Operator manual

KONGSBERG

Kongsberg Simrad EA 500

Hydrographic echo sounder

Base version

Kongsberg Simrad EA 500

Hydrographic echo sounder

Operator manual - Base version

850-043661 / AA000 / 1-11

Note

Kongsberg Simrad AS makes every effort to ensure that the information contained within this document is correct. However, our equipment is continuously being improved and updated, so we cannot assume liability for any errors which may occur.

Warning

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

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Sections

This book is the Operator manual manual for Base version. It describes how to install the various units used by the EA 500 system.

The installation of the hull unit is described in a separate manual.

Remarks

References

Further information about the EA 500 system may be found in the following manuals:

- EA 500 Maintenance manual
- EA 500 Installation manual

The reader

This operator manual is intended to be used by the system operator. He/she should be experienced in the operation of echo sounder systems, or should have attended a Kongsberg Simrad training course.

Note

This manual includes sections that may be revised individually. In the event of a revision to any part of this manual, this “Cover and Contents” section will be replaced.

Document logistics

Rev	Date	Written	Checked	Approved
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Comments

Rev	Comments
A	Original edition. Software version 2.40.
B	Software version 2.60.
C	New rear panel, changes in section 1 only.
D	Software version 3.00.
E	Software version 4.00. The layout of the manual has been updated to confirm with Simrad standards.
F	Corrections and additions throughout the manual, and in the appendices P2265E Error Messages and P2571E EA 500 DWS.
G	Correction in section ”Introduction”, page 9. Change notice D227.
H	Manual modularized, and updated to reflect new software (version 5.20).
I	Updated to software version 5.30.
J	Manual digitized. *System familiarization* and *Operational procedures* converted to QS with new layout, other documents scanned. No changes to the text.

To assist us in making improvements to the product and to this manual, we would welcome comments and constructive criticism. Please send all such - in writing or by e-mail - to:

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Documents

This manual contains the following individual documents:

Cover & Contents . . . . 850-043551 . Rev.J

System familiarization . . . . 850-130645 . Rev.B

Operational procedures . . . . 850-130647 . Rev.B

Command references . . . . 850-130495 . Rev.B (Software version 5.3)

Maintenance . . . . 850-130682 . Rev.B

Technical specifications . . . . 850-130646 . Rev.A

Communication ports . . . . 850-130683 . Rev.A

Theory of operation . . . . 850-130659 . Rev.A

Appendices:

Status and error messages . . . . . . 859-043870 . Rev.F

EA 500 Sample / ping interval . . 859-130088 . Rev.B

EA 500 Pinger mode . . . . 859-043976 . Rev.B

EA 500 Multi-channel option . . . 859-130096 . Rev.B

EA 500 DWS System . . . . 859-130177 . Rev.C

ASCII - Hex conversion table . . . 859-043869 . Rev.C

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850-130645 / AA000 / 1-11

EA 500 System familiarization

This section of the manual describes the hardware for the echo sounder system.

Document revisions

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B	19.10.01	RBr	ESB	GM
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Table of contents

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Rev.A	Original issue. Was formerly section 1 of document P2158E.
Rev.B	Document converted to QS. New images pasted in. No changes to the text.

1 INTRODUCTION

Simrad has been in the business of developing special purpose echo sounders since the 1950's. Accumulated experience, combined with the use of the latest technology and circuit design, has resulted in an echo sounder with greatly improved performance and with a number of unique features.

The EA 500 is a modular, triple frequency, high-performance hydrographic echo sounder, with a very accurate reception system and with independent parallel processing within each of the frequency channels.

A range of single-beam transducers is available to allow a variety of frequencies to be used. A dedicated 120 kHz split-beam transducer is also available for measuring true seabed inclination in the athwartships direction.

A completely new concept is used in the receiver design, providing an instantaneous dynamic range of 160 dB. At the same time, the absolute amplitude measurement accuracy is very high, and this combined with a low self-noise assures optimum operation under most conditions. It should be noted that the receivers are never saturated due to their large instantaneous dynamic range. Hence, very shallow water surveying becomes a trivial exercise.

The bottom detection algorithm is implemented solely in software, and separate calculations are performed for each transducer channel. The algorithm is designed with emphasis on reliability, so that erroneous depth detections should not be output. Where uncertainty exists, the algorithm reports unsuccessful detection rather than an unreliable depth value. This feature is considered essential in modern survey work where a post-processor is used for automatic generation of maps, profiles etc.

The EA 500 system includes a display and colour printers showing echogram and alphanumeric information. The devices are individually controlled in the sense that echogram range and other presentation parameters are set independently for each device.

The sounder is equipped with powerful data interfaces for connection to external postprocessing and data logging systems.

2 THE SYSTEM UNITS

2.1 Configuration

The EA 500 hydrographic echo sounder can be configured for single, double or triple frequency operation. The various components included in a triple frequency delivery are shown in Figure 1. These are:

- Sounder unit
- Display unit (11” LCD, 14” or 20” CRT)
- Transducer(s)
- Colour printer(s)
- RD display

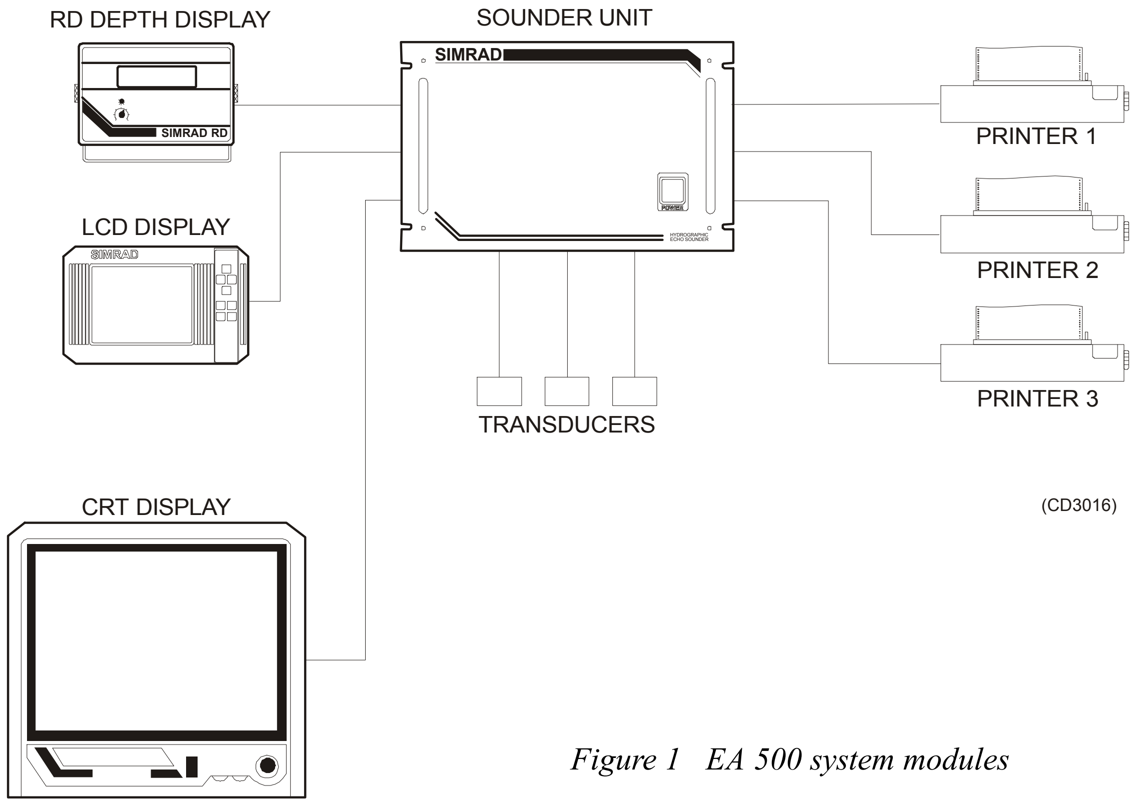

Figure 1 EA 500 system modules

A separate transducer is used for each channel, and the operating frequencies available are in the range 12 to 710 kHz. Single-beam transducers are available for all frequencies, and a split-beam transducer is available at 120 kHz for measurement of bottom slope.

The sounder is typically connected to an 11” LCD display unit or a 14” colour CRT display unit, both with a built-in joystick. An optional display type is a 20” rack/console-mounted colour CRT unit with a small table-mounted keypad unit.

The printers output individually-controllable colour echograms and alphanumeric data. The paper width is 210 mm, with 720-dot resolution across the paper. Transmitter, receiver, processing and power electronics are all housed in the sounder unit; a rugged and compact unit with mechanical dimensions compliant to the 19” rack standard.

2.2 Simplified block diagram

Figure 2 shows the simplified block diagram of the echo sounder electronics.

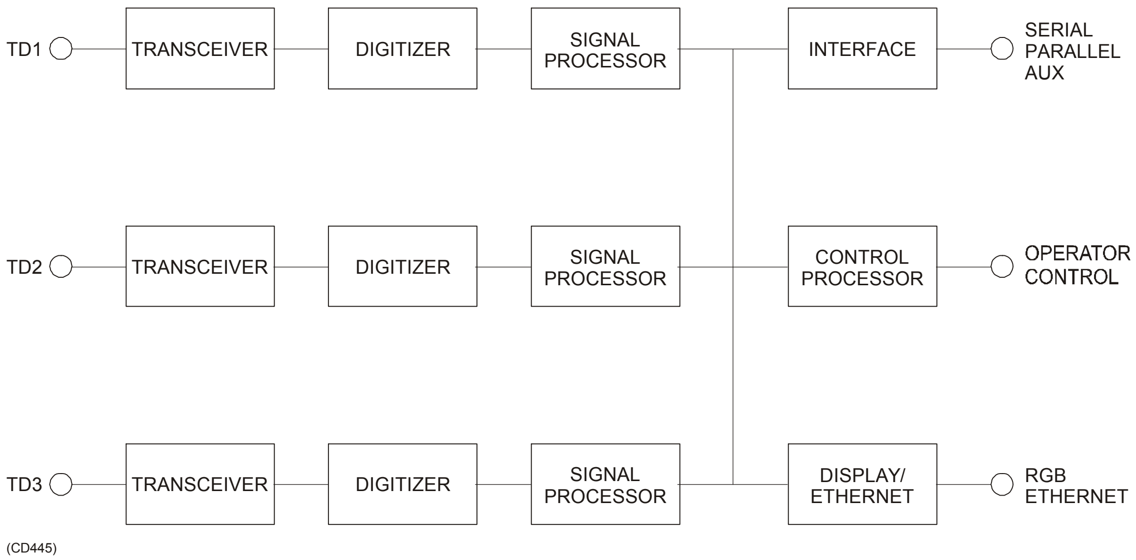

Figure 2 Simplified block diagram

Each transducer channel comprises the following functional modules:

- A transceiver module containing transmitter and receivers
- A digitizer module performing A/D-conversion and measurement of electrical phase (applies to split-beam operation only)
- A dedicated signal processor implementing algorithms for bottom detection, parameter estimation, echogram generation etc.
- A control processor. The signal processor(s) communicates via a common multi-processor bus with the central control processor. This processor coordinates and synchronizes all activities inside the sounder and handles communications with external devices.

- A display/Ethernet module controlled by the control processor; the ”Display” part generates standard RGB (Red Green Blue) video signals, and the ”Ethernet” part contains a LAN interface of the Ethernet type.
- An interface module including RS232 serial interfaces, Centronics printer interfaces, analogue input signals and output signal for external transmit synchronization.

2.3 Interconnections

Figure 3 shows the rear panel of the sounder unit. There are five serial ports of type RS 232:

- Serial port 1 - Remote control and data output.
- Serial port 2 - Annotation input.
- Serial port 3 - Navigation data input/NMEA data output.
- Serial port 4 - Sound velocity probe input.
- Serial port 5 - Simrad RD remote display output.

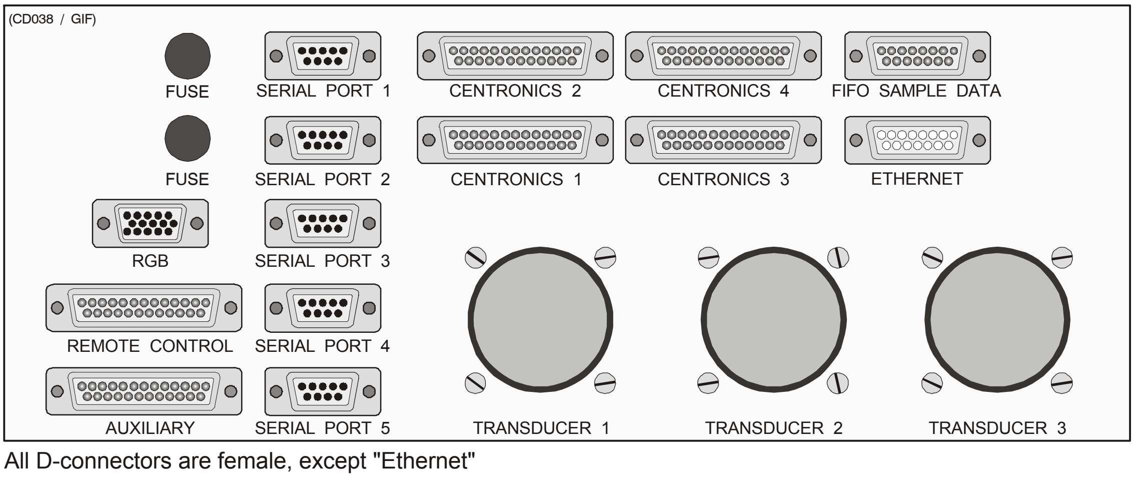

Figure 3 Sounder Unit rear connection panel

Printers 1 to 3 are connected to CENTRONICS ports 1 - 3, and the display/joystick/keypad units are connected to the RGB and the REMOTE CONTROL connectors. Centronics port 4 is used for transducer sequence operation. The REMOTE CONTROL connector comprises parallel lines for cursor control and numeric input. The AUXILIARY connector includes a differential analogue input for heave/roll/pitch sensor signals and external transmission synchronization input/output signals.

850-130647 / AA000 / 1-11

EA 500
Operational procedures

This section of the manual describes the man-machine interface, gives procedures for switching the system on and off, and includes various operational procedures

Document revisions

Rev	Date	Written by	Checked by	Approved by
A	15.03.96	CL	OL	EF
B	19.10.01	RBr	ESB	GM
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Table of contents

Document history

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Rev.B	Document converted to QS, images scanned and pasted in. No changes to the text.

1 INTRODUCTION

1.1 Overview

The display unit normally fitted with the EA 500 echo sounder is a 14” colour display. This unit has a joystick located towards the right side of the front panel, below the display, that is used to control the echo sounder system. Other types of display units may use ”Arrow” keys in place of a joystick. Pushing an arrow key will have the same effect as pressing the joystick in the corresponding direction.

1.2 The joystick

The joystick enables the operator to move a cursor (a reverse video field) over the desired choices in the menu. Each press up ( ) or down ( ) on the joystick will move the cursor one line up or down in the text. A push to the right ( ) will select the particular parameter, or enter the set value, and return the system to the submenu. Pushing to the left ( ) will exit the parameter or submenu without effecting any changes to the values.

A summary of the commands are:

Up - Moves the cursor upwards on the menu or increases value of parameter

Down - Moves the cursor downwards on the menu or decreases value of parameter

Right - Selects parameter/enters value, and returns system to submenu

Left - Exits parameter/submenu without making changes, and returns system to previous menu level.

2 THE DISPLAY AND PRINTER LAYOUT

2.1 The display layout

The display screen is divided into two main sections; the system menu is displayed towards the left side, and the graphic field (echogram) is displayed towards the right.

The following information will be added to the echogram if the appropriate settings are made in the menu by the operator:

- Bottom range echogram.
- Scale lines.
- Bottom slope line.
- Bottom detection lines.
- Event marker.

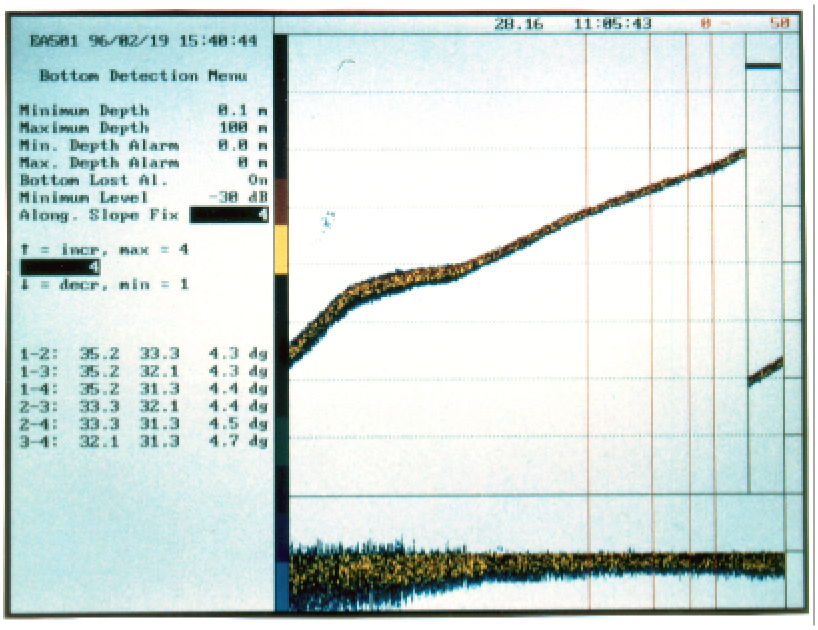

Figure 1 Display echogram example

2.2 The printer layout

The printer is able to generate a combination of echograms, lines and text. Most elements are controlled by parameters located in the Printer Menu.

The printer echogram may contain all the information of the display echogram, as well as the additional elements:

- Nautical mile marker
- Annotation
- Date and time
- Navigation text

The control of one printer device will have no influence on the other EA 500 output devices. The colour printer is specified for a maximum paper speed of 5 lines/sec. It has a graphic resolution of 720 dots, using 12 different colours ranging from blue to red. Black is used mainly on text and separation lines.

The printer may have up to three independent echograms. The echogram number is associated with the transceiver number, hence it will be impossible to print two separate echograms from one transceiver on the same printer.

A typical layout of a printout is shown in figure 2, while figure 3 shows an echogram with along. slope fixes.

