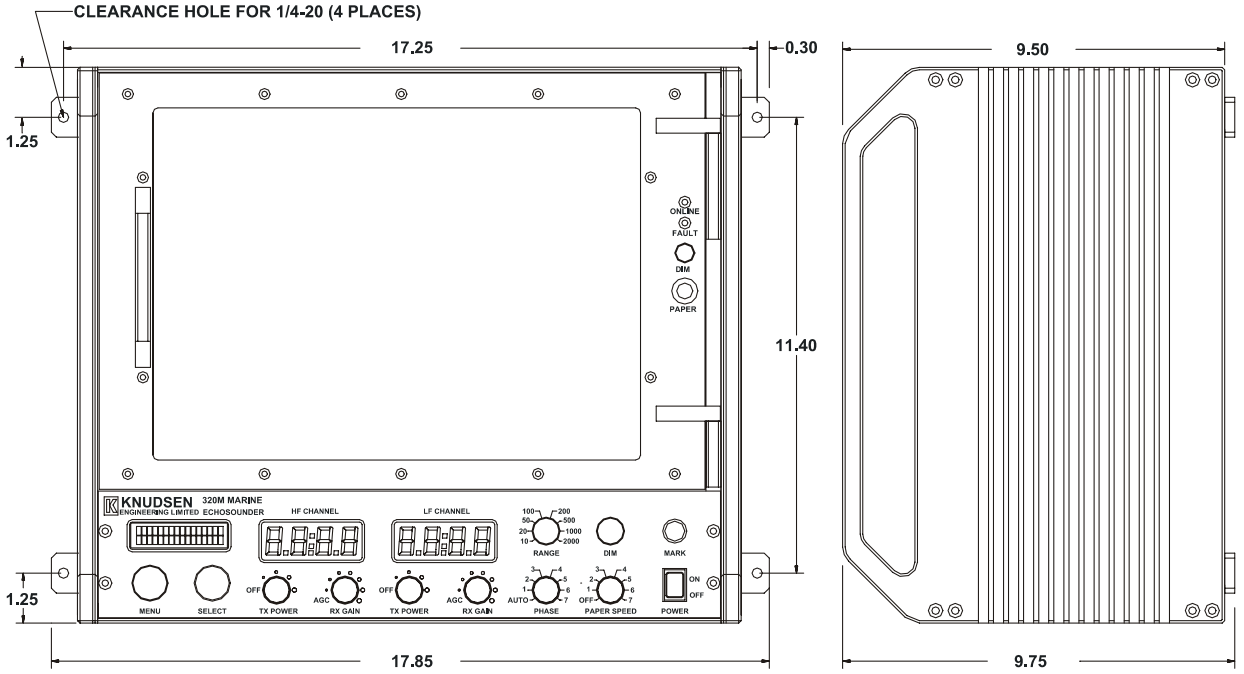


Figure 2-2. 320M Mounting Dimensions - Rack Mount

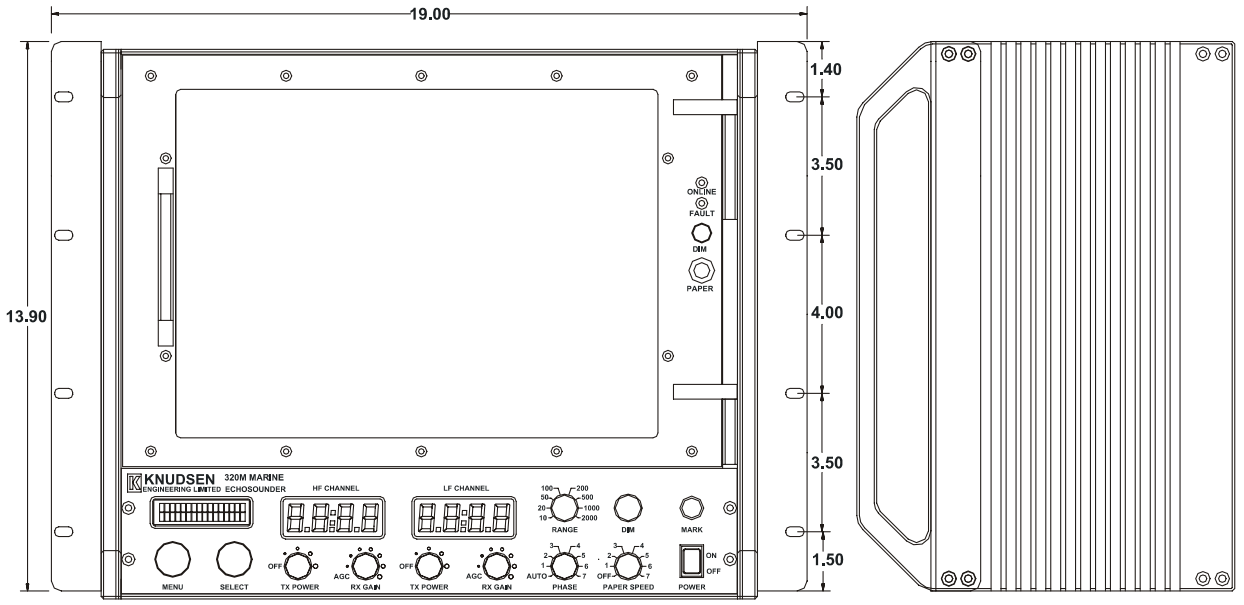
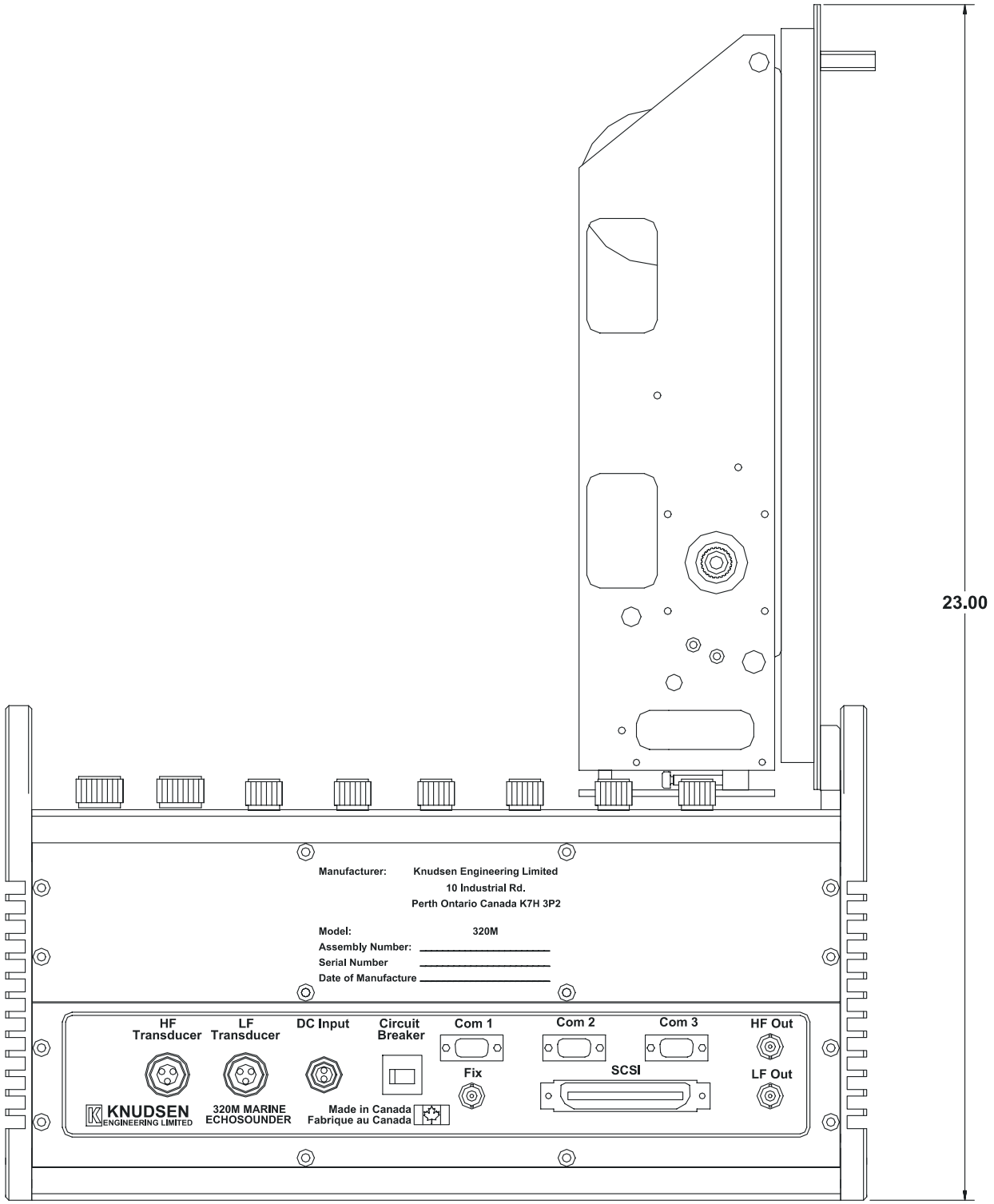


Figure 2-3. Plan View with Printer Door Open



2.3 Electrical Requirements

The 320M Survey Echosounder is configured with a DC power input range of 9 to 36V.

Power input: 9 to 36 VDC (nominal 24 VDC) at approximately 60 Watts.

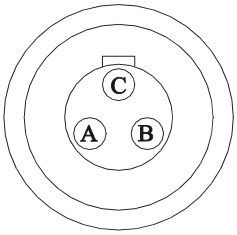
GROUNDING NOTE: In some installations, the system performance may be improved by grounding the 320M enclosure to the vessel ground.

If the power input is connected with the wrong polarity, a protective diode shunts the current to the breaker on the connector panel, causing it to trip. Check the input wiring, then reset the breaker.

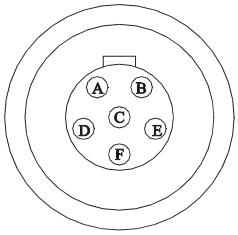
If the power input is accidentally connected to AC power, the large currents involved cause the protective diode to fail shorted. The diode must be replaced before the system can be properly powered-up.

2.4 Transducer Interface Description

Single Frequency



Dual Frequency

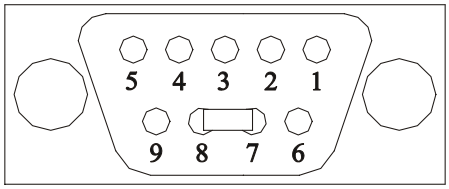


The transducers are driven by the Echosounder. There are two possible configurations for transducer connectors: single or dual frequency connections. If a system has a dual frequency transducer, the HF transducer connector is wired for both HF and LF with a double connector; the LF transducer connector is left unconnected.

2.5 Serial Communications Interface Specifications

There are three serial communication port connectors on the recessed connector panel. All connectors are DB-9M RS-232 ports wired as a PC communication port, with the hardware handshaking lines configured as shown in Section 2.5.1. For most communications programs, hardware handshaking is not required and a standard null modem RS-232 serial cable is all that is required to establish the link between the echosounder and a PC.

2.5.1 RS-232 Com Port Wiring



Pin 2 - RXD Received Data
Pin 3 - TXD Transmitted Data
Pin 5 - GND Signal Ground
Pin 7 - RTS Request To Send: Jumpered to Pin 8
Pin 8 - CTS Clear To Send: Jumpered to Pin 7
Pin 1 ,4 ,6 , & 9 - not connected

2.6 Other Interfaces

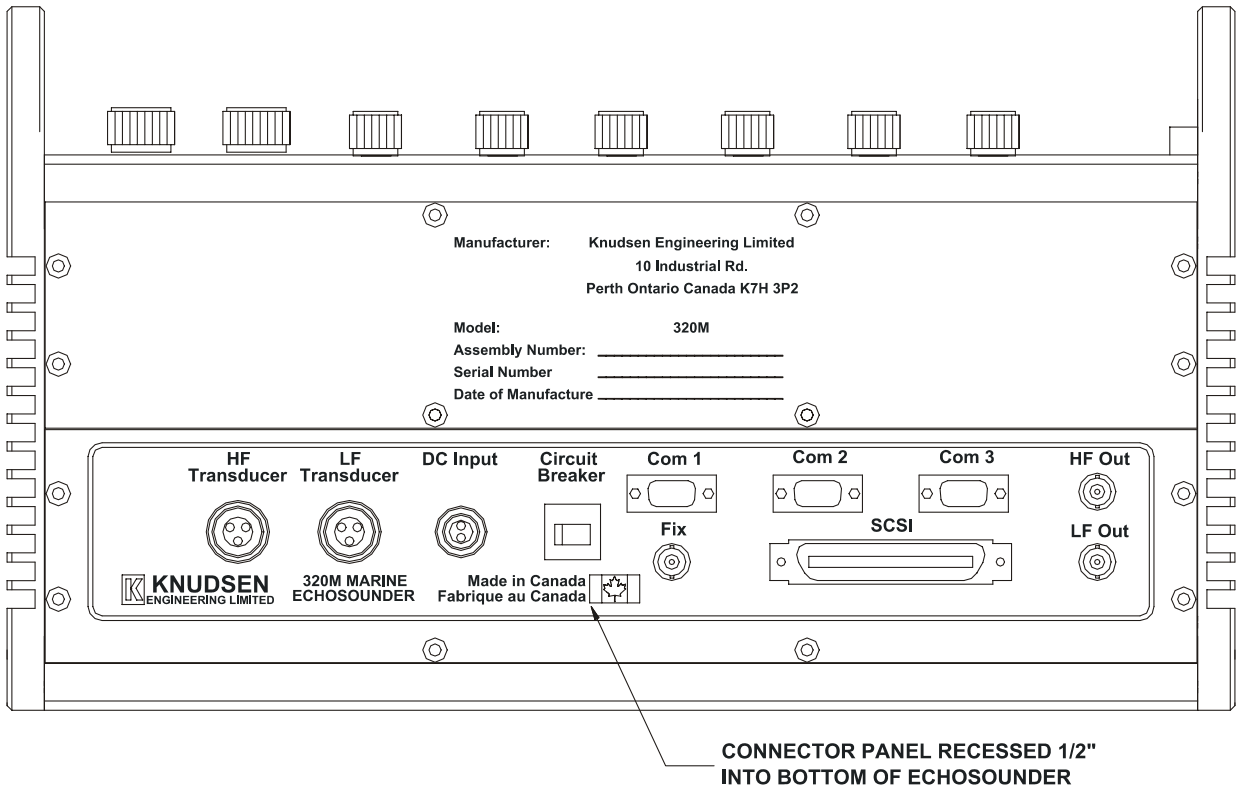
2.6.1 Fix Mark BNC

This is a standard BNC connection that can be connected to a TTL signal or contact closure to initiate a fix mark. It operates on the same manner as the front panel fix mark button.

2.6.2 LF/HF Out

These are standard BNC connections which provide direct access to the analog signal after bandpass anti-aliasing filtering. This interface is useful for oscilloscope viewing of the analog signal.

Figure 2-4. Bottom View - Connector Panel



3 BASIC OPERATIONS

3.1 Power On

After the Echosounder has been installed with the appropriate transducer, power, and peripheral devices connected, and thermal paper installed in the printer, the 320M is ready for operation.

The Echosounder is turned on with the POWER switch on the front panel. Immediately upon power-up the 320M performs a number of self-test diagnostics. These consist of lamp tests, memory tests, and various other internal checks. If there are no problems, the SPM frequency configuration is displayed for a short period of time on the Secondary Function Display - a two line by 16 character LCD display. Then the default power-on screen appears and the system is ready for use. However, if an error was detected, the appropriate error screen will appear and remain; waiting for the operator to press the MENU control knob. This indicates that the operator is aware of the problem but is willing to proceed. Please refer to Section 5.4 for an explanation of power-up errors. The Echosounder also transmits a characteristic "sign-on" message out the COM3 serial port during its initialization sequence.

Note also that the thermal recorder is a separate computer system and runs diagnostics of its own. The status of the printer is indicated by the status of the printer LEDs, which are labelled ONLINE and FAULT. Normal operating conditions show ONLINE steady, FAULT off. (Please refer to the Section 4.2 for a complete explanation of other printer LED states.) A simple check of printer functionality is to push the printer panel PAPER pushbutton. This will cause the paper transport to feed when the printer is working.

3.2 Echosounding

Rotating the **TX POWER** knob from **OFF** to some **transmit power** level setting starts the transmission and reception of pings, and the echosounder will attempt to detect bottom echoes. If it is successful, digitized depths will appear on the appropriate 4-digit LCD **Depth Display**.

Typically, it is most effective to start sounding with a manual **PHASE** selection and low **transmit power**. The **RX GAIN** (**receive gain**) control should be set to **AGC** (automatic gain control).

Rotate the **PAPER SPEED** knob from **OFF** to a paper rate position, so that a visual record of the received signal is available.

If stable, reasonable depths do not appear, the 320M has probably not been able to locate the bottom. The first thing to check is the location in the water column of the *window*, which is controlled by the **RANGE** and **PHASE** switches. The 320M only looks for the bottom in the *window*, and only the *window* is printed on the hardcopy recorder. The **RANGE** switch defines the size of the *window*, and the **PHASE** switch defines its location (or depth), with a 50% overlap between settings.

Start with a **PHASE** setting of 1, which puts the *window* at the top of the water column, and select a **RANGE** value larger than the expected depth of the water. In all probability a bottom echo will now be visible on the chart recorder, and a stable depth value will appear on the digital **Depth Display**.

Once an echo is obtained, some experimentation with **transmit power**, **transmit pulse length** and **transmit blanking** (these last two are secondary controls accessible through the front panel menu system) may then be appropriate to obtain optimum bottom tracking performance. Generally speaking, the lowest **transmit power** and shortest **pulse length** which produce a clean bottom record and a stable depth value should be used. Deeper water or noisier conditions will require more power and longer pulse. The **transmit blanking** distance, from the face of the transducer, must be enough to prevent the tail end of the transmit pulse or transducer ringing from being falsely interpreted as the echo from a very shallow bottom. **Receive gain** can normally be left on **AGC** at all times. One other secondary control which affects the depth detection process, **sensitivity**, can be left initially at the default **OFF** setting.

If stable, reasonable results do not appear and a clear bottom trend is not presented on the hardcopy, the operator needs to take corrective action. Loss of bottom may be due to several reasons:

- The bottom may be outside the selected **RANGE**/**PHASE** *window*. Adjust the *window* appropriately for the expected depth.
- In shallow water, the **transmit power** may be too high, or **pulse length** too long.
- In deep water, the **transmit power** may be too low, or **pulse length** too short.
- The **transmit blanking** value is too small (it is seldom too large, except in very shallow water).

When stable bottom tracking performance has been achieved the **PHASE** control may be changed to the **AUTO** position. Note that before taking this step the **autophase minimum depth** and **autophase maximum depth** parameters should be set, and optionally, the **tracking gate** width and **primary channel** designation.

3.3 Advanced Echosounding

In most instances, the simple instructions provided in the previous sections will be sufficient to get the user up and running with the 320M Echosounder. However, to fully utilize the 320M's capabilities, particularly the more complex functions such as auto phasing, it is necessary to have a thorough understanding of the Secondary Functions and their use. A detailed description and reference for both Primary and Secondary Functions and controls is provided in Sections 3 through 6 of the Operator Controls Manual.

3.4 Interfacing to the Survey Computer/Datalogger

The 320M's **COM3** serial port is the port dedicated to communications with the survey computer. It is a 3-wire (TXD, RXD and GND in a DB-9M connector, RTS/CTS jumpered) RS-232 interface which requires a null modem cable to connect to a standard PC. This is the port used for serial datalogging, and the port through which the survey computer can initiate event marks and send event mark annotation to the echosounder. It is also the port used for configuration and control of the echosounder, either with the configuration utility, **SerialUtility.exe**, supplied with the echosounder (Section 3.5), or with the user's own software.

3.5 Windows Configuration Utility

The Windows program **SerialUtility.exe** is supplied with the echosounder. This is a serial configuration utility which runs on any Windows PC (usually the survey computer) and communicates with the echosounder through the sounder's **COM 3** serial port (see Section 3.4, Interfacing to the Survey Computer/Datalogger). The **COM 3** serial interface protocol is described in "Serial Configuration Utility Software User's Manual".

3.6 Interfacing to Peripheral Devices

The following steps describe how to connect a standard peripheral device to the echosounder.

1. Connect an RS-232 null modem cable between the peripheral device and one of the communications ports on the echosounder's connector panel. Please note:
   a. the survey computer/datalogger must be connected to **COM 3** on the echosounder. Other receivers and sensors can be connected to either **COM 1** or **COM 2** on the echosounder.
   b. the echosounder can only accept one device of a particular type: ie. it cannot interface to 2 heave sensors at one time, or 2 GPS receivers, but it can interface to 1 heave sensor and 1 GPS receiver simultaneously.
2. Power up the echosounder and wait for the power-up initialization to complete.

The next step is to configure the echosounder for the particular peripheral device which has been connected. In most instances the convenient way to do this is with the Windows configuration utility **SerialUtility.exe** (Section 3.5).

If a PC is not conveniently available, and the echosounder software has been compiled with the extended menus compilation option, the following procedure may be used.

1. Advance the **MENU** selection until the appropriate com port setup screen appears, then press the **MENU** knob to access the setup submenus.

2. Rotate the **SELECT** knob until the desired device option is found, the press **SELECT** to accept the selected device driver option.

3. Press the **MENU** knob to step to the baud rate option. Rotate the **SELECT** up or down to choose the baud rate that matches the peripheral device's baud rate. Press **SELECT** to accept the desired baud rate.

4. Press the **MENU** knob to step to the parity option. Rotate the **SELECT** up or down to choose the parity that matches the peripheral device's baud rate. Press **SELECT** to accept the desired parity setting.

5. Press the **MENU** knob to step to the data format option. Rotate the **SELECT** up or down to choose the data format that matches the peripheral device's baud rate. Press **SELECT** to accept the desired data format.

6. Press the **MENU** knob to step to the loopthru option. Rotate the **SELECT** knob to toggle to loopthru option on or off. Press **SELECT** to accept the desired loopthru option. If loopthru is set to **ON** and the selected peripheral device outputs printable ASCII strings, the echosounder will echo these strings upon receipt out **COM3** to any attached survey computer/datalogger.

3.7 Customizing the Serial Data Output

The echosounder can be configured to output serial depth logging strings in a number of different formats. When the system leaves the factory, the default output format is one that is compatible with the Hypack survey program. The echosounder also supports several emulation formats as well as a user-configurable format. The most convenient way to select the output format is with the Windows configuration utility **SerialUtility.exe** (Section 3.5). This utility is the *only* way for the user to modify the user-configurable format.

If the echosounder software has been compiled with the extended menus compilation option, it is possible to select the output format from the front panel menu. The user can select between no data output, the user-configurable format, or a specific emulation string.

If the user-configurable format is selected, the user must define the configuration using the Windows configuration utility **SerialUtility.exe**. This utility enables the user to select from a lengthy list of parameters for inclusion in the output string. The order of these parameter fields is fixed (eg, the HF depth field always precedes the LF depth field when both are selected) but the parameters to be included are up to the operator.

Note that the output datalogging string format, like all other soft-coded parameters, is saved in non-volatile memory (NVM) when the echosounder power is turned off.

3.8 Time Synchronization

The Main Processing Module of the 320 series echosounders contains a battery-backed real time clock/calendar device, similar to the one found on PC motherboards. Date and time can be set by the user through the menu interface on the 320M's front panel. Echosounder time can be set to the nearest minute in this way, or even to the second if the user waits to the changing of the minute to push the **SELECT** knob (the "seconds" count is zeroed by the echosounder whenever a new time is entered).

For applications which require time synchronization between the survey computer and the echosounder to less than a second, the utility program **SerialUtility.exe** may be used (Section 3.5). This Windows application program has a menu command which synchronizes the echosounder to the PC to a hundredth of a second (see command string "$PKEL37: Set Time in milliseconds since midnight" in the "Serial Configuration Utility Software User's Manual"). Note the real-time-clocks in both the echosounder and the PC are subject to drift, typically up to about a second per hour. It may be necessary to occasionally re-synchronize the echosounder to the PC depending on the requirements of the survey.

3.9 Event Marking

The 320M provides the capability of printing annotated event marks (also called fix lines), on the hardcopy recorder. Event marks can be initiated in a number of ways, the simplest of which is to press the **MARK** button on the echosounder's front panel. Event marks can be initiated remotely with a switch connected to the **Fix** BNC connector on the 320M's connector panel. The survey computer/datalogger can initiate an event mark by sending a command string, which may include externally generated annotation, through the **COM3** serial port. Finally, event marks can be initiated at regular intervals by the 320M's internal timebase, at intervals specified by the user. Several commands are available in the Secondary Function Interface for controlling event marking.

The standard internally generated event mark annotation, in addition to the event number, includes echosounder time, LF and HF depth readings, GPS position (if available) and a single character field indicating the source of the event mark, according to Table 3-1.

Table 3-1: Fix Mark Source Codes

Code Letter	Description
M	Front Panel Fix
S	Serial Port Fix with internal and external annotation
R	Remote Connector Fix
T	Internal Timebase Fix
E	Serial Port Fix with external annotation only
P	PC SCSI Port Fix

3.10 End of Day

After the completion of the survey or at the end of the day, it is a recommended practice to "un-load" the printhead. This is done by rotating the head tension lever 90˚. Unloading the printhead serves two purposes:

1. Prevents the printhead from being damaged by sticking to the thermal paper or film,
2. Prevents the printhead from denting the print roller (only a concern if the echosounder is being stored for a long period of time).

If the system is left in a very hot, humid environment at the end of the day, it would also be advisable to remove the thermal paper from the system to prevent damage to the day's survey record and any unused media.

3.11 Batteries and Power Conservation

If the sounder it being powered by battery, it is possible to reduce its power consumption to minimize the drain on the battery. This can be done by dimming the illumination on the front panel displays and the printer using the **DIM** knobs on both.

4 THE THERMAL PRINTER

4.1 Overview

The 320M thermal printer is a high resolution hardcopy device designed to provide a quality record of the echosounder data. It has an automatic self-heating capability as well as temperature dependent burning which ensures consistent operation in various temperature environments. Other features include:

- 5 Mbit/sec data transfer rate
- 1728 pixels per line
- Automatic on/off line control
- LED status indicator
- Line feed control
- 32 level Greyscale mode
- Continuous printing capability
- Temperature reporting in Celsius
- Head operating range 0∘C - 59∘C
- Automatic preheating and cooling hysteresis
- Optical paper out detector
- Head Unload safety switch
- Built-in take-up reel

4.2 Printer Panel LED states and controls

4.2.1 LED Status states

Table 4-1. Printer LED Status State Definitions

ONLINE	FAULT	STATE	FAULT CONDITION
ON	OFF	Steady	Online
OFF	ON	Steady	Paper out
OFF	ON	Slow Flash	Printhead too hot
OFF	ON	Fast Flash	Printhead too cold
ON	ON	Steady	Printer set offline
ON	ON	Slow Flash	Printhead unloaded
OFF	OFF	Slow Flash	Processing fault

4.2.2 PAPER button

This pushbutton is used to form feed (advance) the paper. As long as the button is pressed, the paper will advance provided there is paper loaded. Nothing will happen if there is no paper in the system.

4.2.3 DIM knob

This is a trimpot used to control the intensity of the illumination on the printer. (Note: this DIM is independent of the one on the front panel.) There is an illumination board located alongside the printhead to provide better visibility of the printline.

4.3 Paper Loading Instructions

Figure 4-1 is a plan view of the printer mechanism showing all major parts, including the paper transport path. The following procedures are recommended for paper loading:

4.3.1 Part A - Inserting a New Roll

1. The roll should be KND320 media. It should be clean and dry. Turn off the 320M, and open the printer door.
2. Insure the leading edge of paper is clean and free of tape or other adhesives.
3. Place the new roll into feed brackets so that when the leading edge of the paper is inserted into the paper guide, it comes off the roll from the OUTSIDE.
4. Lift the printhead tension lever so that the printhead is not in contact with the roller .
5. Feed the paper past the paper guide so that it comes out the front of the printer between the roller and printhead.

4.3.2 Part B - Loading the Take-Up Roll

1. Feed this leading edge behind the windows back through the take-up slot.
2. Select an empty KND320 roll core that is in good condition for use as the take up core.
3. Place the take-up roll into the take-up brackets.
4. Attach the leading edge to the empty roll core with tape, (or to the sticky strip that is present on some cores).
5. By hand, turn the take-up roll so that it hides the roller from the OUTSIDE (a mirror image of the feed roller).
6. Lower the printhead tension lever so that the printhead comes in firm contact with the paper.

NOTE: Save the spent feed roll cores for re-use as take up cores. Field experience has shown that operators can never find enough empty cores.

4.4 Record Care

Do not store unused or printed KND320 media in hot or humid places; store it in a cool dark place below 30 degrees Celsius. Do not stack printed paper on or under freshly developed diazo copy sheets.

Thermal records made with KND320 media should be kept dry and away from extended exposure to open sunlight, bright room light, or heat. Do not allow any volatile organic solvent or vinyl chloride to contact the printed paper. Alcohol, plastic tape, or film will fade the printout. To fix printed paper to another piece of paper, use double side plastic tape, or water based or solid glue.

4.4.1 KND320 Media Specifications

Thickness:	.003 inch
Width:	8 ½ inch.
Length:	150 ft.
Wound:	Sensitive side out
Core:	1 inch inner diameter
Roll:	2.622 inch outer diameter

NOTE: Ordinary fax paper which meets these nominal dimensions may be used in the 320M; however, it cannot support 32 greyscale and the record quality will not be as good as with the recommended KND320 plastic film media.