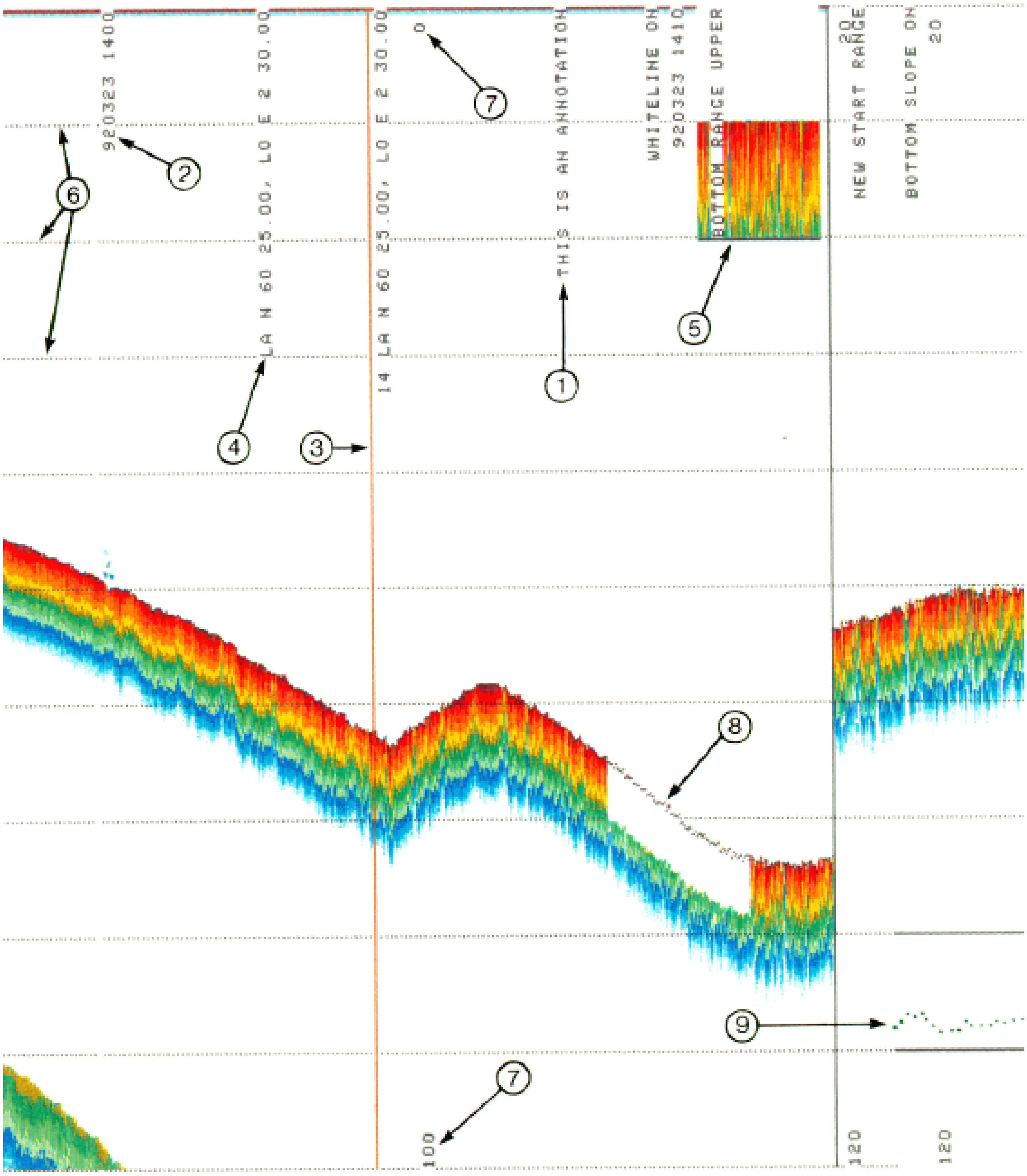

Figure 2 Printer echogram

1 - Annotation text

2 - Annotation date and time

3 - Event marker and number

4 - Navigation data

5 - Bottom range

6 - Scale lines

7 - Range

8 - Bottom detection range

9 - Bottom slope

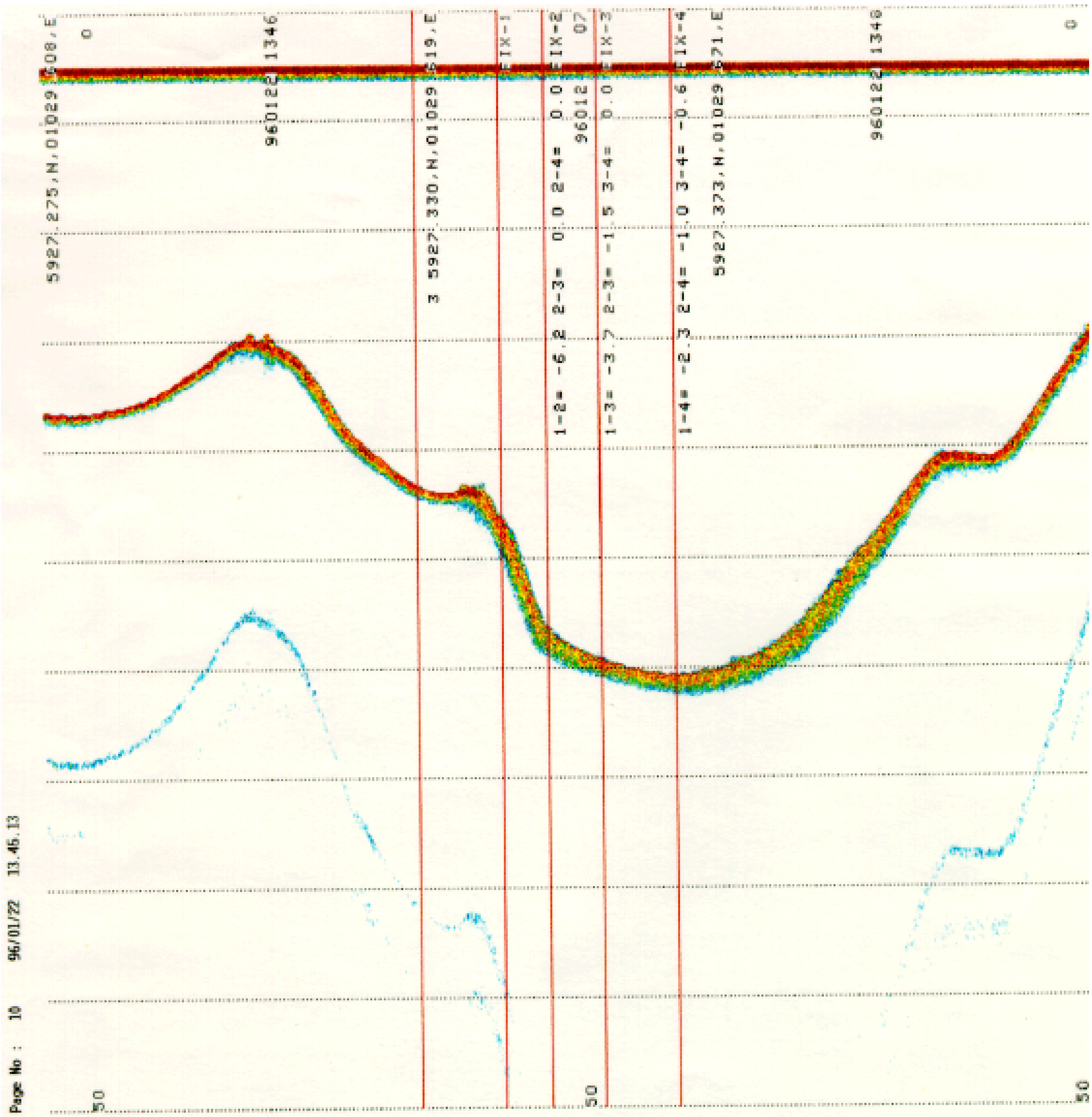

Figure 3 Printout with four along-slope fixes

3 COLOUR SCALE

The colour scale is proportional to the strength of the signals, and the echo strength is divided into twelve colour categories. The scale is logarithmic with a 3 dB step between each colour, giving the colour scale a range of 36 dB from the weakest to the strongest echo signal.

Display colour	Signal strength range
Black/white	From weak signal to −44 dB
Blue	44 to −41 dB
	−41 to −38 dB
	−38 to 35 dB
	−35 to −32 dB
	−32 to −29 dB
	−29 to −26 dB
	−26 to −23 dB
	−20 to −17 dB
	−17 to −14 dB
	−14 to −11 dB
Red	From −11 dB to very strong signal

The colour scale is displayed in the echogram. Note that the above relationship between colours and dB values is only valid when the Colour Gain parameter is set to 0 dB.

4 HOW TO SWITCH THE ECHO SOUNDER ON AND OFF

1 Switch on the mains power to the Sounder Unit. The On/Off switch is located on the front side of the unit.

2 Switch on the mains power to the Display Unit. The On/Off switch is located on the front side of the unit.

3 Switch on the mains power to the printer(s).

4 To switch the echo sounder off, reverse the above procedure.

5 HARD RESET

Hard reset is achieved by pressing the joystick to the left when switching on the power. The contents of the RAM will then be reset, and the sounder will come up with the default settings. Hard reset is also achieved by pressing the switch behind the hole marked HR on the Transceiver Unit front when switching on the power.

6 OPERATIONAL PROCEDURES

6.1 Introduction

The echogram movement across the screen and on the printer is determined by the setting of the Echogram Speed parameter (Display Menu and Printer Menu) and the Ping Interval (Operation Menu). The echogram colour presentation is mainly influenced by Colour Gain and the selected TVG (DISPLAY/Echogram Menu and PRINTER/Echogram Menu). If the Bottom Range Pres. command is enabled, 20% of the main echogram is overwritten by a bottom-referenced echogram. Note that, in the following procedures, # denotes transceiver number and @ printer number.

6.2 How to start the sounder

The following procedure is the minimum required to instruct the echo sounder to start pinging, track the bottom and generate an echogram. In this example it is assumed that only transceiver channel 1 is used.

1 Select the Transceiver menu.

2 Select the Transceiver-1 menu and check that Mode is set to Active.

3 Select the Display menu and check that Echogram is set to 1.

4 Select the Bottom detection-1 menu and set Maximum depth to a value at least as deep as the maximum depth to be expected.

5 Select the Operator menu, and set Ping mode to Normal.

After a short delay, the sounder will start to ping and an echogram will begin scrolling from right to left on the display.

6.3 How to generate a bottom range echogram on the display and printer echograms

1 Select the DISPLAY/Echogram-# Menu (or the PRINTER/Echogram-# Menu).

2 Set the Bot. Range Pres. command to Upper, Bottom or Lower, depending on where you want the Bottom Range to be positioned.

3 Set Bottom Range to the desired range of the bottom echogram.

4 Set Bottom Range Start to the desired upper start depth of the bottom echogram.

The bottom range echogram is independent of the main echogram. It will overwrite 20% of the main echogram. The bottom range echogram is separated from the main echogram with a solid boundary line. The bottom range echogram is blanked out if no bottom detection has been done.

If Sub.Bottom Gain is set above 0.0 dB/m, the bottom range presentation will feature an excess gain below the detected bottom.

6.4 How to generate scale lines on the display and printer echograms

1 Select the DISPLAY/Echogram-# Menu (or the PRINTER-@/Echogram-# Menu).

2 Select Scale Lines and enter the number of equidistant lines you want across the echogram.

6.5 How to generate event markers on the display and printer echograms

1 Select the Display Menu (or the Printer Menu).

2 Set Event Marker to On.

The event input may be caused by an external push button or activated by Event Counter in the Annotation Menu. The event will result in a red vertical line on the screen and on the printout. The echogram printout will also include the current event number and navigation data.

6.6 How to generate bottom detection line(s) on the display and printer echograms

The bottom detection line may be introduced for easy marking of the bottom. Each channel has the possibility of displaying the bottom detection line of other channels.

1 Select the DISPLAY/Echogram-# Menu (or the PRINTER-@/Echogram-# Menu).

2 Set Bot. Det. Line to any of these combinations: 1, 2, 1&2, 3, 1&3, 2&3, 1&2&3.

3 To select which type of sub-bottom presentation you want, set Presentation to Normal, Wh. Line or Contour.

6.7 How to generate annotations on the printer

1 Select the PRINTER-@/Echogram-# Menu.

2 Set Annotation to On.

3 Annotation messages received will then be printed on the echogram.

6.8 How to generate navigation data on the printer

1 Select the PRINTER-@/Echogram-# Menu.

2 Set Navigation Interval to the desired value.

3 The Navigation Interval command sets how often the incoming navigation telegrams are to be printed on the echogram.

If, for example, the navigation telegrams are coming in every second and the Navigation Interval is set to 60, the navigation data will be printed every minute.

No navigation data will appear on the printer when Navigation Interval i set to 0.

6.9 How to generate an athwartships bottom slope line on the display and printer echograms

The athwartships bottom slope line can only be generated if a split-beam transducer is used.

To see the bottom slope line on the display, select the Bottom Detection Menu.

To get a continuous plot of the slope angle on the echogram, select the DISPLAY/Echogram-# Menu (or the PRINTER-@/Echogram-# Menu) and set Bot. Slope Line to On.

The bottom slope information will over-print 20% of the echogram. The athwartships slope line (green) is positive when the bottom is shallower on the starboard side. The slope angle value is plotted as dots in a ±60° scale, with positive values above and negative values below the 0° line.

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COMMAND REFERENCES

P2887E /850-130495 /4AA005

This document describes the menus and commands in the EA 500 echo sounder. Every option is described in detail.

Note that the command options will vary with the software version. *This description is based on software version 5.30.* If your system operates on a different version, please notify Simrad to have your documentation replaced.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
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B	10.06.97	CL	10.06.97	EF	10.06.97	EF

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References

Rev. A First edition as module. Was part of section 2 of P2158E.
Rev. B Updated to software version 5.30

1 INTRODUCTION

Note

This EA 500 Operator Manual is based on software version 5.30. Changes in the software may require amendments to this manual.

The echo sounder is controlled using an interactive menu system. The main menu comprises a list of submenu headings, each of which contains either a list of commands or a further list of submenus. A joystick on the CRT Display Unit (or the "arrow" keys on the LCD Display Unit) is used to move a cursor (inverse video) through the menu, make selections from the menu, and alter the values of the parameters.

When the echo sounder is first switched on, the main menu will be displayed towards the left side of the screen, as shown below:

```
MAIN MENU

OPERATION MENU
DISPLAY MENU
PRINTER MENU
TRANSCEIVER MENU
BOTTOM DETECTION MENU
ETHERNET COM. MENU
SERIAL COM. MENU
ANNOTATION MENU
NAVIGATION MENU
SOUND VELOCITY MENU
MOTION SENSOR MENU
UTILITY MENU
TEST MENU
```

When a submenu is selected from the main menu, the main menu will disappear and the submenu text will be displayed instead.

The following chapters and paragraphs describe the submenus and commands, beginning with the first command in the main menu.

2 OPERATION MENU

```
        OPERATION MENU

Ping Mode                  Off
Ping Auto Start            Off
Ping Interval          0.0 sec
Transmit Power          Normal
Noise Margin              0 dB
```

The Operation Menu is used to activate the sounder, to choose if the sounder is to start pinging immediately after being turned on, to set the interval between pings, to select between full power and reduced power and to set the noise margin.

Ping Mode

Options:

Off
Normal
Ext. Trig.
Multiple

This command enables the echo sounder to operate from either an internal or an external trigger. The command is also used to switch the transmission off, or to switch to the "multipulse" mode.

At power-on this command is set to *Off*, i.e. the sounder is not activated. To start transmitting, either the *Norma*l or the *Ext.trig.* option must be selected.

Normal operation is enabled when this command is set to *Normal*, provided that the transceiver(s) is in the active mode.

Ext.Trig. is used when the sounder is to be triggered by an external pulse.

Multiple enables multiple pulse operation. Refer to the *section Theory of operation* in this manual. *Multiple* can only be used with one active channel at a time.

Ping Auto Start

Options:

Off
On

This command sets the echo sounder to start pinging immediately when switched on. After power on, it will normally be necessary to enter the Operation Menu and set *Ping Mode* to *Normal* to start pinging.

If *Ping Auto Start* is *On* and *Ping Mode* is in any setting other than *Off*, the sounder will start pinging automatically when power is turned on.

Ping Interval

Options:

0.0 to 20.0 seconds in steps of 0.1 second.

This command sets the interval between pings. A fixed ping interval can be set. If the echo sounder is unable to ping as fast as the selected ping interval, a warning will be given, and the ping will be delayed one or more ping intervals. Normal operation is 0.0, i.e. the sounder will ping as fast as possible (only delayed by sound propagation and internal data processing).

Transmit Power

Options:

Normal
Reduced

This command sets the power used during transmission. The transmission power is reduced from its nominal value by 20 dB on all transducer channels by entering *Reduced.* 20 dB down is similar to 1/100 of full power measured in watts.

Noise Margin

Options:

0 to 40 dB in steps of 1 dB

This command enables you to set a noise margin.

The system noise is defined as the sum of receiver noise, local noise and ambient noise. It is continuously estimated during normal operation, and independent computation is performed for each transducer channel. The EA 500 has a continuously increasing transmission loss compensation function included in the software that does not stop at a maximum value. Noise will therefore appear as coloured bands on the echogram when the maximum range of the transducer channel is approached. Consumption of printer ink will then increase considerably. The *Noise Margin* parameter counters this problem. Signal power samples from the receiving system are only forwarded to further processing if their power level exceeds the system noise level plus the *Noise Margin* setting. Thus, with the *Noise Margin* set to *10 dB* most of the noise samples will be disregarded, and only a few noise spikes will appear on the echogram as isolated coloured dots. A Noise Margin of *0 dB* disables the threshold mechanism described. The system noise is defined as the sum of receiver noise, local noise and ambient noise. It is continuously estimated during normal operation based on a precise and relatively robust algorithm.

Note that to observe continuous test signals, the *Noise Margin* must be set to *0 dB*. In general, the noise margin should be kept as low as possible.

3 DISPLAY MENU

```
           DISPLAY MENU

Colour Set               Light
Event Marker               Off
Echogram Speed             1:1
Echogram                     1
Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu
```

The Display Menu is used to choose between different display modes, to introduce an event marker on the display, to select the desired speed of the echogram movement across the screen and to switch the echogram presentation on and off. The Display Menu also contains entry lines for the Echogram submenus.

Colour Set

Options:

Light
Dark
Mono
LCD

This command sets the colour mode for the display. Various display modes can be chosen; light or dark background colour, monochrome, or a video signal which is also suitable for the LCD display unit.

Event Marker

Options:

Off
On

This command enables event markers to be displayed. When *Event Marker* is set to *On*, a vertical line is drawn across the echogram on the display each time an "event" occurs. Refer to paragraph 9, Annotation Menu, for information about how to generate events.

Echogram speed

Options:

1:1	*1:5*
1:2	*1:10*
1:3	

This command selects the frequency at which the pings are displayed. When set to *1:1,* every ping is displayed. Setting *1:2* causes every second ping to be displayed, setting *1:3* causes every third ping to be displayed, etc. Note that this only slows down the display echogram speed; it has no influence on the other output devices.

Echogram

Options:

OFF	*3*
1	*1&3*
2	*2&3*
1&2	*1&2&3*

This command controls selection and composition of echograms displayed on the screen.

Various combinations of echograms can be displayed on the screen, depending on the number of transducers installed in the vessel.

Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu

Selecting one of these options brings up the Echogram submenu. There are three of these submenus, one for each echogram. The heading of the submenu denotes which echogram menu is chosen.

3.1 DISPLAY/ECHOGRAM-# MENU

DISPLAY/Echogram-# Menu	
Transd. Number	1
Range	100 m
Range Start	0 m
Auto Range	Off
Bottom Range	10 m
Bot. Range Start	5 m
Bot. Range Pres.	Off
Sub Bottom Gain	0.0 dB/m
Presentation	Normal
TVG	20 log R
Scale Lines	10
Bot. Det. Line	1
Bot. Det. Colour	Black
Bot. Slope Line	Off
Colour Gain	0 dB

= Transceiver number.

The DISPLAY/Echogram Menu is used to choose the desired echogram presentation on the screen.

Transd. Number

Options:

1 to 32

This command is used to select which transducer echogram is to be displayed. This command applies only to the EA 500 multiplexed system where more than one transducer is used with one channel. It is only effective when *Sequence* in the Transceiver Menu is *On.*

Range

Options:

1 m	*250 m*
5 m	*500 m*
10 m	*750 m*
15 m	*1000 m*
25 m	*1500 m*
50 m	*2500 m*
100 m	*5000 m*
150 m	*10000 m*

This command sets the depth range across the main echogram.

Range Start

Options:

0 to 10,000 meters in steps of 1 m

This command sets the upper start depth for the part of the main echogram to be displayed. The parameter value is only significant while *Auto Range* is set to *Off*.

Range Start is similar to "manual phasing" of the range.

Auto Range

Options:

Off
On

This command switches on and off the *Auto Range* function. *Auto Range* provides automatic adjustment of the *Range Start* value, so that the bottom echo is maintained inside the echogram. If *Auto Range* is set to *On*, the *Range Start* value will have no significance. The *Auto Range* function is similar to "automatic phasing" of the range.

Bottom Range

Options:

0 to 100 m in steps of 1 m.

This command sets the range of the bottom echogram. *Bottom Range* defines an "expanded area", a part of the echogram the user may want a closer look at.

Bot. Range Start

Options:

-100 m to +100 m in steps of 1 m.

This command sets the upper start depth of bottom echogram relative to detected bottom depth. Positive values will be above the bottom and negative values will be below the bottom. This is the starting point for "expanded area".

Bot. Range Pres.

Options:

Off
Upper
Bottom
Lower

This command selects where the bottom echogram is to be positioned. *Upper* will locate the area in the upper part of the display. *Lower* will locate it within the lower part. *Bottom* will position the area immediately below the bottom's digitized line.

Sub Bottom Gain

Options:

0.0 to 5.0 dB/m in 0.1 dB/m steps.

This command adds an extra gain to the sub-bottom echoes, and may improve visual presentation of sub-bottom echoes. When set to *0.5 dB/m*, an extra gain of 0.5 dB per meter below the detected bottom is added to the TVG to compensate for absorption in the bottom.

Presentation

Options:

Normal
Wh. line
Contour

This command affects the presentation of the sub-bottom part of the echogram. In *Normal* mode the echo signal is continuously recorded as received by the transducer.

White line presentation introduces a small gap in the echogram below the detected bottom in order to improve observation of targets close to the bottom.

Contour presentation causes the echogram below the detected bottom to be blanked.

TVG

Options:

20 log R
30 log R
Off

This command controls which transmission loss compensation algorithm is to be used (TVG = Time Variable Gain). 20 log R should be used for normal operations. 30 log R may be used for special operations, such as side scan. *Off* disables the TVG (no transmission loss compensation).

Scale Lines

Options:

0 to 250 lines in steps of 1

This command enables you to set the number of scale lines to be displayed. These equidistant scale lines across the echogram simplify interpretation of the echogram.

Bot. Det. Line

Options:

OFF	*3*
1	*1&3*
2	*2&3*
1&2	*1&2&3*

This command adds bottom detection line(s) to the echogram. *Bot. Det. Line* can be added to the echogram as a verification of where the system defines the true bottom to be. Each channel has the option to implement the *Bot. Det. Line* from other channels.

Bot. Det. Colour

Options:

Black
Red
Green

This command sets the colour of the bottom detection line. The bottom detection line can be displayed in one of three colours to clarify the echogram

Bot. Slope Line

Options:

Off
Upper
Lower

This command is used to switch on and off the athwartships bottom slope line. The bottom slope in the athwartships direction is plotted in a ±60-degree scale. This command only applies to split-beam transceiver channels.

Upper and *Lower* are used to select where the bottom slope line is to be positioned. *Upper* will locate the area in the upper part of the display. *Lower* will locate it within the lower part.

Note if the *Bot. Range Presentation* is already selected, that selection will have preference over the bottom slope presentation.

Colour Gain

Options:

0 to 120 dB in steps of 1 dB

This command sets the colour gain for the display, and affects the colour scale. A value of 0 dB implies normal operation. The *Colour Gain* may be used to boost the echogram colours if the received signal is very weak (for example when the sounder is in the *Passive* mode or no TVG is applied).

4 PRINTER MENU

The Printer Menu is used to choose the desired presentation of echogram and data on the printer printout. When the Printer Menu is accessed, a submenu containing three options is displayed as shown below:

```
        PRINTER MENU

Printer-1 Menu
Printer-2 Menu
Printer-3 Menu
```

The three submenus contain similar parameters, the only difference is in the headings. When one of the commands is selected, a further submenu is displayed as shown below:

```
      PRINTER-@ MENU

Model Type          PaintJet
Navig. Interval            0
Event Marker             Off
Annotation               Off
Echogram Update         Ping
Echogram Speed        0 mm/m
Echogram                 Off
Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu
```

@ = Printer 1/2/3

The Printer Menu is used to choose the desired presentation of echogram and data on the printer printout.