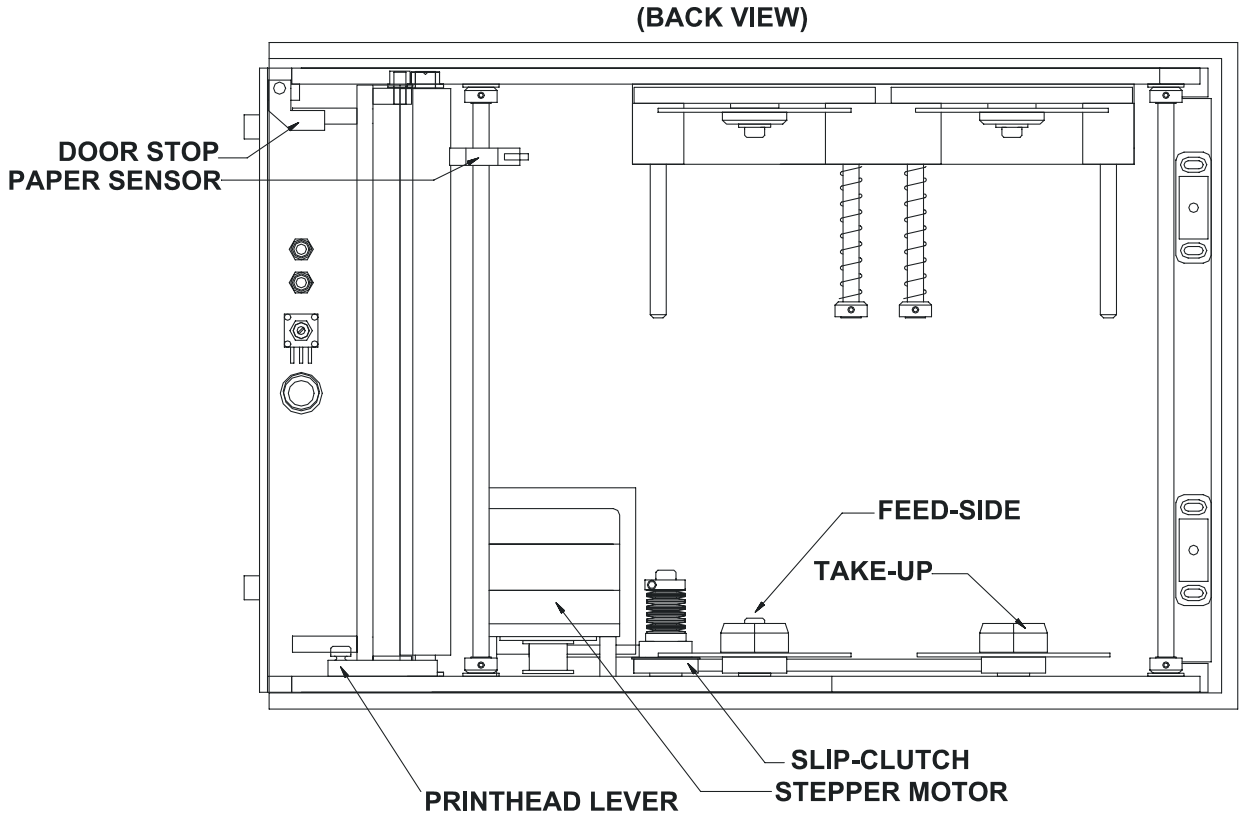
4.4.2 Care After Use

Care should be taken to keep the printer head clean to ensure the best possible quality of recording and to extend the life of the printhead. To clean the head, follow the steps below:

1. Using the head release lever (see Fig. 3-1), unload the head by rotating the lever 90º.
2. Using a cotton swab and isopropyl alcohol, wipe the printing surface of the head several times until no residue or dirt is evident on the swab.
3. Allow the alcohol to dry (approx. 1 minute).
4. Reload the head by rotating the lever back to its original position.
5. Resume normal operation.

IMPORTANT: Whenever the system is not in use (overnight, in storage, etc), the printhead should be left unloaded to prevent the damage to the printhead and the print roller. The printhead can be seriously damaged if the thermal film sticks to the printing surface; this is a very important precaution, especially in very hot, humid environments. Also, if the system is stored for extended periods of time with the printhead loaded, the pressure of the printline surface on the rubber roller can deform the material, resulting in a "dent" in the print roller's surface.

Figure 4-1. The Printer Mechanism



5 MAINTENANCE AND TROUBLESHOOTING

5.1 Hardware Architecture

5.1.1 Module Interconnections

The 320M Marine Echosounder incorporates a very modular architectural design. The system is composed of the following modules along with their accompanying mechanical and cable assemblies.

MPM: Main Processor Module,
SPM: Signal Processing Module,
STM: Switchmode Transmit Module,
PDM: Power Distribution Module,
PCM: Printer Control Module,
FPM: Front Panel Module

The MPM is the host board of the system, the brain of the system, which uses a TMS320C25 as the DSP processor. This board controls all the internal modules as well as providing interfaces to external computers or sensors such as GPS and Heave. This board interfaces with one or two SPMs and STMs depending on single or dual frequency configurations. The MPM takes power from a 5Vdc power cable from the PDM. It interfaces to external devices through three serial port 3-wire cable assemblies and one SCSI port ribbon cable assembly.

Each SPM connects to the MPM as a daughter board using a 36-pin SBX connector, drawing power through this connector in addition to exchanging commands and data with the MPM.

The STMs interface using a 10-pin ribbon cable for transmit drive signals from the MPM, 48Vdc power from the PDM, and a twisted cable for the received analog signal to the SPM.

The FPM provides the interface from the front panel displays and switches to the MPM. It connects to the MPM via a 3-wire serial cable used for data transfers. It takes 5Vdc from the PDM.

The PCM is a computer board, using a TMS320C25 as the processor. It has some built-in self-tests, but stays in an idle loop until it receives control instructions and data from the MPM. The PCM connects to the MPM via a 16-pin ribbon cable that provides a high-speed serial communication link. The PCM connects to the PDM with a combined 5Vdc (for digital power) and 24Vdc (for printhead and motor power) power cable.

All cable end connectors are polarized and fitted to avoid improper insertion.

5.1.2 Power Distribution

The PDM provides the various DC voltages (5Vdc, 24Vdc and 48Vdc) to power the digital portions of the system (MPM, SPMs, PCM), the STM, and the printer. The PDM has limited adjustment over the range of output voltage and comes factory set. There should be no need to adjust the voltage outputs of this module. If you suspect a problem with the PDM or any other part of the system, please contact the factory.

5.2 USER MAINTENANCE

5.2.1 User-serviceable Components

The only user-serviceable components in the system are the protection fuses located on the MPM, STM, and PDM. These fuses are standard 5mm x 20mm slow blow glass type. If a module has a blown fuse, check the input power source to confirm the setting is within specification (9-36Vdc). Replace the fuse and test. If the fuse blows again, please consult the factory. If normal functionality is achieved, continue with use. If a module is determined to be faulty, typically a new replacement module is provided in exchange for the faulty one. A board replacement is easily accomplished and allows for faster system repair than trying to find and repair faulty board components in the field.

5.2.2 Normal User Maintenance

The 320M requires very little maintenance or internal calibration. There are few moving parts to wear or adjust. Internal diagnostics check the subsystems on the MPM and report error codes via the front panel or a PC RS232 link.

5.2.2.1 Printhead Cleaning

The most important maintenance item is the proper cleaning care of the printhead. As the printer is used, small particles of dirt and grit can accumulate on the printhead surface. If too much debris collects on the printing surface, the printing quality deteriorates and missing pixels appear as white lines on the printout. If this debris is not cleaned off, the affected pixels can be permanently damaged. This debris can be cleaned using a cotton swap with isopropyl alcohol solution. Release the printhead and then gently wipe the swap across the printing surface of the printhead. Let the surface dry completely before re-engaging the printhead and resuming printing.

5.2.2.2 Printer Slip-Clutch Adjustment

The printer is designed with a slip-clutch assembly that enables the user to adjust the amount of paper tension at the take-up end. This adjustment is optimized for use with the KND320 plastic thermal media before the system is delivered and should not normally require any change. However, if any of the following symptoms develop, the described adjustment should remedy the problem. If problems continue, contact the factory.

Table 5-1: Printer Slip-Clutch Adjustments

SYMPTOM	ACTION
No paper take-up.	1) Loosen set screw on the slip-clutch collar. 2) Turn the collar a 1/4 turn clock-wise. 3) Tighten the set screw on the collar.
Paper wound too loose.	1) Loosen set screw on the slip-clutch collar. 2) Turn the collar slightly less than a 1/4 turn clockwise. 3) Tighten the set screw on the collar.
Printer making “clunking” sound.	Suggestion 1: 1) Loosen set screw on the slip-clutch collar. 2) Turn the collar a 1/4 turn counter-clockwise. 3) Tighten the set screw on the collar. Suggestion 2: 1) Measure the 24V line on the printer board. (At the 24V fuse) 2) If voltage is less than 24V, contact KEL.

5.2.3 User Calibration

The only user calibration required is a DRAFT and SPEED OF SOUND modification. This is done typically by using a BAR CHECK (see Echosounder Concepts Technical Note D10-02251).

5.2.4 Software Upgrades in the Field

There may be a time when a software upgrade is desired, or required to meet a specific user's special requirement. Knudsen Engineering Limited provides Internet FTP downloads so that the user can get new or revised software. The user can then upload this software into the 320M. The Flash Eprom technology allows serial RS232 software transfer and programming thus eliminating the need to replace eproms. Refer to the Software Installation/Upgrade Manual for instructions to complete the upgrade.

5.3 Basic Troubleshooting Procedures

The 320M can be bench tested with a transducer using in-air echoes from a wall or other hard surfaces. There are no exposed hazards inside the unit, although the Transmitters can generate several hundred volts at the secondary of the output transformer. These points are under a removable protective cover.

With the unit set up, attempt to apply power. Some basic strategy is offered in the following sections.

5.3.1 System Appears Dead

If the system is totally lifeless, start by examining for obvious problems. Open the printer door and check the power distribution module. It has three LEDs which should all be ON in order for the unit to operate; one is for +5V, one for +24 V and one for +48 V. The power distribution module has a backup fuse inside, check it first.

5.3.2 Breaker Tripped

After resetting the breaker, check the input DC polarity, then open the printer door and check the status of the shunt diode across the supply. Then, one by one, start disconnecting power cables at the power distribution module from the STMs, FPM, Printer and MPM until a module is isolated or fault appears.

5.3.3 Other Malfunctions

Review the following table for possible culprits. The technical reference manual contains schematic sets which are highly recommended for serious debugging.

Table 5-2. Possible Malfunctions and Solutions

Symptom	Possible Cause	Action
No Transmit	Transducer	Connect transducer and cable. Check transducer circuit connections.
	Transmitter	Check cables and connections. Check FETs for DC shorts. Check optocoupler output.
No FPM Display	LCD	Check contrast adjustment. Check cables.
	Power	Check of 5V +/- 5% is present
No Serial Communications	Baud	Ensure baud and communications protocols match devices.
	Cables	Check cables (pinouts, connections, etc.)
Missing Lines on Printout	Printhead	Clean burnline with alcohol and swab.
	Communications	Check cables and connections.
Not Printing	Temperature/Status	Ensure printer shows ONLINE steady.
	Cables	Check cables and connections.
Weak Paper Take-up	Take-up Roll	Check that take-up roll is properly seated.
	Pulley	Check for broken take-up pulley.
Paper Tracking	Poor Installation	Remove paper and reinstall with better alignment.

5.4 System Self-Test Tools

5.4.1 Power-On Messages

Upon power-up, the dot matrix LCD will display an initial Front Panel test screen, while internal self-tests are performed (lasts approximately 3 seconds). If any errors are encountered in the self-tests, the LCD screen will display individual messages for each error condition encountered. The user will need to acknowledge each error condition report with a **MENU** press. Once all the error conditions have been acknowledged, or if no error conditions occur, the display will report on the status of the SPM modules installed in the system. This screen indicates if the LF and HF SPM's are responding and if the proper SPM frequencies were detected for each channel. It will remain for approximately 6 seconds, before the initial menu screen appears at which point the user can now operate the system.

5.4.1.1 SPM Sign-On Messages

LF: 50kHz — this message indicates that a nominally functional 50kHz SPM was detected on the LF channel and that it matches the frequency supported by the currently installed version of software.

HF: invalid H/W — this message indicates that a nominally functional SPM was detected on the HF channel but that its frequency is not supported by the currently installed version of software. The sounder disables controls for an unsupported frequency SPM.

LF: not present — this message indicates that either an SPM module is not installed, or that the installed module is not functioning properly and needs to be serviced or replaced.

Double check the SPM sign-on messages to ensure that the installed SPM modules are recognized by the system.

5.4.1.2 Non-Volatile Memory Error

NVM DATA INVALID
LOADED DEFAULTS

This typically means the setup data stored in the NVM has been corrupted. The NVM is protected by the checksum in order to assure that only valid data is used in sounding. In event of an invalid checksum, the 320M and the NVM are loaded with the original default settings. If power fails or is shut off while the processor is computing the checksum on an adjusted parameter, there is a small chance that this message will result. In theory, it is possible for the NVM memory IC to wear out after millions of writes and require replacement; this may be indicated by continual NVM faults.

5.4.1.3 SRAM Errors

PS SRAM FAILED
Error code: xxh

DS SRAM FAILED
Error code: xxh

These error messages indicate hardware problems on the Main Processing Module. The PS SRAM message means that the SRAM chips used for program storage during operation failed the built-in self-tests. The DS SRAM message means that the SRAM chips used for data storage during operation failed their built-in self-tests. If either of these error messages occur, the system's performance is compromised and qualified technical help is required.

NOTE: On older systems, the serial sign-on message may indicate a DS SRAM error = 01h. This simply means that the unit does not have the optional extended SRAM memory chips installed. These extended memory chips are only needed for systems using 3.5kHz correlation; the unit will function normally for all other frequencies.

5.4.1.4 Clock Errors

VALIDATION
ERROR CLOCK

This error message indicates a hardware problem with the internal real-time clock. If the clock fails its validation test, the clock's internal battery backup has failed, and the clock needs to be replaced. The internal battery is rated for a life of ten years.

5.4.1.5 Printer Sign-On Error

ERROR: PRINTER
FAILED SIGN-ON!

This error message indicates a problem with the printer module. The Main Processing Module attempts a handshake sequence with the printer on power up; if the printer does return the appropriate response to the Main Processing Module this error message will occur. This could be a result of older incompatible firmware in the Printer Control Module; a firmware upgrade would solve this problem. It could also be due to a hardware problem in the Printer Control Module, or poor cabling from either the Main Processing Module or the Power Duistribtion Module. Technical support should be contacted if this error consistently occurs.

5.4.2 Miscellaneous Error Messages

5.4.2.1 Printer Errors

WARNING - PRINTER
NOT RESPONDING

This message occurs when the Main Processing Module does not get the expected status word codes from the printer. If the printer's status LEDs do not indicate an error, check to make sure the cables between the MPM and the printer are firmly seated.

5.4.2.2 SPM Operational Errors

TIMING ERROR:
data acquisition

This message occurs when one or more of the SPM modules do not send the correct amount of data to the Main Processing Module within an allowable amount of time. This is an indication that the SPM module is faulty and requires repair or replacement.

Addendum: For 320M/P Users

Virtually all the descriptive text in the document is applicable for 320M/P echosounders but the following figures should be referenced instead of the 320M figures embedded in the document body. The references to bulkhead and rackmount are not applicable for 320M/P echosounders.

Figure 1-1. The 320M/P Survey Echosounder

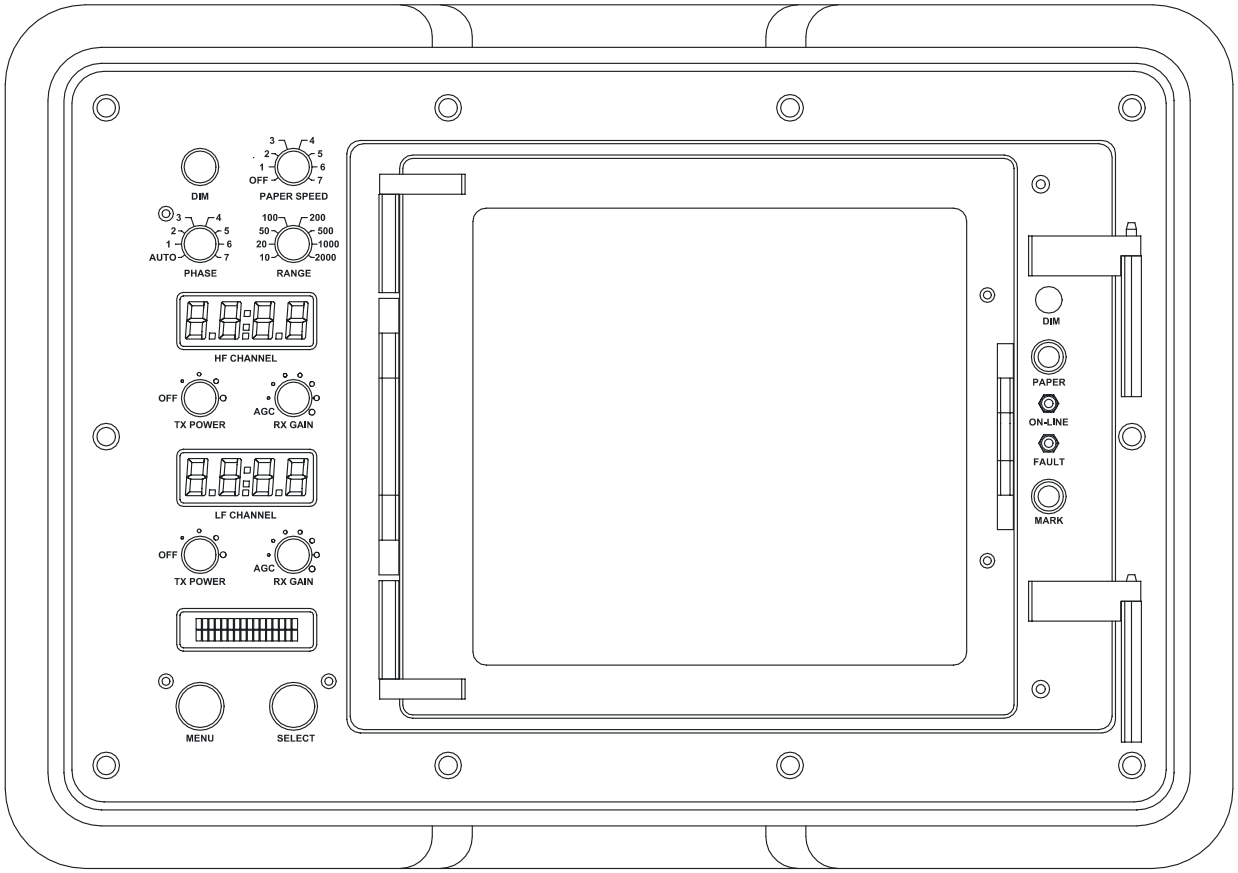


Figure 2-3. Plan View with Printer Door Open

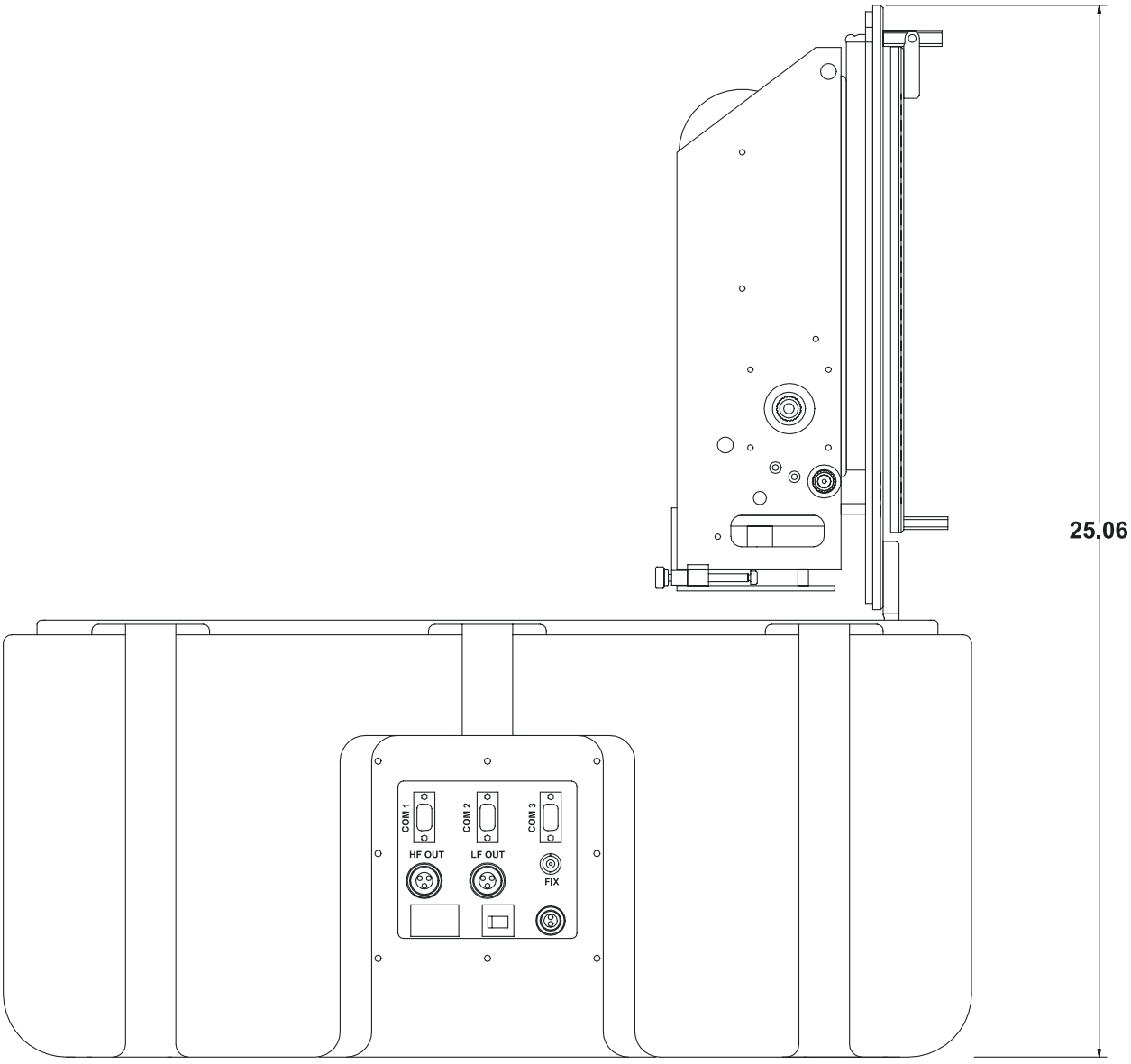


Figure 2-4. Connector Panel

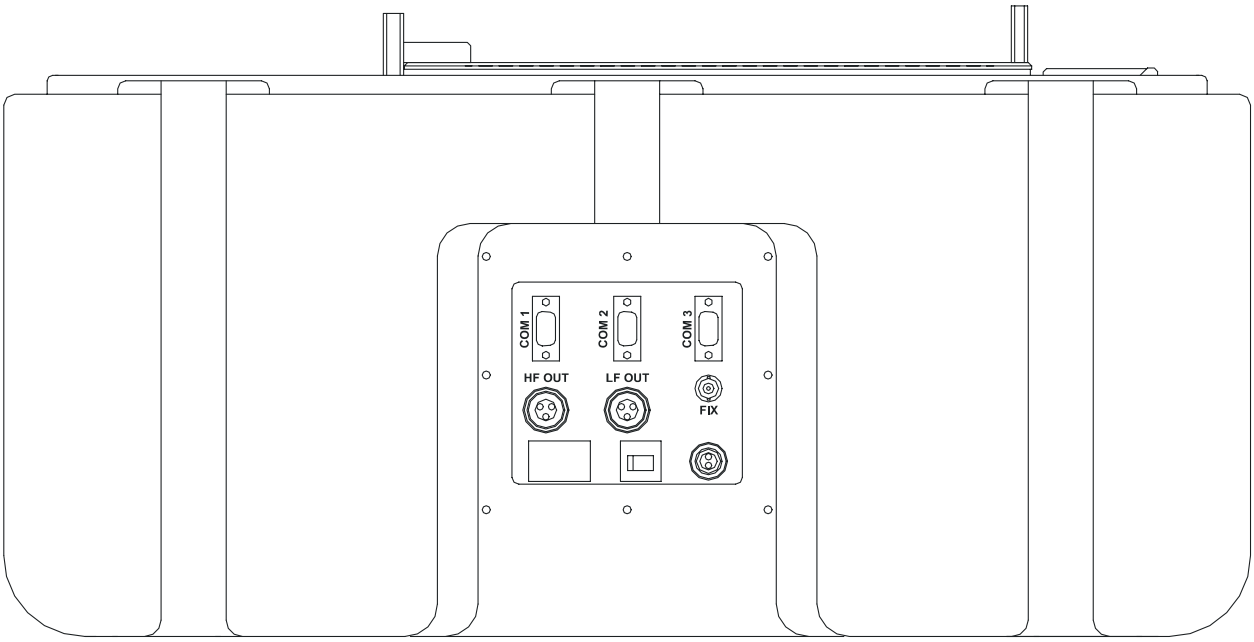
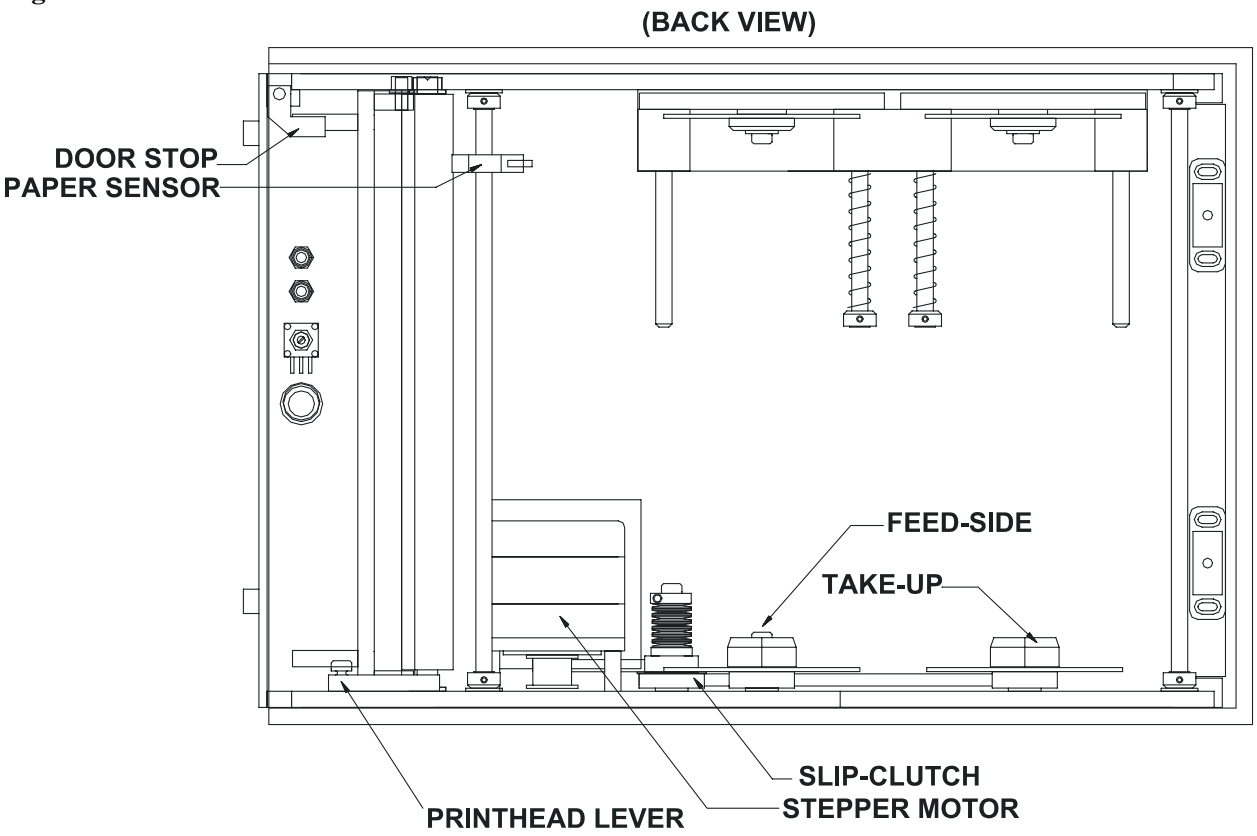


Figure 4-1. The Printer Mechanism



320M MARINE ECHOSOUNDER

OPERATOR CONTROLS MANUAL

Supports Echosounder Firmware #: D40-02000 V4.00

D10 - 02223
Revision 3.0
November 4, 1999

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1 INTRODUCTION

1.1 About this manual

This manual provides detailed information about the front panel operator controls for 320M Echosounders. This manual provides basic operational instructions and detailed descriptions of all the functions accessible from the echosounder front panel.

Section 1 provides a brief summary of the contents of this manual.

Section 2 describes the 320M's Front Panel.

Section 3 describes the front panel's Primary Function Controls that give the 320M its traditional echosounder look and feel

Section 4 describes the front panel's Secondary Function Interface which provides access to all of the Secondary Functions and Parameters.

Section 5 details the operation of the Secondary Function Interface and the various menus that provide the operator with access to the more advanced functions.

Section 6 provides details about the expanded Secondary Function menus available as a compilation option.

1.2 320M Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 (8:30 am to 5:00 pm EST)
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

1.3 Compilation Options

It should be noted that all 320M control functions, whether primary or secondary, are "soft-coded", in that switches never control hardware directly, but merely provide information to the 320M's computer. The operational characteristics of the echosounder are therefore completely under software control. On occasion it is convenient to produce versions of this software with different operational characteristics to meet different user requirements. This is done at the software compilation stage so these differences are referred to as

compilation options. A small number of compilation options are available for the 320M. These are identified and described in the relevant sections of the manual.

Compilation options may be specified by the customer at the time the system is ordered, or subsequently whenever custom software modification is required..

1.4 Notational Conventions

When a front panel control is mentioned in the text, it appears in **CAPITAL LETTERS AND BOLDFACE**, much as it actually appears on the echosounder.

When a user controlled parameter is mentioned in the text, it appears in **boldface**.

Italics are used for important concepts, like the display *window*.

2 THE FRONT PANEL

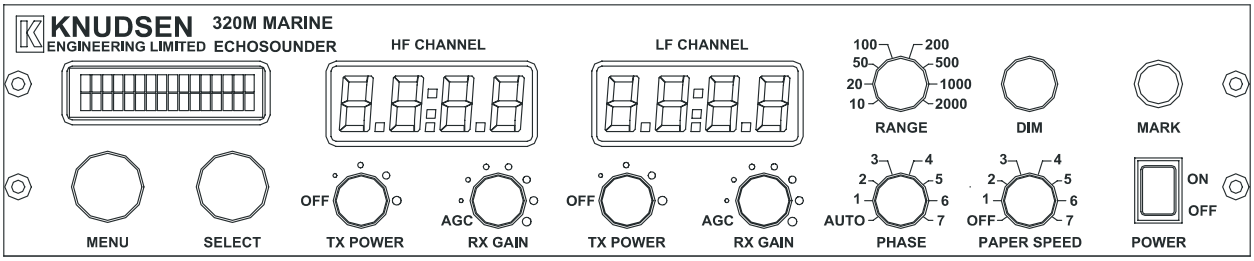

Figure 2-1. 320M Front Panel

The front panel of the 320M Survey Echosounder is shown in Figure 2-1. It contains all of the *primary functions* - those functions for which dedicated front panel access is provided. These include the **4-digit LCD depth displays**, and the following controls:

POWER,
PAPER SPEED,
DIM,
RANGE,
PHASE,
TX POWER,
RX GAIN.

The primary functions and their operation is described in Section 3.

Also on the front panel is the *secondary function* interface, which consists of two identical controls:

MENU,
SELECT.

These are combination rotary optoswitches and pushbuttons, and are used in conjunction with the **2 line by 16 character LCD display** to control all of the echosounder's secondary functions. The secondary function interface and its operation is described in Section 4.

It should be noted that all 320M control functions, whether primary or secondary, are "soft-coded" in that switches never control hardware directly, but merely provide information to the 320M's computer. The operational characteristics of the echosounder are completely under software control.

Note that the 320M never changes parameter values in the middle of a ping-echo cycle. Although operator input is acknowledged immediately, the changes do not take effect until the beginning of the next ping.

3 PRIMARY FUNCTIONS

3.1 POWER

This rocker switch provides power to the Echosounder. With this switch turned on, the Secondary Function Interface, serial ports and front panel switches are active. The **TX POWER** switches control the echosounding function, and the **PAPER SPEED** switch controls the hard copy recording function.

3.2 HF CHANNEL/LF CHANNEL LCDs

These four-digit LCD displays show the depth produced by the depth detection software. This software examines the filtered envelope (amplitude/time record or echogram) of the received signal to locate the bottom echo and thus determine the depth. This depth is corrected for **sound speed** and **draft** (and heave, if a heave sensor is connected and configured), converted to a distance in metres (or feet or fathoms, as the case may be), and displayed. Each new depth value is compared with the depths from previous pings, and if they do not agree to within a specified limit (referred to as the **tracking gate**), the depth is considered invalid and the display shows "**----**" instead of a numerical value.

If **TX POWER** is switched to **OFF**, the depth display indicates the state by displaying "**OFF**".

3.3 RX GAIN

The **RX GAIN** switch controls the analog **receive gain** of the relevant channel. Reducing the analog **receive gain** is useful when sounding in extremely shallow water. This reduces the overall noise while not seriously affecting echo strength. Increasing the analog gain is useful when sounding in very deep water. The **AGC** selection invokes automatic gain control which is the recommended setting for most operating conditions.

3.4 TX POWER

The **TX POWER** switch is used to turn the channel on and to specify the **transmit power** level of the pulse being transmitted. Power levels are controlled by changing the duty cycle of the switchmode transmitter output stage. Although high power signals will always give the strongest echoes, they also produce more ringing and reverberation which may obscure the bottom echo in shallow water. Using high **receive gain** in combination with high **transmit power** in shallow water may cause signal levels high enough to saturate (overload) the receiver, which will mask any echoes.

3.5 RANGE

The **RANGE** switch selects the size of the active *window* in the water column. The active *window* is the only part of the water column in which the echosounder operates. It is the portion of the water column which is printed on the hard copy recorder, and in which the bottom detection software looks for the bottom echo. The bottom *must* be in the selected *window* for the echosounder to function. Eight ranges are available: 10, 20, 50, 100, 200, 500, 1000, and 2000 metres (or feet or fathoms).

3.6 PHASE

The **PHASE** switch selects the depth, or location in the water column, of the active *window* (see explanation in previous section). The effect of the **PHASE** switch depends on the current **RANGE** setting. The standard 320M software compilation provides a 50% overlap between **PHASE** settings.

Table 3-1. Window Limits as defined by Range and first 7 Phases (50% overlap)

Phase	Range							
	10	**20**	**50**	**100**	**200**	**500**	**1000**	**2000**
1	0-10	0-20	0-50	0-100	0-200	0-500	0-1000	0-2000
2	5-15	10-30	25-75	50-150	100-300	250-750	500-1500	1000-3000
3	10-20	20-40	50-100	100-200	200-400	500-1000	1000-2000	2000-4000
4	15-25	30-50	75-125	150-250	300-500	750-1250	1500-2500	3000-5000
5	20-30	40-60	100-150	200-300	400-600	1000-1500	2000-3000	4000-6000
6	25-35	50-70	125-175	250-350	500-700	1250-1750	2500-3500	5000-7000
7	30-40	60-80	150-200	300-400	600-800	1500-2000	3000-4000	6000-8000

3.6.1 Small Phase Overlap Compilation Option

A software compilation option is available for a smaller, 20% overlap between PHASES, but this is only recommended for the special case where a very small *window* is autophased in an area with extended steep slopes.

3.6.2 Autophase

When the **PHASE** control is set to **AUTO**, the phase changes are performed automatically in response to information provided by the **primary channel** bottom tracking algorithm. The auto phasing software adjusts the **phase** setting automatically to maintain the bottom in the active *window*. It should be understood that the auto phasing software is critically dependent on the bottom tracking software - if the bottom is not being tracked successfully, auto phasing will not work.

It is helpful to think of the auto phasing software as having two distinct operating states - searching for the bottom and tracking the bottom. When the **autophase** mode is initially invoked, or whenever the bottom tracking software loses track of the bottom, the auto phasing software shifts into the *bottom search* state. In this state the *window* is opened up to the full extent of the water column from **autophase minimum search depth** to **autophase maximum search depth**. The ping rate usually slows down noticeably because of the larger *window*, and the printer stops printing until the bottom is located. When the bottom is found, the auto phasing software selects the appropriate phase and shifts into the *bottom tracking* state. In this state, the **autophase minimum search depth** and **maximum search depth** parameters have no effect.

Once the auto phasing software is in the *bottom tracking* state, it will continue to auto phase as long as the

primary channel is being tracked successfully. It will re-enter the *bottom search state* if 5 consecutive samples are declared invalid by the bottom tracking software.

Before invoking the **autophase** mode, it is a good idea to set the **autophase minimum search depth** and **autophase maximum search depth** parameters using the secondary controls menu (see Section 5.5).

One other parameter is relevant to auto phasing operation - this is the **primary channel**, accessible through the secondary controls menu, and described in Section 5.6). This parameter can be set to either **HF** (the default) or **LF**. It specifies the channel which is used as the depth reference for phase changes.

3.6.3 Bottom Tracking

Although the bottom tracking process is operational at all times, it is discussed here because it becomes critically important when auto phasing is enabled.

Locating and tracking the bottom is one of the more important software functions performed by the echosounder. The term *bottom tracking* encompasses the process of identifying the bottom echo in the received acoustic signal, locating the precise leading edge of the echo, computing the depth based on travel time and sound speed considerations, and most importantly, deciding whether the result represents a valid depth measurement (it might be a fish, or transducer ringing, or reverberation, or just noise, or even the second echo from the previous ping). The decision must be made immediately, before sending the depth value to the datalogger. The echosounder software, running in real time, does not have the luxury of looking ahead - it can only look back at previous depth samples. The algorithm used in the 320M uses the several previous samples, regardless of whether they were determined at the time to be valid or not (the rationale for including invalid samples in the test is the fundamental uncertainty in the validity designation). A variety of least squares curve fitting exercises is then carried out using the current sample and all or some of the previous several samples. If at least one of the curves fits the data to within a user-specified **tracking gate** tolerance, the current sample is declared to be valid.

Note that bottom tracking is performed independently for each channel. The depth value used by the auto phasing software is specified by the **primary channel** parameter.

3.6.4 Extended Phases Compilation Option

Manual phase control always is limited to the 7 selections provided by the **PHASE** switch. The standard software compilation provides these same seven phases in **autophase** operation. A compilation option is available which provides up to 254 phases in **autophase** mode. This permits a relatively small window to be used in deep water. If this compilation option is in effect, it is important to set the **autophase maximum search depth** value using the secondary controls menu, otherwise the sounder will appear to shut down while it searches to full ocean depth for the bottom.

3.7 MARK

The **MARK** button is used to initiate an event mark (also called a fix mark) on the hardcopy recorder. Pressing the **MARK** button while the printer is recording, will print an event mark indicating time, date, LF and HF depth readings, GPS position (if available), and mark source (M) on the hardcopy.

3.8 PAPER SPEED

The **PAPER SPEED** knob selects the paper speed of the hardcopy recorder. One setting, position 1 on the switch, links the paper speed to the ping rate by printing one line and advancing the paper one line for each ping/echo cycle. This setting produces good results under most conditions. The other switch settings (2 through 7) produce constant paper speeds defined in millimetres per minute, regardless of ping rate. Available speeds are listed in the table below. The **OFF** position disables all printing activity. Note that all paper speeds are independent of ping rate except the 1 line/ping selection.

Table 3-2. Paper Speed Selections

Switch Position	Paper Speed [mm/min]
OFF	0
1	one line per ping
2	10
3	25
4	50
5	100
6	197
7	296

3.9 DIM

This knob controls the illumination brightness for all of the front panel LCD displays. This control is independent of the similar **DIM** control on the printer panel.

4 SECONDARY FUNCTION INTERFACE

The Secondary Function Interface consists of the **MENU** and **SELECT** switches and the **2 line by 16 character LCD display**. The **MENU** and **SELECT** switches are combination rotary optoswitches and pushbuttons, and as explained below, they allow the user access to a wide range of secondary functions.

4.1 MENU

The **MENU** control is a combination rotary optoswitch and pushbutton. Rotating the knob causes a succession of secondary function "menus" to be displayed on the 2 line by 16 character LCD display. With each new position of the **MENU** knob, a new secondary function menu screen is displayed. Note that the optoswitch is soft-coded, and that specific physical angles of rotation do not correspond to specific menu items. The optoswitch functions more in the manner of a mouse or a trackball.

4.2 SELECT

Adjustment of the parameters that are displayed in the secondary function menu screens is accomplished with the **SELECT** switch. The **SELECT** control is also a combination rotary optoswitch and pushbutton. When the knob is rotated, the adjustments appear immediately on the active display window; however new parameter values are not used until the next transmit-receive cycle.

4.3 "*" and "?" Indicators

There are two special symbols used in the Secondary Function Interface to provide the user with important information.

If a menu screen displays an "*" in the lower right hand corner, that means there is at least one sub-menu screen accessible from this point. Pressing the **MENU** knob allows the user to enter a sub-menu. Repeated pressing of the **MENU** knob lets the user cycle through all available sub-menus, eventually returning to the root level. Rotating the **MENU** knob from any menu or sub-menu transfers the user to the root level screen of the next **MENU** selection.

If a menu screen displays a "?" after a parameter selection, it means that the user must acknowledge the selection before it will be used by the echosounder. This is accomplished by pressing the **SELECT** knob. After the **SELECT** is pressed, the "?" symbol disappears indicating that the parameter value displayed is stored in NVM (non-volatile memory) and will be used in the next transmit-receive cycle.

4.4 Menu Lock-out Control

The Secondary Interface menus can be locked to prevent accidental modification of operational parameters. The user simply presses and holds the **MENU** knob down for a 5 second count. This causes the display to change to a simple clock display screen. While this display is present, the user cannot access the menus. To unlock the interface, the user presses and holds the **MENU** knob down for another 5 second count. This will restore the last active menu screen, and restores the ability to modify parameters.

5 SECONDARY FUNCTIONS

5.1 Overview

This section outlines the standard Secondary Functions and the manner in which the operator accesses them through the Secondary Function Interface described in the previous section.

Secondary function parameters differ from the primary parameters in that they are truly soft-coded - their current value is not tied to the orientation of a physical switch on the front panel, such as **RX GAIN** for example. Thus it is both necessary and possible to maintain the values of secondary function parameters after power-down in non-volatile memory (NVM) storage. On power-up, the stored values for the secondary function parameters are read from the NVM; if a checksum error is detected for the NVM on power-up, the parameters are loaded with nominal default values as indicated.

See Figure 5-1 for a flowchart that summarizes the structure of the secondary function menus and sub-menus.

5.2 MPM Software

This root level screen displays the current part number and version number of the MPM (Main Processing Module) software. There is no parameter selection here, simply information about the system configuration.

5.2.1 Printer Software

This sub-menu screen displays the part number and version number of the printer's software. This information is sent from the printer itself. This is a quick indicator that the serial communication from the printer to the MPM is functional. If the numbers displayed are zeros, the communication link has not worked, or the printer is not present. No action can be taken - this is an information-only item.

5.2.2 Restore Defaults

Pressing **SELECT** while in this sub-menu loads all of the secondary function parameters with factory default values, and writes them into the non-volatile memory (NVM).

5.3 Bar Check

This multi-parameter, root level menu item provides access to the primary calibration parameters: **sound velocity**, **HF draft** and **LF draft**. When this menu item is first selected (by rotating the **MENU** knob until the word **BAR** appears), the current values of all three parameters are simultaneously displayed. Pressing **MENU** puts the echosounder into a special bar check mode in which one additional parameter, **bar depth**, appears in the display window. Pressing **MENU** at this point permits the user to cycle through and modify the four visible parameters.

In the special bar check mode, the digitizer search window is centred on the specified **bar depth** and is narrowed to the width of the **tracking gate**.

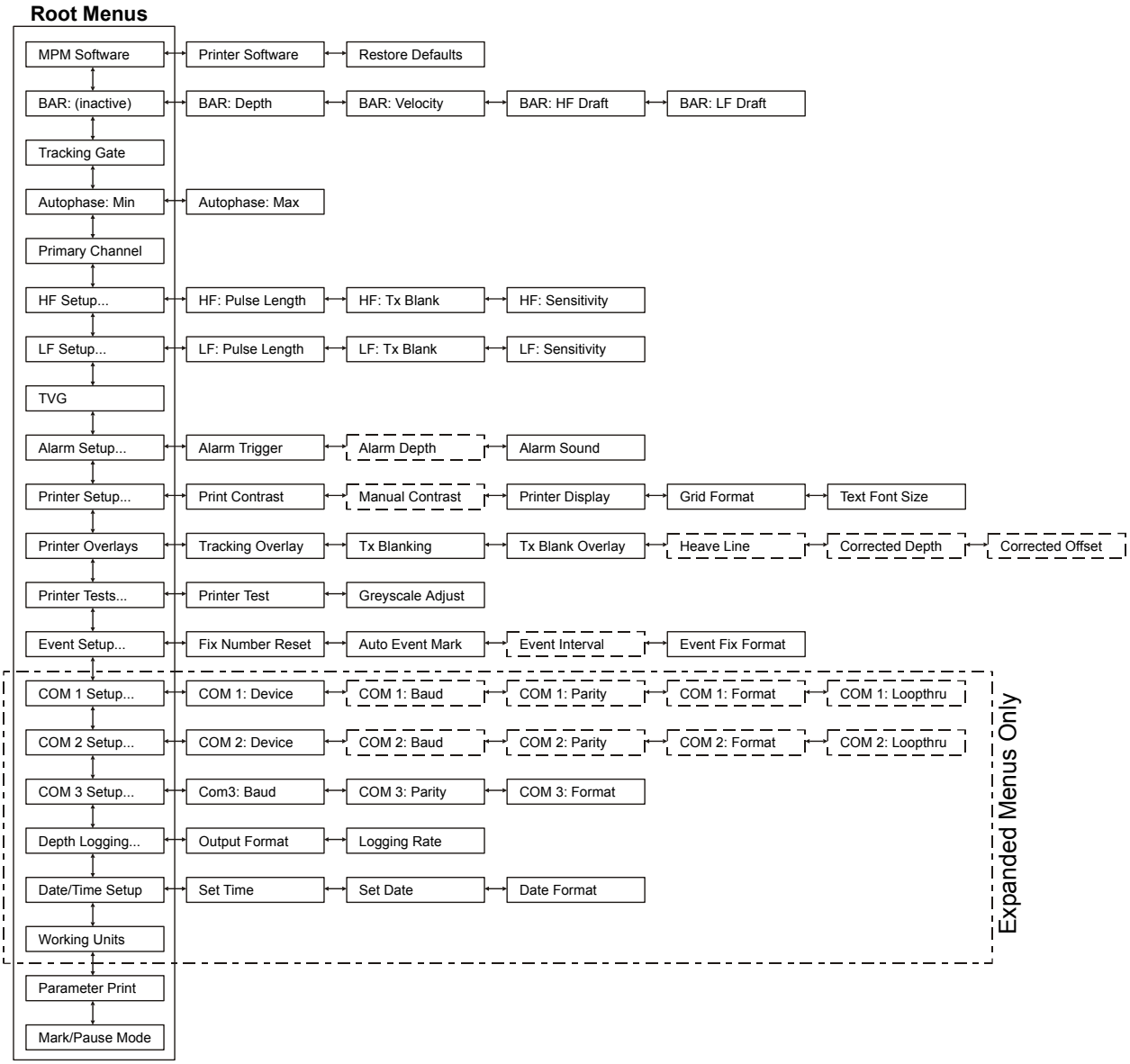

Figure 5-1. Menu Structure Summary

The bar check menu item is unusual in that it displays values of all four parameters simultaneously. The user simply presses the **MENU** knob to cycle through the four parameters and rotates the **SELECT** knob to modify the currently selected parameter, which is identified by an arrow pointer. Rotating the **MENU** knob to another menu screen deactivates the bar check mode, and restores the standard digitizer search window.

For a description of typical bar check procedures, see D10-02251 Echosounder Concepts Technical Note.

5.3.1 Bar Depth

Range:	1- 99 (units dependent on working units selection)
Increment:	1
Default:	10

The user adjusts this parameter to centre the digitizer search window around the expected depth of the test bar. The width of the search window around this centre value is determined by the size of the **tracking gate** (Section 6.4). The echosounder will digitize on the strongest target that falls within this search window. If no target is found, the depth displays will indicate an invalid depth return ("----" appears in the 4-digit display). If the **bar depth** parameter is set to a value not in the current **RANGE**/**PHASE** *window*, the sounder will indicate an error condition by showing " Err" in the 4-digit display(s).

5.3.2 Sound Velocity

Range:	1300 - 1700m/s or	4265 - 5577 ft/s	or 710 - 929 fm/s
Increment:	1m/s	1 ft/s	1 fm/s
Default:	1500m/s	4921 ft/s	850 fm/s

This feature allows the adjustment of the velocity of sound value used by the echosounder for all depth calculations. The user adjusts this value in the course of a bar check, or enters the average expected velocity of sound over the water column of interest obtained from a sound speed sensor.

5.3.3 HF Draft

Range:	0 - 100.00 m	or	0 - 328.08 ft	or 0 - 54.68 fm
Increment:	0.01 m		0.01 ft	0.01 fm
Default:	0		0	0

Draft indicates the vertical distance from the surface of the water to the active face of the transducer. Its main use is to ensure that the echosounder's output is corrected for transducer depth. The draft can be set independently for the low frequency and high frequency channels.

5.3.4 LF Draft

Range:	0 - 100.00 m	or	0 - 328.08 ft	or	0 - 54.68 fm
Increment:	0.01 m		0.01 ft		0.01 fm
Default:	0		0		0

Draft indicates the vertical distance from the transducer to the surface of the water. Its main use is to ensure that the echosounder's output is corrected for transducer depth. The draft can be set independently for the low frequency and high frequency channels.

5.4 Tracking Gate

Range:	2 - 200 [m] or [ft] or [fm]
Increment	1
Default:	10

The **tracking gate** parameter is used by the bottom tracking algorithm to determine the validity of the current depth value. It is a depth variability tolerance value, defined as a distance above or below the bottom depth trend established by the current and several previous samples. If the most recent depth value fits this established trend to within the range defined by the **tracking gate**, it is considered valid and is displayed on the four-digit LCD. If a depth return falls outside of this range, it is deemed invalid and "----" is displayed on the LCD..

For a discussion of the bottom tracking algorithm see Section 3.6.3.

5.5 Autophase Limits

This two-parameter root level menu item provides access to the **autophase minimum search depth** and **autophase maximum search depth** parameters which define the search *window* for bottom acquisition during auto phasing. When **AUTO PHASE** is first invoked, or when the bottom tracking algorithm for the **primary channel** loses bottom lock, the auto phasing software opens up the *window* to the full extent of the water column from **autophase minimum search depth** to **autophase maximum search depth** until it finds the bottom. These parameters only have effect during the bottom search phase. They do not limit the auto phasing process once the **primary channel** bottom tracking software has located the bottom.

Pressing **MENU** here toggles between **autophase minimum search depth** and **autophase maximum search depth**.

5.5.1 Autophase Minimum Search Depth

Range:	0 - 12000
Increment:	depends on current value
Default:	0

5.5.2 Autophase Maximum Search Depth

Range: 20 - 12000
Increment: depends on current value
Default: 12000

5.6 Primary Channel

Range: HF / LF
Increment: N/A
Default: HF

The **primary channel** parameter defines the frequency channel used as the reference depth for the auto phasing algorithm. The printer software uses **primary channel** data for channel-specific overlays (see Printer Overlays, Section 5.12) in the case where both channels are superimposed and only one channel's overlays can be printed.

The **primary channel** designation only has effect when both channels of a dual-channel echosounder are ON. If only one channel is on, it is automatically considered to be the primary channel.

5.7 HF Setup

This is a root level menu item whose sole purpose is to provide a header for the three sub-menus.

5.7.1 HF Pulse Length

Range: Frequency specific
Increment: N/A
Default: N/A

This sub-menu allows the user to specify the high frequency **pulse length**, the duration of the transmit pulse, usually specified in milliseconds or fractions of a millisecond. The choices are frequency specific. Generally, the higher frequencies use shorter pulses and vice versa.

By specifying the **pulse length**, the user indirectly specifies the bandwidth of the digital noise rejection filter applied to the incoming acoustic signal data. The filter bandwidth is usually set to the inverse of the **pulse length** (this relationship is true for the standard continuous wave (CW) signals, but not necessarily for the CHIRP signals used in the very low frequency channels).

Normally, long pulses with narrow bandwidth filters provide better noise rejection in deeper water or noisy conditions, while short pulses with wide bandwidth filters provide better resolution when conditions permit or the water is shallow.

The signal data rate (in samples per second) is also related to the **pulse length** because of the Nyquist requirement that the sampling frequency be at least twice the signal bandwidth. Under rare extreme conditions where the user has specified a very short pulse in deep water or a very long pulse in shallow water, the

echosounder will override the user's **pulse length** selection to meet data rate requirements. When this happens, the **pulse length** parameter value is not changed, and is used again as soon as the extreme conditions are removed.

5.7.2 HF Tx Blank

Range:	0 - 300.0 m	or	0 - 984.3 ft	or	0 - 164.0 fm
Increment:	0.1 m		0.1 ft		0.1 fm
Default:	2.5 m		8.2 ft		1.3 fm

The high frequency **transmit blanking** value is the distance, measured from the face of the HF transducer, to the point in the water column at which the bottom detection software begins to look for the bottom. **Transmit blanking** must be set large enough that transducer ringing following the tail end of the transmit pulse is not falsely interpreted as the echo from a very shallow bottom, but small enough not to unduly limit the minimum depth capability of the echosounder. The optimum value depends on the expected depth conditions, the **pulse length,** the **transmit power** level and the signal frequency. It is best determined by experimentation. Note that **transmit blanking** has effect only when it extends into the *window*, typically when **PHASE** is 1.

5.7.3 HF Sensitivity

Range:	off, 2 to 100
Increment:	1
Default:	off

The **sensitivity** parameter is useful in areas where soft sediments overlay harder materials, and where buried layers may often produce stronger echoes than the real bottom. If **sensitivity** is **OFF** (the default condition), the bottom detection software will always select the strongest echo in the *window*. With layered bottoms, the strongest echo is not necessarily the shallowest echo. Increasing the **sensitivity** causes the bottom detection software to accept a weaker but shallower echo. The higher the **sensitivity**, the weaker the echo, relative to the strongest echo in the *window*, that will be selected. On the other hand, if the **sensitivity** is too high, the bottom detection software will often trigger on noise or small items in the water column.

The easiest way to optimize the **sensitivity** adjustment for a particular survey area is to use the print contrast mode **AUTO W/DEPTH**, which prints a dark overlay pixel at the depth which has been selected by the bottom detection software. This provides a quick visual indication of whether the bottom or a buried layer is being tracked.

5.8 LF Setup

This is a root menu item whose sole purpose is to provide a header for the sub-menus.

5.8.1 LF Pulse Length

See **HF Pulse Length**, Section 5.7.1.

5.8.2 LF Tx Blank

See **HF Tx Blank**, Section5.7.2.

5.8.3 LF Sensitivity

See **HF Sensitivity**, Section 5.7.3.

5.9 TVG

Range: off / 20 log R / 40 log R / bottom ref'd
Increment: N/A
Default: off

This root-level menu item allows the user to select TVG (time-varied gain) on the analog receivers. The **OFF** setting provides constant receive gain throughout each pulse-echo cycle (note that receive gain will still vary from ping to ping if **AGC** is on). When set to **20 log R**, the receive gain is increased linearly (logarithmically if gain is expressed in decibels) with time and range from the instant of transmission, to compensate for signal amplitude loss due to spherical spreading. The **40 log R** setting provides for spherical spreading of both outgoing and returning signals. The **bottom referenced** setting provides a gain ramp starting at the bottom (as determined from the previous ping) to provide approximate compensation for attenuation in sub-bottom sediments. This last setting is intended for sub-bottom profiling applications.

TVG may help to prevent the depth digitizer from falsely triggering on fish or other water column targets at the expense of slightly greater susceptibility to locking on the second echo from the bottom.

Note that TVG operates in addition to the **AGC** or **manual gain** settings which are applied independently to each channel, and which effectively define the starting gain for each channel at the instant of transmission.

5.10 Alarm Setup

This root-level menu item provides the user access to settings for the **alarm trigger**, **alarm depth** and **alarm sound** parameters. Pressing **MENU** takes the user to the first sub-menu, **Alarm Trigger**.

5.10.1 Alarm Trigger

Range:	bottom lost / too shallow
Increment:	N/A
Default:	bottom lost

This sub-menu allows the user to set an **alarm trigger** mechanism. For *bottom lost*, the alarm will sound any time the bottom tracking algorithm for either channel loses the bottom. *Too shallow* will cause the alarm to sound whenever the digitized depth on either channel is shallower than the set alarm depth. The **alarm depth** sub-menu item is accessible only if the **alarm trigger** parameter is set for *too shallow*.

5.10.2 Alarm Depth

Range:	0 - 100 [m] or [ft] or [fm]
Increment:	1
Default:	0

This sub-menu allows the user to set an **alarm depth** value. If either channel's depth below the surface is shallower than this depth, the alarm sounds, if **alarm sound** enabled.

5.10.3 Alarm Sound

Range:	none / front panel / slave panel / front & slave
Increment:	N/A
Default:	none

This sub-menu allows the user to enable the beeper to sound if an alarm condition occurs. If the user wishes to temporarily disable the alarm sound, any adjustment of the menu or select knobs will achieve this without modifying the desired enabled selection. The alarm function is rearmed automatically once the original alarm condition clears.

5.11 Printer Setup

This root level menu screen provides access to a number of options for print contrast, depth grid and text overlay control (graphic overlay control is managed in the next root level menu item). Repeatedly pressing the **MENU** knob will allow the user to access the various options until eventually the original screen reappears indicating all options have been accessed. It is safe to exit by rotating the **MENU** knob from inside any of the option screens.