Model Type

Options:

PaintJet
DeskJet

This command is used to select between printer types.

The echogram layout for the two printers are identical except that the DeskJet does not have continuous paper feeding. To indicate the sequence of the echogram, the DeskJet puts the page number and the time information on the top of each page.

NB! Notice that the use of the eject key on the DeskJet printer will result in black and white printing. Instead re-enter Model Type to empty the buffer and eject the page.

Navig. Interval

Options:

0 to 1000 in steps of 1

This command sets the number of incoming navigation telegrams to the sounder per printout on the printer. If, for example, the telegrams are coming in every second and the *Navig. Interval* is set to 60, the system will generate a printout every minute. No navigation data will appear on the printer when the *Navigation Interval* is set to 0.

Event Marker

Options:

Off
On

When this command is set to *On,* a vertical line is drawn across the echogram each time an "event" occurs. Refer to paragraph 9, Annotation Menu, for information about how to generate events.

Annotation

Options:

Off
On

When this command is set to *On,* annotation messages received will be printed on the echogram.

Echogram Update

Options:

Ping
Fixed

This command selects the frequency at which the echogram is printed. When set to *Ping*, every ping will be printed. When set to *Fixed,* the printing will depend on the parameter *Echogram Speed* (see this). If the ping frequency is low, the same ping may be printed several times until the next ping is transmitted.

Echogram Speed

Options:

0 to 100 mm/m in 1 mm/m steps.

This command sets the speed of the echogram paper in millimeters per minute. This enables the echograms to be compressed to print more information on the page. This command is only effective when *Echogram Update* is set to *Fixed.*

Echogram

Options:

OFF	*3*
1	*1&3*
2	*2&3*
1&2	*1&2&3*
	Slave

This command is used to select the echograms to be printed out. When *Slave* is selected, the echogram(s) printed will be those set on the display.

Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu

Selecting one of these options brings up the Echogram submenu. There are three of these submenus, one for each echogram. The heading of the submenu denotes which echogram menu is chosen.

4.1 PRINTER-@/ECHOGRAM-# MENU

PRINTER-@/Echogram-# Menu	
Transd. number	1
Range	100 m
Range Start	0 m
Auto Range	Off
Bottom Range	10 m
Bot. Range Start	5 m
Bot. Range Pres.	Off
Sub Bottom Gain	0.0 dB/m
Presentation	Normal
TVG	20 log R
Scale Lines	10
Bot. Det. Line	1
Bot. Det. Colour	Black
Bot. Slope Line	Off
Colour Gain	0 dB

@ = Printer number.
# = Transceiver number.

The PRINTER/Echogram Menu is used to choose the desired echogram and data presentation on the printout. There are three identical submenus in this group, each one servicing one of the echograms available to be printed.

Except for the parameter *Scope* in the *Presentation* submenu, the commands are identical to those in the DISPLAY/Echogram Menu, and the descriptions are not repeated here. For descriptions, refer to paragraph 3.1.

Presentation Options:

Normal
Wh. line
Contour
Scope

For descriptions of *Normal, Wh. line* and *Contour*, see paragraph 3.1.

The *Scope* presentation is intended for special purpose studies of the echo return and causes an oscilloscope-like plot of a single ping to be printed.

Echo amplitude and directional angles are plotted; echo amplitude in units of dBW (referred to the transducer terminals) and directional angles in units of phase steps (64 phase steps = 180 electrical degrees). The plot starts at the *Range Start* setting, and a total of 300 samples (basic hardware sampling rate of transceiver) is plotted. If, for example, a *Sample Interval* of 0.02 meter is selected (in the Transceiver Menu), the sample range will be 6 m. Note that no echogram is plotted during the printout period.

For the rest of the commands, refer to descriptions under paragraph 3.1.

5 TRANSCEIVER MENU

```
        TRANSCEIVER MENU

Transceiver-1 Menu
Transceiver-2 Menu
Transceiver-3 Menu
```

Transceiver-1 Menu
Transceiver-2 Menu
Transceiver-3 Menu Selecting one of these options brings up the Transceiver submenu. There are three of these submenus, one for each transceiver in the system. The heading of the submenu denotes which transceiver is chosen.

5.1 TRANSCEIVER-# MENU

```
Transceiver-# Menu 38 kHz

Mode                    Active
Transducer Type           ES38
Transd. Sequence           Off
Transducer Depth        0.00 m
Delay                   0.00 m
Absorption Coef.      10 dBkm
Pulse Length            Medium
Bandwidth                 Auto
Max. Power              2000 W
2-Way Beam Angle      -20.6 dB
Transducer Gain        26.5 dB
Sample Interval         0.10 m
```

= Transceiver number.

The Transceiver-# Menu is used to set important receiver and transmitter parameters. Some of these parameters depend on the transducer type, and are listed in the "Technical specifications" section of this manual.

The transceiver in the EA 500 has a unique signature corresponding to its frequency and type (single or split beam). When the power is switched on, the EA 500 will read this signature and fetch the parameters corresponding to the installed transceiver. The above Transceiver Menu shows the default parameters of a 38 kHz transducer.

The different transducer types that operate on the same frequency use the same transceiver, but may require different nominal values for 2-Way Beam Angle and Transducer Gain parameters. Refer to Technical Specifications section of this manual for correct parameters to enter for the installed transducer. Refer also to the Installation Manual for details concerning installation of an extra transceiver kit.

If a non-Simrad transducer is installed, the relevant parameters must be obtained from the transducer supplier.

Mode

Options:

Off
Active
Passive
Test

This command sets the transceiver operating mode. The transceiver channel is either *Off, Active* (normal operation), *Passive* (the transmitter is disabled) or in *Test* mode (a test signal is inserted in the receiver front end, the transmitter is disabled).

Transducer Type

Options

*

This command introduces a list of transducers depending on the signature read from the transceiver. The transducer type connected to the system should be selected. When set to *Other,* the operator may enter the relevant specifications if a non-standard transducer is to be used.

Transd. Sequence

Options:

Off
On

This operation requires special hardware supplied by Simrad. Up to 32 transducers per transceiver can be used in a multiplexing scheme.

The procedure for Transd. Sequence is:

Set Transd. Sequence to ON

This brings forth the following submenu:

Number	1
State	On
No. of Ping	1
Depth	0.00 m

Number is the transducer number and may be set from 1 to 32.

State will enable the transducer for sequencing if ON and disable the transducer if OFF.

No. of Ping is set to the number of pings before moving to the next transducer in the sequence.

Transducer *Depth* may be set for each transducer according to the physical system setup.

Note that the transducer type and transducer parameters may be set individually for each transducer number.

For more information about Transducer sequence, see Appendix "EA 500 Multi-channel Option".

Transducer Depth Options:

0.00 to 999.99 m in steps of 0.01 m

This command sets the installation depth of the transducer. The transducer will never be installed exactly on the water-line. The installation depth must therefore be input to enable the system to add the difference in depth between the transducer face and the water surface.

Delay Options:

0.00 m to 0.99 m in steps of 0.01 m

This command may be used to compensate for transmission delay in the transducer. The value for a given transducer may be found by carrying out a "bar check".

Absorption Coef.

Options:

0 to 300 dB/km in steps of 1 dB/km

This command sets the local absorption coefficient. The default value is computed according to: Francois and Garrison, J. Acoust. Soc. Am. 72(6), December 1982.

* 10 degrees Celsius
* 35 parts per thousand salinity
* 250 meter depth
* pH = 8

Pulse Length

Options:

Short
Medium
Long

This command selects the pulse length (pulse duration) for the transmitted signal. The user may select between three different pulse lengths. The exact pulse lengths of the transmitted pulses are given in the "Technical specifications" section of this manual.

Bandwidth

Options:

Narrow
Wide
Auto

This command sets the bandwidth for the transceiver. The user may select between *Wide* and *Narrow* manual bandwidth, or *Auto* for automatic selection.

In *Auto* the bandwidth is automatically adjusted to the pulse length:

- *Wide* bandwidth for *Short* and *Medium* pulse length
- *Narrow* bandwidth for *Long* pulse length.

Note that *Narrow* bandwidth should normally not be used in combination with *Short* and *Medium* pulse length.

Max. Power Options:

1 to 10,000 W in steps of 1 W

This command sets the maximum transmission power for the system. The setting only affects the value used in the computations, and it should be set according to the installed transceiver board. (The transceiver board controls the transmitted power).

2-Way Beam Angle Options:

-99.9 dB to 0.0 dB in steps of 0.1 dB

This command sets the equivalent two-way beam angle. This parameter is given by the transducer's characteristics, found in the "Technical specifications" section of this manual. This setting affects the system's computation to establish the correct level of the returned bottom echo. This signal level is used directly to give the echogram correct colours.

Transducer Gain Options:

-99.9 dB to 0.0 dB in steps of 0.1 dB

This command sets the transducer gain. This parameter is given by the transducer's characteristics, found in the "Technical specifications" section of this manual. This setting affects the system's computation to establish correct level of the returned bottom echo. This signal level is directly used to give the echogram correct colours.

Sample Interval Options:

0.01 to 1.00 m in steps of 0.01 m

This command selects the sample interval.

NB: Changing the sample interval from its default value may cause undesirable performance changes regarding resolution, maximum range and ping interval.

For additional information about the use of Sample Interval, refer to appendix "EA 500 Sample Interval/Ping Interval"

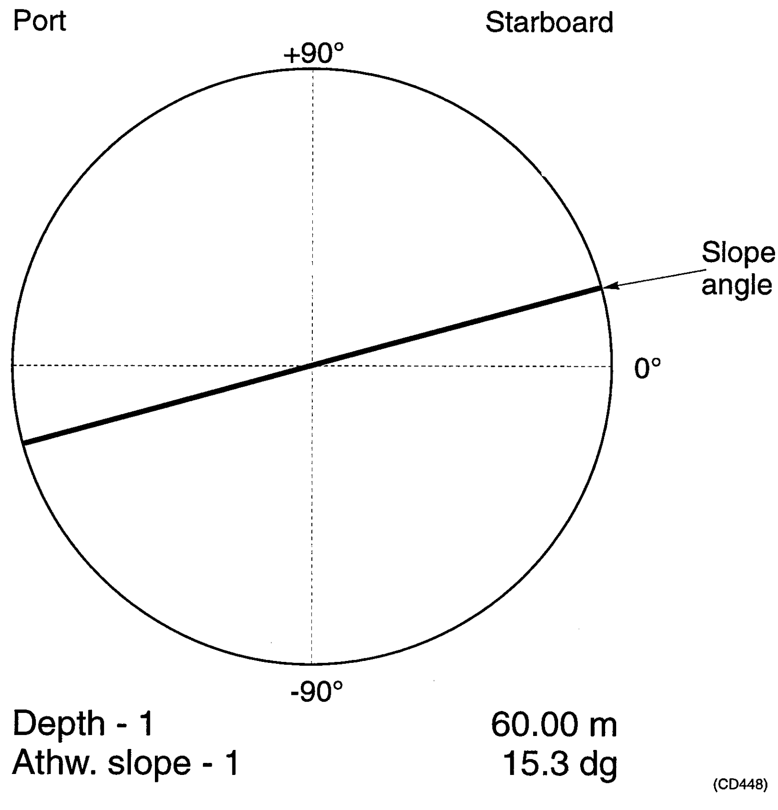
6 BOTTOM DETECTION MENU

```
BOTTOM-DETECTION MENU

Bottom Detection-1 Menu
Bottom Detection-2 Menu
Bottom Detection-3 Menu
```

This menu is used for selection of Bottom Detection submenus. There are three of these submenus, one for each transceiver. The heading of the submenu denotes which transceiver is chosen.

For split-beam transceivers the athwartships bottom slope angle and the depth are displayed in a window below the menu. The depth displayed is a phase-detected depth (centre of footprint). This window is useful for easy visualization of slope angle, but to get a continuous plot of the slope angle, the command *Bot. Slope Line in th*e DISPLAY/Echogram or PRINTER/Echogram Menu is recommended.



6.1 BOTTOM-DETECTION-# MENU

```
  Bottom-Detection-# Menu

Minimum Depth          0.0 m
Maximum Depth            x m
Min. Depth Alarm       0.0 m
Max. Depth Alarm         0 m
Bottom Lost Al.          Off
Minimum Level         -30 dB
Along. Slope Fix           1
```

= Transceiver number.

The Bottom Detection Menu sets the limits for the bottom detection algorithm. Alarm functions related to the bottom are found here. More details about the bottom detection is found in the paragraph Bottom Detection in the "Theory of operation" section of this manual.

Minimum Depth

Options:

0.0 to 9999.9 m in steps of 0.1 m

This command sets the minimum depth for the bottom detection algorithm.

The system will search for a likely bottom echo, starting from the depth set on this command. If you know that the sea bed is at a depth of roughly 150 metres, some time and processing power can be wasted by requiring the echo sounder to search through all the information returning from the water between the surface and, say, 120 metres depth. This command therefore enables the bottom detector to ignore all echoes returning from depths of less than the setting.

A setting of *0.0 m* means the system will start searching for a candidate for a bottom echo, from the surface.

Maximum Depth

Options:

0 to 12,000 m in steps of 1 m

This command sets the maximum depth for the bottom detection algorithm.

The system will stop searching for a likely bottom echo at the depth set on this command. If the system looses bottom track, much time can be wasted by requiring the echo sounder to search for bottom echoes at depths far greater than the known depth in the area in which you are working.

The default value depends on the transceiver installed. A depth setting of *0 m* disables the bottom detection algorithm.

This setting is used during the start-up sequence, and each time the system loses the bottom track. The recommended setting is a little deeper than the greatest depth in the area you are working in.

Min. Depth Alarm

Options:

0.0 to 9999.9 m in steps of 0.1 m

This command turns on an alarm if the detected depth is shallower than this setting. When working in unknown waters, this command can be set to provide a warning that the vessel is moving into danger. A depth setting of *0 m* disables the alarm.

Max. Depth Alarm

Options:

0 to 12,000 m in steps of 1 m.

This command turns on an alarm if the detected depth is greater than this setting. A depth setting of *0 m* disables the alarm.

Bottom Lost Al.

Options:

Off
On

This command turns on an alarm when bottom detection is lost.

Minimum Level

Options:

-80 dB to 0 dB in steps of 1 dB.

This command sets the minimum bottom detection level. After bottom detection, the detected depth is decremented in sample steps until the received echo signal (volume backscattering strength) is below the *Minimum Level* setting.

The bottom detection algorithm contains a threshold of -12 dB relative to peak amplitude. If the *Minimum level* adjustment were not available, the -12 dB threshold would then define the level of a "true" bottom candidate.

Example:
When working in areas with a high density of silt and mud, you may wish to manipulate the bottom detection algorithm to define what is considered to be the "true" bottom. If you know that at -50 dB backscatter strength, the density of silt and mud is at a level where the ship can navigate safely, the *Minimum Level* parameter can be set to *-50 dB*. If the bottom backscatter strength from the area in question is -30 dB, the bottom detection algorithm first back-searches the -12 dB threshold which gives -42 dB. It then compares this level with the *Minimum Level* setting. If the *Minimum Level* is lower, as in our example, there will be a further back-search until this absolute reference is reached. This will result in a shallower depth reading.

From our example we can see that any setting of the *Minimum Level* higher than *-42 dB* would not influence the bottom detection algorithm.

Along. Slope Fix

Options:

1 to 4 in steps of 1

This command makes it possible to get an instantaneous reading of the fore-and-aft (alongship) slope angle between points chosen by the operator.

The procedure is:

Select the Navigation Menu and ensure correct reading of the vessel speed.

Select *Event Marker* in the Display and/or Printer Menu and set it to *On*.

Select the Bottom Detection Menu and the *Along Slope Fix* command, and the following table will appear:

1-2	0.0	0.0	0.0	dg
1-3	0.0	0.0	0.0	dg
1-4	0.0	0.0	0.0	dg
2-3	0.0	0.0	0.0	dg
2-4	0.0	0.0	0.0	dg
3-4	0.0	0.0	0.0	dg

Enter the first fix by entering fix number 1. A fix marker will appear on the echogram and show exactly where in the slope you placed the fix. The first depth value will appear in the table.

Press the joystick to the right again, change the fix number to 2 and enter the next fix. The second depth value will appear in the table and the slope angle will be calculated and displayed in the rightmost row. You may enter fix No. 3 and 4 and also get these slope angles calculated. Altogether 6 different slope angles may be calculated using 4 different depth values..

Example of a completed fix sequence:

1-2	61.9	57.7	4.1	dg
1-3	61.9	64.1	-0.9	dg
1-4	61.9	60.5	0.5	dg
2-3	57.7	64.1	-4.8	dg
2-4	57.7	60.5	-1.6	dg
3-4	64.1	60.5	7.8	dg

If you enter fix No. 1 again, all the values in the table will be erased and you may start the sequence again from the beginning.

7 ETHERNET COMMUNICATION MENU

```
        ETHERNET COM. MENU

Telegram Menu
UDP Port Menu
Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu
Local ETH Addr.
Local IP Addr.
Remote ETH Addr.
Remote IP Addr.
```

The commands and parameters located in the Ethernet Communication Menu enable you to set up the communication ports and addresses as required for your system.

Refer also to the "Communication ports" section of this manual.

Local ETH Addr. Ethernet address of sounder entered as a sequence of 6 bytes.
Default value: *08:00:14:51:57:91.*

Local IP Addr. Internet address of sounder entered as a sequence of 4 bytes.
Default value: *157.237.016.001.*

Remote ETH Addr. Ethernet address of remote host entered as a sequence of 6 bytes.
Default value: *FF:FF:FF:FF:FF:FF*

Remote IP Addr. Internet address of remote host entered as a sequence of 4 bytes.
Default value: *255.255.255.255*

7.1 ETHERNET/TELEGRAM MENU

```
     ETHERNET/Telegram Menu

Remote Control             On
Sample Range              0 m
Status                    Off
Parameter                 Off
Annotation                Off
Navigation                Off
Sound Velocity            Off
Motion Sensor             Off
Depth                     Off
Depth NMEA                Off
Echogram                  Off
Sample Angle              Off
Sample Power              Off
```

This menu basically controls the composition of output data telegrams on the LAN port. The commands are related to binary output telegrams and to the UDP/IP/ETHERNET addressing scheme. For details about telegrams, refer to the LAN port chapter in the "Communication ports" section of this manual.

Remote Control

Options:

Off
On

This command enables the system to interpret *(On)* or ignore *(Off)* external remote control telegrams.

Sample Range

Options

0 to 10,000 m in steps of 1

This command sets the range for the sample angle and sample power telegrams. The range must be at least as large as the assumed depth. The maximum number of samples for each enabled sample telegram is 10,000 values.

Status

Options:

Off
On

This command switches on or off the error, warning and alarm output telegrams.

Parameter

Options:

Off
On

This command switches on and off the parameter enter and parameter request output telegram.

Annotation

Options:

Off
On

This command switches on and off the annotation output telegram.

Navigation

Options:

Off
On

This command switches on and off the navigation output telegram.

Sound Velocity

Options:

Off
On

This command switches on and off the sound velocity output telegram.

Motion Sensor

Options:

Off
On

This command switches on and off the heave, roll and pitch sensor output telegram.

Depth

Options:

Off, 1, 2, 1&2, 3, 1&3, 2&3, 1&2&3

This command switches off, or on for the various transceivers, the detected depth output telegram.

Depth NMEA

Options:

Off
1
2
3

This command switches off, or on for the various transceivers, the detected depth output telegram in NMEA format.

Echogram

Options:

Off, 1, 2, 1&2, 3, 1&3, 2&3, 1&2&3

This command switches off, or on for the various transceivers the echogram output telegram to be used by advanced postprocessing systems, allowing an entire cruise to be replayed off-line on a general purpose computer.

Sample Angle

Options:

Off, 1, 2, 1&2, 3, 1&3, 2&3, 1&2&3

This command switches off, or on for the various transceivers, the sample angle data telegram (max. 10000 samples). Only used in the split-beam system.

Sample Power

Options:

Off, 1, 2, 1&2, 3, 1&3, 2&3, 1&2&3

This command switches off, or on for the various transceivers, the sample power telegram (max. 10000 samples).

7.2 ETHERNET/UDP PORT MENU

```
   ETHERNET/UDP Port Menu
Status                  2000
Parameter               2000
Annotation              2000
Navigation              2000
Sound Velocity          2000
Motion Sensor           2000
Depth                   2000
Echogram                2000
Sample Angle            2000
Sample Power            2000
```

This submenu allows the destination UDP port number of each output telegram type to be individually selected.

All the UDP port destination numbers can be set to values between:

0 to 32767 in steps of 1

Simrad recommends that numbers ≥ 2000 are used.

7.3 ETHERNET/ECHOGRAM-# MENU

```
 ETHERNET/Echogram-# Menu

Range                    100 m
Range Start                0 m
Auto Range               Off
Bottom Range              15 m
Bot. Range Start          10 m
No. of Main Val.         500
No. of Bot. Val.         150
TVG                 20 log R
```

= Transceiver number.

This submenu contains the commands used to adjust the settings for echograms to be transmitted via the Ethernet port.

Except for the commands *No. of Main Val.* and *No. of Bot. Val.* , the commands are identical to those in the DISPLAY/Echogram Menu, described under paragraph 3.1.