5.11.1 Print Contrast

Range: auto: standard / auto: HF black / auto: w/depth / manual
Increment: N/A
Default: auto:standard

The printer displays data in 32 level grey scale format. The **print contrast** control allows the user to either let the echosounder software control the scaling of the data for display (automatic) or to select a fixed scale factor (manual). There are three **auto** selections and one **manual** selection.

When **print contrast** is set to one of the four **auto** selections, the echosounder software automatically scales the echogram according to the amplitude of the bottom echo for each ping to make the most effective use of the grey levels available. Using automatic print contrast typically ensures that the echo return is visible in the hardcopy record. In all of the **auto** modes, the square-law detected signal envelope (echogram) is scaled to normalize the amplitude level representing the bottom detection threshold, which is recalculated for each new ping based on the strength of the bottom echo for that ping (the value of the bottom detection threshold is set at 50% of the amplitude of the echogram peak which has been identified as the bottom echo). Each channel is scaled independently, based on its own echogram characteristics. The differences among the automatic contrast modes relate to how the amplitude-scaled echograms are mapped to the printer's 32 grey levels.

auto: standard This contrast mode uses the full 32-level greyscale range for both channels. The square-law detected signal envelope (echogram) is scaled such that full black corresponds to the amplitude level representing the bottom detection threshold. Each channel is scaled independently, and when the two echograms are overlayed in the **single graph** display mode, the darker echogram prevails.

auto: HF black This contrast mode also scales the echogram for each channel to the bottom detection threshold, but treats HF and LF differently to permit the two traces to be distinguished when the two channels are overlayed. Basically, the amplitude-scaled HF echogram is mapped to a darker sub-set of grey levels and the amplitude-scaled LF echogram is mapped to an equivalent lighter sub-set of grey levels. The grey level actually printed for each pixel is that of whichever channel's scaled echogram was greater. The easiest way to understand this contrast mode is to try it.

auto: w/depth This contrast mode scales each of the echograms to the bottom detection thresholds as above, but limits the maximum intensity to about three quarters of full black. A full-black overlay pixel is then added to the printed echogram at the digitized depth. This contrast mode can be very helpful in assessing the performance of the bottom detection software. The digitized depth overlay is applied to both frequencies unless the printer display is in **single graph** mode and both channels are transmitting; in this case, only the **primary channel** return has the depth overlay applied.

Special note regarding transmit blanking and auto print contrast. This comment applies to the special case where one of the **auto** print contrast modes has been selected, and where the **Tx blanking** printer setup parameter (Section 5.12.2) is **OFF**, and where the **transmit blanking** region as specified by the **HF** or **LF Tx Blank** parameters (Sections 5.7.2 and 5.8.2) extends into printed *window*, usually when the **phase** is one. In this special case, a fixed contrast factor is applied to the initial portion of the echogram, down to the point where **transmit blanking** ends. This is so that each channel's transmit pulse, as seen by that channel's receiver, is printed with a relatively consistent amplitude, subject only to the variations resulting from **AGC** (automatic gain control), if that function is enabled. The transmit pulse invariably saturates the analog input circuits, so **AGC** has little impact in any case.

manual When the manual **print contrast** is selected, the echosounder software uses a fixed scale factor on the echogram data, no matter what the return signal strengths. It is possible to set the scale too high or too low for meaningful hardcopy records, although the fixed scaling can be useful for basic comparative measurements of return signal strengths.

If the manual **print contrast** option has been selected, pressing **MENU** here takes the user to the **Manual Contrast** sub-menu, otherwise to the **Printer Display** sub-menu.

5.11.2 Manual Contrast

Range: 1 to 16
Increment: 1
Default: 8

From this sub-menu, the **manual contrast** scale factor can be adjusted until meaningful results are achieved on the hardcopy record. Each increment represents a factor of two in signal intensity.

5.11.3 Printer Display

Range: Single graph / dual graph
Increment: N/A
Default: Single graph

This menu allows the user to select the data display format on the hardcopy record. There is a single graph option which has the data from two channels superimposed and displayed in one large presentation of 1600 pixels. The dual graph option has the HF channel data displayed in the upper 800 pixels and the LF channel data displayed in the lower 800 pixels.

5.11.4 Grid Format

Range: off / coarse / fine
Increment: N/A
Default: fine

The **grid format** option allows the user to select how the grid on the printer should be displayed. For the single graph format, the coarse grid prints the major division markers and the half division markers; the fine grids prints the tenths division markers as well. For the dual graph format, the coarse grid prints the major division markers only; the fine grid prints the fifths division markers.

5.11.5 Text Font Size

Range: small/large
Increment: N/A
Default: small

Text font size sets the size of grid and annotation text characters overlaid on the hardcopy printout. Note: this control has no effect on the upper and lower banner annotation text. Due to space constraints, these lines are always printed in the small font.

5.12 Printer Overlays

This is a root menu item whose sole purpose is to provide a header for the sub-menus. Pressing **MENU** takes you to the first sub-menu, **Tracking Overlay**.

5.12.1 Tracking Overlay

Range: off / on
Increment: N/A
Default: off

This option allows the tracking gate to be displayed on the hardcopy record as a pair of lines framing the detected bottom. The distance between these lines is specified by the **tracking gate** parameter (Section 5.4). If the system is in Single Graph mode, only the gate overlay for the **primary channel** is displayed. If the system is in Dual Graph mode, the gate overlays for each channel are displayed.

5.12.2 Tx Blanking

Range: off / on
Increment: N/A
Default: off

This sub-menu item allows the user to blank out the transmit pulse portion of the signal echogram on the printed record. If the **Tx Blanking** mode is **ON**, a thin transmit line is printed, but all of the printed pixels between this transmit line and the **transmit blanking** depth are replaced with white. The **transmit blanking** depth in this context refers to the **LF Tx Blank** and **HF Tx Blank** parameters described in Sections 5.7.2 and 5.8.2. If the single graph printer display mode is in use, and both channels are on, the **transmit blanking** depth set for the **primary channel** is used.

If the **Tx Blanking** mode is **OFF** (ie, the transmit pulse is *not* blanked), the transmit portion of the printed echogram is printed at a *fixed* contrast level, even if an **auto** print contrast mode is in effect (see Section 5.11.1, **Print Contrast**).

5.12.3 Tx Blank Overlay

Range: off / on
Increment: N/A
Default: off

This option allows the **transmit blanking** value to be displayed on the hardcopy record as a thin solid line. If the single graph printer display mode is in use, and both channels are on, the **transmit blanking** depth set for the **primary channel** is used.

Pressing **MENU** will take the user to the next sub-menu, **Heave Line**, if a heave sensor has been selected (see Section 6), or back to the root level menu item, **Printer Overlays**.

5.12.4 Heave Line

Range: off / on
Increment: N/A
Default: off

This option allows the heave value received from the sensor to be displayed on the hardcopy record as a thin solid line located near the top of the record. The heave line overlay provides a quality indicator via the thickness of the line; a heave data value with a good quality flag is represented by a thin line, and a poor quality value is represented by a thickening of the line. The overlay appears only if a heave device driver has been selected and activated on a **COM** port.

5.12.5 Corrected Depth

Range: off / on
Increment: N/A
Default: off

This option allows the heave-corrected depth for a channel to be displayed on the hardcopy record as a thick line overlay located at the corrected depth position plus some user selected **offset** (Section 6.12.6). The grey scale record shows the uncorrected bottom (which in this context mean uncorrected for heave, but corrected for **draft**). The **corrected depth** overlay is corrected for both heave and **draft**. If the single graph printer display mode is in use, and both channels are on, the **corrected depth** overlay for the **primary channel** is used.

Pressing **MENU** here will take the user to the sub-menu, **Corrected Offset** if the overlay has been activated, or to the root level menu otherwise.

5.12.6 Corrected Offset

Range: -500.0 to + 500.0 [m] or [ft] or [fm](maximum limited by current range selection)
Increment: 0.1
Default: 0

This option allows the user to select the vertical **offset** (position) for the **corrected depth** overlay. The overlay is printed on the graph at the corrected depth plus the offset value.

5.13 Printer Tests

This root-level menu screen exists only to provides a header for its two sub-menus. Press **MENU** to access the first sub-menu, **Printer Test**.

5.13.1 Printer Test

Range: off / on
Increment: N/A
Default: off

The printer test allows several printer conditions to be examined. In addition to creating a test pattern on the hardcopy record, the following printer functions can be monitored with this routine:

- on/offline status,
- fault status,
- print head temperature.

When running the printer test, the dot matrix LCD screen displays:

```
PRINTER TEST
ON      XX.X C*
```

where XX.X indicates the current head temperature. Should a fault occur during this test, the dot matrix display will show

```
PRINTER TEST
ON    paper out*      or
      head open*      or
       head hot*      or
      head cold*      or
       off-line*
```

depending on the fault. All of these faults will prevent the printer from recording, although echosounding is still possible with the digital displays and the normal datalogging functions.

5.13.2 Greyscale Adjust

Range:	off / on / 0 to -2000
Increment:	1
Default:	off / -700

When this test is turned on, the user is provided access to a **greyscale contrast** adjustment parameter. A greyscale test pattern is printed to illustrate the effect of the changed values for this contrast adjustment. This adjustment should typically need to be done only after the printhead has been changed to account for any variation between printhead average resistances. Each unit will have had this parameter set prior to shipping so user adjustment is not required. The parameter is stored in non-volatile memory; thus if the NVM were reloaded with default values, this parameter may need to be reset back to an optimum value. Decreasing the adjustment value will reduce the greyscale intensity; increasing the value will increase the greyscale intensity.

5.14 Event Setup

This root level menu item is a header only.

5.14.1 Fix Number Reset

Range:	current=xxxxx / reset to one? / select number?
Increment:	N/A
Default:	current=xxxxx

This option displays the event mark number which will be associated with the very next event mark. Rotate **SELECT** one location to the right and a prompt will appear for resetting the event number back to one. Press **SELECT** to reset the event number, and the screen will re-display the event number now set back to one.

The next event to occur will be tagged as event number 1. If instead you wish to set the event number to a pre-define value other than one, rotate **SELECT** to the right to get to the "select number?" prompt. Press **SELECT** and a new prompt will appear for setting the number. Spin the **SELECT** knob until the event number equals the desired value. Press **SELECT** to set the event number to this pre-defined value. The next event to occur will tagged with this pre-defined number. The event mark number ranges from 00001 to 65535. Once the event number reaches 65535, it will reset to 00000 and continue incrementing from that value.

5.14.2 Auto Event Mark

Range: off / on
Increment: N/A
Default: off

This option allows the user to start/stop a timebase controlled event mark. The event marks occur at the time interval selected in the **Event Interval** menu.

5.14.3 Event Interval

Range: 2 seconds - 3600 seconds
Increment: 1 second for 2 to 60 seconds; 30 seconds for 60 to 3600 seconds
Default: 10 seconds

This option allows the user to set the time interval for the timebase controlled event mark. Pressing **SELECT** causes an immediate timer event mark from which subsequent event marks are referenced. This sub-menu item will only appear if **Auto Event Marks** are on.

5.14.4 Event Fix Format

Range: fix number / full annotate
Increment: N/A
Default: full annotate

This option allows the user to select the desired fix line text annotation on the hardcopy record. If the **fix number** option is selected, just the fix number and fix source prefix are annotated on the fix line. If the **full annotate** option is selected, the fix number, fix source prefix, depth for each frequency, speed of sound, and GPS position if available, are annotated on the fix line.

5.15 Parameter Print

This menu allows the user to initiate a parameter printout on the thermal recorder by simply pressing the **SELECT** knob. This parameter printout outputs all the current settings for user-selected parameters in a listing on the thermal printer.

5.16 Mark/Pause Mode

Range: printer pause / fix mark
Increment: N/A
Default: fix mark

This feature allows the user to define the usage mode for the front panel **MARK** switch. If the option is set at **fix mark**, any time the **MARK** button is pressed, an event mark is generated and handled as usual. If the option is set at **printer pause**, the **MARK** button can be used for turning the printing on and off allowing the paper speed switch to be left at the desired setting. In this mode, if the echosounder is printing and the **MARK** button is pressed, the echosounder stops printing and the printer is put OFFLINE, (the printer's green and red LEDs both on steady). When the **MARK** is pressed again, the printer goes back ONLINE (only the green LED on steady) and the echosounder starts printing again.

6 EXPANDED SECONDARY FUNCTION MENUS

The secondary functions described in this section are only available through the front panel menu if the software has been compiled with the **extended menus** compilation option. These functions are normally only required when the echosounder is installed at the beginning of a survey, and are seldom used on a day to day basis. They can conveniently be accessed from the survey computer through the echosounder's **COM 3** serial port using the Serial Configuration Utility **SerialUtility.exe**.

6.1 COM 1 SETUP

This is the root level menu item indicating that the sub-menus access the parameters for the **COM 1** port. Hitting **MENU** at this menu takes the user to first of the **COM 1** sub-menus.

6.1.1 COM 1: Device

Range: none / see Table 6-1
Increment: N/A
Default: none

This sub-menu controls the device driver mapped to the **COM 1** port. If a certain device type, such as a GPS receiver, is already selected for another port, another device of the type cannot be selected on the current port. Devices that are currently supported are listed in the following table.

Table 6-1. 320M's Peripheral Device Drivers

Menu Entry	Device Type	Interface Information
KEL: Remote	Remote Depth Display	KEL's In-house Remote Depth Display Unit
NMEA: $GPGLL	GPS Receiver	Any GPS receiver that can output the NMEA $GPGLL string
NMEA: $GPGGA	GPS Receiver	Any GPS receiver that can output the NMEA $GPGGA string
TSS: 33x	Heave Sensor	TSS Model Series 33x
TSS DMS: TSS1	Heave Sensor	Another TSS model
INNERSPACE 443	Velocity Profiler	Model 443 Velocity Profiler
SEATEX: MRU	Heave Sensor	MRU Model: When the port is first initialized, it sends a command to the MRU to configure the output to contain roll, pitch, heading, heave, time ticks. Only the heave field is used.
Generic #1	General Purpose Input 1	Any device that outputs an ASCII string (max. 127 chars) that can be looped through to the **COM 3** port (PC/datalogger interface port).
Generic #2	General Purpose Input 2	Any device that outputs an ASCII string (max. 127 chars) that can be looped through to the **COM 3** port (PC/ data logger interface port).
Generic #3	General Purpose Input 3	Any device that outputs an ASCII string (max. 127 chars) that can be looped through to the **COM 3** port (PC/ data logger interface port).

Device drivers for the additional GPS Receivers listed in Table 6-2 are available only with software which

has been compiled with the **extra GPS** compilation flag.

Table 6-2. 320M's Extra GPS Device Drivers

Menu Entry	Device Type	Interface Information
TRIMBLE: TANS	GPS Receiver	TANS Model: Single Precision LLA Position Fix Output
TRIMBLE: Path	GPS Receiver	Pathfinder Model: #GXGXP Output
TRIMBLE: 4000	GPS Receiver	4000SSE Model

6.1.2 COM 1: Baud

Range: 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 (/ 38400)
Increment: N/A
Default: 19200

This feature controls the communication speed of the **COM 1** port. Set to match that of external device.

6.1.3 COM 1: Parity

Range: none / odd / even
Increment: N/A
Default: none

This feature controls the parity for the **COM 1** port. Set to match that of external device.

6.1.4 COM 1: Format

Range: 8 data/1 stop / 7 data/2 stop
Increment: N/A
Default: 8 data/1 stop

This feature controls the data format for the **COM 1** port. Set to match that of external device.

6.1.5 COM 1: Loopthru

Range: on / off
Increment: N/A
Default: off

This sub-menu enables **loopthrough** of the data received on the **COM 1** port out through the **COM 3** port to the PC/Datalogger.

6.2 COM 2 Setup

This is the root level menu indicating that the sub-menus access the parameters for the **COM 2** port. Hitting **MENU** at this menu takes the user to first of the **COM 2** sub-menus.

6.2.1 COM 2: Device

Range: none / see Table 6-1
Increment: N/A
Default: none

This feature controls the device driver mapped to the **COM 2** port. If a certain device type, such as a GPS receiver, is already selected for another port, another device of the type cannot be selected on the current port. Devices that are currently supported are listed in Table 6-1.

6.2.2 COM 2: Baud

Range: 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 (/ 38400)
Increment: N/A
Default: 9600

This feature controls the communication speed of the **COM 2** port. Set to match that of external device.

6.2.3 COM 2: Parity

Range: none / odd / even
Increment: N/A
Default: none

This feature controls the parity for the **COM 2** port. Set to match that of external device.

6.2.4 COM 2: Format

Range: 8 data/1 stop / 7 data/2 stop
Increment: N/A
Default: 8 data/1 stop

This feature controls the data format for the **COM 2** port. Set to match that of external device.

6.2.5 COM 2: Loopthru

Range: on / off
Increment: N/A
Default: off

This sub-menu enables **loopthrough** of the data received on the **COM 2** port out through the **COM 3** port to the PC/Datalogger.

6.3 COM 3 Setup

This root level menu item is a header for the sub-menus which the parameters for the **COM 3** serial port, which is always used for communication with the survey computer or datalogger. Hitting **MENU** at this menu takes the user to first of the **COM 3** parameter screens.

6.3.1 COM 3: Baud

Range: 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200 (/ 38400)
Increment: N/A
Default: 19200

This feature controls the communication speed of the **COM 3** port. Before connecting a computer to the 320M, set the baud rate on the 320M to match that of the external computer.

6.3.2 COM 3: Parity

Range: none / odd / even
Increment: N/A
Default: none

This feature controls the parity for the **COM 3** port. Set to match that of the external computer.

6.3.3 COM 3: Format

Range: 8 data/1 stop / 7 data/2 stop
Increment: N/A
Default: 8 data/1 stop

This feature controls the data format for the **COM 3** port. Set to match that of the external computer.

6.4 Depth Logging

This root level menu item provides access to two depth logging sub-menus.

6.4.1 Output Format

Range: none / see following list
Increment: N/A
Default: PKEL: Hypack format

This feature allows the user to select the format most useful for depth logging purposes. The current selections available are as follows:

PKEL: a user-configurable format that can output any of the following: time-stamps, depths referenced to various offsets, heave, position, latency values, speed of sound, and a user-defined header. See Serial Computer Interfacing Manual, Section 4.5 for formatting information. The default format is the HYPACK compatible output (PKEL: 0804 0400).

ISAH: Knudsen: selects the depth format shown below. This format outputs the depth to surface uncorrected for heave offset for a dual channel system. (ie. LF and HF channels.)

$PKEL,007,hhmmss,LF,x.x,HF,x.x*hh<cr><lf>

where: hhmmss = 320B system's time
x.x = depth expressed in metres.

ISAH: Elac: selects the depth format that will interface with the Elac, STG 721C Depth Digitizer record format option on the ISAH package from Questor Tangent. This format outputs the depth to surface uncorrected for heave offset.

Low Frequency: AxxxxxxO<cr><lf>
High Frequency: ExxxxxxO<cr><lf>

where: xxxxxx = depth expressed in centimetres.

HYDRO: Echotrac: selects the Echotrac emulation string. This format outputs depth to surface corrected for heave.

HF Frequency only: fcceH xxxxx<CR>
LF Frequency only: fcceL yyyyy<CR>
Both Frequencies: fcceB xxxxx yyyyy <CR>

where: f = space if no event mark, F if event mark condition
cc = ET for [dm], et for [cm]
e = space if depth data okay, E if data bad
H,L,B = data indicators: H=HF, L=LF, B=both
xxxxx = HF channel depth,
yyyyy = LF channel depth

Note: The echosounder only emulates the Echotrac output string. It cannot accept the annotation commands normally sent to an Echotrac system.

Digitrace [dm]: selects the Digitrace emulation string for units that output the depth to decimetre resolution. This format outputs depth to surface corrected for heave.

HF Frequency only: fDTeH xxxxx<CR>
LF Frequency only: fDTeL xxxxx<CR>

where: f = space if no event mark, F if event mark condition
e = space if depth data okay, E if data bad
H,L = data indicators: H=HF, L=LF
xxxxx = depth

Note: The echosounder only emulates the Digitrace output string. It cannot accept the annotation commands normally sent to a Digitrace system.

Digitrace [cm]: selects the Digitrace emulation string for units that output the depth to centimetre resolution. This format outputs depth to surface corrected for heave.

HF Frequency only: fDTeH xxxxx<CR>
LF Frequency only: fDTeL xxxxx<CR>

where: f = space if no event mark, F if event mark condition
e = space if depth data okay, E if data bad
H,L = data indicators: H=HF, L=LF
xxxxx = depth

Note: The echosounder only emulates the Digitrace output string. It cannot accept the annotation commands normally sent to a Digitrace system.

Simrad:EA200:6: selects the Simrad EA200 - 6 byte format emulation string. This format outputs depth to

surface corrected for heave. Depth value expressed is HF depth value if HF channel is turned on (regardless if LF is on), LF depth value if LF channel only is on.

Dxxxxx

where: xxxxx = depth expressed in decimetres

Note: The echosounder only emulates the Simrad EA200 output string. It cannot accept the annotation commands normally sent to an Simrad system.

Simrad:EA200:7: selects the Simrad EA200 - 7 byte format emulation string. This format outputs depth to surface corrected for heave. Depth value expressed is HF depth value if HF channel is turned on (regardless if LF is on), LF depth value if LF channel only is on.

Dxxxx.x

where: xxxx.x = depth expressed in metres

Note: The echosounder only emulates the Simrad EA200 output string. It cannot accept the annotation commands normally sent to an Simrad system.

Deso 20: selects the Deso 20 emulation string. This format outputs depth to surface corrected for heave.

For this emulation mode, the depth log output format supported is as follows:

Both frequencies: DAXXXXX.XX mDBXXXXX.XX m<CR><LF>
High Frequency only: DBXXXXX.XX m<CR><LF>
Low Frequency only: DAXXXXX.XX m<CR><LF>

where: DB = high frequency channel identifier
DA = low frequency channel identifier
X = number 0 .. 9
m = metre units identifier.

The text annotation format supported is as follows:

TXxxxx....xxxx<CR><LF>

where TX = text identifier
x = ASCII character between 20h and 7Fh.

When this line is received by the sounder, the ASCII characters are stored in the event mark annotation buffer. If an invalid character or more than 50 characters are received, the entire data line received is discarded and the event mark annotation buffer is cleared.

EM3<CR><LF>

When this line is received by the echosounder, it creates an event mark with the current contents of the event mark annotation buffer.

NMEA:SDDBT(HF): selects the NMEA depth below transducer format string. This format outputs depth to transducer for the HF channel only, in either feet, metres, or fathoms in the appropriate field location dependent on the current working units.

$SDDBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>

NMEA SDDBT(LF): same format as NMEA:SDDBT(HF) except outputs LF channel data.

SER to BCD(HF): is a special compilation option that provides interface capability for the 320 echosounder to a specific external Serial-to-BCD converter. This format outputs depth to surface corrected for heave for the HF channel only.

<STX><POL><DATA><L/K><G/N><STATUS><CR><LF>

where: STX = 02h
POL = polarity = 02h for plus, 2Dh for minus
DATA = seven character with embedded decimal point, leading zeros suppressed as 02h
L/K = units: L(4Ch) for pounds, K(4Bh) for kilograms: arbitrarily set to K
G/N =Gross or Net mode: G(47h) or N(4Eh): arbitrarily set to G
STATUS = Space (02h??) for normal, M(4Dh) for motion, I(49h) for invalid data,
O(4Fh) for over/under range

SER to BCD(LF): same format as **SER to BCD(HF**) except outputs LF channel data.

Pressing **MENU** will take the user to the DEPTH LOG RATE sub-menu only if a depth logging format has actually been selected.

6.4.2 Depth Log Rate

This feature controls the output rate of the logged data to allow for data loggers unable to cope with the fast ping rates encountered at shallow ranges. The default setting for logged data output is at the ping rate.

There are six data rates provided:
one output every ping (default),
five output every second
three output every second,
two output every second,
one output every second,
one output every two seconds,
one output every five seconds,
one output every ten seconds.

6.5 Date/Time Setup

This root level menu item provides access to the sub-menus for setting the echosounder's time and date..

6.5.1 Set Time

This sub-menu screen provides access to the **hour** and **minute** parmeters, and allows the user to set the echosounder time. Note that the hour is recorded using a 24 hour format (no AM or PM). The clock is automatically maintained by the real-time clock's built-in battery and will continue to function whether the 320M is on or off. Note that the time displayed will not change with the system's clock while the screen is selected. This function permits the echosounder's internal clock to be set to the closest minute, or to the closest second if the user is willing to wait for the changing of the minute to press the **SELECT** knob (the "seconds" count is set to zero whenever the time is changed). If a higher degree of time synchronization is required between the echosounder and the survey computer, the Windows Serial Configuration Utility, **SerialUtility.exe**, may be used to set the echosounder time to PC time to a hundredth of a second. See the Serial Configuration Utility Software Manual. The 320M maintains time internally to milliseconds.

The date and time should be set whenever the real-time clock is replaced. NOTE: A special clock initialization and start-up command must be run when a new clock is installed. Currently, this command is only accessible through the PC serial debug port.

6.5.1.1 Hour

Range:	0 - 23 hrs.
Increment:	1
Default:	N/A

6.5.1.2 Minute

Range:	0 - 59
Increment:	1
Default:	N/A

6.5.2 Set Date

This sub-menu screen provides access to the echosounder **date.** The sounder's calendar is automatically maintained by the real-time clock's built-in battery and will continue to function whether the 320M is on or off. It also has automatic leap year correction. Note that the date displayed will not change with the system's clock while the screen is selected.

The date and time should be set whenever the real-time clock is replaced. NOTE: A special clock initialization and start-up command must be run when a new clock is installed. Currently, this command is only accessible through the PC serial debug port.

6.5.2.1 Day

Range: 1 - 31 (max. limit depends on month)
Increment: 1
Default: N/A

6.5.2.2 Month

Range: JAN - DEC
Increment: 1 month
Default: N/A

6.5.2.3 Year

Range: 1996 - 2096
Increment: 1
Default: N/A

6.5.3 Date Format

Range: day-month-year / Julian (Jxxx)
Increment: N/A
Default: day-month-year

This sub-menu item allows the user to select the format for the date display format on the hardcopy recorder and in the serial output strings; **day-month-year** (ie. 12 SEP 1994) or **Julian** (ie. J255 1993).

6.6 Working Units

Range: meters / feet / fathoms
Increment: N/A
Default: meters

This feature allows the user to select the desired units of metres, feet or fathoms. When these units are switched, the echosounder recomputes the speed of sound and draft into the appropriate new units.

320 SERIES ECHOSOUNDER

SERIAL CONFIGURATION UTILITY SOFTWARE MANUAL

Supports Software: SerialUtility.exe: D40-02347 V2.00

D10 - 02194
Revision 3.0
November 4, 1999

KNUDSEN
ENGINEERING LIMITED

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CONTENTS

1 INTRODUCTION

1.1 About this manual

This manual provides information about the Windows-based Serial Configuration Utility program, Part #: D40-02347, SerialUtility.exe. This program is designed to communicate with the 320 Series Echosounder to configure mission-specific parameters. This program is essential for users of the 320M series of echosounders since there is no other means of setting some of these parameters.

1.2 Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

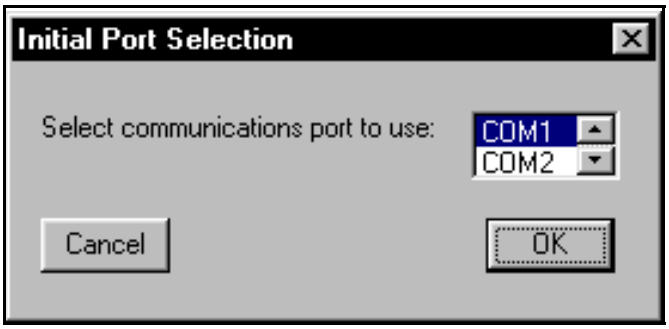
2 OPERATING INSTRUCTIONS

2.1 Overview

The Serial Configuration Utility, SerialUtility.exe, is a specialized Windows communications program designed to link a PC to a 320 series echosounder via the sounder's COM 3 monitor port. The program sends the appropriate control string to the sounder to perform a selected action from the user. (See D10-02390 Serial Computer Interfacing Manual for detailed descriptions of these control strings.)

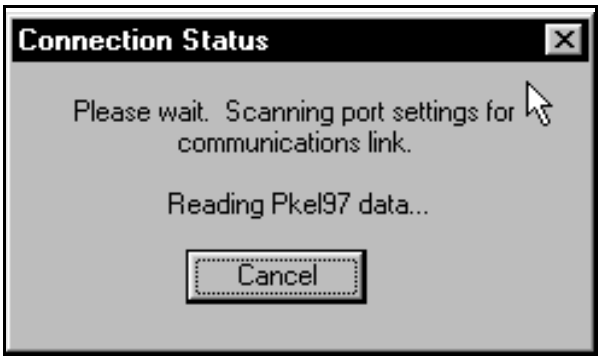
2.2 Description

When the program is invoked, it brings up a dialogue box requesting from the user the PC port to be used to establish the communications link.

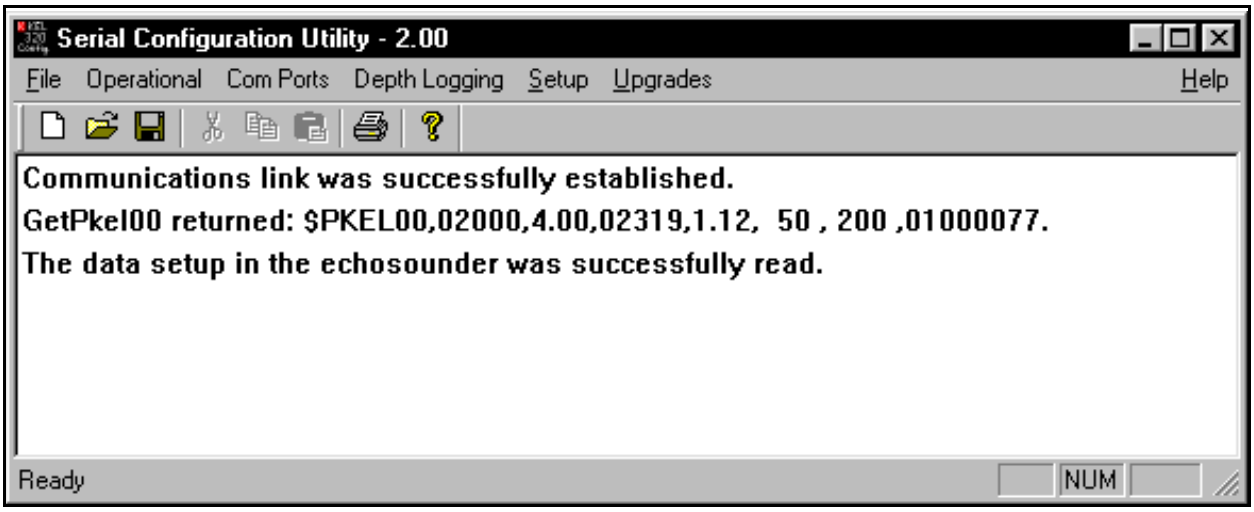


Once the user selects and accepts a particular port, the program confirms that it can initialize the PC port. If port initialization fails, the user will be informed of the failure and the detected fault. Most commonly, the port initialization fails because some other program/device is already using the port.

If PC port initialization passes, the program starts to scan for the actual port configuration settings on the echosounder. It starts with the last configuration stored in the program's main INI file, assuming that the last settings should still be correct. If these settings are no longer correct (PC is now connected to a different sounder perhaps), the program starts to scan all possible combinations of settings supported by the echosounder, starting at the highest baud rate first.



When a working combination of port settings is detected (which may take a while to find), the program then sends data requests to the sounder to determine the current parameter configuration in the sounder. As part of the data request the program runs a verification of the firmware version in the sounder; if the firmware version number is below a certain number, this program cannot interface completely with the echosounder and will inform the user of such a condition.



Once the data configuration has been read, a window pops up with seven control groups on the main menu, and a blank display area used for communications feedback messages.

2.3 File

Echosounder parameter configuration settings can be saved to and loaded from special INI files. The menu items in this group allow access to the saving and loading functions.

2.3.1 Load

When this menu item is selected, the program provides the user with a dialogue box to select the INI file to open. Once a file has been selected and accepted, the program reads the parameter settings and attempts to load them into the echosounder. It reports if an error has occurred during the loading of the echosounder.

2.3.2 Save

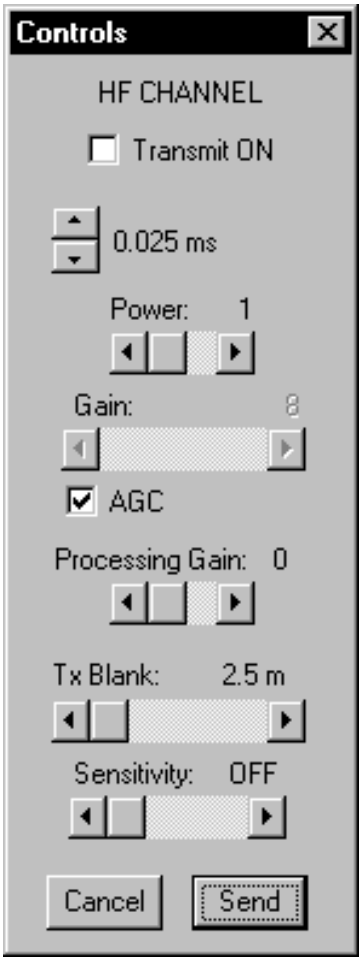
When this menu item is selected, the program provides a dialogue box for the user to select an INI file name to use for saving the data. Once a filename has been entered and accepted, the program takes the current data parameter settings loaded into the PC program, and writes them to the desired file.

2.3.3 Exit

The user can terminate the application using the **Exit** command. The current port configuration settings are saved in the main program INI file and used as a starting reference the next time the application is invoked.

2.4 Operational

2.4.1 HF Controls



The **Transmit On** check box is used to start/stop the HF channel's transmit, receive and datalogging actions.

The next control in the box is the **Pulse Type** parameter. This parameter allows the user a small amount of control over the pulse length used by the transmitter. The echosounder will override the user's selection if the **Range/Phase** selection cannot support it. By specifying the pulse length , the user directly specifies the bandwidth of the digital noise rejection filter applied to the incoming acoustic signal data. The filter bandwidth is usually set to the inverse of the pulse length. Normally, long pulses with narrow bandwidth filters provide better noise rejection in deeper water or noisy conditions, while the short pulses with wide

bandwidth filters provide better resolution when conditions permit or the water is shallow.

The **Power** parameter adjusts the amplitude of the pulse being transmitted by controlling the duty cycle of the switchmode transmitter output stage. Although high power signals will always give the strongest echoes, they also produce more reverberation, which may obscure the bottom echo in shallow water. Using high receive gain in combination with high transmit power in shallow water may cause signal levels high enough to saturate (overload) the receiver, which will mask any echoes. This control is disabled if the **Transmit On** check box is de-selected.

The **Gain** parameter is designed to adjust the sensitivity of the analog receiver. Reducing the analog gain is useful when sounding in extremely shallow water. This reduces the overall noise while not seriously affecting the echo strength. Increasing the analog gain is useful when sounding in very deep water.

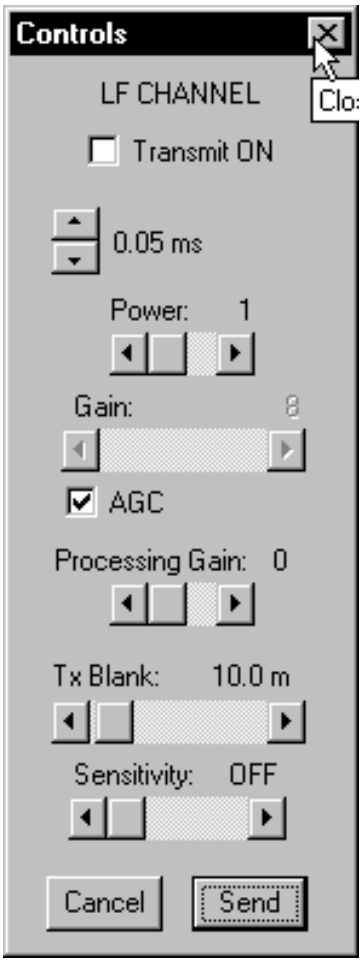
The **AGC** check box invokes automatic gain control. **AGC** is active when there is a check mark in the check box. Under most circumstances, the system should be left in **AGC** mode and the sounder will make the necessary gain changes required for proper data acquisition and presentation.

The **Processing Gain** parameter provides for additional gain in the digital signal processing software which can be used with very low level signals. It is mainly used for the very low frequency sub-bottom profiling systems (under 10 kHz) where very low amplitude echoes from sub-bottom layers are of interest. The default processing gain value is zero and this should be suitable for almost all conditions. Each level above 0 is effectively a 1-bit left shift in the processed digital data (a 1-bit left shift is equivalent to multiplying the data by a factor of 2).

The **Tx Blank** value is the distance, measured from the face of the HF transducer, to the point in the water column at which the bottom detection software begins to look for the bottom. Transmit blanking must be set large enough that transducer ringing following the tail end of the transmit pulse is not falsely interpreted as the echo from a very shallow bottom, but small enough not to unduly limit the minimum depth capability of the echosounder. The optimum value depends on the expected depth conditions, the pulse length, the transmit power level and the signal frequency. It is best determined by experimentation. Note that transmit blanking has effect only when it extends into the *window*, typically when **PHASE** is 1.

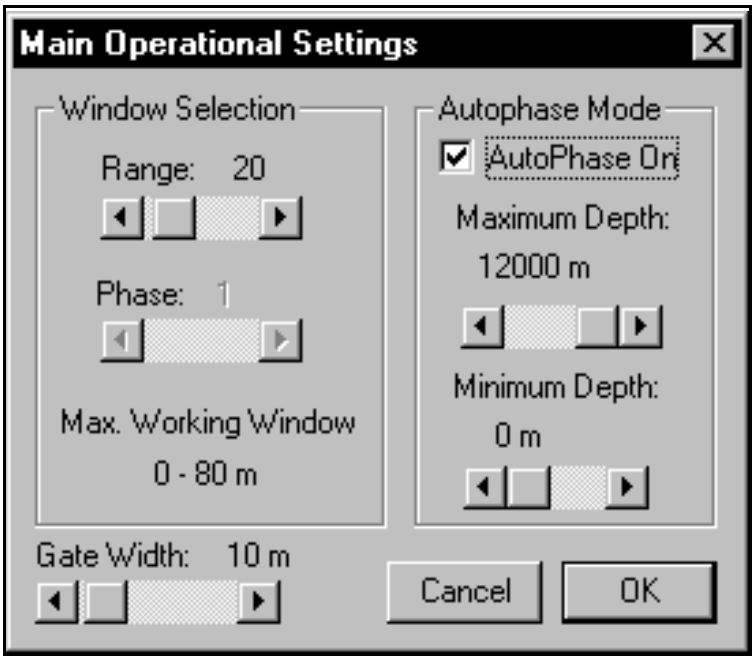
The **Sensitivity** parameter is useful in areas where soft sediments overlay harder materials, and where buried layers may often produce stronger echoes than the real bottom. If **Sensitivity** is **OFF** (the default condition), the bottom detection software will always select the strongest echo in the *window*. With layered bottoms, the strongest echo is not necessarily the shallowest echo. Increasing the **Sensitivity** causes the bottom detection software to accept a weaker but shallower echo. The higher the **Sensitivity**, the weaker the echo, relative to the strongest echo in the *window*, that will be selected. On the other hand, if the **Sensitivity** is too high, the bottom detection software will often trigger on noise or small items in the water column.

2.4.2 LF Controls



The channel controls for the LF channel are identical in performance to the controls for the HF channel.

2.4.3 Main Settings



Window Selection controls:

The **Range** parameter selects the size of the active window in the water column. The active window is the only part of the water column in which the echosounder operates. It is the portion of the water column which is printed on the hard copy recorder, and in which the bottom detection software looks for the bottom echo. The bottom *must* be in the selected *window* for the echosounder to function. Nine ranges are available: 10, 20, 50, 100, 200, 500, 1000, 2000, and 5000 in metres, feet, or fathoms dependent on working units. The **Max. Working Window** description displays the actual limits corresponding to the current combination of the **Range** and **Phase** selections as well as Minimum Depth and Maximum Depth in autophase search mode.

The **Phase** parameter selects the depth, or location in the water column, of the active window. The effect of the **Phase** switch depends on the current range setting. The standard software compilation provides a 50% overlap between **Phase** settings. A software compilation option is available for a smaller 20% overlap between phases, but this is only recommended for the special case where a very small window is autophased in an area with extended steep slopes.

AutoPhase Mode controls:

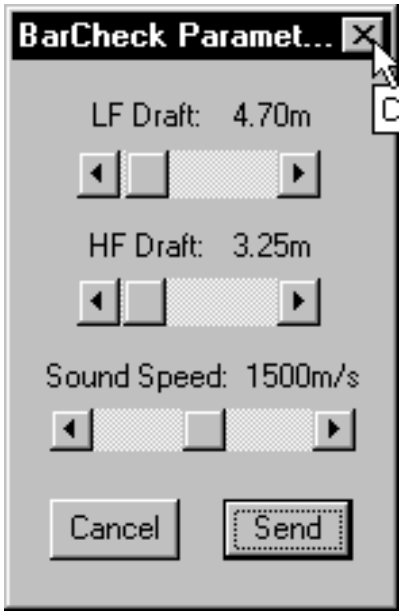
The **AutoPhase On** check box function is used to select or de-select autophase mode. In autophase mode, the echosounder adjusts the phase setting automatically in response to information provided by the primary channel bottom tracking algorithm. The autophasing software adjusts the phase setting automatically to maintain the bottom in the active window, provided the bottom is not deeper than the maximum depth available for the given **Range** selection. The **Max. Working Window** description displays the maximum

limits supported by the current **Range** selection in Autophase Mode.

The **Minimum Depth** and **Maximum Depth** parameters define the search *window* for bottom acquisition during auto phasing. When **AUTO PHASE** is first invoked, or when the bottom tracking algorithm for the **primary channel** loses bottom lock, the auto phasing software opens up the *window* to the full extent of the water column from **autophase minimum search depth** to **autophase maximum search depth** until it finds the bottom. These parameters only have effect during the bottom search phase. They do not limit the auto phasing process once the **primary channel** bottom tracking software has located the bottom.

Gate Width is used by the bottom tracking algorithm to determine the validity of the current depth value. It is a depth variability tolerance value, defined as a distance above or below the bottom depth trend established by the current and several previous samples. If the most recent depth value fits this established trend to within the range defined by the **tracking gate**, it is considered valid and is displayed on the four-digit LCD. If a depth return falls outside of this range, it is deemed invalid and "----" is displayed on the LCD.

2.4.4 BarCheck Parameters



The BarCheck dialogue box provides access to the **Draft** and **Sound Speed** parameters. These parameters are usually adjusted during a bar check.

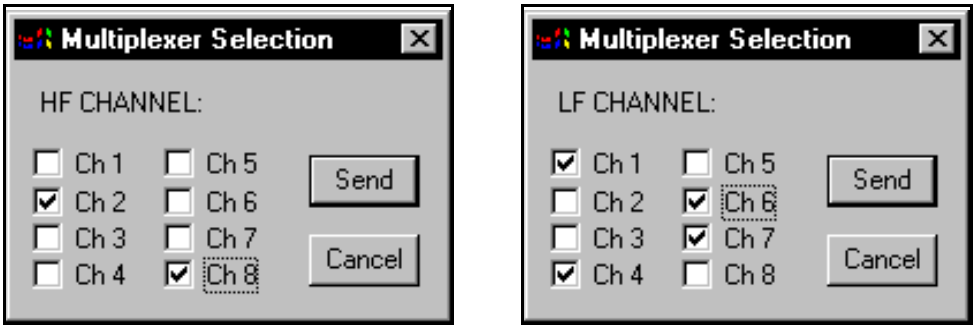
2.4.4.1 Draft

Draft indicates the vertical distance from the surface of the water to the active face of the transducer. Its main use is to ensure that the echosounder's output is corrected for transducer depth. The draft can be set independently for the low frequency and high frequency channels.

2.4.4.2 Sound Velocity

This feature allows the adjustment of the velocity of sound value used by the echosounder for all depth calculations. The user adjusts this value in the course of a bar check, or enters the average expected velocity of sound over the water column of interest, obtained from a sound speed sensor.

2.4.5 Multiplexers: HF/LF



The **Multiplexer** controls are only needed for echosounder systems using the KEL 8:1 Multiplexer box. The Multiplexer allows for more than one transducer channel to be connected to a single echosounder transmitter output. The Multiplexer Selection dialogue box lets the user select which channels of the Multiplexer are to be used. A special compilation code read from the echosounder when this application initializes, indicates if the sounder is configured to use any multiplexer boxes; this application will enable only those control options supported by the sounder.

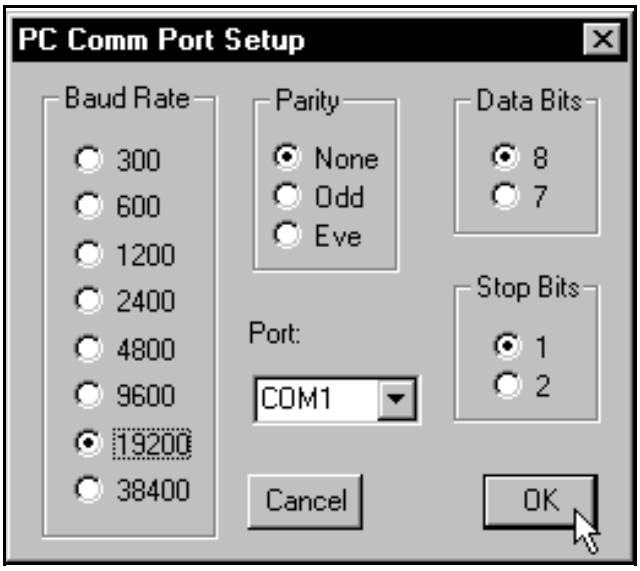
2.4.6 Rescan Sounder Setup

This option can be used to re-read the current settings of all the control parameters in the echosounder.

2.5 Com Ports

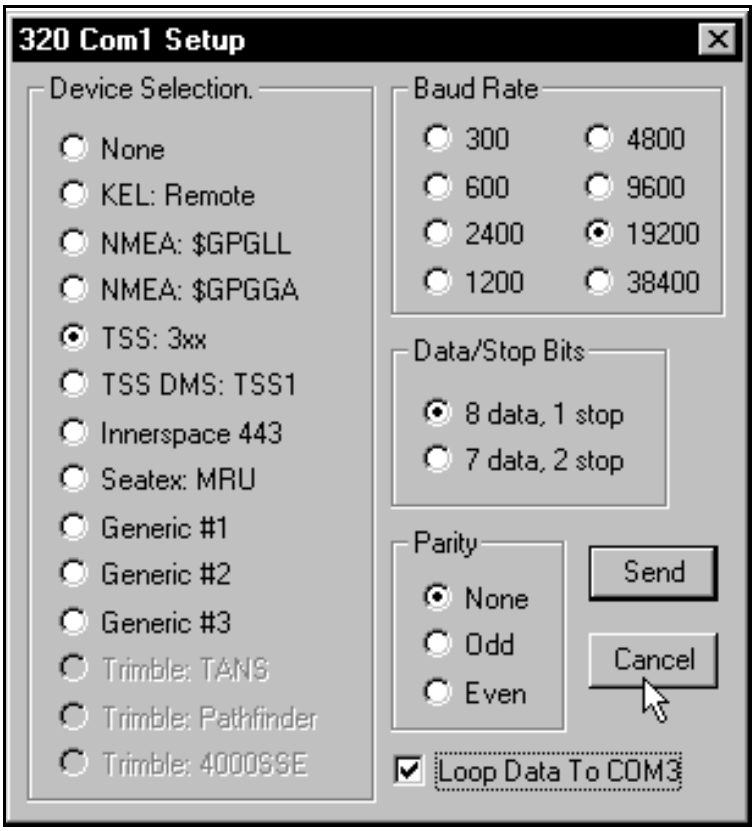
There is one very important connection detail that must be understood to ensure the configuration application works correctly. The PC com port must be configured to match the *current* settings for the echosounder's COM3 port.

2.5.1 PC Port



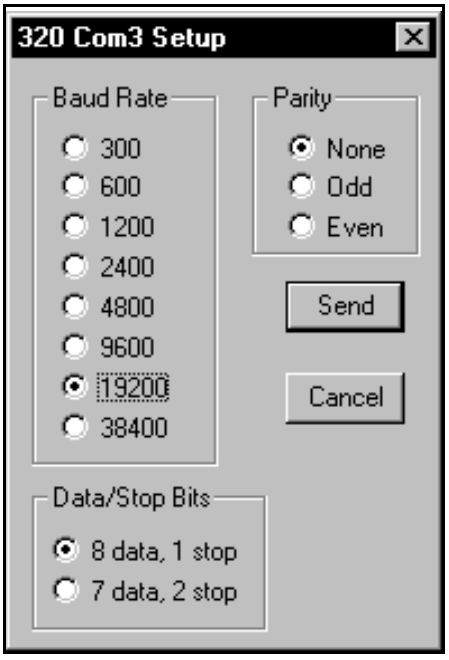
The **PC Port** option pops up a dialogue box that allows the user to select the desired com port to use on the host PC and the communications settings to be used by the selected port. The PC port's communication settings must match those on the echosounder's Com3 port. The echosounder is shipped with the settings at the following defaults: 19200 baud, no parity, 8 data bits, 1 stop bit. Clicking on **OK** accepts the current PC port settings, and the program will initialize the port to the selected settings. Pressing **ESC** or clicking on **CANCEL** eliminates the changes, and restores the original settings.

2.5.2 320 Ports: Com 1/ Com 2/ Com 3/ Com 4



For the menu options for the 320's Com Ports 1, 2, and 4, a dialogue box like the one illustrated above is activated. These three ports can be configured to accept input from external devices. Simply select the desired device driver, and then setup the baud rate, parity, and data/stop bits settings to match those required by the external device. Com Port 4 option will be inactive (greyed out) if the echosounder firmware configuration flags indicate that a front panel is supported (320Ms typically).

If the **Loop Data to COM3** box is check and the selected peripheral device outputs printable ASCII strings, the echosounder will echo these strings upon receipt out Com3 to any attached survey computer/datalogger.



The Com 3 on the echosounder is a special com port. It cannot be connected to other external devices like the other three ports. It is used for data logging to survey computers, and for remote control from a host PC; thus the only settings to be adjusted on this port are the actual communication settings of baud rate, parity, and data/stop bits. When these com settings are modified and accepted, the application automatically attempts to modify the PC port configuration to match the sounder port settings, and tests for successful reconnection.

2.6 Depth Logging

This menu provides access to the echosounder's depth log format options and the data logging rate controls.

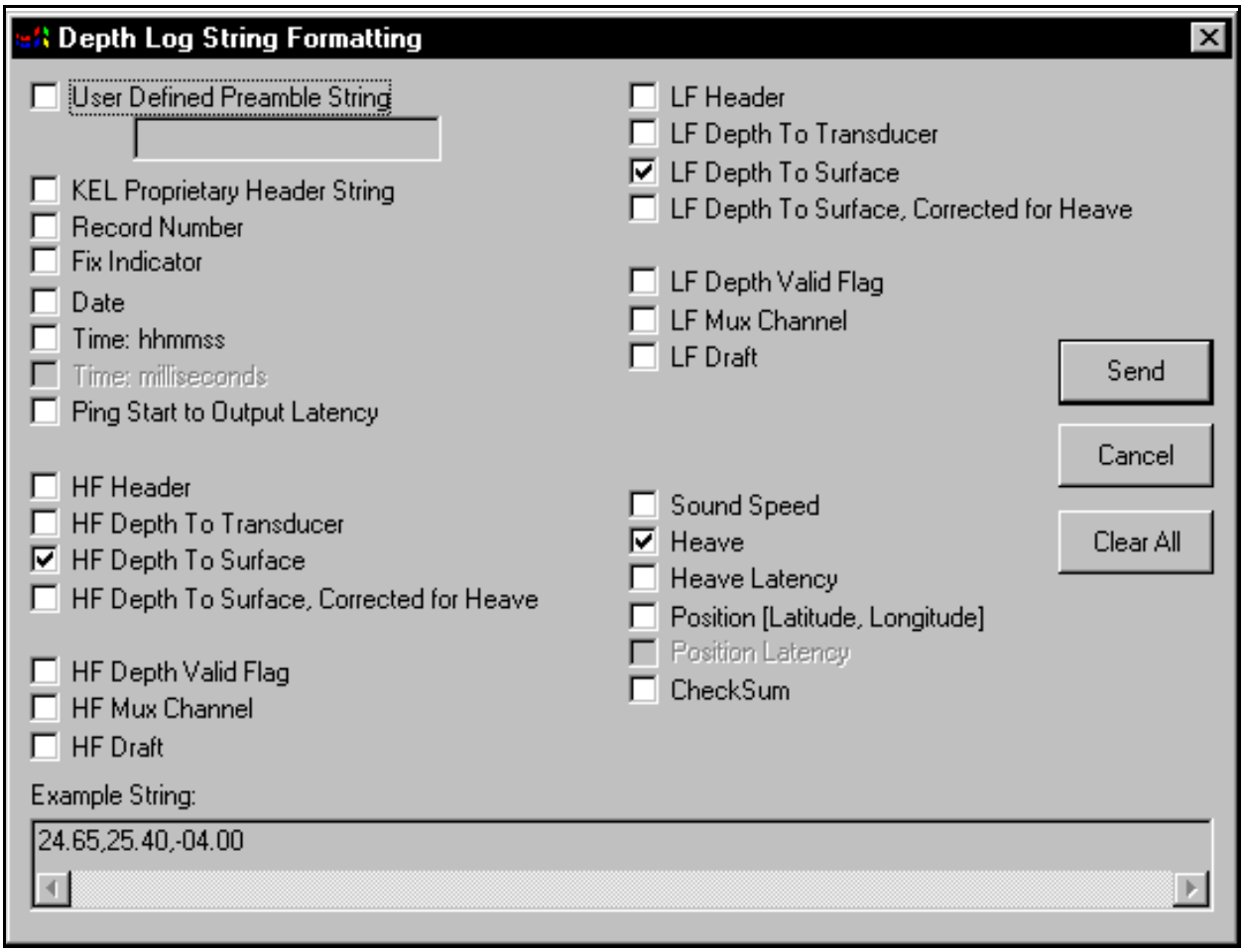
2.6.1 Formats

The echosounder is capable of outputting different types of depth log strings to fit individual customer needs, or to not output any data at all, if desired. To select a depth format simply click on the appropriate menu item; a check mark indicates which a format is selected. Note: only one format can be selected at any given time.

2.6.1.1 None

This option simply turns off the depth logging on the echosounder.

2.6.1.2 Configurable



The **Configurable** option pops up a dialogue box that allows the user to customize the depth logging string with certain limitations. The fields can only appear in the order listed (ie header string, HF depth, LF depth, checksum) separated only by commas (except hhmmss and milliseconds), and terminated only at the very end by <CR>< LF>.

As various fields are selected or deselected, the **Example String** at the bottom of the dialogue box changes to illustrated the expected output format.

Some fields can only be selected if other fields are also selected and will be inactive (greyed out) if the required field is not selected. For example: the Position Latency field is an active option only if the Position field is selected.

2.6.1.3 ISAH: Knudsen

The **ISAH: Knudsen** option selects the depth format shown below. This format outputs the depth to surface uncorrected for heave offset for a dual channel system. (ie. LF and HF channels.)

$PKEL,007,hhmmss,LF,x.x,HF,x.x*hh<cr><lf>

where: hhmmss = 320B system's time
x.x = depth expressed in meters.

2.6.1.4 ISAH: Elac

The **ISAH: Elac** option selects the depth format that will interface with the Elac, STG 721C Depth Digitizer record format option on the ISAH package from Questor Tangent. This format outputs the depth to surface uncorrected for heave offset.

Low Frequency: AxxxxxxO<cr><lf>
High Frequency: ExxxxxxO<cr><lf>

where: xxxxxx = depth expressed in centimetres.

2.6.1.5 Echotrac

The **Echotrac** option selects the Echotrac emulation string. This format outputs depth to surface corrected for heave.

HF Frequency only: fcceH xxxxx<CR>
LF Frequency only: fcceL yyyyy<CR>
Both Frequencies: fcceB xxxxx yyyyy <CR>

where: f = space if no event mark, F if event mark condition
cc = ET for [dm], et for [cm]
e = space if depth data okay, E if data bad
H,L,B = data indicators: H=HF, L=LF, B=both
xxxxx = HF channel depth,
yyyyy = LF channel depth

Note: The echosounder only emulates the Echotrac output string. It cannot accept the annotation commands normally sent to an Echotrac system.

2.6.1.6 Digitrace [dm]

The **Digitrace [dm]** option selects the Digitrace emulation string for units that output the depth to decimeter resolution. This format outputs depth to surface corrected for heave.

HF Frequency only: fDTeH xxxxx<CR>
LF Frequency only: fDTeL xxxxx<CR>

where: f = space if no event mark, F if event mark condition
e = space if depth data okay, E if data bad
H,L = data indicators: H=HF, L=LF
xxxxx = depth

Note: The echosounder only emulates the Digitrace output string. It cannot accept the annotation commands normally sent to a Digitrace system.

2.6.1.7 Digitrace [cm]

The **Digitrace [cm]** option selects the Digitrace emulation string for units that output the depth to centimetre resolution. This format outputs depth to surface corrected for heave.

HF Frequency only: fDTeH xxxxx<CR>
LF Frequency only: fDTeL xxxxx<CR>

where: f = space if no event mark, F if event mark condition
e = space if depth data okay, E if data bad
H,L = data indicators: H=HF, L=LF
xxxxx = depth

Note: The echosounder only emulates the Digitrace output string. It cannot accept the annotation commands normally sent to a Digitrace system.

2.6.1.8 Simrad EA200 (6 byte)

The **Simrad EA200 (6 byte)** option selects the Simrad EA200 - 6 byte format emulation string. This format outputs depth to surface corrected for heave. Depth value expressed is HF depth value if HF channel is turned on (regardless if LF is on), LF depth value if LF channel only is on.

Dxxxxx

where: xxxxx = depth expressed in decimeters

Note: The echosounder only emulates the Simrad EA200 output string. It cannot accept the annotation commands normally sent to an Simrad system.

2.6.1.9 Simrad EA200 (7 byte)

The **Simrad EA200 (7 byte)** option selects the Simrad EA200 - 7 byte format emulation string. This format outputs depth to surface corrected for heave. Depth value expressed is HF depth value if HF channel is turned on (regardless if LF is on), LF depth value if LF channel only is on.

Dxxxx.x

where: xxxx.x = depth expressed in metres

Note: The echosounder only emulates the Simrad EA200 output string. It cannot accept the annotation commands normally sent to an Simrad system.