No. of Main Val.

Options

0 to 700 in steps of 1

This command sets the main echogram resolution (the number of main echogram values).

There are certain limitations on the block size of an Ethernet message. For further details, refer to the "Communication Ports" section of the manual.

No. of Bot. Val.

Options:

0 to 500 in steps of 1

This command sets the bottom-echogram resolution (the number of main echogram values).

There are certain limitations on the block size of an Ethernet message. For further details, refer to the "Communication Ports" section of the manual.

For descriptions of the rest of the commands, refer to paragraph 3.1.

8 SERIAL COMMUNICATION MENU

```
SERIAL COM. MENU

Telegram Menu
USART Menu
Echogram-1 Menu
Echogram-2 Menu
Echogram-3 Menu
```

This menu contains submenus used to access and adjust the various Serial Communication functions. Refer to the “Serial Communication Ports” chapter in the “Communication ports” section of the manual for further details.

8.1 SERIAL/TELEGRAM MENU

```
SERIAL/Telegram Menu

Format                    ASCII
Modem Control               Off
Remote Control               On
Status                      Off
Parameter                   Off
Annotation                  Off
Navigation                  Off
Sound Velocity              Off
Motion Sensor               Off
Depth                       Off
Depth NMEA                  Off
Echogram                    Off
```

This menu contains the commands that control the composition of output data telegrams on the serial port. Refer to the Serial Communication Ports chapter in the Communication ports section of the manual for further details.

Except for the *Format* and the *Modem Control* commands, the commands are identical to those in the ETHERNET/Telegram Menu. For descriptions, refer to paragraph 7.1.

Format

Options:

ASCII
Binary

This command is used to select either the *ASCII* or the *Binary* format for the output telegrams. The formats are described in detail in the "Communication Ports" section of this manual.

Modem Control

Options:

Off
On

This command is used to enable modem data transfer. When *Modem Control* is *On*, a command string for enabling of "auto answer mode" is sent. This enables the echo sounder to be called remotely and for data to be transferred through the telephone network.

8.2 SERIAL/USART MENU

```
SERIAL/USART Menu

Baudrate                    9600
Bits Per Char.                 8
Stop Bits                      1
Parity                      None
```

This menu is used to set up baudrate, bits per character, number of stop bits and parity for serial telegrams.

Baudrate

Options:

300	*4800*
600	*9600*
1200	*19200*
2400	

This command sets the baudrate, in bits per second for the RS 232 port.

Bits per Char.

Options:

7
8

This command sets the number of bits used to transmit each character (RS232 port).

Stop Bits

Options:

1
2

This command sets the number of stop bits used when transmitting a character (RS232 port).

Parity Options:

None
Odd
Even

This command sets the type of parity used (RS 232 port).

8.3 SERIAL/ECHOGRAM-# MENU

```
 SERIAL/Echogram-# Menu

Range                    100 m
Range Start                0 m
Auto Range               Off
Bottom Range              15 m
Bot. Range Start          10 m
No. of Main Val.         250
No. of Bot. Val.          75
TVG                 20 log R
```

= Transceiver number.

This menu is used to enter echogram settings for echograms to be transmitted via the serial port.

For descriptions of the *Range, Range Start, Auto Range, Bottom Range, Bot. Range Start* and *TVG* commands, refer to paragraph 3.1.

For description of the *No. of Main Val.* and *No. of Bot. Val.* commands refer to paragraph 7.3

9 ANNOTATION MENU

```
        ANNOTATION MENU

Event Counter               0
Counter Mode         Increase
Time Interval           0 min
Baudrate                 9600
Bits per Char.              8
Stop Bits                   1
Parity                   None
```

The Annotation Menu contains the commands enabling you to adjust the event count numbers, choosing the time between date/time annotations and setup parameters for the serial port.

The commands *Baudrate*, *Bits per Char.*, *Stop Bits* and *Parity* are the same as for the SERIAL/USART Menu. For descriptions, refer to paragraph 8.2.

Event Counter

Options:

0 to 10,000 in steps of 1.

This command generates an event number. If you enter an "event count number", an "event" with the selected number is generated. Events can thereby be generated via the menu just by entering the current event counter value. Events may also be generated from an external push button, and the event count number will then be incremented by 1 for each push of the button.

An "event" results in an event marker on the echogram on both the display and the printer, if the event marker parameter in the display/printer menu is set to *On*. The current event number is also included on the printout.

Counter Mode

Options:

Increase
Decrease.

This command makes it possible to choose between increasing or decreasing the event number each time an event is generated.

Time Interval

Options:

0 to 60 minutes in steps of 1 minute.

This command enables automatic generation of date/time annotations. Entering a value of n minutes will cause a date/time annotation to occur every nth minute. The value 0 disables this function.

For descriptions of the rest of the commands, refer to paragraph 8.2.

10 NAVIGATION MENU

```
       NAVIGATION MENU
Navig. Input              Off
Start Sequence         $GPGLL
Separation Char.         002C
Stop Character           000D
First Field No.             2
No. of Fields               4
Speed Input            Manual
Manual Speed         10.0 knt
NMEA Transfer             Off
Baudrate                 4800
Bits per Char.              8
Stop Bits                   1
Parity                   None
```

The Navigation Menu contains the commands to set up the system to decode the navigation and NMEA input telegrams.

The commands *Baudrate*, *Bits per Char.*, *Stop Bits* and *Parity* are the same as for the SERIAL/USART Menu. For descriptions, refer to paragraph 8.2.

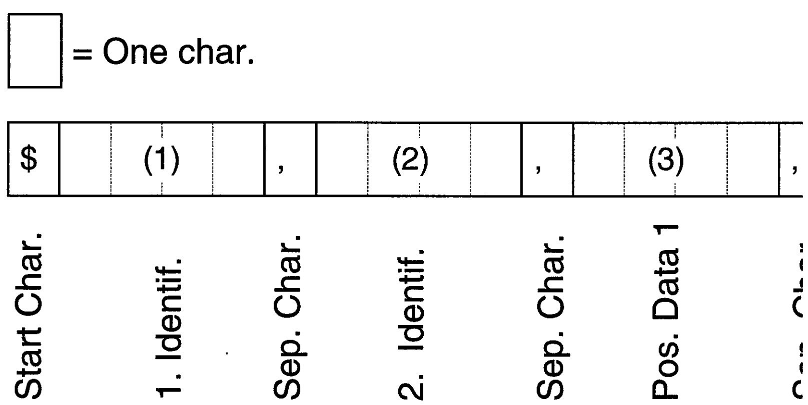
Decoding of navigation input telegrams is based on the recognition of a start sequence, a field separation character and a stop character. The "useful" sub-string within the total telegram is identified by specifying the position of the first field and the number of fields to be included in the navigation data sub-string. E.g. If the following NMEA 0183 telegram is received:

$GPGLL,4728.31,N,12254.25,W<CR><LF>

The "useful" navigation data sub-string becomes:

4728.31,N,12254.25,W

Example:



Note that <CR> denotes carriage return and <LF> denotes linefeed.

Up to six start characters may be defined in the start sequence. However, if there are no problems with ambiguity, some of the characters may be set to ? which indicates “don't care” to test against equality.

The useful parts of the incoming navigation telegrams are displayed continuously while the Navigation Menu is selected. Also the speed extracted from the Speed input telegram is displayed.

Four parameters are provided for configuring the RS232 port.

The RS 232 port may be configured for different baudrates and communication protocols.

Refer to appendix in this manual for table showing ASCII characters versus hexadecimal representation

Navig. Input

Options:

Off
Serial
Ethernet

This command enables you to select the source of the navigation input telegrams. The navigation input telegrams can come from either the serial input or the Ethernet input, or they can be switched off completely.

Start Sequence

Options:

0020h to 007Fh.

This command enables you to change the first characters in the telegram.
Up to 6 characters must be set in a sequence.
The ? sign indicates a don't care character.

Separation Char

Options:

0000h to 007Fh.

This command sets the field separation character to be used. ("," corresponds to ASCII 2C hex)

Stop Character

Options:

0000h to 007Fh.

This command sets the stop character to be used. (<CR> corresponds to ASCII 0D hex)

First Field No.

Options:

1 to 100 in steps of 1.

This command identifies the field in which the first part of the position data will be located. *First Field No.* means the number of the character group which carries the first part of the actual position data. The position data will often be preceded by a number of system identification characters.

No. of Fields

Options:

1 to 100 in steps of 1.

This command sets the number of data fields to be used in the telegram. The *No. of Fields* means the total number of data groups used to give position data, including the 1st field.

Speed Input

Options

Manual
Serial
Ethernet

This command selects the source of the speed telegram input. Information on the vessel's speed can come from one of three sources; manual input, the serial line or the Ethernet line.

If *Manual* is selected, the vessel's speed must be set by the *Manual Speed* command.

Manual Speed

Options:

0.0 to 25.0 knots, in steps of 0.1 knot

This command enables you to select the vessel's speed, and is only effective when *Manua*l is selected as *Speed Input*.

NMEA Transfer

Options:

Off
On

If *NMEA Transfer* is *On,* all NMEA telegrams received on the serial port will be output to the Ethernet port, and all NMEA telegrams received on the Ethernet port will be output to the serial port.

For descriptions of the rest of the commands, refer to paragraph 8.2.

11 SOUND VELOCITY MENU

```
       SOUND-VELOCITY MENU

Profile Type         Absolute
Depth Upper               0 m
Depth Lower            1000 m
Velocity Min.        1400 m/s
Velocity Max.        1600 m/s
Change profile        Set all
Load Profile         NAV.1.0m
Baudrate                 9600
Bits Per Char.              8
Stop Bits                   1
Parity                   None
```

The echo sounder computes the bottom depth using a sound velocity profile. The sound velocity profile may be entered manually via the Sound Velocity Menu, or loaded automatically from a sound velocity probe or an external computer via Ethernet or serial communication ports. The Sound Velocity Menu contains the parameters associated with setting up the sound velocity profile.

For further details, refer to the “Sound velocity” chapter in the “Theory of operation” section of the manual.

The commands *Baudrate*, *Bits per Char.*, *Stop Bits* and *Parity* are the same as for the SERIAL/USART Menu. For descriptions, refer to paragraph 8.2.

Profile Type Options:

Absolute
Mean

This command selects the display mode for the sound velocity profile. The sound velocity profile can be displayed in one of two ways: the *Absolute* velocity at each depth or the average *(Mean)* velocity from the surface and down to each depth can be shown. This command selects between the two.

Depth Upper

Options:

0 - 12,000 m in steps of 1 m.

This command sets the start depth of displayed sound velocity profile.

You need not have the entire sound velocity profile displayed. If you need to make accurate adjustments to a particular part of the profile, the appropriate part can be displayed by setting the limits in this and the *Depth lower* parameters.

Depth Lower

Options:

0 - 12,000 m in steps of 1 m.

This command sets the stop depth of displayed sound velocity profile.

You need not have the entire sound velocity profile displayed. If you need to make accurate adjustments to a particular part of the profile, the appropriate part can be displayed by setting the limits in this and the *Depth upper* parameters.

Velocity Min.

Options:

1400 to 1700 m/s in steps of 1 m/s.

This command sets the lower limit of the displayed sound velocity profile.

Velocity Max.

Options:

1400 to 1700 m/s in steps of 1 m/s.

This command sets the upper limit of the displayed sound velocity profile.

Change Profile

Options:

Set All
Edit

This command is used to change the depth and sound velocity values in the sound velocity profile. *Set All* sets all sound velocity values in the profile to a fixed value.

When *Edit* is selected, the current sound velocity profile may be altered. Altogether 100 pairs of depth and sound velocity values may be entered. The depth range is *0 m* to *12000 m*, and the sound velocity range is *1400 m/s* to *1700 m/s*.

Procedure:
1 - Select the *Pair Number* of the sound velocity value appearing in the menu at the bottom of the text section.

↑ = incr, max = 100	
Pair Number	**1**
↓ = decr, min = 1	
Depth	1 m
Sound Velocity	1500.0 m/s

2 - Select/change the *Depth*

Pair Number	1
↑ = incr, max = 2	
Depth	**1 m**
↓ = decr, min = 0	
Sound Velocity	1500.0 m/s

3 - Select/change the *Sound Velocity*

Pair Number	1
Depth	1 m
↑ = incr, max = 1700	
Sound Velocity	**1500.0 m/s**
↓ = decr, min = 1400	

4 - Confirm new values by pressing the joystick to the right or leave values unchanged by pressing it to the left.

The sound velocity is now set for a certain depth and a pair of data is generated. If a change of a sound velocity value is wanted at other depths, repeat the procedure described above. The cursor will toggle between the depth setting and the sound velocity setting until the new sound velocity profile is entered (by pressing the joystick to the left).

Load Profile

Options:

Nav.1.0m
Nav.0.2m
Simrad-A
Simrad-B
AMLSVP16
AML-Calc

This command is used to load a complete sound velocity profile from an external device. The following options are available:

Nav. 1.0 m: This is for entering a profile on the RS-232 port from a Navitronic sound velocity meter with 1 meter depth resolution.

Nav. 0.2 m: Same as *Nav. 1.0* m, except that the sound velocity probe has a depth resolution of 0.2 meter.

Simrad-A: Loading Simrad ASCII sound velocity profile datagram (RS-232 or Ethernet). For further details, refer to the "Communication Ports" section of this manual.

Simrad-B: Loading Simrad Binary sound velocity profile datagram (RS-232 or Ethernet). The datagram structure is found in the "Communication Ports" section of this manual.

AMLSVP16: Loading data directly from an Applied Microsystems Ltd. SVP-16 probe (RS-232).

AML-Calc: Loading Applied Microsystems Ltd. Calc file from a PC (RS-232).

After a successful transmission, the following message will be displayed:
Load finished, data ok.

Otherwise the following text will be displayed:
Load aborted, bad data

12 MOTION SENSOR MENU

```
        MOTION-SENSOR MENU

Heave                          Off
Roll                           Off
Pitch                          Off
Td-1 Ath. Offset             0.0 m
Td-1 Alo. Offset             0.0 m
Td-2 Ath. Offset             0.0 m
Td-2 Alo. Offset             0.0 m
Td-3 Ath. Offset             0.0 m
Td-3 Alo. Offset             0.0 m
```

This submenu enables you to select the source and format of the signal from the motion sensor device. Heave (meter), roll (degree) and pitch (degree) are continuously displayed at the bottom of the menu during pinging.

Heave

Options:

Off	
Ethernet	
+Linear	*+ 1 volt /m*
-Linear	*- 1 volt /m*

This command defines the *Heave* input signal. The heave input may be input as a numeric value via the Ethernet port or as an analog signal via the Auxiliary port.

Roll

Options:

Off	
Ethernet	
+Linear	*+1 volt /degree*
-Linear	*- 1 volt /degree*
+ArcSine	*Volt = 10 sin(angle)*
-ArcSine	*Volt = -10 sin(angle)*
DWS	

This command defines the roll input signal. The roll may be input as a numeric value via the Ethernet port or as an analog signal via the Auxiliary port.

Roll information is handled in the computations as additional heave. Digital depth value will be corrected, but not the echogram itself.

Pitch

Options:

Off	
Ethernet	
+Linear	*+1 volt /degree*
-Linear	*- 1 volt /degree*
+Arcsine	*Volt = 10 sin(angle)*
-Arcsine	*Volt = -10 sin(angle)*
DWS	

This command defines the *Pitch* input signal. The pitch input may be input as a numeric value via the Ethernet port or as an analog signal via the Auxiliary port.

Pitch information is handled in the computations as additional heave. The digital depth value will be corrected, but not the echogram itself.

Td-# Ath. Offset

Options

-99.9 to +99.9 m

This command enables you to set the athwartships distance between transducer and vertical reference unit. The value must be positive when the transducer is to the starboard side of the vertical reference unit. This parameter is used in the pitch and roll compensation, and will affect the accuracy of the compensation calculation.

Td-# Alo. Offset

Options

-99.9 to +99.9 m

This command enables you to set the fore-and-aft distance between transducer and the vertical reference unit. The value must be positive when the transducer is ahead of the vertical reference unit. This parameter is used in the pitch and roll compensation, and will affect the accuracy of the compensation calculation.

13 UTILITY MENU

```
        UTILITY MENU
Beeper                      On
Status Messages             On
RD Display                 Off
Date                  yy.mm.dd
Time                  hh.mm.ss
External Clock             Off
Password                     0
Default Setting             No
Language               English
```

The Utility Menu contains the miscellaneous commands and parameters that are not included in other menus.

Beeper

Options:

Off
On

This command switches the beeper on and off. The beeper outputs short sound signals if status messages and warnings are displayed, and longer tones if an alarm occurs.

Status Messages

Options:

Off
On

By this command you can instruct the echo sounder to display or not to display the error, warning and alarm messages.

RD Display

Options:

Off
1
2
3

This command enables a designated depth telegram to be sent to the Simrad RD display.

Date

Year, month and day are entered as a triplet into the EA 500 internal clock (battery backup power).

Time

Hour, minute and second are entered as a triplet into the EA 500 internal clock (battery backup power).

External Clock

Options

Off
Serial
Ethernet

This command synchronizes the echo sounder with external clock via Ethernet or serial port.

Password

Options:

0 to 9999.

This command enables the echo sounder to be protected by a password. A password number in the range 0 to 9999 can be entered. The menu system will then be locked until the selected password is re-entered.

Default Setting

Options:

No
Yes

This command sets the default values onto all the system parameters when specifying *YES*.

Language

Options:

English
French
Norw.

This command selects the language in which the menu text is displayed.

14 TEST MENU

```
TEST MENU

Analog Input
Pulse Input
Ethernet
Message
Transceiver
Version
Counter
Scope
Serial Port
DWS
Simrad
```

The Test Menu contains miscellaneous commands for checking the hardware and software in the echo sounder.

Analog Input. The voltage at each of the four analogue inputs (auxiliary connector) is displayed.

Pulse Input. A pulse count number for each of the four external pulse inputs (auxiliary connector) is displayed.

Ethernet. Self testing of the Ethernet interface is performed. Return values are:

- 0 all tests passed
- 1 82586 self test failed
- 2 82586 loopback test failed
- 3 ESI (82501 or 8023) loopback test failed
- 4 transceiver loopback test failed

Message When set to *On*, a test message is transmitted to the Ethernet port and the serial communication port.

Transceiver

This menu entry is primarily used for checking the receiver response. For every ping, the display shows:
- the amplitude of sample 511 (dBW)
- the fore-and-aft electrical phase of sample 511 (phase steps)
- the athwartships electrical phase of sample 511 (phase steps)
- the background noise level (dBW)

Data from all three transducer channels is shown.

Version

The version of the installed software is displayed for each of the CPUs.

Counter

Options:

CP counter
SP-1 counter
SP-2 counter
SP-3 counter

This menu entry is used to check the activity of the control processor and the signal processor(s). A large figure means that the processor in question is not working at full capacity. A zero means that the processor is 100 % employed.

Scope

Options:

Off
AMPL. 1
AMPL. 2
AMPL. 3
AMP&PH 1
AMP&PH 2
AMP&PH 3

This command causes an oscilloscope picture of samples to be displayed. This is useful for checking the echo detection.

Serial Port

Options:

1a (DB)
1b (P5)
2a (P1)
2b (P2)
3a (P3)
3b (P4)

This menu entry is used to check the activity on the serial lines. The following data is presented:

Bytes input
Last inbyte
Bytes output
Last outbyte
Error count

DWS

Options:

OFF
MOSP
SPBTX
MOS/SPTX
TRANSMIT
SIGNAL

This command applies only to the DWS (Deep Water System) option and displays a submenu containing a list of test commands for the DWS circuitry.

Off switches off the *Signal* test.

MOSP runs the MOSP test. This is a test of the common RAM on the MOSP circuit board. Expected result is "MOSP ok".

SPBTX runs the SPBTX test. This is a test of the main RAM, Dual Port RAM, Ralu, multiplier, and software division of the SPBTX circuit board. Expected result is "SPBTX ok".

MOS/SPTX runs the MOS/SPTX test. This is a test of the read/write function to the Dual Port RAM on the SPBTX circuit board from the MOSP circuit board. Expected result is "MOSP/SPBTX ok".

Transmit runs the Transmission board test. This is a test of both the TX 1 circuit boards. Expected result is “Transmit test running”. Verify that each of the 96 TX leds on the front of the TX pcbs lights sequentially. On completion, the test can only be terminated by resetting the DWS transmitter. This is normally achieved by switching the system off then on again.

Signal runs the bottom slope (system) test. Set the parameters as follows:

Operation / Ping Int. = 2.5 sec
Display / Range = 100 m
Display / Range Start = 950 m
Bottom Detection / Max Range = 1250

When *Signal* is selected, the expected result is “Test running”. Go to the Bottom Detection Menu. The expected result is an athwartships slope of approximately 34°, down to starboard.

This test is terminated by selecting *Off*.

Simrad

For Simrad use only.

850-130682 / AA000 / 1-11

EA 500 Maintenance

This section of the manual describes the maintenance to be performed by the system operator.

Document revisions

Rev	Date	Written by	Checked by	Approved by
A	15.03.96	CL	OL	EF
B	21.10.01	RBr	ESB	GM
C				
D				

(The original signatures are recorded in the company's logistic database)

Table of contents

Document history

(The information on this page is for internal use)

Rev.A	First edition as a combined module for EA 500 and EK 500. Was section 5 of P2158E and P2170E.
Rev.B	Document transferred to QS, now only valid for EA 500. No changes to the text.