2.6.1.10 Deso 20

For this emulation mode, the depth log output format supported is as follows:

Both frequencies: DAXXXXX.XX mDBXXXXX.XX m<CR><LF>
High Frequency only: DBXXXXX.XX m<CR><LF>
Low Frequency only: DAXXXXX.XX m<CR><LF>

where: DB = high frequency channel identifier
DA = low frequency channel identifier
X = number 0 .. 9
m = meter units identifier.

The text annotation format supported is as follows:

TXxxxx....xxxx<CR><LF>

where TX = text identifier
x = ASCII character between 20h and 7Fh.

When this line is received by the sounder, the ASCII characters are stored in the event mark annotation buffer. If an invalid character or more than 50 characters are received, the entire data line received is discarded and the event mark annotation buffer is cleared.

EM3<CR><LF>

When this line is received by the echosounder, it creates an event mark with the current contents of the event mark annotation buffer.

2.6.1.11 NMEA: SDDBT (HF)

The **NMEA:SDDBT** option selects the NMEA depth below transducer format string. This format outputs depth to transducer for the HF channel only, in either feet, metres, or fathoms in the appropriate field location dependent on the current working units.

$SDDBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>

2.6.1.12 NMEA: SDDBT (LF)

This is the same format as NMEA: SDDBT (HF) except it outputs LF channel data.

2.6.1.13 Serial to BCD (HF)

The **NMEA:SDDBT** option is a special compilation option that provides interface capability for the 320 echosounder to a specific external Serial-to-BCD converter. This format outputs depth to surface corrected for heave for the Hf channel only.

<STX><POL><DATA><L/K><G/N><STATUS><CR><LF>

where: STX = 02h
POL = polarity = 02h for plus, 2Dh for minus
DATA = seven character with embedded decimal point, leading zeros suppressed as 02h
L/K = units: L(4Ch) for pounds, K(4Bh) for kilograms: arbitrarily set to K
G/N =Gross or Net mode: G(47h) or N(4Eh): arbitrarily set to G
STATUS = Space (02h??) for normal, M(4Dh) for motion, I(49h) for invalid data,
O(4Fh) for over/under range

2.6.1.14 Serial to BCD (LF)

This is the same format as **Serial to BCD (HF**) except it outputs LF channel data.

2.6.2 Logging Rate

The Logging Rate option allows the user to control the output rate of the depth logging string to allow for data loggers unable to cope with the fast ping rates encountered at shallow ranges. There are eight selections available as sub-menu items, with the active selection indicated by a check mark.

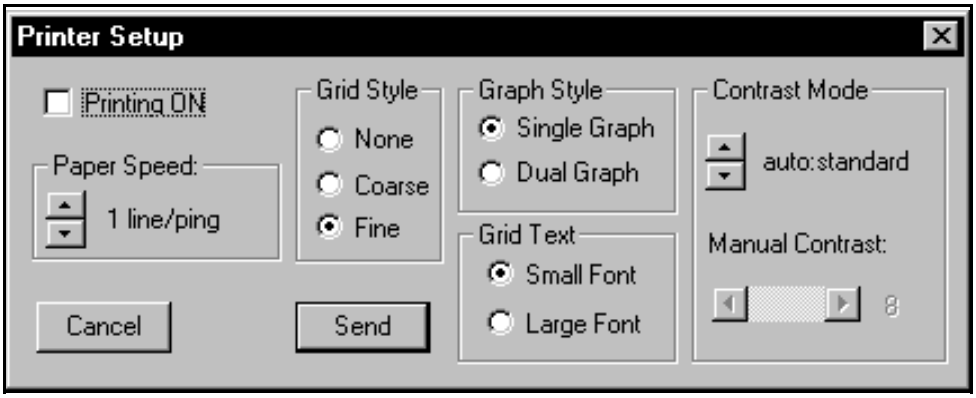
2.7 Setup

This group of menu items allows access to many unrelated parameter controls, most modified only once per survey session.

2.7.1 Printer Setup

This menu item brings up a dialogue box that allows access to 320M printer control parameters. This option is not active (greyed out) if the echosounder firmware configuration flags indicate printer code is not included (for 320B systems)

2.7.1.1 Basic



The **Printing ON** check box is used to start/stop the hardcopy recording on the 320M's thermal printer. If this box is de-selected, all the other printer controls are disabled (greyed out).

The **Paper Speed** control is used to select the desired printing rate; the available options are 1 line/ping, or 8, 16, 32, 128, 215, and 315mm/min.

The **Grid Style** controls allow the user to adjust the grid presentation on the hardcopy recorder. For the single graph format, the coarse grid prints the major division markers and the half division markers; the fine grid prints the tenths division markers as well. For the dual graph format, the coarse grid prints the major division markers only; the fine grid prints the fifths division markers as well. For both modes, the None option simply prints the outside borders.

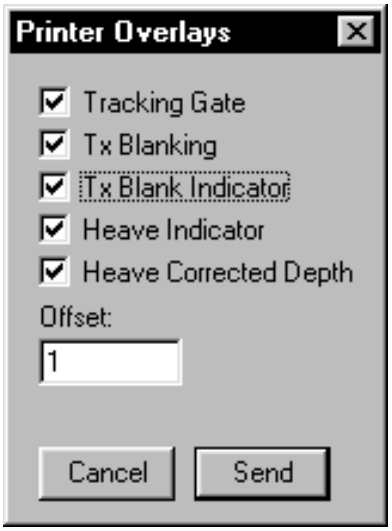
The **Graph Style** controls are used to select the presentation mode for the channel displays. In Single Graph mode, the data for the two channels is "or'ed" together and displayed in one large presentation of 1600 pixels. In the Dual Graph mode, the HF channel data is displayed in the upper 800 pixels and the LF channel data is displayed in the lower 800 pixels.

The **Grid Text** option sets the size of the grid and annotation text characters overlaid on the hardcopy printout. Note: this control has no effect on the upper and lower banner annotation text. Due to space constraints, these lines are always printed in the small font.

The 320M's printer displays data in 32 level greyscale format. The **Contrast Mode** control allows the user to let the system control the scaling of the data for display (auto modes: standard, HF black, black & white, or with depth), or to select a fixed scale factor (manual). When automatic print contrast is on, the system uses the signal returns to determine the best scaling factor to make the most effective use of the greyscale format.

When the manual print contrast mode is selected, the system uses a fixed scale factor on the data, regardless of the return strengths. It is possible to set the scale too high or too low for meaningful hardcopy records, although the fixed scaling can be useful for basic comparative measurements of return signal strengths. When the manual contrast mode is selected, the control for the **Manual Contrast** level control is enabled.

2.7.1.2 Overlays



The **Overlay** controls allow the user to select one or more of the following parameter overlay traces on the hardcopy record.

When **Tracking Gate** is selected (checked), the tracking gate is displayed on the hardcopy record as a pair of solid lines framing the detected bottom. If the system is in Single Graph mode, only the gate overlay for the primary channel is displayed, unless the channel is inactive; then the system will display the overlay for the other channel. If the system is in Dual Graph mode, the gate overlays for each channel are displayed.

When the **Tx Blanking** option is selected the chart record is blanked (set white) up to the Tx Blanking value, if it is visible in the current window. If the system is in Single Graph mode, only the blanking for the primary channel is applied, unless the channel is inactive; then the system will apply the blanking for the other channel. If the system is in Dual Graph mode, the blanking for each channel is applied.

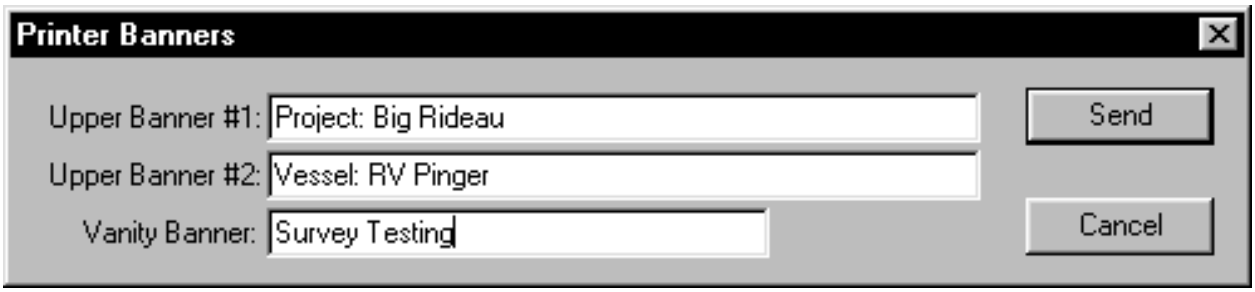
The **Tx Blank Indicator** option allows the Tx Blanking values to be displayed on the hardcopy record as a thin solid line. If the system is in Single Graph mode, only the Tx Blanking overlay for the primary channel is displayed, unless the channel is inactive; then the system will display the overlay for the other channel. If the system is in Dual Graph mode, the overlays for each channel are displayed.

When **Heave** is selected, the heave value received from the sensor is displayed on the hardcopy record as a thin solid line located near the top of the record. The heave line overlay provides a quality indicator via the thickness of the line; a heave data value with a good quality flag is represented by a thin line, and a poor quality value is represented by a thickening of the line.

The **Heave Corrected Depth** option allows the heave-corrected depth for a channel to be displayed on the hardcopy record as a thick line overlay located at the corrected depth position plus some user selected offset. The greyscale record is the uncorrected bottom, (uncorrected in terms of heave, but corrected in terms of draft). The corrected depth overlay is corrected in terms of heave as well as draft. The option for both overlays is accessed only if the printer display selection is set for two graphs.

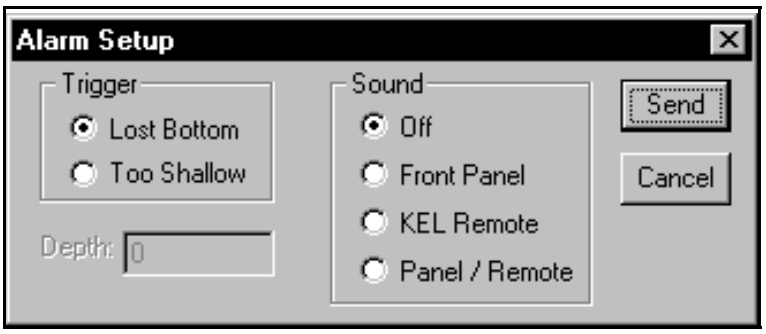
If the **Corrected Depth** option is selected, the **Offset** parameter edit box is made active. This parameter allows the user to select the vertical offset (position) for the corrected depth overlay. The overlay is printed on the graph at the corrected depth plus the offset value. (ie., If the corrected depth = 5m and the offset = -2 m, the overlay will be printed at 3m.)

2.7.1.3 Banners



On the 320M, there are three user-configurable banners on the hardcopy record; two full lines (72 characters) at the very top of the record above the grid (the Upper Banner), and 32 characters inserted in the second line at the very bottom of the record (the Vanity Banner). The banner edit boxes allow the user to set the various text strings to any desired value. The Vanity Banner is preserved in the echosounder's non-volatile memory upon power down, but the Upper Banner lines 1 & 2 are lost in the sounder on power down.

2.7.2 Alarm Setup



This item pops up a dialogue box that allows the user to adjust the alarm trigger and sounding options for 320M systems. There are two alarm trigger conditions available, but only one can be selected at a time.

If **Lost Bottom** is selected, the echosounder will sound its alarm any time the bottom is not located. As soon

as the bottom is re-detected, the alarm will shut off.

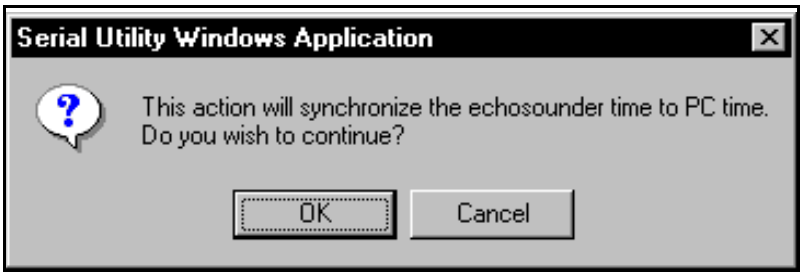
If **Too Shallow** is selected, the echosounder will sound its alarm any time the returned depth is a shallower value than the **Depth** indicated. Once the depth return is deeper again, the alarm will shut off.

2.7.3 Event Marks

The **Event Marks** option pops up a dialogue box that allows the user to adjust the event marking options. The **Next Event Number** will set the echosounder's event counter to the desired value when the **Send** box is clicked. The **Timed Event Marks** check box allows the user to select the echosounder's internally timed event marks. If this box is checked, the echosounder will cause internally generated event mark at the time interval selected in the **Timed Event Interval** box. The units for this interval measurement are seconds.

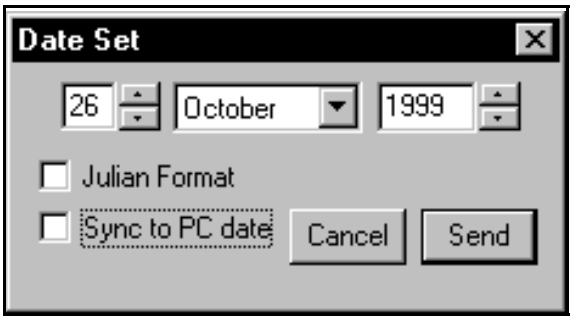
WARNING: Sending the data to the sounder will always cause the Event Number to be modified in the sounder. This application does not monitor what is currently set in the sounder, but simply what was last modified by this application so it is possible to reset the event number to an undesired value.

2.7.4 Set Time



The **Set Time** option brings up a dialogue box that prompts the user to set the echosounder to the current PC time. If the user accepts the action, the sounder is set to PC time to a hundredth of a second.

2.7.5 Set Date



The **Set Date** option brings up a dialogue box that allows the user to set the date manually , or to tell the program to synchronize the echosounder to the current PC date. If the **Sync to PC date** check box is marked, the program ignores the date value displayed in the box and automatically sends the current PC date to the sounder. If the **Julian Format** check box is marked, the application sends the Julian calendar equivalent form of the date to the echosounder, and toggles the echosounder's date format presentation mode to Julian.

2.7.6 Units

There are three selections available in sub-menus of this option: Metres , Feet, or Fathoms. A check mark indicates the currently selected option. The selection can be changed by simply clicking on the desired menu item.

2.7.7 Sync Mode

The **Sync Mode** option allows the user to select between the echosounder's own internal timebase-controlled ping cycle synchronization, or an external ping cycle synchronization signal.

WARNING: If the **Sync Mode** is toggled to external sync, the echosounder will not ping unless there is an external sync signal fed to the appropriate signal on the sounder. Currently, only the 320B/R provides an external connector for this signal connection. Please contact KEL if you wish to use this feature on any other 320 models.

2.7.8 Pinger Mode

This option allows the user to toggle the echosounder's specialized **Pinger Mode** on or off from two sub-menu items. The currently active mode is indicated by a checkmark on the sub-menu item.

The **Pinger Mode** is a special operational mode that is currently only supported on 3.5kHz and 12kHz frequency channels. When the **Pinger Mode** is on, the echosounder does not transmit at all but simply listens, typically for an external pinger device, and displays the received data on one second intervals. The only channel control that has any effect in **Pinger Mode** is Manual **Gain**, (**AGC** must be toggled off). For frequencies that have **Processing Gain** support, the sounder will use the gain value used during the last normal transmit/listen ping cycle; any attempt to modify the parameter during **Pinger Mode** will be ignored.

This menu item is active only if the compilation option is set in the echosounder; this option is made available by customer request.

2.7.9 TVG

This option allows the user to select **TVG** (time varied gain) on the analog receivers. The OFF setting provides constant receive gain throughout each pulse-echo cycle (note that receive gain will still vary from ping to ping if AGC is on). When set to 20 log R, the receive gain is increased linearly (logarithmically if gain is expressed in decibels) with time and range from the instant of transmission, to compensate for signal amplitude loss due to spherical spreading. The 40 log R setting provides for spherical spreading of both outgoing and returning signals. The bottom referenced setting provides a gain ramp at the bottom (as determined from the previous ping) to provide approximate compensation for attenuation in sub-bottom sediments. The last setting is intended for sub-bottom profiling applications.

TVG may help to prevent the depth digitizer from falsely triggering on fish or other water column targets at the expense of slightly greater susceptibility to locking on the second echo from the bottom. TVG operates in addition to the AGC or manual gain settings which are applied to each channel independently, and which effectively define the starting gain for each channel at the instant of transmission. A check mark indicates the currently selected option.

2.7.10 Print Setup on Recorder

This option allows the user to trigger the data parameter print on the echosounder's hardcopy record (320M systems only). This parameter print records the current settings of all the configuration parameters in the echosounder onto the hardcopy record.

2.8 Upgrades

This group of controls is used strictly for echosounder firmware updates and should not be used if no updates are required.

2.8.1 Download Tag

The **Download Tag** option is used for echosounder firmware upgrades. The file selection box that pops up lets the user select the desired tag file to be downloaded to the echosounder. Once a file has been selected by the user, the program downloads it to the echosounder over the serial connection. The transfer time is dependent on the baud rate of the communications link. The tag files are usually a few hundred kilobytes, so faster baud rates such as 19200 or 38400 are recommended.

2.8.2 Initialize NVM

An **Initialize NVM** can be executed at any time to restore all the echosounder's operating parameters to factory default settings.

NOTE: This will cause all previously user-selected parameter values to be lost.

2.8.3 Program PS

The **Program PS** option is only needed after a **Load Tag** command has been performed, to program the new firmware permanently into the echosounder's FLASH eproms. If a new tag file has been downloaded, and the echosounder is powered down before a **Program PS** command has been performed, the new firmware is lost and the echosounder will power back up with the old firmware.

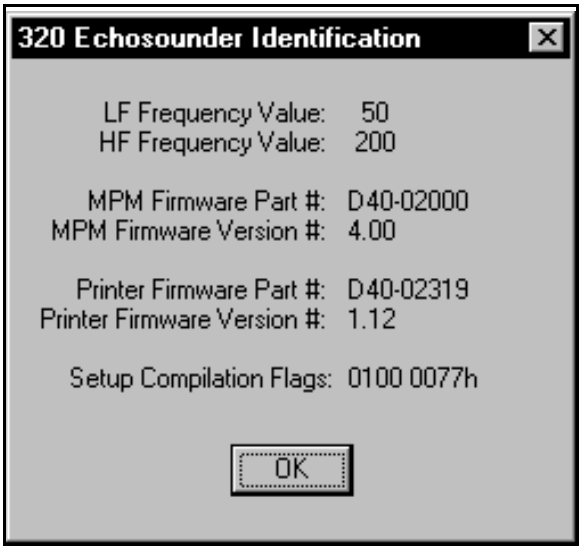
2.8.4 Program Tx

The **Program TX** option is only needed after a **Load Tag** command and a **Program PS** command have been performed, to program the transmit prom data permanently into the echosounder's FLASH eproms. If this command is not executed after a new tag file has been loaded and programmed, the system may not perform properly, since the transmit data in the transmit flash eprom may not be correct.

2.9 Help

The **Help** menu provides access to two options that provide the user with system configuration information that is most useful when contacting the factory for technical assistance. There are no other help features implemented yet.

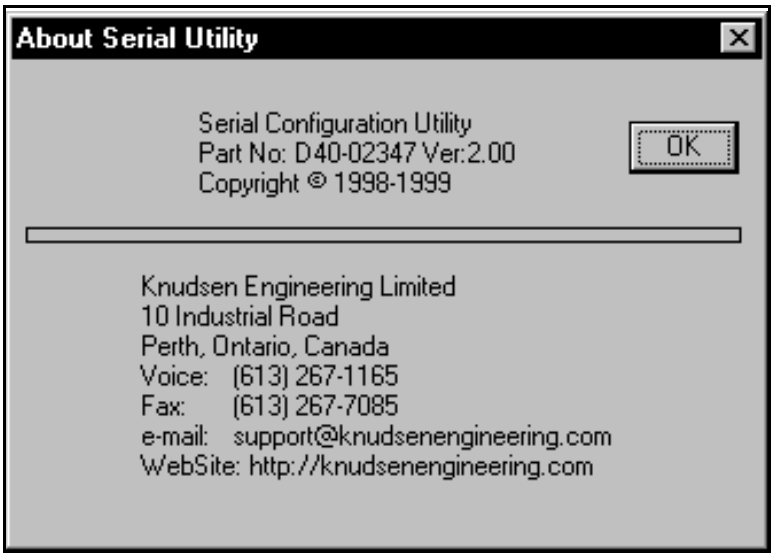
2.9.1 Identification



This option pops up a dialogue box that reports the system information read from the echosounder when the program was invoked and initiated communications with the echosounder. It reports the system's serial number, frequency configuration, and controlling firmware part number and version.

The setup compilation flags are merely an indicator of the particular code options compiled into a user's specific system. This information is really only useful to KEL personnel, and it is helpful if it can be provide when user's contact the factory for assistance.

2.9.2 About Serial Utility...



The **About Serial Utility...** menu item brings up a simple dialogue box stating the name of the PC software program, the KEL part number for the program and the latest revision number, and technical support contact information.

320 SERIES ECHOSOUNDER

SERIAL UPGRADE UTILITY SOFTWARE MANUAL

Supports Software: UpgradeUtility.exe: D40-02346 V2.00

D10 - 02278
Revision 2.0
November 4, 1999

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

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CONTENTS

1 INTRODUCTION

1.1 About this manual

This manual provides information about the Windows-based Serial Upgrade Utility program, Part #: D40-02346, UpgradeUtility.exe. This program is designed to communicate with the 320 Series Echosounder's main processing module and printer control module via their serial ports strictly to perform firmware upgrades.

1.2 Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

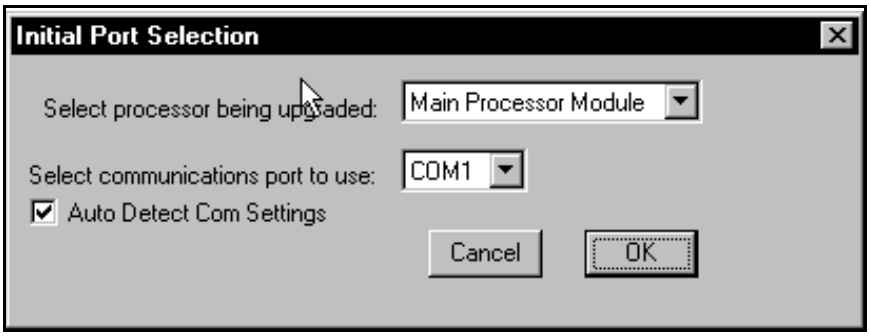
2 OPERATING INSTRUCTIONS

2.1 Overview

The Serial Upgrade Utility, UpgradeUtility.exe, is a specialized Windows serial communications program designed to link a PC to a 320 series echosounder via the sounder's COM 3 serial monitor port. It also links to a 320M series echosounder's thermal printer via its specialized serial com port. This application is designed to provide the user with a standard method for performing firmware upgrades on both modules.

2.2 Description

When the program is invoked, it brings up a dialogue box requesting information from the user about what processing module to upgrade, the PC serial port to be used to establish the communications link, and, for the Main Processor module, whether to let this application auto-detect the processor's serial com port settings.



Once the user selects and accepts particular communication settings, the program first confirms that it can initialize the PC serial port. If port initialization fails, the user will be informed of the failure and the detected fault. Most commonly, the serial port initialization fails because some other program/device is already using the port.

If PC serial port initialization passes and auto-detect is selected, the program starts to scan for the actual serial port configuration settings on the echosounder. It starts with the last configuration stored in the program's main INI file, assuming that the last settings should still be correct. If these settings are no longer correct (PC is now connected to a different sounder perhaps), the program starts to scan all possible combinations of settings supported by the echosounder, starting at the highest baud rate first.

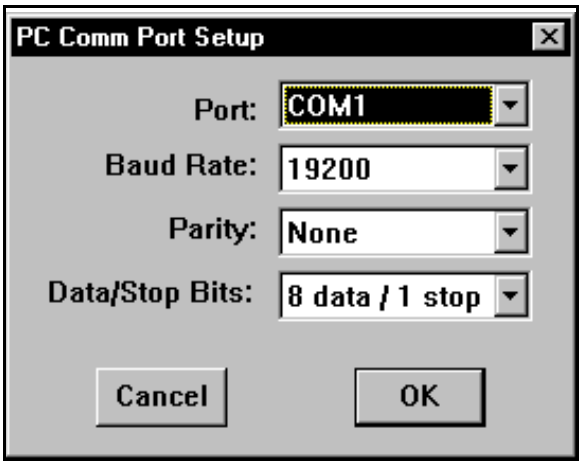
Once serial communications have been established and basic handshaking has been accomplished, a window pops up with four control groups on the main menu, and a blank display area used for communications status messages.

2.3 File

2.3.1 Exit

The user can terminate the application using the **Exit** command. If the Main Processor module was being upgraded, the current serial port configuration settings are saved in the main program INI file and used as a starting reference the next time the application is invoked for a Main Processor upgrade.

2.4 PC Port



The **PC Port** option pops up a dialogue box that allows the user to modify the desired serial com port to use on the host PC and the communications settings to be used by the selected port. The echosounder's Main

Processor module is shipped with the settings at the following defaults: 19200 baud, no parity, 8 data bits, 1 stop bit. The Printer Processor module's com port settings are permanently fixed at: 38400 baud, no parity, 8 data bits, 1 stop bit. Clicking on **OK** accepts the current PC port settings, and the program will initialize the port to the selected settings. Pressing **ESC** or clicking on **CANCEL** eliminates the changes, and restores the original settings.

2.5 Upgrades

2.5.1 Download Tag

The **Download Tag** option is used to send the firmware upgrade file (always a ".tag" filename) to the processor module. The file selection box that pops up lets the user select the desired tag file to be downloaded to the module. Once a file has been selected by the user, the program downloads it to the module's temporary memory over the serial connection. The transfer time is dependent on the baud rate of the communications link and the size of the tag file, but generally it takes about two or three minutes.

NOTE: This command simply loads the new firmware into the processor module's temporary memory. If the echosounder were powered down after this step, the new firmware would be lost and the old firmware would run on power-up. Proceed to the **Program PS** step to store the new firmware permanently in the sounder.

2.5.2 Initialize NVM

This option is only available if the application is being used to upgrade the sounder's Main Processor Module. It loads default parameter values into the NVM (non-volatile memory) on the MPM.

An **Initialize NVM** can be executed at any time to restore all the Main Processor Module's operating parameters to factory default settings.

NOTE: This will cause all previously user-selected parameter values to be lost.

2.5.3 Program PS

The **Program PS** option is needed after a **Download Tag** command has been performed to program the new firmware permanently into the echosounder's FLASH eproms. If a new tag file has been downloaded, and the echosounder is powered down before a **Program PS** command has been performed, the new firmware is lost and the echosounder will power back up with the old firmware.

Program PS causes the program code, which has been downloaded into program SRAM memory on the Main Processor Module, to be copied into FLASH memory (non-volatile program memory).

2.5.4 Program Tx

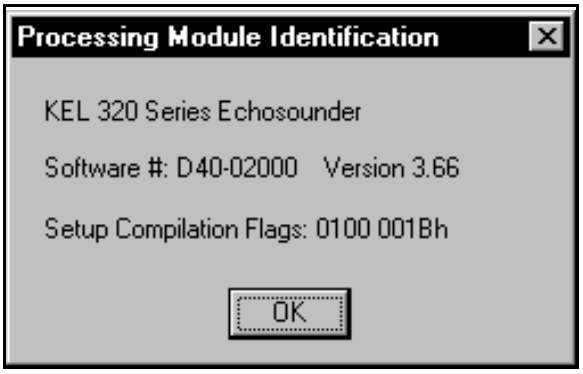
This option is only available if the application is being used to upgrade the sounder's Main Processor module.

The **Program TX** option is needed after a **Load Tag** command and a **Program PS** command have been performed to program the transmit waveform data permanently into the echosounder's FLASH eproms. If this command is not executed after a new tag file has been loaded and programmed, the system may not perform properly, since the old transmit waveform data in the transmit flash eprom may not correspond correctly with the new firmware.

2.6 Help

The **Help** menu provides access to two options that provide the user with system configuration information that is most useful when contacting the factory for technical assistance. There are no other help features implemented yet.

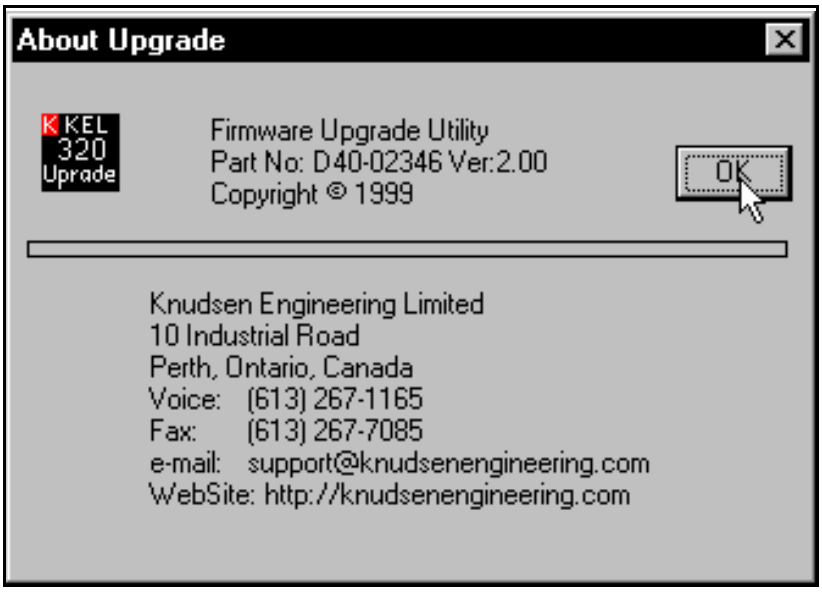
2.6.1 Identification



This option pops up a dialogue box that reports the system information read from the echosounder's processor module when the program was invoked and initiated communications with the module. It reports the module's sign-on message and the firmware part number, version, and compilation configuration loaded in the module. The Main Processor module sign-on message is "KEL 320 Series Echosounder". The Printer Processor module sign-on message is "320M Echosounder Printer".