1 INTRODUCTION

This chapter describes the preventive maintenance to be performed by the system operator. For details about corrective maintenance, refer to the EA/EK/ES 500 Service Manual. For information about error messages, refer to appendix ”Status and error Messages”.

2 PREVENTIVE MAINTENANCE ACTIONS

The preventive maintenance is very limited. When required, clean the surfaces of the equipment with a soft, lint-free cloth and a mild detergent. Keep the fan filter of the sounder unit free from dust and moisture.

For information about preventive maintenance on the printer, refer to the printer instruction manual.

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TECHNICAL SPECIFICATIONS

P3038E / 850-130646 / 4AA005

This section of the manual presents the technical specifications for the EA 500 echo sounder system.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	15.03.96	CL	18.03.96	[illegible]	18.03.96	[illegible]

List of contents

Document history

(The information on this page is for Simrad's internal use)

References

Rev. A First edition as module. Was part of section 1 of P2158E.

1 ECHO SOUNDER UNIT

1.1 OPERATION

Range .... 1, 5, 10, 15, 25, 50, 100, 150, 250, 500, 1000, 1500, 2500, 5000, 10000 metres

Phasing ..... Automatic or manual, 0 to 10000 metres, 1-metre increments

Display and printers ... 1, 2 or 3 echograms simultaneously on each device
Individual setting of range and phasing for each device
12 colours (3 dB per colour)
Separate bottom echogram(s) with sub-bottom excess amplification
Scale lines
Bottom slope (split-beam operation only)

Pingrate .... Adjustable in 0.1-second steps

Bottom detector .... Software multichannel tracking algorithm
Adjustable minimum and maximum depth algorithm

Sound velocity .... Programmable sound velocity profile

Output data .... Programmable composition of telegrams

Navigation input data ...... Programmable format (NMEA 0183 included)

Alarm conditions .... Minimum depth alarm
Maximum depth alarm
Bottom lost alarm

1.2 TRANSMITTER/RECEIVER

Transmission power regulation .... 0 dB, -20 dB relative to full power
(-3 dB, -23 dB jumper selectable)

Transmission power stability .... 0.1 dB over temperature range

Output protection .... Open circuit/short circuit
(limited protection on 12 kHz unit)

Terminal impedance .... 60 ohms

Noise figure .... 10 dB

Receiver input range .... Nonsaturated instantaneous dynamic range -160 dBW to -4 dBW, ≈ 5Vrms (dBs relative to 1 W)

Receiver amplitude resolution .... 0.01 dB

Receiver amplitude accuracy .... 0.1 dB wide bandwidth
0.3 dB narrow bandwidth

1.3 TRANSDUCER TYPES AND TRANSCEIVER PARAMETERS

Trans-ducer type	Freq. (kHz)	Beam type	Absorp-tion coeff. (dB/km)	Pulse length (ms)			Bandwidth (kHz)		Trans-mit. power (kW)	2-way beam angle (dB)	Transd. gain (dB)	3 dB beam width (°)	Sample dist. (cm)
12-16	11.990	single	1	1.0	3.0	10.0	1.2	0.12	2	-14.0	18.5	16 ±2	40
E-12_60	11.990	"	1	1.0	3.0	10.0	1.2	0.12	0.05		11	55 ±11	40
18-11	17.986	"	3	0.7	2.0	7.0	1.8	0.18	2	-17.0	23.0	11 ±2	25
63BA	17.986	"	3	0.7	2.0	7.0	1.8	0.18	4	-14.5	16.3	14x14 ±2	25
27-26	27.027	"	6	0.5	1.5	5.0	2.7	0.27	2	-18.0	24.0	10x13 ±2	15
27-26/21-E	27.027 27.027	"	6	0.5	1.5	5.0	2.7	0.27	3 1.5	-18.0 -13.0	25.5 20.5	10x13±1/2 10x20±1/4	10
38-12x20F	37.878	"	10	0.3	1.0	3.0	3.8	0.38	1	-13.5	21±1.5	12x20±2	10
38-26/22-E	37.878	"	10	0.3	1.0	3.0	3.8	0.38	2.4 1	-17.0 -13.0	24.5 20.5	9x13±1/2 23x13±3/2	10
38-7	37.878	"	10	0.3	1.0	3.0	3.8	0.38	4	-20.5	28.0	7x7±1	10
49-26	49.020	"	14	0.3	1.0	3.0	4.9	0.49	2	-18.0	25.5±1	8x11 ±1/2	8
50-18P	49.020	"	14	0.3	1.0	3.0	4.9	0.49	0.5	-12.5	20±1	18x18±3	8
50-10x17	49.020	"	14	0.3	1.0	3.0	4.9	0.49	1	-15.5	23±1.5	10x17±2	8
70-24	70.422	"	20	0.2	0.6	2.0	7.0	0.7	0.8	-16.5	24	11X11±2	5
120-25	119.047	"	38	0.1	0.3	1.0	12.0	1.2	1	-17.5	25±1	10x10±2	3
120-35/25-E	119.047	"	38	0.1	0.3	1.0	12.0	1.2	2 2	-27 -17.5	35±1 25.5±1	3x3±0.3 9.5x9.5±1	3
200-7	200.000	"	53	0.06	0.2	0.6	20.0	2.0	1	-21.0	28.5	7 ±1	2
200-28E	200.000	"	53	0.06	0.2	0.6	20.0	2.0	1.5	-21.0	28.5	7 ±1	2
200-30G	200.000	"	53	0.06	0.2	0.6	20.0	2.0	0.1	-8.5 ±1	16.6±1	30±3	2
200-35E	200.000	"	53	0.06	0.2	0.6	20.0	2.0	2	-27.5	35	3±0.5	2
710-30	714.286	"	201	0.02	0.05	0.2	71.0	22.4	0.1	-23±1	30.5±1	5 ±0.8	1
710-36	714.286	"	201	0.02	0.05	0.2	71.0	22.4	0.1	-28.5	36±1.5	2.8±0.5	1
38/200	37.878 200.000	"	10 53	0.3 0.06	1.0 0.2	3.0 0.6	3.8 20.0	0.38 2.0	1 1	-15±1 -21±1	22.5±1 28.5±1	13x13±2 7x7±1	10 2
50/200	49.020 200.000	"	14 53	0.3 0.06	1.0 0.2	3.0 0.6	4.9 20.0	0.49 2.0	1 1	-17±1 -21±1	24±1 28.5±1	11x11±2 7x7±1	8 2
ES18	17.986	split	3	0.7	2.0	7.0	1.8	0.18	2	-17±1	25±1	11±2	25
ES38-12	37.878	split	10	0.3	1.0	3.0	3.8	0.38	1	-15.5 ±1	23±1	12±1	10
ES38-B/D	37.878	split	10	0.3	1.0	3.0	3.8	0.38	4	-20.5 ±1	28.0±1	7x7±1	10
ES38-5	37.878	split	10	0.3	1.0	3.0	3.8	0.38	4	-24.0	30.0	4.7	10
ES70-11	70.422	"	20	0.2	0.6	2.0	7.0	0.7	.8	-16.5 ±1	24±1	11±2	5
ES120-7	119.047	"	38	0.1	0.3	1.0	12.0	1.2	1	-20.6	26.5	7.1	3
ES120-4x10	119.047	"	38	0.1	0.3	1.0	12.0	1.2	1	-22.0 ±1	29.5±1	4.4x9 ±0.5/1	3
ES120-2.5x10	119.047	"	38	0.1	0.3	1.0	12.0	1.2	1	-23.5 ±1	31.5±1	2.5x9.5 ±0.5/1	3
ES120H	119.047	split TX	38	0.1	0.3	1.0	12.0	1.2	1	-23±1	31±1 25±1	10x2.5 10x10	3
120-2/50	119.047	side scan	38	0.1	0.3	1.0	12.0	1.2	1	-18±1	25.5±1	1.9x49	3

1.4 PERFORMANCE

Computed maximum range for typical operational conditions:

Computed maximum range for typical operational conditions:				
Transducer type	Frequency (kHz)	Power (kW)	A (m)	B (m)
12-16	12	2	5000	13000
67CA	12	4	6000	13000
63BA	18	4	4700	8100
18-11	18	2	5000	9000
38-7	38	2	2500	3400
49-26	49	2	1700	2400
120-25	120	1	700	940
200-28	200	1	530	680
710-36	710	0.1	110	170
ES38B	38	2	2500	3500
ES120	120	1	700	940

General assumptions:

- Sound absorption according to Francois & Garrison, JASA Dec. 1982 (temperature = 10°C, salinity = 35‰, depth = 250 m, pH = 8).
- Total acoustic noise spectrum level is:

$$142 - 20\log(f) \text{ dB rel } 1 \ \mu\text{Pa per } \sqrt{\text{Hz}}$$

where f is the frequency in Hz (typical noise level for medium size vessel at 10 knots)

Range A (maximum range for automatic bottom detection)
S_S = -10 dB (surface backscattering strength)
Medium pulse length and wide receiving bandwidth
SNR = 20 dB

Range B (maximum range for registration of bottom contour on display or printer)
S_S = -10 dB
Long pulse length and narrow receiving bandwidth
SNR = 10 dB

1.5 INTERFACES

Serial interfaces (9-pin Delta, RS232)	Port 1 - Remote computer command input and data output Port 2 - Annotation input from standard terminal Port 3 - Navigation and NMEA data input, NMEA output Port 4 - Sound velocity probe input Port 5 - RD depth indicator output
Parallel interfaces (25-pin Delta, Centronics)	Port 1 - Colour printer 1 Port 2 - Colour printer 2 Port 3 - Colour printer 3 Port 4 - Transducer sequence
Auxiliary port (25-pin Delta)	Differential analogue input from heave sensor Transmit synchronization input/output Event marker input Alarm output
Remote control signals (25-pin Delta)	Separate lines - digits 0-9 cursor control
LAN port (15-pin Delta)	Ethernet type IEEE 802.3 UDP/IP communication protocol Command input and data output
RGB video (15-pin Delta)	Impedance 75 ohms 640 x 480 pixels resolution Line frequency 30 Hz Frame frequency 60 Hz noninterlaced Composite sync on green
Transducer signals (12-pin MIL type)	Single-beam signals Split-beam signals Cable screen

1.6 TRANSCEIVER UNIT GENERAL SPECIFICATIONS

Supply voltage	187 - 264 VAC 50/60 Hz 90 - 132 VAC 50/60 Hz 21 - 31 VDC 22.5 - 31 VDC (with DC/AC converter)
Power consumption	100 W (one channel) 125 W (two channels) 150 W (three channels)
Operating temperature	0 - 55°C
Dimensions	W480 x H310 x D440 (mm) (standard 19" rack dimensions)
Weight	25 kg (one channel) 30 kg (two channels) 35 kg (three channels)

2 DISPLAY AND KEYPAD UNITS

2.1 CF 140 14" COLOUR DISPLAY WITH BUILT-IN JOYSTICK

Supply voltage . . . . 198 -264 VAC 50/60 Hz
90 - 132 VAC 50/60 Hz

Power consumption . . . . 90 W

Operating temperature . . . . 0 - 40°C

Dimensions . . . . W410 x H360 x D460 (mm)

Weight . . . . 25 kg

2.2 CF 190 20" COLOUR DISPLAY WITH BUILT-IN JOYSTICK

Supply voltage . . . . 198 -264 VAC 50/60 Hz
90 - 132 VAC 50/60 Hz

Power consumption . . . . 105 W

Operating temperature . . . . 0 - 40°C

Dimensions . . . . W498 x H449 x D534 (mm)

Weight . . . . 29 kg

2.3 RD 110 11" LCD MONOCHROME DISPLAY + KEY FUNCTION

Resolution . . . . 640 x 480 pixels

Supply voltage . . . . +5V, ±15V DC (supplied from Sounder Unit)

Operating temperature . . . . 10 - 40°C

Dimensions . . . . W380 x H250 x D75 (mm)

Weight . . . . 6 kg

2.4 RD DISPLAY

Resolution . . . . 5 digits including 1 decimal

Supply voltage . . . . 187 - 264 VAC 50/60 Hz

90 - 132 VAC 50/60 Hz

Operating temperature . . . . 0 - 55°C

Dimensions . . . . W260 x H158 x D127 (mm)

Weight . . . . 2 kg

2.5 KEYPAD FOR CURSOR CONTROL

Dimensions . . . . W50 x H25 x D100 (mm)

Weight . . . . 0.1 kg

3 THE PRINTER

	PaintJet	DeskJet, type 850C
Paper width	210 mm	210mm
Resolution	720 pixels across paper	720 pixels across paper
Supply voltage	187 - 264 VAC 50/60 Hz 90 - 132 VAC 50/60 Hz 21 - 31 VDC	100-240 VAC 50/60 Hz
Power consumption	20 W max.	48 W max.
Operating temperature	0 - 55°C	5 - 40°C
Dimensions	W442 x H98 x D302 (mm)	W444 x H226 x D396 (mm)
Weight	5 kg	6.5 kg

COMMUNICATION PORTS

P3075E / 859-130683 / 4AA005

This section of the manual describes in detail the various communications ports used by the system. Examples are given of the telegrams handled by those ports.

Document revisions

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	Date	Sign	Date	Sign	Date	Sign
A	15.03.96	C L	18.03.96	O. C.	18.03.96	L.F

List of contents

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Revisions:

Rev. A First edition as module. Was section 4 of P2158E.

1 SERIAL COMMUNICATION PORT

1.1 GENERAL

The serial communication port on the EA 500 (port 1) is of type RS 232. Communication parameters such as baud rate, bits per character etc. can be programmed from the *Serial / USART* menu. The port may be connected to an external computer, a terminal, a printer, navigation equipment or any devices that can receive or transmit RS 232 ASCII or binary data.

The messages transmitted and received on the serial communication port are referred to as "telegrams".

The following information applies to all telegrams:

- All output telegrams contain a two-character header indicating the telegram type, for example PR for Parameter Request telegrams.
- "#" stands for the transceiver number 1/2/3 in output telegrams.
- "," separates fields within a telegram.
- <CR> denotes carriage return and <LF> denotes line feed.
- Two consecutive carriage returns <CR><CR> are used as telegram terminator in output telegrams implying that <CR><LF> can be used freely inside the telegrams to obtain a nice printout when connecting a standard printer.
- All output telegrams contain a time tag in the second field: hour, minute, second, hundredth of a second, for example 10024311.
- A menu parameter is identified by including its path in the menu system in the appropriate field.

  For example, the path:

  /Display menu/Echogram-1 menu/Bottom range=20 M

  addresses the *Bottom range* to be used for echogram 1 on the display.

- The * character may be used as a “wild-card” in the parameter input telegrams.
  The path string above would then look like:

  /D*/*1*/B*=20*

- Input telegrams use a single carriage return <CR> as telegram terminator.

- The input telegram interpreter is insensitive to upper/lower case letters.

There are two types of output telegrams:

- Asynchronous telegrams (triggered by uncorrelated external or internal events).

- Ping-based telegrams.

There are five types of input telegrams:

- Parameter request telegram.

- Parameter enter telegram.

- Comment string (annotation) telegram.

- Sound velocity telegram.

- External alarm telegram.

1.2 OUTPUT TELEGRAMS

Serial port output telegrams may be in either ASCII or binary format. The binary format is identical to the LAN (Ethernet) format (refer to paragraph 2) except for a header (4 bytes) containing the number of bytes in the telegram (2 bytes) and its checksum (2 bytes). The checksum is the arithmetic sum of all bytes in the telegram.

1.2.1 Asynchronous output telegrams

Examples of asynchronous ASCII output telegrams:

```
PR,10024311,/OPERATION MENU/Ping Mode=Normal<CR><CR><LF>              → parameter request
PE,10024723,/OPERATION MENU/Ping Interval=1.3 sec<CR><CR><LF>           → parameter enter
CS,10031142,TS measurements near Greenland<CR><CR><LF>        → comment string (annotation)
GL,10031522,4728.31,N,12254.25,W<CR><CR><LF>                            → navigation data
ST,10041148,Ping-interval warning<CR><CR><LF>                           → status telegram
SV,10041150,002,00001,1500.0,00002,1500.0,<CR><CR><LF>          → sound velocity telegram
```

PR is returned as a response to a parameter request (input telegram) and contains the header PR, the time tag, the path and the parameter.

PE reports that a parameter has been entered (due to a manual command operation from the menu), and contains header, time tag, parameter.

CS reports that an annotation comment string has been entered (directly via serial port 2 or as an input annotation telegram), and contains header, time tag, annotation string.

GL contains navigation data: header, time tag, position data sub-string.

ST reports errors, warnings and alarms: header, time tag, message string.

SV sound velocity telegram contains current sound velocity profile: header, time tag, number of valid values, depth-1, sound velocity-1, depth-2, sound velocity-2 and so on.

1.2.2 Ping-based output telegrams

Examples of ping-based ASCII output telegrams:

```
D#,10024331, 74.42,-18,  1,-23<CR><CR><LF>                                 → sounder depth
MS,10024331,-1.23,  0.0,  0.0<CR><CR><LF>                                  → motion sensor
Q#,10024331,0,   74.42,     0.0,  100.0,250,   10.0   -5.0, 75,...<CR><CR><LF>
```

D1, **D2** and **D3** Contain the detected depth: header, time tag, depth [metre], bottom surface backscattering strength [dB], transducer number, athwartships bottom slope [°]. The bottom slope value applies only to split-beam transducer channels.

MS Contains the motion sensor reading: header, time tag, heave [metre], roll [°], pitch [°].

Q1, Q2 and **Q3** contain echogram data: header, time tag, TVG type, depth [metre], range start [metre], range end [metre], number of echogram values, bottom range start [metre], bottom range end [metre], no. of bottom echogram values, echogram data [dB].

The NMEA depth output telegram conforms to the standard NMEA-0183 DBS (Depth Below Surface) telegram format.

1.2.3 Input telegrams

There are five different types of input telegrams:

```
/operation menu/ping mode<CR>                           → parameter request.
/operation/ping interval=1.3<CR>                        → parameter enter.
CS,Measurements near Greenland<CR>                      → comment string (annotation).
SV,10041150,002,00001,1500.0,00002,1500.0,<CR>     → Sound velocity telegram (Simrad-A).
AL,#                                                    → External alarm, where if
                                                        # = 1: critical alarm, and if
                                                        # = 2: non-critical alarm.
```

A PR output telegram is returned by the echo sounder when a parameter request telegram is sent as input to the sounder (see paragraph 1.2.1). A parameter is entered by specifying path and new parameter value, separated by an "=" sign. It should be observed that:

- Continuous parameter values are processed numerically and may be entered with or without dimensions.
- Discrete (fixed) parameter values are processed as strings and must be entered with dimensions.
- The wild-card character * matches any sub-string of characters within menu names, parameter names and discrete parameter value strings.
- There is no distinction between upper and lower case characters.
- The password for the *Utility* menu and *Test* menu parameters cannot be remotely controlled or requested.

When SV is used, *Load Profile* in the Sound Velocity Menu must be set to *SIMRAD-A* (Simrad ASCII Sound Velocity Format).

Some parameters include two or more numerical quantities, and these are remotely entered/requested as shown below:

/eth*/loc*eth*=08:13:14:F3:98:10<CR>
/eth*/loc*ip*=131.051.171.087<CR>
/e*/r*eth*=10:11:AC:52:31:22<CR>
/e*/r*ip*=131.051.171.062<CR>
/utility*/date=90.01.24<CR> → year, month, day
/util*/time=14:41:16<CR> → hour, minute, second

The SIMRAD-B SV (Simrad Binary Sound Velocity) telegram has the following structure:

Description	Res.	Units	Format	Bytes		Valid range	Note
				#	Σ		
Start character	-	Start of text (STX)	ASCII	1	1	02h	
Message type	-	-	binary	1	1	9Ah	
Date	1 1 1	DD-days MM-months YY-years	ASCII ASCII ASCII	2 2 2	6	1 - 31 1 - 12 0 - 99	
Time	1 1 1 0.01	HH-hours MM-minutes SS-seconds hh-seconds	ASCII ASCII ASCII ASCII	2 2 2 2	8	0 - 23 0 - 59 0 - 59 0 - 99	
No. of valid values	1	-	binary	2	2	1 - 100	1)
100 occurrences of: depth sound velocity	 1 0.1	 m m/s	 binary binary	 2 2	400	 0 - 12000 14000 - 17000	
End character	-	End of text (ETX)	ASCII	1	1	03h	
Checksum	- -	LSB MSB	binary binary	1 1	2	0 - 255 0 - 255	2)

Notes

1 The sound velocity profile datagram consists of 100 pairs of depth and corresponding sound velocity values. The "No. of valid values" determines the number of depth and sound velocity values which are valid in the table, starting from the first pair.

2 The checksum is calculated as for the output telegrams.

2 THE LAN PORT

2.1 GENERAL

Much of today's engineering effort is spent on system integration at various levels, and experience has shown that the integration costs frequently become comparable to the equipment cost. The EA 500 is prepared for system integration by incorporating a LAN (Local Area Network) interface of the Ethernet type. This interface provides efficient and high functionality interfacing to standard computers (DEC, SUN, HP, IBM PC etc.) used for remote control, data logging and postprocessing. Communication via the LAN port is based on the TCP/IP (Transport Control Protocol/Internet Protocol) protocol suite, a de facto standard which is included in the operating system kernel of virtually all UNIX computers and is available for most other common operating systems. The TCP/IP/ETHERNET standard is popular within office, engineering and university environments worldwide, and Simrad foresees that LANs of this type will become common on board research vessels in the near future.

The Ethernet standard is based on the CSMA/CD (Carrier Sense Multiple Access with Collision Detection) type of communication with 10 Mbit/s signalling rate over a 50-ohm coax cable. Equipment connected to the cable is individually addressed, and multiple computer-to-computer connections can coexist on the cable simultaneously by timesharing. Data terminal equipment (computers, EA 500 etc.) is connected to the Ethernet cable via a transceiver cable (15-pin Delta connector in each end) and a transceiver (a small unit with a "vampire" coupling mechanism for connection to the coax cable). Maximum extension of the Ethernet cable is 500 meters. The TCP/IP protocols are closely related to the ARPANET (Advanced Research Projects Agency NETwork) and to the UNIX operating system, and both connection-based and datagram-based communication are supported. The maximum average communication transfer rate of the EA 500 LAN interface has been measured to approximately 400 kbit/s which exceeds the continuously maintainable data storing speed of most computers (hard disk limitations). TCP/IP/ETHERNET equipment and parts are available from numerous suppliers, making system integration a "plumber's" task.

Specifically, communication with the EA 500 is based on UDP/IP/ETHERNET (User Datagram Protocol, member of the TCP/IP protocol suite) blocks, which include the following address fields:

- Destination ETHERNET address (6 bytes)
- Destination IP address (4 bytes)
- Destination UDP port number (2 bytes)
- Source ETHERNET address (6 bytes)
- Source IP address (4 bytes)
- Source UDP port number (2 bytes)

Thus, both the destination and source addresses are included in each data block, and a complete address comprises *Ethernet* address, *IP* address and *UDP* port number. Each device on the network must have a unique address. The Ethernet and IP address of the EA 500, henceforth called the local address, and the remote host, are entered from the Ethernet Communication Menu. The local UDP port number is hard coded to 2000 decimal and can not be altered. The destination UDP port number of output telegrams (remote UDP port number) can be individually set from the Ethernet Communication Menu for each telegram type, facilitating reception of different telegram types by separate tasks in a remote computer. There are three Ethernet address types: *Individual* (least significant bit of first byte is zero), *Multicast* (least significant bit of first byte is one), and *Broadcast* (all ones). Note that the EA 500's local Ethernet address must be an *Individual* address.

The LAN telegrams are binary equivalents to the ASCII telegrams on the Serial Communication port:

- Numeric quantities are represented by the appropriate binary type, and text strings remain unchanged.
- Output telegrams do not include carriage returns or line feeds.
- All output telegrams start with a two-character header and a time tag separated by a comma just as the ASCII version of the telegrams.
- Input telegrams on the LAN port and on the Serial Communication port are interpreted identically, implying that input telegrams must be terminated by a carriage return.

The telegrams are described in the next paragraphs using C programming language structures. The size of the various C types are:

- Char 8 bit integer.
- Short 16 bit integer.
- Long 32 bit integer.
- Float 32 bit floating point IEEE 754.

Structure members of the "Array" type are defined by their maximum size. During real data transfer, their actual size depends on EA 500 parameter settings and data statistics. Many computers can only access two-byte quantities at even addresses and four-byte quantities at addresses divisible by four. A few telegrams therefore include a dummy fill parameter to facilitate communication with these computers. Note that binary quantities are transmitted in "Intel byte order" (least significant byte first) and not in "network byte order" (most significant byte first). Thus, byte swapping at the remote host may be required.

2.2 ASYNCHRONOUS OUTPUT

```
struct Text {               /* parameter request */
  char Header[2];           /* "PR" */
  char Separator1[1];       /* "," */
  char Time[8];             /* hour, minute, second, hundredth */
  char Separator2[1];       /* "," */
  char Text[256];           /* parameter path and value */
};

struct Text {               /* parameter enter */
  char Header[2];           /* "PE" */
  char Separator1[1];       /* "," */
  char Time[8];             /* hour, minute, second, hundredth */
  char Separator2[1];       /* "," */
  char Text[256];           /* parameter path and value */
};

struct Text {               /* comment string (annotation) */
  char Header[2];           /* "CS" */
  char Separator1[1];       /* "," */
  char Time[8];             /* hour, minute, second, hundredth */
  char Separator2[1];       /* "," */
  char Text[256];           /* comment string */
};

struct Text {               /* geographical location (navigation) */
  char Header[2];           /* "GL" */
  char Separator1[1];       /* "," */
  char Time[8];             /* hour, minute, second, hundredth */
  char Separator2[1];       /* "," */
  char Text[256];           /* geographical position */
};
```

```
struct Text {                 /* status telegram */
  char  Header[2];            /* "ST" */
  char  Separator1[1];        /* "," */
  char  Time[8];              /* hour, minute, second, hundredth */
  char  Separator2[1];        /* "," */
  char  Text[265];            /* error, warning or alarm message */
};
```

2.3 PING BASED OUTPUT

Binary values, except for the header.

```
struct Depth {                /* detected bottom depth */
  char  Header[2];            /* "D1", "D2", "D3" */
  char  Separator1[1];        /* "," */
  char  Time[8];              /* hour, minute, second, hundredth */
  char  Separator2[1];        /* "," */
  float Depth[4];             /* detected bottom depth [meter] */
  float Ss[4];                /* bottom surface backscattering strength [dB] */
  long Transducer Number[4];    /* transducer number */
  float AthwartShips;         /* athwartships bottom slope [deg] */
};

struct Motion {               /* motion sensor data */
  char  Header[2];            /* "MS" */
  char  Separator1[1];        /* "," */
  char  Time[8];              /* hour, minute, second, hundredth */
  char  Separator2[1];        /* "," */
  float Heave;                /* heave [meter] */
  float Roll;                 /* roll [degree] */
  float Pitch;                /* pitch [degree] */
};


struct Echogram {             /* echogram */
  char  Header[2];            /* "Q1", "Q2", "Q3" */
  char  Separator1[1];        /* "," */
  char  Time[8];              /* hour, minute, second, hundredth */
  char  Separator2[1];        /* "," */
  long  TVGType;              /* TVG type */
  float Depth;                /* detected bottom depth [meter] */
  float SurfaceUpper;         /* upper depth of surface echogram [meter] */
  float SurfaceLower;         /* lower depth of surface echogram [meter] */
  long  SurfaceCount;         /* number of surface echogram data points */
  float BottomUpper;          /* upper depth of bottom echogram [meter] */
  float BottomLower;          /* lower depth of bottom echogram [meter] */
  long  BottomCount;          /* number of bottom echogram data points */
  short Data[714];            /* max 714 pelagic+bottom echogram data points */
};
```

The Q# output telegram may be used by advanced postprocessing systems, and allows the results of an entire cruise to be replayed and recomputed off-line on a general purpose computer. Data elements corresponding to a maximum of 714 data points (pelagic echogram values + bottom echogram values) are transferred as one *UDP/IP/ETHERNET* block, every ping. The resolutions of the surface echogram and the bottom echogram are controlled by parameters in the Ethernet Communication Menu. The TVG type indicates which TVG function is used (0 = 20logR, 1 = 30logR, 2 = no TVG). Depth and range parameters are output in metres. The sizes of the surface echogram array and bottom echogram array are included. The S_S data is output in the EA 500 dB format (refer to paragraph 3 in the "Theory of Operation" section).

```
struct Sample {                /* sample angle data */
  char  Header[2];             /* "B1", "B2", "B3" */
  char  Separator1[1];         /* "," */
  char  Time[8];               /* hour, minute, second, hundredth */
  char  Separator2[1];         /* "," */
  short Block;                 /* sequence number of data block */
  short Offset;                /* offset within total data array */
  short Count;                 /* number of bytes in this data block */
  short Data[727];             /* max 727 data points per data block */
};
```

The B# output telegram provides angle sample data from the transceiver (applies to split beam transducer channels only) and is used for special purpose studies. The fore-and-aft (alongship) and athwartships electrical angles are output as one 16-bit word; the alongship angle as the most significant byte and the athwartships angle as the least significant byte. Angle data is output in units of phase steps (64 phase steps = 180 electrical degrees) where the least significant seven bits are the magnitude and the most significant bit is the sign; zero in the fore and starboard direction, one in the aft and port direction. Thus, an angle is not expressed in 2's complement. All samples (basic sampling rate of transceiver) inside the super layer are output. Sample data is transmitted as one or more data blocks due to the fact that an Ethernet block only can contain data from 727 samples, and reassembly of the blocks at the reception site is based on the Block/Offset/Count parameters:

- Block. A sequence number is assigned to each data block. The first data block is assigned Block=0x0000, the second data block is assigned Block=0x0001, the third data block is assigned Block=0x0002 etc. Arriving at the final data block in the sequence the most significant bit of its block parameter is set to one. For example, with four data blocks in the sequence the last block will be assigned the number Block=0x8003.
- Offset. Each data block contains a fragment of the original total data array. The fragment offset (in bytes) relative the total array is included in each data block.
- Count. The fragment size (in bytes) of the data block.

```
struct Sample {                 /* sample power data */
  char  Header[2];              /* "W1", "W2", "W3" */
  char  Separator1[1];          /* "," */
  char  Time[8];                /* hour, minute, second, hundredth */
  char  Separator2[1];          /* "," */
  short Block;                  /* sequence number of data block */
  short Offset;                 /* offset within total data array */
  short Count;                  /* number of bytes in this data block */
  short Data[727];              /* max 727 data points per data block */
};
```

The W# output telegram provides echo amplitude sample data from the transceiver; power level referred to the transducer terminals as measured by the transceiver. Data is output in the EA 500 dB format (Refer to paragraph 3 in section "Theory of Operation"). See the sample angle telegram for general comments and a description of the fragmentation mechanism.

2.4 ETHERNET PORT 10183 INPUT

The EA 500 is able to recognize NMEA-183 compatible vessel speed telegrams on UDP port number 10183:

```
$GPVTG,ddd,T,ddd,M,ss.s,N,,<CR><LF>
```

```
N     -> knot
ss.s  -> speed
M     -> magnetic
ddd   -> track deg.
T     -> true
ddd   -> track deg.
```

Please note that the EA 500 is only sensitive to the speed value in knots.

THEORY OF OPERATION

P3051E / 850-130659 / 4AA005

This section of the manual explains the theory and mathematical principles behind the EA 500 echo sounder operation.

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1 INTRODUCTION

1.1 GENERAL DESCRIPTION

In its maximum configuration the EA 500 hydrographic echo sounder includes three parallel transducer channels. These three channels contain dedicated hardware, and they are to a large extent functionally independent.

Each channel performs echogram generation, bottom detection and measurement of bottom reflectivity, and for split-beam channels also bottom inclination is determined. The measured parameters are corrected for the effects of sound velocity, and heave/roll/pitch provided a motion sensor is connected.

During transmission, the transducer is excited with a high-power short-duration pulse, and simultaneous excitation occurs for all active transducer channels.

Output data is presented on a display and on three printers, with individual adjustment of echogram range and output format for each of the devices.

Each transducer channel consists of

- Transducer
- Transmitter/receiver and digitizing circuitry
- Signal processing subsystem

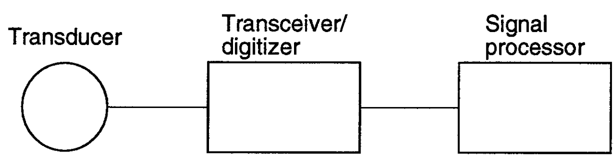


Figure 1 Transducer channel.

1.2 THE TRANSDUCER

The transducers are typically of two types:

Ceramic The ceramic type is relatively lightweight and is characterized by an efficiency of approximately 70%.

Nickel The nickel type is heavier, and has an efficiency of approximately 25%.

The 3-dB beamwidth of commonly-used transducers is in the range 2° to 20°.

The transducer to transceiver/digitizer interface is based on a 60-ohm terminal impedance.

A two-wire connection, plus screen, is used for the single-beam transducers whereas the split-beam transducers require two two-wire connections for the receiver and a two-wire connection for the transmitter, plus screens.

1.3 THE TRANSCEIVER/DIGITIZER

The transceiver/digitizer combination contains the transmitter, receiver and A/D-conversion circuitry.

The receiver does <u>not</u> contain any TVG (Time Varying Gain) function as the EA 500 implements this function solely in software. Instead, the receiving system is designed as a "power meter" with a large instantaneous dynamic range. Input power levels from -160 dBW to 0 dBW (dB's relative 1 W) are measured to a precision of a fraction of a dB and are output to the signal processor as 16-bit digital words using the dBW scale for numeric representation. The receiver includes one receiving channel for single-beam operation and four matched channels plus phase measurement circuitry for split-beam operation.

1.4 THE SIGNAL PROCESSORS

The signal processor is based on the Intel 80286 microprocessor and the 80287 mathematics coprocessor. It is responsible for control of the transmitter/-receiver and for processing of received data. The signal processor generates individual echograms for each output device and estimates physical parameters (depth, bottom backscattering strength etc) from the received signal samples by taking into account instrumental effects, transmission losses and transmitted power.

2 POWER BUDGET

The EA 500 uses a sophisticated receiver design, which is characterized by a very high amplitude measurement accuracy over the entire dynamic input range (-160 dBW to 0 dBW). The absolute power level of the received signal is measured, enabling the EA 500 to estimate bottom reflectivity, or more precisely *surface backscattering strength*, in the absolute sense. The estimation algorithm is based on a physical model which accounts accurately for instrumental effects and propagation losses. This model will be outlined to ensure that the measured output scattering parameters are correctly interpreted.

The radiation and reception properties of a transducer are traditionally stated in terms of source level, directivity index, reception response etc. However, the algorithms of the EA 500 uses the more modern concept of gain to facilitate power budget equations. The gain concept is used widely within many fields in physics, and is accepted internationally as a convenient measure of the radiation properties.

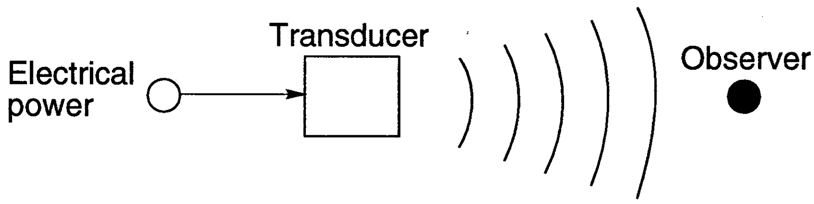


Figure 2 The gain concept.

Gain is defined as the intensity ratio, observed at a distant point, when using a real transducer and an idealized loss-less omni-directional transducer, keeping the electrical input power constant (see figure 2).

Thus, gain accounts for both directional properties and losses, and is independent of input power level, impedance and observation point. However, gain must be referred to a defined point on the terminal side of the transducer in order to uniquely identify the losses which are to be included.

Gain (G) relates to directivity (D) as shown in equation 1:

$$G(\alpha,\beta) = \eta \cdot D(\alpha,\beta) \quad (1)$$

where α and ß are the directional angles, and η is the efficiency of the transducer.

Thus, directivity is a normalized quantity which corresponds to the gain pattern of an identical but loss-less transducer. Whereas gain is used for describing the radiation properties, it is common to state the receiving properties in terms of the effective receiving area (A).

Gain and effective receiving area are related by reciprocity as shown in equation 2:

$$A = \frac{\lambda^2}{4\pi} G \quad (2)$$

where λ is the wavelength and where A and G are both referred to the same point on the terminal side of the transducer.

Figure 3 shows the gain pattern of a typical transducer.

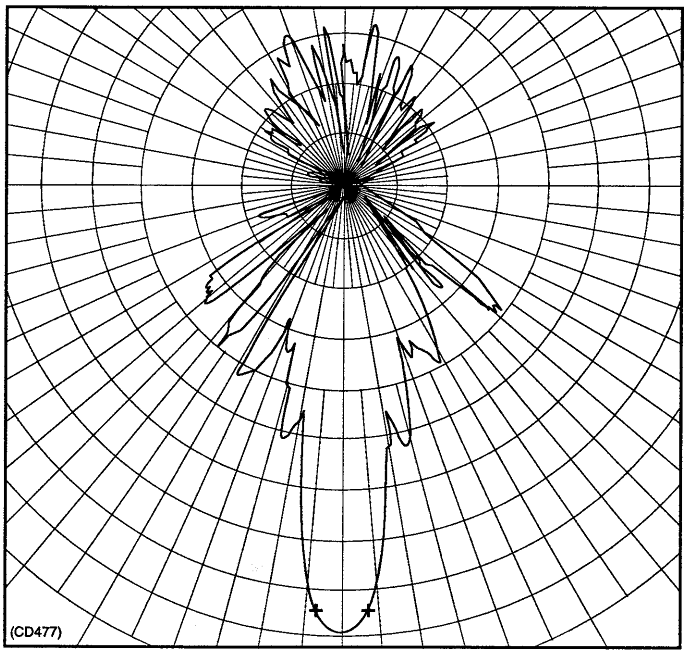


Figure 3 Beam pattern.

The echo from a small object, henceforth called the target, is described by equation (3):

$$P_r = P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G \quad (3)$$

where:

P_r and P_t	are the received and transmitted power referred to the transducer terminals.
G	is the transducer gain towards the target.
r	is the transducer target range.
α	is the attenuation constant.
σ	is the effective backscattering cross-section area of the target.
λ	is the wavelength. This expression can be recognized as the classic radar equation, and its derivation will be recapitulated.

Assuming an idealized loss-less isotropic transducer, the transmitted power will propagate evenly in all directions, and the power density at the transducer-target range is explained in expression 4:

$$\frac{P_t}{4\pi r^2} \quad (4)$$

The real transducer amplifies the radiated signal by a factor G in the direction of the target, and attenuation occurs while propagating from the transducer to the target. Hence, the real power density at the target becomes:

$$P_t G \frac{10^{-\alpha r}}{4\pi r^2} \quad (5)$$

The ability of an object to backscatter energy is stated in terms of its effective backscattering cross section area, henceforth the backscattering area, which roughly corresponds to the physical cross section area as seen from the transducer. Introducing this concept in the derivation the real target can be replaced by an isotropic transmitter of power:

$$P_t G \frac{10^{-\alpha r}}{4\pi r^2} \sigma \quad (6)$$

While propagating back towards the transducer attenuation and spherical spreading occur once more, and the power density at the transducer becomes:

$$P_t\, G \frac{10^{-\alpha r}}{4\pi r^2}\, \sigma\, \frac{10^{-\alpha r}}{4\pi r^2} \quad (7)$$

Received power at the transducer terminals is obtained by multiplying this power density by the effective receiving area of the transducer, and the complete equation becomes:

$$P_r = P_t\, G \frac{10^{-\alpha r}}{4\pi r^2}\, \sigma\, \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G \quad (8)$$

Having established the basic power budget equation for point backscattering, the extension to surface backscattering is straightforward. Whereas scattering from a small object is characterized by its backscattering area, the scattering from a homogeneous surface is characterized by the backscattering area per unit of surface area $\partial\sigma/\partial A$. The power budget equation for surface backscattering becomes (equation 9):

$$P_r = \int_A P_t G \frac{10^{-\alpha r}}{4\pi r^2} \frac{\partial \sigma}{\partial A} \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} G\, dA \quad (9)$$

where $\partial\sigma/\partial A$ is the backscattering area from the small bottom surface area dA, and the integration includes all surface area A contributing to the received signal at the current instant. At this point some simplifying assumptions are necessary in order to arrive at an expression which is suitable for implementation in the sounder. In general, a rough bottom is characterized by a hard consistency causing a strong backscatter echo to occur. However, for a flat bottom more variation can be expected, soft sediments causing weaker echo than a rocky bottom. Consequently, the EA 500 algorithms are tuned to flat bottom operation implying that the integration surface A becomes an infinite horizontal plane at depth r. However, integration is greatly simplified by replacing the flat bottom with a sphere of radius r with its centre at the transducer. For commonly used transducers with a relatively narrow beamwidth the difference between a flat and a spherical bottom is small. Thus, with the spherical bottom assumption the equation reduces to (equation 10):

$$P_r = P_t \frac{10^{-\alpha r}}{4\pi r^2} \frac{\partial\sigma}{\partial A} \frac{10^{-\alpha r}}{4\pi r^2} \frac{\lambda^2}{4\pi} r^2 \int_{4\pi} G^2 d\Omega \quad (10)$$

where integration over all solid angles 4π replaces integration over the spherical surface A ($dA = r^2 d\Omega$). The equivalent two-way solid beam angle Ψ is a key transducer parameter and is defined (equation 11):

$$\int_{4\pi} G^2 d\Omega = G_0^2 \psi \quad (11)$$

where G_0 is the peak gain. Introducing this definition and rearranging the terms:

$$\frac{\partial\sigma}{\partial A} = \frac{P_r 64\pi^3}{P_t G_0^2 \lambda^2 \psi} r^2 10^{2\alpha r} \quad (12)$$

Thus, a simple expression for calculating the bottom reflectivity has been obtained. In underwater acoustics it is common to state bottom reflectivity in terms of surface backscattering strength S_S which is related to ∂σ/∂A as (equation 13):

$$S_S = \frac{\partial\sigma/\partial A}{4\pi r_0^2} = \frac{P_r 16\pi^2}{P_t G_0^2 \lambda^2 r_0^2 \psi} r^2 10^{2\alpha r} \quad (13)$$

where r_0 = 1 meter is the reference range for backscattering strength. Finally, the EA 500 implements a logarithmic version of this equation (equation 14):

$$10\log(S_S) = 10lg(P_r) + 10lg(r^2 10^{2\alpha r}) - 10lg\left(\frac{P_t G_0^2 r_0^2 \lambda^2 \psi}{16\pi^2}\right) \quad (14)$$

The surface backscattering strength is obtained by adding a range dependent term (corresponds to 20logR TVG) and a constant (accounts for equipment parameters) to the received signal power (digital word from the transceiver/digitizer). It should be observed that many of the internal algorithms of the sounder are based on the quantity $10lg(S_S)$; echogram generation, bottom detection etc.