The setup compilation flags are merely an indicator of the particular code options compiled into a user's specific system. This information is really only useful to KEL personnel, and it is helpful if it can be provide when user's contact the factory for assistance.

2.6.2 About Upgrade...



The **About Upgrade...** menu item brings up a simple dialogue box stating the name of the PC software program, the KEL part number for the program and the latest revision number, and technical support contact information.

320 SERIES ECHOSOUNDER

SERIAL COMPUTER INTERFACING MANUAL

Supports Echosounder Firmware #: D40-02000 V5.27

D10 - 02390
Revision 2.0
April 22, 2004

KNUDSEN
ENGINEERING LIMITED

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

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CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 About this manual

This manual provides detailed information about the 320 Series Echosounder serial interface port (COM3) protocols which can be used for data logging, echosounder control, and data loop-through. This information is intended for advanced users with specialized requirements. The following data is supplied for information only; it is not required knowledge for standard system operation.

1.2 Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 OVERVIEW

The 320 Echosounder was designed with a dedicated serial port (COM 3) for communications with the survey computer. This port is used for transmitting depth log strings to the survey computer or data logger, for re-transmitting ASCII strings received on other com ports if requested (loop-through), and for accepting and for acting upon command strings received from the survey computer or data logger. It is also used for system software upgrades.

The echosounder accepts command strings in two distinct formats. The first format is an ASCII string preceded by '$PKEL'. This indicates that the string is a Knudsen Engineering proprietary NMEA string. These strings are assumed to be coming from some data processing program (such as the Serial Configuration Utility program, SerialUtility.exe) and are accepted by the echosounder without echoing the characters back to the external PC to avoid confusing the program.

The second format is an ASCII string preceded by the '/' character (user commands). These strings are assumed to be coming from user input at the keyboard and are accepted with character echoing enabled for the operator's convenience. Either format can be accessed by a user through any communications program.

Note: Different firmware compilations allow access to different combinations of the control strings listed in the following sections. If you have any questions regarding the firmware compilation for your system, please contact the factory or your local representative.

3 KEL PROPRIETARY CONTROL SENTENCES - INPUT

Table 3-1: PC To 320 Echosounder Control Sentences

KEL PROPRIETARY INPUT STRINGS	
Sentence ID	**Description**
0	Request data output string from MPM
1	Set units flag (meters/feet/fathoms)
2	Cause event marker with external annotation, only
3	Cause event marker with internal and external annotation.
4*	Set range
5*	Set auto phase mode, manual phase code
6*	Set HF Tx on/off, HF Tx power level
7*	Set HF AGC, HF manual Rx Gain
8*	Set HF pulse type
9*	Set LF Tx on/off , LF Tx power level
10*	Set LF AGC, LF manual Rx gain
11*	Set LF pulse type
12*	Set HF & LF Draft
13*	Set speed of sound
14*	Set tracking gate width
15*	Set HF & LF transmit blanking
16*	Set alarm trigger, alarm depth, and sound toggle
17	Set Com 1 device, baud, parity, data/stop bits, and loop-through configuration
18	Set Com 2 device, baud, parity, data/stop bits and loop-through configuration
19	Set Com 3 baud, parity, and data/stop bits
20ϕ	Set Com 4 device, baud, parity, data/stop bits and loop-through configuration
21†	Load printer banner vanity string with the characters in Field 1.
22*†	Set printer on/off, printer speed
23*†	Set print contrast, manual contrast
24*†	Set tracking overlay, heave overlay, corrected depth overlay toggles, tx blank overlay, tx blanking
25*†	Select hardcopy format, grid format, and printer font size
26†	Load data string into line 1 of the upper banner.

KEL PROPRIETARY INPUT STRINGS	
Sentence ID	**Description**
27†	Load data string into line 2 of the upper banner.
28	Set time
29	Set date
30	Set depth log flag, set depth log format, load user-defined preamble
31	Set depth log rate code
32*	Set HF and LF multiplexer codes
33*	Set TVG flag
34*	Set event mark number, auto event mark toggle, auto event interval, event mark format
35*	Set Sync Mode
36*	Set Primary Channel
37*	Set Pinger Mode (available only with 3.5 and 12kHz)
38	Set current echosounder time to value expressed in milliseconds since midnight
39*†	Initiate parameter data print out on the sounder's thermal printer.
40*	Set autophase search mode minimum depth and maximum depth
41*	Set HF & LF sensitivity
42*	Set HF & LF processing gain

* Only available on systems with full SERIAL CONTROL compilations.

† Only available on 320M systems.

ϕ Only available on 320B systems.

3.1 $PKEL00: Request Data Output String

Format: $PKEL00,nn<CR><LF>

where: nn = Data Request code = 00 to 99
<CR> = carriage return
<LF> = line feed

This control string is used to request an information string to be returned to the PC by the sounder. The Data Request Code identifies the data response string for the echosounder to return; see Section 4 for details of the response strings.

3.2 $PKEL01: Set Units Flag

Format: $PKEL01,c<CR><LF>

where: c = units flag: 0 = meters, 1 = feet, 2 = fathoms

This control string is used to set the working units flag in the echosounder to the desired value.

3.3 $PKEL02: Event Marker with External Annotation Only

Format: $PKEL02,c--c<CR><LF>

where: c--c = External Annotation String (max. 68 valid ASCII chars)

This control string is used to trigger an event mark which uses only the external annotation string on the hardcopy record for 320Ms and in the SCSI data record (320Ms and 320Bs).

3.4 $PKEL03: Event Marker with Internal and External Annotation

Format: $PKEL03,c--c<CR><LF>

where: c--c = External Annotation String (max. 68 valid ASCII chars)

This control string is used to trigger an event mark which uses the internally generated and the external annotation string data on the hardcopy record for 320Ms and uses just the external annotation in the SCSI data record (320Ms and 320Bs).

3.5 $PKEL04: Set Range

Format: $PKEL04,c<CR><LF>

where: c = range code: 0=10, 1=20, 2=50, 3=100, 4=200, 5=500, 6=1000, 7=2000, 8=5000
(Units are dependent upon the working units setting: either m, ft or fm.)

This control string is used to set the range code parameter in the echosounder.

3.6 $PKEL05: Set Phase

Format: $PKEL05,a,bbb<CR><LF>

where: a = AutoPhase Mode Flag: 0 = off, 1 = on
bbb = Manual Phase Code: 1 to 7 for 320Ms and shallow water systems
1 to 239 for deep water systems

This control string is used to set the autophase flag and manual phase code parameters in the echosounder.

3.7 $PKEL06: Set HF Tx On/Off, HF Tx Power Level

Format: $PKEL06,a,b<CR><LF>

where: a = HF Tx On/Off: 0 = off, 1 = on
b = HF Tx Power: 1 to 4, or 1 to 8 for newer systems

This control string is used to set the HF channel transmit on/off state and transmit power level parameters in the echosounder.

3.8 $PKEL07: Set HF AGC, HF Manual Rx Gain

Format: $PKEL07,a,bbb<CR><LF>

where: a = HF Rx AGC Toggle: 0 = manual, 1 = auto
bbb = HF Manual Rx Gain: 0 to 255

This control string is used to set the HF channel Rx AGC Toggle, and manual Rx Gain parameters in the echosounder.

3.9 $PKEL08: Set HF Pulse Type

Format: $PKEL08,cc<CR><LF>

where: cc = HF Pulse Type Code: 0 to N where N is frequency code specific

This control string is used to set the HF channel PulseType Code parameter in the echosounder.

3.10 $PKEL09: Set LF Tx On/Off, LF Tx Power Level

Format: $PKEL09,a,b<CR><LF>

where: a = LF Tx On/Off: 0 = off, 1 = on
b = LF Tx Power: 1 to 4, or 1 to 8 for newer systems

This control string is used to set the LF channel transmit on/off state and transmit power level parameters in the echosounder.

3.11 $PKEL10: Set LF AGC, Manual Rx Gain

Format: $PKEL07,a,bbb<CR><LF>

where: a = LF Rx AGC Toggle: 0 = manual, 1 = auto
bbb = LF Manual Rx Gain: 0 to 255

This control string is used to set the LF channel Rx AGC Toggle, and manual Rx Gain parameters in the echosounder.

3.12 $PKEL11: Set LF Pulse Type

Format: $PKEL11,cc<CR><LF>

where: cc = LF Pulse Type Code: 0 to N where N is frequency code specific

This control string is used to set the LF channel Pulse Type Code parameter in the echosounder.

3.13 $PKEL12: Set HF and LF Draft

Format: $PKEL12,aaaaa,bbbbb<CR><LF>

where: aaaaa = HF draft: 0 - 10000cm, 0 - 32808 ($^{1}/_{100}$ths ft), or 0 - 5468($^{1}/_{100}$ths fm)
bbbbb = LF draft: 0 - 10000cm, 0 - 32808 ($^{1}/_{100}$ths ft), or 0 - 5468($^{1}/_{100}$ths fm)

This control string is used to set the draft for the HF and LF channels in the echosounder.

3.14 $PKEL13: Set Speed of Sound

Format: $PKEL13,cccc<CR><LF>

where: cccc = Speed of sound in water: 1300 - 1700m/s, 4265 - 5577ft/s, or 710 - 929 fm/s.

This control string is used to set the speed of sound in the echosounder.

3.15 $PKEL14: Set Tracking Gate Width

Format: $PKEL14,www<CR><LF>

where: www = Tracking Gate Width: 2 to 200 (Units are dependent upon the working units setting: either m, ft or fm.)

This control string is used to set the tracking gate width used by the echosounder.

3.16 $PKEL15: Set HF and LF Transmit Blanking

Format: $PKEL15,aaaa, bbbb<CR><LF>

where: aaaa = HF Transmit Blanking: 0 - 3000dm, 0 - 9843($^1/_{10}$ths ft), or 0 - 1640($^1/_{10}$ths fm)
bbbb = LF Transmit Blanking: 0 - 3000dm, 0 - 9843($^1/_{10}$ths ft), or 0 - 1640($^1/_{10}$ths fm)

This control string is used to set the transmit blanking value used in the echosounder.

3.17 $PKEL16: Set Alarm Trigger, Alarm Depth and Alarm Sound Flag

Format: $PKEL16,a,xxx,c<CR><LF>

where: a = Alarm Trigger Method: 0 = bottom lost, 1 = depth too shallow
xxx = Alarm Depth: 0 to 100 in m, ft or fm dependent on working units
c = Alarm Sound Flag: 0 = no sound, 1 = front panel, 2 = KEL remote display, 3 = front panel and remote

This control string is used to select the alarm trigger mode used by the echosounder, to set the alarm trigger depth (if required) and the alarm sound option.

3.18 $PKEL17: Set Com 1 Configuration

Format: $PKEL17,aa,bbbbb,c,d,e<CR><LF>

where:	aa = Com 1 Device Code:	0 to 10 (13 for old GPS support compilations)
	bbbbb = Com 1 Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200, (38400)
	c = Com 1 Parity Code:	0 = none, 1 = odd, 2 = even
	d = Com 1 Data & Stop Bits Code:	0 = 8 data, 1 stop; 1 = 7 data, 2 stop
	e = Com 1 Loopthru Flag:	0 = none, 1 = on

This control string sets the communication port settings for Com1 on the echosounder.

Table 3-2: Serial Port Device Driver Codes

Device Code	Peripheral Device Driver
0	None
1	KEL Remote
2	NMEA: $GPGLL
3	NMEA: $GPGGA
4	TSS: 33x
5	TSS DMS: TSS1
6	Innerspace 443
7	Seatex: MRU
8	Navy Remote
9	Navy NTDS
10	Generic #1
11	Generic #2
12	Generic #3

3.19 $PKEL18: Set Com 2 Configuration

Format: $PKEL18,a,b,c,d,e<CR><LF>

where:	aa = Com 2 Device Code:	0 to 10 (13 for old GPS support compilations)
	bbbbb = Com 2 Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200, (38400)
	c = Com 2 Parity Code:	0 = none, 1 = odd, 2 = even
	d = Com 2 Data & Stop Bits Code:	0 = 8 data, 1 stop; 1 = 7 data, 2 stop
	e = Com 2 Loopthru Flag:	0 = none, 1 = on

This control string sets the communication port settings for Com2 on the echosounder.

3.20 $PKEL19: Set Com 3 Configuration

Format: $PKEL19,b,c,d<CR><LF>

where:	bbbbb = Com 3 Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200, (38400)
	c = Com 3 Parity Code:	0 = none, 1 = odd, 2 = even
	d = Com 3 Data & Stop Bits Code:	0 = 8 data, 1 stop; 1 = 7 data, 2 stop

This control string sets the communication port settings for Com3 on the echosounder.

3.21 $PKEL20: Set Com 4 Configuration

Format: $PKEL20,a,b,c,d,e<CR><LF>

where:	aa = Com 4 Device Code:	0 to 10 (13 for old GPS support compilations)
	bbbbb = Com 4 Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200, (38400)
	c = Com 4 Parity Code:	0 = none, 1 = odd, 2 = even
	d = Com 4 Data & Stop Bits Code:	0 = 8 data, 1 stop; 1 = 7 data, 2 stop
	e = Com 4 Loopthru Flag:	0 = none, 1 = on

This control string sets the communication port settings for Com4 on the echosounder, if available.

3.22 $PKEL21: Load Banner String

Format: $PKEL21,c--c<CR><LF>

where: c--c = Banner Input String (max. 32 valid ASCII chars.)

This control string sets the Vanity Banner string on the echosounder's lower banner.

3.23 $PKEL22: Set Paper Speed

Format: $PKEL22,a,b<CR><LF>

where:	a = Printer Paper On/Off Code:	0 = off, 1 = on
	b = Printer Paper Speed:	0 = off, 1 = 1 line/ping, 2 = 10mm/min, 3 = 25mm/min, 4 = 50mm/min, 5 = 100mm/min, 6 = 197mm/min, 7 = 295mm/min

This control string toggles the printer on and off, and controls the paper speed when on.

3.24 $PKEL23: Set Print Contrast

Format: $PKEL23,c,xx<CR><LF>

where: c = Print Contrast Mode: 0 = auto:standard, 1 = auto:HF black, 3 = auto:w/depth, 4= manual
xx = Manual Contrast Level: 1 to 16

This control string selects the printing contrast mode, and manual print contrast level if applicable.

3.25 $PKEL24: Set Printer Overlay Toggles

Format: $PKEL24,a,b,c,xxxxxx,d<CR><LF>

where: a = Tracking Gate Overlay Flag: 0 = off, 1 = on
b = Heave Trace Overlay Flag: 0 = off, 1 = on
c = Corrected Depth Overlay Flag: 0 = off, 1 = LF on, 2 = HF on
xxxxxx = Corrected Depth Overlay Offset -5000 to +5000 dm, $^{1}/_{10}$ths ft or $^{1}/_{10}$ths fm
d = Tx Blank Overlay Flag: 0 = off, 1 = on
d = Tx Blanking Flag: 0 = off, 1 = on

This control string selects the desired settings for various hardcopy overlays of applicable.

3.26 $PKEL25: Set Hardcopy Format Options

Format: $PKEL25,a,b,c<CR><LF>

where: a = Hardcopy Format: 0 = single graph, 1 = split dual graph
b = Hardcopy Grid Format: 0 = no grid,1 = coarse grid,2 = fine grid
c = Hardcopy Font Size: 0 = small, 1 = large

This control strings sets the basic printer presentational formatting parameters.

3.27 $PKEL26: Load Upper Banner Line 1

Format: $PKEL26,c--c<CR><LF>

where: c--c = Upper Banner Line 1 (max 78 valid ASCII chars)

This controls string sends the data for the first line in the upper margin banner of the echosounder hardcopy record.

3.28 $PKEL27: Load Upper Banner Line 2

Format: $PKEL27,c--c<CR><LF>

where: c--c = Upper Banner Line 2 (max 78 valid ASCII chars)

This control string sends the data for the second line in the upper margin banner of the echosounder hardcopy record.

3.29 $PKEL28: Set Time

Format: $PKEL28,hhmmss<CR><LF>

where: hh = hours: 00 to 23
mm = minutes: 00 to 59
ss = seconds: 00 to 59

This control string sets the time in the echosounder. (See also $PKEL38.)

3.30 $PKEL29: Set Date

Format: $PKEL29,f,yyyy,mm,dd<CR><LF>

where: f = Date Format Code: 0 = day-month-year, 1 = Julian
yyyy = Year: 1996 - 2096
mm = Month: 01 to 12
dd = Day: 01 - 31

This control string sets the date in the echosounder.

3.31 $PKEL30: Set Depth Log Flag, Depth Log Format

Format: $PKEL30,f,hhhh,xxxx,c--c<CR><LF>

where: f = Depth Log Flag: 0 = none, 1 = PKEL, 2 = ISAH:KEL, 3 = ISAH:Elac, 4 = Echotrac, 5 = Digitrace[dm], 6 = Digitrace[cm], 7 = Simrad (6 byte), 8 = Simrad (6 byte), 9 = Deso20, 10 = SDDBS(HF), 11 = SDDBS(LF), [*12 = SERBCD(HF), 13 = SERBCD(LF)*]
hhhh = PKEL Depth Log Format, LSW: 0000 to FFFF hex
xxxx = PKEL Depth Log Format, MSW: 0000 to FFFF hex
c--c = User defined preamble (max. 16 valid ASCII chars)

This control string selects the echosounder's data logging mode, and configures the user-configurable format including the user-defined header string.

3.32 $PKEL31: Set Depth Log Rate Code

Format: $PKEL31,c<CR><LF>

where: c = Depth Log Rate Code 0 = at ping rate, 1 = 5 per second, 2 = 3 per second, 3 = 2 per seconds, 4 = every second, 5 = every 2 seconds, 6 = every 5 seconds, 7 = every 10 seconds

This control string set the depth logging throttling rate code. The sounder may have a faster ping rate, but will output the serial depth log string at the rate determined by the code.

3.33 $PKEL32: Set Mux Codes

Format: $PKEL32,hh,ll<CR><LF>

where: hh = HF Multiplexer Code: 00 to FF hex
ll = LF Multiplexer Code: 00 to FF hex

This control string sets the multiplexer codes for the HF and LF Channels. This is only applicable if a channel is connected to a KEL 1:8 Multiplexer Box and the multiplexer option is compiled in for the appropriate channel.

3.34 $PKEL33: Set TVG Flag

Format: $PKEL33,c<CR><LF>

where: c = TVG Flag: 0 = off, 1 = on

This control string is used to set the state of the TVG flag.

3.35 $PKEL34: Set Event Number, Auto Event Flag and Interval, Event Format

Format: $PKEL34,nnnnn,a,tttt,f<CR><LF>

where: nnnnn = Event Mark Number: 00001 to 65535
a = Auto Event Mark Flag: 0 = off, 1 = on
t = Auto Event Mark Interval: 6 to 3600 seconds
f = Event Mark Format: 0 = fix number only, 1 = full annotate

This control string sets the event mark number, timebase control option, timebase interval, and annotation parameters.

3.36 $PKEL35: Set Sync Mode

Format: $PKEL35,f<CR><LF>

where: f = Sync Mode Flag: 0 = internal, 1 = external; 2 = PC

This control string sets the echosounder's ping synchronization mode.
WARNING: setting the sounder to external sync mode causes the system to enter a state where it will not perform a transmit/acquisition cycle until it receives a strobe signal from an external source. This can appear as a "lock-up" of the sounder if this mode is improperly toggled on when no external signal is available.

3.37 $PKEL36: Set Primary Channel

Format: $PKEL36,f<CR><LF>

where: f = Primary Channel Flag: 0 = HF, 1 = LF

This control string sets the echosounder's primary channel flag.

3.38 $PKEL37: Set Pinger Mode

Format: $PKEL37,f<CR><LF>

where: f = Pinger Mode Flag: 0 = off, 1 = on

This control string controls the echosounder's pinger mode.

3.39 $PKEL38: Set Time in milliseconds since midnight

Format: $PKEL38,tttttttt<CR><LF>

where: tttttttt = Time in milliseconds since midnight

This control string tells the sounder to set the time to the value expressed in milliseconds since midnight. The sounder compensates this value for the time delay taken to send the data to the sounder based on the current baud rate. (See also $PKEL28.)

3.40 $PKEL39: Initiate Parameter Print on the Sounder's Thermal Printer

Format: $PKEL39,<CR><LF>

This control string sends no data to the echosounder. Receipt of this command string automatically initiates the parameter print out on the echosounder's thermal printer.

3.41 $PKEL40: Set Autophase Search Mode Minimum and Maximum Depths

Format: $PKEL40,aaaaa,bbbbb<CR><LF>

where: aaaaa = Minimum Depth: 0 - 12000
bbbbb = Maximum Depth: 20 - 12000
(Units are dependent upon the working units setting: either m, ft or fm.)

This control string is used to set the autophase search mode's minimum and maximum depths used by the echosounder.

3.42 $PKEL41: Set HF and LF Sensitivity

Format: $PKEL41,aaa,bbb<CR><LF>

where: aaa = HF Sensitivity: 1 - 100, (1 = off)
bbb = LF Sensitivity: 1 - 100, (1 = off)

This control string is used to set the channel sensitivity levels.

3.43 $PKEL41: Set HF and LF Processing Gain

Format: $PKEL41,a,b<CR><LF>

where: a = HF Processing Gain: 0 - 8
b = LF Processing Gain: 0 - 8

This control string is used to set the channel processing gain values.

4 KEL PROPRIETARY CONTROL SENTENCES - OUTPUT

Table 4-1. 320 Echosounder to PC Response Sentences

KEL PROPRIETARY OUTPUT STRINGS	
Sentence ID	**Description**
0	System's software part and version numbers, and SPM frequency configurations
1	Returns current units flag.
4*	Returns current range selection
5*	Returns current phase mode, phase selection
6*	Returns current HF Tx on/off, HF Tx power setting
7*	Returns current HF Rx AGC and manual gain settings
8*	Returns current HF pulse type setting
9*	Returns current LF Tx on/off, LF Tx power setting
10*	Returns current LF Rx AGC and manual gain setting
11*	Returns current LF pulse type setting
12*	Returns current HF & LF Draft settings
13*	Returns current speed of sound setting
14*	Returns current tracking gate width
15*	Returns current HF & LF transmit blanking setting
16*	Returns current alarm trigger, alarm depth and sound toggle
17	Returns Com A's device, baud, parity, data/stop bits, and loop-thru configuration
18	Returns Com B's device, baud, parity, data/stop bits, and loop-thru configuration
19	Returns Com C's baud, parity and data/stop bits
20ϕ	Returns Com D's device, baud, parity, data/stop bits, and loop-thru configuration
21†	Returns current contents of the printer banner vanity string.
22*†	Returns current printer on/off, and paper speed
23*†	Returns current print contrast, manual contrast
24*†	Returns current tracking, heave, corrected depth, and tx blank overlay toggles
25*†	Returns current hardcopy format, grid format, and printer font size
26†	Returns current string contents of line 1 of the upper banner.
27†	Returns current string contents of line 1 of the upper banner.
28	Returns MPM's current time of day

KEL PROPRIETARY OUTPUT STRINGS	
Sentence ID	**Description**
29	Returns MPM's current date
30	Returns current depth log flag, depth log format code, user-defined preamble
31	Returns current depth log rate code
32*	Returns current HF and LF multiplexer codes
33*	Returns current TVG flag
34*	Returns current fix number, auto event mark flag and interval, and fix format flag
35*	Returns current sync mode flag
36*	Returns current primary channel flag
37*	Returns current pinger mode flag
38	Returns current echosounder time expressed in milliseconds since midnight
39*†	Reserved
40*	Returns current autophase search mode minimum and maximum depths
41*	Returns current HF & LF sensitivity settings
42*	Returns current HF & LF processing gain settings
97	Returns number of pulse types available for LF channel and a 10 character identification string for each pulse available
98	Returns number of pulse types available for HF channel and a 10 character identification string for each pulse available
99	Data Logger Output String

* Only available on systems with full SERIAL CONTROL compilations.

† Only available on 320M systems.

ϕ Only available on 320B systems.

4.1 $PKEL00 Response: Software ID and Version

Format: $PKEL00,mmmmm,n.nn,ppppp,v.vv,hhhhhh,llllll,xxxxxxxx<CR><LF>

where: mmmmm = MPM Software Part Number: 02000 - Marine Sounder
n.nn = MPM Software Version Number: 0.00 to 9.99
ppppp = Printer Software Part Number: 02319 - Basic Printer
v.vv = Printer Software Version Number: 0.00 to 9.99
hhhhhh = HF Channel Frequency Configuration (6 chars)
llllll = LF Channel Frequency Configuration (6 chars)
xxxxxxxx = Setup Compilation Flags (hex)

4.2 $PKEL01 to $PKEL38

For format information see the appropriate sections describing the Input Control Strings.

4.3 $PKEL97

Format: $PKEL97,dd,ccccccccccc,ccccccccccc,.....<CR><LF>

where: dd = number of LF pulse types available
ccccccccccc = pulse type identification string,
one for each pulse available expressed in order of pulse codes

4.4 $PKEL98

Format: $PKEL98,dd,ccccccccccc,ccccccccccc,.....<CR><LF>

where: dd = number of LF pulse types available
ccccccccccc = pulse type identification string,
one for each pulse available expressed in order of pulse codes

4.5 PKEL Depth Log Output String

The PKEL depth log output string can be configured by the user to contain any combination of the fields listed in Table 4-2. Note that although this string is referred to in this documentation as the “PKEL” string (KEL’s proprietary NMEA label) it can begin with a user-defined preamble or no preamble. The fields appear in the output string in the same order listed below. If a field is selected but no data is available (ie. heave field selected but no heave device selected), the field position is filled with dashes. All the fields are fixed fields, meaning they do not vary in size regardless of the data. Fields, except Time and Milliseconds, are separated by commas.

Two methods are available for configuring the output string format:

1) A Windows serial utility program, SerialUtility.exe, is provided with the echosounder to allow the users to easily modify the depth log format to suit their individual needs. This program communicates with the echosounder's monitor port on COM3 via a null modem RS-232 serial cable.

2) It is possible to send the appropriate instruction directly to the echosounder monitor using any standard communications package with a simple null modem RS-232 serial cable.

The echosounder uses a 32-bit code to setup the configuration of the depth log string. This code is displayed in the secondary function interface menu as a hexadecimal value. The Windows utility program, SerialUtility.exe, automatically sets this code value and sends it to the echosounder. Users familiar with binary and hexadecimal conversions can easily compute the appropriate code value to send to the echosounder for a given configuration. The bit corresponding to a field in the code word is set to 1 to select the field for output, and is reset to 0 to deselect the field.

Table 4-2. PKEL Depth Log String Format

Field #	Field Description	Field Format	Code Word Bit #
0	User defined preamble string	Printable ASCII chars (max.16)	LSW:0
1	KEL Proprietary String Standard Header	$PKEL99	LSW:1
2	Record Number	rrrrr	LSW:2
3	Fix Indicator	Fnnnn	LSW:3
4	Date	Standard: ddmmyyyy Julian: Jdddyyyy	LSW:4
5	Time at start of ping, to second resolution from MPM Real-Time Clock	hhmmss	LSW:5
6	Milliseconds sync'd to Real-Time Clock (Time field must be selected)	.sss	LSW:6
7	Ping Start to Data Output Latency	ttttt	LSW:7
8	High Frequency Identification Header	HF	LSW:8
9	HF Depth, to transducer (uncorrected for any offsets)	xx.xx or xxx.x or xxxx. or xxxxx	LSW:9
10	HF Depth, corrected for draft	xx.xx or xxx.x or xxxx. or xxxxx	LSW:10
11	HF Depth, corrected for draft and heave	xx.xx or xxx.x or xxxx. or xxxxx	LSW:11
12	HF Echo Strength	xxxx	LSW:12
13	HF Depth validity flag	1 = okay, 0 = bad	LSW:13
14	Undefined	n/a	LSW:14

Field #	Field Description	Field Format	Code Word Bit #
15	HF Draft offset	sxxx.xx	LSW:15
16	Low Frequency Identification Header	LF	MSW:0 (16)
17	LF Depth, to transducer (uncorrected for any offsets)	xx.xx or xxx.x or xxxx. or xxxxx	MSW:1 (17)
18	LF Depth, corrected for draft	xx.xx or xxx.x or xxxx. or xxxxx	MSW:2 (18)
19	LF Depth, corrected for draft and heave	xx.xx or xxx.x or xxxx. or xxxxx	MSW:3 (19)
20	LF Echo Strength	xxxx	MSW:4 (20)
21	LF Depth validity flag	1 = okay, 0 = bad	MSW:5 (21)
22	Undefined	n/a	MSW:6 (22)
23	LF Draft offset	sxxx.xx	MSW:7 (23)
24	Mux Enable	x	MSW:8 (24)
25	Mux Transducer	x	MSW:9 (25)
26	Speed of Sound	xxxx	MSW:10 (26)
27	Heave	shhhhq	MSW:11 (27)
28	Heave Latency (Heave field must be selected)	tttt	MSW:12 (28)
29	Position: Latitude, Longitude	ll ll.llllllN,ooo oo.oooooE	MSW:13 (29)
30	Position Latency (position field must be selected)	tttt	MSW:14 (30)
31	Checksum	hh	MSW:15 (31)

Example 1:

To setup the Hypack (knu320ms.dll) and Trimble HydroPro compatible string, select the following fields: HF depth corrected for draft, LF depth corrected for draft, and Heave. This is the factory-default configuration.