From the discussion given here it can be concluded that:

- The output parameter $10lg(S_S)$ can be associated with the true surface backscattering strength for a reasonably flat bottom.
- A long pulse length should be used, especially in deep waters.

3 EA 500 DB FORMAT

Simple conversion between dB and linear scale is obtained in a computer by using 10 dB lg(2) = 3.0103 - - - dB as a reference value in the dB domain. The EA 500 algorithms use 16-bit words to represent dB quantities.

$$\underbrace{\texttt{XXXXXXXX}}_{A}\ \underbrace{\texttt{XXXXXXXX}}_{B}$$

The eight most significant bits (A) correspond to the integer part relative to 3.0103 - - - dB and the eight least significant bits (B) correspond to the fractional part. Thus, the least significant bit corresponds to an increase/decrease of 3.0103 - - - dB/256 ≈ 0.01 dB. Assuming as an example the linear decimal number 178.125 the value of A and B becomes:

$$10 \text{ dB} \times \lg(178.125) = 22.207\cdots \text{ dB}$$

$$22.207\cdots/3.0103\cdots = 7.4767\cdots = \underbrace{00000111}_{A}.\underbrace{01111010}_{B}$$

Conversion to linear scale is based on the relationship:

$$10^{0.30103\cdots \times A.B} = 2^{A.B} = 2^{A+0.B} = 2^{A} \times 2^{0.B}$$

Evidently, the upper byte A is simply the exponent in binary floating point format, and 2 to the power 0.B is the mantissa. Thus, the mantissa can be obtained by using B as the address in an antilog look-up table containing 256 elements, and a similar technique can be used for the inverse conversion from linear to dB scale.

4 BOTTOM DETECTION

The bottom detection algorithm is implemented solely in software, and separate algorithms are run for each transducer channel.

The algorithm is designed with emphasis on reliability, such that erroneous depth detections are never output. Whenever uncertainty is associated with a detection, the algorithm outputs zero depth to indicate that no reliable detection was obtained. The algorithm is designed to maintain bottom lock for a discontinuous jump in bottom depth, and special features have been included to avoid false bottom detection on schools of fish. Operational experience has shown that the algorithm is indeed quite robust; erroneous bottom detections are virtually absent, a dense school of fish does not confuse the algorithm, rough bottom contours cause only a few dropouts to occur.

The algorithm is implemented as a four-fold tracking algorithm. For each ping, up to four candidate bottom returns are identified, and their association with previous bottom candidates is determined in order to perform individual tracking of several potential bottoms simultaneously. For example, bottom return number one could be from a large school of fish, return two from the true bottom, and return three could be the echo which has travelled twice up and down between the surface and the bottom. A quality score is computed for each of the active channels of the tracking algorithm, and the channel with the highest score is assumed to contain the true bottom echo. Reliable depth detections are distinguished from unreliable ones by requiring a certain minimum quality score; reliable detections are output, and zero depth is output for unreliable detections. The computation of quality is based on echo pulse characteristics, ping-to-ping history, proximity to the surface etc. The operating range of the algorithm can be set from the menu system (min depth, max depth).

5 BOTTOM RANGE

Bottom range is available on the display and on the printers, and allows the echogram below the detected bottom to be shown with a resolution different from the main echogram. This feature is useful when studying soft sediment layers and bottom consistency. Waves propagating down into the bottom are strongly attenuated, and echoes from sub-bottom layers are soon below the dynamic range of the echogram colour scale. Hence, additional amplification (performed in software) brings these echoes into the visible range. Excess amplification is set from the menu system in dB's per meter below the detected bottom. A typical value would be 0.5 dB/m. However, the optimum value will depend on bottom type and frequency, and should be found experimentally.

6 SOUND VELOCITY

Sound velocity in the sea varies with temperature, salinity and pressure, and a typical velocity profile is shown in figure 4. Diurnal and seasonal variations occur in the upper 2 - 300 meters, and below 1000 meters the velocity profile is nearly constant. The EA 500 computes bottom depth by using a sound velocity profile rather than an average velocity for all depths. The velocity profile is entered manually via the EA 500 menu system, automatically from a sound velocity probe, or an external computer, or as a combination of these methods. The following details should be observed:

- The default profile assumes a constant velocity of 1500 m/s for all depths down to 12000 meters.
- The sound velocity profile affects the computed bottom depth, echograms and the compensation for path loss (TVG).

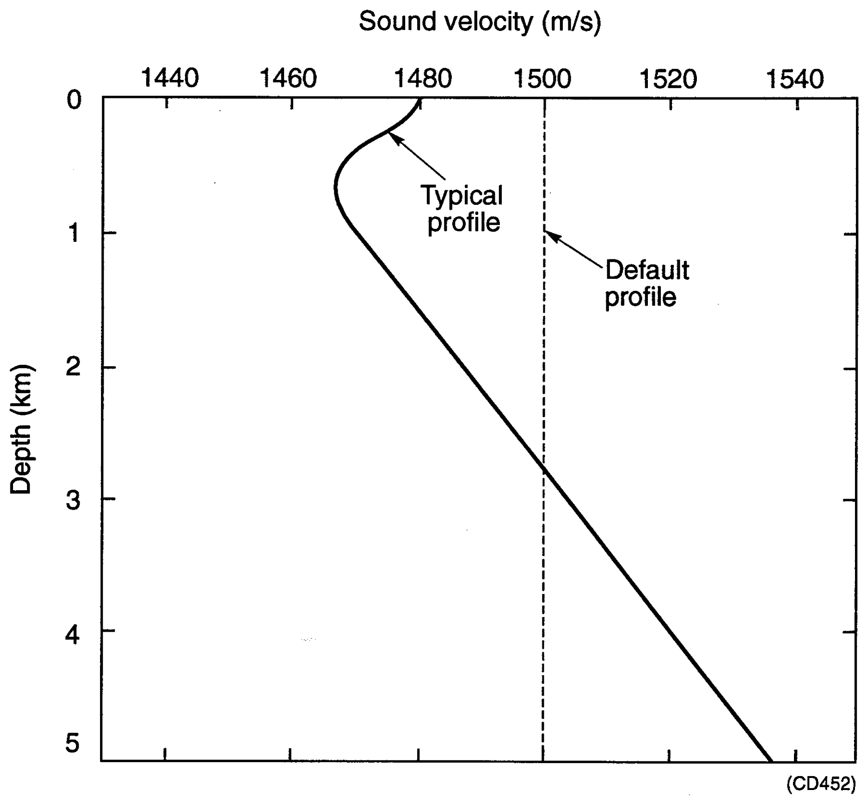
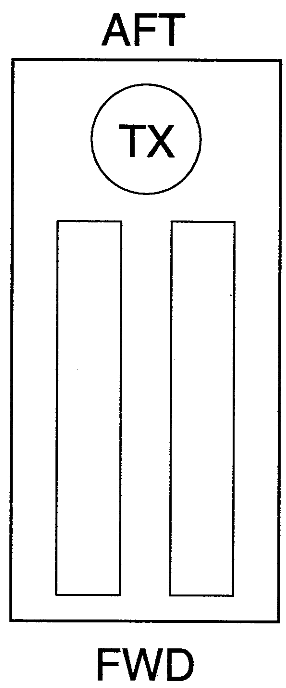


Figure 4 Typical velocity profile.

7 SPLIT-BEAM OPERATION

Figure 5 shows the mechanical layout of a 120 kHz split-beam transducer. The transducer comprises one transmitting element and two separate receiving elements. These allow the direction of arrival of acoustic energy to be determined. Two elements are used for determining the athwartships angle. An acoustic wave-front propagating towards the transducer arrives at different times at the two receiving elements causing the phase angle of the electrical output signal from the elements to differ.



(CD444)

Figure 5 Split-beam transducer.

The ratio between the electrical and the mechanical angle is referred to as the "angle sensitivity" of the transducer, and for the current 120 kHz transducer this sensitivity is 13.3. The EA 500 uses the split-beam feature to estimate bottom slope in the athwartships direction. Figure 6shows echo amplitude and electrical phase as a function of range for a typical situation with bottom slope in the athwartships direction.

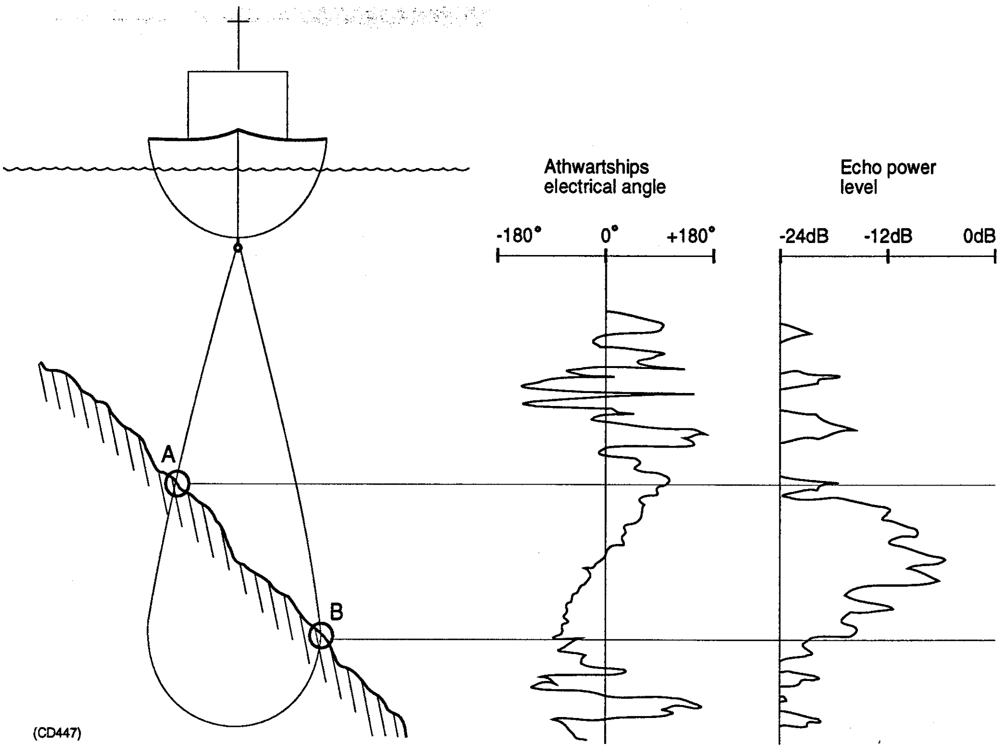


Figure 6 Typical split-beam geometry.

The transmitted pulse first hits the slope at point A, and as time elapses the reflection point travels along the slope towards point B. Consequently, the mechanical arrival angle is subject to a linear shift as the reflection point travels along the slope, and for well behaved slopes the differential electrical phase will move along a tilted straight line with respect to the time axis. Studying the mechanisms involved it is obvious that a steep bottom slope causes a small tilt angle and vice versa. It should also be observed that the straight line collapses for a flat bottom. The EA 500 estimates bottom slope by fitting a straight line to the electrical phase curve, and bottom slope is computed from the tilt of this line.

Bottom slope estimation is only successful for reasonably well behaved slopes with a certain minimum inclination angle, and a number of software tests detects collapse of the algorithm and prevent spurious bottom slope estimates from entering the output data stream. Extensive field trials have revealed that the minimum bottom inclination for successful operation is roughly a function of depth. Figure 7 shows a statistical evaluation of the trial results.

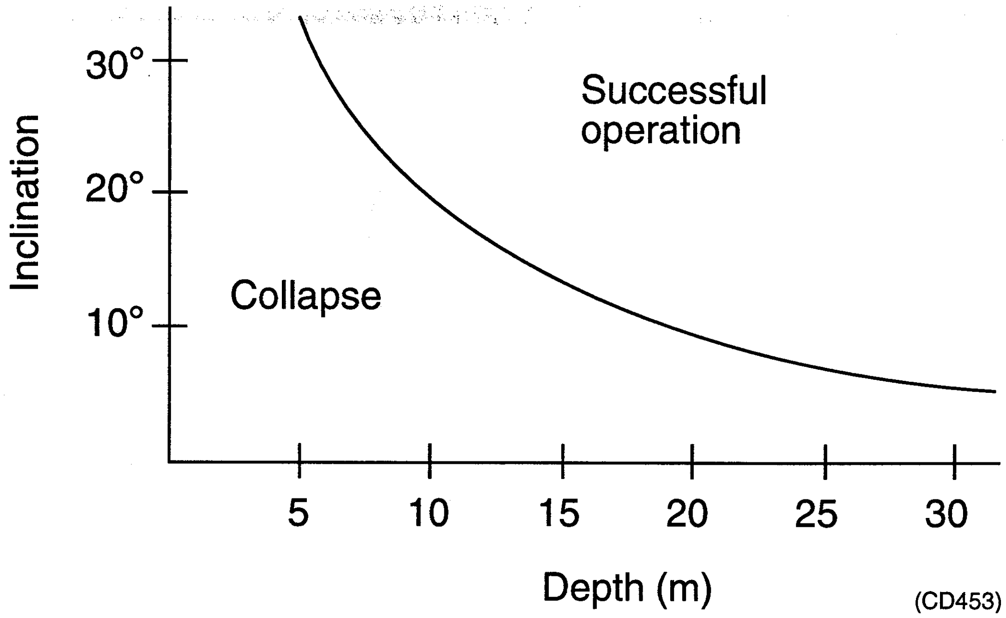


Figure 7 120 kHz split-beam performance.

8 MULTIPULSE OPERATION

The main purpose of multipulse operation is to obtain high ping rates. This requires the handling of multiple pulses in the water simultaneously. The mode is started through the *Ping Mode / Multiple* choices in the menu system.

Obviously this feature is very useful when high horizontal resolution is required in deep waters. The implementation is based on continuous reading of depth samples into a ring buffer. To keep track of ping start and range limits special codes are inserted to ease the finding of current ping and corresponding range window. In order to obtain a good performance this implementation is based on a rather small phased range setting (around the bottom) compared to the depth. This is necessary since the software regulates the transmitter pulse to be triggered outside the current range window. This is done to obtain a clean echogram and help protect the bottom detector against confusion.

The multi-pulse mode never starts before an accepted bottom depth is found in normal ping mode. Then, if multiple ping mode is selected, the high-rate transmitting of transmitter pulses is automatically entered and this will continue as long as the bottom is tracked. If bottom track is lost, normal ping mode takes over until the next bottom depth is detected.

The regulation of the transmitter pulse start to avoid collision with the current range window requires that the ping interval is set to zero, otherwise the triggering will be regulated inside this window and the transmitter pulse will be likely to occur inside the current phased range window.

The following operator recommendations should be taken into account before running the sounder in *Ping mode = Multiple.*

- Select all devices in use to a small phased range (*Range* command).
- Start autophasing (*Auto range* command).
- Set bottom detection limits to include expected depth variations.
- Set *Ping interval* to *0.*
- Set motion sensor function to *Off.*

9 NOISE

The deep water performance of a sounder is determined by the system noise level; the sum of receiver noise, local noise and ambient noise.

Receiver noise includes thermal noise from the receiver itself and pick-up noise from the digital circuitry in the sounder. The EA 500 utilizes a low noise receiver input stage, and the digital noise pick-up has been reduced to an insignificant level by proper internal screening.

Local noise includes propeller noise, engine noise, flow noise and other locally identifiable acoustic noise sources. This noise is generally related to vessel design and transducer installation, and can be reduced significantly by taking the necessary precautions.

Ambient noise is the noise of the sea itself. It is that part of the total noise background of the sea which is not due to some locally identifiable source. The ambient noise level is subject to wide variations. Heavy shipping and strong wind increase the noise level, and in shallow water the noise level is normally higher than in deep water.

Noise can in most practical cases be considered "white", with a continuous power spectral density with respect to frequency. A quantitative evaluation of noise requires that the various contributions are all referred to a common point within the receiving system, and for most purposes it is convenient to use the transducer terminals as the common point. Referred to this point, the total system noise is simply the sum of all individual noise power contributions. Traditionally, receiver noise is stated in terms of noise figure (F), noise temperature (T) or single sided noise power density (S). Yet another quantity, the ambient noise spectrum level (N), is used to specify acoustic noise in the sea. Standard textbooks should be consulted for a general discussion of these quantities.

However, the following equation defines their interrelation (equation 15):
where:

$$P = SB = kTB = kT_0 (F-1) B = NC\frac{\lambda^2}{4\pi}\eta B \quad (15)$$

where:
P is the noise power inside the receiver bandwidth in watts.
B is the equivalent noise bandwidth of the receiver (normally somewhat larger than the 3 dB bandwidth).
$k = 1.38 \times 10^{-23}$ W/Hz/K is the Boltzmann constant.
$T_0 = 290$°K is the standard reference temperature.
$C = 0.67 \times 10^{-18}$ W/Hz/m^2 is equivalent to 1 µPa/√Hz.
λ is the wavelength in water.
η is the efficiency of the transducer.

Recalling that the nominal noise figure of the EA 500 is F ≈ 10 dB at all frequencies it is now a straightforward task to compute that this noise figure corresponds to a noise temperature of T = 2610°K and a single-sided noise power density of $S = 3.6 \times 10^{-20}$ W/Hz. Figure 8 shows receiver noise, local noise (medium size vessel at 10 knots) and average deep water ambient noise as a function of frequency.

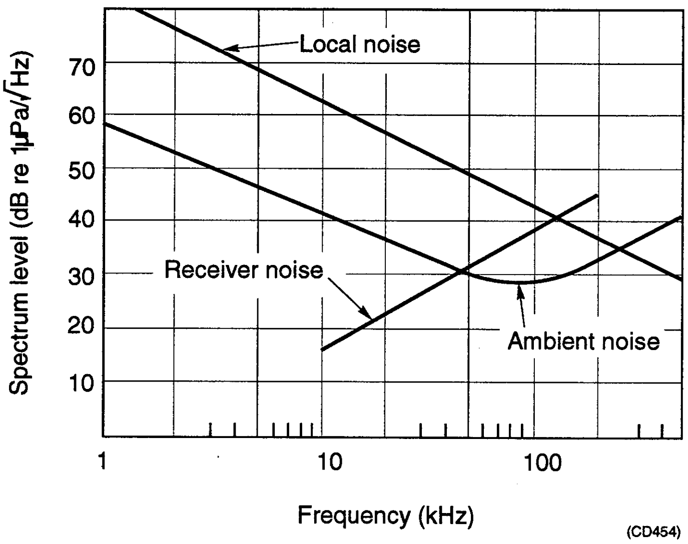


Figure 8 Receiver noise versus ambient noise.

10 SYSTEM CONSIDERATIONS

Figure 9 shows a system implementation with three transducer channels installed. In multichannel operation, the EA 500 utilizes simultaneous transmission on all channels to avoid the transmission on one channel causes disturbances during reception on another channel. However, it should be noted that the receivers will experience a blanking interval subsequent to transmission due to the travel time of the direct transmission signal between the transducers. As a rule, therefore, the transducers should be installed at the same location on the vessel.

When connected to a heave/roll/pitch sensor, compensation for heave is directly applied to both the numerical depth value and echograms. Different locations on the vessel will experience a different heave, and for correct compensation the heave sensor should be located near the transducers. Heave is sampled at the instant of transmission and at the instant of reception of the bottom echo, and the arithmetic mean is used in subsequent processing. Roll and pitch are sampled at the instant of reception only and are not averaged. The heave output telegram is time-tagged with the time of transmission of the ping.

The EA 500 does not perform processing on navigation data. Input navigation data is time-tagged and simply included in the output data stream for use in subsequent postprocessing. Consequently, large variations can be tolerated in data format and position coordinate type; longitude-latitude, x-y coordinates, measured range to local repeaters etc.

Great care has been taken in the design of the sounder to ensure precise time tagging of depth data and heave/roll/pitch data. Thus all time-critical functions are performed by the sounder, and data logging simply becomes a matter of storing the output data sequentially. The timing precision is approximately 0.01 second.

The EA 500 is prepared for interfacing towards data logging and postprocessing systems of varying complexity. A simple system based on a standard PC would typically use the RS232 external computer port where commands for remote control and most of the output data types are available. However, the LAN port must be used for advanced applications where also echogram data are required.