For the 32 bit code:

LSW = 0000 0100 0000 0000b = 0400h
MSW = 0000 1000 0000 0100b = 0804h

Thus the instruction to send to the echosounder would be: $PKEL30,1,0400,0804,<CR><LF>

This would result in a depth log string as follows: xx.xx,xx,xx,shhhhq<CR.<LF>

Example 2:

To setup the Hypack (k320s.dll) compatible string, select the following fields:
User preamble = CHS320M, time, HF header, HF depth corrected for draft, HF validity flag, HF draft, LF header, LF depth corrected for draft, LF validity flag, LF draft , sound speed, and heave.

For the 32 bit code:

LSW = 1010 0101 0010 0001b = A521h
MSW = 0000 1100 1010 0101b = 0CA5h

Thus the instruction to send to the echosounder would be: $PKEL30,1,A521,0CA5,CHS320M<CR><LF>

This would result in a depth log string as follows:

CHS320M,hhmmss,HF,xx.xx,f,sxxx.xx,LF,xx.xx,f,sxxx.xx,xxxx,shhhhq<CR><LF>

Example 3:

For the following code selection:

LSW = 1010 0101 1111 1001b = A5F9h
MSW = 1111 1100 1010 0101b = FCA5h

the resulting instruction would be: $PKEL30,1,A5F9,FCA5,MyString<CR><LF>

and the expected depth log format would be:

MyString,Fnnnn,ddmmyyyy,hhmmss.sss,ttttt,HF,xx.xx,f,sxxx.xx,LF,xx.xx,f,sxxx.xx,xxxx,shhhhq,tttt,ll ll.llllll,ooo oo.oooooo,tttt*hh<CR><LF>

5 USER CONTROL INTERFACE STRINGS

Table 5-1. User Control Input Strings

MONITOR MAINTENANCE INPUT COMMANDS	
Command	**Description**
/?	Show the basic list of the available command set
/GR	Switch program to run out of EPROM
/GT	Switch program to run out of SRAM
/R	Reset program to 'start'
/SBA dec	Set baud rate for COM 1 to 'dec'
/SBB dec	Set baud rate for COM 2 to 'dec'
/SBC dec	Set baud rate for COM 3 to 'dec'
/SBD dec	Set baud rate for COM 4 to 'dec'
/DT	Download TI tag file into SRAM
/VER	Show current software number, version and location where program is running
/ID	Print SCSI ID set by DIP switches
/CCLK	Check the validity bit on the real-time clock
/BAN	Load a string into the banner for the printer
/INVM	Load the non-volatile memory with the defaults values for parameters
/SNVM	Load the non-volatile memory with the current values for parameters
/PRGPS	Program the SRAM contents into EPROM
/PRGTX	Compute and program the pulse data into the TX EPROM

ECHOSOUNDER CONCEPTS

TECHNICAL NOTE

D10 - 02251
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Knudsen Engineering Limited
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Perth, Ontario, Canada

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1 KEL 320 ECHOSOUNDER ARCHITECTURE

Figure 1-1 shows the basic structural and functional partitioning of the standard 320M Marine echosounder. It is a simple and modular arrangement designed for the best overall compromise between many competing requirements and priorities. All 320 Series Echosounders use some or all of these modular components depending on the desired configuration.

In the 320M Survey Echosounder, each acoustic channel is provided with its own Signal Processing Module (SPM), which contains the analog front end components, digitizer, and a dedicated DSP. The SPMs perform all signal processing up to and including envelope detection, and send processed and decimated digital envelope data to the Main Processor Module (MPM). Off-loading the computationally intensive signal processing task from the main processor reduces the overall complexity of the system software, while increasing processing power.

Putting the user interface functions onto a separate front panel module is also part of an overall strategy of modularizing the system design. Partitioning the system into easily tested functional blocks reduces maintenance costs and facilitates servicing in the field by board level replacement.

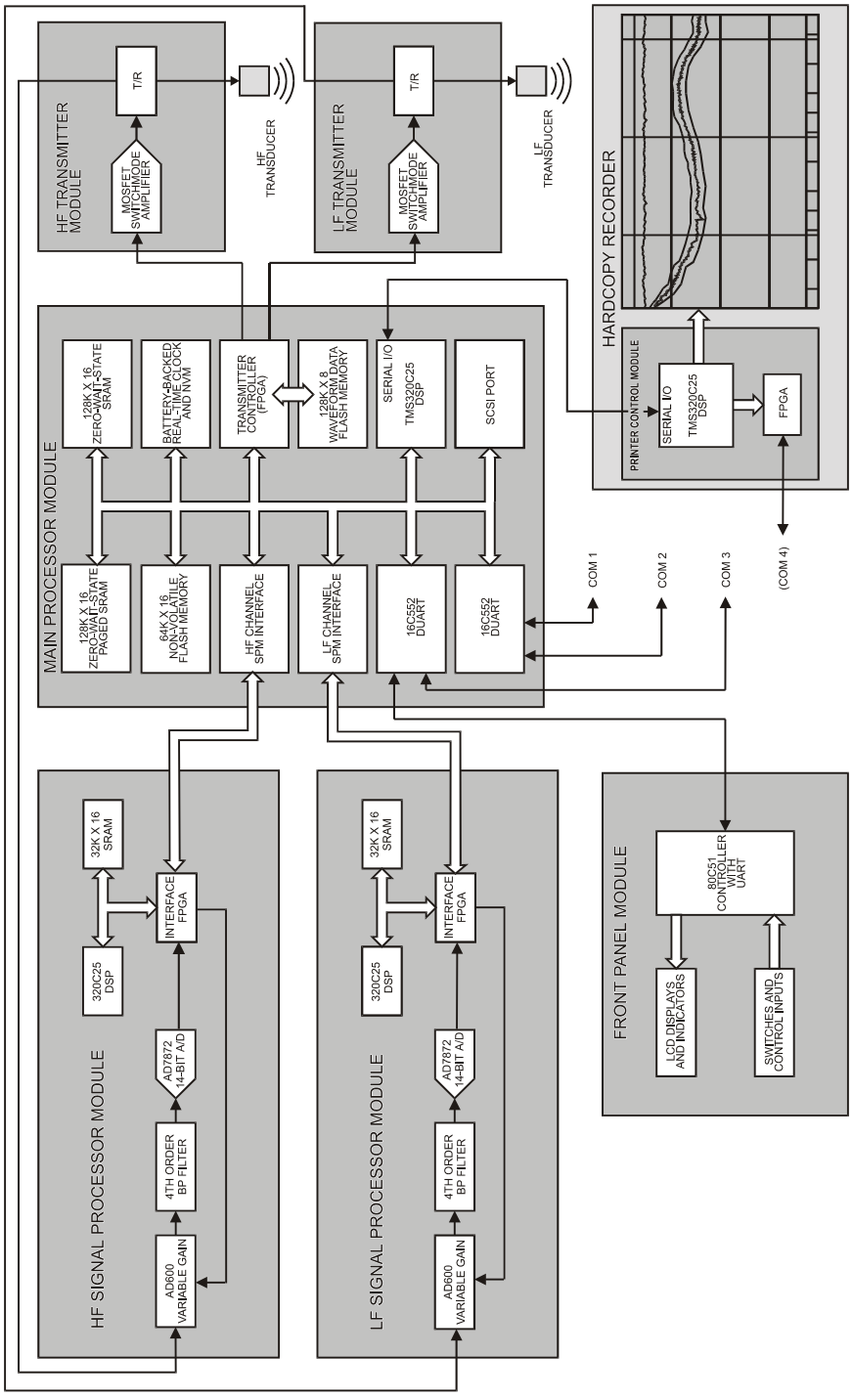
The control panel at the bottom of the unit can be detached as an assembly containing the panel itself, the switches and displays, and the printed circuit Front Panel Module. Removal of the front panel assembly in this manner entails removal of only four screws and four wiring disconnects, and can be accomplished with a Phillips screwdriver.

The thermal hardcopy recorder, which occupies most of the frontal view, is even more modular in execution. The entire printer mechanism, including the printed circuit Printer Control Module, hinges out for access to the paper rolls, and with two wiring disconnects can be lifted entirely off the hinges and removed from the Echosounder as an assembly.

The Transmitter Modules and the Main Processing Module are all mounted to the rear panel of the enclosure with standoffs, and are almost as accessible as the Printer and the Front Panel. The Signal Processing Modules are mounted to the MPM as mezzanine boards. All of these modules are shielded under a protective cover secured with four quarter-turn fasteners.

Finally, the Power Distribution Module mounts directly to a panel which forms part of the external structure of the 320M Echosounder, and which is removable as an assembly with eight screws and several disconnects.

Figure 1-1. The 320M Architecture



2 BASIC ECHOSOUNDER THEORY

2.1 Basic Concepts

The following section is intended for new or occasional operators. It provides a brief introduction to echosounding and to a few of the most important concepts. Experienced users may safely skip this section.

2.2 Pings and Echoes

An echosounder is an acoustic echo ranging device. It measures the depth of the water by transmitting brief pulses of ultrasound downward toward the ocean bottom, and measuring the time it takes for the bottom echo to return. The transmitted pulse, traditionally called a "ping", is a tone of a specified frequency with a duration of anywhere from a sixteenth of a millisecond to four milliseconds. The transducer is mounted through the hull of the ship, near the keel, with its active face pointed straight down. The same transducer is used for both transmitting the ping, and receiving the echo signal. The intensity of the received signal as a function of depth is printed vertically on the graphic recorder. After many repeated pings the bottom is visible as a horizontal black line, which follows the contours of the bottom. The sharpness and clarity of the line depend on the strength and quality of the echo, which depends on many factors, including bottom characteristics, pulse length, depth of the water, and the amount of ambient noise (noise "pollution", which comes from many sources and is unavoidable). The location of the strongest echo is "detected" by software and displayed/recorded as a depth in metres. Each frequency has its own independent display/record.

Echosounder operation is affected by many factors - some much more dominant in their effect than others. Several of the more important factors and their effects are discussed below.

2.3 Bottom Characteristics

The strength of the received echo is strongly affected by the type of bottom. The strongest echoes are produced by rock, gravel or sand (such bottoms are said to exhibit high "target strength"). Mud or silt surfaces have low target strength and produce weaker echoes.

The bottom characteristics can often be deduced from a graphic record, as a result of penetration of the ping into the ocean bottom. Echoes from harder layers a few decimeters beneath the surface of the sea floor often show up as a characteristic layering effect on the graphic record. This is particularly evident in the case of silt overlying rock.

2.4 Pulse Length

The 320 Echosounder's receiver processes the received signal with a bandpass filter with a passband centred at the transducer frequency. This filter allows the received echo to pass through, but rejects ambient noise at all other frequencies. It would seem logical to use the narrowest possible bandwidth, to achieve the greatest possible noise rejection, and thus detect the weakest echoes of the transmit pulse. Unfortunately, it isn't that easy. A signal pulse has a bandwidth approximately equal to the inverse of its duration - thus a one millisecond pulse needs a receive filter with a bandwidth of at least 1 kHz, or it will be attenuated along with the out-of-band noise. The shortest pulses need the widest bandwidth (and achieve poorest noise rejection)

while the longest pulses can use the narrowest filters, with the best noise rejection.

On the other hand, the short pulses produce better "range resolution", which permits more accurate depth measurement, and shows more detail on the bottom. Generally, short pulses are used in shallow water, where resolution is important, and where echoes are strong, while long pulses are used in deep water where echoes are weaker, and the noise rejection capability of narrowband filtering is more important.

2.5 Sound Speed

Because the 320 Echosounder is a digital system with a quartz crystal timebase, it does not require internal recalibration due to aging or temperature, and can measure the return time of the echo with a great deal of accuracy. The ultimate accuracy of the depth measurement also depends on the accuracy of the sound speed value used in the computation.

The speed of sound is not a constant, but depends on several factors, most importantly the salinity and the temperature of the water. Normally, the variations in sound speed from location to location are small enough that only occasional adjustments to this parameter are required, such as when transiting from fresh water to salt water. If maximum accuracy is important however, velocity measurements must be made and the sound speed value entered into the echosounder. Since sound speed can vary significantly with depth (as a result of temperature or salinity gradients) it may be necessary to enter an average velocity based on a measured sound velocity profile.

2.6 Draft

Draft is the nautical term used for the depth of the keel (the deepest point) of the vessel below the surface of the water. In echosounders it generally refers to the depth of the transducer below the water surface. The echosounder compensates for the effect of draft, both in the graphic record and in the digital depth display.

The amount of draft varies from time to time as a result of vessel loading, or a transit from fresh water to salt water, and a new value must periodically be entered into the echosounder.

2.7 Bar Check

A "bar check" is a test procedure used to set-up the appropriate speed of sound and draft settings for a sounding session. Typically, a bar check would be performed as follows.

A "bar" (a target which will return a distinct echo)is lowered to a known short distance below the surface. The draft is then adjusted until the depth return from the bar equals the known value. After the draft has been adjusted, the bar is then lowered to a deeper known depth. The sound speed is then adjusted until the depth return from the bar equals the known value. This procedure must be repeated several times until both elements are calibrated. After this procedure, the system will calibrated for the current water conditions and can be left unmodified for the remainder of the sounding session.

3 ACCURACY OF THE KNUDSEN 320 SERIES ECHOSOUNDERS

Note: We are frequently asked to specify the "accuracy" of the 320 series echosounders, and the answer is never straightforward. Although the following discussion does not provide the definitive response, it may shed light on some of the issues.

3.1 Introduction

Although modern echosounders can be sophisticated and complex, the principle on which they operate is simple - transmit a "ping" and listen for the echo. The time it takes for the bottom echo to return is directly proportional to the round trip distance, or twice the water depth. The accuracy of the depth value depends on a great many factors, some intrinsic to the echosounder and some, the local speed of sound for example, which are environmental factors beyond the control of the echosounder designer. This report discusses those factors which are affected by the design and operation of the echosounder.

Sources of error can conveniently be divided into three categories; repeatability, scale and offset. Repeatability is a fundamental limitation - there is no point in calibrating scale and offset to centimetres if the ping-to-ping variability is measured in decimetres. A brief discussion of some of the factors affecting repeatability and some of the design measures taken to enhance this characteristic is provided below.

Deterministic scale and offset errors which are amenable to calibration represent the main focus of this report. Echosounders are traditionally provided with offset and scale adjustments (in the form of draft and sound speed controls) which permit the user to calibrate the unit for his specific transducer installation and local water conditions. The user can set these two parameters by performing a bar check at two different depths (draft is set at the shallow depth, and sound speed at the deeper depth) and iterating the procedure as necessary to refine the values. Alternatively, the user can measure the draft and sound speed directly and enter the values into the echosounder. In this latter case, the user is trusting that the echosounder manufacturer has calibrated the unit correctly (particularly the draft) at the factory. This report discusses the technical aspects of echosounder calibration and accuracy.

3.2 Repeatability

3.2.1 Background

As already mentioned, ping-to-ping repeatability of the measured depth value is a fundamental limitation to echosounder accuracy. It is important to realize that the typical variability in the echo time-of-arrival measurement is much smaller than the total duration of the echo. The problem is not so much to locate the echo but to locate the precise point in the echo, time after time, which represents the calibrated depth value. Repeatability of the depth measurement therefore hinges on repeatability of the echo itself, at the transducer, and also on the repeatability of the process by which the depth determination is made within the echosounder.

3.2.2 Amplitude Effects

The depth determination invariably involves measurement of the precise instant at which the echo amplitude exceeds some threshold. For this to produce repeatable results, the echo amplitude has to be repeatable in relation to the threshold. Obviously echo amplitude varies widely depending on transmitted power, water depth, bottom reflectivity and receiver gain, and so amplitude normalization is a basic requirement of precision echosounding. Traditionally, amplitude normalization has been accomplished with a combination of automatic gain control (when available) and a considerable reliance on operator attention to control settings.

Amplitude normalization in the KEL 320 Echosounders starts with an assessment of the amplitude of each received echo. This is performed in software, after the signal has been digitized, filtered and envelope detected. The details of the algorithm are beyond the scope of this report, but basically it involves increasing the sample frequency of the envelope record by a factor of four with a cubic spline interpolation, and then cross-correlating the upsampled signal with a replica of the leading edge of the expected echo (this is also part of the bottom-picking algorithm). The correlation peak is scaled to produce a very accurate estimate of echo amplitude. Another filter is used with the correlation results to obtain the background noise level. A threshold is then computed as a specified fraction of the echo amplitude (usually 50%). The point in the sample record at which the envelope signal crosses the threshold is computed using polynomial interpolation and floating point arithmetic. The end result of this process is to decouple the depth measurement from both amplitude variations and sample rate limitations.

3.2.3 Bottom Type

Different bottom types can affect not only the amplitude of the return echo but also its shape. A very smooth, flat bottom provides an almost specular reflection with a well defined leading edge and very little off-axis return. A rough bottom, on the other hand, returns a considerable amount of off-axis scattering which tends to elongate the pulse and shift the point of peak amplitude downward. Generally speaking, bottom type effects are more difficult to compensate in the design of the echosounder than the simple amplitude effects mentioned above. The template-matching correlation scheme used in the 320 Echosounders for both bottom picking and amplitude normalization is very effective in minimizing sensitivity to bottom type.

3.2.4 Sample Rate Effects and Truncation Noise

This repeatability issue is peculiar to digital echosounders. It refers to the errors which accumulate whenever a timebase parameter is truncated or rounded off to the nearest sample interval or improperly interpolated. It ultimately places limits on the achievable resolution and therefore the repeatability of the time delay measurement. In early designs it tended to show up in the form of A/D converter sample-rate limitations. In modern echosounder designs it is more likely to be the result of fixed-point arithmetic or poorly written software.

The only practical solution to truncation and round-off noise is to use floating point arithmetic for all timebase related computations, and to use continuous polynomial interpolation when working with time-sampled data. This is the approach taken in all current releases of KEL 320 software. Digital timebase errors are essentially nonexistent in KEL 320 Echosounders.

3.2.5 Pulse Length Effects

If properly implemented, different transmit pulse lengths are matched to different receive filters, with short pulses matched to wide bandwidth filters, and vice versa (there is very little point in transmitting a long pulse unless the receive filter has an appropriately narrow noise bandwidth). The "group delay" of an analog or digital filter is inversely related to the bandwidth and can be quite considerable in a narrowband filter. Fortunately this is a deterministic effect and can be corrected (see the section on offset calibration). A more fundamental repeatability issue arises from the simple observation that long, narrowband pulses have a much longer rise time than short, wideband pulses, and the threshold crossing instant is more sensitive to minor amplitude variations. This is just another way of stating the well-known fact that longer pulses provide poorer range resolution than short pulses.

3.2.6 Frequency Effects

Hydrographic surveyors are well acquainted with the fact that low frequency sound penetrates soft sediments more readily than high frequency signals. They are also aware that the bottoms of oceans, lakes and rivers are often characterized by one or more layers of soft sediments (sometimes very soft, as in "fluff", which may be more liquid than solid) overlying harder, more acoustically opaque materials. Echoes are generated at the interface between substances of low acoustic impedance (such as water) and higher acoustic impedance (sediment). An even greater acoustic impedance difference may exist between buried layers of soft and hard sediment. A low frequency echosounder will often identify a buried layer of hard sediment as the "real" bottom, while a two-channel echosounder will often detect the shallowest interface on the high frequency channel, and a deeper layer on the low frequency.

If the digitized depth values are consistent under these conditions, the results with a two-channel echosounder can provide useful information about the type of bottom. More often, the depth values "bounce" back and forth between one interface and another, producing misleading data.

3.3 Scale Errors

Modern echosounders use extremely precise quartz crystal timebase control, so in theory calibration error in the scale parameter (sound speed) is effectively zero and can safely be disregarded. In practice, the theoretically achievable accuracy can be compromised by errors in the digital processing of timebase parameters, mostly as a result of fixed-point arithmetic or truncation errors. However, this is a software issue, and is easily resolved with good programming practice and floating-point arithmetic as used in the KEL 320 Echosounders.

Note that the scale parameter calibration error referred to here is the accuracy of the correction applied to the depth value by the echosounder to compensate for the speed of sound value entered by the user, either in the course of a bar check or from a sound velocimeter. The depth accuracy still depends ultimately on the accuracy of the sound velocity value provided by the user. In practice, errors in the sound velocity value account for virtually all of the scale effects on the accuracy of the depth measurement.

3.4 Offset Errors

The offset (draft) parameter is calibrated to zero at the factory to account for all of the small time delays built into the signal paths in the echosounder, by far the largest component of which is group delay through digital filters. The group delay through a transversal digital filter depends on the sampling interval and the number of taps, which varies inversely with the filter bandwidth, which is different for each filter. The important point to note here is that this offset calibration must be carried out independently for each of the different receive filters (or for each different pulse length) for each frequency.

This actually represents one of the big advantages of the digital signal filters used in the KEL 320 products, over the multiple analog filters used in other "digital" echosounders. The group delay values of the digital filters are defined precisely in software, and are compensated for in software, once, for all echosounders using that frequency. No "tuning" of pots or coils in individual echosounders is involved, and of course software never drifts.

It should be noted that all of the digital filtering in KEL 320 Echosounders is performed with transversal, or finite impulse response (FIR) filters which are unconditionally stable.

The two-way group delay of the transducer itself contributes a very small amount to this offset error, varying slightly from transducer to transducer, and so the factory offset calibration (zeroing the draft value) is inherently less precise than the scale calibration.

3.5 Factory Calibration Procedures

3.5.1 Introduction

Factory calibration of the offset (or draft) parameter consists of determining the amount of correction required, for each filter, to zero the draft control. These correction values are entered into the software source code and become part of echosounder firmware. The echosounder then applies these corrections when calculating depth values. The correction values are maintained as 32-bit floating point numbers and have units of echogram envelope sample intervals.

The first step in the calibration procedure is to set all of the corrections to zero in source code, and to compile and load this code into an echosounder. A test is then carried out to measure the draft error for each filter. The required correction values are computed from the measured errors, and entered into the source code, which is then re-compiled and loaded into the echosounder. The final step is to carry out tests to confirm the accuracy of the corrections.

Two somewhat different test procedures are used at Knudsen Engineering. Both are briefly described below.

3.5.2 EDI Calibration Procedure

The primary calibration tests are performed with an EDI DSTS-4A Digital Sounder Test Set manufactured by Electronic Devices Inc. This instrument connects to the transducer output of the echosounder and returns a simulated echo signal after an interval corresponding to a depth value which is set by the operator. The echosounder sound speed parameter is set to the value (1500m/s) used by the DSTS-4A, and draft is set to

zero. The difference between the depth value preset by the operator (d_1) and the depth value reported by the echosounder (d_2) is then converted to a floating point value in units of sample intervals (the sample frequency of each filter is derived from the sounder's highly stable and accurate 40MHz quartz crystal oscillator):

$$n=(2f_e/1500)(d_2-d_1)$$

where f_e is the envelope sampling frequency.

This value (n) is then entered into source code as a floating point draft correction for that filter.

3.5.3 Two-point Calibration Procedure

As a check on the accuracy of the EDI instrument, and in cases where the EDI unit is not ideally suited (eg, chirps or very short pulses), an alternative procedure is sometimes used.

The preliminary steps of zeroing the calibration corrections in source code, loading the code into the echosounder, setting sound speed to 1500m/s and draft to zero are carried out as above. The echosounder is then connected to a suitable transducer set up a precisely measured distance from a target. The echosounder is turned on, and depth values are recorded for all filters. The transducer/target separation is then changed to a second carefully measured value, and the test repeated. Given the two carefully measured ranges (r_1 and r_2), and the two depth values reported by the echosounder (d_1 and d_2), the draft correction can be calculated as follows:

$$n=(2f_e/1500)(r_2d_1-r_1d_2)/(r_2-r_1)$$

where f_e is the envelope sample frequency.

3.6 Summary

To summarize the discussion above:

1) The **scale** error contributed by the echosounder is essentially zero. Scale accuracy is normally controlled by the accuracy of the speed of sound value which is entered by the operator, usually in the course of a bar check.

2) The **offset** error contributed by the echosounder is dependent upon the quality of the factory calibration of each of the filters for zero draft. If present, this error will show up as a change in the depth value when the pulse length is changed, and so its existence and magnitude is easily evaluated. Factory calibrations are carried out under controlled conditions and residual offset or draft errors will invariably be less than the repeatability of the depth measurements.

3) The **repeatability** errors contributed by the echosounder are difficult to measure, because under

normal operating conditions they are dominated by instabilities in the propagation medium, which is of course outside the control of the echosounder.

4 DIGITIZED DEPTH VERSUS PRINTED ECHOGRAM

We are often asked about discrepancies between the digital depth value and the printed echogram. Most often, the printed echogram shows the leading edge of the bottom echo to be shallower than the digitized depth. This note addresses the reason for this apparent discrepancy.

In the early days of echosounders, before digitizers, the printed record was the only record. The hydrographer adjusted the draft and sound speed during a bar check using the depths he scaled directly from the printed record, based on his visual determination of the location of the leading edge of the echo. There were two problems with this approach. First, the hydrographer would have noticed that the depth was slightly dependent on receiver gain. By cranking up the gain he could "thicken" the bottom line and decrease the apparent depth slightly. Reducing the gain had the opposite effect. Second, the person who digitized the printed record back in the shop may have had a slightly different view of the precise location of the leading edge of the echo - a bias toward a lighter or darker shade of grey as the threshold point.

Both of these problems result from the fact that the leading edge of the echo is not a distinct event. The echo arrives as an increase in signal strength from the background noise level to the echo peak over a finite period of time. The rise time of the echo has a minimum duration of about half the transmitted pulse length. To put this into perspective, the duration of the leading edge of the echo from a 0.1 ms transmit pulse (a typical pulse length for high frequency shallow water work) is equivalent to almost 4 centimetres of depth. The longer pulses used in deeper water have longer rise times. In practice, however, the echosounder is more accurate than these rise times would lead us to believe.

In the days before digitizers, the easiest way to deal with the rise time problem was to operate the sounder with receive gain increased to the point where the background noise just started to show, and the bottom echo was strongly saturated. This has the effect of setting the detection threshold very low, almost at the noise level, and it works well because the human brain is very good at distinguishing echo from noise. The repeatability (and accuracy) of depths scaled by hand from such records is typically a fraction of the nominal pulse length.

The digitizer software, on the other hand, is designed to set its threshold at the midpoint of the leading edge, at the 50% amplitude point, because this is the value that provides optimum detection performance.

The problem is that hydrographers tend to set their visual threshold at the point in the echogram where the echo first becomes visible, which is often somewhat shallower. The difference between the digitized depth and what the hydrographer sees on the printed record is more pronounced at the high print contrast levels many users prefer, and with longer pulse lengths.

Two points are worth noting. First, the fact that the digitizer threshold is set at the 50% point rather than at some lower (but still visible on the echogram) value does not mean that the echosounder has a built-in error equal to half the rise time of the echo (or a quarter of the pulse length). In fact, the echosounder software is carefully calibrated at the factory to account for this difference. Separate calibrations are performed for each pulse length, and for each frequency. The results of these calibrations, which are equivalent to "zeroing" the draft parameter, are incorporated in the echosounder firmware.

Second, the point at which the echo becomes visible on the echogram is highly dependent on the print

contrast mode which is used (see the user manual for an explanation of these modes). With most print contrast modes (particularly including manual contrast), the relationship between the greyscale echogram and the digitized depth is subject to interpretation.

In summary, the digitized depth is most likely correct, even if the printed record appears to be slightly shallower. This should only be a matter for concern if the depth discrepancy is much greater than about a quarter of a pulse length.

KNUDSEN ENGINEERING LIMITED

CUSTOMER SERVICE REQUEST

D10-02252 R2.0

Report problems to:
Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085

E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

IN ORDER TO HELP YOU QUICKLY, WE NEED THE FOLLOWING:

Customer #: _____
Customer Name: _____
Contact Person: _____
Phone: _____ **Fax:** _____
E-Mail: _____

Unit Serial #: _____
Firmware Part #: _____ **Version #:** _____
PC Software: Part #: _____ **Version #:** _____

Echosounder settings at failure (if available):

Units: ☐ Meters or ☐ Feet or ☐ Fathoms
Range: ☐10 ☐20 ☐50 ☐100 ☐200 ☐500 ☐1000 ☐2000
Phase: ☐Auto ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7
Autophase Limits: **Min:** _____ **Max:** _____
Primary Channel: ☐ HF ☐ LF

	HF CHANNEL (if available)	LF CHANNEL (if available)
Pulse Length:		
Draft:		
Rx Gain:	☐AGC ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7	☐AGC ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7
Tx Power:	☐1 ☐2 ☐3 ☐4 Other____	☐1 ☐2 ☐3 ☐4 Other____
Tx Blank:		
Sensitivity:		
Processing Gain:		

Peripheral Equipment being used (if any):

GPS Receiver: _____ **Heave Sensor:** _____
Data Logger: _____ **Other:** _____

DESCRIBE PROBLEM:

HOW CAN YOU PROVOKE PROBLEM?

CUSTOMER SERVICE REQUEST