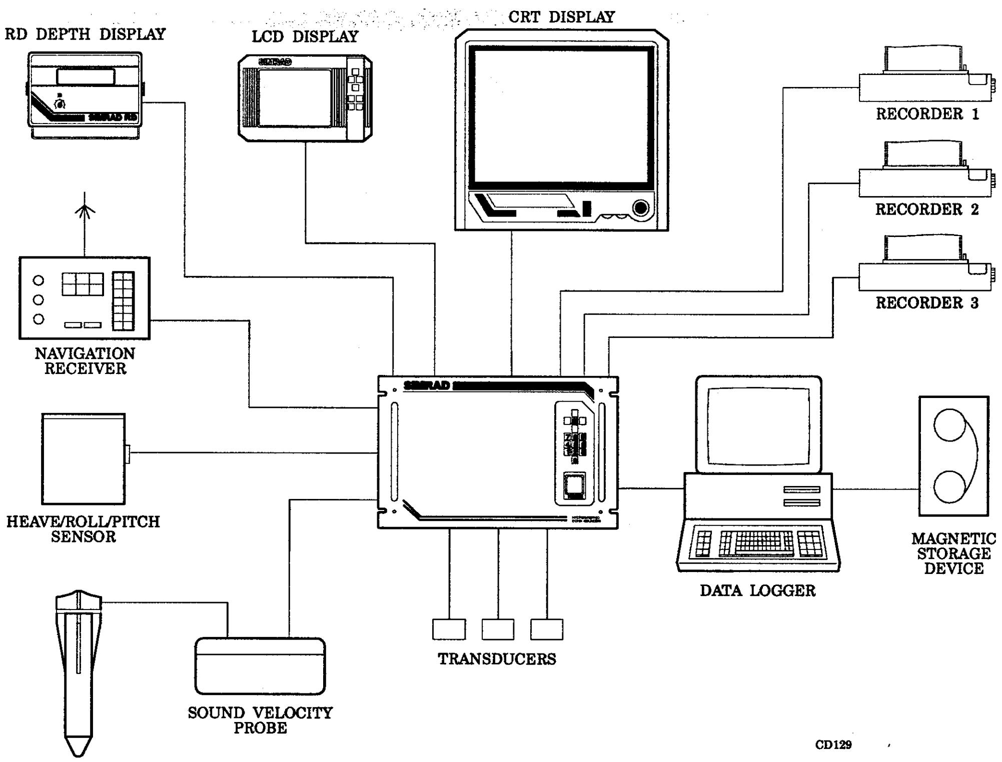


Figure 9 System implementation.

Communication via the LAN port is based on the TCP/IP protocol, the worldwide de facto standard, which is included in the operating system of virtually all UNIX computers and is available for most other common operating systems. The TCP/IP/ETHERNET standard is popular within office, engineering and university environments, and allows multiple computer-to-computer connections to coexist on the cable simultaneously by time sharing. Simrad foresees that LAN's of this type will be common on board research vessels in the future, and the EA 500 thus matches these systems neatly.

The EA 500 includes substantial processing power, more than enough for normal operations and settings. However, some of the software algorithms can be very processor-intensive if unfavourable parameter settings are used. The following guidelines should be observed:

- A high noise margin (for example +10 dB) reduces processing time.
- The processing time for echogram generation is roughly proportional to the total sum of all depth ranges; echogram range on display and printers.
- Extensive use of the RS232 ports and LAN port can reduce the ping rate.
- Split-beam channels require more processing than single-beam channels.
- The sample interval influences processing time and ping rate.

STATUS AND ERROR MESSAGES

P2265E / 859-043870 / 4AA005

This section of the manual details the status and error messages that may be displayed by the echo sounder from time to time. All the possible messages are listed, and an explanation is given for each.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
E	15.03.96	CL	18.03.96	OL	18.03.96	EF
F	22.05.97	CL	22.05.97	HS	22.05.97	RLN

List of contents

Document history

(The remainder of the information on this page is for Simrad internal use).

Revisions:

Rev. A	01.02.91	Original edition.
Rev. B	25.06.92	Minor changes to text.
Rev. C	31.08.92	Document updated, minor changes to text.
Rev. D	16.06.93	Document re-formatted to bring it up to Simrad standards.
Rev. E		Document re-formatted to bring it up to new Simrad standards. This document now applies for both EA 500 and EK 500 echo sounders.
Rev. F		New error message included (Serial receive overload).

1 INTRODUCTION

The 500-series echo sounders may issue alarms, errors, warnings and other messages to the display and external devices (via serial port or Ethernet). Note that the # sign indicates the number of the transceiver unit affected (1/2/3). No number is issued for echo sounders with only one transceiver.

Note that the lists include messages for all the echo sounders in the 500 series.

2 GENERAL MESSAGES

All messages starting with "SP-#" concern signal processor no. # (described in chapter 3).

Message	Explanation
Bottom lost alarm #	Bottom tracking lost for transceiver-#
Display not ready	Display overload (may occur if system unable to update display with the current ping rate)
External trigger error	Expected trigger pulse not received
Illegal remote parameter	Parameter value of received remote command out of range or not recognized
Internal error #	*
Internal error 7	Spurious interrupt (caused by badly formed trigger pulses etc.)
LAN interrupt level fault	*
LAN invalid ind. address	The EA 500 local Ethernet address must be an individual address, i.e. least significant bit of first byte of address must be zero
LAN invalid multic. adr.	Invalid EA 500 multicast address
LAN multicast table full	*
LAN no command blocks	May appear while CPU is heavily loaded. Regular appearance of this message indicates a LAN interface terminator or hardware problem
LAN no transmit blocks	See above
LAN receive overload	Too much data received from LAN (Local Area Network), data is lost
LAN socket table full	*
LAN too high priority	*
LAN too long message	*

Message	Explanation
LAN UDP port busy	*
LAN 82586 init error	Unable to initialize 82586 chip. Possible hardware fault.
Maximum depth alarm #	Bottom of transceiver-# has been detected deeper than the maximum depth alarm setting
Minimum depth alarm #	Bottom of transceiver-# has been detected shallower than the minimum depth alarm setting
Navigation telegram error	Invalid navigation telegram received
Ping interval warning	Ping interval time exceeded
Printer-1 not ready	Printer-1 not connected, offline or not ready to print yet
Printer-2 not ready	Printer-2 not connected, offline or not ready to print yet
Printer-3 not ready	Printer-3 not connected, offline or not ready to print yet
Rem. annotation received	Remote annotation has been received successfully
Remote command ignored	Remote control received while remote control disabled
Remote parameter entered	Remote parameter received, decoded and entered successfully
Remote request executed	Remote request has been executed successfully
Serial Com. load warning	Too much data is directed to serial port, data may soon be lost
Serial Com. overload	Too much data is directed to serial port, data is lost
Serial line 1 error	Serial port 1 failure
Serial line 1B error	RD display serial port failure
Serial line 2 error	Serial port 2 failure
Serial line 3 error	Serial port 3 error
Serial line 4 error	Serial port 4 error
Serial receive overload	Unable to receive more data on serial port. Data is lost
Unknown error	*
Unknown remote command	Invalid remote command path/parameter received
Unknown transceiver type	Transceiver hardware switch not recognized
Display processor error	Display/graphic processor (80786) malfunction
Disk error 0	
File not found	
Replay end of file	
Replay data not found	
Replay bad data	
File create error	
File open error	
File write error	
File close error	

Message	Explanation
Disk full	
External critical alarm	External critical alarm received
External alarm	External alarm received

Table 1

* = Internal software problem encountered. If this error code is displayed, the incident should be reported to Simrad.

3 SIGNAL PROCESSOR (SP) ERROR MESSAGES

3.1 INTRODUCTION

The signal processor will read the control parameters sent by the control processor before initiating a new ping. The program will then test each parameter against its legal values. If the parameter is found to be illegal, or the value does not agree with the other settings, an error message code is sent to the control processor which will issue the error message.

At power-up the signal processors will never start real pinging until all the parameters are granted. However, in order to receive new information from the control processor, it will simulate pinging until no errors occur.

If the error message "SP-# not responding error" is shown on the display, the signal processor has not answered within a time-out period. This error is probably caused by one of the following hardware errors:

1 No signal processor PCB present.

2 A new PROM set is not properly inserted in the signal processor (check carefully).

3 The IC used for signalling is defective (U42 = 8255). This may be checked by inserting a new 8255.

4 The FIFO system on the digital interface pcb is not working properly. (If the sounder uses multiple frequencies, try exchanging the digital interface boards).

5 The signal processor is defective (replace the board, if possible).

3.2 LIST OF SIGNAL PROCESSOR ERROR MESSAGES

Note that the # sign indicates transceiver number (1/2/3) and that all error messages end with "error".

Error message	Legal values
SP-# angle sensi. error	0 to 100 el./mech.
SP-# bandwidth error	0 to 1
SP-# beamtype error	0 to 1
SP-# btm. min. level error	-80 to 0 dB
SP-# btm. max. depth error	0 to 20000 m
SP-# btm. min. depth error	0 to 1000 m
SP-# damping coeff. error	0 to 300 dB/km
SP-# device data error	See note I
SP-# equ. beam angle error	-100 to -1 dB
SP-# FIFO input error	0 to 1
SP-# frequency error	10^4 to 10^6 Hz
SP-# heave conver. error	-10 to 10 V/m
SP-# layer data error	See note III
SP-# noise margin error	0 to 40 dB
SP-# not responding error	See paragraph 3.1
SP-# ping mode error	0 to 3
SP-# pitch conver. error	-10 to 10 V/m
SP-# product type error	0 to 1
SP-# pulse length error	0.02 to 10 ms
SP-# roll conver. error	-10 to 10 V/m
SP-# sample interval error	0.005 to 0.5 m
SP-# sound velocity error	1400 to 1700 m/s
Sample tg error	0 to 1
FIFO tg error	0 to 1
SP-# transceiv. mode error	0 to 3
SP-# transceiver HW error	
SP-# transd. depth error	0 to 1000 m
SP-# transd. seq. error	
SP-# transd. param. error	See note II
SP-# transd. gain error	1 to 100 dB
SP-# transmit power error	0 to 10 kW
SP-# TS phasedevia. error	0 to 10
SP-# TS min. level error	-100 to 0 dB

Error message	**Legal values**
SP-# TS min. length error	0 to 10
SP-# TS max. length error	0 to 10
SP-# TS max. comp. error	0 to 6 dB

Table 2

Note I

SP-# device data error

The appropriate error message in Table 2 will be displayed if one or more of the following parameters are outside legal limits:

Parameter	**Legal values**
Bottom echogram dots	0 to 200.
Bottom range	0 to 100 m.
Bottom range start	-100 to 100 m.
Echogram dots	0 to 1000.
Range	0 to 10000 m.
Range start	0 to 10000 m.
Sub-bottom gain	0 to 5 dB/m.
TVG	0 to 2.

Table 3

Note II

SP-# transd. parameter error

The appropriate error message in Table 2 will be displayed if one or more of the following parameters are outside legal limits:

Parameter	Legal values
Alongship offset angle	-20° to 20° mechanical.
Athwartships offset angle	-20° to 20° mechanical.
Three dB bandwidth	0° to 50° mechanical.

Table 4

Note III

SP-# layer data error

The above error message will occur if one or more of the following parameters are outside legal limits:

Parameter	Legal values
Layer margin	0 to 10
Layer start	-100 to 20000
Layer stop	-100 to 20000
Layer type	0 to 3
No. of sublayers	1 to 50

Table 5

EA 500 SAMPLE / PING INTERVAL

P2483E / 859-130088 / 4AA005

This document provides optimum ping intervals for the various frequencies.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
B						

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Document history

(The remainder of the information on this page is for Simrad internal use).

Revisions:

Rev. A	20.06.92	First edition.
Rev. B		Document updated to Simrad standards.

1 INTRODUCTION

This document is a guide to enable you to optimize the ping rate (ping interval). In earlier software versions, the sample interval has been fixed and dependent on the frequency. In software versions 3.00 and later, the sample interval has been made such that it can be selected as required. The tables contain data of the ping intervals obtained during practical testing with software version 3.0. The tests were carried out with only one channel active at a time.

2 10 M RANGE

Sample interval (m)		**0.20**	**0.10**	**0.05**	**0.03**	**0.02**	**0.01**	**0.005**
Ping interval (second)	**38kHz**	0.35	0.20	0.13	0.10	0.009		
	200kHz			0.13	0.10	0.009	0.12	
	710kHz			0.13	0.10	0.009	0.12	0.20

With 3 cm sample interval and 10 m main range, a sample interval of 0.10 seconds will give 10 pings per second.

With 2 cm sample interval and 10 m main range, more than 10 pings per second will be transmitted.

3 25 M RANGE

Sample interval (m)		0.20	0.10	0.05	0.03	0.02	0.01	0.005
Ping interval (second)	38kHz	0.35	0.21	0.13	0.11	0.13		
	200kHz			0.13	0.11	0.13	0.21	
	710kHz			0.13	0.10	0.009	0.21	0.38

4 50 M RANGE

Sample interval (m)		0.20	0.10	0.05	0.03	0.02	0.01	0.005
Ping interval (second)	38kHz	0.35	0.21	0.13	0.15	0.21		
	200kHz			0.13	0.15	0.21	0.35	
	710kHz			0.13	0.15	0.20	0.34	0.68

EA 500 PINGER MODE

P2372E / 859-043976 / 4AA005

This document describes the 12 kHz listening transducer.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
A	31.08.92					
B	15.03.96	CL	18.03.96	OL	18.03.96	EF

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Document history

(The remainder of the information on this page is for Simrad internal use).

Revisions:

Rev. A 31.08.92 Original version.
Rev. B 15.03.96 Document updated and brought up to Simrad's standards.

1 INTRODUCTION

Simrad has developed a 12 kHz transducer for pinger listening. The transducer beam width is approximately 50°, and the beam is circular. One or more of the three channels of the EA 500 can be used for receiving pinger signals. The frequency of the transceiver channel must correspond with the pinger frequency.

The EA 500 pinger mode may be used for tracking objects relative to the surface/bottom or relative to each other.

Note

To avoid damaging the transducer, Simrad strongly recommends that you install a transceiver board specially made to be used in conjunction with the 12 kHz pinger mode transducer.

2 SPECIFICATIONS

2.1 TRANSDUCER

Transducer reg. no: 312-083741
Frequency: . . . . 12.0 kHz
Transducer beamwidth: . . . . Approx. 50° circular
Receiver bandwidth: . . . . 1.5 kHz

2.2 TRANSCEIVER

Transceiver PCB, 12 kHz reg. no. 382-074824

2.3 RANGE PERFORMANCE (12 KHZ)

Assumed ship noise level: . . . . 50 dB ref. 1µPA, 1 Hz
Assumed signal to noise level: . . . . Better than 10 dB

Pinger source level (rel. 1 µPa) (dB)	Receive direction (rel. to vertical) (°)	Max. range direct signal (m)	Max range bottom reflection (m)
193	0	14000	7000
185	0	11000	3500
185	±50	5000	800
185	> 70	3000	300

3 SYSTEM OPERATION

Select the *Operation* menu and set the *Ping interval* to a desired value corresponding to the pinger pulse repetition rate.

Select the desired *Transceiver-#* menu(s) and set *Mode* to *Passive.* This is a passive listening mode with no transmitter pulses.

The echo sounder can be operated with or without TVG (refer to the *Display / Echogram-#* menu). The parameter *Colour gain* (see the *Display / Echogram-#* menu) may be manipulated to obtain echograms that cover the desired signal strength rate.

4 TIMING STABILITY

Due to the drift of the two independent clocks, one (the echo sounder and one in the pinger) the displayed pulse from a constant-depth pinger may drift slowly over the echogram. The stability of the clock in the echo sounder is better than 50 ppm, corresponding to a drift on the echogram of 4.5 m/min. A similar contribution can be expected as a result of the clock in the pinger.

EA 500 MULTICHANNEL OPTION

P2491E / 859-130096 / 4AA005

This document describes the multiple channel option for the EA 500 echo sounder system.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
B	15.03.96	CL	18.03.96	OE	18.03.96	JT

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Document history

(The information on this page is for Simrad's internal use)

Revisions:

Rev. A	25.06.92	Original version.
Rev. B		Document updated to Simrad Standards, minor changes to text.

1 INTRODUCTION

This option requires special multiplexer hardware, supplied by Simrad, and software version 3.00 or later. Up to 64 transducers per transceiver can be used. The EA 500 multi-channel option is ideal for use in shallow waters where high-accuracy is demanded. Channels, and other areas where monoeuvring is often limited by depth and/or space, are typical areas where this equipment can be used.

To achieve the best results, the transducers should be mounted, at fixed intervals, on a boom system on the sides of the ship, as suggested in the figure below.

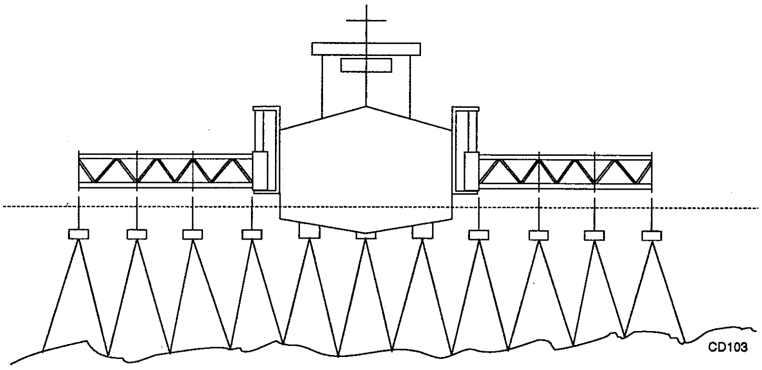

Figure 1 Possible layout for multiple transducers

The operation of the menu is described in the EA 500 Operator Manual.

Example:

With five transducers connected to transceiver channel 1 and five transducers connected to transceiver channel 2, the transducer sequence could be as follows:

	Transceiver 1					Transceiver 2				
Transducer sequence	1	2	3	4	5	6	7	8	9	10

2 CONNECTIONS

The connections to the multiplexer are made via Centronics port 4 on the EA 500. The output system uses 6 bits for selecting the transducer, two bits for selecting transceiver and one bit for WRITE of control word (Strobe).

Before each ping, the program sends out the transceiver bit code to each transceiver. The strobe bit is active low with a duration of minium 10 microseconds.

Pin configuration:

Pin number	Signal name
1	Strobe
2	Transducer bit 0
3	Transducer bit 1
4	Transducer bit 2
5	Transducer bit 3
6	Transducer bit 4
7	Transducer bit 5
8	Transceiver bit 0
9	Transceiver bit 1
10	Not connected
11	Alarm non-critical
12	Not connected
13	Not connected
14	Not connected
15	Alarm critical
16	Transceiver bit 2
17	Not connected
18	Ground
19	Ground
20	Ground
21	Ground
22	Ground
23	Ground
24	Ground
25	Ground

EA 500 DWS
DEEP WATER STABILIZED
BEAM SYSTEM

P2571E / 859-130177 / 4AA005

This document describes the DWS Beam system. This system is an option that can be installed with the EA 500 echo sounder.

Document revisions

Rev	Documentation department		Hardware/Software Design		Project/Product Management	
	Date	Sign	Date	Sign	Date	Sign
C	15.03.96	CL	18.03.96	OE	18.03.96	ST.

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Document history

(The information on this page is for Simrad internal use).

Revisions:

Rev. A	20.01.93	First edition.
Rev. B	16.06.93	Minor changes to text.
Rev. C		Document brought up to Simrad standards, some text corrected.

1 INTRODUCTION

The EA 500 DWS uses electronic beam steering to stabilize the acoustic beam against the vessel's roll and pitch movements.

This option requires a special beamformer cabinet, containing the transmission and reception electronics. The EA 500 Operator Console is connected to this beamformer via a serial line (RS 232 or RS 422). The analogue signal is transmitted from the beamformer cabinet to a special receiver circuit board in the EA 500 Operator Console.

2 SPECIFICATIONS

Transducer Rx reg. no. : 499-108207
Transducer Tx reg. no. : 499-108217
Beamformer cabinet reg. no. : 125-108938
PCB Receiver 12 kHz Split-beam reg. no. : 382-108916

Transmit power	2.5 kW
Transmit frequency	13.0 kHz
Receiver bandwidth	1.5 kHz
Pulse lengths	1/3/10 ms

3 SYSTEM OPERATION

To ensure proper communication between the EA 500 Operator Console and the beamformer cabinet, go to the *Serial communication* menu and set the following parameters:

- Telegram Menu / Remote control = On
- Telegram Menu / Depth = 1
- USART Menu / Parameter = On
- USART Menu / Baudrate = 9600
- USART Menu / Bits per char = 8
- USART Menu / Stop bits = 1
- USART Menu / Parity = None

The beamformer cabinet remote controls some of the parameters in the EA 500 Operator Console.

The message *"Remote parameter entered"* will be issued each time a remote command is accepted by the EA 500 Operator Console. This message will occur from time to time and indicates that the communication system is functioning correctly.

A simple method of verifying normal communications on the serial line, is to enter the *Transceiver* menu and select *Medium* or *Long* pulse length. The message *"Remote parameter entered"* should then be displayed.

If the message *"Remote command ignored"* or *"Illegal remote parameter"* should occur, check that all the parameters mentioned above are set correctly.

As the EA 500 DWS has fixed bandwidth (see above), the parameter *Bandwidth* in the *Transceiver* menu has no significance.

ASCII CHARACTERS - HEXADECIMAL CONVERSION TABLE

P2262E / 859-043869 / 4AA005

This document contains a conversion table to assist you with converting characters from ASCII to hexadecimal and back.

	0X	1X	2X	3X	4X	5X	6X	7X
X0	NUL	DLE	SPACE	0	@	P		p
X1	SOH	DC1	!	1	A	Q	a	q
X2	STX	DC2	"	2	B	R	b	r
X3	ETX	DC3	#	3	C	S	c	s
X4	EOT	DC4	$	4	D	T	d	t
X5	ENQ	NAC	%	5	E	U	e	u
X6	ACK	SYNC	&	6	F	V	f	v
X7	BEL	ETB	'	7	G	W	g	w
X8	BS	CAN	(	8	H	X	h	x
X9	HT	EM	)	9	I	Y	i	y
XA	LF	SUB	*	:	J	Z	j	z
XB	VT	ESC	+	;	K	[	k	{
XC	FF	FS	´	<	L	\	l	|
XD	CR	GS	-	=	M	]	m	}
XE	SO	RS	.	>	N	^	n	~
XF	SI	US	/	?	O	_	o	DEL

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	Date	Sign	Date	Sign	Date	Sign
A	01.11.90	-				
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Rev.A First edition.
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Operator manual / Base version

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